# Accessory

GB

OHM-B

OHM-A

# COMBIVERT

INSTRUCTION MANUAL Braking Resistors

00.F5.ZEB-K000

KEB

03/2006

# 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**

$$t_{Bmin} = \frac{(J_M + J_L) \cdot (n_1 - n_2)}{9{,}55 \cdot (K \cdot M_N + M_L + \frac{P_R \cdot 9{,}55}{(n_1 - n_2)})}$$

Valid range: $n_1 > n_N$

Conditions: $\frac{P_S \cdot 9{,}55}{(n_1 - n_2)} \leq M_N \cdot (1{,}5 - K)$

$f \leq 70\,Hz$

$P_B \leq P_S$

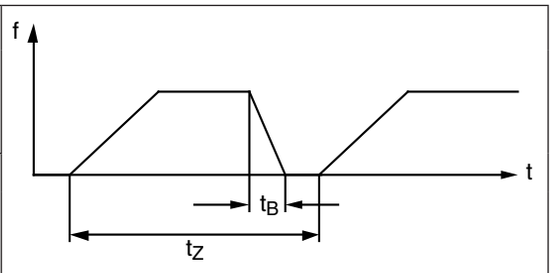
**Cyclic duration factor**

ED for $t_Z \leq 120\,s$

$$ED = \frac{t_B}{t_Z} \cdot 100\,\%$$

ED for $t_Z > 120\,s$

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




| 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 braking power | [W] |
| $P_S$ | = | peak power of braking resistor | [W] |
| K | = | 0,25 for motors to 1,5 kW (default three-phase asynchronous motor)<br>0,20 for motors 2,2…4 kW<br>0,15 for motors 5,5…11 kW<br>0,08 for motors 15…45 kW<br>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** | | | | | | | |
| 07.BR.100-1180 | 1 | 180 | 44 | 0,8 | 6 | – | 16 / 1,5 |
| 09.BR.100-1100 | 1 | 100 | 82 | 1,5 | 6 | – | 14 / 2,5 |
| 10.BR.100-1683 | 1 | 68 | 120 | 2,2 | 6 | – | 14 / 2,5 |
| 12.BR.100-1333 | 1 | 33 | 250 | 4,2 | 6 | – | 14 / 2,5 |
| 13.BR.100-1273 | 1 | 27 | 300 | 5,1 | 6 | – | 12 / 4 |
| 14.BR.100-1203 | 1 | 20 | 410 | 6,9 | 6 | – | 12 / 4 |
| 15.BR.110-1133 | 1 | 13 | 630 | 10 | 6 | 12 / 4 | 12 / 4 |
| 15.BR.226-3806 | 1 | 8 | 2500 | 17 | 30 | 6 / 16 | 8 / 10 |
| 16.BR.110-1103 | 1 | 10 | 780 | 14 | 6 | 12 / 4 | 12 / 4 |
| 16.BR.110-3606 | 1 | 6 | 3000 | 23 | 30 | 6 / 16 | 8 / 10 |
| 17.BR.110-1073 | 1 | 7 | 1200 | 22 | 6 | 12 / 4 | 12 / 4 |
| 17.BR.226-3516 | 1 | 5,6 | 4000 | 27 | 30 | 6 / 16 | 6 / 16 |
| 18.BR.226-1406 | 1 | 4 | 1800 | 29 | 6 | 6 / 10 | 6 / 16 |
