



COMBIVERT ACCESSORIES

INSTRUCTIONS FOR USE | INSTALLATION BRAKING RESISTORS

Translation of the original manual
Document 20116737 EN 07



Preface

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

Signal words and symbols

Certain procedures within this document can cause safety hazards during the installation or operation of the device. Refer to the safety warnings in this document when performing these procedures. Safety signs are also located on the device where applicable. A safety warning is marked by one of the following warning signs:

DANGER	Dangerous situation, which will cause death or serious injury if this safety warning is ignored.
WARNING	Dangerous situation, which may cause death or serious injury if this safety warning is ignored.
CAUTION	Dangerous situation, which may cause minor injury if this safety warning is ignored.
NOTICE	Situation, which can cause damage to property if this safety warning is ignored.

RESTRICTION

Used when the following statements depend on certain conditions or are only valid for certain ranges of values.



Used for informational messages or recommended 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.

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

Although multiple applications are referenced, not every case has been taking into account. If you require further information or if problems occur which are not referenced in the documentation, you can request the necessary information via the local KEB 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 and remain valid in its entirety.

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Table of Contents

- Preface 3**
 - Signal words and symbols 3
 - More symbols..... 3
 - Laws and guidelines..... 4
 - Warranty and liability 4
 - Support 4
 - Copyright..... 4
- Table of Contents 5**
- List of Figures..... 6**
- List of Tables 6**

- 1 Basic safety instructions 7**
 - 1.1 Target group..... 7
 - 1.2 Validity of this manual..... 7
 - 1.3 Electrical connection 8
 - 1.4 Start-up and operation 8

- 2 Product description..... 9**
 - 2.1 Intended use 9

- 3 Determine a suitable braking resistor 10**
 - 3.1 Selection of the braking resistor..... 10
 - 3.2 Braking ramp 10
 - 3.3 Calculation formula 11

- 4 Technical data 12**
 - 4.1 Beside mounted braking resistors 12**
 - 4.1.1 Response threshold and electrical specifications of the installed thermojunctions 13
 - 4.1.2 Ambient conditions 13
 - 4.1.3 IP degree of protection 13
 - 4.1.4 Dimensions..... 14
 - 4.2 Sub-mounted braking resistors 17**
 - 4.2.1 Dimensions..... 18

- 5 Installation Instructions 19**
 - 5.1 Selection of the connection type 19
 - 5.2 Connection of a braking resistor without temperature monitoring..... 20
 - 5.3 Connection of a braking resistor with simple temperature monitoring 20
 - 5.4 Connection of a braking resistor with extended temperature monitoring..... 21
 - 5.5 Connection of a fault sensing 22
 - 5.6 Parallel connection of braking resistors of the sizes 24...30..... 23

- 6 Revision history 24**

List of Figures

Figure 1:	Dimensions type xxBR100-xxxx	14
Figure 2:	Dimensions type xxBR110-xxxx.....	15
Figure 3:	Dimensions type xxBR226-xxxx	16
Figure 4:	Sub-mounted braking resistors - Technical data.....	17
Figure 5:	Sub-mounted braking resistors dimensions.....	18
Figure 6:	Connection of a braking resistor without temperature monitoring	20
Figure 7:	Connection of a braking resistor with simple temperature monitoring	20
Figure 8:	Connection of a braking resistor with extended temperature monitoring.....	21
Figure 9:	Connection of a fault sensing.....	22
Figure 10:	Parallel connection of braking resistors	23

List of Tables

Table 1:	Calculation formula	11
Table 2:	Beside mounted braking resistors - Technical data	12
Table 3:	Response threshold and electrical data.....	13
Table 4:	Ambient conditions.....	13
Table 5:	IP degree of protection.....	13
Table 6:	Dimensions type xxBR100-xxxx	14
Table 7:	Dimensions type xxBR110-xxxx.....	15
Table 8:	Dimensions type xxBR226-xxxx	16
Table 9:	Sub-mounted braking resistor - Technical data.....	17
Table 10:	Sub-mounted braking resistors dimensions.....	18
Table 11:	Selection of the connection type.....	19

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 electrical drive technology. They can be supplemented by local, country or application-specific safety regulations. This list is not exhaustive. Non-compliance will result in the loss of warranty claim.

NOTICE



Dangers and risks due to ignorance.

- ▶ Read the instructions for use!
- ▶ Observe the safety and warning instructions!
- ▶ Ask if anything is unclear!

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 *IEC 60364-5-54*.
- Knowledge of national safety regulations (e.g. *DGUV Regulation 3*).

1.2 Validity of this manual

These Gebrauchsanleitung describe accessory braking resistors for COMBIVERT drive controllers. These Gebrauchsanleitung

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

1.3 Electrical connection

⚠ DANGER



Electrical voltage at terminals and in the device!

Danger to life through electric shock!

- ▶ For any work on the device 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.
- ▶ Wait for the capacitor discharge time (5 minutes), if necessary measure the DC voltage at the terminals.
- ▶ Never bridge upstream protective devices (also not for test purposes).

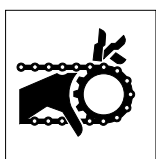
For a trouble-free and safe operation, please pay attention to the following notes:

- The electrical installation must be carried out in accordance with the relevant regulations.
- 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.
- The installer of systems or machines must ensure that the EN requirements remain met for an existing or newly wired circuit with safe separation.
- For drive controllers without safe isolation from the supply circuit (in accordance with [EN 61800-5-1](#)) all control lines must include other protective measures (e.g. double insulation or shielded, earthed and insulated).
- When using components that do not use isolated inputs/outputs, it is necessary that there is potential equality between the components to be connected (e.g. by compensating cable). If disregarded, the components can be destroyed by equalizing currents.

1.4 Start-up and operation

The start-up (i.e. starting the intended operation) is prohibited until it has been ensured that the machine meets the provisions of the Machinery Directive; [EN 60204-1](#) must also be complied with.

⚠ WARNING



Software protection and programming!

Danger due to unintentional behaviour of the drive!

