SERCOS Coupler

(Serial Real Time Communication System)

BK7500

Valid for all BK75xx Bus Coupler

Technical Hardware Documentation

Version 1.1
2006-10-30

BECKHOFF

Contents

Foreword

Notes on the documentation

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 following notes and explanations are followed when installing and commissioning these components.

Liability Conditions

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.
The documentation has been prepared with care. The products described are, however, constantly under development. For that reason the documentation is not in every case checked for consistency with performance data, standards or other characteristics. None of the statements of this manual represents a guarantee (Garantie) in the meaning of § 443 BGB of the German Civil Code or a statement about the contractually expected fitness for a particular purpose in the meaning of § 434 par. 1 sentence 1 BGB. In the event that it contains technical or editorial errors, we retain the right to make alterations at any time and without warning. 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.

Delivery conditions

In addition, the general delivery conditions of the company Beckhoff Automation GmbH apply.

Copyright

Safety Instructions

State at Delivery

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.

Description of safety symbols

The following safety symbols are used in this documentation. They are intended to alert the reader to the associated safety instructions..

Danger

This symbol is intended to highlight risks for the life or health of personnel.

Attention

This symbol is intended to highlight risks for equipment, materials or the environment.

Note

This symbol indicates information that contributes to better understanding.

Basic information

The Beckhoff bus terminal system

Up to 64 bus terminals

each with 2 I/O channels for any form of signal

The bus terminal system is the universal connecting link between a fieldbus system and the sensor/actor level. A unit consists of a bus coupler, which is the interface to the fieldbus, and up to 64 electronic terminals, of which the last is an end terminal. Terminals, each with two I/O channels, are available for any form of technical signal and can be combined as desired. The various types of terminal are all constructed in the same way, so that the planning costs are kept extremely low. The height and depth of the construction are calculated for compact terminal cabinets.

Decentralized wiring of the I/O level

IPC as control unit

Fieldbus technology makes it possible to use compact control architectures. The I/O level does not need to be taken right up to the control unit. Sensors and actors can be connected decentrally with minimal lengths of cable. You can position the control unit at any convenient location in the installation. Using an industrial PC as control unit makes it possible to implement the operating and monitoring element as part of the control hardware, so the control unit can be located on an operating desk, control point or similar. The bus terminals constitute the decentralized input/output level of the control unit in the switch cabinet and its subordinate terminal cabinets. As well as the sensor/actor level, the power unit of the equipment is also controlled via the bus system. The bus terminal replaces a conventional terminal as the cabling level in the switch cabinet; the switch cabinet can be made smaller.

Bus couplers for all current bus systems

The Beckhoff bus terminal system combines the advantages of a bus system with the functionality of compact terminals. Bus terminals can be used on all current bus systems and serve to reduce the diversity of parts in the control unit, while behaving like the conventional standard units for the relevant bus system and supporting the entire range of functionality of the bus system.

Standard C rail assembly

The simple and compact assembly on a standard C rail, and the direct cabling of actors and sensors without cross connections between the terminals, serve to standardize the installation, as does the uniformly designed labeling.

The small size and great flexibility of the bus terminal system mean that you can use it anywhere that you could use a terminal and use any type of connection – analog, digital, serial or direct sensors.

Modularity

The modular construction of the terminal row, using bus terminals with various functions, limits the number of unused channels to at most one per function. Two channels to a terminal is the optimum solution for the number of unused channels and the cost per channel. The possibility of using power input terminals to provide separate power supplies also helps to minimize the number of unused channels.

Display of channel status

The integrated light-emitting diodes close to the sensor/actor indicate the status of each channel.

The K-bus

End terminal

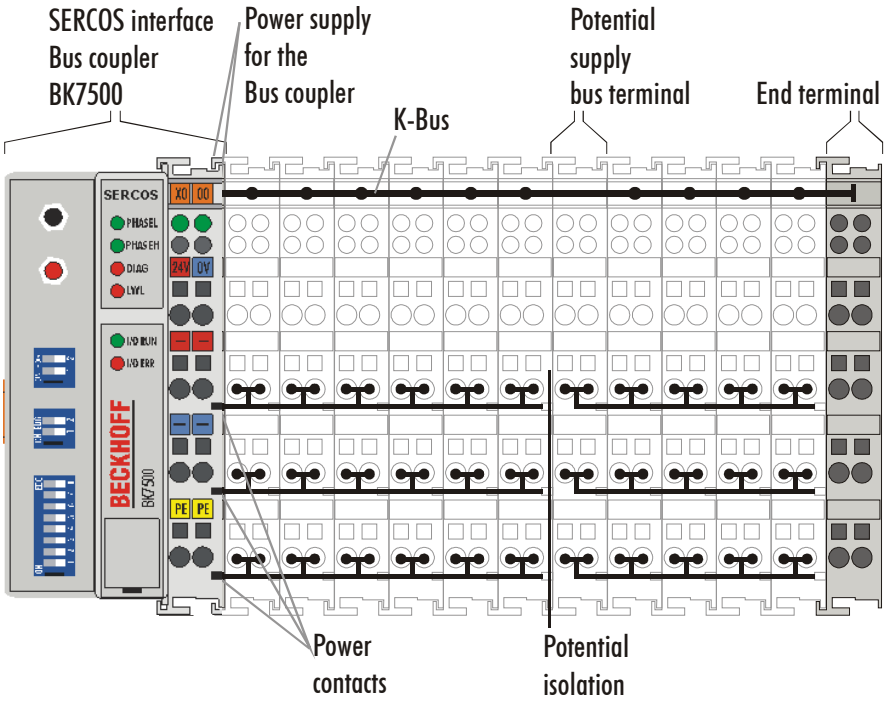
The K-bus is the path taken by data within the terminal row. The bus coupler carries the K bus through all the terminals by means of six contacts on the side walls of the terminals, and the end terminal terminates the K bus. The user does not need to know anything about the function of the K bus or the internal operation of terminals and bus couplers. There are numerous software tools available which provide for convenient planning, configuration and operation.

Power input terminals for separately powered groups

Three power contacts pass the operating power to the following terminals. You can use power input terminals to subdivide the terminal row as desired into groups, each with a separate power supply. These power input terminals are not taken into account for addressing the terminals, you can insert them at any position along the terminal row.

You can install up to 64 terminals on a terminal row, including power input terminals and the end terminal.

