

Control electronics

VTD-60.XX-K5C-S

Translation of the original operating instructions
(ENU)

ebmpapst

the engineer's choice



VTD-60.05-K5C-S



VTD-60.35-K5C-S



VTD-60.13-K5C-S



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Disclaimer

Contents of operating instructions

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Version	Date	Description of change
1.1	21.02.2023	VTD-60.05-K5C-S control electronics added, designations changed: VTD-60.13-K5SB in VTD-60.13-K5C-S , VTD-60.35-K5SB in VTD-60.35-K5C-S , general adaptations

Responsibility for documentation

ebm-papst St. Georgen
GmbH & Co. KG
Hermann-Papst-Strasse 1
78112 St. Georgen

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GmbH & Co. KG
Hermann-Papst-Strasse 1
78112 St. Georgen

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Availability of operating instructions

The operating instructions must be available to the user at all times, to ensure the device is used safely. They must be kept at an easily accessible location at the place of installation, where they can be viewed at all times.

Application

When using the control electronics, it is essential that the safety regulations and the relevant operating instructions in connection with drives or similar are observed. Read these operating instructions carefully before you start working with the control electronics. Observe the hazard and warning notices to avoid the risk of injury or malfunctioning.

These operating instructions are to be viewed as part of the control electronics. The control electronics are only to be sold or passed on together with the operating instructions. Safety regulations and installation instructions may be duplicated and distributed to inform about potential dangers and their prevention. ebm-papst is always looking to advance and enhance its products. As a result, products may differ from these operating instructions. The user must check this before use and take into account any deviations.

Subject to change.

You can find the respective current version of these operating instructions on our homepage: www.ebmpapst.com

1 Introduction

1.1 Foreword

These operating instructions outline the application possibilities, installation, operation, and programming of the control electronics specified on the title page.

When installing and operating the control electronics, all of the safety information listed in Chapter 2 must be adhered to. Abroad, the corresponding laws, guidelines, and regulations of the relevant country also apply.

Read these operating instructions carefully before you start working with the control electronics. Observe the following warning notices in order to avoid risk of injury or malfunction of the control electronics.

1.2 Target group

These operating instructions are only intended for qualified and trained specialist personnel with knowledge of electronics and mechanics.

1.3 Written styles in this document

In these operating instructions, the meaning of certain sections is indicated through various means.

Descriptive text is shown without a preceding symbol.

- Text preceded by a dot (•) indicates a list introduced by a heading.

Underlined blue text indicates a hyperlink, which can be clicked on in the PDF document. The relevant website is then called up.

Underlined green text indicates a non-interactive cross reference, which refers to the relevant chapter of the help file in the "epTools" software.

1.4 Warning notices and notices

Warning notices and notices are always shown before an instruction where carrying out the action could result in a hazard or material damage.

In this documentation, the following **warning notices** are used:



DANGER

Hazard

This notice indicates a hazard with a high level of risk that will directly result in death or severe bodily injury if it is not avoided.

→ This arrow highlights a corresponding precautionary measure in order to prevent the hazard.



WARNING

Hazard

This notice indicates a hazard with a moderate level of risk that may possibly result in death or severe bodily injury if it is not avoided.

→ This arrow highlights a corresponding precautionary measure in order to prevent the hazard.



CAUTION

Hazard

This notice indicates a hazard with a low level of risk that may result in light or moderate bodily injury and material damage if it is not avoided.

→ This arrow highlights a corresponding precautionary measure in order to prevent the hazard.

Notices contain information that is particularly important at the relevant point or make the operating steps described easier. They are emphasized as follows:



NOTE

This notice provides you with recommendations for use and helpful tips.

Safety information

2 Safety information

The VTD-60.XX-K5C-S control electronics have been developed based on state-of-the-art electronics and electrical engineering, as well as recognized guidelines for the safety and protection of users. See also Chapter "2.4 Standards and directives".

The control electronics may only be operated and serviced by authorized specialist personnel who have fully read and understood these operating instructions. These control electronics must be used with due care and in compliance with the safety information outlined in these operating instructions and the country-specific applicable regulations.

2.1 General safety information

Always observe the following safety instructions, regardless of the specific operating conditions:

- Before you start working with the control electronics, switch them off and secure them from switching themselves on again.
- Before opening the control electronics or entering the danger zone, ensure all drives are safely brought to a standstill and are secured against switching on again.
- Do not modify or convert the control electronics, or fit any attachments to them, without approval from ebm-papst.
- Commissioning may only take place following full verification of compliance with all relevant legal requirements, guidelines and application-related safety regulations (e.g. accident prevention regulations).
- The safety hazards associated with the control electronics must be reassessed following installation in the end application.
- Keep the workplace clean and tidy. Untidiness in the work area increases the risk of accidents.

2.2 Documentation

When using the control electronics in connection with drives or similar, the relevant operating instructions must also be observed.

In addition to these operating instructions, "epTools" PC software is required for configuring and parameterizing the control electronics. Operation is described in the help file in the "epTools" software.

You can find the respective current version of these operating instructions and the "epTools" software on our homepage: <https://www.ebmpapst.com/software>.

2.3 Mechanical safety

- Only carry out work when the system/machine is at a standstill.
- Ensure the control electronics have cooled sufficiently.
- Only ever remove the protective devices for repair and assembly work.

2.4 Standards and directives

The control electronics fall under the Machinery Directive, as they concern "partly completed machinery" according to Article 2, Section g, Machinery Directive 2006/42/EC. Applying a CE marking to the nameplate is prohibited. The declaration of incorporation according to Annex II, Part 1, Section B, Machinery Directive, 2006/42/EC has been issued.

2.5 Personnel qualifications

The following qualification requirements are specified in these operating instructions:

- **Qualified electricians:** persons who, due to their specialist training and skills, are able to carry out work on electrical systems and independently identify hazards. A qualified electrician must observe the applicable regulations in their country for installing electrical equipment (e.g. DGUV (German Social Accident Insurance) in Germany).
- **Authorized specialist personnel:** persons who have been trained by the operator about the potential hazards when carrying out their assigned tasks and activities.

Required skills and knowledge by field of work	
Tasks and activities	Required skills and knowledge
Installation	<ul style="list-style-type: none"> • Practical electrical training • Knowledge of the current electrical safety regulations • Knowledge of the relevant electrical safety regulations at the workplace
Configuration	<ul style="list-style-type: none"> • Basic knowledge of the structure and set-up of the described connections and interfaces • Basic knowledge of data transfer
Servicing	<ul style="list-style-type: none"> • Practical technical training • Knowledge of the relevant electrical safety regulations at the workplace

- Only qualified electricians are allowed to install the control electronics, carry out the trial run and perform work on the electrical system.
- Only authorized specialist personnel are allowed to transport, unpack, operate and service the control electronics.

2.6 Safety of persons

- Provide sufficient protection against accidental contact (e.g. cover electrical contacts).
- Do not wear loose clothing or jewelry.
- Keep hair, clothing, and gloves well away from rotating components.
- Use personal protective equipment (e.g. hearing protection, thermal gloves).

2.7 Electric/electromagnetic safety

Electrical charge possible on the control electronics (even when switched off)

Electric shock



DANGER

- Make sure there is no possibility of contact with the control electronics when installed.
- Before working on control electronics that may be electrically charged, make sure that no charge is present any more. Use a two-pole voltage tester.
- Wait five minutes after disconnecting the voltage at all poles before opening the control electronics.

- Depending on the environmental conditions, regularly check the control electronics and connected cables for damage.
- Only use cables and plug connections approved by ebm-papst.
- Immediately replace defective cables and loose connections.
- Ensure EMC capability in the end device/installation state, e.g. with shielding.
- Provide suitable measures for avoiding impermissible electromagnetic interference emissions, such as shielding.
- Use open-loop and closed-loop control devices for influencing the electromagnetic radiation.

Safety information

2.8 Intended use

These control electronics are an installation product. It is intended solely for industrial use in devices and machines and does not have any independent function. The control electronics are not intended to be passed on to end customers. The end manufacturer must ensure all of the motor and electronics combinations are qualified for their intended application and are validated as having overload and locking protection. The end manufacturer is responsible for the end product and must take adequate safety measures. Customer equipment must be capable of withstanding the mechanical and thermal stresses that can arise from these control electronics. This applies for the entire service life of the equipment in which these control electronics are installed. Any other usage above and beyond this does not conform with the intended purpose and constitutes misuse of the control electronics.

Compliance with the intended use also demands:

- Observing the operating instructions.
- Using the control electronics according to the permissible ambient temperatures and nominal data (see Chapter “4 Technical data” on page 16).
- Only using the control electronics in stationary systems.
- Starting up the control electronics only after installation in the customer equipment.
- Operating the control electronics with all protective devices.
- Performing all maintenance work.

2.9 Improper use

In particular, using the control electronics in the following ways is prohibited and could lead be hazardous:

- Operation of the control electronics in technical systems for which there are special requirements with regard to safeguarding against failure.
- Operation of the control electronics in aircraft or spacecraft.
- Operation of the control electronics in residential environments.
- Operation of the control electronics in railway vehicles, motor vehicles, and ships.
- Operation of the control electronics in potentially explosive atmospheres (explosion protection area).
- Operation in medical equipment with a life-sustaining or life-support function.
- Use as a safety component or to perform safety-related functions.
- Operating the device with protective devices that have been tampered with or completely or partially disassembled.
- Operation with extreme vibrations.
- Painting of the control electronics.
- Unfastening of connections (e.g. screws) during operation.
- All other applications not listed as intended uses.



DANGER

Risk of injury

Potential dangers in the event of non-compliance include personal injury and property damage due to reduced service life or explosions caused by elevated surface temperature or sparking.

2.10 Conversions and modifications

Only operate the control electronics in their original and faultless condition. Retrofitting, modifying, and converting the control electronics is strictly prohibited. Any modifications you wish to make must always be agreed with ebm-papst first.

ebm-papst is not liable for any conversions and modifications carried out which have not been expressly approved by us. This also includes any damage resulting from the use of non-original parts or through operating the device outside of the agreed parameters.

2.11 Transport and storage

- Transport and store the control electronics in their original packaging only.
- Store the control electronics so that they are protected from environmental influences and dirt until final installation.
- We recommend storing the control electronics for no longer than one year in order to guarantee trouble-free operation and the longest possible service life.
- If the device is stored for an extended period, it must be connected and started at least every two years.
- Comply with the ambient temperatures specified in Chapter "4 Technical data" on page 16.

