COMBIVERT **F6**

GEBRAUCHSANLEITUNG | **INSTALLATION F6 GEHÄUSE 4 PEAK POWER**

Translation of the original manual
Document 20379969 EN 02

Preface

The hardware and software described in this document are products of KEB. The information contained in this document is valid at the time of publishing. KEB reserves the right to update this document in response to misprints, mistakes or technical changes.

Signal words and symbols

Certain procedures within this document can cause safety hazards during the installation or operation of the device. Refer to the safety warnings in this document when performing these procedures. Safety signs are also located on the device where applicable. A safety warning is marked by one of the following warning signs:

⚠ DANGER	Dangerous situation, which will cause death or serious injury iif this safety warning is ignored.
⚠ WARNING	Dangerous situation, which may cause death or serious injury if this safety warning is ignored.
⚠ CAUTION	Dangerous situation, which may cause minor injury if this safety warning is ignored.
NOTICE	Situation, which can cause damage to property if this safety warning is ignored.

RESTRICTION

Used when the following statements depend on certain conditions or are only valid for certain ranges of values.

Used for informational messages or recommended 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.
https://www.keb-automation.com/search

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.

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.
https://www.keb-automation.com/terms-conditions

Further agreements or specifications require a written confirmation.

Support

Although multiple applications are referenced, not every case has been taking into account. If you require further information or if problems occur which are not referenced in the documentation, you can request the necessary information via the local KEB 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 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.

Other wordmarks or/and logos are trademarks (™) or registered trademarks (®) of their respective owners.

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Glossary

0V	Earth-potential-free common point
1ph	1-phase mains
3ph	3-phase mains
AC	AC current or voltage
AFE	From 07/2019 AIC replaces the previous name AFE
AFE filter	From 07/2019 AIC filter replaces the previous name AFE filter
AIC	Active Infeed Converter
AIC filter	Filter for Active Infeed Converter
Application	The application is the intended use of the KEB product
ASCL	Asynchronous sensorless closed loop
Auto motor ident.	Automatically motor identification; calibration of resistance and inductance
AWG	American wire gauge
B2B	Business-to-business
BiSS	Open source real-time interface for sensors and actuators (DIN 5008)
CAN	Fieldbus system
c.d.f.	Cyclic duration factor
CDM	Complete drive module including auxiliary equipment (control cabinet)
COMBIVERT	KEB drive controller
COMBIVIS	KEB start-up and parameterizing software
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)
DC	DC current or voltage
DI	Demineralized water, also referred to as deionized (DI) water
DIN	German Institut for standardization
DS 402	CiA DS 402 - CAN device profile for drives
ELV	Extra-low voltage
EMC filter	EMC filters are used to suppress conducted interferences in both directions between the drive controller and the mains
Emergency stop	Shutdown of a drive in emergency case (not de-energized)
Emergency switching off	Switching off the voltage supply in emergency case
EMS	Energy Management System
EN	European standard
Encoder emulation	Software-generated encoder output
End customer	The end customer is the user of the customer product
Endat	Bidirectional encoder interface of the company Heidenhain
EtherCAT	Real-time Ethernet bus system of the company Beckhoff
Ethernet	Real-time bus system - defines protocols, plugs, types of cables
FE	Functional earth
FSoE	Functional Safety over Ethernet
FU	Drive controller
GND	Reference potential, ground
GTR7	Braking transistor
HF filter	KEB specific term for an EMC filter (for description see EMC filter).
Hiperface	Bidirectional encoder interface of the company Sick-Stegmann
HMI	Human machine interface (touch screen)
HSP5	Fast, serial protocol
HTL	Incremental signal with an output voltage (up to 30V) -> TTL
IEC	IEC xxxxx stands for an international standard of the International Electrotechnical Commission
IPxx	Protection class (xx for class)
KEB product	The KEB product is subject of this manual
KTY	Silicium temperature sensor (polarized)
Manufacturer	The manufacturer is KEB, unless otherwise specified (e.g. as manufacturer of machines, engines, vehicles or adhesives)
MCM	American unit for large wire cross sections
Modulation	Means in drive technology that the power semiconductors are controlled
MTTF	Mean service life to failure
NHN	Standard elevation zero; based on the specified height definition in Germany (DHHN2016). The international data generally deviate from this by only a few cm to dm, so that the specified value can be applied to the regionally applicable definition.
OC	Overcurrent
OH	Overheat
OL	Overload

OSSD	Output signal swithching device; - an output signal that is checked in regular intervals on its shutdown. (safety technology)
PDS	Power drive system incl. motor and measuring probe
PE	Protective earth
PELV	Protective Extra Low Voltage
PFD	Term used in the safety technology (EN 61508-1...7) for the size of error probability
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 R0=100Ω
Pt1000	Temperature sensor with R0=1000Ω
PTC	PTC-resistor for temperature detection
PWM	Pulse width modulation
RJ45	Modular connector with 8 lines
SCL	Synchronous sensorless closed loop
SELV	Safe extra-low voltage, unearthed
SIL	The safety 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	Logic with 5 V operating voltage
USB	Universal serial bus
VARAN	Real-time Ethernet bus system

Standards for drive controllers

Product standards that apply directly to the drive controller

EN 61800-2	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)
EN 61800-3	Speed-adjustable electrical drives. Part 3: EMC requirements and specific test methods (VDE 0160-103, IEC 61800-3)
EN 61800-5-1	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
EN 61800-5-2	Adjustable speed electrical power drive systems - Part 5-2: Safety Requirements - Functional (IEC 22G/264/CD)
UL 61800-5-1	American version of the IEC 61800-5-1 with „National Deviations“ for USA and Canada
EN 61800-9-2	Adjustable speed electrical power drive systems - Part 9-2: Ecodesign for power drive systems, motor starters, power electronics and their driven applications - Energy efficiency indicators for power drive systems and motor starters

Basic standards to which drive controller standards refer directly

EN 55011	Industrial, scientific and medical equipment - Radio frequency disturbance characteristics - Limits and methods of measurement (IEC 55011/CISPR 11); German version EN 55011
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 | 1994)
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 (IEC 61000-2-1)
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 controller

DGUV regulation 3	Electrical installations and equipment
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 S 455 P	Water treatment and use of materials in cooling systems
VDE 0100	Erection of low-voltage systems – Compliance with all parts (IEC 60364-x-x)
DIN EN 60939-1	Passive filter units for electromagnetic interference suppression - Part 1: Generic specification (IEC 60939-1:2010); German version EN 60939-1:2010

1 Basic Safety Instructions

The products are designed and constructed in accordance with state-of-the-art technology and the recognized 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. Violation 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 *VDE 0100*
- 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 controller shall be protected against excessive strains.

Transport of drive controllers 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 controllers on suitable pallets.

► Do not stack drive controllers or burden them with other heavy objects.

NOTICE

Damage to the coolant connections

Bending of the tubes!

► Never place the device on the coolant connections

Drive controllers contain electrostatic sensitive components.

► Avoid contact.

► Wear ESD-protective clothing.

Do not store drive controllers

- 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 product is not intended for the use in potentially explosive environment.

⚠ CAUTION

Design-related edges and high weight!

Contusions and bruises!

► Never stand under suspended loads.

► Wear safety shoes.

► Secure drive controller 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.
- 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 controller according to the specified degree of protection.
- Make sure that no small parts fall into the product 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 controller.
- Follow all safety instructions!

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 measuring at the input terminals.
- ► Wait until all drives has been stopped in order that no regenerative energy can be generated.
- ► Await capacitor discharge time (5 minutes). Check absence of voltage by measuring at the DC terminals.
- ► If personal protection is required, install suitable protective devices for drive converters.
- ► Never bridge upstream protective devices (even for testing 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 mA AC current (10 mA 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 *VDE 0100*.

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

www.keb.de/fileadmin/media/Techinfo/dr/tn/ti_dr_tn-rcd-00008_en.pdf

Installations which include drive controller 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 controller 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.
- 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, USA UL: 480 / 277 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/dr/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 controller.

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 controllers 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 start-up (i.e. for the specified application) is forbidden 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 controller 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 controller.
- ► 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.

⚠ CAUTION

High sound level during operation!

Hearing damage possible!

- ► Wear hearing protection!

NOTICE

Continuous operation (S1) with load > 60 % or from a rated motor power of 55 kW!

Premature ageing of the electrolytic capacitors!

- ► Mains choke with U_k = 4% absolutely necessary.

If a drive controller with electrolytic capacitors in a DC link has not been in operation for more than one year, observe the following instructions.

www.keb.de/fileadmin/media/Techinfo/dr/tn/ti_dr_tn-format-capacitors-00009_en.pdf

Switching at the output

Switching between motor and drive controller 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 controller 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 controller (mains on) (e.g. due to large rotating masses).

Switching at the input

For applications that require cyclic switching off and on of the drive controller, 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 controller 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 controller. The fan must be replaced in case of audible vibrations or squeak.

► In the case of liquid-cooled drive controllers 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.

1.7 Repair

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

⚠ DANGER

Unauthorized exchange, repair and modifications!

Unpredictable malfunctions!

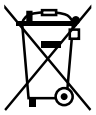
- ► The function of the drive controller is dependent on its parameterization. Never replace without knowledge of the application.
- ► Modification or repair is permitted only by KEB Automation KG authorized personnel.
- ► Only use original manufacturer parts.
- ► Infringement will annul the liability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

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

1.8 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“
Česko			
KEB Automation KG	RETELA	09281/20 ECZ	Klíčové slovo: Zpětný odběr OEEZ
Slowakei			
KEB Automation KG	ASEKOL:	RV22EEZ0000421	Klíčové slovo: ”Spätný odber OEEZ”

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. The COMBIVERT F6 series are drive converters with functional safety, optimized for operation at synchronous and asynchronous motors.

Various safety functions are available for different applications. It can be operated with a fieldbus module at different fieldbus systems. The control board has a system comprehensive operating concept.

The COMBIVERT complies with the requirements of the Machinery Directive. The possible functions are certified via a type test.

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 Machinery Directive, EMC Directive, Low Voltage Directive and other directives and regulations must be observed

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 in the industrie.

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 controller
Series:	COMBIVERT F6
Power range:	22...30 kW / 400 V
	15 kW / 230 V
Housing:	4 Peak Power

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, overvoltage, ground fault and overtemperature
- Analog inputs and outputs, digital inputs and outputs, relay output (potential-free), brake control and -supply, motor protection by I^2t, 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

x x F 6 x x x-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-ready
	4:	Liquid cooler (water), through-mount version IP54-ready
	5:	Air-cooler, through-mount version IP20
	6:	Liquid cooler (water), trough-mount version IP54-ready, sub-mounted braking resistors
	7:	Liquid cooler (oil), through-mount version IP54-ready
	8:	Liquid cooler (oil), through-mount version IP54-ready, sub-mounted braking resistors
	9:	Liquid cooler (water), mounted version, sub-mounted braking resistors
	A:	Liquid cooler (water), mounted version, High Performance, sub-mounted braking resistors
	B:	Liquid cooler (water), through-mount version, IP54-ready, High Performance, sub-mounted braking resistors
	C:	Air-cooler, mounted version, Version 2
	D:	Air-cooler, mounted version, High-Performance
	E:	Liquid cooler (water), mounted version, High-Performance
	F:	Air-cooler, through-mount version IP54-ready, High-Performance
	G:	Liquid cooler (water), trough-mount version IP54-ready, High-Performance
	H:	Air-cooler,, Convektion, trough-mount version IP54-ready
Control board variant		**APPLIKATION**
	1:	Multi Encoder Interface, CAN® [2], Real-Time Ethernet-busmodule [3]
	B	Multi Encoder Interface, CAN® [2], Real-Time Ethernet-busmodule [3], Alternative connector
		KOMPAKT
	1:	Multi Encoder Interface, CAN® [2], STO, EtherCAT® [1]
	2:	Multi Encoder Interface, CAN® [2], STO, VARAN
		PRO
	0:	No Encoder, CAN® [2], Real-Time Ethernetinterface [3]
	1:	Multi Encoder Interface, CAN® [2], Real-Time Ethernet interface [3]
	3:	Multi Encoder Interface, CAN® [2], Real-Time Ethernet interface [3], RS485-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
	B:	Multi Encoder Interface, CAN® [2], Real-Time Ethernet interface [3], alternative connector

continued on the next page

x x F 6 x x x - x x x x

Switching frequency, Software current limit, Turn-off current	0: 2 kHz / 125% / 150%	8: 2 kHz / 180% / 216%
	1: 4 kHz / 125% / 150%	9: 4 kHz / 180% / 216%
	2: 8 kHz / 125% / 150%	A: 8 kHz / 180% / 216%
	3: 16 kHz / 125% / 150%	B: 8 kHz / HSD
	4: 2 kHz / 150% / 180%	C: 6 kHz / HSD
	5: 4 kHz / 150% / 180%	D: Non standard switching frequency / Overload characteristic
	6: 8 kHz / 150% / 180%	E: Special Device
	7: 16 kHz / 150% / 180%	
Voltage / Connection type	1: 3ph 230 V AC/DC with braking transistor	
	2: 3ph 230 V AC/DC without braking transistor	
	3: 3ph 400 V AC/DC with braking transistor	
	4: 3ph 400 V AC/DC without braking transistor	
	A: 3ph 400 V AC/DC incl. GTR7 / max. rectifier / max. pre-charging	
	B: 3ph 400 V AC/DC without GTR7 / max. rectifier / max. pre-charging	
	C: 3ph 400 V AC/DC. GTR7-variant 2	
	D: 3ph 400 V AC/DC GTR7-variant 2 / max. rectifier / max. pre-charging	
Housing	2…9	
Equipment	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	
Control type	A: APPLICATION	
	K: COMPACT	
	P: PRO	
Series	COMBIVERT F6	
Inverter size	10…33	

Table 1: Part code

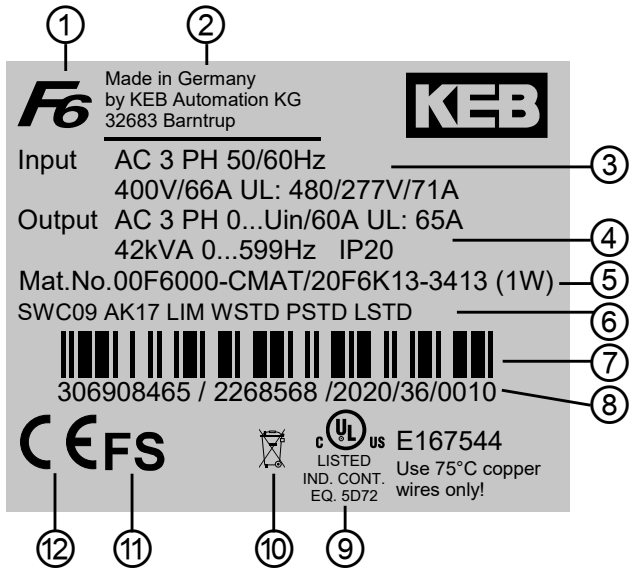
1) *EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany*

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“*, KEB internal 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	FS certification
12	CE certification

