ACCESSORY

COMBIVERT

GB Instruction Manual

Braking Resistors

Mat.No.	Rev.
00F5ZEBK001	1E

KEB

Contents

1. Braking Resistors

The KEB COMBIVERT fitted with an external braking resistor is suitable for a limited 4-quadrant operation. The braking energy, refeed into the DC-bus at generatoric operation, is dissipated over the braking transistor to the braking resistor.
Different braking resistors are available for the KEB COMBIVERT. Please refer to the next page for the corresponding formula and restrictions (valid range).

1.1 Selection of braking resistor:

1. Preset desired braking time.
2. Calculate braking time without braking resistor (t_{Bmin}).
3. A braking resistor is necessary if the desired braking time is smaller than the calculated braking time ($t_B < t_{Bmin}$).
4. Calculate braking torque (M_B). Take the load torque into account at the calculation.
5. Calculate peak braking power (P_B). The peak braking power must always be calculated for the worst case (n_{max} to standstill).
6. Selection of braking resistor:

a) Peak power of the braking resistor $P_S \geq$ peak braking power P_B

b) P_N is to be selected according to the cycle time.
The resistance values shall not decrease the min. permissible value of the braking transistors. The minimum braking resistor can be taken from the technical data of the inverter documentation.
The maximum cyclic duration of a braking resistor shall not be exceeded. For a longer cyclic duration time special designed braking resistors are necessary. The continuous output of the braking transistor must be taken into consideration.

7. Check, whether the desired braking time (tBmin) is attained with the braking resistor.

Restriction: Under consideration of the rating of the braking resistor and the brake power of the motor, the braking torque may not exceed 1,5times of the rating torque of the motor (see formula).
When utilizing the maximum possible braking torque the frequency inverter must be dimensioned for the higher current.

1.2 Braking ramp

The braking ramp is adjusted at the frequency inverter. If it was selected too small, the KEB COMBIVERT switches off automatically and error message overvoltage (E.OP) or overcurrent (E.OC) is displayed. The approximate braking time can be determined according to following formula.

1.3 Calculation formula

Braking time without braking resistor

$$t_{Bmin} = \frac{(J_M + J_L) \cdot (n_1 - n_2)}{9.55 \cdot (K \cdot M_N + M_L)}$$

Valid range: $n_1 > n_N$ (field weakening range)

Required braking torque

$$M_B = \frac{(J_M + J_L) \cdot (n_1 - n_2)}{9.55 \cdot t_B} - M_L$$

Conditions: $M_B \leq 1.5 \cdot M_N$; $f \leq 70\,Hz$

Peak braking power

$$P_B = \frac{M_B \cdot n_1}{9.55}$$

Condition: $P_B < P_S$

Braking time with braking resistor

$$t_{Bmin} = \frac{(J_M + J_L) \cdot (n_1 - n_2)}{9.55 \cdot (K \cdot M_N + M_L + \frac{P_S \cdot 9.55}{(n_1 - n_2)})}$$

