

Documentation | EN

KL5151/KS5151, KL5152/KS5152

Incremental Encoder Interface

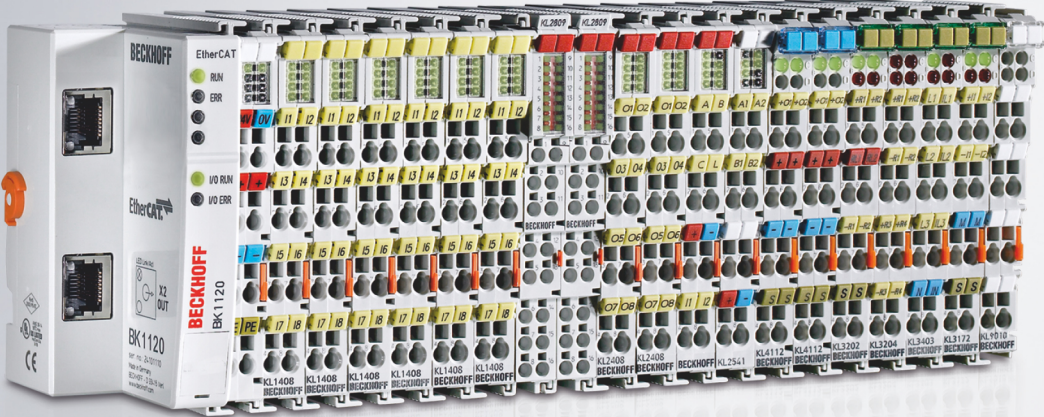


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1 Foreword

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.

The logo for EtherCAT, featuring the word "EtherCAT" in a bold, black, sans-serif font. A red arrow points from the top of the "A" towards the right, ending above the "T". A registered trademark symbol (®) is located to the right of the "T".

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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
2.3.0	<ul style="list-style-type: none"> • Chapter “Technical data” updated • Document structure updated • Chapter “Disposal” added • Chapter “Instructions for ESD protection” updated • Chapter “Beckhoff Identification Code (BIC)” added • New title page • Revision status updated
2.2.0	<ul style="list-style-type: none"> • Notes about operation of KL5151 (KL5151-0050) as one channel up/down counter extended
2.1.0	<ul style="list-style-type: none"> • Technical data updated • Product overview updated • KS2000 settings updated • Wiring and contact assignment extended
2.0.0	<ul style="list-style-type: none"> • Migration • Update revision status
1.3.0	<ul style="list-style-type: none"> • Technical data updated • ATEX notes added • Extended temperature range for KL5151 • Description of control and status bytes of the KL5151-0021 corrected
1.2.0	<ul style="list-style-type: none"> • Introduction updated • Description of the parameterization of the KL5151 by means of KS2000 configuration software updated. • Register description updated • Mounting description expanded • KL5151-0021 added • KL5151-0050 renamed and now available as KL5152
1.1.0	<ul style="list-style-type: none"> • Description of the process images expanded • Mapping tables added
1.0	<ul style="list-style-type: none"> • KL5151-0050 added • Description of the parameterization of the KL5151 by means of KS2000 configuration software added.
0.1	Preliminary version (KL5151only)

Firmware and hardware versions

Documentation Version	KL5151, KS5151		KL5151-0021		KL5152 (KL5151-0050), KS5152	
	Firmware	Hardware	Firmware	Hardware	Firmware	Hardware
2.3.0	4E	11	14	11	4E	11
2.2.0	4E	09	14	09	4E	09
2.1.0	4E	09	14	09	4E	09
2.0.0	4E	09	14	09	4E	09
1.3.0	4C	07	13	07	4C	07
1.2.0	4C	07	13	07	4C	07
1.1.0	3A	02	-	-	3A	02
1.0	3A	02			3A	02
0.1	3A	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 35 04 3A 02:

35 - week of production 35

04 - year of production 2004

3A - firmware version 3A

02 - hardware version 02

2 Product overview

2.1 KL5151/KS5151 - Introduction

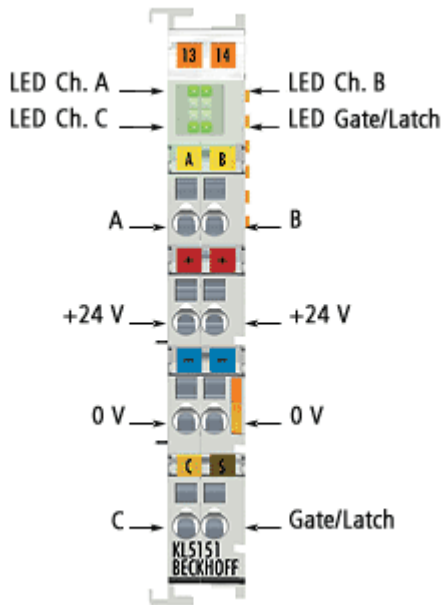


Fig. 1: KL5151

The KL5151/KS5151 Bus Terminal is an interface with 24 V inputs for the direct connection of incremental encoders. A 32 bit counter with a quadrature decoder and a 32 bit latch for the zero pulse can be read, set or enabled.

The KL5151/KS5151 Bus Terminal can also be used as an up/down counter (32 bit). For this input A works as counter input. Input B sets the counting direction. Input C has to be HIGH to enable the counter functionality

2.2 KL5151-0021 - Introduction

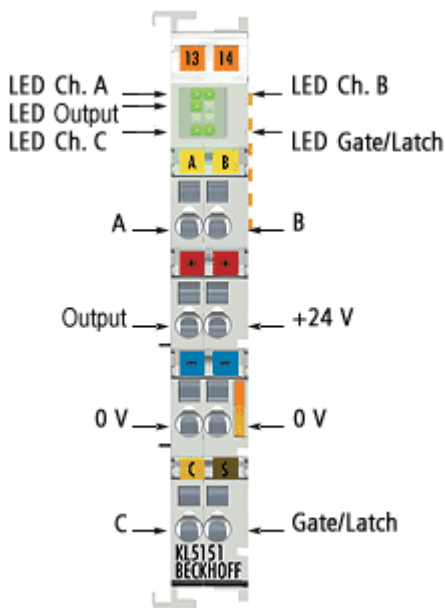


Fig. 2: KL5151-0021

The KL5151-0021 Bus Terminal is an interface with 24 V inputs for the direct connection of incremental encoders. A 32 bit counter with a quadrature decoder and a 32 bit latch for the zero pulse can be read, set or enabled.

The KL5151-0021 Bus Terminal has an additional comparator output.

Operation

Referencing

Enter the reference value for referencing via the output double word [DataOUT1](#) [[▶ 42](#)] and set bits CB1.0 (EnLatchC) and CB1.2 (SetCnt) in the control byte. The reference value is now adopted by the counter on a rising edge at input C.

Measuring the workpiece

At the beginning of the measurement the filter value is preset in the filter register [R0](#) [[▶ 55](#)].

Then set the release bit CB1.1 (EnMeas) in the control byte. If a plate has been successfully measured, the terminal sets bit SB1.1 (MeasDone) in the status byte.

The measurement begins on an appropriate edge. If the level already exists, only the position of the end of the board is determined. The start of the measurement is then taken as the start of the board.

Post-forming sawing

The output has a rise time of 10 μ s and a 40 μ s delay due to the optocoupler.

2.3 KL5152/KS5152 (KL5151-0050) - Introduction

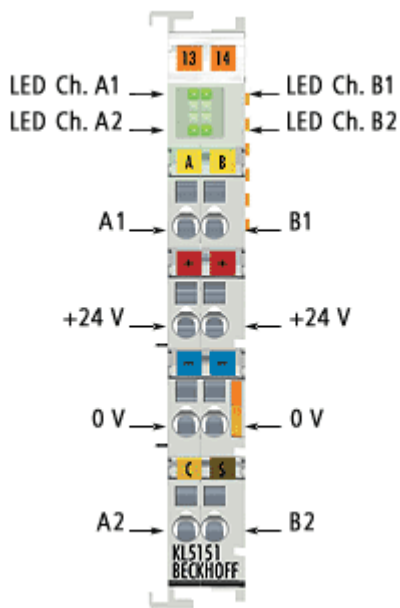


Fig. 3: KL5152

The KL5152/KS5152 (KL5151-0050) Bus Terminal is an interface with 24 V inputs for the direct connection of two incremental encoders. The terminal can optionally be used as a single-channel or two-channel device.

i Operation as a one channel up/down counter

The KL5152/KS5152 (KL5151-0050) Bus Terminal can also be used as a one channel up/down counter (32 bit). For this input A1 works as counter input. Input B1 sets the counting direction. Input A2 has to be HIGH to enable the counter functionality.

Operation as a two channel counter is not possible!

2.4 Technical data

Technical data	KL5151, KS5151	KL5151-0021	KL5152 (KL5151-0050), KS5152
Sensor inputs (channels)	1		2 (as encoder interface) 1 (as counter)
Encoder connection	A, B, C, Gate, 24 V		Channel 1: A1, B1 Channel 2: A2, B2
Encoder operating voltage	24 V _{DC}		
Operation as encoder interface	1 x 32 bit binary		2 x 32 bit binary
Operation as counter	1 x 32 bit binary	-	1 x 32 bit binary
Limit frequency	100 kHz		
Quadrature decoder	4-fold evaluation		
Commands	read, set, latching, Compare function for setting the output (KL5151-0021 only)		
Supply voltage	24 V _{DC} (-15%/+20%)		
Comparator output	0	1	0
Current consumption from the power contacts	Typically 100 mA (without sensor load current)		
Bit width in the K-bus I/O	4 x 16 bit user data, 1 x 8 bit control/status		
Bit width in the input process image	2 data words, 1 status byte	compact [▶ 45]	complete [▶ 45]
		4 data words	4 data words, 2 status bytes
Bit width in the output process image	2 data words, 1 control byte	2 data words, 2 control bytes, 2 filler bytes	4 data words, 2 control bytes
		via the K-bus	
Power supply for electronic	typically 50 mA		
Current consumption from K-bus	approx. 50 g		
Weight	approx. 15 mm x 100 mm x 70 mm		
Dimensions (W x H x D)	on 35 mm mounting rail conforms to EN 60715		
Mountin [▶ 15]g	at all KSxxxx series terminals		
Pluggable wiring	-25°C ... +60°C	0°C ... + 55°C	
Permissible ambient temperature range during operation	-40°C ... + 85°C	-25°C ... + 85°C	
Permissible ambient temperature range during storage	95%, no condensation		
Permissible relative humidity	yes, see Installation instructions for enhanced mechanical load capacity [▶ 18]		
Enhanced mechanical load capacity	conforms to EN 60068-2-6 / EN 60068-2-27		
Vibration/shock resistance	conforms to EN 61000-6-2 / EN 61000-6-4		
EMC immunity/emission	IP20		
Protection class	variable		
Installation position	CE, UKCA, cULus, EAC, ATEX [▶ 30]	CE, UKCA, cULus, EAC, ATEX [▶ 29]	
Approvals/markings*			

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

Ex marking

Standard	Marking
ATEX	II 3 G Ex nA IIC T4 Gc

3 Mounting and wiring

3.1 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 be 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.

