



Operating Manual Harmonic-Filter EPA HFE

Power Rating: 4 - 440kW
Voltage Rating: 380V, 400V, 460V
500V, 600V, 690V

| | | |
|----------|--|-----------|
| 1 | Important information | 3 |
| 1.1 | About the operating instructions..... | 3 |
| 1.2 | Uses terms and definitions | 3 |
| 1.3 | SI units and symbols | 4 |
| 1.4 | Unit designation..... | 5 |
| 1.5 | Legal regulations | 6 |
| 1.6 | Scope of supply..... | 7 |
| 2 | Safety instructions | 8 |
| 2.1 | Layout of the safety instructions..... | 9 |
| 2.2 | General safety guidelines..... | 10 |
| 2.3 | For the safety responsible persons | 12 |
| 2.4 | Specification of the used lines..... | 13 |
| 2.5 | Remaining danger | 13 |
| 3 | Introduction into the subject harmonics | 14 |
| 3.1 | The theoretical basics | 16 |
| 4 | Introduction into the subject filter modules | 20 |
| 4.1 | Harmonic line filter for frequency converters | 20 |
| 5 | EG- directives / Declaration of conformity | 22 |
| 5.1 | What is the purpose of EG-directives?..... | 22 |
| 5.2 | What is the meaning of the CE- marking? | 22 |
| 5.3 | EG-directive low voltage | 22 |
| 5.4 | EG-directive Electromagnetic compatibility..... | 23 |
| 5.5 | EG-directive on machinery | 24 |
| 6 | Selection of the right filter module and technical data | 25 |
| 6.1 | Calculation..... | 25 |
| 6.2 | Worked sample | 26 |
| 6.3 | Characteristics..... | 27 |
| 6.4 | General Data / Operation conditions..... | 28 |
| 6.5 | Rating values..... | 30 |
| 6.6 | Article numbers and Ampacity HFE | 31 |
| 6.7 | Cable cross section | 35 |
| 6.8 | General information..... | 35 |
| 6.9 | Electrical operating conditions HFE | 36 |
| 6.10 | Allocation of the fans | 43 |
| 6.11 | Dimension diagrams..... | 49 |
| 7 | Installation..... | 57 |
| 7.1 | Mechanical installation | 57 |
| 7.2 | International protection rating..... | 58 |
| 7.3 | Specified mounting position | 61 |
| 7.4 | The air ventilation | 62 |
| 8 | Electrical installation..... | 63 |
| 8.1 | Network configuration / Net conditions..... | 63 |
| 8.2 | Wiring diagram HFE | 64 |
| 8.3 | Line connection | 67 |
| 8.4 | Fuses..... | 68 |
| 8.6 | Installation in a CE- typical drive system..... | 70 |
| 8.7 | Installation | 71 |
| 8.8 | Installation of a EMC- conform electrical enclosure | 72 |
| 8.9 | Note | 73 |

Contents

| | | |
|-----------|--|-----------|
| 9 | Commissioning..... | 74 |
| 9.1 | First switching-on | 74 |
| 10 | Capacitor disconnect operation state..... | 75 |
| 11 | EPA product overview..... | 77 |
| 12 | Contact | 78 |
| 13 | Index and directory | 79 |
| 13.1 | List of figures | 80 |
| 13.2 | List of tables | 81 |

1 Important information

1.1 About the operating instructions

- These present operating instructions are the translation of the original instructions, which were composed in the official EU language German.
- This operating instructions act for working secured with the filter module *EPA HFE*. It contains security advices which must be observed and information which are necessary for an undisturbed operation of the units together with the exploitation of all advantages of the system.
- All persons who work on and with the filter module *EPA HFE* must have the operating instructions accessible, or the equal chapters of the operating instructions for other with this option equipped *EPA* products available. All persons must follow the relevant notes and designations.
- The operating instructions must be complete and perfectly legible

1.2 Uses terms and definitions

Filter module

For “Filter module *EPA HFE*” the term “Filter module” is used in the following chapters, if the designation refers to all types (A, B).
For different characteristics, the complete marking (for example HFE-A) is used.

Drive system control

For the frequency convert which is used together with the filter module, the term “Controller” is used.

Drive system

For a drive system with filter modules, controller and other components of the drive system in the following the term “Drive system” is used.

Important information

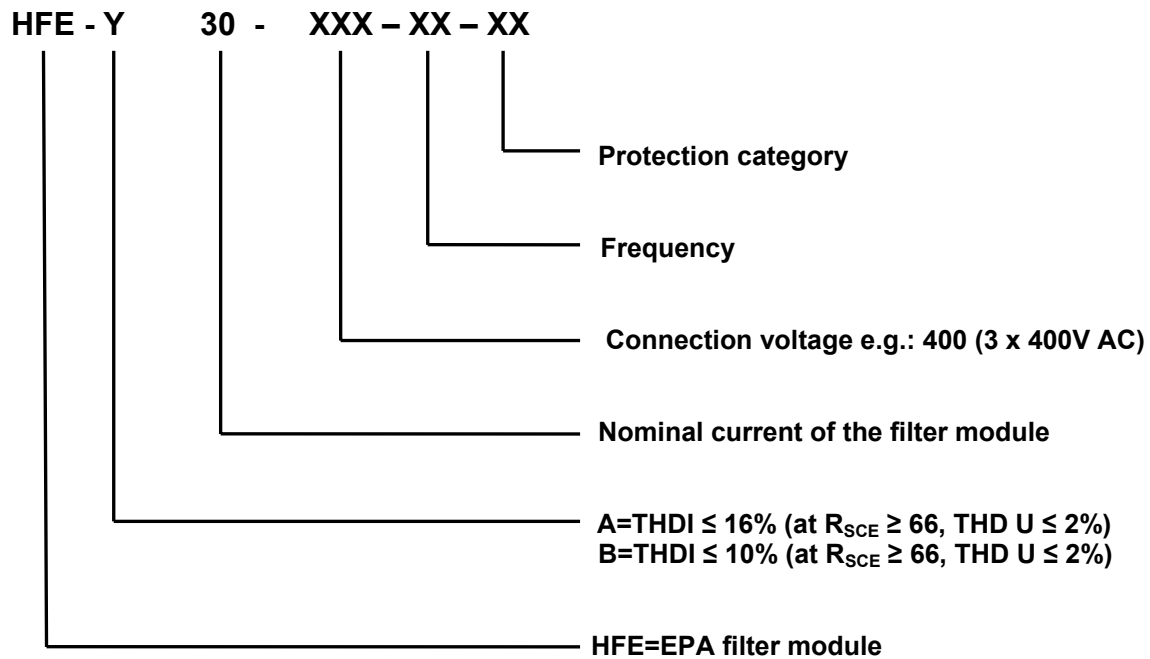
1.3 SI units and symbols

| | Prefix | Symbol | | Prefix | Symbol |
|-----------|--------|--------|------------|--------|--------|
| 10^{24} | Yotta | Y | 10^{-1} | Deci | D |
| 10^{21} | Zetta | Z | 10^{-2} | Centi | C |
| 10^{18} | Exa | E | 10^{-3} | Milli | M |
| 10^{15} | Peta | P | 10^{-6} | Micro | μ |
| 10^{12} | Tera | T | 10^{-9} | Nano | N |
| 10^9 | Giga | G | 10^{-12} | Pico | P |
| 10^6 | Mega | M | 10^{-15} | Femto | F |
| 10^3 | Kilo | k | 10^{-18} | Atto | A |
| 10^2 | Hecto | h | 10^{-21} | Zepto | Z |
| 10^1 | Deca | da | 10^{-24} | Yocto | Y |

| Measure | Name |
|---------------------------|----------|
| Ampere | A |
| Speed | n |
| Farad | F |
| Frequency | f |
| Degree Celsius | °C |
| Gramm | g |
| Henry | H |
| Hertz | Hz |
| Magnetic flux density | T |
| Meter | m |
| Minute | min |
| Newton meter | Nm |
| Second | s |
| Thermodynamic temperature | K |
| Volt | V |
| Resistor, electrical | Ω |
| Real power | W |
| Efficiency factor | η |

| Measure | Name |
|-------------------------------|-------------------|
| Electromagnetic compatibility | EMV |
| Direct current | DC |
| Motor nominal frequency | $f_{M,N}$ |
| Motor power rating | $P_{M,N}$ |
| Motor nominal voltage | $U_{M,N}$ |
| Motor nominal current | $I_{M,N}$ |
| Nominal current HFE module | I_{RMS} |
| Power input current | $I_{FC,L}$ |
| Revolutions per minute | min^{-1} |
| Alternating current | AC |

1.4 Unit designation



Example: Nameplate HFE-A 72-400-50-20-A:

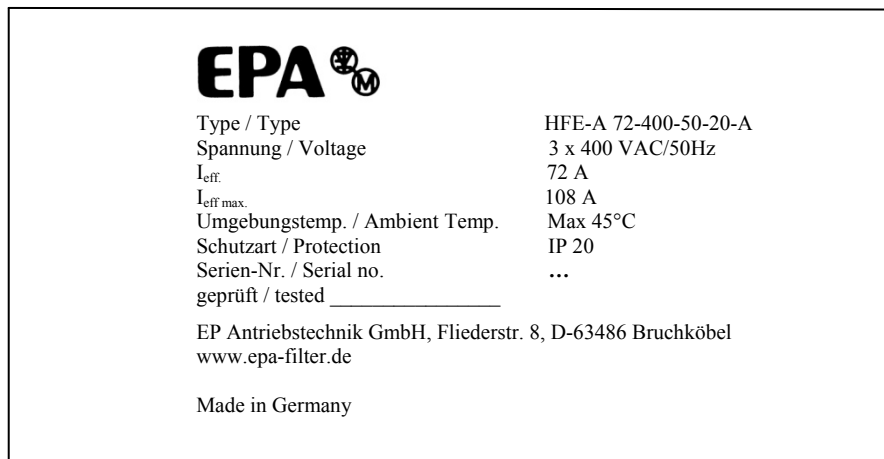


Figure 1: The EPA HFE nameplate

Important information

1.5 Legal regulations

| | | | |
|--------------------------|--|---|--|
| Marking | Name plate | CE-marking | Manufacturer |
| | Filter modules EPA HFE are clearly marked by the content of the nameplate | Conformable to EG directive "low-voltage" | <i>EP Antriebstechnik</i> Fliederstr. 8 D-63486 Bruchköbel |
| Trade mark rights | The filter module EPA HFE is protected in the Federal Republic of Germany by utility patents. Violation of this utility patent and the verbalized trade mark rights will be prosecuted criminally. | | |
| Intended use | Inverter <ul style="list-style-type: none"> only to use under the terms of this operating instructions and the required operational conditions are components <ul style="list-style-type: none"> to reduce the harmonic distortions of the electrical network by specific B6 rectifiers and inverters to fit in a machine to assembly with other components to a machine together are electric equipment to assembly in a electrical enclosure or similar locked up operations rooms conform to the protection requirements of the EG directive "low-voltage " are no machines in terms of the EG directive "machines" are no household appliances, but components which are determined only for the further application in commercial use Drive system with inverter <ul style="list-style-type: none"> conform to the EG directive "Electromagnetic Compatibility", if they are installed by the specifications of the CE-typical drive control system are applicable <ul style="list-style-type: none"> in the public electrical network and closed electrical networks. in the industrial sector and in living areas as well as in business units. The responsibility for the compliancy of the EG directive with the machine application is one for the user. | | |
| Liability | <ul style="list-style-type: none"> The indicated information, technical data and notes in this operating instruction were updated at the time of the printing. No demands for changing a delivered filter module can be asserted by the information, figures and descriptions of these operating instructions. The represented process engineering notes in this operating instructions and circuit details are suggestions, which transferability on the respective application must be verified. For the suitability of the specified procedures and circuit suggestions accepts the <i>EP Antriebstechnik GmbH</i> no guarantee. The data in these operating instructions describe the characteristic of the products without ensuring them. No Liability will be taken over for damages and malfunctions which result by: <ul style="list-style-type: none"> disregard of the operating instructions arbitrary changes on the filter module operating errors improper works on and with the inverter | | |
| Warranty | <ul style="list-style-type: none"> Warranty conditions: Look at the sales - and delivery conditions of the <i>EP Antriebstechnik GmbH</i>. Immediately announce guarantee claims after the discovery of defects or faults The warranty expires in all cases, in which even no liability claims can be asserted. | | |
| Disposal | Material | Recycling | Disposal |
| | Metal | ● | - |
| | Plastic | ● | - |

1.6 Scope of supply

- 1 filter module HFE
- 1 operating instructions
- After receipt of the delivery verify immediately, if the scope of supply correspond to the shipping documents. We make no warranty for later complained defects
- Complain
- visible damages in transit immediately at the deliverer
- visible defects / incompleteness immediately at EPA

Safety instructions

2 Safety instructions



Safety- and application instructions for propulsion converters

(in conformity with low- voltage directive 2006/95/EG)

1. General

During the operation filter modules can own according to their protection class live, blank and if necessary even movable parts, as well as hot surfaces.

The hazard of severe person or property damage exists at not permissible removal of the required coverage, at inadmissible application, at false Installation or operation.

Further information can be learned from the documentation.

All works for transport for installation and commissioning as well as maintenance has to be done by specialized staff (IEC 60364 or CENELEC HD 384 or DIN VDE 0100 und IEC-Report 664 or DIN VDE 0110 and observe national accident prevention regulations).

Specialized staffs in terms of these fundamental safety instructions are persons who are acquainted with installation, assembly, commissioning and operation of the product and who dispose through their work of the corresponding Qualifications.

2. Conventional application

Filter modules are components that are conventional for the installation in electrical systems or machines.

At the installation in machines is the startup of the filter modules (the start of the conventional operation) prohibited until it is determined that the machine complies with the regulations of the EG directive 2006/42/EG (Machine directive); EN 60204 is to observe.

The startup (the start of the conventional operation) is only allowed under compliance of the EMC-directive. The filter modules comply with the requirement of the low- voltage directive 2006/95/EG. The technical Data and also the data of the connecting conditions have to be taken from the nameplate and the documentation and they have to be necessarily observed.

3. Transport, storage

The information for Transport, storage and appropriate Handling has to be observed.

The filter module has to be protected of not permissible stress. Particularly at transport und handling no components must have to be bent and / or insulation distances being changed. The touch of electric components and contacts is therefore to avoid. At mechanical defects at electric and other components it is not allowed to commission the device, because a compliance of applied standards is not longer guaranteed. Climatic conditions have to be observed accordant to prEN 50178.

These safety instructions have to be kept!

Observe also the product specific safety- and application notes of these operating instructions!

4. Assembly

The Assembly and cooling of the devices must occur accordingly the instructions of the respective documentation. The filter modules have to be protected of not permissible stress. Particularly at transport und handling no components must have to be bent and / or insulation distances being changed. The touch of electric components and contacts is therefore to avoid. Electric components must not be mechanical damaged or destroyed. (Under conditions health hazards!).

At mechanical defects at electric and other components it is not allowed to start up the device, because a compliance of applied standards is not longer guaranteed.

5. Electrical connection

At live-line working on filter modules apply national accident prevention regulations (VBG 4) must be observed. Before any installation- and connection works the system must be operated on dead voltage and accordingly must be secured.

The electric installation must be performed according to the respective instructions (e.g. cable cross- section, fuses, connection to the protective conductor). At usage of the filter module with drive system control without a safe disconnect from the supplying circuit (according to VDE 0100) all control cables must be included in additional protective measures (e.g. double insulated or shielded, grounded and insulated).

Notes for the EMV-conform installation – like shielding, grounding, arrangements of filter modules and the installing of conductors – are located in the chapter "Installation of these operating instructions". These notes must even be observed at CE-marked propulsion converters. The compliance of the required limit values by the EMV- legislation is up to the responsibility of the manufacturer of the system or the machine.

6. Operation

After disconnect of the filter modules of the supply voltage, it is not allowed to touch live-line device parts and line connections because possibly charged capacitors must not be touched immediately.

During the operation all covers and doors must be closed.

7. Service and Maintenance

The operation of the manufacturer must be observed.

2.1 Layout of the safety instructions

All safety instructions are built uniformly:

- The pictogram marks the type of danger.
- The signal word marks the severity of danger.
- The legend marks the danger and gives notes, how to avoid the danger.



Signal word

Legend

| | Used pictograms | | Signal words | |
|---|-----------------|------------------------------|-----------------|--|
| Warning of injury to persons | | Imminent danger by current | Danger! | Warns of an immediately imminent Danger. Consequences by disregard: Death or severe injuries |
| | | Warning of a imminent danger | Warning! | Warns of a possible, very danger situation. Possible consequences by disregard: Death or severe injuries |
| | | Dangerous situation | Caution! | Warns of a possible, dangerous situation. Possible consequences by disregard: Minor or small injuries |
| | | Warning of hot surface | Warning! | Warns of touching a hot surface. Possible consequences by disregard: Burnings |
| Warning of property damages | | Harmful situation | Stop! | Warns of possible property damages. Possible consequences by disregard: Damage of the drive system or its surroundings |
| Useful information and application notes | | Information | Note! | Marks a generally, useful note, tip. If you follow it, you make the handling of the filter module easier |

Table 1: Layout of the safety instructions

Safety instructions

2.2 General safety guidelines

- No demand of completeness will be raised with these safety guidelines.
- By questions and problems please confer with a technician of our company.
- The filter module complies at the time of the delivery the status of the technical and is valid fundamentally as reliable.
- The data of these operation instructions describe the characteristics of the products, without assuring them.
- Dangers go out from the filter module for persons, the filter module itself and for other material assets, when
 - not qualified staff are working on and with the filter module
 - the filter module is used improperly
- Filter modules must be so projected, that they comply their function at proper installation, at intended use and at error-free operation and cause no danger for persons. This is valid even for their interaction with the complete plant.
- The in this operation instructions represented procedural notes and circuit details have to be understood analogously and have to be verified to assignability to the current application.
- Operate the drive system only at perfect state.
- Changes or modifications of the filter module are fundamentally prohibited. They require in any event the confer with a technician of our company
- The granted guarantee from us expires, if the device is changed or (even partly) dismantled, or if it is deployed in contradiction to our instruction.
- The right selection and arrangement of the electrical equipment is the responsibility of the installer of the plant, the knowledge of technical rules is expected from the installer.
- The operation of the filter module is only permitted on standard conform grids of the electrical energy supply! Disregard can lead to reduction of the filter effect and possibly to destruction of the filter module.

- According to the corresponding standards and guidelines is the operation even at for a short time overcompensated grids ($\cos\varphi \leq 1$) respectively at compensation plants without chokes not permitted, because the otherwise caused by oscillation recurrent surges can damage all connected loads, particularly electronic equipment for example drive controller and power feedback units damage.

Stop!



An undisturbed and safe operation of the filter module is only to expect under the observance of the following connection instructions.

At deviations of these guidelines in individual case malfunctions and damages could occur:

- Observe the grid voltage.
- Run power- and control lines separated ($> 15\text{cm}$)
- Use shielded / twisted control lines only
- Run the shielding riveted to PE!
- Ground the enclosure of drive, drive control, power feedback unit and filter module safe. Connect Shielding of power lines riveted and extensive (Remove the lacquer)!
- Ground the electrical enclosure or the plant to main ground star point sigmoid (necessarily avoid ground loops!)
- The filter module is only determined for a solid connection, because particularly at the application of interference filter leakage current of 3,5 mA appear. The protective earth conductor must average minimum 10 mm² copper, or one second conductor must be ran electrical parallel to Ground (grounded neutral point sigmoid).

Safety instructions

2.3 For the safety responsible persons

Operator

- Operator is every natural or legal person, which uses the drive system or in which order the drive system is used.
- The operator respectively his safety representative must assure:
 - That all relevant instructions, notes and laws will be abided
 - That only qualified staff works on and with the drive system
 - That the staff has the operating instructions at all respective works available
 - That not qualified staff is the work on and with the drive system prohibited.

Qualified staff

Stop!



Qualified staff means persons, that are entitled (by the safety responsible) due to their training, experience, education, their knowledge in relevant norms, directives, accident directives and operation conditions to execute the necessary works and to recognize possible danger and to avoid it. (Definition of qualified staff IEC 364)

2.4 Specification of the used lines

- The used lines must conform to the required specification at the site
- The regulations about the minimum cross- section of PE-conductors must be necessarily observed.

Connection:

- The connection occurs by the terminals X1.1-X1.3 and X2.1-X2.3
- The temperature monitoring must be connected with the terminals A/B of the filter module with the pulse lock of the converter.

Stop!



If this connection is not made so or analogously (for example with SPS), the filter module can be damaged at constantly overload operation.

Caution!



If this connection is not made so or analogously (for example with SPS) and the installation instructions (chapter 8) are not observed, this could lead to a thermal overload of the filter module and possibly to a smoke emission and/or a fire.

2.5 Remaining danger

Danger!



After switching off the electrical network, the connections for X1.1, X1.2 and X1.3 and if necessary X2.1, X2.2 and X2.3 could lead dangerous voltage for some minutes.

3 Introduction into the subject harmonics

Harmonics are created by electronically regulated equipment or by equipment with non-linear characteristic curve. The equipment adjusts a not sinusoidal current from the grid power supply. This leads to a creation of harmonic currents. Because of galvanic junction the harmonics spread in the whole grid power supply. This leads at a considered grid connection point because of the available grid replacement impedance to a fall of voltage, which leads to a harmonic voltage. The harmonics overlap the fundamental term of the voltage and leads to a distortion of the sinusoidal voltage characteristic.

The mathematician and physician Fourier developed a method, which describes not sinusoidal signals: The harmonic Analysis or even called Fourier transform. At the overlap of an endless number of voltages with respectively rising frequency and aligned amplitude any wave forms occur. The calculation instruction for the coefficients can be taken out of mathematic table books.

As harmonics are sinusoidal oscillations designated, which frequencies are an integer multiple (ordinal number h) of the 50 Hz grid frequency (fundamental term).

As interharmonics are sinusoidal oscillations designated, which frequencies are no integer multiple (μ) of the grid frequency.

The limits for harmonic current emissions are defined in the standard EN 61000-3-12.

The compatibility level of the harmonics voltages is defined in the standards EN 61000-2-2 and EN 50160.

DIN EN 61000-3-12 Electromagnetic Compatibility (EMC):

This standard contains the German version of the European standard EN 61000-3-12:2005 and is identical with the international standard IEC 61000-3-12:2004. It contains requirements and limits for harmonic current emissions, which are caused by devices and equipments, that own a rated current above 16 A to maximum 75 A, and that are designated for connection to the public low-voltage power supply systems.

DIN EN 61000-2-2 Electromagnetic compatibility (EMC):

Environment conditions, compatibility levels for low- frequency, conducted disturbances and signalling transmission in public low-voltage power supply systems (IEC 61000-2-2:2002); German Version EN 61000-2-2:2002

Specifications of the quality of the public low-voltage power supply systems and industrial low- voltage from 50 to 2500 Hz.
Compatibility level U_h for harmonics to $h = 50$

EN 50160: Electricity product characteristics and electromagnetic compatibility: Voltage characteristics of electricity supplied by public distribution systems; Deutsche version EN 50160:2007:

This standard contains the German version of the standard DIN EN 50160 with data to the characteristics of electricity supplied by public distribution systems

Associated to the subject circuit harmonic distortions in industrial circuits the power factor λ plays a central role.

Introduction

3.1 The theoretical basics

At **sinusoidal** current- and voltage characteristics is valid under consideration of a phase difference between current and voltage:

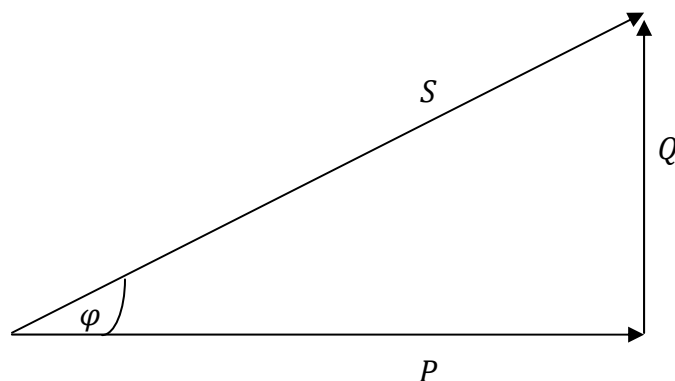
These phase difference often designated, even at measurement devices, as displacement factor.

