



COMBIVERT ACCESSORIES

INSTRUCTIONS FOR USE | INSTALLATION BRAKING RESISTORS

Translation of the original manual
Document 20116737 EN 04



Preface

The described hard- and software are developments of the KEB Automation KG. The enclosed documents correspond to conditions valid at printing. Misprint, mistakes and technical changes reserved.

Signal words and symbols

Certain operations can cause hazards during the installation, operation or thereafter. There are safety informations in the documentation in front of these operations. Security signs are located on the device or machine. A warning contains signal words which are explained in the following table:

DANGER	Dangerous situation, which will cause death or serious injury in case of non-observance of this safety instruction.
WARNING	Dangerous situation, which may cause death or serious injury in case of non-observance of this safety instruction.
CAUTION	Dangerous situation, which may cause minor injury in case of non-observance of this safety instruction.
NOTICE	Situation, which can cause damage to property in case of non-observance.

RESTRICTION

Is used when certain conditions must meet the validity of statements or the result is limited to a certain validity range.



Is used when the result will be better, more economic or trouble-free by following these procedures.

More symbols

- ▶ This arrow starts an action step.
- / - Enumerations are marked with dots or indents.
- => Cross reference to another chapter or another page.



Note to further documentation.
www.keb.de/service/downloads



Laws and guidelines

KEB Automation KG confirms with the EC declaration of conformity and the CE mark on the device nameplate that it complies with the essential safety requirements.

The EC declaration of conformity can be downloaded on demand via our website. Further information is provided in chapter "Certification".

Warranty and liability

The warranty and liability on design, material or workmanship for the acquired device is given in the general sales conditions.



Here you will find our general sales conditions.
www.keb.de/terms-and-conditions



Further agreements or specifications require a written confirmation.

Support

Through multiple applications not every imaginable case has been taken into account. If you require further information or if problems occur which are not treated detailed in the documentation, you can request the necessary information via the local KEB Automation KG agency.

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

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 intended use. However, they are regarded as being only informal and changes are expressly reserved, in particular due to technical changes. 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 intended end use of the product (application) by the customer. They must be repeated, even if only parts of hardware, software or the unit adjustment are modified.

Copyright

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

This KEB product or parts thereof may contain third-party software, including free and/or open source software. If applicable, the license terms of this software are contained in the instructions for use. The instructions for use are already available to you, can be downloaded free of charge from the KEB website or can be requested from the respective KEB contact person.

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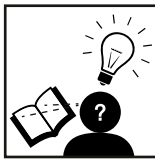
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1 Basic Safety Instructions

The COMBIVERT is designed and constructed in accordance with state-of-the-art technology and the recognised safety rules and regulations. However, the use of such devices may cause functional hazards for life and limb of the user or third parties, or damages to the system 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 will lead to the loss of any liability claims.

Attention



Hazards and risks through ignorance.

- ▶ Read the instruction manual!
- ▶ Observe the safety and warning instructions!
- ▶ If anything is unclear, please contact KEB Automation KG!

1.1 Target group

This instruction manual is determined exclusively for electrical personnel. Electrical personnel for the purpose of this instruction manual must have the following qualifications:

- Knowledge and understanding of the safety instructions.
- Skills for installation and assembly.
- Start-up and operation of the product.
- Understanding of the function in the used machine.
- Detection of hazards and risks of the electrical drive technology.
- Knowledge of *DIN IEC 60364-5-54*.
- Knowledge of national safety regulations (e.g. *DGUV regulation 3*).

1.2 Validity of this manual

This manual describes accessory braking resistors for COMBIVERT drive converters. The manual

- contains only supplementary safety instructions.
- is only valid in connection with the power unit manual of the corresponding COMBIVERT.

1.3 Electrical connection

⚠ DANGER



Voltage at the terminals and in the device !

Danger to life due to electric shock !

- ▶ For any work on the unit switch off the supply voltage and secure it against switching on.
- ▶ Wait until the drive has stopped in order that no regenerative energy can be generated.
- ▶ Await capacitor discharge time (5 minutes) if necessary, measure DC voltage at the terminals.
- ▶ Never bridge upstream protective devices (also not for test purposes).

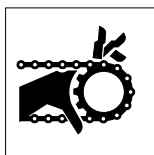
For a trouble-free and safe operation, please pay attention to the following instructions:

- The electrical installation shall be carried out in accordance with the relevant requirements.
- Cable cross-sections and fuses must be dimensioned according to the design of the machine manufacturer. Specified minimum / maximum values may not be fallen below /exceeded.
- With existing or newly wired circuits the person installing the units or machines must ensure the EN requirements are met.
- For drive converters 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.

1.4 Start-up and operation

The drive converter must not be started until it is determined that the installation complies with the machine directive; Account is to be taken of [EN 60204-1](#).

⚠ WARNING



Software protection and programming !

Hazards caused by unintentional behavior of the drive!

- ▶ Check especially during initial start-up or replacement of the drive converter if parameterization is compatible to application.
- ▶ Securing a unit solely with software-supported functions is not sufficient. It is imperative to install external protective measures (e.g. limit switch) that are independent of the drive converter.
- ▶ Secure motors against automatic restart.

2 Product description

The KEB COMBIVERT fitted with an external braking resistor is suitable for a limited 4-quadrant operation.

Regenerative energy can be buffered only limited in drives by the capacitors in the DC link of the inverter and must be discharged from the system. KEB COMBIVERT are available with internal braking transistors (GTR7) which transfer "excess" energy to external resistors.

Braking resistors OHM-A and OHM-B offer a high pulse handling capacity in a small available space and

- are equipped as standard with thermal monitoring by NC contact.
- work without additional noises during braking.
- Universally prepared for worldwide use and approved according to UL/ cUL.

Available as

- universal side-mounted units Ohm-A and Ohm-B for high pulse rating.
- compact sub-mounted modules to absorb lower pulse energy.

2.1 Specified Application

Braking resistors are components designed for inclusion in electrical installations or machinery. Depending on the model they can be mounted beside or below the inverter. Energy is refeed in the DC link during deceleration of drives. This leads to an increase of the DC link voltage. The braking transistor switches and the excess energy is converted via braking resistor into heat in order that the inverter does not release an overvoltage error. The braking resistor must be selected according to the application that the permissible load limit is not exceeded.

