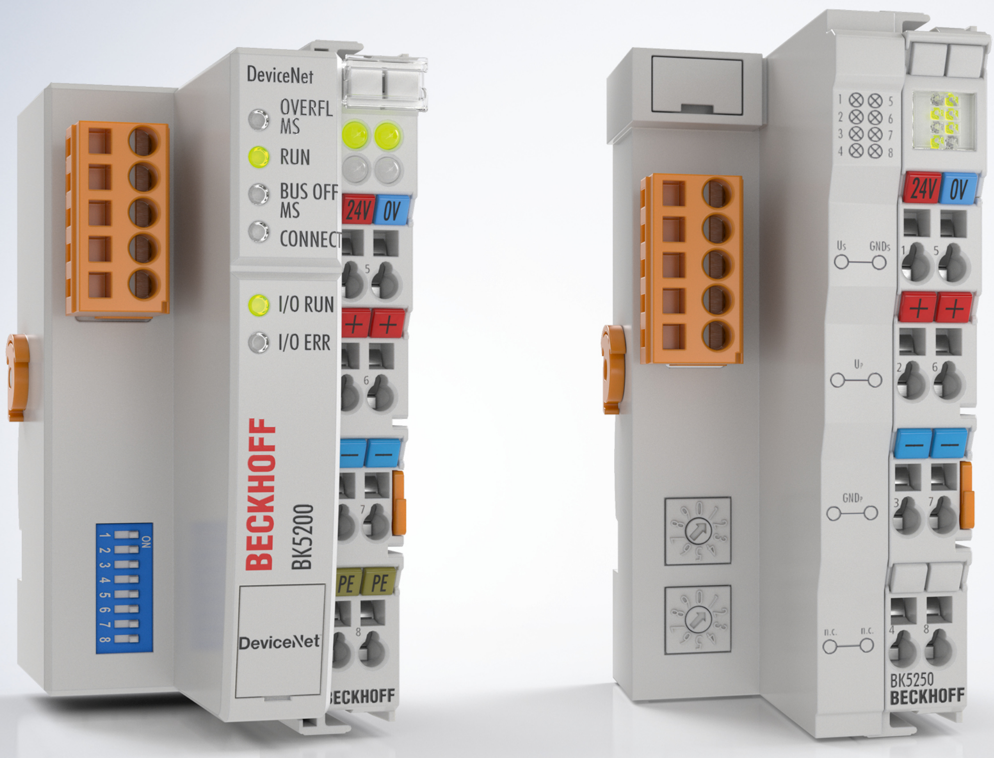
BECKHOFF New Automation Technology

Documentation | EN

BK52x0 and LC5200

Bus Coupler for DeviceNet



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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.

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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	Modifications
2.0.0	• Migration • BK5250 added • Technical data updated • Ex-markings added to the technical data • Chapter *Notes on ESD protection* added • LED function matrix added • Document structure updated • Safety instructions adapted to IEC 82079-1 • New title page

2 Product overview

2.1 BK5200 - Introduction

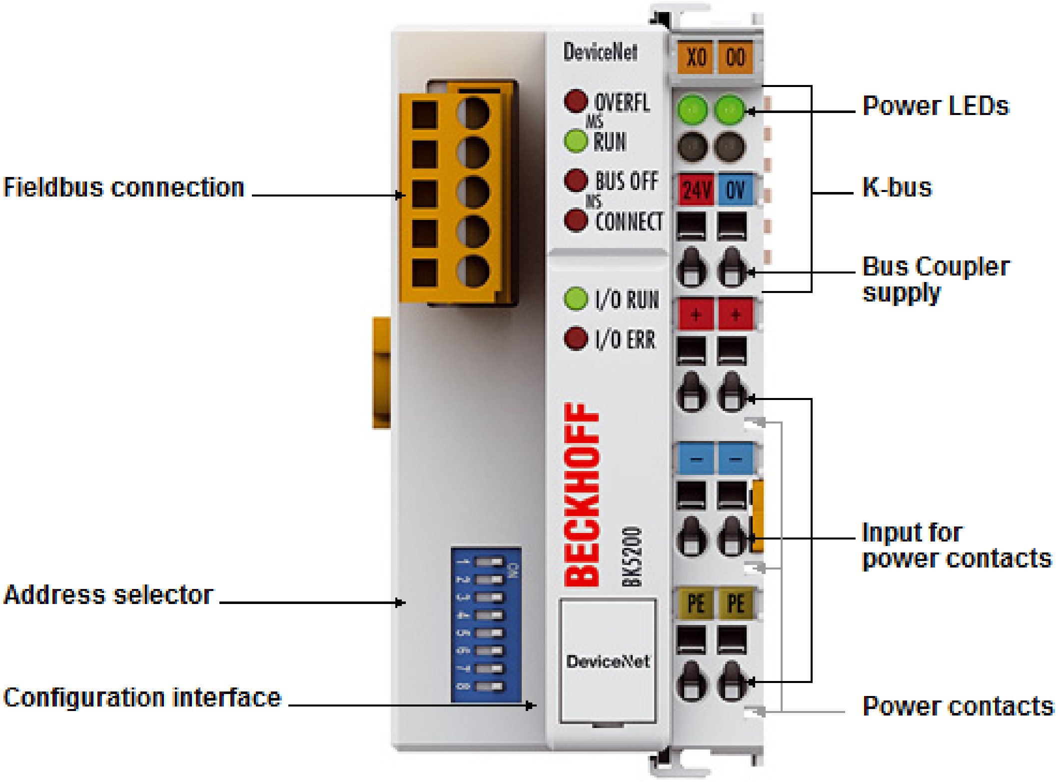

Fig. 1: BK5200 – Bus Coupler for DeviceNet

The BK5200 Bus Coupler connects the DeviceNet bus system to the modularly extendable electronic terminal blocks. One unit consists of one Bus Coupler, any number from 1 to 64 terminals and one bus end terminal.

The DeviceNet Bus Coupler also works without problems with other DeviceNet devices in a network on the basis of the CAN protocol. DeviceNet is based on definitions of communications objects and services for the exchange of data from the sensor/actuator area that have been specially agreed upon for automation technology. The Bus Couplers support all the types of I/O communication described by DeviceNet.

Parameterization of the Bus Couplers and the Bus Terminals can be carried out via the PC using the KS2000 configuration software. Commissioning without KS2000 is also possible. Appropriate EDS files are available for DeviceNet configuration tools.

2.2 BK5250 - Introduction

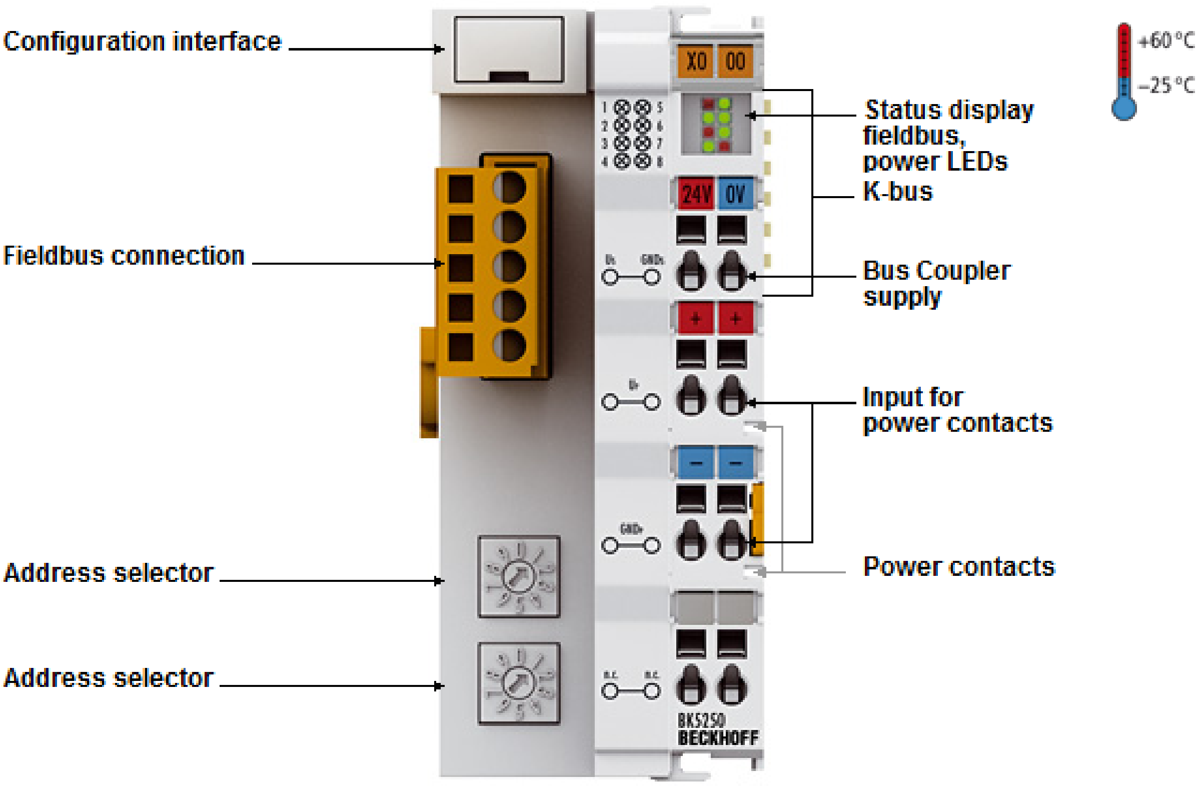

Fig. 2: BK5250 – Compact Bus Coupler for DeviceNet

The Compact Bus Coupler BK5250 for DeviceNet extends the Beckhoff Bus Terminal system by a cost-optimized version in a compact housing. Up to 64 Bus Terminals are supported; with the Terminal Bus Extension, up to 255 Bus Terminals can be connected. The DeviceNet Bus Coupler offers automatic baud rate detection up to 500 kbaud and two address selection switches for address assignment. A 5-pin connector for the fieldbus connection is included in the scope of supply. Optionally, the ZS1052-3000 connector with integrated terminating resistor can be connected.