Figure 1: Nameplate (exemplary)

2.5.1 Configurable options

Features	Feature values	Description
Software	*SWxxx* [1]	Software status of the drive converter
Accessories	*Axxx* [1]	Selected accessories
	NAK	No accessories
Output frequency activation	LIM	Limitation to 599 Hz
	ULO	> 599 Hz activated
Warranty	WSTD	Warranty - Standard
	Wxxx [1]	Warranty extension
Parameterization	PSTD	Parameterization - Standard
	Pxxx [1]	Parameterization - Customer-specific
Nameplate logo	LSTD	Logo - Standard
	Lxxx [1]	Logo - Customer-specific

Figure 2: Configurable options

[1] „*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 (extended to -10…45 °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 • 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	*EN 60721-3-1*	1M2	Vibration amplitude 1.5 mm (2…9 Hz) Acceleration amplitude 5 m/s² (9…200 Hz)
Shock limit values	*EN 60721-3-1*	1M2	40 m/s²; 22 ms
Transport	**Standard**	**Class**	**Descriptions**
Vibration limits	*EN 60721-3-2*	2M1	Vibration amplitude 3.5 mm (2…9 Hz) Acceleration amplitude 10 m/s² (9…200 Hz) (Acceleration amplitude 15 m/s² (200…500 Hz)) [1)]
Shock limit values	*EN 60721-3-2*	2M1	100 m/s²; 11 ms
Operation	**Standard**	**Class**	**Descriptions**
Vibration limits	*EN 60721-3-3*	3M4	Vibration amplitude 3.0 mm (2…9 Hz) Acceleration amplitude 10 m/s² (9…200 Hz)
	EN 61800-5-1	–	Vibration amplitude 0.075 mm (10…57 Hz) Acceleration amplitude 10 m/s² (57…150 Hz)
Shock limit values	*EN 60721-3-3*	3M4	100 m/s²; 11 ms

Table 3: Mechanical environmental conditions

[1)] Not tested

3.1.3 Chemical / mechanical active substances

Storage		**Standard**	**Class**	**Descriptions**
Contamination	Gases	*EN 60721-3-1*	1C2	–
	Solids		1S2	–
Transport		**Standard**	**Class**	**Descriptions**
Contamination	Gases	*EN 60721-3-2*	2C2	–
	Solids		2S2	–
Operation		**Standard**	**Class**	**Descriptions**
Contamination	Gases	*EN 60721-3-3*	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	–
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
Conducted interference emission	*EN 61800-3*	C2 / C3	The specified value is only maintained in connection with a filter. Information about interference suppression (rated switching frequency, max. motor cable length) can be found in the corresponding filter instructions..
Radiated emitted interference	*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 - AC - Power ports	*EN 61000-4-4*	4 kV	–
Surge - Power ports	*EN 61000-4-5*	1 kV 2 kV	Phase-phase Phase-ground
Conducted immunity, 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 % Class 3
Frequency changes	*EN 61000-2-4*	–	≤ 2 %
Voltage deviations	*EN 61000-2-4*	–	±10 %
Voltage unbalances	*EN 61000-2-4*	–	≤ 3 %

Table 6: Electromagnetic compatibility

3.2 Device data of the 230 V peak power devices

3.2.1 Overview of 230 V peak power 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			**16**
Housing			**4**
Rated apparent output power		S_{out} / kVA	24
Max. rated motor power	1)	P_{mot} / kW	15
Rated input voltage		U_N / V	230 (UL: 240)
Input voltage range		U_{in} / V	170...264
Mains phases			3
Mains frequency		f_N / Hz	50 / 60 ±2
Rated input current @ U_N = 230 V		I_{in} / A	68
Rated input current @ U_N = 240 V		I_{in_UL} / A	68
Insulation resistance @ U_{dc} = 500 V		R_{iso} / MΩ	> 20
Leakage current		I_{iso_ac} / mA	> 3.5
Output voltage		U_{out} / V	0...U_{in}
Output frequency	2)	f_{out} / Hz	0...599
Output phases			3
Rated output current @ U_N = 230 V		I_N / A	62
Rated output current @ U_N = 240 V		I_{N_UL} / A	62
Rated output overload (60s)	3) 4)	I_{60s} / %	200
Software current limit	3) 9)	I_{lim} / %	216
Overcurrent	3)	I_{OC} / %	260
Rated switching frequency		f_{SN} / kHz	8
Max. switching frequency	5)	f_{S_max} / kHz	16
Power dissipation at rated operation	1)	P_D / W	677
Overload current over time	3)	I_{OL} / %	=> *„3.2.3.1 Overload characteristic (OL) for 230 V peak power devices“*
Maximum current 0Hz / 50Hz at f_S = 2 kHz		I_{out_max} / %	203 / 260
Maximum current 0Hz / 50Hz at f_S = 4 kHz		I_{out_max} / %	172 / 260
Maximum current 0Hz / 50Hz at f_S = 8 kHz		I_{out_max} / %	133 / 225
Maximum current 0Hz / 50Hz at f_S = 16 kHz		I_{out_max} / %	88 / 158
Max. braking current		I_{B_max} / A	93
Min. braking resistor value		R_{B_min} / Ω	4,5

continued on the next page

Device size		16
Housing		**4**
Braking transistor	6)	Max. cycle time: 120 s; Max c.d.f.: 50 %
Protective function for braking transistor		Short-circuit monitoring
Protective function braking resistor (Error GTR7 always on)	7)	Feedback signal evaluation and current switch-off
Max. motor cable length shielded	8) *l* / m	100

Table 7: Overview of the 230V Peak Power device data

1) *Rated operation corresponds to U_N = 230V, rated switching frequency, output frequency = 50 Hz (4-pole standard asynchronous motor).*

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 maximum output frequencies are subject to export restrictions and are only available on request.*

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

4) *Observe limitations => „3.2.3.1 Overload characteristic (OL) for 230 V peak power devices“.*

5) *A precise description of the derating => „3.4.1 Switching frequency and temperature“.*

6) *The cyclic duration factor is additionally limited by the used braking resistor. Values apply to external braking resistors.*

7) *The feedback signal evaluation monitors the functionality of the brake transistor. The power is switched off via the internal mains input bridge of the AC supply.*

8) *The maximum cable length depends on various factors. Further information can be found in the corresponding filter instructions.*

9) *In overload operation, the mains choke can become saturated, which can lead to reduction in service life.*

3.2.2 Voltage and frequencies for 230V devices

Input voltages and frequencies		
Rated input voltage	U_N / V	230
Rated mains voltage (USA)	U_{N_UL} / V	240
Input voltage range	U_{IN} / V	170...264
Input phases		3
Mains frequency	f_N / Hz	50 / 60
Mains frequency tolerance	± f_N / Hz	2

Table 8: Input voltages and frequencies of the 230V devices

DC link voltage		
DC link rated voltage @ U_N = 400V	U_{N_dc} / V	325
DC link rated voltage @ U_{N_UL} = 480V	$U_{N\_UL\_dc}$ / V	339
DC link voltage working voltage range	U_{IN_dc} / V	240...373

Table 9: DC link voltage for 230V devices

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

Table 10: Output voltages and frequencies of the 230V 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 230V:“).*

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 a maximum output frequency higher than 599Hz are restricted for exportt.*

3.2.2.1 Example of the calculation of the possible motor voltage 230V:

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:*
Drive converter open-loop	4	*open-loop drive converter with mains- and motor choke at non-rigid supply system:*
Drive converter closed-loop	8	*230 V mains voltage - 11 % = 204,7 V motor voltage*
Motor choke U_k	1	
Non-rigid supply system	2	

Table 11: Example of the calculation of the possible motor voltage 230V:

3.2.3 Input and output currents/overload for 230 V peak power devices

Device size			**16**
Rated input current @ U_N = 230 V	1)	I_{in} / A	68
Rated input current @ U_{N_UL} = 240 V	1)	I_{in_UL} / A	68
Rated output current @ U_N = 230 V		I_N / A	62
Rated output current @ U_{N_UL} = 240 V		I_{N_UL} / A	62
Rated output overload (60 s)	2)	I_{60s} / %	200
Overload current	2)	I_{OL} / %	=> *„3.2.3.1 Overload characteristic (OL) for 230 V peak power devices“*
Software current limit	2) 3)	I_{lim} / %	216
Overcurrent	2)	I_{OC} / %	260

Table 12: Input and output currents of the 230 V peak power devices

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

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

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

3.2.3.1 Overload characteristic (OL) for 230 V peak power devices

All drive controllers can be operated at rated switching frequency with an utilisation of 200 % for 60s.

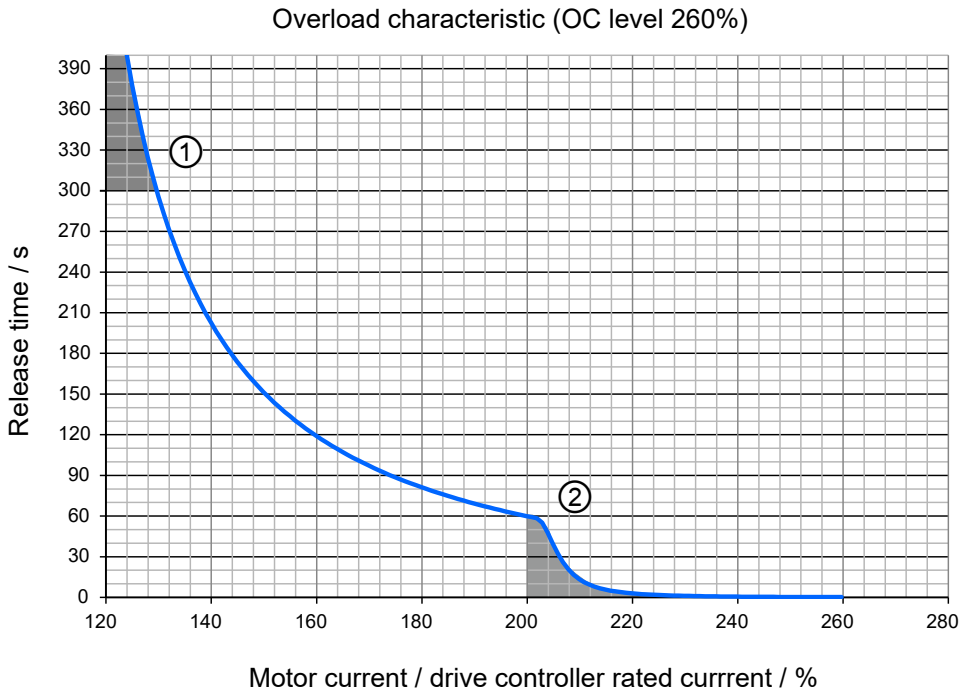
The OL overload function is a root mean square (RMS) function.

The greater the difference between the overload and underload phases, the greater the deviation of the RMS from the arithmetic mean value.

For extreme overloads (=> *„Figure 3: Switch-off time t depending on the overload I/IN at OC level 260 % (OL)“* the load is weighted more heavily. This means the load is provided with a factor for the calculation of the RMS value, by way that the overload protection function triggers, even if the RMS value does not reach 100%.

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 ambient temperatures and/or high heat sink temperatures (for example, by preceding utilisation nearby 100%) the drive controller 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 before triggering the overload error OL and error OL2 can be triggered => *„3.3.3.2 Frequency-dependent maximum current (OL2) for 400 V Peak Power devices“*.



Legend	
1	Thermal overload limit
2	Range for extreme overloads

Figure 3: Switch-off time t depending on the overload I/IN at OC level 260 % (OL)

- 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 controller must remain switched on during the cooling down phase.

Operation in the range of the thermal overload limit

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

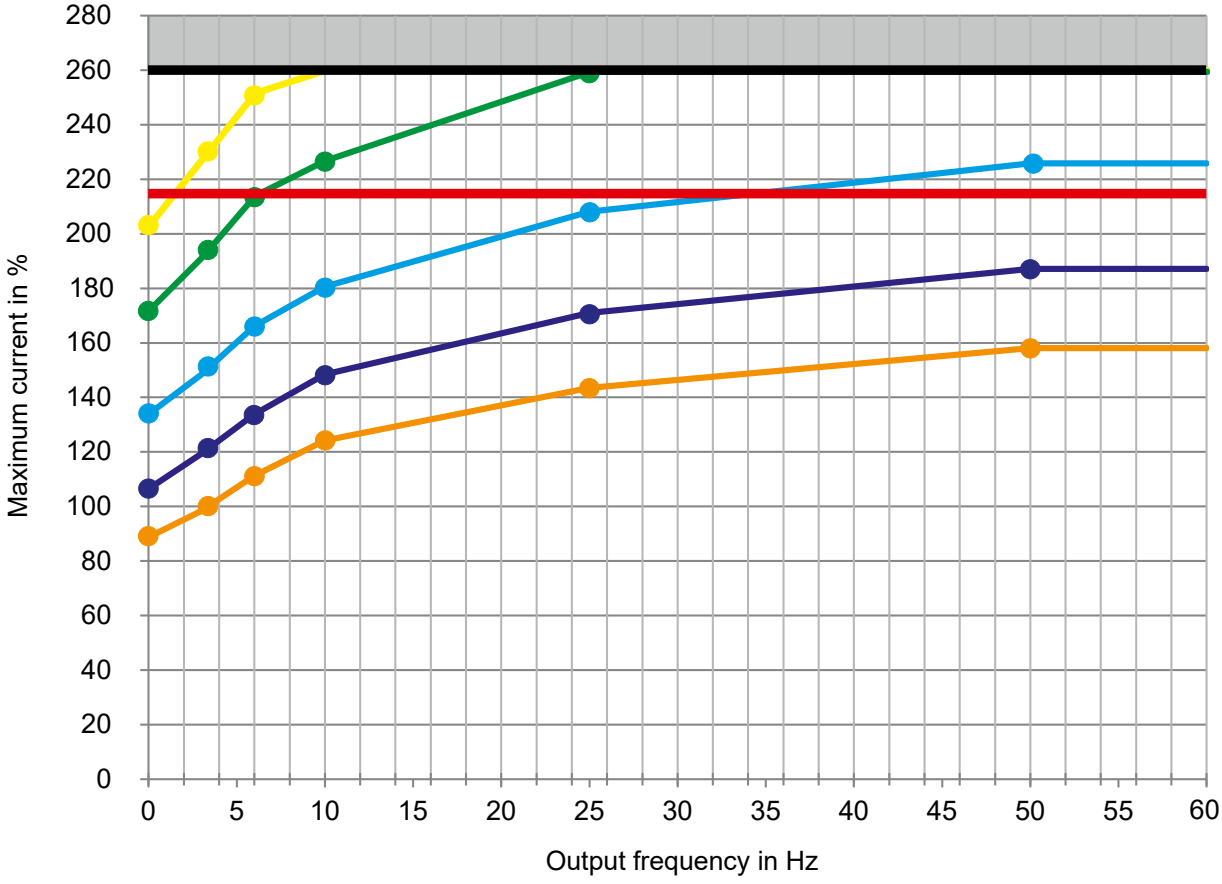
3.2.3.2 Frequency-dependent maximum current (OL2) for 230 V Peak Power devices

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

- Applies for the rated switching frequency: at 0 Hz output frequency the drive controller can provide at least the rated output current.
- 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 controller parameters.

