ELTROPLAN - REVCON®
Elektrotechnische Anlagen GmbH

Operating instructions filter module REVCON® RHF

Power range	4 ... 440kW
Nominal voltage	380V, 400V, 460V 500V, 600V, 690V

Issue 13/09

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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 REVCON® RHF. 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 REVCON® RHF must have the operating instructions accessible, or the equal chapters of the operating instructions for other with this option equipped REVCON® 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 REVCON® RHF“ 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 RHF-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

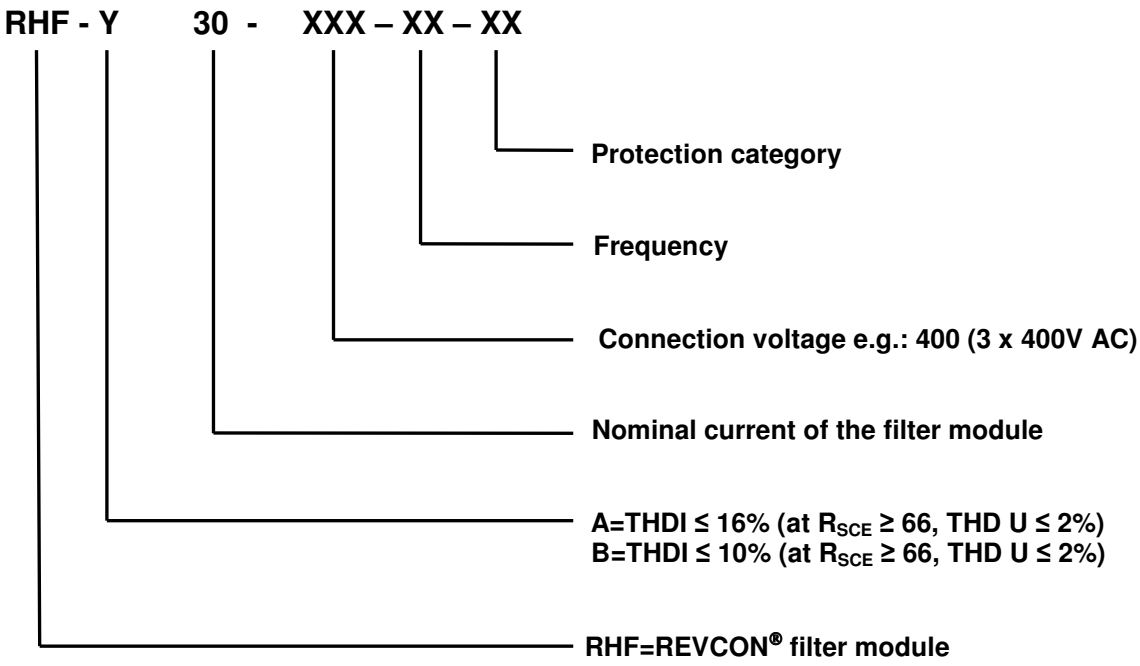
1.3 SI units and symbols

	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	℃
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 RHF module	I_{RMS}
Power input current	$I_{FC,L}$
Revolutions per minute	min^{-1}
Alternating current	AC

1.4 Unit designation



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

REVCON ®

Serien-Nr. / Serial no.	**08/10 RHF-A 72-111**
Artikel-Nr. /Article no.	25010007
Type / Type RHF-A 50-	400-50-20-A
Spannung / Voltage	3 x 400 VAC/50Hz
$I_{eff.}$ 72 A	
$I_{eff\ max.}$ 108 A	
Umgebungstemp. / Ambient Temp.	Max 45°C
Schutzart / Protection	IP 20

