



Instructions for use

COMBIVERT S6

Installation Control PRO

Translation of the original manual

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Imprint

KEB Automation KG
Suedstraße 38, D-32683 Bartrup
Germany
Tel: +49 5263 401-0 • Fax: +49 5263 401-116
E-Mail: info@keb.de • URL: <https://www.keb-automation.com>

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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
(≡▶ Reference ▶ 8])	Reference to a chapter, table or picture with page reference
ru21	Parameter name or parameter index
(🌐▶)	Hyperlink
<Strg>	Control code
COMBIVERT	Lexicon 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 as well as further documents or parts from it for internal purposes. Copyrights are with KEB Automation KG and remain valid in its entirety.

Other wordmarks and/or logos 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) Use suitable voltage sources with safe isolation (SELV/PELV) in accordance with VDE 0100 with nominal voltage of DC 24 V $\pm 10\%$.
- 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 PRO

The control board PRO provides the following functions:

- Digital and analog inputs and outputs
- Serial diagnostic interface for connection to a PC
- Hardware of the control circuit „safety separated“ according to EN 61800-5-1
- Brake control, supply and feedback
- Motor protection by I²t, KTY, PT1000 or PTC input
- 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
07...14	For motor power from 0.75...7.5 kW
3. and 4. digit	Series
S6	COMBIVERT S6
5. digit	Control type
P	PRO
6. digit	Variants
4	reserved
5	Safety module type 5
7. digit	Housing
8. digit	Connection, voltage, options
9. digit	Control board variant
3	PRO Multi-encoder interface, CAN®, RS485 potential-free, Ethernet TCP/IP (no EtherCAT)
4	PRO no encoder interface, CAN®, Ethernet fieldbus interface, safe relay
5	PRO Multi encoder interface, CAN®, Ethernet fieldbus interface, safe relay
E	PRO no encoder interface, CAN®, Ethernet fieldbus interface, safe relay, alternative terminal strip
F	PRO Multi encoder interface, CAN®, Ethernet fieldbus interface, safe relay, alternative terminal strip
10. digit	reserved
11. digit	reserved

3.3 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:

Housing/ phases/ control board	Set contains	Material number
02 / 1ph / PRO	terminal strip 28-pole	00S6ZC0-0011
02 / 3ph / PRO	terminal strip 10-pole	00S6ZC0-0009
04 / 3ph / PRO	terminal strip 8-pole connector 3-pole connector 6-pole shielding bracket 2 x shielding clamp	00S6ZC0-0010

Tab. 1: Connector sets

3.4 Connection and control elements

X1C	Temperature monitoring, brake control/monitoring
X2A	Control terminal block for digital inputs/outputs; 24V supply; relay output; analog inputs and outputs; CAN bus
X2B	Safety module
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 / RS485-Modbus potential-free
X4C	Fieldbus output / Port 1
S1	Rotary coding switch 1 (low byte)
S2	Rotary coding switch 2 (high byte)
FS ST	LED Safety state
VCC	LED voltage supply (24V)
NET ST	LED network / fieldbus state
DEV ST	LED inverter/ device state
OPT	Optional

Tab. 2: Overview Connection and operating elements

3.5 Motor monitoring X1C (temperature, brake)

The terminal block X1C is a 10-pole, pluggable terminal block with spring-cage connection. It contains:

- 2 outputs for control of 24V motor brakes

- 2 control inputs for brakes or relays
- 1 analog input for temperature detection

3.6 Control terminal strip X2A

The control terminal strip X2A is a 28-pole pluggable, double-row terminal strip with spring-cage connection. It contains:

- 8 digital inputs
- 2 digital outputs
- 1 Relay output
- 2 analog inputs (plus 1 switchable analog input)
- 1 analog output
- CAN bus interface
- 24V input and output

3.7 Safety terminal block X2B

The design of the terminal strip X2B depends on the safety module. The description is given in a separate manual for the safety module.

3.8 Encoder interfaces X3A, X3B

The COMBIVERT contains two universal encoder interfaces. The interfaces can be adapted independently to different encoders.

3.9 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.

3.10 Fieldbus interface X4B

The fieldbus interface X4B supports the following protocols depending on the variant:

- EtherCAT IN (Fieldbus)
- Ethernet (Fieldbus)
- RS485 potential-free

3.11 Fieldbus interface X4C

The fieldbus interface X4B supports the following protocols:

- EtherCAT OUT (field bus)
- Ethernet (fieldbus)

3.12 Rotary coding switch S1, S2

If the CAN protocol is active, the rotary coding switches S1 (low byte) and S2 (high byte) define the node ID. If both switches are set to "0" or a faulty node ID is set, the node ID from fb64 is active.

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 ○	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.
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.
Flashing	Green	No error, serves to identify the device (fb.32).

Tab. 6: Function DEV ST - LED

3.13.5 OPT - LED

OPT	LED colour	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

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 90-degree right angle.
- In case of inductive load on the relay outputs, a protective device must be provided (e.g. free-wheeling diode).
- Electromagnetic interference 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 connect the shield at both ends.
 - 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!

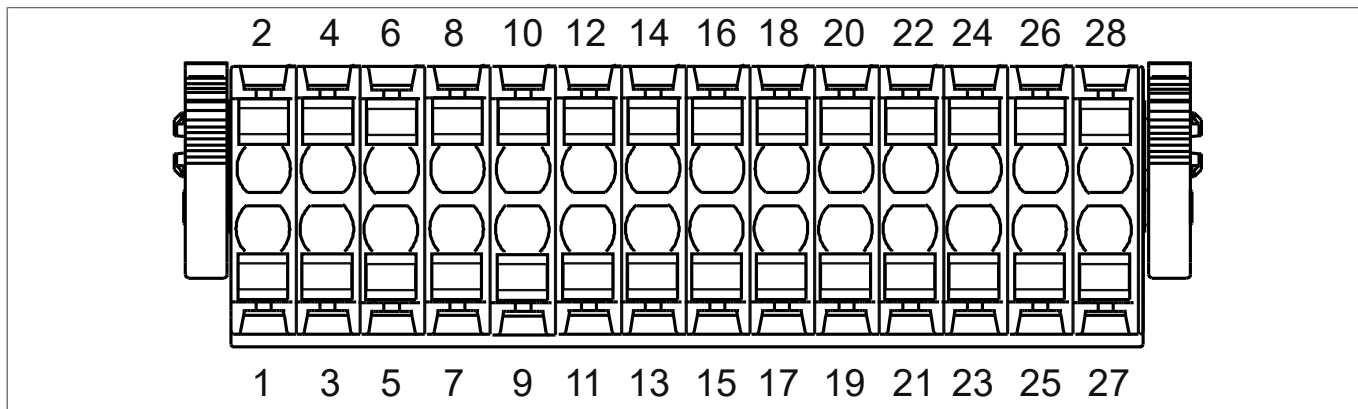
Malfunctions due to loose contacts.

