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CONTROL CABINET

EXTERNAL DRIVE BOX

User Manual

Product Description

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Other functions not described in this documentation may be operable in the controller. The user has no claim to these functions, however, in the case of a replacement or service work.
We have checked the content of this documentation for conformity with the hardware and software described. Nevertheless, discrepancies cannot be precluded, for which reason we are not able to guarantee total conformity. The information in this documentation is checked on a regular basis, however, and necessary corrections will be incorporated in subsequent editions.
Subject to technical alterations without an effect on the function.

PD Interleaf

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1 Drive concept of the external drive box

The external drive box contains the power electronics and some of the safety functions which are required to operate the non-KUKA mechanical device.
The controller is housed in the KR C3E.

Up to two external drive boxes can be interconnected via the ESC bus (interface X15/15.1).

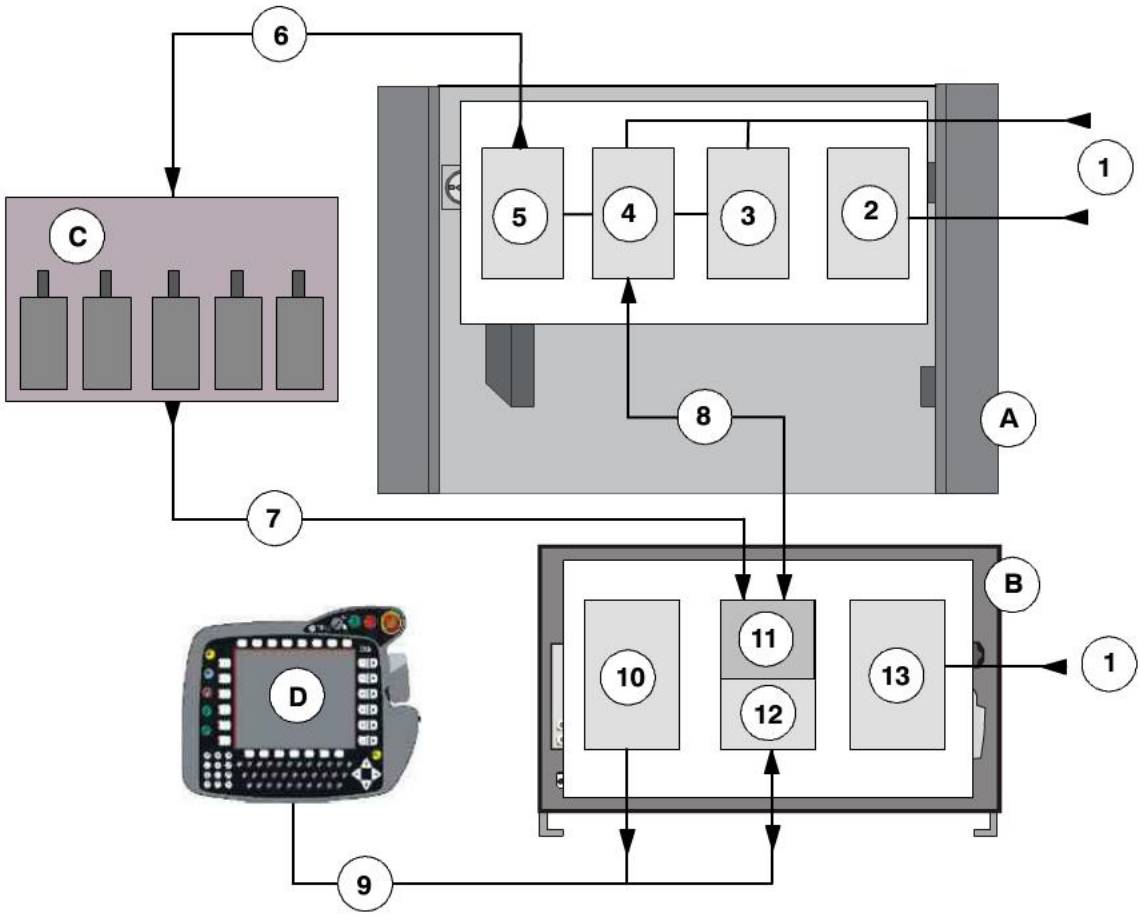


Fig. 1 Drive concept of the external drive box

Legend

A	External drive box	C	Non-KUKA mechanical device
B	KR C3E	D	KCP
1	Power supply connection	8	Data cable to external drive box
2	KPS-27	9	KCP lead
3	Energy recovery unit (optional)	10	KVGA
4	KPS 600	11	DSE-IBS3
5	KSD1	12	MFC2a
6	Motor cable to the drives	13	KPS 8-80
7	RDC2 signals		

2 Structure

2.1 Installation position of the modules

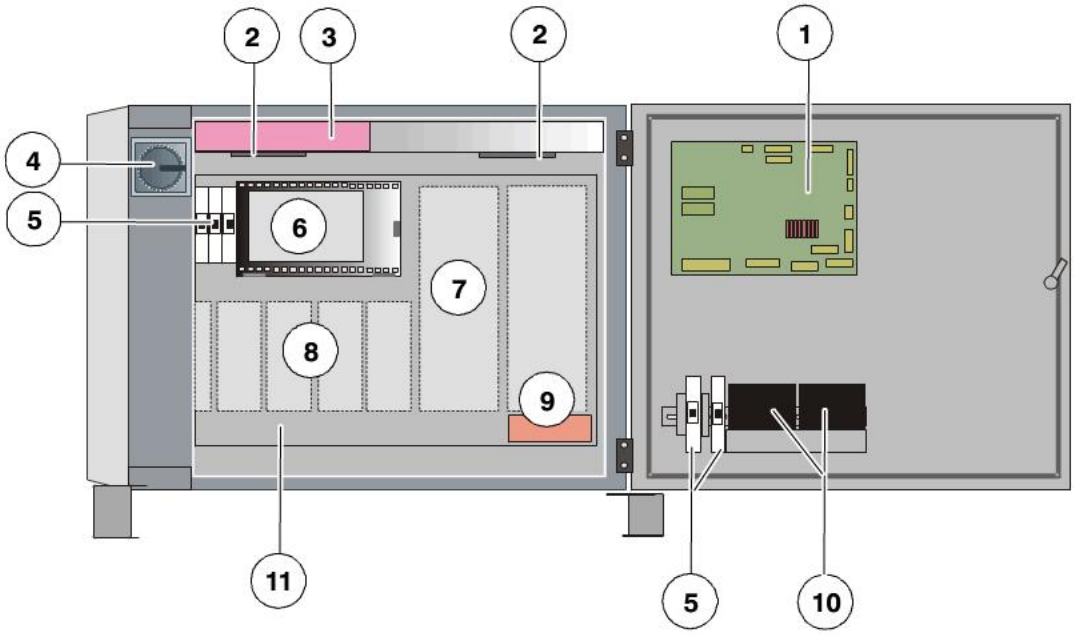


Fig. 2 Overview of the modules in the external drive box

Legend

1	Safety module CI board
2	Internal fans
3	Mains filter
4	Main switch
5	Fuse elements
6	KPS 27 low-voltage power supply
7	KPS 600 power supply unit
8	KSD1 servo drive modules
9	Energy recovery unit, reactor (optional)
10	Batteries
11	Mounting plate A, B, C or D

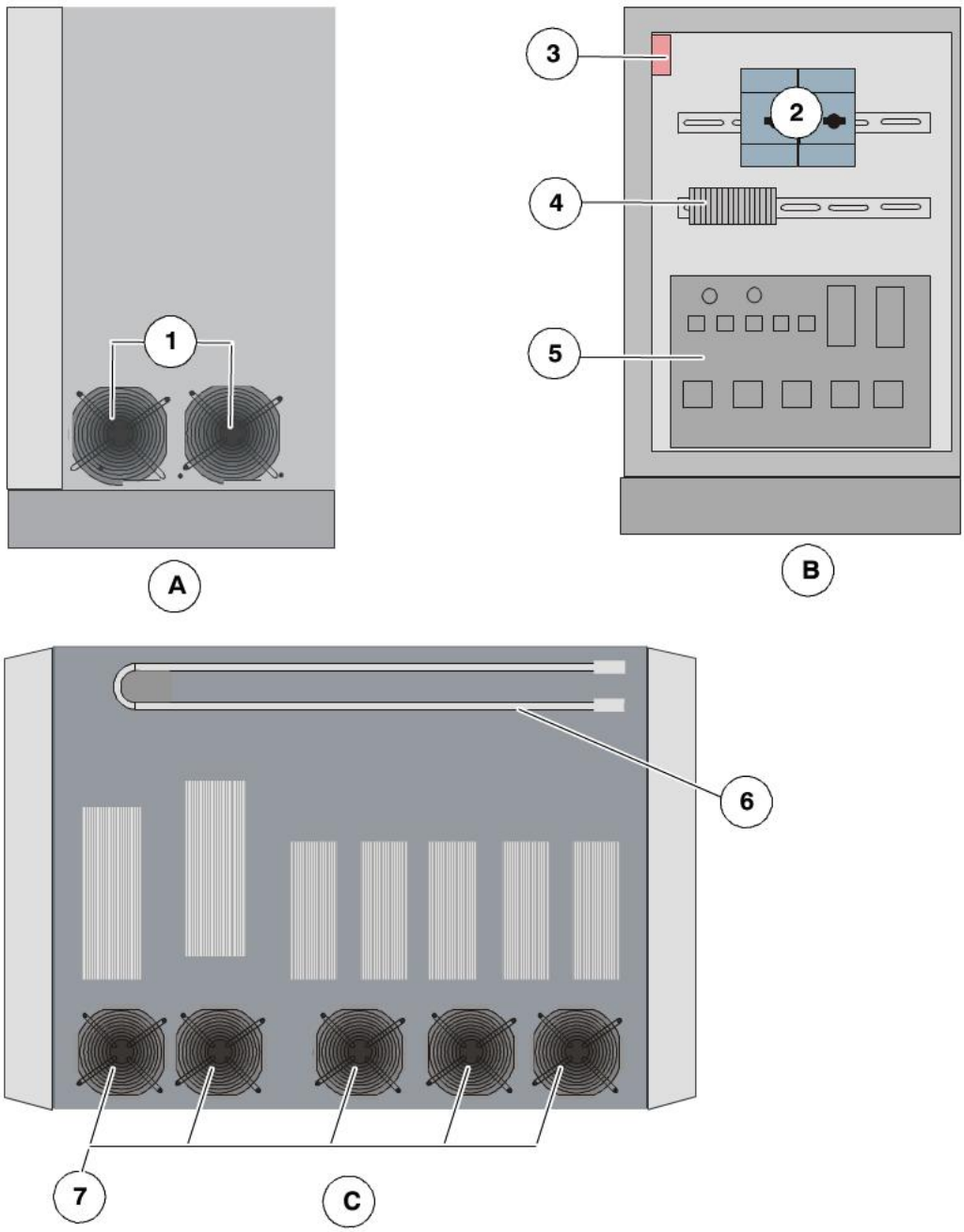


Fig. 3 Overview of the modules in the external drive box

Legend

A	Right side view, exterior	3	Main switch
B	Left side view, interior	4	Terminal block
C	Rear view	5	Connector panel
1	External fans, side	6	Ballast resistors
2	Circuit-breakers	7	External fans, rear