The following characteristics indicate the permissible maximum current for the output frequency values 0 Hz, 3 Hz, 6 Hz, 10 Hz, 25 Hz and 50 Hz. Device size 16 is represented exemplary.



Legend	
	Overcurrent I_{OC}
	Software current limit I_{lim} (the limit can be set with parameter is35)
	Switching frequency 2 kHz
	Switching frequency 4 kHz
	Switching frequency 8 kHz
	Switching frequency 12 kHz
	Switching frequency 16 kHz
	Not available for modulation. Error OC is triggered at 260 % overload.

Figure 4: Typical overload characteristics in the lower output frequencies (OL2) example device size 16

The frequency-dependent maximum current I_{out_max} 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		**16**					
Rated switching frequency		**8**					
Output frequency	***fout* / Hz**	**0**	**3**	**6**	**10**	**25**	**50**
Frequency-dependent maximum current @ *fs* I_{out_max} / % *Basic Time Period = 62.5 µs (Parameter is22=0)*	2 kHz	203	227	251	260	260	260
	4 kHz	172	191	214	233	260	260
	8 kHz	133	148	166	180	208	225
	16 kHz	88	98	111	124	143	158
Frequency-dependent maximum current @ *fs* I_{out_max} / % *Basic Time Period = 71.4 µs (Parameter is22=1)*	1.75 kHz	203	227	251	260	260	260
	3.5 kHz	180	200	223	243	260	260
	7 kHz	143	159	178	194	222	241
	14 kHz	97	108	122	136	157	172
Frequency-dependent maximum current @ *fs* I_{out_max} / % *Basic Time Period = 83.3 µs (Parameter is22=2)*	1.5 kHz	203	227	251	260	260	260
	3 kHz	187	209	233	253	260	260
	6 kHz	153	170	190	207	236	256
	12 kHz	106	119	133	148	171	187
Frequency-dependent maximum current @ *fs* I_{out_max} / % *Basic Time Period = 100 µs (Parameter is22=3)*	1.25 kHz	203	227	251	260	260	260
	2.5 kHz	195	218	242	260	260	260
	5 kHz	162	181	202	220	250	260
	10 kHz	120	133	150	164	189	206

Table 13: Frequency-dependent maximum current for device size 16 peak power

3.2.4 Power dissipation at rated operation of the 230 V peak power devices

Device size			16
Power dissipation at rated operation	[1]	P_D / W	677

Table 14: Power dissipation of the 230 V peak power devices

[1] *Rated operation corresponds to U_N = 230 V; f_{SN} ; I_N ; f_N = 50 Hz (typically value)*

3.2.5 Fusing for 230 V peak power devices

Device size	Max. size of the fuse / A				
	U_N = 230 V gG (IEC)	U_N = 240V Class "J“	U_N = 240V		
	SCCR 30 kA	SCCR 5 kA	SCCR 30 kA	Type	Rating
16	80	100	100	SIBA 20 1xy 20.100	700Vac
			100	COOPER BUSSMANN 170M1367	700Vac

Table 15: Fusings for 230 V peak power devices

[1] "x“ stands for various indicators. "y“ stands for various connection variants.

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 Device data of the 400 V peak power devices

3.3.1 Overview of 400 V peak power 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			**18**	**19**
Housing			**4**	
Rated apparent output power		S_{out} / kVA	35	42
Max. rated motor power	1)	P_{mot} / kW	22	30
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 = 400 V		I_{in} / A	59	66
Rated input current @ U_N = 480 V		I_{in_UL} / A	48	59
Insulation resistance @ U_{dc} = 500 V		R_{iso} / MΩ	> 20	
Leakage current		I_{iso_ac} / mA	> 3.5	> 3.5
Output voltage		U_{out} / V	0...U_{in}	
Output frequency	2)	f_{out} / Hz	0...599	
Output phases			3	
Rated output current @ U_N = 400 V		I_N / A	50	60
Rated output current @ U_N = 480 V		I_{N_UL} / A	40	54
Rated output overload (60s)	3) 4)	I_{60s} / %	160	200
Software current limit	3) 11)	I_{lim} / %	200	225
Overcurrent	3)	I_{OC} / %	240	270
Rated switching frequency		f_{SN} / kHz	4 (S1 operation), 8 (S3 operation) 9)	4 (S1 operation), 8 (S3 operation) 10)
Max. switching frequency	5)	f_{S_max} / kHz	16	16
Power dissipation at rated operation	1)	P_D / W	558	698
Overload current over time	3)	I_{OL} / %	=> *„3.3.3.1 Overload characteristic (OL) for 400 V peak power devices“*	
Maximum current 0Hz / 50Hz at f_S = 2 kHz		I_{out_max} / %	212 / 240	205 / 270
Maximum current 0Hz / 50Hz at f_S = 4 kHz		I_{out_max} / %	162 / 240	152 / 253
Maximum current 0Hz / 50Hz at f_S = 8 kHz		I_{out_max} / %	106 / 188	95 / 172
Maximum current 0Hz / 50Hz at f_S = 16 kHz		I_{out_max} / %	56 / 104	45 / 87

continued on the next page

Device size		18	19
Housing		**4**	
Max. braking current	I_{B_max} / A	93	93
Min. braking resistor value	R_{B_min} / Ω	9	8
Braking transistor [6]		Max. cycle time: 120 s; Max c.d.f.: 50 %	
Protective function for braking transistor		Short-circuit monitoring	
Protective function braking resistor (Error GTR7 always on) [7]		Feedback signal evaluation and current switch-off (only for AC mains connection)	
Max. motor cable length shielded [8]	l / m	50	50

Table 16: Overview of the 400V Peak Power device data

[1] *Rated operation corresponds to U_N = 400V, rated switching frequency, output frequency = 50 Hz (4-pole standard asynchronous motor).*

[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 maximum output frequencies are subject to export restrictions and are only available on request.*

[3] *The values refer in % to the rated output current I_N.*

[4] *Observe limitations => „3.3.3.1 Overload characteristic (OL) for 400 V peak power devices“.*

[5] *A precise description of the derating => „3.4.1 Switching frequency and temperature“.*

[6] *The cyclic duration factor is additionally limited by the used braking resistor. Values apply to external braking resistors.*

[7] *The feedback signal evaluation monitors the functionality of the braking transistor. The power is switched off via the internal mains input bridge of the AC supply. There is no current switch-off with DC supply.*

[8] *The maximum cable length depends on various factors. Further information can be found in the corresponding filter instructions.*

[9] *ED: 70%, Tp: 35s*

[10] *ED: 70%, Tp: 10s*

[11] *In overload operation, the mains choke can become saturated, which can lead to reduction in service life.*

3.3.2 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	±f_N / Hz	2

Table 17: Input voltages and frequencies of the 400V devices

DC link voltage		
DC link rated voltage @ U_N = 400V	U_{N_dc} / V	565
DC link rated voltage @ U_{N_UL} = 480V	$U_{N\_UL\_dc}$ / V	680
DC link voltage working voltage range	U_{IN_dc} / V	390...780

Table 18: 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 19: 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 („3.3.2.1 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 a maximum output frequency higher than 599Hz are restricted for export.*

3.3.2.1 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	*Open-loop drive converter with mains- and motor choke at non-rigid supply system:* *400 V mains voltage (100%) - 36 V reduced 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 20: Example of the calculation of the possible motor voltage:

3.3.3 Input and output currents/overload for 400 V peak power devices

Device size			18	19
Rated input current @ U_N = 400 V	1)	I_{in} / A	59	66
Rated input current @ U_{N_UL} = 480 V	1)	I_{in_UL} / A	48	59
Rated input current DC @ U_{N_dc}= 565 V			73	58
Rated input current DC @ $U_{N\_UL\_dc}$ = 680 V			81	73
Rated output current @ U_N = 400 V		I_N / A	50	60
Rated output current @ U_{N_UL} = 480 V		I_{N_UL} / A	40	54
Rated output overload (60 s)	2)	I_{60s} / %	160	200
Overload current	2)	I_{OL} / %	=> *„3.3.3.1 Overload characteristic (OL) for 400 V peak power devices“*	
Software current limit	2) 3)	I_{lim} / %	200	225
Overcurrent	2)	I_{OC} / %	240	270

Table 21: Input and output currents of the 400 V peak power devices

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

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

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

3.3.3.1 Overload characteristic (OL) for 400 V peak power devices

All drive controllers can be operated at rated switching frequency with an utilisation of 160% or 200 % for 60 s.

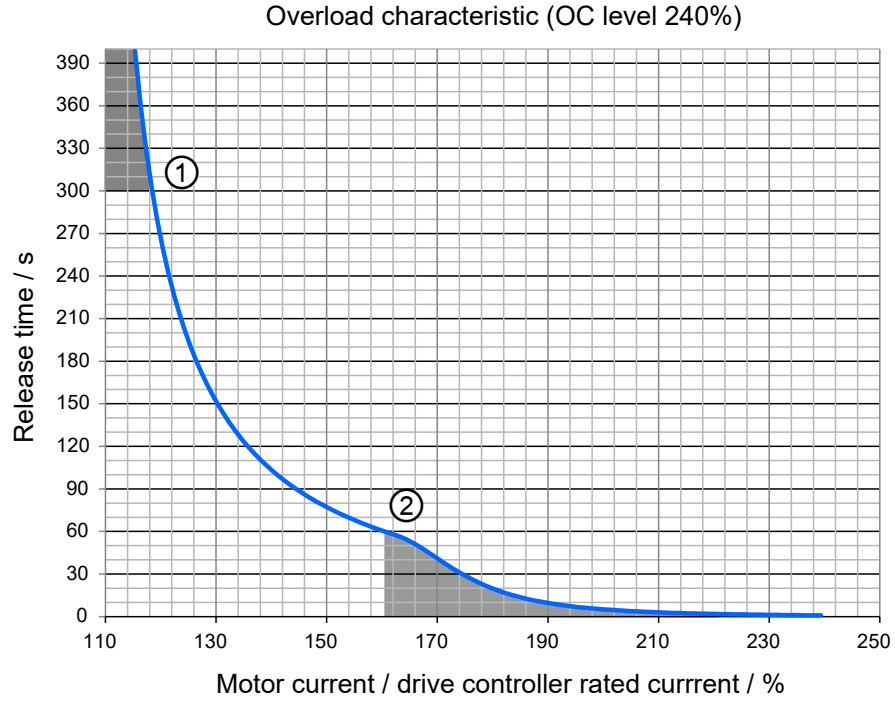
The OL overload function is a root mean square (RMS) function.

The greater the difference between the overload and underload phases, the greater the deviation of the RMS from the arithmetic mean value.

For extreme overloads (=> *„Figure 5: Switch-off time t depending on the overload I/IN at OC level 240 % (OL)“* or *„Figure 6: Switch-off time t depending on the overload I/IN at OC level 270 % (OL)“*) the load is weighted more heavily. This means the load is provided with a factor for the calculation of the RMS value, by way that the overload protection function triggers, even if the RMS value does not reach 100%.

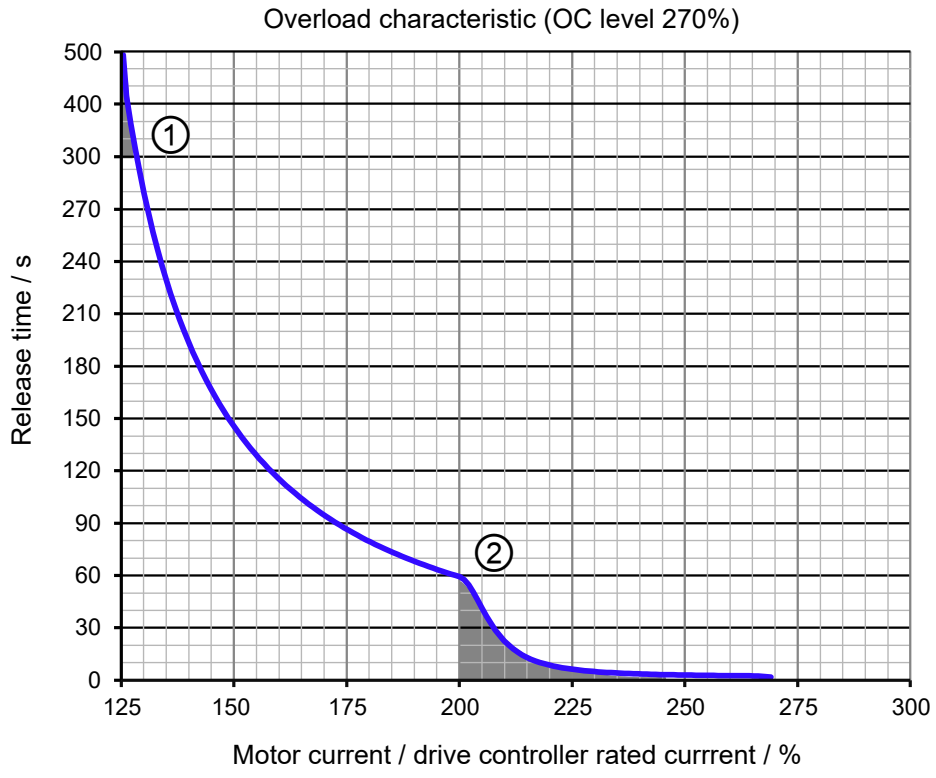
Restrictions:

- 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 ambient temperatures and/or high heat sink temperatures (for example, by preceding utilisation nearby 100%) the drive controller 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 before and error OL2 can be triggered
  => *„3.2.3.2 Frequency-dependent maximum current (OL2) for 230 V Peak Power devices“*.



Legend	
1	Thermal overload limit
2	Range for extreme overloads

Figure 5: Switch-off time t depending on the overload I/IN at OC level 240 % (OL)



Legend	
1	Thermal overload limit
2	Range for extreme overloads

Figure 6: Switch-off time t depending on the overload I/IN at OC level 270 % (OL)

- 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 controller must remain switched on during the cooling down phase.