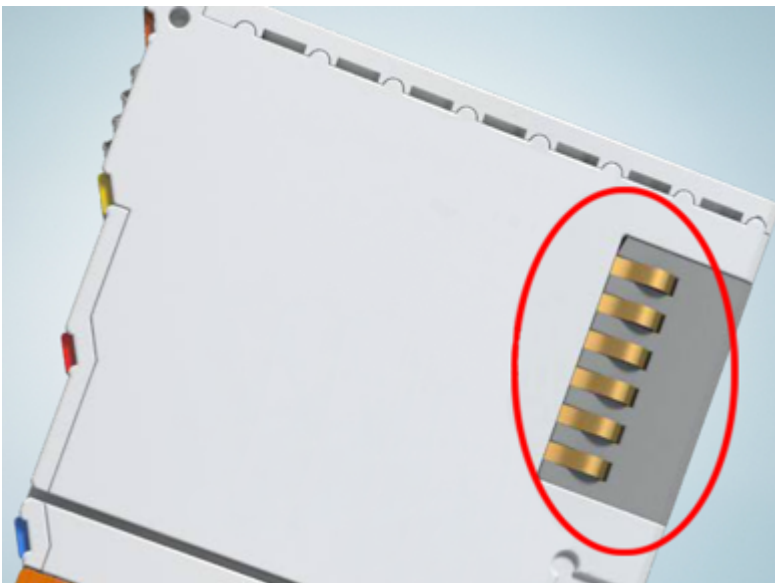


Fig. 4: Spring contacts of the Beckhoff I/O components

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

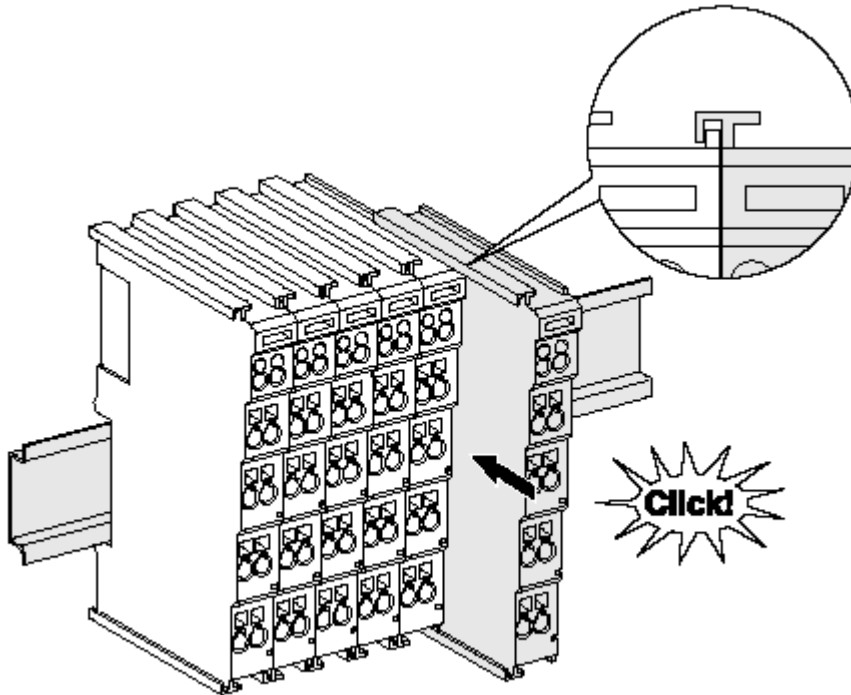


Fig. 5: Attaching on mounting rail

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

1. First attach the fieldbus coupler to the mounting rail.
2. The bus terminals are now attached on the right-hand side of the fieldbus coupler. Join the components with tongue and groove and push the terminals against the mounting rail, until the lock clicks onto the mounting rail.

If the terminals are clipped onto the mounting rail first and then pushed together without tongue and groove, the connection will not be operational! When correctly assembled, no significant gap should be visible between the housings.

i Fixing of mounting rails

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

Disassembly

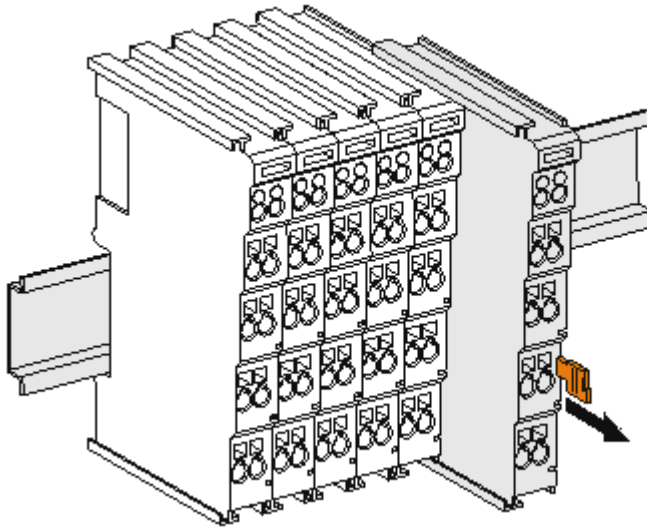


Fig. 6: Disassembling of terminal

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.

i 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.

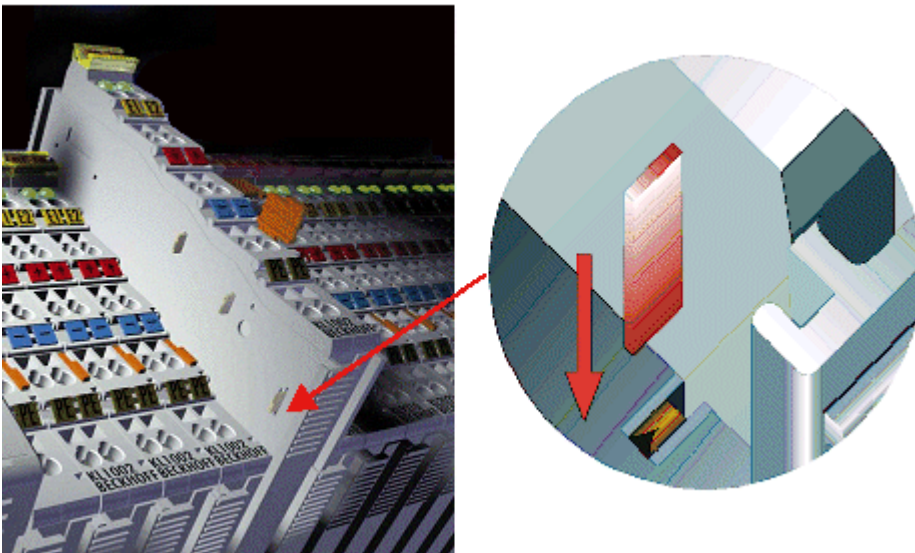


Fig. 7: Power contact on left side

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!

3.3 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.

3.4 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.

3.5 Connection

3.5.1 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. 8: 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. 9: 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 mm² and 2.5 mm² can continue to be used with the proven spring force technology.

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

High Density Terminals (HD Terminals)



Fig. 10: 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 [► 21]!

3.5.2 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

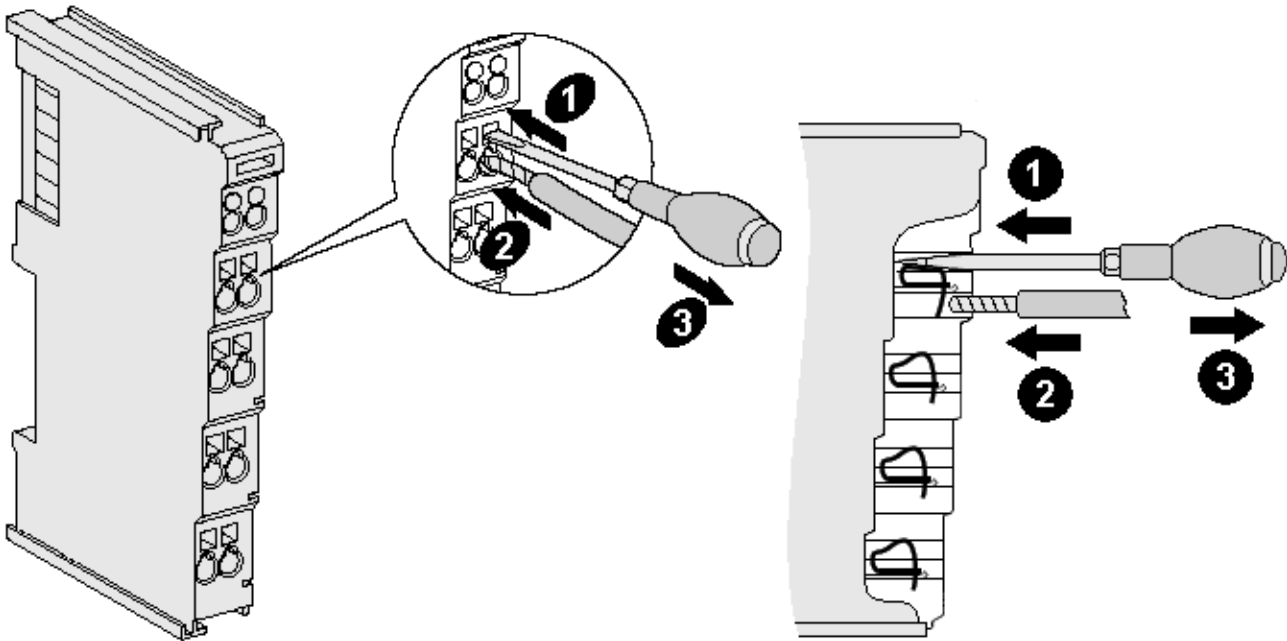


Fig. 11: Connecting a cable on a terminal point

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 [▶ 20]) 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 (see notice [▶ 20])
Wire stripping length	8 ... 9 mm

3.5.3 Shielding



Shielding

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

3.5.4 KL5151/KS5151 - Contact assignment and LEDs

⚠ WARNING

Risk of injury through electric shock and damage to the device!

Bring the Bus Terminals system into a safe, de-energized state before starting mounting, disassembly or wiring of the Bus Terminals.