- ▶ Especially at initial start-up or replacing the drive controller, check whether the parameterisation matches the application.
- ▶ The sole protection of a system by software protection functions is not sufficient. Install protective measures (e.g. limit switches) that are independent of the drive controller.
- ▶ Secure motors against automatic start-up.

2 Product description

The KEB COMBIVERT drive controller 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 drive controller and must be discharged from the system. COMBIVERT drive controllers are available with internal braking transistors which feed "excess" energy to external resistors. The OHM-A and OHM-B braking resistors offer a high pulse strength in a small installation space and

- they are equipped with thermal monitoring by NC contact as standard.
- work without additional noise 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 Intended use

Braking resistors are components intended for installation in electrical systems or machines. Depending on the model they can be mounted beside or below the drive controller. 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 drive controller 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 produkt 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 COMBIVERT drive controller. Please refer to the next page for the corresponding formula and restrictions (valid range).

3.1 Selection of the 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 drive controller 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.

⚠ WARNING

Overheating of the braking resistor!

- ▶ 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 (=> „3.3 Calculation formula“).

NOTICE

Overload of the drive controller!

- ▶ The drive controller must be designed for the increased current when using the maximum possible braking torque.

3.2 Braking ramp

The braking ramp is set on the drive controller. If it is too small, the COMBIVERT switches off automatically and the error message overpotential (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

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

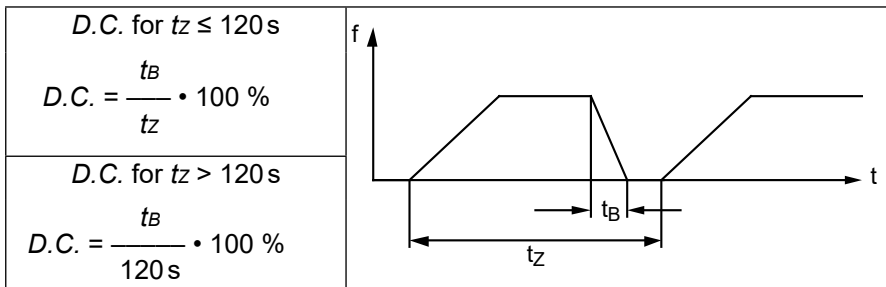
Valid range: $n_1 > n_N$

Conditions:

$$\frac{P_S \cdot 9.55}{(n_1 - n_2)} \leq M_N \cdot (1.5 - K)$$

$f \leq 70$ Hz
 $P_B \leq P_S$

Duty cycle



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 (required)	[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	
D.C.	= Duty cycle	

Table 1: Calculation formula

4 Technical data

4.1 Beside mounted braking resistors

Part number	Number Module	R	P _D	P _S	Duty cycle	Terminals		Core cross section	
		Ω	W	kW	%	AWG / mm ²		AWG / mm ²	
230 V class									
07BR100-1180	1	180	44	0.88	5	–	–	16	1.5
09BR100-1100	1	100	82	1.64	5	–	–	14	2.5
10BR100-1683	1	68	120	2.4	5	–	–	14	2.5
11BR100-1473	1	47	175	3.5	5	–	–	14	2.5
12BR100-1333	1	33	250	5	5	–	–	14	2.5
13BR100-1273	1	27	300	6	5	–	–	12	4
14BR100-1203	1	20	410	8.2	5	–	–	12	4
15BR110-1133	1	13	630	12.6	5	12	4	12	4
16BR110-1103	1	10	780	15.6	5	12	4	12	4
16BR110-3606	1	6	3000	12	25	6	16	8	10
17BR110-1073	1	7	1200	24	5	12	4	12	4
21BR226-1206	1	2	4000	80	5	2x6	2x16	2x6	2x16
400 V class									
07BR100-6620	1	620	56	1.12	5	–	–	16	1.5
09BR100-6390	1	390	90	1.8	5	–	–	16	1.5
10BR100-6270	1	270	130	2.6	5	–	–	16	1.5
11BR100-6180	1	180	190	3.8	5	–	–	14	2.5
12BR100-6150	1	150	230	4.6	5	–	–	14	2.5
13BR100-6110	1	110	350	7	5	–	–	14	2.5
14BR100-6853	1	85	410	8.2	5	–	–	14	2.5
14BR226-7853	1	85	600	4	15	8	10	12	4
14BR226-8453	1	40	3400	8.5	40	6	16	10	6
15BR110-6563	1	56	620	12.4	5	12	4	12	4
16BR110-6423	1	42	820	16.4	5	12	4	12	4
16BR226-7423	1	42	1200	8	15	8	10	10	6
17BR110-6303	1	30	1200	24	5	12	4	12	4
17BR226-6303	1	30	1200	24	5	12	4	12	4
17BR226-7273	1	27	1800	12	15	8	10	8	10
18BR226-6203	1	20	1700	34	5	8	10	8	10
19BR226-6152	1	15	2300	46	5	8	10	8	10
20BR226-6123	1	12	2900	58	5	6	16	6	16
21BR226-6103	1	10	3000	60	5	6	16	6	16
22BR226-6866	1	8.6	4000	80	5	2x6	2x16	2x6	2x16
23BR226-6676	1	6.7	5200	104	5	2x6	2x16	2x6	2x16
24BR226-6506	2	5	6900	138	5	2x6	2x16	2x6	2x16
25BR226-6436	2	4.3	8100	162	5	2x6	2x16	2x6	2x16
26BR226-6386	2	3.8	9200	184	5	2x6	2x16	2x6	2x16
27BR226-6336	2	3.3	10000	200	5	2x6	2x16	2x6	2x16
P _D	Continuous rating								
P _S	Peak load, max. for specified duty cycle								
Duty cycle	Duty cycle 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	Duty cycle	Terminals		Core cross section	
		Ω	W	kW	%	AWG / mm ²		AWG / mm ²	
28BR226-6226	3	2.2	15000	300	5	2x6	2x16	2x6	2x16
29BR226-6176	4	1.7	20000	400	5	2x6	2x16	2x6	2x16
30BR226-6136	5	1.3	26000	520	5	2x6	2x16	2x6	2x16
P _D	Continuous rating								
P _S	Peak load, max. for specified duty cycle								
Duty cycle	Duty cycle referring to a cycle time of 120 s								

