

# COMBIVERT



## F5/F6

**GB** Instruction Manual

**Housing D**

1.5...4.0kW      230 V

1.5...7.5kW      400 V

Original manual	
Mat.No.	Rev.
00F50EB-KD00	1C

**KEB**

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## 1. Preface

### 1.1 General

First we would like to welcome you as a customer of the company Karl E. Brinkmann GmbH and congratulation to the purchase of this product. You have decided for a product on highest technical level.

The described hard- and software are developments of the Karl E. Brinkmann GmbH. The enclosed documents correspond to conditions valid at printing. Misprint, mistakes and technical changes reserved.

The instruction manual must be made available to the user. Before working with the unit the user must become familiar with it. This especially applies to the knowledge and observance of the following safety and warning indications. The pictographs used in this instruction manual have following meaning:

	Danger Warning Caution	Is used, if life or health of the user is in danger or if substantial damage to property can occur.
	Attention observe at all costs	Is used, if a measure is necessary for safe and trouble-free operation.
	Information Aid Tip	Is used, if a measure simplifies the handling or operation of the unit.

### 1.2 Safety instructions

	Observe safety and operating instruc- tions	Precondition for all further steps is the knowledge and observance of the safety -, EMC- and operating instructions (Part 1 „Before Starting“ 0000NEB-0000“). This instruction is provided with the unit or by download of <a href="http://www.keb.de">www.keb.de</a> .
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Non-observance of the safety instructions leads to the loss of any liability claims. The safety and warning instructions specified in this manual do not lay claim on completeness. This list is not exhaustive.

### 1.3 Validity and liability

**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 machine manufacturer.**

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 application. However, they are considered for information only without responsibility. 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 application by the machine manufacturer. They must be repeated, even if only parts of hardware, software or the unit adjustment are modified.

Unauthorised opening and tampering may lead to bodily injury and property damage and may entail the loss of warranty rights. Original spare parts and authorized accessories by the manufacturer serve as security. The use of other parts excludes liability for the consequences arising out of.

The suspension of liability is especially valid also for operation interruption loss, loss of profit, data loss or other damages. This is also valid, if we referred first to the possibility of such damages.

If single regulations should be or become void, invalid or impracticable, the effectivity of all other regulations or agreements is not affected.

### 1.4 Copyright

The customer may use the instruction manual as well as further documents or parts from it for internal purposes. Copyrights are with KEB and remain valid in its entirety. All rights reserved.

KEB®, COMBIVERT®, KEB COMBICONTROL® and COMBIVIS® are registered trademarks of Karl E. Brinkmann GmbH.

Other wordmarks or/and logos are trademarks (TM) or registered trademarks (®) of their respective owners and are listed in the footnote on the first occurrence. When creating our documents we pay attention with the utmost care to the rights of third parties. Should we have not marked a trademark or breach a copyright, please inform us in order to have the possibility of remedy.

### 1.5 Specified application

The KEB COMBIVERT serves exclusively for stepless open loop / closed-loop speed control of three-phase a.c. motors.



The operation of other electric consumers is prohibited and can lead to the destruction of the unit.

The used semiconductors and components of KEB are developed and dimensioned for the use in industrial products. If the KEB COMBIVERT 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 the KEB COMBIVERT outside the indicated limit values of the technical data leads to the loss of any liability claims.

Units with safety function are limited to a service life of 20 years. The units must be changed after this time.

## 1.6 Product description

This instruction manual describes the power circuits of the following units:

Unit type:	Frequency inverter
Series:	COMBIVERT F5/F6
Power range:	1.5...4.0 kW / 230 V class 1.5...7.5 kW / 400 V class
Housing size:	D
Version:	air-cooled

Features of the power circuits:

- only slight switching losses due to IGBT
- low noise development due to high switching frequency
- extensive safety device for current, voltage and temperature
- voltage and current monitoring in static and dynamic operation
- conditionally short circuit proof and earth-fault proof
- hardware current limit
- integrated cooling fan

1.7 Unit identification

15 | F5 | K | 1 | E-3 | 5 | 0 | A

cooling	
0, 5, A, F	Heat sink (standard)
1, B, G	Flat rear
2, C, H	Water cooling
3, D, I	Convection

Encoder interface	
0: none	

Switching frequency; short time current limit; overcurrent limit									
0	2 kHz; 125%; 150%	5	4 kHz; 150%; 180%	A	8 kHz; 180%; 216%	F	16 kHz; 200%; 240%		
1	4 kHz; 125%; 150%	6	8 kHz; 150%; 180%	B	16 kHz; 180%; 216%	G	2 kHz; 400%; 480%		
2	8 kHz; 125%; 150%	7	16 kHz; 150%; 180%	C	2 kHz; 200%; 240%	H	4 kHz; 400%; 480%		
3	16 kHz; 125%; 150%	8	2 kHz; 180%; 216%	D	4 kHz; 200%; 240%	I	8 kHz; 400%; 480%		
4	2 kHz; 150%; 180%	9	4 kHz; 180%; 216%	E	8 kHz; 200%; 240%	K	16 kHz; 400%; 480%		

Input identification									
0	1ph 230 VAC/DC	5	400 V class DC	A	6ph 400 VAC				
1	3ph 230 VAC/DC	6	1ph 230 VAC	B	3ph 600 VAC				
2	1/3ph 230 VAC/DC	7	3ph 230 VAC	C	6ph 600 VAC				
3	3ph 400 VAC/DC	8	1/3ph 230 VAC	D	600 VDC				
4	230 V class DC	9	3ph 400 VAC						

Housing type A, B, D, E, G, H, R, U, W, P	
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Accessories (A...D with safety relay)	
0, A	none
1, B	Braking transistor
2, C	integrated filter
3, D	Braking transistor and integrated filter

Control type	
A	APPLICATION   K   like A with safety technology
B	BASIC (controlled frequency inverter)
C	COMPACT (controlled frequency inverter)
E	SCL   P   like E with safety technology
G	GENERAL (controlled frequency inverter)
H	ASCL   L   like H with safety technology
M	MULTI (regulated, field-oriented frequency inverter for three-phase asynchronous motors)
S	SERVO (regulated frequency inverter for synchronous motors)

Series F5/F6
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Inverter size
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	Devices of type F6-K only support a max. switching frequency of 8 kHz.
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## 1.8 Installation instructions

### 1.8.1 Cooling systems

The KEB COMBIVERT F5/F6 is available for different cooling systems:

#### Heat sink with cooling fan (mounted version)

The standard version is delivered with heat sink and cooling fan.

#### Special versions

The dissipation of power loss must be guaranteed by the machine builder.

#### Flat rear

There is no heat sink at this version. The unit must be mounted on an appropriate ground for heat dissipation.

#### Convection (through-mount version)

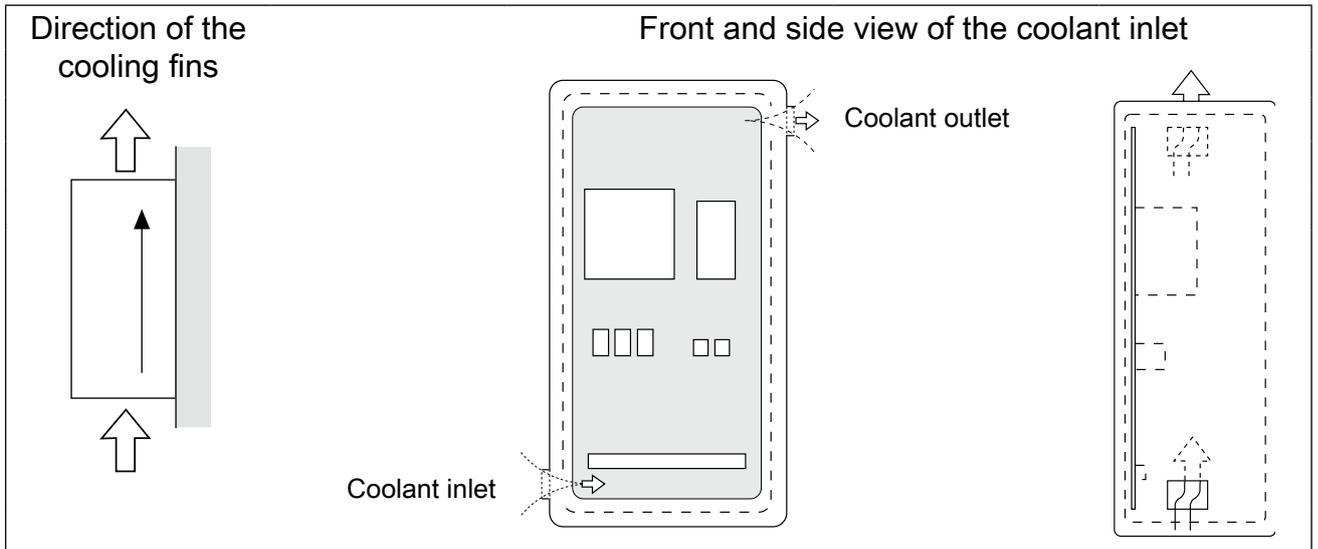
In this version the heat sink is placed externally with a cutout in the control cabinet.



Heat sinks can reach temperatures, which can cause burns when touching. If in case of structural measures a direct contact cannot be avoided, a warning notice "hot surface" must be mounted at the machine.

1.8.2 Control cabinet installation

Mounting distances	Dimension	Distance in mm	Distance in inch
	A	150	6
	B	100	4
	C	30	1.2
	GB	0	0
	X <sup>1)</sup>	50	2
1) Distance to preceding elements in the cabinet door.			



## 1.9 Safety and operating instructions



### Safety and operating instructions for drive converter (in accordance with: Low-Voltage Directive 2006/95/EC)

#### 1. General

In operation, drive converter depending on their degree of protection, may have live, uninsulated and possibly also moving or rotating parts, as well as hot surfaces.

In case of inadmissible removal of the required covers, of improper use, wrong installation or maloperation, there is the danger of serious personal injury and damage to property.

For further information, see documentation.

All operations serving transport, installation and commissioning as well as maintenance are to be carried out by skilled technical personnel (Observe IEC 364 or CENEL-EC HD 384 or DIN VDE 0100 and IEC 664 or DIN/VDE 0110 and national accident prevention rules!).

For the purposes of these basic safety instructions, „skilled technical personnel“ means persons who are familiar with the installation, mounting, commissioning and operation of the product and have the qualifications needed for the performance of their functions.

#### 2. Specified application

Drive converter are components which are intended for the installation in electric systems or machines.

In case of installation in machinery, commissioning of the drive converter (i.e. the starting of normal operation) is prohibited until the machinery has been proved to conform to the provisions of the directive 2006/42/EC (Machinery Safety Directive - MSD). Account is to be taken of EN 60204.