The used semiconductors and components of the KEB Automation KG are developed and dimensioned for the use in industrial products. If the product 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.

3 Determine a suitable 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).

3.1 Selection of braking resistor

1. Preset desired braking time.
2. Calculate braking time without braking resistor (t_{Bmin1}).
3. A braking resistor is required if the desired braking time is smaller than the calculated braking time ($t_B < t_{Bmin1}$).
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 (t_{Bmin2}) will be achieved with the braking resistor.

⚠ CAUTION

Under consideration of the rating of the braking resistor and the brake power of the motor, the braking torque may not exceed 1.5 times 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.

3.2 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.

3.3 Calculation formula

Braking time without braking resistor

$$t_{Bmin1} = \frac{(J_M + J_L) \cdot (n_1 - n_2)}{9.55 \cdot (K \cdot M_N + M_L)}$$

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

$$t_{Bmin2} = \frac{(J_M + J_L) \cdot (n_1 - n_2)}{9.55 \cdot (K \cdot M_N + M_L + \frac{P_s \cdot 9.55}{(n_1 - n_2)})}$$

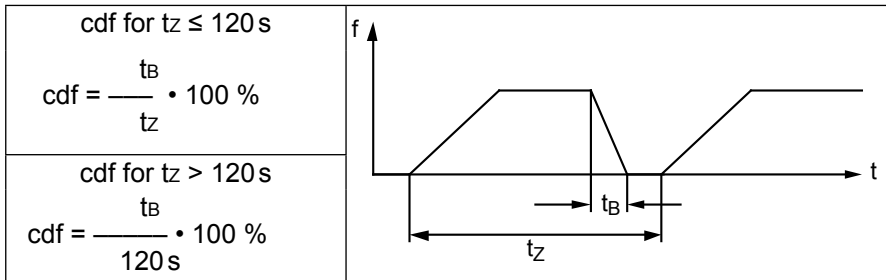
Valid range: $n_1 > n_N$

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



Legend		
J _M	= Mass moment of inertia motor	[kgm ²]
J _L	= Mass moment of inertia load	[kgm ²]
n ₁	= Motor speed prior to deceleration	[rpm]
n ₂	= Motor speed after deceleration (standstill = 0)	[rpm]
n _N	= DASM rated 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 _{Bmin1}	= minimum braking time without braking resistor	[s]
t _{Bmin2}	= minimum braking time with braking resistor	[s]
t _z	= Cycle time	[s]
P _B	= Peak power (necessary)	[W]
P _s	= Peak braking power of the 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	

Table 1: Calculation formula

4 Technical data

4.1 Beside mounted braking resistors

Part Number	Number Module	R	P _D	P _s	ED	Connection terminals		Core cross-section	
		Ω	W	kW	s	AWG / mm ²		AWG / mm ²	
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
11BR100-1473	1	47	175	3	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	6.9	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
17BR226-6303	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
<i>P_D</i>	Continuous rating								
<i>P_s</i>	Peak load, max. for specified ON period								
<i>CDF</i>	ON time referring to a cycle time of 120 s								
Table 2: Beside mounted braking resistors - Technical data									

Part Number	Number Module	R	P _D	P _s	ED	Connection terminals		Core cross-section	
		Ω	W	kW	s	AWG / mm ²		AWG / mm ²	
20BR226-6123	1	12	2900	48	6	6	16	6	16
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

<i>P_D</i>	Continuous rating
<i>P_s</i>	Peak load, max. for specified ON period
<i>CDF</i>	ON time referring to a cycle time of 120s

Table 2: Beside mounted braking resistors - Technical data



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.

4.1.1 Response threshold and electrical specifications of the installed thermojunctions

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

Table 3: Response threshold and electrical data

4.1.2 Ambient conditions

Permissible ambient temperature during operation
-40...45°C

Table 4: Ambient conditions

4.1.3 IP degree of protection

Part Number	Type of protection
xxBR100-xxxx	IP 60
xxBR110-xxxx	IP 20
xxBR226-xxxx	IP 20