The principle of the bus terminal



Bus couplers for various fieldbus systems

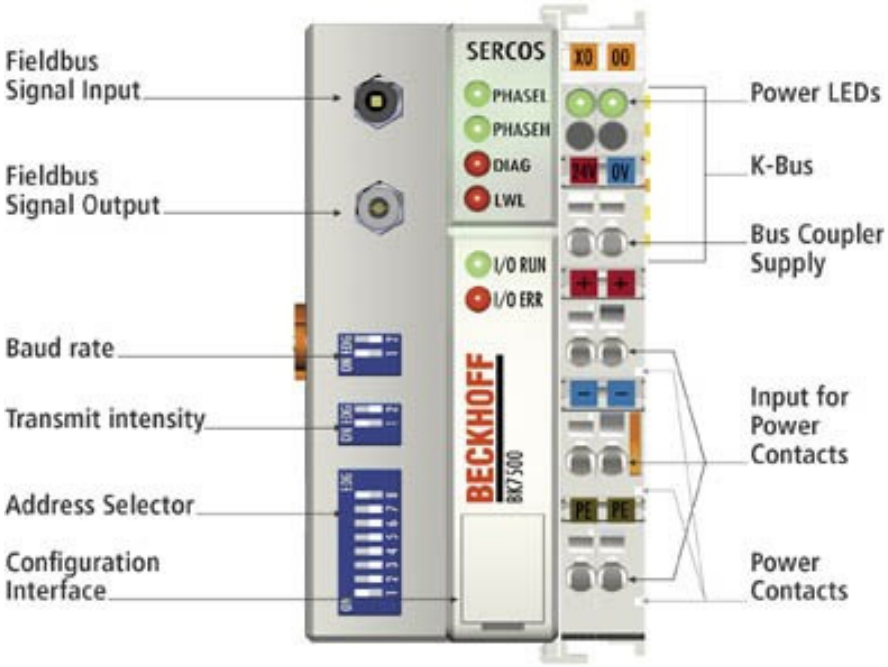
You can use a variety of bus couplers to attach the electronic terminal row quickly and easily to the various fieldbus systems, and you can also subsequently convert to a different fieldbus system. The bus coupler deals with all the necessary monitoring and control tasks for operating the attached bus terminals, indeed all the operation and configuration of the bus terminals is carried out via the bus coupler. The fieldbus, K bus and I/O level are electrically isolated.

If the exchange of data across the fieldbus is temporarily interrupted, logic states are preserved, digital outputs are cleared and analog outputs revert to a reset value which can be individually configured for each output when the equipment is set up.
The default for the analog outputs is 0V or 0mA. Digital outputs assume an inactive state. The bus couplers' timeouts correspond to the usual times for the field bus system. When changing over to a different bus system, pay attention to the change in timeouts in the event of larger-scale bus system cycle times.

The interfaces

There are six ways of making a connection to a bus coupler. These interfaces are designed as plug connections and spring terminals.

The Beckhoff-SERCOS - coupler BK7500



Power supply

24 V DC on the topmost terminals

The bus couplers need an operating power of 24 V DC which is connected via the topmost spring terminals, labeled "24 V" and "0 V". This power supply serves not only the electronic components of the bus coupler but (via the K bus) also the bus terminals. The power supply of the bus coupler circuitry and that of the K-bus (Terminal bus) are electrically isolated from the voltage of the field level.

Power supply to the power contacts

Lower 3 terminal pairs for power input

The six lower connections with spring terminals can be used to supply power to the peripherals. The spring terminals are connected in pairs to the power contacts. The power supply to the power contacts has no connection to the power supply of the bus couplers. The power input is designed to permit voltages up to 24 V. The pair-wise arrangement and the electrical connection between the feed terminal contacts makes it possible to loop through the wires connecting to different terminal points. The load on the power contact may not continuously exceed 10 A. The current capacity between two spring terminals is the same as the capacity of the connecting wires.

maximum 24 V

maximum 10 A

Power contacts

Spring contacts at the side

On the right-hand side face of the bus coupler are three spring contacts which are the power connections. The spring contacts are recessed in slots to prevent them from being touched. When a bus terminal is connected, the blade contacts on the left-hand side of the bus terminal are connected to the spring contacts. The slot and key guides at the top and bottom of the bus couplers and bus terminals ensure reliable location of the power contacts.

Fieldbus connection

SERCOS Fibre optic

Plug SERCOS Z1003

There is a recessed front face on the left hand side. The typical SERCOS connecting plugs can be inserted here. SERCOS consists of a fiber-optic conductor ring into which the bus coupler is inserted. You need a fiber-optic conductor connector type SERCOS Z1003 for connection.

Configuration interface

Serial interface under the front flap

On the lower part of the front face you will find the standard bus couplers which are fitted with an RS232 interface. The miniature plug can be attached to a PC by means of a connection cable and the configuration software KS2000. This interface enables you to configure the bus terminals , e.g. setting the amplification factor of the analog channels. The mapping of the bus terminal data to the process view in the bus coupler can be changed via the interface. You can also access the functionality of the configuration interface via the fieldbus by means of the ADS communications.

K-bus contacts

6 contacts at the side

The connections between the bus coupler and the bus terminals are effected by gold contacts at the right-hand side of the bus coupler. When the bus terminals are plugged together, these gold contacts automatically complete the connection to the bus terminals. The K bus is responsible for the power supply to the electronic components of the K bus in the bus terminals, and for the exchange of data between the bus coupler and the bus terminals. Part of the data exchange takes place via a ring structure within the K bus. Disengaging the K bus, for example by pulling on one the bus terminals, will break this circuit so that data can no longer be exchanged. However, there are mechanisms in place which enable the bus coupler to locate the interruption and report it.

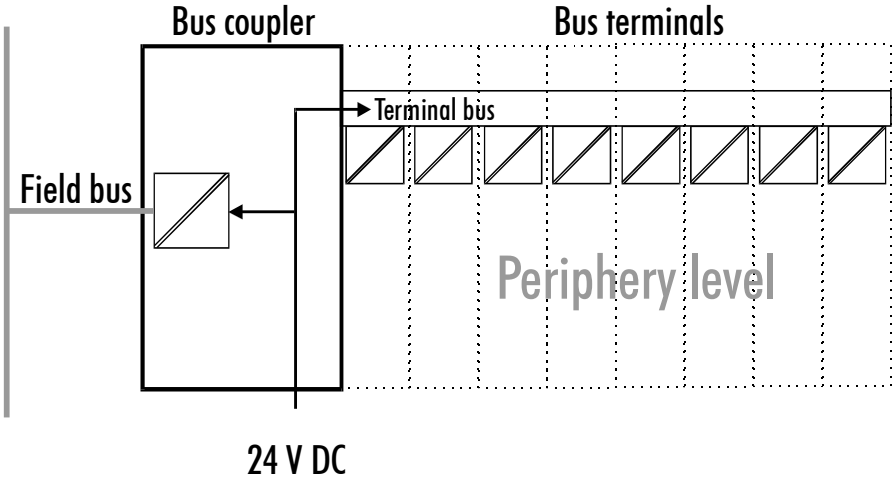
Supply isolation

3 supply groups:
fieldbus
K-bus
peripheral level

The bus couplers operate with three independent supplies. The input power supplies the electrically isolated K-bus circuitry in the bus coupler and the K-bus itself. The power supply is also used to generate the operating power for the fieldbus.