Real power:

$$P = U * I * \cos \varphi$$

Power factor:

$$\lambda = \cos \varphi$$



At non **sinusoidal** current- and voltage characteristics is valid:

The power factor (power factor) is as the ratio of real- and complex power defined:

$$\lambda = \frac{P}{S}$$

For the time variable power $s_{(t)}$ is incidental:

$$s_{(t)} = u_{(t)} * i_{(t)}$$

For the real power P the arithmetic mean of this power function is valid:

$$P = \frac{1}{T} * \int_0^T s(t) dt$$

The complex power complies with the product of root-mean-square voltage and current:

$$S = U * I$$

If the voltage is sinusoidal and the current is afflicted by harmonics, the fundamental reactive power can be calculated:

$$Q_1 = U * I_1 * \sin \varphi_1$$

For the real power follows:

$$P_1 = U * I_1 * \cos \varphi_1$$

For the power factor is valid:

$$\lambda = \frac{U * I_1 * \cos \varphi_1}{U * I}$$

The fundamental factor of the current is defined as:

$$g_i = \frac{I_1}{I}$$

Introduction

The product with all currents forms the distortion reactive power:

$$D = U * \sqrt{\sum_{v=2}^{\infty} I_n x^2}$$

The total harmonic factor describes the ratio of the sum of the powers of all harmonic currents to the sum of the current:

$$k = \frac{\sqrt{\sum_{v=2}^{\infty} I_n x^2}}{I}$$

The total harmonic distortion / THD describe the ratio of the sum of the powers of all harmonic components to the power of the fundamental frequency:

Factor for the voltage:

$$THD_U = \frac{\sqrt{\sum_{v=2}^{40} U_n^2}}{U_1}$$

Total harmonic distortion, factor for the current:

$$THD_I = \frac{\sqrt{\sum_{v=2}^{40} I_n^2}}{I_1}$$

The partial weighted harmonic distortion is the ratio of the root- mean- square value of a selected group of higher order:

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

Total harmonic current (total harmonic current) root- mean- square value of the harmonic currents:

$$THC = \sqrt{\sum_{n=2}^{40} n * I_n^2}$$

Partial odd harmonic distortion is the root- mean- square of the odd harmonic currents:

$$PHC = \sqrt{\sum_{n=21,23}^{39} n * I_n^2}$$

Introduction

4 Introduction into the subject filter modules

4.1 Harmonic line filter for frequency converters

Passive harmonic compensation of the input current of the frequency converter:

The harmonic line filter is used to reduce the circuit harmonic distortions of non linear loads, which are supplied with uncontrolled B6- bridge rectifiers, how for example frequency converters. At the EPA HFE it is about a passive filter module. It is not syntonic to single frequencies how a absorption circuit, but works how a Band- stop filter that attenuates strong all low harmonic oscillations approx. until the fiftieth.

For comparison are in the following chart the circuit harmonic distortions of some potential circuits in principle represented by means of the THDI (total harmonic distortion of current) at the rated point of the rectifier:

| Rectifier without chokes | Rectifier with 4% uk without chokes | Rectifier with HFE- A | Rectifier with HFE- B | Rectifier with HFE- A and link choke | Rectifier with HFE-B and link choke |
|--------------------------|-------------------------------------|-----------------------|-----------------------|--------------------------------------|-------------------------------------|
| 80 % | 40 % | < 16 % | < 10 % | < 10 % | < 5 % |

The passive harmonic Rectifier EPA HFE features an effective, inexpensive and very efficient ($\eta = 99,5\%$) means, to reduce network loads with harmonics.

Figure 2 shows the typical current waveform of a B6 bridge without HFE module:

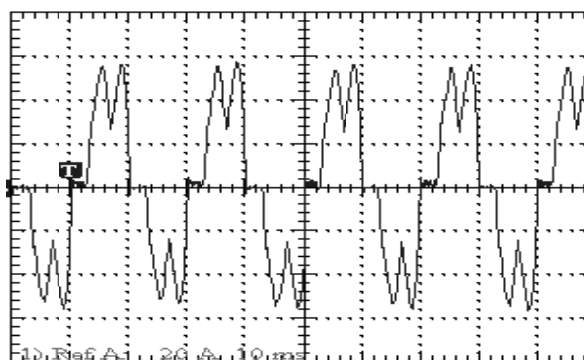


Figure 2: The Current waveform without HFE module

Figure 3 shows the typical current waveform of a B6 bridge with HFE module:

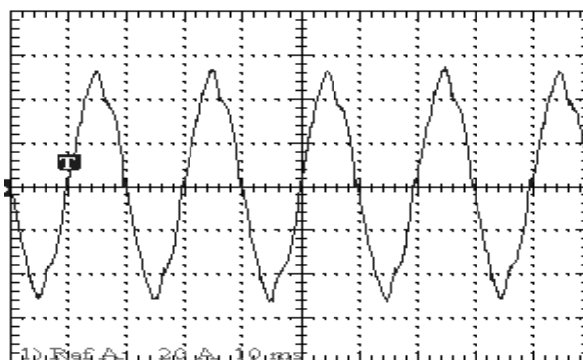


Figure 3: The Current waveform with HFE module

Figure 4 shows the Fourier analysis of the grid current by comparison:

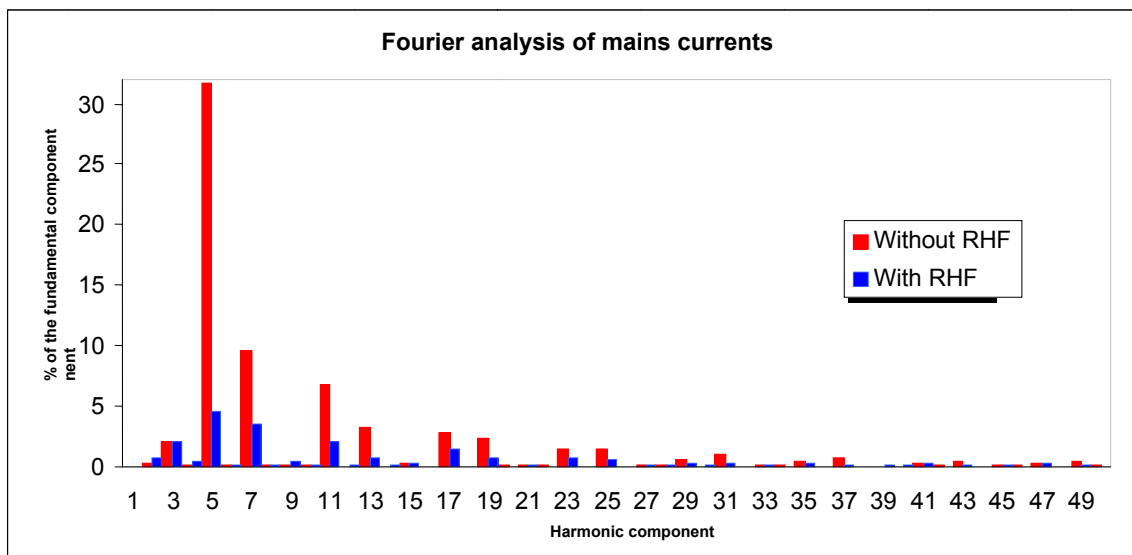


Figure 4: The Fourier analysis of the grid current

5 EC- directives / Declaration of conformity

5.1 What is the purpose of EC-directives?

The EC-directives are composed by the European Council and are used as definitions of common technical requirements and certification procedures inside the European Community. At the moment there are 30 EG-directives for different sections. The standards are or will be converted by the respective member states in national laws. An in a member state issued certificate is automatically valid without more testing in all other member states.

The directive- texts restrict on the formulation of the essentially requirement. The technical details are or will be defined in European harmonized standards.

5.2 What is the meaning of the CE- marking?



After an already made Conformity valuation method the accordance with the requirements of the EC- directives will be confirmed by the mounting of a CE-marking. Within the EC consist for a CE-marked product no trade barriers.

Filter modules with CE-marking comply independently, exclusively the low voltage-standard. To the compliance with the EMC-standard recommendations will be pronounced (EMC standard 2004/108/EC).

5.3 EG-directive low voltage

Low voltage-directive (73/23/EEC)
Changed by: CE - directive (93/68/EEC)
CE - directive (2006/95/EC)

General:

- The low voltage-directive is valid for all electrical devices to use at a nominal voltage between 50V and 1000V alternating voltage and between 75V and 1500V direct voltage and at usual environmental condition. Expected is for example the usage of electrical devices in explosive atmosphere and electrical parts of person- and freight elevator.
- Protection target of the low voltage-directive is to put only such electrical devices on the market, which do not endanger the safety of humans or animals and the conservation of material assets.

EG-declaration of conformity**in terms of the EG-directive low voltage (73/23/EEC)**

Changed by: CE - directive (93/68/EEC)
CE - directive (2006/95/EC)

The filter modules EPA HFE were developed, designed and manufactured in accordance to the above named EG- directive in exclusive accountability by

**EP Antriebstechnik GmbH,
Fliederstraße 8, D-63486 Bruchköbel**

Considered standards:

| Norm | |
|---|--|
| DIN VDE 0160 5.88 +A1 / 4.89 +A2 / 10.88 PRDIN EN 50178 Classification VDE 0160 / 11.94 IEC 61800-3:2004 / EN 61800-3:2004 | Electronic equipment for use in power installations Adjustable speed electrical power drive systems |
| DIN VDE 0100 | Low- voltage electrical installations |
| EN 60529 | International protection rating |

Table 2: Considered standards

5.4 EG-directive Electromagnetic compatibility

EMC directive (89/336/EEC)
Replaced by: EMC-directive (2004/108/EC)

General:

The objective target describes article 4 (2004/108/EC), as follows:

The... designated devices must be so manufactured, that

(a) an intended operation of radio- and telecommunication devices and other devices is possible and

(b) the devices have an adequate stability against electromagnetically disturbances, so that an intended operation is possible.

EC- directives

EC-declaration by the manufacturer

in terms of the EC-standard EMC (2004/108/EC)

The listed *EPA* products are in terms of the EMC no independently recoverable products, this means only after integration in the overall system would they be rateable regarding to EMC. The rating became detected for typical plant constructions, but not for the several products.

**EP Antriebstechnik GmbH,
Fliederstraße 8, D-63486 Bruchköbel**

5.5 EG-directive on machinery

Machine directive (98/37/EC)
Changed by: Modification directive (2006/42/EC)

General:

Machinery means an assembly, fitted with or intended to be fitted with a drive system other than directly applied human or animal effort, consisting of linked parts or components, at least one of which moves, and which are joined together for a specific application.

EG- declaration by the manufacturer

in terms of the EG-directive machines (2006/42/EC)

The filter modules *EPA HFE* were developed, designed and manufactured in accordance to the above named EC- directive in exclusive accountability by

**EP Antriebstechnik GmbH,
Fliederstraße 8, D-63486 Bruchköbel**

The operation of the filter module *EPA HFE* is prohibited as long as it is determined, that the machine, in which it should be installed, conforms to the regulations of the EC-directive machines.

6 Selection of the right filter module and technical data

To reach optimal performance of the filter module and to operate it durable optimal, the filter module must be so dimensioned, that it fits to the load.

As dimension the line input current of the frequency converter must be chosen.

=> $I_{FC,L}$

This is the input current of the frequency converter, **not** to confuse with the classification of the frequency converter. This means the motor current of the frequency converter.

6.1 Calculation

The line input current $I_{FC,L}$ can be calculated with the data of the motor, nominal current $I_{M,N}$ and $\cos \varphi$. Both data are to be found for example on the name plate of the motor.

In the case that the nominal motor voltage, $U_{M,N}$ is unequal to the actual line voltage U_L , the calculated current $I_{FC,L}$ must be corrected with the ratio between these voltages and with the following equation:

The equation is:

$$I_{FC,L} = 1.1 * I_{M,N} * \eta_{FC} * \cos \varphi * ((U_{M,N})/(U_L))$$

The chosen HFE filter module must have an equal nominal current I_{RMS} , which complies with the line input current of the frequency converter or which is larger.

$$I_{RMS} \geq I_{FC,L}$$

If several frequency converters are operated on the same filter module, the HFE filter module must be dimensioned with the sum of the calculated line input current.

Stop!



Is the HFE module dimensioned for a specially load and the motor is exchanged or modified, the current must be calculated again to prevent an overload of the filter module.

Technical data and dimension diagrams

6.2 Worked sample

The following data are known:

| | | |
|---------------------------------------|--------------|-------|
| System line voltage | U_L | 400 V |
| Motor power nameplate | P_M | 55 kW |
| Efficiency of the motor | η_M | 0,96 |
| Efficiency of the frequency converter | η_{FC} | 0,97 |
| Efficiency of the HFE module | η_{HFE} | 0,98 |

The maximum line current I_{RMS} can be calculated by the following equation:

$$I_{RMS} = \frac{P_M}{U_L * \sqrt{3} * \eta_M * \eta_{FC} * \eta_{HFE}}$$

$$I_{RMS} = \frac{55 \text{ kW}}{400 \text{ V} * \sqrt{3} * 0,96 * 0,97 * 0,98}$$

$$I_{RMS} = 86,99 \text{ A}$$

In this case 101 A must be chosen.

Note!



Actually the real nominal current is depending of the load, so it overlies normally under the nominal Data.

6.3 Characteristics

- Small compact size
- Reduction of the THDI to $\leq 15\%$ (10%) at type HFE-A (HFE-B)
- Optional THDI = 5% (depends on the application)
- Power range 4kW to 440KW
- High Efficiency
- User-friendly commissioning, because no programming or setting necessary

Note:

1. The reduction of the low- frequency circuit harmonic distortions on the specified THD I data implies, that the total harmonic distortion of the unaffected line voltage THD U smaller than 2% and the ratio of short circuit power and connected power R_{SCE} is minimum 66. Under these requirements the THD I improve of the line current of the drive controller with the filter module EPA HFE A/B to typically $\leq 15\%$. When these requirements are not or only partially complied, it still implies a significant reduction of the harmonic components, but under conditions the specified THD I-data will be not achieved.
2. Under den same conditions the THD I improves the main current of the drive control with the filter module EPA HFE-B to typically $\leq 10\%$.
3. With the filter module a more better filter effect can be achieved, if the drive control is equipped with a link choke, which inductance complies to a net-sided choking of approx. 4%. At this Configuration THD I-data result of $<10\%$ at otherwise same requirements as beneath 1 respectively of $<5\%$ at otherwise the same requirements as beneath 2.

Technical data and dimension diagrams

6.4 General Data / Operation conditions

| Range | Data |
|--------------------------|--|
| Valid temperature range* | At transport of the device: -25°C...+70°C (following DIN EN 50178) At storage of the device: -25°C...+55°C (following DIN EN 50178) At operation of the device: -20°C...+45°C without power reduction 45°C...+60°C with power reduction |
| Stress of humidity* | Humidity class F without dew (5% - 85% relatively humidity) |
| Altitude of side h* | h ≤ 1000 m üNN without power reduction 1000 m üNN < h 4000 m üNN with power reduction |
| Air pressure* | 86kPa – 106kPa according to VDE 0875 part 11 und prEN55082 |
| Degree of pollution | Stress of humidity 2 following VDE 0110 part 2 |
| Insulation stability | Overvoltage category III following VDE 0110 |
| Package | DIN 55468 for transport package materials |
| Protection class | IP 20 (at HFE and external power choke IP 00) |
| Approvals | CE: Low- voltage directive |

Table 3: General Data / Operation conditions

*Climatic terms following class 3K3 (EN 50178 part 6.1)

Figure 5 shows the Power reduction in dependence of the ambient temperature:

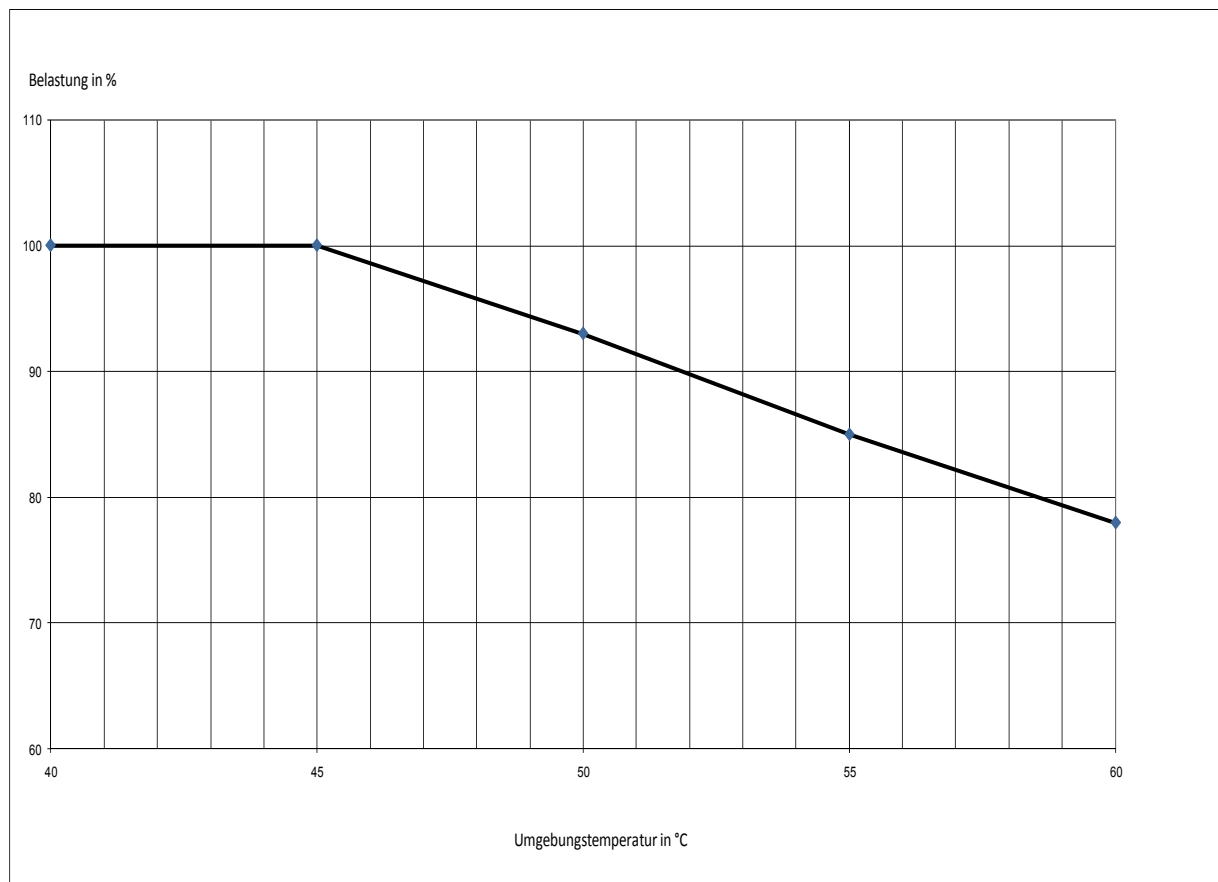


Figure 5: Power reduction in dependence of the ambient temperature

Technical data and dimension diagrams

6.5 Rating values

| Device series | | HFE 380V | HFE 400V | HFE 460V | HFE 500V | HFE 600V | HFE 690V |
|--|----------------------|---|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| Nominal range of the line-to-line line voltage | $U_N[V]$ | 380 | $380 \leq U_N \leq 415$ | $440 \leq U_N \leq 480$ | 500 | 600 | 690 |
| Tolerance of the line-to-line line voltage | $U_N[V]$ | $342 \leq U_N \leq 418$ | $342 \leq U_N \leq 456$ | $396 \leq U_N \leq 528$ | $450 \leq U_N \leq 550$ | $540 \leq U_N \leq 660$ | $540 \leq U_N \leq 759$ |
| Power frequency | $f_N[Hz]$ | $60 \pm 2 \%$ | $50 \pm 2 \%$ | $60 \pm 2 \%$ | $50 \pm 2 \%$ | $60 \pm 2 \%$ | $50 \pm 2 \%$ |
| Overload ability | | 1,5 | | | | | |
| * Efficiency | $\eta[\%]$ | ca. 98,5-99,5 | | | | | |
| ** THD I | $[\%]$ | 5-16 | | | | | |
| $\cos \varphi$ | | at 75% I_N 0,85 cap. at 100% I_N 0,99 cap. at 150% I_N 1,0 cap. | | | | | |
| * Cooling air requirement | m^3 / h | a) Installation size X1-X2: 200 m^3 / h b) Installation size X3-X6: 350 m^3 / h c) Installation size X7-X8: 700 m^3 / h | | | | | |
| Power reduction | $[\%/K]$ $[\%/m]$ | See figure 5 $1000m \text{ üNN} < h \leq 4000m \text{ üNN} \Rightarrow 5\%/1000m$ | | | | | |

Table 4: Rating values

* Depended on the device type and design

** At observation of the following connecting conditions: THD U < 2%, $R_{SCE} > 66$, standard conformable electrical networks

6.6 Article numbers and Ampacity HFE

The indicated current values advert to the line current of the drive control and **not** on the branch current of the filter module itself!

