COMBIVERT

Read Instruction manual part 1 first!

GB INSTRUCTION MANUAL

Power Circuit 0.37...37 kW

Mat. No.	Rev.
00F50EB-K004	1B

GB

Table of Contents

1. General

1.1 Preface

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 niveau.
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 used pictograms have following significance:

 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 the safe and trouble-free operation.
 Information Aid Tip	Is used, if a measure simplifies the handling or operation of the unit.

Non-observance of the safety instructions leads to the loss of any liability claims. This list is not exhaustive.

1.2 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 safety. 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.

1.3 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.

1.4 Specified application

The COMBIVERT F5 serves exclusively for the control and regulation of three-phase motors. The operation of other electric consumers is prohibited and can lead to the destruction of the unit. Frequency inverter are components which are intended for the installation in electric systems or machines.

The used semiconductors and components of KEB are developed and dimensioned for the use in industrial products. If the KEB COMBIVERT F5 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.

1.5 Product Description

In selecting the KEB COMBIVERT you have acquired a frequency inverter with the highest demands on quality and dynamic.

This instruction manual describes the power circuits of the frequency inverter **KEB COMBIVERT F5** in the range of

- **0.37…18.5 kW / 230 V class**
- **0.37…37 kW / 400 V class**

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
- noise immunity according to IEC1000
- hardware current limit
- integrated cooling fan
- uniform mounting grid
- mountable side by side through rack design

This instruction manual is only valid in connection with part 1 and part 3.

1.6 Safety and operating instructions for drive converters

Safety and Operating Instructions
for drive converters
(in conformity with the Low-Voltage Directive 2006/95/EC)

1. General

In operation, drive converters, 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 CENELEC 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 converters are components designed for inclusion in electrical installations or machinery.

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 Directive). Account is to be taken of EN 60204.

Commissioning (i.e. the starting of normal operation) is admissible only where conformity with the EMC directive (2004/108/EC) has been established.

The drive converters meet the requirements of the Low-Voltage directive 2006/95/EC. The harmonized standards EN 50178/ VDE 0160 are used for the drive converters.

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 50178.

4 Installation

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

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

7. Maintenance and servicing

The manufacturer’s documentation shall be followed.

KEEP SAFETY INSTRUCTIONS IN A SAFE PLACE!

1.7 Unit identification

10.F5.C 1 B-3 A 0 A

at frequency inverter: Cooling		at servos: Motor cooling	
0, 5, A, F	Heat sink (standard)	0	Self-cooling
1, B, G	Flat rear	1	External cooling
2, C, H	Water-cooling system		
3, D, I	Convection		

Encoder interface

0: none

at frequency inverter: 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 %

at servos: Motor speed

1	1500 rpm	2	2000 rpm	3	3000 rpm	4	4000 rpm	6	6000 rpm

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 V DC		
4	230 V class DC	9	3ph 400 VAC				

Housing type A, B, D, E, G, H, R, U, W, P

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
B	BASIC (controlled frequency inverter)
C	COMPACT (controlled frequency inverter)
E	SCL
G	GENERAL (controlled frequency inverter)
H	ASCL
M	MULTI (regulated, field-oriented frequency inverter for three-phase asynchronous motors)
S	SERVO (regulated frequency inverter for synchronous motors)

Series F5

at frequency inverter: Inverter size

at servos: motor identification / motor dimension wide

1.8 Installation instructions

1.8.1 Cooling systems

The KEB COMBIVERT F5 is available for different cooling systems:

Standard version

The standard version is delivered with heat sink and cooling fan (described in the following).

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.
- **Water cooling**
  This version is dimensioned for the connection to an available cooling system. The dissipation of the power loss must be ensured by the machine builder. In order to avoid moisture condensation, the minimum inlet temperature may not decrease the ambient temperature. The max. inlet temperature may not exceed 40°C. No aggressive coolant shall be used. Measures against contamination and calcination must be done externally. Max. pressure on the cooling system may not exceed 4 bar (special versions with higher pressures possible on request).
- **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 Safety relay for „safety stop in accordance with EN954-1/ category 3“

With the function "safety stop" one of the following conditions must be fulfilled:

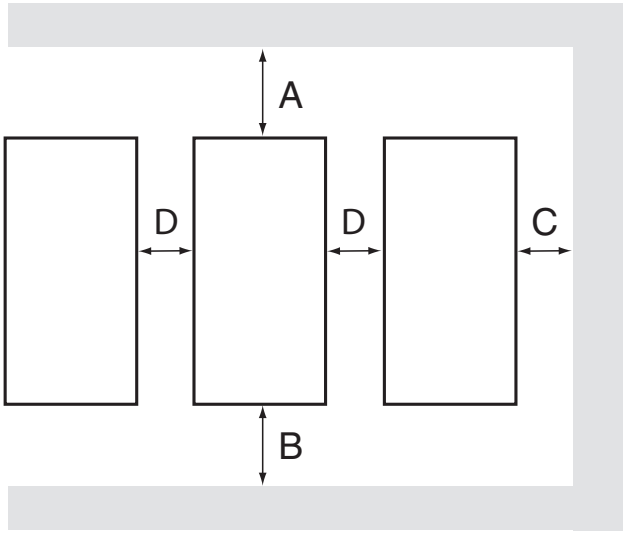
- the power supply to the drive must be interrupted (double security)
- no torque at the drive

The KEB COMBIVERT F5 with safety relay fulfills the condition: no torque by a safe disconnection of the driver signals for the power modules (IGBT). There is no voltage disconnection.
This is guaranteed by a two-channel processing holding signal. On of the channels is developed in programmed electronics. The second channel consists of an electro-mechanical relay. The function of the relay is cyclically monitored by the programmed electronics.

Through the double safety no further measure is needed for the KEB COMBIVERT (e.g. feedback via relay contact) since an individual error in the control does not lead to the loss of the stop function.