2.3 LC5200 - Introduction

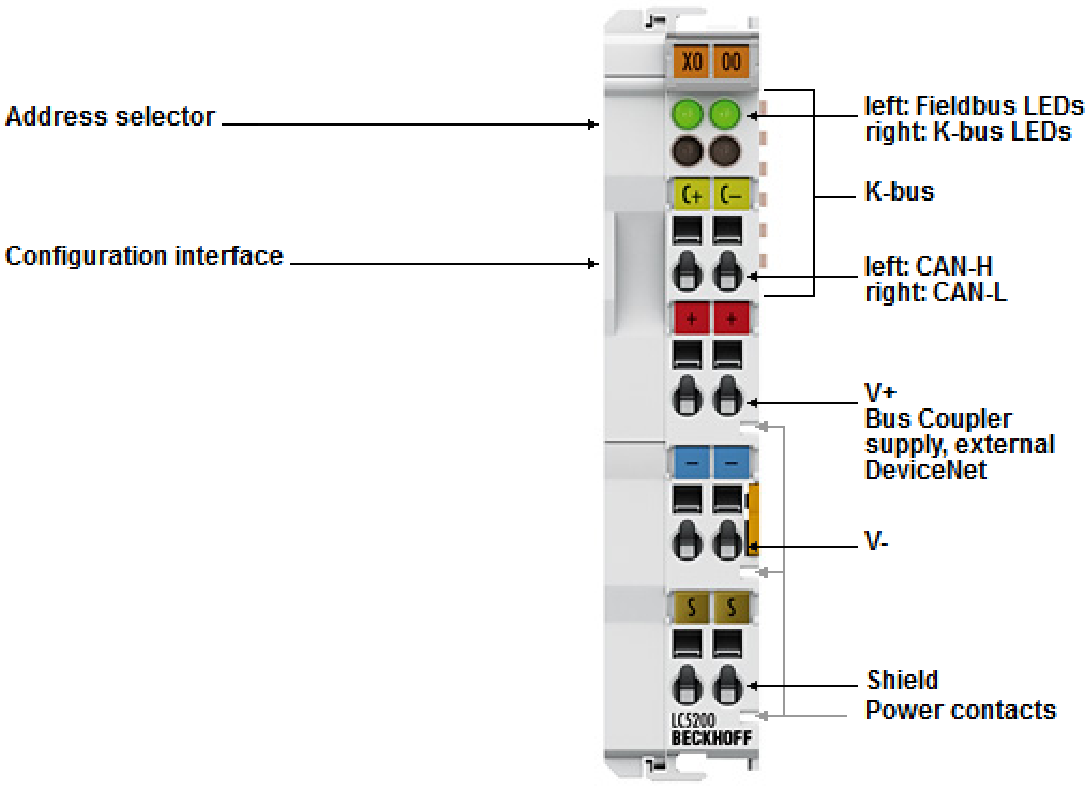

Fig. 3: LC5200 - Low-cost Bus Coupler for DeviceNet

The LC5200 low-cost bus coupler is characterized by its compact design and less expensive connection technology. It corresponds to the functions of the BK5210 DeviceNet Bus Coupler in relation to operation with Bus Terminals and its fieldbus properties. Up to 64 digital input/output terminals can be connected. The firmware can be updated via the configuration interface.

The LC5200 Bus Coupler is particularly suitable for use in small, low-price stations. The 24 V_{DC} supply voltage feeds the peripheral devices via the power contacts, as well as the Bus Coupler electronics and the K-bus electronics. Electrical isolation from the I/O level has been dispensed with in the Bus Coupler; it can be implemented if necessary with a power feed terminal. The LC5200 Bus Coupler can be replaced by a Bus Coupler from the BK5210 series.

All the bit-oriented terminals can be connected to the low-cost Bus Coupler. All digital input and output terminals are supported with the exception of KL15xx, KL25x2, KL2692 and KL27x1. All the system terminals, with and without diagnostics, can also be connected.

2.4 Technical data

Technical data	BK5200	BK5210	BK5250	LC5200
Number of Bus Terminals	64		64 (255 with K-bus extension)	64
Digital peripheral signals	512 inputs/outputs	256 inputs/ outputs	1,020 inputs/ outputs	256 inputs/ outputs
Analog peripheral signals	256 inputs/outputs	-	256 inputs/ outputs	-
Protocols				
Configuration possibility	via the KS2000 configuration software or the controller (TwinCAT)			
Maximum number of bytes	512 bytes of input data, 512 bytes of output data	32 bytes of input data, 32 bytes of output data	512 bytes of input data, 512 bytes of output data	32 bytes of input data, 32 bytes of output data
Bus connection	1 x open pluggable connector, 5-pin			directly to spring-loaded terminal
Power supply	24 V_{DC} (-15%/+20%), via bus cable 11 … 25 V (according to DeviceNet specification)			
Input current	70 mA + (total K-bus current)/4, 500 mA max.			
Input inrush current	approx. 2.5 x continuous current			
K-bus power supply up to	1750 mA	500 mA	1750 mA	500 mA
Power contact voltage	maximum 24 V_{DC}			
Power contact current load	maximum 10 A			
Dielectric strength	500 V (power contact / supply voltage / Bus Coupler)			
Recommended fuse	≤ 10 A			
Mounting [▶ 20]	on 35 mm support rail according to EN 60715			
Weight	app. 150 g	approx. 130 g	approx. 100 g	approx. 100 g
Permissible ambient temperature range during operation	0 °C ... +55 °C	0 °C ... +55 °C	-25 °C ... +60 °C (ET)	0 °C ... +55 °C
Permissible ambient temperature range during storage	-25 °C ... +85 °C	-25 °C ... +85 °C	-40 °C ... +85 °C	-25 °C ... +85 °C
Permissible relative humidity	95 %, no condensation			
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27			
EMC immunity / emission	conforms to EN 61000-6-2 / EN 61000-6-4			
Installation position	variable			
Protection class	IP20			
Approvals/markings	CE, cULus, ATEX [▶ 28]	CE, cULus, GL, ATEX [▶ 28]	CE, cULus, ATEX [▶ 29]	CE, cULus, ATEX [▶ 28]

System data	DeviceNet BK5200, BK5210, BK5250, LC5200		
Number of I/O modules	64		
Data transfer medium	shielded, twisted copper wire with energy supply, 5-pin		
Max. cable length	500 m	250 m	100 m
Data transfer rates	125 kbaud	250 kbaud	500 kbaud
Operation modes	Bit-Strobe, Polling, Cyclic, Change-of-State (COS)		
DeviceNet type	Communications adapter		

Ex marking

Standard	Marking
ATEX	II 3 G Ex nA IIC T4 Gc

3 Basic Function Principles

3.1 The Beckhoff Bus Terminal system

Up to 256 Bus Terminals, with 1 to 16 I/O channels per signal form

The Bus Terminal system is the universal interface between a fieldbus system and the sensor / actuator level. A unit consists of a Bus Coupler as the head station, and up to 64 electronic series terminals, the last one being an end terminal. Up to 255 Bus Terminals can be connected via the K-Bus extension. For each technical signal form, terminals are available with one, two, four or eight I/O channels, which can be mixed as required. All the terminal types have the same mechanical construction, so that difficulties of planning and design are minimized. The height and depth match the dimensions of compact terminal boxes.

Decentralized wiring of each I/O level

Fieldbus technology allows more compact forms of controller to be used. The I/O level does not have to be brought to the controller. The sensors and actuators can be wired decentrally, using minimum cable lengths. The controller can be installed at any location within the plant.

Industrial PCs as controllers

The use of an Industrial PC as the controller means that the operating and observing element can be implemented in the controller's hardware. The controller can therefore be located at an operating panel, in a control room, or at some similar place. The Bus Terminals form the decentralized input/output level of the controller in the control cabinet and the subsidiary terminal boxes. The power sector of the plant is also controlled over the bus system in addition to the sensor/actuator level. The Bus Terminal replaces the conventional series terminal as the wiring level in the control cabinet. The control cabinet can have smaller dimensions.

Bus Couplers for all usual bus systems

The Beckhoff Bus Terminal system unites the advantages of a bus system with the possibilities of the compact series terminal. Bus Terminals can be driven within all the usual bus systems, thus reducing the controller parts count. The Bus Terminals then behave like conventional connections for that bus system. All the performance features of the particular bus system are supported.

Mounting on standardized mounting rails

The installation is standardized thanks to the simple and space-saving mounting on a standardized mounting rail (EN 60715, 35 mm) and the direct wiring of actuators and sensors, without cross connections between the terminals. The consistent labelling scheme also contributes.

The small physical size and the great flexibility of the Bus Terminal system allow it to be used wherever a series terminal is also used. Every type of connection, such as analog, digital, serial or the direct connection of sensors can be implemented.

Modularity

The modular assembly of the terminal strip with Bus Terminals of various functions limits the number of unused channels to a maximum of one per function. The presence of two channels in one terminal is the optimum compromise of unused channels and the cost of each channel. The possibility of electrical isolation through potential feed terminals also helps to keep the number of unused channels low.

Display of the channel state

The integrated LEDs show the state of the channel at a location close to the sensors and actuators.

K-Bus

The K-Bus is the data path within a terminal strip. The K-Bus is led through from the Bus Coupler through all the terminals via six contacts on the terminals' side walls. The end terminal terminates the K-Bus. The user does not have to learn anything about the function of the K-Bus or about the internal workings of the terminals and the Bus Coupler. Many software tools that can be supplied make project planning, configuration and operation easy.

Potential feed terminals for isolated groups

The operating voltage is passed on to following terminals via three power contacts. You can divide the terminal strip into arbitrary isolated groups by means of potential feed terminals. The potential feed terminals play no part in the control of the terminals, and can be inserted at any locations within the terminal strip.

Up to 64 Bus Terminals can be used in a terminal block, with optional K-Bus extension for up to 256 Bus Terminals. This count does include potential feed terminals, but not the end terminal.

Bus Couplers for various fieldbus systems

Various Bus Couplers can be used to couple the electronic terminal strip quickly and easily to different fieldbus systems. It is also possible to convert to another fieldbus system at a later time. The Bus Coupler performs all the monitoring and control tasks that are necessary for operation of the connected Bus Terminals. The operation and configuration of the Bus Terminals is carried out exclusively by the Bus Coupler. Nevertheless, the parameters that have been set are stored in each Bus Terminal, and are retained in the event of voltage drop-out. Fieldbus, K-Bus and I/O level are electrically isolated.

