



# COMBIVERT ACCESSORIES

INSTRUCTIONS FOR USE

INSTALLATION INTRINSICALLY SAFE BRAKING RESISTORS

Translation of the original manual  
Document 20106652 EN 05



# 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:

<b>DANGER</b>	Dangerous situation, which will cause death or serious injury in case of non-observance of this safety instruction.
<b>WARNING</b>	Dangerous situation, which may cause death or serious injury in case of non-observance of this safety instruction.
<b>CAUTION</b>	Dangerous situation, which may cause minor injury in case of non-observance of this safety instruction.
<b>NOTICE</b>	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.
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## 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/nc/search](http://www.keb.de/nc/search)



## Laws and guidelines

KEB Automation KG confirms with the EU declaration of conformity with the CE mark on the unit name plate, that the device complies with the essential safety requirements. The EU 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](http://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.

Other wordmarks or/and logos are trademarks (™) or registered trademarks (®) of their respective owners and are listed in the footnote on the first occurrence.

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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 the intrinsically safe braking resistors for KEB COMBIVERT. The manual

- contains only supplementary safety instructions.
- is only valid in connection with the power unit manual of the 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 Determine a suitable braking resistor

Different braking resistors are available for the KEB COMBIVERT. The respective formulas and restrictions (validity range) can be found on the following pages.

### 2.1 Selection of braking resistor

1. Preset desired braking time.
2. Calculate braking time without braking resistor ( $t_{Bmin1}$ ).
3. A braking resistor is necessary 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 converter 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 ( $t_{Bmin2}$ ) 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 1.5 times of the rating torque of the motor (see formula).

When utilizing the maximum possible braking torque the drive converter must be dimensioned for the higher current.

### 2.2 Braking ramp

The braking ramp is adjusted at the drive converter. If it is chosen too small, the drive converter switches off automatically and the error message "ERROR overpotential" or "ERROR overcurrent" appears. The approximate braking time can be determined according to following formula.

## DETERMINE A SUITABLE BRAKING RESISTOR

### 2.3 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**

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

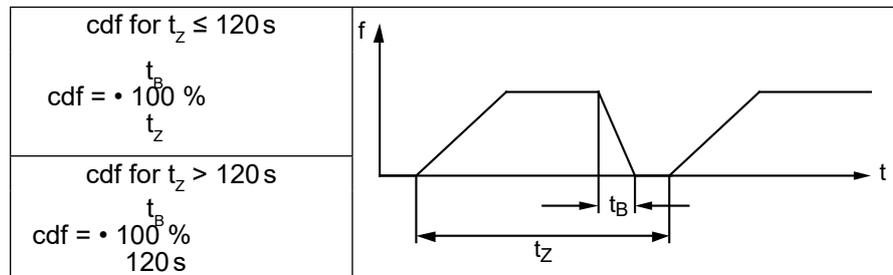
Valid range:  $n_1 > n_N$

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 <sup>2</sup>
$J_L$	= Mass moment of inertia load	kgm <sup>2</sup>
$n_1$	= 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*

### 3 Technical Data

#### 3.1 Intrinsic safety of braking resistors

An intrinsically safe braking resistor melts internally like a fuse at overload due to overheating. There is no short-circuit or ground fault.

As a consequence the drive converter goes into "ERROR overpotential" at the next deceleration process (when the braking resistor is required).

#### 3.2 General data

Material number	<i>R</i>	<i>P<sub>D</sub></i>	<i>P<sub>S</sub></i>	<i>CDF</i>	Core cross-section		Weight
	Ω	W	kW	%	AWG / mm <sup>2</sup>		kg
<b>400/480 V drive converter (max. DC link voltage 840 Vdc)</b>							
<b>Side-mounted braking resistors</b>							
10G6A90-4300	160	200	see „3.3 Technical data at side-mounted“		14	2,5	0.7
13G6B90-4300	110	250			14	2,5	0.8
15G6C90-4300	56	300			14	2,5	1.7
17G6E90-4300	25	300			14	2,5	2.4
19G6E90-4300	15	300			14	2,5	2.0
<b>Sub-mounted braking resistors</b>							
07BR6B1-5390	390	35	1,5	2	14	2,5	0.4
09BR6B1-5270	270	35	2,7	2	14	2,5	0.4
12BR6B1-5150	150	35	5,5	2	14	2,5	0.4
12BR6D1-5150	150	50	5,5	2	14	2,5	0.5
14BR6D1-5853	85	50	10	2	14	2,5	0.5
14BR6E1-5853	85	100	10	2	14	2,5	0.7
16BR6E1-5423	42	100	14	2	14	2,5	0.7
<i>R</i>	Resistance						
<i>P<sub>D</sub></i>	Continuous output power at 40° C and a surface over temperature of 200K						
<i>P<sub>S</sub></i>	Peak braking power						
<i>CDF</i>	Cyclic duration factor						

