MODBUS BK7300

Version: 1.1
Last change: 2006-10-30

BECKHOFF

Please note the following

Target group

This description is only intended for the use of trained specialists in control and automation engineering who are familiar with the applicable national standards.

Safety requirements

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.

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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

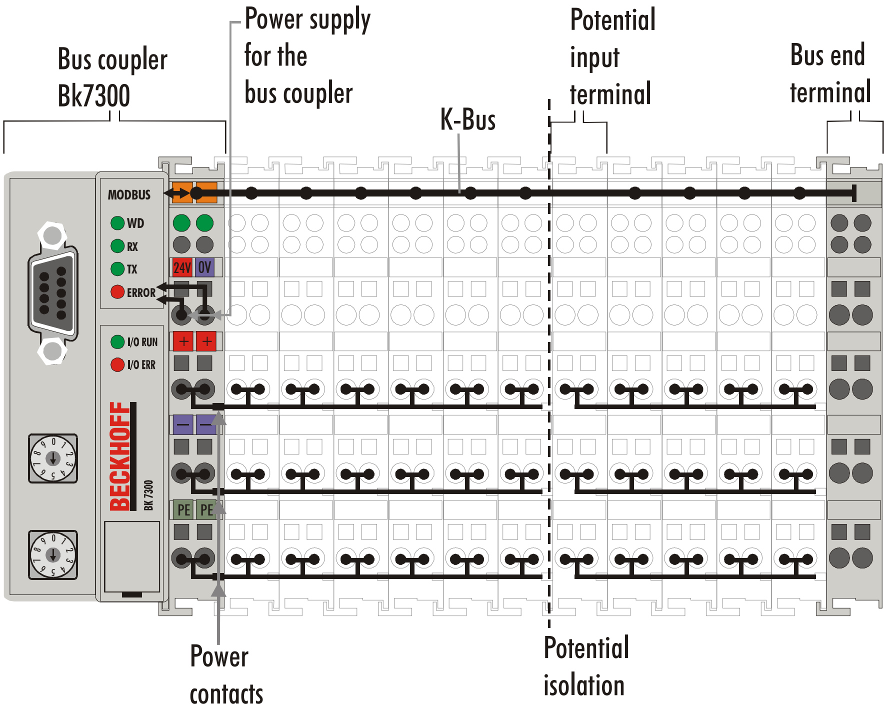
The K-bus is the path taken by data within the terminal row. The bus coupler carries the K bus through all the terminals by means of six contacts on the side walls of the terminals, and the end terminal terminates the K bus. The user does not need to know anything about the function of the K bus or the 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

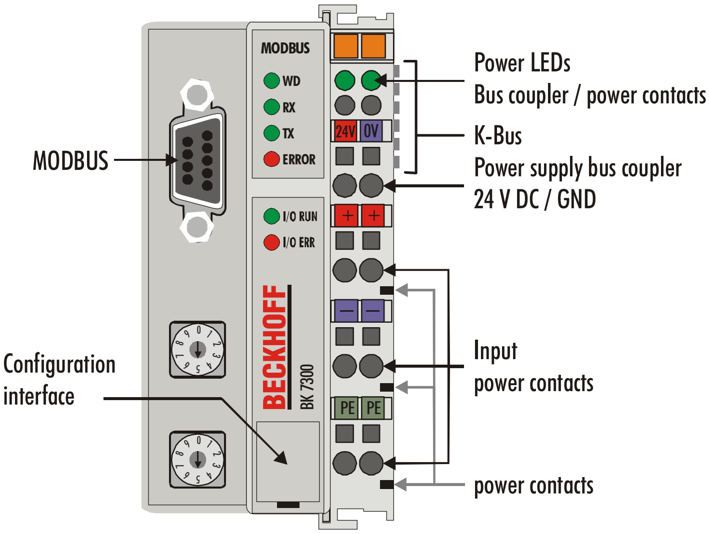
You can use a variety of bus couplers to attach the electronic terminal row quickly and easily to the various fieldbus systems, and you can also subsequently convert to a different fieldbus system. The bus coupler deals with all the necessary monitoring and control tasks for operating the attached bus 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 interfaces

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

The MODBUS - coupler BK7300



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

maximum 24 V

maximum 10 A

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.

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

9 pin sub-D socket strip

There is a recessed front face on the left hand side. The MODBUS connection plug can be inserted here. A full description of the fieldbus interfaces is found elsewhere in this manual. (In the section on The Medium: Plugs and Cables)

Configuration Interface

Serial interface under the front cover

The standard bus couplers have an RS232 interface at the bottom of the front face. 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 analogue channels to be configured. The functionality of the configuration interface can also be reached via the fieldbus using the PLC interface.

KS2000 Software

In order to link the MODBUS BK7300 coupler and the KS2000 configuration software, the coupler's address selection switch must be set to "00", and it must be restarted (i.e. the coupler must be switched off and then on again).

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.

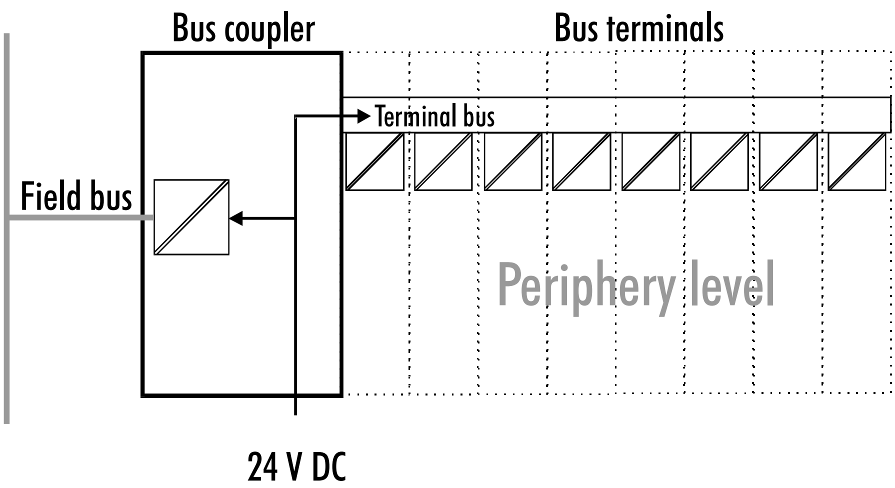
Supply isolation

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.

