



COMBIVERT F6

INSTRUCTIONS FOR USE | INSTALLATION F6 HOUSING 7

Translation of the original manual - Pre-series -
Document 20199655 EN 02



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:

DANGER	Dangerous situation, which will cause death or serious injury in case of non-observance of this safety instruction.
WARNING	Dangerous situation, which may cause death or serious injury in case of non-observance of this safety instruction.
CAUTION	Dangerous situation, which may cause minor injury in case of non-observance of this safety instruction.
NOTICE	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.

More symbols

- ▶ This arrow starts an action step.
- / - Enumerations are marked with dots or indents.
- => Cross reference to another chapter or another page.



Note to further documentation.
www.keb.de/service/downloads



Laws and guidelines

KEB Automation KG confirms with the EC declaration of conformity and the CE mark on the device nameplate that it complies with the essential safety requirements.

The EC declaration of conformity can be downloaded on demand via our website. 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



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.

This KEB product or parts thereof may contain third-party software, including free and/or open source software. If applicable, the license terms of this software are contained in the instructions for use. The instructions for use are already available to you, can be downloaded free of charge from the KEB website or can be requested from the respective KEB contact person.

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Glossary

0V	Earth-potential-free common point	Endat	Bidirectional encoder interface of the company Heidenhain
1ph	1-phase mains	EtherCAT	Real-time Ethernet bus system of the company Beckhoff
3ph	3-phase mains	Ethernet	Real-time bus system - defines protocols, plugs, types of cables
AC	AC current or voltage	FE	Functional earth
AFE	From 07/2019 AIC replaces the previous name AFE	FSoE	Functional Safety over Ethernet
AFE filter	From 07/2019 AIC filter replaces the previous name AFE filter	FU	Drive converter
AIC	Active Infeed Converter	GND	Reference potential, ground
AIC filter	Filter for Active Infeed Converter	GTR7	Braking transistor
Application	The application is the intended use of the KEB product	HF filter	High frequency filter to the mains
ASCL	Asynchronous sensorless closed loop	Hiperface	Bidirectional encoder interface of the company Sick-Stegmann
Auto motor ident.	Automatically motor identification; calibration of resistance and inductance	HMI	Human machine interface (touch screen)
AWG	American wire gauge	HSP5	Fast, serial protocol
B2B	Business-to-business	HTL	Incremental signal with an output voltage (up to 30V) -> TTL
BiSS	Open source real-time interface for sensors and actuators (DIN 5008)	IEC	International standard
CAN	Fieldbus system	IP xx	Degree of protection (xx for level)
CDF	Cyclic duration factor	KEB product	The KEB product is subject of this manual
CDM	Complete drive module including auxiliary equipment (control cabinet)	KTY	Silicium temperature sensor (polarized)
COMBIVERT	KEB drive converters	Manufacturer	The manufacturer is KEB, unless otherwise specified (e.g. as manufacturer of machines, engines, vehicles or adhesives)
COMBIVIS	KEB start-up and parameterizing software	MCM	American unit for large wire cross sections
Customer	The customer has purchased a KEB product from KEB and integrates the KEB product into his product (customer product) or resells the KEB product (dealer)	Modulation	Means in drive technology that the power semiconductors are controlled
DC	DC current or voltage	MTTF	Mean service life to failure
DI	Demineralized water, also referred to as deionized (DI) water	NN	Sea level
DIN	German Institut for standardization	OC	Overcurrent
DS 402	CiA DS 402 - CAN device profile for drives	OH	Overheat
EMC	Electromagnetic compatibility	OL	Overload
Emergency stop	Shutdown of a drive in emergency case (not de-energized)	OSSD	Output signal swithching device; - an output signal that is checked in regular intervals on its shutdown. (safety technology)
Emergency switching off	Switching off the voltage supply in emergency case	PDS	Power drive system incl. motor and measuring probe
EMS	Energy Management System	PE	Protective earth
EN	European standard	PELV	Protective Extra Low Voltage
Encoder emulation	Software-generated encoder output	PFD	Term used in the safety technology (EN 61508-1...7) for the size of error probability
End customer	The end customer is the user of the customer product		

PFH	Term used in the safety technology (EN 61508-1...7) for the size of error probability per hour
PLC	Programmable logic controller
PT100	Temperature sensor with $R_0=100\Omega$
PT1000	Temperature sensor with $R_0=1000\Omega$
PTC	PTC-resistor for temperature detection
PWM	Pulse width modulation
RJ45	Modular connector with 8 lines
SCL	Synchronous sensorless closed loop
SELV	Safety Extra Low Voltage (< 60 V)
SIL	The security integrity level is a measure for quantifying the risk reduction. Term used in the safety technology (EN 61508 -1...7)
SS1	Safety function „Safe stop 1“ in accordance with IEC 61800-5-2
SSI	Synchronous serial interface for encoder
STO	Safety function „Safe Torque Off“ in accordance with IEC 61800-5-2
TTL	Incremental signal with an output voltage up to 5V
USB	Universal serial bus
VARAN	Real-time Ethernet bus system

Standards for drive converters / control cabinets

Product standards that apply directly to the drive converter

EN61800-2	Adjustable speed electrical power drive systems - Part 2: General requirements - Rating specifications for low voltage adjustable frequency a.c. power drive systems (VDE 0160-102, IEC 61800-2)
EN61800-3	Speed-adjustable electrical drives. Part 3: EMC requirements and specific test methods (VDE 0160-103, IEC 61800-3)
EN61800-5-1	Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy (IEC 61800-5-1); German version EN 61800-5-1
EN61800-5-2	Adjustable speed electrical power drive systems - Part 5-2: Safety Requirements - Functional (IEC 22G/264/CD)
UL61800-5-1	American version of the EN61800-5-1 with „National Deviations“

Basic standards to which drive converter standards refer directly

EN 55011	Industrial, scientific and medical equipment - Radio frequency disturbance characteristics - Limits and methods of measurement (CISPR 11); German version EN 55011
EN 55021	Interference to mobile radiocommunications in the presence of impulse noise - Methods of judging degradation and measures to improve performance (IEC/ CISPR/D/230/FDIS); German version prEN 55021
EN 60529	Degrees of protection provided by enclosures (IP Code) (IEC 60529)
EN 60664-1	Insulation coordination for equipment within low-voltage systems Part 1: Principles, requirements and tests (IEC 60664-1)
EN 60721-3-1	Classification of environmental conditions - Part 3-1: Classification of groups of environmental parameters and their severities - Section 1: Storage (IEC 60721-3-1); German version EN 60721-3-1
EN 60721-3-2	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 2: Transportation and handling (IEC 104/670/CD)
EN 60721-3-3	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities; section 3: Stationary use at weatherprotected locations; Amendment A2 (IEC 60721-3-3); German version EN 60721-3-3
EN 61000-2-1	Electromagnetic compatibility (EMC) - Part 2: Environment - Section 1: Description of the environment - Electromagnetic environment for low-frequency conducted disturbances and signalling in public power supply systems
EN 61000-2-4	Electromagnetic compatibility (EMC) - Part 2-4: Environment; Compatibility levels in industrial plants for low-frequency conducted disturbances (IEC 61000-2-4); German version EN 61000-2-4
EN 61000-4-2	Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test (IEC 61000-4-2); German version EN 61000-4-2
EN 61000-4-3	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test (IEC 61000-4-3); German version EN 61000-4-3
EN 61000-4-4	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test (IEC 61000-4-4); German version EN 61000-4-4

EN 61000-4-5	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test (IEC 61000-4-5); German version EN 61000-4-5
EN 61000-4-6	Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields (IEC 61000-4-6); German version EN 61000-4-6
EN 61000-4-34	Electromagnetic compatibility (EMC) - Part 4-34: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests for equipment with mains current more than 16 A per phase (IEC 61000-4-34); German version EN 61000-4-34
EN 61508-1...7	Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 1...7 (VDE 0803-1...7, IEC 61508-1...7)
EN 62061	Safety of machinery - functional safety of electrical, electronic and programmable electronic safety-related systems (VDE 0113-50, IEC 62061)
EN ISO 13849-1	Safety of machinery - safety-related parts of control systems - Part 1: General principles for design (ISO 13849-1); German version EN ISO 13849-1

Standards that are used in the environment of the drive converter

DGUV regulation 3	Electrical installations and equipment
DIN 46228-1	Wire-end ferrules; Tube without plastic sleeve
DIN 46228-4	Wire-end ferrules; Tube with plastic sleeve
DIN IEC 60364-5-54	Low-voltage electrical installations - Part 5-54: Selection and erection of electrical equipment - Earthing arrangements, protective conductors and protective bonding conductors (IEC 64/1610/CD)
DIN VDE 0100-729	Low-voltage electrical installations - Part 7-729: Requirements for special installations or locations - Operating or maintenance gangways (IEC 60364-7-729:2007, modified); German implementation HD 60364-7-729:2009
DNVGL-CG-0339	Environmental test specification for electrical, electronic and programmable equipment and systems
EN 1037	Safety of machinery - Prevention of unexpected start-up; German version EN 1037
EN 12502-1...5	Protection of metallic materials against corrosion - Part 1...5
EN 60204-1	Safety of machinery - electrical equipment of machines Part 1: General requirements (VDE 0113-1, IEC 44/709/CDV)
EN 60439-1	Low-voltage switchgear and controlgear assemblies - Part 1: Type-tested and partially type-tested assemblies (IEC 60439-1); German version EN 60439-1
EN 60947-7-1	Low-voltage switchgear and controlgear - Part 7-1: Ancillary equipment - Terminal blocks for copper conductors (IEC 60947-7-1:2009); German version EN 60947-7-1:2009
EN 60947-8	Low-voltage switchgear and controlgear - Part 8: Control units for built-in thermal protection (PTC) for rotating electrical machines (IEC 60947-8:2003 + A1:2006 + A2:2011)
EN 61373	Railway applications - Rolling stock equipment - Shock and vibration tests (IEC 61373); German version EN 61373
EN 61439-1	Low-voltage switchgear and controlgear assemblies - Part 1: General rules (IEC 121B/40/CDV); German version FprEN 61439-1
VGB R 455 P	Water treatment and use of materials in cooling systems
ISO 4017	Fasteners - Hexagon head screws - Product grades A and B
ISO 4762	Hexagon socket head cap screws
ISO 7090	Plain washers, chamfered - Normal series - Product grade A
ISO 7092	Plain washers - Small series - Product grade A
ISO 7045	Pan head screws with type H or type Z cross recess - Product grade A

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 of the safety instructions by the customer, user or other third party leads to the loss of all resulting claims against the manufacturer.

NOTICE



Hazards and risks through ignorance.

- ▶ Read the instructions for use !
- ▶ 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.

1.2 Transport, storage and proper use

The transport is carried out by qualified persons in accordance with the environmental conditions specified in this manual. Drive converter shall be protected against excessive strains.



Transport of drive converters with an edge length >75 cm

The transport by forklift without suitable tools can cause a deflection of the heat sink. This leads to premature aging or destruction of internal components.

- ▶ Transport of drive converters on suitable pallets.
- ▶ Do not stack drive converters or burden them with other heavy objects.



Drive converters contain electrostatic sensitive components.

- ▶ Avoid contact.
 - ▶ Wear ESD-protective clothing.
-

Do not store drive converters

- in the environment of aggressive and/or conductive liquids or gases.
- with direct sunlight.
- outside the specified environmental conditions.

1.3 Installation

⚠ DANGER

Do not operate in an explosive environment!

- ▶ The COMBIVERT is not intended for the use in potentially explosive environment.
-

⚠ CAUTION

Maximum design edges and high weight!
Contusions and bruises!

- ▶ Never stand under suspended loads.
 - ▶ Wear safety shoes.
 - ▶ Secure drive converter accordingly when using lifting gear.
-

- To prevent damages to the device:
- Make sure that no components are bent and/or isolation distances are changed.
- The device must not be put into operation in case of mechanical defects. Non-compliance with the applicable standards.
- Do not allow moisture or mist to penetrate the unit.
- Avoid dust permeating the device. Allow for sufficient heat dissipation if installed in a dust-proof housing.
- Note installation position and minimum distances to surrounding elements. Do not cover the ventilation openings.
- Mount the drive inverter according to the specified degree of protection.
- Make sure that no small parts fall into the COMBIVERT during assembly and wiring (drilling chips, screws etc.). This also applies to mechanical components, which can lose small parts during operation.
- Check the reliable fit of the device connections in order to avoid contact resistances and sparking.
- Do not walk-on drive converter.
- The safety instructions are to be kept!

1.4 Electrical connection

⚠ DANGER



Voltage at the terminals and in the device !

Danger to life due to electric shock !

- ▶ Never work on the open device or never touch exposed parts.
- ▶ For any work on the unit switch off the supply voltage, secure it against switching on and check absence of voltage by measurement.
- ▶ Wait until all drives has been stopped in order that no regenerative energy can be generated.
- ▶ Await capacitor discharge time (5 minutes) if necessary, measure DC voltage at the terminals.
- ▶ If personal protection is required, install suitable protective devices for drive converters.
- ▶ Never bridge upstream protective devices (also not for test purposes).
- ▶ Connect the protective earth conductor always to drive converter and motor.
- ▶ Install all required covers and protective devices for operation.
- ▶ The control cabinet shall be kept closed during operation.
- ▶ Residual current: This product may cause a dc current in the protective earth conductor. When a residual current protective device (RCD) or a residual current monitoring device (RCM) is used for the protection against direct or indirect contact, only a RCD or RCM type B is permitted on the power supply side of this product.
- ▶ Drive converters with a leakage current $> 3.5\text{mA AC}$ current (10mA DC current) are intended for a stationary connection. Protective earth conductors must be designed in accordance with the local regulations for equipment with high leakage currents according to [EN 61800-5-1](#), [EN 60204-1](#) or [DIN IEC 60364-5-54](#).



If personnel protection is required during installation of the system, suitable protective devices must be used for drive converters.

www.keb.de/fileadmin/media/Manuals/knowledge/04_techinfo/00_general/ti_rcd_0400_0002_gbr.pdf



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. They must always be complied with, also for drive converter bearing a CE marking.

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 by the user according to the specified minimum/maximum values for the application.
- The wiring must be made with flexible copper cable for a temperature $> 75^{\circ}\text{C}$.
- Connection of the drive converter is only permissible on symmetrical networks with a maximum line voltage (L1, L2, L3) with respect to earth (N/PE) of max. 300 V. An isolating transformer must be used for supply networks which exceed this value! In case of non-compliance the control is not longer considered to be a PELV circuit.
- With existing or newly wired circuits the person installing the units or machines must ensure that the PELV requirements are met.
- For drive converters that are not isolated from the supply circuit (in accordance with [EN 60721-3-2](#)) 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.

1.4.1 EMC-compatible installation

Observance of the limit values required by EMC law is the responsibility of the customer.



Notes on EMC-compatible installation can be found here.
www.keb.de/fileadmin/media/Manuals/emv/0000neb0000.pdf



1.4.2 Voltage test

Testing with AC voltage (in accordance with [EN 60204-1](#) chapter 18.4) may not be executed, since there is danger for the power semiconductors in the drive inverter.



Due to the radio interference suppression capacitors, the test generator will switch off immediately with a current fault.



According to [EN 60204-1](#) it is permissible to disconnect already tested components. Drive converters of the KEB Automation KG are delivered ex works voltage tested to 100% according to product standard.

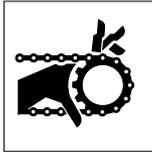
1.4.3 Insulation measurement

An insulation measurement (in accordance with [EN 60204-1](#) chapter 18.3) with DC 500 V is permissible, if all power unit connections (grid-connected potential) and all control connections are bridged with PE. The insulation resistance of the respective device can be found in the technical data.

1.5 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.

⚠ CAUTION



High temperatures at heat sink and coolant!

Burning of the skin!

- ▶ Cover hot surfaces safe-to-touch.
- ▶ If necessary, attach warning signs on the system.
- ▶ Before touching, check the surface and coolant lines.
- ▶ Before working let the unit cool down.