Nominal voltage 380V 60Hz

| EPA - type | Current I_{RMS} 100% [A] AC | Current I_{RMS} 150% [A] AC 1 min in 10 min |
|--------------------------|---|---|
| HFE- A/B 10-380-60-20 A | 10 | 15,0 |
| HFE- A/B 14-380-60-20 A | 14 | 21,0 |
| HFE- A/B 22-380-60-20 A | 22 | 33,0 |
| HFE- A/B 29-380-60-20 A | 29 | 43,5 |
| HFE- A/B 35-380-60-20 A | 35 | 52,5 |
| HFE- A/B 43-380-60-20 A | 43 | 64,5 |
| HFE- A/B 58-380-60-20 A | 58 | 87,0 |
| HFE- A/B 72-380-60-20 A | 72 | 108,0 |
| HFE- A/B 86-380-60-20 A | 86 | 129,0 |
| HFE- A/B 101-380-60-20 A | 101 | 151,5 |
| HFE- A/B 144-380-60-20 A | 144 | 216,0 |
| HFE- A/B 180-380-60-20 A | 180 | 270,0 |
| HFE- A/B 217-380-60-20 A | 217 | 325,5 |
| HFE- A/B 252-380-60-20 A | 252 | 378,0 |
| HFE- A/B 304-380-60-20 A | 304 | 456,0 |
| HFE- A/B 325-380-60-20 A | 325 | 487,5 |
| HFE- A/B 380-380-60-20 A | 380 | 570,0 |
| HFE- A/B 433-380-60-20 A | 433 | 649,5 |

Table 5: Article numbers and Ampacity at nominal voltage 380V 60Hz

Technical data and dimension diagrams

Nominal voltage 400V 50Hz

| EPA - type | Current I_{RMS} 100% [A] AC | Current I_{RMS} 150% [A] AC 1 min in 10 min |
|--------------------------|--|--|
| HFE- A/B 10-400-50-20 A | 10 | 15,0 |
| HFE- A/B 14-400-50-20 A | 14 | 21,0 |
| HFE- A/B 22-400-50-20 A | 22 | 33,0 |
| HFE- A/B 29-400-50-20 A | 29 | 43,5 |
| HFE- A/B 35-400-50-20 A | 35 | 52,5 |
| HFE- A/B 43-400-50-20 A | 43 | 64,5 |
| HFE- A/B 58-400-50-20 A | 58 | 87,0 |
| HFE- A/B 72-400-50-20 A | 72 | 108,0 |
| HFE- A/B 86-400-50-20 A | 86 | 129,0 |
| HFE- A/B 101-400-50-20 A | 101 | 151,5 |
| HFE- A/B 144-400-50-20 A | 144 | 216,0 |
| HFE- A/B 180-400-50-20 A | 180 | 270,0 |
| HFE- A/B 217-400-50-20 A | 217 | 325,5 |
| HFE- A/B 252-400-50-20 A | 252 | 378,0 |
| HFE- A/B 304-400-50-20 A | 304 | 456,0 |
| HFE- A/B 325-400-50-20 A | 325 | 487,5 |
| HFE- A/B 380-400-50-20 A | 380 | 570,0 |
| HFE- A/B 433-400-50-20 A | 433 | 649,5 |

Table 6: Article numbers and Ampacity at nominal voltage 400V 50Hz

Nominal voltage 460V 60Hz

| EPA - type | Current I_{RMS} 100% [A] AC | Current I_{RMS} 150% [A] AC 1 min in 10 min |
|--------------------------|--|--|
| HFE- A/B 10-460-60-20 A | 10 | 15,0 |
| HFE- A/B 14-460-60-20 A | 14 | 21,0 |
| HFE- A/B 22-460-60-20 A | 22 | 33,0 |
| HFE- A/B 29-460-60-20 A | 29 | 43,5 |
| HFE- A/B 35-460-60-20 A | 35 | 52,5 |
| HFE- A/B 43-460-60-20 A | 43 | 64,5 |
| HFE- A/B 58-460-60-20 A | 58 | 87,0 |
| HFE- A/B 72-460-60-20 A | 72 | 108,0 |
| HFE- A/B 86-460-60-20 A | 86 | 129,0 |
| HFE- A/B 101-460-60-20 A | 101 | 151,5 |
| HFE- A/B 144-460-60-20 A | 144 | 216,0 |
| HFE- A/B 180-460-60-20 A | 180 | 270,0 |
| HFE- A/B 217-460-60-20 A | 217 | 325,5 |
| HFE- A/B 252-460-60-20 A | 252 | 378,0 |
| HFE- A/B 304-460-60-20 A | 304 | 456,0 |
| HFE- A/B 325-460-60-20 A | 325 | 487,5 |
| HFE- A/B 380-460-60-20 A | 380 | 570,0 |
| HFE- A/B 433-460-60-20 A | 433 | 649,5 |

Table 7: Article numbers and Ampacity at nominal voltage 460V 60Hz

Technical data and dimension diagrams

Nominal voltage 500V 50Hz

| EPA - type | Current I_{RMS} 100% [A] AC | Current I_{RMS} 150% [A] AC 1 min in 10 min |
|--------------------------|--|--|
| HFE- A/B 15-500-50-20 A | 15 | 22,5 |
| HFE- A/B 20-500-50-20 A | 20 | 30,0 |
| HFE- A/B 24-500-50-20 A | 24 | 36,0 |
| HFE- A/B 29-500-50-20 A | 29 | 43,5 |
| HFE- A/B 36-500-50-20 A | 36 | 54,0 |
| HFE- A/B 50-500-50-20 A | 50 | 75,0 |
| HFE- A/B 58-500-50-20 A | 58 | 87,0 |
| HFE- A/B 77-500-50-20 A | 77 | 115,5 |
| HFE- A/B 87-500-50-20 A | 87 | 130,5 |
| HFE- A/B 109-500-50-20 A | 109 | 163,5 |
| HFE- A/B 128-500-50-20 A | 128 | 192,0 |
| HFE- A/B 155-500-50-20 A | 155 | 232,5 |
| HFE- A/B 197-500-50-20 A | 197 | 295,5 |
| HFE- A/B 240-500-50-20 A | 240 | 360,0 |
| HFE- A/B 296-500-50-20 A | 298 | 447,0 |
| HFE- A 366-500-50-20 A | 366 | 549,0 |
| HFE- A 395-500-50-20 A | 395 | 592,5 |

Table 8: Article numbers and Ampacity at nominal voltage 500V 50Hz

Nominal voltage 600V 60Hz

| EPA - type | Current I_{RMS} 100% [A] AC | Current I_{RMS} 150% [A] AC 1 min in 10 min |
|--------------------------|--|--|
| HFE- A/B 15-600-60-20 A | 15 | 22,5 |
| HFE- A/B 20-600-60-20 A | 20 | 30,0 |
| HFE- A/B 24-600-60-20 A | 24 | 36,0 |
| HFE- A/B 29-600-60-20 A | 29 | 43,5 |
| HFE- A/B 36-600-60-20 A | 36 | 54,0 |
| HFE- A/B 50-600-60-20 A | 50 | 75,0 |
| HFE- A/B 58-600-60-20 A | 58 | 87,0 |
| HFE- A/B 77-600-60-20 A | 77 | 115,5 |
| HFE- A/B 87-600-60-20 A | 87 | 130,5 |
| HFE- A/B 109-600-60-20 A | 109 | 163,5 |
| HFE- A/B 128-600-60-20 A | 128 | 192,0 |
| HFE- A/B 155-600-60-20 A | 155 | 232,5 |
| HFE- A/B 197-600-60-20 A | 197 | 295,5 |
| HFE- A/B 240-600-60-20 A | 240 | 360,0 |
| HFE- A/B 296-600-60-20 A | 296 | 444,0 |
| HFE- A 366-600-60-20 A | 366 | 549,0 |
| HFE- A 395-600-60-20 A | 395 | 592,5 |

Table 9: Article numbers and Ampacity at nominal voltage 600V 60Hz

Technical data and dimension diagrams

Nominal voltage 690V 50Hz

| EPA - type | | Current I_{RMS} 100% [A] AC | Current I_{RMS} 150% [A] AC 1 min in 10 min |
|-------------------|-----------------|---|---|
| HFE- A/B | 15-690-50-20 A | 15 | 22,5 |
| HFE- A/B | 20-690-50-20 A | 20 | 30,0 |
| HFE- A/B | 24-690-50-20 A | 24 | 36,0 |
| HFE- A/B | 29-690-50-20 A | 29 | 43,5 |
| HFE- A/B | 36-690-50-20 A | 36 | 54,0 |
| HFE- A/B | 50-690-50-20 A | 50 | 69,0 |
| HFE- A/B | 58-690-50-20 A | 58 | 87,0 |
| HFE- A/B | 77-690-50-20 A | 77 | 115,5 |
| HFE- A/B | 87-690-50-20 A | 87 | 130,5 |
| HFE- A/B | 109-690-50-20 A | 109 | 163,5 |
| HFE- A/B | 128-690-50-20 A | 128 | 192,0 |
| HFE- A/B | 155-690-50-20 A | 155 | 232,5 |
| HFE- A/B | 197-690-50-20 A | 197 | 295,5 |
| HFE- A/B | 240-690-50-20 A | 240 | 360,0 |
| HFE- A/B | 296-690-50-20 A | 296 | 444,0 |
| HFE- A | 366-690-50-20 A | 366 | 549,0 |
| HFE- A | 395-690-50-20 A | 395 | 592,5 |

Table 10: Article numbers and Ampacity at nominal voltage 690V 50Hz

6.7 Cable cross section

At usage of a HFE-filter module the drive system should be wired with the same cross section as without filter module.

6.8 General information

With this information the installers and users of a plant should be given information on special characteristics and rules in terms on a filter module.

With this information no demand of completeness will be raised.

Compensation plants without chokes and resonance danger

Compensation plants are used in centre of the power supplies of companies. Disturbances or damages at these plants can affect to the power supplies of the company and cause expensive losses of production.

In the in- company praxis are today still many compensation plants without chokes in use. The problems, which can occur in connection with a compensation plant without chokes, are varied:

- Direct Resonance
- Resonance lifting
- Switching transients or
- Impairment of ripple control transmission

For the development of resonances it is not just deciding if an operation itself produces circuit harmonic distortions. Decisive for the risk, to encounter a resonance, is the compensation power at the transformer. Per lager it is, so lager is the risk of a resonance. Thereby is the harmonic preload of the medium voltage level an important factor. This is transmitted by the transformer on it and is effective on the low-voltage level.

Limit exceeding, produced by resonance lifting, can particularly be detected for the 5 electrical network harmonic.

Technical data and dimension diagrams

6.9 Electrical operating conditions HFE

Nominal voltage 380V 60Hz

| EPA - type HFE-A- | Configuration filter module | Weight [kg] | Torque* [Nm] Clamps X1+X2 | Grounding | Cable cross section [mm²] | Cable Lug** |
|------------------------------|--|------------------------|--|------------------|--|--------------------|
| 10-380-60-20 A | X1 | 13,5 | 1,6 | M6 | 0,5-10 | CS |
| 14-380-60-20 A | X1 | 16,3 | 1,6 | M6 | 0,5-10 | CS |
| 22-380-60-20 A | X2 | 22 | 1,6 | M6 | 0,5-10 | CS |
| 29-380-60-20 A | X2 | 25 | 2,4 | M8 | 1,5-25 | CS |
| 35-380-60-20 A | X3 | 33 | 2,4 | M8 | 1,5-25 | CS |
| 43-380-60-20 A | X3 | 37 | 2,4 | M8 | 1,5-25 | CS |
| 58-380-60-20 A | X3 | 38 | 4,5 | M8 | 2,5-50 | CS |
| 72-380-60-20 A | X4 | 43 | 4,5 | M8 | 2,5-50 | CS |
| 86-380-60-20 A | X4 | 55 | 6,0 | M8 | 10-70 | CS |
| 101-380-60-20 A | X5 | 62 | 6,0 | M8 | 10-70 | CS |
| 144-380-60-20 A | X5 | 74 | 12,0 | M8 | 2,5-95 | CL M8 |
| 180-380-60-20 A | X6 | 85 | 12,0 | M8 | 2,5-95 | CL M8 |
| 217-380-60-20 A | X6 | 102 | 60,0 | M12 | 25-300 | CL M16 |
| 252-380-60-20 A | X7 | 117 | 60,0 | M12 | 25-300 | CL M16 |
| 304-380-60-20 A | X7 | 136 | 60,0 | M12 | 25-300 | CL M16 |
| 325-380-60-20 A | X7 | 162 | 60,0 | M12 | 25-300 | CL M16 |
| 380-380-60-20 A | X7 | 172 | 60,0 | M12 | 25-300 | CL M16 |
| 433-380-60-20 A | X8 | 203 | 60,0 | M12 | 25-300 | CL M16 |

Table 11: Electrical operating conditions 380V 60Hz HFE-A

Nominal voltage 380V 60Hz

| EPA - type HFE-B- | Configuration filter module | Weight [kg] | Torque* [Nm] Clamps X1+X2 | Grounding | Cable cross section [mm²] | Cable Lug** |
|------------------------------|--|------------------------|--|------------------|--|--------------------|
| 10-380-60-20 A | X1 | 18 | 1,6 | M6 | 0,5-10 | CS |
| 14-380-60-20 A | X1 | 20,0 | 1,6 | M6 | 0,5-10 | CS |
| 22-380-60-20 A | X2 | 30 | 1,6 | M6 | 0,5-10 | CS |
| 29-380-60-20 A | X3 | 34 | 2,4 | M8 | 1,5-25 | CS |
| 35-380-60-20 A | X3 | 52 | 2,4 | M8 | 1,5-25 | CS |
| 43-380-60-20 A | X3 | 53 | 2,4 | M8 | 1,5-25 | CS |
| 58-380-60-20 A | X4 | 57 | 4,5 | M8 | 2,5-50 | CS |
| 72-380-60-20 A | X4 | 75 | 4,5 | M8 | 2,5-50 | CS |
| 86-380-60-20 A | X5 | 97 | 6,0 | M8 | 10-70 | CS |
| 101-380-60-20 A | X5 | 104 | 6,0 | M8 | 10-70 | CS |
| 144-380-60-20 A | X6 | 106 | 12,0 | M8 | 2,5-95 | CL M8 |
| 180-380-60-20 A | X6 | 126 | 12,0 | M8 | 2,5-95 | CL M8 |
| 217-380-60-20 A | X7 | 135 | 60,0 | M12 | 25-300 | CL M16 |
| 252-380-60-20 A | X7 | 170 | 60,0 | M12 | 25-300 | CL M16 |
| 304-380-60-20 A | X7 | 206 | 60,0 | M12 | 25-300 | CL M16 |
| 325-380-60-20 A | X7 | 229 | 60,0 | M12 | 25-300 | CL M16 |
| 380-380-60-20 A | X7 | 265 | 60,0 | M12 | 25-300 | CL M16 |
| 433-380-60-20 A | X8 | 270 | 60,0 | M12 | 25-300 | CL M16 |

Table 12: Electrical operating conditions 380V 60Hz HFE-B

* Locking torque of the electrical network and converter terminal clamp

** CS \triangleq Cable end sleeve, CL \triangleq Cable lug

Technical data and dimension diagrams

Nominal voltage 400V 50Hz

| EPA - type HFE-A- | Configuration filter module | Weight [kg] | Torque* [Nm] Clamps X1+X2 | Grounding | Cable cross section [mm²] | Cable Lug** |
|------------------------------|--|------------------------|--|------------------|--|--------------------|
| 10-400-50-20 A | X1 | 13,5 | 1,6 | M6 | 0,5-10 | CS |
| 14-400-50-20 A | X2 | 16,3 | 1,6 | M6 | 0,5-10 | CS |
| 22-400-50-20 A | X2 | 22 | 1,6 | M6 | 0,5-10 | CS |
| 29-400-50-20 A | X3 | 33 | 2,4 | M8 | 1,5-25 | CS |
| 35-400-50-20 A | X3 | 37 | 2,4 | M8 | 1,5-25 | CS |
| 43-400-50-20 A | X3 | 39 | 2,4 | M8 | 1,5-25 | CS |
| 58-400-50-20 A | X4 | 44 | 4,5 | M8 | 2,5-50 | CS |
| 72-400-50-20 A | X4 | 56 | 4,5 | M8 | 2,5-50 | CS |
| 86-400-50-20 A | X5 | 62 | 6,0 | M8 | 10-70 | CS |
| 101-400-50-20 A | X5 | 74 | 6,0 | M8 | 10-70 | CS |
| 144-400-50-20 A | X6 | 85 | 12,0 | M8 | 2,5-95 | CL M8 |
| 180-400-50-20 A | X6 | 102 | 12,0 | M8 | 2,5-95 | CL M8 |
| 217-400-50-20 A | X7 | 119 | 60,0 | M12 | 25-300 | CL M16 |
| 252-400-50-20 A | X7 | 136 | 60,0 | M12 | 25-300 | CL M16 |
| 304-400-50-20 A | X7 | 142 | 60,0 | M12 | 25-300 | CL M16 |
| 325-400-50-20 A | X7 | 147 | 60,0 | M12 | 25-300 | CL M16 |
| 380-400-50-20 A | X7 | 172 | 60,0 | M12 | 25-300 | CL M16 |
| 433-400-50-20 A | X8 | 205 | 60,0 | M12 | 25-300 | CL M16 |

Table 13: Electrical operating conditions 400V 50Hz HFE-A

Nominal voltage 400V 50Hz

| EPA - type HFE-B- | Configuration filter module | Weight [kg] | Torque* [Nm] Clamps X1+X2 | Grounding | Cable cross section [mm²] | Cable Lug** |
|------------------------------|--|------------------------|--|------------------|--|--------------------|
| 10-400-50-20 A | X1 | 18 | 1,6 | M6 | 0,5-10 | CS |
| 14-400-50-20 A | X1 | 20 | 1,6 | M6 | 0,5-10 | CS |
| 22-400-50-20 A | X2 | 30 | 1,6 | M6 | 0,5-10 | CS |
| 29-400-50-20 A | X3 | 52 | 2,4 | M8 | 1,5-25 | CS |
| 35-400-50-20 A | X3 | 53 | 2,4 | M8 | 1,5-25 | CS |
| 43-400-50-20 A | X3 | 58 | 2,4 | M8 | 1,5-25 | CS |
| 58-400-50-20 A | X4 | 76 | 4,5 | M8 | 2,5-50 | CS |
| 72-400-50-20 A | X4 | 98 | 4,5 | M8 | 2,5-50 | CS |
| 86-400-50-20 A | X5 | 104 | 6,0 | M8 | 10-70 | CS |
| 101-400-50-20 A | X5 | 106 | 6,0 | M8 | 10-70 | CS |
| 144-400-50-20 A | X6 | 126 | 12,0 | M8 | 2,5-95 | CL M8 |
| 180-400-50-20 A | X6 | 135 | 12,0 | M8 | 2,5-95 | CL M8 |
| 217-400-50-20 A | X7 | 172 | 60,0 | M12 | 25-300 | CL M16 |
| 252-400-50-20 A | X7 | 206 | 60,0 | M12 | 25-300 | CL M16 |
| 304-400-50-20 A | X7 | 221 | 60,0 | M12 | 25-300 | CL M16 |
| 325-400-50-20 A | X8 | 230 | 60,0 | M12 | 25-300 | CL M16 |
| 380-400-50-20 A | X8 | 265 | 60,0 | M12 | 25-300 | CL M16 |
| 433-400-50-20 A | X8 | 272 | 60,0 | M12 | 25-300 | CL M16 |

Table 14: Electrical operating conditions 400V 50Hz HFE-B

* Locking torque of the electrical network and converter terminal clamp

** CS \triangleq Cable end sleeve, CL \triangleq Cable lug

Technical data and dimension diagrams

Nominal voltage 460V 60Hz

| EPA - type HFE-A- | Configuration filter module | Weight [kg] | Torque* [Nm] Clamps X1+X2 | Grounding | Cable cross section [mm²] | Cable Lug** |
|------------------------------|--|------------------------|--|------------------|--|--------------------|
| 10-460-60-20 A | X1 | 13,5 | 1,6 | M6 | 0,5-10 | CS |
| 14-460-60-20 A | X1 | 16,3 | 1,6 | M6 | 0,5-10 | CS |
| 19-460-60-20 A | X2 | 22 | 1,6 | M6 | 0,5-10 | CS |
| 25-460-60-20 A | X2 | 25 | 1,6 | M6 | 0,5-10 | CS |
| 31-460-60-20 A | X3 | 33 | 2,4 | M8 | 1,5-25 | CS |
| 36-460-60-20 A | X3 | 37 | 2,4 | M8 | 1,5-25 | CS |
| 48-460-60-20 A | X3 | 38 | 2,4 | M8 | 1,5-25 | CS |
| 60-460-60-20 A | X4 | 43 | 4,5 | M8 | 2,5-50 | CS |
| 73-460-60-20 A | X4 | 55 | 4,5 | M8 | 2,5-50 | CS |
| 95-460-60-20 A | X5 | 62 | 6,0 | M8 | 10-70 | CS |
| 118-460-60-20 A | X5 | 74 | 6,0 | M8 | 10-70 | CS |
| 154-460-60-20 A | X6 | 85 | 12,0 | M8 | 2,5-95 | CL M8 |
| 183-460-60-20 A | X6 | 102 | 12,0 | M8 | 2,5-95 | CL M8 |
| 231-460-60-20 A | X7 | 117 | 60,0 | M12 | 25-300 | CL M16 |
| 291-460-60-20 A | X7 | 136 | 60,0 | M12 | 25-300 | CL M16 |
| 355-460-60-20 A | X7 | 162 | 60,0 | M12 | 25-300 | CL M16 |
| 380-460-60-20 A | X7 | 172 | 60,0 | M12 | 25-300 | CL M16 |
| 436-460-60-20 A | X8 | 203 | 60,0 | M12 | 25-300 | CL M16 |

Table 15: Electrical operating conditions 460V 60Hz HFE-A

Nominal voltage 460V 60Hz

| EPA - type HFE-B- | Configuration filter module | Weight [kg] | Torque* [Nm] Clamps X1+X2 | Grounding | Cable cross section [mm²] | Cable Lug** |
|------------------------------|--|------------------------|--|------------------|--|--------------------|
| 10-460-60-20 A | X1 | 18 | 1,6 | M6 | 0,5-10 | CS |
| 14-460-60-20 A | X1 | 20 | 1,6 | M6 | 0,5-10 | CS |
| 19-460-60-20 A | X2 | 30 | 1,6 | M6 | 0,5-10 | CS |
| 25-460-60-20 A | X2 | 34 | 1,6 | M6 | 0,5-10 | CS |
| 31-460-60-20 A | X3 | 52 | 2,4 | M8 | 1,5-25 | CS |
| 36-460-60-20 A | X3 | 53 | 2,4 | M8 | 1,5-25 | CS |
| 48-460-60-20 A | X3 | 57 | 2,4 | M8 | 1,5-25 | CS |
| 60-460-60-20 A | X4 | 75 | 4,5 | M8 | 2,5-50 | CS |
| 73-460-60-20 A | X4 | 97 | 4,5 | M8 | 2,5-50 | CS |
| 95-460-60-20 A | X5 | 104 | 6,0 | M8 | 10-70 | CS |
| 118-460-60-20 A | X5 | 106 | 6,0 | M8 | 10-70 | CL M8 |
| 154-460-60-20 A | X6 | 126 | 12,0 | M8 | 2,5-95 | CL M8 |
| 183-460-60-20 A | X6 | 135 | 12,0 | M8 | 2,5-95 | CL M16 |
| 231-460-60-20 A | X7 | 170 | 60,0 | M12 | 25-300 | CL M16 |
| 291-460-60-20 A | X7 | 206 | 60,0 | M12 | 25-300 | CL M16 |
| 355-460-60-20 A | X8 | 229 | 60,0 | M12 | 25-300 | CL M16 |
| 380-460-60-20 A | X8 | 265 | 60,0 | M12 | 25-300 | CL M16 |
| 436-460-60-20 A | X8 | 270 | 60,0 | M12 | 25-300 | CL M16 |

Table 16: Electrical operating conditions 460V 60Hz HFE-B

* Locking torque of the electrical network and converter terminal clamp

** CS \triangleq Cable end sleeve, CL \triangleq Cable lug

Technical data and dimension diagrams

Nominal voltage 500V 50Hz

| EPA - type HFE-A- | Configuration filter module | Weight [kg] | Torque* [Nm] Clamps X1+X2 | Grounding | Cable cross section [mm²] | Cable Lug** |
|------------------------------|--|------------------------|--|------------------|--|--------------------|
| 15-500-50-20 A | X3 | 12 | 2,4 | M8 | 1,5-25 | CS |
| 20-500-50-20 A | X3 | 13 | 2,4 | M8 | 1,5-25 | CS |
| 24-500-50-20 A | X3 | 22 | 2,4 | M8 | 1,5-25 | CS |
| 29-500-50-20 A | X4 | 36 | 4,5 | M8 | 2,5-50 | CS |
| 36-500-50-20 A | X4 | 40 | 4,5 | M8 | 2,5-50 | CS |
| 50-500-50-20 A | X5 | 42 | 6,0 | M8 | 10-70 | CS |
| 58-500-50-20 A | X5 | 52 | 6,0 | M8 | 10-70 | CS |
| 77-500-50-20 A | X6 | 56 | 12,0 | M8 | 2,5-95 | CL M8 |
| 87-500-50-20 A | X6 | 62 | 12,0 | M8 | 2,5-95 | CL M8 |
| 109-500-50-20 A | X6 | 74 | 12,0 | M8 | 2,5-95 | CL M8 |
| 128-500-50-20 A | X6 | 85 | 12,0 | M8 | 2,5-95 | CL M8 |
| 155-500-50-20 A | X7 | 105 | 60,0 | M12 | 25-300 | CL M8 |
| 197-500-50-20 A | X7 | 123 | 60,0 | M12 | 25-300 | CL M16 |
| 240-500-50-20 A | X8 | 136 | 60,0 | M12 | 25-300 | CL M16 |
| 296-500-50-20 A | X8 | 142 | 60,0 | M12 | 25-300 | CL M16 |
| 366-500-50-20 A | X8 | 163 | 60,0 | M12 | 25-300 | CL M16 |
| 395-500-50-20 A | X8 | 185 | 60,0 | M12 | 25-300 | CL M16 |

Table 17: Electrical operating conditions 500V 50Hz HFE-A

Nominal voltage 500V 50Hz

| EPA - type HFE-B- | Configuration filter module | Weight [kg] | Torque* [Nm] Clamps X1+X2 | Grounding | Cable cross section [mm²] | Cable Lug** |
|------------------------------|--|------------------------|--|------------------|--|--------------------|
| 15-500-50-20 A | X3 | 16 | 1,6 | M8 | 1,5-25 | CS |
| 20-500-50-20 A | X3 | 20 | 1,6 | M8 | 1,5-25 | CS |
| 24-500-50-20 A | X3 | 38 | 1,6 | M8 | 1,5-25 | CS |
| 29-500-50-20 A | X4 | 50 | 1,6 | M8 | 2,5-50 | CS |
| 36-500-50-20 A | X4 | 52 | 2,4 | M8 | 2,5-50 | CS |
| 50-500-50-20 A | X5 | 75 | 2,4 | M8 | 10-70 | CS |
| 58-500-50-20 A | X5 | 82 | 2,4 | M8 | 10-70 | CS |
| 77-500-50-20 A | X6 | 96 | 4,5 | M8 | 2,5-95 | CL M8 |
| 87-500-50-20 A | X6 | 104 | 4,5 | M8 | 2,5-95 | CL M8 |
| 109-500-50-20 A | X6 | 130 | 6,0 | M8 | 2,5-95 | CL M8 |
| 128-500-50-20 A | X6 | 135 | 12,0 | M8 | 2,5-95 | CL M8 |
| 155-500-50-20 A | X7 | 168 | 12,0 | M12 | 25-300 | CL M8 |
| 197-500-50-20 A | X7 | 197 | 60,0 | M12 | 25-300 | CL M16 |
| 240-500-50-20 A | X8 | 220 | 60,0 | M12 | 25-300 | CL M16 |
| 296-500-50-20 A | X8 | 228 | 60,0 | M12 | 25-300 | CL M16 |

