Instructions for Use

COMBIVERT F6

Installation F6 Control Compact

Translation of the original manual

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Imprint

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1 Introduction

The described devices, accessories, hardware and/or software are products of KEB Automation KG. The enclosed documents correspond to conditions valid at printing. Misprint, mistakes and technical changes reserved.

1.1 Markings

1.1.1 Warnings

Certain operations can cause hazards during the installation, operation or thereafter. There is safety information in the documentation in front of these operations.

Warnings contain signal words for the severity of the hazard, the type and/or source of the hazard, the consequence of non-compliance and the measures to avoid or reduce the hazard.

⚠ DANGER

Type and/or source of the hazard.

Leads to death or serious bodily injury if not observed.

a) Measures to avoid the hazard.

b) Can be supplemented by an additional danger sign or pictogram.

⚠ WARNING

Type and/or source of the hazard.

May cause death or serious injury if not observed.

a) Measures to avoid the hazard.

b) Can be supplemented by an additional danger sign or pictogram.

⚠ CAUTION

Type and/or source of the hazard.

May cause bodily injury if not observed.

a) Measures to avoid the hazard.

b) Can be supplemented by an additional danger sign or pictogram.

NOTICE

Type and/or source of the hazard.

Can cause damage to property if not observed.

a) Measures to avoid the hazard.

b) Can be supplemented by an additional danger sign or pictogram.

1.1.2 Information notes

Indicates to the user a special condition, prerequisite, scope or simplification.

This is a reference to further documentation. The barcode is for smartphones, the following link is for online users or for typing.

(🌐► https://www.keb-automation.com/search)

Notes on conformity for use in the North American or Canadian market.

1.1.3 Symbols and markers

✓	Condition
a)	Action step
⇨	Result or intermediate result
(≡► Refe [▷ 7])	Reference to a chapter, table or picture with page reference
ru21	Parameter name or parameter index
(🌐►)	Hyperlink
<Strg>	Control code
COMBIVERT	Glossary entry

1.2 Laws and guidelines

KEB Automation KG confirms with the CE mark and the EU declaration of conformity that our device complies with the essential safety requirements.

The EU declaration of conformity can be downloaded on demand via our website.

1.3 Warranty and liability

The warranty and liability on design, material or workmanship for the acquired device is given in the general conditions of sale.

Here you will find our general sales conditions.

(🌐► https://www.keb-automation.com/terms-conditions)

Further agreements or specifications require a written confirmation.

1.4 Support

Through multiple applications, not every possible case has been taken into account. If you require further information or if problems occur which are not treated detailed in the documentation, you can request the necessary information via the local KEB Automation KG agency.

The use of our units in the target products is beyond of our control and therefore exclusively the responsibility of the customer**.**

The information contained in the technical documentation, as well as any support provided verbally, written or through testing, is made to the best of our knowledge and information regarding intended use of KEB products. However, due to technical changes, any information provided is considered non-binding and is subject to change. This also applies to any violation of industrial property rights of a third-party.

Selection of KEB units in view of their suitability for the intended use must be done by the user.

Tests can only be carried out within the scope of the intended end use of the product (Application**) by the** Customer**. They must be repeated, even if only parts of hardware, software or the unit adjustment are modified.**

1.5 Copyright

The customer may use the instructions for use and other documents accompanying the device or parts thereof for internal purposes. Copyrights are with KEB Automation KG and remain valid in its entirety.

Other word and/or figurative marks are trademarks (™) or registered trademarks (®) of their respective owners.

1.6 Validity of this manual

This part of the instruction manual describes the implemented control card.

- The control card is only valid in conjunction with the instructions for use of the power part.
- The control card contains only supplementary safety instructions.
- If certain functions or properties are version-dependent, this is indicated at the appropriate place. The version number of the COMBIVERT can be found in brackets after the material number.

1.7 Target group

The instructions for use is determined exclusively for electrical personnel. Electrical personnel for the purpose of this instruction manual must have the following qualifications:

- Knowledge and understanding of the safety instructions.
- Skills for installation and assembly.
- Start-up and operation of the product.
- Understanding of the function in the used machine.
- Detection of hazards and risks of the electrical drive technology.
- Knowledge of IEC 60364.
- Knowledge of national safety regulations (e. g. DGUV Regulation 3).

2 General Safety Instructions

The products are developed and built according to the state of the art and recognized safety rules. Nevertheless, their use may create dangers to life and limb of the user or third parties or damage to the machine and other material property.

The following safety instructions have been created by the manufacturer for the area of electric drive technology. They can be supplemented by local, country- or application-specific safety instructions. This list is not exhaustive. Non-observance of the safety instructions by the customer, user or other third party leads to the loss of all resulting claims against the manufacturer.

NOTICE

Hazards and risks through ignorance!

a) Read the instructions for use.

b) Observe the safety and warning instructions.

c) Ask if something is unclear.

2.1 Installation

⚠ DANGER

Electrical voltage at terminals and in the device!

Danger to life due to electric shock !

✓ For any work on the device

a) Switch off the supply voltage.

b) Secure it against switching on.

c) Wait until all drives has been stopped in order that no regenerative energy can be generated.

d) Await capacitor discharge time (min. 5 minutes). Measure DC voltage at the terminals.

e) Never bridge upstream protective devices. Also not for test purposes.

NOTICE

Use of suitable voltage sources!

Electric shock!

a) Only use voltage sources with protective separation (SELV/PELV) in accordance with VDE 0100 as per the stated specification.

b) Pay attention to a sufficient overvoltage category of the voltage supply.

c) With existing or newly-wired circuits the person installing the device or machine must ensure that the PELV requirements are met.

For a successful operation, please read the following instructions:

- The electrical installation shall be carried out in accordance with the relevant requirements.
- Cable cross-sections and fuses must be dimensioned by the user according to the specified minimum/maximum values for the application.
- For drive controllers that are not isolated from the supply circuit (in accordance with EN 61800-5-1) all control lines must be included in other protective measures (e.g. double insulation or shielded, earthed and insulated).
- When using components without isolated inputs/outputs, it is necessary that equipotential bonding exists between the components to be connected (e.g. by the equipotential line). Disregard can cause destruction of the components by equalizing currents.

2.2 Start-up and operation

The start-up (i.e. the starting of normal operation) is prohibited until the machinery has been proved to conform to the provisions 2006/42/EG and 2014/30/EU; EN 60204-1 must be observed.

⚠ WARNING

Wrong parameterization

Unintentional behaviour of the drive

✓ During initial start-up or replacement of the drive controller:

a) Secure motors against automatic restart.

b) Check whether the appropriate parameter list for the application has been imported.

⚠ WARNING

Software protection functions as sole protection.

Protection function in case of software problems without function.

✓ Securing a unit solely with software-supported functions is not sufficient.

a) Install external protective measures (e.g. limit switch) that are independent of the drive controller.

2.3 Maintenance

⚠ DANGER

Unauthorized exchange, repair and modifications

Unpredictable malfunctions

a) The function of the drive controller is dependent on its parameterisation. Never replace without knowledge of the application.

b) Modification or repair is permitted only by KEB Automation KG authorized personnel.

c) Only use original manufacturer parts.

d) Infringement will annul the liability for resulting consequences.

3 Product description

3.1 Description of the control board COMPACT

The control board COMPACT provides the following functions:

- Digital and analogue inputs and outputs
- Potential-free relay output
- CAN field bus interface (depending on variant, see type code)
- Serial diagnostic interface for connection to a PC
- Hardware of the control circuit "safely separated" according to EN 61800-5-1
- Brake control and supply
- Motor protection by I²t, KTY, PT1000 or PTC input
- Safety function STO (two channel torque off)
- External supply of the control board

3.2 Variants of the control board

The 11-digit type code indicates the variants of the control board. Positions that are not listed are irrelevant for this manual.

1. and 2. digit	**Device size**
10…33	For motor power from 2.2…450 kW
3. and 4. digit	**Series**
F6	COMBIVERT F6
5. digit	**Control type**
K	COMPACT
6. digit	**Variants**
1	Safety function STO (COMPACT)
7. digit	**Housing**
8. digit	**Connection, voltage, options**
9. digit	**Switching frequency, software current limit, overcurrent**
10. digit	**Control board variant**
1	COMPACT | Multi encoder interface, CAN®, STO, EtherCAT®
2	COMPACT | Multi-Encoder Interface, STO, VARAN®
11. digit	**Heat sink version**

3.3 Safety functions

The safety function STO according to EN 61800-5-2 contains:

- Safe torque off (Safe Torque Off - STO)

The safety function meets the requirements in accordance with

- Performance-Level e (ISO 13849-1).
- SIL 3 (IEC 61508 and IEC 62061).

The safety function protects people against mechanical damage.

NOTICE

FS

The certification of drive controllers with safety technology is only valid under the following conditions:

a) The material number corresponds with the numerical code below.

b) The FS logo is printed on the type plate.

Numerical code for F6 COMPACT with safety technology (x=variable):

xxF6Kxx-xxxx

3.4 Accessories

To be able to use preassembled cables provided by the customer, the connectors of the control are optionally available. The following connector sets are available according to the used options:

Control board	Set contains	Material number
COMPACT	terminal strip 24-pole terminal strip 12-pole-terminal strip 8-pole terminal strip 6-pole	00F6V80-000K

Tab. 1: Connector sets

3.5 Connection and control elements

X1C	Temperature monitoring, brake control
X2A	Control terminal block for digital inputs/outputs; 24V output; relay output
X2B	Safety functions; 24V supply, 2 digital outputs
X2C	CAN bus; analog inputs and outputs
X3A	Encoder interface channel A
X3B	Encoder interface channel B
X4A	Diagnostic interface with RS232/485 interface according to DIN66019 protocol; operator slot
X4B	Fieldbus input / Port 0
X4C	Fieldbus output / Port 1
FS ST	LED Safety state
VCC	LED voltage supply (24V)
NET ST	LED network / fieldbus status
DEV ST	LED inverter/ device status
OPT	optional

Tab. 2: Overview Connection and operating elements

3.6 Motor monitoring X1C (temperature, brake)

Terminal strip X1C is a 6-pole, pluggable terminal strip with spring-cage connection. It contains:

- 1 output for control of 24V motor brakes
- 1 analog input for temperature detection

3.7 Control terminal strip X2A

Control terminal strip X2A is a 24-pole pluggable, double-row terminal strip with spring-cage connection. It contains:

- 8 digital inputs
- 2 digital outputs
- 1 Relay output
- 24V outputs to supply the inputs

3.8 Safety terminal block X2B

Terminal strip X2B is an 8-pole pluggable, double-row terminal strip with spring-cage connection. It contains:

- STO safety inputs
- 2 digital outputs
- Input for DC supply 24V

3.9 CAN bus and analog inputs and outputs X2C

Terminal strip X2C is a 12-pole pluggable, double-row terminal strip with spring-cage connection. It contains:

- CAN bus interface
- 2 analog inputs
- 1 analog output

3.10 Encoder interfaces X3A, X3B

The COMBIVERT is equipped with two universal encoder interfaces (depending on the variant). The interfaces can be adapted to different encoders independently of each other.

3.11 Diagnostic interface X4A

The integrated RS232/485 interface is used to connect service tools (e.g. USB or Bluetooth adapter). The interface also serves as a connection point for the F6 keyboard/display operator. DIN 66019II is used as communication protocol.