- During operation, all covers and doors shall be kept closed.
- Use only approved accessories for this device.
- Never touch terminals, busbars or cable ends.



If a drive converter with electrolytic capacitors in a DC link (see technical data) has not been in operation for more than one year, observe the following instructions.

www.keb.de/fileadmin/media/Manuals/knowledge/04_techinfo/00_general/ti_format_capacitors_0400_0001_gbr.pdf



NOTICE

Continuous operation (S1) with load > 60%!

Premature ageing of the electrolytic capacitors!

- ▶ Insert mains choke with $U_k = 4\%$.
- ▶ From a rated motor power of 55 kW, a mains choke with $U_k = 4\%$ must be used!

Switching at the output

Switching between motor and drive converter is prohibited for single drives during operation as this may trigger the protection gear of the device. Function ‚speed search‘ must be activated if switching can not be avoided. Speed search may only be triggered after closing the motor contactor (e.g. by switching the control release).

Connecting and disconnecting is permissible with multiple motor drives if at least 1 motor is running during the switch-over process. The drive converter must be dimensioned to the occurring starting currents.

The ‚speed search‘ function must be activated if the motor is still running during a restart of the drive converter (mains on) (e.g. due to large rotating masses).

Switching an the input

For applications that require cyclic switching off and on of the drive converter, maintain an off-time of at least 5 min after the last switch on. If you require shorter cycle times please contact KEB Automation KG.

Short-circuit resistance

The drive converters are conditional short-circuit proof. After resetting the internal protection devices, the function as directed is guaranteed.

Exceptions:

- If an earth-leakage fault or short-circuit often occurs at the output, this can lead to a defect in the unit.
- If a short-circuit occurs during regenerative operation (2nd or 4th quadrant, regeneration into the DC link), this can lead to a defect in the unit.

1.6 Maintenance

The following maintenance work has to be carried out when required, but at least once per year by authorized and trained personnel. Check unit for loose screws and plugs and tighten if necessary.

- ▶ Check system for loose screws and plugs and tighten if necessary.
- ▶ Clean drive converter 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.
- ▶ Check the function of the fans of the drive converter. The fan must be replaced in case of audible vibrations or squeak.
- ▶ In the case of liquid-cooled drive converters a visual test of the cooling circuit for leaks and corrosion must be carried out. 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.

1.8 Repair

In case of malfunction, unusual noises or smells inform a person in charge!

DANGER



Unauthorized exchange, repair and modifications!

Unpredictable malfunctions!

- ▶ The function of the drive converter is dependent on its parameterization. Never replace without knowledge of the application.
- ▶ Modification or repair is permitted only by KEB Automation KG authorized personnel.
- ▶ Only use original manufacturer parts.
- ▶ Infringement will annul the liability for resulting consequences.

In case of failure, please contact the machine manufacturer. Only the machine manufacturer knows the parameterisation of the used drive converter and can provide an appropriate replacement or induce the maintenance.

1.7 Disposal

Electronic devices of the KEB Automation KG are exclusively professional devices for further industrial processing (so-called B2B devices).

Manufacturers of B2B devices are obliged to take back and recycle devices manufactured after 14.08.2018. These devices may not be disposed at the collection centres of public sector disposal organisations.



If no deviating agreement has been made between the customer and KEB or no deviating mandatory legal regulation exists, KEB products marked in this way can be returned. Company and keyword to the return point can be taken from the list below. Shipping costs are paid by the customer. Thereupon the devices will be professionally recycled and disposed.

The entry numbers are listed country-specific in the following table. The corresponding KEB return addresses can be found on our website.

Withdrawal by	WEEE-Reg.-No.	Keyword
Austria		
KEB Automation GmbH	ERA: 51976	Stichwort „Rücknahme WEEE“
France		
RÉCYLUM - Recycle point	ADEME: FR021806	Mots clés „KEB DEEE“
Germany		
KEB Automation KG	EAR: DE12653519	Stichwort „Rücknahme WEEE“
Italy		
COBAT	AEE: (IT) 19030000011216	Parola chiave „Ritiro RAEE“
Spain		
KEB Automation KG	RII-AEE 7427	Palabra clave „Retirada RAEE“

The packaging must be feed to paper and cardboard recycling.

2 Product Description

The device series COMBIVERT F6 concerns to drive controllers, which are optimized for operation at synchronous and asynchronous motors. The COMBIVERT can be extended with a safety module for the use in safety-oriented applications. It can be operated with a fieldbus module at different fieldbus systems. The control board has a system comprehensive operating concept.

The COMBIVERT meets the requirements of the Low-Voltage Directive. The harmonized standards of the series *EN 61800-5-1* for drive controller were used.

The COMBIVERT is a product of limited availability in accordance with *EN 61800-3*. This product may cause radio interference in residential areas. In this case the operator may need to take corresponding measures.

The machine directive, EMC directive, Low Voltage Directive and other guidelines and regulations must be observed depending on the version.

2.1 Specified application

The COMBIVERT serves exclusively for the control and regulation of three-phase motors. It is intended for the installation into electrical systems or machines.

Technical data and information for connection conditions shall be taken from the nameplate and from the instructions for use and must be strictly observed.

The used semiconductors and components of the KEB Automation KG are developed and dimensioned for the use in industrial products.

Restriction

If the product 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.

2.1.1 Residual risks

Despite intended use, the drive converter can reach unexpected operating conditions in case of error, with wrong parameterization, by faulty connection or unprofessional interventions and repairs. This can be:

- wrong direction of rotation
- motor speed too high
- motor is running into limitation
- motor can be under voltage even in standstill
- automatic start

2.2 Unintended use

The operation of other electric consumers is prohibited and can lead to the destruction of the devices. The operation of our products outside the indicated limit values of the technical data leads to the loss of any liability claims.

2.3 Product features

These instructions for use describe the power units of the following devices:

Device type:	Drive converter
Series:	COMBIVERT F6
Power range:	110...200 kW / 400 V
Housing:	7

The COMBIVERT F6 is characterized by the following features:

- Operation of three-phase asynchronous motors and three-phase synchronous motors, in operating modes open-loop or closed-loop with and without speed feedback
- Following fieldbus systems are supported: EtherCAT, VARAN, PROFINET, POWERLINK or CAN
- System-overlapping operating concept
- Wide operating temperature range
- Low switching losses by IGBT power unit
- Low noise development due to high switching frequencies
- Different heat sink concepts
- Temperature-controlled fan, easily replaceable
- Torque limits and s-curves are adjustable to protect gearboxes
- General protection functions of the COMBIVERT series against overcurrent, over-voltage, ground fault and overtemperature
- Analog inputs and outputs, digital inputs and outputs, relay output (potential-free), brake control and -supply, motor protection by I²t, KTY- or PTC input, two encoder interfaces, diagnostic interface, fieldbus interface (depending on the control board)
- Integrated safety function according to [EN 61800-5-2](#)

2.4 Part code

xx F6 xx-x-x-x-x

Heat sink version	1: Air-cooler, mounted version
	2: Liquid cooler (water), mounted version
	3: Air-cooler, through-mount version IP54
	4: Liquid cooler (water), through-mount version IP54
	5: Air-cooler, through-mount version IP20
	6: Liquid cooler (water), trough-mount version IP54, sub-mounted braking resistors
	7: Liquid cooler (oil), through-mount version IP54
	9: Liquid cooler (water), mounted version, sub-mounted braking resistors
	A: Liquid cooler (water), trough-mount version IP54, sub-mounted braking resistors version 2
	B: Liquid cooler (water), mounted version, sub-mounted braking resistors version 2
Control board variant	APPLIKATION
	1: Multi Encoder Interface, CAN ^{® 2)} , Real-Time Ethernet-busmodule ³⁾
	KOMPAKT
	1: Multi Encoder Interface, CAN ^{® 2)} , STO, EtherCAT ^{® 1)}
	2: Multi Encoder Interface, CAN ^{® 2)} , STO, VARAN
Switching frequency, Software current limit, Turn-off current	PRO
	3: Multi Encoder Interface, CAN ^{® 2)} , Real-Time Ethernet interface ³⁾ , RD485-potential free
	4: No Encoder, CAN ^{® 2)} , Real-Time Ethernetinterface ³⁾ , safe relay
	5: Multi Encoder Interface, CAN ^{® 2)} , Real-Time Ethernet interface ³⁾ , Safety Relay
	0: 2 kHz / 125% / 150% 6: 8 kHz / 150% / 180%
1: 4 kHz / 125% / 150% 7: 16 kHz / 150% / 180%	
2: 8 kHz / 125% / 150% 8: 2 kHz / 180% / 216%	
3: 16 kHz / 125% / 150% 9: 4 kHz / 180% / 216%	
4: 2 kHz / 150% / 180% A: 8 kHz / 180% / 216%	
5: 4 kHz / 150% / 180% B: 16 kHz / 180% / 216%	
Voltage / Connection type	1: 3ph 230V AC/DC with braking transistor
	2: 3ph 230V AC/DC without braking transistor
	3: 3ph 400V AC/DC with braking transistor
	4: 3ph 400V AC/DC without braking transistor
Housing	2...9
Control type	1: Safety module type 1 /STO at control type K
	3: Safety module type 3
	4: Safety module type 4
	5: Safety module type 5
	A: APPLICATION K: COMPACT P: PRO
Series	COMBIVERT F6
Inverter size	10...33

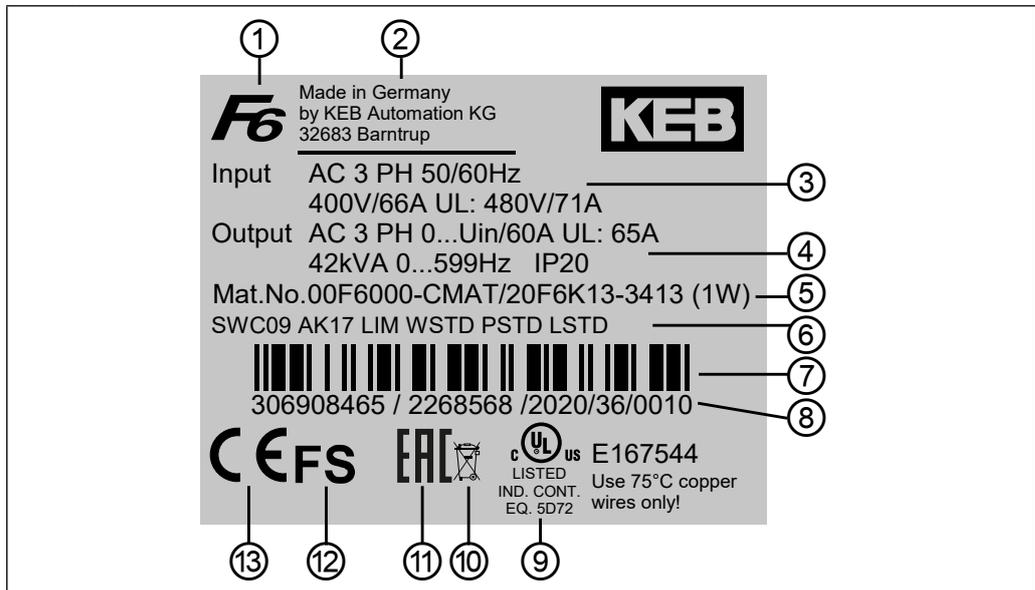
Table 1: Part code

- 1)  *EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany*
- 2)  *CANopen® is registered trademark of CAN in AUTOMATION - International Users and Manufacturers Group e.V.*
- 3) *The Real-Time Ethernetbusmodul / Real-Time Ethernet interface contains various fieldbus control types which can be adjusted by software (parameter fb68)*



The part code may not be used as order code, but only for identification!

2.5 Nameplate



Legend

1	Device series
2	Manufacturer identification
3	Technical data input
4	Technical data output
5	Material number, basic device => „2.4 Part code“, version number
6	Configurable options or customer material number/version => „2.5.1 Configurable options“
7	Barcode Interleaved 2/5 (serial number)
8	Serial-, order number; Year and week of production; Factory
9	UL certification
10	Disposal information
11	EAC certification
12	FS certification
13	CE certification

Figure 1: Nameplate

2.5.1 Configurable options

Features	Feature values	Description
Software	SWxxx	Software status of the drive converter
Accessories	Axxx	Selected accessories
	NAK	No accessories
Output frequency activation	LIM	Limitation to 599 Hz
	ULO	> 599Hz activated
Warranty	WSTD	Warranty - Standard
	Wxxx	Warranty extension
Parameterization	PSTD	Parameterization - Standard
	Pxxx	Parameterization - Customer-specific
Nameplate logo	LSTD	Logo - Standard
	Lxxx	Logo - Customer-specific
<i>Figure 2: Configurable options</i>		

„x“ indicates a variable value

3 Technical Data

Unless otherwise indicated, all electrical data in the following chapter refer to a 3-phase AC mains.

3.1 Operating conditions

3.1.1 Climatic environmental conditions

Storage		Standard	Class	Descriptions
Ambient temperature		EN 60721-3-1	1K4	-25...55 °C
Relative humidity		EN 60721-3-1	1K3	5...95 % (without condensation)
Storage height		–	–	Max. 3000 m above sea level
Transport		Standard	Class	Descriptions
Ambient temperature		EN 60721-3-2	2K3	-25...70 °C
Relative humidity		EN 60721-3-2	2K3	95 % at 40 °C (without condensation)
Operation		Standard	Class	Descriptions
Ambient temperature		EN 60721-3-3	3K3	5...40 °C (extended to -10...45 °C)
Coolant inlet temperature	Air	–	–	5...40 °C (-10...45 °C)
	Liquid	–	–	5...40 °C
Relative humidity		EN 60721-3-3	3K3	5...85 % (without condensation)
Version and degree of protection		EN 60529	IP20	Protection against foreign material > ø12.5 mm No protection against water Non-conductive pollution, occasional condensation when PDS is out of service. Drive controller generally, except power connections and fan unit (IPxxA)
Site altitude		–	–	Max. 2000 m above sea level <ul style="list-style-type: none"> With site altitudes over 1000 m a derating of 1 % per 100 m must be taken into consideration. With site altitudes over 2000 m, the control board to the mains has only basic isolation. Additional measures must be taken when wiring the control.

Table 2: Climatic environmental conditions

3.1.2 Mechanical environmental conditions

Storage		Standard	Class	Descriptions
Vibration limits		<i>EN 60721-3-1</i>	1M2	Vibration amplitude 1.5 mm (2...9Hz) Acceleration amplitude 5 m/s ² (9...200Hz)
Shock limit values		<i>EN 60721-3-1</i>	1M2	40 m/s ² ; 22 ms
Transport		Standard	Class	Descriptions
Vibration limits		<i>EN 60721-3-2</i>	2M1	Vibration amplitude 3.5 mm (2...9Hz) Acceleration amplitude 10 m/s ² (9...200 Hz) (Acceleration amplitude 15 m/s ² (200...500Hz))*
Shock limit values		<i>EN 60721-3-2</i>	2M1	100 m/s ² ; 11 ms
Operation		Standard	Class	Descriptions
Vibration limits		<i>EN 60721-3-3</i>	3M4	Vibration amplitude 3.0 mm (2...9Hz) Acceleration amplitude 10 m/s ² (9...200 Hz)
		<i>EN 61800-5-1</i>	–	Vibration amplitude 0.075 mm (10...57 Hz) Acceleration amplitude 10 m/s ² (57...150 Hz)
Shock limit values		<i>EN 60721-3-3</i>	3M4	100 m/s ² ; 11 ms
Pressure in the water cooler		–	–	Rated operating pressure: 10 bar Max. operating pressure: 10 bar

Table 3: Mechanical environmental conditions

*Not tested

3.1.3 Chemical / mechanical active substances

Storage		Standard	Class	Descriptions
Contamination	Gases	<i>EN 60721-3-1</i>	1C2	–
	Solids		1S2	–
Transport		Standard	Class	Descriptions
Contamination	Gases	<i>EN 60721-3-2</i>	2C2	–
	Solids		2S2	–
Operation		Standard	Class	Descriptions
Contamination	Gases	<i>EN 60721-3-3</i>	3C2	–
	Solids		3S2	–

Table 4: Chemical / mechanical active substances

3.1.4 Electrical operating conditions

3.1.4.1 Device classification

Requirement	Standard	Class	Descriptions
Overvoltage category	EN 61800-5-1	III	–
	EN 60664-1		–
Pollution degree	EN 60664-1	2	Non-conductive pollution, occasional condensation when PDS is out of service

Table 5: Device classification

3.1.4.2 Electromagnetic compatibility

For devices without an internal filter, an external filter is required to comply with the following limits.