Note: All the bus terminals are electrically isolated from the K bus, so that the K-bus is completely electrically isolated.

Setting up the power levels in the bus terminal system



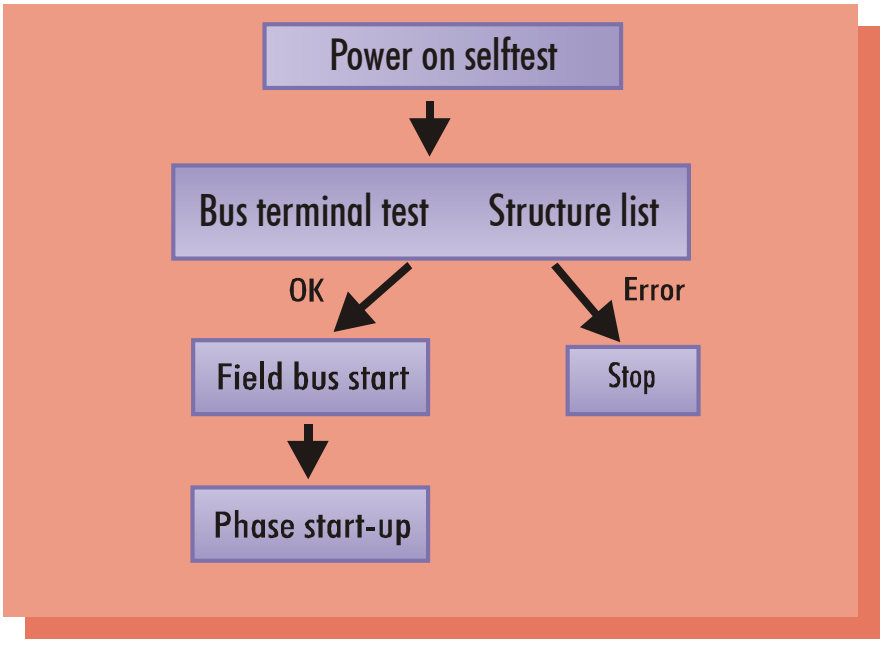
The operating modes of the bus coupler

When it is first switched on the bus coupler carries out a self-test to check the functions of its components and the communications of the K bus, and while this is going on the red I/O LED will flash. When the self-test has been completed successfully, the bus coupler will begin to test the attached bus terminals (the "bus terminal test") and read in the configuration from which it constructs an internal structure list, which is not accessible from outside. If an error occurs the bus coupler will enter the operating mode "STOP". If the start-up sequence is completed without errors the bus coupler will enter the mode "fieldbus start".

Initialisation of the coupler

The BK7500 is now in phase 0 (P0). In this phase it sends telegrams that it has received to the next device in the ring (repeater function). In phase 0, the master sends master sync. telegrams (MST). If these are received ten times without interruption, the master switches to communication phase 1 (P1). Master data telegrams are now also sent. Each slave has its own station address. The slave answers with a drive telegram (AT), and in this way indicates its readiness for changing the phase to communication phase 2 (P2). After the master has switched to phase 2, the SERCOS interface is now in the stage of non-cyclic data exchange. Each cycle now only involves communication with a device in the SERCOS ring. The time slots required for cyclic data exchange are calculated, and are checked by the connected devices. When all the slave devices have reported that they are ready to switch-over, the master can switch to phase 3 with the MST. In phase three (P3), the communication is already almost like that of phase 4. The only difference is that valid cyclic data is still not being transferred. The time slots defined in phase 2 are valid, and are monitored. If the communication is proceeding without error, phase 4 is entered.

Start-up behavior of the bus coupler



Cyclic data exchange

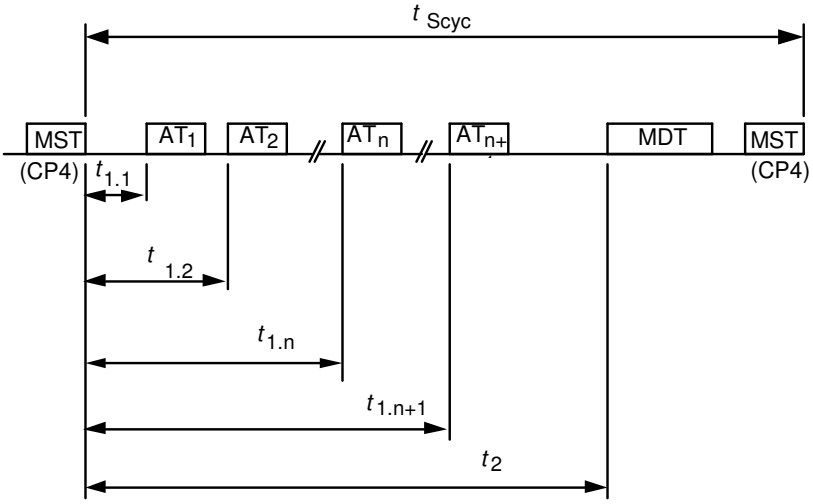
Master Sync. Telegram (MST)
At the beginning of each cycle an MST is sent by the master to all the slaves. The broadcast address is used for this. Each connected slave uses this telegram to determine its send window.

Master Data Telegram (MDT)

The MDT is sent by the master as a broadcast to all devices. It contains the data for all the slave devices. Because of different configurations, the data length can vary.

Drive Telegram (AT)

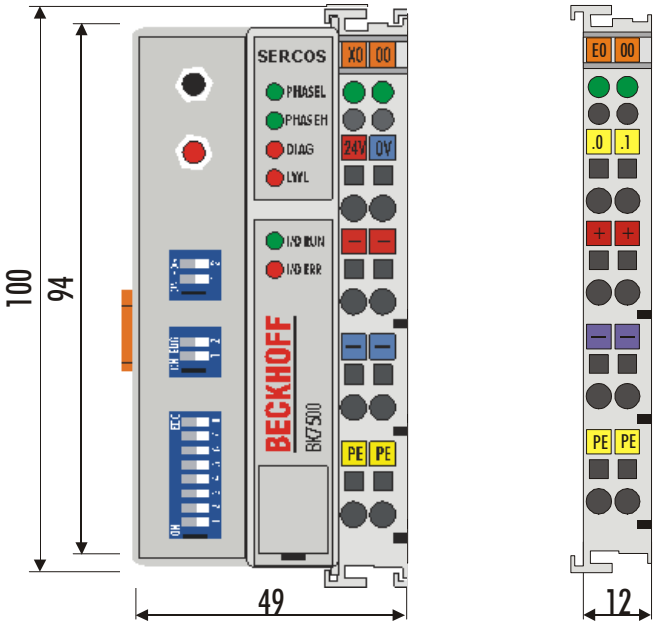
Each slave sends its output data in the appropriate time slot. The telegram contains its station address, so that the master can identify it.



