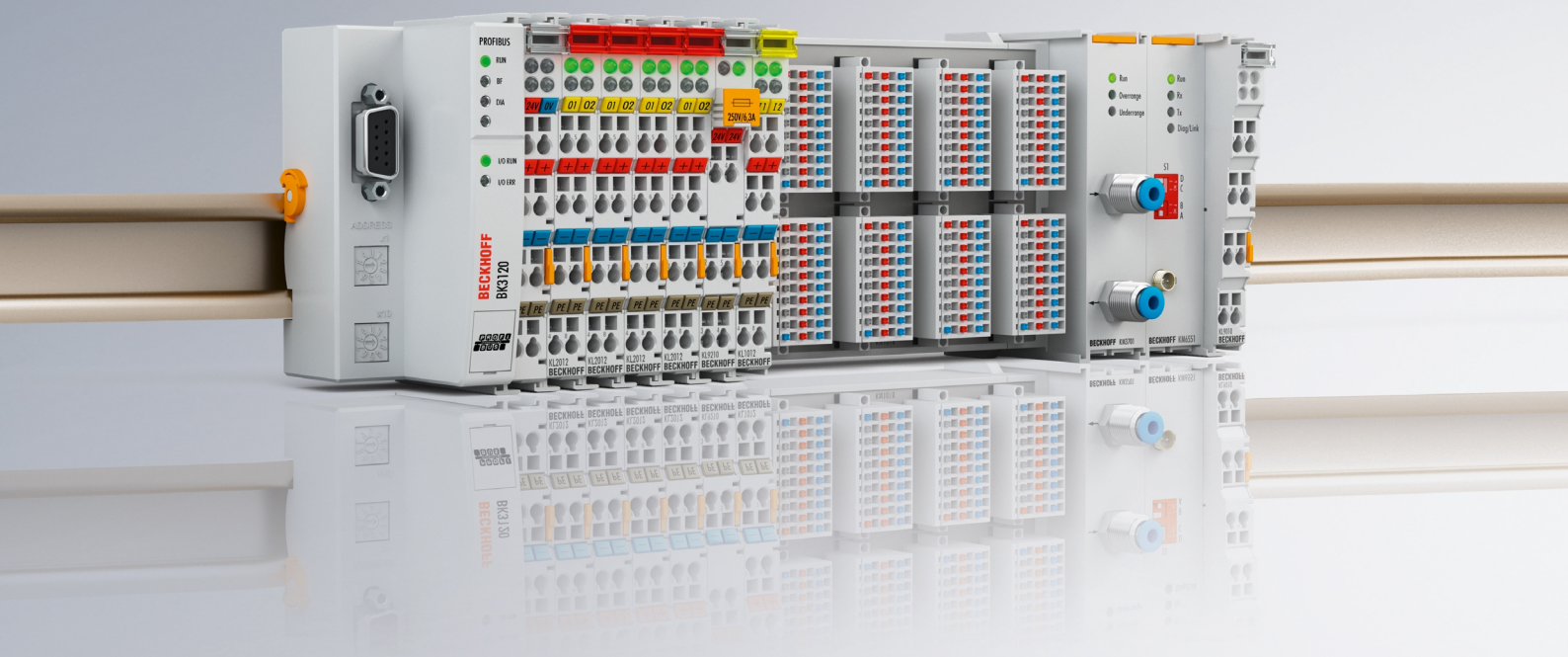
BECKHOFF New Automation Technology

Documentation | EN

KM4602

Two channel analog output module with manual and automatic operation



2023-02-13 | Version: 2.3.0

Table of contents

1 Foreword

1.1 Notes on the documentation

Intended audience

This description is only intended for the use of trained specialists in control and automation engineering who are familiar with the applicable national standards.
It is essential that the documentation and the following notes and explanations are followed when installing and commissioning these components.
It is the duty of the technical personnel to use the documentation published at the respective time of each installation and commissioning.

The responsible staff must ensure that the application or use of the products described satisfy all the requirements for safety, including all the relevant laws, regulations, guidelines and standards.

Disclaimer

The documentation has been prepared with care. The products described are, however, constantly under development.

We reserve the right to revise and change the documentation at any time and without prior announcement.

No claims for the modification of products that have already been supplied may be made on the basis of the data, diagrams and descriptions in this documentation.

Trademarks

Beckhoff®, TwinCAT®, TwinCAT/BSD®, TC/BSD®, EtherCAT®, EtherCAT G®, EtherCAT G10®, EtherCAT P®, Safety over EtherCAT®, TwinSAFE®, XFC®, XTS® and XPlanar® are registered trademarks of and licensed by Beckhoff Automation GmbH. Other designations used in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owners.

Patent Pending

The EtherCAT Technology is covered, including but not limited to the following patent applications and patents: EP1590927, EP1789857, EP1456722, EP2137893, DE102015105702 with corresponding applications or registrations in various other countries.

EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

Copyright

1.2 Safety instructions

Safety regulations

Please note the following safety instructions and explanations!
Product-specific safety instructions can be found on following pages or in the areas mounting, wiring, commissioning etc.

Exclusion of liability

All the components are supplied in particular hardware and software configurations appropriate for the application. Modifications to hardware or software configurations other than those described in the documentation are not permitted, and nullify the liability of Beckhoff Automation GmbH & Co. KG.

Personnel qualification

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

Description of instructions

In this documentation the following instructions are used.
These instructions must be read carefully and followed without fail!

⚠ DANGER

Serious risk of injury!

Failure to follow this safety instruction directly endangers the life and health of persons.

⚠ WARNING

Risk of injury!

Failure to follow this safety instruction endangers the life and health of persons.

⚠ CAUTION

Personal injuries!

Failure to follow this safety instruction can lead to injuries to persons.

NOTE

Damage to environment/equipment or data loss

Failure to follow this instruction can lead to environmental damage, equipment damage or data loss.

Tip or pointer

This symbol indicates information that contributes to better understanding.