1.8.3 Control cabinet installation

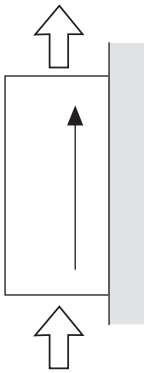
Mounting distances



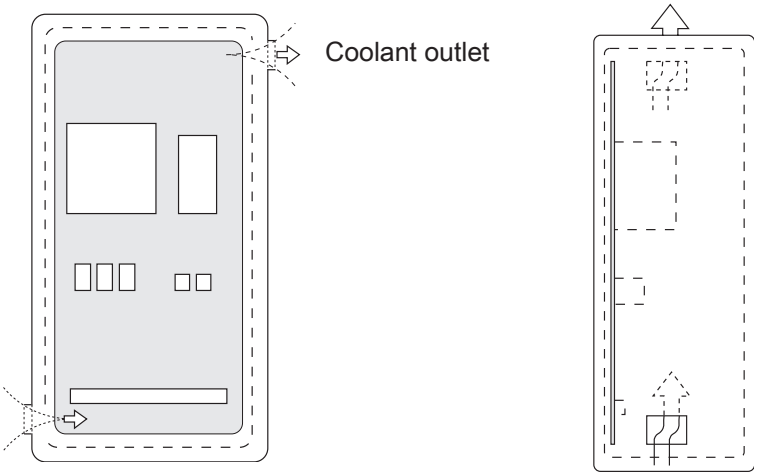
Dimension	Distance in mm	Distance in inch
A	150	6
B	100	4
C	30	1.2
D	0	0
X [1)]	50	2

1) Distance to preceding elements in the cabinet door.

Direction of the cooling fins



Front and side view of the coolant inlet



2. Technical Data

2.1 Operating conditions

		Standard	Standard/class	Instructions
Definition acc.		EN 61800-2		Inverter-product standard: **rated specifications**
		EN 61800-5-1		Inverter-product standard: **general safety**
Site altitude				max. 2000 m above sea level With site altitudes over 1000 m a derating of 1 % per 100 m must be taken into consideration.
Ambient conditions during operation				
Climate	Temperature	EN 60721-3-3	3K3	extended to -10…45 °C[1] With temperature over 45°C to max. 55°C a deration of 5 % per 1 K must be taken into consideration.
	Humidity		3K3	5…85 % (without condensation)
Mechanical	Vibration	Track	EN50155	max. amplitude of a vibration 1 mm (5…13 Hz) max. acceleration amplitude 7 m/s² (13…200 Hz) sine
		Germ. Lloyd	Part 7-3	
		EN 60721-3-3	3M1	
Contamination		Gas	3C2	
		Solids	3S2	
Ambient conditions during transport				
Climate	Temperature	EN 60721-3-2	2K3	
	Humidity		2K3	(without condensation)
Mechanical	Vibration	Track	EN50155	max. amplitude of a vibration 3.5 mm (2…9 Hz) max. acceleration amplitude 15 m/s² (9…200 Hz) sine
		Germ. Lloyd	Part 7-3	
		EN 60721-3-2	2M1	
	Surge	EN 60721-3-2	2M1	max. 100 m/s²; 11 ms
Contamination		Gas	2C2	
		Solids	2S2	
Ambient conditions for the storage				
Climate	Temperature	EN 60721-3-1	1K4	
	Humidity		1K3	(without condensation)
Mechanical	Vibration	Track	EN50155	max. amplitude of a vibration 1 mm (5…13 Hz) max. acceleration amplitude 7 m/s² (13…200 Hz) sine
		Germ. Lloyd	Part 7-3	
		EN 60721-3-1	1M1	
	Surge	EN 60721-3-1	1M1	max. 100 m/s²; 11 ms
Contamination		Gas	1C2	
		Solids	1S2	
Type of protection		EN 60529	IP20	
Environment		IEC 664-1		Pollution degree 2
Definition acc.		EN 61800-3		Inverter-product standard: **EMC**
EMC emitted interference				
Cable-based interferences		----	C2[2]	formerly limit A (B optional) according to EN55011
Radiated interferences		----	C2	formerly limit A according to EN55011
EMC interference immunity				
ESD		EN 61000-4-2	8 kV	AD (air discharge) and CD (contact discharge)
Burst - control lines + bus		EN 61000-4-4	2 kV	
Burst - mains supply		EN 61000-4-4	4 kV	
Surge - mains supply		EN 61000-4-5	1 / 2 kV	Phase-phase / phase-ground
EMF		EN 61000-4-3	10 V/m	
Voltage variation / voltage drop		EN 61000-2-1		+10 %, -15 %; 90 %
Voltage unsymmetries / Frequency changes		EN 61000-2-4		3 %; 2 %

[1] 40°C at size 05/230 V with field bus operation

[2] with filter

2.2 Technical data of the 230 V class

Inverter size			05			07					09				10			
Housing size			A	B		A	B		D		B		D		B		D	
Phases			1	1	3	1	1	3	1	3	1	3	1	3	1	3	1	3
Output rated power		[kVA]	0.9			1.6					2.8				4.0			
Max. rated motor power		[kW]	0.37			0.75					1.5				2.2			
Output rated current		[A]	2.3			4					7				10			
Max. short time current	1)	[A]	4.1			7.2					12.6				18			
OC-tripping current		[A]	5.0			8.6					15.1				21.6			
Input rated current		[A]	4.6	4.6	3.2	8	8	5.6	8	5.6	14	9.8	14	9.8	20	14	20	14
Max. permissible main fuse gG		[A]	16			16	20	16	20	16	20	16	20	16	25	20	25	20
Rated switching frequency		[kHz]	4	16		8	16				16				8		16	
Max. switching frequency		[kHz]	8	16		8	16				16				16			
Power loss at nominal operating		[W]	30	50		60	65		100		90		130		105		170	
Power loss at DC operating		[W]	28	48		55	60		90		80		120		90		155	
Standstill current at 4 kHz	2)	[A]	2.3			4					7				10			
Standstill current at 8 kHz	2)	[A]	2.3			4					7				10			
Standstill current at 16 kHz	2)	[A]	–	2.3		–	4				7				8.5		10	
Min. frequency at continuous full load		[Hz]	6															
Max. heat sink temperature		[°C]	100	90		95	90				90				90			
Motor cable cross-section	3)	[mm²]	1.5			1.5	2.5	1.5	2.5	1.5	2.5	1.5	2.5	1.5	4	2.5	4	2.5
Min. braking resistor	4)	[Ω]	100	56		100	56		56		47				33			
Max. braking current	4)	[A]	4.5	7.5		4.5	7.5		7.5		9.5				12			
Overload characteristic (see annex)			1															
Input rated voltage		[V]	230 (UL: 240)															
Input voltage range (Uin)		[V]	180…260 ±0															
Input voltage at DC operation		[V]	250…370 ±0															
Mains frequency		[Hz]	50 / 60 ±2															
Output voltage		[V]	3 x 0…Uin															
Output frequency		[Hz]	see control board															
Max. motor line length shielded at 4 kHz	5)	[m]	10	30		10	100		100		100		100		100			
Max. motor line length shielded at 8 kHz	5)	[m]	10	20		10	50		50		100		100		100			
Max. motor line length shielded at 16 kHz	5)	[m]	–	10		–	20		20		40		100		100			
For use in USA																		
Max. mains fuse type RK5		[A]	10	10	6	15	15	10	15	10	20	15	20	15	30	25	30	25
MCCB: NKJH Type „E“	6)	[A]	10	10	6.3	16	16	10	16	10	20	16	16	20	25	20	25	20

