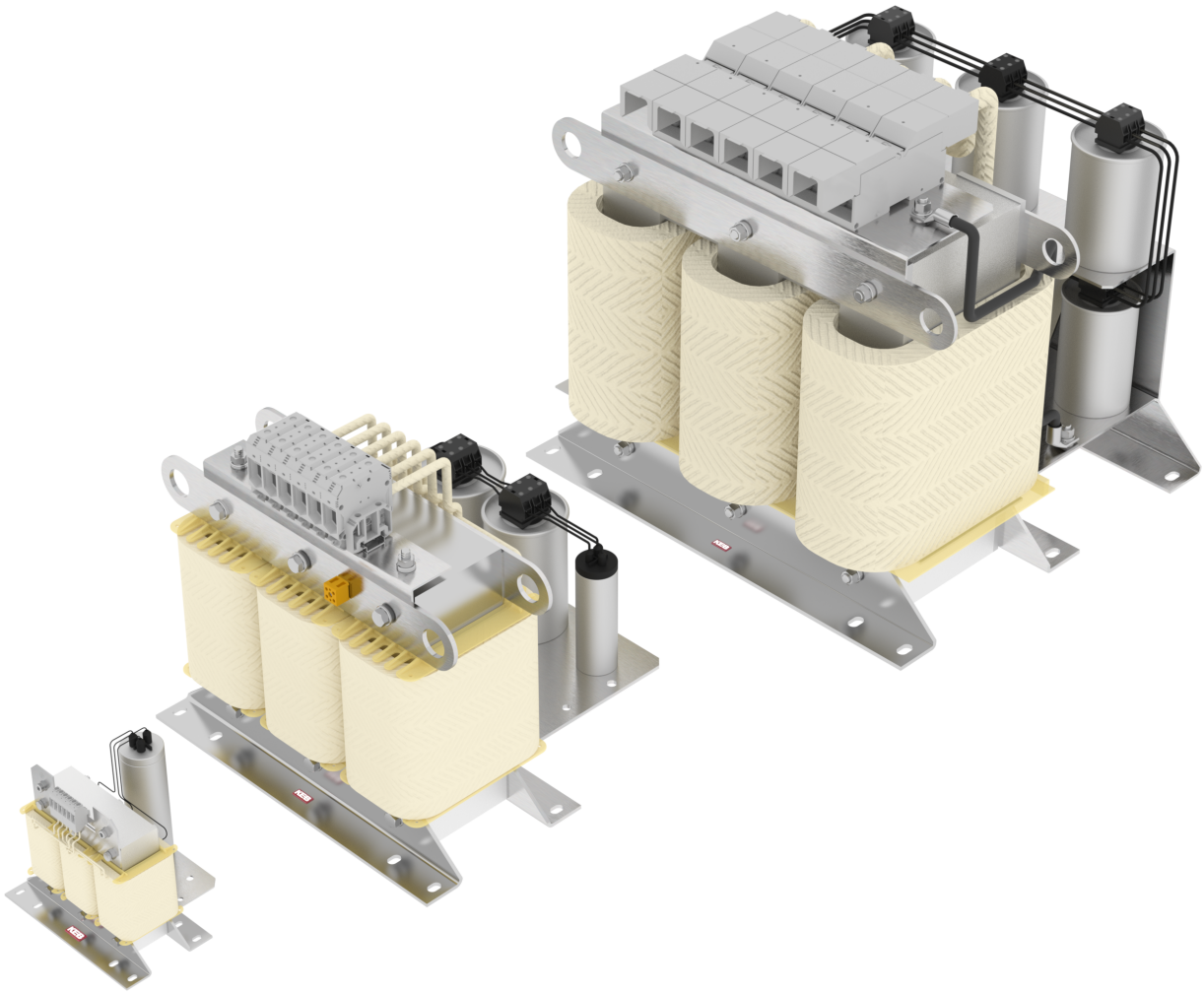


Instructions for Use

COMBILINE Z1

Installation Harmonic Filter

Translation of the original manual

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1 Introduction

The described devices, accessories, hardware and/or software are products of KEB Automation KG. The enclosed documents correspond to conditions valid at printing. Misprint, mistakes and technical changes reserved.

1.1 Markings

1.1.1 Warnings

Certain operations can cause hazards during the installation, operation or thereafter. There is safety information in the documentation in front of these operations.

Warnings contain signal words for the severity of the hazard, the type and/or source of the hazard, the consequence of non-compliance and the measures to avoid or reduce the hazard.

⚠ DANGER



Type and/or source of the hazard.

Leads to death or serious bodily injury if not observed.

a) Measures to avoid the hazard.

b) Can be supplemented by an additional danger sign or pictogram.

⚠ WARNING



Type and/or source of the hazard.

May cause death or serious injury if not observed.

a) Measures to avoid the hazard.

b) Can be supplemented by an additional danger sign or pictogram.

⚠ CAUTION



Type and/or source of the hazard.

May cause bodily injury if not observed.

a) Measures to avoid the hazard.

b) Can be supplemented by an additional danger sign or pictogram.

NOTICE



Type and/or source of the hazard.

Can cause damage to property if not observed.

a) Measures to avoid the hazard.

b) Can be supplemented by an additional danger sign or pictogram.

1.1.2 Information notes



Indicates to the user a special condition, prerequisite, scope or simplification.



This is a reference to further documentation. The barcode is for smartphones, the following link is for online users or for typing.

(🌐► https://www.keb-automation.com/search)



Notes on conformity for use in the North American or Canadian market.

1.1.3 Symbols and markers

✓	Condition
a)	Action step
⇨	Result or intermediate result
(≡► Refe [▷ 8])	Reference to a chapter, table or picture with page reference
ru21	Parameter name or parameter index
(🌐►)	Hyperlink
<Strg>	Control code
COMBIVERT	Glossary entry

1.2 Laws and guidelines

KEB Automation KG confirms with the CE mark and the EU declaration of conformity that our device complies with the essential safety requirements.

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

1.3 Warranty and liability

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



Here you will find our general sales conditions.

(🌐► https://www.keb-automation.com/terms-conditions)

Further agreements or specifications require a written confirmation.

1.4 Support

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

The use of our units in the target products is beyond of our control and therefore exclusively the responsibility of the customer**.**

The information contained in the technical documentation, as well as any support provided verbally, written or through testing, is made to the best of our knowledge and information regarding intended use of KEB products. However, due to technical changes, any information provided is considered non-binding and is subject to change. This also applies to any violation of industrial property rights of a third-party.

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

Tests can only be carried out within the scope of 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.**

1.5 Copyright

The customer may use the instructions for use and other documents accompanying the device or parts thereof for internal purposes. Copyrights are with KEB Automation KG and remain valid in its entirety.

Other word and/or figurative marks are trademarks (™) or registered trademarks (®) of their respective owners.

1.6 Validity of this manual

These instructions for use are valid for the units specified in the product description. It can be supplemented by corresponding options or special designs. It contains:

- Safety instructions to be observed
- Information on intended use
- Description of the device
- Technical Data
- Installation
- Connection
- Operation
- Maintenance, service and disposal

1.7 Target group

The instructions for use 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 IEC 60364.
- Knowledge of national safety regulations (e. g. DGUV Regulation 3).

2 General safety instructions

The products are developed and built according to the state of the art and recognized safety rules. Nevertheless, their use may create dangers to life and limb of the user or third parties or damage to the machine and other material property.

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

NOTICE



Stay safe! Stay informed!