3.12 Fieldbus interfaces X4B, X4C

Depending on the ordered (≡► Variants of the control board [▸ 11]) EtherCAT® or VARAN is available on the interfaces X4B and X4C.

see also

Variants of the control board [▸ 11]

3.13 Status LEDs

3.13.1 Boot display

Before the LEDs start their normal function, they signal the boot procedure after switching on:

LEDs	Status	Note
VCC ○ NET ○ ST DEV ○ ST OPT ○	off	Device off
VCC ● NET ○ ST DEV ○ ST OPT ○	Initialization	Control is supplied with 24 V
VCC ● NET ◐ ST DEV ◐ ST OPT ○	FPGA booted	FPGA has been booted error-free (approx. 6 s)
VCC ● NET ● ST DEV ● ST OPT ○	ready for operation	Device is ready for operation and the LEDs start with their normal function (approx. 3 s)

Tab. 3: LEDs at power on

3.13.2 VCC - LED

VCC	LED colour	Description
off	-	Power supply of the control card switched off.
on	green	Control is supplied with 24 V.

Tab. 4: Function VCC LED

3.13.3 NET ST - LED

NET ST	LED colour	Description
off	-	Device off or booting.
on	yellow	During switching on, if FPGA is booted.
Blink code	various	depending on fieldbus => fieldbus interfaces.

Tab. 5: Function NET ST - LED

3.13.4 DEV ST - LED

DEV ST	LED colour	Description
OFF	-	Device off or in boot process.
ON	Red	Error
ON	Yellow	No error, DC bus not charged.
ON	Green	No error, ready for operation.

DEV ST	LED colour	Description
Flashing	Green	No error, serves to identify the device (fb.32).

Tab. 6: Function DEV ST - LED

3.13.5 OPT - LED

OPT	LED col-our	Description
-	-	reserved for options.

Tab. 7: Function OPT - LED

Tip

The DEV ST and OPT LEDs can be re-programmed for diagnostic purposes (i.e., the OPT LED could be programmed to represent the status of one of the digital inputs).

Refer to the Configuration Handling parameters in the programming manual.

4 Connection of the control board

Observe the following instructions to avoid malfunctions!

- Install control and power cable separately (approx. 10..20 cm (4"..8") distance).
- Cross high voltage conductors at a right angle.
- In case of inductive load on the relay outputs a protective wiring must be provided (e.g. free-wheeling diode).
- Electromagnetic interferences can be prevented by the following measures:
  - Always use twisted and shielded cables for analog control cables. Place the shield on one side of the source.
  - Twist digital control cables. For lengths longer than 3 m (10'), a shield may be required. In this case, place on both sides.
  - When the brake conductors or motor temperature sensor conductors are run together with the motor conductors, the brake and temperature conductors should be shielded. The shield of the brake and temperature sensor conductors should be connected to earth ground together with the motor conductor shield. The shields should be kept as long as possible to prevent cross coupling with the motor conductors.

The terminals of the control terminal blocks, encoder inputs and the communication interface are securely isolated in accordance with IEC 61800-5-1.

4.1 Assembly of wires

NOTICE

Loose and slack cable connections!

Malfunctions due to loose contacts.

a) Observe metal sleeve length and stripping length according to table.

b) Use a suitable pressing tool.

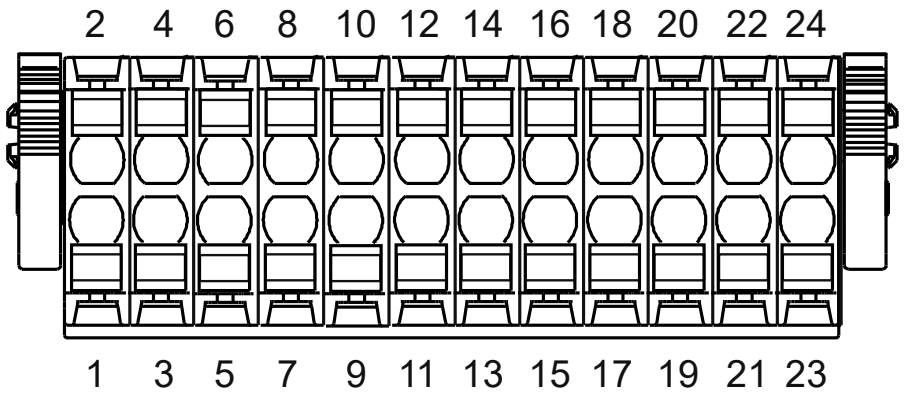
c) Make sure that all wires are inserted into the wire-end sleeve.

d) After inserting the cable into the terminal, check that it is firmly seated.

Cross section	Wire end ferrule	Metal sleeve length	Stripping length
0.5…1 mm² (20…17 AWG)	With plastic collars	10 mm	12 mm
0.5…1.5 mm² (20…16 AWG)	Without plastic collars	10 mm	10 mm
0.2…1.5 mm² (24…16 AWG) Solid or fine strand	Without wire end ferrule	-	10 mm

Tab. 8: Wire end ferrules and stripping length

4.2 Terminal strip X2A



PIN	Name	Description
1	DI1	Digital input 1
2	24Vout	Voltage output for controlling the inputs
3	DI 2	Digital input 2
4	24Vout	Voltage output for controlling the inputs
5	DI 3	Digital input 3
6	24Vout	Voltage output for controlling the inputs
7	DI 4	Digital input 4
8	24Vout	Voltage output for controlling the inputs
9	D	Digital input 5
10	24Vout	Voltage output for controlling the inputs
11	DI 6	Digital input 6
12	24Vout	Voltage output for controlling the inputs
13	DI	Digital input 7
14	24Vout	Voltage output for controlling the inputs
15	DI 8	Digital input 8
16	24Vout	Voltage output for controlling the inputs
17	DO1	Digital output 1
18	0V	Reference potential for digital output
19	DO2	Digital output 2
20	0V	Reference potential for digital output
21	RLB	Relay output / NC contact
22	RLA	Relay output / NO contact
23	RLC	Relay output/ switching contact
24	24Vout	DC voltage output (SELV) to control the digital inputs.

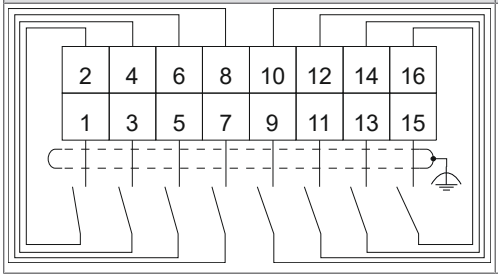
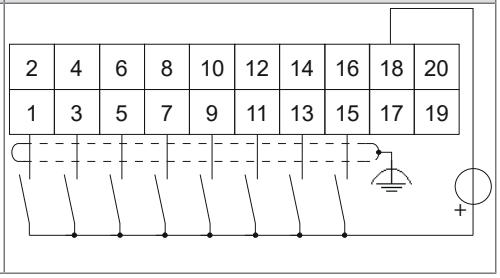
Tab. 9: Assignment of the terminal strip X2A

4.2.1 Digital inputs

Specification

Number	8
Name	DI1…DI8
Terminals	X2A.1/ .3/ .5/ .7/ .9/ .11/ .13/ .15
Classification	Type 3 according to DIN EN 61131-2
Low level (logical 0)	-3 … +5 V
High level (logic 1)	11 … 30 V / 2 … 6 mA

Connection

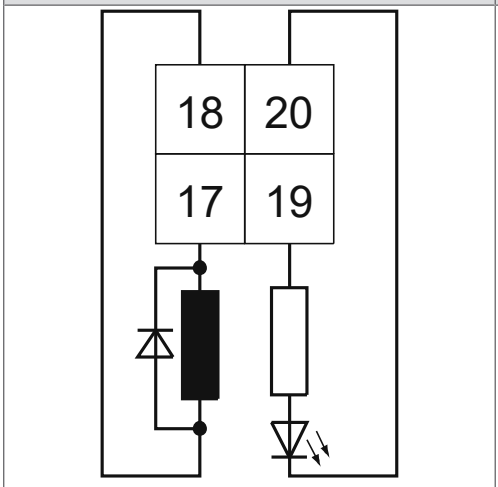
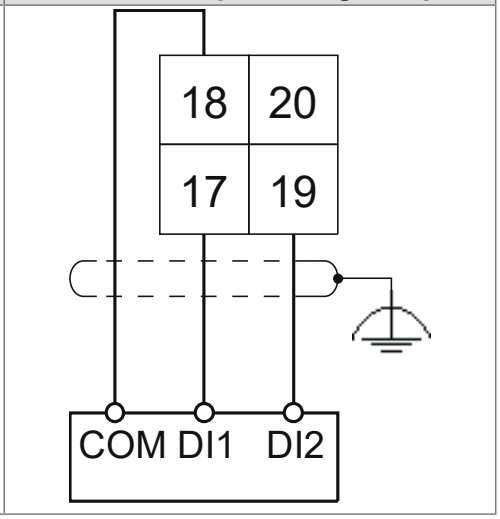
Internal voltage supply	External voltage supply
	

4.2.2 Digital outputs

Specification

Number	2 (+2 at terminal strip X2B)
Name	DO1 … DO2
Terminals	X2A.17, X2A.19
Type	24 V high-side Switch
Classification	DIN EN 61131-2
Output voltage	Minimum P24Vin – 3 V Maximum P24Vin Reference potential 0V (X2A.18 and X2A.20)
Output current	Maximum 100 mA per output (short-circuit proof)
Special features	No internal free-wheeling diode. External free-wheeling diode required for inductive load.

Connection

Connection external loads	Connection outputs to digital inputs
	

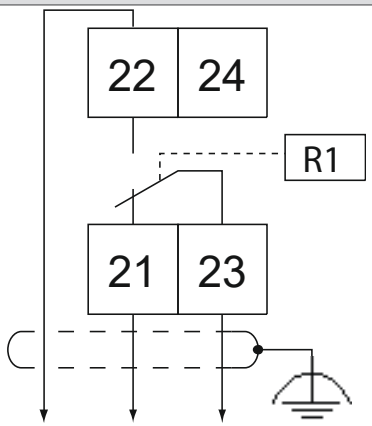
4.2.3 Relay output

Specification

Number	1
Name	R1
Terminals	X2A.21…X2A.23
Type	Form C
Voltage	Maximum DC 30 V
Current	0.01…1 A
Switching cycles	10^{-8} mechanical
	500,000 at 30 V / 1 A
Special features	Resistive load only; no internal free-wheeling branch

Connection

Relay output form C



4.2.4 Voltage supply

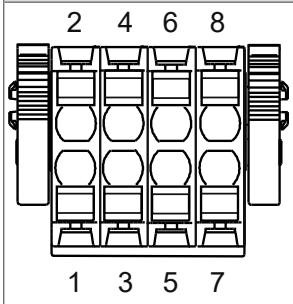
4.2.4.1 Voltage output to supply the inputs

Specification voltage output

Connection see (≡▶ Digital inputs [▶ 17])

Name	24Vout
Terminals	X2A.2/ .4/ .6/ .8/ .10/ .12/ .14/.24 (24Vout)
Output current	max. 100 mA (short-circuit proof) for all 24Vout outputs together
Output voltage	minimum P24Vin - 3V maximum P24Vin
Notes	DC voltage output (SELV) to supply the digital inputs.

4.3 Terminal strip X2B

X2B	PIN	Name	Function
	1	STO1-	Input STO channel 1
	2	STO1+	
	3	STO	Input STO channel 2
	4	STO	
	5	DO3	Digital output 3 Spezification => DO1 and DO2
	6	DO4	Digital output 4 Spezification => DO1 and DO2
	7	0V	Reference potential for P24Vin
	8	P24Vin	DC voltage input 24 V

Tab. 10: Assignment of the terminal strip X2B

4.3.1 Inputs STO

Specification

Number	2
Name	STO1; STO2
Terminals	X2B.1/2 and X2B.3/4
Low level (logical 0)	-3 … +5 V / 30 mA
High level (logic 1)	15 … 30 V / 5 … 30 mA
Others	Both channels potential-free, so that 24 V and 0 V can be connected. Inputs designed for safety switchgear with test pulses (OSSD). Signals are not evaluated, only filtered. OSSD test interval is limited to 10 ms.

