Instructions for Use

COMBIVERT F6

Installation F6 Control PRO

Translation of the original manual

Document 20182705 EN 11

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1 Introduction

The hardware, software and accessories described in this document are products of KEB. The information contained in this document is valid at the time of publishing. KEB reserves the right to update this document in response to misprints, mistakes or technical changes.

1.1 Warning Signs and Key Symbols

Certain procedures within this document can cause safety hazards during the installation or operation of the device.

Refer to the safety warnings in this document when performing these procedures. Safety signs are also located on the device where applicable. A safety warning is marked by one of the following warning signs:

⚠ DANGER

Type and/or source of the hazard.

Indicates a hazardous situation which will result in death or serious injury if not avoided.

a) Measures to avoid the hazard.

b) Can be supplemented by an additional warning sign or symbol.

⚠ WARNING

Type and/or source of the hazard.

Indicates a hazardous situation which may result in death or serious injury if not avoided.

a) Measures to avoid the hazard.

b) Can be supplemented by an additional warning sign or symbol.

⚠ CAUTION

Type and/or source of the hazard.

Indicates a hazardous situation which may result in minor or moderate injury if not avoided.

a) Measures to avoid the hazard.

b) Can be supplemented by an additional warning sign or symbol.

NOTICE

Type and/or source of the hazard.

Indicates a situation that may result in damage to the product or other property if not avoided.

a) Measures to avoid the hazard.

b) Can be supplemented by an additional symbol.

Informational message, prerequisite or recommended procedure.

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)

1.2 More Symbols

✓	Condition
a)	Action step
⇨	Result or intermediate result
(≡► Refe [▷ 6])	Reference to a chapter, table or picture with page reference
ru21	Parameter name or parameter index
(🌐►)	Hyperlink
<Strg>	Control code
COMBIVERT	Glossary entry

1.3 Laws and Requirements

KEB Automation KG provides the EU Declaration of Conformity that the product complies with the essential safety requirements.

The EU Declaration of Conformity can be downloaded on demand via our website.

Further information is provided in the 'Certifications and Approvals' section.

1.4 Warranty

KEB provides a limited warranty on all products. This warranty can be found in the terms and conditions at our website.

General sales conditions for Europe.

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

Further agreements or specifications require written confirmation between the zwischen den contracting parties.

1.5 Support and Liability

It is not possible to cover every potential application of our device in a single manual. If further information is required or if problems occur which are not covered in this document, the necessary information can be requested via the local KEB Automation KG agency.

The use of KEB products in the target application is beyond KEB control. Therefore responsibility lies exclusively with the machine manufacturer, system integrator or customer.

The information contained in this document, as well as any user-specific advice in spoken or written form or generated through testing, is provided to the best of KEB knowledge and is considered for informational purposes only. KEB bears no responsibility or liability for the accuracy of the information listed above, nor for any violation of industrial property rights committed by a third-party in relation to this information.

Selection of the most suitable product for any given application is the responsibility of the machine manufacturer, system integrator or customer.

Evaluation of the product can only be performed by the machine manufacturer in combination with the application. Any tests performed must be repeated every time any part of the hardware or software is modified, or any time the unit adjustment is changed.

1.6 Copyright

1.7 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.

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

Stay safe! Stay informed!

✓ Prior any work on the device

a) Read the instruction manual.

b) Follow all safety and warning instructions.

c) If you are unsure of any part of these instructions, please contact KEB prior to operating the device.

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 have been stopped to ensure 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, even 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 PRO

The control board PRO provides the following basic functions:

- Digital and analog inputs and outputs
- Serial diagnostic interface for connection to a PC
- Control hardware "safely separated" according to EN 61800-5-1
- Brake control, brake supply and feedback
- Motor protection by I²t, KTY, PT1000 or PTC input
- Internal supply of the control board possible.
- 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**

3. and 4. digit	**Series**

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	**Switching frequency, software current limit, overcurrent**

10th place	**Control board design**
0	PRO | no encoder interface, CAN®, Ethernet fieldbus interface, standard relay (Form C)
1	PRO | Multi-encoder interface, CAN®, Ethernet fieldbus interface, standard relay (Form C)
2	PRO | Hiperface DSL® OCT, CAN®, Ethernet fieldbus interface, standard relays (Form C)
3	PRO | Multi-encoder interface, CAN®, RS485 potential-free, Ethernet TCP/IP (no EtherCAT), standard relay (form C)
4	PRO | no encoder interface, CAN®, Ethernet fieldbus interface, safe relay (form A)
5	PRO | Multi-encoder interface, CAN®, Ethernet fieldbus interface, safe relay (form A)

11. digit	**Heat sink version**

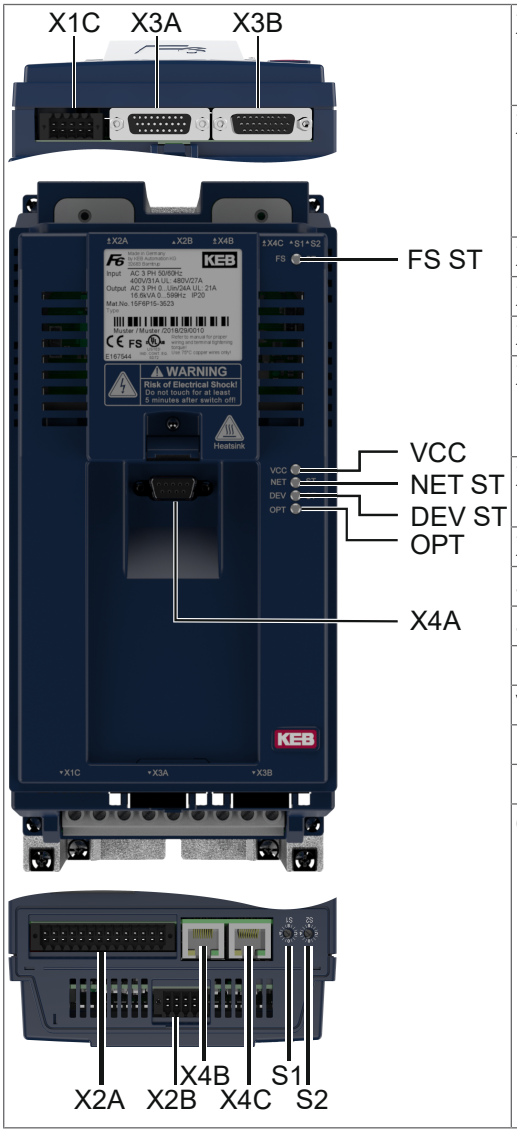
3.3 Accessories

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:

Control board	Set contains	Material number
PRO	Terminal strip 28-pole Terminal strip 10-pole Terminal strip 8-pole	00F6V80-005P

Tab. 1: Connector sets

3.4 Connection and control elements



X1C	Temperature monitoring; brake control/monitoring; input Hiperface DSL OCT (depending on variant)
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 / RS-485 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 control elements

3.5 Motor monitoring X1C (temperature, brake)

The X1C terminal strip is a 10-pin, pluggable terminal strip with spring-loaded connection. It includes:

- 2 outputs for controlling 24V motor brakes
- 2 control inputs for brakes or relays
- 1 analogue input for temperature measurement (not for variant with Hiperface)

- Hiperface DSL OCT input (depending on variant)

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

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 FS ST - LED

FS ST	LED colour		Description
Off		-	No voltage supply of the safety module.
On		Green	Safety module in operation.
On		Red	Safety module in ‘Error’ status.

Tab. 4: Function DEV ST - LED

3.13.3 VCC - LED

VCC	LED colour		Description
Off		-	Power supply to the control board has been switched off.
On		Green	The control unit is supplied with 24V.

Tab. 5: VCC LED function

3.13.4 NET ST - LED

NET ST	LED colour		Description
Off		-	Device off or booting.
Blink code		various	Depending on the fieldbus => fieldbus interfaces.

Tab. 6: NET ST function – LED

3.13.5 DEV ST - LED

DEV ST	LED colour		Description
Off		-	Device off or booting.
On		Red	Error
On		Yellow	No error, DC link not charged.
On		Green	No error, ready for operation.
Flash-ing		Green	No error, serves to identify the device (fb.32).

Tab. 7: Function DEV ST - LED

3.13.6 OPT - LED

OPT	LED colour	Description
-	-	Reserved for options.

Tab. 8: 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.

