AMKASYN
Servo Inverter KE/KW
Supplementary Filter AF-FE1
Device Description

Version: 2023/07
Part no.: 204027
Translation of the "Original Dokumentation"

AMKmotion
MEMBER OF THE ARBURG FAMILY

Notes on this documentation

Name: PDK_204027_AF-FE_Geraetebeschreibung

Version:

Version	Changes	Initials
2023/07	• AMKmotion Design	LeS

Previous version: 2019/04

Product version:

Product	Firmware version (Part no.)	Hardware version
AF-FE1	--	1.00

Purpose: Device description of supplementary filter AF-FE1

Reservation: We reserve the right to modify the content of the documentation as well as the delivery options for the product.

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For fast and reliable troubleshooting, you can help us by informing our Customer Service about the following:

- Type plate data for each unit
- Software version
- Device configuration and application
- Type of fault/problem and suspected cause
- Diagnostic messages (error messages)

E-mail service@amk-motion.com

Internet address: www.amk-motion.com

Appending Documents

Device description

AMK part no.	Title
28932	Servo drives KE/KW
200043	Liquid-cooled cold plate KW-CP
203424	Mains filter

Notation Conventions

Notation	Meaning
	This symbol points to parts of the text to which particular attention should be paid.
0x	0x followed by a hexadecimal number, e.g. 0x500A
'Name' 'Parameter' 'Diagnostic_message'	z.B.: Call up the function 'delete PLC programme' ID2 'SERCOS cycle time' 1042 'Mains phase fault'
'bold'	Menu items and keys available in a software or control unit, e.g.: Click the **'OK'** button in the **'Options'** menu to call up the 'Delete PLC program' function
>Input variable<	A variable that is entered using the operator interface.
->	Task procedure / operating sequence, e.g. **Windows** -> **System Properties** -> **Hardware**

Content

1 For your safety

1.1 Design of Safety Information

Any safety information is configured as follows:

⚠ SIGNAL WORD	
 Symbol	**Type and source of risk** Consequence(s) of non-observance **Steps to prevent:** • ...

1.2 Classes of Hazard

Safety and warning messages are graduated into classes of hazard (according to ANSI Z535). The class of hazard defines the potential risk of harm and is described by a single word, if the safety information is ignored. The signal word is followed by a safety alert symbol (ISO 3864, DIN EN ISO 7010). In accordance with ANSI Z535, the following signal words are used to define the class of hazard.

Safety alert symbol and signal word	Class of hazard and its meaning
⚠ DANGER	DANGER indicates a hazardous situation which, if not avoided, **will** result in death or serious injury
⚠ WARNING	WARNING indicates a hazardous situation which, if not avoided, **could** result in death or serious injury
⚠ CAUTION	CAUTION, used with the safety alert symbol, indicates a hazardous situation which, if not avoided, **could** result in minor or moderate injury
NOTICE	NOTICE is used to address preventions to avoid material damage, but not related to personal injury.

1.3 Used Safety Symbols

Safety symbol	Meaning
	Warning of a danger!
	Warning against dangerous electrical voltage!
 5 min	Warning against dangerous electrical voltage! It will last up to 5 minutes until the energy storage is discharged after it has been electrically disconnected.

1.4 General Safety Instructions

- The electricity, mechanical movements and high temperatures in electrical drive systems present hazards that can result in fatal injuries and material damage. These hazards are present while starting up and operating the unit, and also during servicing or maintenance work.
- Personnel must have read and understood the safety instructions before installing and operating the unit. In the documentation included with the product, the usage warnings pertain to direct hazards and must therefore be followed directly when operating or handling the unit by the operator.

- Compliance with all of the instructions given in the documentation included with the product will ensure safe and fault-free operation of the unit and is a prerequisite for asserting guarantee claims.
- AMK Arnold Müller GmbH & Co. KG shall not be held liable for any damages ensuing from using the unit in a manner contrary to the intended use, from faulty installation or from using the unit beyond the specified operating characteristics and conditions.
- Do not start the system in which the AMK products are installed (begin of intended use) until you can determine that all relevant standards, laws and directives have been complied with.

1.5 Intended Use

The supplementary filter AF-FE1 reduces the effects of the reactive currents in the motor leads and limits the disruption transferred to the public mains supply.

The supplementary filter may only be applied together with compact power supplies without internal mains filter.

The supplementary filter is intended for installation in a closed, adequately dimensioned switch cabinet which provides protection from direct contact in accordance with EN 50178.

