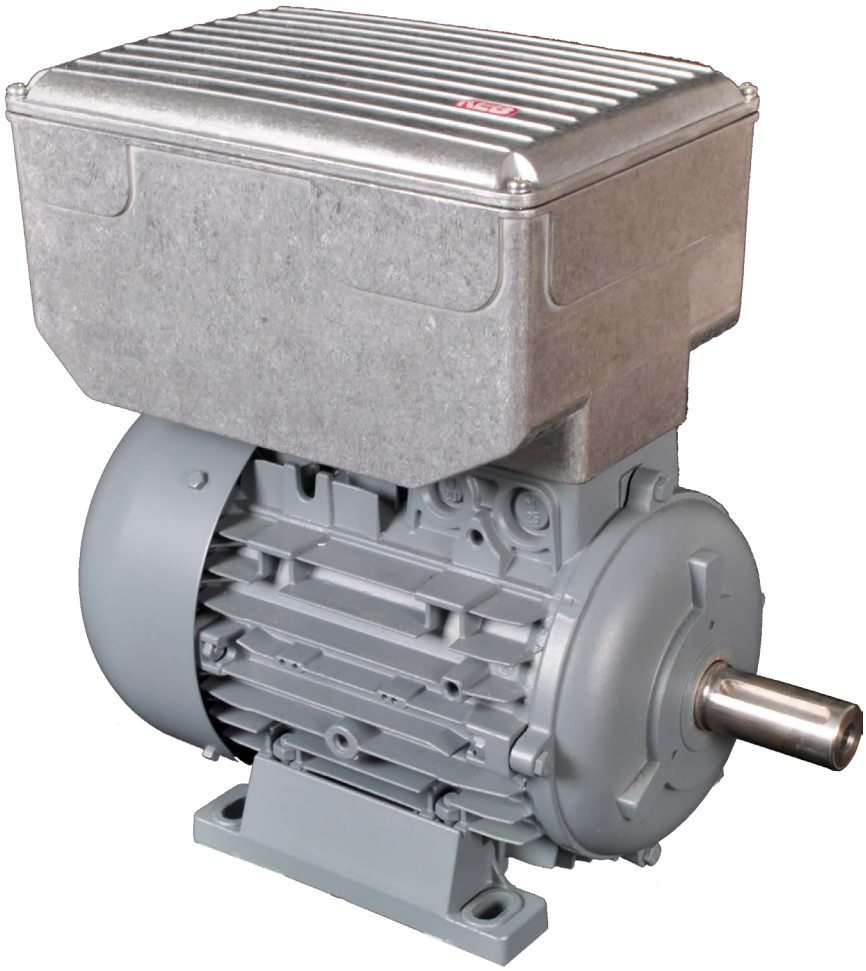


COMBIVERT **G6M**

INSTRUCTIONS FOR USE | **INSTALLATION MOTOR INVERTER**

Translation of the original manual
Document 20167946 EN 00

Preface

The described hard- and software are developments of the KEB Automation KG. The enclosed documents correspond to conditions valid at printing. Misprint, mistakes and technical changes reserved.

Signal words and symbols

Certain operations can cause hazards during the installation, operation or thereafter. There are safety informations in the documentation in front of these operations. Security signs are located on the device or machine. A warning contains signal words which are explained in the following table:

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

RESTRICTION

Is used when certain conditions must meet the validity of statements or the result is limited to a certain validity range.

Is used when the result will be better, more economic or trouble-free by following these procedures.

More symbols

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

Note to further documentation.
www.keb.de/nc/search

Laws and guidelines

KEB Automation KG confirms with the EC declaration of conformity with the CE mark on the unit name plate, that the device complies with the essential safety requirements.

The EC declaration of conformity can be downloaded on demand via our website. Further information is provided in chapter "Certification".

Warranty

The warranty on design, material or workmanship for the acquired device is given in the current terms and conditions.

Here you will find our current terms and conditions.
www.keb.de/terms-and-conditions

Further agreements or specifications require a written confirmation.

Support

Through multiple applications not every imaginable case has been taken into account. If you require further information or if problems occur which are not treated detailed in the documentation, you can request the necessary information via the local KEB Automation KG agency.

The use of our units in the target products is beyond of our control and therefore exclusively the responsibility of the machine manufacturer, system integrator or 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 application. However, they are considered for information only without responsibility. This also applies to any violation of industrial property rights of a third-party.

Selection of our units in view of their suitability for the intended use must be done generally by the user.

Tests can only be done within the application by the machine manufacturer. They must be repeated, even if only parts of hardware, software or the unit adjustment are modified.

Copyright

Table of Contents

List of Figures

List of Tables

Glossary

0V	Earth-potential-free common point
1ph	1-phase mains
3ph	3-phase mains
AC	AC current or voltage
AFE	Active Front End
AFE filter	Filter for the AFE device
ASCL	Asynchronous sensorless closed loop
Auto motor ident.	Automatically motor identification; calibration of resistance and inductance
AW heat exchanger	Air-water heat exchanger
AWG	American wire gauge
B2B	Business-to-business
BiSS	Open source real-time interface for sensors and actuators (DIN 5008)
CAN	Fieldbus system
COMBIVERT	KEB drive converters
COMBIVIS	KEB start-up and parameterizing software
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
EMC	Electromagnetic compatibility
Emergency stop	Shutdown of a drive in emergency case (not de-energized)
Emergency switching off	Switching off the voltage supply in emergency case
EN	European standard
Encoder emulation	Software-generated encoder output
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 converter
GND	Reference potential, ground
GTR7	Braking transistor
HF filter	High frequency filter to the mains
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
I^2t-monitoring	Software function for thermal monitoring of the motor winding
IEC	International standard
IP xx	Degree of protection (xx for level)
KTY	Silicium temperature sensor (polarized)
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
NN	Sea level
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)
PA	Potential equalization
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
Port	Part of a network address to the assignment of TCP and UDP connections
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	Safety Extra Low Voltage (< 60 V)
SF filter	Sine-wave filter

SIL	The security integrity level is a measure for quantifying the risk reduction. Term used in the safety technology (EN 61508 -1...7).
SS1	Safety function „Safe stop 1“ in accordance with IEC 61800-5-2
SSI	Synchronous serial interface for encoder
STO	Safety function „Safe Torque Off“ in accordance with IEC 61800-5-2
TTL	Incremental signal with an output voltage up to 5 V
USB	Universal serial bus
VARAN	Real-time Ethernet bus system

Standards for drive converters / control cabinets

Product standards that apply directly to the drive converter

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 EN 61800-5-1 with „National Deviations“

