COMBIVERT **H6**

INSTRUCTIONS FOR USE | **INSTALLATION ACTIVE INFEED CONVERTER (AIC) AND CHARGING MODULE**

Translation of original manual
Document 20105449 EN 07

Preface

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

Signal words and symbols

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

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

RESTRICTION

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

Used for informational messages or recommended procedures.

More symbols

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

Note to further documentation.
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.

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

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

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

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

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

Copyright

Table of Contents

List of Figures

List of Tables

Glossary

0V	Earth-potential-free common point
1ph	1-phase mains
3ph	3-phase mains
AC	AC current or voltage
AFE	From 07/2019 AIC replaces the previous name AFE
AFE filter	From 07/2019 AIC filter replaces the previous name AFE filter
AIC	Active Infeed Converter
AIC filter	Filter for Active Infeed Converter
Application	The application is the intended use of the KEB product
ASCL	Asynchronous sensorless closed loop
Auto motor ident.	Automatically motor identification; calibration of resistance and inductance
AWG	American wire gauge
B2B	Business-to-business
BiSS	Open source real-time interface for sensors and actuators (DIN 5008)
CAN	Fieldbus system
CDF	Cyclic duration factor
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
EMS	Energy Management System
EN	European standard
Encoder emulation	Software-generated encoder output
End customer	The end customer is the user of the customer product
Endat	Bidirectional encoder interface of the company Heidenhain
EtherCAT	Real-time Ethernet bus system of the company Beckhoff
Ethernet	Real-time bus system - defines protocols, plugs, types of cables
FE	Functional earth
FSoE	Functional Safety over Ethernet
FU	Drive 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
DIN EN 60939-1	Passive filter units for electromagnetic interference suppression - Part 1: Generic specification (IEC 60939-1:2010); German version EN 60939-1:2010

1 Basic Safety Instructions

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

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

NOTICE

Hazards and risks through ignorance.

► Read the instructions for use !

► Observe the safety and warning instructions !

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

1.1 Target group

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

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

1.2 Transport, storage and proper use

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

Transport of drive controllers with an edge length >75 cm

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

► Transport of drive controllers on suitable pallets.

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

NOTICE

Damage to the coolant connections

Bending of the tubes!

► Never place the device on the coolant connections

Drive controllers contain electrostatic sensitive components.

► Avoid contact.

► Wear ESD-protective clothing.

Do not store drive controllers

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

1.3 Installation

⚠ DANGER

Do not operate in an explosive environment!

► The 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.
- Do not allow moisture or mist to penetrate the unit.
- Avoid dust permeating the device. Allow for sufficient heat dissipation if installed in a dust-proof housing.
- Note installation position and minimum distances to surrounding elements. Do not cover the ventilation openings.
- Mount the drive controller according to the specified degree of protection.
- Make sure that no small parts fall into the 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 controller.
- Follow all safety instructions!

1.4 Electrical connection

⚠ DANGER

Voltage at the terminals and in the device!

Danger to life due to electric shock!

- ► Never work on the open device or never touch exposed parts.
- ► For any work on the unit switch off the supply voltage and secure it against switching on.
- ► In spite of missing supply voltage, the Active Infeed Converter can continue to modulate, e.g. in regenerative operation. The isolation from supply must be checked.
- ► Wait until all drives has 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 controllers.
- ► Never bridge upstream protective devices (also not for test purposes).
- ► Always connect the protective earth conductor to drive controller 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 DC current in the protective earth conductor. When a residual current device (RCD) or residual current monitoring device (RCM) is used for protection in case of direct or indirect contact, only a RCD or RCM of type B is permissible on the power supply side of this product.
- ► Drive controllers with a leakage current > 3.5 mA AC current (10 mA DC current) are intended for a fixed connection. Protective conductors are to 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* .

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 carried out with flexible copper cable for a temperature > 75 °C.
- Connection of the Active Infeed Converter is only permissible on symmetrical networks with a maximum line voltage (L1, L2, L3) with respect to earth (N/PE) of max.300V (=> *„3.2 Technical Data of the AIC modules“*). An appropriate transformer must be connected upstream in case of supply networks with higher voltages.

- With existing or newly wired circuits the person installing the units or machines must ensure that the PELV requirements are met.
- For drive controllers that are not isolated from the supply circuit (in accordance with *EN 61800-5-1*) all control lines must be included in other protective measures (e.g. double insulation or shielded, earthed and insulated).
- When using components without isolated inputs/outputs, it is necessary that equipotential bonding exists between the components to be connected (e.g. by the equipotential line). Disregard can cause destruction of the components by the equalizing currents.
- Only use the filter components specified by KEB.
- When connecting several drive controllers to the Active Infeed Converter, the maximum permissible DC link capacities or the charging currents of all connected drive controllers and their interconnection must be observed.

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

1.4.1 EMC-compatible installation

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

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

1.4.2 Voltage test

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

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

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

1.4.3 Insulation measurement

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

1.5 Start-up and operation

The drive controller 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 controller if parameterization is compatible to application.
- ► Securing a unit solely with software-supported functions is not sufficient. It is imperative to install external protective measures (e.g. limit switch) that are independent of the drive controller.
- ► Secure motors against automatic restart.

⚠ CAUTION

High temperatures at heat sink and coolant!

Burning of the skin!

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

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

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

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

Switching at the input

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

Short-circuit resistance

The drive controllers are conditional short-circuit proof. After resetting the internal protection devices, the intended function is guaranteed.

Exceptions:

- Repeatedly occurring ground faults or short-cicuits at the input can lead to the devective of the unit.
- The Active Infeed Converter is not short-circuit proof at the mains input! Conditional protection at the mains input is possible with a semiconductor fuse.
- The short-circuit protection at the DC output must be ensured by internal / external aR or gR fuses.

1.6 Maintenance

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

► Check system for loose screws and plugs and tighten if necessary.

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

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

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

► In the case of liquid-cooled drive controllers a visual test of the cooling circuit for leaks and corrosion must be carried out.The cooling circuit must be completely empty if a unit shall be switched off for a longer period. The cooling circuit must be blown out additionally with compressed air at temperatures below 0°C.

1.7 Repair

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

⚠ DANGER

Unauthorized exchange, repair and modifications!

Unpredictable malfunctions!

► The function of the drive controller is dependent on its parameterization. Never replace without knowledge of the application.

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

► Only use original manufacturer parts.

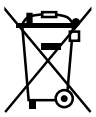
► Infringement will annul the liability for resulting consequences.

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

1.8 Disposal

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

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



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

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

Withdrawal by	WEEE-Reg.-No.		Keyword
Austria			
KEB Automation GmbH	ERA:	51976	Stichwort „Rücknahme WEEE“
France			
RÉCYLUM - Recycle point	ADEME:	FR021806	Mots clés „KEB DEEE“
Germany			
KEB Automation KG	EAR:	DE12653519	Stichwort „Rücknahme WEEE“
Italy			
COBAT	AEE: (IT)	19030000011216	Parola chiave „Ritiro RAEE“
Spain			
KEB Automation KG	RII-AEE	7427	Palabra clave „Retirada RAEE“
Česko			
KEB Automation KG	RETELA	09281/20 ECZ	Klíčové slovo: Zpětný odběr OEEZ

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:

Designation	Function
Rectifier module	Served to supply the main energy flow of DC-coupled drive controllers. 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 when no Active Infeed Converter module is used. An integrated braking transistor can convert energy into heat via a braking resistor.
Charging module	Used for precharging the DC link in the DC-bus connection of drive controllers. The charging module is used in conjunction with an Active Infeed Converter (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 Infeed Converter module (AIC)	**From 07/2019 the term AIC replaces the previously used term AFE.** Served to supply the main energy flow of DC-coupled drive controllers. 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. The Active Infeed Converter is intended exclusively for installation in electrical systems or machines in the industrial sector.

The used semiconductors and components of the KEB Automation KG are developed and dimensioned for the use in industrial products, such as the Active Infeed Converter.

Restriction

If the product is used in machines, which work under exceptional conditions or if essential functions, life-supporting measures or an extraordinary safety step must be fulfilled, the necessary reliability and security must be ensured by the machine builder.

Residual risks

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

- Automatic start
- Overvoltage at the mains connection point in case of supply network failure

2.2 Unintended use

The operation of other electric consumers is prohibited and can lead to the destruction of the devices. The operation of our products outside the indicated limit values of the technical data leads to the loss of any liability claims. In particular, these are not required for applications with renewable energies or stand-alone systems.

2.3 Product features

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

Device type:	Active Infeed Converter (AIC) / charging module
Series:	COMBIVERT H6
Power range:	11…173 kVA / 400 V
Housing:	B, C, E, G, P, S, U, W

The COMBIVERT H6 is characterized by the following features:

- System bus EtherCAT [1)] — Transfer of setpoints and actual values between control and AIC module.
- Error bus — Channel 1: Error output of the connected DC buses
Channel 2: Charge condition 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 unit and driver/power unit are safe separated.
- Internal fuses — The driver/power unit is connected via internal fuses to the DC link bus.
- Cooling System — universally by flat rear and air heat sink

2.3.1 Special features of the AIC module

- System bus EtherCAT — Transfer of setpoints and actual values between control and AIC module.

2.3.2 Particularities of the charging unit

- Temperature inputs — Temperature inputs for braking resistor and filter monitoring
- Switch input — Monitoring of the main contactor with auxiliary contact

1) EtherCAT — *EtherCAT® is a registered trademark and patented technology, licensed by 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	Charging module
										1: Version 1
										2: Version 2
										Active Infeed Converter (AIC)
										1: Overload in accordance with technical data
										2: Special overload behavior
										A-Z: Customer/special version (firmware and download)
									Housing	Flat rear heat sink
										B: 50 mm / E: 200 mm
										C: 100 mm / G: 300 mm
										Air heat sink
										P: 50 mm / U: 200 mm
										S: 100 mm
									Control type	A: KEB default with control release
									Power supply / regenerative unit	D: Active Infeed Converter (AIC) for sine-wave regeneration
										F: Charging module
									Series	COMBIVERT H6 multi-axis drive system
									Device size	14…26

Table 1: Type code

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

3 Technical Data

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

3.1 Operating conditions

3.1.1 Environmental conditions

Storage		**Standard**	**Class**	**Notes**
Ambient temperature		*EN 60721-3-1*	1K4	-25…55 °C
Relative humidity		*EN 60721-3-1*	1K3	5…95 % (without condensation)
Storage height		–	–	Max. 3000 m above sea level
Transport		**Standard**	**Class**	**Notes**
Ambient temperature		*EN 60721-3-2*	2K3	-25…70 °C
Relative humidity		*EN 60721-3-2*	2K3	95 % at 40 °C (without condensation)
Operation		**Standard**	**Class**	**Notes**
Ambient temperature		*EN 60721-3-3*	3K3	5…40 °C (extended to -10…45 °C)
Coolant inlet temperature	Air	–	–	5…40 °C (extended to -10…45 °C)
	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 environmental conditions

3.1.2 Mechanical environmental conditions

Storage	**Standard**	**Class**	**Notes**
Vibration limits	*EN 60721-3-1*	1M2	Vibration amplitude 1.5 mm (2…9 Hz) Acceleration amplitude 5 m/s² (9…200 Hz)
Shock limit values	*EN 60721-3-1*	1M2	40 m/s²; 22 ms
Transport	**Standard**	**Class**	**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 environmental 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 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

Devices without internal filter require an external filter to comply with the following limit values.

EMC emitted interference	Standard	Class	Notes
Line-conducted interferences	*EN 61800-3*	C2	With EMC filter up to 50 m motor cable length
Radiated interferences	*EN 61800-3*	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 measuring and control functions and signal interfaces	*EN 61000-4-4*	2 kV	–
Burst - Power ports	*EN 61000-4-4*	4 kV	–
Surge - Power ports	*EN 61000-4-5*	1 kV 2 kV	Phase-phase Phase-ground
Cable-fed disturbances, induced by high-frequency fields	*EN 61000-4-6*	10 V	0.15...80 MHz
Electromagnetic fields	*EN 61000-4-3*	10 V/m 3 V/m 1 V/m	80 MHz...1 GHz 1.4...2 GHz 2...2.7 GHz
Voltage fluctuations/ voltage drop	*EN 61000-2-1* *EN 61000-4-34*	–	-15 %...+10 % 90 %
Frequency changes	*EN 61000-2-4*	–	≤ 2 %
Voltage deviations	*EN 61000-2-4*	–	±10 %
Voltage unbalances	*EN 61000-2-4*	–	≤ 3 %

Table 6: Electromagnetic compatibility

3.2 Technical Data of the AIC modules

Device size			**14**		**19**		**21**		**24**	**26**
Housing			**C**	**S**	**E**	**U**	**E**	**U**	**G**	**G**
Input data										
Rated input voltage		U_N / V	400 (UL: 480)							
Input voltage range		U_{in} / V	320…480							
Mains frequency		f_N / Hz	50/60 ±5							
Mains phases			3							
Approved mains forms			TN							
Rated input apparent power		S_N / kVA	11		42		62		125	173
Max. input apparent power		$S_{\_max}$ / kVA	23		75		112		187	260
Rated input current		I_N / A	16.5		60		90		180	250
Max. input current (for 60s)	1)	I_{in_max} / A	33		108		162		270	378
Overcurrent cut-off		I_{OC} / %	240		216		216		180	180
Overload current		I_{OL} / %	200		180		180		150	150
Max. permissible mains fuse type gR/aR		$I_{\_max}$ / A	25		80		125		250	350
Recommended supply cable section		Ø / mm²	4		25		50		2x70	2x95
Output data										
Rated output voltage		U_{outN_dc} / V	680							
Output voltage range	2)	$U_{\_dc}$ / V	500…840							
Overvoltage switch-off		U_{OP_dc} / V	840							
Rated apparent output power		P_{outN} / kW	11		42		62		125	173
Nominal input/regenerative current		I_{outN_dc} / A	16.5		60		90		180	250
Max. nominal input/regenerative current (for 60s)	1)	$I_{out\_max\_dc}$ / A	33		108		162		270	378
Overcurrent cut-off		I_{OC_dc} / A	39		173		259		378	518
Rated switching frequency		f_{SN} / kHz	8						8	4
Other data										
Short circuit factor at the connection point		$S_{kn"} / S_n$	15 < $S_{kn"} / S_n$ < 350							
Power dissipation heat sink	3)	P_{Dext} / W	181		698		1090		2315	1979
Power dissipation interior	3)	P_{Dint} / W	53		95		131		218	189
Max. heat sink temperature		T_{HS} / °C	80							
Insulation resistance @ U_{dc} = 500 V		R_{sio} / MΩ	>5							
Supply control unit										
Rated input voltage		U_{CU_dc} / V	24 (±10 %)							
Rated input current	4)	I_{CU_dc} / A	600 mA							
Additional input current for air cooler		I_{CU_dc} / A	0.5		2.4		2.4		-	-

Table 7: Technical Data AIC modules

1) *Restrictions: 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 controller can change to overtemperature error before the protective function OL is triggered.*

2) *The operation is dependent on the voltage setpoint and the control circuit (see Programming manual).*

3) *The data of the power dissipation for heat sinks and interior refer to rated operation. The module is installed on air cooler or heat sinks (water inlet /water outlet temperature 40/45°C). The ambient temperature is 45°C. The splitting will change under other conditions.*

4) *Rated input current, if no digital output is set. At max. load at the digital outputs the input current can be increased up to max. 1A.*

3.2.1 Technical data of the charging units H6

Device size		00 Version 1	00 Version 2
Housing		**B / P**	**B / P**
Input data			
Rated input voltage	U_N / V	400 (UL: 480)	
Input voltage range	U_{in} / V	320…480	
Mains frequency	f_N / Hz	50 / 60 ± 2	
Mains phases		3	
Approved mains forms		TN	
Max. permissible mains fuse	I_{max} / A	10	
Supply cable section	Ø / mm²	1.5	
DC output data			
Output voltage range	U_{dc} / V	452…840	
Rated output current	I_{outN_dc} / A	20	
Output data precharging			
Rated output voltage	U_{outN_dc} / V	565	
Output voltage range	U_{dc} / V	452…680	
Overvoltage switch-off	U_{OP_dc} / V	840	
Max. precharging current	I_{O_dc} / A	5	
Braking transistor			
Max. brake power (switching cycle = 40 %)	P_{max} / kW	46,2	
Max. braking current	IB_{max_dc} / A	146	176
Min. braking resistor	RB_{min} / Ω	6 (-10 %)	5 (-10 %)
Connection cross section	mm²	16	
Response voltage	U_{dc} / V	780	
Switching frequency	f_{SN} / kHz	4	
Switching cycle based on 120 s cycle time	ED / %	40	30
Other data			
Power dissipation interior	P_{Dint} / W	5	
Max. heat sink temperature	THS / °C	80	60
Insulation resistance @ U_{dc} = 500 V	R_{sio} / MΩ	> 5	
Supply control unit			
Input voltage	U_{CU_dc} / V	24 (±10 %)	
Input current [1)]	I_{CU_dc} / A	0.2	

Table 8: Technical data of the charging modules H6

[1)] *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.*

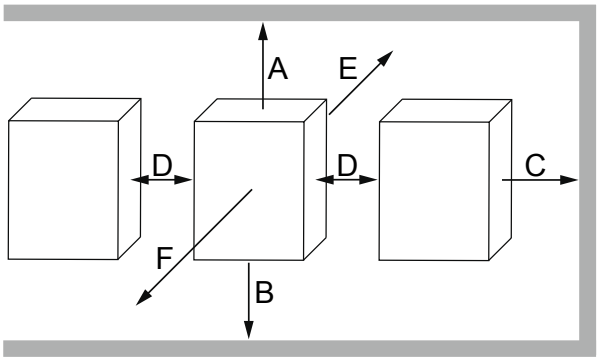
3.3 DC link capacities of the H6 modules

Axis modules	
Device size	**Capacity in µF**
7 / 10 / 12 single axis module	195
7 / 10 / 12 double axis module	195 / 195 / 390
13	280
14	390
15	560
16	705
18	1020
19	1360
20	1650
21	1950
22	2350
23	3100
24	3900
25	4700
Active Infeed Converter (AIC)	
Device size	**Capacity in µF**
14	390
19	1650
21	1950
23	3300
24	3900
26	5200

Table 9: DC link capacities of the H6 modules

3.4 Mechanical installation

3.4.1 Control cabinet installation

Mounting distances	Dimension	Distance in mm	Distance in inch
	A	150	6
	B	100	4
	C	30	1.2
	D	0	0
	E	0	0
	F [1]	50	2

[1] Distance to preceding elements in the control cabinet door.

NOTICE

Alignment of the devices during installation

The DC connection between the modules is made via metal bridges.

► To ensure perfect installation, the horizontal and vertical displacement between the devices 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.