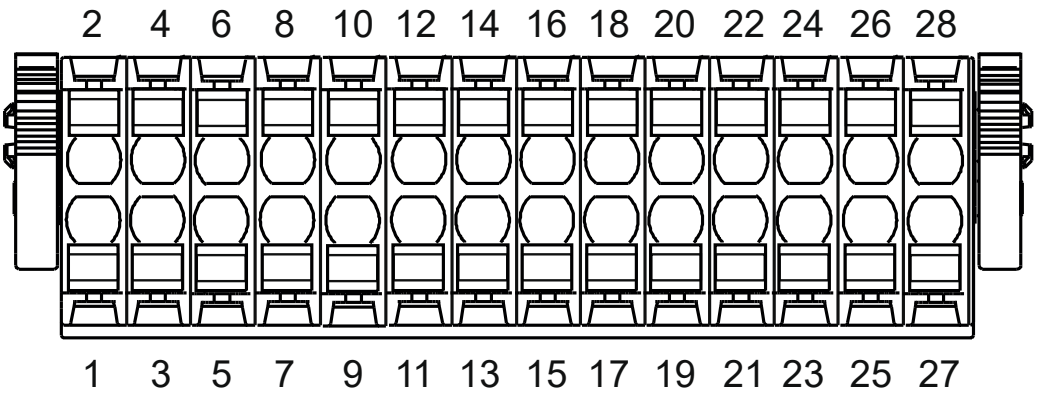
c) Make sure that all wires are inserted into the wire-end sleeve.

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. 9: Wire end ferrules and stripping length

4.2 Terminal strip X2A



PIN	Name	Description
1	DI1 / AN3	Digital input 1 / analogue input 3
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 (no function for "Relay with positive-driven contacts" variant)
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 [▸ 30])
26	24VoutCtrl	DC voltage output (SELV) to supply the digital inputs.Caution, do not couple with other power supplies!
27	0V	Reference potential for P24Vin at external supply
28	P24Vin	Voltage input DC 24 V supplying the control board and the brake output

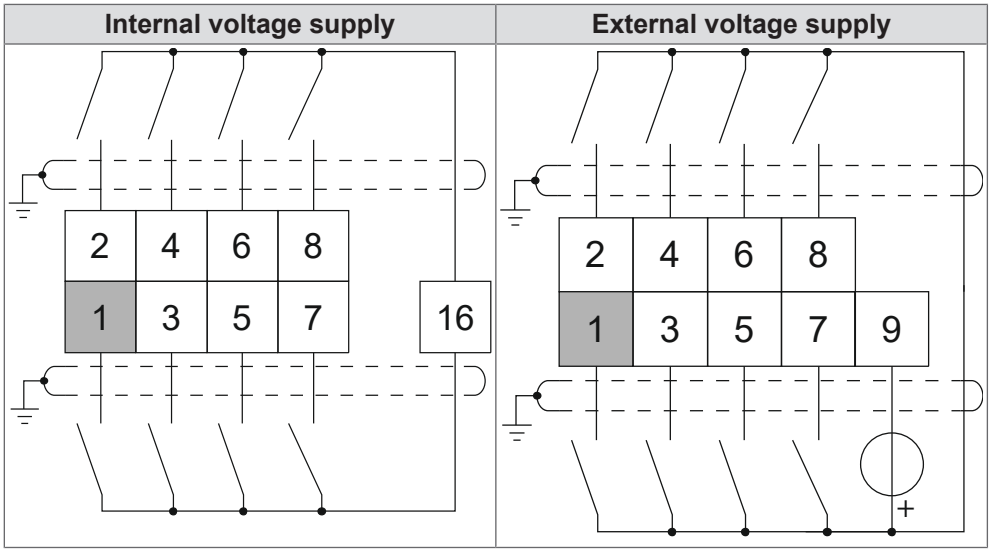
Tab. 10: Assignment of the terminal strip X2A

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

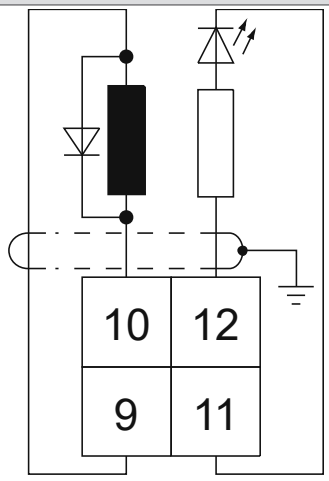
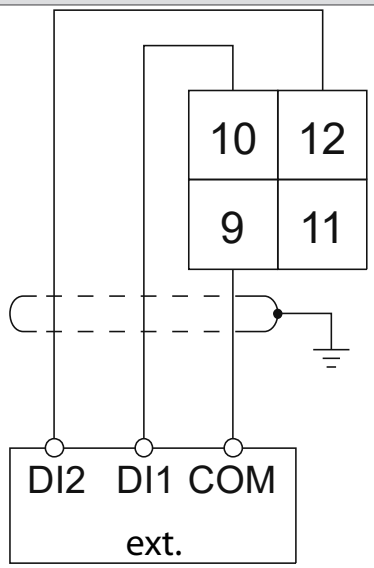


4.2.2 Digital outputs

Specification

Number	4 (2 at terminal strip X2A and 2 at terminal strip X2B)
Name	DO1 … DO2 (Out1 and Out2 on X2B)
Terminals	X2A.10, X2A.12 (X2B.7 and X2B.8)
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. The outputs on X2B are controlled via the safety module.

Connection

Connection external loads	Connection outputs to digital inputs
	

4.2.3 Relay output

The relay output is depending on the ordered variant => (≡► Variants of the control board [▶ 10]).

- Relay output form C
- Safe relay form A with positive-driven contacts

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.

⚠ WARNING

No internal fusing of the relay contacts!

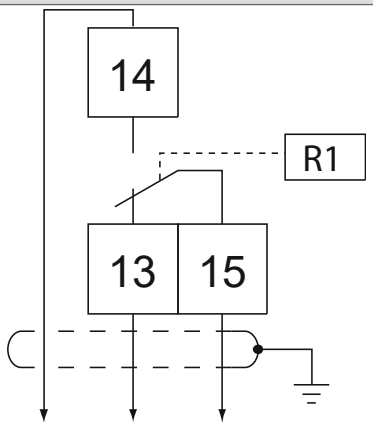
Welding of the relay contacts due to inadmissible overload!

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 relay output form C

Connection relay output form C



4.2.3.2 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 fusing of the relay contacts!

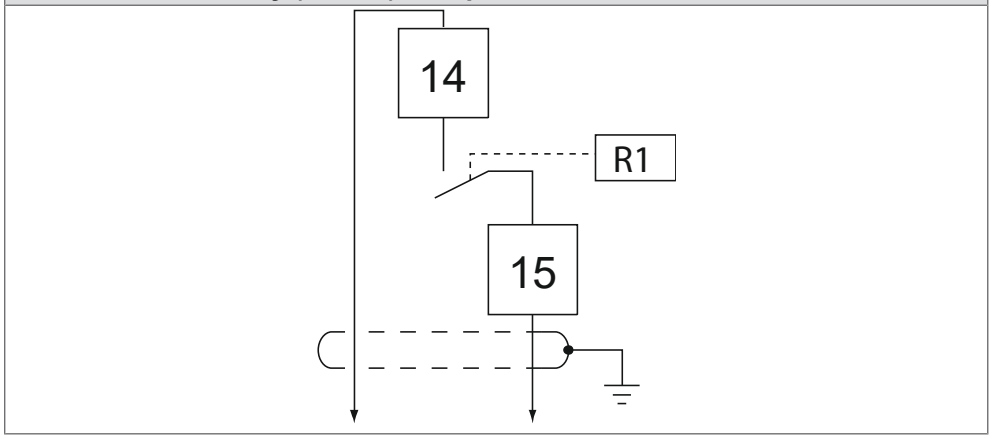
Welding of the relay contacts due to inadmissible overload!

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

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!

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!

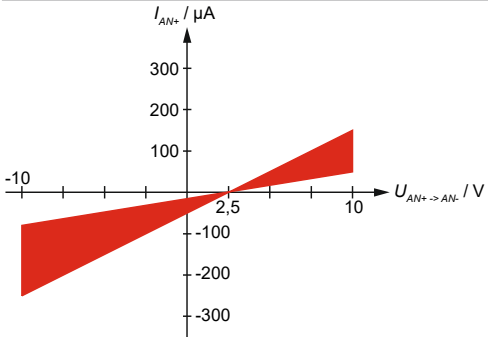
25 % setpoint with open conducter.

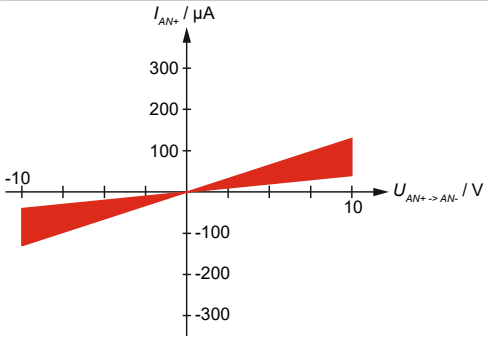
a) If pin AN- is connected to common, a voltage of 2.5 V appears from AN+ to AN- with open conductor (also in the event of a cable break). This corresponds to a setpoint of 25 % in the factory setting.