- 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 mm ² (20...17 AWG)	With plastic collars	10 mm	12 mm
0.5...1,5 mm ² (20...16 AWG)	Without plastic collars	10 mm	10 mm
0.2...1.5 mm ² (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



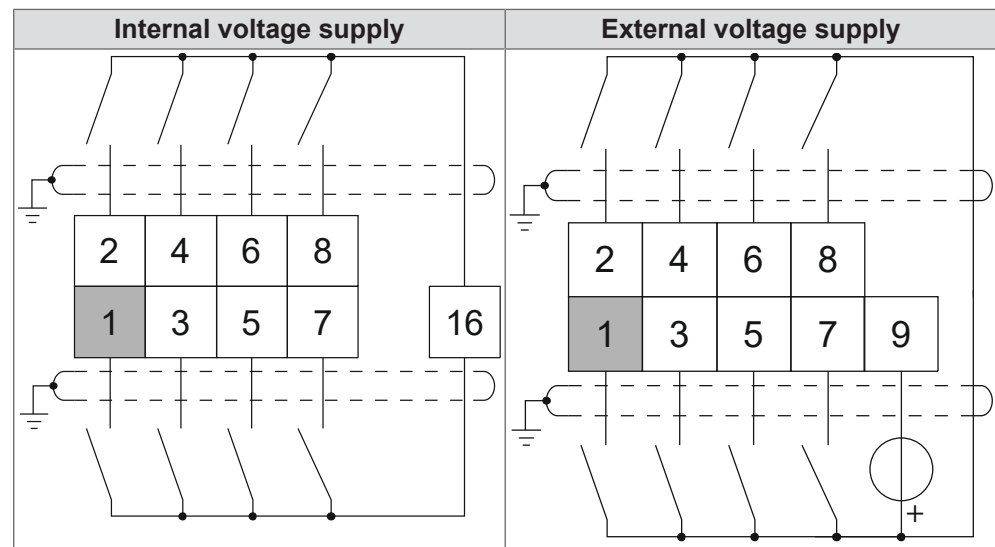
PIN	Name	Description
1	DI1 / AN3	Digital input 1 (standard) / analog input 3 (special software)
2	DI2	Digital input 2
3	DI3	Digital input 3
4	DI4	Digital input 4
5	DI5	Digital input 5
6	DI6	Digital input 6
7	DI7	Digital input 7 (fast input => see programming manual)
8	DI8	Digital input 8 (fast input => see programming manual)
9	0V	Reference potential for digital inputs
10	DO1	Digital output 1
11	0V	Reference potential for digital outputs
12	DO2	Digital output 2
13	RLB	reserved
14	RLA	Relay output / NO contact
15	RLC	Relay output/ switching contact
16	24Vout	DC voltage output 24V (max. 100 mA together with terminal 26) for the inputs (SELV).
17	AN1-	Non-isolated differential input 1
18	AN1+	Non-isolated differential input 1
19	AN2-	Non-isolated differential input 2
20	AN2+	Non-isolated differential input 2
21	0V	Reference potential for analog inputs and outputs
22	ANOUT	Analog output DC 0...10 V
23	CAN low	CAN bus ISO High Speed according to ISO/DIN 11896 => fieldbus interfaces
24	CAN high	CAN bus ISO High Speed according to ISO/DIN 11896 => fieldbus interfaces
25	CAN GND	CAN Ground (=> Fieldbus interfaces [▶ 29])
26	24Vout	DC voltage output 24V (max. 100 mA together with terminal 16) for control the inputs (SELV).
27	0V	Reference potential for P24Vin at external supply
28	P24Vin	Voltage input DC 24 V supplying the control board and the brake output

Tab. 9: Assignment of the terminal strip X2A

4.2.1 Digital Inputs

Specification	Number	8
	Name	DI1...DI8
	Terminals	X2A.1...X2A.8
	Classification	Type 3 according to DIN EN 61131-2
	Low level (logical 0)	-3 ... +5 V / 3 mA
	High level (logic 1)	11 ... 30 V / 2 ... 6 mA
	Special features	DI1 can be used as analog input AN3 depending on the firmware.

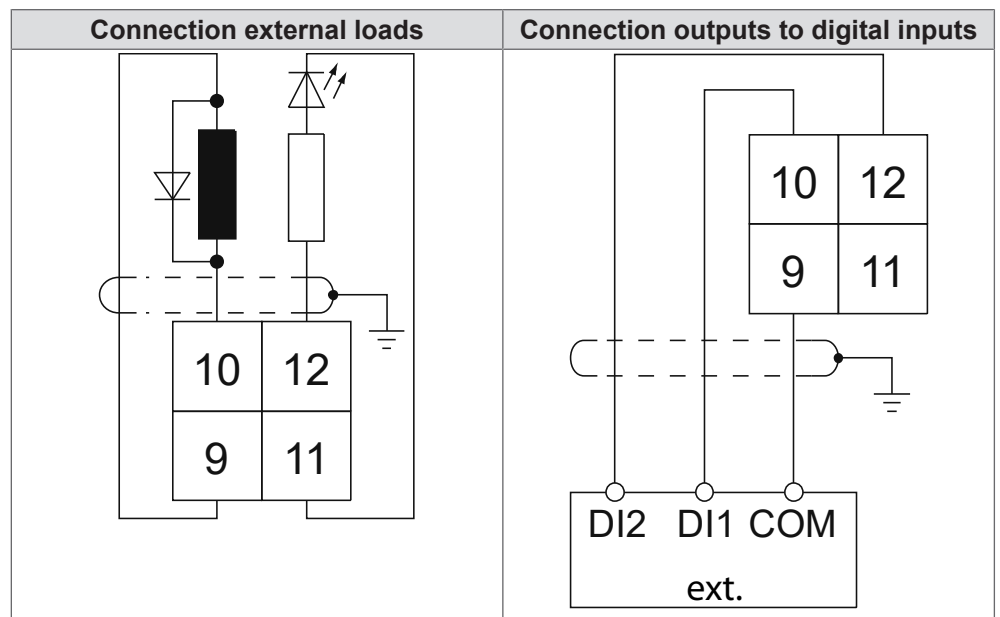
Connection



4.2.2 Digital Outputs

Specification	Number	4 (2 at terminal strip X2A and 2 at terminal strip X2B)
	Name	DO1 ... DO4
	Terminals	X2A.10, X2A.12
	Type	24 V high-side Switch
	Classification	DIN EN 61131-2
	Output voltage	Minimum $P24V_{in} - 3\text{ V}$ Maximum $P24V_{in}$
	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



4.2.3 Relay output

4.2.3.1 Relay output form A

Specification Safe relay Form A with forcibly guided contacts

Number	1
Name	R1
Terminals	X2A.14; X2A.15
Type	Form A
Switching voltage (rated)	DC 24 V
Current	0.01...1 A
Switching frequency	0.1 Hz
Switching cycles	10,000,000 mechanical 500,000 at 30 V / 1 A
Delay time	Switch on (close) maximum 50 ms Switch off (open) maximum 50 ms
Special features	No internal free-wheeling diode. External free-wheeling diode required for inductive load. Control only via safety module.