Mechanical construction and mounting

The Beckhoff bus terminal system is remarkable for its compact construction and high degree of modularity. When you design the installation you will need to plan for one bus coupler and some number of bus terminals. The dimensions of the bus couplers do not depend on the fieldbus system. The clear dimensions of the bus coupler are not exceeded thanks to the use of fiber-optic cable with the Z1003 connectors.

Dimensions of a bus coupler



The overall width of the construction is the width of the bus coupler, including the bus end terminal, plus the width of the installed bus terminals. The bus terminals are 12 mm or 24 mm wide, depending on their function. The LC3100 has a width of 21 mm and the terminals then follow, as on the coupler. Depending on the gauge of cables used the overall height of 68 mm may be overstepped by about 5 mm to 10 mm by the cables at the front.

Assembly and connections

It takes only a slight pressure to latch the bus coupler and the various bus terminals onto a supporting 35mm C rail and a locking mechanism then prevents the individual housings from being removed. You can remove them without effort if you first release the latching mechanism by pulling the orange tab. You should carry out work on the bus terminals and the bus coupler only while they are switched off: if you plug or unplug components while the power is on you may briefly provoke some undefined state (and, for instance, reset the bus coupler).

Maximum number of terminals

You can attach up to 64 bus terminals in series on the right-hand side of the bus coupler. When you assemble the components, make sure that you mount the housings so that each slot comes together with the corresponding key. You cannot make any functional connections merely by pushing the housings together along the supporting track. When they are correctly mounted there should be no appreciable gap between the adjacent housings.

The right-hand side of a bus coupler is mechanically similar to a bus terminal. There are eight connections on the top which can be used to connect to thick-wire or thin-wire lines. The connection terminals are spring loaded. You open a spring terminal by applying a slight pressure with a screwdriver or other pointed tool in the opening above the terminal and you

can then insert the wire into the terminal without any obstruction. When you release the pressure the terminal will automatically close and hold the wire securely and permanently.

The connection between bus couplers and bus terminals is automatically effected by latching the components together. The K bus is responsible for passing data and power to the electronic components of the bus terminals. The field logic receives power via the power contacts. Latching the components together has the effect that the series of power contacts constitutes a continuous power track. Please refer to the circuit diagrams of the bus terminals: some bus terminals do not loop these power contacts through, or not completely (e.g. analog bus terminals or 4-channel digital bus terminals). Each power input terminal interrupts the series of power contacts and constitutes the beginning of a new track. The bus coupler can also be used to supply power to the power contacts.

Insulation test

The power contact labeled "PE" can be used as protective earth or ground. This contact stands proud for safety reasons and can carry short-circuit currents of up to 125A. Note that in the interests of electromagnetic compatibility the PE contacts are capacitively connected to the supporting track. This may lead to spurious results and even damage to the terminal when you test the insulation (e.g. insulation test for breakdown using a 230V mains supply to the PE line). You should therefore disconnect the PE line on the bus coupler while you carry out insulation tests. You can disconnect other power supply points for the duration of the test by drawing the power supply terminals out from the remaining row of terminals by at least 10mm. If you do this, there will be no need to disconnect the PE connections.

PE power contacts

The protective earth power contact ("PE") may not be used for any other connections.

Electrical data

The SERCOS coupler BK7500 and BK7510 differ by virtue of their capacity levels. The following data distinguishes between a standard and an economy variant (BK7500 and BK7510). Compatability with the other SERCOS components is guaranteed in any case. Contrary to the standard bus coupler, the economy variant is limited of the number of I/O´s. Thus, there is no possibility of connecting inputs and outputs other than digital ones. The following table lists an overview of all data:

Technical data	Beckhoff SERCOSCoupler BK7500
Supply voltage	24 V, - 15% +20%
Input current	105 mA typ. 900 mA max.
K bus supply current up to	1.75 A max.
Potential isolation	500 Vrms (K-bus / peripheral voltage)
Number of bus terminals	64
Digital peripheral signals	256 inputs and outputs
Analog peripheral signals	128 inputs and outputs
Peripheral bytes	512 input byte and 512 output byte
Configuration	Via SERCOS Master or KS2000
Fieldbus medium	Fibre optic Z1100
Plug connection	F-SMA-Norm IEC 872-2 Z1003 for Z1100
Baud rate	2 or 4 Mbaud (8 and 16 Mbaud in preparation)
Voltage of the power contact	24V DC / AC
Power contacts current drawn	10 A
Electric strength	500 Vrms (power contact / supply voltage)
Typical weight	150g
Operating temperature	0°C ... +55°C
Storage temperature	-25°C ... +85°C
Relative humidity	95% without dew formation
Vibration/shock stability	According to IEC 68-2-6 / IEC 68-2-27
EMC-immunity. Burst / ESD	According to EN 61000-4-4 / EN 61000-4-2 limit value according to EN 50082-2-4
Installation location	Arbitrary
Protection class	IP20

Current consumption on the K-Bus

For operation of the K-bus electronics, the bus terminals require energy from the K-bus that is supplied by the bus coupler. Refer to the catalog or the corresponding data sheets of the bus terminals for details of the K-bus current consumption. In doing so, pay attention to the maximum output current of the bus coupler that is available for powering the bus terminals. Using a special power supply terminal (KL9400), power can be fed back into the K-bus at any chosen point. If you wish to use a power supply terminal, please contact Beckhoff's technical support. .

The peripheral data in the process image

When the bus coupler is first switched on it determines the configuration of the attached input/output terminals and automatically assigns the physical slots of the input/output channels to the addresses in the process image.

The bus coupler sets up an internal list of assignments in which each of the input and output channels has a specific position in the process image. A distinction is made here between input and output and between bit-oriented (digital) and byte-oriented (analog, or complex) signal processing.

It also forms two groups, whereby one contains only inputs and the other only outputs. In each group, the byte-oriented channels take the lowest addresses, in ascending order, and these are then followed by the bit-oriented channels.

Digital signals (bit-oriented)

Digital signals are bit-oriented. This means that one bit of the process image is assigned to each digital channel. The bus coupler sets up a block of memory containing the current input bits and arranges to immediately write out the bits from a second block of memory which belongs to the output channels.

The precise assignment of the input and output channels to the process image of the control unit is explained in detail in the Appendix by means of an example.