Table 2: General data

#### 3.3 Technical data at side-mounted

Cycle time	120 s						
ON time <i>ED</i>	60 %	40 %	25 %	15 %	6 %	3 %	1 %
Overload factor <i>OF</i>	1,5	2,2	3,0	4,2	8,2	13	22

Table 3: Technical data at side-mounted

Calculation of peak power *P<sub>S</sub>*:

$$\text{Peak power } P_S = \text{continuous output power } P_D \cdot \text{overload factor } OF$$

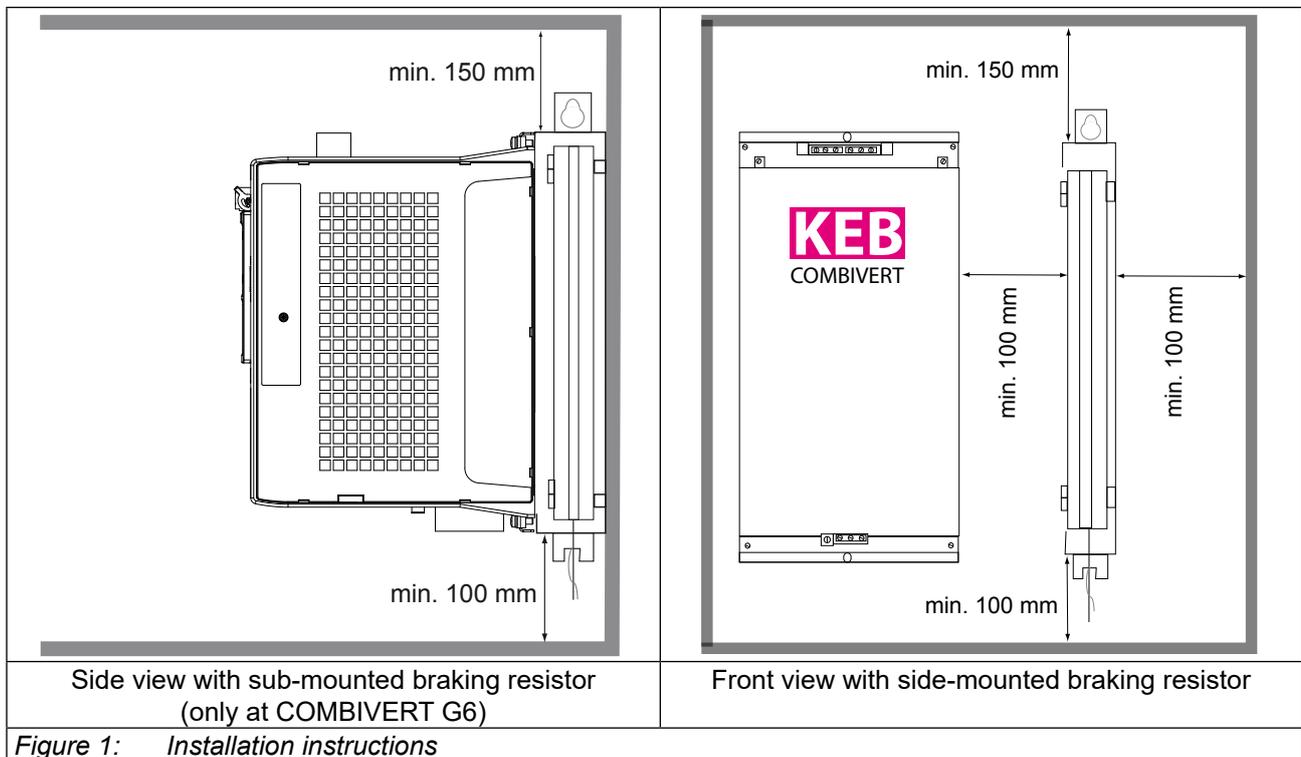
The calculated peak braking power *P<sub>B</sub>* must be smaller than the peak power *P<sub>S</sub>* of the resistance. Please contact KEB if the value is not reached.

