



COMBIVERT H6

INSTRUCTIONS FOR USE | INSTALLATION RECTIFIER MODULE

Translation of original manual
Document 20105353 EN 03



Preface

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

Signal words and symbols

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

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

RESTRICTION

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



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

More symbols

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



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



Laws and guidelines

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

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

Warranty and liability

The warranty and liability on design, material or workmanship for the acquired device is given in the general sales conditions.



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



Further agreements or specifications require a written confirmation.

Support

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

The use of our units in the target products is outside of our control and therefore lies exclusively in the area of responsibility of the customer.

The information contained in the technical documentation, as well as any user-specific advice in spoken and written and through tests, are made to best of our knowledge and information about the intended use. However, they are regarded as being only informal and changes are expressly reserved, in particular due to technical changes. This also applies to any violation of industrial property rights of a third-party. Selection of our units in view of their suitability for the intended use must be done generally by the user.

Tests can only be done within the intended end use of the product (application) by the customer. They must be repeated, even if only parts of hardware, software or the unit adjustment are modified.

Copyright

The customer may use the instructions for use as well as further documents or parts from it for internal purposes. Copyrights are with KEB Automation KG and remain valid in its entirety.

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

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Glossary

0V	Earth-potential-free common point	Endat	Bidirectional encoder interface of the company Heidenhain
1ph	1-phase mains	EtherCAT	Real-time Ethernet bus system of the company Beckhoff
3ph	3-phase mains	Ethernet	Real-time bus system - defines protocols, plugs, types of cables
AC	AC current or voltage	FE	Functional earth
AFE	From 07/2019 AIC replaces the previous name AFE	FSoE	Functional Safety over Ethernet
AFE filter	From 07/2019 AIC filter replaces the previous name AFE filter	FU	Drive converter
AIC	Active Front End module	GND	Reference potential, ground
AIC filter	Filter for Active Front End Module (AIC)	GTR7	Braking transistor
Application	The application is the intended use of the KEB product.	HF filter	High frequency filter to the mains
ASCL	Asynchronous sensorless closed loop	Hiperface	Bidirectional encoder interface of the company Sick-Stegmann
Auto motor ident.	Automatically motor identification; calibration of resistance and inductance	HMI	Human machine interface (touch screen)
AWG	American wire gauge	HSP5	Fast, serial protocol
B2B	Business-to-business	HTL	Incremental signal with an output voltage (up to 30V) -> TTL
BiSS	Open source real-time interface for sensors and actuators (DIN 5008)	IEC	International standard
CAN	Fieldbus system	IP xx	Degree of protection (xx for level)
CDM	Complete drive module including auxiliary equipment (control cabinet)	KEB product	The KEB product is subject of this manual.
COMBIVERT	KEB drive converters	KTY	Silicium temperature sensor (polarized)
COMBIVIS	KEB start-up and parameterizing software	Manufacturer	The manufacturer is KEB, unless otherwise specified (e.g. as manufacturer of machines, engines, vehicles or adhesives).
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)	MCM	American unit for large wire cross sections
DC	DC current or voltage	Modulation	Means in drive technology that the power semiconductors are controlled
DI	Demineralized water, also referred to as deionized (DI) water	MTTF	Mean service life to failure
DIN	German Institut for standardization	NN	Sea level
DS 402	CiA DS 402 - CAN device profile for drives	OC	Overcurrent
EMC	Electromagnetic compatibility	OH	Overheat
Emergency stop	Shutdown of a drive in emergency case (not de-energized)	OL	Overload
Emergency switching off	Switching off the voltage supply in emergency case	OSSD	Output signal swithching device; - an output signal that is checked in regular intervals on its shutdown. (safety technology)
EN	European standard	PDS	Power drive system incl. motor and measuring probe
Encoder emulation	Software-generated encoder output	PE	Protective earth
End customer	The end customer is the user of the customer product.	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 $R_0=100\Omega$
PT1000	Temperature sensor with $R_0=1000\Omega$
PTC	PTC-resistor for temperature detection
PWM	Pulse width modulation
RJ45	Modular connector with 8 lines
SCL	Synchronous sensorless closed loop
SELV	Safety Extra Low Voltage (<60 V)
SIL	The security integrity level is a measure for quantifying the risk reduction. Term used in the safety technology (EN 61508 -1...7)
SS1	Safety function „Safe stop 1“ in accordance with IEC 61800-5-2
SSI	Synchronous serial interface for encoder
STO	Safety function „Safe Torque Off“ in accordance with IEC 61800-5-2
TTL	Incremental signal with an output voltage up to 5V
USB	Universal serial bus
VARAN	Real-time Ethernet bus system

Standards for drive converters / control cabinets

Product standards that apply directly to the drive converter

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

Basic standards to which drive converter standards refer directly

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

EN61000-4-5	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test (IEC 61000-4-5); German version EN 61000-4-5
EN61000-4-6	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
EN61000-4-34	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
EN61508-1...7	Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 1...7 (VDE 0803-1...7, IEC 61508-1...7)
EN62061	Safety of machinery - functional safety of electrical, electronic and programmable electronic safety-related systems (VDE 0113-50, IEC 62061)
EN ISO 13849-1	Safety of machinery - safety-related parts of control systems - Part 1: General principles for design (ISO 13849-1); German version EN ISO 13849-1

Standards that are used in the environment of the drive converter

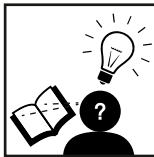
DGUV regulation 3	Electrical installations and equipment
DIN 46228-1	Wire-end ferrules; Tube without plastic sleeve
DIN 46228-4	Wire-end ferrules; Tube with plastic sleeve
DIN IEC 60364-5-54	Low-voltage electrical installations - Part 5-54: Selection and erection of electrical equipment - Earthing arrangements,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

1 Basic Safety Instructions

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

The following safety instructions have been created by the manufacturer for the area of electric drive technology. They can be supplemented by local, country- or application-specific safety instructions. This list is not exhaustive. Non-observance of the safety instructions by the customer, user or other third party leads to the loss of all resulting claims against the manufacturer.

NOTICE



Hazards and risks through ignorance.

- ▶ Read the instructions for use !
- ▶ Observe the safety and warning instructions !
- ▶ If anything is unclear, please contact KEB Automation KG !

1.1 Target group

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

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

Maximum design edges and high weight!
Contusions and bruises!

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

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

1.4 Electrical connection

⚠ DANGER**Voltage at the terminals and in the device !****Danger to life due to electric shock !**

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



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

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



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

For a trouble-free and safe operation, please pay attention to the following instructions:

- The electrical installation shall be carried out in accordance with the relevant requirements.
- Cable cross-sections and fuses must be dimensioned by the user according to the specified minimum/maximum values for the application.
- The wiring must be made with flexible copper cable for a temperature > 75°C.
- Connection of the drive converter is only permissible on symmetrical networks with a maximum line voltage (L1, L2, L3) with respect to earth (N/PE) of max. 300 V. An isolating transformer must be used for supply networks which exceed this value! In case of non-compliance the control is not longer considered to be a PELV circuit.
- With existing or newly wired circuits the person installing the units or machines must ensure that the PELV requirements are met.
- For drive converters that are not isolated from the supply circuit (in accordance with [EN 60721-3-2](#)) all control lines must be included in other protective measures (e.g. double insulation or shielded, earthed and insulated).
- When using components without isolated inputs/outputs, it is necessary that equipotential bonding exists between the components to be connected (e.g. by the equipotential line). Disregard can cause destruction of the components by equalizing currents.

1.4.1 EMC-compatible installation

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



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



1.4.2 Voltage test

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



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



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

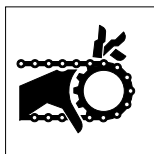
1.4.3 Insulation measurement

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

1.5 Start-up and operation

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

⚠ WARNING



Software protection and programming!

Hazards caused by unintentional behavior of the drive!

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

⚠ VORSICHT



High temperatures at heat sink and coolant!

Burning of the skin!

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

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



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

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



NOTICE

Continuous operation (S1) with load > 60%!

Premature ageing of the electrolytic capacitors!

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

Switching at the output

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

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

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

Switching an the input

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

Short-circuit resistance

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

Exceptions:

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

1.6 Maintenance

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

- ▶ Check system for loose screws and plugs and tighten if necessary.
- ▶ Clean drive converter from dirt and dust deposits. Pay attention especially to cooling fins and protective grid of the fans.
- ▶ Examine and clean extracted air filter and cooling air filter of the control cabinet.
- ▶ Check the function of the fans of the drive converter. The fan must be replaced in case of audible vibrations or squeak.
- ▶ In the case of liquid-cooled drive converters a visual test of the cooling circuit for leaks and corrosion must be carried out. The cooling circuit must be completely empty if a unit shall be switched off for a longer period. The cooling circuit must be blown out additionally with compressed air at temperatures below 0°C.

1.8 Repair

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

DANGER



Unauthorized exchange, repair and modifications!

Unpredictable malfunctions!

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

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

1.7 Disposal

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

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



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

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

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

The packaging must be feed to paper and cardboard recycling.

2 Product Description

The product family COMBIVERT H6 is optimized for the use in multi-axis drives. The structure is modular and thus it can be optimally adapted to the respective requirements. A system consists of the following components:

Name	Function
Rectifier module	Used to supply the main energy flow of DC-coupled drive converters. Consists of a B6 diode or thyristor bridge with following DC link for buffering the energy. The input is supplied with mains voltage. The DC output voltage is equal to the DC link potential. The energy flow is only possible in one direction (no regeneration). The rectifier module controls the precharging. It is used if no Active Front End module (AIC) is used. An integrated braking transistor can convert energy into heat by means of a braking resistor.
Charging module	Used for precharging the DC link in the DC-bus connection of drive converters. The charging module is used in conjunction with an Active Front End module (AIC). It switches and monitors the mains contactor after successful precharging. An integrated braking transistor can convert energy into heat via a braking resistor.
Active Front End Module (AIC)	From 07/2019 the term AIC replaces the previously used term AFE. Used to supply the main energy flow of DC-coupled drive converters. The input is supplied with mains voltage. The DC output voltage is equal to the DC link potential. The energy flow is possible in two directions (power supply and regeneration).The AIC can regenerate excess energy in sinusoidal form from the DC-bus connection into the mains. Precharging is required when using an AIC.
24V power supply module	Provides the 24V DC power supply for the individual modules. The input is supplied from the mains / DC bus. The 24V power supply module can be omitted if an existing 24V supply is to be used.
Control module with 24V power supply	The control module is used for decentralised control of a H6 device network. The H6 control module can be used as gateway between an external fieldbus and system bus. An integrated 24V power supply supplies the 24V bus.
Single axis module	Module for controlling a single drive axis in a drive system. The single axis module is supplied via the DC link bus. Single axis modules are available in different housing designs and performance levels. Different safety modules can be integrated according to the requirements.
Double axis module	Single module is used to control two different axes. The double axis module is supplied via the DC link bus.
DC connection module	The DC connection module enables the connection of other components to the DC link of the COMBIVERT H6. This allows devices of other series or other manufacturers to be connected to the DC bus connection. The branch can optionally be protected with DC fuses. Triggering of the fuse(s) is monitored.
DC terminal	The DC terminal enables the branch via cables from the DC bus bars of the COMBIVERT H6. This allows devices of other series or other manufacturers to be connected to the DC bus connection. The DC terminal is a passive component and has no internal fuses in contrast to the DC connection module.

2.1 Specified application

The COMBIVERT H6 is a DC-coupled drive system for the control of different axes. It 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 name-plate and 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 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.

Residual risks

Despite intended use, drive converters 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:	Drive converter
Series:	COMBIVERT H6
Power range:	30...225 kW / 400 V
Housing:	C, S, G, W

The COMBIVERT H6 is characterized by the following features:

- System bus EtherCAT ¹⁾ Transmission of set and actual values between control and power supply unit.
- Error bus Channel 1: Error output of the connected DC buses
Channel 2: Charge level of the DC link bus
- Diagnostic interface RS232/485 interface for the connection of displays or service tools.
- Inputs and outputs 4 digital inputs
4 digital outputs
- Separate supply Internal supply of the control circuit and driver-/control circuit are safe separated.
- Brake control Temperature inputs for braking resistor and filter monitoring
- Cooling System universally by flat rear and air heat sink

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

2.4 Type code

x x	H 6	x	x	x - x	x	x	x
					Reserved	0: Reserved	
					Reserved	0: Reserved	
					Software configuration	1-9: KEB default A-Z: Customer /special version	
					Hardware configuration	1: Version 1 2: Version 2 A-Z: Customer /special version(firmware and download)	
					Housing	Flat rear heat sink	
						C: 100mm	G: 300mm
					Housing	Air heat sink	
						S: 100mm	W: 300mm
					Control type	A: KEB default with control release	
					Rectifier module	C: Rectifier module with half-controlled bridge rectifier (B6HK)	
					Series	COMBIVERT H6 multi-axis drive system	
					Unit size	19...28	

Table 1: Type code



The type code is not used as order code, but only for identification!

