

COMBIVERT



GB Installation Manual
Control Circuit

F5 with Safety Function „STO“

Original Manual	
Mat.No.	Rev.
00F5NES-K000	1K

KEB

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1. Preface

1.1 General

First we would like to welcome you as a customer of the company Karl E. Brinkmann GmbH and congratulation to the purchase of this product. You have decided for a product on highest technical niveau.

The described hard- and software are developments of the Karl E. Brinkmann GmbH. The enclosed documents correspond to conditions valid at printing. Misprint, mistakes and technical changes reserved.

The instruction manual must be made available to the user. Before working with the unit the user must become familiar with it. This especially applies to the knowledge and observance of the following safety and warning indications. The used pictograms have following significance:

	Danger Warning Caution	Is used, if life or health of the user are endangered or substantial damage to property can occur.
	Attention observe at all costs	Is used, if a measure is necessary for safe and trouble-free operation.
	Information Aid Tip	Is used, if a measure simplifies the handling or operation of the unit.

Non-observance of the safety instructions leads to the loss of any liability claims. This list is not exhaustive.

1.2 Validity and liability

The use of our units in the target products is outside of our control and therefore lies exclusively in the area of responsibility of the machine manufacturer.

The information contained in the technical documentation, as well as any user-specific advice in spoken and written and through tests, are made to best of our knowledge and information about the application. However, they are considered for information only without responsibility. This also applies to any violation of industrial property rights of a third-party.

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

Tests can only be done within the application by the machine manufacturer. They must be repeated, even if only parts of hardware, software or the unit adjustment are modified.

Unauthorised opening and tampering may lead to bodily injury and property damage and may entail the loss of warranty rights. Original spare parts and authorized accessories by the manufacturer serve as security. The use of other parts excludes liability for the consequences arising out of.

The suspension of liability is especially valid also for operation interruption loss, loss of profit, data loss or other damages. This is also valid, if we referred first to the possibility of such damages.

If single regulations should be or become void, invalid or impracticable, the effectivity of all other regulations or agreements is not affected.

1.3 Copyright

The customer may use the instruction manual as well as further documents or parts from it for internal purposes. Copyrights are with KEB and remain valid in its entirety.

1.4 Specified application

The COMBIVERT F5 serves exclusively for the control and regulation of three-phase motors. The operation of other electric consumers is prohibited and can lead to the destruction of the unit. Inverter are components designed for inclusion in electrical installations or machinery.

The used semiconductors and components of KEB are developed and dimensioned for the use in industrial products. If the KEB COMBIVERT F5 is used in machines, which work under exceptional conditions or if essential functions, life-supporting measures or an extraordinary safety step must be fulfilled, the necessary reliability and security must be ensured by the machine builder. The operation of our products outside the indicated limit values of the technical data leads to the loss of any liability claims. The safety function is limited to a service life of 20 years. After this time the unit must be replaced.

1.5 Product description

The product family COMBIVERT F5 with safety function STO has been developed for the use in safety-oriented applications. The basic standards as well as application and country-specific standards must be observed furthermore. The standards referred in this manual must be observed supplementary!

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

- Safe torque off (Safe Torque Off - STO)

The safety function meet the requirements in accordance with performance level e (ISO13849-1) and SIL 3 (IEC 61508 and IEC 62061). In case of proper project design, installation and operation the safety function protect people against mechanical damages.



This accompanying instruction manual contains only information for the installation and connection of the control of the KEB COMBIVERT F5, as well as the safety technology.

This manual is only valid in connection with the EMC- and safety instructions as well as the power circuit manual.

COMBIVERT F5 inverter with integrated safety technology correspond to the following numerical code:

Control HW	used	Inverter	Control SW	Operating mode (ud.02)
1KF5x30-0009 2KF5x30-0008	up to housing size E from housing size G	xxF5Kxx-xxxx	APPLICATION with encoder interface	MULTI
		xxF5Kxx-xx0x	APPLICATION without encoder interface	GENERAL
		xxF5Lxx-xxxx	ASCL	MULTI
		xxF5Pxx-xxxx	SCL	SERVO

	<p>Validity of certificates</p>	<p>The certification of controllers with safety technology since 05.2013 is only valid if the material number corresponds with the specified numerical code and the FS logo is printed on the type plate.</p>	
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2. Control

2.1 Features of the control

The control provides the following analog and digital functions:

- Hardware allocation of digital and analog inputs and outputs.
- HSP5 interface for the connection with an operator or via special cable (00F50C0-0010) with a PC
- Hardware of the control circuit „safety separated“ according to EN 61800-5-1 (base TN-C/S mains)
- Operation and diagnosis via operator
- Safety function STO (two channel torque off)

2.2 Overview

Control 2KF5xxx-xxxx from G housing		Control 1KF5xxx-xxxx in D & E housing	
X2A	Control terminal strip	X6B	HSP5 diagnostic interface
X2B	Terminal block safety function	X6C	depending on the operator
X3A	Encoder interface channel 1 (option)	X6D	
X3B	Encoder interface channel 2 (option)	LED1	Inverter state
X4A	HSP5 interface		

2.2.1 LED1

If the COMBIVERT F5 is operated without plugged operator, the inverter state can be read from integrated status LED..

LED status	Function
off	Unit switched off
on	Unit ready for operation
flashing	Unit in malfunction

2.2.2 HSP5 interface X4A

The HSP5 interface X4A serves for the communication with a control operator. A digital operator, interface operator and different fieldbus operators are available for this. To prevent malfunctions, the inverter must be brought into nOP status before connecting / disconnecting the operator (open control release terminal). When starting the inverter, it is started always with the last stored values or factory setting.

A special HSP5 cable (part number 00.F5.0C0-0010) is required for the operation of the KEB COMBIVERT without operator. This cable is connected between HSP5 interface X4A and serial RS232 PC interface (COM1 or COM2). Operation occurs via the program COMBIVIS.



The HSP5 service cable has an integrated level converter. The connection of a serial standard cable would destroy the PC interface.

2.2.3 Encoder interfaces X3A, X3B

The COMBIVERT F5 can be equipped optionally with encoder interfaces. Different combinations can be used here according to the requirements. The instruction is made separately according to the installed encoder interfaces.

2.2.4 Operators

The COMBIVERT F5 can be equipped optionally with operator. Different control or field bus operators are available here according to the requirements. The instruction is made separately according to the installed operator.

2.2.5 Control terminal strip X2A

The control terminal block X2A is designed as double, plug-in terminal block with spring cage connection. It contains 32 pole.

2.2.6 Safety terminal block X2B

The safety terminal block X2A is designed as double, plug-in terminal block with spring cage connection. It contains 10 pole.

2.3 Connection of the control

The following instructions must be observed at connection:

Attention	Prevent EMC malfunctions
	<ul style="list-style-type: none"> • Use shielded / drilled cables • Lay shield on one side of the inverter onto earth potential • Install control cables and power cables separately (approx. 10...20 cm distance); Kreuzungen im rechten Winkel verlegen • To avoid interferences a separate shielding must be provided for analog and digital control lines. Depending on the use of the relay outputs, an extra shielding is to be used, too. • In case of inductive load on the relay outputs a protective wiring must be provided (e.g. free-wheeling diode)!