✓ Prior any work on the device

a) Read the instruction manual.

b) Follow all safety and warning instructions.

c) If you are unsure of any part of these instructions, please contact KEB prior to operating the device.

2.1 Installation

⚠ DANGER



Explosion hazard due to sparking!

a) Do not operate the unit in a potentially explosive environment.

⚠ CAUTION



Design-related edges and heavy weight

Contusions and bruises

a) Never stand under suspended loads.

b) Wear safety shoes.

c) Secure product accordingly when using lifting tools.

NOTICE

Malfunction due to heat accumulation

a) The installation of liquid-cooled drive controllers with back mount braking resistors is not permitted on back mount filters.

2.2 Electrical installation

⚠ DANGER



Large live parts that can be touched

Risk of death from electric shock!

✓ This device is intended for installation in control cabinets or machinery that may be operated at hazardous voltages. Whenever carrying out any work on the device:

a) Switch off the supply voltage to the control cabinet or machine.

b) Prevent the power from being switched on again.

c) Wait until all drives have come to a standstill so that no energy can be generated by the generators.

d) Wait for the capacitor discharge time of the upstream drive controller (at least 5 minutes) to elapse.

e) Check that there is no voltage by taking a measurement.

f) Never bypass upstream protective devices. Not even for testing purposes.

NOTICE

Cyclical switching on and off

a) For applications that require the drive controller to be switched on and off cyclically, a waiting period of at least 5 minutes must be observed after switching it off before switching it on again.

b) If shorter cycle times are required, please contact KEB.

c) Always follow the motor manufacturer's connection instructions.

2.3 Start-up and operation

⚠ CAUTION



High temperatures at the unit!

Burning of the skin

a) Cover hot surfaces safe-to-touch.

b) If necessary, attach warning signs on the system.

c) Before any working let the unit cool down.

d) Check the temperature before touching any parts.

3 Product description

KEB's passive mains harmonic filters reduce unwanted harmonics in electrical power supply systems. Optimised 400 V/50 Hz and 480 V/60 Hz solutions reduce the THDi to < 8 per cent and the PWHD to < 15 per cent. These harmonic filters, with their innovative internal assembly, also offer a high overload capacity of up to 150 per cent and an efficiency of > 99 per cent. They enable compliance with many international standards.

These standards include:

- IEEE 519-1992 (USA)
- G5/4 Engineering Recommendation (GB)
- EN 61000-3-2 (up to 16 A)
- EN 61000-3-12 (16-75A)
- EN 61000-3-4
- EN 12015 (European lift standard)
- AS 2279 (Australia)
- COP, supply rules (Hong Kong)
- Quality of the Electricity Supply, Harmonics in Public Supply Networks (China)

3.1 Intendend use

The filters of the COMBILINE product series are only suitable for use in conjunction with drive converters. They are intended for installation in electrical systems or machines.

Technical data and information for connection conditions shall be taken from the type plate and from the instruction manual and must be strictly observed.

3.2 Unintended use

Operation of our products outside the limits specified in the technical data leads to the loss of any liability claims and specified approvals/acceptances.

3.3 Advantages

The special assembly of the harmonic filters offers the following advantages:

- optimal filtration effect
- Compact assembly, takes up little space when installed
- ready-to-connect installation solution
- a significant decrease in capacitive currents during idle operation
- no tendency to oscillate under cyclic loading
- significantly lower voltage drop compared with mains chokes
- Extended inverter service life, thanks to the trapezoidal output voltage and the associated
- square-wave current
- Reduction of the THDI to < 8%; PWHD < 15% (version default)
- optional THDI < 15%; PWHD < 39% (version in accordance with EN 12015)
- optional THDI < 5% (extreme demand / upon request)
- wide range of outputs, as the filter modules can be connected in parallel
- very high efficiency

3.4 Application range

Reducing the THDI to the specified value of < 8 % requires a VDE-compliant supply network with a maximum prior load of THDU = 2 % and a minimum ratio of network short-circuit power to connected power, RSCE = 66.

Application range

- compliance with the specified standards
- lower voltage drop compared with a mains choke
- reduction in the effective input current (when powered by generators)
- protection of drive power controller on poor power supplies (voltage transients)
- protection of ‘soft’ networks
- increase service life of the intermediate circuit (several KEB COMBIVERT units can be operated on a single filter)

3.5 Unsuppressed reactive-power compensation equipment and risk of resonance

Reactive-power compensation equipment are used at the center of a company's energy supply. Malfunction or damage to these systems can affect the site’s energy supply and lead to costly production downtime.

In practice, many compensation systems are still in use today. The problems that can arise in this context are varied:

- direct resonance
- risk of resonance
- switching transients
- interference with radio control transmissions.

Whether a plant itself causes grid disturbances is not the only factor determining the occurrence of resonances. The key factor in the risk of resonance occurring is the compensation capacity of the transformer. The higher this power, the greater the risk of resonance. An important factor in this regard is the harmonic load at the medium-voltage level. This is transmitted by the transformer and operates at the low-voltage level.

3.6 Capacitive base load at no-load operation

The KEB harmonic filter is a design patented by KEB. One of the filter’s key features is its very low capacitive load when idle. The capacitance integrated into the filter is choked by a relatively high inductance. All tests, as well as feedback from the field, show that the KEB design does not cause any resonance with the mains supply. During operation at rated current, cosϕ approaches 1.
Switching the capacitors on or off during no-load operation may lead to resonance. In this case, voltage overshoots in the mains supply may lead to an impermissible voltage spike in the drive converter’s DC link.

4 Technical data

4.1 400 V class

Filter type 09…29Z1C04-1000		
Voltage class		400 V
Rated voltage	1)	400 V
Permissible range of the rated voltage		360 V to 440 V
Mains frequency	1)	50 Hz
Overload capacity EN 60146-1-1 / Load class III		150 % for 60 s every 10 min.
Efficiency @	2) 3)	> 99 %
THDI @	2)	<= 15 %
Cos phi	2)	approx. 0.99
Thermal contact (NC contact)		from size 21

1. For rated voltages of ≥ 460 V, the rated current must be multiplied by a factor of 0.86. Due to the switching levels specified by COMBIVERT for the braking transistor and overvoltage protection, the filter can only be operated on a 'genuine' 480 V mains supply if the mains voltage does not exceed 500 V. The filter's open-circuit voltage increase at 50 Hz is 5–6 %.
2. Under rated operation.
3. For installed power ≥ 30 kW rated motor power amplitude modulation (AM) drive controller.

Tab. 1: 400 V class

4.1.1 Thermal contact

To protect the system from inadmissible temperatures, motor chokes from size 25 upwards are fitted with temperature switches. This must be connected with the input terminals T1/T2 of the drive controller.

Rated data for the temperature switch

Description	Value
Type	NC contact
Tripping temperature	155 °C
AC cos φ = 1.0	1 A / 250 V
AC cos φ = 0.6	0.6 A / 250 V
DC ohmic	1.6 A / 24 V
DC ohmic	1.25 A / 48 V

NOTICE

Measurement errors and sooting of the contacts!

a) For devices with PT100/KTY or analog signal evaluation, no temperature switches may be installed in the detection chain as these can distort the signal and lead to incorrect measurements.

b) For devices with a temperature switch, another protective measure must be used.