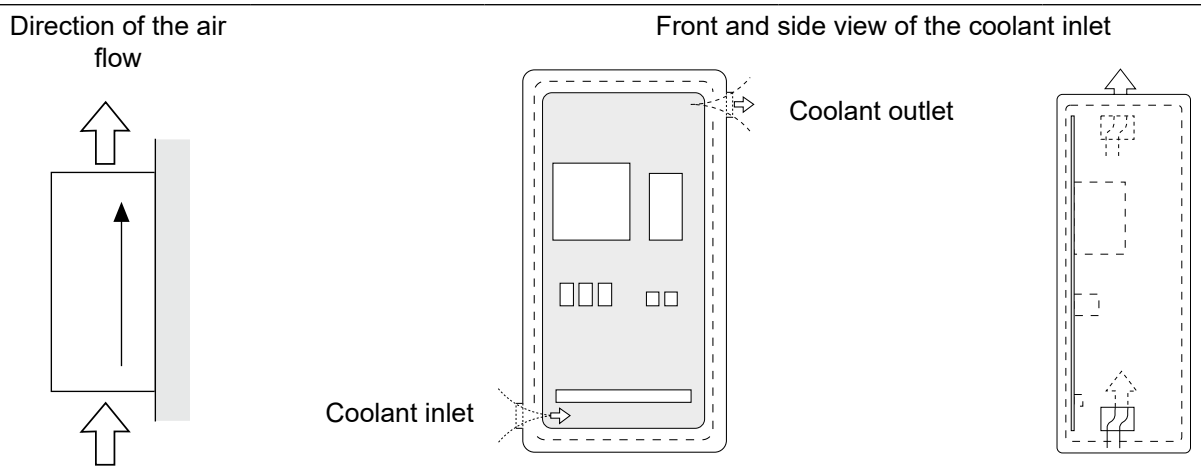


Figure 1: Control cabinet installation

Assembly of the drive converter
For reliable operation, the drive converter must be mounted without any clearance on a smooth, closed, bare metal mounting plate.

3.4.1.1 Mounting instructions for control cabinet installation

The following mounting materials with the appropriate quality must be used to assembly the drive converters.

Required material	Tightening torque
Socket screw *ISO 4762* - M6 x 10 and M6 x 16 - 8.8	5 Nm 45 lb inch

Table 10: Mounting instructions for control cabinet installation

3.4.2 Installation instructions for flat rear heat sink

NOTICE

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.

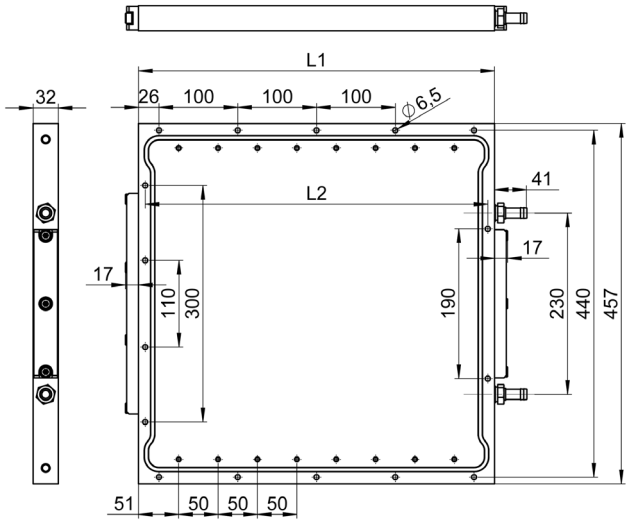
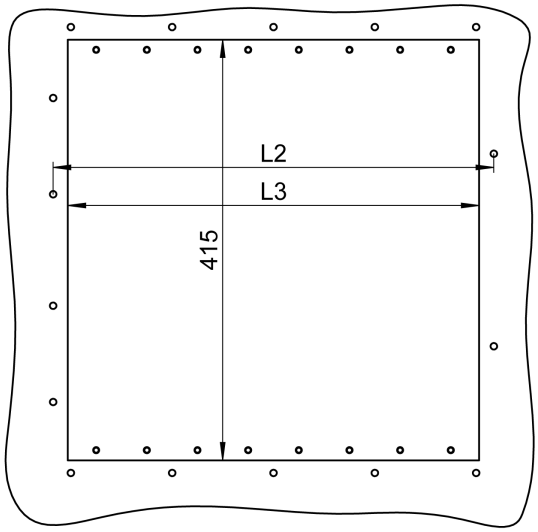
3.4.3 Dimensions central heat sink

3.4.3.1 Air heat sink

Central heat sink for air-cooling upon request.

3.4.3.2 Liquid heat sinks

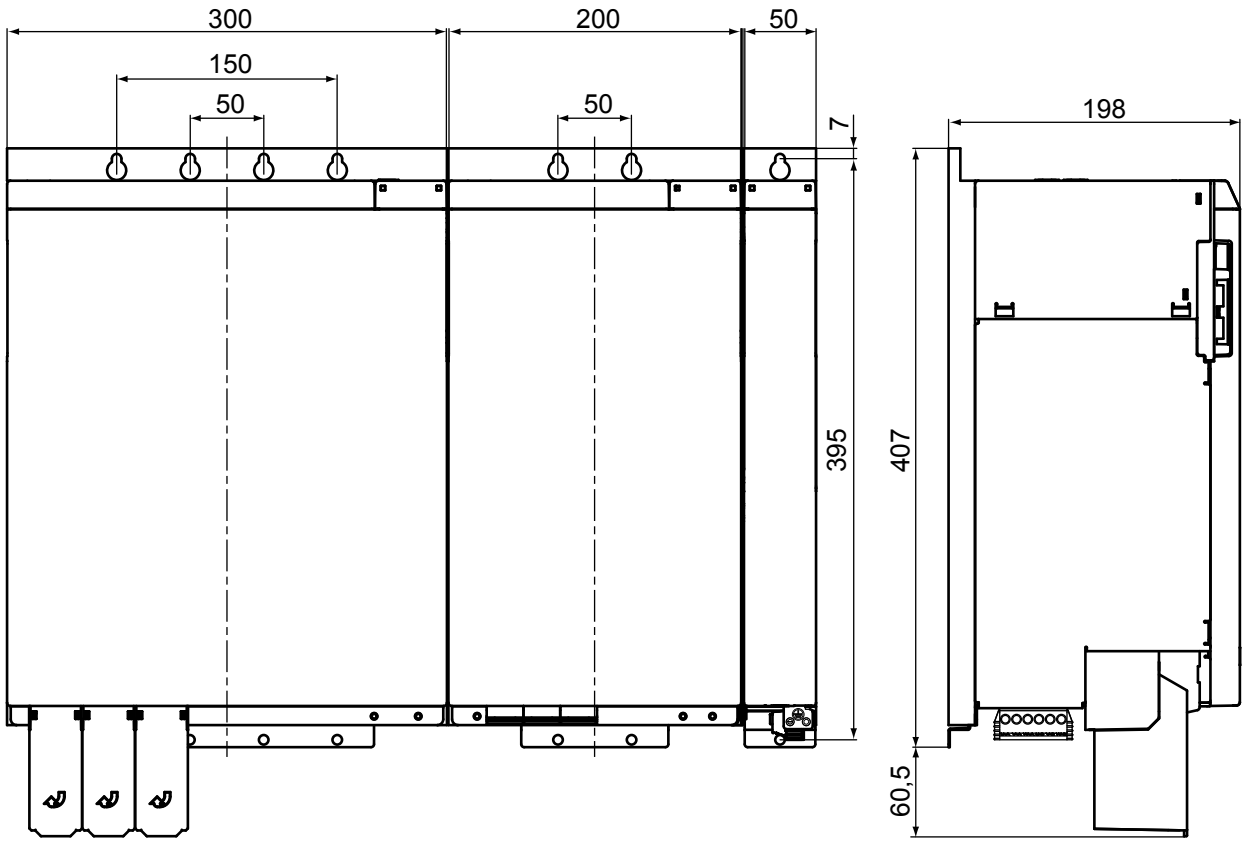
Following liquid heat sinks are available, if no usable cooling surface exists at customer side:

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

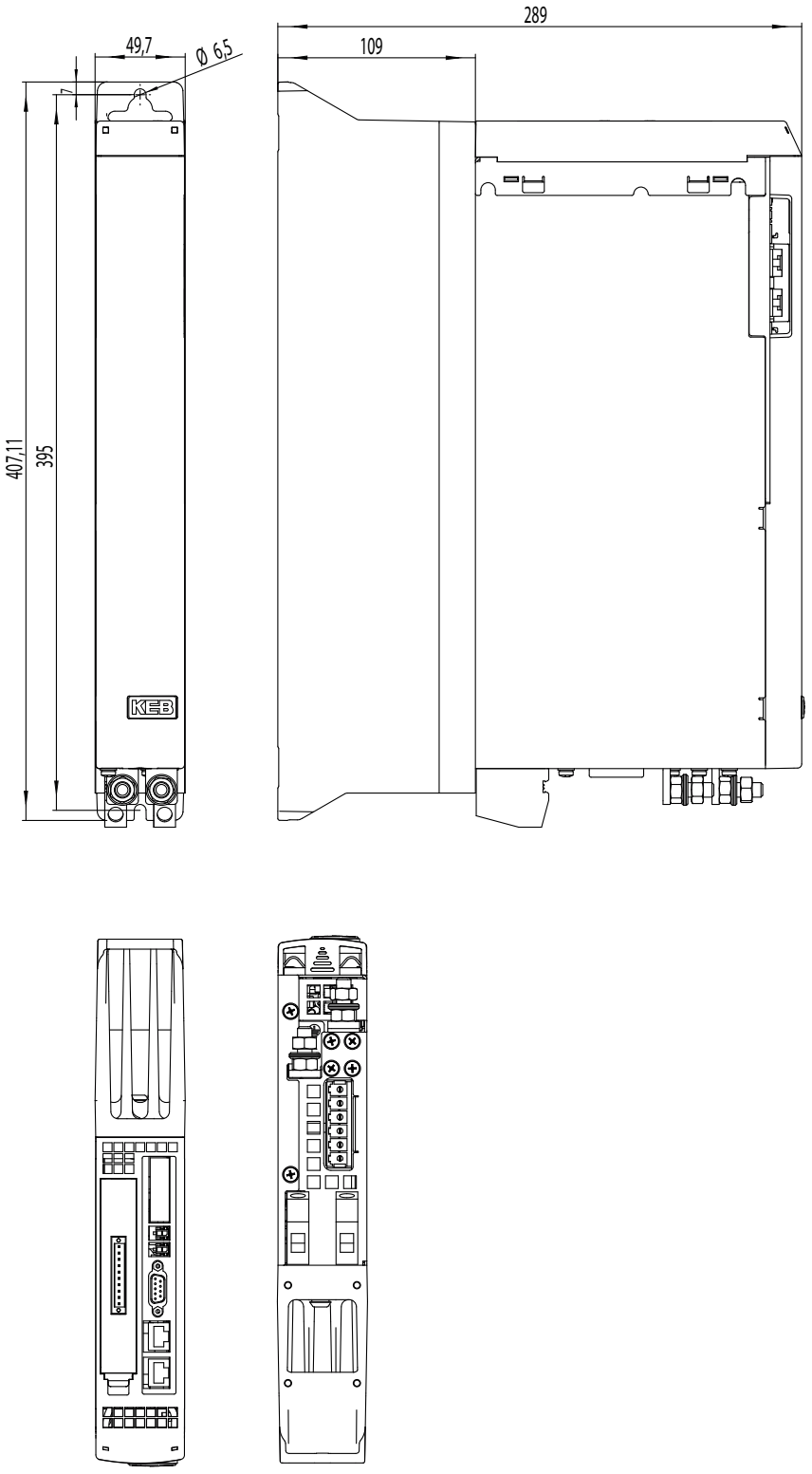
3.4.4 Dimensions and weights of modules with flat rear heat sink



Housing	Module width in mm	Weight in kg
B (charging module)	50	3.8
C	100	5.8
E	200	12.5
G	300	18

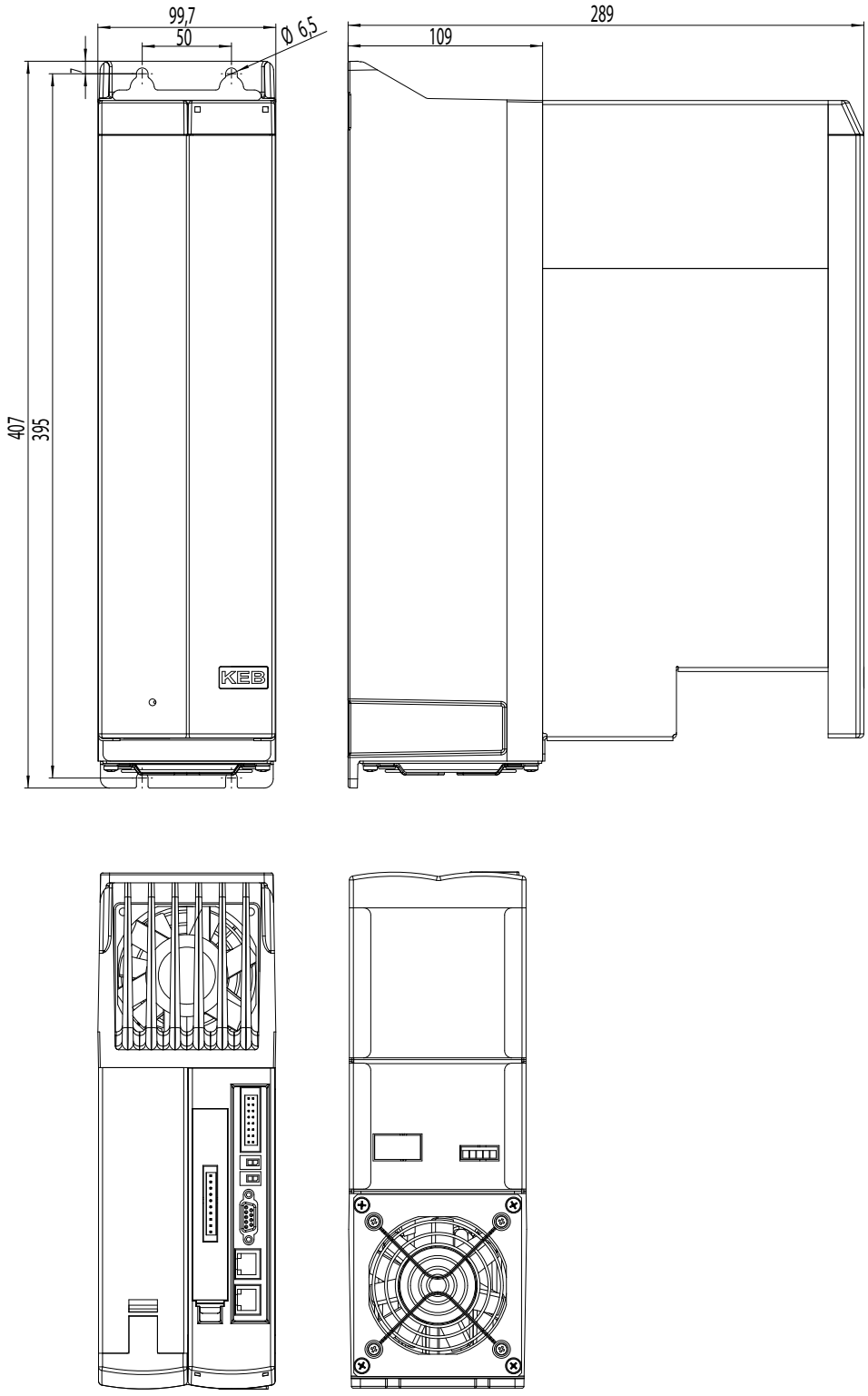
Figure 3: Dimensions and weights of the modules

3.4.5 Dimensions and weights of modules with air heat sink



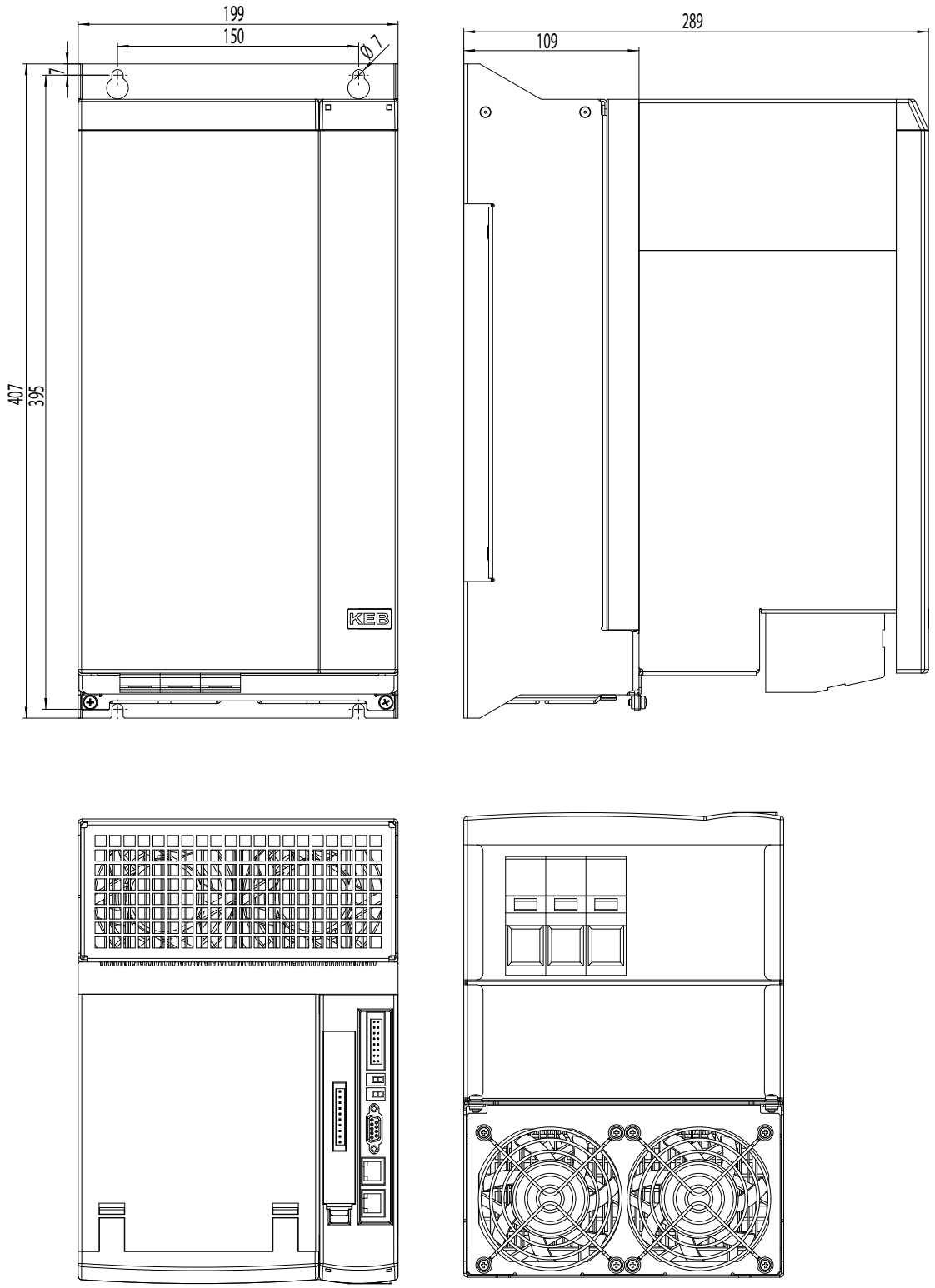
Housing	Module width in mm	Weight in kg
P (charging module)	50	5.5