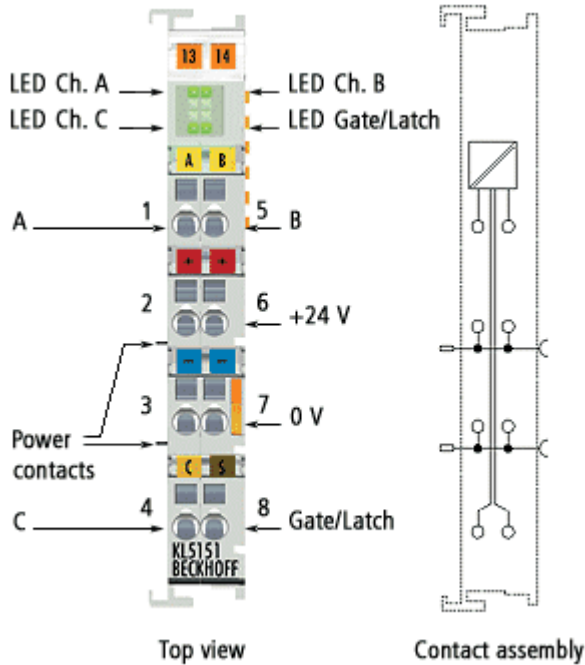


Fig. 12: KL5151 - Contact assignment

KL5151/KS5151 - Contact assignment

Terminal point	No.	In the encoder interface operating mode* connection for	In the counter operating mode* connection for
A	1	Input A	Counter input
+24 V	2	Power contact +24 V (internally connected to terminal point 6)	
0 V	3	Power contact 0 V (internally connected to terminal point 7)	
C	4	Input C or zero input (in case bit 0 (EnLatchC) is set in the control byte, a rising edge at this input causes the current counter value to be saved in the latch register as a reference mark).	Counter enable (gate input for the counter operating mode)
B	5	Input B	Counting direction: high = down low = up
+24 V	6	Power contact +24 V (internally connected to terminal point 2)	
0 V	7	Power contact 0 V (internally connected to terminal point 3)	
Gate/Latch	8	Gate input or Latch input: if <ul style="list-style-type: none"> • bit 3 (EnLatchRise) is set in the control byte, a rising edge • bit 4 (EnLatchFall) is set in the control byte, a falling edge at this input causes the current counter value to be saved in the latch register as a reference mark.	no function

*) The operating mode is set with bit R32.15 [► 57] of the feature register.

KL5151/KS5151 - LED indicators

LED	Function
Ch. A	Lights up when a signal is present at input A.
Ch. B	Lights up when a signal is present at input B.
Ch. C	Lights up when a signal is present at input C (zero input).
Gate / Latch	Lights up when a signal is present at the gate/latch input.

3.5.5 KL5151-0021 - Contact assignment

⚠ WARNING

Risk of injury through electric shock and damage to the device!

Bring the Bus Terminals system into a safe, de-energized state before starting mounting, disassembly or wiring of the Bus Terminals.

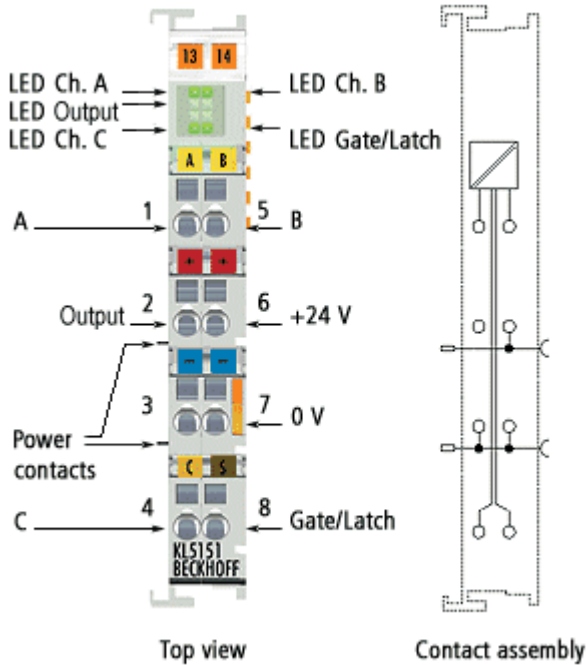


Fig. 13: KL5151-0021

KL5151-0021 - Contact assignment

Terminal point	No.	Connection for
A	1	Input A
Output	2	Comparator output
0 V	3	Power contact 0 V (internally connected to terminal point 7)
C	4	Input C or zero input (in case bit 0 (EnLatchC) is set in the control byte, a rising edge at this input causes the current counter value to be saved in the latch register as a reference mark).
B	5	Input B
+24 V	6	Power contact +24 V
0 V	7	Power contact 0 V (internally connected to terminal point 3)
Gate/Latch	8	Gate input or Latch input: if <ul style="list-style-type: none"> • bit 3 (EnLatchRise) is set in the control byte, a rising edge • bit 4 (EnLatchFall) is set in the control byte, a falling edge at this input causes the current counter value to be saved in the latch register as a reference mark.

KL5151-0021 - LED indicators

LED	Function
Ch. A	Lights up when a signal is present at input A.
Output	Lights up when the comparator output is switched on.
Ch. B	Lights up when a signal is present at input B.
Ch. C	Lights up when a signal is present at input C (zero input).
Gate / Latch	Lights up when a signal is present at the gate/latch input.

3.5.6 KL5152/KS5152 (KL5151-0050) - Contact assignment and LEDs

⚠ WARNING

Risk of injury through electric shock and damage to the device!

Bring the Bus Terminals system into a safe, de-energized state before starting mounting, disassembly or wiring of the Bus Terminals.

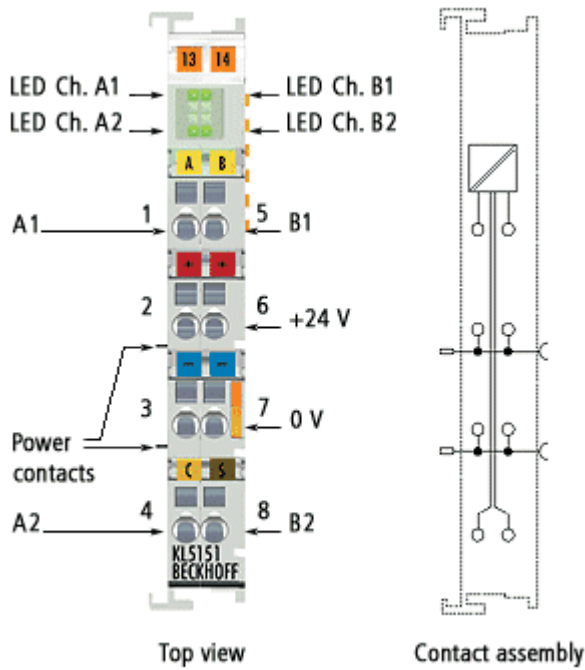


Fig. 14: KL5152 - Contact assignment

KL5152/KS5152 (KL5151-0050) - Contact assignment

Terminal point	No.	In the encoder interface operating mode* connection for	In the counter operating mode* connection for
A1	1	Input A for encoder 1	Counter input
+24 V	2	Power contact +24 V (internally connected to terminal point 6)	
0 V	3	Power contact 0 V (internally connected to terminal point 7)	
A2	4	Input A for encoder 2	Counter enable (gate input for the counter operating mode)
B1	5	Input B for encoder 1	Counting direction: high = down low = up
+24 V	6	Power contact +24 V (internally connected to terminal point 2)	
0 V	7	Power contact 0 V (internally connected to terminal point 3)	
B2	8	Input B for encoder 2	no function

*) The operating mode is set with bit [R32.15](#) [▶ 57] of the feature register.

KL5152/KS5152 (KL5151-0050) - LED indicators

Signal LED	Function	Encoder
Ch. A1	Lights up when a signal is present at input A1.	1
Ch. B1	Lights up when a signal is present at input B1.	
Ch. A2	Lights up when a signal is present at input A2.	2
Ch. B2	Lights up when a signal is present at input B2.	

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 2014/34/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 60079-15! The environmental conditions during use are thereby to be taken into account!
- For dust (only the fieldbus components of certificate no. KEMA 10ATEX0075 X Issue 9): The equipment shall be installed in a suitable enclosure providing a degree of protection of IP54 according to EN 60079-31 for group IIIA or IIIB and IP6X for group IIIC, taking into account the environmental conditions under which the equipment is used!
- 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
- EN 60079-31:2013 (only for certificate no. KEMA 10ATEX0075 X Issue 9)

Marking

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



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

II 3D KEMA 10ATEX0075 X Ex tc IIIC T135°C Dc Ta: 0 ... +55°C
(only for fieldbus components of certificate no. KEMA 10ATEX0075 X Issue 9)

or



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

II 3D KEMA 10ATEX0075 X Ex tc IIIC T135°C Dc Ta: 0 ... +55°C
(only for fieldbus components of certificate no. KEMA 10ATEX0075 X Issue 9)

3.7 ATEX - Special conditions (extended temperature range)

⚠ WARNING

Observe the special conditions for the intended use of Beckhoff fieldbus components with extended temperature range (ET) in potentially explosive areas (directive 2014/34/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 60079-15! The environmental conditions during use are thereby to be taken into account!
- For dust (only the fieldbus components of certificate no. KEMA 10ATEX0075 X Issue 9): The equipment shall be installed in a suitable enclosure providing a degree of protection of IP54 according to EN 60079-31 for group IIIA or IIIB and IP6X for group IIIC, taking into account the environmental conditions under which the equipment is used!
- If the temperatures during rated operation are higher than 70°C at the feed-in points of cables, lines or pipes, or higher than 80°C at the wire branching points, then cables must be selected whose temperature data correspond to the actual measured temperature values!
- Observe the permissible ambient temperature range of -25 to 60°C for the use of Beckhoff fieldbus components with extended temperature range (ET) in potentially explosive areas!
- Measures must be taken to protect against the rated operating voltage being exceeded by more than 40% due to short-term interference voltages!
- The individual terminals may only be unplugged or removed from the Bus Terminal system if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- The connections of the certified components may only be connected or disconnected if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- The fuses of the KL92xx/EL92xx power feed terminals may only be exchanged if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- Address selectors and ID switches may only be adjusted if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!

Standards

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

- EN 60079-0:2012+A11:2013
- EN 60079-15:2010
- EN 60079-31:2013 (only for certificate no. KEMA 10ATEX0075 X Issue 9)

Marking

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



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

II 3D KEMA 10ATEX0075 X Ex tc IIIC T135°C Dc Ta: -25 ... +60°C
(only for fieldbus components of certificate no. KEMA 10ATEX0075 X Issue 9)

or



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

II 3D KEMA 10ATEX0075 X Ex tc IIIC T135°C Dc Ta: -25 ... +60°C
(only for fieldbus components of certificate no. KEMA 10ATEX0075 X Issue 9)

3.8 Continulative documentation for ATEX and IECEx

NOTE



Continulative documentation about explosion protection according to ATEX and IECEx

Pay also attention to the continuative documentation

Ex. Protection for Terminal Systems

Notes on the use of the Beckhoff terminal systems in hazardous areas according to ATEX and IECEx,

that is available for [download](#) within the download area of your product on the Beckhoff homepage www.beckhoff.com!