### 3.4 Special features at sub-mounted version (only for COMBIVERT G6)

Cycle time	120 s	
Max. ambient temperature	45 °C	
Max. housing temperature drive converter	125 °C	
Maximum permissible continuous output power at max. 840 Vdc	10G6A90-4300	40 W (corresponds to 1 % ED)
	13G6B90-4300	60 W (corresponds to 1 % ED)
	15G6C90-4300	90 W (corresponds to 1 % ED)
	17G6E90-4300	150 W (corresponds to 1 % ED)
	19G6E90-4300	200 W (corresponds to 1 % ED)

Table 4: Special features at sub-mounted version (only for COMBIVERT G6)

### 3.5 Installation instructions



**ATTENTION**

**Load limit at sub-mounted version !**

At non-observance of the load limit the sub-mounted braking resistor can reach temperatures which damage the drive converter housing.

### 3.6 Installation instructions

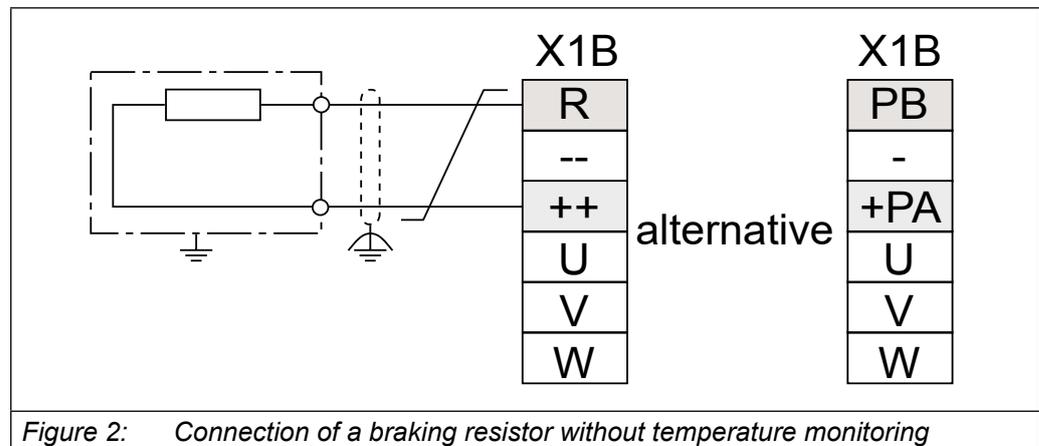
Braking resistors can evolve very high surface temperatures during normal operation. The following points must be considered absolutely for safe operation:

- Observe minimum distances to adjacent materials/surfaces, so neither fire risk nor malfunctions increased by ambient temperature are triggered.
- Sufficient heat dissipation 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.