Operation in the range of the thermal overload limit

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

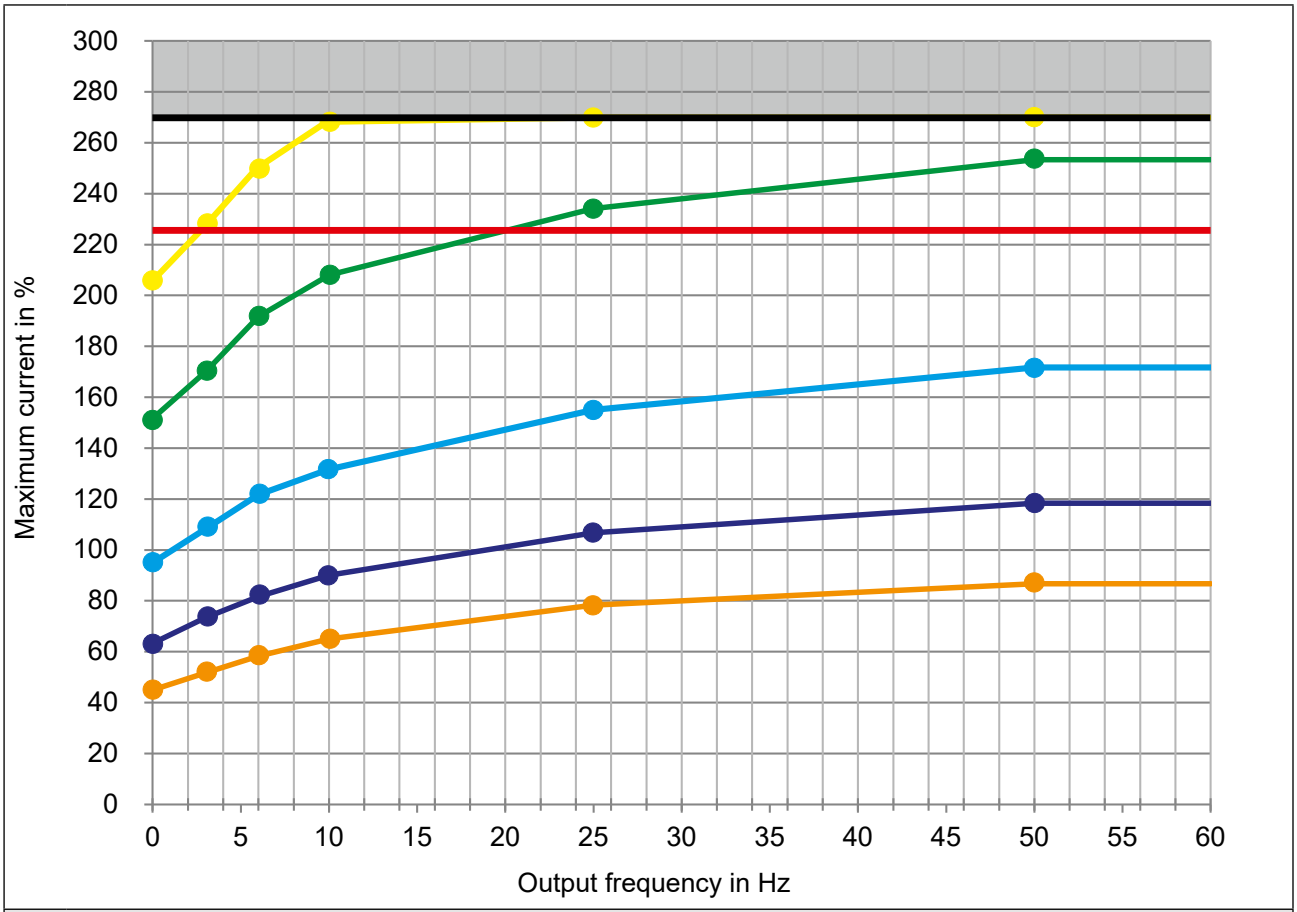
3.3.3.2 Frequency-dependent maximum current (OL2) for 400 V Peak Power devices

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

- Applies for the rated switching frequency: at 0 Hz output frequency the drive controller can provide at least the rated output current.
- 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 controller parameters.

The following characteristics indicate the permissible maximum current for the output frequency values 0 Hz, 3 Hz, 6 Hz, 10 Hz, 25 Hz and 50 Hz. Device size 19 is represented exemplary.



Legend	
	Overcurrent I_{OC}
	Software current limit I_{lim} (the limit can be set with parameter is35)
	Switching frequency 2 kHz
	Switching frequency 4 kHz
	Switching frequency 8 kHz
	Switching frequency 12 kHz
	Switching frequency 16 kHz
	Not available for modulation. Error OC is triggered at 270% overload.

Figure 7: Typical overload characteristics in the lower output frequencies (OL2) example device size 19

The frequency-dependent maximum current I_{out_max} 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		**18**					
Rated switching frequency		**4 (S1 operation), 8 (S3 operation) [1)]**					
Output frequency	**f_{out} / Hz**	**0**	**3**	**6**	**10**	**25**	**50**
Frequency-dependent maximum current @ *fs* I_{out_max} / % *Basic Time Period = 62.5 µs (Parameter is22=0)*	2 kHz	212	234	240	240	240	240
	4 kHz	162	180	202	220	240	240
	8 kHz	106	118	134	148	172	188
	16 kHz	56	64	72	78	94	104
Frequency-dependent maximum current @ *fs* I_{out_max} / % *Basic Time Period = 71.4 µs (Parameter is22=1)*	1.75 kHz	212	234	240	240	240	240
	3.5 kHz	175	194	217	237	240	240
	7 kHz	120	134	151	166	192	210
	14 kHz	66	75	84	92	110	121
Frequency-dependent maximum current @ *fs* I_{out_max} / % *Basic Time Period = 83.3 µs (Parameter is22=2)*	1.5 kHz	212	234	240	240	240	240
	3 kHz	187	207	232	240	240	240
	6 kHz	134	149	168	184	212	232
	12 kHz	76	86	96	106	126	138
Frequency-dependent maximum current @ *fs* I_{out_max} / % *Basic Time Period = 100 µs (Parameter is22=3)*	1.25 kHz	212	234	240	240	240	240
	2.5 kHz	200	221	240	240	240	240
	5 kHz	148	165	185	202	232	240
	10 kHz	91	102	115	127	149	163

Table 22: Frequency-dependent maximum current for device size 18 peak power

[1)] *ED: 70%, Tp: 35s*

Device size		19					
Rated switching frequency		**4 (S1 operation), 8 (S3 operation) [1)]**					
Output frequency	**f_{out} / Hz**	**0**	**3**	**6**	**10**	**25**	**50**
Frequency-dependent maximum current @ *fs* I_{out_max} / % *Basic Time Period = 62.5 µs (Parameter is22=0)*	2 kHz	205	227	250	268	270	270
	4 kHz	152	170	192	207	233	253
	8 kHz	95	108	122	132	155	172
	16 kHz	45	52	58	65	78	87
Frequency-dependent maximum current @ *fs* I_{out_max} / % *Basic Time Period = 71.4 µs (Parameter is22=1)*	1.75 kHz	205	227	250	268	270	270
	3.5 kHz	165	184	206	222	250	270
	7 kHz	109	124	139	150	174	192
	14 kHz	54	63	70	78	93	103
Frequency-dependent maximum current @ *fs* I_{out_max} / % *Basic Time Period = 83.3 µs (Parameter is22=2)*	1.5 kHz	205	227	250	268	270	270
	3 kHz	178	198	221	238	268	270
	6 kHz	123	139	159	169	194	213
	12 kHz	63	73	82	90	107	118
Frequency-dependent maximum current @ *fs* I_{out_max} / % *Basic Time Period = 100 µs (Parameter is22=3)*	1.25 kHz	205	227	250	268	270	270
	2.5 kHz	192	213	235	253	270	270
	5 kHz	138	155	174	188	214	233
	10 kHz	79	91	102	111	131	145

Table 23: Frequency-dependent maximum current for device size 19 peak power

[1)] *ED: 70%, Tp: 10s*

3.3.4 Overview of rectifier data for 400 V devices

Device size			18	19
Rectifier rated power		P_{rect} / kW	25	34
Rectifier continuous power	[1)]	P_{rect_cont} / kW	61	61
Continuous input current @ U_N = 400 V	[1)]	I_{in_cont} / A	121	121
Continuous input current @ U_{N_UL} = 480 V	[1)]	$I_{in\_UL\_cont}$ / A	106	106
Rated output current DC @ U_{N_dc} = 565V		I_{out_dc} / A	73	81
Continuous output current DC @ U_{N_dc} = 565 V	[1)]	$I_{out\_dc\_cont}$ / A	148	148
Rated output current DC @ $U_{N\_UL\_dc}$ = 680V		$I_{out\_UL\_dc}$ / A	58	73
Continuous output current DC @ $U_{N\_UL\_dc}$ = 680 V	[1)]	$I_{out\_UL\_dc\_cont}$ / A	129	129

Table 24: Overview of rectifier data for 400 V devices

[1)] *Continuous operation is a load that exceeds the rated operation. Continuous operation only occurs if the internal rectifier is used to supply additional drive controllers via the DC terminals => „5.3.6 DC-bus connection“. In continuous operation, the OH error can be triggered depending on the operating conditions of the internal inverter.*

3.3.5 Power dissipation at rated operation of the 400 V peak power devices

Device size			18	19
Rated switching frequency		f_{SN} / kHz	4 (S1 operation), 8 (S3 operation) [3]	4 (S1 operation), 8 (S3 operation) [4]
Power dissipation at rated operation	[1]	P_D / W	558	698
Power dissipation at rated operation DC	[2]	P_{D_dc} / W	484	560

Table 25: Power dissipation of the 400 V peak power devices

[1] *Rated operation corresponds to U_N = 400 V; f_{SN} ; I_N ; f_N = 50 Hz (typically value)*

[2] *Rated operation DC corresponds to U_{N_dc} = 565 V; I_N ; f_N = 50 Hz (typically value)*

[3] *ED: 70%, Tp: 35s*

[4] *ED: 70%, Tp: 10s*

3.3.6 Fusing for 400 V peak power devices

3.3.6.1 Fuse protection for AC supply

Device size	Max. size of the fuse / A			
	U_N = 400 V gG (IEC)	U_N = 480V / 277V Class „J“	U_{N_UL} = 480V	
	SCCR 30 kA	SCCR 5 kA	SCCR 30 kA	Type
18	80	60	50	SIBA 20 189 20.50 EATON 170M1364 LITTELFUSE L70QS050
19	80	80	80	SIBA 20 189 20.80 EATON 170M1366

Table 26: Fusings for 400 V peak power 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.

3.3.6.2 Fuse protection for DC supply

Device size	Recommended size of the fuse / A		Permissible fuses [1]
	U_{N_dc} = 565V	$U_{N\_UL\_dc}$ = 680V	
	SCCR 50 kA	SCCR 50 kA	
18	100	80	SIBA 50 250 06.80 SIBA 50 280 06.100 SIBA 20 209 37.100 [2] SIBA 50 268 06.125 SIBA 20 557 34.250 2[2] SIBA 20 031 34.250 Bussmann FWP-100A22F Bussmann 170M1422 Littelfuse L70QS500
19	125	100	

Table 27: DC Fusing of the 400 V / 480 V devices

[1] *Fuses of the same type with lower rated currents can be used if they are suitable for the application.*

[2] *Fuse without UL certification.*

NOTICE

Observe the rated voltage of the fuse!

► The rated voltage of the fuse must be at least equal to the maximum DC supply voltage of the drive controller.

3.3.6.3 Motor protective circuit-breaker / circuit breaker

Device size	Recommended motor-protective circuit-breakers / circuit-breakers						
	IEC(U_N = 400V)			UL(U_{N_UL} = 480V)			
	Type	Rated current / A	SCCR @ U_N / kA	Type	Rated current / A	Rated power / hp	SCCR @ U_{N_UL} / kA
18	Eaton PKZM4-63	63	30	Eaton PKZM4-50	50	30	30
19	Eaton NZ-MN1-A80-NA	80	30	Eaton PKZM4-58	58	40	30

Table 28: Recommended motor protective circuit-breakers / circuit breakers for 400 V / 480 V appliances

Alternative motor-protective circuit-breaker / circuit-breaker			
IEC(U_N = 400V)			
Type	Rated current / A	Rated power / hp	SCCR @ U_N / kA
Eaton PKZM4-63	65	40	30
Siemens 3RV2032-4KA10	73	60	30
Siemens 3RV2042-4MA10	100	75	30
Schneider GV3P65	65	40	30
Eaton NZMN1-A125-NA	125	–	30
Eaton NZMH2-A160-NA	160	–	30
Siemens 3VA5112-6ED31-0AA0	125	–	30
Siemens 3VA5215-6ED31-0AA0	150	–	30
Schneider BJL36125	125	–	30

Table 29: Alternative motor protective circuit-breakers / circuit breaker for 400 V / 480 V appliances

Motor protection switches/circuit breakers of the same type with a lower rated current can be used provided they are suitable for the application.

Motor protection switches/circuit breakers of the same type with lower breaking capacity can be used provided they are suitable for the application. In this case, the SCCR of the combination of drive converter and protection device is reduced to the breaking capacity of the protection device.

Motor protection switches/circuit breakers of the same type with different features (e.g., connection terminals, actuation types, etc.) can be used provided they are suitable for the application and the different features do not have a negative impact on the conduction values (I^2t and Ip).

IEC only:

Motor-protective circuit-breakers / circuit-breakers not listed here can be used provided they fulfil the following requirements:
- Passage integral I^2t @ U_N< 910kA²s
- Forward current Ip @ U_N< 18kA

3.4 General electrical data

3.4.1 Switching frequency and temperature

The drive controller 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 controller switches off due to overheating of the heat sink. If the heat sink temperature falls below the treshold 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.

3.4.1.1 Switching frequency and temperature of the 230 V peak power devices

Device size			**16**
Rated switching frequency	[1]	f_{SN} / kHz	8
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	90
Temperature for derating the switching frequency		T_{DR} / °C	80
Temperature for uprating the switching frequency		T_{UR} / °C	70
Temperature for switching to rated switching frequency		T_{EM} / °C	85

Table 30: Switching frequency and temperature for 230 V peak power devices

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

3.4.1.2 Switching frequency and temperature of the 400 V peak power devices

Device size			**18**	**19**
Rated switching frequency	[1]	f_{SN} / kHz	4 (S1 operation), 8 (S3 operation) [2]	4 (S1 operation), 8 (S3 operation) [3]
Max. switching frequency	[1]	f_{S_max} / kHz	16	16
Min. switching frequency	[1]	f_{S_min} / kHz	2	2
Max. heat sink temperature		T_{HS} / °C	90	90
Temperature for derating the switching frequency		T_{DR} / °C	80	80
Temperature for uprating the switching frequency		T_{UR} / °C	70	70
Temperature for switching to rated switching frequency		T_{EM} / °C	85	85

Table 31: Switching frequency and temperature for 400 V peak power devices

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

[2] *ED: 70%, Tp: 35s*

[3] *ED: 70%, Tp: 10s*

3.4.2 DC link / braking transistor function

Activation of the braking transistor function

To be able to use the braking transistor, the function must be activated with parameter "is30 braking transistor function".

For more information => *F6 Programming manual*.

NOTICE

Falling below the minimum braking resistor value!

Destruction of the drive controller

► The minimum brake resistance value must not fall below!