4 Configuration software KS2000

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. 15: 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 Ethernet coupler
- a KL1xx2 digital input terminal
- a KL5151-0000 incremental encoder terminal
- a KL9010 bus end terminal

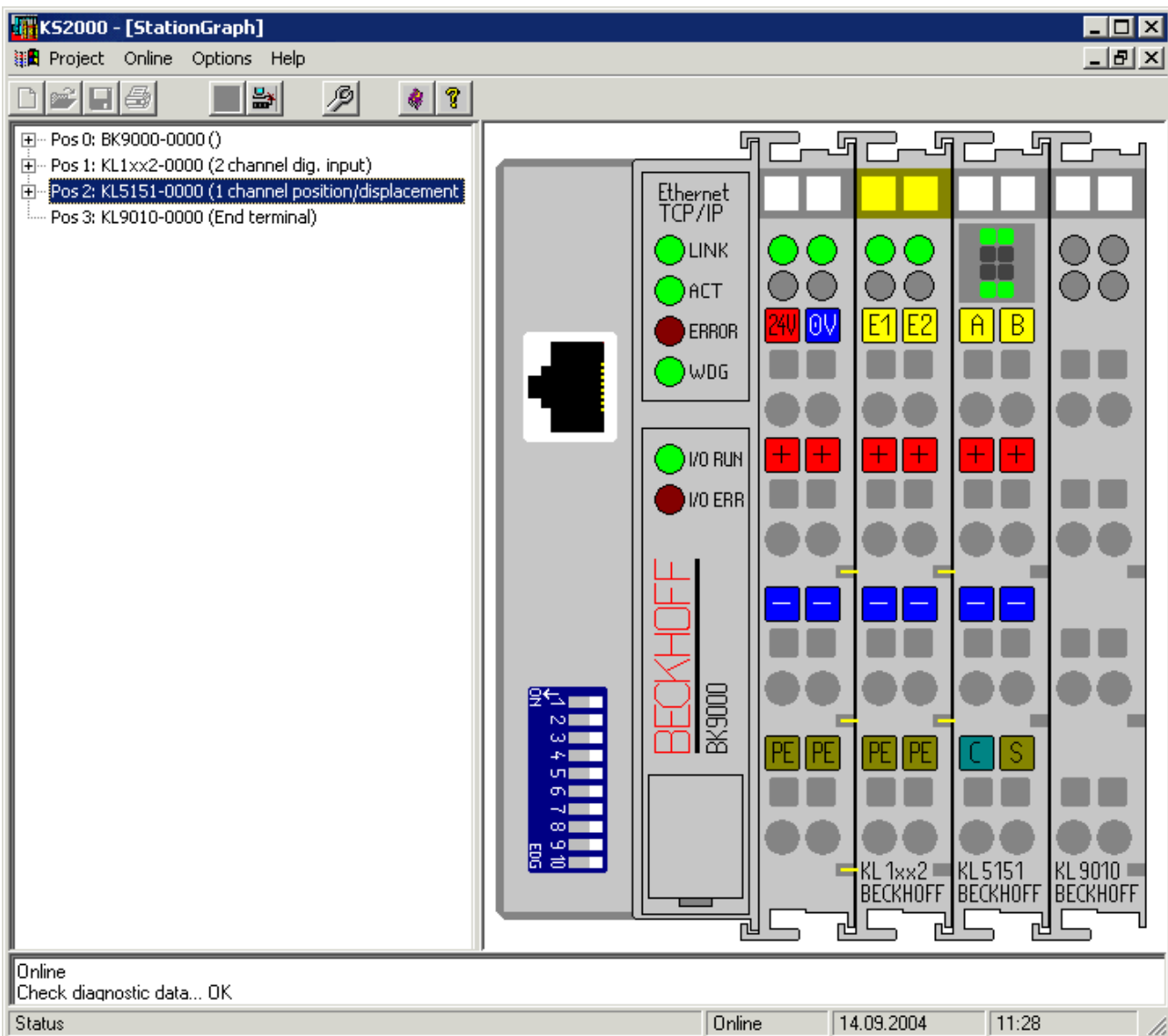


Fig. 16: Display of the fieldbus station in KS2000

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).

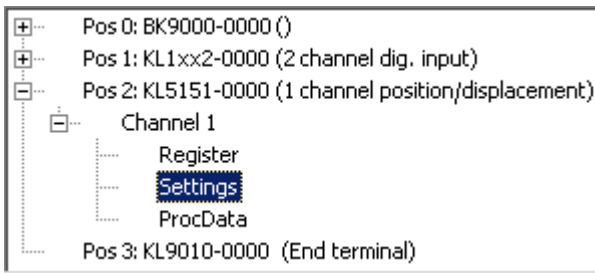


Fig. 17: KS2000 tree branches for channel 1 of the KL5151

For the KL5151, the branches *Register*, *Settings* and *ProcData* are displayed:

- Register permits direct access to the registers of the KL5151.
- Under Settings [▶ 35] you find dialog boxes for parameterizing the KL5151.
- ProcData displays the KL5151 process data.

4.3 Settings

The dialog mask for the parameterization of the KL5151-0000 or KL5152-0000 (KL5151-0050) can be found under *Settings*.

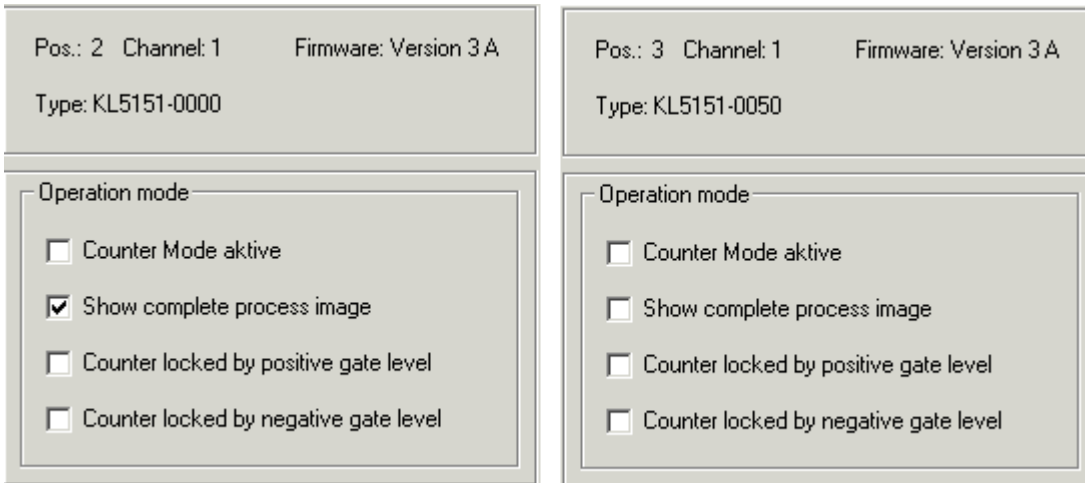


Fig. 18: Settings via KS2000

Operation mode

Counter mode active (R32.15 [▶ 57])

For KL5151-0000 and KL5152-0000 (KL5151-0050) you can activate counter mode here (default: inactive). When counter mode is activated, the terminals operate as a 32 bit up/down counter. The counting direction (up-/down) is set by the level at input B.

i Operation of KL5152-0000 (KL5151-0050) as one channel counter

Because for operation of KL5152-0000 (KL5151-0050) as a counter the A2 connector is used to enable the counter (gate), the operation as a two channel counter is not possible.

Display whole process image (R32.6 [▶ 57])

Meaningful operation of the KL5151-0000 is only possible with the full process image (default: active)!

The KL5152-0000 (KL5151-0050) is factory-set to the small (compact) process image. You can activate evaluation of the full process image for the KL5152-0000 (KL5151-0050) here.

A positive level at the gate locks the counter (R32.5 [[▶ 571](#)])

You can lock the counter by applying a positive level to the gate input (default: inactive).

A negative level at the gate locks the counter (R32.4 [[▶ 571](#)])

You can lock the counter by applying a negative level to the gate input (default: inactive).

5 Access from the user program

5.1 KL5151/KS5151

5.1.1 Process image

In the process image, the KL5151/KS5151 is represented with 5 bytes of input and output data. These are organized as follows:

Format	Input data	Output data
Byte	SB	CB
Double word	DataIN	DataOUT

Key

SB: Status byte

CB: Control byte

DataIN: The current value of the 32-bit counter, or the one stored in the latch (the selection is made with bit CB1.1 of the control byte)

DataOUT: Value specified for the 32 bit counter

- Please refer to the [Mapping \[▶ 40\]](#) page for the allocation of the bytes and words to the addresses of the controller.
- The meaning of the control and status bytes is explained on the [Control and Status bytes \[▶ 38\]](#) page.

i No compact process image

Operation of the KL5151/KS5151 with compact process image (without control and status bytes) is not possible, since the control and status bytes are required for useful process data operation of the terminal. Even if you adjust your Bus Coupler to the compact process image, the KL5151/KS5151 will still be represented with its complete process image!

5.1.2 Control and status bytes

5.1.2.1 Process data mode

Control byte 1 in process data mode

Control byte 1 (CB1) is located in the output image, 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	-	RS_CNT_LAT	EnLatchFall	EnLatchRise	SetCnt	ReadLatch	EnLatchC

Key

Bit	Name	Description
CB1.7	RegAccess	0_{bin} Register communication off (process data mode)
CB1.6	-	reserved
CB1.5	RS_CNT_LAT*	1_{bin} The counter is set to zero by an active edge at the latch input [► 23] . Bits CB1.4, CB1.3 and CB1.0 specify which edge of the latch signal is active.
CB1.4	EnLatchFall*	1_{bin} The falling edge of the latch input [► 23] is active. The counter value is stored in the latch register at the first external latch impulse after the EnLatchFall bit becomes true. The subsequent pulses do not have any effect on the latch register.
CB1.3	EnLatchRise*	1_{bin} The rising edge of the latch input [► 23] is active. The counter value is stored in the latch register on the first external latch pulse after the EnLatchRise bit becomes true (this has priority over EnLatchFall). The subsequent pulses do not have any effect on the latch register.
CB1.2	SetCnt	A rising edge at SetCnt will set the counter to the 32 bit value that is written by the controller into the process output data.
CB1.1	ReadLatch	0_{bin} The current value of the 32 bit counter is mapped to the process input data.
		1_{bin} The 32 bit value stored in the latch counter is mapped to the process input data.
CB1.0	EnLatchC*	1_{bin} The rising edge of the zero input (input C [► 23]) is active. The counter value is stored in the latch register at the first external latch impulse after the EnLatchC bit becomes true. The subsequent pulses do not have any effect on the latch register. (see note below)

*) Does not apply to KL5152-0000 (KL5151-0050), since the latch input and zero input are not available in this case. Always set bits CB1.5, CB1.4, CB1.3 and CB1.0 of the KL5152-0000 (KL5151-0050) to 0_{bin} !