1) With the regulated systems F5-M as well as F5-S 5% are to be subtracted as control reserve
2) Max. current before response of the OL-function (F5-M, F5-S, F5-A)
3) Recommended minimum cross section of the motor line for rated power and a cable length of upto 100 m (copper)
4) This data is only valid for units with internal brake transistor GTR 7 (see "unit identification")
5) At units with integrated filter (see „unit identification“):
up to max. 5 m (10 m at housing A) line length and 4 kHz switching frequency = Limit value B (EN 55011)
up to max. 10 m line length and 16kHz switching frequency = Limit value A (EN 55022)
6) For UL accepted types see annex

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.

Site altitude maximal 2000 m. With site altitudes over 1000 m a derating of 1 % per 100 m must be taken into consideration.

Technical Data of the 230 V Class

Inverter size			12	13	14		15	
Housing size			D	E	E	G	G	H
Phases			3	3	3		3	
Output rated power		[kVA]	6.6	9.5	13		19	
Max. rated motor power		[kW]	4.0	5.5	7.5		11	
Output rated current		[A]	16.5	24	33		48	
Max. short time current	1)	[A]	29.7	36	49.5		86	
OC-tripping current		[A]	35.6	43	59		103	
Input rated current		[A]	23	31	43		63	
Max. permissible main fuse gG		[A]	25	35	50		80	
Rated switching frequency		[kHz]	8	8	4	16	4	16
Max. switching frequency		[kHz]	16	16	16		16	
Power loss at nominal operating		[W]	210	290	350	410	460	430
Power loss at DC operating		[W]	185	365	300	355	375	345
Standstill current at 4 kHz	2)	[A]	16.5	24	33	36	53	53
Standstill current at 8 kHz	2)	[A]	16.5	24	24	36	53	53
Standstill current at 16 kHz	2)	[A]	10	16.8	16.8	33	43	48
Min. frequency at continuous full load		[Hz]			6	3	3	
Max. heat sink temperature		[°C]	90	90	90		90	
Motor cable cross-section	3)	[mm²]	4	6	10		25	
Min. braking resistor	4)	[Ω]	27	16	16	8	8	5.6
Max. braking current	4)	[A]	15	25	25	50	50	70
Overload characteristic (see annex)			1					
Input rated voltage		[V]	230 (UL: 240)					
Input voltage range (Uin)		[V]	180…260 ±0					
Input voltage at DC operation		[V]	250…370 ±0					
Mains frequency		[Hz]	50 / 60 ±2					
Output voltage		[V]	3 x 0…Uin					
Output frequency		[Hz]	see control board					
Max. motor line length shielded		[m]	100					
For use in USA								
Max. mains fuse type RK5		[A]	25	40	50	50	70	70
MCCB: NKJH Type „E“	5)	[A]	25	40	45	--	--	--

1) With the regulated systems F5-M as well as F5-S 5% are to be subtracted as control reserve
2) Max. current before response of the OL-function (F5-M, F5-S, F5-A)
3) Recommended minimum cross section of the motor line for rated power and a cable length of upto 100 m (copper)
4) This data is only valid for units with internal brake transistor GTR 7 (see "unit identification")
5) For UL accepted types see annex

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.

Site altitude maximal 2000 m. With site altitudes over 1000 m a derating of 1 % per 100 m must be taken into consideration.

Inverter size			16	17
Housing size			H	H
Phases			3	3
Output rated power		[kVA]	26	33
Max. rated motor power		[kW]	15	18.5
Output rated current		[A]	66	84
Max. short time current	1)	[A]	99	151
OC-tripping current		[A]	119	181
Input rated current		[A]	73	92
Max. permissible main fuse gG		[A]	80	100
Rated switching frequency		[kHz]	16	4
Max. switching frequency		[kHz]	16	16
Power loss at nominal operating		[W]	550	800
Power loss at DC operating		[W]	435	–
Standstill current at 4 kHz	2)	[A]	72.5	92
Standstill current at 8 kHz	2)	[A]	72.5	84
Standstill current at 16 kHz	2)	[A]	66	84
Min. frequency at continuous full load		[Hz]	3	3
Max. heat sink temperature		[°C]		
Motor cable cross-section	3)	[mm²]	25	35
Min. braking resistor	4)	[Ω]	5.6	5.6
Max. braking current	4)	[A]	70	70
Overload characteristic (see annex)			1	
Input rated voltage		[V]	230 (UL: 240)	
Input voltage range		[V]	180…260 ±0	
Input voltage at DC operation		[V]	250…370 ±0	
Mains frequency		[Hz]	50 / 60 ±2	
Output voltage		[V]	3 x 0…Uin	
Output frequency		[Hz]	see control board	
Max. motor line length shielded		[m]	100	50
For use in USA				
Max. mains fuse type RK5		[A]	90	110
MCCB in accordance with UL489	5)	[A]	–	–

1) With the regulated systems F5-M as well as F5-S 5% are to be subtracted as control reserve
2) Max. current before response of the OL-function (F5-M, F5-S, F5-A)
3) Recommended minimum cross section of the motor line for rated power and a cable length of upto 100 m (copper)
4) This data is only valid for units with internal brake transistor GTR 7 (see "unit identification")
5) For UL accepted types see annex

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.