2.2 Block diagram of power unit

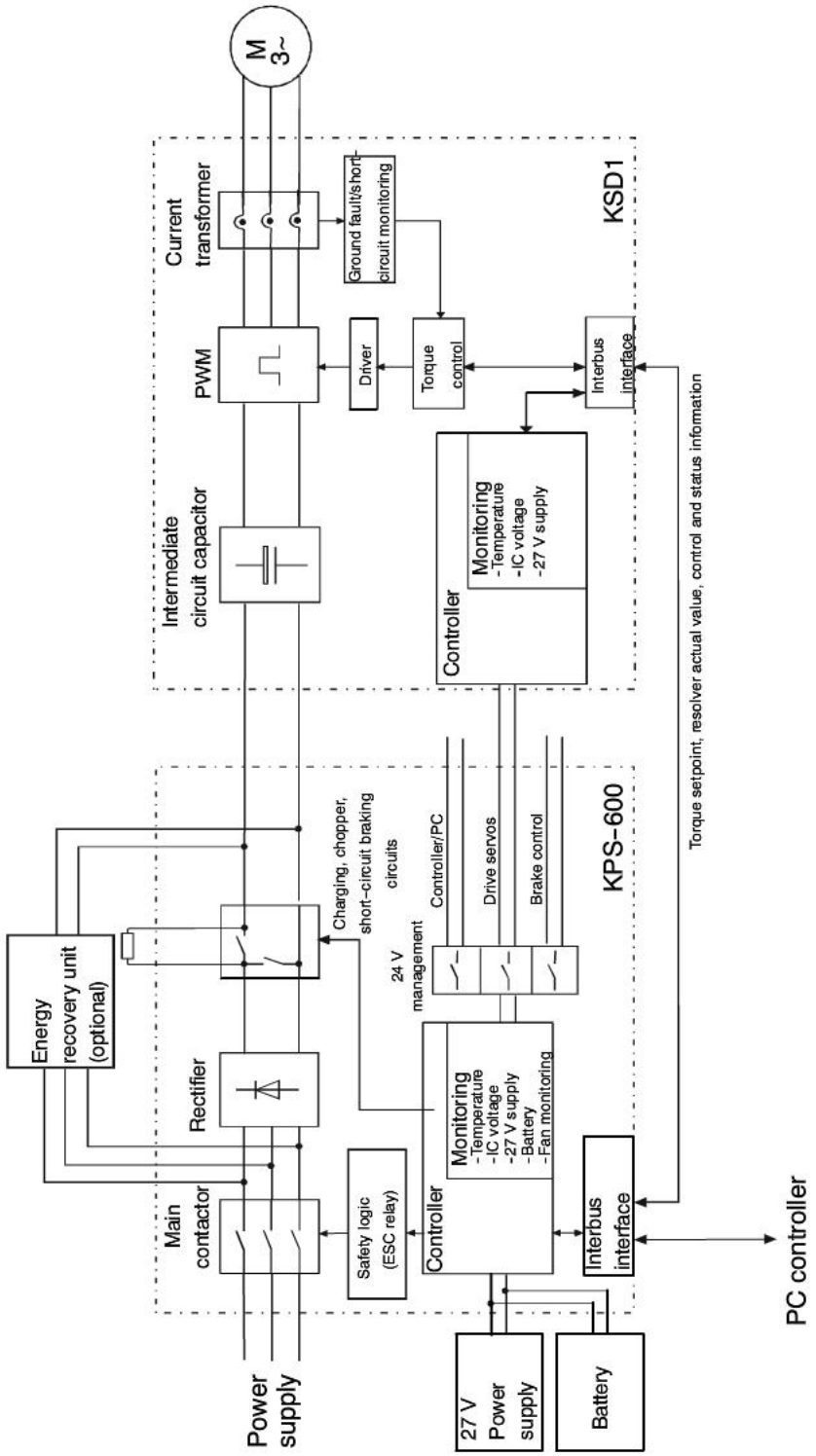


Fig. 4 Block diagram of power unit

3 Mounting plate equipment

3.1 Mounting plate A

Mounting plate A can optionally be fitted with up to 3 KSD1 48/64 servo drive modules (Fig. 5 **[1]**), the KPS 600 power supply unit (Fig. 5 **[2]**) and an energy recovery unit (Fig. 5 **[3]**).

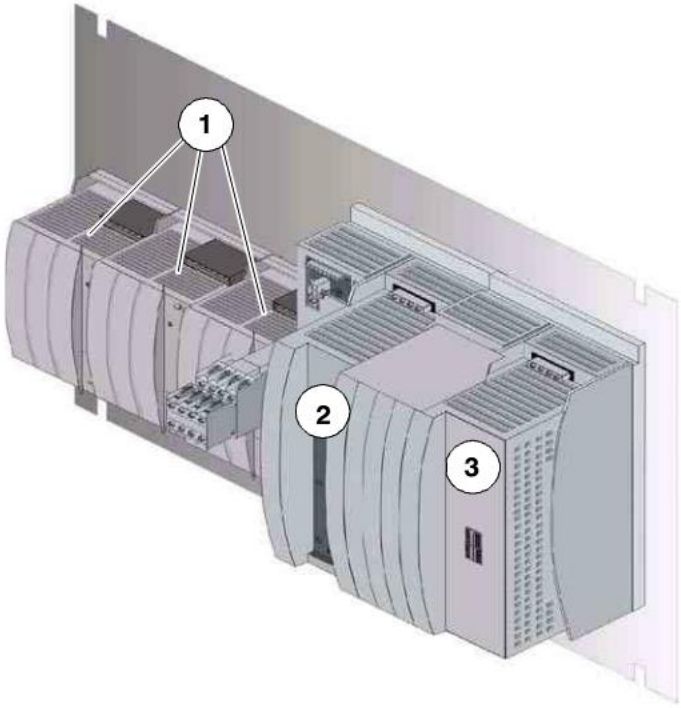


Fig. 5 Example of equipment on mounting plate A

3.1.1 Mounting plate B

Mounting plate B can optionally be fitted with up to 4 KSD1 08/16/32 servo drive modules (Fig. 6 **[1]**), the KPS 600 power supply unit (Fig. 6 **[2]**) and an energy recovery unit (Fig. 6 **[3]**).

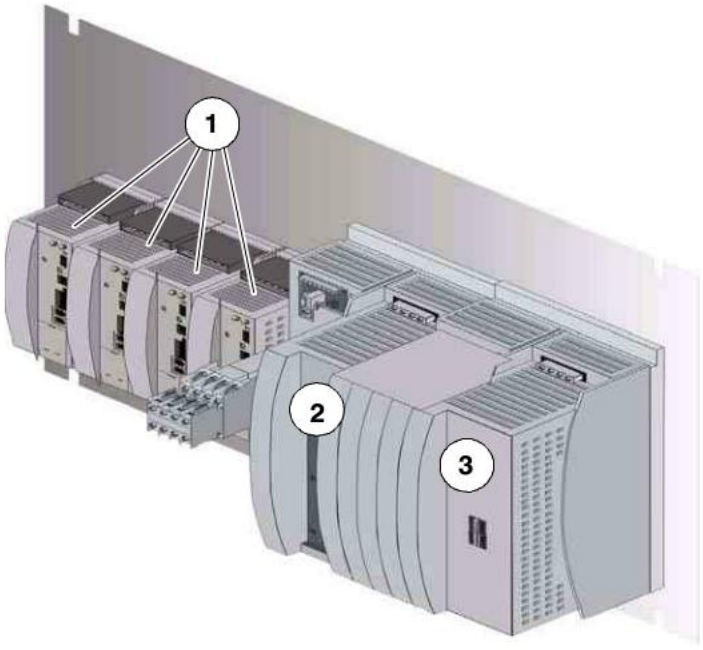


Fig. 6 Example of equipment on mounting plate B

3.1.2 Mounting plate C

Mounting plate C can optionally be fitted with up to 5 KSD1 08/16/32 servo drive modules (Fig. 7 **[1]**) and the KPS 600 power supply unit (Fig. 7 **[1]**).

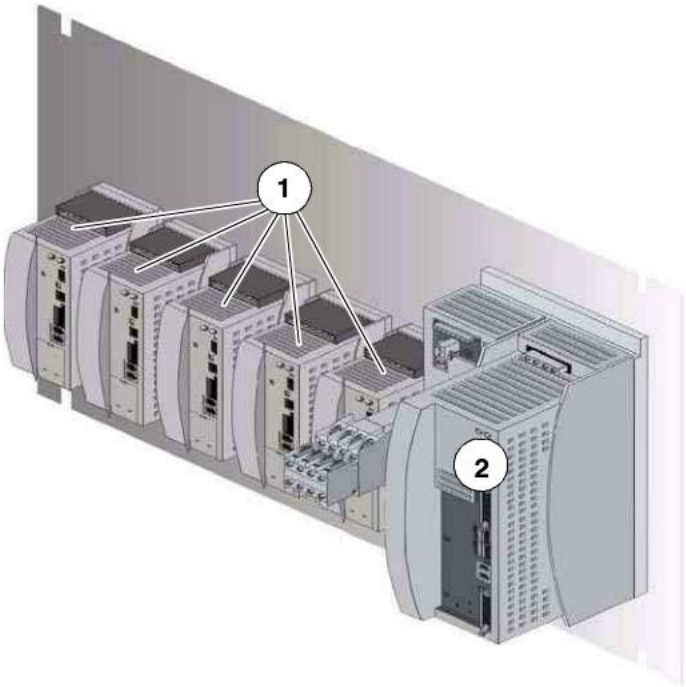


Fig. 7 Example of equipment on mounting plate C

3.1.3 Mounting plate D

Mounting plate D can optionally be fitted with up to 3 KSD1 8/16/32/48/64 servo drive modules (Fig. 8 **[2]**), one KSD1 08/16/32 servo drive module (Fig. 8 **[1]**) and the KPS 600 power supply unit (Fig. 8 **[3]**).

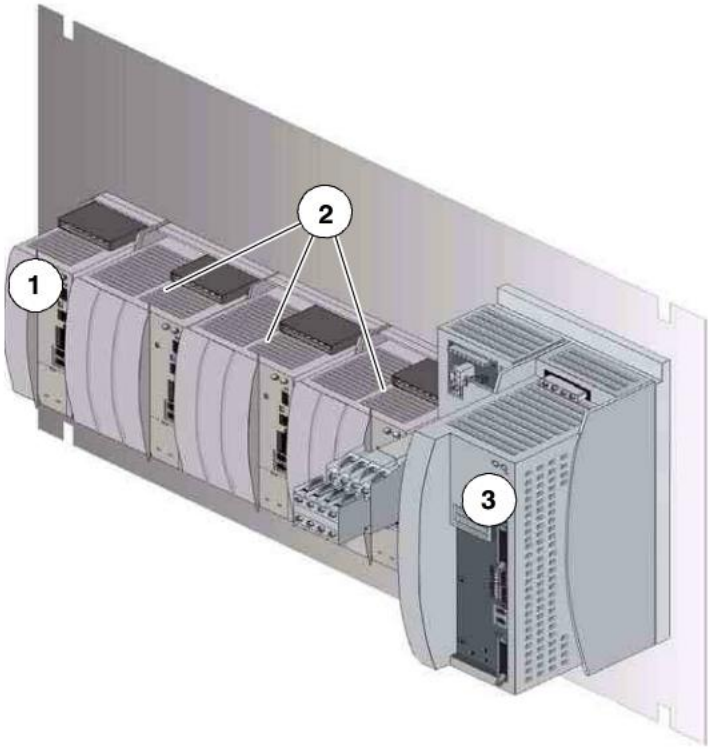


Fig. 8 Example of equipment on mounting plate D

4 Fuse elements

4.1 Installation position of the fuses

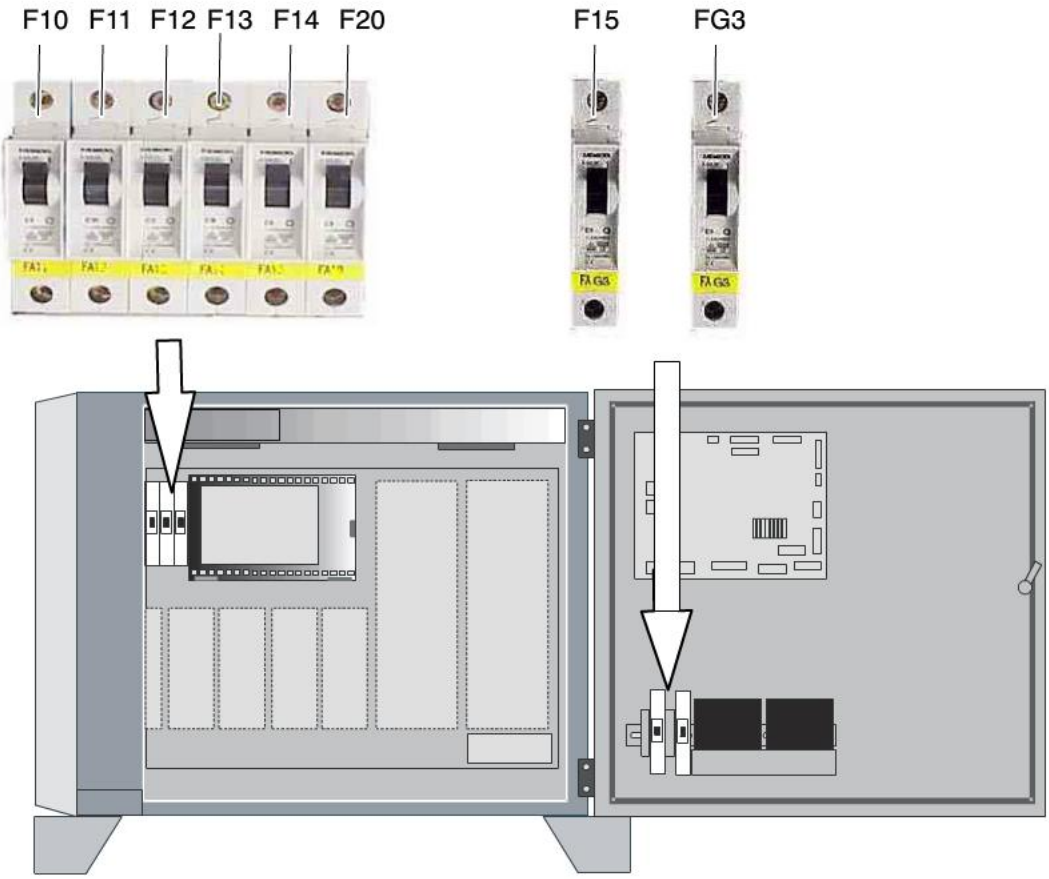


Fig. 9 Arrangement of the fuses

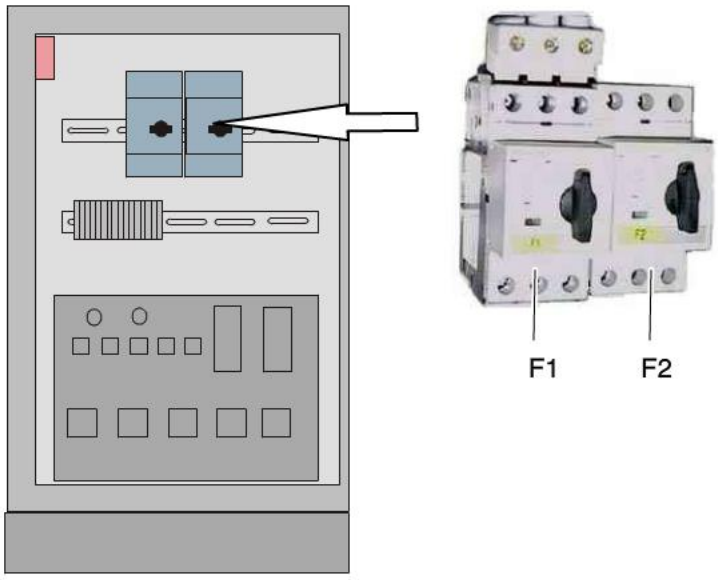


Fig. 10 Arrangement of the motor circuit-breakers

4.2 Classification of the fuses

Fuse	Connected load in A	Designation of the fused circuit
F1	20	KPS600 (G1) power supply
F2	7	KPS27 (G2) power supply
F10	6	+27 V DC output voltage to the KPS600 (G1) power supply unit
F11	10	+27 V DC output voltage to the KPS600 (G1) power supply unit
F12	2	Power supply to fans
F13	8	Power supply to CI board
F14	6	Power supply to drives
F15	6	External +24 V DC supply to PC with battery backup
F20	6	Brakes for drives 1 to X
FG3	10	Battery backup

5 KPS 600/20 supply unit

All the functions required by a drive controller that are not provided by the axis servo are grouped together in the central supply unit KPS (KUKA Power Supply).