Figure 4: Dimensions housing P



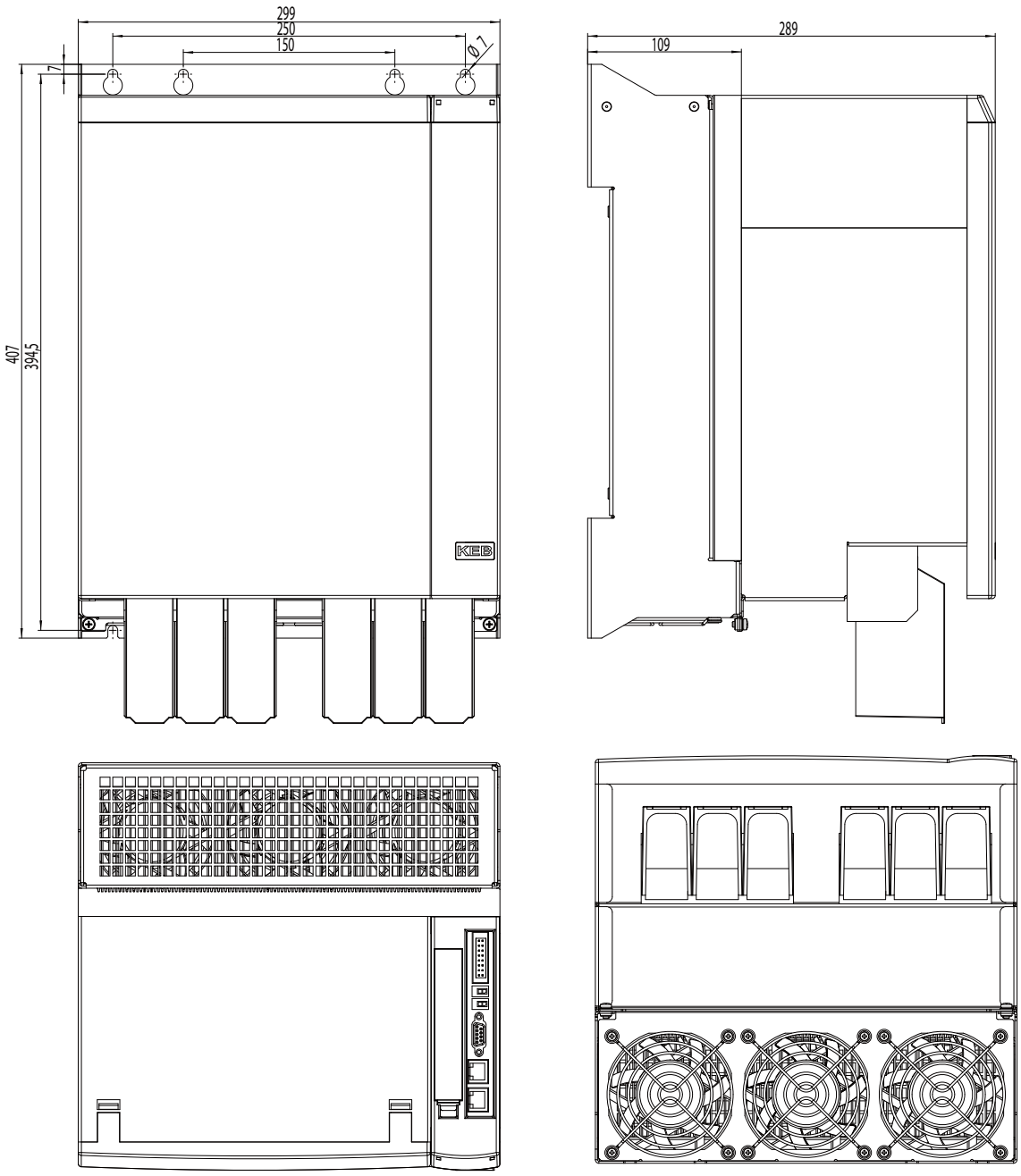
Housing	Module width in mm	Weight in kg
S	100	9

Figure 5: Dimensions housing S



Housing	Module width in mm	Weight in kg
U	200	17

Figure 6: Dimensions housing U



Housing	Module width in mm	Weight in kg
W	300	28

Figure 7: Dimensions housing W

3.4.6 AIC filter 3x400 VAC for switching frequency 8…16 kHz

Figure 1

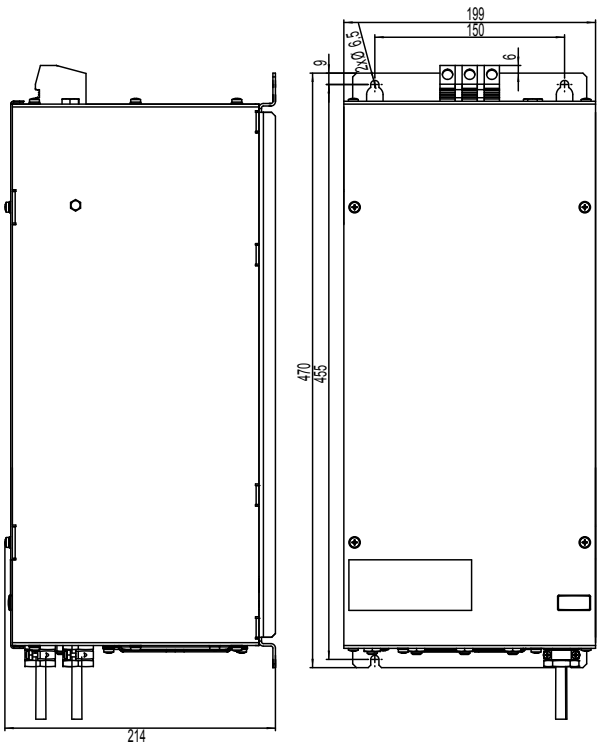
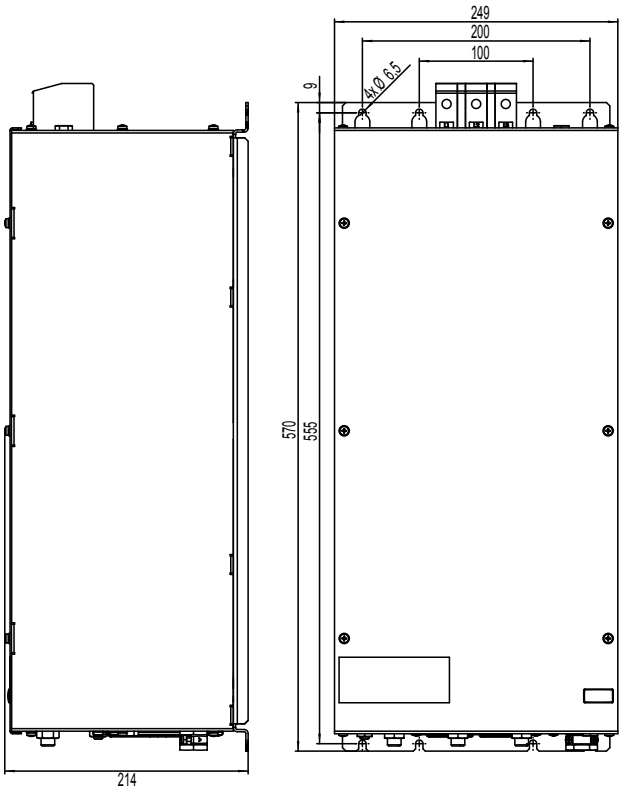


Figure 2



Material number	I_N in A	S in kVA	P_D in W	Terminal	Tightening torque	PE-terminal	Weight in kg	Figure
14H6J4E-1000	16.5	11	160	10…25 mm² AWG 20-4	3 Nm	M8	16	1
19H6J4E-1000	36	25	275				21.5	1
19H6J4F-1000	60	42	395	16…50 mm² AWG 6-0	4 Nm		34	2
21H6J4F-1000	54	37.4	360				32	2
21H6J4F-1001	90	62	535				42.5	2

I_N: Rated current; S: Apparent power; P_D: Power dissipation

Figure 8: AIC filter 3x400 VAC for switching frequency 8…16 kHz

Filter connection

Ring crimp connectors M8 and two terminal blocks (4 mm²) for fan and temperature sensor (KTY +/-) / switch (T1/2) are used for size 26Z1. If a standard AIC or EMC filter is used for the supply unit, KEB must be consulted if more than 6 axes are connected (each with 20 m cable length).

3.4.7 AIC filter 3x400 VAC for switching frequency 4…16 kHz

Figure 1

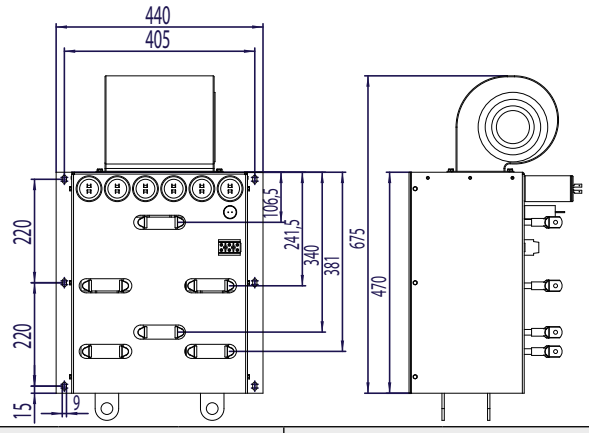


Figure 2

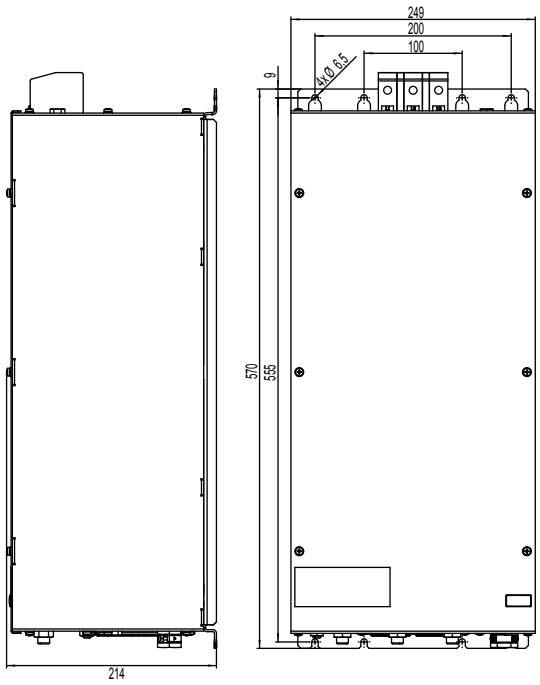
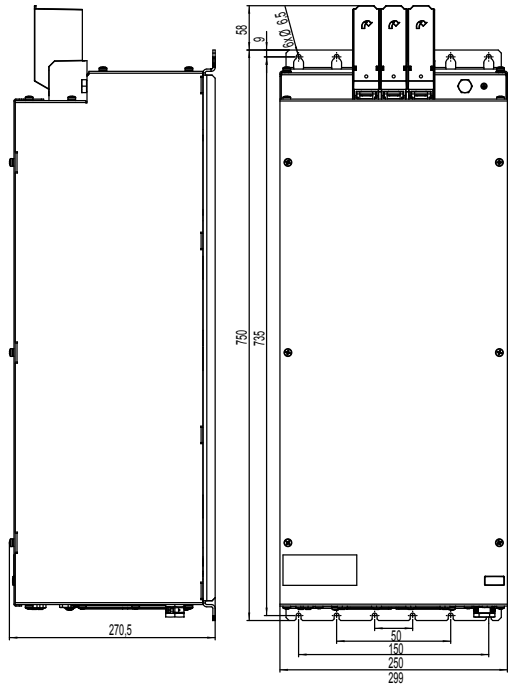


Figure 3



Material number	I_N in A	f_{S_min} in kHz	S in kVA	P_D in W	Connection	Tightening torque	PE-terminal	Weight in kg	Figure
24H6J4F-1000	108	8	75	590	16…50 mm² AWG 6-0	4 Nm	M8	40	2
24H6J4G-1000	180	8	125	1100	M10 Stud	25 Nm 220 lb inch	M10	68	3
26H6J4G-1000 [1]	150	8	104	695					
26H6J4G-A000	150	8	104	695	M10 Stud	25 Nm 220 lb inch	M10	60	3
26Z1K04-1000 [2]	250	4	173	1300	M8	12 Nm	M8	91,6	1
I_N: Rated current; f_{SN}: Switching frequency; S: Apparent power; P_D: Power dissipation									
Figure 9: AIC filter 3x400 VAC for switching frequency 4…16 kHz									

[1] *26H6J4G-1000 with sinus EMC level.*

[2] *For operation without sinus EMC level, the connections U1.2-U1.3, V1.2-V1.3 and W1.2-W1.3 must be bridged. The EMC filter 26E4T60-1001 must be used for rated operation.*

3.4.8 Sine-wave EMC filter with DC regeneration

Alternatively, sine-wave EMC filters with DC regeneration and mains chokes can be used.

Drive controller H6 AIC	Sine-wave EMC filter	Mains chokes	EMC filter	I_N / A	I_{in_max} / A	f_S / kHz
14	0DZ1I05-1001	12Z1B04-1000	12E6T60-3000	9.5	16	8
14	0HZ1I05-1001	14Z1B04-1000	14E6T60-3000	16.5	26	
19/21	0LZ1I05-1001	18Z1B04-1000	18E6T60-3000	50	75	
19/21	0PZ1I05-1001	22Z1B04-1000	20E6T60-3000	60/90	108/162	
24	0PZ1I05-1001	22Z1B04-1000	22E6T60-3000	115	175	
24	0SZ1I05-1001	24Z1B04-1000	24E6T60-3000	180	270	
23	0XZ1I05-1001	27Z1B04-1000	22E6T60-3000	145	290	4
26	0XZ1I05-1001	27Z1B04-1000	24E6T60-3000	200	378	
26	0XZ1I05-1001	27Z1B04-1000	26U5A0U-3000	250	378	

Table 11: Sine-wave EMC filter with DC regeneration

NOTICE

Inadmissible temperatures !

Overload due to overheating !

After an overload I_{in_max} of 60s a partial load operation of 81% of the rated current I_N is mandatory for 540s.

Further information can be found under the following link:

Installation sine-wave EMC filter.
www.keb.de/fileadmin/media/Manuals/dr/ma_dr_z1-inst-sinus-emv-filter_20146892_en.pdf

3.4.8.1 Connection DC regeneration

- DC terminal 00H6M10-1100

Installation DC terminal
www.keb.de/fileadmin/media/Manuals/dr/ma_dr_h6-zub-inst-dc-terminal-20178987_en.pdf

⚠ DANGER

Electrical voltage at the DC terminals!

Danger to life due to electric shock!

► The customer must ensure protection against accidental contact.

- DC connection module 00H6M1x-x100

Installation DC connection module
www.keb.de/fileadmin/media/Manuals/dr/ma_dr_dc-connection-module-zub-20186874_en.pdf

Insertion profiles from Phoenix Contact UKH50EP / 3009228 are not included in the scope of delivery.

4 Installation and Connection

4.1 Construction of the device

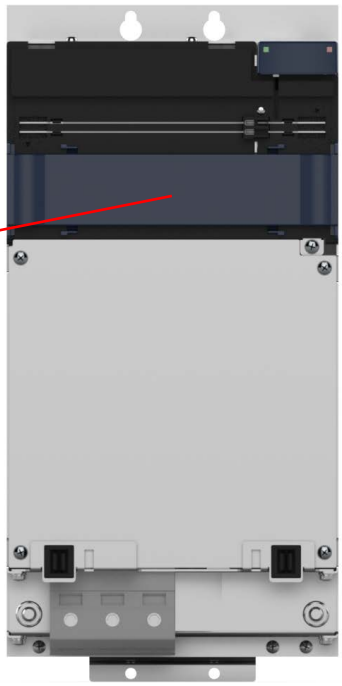
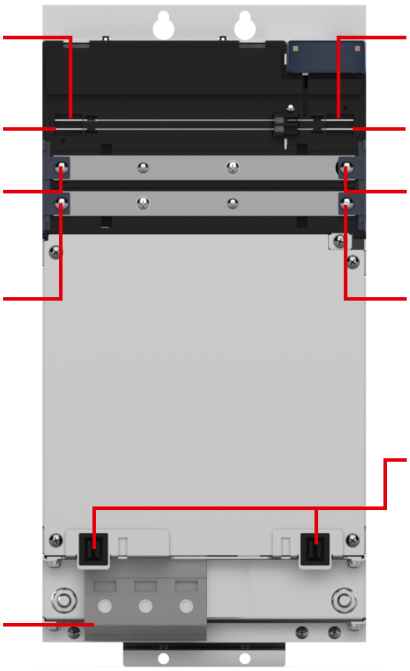
Front view	Remove the front cover	Front without cover
	• Pull with both hands low in the cover. • Tilt cover forward to approx. 45 degrees, until the plates solve above from the mounting. • Remove the cover forward. **Remove the cover from the DC bus** • Compress lug of the cover, remove forward.	

Figure 10: Front view of the device

⚠ DANGER

Hazardous voltage under the cover of the DC bus

► Secure isolation from supply of the DC bus at the power supply and regenerative unit!