Site altitude maximal 2000 m. With site altitudes over 1000 m a derating of 1 % per 100 m must be taken into consideration.

2.3 Technical data of the 400 V class

Inverter size			05		07			09			10			12			13		14		
Housing size			A	B	A	B	D	A	B	D	B	D	D	B	D	E	D	E	D	E	G
Phases			3		3			3			3			3			3		3		
Output rated power		[kVA]	0.9		1.8			2.8			4.0			6.6			8,3		11		
Max. rated motor power		[kW]	0.37		0.75			1.5			2.2			4.0			5.5		7.5		
Output rated current		[A]	1.3		2.6			4.1			5.8			9.5			12		16.5		
Max. short time current	1)	[A]	2.3		4.7			7.4			10.4			17			21.6		29.7		24.8
OC-tripping current		[A]	2.8		5.6			8.9			12.5			21			25.9		35.6		29.7
Input rated current		[A]	1.8		3.6			6			8			13			17		23		
Max. permissible main fuse gG		[A]	16		16			16			16			20			25		25		
Rated switching frequency		[kHz]	4	16	4		16	4		8	8	4	16	4	8	16	4	16	2	8	16
Max. switching frequency		[kHz]	4	16	4		16	4		16		16		4	16		16		8[6]		16
Power loss at nominal operating		[W]	45	60	50		90	60	80	105	120	140	170	150	185	300	185	250	185	320	380
Power loss at DC operating		[W]	44	58	48		87	55	75	100	110	130	160	135	170	285	165	230	160	295	350
Standstill current at 4 kHz	2)	[A]	1.3		2.6			4.1			5.8			9.5			12		14.5		16.5
Standstill current at 8 kHz	2)	[A]	–	1.3	–		2.6	–		4.1	5.8	5.2	5.8	–	9.5		9.5	12	9.9		16.5
Standstill current at 16 kHz	2)	[A]	–	1.3	–		2.6	–		3.5	4.9	3.5	5.8	–	5.8	9.5	5.8	12	5.7	10	12
Min. frequency at continuous full load		[Hz]	6																		3
Max. heat sink temperature		[°C]	90 °C (194 °F)																		
Motor cable cross-section	3)	[mm²]	1.5		1.5			1.5			1.5			2.5			4		4		
Min. braking resistor	4)	[Ω]	390		180		120	110		120	82			82		39	56	39	56		39
Max. braking current	4)	[A]	2.2		4.5		7.5	7		7.5	10			10		21	15	21	15		21
Overload characteristic (see annex)			1																		
Input rated voltage	5)	[V]	400 (UL: 480)																		
Input voltage range		[V]	305…500 ±0																		
Input voltage at DC operation		[V]	420…720 ±0																		
Mains frequency		[Hz]	50 / 60 ±2																		
Output voltage		[V]	3 x 0…Uin																		
Output frequency		[Hz]	see control board																		
Max. motor line length shielded at 4 kHz		[m]	10		10		30	10		100	100			50	100		100		100		
Max. motor line length shielded at 8 kHz		[m]	–	8	–	8	20	–		30	50	100		–	100		100		–	100	
Max. motor line length shielded at 16 kHz		[m]	–	4	–	5	10	–		10	10	20		–	100		100		–	100	
For use in USA																					
Max. mains fuse type RK5		[A]	–	5	–		6	–		10	12			15			25		30		
MCCB: NKJH Type „E“	7)	[A]	–	10	–		10	–		10	12			16			25		–	30	–

1) With the regulated systems F5-M as well as F5-S 5% are to be subtracted as control reserve
2) Max. current before response of the OL-function (F5-M, F5-S, F5-A)
3) Recommended minimum cross section of the motor line for rated power and a cable length of upto 100 m (copper)
4) This data is only valid for units with internal brake transistor GTR 7 (see "unit identification")
5) At rated voltages > 460 V multiply the rated current with factor 0,86
6) At control board BASIC only 2 kHz
7) For UL accepted types see annex

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.

Site altitude maximal 2000 m. With site altitudes over 1000 m a derating of 1 % per 100 m must be taken into consideration.

Inverter size			15			16			17		18		19	20
Housing size			E	G	H	E	G	H	G	H	G	H	H	H
Phases			3			3			3		3		3	3
Output rated power		[kVA]	17			23			29		35		42	52
Max. rated motor power		[kW]	11			15			18.5		22		30	37
Output rated current		[A]	24			33			42		50		60	75
Max. short time current	1)	[A]	36			49.5			63		75		90	112
OC-tripping current		[A]	43			59			75		90		108	135
Input rated current		[A]	31			43			55		65		66	83
Max. permissible main fuse gG		[A]	35			50			63		80		80	100
Rated switching frequency		[kHz]	4	8	16	2	8	16	4	8	2	8	4	2
Max. switching frequency		[kHz]	16			8[6]	16		16		8	16	16	8
Power loss at nominal operating		[W]	350	380	360	330	500	490	500	470	430	610	540	640
Power loss at DC operating		[W]	310	340	320	275	445	430	430	400	345	525	425	500
Standstill current at 4 kHz	2)	[A]	24			27	33		42		45	50	60	67.5
Standstill current at 8 kHz	2)	[A]	16	24	24	–	33		38	42	30	50	54	52.5
Standstill current at 16 kHz	2)	[A]	10	16	24	–	23	33	21	25	0	30	36	–
Min. frequency at continuous full load		[Hz]	6	3		6	3		3					
Max. heat sink temperature		[°C]	90 °C (194 °F)											
Motor cable cross-section	3)	[mm²]	6			10			16		25		25	35
Min. braking resistor	4)	[Ω]	39		22	25		22	25	22	13		13	9
Max. braking current	4)	[A]	21		37	32	30	37	30	37	63		63	88
Overload characteristic (see annex)			1											
Input rated voltage	5)	[V]	400 (UL: 480)											
Input voltage range		[V]	305…500 ±0											
Input voltage at DC operation		[V]	420…720 ±0											
Mains frequency		[Hz]	50 / 60 ±2											
Output voltage		[V]	3 x 0…Uin											
Output frequency		[Hz]	see control board											
Max. motor line length shielded		[m]	100											50
For use in USA														
Max. mains fuse type RK5		[A]	40			50			60		70		90	100
MCCB: NKJH Type „E“	7)	[A]	40	–		50	–		–		–		–	–
MCCB in accordance with UL 489, DG frame	8)	[A]	–	–		–	–		–		–		–	–

1) With the regulated systems F5-M as well as F5-S 5% are to be subtracted as control reserve
2) Max. current before response of the OL-function (F5-M, F5-S, F5-A)
3) Recommended minimum cross section of the motor line for rated power and a cable length of upto 100 m (copper)
4) This data is only valid for units with internal brake transistor GTR 7 (see "unit identification")
5) At rated voltages > 460 V multiply the rated current with factor 0,86
6) At control board BASIC only 2 kHz
7) For UL accepted types see annex
8) For UL accepted types see annex

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.