| 18.BR.226-3416 | 1 | 4,1 | 5000 | 33 | 30 | 6 / 16 | 6 / 16 |
| 19.BR.226-1306 | 1 | 3 | 2000 | 45 | 6 | 6 / 16 | 6 / 16 |
| 19.BR.226-3306 | 1 | 3 | 7500 | 45 | 30 | 6 / 16 | 6 / 16 |
| 20.BR.226-3426 | 1 | 2,4 | 10000 | 57 | 6 | 6 / 16 | 6 / 16 |
| 21.BR.226-1206 | 1 | 2 | 4000 | 68 | 6 | 2 x 6 / 2 x 16 | 2 x 6 / 2 x 16 |
| **400 V class** | | | | | | | |
| 07.BR.100-6620 | 1 | 620 | 56 | 0,9 | 6 | – | 16 / 1,5 |
| 09.BR.100-6390 | 1 | 390 | 90 | 1,5 | 6 | – | 16 / 1,5 |
| 10.BR.100-6270 | 1 | 270 | 130 | 2,1 | 6 | – | 16 / 1,5 |
| 12.BR.100-6150 | 1 | 150 | 230 | 3,85 | 6 | – | 14 / 2,5 |
| 13.BR.100-6110 | 1 | 110 | 350 | 5 | 6 | – | 14 / 2,5 |
| 14.BR.100-6853 | 1 | 85 | 410 | 6,9 | 6 | – | 14 / 2,5 |
| 14.BR.226-7853 | 1 | 85 | 600 | 12 | 18 | 8 / 10 | 12 / 4 |
| 14.BR.226-8453 | 1 | 40 | 3400 | 12 | 48 | 6 / 16 | 10 / 6 |
| 15.BR.110-6563 | 1 | 56 | 620 | 10 | 6 | 12 / 4 | 12 / 4 |
| 15.BR.226-8303 | 1 | 30 | 4000 | 17 | 48 | 2 x 6 / 2 x 16 | 10 / 6 |
| 16.BR.110-6423 | 1 | 42 | 820 | 14 | 6 | 12 / 4 | 12 / 4 |
| 16.BR.226-7423 | 1 | 42 | 1200 | 15 | 18 | 8 / 10 | 10 / 6 |
| 17.BR.110-6303 | 1 | 30 | 1200 | 19 | 6 | 12 / 4 | 12 / 4 |
| 17.BR.226-7273 | 1 | 27 | 1800 | 22 | 18 | 8 / 10 | 8 / 10 |
| 18.BR.226-6203 | 1 | 20 | 1700 | 29 | 6 | 8 / 10 | 8 / 10 |
| 18.BR.226-8203 | 3 | 20 | 15000 | 38 | 30 | 2 x 6 / 2 x 16 | 2 x 8 / 2 x 10 |
| 19.BR.226-6153 | 1 | 15 | 2300 | 38 | 6 | 8 / 10 | 8 / 10 |
| 20.BR.226-6123 | 1 | 12 | 2900 | 48 | 6 | 6 / 16 | 6 / 16 |
| 21.BR.226-6103 | 1 | 10 | 3000 | 53 | 6 | 6 / 16 | 6 / 16 |
| 22.BR.226-6866 | 1 | 8,6 | 4000 | 68 | 6 | 2 x 6 / 2 x 16 | 2 x 6 / 2 x 16 |

| | |
|---|---|
| PD | *Continuous power* |
| ps | *Peak load, max. for specified ON period* |
| cdf | *Cyclic duration factor* |
| | *recommended core cross- section per module* |