Valid range: $n_1 > n_N$

Conditions: $\frac{P_S \cdot 9,55}{(n_1 - n_2)} \leq M_N \cdot (1.5 - K)$

$f \leq 70\,Hz$

$P_B \leq P_S$

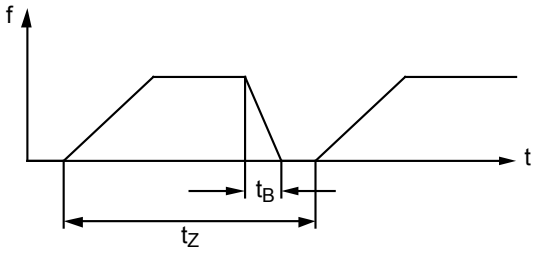
Cyclic duration factor

cdf for $t_Z \leq 120\,s$

$$cdf = \frac{t_B}{t_Z} \cdot 100\ \%$$

cdf for $t_Z > 120\,s$

$$cdf = \frac{t_B}{120\,s} \cdot 100\ \%$$



Legend			
J_M	=	mass moment of inertia motor	[kgm²]
J_L	=	mass moment of inertia load	[kgm²]
n_1	=	motor speed prior to deceleration	[rpm]
n_2	=	motor speed after deceleration (standstill = 0 rpm)	[rpm]
n_N	=	Rated motor speed	[rpm]
M_N	=	Rated motor torque	[Nm]
M_B	=	required braking torque	[Nm]
M_L	=	load torque	[Nm]
t_B	=	required braking time	[s]
t_{Bmin}	=	minimum braking time	[s]
t_Z	=	Cycle time	[s]
P_B	=	peak power (required)	[W]
P_S	=	peak breaking power of braking resistor	[W]
K	=	0.25 for motors to 1.5 kW (default three-phase asynchronous motor)	
		0.20 for motors 2.2…4 kW	
		0.15 for motors 5.5…11 kW	
		0.08 for motors 15…45 kW	
		0.05 for motors > 45 kW	
cdf	=	Cyclic duration factor	

1.4 Beside mounted braking resistor - technical data

Part number	Number of modules	R	P_D	P_S	cdf	Terminals		Core cross-section	
		Ω	[W]	[kW]	[s]	[AWG]	[mm²]	[AWG]	[mm²]
230 V class									
07BR100-1180	1	180	44	0.8	6	–	–	16	1.5
09BR100-1100	1	100	82	1.5	6	–	–	14	2.5
10BR100-1683	1	68	120	2.2	6	–	–	14	2.5
12BR100-1333	1	33	250	4.2	6	–	–	14	2.5
13BR100-1273	1	27	300	5.1	6	–	–	12	4
14BR100-1203	1	20	410	6.9	6	–	–	12	4
15BR110-1133	1	13	630	10	6	12	4	12	4
15BR226-3806	1	8	2500	17	30	6	16	8	10
16BR110-1103	1	10	780	14	6	12	4	12	4
16BR110-3606	1	6	3000	23	30	6	16	8	10
17BR110-1073	1	7	1200	22	6	12	4	12	4
17BR226-3516	1	5.6	4000	27	30	6	16	6	16
18BR226-1406	1	4	1800	29	6	6	10	6	16
18BR226-3416	1	4.1	5000	33	30	6	16	6	16
19BR226-1306	1	3	2000	45	6	6	16	6	16
19BR226-3306	1	3	7500	45	30	6	16	6	16
20BR226-3426	1	2.4	10000	57	6	6	16	6	16
21BR226-1206	1	2	4000	68	6	2x6	2x16	2x6	2x16
400 V class									
07BR100-6620	1	620	56	0.9	6	–	–	16	1.5
09BR100-6390	1	390	90	1.5	6	–	–	16	1.5
10BR100-6270	1	270	130	2.1	6	–	–	16	1.5
11BR100-6180	1	180	190	3.2	6	–	–	14	2.5
12BR100-6150	1	150	230	3.85	6	–	–	14	2.5
13BR100-6110	1	110	350	5	6	–	–	14	2.5
14BR100-6853	1	85	410	6.9	6	–	–	14	2.5
14BR226-7853	1	85	600	12	18	8	10	12	4
14BR226-8453	1	40	3400	12	48	6	16	10	6
15BR110-6563	1	56	620	10	6	12	4	12	4
15BR226-8303	1	30	4000	17	48	2x6	2x16	10	6
16BR110-6423	1	42	820	14	6	12	4	12	4
16BR226-7423	1	42	1200	15	18	8	10	10	6
17BR110-6303	1	30	1200	19	6	12	4	12	4
17BR226-7273	1	27	1800	22	18	8	10	8	10
18BR226-6203	1	20	1700	29	6	8	10	8	10
18BR226-8203	3	20	15000	38	30	2x6	2x16	2x8	2x10
19BR226-6152	1	15	2300	38	6	8	10	8	10
20BR226-6123	1	12	2900	48	6	6	16	6	16

PD	*Continuous power*
PS	*Peak load, max. for specified ON period*
cdf	*ON time referring to a cycle time of 120 s*
	recommended core cross- section per module