1.6 Directives, Laws and Standards

AMKmotion products have been constructed using the "State of the Art" and are safe to operate. AMKmotion issues an EU declaration of conformity for each of its products in which the standards and guidelines relevant for the product are listed. AMKmotion also designates the products with the CE mark which signifies conformity to the standards. Since these standards are listed in the Official Journal of the EU, it can be assumed through their application that the product meets the basic safety and health requirements of the harmonization regulation, the so-called presumption of conformity applies.

1.7 Requirements for the Personnel and Their Qualification

Only authorised and qualified personnel may work on and with the AMKmotion .

Specialised personnel must:

- Perform mechanical and electrical work that is described in this documentation, such as mounting and connecting
- Observe all information in the documentation accompanying the product in order to work with the product safely and in an error-free manner
- Understand and know hazards that occur when handling the product
- Know connections and functions of the system
- Be familiar with the control concept in order to operate the
- Be authorised to switch circuits and devices on and off, earth and label them
- Observe local specific safety requirements

1.8 Safety Rules

In particular on drive systems, the instructions pertaining to safety and the following five safety rules have to be kept in the specified sequence:

1. Switch off electrical circuits (also electronic and auxiliary circuits).
2. Secure against being switched on again.
3. Determine that there is no voltage.
4. Ground and short circuit.
5. Cover or close off neighboring parts that are under voltage.

Reverse the measures taken in reverse order after completing the work.

1.9 Warranty

- All information in the documents accompanying the product must be complied with for a safe and trouble-free operation.
- The assertion of warranty claims is excluded if the information in the documents is not observed completely.
- Hardware and firmware may not be modified except by personnel authorized by AMKmotion and after consultation with AMKmotion.
- The company AMKmotion GmbH + Co KG is not liable for damages from unintended use, incorrect installation or operation, exceeding rated values and non-observance with the environmental conditions.

2 Product overview

2.1 Scope of Delivery

Please check whether the delivered parts correspond with the delivery note. If the delivery is incomplete, please contact your nearest AMKmotion representative.

Check the components for signs of transport damage after their arrival. Do not install and operate any damaged components.

If there is any transport damage, immediately inform the delivering freight carrier and inform your AMKmotion representative.

2.2 Ordering Data

Product name	Order number / AMK part no.
AF-FE1	O956

2.3 Product Description

Equipment with numerous inverter axes are constructed in modular fashion while the axles are operated on a shared DC bus and power is supplied via a compact power supply.

The mains supply is achieved centrally via a main contactor and mains choke on the compact power supply. Some types of compact power supplies are already fitted with internal mains filters. Others require the use of an external filter in front of the mains choke.

The number of inverters and the length of the motor leads connected to them determine the amplitude and duration of the reactive currents on the motor leads.

- In systems with numerous axes connected to a compact power supply, hardware synchronisation is typically activated between the inverters. This minimises the impact of the actual value measurement by means of switching operations of neighbouring inverters. Nevertheless, the reactive currents from the motor leads and motors superimpose one another at the same time.
- From a lead length of approx. 20 m, voltage edges and reactive currents extend in waves over the motor lead. This results in reflections on the lead ends to the sides of the motor and converter.

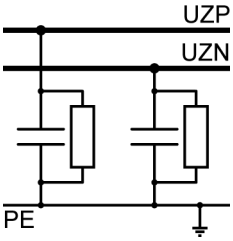
The number of KWs and the total lead length, amplified by the synchronisation, produces a load for the mains filter towards the mains voltage which leads to increased magnetisation of the filter.

This means the filter effect is lost and in addition the reaction of the drives on the mains can disrupt other mains participants and even destroy them in the case of greater drive power. The filter is also overheated due to excessive cyclic magnetisation losses.

In systems with large overall motor lead length, a high-saturation-proof mains filter is therefore used in connection with the supplementary filter unit AF-FE1.

The supplementary filter unit AF-FE1 supplements the mains filter by means of two capacitors with increased ampacity connected to the DC bus. These capacitors provide the pathway for the reactive currents against PE generated by the switching operations. The high-saturation-proof mains filter forms the required current-compensating series inductivity.