The power supply for the intermediate circuit includes the rectifier circuit, the charging circuit, the ballast circuit, the discharging circuit and the main contactor K1. The intermediate circuit voltage is provided to the drive modules and an optional energy recovery unit.

An integrated 27 V power supply provides the power for the motor brakes, the customer-specific peripheral equipment, the drive controller, the servo controllers and for charging the battery (backup for an Uninterruptible Power Supply). The power itself is taken from the external low-voltage power supply unit KPS 27 (in cabinet, bottom left).

A special circuit is provided for controlling the motor holding brakes.

Commands are received from the drive controller and status messages are sent to the drive controller via the communications interface (Interbus). The communications module is monitored by means of a watchdog circuit. In the event of a communication failure, short-circuit braking is activated.



Fig. 11 KPS 600 supply unit

The KPS is divided into two power supply units:

(1)	KPS 600/20,	600 V power supply, 20 A continuous power Intermediate circuit
(2)	KPS 27,	Standard commercial 27 V low-voltage power supply, power output according to the application

The KPS 600/20 incorporates:

- Mains contactor
- Power supply with starting circuit
- Ballast circuit, including short-circuit braking relays
- Brake switches (in common for all 6 robot axes and separate for 2 external axes)
- Monitoring of the KPS heat sink temperature
- Interface to DSE-IBS and servo drive IBS
- Battery charging circuit, disconnection of the backup voltage, voltage distribution 24 V
- Interbus monitoring
- Fan cutoff (output), fan monitoring (input)
- Monitoring of the ballast temperature (input)
- Heat sink temperature
- Internal temperature of control cabinet
- Interface with the safety logic

5.1 Connections

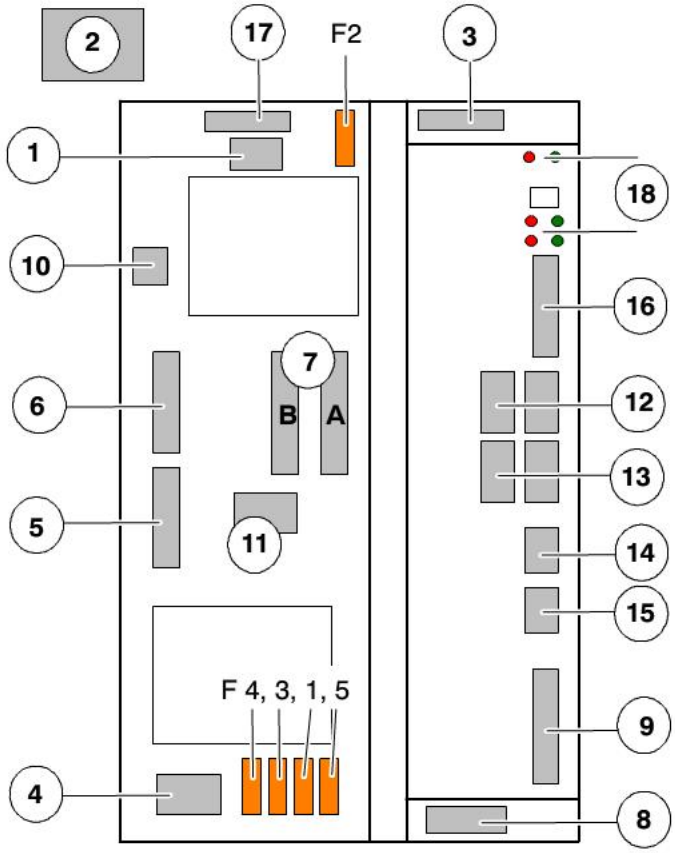


Fig. 12 Connection diagram

Legend

1	X2	K1 control connections
2	G1X2	Mains supply input in cable harness to mains contactor K1
3	X6	27 V connections from the low-voltage power supply unit
4	X7	27 V connections to the battery, the axis servos and the controller
5	X8	Connections for the ballast resistors
6	X9	Connections for the energy recovery unit (mains)
7	X10 (A/B)	Connections for the intermediate circuit (both connections in parallel)
8	X12	Connections for the motor holding brake
9	X14	ESC connection
10	X16	Connection for the mains energy recovery module (IC)
11	X17	Connections for the intermediate circuit of the external axes
12	X110	Fan/resistor monitoring
13	X114	Connections for additional inputs to the control board
14	X121	Connector for Interbus signal input
15	X122	Connector for Interbus signal output
16	X123	Connector for conventional safety technology FE201
17	X-K1a	(Internal) Interface to the power board for the K1 auxiliary contacts
18		LEDs

5.2 Fuse elements

Name	Rating	Function
F1	7.5 A	24 V axis servo fuse X7, pin 8
F2	15 A	24 V DC external periphery
F3	15 A	Battery + fuse X7, pin 2
F4	15 A	Battery – fuse X7, pin 3
F5	7.5 A	PC fuse X7, pin 7

Refer to Fig. 12 for the installation positions of the fuses.

5.3 LEDs

Six LEDs can be seen on the KPS 600.

The two upper LEDs (Fig. 13 **[1] [2]**) indicate internal states of the KPS.

The two red LEDs (Fig. 13 **[3] [5]**) are reserved for the safety logic and are not yet assigned.

The two green LEDs (Fig. 13 **[4] [6]**) indicate the state of the brake control.

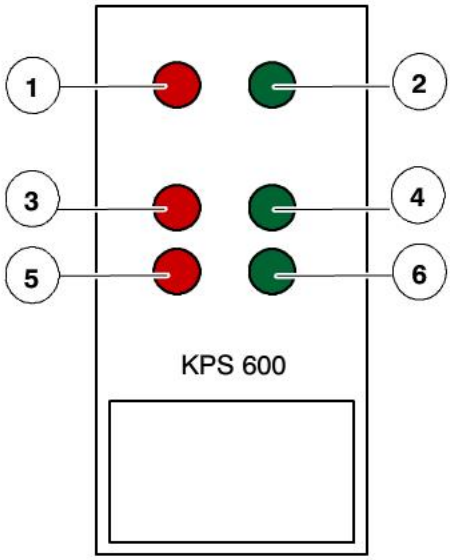


Fig. 13 LED indicators, KPS 600

Legend

1	Red LED	Indication of internal KPS states
2	Green LED	Indication of internal KPS states
3	Red LED	Reserved for the safety logic
4	Green LED	Indication of the state of the brake control
5	Red LED	Reserved for the safety logic
6	Green LED	Indication of the state of the brake control

6 KPS 27 low-voltage power supply

The KPS 27 low-voltage power supply is a standard commercial 27 V power supply and is responsible for the 27 V power supply to the following components:

- Motor brakes
- Periphery
- Robot controller
- Servo controllers
- Batteries



Fig. 14 KPS 27 low-voltage power supply

Legend

1	Power supply connection
2	Operating state indicators
3	Output

6.1 KPS 27 operating state indicators

On the KPS 27 are two LEDs, one green and one red, which indicate the operating states of the low-voltage power supply unit.

LED indicator		State	Meaning
Green LED	(OK)	Lit	Normal operation
Red LED	(Fail)	Lit	Fault

7 KSD1 servo drive modules

Two sizes of KSD1 servo drive module are used in the KR C2:

1 KSD1 -08/16/32

2 KSD1 -48/64

The designation (08 - 64) signifies the maximum acceleration current.

The servo drive modules comprise:

- Power output stage for one robot axis
- Current controller
- Interbus interface
- Monitoring of motor currents and short-circuit protection
- Heat sink temperature monitoring
- Communication monitoring

The KSDs perform the following functions:

- Field-oriented current control
- Commutation
- Monitoring of all drive functions and drive hardware



Fig. 15 KSD1 servo drive modules

7.1 Technical data

	KSD1-08	KSD1-16	KSD1-32	KSD1-48	KSD1-64
Size/width [/mm]	1/88	1/88	1/88	2/132	2/132
Intermediate circuit voltage[V]	0-740	0-740	0-740	0-740	0-740
Max. acceleration current [A_{rms}]	8	16	32	48	64
Rated current [A_{rms}]	4	8	16	17	20
Standstill current [A_{rms}]	5.1	8.5	17.0	22.6	26.9

7.2 Connections

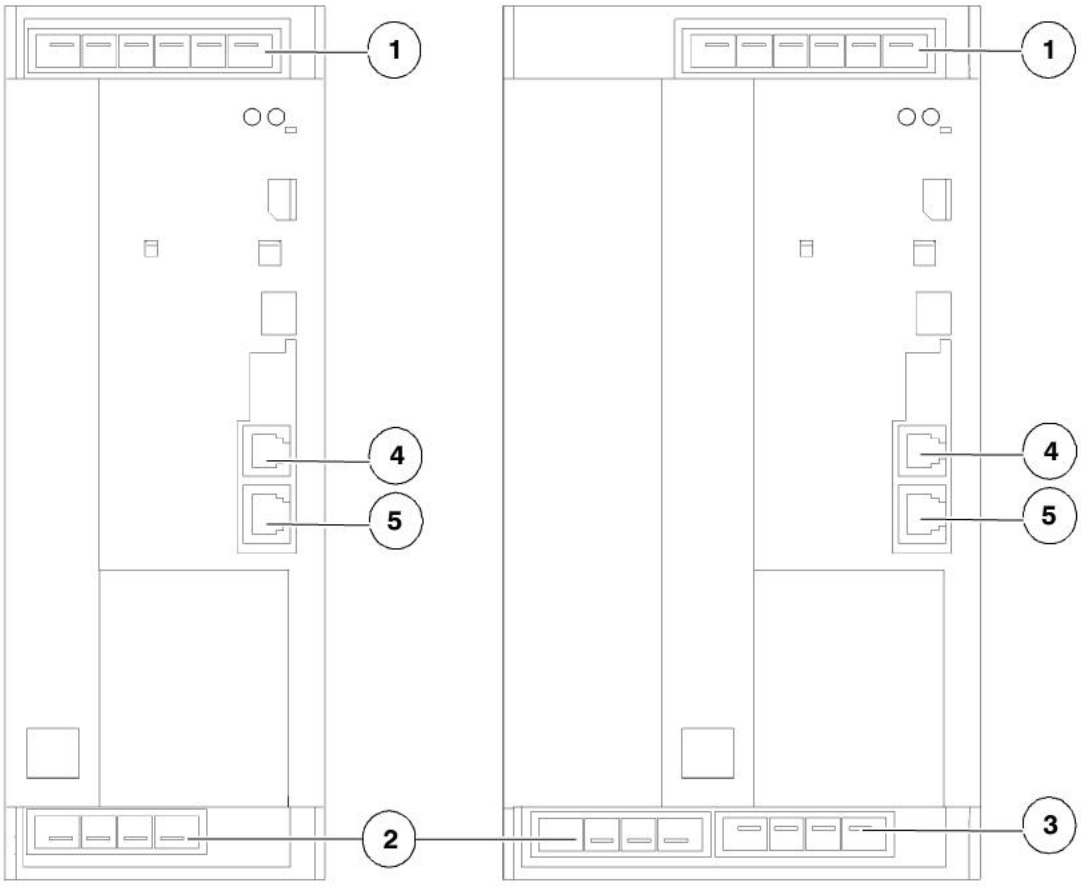


Fig. 16 Servo drive module connections

Legend

1	X1	Int. circ./PE/DC24V connection
2	X2	Motor connection
3	X3	Motor connection
4	X13	Interbus IN
5	X14	Interbus OUT

8 Energy recovery unit (KUKA Recovery Unit)

An energy recovery unit is used to feed the braking energy into the AC power supply. The energy recovery unit is designed as a pulse-controlled converter. This electrical braking process does not function in the event of a power failure, however, as there are no mains to receive the energy.