If the exchange of data over the fieldbus is prone to errors or fails for a period of time, register contents (such as counter states) are retained, digital outputs are cleared, and analog outputs take a value that can be configured for each output when commissioning. The default setting for analog outputs is 0 V or 0 mA. Digital outputs return in the inactive state. The timeout periods for the Bus Couplers correspond to the usual settings for the fieldbus system. When converting to a different bus system it is necessary to bear in mind the need to change the timeout periods if the bus cycle time is longer.

The interfaces

A Bus Coupler has six different methods of connection. These interfaces are designed as plug connectors and as spring-loaded terminals.

3.2 Principle of the Bus Terminal

Fig. 4: Principle of the Bus Terminal

3.3 DeviceNet

3.3.1 DeviceNet Introduction

DeviceNet

Fig. 5: DeviceNet

DeviceNet is an open system based on CAN. CAN was developed some years ago by R. Bosch for data transmission in motor vehicles. Millions of CAN chips are now in use. A disadvantage for application in automation is that CAN does not contain definitions for the application layer. CAN only defines the physical and data link layer.

DeviceNet specifies a uniform application layer and this makes it possible to use the CAN protocol for industrial applications. ODVA (the Open DeviceNet Vendor Association) is an independent association which supports manufacturers and users of the DeviceNet system. ODVA ensures that all devices which conform to the specification can operate together in one system, regardless of their manufacturer.

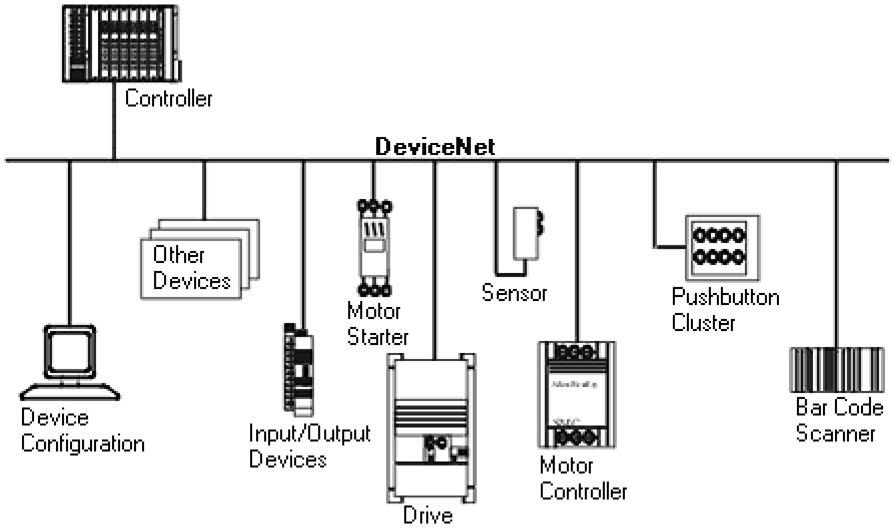

Fig. 6: Example of DeviceNet in use

DeviceNet is a sensor/actuator bus system. It is internationally standardised (EN50325) and is based on CAN (Controller Area Network). DeviceNet supports a number of communication types for the input and output data:

- Polling: The master module ("scanner") sends the output data cyclically to the assigned devices and receives the input data in an answer telegram.
- Change-of-State: Telegrams are sent as soon as their contents have changed.
- Cyclic: The modules send the data automatically after a cycle time has elapsed.
- Strobed: The scanner requests the input data using a broadcast telegram to all the devices.

The DeviceNet devices support all I/O communication types.

The DeviceNet devices are parameterized via acyclical services (explicit messaging).

The effective utilization of the bus bandwidth allows DeviceNet, particularly in Change-of-State mode, to achieve short system reaction times in spite of the relatively low data rates. The BECKHOFF DeviceNet devices have a powerful implementation of the protocol. Through active participation in the ODVA's technical committees, BECKHOFF are contributing to the further development of this bus system, and has in this way itself gathered profound DeviceNet expertise.

Configuration

The node address is set in the range from 0 to 63 using two decimally coded rotary switches. The data transfer rate set at the DeviceNet scanner is automatically recognized by the DeviceNet Box (auto baud rate). "Electronic Data Sheets" (EDS files) for DeviceNet configuration tools are available for download from the Beckhoff internet site (http://www.beckhoff.de), and on the BECKHOFF product CDs. Special I/O parameters that are not covered by the DeviceNet standard can be set via the KS2000 software (serial connection) or via acyclical explicit messages.

Diagnostics

The extensive diagnostic functions of the BECKHOFF DeviceNet devices allow rapid fault localisation. The diagnostic messages are transmitted over the bus and collated by the master. The status of the network connection, the device status, the status of the inputs and outputs and of the power supply are displayed by LEDs.

Data transfer rates

Three data transfer rates from 125 kbaud to 500 kbaud are available for different bus lengths. The effective utilization of the bus bandwidth allows DeviceNet to achieve short system reaction times at relatively low data rates.

Topology

DeviceNet is based on a linear topology. The number of devices participating in each network is logically limited by DeviceNet to 64, but physically the present generation of drivers allows up to 64 nodes in one network segment. The maximum possible size of the network for any particular data rate is limited by the signal propagation delay required on the bus medium. For 500 kbaud, for instance, the network may extend 100 m, whereas at 125 kbaud the network may reach up to 500 m. At low data rates the size of the network can be increased by repeaters, which also allow the construction of tree structures.

Bus access procedures

CAN utilizes the Carrier Sense Multiple Access (CSMA) procedure, i.e. all participating devices have the same right of access to the bus and may access it as soon as it is free (multi-master bus access). The exchange of messages is thus not device-oriented but message-oriented. This means that every message is unambiguously marked with a prioritized identifier. In order to avoid collisions on the bus when messages are sent by different devices, a bit-wise bus arbitration is carried out at the start of the data transmission. The bus arbitration assigns bus bandwidth to the messages in the sequence of their priority. At the end of the arbitration phase only one bus device occupies the bus, collisions are avoided and the bandwidth is optimally exploited.

Configuration and parameterization

The TwinCAT System Manager allows all the DeviceNet parameters to be set conveniently. An "eds" file (electronic data sheet) is available on the BECKHOFF website (http://www.beckhoff.de) for the parameterization of BECKHOFF DeviceNet devices using configuration tools from other manufacturers.

3.3.2 Data exchange

Data string from the DeviceNet master to the Bus Coupler

Data is transferred between masters and slaves in the form of objects. The Bus Coupler recognizes two objects: an input object and an output object. You can use the configuration software to map the input/output bytes onto specific memory areas in the controller. The Bus Coupler uses a consistent algorithm to correlate the object data to the peripherals. Various examples of correlations between addresses and peripherals are explained in the appendix. An object transmitted from the DeviceNet master to the Bus Coupler must first contain all byte-oriented values, which is the data for analog output terminals. The bit-oriented data for digital outputs may not be transmitted until all the byte-oriented values have been sent.

Analog outputs receive 16 bits of data, i.e. two bytes, per channel. An analog output terminal with 2 channels must therefore receive 4 bytes. A digital output terminal with 2 channels requires a total of 2 bits of data, 1 bit for each channel.

First the data from all the analog outputs

The first 4 bytes of an object transmitted to the terminal strip are assigned to the first analog output terminal, which is the analog output terminal closest to the Bus Coupler. Other terminals which are located between the Bus Coupler and the first analog output terminals are disregarded. The next four bytes of the object go to the second analog output terminal in the terminal strip. Any other terminals between the first and second analog output terminals are disregarded.

Then the data for the digital outputs is transmitted in bytes

When the last analog output terminal in the terminal strip has received its data, the digital outputs are served. Data is always transmitted byte-by-byte. The next byte from the data string contains the data for 8 digital outputs. Bit 0 and bit 1 are assigned to channels 1 and 2 of the first digital output terminal after the Bus Coupler. Other types of terminals which are located in between are ignored.

Bit 2 and bit 3 go to the 2 channels of the second digital output terminal, bit 4 and bit 5 to the third and bit 6 and bit 7 to the fourth. There may be other terminals located between these digital output terminals, and if so they will be disregarded.

Additional bytes are read from the data string until the last digital output in the terminal strip has been dealt with. If the total number of digital outputs is not a multiple of 8, there will be a number of bits left over in the last data byte; these will be discarded.

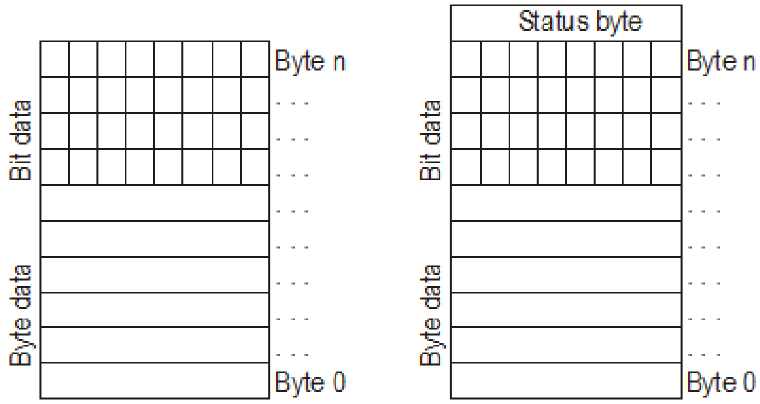

Fig. 7: Data exchange

Object from the Bus Coupler to the DeviceNet master for transferring the input data

The object sent by the Bus Coupler to the DeviceNet master also contains the byte-oriented data at the beginning, followed by the bit-oriented data. Transfers in this direction also include a status byte, which comes right at the end of the object.

The byte-oriented data contains the values from the analog inputs and the bit-oriented data the values from the digital inputs.

Byte-by-byte data

The first four bytes contain the data of the first analog input terminal in the terminal strip. 2 bytes form the 16-bit value of each input. The next four bytes correspond to the next analog input terminal and so on, analogously to the procedure described above.

Bit-by-bit data

After the byte-oriented data from all the analog inputs come the values from the digital inputs. Eight digital inputs are transferred in each byte. As before, if the total number of digital inputs in the terminal strip is not a multiple of 8, the last data byte will contain one or more unused bits.

An extra status byte is transferred at the end of each string sent by the Bus Coupler to the DeviceNet master, and this returns the status of the terminal strip. Its value corresponds to the status displayed on the I/O LEDs on the Bus Coupler. If the terminal strip is working without error, the I/O RUN LED is lit and the status byte contains the value 0. As soon as an error occurs, the I/O ERR LED lights up and the status byte contains the value 1.