geprüft / tested _____

ELTROPLAN-REVCON GmbH Made in Germany

Figure 1: The REVCON® RHF nameplate

Important information

1.5 Legal regulations

<table>
<tr><td>Marking</td><td>Name plate</td><td>CE-marking</td><td>Manufacturer</td></tr>
<tr><td></td><td>Filter modules REVCON® RHF are clearly marked by the content of the nameplate</td><td>Conformable
to EG directive “low-voltage“</td><td>ELTROPLAN-REVCON
Edisonstraße 3
D-59199 Bönen</td></tr>
<tr><td>Trade mark rights</td><td colspan="3">The filter module REVCON® RHF is protected in the Federal Republic of Germany by utility patents. Patent-Nr.: DE 3938654C1 und Patent-Nr.: 90123584.6-2207. Violation of this utility patent and the verbalized trade mark rights will be prosecuted criminally.</td></tr>
<tr><td>Intended use</td><td colspan="3">Filter module REVCON® RHF
• only to use under the terms of this operating instructions and the required operational conditions
• are components
– 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 filter module REVCON® RHF
• conform to the EG directive “Electromagnetic Compatibility“, if they are installed by the specifications of the CE-typical drive control system
• are applicable
– 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.</td></tr>
<tr><td>Liability</td><td colspan="3">• 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 ELTROPLAN-REVCON GmbH 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:
– disregard of the operating instructions
– arbitrary changes on the filter module
– operating errors
– improper works on and with the inverter</td></tr>
<tr><td>Warranty</td><td colspan="3">• Warranty conditions: Look at the sales - and delivery conditions of the ELTROPLAN-REVCON GmbH.
• 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.</td></tr>
<tr><td>Disposal</td><td>Material</td><td>Recycling</td><td>Disposal</td></tr>
<tr><td></td><td>Metal</td><td>●</td><td>-</td></tr>
<tr><td></td><td>Plastic</td><td>●</td><td>-</td></tr>
</table>

1.6 Scope of supply

- 1 filter module RHF
- 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 ELTROPLAN REVCON

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 start-up 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 start-up (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
Notes on transport, storage and appropriate handling must be observed
At non-observance any warranty expires.
The power feedback unit has to be protected from inadmissible stress.
The transport is only valid in original packaging and in the thereon by pictograms marked transport position.
In particular during transport and handling no components are allowed to be bent and / or isolating distances may not be altered. The units are equipped with electrostatic sensitive devices, which may be damaged by improper handling. Therefore it has to be avoided to get in contact with electronic components. If electronic components are damaged mechanically the unit must not be put into operation, as it cannot be ensured, that all relevant standards are observed. Climatic conditions must be observed according to prEN 50178.

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.

These safety instructions have to be kept!

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

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 an 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 surround-ings
Useful infor-mation 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

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 (> 15cm)
- 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).

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 availably
- 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

3.1 The effect of harmonics in a power distribution system

In figure 2 is a transformer on the Primary side connected at a common point of coupling VP1 on the medium voltage supply. The transformer has the Impedance Z_T und supplies a number of loads.

At a common coupling point PCCP2 are all loads connected. Each load is connected with lines that have the corresponding impedances Z_1, Z_2 und Z_3:

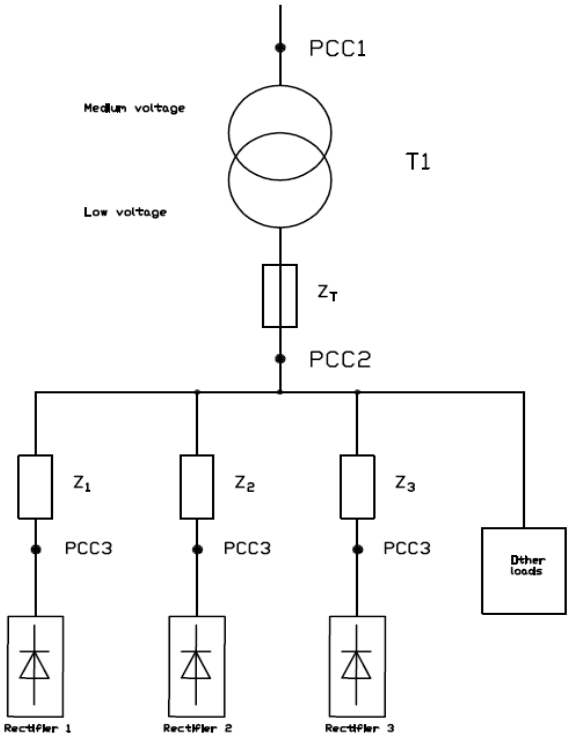


Figure 1: The effects of harmonics

Harmonic currents by non-linear loads cause distortion of the voltage because of the voltage drop on the impedances of the distribution system.

Higher impedances result in higher levels of voltage distortion.

Current distortion relates to the device performance and it relates to the individual load.

It is not possible to determine the voltage distortion in the PCC if only the load's harmonic performance is known.