STO with OSSD signals

The input voltage determines the maximum pulse width of the OSSD signals.

Input voltage	OSSD pulse width
15 V	0.1 ms
18 V	0.8 ms
20 V	1.1 ms
24 V	1.5 ms
30 V	1.8 ms

Tab. 11: OSSD pulse width depending on the input voltage

4.3.2 Digital outputs

Specification

Number	2 (+2 more at X2A)
Name	DO3 … DO4
Terminals	X2B.5, X2B.6
Type	24 V high-side Switch
Classification	DIN EN 61131-2
Output voltage	Minimum P24Vin – 3 V Maximum P24Vin reference potential 0V (X2B.7, X2A.18 and X2A.20)
Output current	Maximum 100 mA per output (short-circuit proof)
Special features	Resistive load only; no internal free-wheeling branch

Connection examples (≡► Digital outputs [▸ 18])

4.3.3 Voltage input

The control card is supplied by

- externally by a central 24 V supply.

To select a suitable voltage source, the maximum current consumption must always be determined.

4.3.3.1 Calculation the current consumption

The input P24Vin (X2B.8) supplies following components:

- Control (control board with safety functions)
- Brake
- HCT
- Encoder

Consumer		Current consumption
Control		0.5 A
Power unit	Housing 2 / 3 / 4	0 A
	Housing 6	0.6 A
	Housing 7 / 8 / 9	1.0 A
Consumer	Brake	Max. 2.0 A
	Encoder	Max. 0.5 A
	Digital output DO1	Max. 0.1 A
	Digital output DO2	Max. 0.1 A
	Voltage output 24Vout	Max. 0.1 A
	Sum DO safety modules	Max. 0.2 A

Tab. 12: Calculation the current consumption

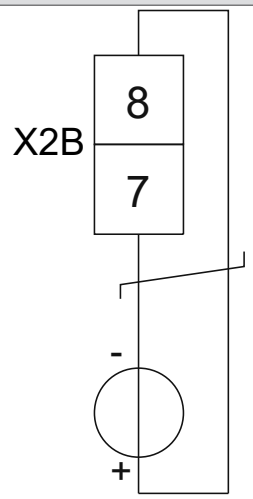
In order to calculate the input current, the currents of the power unit, control and other loads must be added together. The actual current required can be used for the consumers. The maximum current must not be exceeded.

4.3.3.2 External supply

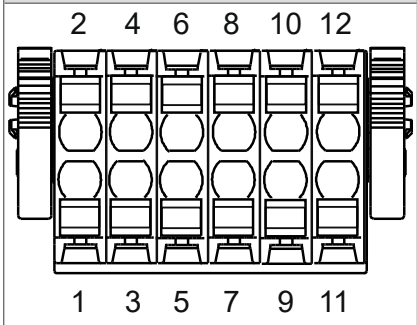
Specification external supply

Voltage	DC 24 V (+20 % / -17 %)
Current consumption	Calculated value up to max. 4.8 A

Voltage supply of the control board



4.4 Terminal strip X2C

X2C	PIN	Name	Notes
	1	CAN low	internally bridged operationally isolated
	2	CAN low	
	3	CAN high	internally bridged operationally isolated
	4	CAN high	
	5	CAN GND	CAN ground operationally isolated (can be wired depending on the customer subscriber).
	6	CAN GND	
	7	AN1-	non-isolated difference input 1
	8	AN1+	
	9	AN2-	non-isolated difference input 2
	10	AN2+	
	11	0V	Reference potential
	12	ANOUT	Analog output

Tab. 13: Assignment of the terminal block X2C

Description CAN bus (≡► CAN [▷ 27])

4.4.1 Analog input

NOTICE

No potential separation of the analog inputs to the control voltage!

Malfunctions or defects due to voltage differences.

a) If the analog value is outside the common mode range, a potential equalisation cable is required between the analog source and the analog input. Connect the potential equalisation cable to 0V of the control terminal block.

NOTICE

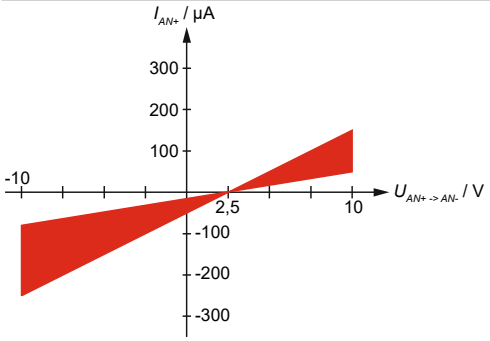
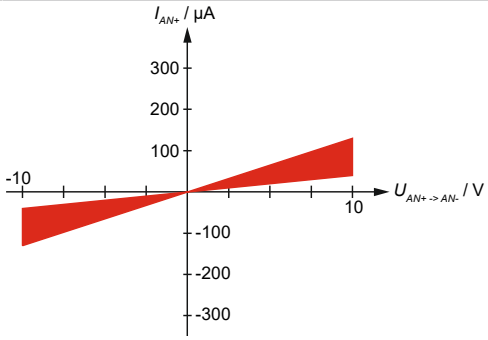
Common-related operation of an analog differential input!

25 % setpoint with open conducter.

a) If pin AN- is connected to common, a voltage of 2.5 V appears from AN+ to AN- with open conductor (also in the event of a cable break). This corresponds to a setpoint of 25 % in the factory setting.

b) Depending on the control board (see programming manual), cable break detection is only possible in 4...20 mA mode.

The following characteristics show the internal resistance depending on the wiring.

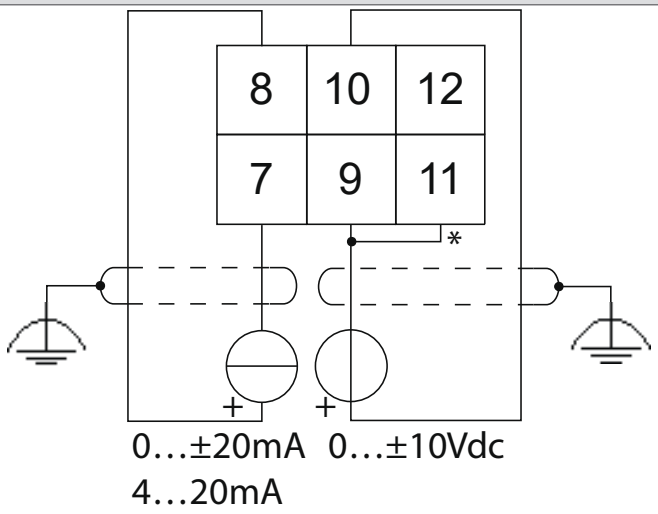
Common-related voltage measurement (AN- to common)	Differential voltage measurement
	

Specification (differential inputs)

Number	2
Name	AN1, AN2
Terminals	X2C.7 (AN1-); X2C.8 (AN1+) X2A.9 (AN2-); X2C.10 (AN2+)
Classification	Non-isolated differential input
Input signals	Current/voltage switchable
Voltage input	DC 0…±10 V
Current input	DC 0…±20 mA; DC 4…20 mA
Input impedance current input	235 Ω…240 Ω
Common mode range	-12.5 V…17.5 V

Connection

Connection of the analog differential inputs AN1 and AN2



*) Equipotential bonding conductor

4.4.2 Analog output

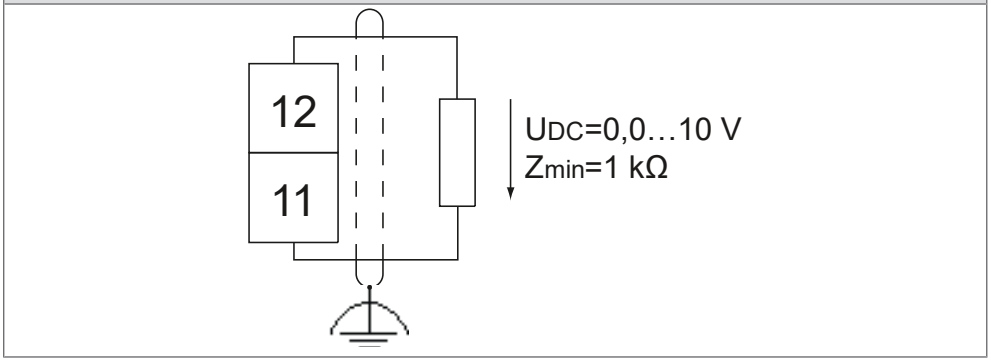
Specification

Number	1
Name	ANOUT
Terminals	X2A.12 analog output X2A.11 reference potential

Classification	DIN EN 61131-2
Voltage output	DC 0.0…10 V (corresponds to 0…100 % output value)
Minimum load impedance	1 kΩ
Notes	In the range up to 0.1 V the output value is not linear to the output voltage.

Connection

Connection of the analogue output ANOUT



5 Diagnosis/visualisation X4A

The integrated serial interface provides the following functions:

- Parameterization of the device with the KEB software COMBIVIS.
- Connection for operator keyboard/display.
- Connection for Bluetooth adapter.
- DIN66019II as communication protocol.

Interface	Specification
RS485	Common-mode voltage range 0…12 V
RS232	ANSI TIA/EIA-232

Tab. 14: Serial interfaces

Name	Material number
Bluetooth adapter	0058060-0060

Tab. 15: Accessories

Name	Material number
RS232 PC inverter (SubD-9 coupling - SubD-9 plug)	0058025-001D
RS232/USB (USB serial converter inclusive cable)	0058060-0040

Tab. 16: Connecting cable

NOTICE

No potential separation of the diagnostic interface to the control voltage!

Malfunction or defect can be caused by voltage differences.

a) Install equipotential bonding conductor if voltage differences > common-mode voltage range.

XML file required for COMBIVIS 6.

a) A current XML file is required for the operation with COMBIVIS 6.

b) The download can be done directly from COMBIVIS 6 while an Internet connection is present.

5.1 Assignment of the terminal strip X4A

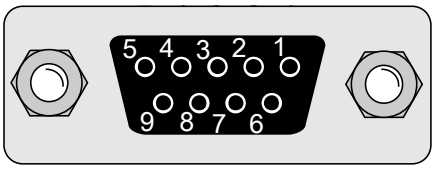


Fig. 1: Pin assignment socket D-Sub-9 (top view)

1	reserved	2	TxD (RS232)
3	RxD (RS232)	4	RxD-A (RS485)
5	RxD-B (RS485)	6	reserved
7	DGND (reference potential)	8	TxD-A (RS485)
9	TxD-B (RS485)		

5.2 Data cable RS232 PC-Drive Controller

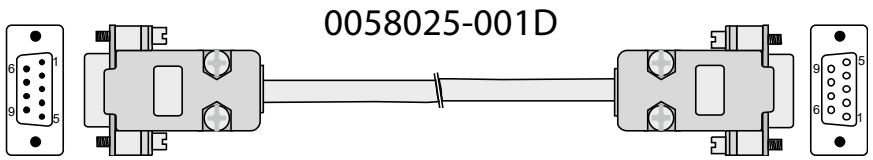


Fig. 2: Serial cable for the connection to a PC

5.3 USB-serial converter

The USB serial converter (material number 0058060-0040) is used to connect drive controllers, operators or IPC controllers with DIN 66019 interface or HSP5 interface to the USB port of personal computers. The USB-serial converter is internally electrically isolated.