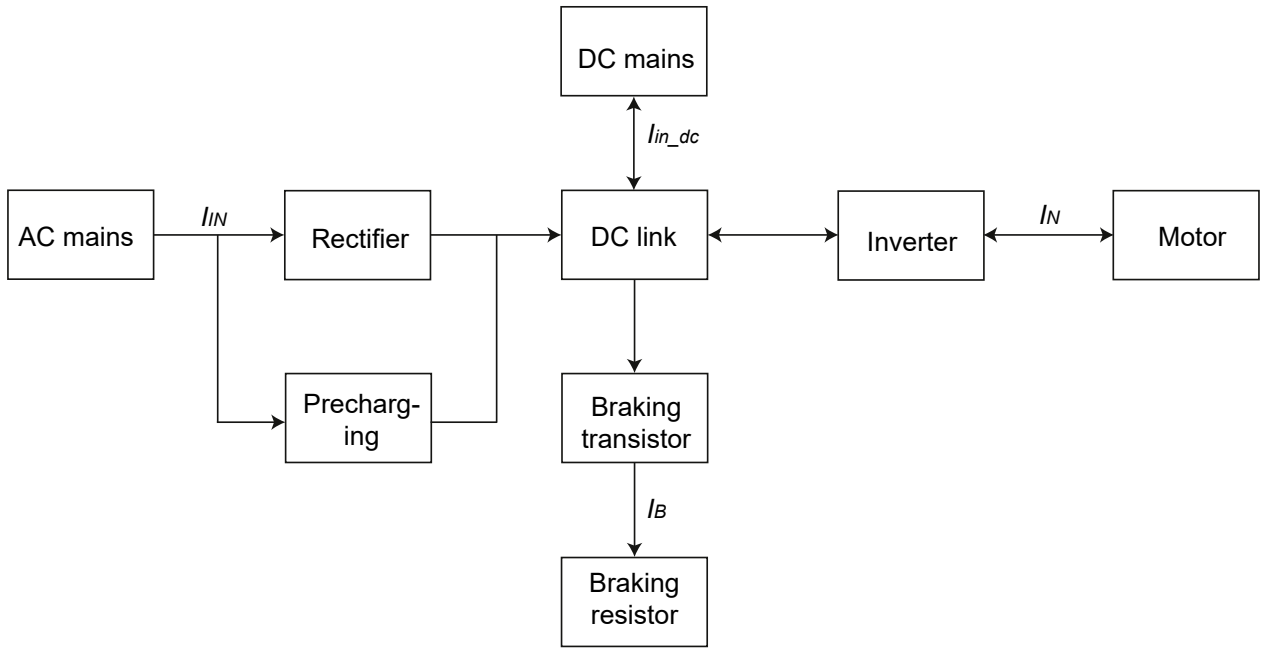


Figure 8: Block diagram of the energy flow

NOTICE

Destruction of the drive controller!

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

► If the error "ERROR GTR7 always ON" occurs, the drive controller is defective and must be disconnected from the power supply no later than 16 hours!

► With DC mains connection and the use of non-intrinsically safe braking resistors or sub-mounted braking resistors, the drive converter must be de-energised after 1 second at the latest.

3.4.2.1 DC link / braking transistor function of the 230 V peak power devices

Device size			**16**
DC link rated voltage @ U_N = 230 V		U_{N_dc} / V	325
Rated DC link voltage @ U_{N_UL} = 240V		$U_{N\_dc\_UL}$ / V	339
DC link voltage working voltage range		U_{in_dc} / V	240…373
DC switch-off level "ERROR underpotential“		U_{UP} / V	216
DC switch-off level "ERROR overpotential“		U_{OP} / V	400
DC switch-off level braking transistor	1)	U_B / V	380
Max. braking current		I_{B_max} / A	93
Braking transistor	2)		Max. cycle time: 120 s; Max c.d.f.: 50 %
Min. braking resistor value		R_{B_min} / Ω	4,5
Protective function braking resistor (Error GTR7 always on)	3)		Feedback signal evaluation and current switch-off
Protective function for braking transistor			Short-circuit monitoring
DC link capacity		C / µF	6120

Table 32: DC link / braking transistor function of the 230 V peak power 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. Values apply to external braking resistors.*

3) *The feedback signal evaluation monitors the functionality of the brake transistor. The power is switched off via the internal mains input bridge of the AC supply.*

3.4.2.2 DC link / braking transistor function of the 400 V peak power devices

Device size			18	19
Rated DC link voltage @ U_N = 400 V		U_{N_dc} / V	565	565
Rated DC link voltage @ U_{N_UL} = 480V		$U_{N\_dc\_UL}$ / V	680	680
DC link voltage working voltage range		U_{in_dc} / V	390...780	390...780
DC switch-off level "ERROR underpotential“		U_{UP} / V	240	240
DC switch-off level "ERROR overpotential“		U_{OP} / V	840	840
DC switch-off level braking transistor	1)	U_B / V	780	780
Max. braking current		I_{B_max} / A	93	105
Braking transistor	2)		Max. cycle time: 120 s; Max c.d.f.: 50 %	
Min. braking resistor value		R_{B_min} / Ω	9	8
Protective function braking resistor (Error GTR7 always on)	3)		Feedback signal evaluation and Power cut-off (only with AC connection)	
Protective function for braking transistor			Short-circuit monitoring	
DC link capacity		C_{int} / µF	1700	2380
Max. prechargeable total capacity @ U_N = 400 V		C_{pc_max} / µF	5700	9500
Max. prechargeable total capacity @ U_{N_UL} = 480 V		$C_{pc\_max\_UL}$ / µF	3900	6600

Table 33: DC link / braking transistor function of the 400 V peak power 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. Values apply to external braking resistors.*

3) *The feedback signal evaluation monitors the functionality of the braking transistor. The power is switched off via the internal mains input bridge of the AC supply. There is no current switch-off with DC power supply.*

3.4.3 Fan

Device size		16	18	19
Interior fan	Number	1		
	Speed-variable	Yes		
Heat sink fan	Number	2		
	Speed-variable	Yes		

Table 34: Fan

The fans are speed-variable. They are automatically controlled to high or low speed depending on the temperature limits set in the software.

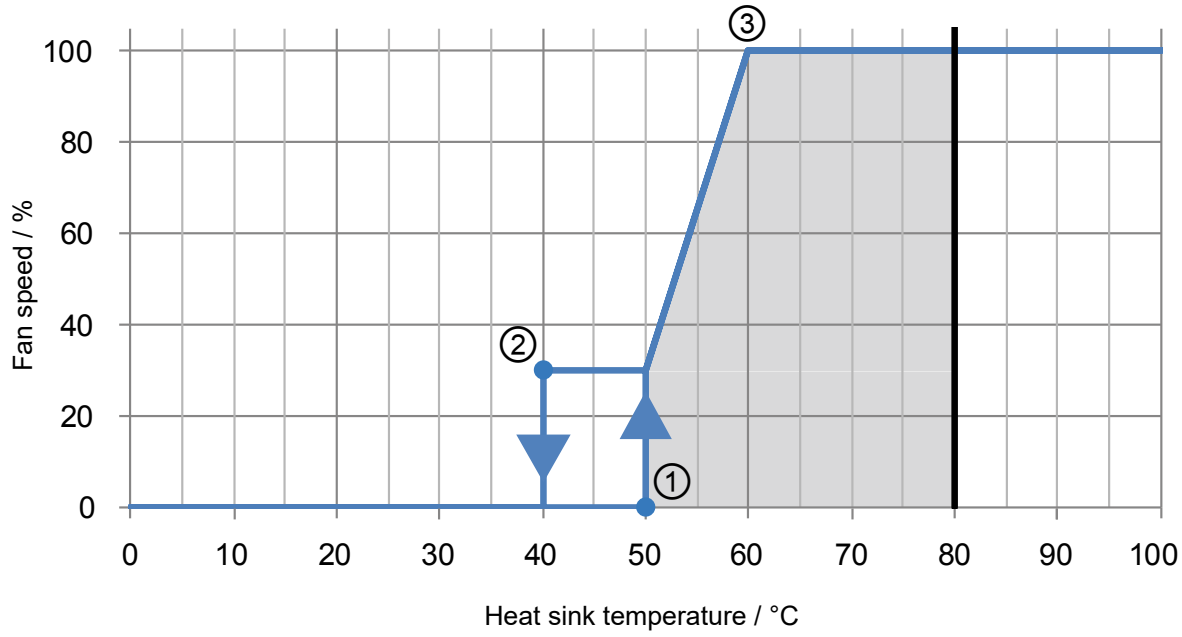
NOTICE

Destruction of the fan!

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

3.4.3.1 Switching behaviour of the fans

The temperature monitoring system controls the fans with 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 9: Switching behaviour of the fans example heat sink fan

3.4.3.2 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.

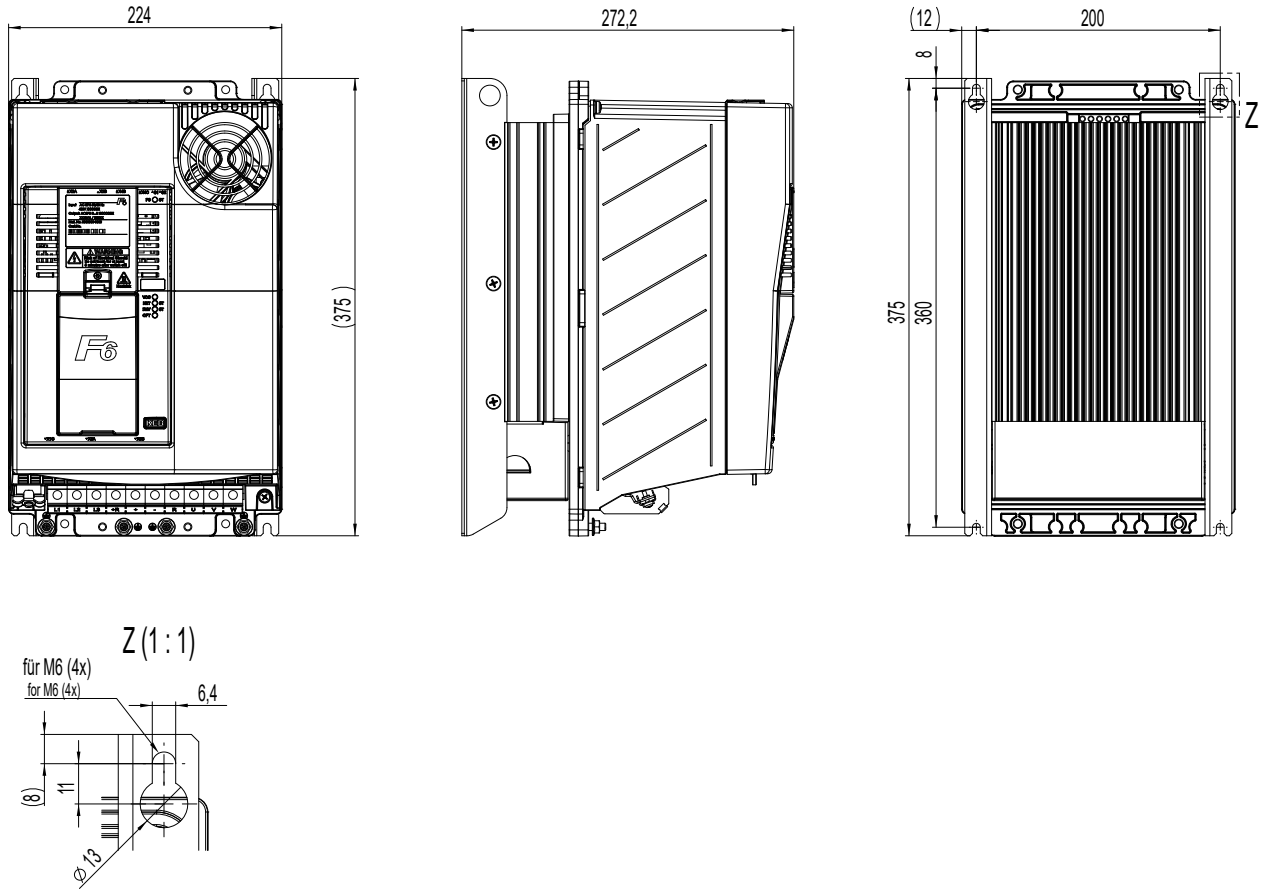
Fan		Heat sink	Interior
Switch-on temperature	*t* / °C	50	45
Maximum speed level	*t* / °C	60	55

Table 35: Switching points of the fans

4 Installation

4.1 Dimensions and weights

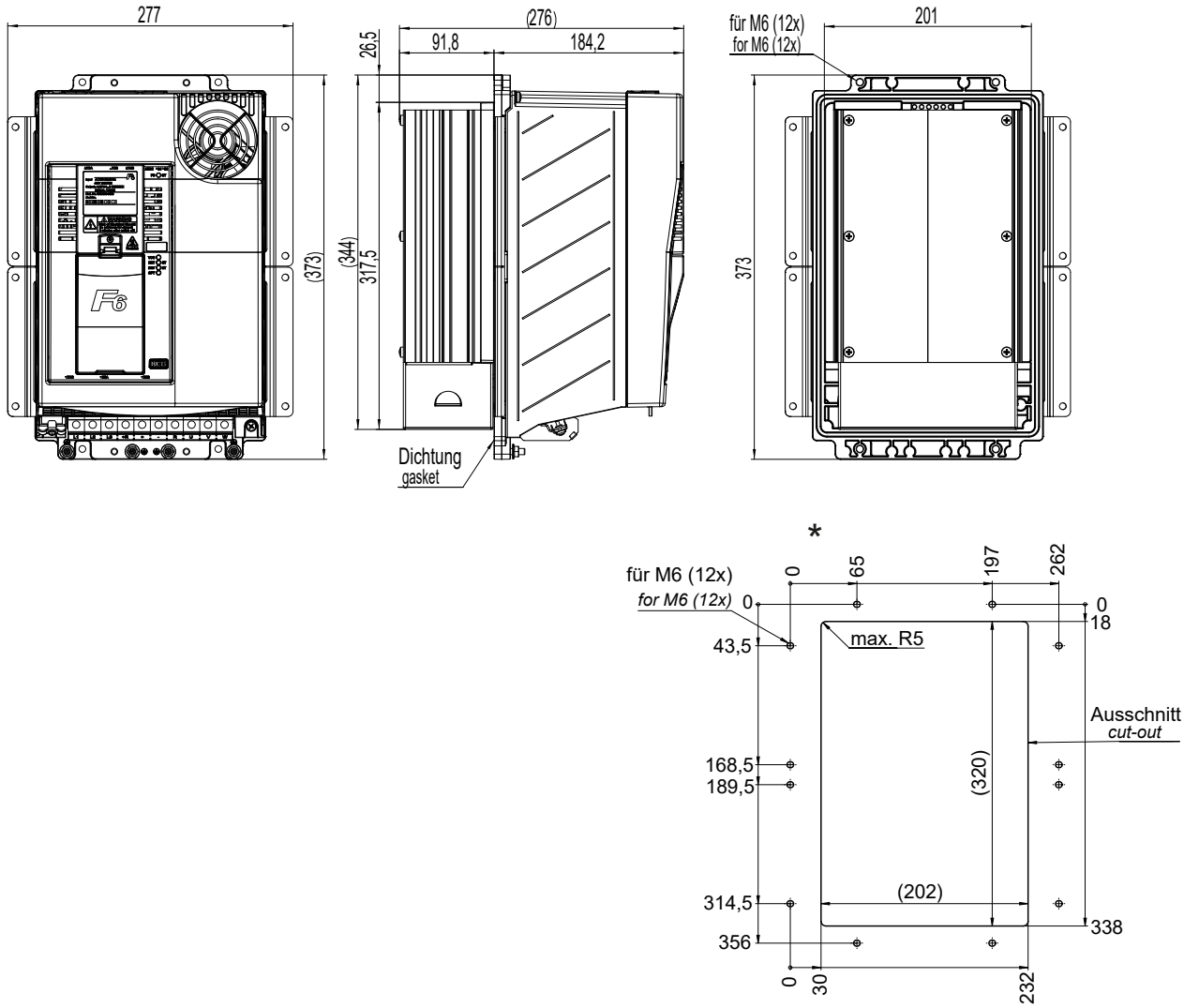
4.1.1 Built-in version air cooler



Housing	4
Weight	13.8 kg
Dimensions	All dimensions in mm

Figure 10: Dimensions built-in version air cooler

4.1.2 Push-through version air cooler IP20, IP54-ready



Housing	4
Weight	13.6 kg
*	Control cabinet cut-out
Dimensions	All dimensions in mm