2.12 What to do in the event of malfunctions and irregularities

The device may only be used in perfect condition. If you notice irregularities, malfunctions, or damage, shut down the device immediately and inform your manager (if there is one).

The user/owner of the control electronics and associated accessories should address all complaints about the product to one of ebm-papst's representatives or directly to:

ebm-papst St. Georgen
GmbH & Co. KG
Hermann-Papst-Strasse 1
78112 St. Georgen

Description

3 Description

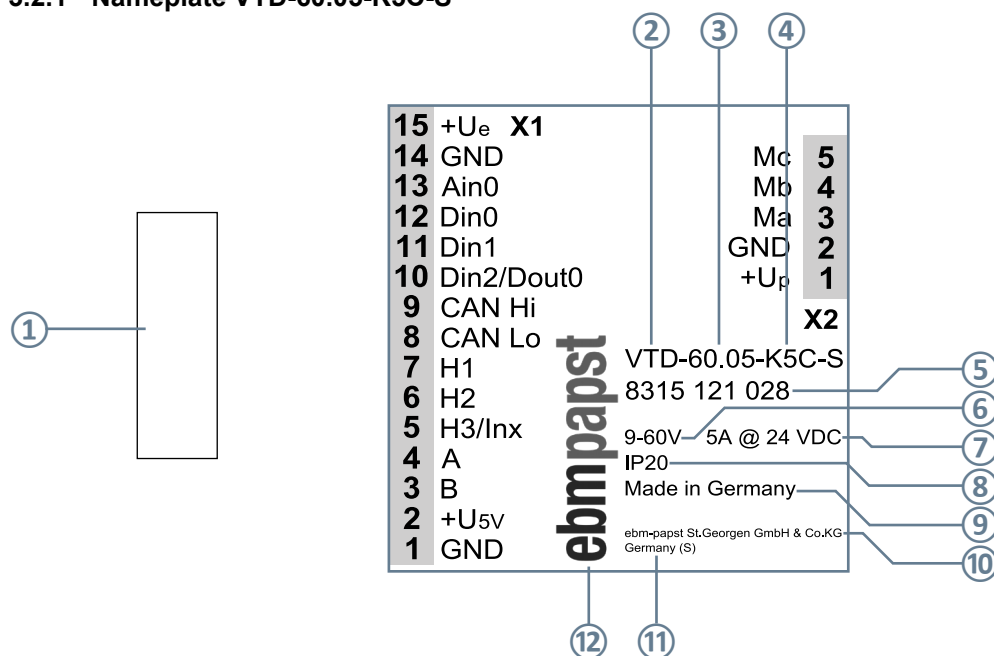
3.1 Description of VTD-60.XX-K5C-S

The VTD-60.XX-K5C-S external control electronics are a compact 4-quadrant controller for operating BLDC motors. The control electronics are designed for nominal voltages of 24 V DC and 48 V DC, as well as peak currents of up to 50 A/100 A. It offers speed, torque, and positioning mode and has integrated digital inputs and outputs as well as analog inputs. An integrated MPU enables the control electronics to be freely programmed, making them ideal for use in intralogistics applications such as crossbelt sorters, warehouse shuttles, and driverless transport systems, as well as other applications in the field of automation. Selecting the operating modes and parameterizing the speed, torque, and position is carried out via the parameterization interface CANopen. The control electronics have integrated overvoltage, undervoltage, and overtemperature monitoring. The status of the control electronics is indicated by three LEDs.

3.2 Nameplate

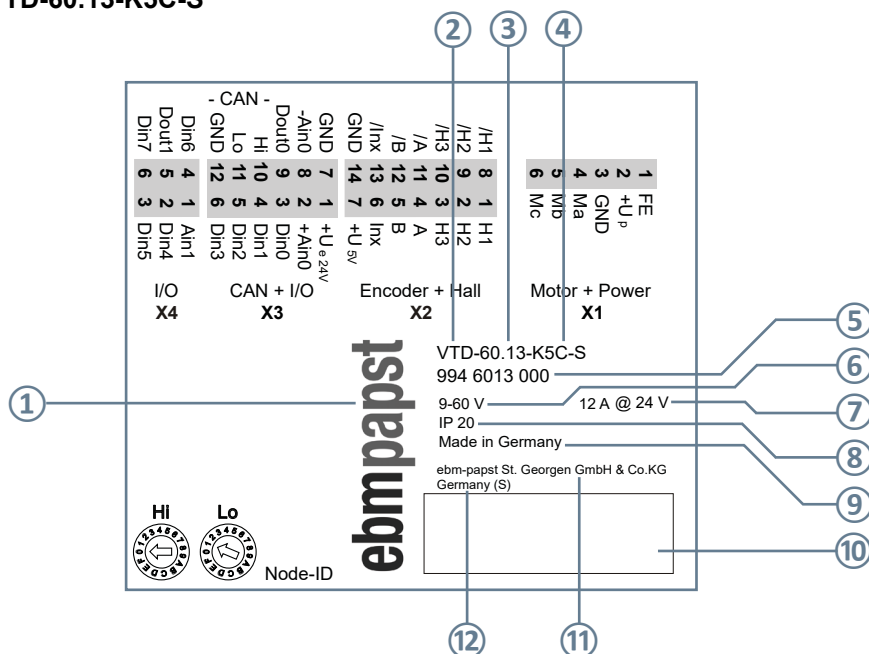
The nameplate with the relevant control electronics characteristics is applied to the exterior of the housing.

3.2.1 Nameplate VTD-60.05-K5C-S



VTD-60.05-K5C-S nameplate legend			
Item	Designation	Item	Designation
①	Serial number (on side of housing)	⑦	Nominal current
②	Control electronics type: VTD = Variotronik	⑧	Protection class
③	Type description: 60 = 60 V DC (max. permissible power supply) 05 = 5 A (permissible continuous current at 24 V DC)	⑨	Country of manufacture
④	K5 = position controller with BUS interface C = CANopen S = plug connection	⑩	Production site
⑤	Item number	⑪	Country code
⑥	Nominal voltage	⑫	Company logo

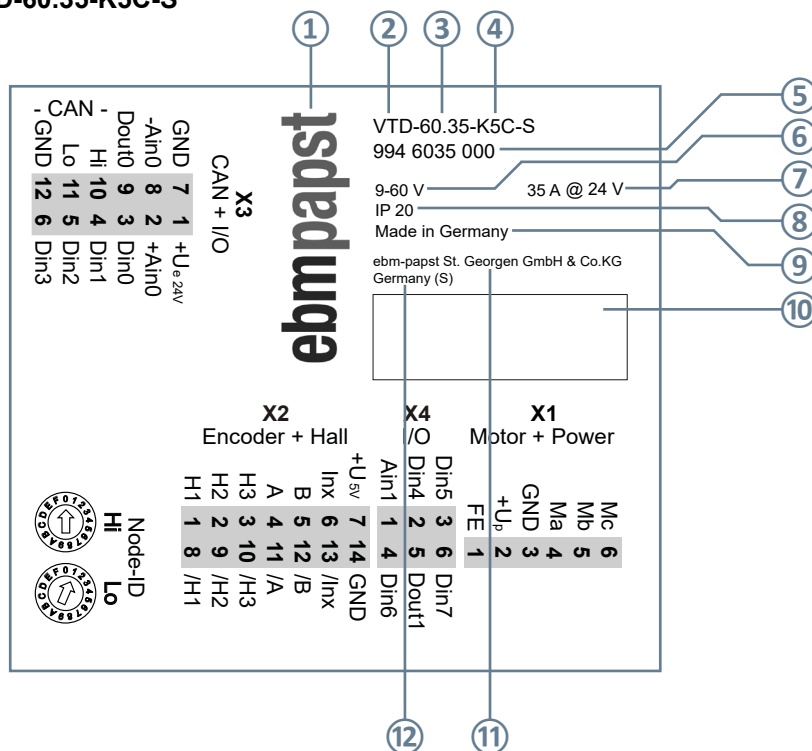
3.2.2 Nameplate VTD-60.13-K5C-S



VTD-60.13-K5C-S nameplate legend			
Item	Designation	Item	Designation
①	Company logo	⑦	Nominal current
②	Control electronics type: VTD = Variotronic	⑧	Protection class
③	Type description: 60 = 60 V DC (max. permissible power supply) 13 = 13 A (12.5 A rounded, permissible continuous current at 24 V DC)	⑨	Country of manufacture
④	K5 = position controller with BUS interface C = CANopen S = plug connection	⑩	Serial number
⑤	Item number	⑪	Production site
⑥	Nominal voltage	⑫	Country code

Description

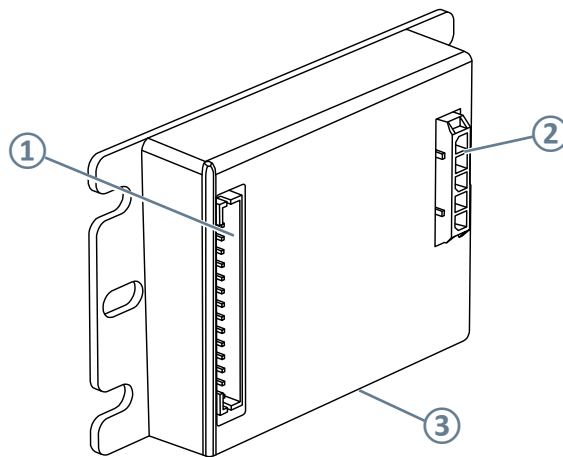
3.2.3 Nameplate VTD-60.35-K5C-S



VTD-60.35-K5C-S nameplate legend			
Item	Designation	Item	Designation
①	Company logo	⑦	Nominal current
②	Control electronics type: VTD = Variotronic	⑧	Protection class
③	Type description: 60 = 60 V DC (max. permissible power supply) 30 = 30 A (permissible continuous current at 24 V DC)	⑨	Country of manufacture
④	K5 = position controller with BUS interface C = CANopen S = plug connection	⑩	Serial number
⑤	Item number	⑪	Production site
⑥	Nominal voltage	⑫	Country code