	The terminals of the control terminal strip and the transmitter inputs are securely isolated in accordance with EN 50178.
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2.3.1 Assembly of the wires

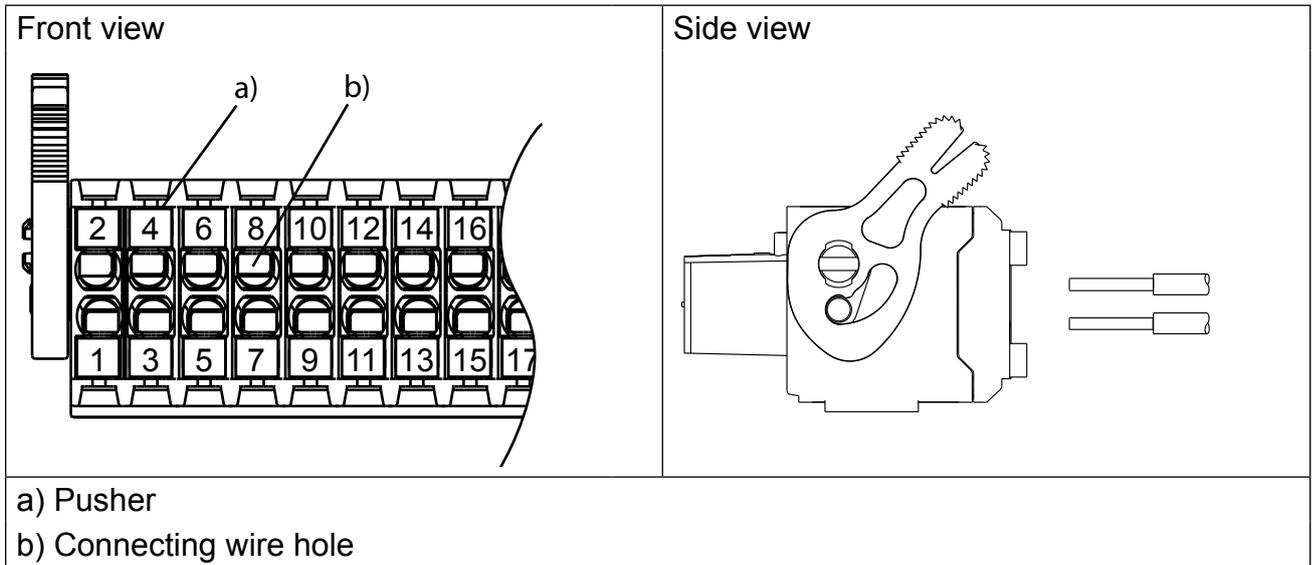
Cross-section / AWG	Metal sleeve length	Stripping length
0.50 mm ² / 21	10 mm	12 mm
0.75 mm ² / 19	12 mm	14 mm
1.00 mm ² / 18	12 mm	15 mm

Info  KEB generally recommends the use of wire-end ferrules in industrial environments.

Cross-section / AWG	Stripping length
0.14 1.5mm ² , 25 16	10 mm
Stranded wire (rigidly and flexibly)	

- Press pusher by hand. Insert connecting wires into the respective hole, that no single wires can be seen from the outside or bend outward.
A first resistance must be overcome when inserting. Release the pusher.
- Check that the connecting wire is fixed and can not be pulled-out. It is important to ensure that the connecting wire and not the insulation is clamped. The connecting wire can also be inserted without pressing the pusher in case of cross-sections upto 1.00 mm².

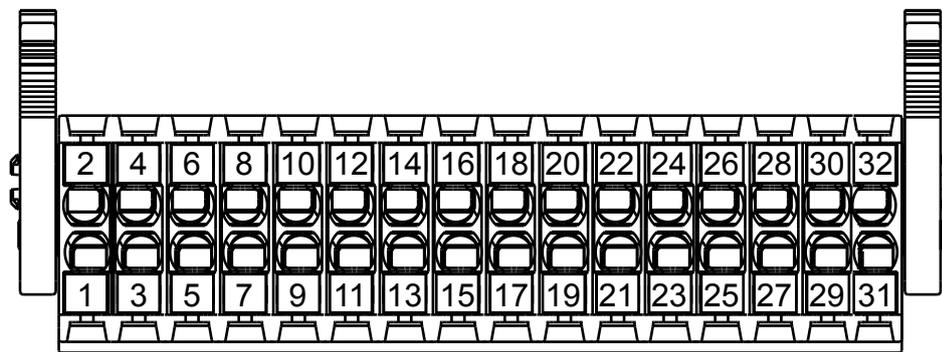
Attention  A safe clamping can not be guaranteed when using shorter wire-end ferrules.



2.4 Assignment of the terminal strip X2A

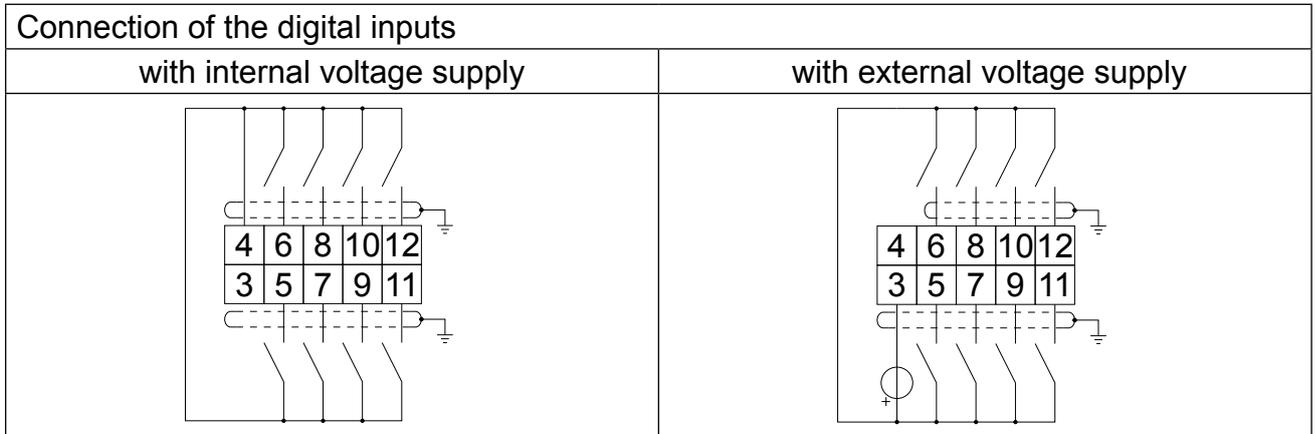
PIN	Name	Description	Specifications
1	0V	Digital mass; reference potential for digital inputs/outputs, U_{in} and U_{out}	
2	U_{in}	Input external voltage supply	$U=24\text{ VDC } +20\%/-15\%$ $I_{max}=1\text{ A}$
3	0V	like pin 1	
4	U_{out}	Voltage output for the control of the digital inputs	$U=24\text{ VDC } \pm 25\%$ $I_{max}(\text{Pin } 4+32)=100\text{ mA}$
5	RST	Programmable digital inputs (Assignment ex factory see chapter 2.4.1)	8 digital inputs according to IEC61131-2 type 1 „0“ = -3...5VDC „1“ = 15...30VDC Scan time $\leq 1\text{ ms}$
6	ST		
7	R		
8	F		
9	I2		
10	I1		
11	I4		
12	I3		