⚠ WARNING

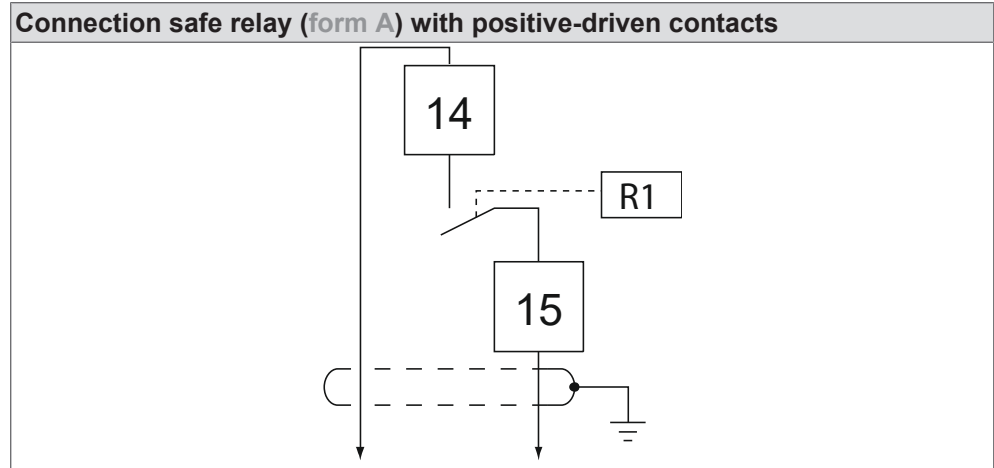


No internal protection of the relay contacts!

Welding of the relay contacts due to inadmissible overload!

- a) Limit the current by the normally open contact to 2 A (e.g. by using a fuse type 2A gG).
- b) Observe further instructions in the safety manual.

Connection safe relay (form A) with positive-driven contacts



4.2.4 Analog input

4.2.4.1 Differential input

NOTICE

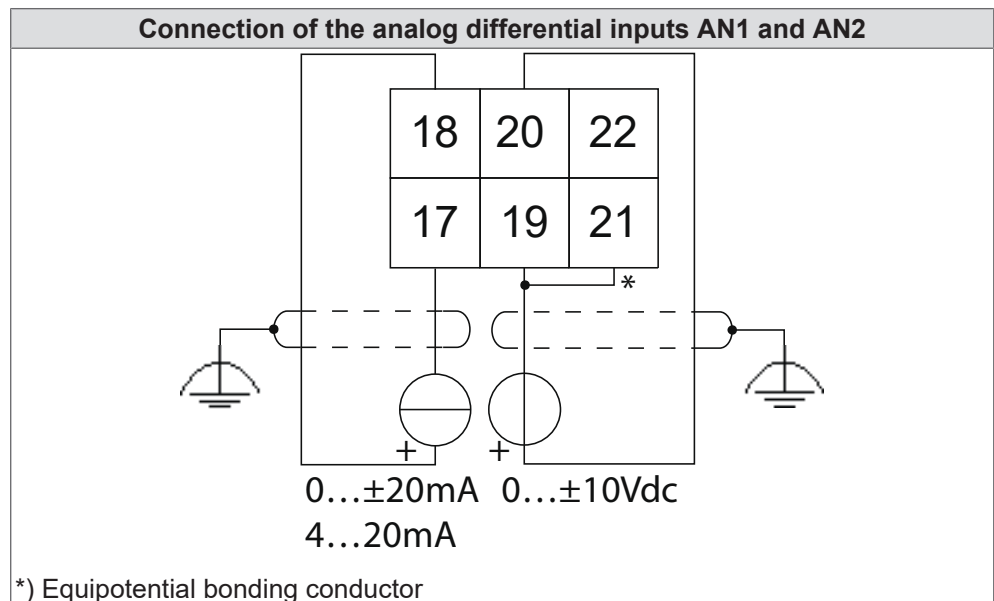
**No potential separation of the analog inputs to the control voltage!
Malfunction or defect may be caused by voltage differences.**

- a) A potential equalizing line between analog value source and analog input is required if the analog value is outside the common mode range.
- b) Connect potential equalizing line with 0V of the control terminal block.

Specification (differential inputs)

Number	2
Name	AN1, AN2
Terminals	X2A.18 (AN1) X2A.20 (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
Common mode range	-12.5 V...17.5 V

Connection

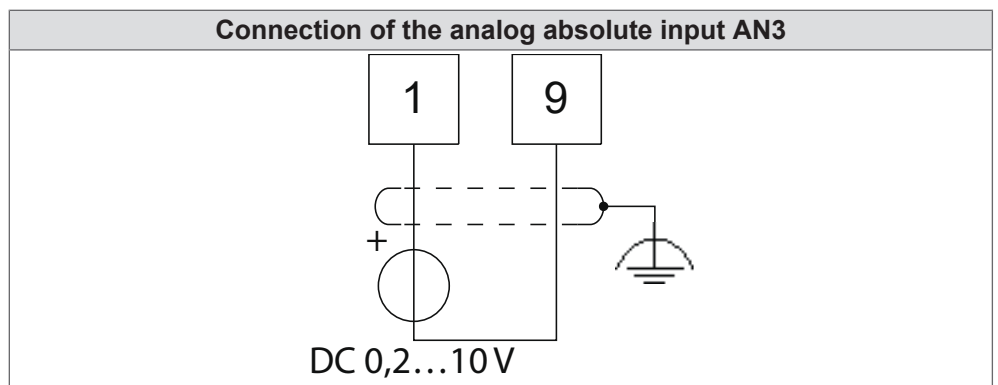


4.2.4.2 Absolute input

Specification (absolute input)

Number	1
Name	AN3
Terminals	X2A.1 (standard: digital input D11); can be used as analog input AN3 depending on the firmware.
Classification	non-isolated absolute input
Input signals	Voltage
Voltage input	DC 0.2...10 V / max. 5 mA
Others	Is not intended for control with potentiometer. The voltage source must be able to supply the input current.

