Instructions for Use

COMBIVERT S6
Installation Control APPLICATION

Translation of the original manual

Document 20109645 EN 07

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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

ℹ	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)
UL	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) 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 APPLIKATION

The control board APPLIKATION provides the following functions:

- Digital and analog inputs and outputs
- Potential-free relay output
- CAN fieldbus interface
- 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**
A	APPLIKATION

6. digit	**Variants**
1	Safety module type 1 (APPLICATION)
3	Safety module type 3

7. digit	**Housing**

8. digit	**Connection, voltage, options**

9. digit	**Control board variant**
1	APPLICATION | Multi encoder interface, CAN®, Realtime Ethernet Module
B	APPLICATION | Multi encoder interface, CAN® , Realtime ethernet module, 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/ control board	Safety module	Set contains	Material number
02 / APPLICATION	Type 1	terminal strip 28-pole terminal strip 10-pole terminal strip 8-pole connector 3-pole connector 6-pole shielding bracket 2 x shielding clamp	00S6ZC0-0002
04 / APPLICATION			00S6ZC0-0003
02 / APPLICATION	Type 3	terminal strip 32-pole terminal strip 28-pole terminal strip 6-pole connector 3-pole connector 6-pole shielding bracket 2 x shielding clamp	00S6ZC0-0004 [1]
04 / APPLICATION			00S6ZC0-0005 [1]
00S6ZC0-001x customized connector sets			

Tab. 1: Connector sets

3.4   Connection and control elements

X1C	Temperature monitoring, brake control/monitoring
X1Z	Strain relief
X2A	Control terminal block for digital inputs/outputs; 24V supply; relay output; analog inputs and outputs; CAN bus
X2B	Safety module (depending on variant)
X3A	Encoder interface channel A
X3B	Encoder interface channel B
X4A	Diagnostic interface with RS232/485 interface according to DIN66019 protocol; operator slot
X4B	Realtime-Ethernetmodul (variantenabhängig)
X4C	Realtime-Ethernet module (depending on variant)
S1	Realtime-Ethernet module (depending on variant) ; rotary coding switch 1 (low byte)
S2	Realtime-Ethernet module (depending on variant) ; rotary coding switch 2 (high byte)
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

3.5   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

3.6 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 Realtime-Ethernet module

The Real-time Ethernet module contains more realtime fieldbus interfaces. The assignment of the fieldbus interfaces, the protocol and the function of the "NET ST" LED depends on the set protocol. The description is given in the Realtime Ethernet module's own manual.