# Braking Resistors

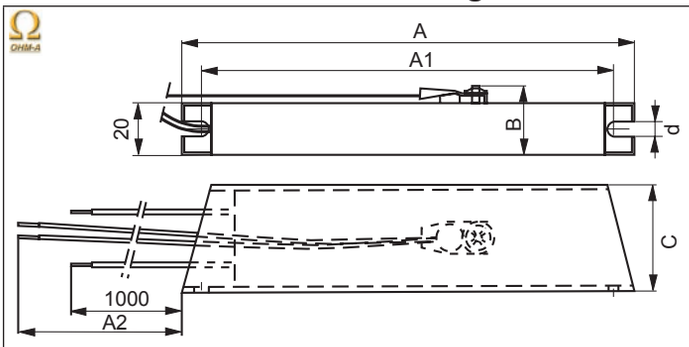
| Part number | Number of modules | R | $P_D$ | $P_S$ | cdf | Terminals | Core cross-section |
|---|---|---|---|---|---|---|---|
| | | Ω | [W] | [kW] | [s] | [AWG] / [mm²] | [AWG] / [mm²] |
| 23.BR.226-6676 | 1 | 6,7 | 5200 | 86 | 6 | 2 x 6 / 2 x 16 | 2 x 6 / 2 x 16 |
| 24.BR.226-6506 | 2 | 5 | 6900 | 115 | 6 | 2 x 6 / 2 x 16 | 2 x 6 / 2 x 16 |
| 25.BR.226-6436 | 2 | 4,3 | 8100 | 135 | 6 | 2 x 6 / 2 x 16 | 2 x 6 / 2 x 16 |
| 26.BR.226-6386 | 2 | 3,8 | 9200 | 154 | 6 | 2 x 6 / 2 x 16 | 2 x 6 / 2 x 16 |
| 27.BR.226-6336 | 2 | 3,3 | 10000 | 173 | 6 | 2 x 6 / 2 x 16 | 2 x 6 / 2 x 16 |
| 28.BR.226-6226 | 3 | 2,2 | 15000 | 260 | 6 | 2 x 6 / 2 x 16 | 2 x 6 / 2 x 16 |
| 29.BR.226-6176 | 4 | 1,7 | 20000 | 340 | 6 | 2 x 6 / 2 x 16 | 2 x 6 / 2 x 16 |
| 30.BR.226-6136 | 5 | 1,3 | 26000 | 440 | 6 | 2 x 6 / 2 x 16 | 2 x 6 / 2 x 16 |
| PD | *Continuous power* | | | | | | |
| ps | *Peak load, max. for specified ON period* | | | | | | |
| cdf | *Cyclic duration factor* | | | | | | |
| | *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.

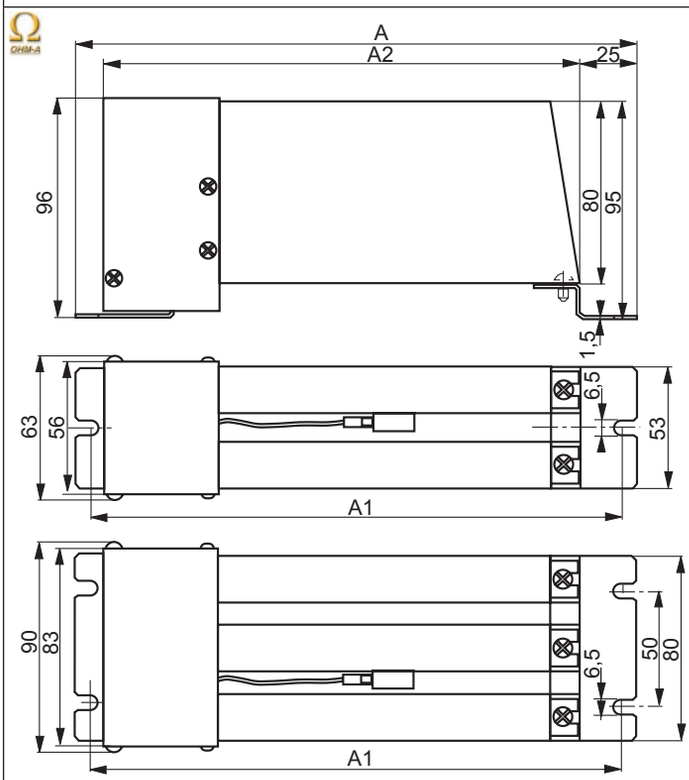
**Opening temperature of the installed thermojunctions**

| Part number | Opening temperature |
|---|---|
| xx.BR.100-xxxx | 160 °C |
| xx.BR.110-xxxx | 160 °C |
| xx.BR.226-xxxx | 240 °C |