Connection

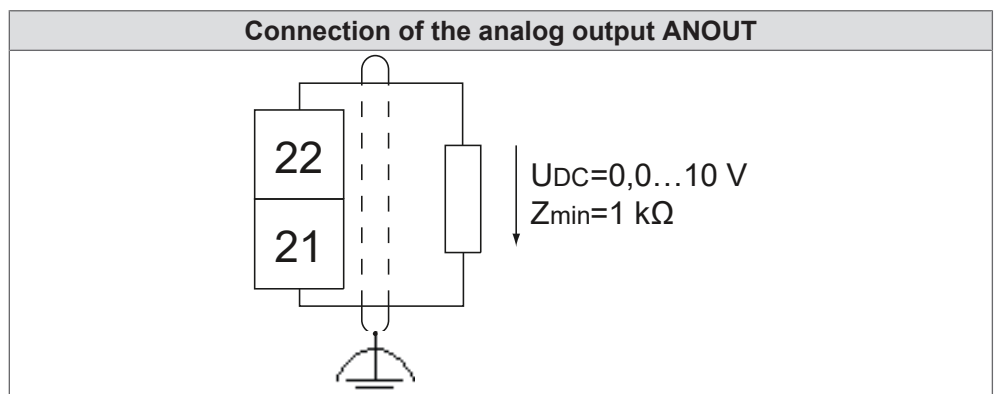


4.2.5 Analog output

Specification

Number	1
Name	ANOUT
Terminals	X2A.22 analog output X2A.21 reference potential
Classification	DIN EN 61131-2
Voltage output	DC 0.0...10 V (corresponds to 0...100 % output value)
Minimum load impedance	1 k Ω
Notes	In the range up to 0.1 V the output value is not linear to the output voltage.

Connection



4.2.6 Voltage supply

4.2.6.1 Voltage input

The control board can be supplied:

- externally by a central 24V supply.

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

4.2.6.1.1 Determination of the current consumption

The input P24Vin (X2A.28) supplies following components:

- Control (control board with safety module)
- Driver/power unit
- Brake
- Encoder

Consumer		Current consumption
Control		0.6 A
Power unit		0,8 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 module	Max. 0.4 A

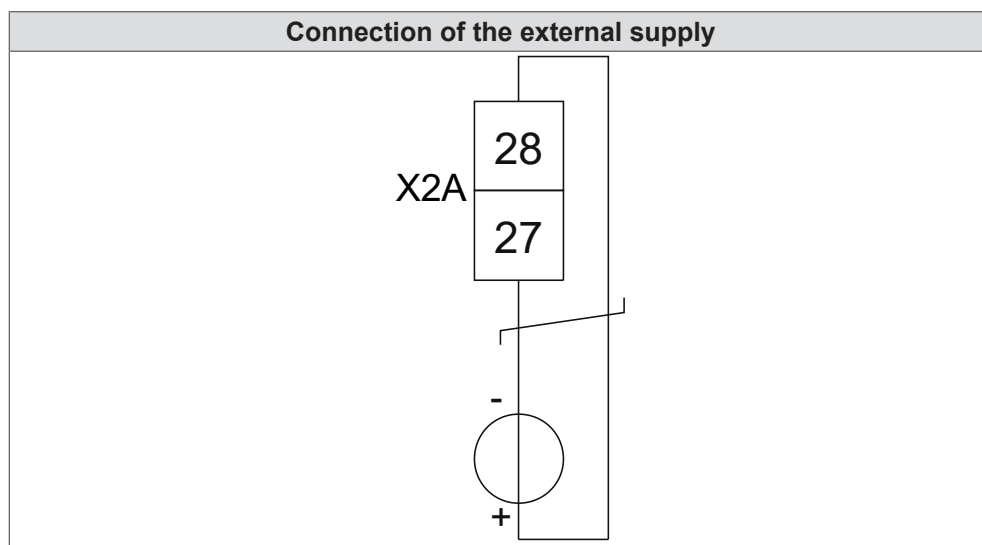
Tab. 10: Calculation the current consumption

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.

4.2.6.1.2 External supply

Specification external supply

Name	P24Vin, 0V
Terminals	X2A.28 (P24Vin) X2A.27 (0V)
Voltage	DC 24 V ($\pm 5\%$)
Current consumption	Calculated value up to max. 4.6 A



The control card is supplied by an external 24 V voltage. An internal supply via a voltage generated in the power section is not provided. When using the **Power-Off** function, the external 24V supply must be maintained until the function has been completed. Further information in the programming manual under "Power-Off function".

4.2.6.2 Voltage output to supply the inputs

Specification voltage output	Name	24Vout 0V (reference potential)
	Terminals	X2A.16, X2A.26 (24Vout) X2A.27 (0V)
	Output current	max. 100 mA (short-circuit proof) total for both terminals
	Output voltage	minimum P24Vin – 3V maximum P24Vin
	Notes	DC voltage output (SELV) to control the digital inputs; Terminals are internally parallel connected.
	Connection see (≡▶ Digital Inputs [▶ 20])	

5 Safety module X2B

The installed safety module is identified by the 6th digit of the material number.

6. digit	Variants
4	reserved
5	Safety module type 5

5.1 Safety manual type 5

The safety module type 5 includes the following functions:

STO, SBC, SS1-r, SS1-t, SLS, SSM, SMS, SLA, SDLC and Safety over EtherCAT®

The description of the functions is given in the safety manual at the following link:

	<p>Safety manual Type 5 (🌐 https://data.keb.de/fileadmin/media/Manuals/dr/ma_dr_safety-typ5-20191137_en.pdf)</p>	
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6 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. 11: Serial interfaces

Name	Material number
Bluetooth adapter	0058060-0060

Tab. 12: 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. 13: Connecting cable

NOTICE

No potential separation of the diagnostic interface to the control voltage! Malfunction or defect can be caused by voltage differences.

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



XML file required for COMBIVIS 6.

- A current XML file is required for the operation with COMBIVIS 6.
- The download can be done directly from COMBIVIS 6 while an Internet connection is present.