Figure 11: Dimensions push-through version air cooler IP20, IP54-ready

4.2 Control cabinet installation

4.2.1 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 *ISO 4017* - M6 - 8.8	9 Nm 79 lb inch
Flat washer *ISO 7090* - 6 - 200 HV	–

Table 36: Mounting instructions for built-in version

Required material	Tightening torque
Hexagon head screw *ISO 4017* - M6 - 8.8	9 Nm 79 lb inch
Flat washer *ISO 7090* - 6 - 200 HV	–

Table 37: Fastening instructions for push-through version

NOTICE

Use of other fixing material

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

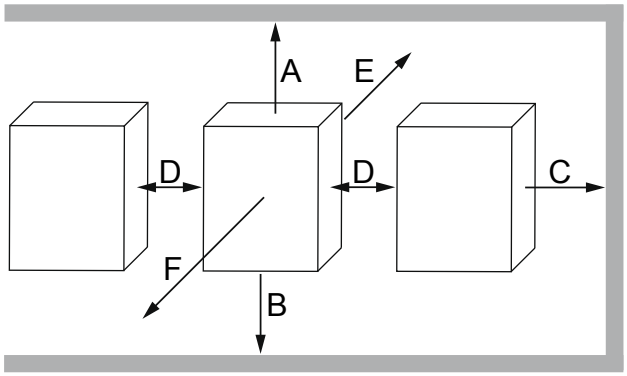
The use of other fixing materials is beyond the control of KEB and is therefore the sole responsibility of the customer.

4.2.2 Mounting distances

Power dissipation for control cabinet design => *„3.2.4 Power dissipation at rated operation of the 230 V peak power devices“*. A lower value can be used here depending on the operating mode/load.

Mounting the drive controller

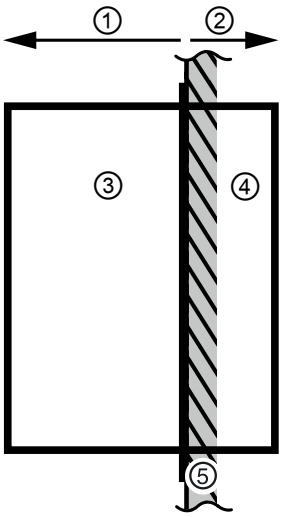
For reliable operation, the drive controller must be mounted without any distance on a smooth, closed, metallically bright mounting plate.

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 12: Mounting distances

4.2.3 Installation of IP54-ready devices



Legend	
1	IP20 zone inside the housing
2	IP54 zone outside the housing
3	Drive controller (power unit and control unit)
4	Drive controller (heat sink)
5	Housing (e.g. Control cabinet wall)

Figure 13: 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 (=> *„5.4.3 Seal 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.

In the case of fan-cooled units, the fans must be protected from negative environmental influences.

These include combustible, oily or dangerous fumes or gases, corrosive chemicals, coarse foreign bodies and excessive dust. This applies especially to the access of the heatsink from the top (air outlet).Icing is inadmissible.

UL: Device heat sink is classified as NEMA type 1

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“*.

NOTICE

Defect due to continuous splash water !

► Never expose the device to continuous splashing water (e.g. direct exposure to rain)!

4.2.4 Control cabinet ventilation

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

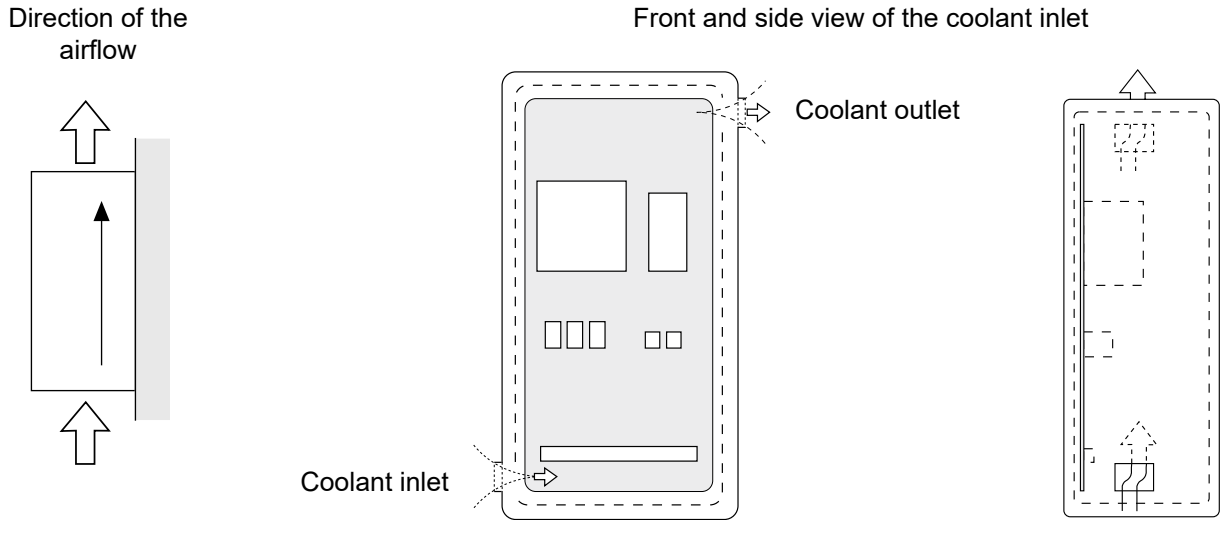
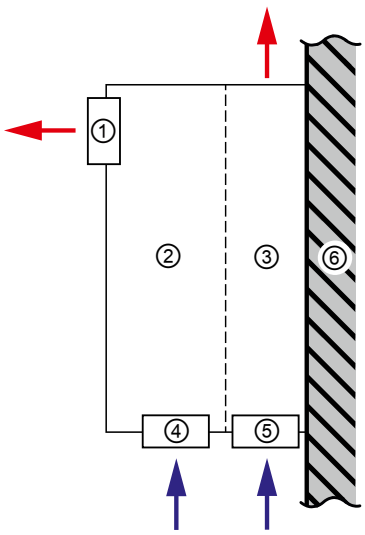


Figure 14: Control cabinet ventilation

4.2.5 Airflow of the drive converter

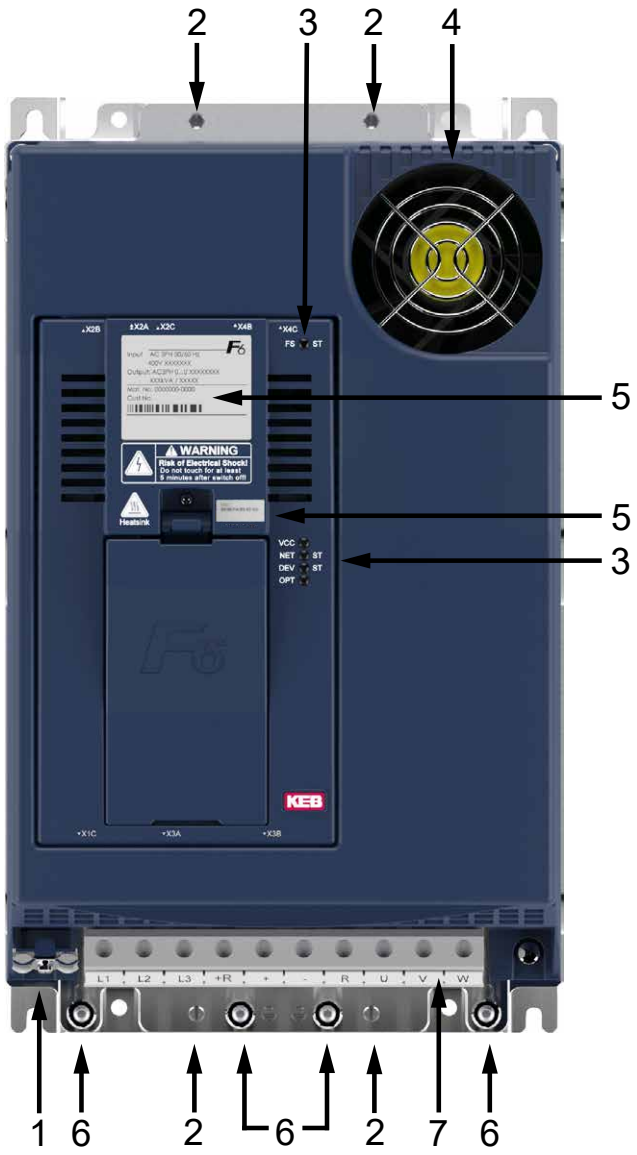


Legend	
→	Airflow direction
1	Interior fan (from housing 4)
2	Drive converter (power unnit and control)
3	Drive converter (heat sink)
4	Interior fan for (housing 2 and 3)
5	Heatsink fan
6	Housing (e.g. Control cabinet rear)

Figure 15: Airflow of the drive converter

5 Installation and connection

5.1 Overview of the COMBIVERT F6



Housing 4	No.	Name	Description
	1	–	Shield clamps for shielded control cables.
	2	–	Fixing points for optional shield connection bracket. The shielding, e.g. of the motor cable, is placed on the base plate in the control cabinet or on the optionally available shield connection bracket 00F6V80-4001.
	3	–	LEDs (=> 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
	4	–	Interior fan
	5	–	Nameplates
	6	PE	Protective earth; at connection to protective earth each terminal may be assigned only once.
	7	X1A	Power circuit terminals for: • Mains input • Braking resistor • DC supply • Motor connection

Figure 16: F6 housing 4 top view

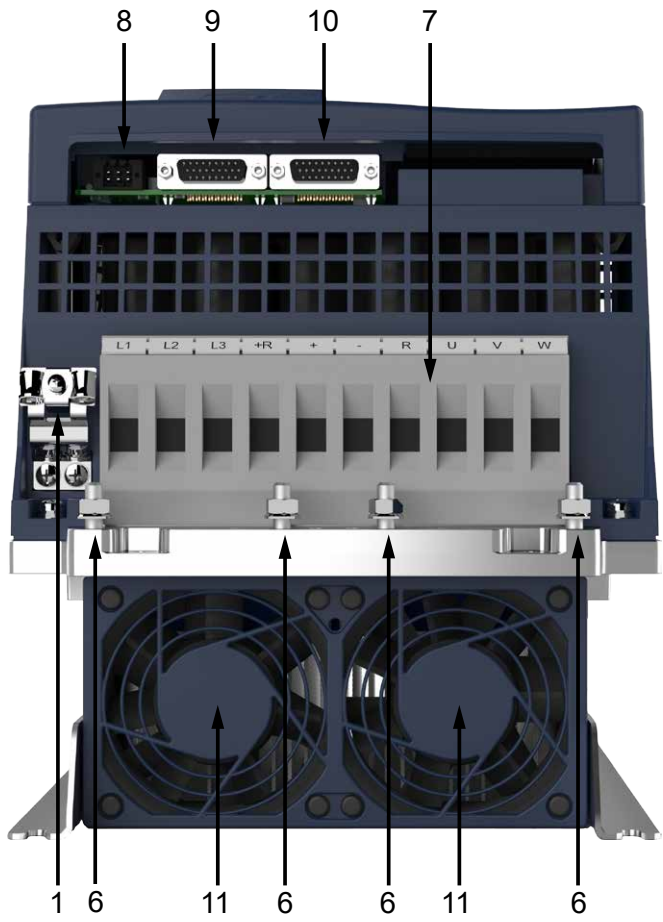
Housing 4	No.	Name	Description
	1	–	Shield clamps for shielded control cables.
	6	PE	Protective earth; at connection to protective earth each terminal may be assigned only once.
	7	X1A	Power circuit terminals for: • Mains input • Braking resistor • DC supply • Motor connection
	8	X1C	Terminal for: • Motor temperature monitoring • Brake control
	9	X3A	Encoder interface channel A
	10	X3B	Encoder interface channel B
	11	–	Heat sink fan

Figure 17: F6 housing 4 front view

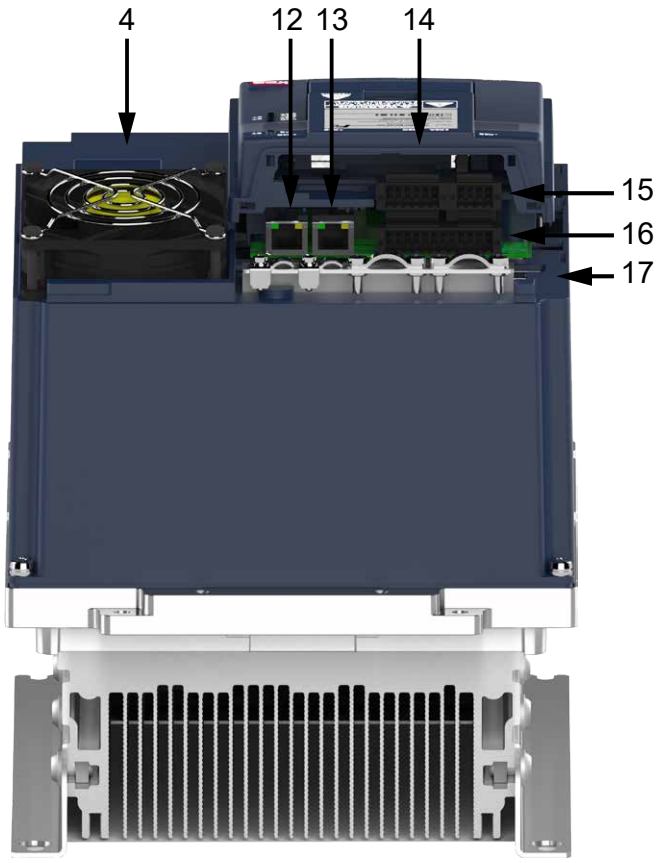
Housing 4	No.	Name	Description
	4	–	Interior fan
	12	X4C	Fieldbus interface (out)
	13	X4B	Fieldbus interface (in)
	14	X2C	Control terminal block for • CAN bus • Analog inputs and analog output
	15	X2B	Safety functions / 24 V DC voltage supply / 2 digital outputs
	16	X2A	Control terminal block for digital inputs and outputs.
	17	–	Shield clamps for shielded control cables.