1.3 Documentation issue status

Version	Comment
2.3.0	• Documentation adapted to changed product marking • Approvals/markings updated • Chapter *Instructions for ESD protection* added • Chapter *Disposal* added • New title page
2.2.0	• Technical data corrected • Document structure revised
2.1.0	• Description of Control Byte corrected
2.0.0	• Migration
1.0.0	• First publication

Firmware and hardware versions

Documentation, version	Firmware version	Hardware version
2.3.0	1C	04
2.2.0	1C	04
2.1.0	1C	03
2.0.0	1C	02
1.0.0	1C	01

The firmware and hardware versions (delivery state) can be taken from the serial number printed on the side of the terminal module.

Syntax of the serial number

Structure of the serial number: WW YY FF HH

WW - week of production (calendar week)
YY - year of production
FF - firmware version
HH - hardware version

Example with serial number 35 05 00 01:

35 - week of production 35
05 - year of production 2005
00 - firmware version 00
01 - hardware version 01

2 Product overview

2.1 Introduction

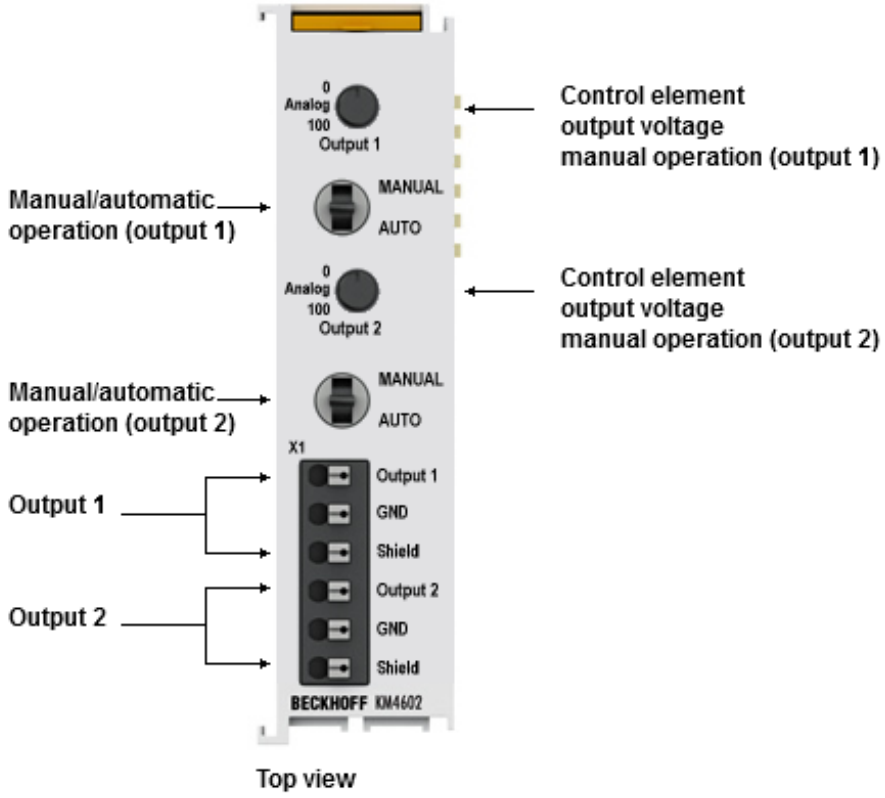


Fig. 1: KM4602

The KM4602 analog output terminal has two potential-free analog outputs (0 to 10 V_{DC}). Both outputs are internally connected to a common ground.

For each channel a switch enables selection between automatic and manual mode:

- In automatic mode, an analog value is output as a function of the process data.
- In manual mode, the value set via the potentiometer is applied to the output.
  The 24 V_{DC} (U_L) Bus Coupler supply voltage is also required for manual mode.

The state of the switches can be read by the controller (bit 0 of the status bytes).

2.2 Technical data

Technical data	KM4602-0000
Number of outputs	2
Connection technology	Single ended
Output voltage	0 to 10 V_{DC}
Load	> 5 kΩ (short-circuit-proof)
Resolution	12 bit
Output error	< ±0.1% (based on the end value)
Power supply for the electronics	via the K-bus
Current consumption from K-bus	typically 175 mA
Width of a bus terminal block	Maximum 64 standard Bus Terminals or 80 cm (one KM4602-0000 corresponds to 2 standard Bus Terminals here)
Data width in the input process image	8 bit status, 16 bit data
Data width in the output process image	8 bit control, 16 bit data
Configuration	no address or configuration settings
Operation modes	Manual or automatic operating mode
Electrical isolation	500 V (K-Bus/signal voltage)
Dimensions without antenna (W x H x D)	approx. 26.5 mm x 100 mm x 55 mm (width aligned: 24 mm)
Weight	approx. 85 g
Permissible ambient temperature range during operation	0°C ... + 55°C
Permissible ambient temperature range during storage	-25°C ... + 85°C
Permissible relative humidity	95%, no condensation
Mounting [▶ 11]	on a 35 mm mounting rail [▶ 10] (e.g. DIN rail TH 35-7.5 conforming to EN 60715)
Vibration/shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2 / EN 61000-6-4, EN 300-440-02
Protection class	IP20
Installation position	variable
Approvals/markings*	CE, UKCA, EAC

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

3 Mounting and wiring

3.1 Instructions for ESD protection

NOTE

Destruction of the devices by electrostatic discharge possible!

