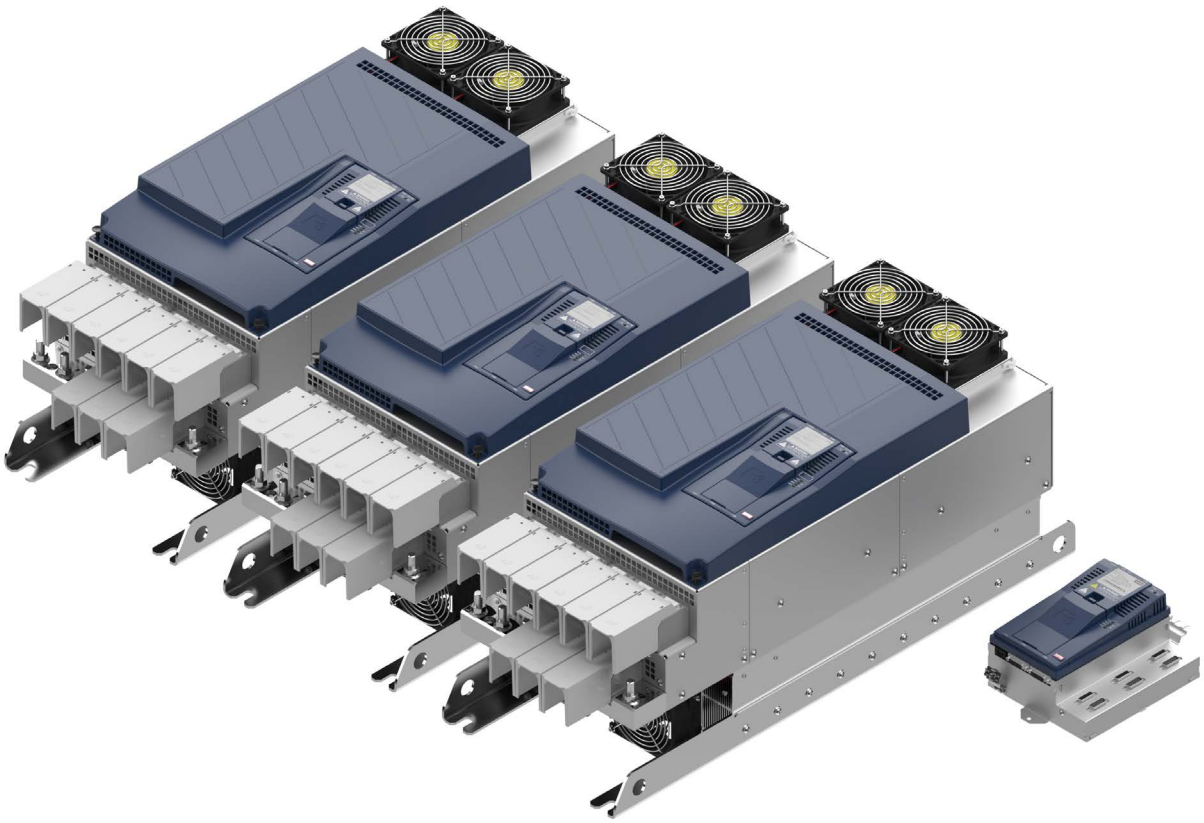


COMBIVERT **F6 SPOD**

INSTRUCTIONS FOR USE | **INSTALLATION F6 SPOD HOUSING 8**

Translation of the original manual
Document 20424359 EN 01

Preface

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

Signal words and symbols

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

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

RESTRICTION

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

Used for informational messages or recommended procedures.

More symbols

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

Note to further documentation.
https://www.keb-automation.com/search

Laws and guidelines

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

The EC declaration of conformity can be downloaded on demand via our website.

Warranty and liability

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

Here you will find our general sales conditions.
https://www.keb-automation.com/terms-conditions

Further agreements or specifications require a written confirmation.

Support

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

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

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

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

Copyright

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

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

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

Table of Contents

1 Basic Safety Instructions

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

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

NOTICE

Hazards and risks through ignorance!

► Read the instructions for use!

► Observe the safety and warning instructions!

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

1.1 Target group

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

- Knowledge and understanding of the safety instructions.
- Skills for installation and assembly.
- Start-up and operation of the product.
- Understanding of the function in the used machine.
- Detection of hazards and risks of the electrical drive technology.
- Knowledge of *VDE 0100*
- Knowledge of national safety regulations.

1.2 Transport, storage and proper use

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

Transport of drive controllers with an edge length >75 cm

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

► Transport of drive controllers on suitable pallets.

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

NOTICE

Damage to the coolant connections

Bending of the tubes!

► Never place the device on the coolant connections

Drive controllers contain electrostatic sensitive components.

► Avoid contact.

► Wear ESD-protective clothing.

Do not store drive controllers

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

1.3 Installation

⚠ DANGER

Do not operate in an explosive environment!

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

⚠ CAUTION

Design-related edges and high weight!

Contusions and bruises!

► Never stand under suspended loads.

► Wear safety shoes.

► Secure drive controller accordingly when using lifting gear.

To prevent damages to the device:

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

1.4 Electrical connection

⚠ DANGER

Voltage at the terminals and in the device!

Danger to life due to electric shock !

- ► Never work on the open device or never touch exposed parts.
- ► For any work on the unit switch off the supply voltage, secure it against switching on and check absence of voltage by measuring at the input terminals.
- ► Wait until all drives has been stopped in order that no regenerative energy can be generated.
- ► Await capacitor discharge time (5 minutes). Check absence of voltage by measuring at the DC terminals.
- ► If personal protection is required, install suitable protective devices for drive controllers.
- ► Never bridge upstream protective devices (even for testing purposes).
- ► Connect the protective earth conductor always 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 a dc current in the protective earth conductor. When a residual current protective device (RCD) or a residual current monitoring device (RCM) is used for the protection against direct or indirect contact, only a RCD or RCM type B is permitted on the power supply side of this product.
- ► Drive controllers with a leakage current > 3.5 mA AC current (10 mA DC current) are intended for a stationary connection. Protective earth conductors must be designed in accordance with the local regulations for equipment with high leakage currents according to *EN 61800-5-1, EN 60204-1* or *VDE 0100*.

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

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

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

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

- The electrical installation shall be carried out in accordance with the relevant requirements.
- Cable cross-sections and fuses must be dimensioned by the user according to the specified minimum/maximum values for the application.
- Connection of the drive controller is only permissible on symmetrical networks with a maximum line voltage (L1, L2, L3) with respect to earth (N/PE) of max. 300 V, USA UL: 480 / 277 V. An isolating transformer must be used for supply networks which exceed this value! In case of non-compliance the control is not longer considered to be a PELV circuit.
- With existing or newly wired circuits the person installing the units or machines must ensure that the PELV requirements are met.
- For drive controllers that are not isolated from the supply circuit (in accordance with *EN 60721-3-2*) all control lines must be included in other protective measures (e.g. double insulation or shielded, earthed and insulated).
- When using components without isolated inputs/outputs, it is necessary that equipotential bonding exists between the components to be connected (e.g. by the equipotential line). Disregard can cause destruction of the components by equalizing currents.

1.4.1 EMC-compatible installation

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

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

1.4.2 Voltage test

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

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

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

1.4.3 Insulation measurement

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

1.5 Start-up and operation

The start-up (i.e. for the specified application) is forbidden until it is determined that the installation complies with the machine directive; account is to be taken of *EN 60204-1*.

⚠ WARNING

Software protection and programming!

Hazards caused by unintentional behavior of the drive!

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

⚠ CAUTION

High temperatures at heat sink and coolant!

Burning of the skin!

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

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

⚠ CAUTION

High sound level during operation!

Hearing damage possible!

- ► Wear hearing protection!

NOTICE

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

Premature ageing of the electrolytic capacitors!

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

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

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

Switching at the output

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

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

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

Switching at the input

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

Short-circuit resistance

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

Exceptions:

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

1.6 Maintenance

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

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

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

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

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

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

1.7 Repair

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

⚠ DANGER

Unauthorized exchange, repair and modifications!

Unpredictable malfunctions!

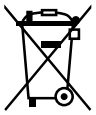
- ► The function of the drive controller is dependent on its parameterization. Never replace without knowledge of the application.
- ► Modification or repair is permitted only by KEB Automation KG authorized personnel.
- ► Only use original manufacturer parts.
- ► Infringement will annul the liability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

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

1.8 Disposal

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

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



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

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

Withdrawal by	WEEE-Reg.-No.		Keyword
Austria			
KEB Automation GmbH	ERA:	51976	Stichwort „Rücknahme WEEE“
France			
RÉCYLUM - Recycle point	ADEME:	FR021806	Mots clés „KEB DEEE“
Germany			
KEB Automation KG	EAR:	DE12653519	Stichwort „Rücknahme WEEE“
Italy			
COBAT	AEE: (IT)	19030000011216	Parola chiave „Ritiro RAEE“
Spain			
KEB Automation KG	RII-AEE	7427	Palabra clave „Retirada RAEE“
Česko			
KEB Automation KG	RETELA	09281/20 ECZ	Klíčové slovo: Zpětný odběr OEEZ
Slowakei			
KEB Automation KG	ASEKOL:	RV22EEZ0000421	Klíčové slovo: ”Spätný odber OEEZ”

The packaging must be feed to paper and cardboard recycling.

2 Product description

The COMBIVERT F6 SPOD (System of Parallel Operated Devices) series consists of a control unit and up to three drive units for operating a motor. The systems described in this manual require additional external components (mains chokes, EMC filters, motor chokes, fuses, etc.) for their intended use. This document contains selection aids for suitable components. The technical data for the external components can be found in the operating instructions for the external components used.

The F6 SPOD complies with the requirements of the Machinery Directive. The possible functions are certified by a type examination.

The F6 SPOD is a product with limited availability according to *EN 61800-3*.

This product may cause radio interference in residential areas. In this case the operator may need to take corresponding measures.

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

2.1 System description

The F6 SPOD provides the user with the same interfaces as a drive converter from the COMBIVERT F6 series. An F6 SPOD is used to supply a motor via several power sections that are controlled by a common control system.

The *„Figure 1: Schematic connection overview“* shows a typical SPOD system.

2.1.1 Control Unit

Each F6 SPOD contains exactly one Control Unit. The Control Unit can be equipped with the control variants (A, P) familiar from the COMBIVERT F6.

This contains the control-side customer interface (digital/analogue I/Os, communication interfaces, etc.) as well as the interface to the motor-side sensor technology (position/speed feedback systems, brake, motor temperature sensor, etc.).

The Control Unit also contains the interface to the system's external 24V auxiliary power supply.

It distributes the control signals generated by the internal control system to the connected Drive Units and prepares the information provided by the sensors of the connected Drive Units for the internal control system.

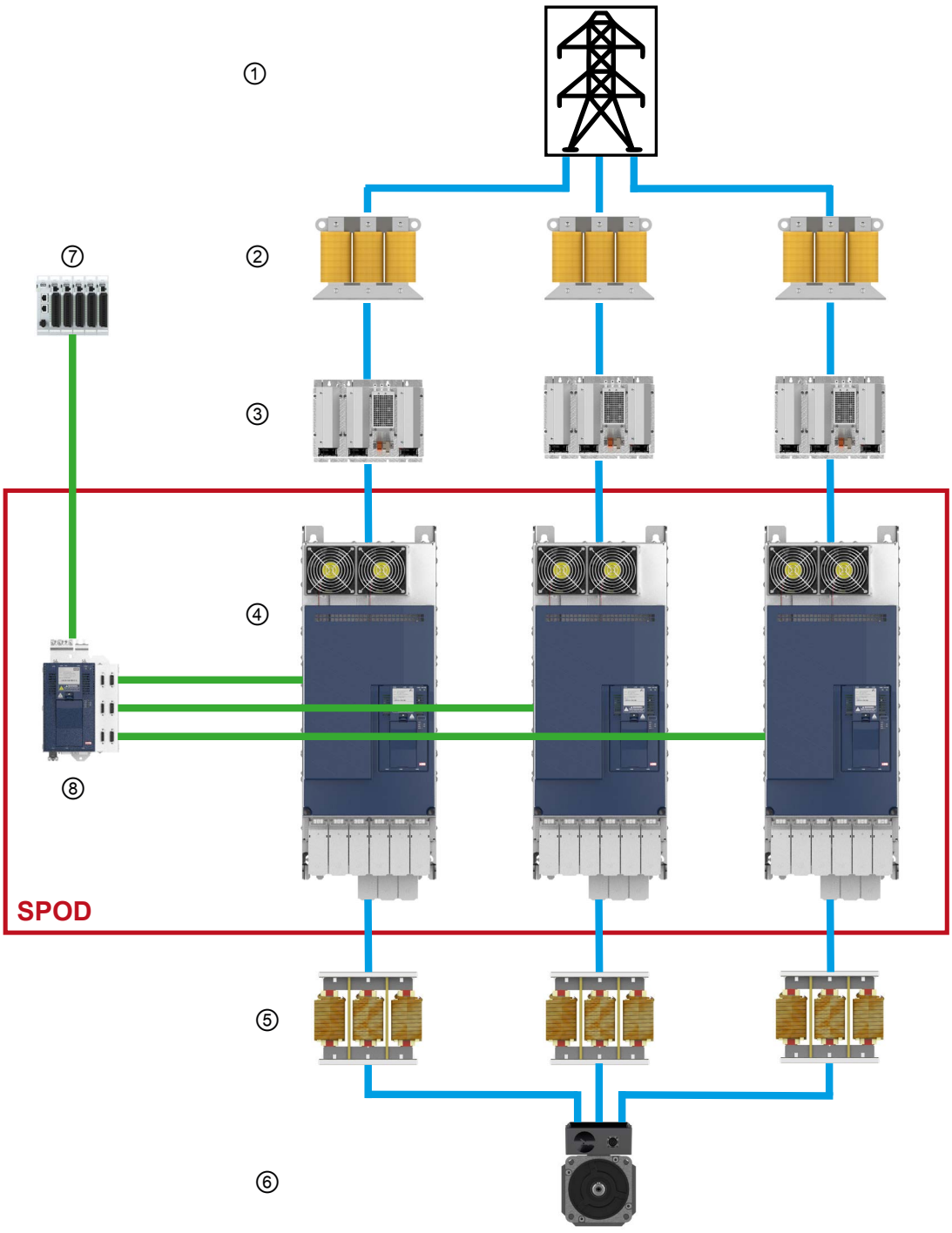
It identifies the connected Drive Units and configures them as required. This ensures consistent configuration of the system.

2.1.2 Drive Unit

The F6 SPOD contains up to 3 Drive Units. The Drive Units are connected to the Control Unit via the data connections (X7A, X7B).

The Drive Units are based on power sections from the COMBIVERT F6 series and contain the system's power interfaces (mains connection, motor connection).

2.1.3 Schematic connection overview



Legend			
1	Supply network	5	Motor choke
2	Mains choke	6	Motor
3	EMC filter	7	Application control
4	Drive Unit	8	Control Unit
	Service connections		
	Control connections		

Figure 1: Schematic connection overview

2.2 Specified application

The F6 SPOD is used exclusively for controlling and regulating three-phase motors. It is intended for installation in electrical systems or machines in industry.

The technical data as well as information concerning the supply conditions shall be taken from the nameplate and from the instructions for use and shall be strictly observed.

The used semiconductors and components of KEB Automation KG are developed and dimensioned for the use in industrial products.

Restrictions

If the KEB COMBIVERT F5 is used in machines, which work under exceptional conditions or if essential functions, life-supporting measures or an extraordinary safety step must be fulfilled, the necessary reliability and security must be ensured by the machine builder.

2.2.1 Residual risks

Despite proper use, the drive converter may assume unpredictable operating states in the event of a fault, incorrect parameterization, faulty connection, or improper intervention and repairs. This can be:

- Wrong direction of rotation
- Motor speed too high
- Motor runs into limitation
- Motor may still carry live current when at rest
- Automatic restart

2.3 Improper use

The operation of other electric consumers is prohibited and can lead to the destruction of the devices. The operation of our products outside the indicated limit values of the technical data leads to the loss of any liability claims.

2.4 Part code

2.4.1 Part code F6 SPOD

Part code for a COMBIVERT F6 SPOD.
This key defines the technical characteristics of the F6 SPOD.

x x	F 6	x	x	x	-	x	x	x	x		
									Heat sink design	1:	Air cooler, built-in version
										2:	Liquid cooler, built-in version
										3:	Air cooler, push-through version IP54-ready
										4:	Liquid cooler, push-through version, IP54-ready
									Control board version		**APPLICATION**
										1:	Multi Encoder Interface, CAN® [2], Real-Time Ethernet bus module [3]
											PRO
										1:	Multi-encoder interface / Ethernet fieldbus interface
										3:	Multi-encoder interface / RS 485 (potential-free), Ethernet (no node switch)
										5:	Multi Encoder Interface, CAN® [2], Real-Time Ethernet interface [3], safe relay
									Switching frequency/ Software current limit/ Shutdown current	0:	2 kHz / 125 % / 150 %
										1:	4 kHz / 125 % / 150 %
									Voltage / Mode of connection	3:	3ph 400 V AC/DC with braking transistor
										4:	3ph 400 V AC/DC without braking transistor
									Housing	L:	1 x Control Unit / 2 x Drive Unit Housing 8
										M:	1 x Control Unit / 2 x Drive Unit Housing 8
									Variants	1:	Safety module type 1
										3:	Safety module type 3
										5:	Safety module type 5
									Control type	A:	APPLICATION
										P:	PRO
									Series		COMBIVERT F6
									Device size		33...39

Table 1: Part code F6 SPOD

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

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

[3] *The Real-Time Ethernet bus module / the Real-Time Ethernet interface contains various fieldbus controls which can be set by software (parameter fb68).*

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

2.4.2.1 System identifier

With the help of the system identifier, the appropriate technical data for a device can be clearly assigned using the material number => *„3.2 Device data System“.*

The system identifier is formed from the material number and consists of selected digits of the material number.

Example: 33-L-0-1 Device size 33, 1× Control Unit / 2× Drive Unit Housing 8. 2 kHz, air cooler, built-in version

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

Heat sink design	1:	Air cooler, built-in version
	2:	Liquid cooler, built-in version
	3:	Air cooler, push-through version IP54-ready
	4:	Liquid cooler, push-through version, IP54-ready
Switching frequency/ Software current limit/ Shutdown current	0:	2 kHz / 125 % / 150 %
	1:	4 kHz / 125 % / 150 %
Housing	L:	1 x Control Unit / 2 x Drive Unit Housing 8
	M:	1 x Control Unit / 2 x Drive Unit Housing 8
Device size	33...39	

Table 2: System identifier

2.4.3 Part code Control Unit

The part code for the Control Unit is described here for information purposes. The F6 SPOD is fully described by the "part code F6 SPOD" => *„2.4.1 Part code F6 SPOD“.*

However, it is helpful to interpret the material numbers of the Control Units used in the systems and to store them with technical characteristics.

M0 F6 x x 0-0 0 x x

Special variants	1: Standard
	2: Special version SM3-Profisafe (only with SM3)
Control board version	**APPLICATION**
	1: Multi-encoder interface / EtherCAT, Profinet, Powerlink, CAN, Ethernet IP
	PRO
	1: Multi-encoder interface / Ethernet fieldbus interface
	3: Multi-encoder interface / RS 485 (potential-free), Ethernet (no node switch)
	5: Multi-encoder interface / Ethernet fieldbus interface
Variants	1: Safety module 1 (A control)
	3: Safety module 3 (A control)
	5: Safety module 5 (P control)
Control type	A: Application version
	P: Pro version

Table 3: Part code Control Unit

2.4.4 Part code Drive Unit

*The art code for the Control Unit is described here for information purposes. The F6 SPOD is fully described by the "part code F6 SPOD" => *„2.4.1 Part code F6 SPOD“.*

Er ist abeHowever, it is helpful to interpret the material numbers of the Control Units used in the systems and to store them with technical characteristics.

Drive Units use the part code of the COMBIVERT F6 standard devices.

Only the elements relevant to Drive Units are described below.

The first two digits describe the size of the power section used in the drive unit when used in a single COMBIVERT F6 unit (not as part of an F6 SPOD).

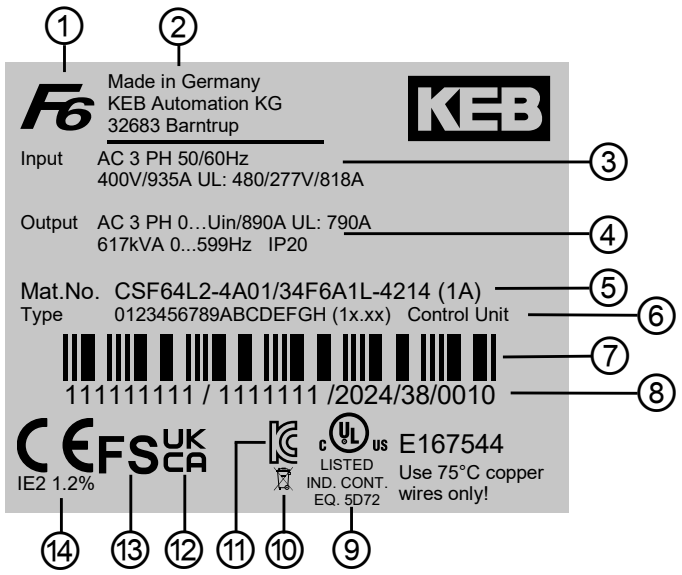
x x F 6 S 0 x - x x 0 x

Heat sink design	1:	Air cooler, built-in version
	2:	Liquid cooler, built-in version
	3:	Air cooler, push-through version IP54-ready
	4:	Liquid cooler, push-through version, IP54-ready
Switching frequency, Software current limit, Overcurrent	0:	2 kHz / 125 / 150 %
	1:	4 kHz / 125 / 150 %
Voltage, Connection type	3:	3ph 400 V AC/DC with braking transistor
	4:	3ph 400 V AC/DC without braking transistor
Housing size	8:	Housing 8
Device size (Drive Unit)	30	

Table 4: Part code Drive Unit

2.5 Name plates

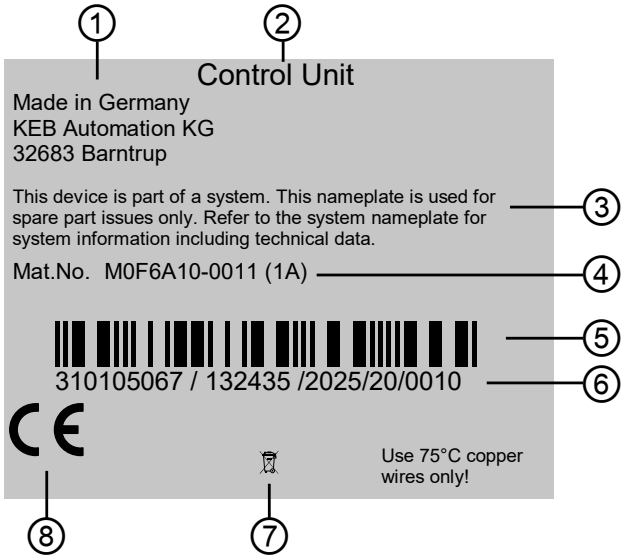
2.5.1 Name plate F6 SPOD



Legend	
1	Device series
2	Manufacturer identification
3	Technical data input
4	Technical data output
5	System number / standard system number => *„2.4.1 Part code F6 SPOD“, KEB internal version number, customer-specific system number (optional)*
6	Customer material number, version number for customer material number (optional), identification of system component (Control Unit / Drive Unit 1 / Drive Unit 2 / Drive Unit 3)
7	Barcode Interleaved 2/5 (serial number)
8	Serial-, order number; Year and week of production; Factory
9	UL certification
10	Disposal information
11	KC certification
12	UKCA marking
13	FS certification
14	CE certification

Figure 2: Type plate for customer-specific SPOD systems (example)

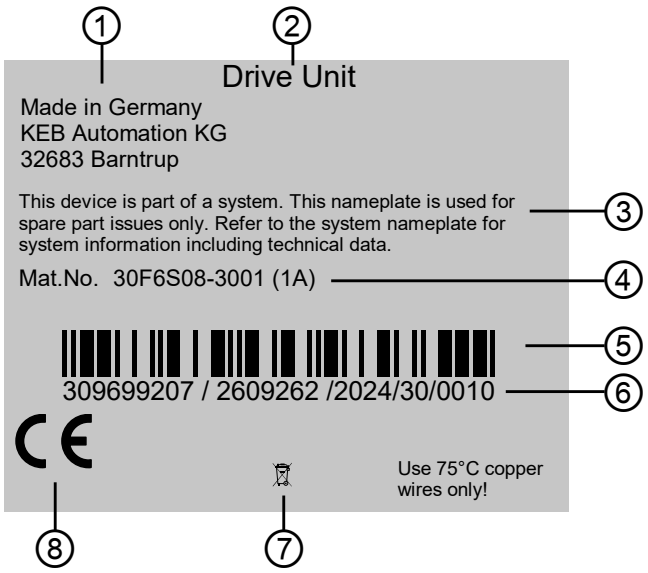
2.5.2 Name plate Control Unit



Legend	
1	Manufacturer identification
2	Labelling of system components
3	Reference to a subsystem
4	Control Unit material number
5	Barcode Interleaved 2/5 (serial number)
6	Serial-, order number; year and week of production; factory
7	Disposal information
8	CE certification

Figure 3: Name plate Control Unit(example)

2.5.3 Name plate Drive Unit



Legend	
1	Manufacturer identification
2	Labelling of system components
3	Reference to a subsystem
4	Drive Unit material number
5	Interleaved 2/5 barcode (serial number)
6	Serial-, order number; year and week of production; factory
7	Disposal information
8	CE certification

Figure 4: Name plate Drive Unit (example)

3 Technical Data

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

3.1 Operating conditions

3.1.1 Climatic environmental conditions

Storage		**Standard**	**Class**	**Descriptions**
Ambient temperature		*EN 60721-3-1*	1K4	-25…55 °C
Relative humidity		*EN 60721-3-1*	1K3	5…95 % (without condensation)
Storage height		–	–	Max. 3000 m above sea level
Transport		**Standard**	**Class**	**Descriptions**
Ambient temperature		*EN 60721-3-2*	2K3	-25…70 °C
Relative humidity		*EN 60721-3-2*	2K3	95 % at 40 °C (without condensation)
Operation		**Standard**	**Class**	**Descriptions**
Ambient temperature		*EN 60721-3-3*	3K3	5…40 °C (extended to -10…45 °C)
Coolant inlet temperature	Air	–	–	5…40 °C (extended to -10…45 °C)
	Water [1)]	–	–	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. Drive converter generally, except power connections and fan unit (IPxxA)
Site altitude		–	–	Max. 2000 m above sea level • With site altitudes over 1000 m a derating of 1 % per 100 m must be taken into consideration. • With site altitudes over 2000 m, the control board to the mains has only basic isolation. Additional measures must be taken when wiring the control.