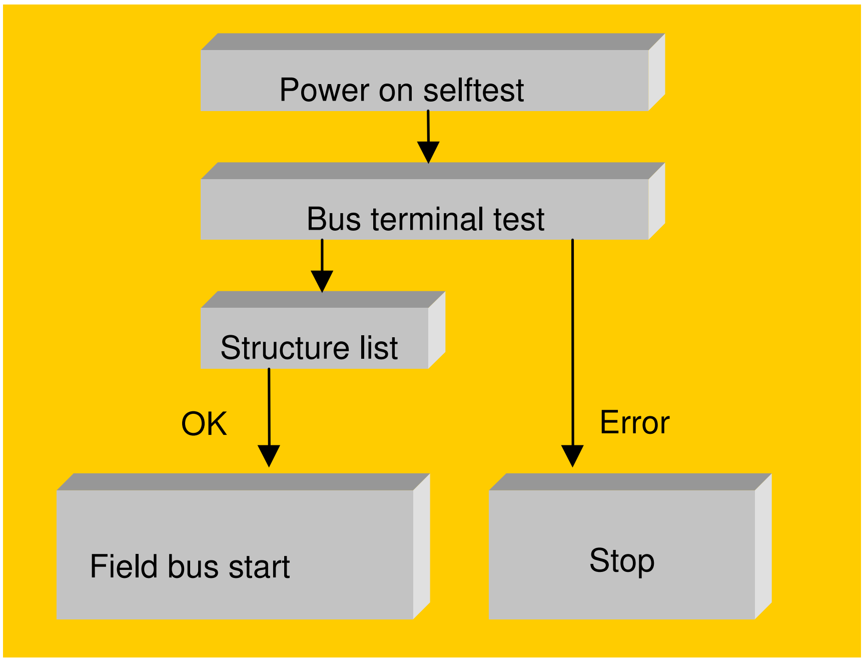
Setting up the power levels in the bus terminal system



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".

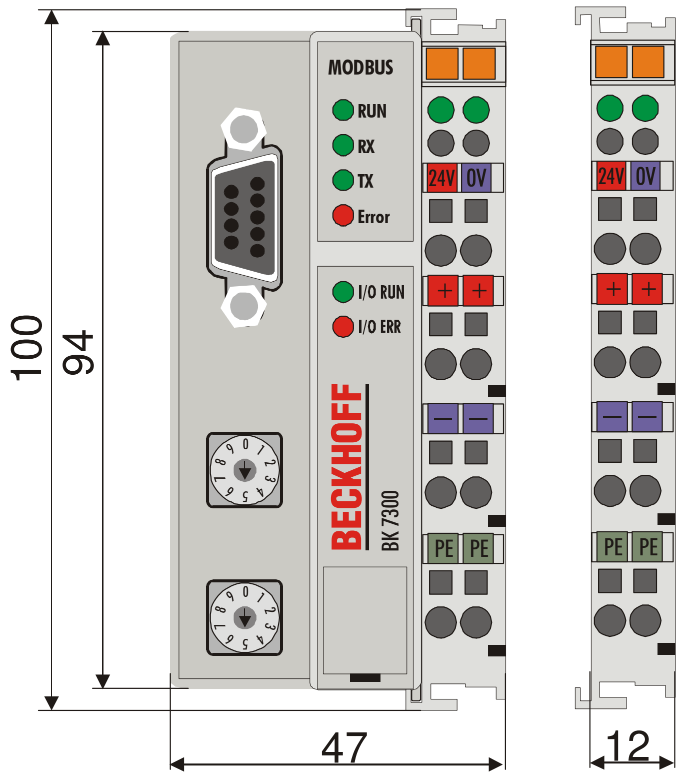
Start-up behaviour of the bus coupler



Mechanical construction

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. If you use large plugs, for example like some of the bus plugs used for the Profibus, they may protrude above the overall height of the cabinet.

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. 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. In the case of digital 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 MODBUS – the fieldbus-specific electrical data is listed in this section. The following table gives an overview of all the data:

Technical data	**BK7300**
Supply voltage	24 V DC
Input current	70mA + (total K-bus current)/4 500 mA max.
Power-on surge	2.5 x steady operating current
K bus supply current up to	1750 mA max.
Configuration facility	via KS2000 or the controller
Number of bus terminals	64
Digital peripheral signals	256 inputs/outputs
Analogue peripheral signals	128 inputs/outputs
Baud rate	From 150 baud to 38400 baud
Protocol	RTU and ASCII
Bus connection	D-Sub RS 485 9-pin
Voltage of the power contact	24 V DC / AC max.
Power contacts current drawn	10 A max.
Electric strength	500 Veff (power contact / supply voltage / fieldbus) none
Typical weight	170 g
Operating temperature	0°C ... +55°C
Storage temperature	-20°C ... +85°C
Relative humidity	95% without dew formation
Vibration/shock stability	according to IEC 68-2-6 / IEC 68-2-27
EMC immunity/ transmission	according to EN 50082 (ESD, burst) / EN 50081
Installation location	Any
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 catalogue 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

A 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.

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, ...)

Data consistency

Items of data are said to be consistent if their content all belongs together, and if they are transmitted as a single block. Examples of data items that belong together are: 1. the high and low bytes of an analogue value (word consistency), and 2. a 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 read in or written together. Byte consistency is sufficient for handling digital signals. Whenever values have a length of more than 8 bits, analogue 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 used master interfaces. Those chapters of this manual that deal with the fieldbus refer to the most widespread interfaces.

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

Preparing for 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.

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.

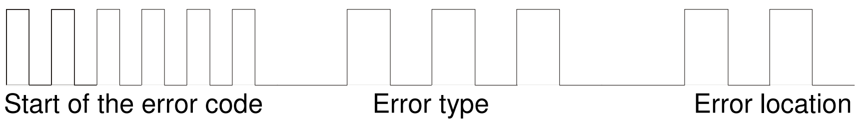
On the upper right hand side of the bus couplers are two more green LEDs that indicate the supply voltage. The left hand LED indicates the 24 V supply of the bus coupler. The right hand LED signals the supply to the power contacts.

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. The red LED blinks with two different frequencies in order to indicate an error. The error is encoded in the blinks as follows:

Blink code

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



Error code	Error argument	Description	Remedy
Persistent, continuous blinking		EMC problems	- Check power supply for overvoltage or undervoltage peaks - Implement EMC measures - If a terminal 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	K-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	K-bus data error Break behind terminal n (0: coupler)	- Check whether the n+1 terminal is correctly connected; replace if necessary. – Check whether the end terminal 9010 is connected.
5 pulses	n	K-bus error with register communication with terminal n	Replace terminal
14 pulses	n	Terminal n has the wrong format	- Start the coupler again, and if the error occurs again then exchange the terminal
15 pulses	n	Number of terminals is no longer correct	- Start the coupler again, and if the error occurs again after this, use the KS2000 software to set manufacturer's settings
16 pulses	n	Length of the terminal bus data is no longer correct	- Start the coupler again, and if the error occurs again after this, use the KS2000 software to set manufacturer's settings

The number of pulses (n) 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.