Table 2: Beside mounted braking resistors - Technical data



Calculation P_{max} in s: P_D x 120 / ED
 Calculation P_{max} in %: P_D / ED

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	250 VAC/0.5A
xxBR110-xxxx	160 °C	NC contact	30 VDC/0.5A
xxBR226-xxxx	240 °C	NC contact	250 VAC/3A 30 VDC/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	Degree of protection
xxBR100-xxxx	IP 60
xxBR110-xxxx	IP 20
xxBR226-xxxx	IP 20

Table 5: IP degree of protection

4.1.4 Dimensions

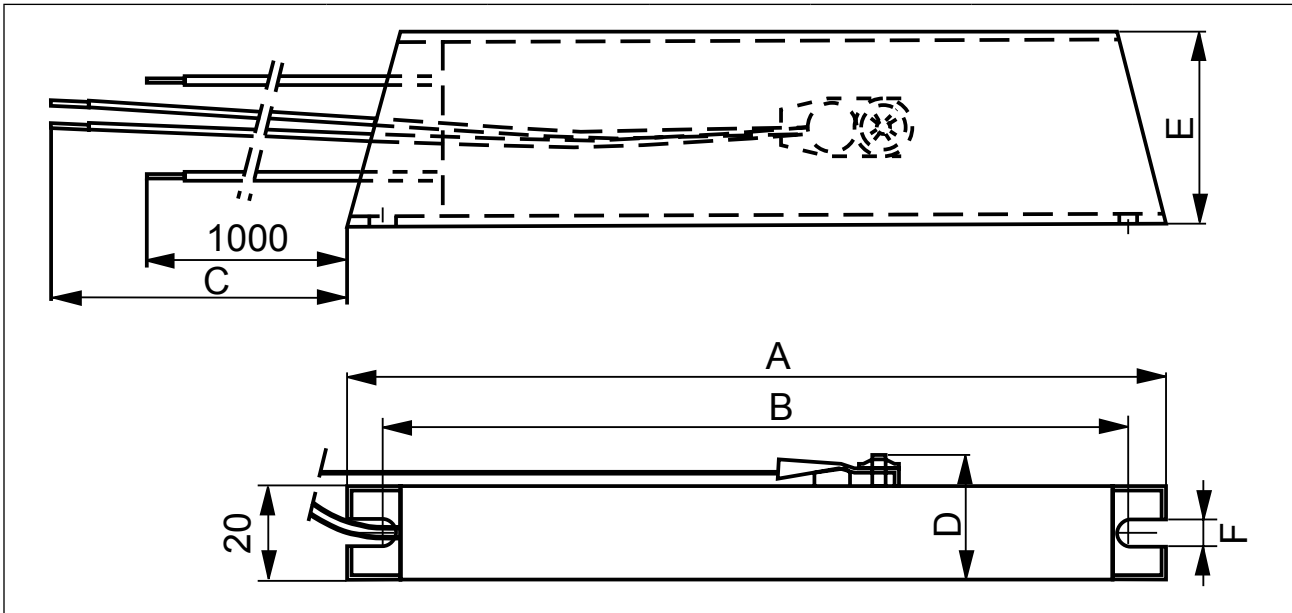


Figure 1: Dimensions type xxBR100-xxxx