<table>
<tr><th>Description</th><th>Terminal</th><th>Connections of the front side</th><th>Terminal</th><th>Description</th></tr>
<tr><td>+24V bus</td><td>X1C.1</td><td rowspan="7">  </td><td>X1C.3</td><td>+24V bus</td></tr>
<tr><td>0 V</td><td>X1C.2</td><td>X1C.4</td><td>0 V</td></tr>
<tr><td>DC bus +</td><td>X1D.1</td><td>X1D.3</td><td rowspan="2">DC bus (displayed with protection against contact for exterior devices)</td></tr>
<tr><td>DC bus -</td><td>X1D.2</td><td>X1D.4</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="2"></td><td colspan="2">Snap-in for front cover</td></tr>
<tr><td>Output to the filter</td><td>X1A</td><td colspan="2"></td></tr>
<tr><td colspan="5">Figure 11: Connections of the front side</td></tr>
</table>

View rear side of the device

Size C / S

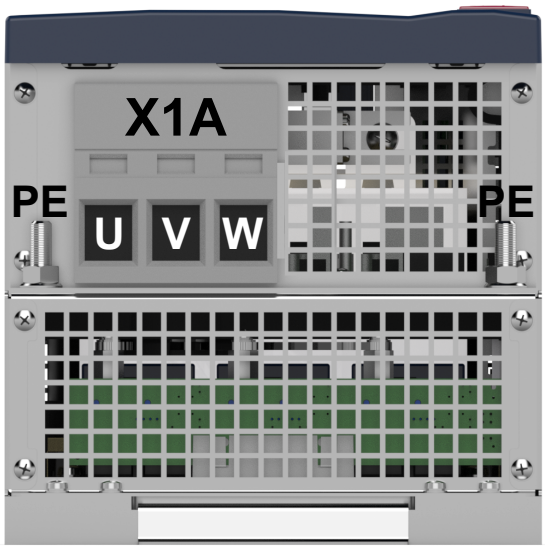
Terminal connection		Function	Conductor cross-section	Tightening torque
X1A	U	Connection to the filter (connect inphase)	0.2...6 mm² AWG 24-10	0.7 Nm 6.2 lb inch
	V			
	W			
X1B	BR+	Connection for 24 V DC brake	0.25...1.5 mm² AWG 28-16	0.25 Nm 2.2 lb inch
	BR-			
	T1	Connection for PTC / KTY filter temperature monitoring		
	T2			
PE	⏚	Connection for shielding/ earthing	M6 stud for ring crimp connector	1.3 Nm 11.5 lb inch

Figure 12: View of the bottom of the device size C / S

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

View rear side of the device

Size E / U



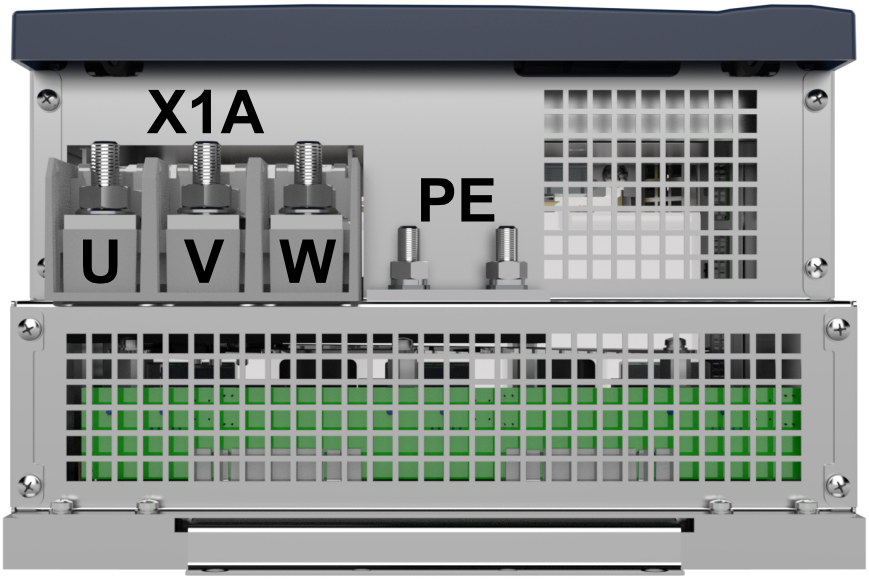
Terminal connection		Function	Conductor cross-section	Tightening torque
X1A	U	Connection to the filter. Connect inphase.	35...95 mm² AWG 4-0	15 Nm 132 lb inch
	V			
	W			
PE	⏚	Connection for shielding/ earthing	M8 stud for ring crimp connector	12 Nm 110 lb inch

Figure 13: View of the bottom of the device size E / U

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

View rear side of the device

Size G/W

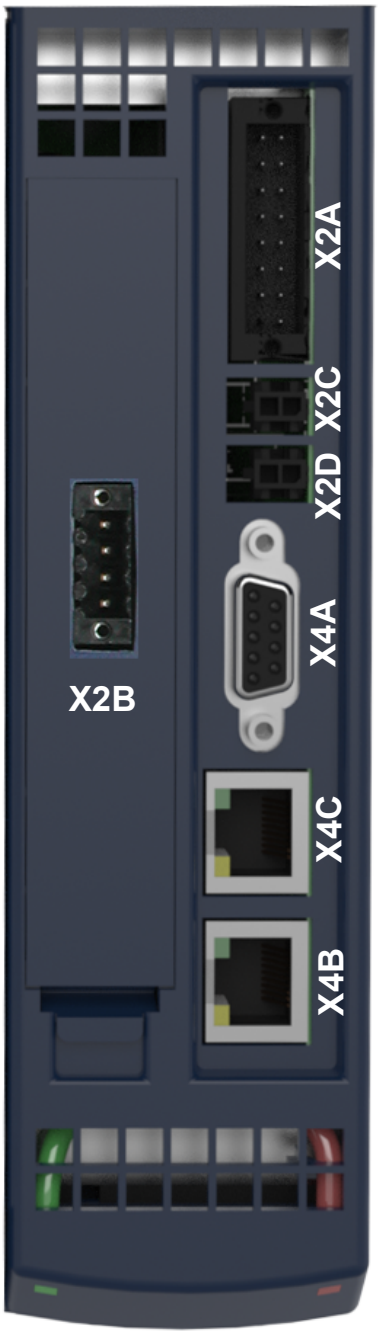


Terminal connection		Function	Conductor cross-section	Tightening torque
X1A	U	Connection to the filter. Connect inphase.	M10 stud for ring crimp connector max. width 30 mm	12 Nm 110 lb inch
	V			
	W			
PE	⏚	Connection for shielding/ earthing	M8 stud for ring crimp connector	12 Nm 110 lb inch

Figure 14: View of the bottom of the device size G/W

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

View upper side of the device



Digital inputs and outputs

X2A	Dig. input 4	16	15	0V
	Dig. input 3	14	13	0V
	Dig. input 2	12	11	0V
	Dig. input 1	10	9	0V
	Dig. output 4	8	7	0V
	Dig. output 3	6	5	0V
	Dig. output 2	4	3	0V
	Dig. output 1	2	1	0V
X2C	Error chain	2	1	Charging status 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	EtherCAT out	LED	1	TX+
		Speed	2	TX-
			3	RX+
			4	–
X4B	EtherCAT in		5	–
			6	RX-
		Link/Activity	7	–
		LED	8	–

	Safety module (type 0 "default“ is displayed here)	
X2B	4 Brake	- no function -
	3 0V	Reference potential
	2 24V	Output DC 24 V / 100 mA
	1 ST	Control release

Figure 15: View upper side of the device

4.1.1 Status LED displays AIC module

Status LED 1 Safety module		Status LED 2 AIC module

Figure 16: Status LED displays AIC module

4.1.1.1 Status LED 1 AIC module

The LED displays the status of the AIC module.

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

Table 12: Status LED 1 AIC module

4.1.1.2 Status LED 2 safety module

The LED indicate the state of the safety module.

LED	Status
off	No voltage supply of the safety module
green	Safety module ready for operation
red	Safety module in error routine

Table 13: Status LED 2 safety module

4.2 Structure of the charging module

Front view	Remove the front cover	Front without cover
	• Pull with both hands low in the cover. • Tilt cover forward to approx. 45 degrees, until the plates solve above from the mounting. • Remove the cover forward. **Remove the cover from the DC bus** • Compress lug of the cover, remove forward.	

Figure 17: Front view of the device

⚠ DANGER

Hazardous voltage under the cover of the DC bus

► Secure isolation from supply of the DC bus at the power supply and regenerative unit!

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

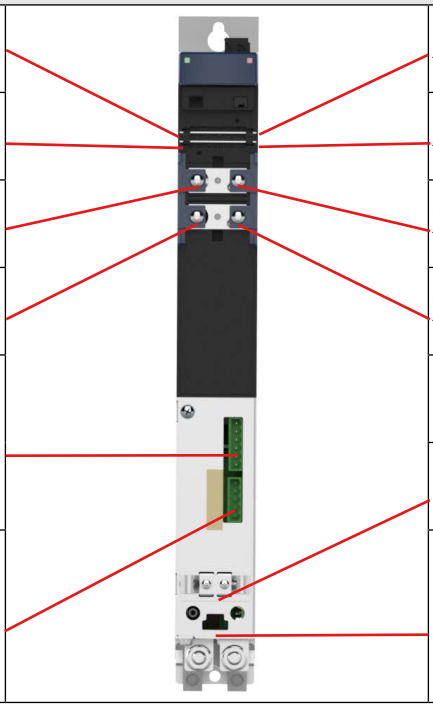
Connections of the front side				
+24V bus	X1C.1		X1C.3	+24V bus
0 V	X1C.2		X1C.4	0 V
DC bus +	X1D.1		X1D.3	DC bus +
DC bus -	X1D.2		X1D.4	DC bus -
Protection feedback and temperature switch	X1E			
			Shield clamps	
Contactor and fan control	X1F		Snap-in for front cover	

Figure 18: Connections of the front side

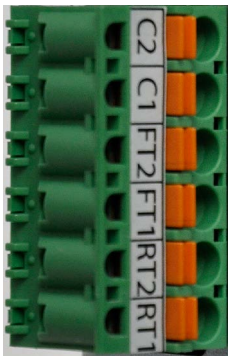
X1E	Name	Function	Connection data
	C2	Control input (for checking whether the contactor has switched)	Permissible connection cross section: 0.2…2.5 mm², AWG 24-12 Stripping length: 10 mm
	C1		
	FT2	Temperature monitoring of the AIC filter	
	FT1		
	RT2	Temperature monitoring of the braking resistor	
	RT1		

Figure 19: Terminal block X1E

X1F	Name	Function	Connection data
	C-out	Control for supply /regenerative contactor; switches after completion of the precharging	Permissible connection cross section: 0.2…2.5 mm², AWG 24-12 Stripping length: 10 mm max. load: 6 A / 1500 VA max. inductive load: 24 V DC (DC13): 2 A 250 V AC (AC15): 3 A max. starting current (capacitive load of the protective circuit): < 2.0 A during the relevant time of 1 ms
	C-in		
	–	not assigned	
	F-out	Control for fans of the AIC filter	
	F-in		

Figure 20: Terminal block X1F

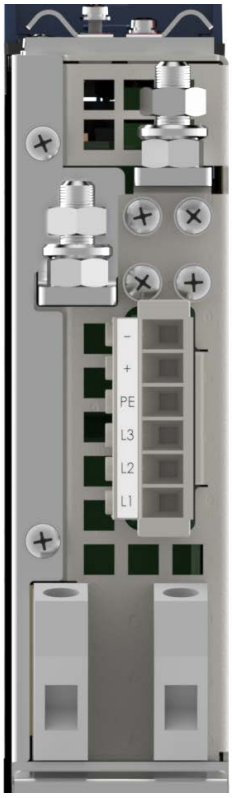
View rear side of the device		
	⏚	Protective earth and function earth
	X1A	Power unit terminal strip
	X1B	Connection for braking resistor

Figure 21: View rear side of the device

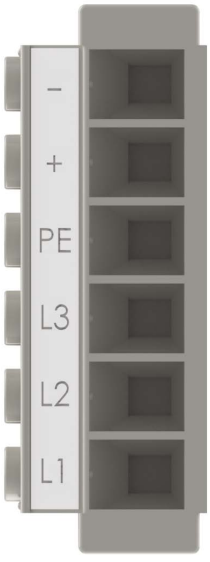
X1A	Name	Function	Conductor cross-section	Tightening torque
	L1, L2, L3	Mains connection for pre-charging	0.2...6 mm² AWG 24-10	0.7 Nm 6.2 lb inch
	PE	Connection for protective earth		
	+, -	DC link connection for sine-wave EMC filter		

Figure 22: Terminal block X1A

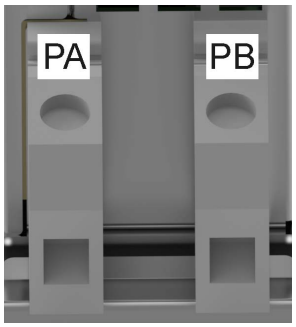
X1B	Name	Function	Conductor cross-section	Tightening torque
	PA	Connection for braking resistor	0.5...16 mm² AWG 20-4	2 Nm 18 lb inch
	PB			

Figure 23: Terminal block X1B

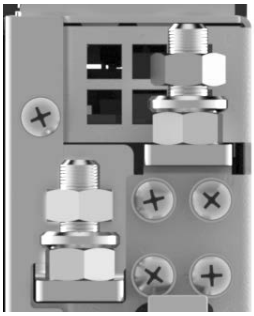
⏚	Name	Function	Conductor cross-section	Tightening torque
	⏚	Connection for protective earth and function earth	M8	4.5 Nm 40 lb inch

Figure 24: Connection for protective earth and function earth

4.2.1 Status LED displays charging unit

Status LED 1 - without function -		Status LED 2 Charging module

Figure 25: Status LED displays charging unit

4.2.2 Status LED charging unit

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

Table 14: Status LED charging unit

View upper side of the device

Digital inputs and outputs

X2A	Dig. input 4	16	15	24 V / < 0.7 Adc output
	Dig. input 3	14	13	24 V / < 0.7 Adc output
	Dig. input 2	12	11	24 V / < 0.7 Adc output
	Dig. input 1	10	9	24 V / < 0.7 Adc output
	Dig. output 4	8	7	0V
	Dig. output 3	6	5	0V
	Dig. output 2	4	3	0V
	Dig. output 1	2	1	0V
X2C	Error chain	2	1	Charging status 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	no function			
X4B	no function			

Figure 26: View upper side of the device

4.3 Connection of the power unit

4.3.1 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 power supply module. 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.

If the DC current is greater than 350A, the current must be limited to this value for each DC bus connection X1D and the total current must be divided between the right and left connection.

⚠ DANGER

Dangerous voltage

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

Bridges for the connection of the DC bus between the devices	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 screw driver TX20	Tightening torque 3.0 Nm (bridge) 1.1…1.2 Nm (plastic cap)

Figure 27: Connection of the DC bus

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

4.3.2 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. Generally this voltage is provided by the COMBIVERT H6 power supply module, but also an existing voltage source can be used.

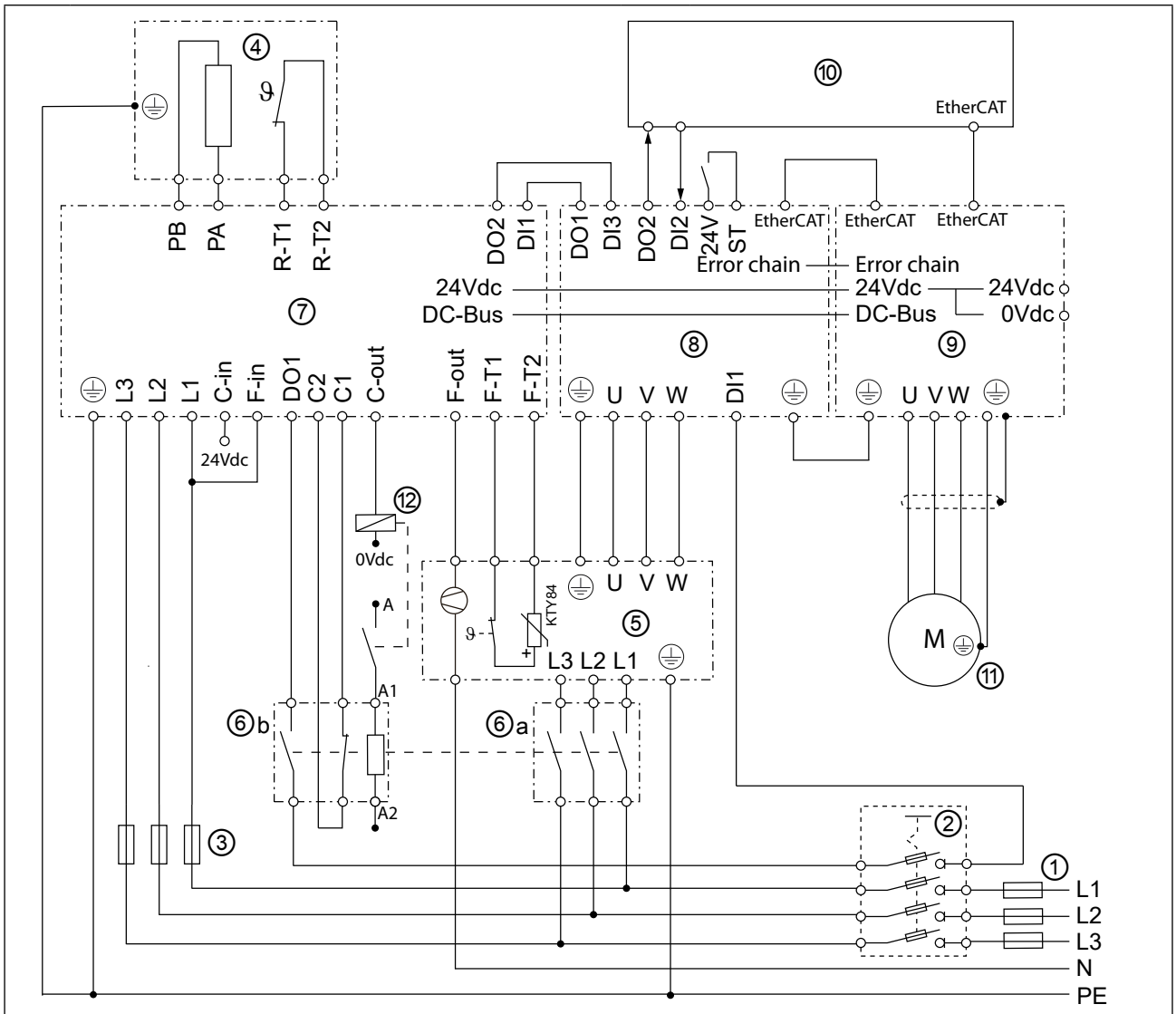
The bridge for the connection of the 24V bus is attached to the devices and fixed with a screw.	
Cross-head screw M3x10	Tightening torque 0.5 Nm

Figure 28: 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.