## 1.5 Beside mounted braking resistors - dimensions

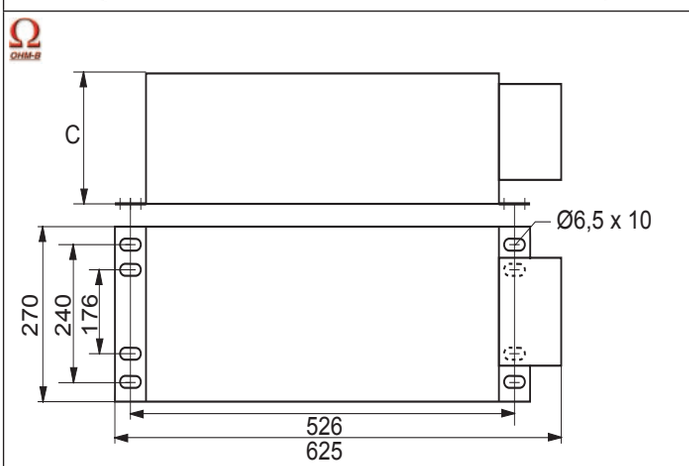



| Part number | A | A1 | A2 | B | C | GB |
|---|---|---|---|---|---|---|
| 07.BR.100-xxxx | 160 | 145 | 1120 | 26 | 40 | 6 |
| 09.BR.100-xxxx | 240 | 222 | 1060 | 26 | 40 | 6 |
| 10.BR.100-xxxx | 300 | 285 | 1030 | 26 | 40 | 6 |
| 11.BR.100-xxxx | 240 | 225 | 1085 | 28 | 80 | 5,5 |
| 12.BR.100-xxxx | 300 | 285 | 1055 | 28 | 80 | 5,5 |
| 13.BR.100-xxxx | 400 | 400 | 1005 | 28 | 80 | 5,5 |
| 14.BR.100-xxxx | 400 | 400 | 1005 | 28 | 80 | 5,5 |