Characteristics:

- Automatic rotating field detection
- Self-synchronizing
- Overload protection in energy recovery mode
- Temperature-controlled fan
- Visual indication of the operating state via LED
- Automatic adaptation of the energy recovery voltage threshold to the mains voltage
- Monitoring of mains voltage, mains frequency, intermediate circuit voltage and temperature



Fig. 17 Energy recovery unit

8.1 Connections and LED indicators on the energy recovery unit

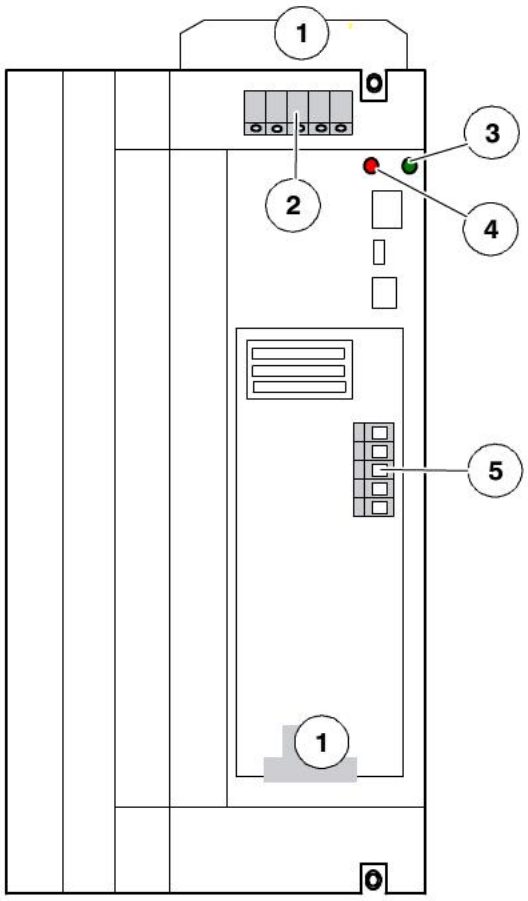


Fig. 18 Energy recovery unit

Legend

1	Shield plate
2	Mains and DC connection
3	Green LED
4	Red LED
5	Signal outputs A1, A2 and disable input E1

8.1.1 LED

The LEDs on the energy recovery unit indicate the operating state.

LED		Operating state
Green	**Red**	
ON	OFF	Energy recovery unit feeding into mains voltage. Supply voltages Vcc (+15 V) have reached their minimum value. No fault has occurred.
OFF	ON	A fault has occurred.

8.2 Fault messages

If the external power supply remains intact in the event of a fault, the state of terminals A1 and A2 indicates the type of fault:

- A1 = LOW All faults (group error message)
- A2 = LOW Only power mains faults

Terminal X2		Operational performance	Possible cause	Remedy	Fault reset...
A1	**A2**				
HIGH	HIGH	Energy recovery possible	No fault		
LOW	HIGH	Energy recovery disabled	Overtemperature - Ambient temperature too high - Energy recovery module overload	- Lower the ambient temperature - Check rating	Automatically once the energy recovery module has cooled
			Overcurrent in energy recovery mode - Peak braking performance too high	- Use additional brake units	By switching to mains
LOW	LOW	Operation not possible	Supply voltage < 320 V > 555 V - Isolated operation with generator - All-pole mains failure	- Use additional brake units - Switch mains on	Automatically when mains voltage within the permitted range
		Energy recovery disabled	Mains frequency < 48 Hz or > 62 Hz - Isolated operation with generator	- Check generator rating	Automatically when mains frequency within the permitted range
		Energy recovery disabled	Single-pole mains phase failure L1, L2 or L3 - Defective fuse	- Replace fuse in deenergized state	Automatically when mains supply re-established

8.2.1 Fault message reaction times in the event of mains faults

The reaction time for fault messages via A1 and A2 is < 10ms, depending on the type of fault.

The reaction time when mains power is re-established (switched on) is < 0.5 s, depending on the type of fault.

9 ESC safety system

The Electronic Safety Circuit (ESC) is a microcontroller-based safety bus. This dual-channel system permanently monitors all connected safety-relevant components.

The ESC system consists of at least 3 modules, so-called nodes.

- KCP (master)
- KPS 600
- MFC (passive node)

The nodes are connected to each other via power supply and communication lines. Each node consists of two ESC chips (A and B). Component-specific, safety-related operator control elements (e.g. Emergency Stop buttons) are connected to these chips.

The ESC safety system uses the node periphery to simulate all the interfaces of a conventional safety system. The node periphery interfaces are designed in such a way that safety component malfunctions are detected and set to a safe state.

In the event of a fault or interruption in the safety circuit or failure of the power supply, each node sets its outputs to a safe state. The ESC system switches off the power supply to the drive units, causing the axis kinematic system to stop.

9.1 ESC components

- **KCP**

  The node built into the KCP teach pendant is the ESC system master. The ESC circuit is initialized from here.
  The node receives the signals from the dual-channel operator control elements *Emergency Stop button* and *enabling switches*, and the single-channel operator control elements *Enable Drives*, *Activate Drives*, *AUTO mode* and *TEST mode*.
  The ESC circuit will only function with the KCP connected. Disconnecting the KCP during operation causes the drives to switch off immediately.

- **KPS 600**

  The KPS power supply integrated into the control cabinet also has a built-in node. In the event of a fault, the drives contactor on the KPS is switched off here. This brings the robot axes to a standstill. The KPS has 6 LEDs for diagnostic purposes. LEDs V1 and V2 are relevant for the ESC system. These LEDs normally pulse, i.e. they flash with a specific frequency. In the event of a fault in the ESC system, the LEDs remain constantly lit.

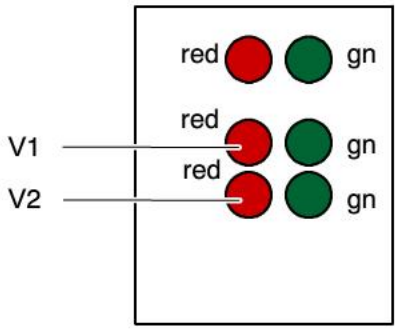


Fig. 19 LEDs on the KPS 600 (front side, top right)

Designation	State of the red LED	Meaning
V1	LED on	General EMERGENCY STOP activated
V2	LED on	Local EMERGENCY STOP activated

- **MFC2**
  The multi-function card is used to process the VxWorks system. It incorporates an Ethernet controller and forms the interface between the KUKA Control Panel and the PC. The card is designed as a PC plug-in card and also serves as a motherboard for up to two DSE-IBS modules.
  On the MFC is a passive node which taps information from the ESC circuit and then passes it on to the controller.

- **ESC-CI2** and **CI board**
  The ESC-CI2 board installed in the KR C3E controller and the CI board in the external drive box are part of the computer-aided safety system. They contain the connections for linking the individual nodes, the fuses and the relays, activated by the KPS via X2, for the local Emergency Stop. The ESC-CI2 links the KPS inputs/outputs with the X11 customer interface.

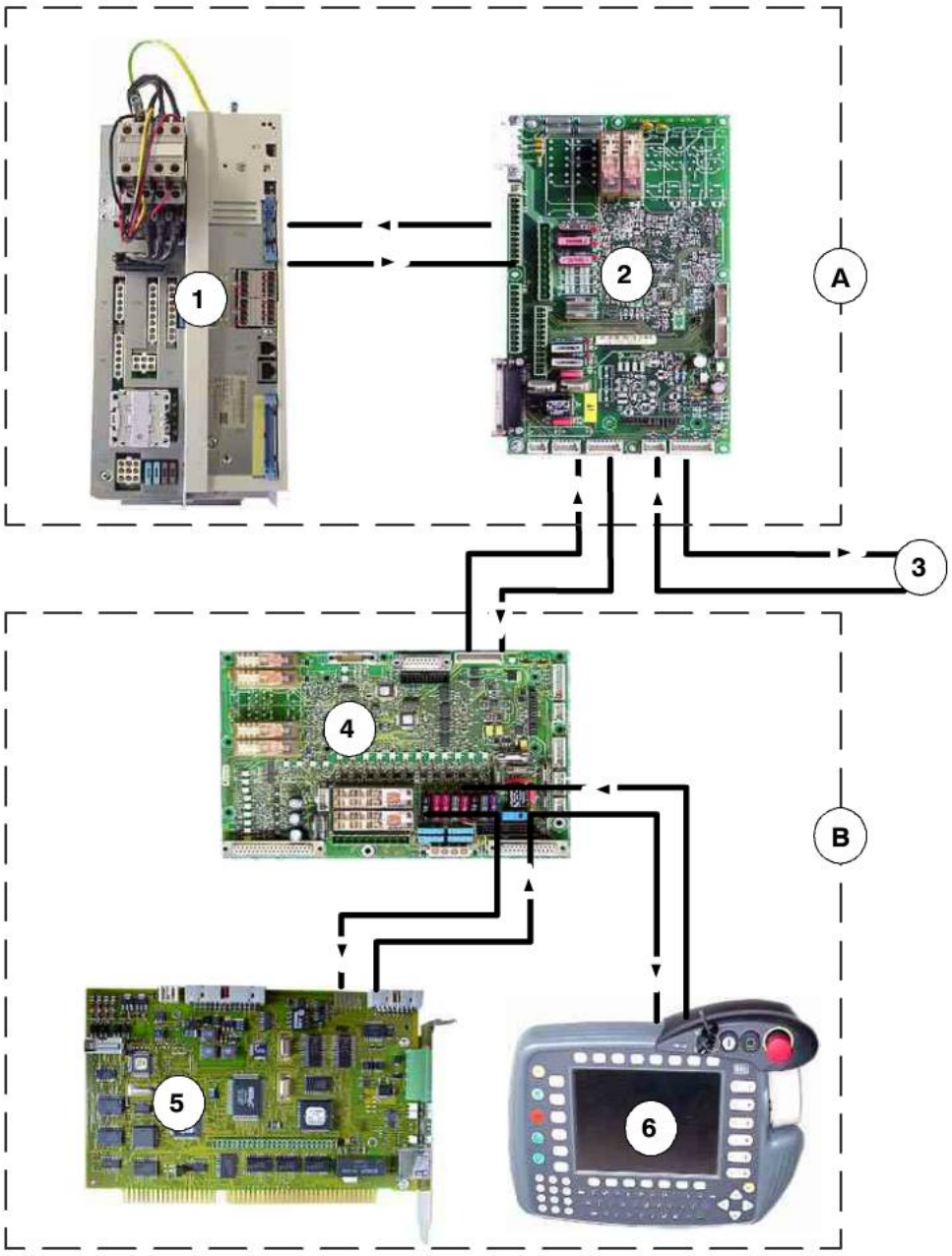


Fig. 20 Structure of the ESC circuit: external drive box with KR C3E controller

Legend (for Fig. 20)

A	External drive box
B	KR C3E controller
1	KPS 600
2	CI board
3	ESC interface to external drive box 2
4	ESC-CI2 board with node
5	MFC, passive ESC node
6	KCP, ESC node (master)

9.2 CI board

As standard, the CI board, which has no node of its own, is used in the controller. This board connects the nodes that are present in the ESC circuit and distributes the signals to the individual interfaces.

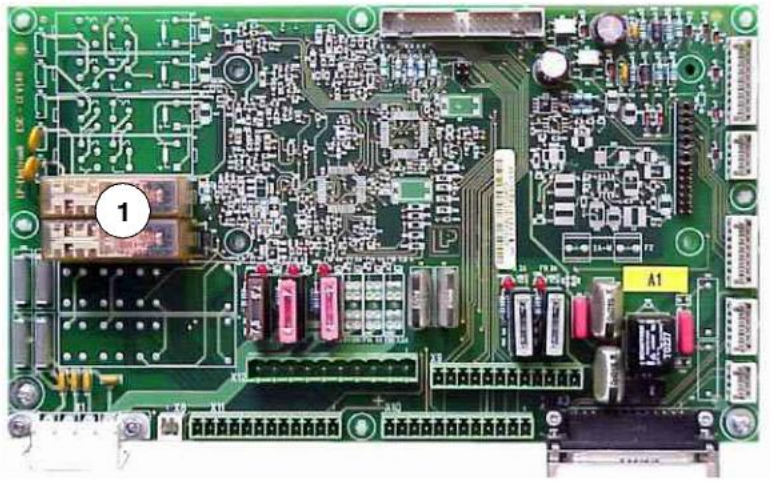


Fig. 21 CI board

Legend

1	Relays K3 and K4 for message: Local Emergency Stop

9.2.1 CI board interface description

For detailed information about all connections and the connector assignment, please refer to the accompanying circuit diagrams and cabling description.