4.2 Environmental conditions

Filter type 09…29Z1C04-1000	
Storage temperature	-25...70 °C (-13...158 °F)
Operating temperature	-10...45 °C (14...113 °F)
Construction/protection type (EN 60529)	IP20
Environment (IEC 664-1)	Degree of contamination 2
Climatic category	3K3

Tab. 2: Environmental conditions

4.3 Rated data for series THD = 8 %

Part number	Rated current	Rated power	Power loss, power dissipation	Weight	Connection cross section	PE connection
	***Iin* / A**	***Pin* / kW**	***PD* / W**	***m* / kg**	***A* / mm²**	
09Z1C04-1000	4.3	1.5	60	5.8	4	M4
12Z1C04-1000	10	4	110	11.5	4	M6
13Z1C04-1000	12.6	5.5	130	13.4	4	M6
14Z1C04-1000	17.3	7.5	180	18.3	16	M6
15Z1C04-1000	25.2	11	190	25.5	16	M6
16Z1C04-1000	34.7	15	260	38.5	16	M8
17Z1C04-1000	44.1	18.5	270	47.1	16	M8
18Z1C04-1000	52.5	22	285	54.6	35	M8
19Z1C04-1000	63	30	420	63	35	M8
20Z1C04-1000	79	37	430	72.6	35	M8
21Z1C04-1000	95	45	520	96	50	M10
22Z1C04-1000	121	55	590	107.7	50	M10
23Z1C04-1000	158	75	785	162	95	M10
24Z1C04-1000	189	90	950	182.5	95	M10
25Z1C04-1000	221	110	1145	244	150	M10
26Z1C04-1000	263	132	1360	241.5	150	M10
27Z1C04-1000	315	160	1480	294	240	M10
28Z1C04-1000	390	200	1650	353	2x150	M12
29Z1C04-1000	485	250	1800	513	2x240	M12

4.4 Rated data for series THD = 15 %

Part number	Rated current	Rated power	Power loss, power dissip-ation	Weight	Connection cross section	PE connection
	Iin / A	*Pin* / kW	*PD* / W	*m* / kg	*A* / mm²	
07Z1C04-1001	2.4	0.75	40	2.6	4	M4
10Z1C04-1001	6.1	2.2	65	4.8	4	M4
12Z1C04-1001	10	4	90	6.8	4	M4
13Z1C04-1001	12.6	5.5	105	8.7	4	M6
14Z1C04-1001	17.3	7.5	135	11.5	4	M6
15Z1C04-1001	25.2	11	165	16.3	16	M6
16Z1C04-1001	34.7	15	210	22.6	16	M8
17Z1C04-1001	44.1	18.5	255	27	16	M8
18Z1C04-1001	52.5	22	295	33	35	M8
19Z1C04-1001	63	30	360	38.7	35	M8

4.5 Options

- Option HF filter integrated
- 3-phase / AC 230 V / AC 500 V / AC 690 V
- Enclosure type, mechanical design: IP23

4.6 Dimensions

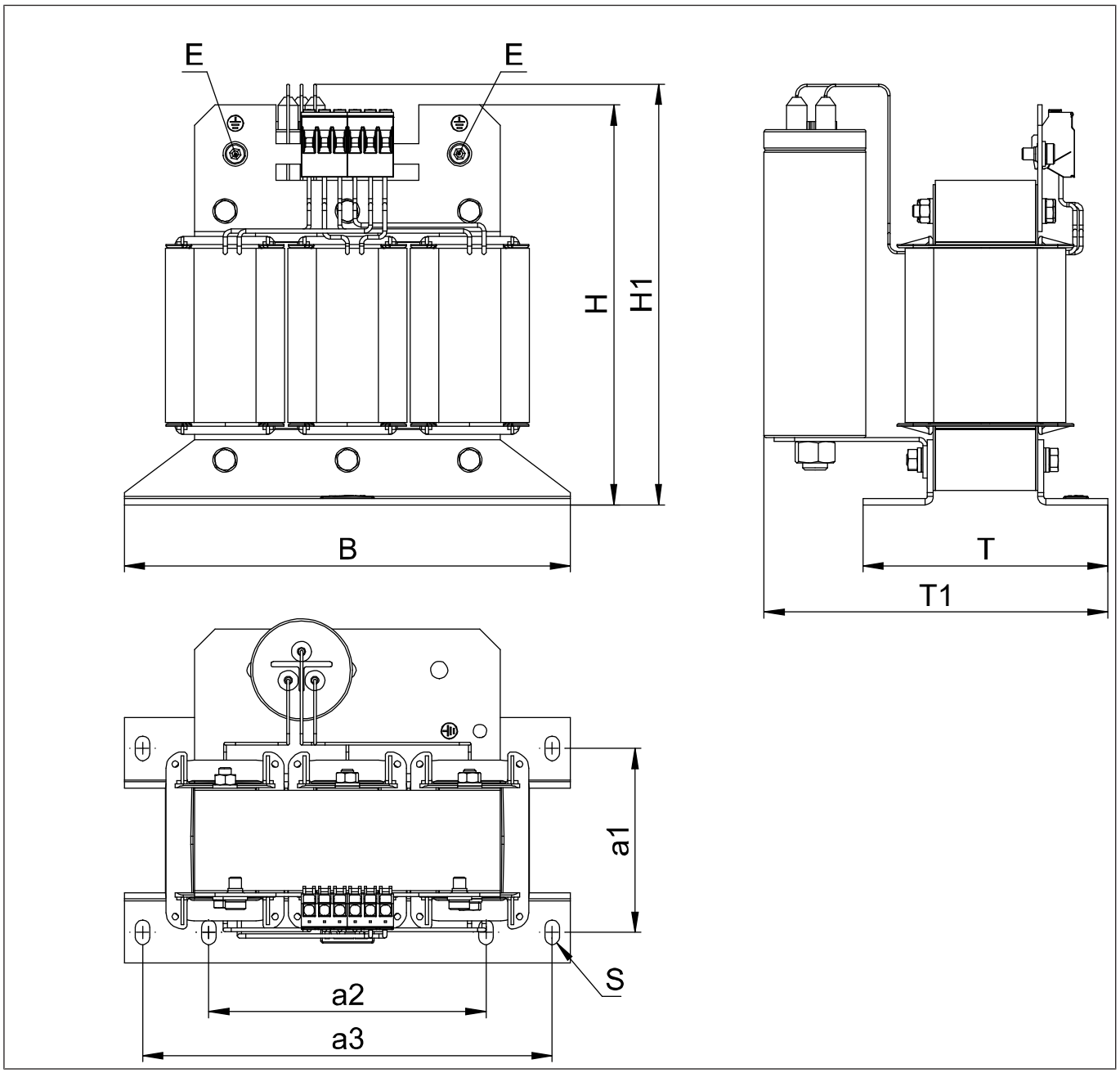


Fig. 1: Dimensions 09-22Z1C04-1000

Part no.	B	B1	T	T1	H	H1	A1	A2	A3	A4	S	E
09Z1C04-1000	178	–	89	142	170	–	69	113	166	–	M4	M4
12Z1C04-1000	219	–	120	169	196	206	90	136	201	–	M6	M6
13Z1C04-1000	243	–	114	168	215	–	84	156	225	–	M6	M6
14Z1C04-1000	291	–	118	187	251	–	86	185	273	–	M8	M6
15Z1C04-1000	291	–	138	207	251	–	106	185	273	–	M8	M6
16Z1C04-1000	352	–	143	236	323	–	103	224	328	–	M8	M8
17Z1C04-1000	352	–	168	276	322	–	128	224	328	–	M8	M8
18Z1C04-1000	352	–	184	277	327	–	144	224	328	–	M8	M8
19Z1C04-1000	352	–	192	355	327	–	152	224	328	–	M8	M8