Table 5: Climatic environmental conditions

[1)] *Observe the notes on the coolant => „6.1.3 Requirements for the coolant“.*

3.1.2 Mechanical environmental conditions

Storage	Standard	Class	Descriptions
Vibration limits	*EN 60721-3-1*	1M2	Vibration amplitude 1.5 mm (2…9 Hz) Acceleration amplitude 5 m/s² (9…200 Hz)
Shock limit values	*EN 60721-3-1*	1M2	40 m/s²; 22 ms
Transport	**Standard**	**Class**	**Descriptions**
Vibration limits	*EN 60721-3-2*	2M1	Vibration amplitude 3.5 mm (2…9 Hz) Acceleration amplitude 10 m/s² (9…200 Hz)
Shock limit values	*EN 60721-3-2*	2M1	100 m/s²; 11 ms
Operation	**Standard**	**Class**	**Descriptions**
Vibration limits	*EN 60721-3-3*	3M4	Vibration amplitude 3.0 mm (2…9 Hz) Acceleration amplitude 10 m/s² (9…200 Hz)
	EN 61800-5-1	–	Vibration amplitude 0.075 mm (10…58 Hz) Acceleration amplitude 10 m/s² (58…150 Hz)
Shock limit values	*EN 60721-3-3*	3M4	100 m/s²; 11 ms
Pressure in the water cooler	–	–	Rated operating pressure: 10 bar Max. operating pressure: 10 bar

Table 6: Mechanical environmental conditions

3.1.3 Further environmental operating conditions

Operation	Standard	Class	Descriptions
Chemically active substances	*EN 60721-3-3*	3C2	No salt spray
Mechanically active substances		3S2	–
Organic		3B1	–
UV resistance		–	No requirement

Table 7: Further environmental operating conditions

3.1.4 Electrical operating conditions

3.1.4.1 Device classification

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

Table 8: Device classification

3.1.4.2 Electromagnetic compatibility

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

EMC emitted interference	**Standard**	**Class**	**Descriptions**
Conducted interference emission	*EN 61800-3*	C3	The specified value is only maintained in conjunction with a throttle without filter.
		C2 / C3	The specified value is only maintained in conjunction with a choke and a filter. Information on interference suppression (rated switching frequency, max. motor cable) can be found in the corresponding filter instructions.
Radiated emitted interference	*EN 61800-3*	C2	–
EMF	*EN 61800-5-1*	–	Table P.2
Immunity	**Standard**	**Level**	**Descriptions**
Static discharges	*EN 61000-4-2*	8 kV 4 kV	AD (air discharge) CD (contact discharge)
Burst - Ports for process measurement control lines and signal interfaces	*EN 61000-4-4*	2 kV	–
Burst - AC - Power ports	*EN 61000-4-4*	4 kV	–
Surge - Power ports	*EN 61000-4-5*	1 kV 2 kV	Phase-phase Phase-ground
Conducted immunity, induced by high-frequency fields	*EN 61000-4-6*	10 V	0.15...80 MHz
Electromagnetic fields	*EN 61000-4-3*	10 V/m 3 V/m 1 V/m	80 MHz...1 GHz 1.4...2 GHz 2...2.7 GHz
voltage dips	*EN 61000-4-11* *EN 61000-4-34*	Class 3	–
frequency fluctuations	*EN 61000-4-28*	± 2 %	–
Voltage unbalance	*EN 61000-2-4*	≤ 3 %	–

Table 9: Electromagnetic compatibility

3.2 Device data System

3.2.1 Overview of system data (2-part systems)

The technical data are for 2/4-pole standard motors. With other pole numbers the drive converter must be dimensioned onto the rated motor current. Contact KEB for special or medium frequency motors.

Size			**33**		
System identifiers			**33-L-0-1** **33-L-0-3**	**33-L-0-2** **33-L-0-4**	**33-L-1-2** **33-L-1-4**
Housing			**8**		
Number of power units			**2**		
Cooling type			**Air cooler**	**Liquid cooler**	
Rated apparent output power		S_{out} / kVA	554		
Max. rated motor power	1)	P_{mot} / kW	450		
Rated input voltage		U_N / V	400 (UL: 480)		
Input voltage range		U_{in} / V	280...550		
Mains phases			3		
Mains frequency		f_N / Hz	50 / 60 ±2		
Rated input current @ U_N = 400V		I_{in} / A	840		
Rated input current @ U_N = 480V		I_{in_UL} / A	726		
Insulation resistance @ U_{dc} = 500V	2)	R_{iso} / MΩ	> 15		
Output voltage		U_{out} / V	0...U_{in}		
Output frequency	3)	f_{out} / Hz	0...599		
Output phases			3		
Rated output current @ U_N = 400V		I_N / A	800		
Rated output current @ U_N = 480V		I_{N_UL} / A	692		
Rated output overload (60 s)	4) 5)	I_{60s} / %	125		
Software current limit	4)	I_{lim} / %	125		
Overcurrent	4)	I_{OC} / %	150		
Rated switching frequency		f_{SN} / kHz	2	2	4
Max. switching frequency	6)	f_{S_max} / kHz	8		
Power dissipation at rated operation	1)	P_D / kW	6,8	6,2	7,8
Maximum current 0Hz / 50Hz at f_S= 2 kHz		I_{out_max} / %	100 / 150	125 / 150	125 / 150
Maximum current 0Hz / 50Hz at f_S= 4 kHz		I_{out_max} / %	60 / 135	75 / 150	90 / 150
Maximum current 0Hz / 50Hz at f_S= 8 kHz		I_{out_max} / %	30 / 70	40 / 100	45 / 110
DC link capacity	2)	C_{DC} / µF	18600		
Max. braking current	2)	I_{B_max} / A	380		
Min. braking resistor value	2)	R_{B_min} / Ω	2,2		
Braking transistor	2) 7)		Max. cycle time: 120s; Max c.d.f.: 50 %		
Protective function for braking transistor			Short-circuit monitoring		

continued on the next page

Size		**33**		
System identifiers		**33-L-0-1** **33-L-0-3**	**33-L-0-2** **33-L-0-4**	**33-L-1-2** **33-L-1-4**
Housing		**8**		
Number of power units		**2**		
Cooling type		**Air cooler**	**Liquid cooler**	
Protection function braking resistor [8]		Feedback signal evaluation and current shutdown (only for AC mains connection)		
Max. motor cable length shielded [9]	*l* / m	100	100	50
Max. heat sink temperature 1	T_{HS1} / °C	100	80	75
Max. heat sink temperature 2	T_{HS2} / °C	90	75	
Max. heat sink temperature 3	T_{HS3} / °C	95	80	75
Max. interior temperature power unit 1	T_{ID_PU1} / °C	65		
Max. interior temperature power unit 2	T_{ID_PU2} / °C	80		
Max. interior temperature power unit 3	T_{ID_PU3} / °C	90		
Temperature for derating the switching frequency	T_{DR} / °C	90	70	65
Temperature for uprating the switching frequency	T_{UR} / °C	85	65	60
Temperature for switching to rated switching frequency	T_{EM} / °C	95	75	70
Rated DC link voltage @ U_N = 400V	U_{N_DC} / V	565		
Rated DC link voltage @ U_N = 480V	$U_{N\_DC\_UL}$ / V	680		
DC link voltage working voltage range	U_{IN_DC} / V	390...780		
DC switch-off level "ERROR underpotential“	U_{UP} / V	240		
DC switch-off level "ERROR overpotential“	U_{OP} / V	840		
DC switch-off level braking resistor	U_B / V	780		
Reset level "Error! Undervoltage“	U_{UP_reset} / V	300		
DC switch-off level "ERROR" Undervoltage @ PowerOff	U_{UP_PO} / V	200		

Table 10: System data 33

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

2) *The specifications apply per Drive Unit.*

3) *The output frequency is to be limited in such a way that it does not exceed 1/10 of the switching frequency. Notice! Devices with a maximum output frequency higher than 599Hz are subject to export restrictions.*

4) *The values refer to the percentage of the initial rated current I_N and can be set in parameter is35.*

5) *Observe limitations => 3.2.4 Overload characteristic (OL).*

6) *A detailed description of the derating => 3.2.3 Switching frequency and temperature.*

7) *The cyclic duration factor is additionally limited by the used braking resistor.*

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

9) *The specification for the maximum motor cable length applies to a single motor cable (Drive Unit -> motor). When operating motor cables (Drive Unit -> motor) in parallel, the information provided at => „5.10.3 Motor cable lengths“ must be taken into account. Further information can be found in the corresponding filter instructions.*

Size			**34**		
System identifiers			**34-L-0-1** **34-L-0-3**	**34-L-0-2** **34-L-0-4**	**34-L-1-2** **34-L-1-4**
Number of power units			**2**		
Cooling type			**Air cooler**	**Liquid cooler**	
Rated apparent output power		S_{out} / kVA	617		
Max. rated motor power	1)	P_{mot} / kW	500		
Rated input voltage		U_N / V	400 (UL: 480)		
Input voltage range		U_{in} / V	280...550		
Mains phases			3		
Mains frequency		f_N / Hz	50 / 60 ±2		
Rated input current @ U_N = 400V		I_{in} / A	935		
Rated input current @ U_N = 480V		I_{in_UL} / A	818		
Insulation resistance @ U_{dc} = 500V	2)	R_{iso} / MΩ	> 15		
Output voltage		U_{out} / V	0...U_{in}		
Output frequency	3)	f_{out} / Hz	0...599		
Output phases			3		
Rated output current @ U_N = 400V		I_N / A	890		
Rated output current @ U_N = 480V		I_{N_UL} / A	790		
Rated output overload (60 s)	4) 5)	I_{60s} / %	125		
Software current limit	4)	I_{lim} / %	125		
Overcurrent	4)	I_{OC} / %	150		
Rated switching frequency		f_{SN} / kHz	2	2	4
Max. switching frequency	6)	f_{S_max} / kHz	8		
Power dissipation at rated operation	1)	P_D / kW	7,7	7,1	8,9
Maximum current 0Hz / 50Hz at f_S= 2 kHz		I_{out_max} / %	80 / 150	115 / 150	120 / 150
Maximum current 0Hz / 50Hz at f_S= 4 kHz		I_{out_max} / %	50 / 120	70 / 150	85 / 150
Maximum current 0Hz / 50Hz at f_S= 8 kHz		I_{out_max} / %	25 / 65	35 / 90	40 / 100
DC link capacity	2)	C_{DC} / µF	18600		
Max. braking current	2)	I_{B_max} / A	380		
Min. braking resistor value	2)	R_{B_min} / Ω	2,2		
Braking transistor	2) 7)		Max. cycle time: 120s; Max c.d.f.: 50 %		
Protective function for braking transistor			Short-circuit monitoring		
Protection function braking resistor	8)		Feedback signal evaluation and current shutdown (only for AC mains connection)		
Max. motor cable length shielded	9)	l / m	100	100	50

continued on the next page

Size		34		
System identifiers		34-L-0-1 34-L-0-3	34-L-0-2 34-L-0-4	34-L-1-2 34-L-1-4
Number of power units		2		
Cooling type		Air cooler	Liquid cooler	
Max. heat sink temperature 1	T_{HS1} / °C	100	80	75
Max. heat sink temperature 2	T_{HS2} / °C	90	75	
Max. heat sink temperature 3	T_{HS3} / °C	95	80	75
Max. interior temperature power unit 1	T_{ID_PU1} / °C	65		
Max. interior temperature power unit 2	T_{ID_PU2} / °C	80		
Max. interior temperature power unit 3	T_{ID_PU3} / °C	90		
Temperature for derating the switching frequency	T_{DR} / °C	90	70	65
Temperature for uprating the switching frequency	T_{UR} / °C	85	65	60
Temperature for switching to rated switching frequency	T_{EM} / °C	95	75	70
Rated DC link voltage @ U_N = 400V	U_{N_DC} / V	565		
Rated DC link voltage @ U_N = 480V	$U_{N\_DC\_UL}$ / V	680		
DC link voltage working voltage range	U_{IN_DC} / V	390...780		
DC switch-off level "ERROR underpotential“	U_{UP} / V	240		
DC switch-off level "ERROR overpotential“	U_{OP} / V	840		
DC switch-off level braking resistor	U_B / V	780		
Reset level "Error! Undervoltage“	U_{UP_reset} / V	300		
DC switch-off level "ERROR" Undervoltage @ PowerOff	U_{UP_PO} / V	200		

Table 11: System data 34

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

2) *The specifications apply per Drive Unit.*

3) *The output frequency is to be limited in such a way that it does not exceed 1/10 of the switching frequency. Notice! Devices with a maximum output frequency higher than 599Hz are subject to export restrictions.*

4) *The values refer to the percentage of the initial rated current I_N and can be set in parameter is35.*

5) *Observe limitations => 3.2.4 Overload characteristic (OL).*

6) *A detailed description of the derating => 3.2.3 Switching frequency and temperature.*

7) *The cyclic duration factor is additionally limited by the used braking resistor.*

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

9) *The specification for the maximum motor cable length applies to a single motor cable (Drive Unit -> motor). When operating motor cables (Drive Unit -> motor) in parallel, the information provided at => „5.10.3 Motor cable lengths“ must be taken into account. Further information can be found in the corresponding filter instructions.*

Size			**35**		
System identifiers			**35-L-0-1** **35-L-0-3**	**35-L-0-2** **35-L-0-4**	**35-L-1-2** **35-L-1-4**
Number of power units			**2**		
Cooling type			**Air cooler**	**Liquid cooler**	
Rated apparent output power		S_{out} / kVA	693		
Max. rated motor power	1)	P_{mot} / kW	560		
Rated input voltage		U_N / V	400 (UL: 480)		
Input voltage range		U_{in} / V	280...550		
Mains phases			3		
Mains frequency		f_N / Hz	50 / 60 ±2		
Rated input current @ U_N = 400V		I_{in} / A	1050		
Rated input current @ U_N = 480V		I_{in_UL} / A	923		
Insulation resistance @ U_{dc} = 500V	2)	R_{iso} / MΩ	> 15		
Output voltage		U_{out} / V	0...U_{in}		
Output frequency	3)	f_{out} / Hz	0...599		
Output phases			3		
Rated output current @ U_N = 400V		I_N / A	1000		
Rated output current @ U_N = 480V		I_{N_UL} / A	891		
Rated output overload (60 s)	4) 5)	I_{60s} / %	125		
Software current limit	4)	I_{lim} / %	125		
Overcurrent	4)	I_{OC} / %	150		
Rated switching frequency		f_{SN} / kHz	2	2	4
Max. switching frequency	6)	f_{S_max} / kHz	8		
Power dissipation at rated operation	1)	P_D / kW	8,9	8,3	10,2
Maximum current 0Hz / 50Hz at f_S= 2 kHz		I_{out_max} / %	70 / 150	100 / 150	105 / 150
Maximum current 0Hz / 50Hz at f_S= 4 kHz		I_{out_max} / %	40 / 105	60 / 130	75 / 150
Maximalstrom 0Hz / 50Hz bei f_S = 8 kHz		I_{out_max} / %	20 / 55	30 / 80	35 / 90
DC link capacity	2)	C_{DC} / µF	18600		
Max. braking current	2)	I_{B_max} / A	380		
Min. braking resistor value	2)	R_{B_min} / Ω	2,2		
Braking transistor	2) 7)		Max. cycle time: 120s; Max. *ED*: 50 %		
Schutzfunktion für Bremstransistor			Short-circuit monitoring		
Schutzfunktion Bremswiderstand	8)		Feedbacksignalauswertung und Stromabschaltung (only for AC mains connection)		
Max. Motorleitungslänge geschirmt	9)	*l* / m	100	100	50

continued on the next page

Size		35		
System identifiers		**35-L-0-1** **35-L-0-3**	**35-L-0-2** **35-L-0-4**	**35-L-1-2** **35-L-1-4**
Number of power units		**2**		
Cooling type		**Air cooler**	**Liquid cooler**	
Max. heat sink temperature 1	T_{HS1} / °C	100	80	75
Max. heat sink temperature 2	T_{HS2} / °C	90	75	
Max. heat sink temperature 3	T_{HS3} / °C	95	80	75
Max. interior temperature power unit 1	T_{ID_PU1} / °C	65		
Max. interior temperature power unit 2	T_{ID_PU2} / °C	80		
Max. interior temperature power unit 3	T_{ID_PU3} / °C	90		
Temperature for derating the switching frequency	T_{DR} / °C	90	70	65
Temperature for uprating the switching frequency	T_{UR} / °C	85	65	60
Temperature for switching to rated switching frequency	T_{EM} / °C	95	75	70
Rated DC link voltage @ U_N = 400V	U_{N_DC} / V	565		
Rated DC link voltage @ U_N = 480V	$U_{N\_DC\_UL}$ / V	680		
DC link voltage working voltage range	U_{IN_DC} / V	390...780		
DC switch-off level "ERROR underpotential“	U_{UP} / V	240		
DC switch-off level "ERROR overpotential“	U_{OP} / V	840		
DC switch-off level braking resistor	U_B / V	780		
Reset level "Error! Undervoltage“	U_{UP_reset} / V	300		
DC switch-off level "ERROR" Undervoltage @ PowerOff	U_{UP_PO} / V	200		

Table 12: System data 35

1) *Rated operation corresponds to U_N = 400 V, rated switching frequency, output frequency = 50 Hz (4-pole standard asynchronous motor). The specifications apply only to the drive module (BDM) without accessories (filter and choke).*

2) *The specifications apply per Drive Unit.*

3) *The output frequency is to be limited in such a way that it does not exceed 1/10 of the switching frequency. Notice! Devices with a maximum output frequency higher than 599Hz are subject to export restrictions.*

4) *The values refer to the percentage of the initial rated current I_N and can be set in parameter is35.*

5) *Observe limitations => 3.2.4 Overload characteristic (OL).*

6) *A detailed description of the derating => 3.2.3 Switching frequency and temperature.*

7) *The cyclic duration factor is additionally limited by the used braking resistor.*

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

9) *The specification for the maximum motor cable length applies to a single motor cable (Drive Unit -> motor). When operating motor cables (Drive Unit -> motor) in parallel, the information provided at => „5.10.3 Motor cable lengths“ must be taken into account. Further information can be found in the corresponding filter instructions.*

3.2.2 Overview of system data (3-part systems)

The technical data are for 2/4-pole standard motors. With other pole numbers the drive converter must be dimensioned onto the rated motor current. Contact KEB for special or medium frequency motors.

Size			**36**		
System identifiers			**36-M-0-1** **36-M-0-3**	**36-M-0-2** **36-M-0-4**	**36-M-1-2** **36-M-1-4**
Number of power units			**3**		
Cooling type			**Air cooler**	**Liquid cooler**	
Rated apparent output power		S_{out} / kVA	797		
Max. rated motor power	1)	P_{mot} / kW	630		
Rated input voltage		U_N / V	400 (UL: 480)		
Input voltage range		U_{in} / V	280...550		
Mains phases			3		
Mains frequency		f_N / Hz	50 / 60 ±2		
Rated input current @ U_N = 400V		I_{in} / A	1210		
Rated input current @ U_N = 480V		I_{in_UL} / A	1057		
Insulation resistance @ U_{dc} = 500V	2)	R_{iso} / MΩ	> 15		
Output voltage		U_{out} / V	0...U_{in}		
Output frequency	3)	f_{out} / Hz	0...599		
Output phases			3		
Rated output current @ U_N = 400V		I_N / A	1150		
Rated output current @ U_N = 480V		I_{N_UL} / A	1021		
Rated output overload (60 s)	4) 5)	I_{60s} / %	125		
Software current limit	4)	I_{lim} / %	125		
Overcurrent	4)	I_{OC} / %	150		
Rated switching frequency		f_{SN} / kHz	2	2	4
Max. switching frequency	6)	f_{S_max} / kHz	8		
Power dissipation at rated operation	1)	P_D / kW	10,7	10	12,1
Maximum current 0Hz / 50Hz at f_S= 2 kHz		I_{out_max} / %	105 / 150	125 / 150	135 / 150
Maximum current 0Hz / 50Hz at f_S= 4 kHz		I_{out_max} / %	60 / 140	80 / 150	100 / 150
Maximum current 0Hz / 50Hz at f_S= 8 kHz		I_{out_max} / %	30 / 75	40 / 100	50 / 120
DC link capacity	2)	C_{DC} / µF	18600		
Max. braking current	2)	I_{B_max} / A	380		
Min. braking resistor value	2)	R_{B_min} / Ω	2,2		
Braking transistor	2) 7)		Max. cycle time: 120s; Max c.d.f.: 50 %		
Protective function for braking transistor			Short-circuit monitoring		
Protection function braking resistor	8)		Feedback signal evaluation and current shutdown (only for AC mains connection)		
Max. motor cable length shielded	9)	l / m	100	100	50

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Size		36		
System identifiers		**36-M-0-1** **36-M-0-3**	**36-M-0-2** **36-M-0-4**	**36-M-1-2** **36-M-1-4**
Number of power units		**3**		
Cooling type		**Air cooler**	**Liquid cooler**	
Max. heat sink temperature 1	T_{HS1} / °C	100	80	75
Max. heat sink temperature 2	T_{HS2} / °C	90	75	
Max. heat sink temperature 3	T_{HS3} / °C	95	80	75
Max. interior temperature power unit 1	T_{ID_PU1} / °C	65		
Max. interior temperature power unit 2	T_{ID_PU2} / °C	80		
Max. interior temperature power unit 3	T_{ID_PU3} / °C	90		
Temperature for derating the switching frequency	T_{DR} / °C	90	70	65
Temperature for uprating the switching frequency	T_{UR} / °C	85	65	60
Temperature for switching to rated switching frequency	T_{EM} / °C	95	75	70
Rated DC link voltage @ U_N = 400V	U_{N_DC} / V	565		
Rated DC link voltage @ U_N = 480V	$U_{N\_DC\_UL}$ / V	680		
DC link voltage working voltage range	U_{IN_DC} / V	390...780		
DC switch-off level "ERROR underpotential“	U_{UP} / V	240		
DC switch-off level "ERROR overpotential“	U_{OP} / V	840		
DC switch-off level braking resistor	U_B / V	780		
Reset level "Error! Undervoltage“	U_{UP_reset} / V	300		
DC switch-off level "ERROR" Undervoltage @ PowerOff	U_{UP_PO} / V	200		

Table 13: System data 36

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

2) *The specifications apply per Drive Unit.*

3) *The output frequency is to be limited in such a way that it does not exceed 1/10 of the switching frequency. Notice! Devices with a maximum output frequency higher than 599Hz are subject to export restrictions.*

4) *The values refer to the percentage of the initial rated current I_N and can be set in parameter is35.*

5) *Observe limitations => 3.2.4 Overload characteristic (OL).*

6) *A detailed description of the derating => 3.2.3 Switching frequency and temperature.*

7) *The cyclic duration factor is additionally limited by the used braking resistor.*

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

9) *The specification for the maximum motor cable length applies to a single motor cable (Drive Unit -> motor). When operating motor cables (Drive Unit -> motor) in parallel, the information provided at => „5.10.3 Motor cable lengths“ must be taken into account. Further information can be found in the corresponding filter instructions.*

The technical data are for 2/4-pole standard motors. With other pole numbers the drive converter must be dimensioned onto the rated motor current. Contact KEB for special or medium frequency motors.