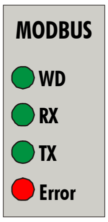
In the case of some errors, rectification does not cause the bus coupler to leave the blink sequence. The bus coupler stays in the "Stop" state. The bus coupler can only be re-started either by switching the power supply off and on again, or by a software reset.

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 after switching on.

MODBUS LEDs

WD	Watchdog is active
RX	Receive Data Data is being received
TX	Transmit Data Data is being transmitted
Error	Error Data Error in data transmission, checksum error



If a K-bus error occurs during operation, the procedures for reaction to a K-bus error are executed in accordance with the parameterisation. If the K-bus error occurs during booting, the slave is not included in the data exchange.

Fieldbus errors

WD

A fieldbus error only occurs when the watchdog (WD) period has elapsed. The watchdog is preset to 1000 ms. The WD is activated as soon as a "write" access has been made to the coupler's process data (WD LED goes on). After this, another "write" command must be sent to the process data within the set WD time, in order to start the WD from zero again.

Once a WD error has occurred, data communication can only be restarted by resetting the coupler (see "Coupler Reset", under Diagnostics).

The maximum watchdog time is 65000 ms, and it can be set by rotary switch or via the KS2000 software.

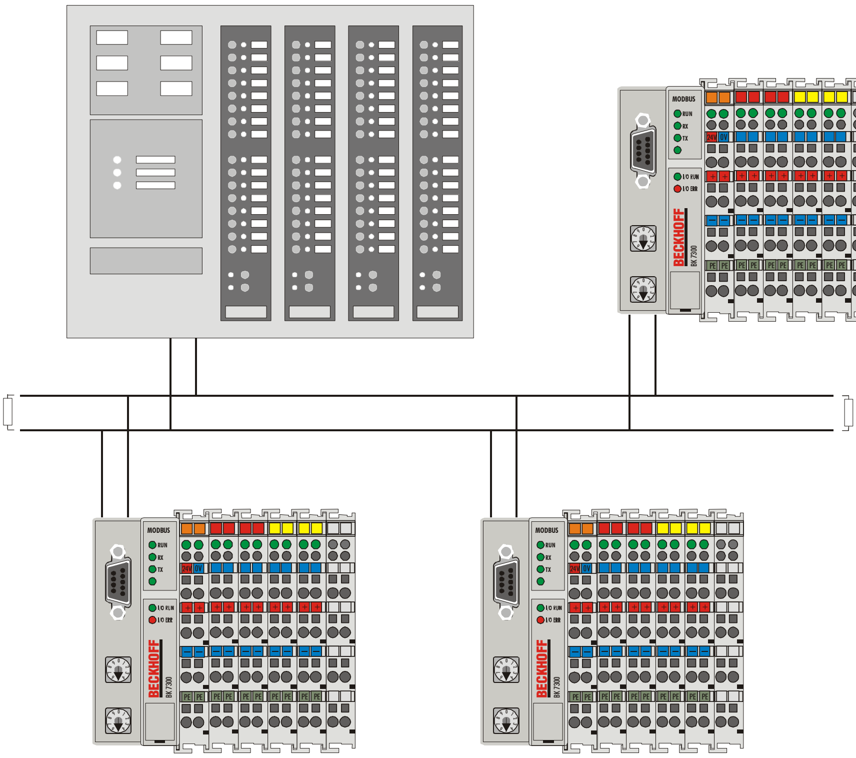
MODBUS

Basic Principles

The MODBUS is a master-slave bus system in which only one device (the master) actively starts a transaction (queries). The passive device (the slave) then sends an answer (response) if the telegram was directly addressed to it and provided that it has no errors.

Bus Topology

Physically, the BK7300 uses RS485 transmission. This means that a two-wire cable is needed for the data transmission. The topology is linear. At the beginning and end of the lines the bus requires termination resistors. The structure of the Modbus network is similar to that of PROFIBUS.



Broadcast function

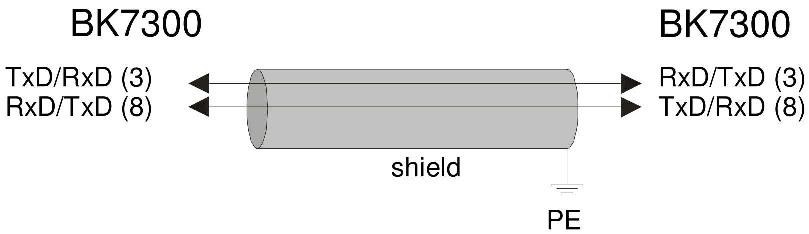
The Beckhoff bus couplers support the broadcast function. For this purpose the slave address in the telegram must be set to "00". Slaves do not answer a broadcast. Not all functions are supported.
Functions that support a broadcast:

- 5 Force single coil
- 6 Preset single register
- 15 Force multiple coils
- 16 Preset multiple register

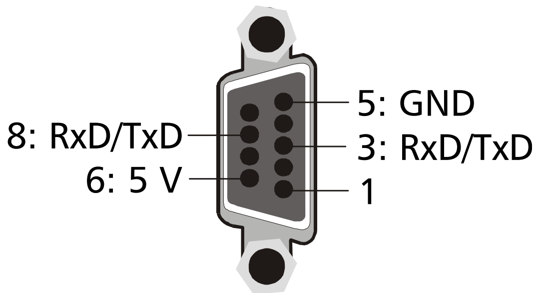
PIN assignment

The BK7300 uses RS485 for the data transmission. A screened two-wire cable is sufficient. The connection to the coupler is a 9-pin sub-D socket. The data line is connected to PIN 3 and PIN 8.

Cable

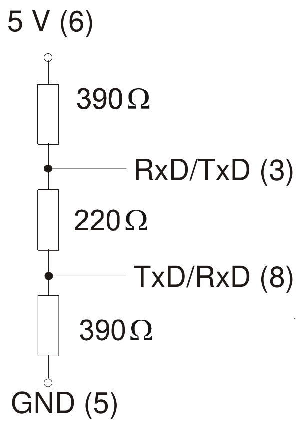


Sub-D socket



Bus termination

The MODBUS requires termination resistors at the beginning and end of the bus lines.