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

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

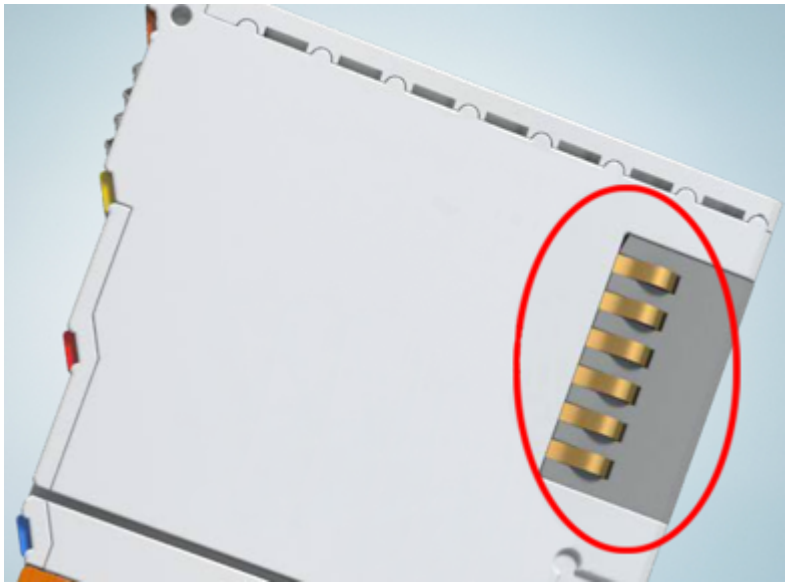


Fig. 2: Spring contacts of the Beckhoff I/O components

3.2 Recommended mounting rails

Terminal Modules and EtherCAT Modules of KMxxxx and EMxxxx series, same as the terminals of the EL66xx and EL67xx series can be snapped onto the following recommended mounting rails:

- mounting rail TH 35-7.5 with 1 mm material thickness (according to EN 60715)
- mounting rail TH 35-15 with 1.5 mm material thickness

Pay attention to the material thickness of the mounting rail

Terminal Modules and EtherCAT Modules of KMxxxx and EMxxxx series, same as the terminals of the EL66xx and EL67xx series does not fit to the mounting rail TH 35-15 with 2.2 to 2.5 mm material thickness (according to EN 60715)!

3.3 Mounting and demounting - terminals with front unlocking

The terminal modules are fastened to the assembly surface with the aid of a 35 mm mounting rail (e.g. mounting rail TH 35-15).

Fixing of mounting rails

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

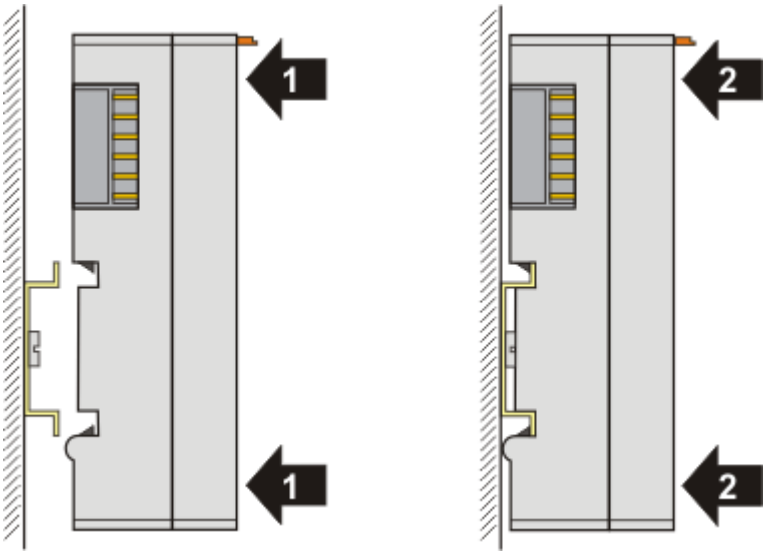
⚠ WARNING

Risk of electric shock and damage of device!

Bring the bus terminal system into a safe, powered down state before starting installation, disassembly or wiring of the Bus Terminals!

Mounting

- Fit the mounting rail to the planned assembly location.

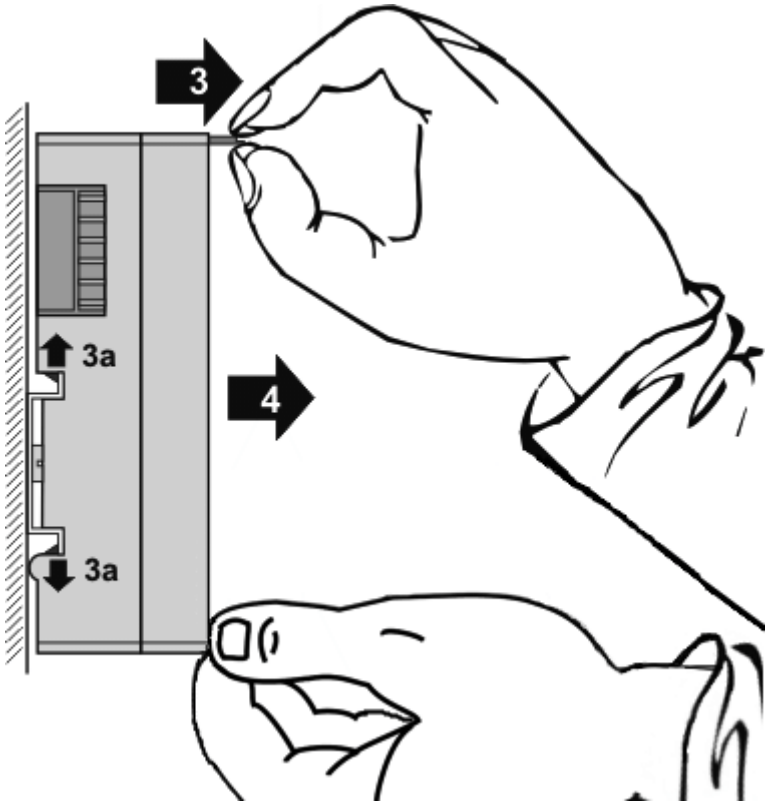


and press (1) the terminal module against the mounting rail until it latches in place on the mounting rail (2).

- Attach the cables.

Demounting

- Remove all the cables.
- Lever the unlatching hook back with thumb and forefinger (3). An internal mechanism pulls the two latching lugs (3a) from the top hat rail back into the terminal module.