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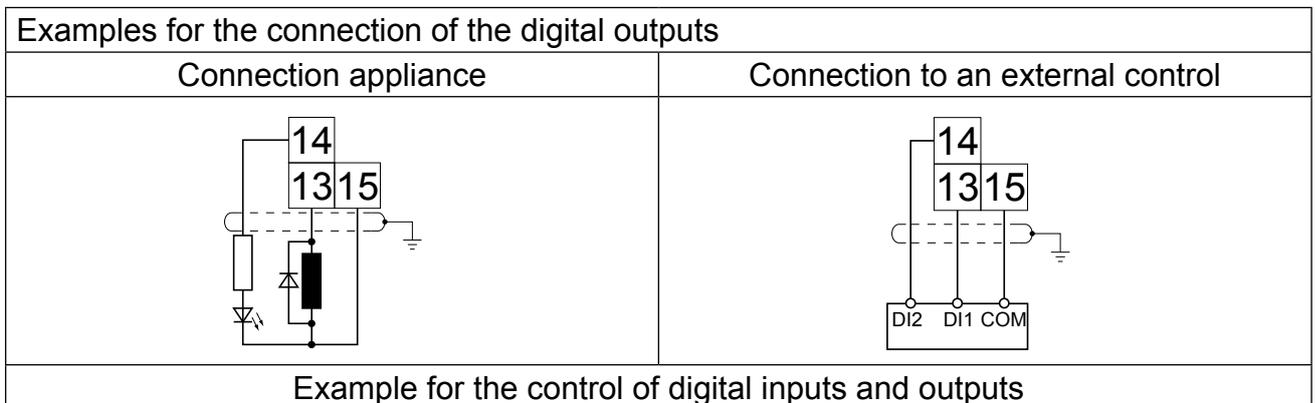
PIN	Name	Description	Specifications
13	O2	Programmable digital outputs (Assignment ex factory see chapter 2.4.2)	2 short-circuit proof digital 24 V outputs specified according to IEC61131-2 I _{max} = 100mA per output Switching of inductive load (without free-wheeling path) up to 300mJ maximum switching frequency = 1kHz
14	O1		
15	0V	like pin 1	
16	CRF	Reference voltage for setpoint potentiometer	10VDC +5%; I _{max} = 4 mA
17	AN1-	Programmable analog inputs (Assignment ex factory see chapter 2.4.3)	0...±10Vdc (R _i =55 kΩ) 0...±20 mA (R _i =250 Ω) 4...20 mA (R _i =250 Ω) Resolution: 11 Bit + sign Scan time ≤ 1 ms
18	AN1+		
19	AN2-		
20	AN2+		
21	COM	Analog mass; Reference potential for analog inputs and outputs	
22	ANOUT1	Programmable analog output 1 (Assignment ex factory see chapter 2.4.4)	U=0...±10Vdc (max.11.5Vdc) I _{max} =10 mA; Ri = 100 Ω Res:11Bit + sign
23	COM	like Pin 21	
24	ANOUT2	Programmable analog output 2 (Assignment ex factory see chapter 2.4.4)	
25	R2-C	Relay 2 switching contact	Programmable relay outputs (Assignment ex factory see chapter 2.4.5) U _{max} = 30Vdc I = 0.01...1A
26	R1-C	Relay 1 switching contact	
27	R2-B	Relay 2 NC contact	
28	R1-B	Relay 1 NC contact	
29	R2-A	Relay 2 NO contact	
30	R1A	Relay 1 NO contact	
31	0V	like pin 1	
32	U _{out}	like pin 4	

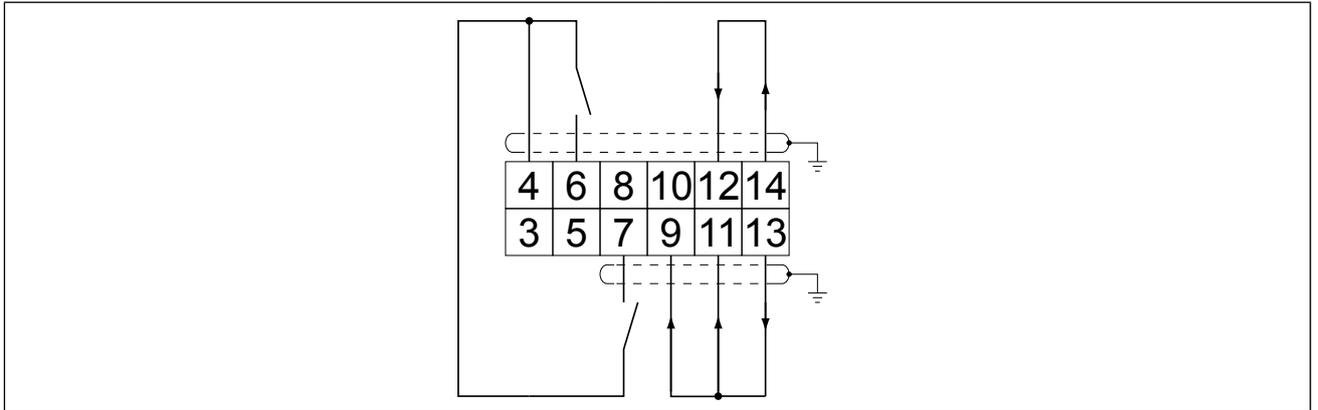
2.4.1 Connection of the digital inputs



Factory setting of the digital inputs					
Input	Operating mode	GENERAL		MULTI/SERVO	
		RST		Reset	
ST		Control release		Control release / reset	
R		Direction of rotation reverse		Limit switch left	
F		Direction of rotation forward		Limit switch right	
I1		Step value 1	I1+I2=fixed value 3	Step value 1	I1+I2=fixed value 3
I2		Step value 1		Step value 1	
I3		External error input (E.EF)		External error input (E.EF)	
I4		Activates DC braking		-	

2.4.2 Connection of the digital outputs





Factory setting of the digital outputs		
Operating mode Input	GENERAL	MULTI/SERVO
O1	Ready signal	Ready signal
O2	Switch at actual value=setpoint value	Switch at actual value=setpoint value

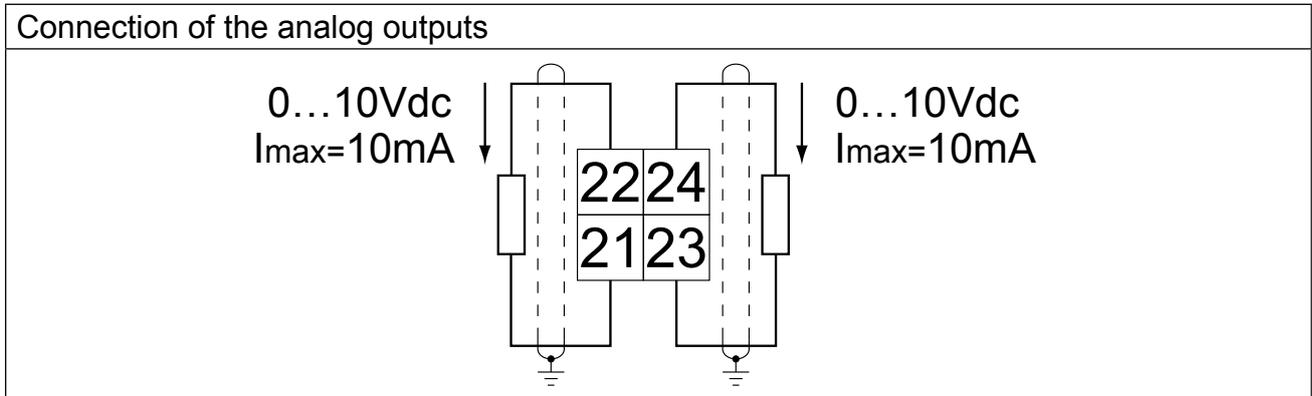
2.4.3 Connection of the analog inputs

Examples for the connection of the analog setpoint input

! *) Connect potential equalizing line only if a potential difference of >30V exists between the controls. The internal resistance is reduced to 30 kΩ.