The drive converter meet the requirements of the Low-Voltage directive 2006/95/EC. They are subject to the harmonized standards of the series EN 61800-5-1.

The technical data as well as information concerning the supply conditions shall be taken from the rating plate and from the documentation and shall be strictly observed.

#### 3. Transport, storage

The instructions for transport, storage and proper use shall be complied with.

The climatic conditions shall be in conformity with EN 61800-5-1.

#### 4. Installation

The installation and cooling of the appliances shall be in accordance with the specifications in the pertinent documentation.

The drive converter shall be protected against excessive strains. In particular, no components must be bent or isolating distances altered in the course of transportation or handling. No contact shall be made with electronic components and contacts.

Drive converter contain electrostatic sensitive components which are liable to damage through improper use. Electric components must not be mechanically damaged or destroyed (potential health risks).

#### 5. Electrical connection

When working on live drive converter, the applicable national accident prevention rules (e.g. VBG 4) must be complied with.

The electrical installation shall be carried out in accordance with the relevant requirements (e.g. cross-sectional areas of conductors, fusing, PE connection). For further information, see documentation.

Instructions for the installation in accordance with EMC requirements, like screening, earthing, location of filters and wiring, are contained in the drive converter documentation. They must always be complied with, also for drive converter bearing a CE marking. Observance of the limit values required by EMC law is the responsibility of the manufacturer of the installation or machine.

#### 6. Operation

Installations which include drive converter shall be equipped with additional control and protective devices in accordance with the relevant applicable safety requirements, e.g. act respecting technical equipment, accident prevention rules etc.. Changes to the drive converter by means of the operating software are admissible.

After disconnection of the drive converter from the voltage supply, live appliance parts and power terminals must not be touched immediately because of possibly energized capacitors. In this respect, the corresponding signs and markings on the drive converter must be observed.

During operation, all covers and doors shall be kept closed.

#### 7. Maintenance

The manufacturer's documentation shall be followed.

**KEEP SAFETY INSTRUCTIONS IN A SAFE PLACE!**

## Technical Data

## 2. Technical Data

### 2.1 Operating conditions

		Standard	Standard/ class	Instructions
<b>Definition acc.</b>		EN 61800-2		Inverter product standard: <b>rated specifications</b>
		EN 61800-5-1		Inverter product standard: <b>general safety</b>
<b>Site altitude</b>				max. 2000 m above sea level (over 1000 m a derating of 1 % per 100 m must be taken into consideration).
<b>Ambient conditions during operation</b>				
Climate	Temperature	EN 60721-3-3	3K3	extended to -10...45 °C (use frost protection for water cooling systems and temperatures below zero) <sup>3)</sup>
	Humidity		3K3	
Mechanical	Vibration		3M1	
	Gas		3C2	
Contamination	Solids		3S2	
<b>Ambient conditions during transport</b>				
Climate	Temperature	EN 60721-3-2	2K3	Drain heat sink completely (without condensation)
	Humidity		2K3	
Mechanical	Vibration		2M1	max. 100 m/s <sup>2</sup> ; 11 ms
	Surge		2M1	
Contamination	Gas		2C2	
	Solids	2S2		
<b>Ambient conditions for the storage</b>				
Climate	Temperature	EN 60721-3-1	1K4	Drain heat sink completely (without condensation)
	Humidity		1K3	
Mechanical	Vibration		1M1	max. 100 m/s <sup>2</sup> ; 11 ms
	Surge		1M1	
Contamination	Gas		1C2	
	Solids	1S2		
<b>Type of protection</b>		EN 60529	IP20	
<b>Environment</b>		IEC 664-1		Pollution degree 2
<b>Definition acc.</b>		EN 61800-3		Inverter product standard: <b>EMC</b>
<b>EMC emitted interference</b>				
	Cable-based interferences	–	C2 <sup>1) 2)</sup>	Earlier limit value A (B optional) according to EN55011
	Radiated interferences	–	C2 <sup>2)</sup>	Earlier limit value according to EN55011
<b>Interference immunity</b>				
	Static discharges	EN 61000-4-2	8 kV	AD (air discharge) and CD (contact discharge)
	Burst - Ports for process measurement control lines and signal interfaces	EN 61000-4-4	2 kV	
	Burst - power interfaces	EN 61000-4-4	4 kV	
	Surge - power interfaces	EN 61000-4-5	1 / 2 kV	Phase-phase / phase-ground
	Electromagnetic fields	EN 61000-4-3	10 V/m	
	Cable-fed disturbances, induced by high frequency fields	EN 61000-4-6	10 V	0.15-80 MHz
	Voltage variation / voltage drop	EN 61000-2-1	3	+10 % -15 % 90 %
	Voltage unsymmetries / Frequency changes	EN 61000-2-4	3	3 % 2 %

1)



This product can cause high frequency disturbances in residential areas (category C1) which require noise suppression measures.

2)

The specified value is only met in connection with a corresponding filter.

3)

Depending on the operating conditions and corresponding power reduction, higher temperatures are permissible after consulting KEB.

**2.2 Technical data of the 230V class**

Inverter size		07	09	10	12
Housing size		D	D	D	D
Phases		1   3	1   3	1   3	3
Output rated power	[kVA]	1.6	2.8	4.0	6.6
Max. rated motor power	[kW]	0.75	1.5	2.2	4.0
Output rated current	[A]	4	7.0	10	16.5
Max. short time current	1) [A]	7.2	12.6	18	29.7
OC-tripping current	[A]	8.6	15.1	21.6	35.6
Input rated current	[A]	8   5.6	14   9.8	20   14	23
Max. permissible main fuse gG	5) [A]	20   16	20   16	25   20	25
Rated switching frequency	[kHz]	16	16	16	8
Max. switching frequency	[kHz]	16	16	16	16
Power loss at nominal operating	[W]	100	130	170	210
Power loss at DC supply	[W]	90	120	155	185
Standstill current at 4 kHz	2) [A]	4	7	10	16.5
Standstill current at 8 kHz	2) [A]	4	7	10	16.5
Standstill current at 16 kHz	2) [A]	4	7	10	10
Min. frequency at continuous full load	[Hz]	6	6	6	6
Max. heat sink temperature		90 °C (194 °F)			
Motor cable cross-section	3) [mm <sup>2</sup> ]	2.5   1.5	2.5   1.5	4   2.5	4
Min. braking resistor	4) [Ω]	56	47	33	27
Max. braking current	4) [A]	7.5	9.5	12	15
Overload characteristic		(see annex A)			
Input rated voltage	[V]	230 (UL: 240)			
Input voltage range U <sub>in</sub>	[V]	180...260 ±0			
Input voltage at DC operation	[V]	250...370 ±0			
Mains frequency	[Hz]	50 / 60 ±2			
permitted mains forms		TN, TT, IT6), Δ-mains7)			
Output voltage	8) [V]	3 x 0...U <sub>in</sub>			
Output frequency	9) [Hz]	see control board			
Max. motor line length shielded at 4 kHz	[m]	100	100		
Max. motor line length shielded at 8 kHz	[m]	50	100		
Max. motor line length shielded at 16 kHz	[m]	20	100		

- 1) With regulated systems 5% are to be subtracted as overmodulation capacity
- 2) Max. current before the OL2 function triggers (not at F5 in operating mode v/f)
- 3) Recommended minimum cross section of the motor line for rated power and a cable length of upto 100 m (CU)
- 4) This data is only valid for units with internal braking transistor (see "unit identification")
- 5) Protection in accordance with UL see annex B
- 6) IT system optional
- 7) Phase conductor grounded mains are only permissible without HF filters
- 8) The voltage at the motor is dependent on the series-connected units and on the control method (see A.3)
- 9) The output frequency is to be limited in such way that 1/10 of the switching frequency is not exceeded

The technical data are for 2/4-pole standard motors. With other pole numbers the inverter must be dimensioned onto the motor rated current. Contact KEB for special or medium frequency motors.

## Technical Data of the 400 V Class

### 2.3 Technical data of the 400V class

Inverter size			07	09	10	12	13	14		
Housing size			D	D	D	D	D	D		
Phases			3	3	3	3	3	3		
Output rated power		[kVA]	1.8	2.8	4.0	6.6	8.3	11		
Max. rated motor power		[kW]	0.75	1.5	2.2	4.0	5.5	7.5		
Output rated current		[A]	2.6	4.1	5.8	9.5	12	16.5		
Max. short time current	1)	[A]	4.7	7.4	10.4	17	21.6	29.7		
OC-tripping current		[A]	5.6	8.9	12.5	21	25.9	35.6		
Input rated current		[A]	3.6	6	8	13	17	23		
Max. permissible main fuse gG	7)	[A]	16	16	16	20	25	25		
Rated switching frequency		[kHz]	16	8	4	8	16	8	4	2
Max. switching frequency	6)	[kHz]	16	16	16	16	16	16	16	
Power loss at nominal operating		[W]	90	105	140	160	170	185	185	185
Power loss at DC supply		[W]	87	100	130	150	160	170	165	160
Standstill current at 4 kHz	2)	[A]	2.6	4.1	5.8	5.8	5.8	9.5	12	14.5
Standstill current at 8 kHz	2)	[A]	2.6	4.1	5.2	5.8	5.8	9.5	9.5	9.9
Standstill current at 16 kHz	2)	[A]	2.6	3.5	3.5	2.9	5.8	5.8	5.7	5.7
Min. frequency at continuous full load		[Hz]	6	6	6	6	6	6	6	
Max. heat sink temperature			90 °C (194 °F)							
Motor cable cross-section	3)	[mm <sup>2</sup> ]	1.5	1.5	1.5	2.5	4	4		
Min. braking resistor	4)	[Ω]	120	120	82	82	56	56		
Max. braking current	4)	[A]	7.5	7.5	10	10	15	15		
Overload characteristic			(see annex A)							
Input rated voltage	5)	[V]	400 (UL: 480)							
Input voltage range		[V]	305...528 ±0							
Input voltage at DC operation		[V]	420...746 ±0							
Mains frequency		[Hz]	50 / 60 ±2							
permitted mains forms			TN, TT, IT8), Δ-mains9)							
Output voltage	10)	[V]	3 x 0...U <sub>in</sub>							
Output frequency	11)	[Hz]	see control board							
Max. motor line length shielded at 4 kHz		[m]	30	100	100	100	100	100		
Max. motor line length shielded at 8 kHz		[m]	20	30	100	100	100	–		
Max. motor line length shielded at 16 kHz		[m]	10	10	20	100	100	–		

- 1) With regulated systems 5% are to be subtracted as overmodulation capacity
- 2) Max. current before the OL2 function triggers (not at F5 in operating mode v/f)
- 3) Recommended minimum cross section of the motor line for rated power and a cable length of upto 100m (copper)
- 4) This data is only valid for units with internal brake transistor GTR 7 (see "unit identification")
- 5) At rated voltages  $\geq 460V$  multiply the rated current with factor 0.86
- 6) With BASIC control board only 2 kHz, with COMPACT only 8 kHz, with F6-K only 8 kHz
- 7) Protection in accordance with UL see annex B
- 8) Restrictions when using HF filters
- 9) Phase conductor grounded mains are only permissible without HF filters
- 10) The voltage at the motor is dependent on the series-connected units and on the control method (see A.3)
- 11) The output frequency is to be limited in such way that 1/10 of the switching frequency is not exceeded

The technical data are for 2/4-pole standard motors. With other pole numbers the inverter must be dimensioned onto the motor rated current. Contact KEB for special or medium frequency motors.