Basic standards to which drive converter standards refer directly

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

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

Standards that are used in the environment of the drive converter

EN 60204-1	Safety of machinery - electrical equipment of machines Part 1: General requirements (VDE 0113-1, IEC 44/709/CDV)
DIN IEC 60364-5-54	Low-voltage electrical installations - Part 5-54: Selection and erection of electrical equipment - Earthing arrangements, protective conductors and protective bonding conductors (IEC 64/1610/CD)
DIN VDE 0100-729	Low-voltage electrical installations - Part 7-729: Requirements for special installations or locations - Operating or maintenance gangways (IEC 60364-7-729:2007, modified); German implementation HD 60364-7-729:2009
EN 1037	Safety of machinery - Prevention of unexpected start-up; German version EN 1037
EN 61439-1	Low-voltage switchgear and controlgear assemblies - Part 1: General rules (IEC 121B/40/CDV); German version FprEN 61439-1
EN 61373	Railway applications - Rolling stock equipment - Shock and vibration tests (IEC 61373); German version EN 61373
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
DGUV regulation 3	Electrical installations and equipment
DIN 46228-1	Wire-end ferrules; Tube without plastic sleeve
DIN 46228-4	Wire-end ferrules; Tube with plastic sleeve

1 Basic Safety Instructions

The COMBIVERT is designed and constructed in accordance with state-of-the-art technology and the recognised safety rules and regulations. However, the use of such devices may cause functional hazards for life and limb of the user or third parties, or damages to the system and other material property.

The following safety instructions have been created by the manufacturer for the area of electric drive technology. They can be supplemented by local, country- or application-specific safety instructions. This list is not exhaustive. Non-observance will lead to the loss of any liability claims.

NOTICE

Hazards and risks through ignorance.

► Read the instruction manual!

► Observe the safety and warning instructions!

► If anything is unclear, please contact KEB Automation KG!

1.1 Target group

This instruction manual is determined exclusively for electrical personnel. Electrical personnel for the purpose of this instruction manual must have the following qualifications:

- Knowledge and understanding of the safety instructions.
- Skills for installation and assembly.
- Start-up and operation of the product.
- Understanding of the function in the used machine.
- Detection of hazards and risks of the electrical drive technology.
- Knowledge of *DIN IEC 60364-5-54*.
- Knowledge of national safety regulations (e.g. *DGUV regulation 3*).

1.2 Transport, storage and proper use

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

Transport of drive converters with an edge length >75 cm

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

► Transport of drive converters on suitable pallets.

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

Drive converters contain electrostatic sensitive components.

► Avoid contact.

► Wear ESD-protective clothing.

Do not store drive converters

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

1.3 Installation

⚠ DANGER

Do not operate in an explosive environment!

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

⚠ CAUTION

Design-related edges and high weight!

Contusions and bruises!

► Never stand under suspended loads.

► Wear safety shoes.

► Secure drive converter accordingly when using lifting gear.

To prevent damages to the device:

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

1.4 Electrical connection

⚠ DANGER

Voltage at the terminals and in the device!

Danger to life due to electric shock !

- ► Never work on the open device or never touch exposed parts.
- ► For any work on the unit switch off the supply voltage and secure it against switching on.
- ► Wait until the drive has stopped in order, that perhaps regenerative energy can be generated.
- ► Await capacitor discharge time (5 minutes) if necessary, measure DC voltage at the terminals.
- ► If personal protection is required, install suitable protective devices for drive converters.
- ► Never bridge upstream protective devices (also not for test purposes).
- ► Connect the protective earth conductor to drive converter and motor everytime.
- ► Install all required covers and protective devices for operation.
- ► The control cabinet shall be kept closed during operation.

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 accordly to the specified minimum / maximum values for the opperation.
- Drive converters are only intended for permanent connection. Cross-sections of protective earth conductors should be interpreted in accordance with *DIN IEC 60364-5-54*..
- Connection of the drive converter is only permissible on symmetrical networks with a maximum line voltage (L1, L2, L3) with respect to earth (N/PE) of max. 300 V. An isolating transformer must be used for supply networks which exceed this value. In case of non-compliance the control is not longer considered as "PELV circuit".
- With existing or newly wired circuits the person installing the units or machines must ensure the EN requirements are met.
- For drive converters that are not isolated from the supply circuit (in accordance with *EN 61800-5-1*) all control lines must be included in other protective measures (e.g. double insulation or shielded, earthed and insulated).
- When using components without isolated inputs/outputs, it is necessary that equipotential bonding exists between the components to be connected (e.g. by the equipotential line). Disregard can cause destruction of the components by equalizing currents.

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

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

Installations which include drive converter shall be equipped with additional control and protective devices in accordance with the relevant applicable safety requirements, e.g. act respecting technical equipment, accident prevention rules etc. They must always be complied with, also for drive converter bearing a CE marking.

1.4.1 EMC-compatible installation

Observance of the limit values required by EMC law is the responsibility of the manufacturer of the installation or machine.

Notes on EMC-compatible installation can be found here.

https://www.keb.de/fileadmin/media/Manuals/emv/0000neb0000.pdf

1.4.2 Voltage test

Testing with AC voltage (in accordance with *EN 60204-1* Chapter 18.4) may not be executed, since there is danger for the power semiconductors in the drive converter.

Because of the noise suppression capacitors the test generator will immediately trigger with current error.

Accordng to *EN 60204-1* it is permissible to disconnect already tested components. Drive converters of the KEB Automation KG are delivered ex works voltage tested to 100% according to product standard.

1.4.3 Insulation measurement

An insulation measurement (in accordance with *EN 60204-1* chapter 18.3) with DC 500 V is permissible, if all power unit connections (grid-connected potential) and all control connections are bridged with PE. At any unit it can be expected with an insulating resistance > 5 MΩ!

1.5 Start-up and operation

The drive converter must not be started until it is determined that the installation complies with the machine directive; Account is to be taken of *EN 60204-1*.

⚠ WARNING

Software protection and programming!

Hazards caused by unintentional behavior of the drive!

- ► Check especially during initial start-up or replacement of the drive converter if parameterization is compatible to application.
- ► Securing a unit solely with software-supported functions is not sufficient. It is imperative to install external protective measures (e.g. limit switch) that are independent of the drive converter.
- ► Secure motors against automatic restart.

⚠ CAUTION

High temperatures at heat sink and coolant!

Burning of the skin!

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

Observe the following instructions if the drive converter for more than one year was not in operation before start-up.
https://www.keb.de/fileadmin/media/Manuals/knowledge/04_techinfo/00_general/ti_format_capacitors_0400_0001_gbr.pdf

Switching at the output

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

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

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

Switching on the input

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

Short-circuit proof

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.