Analog signals (byte-oriented)

The processing of analog signals is always byte-oriented and analog input and output values are stored in memory in a two-byte representation. The values are held as "SIGNED INTEGER” or "twos-complement”. The digit "0” represents the input/output value "0V”, "0mA” or "4mA”. When you use the default settings, the maximum value of the input/output value is given by "7FFF” hex. Negative input/output values, such as -10V, are represented as "8000” hex and intermediate values are correspondingly proportional to one another. The full range of 15-bit resolution is not realized at every input/output level. If you have an actual resolution of 12 bits, the remaining three bits have no effect on output and are read as "0” on input. Each channel also possesses a control and status byte in the lowest value byte. If the control/status byte is mapped in the control unit has to be configured in the master configuration software. An analog channel is represented by 2 bytes user data in the process image.

Special signals and interface

The BK7500 bus coupler supports bus terminals with additional interfaces, such as RS232, RS485, incremental encoder, etc.. These signals can be regarded in the same way as the analog signals described above. A 16-bit data width may not be sufficient for all such special signals; the bus coupler can support any data width. With regard to accessing these values, please ensure that data consistency is safeguarded. That is to say, do not send any "update" command between access operations and do not switch the bus coupler to "freewheeling" mode.

Default assignment of inputs and outputs to the process image

When the bus coupler is first switched on it determines the number of attached bus terminals and sets up a list of assignments. This list distinguishes between analog channels and digital channels and between input and output; which are grouped separately. The assignments begin immediately to the left of the bus coupler. The software in the bus coupler creates the assignment list by collecting the entries for the individual channels one at a time, counting from left to right. These assignments distinguish four groups:

	Function type of the channel	Assignment level
1.	Analog outputs	byte-wise assignment
2.	Digital outputs	bit-wise assignment
3.	Analog inputs	byte-wise assignment
4	Digital inputs	bit-wise assignment

Analog inputs/ouputs are representative of other complex multi-byte signal bus terminals (RS232, SSI sensor interface, ...)

Overview of the subdivision of the process image in the bus coupler:

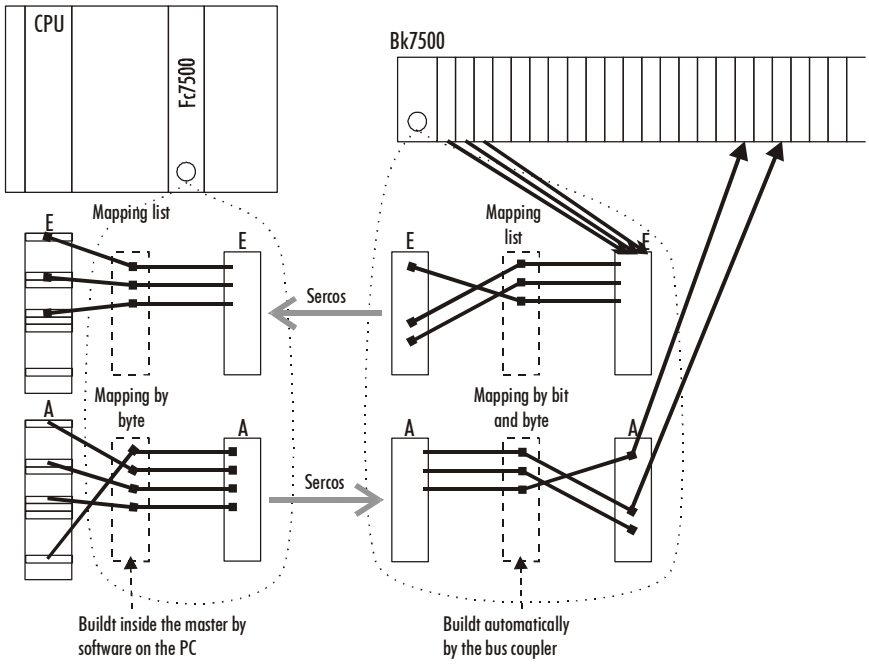
Output data in the bus coupler

O0 ... Ox	byte-oriented data
Ox+1 ... Ox+y	bit-oriented data

Input data in the bus coupler

I0 ... Ix	byte-oriented data
Ix+1 ... Ix+y	bit-oriented data

The path from the I/Os to the PROFIBUS process image



Data consistency

Data which contains no contradictions is said to be consistent. The following consistency is required here:
1. The high byte and low byte of an analog value (word consistency),
2. The control/status byte and the corresponding parameter word for accessing the register.

The interaction of the peripherals with the control unit means that data can initially be guaranteed consistent only within an individual byte or word: the bits which make up a byte or a word are read in together, or written out together. Byte-wise consistency is quite adequate for processing digital signals but is not sufficient for transferring values longer than eight bits, such as analog values. The various bus systems guarantee consistency to the required length. It is important to use the appropriate procedure for importing this consistent data from the master bus system to the control unit. You will find a detailed description of the correct procedure in the User Guide of the appropriate bus system, in particular in the description of the standard master units that are installed.

Processing complex signals

All byte-oriented signal channels such as RS232, RS485 and incremental encoder, can use byte lengths greater than two. Apart from the actual difference in length, the procedure is always comparable with that for analog signals.

Starting operation and diagnostics

After switching on, the bus coupler immediately checks the connected configuration. Error-free start-up is signalled by extinction of the red LED “I/O ERR“. 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.
You will find a detailed description in the chapter entitled "The diagnostic LEDs".

The diagnostic LEDs

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 field bus. The significance of the “field bus status“ LED is explained in the relevant sections of this manual - it conforms to conventional field bus displays.

On the upper right hand side of the bus couplers are two more green LEDs that indicate the supply voltage. The left hand LED indicates the 24 V supply of the bus coupler. The right hand LED signals the supply to the power contacts.

Local errors

Two LEDs, the “I/O” LEDs, in the area below the field bus status LEDs referred to above, serve to indicate the operating status of the bus terminals and the connections to these terminals. The green LED lights up in order to indicate fault-free operation, where “error-free” implies that communication with the fieldbus system is also operating correctly. The red LED blinks with two different frequencies in order to indicate an error. The error is encoded in the blinks as follows:

Code of flashes

Rapid flashing	Start of the error code
First slow sequence	Type of error
Second slow sequence	Location of error

Location of error

The number of flashes corresponds to the position of the last bus terminal before the error, not counting passive bus terminals such as power input terminals.

The bus coupler will carry on flashing the error code even when you have cleared the fault and its operating mode will remain at "Stop”. The only way to restart the bus coupler is by switching the power supply off and on again.