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

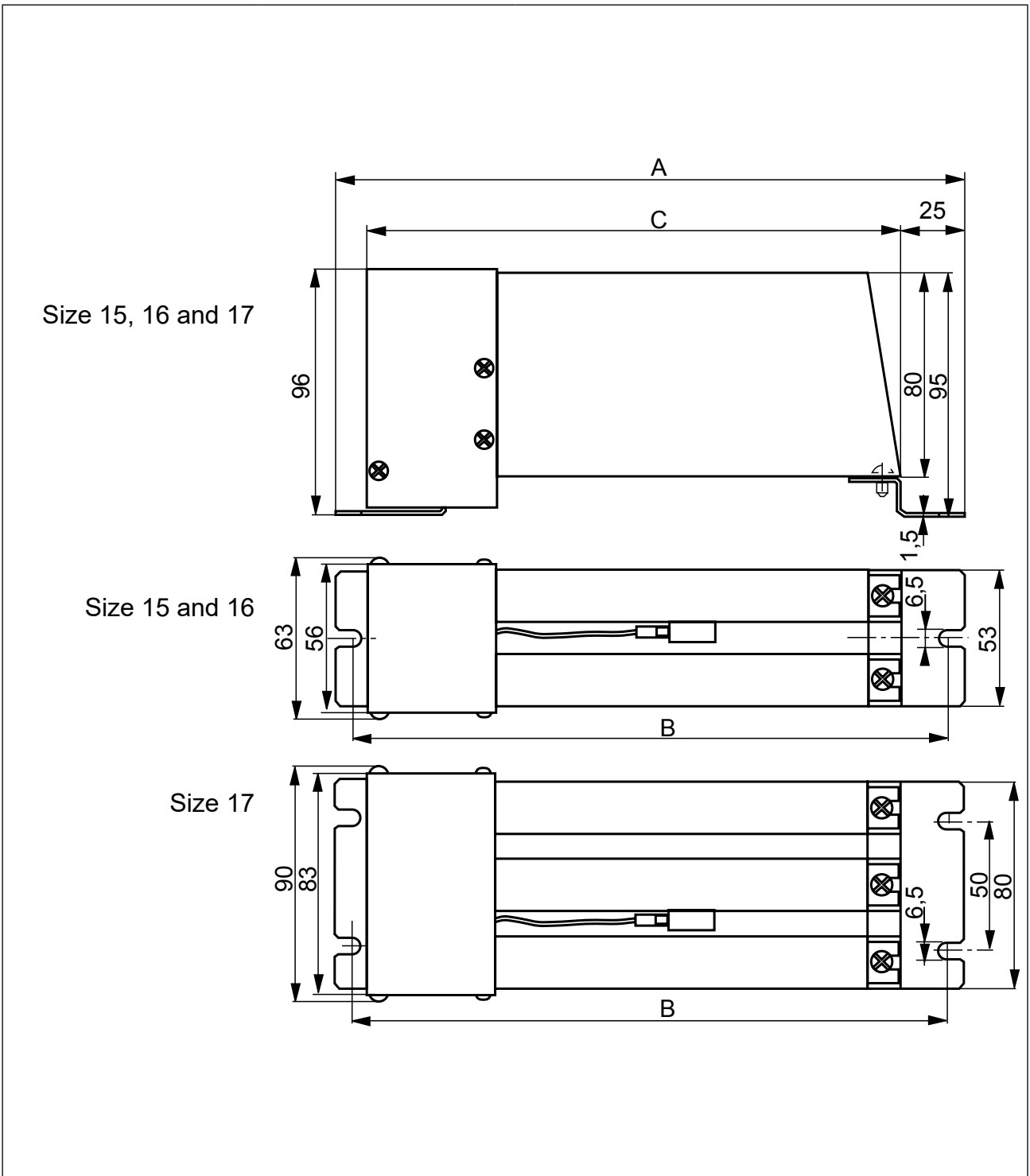


Figure 2: Dimensions type xxBR110-xxxx

Part number	A	B	C
15BR110-xxxx	370	355	300
16BR110-xxxx	470	455	400
17BR110-xxxx	470	455	400

Table 7: Dimensions type xxBR110-xxxx

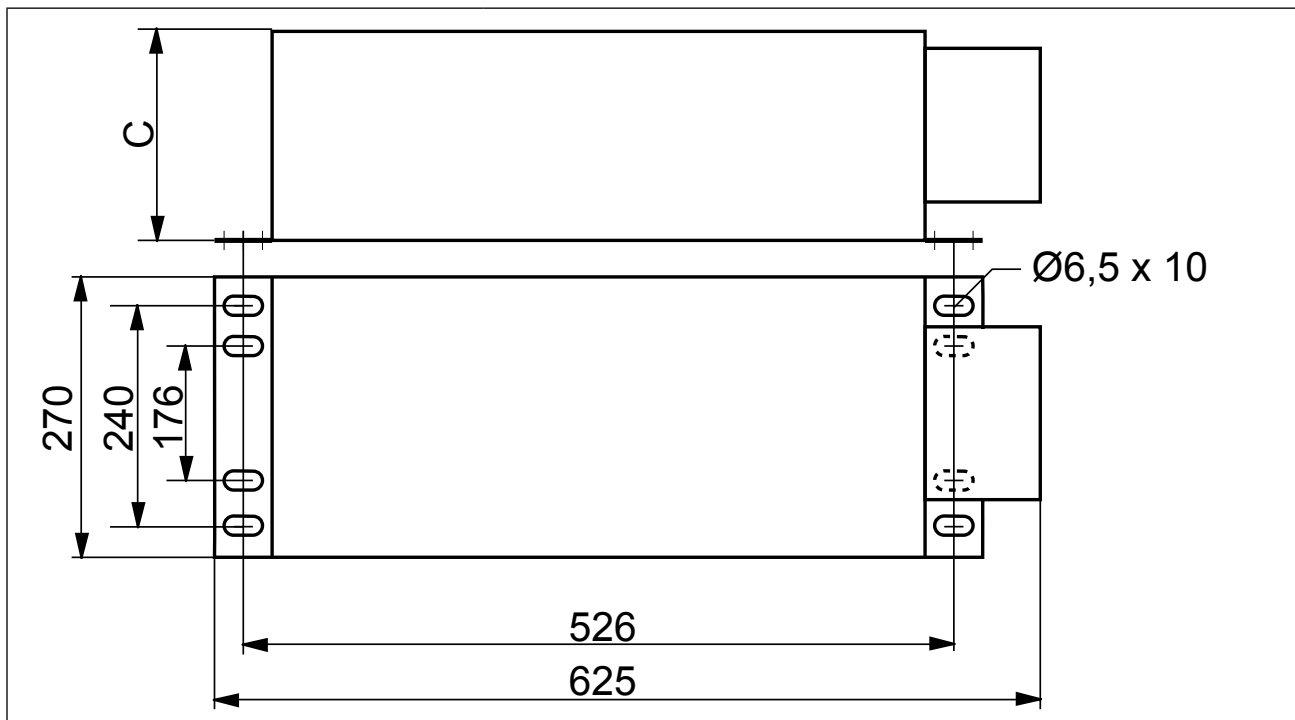


Figure 3: Dimensions type xxBR226-xxxx

Part number	C
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 designed for space-saving installation directly under the drive controller. 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