► Clean drive converter from dirt and dust deposits. Pay attention especially to cooling fins and protective grid of the fans.

► Examine and clean extracted air filter and cooling air filter of the control cabinet.

► Check the function of the fans of the drive converter. The fan must be replaced in case of audible vibrations or squeak.

► Make a visual leak test of the cooling circuit for water-cooled inverters.

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 converter is dependent on its parameterization. Never replace without knowledge of the application.

► Modification or repair is permitted only by KEB Automation KG authorized personnel.

► Only use original manufacturer parts.

► Infringement will annul the liability for resulting consequences.

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

1.8 Disposal

Drive converters with safety function are limited to a service life of 20 years. Then the devices must be replaced.

Drive converters of the KEB Automation KG are professional, electronic devices exclusively for further industrial processing (so-called B2B devices). Thus the marking does not occur with the symbol of the crossed-out wheeled bin, but by the word mark and the date of manufacture.

Unlike devices mainly used in private households, these devices may not be disposed at the collection centres of public sector disposal organisations. They must be disposed after the end of use in accordance with national applicable law to environmentally correct disposal of electrical and electronic equipment.

2 Product description

The unit series G6M concerns to drive converters, which are optimized for open loop operation at controlled three-phase AC drives.

The COMBIVERT G6M is specially designed for the installation at the motor. The units are equipped with an integrated EMC filter. This instruction manual describes only the power unit.

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

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

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

2.1 Specified application

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

Technical data and information for connection conditions shall be taken from the type plate and from the instruction manual 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 KEB COMBIVERT F5 is used in machines, which work under exceptional conditions or if essential functions, life-supporting measures or an extraordinary safety step must be fulfilled, the necessary reliability and security must be ensured by the machine builder.

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 unit. 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

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

Unit type:	Motor inverter
Series:	COMBIVERT G6M
Power range:	0,75...1,5 kW @ 230 V / 0,75...2,2 kW @ 400 V
Housing size:	M

The COMBIVERT COMBIVERT G6M is characterized by the following features:

- Operation at controlled three-phase AC drives.
- Internal filter
- following fieldbus systems are supported: Analog / Digital, EtherCAT, VARAN, PROFINET, IO-Link oder CAN
- low switching losses by IGBT power unit
- COMBIVERT 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, diagnostic interface, fieldbus interface

2.4 Part code

x x G 6 x x x - x x x x		
	Optionen[1]	0: Standard A: Brake control
	Control, keyboard, Display[1]	A: G6L-G Open-loop without keyboard/display 0: G6-G Open-loop without keyboard/display 1: G6-G Open-loop with keyboard/display
	Switching frequency; short time current limit; overcurrent cut-off	9: 4 kHz / 180% / 216% A: 8 kHz / 180% / 216%
	Voltage / Connection type[1]	0: 1ph 230 V AC/DC 3: 3ph 400 V AC/DC A-Z: Customer-/special version (firmware,hardware, download)
	Housing	M
	Variants	3: internal filter, with braking transistor, without safety function STO
	Control type	C: Analog/digital (standard) D: CAN® [2] E: IO-Link® [3] F: EtherCAT® [4] H: reserved I: VARAN
	Series	COMBIVERT G6
	Inverter size	07, 09, 10

Table 1: Part code

[1] *Not valid at customer/special version*

[2] *CANopen® is registered trademark of CAN in AUTOMATION - International Users and Manufacturers Group e.V.*

[3] *IO-LINK® is registered trademark of PROFIBUS user organisation e.V.*

[4] *EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany*

3 Technical Data

3.1 Operating conditions

3.1.1 Climatic conditions

Storage		**Standard**	**Class**	**Note**
Surrounding 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 aboce sea level
Transport		**Standard**	**Class**	**Note**
Surrounding temperature		*EN 60721-3-2*	2K3	-25…70 °C
Relative humidity		*EN 60721-3-2*	2K3	95 % bei 40 °C (without condition)
Operation		**Standard**	**Class**	**Note**
Surrounding temperature		*EN 60721-3-3*	3K3	5…40 °C (extended to -10…45 °C) With temperature over 45°C to max. 55°C a derating of 5 % per 1 K must be taken into consideration.
Coolant inlet temperature	Air	–	–	5…40 °C (-10…45 °C)
	Water	–	–	5…40 °C
Relative humidity		*EN 60721-3-3*	3K3	5…85 % (without condensation)
Version and degree of protection		*EN 60529*	IP54	Protection against dust in hazardous quantities Protection against splash water on all sides Non-conductive pollution, occasional condensation when PDS is out of service. The degree of protection is obtained if the mounting in the final application is correctly executed by the customer
Site altitude		–	–	max. 2000 m above sea level • Ab 1000 m ist eine Leistungsreduzierung von 1 % pro 100 m zu berücksichtigen. • Ab 2000 m hat die Steuerkarte zum Netz nur noch Basisisolation. Additional measures must be carried out when wiring the control system.

Table 2: Climatic conditions

3.1.2 Mechanical ambient conditions

Storage	**Standard**	**Class**	**Note**
Vibration limits	*EN 60721-3-1*	1M1	Amplitude of a vibration 0,3 mm (2…9 Hz) Acceleration 1 m/s² (9…200 Hz)
Shock limit values	*EN 60721-3-1*	1M1	40 m/s²; 22 ms
Transport	**Standard**	**Class**	**Note**
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))*
Shock limit values	*EN 60721-3-2*	2M1	100 m/s²; 11 ms
Operation	**Standard**	**Class**	**Note**
Vibration limits	*EN 60721-3-3*	3M4	Vibration amplitude 3.5 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 ambient conditions

**Not tested*

3.1.3 Chemical/mechanical active substances

Storage		**Standard**	**Class**	**Note**
Contamination	Gases	*EN 60721-3-1*	1C2	–
	Solids		1S2	–
Transport		**Standard**	**Class**	**Note**
Contamination	Gases	*EN 60721-3-2*	2C2	–
	Solids		2S2	–
Operation		**Standard**	**Class**	**Note**
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 Equipment classification