Simplified diagram AF-FE1

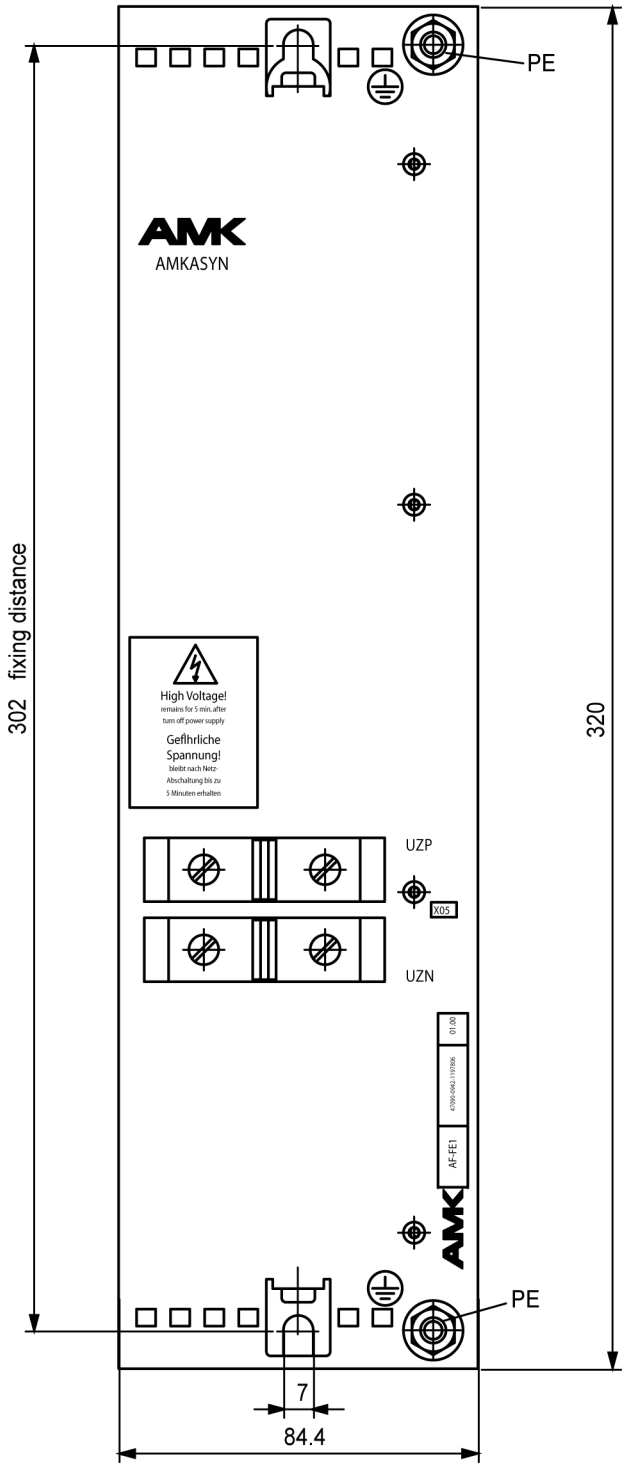


2.4 Technical data

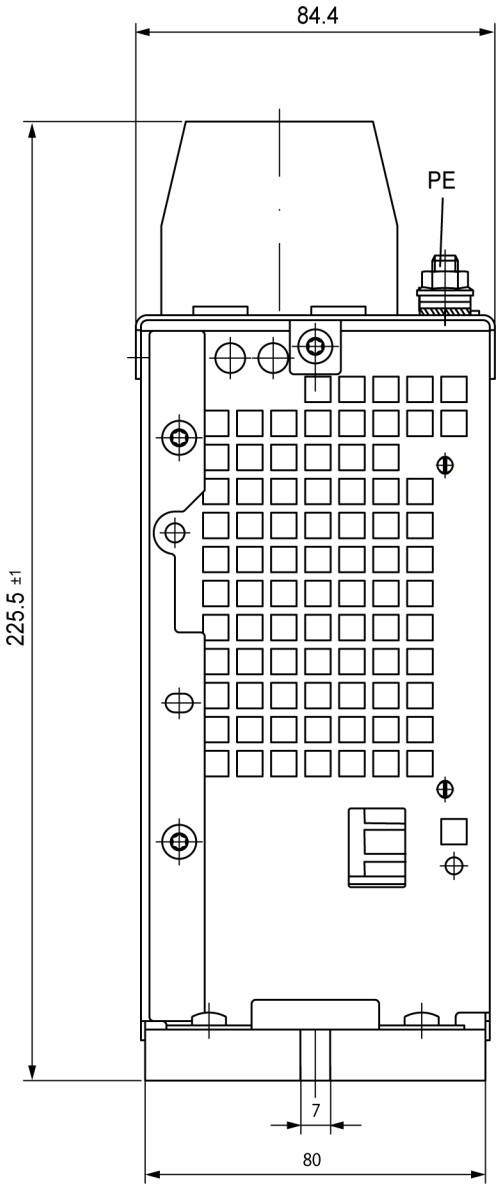
Name	AF-FE1
Input voltage	540 - 800 VDC
Permissible voltage increase per UZP / UZN	max. 340 V/µs
Current	max. 101 A eff
Conduction after PE per UZP / UZN (AWG 6, CSA22.1, Tab. 3, 105°C, Col. 4)	max. 52 A eff
Cooling	no cooling necessary
Outside measurements W x D x H	85 x 226 x 320 mm
Weight	2.8 kg