● EnLatchC or EnLatchRise and EnLatchFall?

i If bit CB1.0 (EnLatchC) is set, bit CB1.3 (EnLatchRise) and bit CB1.4 (EnLatchFall) must not be set, otherwise you cannot know which event has caused a counter value to be stored in the latch.

Status byte 1 in process data mode

The status byte 1 (SB1) is located in the input image, 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	-	-	StGate	StLatchC	SetCnt	ReadLatch	ValLatchC

Key

Bit	Name	Description
SB1.7	RegAccess	0 _{bin} Acknowledgement for process data mode
SB1.6	-	reserved
SB1.5	-	reserved
SB1.4	StGate	KL5151-0000: Status of the external <u>gate/latch input</u> [► 23] KL5152-0000 (KL5151-0050): reserved
SB1.3	StLatchC	KL5151-0000: Status of the zero input (<u>input C</u> [► 23]) KL5152-0000 (KL5151-0050): reserved
SB1.2	SetCnt	Acknowledgement that the data for setting the counter has been adopted by the terminal.
SB1.1	ReadLatch	0 _{bin} The current value of the 32 bit counter has been mapped to the process data. 1 _{bin} The 32 bit value stored in the latch counter has been mapped to the process data.
SB1.0	ValLatchC*	1 _{bin} A zero-point latch has occurred: a rising edge at the zero input (<u>input C</u> [► 23]) has caused the current counter value to be stored in the latch register as a reference mark. Subsequent pulses do not have any effect on the latch register. To reactivate the <u>gate/latch input</u> [► 23] you must: <ul style="list-style-type: none"> • set bit 0 (EnLatchC) in the control byte to 0_{bin}. • wait until this change has been acknowledged by resetting bit 0 (ValLatchC) in the status byte. • set bit 0 (EnLatchC) in the control byte to 1_{bin} again.

*) Does not apply to KL5152-0000 (KL5151-0050), since the latch input and zero input are not available in this case.

5.1.2.2 Register communication

Control byte 1 in register communication

Control byte 1 (CB1) is located in the output image, 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 <u>register</u> [► 54] that you - want to read with input data word 0 or - write to with output data word 0.

⚠ CAUTION

No valid process data during the register communication!

It is not possible to access the data registers during register communication! Process data that may still be displayed is not valid!

Status byte 1 in register communication

The status byte 1 (SB1) is located in the input image, 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	Reg. no.					

Key

Bit	Name	Description
SB1.7	RegAccess	1 _{bin} Acknowledgement 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.

Channel 2 (KL5152-0000 and KL5151-0050 only)

The control and status bytes of channel 2 (CB2 and SB2) have the same structure as the control and status bytes of channel 1.

5.1.3 Mapping

The Bus Terminals occupy addresses within the process image of the controller. The assignment of process data (input and output data) and parameterization data (control and status bytes) to the control addresses is called mapping. The type of mapping depends on:

- the fieldbus system used
- the terminal type
- the parameterization of the Bus Coupler such as
 - Intel or Motorola format
 - word alignment switched on or off

The Bus Couplers (BKxxxx, LCxxxx) and Bus Terminal Controllers (BCxxxx, BXxxxx) are supplied with certain default settings. The default setting can be changed with the KS2000 configuration software or with a master configuration software (e.g. TwinCAT System Manager or ComProfibus).

The following tables show the mapping depending on different conditions. For information about the contents of the individual bytes please refer to the pages [Process image](#) [► 37] and [Control and status byte](#) [► 38].

Complete evaluation

Control and status bytes can be accessed.

Complete evaluation in Intel format

Default mapping for CANopen, CANCEL, DeviceNet, ControlNet, Modbus, RS232 and RS485 coupler.

Parameterization of the Bus Coupler	Address	Input data		Output data	
	Word offset	High byte	Low byte	High byte	Low byte
Complete evaluation: n/a	0	DataIN D0	SB	DataOUT D0	CB
Motorola format: no	1	DataIN D2	DataIN D1	DataOUT D2	DataOUT D1
Word alignment: no	2	reserved	DataIN D3	reserved	DataOUT D3

Complete evaluation in Motorola format

Parameterization of the Bus Coupler	Address	Input data		Output data	
	Word offset	High byte	Low byte	High byte	Low byte
Complete evaluation: n/a	0	DataIN D3	SB	DataOUT D3	CB
Motorola format: yes	1	DataIN D1	DataIN D2	DataOUT D1	DataOUT D2
Word alignment: no	2	reserved	DataIN D0	reserved	DataOUT D0

Complete evaluation in Intel format with word alignment

Default mapping for EtherCAT, Lightbus and Ethernet coupler as well as Bus Terminal Controllers (BCxxxx, BXxxxx).

Parameterization of the Bus Coupler	Address	Input data		Output data	
	Word offset	High byte	Low byte	High byte	Low byte
Complete evaluation: n/a	0	reserved	SB	reserved	CB
Motorola format: no	1	DataIN D1	DataIN D0	DataOUT D1	DataOUT D0
Word alignment: yes	2	DataIN D3	DataIN D2	DataOUT D3	DataOUT D2

Complete evaluation in Motorola format with word alignment

Parameterization of the Bus Coupler	Address	Input data		Output data	
	Word offset	High byte	Low byte	High byte	Low byte
Complete evaluation: n/a	0	reserved	SB1	reserved	CB1
Motorola format: yes	1	DataIN D2	DataIN D3	DataOUT D2	DataOUT D3
Word alignment: yes	2	DataIN D0	DataIN D1	DataOUT D0	DataOUT D1

Legend

Complete evaluation: In addition to the process data, the control and status bytes are also mapped into the address space.

Motorola format: Motorola or Intel format can be set.

Word alignment: In order for the word address range to commence at a word boundary, empty bytes are inserted into the process image as appropriate.

SB: Status byte (appears in the input process image)

CB: Control byte (appears in the output process image)

DataIN D0: Input double word, lowest significant data byte

DataIN D1: Input double word, ...

DataIN D2: Input double word, ...

DataIN D3: Input double word, highest significant data byte

DataOUT D0: Output double word, lowest significant data byte

DataOUT D1: Output double word, ...

DataOUT D2: Output double word, ...

DataOUT D3: Output double word, highest significant data byte

reserved: This byte occupies process data memory, although it has no function.

Compact evaluation

● No compact process image

I Operation of the KL5151-0000 with compact process image (without control and status bytes) is not possible, since the control and status bytes are required for useful process data operation of the terminal. Even if you adjust your Bus Coupler to the compact process image, the KL5151-0000 will still be represented with its complete process image!

5.2 KL5151-0021

5.2.1 Process image

In the process image, the KL5151-0021 is represented with 5 bytes of input and output data. These are organized as follows:

Format	Input data	Output data
Byte	SB1 [▶ 42]	CB1 [▶ 42]
Double word	DataIN1	DataOUT1
Byte	SB2	CB2
Double word	DataIN2	DataOUT2

Key

SB1: Status byte 1

CB1: Control byte 1

SB1: Status byte 2 (not used)

CB1: Control byte 2 (not used)

DataIN1: The current value of the 32-bit counter, or the one stored in the latch (the selection is made with bit CB1.1 of the control byte)

DataOUT1: Compare value for setting the comparator output (enabled by bit CB1.6 of the control byte).

DataIN2: 32-bit latch

DataOUT2: Compare value for resetting the comparator output

- The meaning of the control and status bytes is explained on the [Control and Status bytes \[\[▶ 42\]\(#\)\]](#) page.



No compact process image

Operation of the KL5151-0021 with compact process image (without control and status bytes) is not possible, since the control and status bytes are required for useful process data operation of the terminal. Even if you adjust your Bus Coupler to the compact process image, the KL5151-0021 will still be represented with its complete process image!

5.2.2 Control and status bytes

5.2.2.1 Process data mode

Control byte 1 in process data mode

Control byte 1 (CB1) is located in the output image, 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	EnComp	SetOut	ReadLatchN	ReadLatchP	SetCnt	EnMeas	EnLatchC

Key

Bit	Name	Description
CB1.7	RegAccess	0 _{bin} Register communication off (process data mode)
CB1.6	EnComp	0 _{bin} Compare function for setting and resetting the output not enabled
		1 _{bin} Compare function for setting and resetting the output enabled
CB1.5	SetOut	0 _{bin} sets output manually to 0 V
		1 _{bin} sets output manually to 24 V
SetOut only functions if EnComp = 0 _{bin}		
CB1.4	ReadLatchN	1 _{bin} Read the negative edge
CB1.3	ReadLatchP	1 _{bin} Read the positive edge
CB1.2	SetCnt	A rising edge at SetCnt will set the counter to the 32 bit value that is written by the controller into the process output data.
CB1.1	EnMeas	0 _{bin} Workpiece measurement enabled
		1 _{bin} Workpiece measurement not enabled
If the workpiece measurement is enabled, it is read via CB1.3 and CB1.4 and saved in two latch values.		
CB1.0	EnLatchC	1 _{bin} The rising edge of the zero input (input C [▶ 25]) is active. The counter value is stored in the latch register at the first external latch impulse after the EnLatchC bit becomes true. The subsequent pulses do not have any effect on the latch register. (see note below)

EnLatchC or EnLatchRise and EnLatchFall?

i If bit CB1.0 (EnLatchC) is set, bit CB1.3 (EnLatchRise) and bit CB1.4 (EnLatchFall) must not be set, otherwise you cannot know which event has caused a counter value to be stored in the latch.

Status byte 1 in process data mode

The status byte 1 (SB1) is located in the input image, 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	-	StOut	StGate	StLatchC	SetCnt	MeasDone	ValLatchC

Key

Bit	Name	Description
SB1.7	RegAccess	0 _{bin} Acknowledgement for process data mode
SB1.6	-	reserved
SB1.5	StOut	0 _{bin} Status of the output is 0 V
		1 _{bin} Status of the output is 24 V
SB1.4	StGate	Status of the external gate/latch input [▶ 25]
SB1.3	StLatchC	Status of the zero input (input C)
SB1.2	SetCnt	Acknowledgement that the data for setting the counter has been adopted by the terminal.
SB1.1	MeasDone	1 _{bin} Measurement done
SB1.0	ValLatchC	1 _{bin} A zero-point latch has occurred: a rising edge at the zero input (input C [▶ 25]) has caused the current counter value to be stored in the latch register as a reference mark. Subsequent pulses do not have any effect on the latch register. To reactivate the gate/latch input [▶ 25] you must: <ul style="list-style-type: none"> • set bit 0 (EnLatchC) in the control byte to 0_{bin}. • wait until this change has been acknowledged by resetting bit 0 (ValLatchC) in the status byte. • set bit 0 (EnLatchC) in the control byte to 1_{bin} again.