5.4 Connection of the RS485 interface

The RS485 interface supports half-duplex and duplex operation. Wiring examples can be found in the following link:

	Technical information - RS485 connection: (🌐► https://www.keb-automation.com/000C) Document: ti_dr_tn-rs485-connection-0002_en	

5.5 Remote control

The F6 operator with display/keypad can be operated up to 30 m away from the unit.

Recommended connection:

- Commercially available network cable 1:1 with RJ45 plugs (min. CAT5)
- Install to both ends an RJ45 socket on D-SUB DE-9 (1x female; 1x male)
- **Important!** The shielding from X4A to the operator must be connected via the CAT5 cable.

Signal	D-SUB DE-9 pin	RJ45 pin
RxD-A	4	1
RxD-B	5	2
TxD-A	8	4
TxD-B	9	5
reserved	6	3
DGND	7	6
Shielding	Housing	Housing

Tab. 17: Wiring of the DE-9 - RJ45 adapters

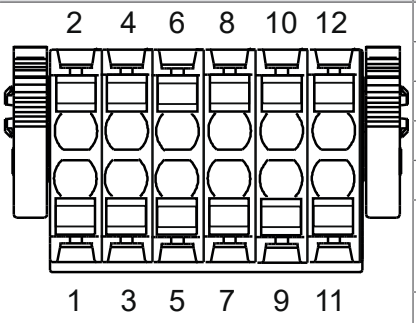
6 Fieldbus interfaces

6.1 Type code fieldbus

A CAN interface is integrated in the control unit as standard. Other fieldbus interfaces are identified by the 10th digit of the material number.

10. digit	**Control board variant**
1	COMPACT | Multi encoder interface, CAN®, STO, EtherCAT®
2	COMPACT | Multi-Encoder Interface, STO, VARAN®

6.2 CAN

X2C	PIN	Name	Notes
	1	CAN low	internally bridged operationally isolated
	2	CAN low	
	3	CAN high	internally bridged operationally isolated
	4	CAN high	
	5	CAN GND	CAN ground operationally isolated (can be wired depending on the customer subscriber).
	6	CAN GND	
	7	AN1-	non-isolated difference input 1
	8	AN1+	
	9	AN2-	non-isolated difference input 2
	10	AN2+	
	11	0V	Reference potential
	12	ANOUT	Analog output

Tab. 18: Assignment of the terminal block X2C

Specification

Fieldbus type	CAN® (EtherCAT version only)
Transmission level	According to DIN ISO 11898; ISO High Speed
Transmission speed	20, 25, 50, 100, 125, 250, 500, 1000 kbit/s; adjustable via (fb66)
Potential separation	Operationally isolated (functionally isolated) to the control potential.
Bus termination	Wire 120 Ω external between (CAN High and CAN Low) at both ends of the bus line.

Connection

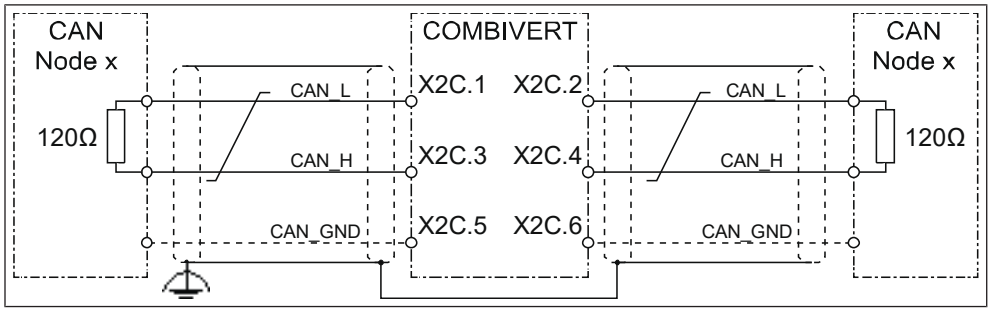


Fig. 3: Connection CAN bus

NET ST - LED in CAN mode

According to CiA 303-3, the NET ST LED is a combination of RUN and ERROR LED.

Light pattern NET ST LED (red/ green combination)

Status	Light pattern	Description
Pre-Op	g-0 (grid 200 ms)	Device in state PRE-OPERATIONAL
Stop	g-0-0-0-0-0 (grid 200 ms)	Device in state STOPPED
Op	g (continuously	Device in state OPERATIONAL no error
Bus off	r (continuously)	CAN bus off.
Invalid Configuration	r-0 (grid 200 ms)	General configuration error.
Warning limit reached	r-0-0-0-0-0 (grid 200 ms)	The error counter has reached or exceeded a warning level.
Legend	r: Red g: Green 0: off	The signals from red/ green are shifted by 180°. Red has priority for superimposition.

6.3 EtherCAT

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

Specification

Fieldbus type	EtherCAT
Transmission level	100Base-Tx according to IEEE802.3 with autonegotiation and auto-crossover
Connections	X4B: EtherCAT IN X4C: EtherCAT OUT
Device addressing	ECAT-Addr; is usually assigned by the master at start-up.
Device identification	StationAlias is supported. The cell in the ECAT-EEPROM(SII) can be written by the master and is stored non-volatile. Extension of the state machine is not supported (IdentificationReg 134 = False).
Hot Connect	Yes via StationAlias.
Number SyncManager	4 (Receive, Send-Mailbox, PDOUT, PDIN data).
Number FMMUs	3 (PDOUT, PDIN data, Send-Mailbox-Status).
Max. number PDOUT data	Max. 2 PDOs; Mapping freely selectable. 32 Byte + optional FSoE data. 64 Byte + optional FSoE data (from SW 2.8).
Max. number PDIN data	Max. 2 PDOs; Mapping freely selectable. 32 Byte + optional FSoE data. 64 Byte + optional FSoE data (from SW 2.8).
Acyclic data traffic:	Supported mailbox protocols CoE; SDO download; SDO-Upload (Complete Access is not supported); Emergency
Distributed Clocks (DC)	Yes, 32 Bit; minimum cycle time: 500 µs (is22=8 x tp) 250 µs (is22=4 x tp) from SW 2.8 => Synchronous communication mode

Connection

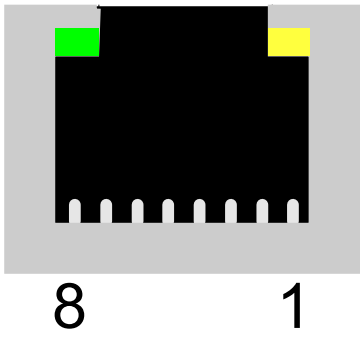


Fig. 4: RJ45 socket front view

PIN	RJ45 without supply voltage (Viewing with Auto-Cross Over)	
1	TX+	RX+
2	TX-	RX-
3	RX+	TX+
4	Reserved	
5	Reserved	
6	RX-	TX-
7	GND	
8	GND	

Tab. 19: PIN assignment RJ45 EtherCAT

LED / light pattern	Function
Yellow	**without function**
Green	**Link/Activity**
Off	Port closed
On	Port open; no data traffic
Flicker	Port open; with data traffic

Tab. 20: Function of the LEDs

According to ETG1300, the NET ST LED is a combination of RUN and ERROR LED.

Light pattern NET ST LED (red/ green combination)

Status	Light pattern	Description
init	0	Device in INITIALISATION status; no error
Pre-Op	g-0 (grid 50 ms)	Device in PRE-OPERATIONAL status
Safe-Op	g-0-0-0-0-0 (grid 200 ms)	Device in SAFE-OPERATIONAL status
Op	g (permanent)	Device in OPERATIONAL status; no error
error	R (permanent)	Communication or device error.
LOAD ERROR	r-0 (grid 50 ms)	Loading error during initialisation
Invalid configuration	r-0 (grid 200 ms)	General configuration error.
Warning limit reached	r-0-0-0-0-0 (grid 200 ms)	An error counter has reached or exceeded the warning level.
Local Error	r-0-0-0-0-0 (grid 200 ms)	Local error; Device has independently changed status from OPERTIONAL to SAFE-OPERATIONAL. Error bit is set to "1".
Process Data or EtherCAT Watchdog	r-0-r-0-0-0-0-0 (grid 200 ms)	A watchdog error has occurred in the application.
Legend	r: Red g: Green 0: off	The red/green signals are shifted by 180°. In case of overlapping, red has priority.

Error status list

Error	Meaning	Example
Communication or device error	A communication or device error has occurred.	The device stops responding

Error	Meaning	Example
Process data watchdog timeout	The watchdog application reports a timeout.	Sync-Manager timeout
Local error	The fieldbus status has changed due to an error.	Device changes its EtherCAT status from OP to SafeOPError due to a synchronisation error.
Invalid configuration	General configuration error	Change of status due to register or object settings that are not possible or invalid hardware configuration.
Loading error	Loading error during initialisation	Checksum error in the flash memory of the application controller.

Tab. 21: Error status list

6.4 VARAN

Specification

Fieldbus type	VARAN
Transmission level	100Base-Tx according to IEEE802.3 with autonegotiation and auto-crossover
Connections	X4B: VARAN IN X4C: VARAN OUT

Connection

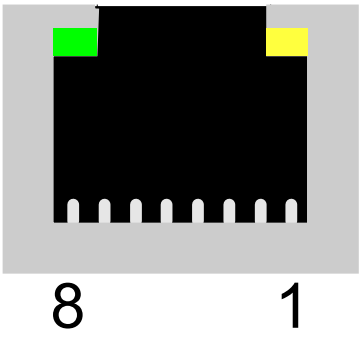


Fig. 5: RJ45 socket front view

PIN	RJ45 without supply voltage (Viewing with Auto-Cross Over)	
1	TX+	RX+
2	TX-	RX-
3	RX+	TX+
4	Reserved	
5	Reserved	
6	RX-	TX-
7	GND	
8	GND	

Tab. 22: PIN assignment RJ45 VARAN

LED / light pattern	Function
yellow	**Activity**
off	No data traffic or deactivated
ON	Lights up when receiving data via the VARAN bus
green	**Link**
off	No connection
On	Lights up when there is a connection between two PHYs.

Tab. 23: Function of the LEDs

Light pattern NET ST LED

At VARAN, the NET ST LED has no function.

7 Encoder interfaces

7.1 Multi-Encoder-Interface

The multi-encoder interface consists of two channels. Channel A supports the following encoder types:

- Incremental encoder input (RS485) with or without zero signal
- Resolver
- EnDat (digital with 1 Vpp incremental signals)
- BiSS (digital)
- Hiperface
- SinCos with/without zero signal; with/without absolute position (SSI or analogue 1 Vpp)

Channel B supports the following encoder types:

- Incremental encoder input (RS485) with or without zero signal
- Incremental encoder input (HTL)
- Incremental encoder output (RS485)
- SSI
- BiSS (digital)
- EnDat (digital)

NOTICE

Connection of analog and digital EnDat encoders!

a) Analog EnDat encoders can only be operated on channel A.

b) Digital EnDat encoders can be operated on channel A and/or channel B.

c) Mixed operation of analog and digital EnDat encoders is not possible.

NOTICE

Undefined states by plugging of encoder cables during operation!

Malfunctions can be caused by incorrect speed or position values.

a) Never plug or unplug the connector on the encoder interface during operation.