Size			**37**		
System identifiers			**37-M-0-1** **37-M-0-3**	**37-M-0-2** **37-M-0-4**	**37-M-1-2** **37-M-1-4**
Number of power units			**3**		
Cooling type			**Air cooler**	**Liquid cooler**	
Rated apparent output power		S_{out} / kVA	921		
Max. rated motor power	1)	P_{mot} / kW	710		
Rated input voltage		U_N / V	400 (UL: 480)		
Input voltage range		U_{in} / V	280...550		
Mains phases			3		
Mains frequency		f_N / Hz	50 / 60 ±2		
Rated input current @ U_N = 400V		I_{in} / A	1400		
Rated input current @ U_N = 480V		I_{in_UL} / A	1221		
Insulation resistance @ U_{dc} = 500V	2)	R_{iso} / MΩ	> 15		
Output voltage		U_{out} / V	0...U_{in}		
Output frequency	3)	f_{out} / Hz	0...599		
Output phases			3		
Rated output current @ U_N = 400V		I_N / A	1330		
Rated output current @ U_N = 480V		I_{N_UL} / A	1179		
Rated output overload (60 s)	4) 5)	I_{60s} / %	125		
Software current limit	4)	I_{lim} / %	125		
Overcurrent	4)	I_{OC} / %	150		
Rated switching frequency		f_{SN} / kHz	2	2	4
Max. switching frequency	6)	f_{S_max} / kHz	8		
Power dissipation at rated operation	1)	P_D / kW	12,9	12,2	14,6
Maximum current 0Hz / 50Hz at f_S= 2 kHz		I_{out_max} / %	90 / 150	115 / 150	120 / 150
Maximum current 0Hz / 50Hz at f_S= 4 kHz		I_{out_max} / %	45 / 120	70 / 150	85 / 150
Maximum current 0Hz / 50Hz at f_S= 8 kHz		I_{out_max} / %	25 / 65	35 / 90	40 / 105
DC link capacity	2)	C_{DC} / µF	18600		
Max. braking current	2)	I_{B_max} / A	380		
Min. braking resistor value	2)	R_{B_min} / Ω	2,2		
Braking transistor	2) 7)		Max. cycle time: 120s; Max c.d.f.: 50 %		
Protective function for braking transistor			Short-circuit monitoring		
Protection function braking resistor	8)		Feedback signal evaluation and current shutdown (only for AC mains connection)		
Max. motor cable length shielded	9)	l / m	100	100	50
Max. heat sink temperature 1		T_{HS1} / °C	100	80	75

continued on the next page

Size		**37**		
System identifiers		**37-M-0-1** **37-M-0-3**	**37-M-0-2** **37-M-0-4**	**37-M-1-2** **37-M-1-4**
Number of power units		**3**		
Cooling type		**Air cooler**	**Liquid cooler**	
Max. heat sink temperature 2	T_{HS2} / °C	90	75	
Max. heat sink temperature 3	T_{HS3} / °C	95	80	75
Max. interior temperature power unit 1	T_{ID_PU1} / °C	65		
Max. interior temperature power unit 2	T_{ID_PU2} / °C	80		
Max. interior temperature power unit 3	T_{ID_PU3} / °C	90		
Temperature for derating the switching frequency	T_{DR} / °C	90	70	65
Temperature for uprating the switching frequency	T_{UR} / °C	85	65	60
Temperature for switching to rated switching frequency	T_{EM} / °C	95	75	70
Rated DC link voltage @ U_N = 400V	U_{N_DC} / V	565		
Rated DC link voltage @ U_N = 480V	$U_{N\_DC\_UL}$ / V	680		
DC link voltage working voltage range	U_{IN_DC} / V	390...780		
DC switch-off level "ERROR underpotential“	U_{UP} / V	240		
DC switch-off level "ERROR overpotential“	U_{OP} / V	840		
DC switch-off level braking resistor	U_B / V	780		
Reset level "Error! Undervoltage“	U_{UP_reset} / V	300		
DC switch-off level "ERROR" Undervoltage @ PowerOff	U_{UP_PO} / V	200		

Table 14: System data 37

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

2) *The specifications apply per Drive Unit.*

3) *The output frequency is to be limited in such a way that it does not exceed 1/10 of the switching frequency. Notice! Devices with a maximum output frequency higher than 599Hz are subject to export restrictions.*

4) *The values refer to the percentage of the initial rated current I_N and can be set in parameter is35.*

5) *Observe limitations => 3.2.4 Overload characteristic (OL).*

6) *A detailed description of the derating => 3.2.3 Switching frequency and temperature.*

7) *The cyclic duration factor is additionally limited by the used braking resistor.*

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

9) *The specification for the maximum motor cable length applies to a single motor cable (Drive Unit -> motor). When operating motor cables (Drive Unit -> motor) in parallel, the information provided at => „5.10.3 Motor cable lengths“ must be taken into account. Further information can be found in the corresponding filter instructions.*

Size			**38**		
System identifiers			**38-M-0-1** **38-M-0-3**	**38-M-0-2** **38-M-0-4**	**38-M-1-2** **38-M-1-4**
Number of power units			**3**		
Cooling type			**Air cooler**	**Liquid cooler**	
Rated apparent output power		S_{out} / kVA	1005		
Max. rated motor power	1)	P_{mot} / kW	800		
Rated input voltage		U_N / V	400 (UL: 480)		
Input voltage range		U_{in} / V	280...550		
Mains phases			3		
Mains frequency		f_N / Hz	50 / 60 ±2		
Rated input current @ U_N = 400V		I_{in} / A	1520		
Rated input current @ U_N = 480V		I_{in_UL} / A	1340		
Insulation resistance @ U_{dc} = 500V	2)	R_{iso} / MΩ	> 15		
Output voltage		U_{out} / V	0...U_{in}		
Output frequency	3)	f_{out} / Hz	0...599		
Output phases			3		
Rated output current @ U_N = 400V		I_N / A	1450		
Rated output current @ U_N = 480V		I_{N_UL} / A	1294		
Rated output overload (60 s)	4) 5)	I_{60s} / %	125		
Software current limit	4)	I_{lim} / %	125		
Overcurrent	4)	I_{OC} / %	150		
Rated switching frequency		f_{SN} / kHz	2	2	4
Max. switching frequency	6)	f_{S_max} / kHz	8		
Power dissipation at rated operation	1)	P_D / kW	14,5	13,7	16,3
Maximum current 0Hz / 50Hz at f_S= 2 kHz		I_{out_max} / %	80 / 150	105 / 150	110 / 150
Maximum current 0Hz / 50Hz at f_S= 4 kHz		I_{out_max} / %	40 / 110	65 / 135	80 / 150
Maximum current 0Hz / 50Hz at f_S= 8 kHz		I_{out_max} / %	20 / 60	30 / 80	40 / 95
DC link capacity	2)	C_{DC} / µF	18600		
Max. braking current	2)	I_{B_max} / A	380		
Min. braking resistor value	2)	R_{B_min} / Ω	2,2		
Braking transistor	2) 7)		Max. cycle time: 120s; Max c.d.f.: 50 %		
Protective function for braking transistor			Short-circuit monitoring		
Protection function braking resistor	8)		Feedback signal evaluation and current shutdown (only for AC mains connection)		
Max. motor cable length shielded	9)	l / m	100	100	50

continued on the next page

Size		38		
System identifiers		38-M-0-1 38-M-0-3	38-M-0-2 38-M-0-4	38-M-1-2 38-M-1-4
Number of power units		3		
Cooling type		Air cooler	Liquid cooler	
Max. heat sink temperature 1	T_{HS1} / °C	100	80	75
Max. heat sink temperature 2	T_{HS2} / °C	90	75	
Max. heat sink temperature 3	T_{HS3} / °C	95	80	75
Max. interior temperature power unit 1	T_{ID_PU1} / °C	65		
Max. interior temperature power unit 2	T_{ID_PU2} / °C	80		
Max. interior temperature power unit 3	T_{ID_PU3} / °C	90		
Temperature for derating the switching frequency	T_{DR} / °C	90	70	65
Temperature for uprating the switching frequency	T_{UR} / °C	85	65	60
Temperature for switching to rated switching frequency	T_{EM} / °C	95	75	70
Rated DC link voltage @ U_N = 400V	U_{N_DC} / V	565		
Rated DC link voltage @ U_N = 480V	$U_{N\_DC\_UL}$ / V	680		
DC link voltage working voltage range	U_{IN_DC} / V	390...780		
DC switch-off level "ERROR underpotential“	U_{UP} / V	240		
DC switch-off level "ERROR overpotential“	U_{OP} / V	840		
DC switch-off level braking resistor	U_B / V	780		
Reset level "Error! Undervoltage“	U_{UP_reset} / V	300		
DC switch-off level "ERROR" Undervoltage @ PowerOff	U_{UP_PO} / V	200		

Table 15: System data 38

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

2) *The specifications apply per Drive Unit.*

3) *The output frequency is to be limited in such a way that it does not exceed 1/10 of the switching frequency. Notice! Devices with a maximum output frequency higher than 599Hz are subject to export restrictions.*

4) *The values refer to the percentage of the initial rated current I_N and can be set in parameter is35.*

5) *Observe limitations => 3.2.4 Overload characteristic (OL).*

6) *A detailed description of the derating => 3.2.3 Switching frequency and temperature.*

7) *The cyclic duration factor is additionally limited by the used braking resistor.*

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

9) *The specification for the maximum motor cable length applies to a single motor cable (Drive Unit -> motor). When operating motor cables (Drive Unit -> motor) in parallel, the information provided at => „5.10.3 Motor cable lengths“ must be taken into account. Further information can be found in the corresponding filter instructions.*

Size			**39**		
System identifiers			**39-M-0-1** **39-M-0-3**	**39-M-0-2** **39-M-0-4**	**39-M-1-2** **39-M-1-4**
Number of power units			**3**		
Cooling type			**Air cooler**	**Liquid cooler**	
Rated apparent output power		S_{out} / kVA	1081		
Max. rated motor power	1)	P_{mot} / kW	900		
Rated input voltage		U_N / V	400 (UL: 480)		
Input voltage range		U_{in} / V	280...550		
Mains phases			3		
Mains frequency		f_N / Hz	50 / 60 ±2		
Rated input current @ U_N = 400V		I_{in} / A	1630		
Rated input current @ U_N = 480V		I_{in_UL} / A	1429		
Insulation resistance @ U_{dc} = 500V	2)	R_{iso} / MΩ	> 15		
Output voltage		U_{out} / V	0...U_{in}		
Output frequency	3)	f_{out} / Hz	0...599		
Output phases			3		
Rated output current @ U_N = 400V		I_N / A	1560		
Rated output current @ U_N = 480V		I_{N_UL} / A	1380		
Rated output overload (60 s)	4) 5)	I_{60s} / %	125		
Software current limit	4)	I_{lim} / %	125		
Overcurrent	4)	I_{OC} / %	150		
Rated switching frequency		f_{SN} / kHz	2	2	4
Max. switching frequency	6)	f_{S_max} / kHz	8		
Power dissipation at rated operation	1)	P_D / kW	15,9	15	17,8
Maximum current 0Hz / 50Hz at f_S= 2 kHz		I_{out_max} / %	70 / 150	100 / 150	105 / 150
Maximum current 0Hz / 50Hz at f_S= 4 kHz		I_{out_max} / %	35 / 100	60 / 125	75 / 150
Maximum current 0Hz / 50Hz at f_S= 8 kHz		I_{out_max} / %	20 / 55	30 / 75	35 / 90
DC link capacity	2)	C_{DC} / µF	18600		
Max. braking current	2)	I_{B_max} / A	380		
Min. braking resistor value	2)	R_{B_min} / Ω	2,2		
Braking transistor	2) 7)		Max. cycle time: 120s; Max c.d.f.: 50 %		
Protective function for braking transistor			Short-circuit monitoring		
Protection function braking resistor	8)		Feedback signal evaluation and current shutdown (only for AC mains connection)		
Max. motor cable length shielded	9)	l / m	100	100	50

continued on the next page

Size		**39**		
System identifiers		**39-M-0-1** **39-M-0-3**	**39-M-0-2** **39-M-0-4**	**39-M-1-2** **39-M-1-4**
Number of power units		**3**		
Cooling type		**Air cooler**	**Liquid cooler**	
Max. heat sink temperature 1	T_{HS1} / °C	100	80	75
Max. heat sink temperature 2	T_{HS2} / °C	90	75	
Max. heat sink temperature 3	T_{HS3} / °C	95	80	75
Max. interior temperature power unit 1	T_{ID_PU1} / °C	65		
Max. interior temperature power unit 2	T_{ID_PU2} / °C	80		
Max. interior temperature power unit 3	T_{ID_PU3} / °C	90		
Temperature for derating the switching frequency	T_{DR} / °C	90	70	65
Temperature for uprating the switching frequency	T_{UR} / °C	85	65	60
Temperature for switching to rated switching frequency	T_{EM} / °C	95	75	70
Rated DC link voltage @ U_N = 400V	U_{N_DC} / V	565		
Rated DC link voltage @ U_N = 480V	$U_{N\_DC\_UL}$ / V	680		
DC link voltage working voltage range	U_{IN_DC} / V	390...780		
DC switch-off level "ERROR underpotential“	U_{UP} / V	240		
DC switch-off level "ERROR overpotential“	U_{OP} / V	840		
DC switch-off level braking resistor	U_B / V	780		
Reset level "Error! Undervoltage“	U_{UP_reset} / V	300		
DC switch-off level "ERROR" Undervoltage @ PowerOff	U_{UP_PO} / V	200		

Table 16: System data 39

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

2) *The specifications apply per Drive Unit.*

3) *The output frequency is to be limited in such a way that it does not exceed 1/10 of the switching frequency. Notice! Devices with a maximum output frequency higher than 599Hz are subject to export restrictions.*

4) *The values refer to the percentage of the initial rated current I_N and can be set in parameter is35.*

5) *Observe limitations => 3.2.4 Overload characteristic (OL).*

6) *A detailed description of the derating => 3.2.3 Switching frequency and temperature.*

7) *The cyclic duration factor is additionally limited by the used braking resistor.*

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

9) *The specification for the maximum motor cable length applies to a single motor cable (Drive Unit -> motor). When operating motor cables (Drive Unit -> motor) in parallel, the information provided at => „5.10.3 Motor cable lengths“ must be taken into account. Further information can be found in the corresponding filter instructions.*

3.2.3 Switching frequency and temperature

The drive converter cooling is designed by way that the heat sink overtemperature threshold is not exceeded at rated conditions. A switching frequency higher than the rated switching frequency produces higher losses and thus a higher heat sink heating.

If the heat sink temperature reaches a critical threshold (T_{DR}), the switching frequency can be reduced automatically step by step. This prevents that the drive converter switches off due to overheating of the heat sink. If the heat sink temperature falls below the treshold T_{UR}, the switching frequency is increased back to the setpoint. At temperature T_{EM} the switching frequency is immediately reduced to rated switching frequency. „Derating“ must be activated, for this function to work.

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

- Lower maximum currents apply for switching frequencies > rated switching frequency.

If error (OL2) shall be triggered on exceeding the maximum currents or if the switching frequency is automatically reduced (derating) can be adjusted in the drive converter parameters.

3.2.4 Overload characteristic (OL)

All drive converter can be operated at rated switching frequency with an utilisation of 125 % for 60 s.

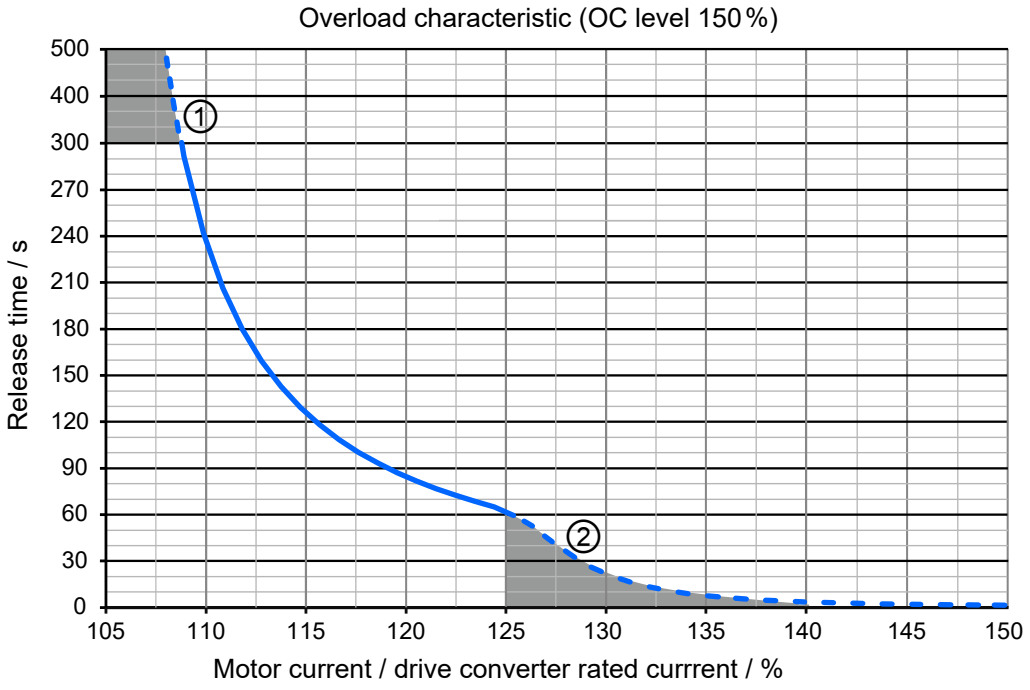
The OL overload function is a root mean square (RMS) function.

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

For extreme overloads => *„Figure 5: Switch-off time t depending on the overload I/IN at OC level 150 %“*, the load is weighted more heavily. This means the load is provided with a factor for the calculation of the RMS value, by way that the overload protection function triggers, even if the RMS value does not reach 100%.

Restrictions:

- The thermal design of the heat sink is based on the rated operation. The following values are taken into account: rated output current, ambient temperature, rated switching frequency, rated voltage.
- At high ambient temperatures and/or high heat sink temperatures (for example, by preceding utilisation nearby 100%) the drive converter can change to overtemperature error before triggering the protective function OL.
- At low output frequencies or switching frequencies higher than the rated switching frequency, the frequency-dependent maximum current can be exceeded before and error OL2 can be triggered
  (*=> 3.2.3 Switching frequency and temperature*).



Legend	
1	Thermal overload limit
2	Range for extreme overloads

Figure 5: Switch-off time t depending on the overload I/IN at OC level 150 %

3.2.5 DC link / braking transistor function

Activation of the braking transistor function.

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

For more information => *F6 Programming manual*.

NOTICE

Falling below the minimum braking resistance value!

Destruction of the drive converter

► The minimum brake resistance value must not fall below!

The following illustration applies to each module.

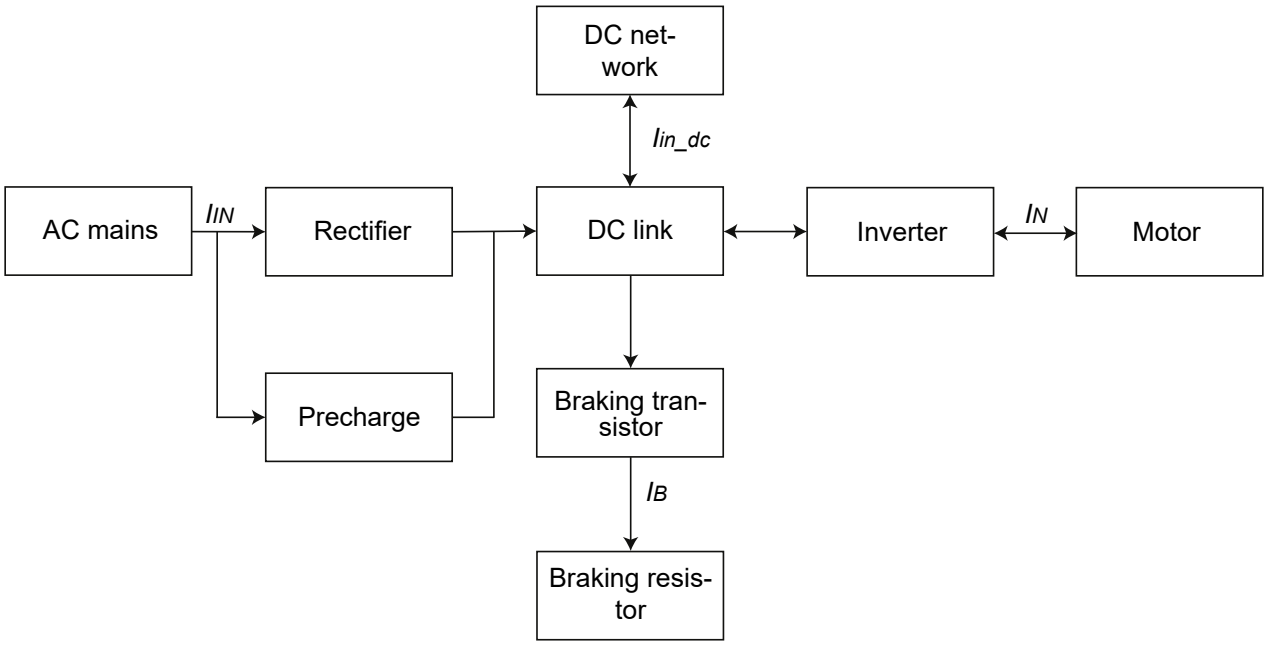


Figure 6: Block diagram of the energy flow

NOTICE

Destruction of the drive converter!

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

► If the error "ERROR GTR7 always ON" occurs, the drive converter is defective and must be disconnected from the power supply after 16 hours at the latest!

► When connected to a DC mains supply and using non-intrinsically safe braking resistors or under-mount braking resistors, the drive converter must be disconnected from the power supply after 1 second at the latest.

3.2.6 Fan

Fan specifications per Drive Unit		
Interior fan	Number	2
	Speed-variable	yes
Heat sink fan [1)]	Number	2
	Speed-variable	yes

Figure 7: Fan

[1)] *Observe external heat sink fan supply => „5.5.2 External heat sink fan supply“*

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

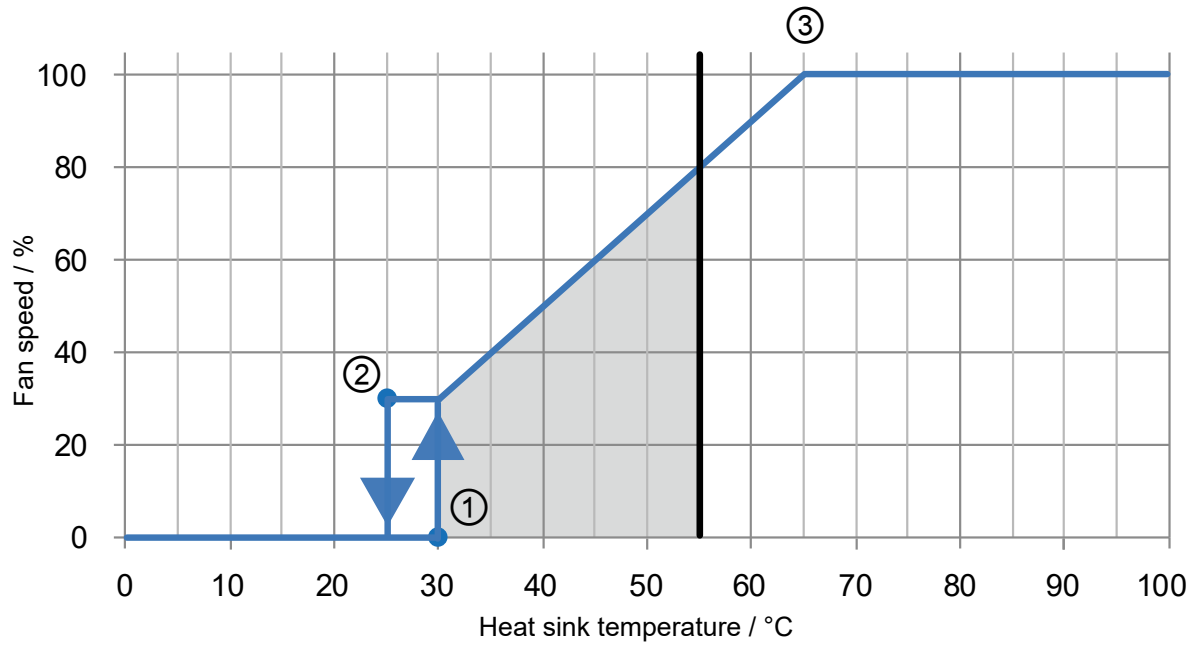
NOTICE

Destruction of the fans!