EMC emitted interference	Standard	Class	Descriptions
Cable-conducted interferences	EN 61800-3	C2	–
Radiated interferences	EN 61800-3	C2	–
Immunity	Standard	Level	Descriptions
Static discharges	EN 61000-4-2	8 kV 4 kV	AD (air discharge) CD (contact discharge)
Burst - Ports for process measurement control lines and signal interfaces	EN 61000-4-4	2 kV	–
Burst - Power ports	EN 61000-4-4	4 kV	–
Surge - Power ports	EN 61000-4-5	1 kV 2 kV	Phase-phase Phase-ground
Cable-fed disturbances, induced by high-frequency fields	EN 61000-4-6	10 V	0.15...80 MHz
Electromagnetic fields	EN 61000-4-3	10 V/m 3 V/m 1 V/m	80 MHz...1 GHz 1.4...2 GHz 2...2.7 GHz
Voltage fluctuations/ voltage dips	EN 61000-2-1 EN 61000-4-34	–	-15 %...+10 % 90 %
Frequency changes	EN 61000-2-4	–	≤ 2 %
Voltage deviations	EN 61000-2-4	–	±10 %
Voltage unbalance	EN 61000-2-4	–	≤ 3 %

Table 6: Electromagnetic compatibility

3.2 Device data of the 400V devices

3.2.1 Overview of the 400V devices

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

Device size		25	26	27	28	28 ⁸⁾
Housing		7				
Rated apparent output power	S_{out} / kVA	145	173	208	256	
Max. rated motor power	³⁾ P_{mot} / kW	110	132	160	200	
Rated input voltage	U_N / V	400 (UL: 480)				
Input voltage range	U_{in} / V	280...550				
Mains phases		3				
Mains frequency	f_N / Hz	50 / 60 ±2				
Rated input current @ $U_N = 400V$	I_{in} / A	221	263	315	390	
Rated input current @ $U_N = 480V$	I_{in_UL} / A	186	217	269	337	
Insulation resistance @ $U_{dc} = 500V$	R_{iso} / MΩ	> 15				
Output voltage	U_{out} / V	0... U_{in}				
Output frequency	²⁾ f_{out} / Hz	0...599				
Output phases		3				
Rated output current @ $U_N = 400V$	I_N / A	210	250	300	370	
Rated output current @ $U_N = 480V$	I_{N_UL} / A	180	210	260	325	
Rated output overload (60 s)	^{1) 5)} I_{60s} / %	125				
Software current limit	¹⁾ I_{lim} / %	125				
Overcurrent	¹⁾ I_{OC} / %	150				
Rated switching frequency	f_{SN} / kHz	4	4	2	2	
Max. switching frequency	⁴⁾ f_{S_max} / kHz	16				
Power dissipation at rated operation	³⁾ P_D / W	2200	2700	2700	3556	
Overload current over time	¹⁾ I_{OL} / %	„3.2.3.1 Overload characteristic (OL)“				
Maximum current 0Hz/50Hz at $f_S = 2$ kHz	I_{out_max} / %	133/150	100/150	90/150	84/150	100/150
Maximum current 0Hz/50Hz at $f_S = 4$ kHz	I_{out_max} / %	100/150	70 / 150	58 / 107	60 / 124	58/150
Maximum current 0Hz/50Hz at $f_S = 8$ kHz	I_{out_max} / %	54 / 123	28 / 70	23 / 61	33 / 78	34/61

continued on the next page

Device size	25	26	27	28	28 ⁸⁾
Housing	7				
Maximum current 0Hz/50Hz at $f_s = 16\text{ kHz}$ $I_{out_max} / \%$	21 / 57	14 / 35	12 / 31	9 / 26	17 / 31
Max. braking current I_{B_max} / A	382				
Min. braking resistor value R_{B_min} / Ω	2.2				
Braking transistor ⁷⁾	Max. cycle time: 120s; ED: 50 %				
Protective function for braking transistor	Short-circuit monitoring				
Protective function braking resistor (Error GTR7 always on) ⁶⁾	Feedback signal evaluation and current shutdown				
Table 7: Overview of the 400 V device data					

- 1) The values refer in % to the rated output current I_N .
- 2) The output frequency is to be limited in such a way that it does not exceed 1/10 of the switching frequency. Devices with higher max. output frequency are subject to export restrictions and are only available on request.
- 3) Rated operation corresponds to $U_N = 400\text{V}$, rated switching frequency, output frequency = 50Hz (4-pole standard asynchronous motor).
- 4) A detailed description of the Derating => „3.3.1 Switching frequency and temperature“.
- 5) Observe limitations => „3.2.3.1 Overload characteristic (OL)“.
- 6) The feedback signal evaluation monitors the functionality of the braking transistor. Power off occurs via the internal mains input bridge of the AC supply.
- 7) The cyclic duration factor is additionally limited by the used braking resistor.
- 8) Only available as fluid cooler (water).

3.2.2 Voltage and frequencies for 400V devices

Input voltages and frequencies		
Rated input voltage	U_N / V	400
Rated mains voltage (USA)	U_{N_UL} / V	480
Input voltage range	U_{IN} / V	280...550
Input phases		3
Mains frequency	f_N / Hz	50/60
Mains frequency tolerance	$\pm f_N / \text{Hz}$	2
Table 8: Input voltages and frequencies of the 400V devices		

DC link voltage		
DC link rated voltage @ $U_N = 400\text{V}$	U_{N_dc} / V	565
DC link rated voltage @ $U_{N_UL} = 480\text{V}$	$U_{N_UL_dc} / \text{V}$	680
DC link voltage working voltage range	U_{IN_dc} / V	390...780
Table 9: DC link voltage for 400V devices		

Output voltages and frequencies		
Output voltage at AC supply	¹⁾ U_{out} / V	0... U_{N_ac}
Output frequency	²⁾ f_{out} / Hz	0...599
Output phase		3

Table 10: Output voltages and frequencies of the 400V devices

¹⁾ The voltage to the motor is dependent on the actual input voltage and the control method („Example of the calculation of the possible motor voltage:“).

²⁾ The output frequency is to be limited in such a way that it does not exceed 1/10 of the switching frequency. Devices with higher max. output frequency are subject to export restrictions and are only available on request.

3.2.2.1 Example of the calculation of the possible motor voltage:

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

Component	Reduction / %	Example
Mains choke U_k	4	Example: open-loop drive converter with mains- and motor choke at non-rigid supply system: 400 V mains voltage - 11 % = 356 V motor voltage
Drive converter open-loop	4	
Drive converter closed-loop	8	
Motor choke U_k	1	
Non-rigid supply system	2	

Table 11: Example of the calculation of the possible motor voltage:

3.2.3 Input and output currents/ overload

Device size		25	26	27	28
Rated input current @ $U_N = 400V$	¹⁾ I_{in} / A	221	263	315	390
Rated input current @ $U_{N_UL} = 480V$	¹⁾ I_{in_UL} / A	186	217	269	337

Table 12: Input currents of the 400 V devices

¹⁾ The values resulting from rated operation with B6 rectifier circuit and mains choke 4% U_k .

Device size		25	26	27	28
Rated output current @ $U_N = 400V$	I_N / A	210	250	300	370
Rated output current @ $U_{N_UL} = 480V$	I_{N_UL} / A	180	210	260	325
Rated output overload (60 s)	¹⁾ $I_{60s} / \%$	125			
Overload current	¹⁾ $I_{OL} / \%$	„3.2.3.1 Overload characteristic (OL)“			
Software current limit	¹⁾²⁾ $I_{lim} / \%$	125			
Overcurrent	¹⁾ $I_{OC} / \%$	150			

Table 13: Output currents of the 400V devices

¹⁾ The values refer in % to the rated output current I_N .

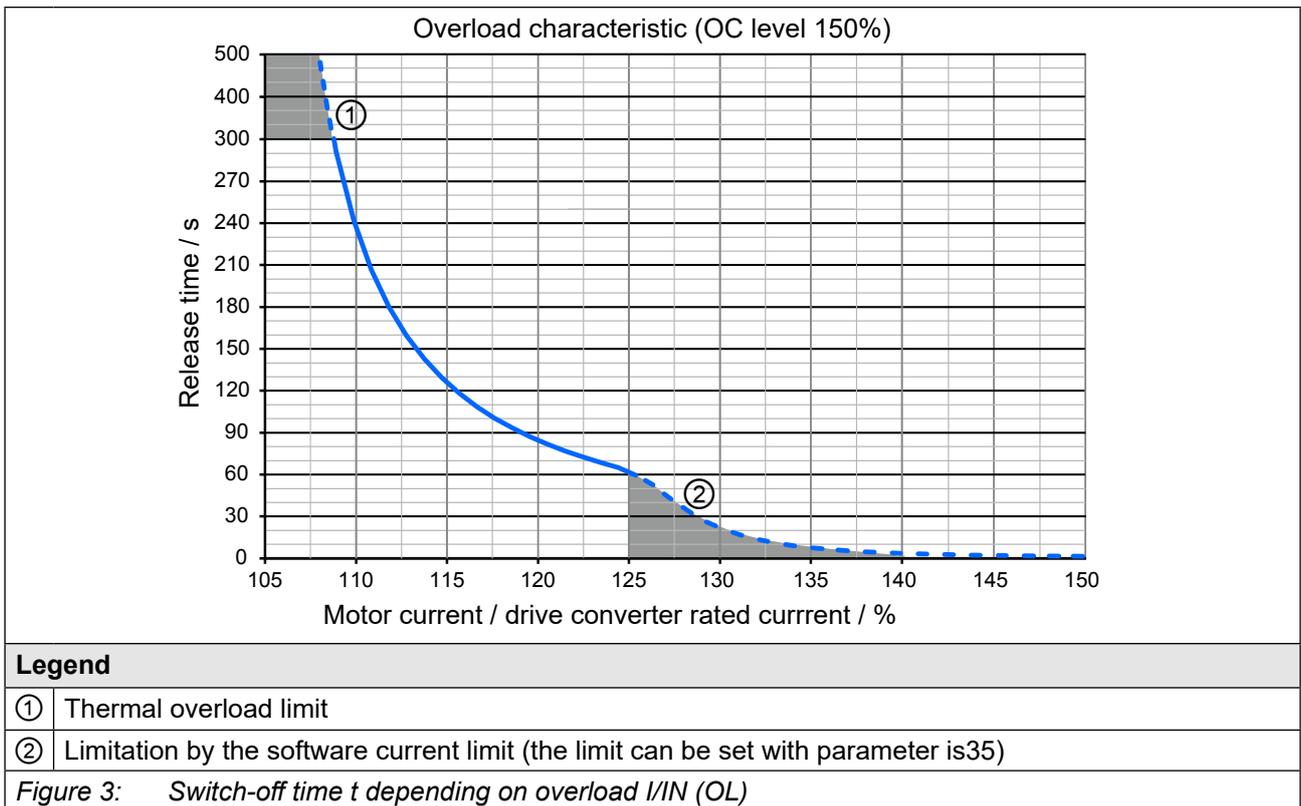
²⁾ Limitation of the current setpoint in closed-loop operation. This setpoint limit is not active in v/f operation.

3.2.3.1 Overload characteristic (OL)

All drive converters can be operated at rated switching frequency with an utilization of 125 % for 60 s.

Restrictions:

- The thermal design of the heat sink is based on the rated operation. The following values are taken into account: Rated output current, ambient temperature, rated switching frequency, rated voltage.
- At high surrounding temperatures and/or high heat sink temperatures (for example, by preceding utilization nearby 100%) the drive converter can change to overtemperature error before triggering the protective function OL.
- At low output frequencies or switching frequencies higher than the rated switching frequency, the frequency-dependent maximum current can be exceeded and error OL2 can be triggered
=> „3.2.3.2 Frequency-dependent maximum current (OL2)“.



- On exceeding a load of 105 % the overload integrator starts.
- When falling below the integrator counts backwards.
- If the integrator reaches the overload characteristic „Error! overload (OL)“ is triggered.

After a cooling down period, the integrator can be reset now. The drive converter must remain switched on during the cooling down phase.

Operation in the range of the thermal overload limit

Due to the high slope of the overload characteristic, the duration of a permissible overload in range ① cannot be determined exactly. Therefore, the design of the drive converter should be assumed to have a maximum overload time of 300s.

3.2.3.2 Frequency-dependent maximum current (OL2)

The characteristics of the maximum currents for a switching frequency which are depending on the output frequency are different for each drive converter, but the following rules are generally applicable:

- Lower maximum currents apply for switching frequencies > rated switching frequency.

If error (OL2) shall be triggered on exceeding the maximum currents or if the switching frequency is automatically reduced (derating) can be adjusted in the drive converter parameters.

The following characteristic curve indicates the permissible maximum current for the output frequency values 0Hz, 1.5Hz, 3Hz, 6Hz, 10Hz and 25Hz. Device size 28 is represented exemplary.

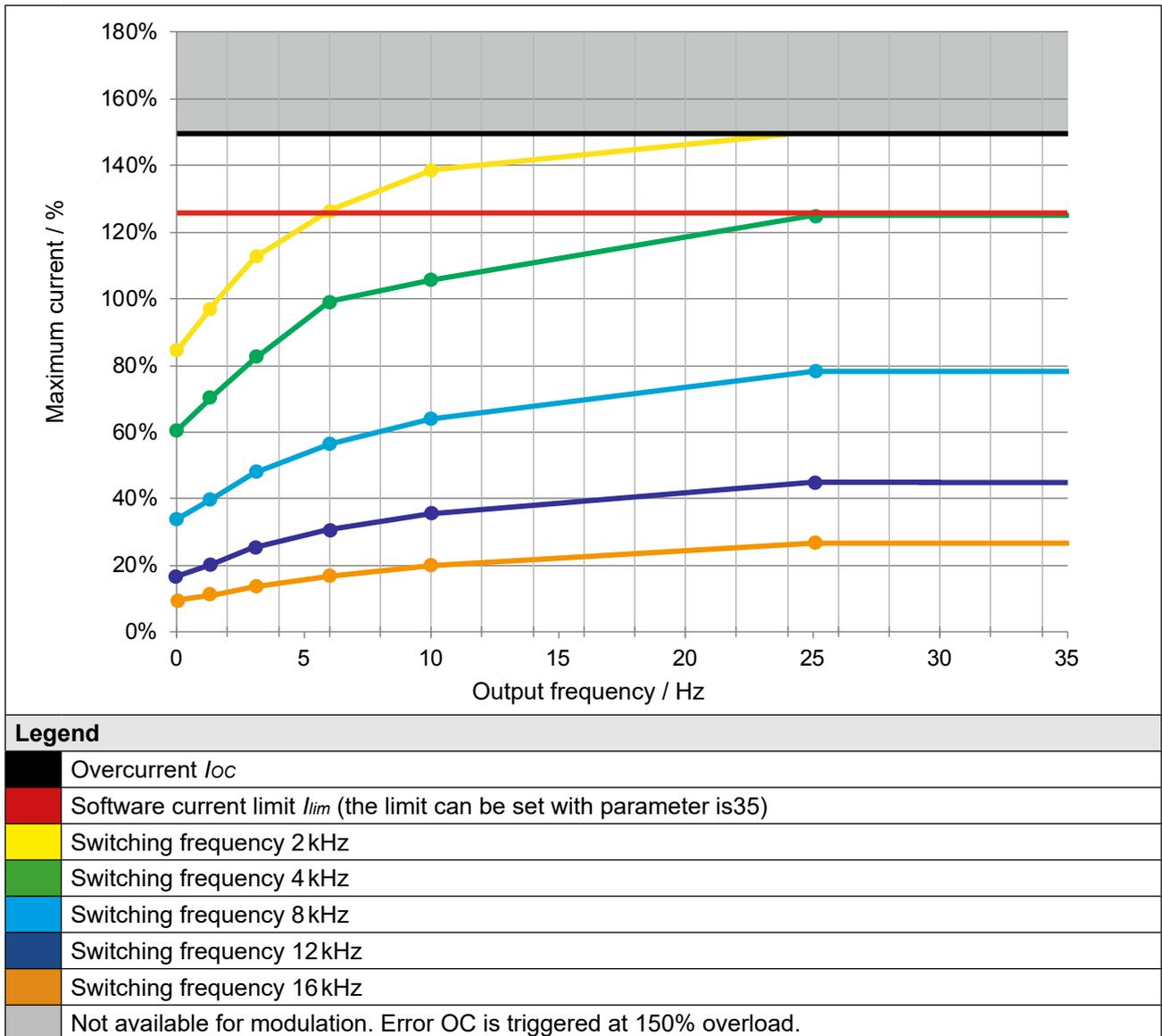


Figure 4: Typical overload characteristics in the lower output frequencies (OL2) Example. Device size 28



The frequency-dependent maximum current I_{lim} refers in % to the rated output current I_N .