7.1.1 Input signals

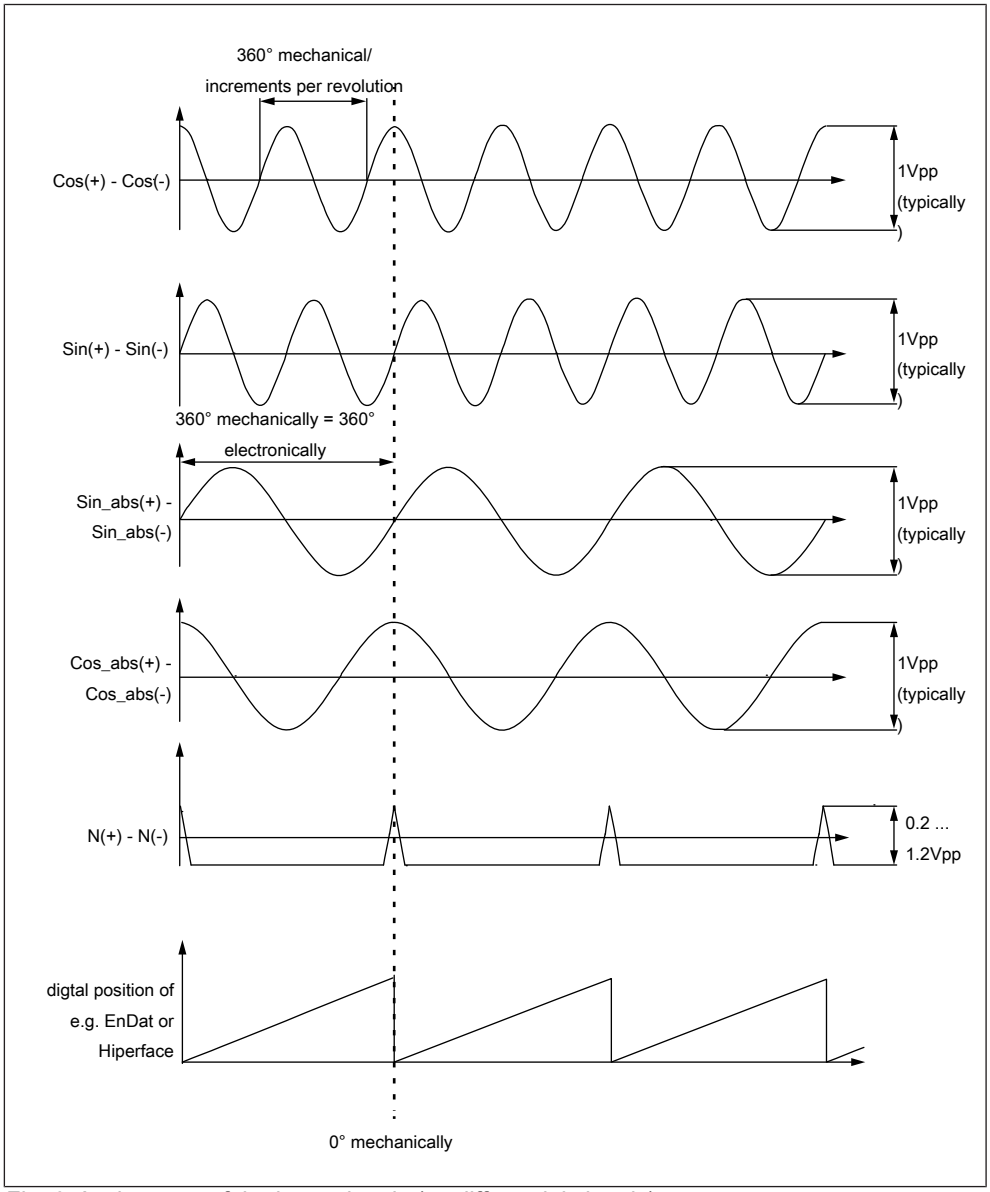


Fig. 6: Assignment of the input signals (as differential signals)

a) For rectangular incremental signals, the characteristic of the signal corresponds to A -> COS and B-> SIN.

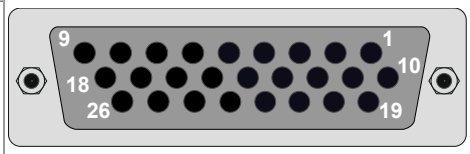
b) The identification "C" and "D" for the absolute signals must be checked. Frequently signal C corresponds to -> SIN_abs and D to -> (inverted) COS_abs.Thus D+ is at COS_abs- and D- is at COS_abs+.

Alternative designation of encoder signals (≡► Info)

Encoder signal	KEB signal input	Encoder signal	KEB signal input
A+	COS+	B+	SIN+
A-	COS-	B-	SIN-
R+	N+	R-	N-
C+	SIN_abs+	D+	COS_abs-
C-	SIN_abs-	D-	COS_abs+

Tab. 24: Alternative designation of encoder signals

7.1.2 Encoder sockets X3A/X3B

X3A / X3B: connector socket			(front view socket)			D-Sub DB-26 (HD), triple row		
Counterpart: connector						D-Sub DB-26 (HD), triple row, with fixing screws UNC 4.40		
Encoder	Incremental encoder RS485 and 1Vpp (only channel 1)	Incremental encoder HTL	Resolver	Hiperface	SinCos (absolute)	SSI, EnDat (digital 2.1/2.2), BiSS (digital)	Sin/Cos-SSI, EnDat (1Vpp + digital 2.1/2.2), BiSS (digital)	Incremental encoder emulation RS485
Channel	A / B	B	A	A	A	A / B	A	B
PIN								
1	A+			Cos+	Cos+		Cos+	A+ (out)
2	A-			Cos-	Cos-		Cos-	A- (out)
3	B+			Sin+	Sin+		Sin+	B+ (out)
4	B-			Sin-	Sin-		Sin-	B- (out)
5	N+			Data+	N+	Data+	Data+	N+ (out)
6	N-			Data-	N-	Data-	Data-	N- (out)
8, 9	5.25 V (available as soon as a sensor type is set)							
10			Cos+		Cos_abs+	Clock-	Clock-	
11			Cos-		Cos_abs-			
12			Sin+		Sin_abs+	Clock+	Clock+	
13			Sin-		Sin_abs-			
14			Exciter+					
15			Exciter-					
7, 16, 17	0V/COM and internal shields							
18	24 V	24 V			24 V	24 V	24 V	
19		A_HTL+						
20		A_HTL-						
21		B_HTL+						
22		B_HTL-						
23		N_HTL+						
24		N_HTL-						
25, 26	8 V (depending on parameter ec14, if an encoder type is set)							

Tab. 25: Assignment of encoder sockets X3A and X3B

Notes for PIN 25/26

Supply voltage of U_{DC} = 8 V is only output if

- parameter ec14 bit 1 = "manual" and ec14 bit 0 = "8V" is set.
- parameter ec14 bit 1 = "automatic" and ec16 = "Hiperface" or "Resolver" is set.

All other voltages at these contacts are not defined and must not be used to supply encoders!

7.1.3 Encoder cable length

The maximum encoder cable length is 50 m. In addition, the value is limited by the signal frequency, cable capacity and supply voltage.

The maximum encoder cable length due to the voltage drop on the supply line is calculated as follows:

$$\text{max. encoder cable length} = \frac{\text{voltage supply - min. encoder voltage}}{\text{max. encoder current} \bullet 2 \bullet \text{wire resistor per meter}}$$

Fig. 7: Encoder cable length

The supply voltage depends on the set encoder. The other values can be found in the data sheet of the encoder and the encoder cable.

7.1.4 Encoder cable

Pre-assembled encoder cables:

- offer the best protection against interference.
- save installation time.
- are available in cable lengths of 5 m, 10 m, 15 m, 20 m, 25 m and 30 m.

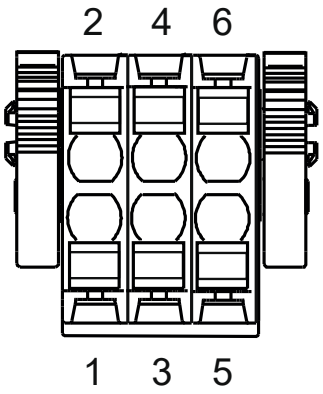
7.1.5 Description of the encoder interfaces

PIN	Signals	Description
1, 2, 3, 4	A+/- B+/- Cos+/- Sin+/-	**Only channel A:** Input for two sine-wave, shifted by 90° differential signals with 1 Vpp, maximum 200 kHz. Single-ended (e.g. Cos+ against GND): Constant component 2.5 V ±0.5 V Differential (e.g. Cos+ against Cos-): Constant component 0 V ±0.1 V signal level Uss=0.6 V…1.2 V **Channel A:** Input for square-wave incremental signals according to RS485 maximum 200 kHz. **Channel B:** Input for square-wave incremental signals according to RS485 maximum 500 kHz. Incremental encoder simulation: Position changes of channel A are output to channel B with two 90° shifted RS485 signals.Maximum output frequency 500 kHz.
5, 6	N+/- Data+/-	**Only channel A:** Input zero signal once per revolution. Differential signal level (N+ … N-): • higher 50 mV: zero signal is active • from 50 mV to -50 mV: undefined • lower -50 mV: zero signal is inactive Signal length 330°…360° of the signal length of the incremental signals. **Channel A and B:** Input zero signal or data RS485. Zero signal is 1-active, if signals A and B are also 1-active. **only channel B:**

PIN	Signals	Description
		Output zero signal RS485. Zero signal is 1-active, if signals A and B are also 1-active. Is output, if the position on channel A is 0°.
10, 11, 12, 13	Sin+/- Cos+/- Sin_abs+/- Cos_abs+/-	**Only channel A:** Input for sinusoidal absolute signals Uss=1 V for SinCos encoder Uss=3.8 V maximum for resolver
10, 12	Clock+/-	Output for clock signal RS485
14, 15	Exciter+/-	**Only channel A:** Output field voltage for resolver: Ueff=2.54 V ≙ Uss=7.2 V ±5 %; max. Ieff=30 mA; 10 kHz Coupling factor for resolver: 0.5 ±10 % Phase shifting 0° ±5°
25, 26	5.25 V / 8 V	Output supply voltage for encoder: ec14 = 0 => 5.25 V +5 %/ -10 % ec14 = 1 => 8 V +5 %/ -10 % ec14 = 2 => automatically, depending on the set encoder type (ec16) Max. 500 mA total (250 mA per channel)
8, 9	5.25 V	Output supply voltage for encoder: 5.25 V +5 %/ -10 % Max. 500 mA total (250 mA per channel)
18	24 V	Output supply voltage for encoder: Udc=24 V max. 500 mA total (250 mA per channel) • Minimum P24V_IN - 3 V • Maximum P24V_IN
19, 20, 21, 22, 23, 24	A_HTL+/- B_HTL+/- N_HTL+/-	**Only channel B:** Input HTL signals 10 V…30 V maximum 150 kHz

Tab. 26: Encoder specifications

8 Brake control and temperature detection

X1C	PIN	Name	Notes
	1	BR+	Brake control / output
	2	BR-	Brake control / output
	3	Reserved	
	4	Reserved	
	5	TA1	Temperature detection / input +
	6	TA2	Temperature detection / input -

Tab. 27: Assignment of the terminal block X1C

8.1 Brake control

⚠ CAUTION

Incorrect dimensioning of the brake may cause malfunctions

Brake does not release or only with delay

a) Choose the input voltage tolerance of the brake corresponding to the tolerance of the output voltage.

b) Use an auxiliary relay or contactor if necessary.