3.3.3 Vendor ID

The Vendor ID is # 108

3.3.4 DeviceNet Group

The BK5200, BK5210 and LC5200 Bus Couplers are exclusively Group 2 devices.

IDENTIFIER BITS											MESSAGE ID MEANING
10	9	8	7	6	5	4	3	2	1	0	
1	0	MAC ID						Group 2 Message ID			Group 2 Messages
1	0	MAC ID						0	0	0	Group 2 Message Identifier
1	0	MAC ID						0	0	1	
1	0	MAC ID						0	1	0	
1	0	MAC ID						0	1	1	
1	0	MAC ID						1	0	0	
1	0	MAC ID						1	0	1	
1	0	Destination MAC ID						1	1	0	Reserved for Predefined Master/Slave Connection Management
1	0	Destination MAC ID						1	1	1	Duplicate MAC ID Check Message

Fig. 8: Overview of the identifiers used

4 Mounting and wiring

4.1 Instructions for ESD protection

NOTE

Destruction of the devices by electrostatic discharge possible!

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

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

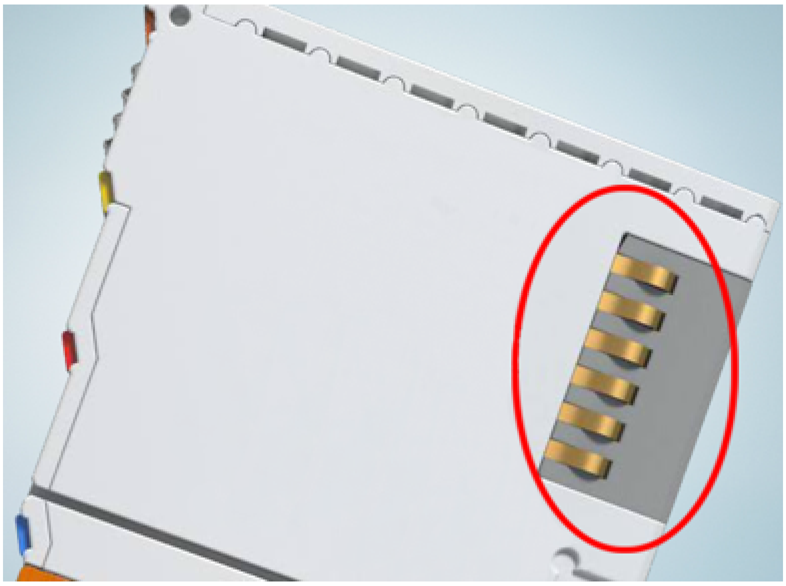

Fig. 9: Spring contacts of the Beckhoff I/O components

4.2 Dimensions

The system of the Beckhoff Bus Terminals is characterized by low physical volume and high modularity. When planning a project it must be assumed that at least one Bus Coupler and a number of Bus Terminals will be used. The dimensions of the Bus Couplers are independent of the fieldbus system.

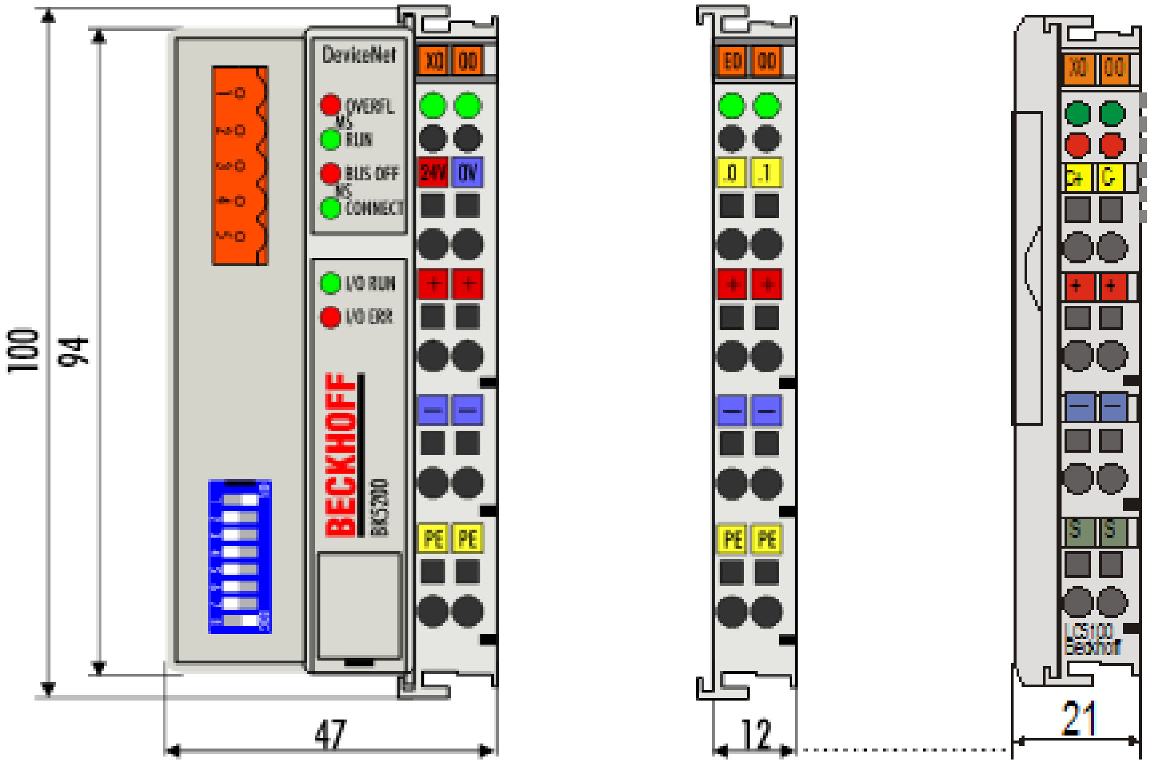

Fig. 10: Dimensions

4.3 Installation on mounting rails

⚠ **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.

Mounting

The Bus Couplers and Bus Terminals are attached to commercially available 35 mm mounting rails (DIN rail 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 slot and key and push the terminals against the mounting rail, until the lock clicks onto the mounting rail.
   If the terminals are clipped onto the mounting rail first and then pushed together without tongue and groove, the connection will not be operational! When correctly assembled, no significant gap should be visible between the housings.

Fixing of mounting rails

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

Disassembly

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

1. Carefully pull the orange-colored lug approximately 1 cm out of the terminal to be disassembled, until it protrudes loosely. The lock with the mounting rail is now released for this terminal, and the terminal can be pulled from the mounting rail 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 away from the mounting rail.

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.

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 and EL91xx, EL92xx) interrupt the power contacts and thus represent the start of a new supply rail.

PE power contact

The power contact labelled 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.

NOTE

Risk of damage to 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!

Wiring

Up to eight connections enable the connection of solid or finely stranded cables to the Bus Terminals. The terminals are implemented in spring force technology. Connect the cables as follows:

1. Open a spring-loaded terminal by slightly pushing with a screwdriver or a rod into the square opening above the terminal.
2. The wire can now be inserted into the round terminal opening without any force.
3. The terminal closes automatically when the pressure is released, holding the wire safely and permanently.

Shielding

Analog sensors and actuators should always be connected with shielded, pair-wise twisted cables.

4.4 Power supply, potential groups

Power supply

The Bus Couplers require a 24 V DC supply for their operation. In the case of the BK52x0 Bus Couplers this is connected via the upper spring-loaded terminals marked "24 V" and "0 V". This supply voltage feeds not only the Bus Coupler electronics, but also the Bus Terminals via the K-bus. In the BK52x0 Bus Couplers the power supply for the bus coupler electronics and that of the K-bus are electrically isolated from the field level potentials.

Power supply for the power contacts

The bottom six connections with spring-loaded terminals can be used to feed the supply for the peripherals. The spring-loaded terminals are joined in pairs to a power contact. The supply for the power contacts has no connection to the power supply for the Bus Coupler (BK52x0). The design of the supply permits voltages of up to 24 V. The assignment in pairs and the electrical connection between feed terminal contacts allows the connection wires to be looped through to various terminal points. The current load from the power contact must not exceed 10 A for long periods. The current carrying capacity between two spring-loaded terminals is identical to that of the connecting wires.

Power contacts

On the right side of the Bus Coupler there are three spring contacts for the power contact connections. The spring contacts are hidden in slots so that they cannot be accidentally touched. By attaching a Bus Terminal the blade contacts on the left side of the Bus Terminal are connected to the spring contacts. The tongue and groove guides on the top and bottom of the Bus Coupler and of the Bus Terminals guarantees that the power contacts mate securely.

Fieldbus connection

The BK52x0 Bus Couplers have a recessed front surface on the left side. The DeviceNet connection plug can be inserted here. A full description of the fieldbus interfaces is found elsewhere in this manual.

In the LC5200 Bus Coupler the bus is connected directly at the upper terminal pair.

Configuration interface

The BK52x0 Bus Couplers have an RS232 interface at the bottom of the front face, whereas on the LC5200 it is located under the cover on the side. The miniature connector can be joined to a PC with the aid of a connecting cable and the KS2000 configuration software. The interface allows the analog channels to be configured and also permits firmware updating.

The functionality of the configuration interface can also be reached via the fieldbus using the object attributes for the register communication.

K-bus contacts

In order to connect the Bus Coupler and Bus Terminals the Bus Coupler has gold contacts on the right side. When the Bus Terminals are pushed together the gold contacts automatically make the connection between the Bus Terminals. The power supply to the K-bus electronics in the Bus Terminals and the data exchange between the Bus Coupler and the Bus Terminals is carried out by the K-bus. A part of the data exchange takes place via a ring structure within the K-bus. Opening the K-bus, e.g. by pulling out one of the Bus Terminals, opens the ring. Data exchange is no longer possible. Special mechanisms nevertheless allow the Bus Coupler to identify the location of the interruption and to report it.

Electrical isolation

The Bus Couplers operate by means of three independent potential groups. The supply voltage feeds the K-bus electronics in the Bus Coupler and the K-bus itself in an electrically isolated manner. The supply voltage is also used to generate the operating voltage for the fieldbus.

Note: All the Bus Terminals are electrically isolated from the K-bus. The K-bus is thus electrically isolated from everything else.