3.11 Status LEDs

3.11.1 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

LEDs	Status	Note
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

3.11.2 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

3.11.3 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

3.11.4 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

3.11.5 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 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
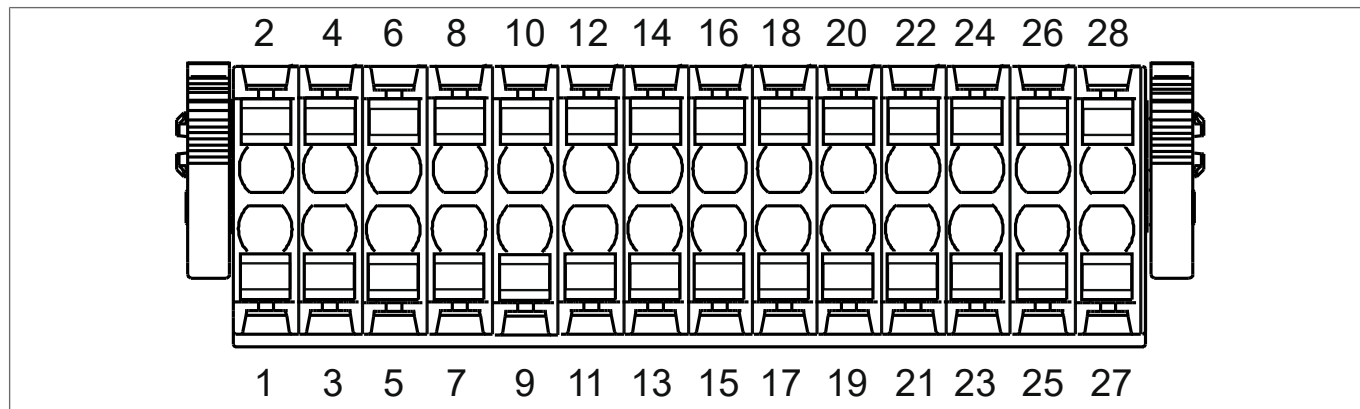
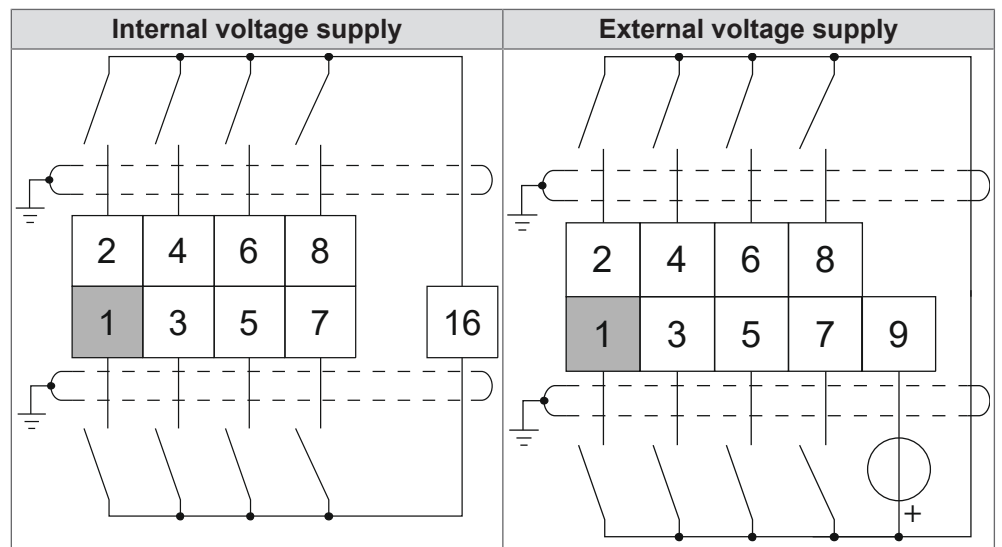| PIN	Name	Description
1	DI1 / AN3	Digital input 1 (standard) / analog input 3 (special software)
2	DI2	Digital input 2
3	DI3	Digital input 3
4	DI4	Digital input 4
5	DI5	Digital input 5
6	DI6	Digital input 6
7	DI7	Digital input 7
8	DI8	Digital input 8
9	0V	Reference potential for digital inputs
10	DO1	Digital output 1
11	0V	Reference potential for digital outputs
12	DO2	Digital output 2
13	RLB	Relay output / NC contact
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 controlling 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 [▶ 28])
26	24Vout	DC voltage output 24V (max. 100 mA together with terminal 16) for controlling the inputs (SELV).
27	0V	Reference potential for P24Vin at external supply
28	P24Vin	DC voltage input DC 24V to supply the control board

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
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

Internal voltage supply	External voltage supply
2 4 6 8 1 3 5 7 16	2 4 6 8 1 3 5 7 9

4.2.2 Digital outputs

Specification

Number	2
Name	DO1 … DO2
Terminals	X2A.10, X2A.12
Type	24 V high-side Switch
Classification	DIN EN 61131-2
Output voltage	Minimum P24Vin – 3 V Maximum P24Vin
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**
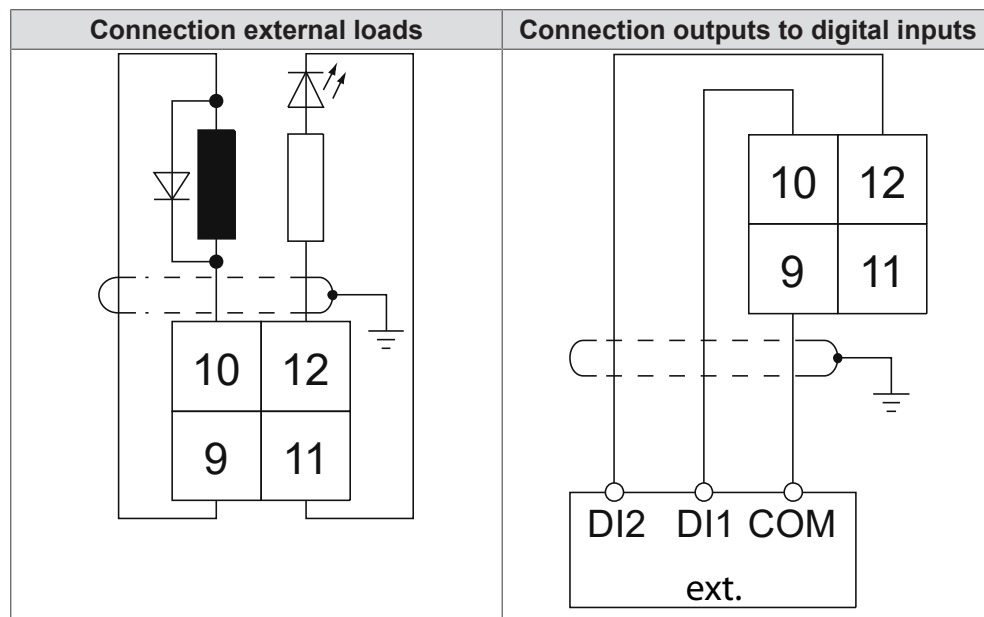
4.2.3   Relay output