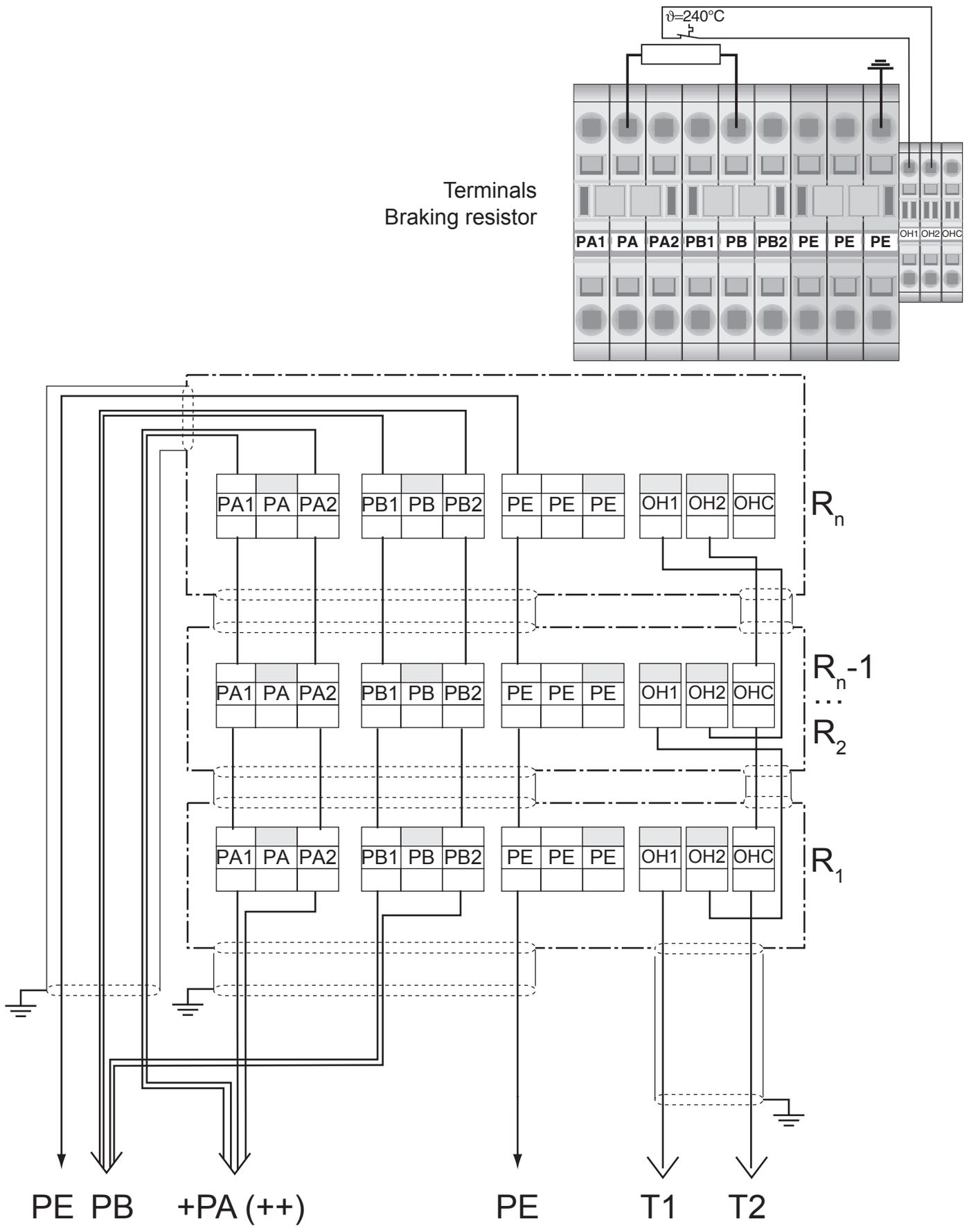

| Part number | A | A1 | A2 |
|---|---|---|---|
| 15.BR.110-xxxx | 370 | 355 | 300 |
| 16.BR.110-xxxx | 470 | 455 | 400 |

| Part number | A | A1 | A2 |
|---|---|---|---|
| 17.BR.110-xxxx | 470 | 455 | 400 |




| Part number | C |
|---|---|
| 18.BR.226-6203 | 116 |
| 19.BR.226-6153 | 116 |
| 20.BR.226-6123 | 223 |
| 21.BR.226-6103 | 223 |
| 22.BR.226-6866 | 273 |
| 23.BR.226-6676 | 273 |
| 24.BR.226-6506 | = 2 x 21.BR.226-6103 |
| 25.BR.226-6436 | = 2 x 22.BR.226-6866 |
| 26.BR.226-6386 | = 1 x 22.BR.226-6866+<br>1 x 23.BR.226-6676 |
| 27.BR.226-6336 | = 2 x 23.BR.226-6676 |
| 28.BR.226-6226 | = 3 x 23.BR.226-6676 |
| 29.BR.226-6176 | = 4 x 23.BR.226-6676 |
| 30.BR.226-6136 | = 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:

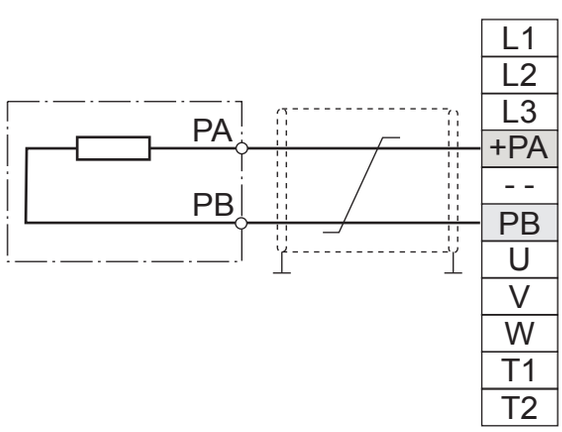
| | |
|---|---|
| • | Select minimum distances to adjacent units in such way that neither fire risk nor malfunctions increased by ambient temperature releases. |
| • | Sufficient cooling must be available when the unit is installed in a control cabinet. |
| • | A warning notice "hot surface" must be 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

| | Without temperature monitoring | Simple temperature monitoring | Extended 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)] |