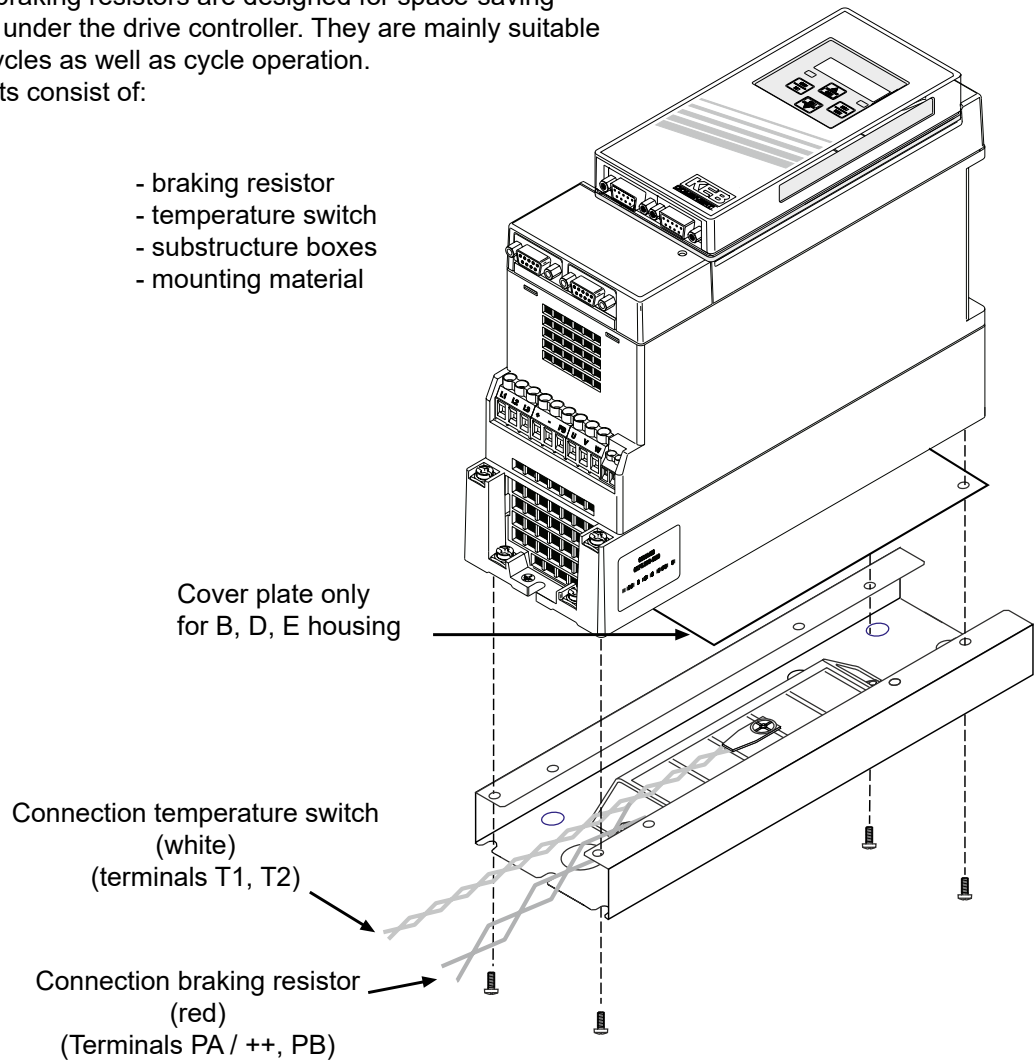


Figure 4: Sub-mounted braking resistors - Technical data

Size	Housing	R	P _D	P _S	D.C. 5%	D.C. 10%	D.C. 20%	D.C. 40%	Weight
		Ω	W	kW	W	W	W	W	kg
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
P _D	Continuous rating								
P _S	Peak load for maximum 3 s								
D.C.	Duty cycle referring to a cycle time of 120 s								

Table 9: Sub-mounted braking resistor - Technical data

4.2.1 Dimensions

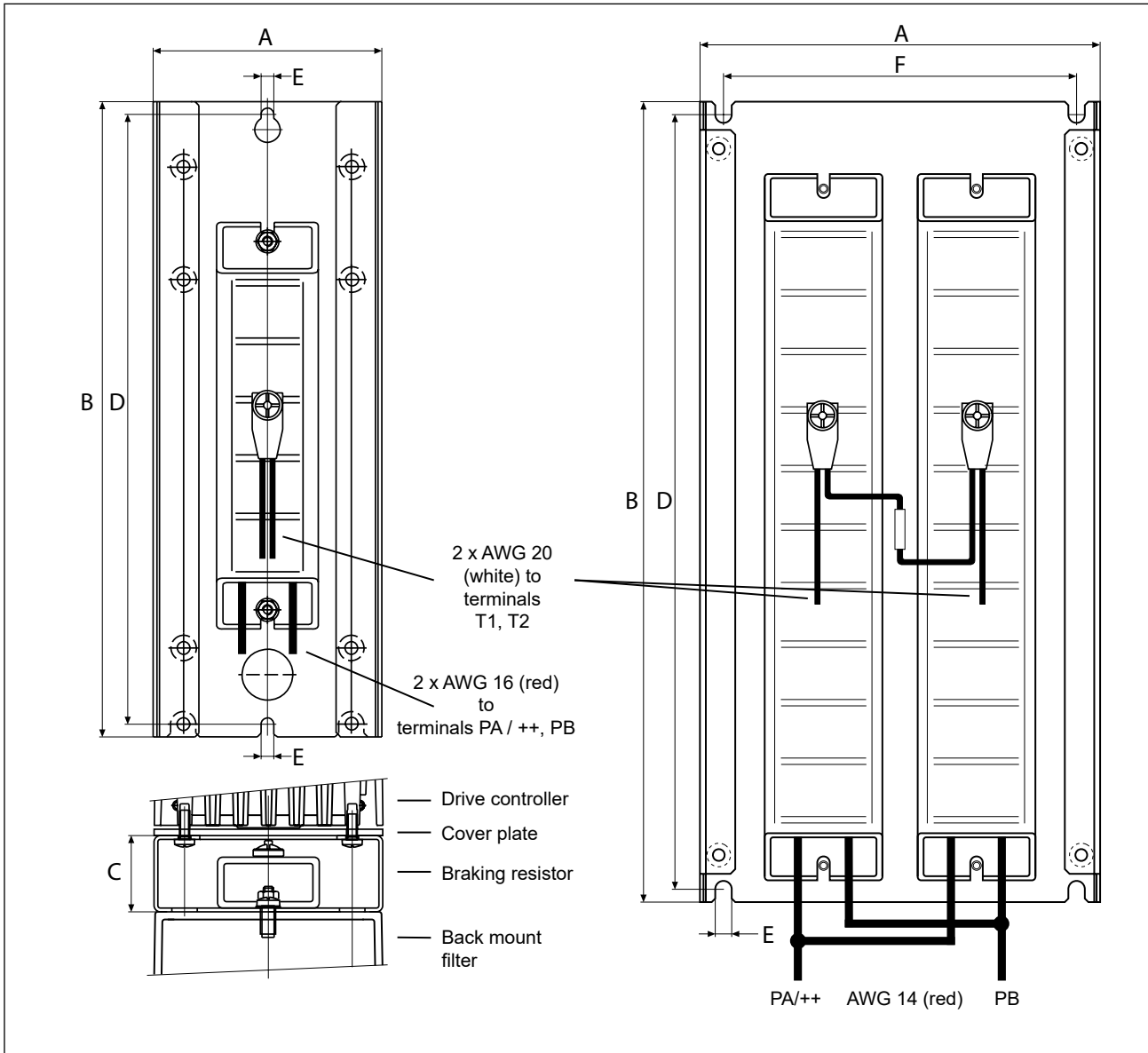


Figure 5: Sub-mounted braking resistors dimensions

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 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.