No braking resistor may be connected for control type "Basic" at an input rated voltage of 480 Vac. The response threshold of the braking transistor (Pn.69) for all other controls without safety technology (A, E, G, H, M) must be adjusted at least to 770 Vdc (see annex D).

## 2.4 DC supply

### 2.4.1 Calculation of the DC input current

The **DC input current** of the inverter is basically determined by the used motor. The data can be taken from the motor name plate.

**230V class :**

$$I_{DC} = \frac{\sqrt{3} \cdot \text{rated motor voltage} \cdot \text{rated motor current} \cdot \text{Motor } \cos \varphi}{\text{DC voltage (310 V)}}$$

**400V class :**

$$I_{DC} = \frac{\sqrt{3} \cdot \text{rated motor voltage} \cdot \text{rated motor current} \cdot \text{Motor } \cos \varphi}{\text{DC voltage (540 V)}}$$

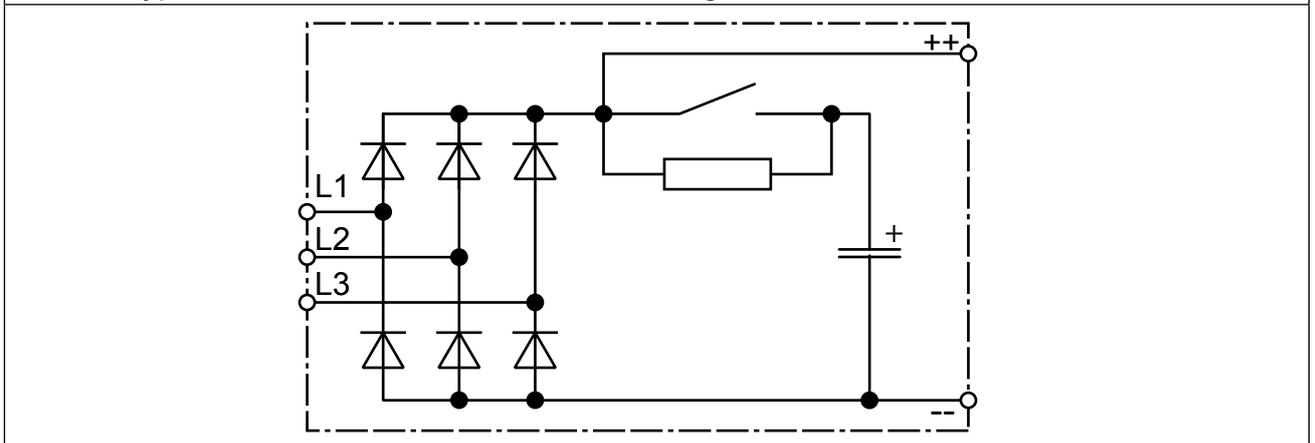
The **DC input peak current** is determined by the operating range.

- If you accelerate on the hardware current limit, the short-time current limit of the inverter must be used in the formula above (instead of the rated motor current).
- If the motor in normal operation is never stressed with rated torque, it can be calculated with the real motor current.

### 2.4.2 Internal input circuit

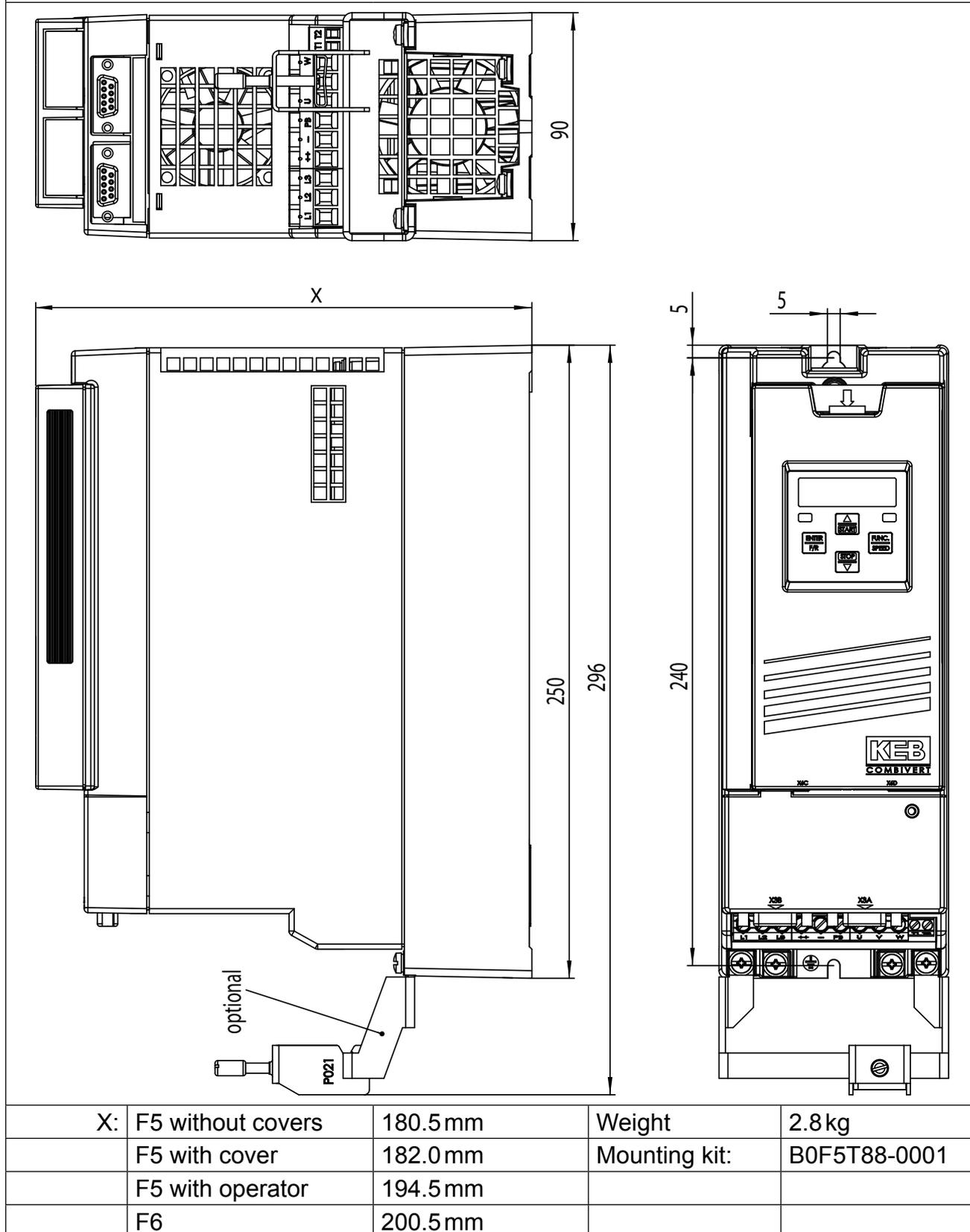
The COMBIVERT F5/F6 in D housing corresponds to the inverter type A1. Pay attention to the inverter type in DC interconnection and in operation at regenerative units.

Inverter type for COMBIVERT F5/F6 in D housing: A1

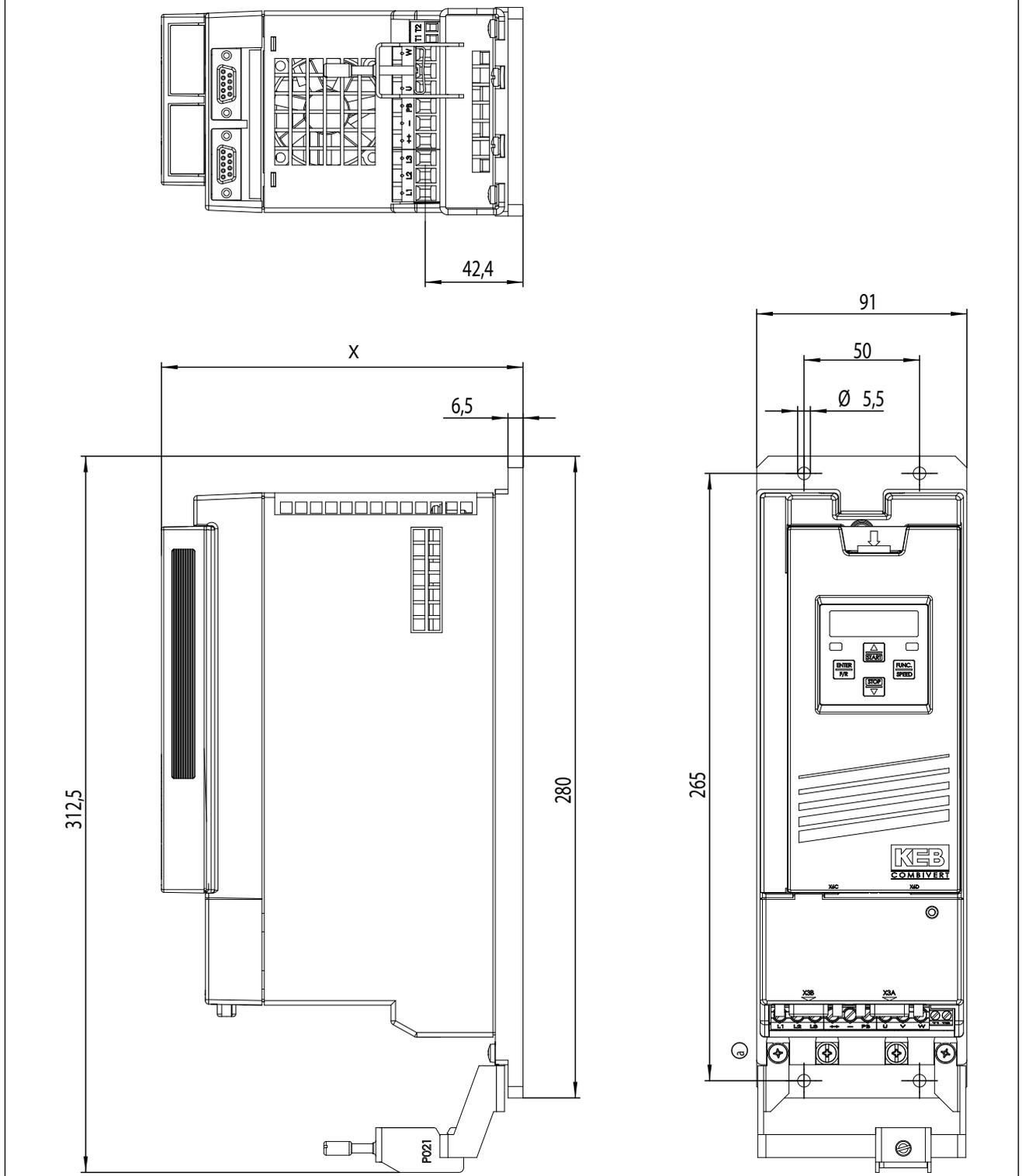


## 2.5 Dimensions and weights

Dimensions mounted version (representation with optional mounting kit)