4.2.3.1   Relay output form C

Specification relay output Form C

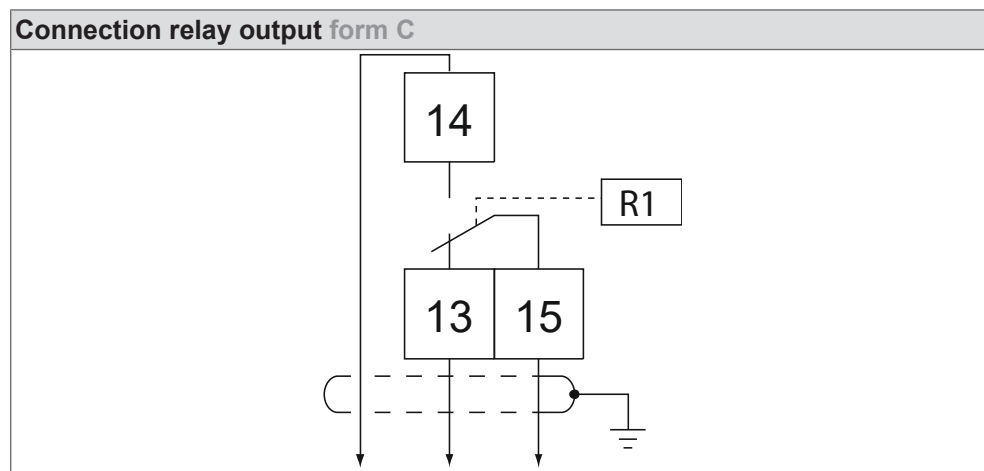|	
Number	1
Name	R1
Terminals	X2A.13 (NC contact)
	X2A.14 (NO contact)
	X2A.15 (switching contact)
Type	Form C
Voltage	Maximum DC 30 V
Current	0.01…1 A
Switching cycles	10^8 mechanical
	500,000 at 30 V / 1 A
Special features	No internal free-wheeling diode. External free-wheeling diode required for inductive load.

Connection relay output form C

Connection relay output form C

4.2.4 Analog input

4.2.4.1 Differential 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.

⚠ **WARNING**

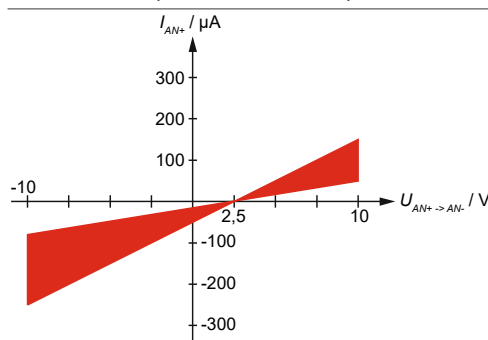**Common-related operation of an analog differential input!**

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 conducter (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.

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

Common-related voltage measurement (AN- to common)	Differential voltage measurement
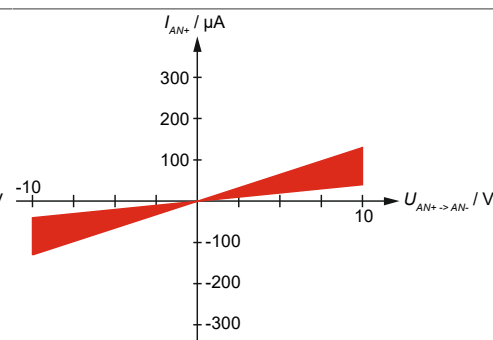
Specification (differential inputs)		
Number	2
Name	AN1, AN2
Terminals	X2A.17 (AN1-)
	X2A.18 (AN1+)
	X2A.19 (AN2-)
	X2A.20 (AN2+)
Classification	Non-isolated differential input
Input signals	Current/voltage switchable
Voltage input	DC 0…±10 V
Current input	DC 0…±20 mA; DC 4…20 mA
Resolution	12 bit
Input 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