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

Table 5: Equipment classification

3.1.4.2 Electromagnetic compatibility

The specified values are only valid for devices with mains choke

EMC emitted interference	Standard	Class	Note
Cable-based interferences	*EN 61800-3*	C1/C2	–
Radiated interferences	*EN 61800-3*	C2	–
Interference immunity	**Standard**	**Level**	**Note**
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*	1 kV	–
Burst - Power ports	*EN 61000-4-4*	2 kV	–
Surge - Power ports	*EN 61000-4-5*	1 kV 2 kV	Phase-phase Phase-ground
Immunity to conducted disturbances, induced by radio-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 14...2 GHz 2...2.7 GHz
Voltage variation / voltage drop	*EN 61000-2-1* *EN 61000-4-34*	–	-15 %...+10 % 90 %
frequency changes	*EN 61000-2-4*	–	≤ 2 %
Voltage deviations	*EN 61000-2-4*	–	±10 %
Voltage unbalance	*EN 61000-2-4*	–	≤ 3 %

Table 6: Electromagnetic compatibility

3.2 Unit data of the 230V units

3.2.1 Overview

Inverter size			**07**	**09***
Housing size			**M**	
Output rated power		S_{out} / kVA	1,6	2,8
Max. rated motor power		P_{mot} / kW	0,75	1,5
Input rated voltage		U_{N_ac} / V	230 (UL: 240)	
Input voltage range		U_{IN_ac} / V	195...264	
Phases			1	
Mains frequency		f_N / Hz	50 / 60 ±2	
Input rated current @ U_{N_ac} = 230V		I_{IN} / A	8	14
Input rated current @ U_{N_ac} = 240V		I_{IN_UL} / A	8	14
Output voltage	5)	U_{out} / V	0...Uin respectively (Uindc / √2)	
Output frequency	2)	f_{out} / Hz	0...400 (f_{SN}=4kHz) 0...599 (f_{SN}=8kHz)	
Output phases			3	
Output rated current @ U_{N_ac} = 230V		I_N / A	4	7
Output rated current @ U_{N_ac} = 240V		I_{IN_UL} / A	4,1	6,8
Short time current limit	1)	I_{HSR} / %	180	
Over current	1)	I_{OC} / %	216	
Rated switching frequency	2)	f_{SN} / kHz	8	4
Max. switching frequency	2)	f_{Smax} / kHz	8	
Corner frequency		f_d / Hz	6	
Power loss at nominal operating	3)	P_D / W	45	63
Power dissipation at Standby (noP)	3)	P_{D_nop} / W	8	
Maximum current 0Hz / 6Hz at f_S=4 kHz	1)	I_{Max_Out} / %	100 / 180	100 / 180
Maximum current 0Hz / 6Hz at f_S=8 kHz	1)	I_{Max_Out} / %	100 / 180	100 / 150
Max. heat sink temperature		T_{HS} / C°	90	
Temperature for derating the switching frequency	4)	T_{dr} / C°	85	
Temperature for uprating the switching frequency	4)	T_{ur} / C°	80	
Max. braking current		I_{B_max} / A	7,5	
Min. brake resistance value		R_{B_min} / Ω	56	
DC switch-off level „Error! Under potential“		U_{UP} / V	216	
DC switch-off level „Error! Over potential“		U_{OP} / V	400	
Insulating resistance		R / MΩ	10	
Max. permissible main fuse type gG		A	20	

Table 7: Overview of the 230 V unit data

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

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

3) Rated operation corresponds U_{N_ac}= 230V, , rated switching frequency, output frequency = 50 Hz.

4) On reaching the temperature Tdr the switching frequency is step down. . The switching frequency is increased again on cooling down to temperature Tur.

5) The voltage at the motor is dependent on the series-connected units and on the control method

** Only upon request*

3.3 Unit data of the 400V units

3.3.1 Overview

Inverter size			**07**	**09**	**10**
Housing size				**M**	
Output rated power		S_{out} / kVA	1,8	2,8	4
Max. rated motor power		P_{mot} / kW	0,75	1,5	2,2
Input rated voltage		U_{N_ac} / V	400 (UL: 480)		
Input voltage range		U_{IN_ac} / V	305...528		
Phases			3		
Mains frequency		f_N / Hz	50 / 60 ±2		
Rated input current @ U_{N_ac} = 400V		I_{IN} / A	3,6	6	8
Rated input current @ U_{N_ac} = 480V		I_{IN_UL} / A	2,5	4,8	7
Output voltage		U_{out} / V	0...Uin respectively (Uindc / √2)		
Output frequency	2)	f_{out} / Hz	0...400 (f_{SN}=4kHz) 0...599 (f_{SN}=8kHz)		
Output phases			3		
Output rated current @ U_{N_ac} = 400V		I_N / A	2,6	4,1	5,8
Output rated current @ U_{N_ac} = 480V		I_{IN_UL} / A	1,8	3,4	4,8
Short time current limit	1)	I_{HSR} / %	180		
Over current	1)	I_{OC} / %	216		
Rated switching frequency	2)	f_{SN} / kHz	8	4	4
Max. switching frequency	2)	f_{Smax} / kHz	8		
Corner frequency		f_d / Hz	6		
Power loss at nominal operating	3)	P_D / W	45	49	70
Power dissipation at Standby (noP)	3)	P_{D_nop} / W	10		
Maximum current 0Hz/6Hz at f_S=4 kHz	1)	I_{Max_Out} / %	100 / 180	100 / 180	100 / 180
Maximum current 0Hz/6Hz at f_S=8 kHz	1)	I_{Max_Out} / %	100 / 180	100 / 150	85 / 150
Max. heat sink temperature		T_{HS} / C°	90		
Temperature for derating the switching frequency	4)	T_{dr} / C°	85		
Temperature for uprating the switching frequency	4)	T_{ur} / C°	80		
Max. braking current		I_{B_max} / A	7		
Min. brake resistance value		R_{B_min} / Ω	120		
DC switch-off level „Error! Under potential“		U_{UP} / V	240		
DC switch-off level „Error! Over potential“		U_{OP} / V	840		
Insulating resistance		R / MΩ	10		
Max. permissible main fuse type gG		A	16		

Table 8: Overview of the 400V unit data

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

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

3) Rated operation corresponds U_{N_ac}= 230V, , rated switching frequency, output frequency = 50 Hz.

4) On reaching the temperature Tdr the switching frequency is step down. . The switching frequency is increased again on cooling down to temperature Tur.

5) The voltage at the motor is dependent on the series-connected units and on the control method

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

The service life of the frequency inverter with intermediate voltage circuit depends on the current load of the electrolytic capacitors in the intermediate circuit. 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). For continuous duty (S1) drives with a medium duty of >60%, KEB provided the use of mains chokes with a terminal voltage (Uk) of 4%. The term "hard" power system means that the nodal point power (S_{Net}) of the mains is very high (>> 200) compared to the output rated power of the inverter (S_{out}).