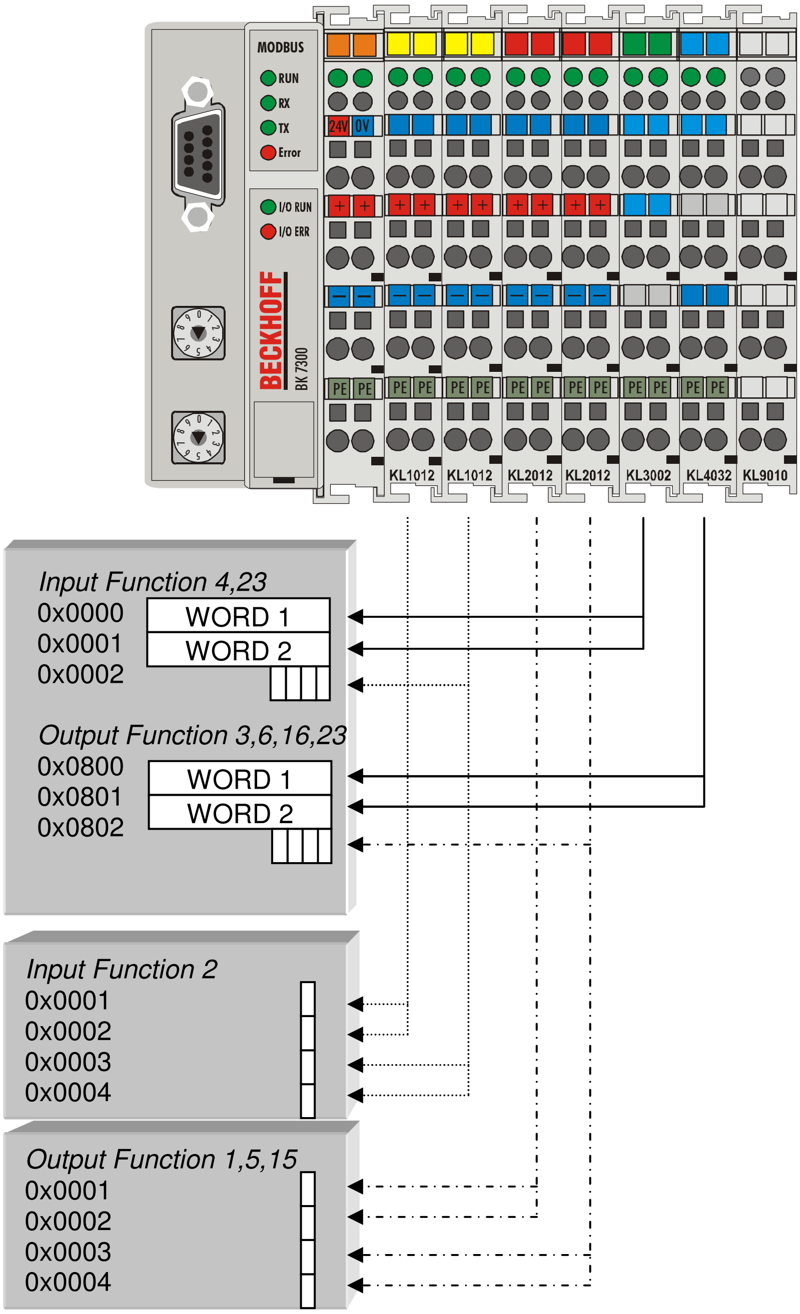
Process Data and Memory Map

The following example illustrates how the process image is constructed in the coupler, and the functions of the MODBUS telegram with which digital and analogue values can be read.

The input process image in the BK7300 starts from address 0x0000. All the byte-oriented bus terminals (see Appendix) are entered here into the process image first. The bit-oriented bus terminals them follow, and each word is filled before starting a new one.

The output process image starts at address 0x0800. The byte-oriented bus terminals are again here entered first, and the bit-oriented terminals follow.

All the digital signals can be directly addressed with functions 1, 2, 5 and 15.



Settings and Parameterisation

The Modbus is parameterised by means of the rotary switch on the BK7300. Only the bus coupler's end terminal may be inserted for this.

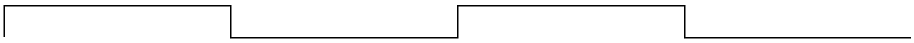
Only plug the KL9010 into the BK7300. Use the rotary switch to select the parameters. The x10 address switch is used to select the parameter, while the x1 address switch is used for the associated setting. The settings can be found in the table. Connect the bus coupler's 24 V supply, and the Modbus coupler will now start up in parameterisation mode. The LEDs WD, RX, TX and ERROR are now toggled, and the LEDs I/O RUN and I/O ERR give the function value.

Example

You want to check whether the correct baud rate has been set.

1. Switch off the coupler's 24 V supply
2. Remove all the terminals except the KL9010 end terminal
3. Set the x10 address selection switch to 0 and the x1 switch to 3
4. Switch on the coupler's 24 V supply again

The coupler indicates the set baud rate via the LEDs.
3 x flashes of the I/O RUN and I/O ERR LEDs means 9600 baud



WD,RX,TX,ERROR LEDs

I/O Run, I/O ERR

Now you want to set a new rate of 1200 baud

5. Switch off the coupler's 24 V supply
6. Set the x10 address selection switch to 3 and the x1 switch to 6
7. Switch on the coupler's 24 V supply again

The coupler indicates the new set baud rate via the LEDs.
6 x flashes of the I/O RUN and I/O ERR LEDs means 1200 baud

Incorrect Entry

If a parameter is set that the Modbus coupler does not recognise, this is indicated by a constant even flashing of the I/O RUN and I/O ERR LEDs, while all the other LEDs remain off.

KS2000

The parameterisation settings can also be carried out with the KS2000 software.

Parameterisation Table

Parameter	x 10	x 1	Default	Parameter value	
	0	1..9	-	Indicates the parameter of the x 10 function	
Modbus	1	1	1	RTU mode	
		2		ASCII mode	
Frame	2	1	1	8 data bits, no parity	one stop bit
		2		8 data bits even Parity	one stop bit
		3		8 data bits odd Parity	one stop bit
		4		7 data bits even Parity	one stop bit
		5		7 data bits odd Parity	one stop bit
		6		one stop bit	
		7		2 stop bits	
		8		8 data bits, no parity	two stop bits
		9		8 data bits even Parity	two stop bits
		10		8 data bits odd Parity	two stop bits
		11		7 data bits even Parity	two stop bits
		12		7 data bits odd Parity	two stop bits
Baud rate	3	1	3	38400 baud	
		2		19200 baud	
		3		9600 baud	
		4		4800 baud	
		5		2400 baud	
		6		1200 baud	
		7		600 baud	
		8		300 baud	
		9		150 baud	
End of Frame Time	4	0..9	0	In ms for RTU mode (0 dependent on the baud rate) In seconds for ASCII mode (0 EOF time switched off)	
Watchdog 100 ms	5	0..9	0	Watchdog x 100 ms	
Watchdog 1000 ms	6	0..9	1	Watchdog x 1000 ms	
Factory setting	9	9			

Protocol

ASCII

In ASCII mode the telegram starts with a colon (:) character (0x3A), and ends with a carriage return and a line feed (CRLF) (0x0D, 0x0A). The characters transferred are represented in the ASCII code.

