COMBIVERT **H6**

INSTRUCTIONS FOR USE | **INSTALLATION 24V POWER SUPPLY MODULE**

Translation of original manual
Document 20105427 EN 04

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.

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

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Glossary

0V	Earth-potential-free common point
1ph	1-phase mains
3ph	3-phase mains
AC	AC current or voltage
AFE	From 07/2019 AIC replaces the previous name AFE
AFE filter	From 07/2019 AIC filter replaces the previous name AFE filter
AIC	Active Front End module
AIC filter	Filter for Active Front End Module (AIC)
Application	The application is the intended use of the KEB product.
ASCL	Asynchronous sensorless closed loop
Auto motor ident.	Automatically motor identification; calibration of resistance and inductance
AWG	American wire gauge
B2B	Business-to-business
BiSS	Open source real-time interface for sensors and actuators (DIN 5008)
CAN	Fieldbus system
CDM	Complete drive module including auxiliary equipment (control cabinet)
COMBIVERT	KEB drive converters
COMBIVIS	KEB start-up and parameterizing software
Customer	The customer has purchased a KEB product from KEB and integrates the KEB product into his product (customer product) or resells the KEB product (dealer)
DC	DC current or voltage
DI	Demineralized water, also referred to as deionized (DI) water
DIN	German Institut for standardization
DS 402	CiA DS 402 - CAN device profile for drives
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
End customer	The end customer is the user of the customer product.
Endat	Bidirectional encoder interface of the company Heidenhain
EtherCAT	Real-time Ethernet bus system of the company Beckhoff
Ethernet	Real-time bus system - defines protocols, plugs, types of cables
FE	Functional earth
FSoE	Functional Safety over Ethernet
FU	Drive 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
IEC	International standard
IP xx	Degree of protection (xx for level)
KEB product	The KEB product is subject of this manual.
KTY	Silicium temperature sensor (polarized)
Manufacturer	The manufacturer is KEB, unless otherwise specified (e.g. as manufacturer of machines, engines, vehicles or adhesives).
MCM	American unit for large wire cross sections
Modulation	Means in drive technology that the power semiconductors are controlled
MTTF	Mean service life to failure
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)
PDS	Power drive system incl. motor and measuring probe
PE	Protective earth
PELV	Protective Extra Low Voltage
PFD	Term used in the safety technology (EN 61508-1...7) for the size of error probability

PFH	Term used in the safety technology (EN 61508-1...7) for the size of error probability per hour
PLC	Programmable logic controller
PT100	Temperature sensor with R0=100Ω
PT1000	Temperature sensor with R0=1000Ω
PTC	PTC-resistor for temperature detection
PWM	Pulse width modulation
RJ45	Modular connector with 8 lines
SCL	Synchronous sensorless closed loop
SELV	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 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

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 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!

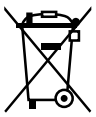
- ► The function of the drive converter is dependent on its parameterization. Never replace without knowledge of the application.
- ► Modification or repair is permitted only by KEB Automation KG authorized personnel.
- ► Only use original manufacturer parts.
- ► Infringement will annul the liability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

Unit type	24V power supply module with/without output terminal Control module with 24V power supply

2.3.1 COMBIVERT H6 series

Application area	• large power range at the axis • adaptable by modular design according to the application
Safety	• STO, SBC as standard • expandable by modules according to the requirements
Cooling System	• Flat rear on different heat sink sizes • Air heat sink

continued on the next page

Control	• EtherCAT system bus for transmission of setpoints and actual values between control, Active Front End modules and axis modules. • Drive profiles according to CiA402
Regulation	• Synchronous and asynchronous machines, with and without encoder feedback
Error bus	• Channel 1: Error output of the connected DC buses • Channel 2: Charge condition of the DC link bus
Separate supply	• internal supply of the control circuit and driver/control circuit are safely separated

2.3.2 24V power supply module without output terminal

Output	• Short-circuit proof 24V DC voltage power supply with 25A rated output current • 1 x DC 24 V / 19A output (optional)
Input	• Mains supply without connection to the DC link of the H6 system (thus decoupling of the supply at B6 supply / Active Infeed Controller) • Mains supply with connection to the DC link of the H6 system in order to use regenerative energy for buffering in case of power failure

2.3.3 24V power supply module with output terminal

Output	• Short-circuit proof 24V DC voltage power supply with 25A rated output current • 1 x DC 24 V / 5A output • 1 x DC 24 V / 7A output • 1 x DC 24 V / 19A output (optional)
Input	• Mains supply without connection to the DC link of the H6 system (thus decoupling of the supply at B6 supply / Active Infeed Controller) • Mains supply with connection to the DC link of the H6 system in order to use regenerative energy for buffering in case of power failure
Digital inputs and outputs	• 1 x digital input • 1 x digital output

2.3.4 Control module with 24V power supply

Output	• Short-circuit proof 24V DC voltage power supply with 25A rated output current • 4 x DC output 24 V / 0.7 A (max. 1 A total current) • 1 x DC 24 V / 19 A output (optional)

continued on the next page

Input	• Mains supply without connection to the DC link of the H6 system (thus decoupling of the supply at B6 supply / Active Infeed Controller) • Mains supply with connection to the DC link of the H6 system in order to use regenerative energy for buffering in case of power failure
Digital inputs and outputs	• 4 x digital input • 4 x digital output
Fieldbus	• EtherCAT • optional PROFIBUS DP, InterBus, CanOpen, Profilink, ProfiNET
Diagnosis/visualisation	RS232/485 interface with DIN66019II protocol

2.4 Type code

x x H 6 x x x - x x x x

reserved	0: reserved
Encoder interface	A: No encoder interface B: Two-channel multi encoder interface
Software configuration	1: BASIC 2: PRO ADVANCED 3-9: KEB default A-Z: Customer / special version
Hardware configuration	1: No DC bus connection 2: DC bus connection / operation at rectifier modules (B6) 3: DC bus connection / operation at Active Front End modules (AIC) 4: No DC bus connection with external 24V connection 5: DC bus connection / operation at rectifier modules (B6) with external 24V connection 6: DC bus connection / operation at Active Front End modules (AIC) with external 24V connection A-Z: Customer / special version(firmware and download)
Housing	B: 50 mm flat rear heat sink P: 50 mm air-cooled heat sink
Control type	B: 24V power supply module without control terminal strip C: 24V power supply module with control terminal strip D: Control module with 24V power supply
Unit type	G: 24V power supply module / control module
Series	H6 multi-axes drive system

continued on the next page

x x	H 6	x	x	x	-	x	x	x	x

Fieldbus slave module	01: No fieldbus slave module
	02: reserved
	03: PROFIBUS® 1) DP
	04: Interbus
	05: CANopen® 2)
	06: ProfiNet
	07: POWERLINK
	08: EtherCAT® 3)