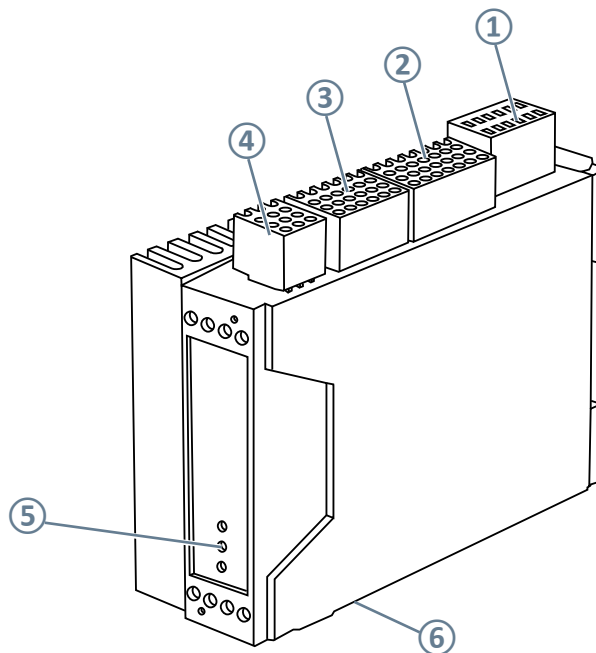
3.3 Device view

3.3.1 VTD-60.05-K5C-S



VTD-60.13-K5C-S device view legend			
Item	Designation	Item	Designation
①	Interface X1	③	Status LED
②	Interface X2		

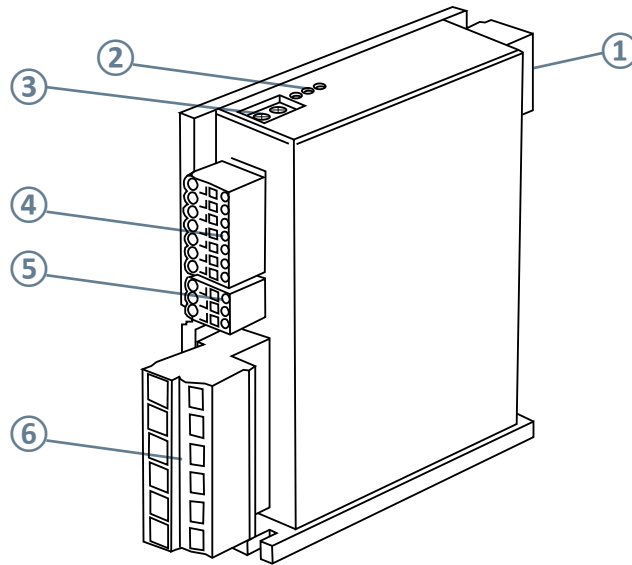
3.3.2 VTD-60.13-K5C-S



VTD-60.13-K5C-S device view legend			
Item	Designation	Item	Designation
①	Interface X1	④	Interface X4
②	Interface X2	⑤	Status LED
③	Interface X3	⑥	HEX switch

Description

3.3.3 VTD-60.35-K5C-S



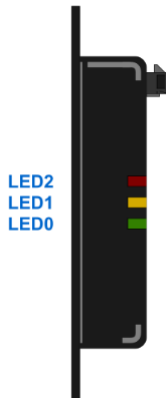
VTD-60.35-K5C-S device view legend

Item	Designation	Item	Designation
①	Interface X3	④	Interface X2
②	Status LED	⑤	Interface X4
③	HEX switch	⑥	Interface X1

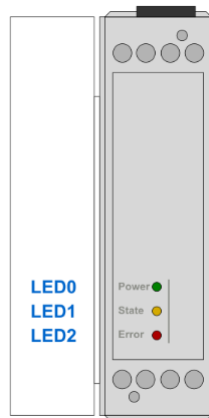
3.4 Status LED

The control electronics have three LEDs displaying the device status.

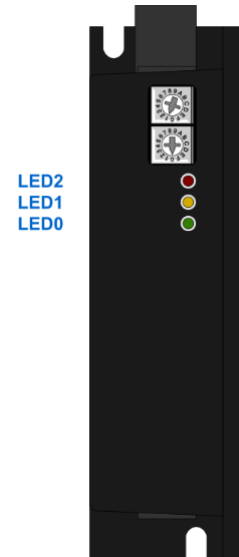
VTD-60.05-K5C-S



VTD-60.13-K5C-S



VTD-60.35-K5C-S



Status LED legend			
LED	Color	State	Description
● LED0 "Power"	Green	Lit up	Normal operation
		Not lit up	No power supply
		Flashing	Bootloader mode (no firmware)
● LED1 "State"	Yellow	Lit up	CANopen Pre-Operational state (PDOs not active)
		Not lit up	CANopen Operational state (PDOs active)
		Flashing	Bootloader mode (flashes in the event of incoming message)
● LED2 "Error"	Red	Lit up	General error
		Not lit up	No error (normal operation)
		Flashing	Number of pulses 1: Short circuit
			Number of pulses 2: No supply voltage
			Number of pulses 3: Overtemperature
Number of pulses 4: Communication error			

4 Technical data

4.1 Power

Characteristic	Unit	VTD-60.05-K5C-S	VTD-60.13-K5C-S	VTD-60.35-K5C-S
Nominal voltage (logic supply U_L)	V DC	9 to 30	9 to 30	9 to 30
Perm. supply voltage range (U)	V DC	9 to 60	9 to 60	9 to 60
Maximum output current	A	15	50	100
Permissible continuous output current ¹⁾	A	5 (at 24 V)	12.5 (at 24 V)	35 (at 24 V)
		4.3 (at 60 V)		26 (at 48 V)
Switching frequency ³⁾	kHz	32	32	32
Nominal voltage (power supply U_N)	V DC	24 60	24 48	24 48
Logic current draw (at 24 V DC) ²⁾	mA	40	60	70
Maximum commutation frequency (per track)	kHz	10	10	10
Minimum terminal inductance	mH	0.2	0.2	0.2
Parametrization interface	-	CANopen	CANopen	CANopen
Efficiency (in the optimum operating range)	%	95	95	95
Approval	-	UL (certificate available on request)	-	-
Material no.	-	8315 121 028	994 6013 000	994 6035 000

Commutation: block-shaped commutation (using 3 digital Hall sensors)

¹⁾ connecting cable with maximum possible cable cross-section, PWM frequency 32 kHz (asymmetric), ambient temperature 40°C, I/Os and 5 V output, effective current: 5 A
-> 4.1 Aeff, 4.3 A -> 3.5 Aeff

²⁾ output stage off, 5 V output (encoder supply) is unloaded

³⁾ Standard value, other values can be set

4.2 Motor types

Characteristic	VTD-60.05-K5C-S	VTD-60.13-K5C-S	VTD-60.35-K5C-S
Brushed motors	•	•	•
Brushless motors	•	•	•
Linear motors	•	•	•
Stepper motors	-	-	-

4.3 Mechanical data

Characteristic	Unit	VTD-60.05-K5C-S	VTD-60.13-K5C-S	VTD-60.35-K5C-S
Dimensions LxWxH	mm	74 x 45.5 x 14	110 x 40 x 77	111 x 100 x 30
Weight	g	30	310	380
Assembly	-	Wall	DIN rail/wall	Wall
Connector	-	Crimping technology	Spring/screw terminals	

4.4 Environment

Characteristic	Unit	VTD-60.05-K5C-S	VTD-60.13-K5C-S	VTD-60.35-K5C-S
Permissible ambient temperature range (T_U)	°C	-25 to +70	-40 to +70 ²⁾	-40 to +70 ²⁾
Permissible ambient temperature range (storage)	°C	-25 to +85	-40 to +85	-40 to +85
Permissible ambient humidity ¹⁾	%	5 to 90	5 to 90	5 to 90
Degree of protection	-	IP20	IP20	IP20

¹⁾ Condensation not permissible

²⁾ Hex switches should not be used for $T < -25^\circ\text{C}$ (Node ID can be set using firmware parameters)

4.5 Controller cycle times

Characteristic	Unit	VTD-60.05-K5C-S	VTD-60.13-K5C-S	VTD-60.35-K5C-S
Current regulator (CURR)	µs	125	125	125
Speed controller (SVEL)	µs	250	250	250
Speed controller (VEL)	µs	2000 ¹⁾	2000 ¹⁾	2000 ¹⁾
Position controller (POS)	µs	2000 ¹⁾	2000 ¹⁾	2000 ¹⁾

¹⁾ Standard value, other values can be set

4.6 CAN bus

Characteristic	Unit	VTD-60.05-K5C-S	VTD-60.13-K5C-S	VTD-60.35-K5C-S
Protocol	-	DS301	DS301	DS301
Device profile	-	DS402	DS402	DS402
Max. baud rate	Mbit/s	1	1	1
CAN specification	-	2.0B	2.0B	2.0B
Electrically isolated	-	No	No	Yes

4.7 Encoder supply (rotary encoder/Hall)

Characteristic	Unit	VTD-60.05-K5C-S	VTD-60.13-K5C-S	VTD-60.35-K5C-S
Output voltage	V	5	5	5
Maximum output current	A	0.2	0.2	0.2

4.8 Rotary encoder

Characteristic	Unit	VTD-60.05-K5C-S	VTD-60.13-K5C-S	VTD-60.35-K5C-S
Type	-	Incremental	Incremental	Incremental
Signals	-	A, B, Inx	A, /A, B, /B, Inx, /Inx	
Max. frequency per track	kHz	100	500	500
Input signal (24 V tolerant)	V	0 to 5	0 to 5	0 to 5
Signal type	-	open collector, single ended	Differential, open collector, single ended	

4.9 Hall sensors

Characteristic	Unit	VTD-60.05-K5C-S	VTD-60.13-K5C-S	VTD-60.35-K5C-S
Signals	-	H1, H2, H3	H1, /H1, H2, /H2, H3, /H3	
Max. frequency per track	kHz	10	10	10
Input signal (24 V tolerant)	V	0 to 5	0 to 5	0 to 5
Signal type	=	open collector, single ended	Differential, open collector, single ended	

4.10 Digital inputs

Characteristic	Unit	VTD-60.05-K5C-S	VTD-60.13-K5C-S	VTD-60.35-K5C-S
Number	-	+/-30V tolerant: 2 (Din0..1) 0-30V tolerant: 1 (Din2)	8 (Din 0 to 7)	8 (Din 0 to 7)
Low level	V	0 to 5	0 to 5	0 to 5
High level	V	8 to 30	8 to 30	8 to 30
Note	-	Din2 parallel to Dout0 ¹⁾	-	-

¹⁾ Input voltage must not exceed the supply voltage of the electronics (U_e)