- Pull (4) the terminal module away from the mounting surface.
  Avoid canting of the module; you should stabilize the module with the other hand, if required.

3.4 Dimensions

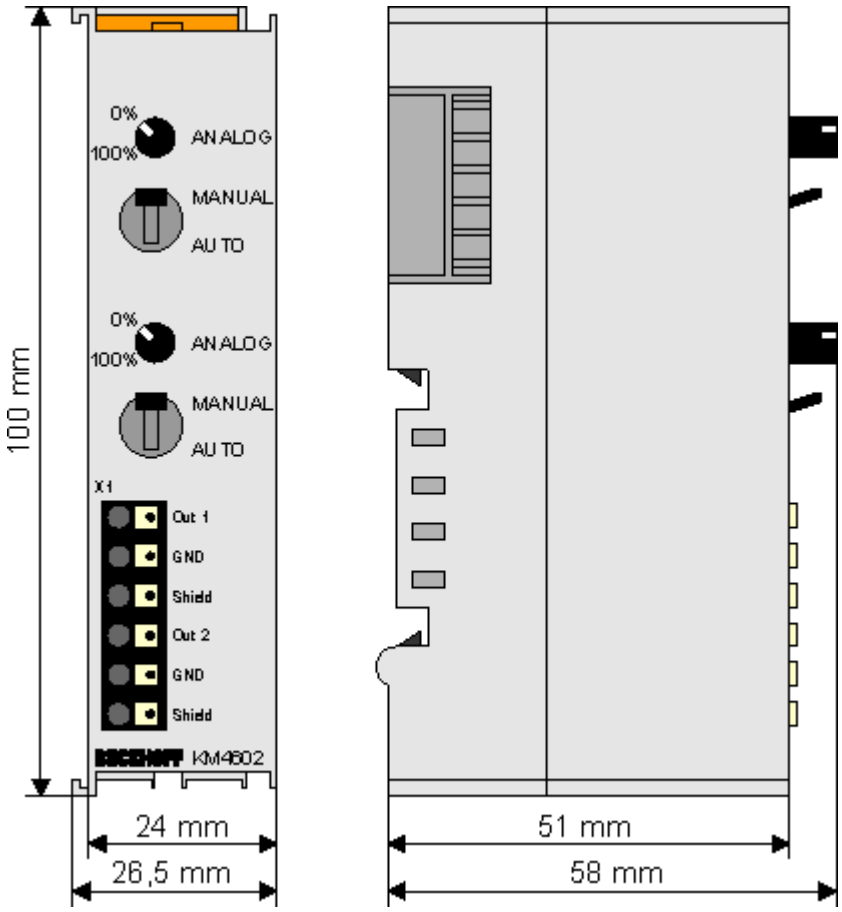


Fig. 3: KM4602 dimensions

3.5 Disposal

Products marked with a crossed-out wheeled bin shall not be discarded with the normal waste stream. The device is considered as waste electrical and electronic equipment. The national regulations for the disposal of waste electrical and electronic equipment must be observed.

3.6 Connection

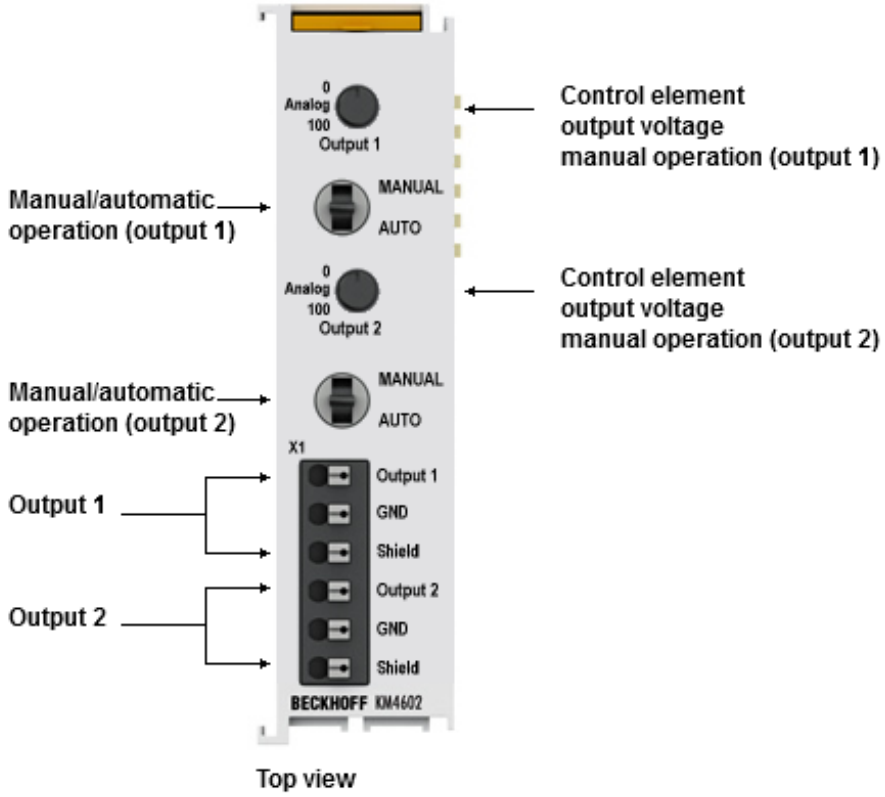


Fig. 4: KM4602 connection

Terminal point	Description
Channel 1	Signal connection for channel 1
Ground	Earth connection for channel 1
Shield	Shield connection for channel 1
Channel 2	Signal connection for channel 2
Ground	Earth connection for channel 3
Shield	Shield connection for channel 2