3.4 Maximum load and derating depending on the switching frequency

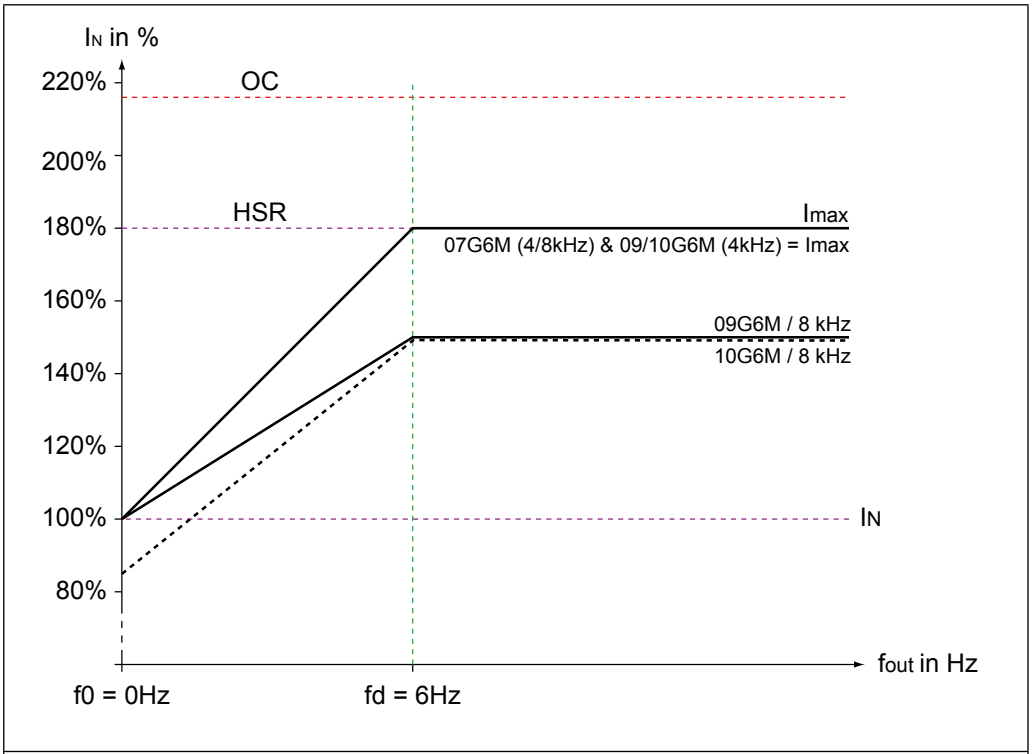


Figure 1: Maximum load and derating depending on the switching frequency

3.5 Overload characteristic

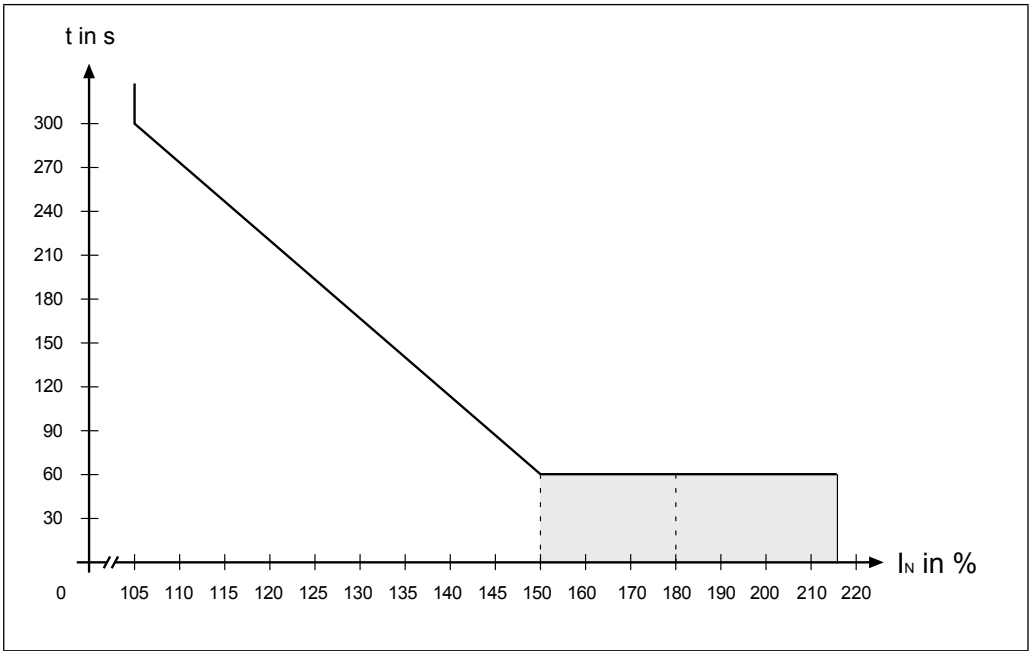
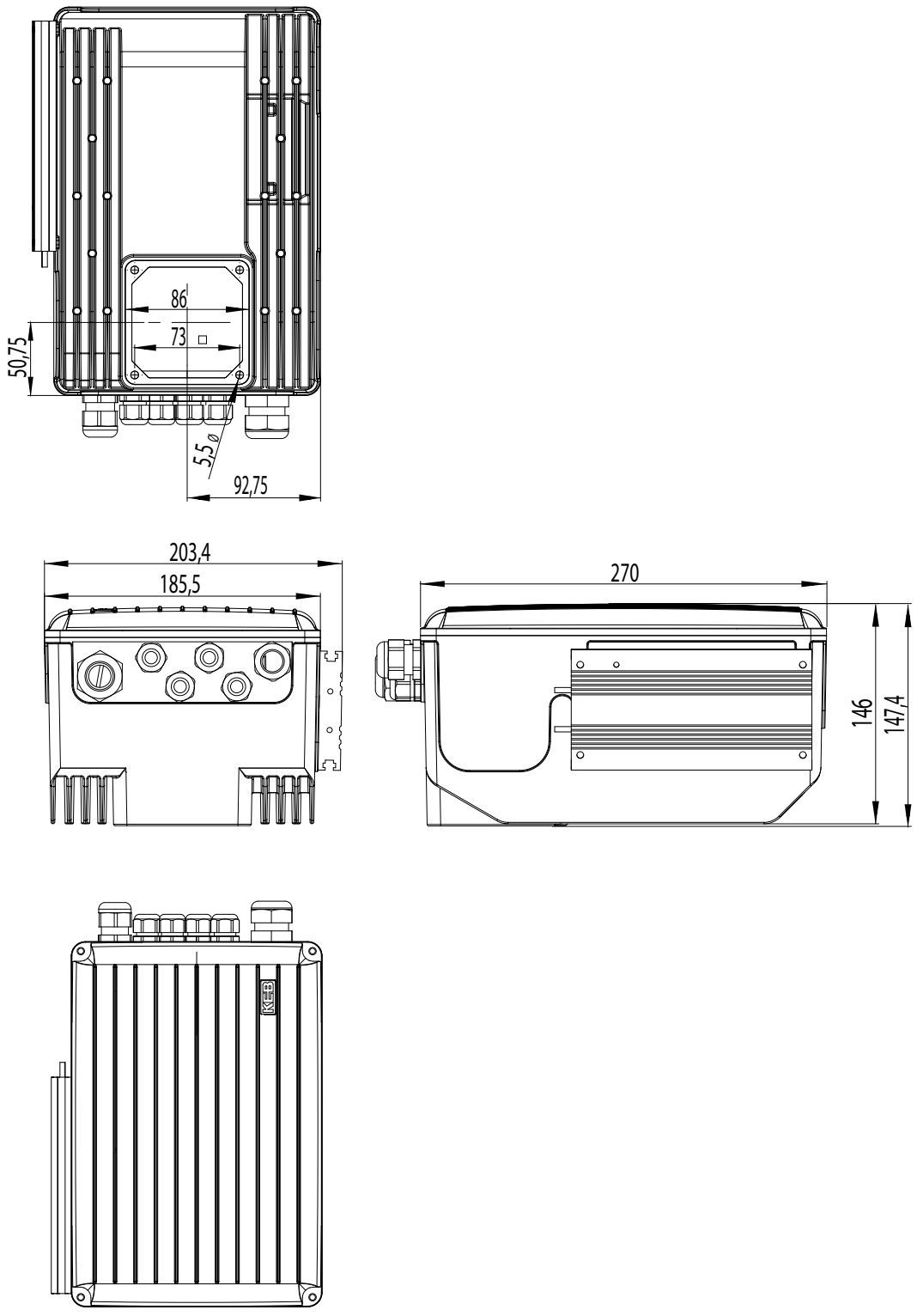