2.5 Dimensional Drawings

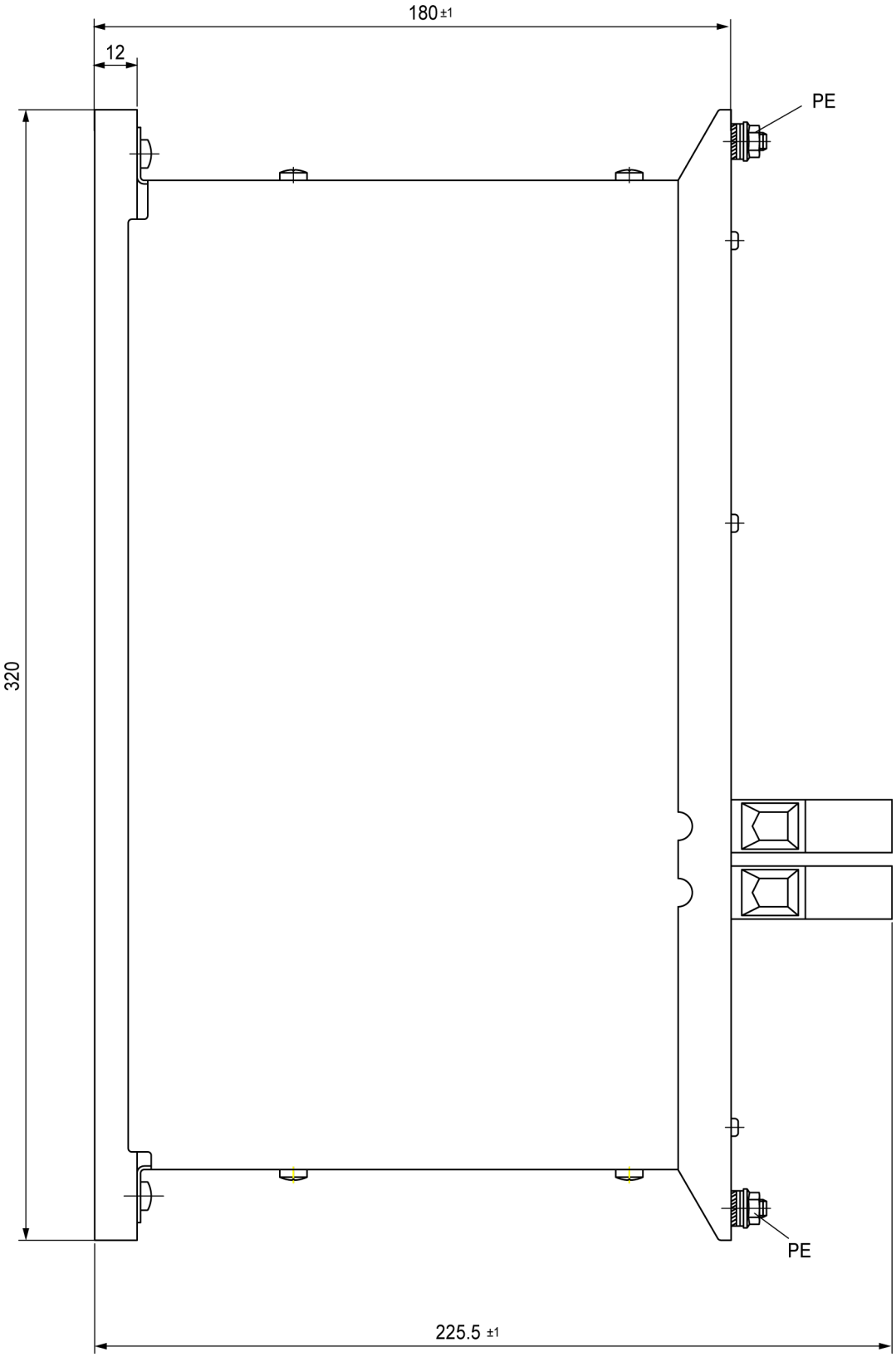
Front view



View from the bottom



Side view



3 Assembly and connection

3.1 For Your Safety

⚠ DANGER	
	**Lethal electrical hazard when touching electrical connections!** Electrical terminals and connectors carry voltages that may cause death or serious injury upon contact. When the LEDs on the front panels of the KE are OFF, this does not indicate that the electrical terminals have been de-energized. **Steps to prevent:** • Prior to any work on the device: Observe the 5 safety rules. • Measure the terminal voltages. There may be no voltage present. • Plug and pull connections only when there is no voltage.