Part no.	B	B1	T	T1	H	H1	A1	A2	A3	A4	S	E
20Z1C04-1000	388	–	183	321	361	–	143	248	364	–	M8	M8
21Z1C04-1000	412	–	192	360	401	–	152	264	388	–	M8	M10
22Z1C04-1000	412	–	212	380	400	–	172	264	388	–	M8	M10

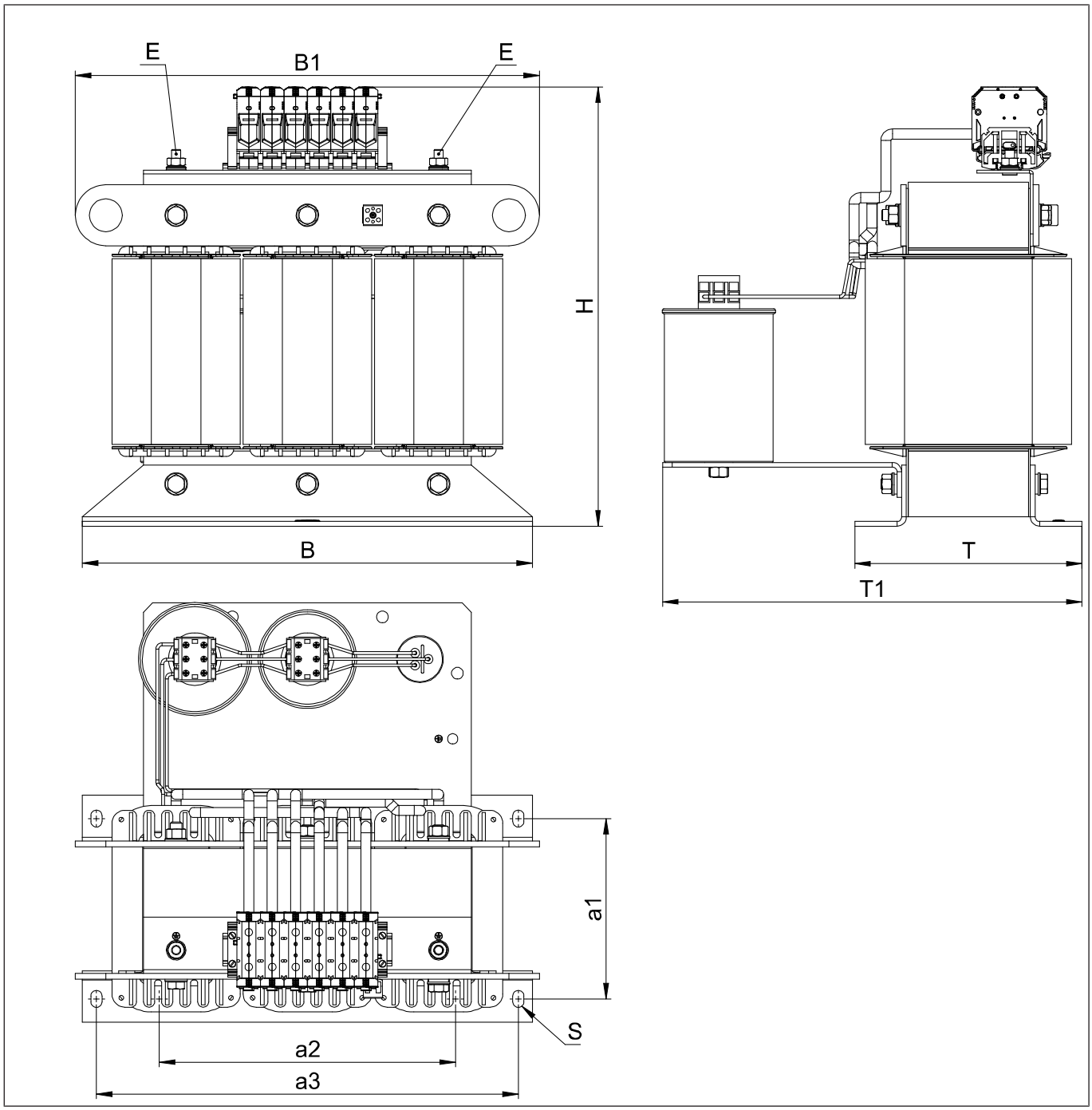


Fig. 2: Dimensions 23-27Z1C04-1000

Part no.	B	B1	T	T1	H	H1	A1	A2	A3	A4	S	E
23Z1C04-1000	480	495	242	447	468	–	192	316	450	–	M10	M10
24Z1C04-1000	552	–	241	516	521	–	181	356	516	–	M12	M10
25Z1C04-1000	552	–	271	546	545	–	211	356	516	–	M12	M10

Part no.	B	B1	T	T1	H	H1	A1	A2	A3	A4	S	E
26Z1C04-1000	552	–	291	566	545	–	231	356	516	–	M12	M10
27Z1C04-1000	552	–	312	595	558	–	252	356	516	–	M12	M10