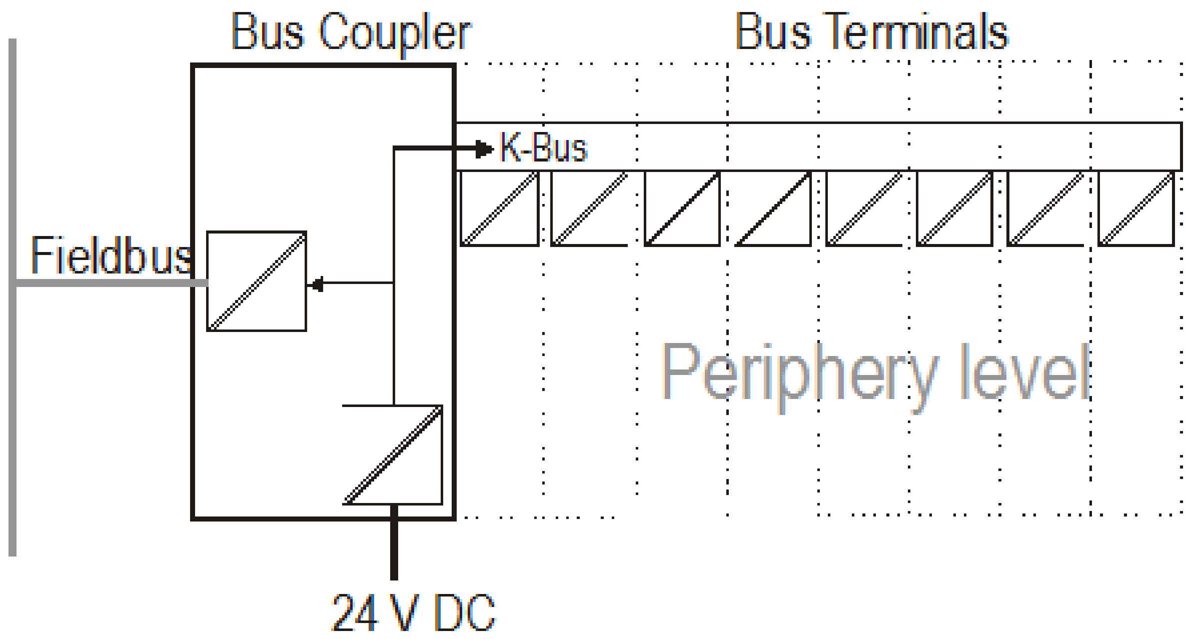

Fig. 11: BK5200, BK5210, BK5250 – potential groups

The LC5200 does not provide electrical isolation from the fieldbus and peripheral level. If the peripheral level nevertheless needs to have an electrically isolated implementation, this can easily be achieved through the use of isolating terminals (KL9xxx).

4.5 Electrical isolation

BK5200, BK5210

The BK5200 and BK5210 Bus Couplers have electrical isolation between the DeviceNet bus cable and the communication electronics of the Bus Coupler.

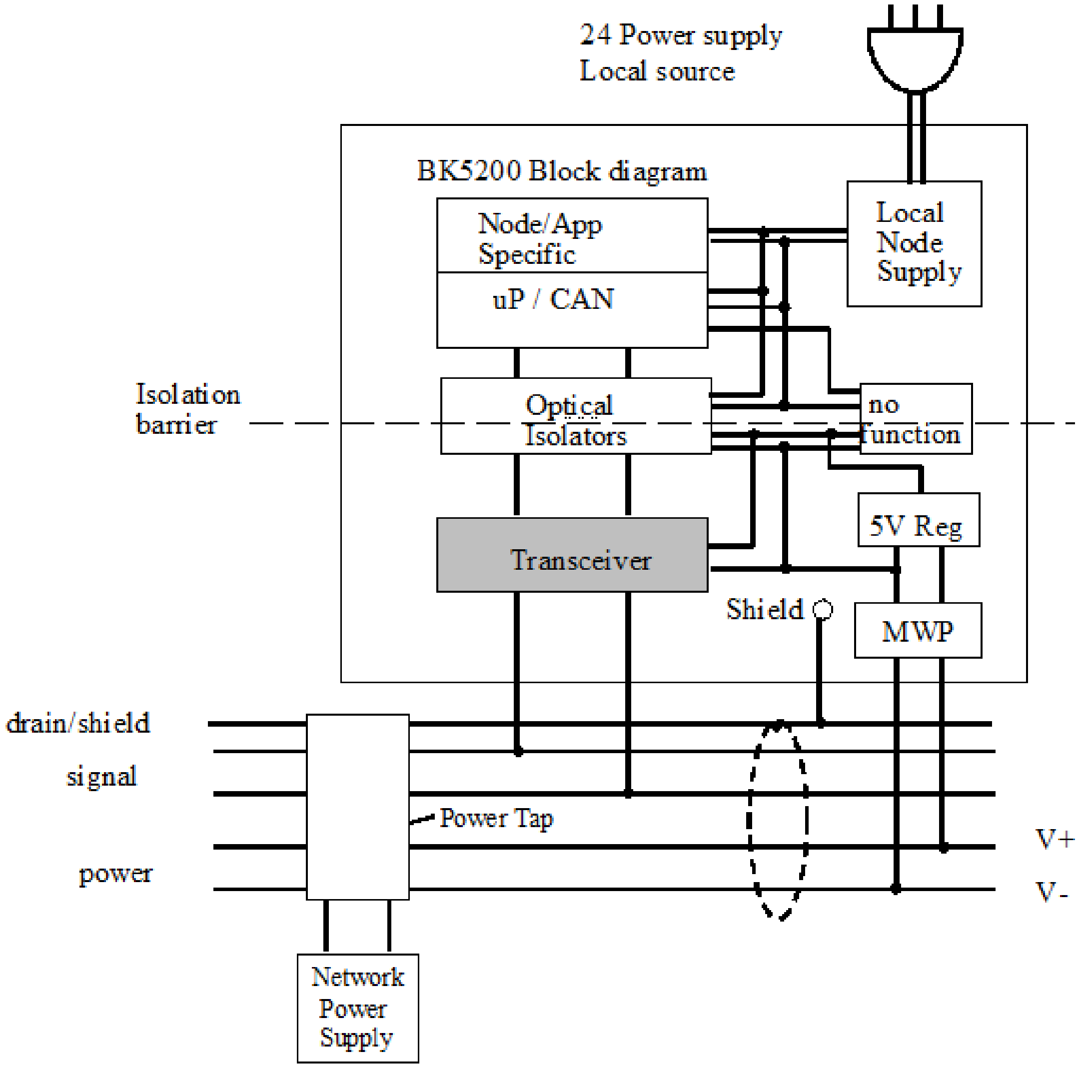

Fig. 12: Potential levels of the BK5200 and BK5210

LC5200

The LC5200 does not provide electrical isolation from the fieldbus and peripheral level. If the peripheral level nevertheless needs to have an electrically isolated implementation, this can easily be achieved through the use of isolating terminals (KL9xxx).

4.6 DeviceNet connection – pin assignment

A 5-pin connector is supplied for the connection of the DeviceNet bus cable. When it is plugged into the Bus Coupler, pin 1 is at the top. The figure shows the socket in the Bus Coupler. The power supplied by this plug is isolated from the power supply of the terminal to the right of the Bus Coupler. Both power sources must be connected before the system can operate.

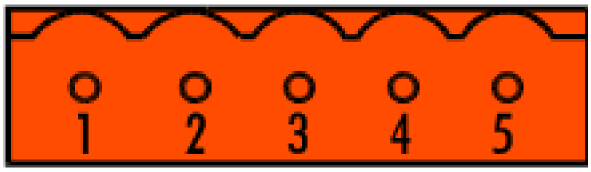

Fig. 13: DeviceNet connection – pin assignment

Pin	Signal
1	V+
2	CAN-H
3	GND
4	CAN-L
5	V-

LC5200 DeviceNet connection

In the low-cost LC5200 coupler, the CAN line is connected directly to the terminal points 1 (CAN-H, marked with C+) and 5 (CAN-L, marked with C-). V+ is applied to the terminal points 2 or 6. V- is applied to the terminal points 3 or 7. The shield can optionally be applied to terminal points 4 or 8, which are connected to the DIN rail via an R-C circuit.

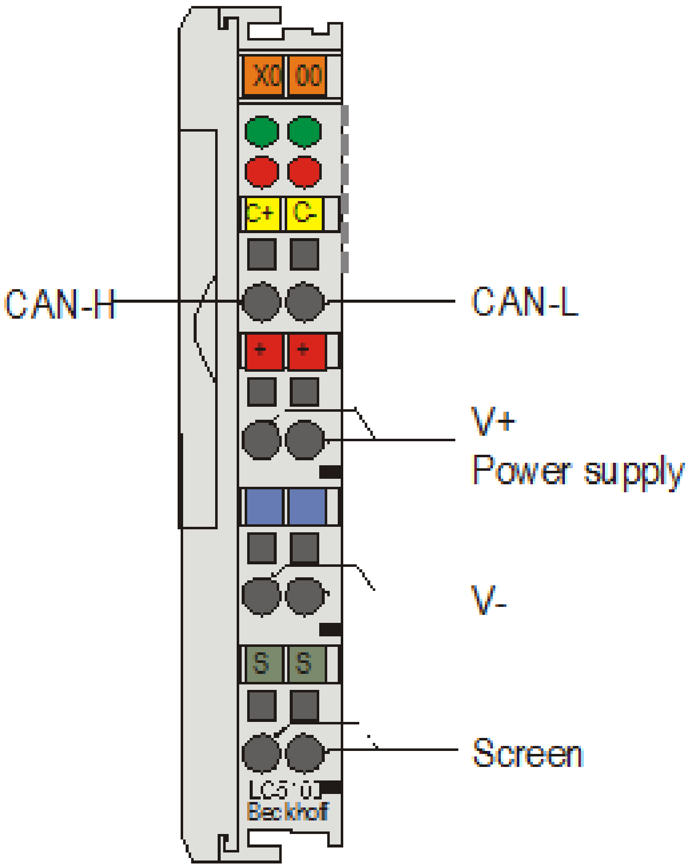

Fig. 14: LC5200 - Connection diagram

4.7 Bus cable lengths and pin assignment

The maximum length of cable which can be used depends on the selected baud rate. The following lengths should be understood as the total length of the main line plus any drop lines.