5.2.2.2 Register communication

Control byte 1 in register communication

Control byte 1 (CB1) is located in the output image, 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 [► 54] that you - want to read with input data word 0 or - write to with output data word 0.

⚠ CAUTION

No valid process data during the register communication!

It is not possible to access the data registers during register communication! Process data that may still be displayed is not valid!

Status byte 1 in register communication

The status byte 1 (SB1) is located in the input image, 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	Reg. no.					

Key

Bit	Name	Description
SB1.7	RegAccess	1 _{bin} Acknowledgement 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.

Control byte 2 and status byte 2

Control byte 2 and status byte 2 (CB2 and SB2) are not used.

5.3 KL5152/KS5152 (KL5150-0050)

5.3.1 Process image

The terminal can be operated with variously sized process images:

- compact process image
- compact process image on Bus Coupler that is set to complete process image (e.g. Lightbus)
- complete process image

The compact process image is activated in the delivery condition of the KL5151-0050. The size of the process image can be specified through bit [R32.6 \[► 57\]](#) of the feature register.

Control byte, status byte and mapping

- The meaning of the control and status bytes is explained on the [Control and Status bytes \[► 38\]](#) page.
- Please refer to the [Mapping \[► 50\]](#) page for the allocation of the bytes and words to the addresses of the controller.

Compact process image

For operation with compact process image, you must configure your Bus Coupler to compact mapping and bit [R32.6 \[► 57\]](#) of the feature register of the KL5151-0050 must be 1_{bin}.

The KL5151-0050 is represented in the compact process image with 8 bytes of input data and 8 bytes of output data. These are organized as follows:

Input data		Output data	
Format	Contents	Format	Contents
Double word	DataIN1	Byte	CB1PD
		Byte	reserved
		Byte	CB2PD
		Byte	reserved
Double word	DataIN2	Double word	DataOUT

Key

CB1PD: Control byte for process data operation of channel 1

CB2PD: Control byte for process data operation of channel 2

DataIN1: The current value of the 32-bit counter 1, or the one stored in the latch (the selection is made with bit CB1.1 of the control byte 1)

DataIN2: The current value of the 32-bit counter 2, or the one stored in the latch (the selection is made with bit CB2.1 of the control byte 2)

DataOUT: 32 bit specification of the value for counter 1 and counter 2



No register communication possible

In this configuration the control bytes are suitable only for process data operation. Register communication is not possible!

Complete process image

For operation with complete process image, you must configure your Bus Coupler to complete mapping and bit [R32.6 \[► 57\]](#) of the feature register of the KL5151-0050 must be 0_{bin}.

The KL5151-0050 is represented in the complete process image with 10 bytes of input data and 10 bytes of output data. These are organized as follows:

Input data		Output data	
Format	Contents	Format	Contents
Byte	SB1	Byte	CB1
Double word	DataIN1	Double word	DataOUT1
Byte	SB2	Byte	CB2
Double word	DataIN2	Double word	DataOUT2

Key

SB1: Status byte for channel 1
 SB2: Status byte for channel 2
 CB1: Control byte for channel 1
 CB2: Control byte for channel 2

DataIN1: The current value of the 32-bit counter 1, or the one stored in the latch (the selection is made with bit CB1.1 of the control byte 1)

DataIN2: The current value of the 32-bit counter 2, or the one stored in the latch (the selection is made with bit CB2.1 of the control byte 2)

DataOUT1: 32 bit specification of the value for counter 1

DataOUT2: 32 bit specification of the value for counter 2

Register communication possible

In this configuration you can use the control and status bytes alternatively for register communication or process data operation.

Compact process image on Bus Coupler that is set to complete process image

If the KL5151-0050 is operated on a Bus Coupler that is set by default to complete process image (e.g. Lightbus), but bit [R32.6](#) [[▶ 57](#)] of the feature register is 1_{bin}, the following process image results:

Input data		Output data	
Format	Contents	Format	Contents
Byte	SB1RC	Byte	CB1RC
Double word	DataIN1	Byte	CB1PD
		Byte	reserved
		Byte	CB2PD
		Byte	reserved
Byte	SB2RC	Byte	CB2RC
Double word	DataIN2	Double word	DataOUT

Key

SB1RC: Status byte for register communication with channel 1
 SB2RC: Status byte for register communication with channel 2
 CB1RC: Control byte for register communication with channel 1
 CB2RC: Control byte for register communication with channel 2

CB1PD: Control byte for process data operation of channel 1

CB2PD: Control byte for process data operation of channel 2

DataIN1: The current value of the 32-bit counter 1, or the one stored in the latch (the selection is made with bit CB1.1 of the control byte 1)

DataIN2: The current value of the 32-bit counter 2, or the one stored in the latch (the selection is made with bit CB2.1 of the control byte 2)

DataOUT: 32 bit specification of the value for counter 1 and counter 2

i Register communication possible

In this configuration you have different control and status bytes for register communication and process data operation. These are only suitable for the respectively specified purpose!
 You can switch from process data operation to register communication with bit 7 of the control byte for register communication.
 Bit 7 of the control byte for process data operation is not evaluated.

5.3.2 Control and status bytes

5.3.2.1 Process data mode

Control byte 1 in process data mode

Control byte 1 (CB1) is located in the output image, 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	-	RS_CNT_LAT	EnLatchFall	EnLatchRise	SetCnt	ReadLatch	EnLatchC

Key

Bit	Name	Description
CB1.7	RegAccess	0 _{bin} Register communication off (process data mode)
CB1.6	-	reserved
CB1.5	RS_CNT_LAT*	1 _{bin} The counter is set to zero by an active edge at the <u>latch input</u> [► 23]. Bits CB1.4, CB1.3 and CB1.0 specify which edge of the latch signal is active.
CB1.4	EnLatchFall*	1 _{bin} The falling edge of the <u>latch input</u> [► 23] is active. The counter value is stored in the latch register at the first external latch impulse after the EnLatchFall bit becomes true. The subsequent pulses do not have any effect on the latch register.
CB1.3	EnLatchRise*	1 _{bin} The rising edge of the <u>latch input</u> [► 23] is active. The counter value is stored in the latch register on the first external latch pulse after the EnLatchRise bit becomes true (this has priority over EnLatchFall). The subsequent pulses do not have any effect on the latch register.
CB1.2	SetCnt	A rising edge at SetCnt will set the counter to the 32 bit value that is written by the controller into the process output data.
CB1.1	ReadLatch	0 _{bin} The current value of the 32 bit counter is mapped to the process input data.
		1 _{bin} The 32 bit value stored in the latch counter is mapped to the process input data.
CB1.0	EnLatchC*	1 _{bin} The rising edge of the zero input (<u>input C</u> [► 23]) is active. The counter value is stored in the latch register at the first external latch impulse after the EnLatchC bit becomes true. The subsequent pulses do not have any effect on the latch register. (see note below)

*) Does not apply to KL5152-0000 (KL5151-0050), since the latch input and zero input are not available in this case. Always set bits CB1.5, CB1.4, CB1.3 and CB1.0 of the KL5152-0000 (KL5151-0050) to 0_{bin}!

i EnLatchC or EnLatchRise and EnLatchFall?

If bit CB1.0 (EnLatchC) is set, bit CB1.3 (EnLatchRise) and bit CB1.4 (EnLatchFall) must not be set, otherwise you cannot know which event has caused a counter value to be stored in the latch.

Status byte 1 in process data mode

The status byte 1 (SB1) is located in the input image, 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	-	-	StGate	StLatchC	SetCnt	ReadLatch	ValLatchC

Key

Bit	Name	Description
SB1.7	RegAccess	0 _{bin} Acknowledgement for process data mode
SB1.6	-	reserved
SB1.5	-	reserved
SB1.4	StGate	KL5151-0000: Status of the external <u>gate/latch input</u> [► 23] KL5152-0000 (KL5151-0050): reserved
SB1.3	StLatchC	KL5151-0000: Status of the zero input (<u>input C</u> [► 23]) KL5152-0000 (KL5151-0050): reserved
SB1.2	SetCnt	Acknowledgement that the data for setting the counter has been adopted by the terminal.
SB1.1	ReadLatch	0 _{bin} The current value of the 32 bit counter has been mapped to the process data. 1 _{bin} The 32 bit value stored in the latch counter has been mapped to the process data.
SB1.0	ValLatchC*	1 _{bin} A zero-point latch has occurred: a rising edge at the zero input (<u>input C</u> [► 23]) has caused the current counter value to be stored in the latch register as a reference mark. Subsequent pulses do not have any effect on the latch register. To reactivate the <u>gate/latch input</u> [► 23] you must: <ul style="list-style-type: none"> • set bit 0 (EnLatchC) in the control byte to 0_{bin}. • wait until this change has been acknowledged by resetting bit 0 (ValLatchC) in the status byte. • set bit 0 (EnLatchC) in the control byte to 1_{bin} again.

*) Does not apply to KL5152-0000 (KL5151-0050), since the latch input and zero input are not available in this case.

5.3.2.2 Register communication**Control byte 1 in register communication**

Control byte 1 (CB1) is located in the output image, 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 <u>register</u> [► 54] that you - want to read with input data word 0 or - write to with output data word 0.

⚠ CAUTION

No valid process data during the register communication!

It is not possible to access the data registers during register communication! Process data that may still be displayed is not valid!

Status byte 1 in register communication

The status byte 1 (SB1) is located in the input image, 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	Reg. no.					

Key

Bit	Name	Description	
SB1.7	RegAccess	1 _{bin}	Acknowledgement 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.	

Channel 2 (KL5152/KS5152 and KL5151-0050 only)

The control and status bytes of channel 2 (CB2 and SB2) have the same structure as the control and status bytes of channel 1.

5.3.3 Mapping

The Bus Terminals occupy addresses within the process image of the controller. The assignment of process data (input and output data) and parameterization data (control and status bytes) to the control addresses is called mapping. The type of mapping depends on:

- the fieldbus system used
- the terminal type
- the parameterization of the Bus Coupler such as
 - compact or full evaluation
 - Intel or Motorola format
 - word alignment switched on or off
- the parameterization of the KL5152-0000 (KL5151-0050) to compact or complete evaluation (bit [R32.6](#) [[▶ 57](#)] of the feature register)

The Bus Couplers (BKxxxx, LCxxxx) and Bus Terminal Controllers (BCxxxx, BXxxxx) are supplied with certain default settings. The default setting can be changed with the KS2000 configuration software or with a master configuration software (e.g. TwinCAT System Manager or ComProfibus).