4.11 Digital outputs

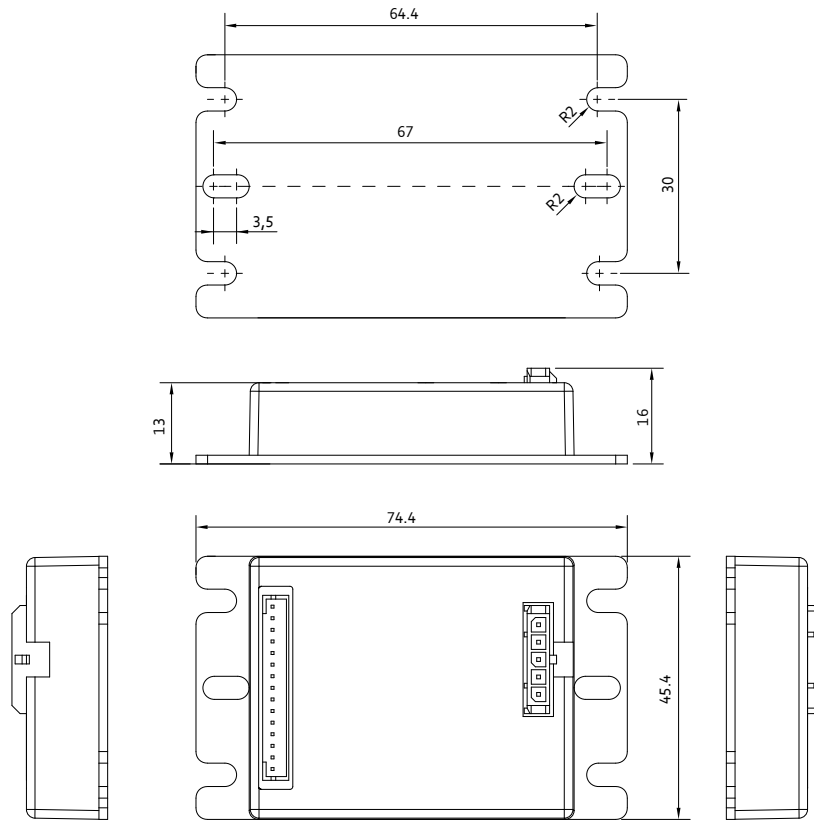
Characteristic	Unit	VTD-60.05-K5C-S	VTD-60.13-K5C-S	VTD-60.35-K5C-S
Number	-	1 (Dout0)	2 (Dout 0 to 1)	
Continuous output current	A	-	1.5	1.5
Loads	-	Resistive, inductive	Resistive, inductive	Resistive, inductive
Input signal (24 V tolerant)	V	Nominal voltage (logic supply U _L)		
Signal type	-	Pulse-switching	Pulse-switching	Pulse-switching
Note	-	Dout0 parallel to Din2	-	-

4.12 Analog inputs

Characteristic	VTD-60.05-K5C-S	VTD-60.13-K5C-S	VTD-60.35-K5C-S
Number	1 (Ain0)	2 (Ain 0 to 1)	2 (Ain 0 to 1)
Signal type – Ain0	+/- 10 V, 12 bit, single ended	± 10 V, 12 bit, differential	± 10 V, 12 bit, differential
Signal type – Ain1	=	± 10 V, 12 bit, single ended	± 10 V, 12 bit, single ended

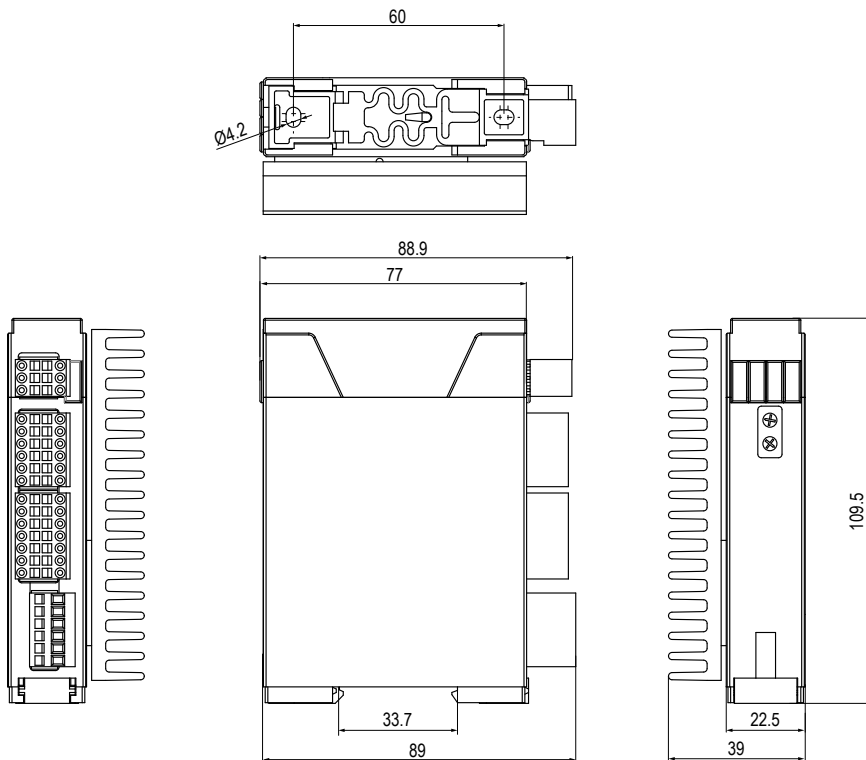
4.13 Dimensional drawings

VTD-60.05-K5C-S



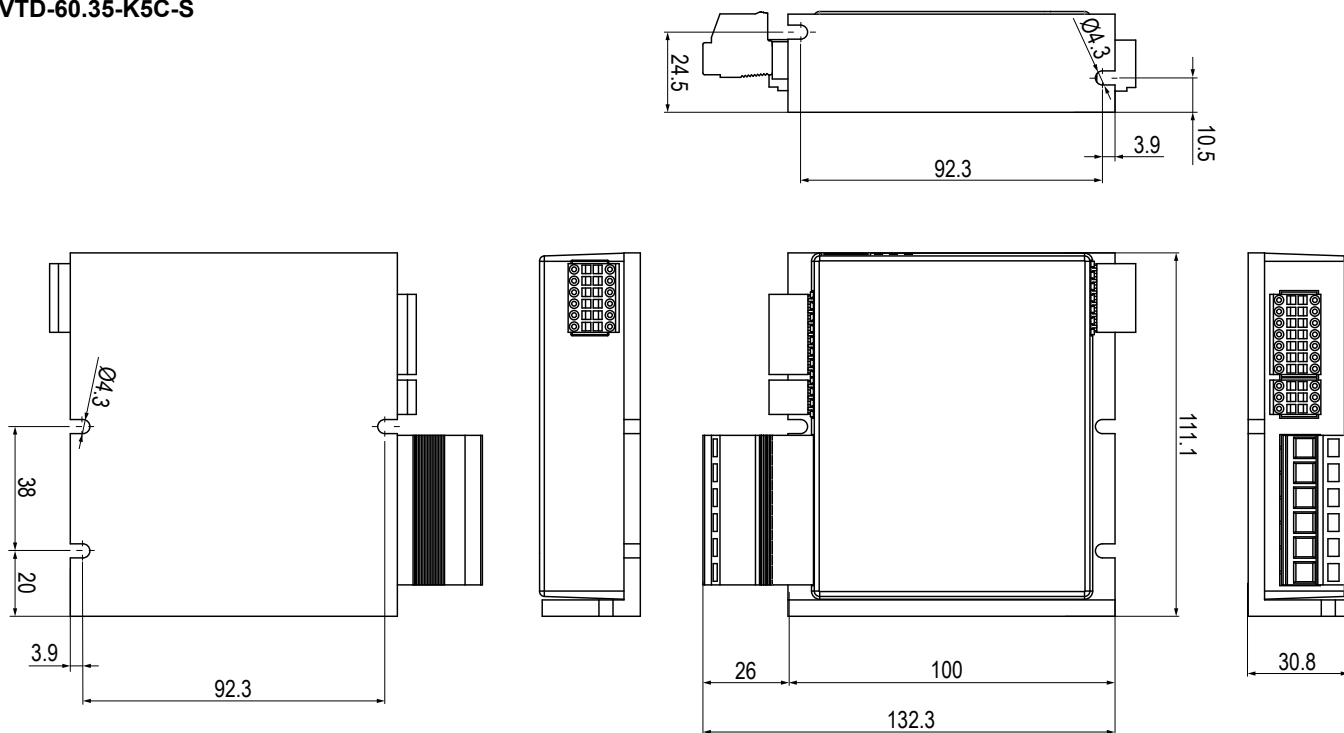
All dimensions in mm.

VTD-60.13-K5C-S



All dimensions in mm.

VTD-60.35-K5C-S



All dimensions in mm.

5 Installation

Dangerous movements in combination with drives or similar (see operating instructions of the relevant product)

Check the control electronics' electrical equipment at regular intervals.

- Ensure there are sufficient protective fixtures in the devices/systems, as actuating the motors in the wrong way can lead to dangerous movements.



DANGER

Possible remedial actions include:

- No lingering within the movement area of the devices or systems.
 - Ensure that the stability of the (protection) covers and housing is sufficient enough to resist the maximum movement or rotation energy.
 - Before opening the control electronics or entering the danger zone, ensure all connected drives are safely brought to a standstill and are secured against switching on again.
-

Impermissibly high load

Do not make any changes to the control electronics

- Subjecting the control electronics to impermissible loads (e.g. impact, heat, overvoltage, mechanical load) might damage them. In this case, decommission the control electronics immediately and, before recommissioning them, check that they are in proper condition.
-



WARNING



WARNING

Electromagnetic radiation

When integrating the control electronics into the system, the interaction may cause interference in terms of electromagnetic compatibility (EMC). Ensure that the entire system is electromagnetically compatible.



WARNING

Health hazards for persons with pacemakers, metal implants, and hearing aids

For these people, access to the following areas is prohibited:

- Areas in which electrical devices and parts are assembled, operated, or put into operation.
 - Areas in which motor parts with permanent magnets are stored, repaired, or assembled.
-



WARNING

Depending on the installation and operating conditions, the sound pressure level may exceed 70 dB(A)

Risk of noise-induced hearing loss

- Take appropriate technical safety measures.
 - Protect operating personnel with appropriate safety equipment such as hearing protection.
-



CAUTION

Hot surface – risk of burns

- Ensure sufficient protection against accidental contact.
 - Ensure there is sufficient cooling.
-



CAUTION

Risk of cutting and crushing hazard when removing the control electronics from packaging and when assembling

Carefully remove the control electronics from packaging, touching only the housing. Never subject to any impacts!