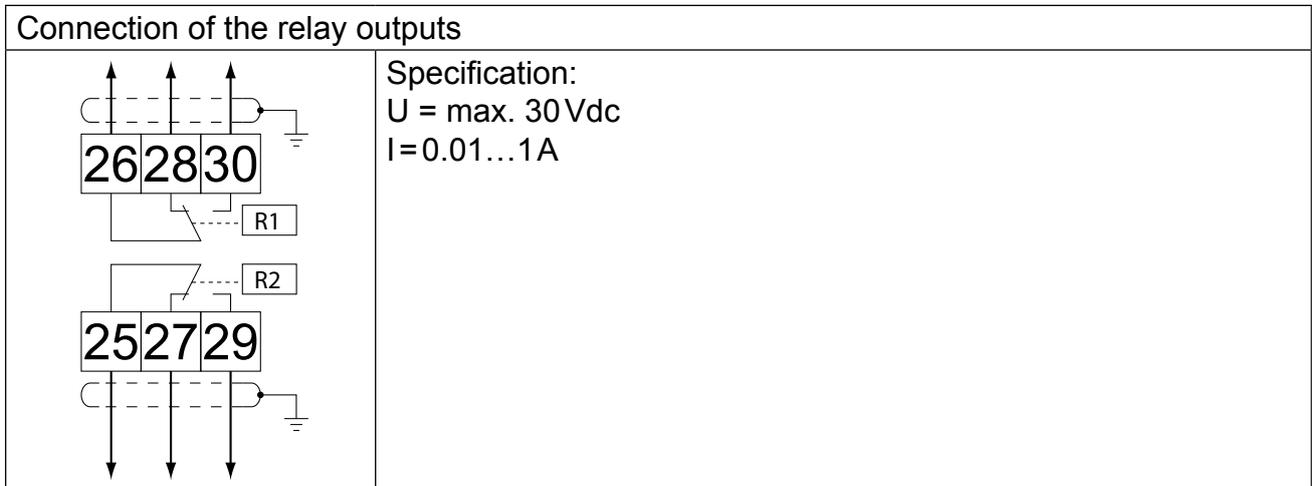
Factory setting of the setpoint inputs		
Operating mode Input	GENERAL	MULTI/SERVO
AN1	Setting analog setpoint 0...±10Vdc	Analog setpoint for speed-controlled operation 0...±10Vdc
AN2	—	Analog setpoint for torque-controlled operation 0...±10Vdc

2.4.4 Connection of the analog outputs



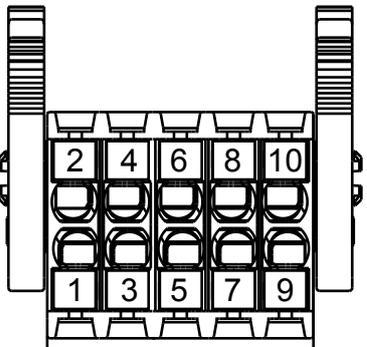
Factory setting of the analog outputs		
Operating mode Input	GENERAL	MULTI/SERVO
AO1	Output frequency 0...100 Hz	Speed actual value 0...3000 rpm
AO2	Apparent current 0...2•IoutN	Apparent current 0...2•IoutN

2.4.5 Connection of the relay outputs



Factory setting of the relay outputs		
Operating mode Input	GENERAL	MULTI/SERVO
R1	Fault relay	Fault relay
R2	Frequency dependent switch	RUN-Relay (set at modulation on)

2.5 Assignment of the terminal block X2B

X2B	PIN	Name	I/O
	1	STO1+	Input STO channel 1
	2	STO1+	
	3	STO1-	
	4	STO1-	
	5	STO2+	Input STO channel 2
	6	STO2+	
	7	STO2-	
	8	STO2-	
	9	STO-OUT	Output STO
	10	STO-OUT	

The individual channels are designed potential-free, so 24V and 0V can be connected. The inputs are designed by way that safety switchgear units with test pulses (OSSD signals) can be connected. The signals are not evaluated, they are only filtered. The OSSD test interval is limited to 10 ms.

The output STO-OUT at terminal 9/10 is switched against the mass of the control.

2.5.1 inputs

2.5.1.1 Specification of the STO inputs

STO inputs	Status 0		Status 1	
	UL [V]	IL [mA]	UH [V]	IH [mA]
max.	5	25	30	25
min.	-3	not defined	15	5

The maximum short-term starting current of the input is limited to 300 mA.

2.5.1.2 STO with OSSD signals

The filter time depends on the minimum input voltage and can be specified as follows:

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

2.5.2 Output STO

The short-circuit proof, digital output is specified in accordance with IEC61131-2. The output rated current is 100 mA at 24Vdc. The output is active, if the inputs STO1 and STO2 are set.

3. Safety Function STO

	<p>Only Qualified Staff</p>	<p>Uncontrolled start of the drive is possible by improper installation of the safety technology. This may cause death, serious bodily injuries or substantial damage to property.</p> <p>Therefore the safety function may only be installed and put into operation by qualified personnel which are trained in safety technology.</p>
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	<p>Observe Standards</p>	<p>The COMBIVERT F5 with safety function must not be started until it is determined that the installation complies with 2006/42/EC (machine directive) as well as the EMC directive (2004/108/EC)(note EN60204).</p> <p>The COMBIVERT F5 with safety function meets the requirements of the Low-Voltage Directive 2006/95/EC. The harmonized standard of the series EN 61800-5-1 (VDE 0160) is used.</p> <p>This is a product of limited availability in accordance with IEC 61800-3. This product may cause radio interference in residential areas. In this case the operator may need to take corresponding measures.</p>
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With electronic protection devices is the safety function integrated in the drive control in order to minimize or eliminate danger by malfunctions in machines. The integrated safety function replace the complex installation of external safety components. The safety function can be requested or released by an error.

	<p>Regular checks</p>	<p>In order to ensure permanent security, the function must be checked in regular intervals according to the results of the risk analysis.</p>
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Installation work or troubleshooting can be necessary in hazard areas, whereby protective devices such as line- or motor contactors shall not be activated. The safety function STO can be used there. Depending on the application the use of line or motor contactors can be void by using STO.

In case of error or request, the power semiconductor of the drive module are switched off and the drive is not supplied, which causes a rotation or torque (in case of a linear drive movement or force). The unit can be safe switched off and/or remain if an error occurs.