### 3.7 Connection of a braking resistor without temperature monitoring

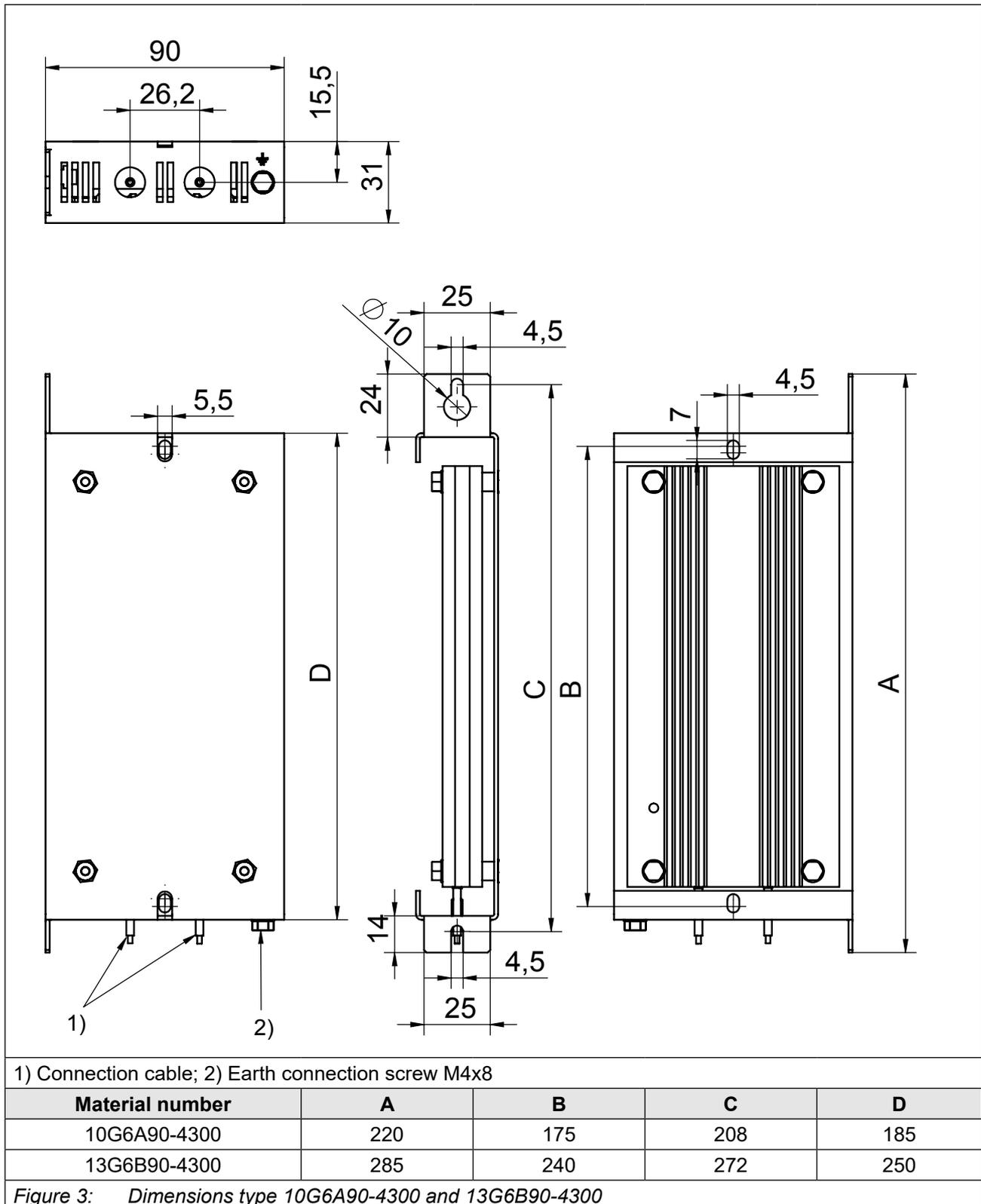
This connection type has no temperature detection. A short circuit in regenerative operation neither leads to an error, nor to the disconnection of the mains voltage. The circuit is only suitable by using an intrinsically safe braking resistor or in areas without increased fire protection.