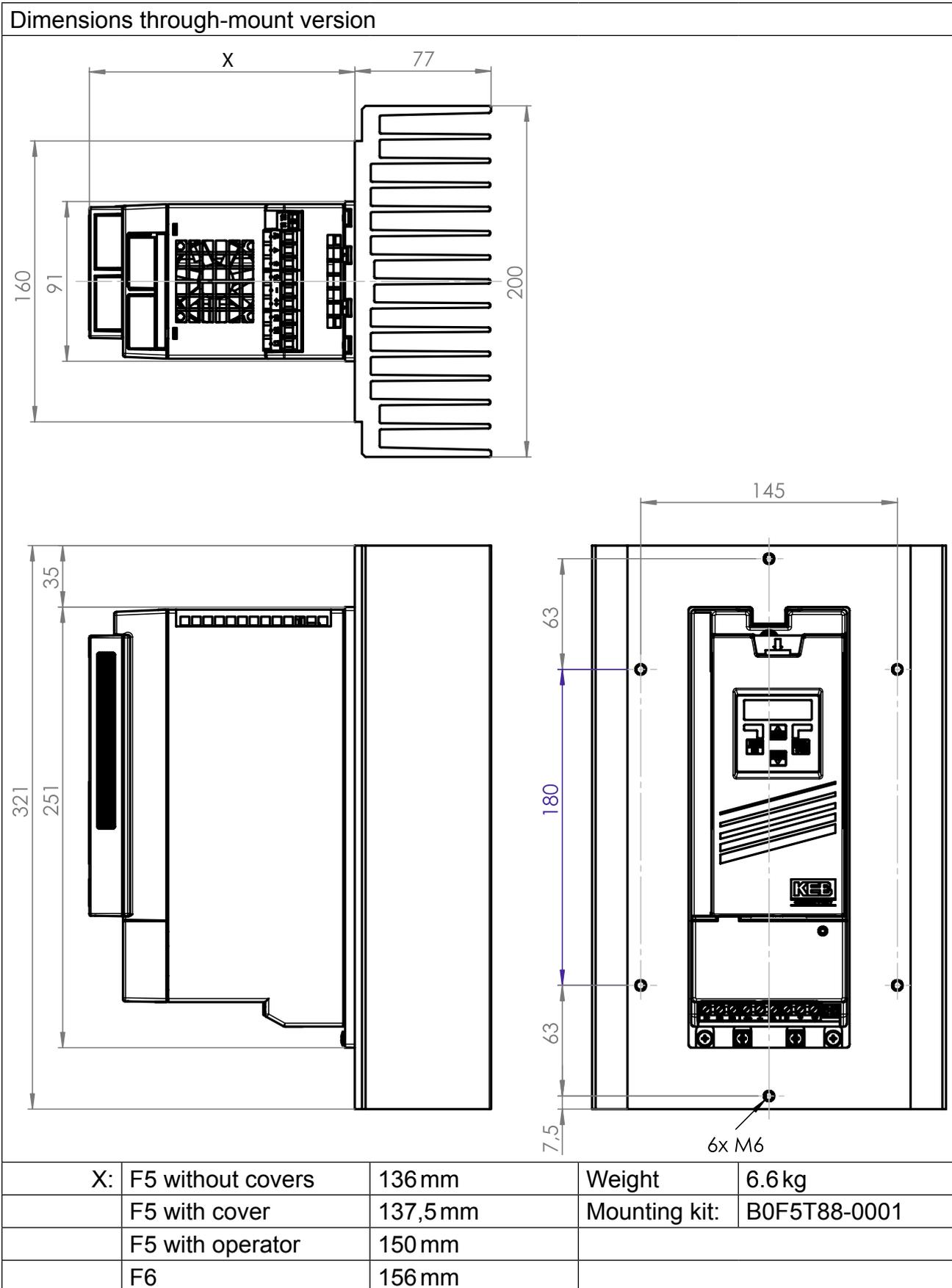


Dimensions Flatrear (representation with optional mounting kit)

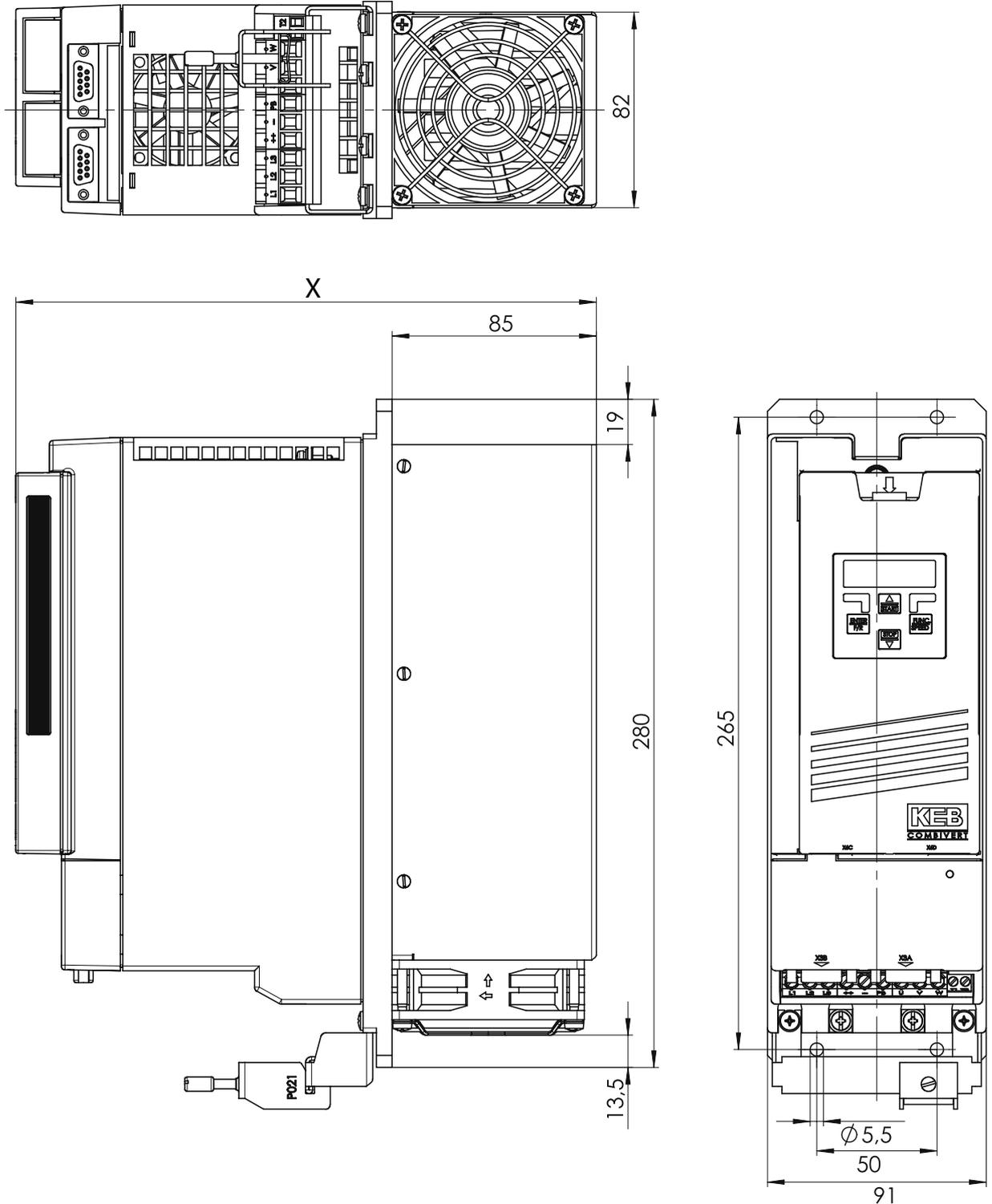


X:	F5 without covers	142.5 mm	Weight	2.7 kg
	F5 with cover	144.0 mm	Mounting kit:	B0F5T88-0001
	F5 with operator	156.5 mm		
	F6	162.5 mm		

# Technical Data - Dimensions and Weights



Dimensions through-mount version (special version with optional mounting kit)



X:	F5 without covers	227.5 mm	Weight	4.2 kg
	F5 with cover	229.0 mm	Mounting kit:	B0F5T88-0001
	F5 with operator	241.5 mm	Seal	09F4T45-0087
	F6	247.5 mm		

## 2.6 Terminal strips of the power circuit

	Observe input voltage, since 230 V and 400 V class possible
	All terminal strips following the requirements of the EN 60947-7-1 (IEC 60947-7-1)

	Name	Function	Cable cross-sections	Terminals No.
	L1, N	1-phase mains connection		1
	L1, L2, L3	3-phase mains connection		
	U, V, W	Motor connection		
	++, PB	Connection for braking resistor		
	++, --	Connection for braking module, Regenerative- and supply unit or as DC voltage input 250...370 VDC (230 V class) 420...720 VDC (400 V class)		
	T1, T2	Connection for temperature sensor		2
		PE connection		3
	Connection for shielding/screening shield			

### 2.6.1 Permissible cable cross-sections and tightening torques of the terminals

No.	permissible cross-section flexible with wire-end ferule				Tightening torque	
	mm <sup>2</sup>		AWG		Nm	lb inch
	min	max	min	max		
1	0.25	1.5	24	10	0.6	5
2	0.14	1.5	26	14	0.6	5
3	Screw M4 for ring thimble				1.3	11

## 2.7 Accessories

### 2.7.1 Filter and chokes

Voltage class	Inverter size	Filter	Mains choke 50 Hz (4 % Uk)	Motor choke 100 Hz (4 % Uk)
230 V 1-phase	07	10E5T60-1002	07Z1B02-1000	–
	09		09Z1B02-1000	–
	10		10Z1B02-1000	–
230 V 3-phase	07	10E5T60-1002	07Z1B03-1000	–
	09	13E5T60-1001	09Z1B03-1000	–
	10		10Z1B03-1000	–
	12	14U5T60-1001	12Z1B03-1000	–