The current remains constant from the last specified output frequency value.



The values for the respective device size are listed in the following tables.

Frequency-dependent maximum current

Device size		25					
Rated switching frequency		4 kHz					
Output frequency	f_{out} / Hz	0	1.5	3	6	10	25
Frequency-dependent maximum current @ f_s <i>Basic Time Period = 62.5 μs (Parameter is22=0)</i>	2 kHz	133	150	150	150	150	150
	4 kHz	100	118	136	150	150	150
	8 kHz	55	66	77	91	102	124
	16 kHz	21	26	32	38	44	57
Frequency-dependent maximum current @ f_s <i>Basic Time Period = 71.4 μs (Parameter is22=1)</i>	1.75 kHz	133	150	150	150	150	150
	3.5 kHz	108	126	139	150	150	150
	7 kHz	66	79	91	105	114	130
	14 kHz	28	35	42	50	57	71
Frequency-dependent maximum current @ f_s <i>Basic Time Period = 83.3 μs (Parameter is22=2)</i>	1.5 kHz	133	150	150	150	150	150
	3 kHz	117	134	143	150	150	150
	6 kHz	77	92	106	120	126	137
	12 kHz	36	43	51	61	69	86
Frequency-dependent maximum current @ f_s <i>Basic Time Period = 100 μs (Parameter is22=3)</i>	1.25 kHz	133	150	150	150	150	150
	2.5 kHz	125	142	146	150	150	150
	5 kHz	89	105	121	135	138	144
	10 kHz	45	54	64	76	86	105

Table 14: Frequency-dependent maximum current for device size 25

Device size		26					
Rated switching frequency		4 kHz					
Output frequency	f_{out} / Hz	0	1.5	3	6	10	25
Frequency-dependent maximum current @ f_s <i>Basic Time Period = 62.5 μs (Parameter is22=0)</i>	2 kHz	100	133	150	150	150	150
	4 kHz	70	78	90	112	129	150
	8 kHz	28	44	50	58	64	71
	16 kHz	14	22	26	30	32	36
Frequency-dependent maximum current @ f_s <i>Basic Time Period = 71.4 μs (Parameter is22=1)</i>	1.75 kHz	100	133	150	150	150	150
	3.5 kHz	78	92	107	131	149	150
	7 kHz	39	52	60	72	80	99
	14 kHz	17	26	30	35	37	42
Frequency-dependent maximum current @ f_s <i>Basic Time Period = 83.3 μs (Parameter is22=2)</i>	1.5 kHz	100	133	150	150	150	150
	3 kHz	85	105	125	150	150	150
	6 kHz	49	61	70	85	96	127
	12 kHz	19	30	34	40	43	48
Frequency-dependent maximum current @ f_s <i>Basic Time Period = 100 μs (Parameter is22=3)</i>	1.25 kHz	100	133	150	150	150	150
	2.5 kHz	93	119	143	150	150	150
	5 kHz	60	69	80	99	113	150
	10 kHz	24	37	42	49	53	59

Table 15: Frequency-dependent maximum current for device size 26

Device size		27					
Rated switching frequency		2 kHz					
Output frequency	f_{out} / Hz	0	1.5	3	6	10	25
Frequency-dependent maximum current @ f_s <i>Basic Time Period = 62.5 μs (Parameter is22=0)</i>	2 kHz	90	108	129	150	150	150
	4 kHz	58	67	77	89	97	107
	8 kHz	24	38	44	50	55	61
	16 kHz	12	19	22	26	28	31
Frequency-dependent maximum current @ f_s <i>Basic Time Period = 71.4 μs (Parameter is22=1)</i>	1.75 kHz	90	108	129	150	150	150
	3.5 kHz	66	78	90	109	120	134
	7 kHz	32	45	52	60	66	73
	14 kHz	14	23	26	30	33	36
Frequency-dependent maximum current @ f_s <i>Basic Time Period = 83.3 μs (Parameter is22=2)</i>	1.5 kHz	90	108	129	150	150	150
	3 kHz	74	88	103	130	142	150
	6 kHz	41	53	61	70	76	84
	12 kHz	16	26	30	34	37	41
Frequency-dependent maximum current @ f_s <i>Basic Time Period = 100 μs (Parameter is22=3)</i>	1.25 kHz	90	108	129	150	150	150
	2.5 kHz	82	98	116	150	150	150
	5 kHz	50	60	69	80	87	96
	10 kHz	20	32	37	42	46	51

Table 16: Frequency-dependent maximum current for device size 27

DEVICE DATA OF THE 400V DEVICES

Device size		28					
Rated switching frequency		2 kHz					
Output frequency	f_{out} / Hz	0	1.5	3	6	10	25
Frequency-dependent maximum current @ f_s <i>Basic Time Period = 62.5 μs (Parameter is22=0)</i>	2 kHz	84	99	112	126	138	150
	4 kHz	60	71	81	94	105	124
	8 kHz	33	40	47	56	63	78
	16 kHz	9	11	13	16	20	26
Frequency-dependent maximum current @ f_s <i>Basic Time Period = 71.4 μs (Parameter is22=1)</i>	1.75 kHz	84	99	112	126	138	150
	3.5 kHz	66	78	89	102	113	133
	7 kHz	40	48	56	65	74	89
	14 kHz	13	16	19	24	28	36
Frequency-dependent maximum current @ f_s <i>Basic Time Period = 83.3 μs (Parameter is22=2)</i>	1.5 kHz	84	99	112	126	138	150
	3 kHz	72	85	97	110	121	142
	6 kHz	47	55	64	75	84	101
	12 kHz	17	21	25	31	36	45
Frequency-dependent maximum current @ f_s <i>Basic Time Period = 100 μs (Parameter is22=3)</i>	1.25 kHz	84	99	112	126	138	150
	2.5 kHz	78	92	104	118	130	150
	5 kHz	53	63	73	84	95	113
	10 kHz	25	30	36	43	50	61

Table 17: Frequency-dependent maximum current for device size 28

Device size		28 ¹⁾					
Rated switching frequency		2 kHz					
Output frequency	f_{out} / Hz	0	1.5	3	6	10	25
Frequency-dependent maximum current @ f_s <i>Basic Time Period = 62.5 μs (Parameter is22=0)</i>	2 kHz	100	107	120	150	150	150
	4 kHz	58	70	85	115	128	150
	8 kHz	34	38	44	51	55	61
	16 kHz	17	19	22	26	28	31
Frequency-dependent maximum current @ f_s <i>Basic Time Period = 71.4 μs (Parameter is22=1)</i>	1.75 kHz	100	107	120	150	150	150
	3.5 kHz	69	79	94	123	138	150
	7 kHz	40	46	54	67	73	83
	14 kHz	20	22	26	30	33	36
Frequency-dependent maximum current @ f_s <i>Basic Time Period = 83.3 μs (Parameter is22=2)</i>	1.5 kHz	100	107	120	150	150	150
	3 kHz	79	88	103	132	147	150
	6 kHz	46	54	65	83	92	105
	12 kHz	23	26	30	34	37	42
Frequency-dependent maximum current @ f_s <i>Basic Time Period = 100 μs (Parameter is22=3)</i>	1.25 kHz	100	107	120	150	150	150
	2.5 kHz	90	97	112	141	150	150
	5 kHz	52	62	75	99	110	127
	10 kHz	28	32	37	42	46	52

Table 18: Frequency-dependent maximum current for device size 28

¹⁾ Only available as fluid cooler (water)

3.2.4 Power dissipation at rated operation

Device size		25	26	27	28
Rated switching frequency	f_{SN} / kHz	4	4	2	2
Power dissipation at rated operation	¹⁾ P_D / W	2200	2700	2700	3556

Table 19: Power dissipation of the 400 V devices

¹⁾ Rated operation corresponds to $U_N = 400\text{ V}$; f_{SN} ; I_N ; $f_N = 50\text{ Hz}$ (typically value)

3.2.5 Protection of the drive converter

Device size	Max. size of the fuse / A			
	$U_N = 400\text{ V}$ gG (IEC)	$U_N = 480\text{ V}$ class „J“	SCCR 100 kA	$U_N = 480\text{ V}$ gR
	SCCR 30 kA	SCCR 18 kA		Type
25	250	250	250	SIBA 2061032.250
				COOPER BUSSMANN 170M4009
				COOPER BUSSMANN 170M4109
				COOPER BUSSMANN 170M4159
				COOPER BUSSMANN 170M4259
				LITTELFUSE PSR030FL0250
26	315	300	315	SIBA 2061032315
				COOPER BUSSMANN 170M4010
				COOPER BUSSMANN 170M4110
				COOPER BUSSMANN 170M4160
				COOPER BUSSMANN 170M4260
				LITTELFUSE PSR030FL0315
27	355	350	350	SIBA 20 610 32.350
				COOPER BUSSMANN 170M4011
				COOPER BUSSMANN 170M4111
				COOPER BUSSMANN 170M4161
				COOPER BUSSMANN 170M4261
				LITTELFUSE PSR030FL0350
28	400	450	450	SIBA 20 610 32.450
				COOPER BUSSMANN 170M4013
				COOPER BUSSMANN 170M4113
				COOPER BUSSMANN 170M4163
				COOPER BUSSMANN 170M4263
				LITTELFUSE PSR030FL0450

Table 20: Fusing of the 400 V / 480 V devices



Short-circuit capacity

After requests from *EN 60439-1* and *EN 61800-5-1* the following is valid for the connection to a network: The devices are suitable for use in a circuit capable of delivering not more than 30 kA eff. unaffected symmetrical short-circuit current.

3.3 General electrical data

3.3.1 Switching frequency and temperature

The drive converter cooling is designed by way that the heat sink overtemperature threshold is not exceeded at rated conditions. A switching frequency higher than the rated switching frequency also produces higher losses and thus a higher heat sink heating. If the heat sink temperature reaches a critical threshold (T_{DR}), the switching frequency can be reduced automatically step by step. This prevents that the drive converter switches off due to overheating of the heat sink. If the heat sink temperature falls below T_{UR} , the switching frequency is increased back to the setpoint. At temperature T_{EM} the switching frequency is immediately reduced to rated switching frequency. "Derating" must be activated, for this function to work.

3.3.1.1 Switching frequencies and temperatures for air coolers

Device size		25	26	27	28
Rated switching frequency	¹⁾ f_{SN} / kHz	4	4	2	2
Max. switching frequency	¹⁾ f_{S_max} / kHz	16			
Min. switching frequency	¹⁾ f_{S_min} / kHz	2			
Max. heat sink temperature	T_{HS} / °C	77	94	92	97
Temperature for derating the switching frequency	T_{DR} / °C	67	84	82	87
Temperature for uprating the switching frequency	T_{UR} / °C	57	74	72	77
Temperature for switching to rated switching frequency	T_{EM} / °C	72	89	87	92

Table 21: Switching frequency and temperature of the 400 V devices

¹⁾ The output frequency is to be limited in such a way that it does not exceed 1/10 of the switching frequency.

3.3.1.2 Switching frequencies and temperatures for fluid coolers (water)

Device size		25	26	27	28
Rated switching frequency	¹⁾ f_{SN} / kHz	4	4	2	2
Max. switching frequency	¹⁾ f_{S_max} / kHz	16			
Min. switching frequency	¹⁾ f_{S_min} / kHz	2			
Max. heat sink temperature	T_{HS} / °C	77	94	92	80
Temperature for derating the switching frequency	T_{DR} / °C	67	84	82	70
Temperature for uprating the switching frequency	T_{UR} / °C	57	74	72	60
Temperature for switching to rated switching frequency	T_{EM} / °C	72	89	87	75

Table 22: Switching frequency and temperature of the 400 V devices

¹⁾ The output frequency is to be limited in such a way that it does not exceed 1/10 of the switching frequency.

3.3.2 DC link / braking transistor function

**Activation of the braking transistor function**

In order to use the braking transistor, the function must be activated with parameter "is30 braking transistor function".

For more information => [F6 Programming manual](#).

NOTICE**Destruction of the drive converter if the value falls below the minimum brake resistance value**

- The minimum brake resistance value must not fall below!

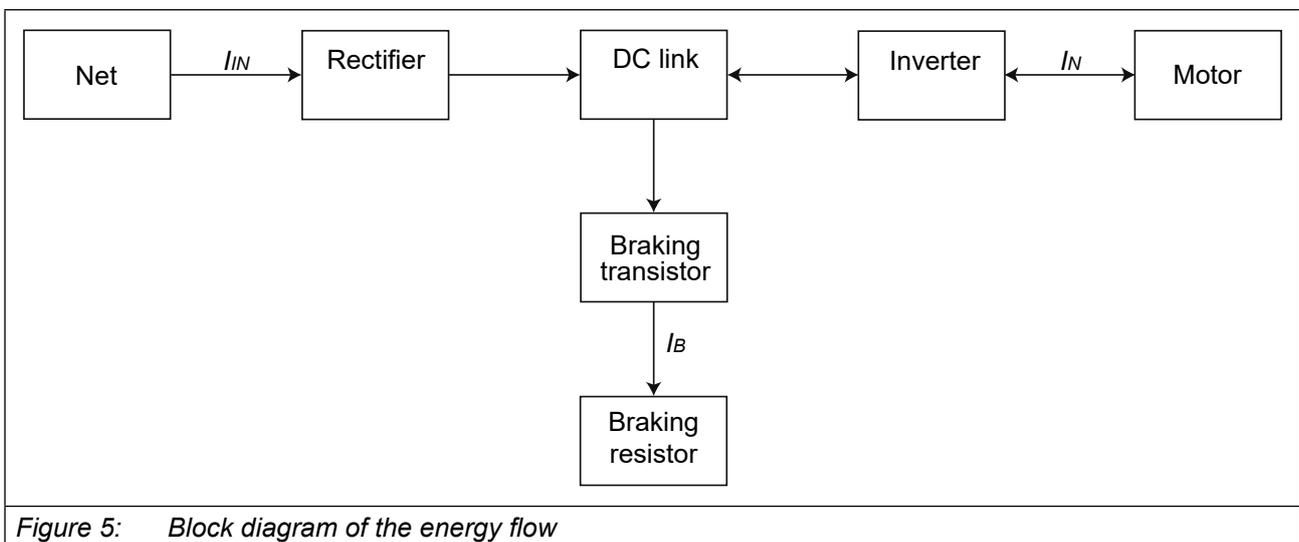


Figure 5: Block diagram of the energy flow

NOTICE**Destruction of the drive converter**

If the error "ERROR GTR7 always ON" occurs, the current consumption is switched off internally via the mains input bridge of the AC supply.