9.2.2 Plug-in connections and fuses

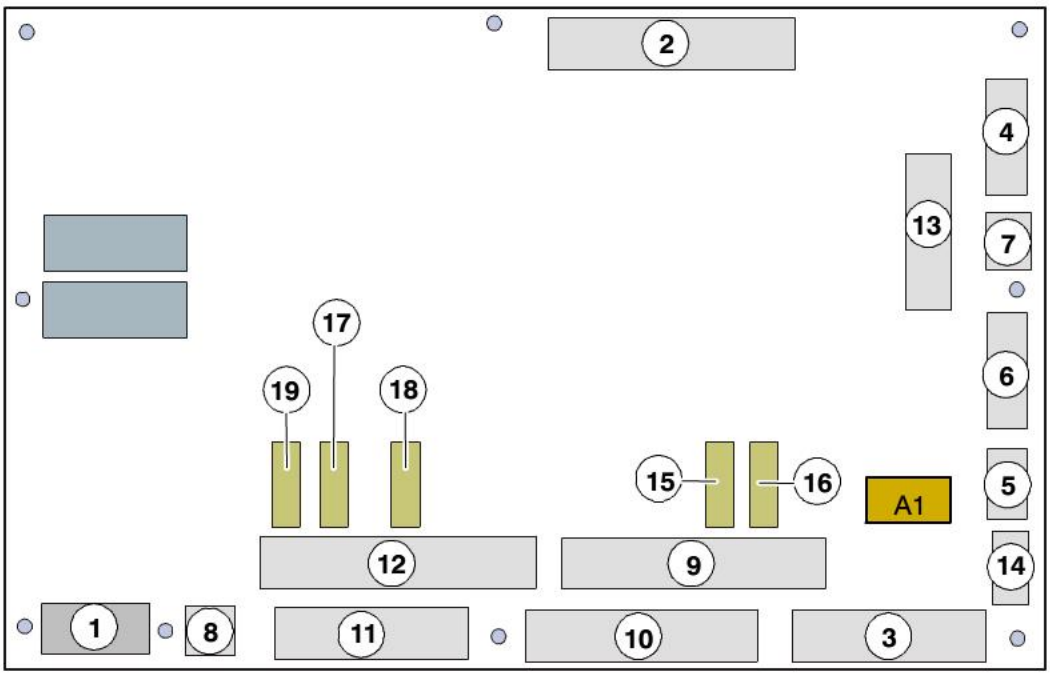


Fig. 22 CI board equipment

Legend

1	X1		Internal 27 V power supply
2	X2		KPS module connection
3	X3		MFC connection
4	X4		External mode selector switch (optional)
5	X5		KCP2 connection
6	X6		Connector for internal/external power supply and ESC bus
7	X7		CAN connection, I/O board
8	X8		External control connection
9	X9		External control connection
10	X10		Peripheral interface (inputs)
11	X11		Peripheral interface (outputs)
12	X12		Peripheral interface (outputs >500 mA)
13	X13		Jumper plug (bus coupler interface)
14	X21		KCP power supply and CAN
15	F10	2 A	ESC-VCC
16	F11	2 A	ESC-VCC
17	F12	4 A	Periphery
18	F13	4 A	Periphery
19	F16	7.5 A	Periphery

9.3 Internal fault analysis

Faults which cause the system to shut down:

- Cross-connection between the A/B channels of an input signal
- Cross-connection between one input channel and the supply voltage/ground
- Communication error (e.g. bus cable discontinuity)
- Hardware fault (e.g. defective relay contacts of the safe outputs)
- Defective ESC chip

9.3.1 Output test

Each ESC chip compares the state of the outputs with the state of the return signals. In the event of disparity, the outputs are set to a safe state.

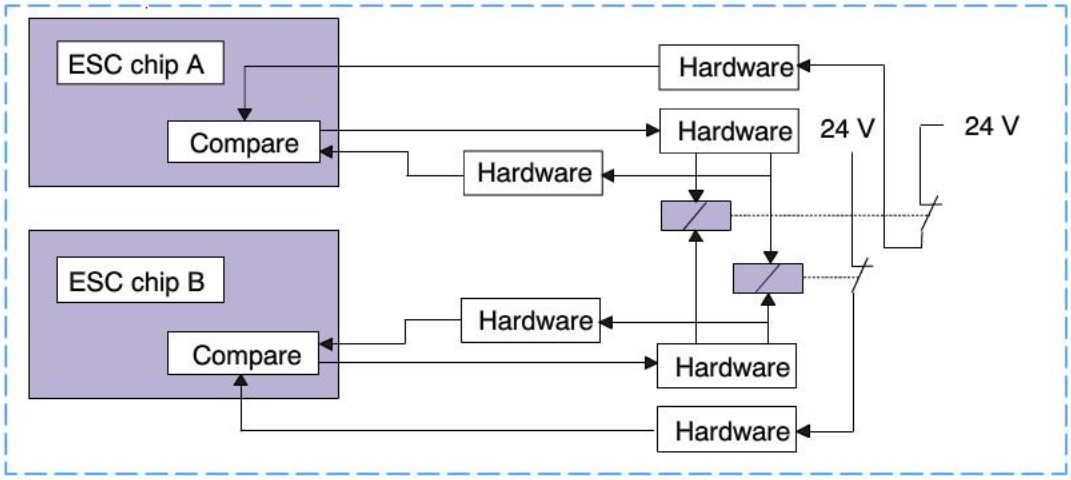


Fig. 23 Output test

9.3.2 I/O check

Each ESC chip sends a bit pattern to its outputs and compares the return signals with this pattern (pulse check).
In the event of disparity, the outputs are set to a safe state.

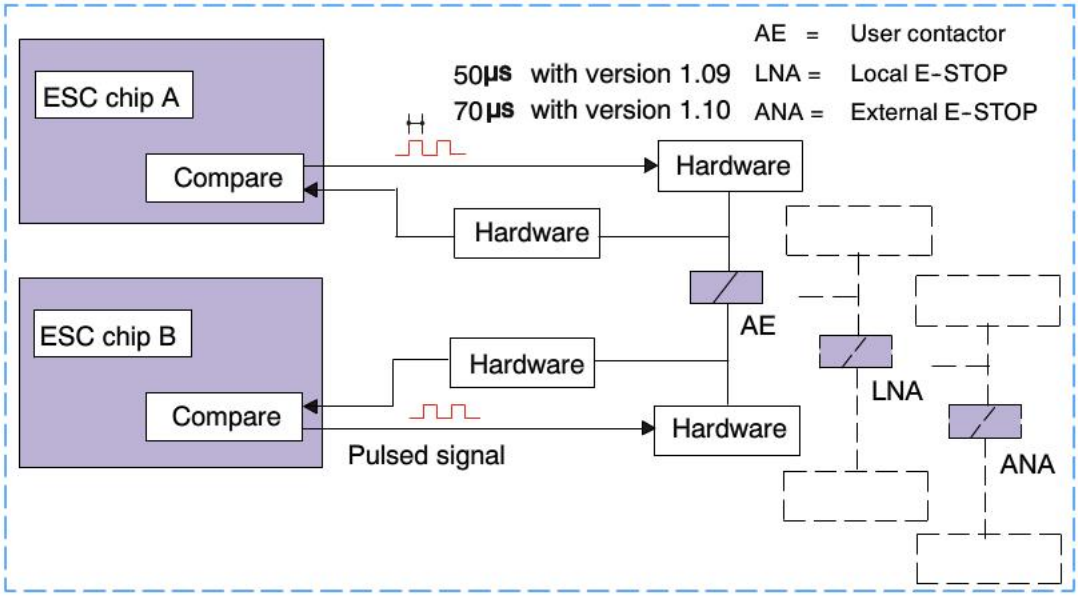


Fig. 24 I/O check

9.3.3 Cross-connection

TA 24 V becomes 0 V when the test output is set.
The ESC chip expects a LOW signal at its inputs.
In the event of disparity, the outputs are set to a safe state.

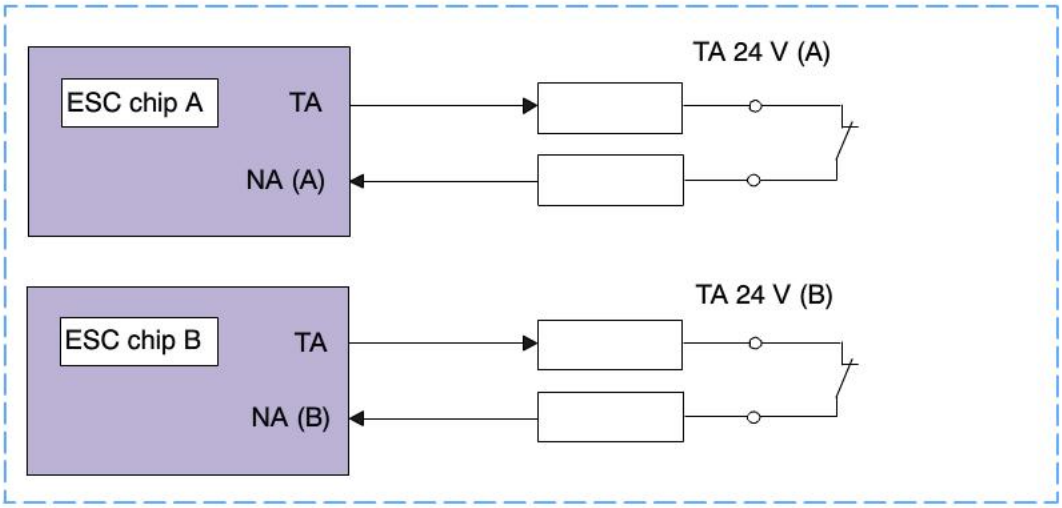


Fig. 25 Cross-connection

9.3.4 Relay test

The ESC chip expects a HIGH signal at this input.
If a relay switches incorrectly, the input is set to LOW.
In the event of disparity, the outputs are set to a safe state.

For the purposes of monitoring this contact path, the test output is additionally set cyclically by the software. The input is here set to LOW.
The ESC chip now expects a LOW signal.
In the event of disparity, the outputs are set to a safe state.

The setting of this test output prevents a jamming of the relay contacts from going unnoticed.

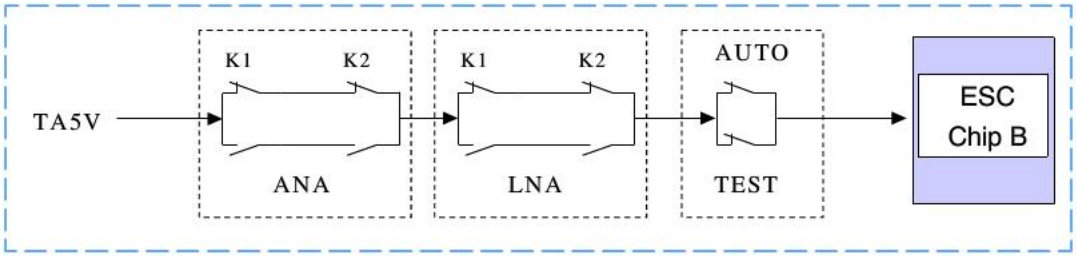


Fig. 26 Relay test

10 Mains filter

The principal function of mains filters (interference suppressor filters) is to allow the useful signal (in this case the 50 Hz supply voltage) to pass through unimpeded as far as possible and to effectively suppress noise signals (higher-frequency, conducted interference voltages) (low-pass character).
In the external drive box or component test stand, these conducted interferences mainly emerge from the power module and spread throughout the entire power mains (without interference suppressor filters). Any device connected to a socket-outlet can therefore be reached and thus also electromagnetically affected. The source of this interference on drives is the 4 kHz fundamental frequency for pulse width modulation (PWM) and the resultant harmonics of up to several megahertz.

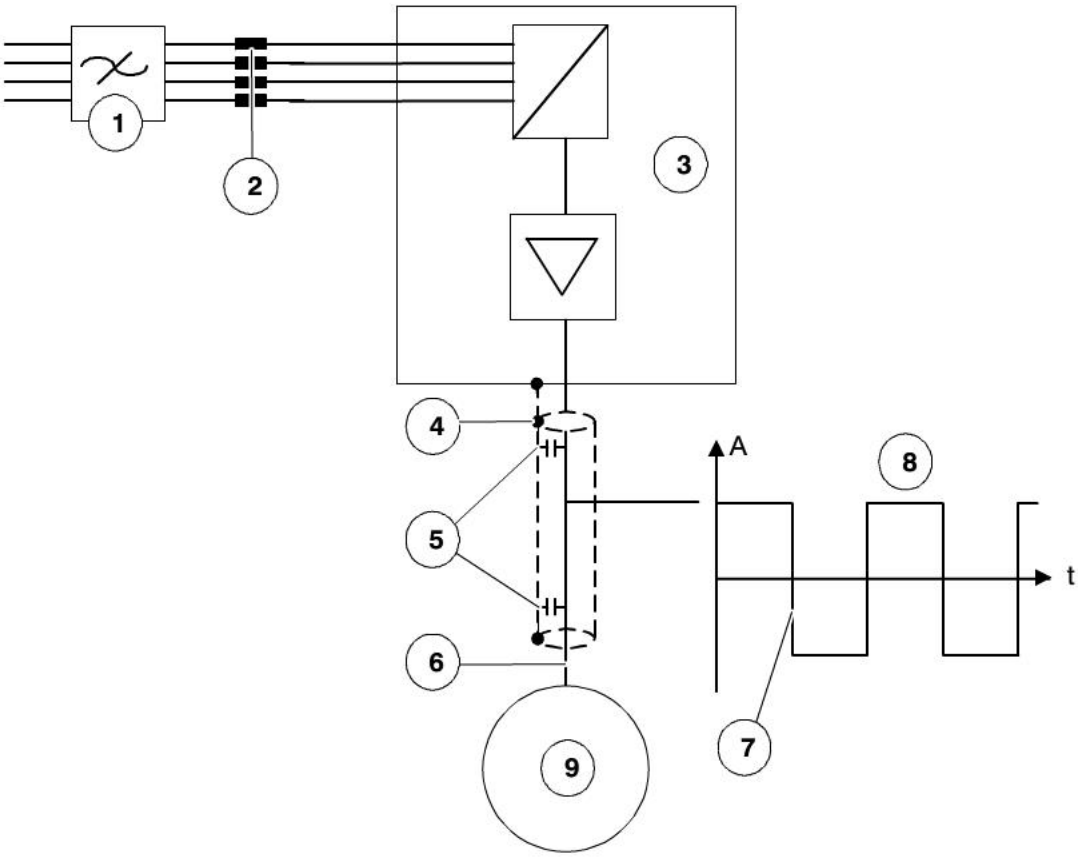


Fig. 27 Creation of interference frequencies

Legend

1	Filter
2	Line reactors
3	KSD1
4	Shield
5	Capacitive coupling to the shield
6	Motor cable
7	Steep edge -> high-frequency harmonics (interference frequencies)
8	Clock frequency 4 kHz
9	Motor

The longer the motor cable, the greater the capacitance => higher interference.