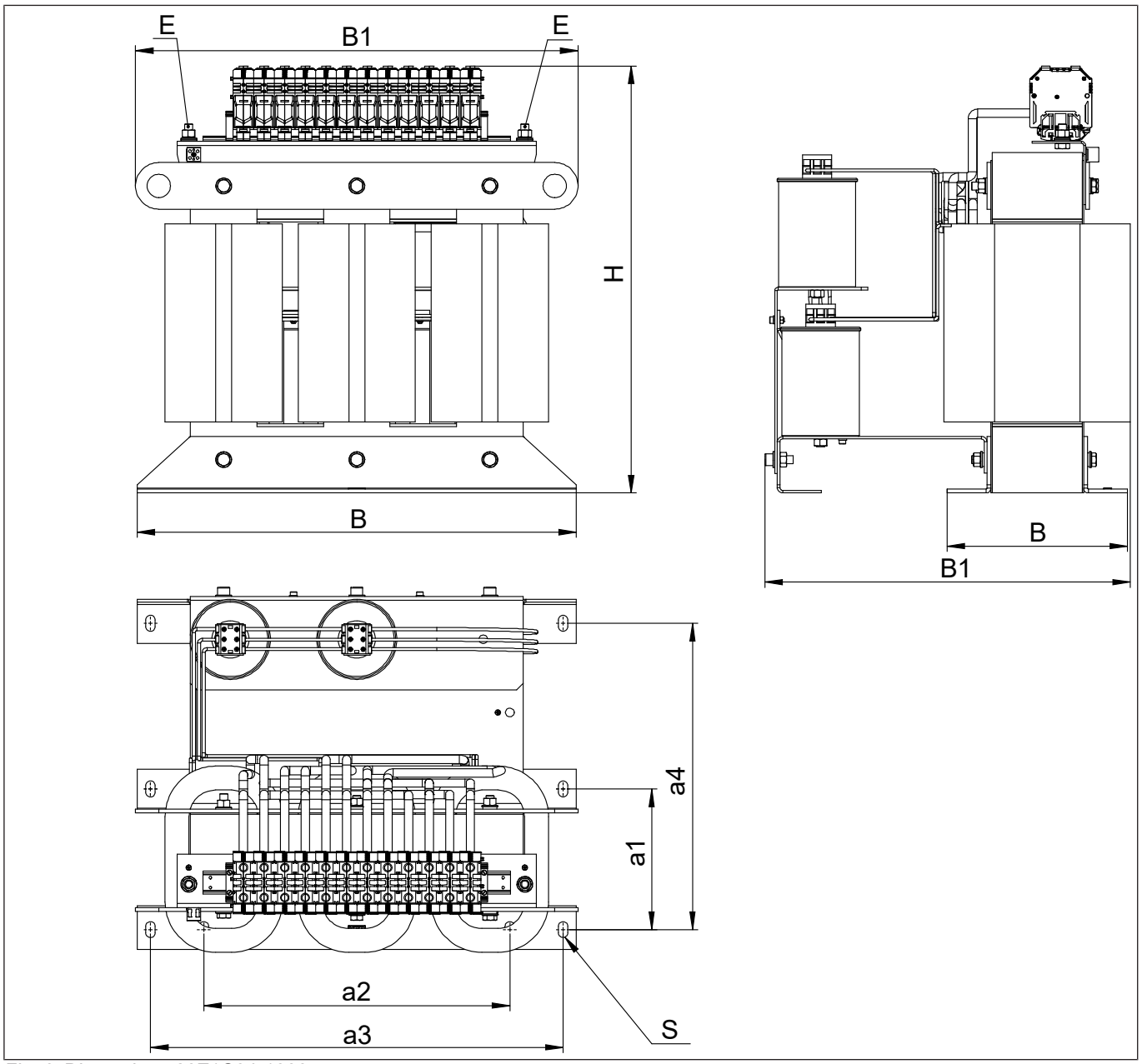


Fig. 3: Dimensions 28Z1C04-1000

Part no.	B	B1	T	T1	H	H1	A1	A2	A3	A4	S	E
28Z1C04-1000	660	665	271	549	642	–	211	460	620	460	M12	M12

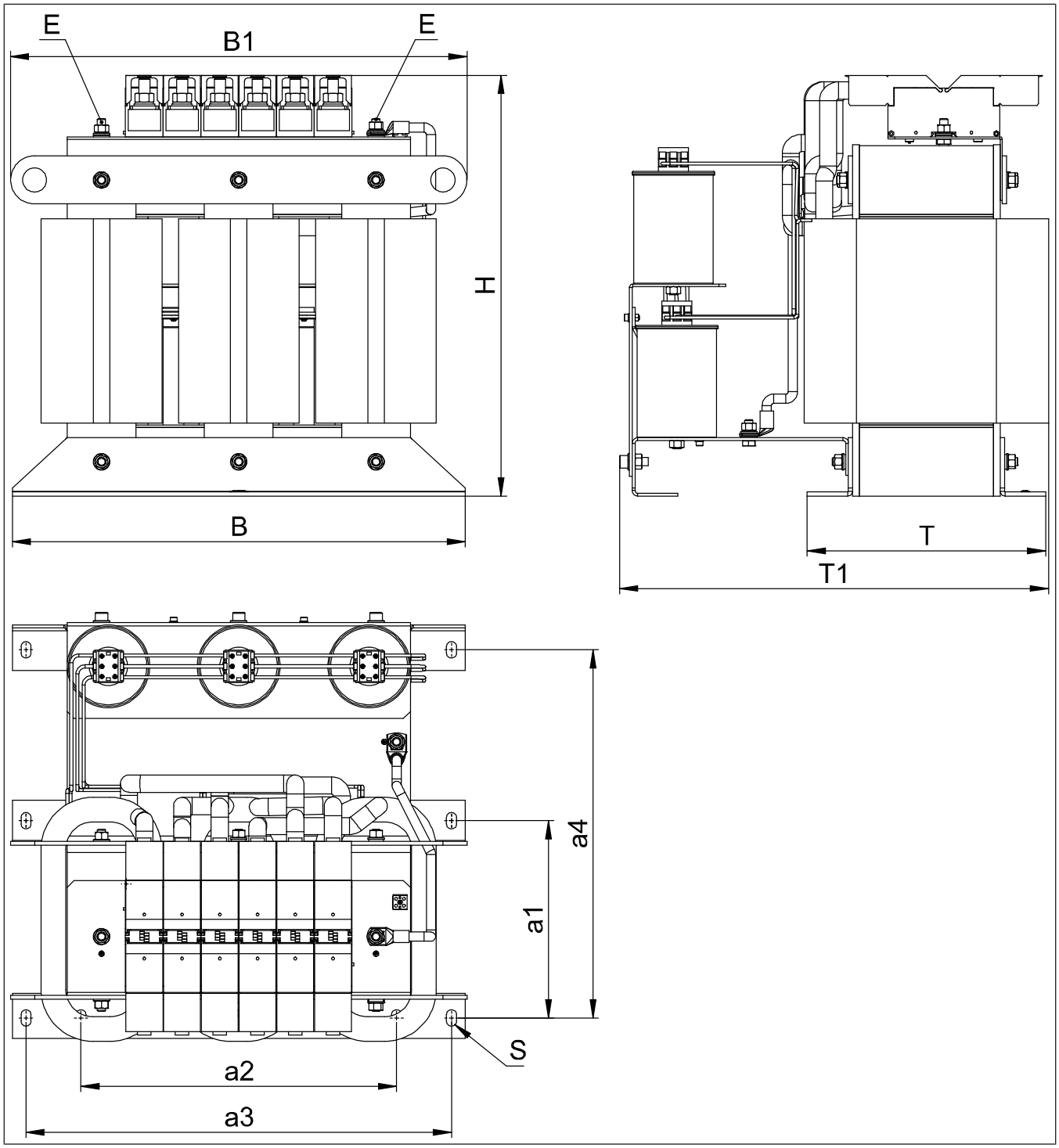


Fig. 4: Dimensions 29Z1C04-1000

Part no.	B	B1	T	T1	H	H1	A1	A2	A3	A4	S	E
29Z1C04-1000	660	665	347	625	613	–	287	460	620	536	M12	M12

4.7 Installation

4.7.1 Connection

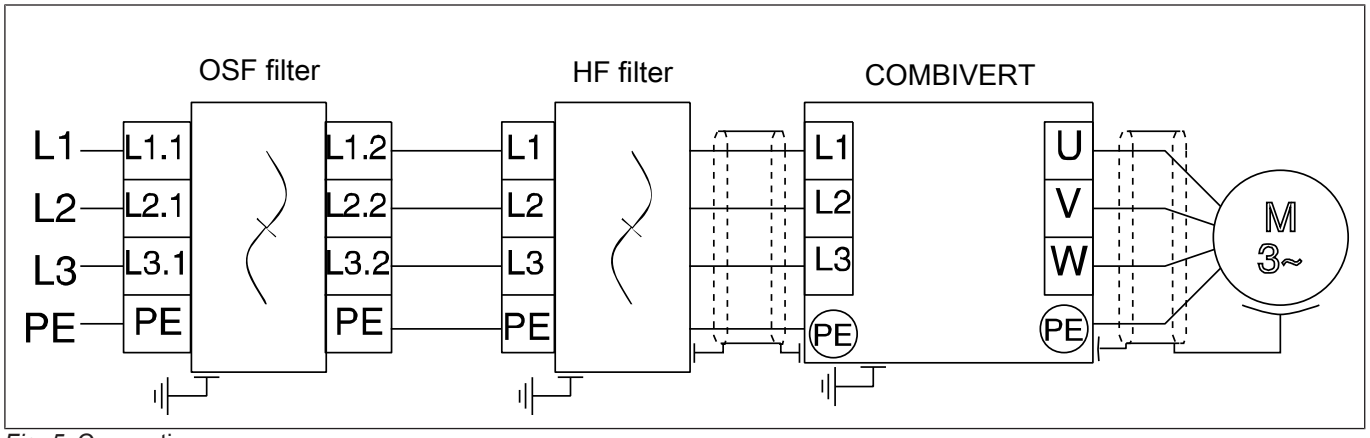


Fig. 5: Connection

4.7.2 Installation instructions

The KEB harmonic filter is to be used as a built-in unit only. Please note the following during installation:

- The distance from adjacent assemblies must not be less than 150 mm.
- A clearance of 150 mm must be maintained above and below the filter.
- The maximum cable length of 5 m between the OSF and the inverter must not be exceeded.
- Adequate impurities must be taken to prevent contamination of any kind..
- The permissible ambient temperatures must not be exceeded.
- Die mounting orientation erfolgt vertical oder liegend.