	<p>Electric Shock</p>	<p>Continue mains voltage with active STO function.</p>
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Compared to the disconnection by line contactors or motor contactors the integrated safety function enables a simple integration of drives to functional groups of a system. Thereby safe torque off can be limited to certain systems. A further advantage is that the recharge and discharge time of the inverter DC link must not be considered. Thus the unit is faster again ready for operation after an interruption.

Safety Function STO

Regular electromechanical equipment are liable to abrasion. Loss of these equipment occurs by using the STO function and the maintenance costs are reduced.

Characteristic data for „Safe torque off“

- Power supply for the rotation direction of the motor is interrupted (free-wheeling motor)
- Used when monitoring of standstill is not necessary
- Unintentional starting of the motor is prevented
- No galvanic isolation of the motor from the dc link circuit

What is realized by the STO function related to EN60204 -1 ?

- Emergency stop can be realized by the STO function, since the mains voltage may remain effective.
- Emergency stop can be realized only in connection with a line contactor, which disconnects the mains voltage!

3.1 Emergency stop according EN 60204

By using suitable safety switchgear units, stop category 0 and 1 according to EN 60204 -1 can be reached by the STO function in the system. Note chapter 3.6 for safety switchgear units.

Stop category 0	„uncontrolled stop“, i.e. stop by immediate removal of power to the actuators.
Stop category 1	„controlled stop“, i.e. power to the actuators is retained to apply braking until the stop is achieved. The energy is switched off at standstill.

Emergency stop to EN 60204 must be functional in all operating modes of the drive module. The reset of emergency stop may not lead to an uncontrolled start of the drive.

	Restart only after confirmation	The drive restarts if function STO is no longer released. In order to comply with EN 60204, it must be ensured by external measures that the drive restarts only after confirmation.
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Without mechanical brake the drive leads to coast; motor is free-wheeling. Additional protective devices must be installed (e.g.locking systems) if damage to persons or property can occur.

	Ensure coast of the motor	If danger to persons occur after switching off the motor control by STO, the entrance to hazard areas must remain closed until the drive stops.
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	Jerks in error case	In case of double malfunction it can lead to unwanted jerk, the rotation angle is depending on the number of poles of the selected drive and the gear ratio.
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Calculation of the jerk:

$\text{Rotation angle of the jerk } W_R [^\circ] = \frac{180^\circ}{\text{Pole-pair number } p \cdot \text{gear reduction ratio } g}$

This behaviour can occur either by a short circuit of the IGBTs or by interconnection (also short circuit) of the control drivers. The error should be regarded as critical, if the drive remains in STO status.

3.2 Classification of STO according IEC 61508

PFH	$2.6 \cdot 10^{-12}$ 1/h
PFD	$2.3 \cdot 10^{-7}$ on demand
Proof-Test-Interval T	20 years

For SIL classification in connection with the applications consider the failure rates of the external switch devices for final evaluation.

3.3 Classification of STO according ENISO 13849

Category	4
MTTF _D	>1000 years
DC	high

For the classification within a performance level in connection with the applications consider the failure rates of the external switch devices for final evaluation.

3.4 Additional instructions

- The unit must be isolated from mains by main switch when working on parts under voltage.
- Mechanical brakes must be installed additionally if external forces have effect to the drive axis, e.g. vertical axes (hanging loads) or rotary axes with asymmetrical weight distribution.
- For the protection against pollution (pollution degree 2) the installation of the units must be provided in environment with increased protection (e. g. control cabinet IP 54).
- Make sure that no small parts fall into the COMBIVERT during assembly and wiring. This also applies to mechanical components, which can lose small parts during operation.
- Check the safety functions and error responses and generate an acceptance report after installation.
- The start-up can be prevented with interruption of the STO signals. STO may not be released in case of danger according to EN 60204-1. Also note the instructions to the external safety switch devices.
- Dimension the safety application by way that the corresponding input current of the safety functions is available for the inputs (see chapter 2.5.1).

	Selection of suitable voltage sources	Use for the connection only suitable voltage sources with safe isolation (SELV / PELV) in accordance with VDE 0100 with nominal voltage of 24 Vdc ± 10%. Pay attention on a sufficient over-voltage category of the voltage supply.
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3.5 Functional Description

The COMBIVERT with integrated safety function meets the following function according to IEC 61800-5-2:

- „Safe torque off" (STO)

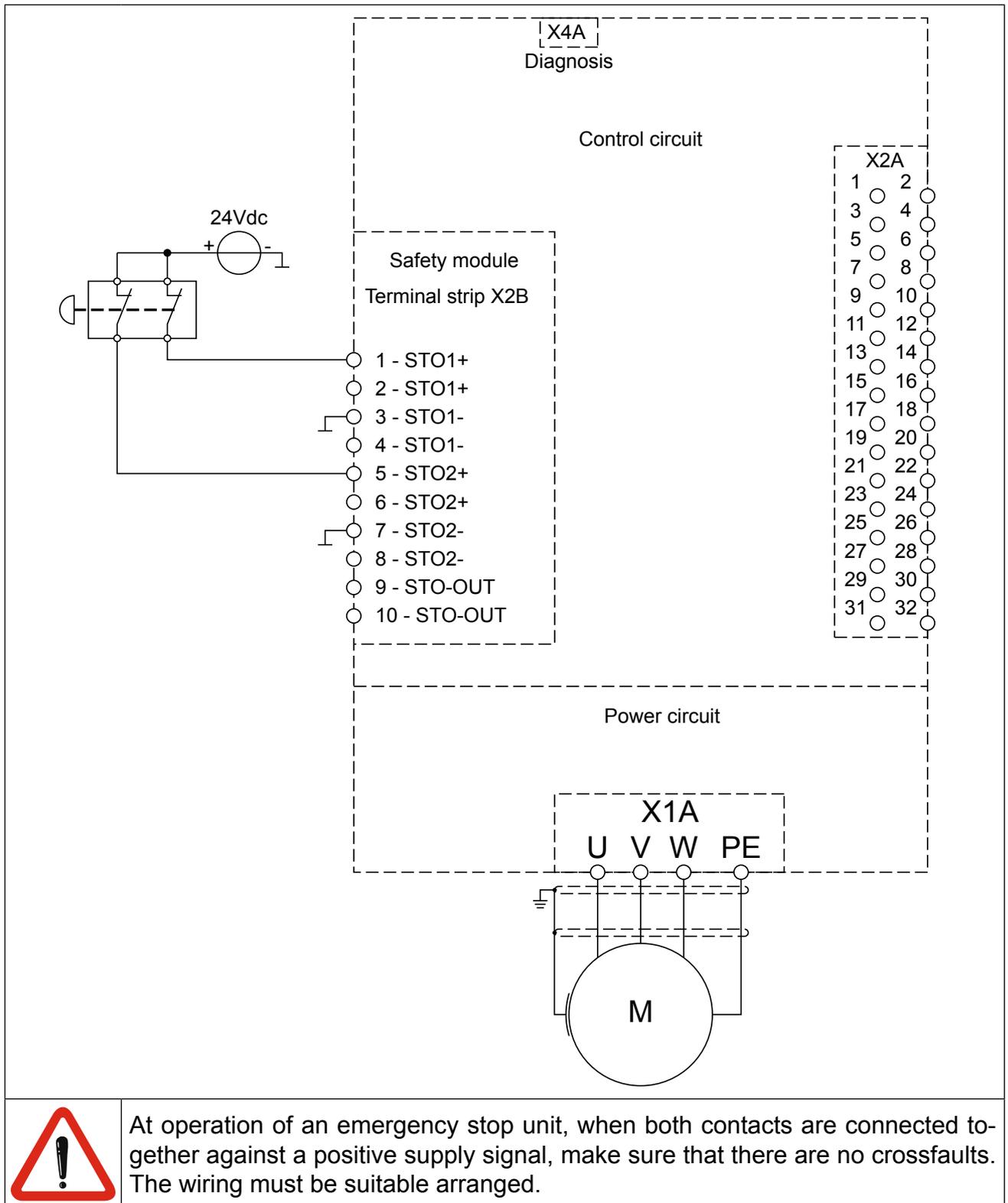
The safety-related disconnection according to STO is reached by a two-channel opto-coupler blockage. The supply of the opto-couplers, which are responsible for the commutation of the connected drive occurs via transformation coupling of the input voltage. This ensures at input voltage loss that no supply of the opto-couplers is possible. If the opto-couplers are not longer supplied, no IGBT can be controlled and thus no energy can be supplied to the drive.