- Wear safety shoes and cut-resistant safety gloves.
-



CAUTION

Voltage

The control electronics are a built-in part without an isolating switch.

- Only connect the control electronics to suitable electrical circuits. Note that the power supply units must be suitably protected against secondary generator voltage.
 - When working on the control electronics, it is imperative that the system/machine is brought to a standstill and secured against switching on again.
-



NOTE

Electrostatic charging

Risk of damaging electronic components

- Use ESD protective equipment during assembly and disassembly.
-

Prerequisites for connection and start-up:**NOTE**

- Before connecting the control electronics, make sure that the power supply matches the product voltage.
 - Check whether the information on the nameplate or in the detailed specifications matches the connection data of the power supply.
 - Only use cables designed for the current level indicated on the nameplate and for the corresponding ambient conditions. Ensure the mechanical protection of the electrical hookup.
 - Ensure that the power supply lines are not mixed up.
 - Before connecting the motor, set the desired parameters and check whether the status LEDs (see Chapter "3.4 Status LED" on page 15) show normal operation.
-

5.1 Mounting conditions

The control electronics can be installed in any desired location directly on or in the machine using four screws, or in a switch cabinet with a DIN rail.

**CAUTION****Damage to the control electronics; ensure smooth operation**

- Do not bend the cables
 - Fit the cables to the plugs without tensile stress
 - Protect the control electronics and plug connections against splashing water
-

5.2 Mechanical installation

5.2.1 Assembly directly in or on the machine

1. Mechanically install the control electronics where the four attachment points in or on the machine/switch cabinet are located using 4x M5 screws.
2. Electrically connect the control electronics in the machine/switch cabinet using plugs (included in scope of delivery). For interfaces, see Chapter "5.3 Electrical installation" on page 23.
3. Establish the power supply.

5.2.2 Installation on DIN rail

Please contact ebm-papst for information about installation on a DIN rail.

5.3 Electrical installation

Mechanical installation should be performed first before electrical hookup.



DANGER

Danger to life due to electric shock when touching live parts

- Only allow work to be carried out by a qualified electrician.
- Make sure that the cables are de-energized.
- Make sure that the operating voltage cannot switch back on.
- Never work on live parts.

5.3.1 Interfaces VTD-60.13-K5C-S, VTD-60.35-K5C-S

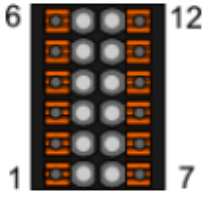
X1 – power supply and motor connection

Plug	Terminal	Signal	Description
	X1.1	FE	Functional earth
	X1.2	+Up	Power supply for output
	X1.3	GND	Ground for output
	X1.4	Ma	Motor phase A
	X1.5	Mb	Motor phase B
	X1.6	Mc	Motor phase C


X2 – Hall sensors and rotary encoders

Plug	Terminal	Signal	Description
	X2.1	H1	Hall sensor signal 1
	X2.2	H2	Hall sensor signal 2
	X2.3	H3	Hall sensor signal 3
	X2.4	A	Incremental encoder – track A
	X2.5	B	Incremental encoder – track B
	X2.6	Inx	Incremental encoder – index
	X2.7	+U5V	5 V encoder supply (Hall and rotary encoder)
	X2.8	/H1	Hall sensor signal 1 negated
	X2.9	/H2	Hall sensor signal 2 negated
	X2.10	/H3	Hall sensor signal 3 negated
	X2.11	/A	Incremental encoder – track A negated
	X2.12	/B	Incremental encoder – track B negated
	X2.13	/Inx	Incremental counter – index negated
	X2.14	GND	Ground, encoder supply (note: do not connect to system ground)

X3 – digital/analog inputs and outputs, CAN


Plug	Terminal	Signal	Description
	X3.1	+Ue24 V	Power supply for electronics
	X3.2	+Ain0	Analog input 0, positive
	X3.3	Din0	Digital input 0
	X3.4	Din1	Digital input 1
	X3.5	Din2	Digital input 2
	X3.6	Din3	Digital input 3
	X3.7	GND	Ground for electronics
	X3.8	-Ain0	Analog input 0, negative
	X3.9	Dout0	Digital output 0
	X3.10	CAN Hi	CAN High
	X3.11	CAN Lo	CAN Low
	X3.12	CAN GND	Ground for CAN

X4 – digital/analog inputs and outputs


Plug	Terminal	Signal	Description
	X4.1	Ain1	Analog input 1
	X4.2	Din4	Digital input 4
	X4.3	Din5	Digital input 5
	X4.4	Din6	Digital input 6
	X4.5	Dout1	Digital output 1
	X4.6	Din7	Digital input 7

5.3.2 Interfaces VTD-60.05-K5C-S

X1 – Hall sensors and rotary encoders

Plug	Terminal	Signal	Description
	X1.1	GND	Ground, encoder supply (note: do not connect to system ground)
	X1.2	+U5V	5 V encoder supply (Hall and rotary encoder)
	X1.3	B	Incremental encoder – track B
	X1.4	A	Incremental encoder – track A
	X1.5	H3/Inx	Hall sensor signal 3/ incremental encoder - index
	X1.6	H2	Hall sensor signal 2
	X1.7	H1	Hall sensor signal 1
	X1.8	CAN Lo	CAN Low
	X1.9	CAN Hi	CAN High
	X1.10	Din2/Dout0	Digital input 2/digital output 0
	X1.11	Din1	Digital input 1
	X1.12	Din0	Digital input 0
	X1.13	Ain0	Analog input 0
	X1.14	GND	Ground for electronics
	X1.15	+Ue	Power supply for electronics

X2 – power supply and motor connection

Plug	Terminal	Signal	Description
	X2.1	+Up	Power supply for output
	X2.2	GND	Ground for output
	X2.3	Ma	Motor phase A
	X2.4	Mb	Motor phase B
	X2.5	Mc	Motor phase C

Installation

5.4 Connecting control electronics to electricity source

5.4.1 Connector systems (VTD-60.13-K5C-S, VTD-60.35-K5C-S)



NOTE

In order to operate the motor with nominal current, the cross-sections of the connecting cables must be configured to the respective operating current in accordance with applicable national standards.

The maximum possible cross-sections of the connectors must be used for the nominal values of the device. A minimum cable length of 20 cm must be adhered to.



NOTE

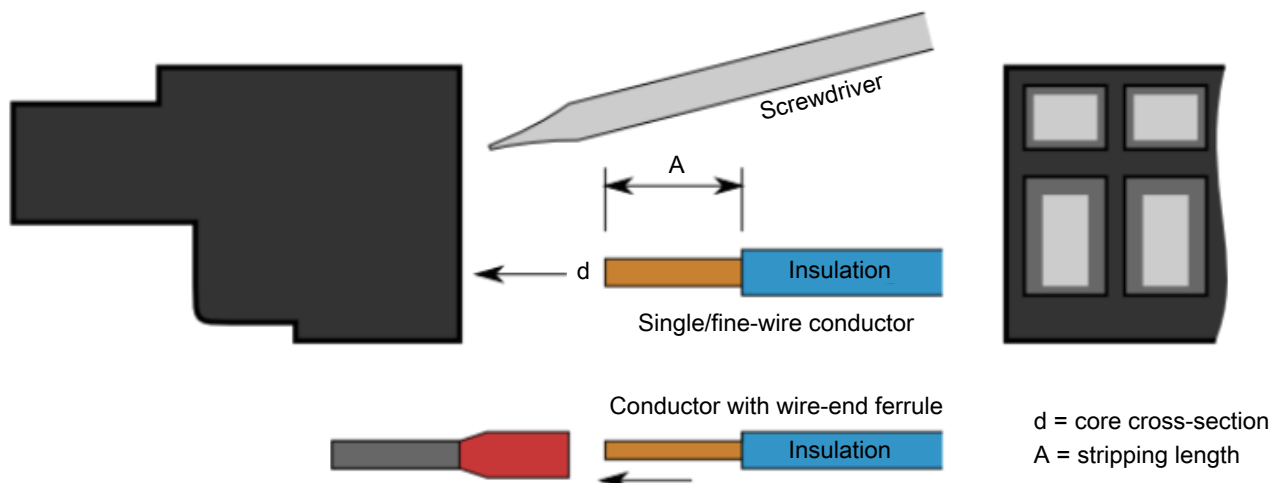
Make sure that the cores are correctly clamped to the stripped part of the conductor and not to the insulation.

Further information can be found at www.weidmueller.com.

Connection of the tension spring terminals Weidmueller BLZF 3.5 (installed in VTD-60.13-K5C-S – interface X1)

The drive controllers use connectors with tension spring technology for single/fine wire conductors.

The following overview shows which conductor cross-sections can be used with the connector:

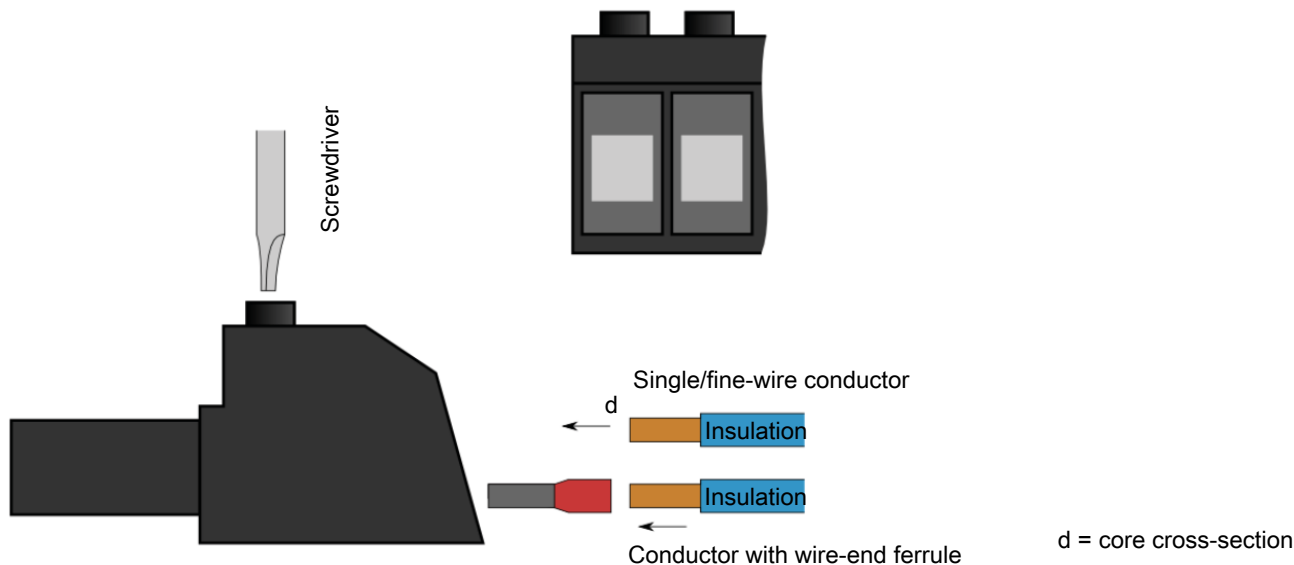


Terminal	Designation/item no.	Terminal area (cross-section d) mm ²				Stripping length mm
		Single-wire H05(07)V-U	Fine-wire H05(07)V-K	Fine-wire with wire-end ferrule	Fine wire with wire-end ferrule and plastic collar	
X1	BLZF 3.5/180/6 1690460000	0.2 to 1.5	0.2 to 1.5	0.2 to 1.5	0.2 to 1	10