Voltage class	Inverter size	Filter	Mains choke 50 Hz (4 % Uk)	Motor choke 100 Hz (4 % Uk)
400 V	07	10E5T60-1002	07Z1B04-1000	07Z1F04-1010
	09		09Z1B04-1000	09Z1F04-1010
	10		10Z1B04-1000	10Z1F04-1010
	12	13E5T60-1001	12Z1B04-1000	12Z1F04-1010
	13		13Z1B04-1000	13Z1F04-1010
	14	14E5T60-1001	14Z1B04-1000	14Z1F04-1010

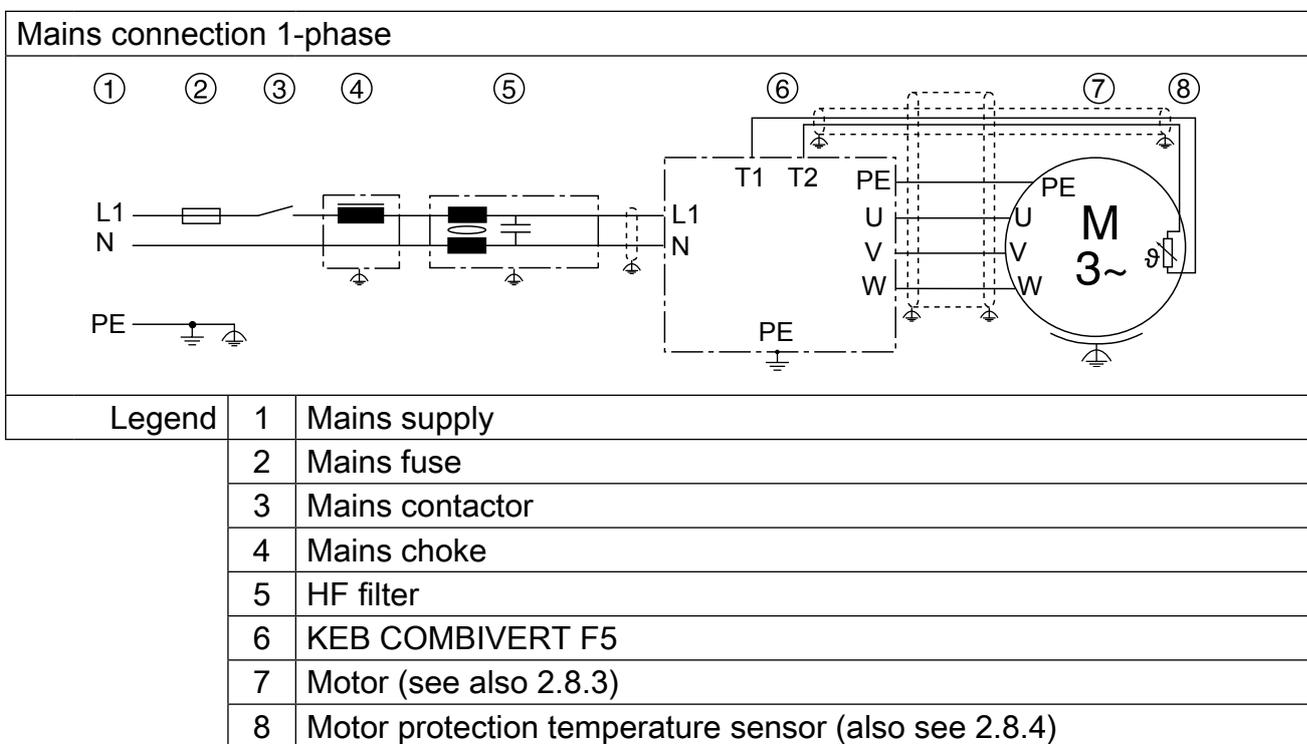
## Connection Power Unit

### 2.8 Connection Power Unit

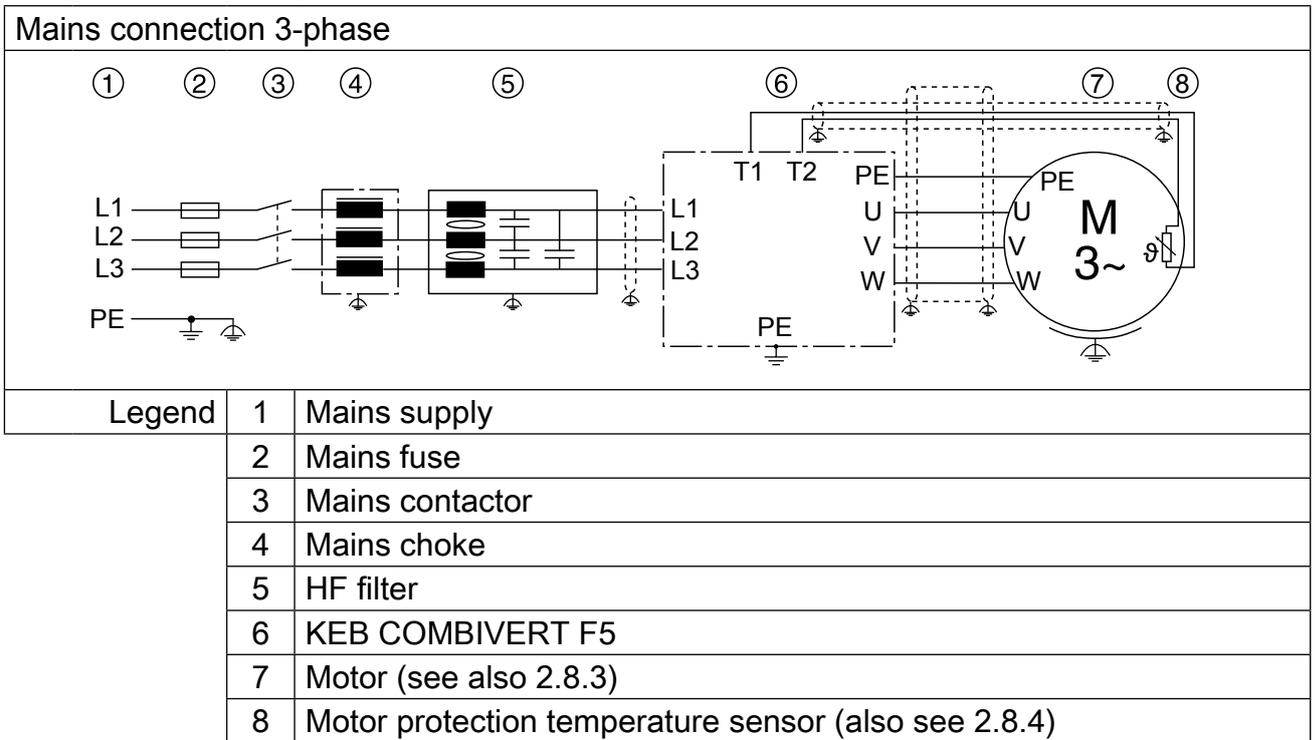
#### 2.8.1 Mains and motor connection

	Absolutely pay attention to the supply voltage of the KEB COMBIVERT. A 230 V unit at 400 V mains is destroyed immediately.
	Exchanging mains and motor connection leads to immediate destruction of the unit.
	Pay attention to the supply voltage and the correct polarity of the motor!

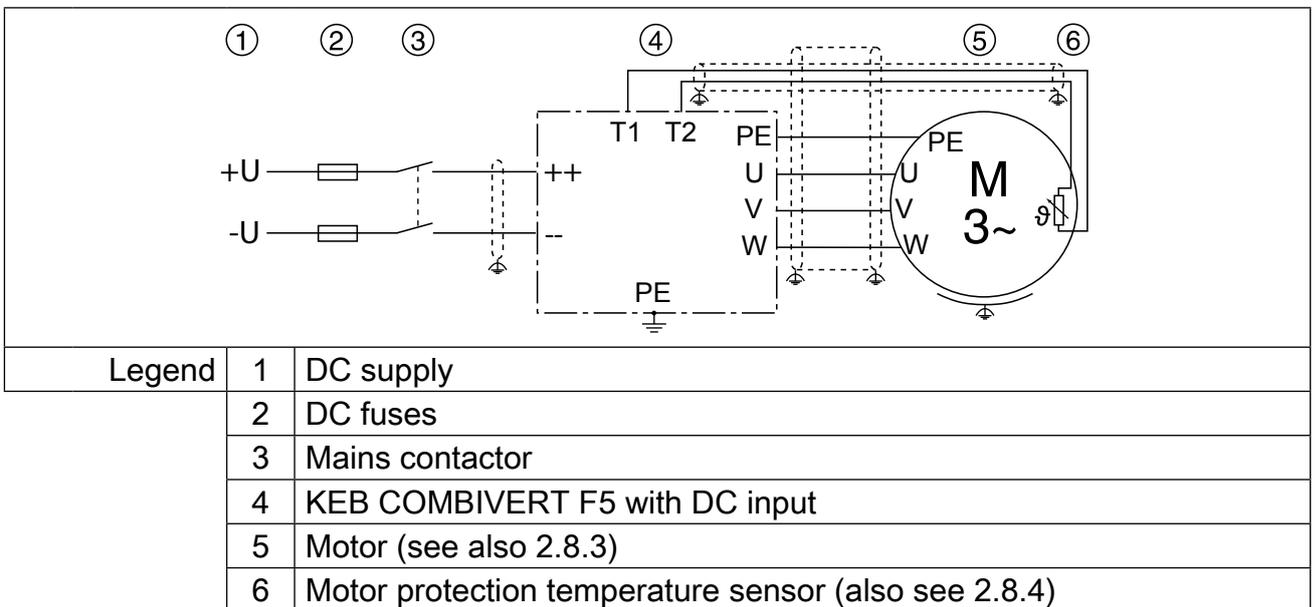
##### 2.8.1.1 Mains connection 1-phase



2.8.1.2 Mains connection 3-phase



2.8.1.3 DC connection



2.8.2 Selection of the motor cable

The correct selection and wiring of the motor cable is very important:

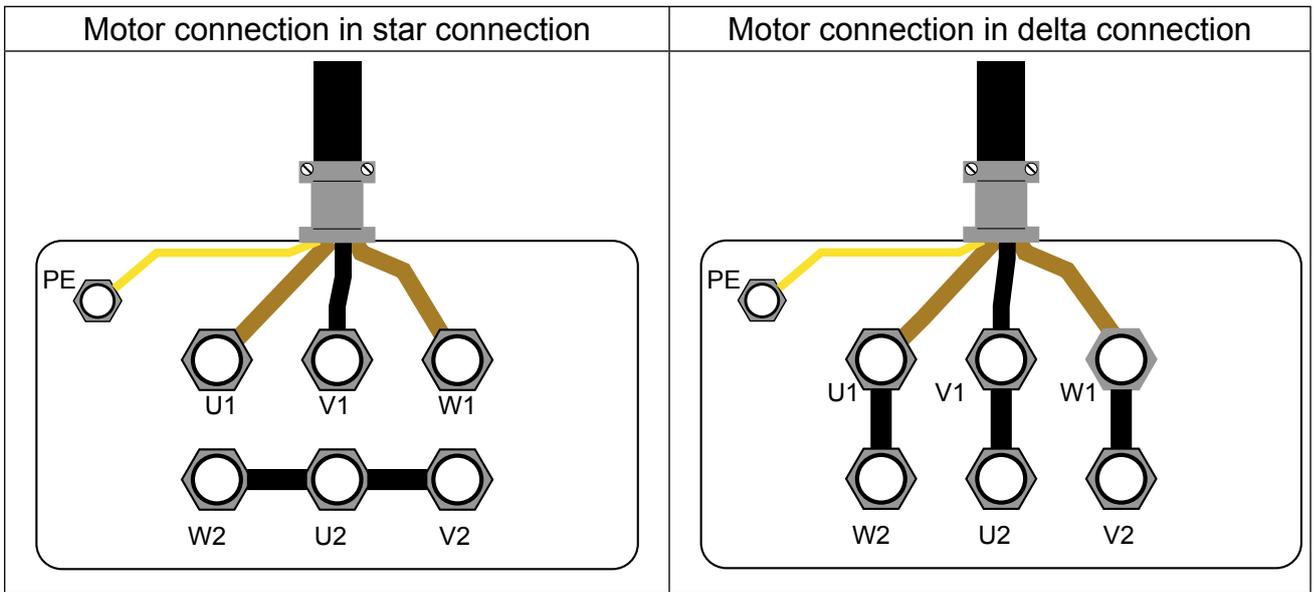
- lower abrasion of the motor bearings by leakage currents
- improved EMC characteristics
- lower symmetrical operating capacities
- less losses by transient currents

# Connection Power Unit

## 2.8.3 Connection of the motor

As standard the connection of the motor must be carried out in accordance with the following table:

230/400 V motor		400/690 V motor	
230 V	400 V	400 V	690 V
Delta	Star	Delta	Star



	The connecting-up instructions of the motor manufacturer are generally valid!
--	---

	<p>Protect motor against voltage peaks!</p> <p>Inverters switch with dv/dt of approx. 5kV/μs at the output. Voltage peaks at the motor which endanger the insulation system can occur especially in case of long motor lines (&gt; 15 m). A motor choke, a dv/dt-filter or sine-wave filter can be used for protection of the motor.</p>
--	--

### 2.8.3.1 Motor cable length for parallel operation of motors

The resulting motor cable length for parallel operation of motors, or parallel installation with multiple cables arises from the following formula:

$\text{resulting motor cable length} = \sum \text{single line length} \times \sqrt{\text{Number of motor lines}}$
---

**2.8.4 Temperature detection T1, T2**

In.17	Function of T1, T2	Pn.72 (dr33)	Resistance	Display ru.46 (F6 => ru28)	Error/Warning <sup>1)</sup>
5xh	PTC (in accordance with DIN EN 60947-8)	1	< 750 Ω	T1-T2 closed	–
			0.75...1.65 kΩ (reset resistance)	undefined	–
			1.65...4 kΩ (tripping resistance)	undefined	x
			> 4 kΩ	T1-T2 open	x
1)	The column is valid at factory setting. The function must be programmed accordingly with parameters Pn.12, Pn.13, Pn.62 and Pn.72 for F5 in operating mode GENERAL.				



- Do not lay PTC cable of the motor (also shielded) together with control cable!
- PTC cable inside the motor cable only permissible with double shielding!

**2.8.4.1 Use of the temperature input**

Wiring example in PTC mode	
Thermal contact (NC contact)	
Temperature sensor (PTC)	
Mixed sensor chain	

The function can be switched off with Pn.12="7" (CP.28) if no evaluation of the input is desired (standard in operating mode GENERAL). Alternatively a bridge can be installed between T1 and T2.

## 2.8.5 Connection of a braking resistor

	Braking resistors dissipate the produced energy of the motor into heat during generative operation. Thus braking resistors can cause very high surface temperatures. During assembly pay attention to appropriate protection against contact and fire.
	The use of a regenerative unit is reasonable for applications which produce a lot of regenerative energy. Regeneration of excess energy into the mains.
	The mains voltage must always be switched off in order to guarantee fire protection in case of a defective braking transistor.
	The frequency inverter remains in operation in spite of switched off power supply in generative operation. An error must be released by external wiring which switches the modulation off in the inverter. This can occur e.g. at terminals T1/T2 or via digital input. The frequency inverter must be programmed accordingly in each case.
	No braking resistor may be connected for control type "Basic" at an input rated voltage of 480 Vac. The response threshold of the braking transistor (Pn.69) for all other controls without safety technology (A, E, G, H, M) must be adjusted at least to 770 Vdc (see annex D).

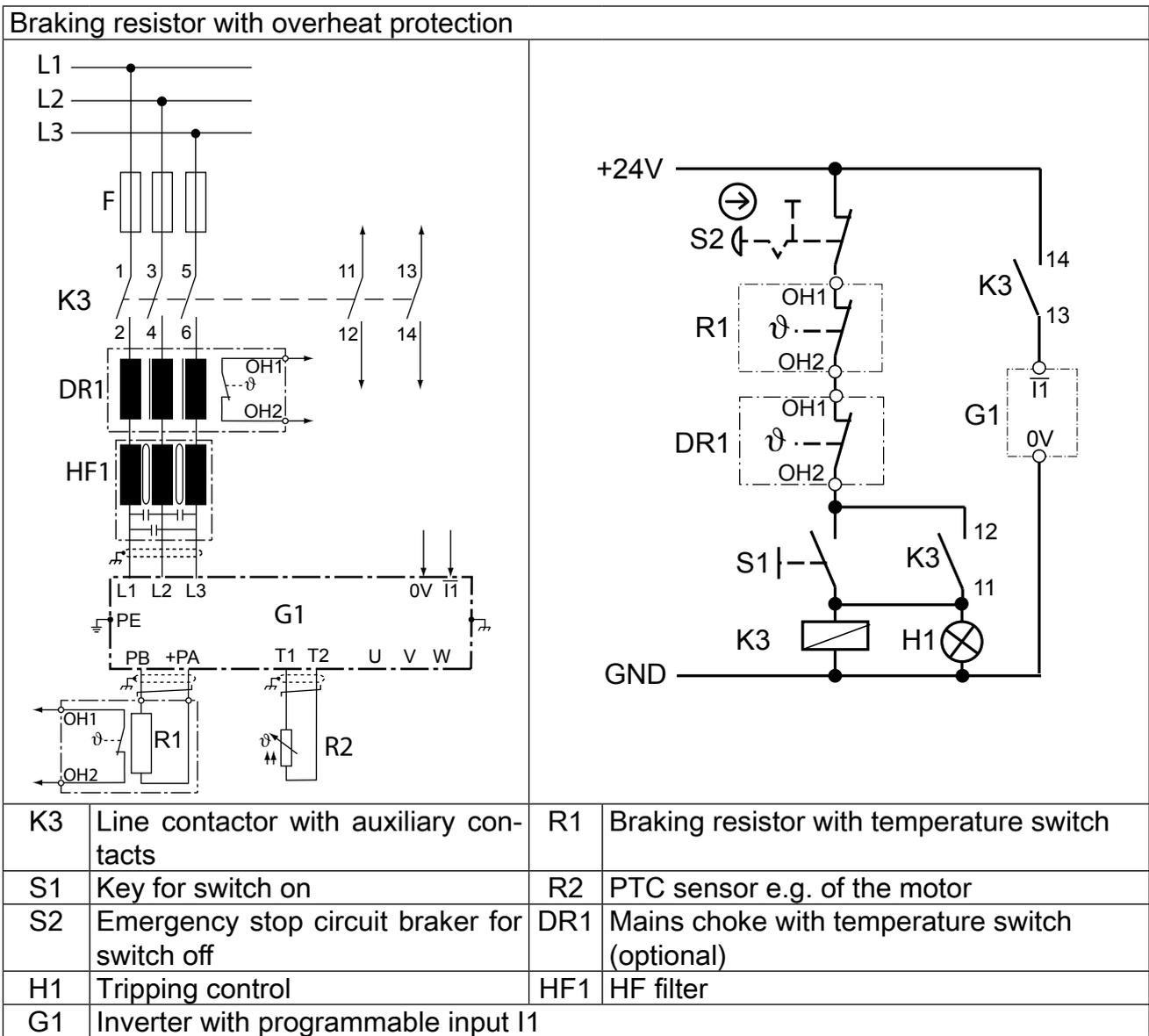
### 2.8.5.1 Braking resistor without temperature monitoring

Intrinsically safe braking resistor without temperature monitoring	
	Only "intrinsically safe" braking resistors are permissible for operation without temperature monitoring.

2.8.5.2 Braking resistor with overheat protection

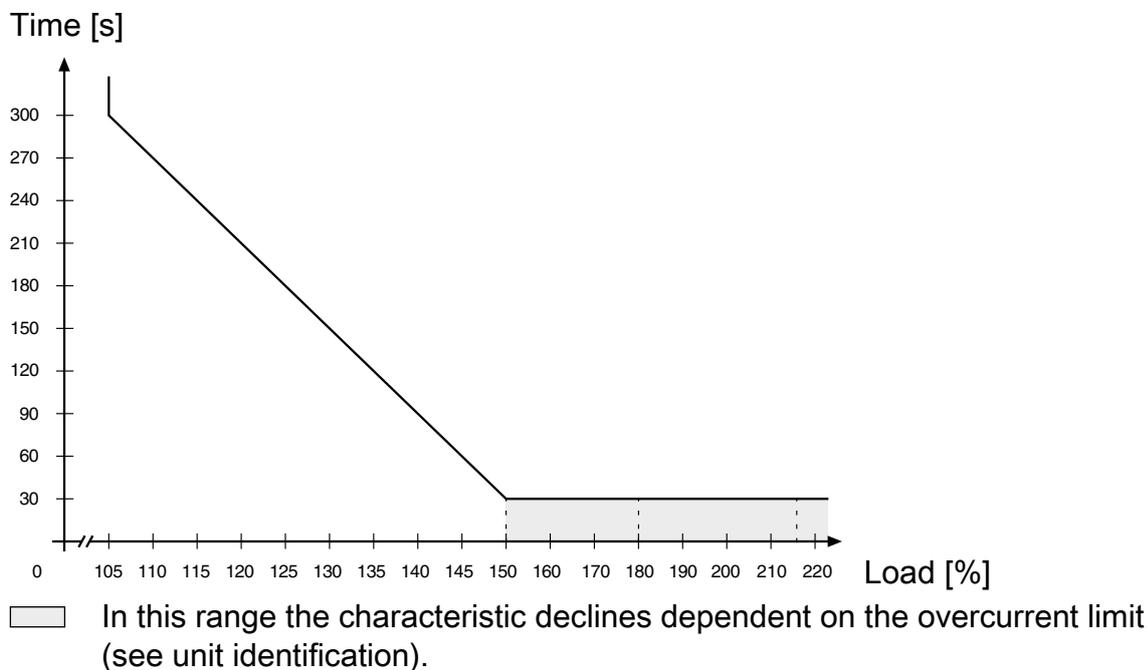
This circuit offers a direct protection with defective braking transistor (GTR7). The braking resistor overheats and opens the terminals OH1 and OH2 with defective GTR7. The OH terminals open the holding circuit of the input contactor, so that the input voltage is switched off in error case. An error in inverter is released by opening the auxiliary contacts of K3. Regenerative operation is also secured by the internal fault disconnection. The input must be programmed and inverted to "external error". Automatic restarting after cooling of the braking resistor is prevented by the self-holding circuit of K3.