5.1 Selection of the connection type

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

Monitored malfunction	Extended temperature monitoring		
	Simple temperature monitoring		
	Without temperature monitoring		
Ramps too short	—	+	+
Duty cycle too long	—	+	+
Incorrect dimensioning of the braking resistor	—	+	+
Input voltage too high	—	+	+
Generatoric operation	—	+	+ ¹⁾
Short circuit in the braking transistor	—	—	+
Short circuit in the braking transistor (regenerative)	—	—	+ ¹⁾

Table 11: 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 drive controller remains in operation despite the mains supply being switched off. 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. In any case, the drive controller must be programmed accordingly.

5.2 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.

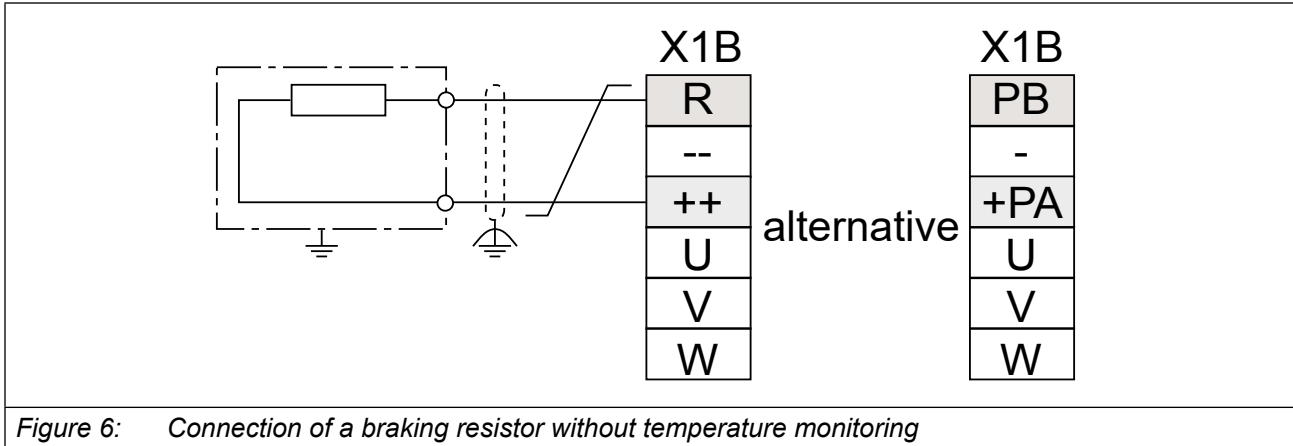


Figure 6: Connection of a braking resistor without temperature monitoring



The terminal designations can vary depending on the series.

5.3 Connection of a braking resistor with simple temperature monitoring

This circuit triggers an overtemperature fault in the drive controller. 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.