Figure 2: Overload characteristic

On exceeding a load of 105% the overload integrator starts. When falling below the integrator counts backwards. If the integrator achieves the overload characteristic that corresponds to the inverter, the „ERROR ! overload“ is triggered..

3.6 Mechanical Installation

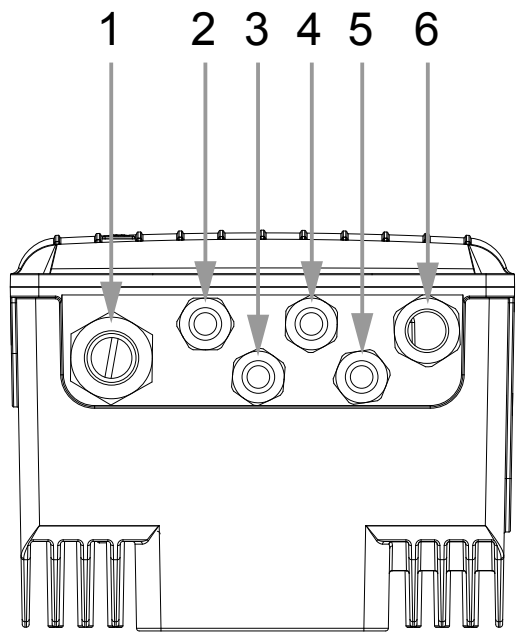
3.6.1 Dimensions and weight with braking resistor



Weight in kg	5,0

Figure 3: Dimension and weights of the G6M

3.6.2 Dimensions of the PG cable glands



No.	Thread sizes
1	M25 x 1.5
2	M16 x 1.5
3	M16 x 1.5
4	M16 x 1.5
5	M16 x 1.5
6	M20 x 1.5

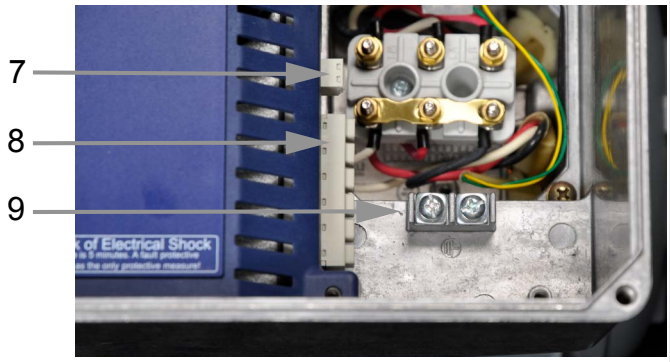
Figure 4: Overview of the PG cable glands

4 Installation and Connection

4.1 Overview of the COMBIVERT G6M

No.	Name	Description
1	X4A	Diagnostic interface; RS232/485 interface with DIN66019-II
2	X2B	reserved
3	X1A	Mains input 3-phase (400 VAC) / mains input 1-phase (230 VAC)
4	X2A	Control terminal strip 32-pole
5	–	Type plate
6	LED1	Inverter state (if without keyboard/display)

Figure 5: Overview of the COMBIVERT G6M



No.	Name	Description
7	X1C	Temperature monitoring; Connection for external PTC or temperature switch
8	X1B	Terminal block for three-phase motor and braking resistor
9	PE, ⏚	Protective earth; at connection to protective earth each terminal may be assigned only once.

Figure 6: Top view at the bottom right without shield plate

4.2 Connection of the Power Unit

Attention

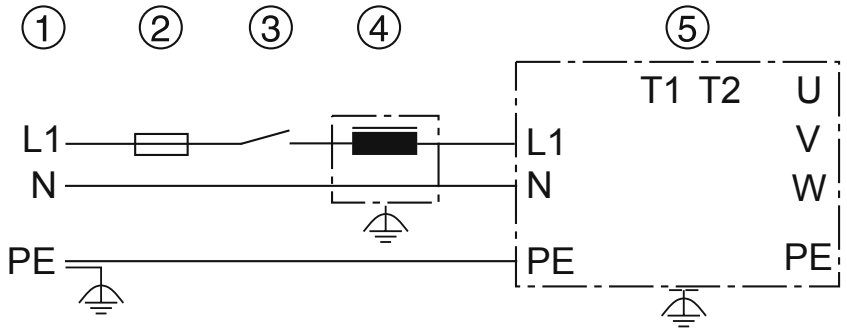
Destruction of the drive converter!

► Never exchange mains input and motor output!

The terminal strips meet the requirements on IEC 60947-7-1

Some countries demand that the PE-terminal is directly connected to the terminal box (not over the mounting plate).