Site altitude maximal 2000 m. With site altitudes over 1000 m a derating of 1 % per 100 m must be taken into consideration.

2.4 DC supply

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:

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

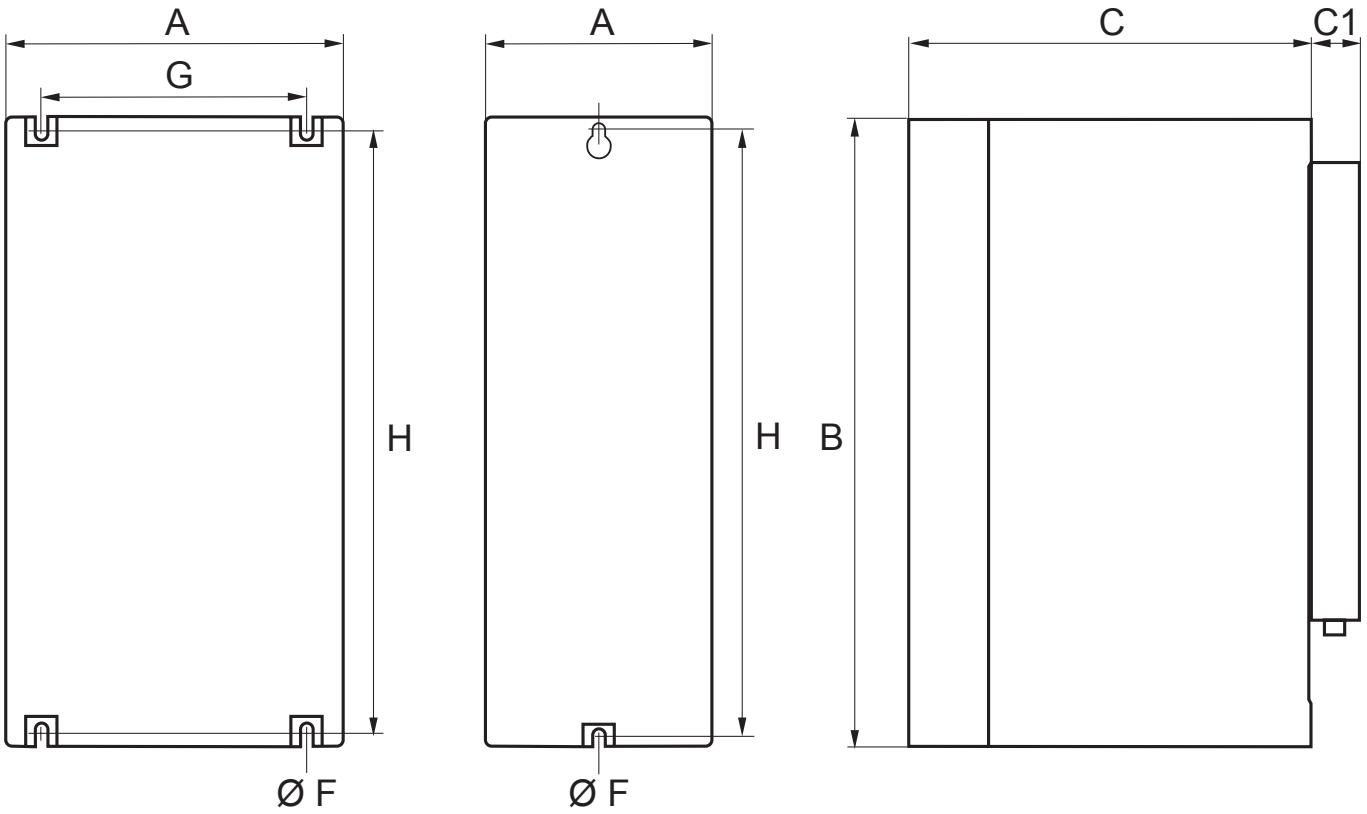
400V Class:

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

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 motor rated current)
- if the motor in normal operation is never stressed with rated torque, it can be calculated with the real motor current.

2.4 Dimensions and Weights

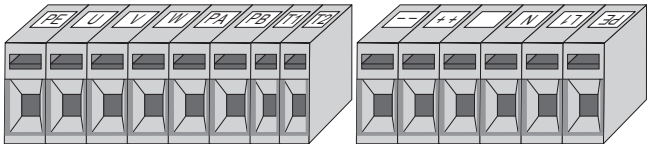


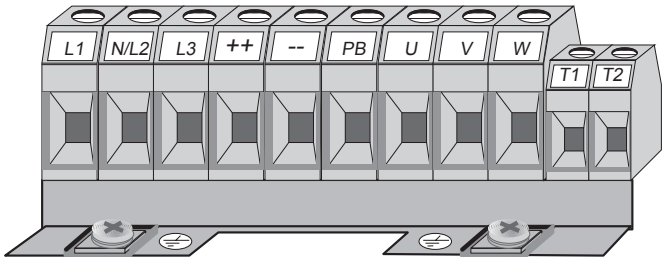
housing	A	A*	B	B*	C	C*	C1	F	G	G*	H	H*
A	76	76	191	216	144	184	14	5	–	–	175	175
B	90	90	220	249	160	200	14	5	–	–	210	240
D	90	90	250	285	181	221	14	5	–	–	240	275
E	130	132	290	352	208	258	14	7	–	100	275	335
G	170	181	340	415	255	311	–	7	150	150	330	400
H	297	300	340	445	255	321	–	7	250	250	330	420
* with submounted filter; C1 Operator												