3.2 Avoiding Material Damage

NOTICE	
Material Damage!	**Short circuit due to penetrating foreign objects or water** Foreign objects such as metal shavings, screws, etc. cause short circuits. In particular it needs to be prevented that water, e.g. condensation water, seeps in through the cooling units. A temporary forming of dew may only occur as long as the devices are out of operation. **Steps to prevent:** • The modules need to be protected against penetrating foreign objects or water. • When applying mains voltage, no dew may be present any longer.

NOTICE	
Material Damage!	**Observe the tightening torques.** Note the tightening torques specified in the documentation for screw connections and screw terminals, otherwise the conductivity and the security of the connection are not ensured.

3.3 Assembly

The supplementary filter AF-FE1 is integrated in the direct voltage DC bus (Siehe 'Connection' auf Seite 14.) and must be positioned as close as possible to the compact power supply KE / KEN / KES.

As the supplementary filter need not necessarily be cooled via the rear wall, an attachment to the rear assembly wall of the switch cabinet is possible. Even so, the tap line between the compact power supply and the supplementary filter must be kept as short as possible. The maximum possible distance depends on the equipment.

The supplementary filter may not be connected to the end of the row of inverters.

The supplementary filter can also be fitted next to the compact power supply on the cold plate.

3.3.1 Attachment on the Rear Assembly Wall

If the supplementary filter is to be attached to the rear assembly wall of the switch cabinet, the distance to the compact power supply is to be kept as short as possible. However, there should also be clearance above and below the KE/KW modules of 100 mm in each case. The supplementary filter can be attached directly to the sides.

In accordance with the dimensional drawing, the bore holes are to have an M6 internal thread.

The supplementary filter is attached with M6 x 20 mm screws which are tightened with 9.6 Nm.

3.3.2 Assembly on Cold Plate KW-CPxx

The supplementary filter is assembled directly on the cooling system without thermal conductance paste.

Take the following into account during the assembly process:

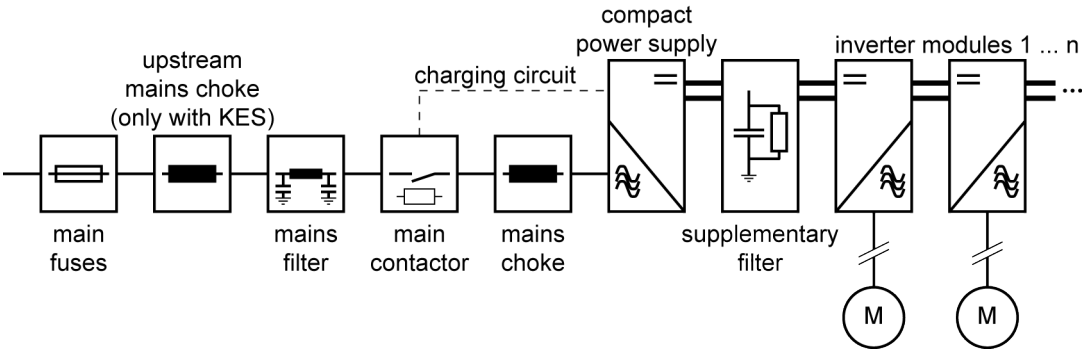
- the protective cardboard on the contact surface (cold plate) of the supplementary filter must be removed.
- The assembly surfaces of the supplementary filter and cold plate place must be clean and scratch-free.
- For the attachment of the supplementary filter, the cold plate has a T slot in accordance with DIN 508 at both the top and bottom. Appropriate slot nuts (AMK part no. 18139) must be used in these with an internal thread of M6 for attachment screws M6 x 20 mm.
- The attachment screws are tightened with 8 Nm (Tool: Allen size 5).

(CF. also 'PDK_200043_KW-CPxxx')