 If the PTC evaluation of the motor at terminals T1/T2 is not used, these terminals can be used instead of the programmable input.



## Annex A

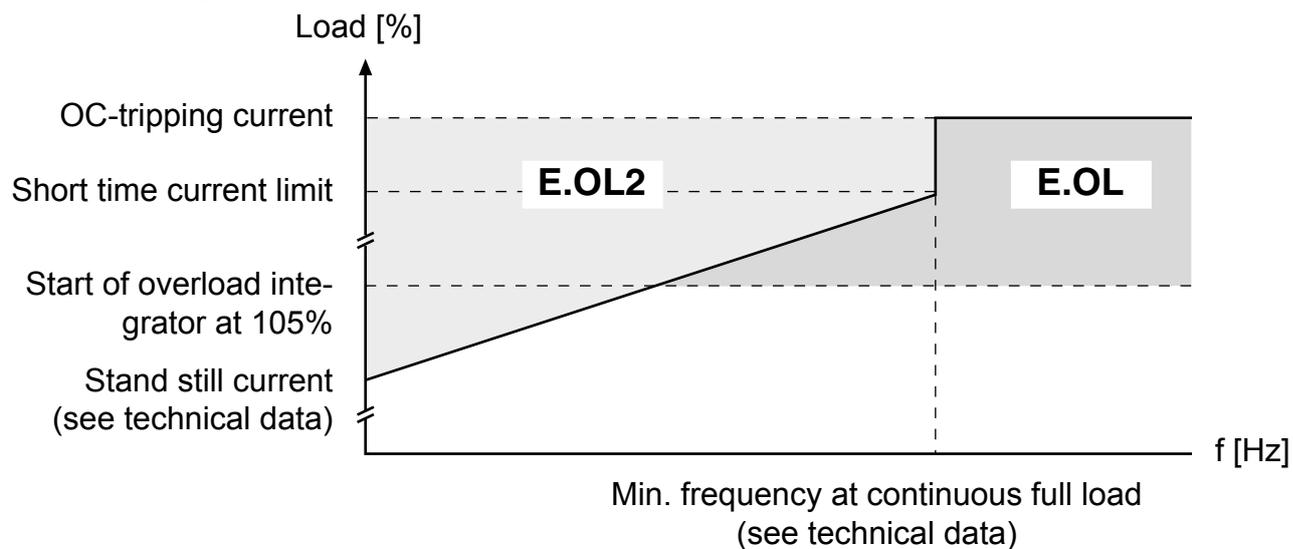
### A.1 Overload characteristic



On exceeding a load of 105% the overload integrator starts. When falling below the integrator counts backwards. If the integrator achieves the overload characteristic that corresponds to the inverter, the error E.OL is triggered.

### A.2 Overload protection in the lower speed range

(only operating mode MULTI and SERVO)



A PT1 element ( $\tau=280$  ms) starts if the permissible current is exceeded. After its sequence of operation the error E.OL2 is triggered.

**A.3 Calculation of the motor voltage**

The motor voltage for dimensioning of the drive is depending on the used components. The mains voltage reduces according to the following table:

Mains choke Uk	4 %	Example: Closed-loop inverter with mains- and motor choke at non-rigid supply system: 400V mains voltage - 15 % = 340V motor voltage
Inverter open-loop	4 %	
Inverter closed-loop	8 %	
Motor choke Uk	1 %	
Non-rigid supply system	2 %	

**A.4 Shut down**

All work may only be done by qualified personnel. The security must be ensured as follows:

- Disconnect power supply at MCCB
- Secure against restarting
- Await discharge time of capacitors (if necessary controlling by measurement at „+PA“ and „-“, respectively “++“ and „--“)
- Ensure loss of voltage by measurement

**A.4.1 Maintenance**

In order to avoid premature ageing and avoidable malfunctions, the measures mentioned below must be carried out in the appropriate cycle.

Cycle	Function
Constant	Pay attention to unusual noises of the motor (e.g. vibrations) as well as of the frequency inverter (e.g. fan).
	Pay attention to unusual smells of the motor or frequency inverter (e.g. evaporation of capacitor electrolyte, braise of the motor winding)
Monthly	Check unit for loose screws and plugs and if necessary tighten up.
	Clean frequency inverter from dirt and dust deposits. Pay attention especially to cooling fins and protective grid of the fans.
	Examine and clean extracted air filter and cooling air filter of the control cabinet.
Annual	Examine function of the fans of the KEB COMBIVERT. The fans must be replaced in case of audible vibrations or squeak.
	Check the connecting ducts for corrosion and change it if necessary for units with water cooling.

**A.4.2 Storage**

The DC link of the KEB COMBIVERT is equipped with electrolytic capacitors. If the electrolytic aluminium capacitors are stored de-energized, the internal oxide layer is removed slowly. Due to the leakage current the oxide layer is unrenewed. If the capacitor starts running with rated voltage there is a high leakage current which can destroy the capacitor.

In order to avoid defectives, the KEB COMBIVERT must be started up depending on the storage period in accordance with the following specification:

Storage period < 1 year
• Start-up without special measures
Storage period 1...2 years
further on next side

<ul style="list-style-type: none"> <li>Operate frequency inverter one hour without modulation</li> </ul>		
Storage period 2...3 years		
<ul style="list-style-type: none"> <li>Remove all cables from the power circuit; especially of braking resistor or module</li> <li>Open control release</li> <li>Connect variable transformer to inverter input</li> </ul>		
<ul style="list-style-type: none"> <li>Increase variable transformer slowly to indicated input voltage (&gt;1 min) and remain at least on the specified time.</li> </ul>		
Voltage class	Input voltage	Residence time
230 V	0...160 V	15 min
	160...220 V	15 min
	220...260 V	1 h
400 V	0...280 V	15 min
	280...400 V	15 min
	400...500 V	1 h
Storage period > 3 years		
<ul style="list-style-type: none"> <li>Input voltages as before, however double the times per year. Eventually change capacitors.</li> </ul>		

After expiration of this start-up the KEB COMBIVERT can be operated on nominal rating conditions or delivered to a new storage.

### A.4.3 Cooling circuit

The cooling circuit must be completely empty if a unit shall be switched off for a longer period. The cooling circuit must be blown out additionally with compressed air at temperatures below 0°C.

### A.4.4 Fault correction

A defective device should only be repaired by KEB or an authorized partner. Defective components, modules or options may only be replaced by original parts. The device must be returned in original packaging with a detailed bug report.

### A.4.5 Disposal

Defective devices which should not be repaired or which are not safe because of their service life are applied as electronic waste and must be disposed as hazardous waste according to the local regulations.

## Annex B

### B.1 Certification

#### B.1.1 CE Marking

CE marked frequency inverter and servo drives were developed and manufactured to comply with the regulations of the Low-Voltage Directive 2006/95/EC.

The inverter or servo drive must not be started until it is determined that the installation complies with the Machine directive (2006/42/EC) as well as the EMC-directive (2004/108/EC) (note EN 60204).

The frequency inverters and servo drives meet the requirements of the Low-Voltage Directive 2006/95/EC. They are subject to the harmonized standards of the series EN61800-5-1.

This is a product of limited availability in accordance with IEC61800-3. This product may cause radio interference in residential areas. In this case the operator may need to take corresponding measures.

#### B.1.2 UL Marking

	<p>Acceptance according to UL is marked at KEB inverters with the adjacent logo on the type plate.</p>
--	--

To be conform according to UL for use on the North American and Canadian Market the following additionally instructions must be observed (original text of the UL-File):

- For control cabinet mounting as „Open Type“
- „Only for use in WYE 480V/277V supply sources“
- Operator and Control Board Rating of relays (30Vdc.: 1A)
- Maximum Surrounding Air Temperature 45 °C (113 °F)
- Overload protection at 130 % of inverter output rated current (see type plate)
- Motor protection by adjustment of inverter parameters. For adjustment see application manual parameters Pn.14 and Pn.15.
- „Use 60/75°C Copper Conductors Only“
- Terminals - Torque Value for Field Wiring Terminals, the value to be according to the R/C Terminal Block used.
- Use in a Pollution Degree 2 environment
- "Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the Manufacturer Instructions, National Electrical Code and any additional local codes", or the equivalent".

further on next side

- “D Housing - Series Combivert, Cat. Nos. 07, 09, 10, 12, 13 or 14, followed by F5, followed by B or C, followed by 0, 1, 2, 3, A, B, C or D, followed by D-, followed by four suffixes.

D Housing - Series Combivert, Cat. No. 07, 09, 10, 12, 13 or 14, followed by F5, followed by B or C, followed by 0, 1, 2, 3, A, B, C or D, followed by D-, followed by three suffixes and followed by 4 or E or J.

Motor Overtemperature Protection:

above drive models are not provided with load and speed sensitive overload protection and thermal memory retention up on shutdown or loss of power (for details see NEC, article 430.126(A)(1)).

For 240 V Models:

„Suitable For Use On A Circuit Capable Of Delivering Not More Than 10000 rms Symmetrical Amperes, 240 Volts Maximum, when Protected by Fuses, see Instruction Manual for specified fuse details and alternate Branch Circuit Protection details.”

For 480 V Models:

„Suitable For Use On A Circuit Capable Of Delivering Not More Than 10000 rms Symmetrical Amperes, 480 Volts Maximum, when Protected by Fuses, see Instruction Manual for specified fuse details and alternate Branch Circuit Protection details.”