Connection of the screw terminals Weidmueller BVZ 7.62 HP (installed in VTD-60.35-K5C-S – interface X1)

The drive controllers use connectors with screw technology for the output side

The following overview shows which conductor cross-sections can be used with the connector:

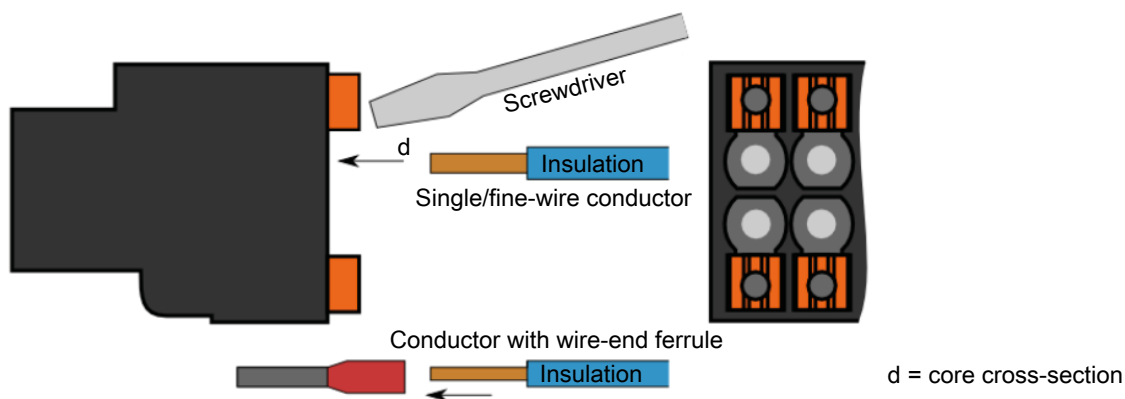


Terminal	Designation/item no.	Terminal area (cross-section d) mm ²				Stripping length mm
		Single-wire H05(07)V-U	Fine-wire H05(07)V-K	Fine-wire with wire-end ferrule	Fine wire with wire-end ferrule and plastic collar	
X1	BLZ 7.62HP/06 1929970000	0.2 to 6	0.5 to 6	0.25 to 6	0.25 to 6	12

Connection of tension spring terminals Weidmueller B2CF 3.5 (installed in VTD-60.13-K5C-S, VTD-60.35-K5C-S - interfaces X2, X3, X4)

The drive controllers use connectors with tension spring technology for single/fine-wire conductors

The following overview shows which conductor cross-sections can be used with the connector:



Terminal	Designation/item no.	Terminal area (cross-section d) mm ²				Stripping length mm
		Single-wire H05(07)V-U	Fine-wire H05(07)V-K	Fine-wire with wire-end ferrule	Fine wire with wire-end ferrule and plastic collar	
X2	B2CF 3.5/14 1277520000	0.14 to 1.5	0.14 to 1.5	0.14 to 1.5	0.14 to 1	10
X3	B2CF 3.5/12 1277510000					
X4	B2CF 3.5/6 1277470000					

Installation

5.4.2 Connector systems (VTD-60.05-K5C-S)



In order to operate the motor with nominal current, the cross-sections of the connecting cables must be configured to the respective operating current in accordance with applicable national standards.

NOTE

The maximum possible cross-sections of the connectors must be used for the nominal values of the device. A minimum cable length of 20 cm must be adhered to.



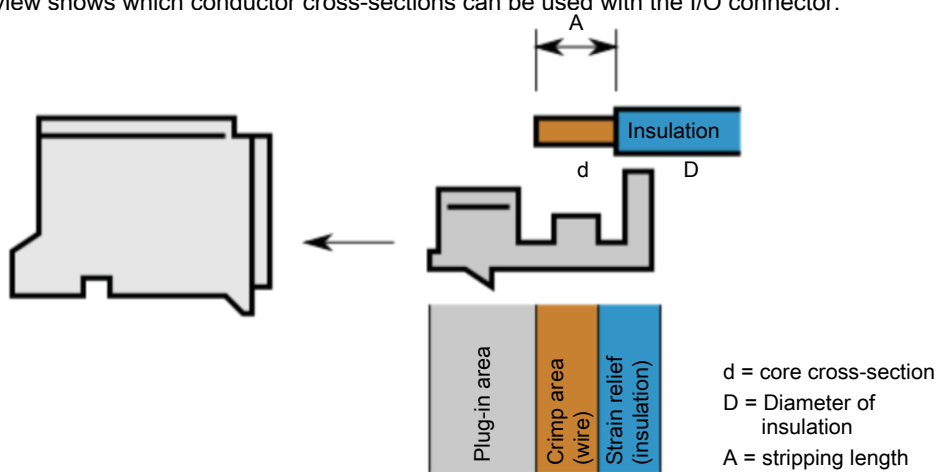
Using tools not specified by the manufacturer can impair the reliability of the crimp connection and can even cause a failure.

NOTE

For more information, see www.jst.com and www.molex.com.

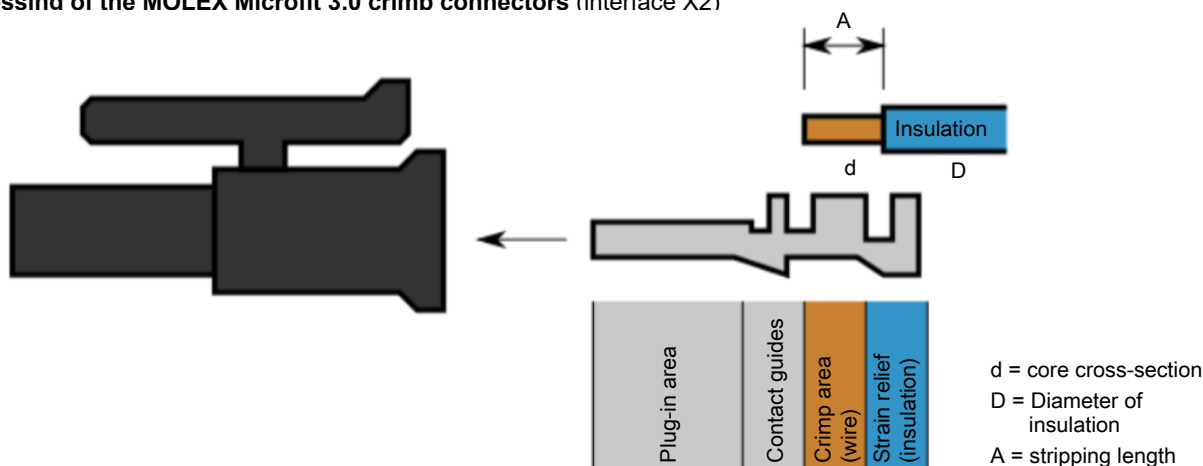
Connecting the crimp connectors of JST PH series (interface X1)

The following overview shows which conductor cross-sections can be used with the I/O connector:



Terminal	Designation/item no.	Cable cross-section d (AWG) (mm ²)	Max. insulation cross-section D (mm)	Stripping length mm
X1	<ul style="list-style-type: none"> Crimp housing - PHR-15 Crimp contact - SPH-002T-P0.5L Crimp tool - WC-240 	AWG 24 ... 30 0.05 ... 0.22	1.5	~1.5 ... 2

Processing of the MOLEX Microfit 3.0 crimp connectors (interface X2)



Terminal	Designation/item no.	Cable cross-section d (AWG) (mm ²)	Max. insulation cross-section D (mm)	Stripping length mm
X1	<ul style="list-style-type: none"> Crimp housing - 43645-0500 Crimp contact - 43030-0001 Crimp tool - 63819-0000 	AWG 20 ... 24 0.2 ... 0.519	1.85	~2.54 ... 2.92

5.5 Schematic overview



The USB interface adapter accessory part is not included in the scope of delivery, but is required for commissioning or parametrization using the "epTools" software (see Chapter "8 Accessories" on page 36).

NOTE



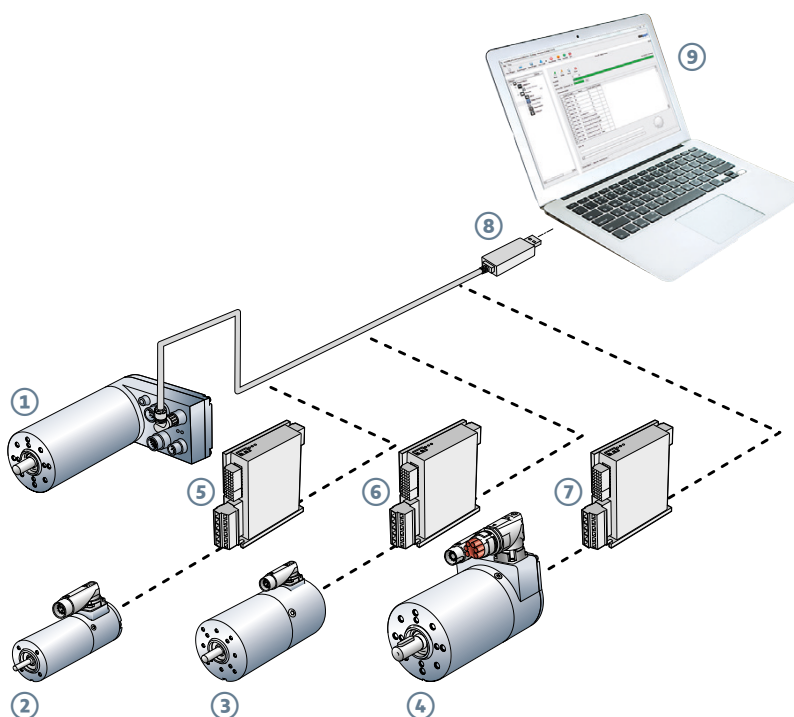
→ Check the pin assignment of your plug (see Chapter "5.3 Electrical installation" on page 23).