Table 18: Electrical operating conditions 500V 50Hz HFE-B

* Locking torque of the electrical network and converter terminal clamp

** CS \triangleq Cable end sleeve, CL \triangleq Cable lug

Technical data and dimension diagrams

Nominal voltage 600V 60Hz

| EPA - type HFE-A- | Configuration filter module | Weight [kg] | Torque* [Nm] Clamps X1+X2 | Grounding | Cable cross section [mm²] | Cable Lug** |
|------------------------------|--|------------------------|--|------------------|---|--------------------|
| 15-600-60-20 A | X3 | 12 | 2,4 | M8 | 1,5-25 | CS |
| 20-600-60-20 A | X3 | 13 | 2,4 | M8 | 1,5-25 | CS |
| 24-600-60-20 A | X3 | 22 | 2,4 | M8 | 1,5-25 | CS |
| 29-600-60-20 A | X4 | 36 | 4.5 | M8 | 2,5-50 | CS |
| 36-600-60-20 A | X4 | 40 | 4.5 | M8 | 2,5-50 | CS |
| 50-600-60-20 A | X5 | 42 | 6,0 | M8 | 10-70 | CS |
| 58-600-60-20 A | X5 | 52 | 6,0 | M8 | 10-70 | CS |
| 77-600-60-20 A | X6 | 56 | 12,0 | M8 | 2,5-95 | CS |
| 87-600-60-20 A | X6 | 62 | 12,0 | M8 | 2,5-95 | CS |
| 109-600-60-20 A | X6 | 74 | 12,0 | M8 | 2,5-95 | CS |
| 128-600-60-20 A | X6 | 85 | 12,0 | M8 | 2,5-95 | CL M8 |
| 155-600-60-20 A | X7 | 105 | 60,0 | M12 | 25-300 | CL M8 |
| 197-600-60-20 A | X7 | 123 | 60,0 | M12 | 25-300 | CL M16 |
| 240-600-60-20 A | X8 | 136 | 60,0 | M12 | 25-300 | CL M16 |
| 296-600-60-20 A | X8 | 142 | 60,0 | M12 | 25-300 | CL M16 |
| 366-600-60-20 A | X8 | 163 | 60,0 | M12 | 25-300 | CL M16 |
| 395-600-60-20 A | X8 | 185 | 60,0 | M12 | 25-300 | CL M16 |

Table 19: Electrical operating conditions 600V 60Hz HFE-A

Nominal voltage 600V 60Hz

| EPA - type HFE-B- | Configuration filter module | Weight [kg] | Torque* [Nm] Clamps X1+X2 | Grounding | Cable cross section [mm²] | Cable Lug** |
|------------------------------|--|------------------------|--|------------------|---|--------------------|
| 15-600-60-20 A | X3 | 16 | 2,4 | M8 | 1,5-25 | CS |
| 20-600-60-20 A | X3 | 20 | 2,4 | M8 | 1,5-25 | CS |
| 24-600-60-20 A | X3 | 38 | 2,4 | M8 | 1,5-25 | CS |
| 29-600-60-20 A | X4 | 50 | 4.5 | M8 | 2,5-50 | CS |
| 36-600-60-20 A | X4 | 52 | 4.5 | M8 | 2,5-50 | CS |
| 50-600-60-20 A | X5 | 75 | 6,0 | M8 | 10-70 | CS |
| 58-600-60-20 A | X5 | 82 | 6,0 | M8 | 10-70 | CS |
| 77-600-60-20 A | X6 | 96 | 12,0 | M8 | 2,5-95 | CL M8 |
| 87-600-60-20 A | X6 | 104 | 12,0 | M8 | 2,5-95 | CL M8 |
| 109-600-60-20 A | X6 | 130 | 12,0 | M8 | 2,5-95 | CL M8 |
| 128-600-60-20 A | X6 | 135 | 12,0 | M8 | 2,5-95 | CL M8 |
| 155-600-60-20 A | X7 | 168 | 60,0 | M12 | 25-300 | CL M8 |
| 197-600-60-20 A | X7 | 197 | 60,0 | M12 | 25-300 | CL M16 |
| 240-600-60-20 A | X8 | 220 | 60,0 | M12 | 25-300 | CL M16 |
| 296-600-60-20 A | X8 | 228 | 60,0 | M12 | 25-300 | CL M16 |

Table 20: Electrical operating conditions 600V 60Hz HFE-B

* Locking torque of the electrical network and converter terminal clamp

** CS \triangleq Cable end sleeve, CL \triangleq Cable lug

Technical data and dimension diagrams

Nominal voltage 690V 50Hz

| EPA - type HFE-A- | Configuration filter module | Weight [kg] | Torque* [Nm] Clamps X1+X2 | Grounding | Cable cross section [mm²] | Cable Lug** |
|------------------------------|--|------------------------|--|------------------|--|--------------------|
| 15-690-50-20 A | X3 | 12 | 2,4 | M8 | 1,5-25 | CS |
| 20-690-50-20 A | X3 | 13 | 2,4 | M8 | 1,5-25 | CS |
| 24-690-50-20 A | X3 | 22 | 2,4 | M8 | 1,5-25 | CS |
| 29-690-50-20 A | X4 | 36 | 4.5 | M8 | 2,5-50 | CS |
| 36-690-50-20 A | X4 | 40 | 4.5 | M8 | 2,5-50 | CS |
| 50-690-50-20 A | X5 | 42 | 6,0 | M8 | 10-70 | CS |
| 58-690-50-20 A | X5 | 52 | 6,0 | M8 | 10-70 | CS |
| 77-690-50-20 A | X6 | 56 | 12,0 | M8 | 2,5-95 | CL M8 |
| 87-690-50-20 A | X6 | 62 | 12,0 | M8 | 2,5-95 | CL M8 |
| 109-690-50-20 A | X6 | 74 | 12,0 | M8 | 2,5-95 | CL M8 |
| 128-690-50-20 A | X6 | 85 | 12,0 | M8 | 2,5-95 | CL M8 |
| 155-690-50-20 A | X7 | 105 | 60,0 | M12 | 25-300 | CL M8 |
| 197-690-50-20 A | X7 | 123 | 60,0 | M12 | 25-300 | CL M16 |
| 240-690-50-20 A | X8 | 136 | 60,0 | M12 | 25-300 | CL M16 |
| 296-690-50-20 A | X8 | 142 | 60,0 | M12 | 25-300 | CL M16 |
| 366-690-50-20 A | X8 | 163 | 60,0 | M12 | 25-300 | CL M16 |
| 395-690-50-20 A | X8 | 185 | 60,0 | M12 | 25-300 | CL M16 |

Table 21: Electrical operating conditions 690V 50Hz HFE-A

Nominal voltage 690V 50Hz

| EPA - type HFE-B- | Configuration filter module | Weight [kg] | Torque* [Nm] Clamps X1+X2 | Grounding | Cable cross section [mm²] | Cable Lug** |
|------------------------------|--|------------------------|--|------------------|--|--------------------|
| 15-690-50-20 A | X3 | 16 | 2,4 | M8 | 1,5-25 | CS |
| 20-690-50-20 A | X3 | 20 | 2,4 | M8 | 1,5-25 | CS |
| 24-690-50-20 A | X3 | 38 | 2,4 | M8 | 1,5-25 | CS |
| 29-690-50-20 A | X4 | 50 | 4.5 | M8 | 2,5-50 | CS |
| 36-690-50-20 A | X4 | 52 | 4.5 | M8 | 2,5-50 | CS |
| 50-690-50-20 A | X5 | 75 | 6,0 | M8 | 10-70 | CS |
| 58-690-50-20 A | X5 | 82 | 6,0 | M8 | 10-70 | CS |
| 77-690-50-20 A | X6 | 96 | 12,0 | M8 | 2,5-95 | CL M8 |
| 87-690-50-20 A | X6 | 104 | 12,0 | M8 | 2,5-95 | CL M8 |
| 109-690-50-20 A | X6 | 130 | 12,0 | M8 | 2,5-95 | CL M8 |
| 128-690-50-20 A | X6 | 135 | 12,0 | M8 | 2,5-95 | CL M8 |
| 155-690-50-20 A | X7 | 168 | 60,0 | M12 | 25-300 | CL M8 |
| 197-690-50-20 A | X7 | 197 | 60,0 | M12 | 25-300 | CL M16 |
| 240-690-50-20 A | X8 | 220 | 60,0 | M12 | 25-300 | CL M16 |
| 296-690-50-20 A | X8 | 228 | 60,0 | M12 | 25-300 | CL M16 |

Table 22: Electrical operating conditions 690V 50Hz HFE-B

* Locking torque of the electrical network and converter terminal clamp

** CS \triangleq Cable end sleeve, CL \triangleq Cable lug

Technical data and dimension diagrams

Table 23 shows the external dimensions of the filter modules in dependence of the enclosure type:

| Enclosure type | Height A [mm] | Width B [mm] | Depth C [mm] |
|----------------|------------------|-----------------|-----------------|
| X1 | 347 | 190 | 206 |
| X2 | 451 | 232 | 248 |
| X3 | 605 | 378 | 242 |
| X4 | 634 | 378 | 333 |
| X5 | 747 | 418 | 333 |
| X6 | 778 | 418 | 400 |
| X7 | 911 | 468 | 449 |
| X8 | 911 | 468 | 540 |

Table 23: The external dimensions of the filter modules with external fan

6.10 Allocation of the fans

Nominal voltage 380V 60Hz HFE-A

| EPA - type HFE-A- | Fan | Number | Power loss P [W] | Air mass V [m³/s] |
|------------------------------|------------|---------------|-----------------------------|---|
| 10-380-60-20 A | - | - | 93 | - |
| 14-380-60-20 A | - | - | 118 | - |
| 22-380-60-20 A | Internal | 1 | 206 | 200 |
| 29-380-60-20 A | Internal | 1 | 224 | 350 |
| 35-380-60-20 A | Internal | 1 | 233 | 350 |
| 43-380-60-20 A | Internal | 1 | 242 | 350 |
| 58-380-60-20 A | Internal | 1 | 274 | 350 |
| 72-380-60-20 A | Internal | 1 | 352 | 350 |
| 86-380-60-20 A | Internal | 1 | 374 | 350 |
| 101-380-60-20 A | Internal | 1 | 428 | 350 |
| 144-380-60-20 A | Internal | 1 | 488 | 350 |
| 180-380-60-20 A | Internal | 1 | 692 | 350 |
| 217-380-60-20 A | Internal | 2 | 743 | 700 |
| 252-380-60-20 A | Internal | 2 | 864 | 700 |
| 304-380-60-20 A | Internal | 2 | 905 | 700 |
| 325-380-60-20 A | Internal | 2 | 952 | 700 |
| 380-380-60-20 A | Internal | 2 | 1175 | 700 |
| 433-380-60-20 A | Internal | 2 | 1542 | 700 |

Table 24: Fans at nominal voltage 380V 60Hz type HFE-A

Nominal voltage 380V 60Hz HFE-B

| EPA - type HFE-B- | Fan | Number | Power loss P [W] | Air mass V [m³/s] |
|------------------------------|------------|---------------|-----------------------------|---|
| 10-380-60-20 A | - | - | 131 | - |
| 14-380-60-20 A | External | 1 | 184 | 200 |
| 22-380-60-20 A | External | 1 | 258 | 200 |
| 29-380-60-20 A | External | 1 | 298 | 350 |
| 35-380-60-20 A | External | 1 | 335 | 350 |
| 43-380-60-20 A | Internal | 1 | 396 | 350 |
| 58-380-60-20 A | Internal | 1 | 482 | 350 |
| 72-380-60-20 A | Internal | 1 | 574 | 350 |
| 86-380-60-20 A | Internal | 1 | 688 | 350 |
| 101-380-60-20 A | Internal | 1 | 747 | 350 |
| 144-380-60-20 A | Internal | 1 | 841 | 350 |
| 180-380-60-20 A | Internal | 1 | 962 | 350 |
| 217-380-60-20 A | External | 2 | 1080 | 700 |
| 252-380-60-20 A | External | 2 | 1194 | 700 |
| 304-380-60-20 A | External | 2 | 1288 | 700 |
| 325-380-60-20 A | External | 2 | 1406 | 700 |
| 380-380-60-20 A | External | 2 | 1510 | 700 |
| 433-380-60-20 A | External | 2 | 1852 | 700 |

Table 25: Fans at nominal voltage 380V 60Hz type HFE-B

Technical data and dimension diagrams

Nominal voltage 400V 50Hz HFE-A

| EPA - type HFE-A- | Fan | Number | Power loss P [W] | Air mass V [m³/s] |
|------------------------------|------------|---------------|-----------------------------|---|
| 10-400-50-20 A | - | - | 93 | - |
| 14-400-50-20 A | External | 1 | 118 | 200 |
| 22-400-50-20 A | Internal | 1 | 206 | 200 |
| 29-400-50-20 A | Internal | 1 | 224 | 350 |
| 35-400-50-20 A | Internal | 1 | 233 | 350 |
| 43-400-50-20 A | Internal | 1 | 242 | 350 |
| 58-400-50-20 A | Internal | 1 | 274 | 350 |
| 72-400-50-20 A | Internal | 1 | 352 | 350 |
| 86-400-50-20 A | Internal | 1 | 374 | 350 |
| 101-400-50-20 A | Internal | 1 | 428 | 350 |
| 144-400-50-20 A | Internal | 1 | 488 | 350 |
| 180-400-50-20 A | Internal | 1 | 692 | 350 |
| 217-400-50-20 A | Internal | 2 | 743 | 700 |
| 252-400-50-20 A | Internal | 2 | 864 | 700 |
| 304-400-50-20 A | Internal | 2 | 905 | 700 |
| 325-400-50-20 A | Internal | 2 | 952 | 700 |
| 380-400-50-20 A | Internal | 2 | 1175 | 700 |
| 433-400-50-20 A | Internal | 2 | 1542 | 700 |

Table 26: Fans at nominal voltage 400V 50Hz type HFE-A

Nominal voltage 400V 50Hz HFE-B

| EPA - type HFE-B- | Fan | Number | Power loss P [W] | Air mass V [m³/s] |
|------------------------------|------------|---------------|-----------------------------|---|
| 10-400-50-20 A | - | - | 131 | - |
| 14-400-50-20 A | External | 1 | 184 | 200 |
| 22-400-50-20 A | External | 1 | 258 | 200 |
| 29-400-50-20 A | External | 1 | 298 | 350 |
| 35-400-50-20 A | External | 1 | 335 | 350 |
| 43-400-50-20 A | Internal | 1 | 396 | 350 |
| 58-400-50-20 A | Internal | 1 | 482 | 350 |
| 72-400-50-20 A | Internal | 1 | 574 | 350 |
| 86-400-50-20 A | Internal | 1 | 688 | 350 |
| 101-400-50-20 A | Internal | 1 | 747 | 350 |
| 144-400-50-20 A | Internal | 1 | 841 | 350 |
| 180-400-50-20 A | External | 1 | 962 | 350 |
| 217-400-50-20 A | Internal | 2 | 1080 | 700 |
| 252-400-50-20 A | Internal | 2 | 1194 | 700 |
| 304-400-50-20 A | External | 2 | 1288 | 700 |
| 325-400-50-20 A | External | 2 | 1406 | 700 |
| 380-400-50-20 A | External | 2 | 1510 | 700 |
| 433-400-50-20 A | External | 2 | 1852 | 700 |

Table 27: Fans at nominal voltage 400V 50Hz type HFE-B

Technical data and dimension diagrams

Nominal voltage 460V 60Hz HFE-A

| EPA - type HFE-A- | Fan | Number | Power loss P [W] | Air mass V [m³/s] |
|------------------------------|------------|---------------|-----------------------------|---|
| 10-460-60-20 A | - | - | 93 | - |
| 14-460-60-20 A | Internal | 1 | 118 | 200 |
| 19-460-60-20 A | Internal | 1 | 206 | 200 |
| 25-460-60-20 A | Internal | 1 | 224 | 200 |
| 31-460-60-20 A | Internal | 1 | 233 | 350 |
| 36-460-60-20 A | Internal | 1 | 242 | 350 |
| 48-460-60-20 A | Internal | 1 | 274 | 350 |
| 60-460-60-20 A | Internal | 1 | 352 | 350 |
| 73-460-60-20 A | Internal | 1 | 374 | 350 |
| 95-460-60-20 A | Internal | 1 | 428 | 350 |
| 118-460-60-20 A | Internal | 1 | 488 | 350 |
| 154-460-60-20 A | Internal | 1 | 692 | 350 |
| 183-460-60-20 A | Internal | 2 | 743 | 350 |
| 231-460-60-20 A | Internal | 2 | 864 | 700 |
| 291-460-60-20 A | Internal | 2 | 905 | 700 |
| 355-460-60-20 A | Internal | 2 | 952 | 700 |
| 380-460-60-20 A | Internal | 2 | 1175 | 700 |
| 436-460-60-20 A | Internal | 2 | 1542 | 700 |

Table 28: Fans at nominal voltage 460V 60Hz type HFE-A

Nominal voltage 460V 60Hz HFE-B

| EPA - type HFE-B- | Fan | Number | Power loss P [W] | Air mass V [m³/s] |
|------------------------------|------------|---------------|-----------------------------|---|
| 10-460-60-20 A | - | - | 131 | - |
| 14-460-60-20 A | External | 1 | 184 | 200 |
| 19-460-60-20 A | External | 1 | 258 | 200 |
| 25-460-60-20 A | Internal | 1 | 298 | 200 |
| 31-460-60-20 A | Internal | 1 | 335 | 350 |
| 36-460-60-20 A | Internal | 1 | 396 | 350 |
| 48-460-60-20 A | Internal | 1 | 482 | 350 |
| 60-460-60-20 A | Internal | 1 | 574 | 350 |
| 73-460-60-20 A | Internal | 1 | 688 | 350 |
| 95-460-60-20 A | Internal | 1 | 747 | 350 |
| 118-460-60-20 A | Internal | 1 | 841 | 350 |
| 154-460-60-20 A | External | 1 | 962 | 350 |
| 183-460-60-20 A | External | 1 | 1080 | 350 |
| 231-460-60-20 A | External | 2 | 1194 | 700 |
| 291-460-60-20 A | External | 2 | 1288 | 700 |
| 355-460-60-20 A | External | 2 | 1406 | 700 |
| 380-460-60-20 A | External | 2 | 1510 | 700 |
| 436-460-60-20 A | External | 2 | 1852 | 700 |

Table 29: Fans at nominal voltage 460V 60Hz type HFE-B

Technical data and dimension diagrams

Nominal voltage 500V 50Hz HFE-A

| EPA - type HFE-A- | Fan | Number | Power loss P [W] | Air mass V [m³/s] |
|------------------------------|------------|---------------|-----------------------------|---|
| 15-500-50-20 A | Internal | 1 | 224 | 350 |
| 20-500-50-20 A | Internal | 1 | 233 | 350 |
| 24-500-50-20 A | Internal | 1 | 242 | 350 |
| 29-500-50-20 A | Internal | 1 | 274 | 350 |
| 36-500-50-20 A | Internal | 1 | 352 | 350 |
| 50-500-50-20 A | Internal | 1 | 374 | 350 |
| 58-500-50-20 A | Internal | 1 | 428 | 350 |
| 77-500-50-20 A | Internal | 1 | 488 | 350 |
| 87-500-50-20 A | Internal | 1 | 692 | 350 |
| 109-500-50-20 A | Internal | 1 | 743 | 350 |
| 128-500-50-20 A | Internal | 1 | 864 | 350 |
| 155-500-50-20 A | Internal | 2 | 905 | 700 |
| 197-500-50-20 A | Internal | 2 | 952 | 700 |
| 240-500-50-20 A | Internal | 2 | 1175 | 700 |
| 296-500-50-20 A | Internal | 2 | 1288 | 700 |
| 366-500-50-20 A | External | 2 | 1542 | 700 |
| 395-500-50-20 A | External | 2 | 1852 | 700 |

Table 30: Fans at nominal voltage 500V 50Hz type HFE-A

Nominal voltage 500V 50Hz HFE-B

| EPA - type HFE-B- | Fan | Number | Power loss P [W] | Air mass V [m³/s] |
|------------------------------|------------|---------------|-----------------------------|---|
| 15-500-50-20 A | Internal | 1 | 298 | 350 |
| 20-500-50-20 A | Internal | 1 | 335 | 350 |
| 24-500-50-20 A | Internal | 1 | 396 | 350 |
| 29-500-50-20 A | Internal | 1 | 482 | 350 |
| 36-500-50-20 A | External | 1 | 574 | 350 |
| 50-500-50-20 A | Internal | 1 | 688 | 350 |
| 58-500-50-20 A | External | 1 | 747 | 350 |
| 77-500-50-20 A | Internal | 1 | 841 | 350 |
| 87-500-50-20 A | Internal | 1 | 962 | 350 |
| 109-500-50-20 A | Internal | 1 | 1080 | 350 |
| 128-500-50-20 A | External | 1 | 1194 | 350 |
| 155-500-50-20 A | External | 2 | 1288 | 700 |
| 197-500-50-20 A | External | 2 | 1406 | 700 |
| 240-500-50-20 A | External | 2 | 1510 | 700 |
| 296-500-50-20 A | External | 2 | 1852 | 700 |

Table 31: Fans at nominal voltage 500V 50Hz type HFE-B

Technical data and dimension diagrams

Nominal voltage 600V 60Hz HFE-A

| EPA - type HFE-A- | Fan | Number | Power loss P [W] | Air mass V [m³/s] |
|------------------------------|------------|---------------|-----------------------------|---|
| 15-600-60-20 A | Internal | 1 | 224 | 350 |
| 20-600-60-20 A | Internal | 1 | 233 | 350 |
| 24-600-60-20 A | Internal | 1 | 242 | 350 |
| 29-600-60-20 A | Internal | 1 | 274 | 350 |
| 36-600-60-20 A | Internal | 1 | 352 | 350 |
| 50-600-60-20 A | Internal | 1 | 374 | 350 |
| 58-600-60-20 A | Internal | 1 | 428 | 350 |
| 77-600-60-20 A | Internal | 1 | 488 | 350 |
| 87-600-60-20 A | Internal | 1 | 692 | 350 |
| 109-600-60-20 A | Internal | 1 | 743 | 350 |
| 128-600-60-20 A | Internal | 1 | 864 | 350 |
| 155-600-60-20 A | Internal | 2 | 905 | 700 |
| 197-600-60-20 A | Internal | 2 | 952 | 700 |
| 240-600-60-20 A | Internal | 2 | 1175 | 700 |
| 296-600-60-20 A | Internal | 2 | 1288 | 700 |
| 366-600-60-20 A | External | 2 | 1542 | 700 |
| 395-600-60-20 A | External | 2 | 1852 | 700 |

Table 32: Fans at nominal voltage 600V 60Hz type HFE-A

Nominal voltage 600V 60Hz HFE-A

| EPA - type HFE-B- | Fan | Number | Power loss P [W] | Air mass V [m³/s] |
|------------------------------|------------|---------------|-----------------------------|---|
| 15-600-60-20 A | Internal | 1 | 298 | 350 |
| 20-600-60-20 A | Internal | 1 | 335 | 350 |
| 24-600-60-20 A | Internal | 1 | 396 | 350 |
| 29-600-60-20 A | Internal | 1 | 482 | 350 |
| 36-600-60-20 A | External | 1 | 574 | 350 |
| 50-600-60-20 A | Internal | 1 | 688 | 350 |
| 58-600-60-20 A | External | 1 | 747 | 350 |
| 77-600-60-20 A | Internal | 1 | 841 | 350 |
| 87-600-60-20 A | Internal | 1 | 962 | 350 |
| 109-600-60-20 A | Internal | 1 | 1080 | 350 |
| 128-600-60-20 A | External | 1 | 1194 | 350 |
| 155-600-60-20 A | External | 2 | 1288 | 700 |
| 197-600-60-20 A | External | 2 | 1406 | 700 |
| 240-600-60-20 A | External | 2 | 1510 | 700 |
| 296-600-60-20 A | External | 2 | 1852 | 700 |