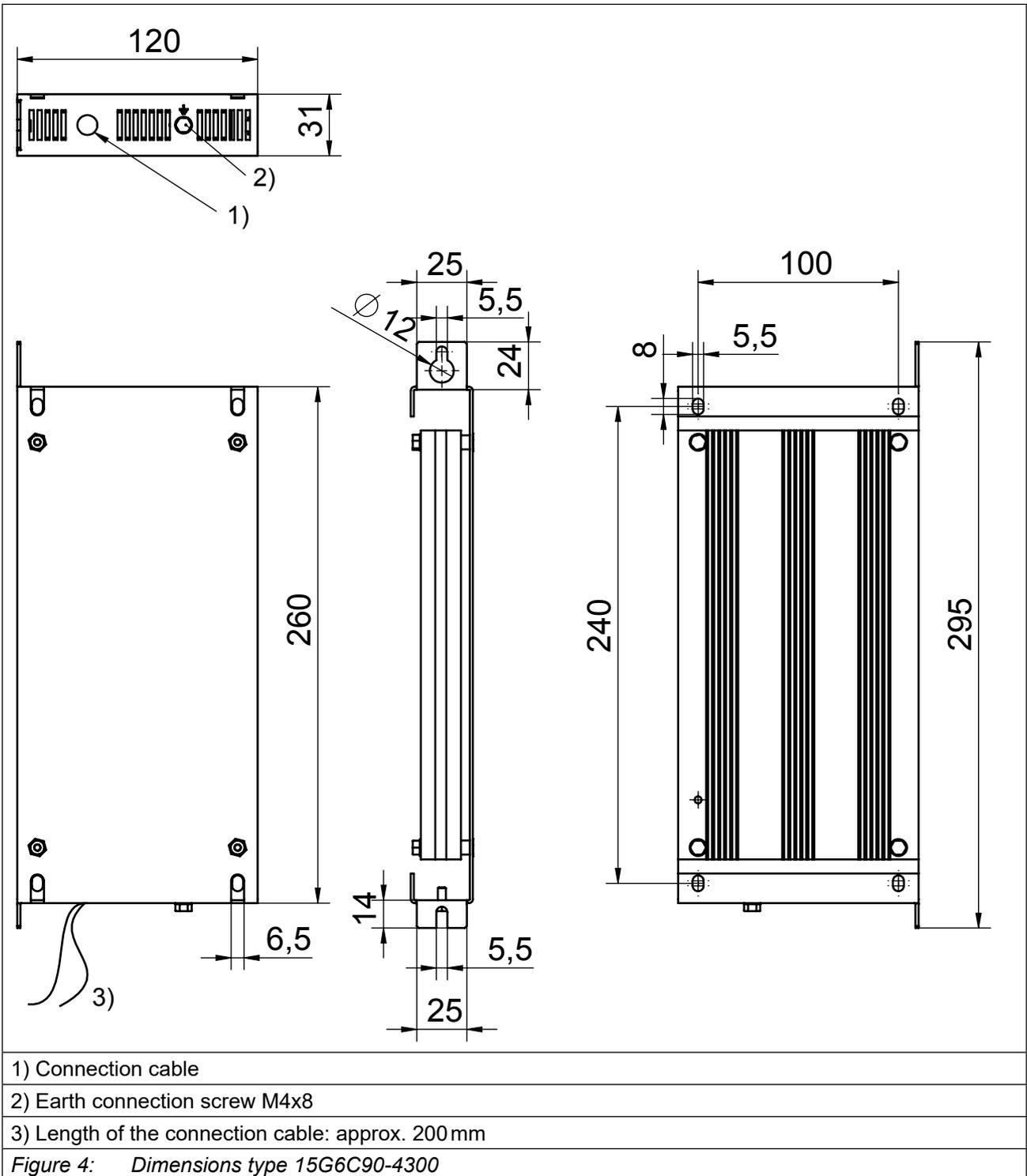
The terminal description can vary depending on the series.