Specification brake/relay output

Name	BR+ (X1C.1); BR- (X1C.2)
Function	Output to supply a brake or relay.
Output voltage (DC)	minimum P24Vin – 2.4V maximum P24Vin
maximum output current	2 A
Others	Internal free-wheeling path; internal filter circuit; short-circuit proof

Connection

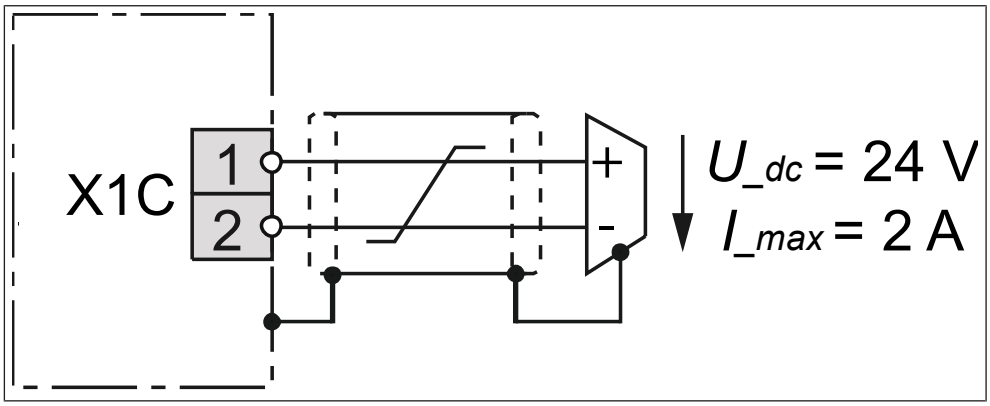


Fig. 8: Connection of a brake

8.2 Temperature detection

⚠ DANGER

Electric shock by sensors without protective separation!

a) Only use sensors with basic insulation.

NOTICE

Malfunctions due to wrong cables or incorrect placement!

Malfunctions of the control due to capacitive or inductive coupling.

a) Motor temperature sensor conductors must not be routed together with other low voltage control cables; even when shielded.

b) Motor temperature sensor conductors must be double shielded when inclosed in the same overall cable containing the U,V,W motor conductors.

Specification temperature input

Name	TA1; TA2
Terminals	X1C.5 (TA1) input + X1C.6 (TA2) input -
Function	Temperature sensor input (switchable)
Others	Terminals TA1 and TA2 have basic insulation to the SELV voltage (DC 24 V) of the control card. A system voltage of 300 V is defined (Phase – PE).

A switchable temperature evaluation is implemented in COMBIVERT. The desired operating mode can be adjusted by software (dr33).

Operating mode (dr33)		Resistance	Temperature/state
0	KTY84/130	0.49 kΩ	0 °C
		1 kΩ	100 °C
		1.72 kΩ	200 °C
1	PTC in accordance with EN 60947-8 (standard)	<0.75 kΩ	TA1-TA2 closed
		0.75…1.5 kΩ	Reset resistance
		1.65…4 kΩ	Tripping resistance
		> 4 kΩ	TA1-TA2 open
2	by encoder	digital by the encoder channel	
3	KTY83/110	0.82 kΩ	0 °C
		1.67 kΩ	100 °C
		2.53 kΩ	175 °C
4	PT1000	1 kΩ	0 °C
		1.38 kΩ	100 °C
		1.75 kΩ	200 °C
-	Monitoring	<0.04 kΩ	Short circuit
		> 79.5 kΩ	No connection (sensor break)

8.2.1 Operation without temperature detection

Use of the COMBIVERT without evaluation of the temperature input:

Switch off evaluation (pn12 =7) or install bridge between terminal TA1 (X1C.5) and TA2 (X1C.6) (dr33=1).

8.2.2 Connection of a KTY sensor

NOTICE

No protection of the motor winding in case of wrong connection!

Non-observance leads to incorrect measurements and possibly to the destruction of the motor winding.

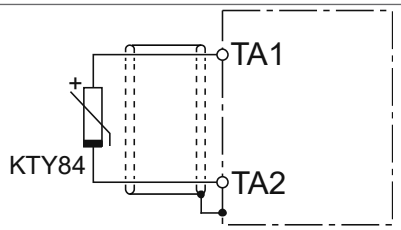
a) Operate KTY sensors in forward direction.

b) KTY sensors may not be combined with other sensors.

Settings KTY input

Setting dr33 = 0 => KTY84/130
dr33 = 3 => KTY83/110

Connection KTY sensor

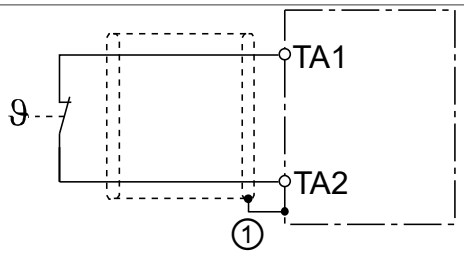
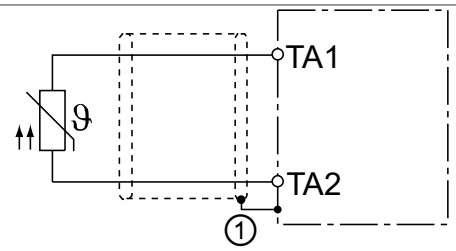
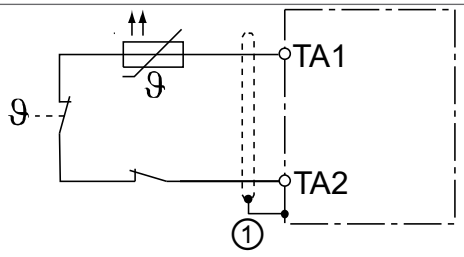


8.2.3 Connection of PTC, temperature switch or PT1000

Settings of PTC, temperature switch or PT1000

Stetting dr33 = 1 => PTC or temperature switch
dr33 = 4 => PT1000

Connection

Thermal contact (NC contact)	
Temperature sensor (PTC) or PT1000	
Mixed sensor chain	
① Connection via shield bracket (if not available, place on mounting plate).	

Tab. 28: Connection examples

9 Safety function STO

⚠ DANGER

Improper installation of safety technology!

Death and serious bodily injuries.

a) Therefore the safety functions may only be installed and put into operation by qualified personnel which are trained in safety technology.

b) Check the safety functions and error responses and generate an acceptance report after installation.

Electronic protective devices are used to integrate safety functions into the drive control system in order to minimise or eliminate hazards caused by malfunctions in machines.

The integrated safety functions replace the time-consuming installation of external safety components. The safety functions can be requested or triggered by a fault.

Safety functions protect persons from mechanical damage when project planning, installation and operation are carried out properly.

⚠ WARNING

Failure of safety functions

No protection

✓ To ensure the safety permanently:

a) The safety functions must be checked in regular intervals.

b) The intervals result from the risk analysis.

c) The useful life is limited to 20 years. After this time the unit must be replaced.

9.1 Description of STO

STO **(Safe Torque Off) "Safe Torque Off"**

In hazardous areas, set-up or troubleshooting work may be necessary where protective devices such as mains or motor contactors should not be activated. The safety function STO can be used there.

Compared to disconnection by mains contactors or motor contactors, the integrated safety function enables the drives of a system to be easily combined into functional groups. The safely switched off torque can thus be limited to certain plant areas. Depending on the application, the use of mains or motor contactors can be omitted by using STO.

In error case or on demand, the power semiconductors of the drive module are switched off and no energy is supplied to the drive which would cause rotation or torque (or in the case of a linear drive, movement or force). If an error occurs, the system can still be switched off safely or remain switched off.

⚠ DANGER

Continue mains voltage with active STO function!

Electric Shock

a) Always switch off the power supply before working on the device.

b) Await discharge time.

Another advantage is that the charging and discharging time of the DC link must not be considered. This means that the system is ready for operation again more quickly after an operational interruption.

Regular electromechanical equipment is subject to wear and tear. Using the STO function eliminates the need for these items of equipment and reduces maintenance costs.

Characteristics for STO **:**

- Energy supply for the rotating field of the motor is interrupted (motor coasts down).
- Use when monitoring for standstill is not required.
- Unintentional start-up of the motor is prevented.
- No galvanic isolation of the motor from the drive controller DC link.

The safety functions meet the requirements of performance level e (ISO 13849-1) and SIL 3 (IEC 61508 and IEC 62061).

Safety functions protect persons from mechanical damage when project planning, installation and operation are carried out properly.

What can the STO function do in relation to EN 60204-1 ?

- Emergency stop can be realised by the STO function, because the mains voltage may still be applied.
- Emergency stop can only be realised in conjunction with a mains contactor that switches off the mains voltage!

9.2 Emergency stop according to EN 60204

By using suitable safety switchgear, the STO function can achieve stop categories 0 and 1 according to EN 60204-1 in the system ().

- **Stop category 0**
  "uncontrolled stop", i.e. stop by immediately switching off the energy to the drive elements.
- **Stop category 1**
  "controlled stop", i.e. the energy to the drive elements is maintained to achieve the stop. The energy is only interrupted when standstill is reached.

Emergency stop according to EN 60204-1 must be functional in all operating modes of the drive module. Resetting emergency stop must not lead to uncontrolled start-up of the drive.

NOTICE

Automatic restart when STO is no longer triggered.

Unpredictable consequences for personnel and machine.

✓ In order to comply with EN 60204-1, observe the following:

a) Ensured by external measures that the drive restarts only after confirmation.

⚠ DANGER

Motor coast in the event of a fault

Danger to persons

✓ If there is a danger to persons after the motor control has been switched off by STO:

a) Block access to the hazardous area.

b) Wait until the drive stops.

⚠ DANGER

Jerking of the drive in the event of a fault

Danger to persons

✓ In case of double malfunction it can lead to unwanted jerk. The rotation angle is depending on the number of poles of the selected drive and the gear ratio.

a) Switch off the supply voltage before carrying out any work on the machine.

b) Await capacitor discharge time (min. 5 minutes). Measure DC voltage at the terminals.

Calculation of the jerk:

Angle of rotation of the jerk Wr = 180°/ (number of pole pairs x gear reduction ratio)

The probability of a jerk is < 1.84-10^{-15} 1/h. This behaviour can be caused by a short circuit of the IGBTs. The error is only to be considered critical if the drive remains in the STO state.

9.3 Classification from STO to IEC 61508

PFH	4.04 • 10^{-12} 1/h
PFD	3.54205 • 10^{-7} per request
Proof test interval	20 years

For the SIL classification in connection with the applications, the failure rates of the external switching devices must be considered for the final assessment.

9.4 Classification from STO to EN ISO 13849

Control category	4
$MTTF_D$	>2500 years
DC value	high

For the classification within a performance level in connection with the applications, the failure rates of the external switching devices must be considered for the final assessment.

9.5 Functional description

The COMBIVERT with integrated safety technology fulfils the following function according to EN 61800-5-2:

The safety-oriented shutdown according to STO is achieved by a two-channel opto-coupler lock. The supply of the optocouplers, which are responsible for the commutation of the connected drive, is done by a transformer coupling of the input voltage. This ensures that the optocouplers cannot be supplied if the input voltage is lost. If the optocouplers are no longer supplied, no IGBT can be controlled and thus no energy can be supplied to the drive.

The dual-channel capability is achieved by using input STO1 to suppress the supply voltage (VTRO) of the upper optocouplers of the inverter bridge and input STO2 to suppress the supply voltage of the lower optocouplers (VTRU).

Maximum switch-on delay (UIN=15V)	7 ms
Maximum switch-off delay (UIN=30 V) at active modulation	10 ms
Maximum switch-off delay (UIN=30 V) at inactive modulation until safe state of the driver voltage is reached.	50 ms

Tab. 29: Technical data of the STO function

9.6 Wiring proposals

9.6.1 Direct switch-off with emergency stop switch

⚠ CAUTION

Emergency stop device in which both contacts are connected together against a positive supply signal!

In case of a short circuit, the system only works on one channel!

a) The wiring must be arranged by way, that no cross-connections occur.

b) Avoid short circuit between adjacent terminals (STO1+ & STO2+, STO1- & STO2- or STO2+ & Out3).