Table 33: Fans at nominal voltage 600V 60Hz type HFE-B

Technical data and dimension diagrams

Nominal voltage 690V 50Hz HFE-A

| EPA - type HFE-A- | Fan | Number | Power loss P [W] | Air mass V [m³/s] |
|------------------------------|------------|---------------|-----------------------------|---|
| 15-690-50-20 A | Internal | 1 | 224 | 350 |
| 20-690-50-20 A | Internal | 1 | 233 | 350 |
| 24-690-50-20 A | Internal | 1 | 242 | 350 |
| 29-690-50-20 A | Internal | 1 | 274 | 350 |
| 36-690-50-20 A | Internal | 1 | 352 | 350 |
| 50-690-50-20 A | Internal | 1 | 374 | 350 |
| 58-690-50-20 A | Internal | 1 | 428 | 350 |
| 77-690-50-20 A | Internal | 1 | 488 | 350 |
| 87-690-50-20 A | Internal | 1 | 692 | 350 |
| 109-690-50-20 A | Internal | 1 | 743 | 350 |
| 128-690-50-20 A | Internal | 1 | 864 | 350 |
| 155-690-50-20 A | Internal | 2 | 905 | 700 |
| 197-690-50-20 A | Internal | 2 | 952 | 700 |
| 240-690-50-20 A | Internal | 2 | 1175 | 700 |
| 296-690-50-20 A | Internal | 2 | 1288 | 700 |
| 366-690-50-20 A | External | 2 | 1542 | 700 |
| 395-690-50-20 A | External | 2 | 1852 | 700 |

Table 34: Fans at nominal voltage 690V 50Hz type HFE-A

Nominal voltage 690V 50Hz HFE-B

| EPA - type HFE-B- | Fan | Number | Power loss P [W] | Air mass V [m³/s] |
|------------------------------|------------|---------------|-----------------------------|---|
| 15-600-60-20 A | Internal | 1 | 298 | 350 |
| 20-600-60-20 A | Internal | 1 | 335 | 350 |
| 24-600-60-20 A | Internal | 1 | 396 | 350 |
| 29-600-60-20 A | Internal | 1 | 482 | 350 |
| 36-600-60-20 A | External | 1 | 574 | 350 |
| 50-600-60-20 A | Internal | 1 | 688 | 350 |
| 58-600-60-20 A | External | 1 | 747 | 350 |
| 77-600-60-20 A | Internal | 1 | 841 | 350 |
| 87-600-60-20 A | Internal | 1 | 962 | 350 |
| 109-600-60-20 A | Internal | 1 | 1080 | 350 |
| 128-600-60-20 A | External | 1 | 1194 | 350 |
| 155-600-60-20 A | External | 2 | 1288 | 700 |
| 197-600-60-20 A | External | 2 | 1406 | 700 |
| 240-600-60-20 A | External | 2 | 1510 | 700 |
| 296-600-60-20 A | External | 2 | 1852 | 700 |