Baud rate	Bus length
500 kbit/s	< 100 m
250 kbit/s	< 250 m
125 kbit/s	< 500 m

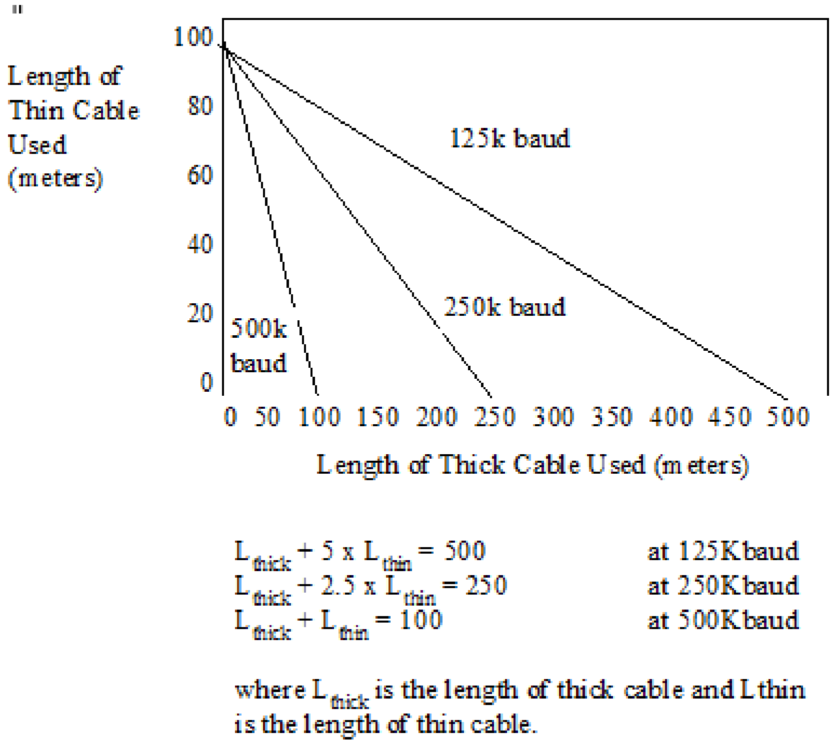

Fig. 15: DeviceNet – Baud rate and bus length

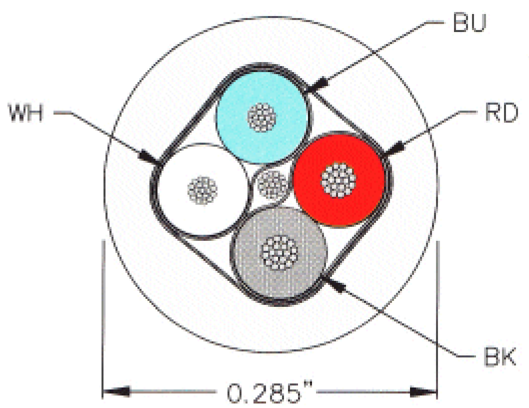

Fig. 16: Layout of the ZB5200 CAN/DeviceNet cable

The cable consists of two shielded wire pairs. One pair carries out the transmission. The second pair distributes the supply voltage.

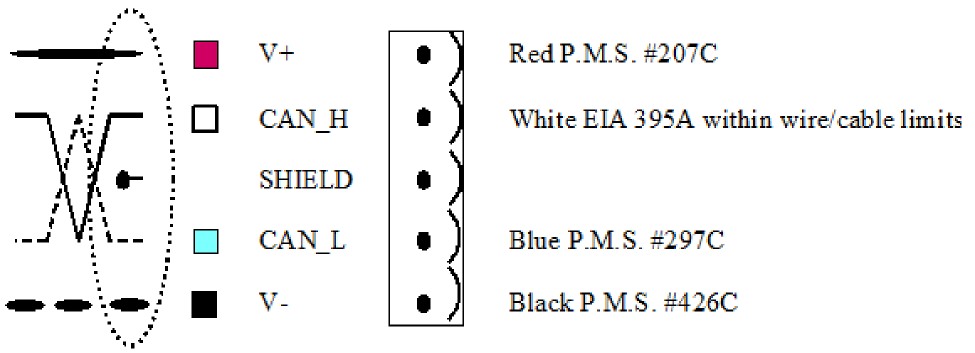

Fig. 17: Cable assignment

4.8 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)

4.9 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)

4.10 Continuative documentation for ATEX and IECEx

Continuative 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 on the Beckhoff homepage www.beckhoff.com!

5 Parameterization and Commissioning

5.1 Start-up behaviour of the Bus Coupler

Immediately after being switched on, the Bus Coupler checks, in the course of a self-test, all the functions of its components and the communication on the K-bus/E-bus. The red I/O LED blinks while this is happening. After completion of the self-test, the Bus Coupler starts to test the attached Bus Terminals (the "Bus Terminal Test"), and reads in the configuration. The Bus Terminal configuration is used to generate an internal structure list, which is not accessible from outside. In case of an error, the Bus Coupler enters the *Stop* state. Once the start-up has completed without error, the Bus Coupler enters the *fieldbus start* state.

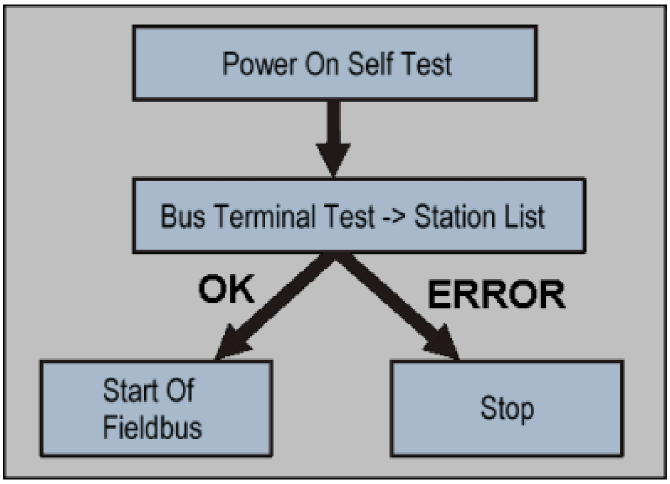

Fig. 18: Start-up behaviour of the Bus Coupler

The Bus Coupler can be made to enter the normal operating state by switching it on again once the fault has been rectified.

5.2 Peripheral Data in the Process Image

After being switched on, the Bus Coupler determines the configuration of the inserted input/output terminals. The assignment of the physical slots for the input/output channels and the addresses in the process image is carried out automatically by the Bus Coupler.

The Bus Coupler creates an internal assignment list, in which the input/output channels have a specific position in the process image. A distinction is made here according to inputs and outputs, and according to bit-oriented (digital) and byte-oriented (analog or complex) signal processing.

Two groups are created, one for inputs and the other for outputs. Each group has the byte-oriented channels in ascending sequence starting from the lowest address. The bit-oriented channels are placed after this block.

Digital signals (bit-oriented)

The digital signals are bit-oriented. This means that one bit in the process image is assigned to each channel. The Bus Coupler creates a memory area containing the current input bits, and ensures that the bits in a second memory area dedicated to the output channels are written out immediately.

The details of the assignment of the input and output channels to the controller's process image is explained fully with the aid of an example in the appendix.

Analog signals (byte-oriented)

The processing of analog signals is always byte-oriented. Analog input and output values are represented in memory by two bytes each. The values are represented in "SIGNED INTEGER" or "two's complement". The numerical value "0" stands for input/output value "0 V", "0 mA" or "4 mA". The maximum value of an output or input value is represented, according to the standard settings, by "7FFF" hex. Negative input/output values, e.g. -10 V are mapped as "1000" hex. The intermediate values are correspondingly proportional. A range with a resolution of 15 bits is not achieved for all input and output stages. With an actual resolution of 12 bits, the last 3 bits for outputs have no effect and for inputs they are read "0". Each channel also has a control and status byte. The control and status byte is the highest value byte. Version 2.0 of the DeviceNet coupler does not permit the control and status byte to be read. An analog channel is represented in the process image by 2 bytes. The following versions permit expansion of a channel's data width by means of the KS2000 configuration software.

Special signals and interfaces

A Bus Coupler supports Bus Terminals with other interfaces such as RS232, RS485, incremental encoder and others. These signals can be considered similarly to the analog signals named above. For some special signals the bit width of 16 is not sufficient. The Bus Coupler can support any byte width.

Default assignment of inputs/outputs to the process image

Once it has been switched on, the Bus Coupler finds out how many Bus Terminals are inserted, and creates an assignment list. The analog and digital channels, divided into inputs and outputs, are assembled into separate parts of this list. The assignment starts on the left next to the Bus Coupler. The software in the Bus Coupler collects the individual entries for each of the channels in order to create the assignment list counting from left to right.

Four groups are distinguished in the assignment

	Functional type of the channel	Assignment level
1.	Analog outputs	assignment by bytes
2.	Digital outputs	assignment by bits
3.	Analog inputs	assignment by bytes
4.	Digital inputs	assignment by bits

Complex multi-byte signal Bus Terminals are represented as analog inputs or outputs.