4.3.3 Connection of filter, charging and AIC module



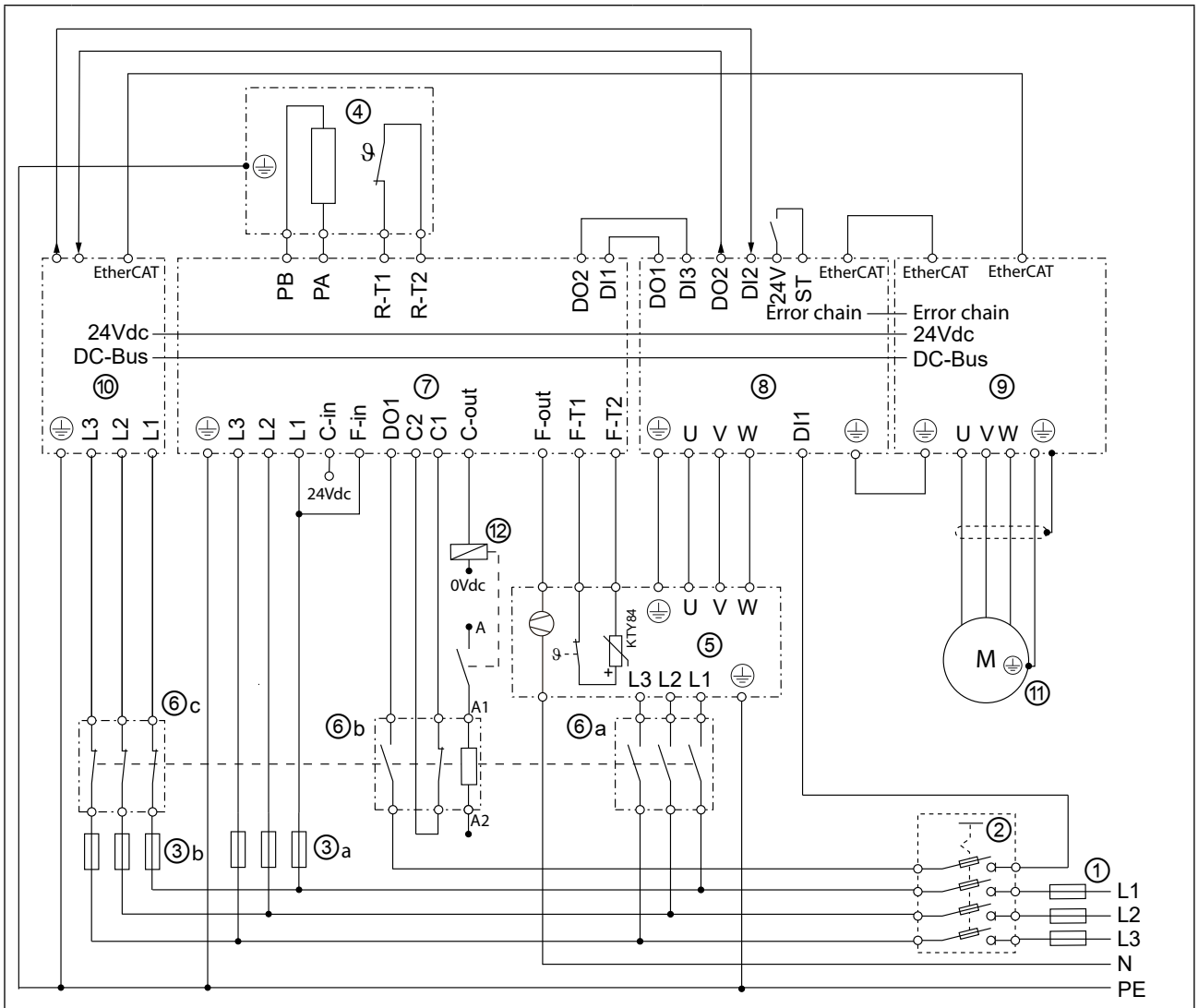
Legend			
1	Main fuses	7	Charging module
2	Main switch S1	8	AIC module
3	Fuse charging module	9	Axis module
4	Braking resistor with temperature switch	10	Superior control (optional)
5	AIC filter with fan and temperature switch	11	Motor
6	Mains contactor K1 with protective circuit	12	Decoupling relay with protective circuit [1]

Figure 29: Connection of filter, charging and AIC module

[1] *The decoupling relay is not required, if ensured that the load capacitiy of the relais contact is not exceeding, no capacitive load.*

The connection lines between AIC and filter are partly unshielded and must be laid at a distance of 15 cm from other cables => *„1.4.1 EMC-compatible installation“*.

4.3.4 Connection of filter, charging, AIC module and control at DC bus



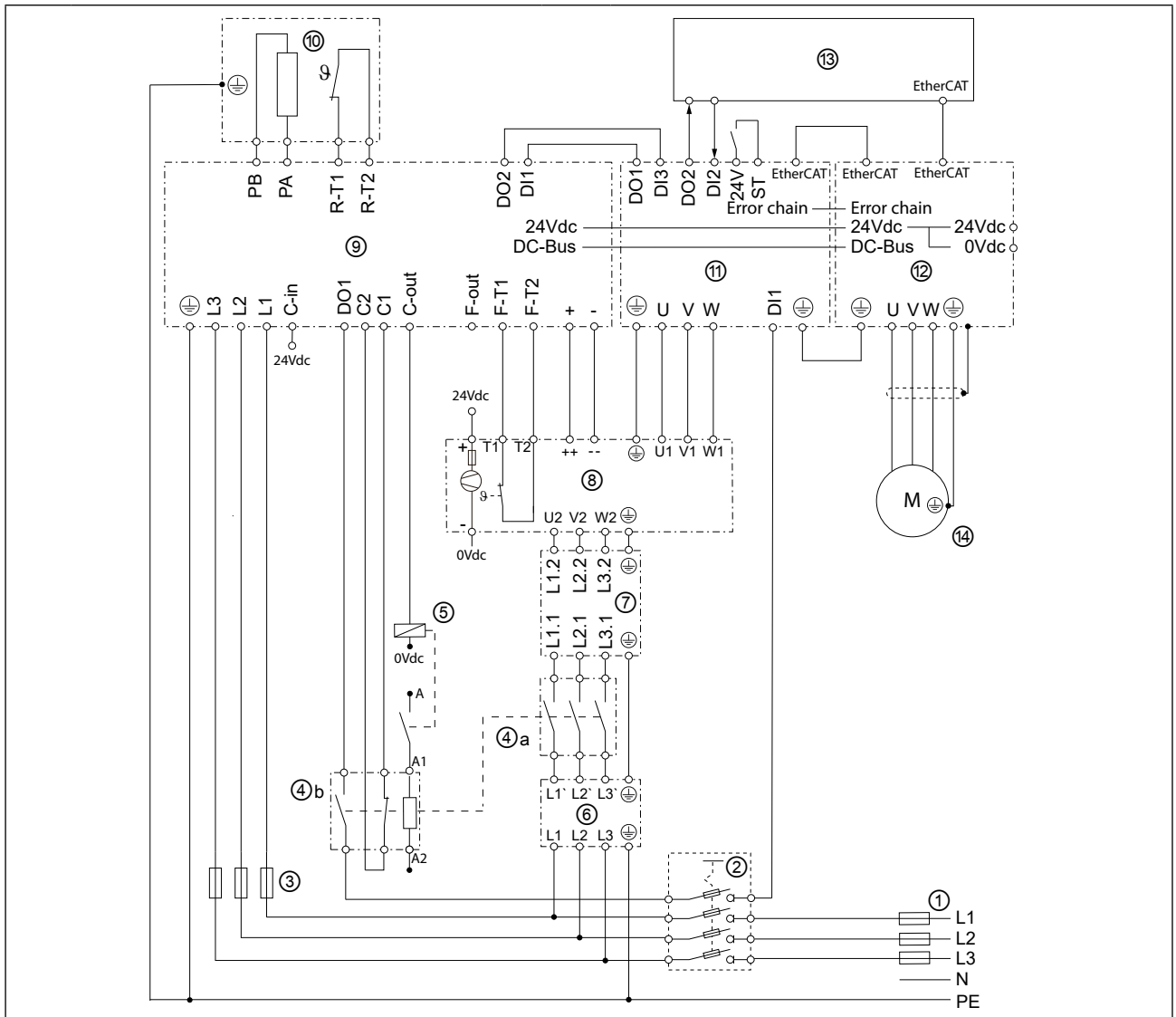
Legend			
1	Main fuses	7	Charging module
2	Main switch S1	8	AIC module
3	Fuses charging and 24V module	9	Axis module
4	Braking resistor with temperature switch	10	24V module / control
5	AIC filter with fan and temperature switch	11	Motor
6	Mains contactor K1 with protective circuit	12	Decoupling relay with protective circuit [1]

Figure 30: Connection of filter, charging, AIC module and control at DC bus

[1] *The decoupling relay is not required, if ensured that the load capacitiy of the relais contact is not exceeding, no capacitive load.*

The connection lines between AIC and filter are partly unshielded and must be laid at a distance of 15 cm from other cables => *„1.4.1 EMC-compatible installation“*.

4.3.5 Connection of sine-wave EMC filter and AIC module size 14



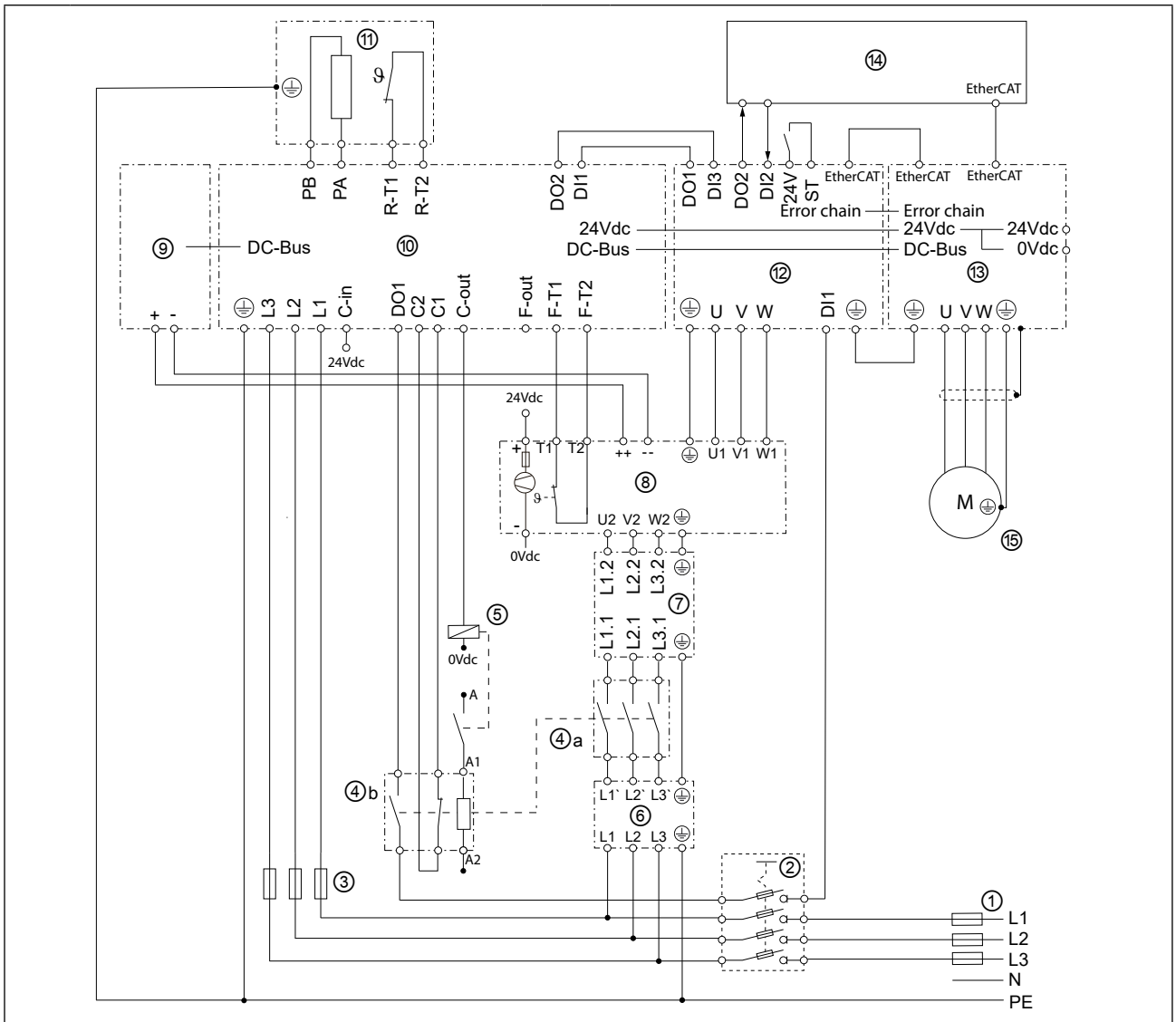
Legend			
1	Main fuses	8	Sine-wave EMC filter with fan and temperature switch
2	Main switch S1	9	Charging module
3	Fuse charging module	10	Braking resistor with temperature switch
4	Mains contactor K1 with protective circuit	11	AIC module
5	Decoupling relay with protective circuit [1)]	12	Axis module
6	EMC filter	13	Superior control (optional)
7	Mains choke	14	Motor

Figure 31: Connection of sine-wave EMC filter and AIC module size 14

[1)] *The decoupling relay is not required, if ensured that the load capacitiy of the relais contact is not exceeding, no capacitive load.*

The connection lines between AIC and filter are partly unshielded and must be laid at a distance of 15 cm from other cables => *„1.4.1 EMC-compatible installation“*.

4.3.6 Connection of sine-wave EMC filter, DC terminal and AIC module size 19...26



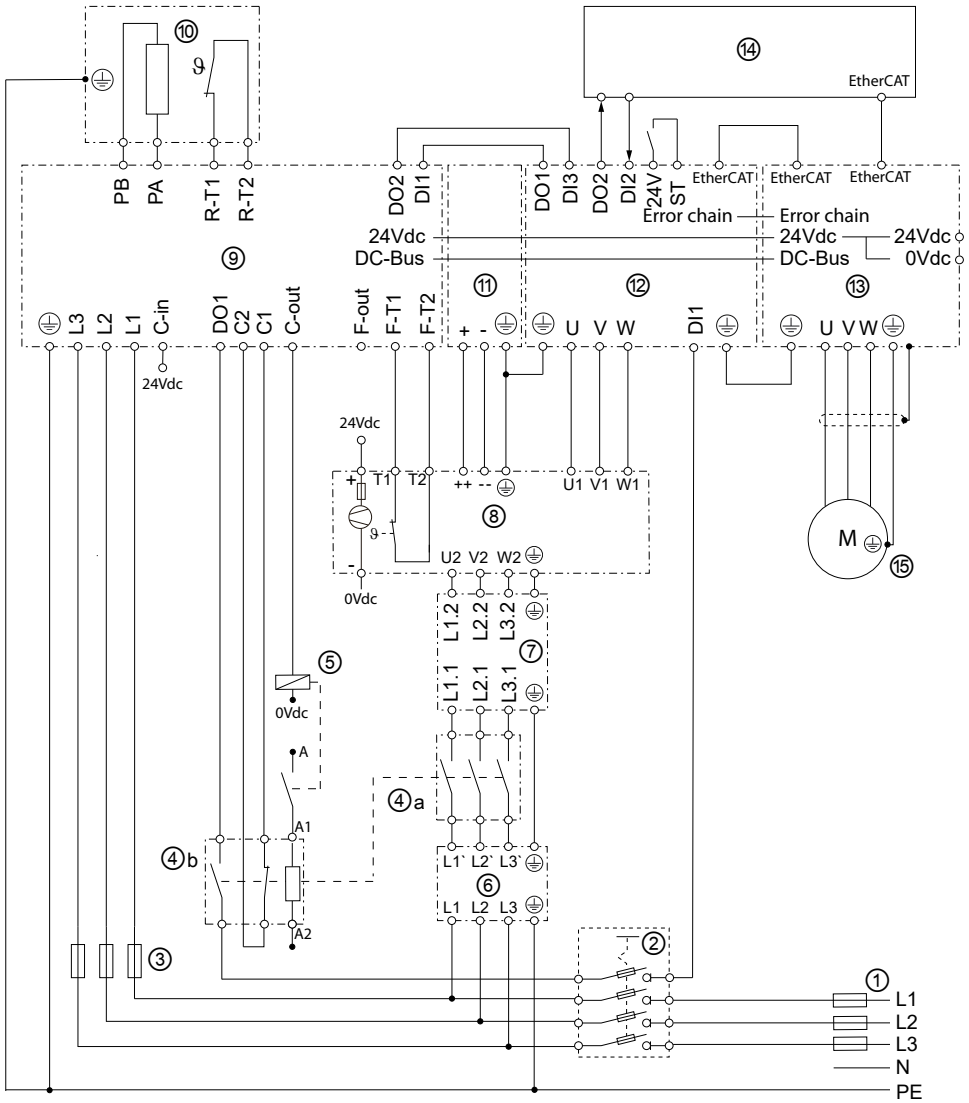
Legend			
1	Main fuses	9	DC terminal
2	Main switch S1	10	Charging module
3	Fuse charging module	11	Braking resistor with temperature switch
4	Mains contactor K1 with protective circuit	12	AIC module
5	Decoupling relay with protective circuit [1)]	13	Axis module
6	EMC filter	14	Superior control (optional)
7	Mains choke	15	Motor
8	Sine-wave EMC filter with fan and temperature switch		

Figure 32: Connection of sine-wave EMC filter, DC terminal and AIC module size 19...26

[1)] *The decoupling relay is not required, if ensured that the load capacitiy of the relais contact is not exceeding, no capacitive load.*

The connection lines between AIC and filter are partly unshielded and must be laid at a distance of 15 cm from other cables => *„1.4.1 EMC-compatible installation“*.

4.3.7 Connection of sine-wave EMC filter, DC terminal and AIC module size 19...26



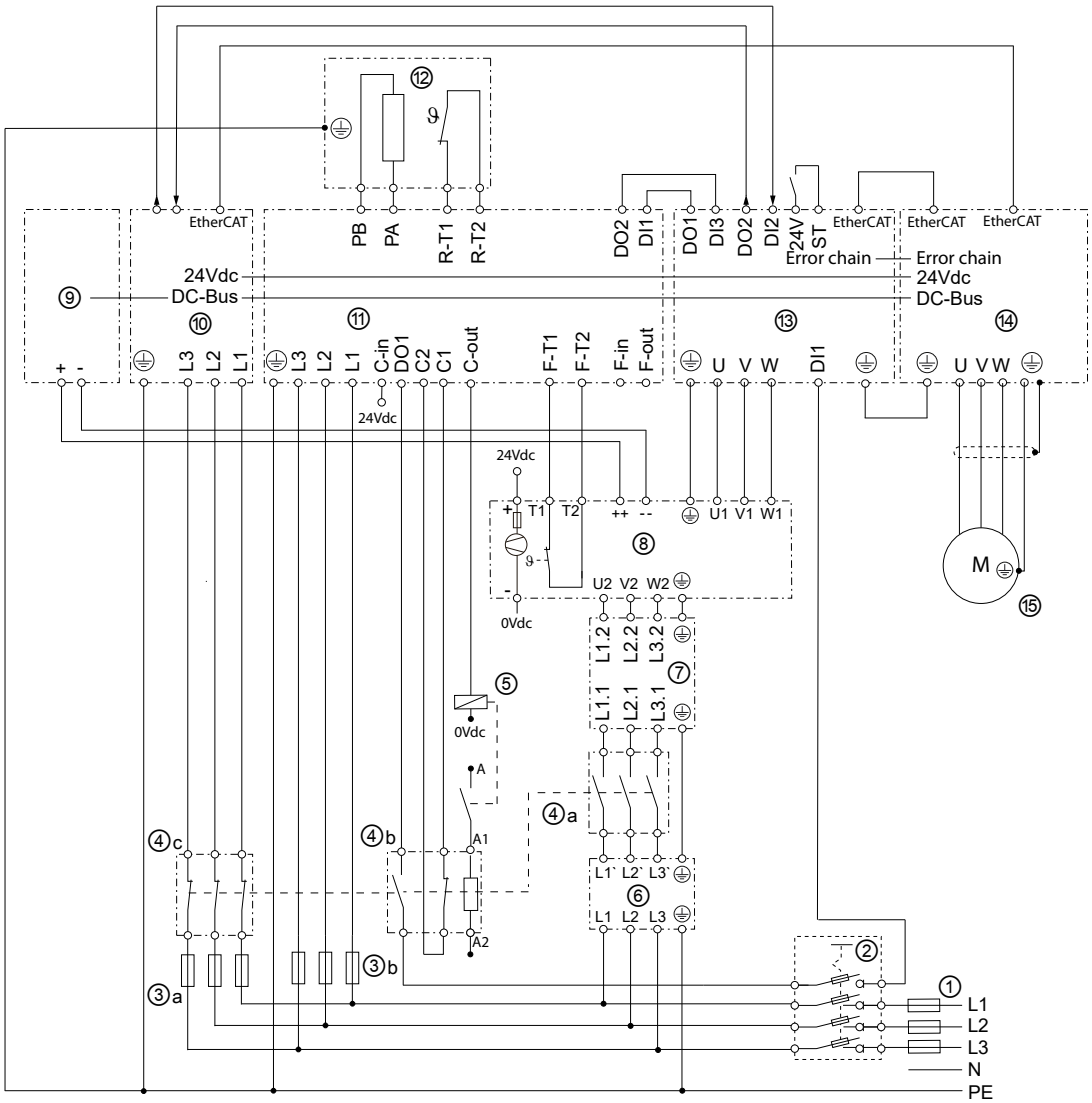
Legend			
1	Main fuses	9	Charging module
2	Main switch S1	10	Braking resistor with temperature switch
3	Fuse charging module	11	DC connection module with insertion profiles
4	Mains contactor K1 with protective circuit	12	AIC module
5	Decoupling relay with protective circuit [1)]	13	Axis module
6	EMC filter	14	Superior control (optional)
7	Mains choke	15	Motor
8	Sine-wave EMC filter with fan and temperature switch		

Figure 33: Connection of sine-wave EMC filter, DC terminal and AIC module size 19...26

[1)] *The decoupling relay is not required, if ensured that the load capacitiy of the relais contact is not exceeding, no capacitive load.*

The connection lines between AIC and filter are partly unshielded and must be laid at a distance of 15 cm from other cables => *„1.4.1 EMC-compatible installation“*.