The configuration of the distribution system and the relevant impedances must be known to calculate the distortion in the PCC.
A common used term to describe the impedance of a grid is the short circuit ratio Rsce, defined as the ratio between the short circuit apparent power of the supply at the PCC (S_{sc}) and the rated apparent power of the load (S_{equ}).

$$R_{SCE} = S_{SC}/S_{equ}$$

with

$$S_{SC} = U^2/Z_{Netz}$$

and

$$S_{equ} = U \times I_{equ}$$

3.2 The negative effect of harmonics is twofold

- Harmonic currents contribute to system losses (power cable, transformer etc.)
- Harmonic voltage distortion causes disturbances at other loads and increase losses at other loads

3.3 Harmonic limitation standards and requirements

The requirements for harmonic limitation are:

- Application specific requirements
- Requirements from standards that have to be observed

The application specific requirements are related to a specific installation with technical reasons for the limiting of harmonics.
For example: A 250kVA transformer is connected with two 110kW motors. One is connected direct and the other motor is supplied by a frequency converter.
If the other motor should also be supplied by a frequency converter, is the transformer in this case, dimensioned too small.
In the system should be refitted without changing the transformer, the harmonic distortion from the two drives must be mitigated using RHF filters.

Introduction

There are various harmonic standards, regulations and recommendations. Different standards are applied in different geographical areas and industries. The following standards that are applicable will be specified:

- IEC/EN 61000-3-2
- IEC/EN 61000-3-12
- IEC/EN 61000-3-4
- IEC 61000-2-2
- IEC 61000-2-4
- IEEE 519
- G5/4

IEC 61000-3-2:
The scope of IEC 61000-3-2 is equipment connected to the public low-voltage distribution system with an input current up to and including 16 A per phase. Four emission classes are defined: Class A through D.

IEC 61000-3-12:
The scope of IEC 61000-3-12 is equipment connected to the public low-voltage distribution system having an input current between 16A and 75A.
The emission limits are currently only for 230/400V 50Hz systems and limits for other systems will be added in the future. The emission limits that apply for drives are given in Table 4 in the standard. There are requirements for individual harmonics (5th, 7th, 11th, and 13th) and for THD and PWHD.

IEC 61000-3-4:
Limits, Limitation of emission of harmonic currents in low-voltage power supply systems for equipment with rated current greater than 16A.
The IEC 61000-3-12 supersedes IEC 61000-3-4 for currents up to 75A. Therefore the scope of IEC 61000-3-4 is equipment with rated current greater than 75A connected to the public low voltage distribution system. It has the status of a *Technical report* and should not be seen as an international standard.
A three-stage assessment procedure is described for the connection of equipment to the public supply and equipment above 75A is limited to stage 3 *connection based on the load's agreed power*. The supply authority may accept the connection of the equipment on the basis of the agreed active power of the load's installation and local requirements of the power supply authority apply. The manufacturer shall provide individual harmonics and the values for THD and PWHD.

IEC 61000-2-2 and IEC 61000-2-4: Compatibility levels for low- frequency conducted disturbances
The IEC 61000-2-2 and IEC 61000-2-4 are standards that stipulate compatibility levels for low-frequency conducted disturbances in public low-voltage supply systems (IEC 61000-2-2) and industrial plants (IEC 61000-2-4).
These low-frequency disturbances include harmonics, but are not limited to harmonics.
The values prescribed in these standards should be taken into consideration when planning installations. In some situations the harmonic compatibility levels cannot be observed in installations with frequency converters and harmonic mitigation is needed.

IEEE519, IEEE recommended practices and requirements for harmonic control in electrical power systems:
IEEE519 establishes goals for the design of electrical systems that include both linear and nonlinear loads. Waveform distortion goals are established and the interface between sources and loads is described as point of common coupling (PCC).

Introduction

IEEE519 is a system standard that aims the control of the voltage distortion at the PCC to a THD of 5% and limits the maximum individual frequency voltage harmonic to 3%. The development of harmonic current limits aims the limitation of harmonic injection from individual customers so they will not cause unacceptable voltage distortion levels and the limitation of the overall harmonic distortion of the system voltage supplied by the utility.

The current distortion limits are given in Table 10.3 in the standard and depend on the ratio ISC/IL where ISC is the short circuit current at the utility PCC and IL is the maximum demand load current.

The limits are given for individual harmonics up to the 35th and total demand distortion (TDD). Please note that these limits apply at the PCC to the utility. While requiring individual loads to comply with these limits also ensures the compliance at the PCC, this is rarely the most economic solution, being unnecessarily expensive. The most effective way to meet the harmonic distortion requirements is to mitigate at the individual loads and measure at the PCC.