Terminal bus error

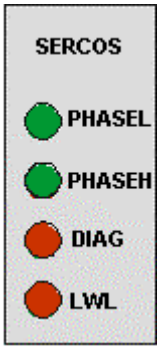
Error code	Error code argument	Description	Remedy
Persistent, continuous blinking		EMC problems	- Check power supply for overvoltage or undervoltage peaks - Implement EMC measures - If a K-bus error is present, it can be localised by a restart of the coupler (by switching it off and then on again)
1 pulse	0 1 2	EEPROM checksum error Inline code buffer overflow Unknown data type	- Set manufacturer's setting with the KS2000 - Connect fewer terminals; too many entries in the table for the programmed configuration - Software update required for the coupler
2 pulses	0 n (n > 0)	Programmed configuration Incorrect table entry / bus coupler Incorrect table comparison (terminal n)	- Check programmed configuration for correctness - Incorrect table entry / bus coupler
3 pulses	0	Terminal bus command error	- No terminal connected; attach terminals. - One of the terminals is defective; halve the number of terminals attached and check whether the error is still present with the remaining terminals. Repeat until the defective terminal is located.
4 pulses	0 n	Terminal bus data error Break behind terminal n (0: coupler)0 n	- Check whether the n+1 terminal is correctly connected; replace if necessary. – Check whether the end terminal 9010 is connected.
5 pulses	n	Terminal bus error with register communication with terminal n	Replace terminal n.
6 pulses	0 1 2	No ident of the MDT No ident of the AT Ident im MDT ans S370 konfigurated	
7 pulses		Klemme wird vom Koppler nicht unterstützt	

Fieldbus error

Fieldbus error

The fieldbus status LEDs indicate the operational state of the fieldbus. The functions of the SERCOS are indicated by the LED "PHASEL", PHASEH", "LWL" and "DIAG".
The meaning of the first 4 LED`s:
PHASEL Communication phase low
PHASEH Communication phase high
DIAG without function
LWL shows quality of the fibre optic connection

Diagnostic - LEDs of the BK7500



I / O RUN	PHASEL	PHAESH	Optical fibres	Meaning	Remedy
lit	lit	lit	off	Telegrams are passing cyclically along the ring Inputs are read and outputs are set.	
lit	off	lit	off	The SERCOS ring is in phase 3	
lit	lit	off	off	The SERCOS ring is in phase 2	
off	lit	off	off	The SERCOS ring is in phase 1	
off	off	off	off	The SERCOS ring is in phase 0	

Attention must be paid to the fact that there is a connection between the green I/O LED and the field bus. The I/O LED lights up in connection with access to the internal K-bus. The green I/O LED does not light up until a trigger begins via the field bus. This means that the field bus must access the bus coupler and the controller software must clear a cyclical trigger. The green I/O LED indicates access to the internal K-bus and is reset after 100 ms.

The bus coupler queries the configuration of the bus terminals after switching on and does not exchange data with the terminals. That is to say, the red I/O LED goes off after an error-free startup without the green I/O LED having to light up. The green I/O LED does not light up until data exchange is begun via the Beckhoff-Lightbus.

Setting the Transmission Rate

Setting the transmission rate in the BK7500

2 Mbd

4 Mbd

8 Mbd

16 Mbd

Setting the Cable Length

Setting the cable length to the next device

The cable length is set at the coupler in the following stages: 0...15, 15...30 and 30...45 m. This is necessary in order to adapt the transmission power to the cable attenuation.

0 .. 15 m

15 .. 30 m

30 ..45 m

Setting the Station Address

DIP switchh

In the BK7500 the station address must be set at the coupler's DIP switch.

Example

DIP-Bit 1-8

$2^0 + 0^1 + 0^2 + 2^3 + 0^4 + 0^5 + 2^6 + 2^7 = 201$

$1 + 0 + 0 + 8 + 0 + 0 + 64 + 128 = 201$

SERCOS interface Coupler BK7500

Introduction to the SERCOS Interface System

The SERCOS interface (Serial Real-time Communication System) has become established round the world in the numerical controller sector. The BK7500 now also permits connection to the sensor / actuator level.
Its high real-time performance, and the interference immunity of the optical fibre technology are important features of this bus system.
The BK7500 Lightbus is designed for fast data exchange at the sensor / actuator level. Central control devices (such as, for example, programmable logic controllers) communicate here over a fast serial connection with distributed input and output devices. Data is exchanged with these distributed devices cyclically. The central controller (master) reads the input information from the slaves (drive telegram) and sends the output information to the slaves (master data telegram).
A high data throughput is not in itself sufficient for successful use of a bus system. Ease of handling, good diagnostic facilities and secure transmission technology are also of the utmost importance if the user's demands are to be satisfied.

System configurations and device types

A single-master system can be implemented with the SERCOS interface. A maximum of 254 slaves can be connected to one bus.
A BK7500 is a peripheral device (sensor/actuator) that reads input information and passes output information on to the peripherals. It is also possible to have device configurations that only handle either input or output information. Typical Beckhoff Bus Terminals are binary inputs/outputs for 24V or 230V, analog inputs, analog outputs, counters, incremental encoders etc. The quantity of input and output information is device-dependent, and is limited in the BK7500 to 32 bytes of input data and 32 bytes of output data.

IDN	Name	Type	Attributes	Default value	
P-0-0001	I/O analog terminals	Uint 16	Read/Write	none	

Meaning

This parameter allows a table to be selected in the Bus Coupler. See also the section on the register structure.

It can also be selected in the MDT.

IDN	Name	Type	Attributes	Default value	
P-0-0010	Current table	Uint 16	read	none	

Meaning

This parameter allows a table to be selected in the Bus Coupler. See also the section on the register structure.

It can also be selected in the MDT.

IDN	Name	Type	Attributes	Default value	
P-0-0011	Current register number	Uint 16	read	none	

Meaning

This parameter allows a table to be selected in the Bus Coupler. See also the section on the register structure.

It can also be selected in the MDT.

IDN	Name	Type	Attributes	Default value	Function
P-1-0012	Register value	Uint 16	read	none	

Meaning

The I/O Data Channel

Function

Set and actual values are exchanged between the controller and the BK7500 via the I/O data channels. Set and actual values may be exchanged either cyclically or non-cyclically.
The controller needs the I/O data base in order to address the I/O data channel.
The set and actual values of a BK7500 are divided into the following types.

I/O terminal types

Digital input terminals KL1xxx (without KL1501)
Digital output terminals KL2xxx (without KL2502)
Analog input terminal KL3xxx
Analog output terminal KL4xxx
Encoder terminal KL5xxx
Communication terminal KL6xxx

IDN	Name	Type	Attributes	Default value	
S-1-0000	I/O data base	IDN	Read/Write		IDN: I/O base + 00000

Meaning

This operating data contains the IDN of the first I/O data channel, i.e. the IDN of the channel container for this I/O data channel. The controller reads this value in order to calculate the IDN of the I/O data channel.

IDN	Name	Type	Attributes	Default value	
S-1-0001	Max I/O Channel	Uint 16	Read/Write		IDN: I/O base + 00001

Meaning

This operating data indicates the maximum number of I/O data channels in the BK7500.