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

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

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





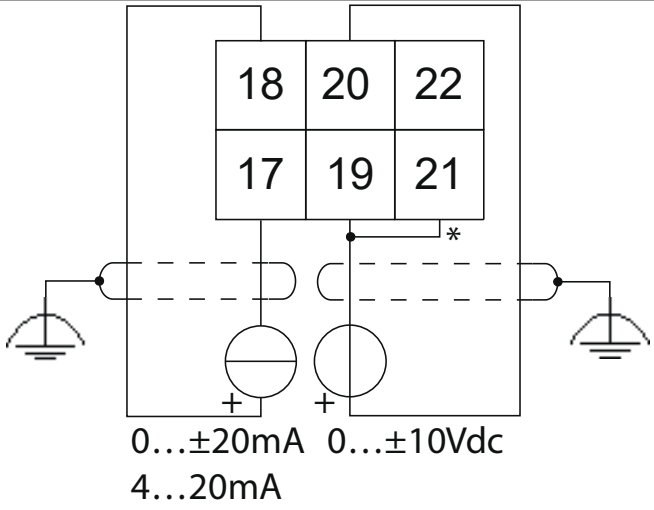
Specification (differential inputs)

Number	2
Name	AN1, AN2

Terminals	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



*) Equipotential bonding conductor

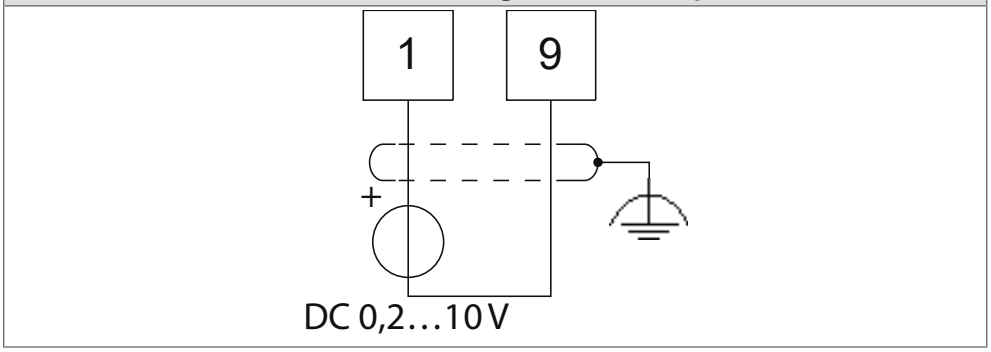
4.2.4.2 Absolute input

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



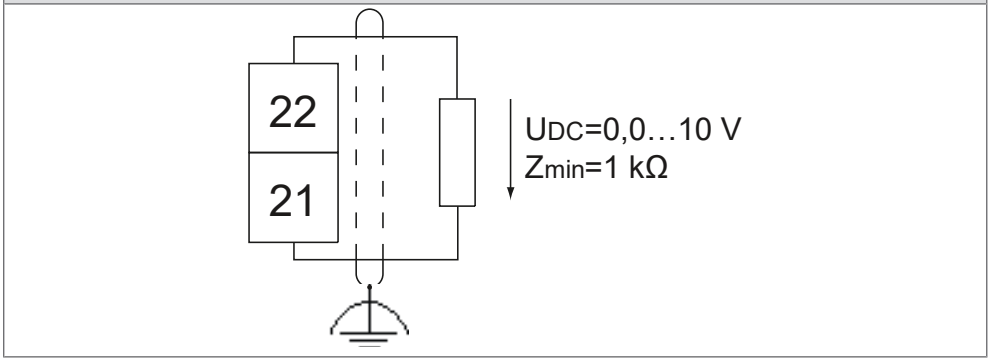
4.2.5 Analog output

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



4.2.6 Voltage supply

4.2.6.1 Voltage input

The control board can be supplied:

- externally by a central 24 V supply.
- internally, by its own switching power supply.
- in mixed operation, by external and internal 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)
- Brake
- HCT
- Encoder

Loads		Current consumption
Control		0.6 A
Power unit	Housing 2 / 3 / 4	0 A
	Housing 6	0.6 A
	Housing 7 / 8 / 9	1.0 A
Ancillary loads	Brake	Max. 2.0 A
	Encoder	Max. 0.5 A
	Digital output DO1	Max. 0.1 A
	Digital output DO2	Max. 0.1 A
	Voltage output 24Vout	Max. 0.1 A
	Sum DO safety modules	Max. 0.4 A

Tab. 11: Calculation the current consumption

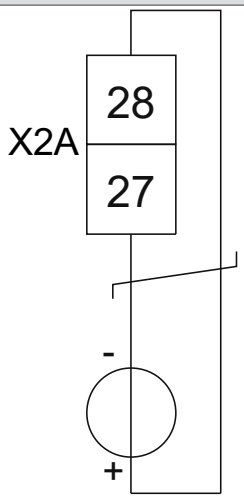
In order to calculate the input current, the currents of the power unit, control and other loads must be added together. The actual current required can be used for the consumers. The maximum current must not be exceeded.

4.2.6.1.2 External supply

Specification external supply

Name	P24Vin, 0V
Terminals	X2A.28 (P24Vin) X2A.27 (0V)
Voltage	DC 24 V (+20 % / -17 %)
Current consumption	Calculated value up to max. 4.8 A

Connection of the external supply



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".

4.2.6.1.3 Internal supply

The internal supply occurs via the 24VoutCtrl output. This is connected with the P24Vin input. The output may only be used to supply the control board.

Specification internal supply

Name	24VoutCtrl; P24Vin
Terminals	X2A.26 (24VoutCtrl) X2A.28 (P24Vin)
Output voltage	DC 24 V (-17 % / +20 %)
Maximum output current	1.5 A (housing 2 / 3 / 4) 2.1 A (housing 6) 2.5 A (housing 7 / 8 / 9)
Reference potential	0V (terminal X2A.27)

NOTICE

Too much current load!

Malfunctions can occur at the device and in the application.

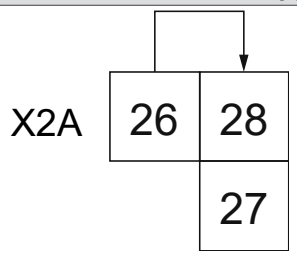
a) Determine the maximum current according "Determination of the current consumption".

b) If current consumption at P24Vin is higher than max. output current at 24VoutCtrl, then select external or mixed supply.

Observe the input voltage of the device!

a) The connected loads must be designed for the voltage tolerance of the voltage output 24VoutCtrl.

Connection for internal supply



see also

Calculation the current consumption [▸ 23]

4.2.6.1.4 Mixed supply

Mixed voltage supply is used,

- if the drive controller is to remain in operation when the high voltage supply of the drive controller is switched off.
- so that the drive controller can continue to operate if the external power supply fails.

Install protective diode

a) Diode D1 prevents the voltage output from supplying other loads if the external supply fails (see connection diagram "Connection with mixed supply").

NOTICE

Too much current load!

Malfunctions can occur at the device and in the application.

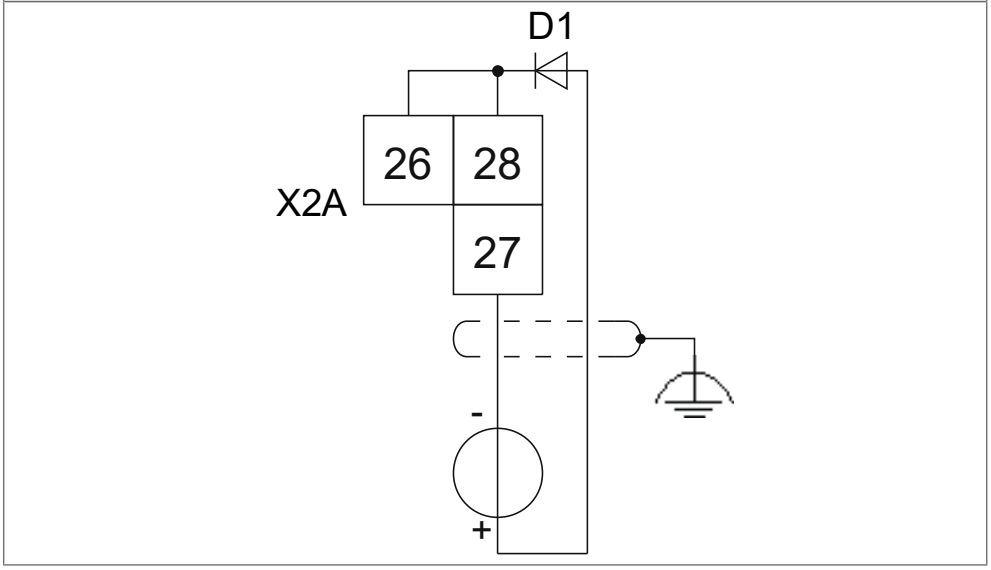
a) Determine the maximum current according "Determination of the current consumption".

b) If current consumption at P24Vin is higher than max. output current at 24VoutCtrl, then select external or mixed supply.