Figure 18: F6 housing 4 rear view with control board COMPACT

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

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 APPLICATION
www.keb.de/fileadmin/media/Manuals/dr/ma_dr_f6-cu-a-inst-20118593_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

5.2 Connection of the power unit

NOTICE

Destruction of the drive controller!

► Never exchange mains input and motor output!

5.2.1 Connection of the voltage supply

The COMBIVERT F6 can be supplied via terminals L1, L2 and L3 (AC power supply) or via terminals + and - (DC power supply with inrush current limitation)

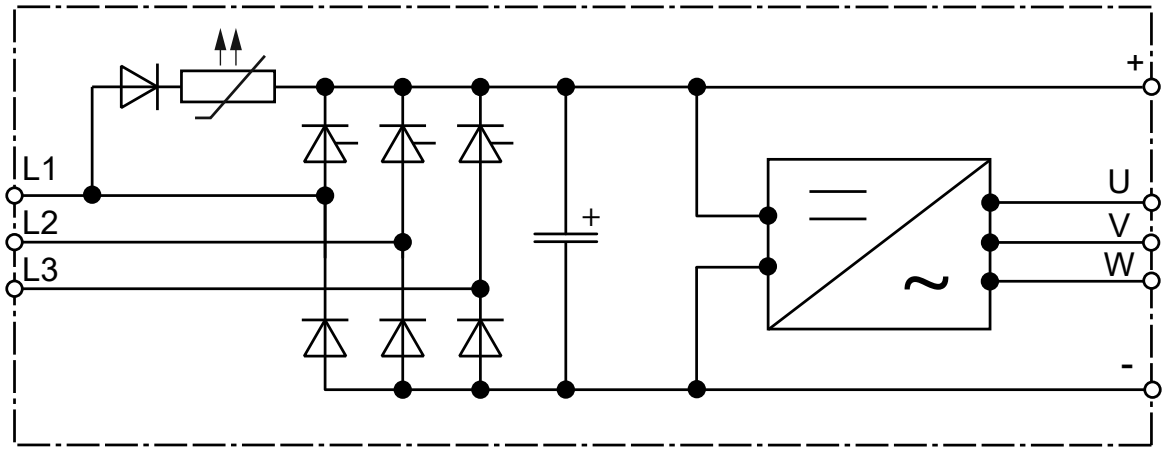


Figure 19: Input circuit

NOTICE

With AC power supply, observe the minimum waiting time between two switch-on procedures!

Cyclical switching off and on of the drive converter leads to temporary high impedance of the PTC precharging resistor. After the PTC precharging resistor has cooled down, it can be restarted without restrictions. The waiting time between two switch-on processes depends on the external capacitance, the AC mains voltage and the ambient temperature.

► Without external capacity: 5 min

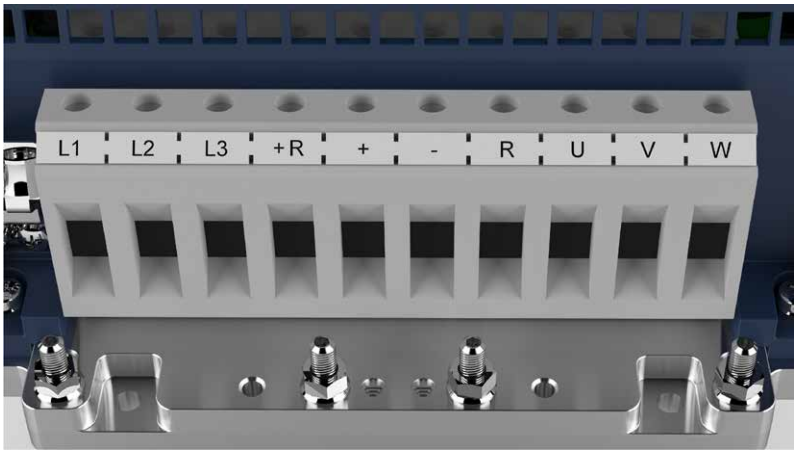
► With external capacity (additional drive converters): 20 min

NOTICE

No inrush current limitation with DC power supply!

► An external inrush current limiter must be provided for DC power supplies.

5.2.1.1 Terminal block X1A



Name	Function	Cross-section for terminal connection	Tightening torque	Max. number of conductors
L1	Mains connection 3-phase	Flexible cable with wire end ferrule 1.5...35 mm² (without wire end ferrule up to max. 50 mm²) For 2 conductors max. 16 mm² UL: Flexible cable without wire-end ferrule AWG 16...1	3.2...3.7 Nm 28...32 lb inch	For IEC: 2 For UL: 1
L2				
L3				
+R	Connection for braking resistor (between +R and R)			
+	DC terminals			
-				
R	Connection for braking resistor (between +R and R)			
U	Motor connection			
V				
W				

Figure 20: Terminal block X1A

5.2.2 Protective earth and functional earth

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

5.2.2.1 Protective earth

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

⚠ CAUTION

Electric shock due to incorrect dimensioning!

► Cross-section wire to ground should be selected according to *VDE 0100*!

Name	Function	Connection type	Tightening torque
PE, ⏚	Connection for protective earth	M6 threaded pin with nut for 6.5 mm crimp connectors	6.1...12 Nm 54...106 lb inch

Figure 21: Connection for protective earth

Incorrect installation of the PE connection

Only the M6 threaded pins with nut may be used to connect the protective earth!

5.2.2.2 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

5.3 Mains connection

5.3.1 Supply cable

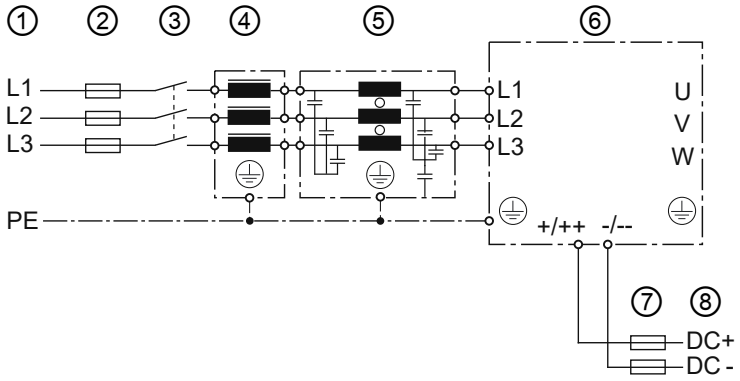
The conductor cross-section of the supply cable is determined by the following factors:

- Input current of the drive controller
- Used line type
- Installation and ambient temperatures
- The locally valid electrical regulations

The application engineer is responsible for the design!

5.3.2 AC mains connection

5.3.2.1 AC supply 3-phase



No.	Type	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, USA UL: 480 / 277 V. (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	see chapter “Protection of the drive controllers”	
3	Mains contactor	-	
4	Mains choke	see notes in chapter “Filters and chokes”	
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	Drive controller	COMBIVERT F6	
7	DC-fuses	See note in chapter „Fusing of the devices”.	
8	DC-supply	DC supply generated by the drive controller for connecting further drive controllers => *„5.3.3 DC mains connection“*	

Figure 22: Connection of the mains supply 3-phase

5.3.2.2 Note on hard power systems

The service life of drive controllers with voltage DC link depends on the DC voltage, ambient temperature and the current load of the electrolytic capacitors in the DC link. The use of mains chokes can increase the service life of the condensators to a considerable extent, especially when connecting to "hard“ power systems or when under permanent drive load (continuous duty).

The term "hard" power system means that the nodal point power (S_{Net}) of the mains is very high (>> 200) compared to the rated apparent output power of the drive controller (S_{out}).

$k = \frac{S_{Net}}{S_{out}} >> 200$	e.g.	$k = \frac{2\,MVA\ (supply\ transformer)}{62\,kVA\ (21F6)} = 33$	—>	no choke required

A listing of filters and chokes => *„5.4.1 Filters and chokes“*

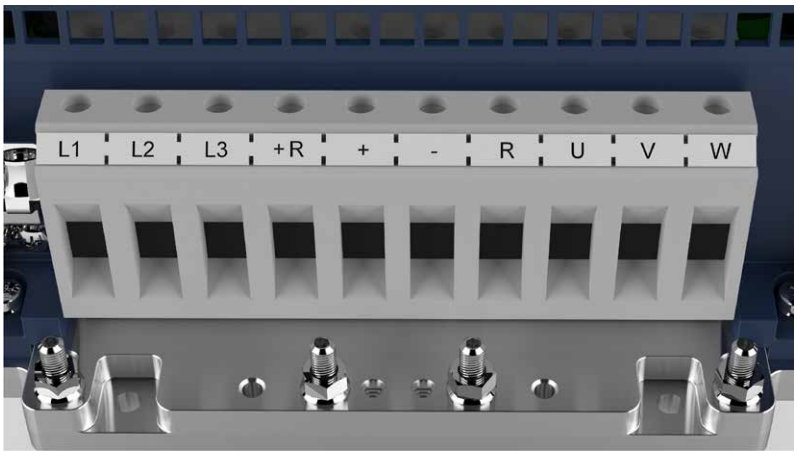
5.3.3 DC mains connection

NOTICE

DC operation

► The DC power supply of 230V devices is only permitted after consultation with KEB!

5.3.3.1 Terminal block X1A DC connection



Name	Function	Cross-section for terminal connection	Tightening torque	Max. number of conductors
+	DC terminals	Flexible cable with wire end ferrule 1.5...35 mm² (without wire end ferrule up to max. 50 mm²) For 2 conductors max. 16 mm² UL: Flexible cable without wire-end ferrule AWG 16...1	3.2...3.7 Nm 28...32 lb inch	For IEC: 2 For UL: 1
-				

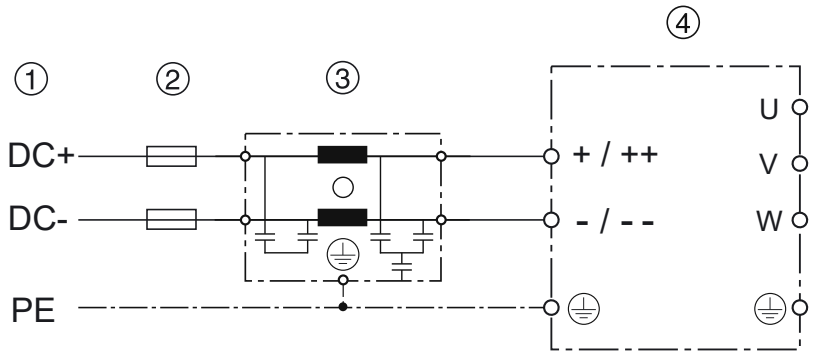
Figure 23: Terminal block X1A DC connection

5.3.3.2 Connection at DC voltage supply

NOTICE

Destruction of the drive controller!

► Never exchange “+ / ++” and “- / --”!

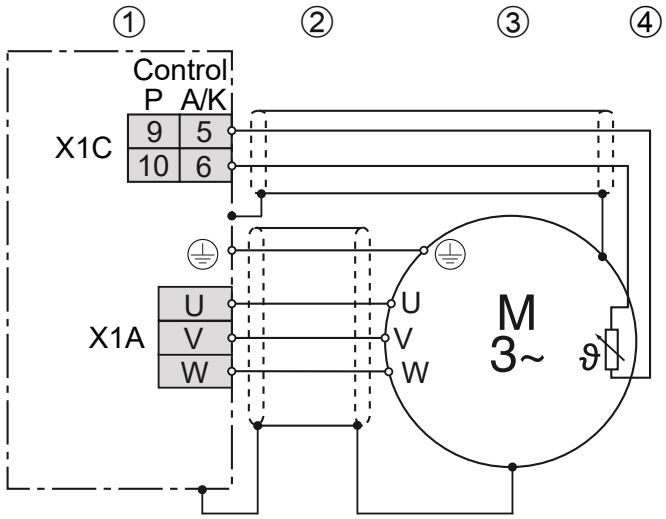


No.	Type	Description
1	Mains connection	2-phase
2	DC mains fuses	See note in chapter “Fuse protection for DC-supply”
3	HF-Filter	Type aR
4	Drive controller	COMBIVERT F6

Figure 24: Connection at DC voltage supply

5.3.4 Connection of the motor

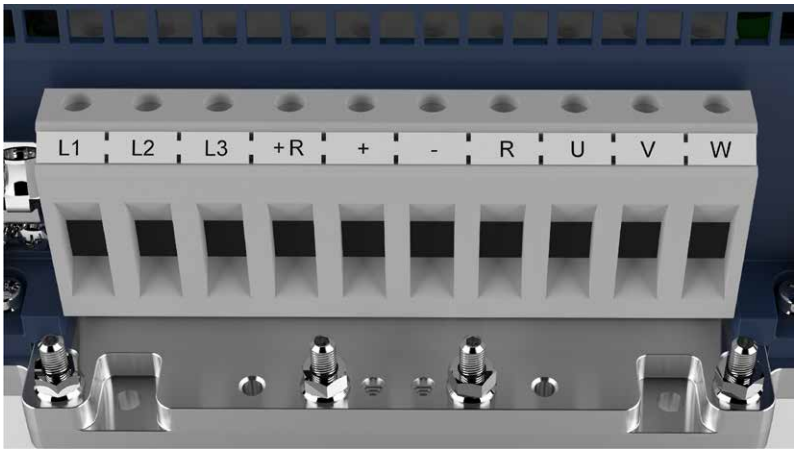
5.3.4.1 Wiring of the motor



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) => *Instructions for use "Control circuit"*

Figure 25: Wiring of the motor

5.3.4.2 Terminal block X1A motor connection



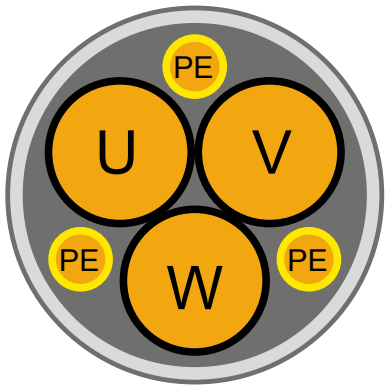
Name	Function	Cross-section for terminal connection	Tightening torque	Max. number of conductors
U	Motor connection	Flexible cable with wire end ferrule 1.5...35 mm² (without wire end ferrule up to max. 50 mm²) For 2 conductors max. 16 mm² UL: Flexible cable without wire-end ferrule AWG 16...1	3.2...3.7 Nm 28...32 lb inch	For IEC: 2 For UL: 1
V				
W				

Figure 26: Terminal block X1A motor connection

5.3.4.3 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 (*„5.3.4.4 Motor cable length and conducted interferences at AC supply“*)
- 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

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

Further information on the motor cable length can be found in the corresponding filter instructions.

5.3.4.5 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:

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

5.3.4.6 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 cable.
- on the ambient conditions such as bundling and temperature.