6.1 Assignment of the terminal strip X4A

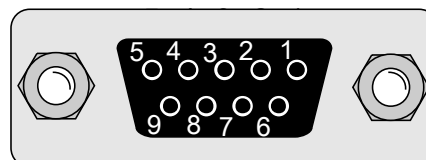


Fig. 1: Pin assignment socket D-Sub-9 (top view)

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)	

6.2 Data cable RS232 PC-Drive Controller

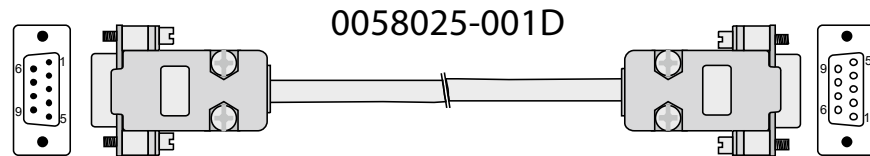


Fig. 2: Serial cable for the connection to a PC

6.3 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.

6.4 Connection of the RS485 interface

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



Wiring examples can be found under the following link:

https://www.keb.de/fileadmin/media/Techinfo/dr/tn/ti_dr_tn-rs485-connection-00002_en.pdf



6.5 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. 14: Wiring of the DE-9 - RJ45 adapters

7 Fieldbus interfaces

7.1 Type code fieldbus

A CAN interface is integrated in the control unit as standard. Other fieldbus interfaces are identified by the 9th digit of the material number:

9. digit	Control board variant
3	PRO Multi-encoder interface, CAN®, RS485 potential-free, Ethernet TCP/IP (no EtherCAT)
4	PRO no encoder interface, CAN®, Ethernet fieldbus interface, safe relay
5	PRO Multi encoder interface, CAN®, Ethernet fieldbus interface, safe relay
E	PRO no encoder interface, CAN®, Ethernet fieldbus interface, safe relay, alternative terminal strip
F	PRO Multi encoder interface, CAN®, Ethernet fieldbus interface, safe relay, alternative terminal strip

7.2 CAN

Specification

Fieldbus type

CAN

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

Functional insulation between CAN terminals and to the control potential.

Bus termination

120 Ω external between (CAN High and CAN Low) at both ends of the bus line.

Connection

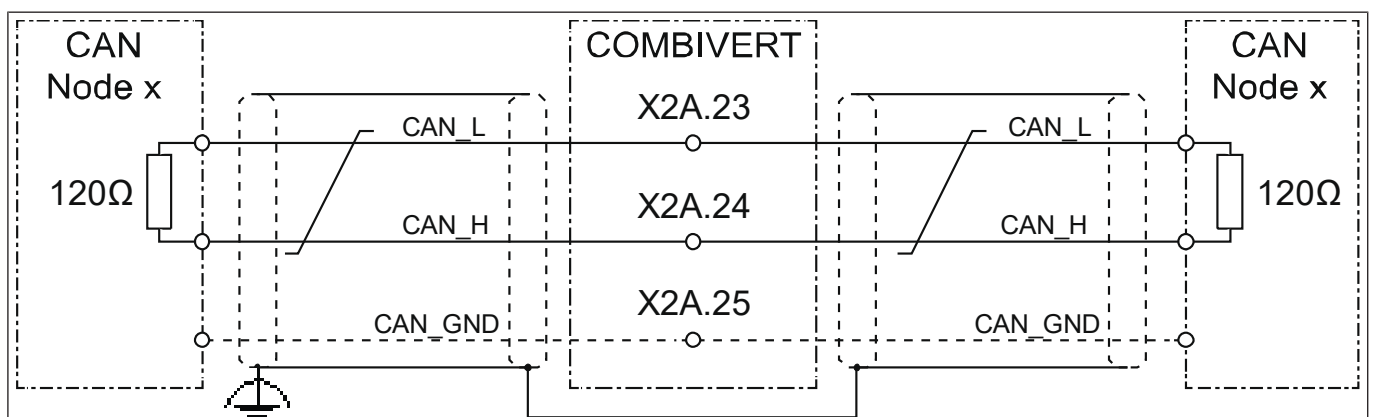


Fig. 3: Connection CAN bus

Clamp	Name	Note
X2A.23	CAN low	No internal bus termination
X2A.24	CAN high	
X2A.25	CAN GND	CAN ground (can be wired depending on the customer subscriber)

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.

7.3 EtherCAT



EtherCAT® and Safety over EtherCAT® are registered trademarks and patented technologies, licensed by 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
Rotary coding switch S1, S2	No function with EtherCAT
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, PDOOUT, PDIN data).
Number FMMUs	3 (PDOOUT, PDIN data, Send-Mailbox-Status).
Max. number PDOOUT 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 μ s (is22=8 x tp) 250 μ s (is22=4 x tp) from SW 2.8 => Synchronous communication mode
Minimum FSoE watchdog time	35 ms (safety module type 5)

Connection

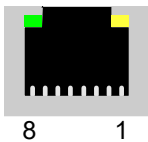


Fig. 4: RJ45 socket front view

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. 15: 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. 16: 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.

Status	Light pattern	Description
Local Error	r-0-0-0-0-0 (grid 200 ms)	Local error; Device has independently changed status from OPERATIONAL to SAFE-OPERATIONAL. Error bit is set to "1".
Process Data or EtherCAT Watchdog	r-0-r-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
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. 17: Error status list

7.3.1 Synchronous communication mode

The COMBIVERT with control board PRO supports a so-called synchronous communication mode. This is titled differently for the different fieldbuses. In EtherCAT, this functionality is managed under the term Distributed Clocks (DC).

Ultimately, the synchronous operating mode means that the internal interrupt grid of the drive controller is synchronised to the synchronous signal generated by the fieldbus.

The COMBIVERT with control board PRO does not support any values for the synchronous cycle time. Which dependencies exist here and which parameters have an influence can be found in the chapters "Switching frequency and derating" in the programming manual.