For all Models:

Branch Circuit Protection: **input fusing for inverters of Drive Series F5-D and F6-D:**

Inverter model F5/F6	Input Voltage (V)	UL 248 Fuse class RK5 or J or CC [A] *	Semiconductor fuses Cat. No. (#)
07	240 /1ph	15	50 140 06 40
	240 /3ph	10	50 140 06 20
07	480 / 3ph	10	50 140 06 12
09	240 /1ph	20	50 140 06 40
	240 /3ph	15	50 140 06 25
09	480 / 3ph	10	50 140 06 12
10	240 /1ph	30	50 140 06 63
	240 /3ph	20	50 140 06 35
10	480 / 3ph	12	50 140 06 16
12	240 /1ph	35	50 140 06 100
	240 /3ph	25	50 140 06 50
12	480 / 3ph	15	50 140 06 25
13	480 / 3ph	25	50 140 06 40
14	480 / 3ph	30	50 140 06 40

\*) The voltage rating of the Class rated fuses (CC,J or RK5) shall be at least equal to the voltage rating of the Drives.

(#) manufactured by Siba Sicherungen-Bau GmbH

Branch Circuit Protection: **Type E Self Protected Manual Motor Controllers for Drive series inverters F5–D and F6-D.**

Listed (NKJH) Type E Self Protected Manual Motor Controllers. Type and manufacturer and electrical ratings as specified below:

240V devices:

Inverter model F5/F6	Drive input rating	Self Protected Manual Motor Controller Type and manufacturer	Self Protected Manual Motor Controller rating
07	240V/ 1ph	PKZMO-16E, Eaton Industries	230V/ 1ph, 2 hp
07	240V/ 3ph	PKZMO-10E, Eaton Industries	230V/ 3ph, 3 hp
09	240V/ 1ph	PKZMO-20E, Eaton Industries	230V/ 1ph, 3 hp
09	240V/ 3ph	PKZMO-16E, Eaton Industries	230V/ 3ph, 5 hp
10	240V/ 1ph	PKZMO–32E, Eaton Industries	230V/ 1ph, 5 hp
10	240V/ 3ph	PKZMO-16E, Eaton Industries	230V/ 3ph, 5 hp
12	240V/ 1ph	PKZMO-40E, Eaton Industries	230V/ 1ph, 7,5 hp
12	240V/ 3ph	PKZMO-25E, Eaton Industries	230V/ 3ph, 7,5 hp

480V devices:

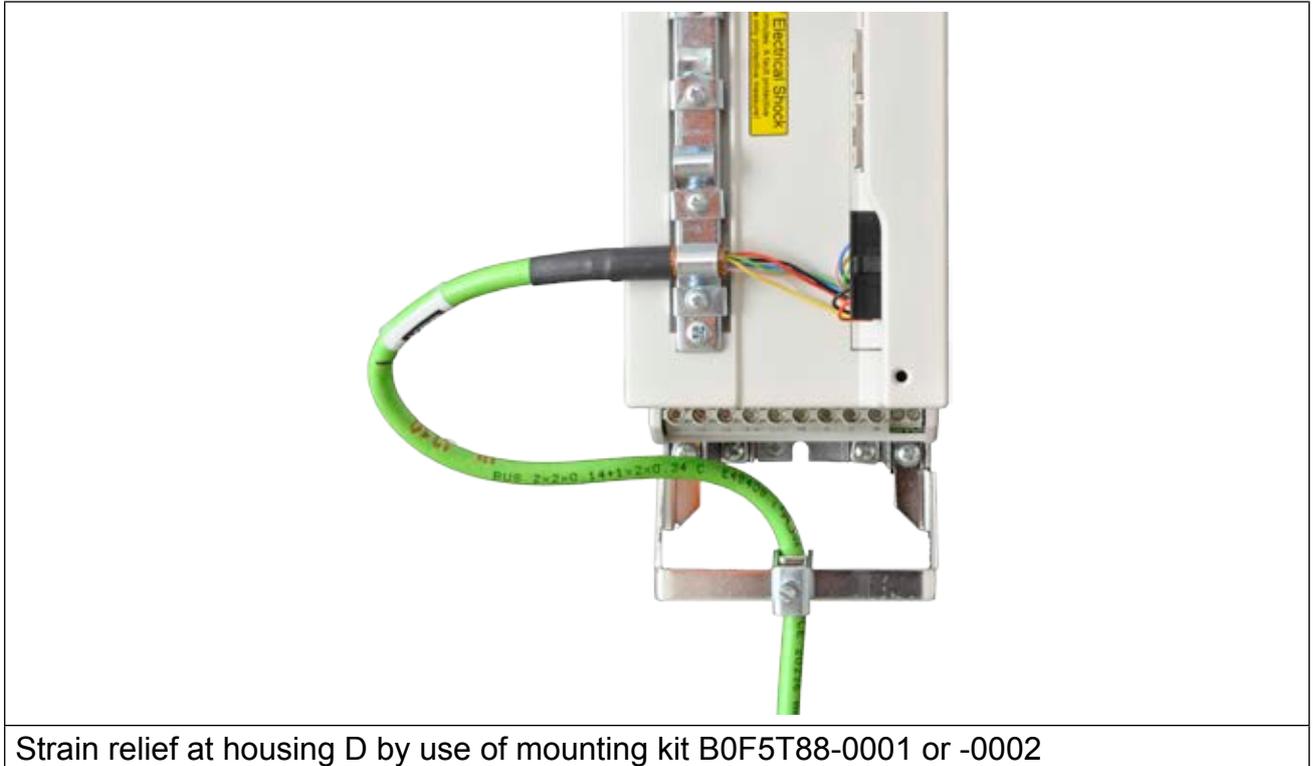
Inverter model F5/F6	Drive input rating (#)	Self Protected Manual Motor Controller Type and manufacturer	Self Protected Manual Motor Controller rating
07	480V/ 3ph	PKZMO-10E, Eaton Industries	480Y/277V, 7,5 hp
09	480V/ 3ph	PKZMO-10E, Eaton Industries	480Y/277V, 7,5 hp
10	480V/ 3ph	PKZMO-12E, Eaton Industries	480Y/277V, 7,5 hp
12	480V/ 3ph	PKZM4-16E, Eaton Industries	480Y/277V, 10 hp
13	480V/ 3ph	PKZM4-25E, Eaton Industries	480Y/277V, 15 hp
14	480V/ 3ph	PKZM4-25E, Eaton Industries	480Y/277V, 15 hp

(#) all Drives series which use a Self Protected Motor Controller rated 480Y/277V are suitable for 480y/277V sources only.

**Only for F6 housing E series:**

“For Connector CN300 on Control Board:

Only use KEB Cable assembly Cat.No. 00H6L41-0xxx or 00H6L53-2xxx (where x = any digit) and use strain relief provisions as described below:”



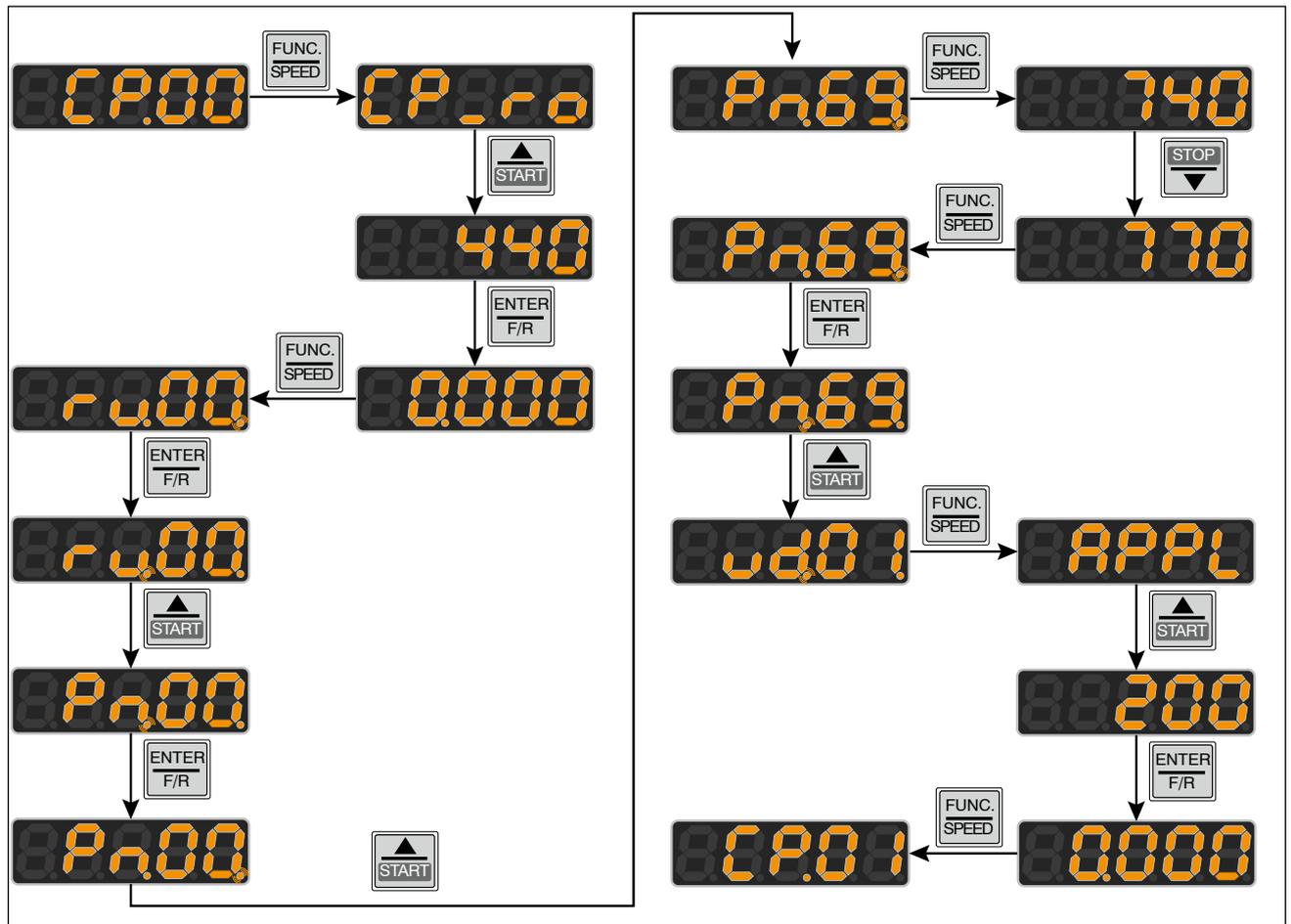
Strain relief at housing D by use of mounting kit B0F5T88-0001 or -0002

## Annex D

### D.1 Changing the response threshold of the braking transistor

(not valid for control type „BASIC“)

To avoid a premature switching of the brake transistor at an input rated voltage of 480Vac, the response threshold must be controlled or adjusted according to the following graphic.





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