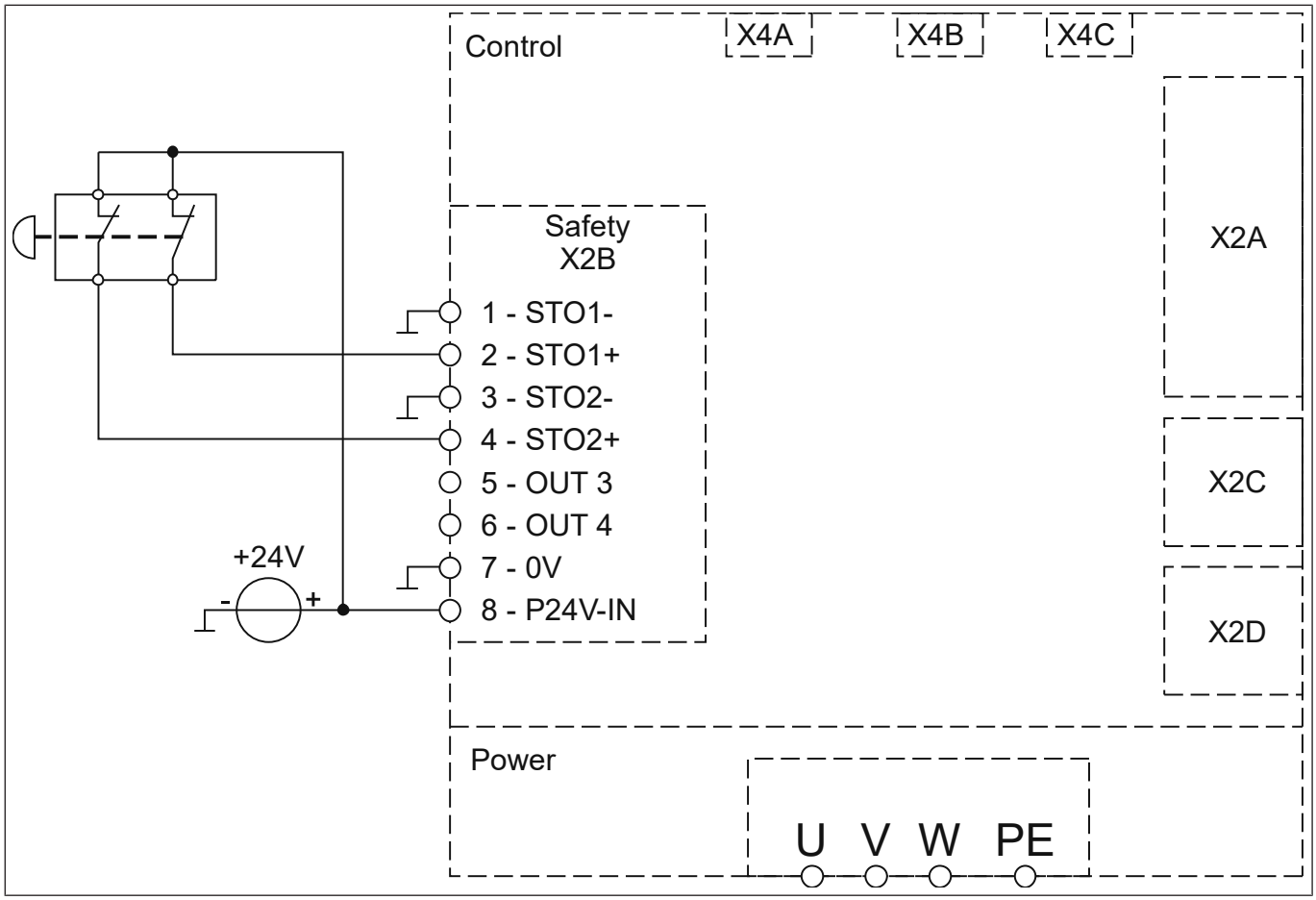


Fig. 9: Direct switch-off with emergency stop switch

9.6.2 Direct switch-off with emergency stop switch and monitoring of the wiring

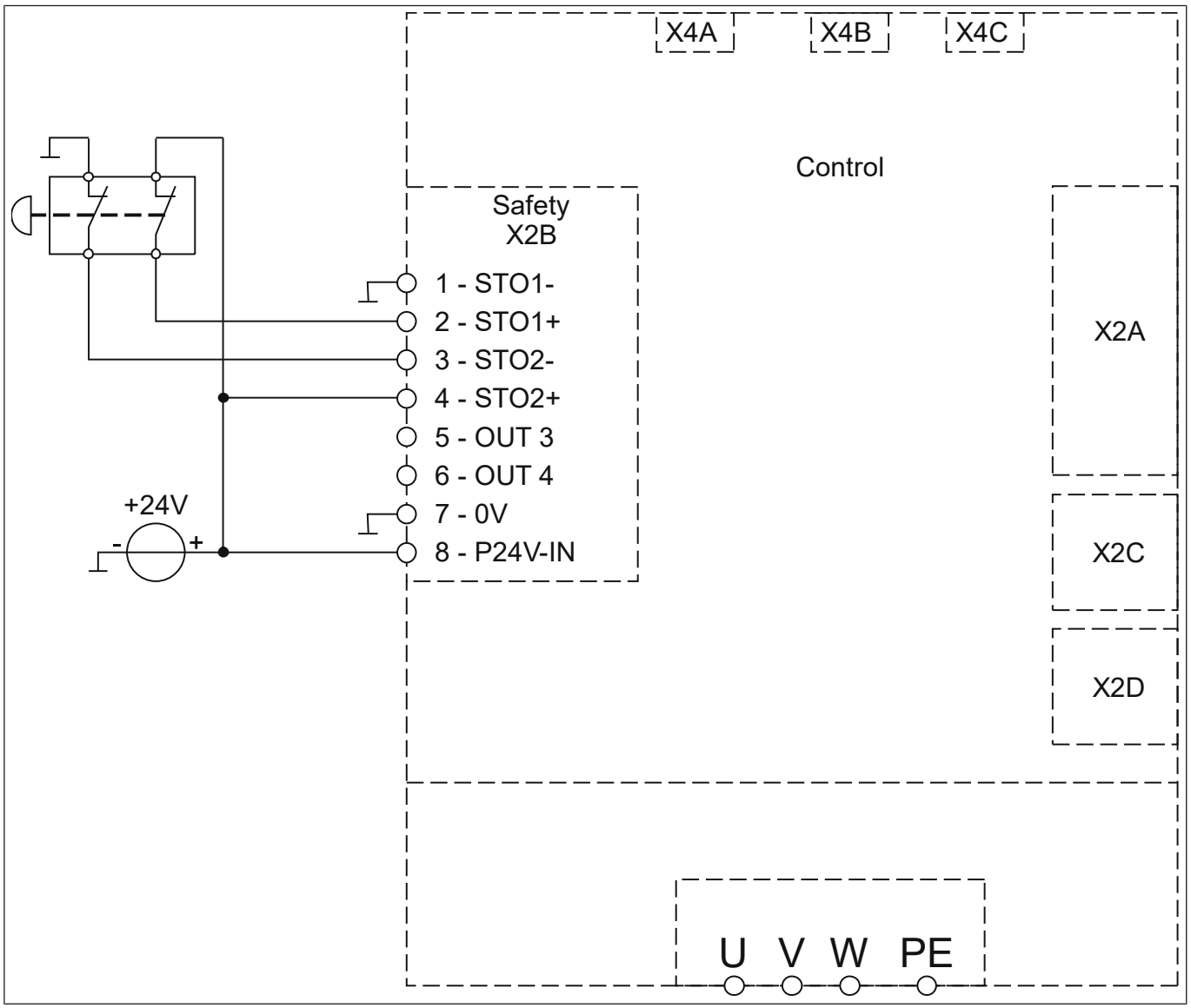


Fig. 10: Direct switch-off with emergency stop switch and monitoring of the wiring

The shown circuit detects wiring faults in the area of the emergency stop switchgear and the supply line. A possible short circuit on the primary side of the emergency stop switchgear (ground and DC +24 V) and a short circuit on the secondary side of the device or within the wiring leads either directly or with closed contacts to a short circuit of the supply, whereby an upstream 24 V fuse trips.

In addition to the two applications shown here with an emergency stop switching device, other sensors (such as door switches, etc.) can be used in the same way.

9.6.3 Direct switch-off by safety module with test pulses

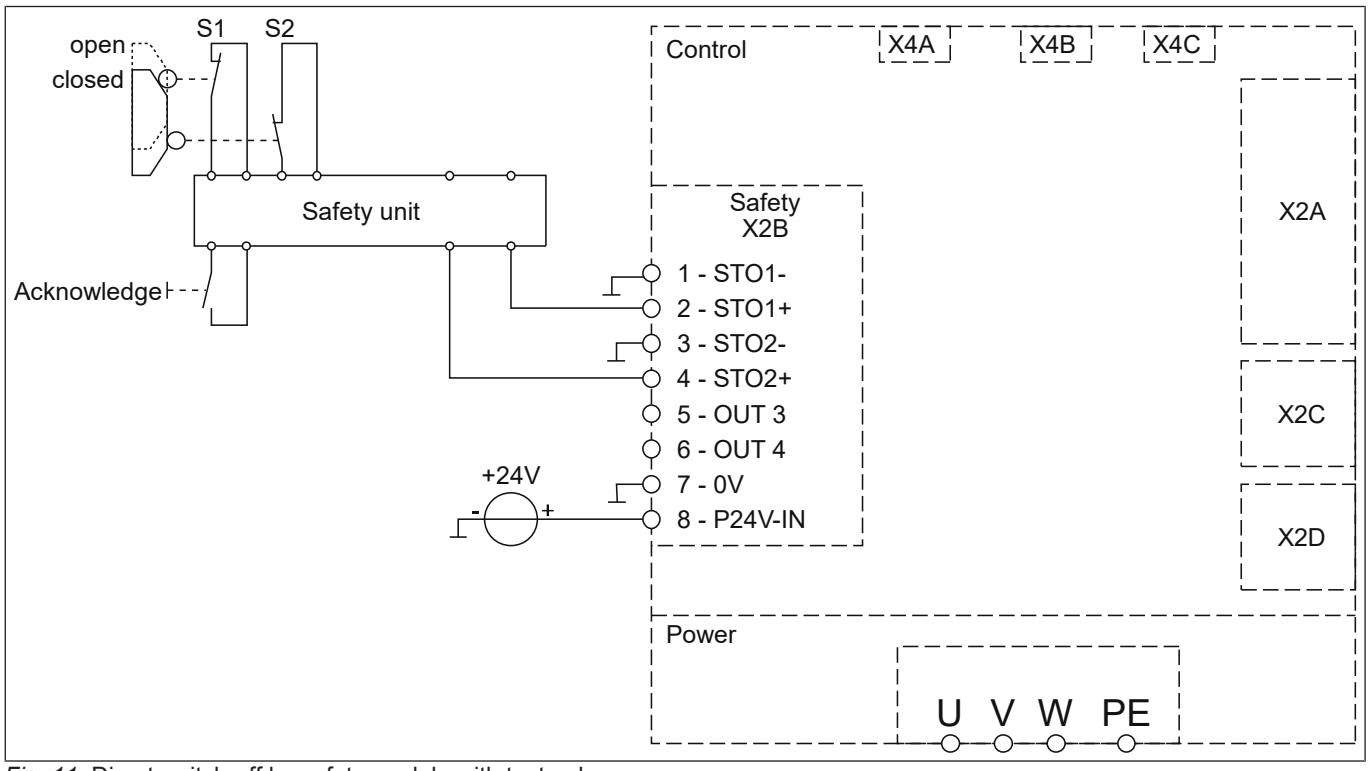


Fig. 11: Direct switch-off by safety module with test pulses

When the emergency stop device is actuated, e.g. by a safety door, the enable paths of the safety module are interrupted. This leads to the removal of the STO signals (X2B.2 and 4) and thus to the energy shutdown of the motor.