Internal KM4602 configuration

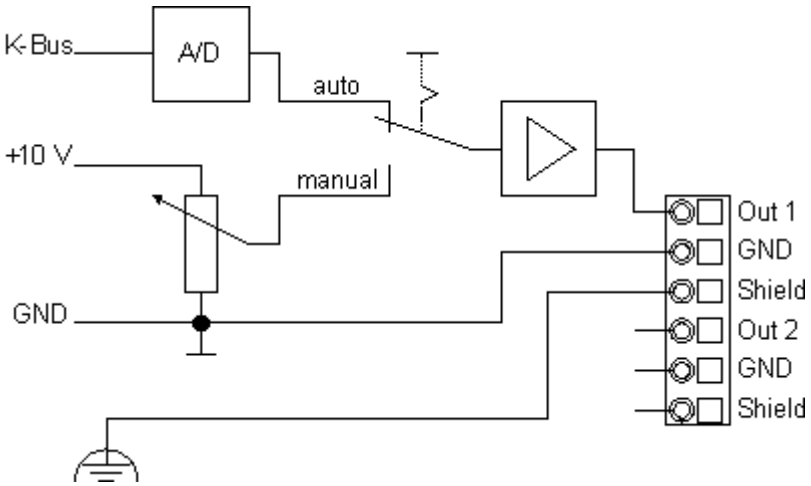


Fig. 5: Internal KM4602 configuration

4 Access from the user program

4.1 Process image

The KM4602 terminal module represents itself in the process image with a maximum of 6 bytes of input data and 6 bytes of output data. These are organized as follows:

Format	Input data	Output data
Byte	SB1 [▶ 17]	CB1 [▶ 17]
Word	DataIN1	DataOUT1
Byte	SB2	CB2
Word	DataIN2	DataOUT2

Key

SB n: Status byte for channel n
CB n: Control byte for channel n

DataIN n: Input data word channel n
DataOUT n: Output data word channel n

- Please refer to the Mapping [▶ 15] page for the allocation of the bytes and words to the addresses of the controller.
- The meaning of the control and status bytes is explained in Control and status bytes [▶ 17].
- In process data mode the analog values are transferred in output data words DataOUT1 and DataOUT4. Input data words DataIN1 and DataIN4 are not used.

Data format

Process data		Output voltage
hexadecimal	decimal	
0x0000	0	0 V
0x3FFF	16383	5 V
0x7FFF	32767	10 V

4.2 Mapping

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

- the fieldbus system used
- the terminal type
- the parameterization of the Bus Coupler (conditions) such as
  - compact or full evaluation.
  - Intel or Motorola format.
  - word alignment switched on or off.

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

The following tables show the mapping depending on different conditions. For information about the contents of the individual bytes please refer to the pages *Process image* and *Control and status byte*.

Compact evaluation

With compact evaluation, the analog output terminals only occupy addresses in the output process image. Control and status bytes cannot be accessed.

Compact evaluation in Intel format

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

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: no Motorola format: no Word alignment: any	0	-	-	Ch1 D1	Ch1 D0
	1	-	-	Ch2 D1	Ch2 D0

Compact evaluation in Motorola format

Default mapping for PROFIBUS and Interbus coupler

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: no Motorola format: yes Word alignment: any	0	-	-	Ch1 D0	Ch1 D1
	1	-	-	Ch2 D0	Ch2 D1

Complete evaluation

For complete evaluation, the analog output terminals occupy addresses in the input and output process image. Control and status bytes can be accessed.

Complete evaluation in Intel format

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: no Word alignment: no	0	Ch1 D0	SB1	Ch1 D0	CB1
	1	SB2	Ch1 D1	CB2	Ch1 D1
	2	Ch2 D1	Ch2 D0	Ch2 D1	Ch2 D0

Complete evaluation in Motorola format

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: yes Word alignment: no	0	Ch1 D1	SB1	Ch1 D1	CB1
	1	SB2	Ch1 D0	CB2	Ch1 D0
	2	Ch2 D0	Ch2 D1	Ch2 D0	Ch2 D1

Complete evaluation in Intel format with word alignment

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

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: no Word alignment: yes	0	reserved	SB1	reserved	CB1
	1	Ch1 D1	Ch1 D0	Ch1 D1	Ch1 D0
	2	reserved	SB2	reserved	CB2
	3	Ch2 D1	Ch2 D0	Ch2 D1	Ch2 D0

Complete evaluation in Motorola format with word alignment

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: yes Word alignment: yes	0	reserved	SB1	reserved	CB1
	1	Ch1 D0	Ch1 D1	Ch1 D0	Ch1 D1
	2	reserved	SB2	reserved	CB2
	3	Ch2 D0	Ch2 D1	Ch2 D0	Ch2 D1

Key

Complete evaluation: In addition to the process data, the control and status bytes are also mapped into the address space.
Motorola format: Motorola or Intel format can be set.
Word alignment: In order for the channel address range to commence at a word boundary, empty bytes are inserted into the process image as appropriate.

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

Ch n D0: channel n, lower-value data byte
Ch n D1: channel n, higher-value data byte

Reserved: This byte occupies process data memory, although it has no function.
"-": This byte is not assigned or used by the terminal/module.

4.3 Control and status byte

Channel 1

Process data mode

Control byte 1 (for process data mode)

Control byte 1 (CB1) is located in the output image, and is transmitted from the controller to the terminal module.

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

Key

Bit	**Name**	**Description**	
CB1.7	RegAccess	0_{bin}	Register communication off (process data mode)
CB1.6 to CB1.1	-	0_{bin}	reserved
...	...	...	...
CB1.0	-	0_{bin}	reserved

Status byte 1 (for process data mode)

Status byte 1 (SB1) is located in the input image and is transmitted from terminal module to the controller.

Bit	SB1.7	SB1.6	SB1.5	SB1.4	SB1.3	SB1.2	SB1.1	SB1.0
Name	RegAccess	-	-	-	-	-	-	OperationMode

Key

Bit	Name	Description	
SB1.6	RegAccess	0_{bin}	Acknowledgement for process data mode
SB1.6	-		reserved
...	...	...	...
SB1.1	-	0_{bin}	reserved
SB1.0	OperationMode	0_{bin}	Manual mode is enabled for this channel.
		1_{bin}	Automatic mode is enabled for this channel.