The distribution of the process image in the Bus Coupler in overview:

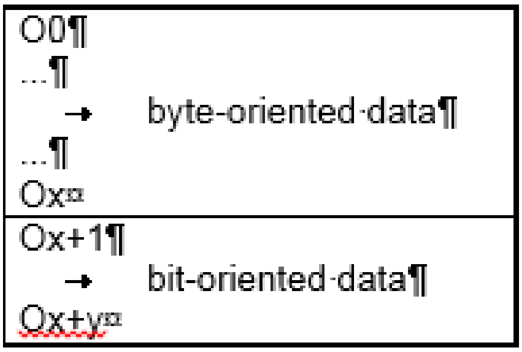

Fig. 19: Output data in the Bus Coupler

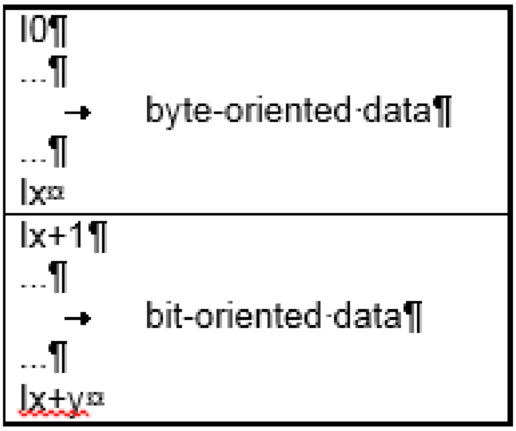

Fig. 20: Input data in the Bus Coupler

Process image in the BK5200 and in the PLC (scanner)

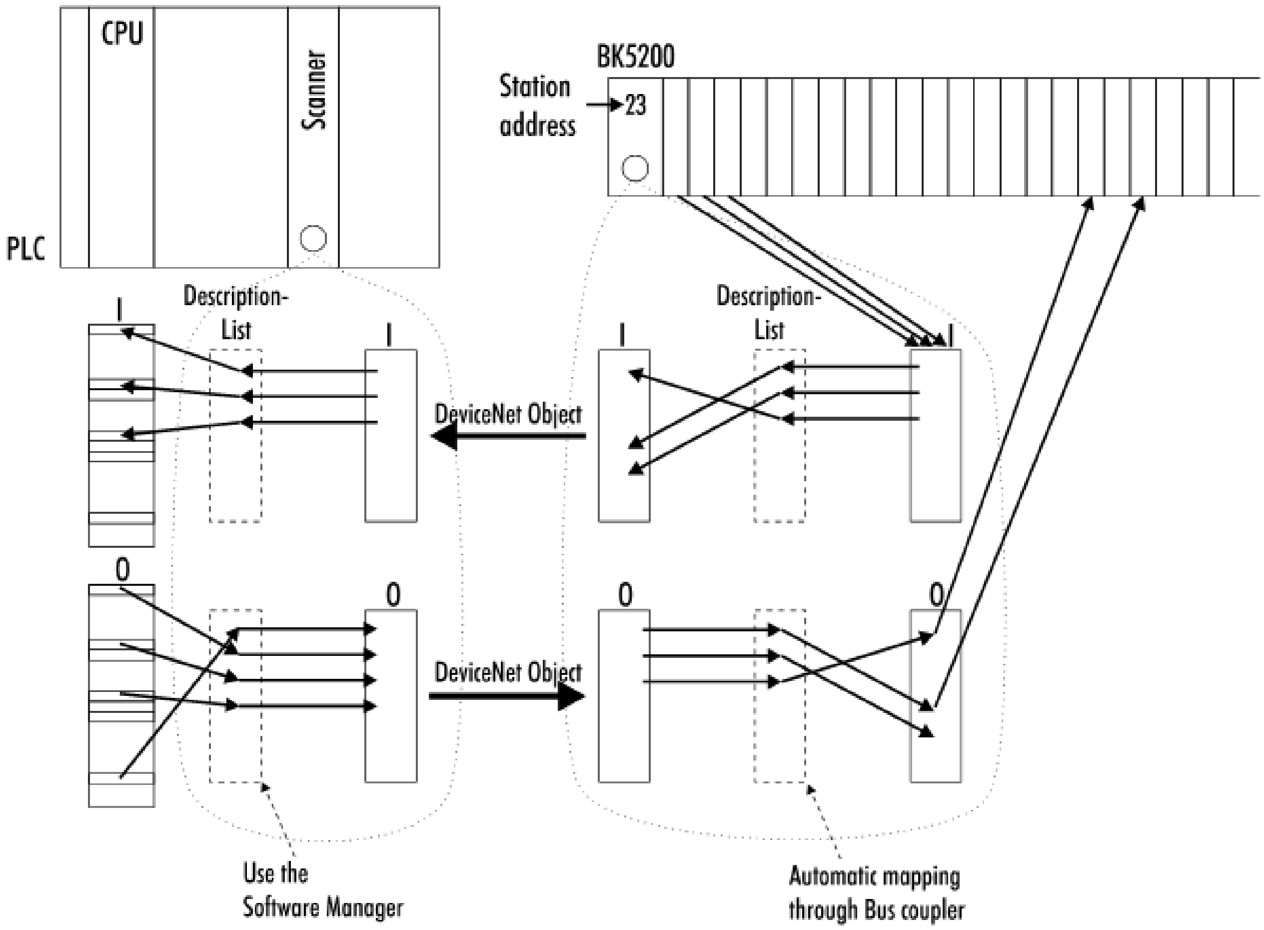

Fig. 21: Process image in the BK5200 and in the PLC (scanner)

Data consistency

Data whose content is all correctly associated is said to be consistent.
Examples of data items that belong together are

1. the high and low byte of an analog value (word consistency)
2. the control/status byte and the associated parameter word for access to the registers.

Data consistency in the interaction of peripheral devices and their controllers is, in a basic sense, only assured for a single byte. In other words, the bits of a byte are written or read together. Byte consistency is sufficient for handling digital signals. Whenever values have a length of more than 8 bits, analog values for instance, the consistency must be extended. The different bus systems guarantee consistency up to the required length. Correct transfer of the consistent data from the bus system master to the controller is important. The corresponding manual for the bus system will provide a detailed description of the correct procedure, in particular the description of the master interfaces used. Those chapters of this manual that deal with the fieldbus refer to the most widespread interfaces.

Complex signal processing

All the byte-oriented signal channels such as RS232, RS485 or incremental encoders operate to some extent with byte lengths of more than two. Apart from the difference in length, they are always handled similarly to the analog signals.

5.3 Configuration of the Bus Coupler

Set all the DIP switches to the desired configuration before you switch on the Bus Coupler. Switches 7 and 8 are used to set the baud rate, as shown in the following table.

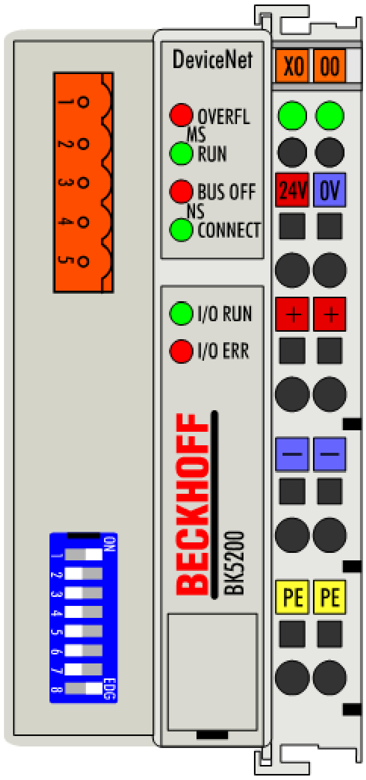

Fig. 22: BK5200 - Configuration

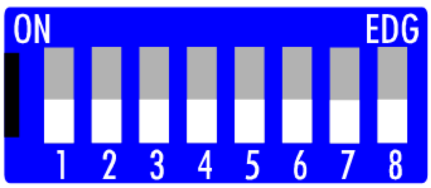

Fig. 23: DIP switch

Setting the baud rate

Setting baud rates	1	2	3	4	5	6	7	8
125 kbaud							off	off
250 kbaud							on	off
500 kbaud							off	on
(Default) 125 kbaud							on	on

Setting the MAC ID

The MAC ID is set with DIP switches 1 to 6: Switch 1 is the lowest value bit 20 and switch 6 the highest value bit 25. The bit is set when the switch is ON.

You can select the MAC ID from the range 0 to 63.

Switch on the Bus Coupler

When you have set all the DIP switches to the desired configuration you can switch on the Bus Coupler. Any changes you make to the switches while the system is in operation will have no effect until the next time it is switched on.

5.4 Diagnostic LEDs

After switching on, the Bus Coupler immediately checks the connected configuration. Error-free start-up is indicated when the red "I/O ERR" LED goes out. If the "I/O ERR" LED blinks, an error in the area of the terminals is indicated. The error code can be determined from the frequency and number of blinks. This permits rapid rectification of the error.

The Bus Coupler has two groups of LEDs for the display of status. The upper group with four LEDs indicates the status of the respective fieldbus. The significance of the "fieldbus status" LED is explained in the relevant sections of this manual - it conforms to conventional fieldbus displays.

On the upper right side of the Bus Couplers are two more green LEDs that indicate the supply voltage. The left LED indicates the presence of the 24 V supply for the Bus Coupler. The right LED indicates the presence of the supply to the power contacts.

Local errors

Two LEDs – the "I/O - LEDs" – below the above-mentioned Fieldbus Status LEDs display the operating states of the Bus Terminals and the connection to these Bus Terminals. The green LED lights up in order to indicate fault-free operation. The red LED blinks with two different frequencies in order to indicate an error. The error is encoded in the blink code in the following way:

Fast flashing	Start of the error code
First slow sequence	Error code
Second slow sequence	Error code argument

Error code	Error code argument	Description
1 pulse	0 1 2	EEPROM checksum error Inline code buffer overflow Unknown data type
2 pulses	0 n (n>0)	Programmed configuration Incorrect table entry / Bus Coupler Incorrect table comparison (terminal n)
3 pulses	0	Terminal bus command error
4 pulses	0 n	Terminal bus data error Break behind terminal n (0 coupler)
5 pulses	n	Terminal bus error in register communication with terminal n
6 pulses	0 n (n>0)	Special fieldbus error

The number of pulses in the first sequence indicates the error type, while the second sequence indicates the position of the last Bus Terminal before the fault. Passive Bus Terminals, such as a power feed terminal, are not included in the count.

In the case of some errors, rectification does not cause the Bus Coupler to leave the blink sequence. The operating state of the Bus Coupler remains "Stop". The Bus Coupler can only be re-started either by switching the power supply off and on again, or by a scanner reset.

Insertion and removal of Bus Terminals is only permitted when switched off. The electronics in the Bus Terminals and in the Bus Coupler are protected to a large measure against damage, but incorrect function and damage cannot be ruled out if they are plugged in under power.

The occurrence of a fault in the course of operation does not immediately trigger the display of error codes by the LEDs. The Bus Coupler must be requested to diagnose the Bus Terminals. The diagnostic request is generated at power-up or through an access by the fieldbus to the Bus Coupler. This means that if no data is being exchanged over DeviceNet when a Bus Terminal is removed from the system, the Bus Coupler will not necessarily report an error.