Part number	Number of modules	R	P_D	P_S	cdf	Terminals		Core cross-section	
		Ω	[W]	[kW]	[s]	[AWG]	[mm²]	[AWG]	[mm²]
21BR226-6103	1	10	3000	53	6	6	16	6	16
22BR226-6866	1	8.6	4000	68	6	2x6	2x16	2x6	2x16
23BR226-6676	1	6.7	5200	86	6	2x6	2x16	2x6	2x16
24BR226-6506	2	5	6900	115	6	2x6	2x16	2x6	2x16
25BR226-6436	2	4.3	8100	135	6	2x6	2x16	2x6	2x16
26BR226-6386	2	3.8	9200	154	6	2x6	2x16	2x6	2x16
27BR226-6336	2	3.3	10000	173	6	2x6	2x16	2x6	2x16
28BR226-6226	3	2.2	15000	260	6	2x6	2x16	2x6	2x16
29BR226-6176	4	1.7	20000	340	6	2x6	2x16	2x6	2x16
30BR226-6136	5	1.3	26000	440	6	2x6	2x16	2x6	2x16

PD	*Continuous power*
PS	*Peak load, max. for specified ON period*
cdf	*ON time referring to a cycle time of 120 s*
	recommended core cross- section per module

The calculated peak braking power must be smaller than the maximum load capacity of the resistance. Please contact KEB if the value is not reached.

Response threshold and electrical specifications of the installed thermojunctions

Part number	Temperature	Switch type	max. load
xxBR100-xxxx	160 °C	NC contact	250 Vac / 0.5 A 30 Vdc / 0.5 A
xxBR110-xxxx	160 °C	NC contact	
xxBR226-xxxx	240 °C	NC contact	250 Vac / 3 A 30 Vdc / 3 A

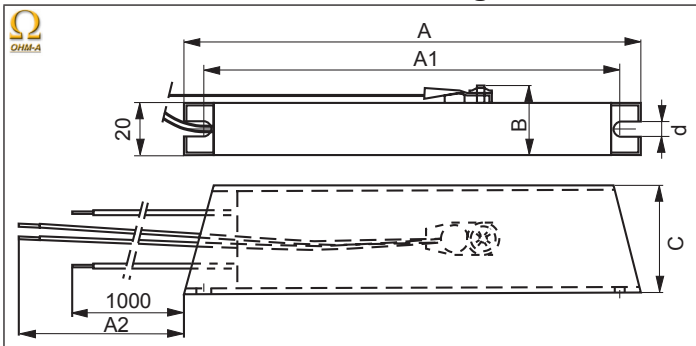
Ambient conditions

Permissible ambient temperature at operation
-40…45 °C

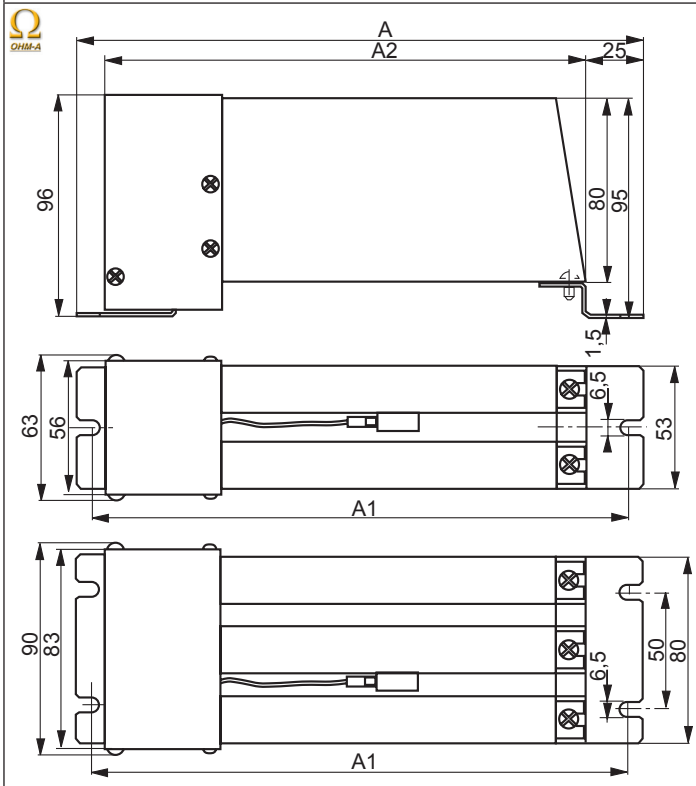
Degree of protection

Part number	degree of protection
xxBR100-xxxx	IP 60
xxBR110-xxxx	IP 20
xxBR226-xxxx	IP 20