### 3.8 Dimensions

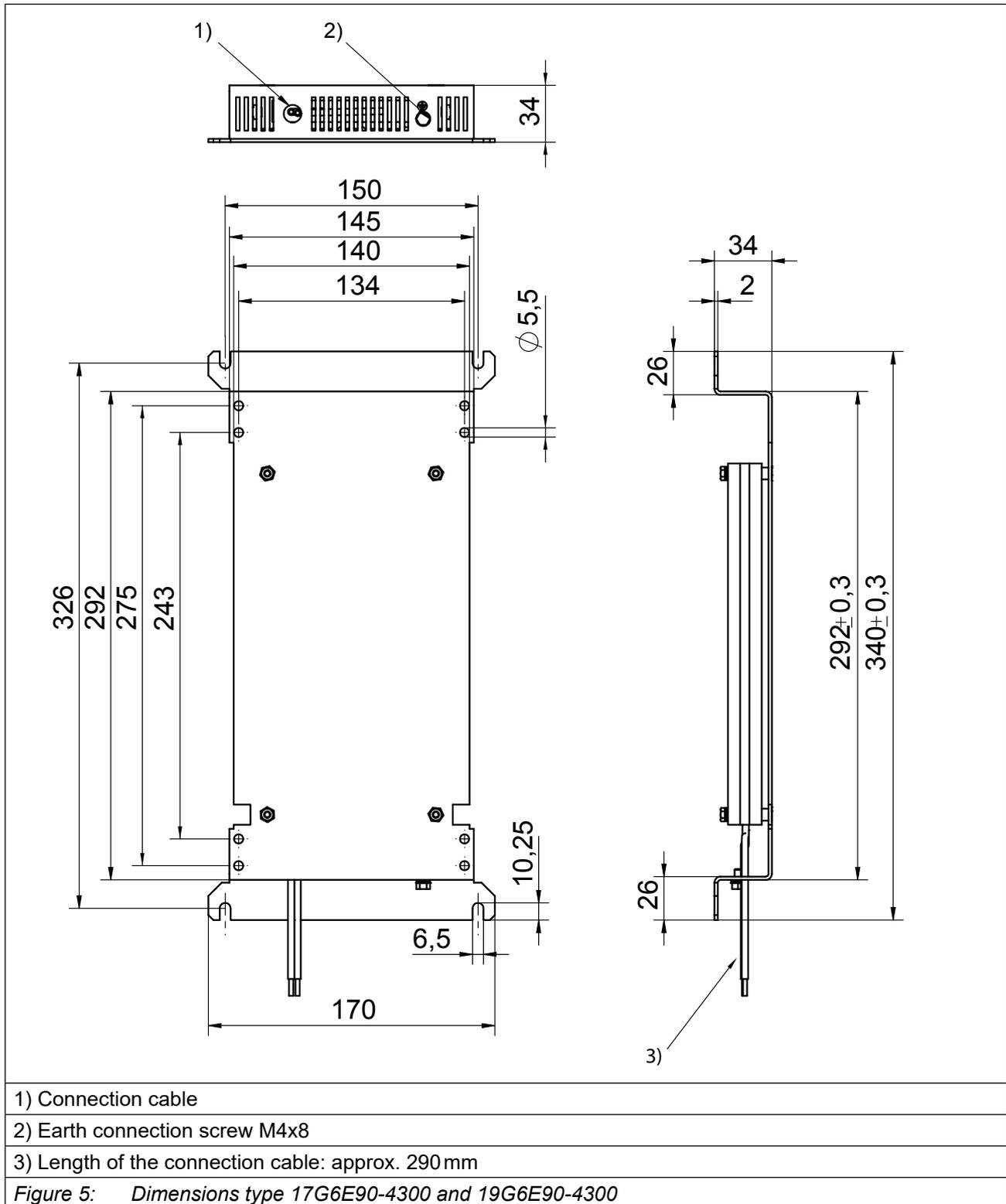
#### 3.8.1 Type 10G6A90-4300 and 13G6B90-4300