The following tables show the mapping depending on different conditions. For information about the contents of the individual bytes please refer to the pages [Process image](#) [[▶ 45](#)] and [Control and status byte](#) [[▶ 38](#)].

Compact evaluation

For operation with compact process image, you must configure your Bus Coupler to compact mapping and bit [R32.6](#) [[▶ 57](#)] of the feature register of the KL5152-0000 (KL5151-0050) must be 1_{bin}.

In this configuration the control bytes are suitable only for process data operation. Register communication is not possible!

Compact evaluation in Intel format

Default mapping for CANopen, CANCEL, DeviceNet, ControlNet, Modbus, RS232 and RS485 coupler

Parameterization of the Bus Coupler	Address	Input data		Output data	
	Word offset	High byte	Low byte	High byte	Low byte
Complete evaluation: no	0	DataIN1 D1	DataIN1 D0	reserved	CB1PD
Motorola format: no	1	DataIN1 D3	DataIN1 D2	reserved	CB2PD
Word alignment: n/a	2	DataIN2 D1	DataIN2 D0	DataOUT D1	DataOUT D0
	3	DataIN2 D3	DataIN2 D2	DataOUT D3	DataOUT D2

Compact evaluation in Motorola format

Default mapping for PROFIBUS and Interbus coupler

Parameterization of the Bus Coupler	Address	Input data		Output data	
	Word offset	High byte	Low byte	High byte	Low byte
Complete evaluation: no	0	DataIN1 D2	DataIN1 D3	CB2PD	reserved
Motorola format: yes	1	DataIN1 D0	DataIN1 D1	CB1PD	reserved
Word alignment: n/a	2	DataIN2 D2	DataIN2 D3	DataOUT D2	DataOUT D3
	3	DataIN2 D0	DataIN2 D1	DataOUT D0	DataOUT D1

Complete evaluation

For operation with complete process image, you must configure your Bus Coupler to complete mapping and bit [R32.6](#) [[▶ 57](#)] of the feature register of the KL5151-0050 must be 0_{bin}.

In this configuration you can use the control and status bytes alternatively for register communication or process data operation.

Complete evaluation in Intel format

Parameterization of the Bus Coupler	Address	Input data		Output data	
	Word offset	High byte	Low byte	High byte	Low byte
Complete evaluation: yes	0	DataIN1 D0	SB1	DataOUT1 D0	CB1
Motorola format: no	1	DataIN1 D2	DataIN1 D1	DataOUT1 D2	DataOUT1 D1
Word alignment: no	2	SB2	DataIN1 D3	CB2	DataOUT1 D3
	3	DataIN2 D1	DataIN2 D0	DataOUT2 D1	DataOUT2 D0
	4	DataIN2 D3	DataIN2 D2	DataOUT2 D3	DataOUT2 D2

Complete evaluation in Motorola format

Parameterization of the Bus Coupler	Address	Input data		Output data	
	Word offset	High byte	Low byte	High byte	Low byte
Complete evaluation: yes	0	DataIN1 D3	SB1	DataOUT1 D3	CB1
Motorola format: yes	1	DataIN1 D1	DataIN1 D2	DataOUT1 D1	DataOUT1 D2
Word alignment: no	2	SB2	DataIN1 D0	CB2	DataOUT1 D0
	3	DataIN2 D2	DataIN2 D3	DataOUT2 D2	DataOUT2 D3
	4	DataIN2 D0	DataIN2 D1	DataOUT2 D0	DataOUT2 D1

Complete evaluation in Intel format with word alignment

Parameterization of the Bus Coupler	Address	Input data		Output data	
	Word offset	High byte	Low byte	High byte	Low byte
Complete evaluation: yes	0	reserved	SB1	reserved	CB1
Motorola format: no	1	DataIN1 D1	DataIN1 D0	DataOUT1 D1	DataOUT1 D0
Word alignment: yes	2	DataIN1 D3	DataIN1 D2	DataOUT1 D3	DataOUT1 D2
	3	reserved	SB2	reserved	CB2
	4	DataIN2 D1	DataIN2 D0	DataOUT2 D1	DataOUT2 D0
	5	DataIN2 D3	DataIN2 D2	DataOUT2 D3	DataOUT2 D2

Complete evaluation in Motorola format with word alignment

Parameterization of the Bus Coupler	Address	Input data		Output data	
	Word offset	High byte	Low byte	High byte	Low byte
Complete evaluation: yes	0	reserved	SB1	reserved	CB1
Motorola format: yes	1	DataIN1 D2	DataIN1 D3	DataOUT1 D2	DataOUT1 D3
Word alignment: yes	2	DataIN1 D0	DataIN1 D1	DataOUT1 D0	DataOUT1 D1
	3	reserved	SB2	reserved	CB2
	4	DataIN2 D2	DataIN2 D3	DataOUT2 D2	DataOUT2 D3
	5	DataIN2 D0	DataIN2 D1	DataOUT2 D0	DataOUT2 D1

Compact process image on Bus Coupler that is set to complete process image

If the KL5152-0000 (KL5151-0050) is operated on a Bus Coupler that is set by default to complete process image (e.g. Lightbus), but bit [R32.6 \[► 57\]](#) of the feature register is 1_{bin} (default setting), the following process image results:

In this configuration you have different control and status bytes for register communication and process data operation. These are only suitable for the respectively specified purpose!

Intel format

Parameterization of the Bus Coupler	Address	Input data		Output data	
	Word offset	High byte	Low byte	High byte	Low byte
Complete evaluation: yes	0	DataIN1 D0	SB1RC	CB1PD	CB1RC
Motorola format: no	1	DataIN1 D2	DataIN1 D1	CB2PD	reserved
Word alignment: no	2	SB2RC	DataIN1 D3	CB2RC	reserved
	3	DataIN2 D1	DataIN2 D0	DataOUT D1	DataOUT D0
	4	DataIN2 D3	DataIN2 D2	DataOUT D3	DataOUT D2

Motorola format

Parameterization of the Bus Coupler	Address	Input data		Output data	
	Word offset	High byte	Low byte	High byte	Low byte
Complete evaluation: yes	0	DataIN1 D3	SB1RC	reserved	CB1RC
Motorola format: yes	1	DataIN1 D1	DataIN1 D2	reserved	CB2PD
Word alignment: no	2	SB2RC	DataIN1 D0	CB2RC	CB1PD
	3	DataIN2 D2	DataIN2 D3	DataOUT D2	DataOUT D3
	4	DataIN2 D0	DataIN2 D1	DataOUT D0	DataOUT D1

Intel format with word alignment

Default mapping for Lightbus, EtherCAT and Ethernet coupler as well as Bus Terminal Controllers (BCxxxx, BXxxxx)

Parameterization of the Bus Coupler	Address	Input data		Output data	
	Word offset	High byte	Low byte	High byte	Low byte
Complete evaluation: yes	0	reserved	SB1RC	reserved	CB1RC
Motorola format: no	1	DataIN1 D1	DataIN1 D0	reserved	CB1PD
Word alignment: yes	2	DataIN1 D3	DataIN1 D2	reserved	CB2PD
	3	reserved	SB2RC	reserved	CB2RC
	4	DataIN2 D1	DataIN2 D0	DataOUT D1	DataOUT D0
	5	DataIN2 D3	DataIN2 D2	DataOUT D3	DataOUT D2

Motorola format with word alignment

Parameterization of the Bus Coupler	Address	Input data		Output data	
	Word offset	High byte	Low byte	High byte	Low byte
Complete evaluation: yes	0	reserved	SB1RC	reserved	CB1RC
Motorola format: yes	1	DataIN1 D2	DataIN1 D3	CB2PD	reserved
Word alignment: yes	2	DataIN1 D0	DataIN1 D1	CB1PD	reserved
	3	reserved	SB2RC	reserved	CB2RC
	4	DataIN2 D2	DataIN2 D3	DataOUT D2	DataOUT D3
	5	DataIN2 D0	DataIN2 D1	DataOUT D0	DataOUT D1

Key

Complete evaluation: In addition to the process data, the control and status bytes are also mapped into the address space.

Motorola format: Motorola or Intel format can be set.

Word alignment: In order for the channel address range to commence at a word boundary, empty bytes are inserted into the process image as appropriate.

SB n: Status byte for channel n (appears in the input process image).

CB n: Control byte for channel n (appears in the output process image).

SB n PD: Status byte for channel n, to be used only for process data operation (appears in the input process image)

CB n PD: Control byte for channel n, to be used only for process data operation (appears in the output process image)

SB n RC: Status byte for channel n, to be used only for register communication (appears in the input process image)

CB n RC: Control byte for channel n, to be used only for register communication (appears in the output process image)

DataIN n D0: Channel n, input double word, lowest significant data byte

DataIN n D1: Channel n, input double word, ...

DataIN n D2: Channel n, input double word, ...

DataIN n D3: Channel n, input double word, highest significant data byte

DataOUT n D0: Channel n, output double word, lowest significant data byte

DataOUT n D1: Channel n, output double word, ...

DataOUT n D2: Channel n, output double word, ...

DataOUT n D3: Channel n, output double word, highest significant data byte

reserved: This byte occupies process data memory, although it has no function.

5.4 Register

5.4.1 Register overview

Register	Comment		Default value		R/W	Memory
R0 [▶ 55]	KL5151-0021:	Filter register	0x0000	0 _{dec}	R/W	RAM
	other types:	reserved	-	-	-	-
R1 to R5	reserved		-	-	-	-
R6	Diagnostic register (not used)		0x0000	0 _{dec}	R	RAM
R7	Command register (not used)		0x0000	0 _{dec}	R/W	RAM
R8 [▶ 55]	Terminal description	KL5151-0000:	0x141F	5151 _{dec}	R	ROM
		KL5151-0023:				
		KL5151-0050:				
		KL5152-0000:	0x1420	5152 _{dec}		
R9 [▶ 55]	Firmware version		e.g. 0x3341	e.g. 3A _{ASCII}	R	ROM
R10 [▶ 55]	Multiplex shift register		0x0228	552 _{dec}	R	ROM
R11 [▶ 55]	Signal channels	KL5151-0000:	0x0128	296 _{dec}	R	ROM
		KL5151-0023:	0x0150	336 _{dec}		
		KL5151-0050:	0x0228	552 _{dec}		
		KL5152-0000:				
R12 [▶ 55]	Minimum data length	KL5151-0000:	0x2828	10280 _{dec}	R	ROM
		KL5151-0023:	0x5050	20560 _{dec}		
		KL5151-0050:	0xA8A8	43176 _{dec}		
		KL5152-0000:				
R13 [▶ 55]	Data type		0x0006	6 _{dec}	R	ROM
R14	reserved		-	-	-	-
R15	Alignment register		variable	variable	R/W	RAM
R16 [▶ 55]	Hardware version		e.g. 0x0000	e.g. 0 _{dec}	R/W	SEEROM/RAM
R17 to R30	reserved		-	-	-	-
R29 [▶ 56]	Terminal type Special identifier	KL5151-0000:	0x0000	0 _{dec}	R	ROM
		KL5151-0023:	0x0017	23 _{dec}		
		KL5151-0050:	0x0032	50 _{dec}		
		KL5152-0000:	0x0000	0 _{dec}		
R31 [▶ 56]	Code word register		0x0000	0 _{dec}	R/W	RAM
R32 [▶ 57]	Feature register	KL5151-0000:	0x0000	0 _{dec}	R/W	SEEROM/RAM
		KL5151-0023:	0x0000	0 _{dec}		
		KL5151-0050:	0x00C0	192 _{dec}		
		KL5152-0000:				
R33 to R34	reserved		-	-	-	-
R35 [▶ 58]	KL5151-0021	Filter default	0x0000	0 _{dec}	R/W	SEEROM/RAM
	other types	reserved	-	-	-	-
R36 to R63	reserved		-	-	-	-

5.4.2 Register description

R0: Filter register (KL5151-0021 only)

Workpiece lengths are only valid if they are longer than the lengths specified here (specified in increments).