- The drive converter must be electrically isolated from the supply system within 5 minutes!

Device size		25	26	27	28
Rated DC link voltage @ $U_N = 400V$	U_{N_dc} / V	565			
Rated DC link voltage @ $U_{N_UL} = 480V$	$U_{N_dc_UL} / V$	680			
DC link voltage working voltage range	U_{in_dc} / V	390...780			
DC switch-off level "ERROR underpotential"	U_{UP} / V	240			
DC switch-off level "ERROR overpotential"	U_{OP} / V	840			
DC switch-off level braking resistor	¹⁾ U_B / V	780			
Max. braking current	I_{B_max} / A	382			
Min. braking resistor value	R_{B_min} / Ω	2,2			
Braking transistor	²⁾	Max. cycle time: 120 s; ED: 50 %			
Protective function for braking transistor		Short-circuit monitoring			
Protective function braking resistor (Error GTR7 always on)	³⁾	Feedback signal evaluation and current shutdown			
DC link capacity	$C / \mu F$	6600	7800	10400	12400

Table 23: DC link / braking transistor function of the 400 V devices

- ¹⁾ The DC switching level for the braking transistor is adjustable. The default value is the value specified in the table.
- ²⁾ The cyclic duration factor is additionally limited by the used braking resistor.
- ³⁾ The feedback signal evaluation monitors the functionality of the braking transistor. Power off occurs via the internal mains input bridge of the AC supply.

3.3.3 Sub-mounted braking resistors

Technical data of the sub-mounted braking resistors		
Braking resistor value	R / Ω	4
Rated power	P_D / W	1460
Cyclic duration factor referring to 120s @ $U_{N_dc} = 780V$	ED / s	0.9

Table 24: Sub-mounted braking resistors

NOTICE

In braking mode (with sub-mounted braking resistors), the power to be dissipated by the heat sink increases. This must be observed when designing the cooling system.

3.3.4 Fan

Device size		25	26	27	28
Interior fan	Number	2			
	Speed-variable	yes			
Heat sink fan	Number	2			
	Speed-variable	yes			

Table 25: Fan



The fans are speed-adjustable. Depending on the setting of the software they are automatically controlled to high or low speed.

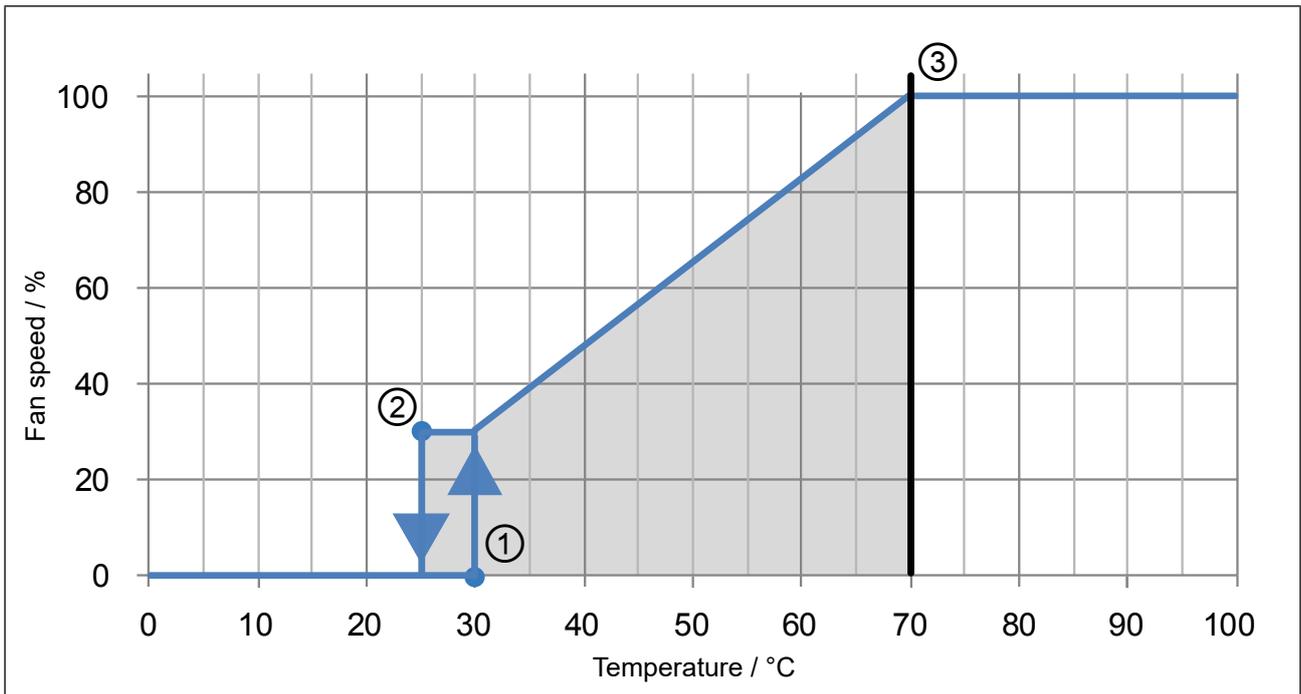
NOTICE

Destruction of the fan!

► Take care that no foreign substances drop into the fan!

3.3.4.1 Switching behaviour of the fans

The fans have different switch-on and switch-off points.



Legend	
	Fan speed in dependence on the temperature
	Setting range for the switch-on temperature
	Maximum switch-on temperature
①	Switch-on point
②	Switch-off point
③	Switching point maximum speed level

Figure 6: Switching behaviour of the fans example heat sink fan

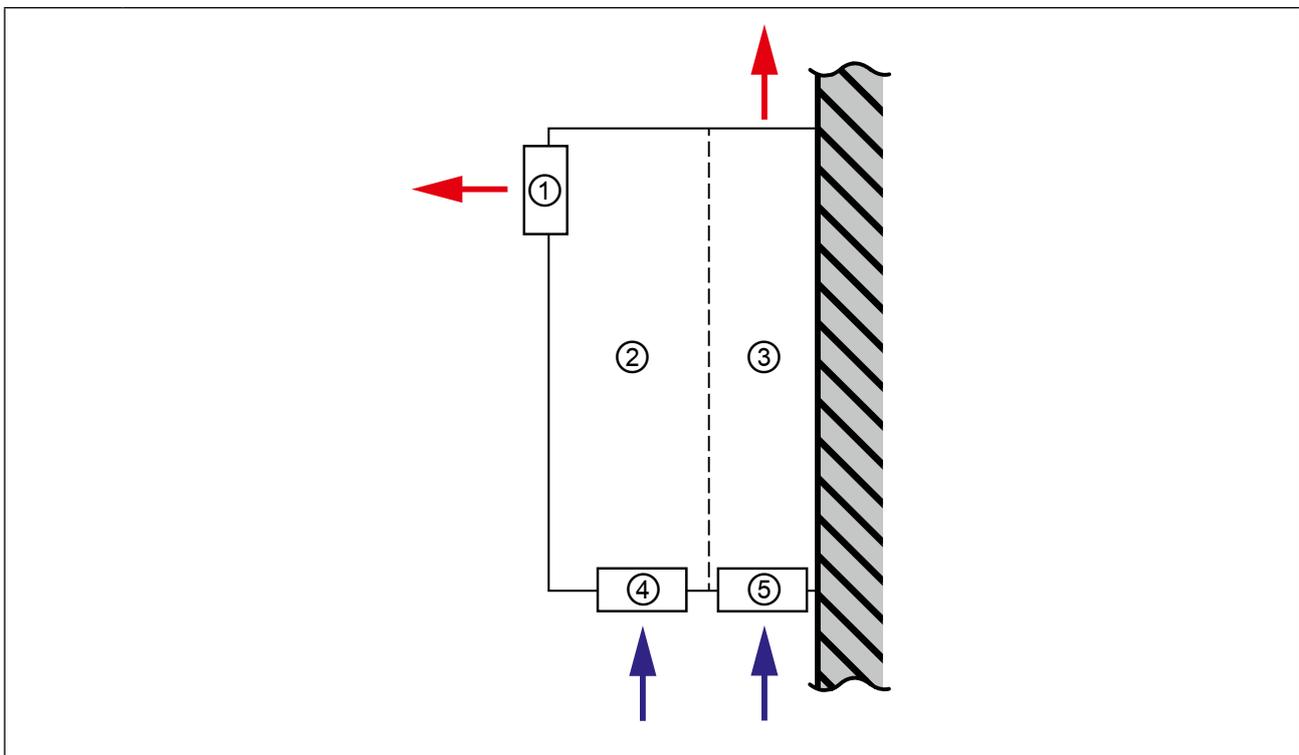
3.3.4.2 Switching points of the fans

The switching point for the switch-on temperature and the maximum speed level of the fans are adjustable. The following table shows the default values.

Fan		Heat sink	Interior
Switch-on temperature	$T / ^\circ\text{C}$	30	20
Maximum speed level	$T / ^\circ\text{C}$	70	40

Table 26: Switching points of the fans

3.3.4.3 Airflow of the drive converter

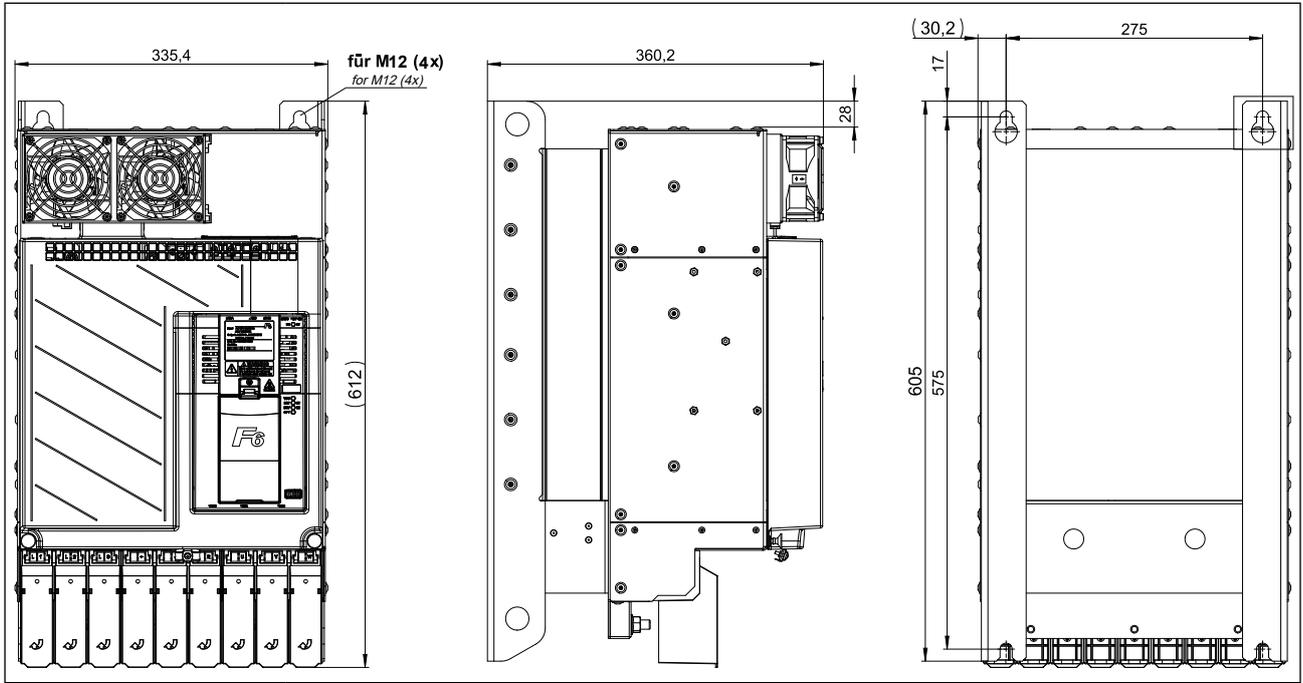


Legend	
	Airflow direction
①	Interior fan (from housing 4)
②	Drive converter (power unnit and control)
③	Drive converter (heat sink)
④	Interior fan for (housing 2 and 3)
⑤	Heatsink fan