Observe the input voltage of the device!

a) The connected loads must be designed for the voltage tolerance of the voltage output 24VoutCtrl.

Connection for mixed supply



see also

Calculation the current consumption [▶ 23]

4.2.6.2 Voltage output to supply the inputs

Specification voltage output

Name	24Vout 0V (reference potential)
Terminals	X2A.16 (24Vout) X2A.27 (0V)
Output current	max. 100 mA (short-circuit proof)
Output voltage	minimum P24Vin - 3V maximum P24Vin
Notes	DC voltage output (SELV) to supply the digital inputs.

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

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:

Safety manual type 5

(🌐► https://www.keb-automation.com/0004)

Document: ma_dr_safety-typ5-20191137_en

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. 12: Serial interfaces

Name	Material number
Bluetooth adapter	0058060-0060

Tab. 13: 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. 14: 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

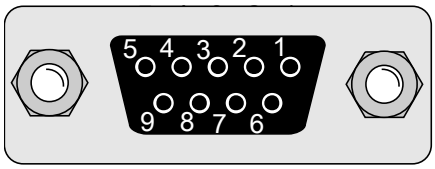


Fig. 1: Pin assignment socket D-Sub-9 (top view)

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

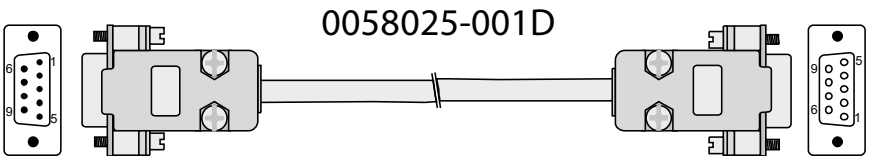


Fig. 2: Serial cable for the connection to a PC

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:

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

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. 15: 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 10th digit of the material number.

10th place	Control board design
0	PRO | no encoder interface, CAN®, Ethernet fieldbus interface, standard relay (Form C)
1	PRO | Multi-encoder interface, CAN®, Ethernet fieldbus interface, standard relay (Form C)
2	PRO | Hiperface DSL® OCT, CAN®, Ethernet fieldbus interface, standard relays (Form C)
3	PRO | Multi-encoder interface, CAN®, RS485 potential-free, Ethernet TCP/IP (no EtherCAT), standard relay (form C)
4	PRO | no encoder interface, CAN®, Ethernet fieldbus interface, safe relay (form A)
5	PRO | Multi-encoder interface, CAN®, Ethernet fieldbus interface, safe relay (form A)

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

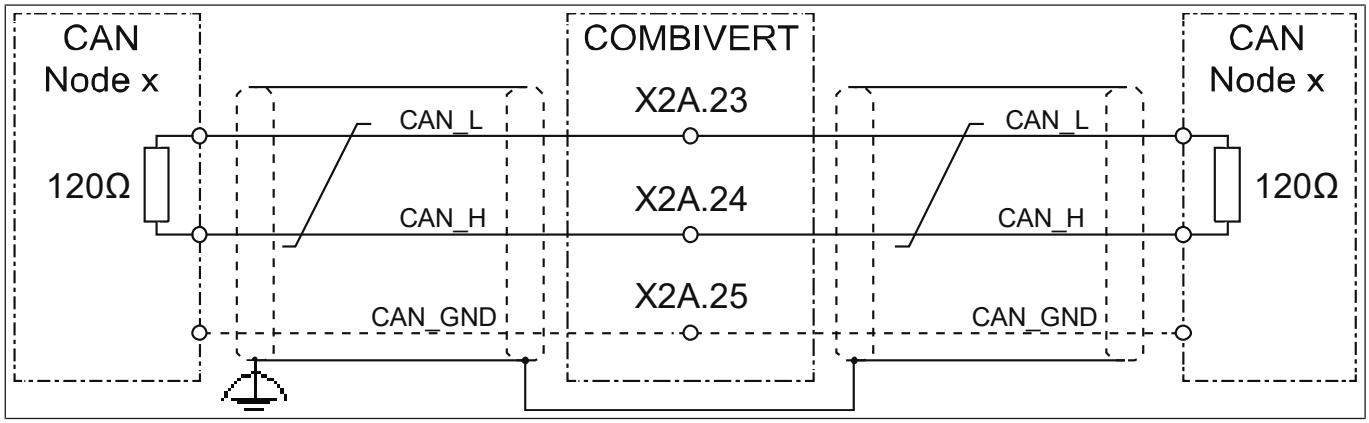


Fig. 3: Connection CAN bus

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-OP-ERATIONAL
Stop	g-0-0-0-0-0 (grid 200 ms)	Device in state STOPPED
Op	g (continuously	Device in state OPERA-TIONAL no error
Bus off	r (continuously)	CAN bus off.
Invalid Configuration	r-0 (grid 200 ms)	General configuration er-ror.
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 super-imposition.

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, PDOUT, PDIN data).
Number FMMUs	3 (PDOUT, PDIN data, Send-Mailbox-Status).
Max. number PDOUT data	Max. 2 PDOs; Mapping freely selectable. 32 Byte + optional FSoE data. 64 Byte + optional FSoE data (from SW 2.8).

Max. number PDIN data	Max. 2 PDOs; Mapping freely selectable. 32 Byte + optional FSoE data. 64 Byte + optional FSoE data (from SW 2.8).
Acyclic data traffic:	Supported mailbox protocols CoE; SDO download; SDO upload (Complete Access is not supported); Emergency
Distributed Clocks (DC)	Yes, 32 Bit; minimum cycle time: 500 µs (is22=8 x tp) 250 µs (is22=4 x tp) from SW 2.8 => Synchronous communication mode
Minimum FSoE watchdog time	35 ms (safety module type 5)

Connection

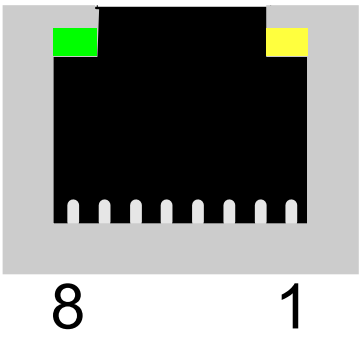


Fig. 4: RJ45 socket front view

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. 16: 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. 17: 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 OPERTIONAL to SAFE-OPERATIONAL. Error bit is set to "1".
Process Data or EtherCAT Watchdog	r-0-r-0-0-0-0-0 (grid 200 ms)	A watchdog error has occurred in the application.
Legend	r: Red g: Green 0: off	The red/green signals are shifted by 180°. In case of overlapping, red has priority.

Error status list

Error	Meaning	Example
Communication or device error	A communication or device error has occurred.	The device stops responding
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. 18: 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 with bus termination

7.4.1 Specification

Specification

Interface	RS485 potential-free with bus termination 4W
Transmission speed	9.6, 19.2, 38.4, 55.5, 57.6, 100, 115.2, 125, 250, 500 kBit/s
Bus nodes	2
Common-mode voltage range	0...12 V to the 'bus reference potential' BUS-COM
Potential separation	Potential-free to reference potential 0V/ COM (functional isolation)
Bus termination	120 Ω each (pin 1 and 2; 4 and 5); integrated (cannot be switched off)
Connection cable (minimum requirement)	CAT.5e network cable (S/UTP)

7.4.2 Connection

Connection X4B

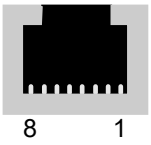


Fig. 5: RJ45 socket front view

PIN	Modbus name	EIA/TIA-485 name	Function
1	RxD0	(RxD-A) / A'	Receive signal inverted
2	RxD1	(RxD-B) / B'	Receive signal
3	n.c.	n.c.	reserved
4	TxD1	(TxD-B) / B	Transmission signal
5	TxD0	(TxD-A) / A	Transmission signal inverted
6	n.c.	n.c.	reserved
7	n.c.	n.c.	reserved
8	Common	(BUS-COM) / C/C'	Reference potential (does not have to be connected)
Housing	Shielding	Shielding	Functional earth (FE)

Tab. 19: PIN assignment RS485 potential-free to RJ45 plug

Schematic diagram 4W

Note: new MODBUS terminology:

Master => Client

Slave => Server

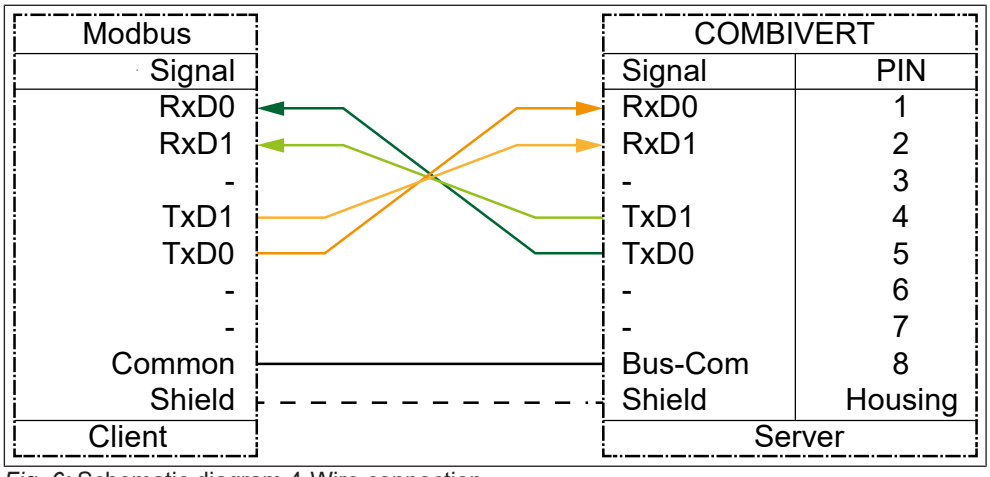


Fig. 6: Schematic diagram 4-Wire connection

7.4.3 Wiring example

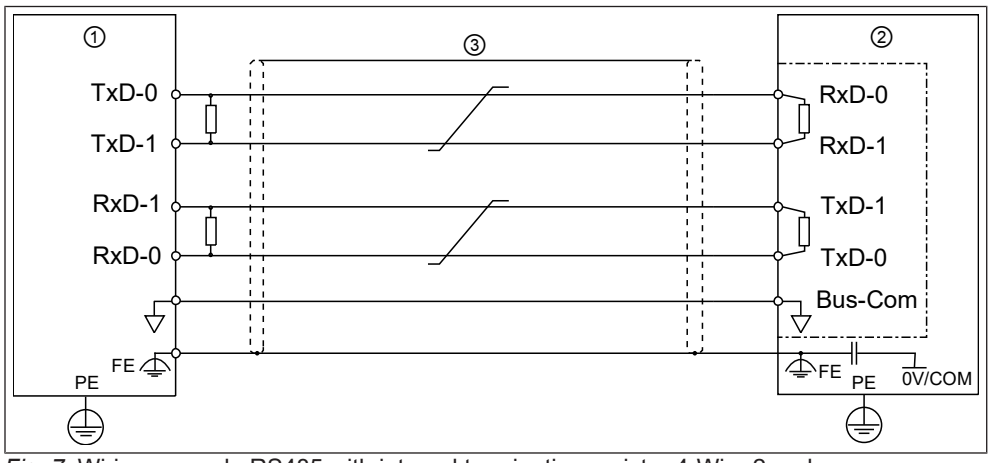


Fig. 7: Wiring example RS485 with internal terminating resistor 4-Wire 2 nodes

① Modbus master	② COMBIVERT as Modbus slave with internal bus termination
③ Connecting cable 4-Wire (twisted/ shielded)	

7.5 RS485 potential-free without bus termination

The interface RS485 potential-free without bus termination has no integrated bus termination resistors. This means that topologies with more than two participants can be realised. Optionally, external 2W or 4W wiring can be selected.

The interface RS485 potential-free without bus termination is a special variant. It cannot be retrofitted and must be taken into account when ordering. It can be recognised by the following marking on the fieldbus interface (F6) or on the nameplate (S6):

Fig. 8: No internal termination

7.5.1 Specification

Specification

Interface	RS485 without bus termination 2W/4W
Transmission speed	9.6, 19.2, 38.4, 55.5, 57.6, 100, 115.2, 125, 250, 500 kBit/s
Bus nodes	32 (up to 256 at min. 96 kΩ input resistance)
Common-mode voltage range	0...12 V to "bus reference potential" BUS-COM
Potential separation	Potential-free to reference potential 0V/ COM (functional isolation)
Bus termination	No integrated bus termination.
Stub cable length	1.5 m
Connection cable (minimum requirement)	CAT.5e network cable (S/UTP)

Stub cable

On (≡► Stub cables [▷ 37]) must not use terminating resistors. Therefore, only COMBIVERT with RS485 potential-free interface without bus termination 2W/4W may be used. If stub cables cannot be avoided, they must be kept as short as possible.

7.5.2 Connection

Connection X4B

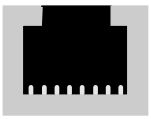


Fig. 9: RJ45 socket front view

PIN	Modbus name	EIA/TIA-485 name	Function
1	RxD0	(RxD-A) / A‘	Receive signal inverted
2	RxD1	(RxD-B) / B‘	Receive signal
3	n.c.	n.c.	reserved
4	TxD1	(TxD-B) / B	Transmission signal
5	TxD0	(TxD-A) / A	Transmission signal inverted
6	n.c.	n.c.	reserved
7	n.c.	n.c.	reserved
8	Common	(BUS-COM) / C/C‘	Reference potential (does not have to be connected)
Housing	Shielding	Shielding	Functional earth (FE)

Tab. 20: PIN assignment RS485 potential-free without bus termination to RJ45 plug

Schematic diagram 4W

Note: new MODBUS termino-logy:

Master => Client

Slave => Server

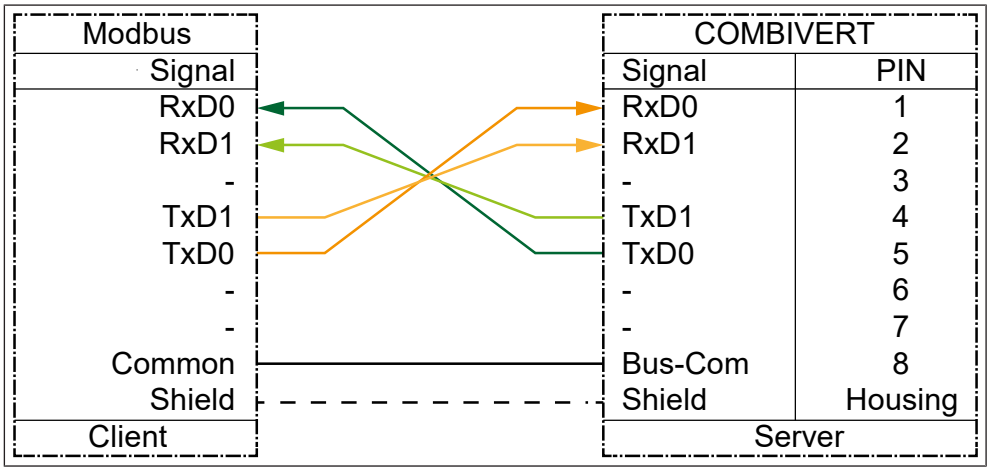


Fig. 10: Schematic diagram 4-Wire connection

Schematic diagram 2W

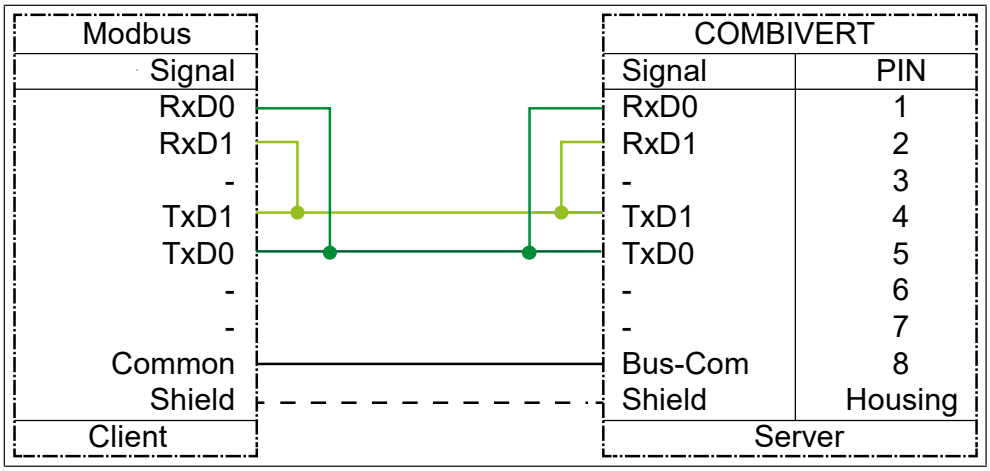


Fig. 11: Schematic diagram 2-Wire connection

7.5.3 Wiring example

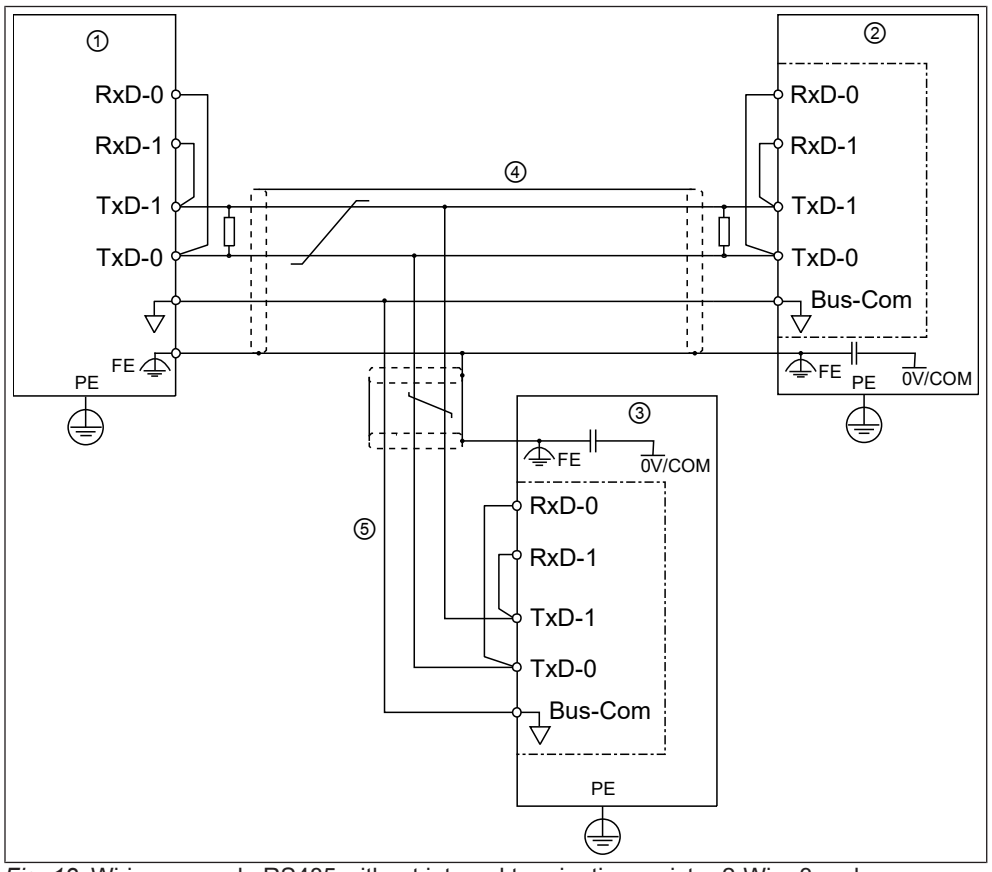


Fig. 12: Wiring example RS485 without internal terminating resistor 2-Wire 3 nodes

① Modbus master	② COMBIVERT as Modbus slave without bus termination
③ COMBIVERT as Modbus slave without bus termination	④ Connecting cable 2-Wire (twisted/ shielded)
⑤ Stub cable 2-Wire	

8 Encoder interfaces

8.1 Type code encoder interface

The 10th digit of the material number indicates which encoder interface is installed.

10th place	Control board design
0	PRO | no encoder interface, CAN®, Ethernet fieldbus interface, standard relay (Form C)
1	PRO | Multi-encoder interface, CAN®, Ethernet fieldbus interface, standard relay (Form C)
2	PRO | Hiperface DSL® OCT, CAN®, Ethernet fieldbus interface, standard relays (Form C)
3	PRO | Multi-encoder interface, CAN®, RS485 potential-free, Ethernet TCP/IP (no EtherCAT), standard relay (form C)
4	PRO | no encoder interface, CAN®, Ethernet fieldbus interface, safe relay (form A)
5	PRO | Multi-encoder interface, CAN®, Ethernet fieldbus interface, safe relay (form A)

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.

8.2.1 Input signals

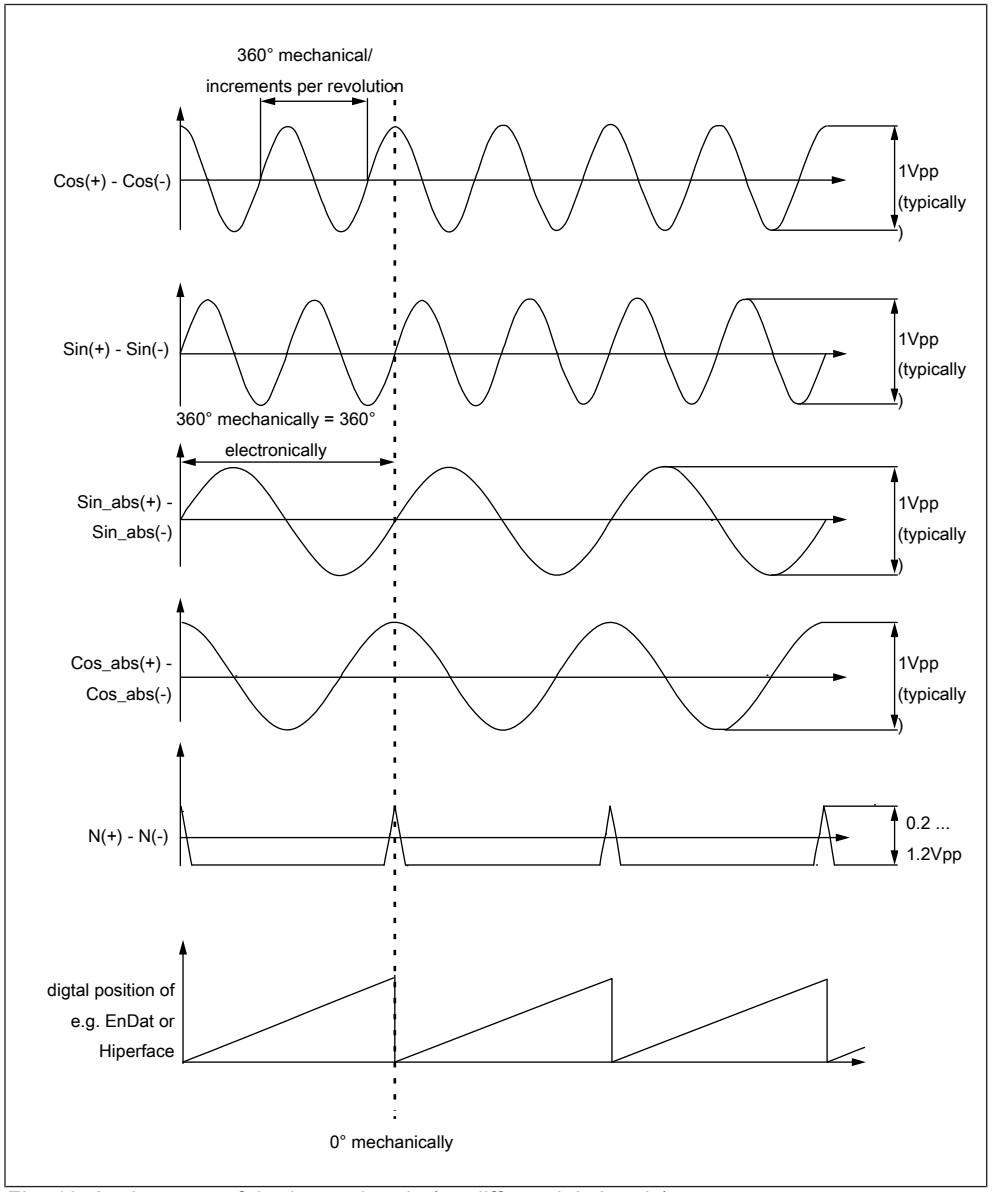


Fig. 13: Assignment of the input signals (as differential signals)

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

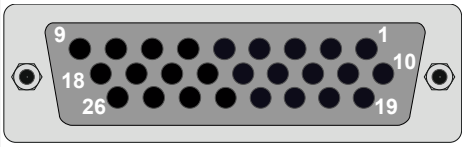
b) The identification "C" and "D" for the absolute signals must be checked. Frequently signal C corresponds to -> SIN_abs and D to -> (inverted) COS_abs.Thus D+ is at COS_abs- and D- is at COS_abs+.

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. 21: Alternative designation of encoder signals

8.2.2 Encoder sockets X3A/X3B

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

Tab. 22: 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!

8.2.3 Encoder cable length

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

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

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

Fig. 14: 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.