Register communication

Control byte 1 (in register communication)

Control byte 1 (CB1) is located in the output image, and is transmitted from the controller to the terminal module.

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

Key

Bit	Name	Description	
CB1.7	RegAccess	1_{bin}	Register communication switched on
CB1.6	R/W	0_{bin}	Read access
		1_{bin}	Write access
CB1.5 to CB1.0	Reg. no.	Register number: Enter the number of the register [▶ 19] that you - want to read with input data word DataIn or - want to write with output data word DataOut.	

Status byte 1 (in register communication)

Status byte 1 (SB1) is located in the input image and is transmitted from terminal module to the controller.

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

Key

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

Channel 2

The control and status bytes of channel 2 (CB2 and SB2) have the same structure as the control and status bytes of channel 1 [▶ 17].

4.4 Register overview

The following registers are used for parameterization of the KM4602. Each signal channel of the analog terminal has one register that can be read or written to with the aid of control [▶ 18], status [▶ 18] and data bytes [▶ 15] via register communication.

Register no.	Comment	Default value		R/W	Memory
R0 [▶ 20]	Process data for D/A-C	-	-	R	RAM
R1	reserved	-	-	-	-
...	...	...	...	...	...
R5	reserved	-	-	-	-
R6 [▶ 20]	Diagnostic register (not used)	-	-	R	RAM
R7 [▶ 20]	Command register (not used)	0x0000	0_{dec}	R/W	RAM
R8 [▶ 20]	Terminal type	0x11FA	4602_{dec}	R	ROM
R9 [▶ 20]	Firmware version	e.g. 0x3141	e.g. $1A_{ASCI}$	R	ROM
R10 [▶ 20]	Data length (multiplex shift register)	0x0218	536_{dec}	R	ROM
R11 [▶ 20]	Signal channels	0x0218	536_{dec}	R	ROM
R12 [▶ 20]	Minimum data length	0x9800	38912_{dec}	R	ROM
R13 [▶ 21]	Data structure (data type register)	0x0000	0_{dec}	R	ROM
R14	reserved	-	-	-	-
R15 [▶ 21]	Alignment register	e.g. 0x7F80	e.g. 32640_{dec}	R/W	RAM
R16 [▶ 21]	Hardware version number	e.g. 0x0000	e.g. 0_{dec}	R/W	SEEPROM
R17 [▶ 21]	Hardware compensation: offset (B_a)	0x0001	1_{dec}	R/W	SEEPROM
R18 [▶ 21]	Hardware compensation: gain (A_a)	typ. 0x0E99	typ. 3737_{dec}	R/W	SEEPROM
R19 [▶ 21]	Manufacturer scaling: Offset (B_h)	0x0000	0_{dec}	R/W	SEEPROM
R20 [▶ 21]	Manufacturer scaling: Gain (A_h)	typ. 0x0020	typ. 32_{dec}	R/W	SEEPROM
R21 [▶ 21]	Manufacturer's switch-on value	0x0000	0_{dec}	R/W	SEEPROM
R22	reserved	-	-	-	-
...	...	...	...	...	...
R30	reserved	-	-	-	-
R31 [▶ 22]	Code word register	0x0000	0_{dec}	R/W	RAM
R32 [▶ 22]	Feature register	0x0006	6_{dec}	R/W	SEEPROM
R33 [▶ 22]	User scaling: offset (B_w)	0x0000	0_{dec}	R/W	SEEPROM
R34 [▶ 22]	User scaling: gain (A_w)	0x0100	256_{dec}	R/W	SEEPROM
R35 [▶ 23]	User's switch-on value (Y_2)	0x0000	0_{dec}	R/W	SEEPROM
R36	reserved	-	-	-	-
...	...	...	...	...	...
R63	reserved	-	-	-	-

4.5 Register description

The following registers are used for parameterization of the KM4602. Each signal channel of the analog terminal has one register that can be read or written to with the aid of control [▶ 18], status [▶ 18] and data bytes [▶ 15] via register communication.

R0: Process data for D/A-C

Process data, which are transferred to the D/A converter.

R6: Diagnostic register

The diagnostics register of the KM4602 is currently not used.

R7: Command register

The command register of the KM4602 is currently not used.

R8: Terminal description

The description of the terminal is contained in register R8.
KM4602: 0x11FA (4602_{dec})

R9: Firmware version

Register R9 contains the ASCII coding of the terminal's firmware version, e.g. **0x3141 ($1A_{ASCII}$)**. **'0x31'** corresponds to the ASCII character **'1'** and **'0x41'** to the ASCII character **'A'**. This value cannot be changed.

R10: Data length (multiplex shift register)

R10 contains the number of multiplexed shift registers and their length in bits.

R11: Signal channels

Unlike R10, this contains the number of channels that are logically present. Thus for example a shift register that is physically present can perfectly well consist of several signal channels.

R12: Minimum data length

The particular byte contains the minimum data length for a channel that is to be transferred. If the MSB is set, the control and status byte is not necessarily required for the terminal function and is not transferred to the control, if the Bus Coupler is configured accordingly.

R13: Data structure (data type register)

Data type register	Meaning
0x00	Terminal with no valid data type
0x01	Byte array
0x02	Structure: 1 byte, n bytes
0x03	Word array
0x04	Structure: 1 byte, n words
0x05	Double word array
0x06	Structure: 1 byte, n double words
0x07	Structure: 1 byte, 1 double word
0x08	Structure: 1 byte, 1 double word
0x11	Byte array with variable logical channel length
0x12	Structure: 1 byte, n bytes with variable logical channel length (e.g. 60xx)
0x13	Word array with variable logical channel length
0x14	Structure: 1 byte, n words with variable logical channel length
0x15x	Double word array with variable logical channel length
0x16	Structure: 1 byte, n double words with variable logical channel length

R15: Alignment register

Via the alignment register bits, the Bus Coupler arranges the address range of an analog terminal such that it starts at a byte boundary.