1.5 Beside mounted braking resistors - dimensions

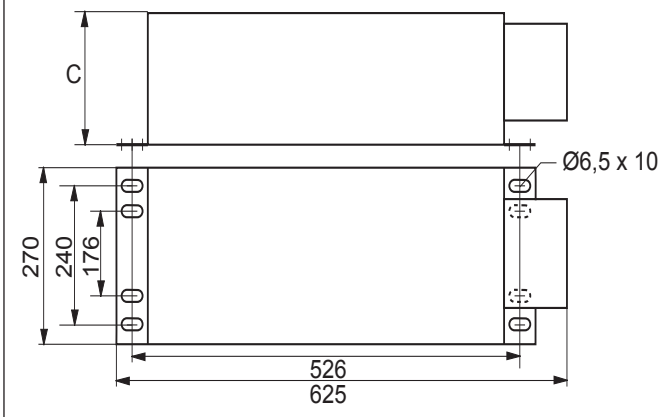


Part number	A	A1	A2	B	C	GB
07BR100-xxxx	160	145	1120	26	40	6
09BR100-xxxx	240	222	1060	26	40	6
10BR100-xxxx	300	285	1030	26	40	6
11BR100-xxxx	240	225	1085	28	80	5.5
12BR100-xxxx	300	285	1055	28	80	5.5
13BR100-xxxx	400	400	1005	28	80	5.5
14BR100-xxxx	400	400	1005	28	80	5.5



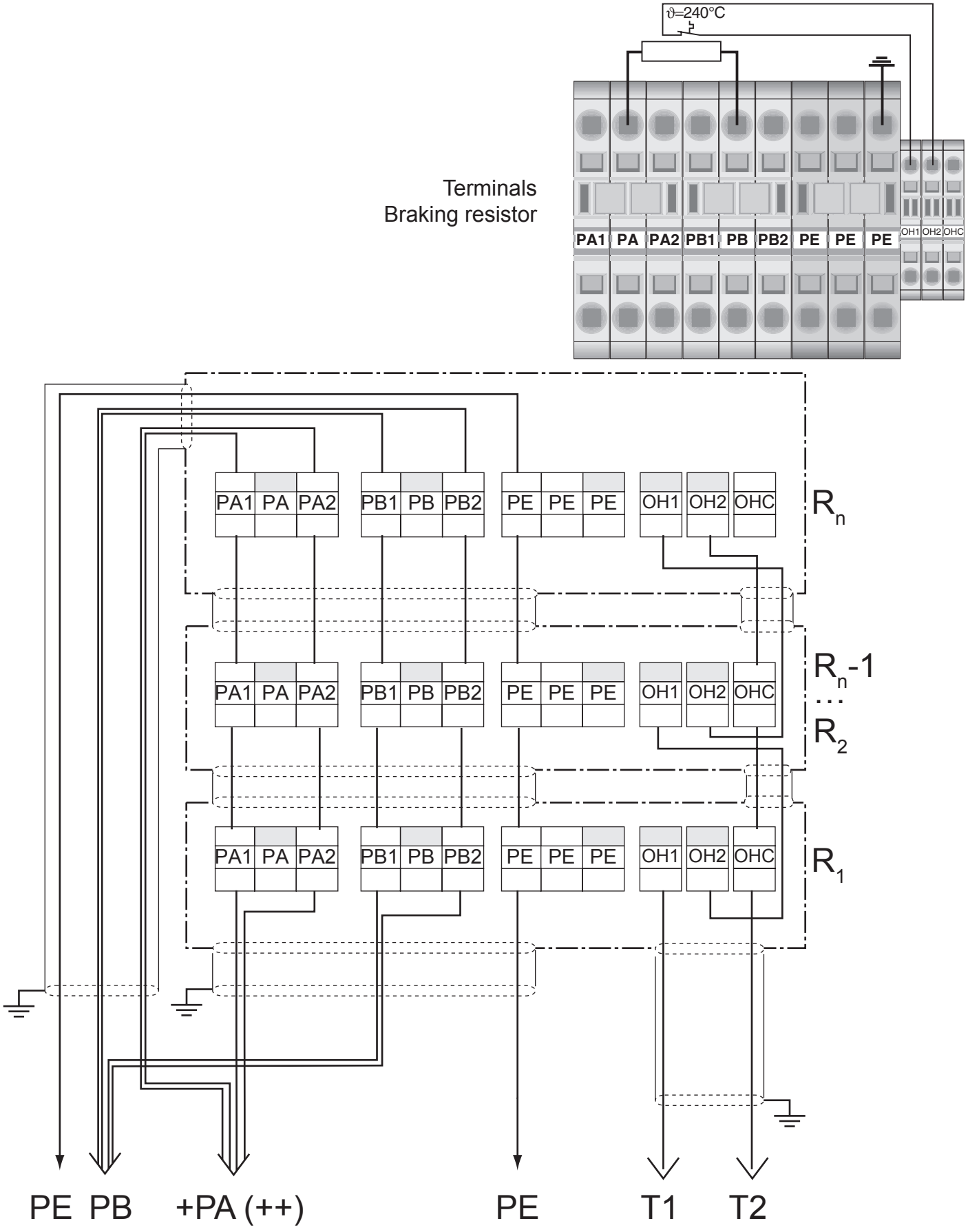
Part number	A	A1	A2
15BR110-xxxx	370	355	300
16BR110-xxxx	470	455	400