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

3.2.6.1 Switching behaviour of the fans

The temperature monitoring controls the fans with different switching on and off points.



Legend	
	Fan speed in dependence on the temperature
	Setting range for the switch-on temperature
	Maximum switch-on temperature
1	Switch-on point
2	Switch-off point
3	Switching point maximum speed level

Figure 8: Exemplary switching behaviour of the heat sink fans

3.2.6.2 Switching points of the fans

The switching point for the switch-on temperature and the maximum speed level of the fans are adjustable. The following table shows the default values.

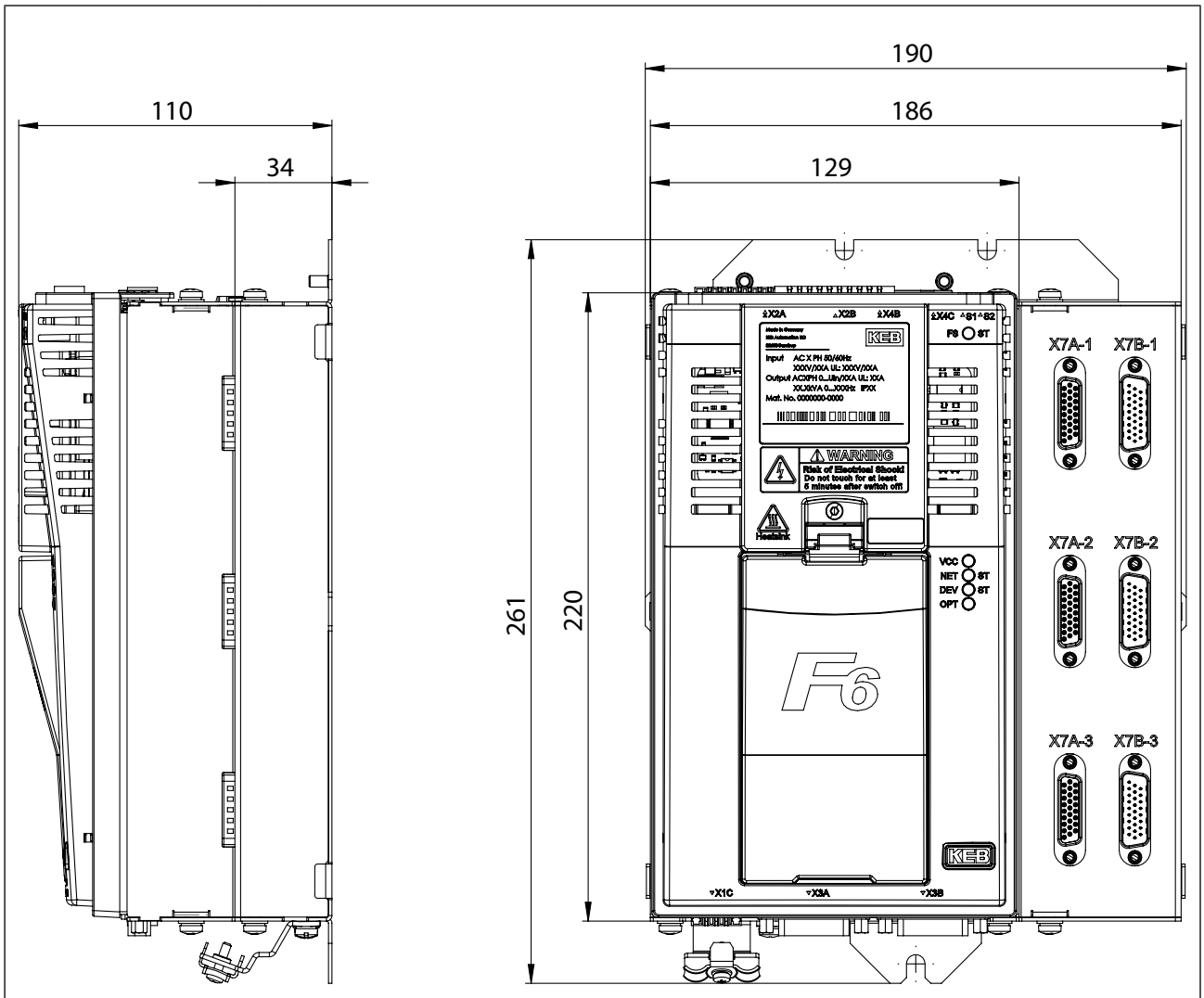
Fan		Heat sink	Interior
Switch-on temperature	*T* / °C	30	20
Maximum speed level	*T* / °C	65	40

Table 17: Switching points of the fans

4 Mechanical Installation

4.1 Dimensions and Weights

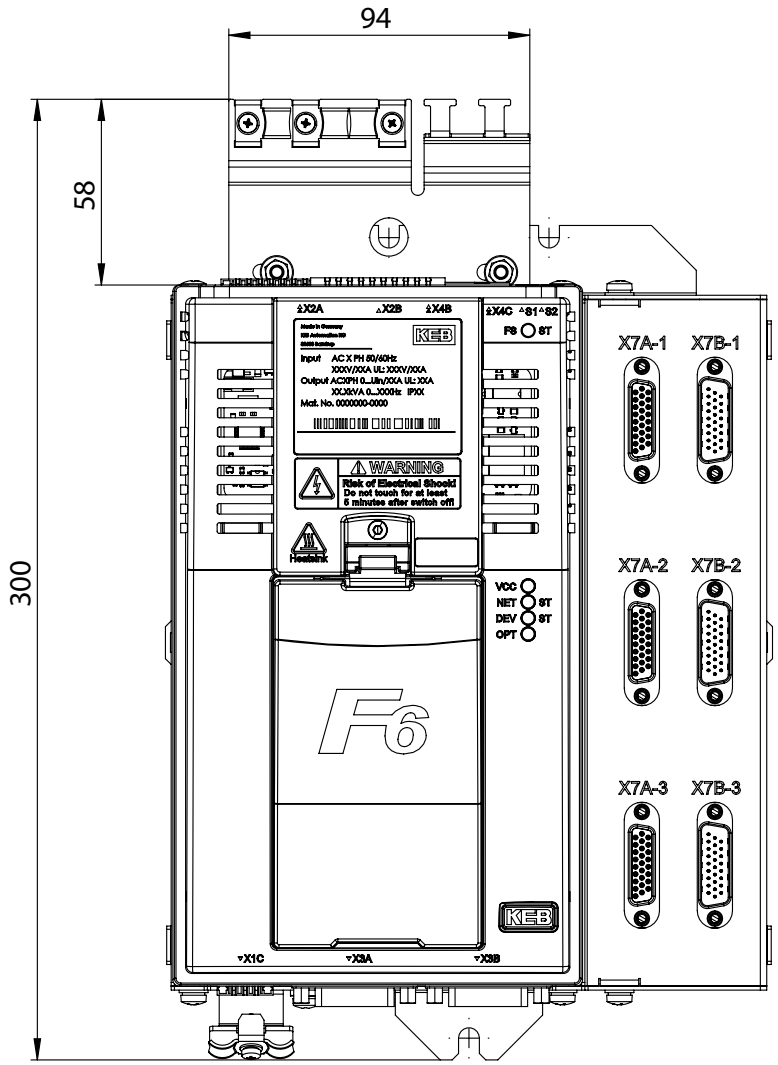
4.1.1 Control Unit



Housing	Control Unit
Weight	1.7 kg
Dimensions	All dimensions in mm

Figure 9: Dimensions Control Unit

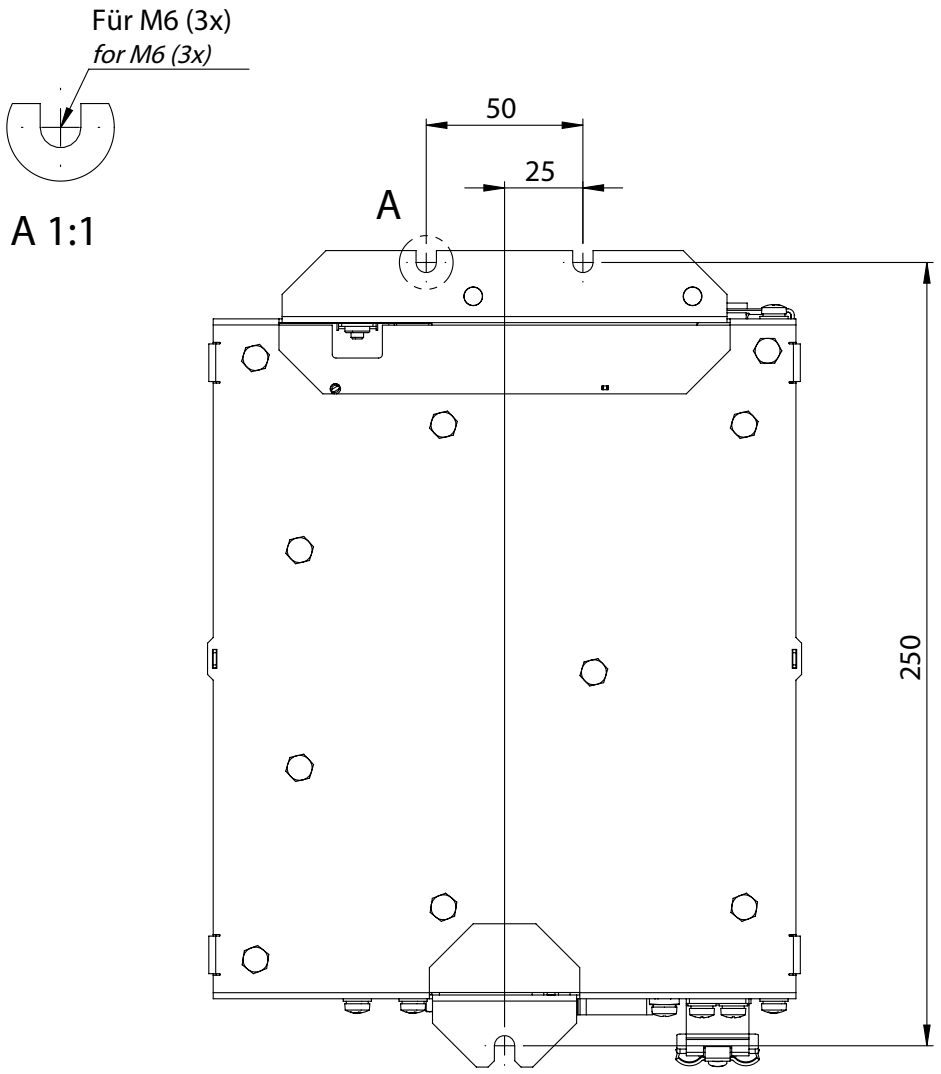
4.1.2 Control Unit with accessories



Housing	Control Unit
Weight	1.8 kg
Dimensions	All dimensions in mm

Figure 10: Dimensions Control Unit with accessories

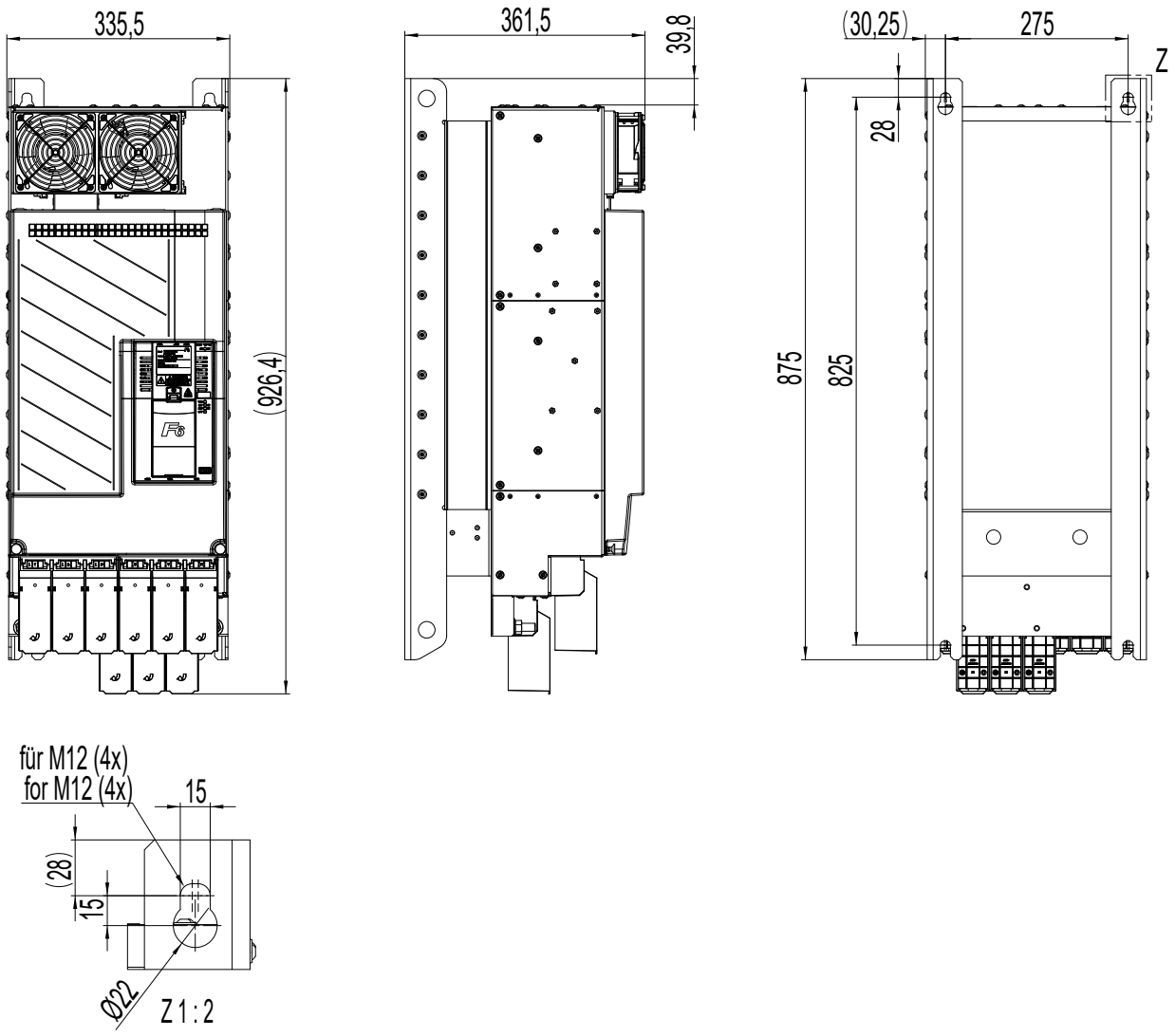
4.1.3 Installation Dimensions Control Unit



Housing	Control Unit
Weight	1.8 kg
Dimensions	All dimensions in mm

Figure 11: Installation Dimensions Control Unit

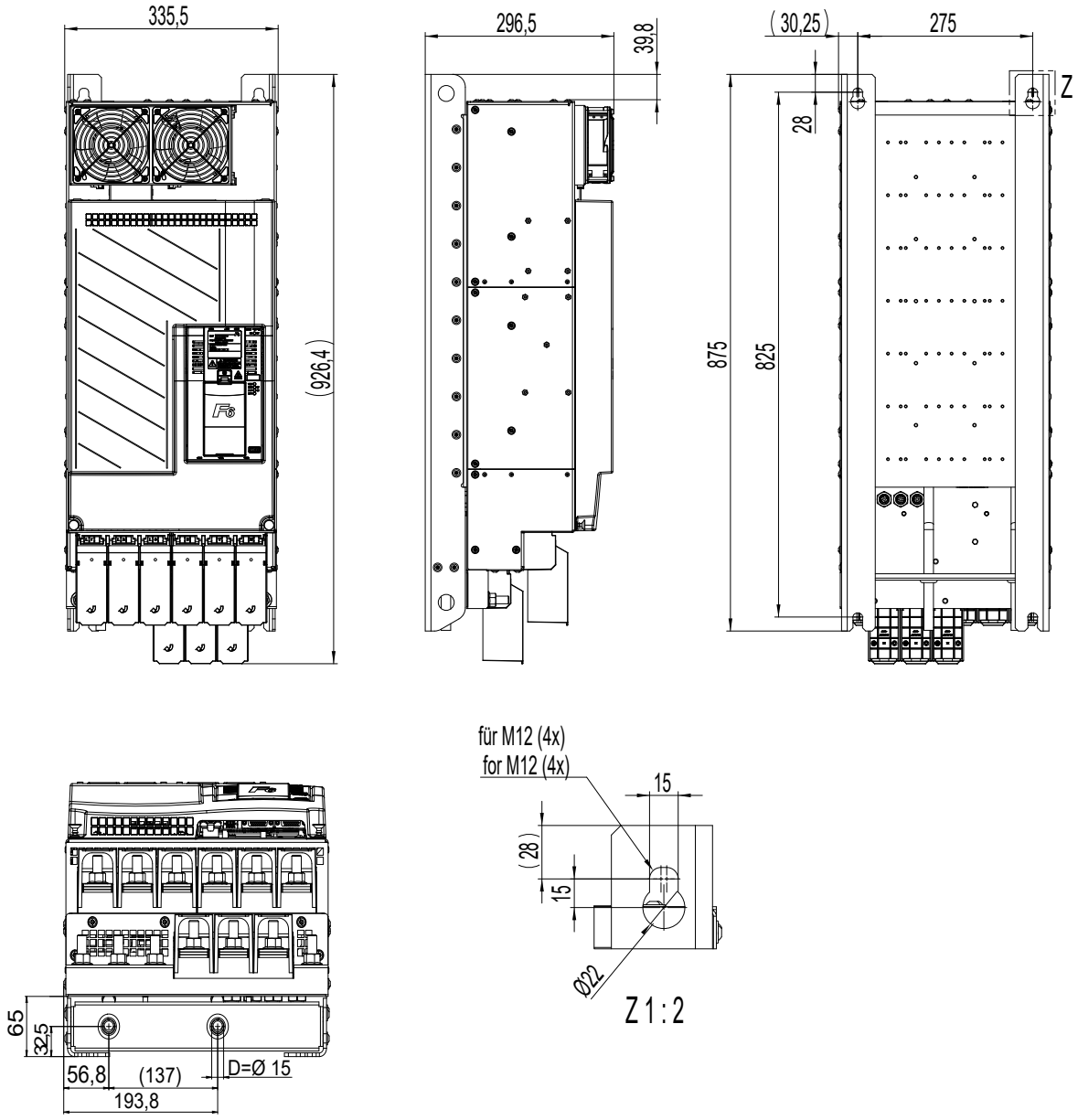
4.1.4 Built-in version air cooler Drive Unit



Housing	8
Weight	85 kg
Dimensions	All dimensions in mm

Figure 12: Dimensions Built-in version air cooler Drive Unit

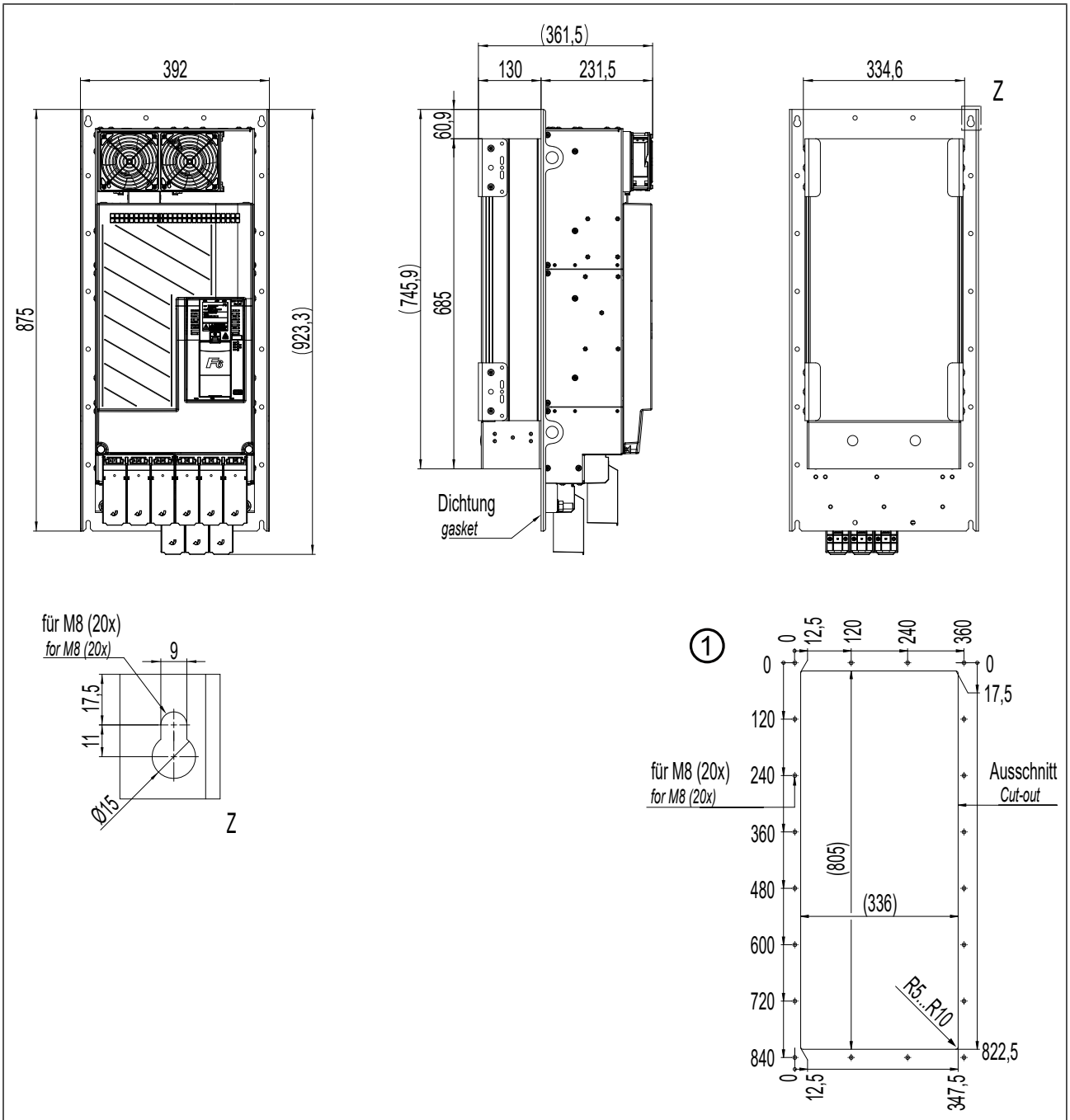
4.1.5 Built-in version Liquid cooler Drive Unit