5.3.4.7 Interconnection of the motor

NOTICE

Incorrect behavior of the motor!

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

NOTICE

Protect motor against voltage peaks!

► Drive controllers 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.

5.3.4.8 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 dependending 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 pn12 = 7) => *Programming manual*

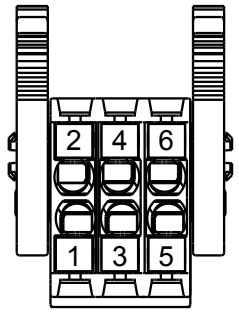
X1C	PIN	Name	Description
	1	BR+	Brake control / output +
	2	BR-	Brake control / output -
	3	reserved	–
	4	reserved	–
	5	TA1	Temperature detection / output +
	6	TA2	Temperature detection / output -

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

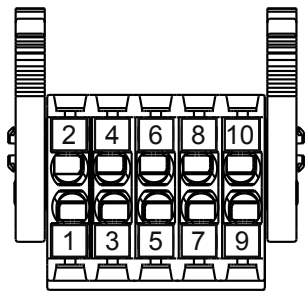
X1C	PIN	Name	Description
	1	BR+	Brake control / output +
	2	BR-	Brake control / output -
	3	0V	For supply of the checkback inputs
	4	24Vout	
	5	DIBR1	Checkback input 1 for brake and relay
	6	DIBR2	Checkback input 2 for brake and relay
	7	reserved	–
	8	reserved	–
	9	TA1	Temperature detection / output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

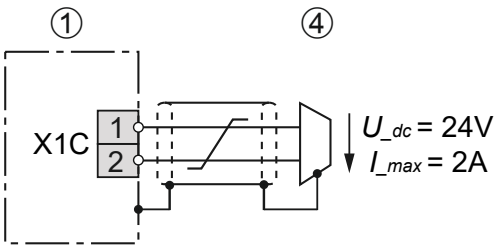
Figure 29: Terminal block X1C for control board PRO

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.



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.

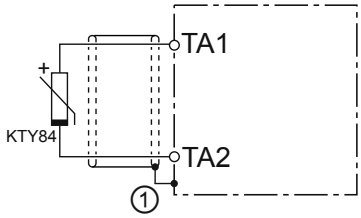
For control board PRO

The brake can be supplied with both, internal and external voltage. Voltage tolerances and output currents vary for internal and external voltage supply..

Respect the specifications
=> *instruction manual „control board“*

1	COMBIVERT
4	Brake

Figure 30: Connection of the brake control



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.

1	Connection via shield plate (if not available, place on the mounting plate).

Figure 31: Connection of a KTY sensor

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.

Further information about the wiring of the temperature monitoring and the brake control have to be observed in the respective control unit manual.

5.3.5 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 vale has fallen below the minimum brake resistance value!

► The minimum brake resistance value must not fall below!
„3.3 Device data of the 400 V peak power devices“

⚠ CAUTION

Hot surfaces caused by load of the braking resistor!

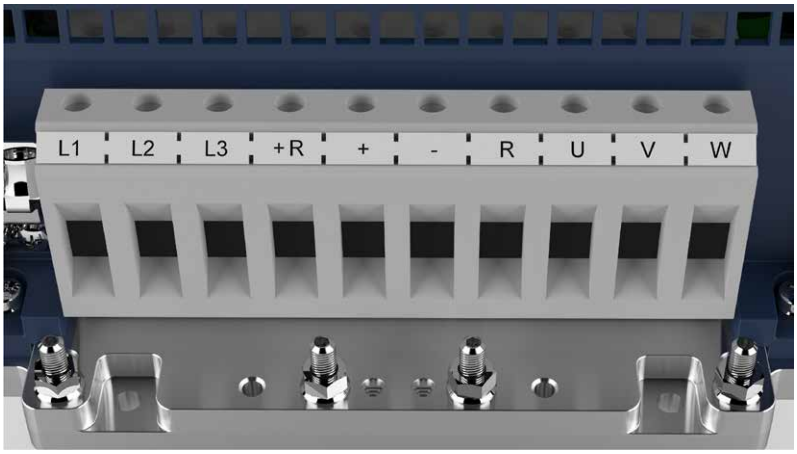
Burning of the skin!

► Cover hot surfaces safe-to-touch.

► Before touching, check the surface.

► If necessary, attach warning signs on the system.

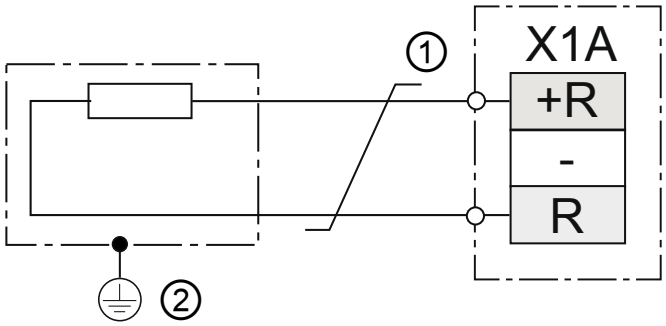
5.3.5.1 Terminal block X1A connection braking resistor



Name	Function	Cross-section for terminal connection	Tightening torque	Max. number of conductors
+R	Connection for braking resistor (between +R and R)	Flexible cable with wire end ferrule 1.5...35 mm² (without wire end ferrule up to max. 50 mm²) For 2 conductors max. 16 mm² UL: Flexible cable without wire-end ferrule AWG 16...1	3.2...3.7 Nm 28...32 lb inch	For IEC: 2 For UL: 1
R				

Figure 32: Terminal block X1A connection braking resistor

5.3.5.2 Use of intrinsically safe braking resistors



Legend	
1	Twist the connection cable. When extending the connection cables, the cables must be shielded additionally and connected on both sides.
2	Protective earthing is provided via the housing.

Figure 33: Use of intrinsically safe braking resistors

Intrinsically safe braking resisitors behave in error case such as a safety fuse. They interrupt themselves without fire risk.

More information about intrinsically safe braking resistors

www.keb.de/fileadmin/media/Manuals/dr/ma_dr_safe-braking- resistors-20106652_en.pdf

5.3.5.3 Use of a non-intrinsically safe braking resistor

⚠ 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 faults on the drive converter (e.g. external input).
- ► Switch off input voltage (e.g. input contactor).
- ► Connection examples for non-intrinsically safe braking resistors
- ► => *Instructions for use "Installation braking resistors“*

Instructions for use "Installation braking resistors“

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

5.3.6 DC-bus connection

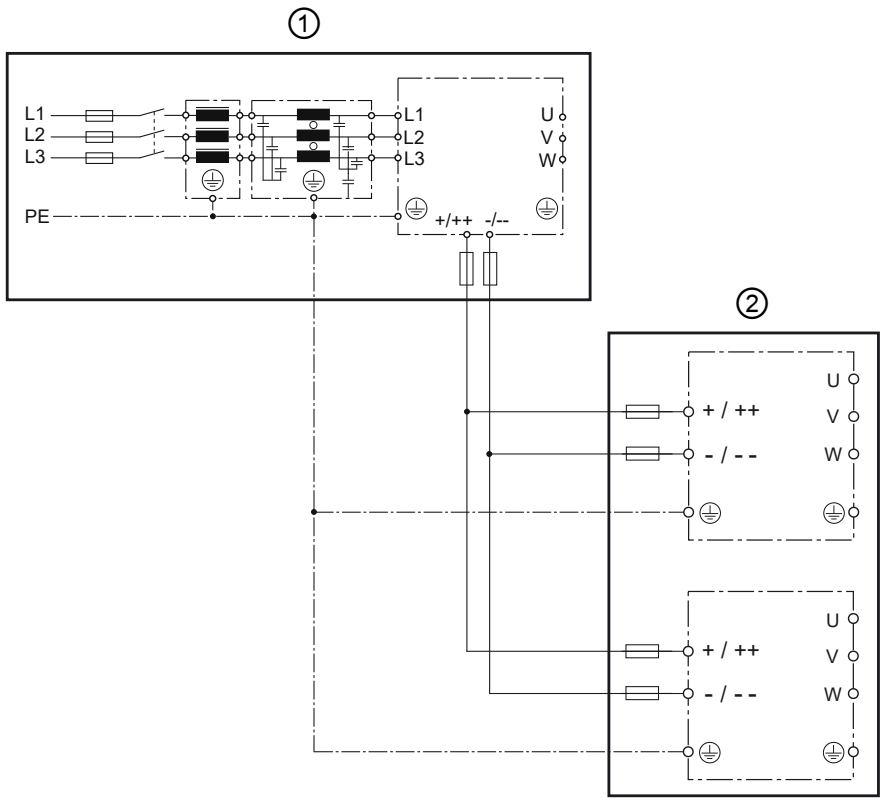
The DC link of several drive controllers are coupled in a DC-bus connection. This enables energy to be exchanged between the devices and increases the energy efficiency of the application.

As part of a DC-bus connection, this drive controller can either be supplied via the DC terminals => *„5.3.3 DC mains connection“* or supply other drive controllers via the DC terminals => *„5.3.2 AC mains connection“.*

KEB drive converters meet the requirements of the EMC product standard EN IEC 61800-3 for DC power supplies. Due to the large number of possible interconnection options in the DC network, the user is responsible for ensuring the conformity of the overall system.

The following additional safety instructions must be observed when using this drive controller in a DC-bus connection:

- This drive controller may only be operated together with other F6 and S6 drive controllers of the 400V class in a DC-bus connection.
- This drive controller must be installed in an enclosure.
- This drive controller must be protected with fuses at the DC terminals => *„3.3.6.2 Fuse protection for DC supply“.*
- If one fuse in the DC-bus connection blows as a result of a short circuit, all fuses in the DC-bus connection should be replaced due to the risk of prior damage.
- The parameterisation of the input phase failure detection must be adapted => F6 Programming manual.



Legend	
1	Drive controller for supplying further drive controllers
2	Other drive controllers connected to the DC-bus connection

Figure 34: DC-bus connection

① When using this drive controller to supply other drive controllers via the DC terminals, the following must also be observed:

- The maximum prechargeable total capacity (internal capacity + external capacity) must not be exceeded => *„3.4.2.2 DC link / braking transistor function of the 400 V peak power devices“.*
- The minimum waiting time between two precharging procedures must be observed => *„5.2.1 Connection of the voltage supply“.*
- Drive controllers supplied via the DC terminals must not be loaded during precharging.
- Overloading of the rectifier must be prevented by the user => *„3.3.4 Overview of rectifier data for 400 V devices“.*

② When supplying this drive controller via the DC terminals, the following must also be observed:

- The drive controller must be pre-charged by the supplying drive controller or an external pre-charging module.

5.4 Accessories

5.4.1 Filters and chokes

Voltage class	Drive controller size	HF filter	Mains choke 50 Hz / 4 % U_k
230 V	16	20E6T60-3000	16Z1B03-1000

Table 38: Filters and chokes for 230 V devices

Voltage class	Drive controller size	HF filter	Mains choke 50 Hz / 4 % U_k
400 V	18	18E6T60-3000	18Z1B04-1000
	19	20E6T60-3000	19Z1B04-1000

Table 39: Filters and chokes for 400 V devices

The specified filters and chokes are designed for rated operation.

5.4.2 Shield connection bracket mounting kit

Name	Material number
Shield connection bracket mounting kit	00F6V80-4001

Table 40: Shield connection bracket mounting kit

5.4.3 Seal IP54-ready devices

Name	Material number
Seal IP54	40F6T45-0004

Table 41: Seal for IP54-ready devices

5.4.4 Side-mounted braking resistors

Technical data and design about intrinsically safe braking resistors => *https://www.keb.de/fileadmin/media/Manuals/dr/ma_dr_safe-braking-resistors-20106652_en.pdf*

Technical data and design about non-intrinsically safe braking resistors => *https://www.keb.de/fileadmin/media/Manuals/dr/ma_dr_braking-resistors-20116737_en.pdf*

6 Certification

6.1 CE marking

The drive controllers marked with a CE logo meet the requirements of the Machinery Directive, the EMC and Rohs Directive and the energy efficiency regulation.

For further information regarding the CE declarations of conformity
=> *„6.3 Further informations and documentation“*

6.2 UL certification

c UL us	Acceptance according to UL is marked on the nameplate of KEB drive converters by the adjacent logo.	UL file number E167544

For conformity in accordance with UL for use on the North American and Canadian markets, the following additional instructions must be observed (English original text):

- All models: Maximum Surrounding Air Temperature: 45°C
- Use 75°C Copper Conductors Only
- Models 18F6, 19F6 and 20F6: Suitable For Use On A Circuit Capable Of Delivering Not More Than 5000 rms Symmetrical Amperes, 480 Volts Maximum when protected by Class J Fuses, see instruction manual for Branch Circuit Protection details.

  All models: Suitable For Use On A Circuit Capable Of Delivering Not More Than 30000 rms Symmetrical Amperes, 480 Volts Maximum when protected by Semiconductor Fuses by SIBA, Type 20 189 20, or by EATON, Type 170M1368, or by motor controller, see instruction manual for Branch Circuit Protection details.

  When DC supplied:

  Suitable For Use On A Circuit Capable Of Delivering Not More Than 50000 rms Symmetrical Amperes, 680 Volts DC Maximum when protected by Semiconductor Fuses as Specified in the Manual.

  CSA: For Canada, this marking shall be provided on the device or on a separate label shipped with the device.

  Details of the prescribed Branch Circuit Protection as specified in the below section ‘Branch Circuit Protection’ of this Report need to be marked in the instruction manual.
- 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.

  CSA: For Canada: Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the Canadian Electrical Code, Part I”
- For installations according to Canadian National Standard C22.2 No. 274-13:

  For use in Pollution Degree 2 and Overvoltage Category III environments only.
- Control Circuit Overcurrent Protection Required or equivalent.
- WARNING – The opening of the branch circuit protective device may be an indication that a fault current has been interrupted. To reduce the risk of fire or electrical shock, current-carrying parts and other components of the controller should be examined and replaced if damaged. If burnout of the current element of an overload relay occurs, the complete overload relay must be replaced.

- Internal Overload Protection Operates prior to reaching the 130% of the Motor Full Load Current, see manual for adjustment instructions or equivalent wording.
- External break resistor ratings and duty cycle:
  - Duty cycle 50%
  - Max. 60 sec on-time, (60 sec off-time)
- Internal break resistor ratings and duty cycle:
  - Duty cycle 0.79%
  - Max. 0.95 sec on-time, (119.05 sec off-time)

6.3 Further informations and documentation

You find supplementary manuals and instructions for the download under *www.keb-automation.com/search*

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

Other markings and approvals not listed here are identified by a corresponding logo on the rating plate or device, if applicable. The corresponding certificates are available on our website.

Others

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

7 Revision history

Version	Date	Description
00	2024-05	Pre-series version of the manual created.
01	2024-08	Adding of the 230 V devices
02	2025-07	UL text updated. Information on motor protection switches and circuit breakers added. Added description of 400 V DC-ready devices.

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