Table 5: IP degree of protection

4.1.4 Dimensions

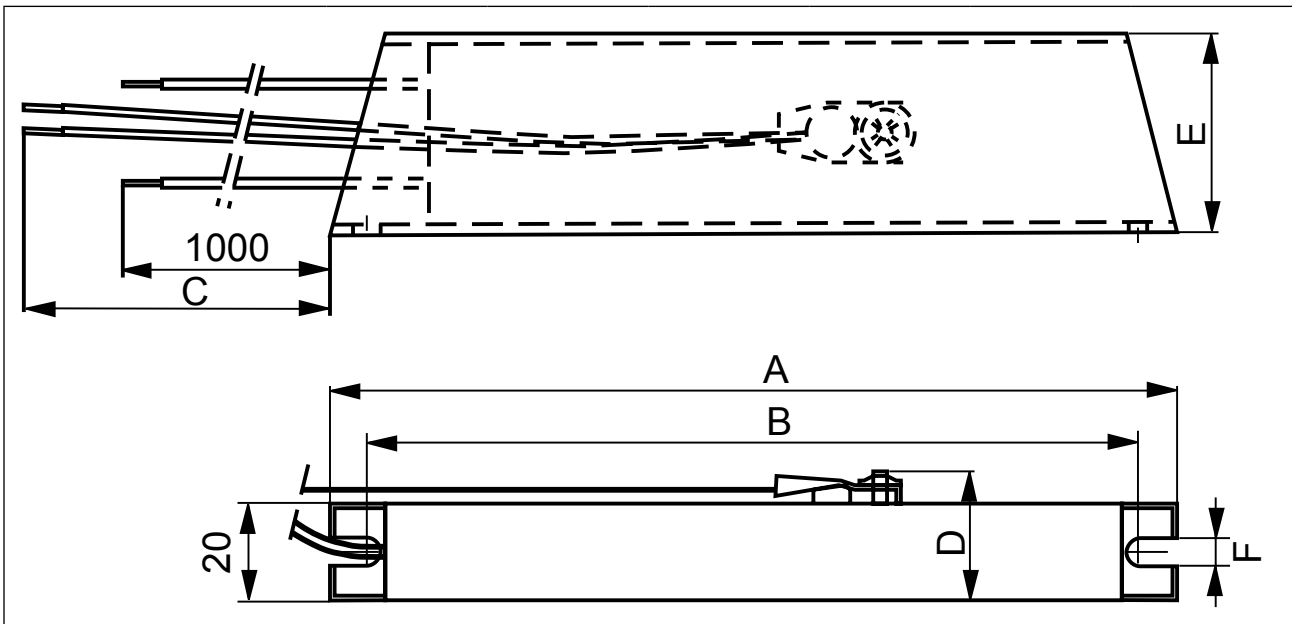


Figure 1: Dimensions type xxBR100-xxxx

Part Number	A	B	C	D	E	F
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	385	1005	28	80	5.5
14BR100-xxxx	400	385	1005	28	80	5.5

Table 6: Dimensions type xxBR100-xxxx

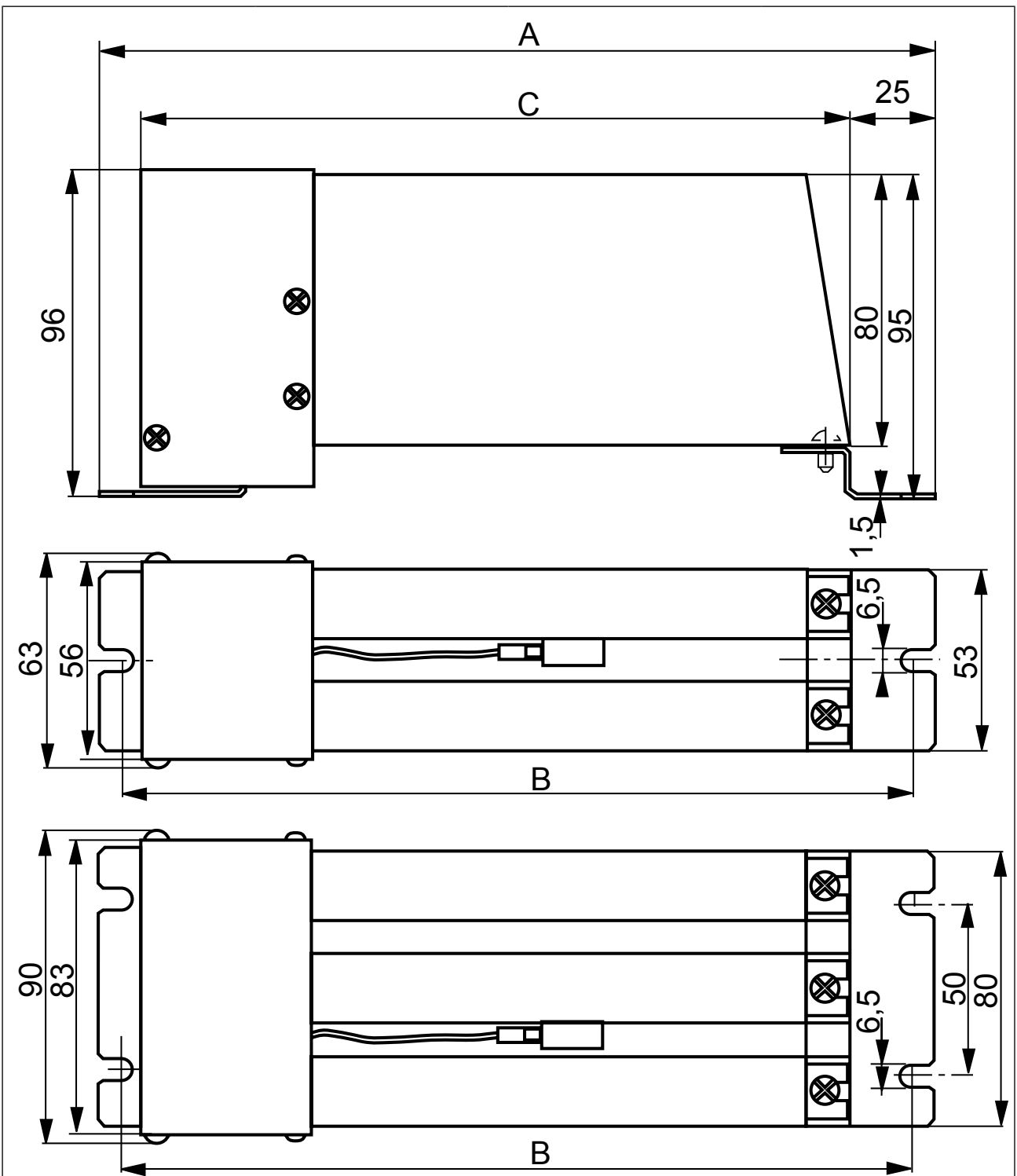


Figure 2: Dimensions type xxBR110-xxxx

Part Number	A	B	C
15BR110-xxxx	370	355	300
16BR110-xxxx	470	455	300
17BR110-xxxx	470	455	300