If in a specific application it is required that the individual drive should comply with the IEEE519 current distortion limits, an AHF can be employed to meet these limits. G5/4, Engineering recommendation, planning levels for harmonic voltage distortion and the connection of nonlinear equipment to transmission systems and distribution networks in the United Kingdom:

G5/4 sets the Planning levels for harmonic voltage distortion to be used in the process of connecting non-linear equipment. A process for establishing individual customer emission-limits based on these planning levels is described.

G5/4 is a system level standard. For 400V the voltage THD planning level is 5% at the PCC. Limits for odd and even harmonics in 400V systems are given in Table 2 in the standard. An assessment procedure for the connection of non-linear equipment is described. The procedure follows three stages, aiming to balance the level of detail required by the assessment process with the degree of risk that the connection of particular equipment will result in unacceptable voltage harmonic distortion.

A RHF-filter should be employed to meet the requirements of G5/4.

3.4 Harmonic Mitigation

To mitigate the harmonics caused by the frequency converter 6-pulse rectifier several solutions exist and they all have their advantages and disadvantages. The choice of the right solution depends on several factors:

- The grid (background distortion, mains unbalance, resonance and type of supply – transformer / generator)
- Application (load profile, number of loads and load size) Local / national requirements/regulations (IEEE519, IEC, G5/4, etc.)
- Total cost of ownership (initial cost, efficiency, maintenance, etc.)

IEC standards are harmonized by various countries or supranational organizations. All above mentioned IEC standards are harmonized in the European Union with the prefix “EN”.
For example the European EN 61000-3-2 is the same as IEC 61000-3-2. The situation is similar in Australia and New Zealand, with the prefixes AS/NZS.
Harmonic solutions can be divided into two main categories: Passive and active, were the passive solutions consist of capacitors, inductors or a combination of the two in different arrangements.
The simplest solution is to add inductors/reactors of typically 3% to 5% in front of the frequency converter. This added inductance reduces the amount of harmonic currents produced by the drive.
More advanced passive solutions combine capacitors and inductors in trap arrangement specially tuned to eliminate harmonics starting from e.g. the 5th harmonic.

4 Introduction into the subject filter modules

4.1 Function principle REVCON RHF

The REVCON RHF consists of a main inductor L_0 and a two-stage absorption circuit with the inductance L1 and L2 and the capacitors C1 and C2.
The absorption circuit eliminates harmonics starting at the fifth order and is specific for the designed supply frequency.
The filter performance in terms of THDI varies as a function of the load.

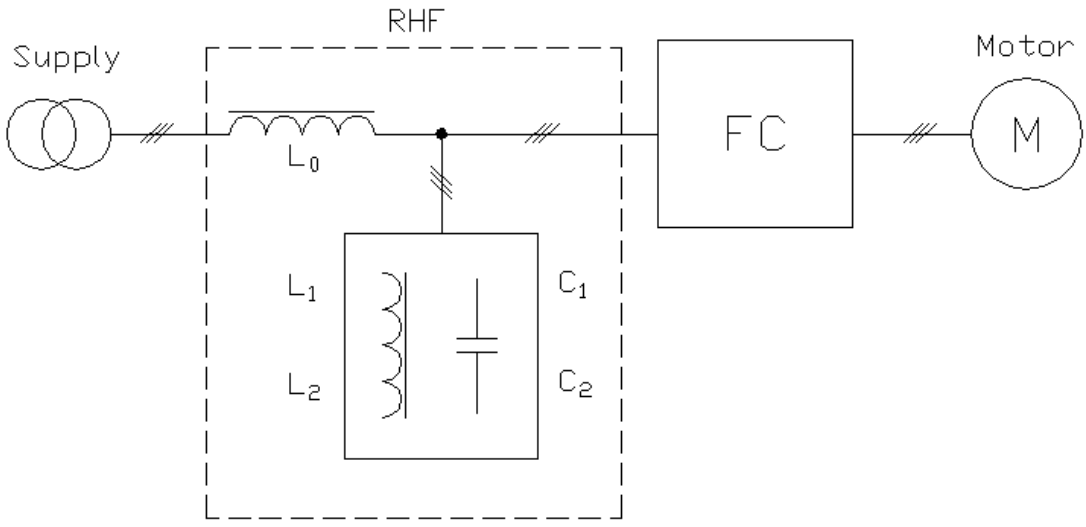


Figure 2: Function principle RHF

The REVCON RHF is available in two variants for two performance levels: RHF-B with 5% THDI (total current harmonic distortion) and RHF-A with 10% THDI. The strategy behind the two levels is to offer a performance similar to 12 pulse rectifiers with the RHF-A and a performance similar to 18 pulse rectifiers with RHF-B.
The filter performance in terms of THDI varies as a function of the load. At nominal load the performance of the filter should be equal or better than 10% THID for RHF-A and 5% THID for RHF-B.
At partial load the THID has higher values. However, the absolute value of the harmonic current is lower at partial loads, even if the THDI has a higher value. Consequently, the negative effect of the harmonics at partial loads will be lower than at full load.