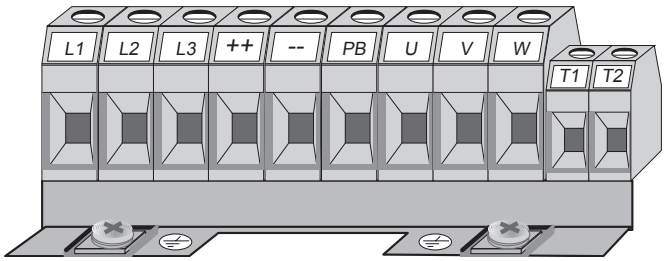
housing	Heat sink (standard) [kg]	Heat sink with filter [kg]	Flat rear [kg]	Convection [kg]
A	1.2	1.8	–	–
B	2	3.3	1.8	6.1
D	2.2	4.3	2.5	6.5
E	5	5.5	5.1	12.6
G	10	13.2	7	15.8
H	14	19.1	15	22

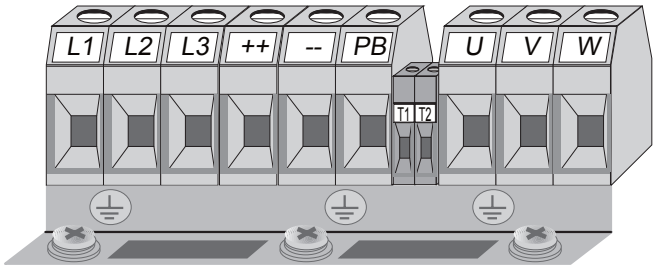
2.5 Terminal strips of the power circuit

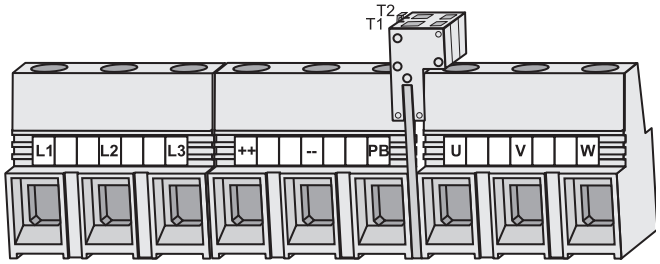
⚠	**Attention! 230 V and 400 V-classes are possible**
ℹ	All terminal strips meet the requirements on EN 60947-7-1 (IEC 60947-7-1)

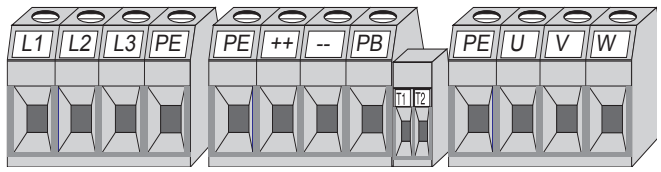
Housing size A	**Name**	**Function**	**Cable cross-section terminal no.**
Motor side Line side 	**U, V, W**	Motor connection	1
	PA, PB	Connection for braking resistor	
	T1, T2	Connection for temperature sensor	
	++, – –	Connection for braking module, Regenerative unit and supply unit or as DC voltage input 250…370 VDC (230 V class) 420…720 VDC (400 V class)	
	L1, N	1-phase mains connection	
	L1, L2, L3	3-phase mains connection	
	PE	Connection for shielding /earthing	

Housing size B, D, 12…14.E.400 V	**Name**	**Function**	**Cable cross-section terminal no.**
	**L1, N**	1-phase mains connection	2
	L1, L2, L3	3-phase mains connection	
	U, V, W	Motor connection	
	++, PB	Connection for braking resistor	
	++, – –	Connection for braking module, regenerating front end and supply units or DC voltage input 250…370 VDC (230 V class) 420…720 VDC (400 V class)	
	T1, T2	Connection for temperature sensor	3
	PE, ⏚	Connection for shielding /earthing	4

Housing size E.200 V and ≥ 15.E.400 V	**Name**	**Function**	**Cable cross-section terminal no.**
	**L1, L2, L3**	3-phase mains connection	5
	U, V, W	Motor connection	
	++, PB	Connection for braking resistor	
	++, – –	Connection for braking module, regenerating front end and supply units or DC voltage input 250…370 VDC (230 V class) 420…720 VDC (400 V class)	
	T1, T2	Connection for temperature sensor	3
	PE, ⏚	Connection for shielding /earthing	4

Housing size G (without 15.200 V and 18.400 V)	Name	Function	Cable cross-section terminal no.
	**L1, L2, L3**	3-phase mains connection	5
	U, V, W	Motor connection	
	++, PB	Connection for braking resistor	
	++, – –	Connection for braking module, regenerating front end and supply units or DC voltage input 250…370 VDC (230 V class) 420…720 VDC (400 V class)	
	T1, T2	Connection for temperature sensor	3
	PE, ⏚	Connection for shielding /earthing	4

Housing size G 15.200 V and 18.400 V	Name	Function	Cable cross-section terminal no.
	**L1, L2, L3**	3-phase mains connection	6
	U, V, W	Motor connection	
	++, PB	Connection for braking resistor	
	++, – –	Connection for regenerative unit 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	10
	PE, ⏚	Connection for shielding /earthing	9

Housing size H	Name	Function	Cable cross-section terminal no.
	**L1, L2, L3**	3-phase mains connection	7
	U, V, W	Motor connection	
	++, PB	Connection for braking resistor	
	++, – –	Connection for regenerative unit 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	3
	PE, ⏚	Connection for shielding /earthing	7