ASCII frame

start	address	function	data	LRC	END
1 character :	2 characters	2 characters	n characters	2 characters	2 characters CRLF

RTU

In RTU mode the protocol starts with a pause of 3.5 character times, and finishes in the same way (illustrated in the diagram with T1-T2-T3-T4). The characters permitted for transmission in all fields are hexadecimal 0... 9, A..., F.

RTU frame

start	address	function	data	CRC Check	END
T1-T2-T3-T4	1 character	1 character	n characters	2 characters	T1-T2-T3-T4

Functions

In the MODBUS protocol, the functions determine whether data are to be read or written, and what kind of data is involved. In the ASCII protocol the fourth and fifth bytes are function bytes, while in the RTU protocol it is the second byte.
The Beckhoff MODBUS coupler supports the following functions:

Function	Code	Description
Read coil status	1	Read digital outputs
Read input status	2	Read digital inputs
Read holding registers	3	Read analogue outputs / GPR
Read input registers	4	Read analogue inputs / GPR
Force single coil	5	Write one digital output
Preset single register	6	Write one analogue output / GPR
Diagnostics	8	Read the MODBUS diagnostic register
Force multiple coils	15	Write a number of digital outputs
Preset multiple registers	16	Write a number of analogue outputs / GPR
Read / Write Registers	23	Write and read a number of process data outputs / GPRs

GPR – General Preset Register (see Modbus Interface)

The functions are briefly described below and clarified with the aid of an example.

Read Digital Outputs (Function 1)

READ COIL STATUS

Function 1 can be used to read the settings of the digital outputs.

In this example the first 10 digital outputs of slave number 11 are read. The start address is zero. If an offset is to be entered, this is done in the "Start address" field.

Query

Byte Name	Example	RTU	ASCII	
Start frame			„:“	0x3A
Slave address	11	0x0B	„0B“	0x30, 0x42
Function code	1	0x01	„01“	0x30, 0x31
Start address high	0	0x00	„00“	0x30, 0x30
Start address low	0	0x00	„00“	0x30, 0x30
Count high	0	0x00	„00“	0x30, 0x30
Count low	10	0x0A	„10“	0x31, 0x30
Error Check LRC / CRC		0xBC 0xA7	„E4“	0x45, 0x34
End of frame		t1-t2-t3	CRLF	0xD, 0xA

Response

The coupler answers with byte count 2, i.e. 2 bytes of data are returned. The request was for 10 bits, and these are now distributed over 2 bytes. The third bit in the output process image of the BK7300 is set, and the coupler returns a "4" in the first data byte.

Byte Name	Example	RTU	ASCII	
Start frame			„:“	0x3A
Slave address	11	0x0B	„0B“	0x30, 0x42
Function code	1	0x01	„01“	0x30, 0x31
Byte Count	2	0x02	„02“	0x30, 0x32
Data bits 0..7	4	0x04	„04“	0x30, 0x34
Data bits 8..15	0	0x00	„00“	0x30, 0x30
Error Check LRC / CRC		0x23 0x3D	„EE“	0x45, 0x45
End of frame		t1-t2-t3	CRLF	0xD, 0xA

Read Digital Inputs (Function 2)

READ INPUT STATUS

Function 2 can be used to read the digital input data.
In this example the first 10 digital inputs of slave number 11 are read. The start address is zero. If an offset is to be entered, this is done in the "Start address" field.

Query

Byte Name	Example	RTU	ASCII	
Start frame			„:“	0x3A
Slave address	11	0x0B	„0B“	0x30, 0x42
Function code	2	0x02	„02“	0x30, 0x32
Start address high	0	0x00	„00“	0x30, 0x30
Start address low	0	0x00	„00“	0x30, 0x30
Count high	0	0x00	„00“	0x30, 0x30
Count low	10	0x0A	„10“	0x31, 0x30
Error Check LRC / CRC		0xF8 0xA7	„E3“	0x45, 0x33
End of frame		t1-t2-t3	CRLF	0xD, 0xA

Response

The coupler answers with byte count 2, i.e. 2 bytes of data are returned. The request was for 10 bits, and these are now distributed over 2 bytes. The first bit in the input process image of the BK7300 is set, and the coupler returns a "1" in the first data byte.

Byte Name	Example	RTU	ASCII	
Start frame			„:“	0x3A
Slave address	11	0x0B	„0B“	0x30, 0x42
Function code	2	0x02	„02“	0x30, 0x32
Byte Count	2	0x02	„02“	0x30, 0x32
Data 0..7	1	0x01	„01“	0x30, 0x31
Data 8..15	0	0x00	„00“	0x30, 0x30
Error Check LRC / CRC		0x20 0x29	„F0“	0x46, 0x30
End of frame		t1-t2-t3	CRLF	0xD, 0xA

Read Analogue Outputs (Function 3)

READ HOLDING REGISTERS

Function 3 can be used to read the output words and the registers.

In this example the first two analogue outputs of slave number 11 are read. The analogue outputs begin at offset 0x800 (hex). The length indicates the number of channels to be read.

Query

Byte Name	Example	RTU	ASCII	
Start frame			„:“	0x3A
Slave address	11	0x0B	„0B“	0x30, 0x42
Function code	3	0x03	„03“	0x30, 0x33
Start address high	8	0x08	„08“	0x30, 0x38
Start address low	0	0x00	„00“	0x30, 0x30
Count high	0	0x00	„00“	0x30, 0x30
Count low	2	0x02	„02“	0x30, 0x32
Error Check LRC / CRC		0xC6 0xC1	„E8“	0x45, 0x38
End of frame		t1-t2-t3	CRLF	0xD, 0xA

Response

The coupler answers with byte count 4, i.e. 4 bytes of data are returned. The request was for 2 analogue channels, and these are now distributed over 2 words. In the analogue output process image, the first channel has the value 0x3FFF, while the second channel has the value 0x0.

Byte Name	Example	RTU	ASCII	
Start frame			„:“	0x3A
Slave address	11	0x0B	„0B“	0x30, 0x42
Function code	3	0x03	„03“	0x30, 0x31
Count byte	4	0x04	„04“	0x30, 0x30
Data 1 high byte	63	0x3F	„3F“	0x33, 0x46
Data 1 low byte	255	0xFF	„FF“	0x46, 0x46
Data 2 high byte	0	0x00	„00“	0x30, 0x30
Data 2 low byte	0	0x00	„00“	0x30, 0x30
Error Check LRC / CRC		0xC6 0xC1	„B0“	0x42, 0x30
End of frame		t1-t2-t3	CRLF	0xD, 0xA

Read Analogue Inputs (Function 4)

READ INPUT REGISTER

Function 4 is used to read the analogue inputs.