Table 7: Dimensions type xxBR110-xxxx

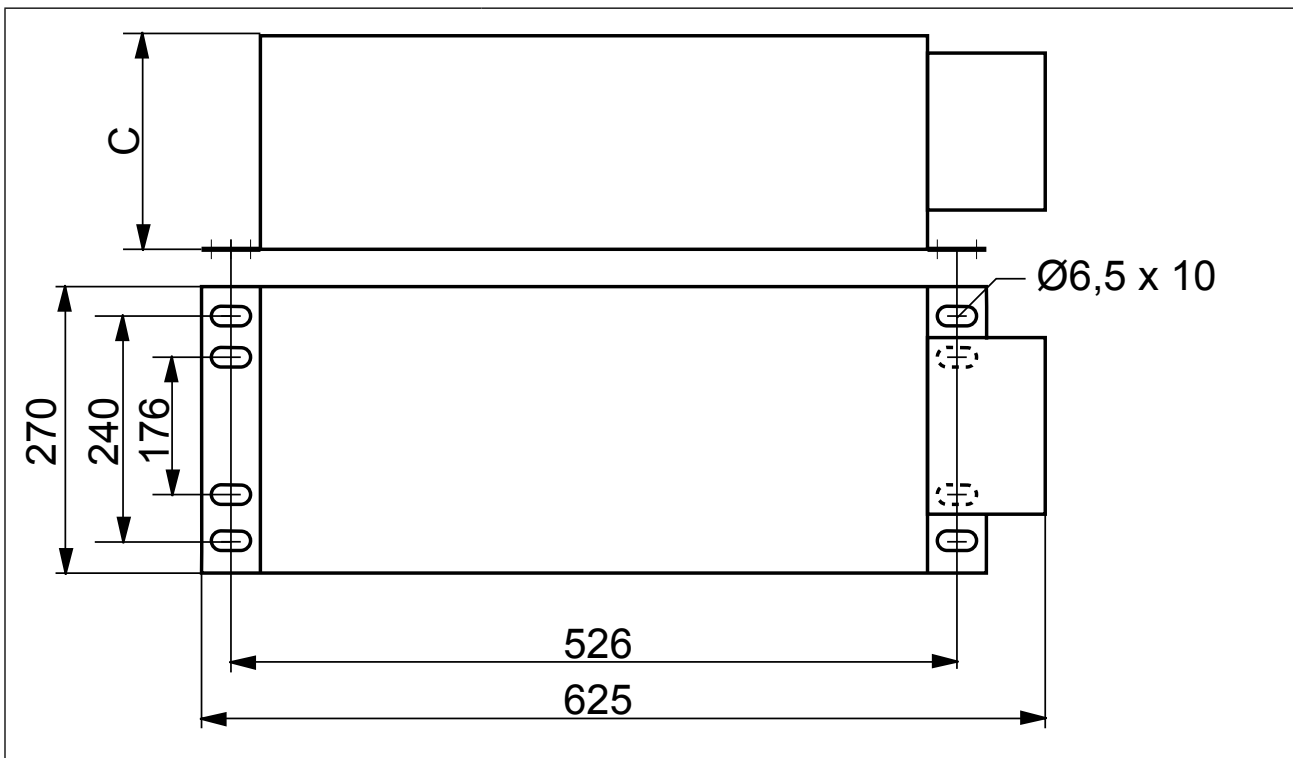


Figure 3: Dimensions type xxBR226-xxxx

Part Number	
14BR226-7853	119,5
15BR226-8303	119,5
16BR226-7423	119,5
17BR226-6303	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 21BR226-6103
25BR226-6436	= 2 x 22BR226-6866
26BR226-6386	= 1 x 22BR226-6866+ 1 x 23BR226-6676
27BR226-6336	= 2 x 23BR226-6676
28BR226-6226	= 3 x 23BR226-6676
29BR226-6176	= 4 x 23BR226-6676
30BR226-6136	= 5 x 23BR226-6676

Table 8: Dimensions type xxBR226-xxxx

4.2 Sub-mounted braking resistors

The sub-mounted braking resistors are intended for a space-saving installation directly under the inverter. They are mainly suitable for short braking cycles as well as cycle operation. The component sets consist of:

- Braking resistor
- Temperature switch
- Substructure boxes
- Mounting material

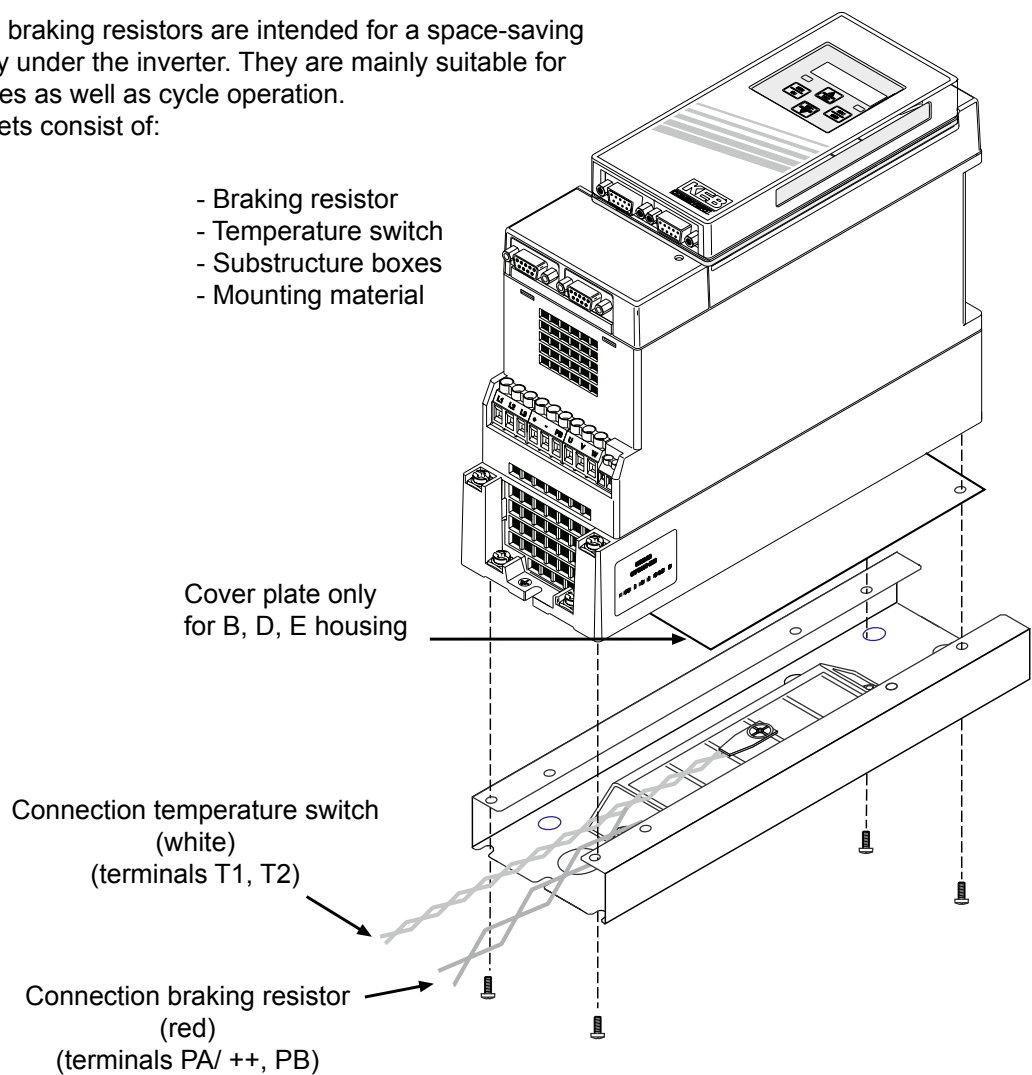


Figure 4: Sub-mounted braking resistors - Technical data

Size	Housing	R	Pd	Ps	CDF 5%	CDF 10%	CDF 20%	CDF40%	Weight
		Ω	W	kW	W	W	W	W	
09F5B90-0300	B	160	35	3.6	700	350	175	90	0.89
10F5D90-4300	D	160	35	3.6	700	350	175	90	0.89
12F5B90-0300	B/D	82	35	7.8	700	350	175	90	0.9
12F5D90-4300	B/D	82	35	7.8	700	350	175	90	0.9
14F5E90-4300	E	60	60	9.6	1200	600	300	150	1.3
15F5E90-4300	E	30	2x60	19	2400	120	600	300	1.5
15F4G50-4200	G	50	80	11.5	1600	800	400	200	1.5
16F4G50-4200	G	25	2x80	23	3200	1600	800	400	1.9
Pd	Continuous rating								
Ps	Peak load for max. 3s								
CDF	ON time referring to a cycle time of 120 s								

Table 9: Sub-mounted braking resistors - Technical data

4.2.1 Dimensions

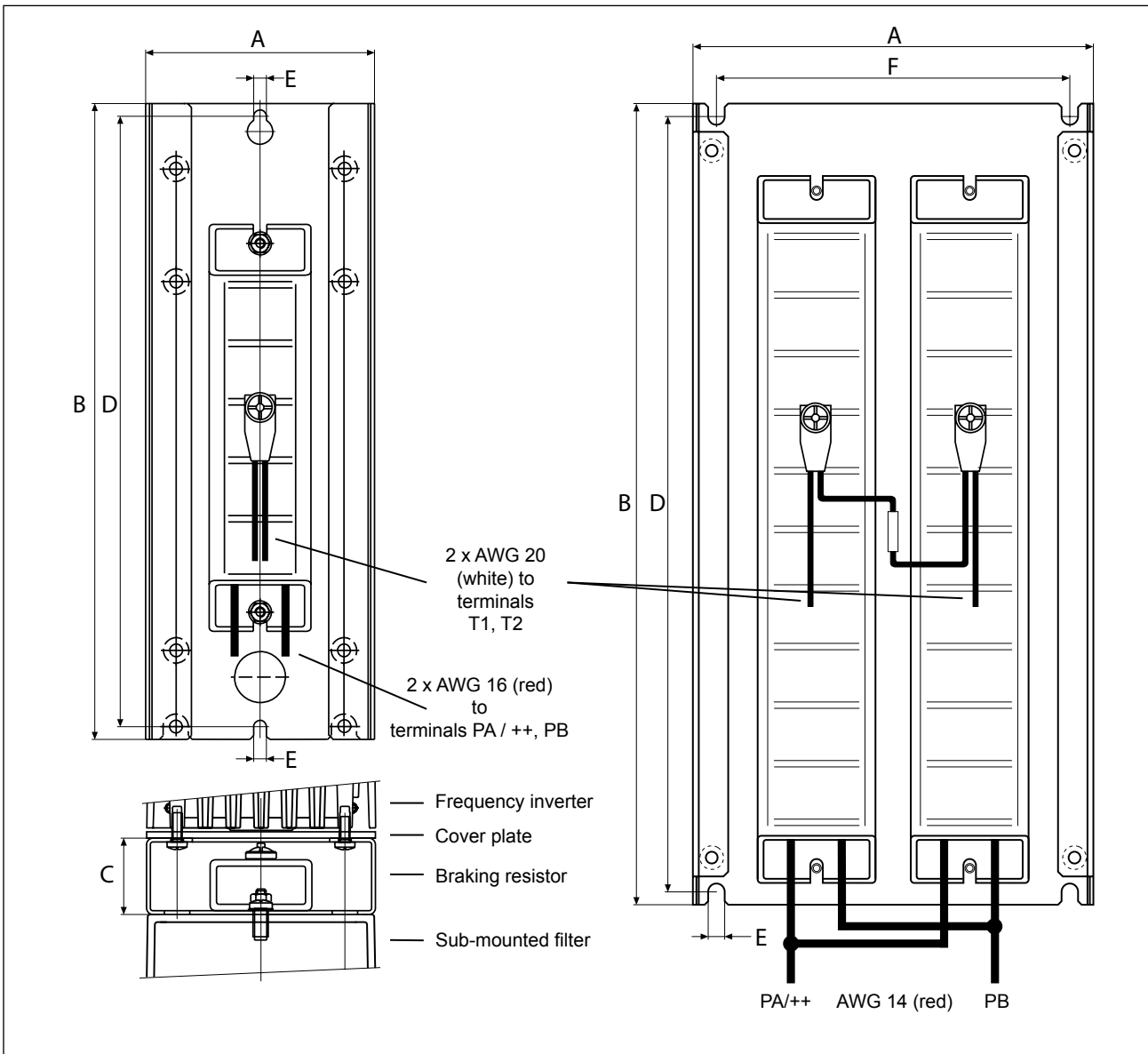


Figure 5: Sub-mounted braking resistors dimensions

Page	Housing			
	B	D	E	G
mm				
A	90	90	130	170
B	220	250	290	340
C	30	30	30	25
D	210	240	275	329
E	5	5	7	7
F	-	-	-	150

Table 10: Sub-mounted braking resistors dimensions


5 Phased-out serie especially for COMBIVERT 56

Part number	Voltage class	R	P_D
	V	Ω	W
0956080-4008	400	390	150
1056080-4008	400	270	285
1256080-4008	400	150	430
1356080-40S8	400	100	380
1356080-4008	400	100	600
1456080-4008	400	82	800
1456080-40S8	400	82	430
1556080-40S8	400	50	600
1556080-4008	400	56	1200
1556080-2008	200	13.6	1520
1656080-4008	400	39	1700
1656080-4018	400	39	5000
1756080-4008	400	28	3000
2156080-4008	400	11	8000
2256080-4008	400	8.9	9500
2356080-4018	400	6.2	31000
P_D	Continuous rating		

Table 11: Phased-out serie especially for COMBIVERT 56

6 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.	