| 18 | 20 | 22 |
| 17 | 19 | 21 |

0…±20mA　0…±10Vdc
4…20mA

*) Equipotential bonding conductor
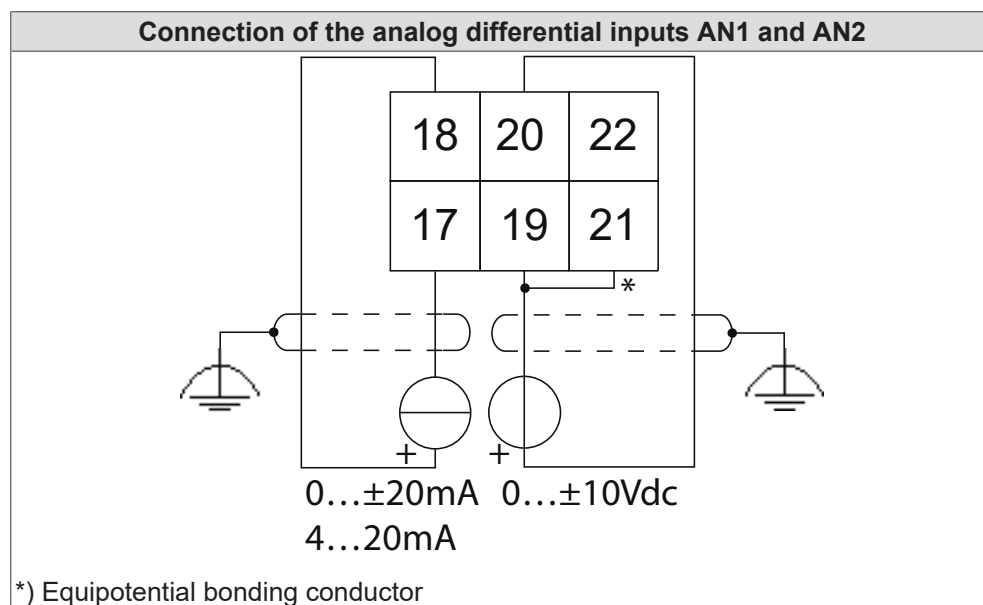
4.2.4.2　Absolute input

Specification (absolute input)

Number	1
Name	AN3
Terminals	X2A.1 (standard: digital input DI1); 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

Connection of the analogue absolute input AN3

| 1 | 9 |

DC 0,2…10 V
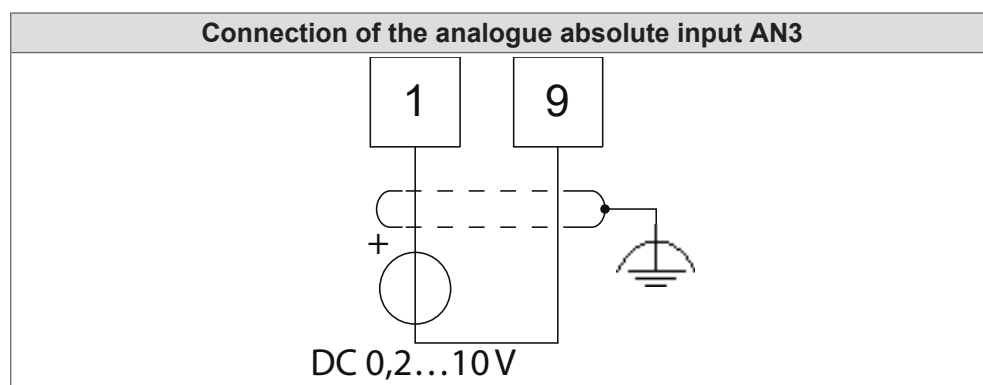
4.2.5　Analog output

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)