Table 1: Type code

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

1) *PROFIBUS® is a registered trademark of the PROFIBUS user organisation e.V.*

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

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

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 • 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/s² (9…200 Hz)
Shock limit values	*EN 60721-3-1*	1M1	40 m/s²; 22 ms
Transport	**Standard**	**Class**	**Notes**
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**	**Notes**
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
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	Gases	*EN 60721-3-1*	1C2	–
	Solids		1S2	–
Transport		**Standard**	**Class**	**Notes**
Contamination	Gases	*EN 60721-3-2*	2C2	–
	Solids		2S2	–
Operation		**Standard**	**Class**	**Notes**
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	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: Equipment 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 24V modules

Housing			**B, P**
Input data mains supply			
Rated input voltage		U_N / V	400
Rated input voltage UL		U_{N_UL} / V	480
Input voltage range		U_{in} / V	320…528
Input voltage range	1)	U_{in_dc} / V	210…750
Mains frequency		f_N / Hz	50/60 ±2
Phases			3
Rated input power		S_N / kVA	0.6
Rated input current		I_N / A	1
Max. permissible main fuse type gL/gG		I_a / A	10
Supply cable cross-section		A_a / mm²	1.5
Input data DC supply			
DC supply			Only for connection to H6 DC bus
Output data			
Rated output voltage		U_{outN_dc} / V	24.2 (± 2%)
Rated output current 1 (internal)		I_{outN_dc} / A	25
Rated output current 2 (X2A)	2)	I_{outN_dc} / A	5
Rated output current 3 (X2A)	2)	I_{outN_dc} / A	7
Rated output current 4 (X1B)	3)	I_{outN_dc} / A	19
Rated output current total (1-4)		I_{outN_dc} / A	25
Connection cross section 24V bus		$A_{\_24v}$ / mm²	2 x 1.0
Other data			
Fuse F1 (5 x 20 mm, time-lag)	4)	I_{F1} / A	20
Power dissipation heat sink		P_{D_ext} / W	tbd
Power dissipation interior		P_{D_int} / W	tbd
Max. heat sink temperature		T_{HS} / °C	80
Supply control circuit			
Input voltage		U_{CU_dc} / V	24 (±10 %)
Input current	5)	I_{CU_dc} / A	0,6

Table 7: Performance data

1) Powerderating U_{in} < 260 VDC 2 %/V.

2) Only for control type „C“.

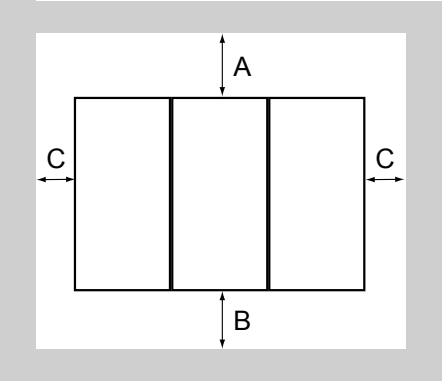
3) Only at xxH6xxx-Yxxx Y = 4,5,6.

4) The dimensioning of the external 24 V connection cables depends on the application. The microfuse F1 must be adjusted to a lower value according to the application, if necessary.

5) Only for control type „D“; Input current, if no digital input is set. The input current can increase to maximally 0.7 A at max. load of the digital output.

3.3 Mechanical installation

3.3.1 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.

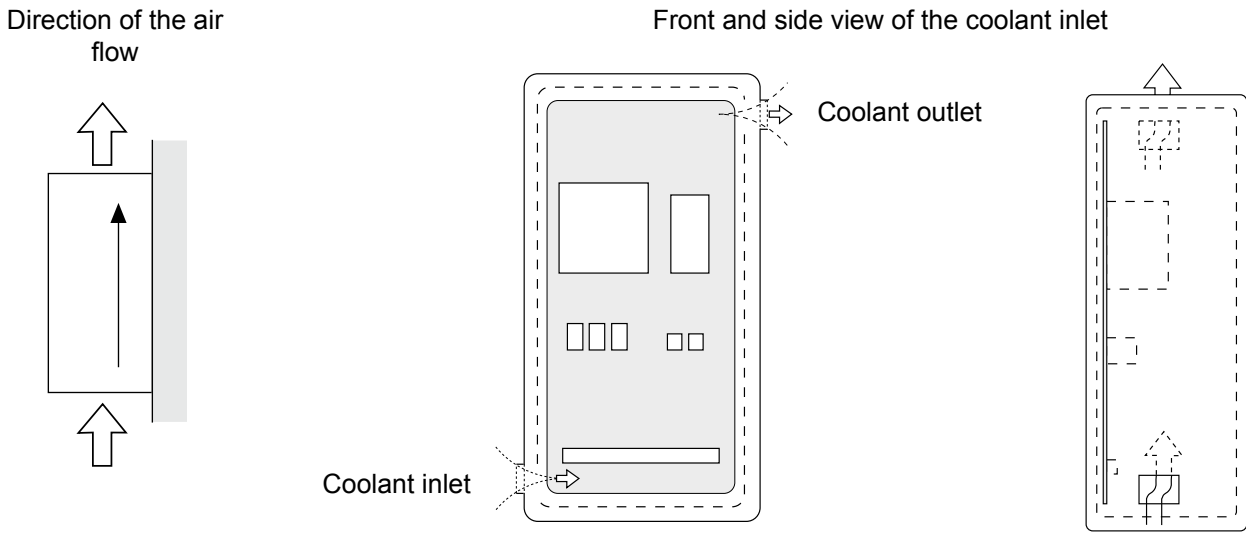


Figure 1: Control cabinet installation

3.3.2 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.

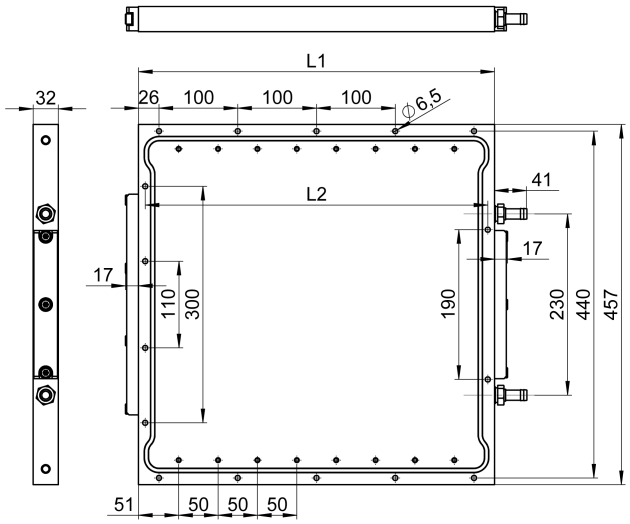
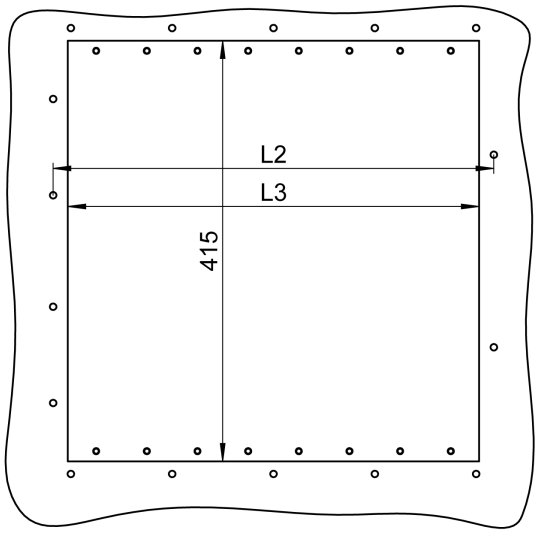
3.3.3 Dimensions central heat sink

3.3.3.1 Air heat sink

Central heat sink for air-cooling upon request.