The two channels are reached by way that input STO1 prevents the voltage supply (VTRO) of the upper opto-couplers of the inverter bridge and input STO2 the lower opto-couplers (VTRU).

Technical data of the STO function	
Maximum ON delay ($U_{IN} = 15V$)	7 ms
Maximum OFF delay ($U_{IN}=30V$) at	
... active modulation	10 ms
... inactive modulation until safe state of the driver voltage is reached	50 ms

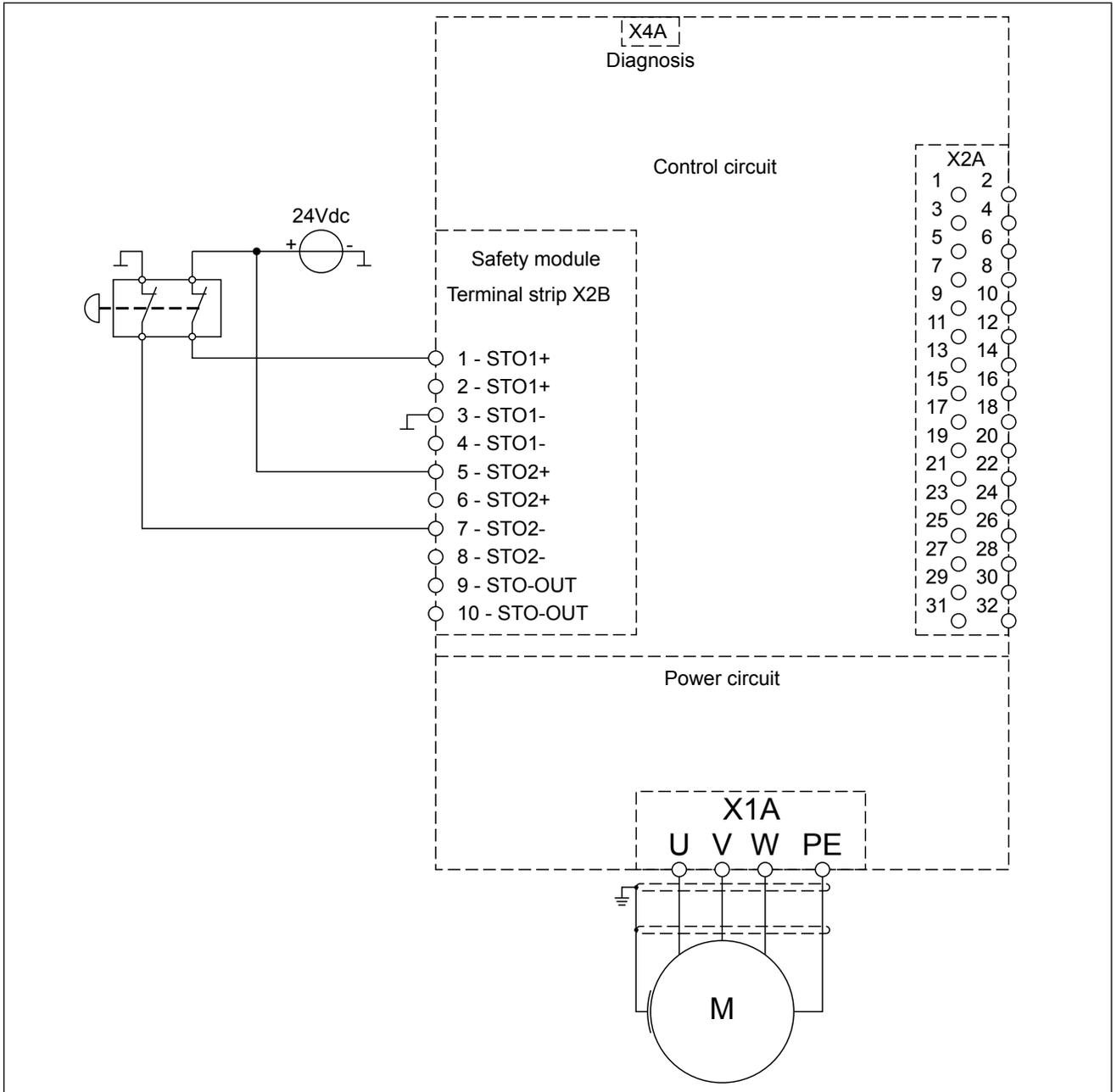
3.6 Wiring Examples

3.6.1 Direct switching off with emergency stop switch



At operation of an emergency stop unit, when both contacts are connected together against a positive supply signal, make sure that there are no crossfaults. The wiring must be suitable arranged.