3 Technical Data

3.1 Operating conditions

3.1.1 Climatic ambient conditions

Storage		Standard	Class	Notes
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 above sea level
Transport		Standard	Class	Notes
Surrounding 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	Notes
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 deration 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	IP20	Protection against foreign material > ø12.5 mm No protection against water Non-conductive pollution, occasional condensation when PDS is out of service.
Site altitude		–	–	Max. 2000 m above sea level <ul style="list-style-type: none"> With site altitudes over 1000 m a derating of 1 % per 100 m must be taken into consideration. With site altitudes over 2000 m, the control board to the mains has only basic isolation. Additional measures must be taken when wiring the control.

Table 2: Climatic ambient conditions

3.1.2 Mechanical ambient conditions

Storage	Standard	Class	Notes
Vibration limits	EN 60721-3-1	1M1	Vibration amplitude 0.3 mm (2...9 Hz) Acceleration amplitude 1 m/s ² (9...200 Hz)
Shock limit values	EN 60721-3-1	1M1	40 m/s ² ; 22 ms
Transport	Standard	Class	Notes
Vibration limits	EN 60721-3-3	2M1	Vibration amplitude 3.5 mm (2...9 Hz) Acceleration amplitude 10 m/s ² (9...200 Hz) Acceleration amplitude 15 m/s ² (200...500 Hz)
Shock limit values	EN 60721-3-2	2M1	100 m/s ² ; 11 ms
Operation	Standard	Class	Notes
Vibration limits	EN 60721-3-3	3M4	Vibration amplitude 3.5 mm (2...9 Hz) Acceleration amplitude 10 m/s ² (9...200 Hz)
	ISO 4762	1 A	Railway applications Attached to the vehicle body.
Shock limit values	EN 60721-3-3	3M4	100 m/s ² ; 11 ms
Pressure in the water cooler	–	–	Max. operating pressure: 10 bar

Table 3: Mechanical ambient conditions

3.1.3 Chemical / mechanical active substances

Storage	Standard	Class	Notes	
Contamination	EN 60721-3-1	Gases	1C2	–
		Solids	1S2	–
Transport	Standard	Class	Notes	
Contamination	EN 60721-3-2	Gases	2C2	–
		Solids	2S2	–
Operation	Standard	Class	Notes	
Contamination	EN 60721-3-3	Gases	3C2	–
		Solids	3S2	–

Table 4: Chemical / mechanical active substances

3.1.4 Electrical operating conditions

3.1.4.1 Device classification

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

Table 5: Device classification

3.1.4.2 Electromagnetic compatibility

The indicated values are only valid for units with external filter.

EMC emitted interference	Standard	Class	Notes
Cable-based interferences	ISO 7090	C2	–
Radiated interferences	ISO 7090	C2	–
Interference immunity	Standard	Level	Notes
Static discharges	EN 61000-4-2	8 kV 4 kV	AD (air discharge) CD (contact discharge)
Burst - Ports for process measurement control lines and signal interfaces	EN 61000-4-4	2 kV	–
Burst - Power ports	EN 61000-4-4	4 kV	–
Surge - Power ports	EN 61000-4-5	1 kV 2 kV	Phase-phase Phase-ground
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 1.4...2 GHz 2...2.7 GHz
Voltage variation/ voltage drop	EN 61000-2-1 ISO 7092	–	-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 Technical data of the H6 power supply units

Unit size		19	20	21	24	25	27	28 ¹⁾
Housing		C / S			G / W			
Input data								
Rated input voltage	U_{N_ac} / V	400 (UL: 480)						
Input voltage range	U_{in_ac} / V	320...528						
Mains frequency	f_N / Hz	50/60 ±2						
Phases		3						
Approved mains forms	²⁾	TN, TT						
Rated input power	S_N / kVA	31	39.5	51	104	131	170	242
Rated input active power	P_N / kW	30	37	48	95	120	155	225
Max. input power	S_{max} / kVA	56	71	92	187	236	306	436
Max. input active power	P_{max} / kW	54	67	86	171	216	279	405
Rated input current	I_{N_ac} / A	45	57	74	150	190	245	350
Max. input current (for 60s)	³⁾ I_{max_ac} / A	81	103	133	270	341	441	630
Base load current ($I_{N_ac} \times 0.86$)	I_{H_ac} / A	37	47	61	123	155	201	287
Current S6 operation (40% for 10 min)	I_{S6_ac} / A	58	74	96	195	246	319	455
Overcurrent cut-off	I_{OC_ac} / A	97	123	160	324	410	529	756
Max. permissible mains fuse type gL/gG	I_{max} / A	50	63	80	200	250	315	400
Recommended supply cable section	\varnothing / mm^2	16	25	25	120	2x70	2x95	2x120
Output data								
Rated output voltage	U_{outN_dc} / V	540						
Output voltage range	U_{dc} / V	452...746						
Overvoltage switch-off	U_{OP_dc} / V	840						
Maximum ext. load current	I_{ext_dc} / A	5						
Rated output current	I_{outN_dc} / A	55	70	90	180	230	300	435
Max. output current (for 60s)	³⁾ $I_{out_max_dc} / A$	99	126	162	324	414	540	783
Overcurrent cut-off (E.OC)	I_{dc} / A	119	151	194	389	497	648	940
Braking transistor (GTR7)								
Max. braking current	$I_{B_max_dc} / A$	79	79	79	184	208	293	360
Min. braking resistor	R_{B_min} / Ω	10	10	10	4.3	3.8	2.7	2.2
Response voltage	U_{dc} / V	790						
Rated switching frequency	f_{SN} / kHz	4						
Switching cycle based on 120s cycle time	$t_{sc} / \%$	40						
Other data								
Power dissipation heat sink	P_{D_ext} / W	175	250	320	375	450	650	950
Power dissipation interior	P_{D_int} / W	60	75	85	60	70	85	110
Max. heat sink temperature	$T_{HS} / ^\circ C$	80	60/80	60	80	60	80	60
Supply control circuit								
Input voltage	U_{CU_dc} / V	24 (±10%)						
Input current	⁴⁾ I_{CU_dc} / mA	600						
Additional input current for air cooler	I_{CU_dc} / A	-	-	0.3	3.6	3.6	3.6	3.6

Table 7: Technical data of the H6 rectifier modules

- 1) The max. surrounding temperature $T_a = 30^\circ C$ must be maintained for the air-cooled version.
- 2) IT system application only upon request.
- 3) Limitations: The thermal dimensioning of the heat sinks is based on the rated current and the maximum permissible ambient temperature. At high ambient temperatures and / or high heatsink temperatures (for example, due to a preceding utilization nearby 100%), the drive converter can change to over-temperature error before the protective function OL is triggered.
- 4) Input current, if no digital input is set. At max. load at the digital outputs the input current can be increased up to max. 1A.

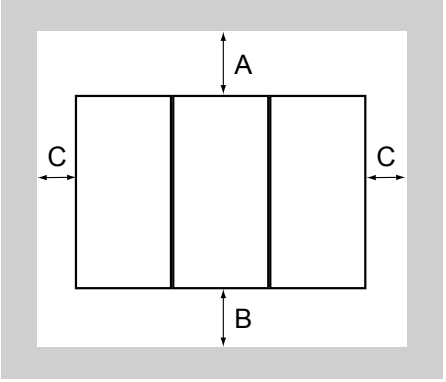
3.3 DC link capacity

Rectifier module	
Housing	Capacity in uF
19	1100
20	1100
21	1100
24	3300
25	3300
27	4700
28	4700

Table 8: DC link capacity

3.4 Mechanical installation

3.4.1 Control cabinet installation

Mounting distances	Dimension	Distance in mm	Distance in inch
	A	150	6
	B ¹⁾	100	4
	C	30	1.2
	X ²⁾	50	2
	1) Minimum distance for cooling 2) Distance to preceding elements in the cabinet door.		

ATTENTION

Horizontal installation in the control cabinet must be done with special care and the displacement between the units must be kept to a minimum.

CAUTION



Hot Surface

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

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

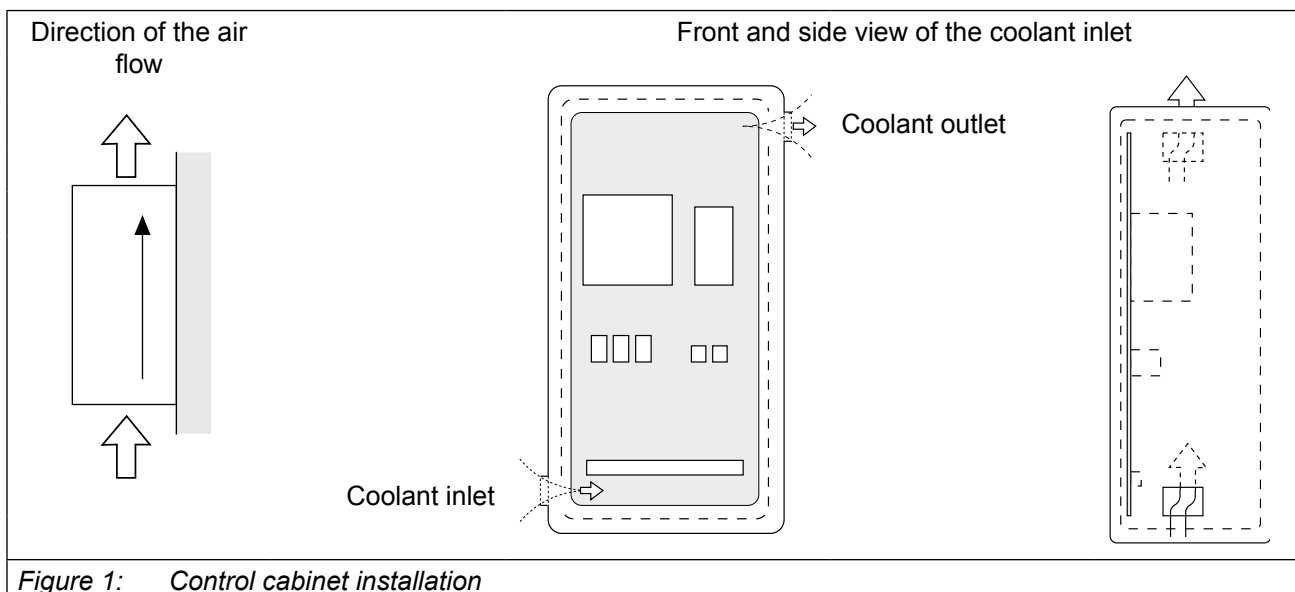


Figure 1: Control cabinet installation

3.4.2 Installation instructions for flat rear heat sink

ATTENTION**Overheating of the device.****Never operate flat rear devices without main cooler.**

- ▶ Select suitable cooling surfaces (e.g. water heat sink, ribbed heat sink, machine base).
- ▶ Screw the flat rear of the devices to the cooling surface.
- ▶ Ensure good thermal conductivity (e.g. thermal paste)
- ▶ The machine builder is responsible for the cooling of the units.

**Heat-conducting paste**

Information about the correct application of the heat-conducting paste are available at www.keb.de under the search term "Heat-conducting paste".

Select correct flow temperature for liquid coolers

- ▶ The flow temperature must be choose in such a way, that no moisture condensation occurs.