Housing	8
Weight	69 kg
Dimensions	All dimensions in mm

Figure 13: Dimensions Built-in version Liquid cooler Drive Unit

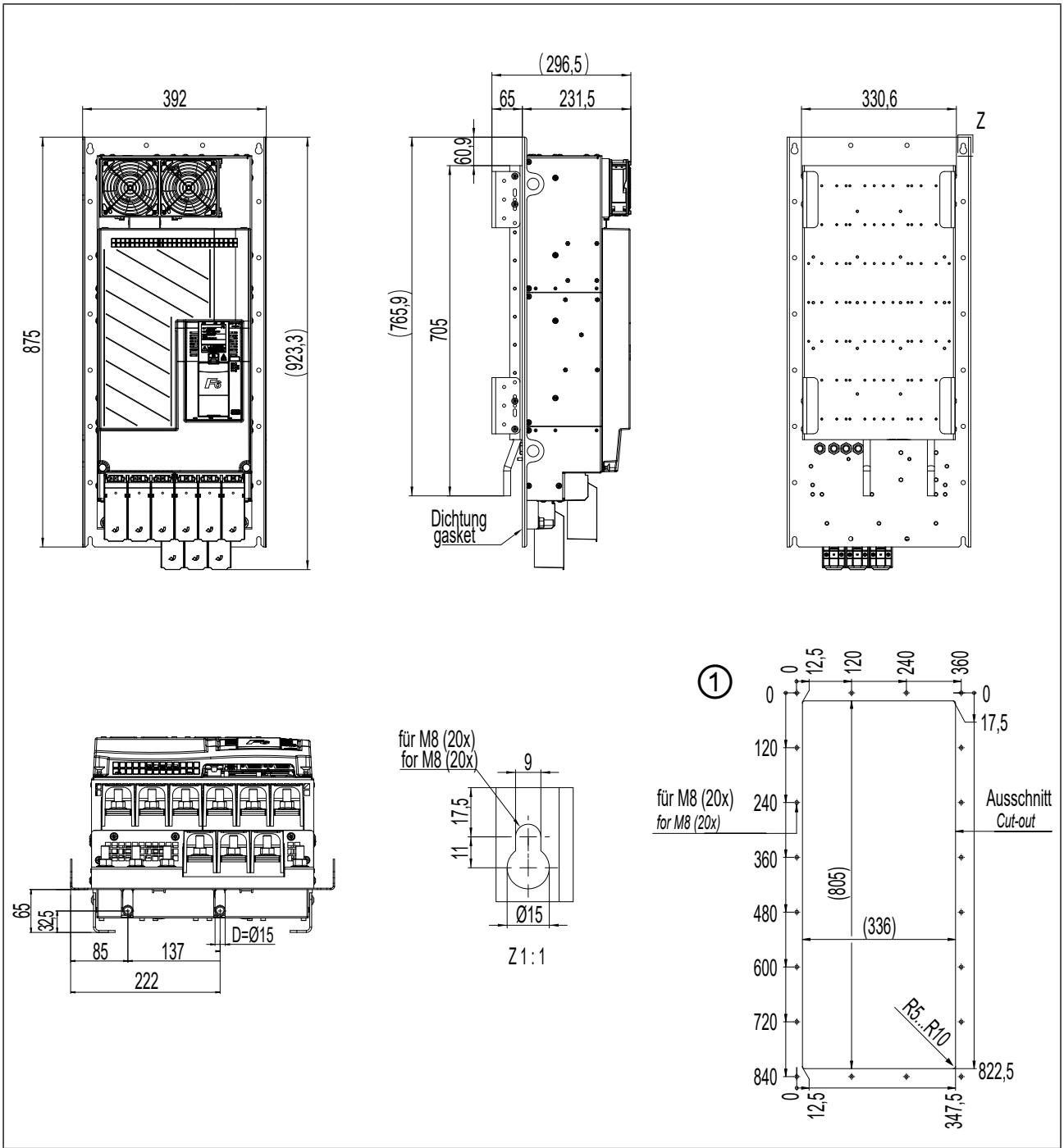
4.1.6 Push-through version air cooler IP20, IP54-ready Drive Unit



Housing	8
Weight	82 kg
1	Control cabinet cut-out
Dimensions	All dimensions in mm

Figure 14: Dimensions Push-through version air cooler IP20, IP54-ready Drive Unit

4.1.7 Push-through version air cooler IP20, IP54-ready Drive Unit



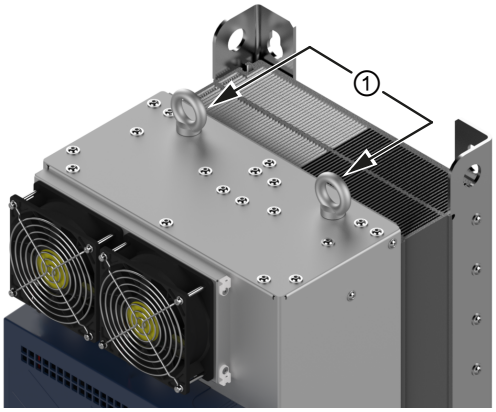
Housing	8
Weight	68 kg
1	Control cabinet cut-out
Dimensions	All dimensions in mm

Figure 15: Dimensions Push-through version air cooler IP20, IP54-ready Drive Unit

4.2 Control cabinet installation

4.2.1 Control cabinet installation

Drive controllers in housings 7, 8 and 9 have 2 threaded bushes for M10 ring bolts according to *DIN 580* on the top. These are used to accommodate appropriate lifting devices for transport.



Legend	
1	M10 ring bolts

Figure 16: Example of an F6 in housing 8 with M10 ring bolts

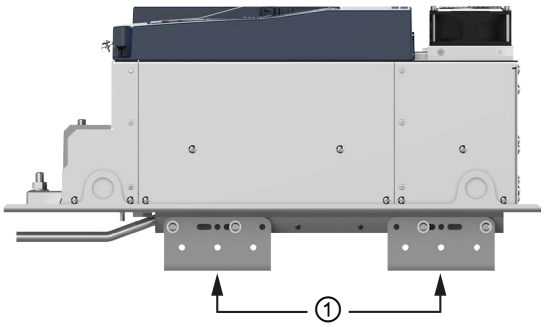
4.2.2 Devices with transport bracket

The transport bracket can be removed after mounting the drive controller. The transport brackets must be stored to make the drive controller transportable again in case of service.

NOTICE

Damage caused by improper mounting

► The transport brackets must not be used to fasten the drive controller!



Legend	
1	Transport bracket

Figure 17: Example of an F6 housing 7 with transport brackets

NOTICE

Damage to the water connections

Bending of the tubes!

► Never set the device down or transport it without the transport brackets!

4.2.3 Mounting instructions

For mounting the drive converter, the following mounting materials were tested with the corresponding quality by KEB.

NOTICE

Use of other mounting material!

► The alternatively selected mounting material must comply with the above-mentioned material characteristics (quality) and tightening torques!

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

4.2.3.1 Mounting instructions Control Unit

Required material	Tightening torque
Hexagon-head screw *ISO 4762* - M6 - 8.8 galvanised	9 Nm 80 lb inch
Flat washer *ISO 7090* - 12 - 200 HV galvanised	–

Table 18: Mounting instructions Control Unit

4.2.3.2 Mounting instructions Drive Unit installation version

Required material	Tightening torque
Hexagon-head screw *ISO 4017* - M12 - 8.8 galvanised	80 Nm 705 lb inch
Flat washer *ISO 7090* - 12 - 200 HV galvanised	–

Table 19: Mounting instructions Drive Unit installation version

4.2.3.3 Mounting instructions Drive Unit push-through version

Required material	Tightening torque
Hexagon-head screw *ISO 4017* - M8 - 8.8 galvanised	22 Nm 190 lb inch
Flat washer *ISO 7090* - 8 - 200 HV galvanised	–

Table 20: Mounting instructions Drive Unit push-through version

4.2.4 Mounting distances

For trouble-free operation, the drive converter must be mounted without any gap on a smooth, closed mounting plate.

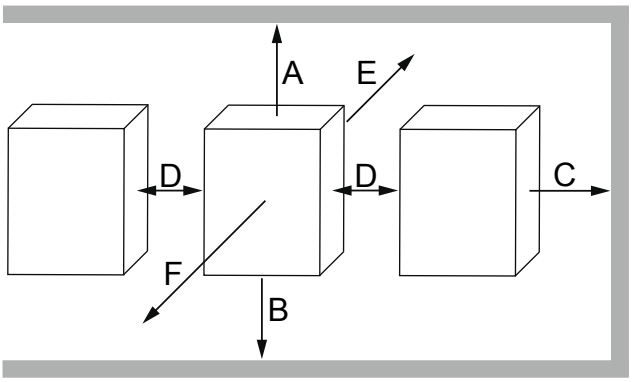
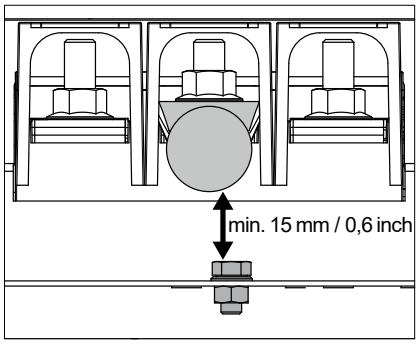
Mounting distances	Dimension	Distance in mm	Distance in inch
	A	150	6
	B	100	4
	C	100	4
	D	50...230	2...9
	E	0	0
	F [1]	50	2
	[1] Distance to preceding elements in the control cabinet door.		

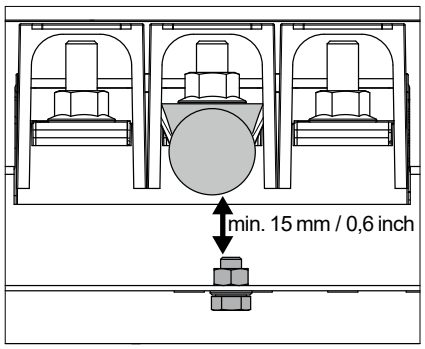
Figure 18: Mounting distances

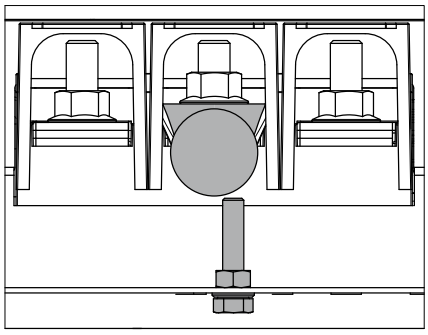
NOTICE

Voltage flashover!

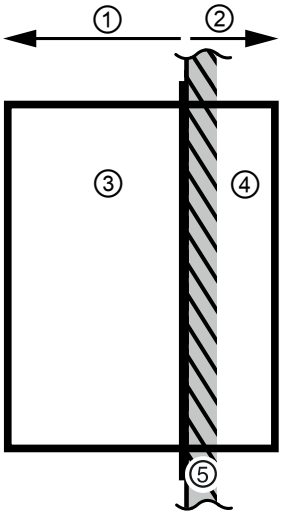
- ► Observe screw length for push-through version!
- ► Maintain an insulation distance of at least 15 mm (0.6 inch) between conductor and screw!







4.2.5 Installation of IP54-ready devices



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

Figure 19: Installation of IP54-ready devices

IP54 zone: Heat sink outside the housing

The protection class IP54 can only be achieved when the device is properly installed.

For proper installation, a suitable IP54 seal (=> *„7.4 Seal for IP54-ready devices“*) must be installed between heat sink and housing (e.g. control cabinet wall).

The tightness must be checked after the installation. If properly installed, the separation to the housing corresponds to degree of protection IP54.

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

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

UL: Device heat sink is classified as NEMA type 1

IP20 zone: Device inside the housing

This part is intended for the installation in a suitable housing for the required degree of protection (e.g. control cabinet).

The power connections are excluded => *„3.1.1 Climatic environmental conditions“*.

NOTICE

Defect due to continuous splash water !

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

4.2.6 Control cabinet ventilation

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

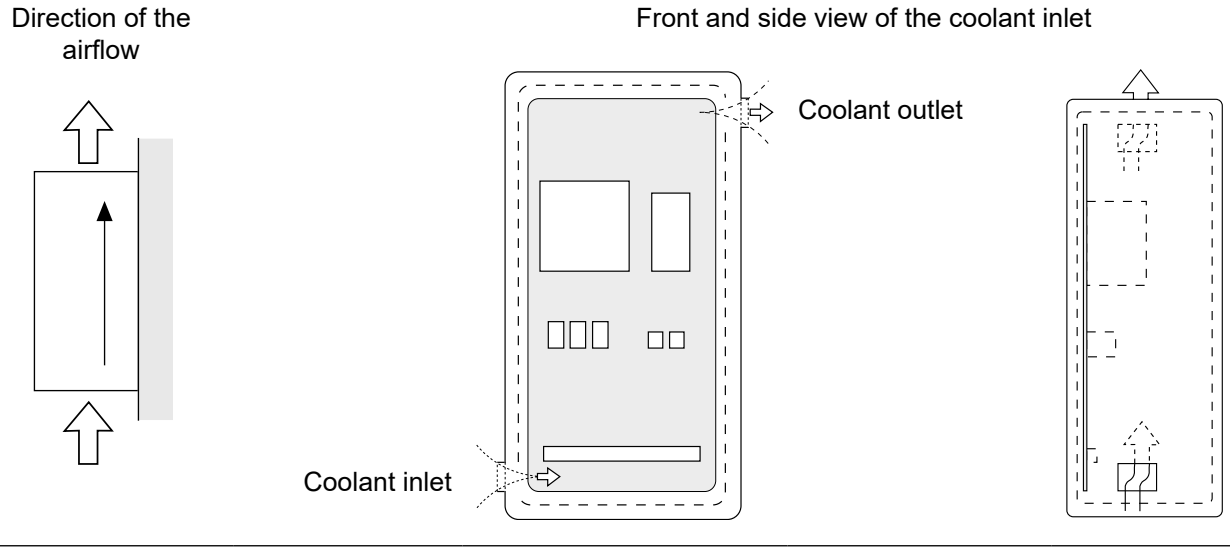
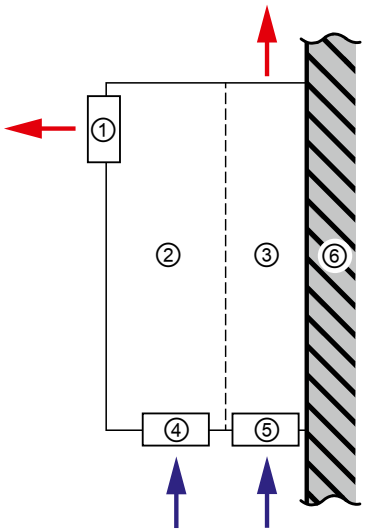


Figure 20: Control cabinet ventilation

4.2.7 Airflow of the drive controller



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

Figure 21: Airflow of the drive controller

5 Electrical Installation

This chapter contains the information which must be observed when selecting the wires, the protective measures and wiring in the control cabinet.

Current laws and local regulations must always be observed when planning and carrying out the installation. KEB assumes no liability for installations where laws, local and / or other regulations have not been complied with. If the recommendations given by KEB are not observed, you might experience problems when using the drive converter which are not covered by the warranty.

NOTICE

Exclusion of liability in case of non-observance!

► Current laws and local regulations must always be observed when planning and carrying out the installation.

5.1 Wiring

- Lay noise-affected or noise sensitive cables as far apart from each other as possible (minimum 200 mm).
- If the distance cannot be maintained, additional shielding measures must be provided.
- Cables must be routed as closely as possible to earthed housing parts, mounting plates or cabinet frames. This reduces noise emissions and noise injections.
- Crossings of cables of different classes are to be tolerated, parallel laying should be avoided.
- If another laying is not possible, cross the cables at right angles, especially if the signals are sensitive and interference emitted.
- Cores of signal and data lines that are not used must be earthed at both ends.
- Avoid long lines and interference sources in order to prevent additional coupling points.
- Ground unused lines on one side in the control cabinet.
- Establish ground connections with the largest possible cross-section to other control cabinets, system components and decentralized devices.
- Avoid larger conductor loops.

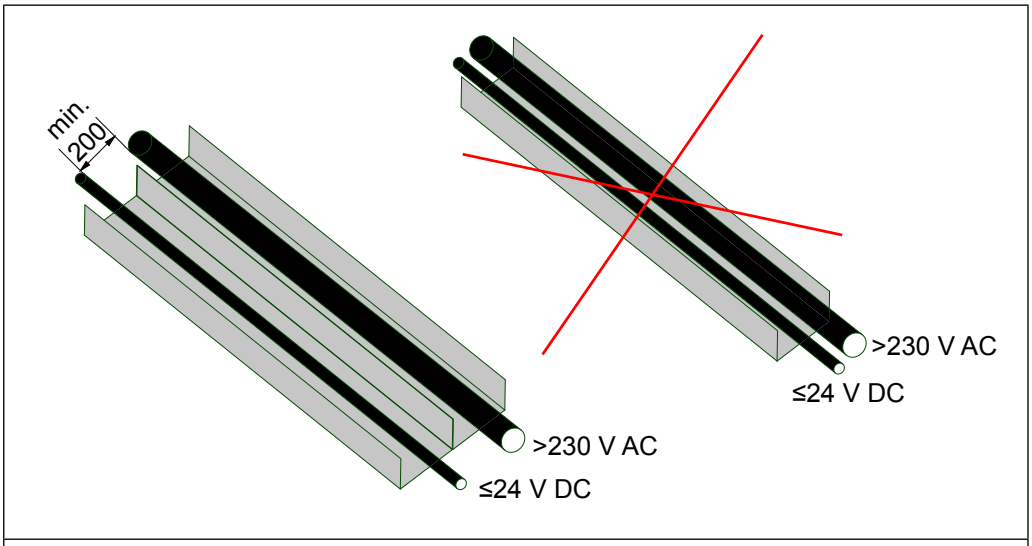


Figure 22: Laying the cables

5.2 Connection of the shield connection

- Cable shields must not be used for power supply.
- A cable shield must not assume the function of an N or PE conductor.
- Always lay cable shields over a large surface.
- Do not extend the cable shield by unshielded wire connections to the earthing point. This reduces the shielding effect by up to 90 %.
- Lay the cable shield over a large surface directly after the entry point of the control cabinet.

5.3 Connection of the protective earth

- The drive converter or the control cabinet in which the drive converter is installed must be connected to protective earth at the installation site.
- Use a protective earth conductor that corresponds at least half the cross-section of the cables used to supply the power terminals.
- An earthing stud is provided at the drive converter for connecting the motor protective earth.
- The resistance of the protective earth should be 0.1 Ω or less.
- According to *EN 61800-5-1* the minimum cross-section of the protective earth conductor must comply with the local safety regulations for protective earth conductors for equipment with high leakage current.

⚠ WARNING

Injuries due to indirect contact!

► The device only meets the requirements for protection against indirect contact if the protective earth conductor is correctly connected.

5.4 Control Unit

Control Unit Overview	No.	Name	Description
	1	---	Shield terminals for shielded control cables (accessories)
	2	---	System type plate
	3	---	LEDs (see the manual for control unit chapter "Overview“) • For control card APPLICATION and PRO: Status indication of the safety module
	4	X7A-1...3	Connections for system connection
		X7B-1...3	

Figure 23: Control Unit Top view

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

Control Unit Overview	No.	Name	Description
	5	---	Example representation. For a description, see the operating instructions for the corresponding COMBIVERT F6 control card.
	6	---	
	7	---	
	8	---	
	9	---	
	10	X8A	External power supply

Figure 24: Control Unit Rear view

Control Unit Overview	No.	Name	Description
	11	---	Example representation. For a description, see the operating instructions for the corresponding COMBIVERT F6 control card.
	12	---	
	13	---	
	14	---	Shield terminals for shielded control cables
	15	---	Name plate Control Unit
	16	⏚	Protective earth

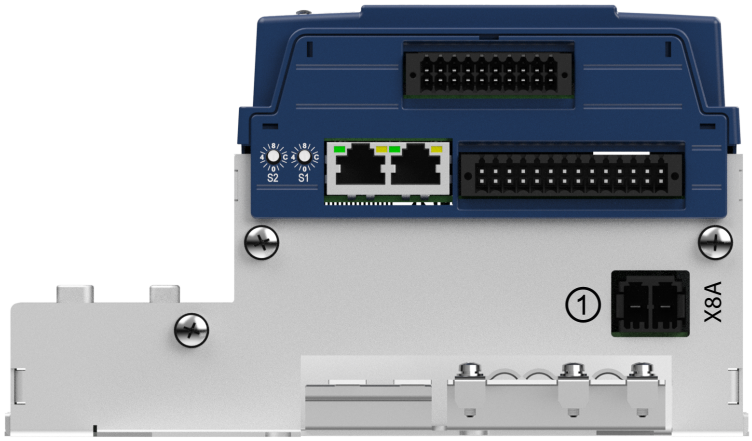
Name	Function	Terminal connection	Tightening torque	Max. number of conductors
⏚	Protective earth	M4 screw	1.3 Nm / 11 lb inch	1

Figure 25: Control Unit Front view

Instructions for use COMBIVERT F6 control board APPLICATION
www.keb.de/fileadmin/media/Manuals/dr/ma_dr_f6-cu-a-inst-20118593_en.pdf

Instructions for use COMBIVERT F6 control board PRO
www.keb.de/fileadmin/media/Manuals/dr/ma_dr_f6-cu-p-inst-20182705_de.pdf

5.4.1 External control supply



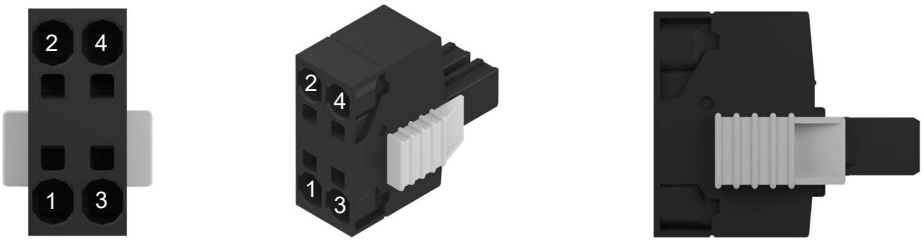
Legend			
1		X8A	Connection +/- for external 24V voltage supply
Max. number of conductors			2
Supply voltage		$U_{\_dc}$ / V	24 -15/+20%
Rated input current		I_{F_dc} / A	8
Peak current		$I_{\_Peak}$ / A	10
Connection cross section	for IEC	*A* / mm²	0.2...4 (Flexible cable with wire-end ferrule) 1.5 max. (with 2 conductors)
	for UL	*A* / AWG	24...10 (UL: Flexible cable without wire-end ferrule) 14 max. (with 2 conductors)

Figure 26: External control supply

The control card and the heat sink fans should be supplied via separate external voltage sources.

In the event of a fault in the heat sink fans, this provides a trouble-free supply of the control system.