3.3.3.2 Liquid heat sinks

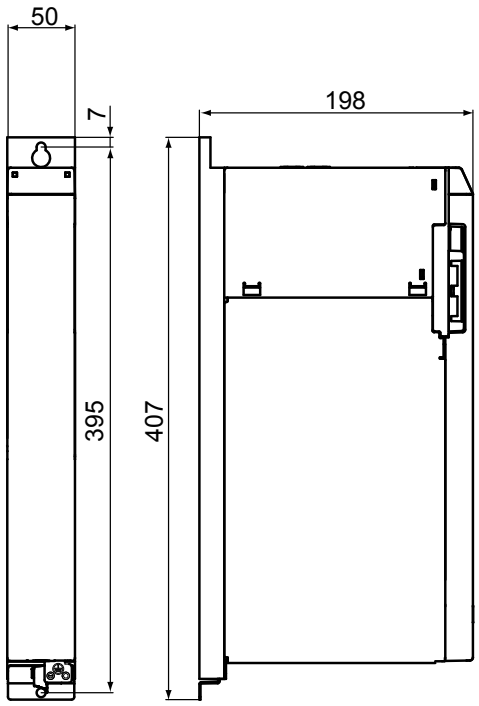
Following liquid heat sinks are available, if no usable cooling surface exists at customer side:

Heat sink	Cabinet outcut
	

Size	L1 in mm	L2 in mm	L3 in mm
04H6TFW-0400	452	435	406
06H6TFW-0600	652	635	606
08H6TFW-0800	852	835	806
10H6TFW-1000	1052	1035	1006
12H6TFW-1200	1252	1235	1206

Figure 2: Main heat sink for COMBIVERT H6

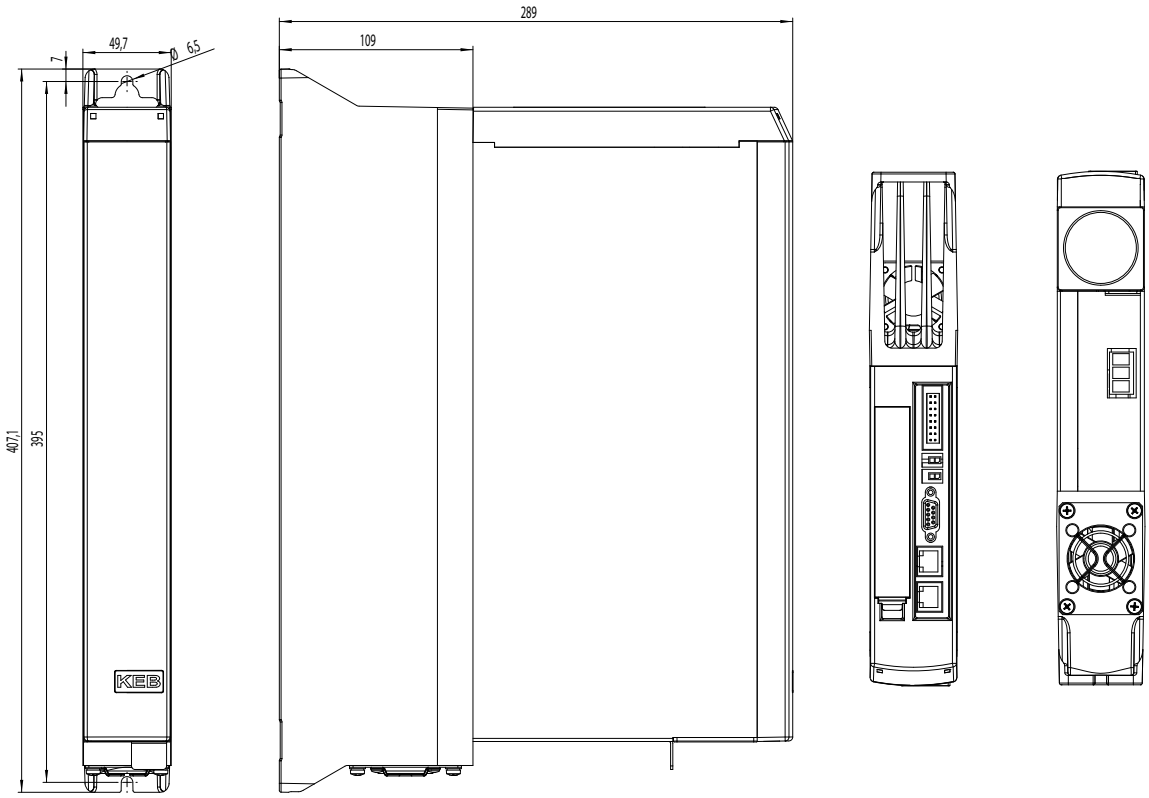
3.3.4 Dimensions and weights of modules with flat rear heat sink



Housing size	Module width in mm	Weight in kg
B	50	3.8
B (with control module)	50	4.0

Figure 3: Dimensions and weights of modules with flat rear heat sink

3.3.5 Dimensions and weights of modules with air heat sink



Housing size	Module width in mm	Weight in kg
P	50	5.5

Figure 4: Dimensions and weights of modules with air heat sink

4 Installation and Connection

4.1 Construction of the unit

Front view		Front without cover
	**Remove the front cover** • Press with your thumb centrally the bottom of the lid. • Slightly lift the lid at the bottom. • Pull the lid downwards. **Remove the cover from the DC bus** • Press the lugs of the cover together and pull them off to the front.	

Figure 5: Front view of the device

DANGER

Dangerous voltage

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

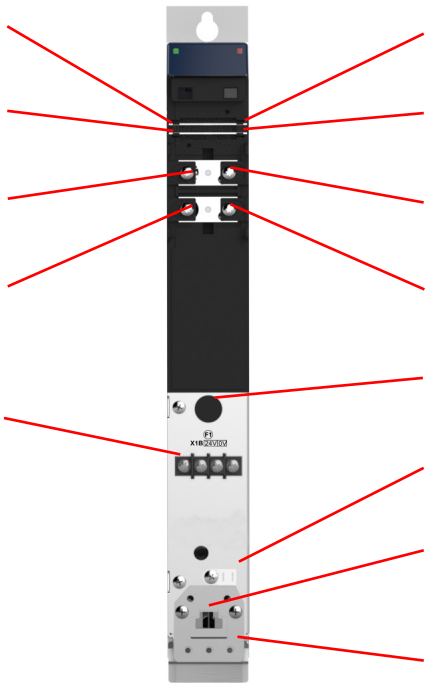
Description	Terminal	Connections of the front side	Terminal	Description
+24V bus	X1C.1		X1C.3	+24V bus
0 V	X1C.2		X1C.4	0 V
DC bus+	X1D.1		X1D.3	DC bus+
DC bus-	X1D.2		X1D.4	DC bus-
24V 0V (optional)	X1B		F1	Microfuse (optional) 5 x 20 mm, T 20A
			—	Cable fastening (strain relief)
			—	Snapper for front cover
			⏚	Connection for protective earth [1]

Figure 6: Connections of the front side

1) Only available with material number xH6xxx-[4, 5, 6]xxx.