6.1 Selection of the connection type

The errors listed in the table can already be secured previously by temperature monitoring.

Monitored malfunction	Extended temperature monitoring		
	Simple temperature monitoring		
	Without temperature monitoring		
Ramps too short	–	+	+
ON period too long	–	+	+
incorrect dimensioning of the braking resistance	–	+	+
input voltage too high	–	+	+
Generatoric operation	–	+	+ ¹⁾
Short circuit in the braking transistor	–	–	+
Short circuit in the braking transistor (generating)	–	–	+ ¹⁾

Table 12: Selection of the connection type

+ The error will be secured in this use.

– The error is not secured in this use.

1) In regenerative operation the frequency inverter remains in operation in spite of switched off power supply. 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.

6.2 Connection of a braking resistor without temperature monitoring

This type of connection has no temperature detection. A short circuit in regenerative operation does not lead to an error, nor to switching off the mains voltage. The circuit is only suitable by using an intrinsically safe braking resistor or in areas without increased fire protection.

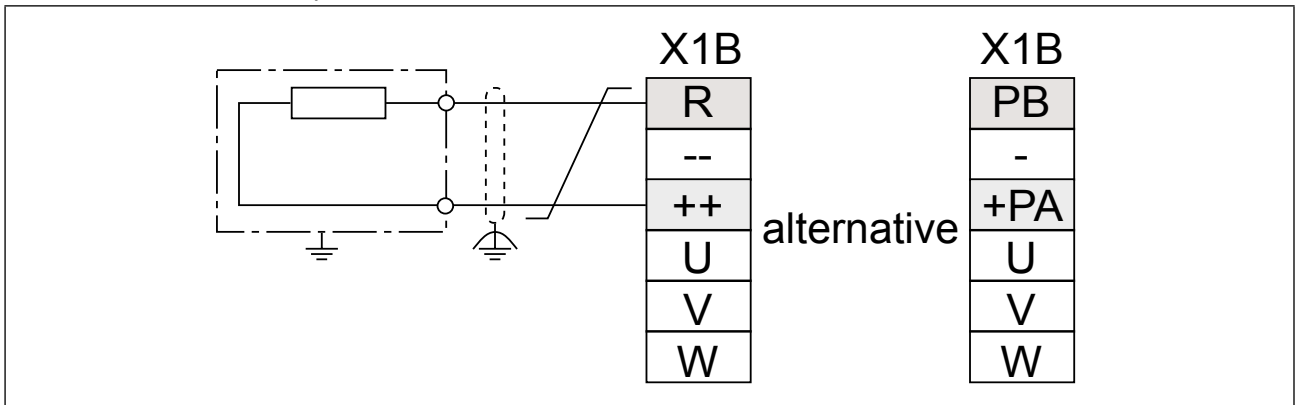


Figure 6: Connection of a braking resistor without temperature monitoring



The terminal designations can vary depending on the series.

6.3 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. If increased fire protection is required do **not** use this circuit without external measures.