3.4.3 Dimensions central heat sink

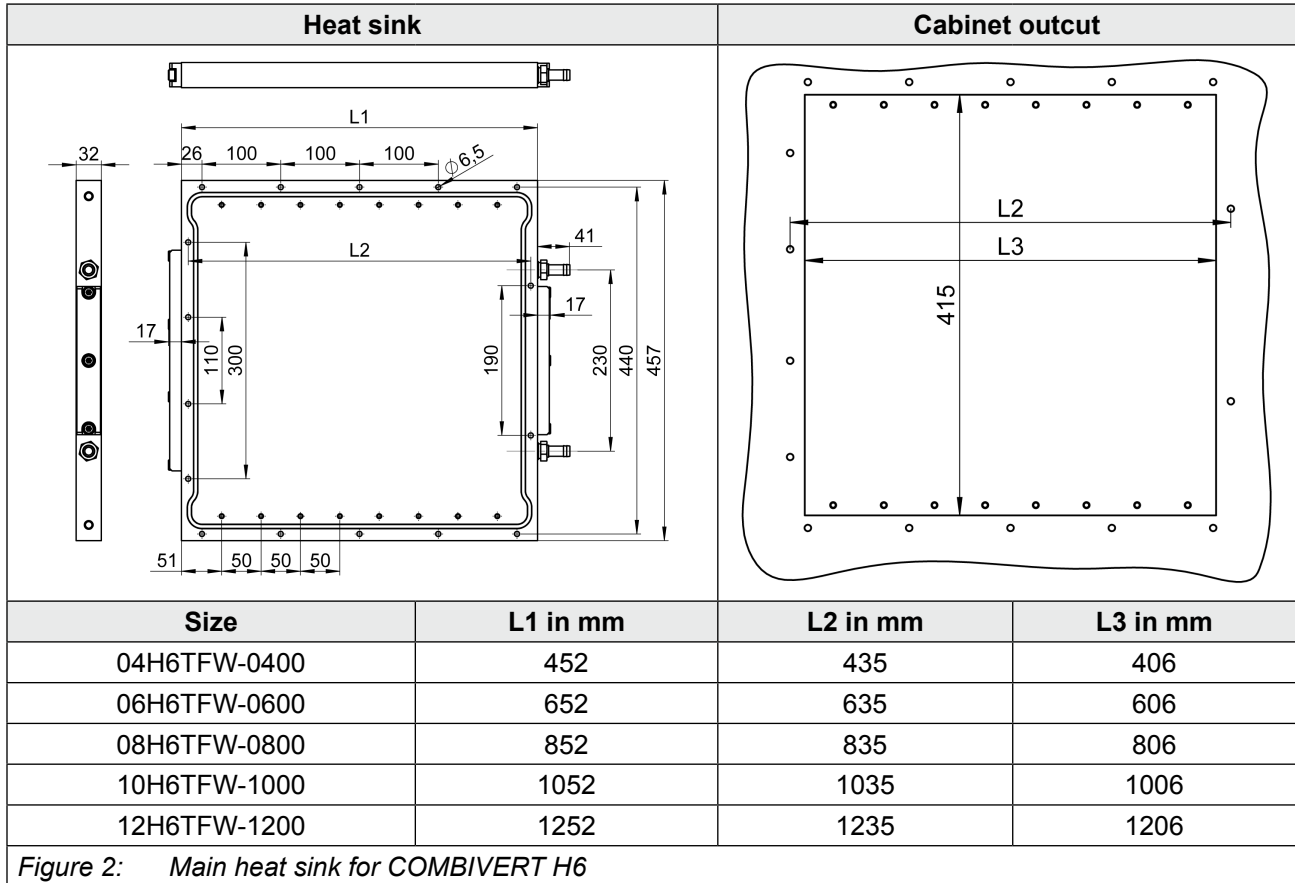
3.4.3.1 Air heat sink



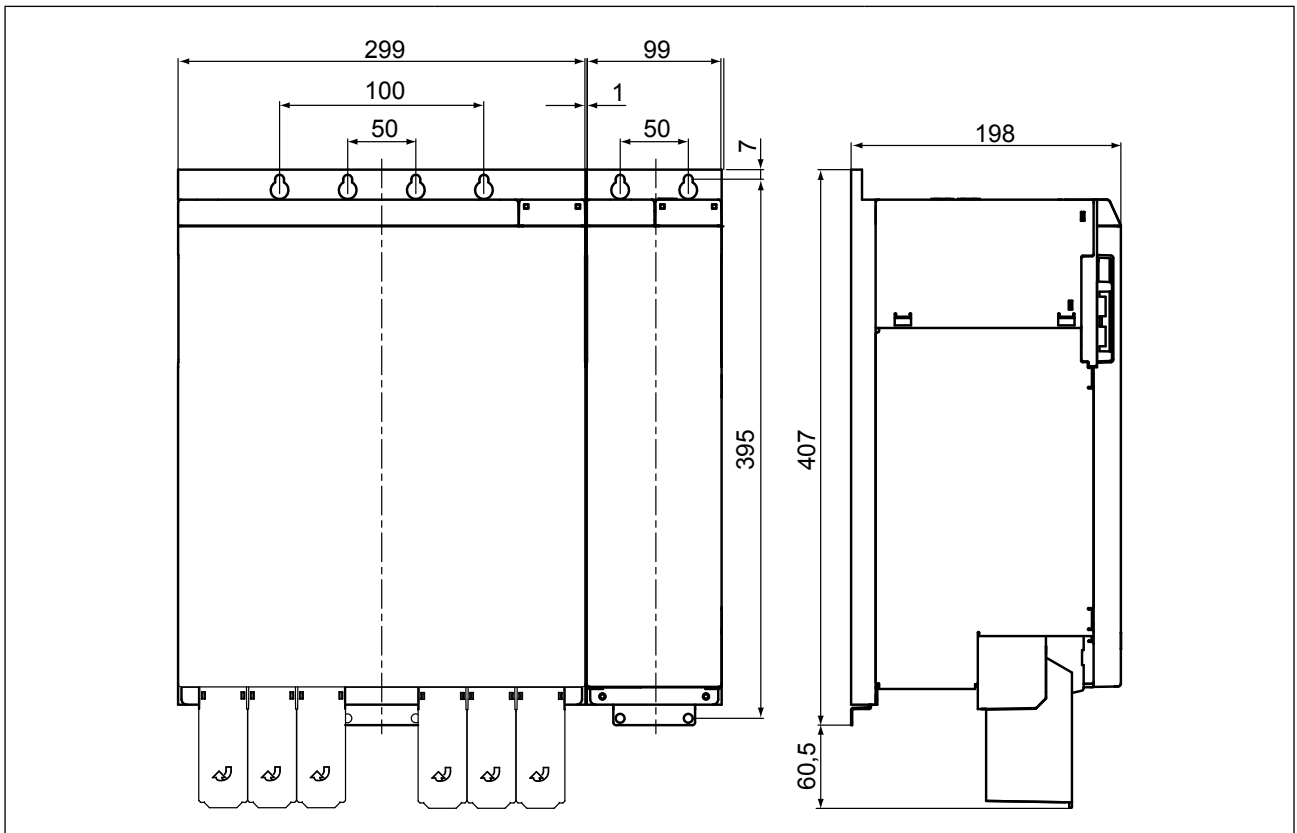
Central heat sink for air-cooling upon request.

3.4.3.2 Liquid heat sinks

Following liquid heat sinks are available, if no usable cooling surface exists at customer side:



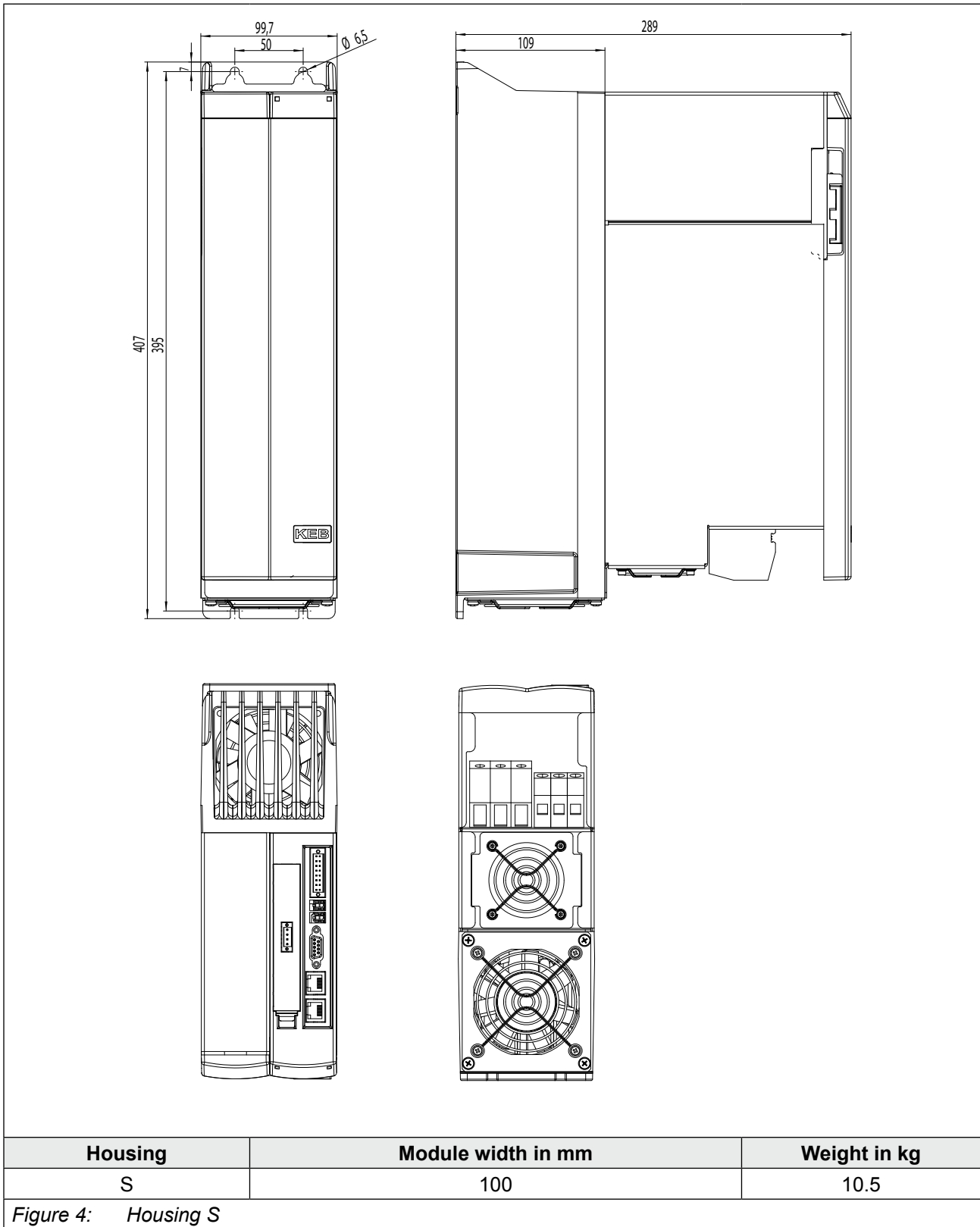
3.4.4 Dimensions and weights of the power supply units with flat rear heat sink

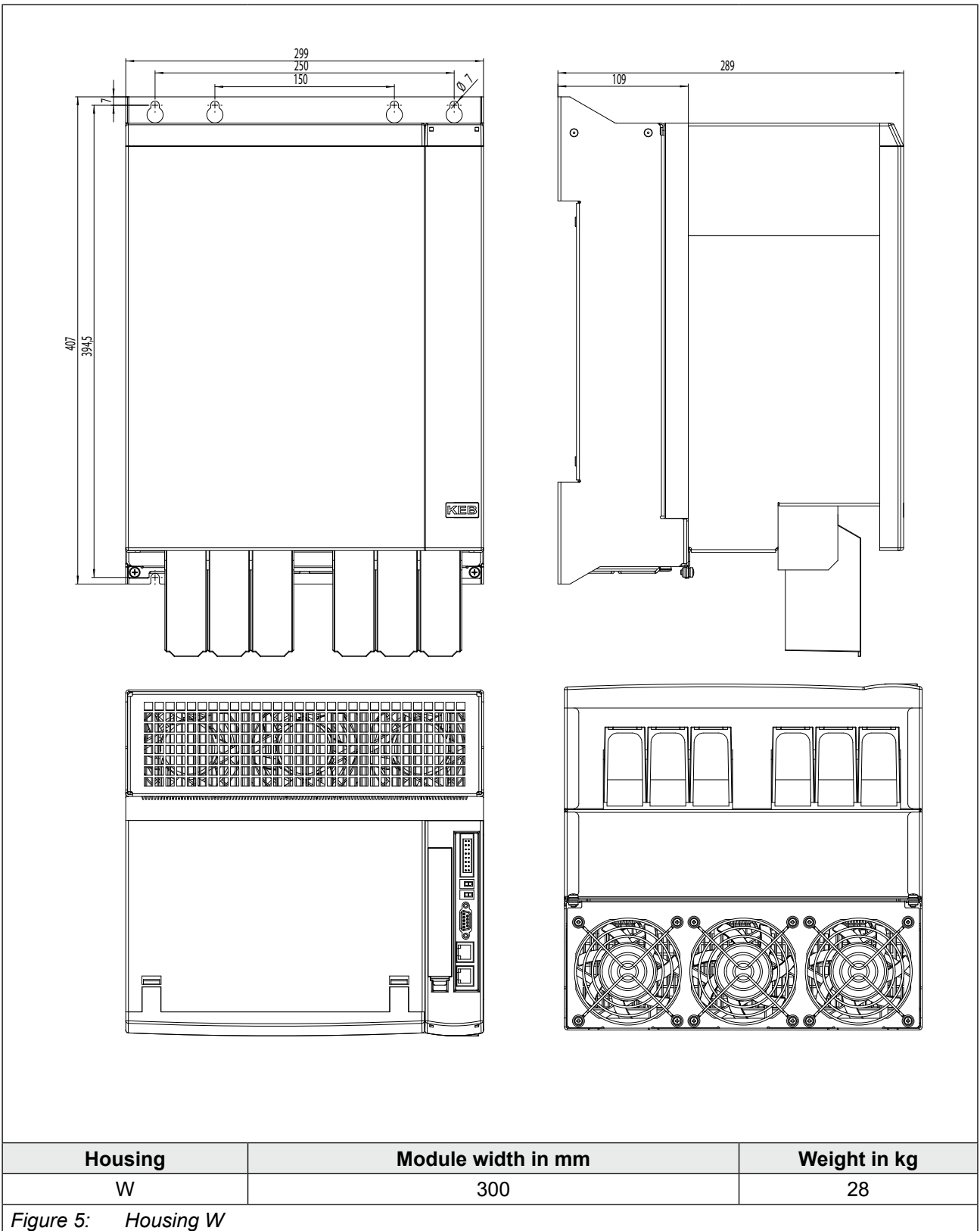


Housing	Module width in mm	Weight in kg
C	100	7.5
G	300	20
G	300	22

Figure 3: Housing C and G

3.4.5 Dimensions and weights of the power supply units with air heat sink





3.4.6 Mains chokes

Mains choke $U_{N_ac}=400\text{ V}$; $f_N=50\text{ Hz}$; $T_{max}=45^\circ\text{C}$