Table 35: Fans at nominal voltage 690V 50Hz type HFE-B

Technical data and dimension diagrams

6.11 Dimension diagrams

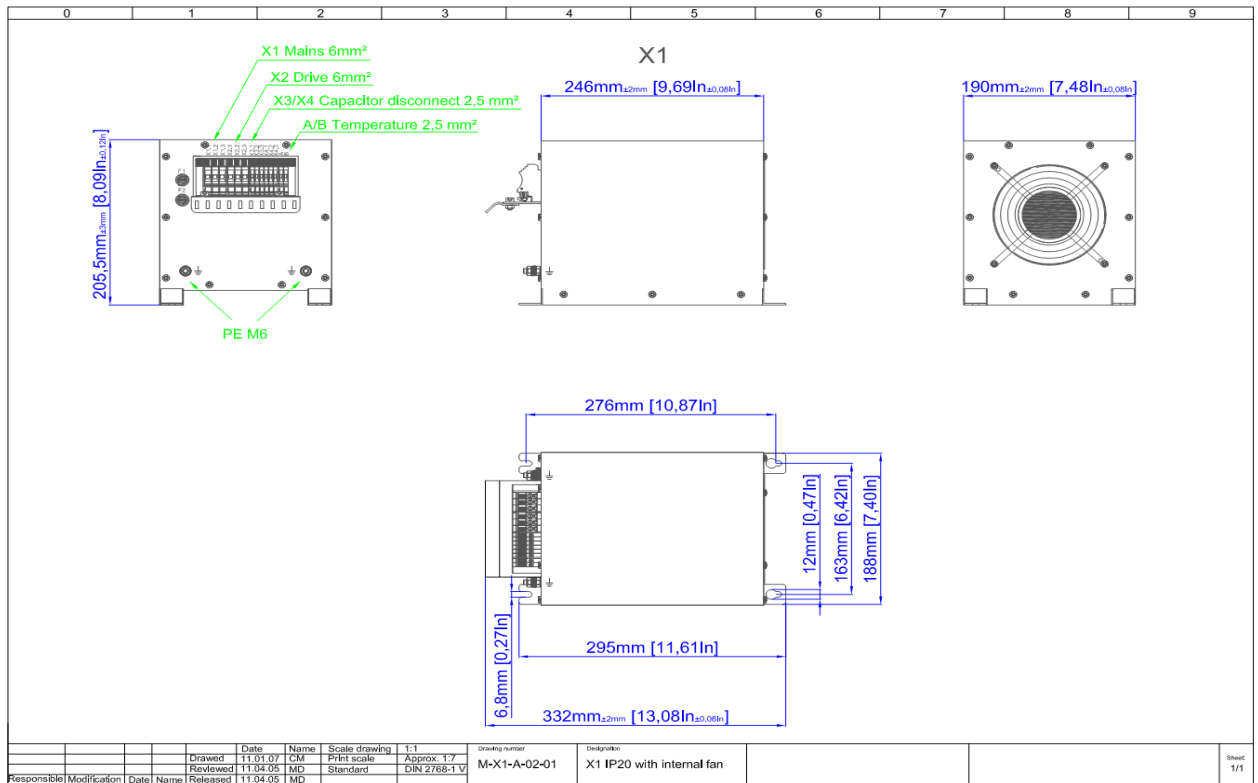


Figure 6: Dimension diagram configuration X1 internal fan

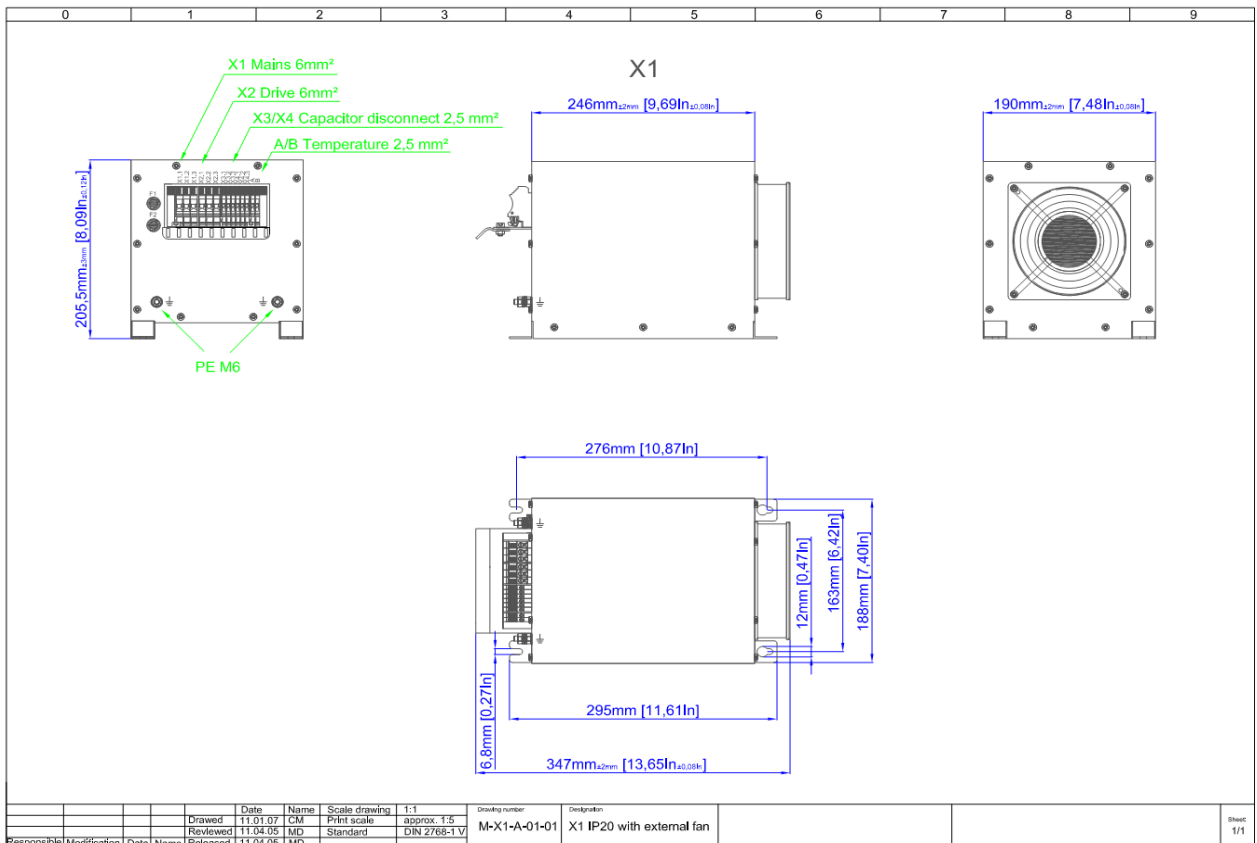


Figure 7: Dimension diagram configuration X1 external fan

Technical data and dimension diagrams

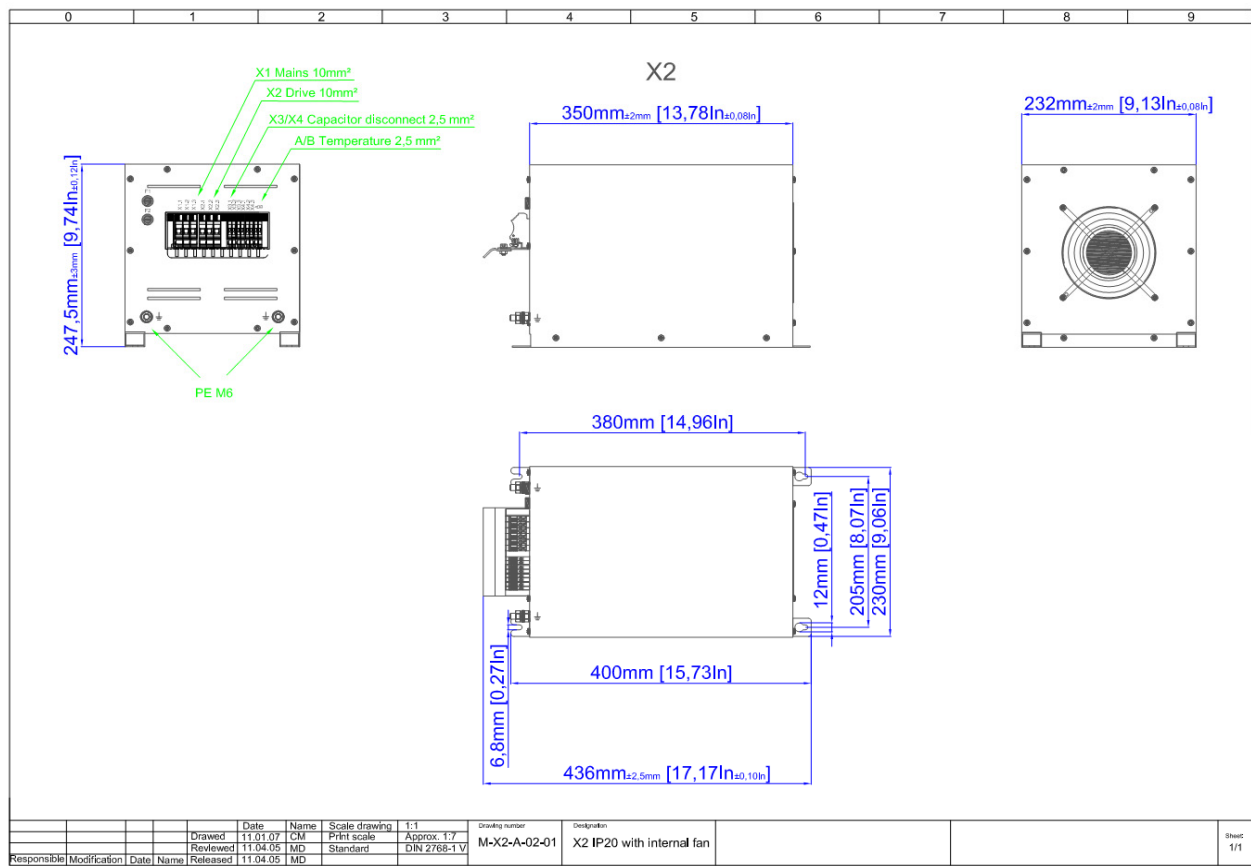


Figure 8: Dimension diagram configuration X2 internal fan

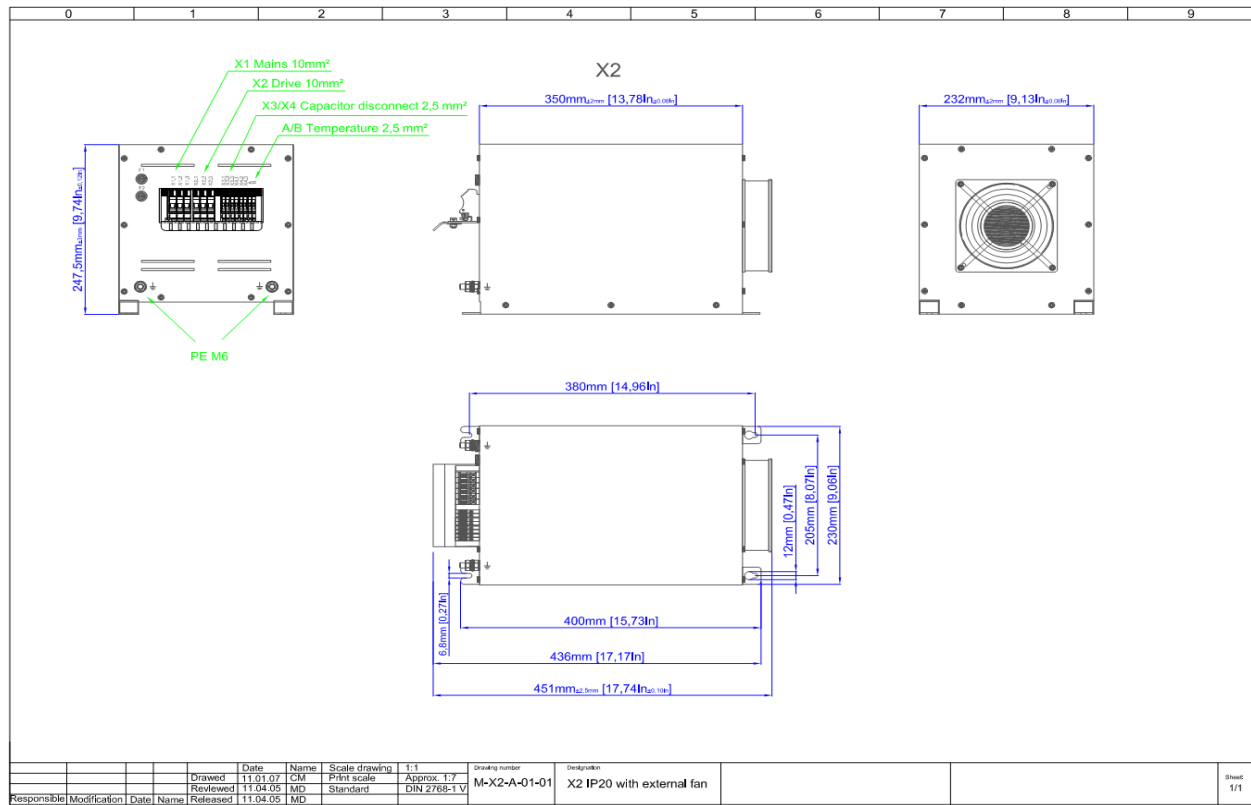


Figure 9: Dimension diagram configuration X2 external fan

Technical data and dimension diagrams

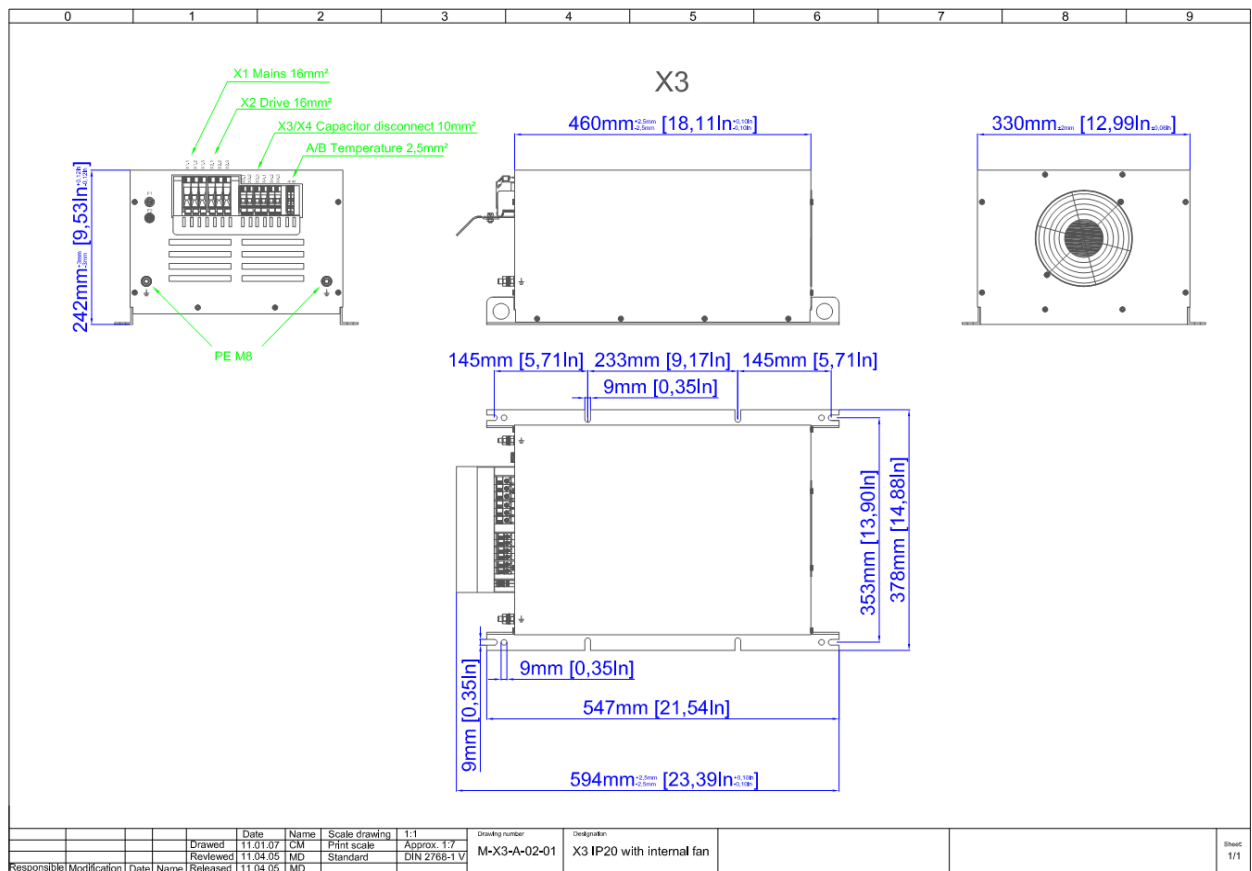


Figure 10: Dimension diagram configuration X3 internal fan

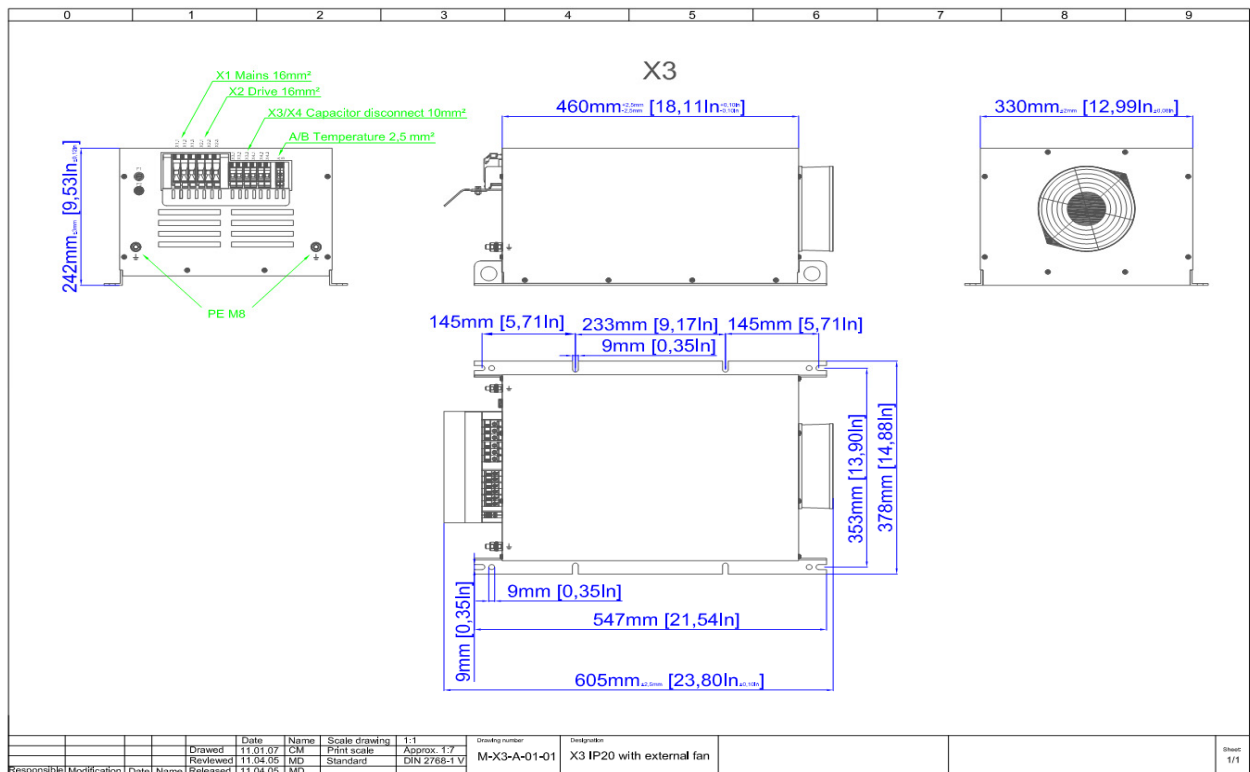


Figure 11: Dimension diagram configuration X3 external fan

Technical data and dimension diagrams

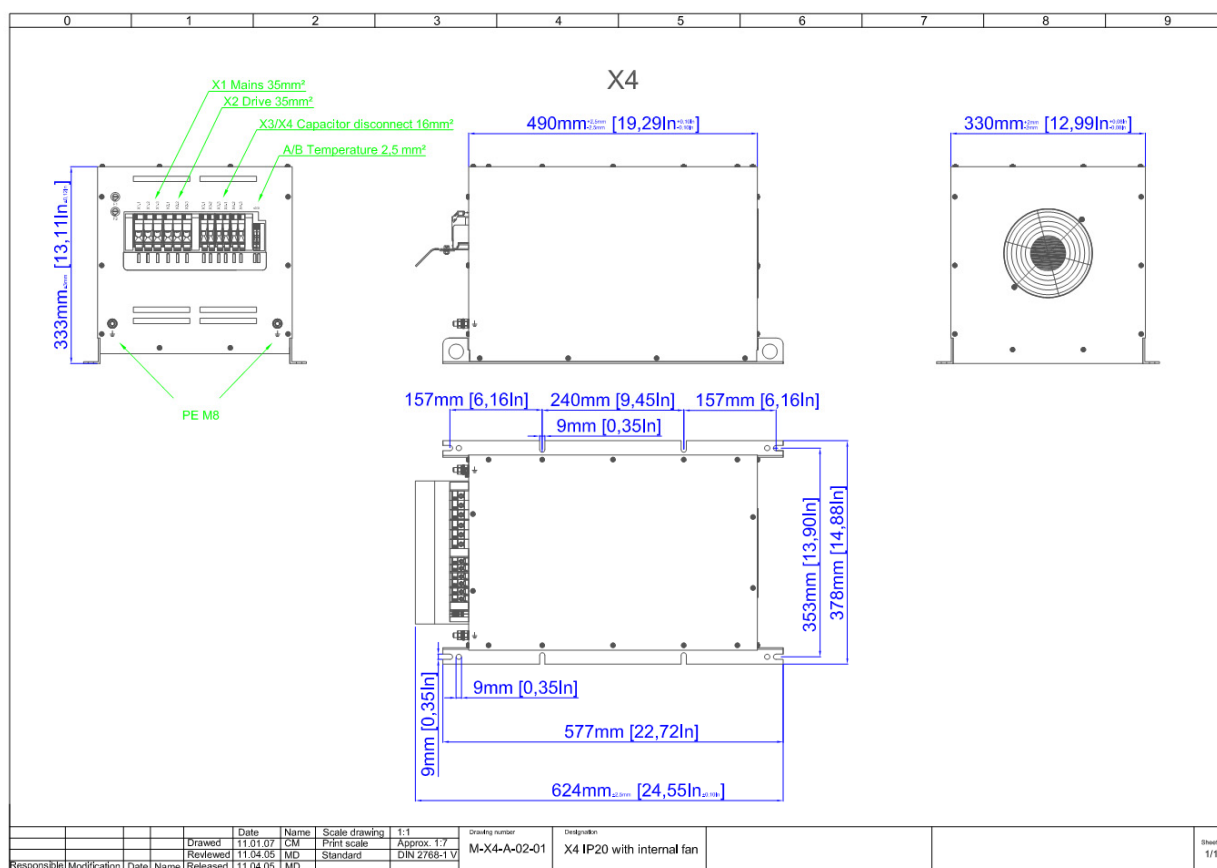


Figure 12: Dimension diagram configuration X4 internal fan

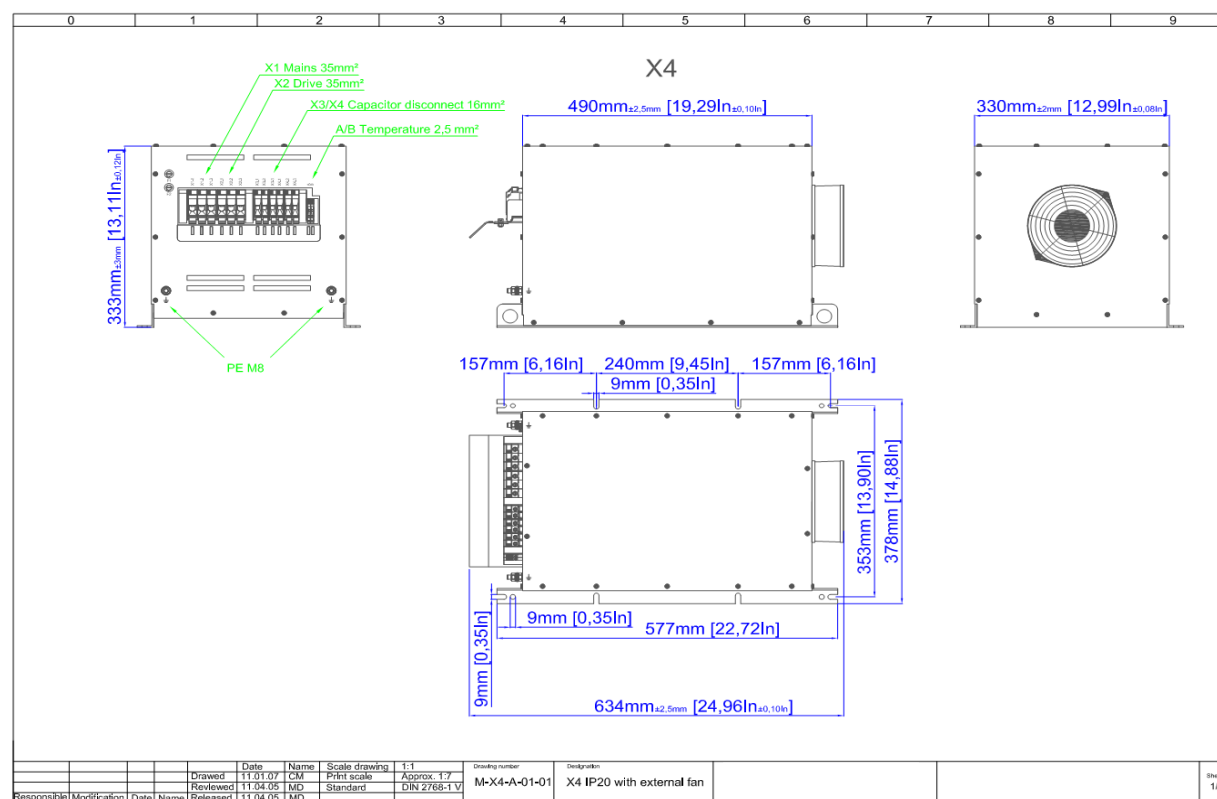


Figure 13: Dimension diagram configuration X4 external fan

Technical data and dimension diagrams

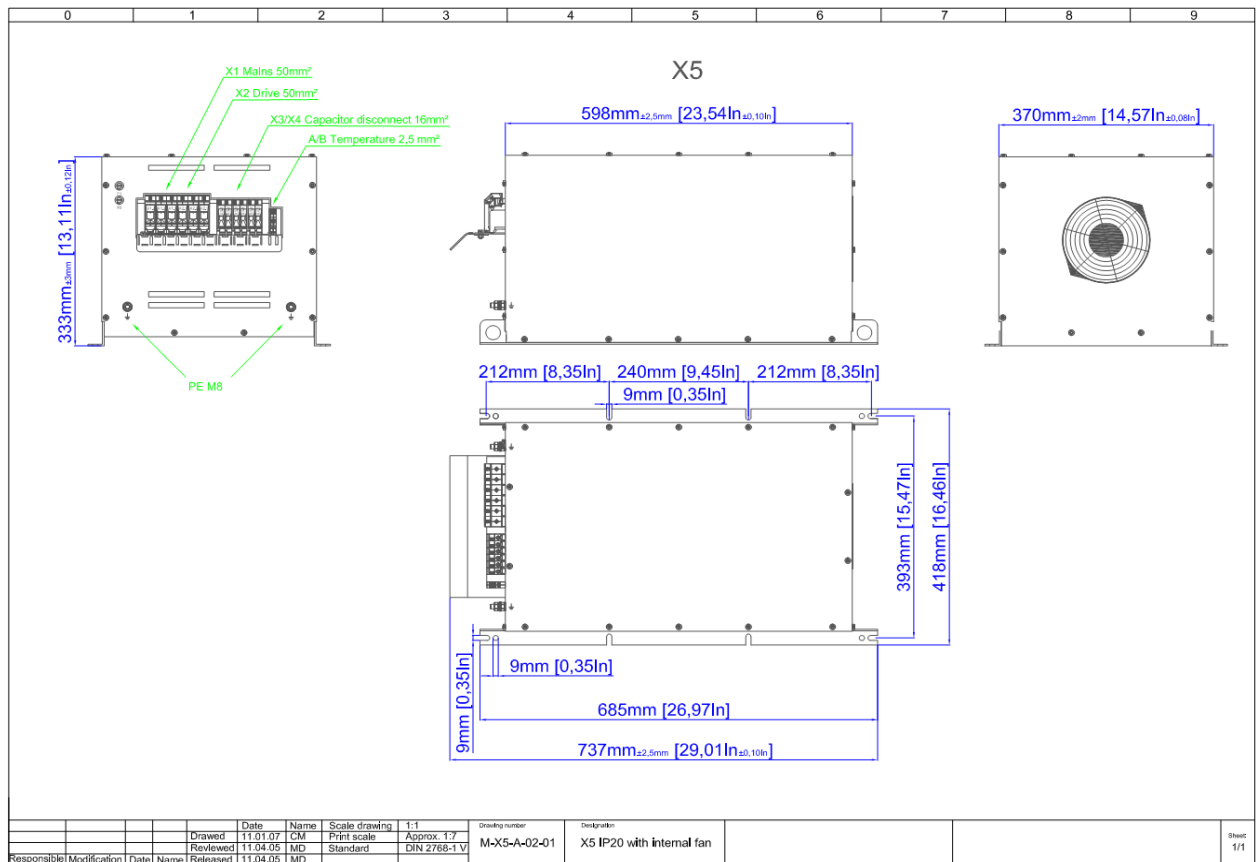


Figure 14: Dimension diagram configuration X5 internal fan

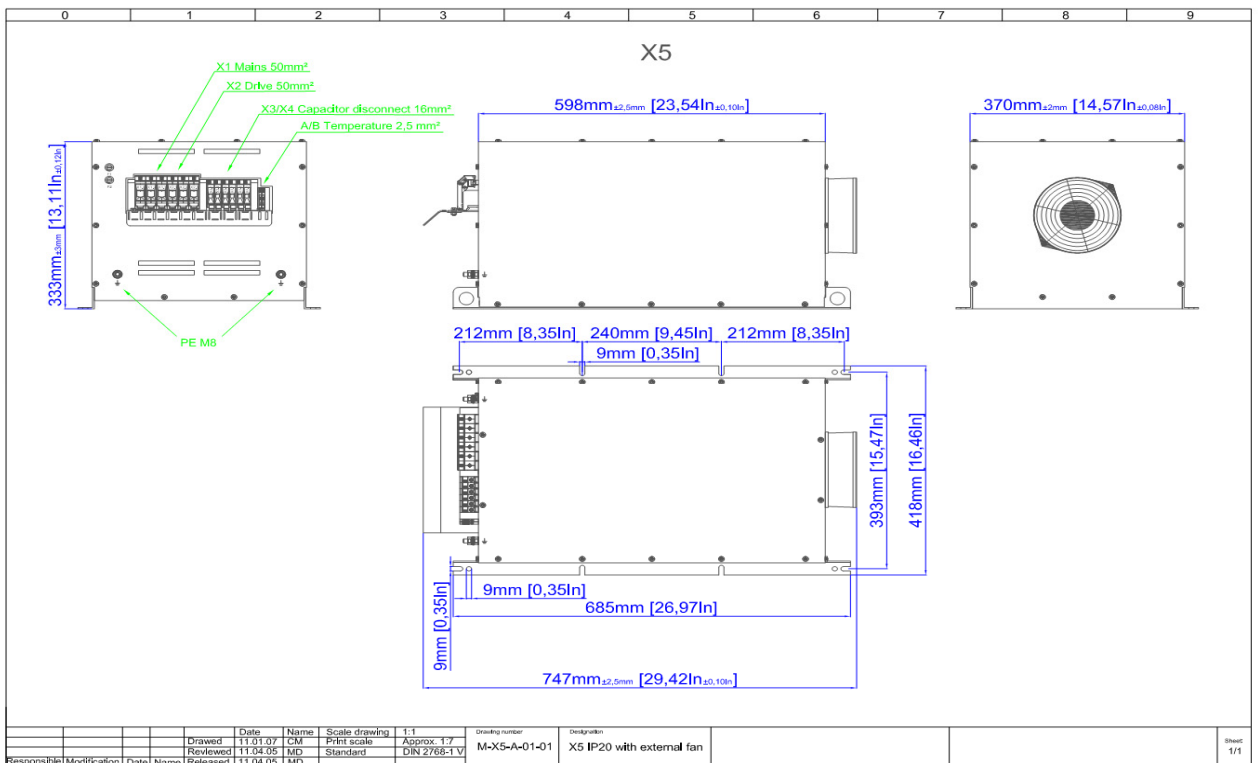


Figure 15: Dimension diagram configuration X5 external fan

Technical data and dimension diagrams

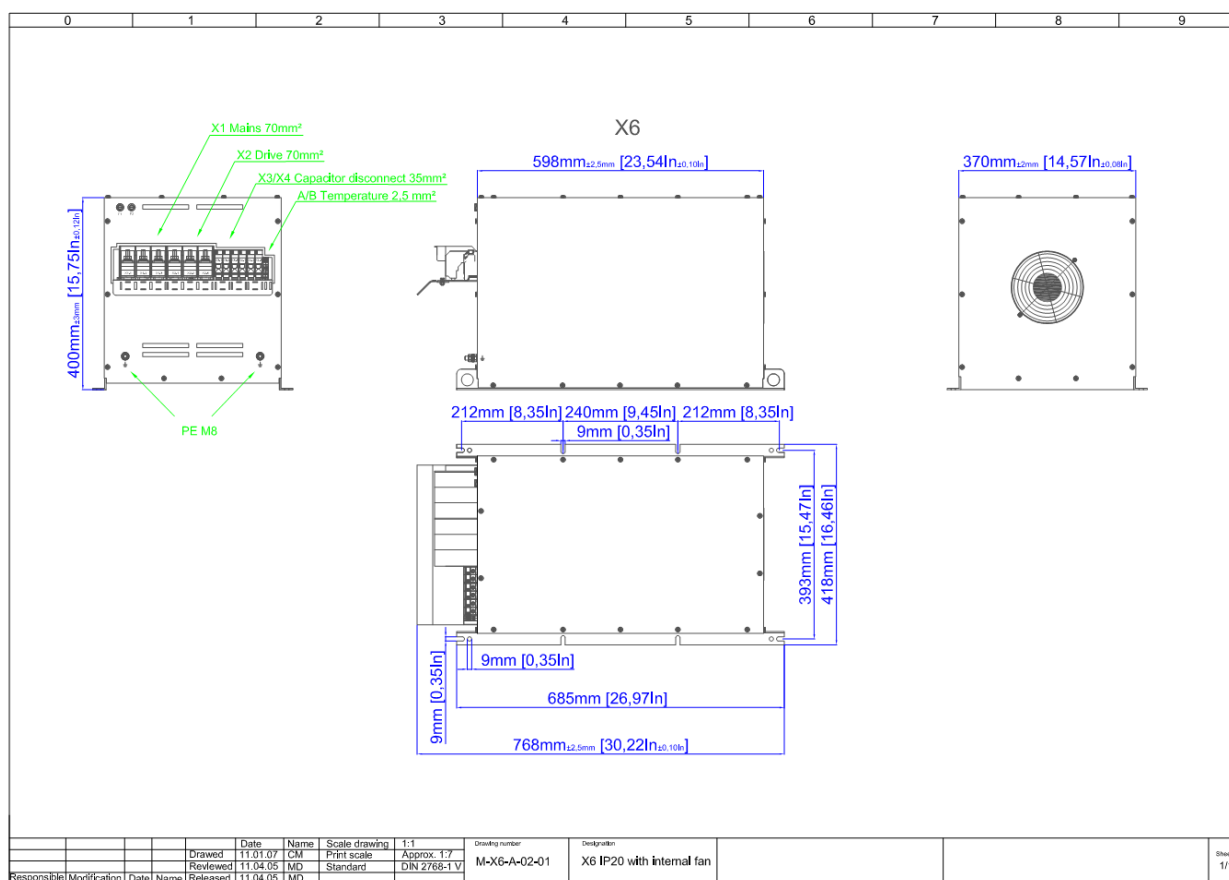


Figure 16: Dimension diagram configuration X6 internal fan

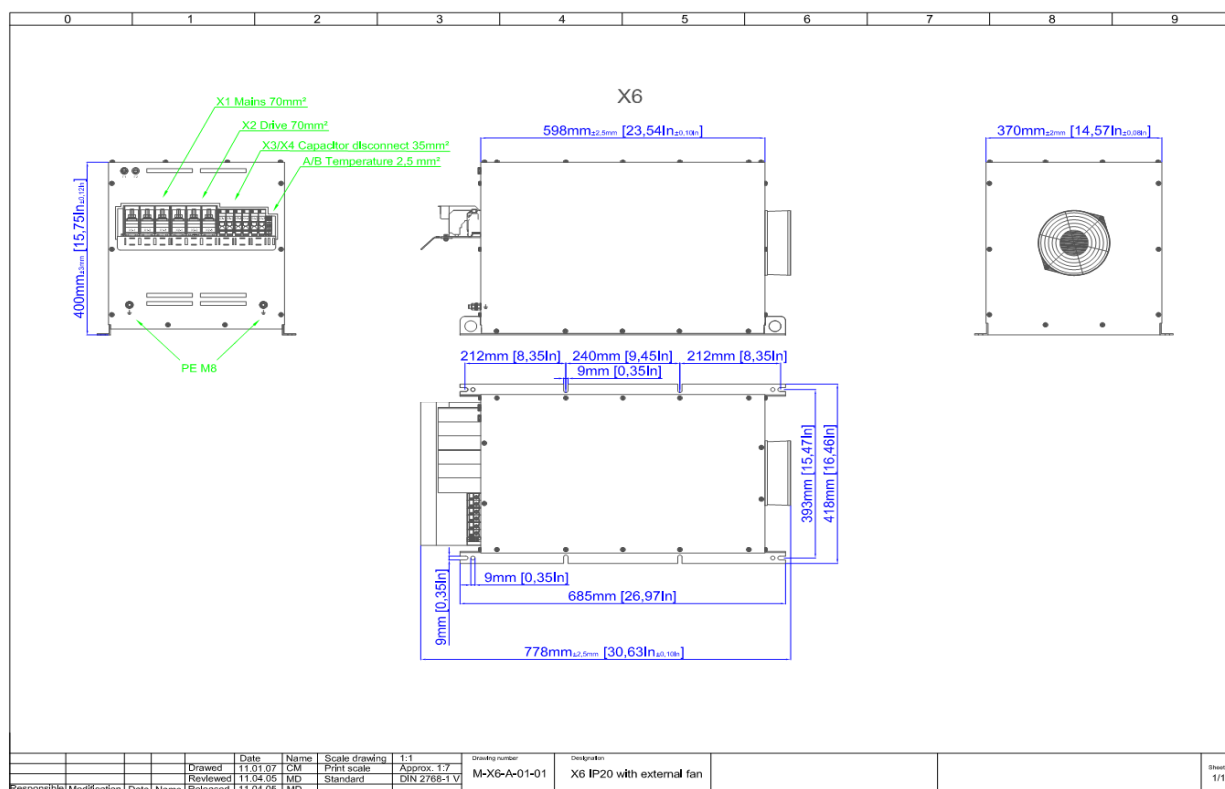


Figure 17: Dimension diagram configuration X6 external fan

Technical data and dimension diagrams

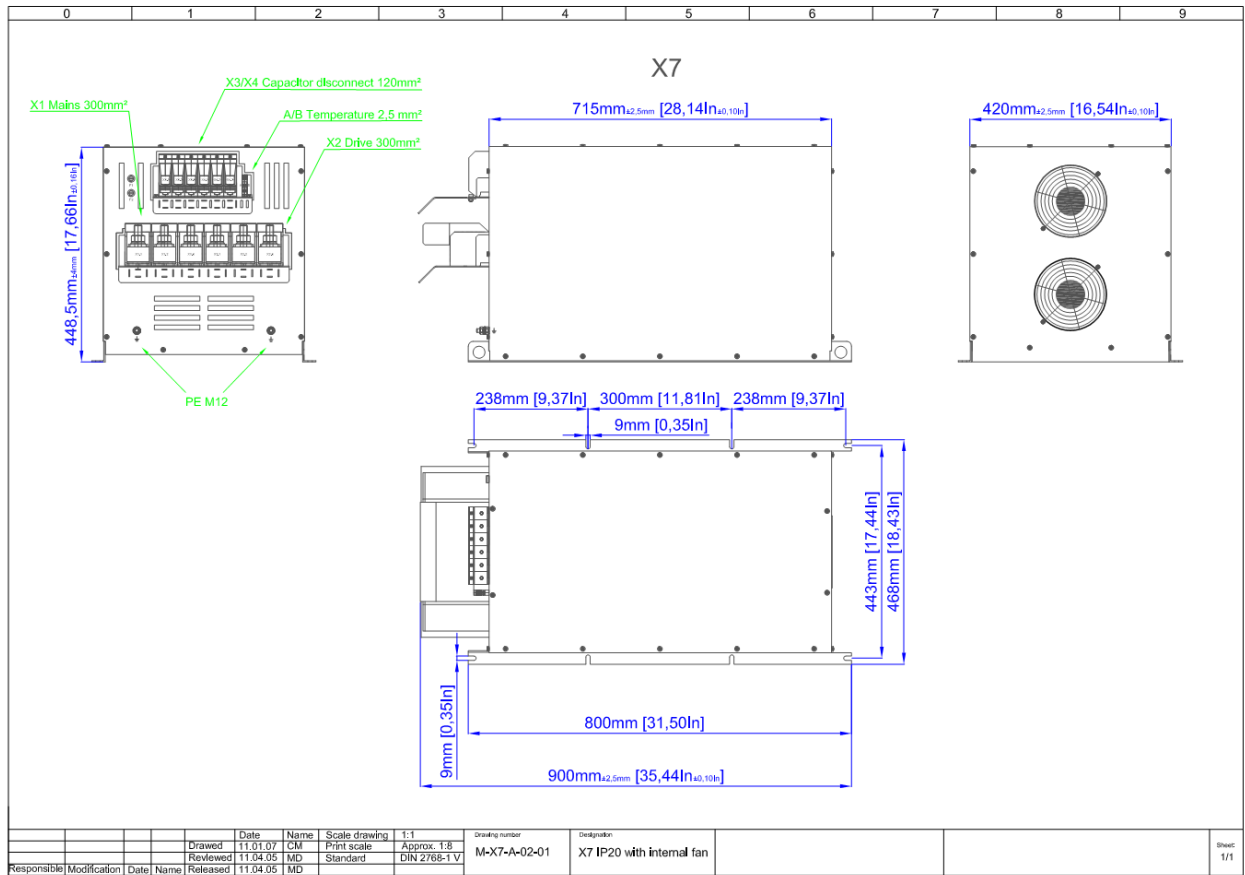


Figure 18: Dimension diagram configuration X7 internal fan

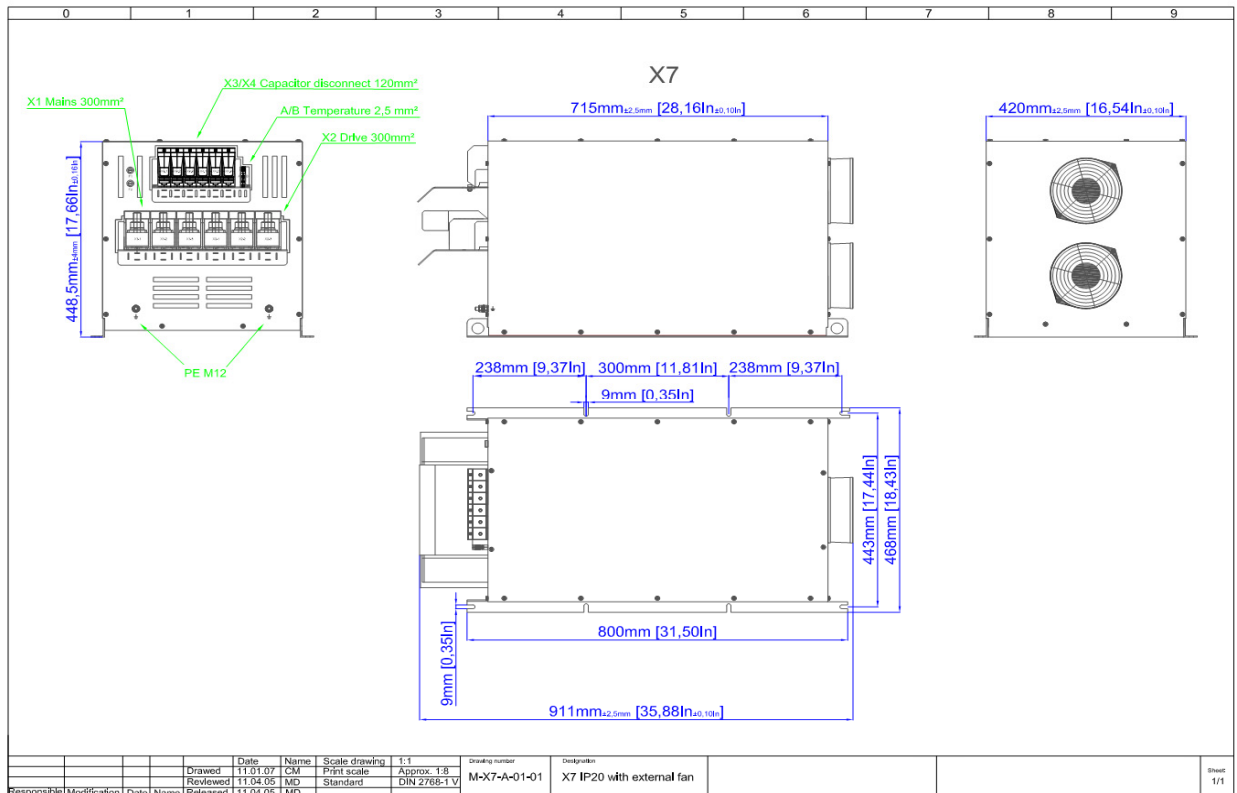


Figure 19: Dimension diagram configuration X7 external fan

Technical data and dimension diagrams

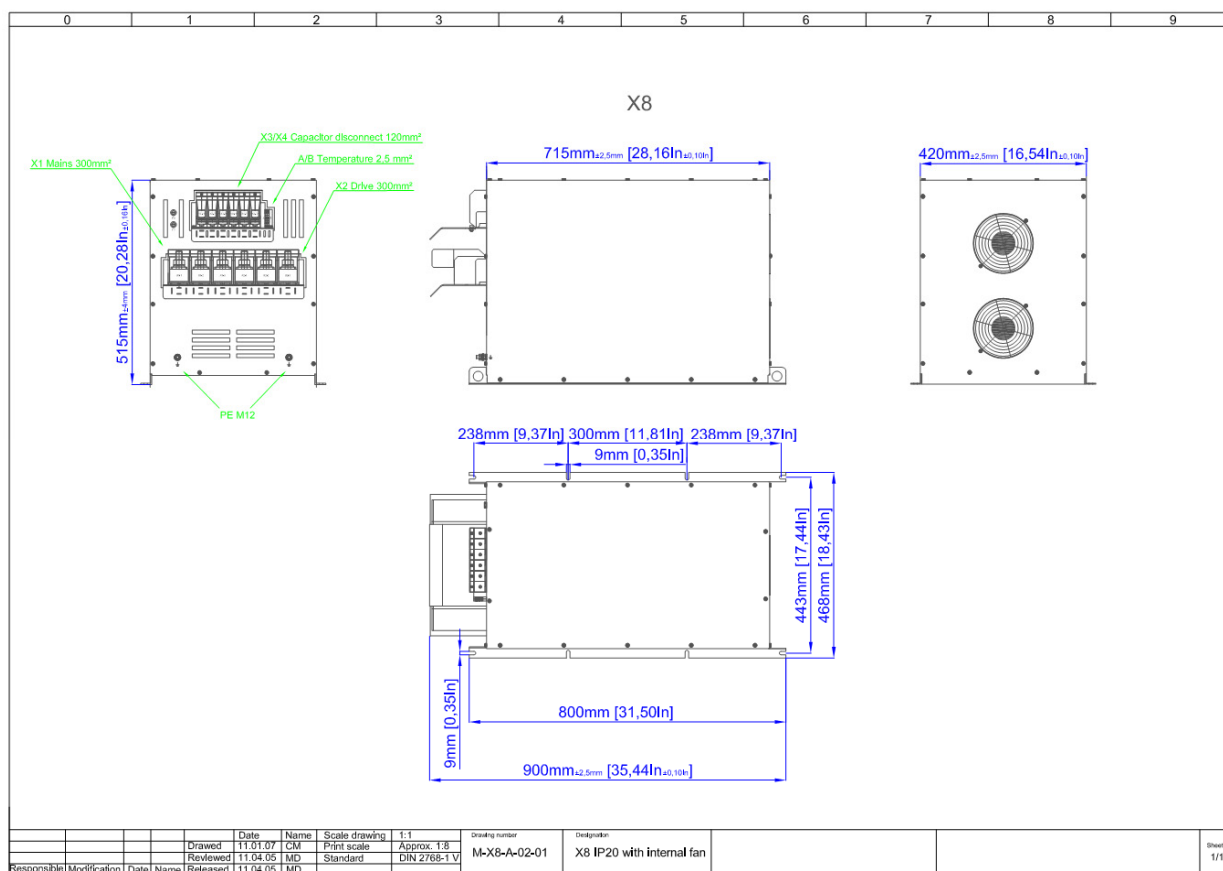


Figure 20: Dimension diagram configuration X8 internal fan

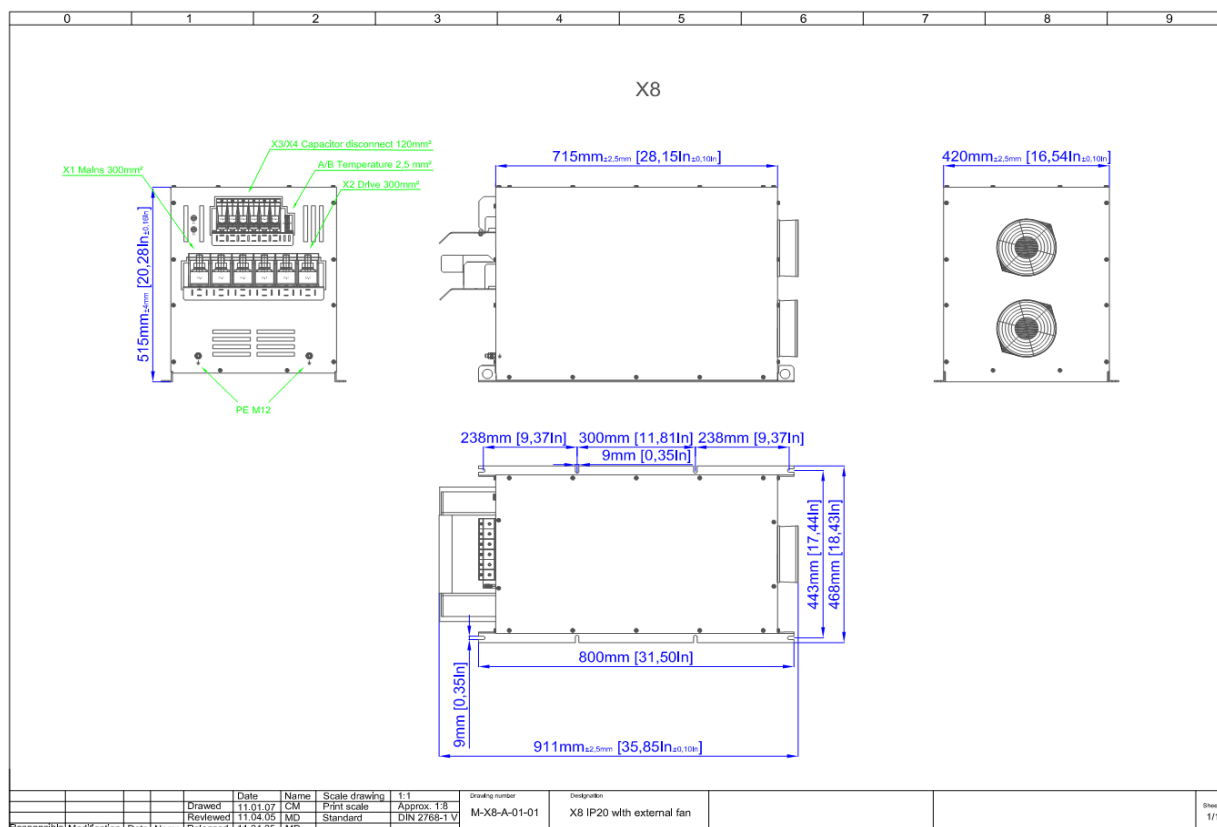


Figure 21: Dimension diagram configuration X8 external fan

7 Installation

7.1 Mechanical installation

Important information

- Use the filter modules only as built-in type!
- Observe the free space of the installation!
- Several filter modules in one electrical enclosure can be mounted without clearance side by side.
- Observe 150mm free space above- and below (see figure 22).
- The natural convection must not be constrained.
- At polluted convection (dust, fibrous material, fat, aggressive gases), which could affect the function of the filter module:
- Make adequate retaliatory actions, for example separate airflow, mounting of filter modules, regular cleaning, etc.
- Do not exceed the admissible range of the operating- ambient temperature.

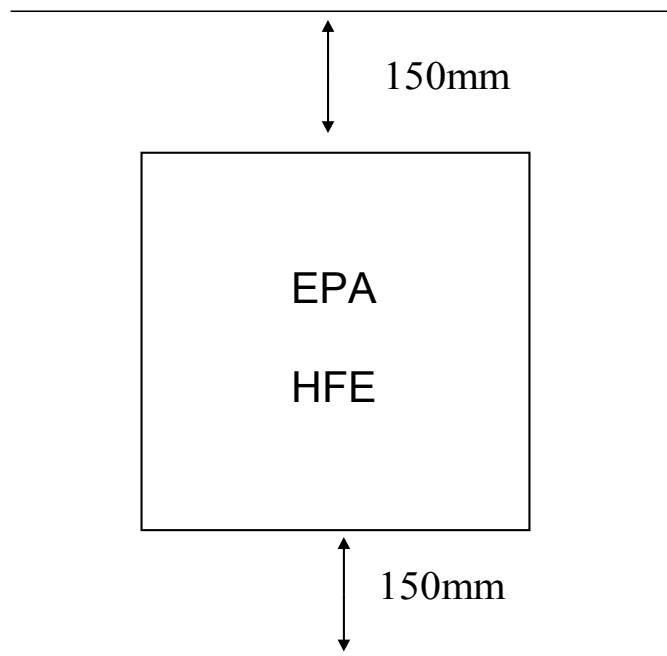


Figure 22: 150mm free space above and below

Installation

7.2 International protection rating



Warning!

Warning before touching a hot surface! The direct touching can lead to a burning of the skin!

IP 20:

- The free space of the filter module must average minimum 150 mm
- The surface temperature of the IP 20 filter module does not exceed 70°C
- The filter module can be mounted side by side among the frequency converter

Installation

IP21 (optional):

IP21 / Nema1 enclosure equipments are available and listed in the following charts:

External ventilator:

| Enclosure size | Enclosure width | a | b | c | d | e | weight |
|----------------|-----------------|-----|-----|-------|-------|-------|--------|
| X1 | 190 | 120 | 160 | 329,5 | 344,5 | 215,5 | 2,8 |
| X2 | 232 | 190 | 180 | 433,5 | 448,5 | 257,5 | 3,3 |
| X3 | 330 | 145 | 210 | 543,5 | 558,5 | 252,0 | 4,9 |
| X4 | 330 | 230 | 230 | 573,5 | 588,5 | 343,0 | 6,5 |
| X5 | 370 | 230 | 250 | 681,5 | 696,5 | 343,0 | 7,8 |
| X6 | 370 | 300 | 270 | 681,5 | 696,5 | 410,0 | 9,2 |
| X7 | 420 | 300 | 320 | 796,5 | 811,5 | 458,5 | 13,7 |
| X8 | 420 | 400 | 350 | 796,5 | 811,5 | 553,0 | 16,9 |

Table 36: IP21 External ventilator

Internal ventilator:

| Enclosure size | Enclosure width | a | b | c | d | e | weight |
|----------------|-----------------|-----|-----|-------|-------|-------|--------|
| X1 | 190 | 120 | 160 | 309,5 | 329,5 | 215,5 | 2,7 |