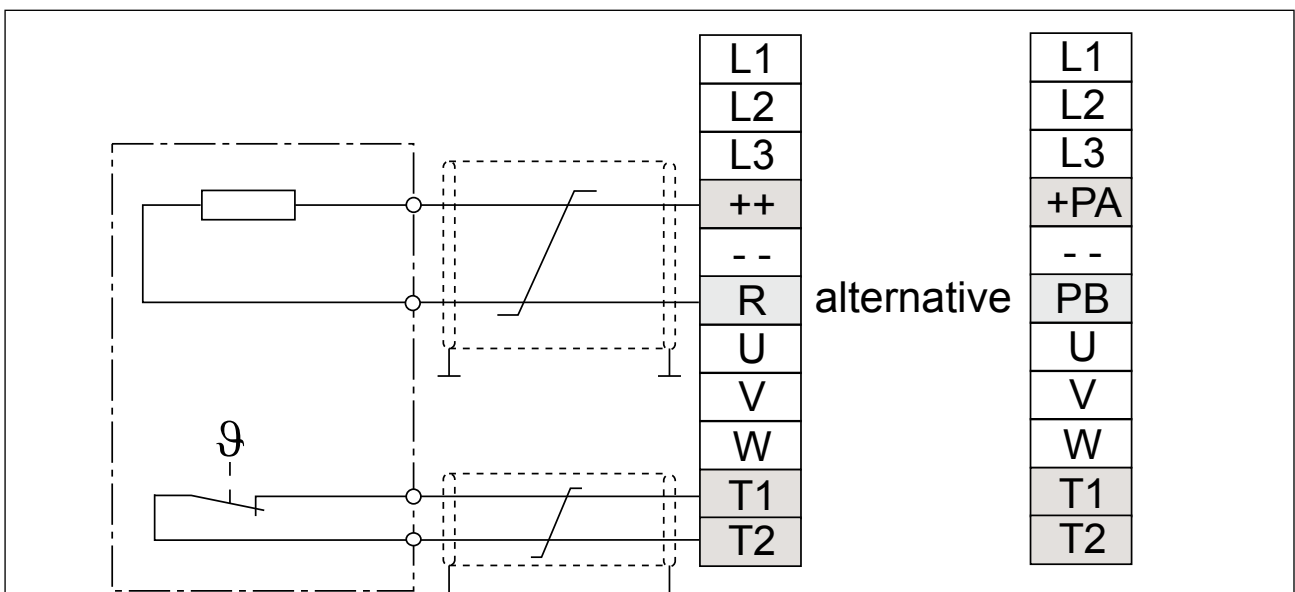


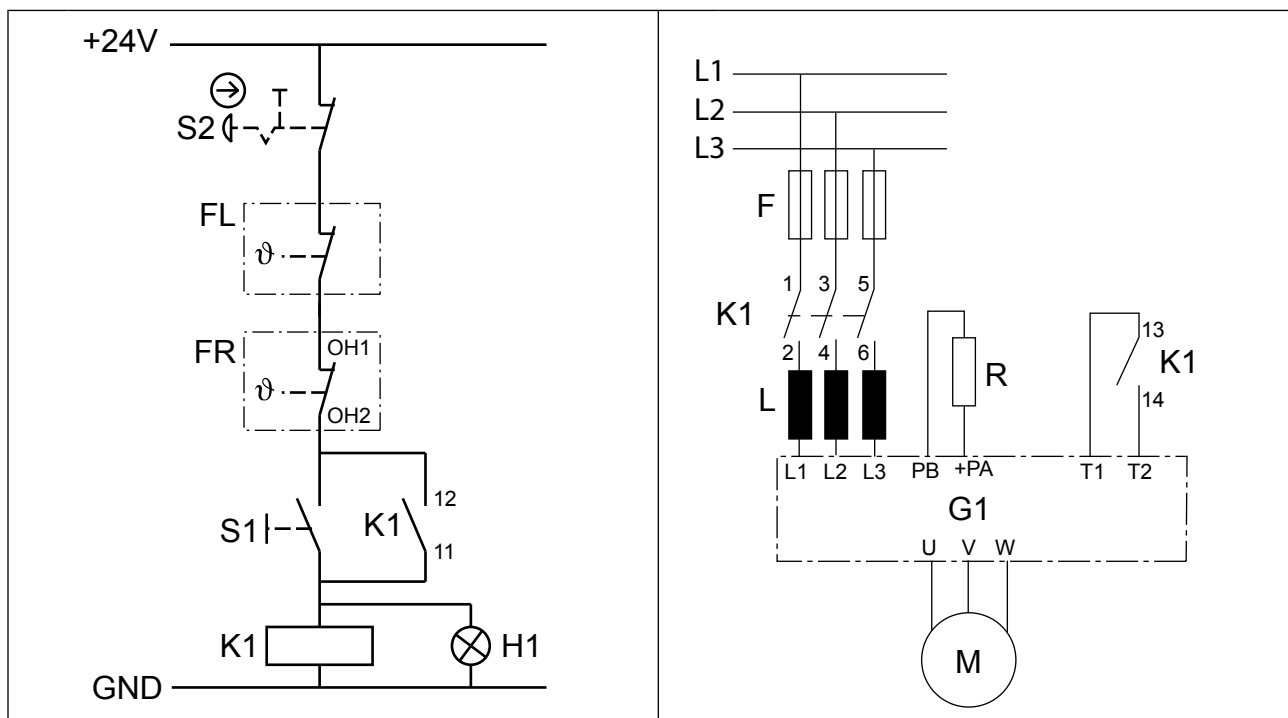
Figure 7: Connection of a braking resistor with simple temperature monitoring



The terminal designations can vary depending on the series.

6.4 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.



Legend

K1	Line contactor with auxiliary contacts	M	Motor
S1	Pushbutton or contact of superior control for switching on	F	Mains fuse
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
L	Mains choke (optional)		

Figure 8: Connection of a braking resistor with extended temperature monitoring

6.5 Connection of a fault sensing

<ul style="list-style-type: none"> • 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 	
<ul style="list-style-type: none"> • The evaluation of the input must be activated in the software. 	

Figure 9: Connection of a fault sensing



The terminal designations can vary depending on the series.

⚠ CAUTION

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).