In this example the first two analogue inputs of slave number 11 are read. The analogue outputs begin at offset 0x0000 (hex). The length indicates the number of words to be read. A KL3002 has 2 words of input data, which is why the value to be entered in "Count low" is two.

Query

Byte Name	Example	RTU	ASCII	
Start frame			„:“	0x3A
Slave address	11	0x0B	„0B“	0x30, 0x42
Function code	4	0x04	„04“	0x30, 0x34
Start address high	0	0x00	„00“	0x30, 0x30
Start address low	0	0x00	„00“	0x30, 0x30
Count high	0	0x00	„00“	0x30, 0x30
Count low	2	0x02	„02“	0x30, 0x32
Error Check LRC / CRC		0x71 0x61	„EF“	0x45, 0x46
End of frame		t1-t2-t3	CRLF	0xD, 0xA

Response

The coupler answers with byte count 4, i.e. 4 bytes of data are returned. The request was for 2 analogue channels, and these will now be distributed over 2 words. In the analogue input process image, the first channel has the value 0x0038, while the second channel has the value 0x3F1B.

Byte Name	Example	RTU	ASCII	
Start frame			„:“	0x3A
Slave address	11	0x0B	„0B“	0x30, 0x42
Function code	4	0x04	„04“	0x30, 0x34
Count byte	4	0x04	„04“	0x30, 0x30
Data 1 high byte	0	0x00	„00“	0x30, 0x30
Data 1 low byte	56	0x38	„38“	0x33, 0x38
Data 2 high byte	63	0x3F	„3F“	0x33, 0x46
Data 2 low byte	11	0x0B	„0B“	0x30, 0x42
Error Check LRC / CRC		0x80 0x7E	„6A“	0x36, 0x41
End of frame		t1-t2-t3	CRLF	0xD, 0xA

Writing a Digital Output (Function 5)

FORCE SINGLE COIL

Function 5 can be used to write a digital output. In this example the third digital output of slave number 11 is written. The digital outputs begin at offset 0x0000 (hex). The digital value is located in the high byte of the data. To switch the output on, "Data high" must contain 0xFF (hex), while 0x00 (hex) is used to switch the output off again. "Data low" must contain 0x00 (hex).

Query

Byte Name	Example	RTU	ASCII	
Start frame			„:“	0x3A
Slave address	11	0x0B	„0B“	0x30, 0x42
Function code	5	0x05	„05“	0x30, 0x35
Start address high	0	0x00	„00“	0x30, 0x30
Start address low	2	0x02	„02“	0x30, 0x32
Data high	255	0xFF	„FF“	0x46, 0x46
Data low	0	0x00	„00“	0x30, 0x32
Error Check LRC / CRC		0x2D 0x50	„EF“	0x45, 0x46
End of frame		t1-t2-t3	CRLF	0xD, 0xA

Response

The coupler answers with the same telegram.

Byte Name	Example	RTU	ASCII	
Start frame			„:“	0x3A
Slave address	11	0x0B	„0B“	0x30, 0x42
Function code	5	0x05	„05“	0x30, 0x35
Start address high	0	0x00	„00“	0x30, 0x30
Start address low	2	0x02	„02“	0x30, 0x32
Data high	255	0xFF	„FF“	0x46, 0x46
Data low	0	0x00	„00“	0x30, 0x32
Error Check LRC / CRC		0x2D 0x50	„EF“	0x45, 0x46
End of frame		t1-t2-t3	CRLF	0xD, 0xA

Writing an Analogue Output (Function 6)

PRESET SINGLE REGISTER

Function 6 can be used to access the output process image and the interface.

The first analogue output of slave number 11 is written with function 6. The analogue outputs begin at offset 0x0800 (hex). Here again the offset always describes a word. This means offset 0x0803 refers to the fourth word in the output process image.

Query

Byte Name	Example	RTU	ASCII	
Start frame			„:“	0x3A
Slave address	11	0x0B	„0B“	0x30, 0x42
Function code	6	0x06	„06“	0x30, 0x36
Start address high	8	0x08	„08“	0x30, 0x38
Start address low	0	0x00	„00“	0x30, 0x30
Data high	63	0x3F	„3F“	0x33, 0x46
Data low	255	0xFF	„FF“	0x46, 0x46
Error Check LRC / CRC		0xDA 0xB0	„A9“	0x41, 0x39
End of frame		t1-t2-t3	CRLF	0xD, 0xA

Response

The coupler answers with the same telegram.

Byte Name	Example	RTU	ASCII	
Start frame			„:“	0x3A
Slave address	11	0x0B	„0B“	0x30, 0x42
Function code	6	0x06	„06“	0x30, 0x36
Start address high	8	0x08	„08“	0x30, 0x38
Start address low	0	0x00	„00“	0x30, 0x30
Data high	63	0x3F	„3F“	0x33, 0x46
Data low	255	0xFF	„FF“	0x46, 0x46
Error Check LRC / CRC		0xDA 0xB0	„A9“	0x41, 0x39
End of frame		t1-t2-t3	CRLF	0xD, 0xA

Writing a Number of Digital Outputs (Function 15)

FORCE MULTIPLE COILS

Function 15 can be used to set or reset a number of digital outputs at the same time.

In this example the first 20 digital outputs of slave number 11 are written. The digital outputs begin at offset 0x0000 (hex). Here the offset always describes a bit. Offset 0x0003 writes to the fourth bit in the output process image. The length indicates the number of bits, and the "Byte count" is composed from the combination all the bytes that are to be written.

Example: 20 bits – corresponds to 24 bits – count is 3 bytes (round up to the nearest byte)

The data bytes contain the values for the individual bits.

In this example, the first 16 bits are set to "TRUE", while bits 17 to 20 are "FALSE".

Query

Byte Name	Example	RTU	ASCII	
Start frame			„:“	0x3A
Slave address	11	0x0B	„0B“	0x30, 0x42
Function code	15	0x0F	„0F“	0x30, 0x46
Start address high	0	0x00	„00“	0x30, 0x30
Start address low	0	0x00	„00“	0x30, 0x30
Length high	0	0x00	„00“	0x30, 0x30
Length low	20	0x14	„14“	0x31, 0x34
Byte Count	3	0x03	„03“	0x30, 0x33
Data 1 bit 0..7	255	0xFF	„FF“	0x46, 0x46
Data 2 bit 8..15	255	0xFF	„FF“	0x46, 0x46
Data 3 bit 16..19	0	0x00	„00“	0x30, 0x30
Error Check LRC / CRC		0x01 0x95	„D1“	0x44, 0x31
End of frame		t1-t2-t3	CRLF	0xD, 0xA

Response

The coupler answers with the same telegram.