Part number	A	A1	A2
17BR110-xxxx	470	455	400



Part number	C
14BR226-7853	119,5
15BR226-8303	119,5
16BR226-7423	119,5
17BR226-7273	119,5
18BR226-6203	119,5
19BR226-6152	119,5
20BR226-6123	223,5
21BR226-6103	223,5
22BR226-6866	273,5
23BR226-6676	273,5
24BR226-6506	= 2 x 21.BR.226-6103
25BR226-6436	= 2 x 22.BR.226-6866
26BR226-6386	= 1 x 22.BR.226-6866+ 1 x 23.BR.226-6676
27BR226-6336	= 2 x 23.BR.226-6676
28BR226-6226	= 3 x 23.BR.226-6676
29BR226-6176	= 4 x 23.BR.226-6676
30BR226-6136	= 5 x 23.BR.226-6676

1.6 Parallel connection of braking resistors of the sizes 24…30



1.7 Installation instructions

Braking resistors can evolve very high surface temperatures during normal operation. The following points must be considered absolutely for safe operation:

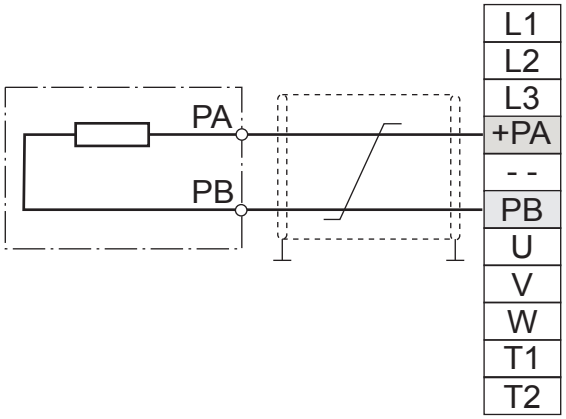
•	Select minimum distances to adjacent units in such way that neither fire risk nor malfunctions increased by ambient temperature releases.
•	Sufficient cooling must be available when the unit is installed in a control cabinet.
•	A warning notice "hot surface" must be placed in case of structural measures if a protection against contact for the service personnel cannot be ensured. 
•	Connect temperature monitoring of the braking resistors
•	Make fire preventions if necessary.