3.8.2 Type 15G6C90-4300



3.8.3 Type 17G6E90-4300 and 19G6E90-4300



3.8.4 Type 07BR6B1-5390, 09BR6B1-5270 and 12BR6B1-5150

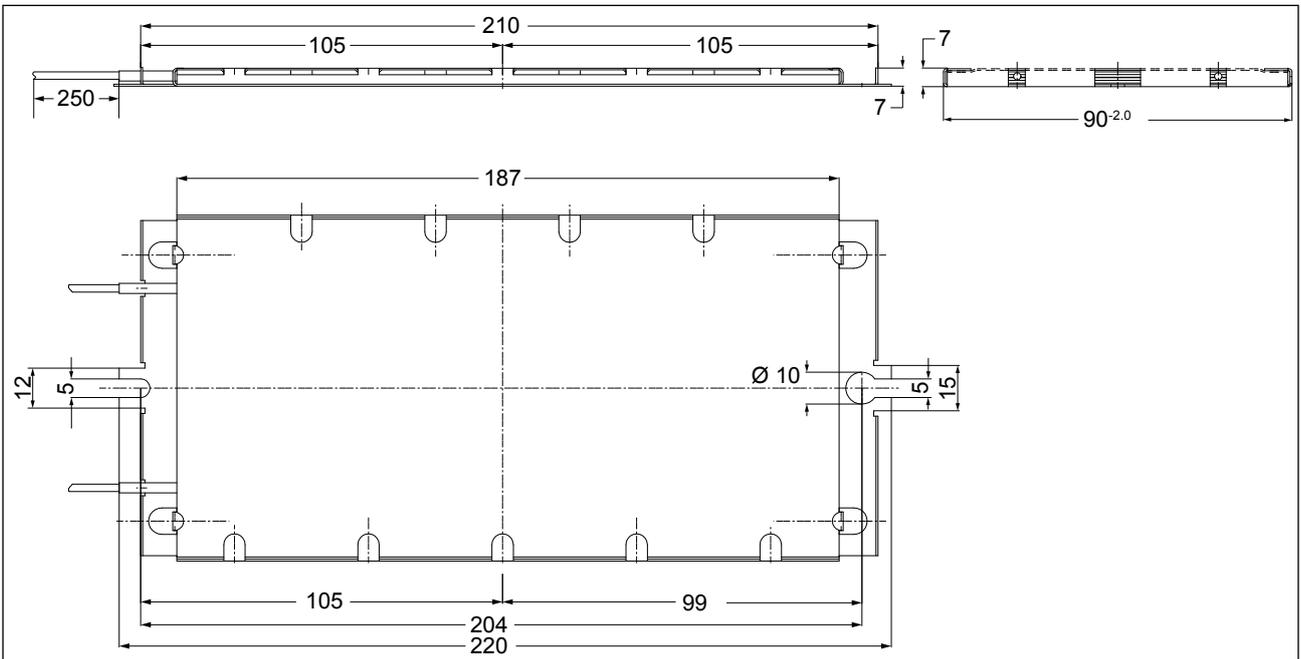


Figure 6: Dimensions type 07BR6B1-5390, 09BR6B1-5270 and 12BR6B1-5150

3.8.5 Type 12BR6D1-5150 and 14BR6D1-5853

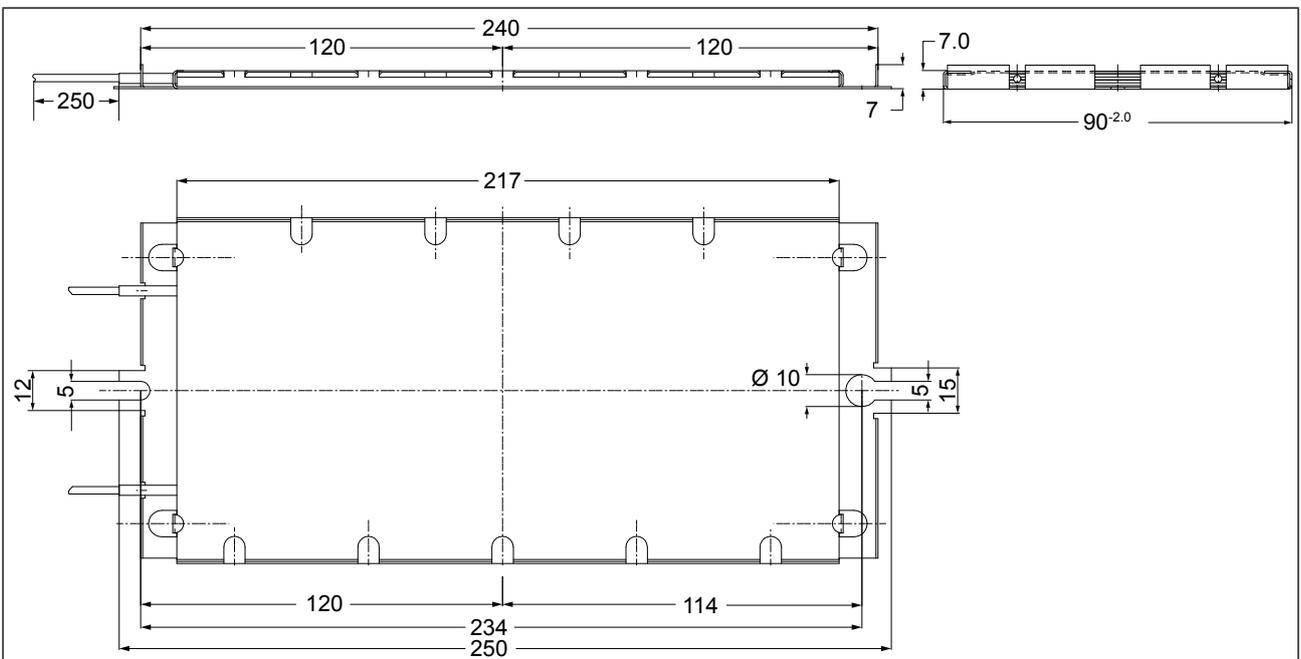


Figure 7: Dimensions type 12BR6D1-5150 and 14BR6D1-5853

3.8.6 Type 14BR6E1-5853 and 16BR6E1-5423

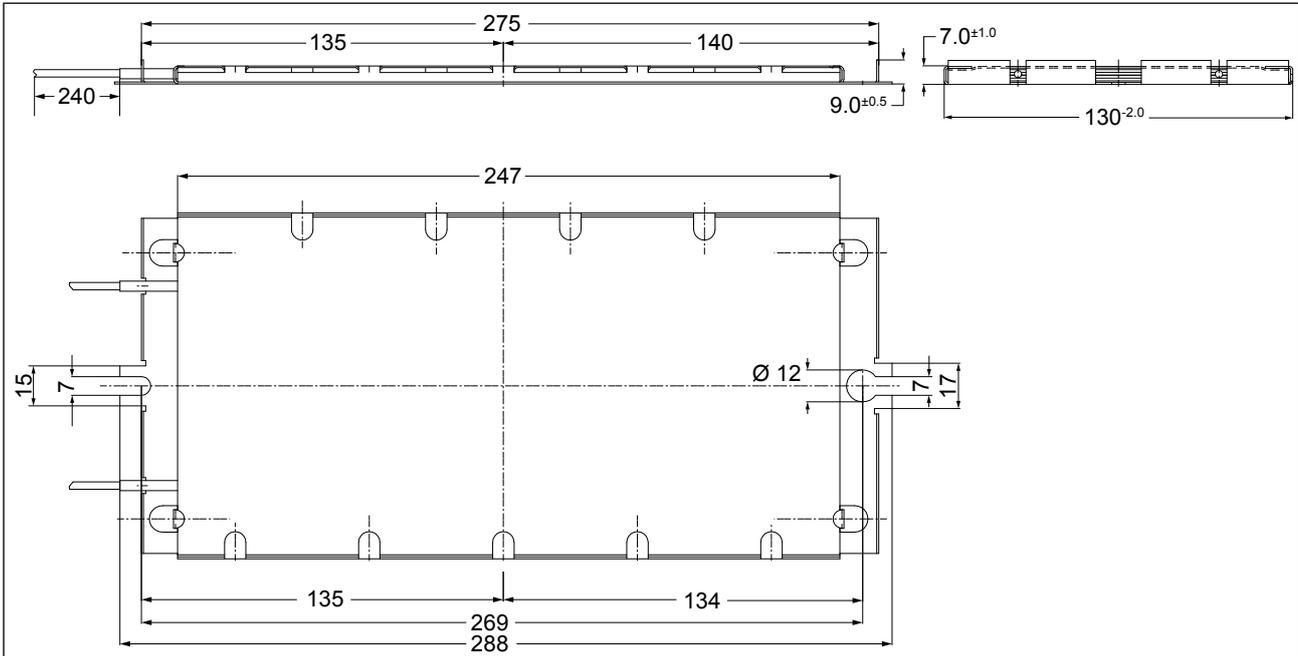


Figure 8: Dimensions type 14BR6E1-5853 and 16BR6E1-5423

## 4 Certification

### 4.1 CE-Marking

	By adjacent logo on the product, we confirm that the product meets the product-specific, applicable European Directives.
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The resistors are marked according to the Low-Voltage Directive CE.

### 4.2 UL Certification

	An UL certification of the resistors is marked by adjacent logo on the product.
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The resistors of the type 10G6A90-4300, 13G6B90-4300, 15G6C90-4300, 17G6E90-4300 and 19G6E90-4300 are UL approved for the United States (NMTR2) and for Canada (NMTR8) in file E212934 and approbated with KEB inverters type G6, S6.



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