7.4 RS485 potential-free

Specification

Interface	RS485 4W
Transmission speed	9.6, 19.2, 38.4, 55.5, 57.6, 100, 115.2, 125, 250, 500 kBit/s
Bus nodes	2 (1:1 connection through fixed bus terminating resistor)
Common-mode voltage range	0...12 V to the reference potential
Potential separation	Potential-free to the reference potential (functional separation)
Bus termination	120 Ω each (pin 1 and 2; 4 and 5); integrated (cannot be switched off)

max.line length 1200 m (depending on bus speed)
 Connection cable (minimum requirement) S/UTP (twisted pairs, shield connected to PE on one side)

Connection X4B

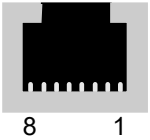


Fig. 5: RJ45 socket front view

PIN	Signal	EIA/TIA-485 Name	Function
1	RxD-B	B'	Receive signal
2	RxD-A	A'	Received signal inverted
3	n.c.	n.c.	reserved
4	TxD-A	A	Transmit signal inverted
5	TxD-B	B	Transmission signal
6	n.c.	n.c.	reserved
7	n.c.	n.c.	reserved
8	GND	GND	Reference potential
Housing	Shielding	Shielding	Shielding

Tab. 18: PIN assignment RS485 4W-Modbus to RJ45 plug

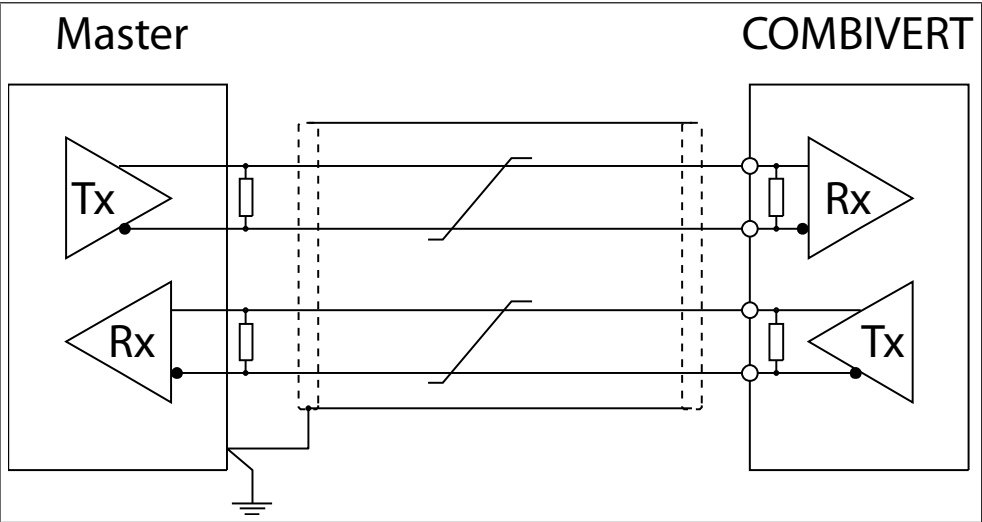


Fig. 6: Connection diagram RS485-Modbus 4W

8 Encoder interfaces

8.1 Type code encoder interface

A CAN interface is integrated in the control unit as standard. Other fieldbus interfaces are identified by the 9th digit of the material number:

9. digit	Control board variant
3	PRO Multi-encoder interface, CAN®, RS485 potential-free, Ethernet TCP/IP (no EtherCAT)
4	PRO no encoder interface, CAN®, Ethernet fieldbus interface, safe relay
5	PRO Multi encoder interface, CAN®, Ethernet fieldbus interface, safe relay
E	PRO no encoder interface, CAN®, Ethernet fieldbus interface, safe relay, alternative terminal strip
F	PRO Multi encoder interface, CAN®, Ethernet fieldbus interface, safe relay, alternative terminal strip

8.2 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.

8.3 Input signals

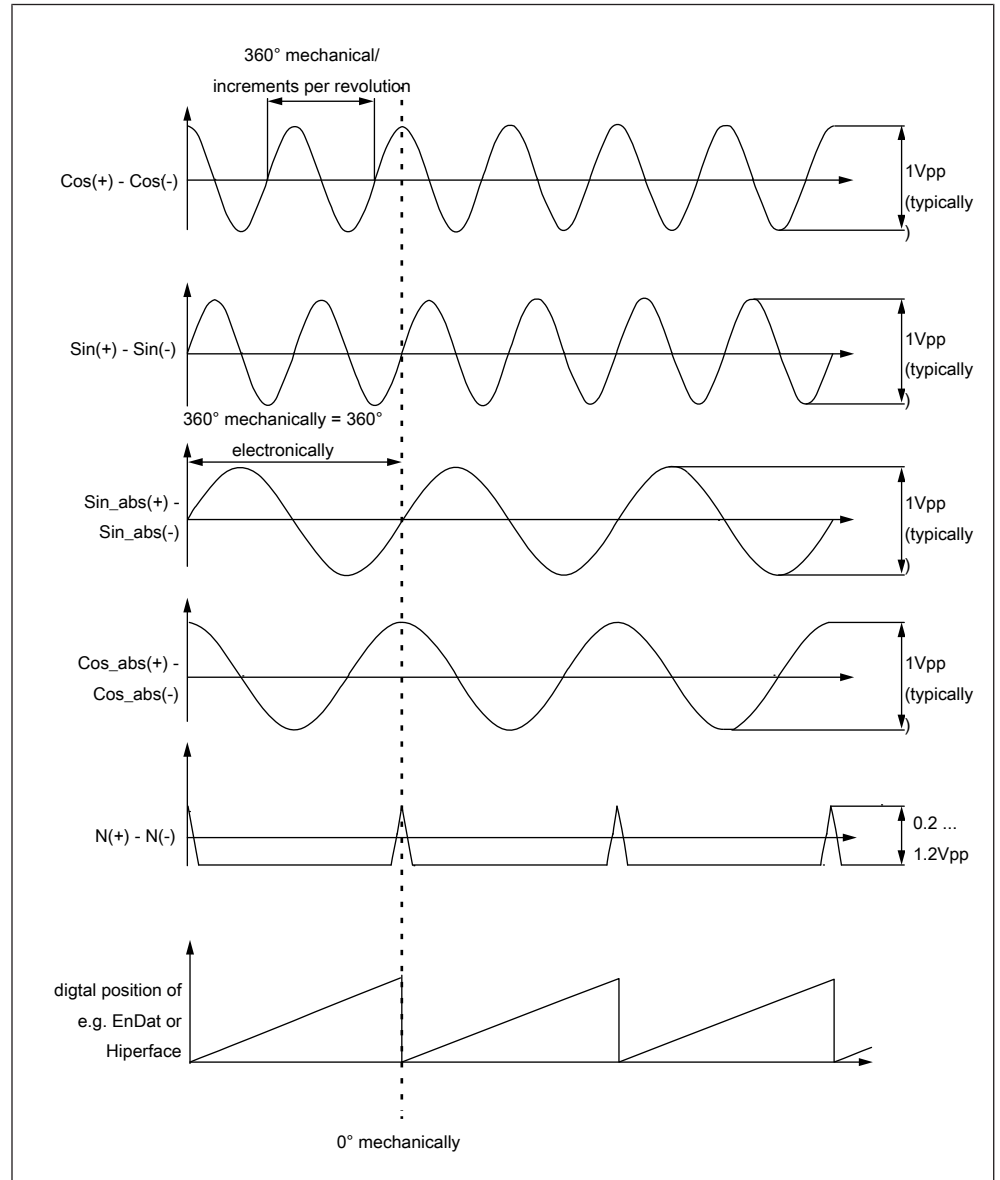


Fig. 7: Assignment of the input signals (as differential signals)