View rear side of the unit

Size B/P

1)

Line terminal strip X1A		
L1	Mains input 3-phase 400 V	
L2		
L3		
	Cross-section	**Tightening torque**
	0.2...6 mm² AWG 24-10	0.7 Nm 6.2 lb inch
Protective earth and function earth		
⏚	2 x screw terminal for ring cable lug Ø 4 mm thereof 1 x protective earth 1 x function earth 3 x screw terminal for ring cable lug [1)]	
	Cross-section	**Tightening torque**
	Screw M4 for ring cable lug	1.3 Nm 11.5 lb inch

Figure 7: View rear side of the unit

1) Only available with material number xH6xxx-[4, 5, 6]xxx.

The terminal strips meet the requirements of *EN 60947-7-1*.

View of the unit top side for control type „D“

X2A	Digital inputs and outputs			
	Dig. input 4	16	15	DC 24 V/< 0.7 A output
	Dig. input 3	14	13	DC 24 V/< 0.7 A output
	Dig. input 2	12	11	DC 24 V/< 0.7 A output
	Dig. input 1	10	9	DC 24 V/< 0.7 A output
	Dig. output 4	8	7	0 V
	Dig. output 3	6	5	0 V
	Dig. output 2	4	3	0 V
	Dig. output 1	2	1	0 V
X2C	Error chain	2	1	Charge condition of the DC link and error output of the axis modules
X2D	Error chain	2	1	
X4A	reserved	1		
	TxD (RS232)	2	6	reserved
	RxD (RS232)	3	7	DGND (reference potential)
	RxD-A (RS485)	4	8	TxD-A (RS485)
	RxD-B (RS485)	5	9	TxD-B (RS485)
X4C	Ethernet CoDeSys, COMBIVIS, visualisation or superior control	LED	1	TX+
		Speed	2	TX-
			3	RX+
			4	–
			5	–
			6	RX-
X4B	EtherCAT Master out	Link	7	–
		LED	8	–

Figure 8: View of the unit top side for control type „D“

View of the unit top side for control type „C“

X2A

Digital inputs and outputs			
Output 3 (DC 24 V / 7 A)	16	15	0 V
	14	13	
	12	11	
	10	9	
Output 2 (DC 24 V / 5 A)	8	7	0 V
	6	5	
	4	3	
DI1 digital input (release for output DC 5A)	2	1	DO1 digital output voltage output Release (DC 24V / 100 mA)

Figure 9: View of the unit top side for control type „C“

4.1.1 Status LEDs

Status LED Safety module		**Status LED Unit**
- without function -		only for control type „D“ and „C“

Figure 10: Status LEDs

4.2 Connection of the power unit

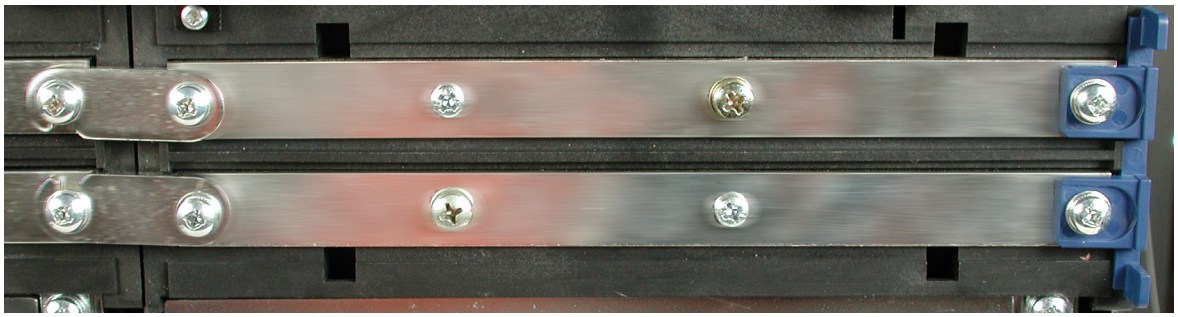
4.2.1 Connection of the DC bus X1D

The tinned copper bars connect the DC bus of the different H6 devices. Precharging, power supply and regeneration (if required) is provided by the Active Front End module (AIC) or the rectifier module. The 24V power supply module provides the 24V voltage. 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

Dangerous voltage

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



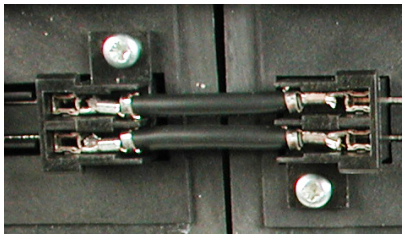
Bridges for the connection of the DC bus between the units	upper rail = DC+ lower rail = DC–	Place plastic cap as protection against accidental contact at the end of the system
Torx oval-head screw M4x10	required tool Torx screwdriver TX20	Tightening torque3.0 Nm (bridge) 1.1…1.2 Nm (plastic cap)

Figure 11: 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 24V DC voltage. This voltage is usually provided by the COMBIVERT H6 power supply module, but can also be used by an existing 24 V voltage source.



The bridge for the connection of the 24V bus is attached to the units and fixed with a screw.	
Cross-head screw M3x10	Tightening torque 0.5 Nm

Figure 12: Connection of the 24V bus

NOTICE

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

NOTICE

Parallel connection of 24V power supply modules is not permitted.