5.4.1 LED displays

Module Status MS

LED		Meaning
RUN	green LED blinks	Configuration is incorrect
	green LED is steadily lit	Status is OK
OVERFL	red LED blinks	K-bus error
	red LED is steadily lit	Receive queue overflow

Network Status NS

LED		Meaning
CONNECT	green LED blinks	Bus Coupler is ready for communication, but not yet assigned to the master
BUS OFF	green LED is steadily lit	Bus Coupler is assigned to the master, data is being exchanged
	red LED blinks	Timeout on I/O connection
	red LED is steadily lit	BUS OFF: CAN error, devices have identical node address

I/O Status

LED		Meaning
I/O RUN	green LED is lit	The Bus Terminals are working correctly
I/O ERR	red LED is lit	I/O error, a Bus Terminal or an internal K-bus with a fault
I/O ERR	red LED blinks	The Bus Terminals are being configured

5.4.2 LED Function Matrix

LEDs Products	Network Status NS (duo LED)	Module Status MS (duo LED)	Network Status NS (duo LED)	Module Status MS (duo LED)	Net/Mod Status NMS (duo LED)	ADR (LED red)	RUN (LED green)
BK5200	X	X					
BK5210B1			X	X			
BK5210B2			X			X	X
BK5220			X			X	X
BK5250			X			X	X
LC5200					X		
IP Compact Box					X		
IP Coupler Box					X		
LEDs	**NS**	**MS**	**NS**	**MS**	**NMS**	**ADR**	**RUN**
green flashing	Boot Up OK, Device has executed duplicate MAC Id Check and is online	IO Data length is not OK, check adjusted IO Data length at master / scanner	Boot Up OK, Device has executed duplicate MAC Id Check and is online	IO data length is not OK, check adjusted IO data length at master/scanner	Boot Up OK, Device has executed duplicate MAC Id Check and is online		IO data length is not OK, check adjusted IO data length at master/scanner
	Device is not allocated by a master/scanner, no data exchange with a master/scanner		Device is not allocated by a master/scanner, no data exchange with a master/scanner		Device is not allocated by a master/scanner, no data exchange with a master/scanner		
green ON	No Error	No Error	No Error	No Error	No Error		No Error
	Device is allocated by a master, data exchange with master/scanner is OK		Device is allocated by a master, data exchange with master/scanner is OK		Device is allocated by a master, data exchange with master/scanner is OK		
green OFF	No baud rate, device is not able to detect DeviceNet baud rate (IO LEDs ON)	K-Bus error, check for error at connected terminals	BusSense error (all OFF, including IO LEDs)	BusSense error (all OFF, including IO LEDs)	BusSense error (all OFF, including IO LEDs)		BusSense error (all OFF, including IO LEDs)
			No baud rate, device is not able to detect DeviceNet baud rate (IO LEDs ON)		No baud rate, device is not able to detect DeviceNet baud rate (IO LEDs ON)		K-Bus error

LEDs Products	Network Status NS (duo LED)	Module Status MS (duo LED)	Network Status NS (duo LED)	Module Status MS (duo LED)	Net/Mod Status NMS (duo LED)	ADR (LED red)	RUN (LED green)
BK5200	X	X					
BK5210B1			X	X			
BK5210B2			X			X	X
BK5220			X			X	X
BK5250			X			X	X
LC5200					X		
IP Compact Box					X		
IP Coupler Box					X		
LEDs	**NS**	**MS**	**NS**	**MS**	**NMS**	**ADR**	**RUN**
red flashing	Time-Out, no connection to master, check cabling	K-Bus error, check for error at connected terminals	Time-Out, no connection to master, check cabling	K-Bus error, check for error at connected terminals	Time-Out, no connection to master, check cabling	MAC-ID (Node Address) is set by software, differs from adjustments of DIP switches	
		Diagnostic of connected terminal		Diagnostic of connected terminal	K-Bus error, check for error at connected terminals		
red ON	Duplicate MAC Id fault, check for same address in network		Duplicate MAC Id fault, check for same address in network	CAN Rx/Tx Overrun, reduce IO cycle time for device at Scanner	Duplicate MAC Id fault, check for same address in network	CAN Rx/Tx Overrun, reduce IO cycle time for device at Scanner	
	Bus OFF, check cabling, check bus termination, check bus length		Bus OFF, check cabling, check bus termination, check bus length		Bus OFF, check cabling, check bus termination, check bus length		
	CAN Rx/Tx Overrun, reduce IO cycle time for device at scanner	CAN Rx/Tx Overrun, reduce IO cycle time for device at scanner	CAN Rx/Tx Overrun, reduce IO cycle time for device at scanner		CAN Rx/Tx Overrun, reduce IO cycle for device time at scanner		
red OFF	No baud rate, Device is not able to detect DeviceNet baud rate (IO LEDs ON)	No error	BusSense error (all OFF, including IO LEDs)	BusSense error (all OFF)	BusSense error (all OFF, including IO LEDs)	MAC Id (Node address) from DIP switches is valid	
			No baud rate, Device is not able to detect DeviceNet baud rate (IO LEDs ON)		No baud rate, Device is not able to detect DeviceNet baud rate (IO LEDs ON)		
all OFF **IO LEDs ON**	No baud rate, Device is not able to detect DeviceNet baud rate (IO LEDs ON)	No baud rate, Device is not able to detect DeviceNet baud rate (IO LEDs ON)	No baud rate, Device is not able to detect DeviceNet baud rate (IO LEDs ON)	No baud rate, Device is not able to detect DeviceNet baud rate (IO LEDs ON)	No baud rate, Device is not able to detect DeviceNet baud rate (IO LEDs ON)	No baud rate, Device is not able to detect DeviceNet baud rate (IO LEDs ON)	No baud rate, Device is not able to detect DeviceNet baud rate (IO LEDs ON)
all OFF **IO LEDs OFF**			BusSense error (all OFF, including IO LEDs)	BusSense error (all OFF, including IO LEDs)	BusSense error (all OFF, including IO LEDs)	BusSense error (all OFF, including IO LEDs)	BusSense error (all OFF, including IO LEDs)

6 Appendix

6.1 Composition of a process image in the Bus Coupler

An example shows the assignment of input and output channels to the process image. The sample construction should consist of the following bus - terminal - assemblies:

Position	Functional groups on the rail
POS01	Bus Coupler
POS02	Digital inputs, 2 channels
POS03	Digital inputs, 2 channels
POS04	Digital inputs, 2 channels
POS05	Digital inputs, 2 channels
POS06	Digital inputs, 2 channels
POS07	Digital outputs, 2 channels
POS08	Digital outputs, 2 channels
POS09	Digital outputs, 2 channels
POS10	Analog inputs, 2 channels
POS11	Analog outputs, 2 channels
POS12	Analog outputs, 2 channels
POS13	Analog inputs, 2 channels
POS14	Power feed terminal
POS15	Digital inputs, 2 channels
POS16	Digital inputs, 2 channels
POS17	Digital inputs, 2 channels
POS18	Digital outputs, 2 channels
POS19	Digital outputs, 2 channels
POS20	Analog outputs, 2 channels
POS21	End terminal

By default, DeviceNet only supports signal channels that are 16 bits wide. The STATUS/CONTROL BYTE is not available. This means, for example, that an analog input terminal with 2 channels appears in the process image with 2 x 16 bits. The images have corresponding differences with respect to byte addresses and assignments.

Area for byte-oriented data, analog outputs

Relative byte address	Bit position	Process image in the controller	Position in the block
0, 1	none	O0, O1	POS11
2, 3	none	O2, O3	POS11
4, 5	none	O4, O5	POS12
6, 7	none	O6, O7	POS12
8, 9	none	O8, O9	POS20
10, 11	none	O10, O11	POS20

Area for bit-oriented data, digital outputs

Relative byte address	Bit position	Process image in the controller	Position in the block
12	0	O12	POS07
12	1	O12	POS07
12	2	O12	POS08
12	3	O12	POS08
12	4	O12	POS09
12	5	O12	POS09
12	6	O12	POS18
12	7	O12	POS18
13	0	O13	POS19
13	1	O13	POS19

Area for byte-oriented data, analog inputs

Relative byte address	Bit position	Process image in the controller	Position in the block
0, 1	none	I0, I1	POS10
2, 3	none	I2, I3	POS10
4, 5	none	I4, I5	POS13
6, 7	none	E6, E7	POS13

Area for bit-oriented data, digital inputs

Relative byte address	Bit position	Process image in the controller	Position in the block
4	0	E4	POS01
4	1	E4	POS1
4	2	E4	POS2
4	3	E4	POS2
4	4	E4	POS3
4	5	E4	POS3
4	6	E4	POS4
4	7	E4	POS4
5	0	E5	POS5
5	1	E5	POS5
5	2	E5	POS6
5	3	E5	POS6
5	4	E5	POS15
5	5	E5	POS15
5	6	E5	POS16
5	7	E5	POS16
6	0	I6	POS17
6	1	I6	POS17

Positions POS14 and POS21 are not relevant to data exchange. They do not appear in the list. If a byte is not fully utilized, e.g. E8, the Bus Coupler pads the remaining bits of the byte with zeros.

Distribution of the process image in the Bus Coupler

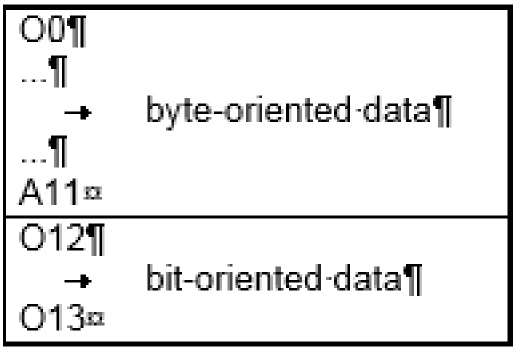

Fig. 24: Process image in the Bus Coupler – output data

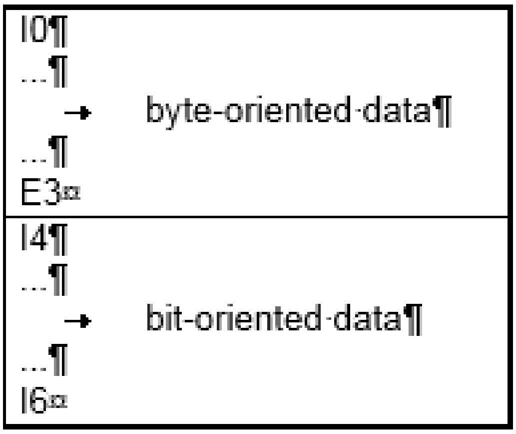

Fig. 25: Process image in the Bus Coupler – input data

The base addresses I0 and O0 listed here are used as relative addresses or addresses in the Bus Coupler. Depending on the higher-level DeviceNet system, the addresses can appear at a freely selectable position in the process image of the controller by the bus master. You can use the configuration software of the master to assign the bytes to the addresses in the process image of the controller.

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.

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