R16: Hardware version number

Register R16 contains the hardware revision level of the terminal; this value cannot be changed.

R17: Hardware compensation - offset (B_a)

This register is used for the offset compensation of the terminal (see equation 1.1). Register value (16 bit signed integer). Default: 0x0001 (1_{dec})

R18: Hardware compensation - gain (A_a)

This register is used for the gain compensation of the terminal (see equation 1.1). Register value (16 bit unsigned integer x 2^{-12}). Default: typically 0x0E99 (3737_{dec})

R19: Manufacturer scaling - offset (B_h)

This register contains the offset for the manufacturer scaling (see equation 1.3). Register value (16 bit signed integer). Default: 0x0000 (0_{dec})
Manufacturer scaling can be activated via bit R32.1 [▶ 22]of the feature register.

R20: Manufacturer scaling - gain (A_h)

This register contains the gain for manufacturer scaling (see equation 1.3). Register value (16 bit unsigned integer x 2^{-8}). Default: typically 0x0020 (32_{dec})
Manufacturer scaling can be activated via bit R32.1 [▶ 22]of the feature register.

R21: Manufacturer's switch-on value

The terminal applies the manufacturer switch-on value to its output after a system reset or a watchdog timer overflow (terminal has received no process data for 100 ms). Register value (16 bit signed integer).

R31: Code word register

- If you write values into the user registers without first entering the user code word (0x1235) into the code word register, the terminal will not accept the supplied data.
- If you write values into the user registers and have previously entered the user code word (0x1235) in the code word register, these values are stored in the RAM registers and in the SEEPROM registers and are therefore retained if the terminal is restarted.

The code word is reset with each restart of the terminal.

R32: Feature register

The feature register specifies the terminal's configuration. Default: 0x0006 (6_{dec})

Bit	R32.15	R32.14	R32.13	R32.12	R32.11	R32.10	R32.9	R32.8
Name	-	-	-	-	-	-	-	enUserActValue

Bit	R32.7	R32.6	R32.5	R32.4	R32.3	R32.2	R32.1	R32.0
Name	-	-	enSignRepr	-	enSignAmRepr	enWdTimer	enManScal	enUsrScal

Key

Bit	Name	Description		default
R32.15	-	reserved		0_{bin}
...	...	...		...
R32.9	-	reserved		0_{bin}
R32.8	enUserActValue	0_{bin}	Manufacturer switch-on value active	0_{bin}
		1_{bin}	User switch-on value active	
R32.7	-	reserved		0_{bin}
R32.6	-	reserved		0_{bin}
R32.5	enSignRepr	0_{bin}	Absolute value calculation not active	0_{bin}
		1_{bin}	Absolute value calculation active	
R32.4	-	reserved		0_{bin}
R32.3	enSignAmRepr	0_{bin}	Two's complement representation is active	0_{bin}
		1_{bin}	The arithmetic sign of numerical quantities is active (-1_{dec} = 0x8001)	
R32.2	enWdTimer	0_{bin}	Watchdog timer is not active	1_{bin}
		1_{bin}	Watchdog timer is active (the watchdog is triggered if no process data are received for 100 ms)	
R32.1	enManScal	0_{bin}	Manufacturer scaling is active	1_{bin}
		1_{bin}	Manufacturer scaling is not active	
R32.0	enUsrScal	0_{bin}	User scaling is not active	0_{bin}
		1_{bin}	User scaling is active	

R33: User scaling - offset (B_w)

This register contains the offset of the user scaling.
User scaling can be activated in the feature register via bit R32.0 [▶ 22].

R34: User scaling - gain (A_w)

This register contains the gain of the user scaling. Default: 0x0100 (256_{dec})
User scaling can be activated in the feature register via bit R32.0 [▶ 22].

R35: User's switch-on value

If the user switch-on value has been activated with bit R32.8 [▶ 22] of the feature register, the terminal sets its output to the user switch-on value in place of the manufacturer switch-on value on the occurrence of a system reset or a watchdog timer overflow (terminal has not received any process data for 100 ms).

4.6 Examples of Register Communication

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

4.6.1 Example 1: Reading the firmware version from register 9

Output Data

Byte 0: Control byte	Byte 1: DataOUT1, high byte	Byte 2: DataOUT1, low byte
0x89 (1000 1001_{bin})	0xXX	0xXX

Explanation:

- Bit 0.7 set means: Register communication switched on.
- Bit 0.6 not set means: reading the register.
- Bits 0.5 to 0.0 specify the register number 9 with 00 1001_{bin}.
- The output data word (byte 1 and byte 2) has no meaning during read access. To change a register, write the required value into the output word.

Input Data (answer of the Bus Terminal)

Byte 0: Status byte	Byte 1: DataIN1, high byte	Byte 2: DataIN1, low byte
0x89	0x33	0x41

Explanation:

- The terminal returns the value of the control byte as a receipt in the status byte.
- The terminal returns the firmware version 0x3341 in the input data word (byte 1 and byte 2). This is to be interpreted as an ASCII code:
  - ASCII code 0x33 represents the digit 3
  - ASCII code 0x41 represents the letter A
    The firmware version is thus 3A.

4.6.2 Example 2: Writing to an user register

Code word

In normal mode all user registers are read-only with the exception of Register 31. In order to deactivate this write protection you must write the code word (0x1235) into Register 31. If a value other than 0x1235 is written into Register 31, write protection is reactivated. Please note that changes to a register only become effective after restarting the terminal (power-off/power-on).

I. Write the code word (0x1235) into register 31.

Output Data

Byte 0: Control byte	Byte 1: DataOUT1, high byte	Byte 2: DataOUT1, low byte
0xDF (1101 1111_{bin})	0x12	0x35

Explanation:

- Bit 0.7 set means: Register communication switched on.
- Bit 0.6 set means: writing to the register.
- Bits 0.5 to 0.0 specify the register number 31 with 01 1111_{bin}.
- The output data word (byte 1 and byte 2) contains the code word (0x1235) for deactivating write protection.