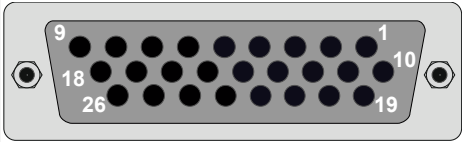
- a) For rectangular incremental signals, the characteristic of the signal corresponds to A -> COS and B -> SIN.
- b) The identification "C" and "D" for the absolute signals must be checked. Frequently signal C corresponds to -> SIN_abs and D to -> (inverted) COS_abs. Thus D+ is at COS_abs- and D- is 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. 19: Alternative designation of encoder signals

8.4 Encoder sockets X3A/X3B

X3A / X3B: Plug-in connector socket			(front view socket)			D-Sub DB-26 (HD), triple row		
Counterpart: Plug-in connector						D-Sub DB-26 (HD), triple row, with fixing screw		
Encoder	Incremental encoder RS485 and 1Vpp (channel 1 only)	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
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 (is output, if an encoder 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	GND and internal shield							
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. 20: Assignment of the encoder sockets X3A and X3B

Notes for Pin 25 / 26

Supply voltage of $U_{DC} = 8\text{ V}$ is issued if

- Parameter ec14 Bit 1 = "manual" and ec14 Bit 0 = "8V" is set.
- Parameter ec14 Bit 1 = "automatically" and ec16 = "Hiperface" or "Resolver" is set.

All other voltages are not defined at these contacts and may not be used for supply of encoders!

8.5 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:

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

Fig. 8: 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.

8.6 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.

8.7 Description of the encoder interfaces

PIN	Signals	Description
1, 2, 3, 4	A+/- B+/- Cos+/- Sin+/-	<p>Only channel A:</p> <p>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</p> <p>Differential (e.g. Cos+ against Cos-): Constant component 0 V ±0.1 V signal level U_{ss}=0.6 V...1.2 V</p> <p>Channel A:</p> <p>Input for square-wave incremental signals according to RS485 maximum 200 kHz.</p> <p>Channel B:</p> <p>Input for square-wave incremental signals according to RS485 maximum 500 kHz.</p> <p>Incremental encoder simulation: Position changes of channel A are output to channel B with two 90° shifted RS485 signals. Maximum output frequency 500 kHz.</p>
5, 6	N+/- Data+/-	<p>Only channel A:</p> <p>Input zero signal once per revolution.</p> <p>Differential signal level (N+ ... N-):</p> <ul style="list-style-type: none"> • higher 50 mV: zero signal is active • from 50 mV to -50 mV: undefined • lower -50 mV: zero signal is inactive <p>Signal length 330° ... 360° of the signal length of the incremental signals.</p> <p>Channel A and B:</p> <p>Input zero signal or data RS485. Zero signal is 1-active, if signals A and B are also 1-active.</p> <p>only channel B:</p> <p>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°.</p>

PIN	Signals	Description
10, 11, 12, 13	Sin+/- Cos+/- Sin_abs+/- Cos_abs+/-	Only channel A: Input for sinusoidal absolute signals U _{ss} =1 V for SinCos encoder U _{ss} =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: U _{eff} =2.54 V ± U _{ss} =7.2 V ±5 %; max. I _{eff} =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: U _{dc} =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. 21: Encoder specifications

9 Brake control and temperature detection

X1C		PIN	Name	Notes			
2	4	6	8	10	1	BR+	Brake control / output
					2	BR-	Brake control / output
					3	0V	For supplying the feedback inputs P24Vin - 0.5V / max. 1A (BR+ and 24Vout in total 2A)
					4	24Vout	
					5	BCF1	Feedback input for brake control
					6	BCF2	Feedback input for brake control
					7/8	reserved	
					9	TA1	Temperature detection / input+
					10	TA2	Temperature detection / input-

Tab. 22: Assignment of the terminal block X1C

9.1 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 control one/two brake(s) or relay(s).
Output voltage (DC)	minimum P24Vin – 1.2V maximum P24Vin
Maximum output current	One brake: 2 A two brakes: 2 x 1 A
Others	Internal free-wheeling path; internal filter circuit; not short-circuit proof

Features

- Safely control one brake/relay
- Control two single brakes/relays together (must be the same brake/relay twice).
- Internal brake feedback without additional wiring or external via two brake control feedback inputs.
- ECO Mode by pulse width modulated control.
- Rapid demagnetization with a counter voltage of 27.5 V (maximum every 5 s).
- Current monitoring

The control, parameterization and reading of the feedback inputs of the brake is carried out via the integrated safety module. Corresponding wiring and parameterization suggestions are described in the safety manual type 5.

When using the internal supply:

- ECO operation of the brake is not recommended.
- the total current consumption of the control card must be observed.

Connection

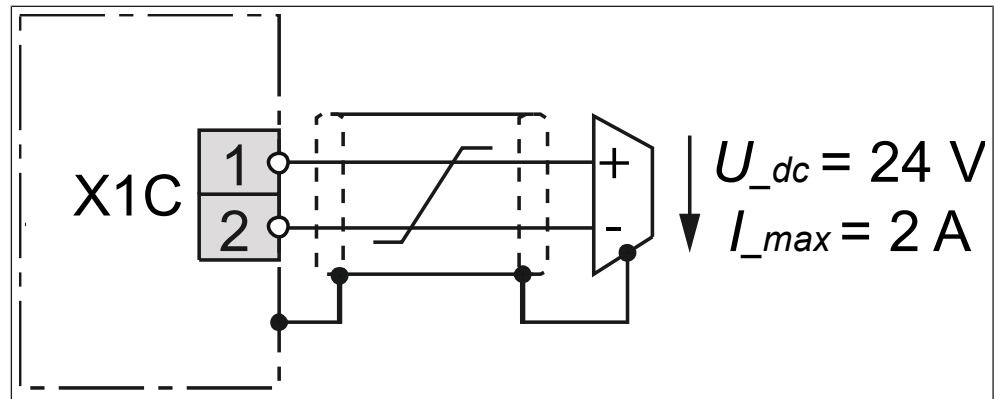


Fig. 9: Connection of a brake

9.2 Temperature detection

DANGER



Electric shock by sensors without protective separation!

- a) Only use sensors with basic insulation.
- b) Only sensors with double insulation (basic insulation plus additional insulation) are permitted up to the specified year/week of manufacturing (see specification).