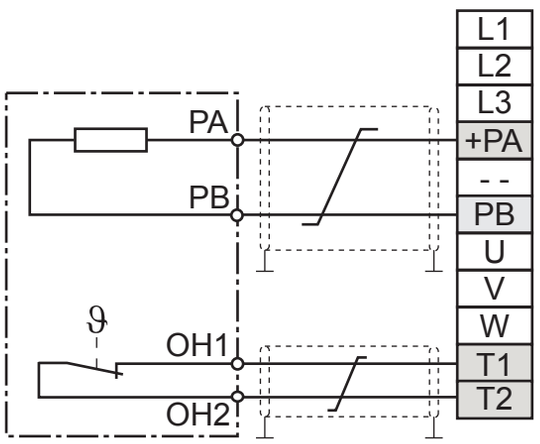
*1) The frequency inverter remains in operation in spite of switched off power supply in generatoric operation. An error must be released here, which leads to the disconnection of the modulation. This can occur e.g. via an additional auxiliary contact at the line contactor K1 (terminals 13/14) at terminals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



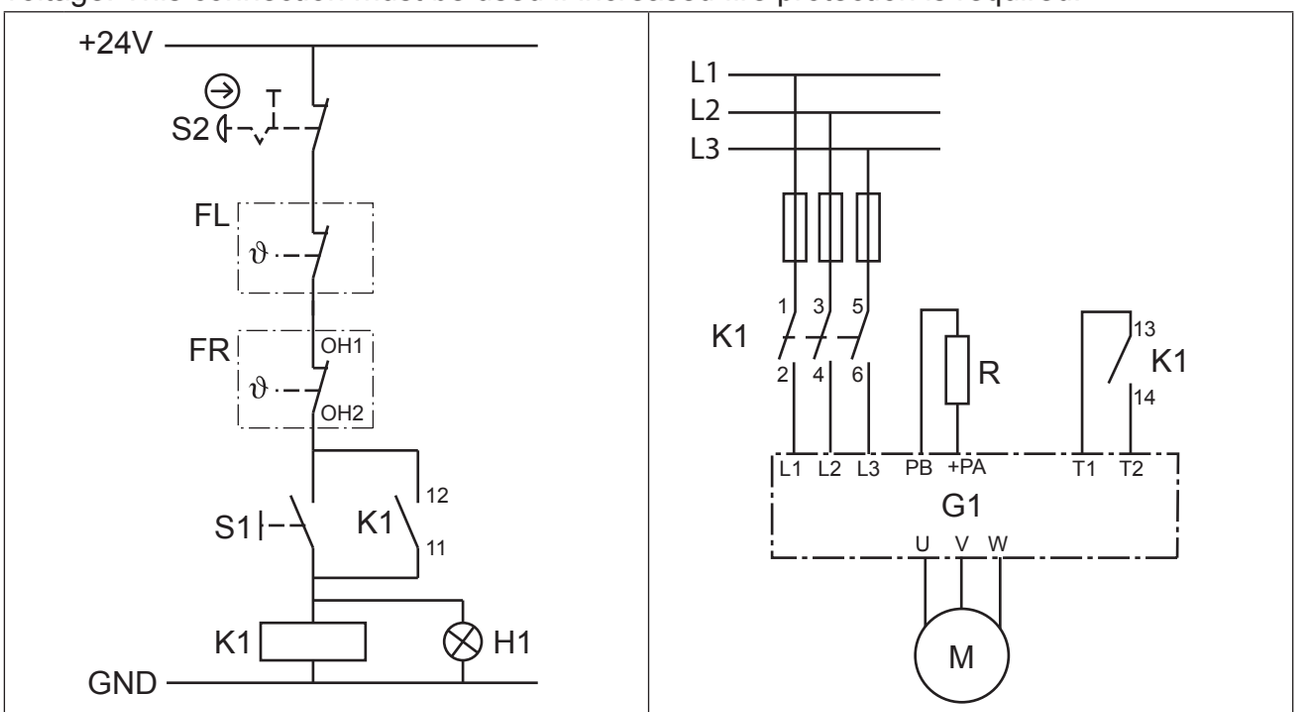
### 1.10 Connection of a braking resistor with simple temperature monitoring