Choke	Fig-ure	I_N in A	I_{max} in A	L in mH	Dimensions in mm									Weight in kg
					B	H	H1	T	L1	L2	L3	d1	d2	
19Z1B04-1000	1	63	94.5	0.467	219	121	135	220	201	136	91	7	12	12
20Z1B04-1000	1	79	118.5	0.372	219	121	150	220	201	136	91	7	12	12
21Z1B04-1000	2	95	142.5	0.31	267	109	155	207	249	176	82	7	12	15.6
24Z1B04-1000	2	189	283.5	0.156	316	153	225	235	292	200	113	10	16	24.8
25Z1B04-1000	2	221	331.5	0.133	316	153	222	234	292	200	113	10	16	25
27Z1B04-1000	2	315	472.5	0.093	352	145	230	265	328	224	106	10	16	34
28Z1B04-1000	2	390	585	0.075	388	150	245	295	364	248	112	10	16	41.5

Figure 1

Figure 2

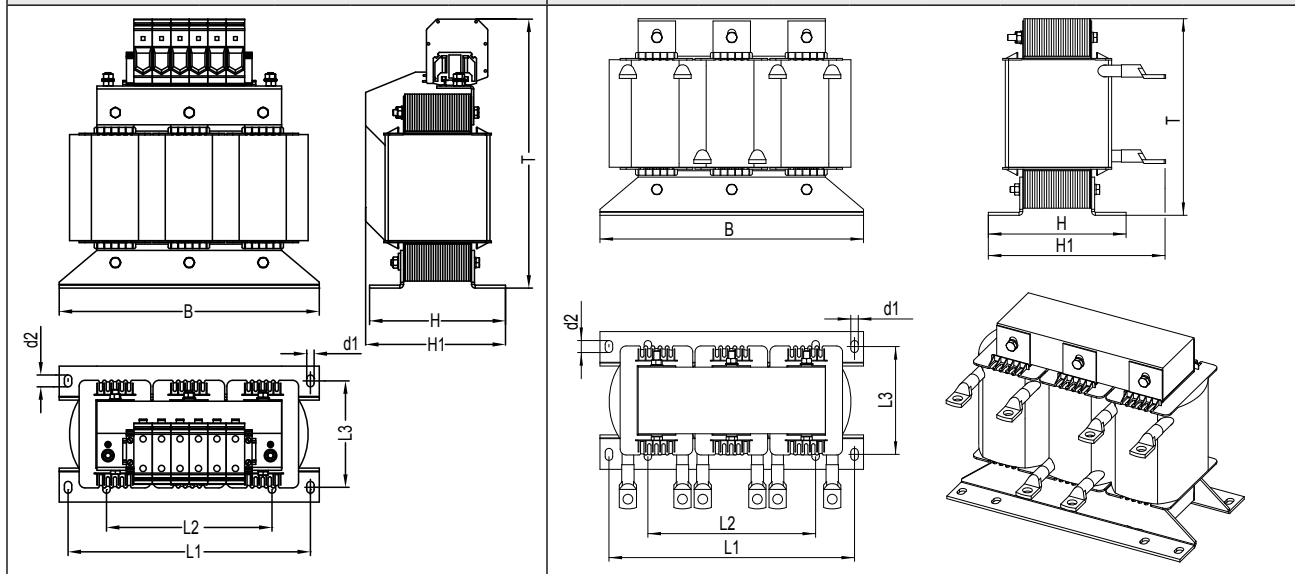


Table 9: Mains chokes

3.4.7 EMC filter

EMC filter $U_{in_max_ac} = 3 \times 480 \text{ V}$; $f_N = 50 \text{ Hz}$; $T_{max} = 45^\circ \text{ C}$

Filter	Figure	I_N in A	I_{lk50} in mA	I_{lkmax} in mA	P_d in W	Radio interference level up to switching frequency and motor line length			Weight in kg
20E6T60-3000	1	100	<3	30	50	C1 8 kHz 50 m	C1 16 kHz 30 m	C2 16 kHz 100 m	–
22E6T60-3000	2	150	<3	45	80	C1 4 kHz 50 m	C1 16 kHz 30 m	C2 16 kHz 50 m	–
24E6T60-3000	2	200	<3	30	100	C1 4 kHz 50 m	C1 8 kHz 30 m	C2 8 kHz 30 m	–
28E4T60-1001	3	410	60	220	50	C2 2 kHz 30 m	C2 8 kHz 30 m	C2 16 kHz 30 m	18.5

I_N = rated current; I_{lk_50} = leakage current at 50 Hz; I_{lk_max} = max. leakage current (phase-PE); P_d = power dissipation

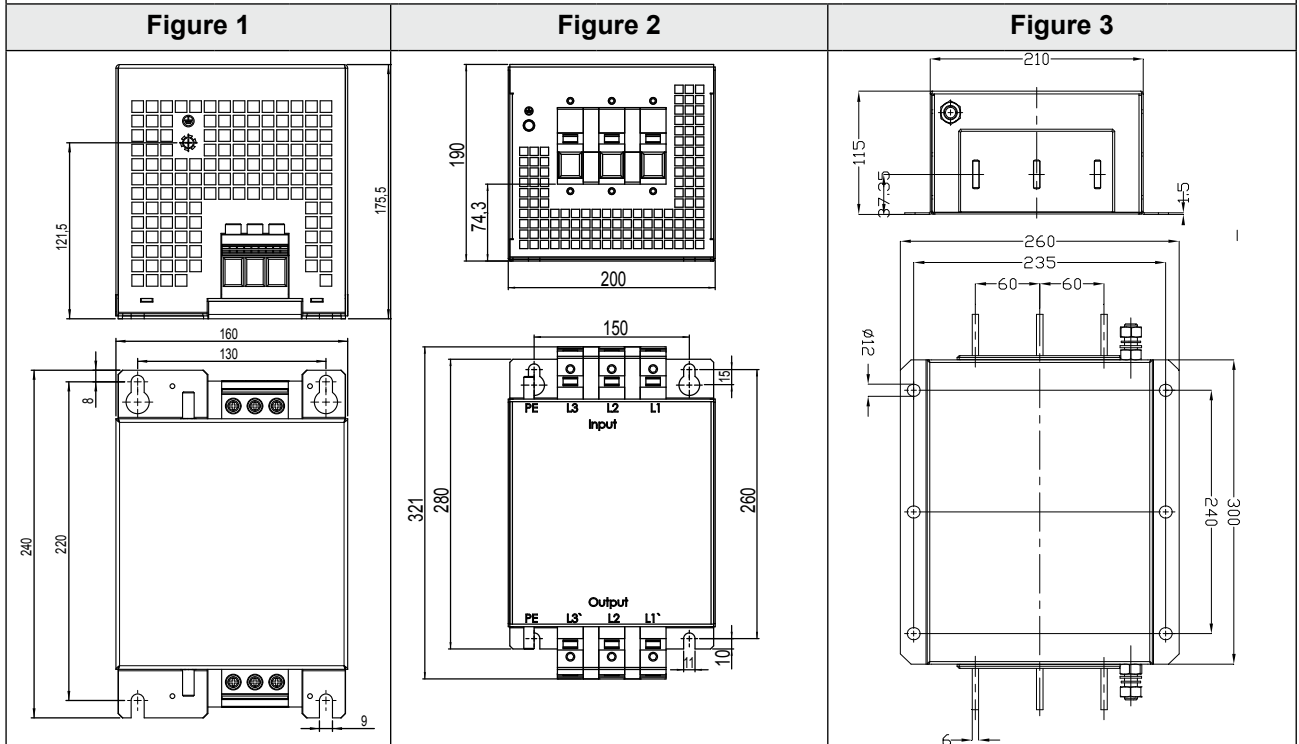


Table 10: EMC filter

3.4.7.1 Connection cross sections and tightening torques

Filter	Mains connection 3-phase	Tightening torque	PE	Tightening torque
20E6T60-3000	16...50 mm ² (AWG 6-0)	6...8 Nm (60 lb inch)	M8	12 Nm (105 lb inch)
22/24E6T60-3000	35...95 mm ² (AWG 4-0)	15 Nm (130 lb inch)	M10	25 Nm (220 lb inch)
28E4T60-1001	M10	25 Nm (220 lb inch) [recommended]	M12	40 Nm (354 lb inch) [recommended]

Table 11: Connection cross sections and tightening torques

4 Installation and Connection

4.1 Construction of the unit

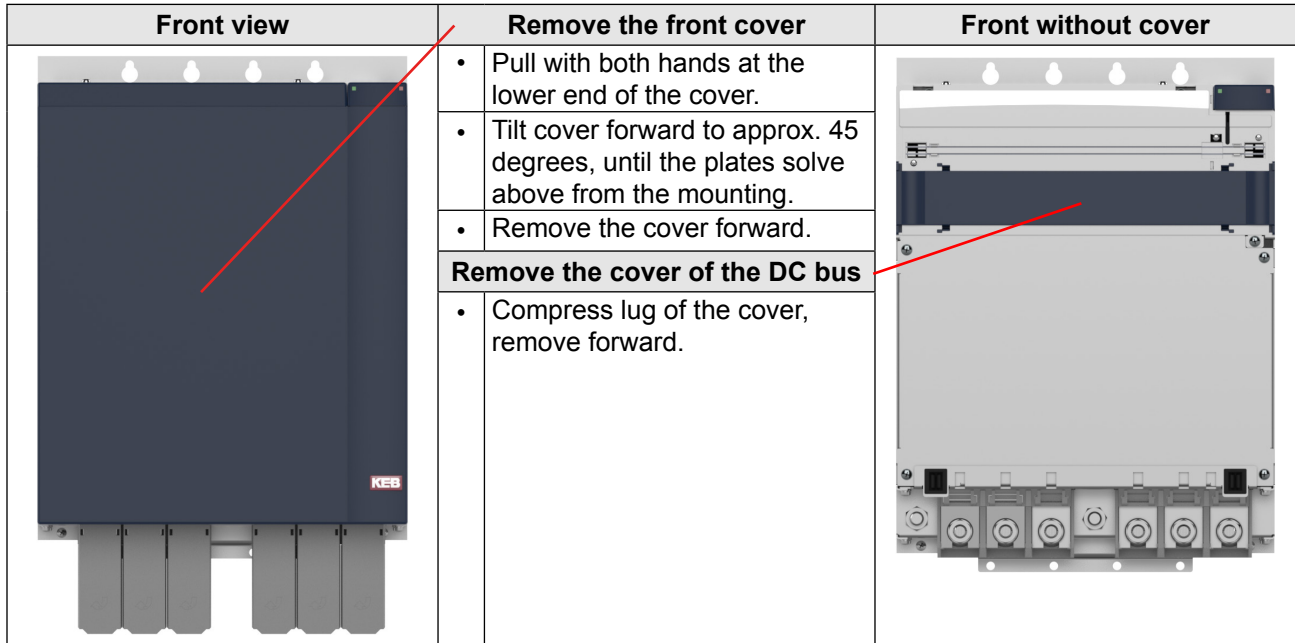


Figure 6: Construction of the unit

⚠ DANGER

Dangerous voltage

- ▶ Secure voltage disconnection of the DC bus at the power supply and regenerative unit!