R6: Diagnostic register

Is not used

R7: Command register

Is not used

R8: Terminal description

Register R8 contains the terminal identifier in hexadecimal coding.

KL5151-0000: 0x141F (5151_{dec})

KL5151-0023: 0x141F (5151_{dec})

KL5151-0050: 0x141F (5151_{dec})

KL5152-0000: 0x1420 (5152_{dec})

R9: Firmware version

Register R9 contains the firmware revision level of the terminal in hexadecimal coding, e.g. 0x3341. This is to be interpreted as an ASCII code:

- ASCII code 0x33 represents the digit 3
 - ASCII code 0x41 represents the letter A
- So the firmware version is 3A in this example.

R10: Shift register length

0x0228

R11: Number of signal channels

KL5151-0000: 0x0128 (296_{dec})

KL5151-0023: 0x0150 (336_{dec})

KL5151-0050: 0x0228 (552_{dec})

KL5152-0000: 0x0228 (552_{dec})

R12: Minimum data length

KL5151-0000: 0x2828 (10280_{dec})

KL5151-0023: 0x5050 (20560_{dec})

KL5151-0050: 0xA8A8 (43176_{dec})

KL5152-0000: 0xA8A8 (43176_{dec})

R13: Data type

Register R13 contains the data type of the Bus Terminal. 0x0006 represents a special function.

R15: Alignment register

The terminal in the Bus Coupler is set to a byte limit with the bits of the alignment register.

R16: Hardware version number

Register R16 contains the hardware revision level of the terminal in hexadecimal coding, e.g. 0x0000 (0_{dec}).

R29: Terminal type - special identification

KL5151-0000: 0x0000 (0_{dec})
KL5151-0023: 0x0017 (23_{dec})
KL5151-0050: 0x0032 (50_{dec})
KL5152-0000: 0x0000 (0_{dec})

User register

The user registers of the terminal can be written by the user program in order to change the characteristics of the terminal at run-time.

R31: Code word register

- If you write values into the user registers without previously having entered the user code word (0x1235) in the code word register, these values are only stored in the RAM registers, but not in the EPROM registers and are therefore lost if the terminal is restarted.
- 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 EPROM registers and are therefore retained if the terminal is restarted.

The code word is reset if the terminal is restarted.

R32: Feature register (KL5151-0000, KL5151-0050, KL5152-0000)

The feature register specifies a variety of properties for the terminal.

Bit	Feature	Value	Explanation	Default
R32.15	OperationMode	0 _{bin}	Encoder interface	0 _{bin}
		1 _{bin}	One channel counter (32-bit up/down)	
R32.14	-	reserved		0 _{bin}
...
R32.8	-	reserved		0 _{bin}
R32.7	-	reserved		KL5151-0000: 0 _{bin} KL5151-0021: 0 _{bin} KL5151-0050: 1 _{bin} KL5152-0000: 1 _{bin}
R32.6	enCompact ProcessImage	0 _{bin}	KL5151-0050, KL5152-0000: <u>complete process image [▶ 45]</u> with status and control bytes KL5151-0000: <u>complete process image [▶ 37]</u> with status and control byte	KL5151-0000: 0 _{bin} KL5151-0021: 0 _{bin} KL5151-0050: 1 _{bin} KL5152-0000: 1 _{bin}
		1 _{bin}	KL5151-0050, KL5152-0000: <u>Compact process image [▶ 45]</u> without status byte but with control byte KL5151-0000: Compact process image without status byte and without control byte Useful operation of the KL5151-0000 with compact process image is not possible, since the control byte is required for the control of the counter and the latch!	
R32.5	enPosGateLock	0 _{bin}	A positive level at the <u>gate input [▶ 23]</u> does not lock the counter.	0 _{bin}
		1 _{bin}	A positive level at the <u>gate input [▶ 23]</u> locks the counter.	
R32.4	enNegGateLock	0 _{bin}	A negative level at the <u>gate input [▶ 23]</u> does not lock the counter.	0 _{bin}
		1 _{bin}	A negative level at the <u>gate input [▶ 23]</u> locks the counter.	
R32.3	-	reserved		0 _{bin}
...
R32.0	-	reserved		0 _{bin}

● Operation of KL5152-0000 (KL5151-0050) as one channel counter

i Because for operation of KL5152-0000 (KL5151-0050) as a counter the A2 connector is used to enable the counter (gate), the operation as a two channel counter is not possible.

R32: Feature register (KL5151-0021)

The feature register specifies a variety of properties for the terminal.

Bit	Feature	Value	Explanation	Default
R32.15	-	reserved		0 _{bin}
R32.14	B_MES_INV	0 _{bin} 1 _{bin}	determine the positive edge first, then the negative carry out an inverted measurement: i.e. determine the negative edge first, then the positive	0 _{bin}
R32.13	-	reserved		0 _{bin}
...
R32.0	-	reserved		0 _{bin}

R35: Filter default (KL5151-0021 only)

The value stored here is entered after a reset of the terminal in register R0 [▶_55] (specified in increments).

5.4.3 Examples of Register Communication

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

5.4.3.1 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.

5.4.3.2 Example 2: Writing to an user register

Code word

I 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})	0xFF	0xFF

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})	0xFF	0xFF

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})	0xFF	0xFF

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})	0xFF	0xFF

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})	0xFF	0xFF

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 Beckhoff Identification Code (BIC)

The Beckhoff Identification Code (BIC) is increasingly being applied to Beckhoff products to uniquely identify the product. The BIC is represented as a Data Matrix Code (DMC, code scheme ECC200), the content is based on the ANSI standard MH10.8.2-2016.

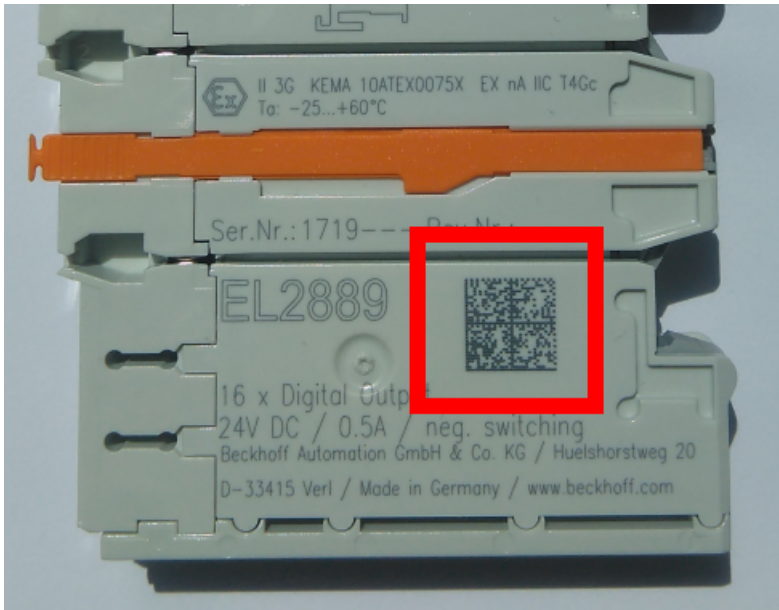


Fig. 19: BIC as data matrix code (DMC, code scheme ECC200)

The BIC will be introduced step by step across all product groups.

Depending on the product, it can be found in the following places:

- on the packaging unit
- directly on the product (if space suffices)
- on the packaging unit and the product

The BIC is machine-readable and contains information that can also be used by the customer for handling and product management.

Each piece of information can be uniquely identified using the so-called data identifier (ANSI MH10.8.2-2016). The data identifier is followed by a character string. Both together have a maximum length according to the table below. If the information is shorter, spaces are added to it.

Following information is possible, positions 1 to 4 are always present, the other according to need of production:

Position	Type of information	Explanation	Data identifier	Number of digits incl. data identifier	Example
1	Beckhoff order number	Beckhoff order number	1P	8	1P 072222
2	Beckhoff Traceability Number (BTN)	Unique serial number, see note below	SBTN	12	S BTNk4p562d7
3	Article description	Beckhoff article description, e.g. EL1008	1K	32	1K EL1809
4	Quantity	Quantity in packaging unit, e.g. 1, 10, etc.	Q	6	Q 1
5	Batch number	Optional: Year and week of production	2P	14	2P 401503180016
6	ID/serial number	Optional: Present-day serial number system, e.g. with safety products	51S	12	51S 678294
7	Variant number	Optional: Product variant number on the basis of standard products	30P	32	30P F971, 2*K183
...					

Further types of information and data identifiers are used by Beckhoff and serve internal processes.

Structure of the BIC

Example of composite information from positions 1 to 4 and with the above given example value on position 6. The data identifiers are highlighted in bold font:

1P072222**S**BTNk4p562d7**1K**EL1809 **Q**1 **51S**678294

Accordingly as DMC:



Fig. 20: Example DMC **1P**072222**S**BTNk4p562d7**1K**EL1809 **Q**1 **51S**678294

BTN

An important component of the BIC is the Beckhoff Traceability Number (BTN, position 2). The BTN is a unique serial number consisting of eight characters that will replace all other serial number systems at Beckhoff in the long term (e.g. batch designations on IO components, previous serial number range for safety products, etc.). The BTN will also be introduced step by step, so it may happen that the BTN is not yet coded in the BIC.

NOTE

This information has been carefully prepared. However, the procedure described is constantly being further developed. We reserve the right to revise and change procedures and documentation at any time and without prior notice. No claims for changes can be made from the information, illustrations and descriptions in this information.

6.2 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!

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You will also find further documentation for Beckhoff components there.

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