3.4 Connection

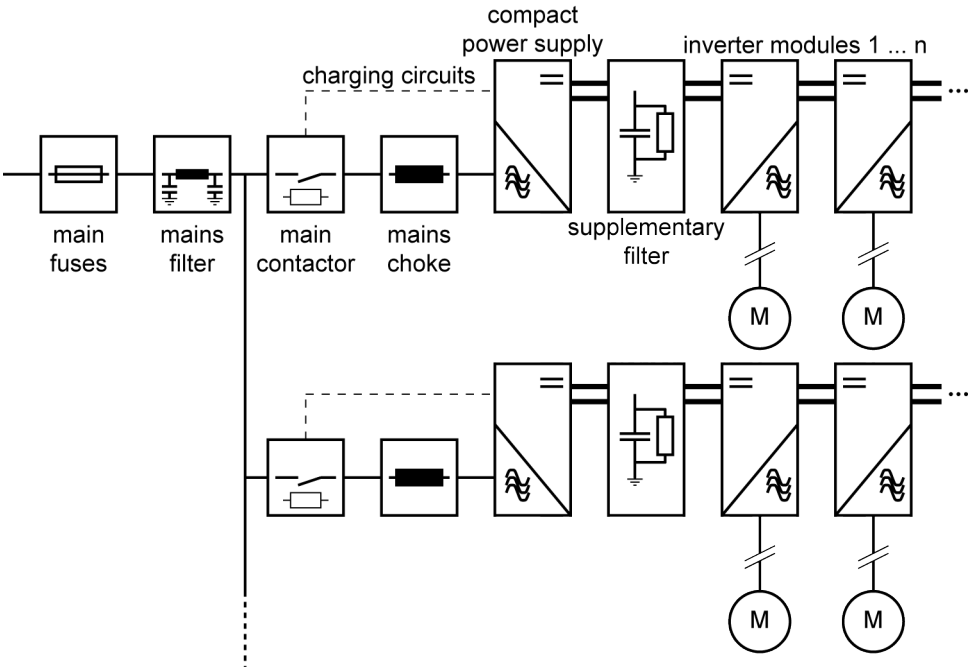
The supplementary filter AF-FE1 is integrated in the direct voltage DC Bus between the compact power supply and the first inverter.

Arrangement of the supplementary filter with one compact power supply KEN / KE / KES:

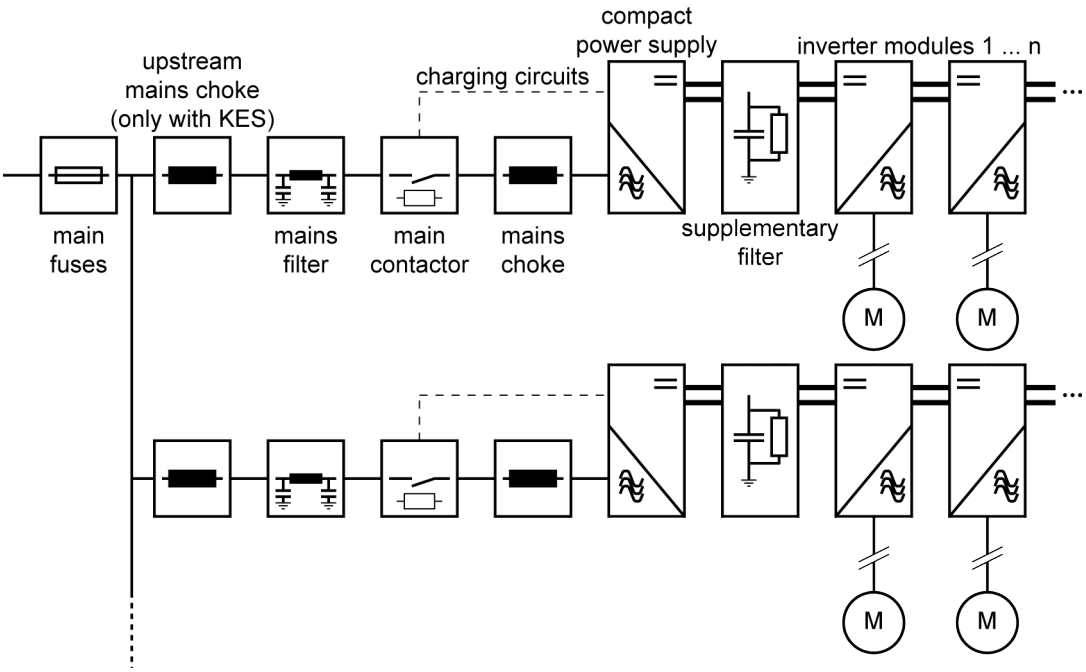


Arrangement of filter supplements with several compact power supplies:

Compact power supply KEN or KE



Compact power supply KES



NOTICE	
Material Damage!	**Destruction of standard mains filter due to less ampacity** In combination with a supplementary filter AF-FE1 the standard mains filters AF 90 / AF 180 may be destroyed because they feature less ampacity than the mains filters AF 90-S / AF 180-S. **Steps to prevent:** • In combination with the supplementary filter AF-FE1, use exclusively the mains filters AF 90-S or AF 180-S

NOTICE	
Material Damage!	**Destruction of compact power supply with integrated mains filter** If the supplementary filter AF-FE1 is applied together with a compact power supply with integrated mains filter (KE / KEN-5 / -10 / -20 / -40), the power supply can be damaged. The integrated mains filters in these power supplies feature less ampacity than the mains filter AF 90-S / AF 180-S **Steps to prevent:** • The supplementary filter AF-FE1 may only be implemented with compact power supplies without integrated mains filter: ◦ KEN 60 (KE 60-S4)/ KEN 120 ◦ KE 60 / KE 120 ◦ KES 60 / KES 120