NOTICE

Incorrect mounting orientation!

Damage to or destruction of the capacitors due to exposure to heat!

a) The capacitors must be positioned either directly below the choke (see illustration) or standing on the floor.

b) The capacitors must not be positioned above the choke!

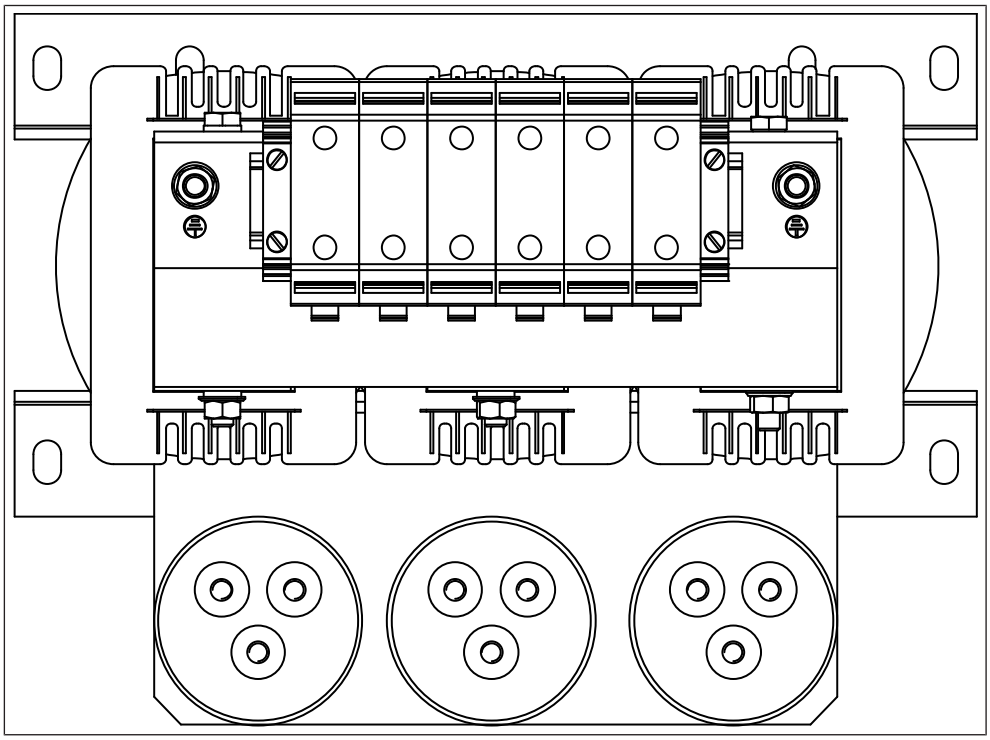


Fig. 6: Mounting orientation

4.8 Mode of action sine-wave EMC filter

4.8.1 Voltage und current amplitude modulation (AM) network

Without smoothing choke sharp current spikes occur as a result of the rapid charging of the DC link capacitors. The resulting increase in the ripple of the DC link voltage is transmitted to the motor in the form of torque fluctuations.

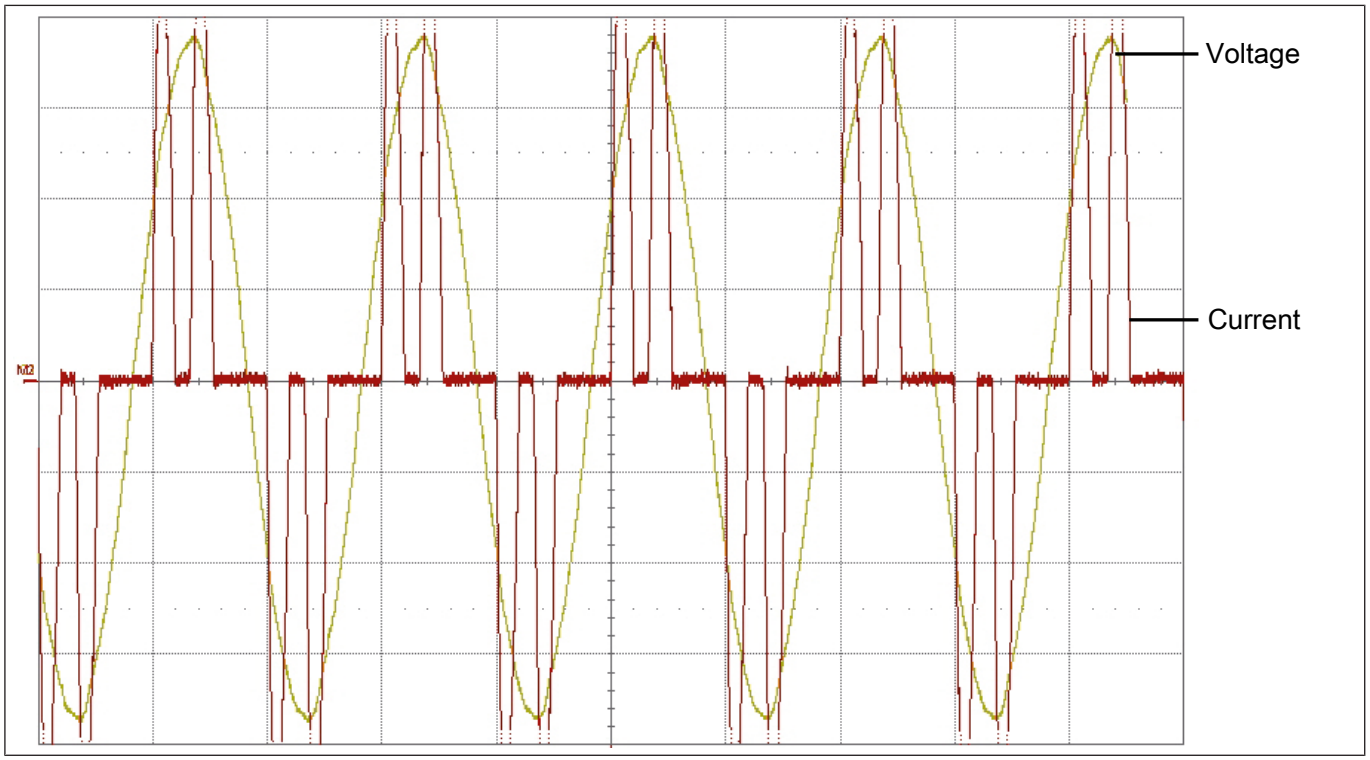


Fig. 7: voltage und current amplitude modulation (AM) network

4.8.2 Voltage and current with mains choke uk = 4 %

With inductance (mains choke), the amplitudes of the currents are reduced as a result of smoothing. The DC link voltage is less rippled, thereby extending the service life of the capacitors.