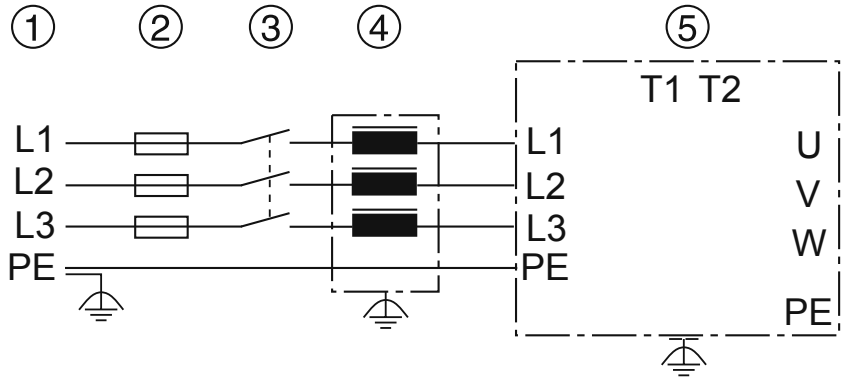
4.2.1 AC supply 230V / 1-phase



No.	Type	Description	
1	Mains voltage	1-phase 230 VAC	
	Mains form	TN, TT	IT
	Personal protection	RCMA with separator or RCD type B	Earth leakage monitor
2	Main fuses	Type gG or MCCB	
3	Mains contactor	-	-
4	Mains choke	07Z1B02-1000 or 09Z1B02-1000	
5	KEB COMBIVERT	G6	

Figure 7: Connection of the mains supply 230 VAC / 1-phase

4.2.2 AC supply 400V / 3-phase



No.	Type	Description	
1	Mains voltage	3-phase 400 VAC	
	Mains form	TN, TT	IT
	Personal protection (if required)	RCMA with separator or RCD type B	Earth leakage monitor
2	Main fuses	Type gG or MCCB	
3	Mains contactor	-	-
4	Mains choke (optional)	07Z1B02-1000, 09Z1B02-1000 or 10Z1B04-1000	
5	KEB COMBIVERT		

Figure 8: Connection of the mains supply 400 VAC / 3-phase

4.2.3 Line terminal strip X1A

X1A	Name	Function	Cross-section	Tightening torque
	L1, N	Mains connection 1-phase	0.2…2.5 mm² AWG 24...12	0.5…0.6 A 5…7 lb-inch
	L1, L2, L3	Mains connection 3-phase	0.2…2.5 mm² AWG 24...12	0.5…0.6 A 5…7 lb-inch
	PE, ⏚	Connection for protective earth	Screw M4	1.3 Nm 11 lb-inch

Figure 9: Line terminal strip X1A

4.2.4 Cross-section of the supply cable

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

- • input current of the drive converter
- • used cable type / installation and ambient temperatures
- • Applicable local electrical regulations

The application engineer is responsible for the design!

4.3 Connection of the motor

The following steps must be observed if the inverter is not pre-installed on a motor.

4.3.1 Motor cable cross-section

The cable cross-section of the motor cable depends on the real effective value of the motor current, the line length, the type of the used cable (observe the manufacturer's specifications) as well as the ambient conditions such as bundling and temperature. Also observe the electrical regulations applicable for the operation site.

4.3.2 Connection of the motor

Attention

Incorrect behavior of the motor!

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

Attention

Protect motor against voltage peaks!

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

4.3.3 Terminal strip X1B motor connection

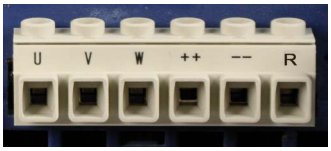
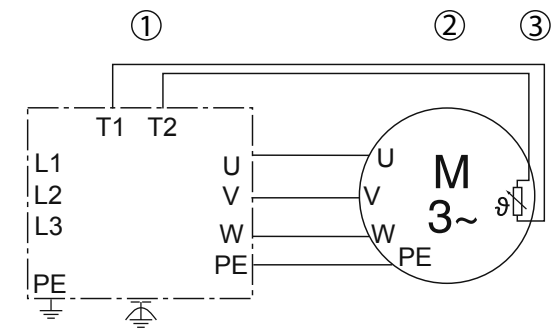
X1B	Name	Function	Cross-section	Tightening torque
	U, V, W	Motor connection	0.2...2.5 mm² AWG 24...12	0.5…0.6 A 5…7 lb-inch
	PE, ⏚	Connection for protective earth	Screw M4	1.3 Nm 11 lb-inch

Figure 10: Terminal block X1B

4.3.4 Wiring of the motor



Legend	
1	KEB COMBIVERT
2	Three-phase motor
3	Temperature monitoring (optional) see chapter „Temperature detection"

Figure 11: Wiring of the motor

4.4 Connection of a braking resistor

Attention

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!

⚠ CAUTION

Hot surfaces caused by load of the braking resistor!

Burning of the skin!

► Cover hot surfaces safe-to-touch.

► Before touching, check the surface.

► If necessary, attach warning signs on the system.

4.4.1 Terminal strip X1B connection braking resistor

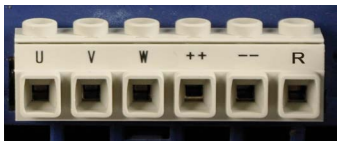
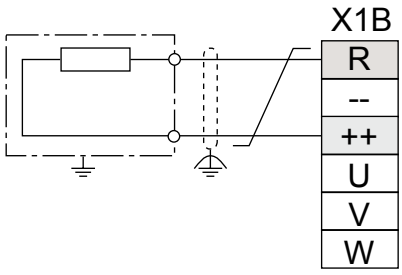
X1B	Name	Function	Cross-section	Tightening torque
	++, R	Connection for braking resistor (alternatively ++, PB)	0.2...2.5 mm² AWG 24...12	0.5…0.6 A 5…7 lb-inch
	– –	DC link –		
	PE, ⏚	Connection for protective earth	Screw M4	1.3 Nm 11 lb-inch

Figure 12: Terminal block X1B

4.4.2 Wiring of an intrinsically safe braking resistor



Only "intrinsically safe" braking resistors are permissible for this operation, since these resistors interrupt themselves at fault such as safety fuse without fire risk. Further information can be found in the instruction manual for G6 braking resistors.