| X2 | 232 | 190 | 180 | 413,5 | 433,5 | 257,5 | 3,2 |
| X3 | 330 | 145 | 210 | 523,5 | 543,5 | 252,0 | 4,7 |
| X4 | 330 | 230 | 230 | 553,5 | 573,5 | 343,0 | 6,3 |
| X5 | 370 | 230 | 250 | 661,5 | 681,5 | 343,0 | 7,5 |
| X6 | 370 | 300 | 270 | 661,5 | 681,5 | 410,0 | 8,9 |
| X7 | 420 | 300 | 320 | 776,5 | 796,5 | 458,5 | 13,3 |
| X8 | 420 | 400 | 350 | 776,5 | 796,5 | 553,0 | 16,5 |

Table 37: IP21 Internal ventilator

Installation

Figure 23 shows the equipment with an IP21 enclosure:

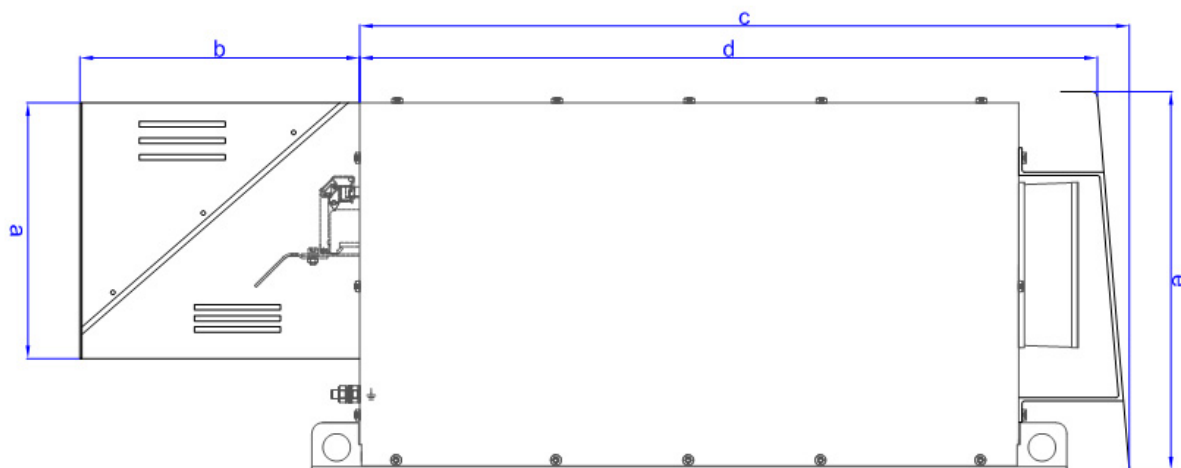


Figure 23: Equipment with an IP21 enclosure

7.3 Specified mounting position

A vertical assembling is specified. The clamps must be directed below. At assembling the device within an electrical enclosure must be ensured, that the waste heat in the electrical enclosure is discharged adequate. The air temperature of 45°C in direct proximity of the device must not be exceeded. The air entrance- and air outlet on the up- and bottom side of the device (as far as available) must not be buried by installation material as cable ducts or other devices. For the fixing the mounting plates of the accessories are recommended and for example a fixing on rails.

Stop!



If these mounting instructions are not observed, this can lead to a thermal overcharge of the filter module.

Caution!



If these mounting instructions and the connection instructions (chapter 9.2) are not observed, this can lead to a thermal overcharge of the filter module and under circumstances to a production of smoke and/or a burning.

Installation

7.4 The air ventilation

The filter modules are cooled by ventilation. Therefore the air must be able to move free above and below the filter module. If the filter module is mounted in an electrical enclosure or in other industrial enclosures, it must be guaranteed, that an adequate airflow streams through the filter module.

So the danger of overheating the filter module and the surrounding components diminished.

If other heat sources for example the frequency converter are installed in the same enclosure, the heat that is created by both components must be considered at the dimensioning of the cooling for the enclosure.

The filter modules must be mounted on the wall in that way, that the air is guided through the air gap between wall and filter module (see figure 24). At an installation on rails without rear panel, the filter module is not cooled adequate, because of the wrong air flow. This is only allowed with the optional rear panel.

Figure 24 shows the correct mounting of the filter module:

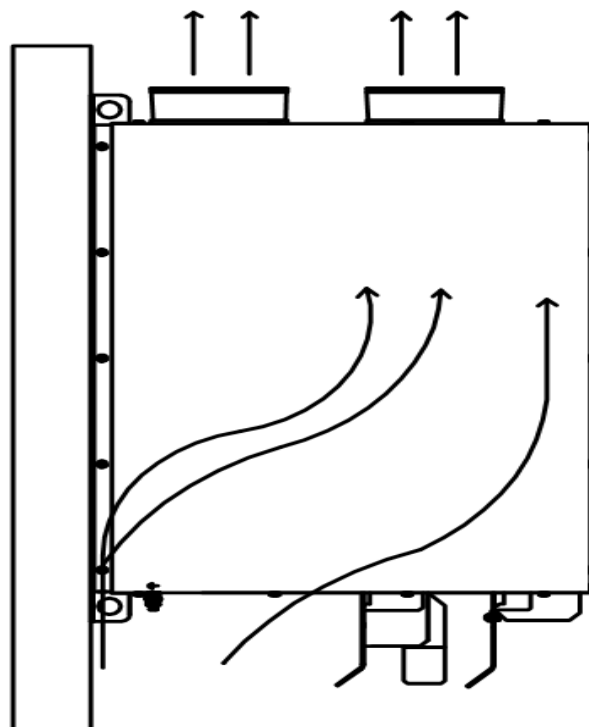


Figure 24: The correct mounting of the filter module

8 Electrical installation

8.1 Network configuration / Net conditions

Note!



If you want to operate the filter module on electrical networks, which are not mentioned in the following chart, please confer with a technician of our company.

| Standard conform grounding system | Operation of the filter module |
|-----------------------------------|--------------------------------|
| With direct grounded star point | Allowed |
| With indirect grounded star point | Allowed |
| With insulated star point | Allowed |

Table 38: Network configuration / Net conditions

Stop!



At adverse voltage ratios (THD U >5%, $\Delta f > 2$ Hz, unbalanced networks >3%) is to figure on durability shortening of the components.

Electrical installation

8.2 Wiring diagram HFE

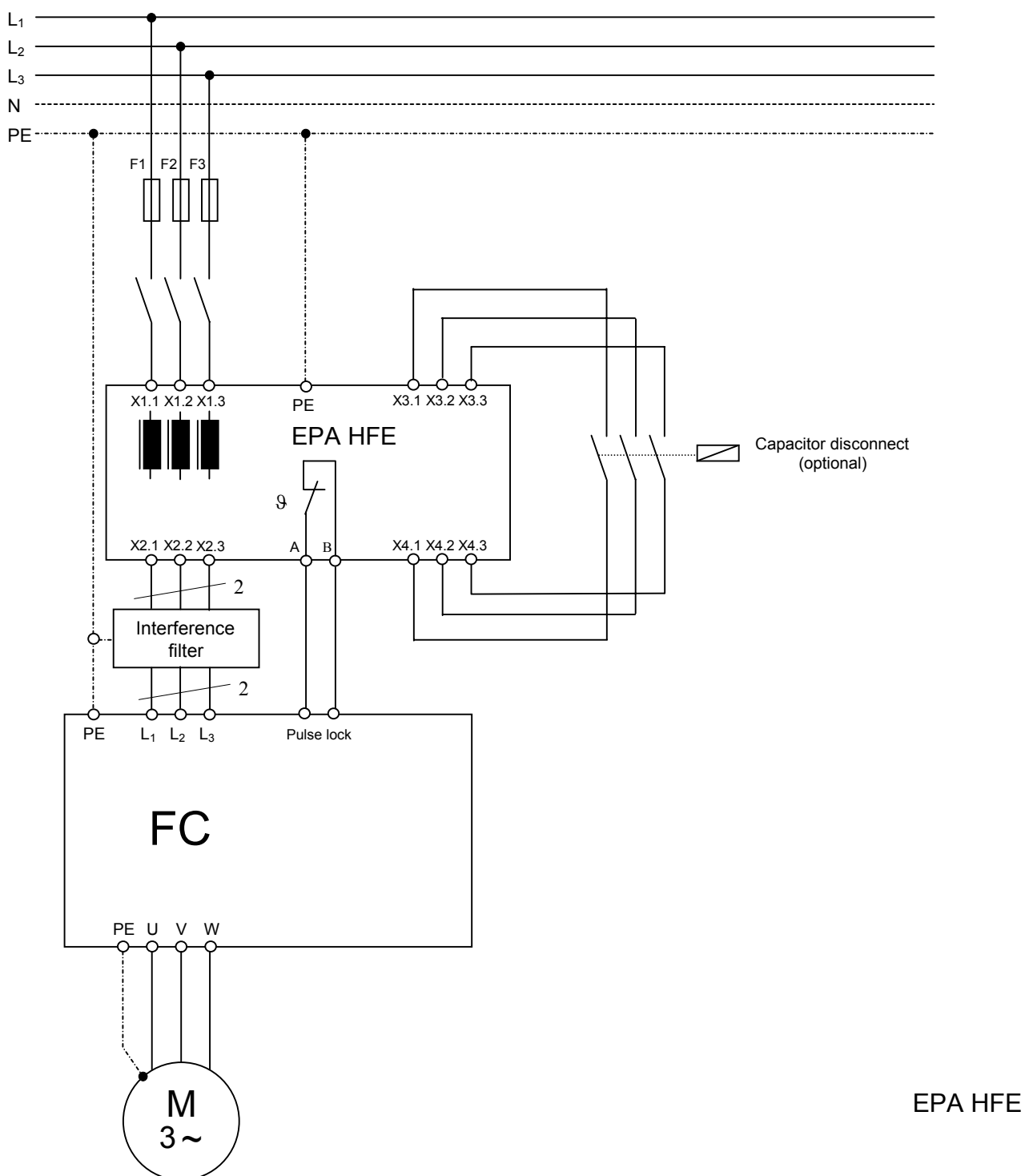


Figure 25: The Wiring of the filter module *EPA HFE* to a frequency converter

Electrical installation



Stop!

Filter modules must only be connected in parallel from a current rating of 217 ampere.

If filter modules are connected in parallel it is valid that:

- The sum of the current and the sum of the power of the frequency converter complies with the sums of the filter modules.

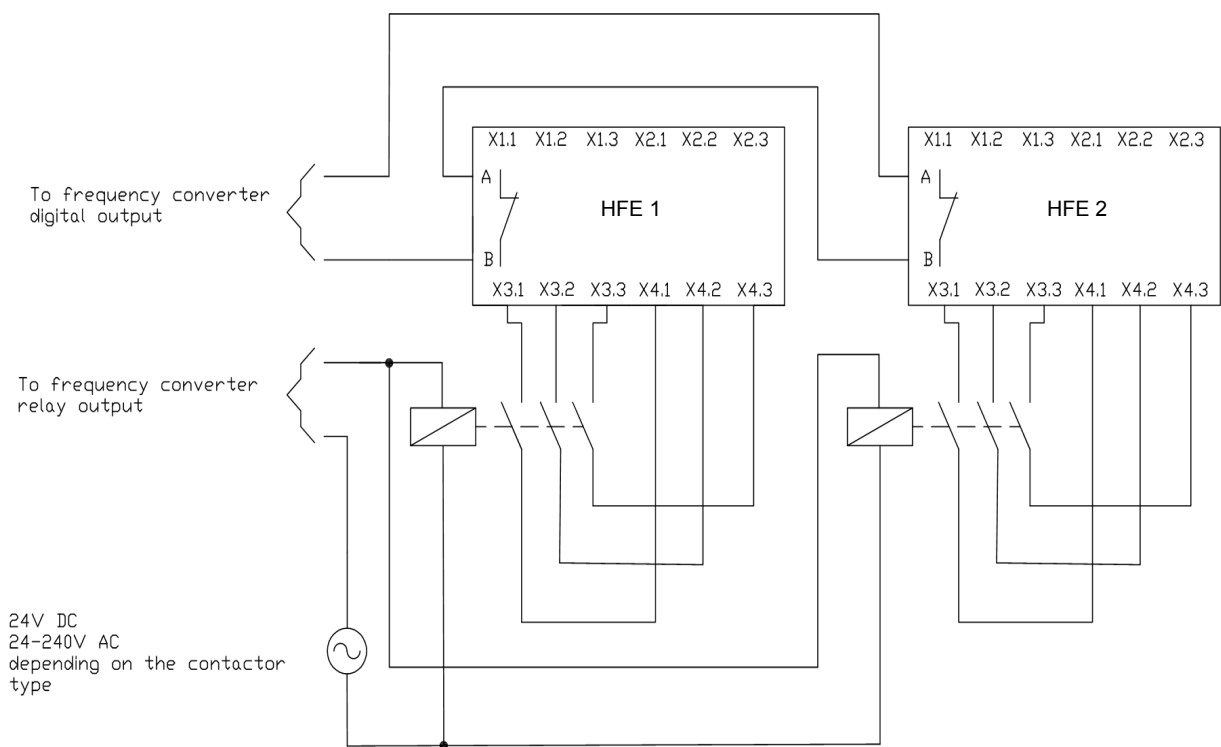


Figure 26: The connection in parallel of filter modules

Electrical installation

If frequency converters are connected in parallel it is valid that:

- The current sum and the power sum of the frequency converter comply with the sum of the filter module.