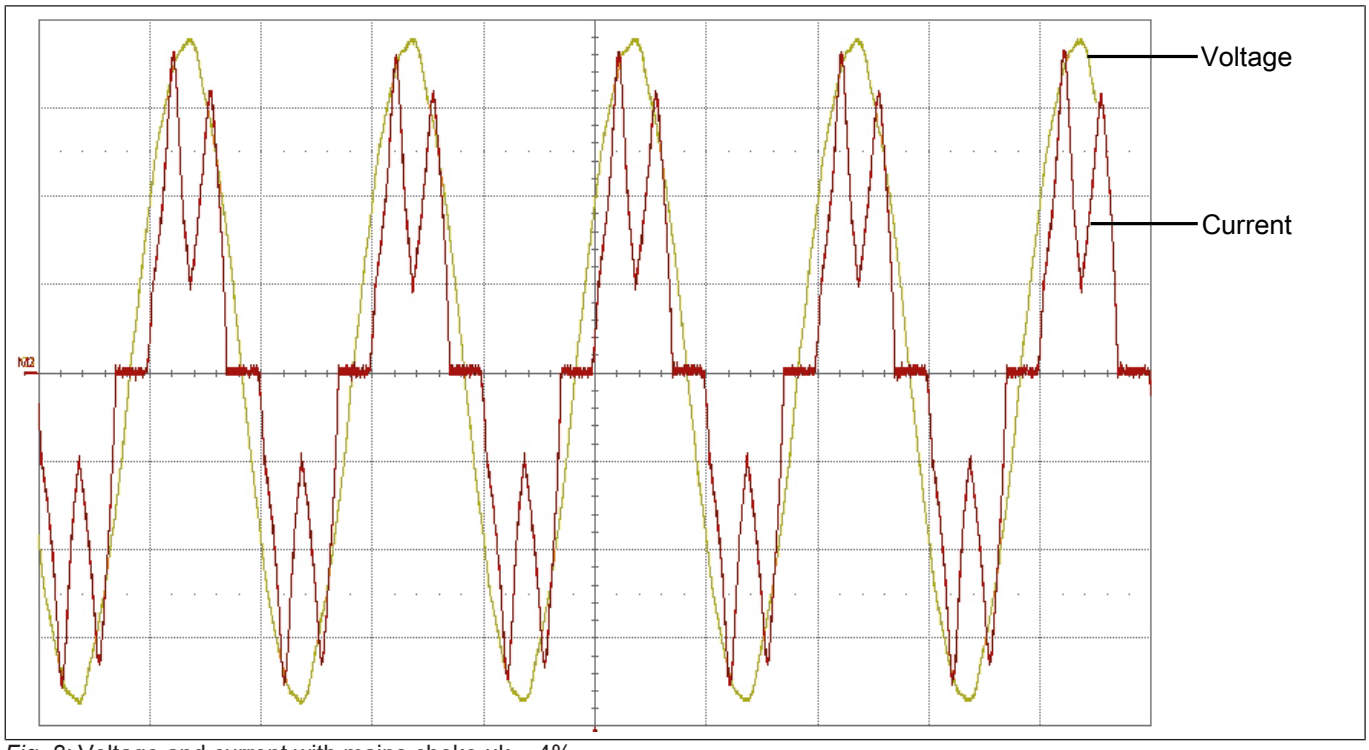


Fig. 8: Voltage and current with mains choke uk = 4%

4.8.3 Voltage and current with harmonic filter THD < 8 %

With the harmonic filter and the sinusoidal currents on the mains side, the amplitudes of the currents are further reduced compared t , where a choke is used. The output signals are almost rectangular, thereby producing a very smooth voltage in the DC link and extending the service life of the capacitors.

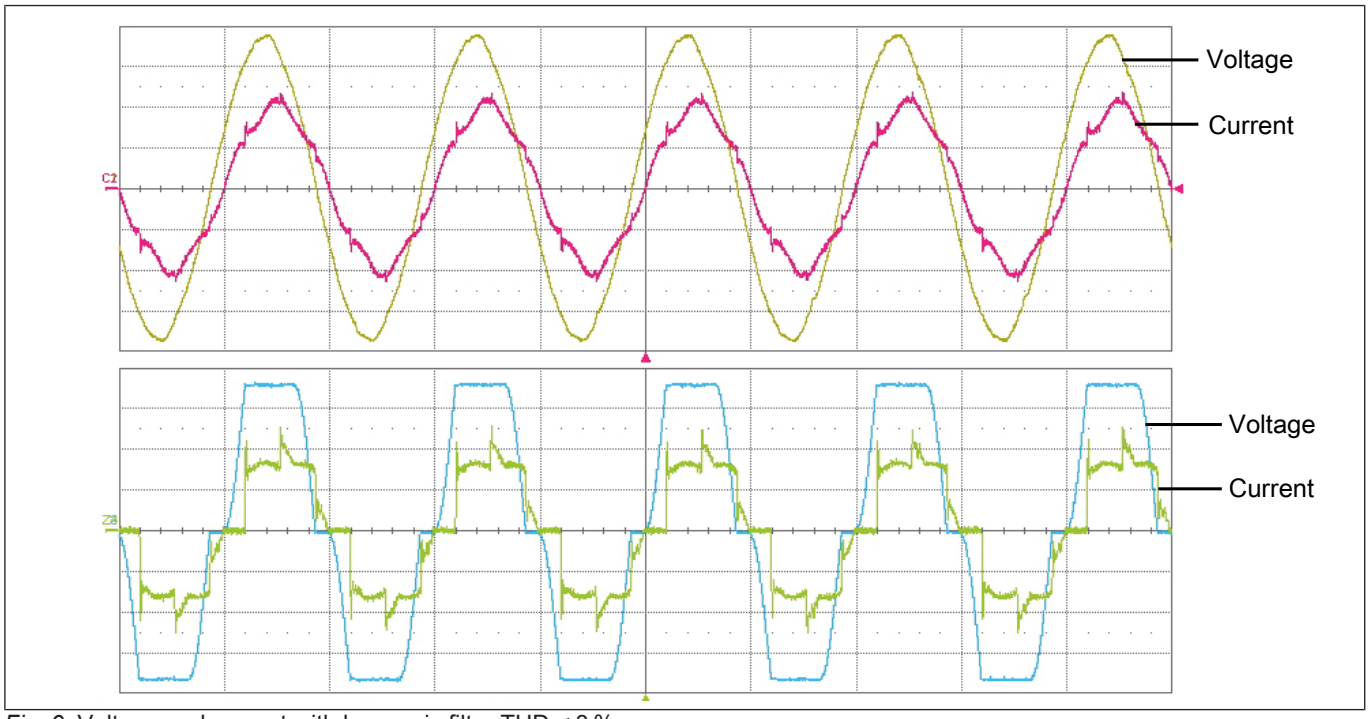
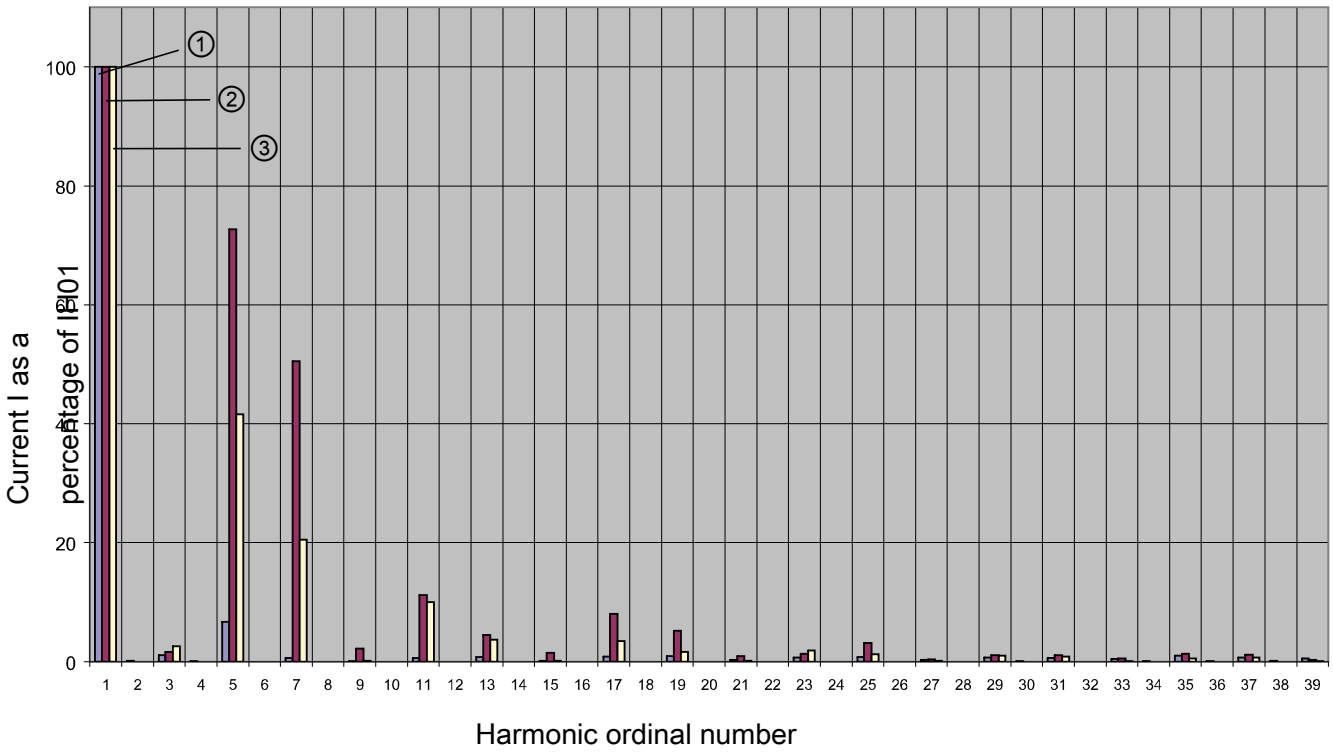