11 Brake module SBM2 (optional)

11.1 Use

11.1.1 Single-axis switching for non-safety-oriented applications

The SBM2 enables single-axis activation of the brakes. The brakes are controlled by the servo bus and the brake connection is monitored for open circuit and short circuit. The results of the monitoring are evaluated in the servo drive module and signaled to the controller.

In this type of application, inputs SI1 and SI2 must be set to HIGH. Output SO remains unwired.

11.1.2 Single-axis switching for safety-oriented applications

The SBM2 brake module supports the safety functions “Safe stop” and “Protection against unexpected start-up” according to the specifications of EN 954-1 “Control category 3” and EN 1037 “Prevention of unexpected start-up”.

Inputs SI1 and SI2 and checkback output SO are available for these functions. They are designed with PLC levels (24 V DC).

Inputs SI1 and SI2 disable the inverter, while checkback output SO is used for checking the correct functioning of inputs SI1 and SI2. Output SO signals that the axis is disconnected.

Output SO is connected to an external power supply, thus enabling multiple checkback contacts connected in series (e.g. all the checkback contacts of a specific workgroup) to return the complete feedback.

Only components that have been approved for failsafe technology may be used for activation and evaluation of these signals (e.g. PNOZ, safety controller, etc.).

The correct dual-channel functioning must be checked by the external controller at regular intervals.

If the check is initiated and carried out manually, the EMERGENCY STOP on the controller must be activated first.

11.2 Safety



Installation or exchange of this option or individual components thereof may be performed only by qualified KUKA personnel specially trained for this purpose and acquainted with the risks involved.
Failure to observe these safety instructions could result in injury or a fatal accident and/or damage to the robot system or other property.



Before connection, testing and installation work, always refer to the accompanying circuit diagram and cabling description.

11.2.1 Additional safety instructions for the “Safe stop” function

- The “Safe stop” function may be installed and started up by qualified and trained KUKA personnel only.
- The functions of the two safe inputs must be verified cyclically by means of external wiring.
- All control components (switches, relays, PLC, etc.) must meet the requirements of EN 954-1 and EN 954-2.
- The use of wire end sleeves is absolutely essential.
- All safety-related cables outside of the control cabinet (e.g. control cables for the safety relay, checkback contact) must be routed so that they are protected, e.g. in cable ducts. It must be ensured that there is no chance of short-circuits between the individual cables.
  For other safety measures, see EN 954-2, Table D4.
- If the effects of external forces (e.g. sagging of suspended axes) are to be expected during “Safe stop”, then additional measures must be taken (e.g. mechanical brakes, interlocks or additional cyclical brake monitoring).



There is no electrical insulation between the motor and the axis module, no service switch and no repair switch.
The “Safe stop” function cannot be used as an axis-specific EMERGENCY STOP. The EMERGENCY STOP function requires electrical isolation of the cable route to the motor.

11.2.2 Liability

This option is designed and built using state-of-the-art technology and in accordance with the recognized safety rules. Nevertheless, improper installation of this unit or its employment for a purpose other than the intended one may constitute a risk to life and limb of operating personnel or of third parties, or cause damage to or failure of the control cabinet, resulting in damage to or failure of the entire robot system and other material property.

The option “SBM2” may only be used in technically perfect condition in accordance with its designated use and only by safety-conscious persons who are fully aware of the risks involved in its operation. Connection and use must be carried out in compliance with this documentation.

11.2.3 Designated use

Using this option for any purpose other than or additional to that described in Chapter 11.1 is considered contrary to its designated use. The manufacturer cannot be held liable for any damage resulting from such use. The risk lies entirely with the user.

No liability can be accepted if these directions are disregarded.

11.3 Installation position of SBM2 and interference suppression modules

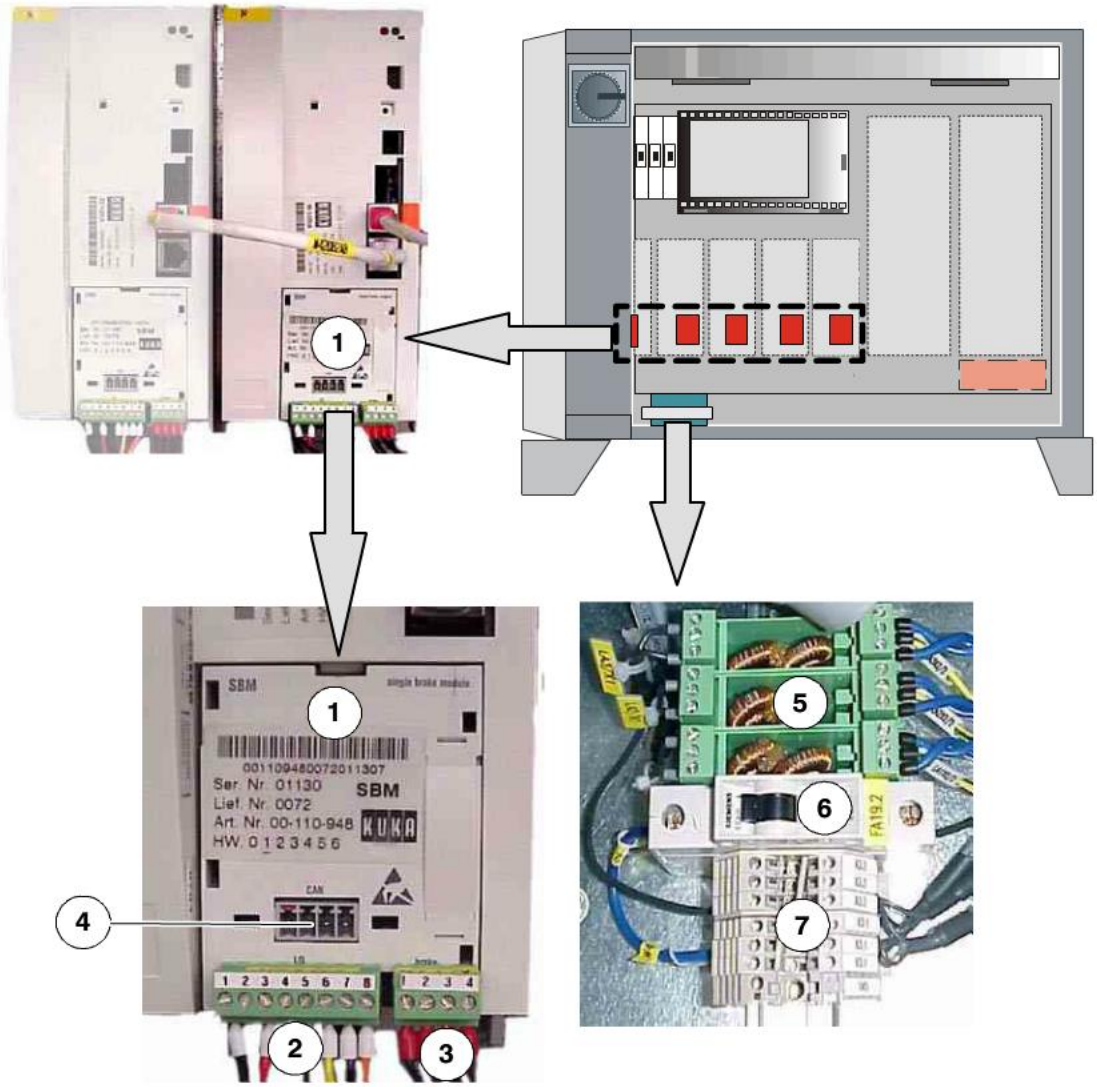


Fig. 28 Configuration example: SBM2 and interference suppression modules in the external drive box

Legend

1		Brake module SBM2
2	X2	I/O connector
3	X3	Brake connector
4	X4	CAN connector
5		Interference suppression modules
6		Fuse FA 19.2
7		Terminal block

11.4 “Safe stop” function test

11.4.1 Fundamentals

In order to achieve safety category 3, the signal “Safe stop initiated” must additionally be checked for accuracy. This requires external wiring. You will have to adapt the external wiring to the existing safety concepts and check them for correct operation.

The control functions can be carried out using:

- a safety PLC
- PNOZ via a PLC program
- PNOZ via PLC or Soft PLC (KUKA Soft PLC)



If the function test for “Safe stop” leads to non-permissible states at the terminals, start-up is not permitted!

Function tests of “Safe stop” must be repeated at regular intervals, not to exceed one year.

11.4.2 Wiring example for safety PLC

This wiring example shows the wiring of the SBM2 with a safety PLC.