This connection causes malfunctions. A short circuit in the braking transistor is recognized, 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

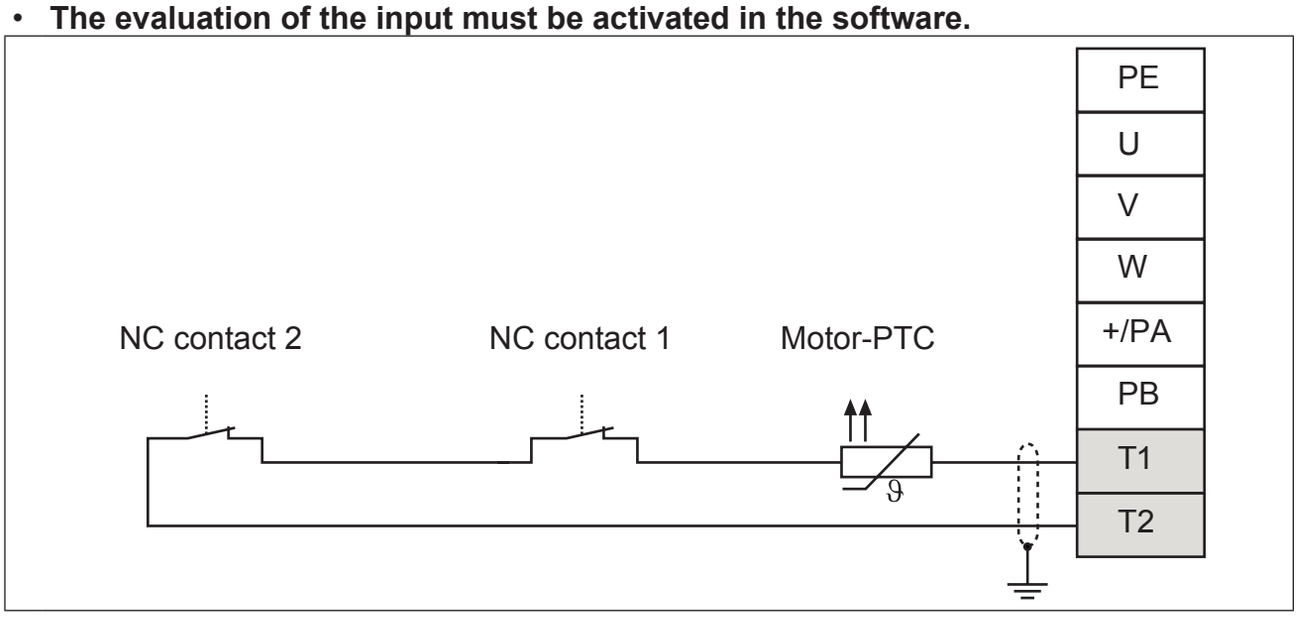
Protection in case of defective braking transistor is only available with switching off the mains voltage. This connection must be used if increased fire protection is required.




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

## 1.12 Connection of a fault sensing

- Do not lay connection cable 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 this units (e.g. programmed digital output leads in switching off of power supply).