→ Connect the built-in connector with the mating connector

NOTE

→ Ensure that the plug is properly engaged.

Parameterization and commissioning



① ECI-63.XX-K5C

② ECI-42.XX-K1

③ ECI-63.XX-K1

④ ECI-80.XX-K1

Control electronics:

- ⑤ ■ VTD-60.05-K5C-S (CANopen)
- VTD-60.13-K5C-S (CANopen)

Control electronics:

- ⑥ ■ VTD-60.13-K5C-S (CANopen)
- VTD-60.35-K5C-S (CANopen)

Control electronics:

- ⑦ ■ VTD-60.13-K5C-S (CANopen)
- VTD-60.35-K5C-S (CANopen)

⑧ Interface adapter

⑨ PC with "epTools" software

5.6 Order of electrical hookup for commissioning

1. Connect the control electronics (5, 6 or 7) to the USB interface adapter (8).
2. Connect the USB interface adapter (8) to the computer (9).
3. Connect the motor (1, 2, 3 or 4) to the control electronics (5, 6 or 7).
4. Connect the power supply to the control electronics (5, 6 or 7).

Installation

5.7 Wiring examples

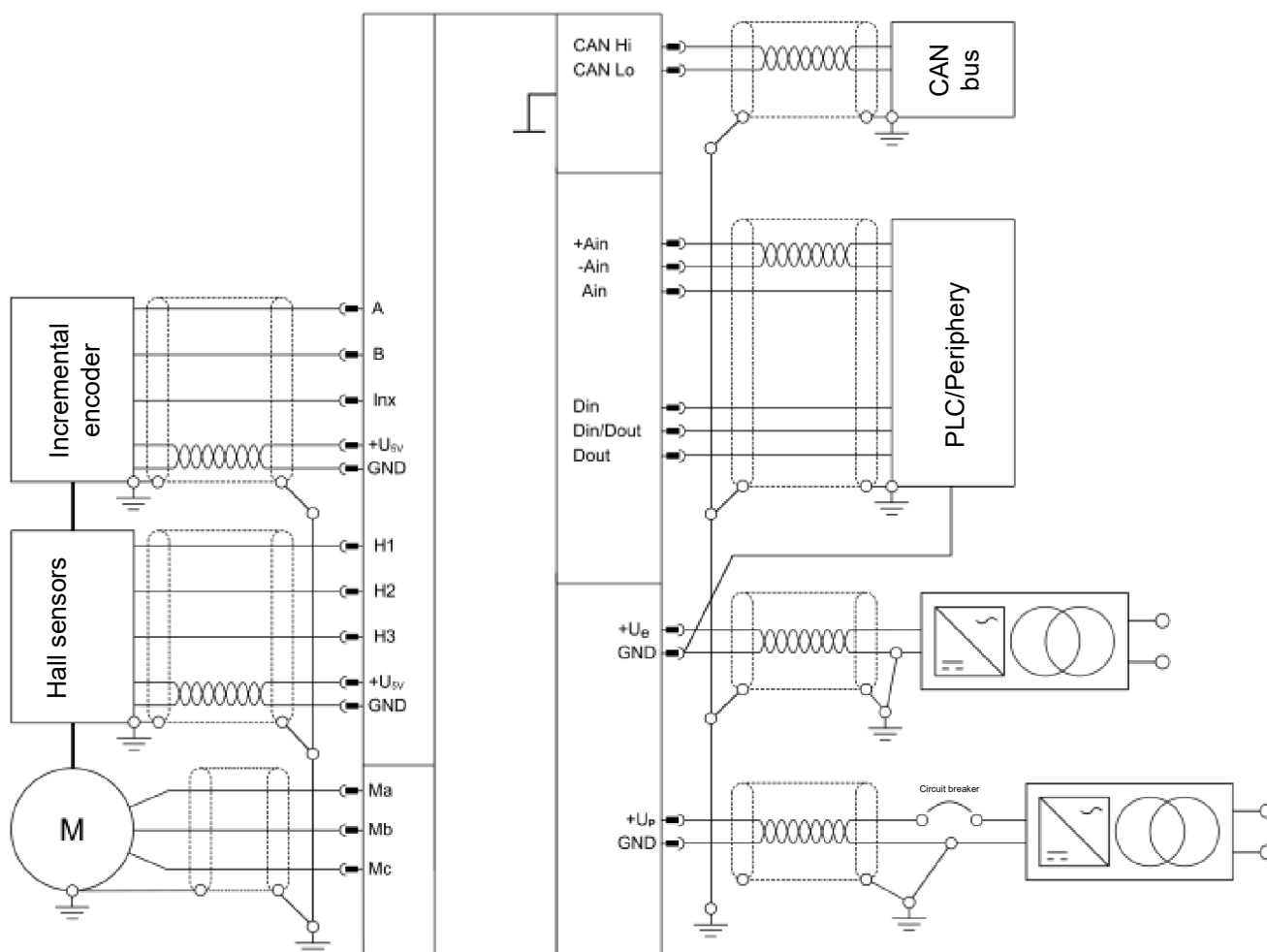


The +U5V pin is used to provide 5 V from the controller for supplying the motor encoders. No external voltage may be applied to this pin!

CAUTION

If voltage is applied to the +U5V pin (see Chapter "5.3.1 Interfaces VTD-60.13-K5C-S, VTD-60.35-K5C-S" on page 23) on the controller, this can result in irreparable damage to the device.

5.7.1 EMC-compatible wiring



Electrostatically sensitive devices and components

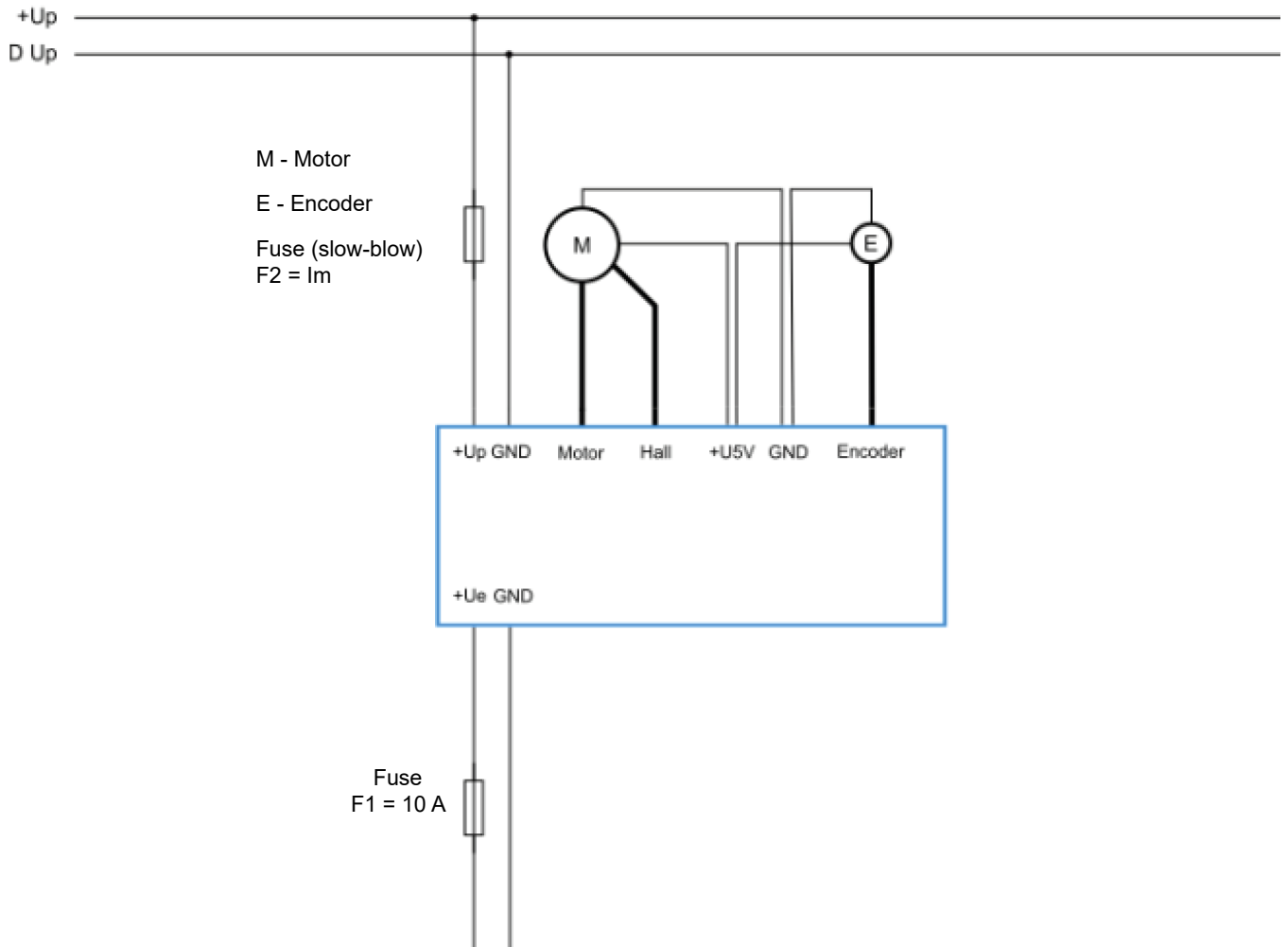


NOTE

When the devices are installed, commissioned and serviced, safety measures against the effects of electrostatic discharges (ESD) must be observed. This applies in particular to anti-static clothing, anti-static tools and an anti-static working environment. The device must be handled particularly carefully in this regard.

- To protect against electrostatic discharge during operation, all connectors must be connected to the device even if the signals on them are not used. The connectors provide protection against contact.
- Circuit boards without a housing may only be processed by trained personnel in an anti-static environment.

5.7.2 Motor



Operation

6 Operation

6.1 Switching on the control electronics

Use the higher-level control system to provide the power supply. Switch on the control electronics by activating the enable input.

6.2 Setting operating modes

There are various operating modes to choose from. You can set the operating modes using parameters. You can find a detailed description of the individual parameters in the help file for the "epTools" software.