4.2.3 Connection of the external 24V supply X1B

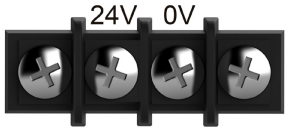
X1B	Name	Function	Connection	Tightening torque
	24V	Connection for external 24V supply (optional)	Ring cable lug: forked < 8 mm Cross-section: ≤ 6 mm²	1.3 Nm 12 lb inch
	0V			

Figure 13: Connection of the external 24V supply X1B

4.2.3.1 Internal wiring with option (schematic diagram))

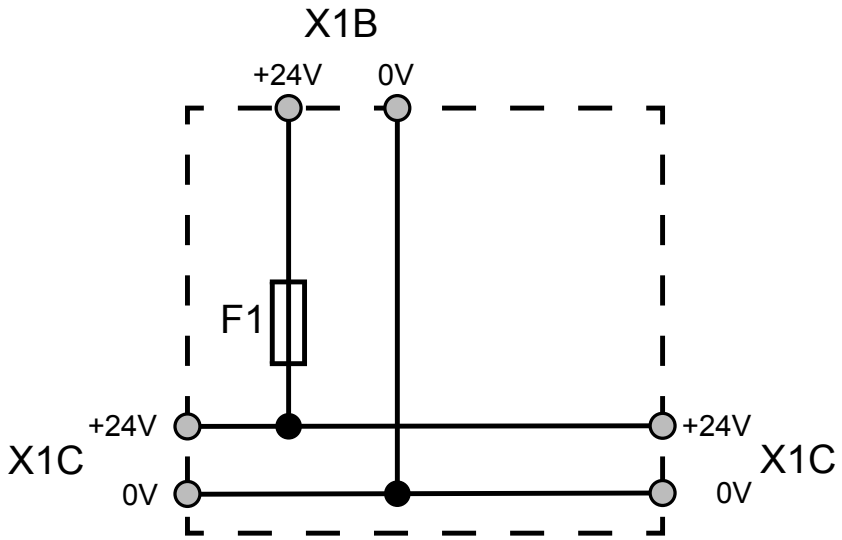
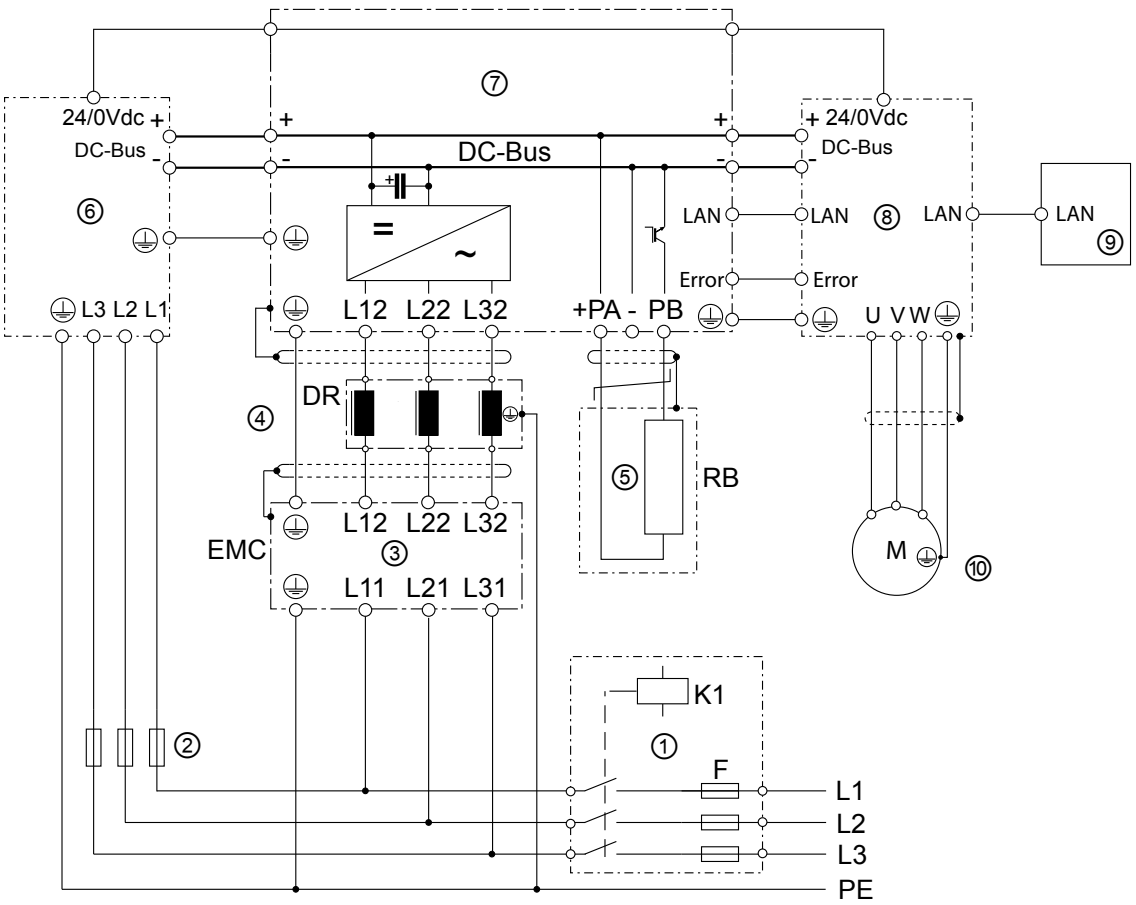


Figure 14: Internal wiring with option (schematic diagram))

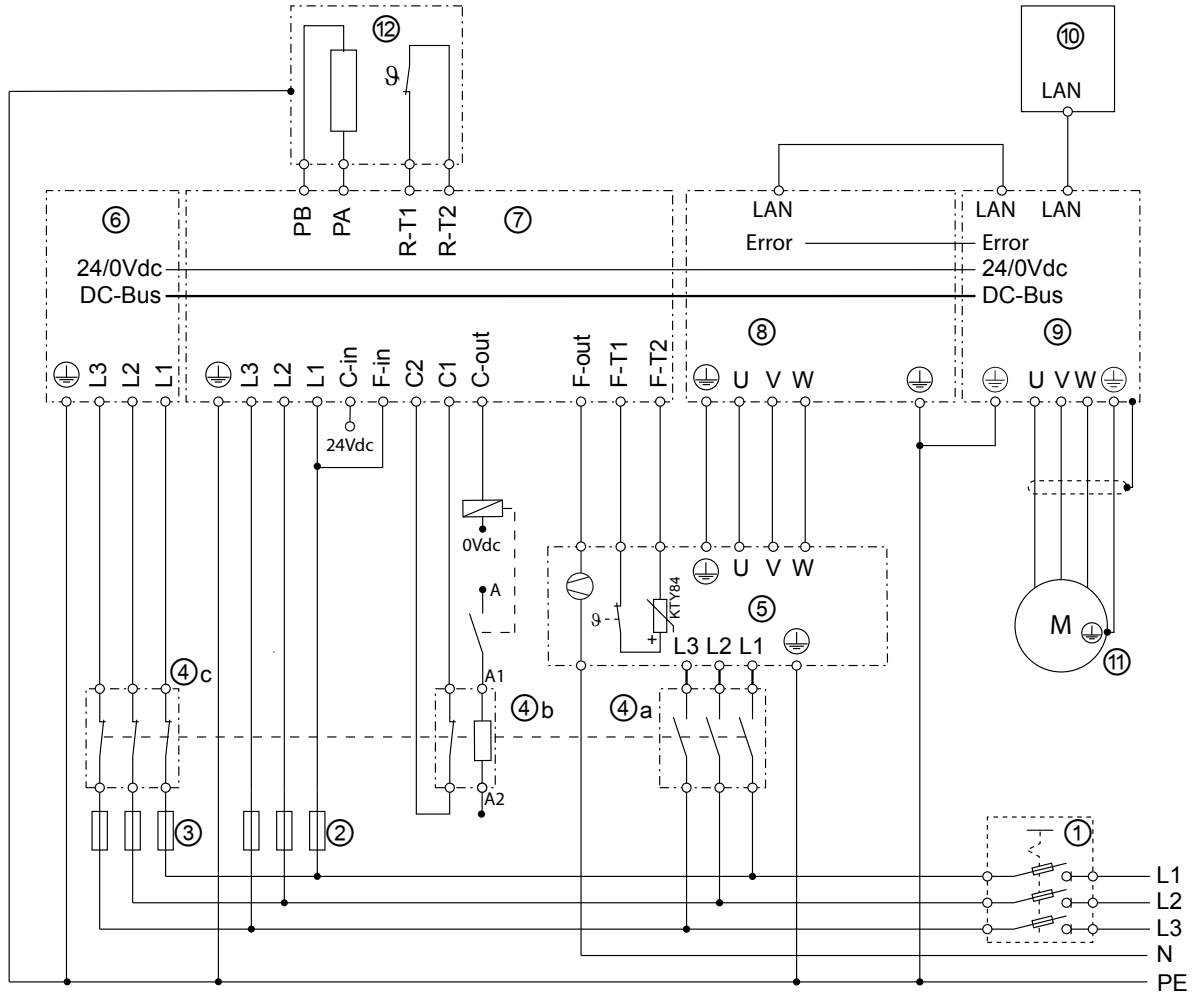
4.2.4 Connection of the 24V supply hardware configuration 1 (with DC bus) rectifier module