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.9 (TA1) input + X1C.10 (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

Operating mode (dr33)		Resistance	Temperature/state
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)

9.2.1 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.9) and TA2 (X1C.10) (dr33=1).

9.2.2 Connection of a KTY sensor

NOTICE

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

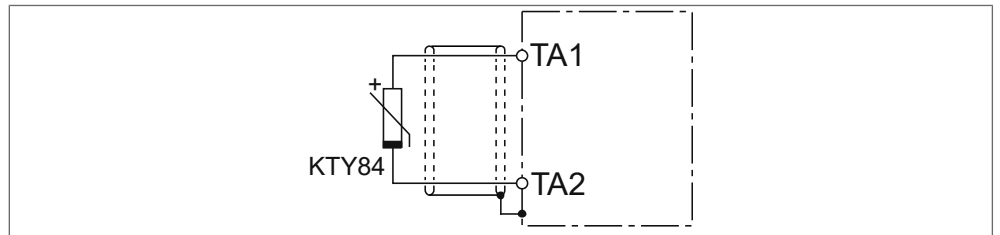
Non-observance leads to incorrect measurements and possibly to the destruction of the motor winding.

- 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

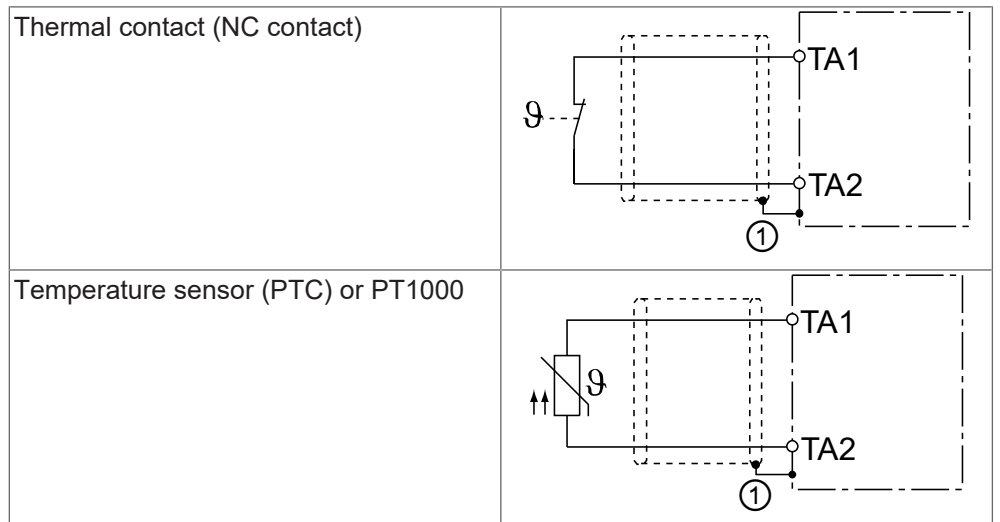


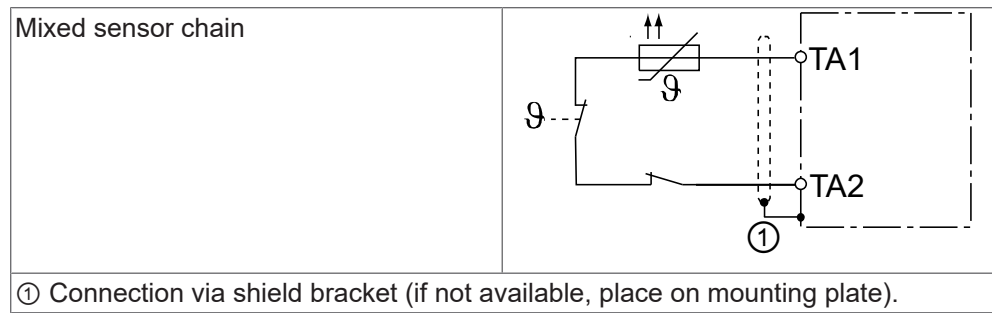
9.2.3 Connection of PTC, temperature switch or PT1000

Settings of PTC, temperature switch or PT1000

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

Connection





Tab. 23: Connection examples

10 Revision History

Edition	Version	Note
2018-12	00	Pre-series version.
2019-07	01	Series version
2022-10	02	Function yellow LED EtherCAT changed; editorial changes due to conversion to editorial system.
2022-11	03	Encoder interface pin 19 changed
2023-12	04	Type code Digit 9 extended. Relay classified in Form A. RS485 potential-free assignment and description changed. Description X2A PIN 25 changed. Alternative designation for encoder signals inserted. English version only! Translation of control terminal X2A PIN 28 corrected. Values for (≡► Assembly of wires [► 18]) adapted. Light pattern (≡► CAN [► 29]) corrected. Editorial changes.

Glossary

4W

4-Wire; is used in the field of network technology for serial full duplex operation.

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).

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

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)

EnDat

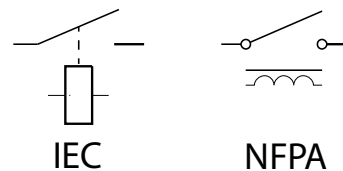
Bidirectional encoder interface of the company Heidenhain.

EtherCAT®



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

Form A



Form A describes a relay with two contacts (switching contact and normally open contact). Also referred to as SPST NO (single pole, single throw; normally open).

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 61800-5-1

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

PELV

Safe protective extra-low voltage (earthed).

Power-off function

The power-off function (short: Power-Off) is used for a targeted reaction in the event of a mains voltage failure (e.g. stopping the drive). The energy stored in the drivetrain is utilised for this purpose.

RS485

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

Safety over EtherCAT®

**Safety over
EtherCAT®** 

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

SBC

Safe Brake Control.

SDLC

Safe Door Lock Control

SELV

Safe protective extra-low voltage (unearthed; <60V).

SinCos

Incremental encoder with sinusoidal signals.

SLA

Safely limited acceleration

SLS

Safely limited speed

SMS

Safe maximum speed

SS1-r

Safe Stop 1 ramp monitored (with deceleration ramp monitoring; STO (Safe torque off) is assumed after reaching the idle position.

SS1-t

Safe Stop 1 time controlled STO (Safe torque off) is assumed after the deceleration time has elapsed.

SSI

Synchronous serial interface for encoder.

SSM

Safe speed monitor

STO

Safe torque off (STO).

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KEB Automation KG • Suedstraße 38 • D-32683 Barntrup • Tel: +49 5263 401-0 • E-Mail: info@keb.de