Resolution	11 bit
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

22

21

$U_{DC}=0,0…10$ V
$Z_{min}=1$ kΩ
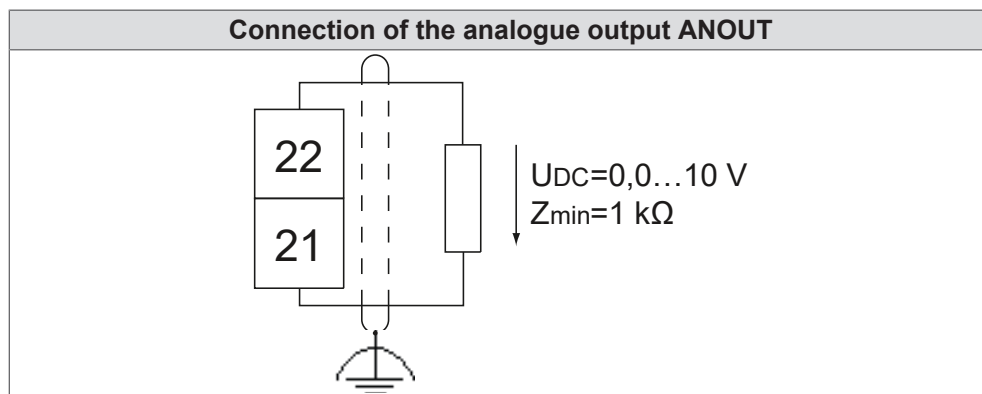
4.2.6   Voltage supply

4.2.6.1   Voltage input

The control board can be supplied:

• externally by a central 24 V supply.

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

4.2.6.1.1   Calculation 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.
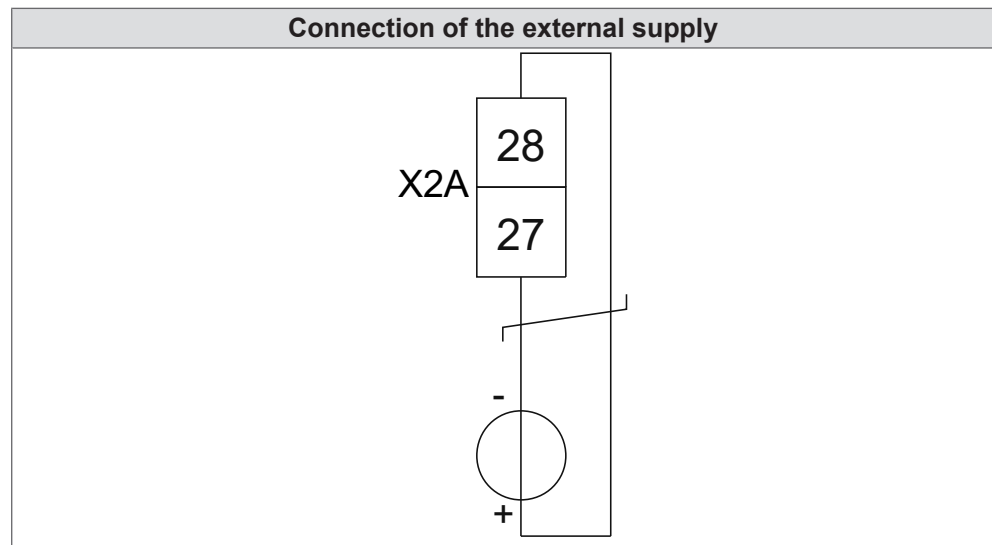
4.2.6.1.2   External supply

Specification external supply

Name	P24Vin, 0V
Terminals	X2A.28 (P24Vin)
	X2A.27 (0V)
Voltage	DC 24 V (±5 %)

Current consumption	Calculated value up to max. 4.6 A

Connection of the external supply

X2A | 28 |
| 27 |

-

+

ℹ	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 [► 19])

5 Safety module X2B

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

6. digit	Variants
1	Safety module type 1 (APPLICATION)
3	Safety module type 3

5.1 Safety module type 1

The safety module type 1 includes the following functions:

STO and SBC.

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

	Safety manual Type 1 (🌐► https://data.keb.de/fileadmin/media/Manuals/dr/ma_dr_safety-typ-1-shb-20109577_en.pdf)	

5.2 Safety module type 3

The safety module type 3 includes the following functions:

STO, SBC, SS1, SS2, SEL, SLI, SLP, SOS, SLA, SDI, SLS, SSM, SMS, SAR, SSR and Safety over EtherCAT®

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

	Safety manual Type 3 (🌐► https://data.keb.de/fileadmin/media/Manuals/dr/ma_dr_safety-typ3-20148769_en.pdf)	

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.

　　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.