Input Data (answer of the Bus Terminal)

Byte 0: Status byte	Byte 1: DataIN1, high byte	Byte 2: DataIN1, low byte
0x9F (1001 1111_{bin})	0xXX	0xXX

Explanation:

- The terminal returns a value as a receipt in the status byte that differs only in bit 0.6 from the value of the control byte.
- The input data word (byte 1 and byte 2) is of no importance after the write access. Any values still displayed are invalid!

II. Read Register 31 (check the set code word)

Output Data

Byte 0: Control byte	Byte 1: DataOUT1, high byte	Byte 2: DataOUT1, low byte
0x9F (1001 1111_{bin})	0xXX	0xXX

Explanation:

- Bit 0.7 set means: Register communication switched on.
- Bit 0.6 not set means: reading the register.
- Bits 0.5 to 0.0 specify the register number 31 with 01 1111_{bin}.
- The output data word (byte 1 and byte 2) has no meaning during read access.

Input Data (answer of the Bus Terminal)

Byte 0: Status byte	Byte 1: DataIN1, high byte	Byte 2: DataIN1, low byte
0x9F (1001 1111_{bin})	0x12	0x35

Explanation:

- The terminal returns the value of the control byte as a receipt in the status byte.
- The terminal returns the current value of the code word register in the input data word (byte 1 and byte 2).

III. Write to Register 32 (change contents of the feature register)

Output data

Byte 0: Control byte	Byte 1: DataIN1, high byte	Byte 2: DataIN1, low byte
0xE0 (1110 0000_{bin})	0x00	0x02

Explanation:

- Bit 0.7 set means: Register communication switched on.
- Bit 0.6 set means: writing to the register.
- Bits 0.5 to 0.0 indicate register number 32 with 10 0000_{bin}.
- The output data word (byte 1 and byte 2) contains the new value for the feature register.

⚠ CAUTION

Observe the register description!

The value of 0x0002 given here is just an example!
The bits of the feature register change the properties of the terminal and have a different meaning, depending on the type of terminal. Refer to the description of the feature register of your terminal (chapter *Register description*) regarding the meaning of the individual bits before changing the values.

Input data (response from the Bus Terminal)

Byte 0: Status byte	Byte 1: DataIN1, high byte	Byte 2: DataIN1, low byte
0xA0 (1010 0000_{bin})	0xXX	0xXX

Explanation:

- The terminal returns a value as a receipt in the status byte that differs only in bit 0.6 from the value of the control byte.
- The input data word (byte 1 and byte 2) is of no importance after the write access. Any values still displayed are invalid!

IV. Read register 32 (check changed feature register)

Output Data

Byte 0: Control byte	Byte 1: DataOUT1, high byte	Byte 2: DataOUT1, low byte
0xA0 (1010 0000_{bin})	0xXX	0xXX

Explanation:

- Bit 0.7 set means: Register communication switched on.
- Bit 0.6 not set means: reading the register.
- Bits 0.5 to 0.0 indicate register number 32 with 10 0000_{bin}.
- The output data word (byte 1 and byte 2) has no meaning during read access.

Input Data (answer of the Bus Terminal)

Byte 0: Status byte	Byte 1: DataIN1, high byte	Byte 2: DataIN1, low byte
0xA0 (1010 0000_{bin})	0x00	0x02

Explanation:

- The terminal returns the value of the control byte as a receipt in the status byte.
- The terminal returns the current value of the feature register in the input data word (byte 1 and byte 2).

V. Write register 31 (reset code word)

Output Data

Byte 0: Control byte	Byte 1: DataOUT1, high byte	Byte 2: DataOUT1, low byte
0xDF (1101 1111_{bin})	0x00	0x00

Explanation:

- Bit 0.7 set means: Register communication switched on.
- Bit 0.6 set means: writing to the register.
- Bits 0.5 to 0.0 specify the register number 31 with 01 1111_{bin}.
- The output data word (byte 1 and byte 2) contains 0x0000 for reactivating write protection.

Input Data (answer of the Bus Terminal)

Byte 0: Status byte	Byte 1: DataIN1, high byte	Byte 2: DataIN1, low byte
0x9F (1001 1111_{bin})	0xXX	0xXX

Explanation:

- The terminal returns a value as a receipt in the status byte that differs only in bit 0.6 from the value of the control byte.
- The input data word (byte 1 and byte 2) is of no importance after the write access. Any values still displayed are invalid!

5 Appendix

5.1 Support and Service

Beckhoff and their partners around the world offer comprehensive support and service, making available fast and competent assistance with all questions related to Beckhoff products and system solutions.

Beckhoff's branch offices and representatives

Please contact your Beckhoff branch office or representative for local support and service on Beckhoff products!

The addresses of Beckhoff's branch offices and representatives round the world can be found on her internet pages: www.beckhoff.com

You will also find further documentation for Beckhoff components there.

Beckhoff Support

Support offers you comprehensive technical assistance, helping you not only with the application of individual Beckhoff products, but also with other, wide-ranging services:

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

Hotline:	+49 5246 963 157
e-mail:	support@beckhoff.com

Beckhoff Service

The Beckhoff Service Center supports you in all matters of after-sales service:

- on-site service
- repair service
- spare parts service
- hotline service

Hotline:	+49 5246 963 460
e-mail:	service@beckhoff.com

Beckhoff Headquarters

Beckhoff Automation GmbH & Co. KG

Huelshorstweg 20
33415 Verl
Germany

Phone:	+49 5246 963 0
e-mail:	info@beckhoff.com
web:	www.beckhoff.com

Table of figures

More Information:
www.beckhoff.de/KM4602

Beckhoff Automation GmbH & Co. KG
Hülshorstweg 20
33415 Verl
Germany
Phone: +49 5246 9630
info@beckhoff.com
www.beckhoff.com