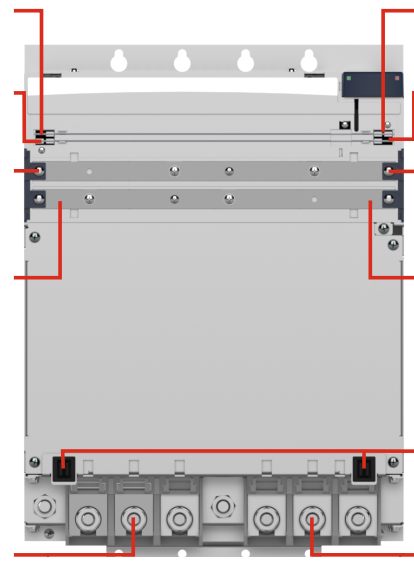
Description	Terminal	Connections of the front side	Terminal	Description
+24V bus	X1C.1		X1C.3	+24V bus
0V	X1C.2		X1C.4	0V
DC bus+	X1D.1		X1D.3	DC bus (displayed with protection against contact for exterior units)
DC bus-	X1D.2		X1D.4	
			Snap-in for front cover	
Line terminal strip	X1A		X1B	DC connection and braking resistor

Figure 7: Connections of the front side

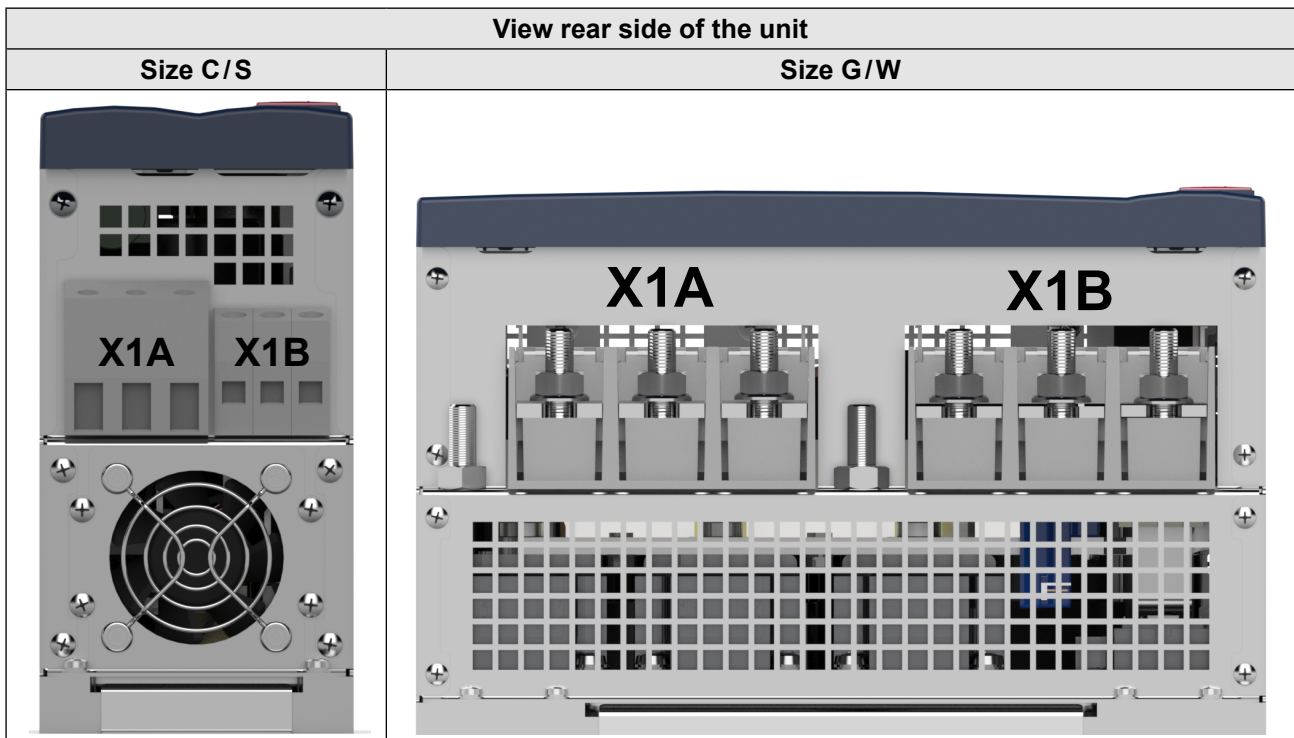


Figure 8: View rear side of the unit

Power unit terminal strips		
X1A	L1	Mains connection via mains choke
	L2	
	L3	
X1B	PA	<ul style="list-style-type: none"> • DC link + (output with precharging) • Connection for braking resistor
	—	DC link -
	PB	Connection for braking resistor
⊕	PE	Connection for protective earth / earthing

Internal wiring of the rectifier module (schematic diagram)

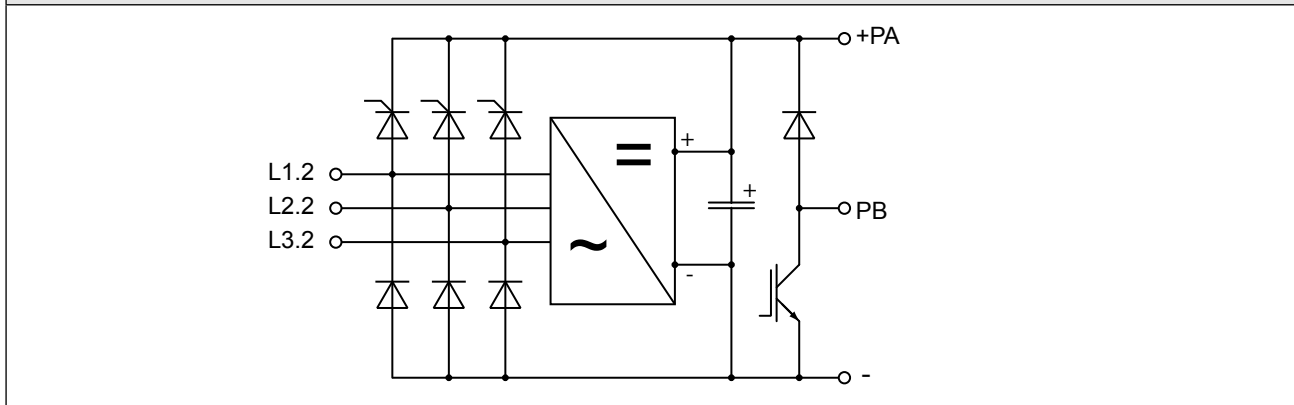


Figure 9: Internal wiring of the rectifier module (schematic diagram)

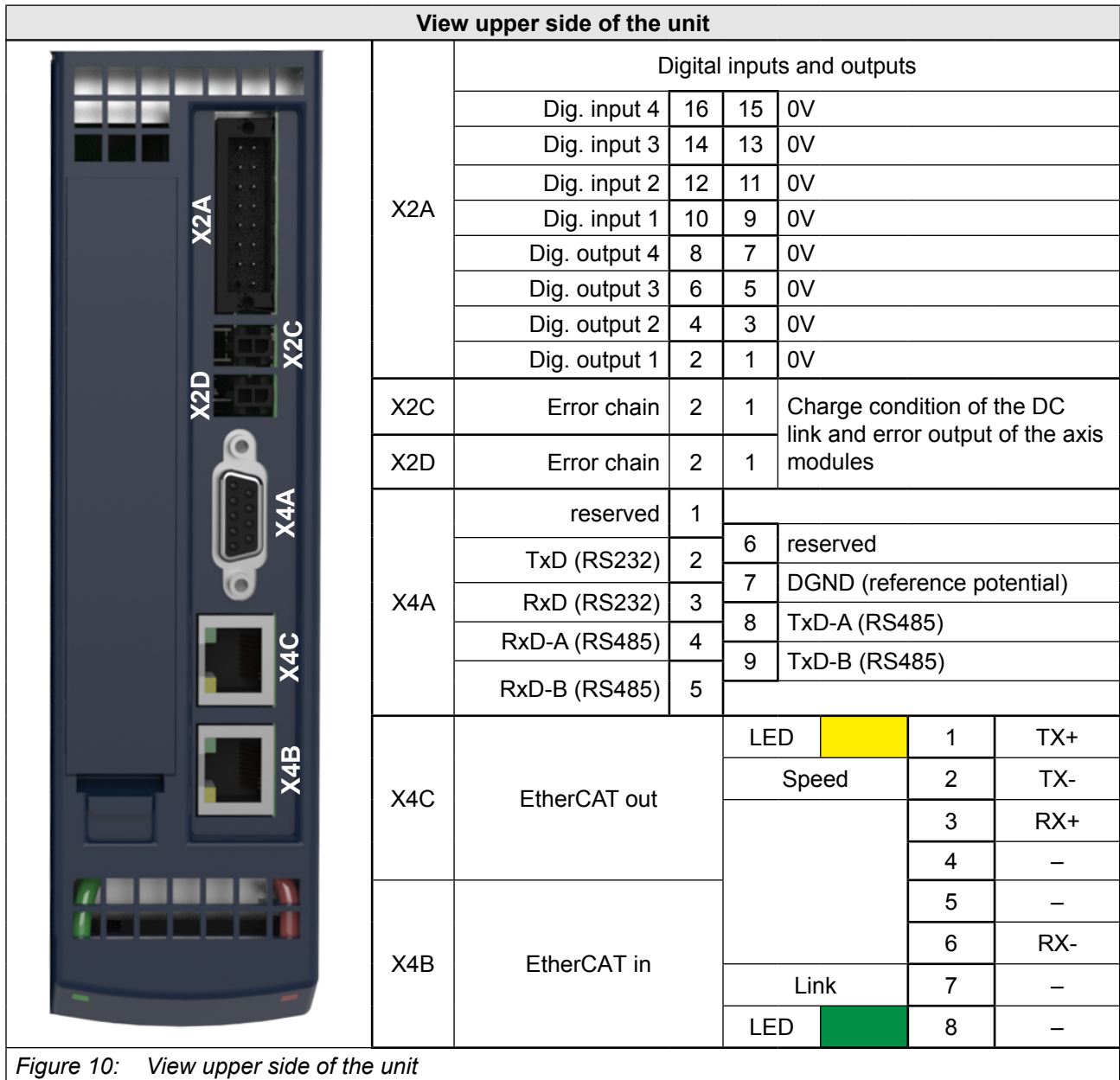


Figure 10: View upper side of the unit

4.1.1 Status-LEDs



4.1.1.1 Status-LED safety module



The status-LED "Safety module" has no function on the rectifier module.

4.1.1.2 Status-LED unit

LED	Status
off	No voltage supply of the unit
yellow	Unit initialised
green	Unit ready for operation
red	Unit in error routine

4.2 Connection of the power unit

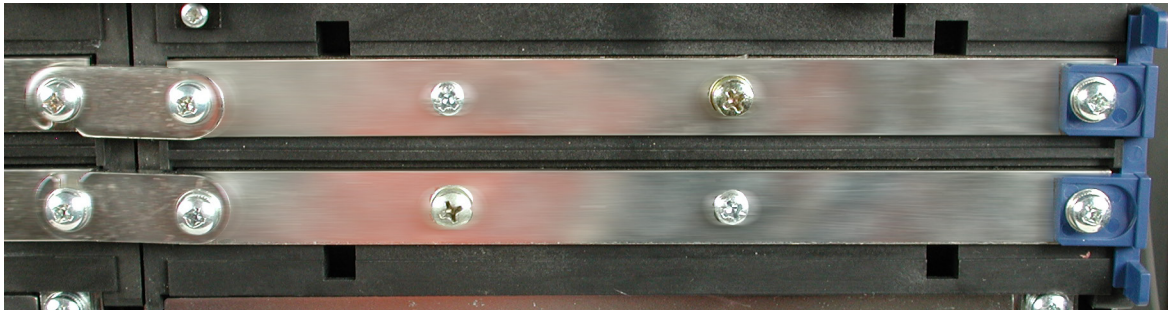
4.2.1 Connection of the DC bus X1D

The copper bars connect the DC bus of the different H6 devices. Precharging, power supply and regeneration (if required) is provided by the supply unit. The electrical connection is made with metal bridges, which must be mounted (as illustrated in the photo). A plastic cap must be installed at both ends of the H6 system as protection against accidental contact.

⚠ DANGER

Caution, dangerous voltage

- ▶ The voltage on the DC bus during operation can be up to 840 Vdc!



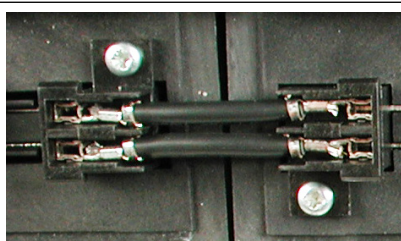
Bridges for the connection of the DC bus between the units	upper rail = DC+ lower rail = DC-	Place plastic cap as protection against accidental contact at the end of the system
Torx raised-head screw M4 x 10	required tool Torx screwdriver TX20	Tightening torque 3.0 Nm (bridge) 1.1...1.2 Nm (plastic cap)

Figure 12: Connection of the DC bus

Attach the cover for the DC bus again after the installation.

4.2.2 Connection of the 24V bus X1C

The 24V bus supplies the control and the driver circuit of the axis module and the power supply and regenerative unit with 24VDC voltage. Generally this voltage is provided by the COMBIVERT H6 supply unit, but it can also be used by an existing voltage source.



The bridge for the connection of the 24V bus is attached to the units and fixed with a screw.

Cross-drive screw M3x10

Tightening torque 0.5 Nm

Figure 13: Connection of the 24V bus

ATTENTION

The assembly of the jumper must be carried out with special care. Tilting or breaking the plug contacts is to be prevented.

4.2.3 Power unit terminal strips X1A, X1B



The terminal strips meet the requirements of [EN 60947-7-1](#).

Housing C/S				
Terminal		Function	Cross-section	Tightening torque
X1A	L12, L22, L32	Connection of the mains supply via mains choke	10...25 mm ² AWG 8-2	2 Nm 18 lb inch
X1B	PA, -	Connection +/- DC link	0.5...16 mm ² AWG 10-2	
	PA, PB	Connection for braking resistor		
PE		Connection for shielding/earthing	Screw M5 for crimp connector	

Table 12: Power unit terminal strips housing C/S



PA corresponds to +PA, for housing G/W, + is not shown due to space reasons.