1.8 Selection of the connection type

			Extended temperature monitoring
		Simple temperature monitoring	
	Without temperature monitoring		
Monitored malfunction			
Ramps too short	–	O	O
ON period too long	–	O	O
Wrong dimensioning of the braking resistor	–	O	O
input voltage too high	–	O	O
Generatoric operation	–	O	o [1)]
Short circuit in the braking transistor	–	–	O
Short circuit in the braking transistor (generating)	–	–	o [1)]

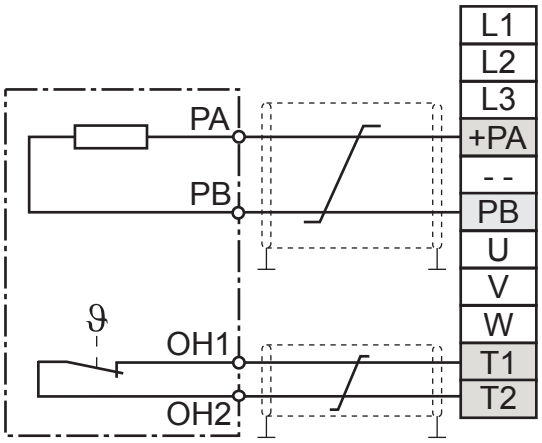
1) The frequency inverter remains in operation in spite of switched off power supply in generatoric operation. An error must be released here, which leads to the disconnection of the modulation. This can occur e.g. via an additional auxiliary contact at the line contactor K1 (terminals 13/14) at terminals T1/T2 or via digital input. The frequency inverter must be programmed accordingly in each case.

1.9 Connection of a braking resistor without temperature monitoring



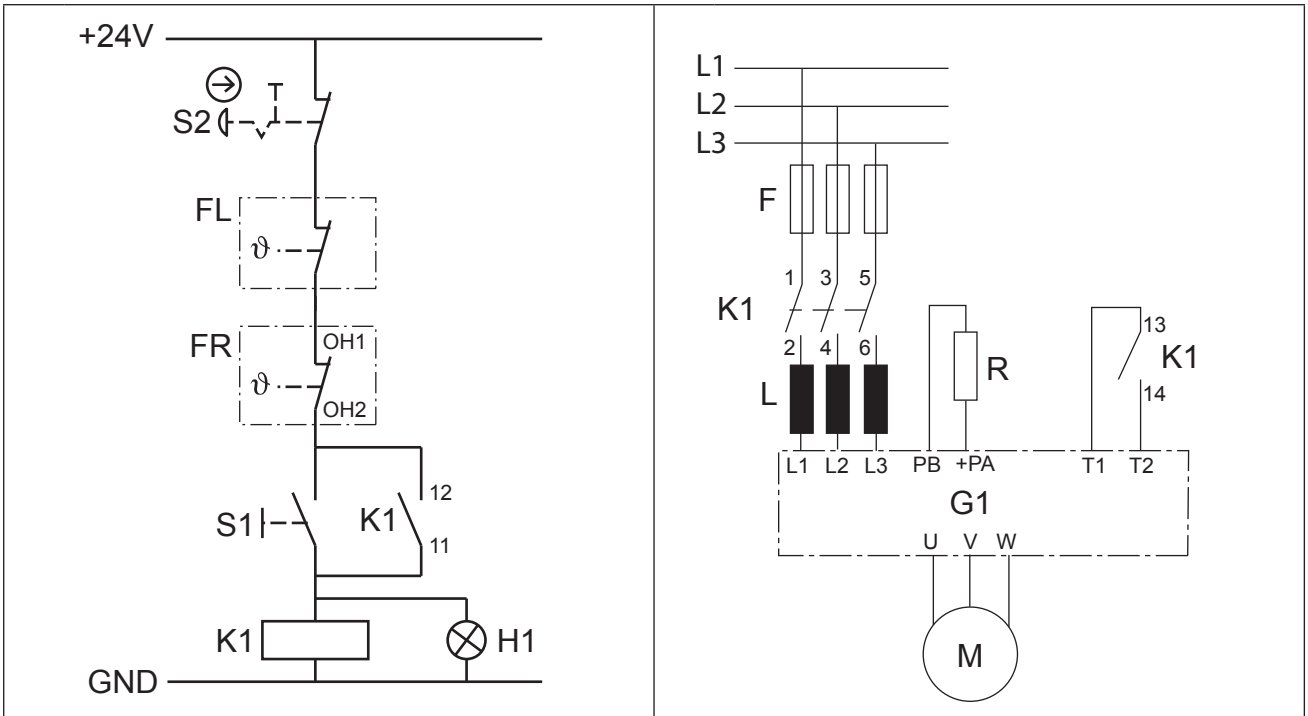
1.10 Connection of a braking resistor with simple temperature monitoring

This circuit releases a overtemperature error in the frequency inverter. A short circuit in the braking transistor is detected indirectly by the temperature, but it does not lead to the disconnection of the mains voltage. This connection cannot be used without external measures, if increased fire protection is required.