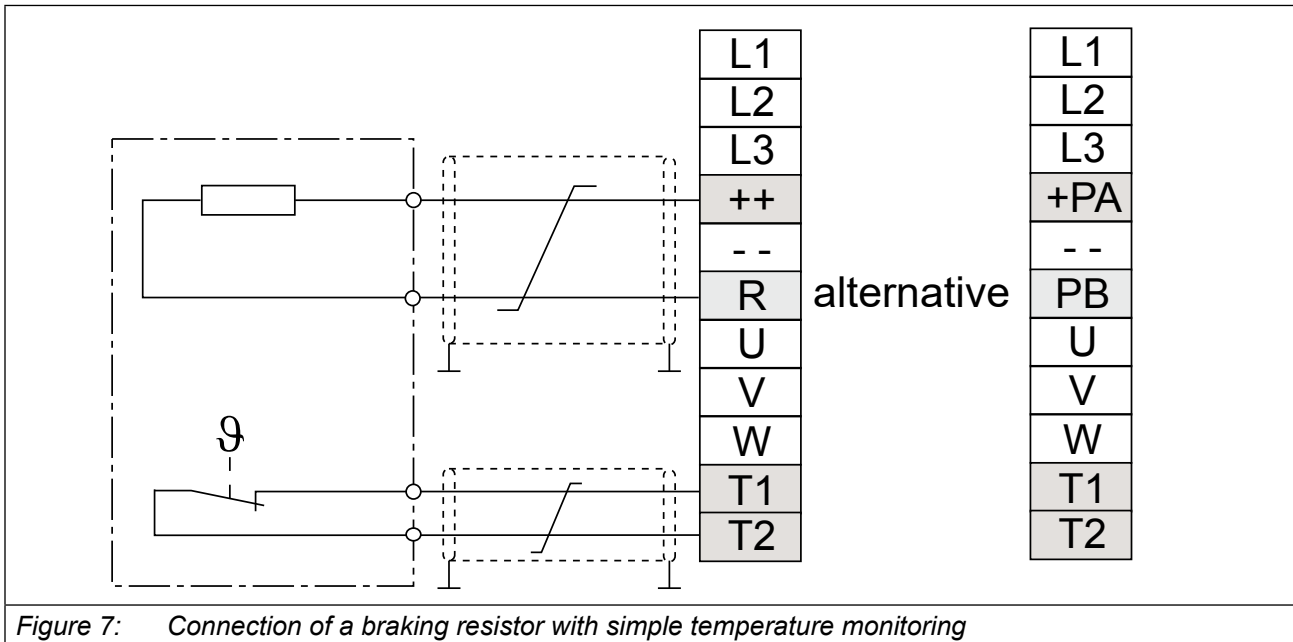


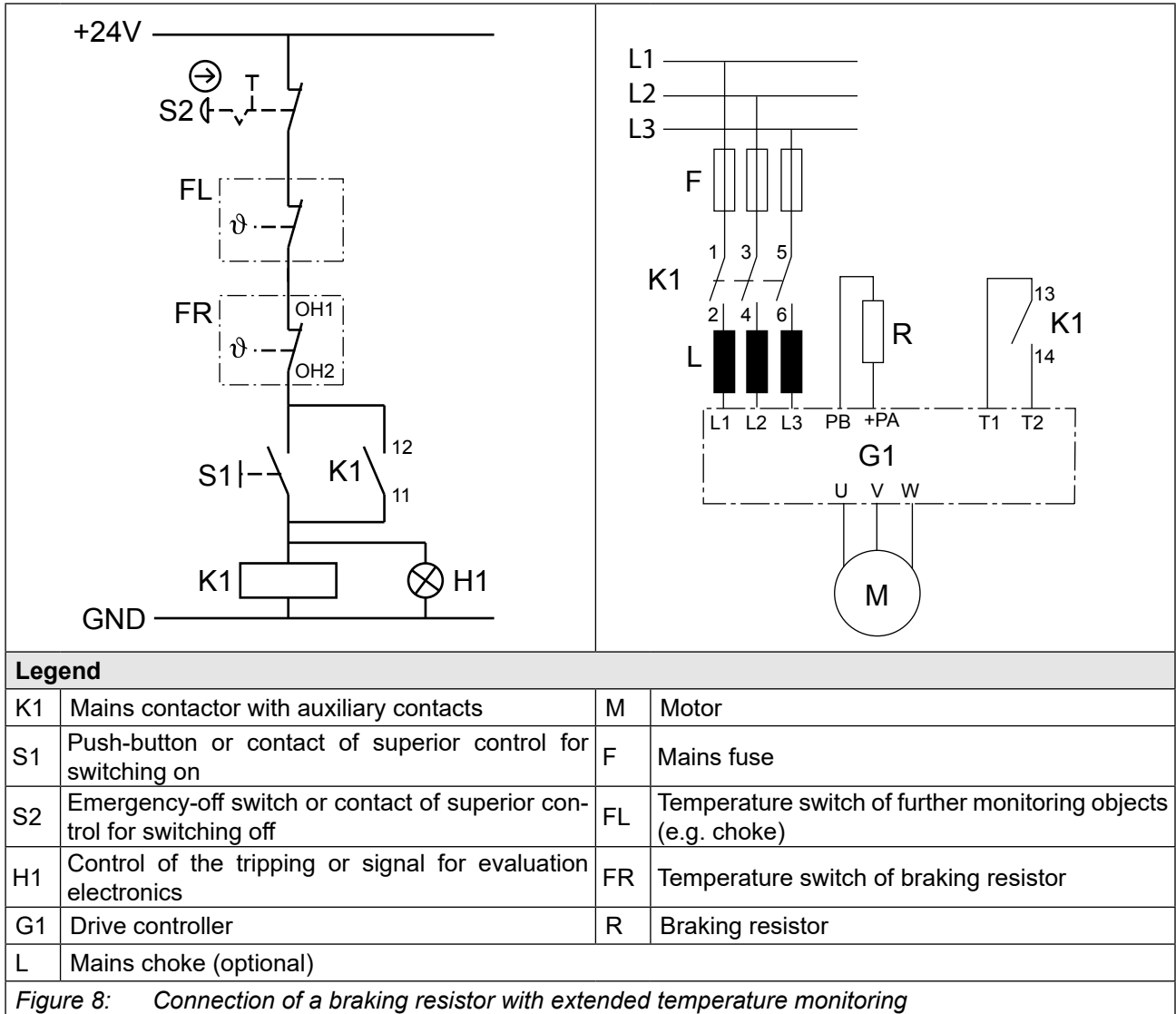
Figure 7: Connection of a braking resistor with simple temperature monitoring



The terminal designations can vary depending on the series.

5.4 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.



5.5 Connection of a fault sensing

- ▶ Do not place connection cable parallel with control cables.
- ▶ Terminals T1 and T2 (conform to *DINEN 60947-8*).
- ▶ Tripping resistance 1650...4000 Ω.
- ▶ Reset resistance 750...1650 Ω.

NOTICE



Missing protective function!

- ▶ The evaluation of the input must be activated in the software.