Housing G/W				
Terminal		Function	Cross-section	Tightening torque
X1A	L12, L22, L32	Connection of the mains supply via mains choke	M10stud for ring crimp connector max. width 30 mm	25 Nm 220 lb inch
X1B	+PA, -	Connection +/- DC link		
	+PA, PB	Connection for braking resistor		
PE		Connection for shielding/earthing		

Table 13: Power unit terminal strips housing G/W

4.2.4 Connection for power supply

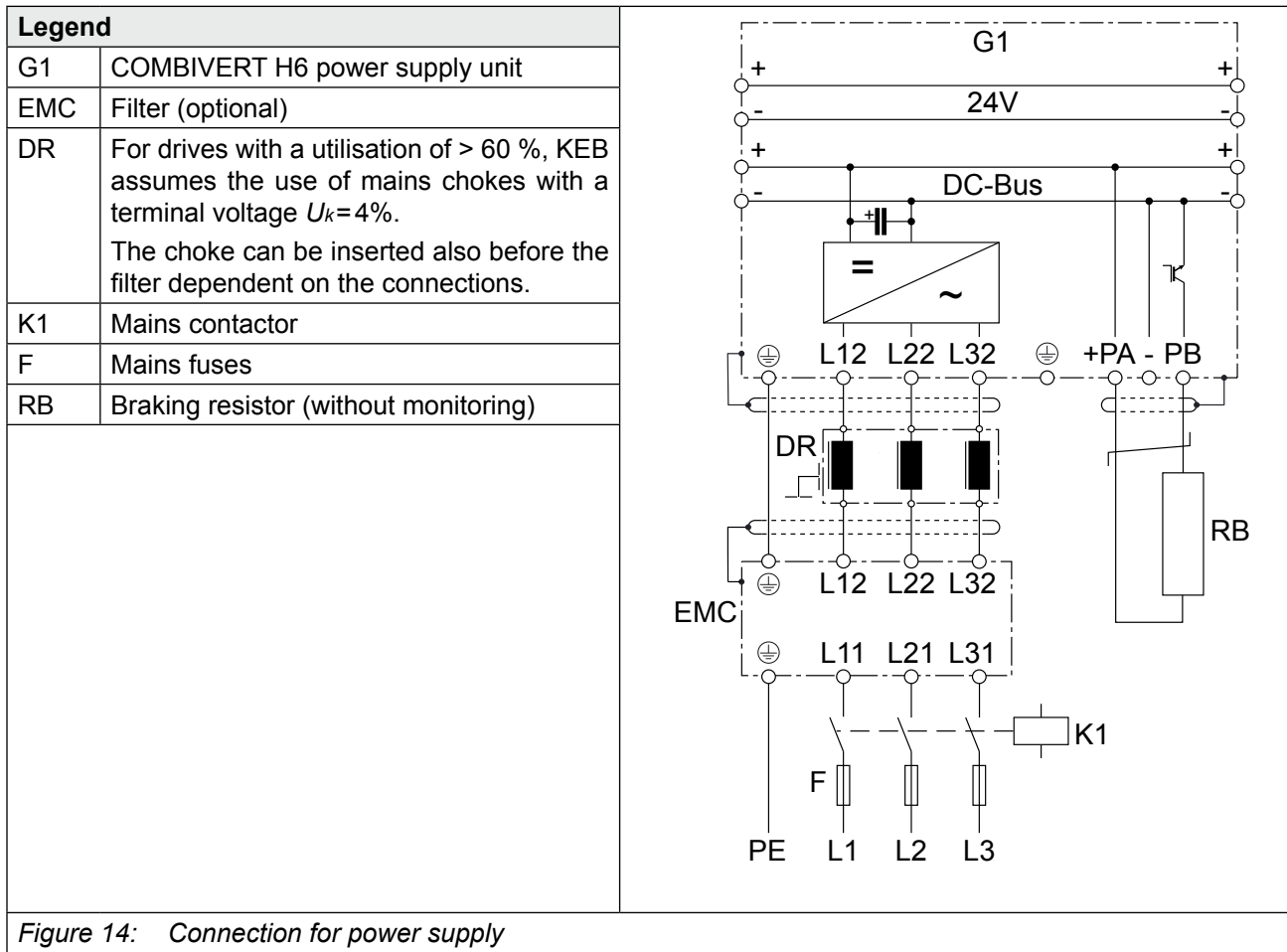


Figure 14: Connection for power supply

4.2.5 Connection of a braking resistor with fire protection monitoring

The correct size of the braking resistor RB is the responsibility of the customer. The temperature sensor must be monitored and the load switched off in case of overheating.

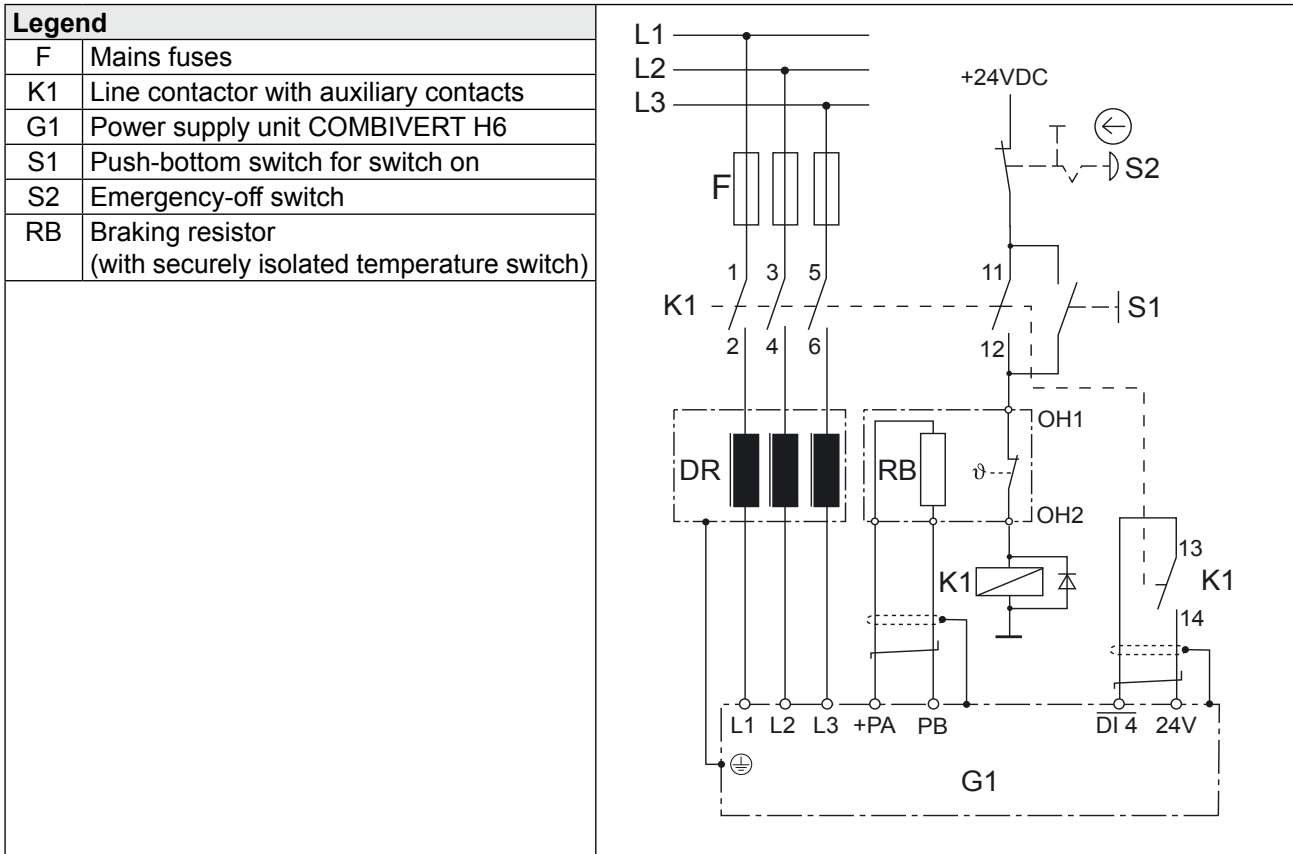


Figure 15: Connection of a braking resistor

In the example above the locking of the line contactor K1 is interrupted in case of overheating of the braking resistor. The line contactor drops out and switches off the mains voltage. The auxiliary contacts 13/14 of K1 open the error linkage circuit at terminals DI4/24V and release an error. The modulation is switched off. Thus the drive in regenerative operation does not regenerate further energy into the DC link circuit.

NOTICE

External error

The input DI4 must be programmed to "external error" and inverted. Depending on the case of application (e.g. no regenerative operation) simple circuits can be used.

4.3 Connection of the control

4.3.1 Error chain terminal X2C, X2D

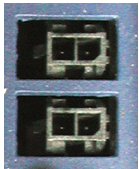

Channel		Name	Description	Connecting cable error linkage circuit										
2	1													
		X2C	The terminal strips X2C and X2D are internally parallel connected. Thus, each terminal strip can be used as input or output. Based on the power supply unit the error chain contains two channels and can supply maximally 64 axis modules.											
		X2D			Status channel 1: <table border="1" style="margin-left: 20px;"> <tr> <td>OK</td> <td>=</td> <td>$U > 9V$</td> </tr> <tr> <td>Error</td> <td>=</td> <td>$U < 5V$</td> </tr> </table> Status channel 2: <table border="1" style="margin-left: 20px;"> <tr> <td>Release axis modules</td> <td>=</td> <td>$U < 5V$</td> </tr> <tr> <td>no release axis modules</td> <td>=</td> <td>$U > 9V$</td> </tr> </table>	OK	=	$U > 9V$	Error	=	$U < 5V$	Release axis modules	=	$U < 5V$
OK	=	$U > 9V$												
Error	=	$U < 5V$												
Release axis modules	=	$U < 5V$												
no release axis modules	=	$U > 9V$												

Figure 16: Error chain terminal X2C, X2D

4.3.1.1 Error linkage circuit (channel 1)

The first error channel is an error linkage circuit. If there is an error in a module, the other modules can be notified of the error directly via this channel. The response to the error can be parameterized.

4.3.1.2 Error power supply unit (channel 2)

At this error channel the axis modules get the information that the power supply unit is in error status and the modulation of all axis modules must be switched off.

4.3.1.3 Wiring example error linkage circuit

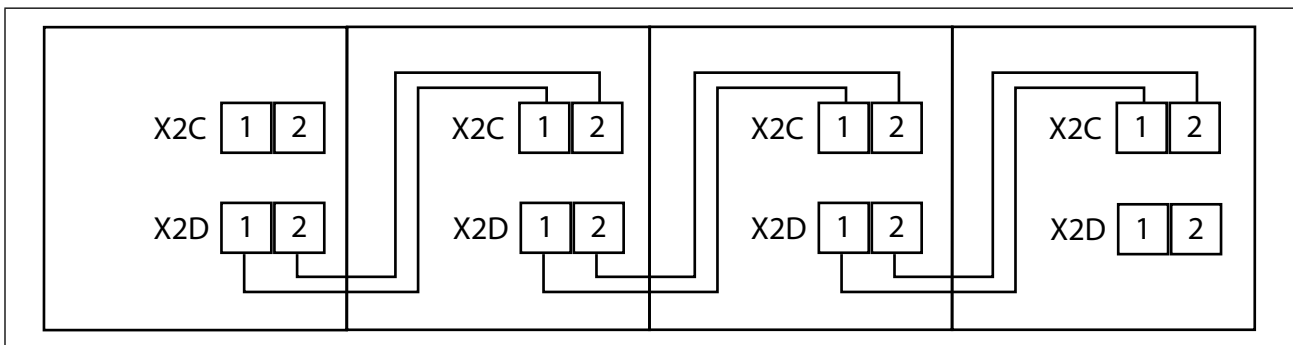


Figure 17: Wiring example error linkage circuit

4.3.2 EtherCat system bus terminal X4B

The EtherCAT system bus serves for the communication of the master with the axis modules and the power supply and regenerative unit. „CanOpen over EtherCAT “ is used as protocol. Upto eight axes can be operated isochron with a cycle time of <math><250 \mu\text{s}</math>.

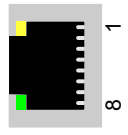
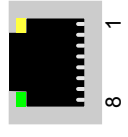
Description of the LEDs		RJ45 socket		Assignment	
LED green	Link		X4C EtherCAT OUT	1	TX+
off	Connection off			2	TX-
flashing	Communication			3	RX+
on	Connection on			4	–
				5	–
LED yellow	Speed		X4B EtherCAT IN	6	RX-
off	10 MBit			7	–
on	100 Mbit			8	–

Table 14: EtherCat System bus socket X4B

4.3.3 Diagnosis/Visualisation X4A

The integrated RS232/485 interface serves for the connection of service tools (e.g. COMBIVIS) and displays. Telegram DIN66019II is used as communication protocol.

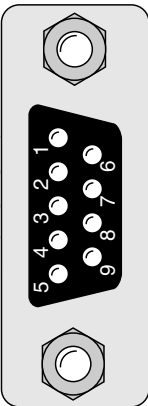
Interface	Standard	Connecting cable
RS485	TIA/EIA-485 and ISO 8482	
RS232	ANSI TIA/EIA-232	0058025-001D and if necessary USB serial converter

Table 15: Diagnosis/Visualisation X4A

ATTENTION

The diagnostic interface is not electrically isolated, it has the same potential as control potential.

4.3.3.1 Assignment of the interfaces

				
reserved - do not assign!	1		6	reserved - do not assign!
TxD (RS232)	2		7	DGND (reference potential)
RxD (RS232)	3		8	TxD-A (RS485)
RxD-A (RS485)	4		9	TxD-B (RS485)
RxD-B (RS485)	5			
<p>Figure 18: Assignment of the interfaces</p>				

4.3.4 Digital inputs and outputs X2A

Additionally to the central inputs and outputs of the control unit each axis module is equipped with own inputs and outputs. Terminal block X2A includes four digital inputs and four digital outputs with the appropriate mass terminals.