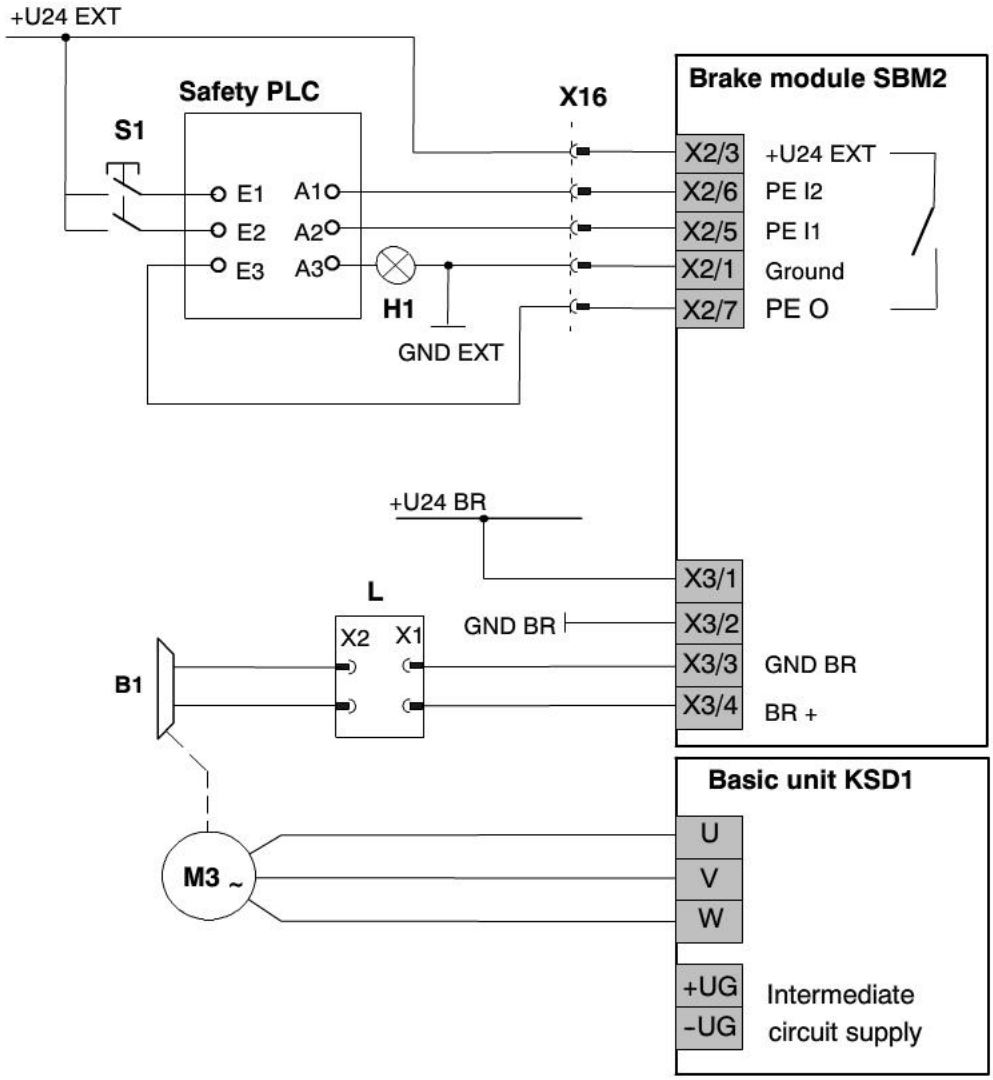


Fig. 29 Wiring for external safety PLC

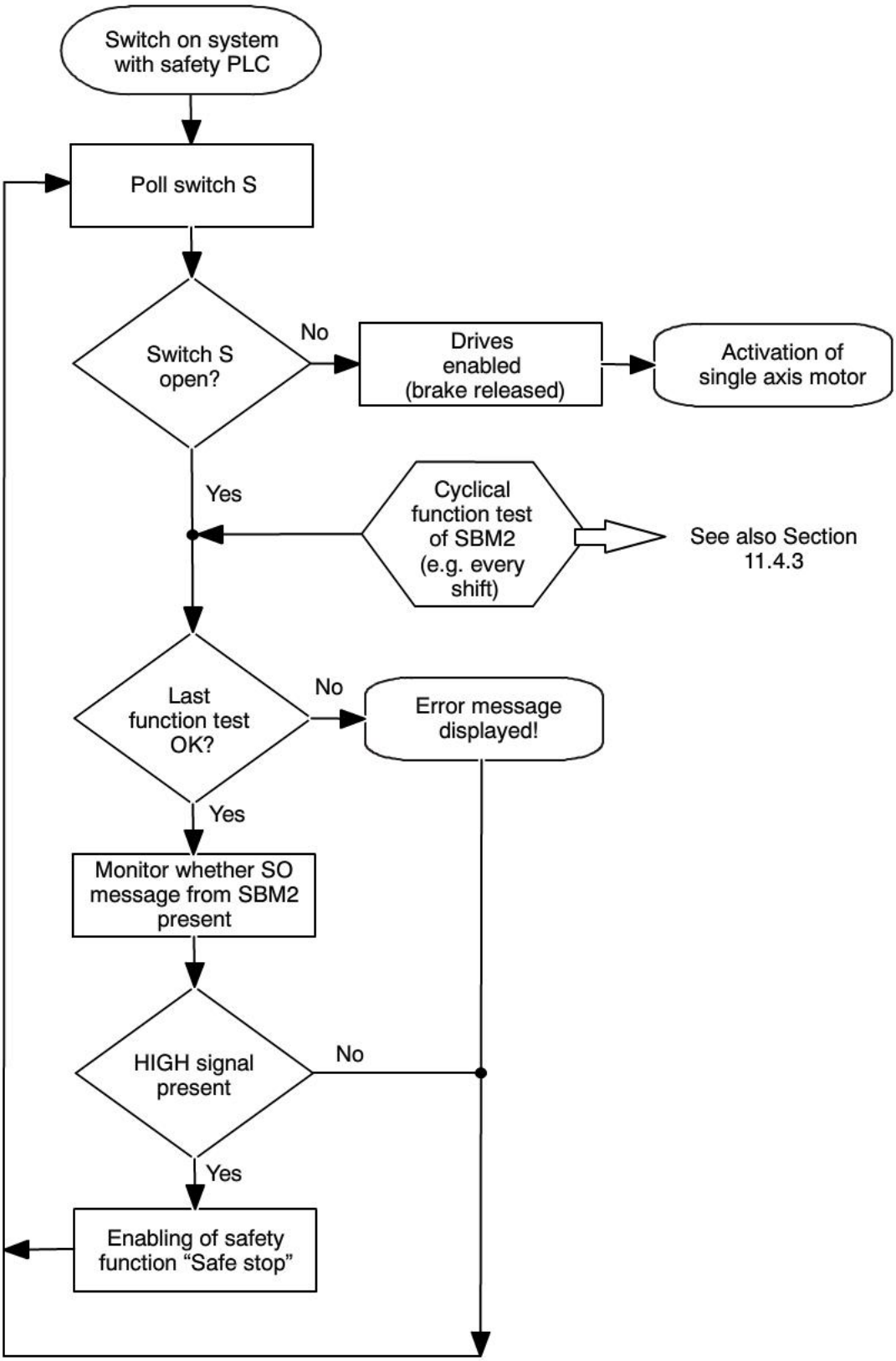
Legend

S1	Drives enable (S1 closed)
S1	Safe stop (S1 open)
LA	Interference suppression module
X16	I/O interface
B1	Motor brake
PE I1	Servo enable
PE I2	Optocoupler power unit enable
SLO	“Safe stop”

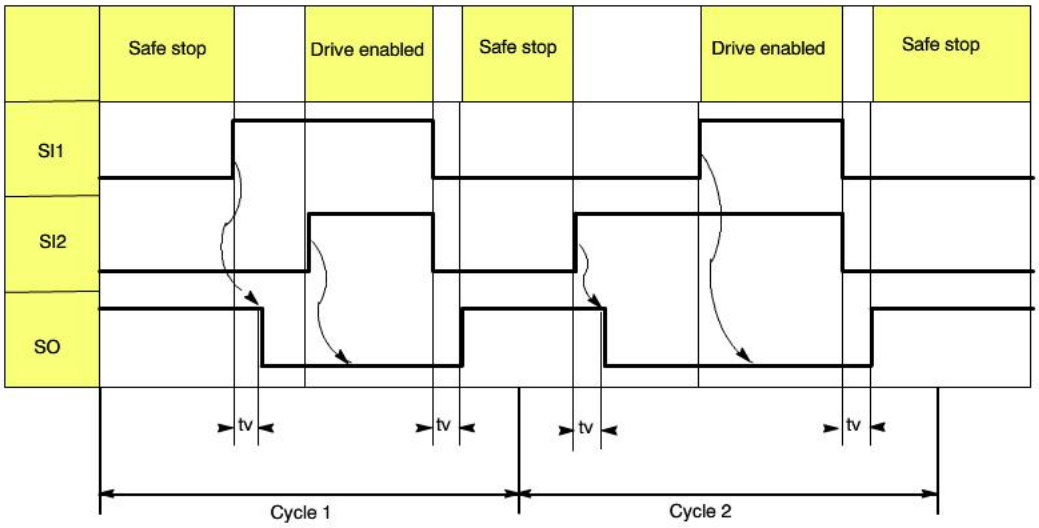
Note the response of the drive when you deactivate the “Servo enable” and/or “Optocoupler power unit enable”.

The motor brake engages immediately, which can cause increased wear on the brake (see data sheet for the brake).

11.4.2.1 PLC flowchart



11.4.3 Sequence cycle



Cycle 1

- Start point: SI1 and SI2 set to LOW, SO set to HIGH (safe stop)
- Set SI1 to HIGH
- SO goes to LOW
- Set SI2 to HIGH
- SO remains LOW
- Drive is now enabled

Cycle 2

- Start point: SI1 and SI2 set to LOW, SO set to HIGH (safe stop)
- Set SI2 to HIGH
- SO goes to LOW
- Set SI1 to HIGH
- SO remains LOW
- Drive is now enabled

The maximum delay “tv” between a change to the signals SI1 and SI2 and a reaction from SO is 40 ms.

If the states of checkback output SO listed above do not have the correct levels, this means that a safety-related fault has occurred. The drive controller must be safely deactivated, e.g. by activating EMERGENCY STOP or some other safety input.



The drive controller must not be restarted until the fault has been eliminated and a test run has been successfully completed.

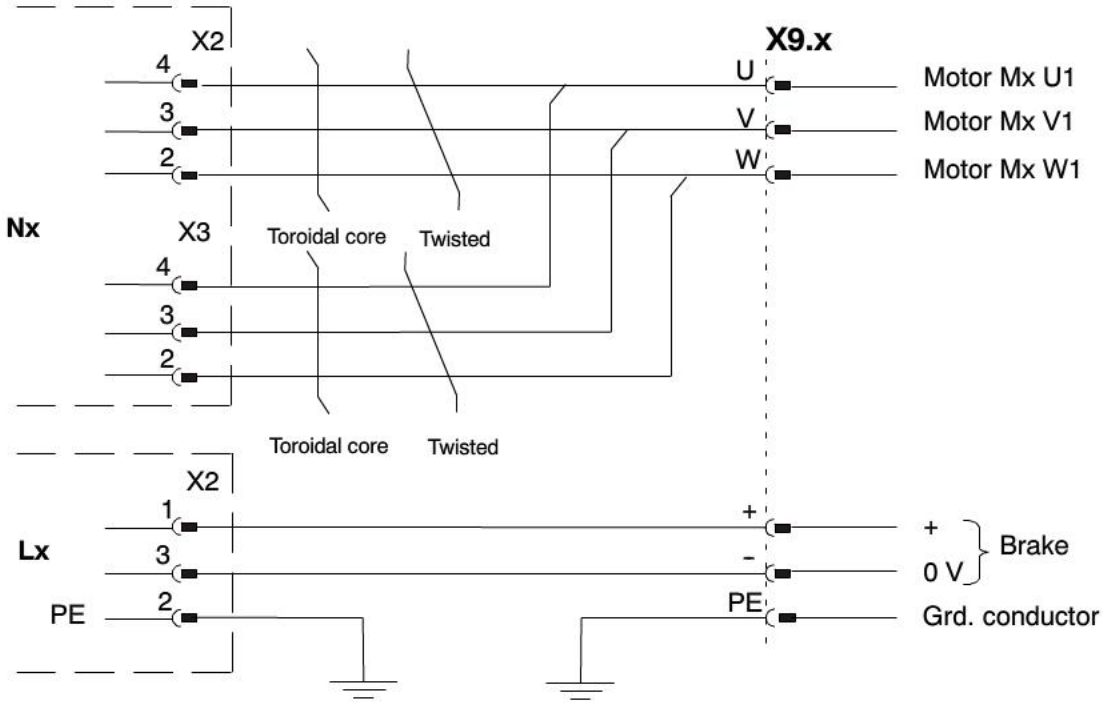
Cycles 1 and 2 must be run in succession during testing each shift or each year. In the case of continuous testing in the running application, testing must alternate between cycles 1 and 2 each time the drives are enabled.



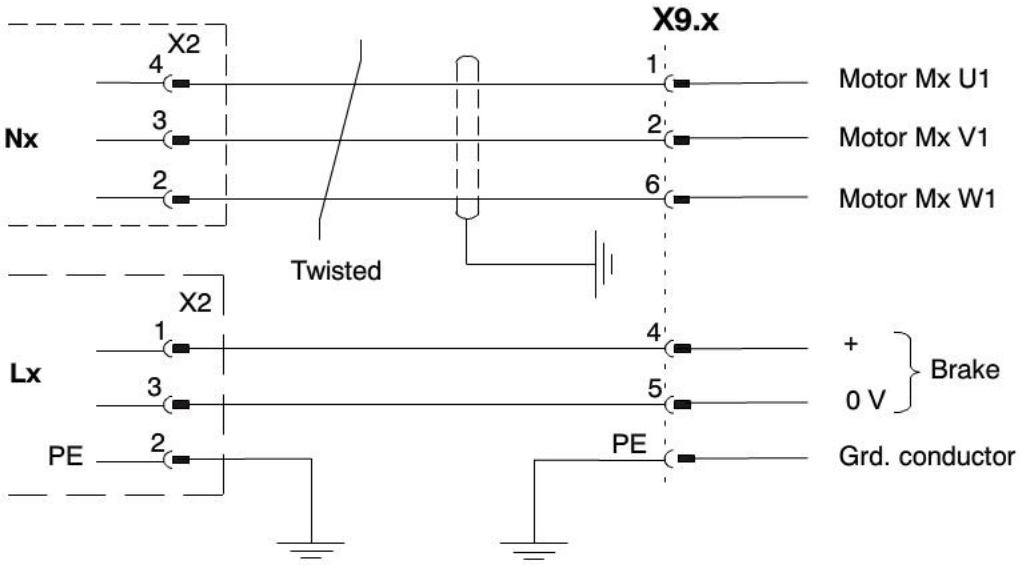
We recommend cyclical testing in the running application.