Fig. 9: Voltage and current with harmonic filter THD < 8 %

4.9 Annex

4.9.1 Fourier transformation / spectrum



1	Spectrum of the input current of a KEB harmonic filter (8 % THDI)
2	Spectrum of the input current of a KEB drive controller without choke
3	Spectrum of the input current of a KEB drive controller with choke

Tab. 3: Fourier transformation / spectrum

4.9.2 Formula and abbreviations

THD (Total Harmonic Distortion)

$$THD = \sqrt{\sum_{n=2}^{40} \left(\frac{I_n}{I_1} \right)^2}$$

THDU (Total Harmonic Distortion Voltage)
THDI (Total Harmonic Distortion Current)

PWHD (Partial Weighted Harmonic Distortion)

$$PWHD = \sqrt{\sum_{n=14}^{40} n \left(\frac{I_n}{I_1} \right)^2}$$

S_{equ} (Rated Apparent Power of the Equipment)

$$S_{equ} = \sqrt{3} * U_i * I_{equ}$$

R_{sce} (Short-circuit Ratio)

$$R_{sce} = \frac{S_{SC}}{S_{equ}}$$

5 Maintenance, service and disposal

⚠ DANGER



Electrical voltage at terminals and in the device!

Danger to life due to electric shock !

✓ For any work on the device

a) Switch off the supply voltage.

b) Secure it against switching on.

c) Wait until all drives has been stopped in order that no regenerative energy can be generated.

d) Await capacitor discharge time (min. 5 minutes). Measure DC voltage at the terminals.

e) Never bridge upstream protective devices. Also not for test purposes.

5.1 Maintenance

The following maintenance work must be carried out as required, but at least once a year, by authorised and instructed personnel.

- Check the system for loose screws and plugs and tighten if necessary.
- Remove dirt and dust deposits from the devices.
- Checking or cleaning ventilation inlets and outlets. Pay particular attention to cooling fins and protective grilles of fans (if available).
- Check or clean the exhaust air filter and the supply air filter of the control cabinet.
- If available, check the function of the fans of the device. If there are audible vibrations or squeaking, replace the fans.
- In the case of liquid-cooled devices, a visual inspection of the cooling circuit for leaks and corrosion must be carried out. If a system shall be switched off for a longer time, the cooling circuit must be completely drained. At temperatures below 0 °C, the cooling circuit must also be blown out with compressed air.

5.1.1 Cleaning

- Switch off the power before any cleaning operation.
- Clean the front panel of the system with a soft damp cloth.
- Do not use cleaning agents or solvents or other objects that could attack or scratch the surface.

5.2 Service

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

⚠ DANGER

Unauthorized exchange, repair and modifications

Unpredictable malfunctions

a) The function of the drive controller is dependent on its parameterisation. Never replace without knowledge of the application.

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

c) Only use original manufacturer parts.

d) 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 device and can provide an appropriate replacement or induce the maintenance.

In case of failure, please contact the machine manufacturer. He can supply an appropriate original unit or an approved successor item or arrange for maintenance.

⚠ CAUTION

Unauthorized exchange, repair and modifications

Malfunctions and failures of connected devices or the machine

a) When replacing, only replace with original filter.

b) Carefully replace the shielding in particular.

Technical support and repairs

KEB offers wide-ranging, complete after-sales technical support. The staff who deal with this handle questions on the entire range of products skilfully, quickly, and efficiently.

You can phone our staff in the service department, and they will give you complete, prompt advice on how to resolve your problems.

Telephone: +49 (0) 5263 401-0

Fax: +49 (0) 5263 401-116

E-Mail: (🌐► service@keb.de)

5.3 Disposal

Electronic devices of KEB Automation KG are intended for professional, commercial processing (so-called B2B devices).

Manufacturers of B2B devices are obliged to take back and recycle devices manufactured after 14.08.2018. In principle, these devices may not be left at public or communal recycling or collection points.



Unless otherwise agreed between the customer and KEB or unless there is a deviating mandatory legal regulation, KEB products labelled in this way can be returned. Company and keyword for the return point can be found in the list below.

Shipping costs are at the expense of the customer. The devices are then professionally recycled and disposed of.

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

Withdrawal by	WEEE registration no.	Keyword
Germany		
KEB Automation KG	EAR: DE12653519	Keyword: "Withdrawal WEEE"
France		
RÉCYLUM – Recycle point	ADEME: FR021806	Mots clés "KEB DEEE"
Italy		
COBAT	AEE: (IT) 19030000011216	Parola chiave "Ritiro RAEE"
Austria		
KEB Automation GmbH	ERA: 51976	Keyword: "Withdrawal WEEE"
Spain		
KEB Automation KG	RII-AEE: 7427	Palabra clave "Retirada RAEE"
Czech republic		
KEB Automation KG	RETELA: 09281/20-ECZ	Kličové slovo "Zpětný odběr OEEZ"
Slovakia		
KEB Automation KG	ASEKOL: RV22EEZ0000421	Kľúčové slovo: "Spätný odber OEEZ

The packaging must be sent for paper and cardboard recycling.

6 Revision history

Output	Version	Note
2026-08	00	Changeover to CI design and version number

Glossary

Application

The application is the intended use of the KEB product.

COMBIVERT

Proper name for a KEB Drive Controller.

Customer

The customer has purchased a product from KEB and integrates the KEB product into his product (customer product) or resells the KEB product (re-seller).

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Notes



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