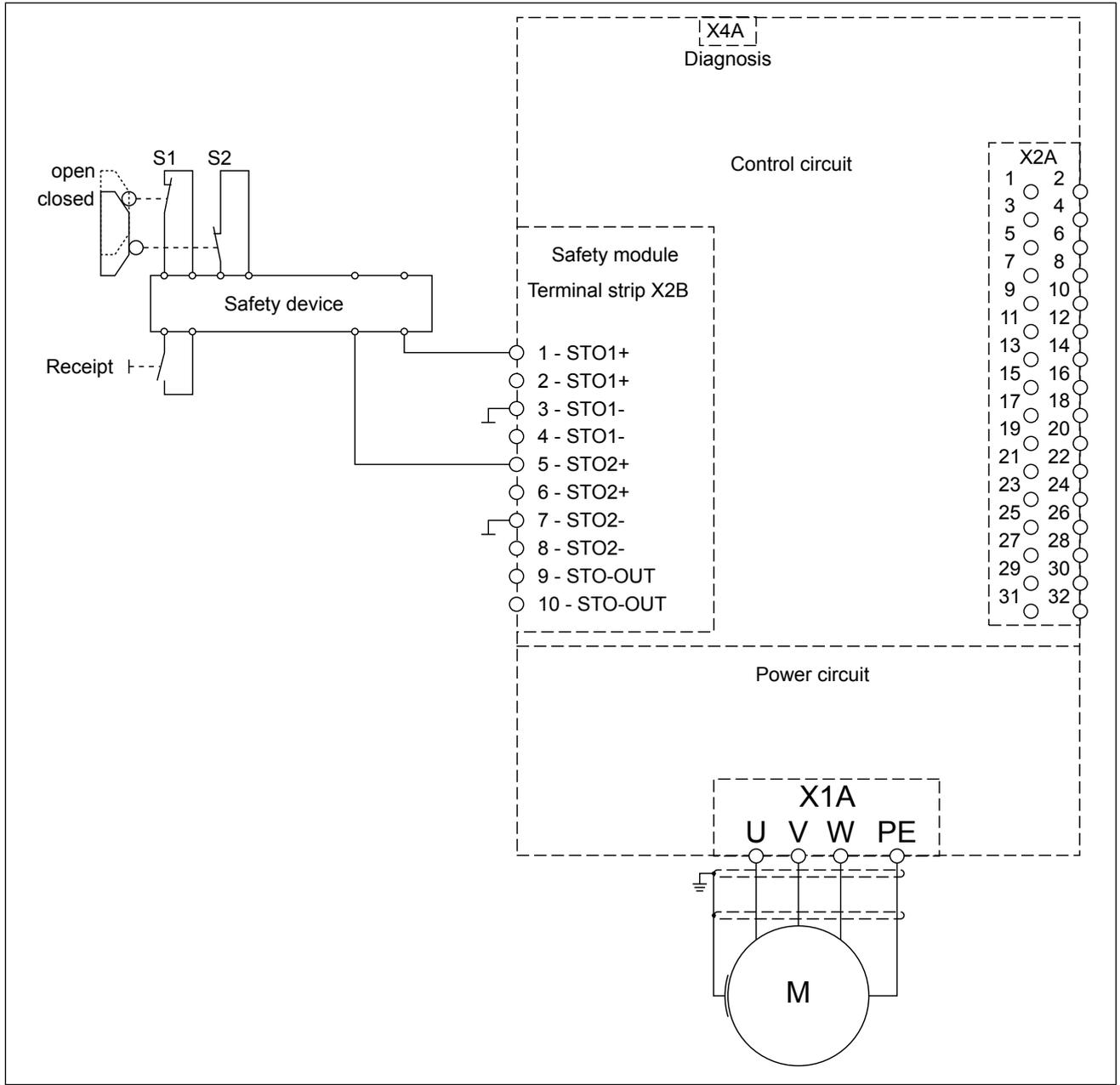
3.6.2 Direct switching off with emergency stop switch and monitoring of the wiring



The displayed circuit shows wiring errors in the area of the emergency stop unit and supply line. A possible short circuit on the primary side of the emergency stop switchgear (mass and 24 Vdc) and a short circuit on the secondary side of the unit or within the wiring leads either directly or with closed contacts to a short circuit of the supply, whereby a series-connected 24V fuse triggers.

Besides the two displayed applications with an emergency stop switchgear, other sensors (like door switches etc.) can be used similarly.

3.6.3 Direct switching off by safety module with test pulses

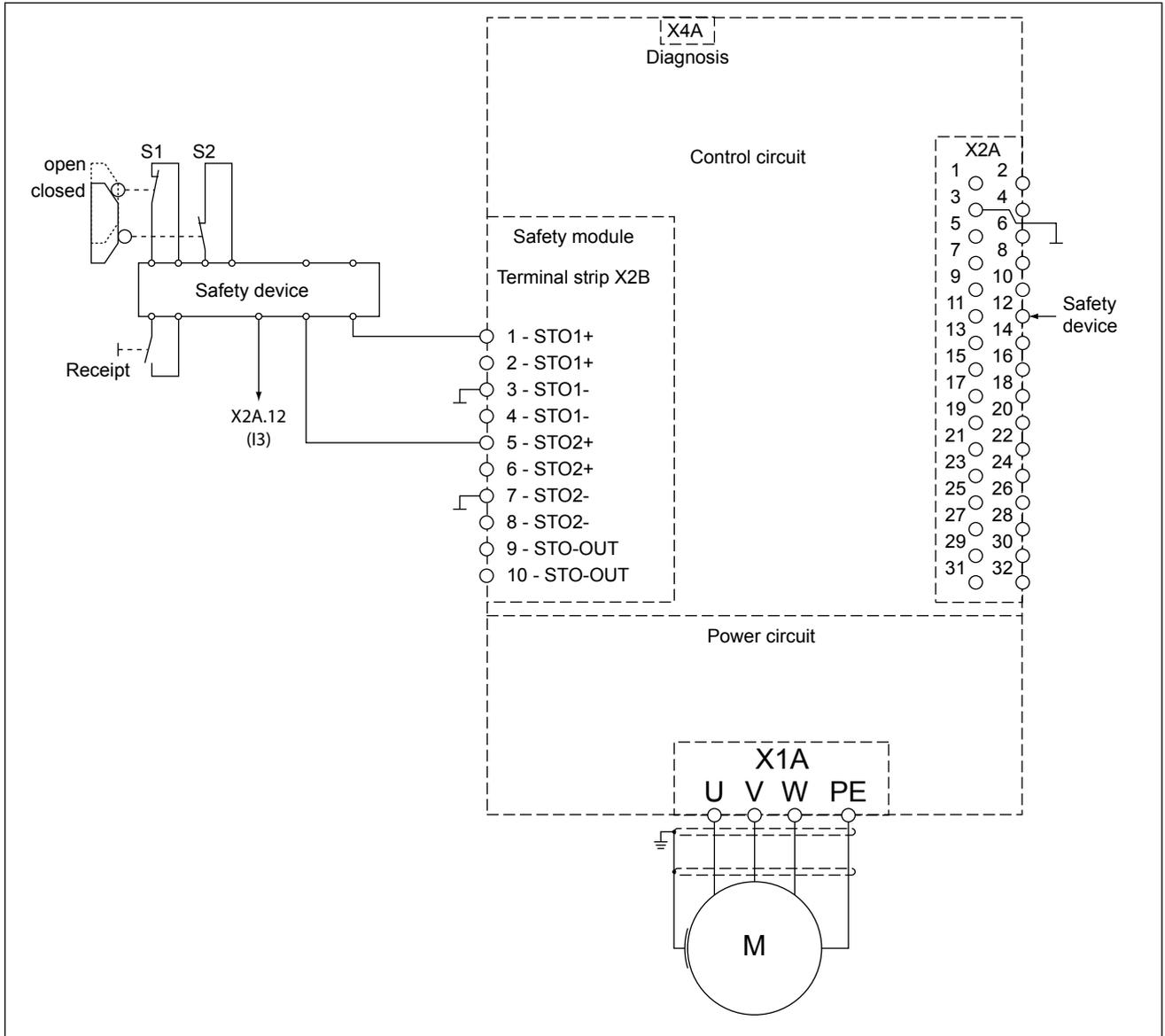


With operation of the emergency stop unit, e.g. by protection door, the release paths of the safety module are disconnected. This leads to the loss of the STO signals (X2B.1 and 5) and thus to energy disconnection of the drive. The safety module makes a consistency check of all signal paths via test signals (OSSD).