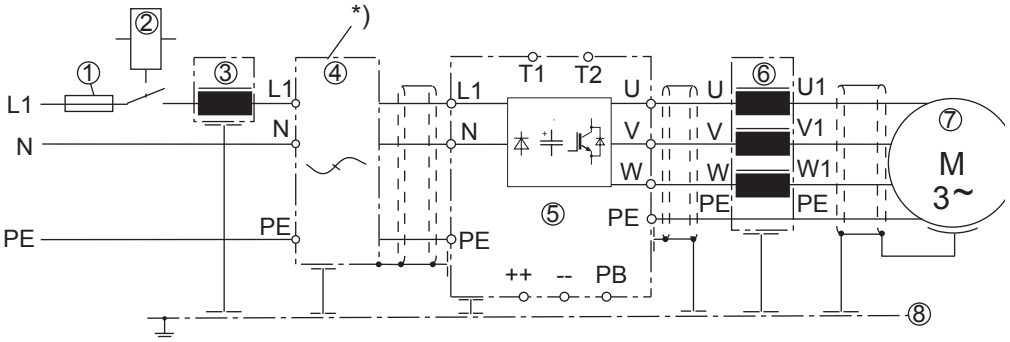
2.5.1 Permissible cable cross-sections and tightening torques of the terminals

No.	permissible cross-section flexible with wire-end ferrule				Tightening torque	
	mm²		AWG/MCM		Nm	lb inch
	min	max	min	max		
1	0.2	1.5	24	16	–	–
2	0.2	0.6	30	10	0.6	5.5
3	0.2	1.5	26	14	0.6	5
4	Screw M4 for ring thimble				1.3	11
5	6	16	22	8	1.2	20.5
6	1.3	25	16	4	2…4	18
7	2.5	35	12	2	3...5	51
8	0.2	1	24	16	–	–
9	Screw M4 for ring thimble				4.5	40

2.6 Connection Power Unit

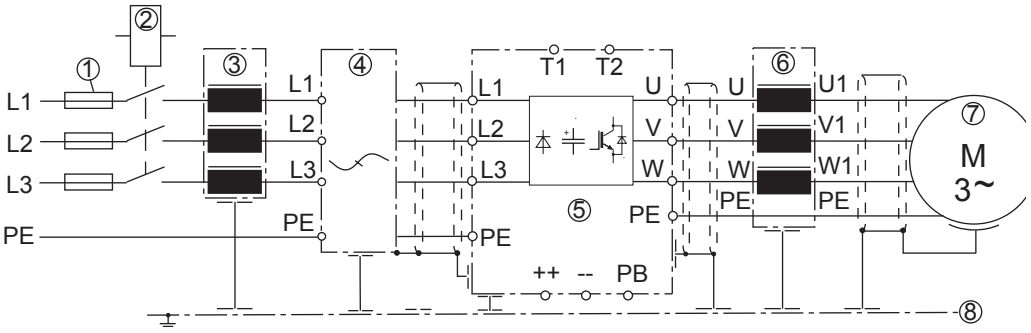
Exchanging mains and motor connection leads to immediate destruction of the unit.	Pay attention to the supply voltage and the correct polarity of the motor !

1-ph. connection



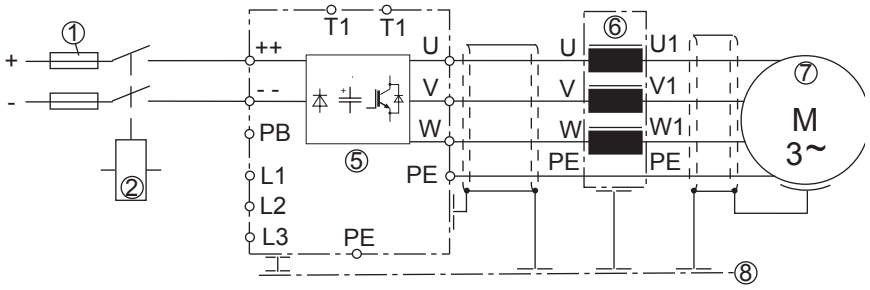
* The external radio interference filter is not applicable for units with integrated interference suppression (see „unit identification“).

3-ph. connection



DC supply

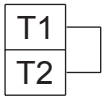
250...370V DC (230V class)
420...720V DC (400V class)



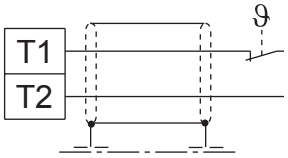
Legend		
	1	Mains fuse
	2	Main contactor
	3	Mains choke
	4	Radio interference filter
	5	KEB COMBIVERT
	6	Motor choke or output filter (not at F5-M or F5-S)
	7	Motor
	8	Mounting plate

<table>
<tr><td>External temperature monitoring

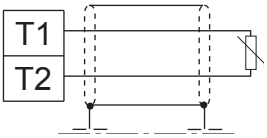
Do not lay connection cable (also shielded) together with control cable!
In the motor cable, only permitted with double shielded motor cable!</td><td>The function must be activated via the software of the control card (CP.28/Pn.12) in order that an evaluation occurs at F5-B/C/G.

F5-E/H/M/S:
Bridge, if no monitoring is done

Thermostat relay
(NC contact)

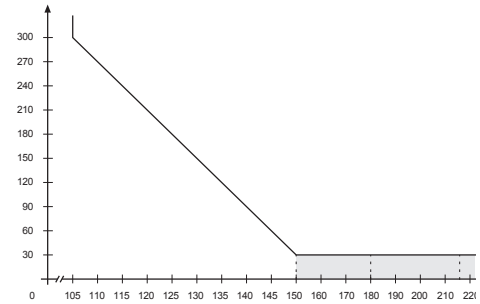
 

Temperature sensor (PTC)
Response resistance
1650 Ω…4 kΩ
Resetting resistance
750 Ω…1650 Ω
(according to
DIN EN 60947-8)</td></tr>
<tr><td>Braking resistor</td><td>When using a braking resistor absolutely observe the safety and connecting-up instructions from the instruction manual „braking resistor“.</td></tr>
</table>