6.3 Checking functions

The LED on the control electronics provides information about the current operating status, see Chapter "3.4 Status LED" on page 15.

6.4 Switching off the control electronics

"Take away" approval of the enabler to switch off the control electronics. Use the higher-level control system to switch off the power supply.

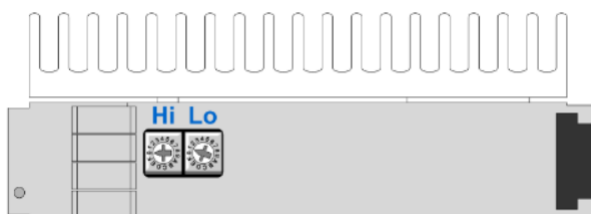
6.5 Parameterization/description of parameters

Use the "epTools" software to carry out the parameterization. You can find further information and a detailed parameter description in the software's help file.

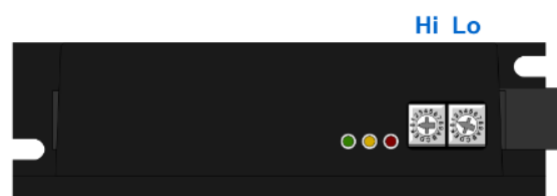
You will need the USB interface adapter to carry out the commissioning and parameterization (see Chapter "8.1 Accessories available to order" on page 36).

6.6 Setting options using HEX switches (VTD-60.13-K5C-S, VTD-60.35-K5C-S)

VTD-60.13-K5C-S

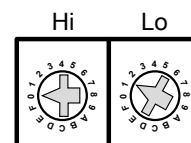


VTD-60.35-K5C-S



CAN bus address

The CAN bus address (node ID) can be changed using the HEX switches on the bottom of the device. The set address is available in hexadecimal format.



Node ID		Description
0		Not permitted
1 to 127	01h to 7Fh	After switching on, the device is in "Pre-Operational" state
128 to 255	80h to FFh	Not permitted

Resetting parameters

If the HEX switches are set to 00h at switch-on, the controller resets the values of the parameters. The following sequence can be observed:

- The green LED0 "Power" flashes 10s in a 500ms cycle
- The yellow LED1 "State" flashes 4 times
- Both LEDs flash in a 100 ms cycle

The sequence has ended when the green and yellow LEDs light up. The node ID of the device must then be set and a restart carried out.

CAN bus baud rate

The standard transmission speed of the devices is 125 kbit/s. It can be changed both on the software side and using the HEX switches in accordance with the following procedure:

	Action	Display
1	Switching off the device	
2	Setting HEX switch to 00h	
3	Switching on the device	The green status LED flashes in a cycle of 500 ms
4	Within 10 sec, the HEX switch Hi must be set to the value "F". The direction of rotation of the HEX switch is not relevant for this.	The green status LED flashes in a cycle of 200 ms
5	Within 10 sec, the HEX switch Lo must be used to set an index of the transmission speed. Index 0 – baud rate 1 Mbit/s Index 1 – baud rate 800 kbit/s Index 2 – baud rate 500 kbit/s Index 3 – baud rate 250 kbit/s Index 4 – baud rate 125 kbit/s Index 5 – baud rate 100 kbit/s Index 6 – baud rate 50 kbit/s Index 7 – baud rate 20 kbit/s Index 8 – baud rate 10 kbit/s	Module confirms transfer or displays an error. If a supported index is selected, the yellow status LED flashes several times. The green and yellow status LEDs then flash in a cycle of 100 ms. If an invalid or unsupported index is set, the red and green status LEDs flash quickly.



NOTE

Note that the software baud rate (see epTools help file: [Parameter 2000h – 2000.03h CANopen configuration – user baud rate](#)) has a higher priority than the baud rate via the HEX switches. The device only accepts changes to the baud rate via the HEX switches if the parameter [DS2000_CopConfigParam_UserBaudrate](#) is set to the value -1. If you want to reset the value of this parameter to the default value using the HEX switches, follow the tips from the "Resetting parameters" section above

6.7 Setting options using epTools

CAN bus address

The CAN bus address can also be changed using software (see epTools help file: [Parameters 2000h – 2000.02h CANopen configuration – user node ID](#) and [ep Tools – CAN configuration](#))



NOTE

Each address may only occur once in the network! Changing the node address using a HEX switch or software only takes effect after the device has been switched on again.

Please note that the software node ID (see epTools help file: [Parameter 2000h – 2000.02h CANopen configuration – user node ID](#)) has a higher priority than the node ID via the HEX switches. The device only accepts the node ID set by the HEX switches if the parameter [DS2000_CopConfigParam_UserNodeId](#) is set to the value -1.

If you want to reset the value of this parameter to the default value using the HEX switches, follow the tips from the "Resetting parameters" section below.

CAN bus baud rate

The standard transmission speed of the devices is 125 kbit/s. It can be used on the software side (see epTools help file: [Parameter 2000h – 2000.03h CANopen configuration – user baud rate](#) and [epTools - CAN configuration](#)) and using the HEX switches:



NOTE

Note that the software baud rate (see epTools help file: [Parameter 2000h – 2000.03h CANopen configuration – user baud rate](#)) has a higher priority than the baud rate via the HEX switches. The device only accepts changes to the baud rate via the HEX switches if the parameter [DS2000_CopConfigParam_UserBaudrate](#) is set to the value -1. If you want to reset the value of this parameter to the default value using the HEX switches, follow the tips from the "Resetting parameters" section above

7 Maintenance & error handling



Do not perform any repairs on the control electronics. Send the control electronics to ebm-papst for repair or replacement.

NOTE

7.1 Cleaning

To ensure a long service life, check the control electronics regularly for proper operation and soiling. The frequency of checking is to be adapted accordingly depending on the degree of contamination. When cleaning the control electronics, the following instructions must be observed:

- Do not clean the control electronics using a water jet or high-pressure cleaner.
- Do not use acid, alkali, or solvent-based cleaning agents.
- Do not use any sharp-edged or pointed objects.

7.2 Safety checks



Mechanical installation should be performed first before electrical hookup.

DANGER

Danger to life due to electric shock when touching live parts

- Only allow work to be carried out by a qualified electrician.
- Make sure that the cables are de-energized.
- Make sure that the operating voltage cannot switch back on.
- Never work on live parts.



Hot surface – risk of burns

CAUTION

- Ensure sufficient protection against accidental contact.
- Ensure there is sufficient cooling.

What should be checked?	How to check	How often	Measure
Mounting the control electronics	Visual inspection	At least every 6 months	Mount
Check cables for damage	Visual inspection	At least every 6 months	Replace cables
Check control electronics for external damage	Visual inspection	At least every 6 months	Replace control electronics



In the event of further malfunctions, please contact ebm-papst.

You should have the following information at the ready:

NOTE

- Nameplate data
- Type and extent of malfunction
- Circumstances surrounding the malfunction
- Application data (cycle of torque, speed, loads, ambient conditions, etc.)

Do not operate the control electronics until the malfunction is conclusively resolved.

7.3 Disposal

Environmental protection and resource conservation are top priority corporate goals at ebm-papst. ebm-papst operates an environmental management system certified in accordance with ISO 14001 and which is implemented consistently in line with German standards. Right from the development stage, environmentally friendly design, technical safety, and health protection are essential prerequisites. The following chapter contains recommendations for environmentally friendly disposal of the control electronics.

7.3.1 Country-specific legal requirements



NOTE

Country-specific legal requirements

Always observe the applicable country-specific legal regulations with regard to the disposal of control electronics or waste occurring in the various phases of the lifecycle. The corresponding disposal standards must also be observed.

7.3.2 Disassembly

Disassembly of the control electronics must be performed or supervised by qualified personnel with the appropriate technical knowledge.

The control electronics are to be disassembled into suitable components for disposal employing standard procedures for motors.

7.3.3 Component disposal

The control electronics are mostly made of steel, copper, aluminum, and plastic.

Metallic materials are generally considered to be fully recyclable.

Separate the components for recycling into the following categories:

- Steel and iron
- Aluminum
- Non-ferrous metal, e.g. motor windings
- Plastics, particularly with brominated flame retardants, in accordance with marking
- Insulating materials
- Cables and wires
- Electronic scrap, e.g. circuit boards

Electrical insulating materials on the control electronics, in cables, and in wires are made of similar materials and are therefore to be treated in the same manner.

The materials concerned are as follows:

- Various insulators
- Power cables
- Cables for internal wiring
- Electrolytic capacitors

Dispose of electronic components employing the proper procedures for electronic scrap.



NOTE

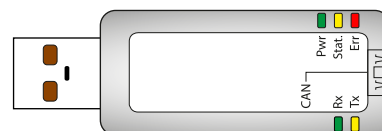
→ Please contact ebm-papst for any other questions regarding disposal.

Accessories

8 Accessories

8.1 Accessories available to order

Designation	Order number	Description
Cable set VTD-60.05-K5C-S	8315 121 035	Cable set; mating connector included in scope of delivery
USB CAN adapter	914 0000 401	USB interface adapter



Functional description of LED displays

LED designation	Color	Display	Function assignment
LED0 "Power"	Green	Lit up	Normal operation
		Not lit up	No power supply
		Flashing	Bootloader mode (no firmware)
LED1 "State"	Yellow	Not lit up	Normal operation
		Flashing	Bootloader mode (flashes in the event of incoming message)
LED2 "Error"	Red	Lit up	Error
		Not lit up	No error (normal operation)
LED3 "Rx"	Green	Flashing	Flashes in the event of incoming message
		Not lit up	No incoming message
LED4 "Tx"	Yellow	Flashing	Flashes in the event of outgoing message
		Not lit up	No outgoing message

8.2 Software "epTools"

For settings and parameterization of the control electronics, the PC software "epTools" is required. Operation is described in the "epTools" software help file.

The respective current version of the "epTools" software can be found on our homepage: <https://www.ebmpapst.com/software>.



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the engineer's choice

**ebm-papst St. Georgen
GmbH & Co. KG
Hauptverwaltung (Head Office)**

Hermann-Papst-Strasse 1
78112 St. Georgen
GERMANY
Phone +49 7724 81-0
Fax +49 7724 81-1309
info2@de.ebmpapst.com

**ebm-papst St. Georgen
GmbH & Co. KG
Plant 7 in Lauf**

Industriestrasse 9
91207 Lauf a. d. Pegnitz
GERMANY
Phone +49 9123 945-0
Fax +49 9123 945-145
info4@de.ebmpapst.com