4.3.4.1 Technical data of the inputs

The digital inputs are specified in accordance with IEC61131-2 type 3.

Status „0“	Status „1“
-3...5V	11...30V

4.3.4.2 Technical data of the outputs

The digital outputs are short-circuit proof and specified in accordance with [IEC61131-2](#).

Max. switching voltage	30V
Max. current	0.7A per output 1A total current for all outputs
Internal resistance	250 Ω
Max. switching frequency	1 kHz
Inductive load	without free-wheeling diode max. 300 mJ

Table 16: Technical data of the outputs

4.3.5 Assembly of the wires to PUSH IN terminals

ATTENTION

Malfunctions caused by loose cable connections!

- Observe metal sleeve length and stripping length

Cross-section	Wire-end ferrule	Metal sleeve length	Stripping length
0.50 mm ²	with plastic collars (DIN 46228-4)	10 mm	12 mm
0.75 mm ²		12 mm	14 mm
1.00 mm ²		12 mm	15 mm
1.50 mm ²	without plastic collars (DIN 46228-1)	10 mm	10 mm
0.2...1.5 mm ² single-wire or fine-wire	without wire-end ferrule	–	10...15 mm

Table 17: Wire-end ferrules and stripping length

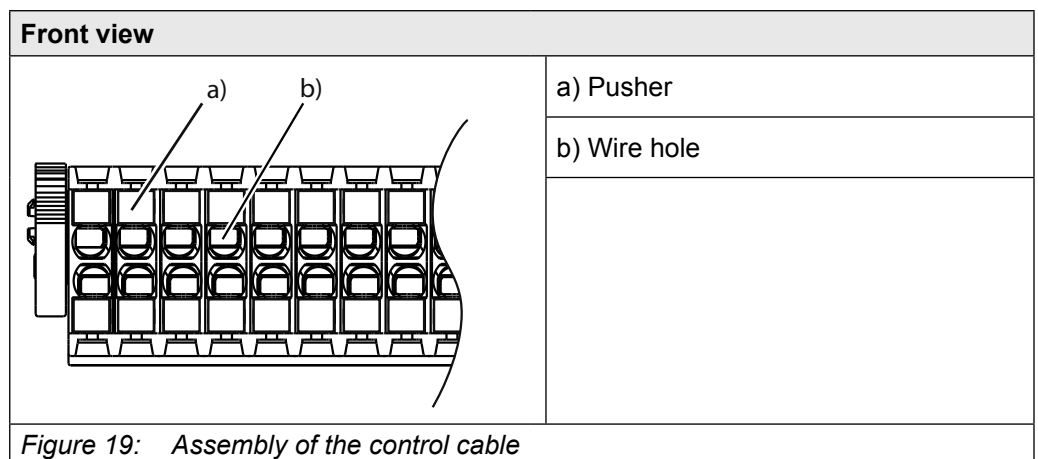


Figure 19: Assembly of the control cable

- Press pusher by hand. Insert connecting wires into the respective hole, that no single wires can be seen from the outside or bend outward. A first resistance must be overcome when inserting. Release the pusher.
- Check that the connecting wire is fixed and can not be pulled-out. It is important to ensure that the connecting wire and not the insulation is clamped. The connecting wire can also be inserted without pressing the pusher in case of cross-sections upto 1.00 mm².

4.3.5.1 Assignment of the terminal block X2A

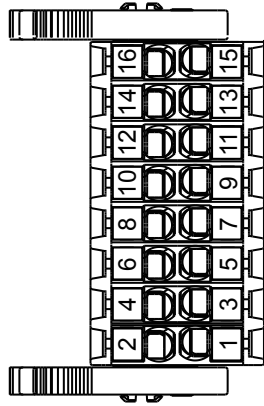
Digital inputs and outputs						
Function	Pre-setting	Term.		Term.	Function	
Digital input DI 4	Prog. /ext. error	16		15	0V	
Digital input DI 3	not preset	14		13	0V	
Digital input DI 2	Soft-/hardware release, unchangeable	12		11	0V	
Digital input DI 1	Control release/reset, unchangeable	10		9	0V	
Digital output DO 4	not preset	8		7	0V	
Digital output DO 3	Thyristor active/deactive	6		5	0V	
Digital output DO 2	Error	4		3	0V	
Digital output DO 1	Release axis module	2		1	0V	

Figure 20: Assignment of the terminal block X2A

4.3.5.2 Connection of the digital inputs

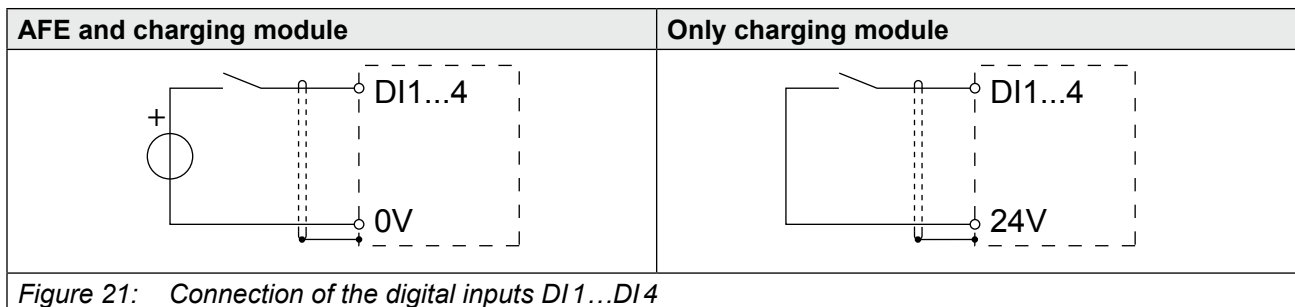


Figure 21: Connection of the digital inputs DI 1...DI 4

4.3.5.3 Connection of the digital outputs

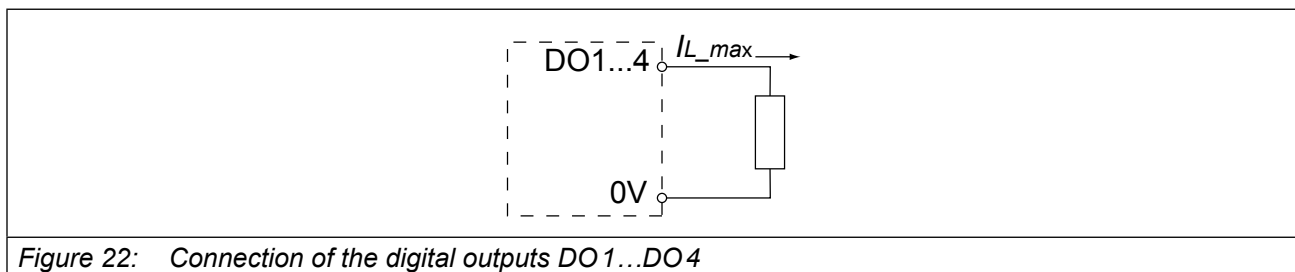
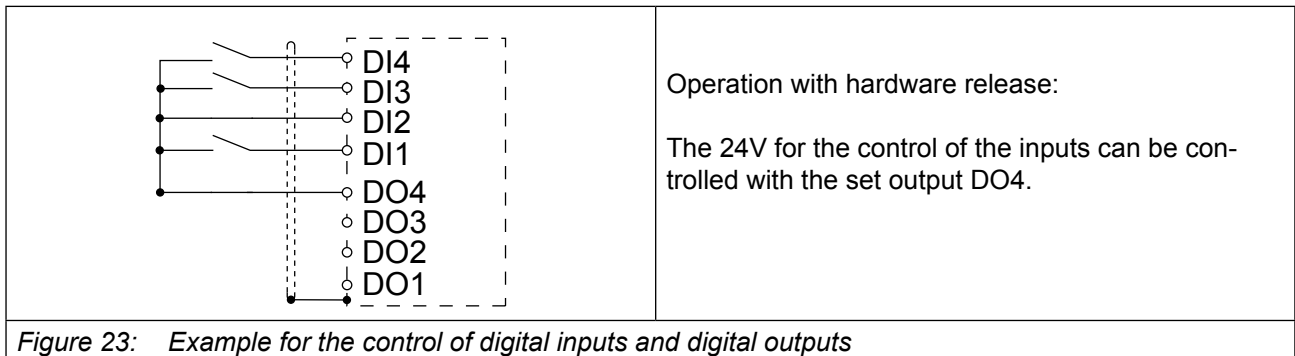


Figure 22: Connection of the digital outputs DO 1...DO 4

4.3.5.4 Example for the control of digital inputs and digital outputs



5 Certification

5.1 CE Marking


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

The drive converter or servo drive must not be started until it is determined that the installation complies with the Machine directive (2006/42/EC) as well as the EMC-directive (2004/108/EC)(note [EN 60204-1](#)).

The drive converters and servo drives meet the requirements of the Low-Voltage Directive 2006/95/EC. The harmonized standards of the series [EN 61800-5-1](#) in connection with [EN 60439-1](#) and [EN 60146](#) were used.

This is a product of limited availability in accordance with [EN 61800-3](#). This product may cause radio interference in residential areas. In this case the operator may need to take corresponding measures.

5.2 UL Marking

	<p>Acceptance according to UL is marked at KEB inverters with the adjacent logo on the type plate.</p>
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To be conform according to UL for use on the North American and Canadian Market the following additionally instructions must be observed (summary of original texts of the UL files):

- These devices shall be mounted within a suitable ultimate enclosure.
- These devices are intended for use in a controlled environment, Pollution Degree 2 or cleaner.
- The spacings from exposed live parts to other live parts or enclosure shall be maintained in accordance with the requirements for the end-use equipment.
- Devices provided with Flat Rear Heat Sink are intended to be mounted with adequate Heat Sink assemblies in the end-use equipment. The cooling suitability of the devices provided with a Flat Rear Heat Sink, shall be determined in the end-use equipment by subjected Temperature Test.
- These devices shall be used within their electrical rating.
- The terminals on these devices are suitable for factory and field wiring.
- These devices are evaluated for use in maximum Surrounding Air Temperature of 45°C.
- These devices shall be provided with a wiring diagram to indicate the wiring connections.
- These devices are evaluated for use with the following copper conductors only:

Inverter	Copper conductors
19H6	60°C or 75°C
20H6	
21H6	
24H6	75°C
25H6	
27H6	
28H6	

- These supply modules are only for use with drive modules that are part of the COMBIVERT H6 series.
- Brake Resistors provided in the end-use shall be controlled by manufacturer and type designation, and separately subjected to above specified tests, due to differences in brake resistors construction, even with identical rating.
- Connection of an External Temperature Sensor was not evaluated.
- Maximum heatsink temperature for H6 models shall be maintained at the following listed values via a liquid cooled system:

Inverter	Maximum heatsink temperature
19H6	80°C
20H6	
21H6	60°C
24H6	80°C
25H6	60°C
27H6	80°C
28H6	60°C

- Suitable for use on a Circuit Capable of delivering not more 18k rms Symmetrical Amperes, 480 Volts maximum when protected by fuses as specified in the following table:

Branch Circuit Protection for Rectifier Units H6:

UL 248 Fuses; Class J as specified below

Inverter	Input Voltage [V]	UL 248 Fuse [A]
19H6	480 / 3ph	60
20H6	480 / 3ph	80
21H6	480 / 3ph	100
24H6	480 / 3ph	200
25H6	480 / 3ph	250
27H6	480 / 3ph	300
28H6	480 / 3ph	400

5.3 Further information and documentation

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

General instructions

- EMC and safety instructions
- Manuals for further control boards

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 certification
- FS certification

Others

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

6 Cooling System

6.1 Installation of water-cooled units

Water-cooled drive converters are operated in continuous operation with lower temperature than air-cooled inverters. This has positive effects on lifetime-relevant components such as fan and DC link circuit capacitors and power modules (IGBT). Also the temperature dependent switching losses are positively effected. The use of water-cooled KEB COMBIVERT drive converters is offered in the drive technology, because there are process-caused coolants available with some applications. The following instructions must be observed absolutely when this units are used.

6.1.1 Heat sink and operating pressure

Design system	Material (voltage)	max. operating pressure	Connecting duct
Extrusion casting heat sink	Aluminium (-1.67 V)	10 bar	0000650-G140

The heat sinks are sealed with sealing rings and posses a surface protection (anodized) even in the ducts.

ATTENTION

Maximum operating pressure

The heat sink is permitted for a pressure or leak test upto 2-fold, maximum operating pressure. An UL acceptance with 5-fold, maximum operating pressure was executed. Pay attention to the guidelines 97/23/EC of pressure units.

6.1.2 Materials in the cooling circuit

For the screw connections and also for the metallic articles in the cooling circuit which are in contact with the coolant (electrolyte) a material is to be selected, which forms a small voltage difference to the heat sink in order to avoid contact corrosion and/or pitting corrosion (electro-chemical voltage series, see table). An aluminum screw connection or ZnNi coated steel screw connection is recommended. Other materials must be examined in each case before employment. The specific case of application must be checked by the customer in tuning of the complete cooling circuit and must be classified according to the used materials. With hoses and seals take care that halogen-free materials are used.