6.6 Parallel connection of braking resistors of the sizes 24...30

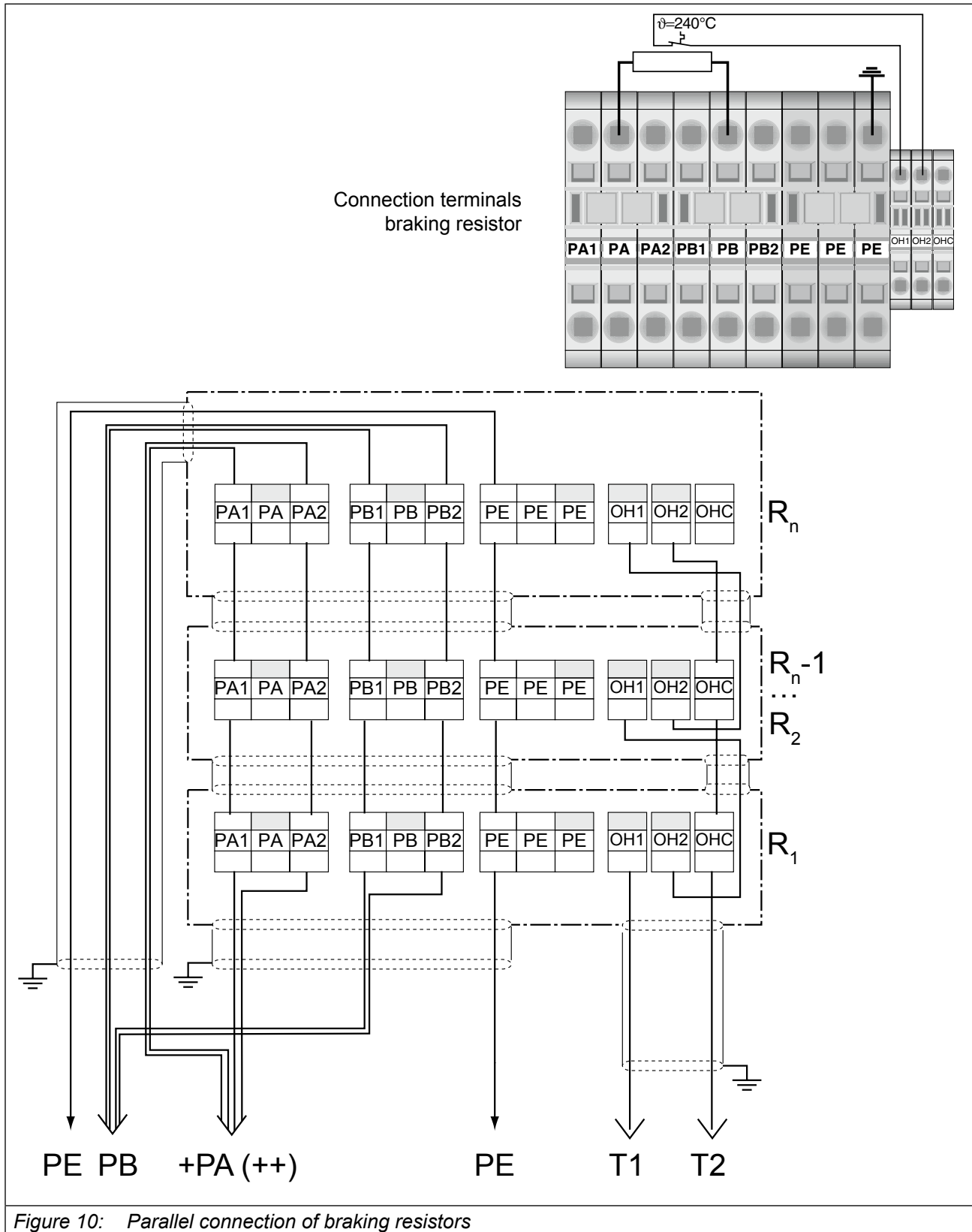


Figure 10: Parallel connection of braking resistors

Austria | KEB Automation GmbH

Ritzstraße 8 4614 Marchtrenk Austria
 Tel: +43 7243 53586-0 Fax: +43 7243 53586-21
 E-Mail: info@keb.at Internet: www.keb.at

Belgium | KEB Automation KG

Herenveld 2 9500 Geraardsbergen Belgium
 Tel: +32 544 37860 Fax: +32 544 37898
 E-Mail: vb.belgien@keb.de Internet: www.keb.de

Brazil | KEB South America - Regional Manager

Rua Dr. Omar Pacheco Souza Riberio, 70
 CEP 13569-430 Portal do Sol, São Carlos Brazil
 Tel: +55 16 31161294 E-Mail: roberto.arias@keb.de

Czech Republic | KEB Automation GmbH

Videnska 188/119d 61900 Brno Czech Republic
 Tel: +420 544 212 008
 E-Mail: info@keb.cz Internet: www.keb.cz

France | Société Française KEB SASU

Z.I. de la Croix St. Nicolas 14, rue Gustave Eiffel
 94510 La Queue en Brie France
 Tel: +33 149620101 Fax: +33 145767495
 E-Mail: info@keb.fr Internet: www.keb.fr

Germany | Gearing Motors

KEB Antriebstechnik GmbH
 Wildbacher Straße 5 08289 Schneeberg Germany
 Telefon +49 3772 67-0 Telefax +49 3772 67-281
 Internet: www.keb-drive.de E-Mail: info@keb-drive.de

Italy | KEB Italia S.r.l. Unipersonale

Via Newton, 2 20019 Settimo Milanese (Milano) Italia
 Tel: +39 02 3353531 Fax: +39 02 33500790
 E-Mail: info@keb.it Internet: www.keb.it

Japan | KEB Japan Ltd.

15 - 16, 2 - Chome, Takanawa Minato-ku Tokyo 108 - 0074 Japan
 Tel: +81 33 445-8515 Fax: +81 33 445-8215
 E-Mail: info@keb.jp Internet: www.keb.jp

P. R. China | KEB Power Transmission Technology (Shanghai) Co. Ltd.

No. 435 QianPu Road Chedun Town Songjiang District
 201611 Shanghai P.R. China
 Tel: +86 21 37746688 Fax: +86 21 37746600
 E-Mail: info@keb.cn Internet: www.keb.cn

Poland | KEB Automation KG

Tel: +48 60407727
 E-Mail: roman.trinczek@keb.de Internet: www.keb.de

Republic of Korea | KEB Automation KG

Room 1709, 415 Missy 2000 725 Su Seo Dong
 Gangnam Gu 135- 757 Seoul Republic of Korea
 Tel: +82 2 6253 6771 Fax: +82 2 6253 6770 E-Mail: vb.korea@keb.de

Russian Federation | KEB RUS Ltd.

Lesnaya str, house 30 Dzerzhinsky MO
 140091 Moscow region Russian Federation
 Tel: +7 495 6320217 Fax: +7 495 6320217
 E-Mail: info@keb.ru Internet: www.keb.ru

Spain | KEB Automation KG

c / Mitjer, Nave 8 - Pol. Ind. LA MASIA
 08798 Sant Cugat Sesgarrigues (Barcelona) Spain
 Tel: +34 93 8970268 Fax: +34 93 8992035 E-Mail: vb.espana@keb.de

Switzerland | KEB Automation AG

Witzbergstrasse 24 8330 Pfäeffikon/ZH Switzerland
 Tel: +41 43 2886060 Fax: +41 43 2886088
 E-Mail: info@keb.ch Internet: www.keb.ch

United Kingdom | KEB (UK) Ltd.

5 Morris Close Park Farm Industrial Estate
 Wellingborough, Northants, NN8 6 XF United Kingdom
 Tel: +44 1933 402220 Fax: +44 1933 400724
 E-Mail: info@keb.co.uk Internet: www.keb.co.uk

United States | KEB America, Inc

5100 Valley Industrial Blvd. South
 Shakopee, MN 55379 United States
 Tel: +1 952 2241400 Fax: +1 952 2241499
 E-Mail: info@kebameric.com Internet: www.kebameric.com



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www.keb.de

KEB Automation KG Suedstrasse 38 32683 Barntrup Tel. +49 5263 401-0 E-Mail: info@keb.de