4.3.8 Connection sine-wave EMC filter, DC terminal, AIC module size 19...26, 24V module / Ctrl at DC bus



Legend			
1	Main fuses	9	DC terminal
2	Main switch S1	10	24V module / control (xxH6Gxx-3/6xxx)
3	Fuse charging and 24V module	11	Charging module
4	Mains contactor K1 with protective circuit	12	Braking resistor with temperature switch
5	Decoupling relay with protective circuit [1)]	13	AIC module
6	EMC filter	14	Axis module
7	Mains choke	15	Motor
8	Sine-wave EMC filter with fan and temperature switch		

Figure 34: Connection sine-wave EMC filter, DC terminal, AIC module size 19...26, 24V module / Ctrl at DC bus

[1)] *The decoupling relay is not required, if ensured that the load capacitiy of the relais contact is not exceeding, no capacitive load.*

The connection lines between AIC and filter are partly unshielded and must be laid at a distance of 15 cm from other cables => *„1.4.1 EMC-compatible installation“*.

4.3.9 Temperature monitoring of the braking resistor

4.3.9.1 Terminals R-T1, R-T2

NOTICE

Connection temperature switch!

Connect the safe separated temperature switch at the input of the charging unit.

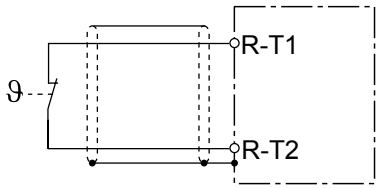
Thermal contact (NC contact) minimum switching current: 2 mA	

Figure 35: Wiring example temperature monitoring

NOTICE

Operation without braking resistor!

If no braking resistor is required, a bridge must be installed between R-T1 and R-T2 to evaluate the input, otherwise there is no precharging and modulation.

4.4 Connection of the control

4.4.1 Error chain terminal X2C, X2D

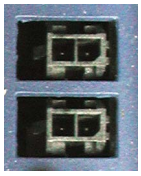
<table>
<tr><th colspan="2">Channel</th><th rowspan="2">Name</th><th rowspan="2">Description</th><th rowspan="2">Connecting cable error chain</th></tr>
<tr><th>2</th><th>1</th></tr>
<tr><td colspan="2">  </td><td>X2C
X2D</td><td>The terminal strips X2C and X2D are internally parallel connected. Thus, 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.
Status channel 1:
<table><tr><td>OK</td><td>=</td><td>U > 9 V</td></tr><tr><td>Error</td><td>=</td><td>U < 5 V</td></tr></table>
Status channel 2:
<table><tr><td>Release axis modules</td><td>=</td><td>U < 5 V</td></tr><tr><td>no release axis modules</td><td>=</td><td>U > 9 V</td></tr></table></td><td>  </td></tr>
</table>

Figure 36: Error chain terminal X2C, X2D

4.4.1.1 Error chain (channel 1)

The first error channel is an error chain. 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.

4.4.1.2 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.

4.4.1.3 Wiring example error chain

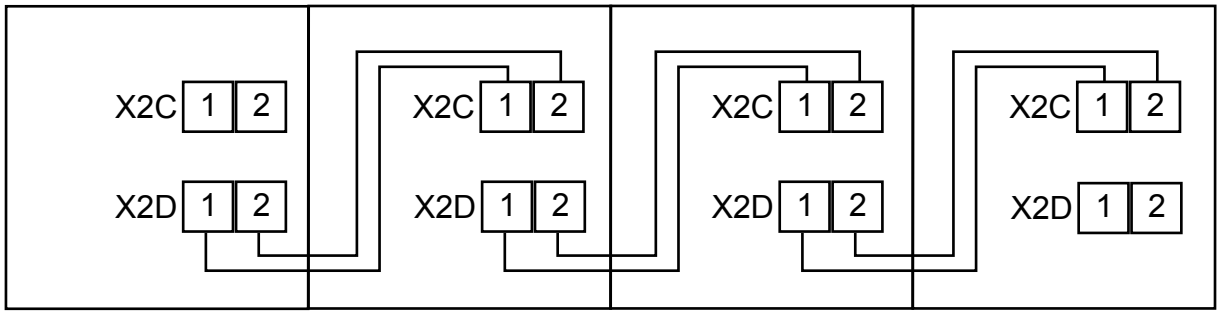


Figure 37: Wiring example error chain

4.4.2 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 <250 µs.

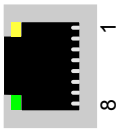
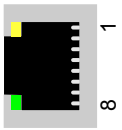
Description of the LEDs		RJ45 socket		Assignment	
LED green	Link		X4C EtherCAT OUT	1	TX+
off	Connection off			2	TX-
flashing	Communication			3	RX+
on	Connection on			4	–
				5	–
LED yellow	Speed		X4B EtherCAT IN	6	RX-
off	10 MBit			7	–
on	100 Mbit			8	–

Table 15: EtherCat System bus socket X4B

Does not apply to the charging module!

4.4.3 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 16: Diagnosis/visualisation X4A

NOTICE

Defect with wrong potential!

Destruction of the interface!

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

4.4.3.1 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

4.4.3.2 Technical data of the outputs

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

Technical Data		
Max. switching voltage	*U* / V	30
Max. current	*I* / A	0.7 (per output) 1 (total current for all outputs)
Internal resistance	*R* / Ω	250
Max. switching frequency	*f* / kHz	1
Inductive load	*L* / mJ	max. 300 (without free-wheeling diode)

Table 17: Technical data of the digital output

4.4.3.3 Assignment of the interfaces

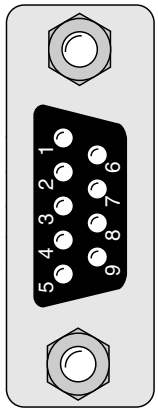
reserved - do not assign!	1		6	reserved - do not assign!
TxD (RS232)	2		7	DGND (reference potential)
RxD (RS232)	3		8	TxD-A (RS485)
RxD-A (RS485)	4		9	TxD-B (RS485)
RxD-B (RS485)	5			

Figure 38: Assignment of the interfaces

4.4.4 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.

4.4.4.1 Assembly of the wires to PUSH IN terminals

NOTICE

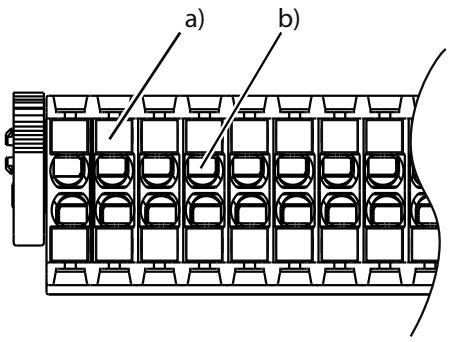
Malfunctions caused by loose cable connections!

► 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 18: Wire-end ferrules and stripping length

Front view



a) Pusher

b) Wire hole

Figure 39: 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.

4.4.4.2 Assignment of the terminal block X2A AIC module

Digital inputs and outputs					
Function	**Default setting**	**Pin**		**Pin**	**Function**
Digital input DI 4	Reset, unchangeable	16		15	0 V
Digital input DI 3	Prog. error, unchangeable	14		13	0V
Digital input DI 2	Release AIC / Reset, unchangeable	12		11	0V
Digital input DI 1	Precharging complet-ed, unchangeable	10		9	0V
Digital output DO 4	Not preset	8		7	0V
Digital output DO 3	Not preset	6		5	0V
Digital output DO 2	Ready for operation, changeable	4		3	0V
Digital output DO 1	Start pre-charge, unchangeable	2		1	0V

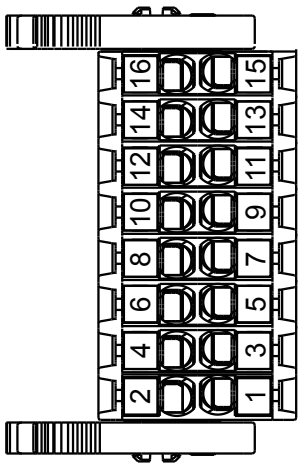


Figure 40: Assignment of the terminal block X2A AIC module

4.4.4.3 Assignment of the terminal block X2A charging module

Digital inputs and outputs					
Function	**Default setting**	**Pin**		**Pin**	**Function**
Digital input DI 4	Not preset	16		15	24 V/<0.7 Adc
Digital input DI 3	Not preset	14		13	24 V/<0.7 Adc
Digital input DI 2	Not preset	12		11	24 V/<0.7 Adc
Digital input DI 1	Start precharging, unchangeable	10		9	24 V/<0.7 Adc
Digital output DO 4	Not preset	8		7	0V
Digital output DO 3	Not preset	6		5	0V
Digital output DO 2	Supply failure, unchangeable	4		3	0V
Digital output DO 1	Precharging completed (main contactor active), unchangeable	2		1	0V

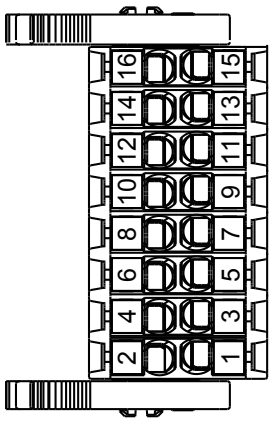


Figure 41: Assignment of the terminal block X2A charging module

4.4.4.4 Connection of the digital inputs

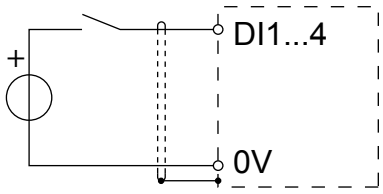
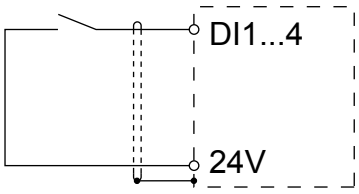
AIC and charging module	Only charging module
	

Figure 42: Connection of the digital inputs DI1…DI4

4.4.4.5 Connection of the digital outputs

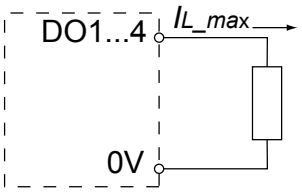


Figure 43: Connection of the digital outputs DO1…DO4

4.4.4.6 Example for the control of digital inputs and digital outputs

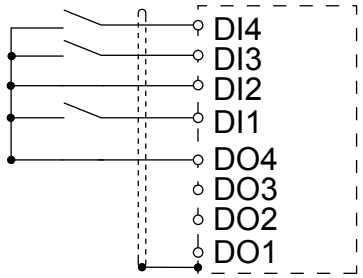
	Operation with hardware release: The 24V for the control of the inputs can be controlled with the set output DO4.

Figure 44: Example for the control of digital inputs and digital outputs

4.5 Safety modules terminal block X2B (not for charging module)

4.5.1 Module type 0 terminal block X2B

Module type 0 is used for switching the control release and brake control release if no safety requirements are made.

Pin	Name	Description
4	BR	no function
3	0V	Mass
2	24V	24 V output (I_N = 100 mA)
1	ST	Control release
Assembly and cable cross-sections => *„4.4.4.1 Assembly of the wires to PUSH IN terminals“*.		

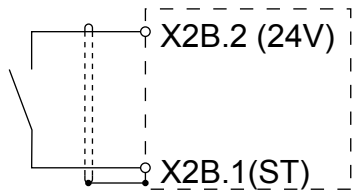
Figure 45: Safety module type 0 terminal block X2B (top view)

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

Status "0“	Status "1“
-3…5V	11…30 V

4.5.2 Control release

The driver modules of the power modules are supplied with voltage by switching the control release.



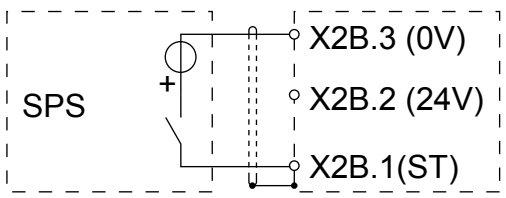


Figure 46: Connection of the control release via switch and PLC

5 Cooling System

5.1 Safety instructions for the use of liquid heat sinks

⚠ CAUTION

High temperatures at heat sink and coolant!

Burns of the skin

► Cover hot surfaces safe-to-touch.

► If necessary, attach warning signs on the system.

► Before touching, check surface and coolant lines.

► Before working let the unit cool down.

NOTICE

Keep electrochemical processes low!

► In the case of water cooling, ensure an appropriate conductor cross-section for equipotential bonding.

5.2 Start-Up

5.2.1 Flushing the cooling circuit

In order to vent the system beforehand, it is necessary to flush the cooling circuit. To do this

- first check the tightness of the cooling circuit.
- Check valves and pumps for function.
- Open the shut-off valves, if available.
- Open solenoid valve manually.

The times of the flushing process can be found in the table.

Volume flow / l/min	Time / s
5	10
10	5
15	2

Table 19: Flushing time for venting the cooling circuit

NOTICE

Observe flushing time!

► A flushing time of 10 seconds must not be exceeded, as condensation can already occur at very low flow temperatures.

5.3 Decommissioning and storage

In order to avoid deposits and corrosion, the cooling circuit must be completely emptied if it is switched off or stored for a longer period of time. If there is a risk of frost, the cooling circuit must be blown out with compressed air.

5.4 Installation of water-cooled devices

Water-cooled drive controllers are operated in continuous operation with lower temperature than air-cooled devices. This has positive effects on lifetime-relevant components such as fan and DC link capacitors and power modules (IGBT). Also the temperature dependent switching losses are positively effected. The use of water-cooled KEB COMBIVERT drive controllers 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.

5.4.1 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 by sealing rings and also have surface protection (anodized) in the channels.

NOTICE

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.

5.4.2 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

continued on the next page

Material	Generated Ion	Standard potential	Material	Generated Ion	Standard potential
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
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 20: Electrochemical series / standard potentials against hydrogen

5.4.3 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:

Requirements	Description
VGB Coolant-Guidelines	The VGB cooling water guideline (*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.
Suspended particles	The size and the proportion of suspended particles in the cooling water should not exceed the following values: < 100 µm < 10 mg per liter. Water filters can offer a remedy.
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 should have a low total hardness (<20 °dH) 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 21: Requirements on the coolant

NOTICE

Corrosion at the heat sink!

Do not use pure water for cooling!

► Mandatory use of corrosion protection inhibitors.

► Use an antifreeze / glycol mixture for use below 0 °C.

5.4.3.1 Special requirements for open and half-open cooling systems:

Requirements	Description
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.

Table 22: Special requirements for open and semi-open cooling systems

NOTICE

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.

5.4.4 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 conductor cross-section at required equipotential bonding in order to avoid electro-chemical procedures.

5.4.5 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. 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 controller, because the drive controller can be destroyed through eventual occuring short-circuits.

NOTICE

Destruction of the drive controller by short circuit!

The user must guarantee that any moisture condensation is avoided!

The following dew point table is used to determine the permissible temperature differences. The table shows the coolant inlet temperature depending on ambient temperature and air humidity.