Figure 7: Airflow of the drive converter

3.4 Dimensions and weights

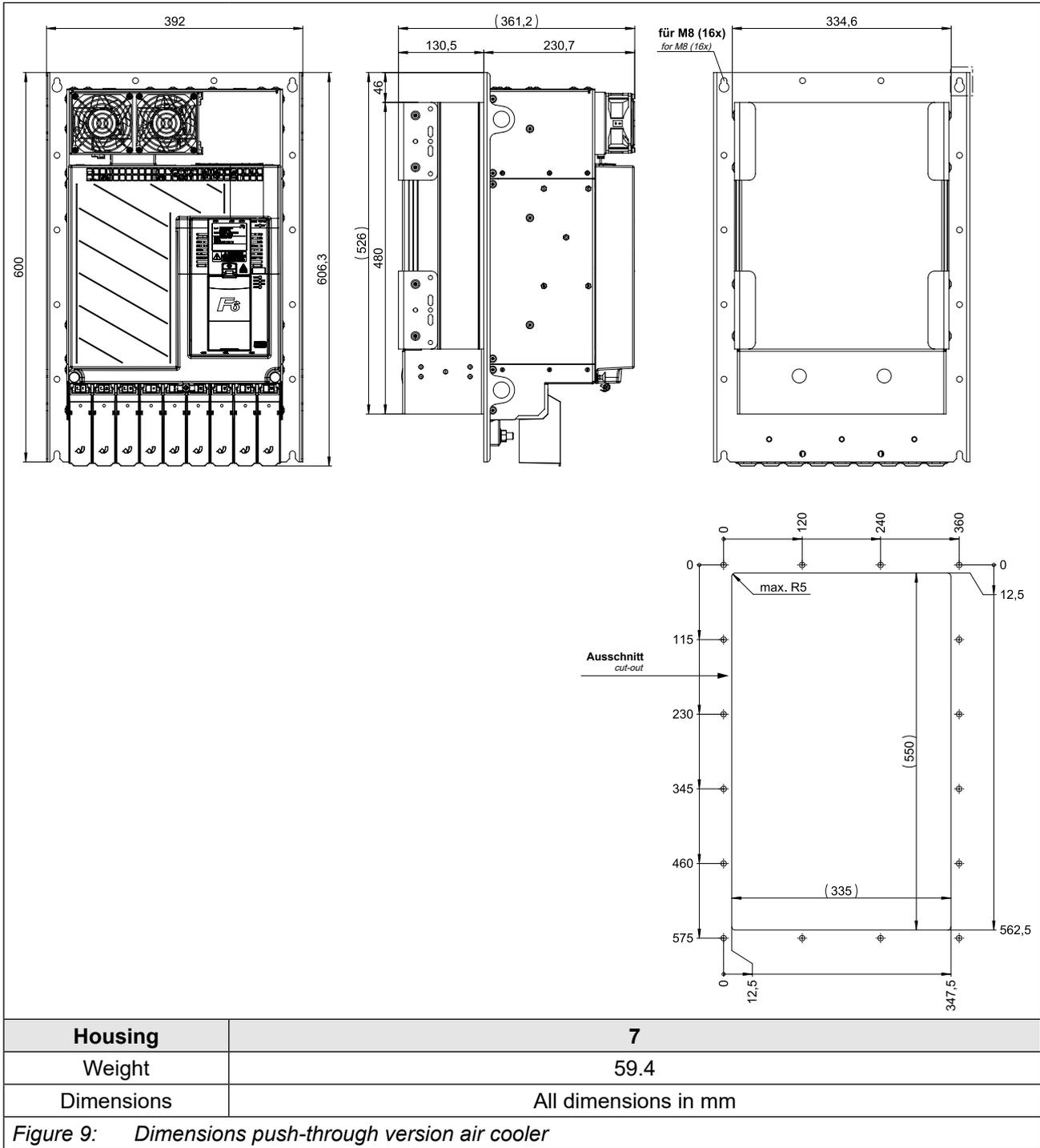
3.4.1 Built-in version air cooler



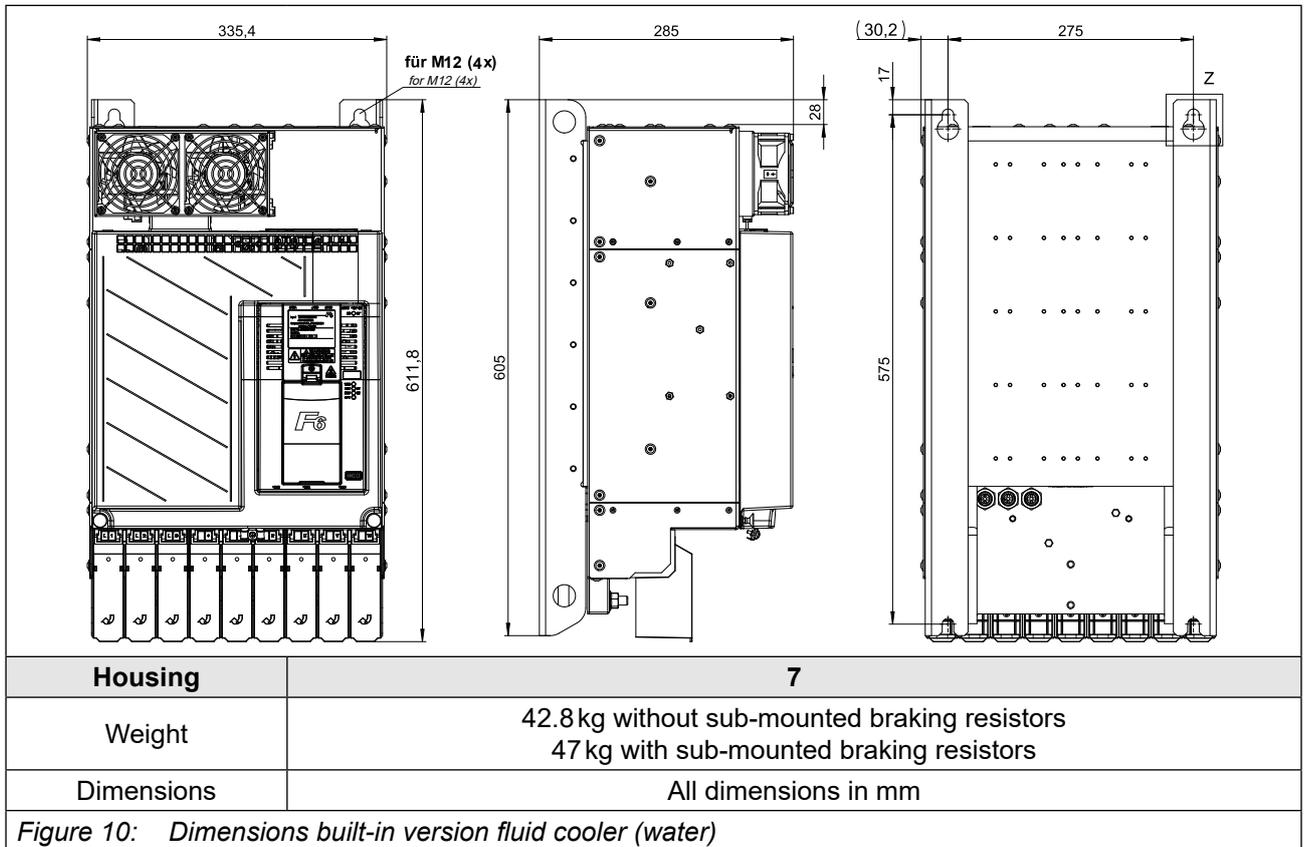
Housing	7
Weight	56.5 kg
Dimensions	All dimensions in mm

Figure 8: Dimensions built-in version air cooler

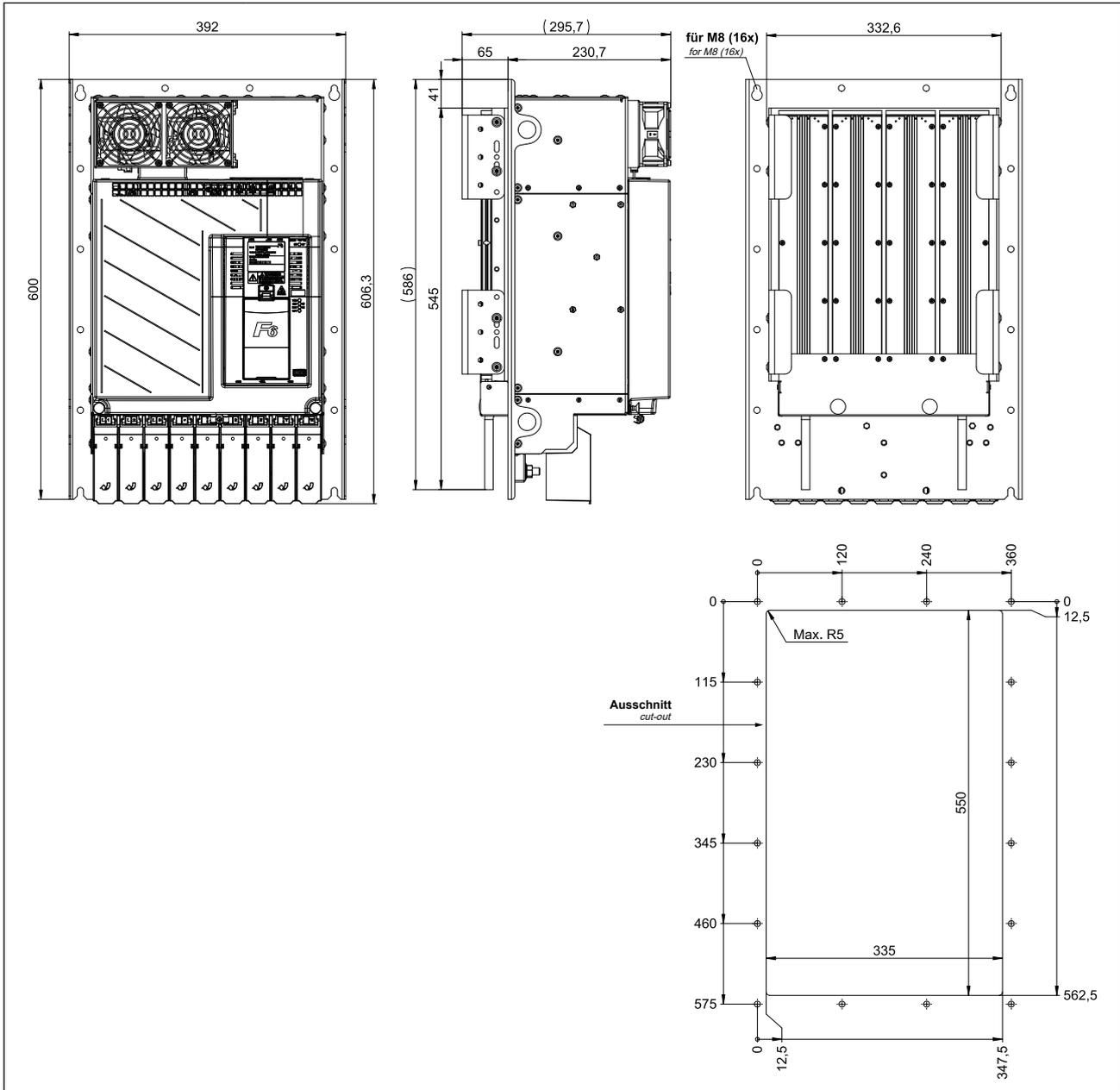
3.4.2 Push-through version air cooler



3.4.3 Built-in version fluid cooler (water)



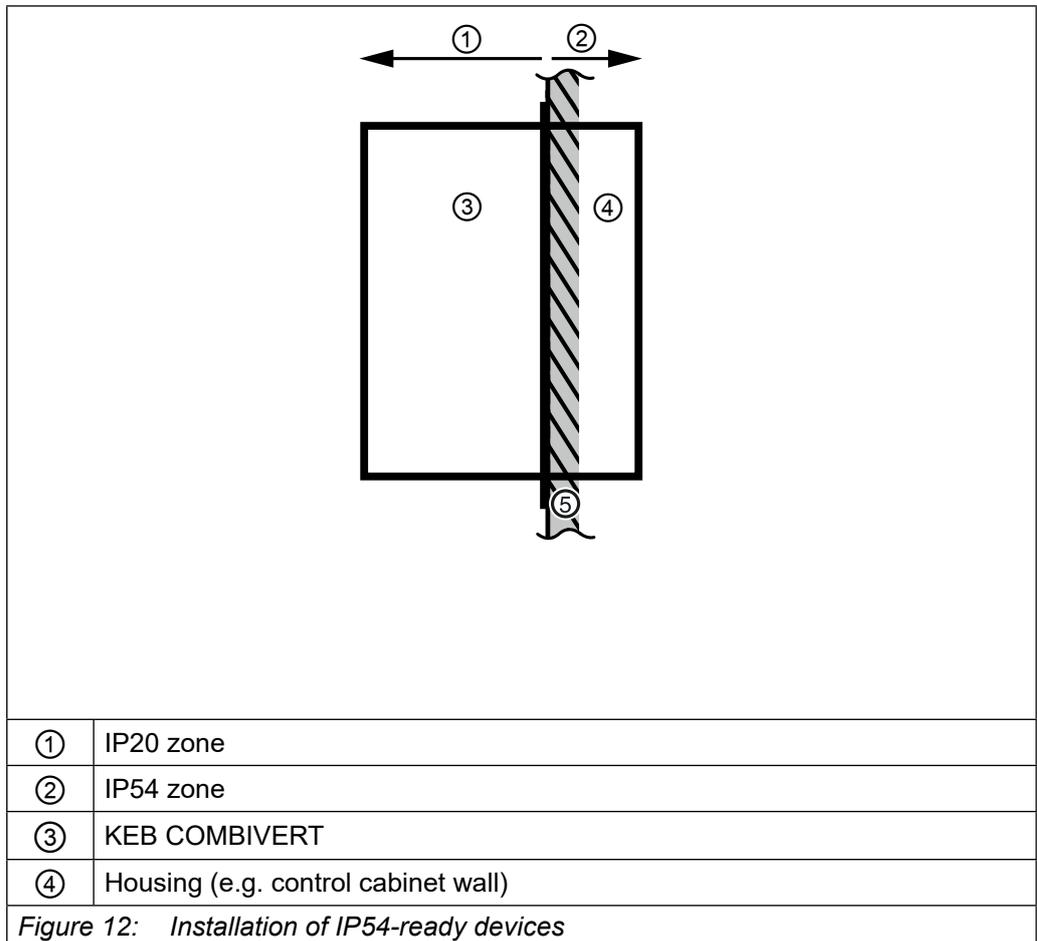
3.4.4 Push-through version fluid cooler (water) IP20, IP54-ready



Housing	7
Weight	45.7 kg without sub-mounted braking resistors 49.9 kg with sub-mounted braking resistors
Dimensions	All dimensions in mm

Figure 11: Dimensions push-through version fluid cooler (water) IP20, IP54-ready

3.4.5 Installation of IP54-ready devices



IP54 zone: Heat sink outside the housing

The protection class IP54 can only be achieved when the device is properly installed.

For proper installation, a suitable IP54 seal (=> „4.3.2 Seal for IP54-ready devices“) must be installed between heat sink and housing (e.g. control cabinet wall).

The tightness must be checked after the installation. If properly installed, the separation to the housing corresponds to degree of protection IP54.

IP20 zone: Device inside the housing

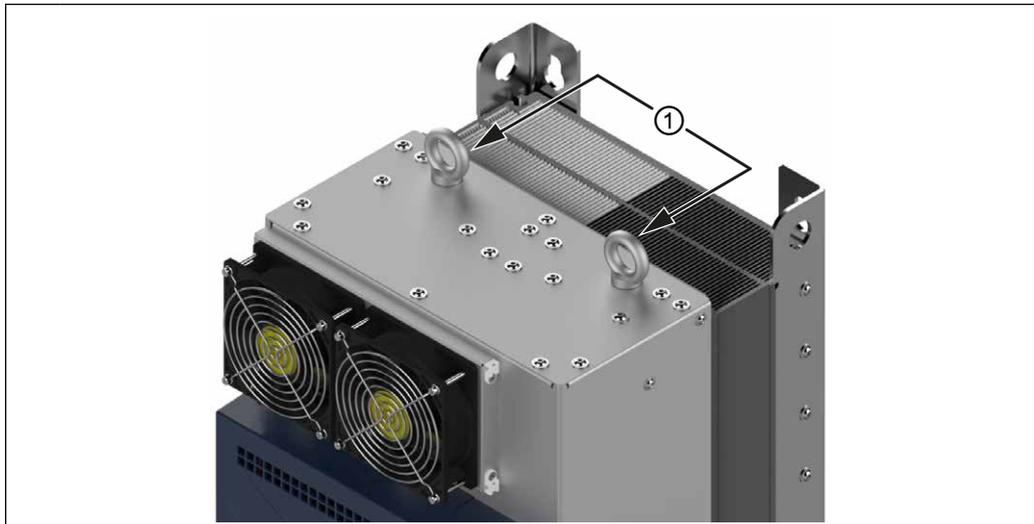
This part is intended for the installation in a suitable housing for the required degree of protection (e.g. control cabinet).

The power connections are excluded => „3.1.1 Climatic environmental conditions“.

UL: Device heat sink is classified as NEMA type 1

3.4.6 Control cabinet installation

For drive converters in housing 7, 8 and 9, there are 2 threaded bushes on the top for M10 ring bolts according to *DIN 580*. These serve to accommodate appropriate lifting devices for the transport.



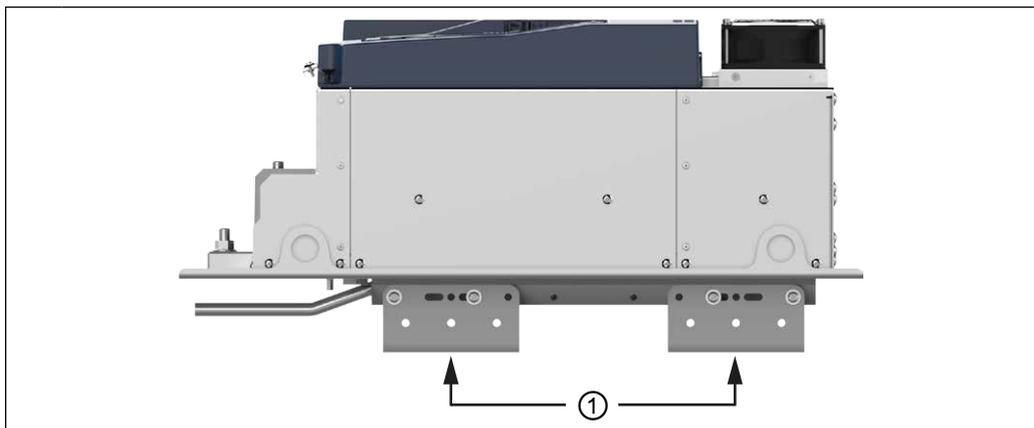
Legend

1 | M10 ring bolts

Figure 13: Example of an F6 in housing 8 with M10 ring bolts

3.4.6.1 Devices with foot bracket

The foot bracket can be removed after mounting the drive converter. The foot angles must be stored to make the drive converter transportable again in case of service.



Legende

1 | Foot bracket

Figure 14: Example of an F6 housing 7 with foot bracketes

NOTICE

Damage to the water connections

Bending of the tubes!

- ▶ Never set the device down or transport it without the foot bracket!

3.4.6.2 Mounting instructions

For the mounting of the drive controllers the following mounting materials with the appropriate quality were tested by KEB.