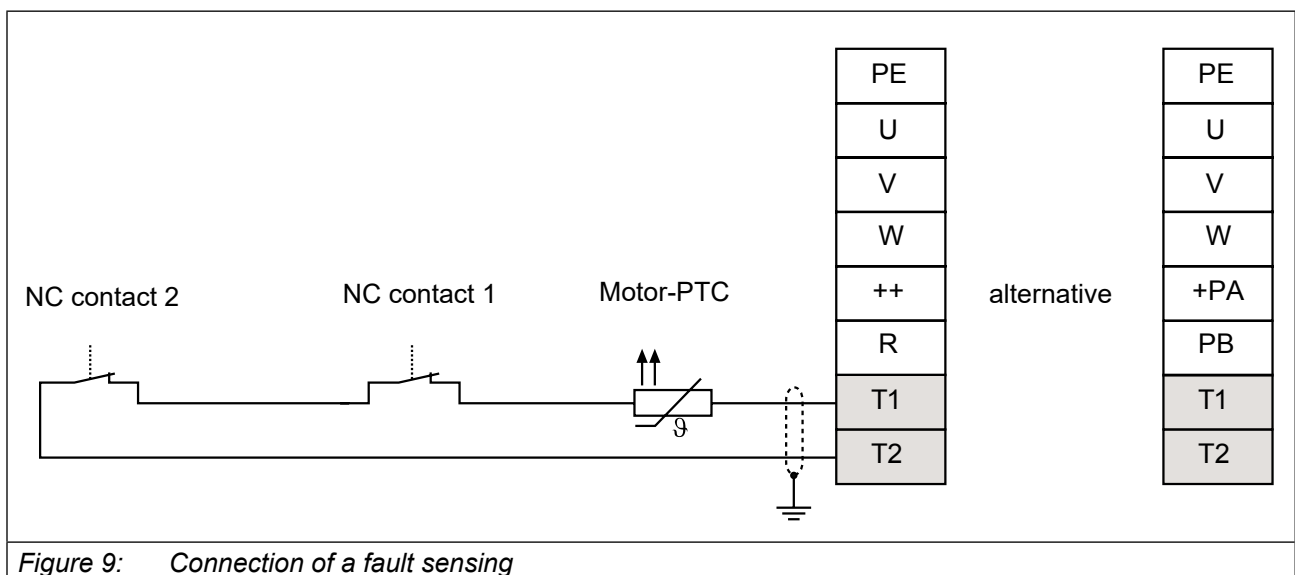


Figure 9: Connection of a fault sensing



The terminal designations can vary depending on the series.

NOTICE

Distortion of measurement and sooting of the contacts!

- ▶ No temperature switches shall be installed into the fault sensing at devices with PT100-/ KTY evaluation.
- ▶ Another protective measure must be used for these devices (e.g. programmed digital output that can lead in switching off of power supply).

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

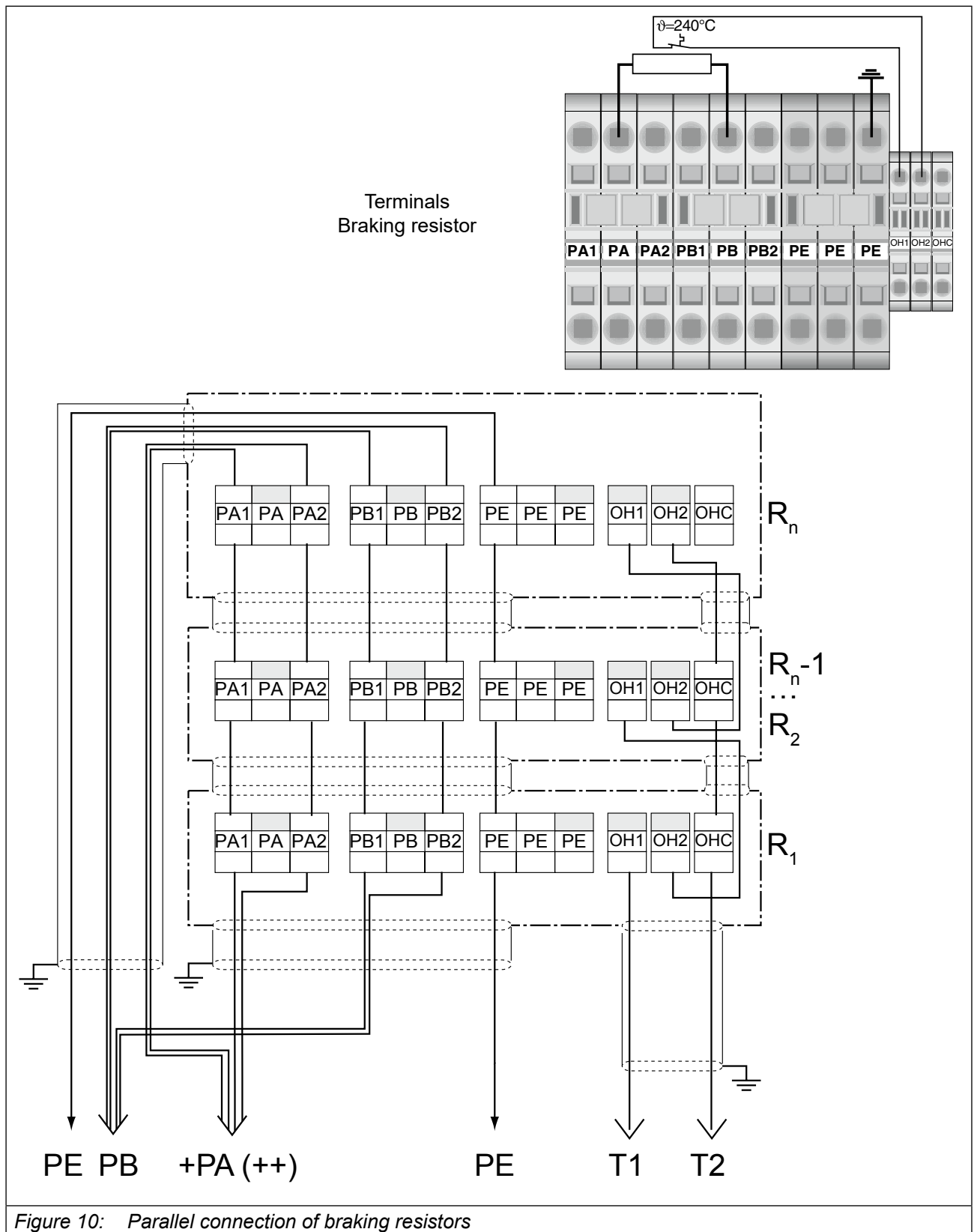


Figure 10: Parallel connection of braking resistors

6 Revision history

Version	Date	Description
00	2016-01	Completely revised. Changed to document version.
01	2017-03	Material number error corrected, changed to new KEB ci optics.
02	2017-07	Error in the table for the F5 resistors corrected.
03	2019-03	Error corrected in the table for the side-mounted braking resistors.
04	2020-04	Error in mounting dimensions corrected.
05	2022-11	Missing descriptions added.
06	2023-04	Chapter "Discontinuation series especially for COMBIVERT 56" removed.
07	2024-09	ED value corrected from s in %. Ps recalculated.

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