Legend	
1	Mains fuses and line contactor
2	Fuses for 24V supply
3	Filter (optional)
4	Mains chokes
5	External braking resistor with overtemperature switch
6	24V supply with additional DC coupling
7	Rectifier module
8	Axis module
9	Superior control (optional)
10	Motor

Figure 15: Connection of the 24V supply (with DC bus) rectifier module

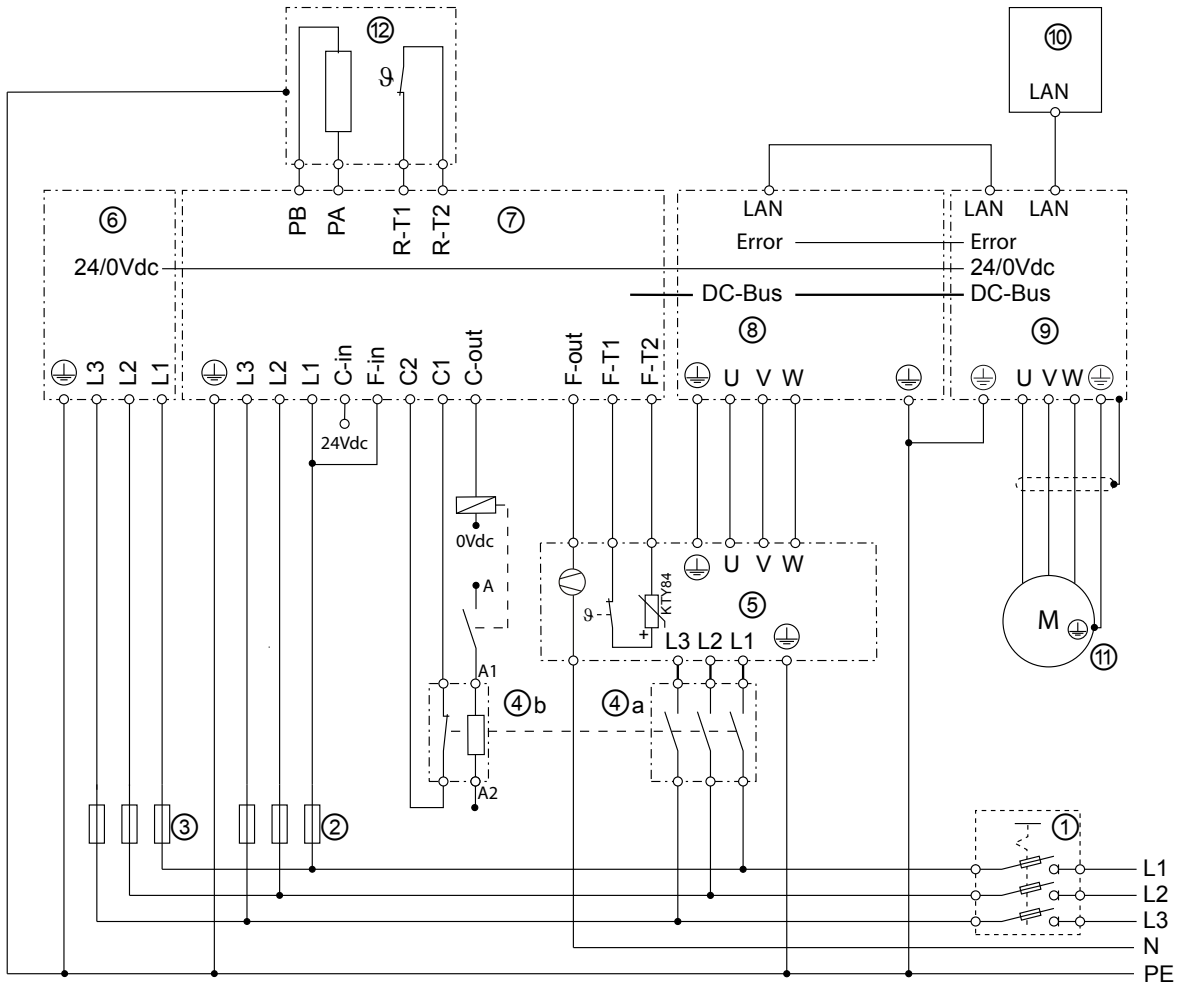
4.2.5 Connection of the 24V supply hardware configuration 3 (with DC bus) with AIC



Legend	
1	Fuse-load break switch
2	Pre-charging fuses
3	Fuses for 24V supply
4	Line contactor with auxiliary contact
5	LCL filter with fan and temperature monitoring/-switching off
6	24V supply with change-over to DC operation
7	Charging module
8	AIC module
9	Axis module
10	Superior control (optional)
11	Motor
12	Braking resistance with temperature switch

Figure 16: Connection of the 24V supply (with DC bus) with AIC

4.2.6 Connection of the 24V supply hardware configuration 2 (without DC bus) with AIC



Legend	
1	Fuse-load break switch
2	Pre-charging fuses
3	Fuses for 24V supply
4	Line contactor with auxiliary contact
5	LCL filter with fan and temperature monitoring/-switching off
6	24V supply without change-over to DC operation
7	Charging module
8	AIC module
9	Axis module
10	Superior control (optional)
11	Motor
12	Braking resistance with temperature switch