Required material	Tightening torque
Hexagon-head screw <i>ISO 4017</i> - M10 - 8.8	50 Nm 442 lb inch
Flat washer <i>ISO 7090</i> - 10 - 200 HV	—
<i>Table 27: Mounting instructions for built-in version</i>	

Required material	Tightening torque
Hexagon-head screw <i>ISO 4017</i> - M8 - 8.8	25 Nm 221 lb inch
Flat washer <i>ISO 7090</i> - 8 - 200 HV	—
<i>Table 28: Mounting instructions for push-through version</i>	

NOTICE

Use of other fixing material

- ▶ The alternatively selected fixing material must meet the above material characteristics (quality) and tightening torques!

The use of other fixing materials is beyond the control of KEB and is therefore the sole responsibility of the customer.

3.4.6.3 Mounting distances

Power loss for the control cabinet dimension „3.2.4 Power dissipation at rated operation“. A lower value can be used here depending on the operating mode/load.



Mounting the drive converter

For reliable operation, the drive converter must be mounted without any distance on a smooth, closed, metallicly bright mounting plate.

Mounting distances	Dimension	Distance in mm	Distance in inch
	A	150	6
	B	100	4
	C	30	1.2
	D	0	0
	E	0	0
	F ¹⁾	50	2
	1) Distance to preceding elements in the control cabinet door.		

Figure 15: Mounting distances

If construction-conditioned the control cabinet cannot be without indoor ventilation, appropriate filters must avoid suction of foreign objects.

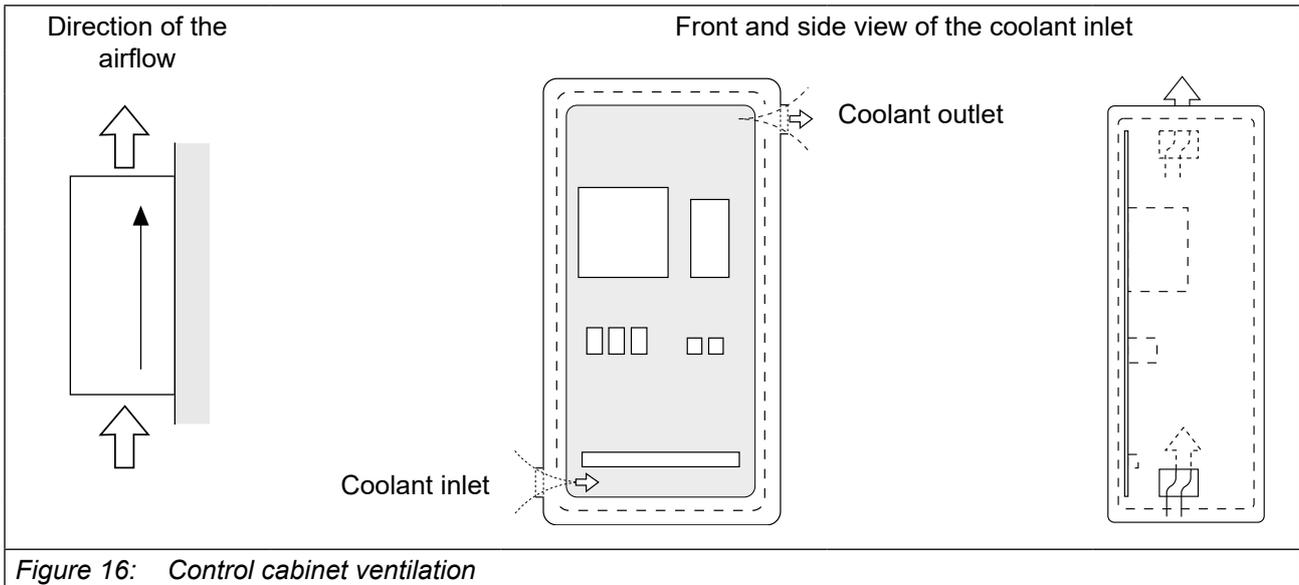


Figure 16: Control cabinet ventilation

4 Installation and Connection

4.1 Overview of the COMBIVERT F6

Housing 7		No.	Name	Description
	1	---	Interior fan	
	2/6	---	Shield clamps for shielded control lines	
	3	FAN	External heat sink fan supply	
	4	---	Nameplates	
	5	---	LEDs (see the manual for control unit chapter „Overview“) • For control board COMPACT: FS without function. • For control card APPLICATION and PRO: Status indication of the safety module	
	7	X1A	Power circuit terminals for: • Mains input • Braking resistor • DC voltage interface • Motor connection	
	8	PE	Protective earth; at connection to protective earth, each connection point may only be occupied once	

Figure 17: F6 housing 7 top view

Housing 7		No.	Name	Description
	6	---	Shield clamps for shielded control lines	
	7	X1A	Power circuit terminals for: <ul style="list-style-type: none"> • Mains input • Braking resistor • DC voltage interface • Motor connection 	
	8	PE	Protective earth; at connection to protective earth each terminal may be assigned only once	
	9	X1C	Terminal for: <ul style="list-style-type: none"> • Motor temperature monitoring • Brake control 	
	10	X3A	Encoder interface channel A	
	11	X3B	Encoder interface channel B	
	12	---	Heat sink fan	

Figure 18: F6 housing 7 front view

Housing 7		No.	Name	Description
	1	---	Interior fan	
	2	---	Shield clamps for shielded control lines	
	13	S1	Rotary coding switch A	
	14	S2	Rotary coding switch B	
	15	X4C	Fieldbus interface (out)	
	16	X4B	Fieldbus interface (in)	
	17	X2B	Safety module	
	18	X2A	Control terminal block for <ul style="list-style-type: none"> • CAN bus • Analog inputs and analog output • Digital inputs and outputs • 24 V DC voltage supply 	

Figure 19: F6 housing 7 rear view with control board APPLICATION



Further information can be found in the respective control board manual.



Instructions for use COMBIVERT F6 control board APPLICATION
www.keb.de/fileadmin/media/Manuals/dr/ma_dr_f6-cu-a-inst-20118593_en.pdf



Instructions for use COMBIVERT F6 control board COMPACT
www.keb.de/fileadmin/media/Manuals/dr/ma_dr_f6-cu-k-inst-20144795_en.pdf



Instructions for use COMBIVERT F6 control board PRO
www.keb.de/fileadmin/media/Manuals/dr/ma_dr_f6-cu-p-inst-20182705_en.pdf



4.2 Connection of the power unit

NOTICE

Destruction of the drive controller!

- ▶ Never exchange mains input and motor output!

4.2.1 Connection of the voltage supply

The COMBIVERT F6 housing 7 can be supplied by mains via terminals L1, L2 and L3.

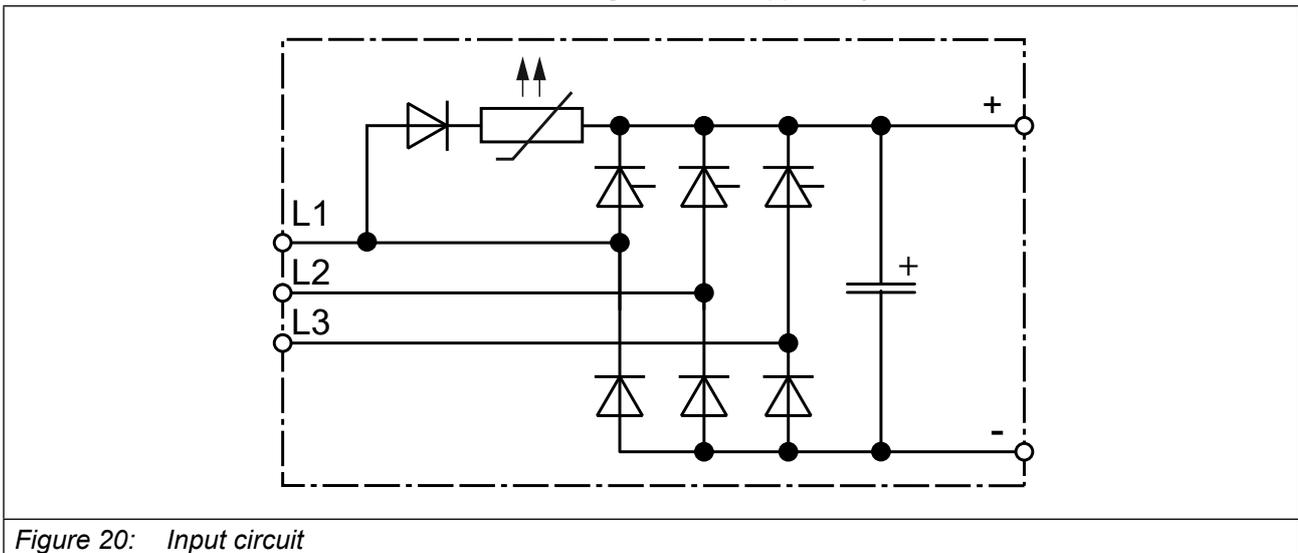


Figure 20: Input circuit



Minimum waiting period between two switch-on procedures 5 minutes!

Cyclic switching on and off of the device leads to temporary high resistance of the resistor (PTC) in the input. After the PTC has cooled down, it can be restarted without restrictions.

4.2.1.1 Terminal block X1A for 400 V devices



Name	Function	Cross-section for terminal connection	Tightening torque	Max. number of conductors
L1	Mains connection 3-phase	10 mm stud for M10 crimp connector	25 Nm 220 lb inch	2
L2				
L3				
+	DC terminals			
-				
R	Connection for braking resistor (between + and R)			
U	Motor connection			
V				
W				

Figure 21: Terminal block X1A for 400 V devices

4.2.2 Protective earth and functional earth



Protective and functional earth must not be connected to the same terminal.

4.2.2.1 Protective earth

The protective earth (PE) serves for electrical safety particularly personal protection in error case.



Electric shock due to incorrect dimensioning!



► Cross-section wire to ground should be selected according to *DIN IEC 60364-5-54!*

Name	Function	Terminal connection	Tightening torque	Max. number of conductors
PE,	Connection for protective earth	10 mm threaded pin for M10 crimp connectors	25 Nm 220 lb inch	1

Figure 22: Connection for protective earth



Incorrect installation of the PE connection

Only M10 threaded pins with nut may be used as connection for protective earth!

4.2.2.2 Functional earthing

A functional earthing may also be necessary, if for EMC requirements additional potential equalization between devices or parts of the system must be available.



The use of the functional earth (FE) is not required if the frequency inverter is EMC-technically wired.

The functional earth may not be wired green/yellow!

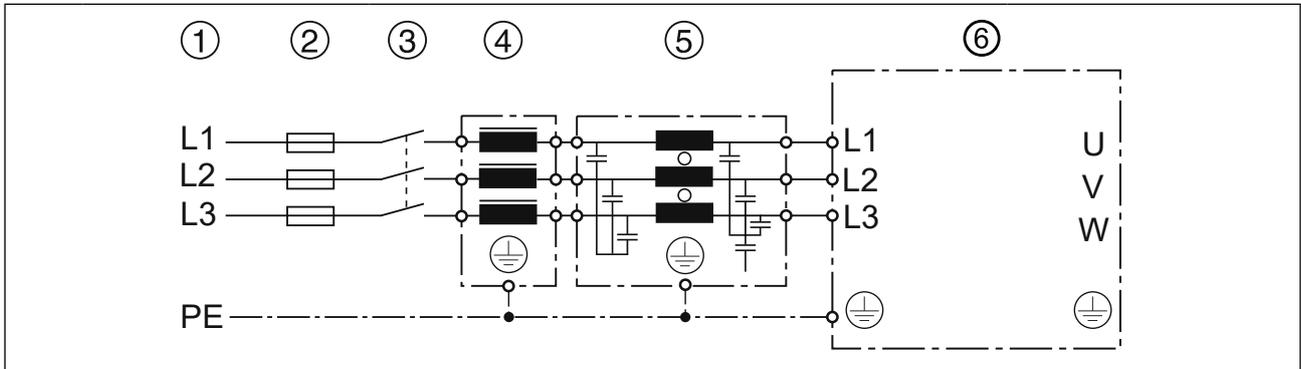


Notes on EMC-compatible installation can be found here.
www.keb.de/fileadmin/media/Manuals/emv/0000neb0000.pdf



4.2.3 AC mains connection

4.2.3.1 AC supply 3-phase



No.	Typ	Description	
①	Mains phase	3-phase	
	Mains form	TN, TT	IT
		The rated voltage between one phase conductor and earth potential (or the neutral point in the IT system) must not exceed 300V. (For the IT system, a short-term disconnection must be ensured).	
Personal protection	RCMA with separator or RCD type B	Insulation monitors	
②	Mains fuses	Type gG or MCCB	
③	Mains contactor		
④	Mains choke	see notes under the table	
⑤	HF filter for TN-, TT systems	Required for compliance with the limit values in accordance with EN 61800-3 .	
	HF filter for IT systems		
⑥	KEB COMBIVERT	F6	

Figure 23: Connection of the mains supply 3-phase

4.2.3.2 Supply cable

The conductor cross-section of the supply cable is determined by the following factors:

- Input current of the drive converter
- Used line type
- Installation and ambient temperatures
- Applicable local electrical regulations



The application engineer is responsible for the design!

4.2.4 DC connection

4.2.4.1 Terminal block X1A DC connection

NOTICE

DC operation is only permitted after consultation with KEB!

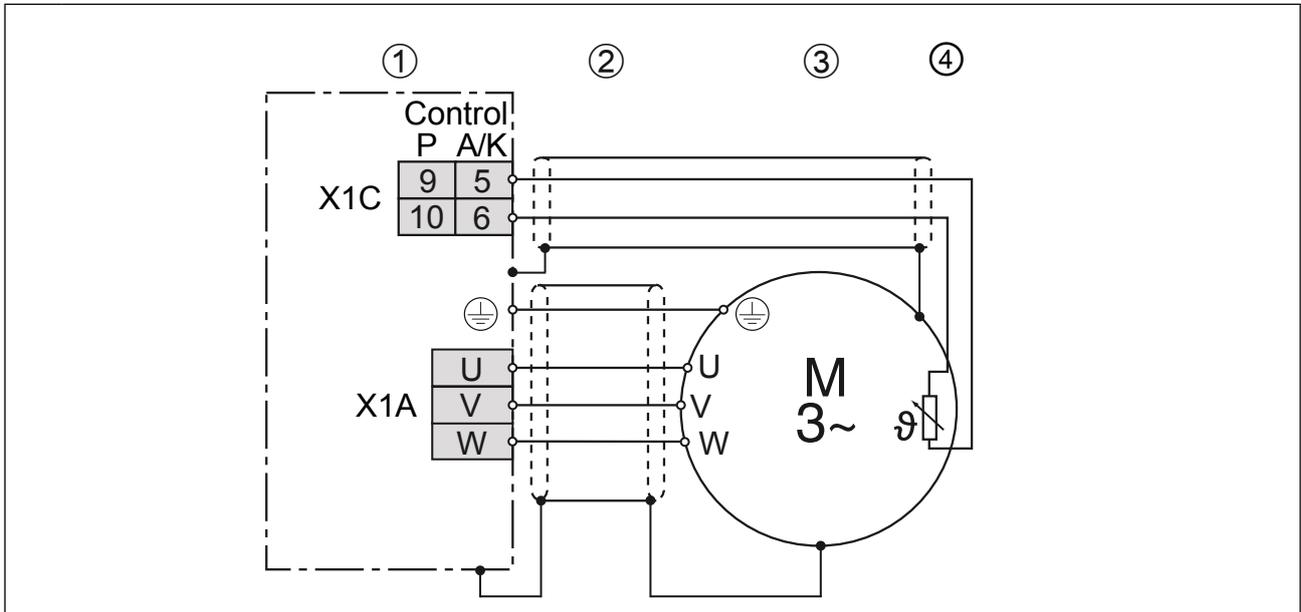


Name	Function	Cross-section for terminal connection	Tightening torque	Max. number of conductors
+	DC terminals	10 mm stud for M10 crimp connector	25 Nm 220 lb inch	2
-				

Figure 24: Terminal block X1A DC connection

4.2.5 Connection of the motor

4.2.5.1 Wiring of the motor



Legend

①	KEB COMBIVERT
②	Apply motor cable, shielding on both sides over a large surface on the bare metallic frame or mounting plate (remove paint if necessary)
③	Three-phase motor
④	Temperature monitoring (optional) => <i>Instructions for use "Control unit"</i>

Figure 25: Wiring of the motor

4.2.5.2 Terminal block X1A motor connection



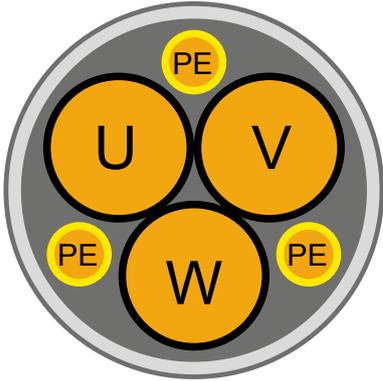
Name	Function	Cross-section for terminal connection	Tightening torque	Max. number of conductors
U	Motor connection	10 mm stud for M10 crimp connector	25 Nm 220 lb inch	2
V				
W				

Figure 26: Terminal block X1A motor connection

4.2.5.3 Selection of the motor line

The correct cabling as well as the motor line itself play an important part in case of low power in connection with long motor line lengths. Low-capacitance line (phase/phase < 65 pF/m, phase/screen < 120 pF/m) at the inverter output have the following effects:

- allow major motor line lengths („Selection of the motor line“)
- better EMC properties (reduction of the common-mode output currents to earth)



The use of shielded motor lines with symmetrical structure is required for higher motor power (from 30 kW). In these lines the protective earth conductor is tripartite and evenly arranged between the phase lines. A cable without protective earth conductor can be used if local regulations so permit. Then the protective earth conductor must be laid externally. Certain lines also permit the shield for the use as protective earth conductor. For this, observe the details of the line manufacturer!