6.1　Assignment of the terminal strip X4A

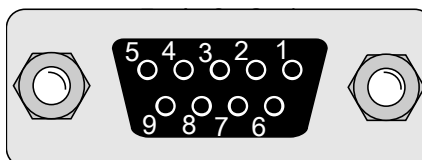*Fig. 1:* Pin assignment socket D-Sub-9 (top view)

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)		

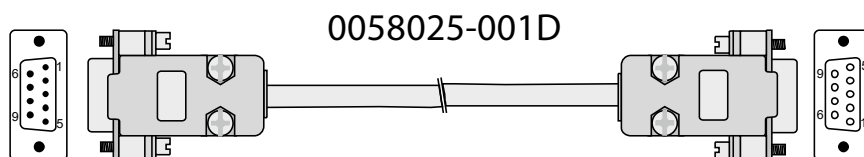## 6.2 Data cable RS232 PC-Drive Controller

0058025-001D

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
1	APPLICATION | Multi encoder interface, CAN®, Realtime Ethernet Module
B	APPLICATION | Multi encoder interface, CAN® , Realtime ethernet module, alternative terminal strip

7.2 CAN

Specification

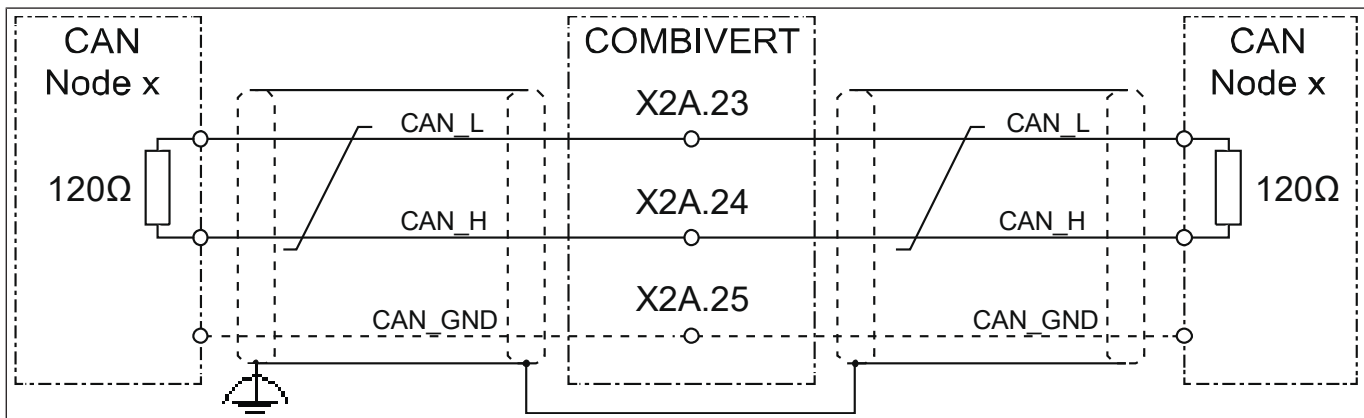|	
Fieldbus type	CAN
Transmission level	According to DIN ISO 11898; ISO High Speed
Transmission speed	20, 25, 50, 100, 125, 250, 500, 1000 kbit/s; adjustable via (fb66)
Potential separation	Functional insulation between CAN terminals and to the control potential.
Bus termination	120 Ω external between (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.

Status	Light pattern	Description
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 Realtime-Ethernet module

The real-time Ethernet module is depending on the ordered variant. It includes different fieldbus controls. The active fieldbus control is set with parameter fb68.

The description is given in a separate manual at the following link:

Realtime-Ethernet module

(🌐► https://www.keb.de/fileadmin/media/Manuals/dr/ma_dr_rte-inst-20148981_en.pdf)

8   Encoder interfaces

8.1   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.