The safety module performs a consistency check of all signal paths via test signals (OSSD).

9.6.4 Wiring SS1

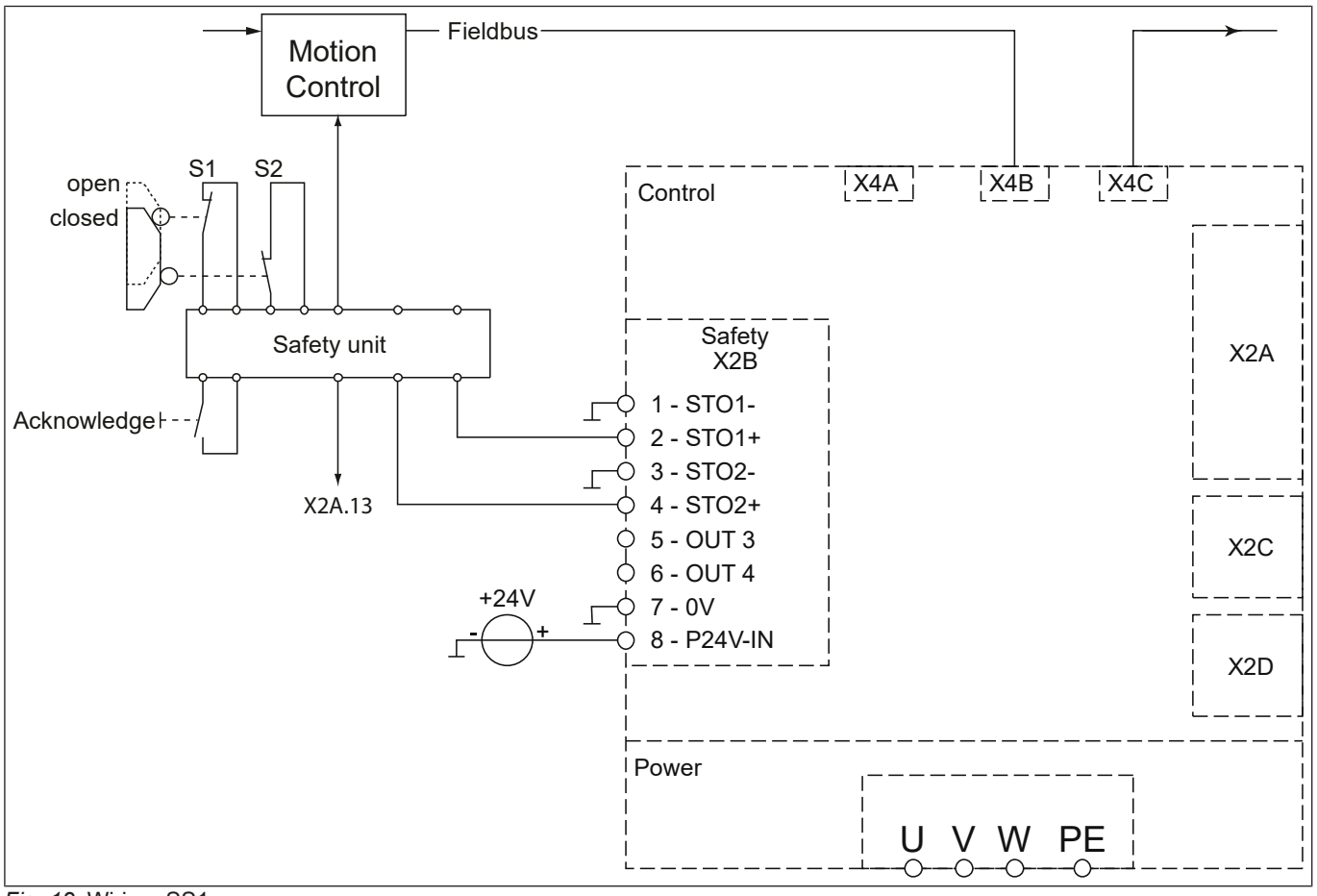


Fig. 12: Wiring_SS1

With triggering SS1 (Safe Stop 1), the motor is only switched torque-free when it has reached standstill [EN 61800-5-2]. The idle state is not queried directly, but the maximum time until the standstill is reached is estimated.

This time period is loaded into a safe time relay that finally switches the motor torque-free.

When the emergency stop device is actuated, the motor is brought to a standstill with a deceleration ramp via input X2A.13 (I7).

At the same time, the safe time expires in the safety module. After the safe time has elapsed, the control signals STO1+ and STO2+ (X2B.2 and X2B.4) are switched off and by way the energy supply of the motor is interrupted.

A suitable parameterisation of the control is necessary for the function "Stop drive".

10 Certification

Current certificates, declarations and revision lists for your product can be viewed or downloaded from our website at the following link:

(🌐► keb-automation.com/search)

By entering the article number, you will receive a list of the corresponding documents in the "Certificates" drop-down menu.

If you need help or further documentation, please contact our customer service.

10.1 CE marking

Conformity with the EU directives and guidelines applicable on the production date is confirmed by the CE mark on the nameplate.

The current EU Declaration of Conformity for this product is available via the link above.

10.2 FS marking

The safety-relevant functions integrated in this product have been developed, implemented and tested in accordance with the applicable standards and guidelines for functional safety. These safety functions were approved as part of a qualified testing and assessment procedure.

The function of the safety-related functions was documented and successfully validated. This ensures that the safety functions fulfil the specified requirements and work reliably under the intended operating conditions.

A corresponding certificate and further information on functional safety are available on our website.

Please note that changes to the product, especially to safety-relevant components, may affect the validity of the acceptance and thus the certificate. In such cases, a re-examination is required.

10.3 UL certification

UL (Underwriters Laboratories) approval ensures that a product fulfils the safety-related requirements for the North American market. UL is an independent organisation that tests and certifies products, components and systems for safety, quality and conformity with applicable standards.

Products that have received UL approval are marked with the UL logo on the nameplate. This symbol indicates that the product has been successfully tested in accordance with UL specifications and is approved for use in the USA or Canada. Depending on the type of approval, the logo with the UL file can also be marked with additional information (e.g. "cULus" for Canada and the USA).

The approval is linked to certain requirements. These are marked accordingly in this and/or further instructions. Only the assemblies/components described in the approval may be used.

A deviation from the tested specifications or the use of non-certified parts can lead to the loss of UL approval and thus jeopardise the operating permit in the target market.

10.4 Further markings

Other markings and approvals not listed here are identified by a corresponding logo on the rating plate or device, if applicable. The corresponding certificates are available on our website.

11 Revision history

Edition	Version	Note	FS
2018-12	00	Pre-series version.	N
2019-07	01	Series version	N
2019-08	02	Values for temperature input changed; editorial changes.	N
2021-08	03	Notes for positive-driven relay inserted; RS485 potential-free inserted; CAN interface; base-isolated temperature input; editorial changes due to conversion to editorial system.	Y
2022-10	04	Function yellow LED EtherCAT changed; Encoder interface pin 19 changed	N
2022-11	05	Changing the filter (F6K) in english version.	N
2023-04	06	New certificate inserted. Designation of the relay changed. Operation without temperature monitoring pn33 changed to pn12. CAN interface functionally isolated. Index corrected in english version.	Y
2023-07	07	CAN interface removed from VARAN.	N
2023-12	08	Alternative designation for encoder signals inserted. Designation X1A removed from wiring proposals for STO. (≡► Terminal strip X2A [▸ 17]) PIN 4 and PIN 11 corrected. (≡► Temperature detection [▸ 37]) Hazard warning corrected. Values for (≡► Assembly of wires [▸ 16]) adapted. (≡► CAN [▸ 27]) corrected. Editorial changes.	N
2025-08	09	Designation GND in 0V/COM at (≡► encoder interfaces [▸ 33]) changed. Note for (≡► common-related operation [▸ 22]) of the analog differential inputs inserted. Warning notice inserted for protection for relay output form C. Chapter Certification revised.	Y

FS: (Y) Version contains safety-relevant changes; (N) version contains changes for product improvement or bug fixing.

List of Figures

List of Tables

Glossary

Application

The application is the intended use of the KEB product.

Autonegotiation

Procedure for determining the max. transmission speed.

BiSS

Open source real-time interface for sensors and actuators.

CAN®

Serial bus system running protocols such as CANopen, Devicenet or J1939. CAN is a registered trademark of the CAN in AUTOMATION - International Users and Manufactures Group e.V.

COMBIVERT

Proper name for a KEB Drive Controller.

COMBIVIS

KEB start-up and parameterizing software.

Customer

The customer has purchased a product from KEB and integrates the KEB product into his product (customer product) or resells the KEB product (reseller).

DC-Value

Diagnostic coverage measures the quality of testing and monitoring measures in accordance with ISO 13849-1.

DIN 66019

Information processing; control method with the 7-bit code during data transmission.

DIN EN 61131-2

Programmable controllers - Part 2: Equipment requirements and tests.

Directive 2006/42/EC

Machinery Directive

Directive 2014/30/EU

Electromagnetic Compatibility (EMC) Directive

Emergency off

Switching off the power supply in case of emergency.

Emergency stop

Shutting down a drive in case of emergency (not de-energised).

EN 60204-1

Safety of machinery - Electrical equipment of machines - Part 1: General requirements (VDE 0113-1, IEC 44/709/CDV).

EN 61800-5-1

Adjustable speed electrical power drive systems. Part 5-1: Safety requirements - Electrical, thermal and energy requirements (VDE 0160-105-1, IEC 61800-5-1)

EN 61800-5-2

Adjustable speed electrical power drive systems. Part 5-2: Safety requirements - Functional safety (VDE 0160-105-2, UL 61800-5-2, IEC 22G/264/CD)

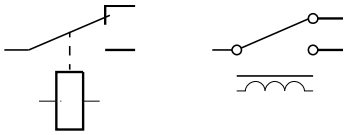
EnDat

Bidirectional encoder interface of the company Heidenhain.

EtherCAT®

EtherCAT is a real-time Ethernet bus system. EtherCAT is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

Form C



IEC NFPA

Form C describes a relay with three contacts (switching contact, NC contact and NO contact). Also named as SPDT (single pole, double throw).

HCT

Component for current measurement in the power circuit.

Hiperface

Bidirectional encoder interface of the company Sick-Stegmann.

HSP5

Fast, serial protocol.

HTL

Incremental signal with an output voltage (up to 30V) -> TTL.

IEC 61508

Functional safety of electrical/electronic/programmable electronic safety-related systems.

IEC 61800-5-1

Electric power drive systems with adjustable speed. Part 5-1: Safety requirements - Electrical, thermal and energy requirements. German version EN 61800-5-1.

IEC 62061

Safety of machinery - Functional safety of safety-related control systems.

ISO 13849-1

Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design.

MTTF

Mean service life until failure (Mean Time To Failure).

PELV

Safe protective extra-low voltage (earthed).

PFD

PFD (Probability of Failure on Demand) is a measure of the failures per demand in accordance with IEC 61508. It is used to determine the reliability of safety-related systems.

PFH

The PFH value (Probability of Failure on Demand per Hour) indicates the average probability of a dangerous failure per hour.

RS485

RS-485 is an industry standard according to EIA-485 for a physical interface for asynchronous, serial data transmission.

SELV

Safe extra-low voltage (unearthed).

SIL

The safety integrity level is a unit of measurement for quantifying risk reduction in accordance with IEC 61508.

SinCos

Incremental encoder with sinusoidal signals.

SSI

Synchronous serial interface for encoder.

STO

Safe torque off (STO).

VARAN

Real-time Ethernet bus system

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