Figure 27: Symmetrical motor line

4.2.5.4 Motor cable length and conducted interferences at AC supply

The maximum motor cable length is depending on the capacity of the motor cable as well as on the EMC emitted interference. External measures must be taken here (e.g. the use of a line filter). The following information is valid for the operation under rated conditions and the use of KEB listed filters under chapter „4.3.1 Filters and chokes“!

Device size	Max. motor cable length shielded		Max. leakage current (at $f_N \leq 100\text{Hz}$)
	in accordance with <i>EN 61800-3</i>		
	Category C2		
	Motor cable (low capacitance)		
25	50 m		< 5 mA
26			
27			
28			

Table 29: Max. motor cable length



The line length can be increased significant by using motor chokes or motor filters. KEB recommends the use of motor chokes or filters for a cable length upto 25m.

4.2.5.5 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:

$$\text{Resulting motor cable length} = \sum \text{single cable length} \times \sqrt{\text{Number of motor cables}}$$

4.2.5.6 Motor cable cross-section

The motor cable cross-section is dependent

- on the characteristic of the output current (e.g. harmonic content)
- on the real effective value of the motor current
- on the cable length
- on the type of the used line
- on the ambient conditions such as bundling and temperature

4.2.5.7 Interconnection of the motor

NOTICE

Incorrect behavior of the motor!

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

Protect motor against voltage peaks !

- ▶ Drive converters switch at the output with high dv/dt. Voltage peaks that endanger the insulation system at the motor can occur especially in case of long motor cables (>15 m). A motor choke, a dv/dt-filter or sine-wave filter can be used to protect the motor with regard to the operating mode.

4.2.5.8 Connection of the temperature monitoring and brake control (X1C)

A switchable temperature evaluation is implemented in the COMBIVERT.

There are different types for the evaluation available. These are depending on the control board => *instruction manual „control board“*.

The desired operating mode can be adjusted via software (dr33). If the evaluation is not required, it must be deactivated via software (parameter pn33 = 7) => *Programming manual*

X1C	PIN	Name	Description
	1	BR+	Brake control / output +
	2	BR-	Brake control / output -
	3	reserved	–
	4	reserved	–
	5	TA1	Temperature detection / output +
	6	TA2	Temperature detection / output -

Figure 28: Terminal block X1C for control board APPLICATION and COMPACT

X1C	PIN	Name	Description
	1	BR+	Brake control / output +
	2	BR-	Brake control / output -
	3	0V	For supply of the checkback inputs
	4	24Vout	
	5	DIBR1	Checkback input 1 for brake and relay
	6	DIBR2	Checkback input 2 for brake and relay
	7	reserved	–
	8	reserved	–
	9	TA1	Temperature detection / output +
		DSL+	Digital motor temperature and position detection
10	TA2	Temperature detection / output -	
	DSL-	Digital motor temperature and position detection	

Figure 29: Terminal block X1C for control board PRO

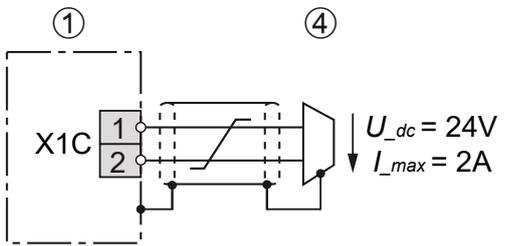
NOTICE

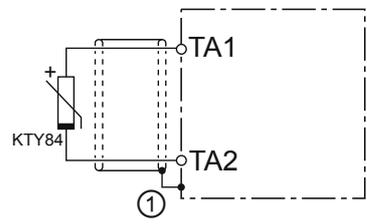
Malfunctions due to incorrect line or laying!

Malfunctions of the control due to capacitive or inductive coupling.

- ▶ Do not route cables from the motor temperature sensor (also shielded) together with control cables.
- ▶ Cables from the motor temperature sensor within the motor cables may only be used with double shielding!
- ▶ The input of the temperature detection has basic isolation.

CONNECTION OF THE POWER UNIT

		<p>For control board APPLICATION and COMPACT. The voltage to the control of a brake is decoupled from the internal voltage supply. The brake works only with external voltage supply.</p> <p>For control board PRO The brake can be supplied with both, internal and external voltage. Voltage tolerances and output currents vary for internal and external voltage supply..</p>
①	COMBIVERT	<p>Respect the specifications => <i>instruction manual „control board“</i></p>
④	Brake	
<p>Figure 30: Connection of the brake control</p>		

		<p>KTY sensors are polarized semiconductors and must be operated in forward direction! To this connect the anode to TA1 and the cathode to TA2! Non-observance leads to incorrect measurements in the upper temperature range. A protection of the motor winding is then no longer guaranteed.</p>
①	<p>Connection via shield plate (if not available, place on the mounting plate).</p>	
<p>Figure 31: Connection of a KTY sensor</p>		

NOTICE

No protection of the motor winding in case of wrong connection.

- ▶ Operate KTY sensors in forward direction.
- ▶ KTY sensors may not be combined with other detections.

NOTE

„Basic insulation“ against SELV voltage of the control. A system voltage (Phase – PE) of 300V is defined. Consequently, the connected sensors also must have a „basic insulation“ to the mains potential (e.g. motor winding)!



More information about the wiring of the temperature monitoring and the brake control are described in the respective control unit manual.

4.2.6 Connection and use of a braking resistor

⚠ CAUTION**Fire risk by using brake resistors !**

- ▶ The risk of fire can be significantly reduced by using „intrinsically safe braking resistors“ or by using suitable monitoring functions / circuits.

NOTICE**Destruction of the frequency inverter if the value has fallen below the minimum brake resistance value!**

- ▶ The minimum brake resistance value must not fall below!
„Device data of the 400V devices“

⚠ CAUTION**Hot surfaces caused by load of the braking resistor!****Burning of the skin!**

- ▶ Cover hot surfaces safe-to-touch.
- ▶ Before touching, check the surface.
- ▶ If necessary, attach warning signs on the system.

4.2.6.1 Installation instructions for side-mounted braking resistors



Instructions for the installation of intrinsically safe braking resistors https://www.keb.de/fileadmin/media/Manuals/dr/ma_dr_safe-braking-resistors-20106652_en.pdf Chapter „Installation instructions“.



4.2.6.2 Terminal block X1A connection braking resistor



Name	Function	Cross-section for terminal connection	Tightening torque	Max. number of conductors
+	Connection for braking resistor (between + and R)	10 mm stud for M10 crimp connector	25 Nm 220 lb inch	2
R				

Figure 32: Terminal block X1A connection braking resistor



On devices with sub-mounted braking resistors there is no electrical connection to the braking transistor at terminal R!

4.2.6.3 Use of non-intrinsically safe braking resistors

⚠ WARNING**Use of non-intrinsically safe braking resistors****Fire or smoke emission in case of overload or error!**

- ▶ Only use braking resistors with temperature sensor.
- ▶ Evaluate temperature sensor.
- ▶ Trigger an error at the drive converter (e.g. external input).
- ▶ Switch off input voltage (e.g. input contactor).
- ▶ Connection examples for non-intrinsically safe braking resistors
=> *Instruction for use „Installation braking resistors“.*



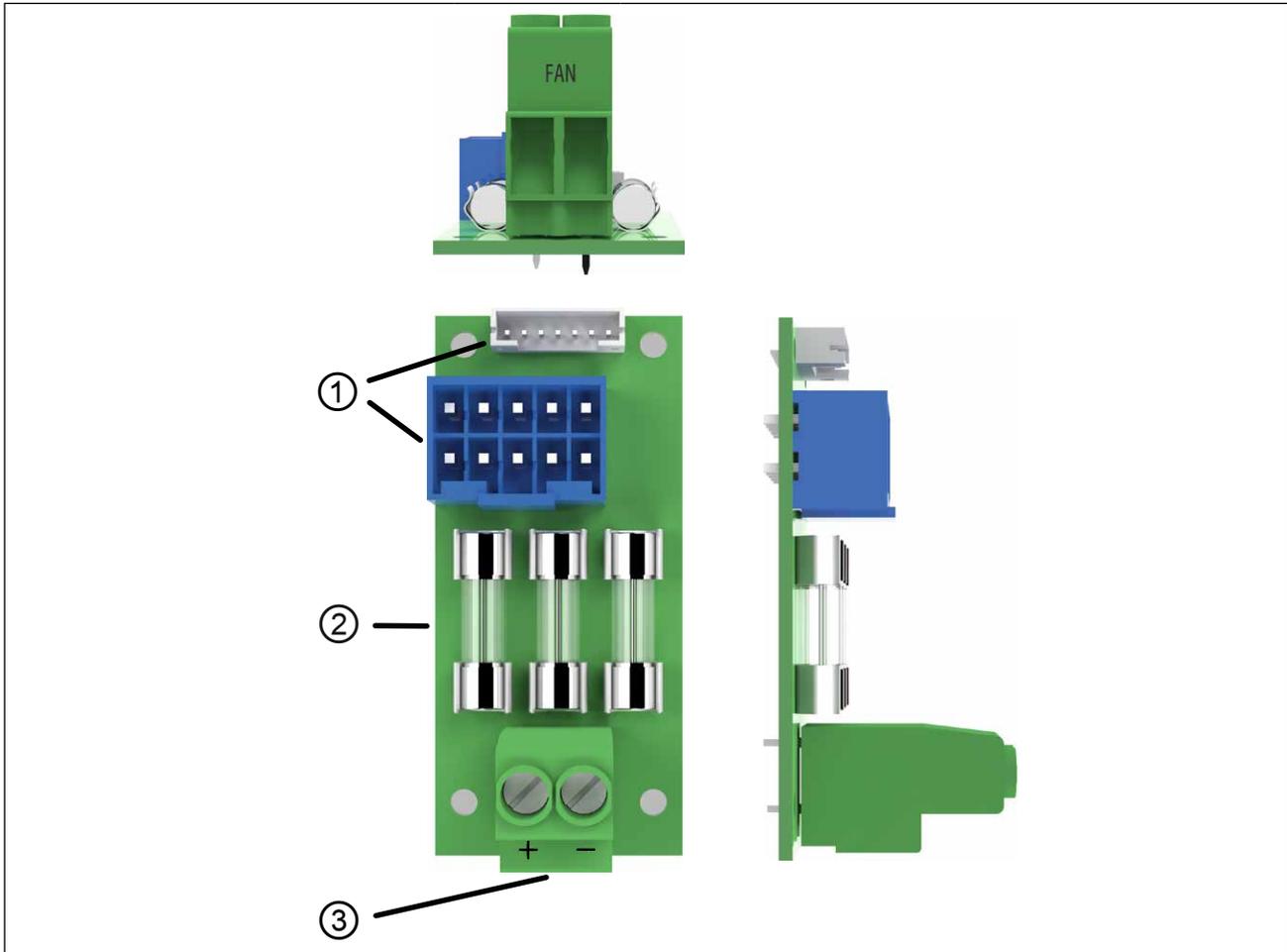
Instructions for use „Installation braking resistors“

www.keb.de/fileadmin/media/Manuals/dr/ma_dr_braking-resis-tors-20116737_en.pdf

resis-



4.2.7 External heat sink fan supply (FAN)



Legend		
①		Only internal use
②		Fuse: F200, F201, F202 SIBA GmbH No. 179120.10
③		FAN: Connection +/- for external 24 V voltage supply
Fuse(s)	I / A	10 (Type gG)
Max. number of conductors		2
Supply voltage	U_{FAN_dc} / V	$24 \pm 5\%$
Rated current	I_{FAN_dc} / A	8
Peak current	I_{FAN_Peak} / A	12
Tightening torque	F_N / Nm	0.5...0.6
Connection cross section	for IEC A / mm^2	0.2...4 (Flexible cable with wire end ferrule) 1.5 max. (with 2 conductors)
	for UL A / AWG	24...10 (UL: Flexible cable without wire end ferrule) 15 max. (with 2 conductors)

Figure 33: External heat sink fan supply

4.3 Accessories

4.3.1 Filters and chokes

Voltage class	Drive converter size	HF filter	Mains choke 50 Hz / 4% U_k
400 V	25	27E6T60-3000 alternatively 26E4T60-1001	25Z1B04-1000
	26	27E6T60-3000 alternatively 26E4T60-1001	26Z1B04-1000
	27	27E6T60-3000 alternatively 28E4T60-1001	27Z1B04-1000
	28	28E4T60-1001 alternatively 28E4T60-1001	28Z1B04-1000

Table 30: Filters and chokes



The specified filters and chokes are designed for rated operation.

4.3.2 Seal for IP54-ready devices

Name	Material number
Flat seal IP54	70F6T45-0001

Table 31: Seal for IP54-ready devices

4.3.3 Side-mounted braking resistors



Technical data and design about non-intrinsically safe braking resistors

www.keb.de/fileadmin/media/Manuals/dr/ma_dr_braking-resistors-20116737_en.pdf



4.3.4 Connections to the coolant

Name	Material number
Functional nut for 12mm tube	0000651-FM12

Table 32: Seal for IP54-ready devices

5 Certification

5.1 CE-Marking

CE marked drive controllers were developed and manufactured to comply with the regulations of the Low-Voltage Directive and EMC directive. The harmonized standards of the series *EN 12502-1...5* and *EN 61800-3* were used.



For more information about the CE Declarations of Conformity „*5.3 Further informations and documentation*“.

5.2 UL certification

An UL certification is in preparation.

5.3 Further informations and documentation

You find supplementary manuals and instructions for the download under www.keb.de/de/service/downloads

General instructions

- EMC and safety instructions
- Manuals for additional control boards, safety modules, fieldbus modules, etc.

Instruction and information for construction and development

- Input fuses in accordance with UL
- Programming manual for control and power unit
- Motor configurator to select the appropriate drive converter and to create downloads for parameterizing the drive converter

Approvals and approbations

- Declaration of conformity CE
- TÜV certificate
- FS certification

Others

- COMBIVIS, the software for comfortable parameterization of drive converters via PC (available per download)
- EPLAN drawings

6 Revision History

Version	Date	Description
00	2019-11	Creation of the pre-series version
01	2020-11	Extension of the technical data, type code adapted
02	2020-02	Inclusion of devices with sub-mounted braking resistors

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