8.2 Input signals
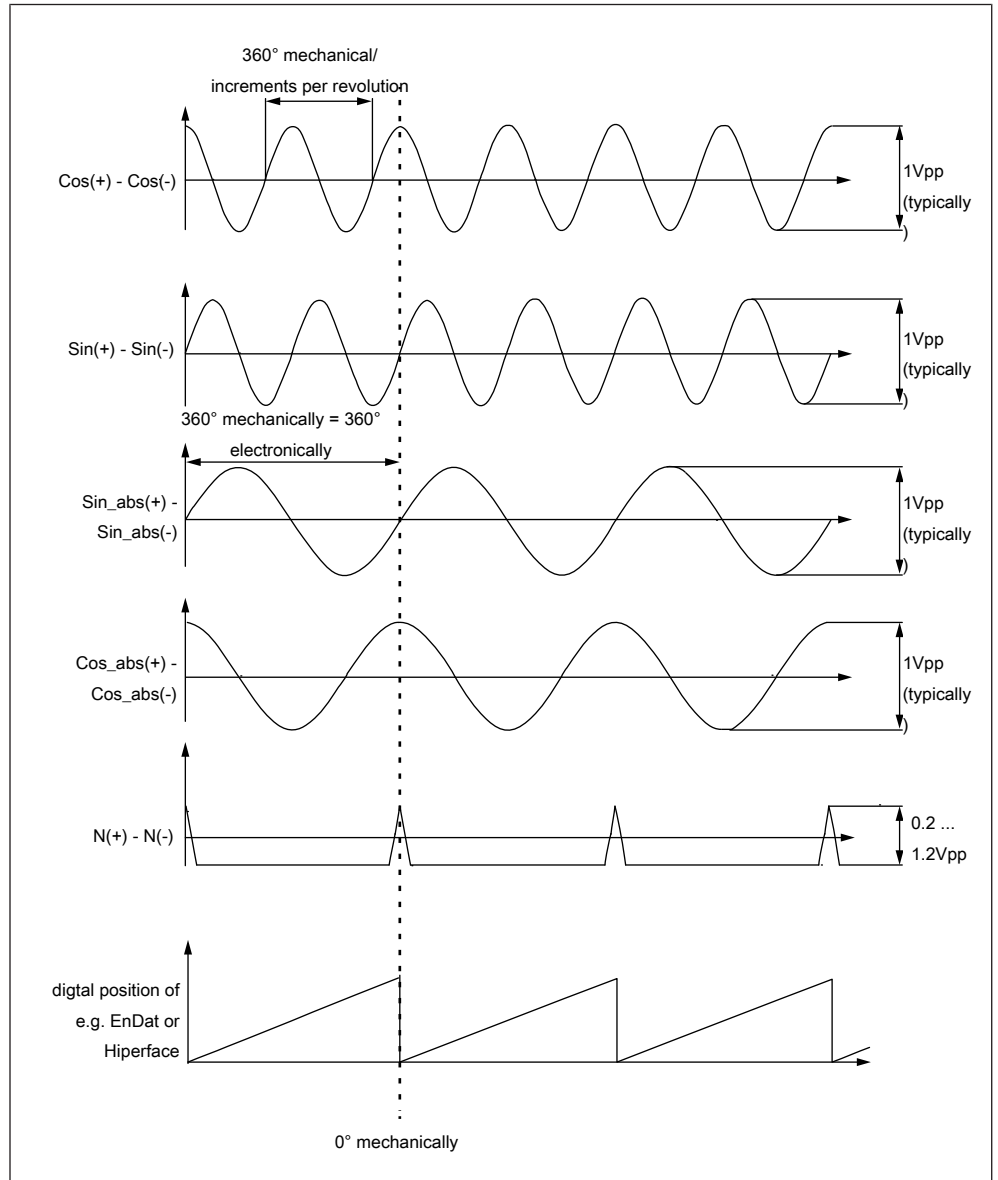
Fig. 4: Assignment of the input signals (as differential signals)
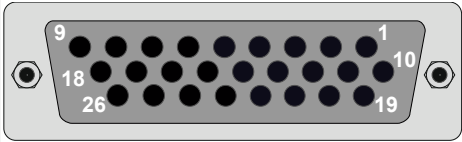
a) For rectangular incremental signals, the characteristic of the signal corresponds to A -> COS and B-> SIN.

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. 15: Alternative designation of encoder signals

8.3 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. 16: 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!

8.4 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:

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

Fig. 5: 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.

8.5 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.

8.6 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:** 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°.

PIN	Signals	Description
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. 17: Encoder specifications

9 Brake control and temperature detection

X1C		PIN	Name	Notes
2 4 6 (terminal diagram) 1 3 5		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. 18: 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 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