**Karl E. Brinkmann GmbH**
Försterweg 36-38 • D-32683 Barntrup
fon: +49 5263 401-0 • fax: +49 5263 401-116
net: www.keb.de • mail: info@keb.de

**KEB Antriebstechnik GmbH & Co. KG**
Wildbacher Str. 5 • **D**–08289 Schneeberg
fon: +49 3772 67-0 • fax: +49 3772 67-281
mail: info@keb-combidrive.de

**KEB Antriebstechnik Austria GmbH**
Ritzstraße 8 • **A**-4614 Marchtrenk
fon: +43 7243 53586-0 • fax: +43 7243 53586-21
net: www.keb.at • mail: info@keb.at

**KEB Antriebstechnik**
Herenveld 2 • **B**-9500 Geraadsbergen
fon: +32 5443 7860 • fax: +32 5443 7898
mail: vb.belgien@keb.de

**KEB Power Transmission Technology (Shanghai) Co. Ltd.**
Industry Development District
No. 28 Dongbao Road Song Jiang
**CHN**-201613 Shanghai, PR. China
fon: +86 21 51 099 995 • fax: +86 21 67 742 701
net: www.keb.cn • mail: info@keb.cn

**KEB Antriebstechnik Austria GmbH**
Organizační složka
K. Weise 1675/5 • **CZ**-370 04 České Budějovice
fon: +420 387 699 111 • fax: +420 387 699 119
net: www.keb.cz • mail: info.keb@seznam.cz

**KEB España**
C/ Mitjer, Nave 8 - Pol. Ind. LA MASIA
**E**-08798 Sant Cugat Sesgarrigues (Barcelona)
fon: +34 93 897 0268 • fax: +34 93 899 2035
mail: vb.espana@keb.de

**Société Française KEB**
Z.I. de la Croix St. Nicolas • 14, rue Gustave Eiffel
**F**-94510 LA QUEUE EN BRIE
fon: +33 1 49620101 • fax: +33 1 45767495
net: www.keb.fr • mail: info@keb.fr

**KEB (UK) Ltd.**
6 Chieftain Buisiness Park, Morris Close
Park Farm, Wellingborough **GB**-Northants, NN8 6 XF
fon: +44 1933 402220 • fax: +44 1933 400724
net: www.keb-uk.co.uk • mail: info@keb-uk.co.uk

**KEB Italia S.r.l.**
Via Newton, 2 • **I**-20019 Settimo Milanese (Milano)
fon: +39 02 33500782 • fax: +39 02 33500790
net: www.keb.it • mail: kebitalia@keb.it

**KEB - YAMAKYU Ltd.**
15–16, 2–Chome, Takanawa Minato-ku
**J**–Tokyo 108-0074
fon: +81 33 445-8515 • fax: +81 33 445-8215
mail: info@keb.jp

**KEB Polska**
ul. Budapesztańska 3/16 • **PL**–80-288 Gdańsk
fon: +48 58 524 0518 • fax: +48 58 524 0519
mail: vb.polska@keb.de

**KEB Taiwan Ltd.**
No.8, Lane 89, Sec.3; Taichung Kang Rd.
**R.O.C.**-Taichung City / Taiwan
fon: +886 4 23506488 • fax: +886 4 23501403
mail: info@keb.com.tw

**KEB Korea Seoul**
Room 1709, 415 Missy 2000
725 Su Seo Dong, Gang Nam Gu
**ROK**-135-757 Seoul/South Korea
fon: +82 2 6253 6771 • fax: +82 2 6253 6770
mail: vb.korea@keb.de

**KEB Sverige**
Box 265 (Bergavägen 19)
**S**-43093 Hälsö
fon: +46 31 961520 • fax: +46 31 961124
mail: vb.schweden@keb.de

**KEB America, Inc.**
5100 Valley Industrial Blvd. South
**USA**-Shakopee, MN 55379
fon: +1 952 224-1400 • fax: +1 952 224-1499
net: www.kebamerica.com • mail: info@kebamerica.com