Safety Function STO

3.6.4 Wiring SS1

At tripping SS1 (Safe Stop 1) the drive is only disconnected from supply when it has reached a standstill [IEC 61800-5-2]. The stop mode is not directly requested, but the maximum time until reaching the standstill is estimated. This period is loaded in a safe time relay, which disconnects the drive finally from supply.



When pressing the emergency stop unit the drive is stopped with a deceleration ramp via input X2A.12 (I3).

Simultaneously the expiration of the safe time occurs in the safety module. After expiration of the safe period the control signals STO1+ und STO2+ (X2B.1 and 5) are removed and thus the energy supply of the drive is disconnected.

The following adjustments must be done in COMBIVERT for the function „drive stop“:

Parameter	Adjustment
Pn.03 „Reaction to error prog. input“	1: quick stopping; modulation off; no automatic restart

Function: If the selected input becomes active, the drive decelerates with the quick stopping function. The drive changes into status 31 „Error! External input“, when PN.68 is activated (<> 0) and the adjusted time has expired.

4. Certification

4.1 Annex to the declaration of conformity

Annex to the declaration of conformity EC for systems with functional safety:

Product designation:	Inverter - type series	xxF5Kxx-xxxx xxF5Lxx-xxxx xxF5Pxx-xxxx
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Herewith we declare that the safety module described above corresponds with all relevant regulations of the machinery safety directive 2006/42/EC.

The above mentioned safety module meets the requirements of the following guidelines and standards:

• Machinery safety directive	2006/42/EC
• EMC directive	2004/108/EC
• Low-Voltage Directive	2006/95/EC

EN standards	Output	Text	Reference	Output
EN 61800-5-1	09/2003	Electrical power drive systems with adjustable speed: security requirements	VDE 0160 Part 105	09/2003

informative:

EN 50178	1997	Installation of high voltage systems with electronic equipment	VDE 0160	04/1998
EN 60664-1	2007	Isolation coordinats for electrical equipment in low-voltage systems	VDE 0110	01/2008
EN 61800-2	10/1998	Basic determinations for AC inverter	VDE 0160 Part 102	08/1999

especially for systems with functional safety additionally:

EN 61800-5-2	2007	Electrical power drive systems with adjustable speed: functional safety requirements	VDE 0160 Part 105-2	04/2008
EN 61508-(1...7)		Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 1 up to 7	VDE 0803	11/2002
EN 60204-1 +A1	2006 2009	Electrical equipment of machines; Part1: General requirements	VDE 0113-1 +A1	2007 10/2009
EN 62061		Safety of machinery functional security requirements	VDE 0113 Part 50	10/2005
EN 13849-(1, 2)		Safety of machinery	–	08/2008

The conformity was confirmed by the TÜV Rheinland with the EC type examination 01/205/5141/11.

The number and address of the indicated constitution:

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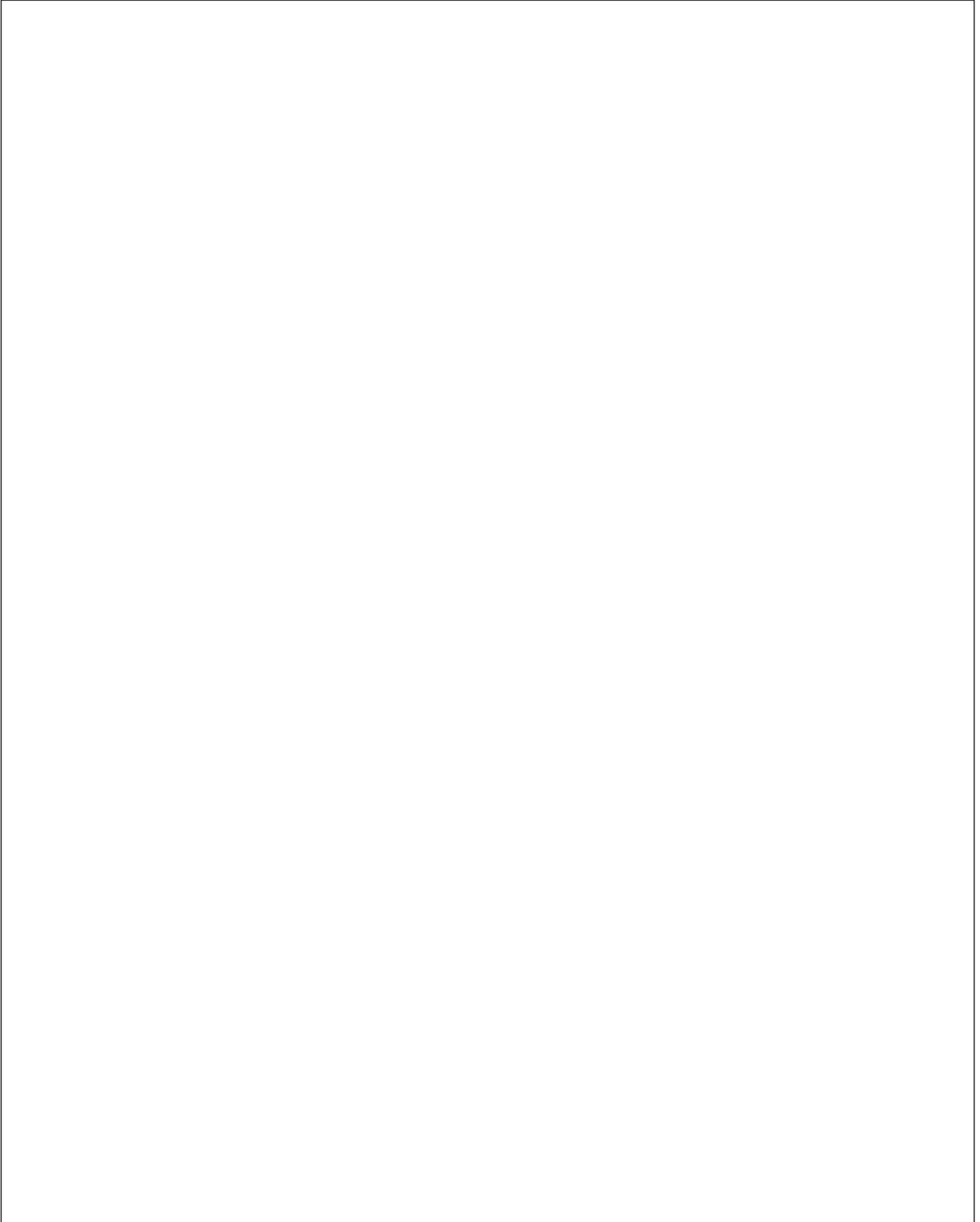
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Revision history

5. Revision history

Revision	Date	Description
Rev.1D	2011-02	First published version
Rev.1E	2011-08	Correction: Assignment of the terminal strip; Resolution: 11 Bit + sign
Rev.1F	2012-01	Inscribed certification number; Typing error chapter 3.3.6 in german corrected
Rev.1G	2012-09	Correction input external voltage supply
Rev.1H	2013-03	FS marking inserted; Terminal blocks changed to new standard; Switching condition output STO corrected
Rev.1J	2013-09	New picture on title, strip control wires
Rev.1K	2014-07	Control categorie to categorie and assembly of wire-end ferrule changed





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