1.11 Connection of a braking resistor with extended temperature monitoring

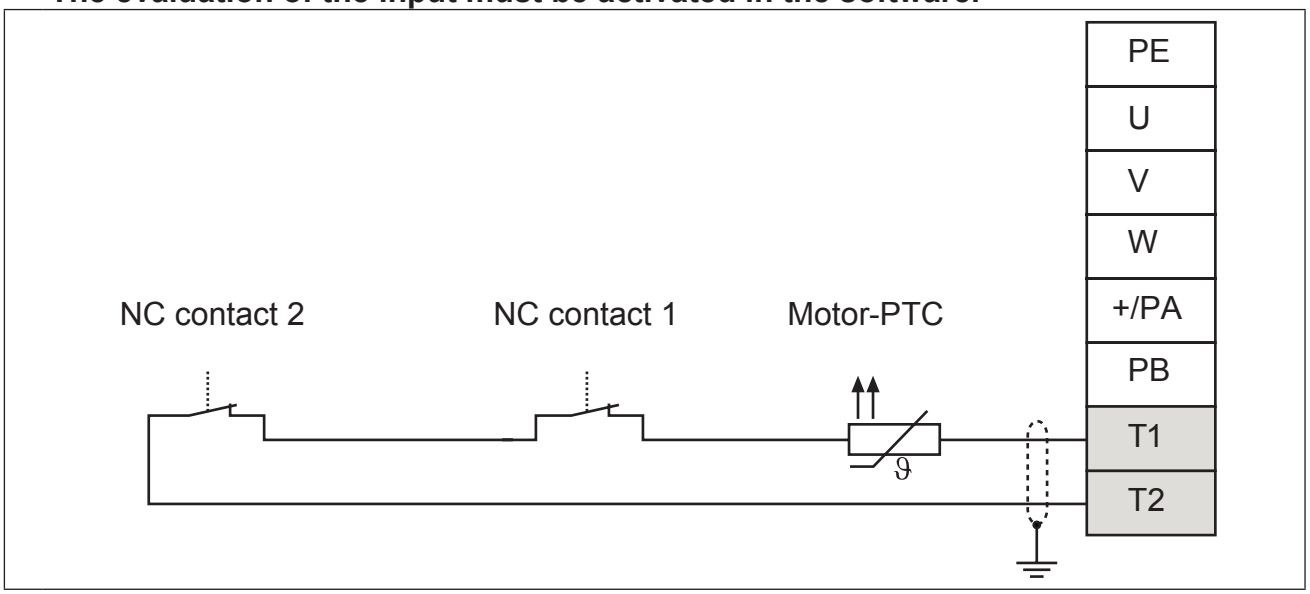
Protection in case of defective braking transistor is only available with switching off the mains voltage. This connection must be used if increased fire protection is required.



K1	Line contactor with auxiliary contacts	M	Motor
S1	Pushbutton or contact of superior control for switching on	F	Main fuses
S2	Emergency stop switch or contact of superior control for switching off	FL	Temperature switch of further monitoring objects (e.g. choke)
H1	Control of the tripping or signal for evaluation electronics	FR	Temperature switch of braking resistor
G1	Frequency inverter	R	Braking resistor
I	Mains choke (optional)		

1.12 Connection of a fault sensing

- Do not place connection cable parallel with control cables
- Terminals T1 and T2 (conform to DIN EN 60947-8)
- Tripping resistance 1650…4000 Ω
- Reset resistance 750…1650 Ω
- **The evaluation of the input must be activated in the software.**



No temperature switches shall be installed into the fault sensing at units with PT100-/ KTY evaluation, because measuring corruptions can occur or the contacts can be simmered. Another protective measure must be used for these units (e.g. programmed digital output leads in switching off of power supply).

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