Annex A

A.1 Overload characteristic

Time [s] Characteristic 1

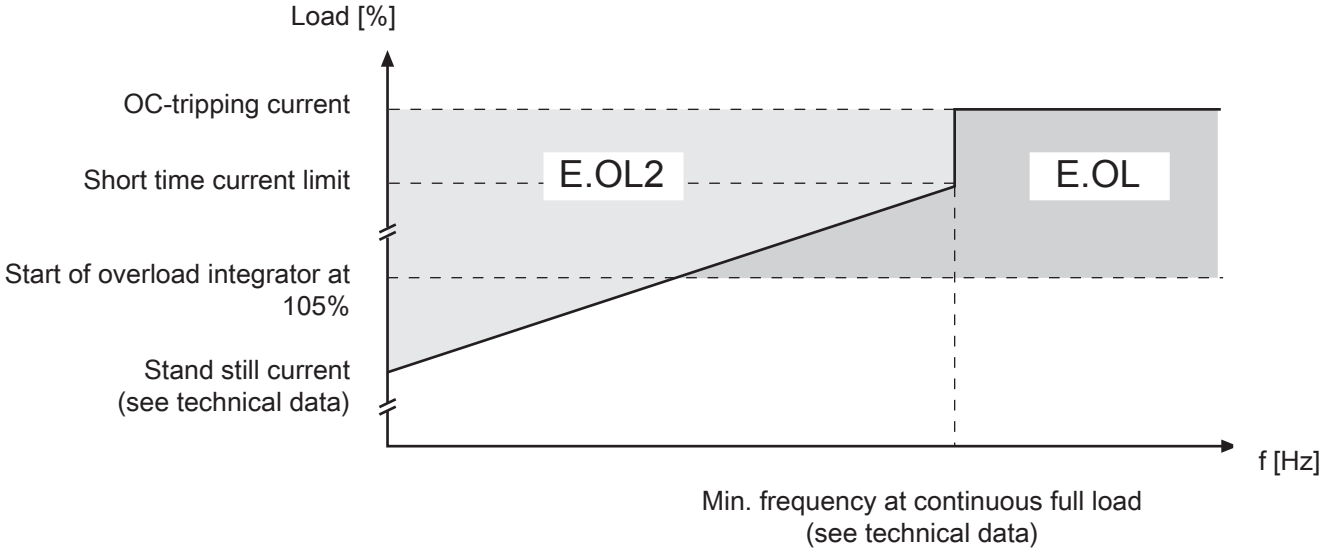


The characteristic declines device-dependently in this range (see unit identification).

On exceeding a load of 105% the overload integrator starts. When falling below the integrator counts backwards. Error E.OL is triggered if the integrator achieves the inverter appropriate overload characteristic.

A.2 Overload protection in the lower speed range

(only for F5-M and F5-S)



A PT1-element ($\tau = 280$ ms) starts if the permissible current is exceeded. After its sequence of operation 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 %
Inverter open loop	4 %
Inverter closed loop	8 %
Motor choke Uk	1 %
Non-rigid supply system	2 %

Example:
Closed loop inverter with mains- and motor choke at non-rigid supply system:
400 V mains voltage - 15 % = 340 V motor voltage

A.4 Protection in accordance with UL

A.4.1 Protection with MCCB „NKJH2“

Manufacturer	UL-File	Type	required mains terminal
Siemens	E 156943	3 RV 1021 - 1xA10	3RV1928-1H
		3 RV 1031 - 4xA10	----
ABB Stotz	E 195536	MS 325 - xx	S3-M3
		MS 450 - xx	----
Rockwell / Allen Bradley	E 205542	140M-C2E-Bxx or Cxx	----
		140M-F8E-Cxx	----
Moeller	E 123500	PKZM0 - xx E (only up to 25A)	BK25/3 - PKZ0-E

Where x or xx means that here current rating or letter for current rating is given.

A.4.2 Protection with MCCB in accordance with UL 489 (UL: DIVQ)

Authorized manufacturers of MCCB´s with the specified rated currents of the MCCB´s described in chapter 2.2 and 2.3:

Manufacturer	UL-File	Type	Siemens part number
Siemens	E10848	VL400 UL, JG-Frame	3VL41 40-xKE30-zzzz [1)]
		VL400X UL, LG-Frame	3VL45 60-xKE30-zzzz [1)]
1) zzzz: for options (see Siemens catalog)			

A.5 Maintenance

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

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.
	Examine function of the fans of the KEB COMBIVERT. The fans must be replaced in case of audible vibrations or squeak.
	Make a visual leak test of the cooling circuit for water-cooled inverters.

A.6 Shut down

A.6.1 Storage

The DC link of the KEB COMBIVERT is equipped with electrolytic capacitors. If electrolytic capacitors are stored de-energized, the oxide film working as dielectric fluid reacts with the acidic electrolyte and destroy themselves slowly. This affects the dielectric strength and the capacity.
If the capacitor starts running with rated voltage, it is tried to build the oxide film abrupt again. This causes heat and gas and leads to the destruction of 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			
•	Operate frequency inverter one hour without modulation		
Storage period 2…3 years			
•	Remove all cables from the power circuit; especially of braking resistor or module		
•	Open control release		
•	Connect variable transformer to inverter input		
•	Increase variable transformer slowly to indicated input voltage (>1 min) and remain at least on the specified time.		
	Voltage class	Input voltage	Residence time
	230 V	0…160 V	15 rpm
		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
	690 V	0…420 V	15 min
		420…600 V	15 min
		600…760 V	1 h
Storage period > 3 years			
•	Input voltages as before, however double the times per year. Eventually change capacitors.		

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

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/EG) 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. The harmonized standards of the series EN 61800-5-1 in connection with EN 60439-1 and EN 60146 were used.
This is a product of limited availability in accordance with IEC 61800-3. 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

c UL us	Acceptance according to UL is marked at KEB inverters with the adjacent logo on the type plate.

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

- For control cabinet mounting as „Open Type“
- Control Board Rating (max. 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 adjustement see application manual parameters Pn.14 and Pn.15.
- „Use 60/75°C copper conductors only“ for equipment rated 100 Amperes or less and “Use 75°C copper conductors only” for equipment rated grater than 100 Ampers.
- 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”.
- For 240 V models:
  „Suitable for use on a circuit capable of delivering not more than x1) rms symmetrical amperes, 240 Volts maximum, when protected by fuses or see instruction manual for alternate BCP“
  For 480 V models:
  „Suitable for use on a circuit capable of delivering not more than x1) rms symmetrical amperes, 480 Volts maximum, when protected by fuses or see instruction manual for alternate BCP“
  For all models:
  For details of the branch circuits protection, which can be used, see technical data

[1)] x depends on the housing size according to the following table:	
Housing size	**SC rating**
B	5 kA
A, D, E, G	10 kA
H	18 kA

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