Byte Name	Example	RTU	ASCII	
Start frame			„:“	0x3A
Slave address	11	0x0B	„0B“	0x30, 0x42
Function code	6	0x06	„06“	0x30, 0x36
Start address high	8	0x08	„08“	0x30, 0x38
Start address low	0	0x00	„00“	0x30, 0x30
Data high	63	0x3F	„3F“	0x33, 0x46
Data low	255	0xFF	„FF“	0x46, 0x46
Error Check LRC / CRC		0xDA 0xB0	„A9“	0x41, 0x39
End of frame		t1-t2-t3	CRLF	0xD, 0xA

Writing a Number of Analogue Outputs (Function 16)

PRESET MULTIPLE REGISTERS

Function 16 can be used to write a number of analogue outputs. In this example the first 2 analogue output words of slave number 11 are written. The analogue outputs begin at offset 0x0800 (hex). Here the offset always describes a word. Offset 0x0003 writes to the fourth word in the output process image. The length indicates the number of words, and the "Byte count" is composed from the combination all the bytes that are to be written.

Example: 4 words – correspond to a byte count of 8

The data bytes contain the values for the analogue outputs. In this example, two words are to be written. The first word is to receive the value 0x7FFF (hex), and the second word is to receive the value 0x3FFF.

Query

Byte Name	Example	RTU	ASCII	
Start frame			„:“	0x3A
Slave address	11	0x0B	„0B“	0x30, 0x42
Function code	16	0x10	„10“	0x31, 0x30
Start address high	8	0x08	„08“	0x30, 0x38
Start address low	0	0x00	„00“	0x30, 0x30
Length high	0	0x00	„00“	0x30, 0x30
Length low	2	0x02	„02“	0x30, 0x32
Byte Count	4	0x04	„04“	0x30, 0x34
Data 1 byte 1	127	0x7F	„7F“	0x37, 0x46
Data 1 byte 2	255	0xFF	„FF“	0x46, 0x46
Data 2 byte 1	63	0x3F	„3F“	0x33, 0x46
Data 2 byte 2	255	0xFF	„FF“	0x46, 0x46
Error Check LRC / CRC		0xCD 0xE3	„1B“	0x31, 0x42
End of frame		t1-t2-t3	CRLF	0xD, 0xA

Response

The coupler replies with the start address and the length of the transmitted words.

Byte Name	Example	RTU	ASCII	
Start frame			„:“	0x3A
Slave address	11	0x0B	„0B“	0x30, 0x42
Function code	16	0x10	„10“	0x31, 0x30
Start address high	8	0x08	„08“	0x30, 0x38
Start address low	0	0x00	„00“	0x30, 0x30
Length high	0	0x00	„00“	0x30, 0x30
Length low	2	0x02	„02“	0x30, 0x32
Error Check LRC / CRC		0x43 0x02	„DB“	0x44, 0x42
End of frame		t1-t2-t3	CRLF	0xD, 0xA

Writing and Reading a Number of Analogue Outputs or Inputs (Function 23)

READ / WRITE REGISTERS

A number of analogue outputs can be written and a number of analogue inputs read with one telegram using function 23. In this example the first 2 analogue output words of slave number 11 are written, and the first two analogue inputs are read. The analogue outputs start at offset 0x0800 (hex), while the inputs start at offset 0x0000 (hex). Here the offset always describes a word. Offset 0x0003 writes to the fourth word in the output process image. The length indicates the number of words, and the "Byte count" is composed from the combination all the bytes that are to be written.

Example: 4 words – correspond to a byte count of 8

The data bytes contain the values for the analogue outputs. In this example, two words are to be written. The first word is to receive the value 0x3FFF (hex), and the second word is to receive the value 0x7FFF.

Query

Byte Name	Example	RTU	ASCII	
Start frame			„:"	0x3A
Slave address	11	0x0B	„0B"	0x30, 0x42
Function code	23	0x17	„17"	0x31, 0x37
Read start address high	0	0x00	„00"	0x30, 0x30
Read start address low	0	0x00	„00"	0x30, 0x30
Read length high	0	0x00	„00"	0x30, 0x30
Read length low	2	0x02	„02"	0x30, 0x32
Write start address high	8	0x08	„08"	0x30, 0x38
Write start address low	0	0x00	„00"	0x30, 0x30
Write length high	0	0x00	„00"	0x30, 0x30
Write length low	2	0x02	„02"	0x30, 0x32
Byte Count	4	0x04	„04"	0x30, 0x34
Data 1 high	63	0x3F	„3F"	0x33, 0x46
Data1 low	255	0xFF	„FF"	0x46, 0x46
Data 2 high	127	0x7F	„7F"	0x37, 0x46
Data 2 low	255	0xFF	„FF"	0x46, 0x46
Error Check LRC / CRC		0x76 0xD3	„12"	0x31, 0x32
End of frame		T1-t2-t3	CRLF	0xD, 0xA

Response

The coupler replies with the start address and the length of the bytes to be transferred in "Byte count". The data information follows. In this example the first word contains 0x0038 (hex) while the second word contains 0x3F0B.

Byte Name	Example	RTU	ASCII	
Start frame			„:"	0x3A
Slave address	11	0x0B	„0B"	0x30, 0x42
Function code	23	0x17	„17"	0x31, 0x37
Byte Count	4	0x04	„04"	0x30, 0x34
Data 1 high	0	0x00	„00"	0x30, 0x30
Data 1 low	56	0x38	„38"	0x33, 0x38
Data 2 high	63	0x3F	„3F"	0x33, 0x46
Data 2 low	11	0x0B	„0B"	0x30, 0x42
Error Check LRC / CRC		0x82 0xDD	„58"	0x35, 0x38
End of frame		t1-t2-t3	CRLF	0xD, 0xA

Diagnostics

In the Modbus, function 08 provides a series of tests for examination of the communication system between the master and the slave and for inspection of a variety of internal error states within the slave. A broadcast telegram is not supported.

The function uses a two-byte sub-function code field in the query to define the test that is to be carried out. The slave outputs the function code and the sub-function code as an answer.

The diagnostic queries use a two-byte data field to send diagnostics data or control information to the slave.