8.2.4 Encoder cable

Pre-assembled encoder cables:

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

8.2.5 Description of the encoder interfaces

PIN	Signals	Description
1, 2, 3, 4	A+/- B+/- Cos+/- Sin+/-	**Channel A only:** Input for two sine-wave differential signals shifted by 90° with Upp=1V, maximum 200kHz. Ground-referenced (e.g. Cos+ against GND): DC component 2.5 V ±0.5 V Differential (e.g. Cos+ versus Cos-): DC 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 200kHz. **Channel B:** Input for square-wave incremental signals according to RS485, maximum 500kHz. Incremental encoder simulation: Position changes of channel A are output to channel B with two 90° shiftet RS485 signals. Maximum output frequency 500 kHz.
5, 6	N+/- Data+/-	**Channel A only:** Zero signal input once per revolution. Differential signal level (N+ … N-): • higher than 50 mV: Zero signal is active • from 50 mV to -50 mV: undefined • Lower than -50 mV: zero signal is inactive Signal length 330°…360° of the signal length of the incremental signals. **Channels A and B:** . Zero signal is 1-active, if signals A and B are also 1-active. **Channel B only:** 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+/-	**Channel A only:** Input for sinusoidal absolute signals Upp=1V for SinCos encoders Upp=3.8V maximum for resolvers
10, 12	Clock+/-	Output for RS485 clock signal
14, 15	Exiter+/-	**Channel A only:** Output of the variable excitation voltage for resolvers (default): Ueff=2.54 V ≙ Upp=7.2 V ±5% for a coupling factor of the resolver of 0.5 ±10%. Output frequency: 10 kHz Maximum output current: ieff = 30 mA Phase shift: 0° ± 5° **Only control board APPLICATION and PRO:** Further setting options for the excitation voltage can be found in the corresponding programming manual (from software version V3.3).
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 => automatic, depending on the set encoder type (ec16) Max. 500 mA in 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=24V max. 500mA total (250mA per channel) • Minimum P24V_IN - 3V • Maximum P24V_IN
19, 20, 21, 22, 23, 24	A_HTL+/- B_HTL+/- N_HTL+/-	**Channel B only:** HTL signal input 10 V…30 V maximum 150 kHz

Tab. 23: Encoder specifications

8.3 Hiperface DSL® OCT

Hiperface DSL® is a fully digital, serial interface protocol for communication between Drive Controller and encoder feedback. In combination with OCT, the motor's power supply and data transmission for the encoder system are realised via a single standard motor connection cable.

Diagnostic data such as temperature and operating hours can be transmitted via the protocol.

8.3.1 Specification

Protocol	Hiperface DSL®
Interface	X1C.9 DSL+ X1C.10 DSL-
Potential separation	Basic isolation for SELV voltage (DC 24V) of the control card. A system voltage of 300 V is defined (Phase – PE).
Cable length	max. 50 m

8.3.2 Connection of Hiperface DSL® encoders

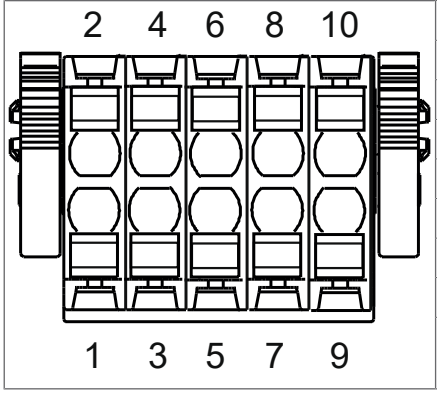
NOTICE

Potential malfunctions caused by untested cables!

Please use only KEB cables (00S6L3x-xxxx).

a) If cables from other manufacturers are used, trouble-free operation cannot be guaranteed.

b) The pin configuration set out below must be strictly adhered to in all cases.

X1C	PIN	Name	Notes
	1	BR+	(≡► Brake control and temperature detection [▷ 46])
	2	BR-	
	3	0V	
	4	24Vout	
	5	BCF1	
	6	BCF2	
	7/8	reserved	
	9	DSL+	Hiperface DSL OCT+ [1]
	10	DSL-	Hiperface DSL OCT- [1]

Tab. 24: Assignment of terminal block X1C with Hiperface DSL® OCT

1) Special allocation only for Hiperface DSL® OCT.

To ensure the most interference-free connection possible, the inner and outer shields of the motor cable must be connected on both sides.

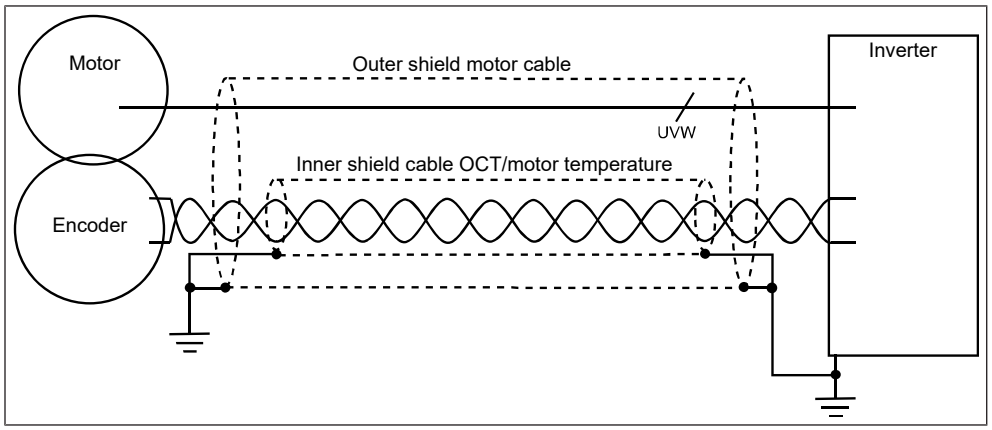


Fig. 15: Connection principle shielding of the motor cable for OCT cables

Additional information on installation can be found in the following info:

Fundamentals of Electromagnetic Compatibility:
(► https://www.keb-automation.com/000A)
Document: ti_dr_tn-emc-00011_en

8.3.3 Parameterisation

As with all other smart transmitters, parameterisation is carried out via the ec parameters.

Activation takes place in parameter ec16 = "Hiperface DSL". After activation, the position and speed are determined. The connected encoder type is displayed in ec17 and the encoder resolutions in ec.40/ec41.

With ec46, motor data can be stored and read out in the encoder.

The following tables show the error and warning messages for Hiperface DSL.

Parameter ec01		**Address 0x2801 and 0x4801**
Value	**Error message**	**Description**
211	DSL ‘no communication’	The first attempt to establish a connection to the encoder has failed. No encoder is connected.
212	DSL “Error when initially clearing the encoder status flags”	The first attempt to clear the encoder’s status messages failed.
213	DSL “Error deleting encoder status flags”	The attempt to clear the encoder’s status messages has failed. However, the first deletion was successful. Possible causes include EMC interference or unexpected or incompatible behaviour on the part of the encoder.
214	DSL “Error during the first encoder read”	The first read operation from the encoder during initialisation failed. However, a connection to the encoder was successfully established.
215	DSL ‘unsupported encoder type’	The selected sensor type is not supported.
216	DSL “Error reading from the encoder”	An error occurred whilst reading a value from the encoder nameplate during initialisation. However, the first read operation was successful. Possible causes include electromagnetic interference or unexpected or incompatible behaviour on the part of the encoder.
217	DSL “Too much cable interference during initialisation”	During initialisation, too much interference was detected on the encoder line. Check the cable to the encoder.
221	DSL “Channel for long messages is not free”	Access to the encoder memory is faulty. Possible causes include electromagnetic interference or unexpected or incompatible behaviour on the part of the encoder.
222	DSL “No response on the Long Message channel”	
231	DSL “unexpected flags set in the EVENT register”	DSL communication is not working properly, even though it was working fine previously. Possible causes include electromagnetic interference or a faulty encoder cable, encoder signal processing or the encoder itself.
232	DSL: “Error counter for rapid position has gone up”	
233	DSL ‘poor transmission quality’	
234	DSL ‘estimated position value due to transmission fault’	
235	DSL “Position detection check not completed”	
236	DSL “Long message channel in use”	Access to the encoder memory is faulty. Possible causes include electromagnetic interference or unexpected or incompatible behaviour on the part of the encoder.
237	DSL “No response to long message”	
238	DSL “Long Message Error”	

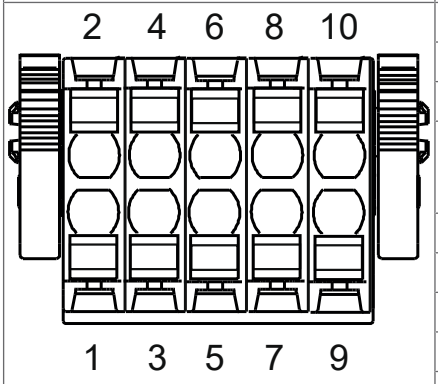
Tab. 25: Error messages in ec01: ‘Encoder interface error’ (0x2801, 0x4801) for Hiperface DSL

Parameter ec02		**Address 0x2802 and 0x4802**
Value	**Warning message**	**Description**
50	DSL “Unexpected flags are set in the EVENT register”	A transmission error has occurred. The EVENT register has a value other than 0x0003.
51	DSL “The signal quality has deteriorated”	The signal quality measured has deteriorated.