5.4.1.1 Terminal for X8A



Legend		
1	P24Vin	DC 24 V DC voltage input for supplying the Control Unit and the control card
2	P24VOut	DC 24 V DC voltage output for supplying the control card
3	0VIn	Reference potential for P24VIn
4	0VOut	Reference potential for P24VOut

Figure 27: Terminal for X8A

5.5 Drive Unit

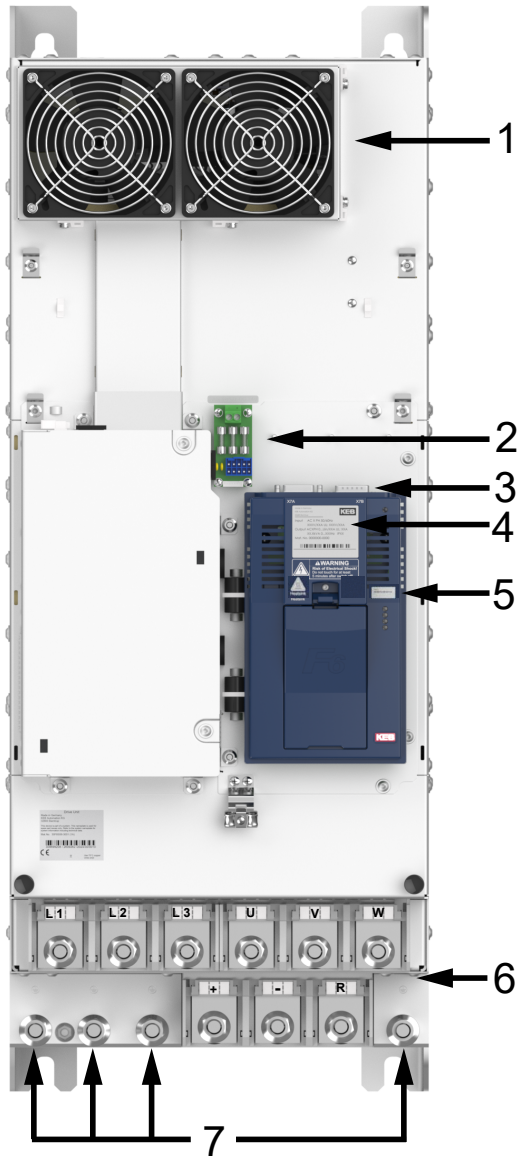
Drive Unit Overview	No.	Name	Description
	1	---	Interior fan
	2	FAN	External heat sink fan supply[1)]
	3	X7A/X7B	Connection to the Control Unit
	4	---	System type plate
	5	---	MAC address (Control Unit only)
	6	X1A	Power circuit terminals for: • Mains input • Braking resistor • DC voltage interface • Motor connection
	7	PE	Protective earth; at connection to protective earth each terminal may be assigned only once

Figure 28: Drive Unit Top view

[1)] *External heat sink fan supply=> „5.5.2 External heat sink fan supply“*

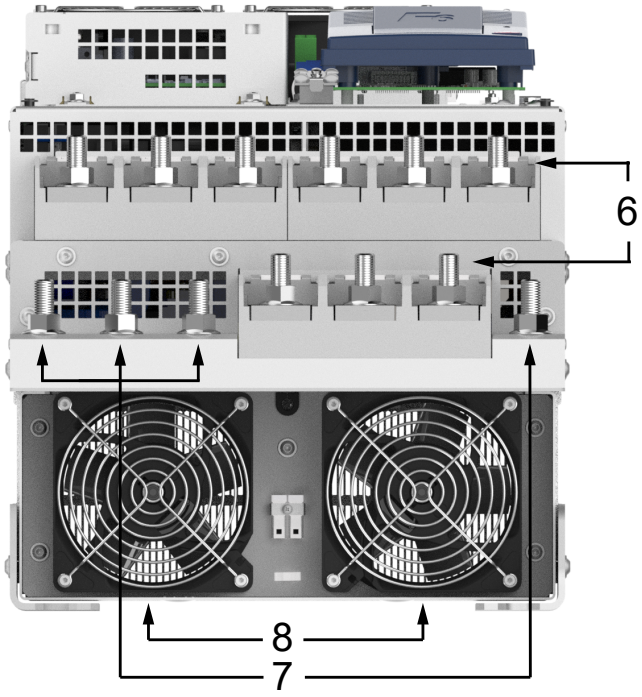
Drive Unit Overview	No.	Name	Description
	6	X1A	Power circuit terminals for: • Mains input • Braking resistor • DC voltage interface • Motor connection
	7	PE	Protective earth; at connection to protective earth each terminal may be assigned only once
	8	---	Heat sink fan

Figure 29: Drive Unit Front view

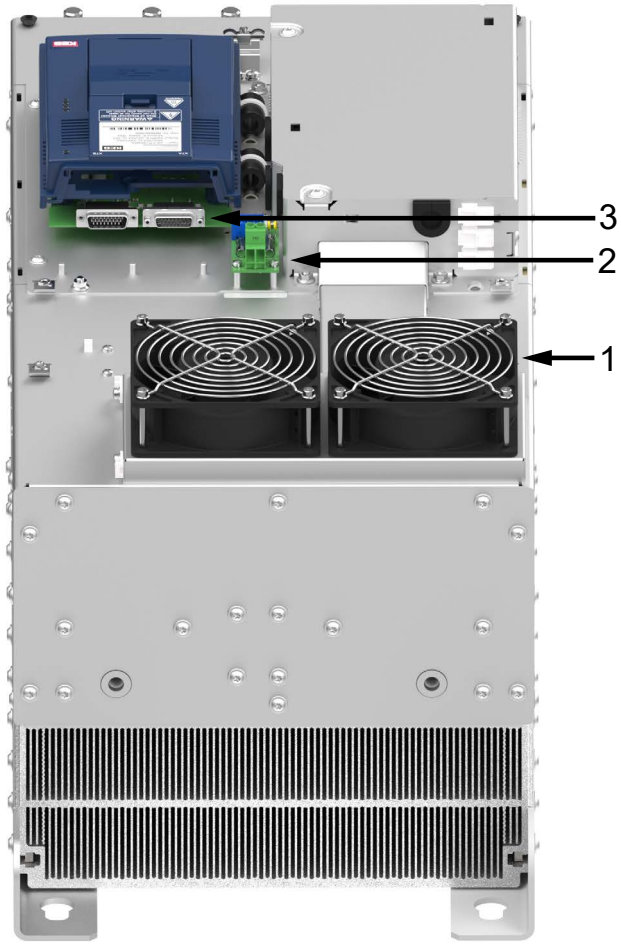
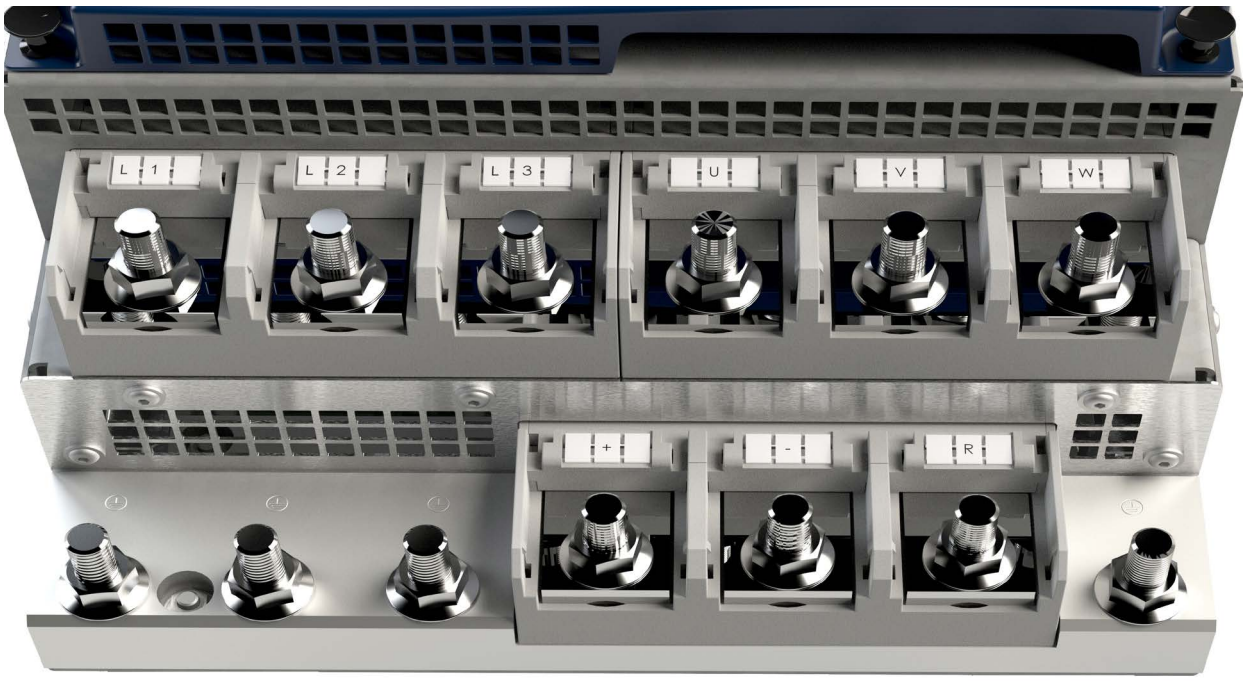
Drive Unit Overview	No.	Name	Description
	1	---	Interior fan
	2	FAN	External heat sink fan supply[1)]
	3	X7A/X7B	Connection to the Control Unit

Figure 30: Drive Unit Rear view

[1)] *External heat sink fan supply => „5.5.2 External heat sink fan supply“*

5.5.1 Terminal block X1A



Name	Function	Terminal connection	Tightening torque	Max. number of conductors
L1	Mains connection 3-phase	12 mm stud for M12 crimp connector	35 Nm 310 lb inch	2
L2				
L3				
U	Motor connection			
V				
W				
+	DC terminals			
-				
R	Connection for braking resistor (between + and R)			
⏚	Protective earth [1)]			1

Figure 31: Terminal block X1A

[1)] *When connecting the protective earth, each connection point may only be used once.*

5.5.2 External heat sink fan supply

The information on the external heat sink fan supply applies to each Drive Unit.

The external heat sink fan supply is only available for air-cooled appliances.

The control card and the heat sink fans should be supplied via separate external voltage sources.

In the event of a fault in the heat sink fans, this provides a trouble-free supply of the control system.

Avoid overtemperature errors by adjusting the fan voltage

The voltage drop across the supply cable must be taken into account when supplying the fans with power.

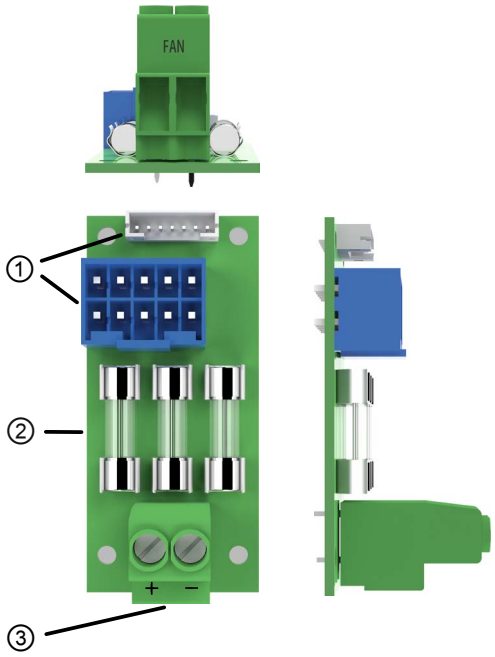
The voltage at the FAN terminal must be 24V at full fan speed. KEB recommends a voltage source with adjustable output voltage

NOTICE

Use of unsuitable voltage sources!

Electric shock!

- ► Only voltage sources (PELV) according to VDE 0100 permitted.
- ► Ensure that the overvoltage category of the voltage supply is sufficient.
- ► Observe the tripping characteristics of the fuses when selecting the voltage source for the heat sink fan supply.



Legend			
1			Internal use only
2			Fuse: F200, F201, F202 SIBA GmbH No. 179120.4
3			FAN: Connection +/- for external 24V voltage supply
Fuse(s)		*I* / A	4 (Type gG)
Max. number of conductors			2
Supply voltage		U_{FAN_dc} / V	24 -5/+15%
Rated input current		I_{FAN_dc} / A	8
Peak current		I_{FAN_Peak} / A	12
Tightening torque		F_N / Nm	0,5...0,6
		F_N / lb inch	4,5...5,3
Connection cross section	for IEC	*A* / mm²	0.2...4 (Flexible cable with wire-end ferrule) 1.5 max. (with 2 conductors)
	for UL	*A* / AWG	24...10 (UL: Flexible cable without wire-end ferrule) 14 max. (with 2 conductors)

Figure 32: External heat sink fan supply

5.6 Connecting the system connection cables

System connection cable => *„7.3 System connection cable“.*

NOTICE

Incorrect connection of the Drive Units to the Control Unit!

Drive Units are not recognised.

- ► It is essential to observe the connection sequence of the Drive Units.
- ► The system is always connected according to the numbering.
- ► In a system with only two Drive Units, connections X7A-3 and X7B-3 remain unused.

The following is a schematic representation.
Connections between the Control Unit and the Drive Units must only be made using connection cables of equal length.

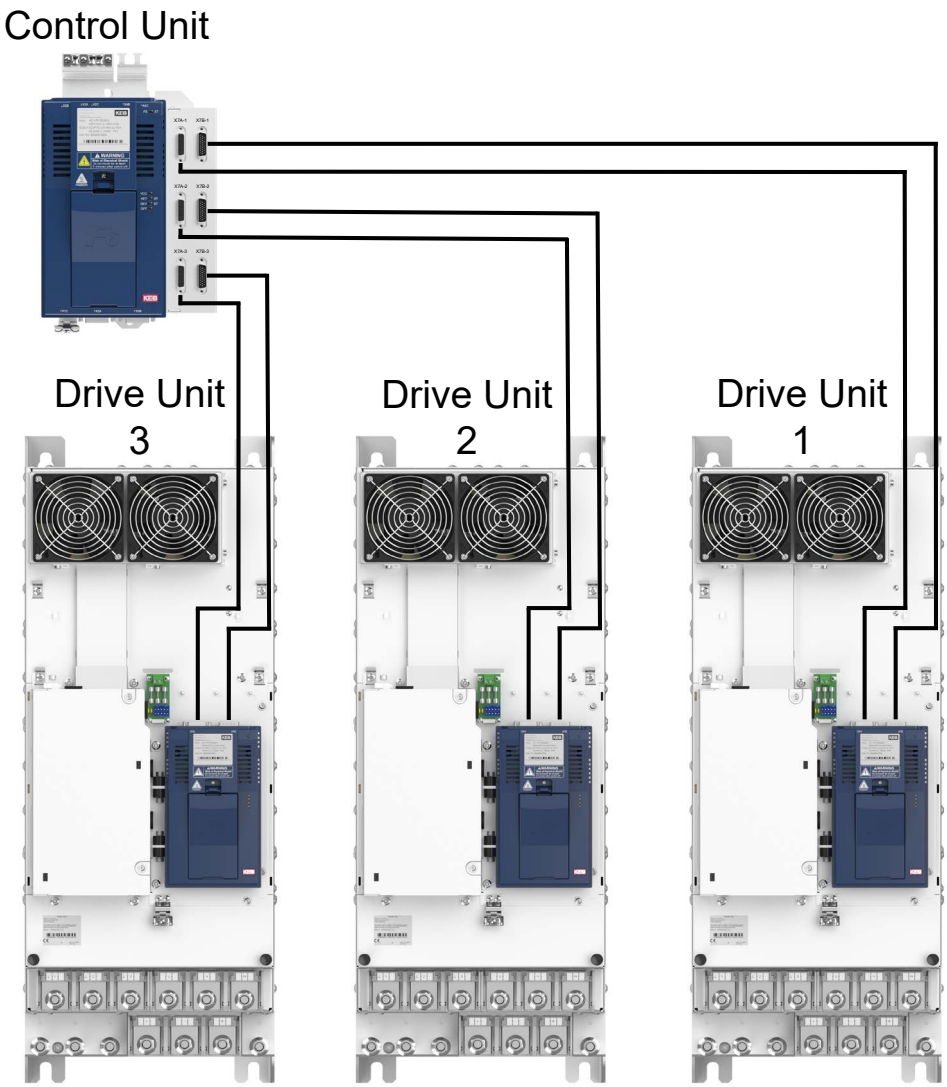


Figure 33: Connecting the system connection cables

5.6.1 Control Unit Strain relief

NOTICE

Loose cables due to lack of strain relief on the Control Unit.

System malfunctions.

- ► A strain relief must be provided in the control cabinet for the system cables on the Control Unit.
- ► The strain relief must be provided within the first 30 cm after the Control Unit housing.

Figure 34: Control Unit Strain relief

5.6.2 Drive Unit Strain relief

Exemplary illustration to demonstrate the fixing points.

► Secure the connecting cables to the brackets shown using cable ties.

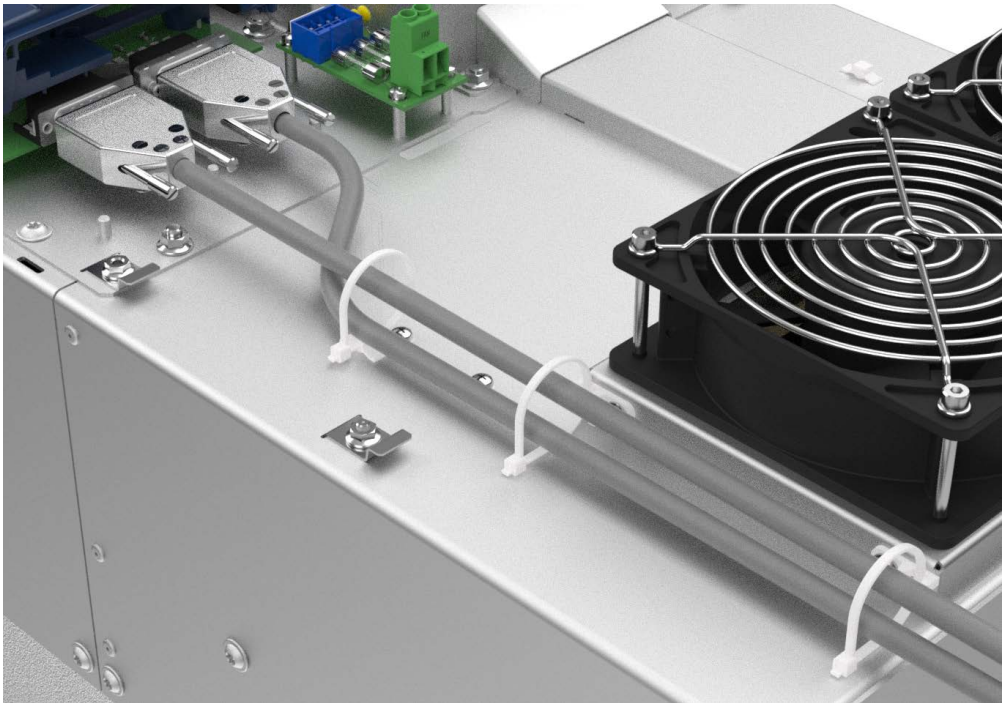


Figure 35: Drive Unit Strain relief

5.7 Fuses

System identifier	Number of Drive Units	Number of fuses per Drive Unit	Max. size of the fuse / A			
			U_N = 400V gG (IEC)	U_N = 480V class „J“	U_N = 480V	
			SCCR 100 kA	SCCR 18 kA	SCCR 100 kA	Type [1]
33	2	3	630	600	550	COOPER BUSSMANN 170M3022 COOPER BUSSMANN 170M3122 COOPER BUSSMANN 170M3172 COOPER BUSSMANN 170M3272 SIBA 206xy32.550
					600	LITTELFUSE L70QS600.X
34, 35	2	3	630	600	630	COOPER BUSSMANN 170M3023 COOPER BUSSMANN 170M3123 COOPER BUSSMANN 170M3173 COOPER BUSSMANN 170M3273 SIBA 206xy32.630
					600	LITTELFUSE L70QS600.X
36	3	3	630	600	550	COOPER BUSSMANN 170M3022 COOPER BUSSMANN 170M3122 COOPER BUSSMANN 170M3172 COOPER BUSSMANN 170M3272 SIBA 206xy32.550
					600	LITTELFUSE L70QS600.X
37, 38, 39	3	3	630	600	630	COOPER BUSSMANN 170M3023 COOPER BUSSMANN 170M3123 COOPER BUSSMANN 170M3173 COOPER BUSSMANN 170M3273 SIBA 206xy32.630
					600	LITTELFUSE L70QS600.X

Table 21: Fuses

[1] *"x" stands for different indicators. "y" stands for different connection variants.*

Short-circuit capacity

According to requirements from *EN 61439-1* and *EN 61800-5-1* , the following applies to connection to a mains supply: The devices are suitable for the use in a circuit capable of delivering not more than 100 kA eff. unaffected symmetrical short-circuit current.

5.8 Protective and functional earthing

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

5.8.1 Protective earth

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

⚠ CAUTION

Electric shock due to incorrect dimensioning!

► The earthing cross-section is in accordance with *VDE 0100* !

Device	Name	Function	Terminal connection	Tightening torque	Max. number of conductors
Control Unit	⏚	Connection for protective earth	M4 screw	1.3 Nm / 11 lb inch	1
Drive Unit			12 mm threaded pin for M12 crimp connectors	35 Nm / 310 lb inch	

Figure 36: Connection for protective earth

Incorrect assembly of the PE connection

Pre-mounted M12 screws and M12 nuts with flange must be used to attach the PE tubular cable lugs.

5.8.2 Functional earthing

A functional earthing may also be necessary, if for EMC requirements additional potential equalization between devices or parts of the system must be done.

The use of the functional earth (FE) is not required if the drive converter is EMC-technically wired.

The functional earth may not be wired green / yellow!

Instructions for use EMC and safety instructions.
www.keb.de/fileadmin/media/Manuals/dr/emv/0000ndb0000.pdf

5.9 Mains connection

The F6 SPOD is connected to the grid via a 400 V AC supply network.

NOTICE

Destruction of the drive converter!

► Never exchange mains input and motor output!

NOTICE

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

Cyclical switching off and on of the drive current converter leads to temporary high impedance of the PTC precharge resistor. After the PTC has cooled down, recommissioning is possible without restriction. The waiting time between two switch-on operations depends on the external capacity, the AC mains voltage and the ambient temperature.

► Without external capacity: 5 min.

► With external capacity (additional drive converters): Up to 20 minutes.

5.9.1 Note about hard mains

In drive converters with a DC link, the service life depends on the

- DC voltage level.
- the ambient temperature.
- the current load on the electrolytic capacitors in the intermediate circuit.

The use of mains chokes can significantly increase the service life of the capacitors, especially under permanent drive load (continuous duty) or when connecting to „hard“ power systems.

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

$$k = \frac{S_{net}}{S_{out}} >> 200$$

5.9.2 Supply cable

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

- Input current of the drive converter
- Used cable type
- Installation method and ambient temperatures
- The locally valid electrical regulations

The application engineer is responsible for the design!

5.10 Motor connection

- The motor cables must be designed to the maximum continuous current.
- They are valid for 0...100 Hz (up to 300 Hz the cable losses increase by approx. 25 % due to the skin effect).
- The IGBT modules cause high-frequency interferences, the longer the motor cable length the higher the discharge to the earth potential.
- The consequence is an increase of conducted interferences on the mains side.
- If the motor cables are too long, damping of the mains filters is no longer sufficient and the permissible interference limits are exceeded.
- At the output of the drive converter, pulses of approximately 1.35-fold of the mains voltage and very short rise times are generated independently of the output frequency.
- This is the case for all drive converters with modern IGBT inverter technology.
- The voltage of the pulses can almost double at the motor connections depending on the characteristics of the motor cable.
- This can lead to additional load of the motor and the motor cable insulation.
- Modern speed-controlled drives with their fast rising voltage pulses and high switching frequencies can cause current pulses through the motor bearings which can gradually damage the bearing raceways.

NOTICE

Protect the motor against voltage peaks!

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

► Drive converter switch at the output with a high rate of voltage rise. Voltage peaks at the motor which endanger the insulation system can occur especially in case of long motor lines (> 15 m). A motor choke, a dv/dt filter or sine-wave filter can be used to protect the motor.

5.10.1 Selection of the motor cable

Correct selection and laying of the motor cable is very important for high motor ratings:

- Smaller load of the motor bearings by bearing currents.
- Improved EMC characteristics.
- Lower symmetrical operating capacities.
- Less losses by transient currents.
- Due to the high currents, shielded motor cables can be connected in parallel between drive converter and motor.
- All three phases must passing through each shielded motor cable.
- To keep asymmetry as small as possible, all motor cables should have the same length.
- The shielding must be placed always with large surface on both sides (mounting plate and motor housing).

5.10.2 Recommended cable type

Symmetrical shielded cables are recommended for high motor power.

- The protective earth conductor is tripartited and uniformly placed between the phase lines.
- Compliance with the requirements of *DIN EN 12502-1...5*.

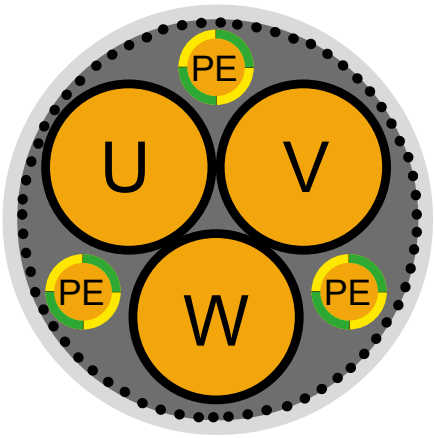


Figure 37: Symmetrical motor cable

5.10.3 Motor cable lengths

The maximum motor cable length is depending on the capacity of the motor cable as well as on the EMC emitted interference. External measures must be taken here (e.g. the use of a line filter).

- The permissible cable length is reduced if the minimum cross-section of the motor connection is distributed across several cables.
- In case of parallel connection of motor cables, the cable capacitance is doubling, which leads to higher leakage currents between drive converter and motor. These should always be kept as small as possible.

- The permissible cable lengths depend on the number of cables per phase.
- Longer cables may only be provided after consultation with KEB.
- The specified cable lengths represent the actual distance between drive converter and motor.

The resulting motor cable length for parallel operation of motors, or parallel installation of multiple cables arises from the following formula:

$$\text{Resulting motor cable length} = \left(\sum_{l=1}^{n} \text{Motor cable lengths}\right) * \sqrt{n\ [\text{number of motor cables}]}$$

This formula applies to the design of a Drive Unit (Drive Unit -> motor) within the SPOD system, => *„5.10 Motor connection“.*

5.10.4 Example of motor voltage calculation

The motor voltage for dimensioning of the drive is depending on the used components. The motor voltage reduces according to the following table:

Component	Reduction / %	Example
Mains choke U_k	4	*Open-loop drive converter with mains and motor choke at non-rigid supply system:* *400 V mains voltage (100%) - 44 V reduced voltage (11%) = 356 V motor voltage*
Drive converter open-loop	4	
Drive converter closed-loop	8	
Motor choke U_k	1	
Non-rigid supply system	2	

Table 22: Example of motor voltage calculation

5.10.5 Interconnection of the motor

NOTICE

Incorrect behaviour of the motor!

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

NOTICE

Protect the motor against voltage peaks!

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

5.11 Connection of the braking resistors

5.11.1 Use of braking resistors

⚠ CAUTION

Fire hazard when using braking resistors!