A liability for occuring damages by wrongly used materials and from this resulting corrosion cannot be taken over!

Material	Generated Ion	Standard potential	Material	Generated Ion	Standard potential
Lithium	Li ⁺	-3.04 V	Cobald	Co ²⁺	-0.28 V
Potassium	K ⁺	-2.93 V	Nickel	Ni ²⁺	-0.25 V
Calcium	Ca ²⁺	-2.87 V	Tin	Sn ²⁺	-0.14 V
Sodium	Na ⁺	-2.71 V	Lead	Pb ³⁺	-0.13 V
Magnesium	Mg ²⁺	-2.38 V	Iron	Fe ³⁺	-0.037 V
Titan	Ti ²⁺	-1.75 V	Hydrogen	2H ⁺	0.00 V

continued on the next page

6.1.3 Requirements on the coolant

The requirements on the coolant are depending on the ambient conditions, as well as from the used cooling system. General requirements on the coolant:

Standards	TrinkwV 2001, DIN EN 12502 part 1-5, DIN 50930 part 6, DVGW work sheet W216
VGB Cooling water directive	The VGB cooling water directive (VGB-R 455 P) contains instructions about common process technology of the cooling. Particularly the interactions between cooling water and components of the cooling system are described.
pH-value	Aluminum is particularly corroded by lixiviums and salts. The optimal pH value for aluminum should be in the range of 7.5... 8.0.
Abrasive substances	Abrasive substances as used in abrasive (quartz sand), clogging the cooling circuit.
Copper cuttings	Copper cuttings can attach the aluminum and this leads to a galvanic corrosion. Copper should not be used together with aluminum due to electro-chemical voltage difference.
Hard water	Cooling water may not cause scale deposits or loose excretions. It shall have a low total hardness (<20°d) especially carbon hardness.
Soft water	Soft water (<7°dH) corrodes the material.
Frost protection	An appropriate antifreeze must be used for applications when the heat sink or the coolant is exposed temperatures below zero. Use only products of one manufacturer for a better compatibility with other additives.
Corrosion protection	Additives can be used as corrosion protection. In connection with frost protection the antifreeze must have a concentration of 20...25Vol %, in order to avoid a change of the additives.
<i>Table 18: Requirements on the coolant</i>	

Special requirements for open and half-open cooling systems:

Impurities	Mechanical impurities in half-open cooling systems can be counteracted when appropriate water filters are used.
Salt concentration	The salt content can increase through evaporation at half-open systems. Thus the water is more corrosive. Adding of fresh water and removing of process water works against.
Algae and myxobacteria	Algae and myxobacteria can arise caused by increased water temperature and contact with atmospheric oxygen. The algae and myxobacteria clog the filters and obstruct the water-flow. Biocide containing additives can avoid this. Especially at longer off periods of the cooling circuit preventive maintenance is necessary.
Organic materials	The contamination with organic materials must be kept as small as possible, because separate slime can be caused by this.

ATTENTION

Loss of the warranty claims

Damages at the unit which are caused by clogged, corroded heat sinks or other obvious operating errors, leads to the loss of the warranty claims.

6.1.4 Connection to the cooling system

- Screw in connecting duct in accordance with the manual.
- The connection to the coolant must be carried out with flexible, pressure-resistant hoses and secured with clamps.
- Pay attention to flux direction and check tightness!
- The cooling flow must always be started before starting the KEB COMBIVERT.

The connection to the cooling system can occur as closed or open cooling circuit. The connection to a closed cycle cooling circuit is recommended, because the danger of contamination of coolant is very small. Preferably also a monitoring of the pH value of the coolant should be installed.

Pay attention to a corresponding cable cross section at required equipotential bonding in order to avoid electro-chemical procedures.

6.1.5 Coolant temperature and moisture condensation

The inlet temperature may not exceed 40 °C. The maximum heat sink temperature is 60 °C or 80 °C depending on the power unit and overload capacity (see „Technical data“). To ensure a safe operation the coolant output temperature must be 10K below this temperature.

Due to high air humidity and high temperatures it can lead to moisture condensation. Moisture condensation is dangerous for the drive converter, because the drive converter can be destroyed through eventual occurring short-circuits.

ATTENTION

The user must guarantee that any moisture condensation is avoided!

In order to avoid a moisture condensation the following possibilities can be done. The application of both methods is recommended.

Supply of temper coolant

This is possible by using heatings in the cooling circuit for the control of the coolant temperature. The following dew point table is available for this:

Coolant inlet temperature is depending on ambient temperature and air humidity:

Air humidity in % \ Surrounding temperature in °C	10	20	30	40	50	60	70	80	90	100
-25	-45	-40	-36	-34	-32	-30	-29	-27	-26	-25
-20	-42	-36	-32	-29	-27	-25	-24	-22	-21	-20
-15	-37	-31	-27	-24	-22	-20	-18	-16	-15	-15
-10	-34	-26	-22	-19	-17	-15	-13	-11	-11	-10
-5	-29	-22	-18	-15	-13	-11	-8	-7	-6	-5
0	-26	-19	-14	-11	-8	-6	-4	-3	-2	0
5	-23	-15	-11	-7	-5	-2	0	2	3	5
10	-19	-11	-7	-3	0	1	4	6	8	9
15	-18	-7	-3	1	4	7	9	11	13	15
20	-12	-4	1	5	9	12	14	16	18	20
25	-8	0	5	10	13	16	19	21	23	25
30	-6	3	10	14	18	21	24	26	28	30
35	-2	8	14	18	22	25	28	31	33	35
40	1	11	18	22	27	31	33	36	38	40
45	4	15	22	27	32	36	38	41	43	45
50	8	19	28	32	36	40	43	45	48	50

Table 19: Supply of temper coolant

Temperature control

The cooling system can be connected by means of pneumatic or magnetic valves. A relay is frontend. In order to avoid pressure surges, the valves for the temperature control must be inserted in the flow line of the cooling circuit. All usual valves can be used. Pay attention that the valves are faultless and do not clamp.

Emptying the cooling circuit

If a system shall be switched off for a longer period, the cooling circuit must be drained completely. In the case of temperatures below 0°C, the cooling circuit must be blown out additionally with compressed air.

6.1.6 Coolant heating depending on power loss and flow rate with water

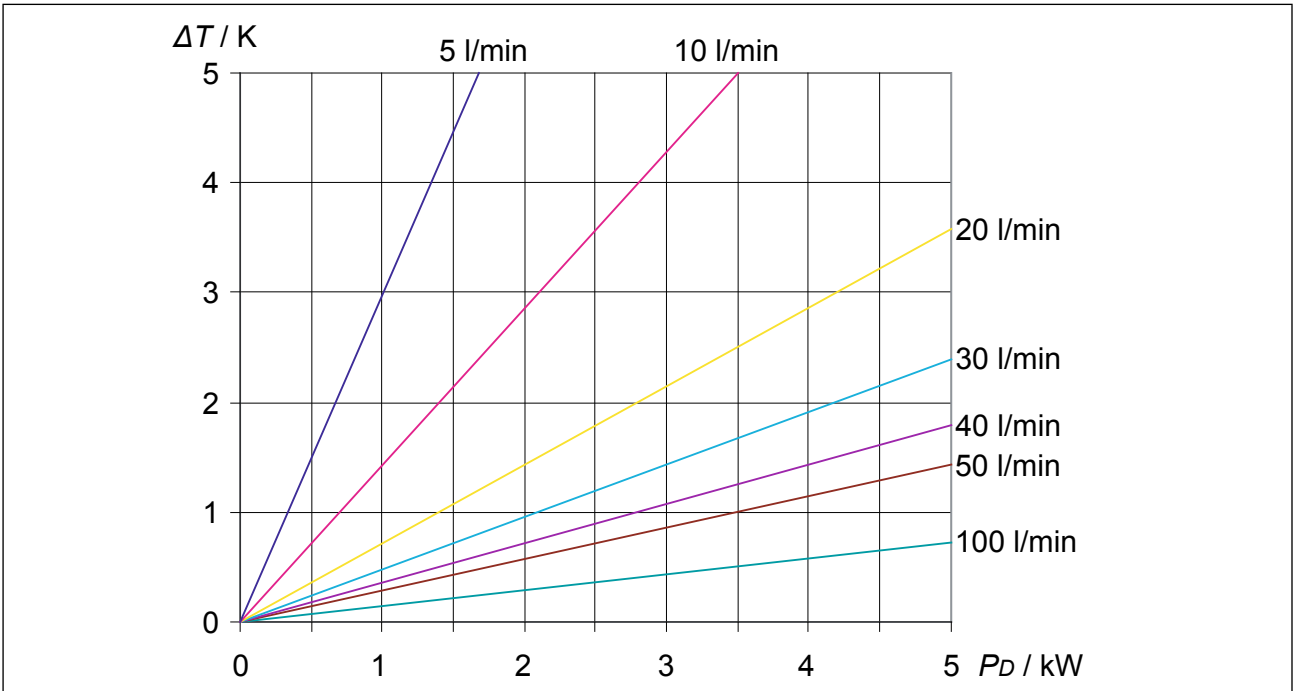


Figure 24: Coolant heating depending on power loss

6.1.7 Typically fall of pressure depending on the rate of flow

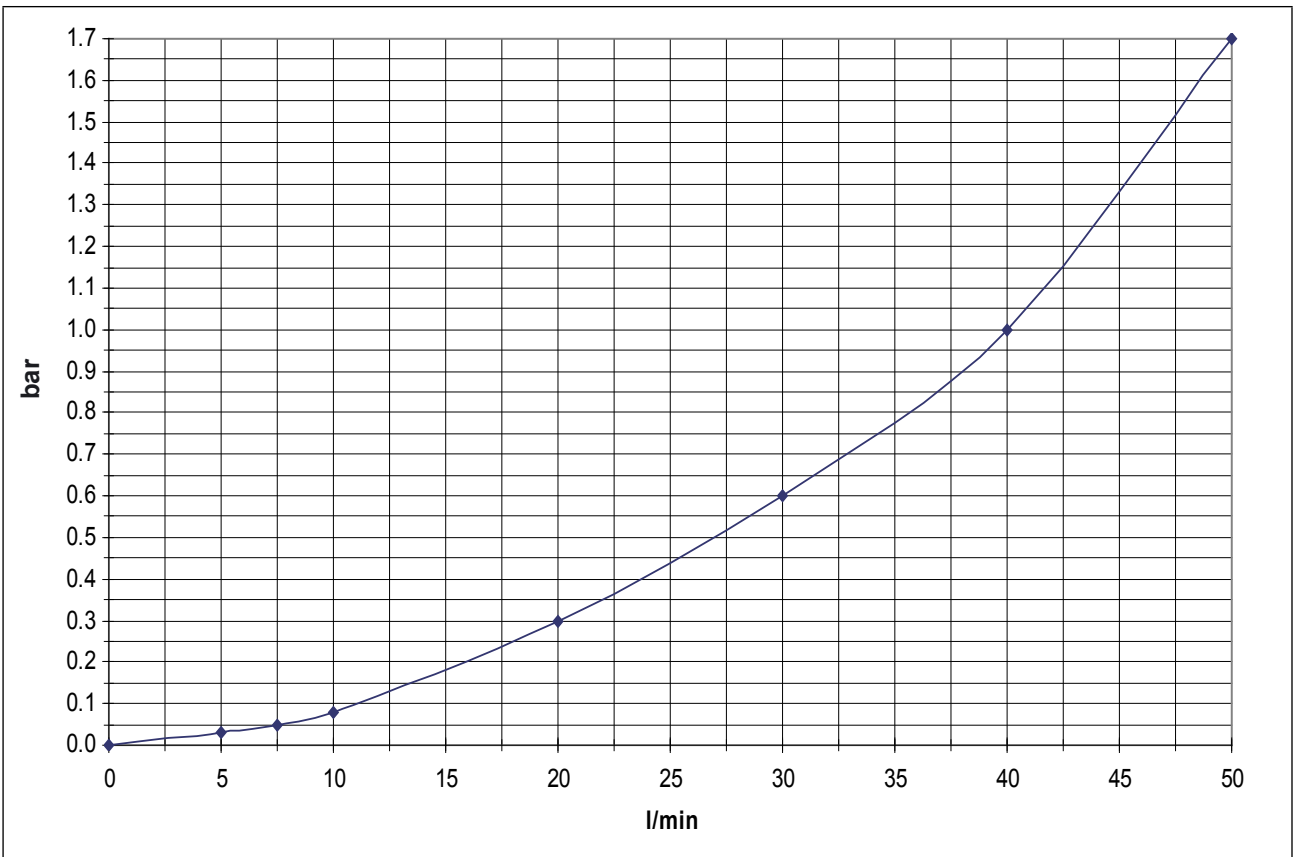


Figure 25: Typically fall of pressure depending on the rate of flow

7 Revision History

Version	Date	Description
00	2015-11	Conversion to document version
01	2016-08	Heatsink concepts, wrong terminal
02	2018-01	New CI optics, general revision, linking with InCopy components
03	2019-06	Product description adapted, updates have been made

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