IDN	Name	Type	Attributes	Default value	
S-1-0002	List I/O data channels	Uint 16	Read/Write		IDN: I/O base + 00002

Meaning

The BK7500 writes the required I/O data channels with their absolute addresses into this operating data.

IDN	Name	Type	Attributes	Default value	
S-2-0000	I/O data channel	Uint 16	Read		IDN: I/O data base + 0000

Meaning

This operating data contains the IDN of the first I/O data channel. Observe the mapping of the terminals!

IDN	Name	Type	Attributes	Default value	Function
S-2-0001	Channel type	Variable	Read/Write		I/O data channel + 0001

Meaning

The channel type describes the type of the terminal. This also depends on the IDN P-0-0001 (see Table xxx).

KL1xxx (strict)	0x0001 16 bit data (without KL1501)
KL1xxx (compact)	0x0001 32 bit data (without KL1501)
KL2xxx (strict)	0x0001 16 bit data (without KL2502)
KL2xxx (compact)	0x0001 32 bit data (without KL2502)
KL1501 (strict/ compact)	0x8006 16 bit data
KL2502 (strict)	0x8003 16 bit data
KL3xxx (strict)	0x8002 16 bit data
KL3xxx (compact)	0x8002 32 bit data
KL4xxx (strict)	0x0003 16 bit data
KL4xxx / KL2502 (compact)	0x8003 16 bit data
KL5xxx (strict / compact)	0x8007 16 bit data
KL6xxx (standard)	0x8004 16 bit data
KL6xxx (alternative)	0x8004 16 bit data

IDN	Name	Type	Attributes	Default value	Function
S-2-0002	Channel IDN list	IDN			I/O data channel + 0002

Meaning

This list contains the identification numbers supported by the relevant channel.

IDN	Name	Type	Attributes	Default value	Function
S-2-0003	Occupied inputs	Uint 16	Read		I/O data channel + 0003

Meaning

This operating data contains a bit mask specifying the occupied inputs for this channel. Every bit that is set represents a usable input.

IDN	Name	Type	Attributes	Default value	Function
S-0-0011	I/O state class 1	Uint 16	Read		

Meaning

Affects bits 11-13 in the I/O station's status word.

IDN	Name	Type	Attributes	Default value	Function
S-0-0030	Manufacturer version	Variable, 1 byte	Read	0xXXXX	

Meaning

Shows the manufacturer version in the operating data.

IDN	Name	Type	Attributes	Default value	Function
S-0-0096	Slave identification	Uint 16	Read		

Meaning Shows the station's SERCOS address.

IDN	Name	Type	Attributes	Default value	Function
S-0-0135	"Drive" status	Uint 16	Read	0xXXXX	

Meaning Shows the status of the BK7500 in the operating data via the service channel.

IDN	Name	Type	Attributes	Default value	Function
S-0-0143	System interface version	string	Read	0x	

Meaning Shows the version of the interface specification in the operating data.

IDN	Name	Type	Attributes	Default value	Function
S-0-0185	Length of the data in the AT		Read	0x	

Meaning Shows in the operating data the maximum length (in bytes) of the configurable data in the drive telegram.

IDN	Name	Type	Attributes	Default value	Function
S-0-0186	Length of the data in the MDT		Read	0x	

Meaning Shows in the operating data the maximum length (in bytes) of the configurable data in the MDT.

IDN	Name	Type	Attributes	Default value	Function
S-0-0187	IDN list of the data in the AT		Read	0x	

Meaning Shows in the operating data a list of the cyclic IDNs to be processed as actual values.

IDN	Name	Type	Attributes	Default value	Function
S-0-0188	IDN list of the data in the MDT		Read	0x	

Meaning Shows in the operating data a list of the cyclic IDNs to be processed as set values.

IDN	Name	Type	Attributes	Default value	Function
S-0-0290	Device type		Read	0x	

Meaning Shows the device type (drive, I/O, mixed station) in the operating data
Bit 0,1
0 0 = drive
1 0 = I/O station
0 1 = mixed station
1 1 = reserved
Bit 15
0 = device specified by the SERCOS working circle
1 = device specified by the manufacturer

IDN	Name	Type	Attributes	Default value	Function
S-0-0291	I/O base	IDN	Read	0x1000	

Meaning The base identification number of the I/O station is stored in the operating data for calculation of the general I/O-specific identification numbers.

BK7500 Sercos Coupler

The transfer medium: plugs and cables

Fiber optic conductor: the SERCOS User group elaborated the specification of a transmission technology based on fiber optic conductors for applications in highly interference-prone environments and also to increase the range.

Using the SERCOS bus couplers BK7500 the realization of optical Sercos networks with ring technology (optical one fiber with plastic fiber conductor) is possible. The maximum amount of stations is 254. The baud rate can be adjusted via DIP switches on the BK7500. Additional information can be find in the following table:

Fundamental properties of optical fibre transmission technology

The Medium	
Network topology	Ring system, active devices between the cable sections
Medium	Z1100 plastic optical fibre Z1101 plastic optical fibre with PU cladding
Number of stations	254 stations in the ring
with plastic optical fibre	0.3 m to 45 m
Min. bending radius	3 cm
Transmission rate	2, 4, 8 Mbit/s or 16 Mbit/s
Plug connector	Z1003 standard plug F-SMA for plastic optical fibres

It is possible to prepare plastic fiber-optic conductors using usual tools. Special tools are needed to prepare the HCS conductors.

A closed ring must be established in one system. The data path begins in the master and passes through all stations. The return path must end in the master again.

The plastic fiber-optic cable can be processed without special tools. A connector can be produced swiftly and reliably using a knife, pliers and emery paper. The connector engages in the slaves.

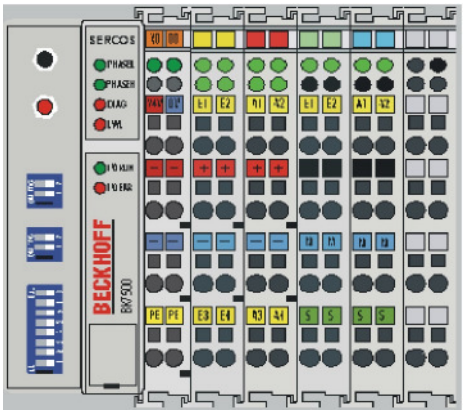
Each station in the ring has on "incoming" and a "continuing" Interface. Swapping of the "incoming" and "continuing" interfaces will not damage them. In the activated state, the fault can be located easily. The red lit end of the fiber-optic conductor is plugged into the interface that is not lit.