► The risk of fire can be significantly reduced by using "intrinsically safe braking resistors" or by using suitable monitoring functions / circuits.

NOTICE

Falling below the minimum braking resistance value!

Destruction of the drive converter!

► The minimum brake resistance value must not fall below! *„3.2 Device data System“*

⚠ CAUTION

Hot surfaces caused by load of the braking resistor!

Burning of the skin!

► Cover hot surfaces in a touch-safe manner.

► Before touching, check the surface.

► If necessary, attach warning signs to the system.

5.11.2 Use of non-intrinsically safe braking resistors

⚠ WARNING

Use of non-intrinsically safe braking resistors

Fire or smoke in case of overload or fault!

► Only use braking resistors with temperature sensor.

► Evaluate temperature sensor.

► Trigger a fault on the drive converter (e.g. external input).

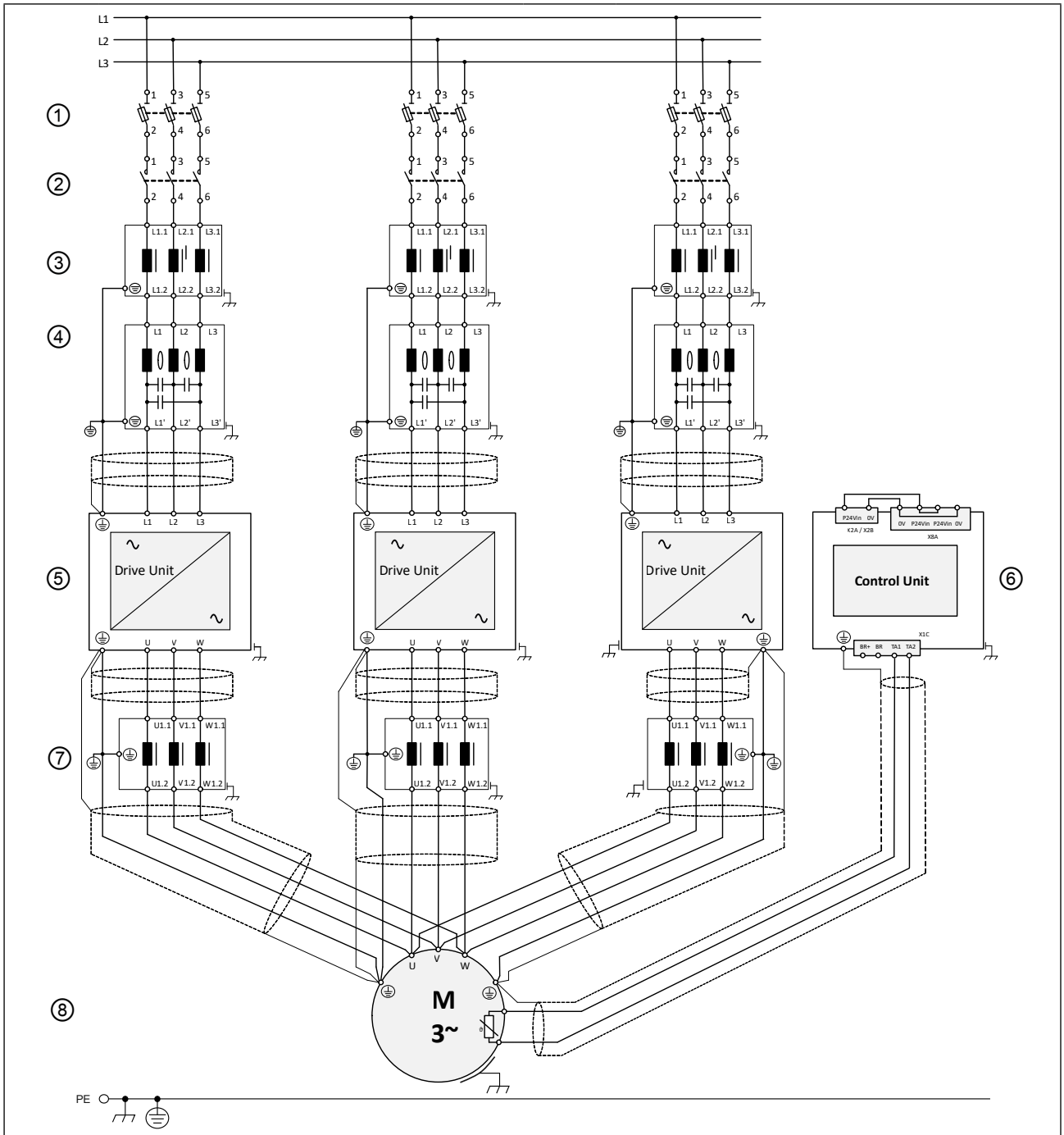
► Switching off input voltage (e.g. input contactor).

► Connection examples for non-intrinsically safe braking resistors => *Instructions for use "Installation braking resistors“.*

Instructions for use "Installation braking resistors“
www.keb.de/fileadmin/media/Manuals/dr/ma_dr_braking-resistors-20116737_de.pdf

5.12 Wiring diagrams

5.12.1 Mains and motor connection



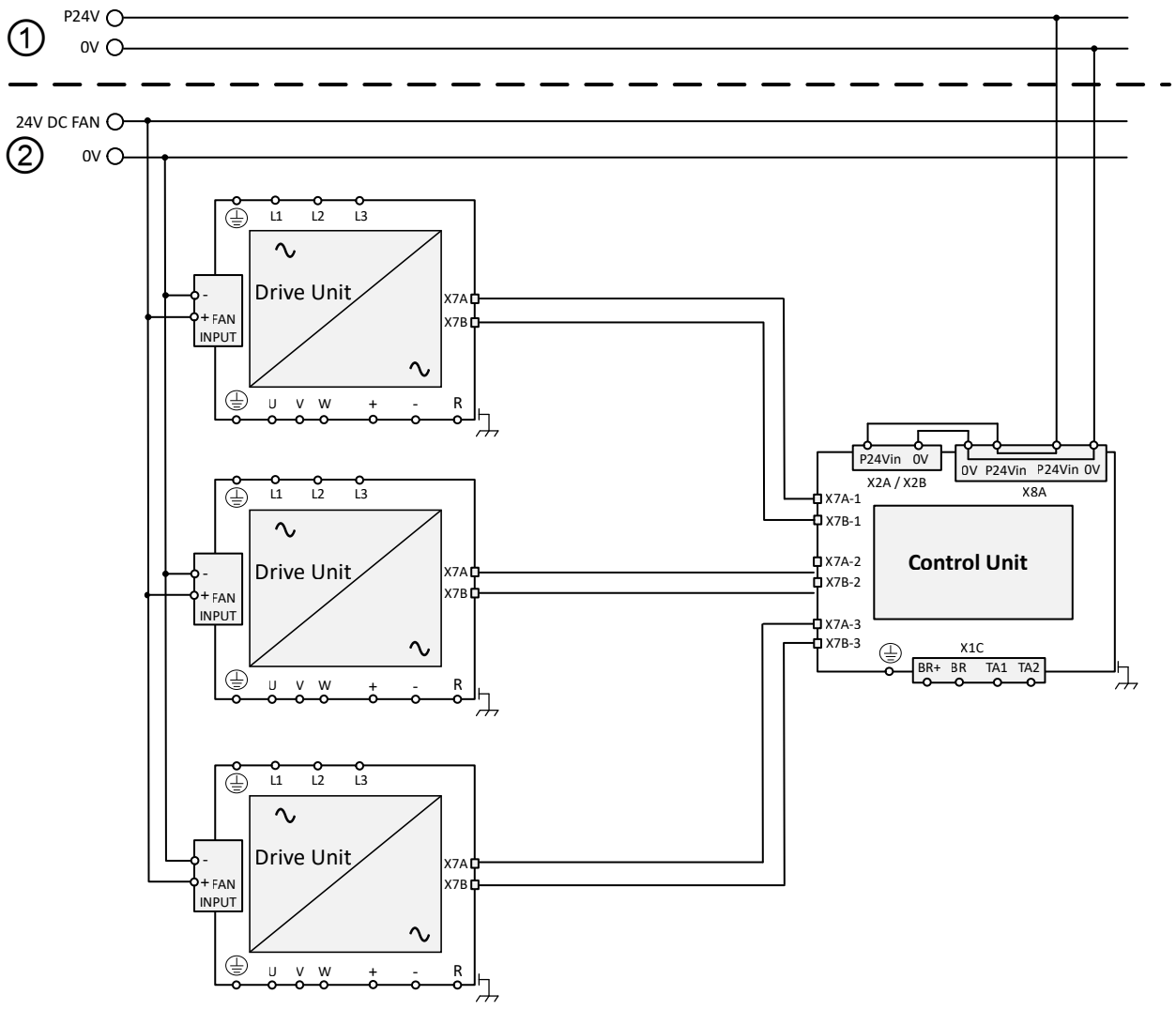
Legend			
1	Mains fuses	5	Drive Unit
2	Mains contactor	6	Control Unit
3	Mains choke	7	Motor choke
4	HF filter	8	Motor

Figure 38: Mains and motor connection

5.12.2 Connection diagram for 24 V DC power supply

The control card and the heat sink fans should be supplied via separate external voltage sources.

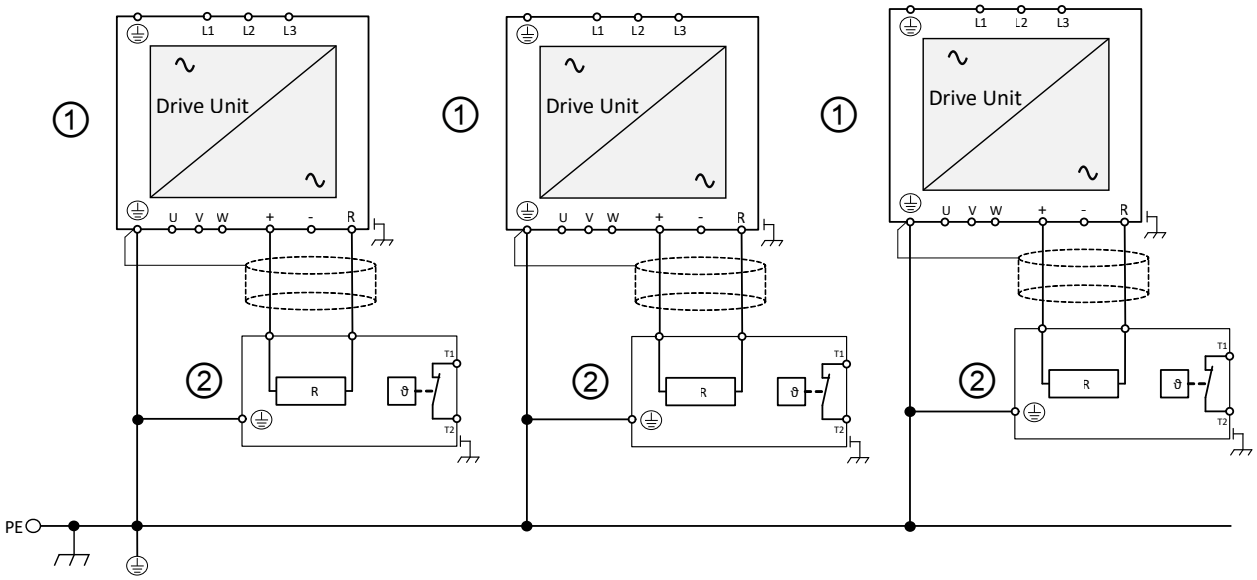
In the event of a fault in the heat sink fans, this provides a trouble-free supply of the control system.



Legend	
1	External control supply
2	External heat sink fan supply

Figure 39: Connection diagram for 24 V DC power supply

5.12.3 Wiring diagram for braking resistors



Legend	
1	Drive Unit
2	Braking resistor

Figure 40: Wiring diagram for braking resistors

6 Operation of Liquid-Cooled Devices

6.1 Water-cooled devices

The use of water-cooled KEB COMBIVERT drive controller is offered, because there are process-caused coolants available with some applications. However, the following instructions must be observed.

6.1.1 Heat sink and operating pressure

Design system	Material	max. operating pressure	Connection
Aluminium heat sink with stainless steel tubes	Stainless steel 1.4404	10 bar	*=> „6.1.4 Connection of the cooling system“*

NOTICE

Deformation of the heat sink!

- ► In order to avoid a deformation of the heat sink and the damages thereby, the indicated maximum operating pressure may not be exceeded briefly also by pressure peaks.
- ► Observe the Pressure Equipment Directive 2014/68/EU!

6.1.2 Materials in the cooling circuit

For the screw connections and also for the metallic articles in the cooling circuit which are in contact with the coolant (electrolyte) a material is to be selected, which forms a small voltage difference to the heat sink in order to avoid contact corrosion and/or pitting corrosion (electro-chemical voltage series, see the following table). 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	formed ion	Standard potential	Material	formed ion	Standard potential
Lithium	Li+	-3.04 V	Nickel	Ni2+	-0.25 V
Potassium	K+	-2.93 V	Tin	Sn2+	-0.14 V
Calcium	Ca2+	-2.87 V	Lead	Pb3+	-0.13 V
Sodium	Na+	-2.71 V	Iron	Fe3+	-0.037 V
Magnesium	Mg2+	-2.38 V	Hydrogen	2H+	0.00 V
Titan	Ti2+	-1.75 V	**Stainless steel (1.4404)**	**various**	**0.2...0.4 V**
Aluminium	Al3+	-1.67 V	Copper	Cu2+	0.34 V
Manganese	Mn2+	-1.05 V	Carbon	C2+	0.74 V
Zinc	Zn2+	-0.76 V	Silver	Ag+	0.80 V
Chrome	Cr3+	-0.71 V	Platinum	Pt2+	1.20 V

continued on the next page

Material	formed ion	Standard potential	Material	formed ion	Standard potential
Iron	Fe2+	-0.44 V	Gold	Au3+	1.42 V
Cadmium	Cd2+	-0.40 V	Gold	Au+	1.69 V
Cobald	Co2+	-0.28 V			

Table 23: Electrochemical series / standard potentials against hydrogen

6.1.3 Requirements for the coolant

The requirements for the coolant depend on the ambient conditions as well as the used cooling system.

General requirements for the coolant:

Requirement	Description
Standards	Corrosion protection according to *EN 12502-1...5*, water treatment and use of materials in cooling systems according to *VGB S 455 P*.
VGB Cooling water directive	The VGB cooling water directive (*VGB S 455 P*) contains instructions about common process technology of the cooling. Particulary the interactions between cooling water and components of the cooling system are described.
Abrasive substances	Abrasive substances as used in abrasive (quartz sand), clogging the cooling circuit.
Hard water	Cooling water may not cause scale deposits or loose excretions. The total hardness should be between 7...20 °dH, the carbon hardness at 3...10 °dH.
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. KEB recommends the antifreeze Antifrogen N from Clariant with a maximum volume content of 52 %.
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. Alternatively, an antifreeze / glycol with a concentration of 20% ... max. vol 52% can be used. If antifreeze is used, the water does not need to be provided with additional additives.

Table 24: Requirements for the coolant

Special requirements for open and half-open cooling systems:

Requirement	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 25: Special requirements for open and half-open cooling systems

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

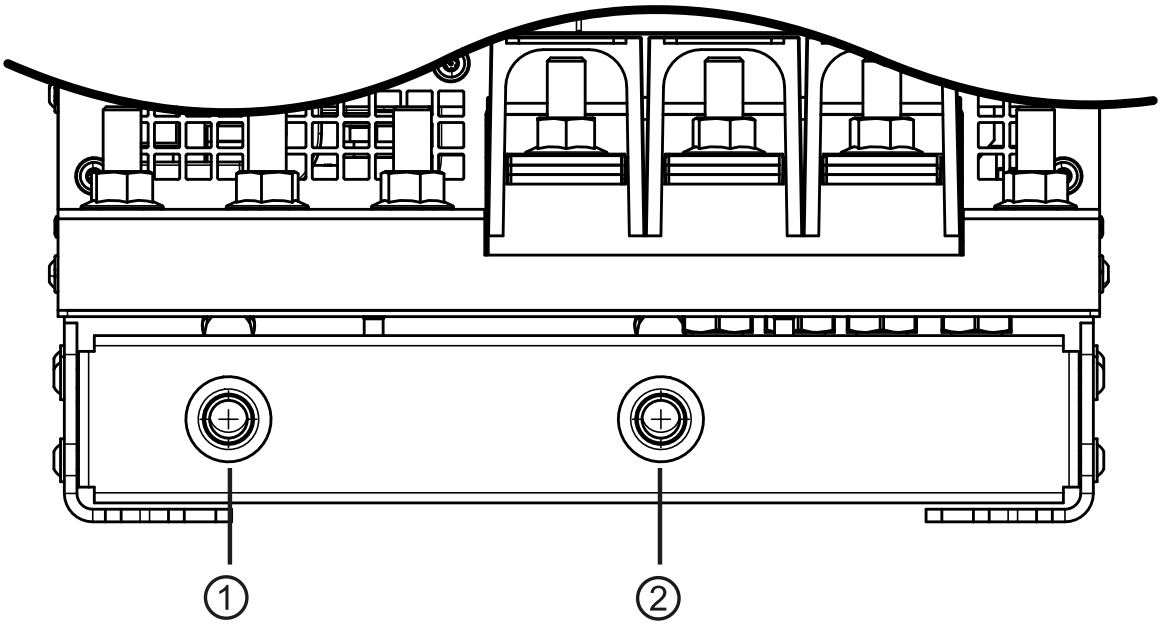
6.1.4 Connection of the cooling system

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.

=> „6.4.1 Typical pressure loss Aluminium heat sink with stainless steel pipes“

Other elements in the cooling circuit such as pumps, shut-off valves, ventilation etc. must be attached according to the cooling system and the local conditions.



No.	Connection	Type
1	Flow	Open pipe ends for the connection of the cooling system Pipe diameter outside: 15 mm
2	Return flow	

Figure 41: Open pipe ends for the connection of the cooling system

For the connection of the cooling system KEB recommends the use of functional nuts, e.g. from the manufacturer "Parker", type FMxxL71 (xx = pipe diameter).

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

6.1.5 Coolant temperature

The flow temperature should be chosen depending on the volume flow, so that at rated operating the heatsink temperature is always 10 K below the overheat temperature level. As a result, a sporadic shutdown is avoided.

The maximum heat sink temperature can be found in chapter => *„3.2 Device data System“* .

6.1.5.1 Supply of tempered coolant

- The supply of optimally tempered coolant is possible by using heaters in the cooling circuit to control the coolant temperature.
- The following dew point table shows the coolant inlet temperature as a function of ambient temperature and air humidity.

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

Table 26: Dew point table

Information on coolant management is given in the following document

www.keb.de/fileadmin/media/Techinfo/dr/an/ti_dr_an-liquid-cooling-00004_en.pdf

6.1.6 Moisture condensation

A temperature difference between drive converter and ambient temperature can lead to condensation at high humidity.

Moisture condensation is considered to be a threat to the drive controller. The drive converter can be destroyed through occuring short-circuits.

NOTICE

Destruction of the drive converter due to short circuit!

► Avoid any condensation.

NOTICE

Destruction of the drive converter due to condensation!

► Use only NC valves!

6.1.7 Storage

NOTICE

Destruction of the heat sink at storage / transport of water-cooled devices!

Observe the following points when storing water-cooled devices:

► Completely empty the cooling circuit

► Blow out the cooling circuit with compressed air

6.1.8 Permissible volume flow for liquid cooling

When using a parallel connection, the total volume flow must be selected according to the number of Drive Units.

The permissible volume flow is specified in the following table.

Permissible volume flow per Drive Unit		
Min. volume flow	Q_{min} / l/min	10
Max. volume flow	Q_{max} / l/min	33

Table 27: Permissible volume flow with water cooling

The volume flow depends on the total power dissipation.
=> „6.4 Diagrams of the cooling design“

NOTICE

Destruction of the heat sink due to erosion!

► The maximum permissible volume flow must not be exceeded.

NOTICE

Damages at the device!

► A discontinuous mode is not recommended, this will lead to a reduction of the service life.

► The max. pressure in the cooling system may not exceed 10 bar.

► The cooling flow must always be started before starting the COMBIVERT.

6.2 Parallel connection of the coolant circuit

- Parallel connection of the coolant circuit is recommended during rated operation.
- Mandatory for special applications with higher switching frequencies.
- The total volume flow to be selected depends on the size of the device, the output current at rated operation and the resulting power dissipation for the drive converter system.
- The correlation between total power dissipation, volume flow and temperature difference are shown in the diagram *„6.4.2 Volume flow and temperature difference for parallel connection“* and must be within the recommended operational range.
- The use of volume flow meters as well as temperature monitoring is recommended.

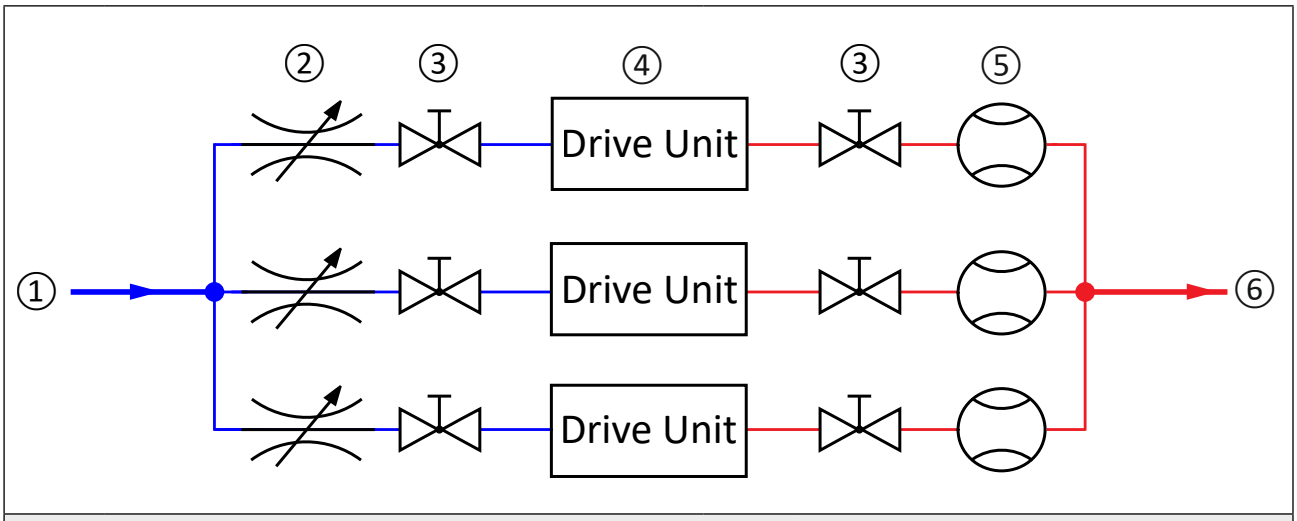
NOTICE

Damage due to non-observance!

- ► The maximum temperature difference (ΔT) between flow and return flow may not exceed 7K.
- ► If the volume flow (above 33l/min per Drive Unit) is selected too large, increases the risk of erosion in the liquid cooler.
- ► Always start the coolant flow before commissioning.

6.2.1 Connection scheme parallel connection of the cooling circuit

This connection scheme is only an installation proposal and does not replace professional planning and execution.



Legend			
1	Flow entire system	4	Drive Unit
2	Throttle valve 10...40l/min	5	Volume flow meter
3	Ball valve / stop valve	6	Return flow entire system

Figure 42: Connection scheme parallel connection of the cooling circuit

6.3 Series connection cooling circuit

KEB generally recommends using a parallel connection for the cooling circuits.

When using a series connection, please note the following:

- The cooling circuits of Drive Units 2 and 3 depend on the temperature delta of the respective upstream Drive Unit in the flow. This means that Drive Units 2 and 3 are generally closer to the OH threshold.
- In addition, device sizes 36–37 have a greater temperature reserve to the OH threshold than device sizes 38–39.
- Select the flow temperature depending on the volume flow so that, during rated operation, the heat sink temperature is always 10K below the overtemperature level (OH) of the last drive unit in the system. As a result, a sporadic shutdown is avoided.
- Does the drive converter system work at rated operation the execution of the coolant circuit can be carried out in a series circuit.
- It should be noted that the pressure drop in the entire system does not exceed 10 bar.
- The volume flow to be selected depends on the size of the device, the output current at rated operation and the resulting power loss for the drive converter system.
- The correlation between total power dissipation, volume flow and temperature difference are shown in the diagram *„6.4.3 Volume flow and temperature difference for series connection“*and must be within the recommended operational range.

NOTICE

Erosion in the liquid cooler!

► Do not exceed a maximum flow rate of 33 litres per minute.