Select the mains choke according to the compact power supply.
(See also document 'PDK_028932_KEKW_Hardware')

Mains filter and mains choke

Compact power supply	Mains filter		Mains choke	
	Type	AMK part no.	Type	AMK part no.
KEN 60 (KE 60-S4)	AF 90-S	O825	ALN 85	O729
KEN 120	AF 180-S	O812	ALN 180	O739

Compact power supply	Mains filter		Mains choke	
	Type	AMK part no.	Type	AMK part no.
KE 60	AF 90-S	O825	ALN 85	O729
KE 120	AF 180-S	O812	ALN 180	O739
KES 60	AF 90-S	O825	ALN 90-S 1)	O770
			ALN 45-SI 2)	O789
KES 120	AF 180-S	O812	ALN 180-S 1)	O771
			ALN 60-SI 2)	O790

1) continuous operation
2) pulsed operation

When using the supplementary filter AF-FE1 together with a mains filter AFxxx-**S**, the terminal X03 of the mains filter must not be connected!

3.4.1 PE Connection

DANGER

Risk of death by electrical shock

In the event of an interruption to the PE connection, avoid touching the casing because life-threatening levels of voltage may be present!

The PE connection is mandatory for the function of the supplementary filter and must be connected!

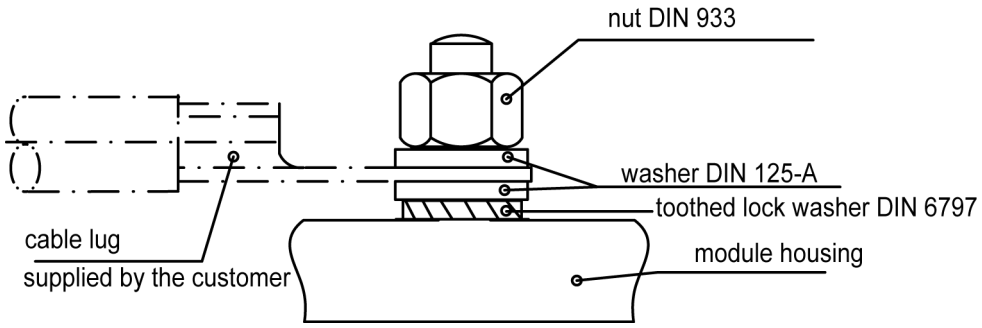
Steps to prevent:

- EN50178 requires that the devices be firmly connected on the power side.
- The PE conductor must have a cross-section of at least 10 mm^2.

Description:

The PE connection is a screw bolt on the module casing (see front view) for attaching PE lines and cable shields.

Configure as follows:



Connection:

Recommended cable type	1-wire, unshielded
Cable assembly	Ring cable lug
Recommended wire cross-sections	25 mm^2 AWG 2
Tightening torque	15 Nm
Note	The casing of the supplementary filter must be connected to earth (central PE bus bar in switch cabinet) directly and on the most direct means possible. Throughout the entire system, the earthing must be installed in a star-shaped configuration, extending from the central earthing point.

3.4.2 [X05] DC Bus

⚠ DANGER	
5 min	**Risk of death by electric shock** LED displays on the front of the compact power supply cabinets, when indicating OFF, do not mean that the device terminals are voltage-free. After switching off the network, the buffer capacitors for the DC bus may still be charged and result in hazardous direct current. **Steps to prevent:** • After switching off, expect a discharge time of at least 5 minutes. • For safety's sake, measure the voltage in the DC Bus at the UZP/UZN terminals.

Description:

The direct voltage DC bus supplies the compact inverters connected.

Technical Data:

Siehe 'Technical data' auf Seite 9.

Version:

Type	Pins
Screw terminal	2

Module name	Connection
UZP	DC bus voltage (+)
UZN	DC bus voltage (-)

Connection:

Recommended cable type	2 x 1 wire, unshielded Use only AMK DC bus UZ cable sets.
Cable assembly	Wire end ferrule with plastic sheath
Shield connection	If available, attach on both sides
Cross-section min./max.	4 mm² / 25 mm² AWG 10 / AWG 2
Recommended wire cross-sections	Cable set KW-UZ170/1 (46622) 25 mm^2 / AWG 2 170 mm Use in combination with KE / KEN / KES 60
Cable stripping length	19 mm
Tightening torque	4.0 - 4.5 Nm
Terminal	HDFKV25TWIN[1)]

Note	1) When using pin cable lug: Siehe 'Terminal connection technology' auf Seite 17.