Figure 17: Connection of the 24V supply (without DC bus) with AIC

4.3 Connection of the control type „D“

4.3.1 Inputs and outputs X2A

4.3.1.1 Assignment of the terminal block X2A

Digital inputs and outputs				
Function	**Term.**		**Term.**	**Function**
Digital input 4	16		15	DC 24 V/< 0.7 A output
Digital input 3	14		13	DC 24 V/< 0.7 A output
Digital input 2	12		11	DC 24 V/< 0.7 A output
Digital input 1	10		9	DC 24 V/< 0.7 A output
Digital output 4	8		7	0V
Digital output 3	6		5	0 V
Digital output 2	4		3	0 V
Digital output 1	2		1	0 V

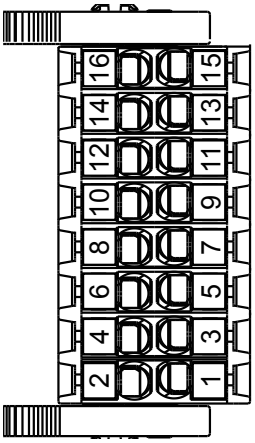


Figure 18: Assignment of the terminal block X2A

4.3.1.2 Technical data of the digital inputs control type „D“

The digital input is specified in accordance with IEC61131-2 type 3.

Status „0“	**Status „1“**
-3…5 V	11…30 V

Table 8: Technical data of the digital inputs control type „D“

4.3.1.3 Technical data of the digital outputs control type „D“

The digital output is short-circuit proof and specified in accordance with IEC61131-2.

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

Table 9: Technical data of the digital outputs control type „D“

4.3.1.4 Technical data of the 24V outputs

Four independent DC 24 V / < 0.7 A outputs are available. The total current of the short-circuit-proof outputs is max. 1 A.

4.3.2 Assembly of the wires to PUSH IN terminals

ATTENTION

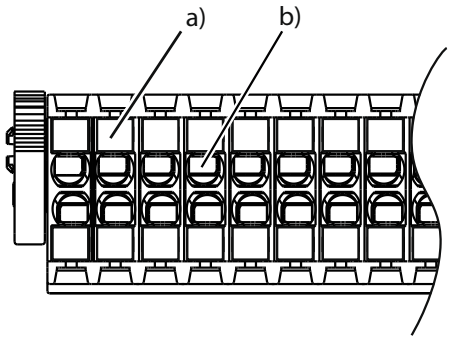
Malfunctions caused by loose cable connections!

► Observe metal sleeve length and stripping length

Cross-section	Wire-end ferrule	Metal sleeve length	Stripping length
0.50 mm²	with plastic collars (*DIN 46228-4*)	10 mm	12 mm
0.75 mm²		12 mm	14 mm
1.00 mm²		12 mm	15 mm
1.50 mm²	without plastic collars (*DIN 46228-1*)	10 mm	10 mm
0.2…1.5 mm² single-wire or fine-wire	without wire-end ferrule	–	10…15 mm

Table 10: Wire-end ferrules and stripping length

Front view



a) Pusher

b) Wire hole

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.

4.3.3 EtherCat system bus terminals 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.

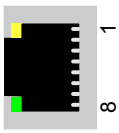
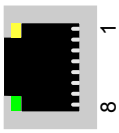
Description of the LEDs		RJ45 socket		Assignment	
LED yellow	Link		X4C Fieldbus Slave module	1	TX+
off	Connection off			2	TX-
flashing	Communication			3	Rx+
on	Connection on			4	–
				5	–
LED green	Speed		X4B EtherCAT OUT	6	RX-
off	10 MBit			7	–
on	100 Mbit			8	–

Table 11: EtherCat system bus socket X4B

4.3.4 Fieldbus slave module socket X4C

The fieldbus slave module serves for the connection to a superior control. The following slave modules are available:

Slave module	Material number
Profibus DP	03H6GAx-xxxx
Interbus	04H6GAx-xxxx
CanOpen	05H6GAx-xxxx

Table 12: Fieldbus slave module socket X4C

4.3.5 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 13: Diagnosis / Visualisation X4A

ATTENTION

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

COMBIVIS 6

A current XML file is required for the operation with COMBIVIS 6. At active internet connection the download can directly be done from COMBIVIS 6.

4.3.5.1 Assignment of the interfaces

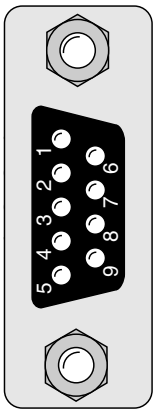
reserved - do not assign!	1		6	reserved - do not assign!
TxD (RS232)	2		7	DGND (reference potential)
RxD (RS232)	3		8	TxD-A (RS485)
RxD-A (RS485)	4		9	TxD-B (RS485)
RxD-B (RS485)	5			

Figure 20: Assignment of the interfaces

4.4 Connection of the control type „B“

Devices with control type "B" consist only of the 24V power supply module. They have no control module and no 24 V output terminal.Further connection is therefore not necessary.

4.5 Connection of the control type „C“

4.5.1 Assignment of the terminal block X2A

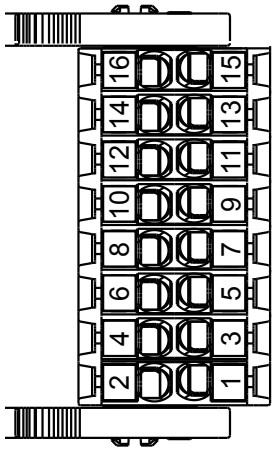
Digital inputs and outputs				
Function	**Term.**		**Term.**	**Function**
Output DC 24 V / 7 A	16		15	0 V
	14		13	
	12		11	
	10		9	
Output DC 24 V / 5 A	8		7	0 V
	6		5	
	4		3	
Digital input DI 1 (release for output DC 24 V / 5 A)	2		1	DO1 voltage output Release (DC 24 V / 100 mA)

Figure 21: Assignment of the terminal block X2A

4.5.1.1 Technical data of the inputs

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

Status „0“	Status „1“
-3…5V	11…30 V

4.5.1.2 Technical data of the outputs

The digital outputs are short-circuit proof and specified in accordance with *IEC61131-2*.

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

Table 14: Technical data of the outputs

4.5.1.3 Technical data of the 24V outputs

Two independent DC 24V outputs (5A/7A) are available. The outputs are short-circuit proof. The assignment is described under *„Assignment of the terminal block X2A“*.

5 Certification

5.1 CE Marking

CE marked power supplies were developed and manufactured to comply with the regulations of the Low-Voltage Directive 2014/35/EU and EMC directive (2014/30/EU).

The start-up (i.e. the starting of normal operation) of the 24V power supplies is prohibited until it is determined that the unit or machinery complies with the machine directive (2006/42/EC).

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

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

To be conform according to UL for 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 60°C or 75°C copper conductors only.
- These 24V supply module are only for use in combination with other supply and drive modules that are part of the Combivert H6 series.
- Maximum heatsink temperature for all H6 drive modules shall be maintained at 80°C via a liquid cooled system.
- Short Circuit rating only achieved when used with H6 supply modules. See supply module ratings for Short Circuit rating information.