NOTICE

Damage due to overpressure!

► Series connection of liquid-cooled devices with stainless steel piping is only permitted if the total system pressure cannot exceed 10 bar.

► => *„6.4.1 Typical pressure loss Aluminium heat sink with stainless steel pipes“*.

NOTICE

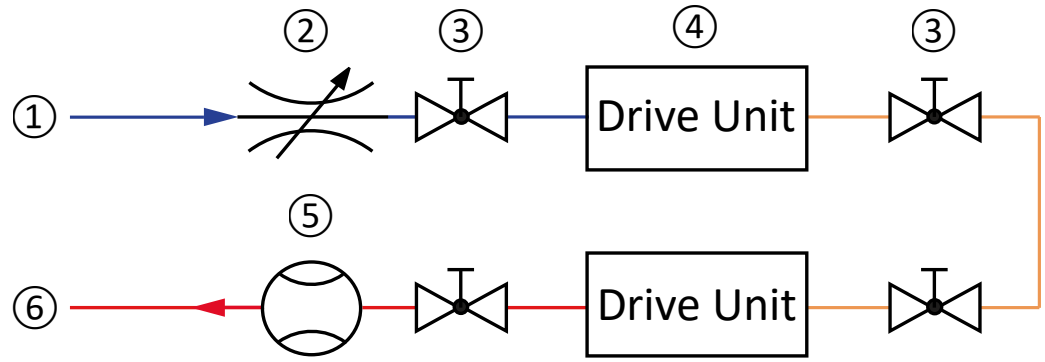
Damage due to missing cooling!

► Always start the coolant flow before commissioning the COMBIVERT.

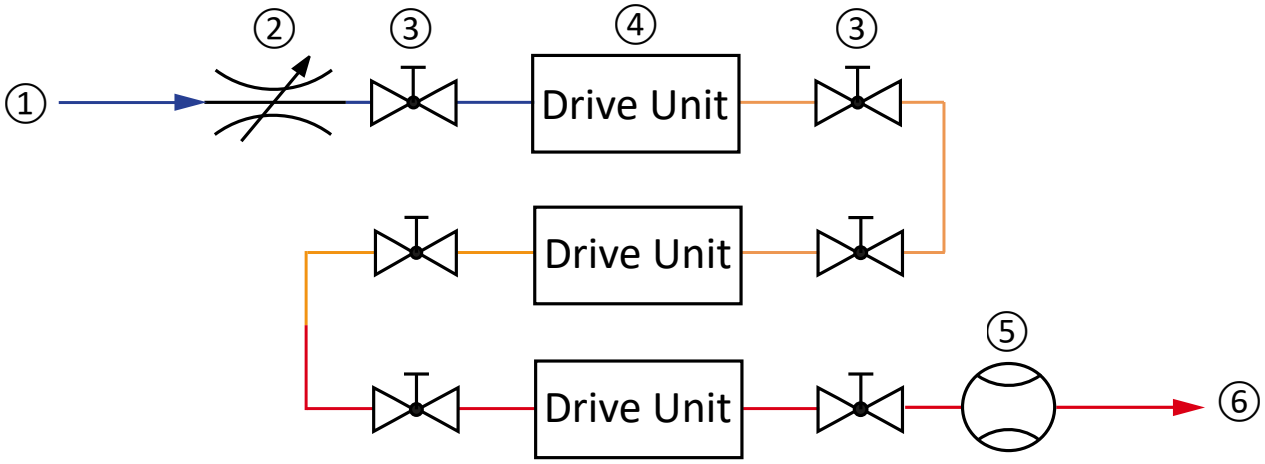
6.3.1 Connection diagram series connection cooling circuit

This connection scheme is only an installation proposal and does not replace professional planning and execution.

Coolant connection for a dual system



Coolant connection for a 3-way system



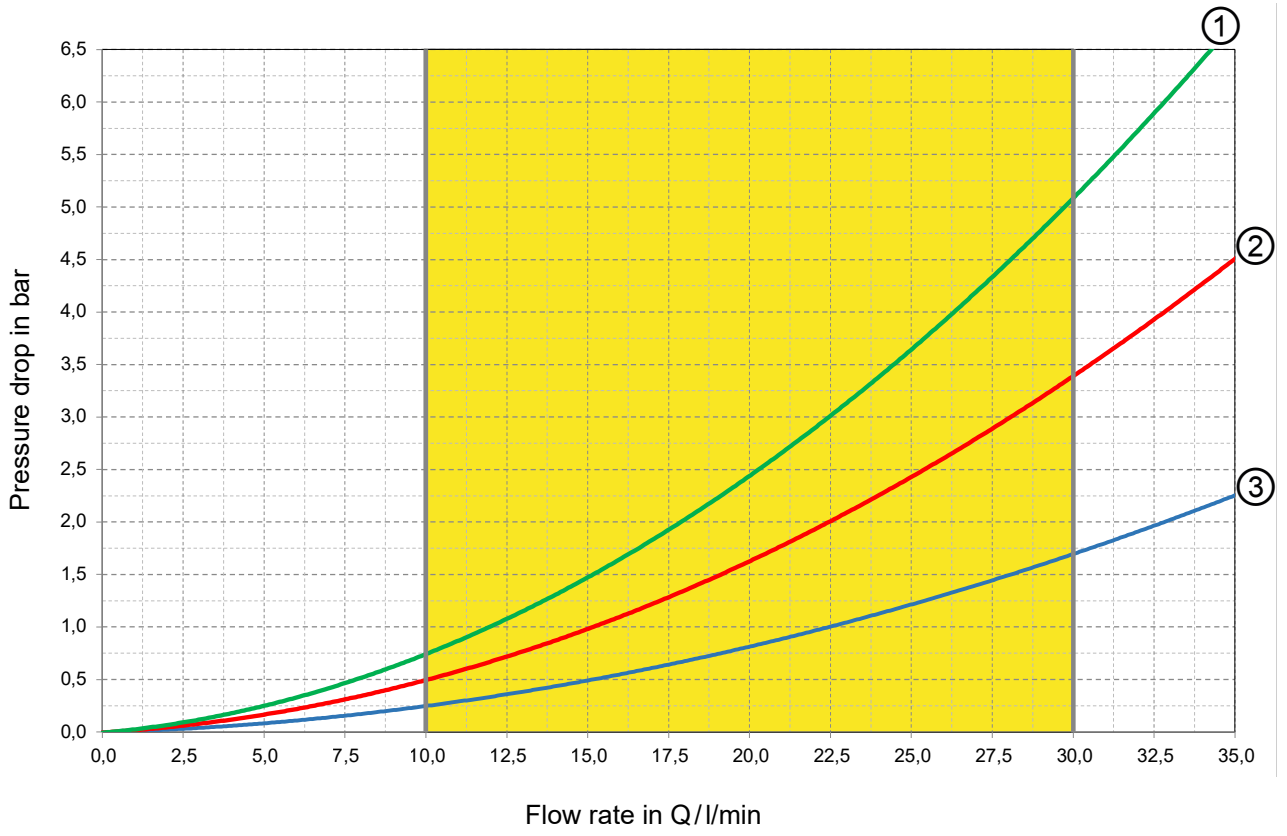
Legend			
1	Flow entire system	4	Drive controller
2	Throttle valve 10...40 l/min	5	Volume flow meter
3	Ball valve / stop valve	6	Return flow entire system

Figure 43: Connections to the coolant series connection

6.4 Diagrams of the cooling design

6.4.1 Typical pressure loss Aluminium heat sink with stainless steel pipes

- The curve characteristic described below is valid for 25 °C flow temperature and Antifrogen N 52 %.
- If higher flow temperatures are used, the pressure drop in the system decreases.
- This also applies to cooling medium such as water or another glycol mixture.
- A glycol mixture from Clariant in a ratio of 52 % or 33 % is recommended.



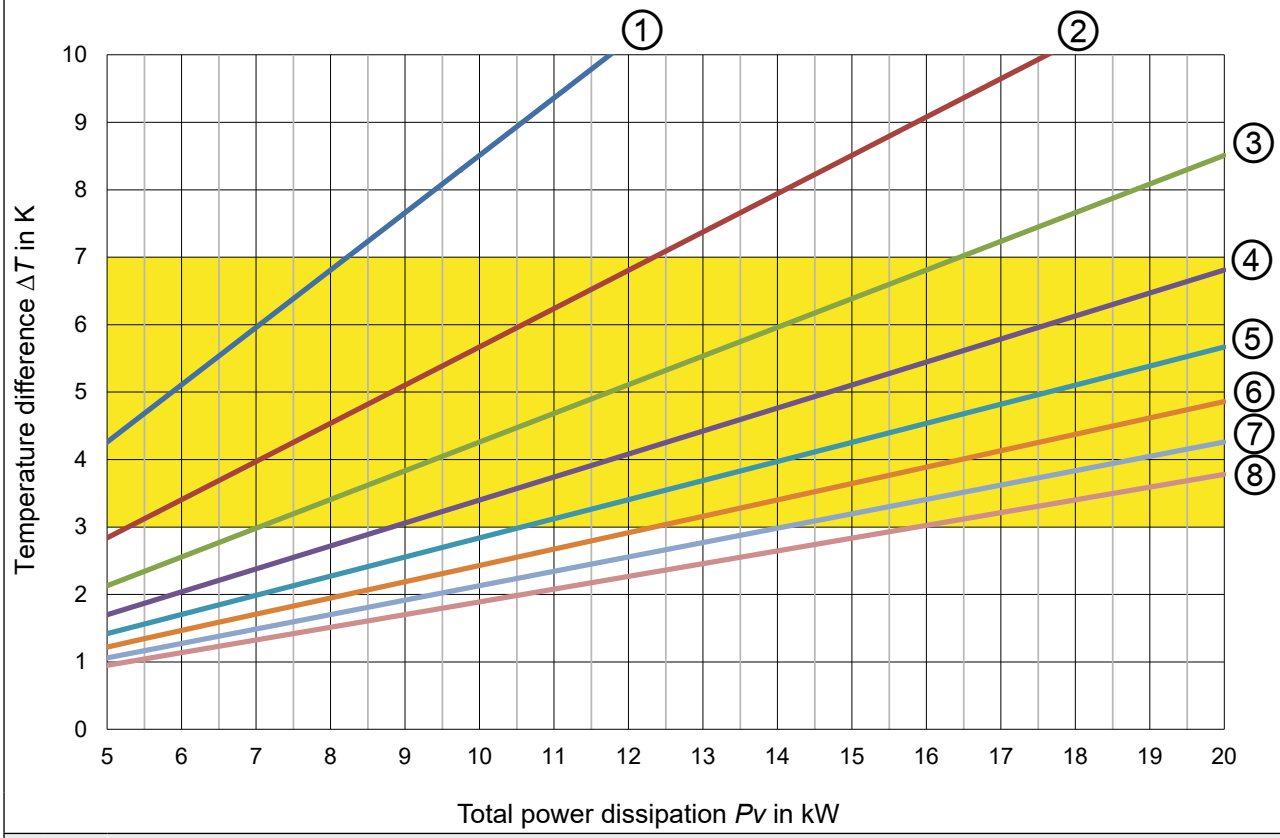
Legend	
Recommended working range	
	10...30 l/min
Cooling circuit design	
1	Series connection of 3-system
2	Series connection of 2-system
3	Parallel connection of the cooling circuits of all Drive Units

Figure 44: Pressure drop of the heat sink as a function of the volume flow

The selection of the connection diagram (series or parallel connection) of the cooling circuit depends on the total power dissipation of the drive converter system.

6.4.2 Volume flow and temperature difference for parallel connection

- Volume flow depending on the total power dissipation and temperature difference.
- The diagram applies to the parallel connection of liquid coolers.
- The curve characteristic described below is valid for 25 °C flow temperature and Antifrogen N 52 %.



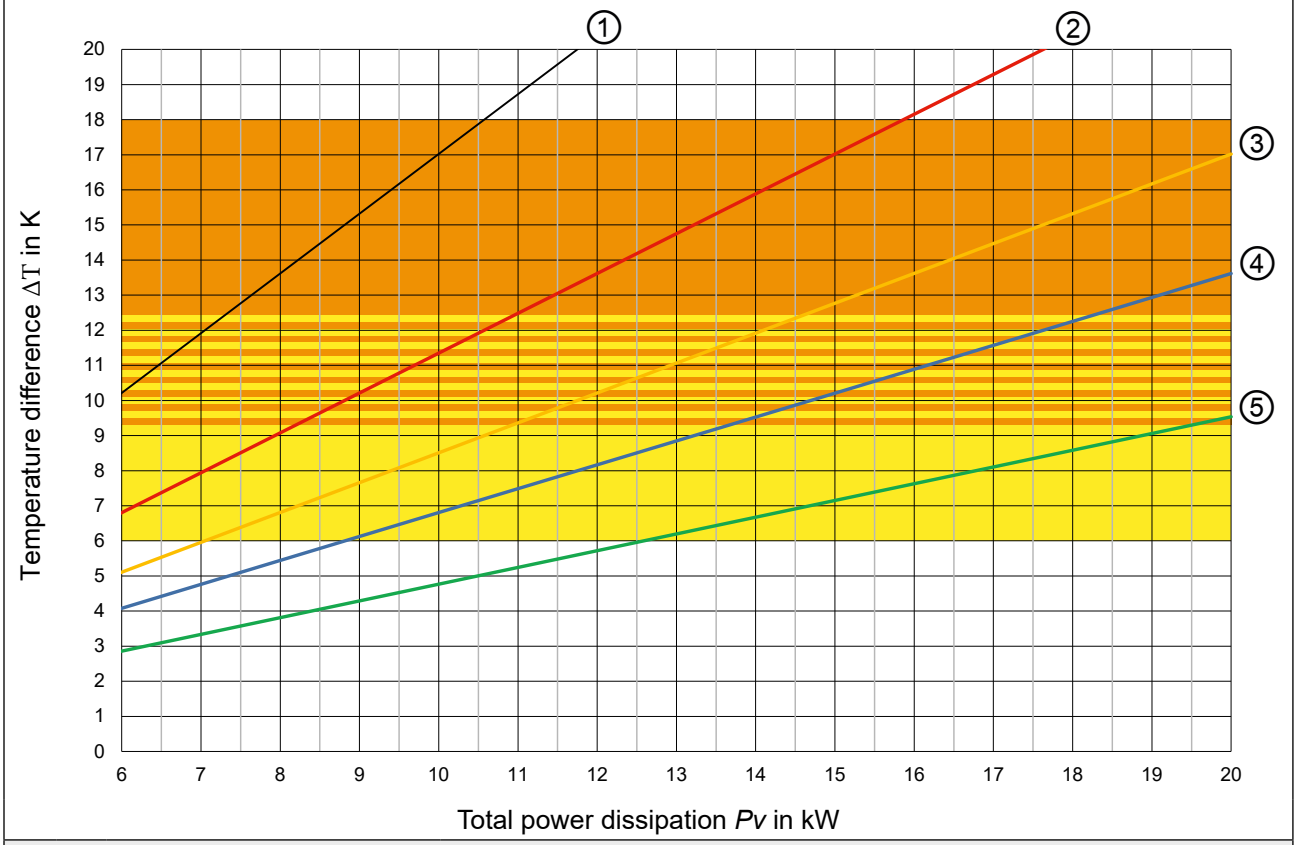
Legend	
Recommended working range	
	ΔT = 3...7 K
Volume flow	
1	20 l/min
2	30 l/min
3	40 l/min
4	50 l/min
5	60 l/min
6	70 l/min
7	80 l/min
8	90 l/min

Figure 45: Volume flow and temperature difference for parallel connection

- The points 1...8 are each based on the total volume flow of the drive controller system.
- The total volume flow must be divided by the number of Drive Units.
- The determined value for the volume flow is set for each Drive Units by means of throttle valves.

6.4.3 Volume flow and temperature difference for series connection

- Volume flow as a function of total power dissipation and temperature difference.
- The diagram below applies to the series connection of liquid coolers.



Legend		
Recommended working range		
	3-piece system	ΔT = 9...18 K
	2-piece system	ΔT = 6...12 K
Volume flow		
1	10 l/min	
2	15 l/min	
3	20 l/min	
4	25 l/min	
5	30 l/min	

Figure 46: Volume flow and temperature difference for series connection

NOTICE

Damage due to overpressure!

► The operating pressure must not exceed 10 bar.

► => *„6.4.1 Typical pressure loss Aluminium heat sink with stainless steel pipes“*.

7 Accessories

7.1 Filters and chokes (IEC-compliant installation)

NOTICE

Overheating of the back mount filters!

► The use of sub-mounted filters for drive controllers with the material number xxF6xxx-xxx9 (fluid cooler water, built-in version) leads to overheating and is not permitted!

The specified filters and chokes are designed for rated operation.

System	Mains choke 50 Hz / 4 % U_k	HF filter	Motor choke	
			max. 100Hz	0…1600Hz
33	2 x 29Z1B04-1000 or 2 x 29Z1B04-1007	2 x 30E6T60-1150 or 2 x 30E4T60-1001 or 2 x 30E4T60-1051	2 x 29Z1F04-1010 or 2 x 29Z1A04-1001	2 x 29Z2F04-1003
34	2 x 29Z1B04-100X or 2 x 29Z1B04-1007	2 x 30E6T60-1150 or 2 x 30E4T60-1001 or 2 x 30E4T60-1051	2 x 29Z1F04-1010 or 2 x 29Z1A04-1001	2 x 29Z2F04-1003
35	2 x 30Z1B04-1000 or 2 x 30Z1B04-1007	2 x 30E6T60-1150 or 2 x 30E4T60-1001 or 2 x 30E4T60-1051	2 x 30Z1F04-1010 or 2 x 31Z1A04-1000	2 x 30Z2F04-1003
36	3 x 29Z1B04-100X or 3 x 29Z1B04-1007	3 x 30E6T60-1150 or 3 x 30E4T60-1001 or 3 x 30E4T60-1051	3 x 29Z1F04-1010 or 3 x 29Z1A04-1001	3 x 29Z2F04-1003
37	3 x 30Z1B04-1000 or 3 x 30Z1B04-1007	3 x 30E6T60-1150 or 3 x 30E4T60-1001 or 3 x 30E4T60-1051	3 x 30Z1F04-1010 or 3 x 31Z1A04-1000	3 x 30Z2F04-1003
38	3 x 30Z1B04-1000 or 3 x 30Z1B04-1007	3 x 30E6T60-1150 or 3 x 30E4T60-1001 or 3 x 30E4T60-1051	3 x 30Z1F04-1010 or 3 x 31Z1A04-1000	3 x 30Z2F04-1003
39	3 x 30Z1B04-1000 or 3 x 30Z1B04-1007	3 x 30E6T60-1150 or 3 x 30E4T60-1001 or 3 x 30E4T60-1051	3 x 30Z1F04-1010 or 3 x 31Z1A04-1000	3 x 30Z2F04-1003

Table 28: Filters and chokes (IEC-compliant installation)

Instructions for use "Installation of HF filter E6 bottom-mounted"
www.keb.de/fileadmin/media/Manuals/dr/ma_dr_e6-hf-filter-geh8-20319761_en.pdf

Instructions for use "Installation of HF filter E4 bottom-mounted"
www.keb.de/fileadmin/media/Manuals/dr/ma_dr_e4-hf-filter-sm-20358802_en.pdf

7.2 Filters and chokes (UL and CSA compliant installation)

NOTICE

Overheating of the back mount filters!

▶ The use of sub-mounted filters for drive controllers with the material number xxF6xxx-xxx9 (fluid cooler water, built-in version) leads to overheating and is not permitted!

The specified filters and chokes are designed for rated operation.

System	Mains choke 50 Hz / 4 % U_k	HF filter	Motor choke	
			max. 100Hz	0…1600Hz
33	2 x 29Z1B04-1000 or 2 x 29Z1B04-1007	2 x 30E6T60-1150 or 2 x 30E4T60-1001	2 x 29Z1A04-1001	2 x 29Z2F04-1003
34	2 x 29Z1B04-100X or 2 x 29Z1B04-1007	2 x 30E6T60-1150 or 2 x 30E4T60-1001	2 x 29Z1A04-1001	2 x 29Z2F04-1003
35	2 x 30Z1B04-1000 or 2 x 30Z1B04-1007	2 x 30E6T60-1150 or *(in preparation)*	*In preparation*	2 x 30Z2F04-1003
36	3 x 29Z1B04-100X or 3 x 29Z1B04-1007	3 x 30E6T60-1150 or 3 x 30E4T60-1001	3 x 29Z1A04-1001	3 x 29Z2F04-1003
37	3 x 30Z1B04-1000 or 3 x 30Z1B04-1007	3 x 30E6T60-1150 or 3 x 30E4T60-1001	3 x 31Z1A04-1000	3 x 30Z2F04-1003
38	3 x 30Z1B04-1000 or 3 x 30Z1B04-1007	3 x 30E6T60-1150 or 3 x 30E4T60-1001	*In preparation*	3 x 30Z2F04-1003
39	3 x 30Z1B04-1000 or 3 x 30Z1B04-1007	3 x 30E6T60-1150 or *(under preparation)*	*In preparation*	3 x 30Z2F04-1003

Table 29: Filters and chokes (UL and CSA compliant installation)

Instructions for use "Installation of HF filter E6 bottom-mounted"
www.keb.de/fileadmin/media/Manuals/dr/ma_dr_e6-hf-filter-geh8-20319761_en.pdf

Instructions for use "Installation of HF filter E4 bottom-mounted"
www.keb.de/fileadmin/media/Manuals/dr/ma_dr_e4-hf-filter-sm-20358802_en.pdf

7.3 System connection cable

NOTICE

Malfunctions caused by EMC interference!

► Only use cables of the same length per system.

Material number	Length in m
00F6L70-A1P5 00F6L70-B1P5	1.5
00F6L70-A003 00F6L70-B003	3
00F6L70-A005 00F6L70-B005	5

Table 30: System connection cable

7.4 Seal for IP54-ready devices

Name	Material number
Flat seal IP54	00F6T45-0001

Table 31: Seal for IP54-ready devices

7.5 Side-mounted braking resistors

Technical data and design about non-intrinsically safe braking resistors

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

8 Approvals and certifications

8.1 CE marking

The drive converter marked with a CE logo comply with the requirements specified by European Union guidelines. The CE Declaration of Conformity is available on the Internet at *www.keb-automation.com/search* verfügbar.

For further information regarding the CE declarations of conformity
=> *„8.4 Further informations and documentation“*

8.2 UL certification

c UL us	Acceptance according to UL is marked at KEB drive controllers with the adjacent logo on the nameplate.

Under preparation

8.3 Functional safety

Functional safety can be traced back to the functions of the control card and safety modules used in the control unit.

NOTICE

Parallel connection of Drive Units with PRO control board and safety module type 5.

The output frequency cannot be clearly determined!

► Only the safety functions STO, SBC and SS1-t are permitted!

The parallel connection results in a higher probability of a jolt in the event of a fault. With three Drive Units remaining in STO for 24 hours, the probability is negligible at 3.5 *10^-12 1/h.

Furthermore, parasitic vibrations may occur due to transmission from the Control Unit to the Drive Units. These are also negligible under the conditions stated above, at 2.1*10^-13.

8.4 Further informations and documentation

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

General instructions

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

Instruction and information for construction and development

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

Approvals and approbations

- Declaration of conformity CE
- TÜV certificate
- FS certification

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

Others

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

9 Revision history

Version	Date	Description
00	2025-11	Pre-series version
01	2026-03	Series version

Glossary

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

OSSD	Output signal swithching device; - an output signal that is checked in regular intervals on its shutdown. (safety technology)
PDS	Power drive system incl. motor and measuring probe
PE	Protective earth
PELV	Protective Extra Low Voltage
PFD	Term used in the safety technology (EN 61508-1...7) for the size of error probability
PFH	Term used in the safety technology (EN 61508-1...7) for the size of error probability per hour
PLC	Programmable logic controller
Pt100	Temperature sensor with R0=100Ω
Pt1000	Temperature sensor with R0=1000Ω
PTC	PTC-resistor for temperature detection
PWM	Pulse width modulation
RJ45	Modular connector with 8 lines
SCL	Synchronous sensorless closed loop
SELV	Safe extra-low voltage, unearthed
SIL	The safety integrity level is a measure for quantifying the risk reduction. Term used in the safety technology (EN 61508 -1...7)
SS1	Safety function „Safe stop 1“ in accordance with IEC 61800-5-2
SSI	Synchronous serial interface for encoder
STO	Safety function „Safe Torque Off“ in accordance with IEC 61800-5-2
TTL	Logic with 5 V operating voltage
USB	Universal serial bus
VARAN	Real-time Ethernet bus system

List of Figures

List of Tables

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Automation **with Drive**

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