Air humidity in % / Ambient 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 23: Dew point table

To avoid condensation, the following options are available:

- Supply of temper coolant
- Coolant control

Further information can be found under the following link:

Info sheet Coolant Management

www.keb.de/fileadmin/media/Techinfo/dr/an/ti_dr_an-h6-liquid-cooling-00011_en.pdf

5.4.6 Coolant heating depending on power dissipation and flow rate with water

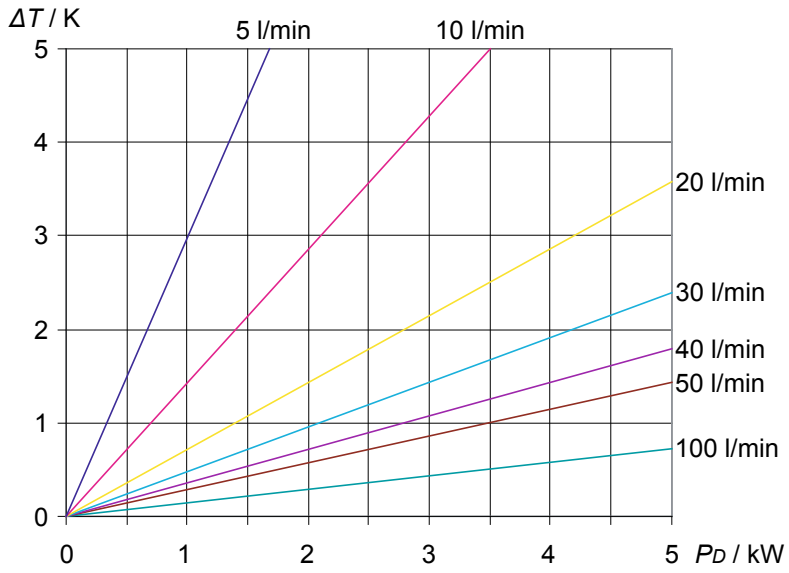


Figure 47: Coolant heating depending on power dissipation

5.4.7 Typically fall of pressure depending on the rate of flow (volume flow)

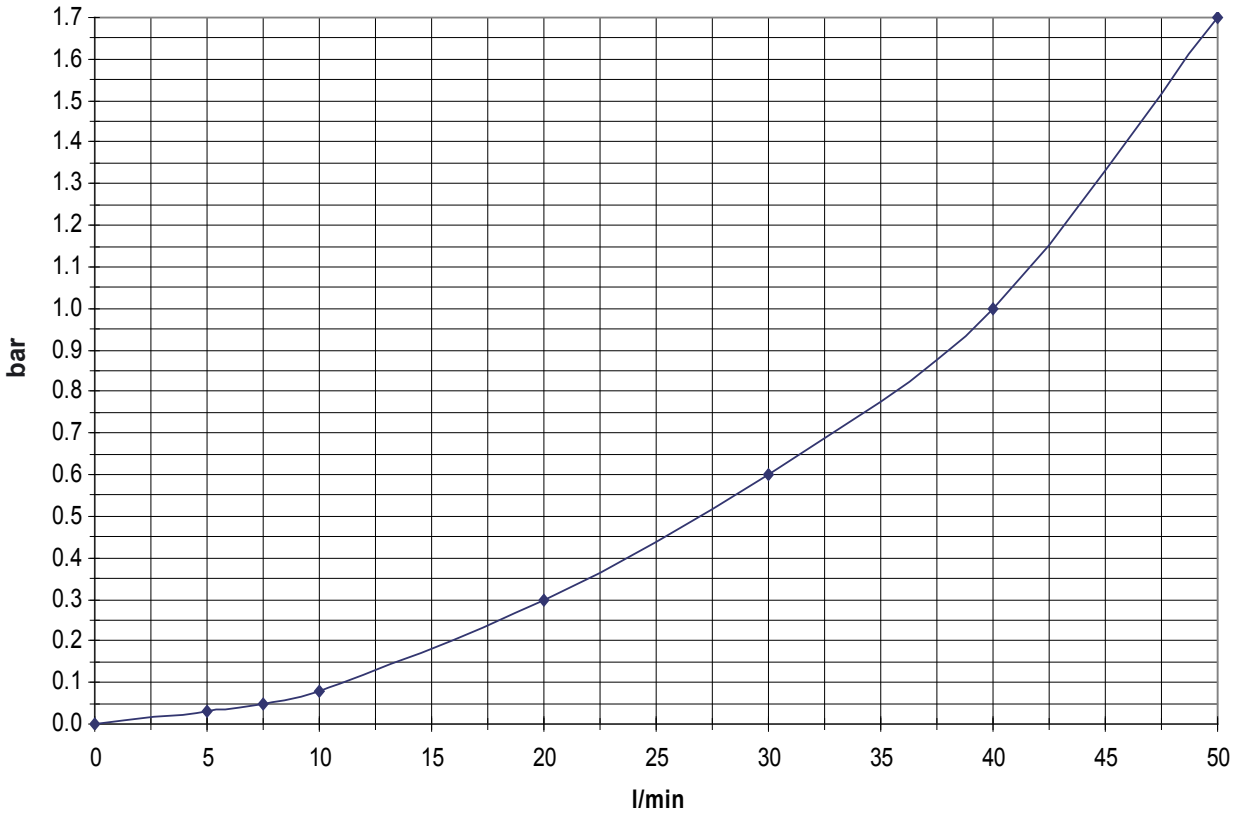


Figure 48: Typically fall of pressure depending on the rate of flow (volume flow)

In order to monitor the flow in the cooling system, KEB recommends the use of a flow monitor.

6 Start-Up

NOTICE

Avoidance of hardware damage!

In order to avoid hardware damage it is absolutely necessary to parameterize the initial settings before switching on the AC voltage for the first time!

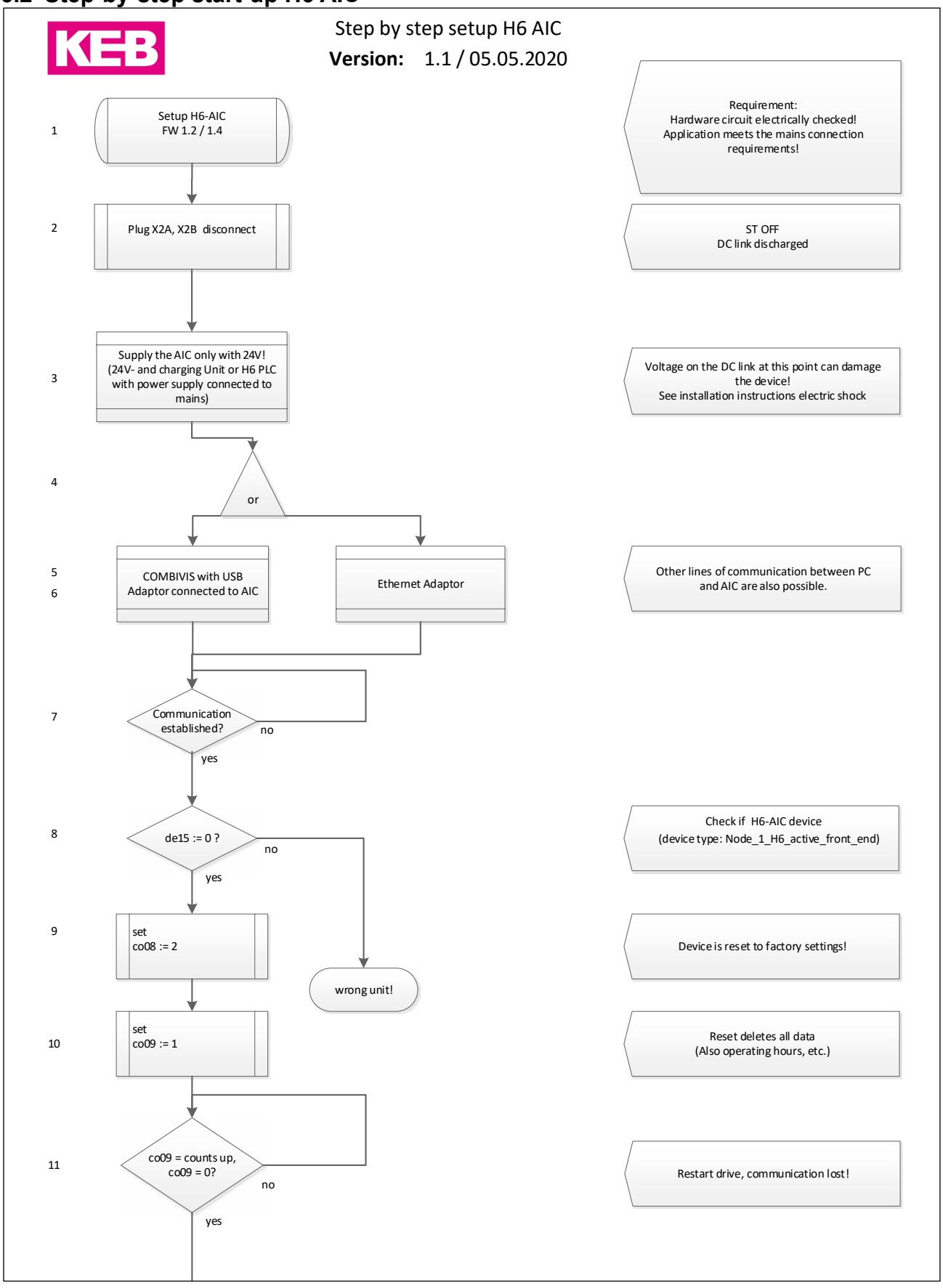
Further information about start-up => *„6.2 Step-by-step start-up H6 AIC“*.

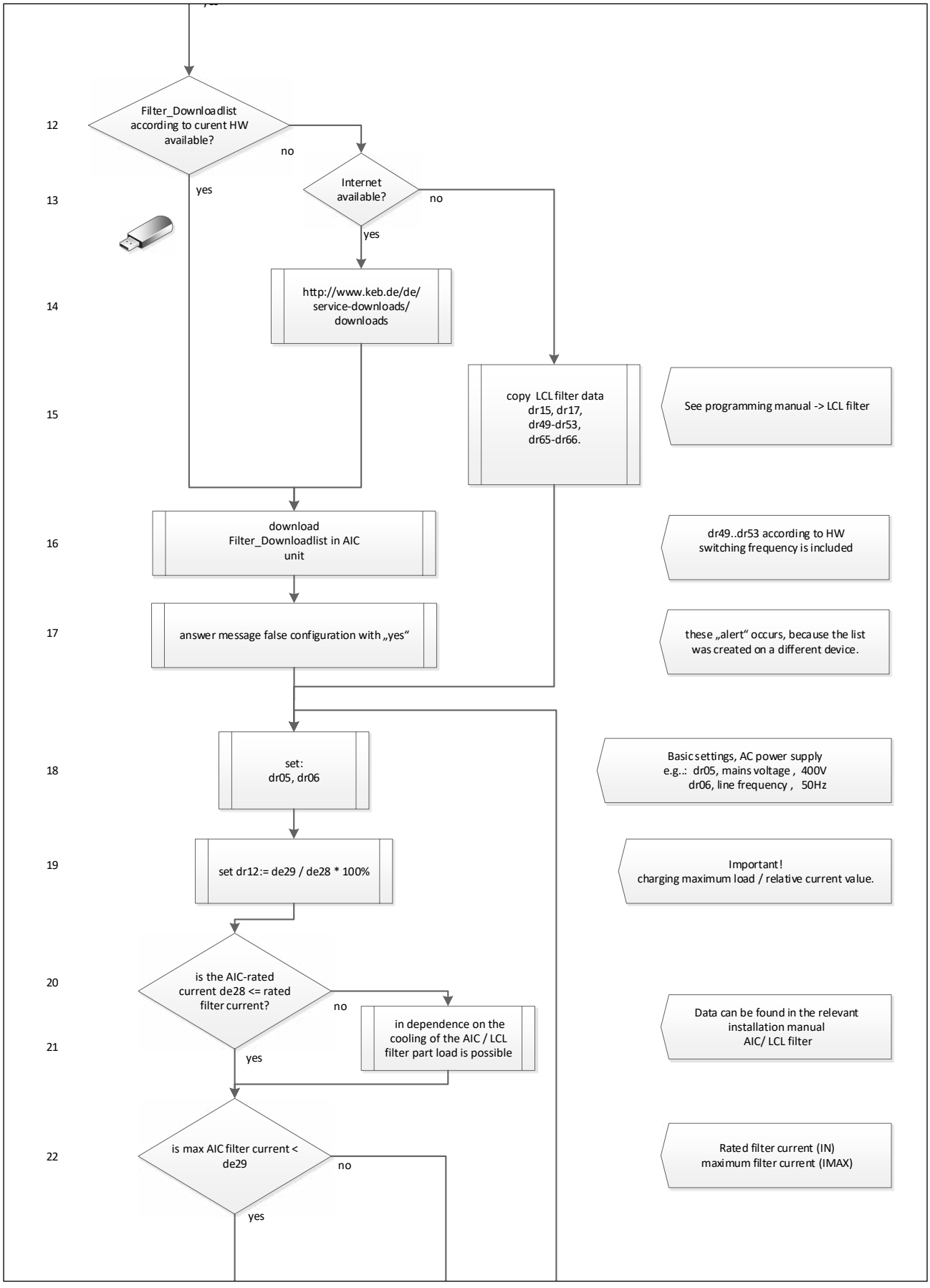
6.1 Default setting

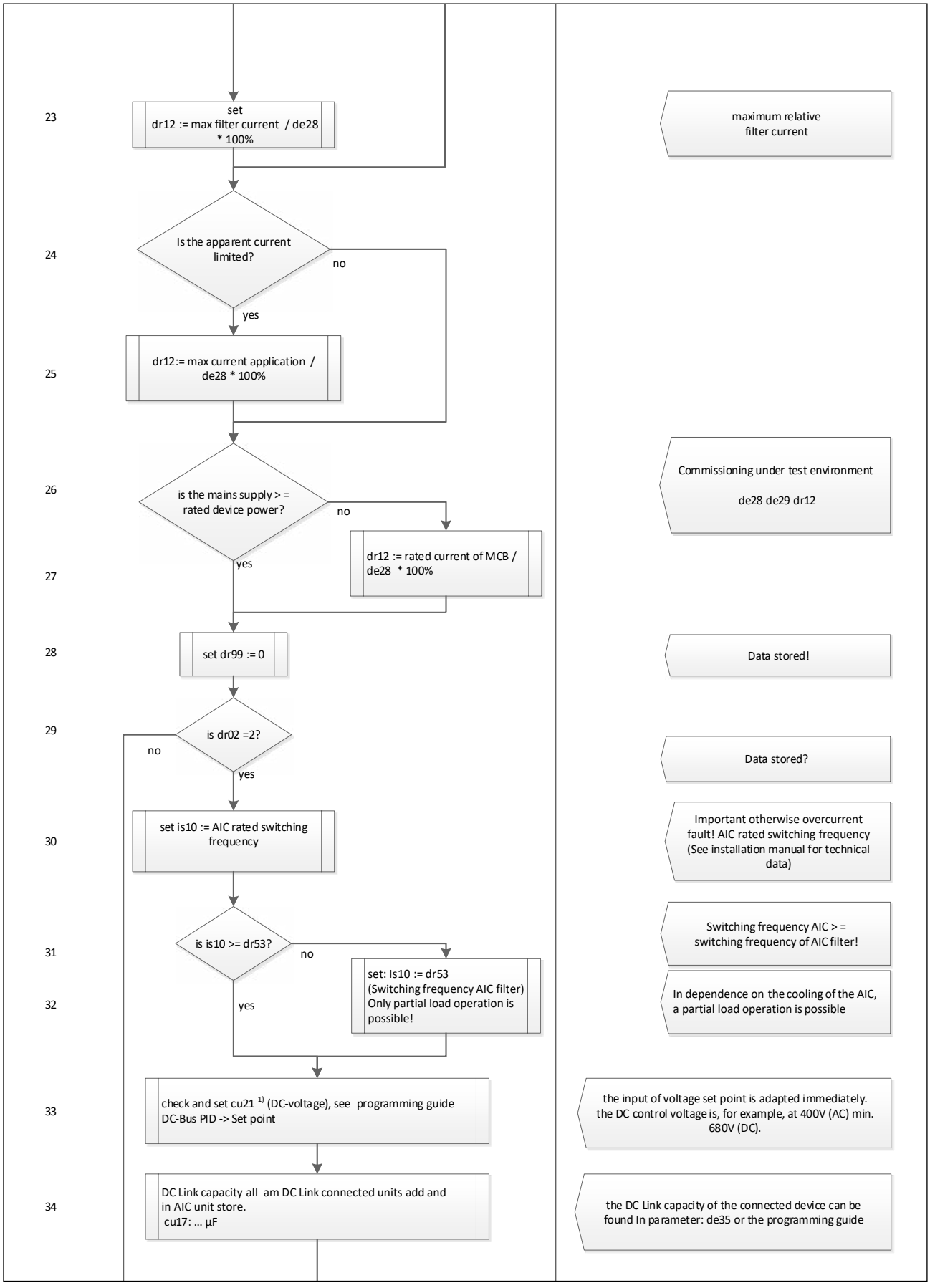
The COMBIVERT H6 AIC is an universally applicable power supply / regenerative unit that requires an individual adjustment of the basic settings depending on the mains supply, used filters and the connected devices.

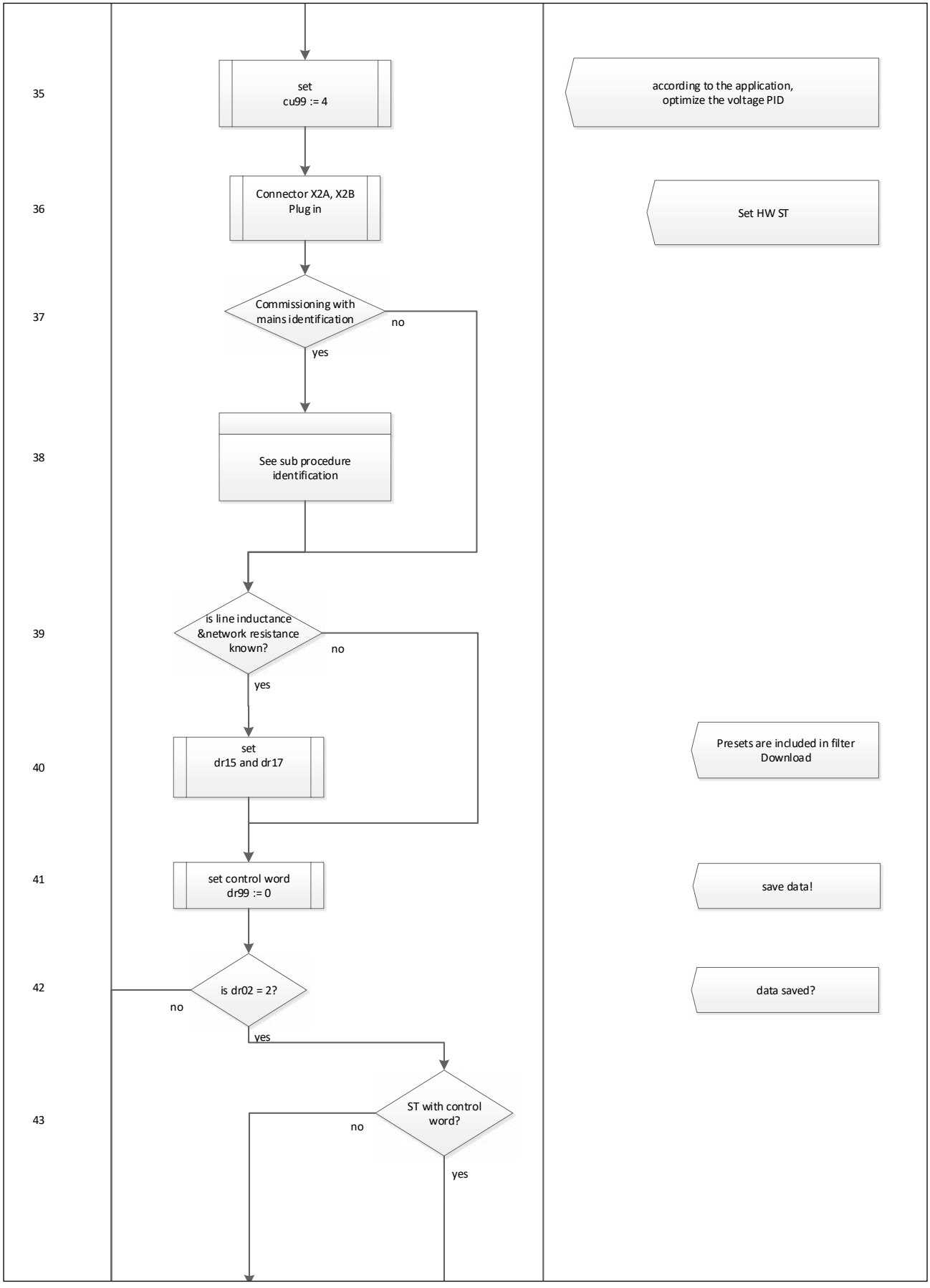
The appropriate COMBIVIS files can be downloaded from *www.keb.de* under the search term *"Download H6 AFE Filter“* .