$$U_{dc} = 24\ \text{V}$$
$$I_{max} = 2\ \text{A}$$

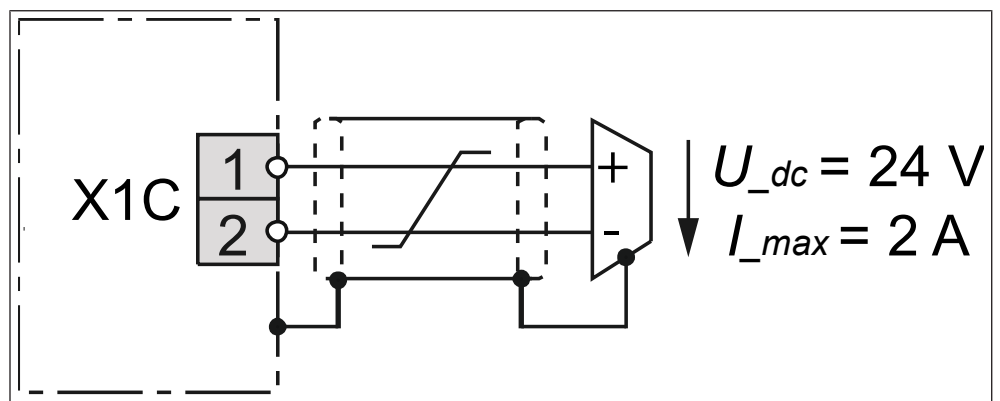*Fig. 6:* Connection of a brake

9.2 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)

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.5) and TA2 (X1C.6) (dr33=1).

9.2.2   Connection of a KTY sensor

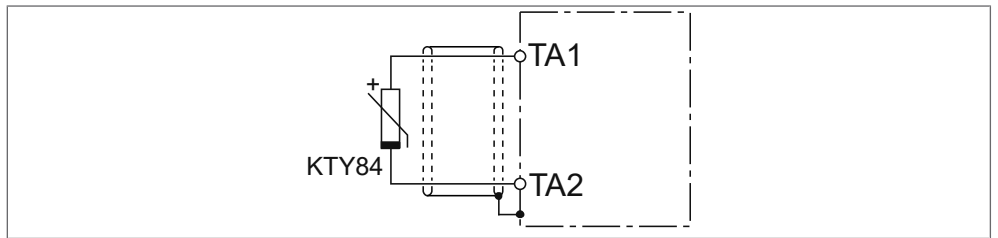| NOTICE	**No protection of the motor winding in case of wrong connection!**
	Non-observance leads to incorrect measurements and possibly to the destruction of the motor winding.

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	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. 19: Connection examples

10 Revision history

Edition	Version	Note
2016-10	00	Completion pre-series version.
2017-03	01	Completion of series version
2017-09	02	Designation of the terminals in chapter 2.4.7 corrected. New specification of the analog input inserted.
2017-09	03	Input terminals adapted for universal use. Editorial changes.
2022-10	04	Function yellow LED EtherCAT changed; editorial changes due to conversion to editorial system.
2022-11	05	Encoder interface pin 19 changed
2023-04	06	Relay designation changed. Operation without temperature monitoring pn33 changed to pn12. Description X2A PIN 25 changed. Chapter certification removed. Alternative designation for encoder signals inserted. English version only! Translation of control terminal X2A PIN 28 corrected.
2025-05	07	(≡► Temperature detection [▷ 35]) Hazard warning corrected. Values for (≡► Assembly of wires [▷ 17]) adapted. (≡► CAN [▷ 28]) corrected. Editorial changes. Designation GND in 0V/COM at (≡► encoder interfaces [▷ 32]) changed. Note for common-related operation of the analog differential inputs inserted. Warning notice inserted for protection for relay output form C. Resolution for analogue inputs and outputs added.

Glossary

Application

The application is the intended use of the KEB product.

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).
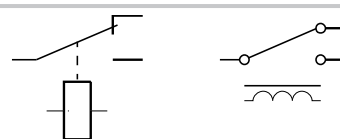
EN 61800-5-1

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.

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).

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

Electric power drive systems with adjustable speed. 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® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

SAR

Safe acceleration range; as SLA, but with upper and lower limit with the same sign.

SBC

Safe Brake Control.

SDI

Safe direction

SEL

Safe Emergency Limit

SELV

Safe extra-low voltage (unearthed).

SELV

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

SinCos

Incremental encoder with sinusoidal signals.

SLA

Safely limited acceleration

SLI

Safely limited increment

SLP

Safely limited position

SLS

Safely limited speed

SMS

Safe maximum speed

SOS

Safe operating stop

SS1

Safe stop 1emergency stop according to IEC 60204-1 Stop category 1

SS2

Safe stop 2; emergency stop according to IEC 60204-1 Stop category 2

SSI

Synchronous serial interface for encoder.

SSM

Safe speed monitor

SSR

Safe speed range; like SLS but with an upper and lower limit with the same sign.

STO

Safe torque off (STO).

Index

Notes

KEB

KEB

Automation **with Drive**   **www.keb-automation.com**