EXAMPLE

Query

Byte Name	Example	RTU	ASCII	
Start frame			„:“	0x3A
Slave address	11	0x0B	„0B“	0x30, 0x42
Function code	8	0x08	„08“	0x30, 0x38
Subfunction high	0	0x00	„00“	0x30, 0x30
Subfunction low	0	0x00	„00“	0x30, 0x30
Data high	2	0x02	„02“	0x30, 0x32
Data low	3	0x03	„03“	0x30, 0x33
Error Check LRC / CRC		0xA1 0xC0	„E8“	0x45, 0x38
End of frame		t1-t2-t3	CRLF	0xD, 0xA

Response

Byte Name	Example	RTU	ASCII	
Start frame			„:“	0x3A
Slave address	11	0x0B	„0B“	0x30, 0x42
Function code	8	0x08	„08“	0x30, 0x38
Subfunction high	0	0x00	„00“	0x30, 0x30
Subfunction low	0	0x00	„00“	0x30, 0x30
Data high	2	0x02	„02“	0x30, 0x32
Data low	3	0x03	„03“	0x30, 0x33
Error Check LRC / CRC		0xA1 0xC0	„E8“	0x45, 0x38
End of frame		t1-t2-t3	CRLF	0xD, 0xA

Echoes a query (Sub-Function 0)

Sub-function 0 causes the data that is sent to the slave by the master to be returned.

Coupler Reset (Sub-Function 1)

Sub-function 1 re-initialises the BK7300. Error counters are reset, and the coupler executes a self-test. No telegrams are either received or sent while the coupler is being reset.

Sub-function	Data field (query)	Data field (response)
00 01	00 00	00 00

Delete All Counter Contents (Sub-Function 10)

Calling this sub-function deletes the contents of all error counters in the coupler.

Sub-function	Data field (query)	Data field (response)
00 0B	00 00	Echo Query Data

Bus Communication Error Counter (Sub-Function 11)

Returns the number of faulty communications.

Sub-function	Data field (query)	Data field (response)
00 0C	00 00	CRC error counter

Error Answer Counter (Sub-Function 13)

This counter contains the number of error answer telegrams that the coupler has sent.

Sub-function	Data field (query)	Data field (response)
00 0D	00 00	Error Answer Counter

Slave Answers (Sub-function 14)

Contains the number of answers that the slave has sent.

Sub-function	Data field (query)	Data field (response)
00 0E	00 00	Slave Massage Count

Unsent Slave Answers (Sub-Function 15)

Contains the number of answers that the slave has not sent. For example, the slave does not send an answer to a broadcast message.

Sub-function	Data field (query)	Data field (response)
00 0F	00 00	Slave No Response Count

Number of Error Answers (Sub-Function 16)

Contains the number of error answers that the slave has sent.

Sub-function	Data field (query)	Data field (response)
00 10	00 00	Number of error answers

BK7300 Error Answers

EXCEPTION RESPONSE

When the user sends the slave either a request or information that the coupler does not understand, the BK7300 responds with an error report. This answer contains the function and the error code. 0x80 is added to the value returned by the function.

Code	Name	Meaning
1	ILLEGAL FUNKTION	Function not implemented
2	ILLEGAL DATA ADDRESS	Invalid address or length
3	ILLEGAL DATA VALUE	Invalid parameter • Diagnostic functions • Incorrect number of read/write accesses to the register
4	SLAVE DEVICE ERROR	Watchdog or K-bus error

Example

The following example contains an invalid "Start address".

Query

BYTE	Contents	Example
1	Slave address	0B
2	Function	01
3	Start address high	0D
4	Start address low	FF
5	Data high	FF
6	Data low	01
7	LRC	

The slave's answer contains the function plus 0x80, together with error code "02", i.e. an invalid address.

Response

BYTE	Contents	Example
1	Slave address	0B
2	Function	81
3	Error code	02
4	LRC	

Appendix

MODBUS Interface

address		Description		
0x0000 0x00FF		Process data interface inputs		
0x0800 0x08FF		Process data interface outputs		
0x1000- 0x1006	Only Read	Bus coupler identification		
0x100A	Only Read	2 byte PLC interface		
0x100B	Only Read	Terminal diagnostics		
0x100C	Only Read	Bus coupler status		
0x1010	Only Read	Process image length in bits	Analogue outputs	
0x1011	Only Read	Process image length in bits	Analogue inputs	
0x1012	Only Read	Process image length in bits	Digital outputs	
0x1013	Only Read	Process image length in bits	Digital inputs	
0x1020	Only Read	Watchdog	Current time in [ms]	1000
0x110A	Read/Write	2 byte PLC interface		
0x110B	Read/Write	Terminal diagnostics		
0x1120	Read/Write	Watchdog	Pre-defined time in [ms]	1000

Bus coupler status 0x100C	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	FB														CNF	KB

FB: Fieldbus error, watchdog time elapsed
KB: terminal bus error
CNF: BK configuration window

2 byte PLC interface/
2 byte diagnostic interface

Registers in the complex terminals and bus coupler registers can both be read or written using the 2 byte PLC interface. The complex terminal registers are described in the associated terminal documentation. The bus coupler registers can be used, for example, to read terminal bus diagnostics data, the terminal composition or the cycle times, and the programmed configuration can be written. It is also possible for a manual terminal bus reset to be carried out. The 2-byte PLC interface requires two bytes each of output and input data. They are handled using a special protocol. A description of the 2 byte PLC interface, the registers available in the bus couplers and of function blocks for various PLCs that implement the 2 byte PLC interface can be supplied on request.

The terminals' error messages can be sent over the 2-byte diagnostic interface. Terminal bus diagnostics must however be activated for this purpose. The 2-byte diagnostic interface occupies two bytes each of output and input data. They are handled using a special protocol. A description of the 2 byte-diagnostic interface can be supplied on request.

Terminal Mapping

The precise assignment of the byte-oriented bus terminals may be found in the bus terminal configuration guide.

The documentation is available on the product CD or on the Internet under www.beckhoff.de.

Byte oriented bus terminals	Bit oriented bus terminals
KL1501	KL10XX, KL11XX, KL12XX, KL17XX
KL2502	KL20XX, KL21XX, KL22XX, KL26XX KL27XX
KL3XXX	
KL4XXX	
KL5XXX	
KL6XXX	
	KL9110, KL9160, KL9210, KL9260

List of References

Modicon: „MODBUS Protocol Reference Guide“
http://www.modicon.com

Software – Win-TECH
http://www.win-tech.com

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Beckhoff Headquarters

Beckhoff Automation GmbH
Eiserstr. 5
33415 Verl
Germany

phone:	+ 49 (0) 5246/963-0
fax:	+ 49 (0) 5246/963-198
e-mail:	info@beckhoff.com
web:	www.beckhoff.com

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e-mail:	service@beckhoff.com