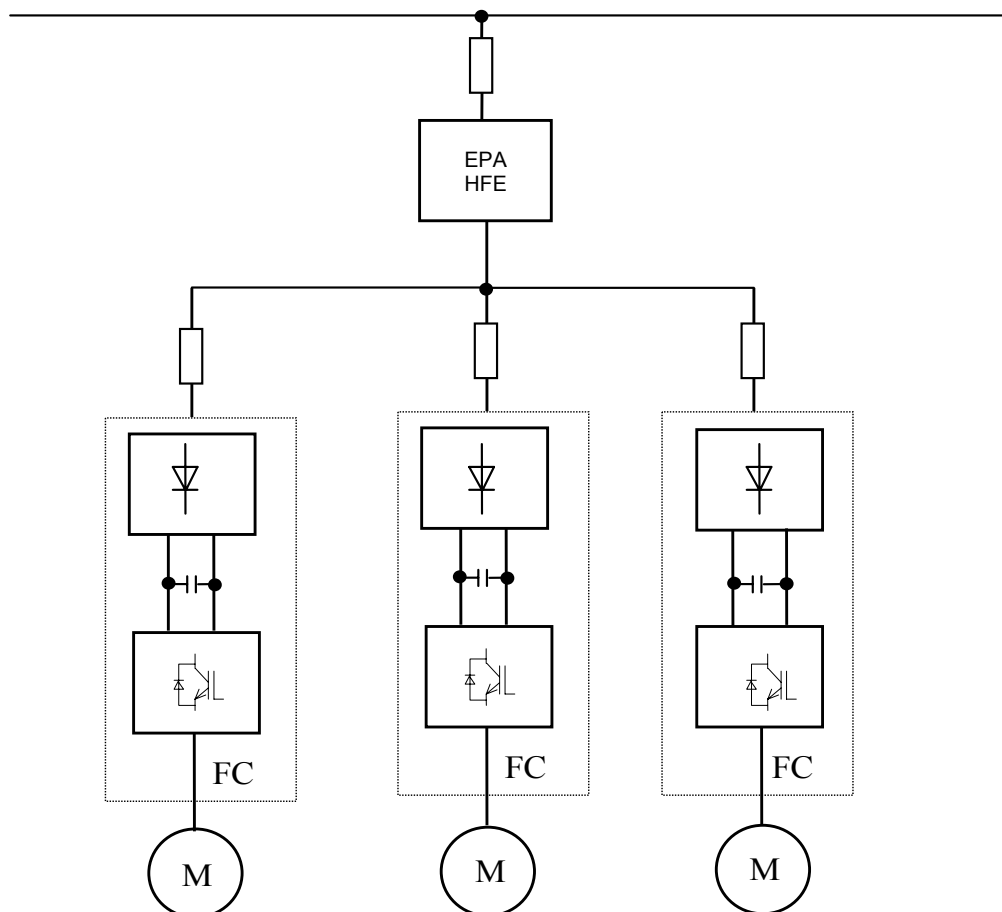


Figure 27: The connection in parallel of frequency converters

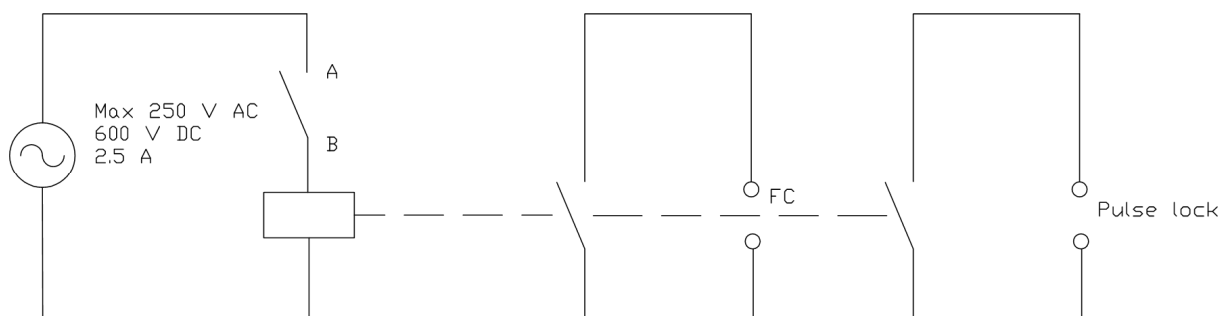


Figure 28: Galvanic isolated switch

8.3 Line connection

- The cable-cross sections are references and apply to the operation
 - in electrical enclosures and machines
 - Installation in the line channel
 - max. ambient air temperature +45°C.
- At the choice of the cable-cross section the fall of voltage should be considered at load.

The observance of further standards (EN 60204-1, VDE 0289 and others) is up to the responsibility of the installer of the plant / the operator.

Connection:

- All connections have to be manufactured so short and induction less as possible.
- To the compliance of the EMC-directives (according to consisting standards as EN 61800-3:2004 / IEC 61800-3:2004) shielded lines have to be applied.
- The connection must occur always 3 phase.
- Connect the protective conductor of the input lead at the earth bolt of the device.

Electrical installation

8.4 Fuses

To protect the installation before electrical hazard and fire hazard must be all filter modules must be short circuit- and overcurrent protected following the national / international regulations.

Table 39 shows the maximal rating of the fuses:

| Nominal current 380 V 60 Hz, 400 V 50 Hz [A] | Nominal current 460 V, 60 Hz [A] | Maximal Nominal current Fuses [A] |
|--|--|---|
| 10 | 10 | 16 |
| 14 | 14 | 35 |
| 22 | 22 | 35 |
| 29 | 29 | 50 |
| 35 | 35 | 50 |
| 43 | 43 | 63 |
| 58 | 58 | 80 |
| 72 | 72 | 125 |
| 86 | 86 | 160 |
| 101 | 101 | 250 |
| 144 | 144 | 250 |
| 180 | 180 | 315 |
| 217 | 217 | 350 |
| 252 | 252 | 400 |
| 304 | 304 | 500 |
| 325 | 325 | 630 |
| 380 | 380 | 630 |
| 433 | 433 | 800 |

Table 39: The maximal rating of the fuses



Caution!

At the applications where filter modules are connected in parallel, it can be important to install the fuses before the filter module and before the frequency converter.

Electrical installation

Table 40 shows the maximal rating of the fuses:

| Nominal current 380 V 60 Hz, 400 V 50 Hz [A] | Nominal current 460 V, 60 Hz [A] | Maximal Nominal current Fuses [A] |
|--|--|---|
| 15 | 15 | 35 |
| 20 | 20 | 35 |
| 24 | 24 | 50 |
| 29 | 50 | 50 |
| 36 | 36 | 63 |
| 50 | 50 | 80 |
| 58 | 58 | 125 |
| 77 | 77 | 160 |
| 87 | 87 | 250 |
| 109 | 109 | 250 |
| 128 | 250 | 250 |
| 155 | 155 | 315 |
| 197 | 197 | 350 |
| 240 | 240 | 400 |
| 296 | 296 | 500 |
| 366 | 366 | 630 |
| 395 | 395 | 630 |

Table 40: The maximal rating of the fuses

Caution!



At the applications where filter modules are connected in parallel, it can be important to install the fuses before the filter module and before the frequency converter.

Electrical installation

8.6 Installation in a CE- typical drive system

| | |
|----------------------------|---|
| General information | <ul style="list-style-type: none">• The responsibility for the compliancy of the EG directives with the Machine application is one for the user.– If you observe the following measures, you can assume, that at the operation of the machine no by the filter module caused EMC-problems occur and that the EG-directives respectively the EMC-directives are complied.– If devices are operated in proximity to the filter modules, which do not comply with the CE-standards in terms of the interference immunity of the EN 500082-2, these devices can be affected electromagnetic by the filter module. |
| Design | <ul style="list-style-type: none">• Connect filter modules extensive to the earthed mounting plate:<ul style="list-style-type: none">– Mounting plates with electrical conducting surface (zinc coated or stainless steel) allow a durable contacting.– Coated plates are not adequate for a EMC-conform installation• If you use several mounting plates:<ul style="list-style-type: none">– Connect mounting plates extensive and conducting to each other (for example with copper band)• At the installing of lines observe the spatial separation of the power lines from the control lines.• Conduits preferably close by reference potential. Levitating lines operate as antenna. |
| Shielding | <ul style="list-style-type: none">• Metallic cable connections ensure an extensive connection of the shield with the enclosure• At contactors and clamps in the shielded lines:<ul style="list-style-type: none">- Interconnect the shields of the there connected lines and also connect extensive with the mounting plate• At power lines among the interference filter and the drive system longer as 300mm:<ul style="list-style-type: none">- Shield power lines- Connect the shield of the power lines direct to the drive controller / to the feed back unit, to the interference filter and to the filter module and connect extensive to the mounting plate.• Shield the control lines:<ul style="list-style-type: none">- Connect the shield beeline to the shield connections. |
| Grounding | <ul style="list-style-type: none">• Ground all metallic electrically conductive Components (feed back unit, drive controller, interference filter and filter module) by corresponding lines from a central (ground point, PE-bar).• Observe the in den safety regulations defined minimum cable cross section:<ul style="list-style-type: none">- But for the EMC is not the cable cross section decisive, but the surface of the line and the 2-dimensional contacting. |

8.7 Installation

Functional- and proper construction of electrical enclosure or plant:

To avoid disturbance decoupling

- a) Power-/supply lines
- b) Motor lines of converters / servo amplifiers
- c) And control- and data lines (low voltage level < 48 V) must be installed with a clearance of minimum 15 centimetres.

To receive low resistance high frequency connections, groundings and shielding and other metallic connections (for example mounting plate, installed devices) must be applied extensive on metallic blank background. Use rounding- and potential equalization lines with large as possible cross-section (minimum 10mm²) or thick ground strap.

Use shielded lines only with copper- or tinned copper braid, because steel braid is inappropriate in high frequency range. Always lay the shield with clamps or metal bolting on the equalization lines, and accordingly PE-connections. No extending with single conductors!

Inductive switching elements (contactor, relay and so on) always finish with suppressor elements as varistors, RC-elements or protective diodes.

Make all connections short as possible and lead close to reference potential, because levitating lines operate as antenna.

Avoid loops at all connection lines. Lay not accounted stranded wires on both sides at protective earth.

At unshielded lines forward- and return conductor must be twisted, to attenuate symmetric disturbances.

Electrical installation

8.8 Installation of a EMC- conform electrical enclosure

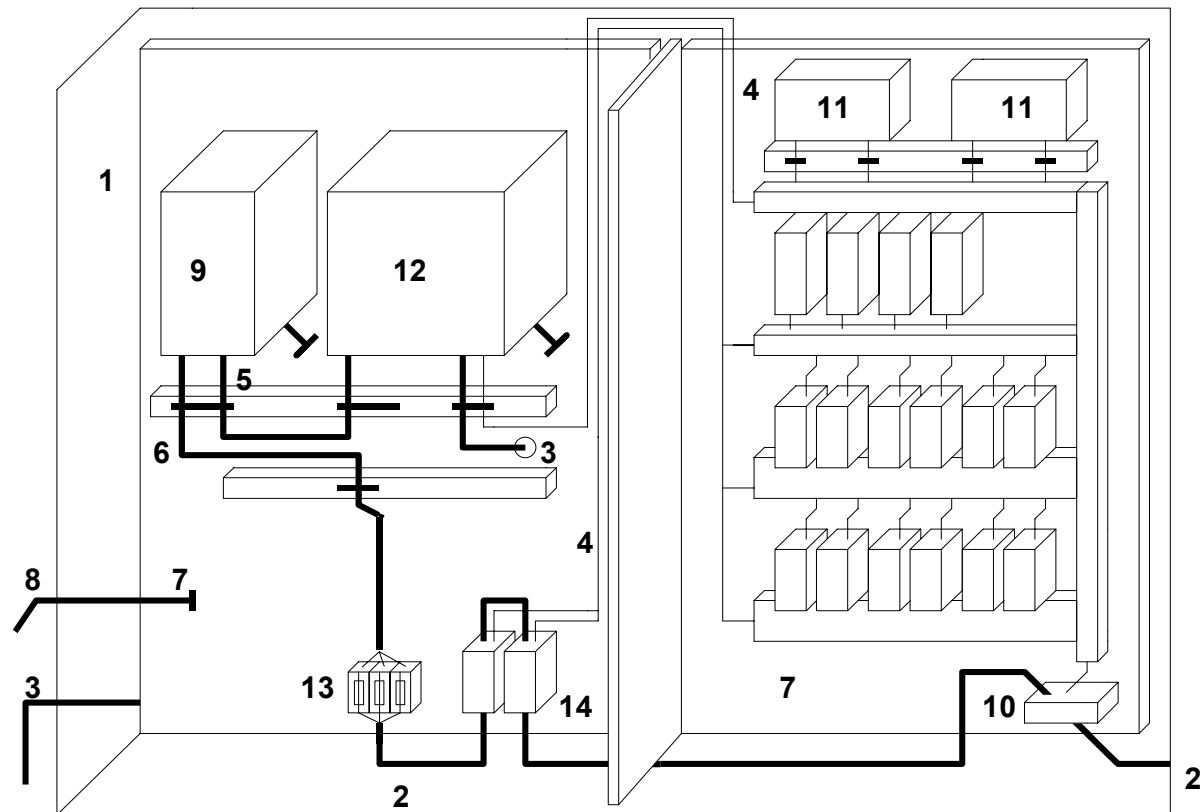


Figure 29: EMC-conform electrical enclosure

- | | |
|--|--|
| 1. Electrical enclosure | 8. Potential equalization with the construction ground |
| 2. Power line | 9. Filter module |
| 3. Motor line | 10. Power connection |
| 4. Control line | 11. SPS |
| 5. Line between filter module and drive control | 12. Drive controller |
| 6. Power line of the filter module and the drive control | 13. Electrical network fuse |
| 7. Mounting plate | 14. Electrical network contactor |

8.9 Note

An electrical enclosure has to be divided fundamentally in power range and control range. It is irrelevant, if the system is installed inside an electrical enclosure or comprises several electrical enclosures. Because of a strong radiation of the power lines the installation of a screening wall is recommended. It must be excellent connected with the frame or the mounting plate (remove the lacquer).

The mounting plate of the drive control is to regard as star point for the total grounding and screening connection in the machine or plant. If the drive or other plant components lead to disturbances, the HF- connection of these components is bad. In that case a potential equalization must be parallel executed.

Commissioning

9 Commissioning

**Stop!**

Check before the first switching-on the wiring on completeness, polarity reversal, short circuit and earth fault.

**Stop!**

A disturbance of the drive controller is at incorrect connection not to exclude in any case.

**Stop!**

If according to the commissioning only one provisional power supply is provided, so that the in this operating instruction specified data for this voltage (for example: chapter 3) is not abided, we adviser, to switch off the filter circuit.

9.1 First switching-on

- Switch on the electrical network
- Check the operation state of the drive systems

Capacitor disconnect operation state

10 Capacitor disconnect operation state

At nominal power is the adjusting of reactive power by the filter module nearly or equal zero. At turndown the (capacitive) adjusting of reactive power rises. At the delivery six additionally clamps X3.1 ... X4.3 are (one pair for every live wire) bridged. If the bridge circuit is replaced by a three- pole contactor, two operating conditions are possible:

A „Normal“ operation of filter module and controller at enclosed contactor

B „Standby“ operation at unclosed contactor

Table 41 shows the nominal power of the contactor depending on the nominal current:

| Nominal current 380-415 V 50 und 60 Hz [A] | Nominal current 440-480 V 60 Hz [A] | Contactor Nominal power* [KVA _r] |
|--|---|--|
| 10 | 10 | 1 |
| 14 | 14 | 2 |
| 22 | 19 | 4 |
| 29 | 25 | 6 |
| 34 | 31 | 7 |
| 40 | 36 | 7 |
| 55 | 48 | 9 |
| 66 | 60 | 11 |
| 82 | 73 | 15 |
| 96 | 95 | 17 |
| 133 | 118 | 22 |
| 171 | 154 | 29 |
| 204 | 183 | 36 |
| 251 | 231 | 44 |
| 304 | 291 | 51 |
| 325 | 355 | 58 |
| 380 | 380 | 66 |
| 480 | 436 | 88 |

Table 41: The nominal power of the contactor

* Minimum 50 % of the nominal load



Stop!

The contactor must not be switched, if the controller is not disabled!

Capacitor disconnect operation state

Stop!



If the contactor is switched, while the controller is not disabled, the contactor and possibly other components could be damaged!

Stop!



The contactor should be switched at fewer than 20 % of the output power.

Stop!



25 seconds must be waited before the resetting until the contactor is discharged!

11 EPA product overview

- Power line filter for one- and three-phase networks
(with and without neutral)
- Filters for DC applications
- Components for use in motor cables of frequency inverters
- Sinusoidal output filters
- dV / dt filters
- Current-compensating motor chokes
- Line reactors
- DC link chokes
- Harmonic reduction filters

Contact

12 Contact

EP Antriebstechnik GmbH
Fliederstr. 8
D-63486 Bruchköbel

Telephone **+49 (0)6181 9704-0**
Fax **+49 (0) 6181 9704-99**
E-Mail info@epa-filter.de
Web www.epa-filter.de

< TECHNICAL CHANGES RESERVED >

ISSUE STATUS 11/09

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13 Index and directory**A**

Ampacity31

C

Cable connections70
Commissioning8, 27, 74
Compensation plants11, 35
Connection13, 67
Contact78
Cooling air57

D

Danger13
Declaration of conformity22, 23
Dimensions36
Drive controller11
Drive system3, 6, 10

E

Efficiency30
Electrical network6, 13, 35, 72

F

First switching-on74
Free space of the installation57

G

Guarantee10

I

Inbetriebnahme74
Installation, electrical63
Installation, mechanical57
Introduction14, 20

L

Line current31, 35
Line-to line voltage30
Low voltage-directive8, 22, 28

M

Mounting position61

N

Network configuration63

O

Operation state74
Operator12

P

Pictograms9
Power frequency30

Q

Qualified staff12

S

Safety12, 22
Safety guidelines10
Safety instructions8
Scope of supply7
Shielding70
SI Units and symbols4
Standards23, 67

T

THDI5, 20, 27
Transport8, 28

U

Unit designation5

V

Ventilation62
Visible damages in transit7

W

Warning9, 13
Warranty6
Weight36, 37, 38, 39, 40, 41
Wiring diagram64

Exhibit

13.1 List of figures

| | |
|--|----|
| Figure 1: The EPA HFE nameplate | 5 |
| Figure 2: The Current waveform without HFE module | 20 |
| Figure 3: The Current waveform with HFE module | 21 |
| Figure 4: The Fourier analysis of the grid current | 21 |
| Figure 5: Power reduction in dependence of the ambient temperature | 29 |
| Figure 6: Dimension diagram configuration X1 internal fan | 49 |
| Figure 7: Dimension diagram configuration X1 external fan | 49 |
| Figure 8: Dimension diagram configuration X2 internal fan | 50 |
| Figure 9: Dimension diagram configuration X2 external fan | 50 |
| Figure 10: Dimension diagram configuration X3 internal fan | 51 |
| Figure 11: Dimension diagram configuration X3 external fan | 51 |
| Figure 12: Dimension diagram configuration X4 internal fan | 52 |
| Figure 13: Dimension diagram configuration X4 external fan | 52 |
| Figure 14: Dimension diagram configuration X5 internal fan | 53 |
| Figure 15: Dimension diagram configuration X5 external fan | 53 |
| Figure 16: Dimension diagram configuration X6 internal fan | 54 |
| Figure 17: Dimension diagram configuration X6 external fan | 54 |
| Figure 18: Dimension diagram configuration X7 internal fan | 55 |
| Figure 19: Dimension diagram configuration X7 external fan | 55 |
| Figure 20: Dimension diagram configuration X8 internal fan | 56 |
| Figure 21: Dimension diagram configuration X8 external fan | 56 |
| Figure 22: 150mm free space above and below | 57 |
| Figure 23: Equipment with an IP21 enclosure | 60 |
| Figure 24: The correct mounting of the filter module | 62 |
| Figure 25: The Wiring of the filter module <i>EPA</i> HFE to a frequency converter | 64 |
| Figure 26: The connection in parallel of filter modules | 65 |
| Figure 27: The connection in parallel of frequency converters | 66 |
| Figure 28: Galvanic isolated switch | 66 |
| Figure 29: EMC-conform electrical enclosure | 72 |

13.2 List of tables

| | |
|---|----|
| Table 1: Layout of the safety instructions | 9 |
| Table 2: Considered standards | 23 |
| Table 3: General Data / Operation conditions | 28 |
| Table 4: Rating values | 30 |
| Table 5: Article numbers and Ampacity at nominal voltage 380V 60Hz | 31 |
| Table 6: Article numbers and Ampacity at nominal voltage 400V 50Hz | 32 |
| Table 7: Article numbers and Ampacity at nominal voltage 460V 60Hz | 32 |
| Table 8: Article numbers and Ampacity at nominal voltage 500V 50Hz | 33 |
| Table 9: Article numbers and Ampacity at nominal voltage 600V 60Hz | 33 |
| Table 10: Article numbers and Ampacity at nominal voltage 690V 50Hz | 34 |
| Table 11: Electrical operating conditions 380V 60Hz HFE-A | 36 |
| Table 12: Electrical operating conditions 380V 60Hz HFE-B | 36 |
| Table 13: Electrical operating conditions 400V 50Hz HFE-A | 37 |
| Table 14: Electrical operating conditions 400V 50Hz HFE-B | 37 |
| Table 15: Electrical operating conditions 460V 60Hz HFE-A | 38 |
| Table 16: Electrical operating conditions 460V 60Hz HFE-B | 38 |
| Table 17: Electrical operating conditions 500V 50Hz HFE-A | 39 |
| Table 18: Electrical operating conditions 500V 50Hz HFE-B | 39 |
| Table 19: Electrical operating conditions 600V 60Hz HFE-A | 40 |
| Table 20: Electrical operating conditions 600V 60Hz HFE-B | 40 |
| Table 21: Electrical operating conditions 690V 50Hz HFE-A | 41 |
| Table 22: Electrical operating conditions 690V 50Hz HFE-B | 41 |
| Table 23: The external dimensions of the filter modules with external fan | 42 |
| Table 24: Fans at nominal voltage 380V 60Hz type HFE-A | 43 |
| Table 25: Fans at nominal voltage 380V 60Hz type HFE-B | 43 |
| Table 26: Fans at nominal voltage 400V 50Hz type HFE-A | 44 |
| Table 27: Fans at nominal voltage 400V 50Hz type HFE-B | 44 |
| Table 28: Fans at nominal voltage 460V 60Hz type HFE-A | 45 |
| Table 29: Fans at nominal voltage 460V 60Hz type HFE-B | 45 |
| Table 30: Fans at nominal voltage 500V 50Hz type HFE-A | 46 |
| Table 31: Fans at nominal voltage 500V 50Hz type HFE-B | 46 |
| Table 32: Fans at nominal voltage 600V 60Hz type HFE-A | 47 |
| Table 33: Fans at nominal voltage 600V 60Hz type HFE-B | 47 |
| Table 34: Fans at nominal voltage 690V 50Hz type HFE-A | 48 |
| Table 35: Fans at nominal voltage 690V 50Hz type HFE-B | 48 |
| Table 36: IP21 External ventilator | 59 |
| Table 37: IP21 Internal ventilator | 59 |
| Table 38: Network configuration / Net conditions | 63 |
| Table 39: The maximal rating of the fuses | 68 |
| Table 40: The maximal rating of the fuses | 69 |
| Table 41: The nominal power of the contactor | 75 |

Ihr Partner für elektrische Antriebe / your partner for electrical drives



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EP ANTRIEBSTECHNIK GmbH

Fliederstraße 8

63486 Bruchköbel

Telefon +49 (0)6181 9704-0

Telefax +49 (0)6181 9704-99

e-mail: info@epa-antriebe.de

www.epa-antriebe.de

Postfach 1333

63480 Bruchköbel

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