11.5 Connector pin allocation

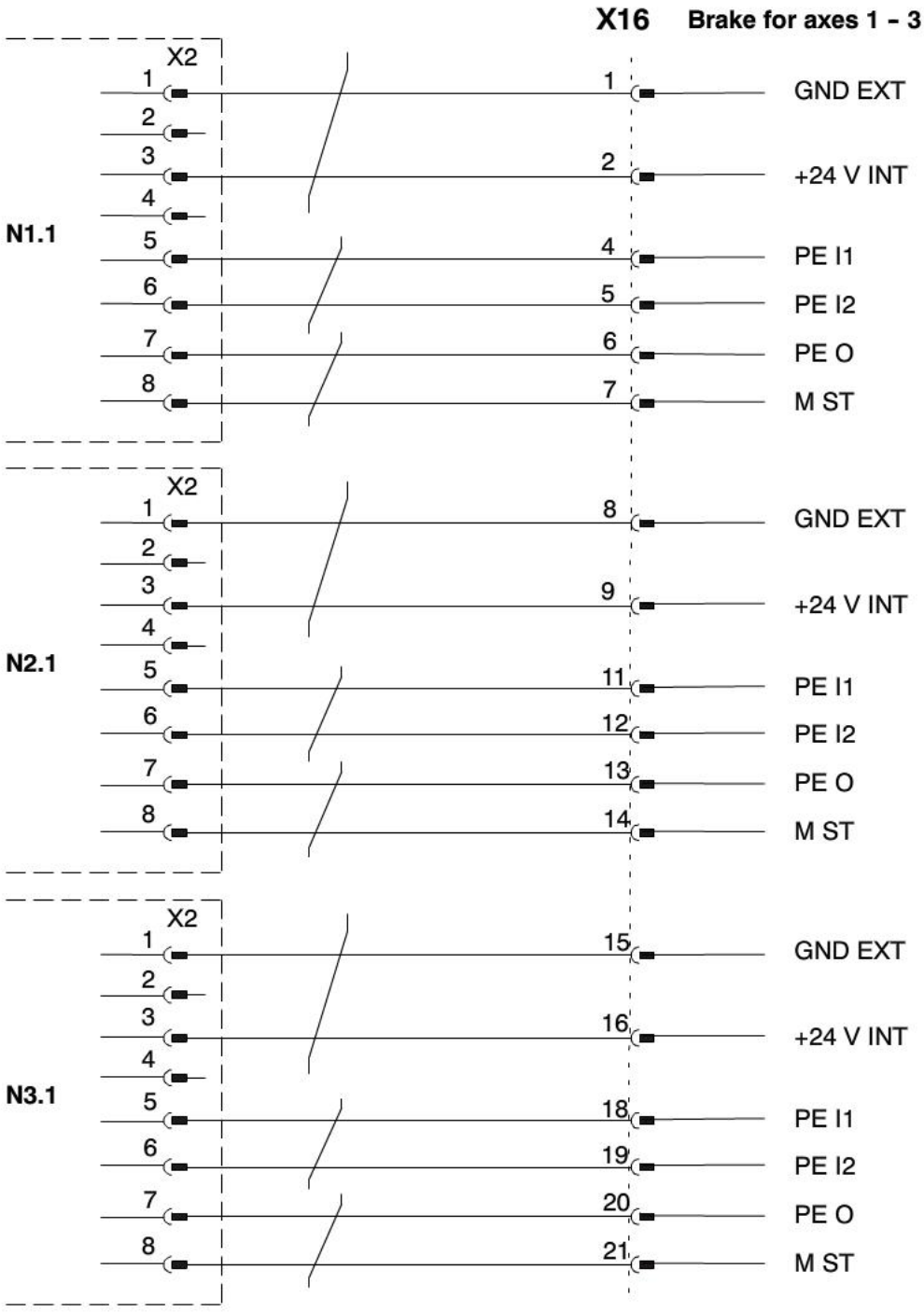
11.5.1 Motor connector for KSD1, size 48/64



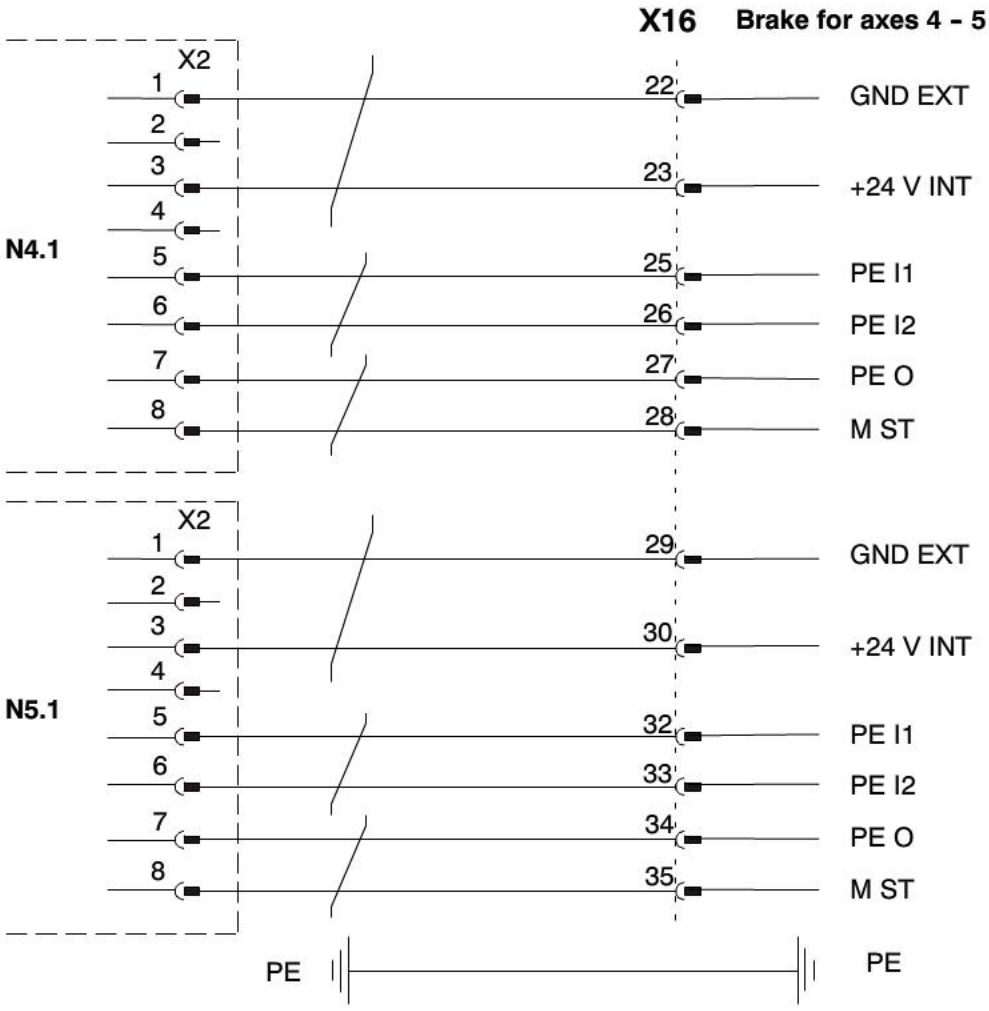
11.5.2 Motor connector for KSD1, size 08/16/32



11.5.3 I/O interface X16



Connector assignment X16 brakes (continued)



11.5.4 SBM2 connector

I/O terminals

Pin no.	Designation	Description
X2/1	GND EXT	External ground. Common ground for digital inputs and outputs. Isolated from brake ground GND_BR.
X2/2	GND INT	Internal ground.
X2/3	+U24 EXT	External power supply for the digital output.
X2/4	+U24 INT	Internal power supply.
X2/5	PE I1	Input 1: LOW level - disables the activation pulse to the inverter. - interrupts the power supply for the brake driver.
X2/6	PE I2	Input 2: LOW level - interrupts the activation of the transmission elements for the control pulses to the inverter. - disables the activation of the brake driver.
X2/7	PE O	Output 1: HIGH level Checkback signal: “Safe stop”
X2/8	M ST	Output 2: HIGH level Signal: “Axis ready for disconnection”.

Brake terminals

Pin no.	Designation	Description
X3/1	+U24 BR	Power supply for the brake (switched by the safety logic, e.g. via make contacts of the main contactor).
X3/2	GND BR	Ground for the power supply to the brake.
X3/3	GND BR	Ground terminal of the brake.
X3/4	BR +	Positive terminal of the brake.

CAN terminals

Pin no.	Designation	Description
X4/1	CAN HIGH	CAN high.
X4/2	CAN LOW	CAN low.
X4/3	CAN GND	CAN ground.
X4/4	CAN IDENT	Identification.

11.6 Technical data

Terminal	Function		Electrical data
X2	**"Safe stop" connection**		
X2/1 (GND_{ext})	Reference potential for "Safe stop"		
X2/3 (S24)	Low voltage supply for "Safe stop"		18...30 V DC / 0.5 A
X2/7 (PE O)	Output for checkback signal "Safe stop initiated"	LOW during operation HIGH "Safe stop" active	24 V DC 0.5 A short-circuit proof
X2/5 (PE I1)	Input 1 "Safe stop"	LOW Axis module disabled HIGH Axis module enabled	LOW: -3...+5 V/ -3...+15 mA HIGH: +15...+30 V/ +2...+15 mA Input current at 24 V DC: 8 mA per input
X2/6 (PE I2)	Input 2 "Safe stop"	LOW Optocoupler power unit disabled HIGH Optocoupler power unit enabled	
X2	**Other connections**		
X2/2 (GND_{int})	Reference potential for internal signals		
X2/4 ($U24_{int}$)	Power supply for SBM2		21...28 V DC / 30 mA
X2/8 (F0)	Freely programmable output	LOW Output not active HIGH Output active	24 V DC 0.5 A short-circuit proof
X3	**Motor brake connection**		
X3/1 (24 V)	Power supply to motor brake		21...28 V DC / 1.6 A
X3/2 (GND_{BR})	Reference potential for terminal X3/1		
X3/3 (GND_{BR})	Motor brake connection		21...28 V DC / 1.6 A short-circuit proof
X3/4 (+BR)	Motor brake connection		
X4	**CAN communication connection**		
X4/1 (HIGH)	CAN high		
X4/2 (LOW)	CAN low		
X4/3 (GND)	CAN GND		
X4/4 (IDENT)	Identification of the CAN function		

12 Cooling

The external drive box is divided into two cooling zones. The air in the inner zone, containing the entire control electronics, is cooled by a heat exchanger. In the outer zone, the ballast resistors and the heat sinks of the servo modules, energy recovery unit and KPS are cooled directly by ambient air.

Upstream installation of filter mats causes an excessive rise in temperature and hence a reduction in the service life of the installed devices!

The ventilation slits on the external drive box must not be covered.

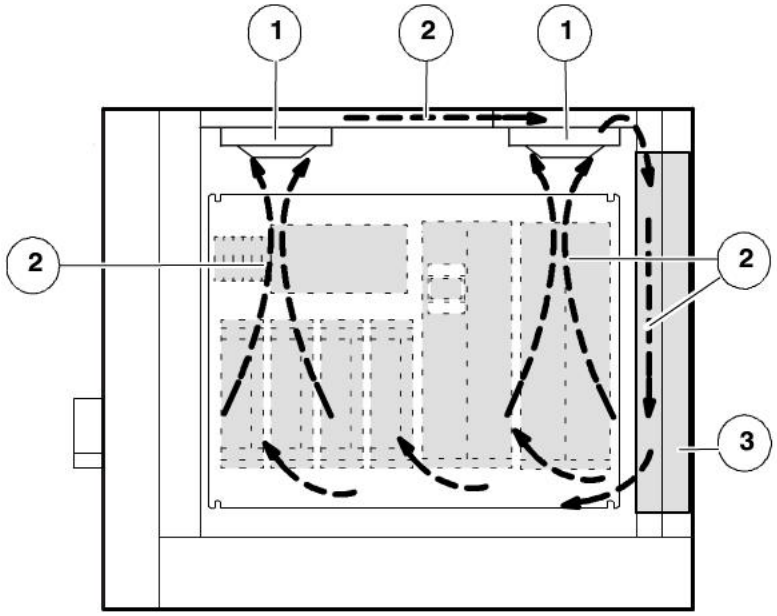


Fig. 30 Front view, inner cooling circuit

Legend

1	Fans, inner cooling circuit
2	Inner cooling circuit
3	Heat exchanger at side

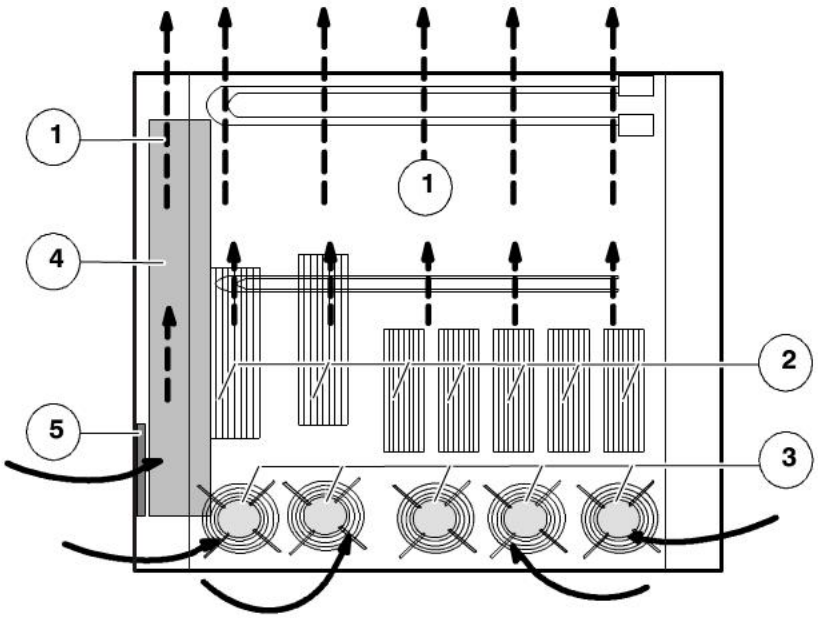


Fig. 31 Rear view, outer cooling circuit

Legend

1	Outer cooling circuit, rear
2	Outer cooling circuit, side
3	Fans, outer cooling circuit, rear
4	Heat exchanger at side
5	Fan, outer cooling circuit, side

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