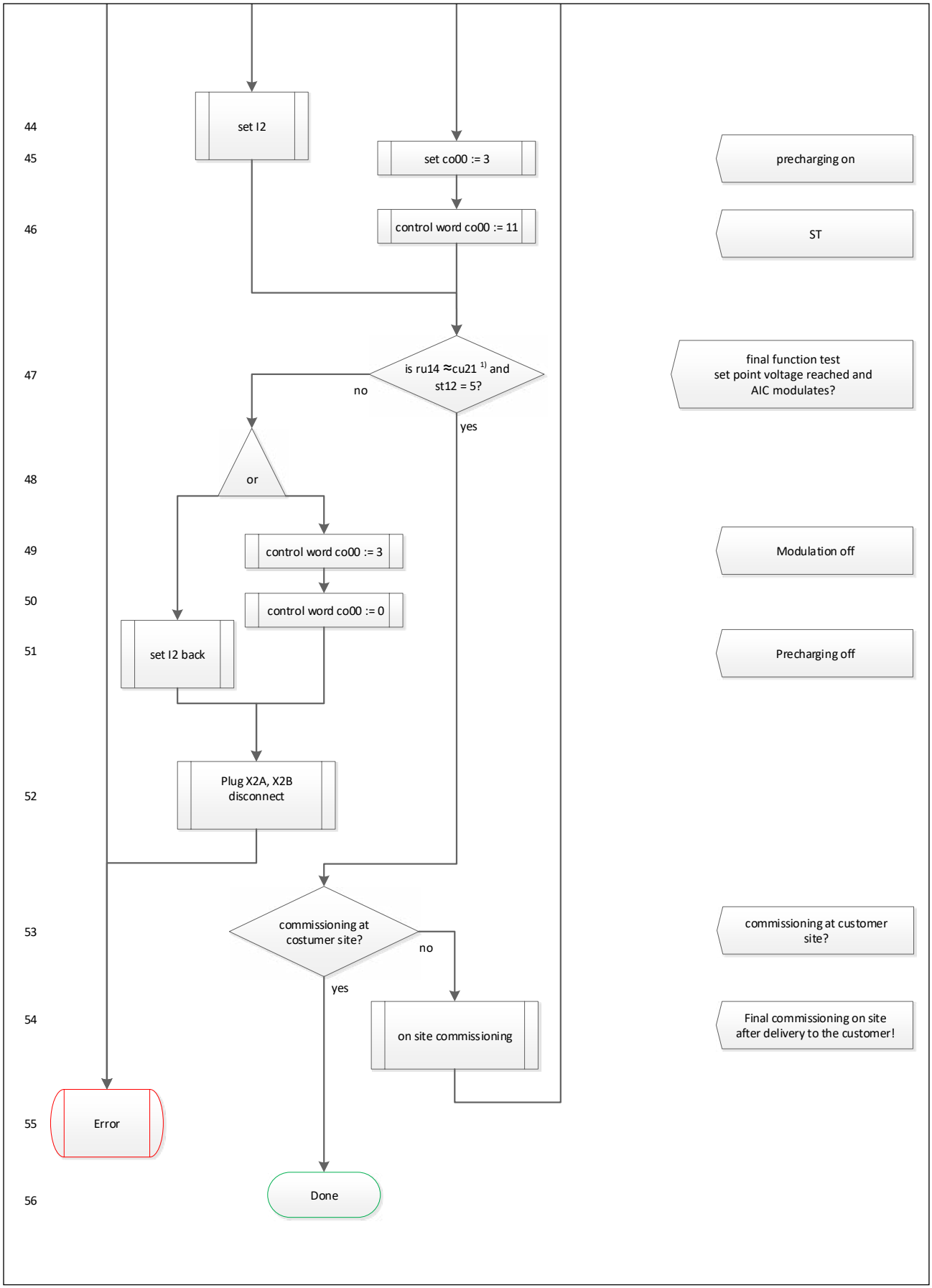
6.2 Step-by-step start-up H6 AIC

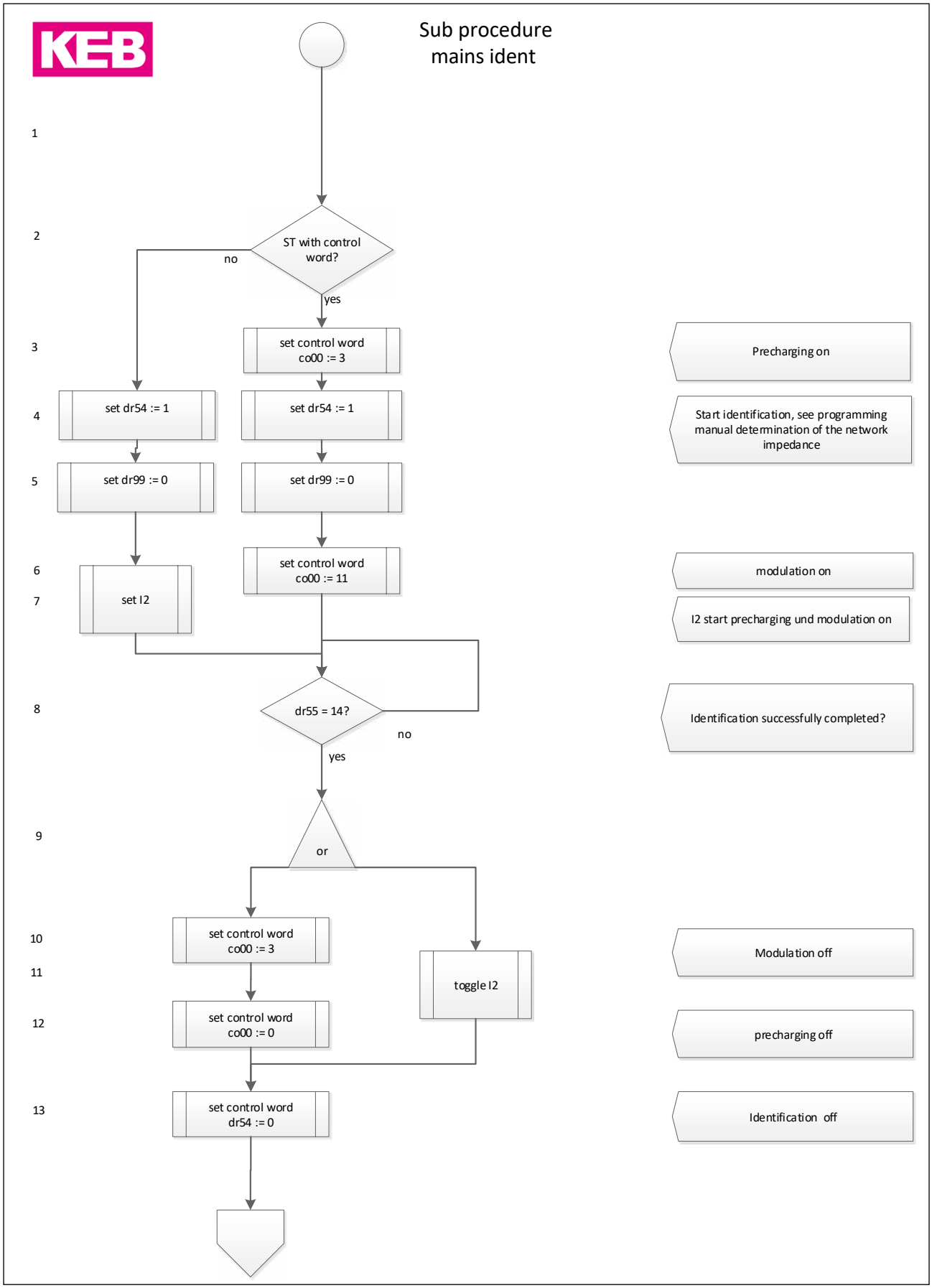



12
Filter_Downloadlist according to curent HW available?
no
yes
13
Internet available?
no
yes
14
http://www.keb.de/de/service-downloads/downloads
15
copy LCL filter data dr15, dr17, dr49-dr53, dr65-dr66.
See programming manual -> LCL filter
16
download Filter_Downloadlist in AIC unit
dr49..dr53 according to HW switching frequency is included
17
answer message false configuration with „yes“
these „alert“ occurs, because the list was created on a different device.
18
set: dr05, dr06
Basic settings, AC power supply
e.g.: dr05, mains voltage , 400V
dr06, line frequency , 50Hz
19
set dr12:= de29 / de28 * 100%
Important!
charging maximum load / relative current value.
20
is the AIC-rated current de28 <= rated filter current?
no
21
in dependence on the cooling of the AIC / LCL filter part load is possible
Data can be found in the relevant installation manual AIC/ LCL filter
yes
22
is max AIC filter current < de29
no
Rated filter current (IN)
maximum filter current (IMAX)
yes


23
set
dr12 := max filter current / de28 * 100%
maximum relative filter current
24
Is the apparent current limited?
no
yes
25
dr12:= max current application / de28 * 100%
26
is the mains supply > = rated device power?
no
yes
dr12 := rated current of MCB / de28 * 100%
Commissioning under test environment
de28 de29 dr12
27
28
set dr99 := 0
Data stored!
29
is dr02 =2?
no
yes
Data stored?
30
set is10 := AIC rated switching frequency
Important otherwise overcurrent fault! AIC rated switching frequency (See installation manual for technical data)
31
is is10 >= dr53?
no
yes
set: Is10 := dr53
(Switching frequency AIC filter)
Only partial load operation is possible!
Switching frequency AIC > = switching frequency of AIC filter!
32
In dependence on the cooling of the AIC, a partial load operation is possible
33
check and set cu21 1) (DC-voltage), see programming guide DC-Bus PID -> Set point
the input of voltage set point is adapted immediately. the DC control voltage is, for example, at 400V (AC) min. 680V (DC).
34
DC Link capacity all am DC Link connected units add and in AIC unit store.
cu17: ... µF
the DC Link capacity of the connected device can be found In parameter: de35 or the programming guide


35
set
cu99 := 4
according to the application,
optimize the voltage PID
36
Connector X2A, X2B
Plug in
Set HW ST
37
Commissioning with
mains identification
no
yes
38
See sub procedure
identification
39
is line inductance
&network resistance
known?
no
yes
40
set
dr15 and dr17
Presets are included in filter
Download
41
set control word
dr99 := 0
save data!
42
is dr02 = 2?
no
yes
data saved?
43
ST with control
word?
no
yes


44
45
46
47
48
49
50
51
52
53
54
55
56
set I2
set co00 := 3
control word co00 := 11
is ru14 ≈cu21 1) and st12 = 5?
no
yes
or
control word co00 := 3
control word co00 := 0
set I2 back
Plug X2A, X2B disconnect
commissioning at costumer site?
no
yes
on site commissioning
Error
Done
precharging on
ST
final function test set point voltage reached and AIC modulates?
Modulation off
Precharging off
commissioning at customer site?
Final commissioning on site after delivery to the customer!


Sub procedure
mains ident
1
2
ST with control word?
no
yes
3
set control word co00 := 3
Precharging on
4
set dr54 := 1
set dr54 := 1
Start identification, see programming manual determination of the network impedance
5
set dr99 := 0
set dr99 := 0
6
set control word co00 := 11
modulation on
7
set I2
I2 start precharging und modulation on
8
dr55 = 14?
no
yes
Identification successfully completed?
9
or
10
set control word co00 := 3
Modulation off
11
toggle I2
12
set control word co00 := 0
precharging off
13
set control word dr54 := 0
Identification off

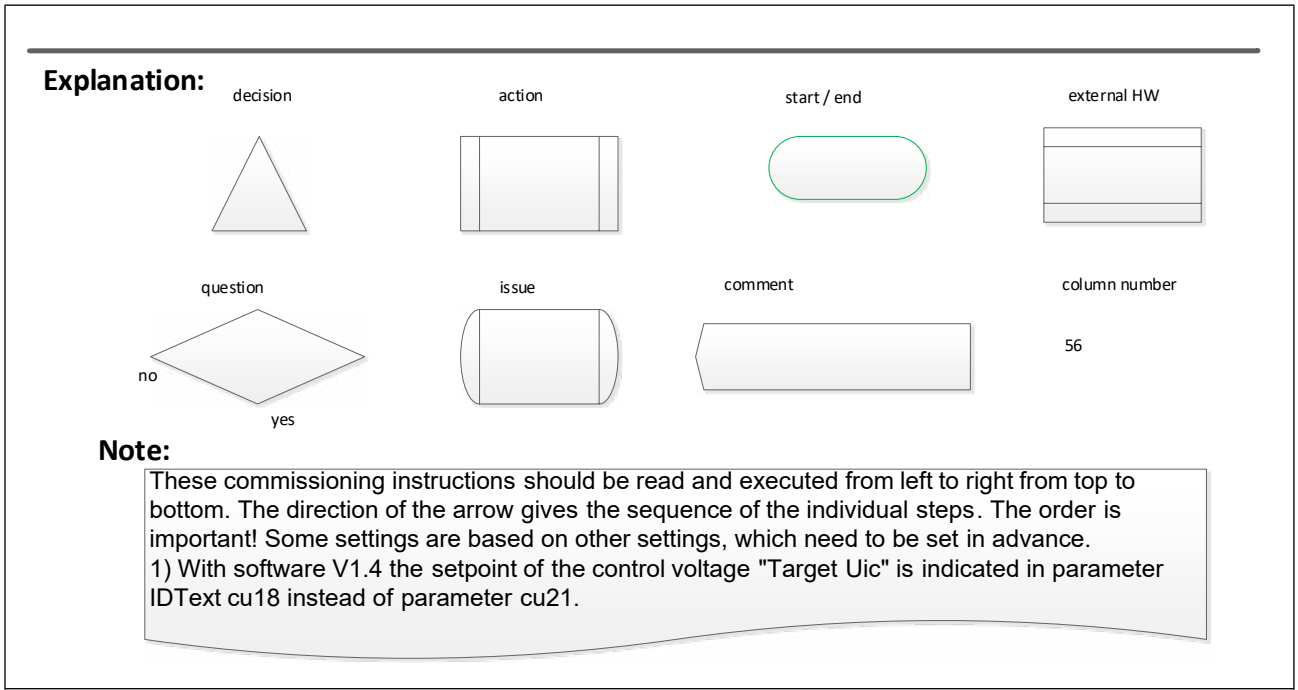


Figure 49: Step-by-step start-up H6 AIC

7 Certification

7.1 CE-Marking

CE marked drive controllers have been developed and manufactured in accordance with the regulations of the Low Voltage Directive and EMC Directive. The harmonised standards of the series *EN 61800-5-1* and *EN 61800-3* are applied.

For more information on the CE declarations of conformity
=> *„7.3 Further informations and documentation“*.

7.2 UL Marking

- In preparation -

7.3 Further informations and documentation

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

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

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

Approvals and approbations
- Declaration of conformity CE
- TÜV certificate
- FS certification

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

8 Revision History

Version	Date	Description
00	2015-10	Completion Pre-series
01	2016-08	Heatsink concepts, wrong terminal
02	2017-09	New CI, general revision, linkage with InCopy components
03	2018-05	Editorial changes
04	2019-06	Product description adapted, updates have been made
05	2020-05	Change of the assignment table for the filters and the flow chart
06	2021-03	Renaming of Active Front End (AFE) to Active Infeed Converter (AIC); general revisions
07	2022-01	Adaptation of the general safety instructions and various circuit diagrams

Austria | KEB Automation GmbH
Ritzstraße 8 4614 Marchtrenk Austria
Tel: +43 7243 53586-0 Fax: +43 7243 53586-21
E-Mail: info@keb.at Internet: www.keb.at

Benelux | KEB Automation KG
Dreef 4 - box 4 1703 Dilbeek Belgium
Tel: +32 2 447 8580
E-Mail: info.benelux@keb.de Internet: www.keb.de

Brazil | KEB South America - Regional Manager
Rua Dr. Omar Pacheco Souza Riberio, 70
CEP 13569-430 Portal do Sol, São Carlos Brazil
Tel: +55 16 31161294 E-Mail: roberto.arias@keb.de

Czech Republic | KEB Automation GmbH
Videnska 188/119d 61900 Brno Czech Republic
Tel: +420 544 212 008
E-Mail: info@keb.cz Internet: www.keb.cz

France | Société Française KEB SASU
Z.I. de la Croix St. Nicolas 14, rue Gustave Eiffel
94510 La Queue en Brie France
Tel: +33 149620101 Fax: +33 145767495
E-Mail: info@keb.fr Internet: www.keb.fr

Germany | **Geared Motors**
KEB Antriebstechnik GmbH
Wildbacher Straße 5 08289 Schneeberg Germany
Telefon +49 3772 67-0 Telefax +49 3772 67-281
Internet: www.keb-drive.de E-Mail: info@keb-drive.de

Italy | KEB Italia S.r.l. Unipersonale
Via Newton, 2 20019 Settimo Milanese (Milano) Italia
Tel: +39 02 3353531 Fax: +39 02 33500790
E-Mail: info@keb.it Internet: www.keb.it

Japan | KEB Japan Ltd.
15 - 16, 2 - Chome, Takanawa Minato-ku Tokyo 108 - 0074 Japan
Tel: +81 33 445-8515 Fax: +81 33 445-8215
E-Mail: info@keb.jp Internet: www.keb.jp

P. R. China | KEB Power Transmission Technology (Shanghai) Co. Ltd.
No. 435 QianPu Road Chedun Town Songjiang District
201611 Shanghai P.R. China
Tel: +86 21 37746688 Fax: +86 21 37746600
E-Mail: info@keb.cn Internet: www.keb.cn

Poland | KEB Automation KG
Tel: +48 60407727
E-Mail: roman.trinczek@keb.de Internet: www.keb.de

Republic of Korea | KEB Automation KG
Deoksan-Besttel 1132 ho Sangnam-ro 37
Seongsan-gu Changwon-si Gyeongsangnam-do Republic of Korea
Tel: +82 55 601 5505 Fax: +82 55 601 5506
E-Mail: jaeok.kim@keb.de Internet: www.keb.de

Russian Federation | KEB RUS Ltd.
Lesnaya str, house 30 Dzerzhinsky MO
140091 Moscow region Russian Federation
Tel: +7 495 6320217 Fax: +7 495 6320217
E-Mail: info@keb.ru Internet: www.keb.ru

Spain | KEB Automation KG
c / Mitjer, Nave 8 - Pol. Ind. LA MASIA
08798 Sant Cugat Sesgarrigues (Barcelona) Spain
Tel: +34 93 8970268 Fax: +34 93 8992035 E-Mail: vb.espana@keb.de

Switzerland | KEB Automation AG
Witzbergstrasse 24 8330 Pfaeffikon/ZH Switzerland
Tel: +41 43 2886060 Fax: +41 43 2886088
E-Mail: info@keb.ch Internet: www.keb.ch

United Kingdom | KEB (UK) Ltd.
5 Morris Close Park Farm Indusrial Estate
Wellingborough, Northants, NN8 6 XF United Kingdom
Tel: +44 1933 402220 Fax: +44 1933 400724
E-Mail: info@keb.co.uk Internet: www.keb.co.uk

United States | KEB America, Inc
5100 Valley Industrial Blvd. South
Shakopee, MN 55379 United States
Tel: +1 952 2241400 Fax: +1 952 2241499
E-Mail: info@kebamerica.com Internet: www.kebamerica.com

MORE KEB PARTNERS WORLDWIDE:

... www.keb.co.uk/contact/contact-worldwide

Automation **with Drive**

www.keb.de

KEB Automation KG Suedstrasse 38 32683 Barntrup Tel. +49 5263 401-0 E-Mail: info@keb.de