Parameter ec02		Address 0x2802 and 0x4802
Value	**Warning message**	**Description**
52	DSL ‘estimated position value’	The transmission is disrupted; the position value has been estimated.
53	DSL: ‘Cable faults detected’	Interference was detected on the encoder line during initialisation.
54	DSL “The cable cable run time has reached the maximum”	The signal delay time has reached its maximum or the cable length of 100 m. This is normal for a cable length of around 100 metres. If the cable is significantly shorter, it should be checked.
55	DSL “Synchronisation mode enabled for testing and debugging purposes”	For testing: DSL-Core operates in "sync mode"; the sampling point for the positions is the falling edge of the sync signal, as is the case with all other encoder types.

Tab. 26: Warning messages in ec02 “Warning Encoder Interface” (0x2802, 0x4802) for Hiperface DSL

9 Brake control and temperature detection

X1C	PIN	Name	Notes
	1	BR+	Brake control / output
	2	BR-	Brake control / output
	3	0V	To power the feedback inputs U = P24Vin – 0.5V I = max. 1A (BR+ and 24Vout combined: max. 2A)
	4	24Vout	
	5	BCF1	Feedback input for brake control
	6	BCF2	Feedback input for brake control
	7/8	reserved	
	9	TA1	Temperature measurement / input+ [1)]
	10	TA2	Temperature measurement / input- [1)]

Tab. 27: Assignment of the terminal block X1C

1) Note special assignment for Hiperface DSL® OCT variant.

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 (it 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

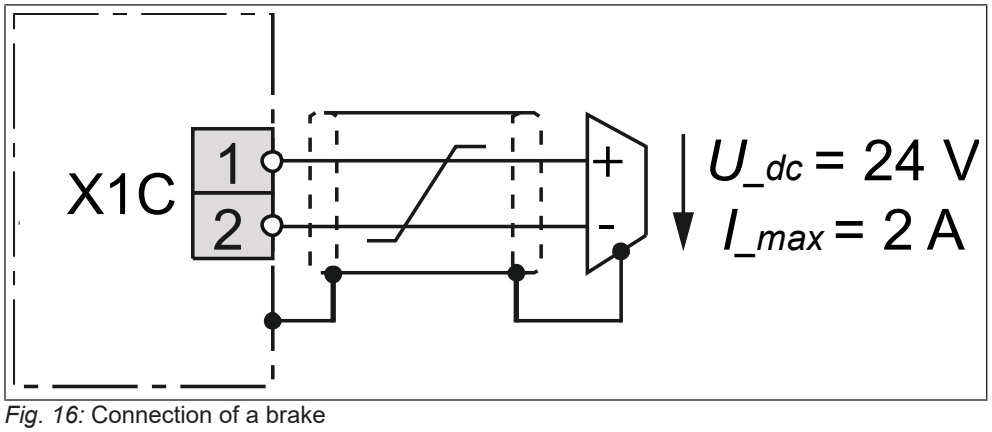


Fig. 16: Connection of a brake

9.2 Temperature detection

⚠ DANGER

Electric shock by sensors without protective separation!

a) Only use sensors with basic insulation.

b) Up to the specified year/week of manufacture (Tab. :) only sensors with double insulation (basic insulation plus additional insulation) are permitted.

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 board from production year/week 2021/50. 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.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.

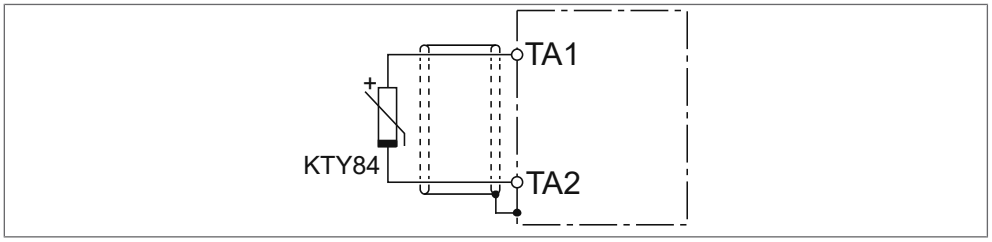
b) KTY sensors may not be combined with other sensors.

Settings KTY input

Setting

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

Connection KTY sensor



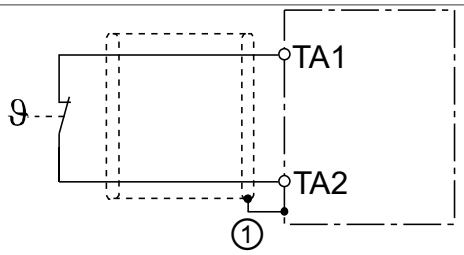
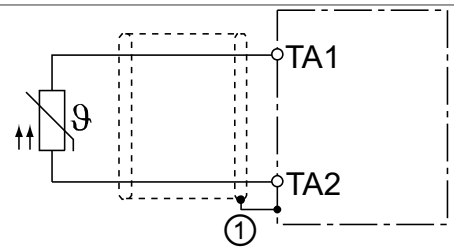
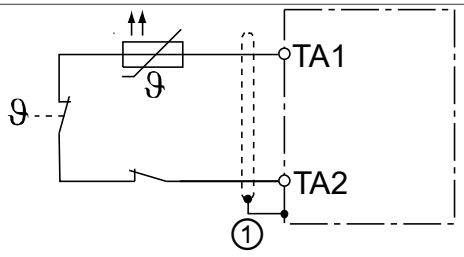
9.2.3 Connection of PTC, temperature switch or PT1000

Settings for PTC, thermal contact or PT1000

Setting

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

Connection

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

Tab. 28: Connection examples

10 Certifications and approvals

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

(🌐► keb-automation.com/search)

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

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

10.1 CE marking

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

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

10.2 FS marking

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

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

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

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

10.3 UL certification

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

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

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

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

10.4 Further markings

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

11 Revision history

Edition	Ver.	Note	FS
2018-12	00	Pre-series version.	N
2019-07	01	Series version	N
2019-08	02	Values for temperature input changed; editorial changes.	N
2020-05	03	Notes for positive-driven relay inserted; CAN interface in preparation; editorial changes.	Y
2022-03	04	RS485 potential-free inserted; CAN interface; base-isolated temperature input; function LED1 EtherCAT; conversion to editorial system.	N
2022-10	05	Socket for RS485 interface without LEDs.	Y
2022-11	06	Encoder interface pin 19 changed.	N
2023-09	07	Type code digit 10 extended. Relay classified as Form A and Form C. 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. Editorial changes.	Y
2023-12	08	Values for (≡► Assembly of wires [▷ 15]) adapted. Light pattern (≡► CAN [▷ 31]) corrected.	N
2024-06	09	Fieldbus interface (≡► RS485 without bus termination [▷ 35]) inserted. RS485 assignment changed. Designation GND in 0V/ COM at (≡► Encoder interfaces [▷ 40]) changed. Note for common-related operation of the analog differential inputs inserted. Warning notice inserted for protection for relay output form C.	N
2025-11	10	(≡► Hiperface DSL® OCT [▷ 42]) added. Variable excitation voltage for resolver inserted. Editorial changes.	N
2026-07	11	Additions to the (≡► Hiperface DSL® OCT [▷ 42]) inserted. Editorial changes to the type code.	N

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

List of Figures

List of Tables

Glossary

2W

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

4W

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

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.

Client

The client initiates communication and sends requests (formerly the master). Typical clients include PLCs, HMIs or generally higher-level control systems.

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

Drive Controller

Designation for a frequency inverter or servo controller

DSL®

DSL® stands for Digital Servo Link. It is a digital, serial interface protocol between drive controllers and motor encoders.

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)

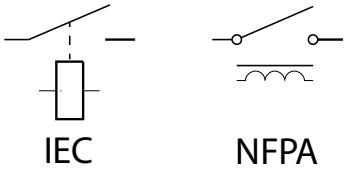
EnDat

Bidirectional encoder interface of the company Heidenhain.

EtherCAT®

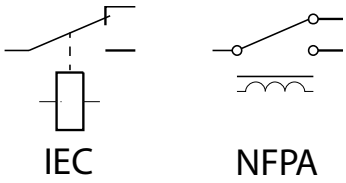
EtherCAT is a real-time Ethernet bus system. EtherCAT is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

Form A



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

Form C



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

Functional earth

Functional earth is used exclusively to dissipate interferences. It offers no contact protection for persons.

HCT

Component for current measurement in the power circuit.

Hiperface

Bidirectional encoder interface of the company Sick-Stegmann.

HSP5

Fast, serial protocol.

HTL

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

IEC 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.

OCT

OCT stands for One Cable Technology. This means that the motor supply and encoder signals are transmitted via a common cable.

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 extra-low voltage (unearthed).

Server

A server (formerly known as a slave) waits for requests. There may be several servers connected to a single client. A frequency inverter is a typical server.

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 controlledSTO (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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Notes

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