Appendix

Example: composition of a process image in the Bus Coupler

The hardware configuration:

Bk7500
KL1104
KL2114
KL3062
KL4002
KL9010



Plug the terminals into the coupler in the sequence that can be seen in the picture, and set address 2 at the "station address" DIP switch.
Connect the 24V /0V and the +/- contacts to the 24V DC supply voltage, and switch the supply voltage on.

The 2 green LEDs at the supply assembly should now illuminate. If this is not the case, the voltage must be checked.

Connect the BK7500 SERCOS Coupler to the SERCOS Master with the optical fibre. The master's sender must be connected to the receiver at the BK7500, and the sender at the coupler must be connected to the master's receiver.
Examine the length of the cable between the BK7500 sender and the SERCOS master receiver, and set the DIP switch for "cable length" (see label on the Bus Coupler) correctly.
The same setting is required at the master end.

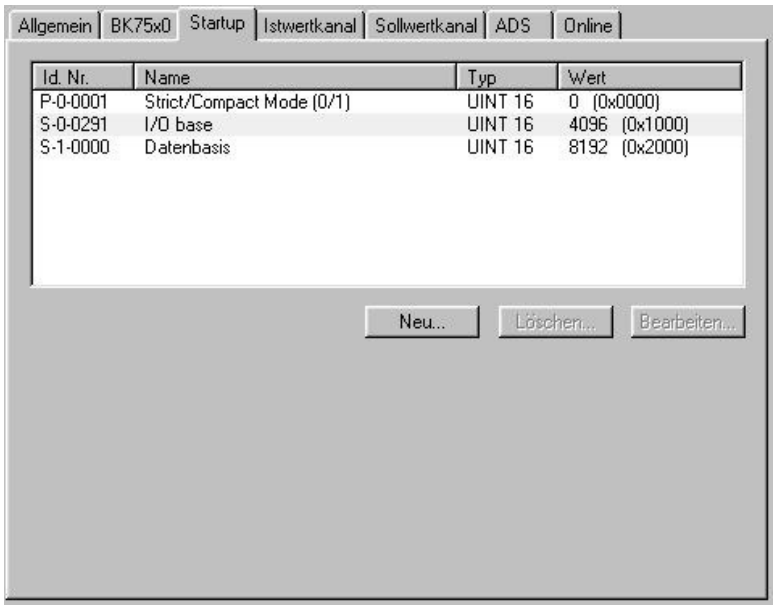
If the SERCOS Master is already active (detectable from the red light at the SERCOS Master Sender) the "LWL" LED at the BK7500 should go out, provided the connections are correct.

You must check the optical fibre if this LED continues to shine.

Configuration of the SERCOS master

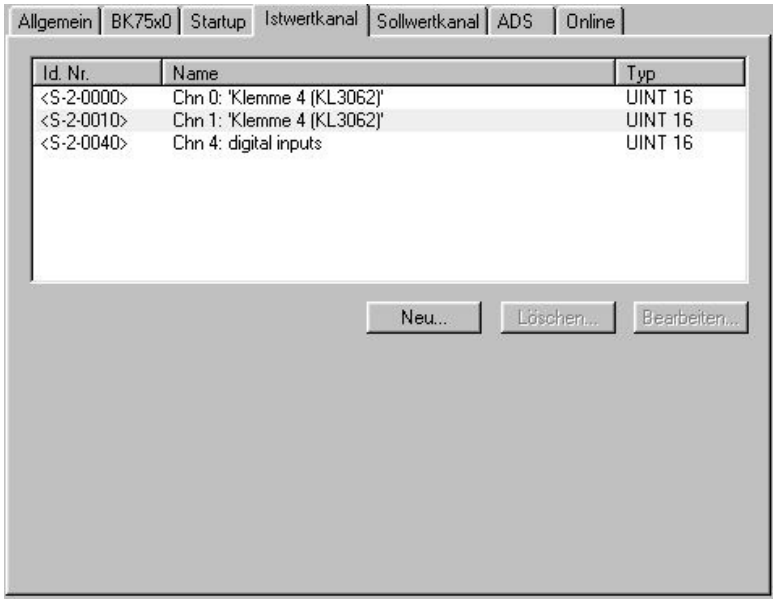
Configuration of the AT

S-2-0000 Chn 1	Data (Terminal KL3062)	UINT 16
S-2-0005 Chn 1	Status (Terminal Kl3062)	UINT 16
S-2-0010 Chn 2	Data (Terminal KL3062)	UINT 16
S-2-0015 Chn 2	Status (Terminal Kl3062)	UINT 16
S-2-0040 Chn 1-16	Data (All digital Input)	UINT 16



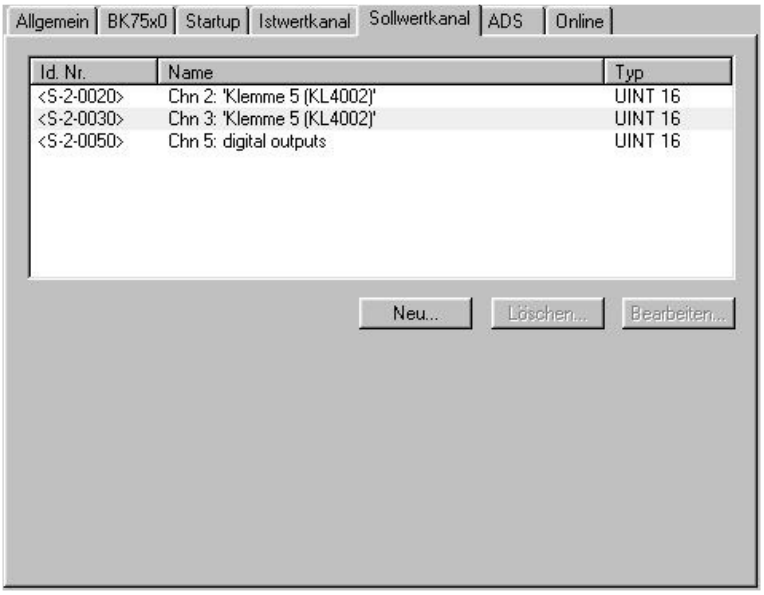
Configuration of the MDT

S-2-0020 Chn 1	Data (Terminal KL4002)	UINT 16
S-2-0030 Chn 2	Status (Terminal l4002)	UINT 16
S-2-0050 Chn 1-16	(All digital Outputs)	UINT 16



Base settings

P-0-0001 Strict/Compact Mode (0/1)	UINT 16
(0x0000) := strict >> each clamp channel gets its own I/O channel	
S-0-0291 I/O Base	UINT 16
(0x1000) := Pointer on the IDN S-1-0000	
S-1-0000 Database	UINT 16
(0x2000) := Pointer to the first I/O Channel >>> see S-2-0000 Chn 1 Data (Terminal KL3062	



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