Figure 13: Wiring of an intrinsically safe braking resistor

4.5 Connection of a brake (optional and only for 400V units)

4.5.1 Brake control card

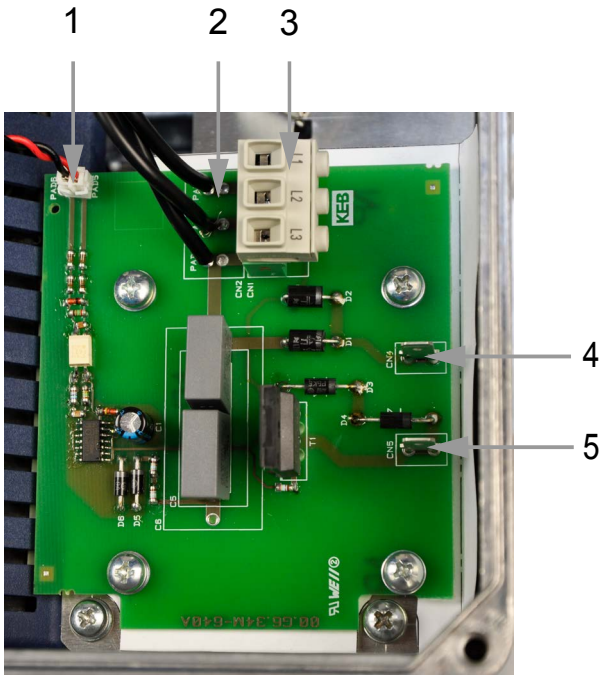
Overview of the brake control card	No.	Name	Description
	1	X2C	Connection of the control lines
	2	X1E	Output terminal / cable for the three mains phases
	3	X1D	Input terminal for the three mains phases
	4	HB +	+ Connection for the brake
	5	HB -	- Connection for the brake

Figure 14: Brake control card

4.5.2 Wiring of the brake control card to the inverter

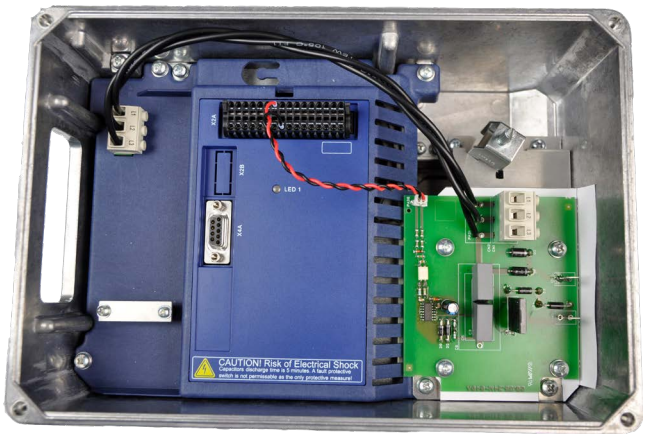
Overview for wiring of the brake control card	Description
	The three mains phases are connected to input terminal X1D of the brake control card. The three mains phases must be connected from terminal X1E of the brake control card to terminal X1A of the frequency inverter. The control lines must be connected from the inverter terminal X2A pin 14, 15 to the terminal block X2C of the brake control card. The brake must be connected to terminals HB+ and HB-.

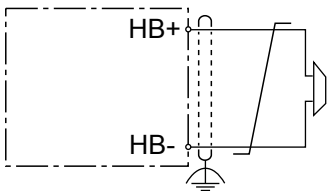
Figure 15: Wiring of the brake control card

Attention

Destruction of the brake!

- ► The digital output 1 has a changed factory setting at the G6M with brake control. The digital output 1 is switching at 4Hz.
- ► The brake must be designed for 205 Vdc / 0.5A!

4.5.3 Brake connection terminals HB+/HB-



Name	Description
HB+	Direct control of a brake
HB-	
⏚	Function earth

Figure 16: Terminals HB+/HB-

4.5.4 Line terminal strip X1D/X1E

X1D/X1E	Name	Function	Cross-section	Tightening torque
	L1, L2, L3	Mains connection 3-phase	0.2…2.5 mm² AWG 24...12	0.5…0.6 A 5…7 lb-inch

Figure 17: Line terminal strip X1D/X1E

Alternatively, it is possible that terminal X1E is not assembled and the lines for the three mains phases are directly soldered on the brake control card

4.6 Connection of a temperature detection

4.6.1 Temperature detection terminals T1, T2

The KEB COMBIVERT is delivered with a PTC evaluation. The function corresponds to DIN EN 60947-8 and works in accordance with the following table:

Function of T1, T2	Resistance	Display ru46	Error/warning
PTC or temperature switch	< 750 Ω	T1-T2 closed	–
	0.75…1.65 kΩ (reset resistance)	undefined	
	1.65…4 kΩ (tripping resistance)		
	> 4 kΩ	T1-T2 open	x

Figure 18: Temperature detection

The behaviour of the inverter in case of error/warning is defined with parameter CP37. As standard the PTC input is deactivated. An instruction for the activation can be found in the annex.

4.6.2 Terminal strip X1C temperature detection

X1C	Name	Function	Cross-section	Tightening torque
	T1, T2	Connection for temperature sensor	0.14...1.5 mm² AWG 28...16	0.22...0.25 Nm 2 lb-inch

Figure 19: Terminal block X1C

4.6.3 Use of the temperature input in the PTC mode

If the temperature input is operated in the PTC mode, the user can provide all possibilities within the resistance range specified in chapter „Temperature detection terminals T1, T2“.

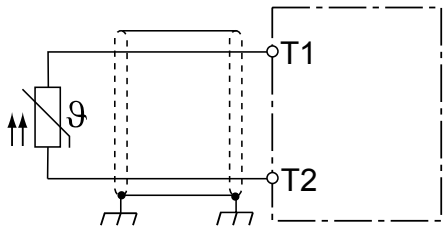
Temperature sensor (PTC) e.g. at motor temperature detection	

Figure 20: Wiring example in the PTC mode

5 Certification

5.1 Certification

5.1.1 CE-Marking

CE marked frequency inverter and servo drives were developed and manufactured to comply with the regulations of the Low-Voltage Directive. The harmonized standards of the series *EN 61800-5-1* and *EN 61800-3* were used.

This 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 inverters or servo drives must not be started until it is determined that the installation complies with the machine directive as well as the EMC-directive (note *EN 60204-1*).

5.1.2 UL certifications

An UL certification is in preparation.

5.2 Further informations and documentation

You find supplementary manuals and instructions for the download under "http://www.keb.de > Service & Downloads > Downloads".

General instructions

- EMC and safety instructions
- Manuals for 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 inverter and to create downloads for parameterizing the inverter.

Approvals and approbations

- Declaration of conformity CE
- TÜV certificate
- FS Certification

Others

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

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