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+}	-2.38V	Iron	Fe^{3+}	-0.037 V
Titan	Ti^{2+}	-1.75 V	Hydrogen	$2H^{+}$	0.00 V

continued on the next page

Material	Generated Ion	Standard potential	Material	Generated Ion	Standard potential
Aluminium	Al^{3+}	-1.67 V	Copper	Cu^{2+}	0.34 V
Manganese	Mn^{2+}	-1.05 V	Carbon	C^{2+}	0.74 V
Zinc	Zn^{2+}	-0.76 V	Silver	Ag^{+}	0.80 V
Chrome	Cr^{3+}	-0.71 V	Platinum	Pt^{2+}	1.20 V
Iron	Fe^{2+}	-0.44 V	Gold	Au^{3+}	1.42 V
Cadmium	Cd^{2+}	-0.40 V	Gold	Au^{+}	1.69 V

Table 15: Electrochemical voltage series / standard potentials against hydrogen

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…25 Vol %, in order to avoid a change of the additives.

Table 16: Requirements on the coolant

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 10 K 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 occuring 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 17: 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

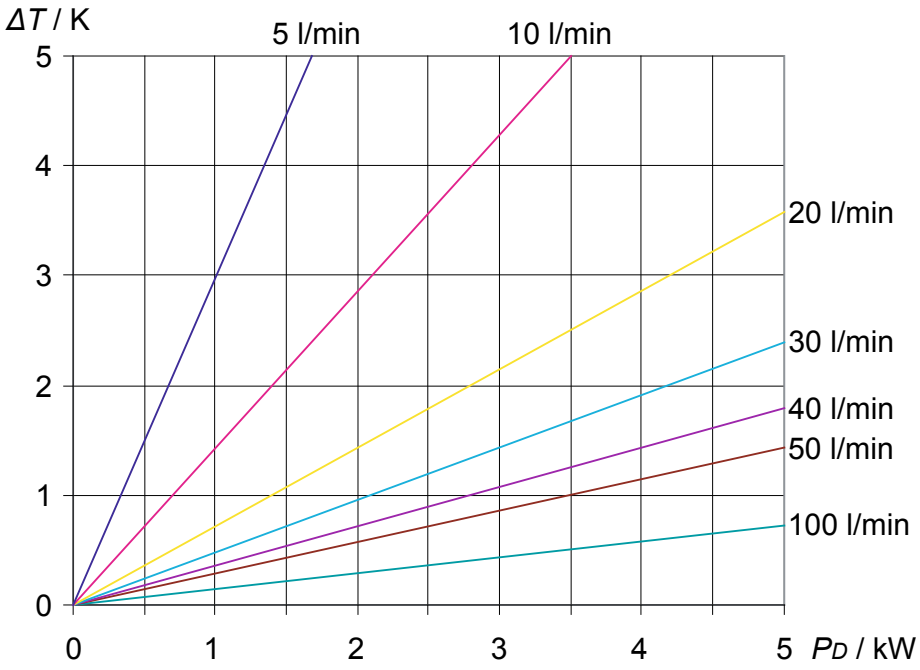


Figure 22: Coolant heating depending on power loss

6.1.7 Typically fall of pressure depending on the rate of flow

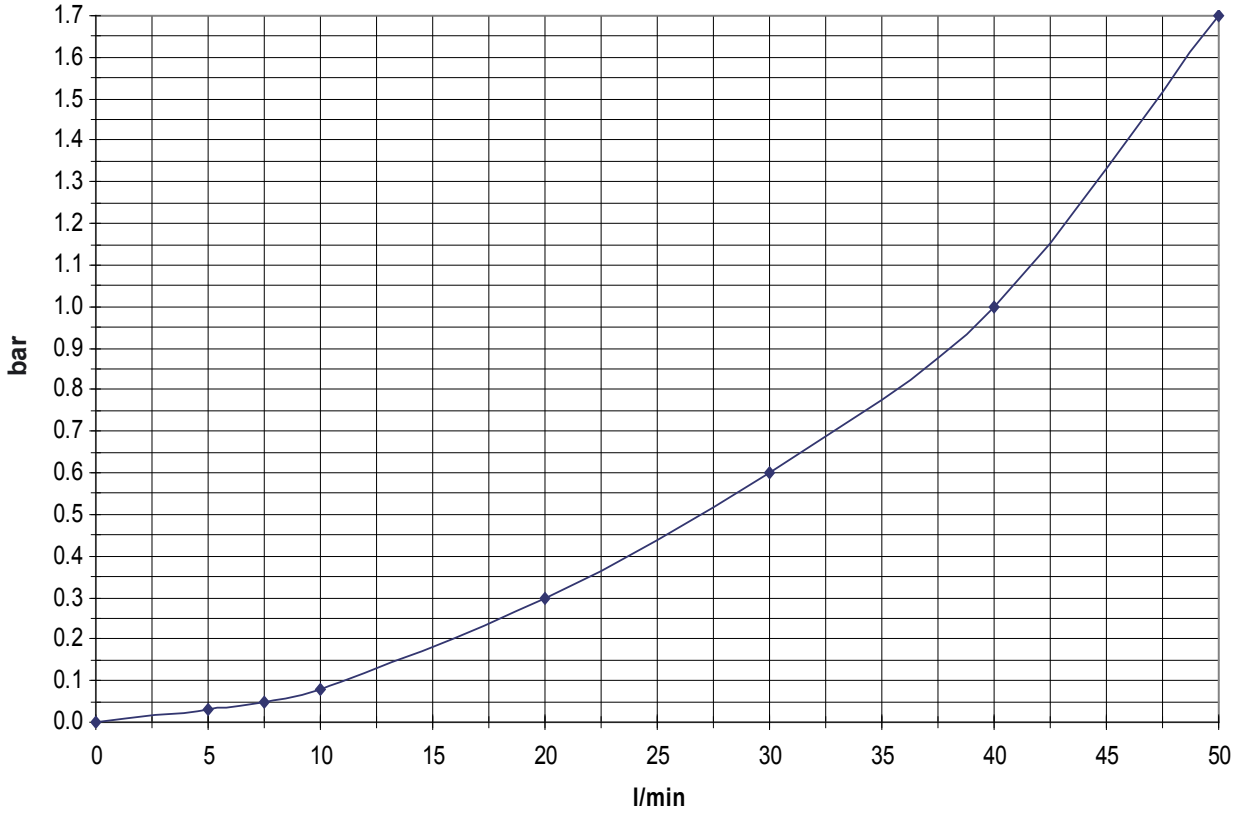


Figure 23: Typically fall of pressure depending on the rate of flow

7 Revision History

Version	Date	Description
00	2015-07	Conversion to document version
01	2016-08	Heatsink concepts
02	2017-09	New CI, general revision, linkage with InCopy components
03	2018-11	Revision of the product description and design of the device
04	2019-06	Updates made

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