When using the supplementary filter AF-FE1 together with a mains filter AFxxx-**S**, the terminal X03 of the mains filter must not be connected!

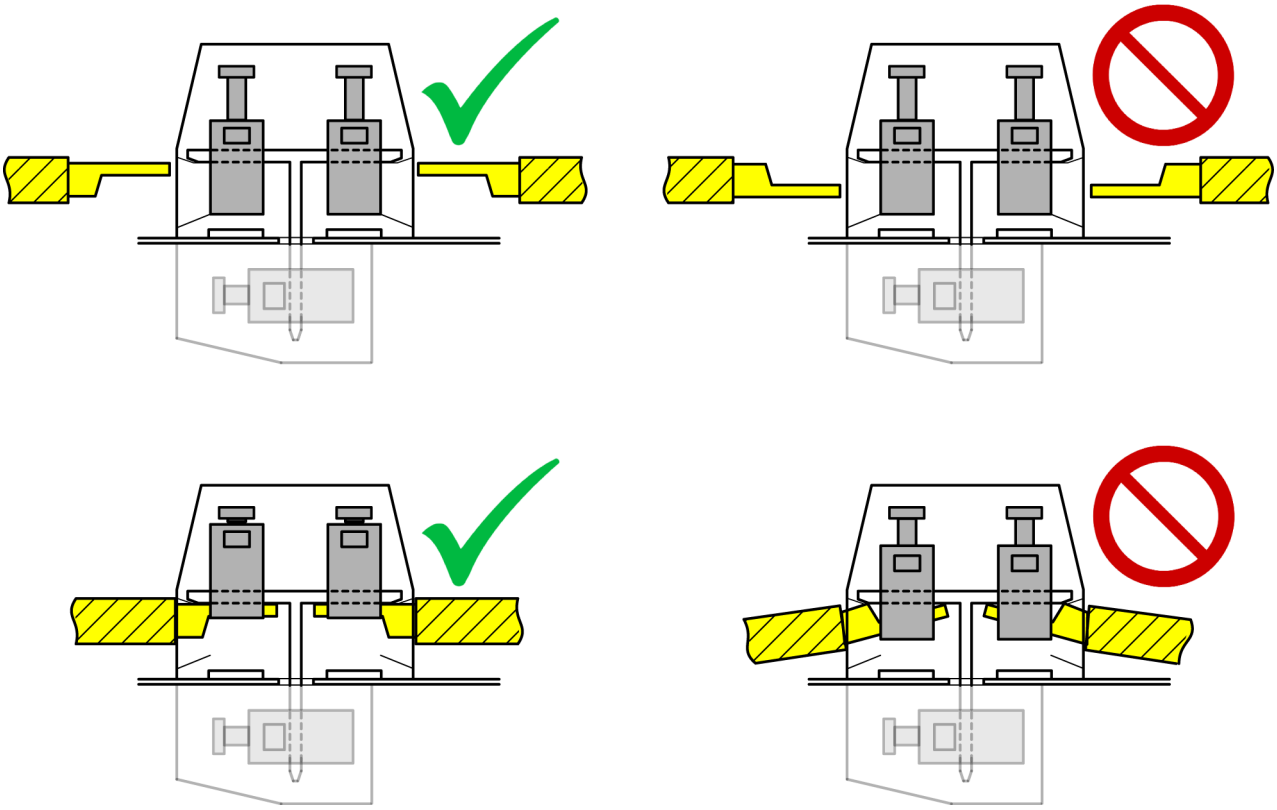
When using the supplementary filter AF-FE1 with a compact power supply KE / KEN / KES 120, the UZ cable sets are to be requested from your AMK representative.

3.4.3 Terminal connection technology

When using pin cable lugs please note!

Terminal HDFKVxx - TWIN

Connection	Description
[X05]	DC bus



Your opinion is important!

With our documentation we want to offer you the highest quality support in handling the AMKmotion products.
That is why we are now working on optimizing our documentation.
Your comments or suggestions are always of interest to us.
We would be grateful if you take a bit of time and answer our questions. Please return a copy of this page to us.

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Thank you for your assistance.
Your AMKmotion documentation team

1. How would you rate the layout of our AMKmotion documentation?

   (1) very good (2) good (3) satisfactory (4) less than satisfactory (5) poor

2. Is the content structured well?

   (1) very good (2) good (3) moderate (4) hardly (5) not at all

3. How easy is it to understand the documentation?

   (1) very easy (2) easy (3) moderately easy (4) difficult (5) extremely difficult

4. Did you miss any topics in the documentation?

   (1) no (2) if yes, which ones:

5. How would you rate the overall service at AMKmotion?

   (1) very good (2) good (3) satisfactory (4) less than satisfactory (5) poor

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