For example:

An 18.5kW drive is installed on a 400V/50Hz grid with a 35A RHF-A (type code RHF-A-35-400-50-20-A).

The following values are measured for different load currents, using a harmonic analyzer:

I_N RMS [A]	I_1 RMS [A] Fundamental current 50 Hz	THDI [%]	Total harmonic current I_h RMS [A]*
9,60	9,59	5,45	0,52
15,24	15,09	13,78	2,07
20,54	20,08	12,46	2,50
25,17	25,00	11,56	2,89
30,27	30,10	10,50	3,15
35,20	34,03	9,95	3,39

Table 1: Measurement RHF-A 35-400-50-20-A

* Calculated values

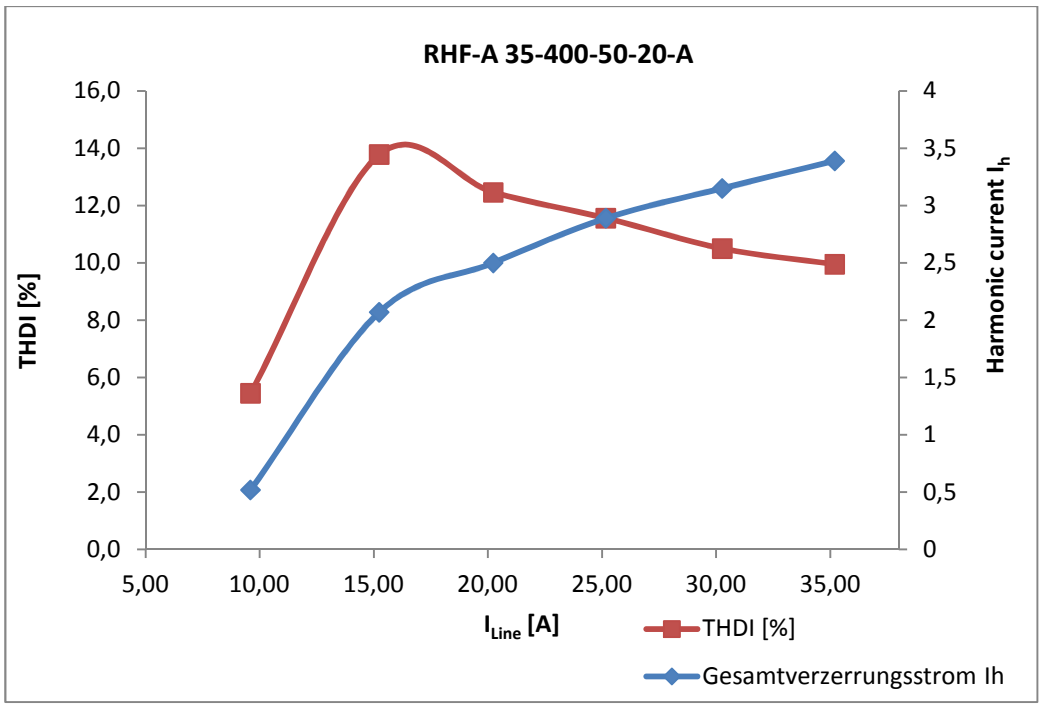


Table 2: Diagram RHF-A 35-400-50-20-A

It can be observed that at partial load 15A, the THDI is approximately 14%, compared to 10% at the nominal load of 34A. On the other hand, the total harmonic current is only 2.07A at 15A line current against 3.39A harmonic current at 34A line current. Therefore is the THDI only a relative indicator of the harmonic performance. The harmonic distortion of the voltage will be less at partial load than at nominal load. Factors such as background distortion and grid unbalance can affect the performance of RHF- filter. The specific figures are different from filter to filter and the graphs below show typical performance characteristics.

Background distortion: The design of the filters aims to achieve 10% respectively 5% THDI levels with a background distortion of THDU = 2%. Practical measurements on typical grid conditions in installations with frequency converters show that often the performance of the filter is slightly better with a 2% background distortion.
The complexity of the grid conditions and the different specific harmonics cannot allow a general rule about the performance on a distorted grid. Therefore the worst-case performance is chosen to consider characteristics with the background distortion:

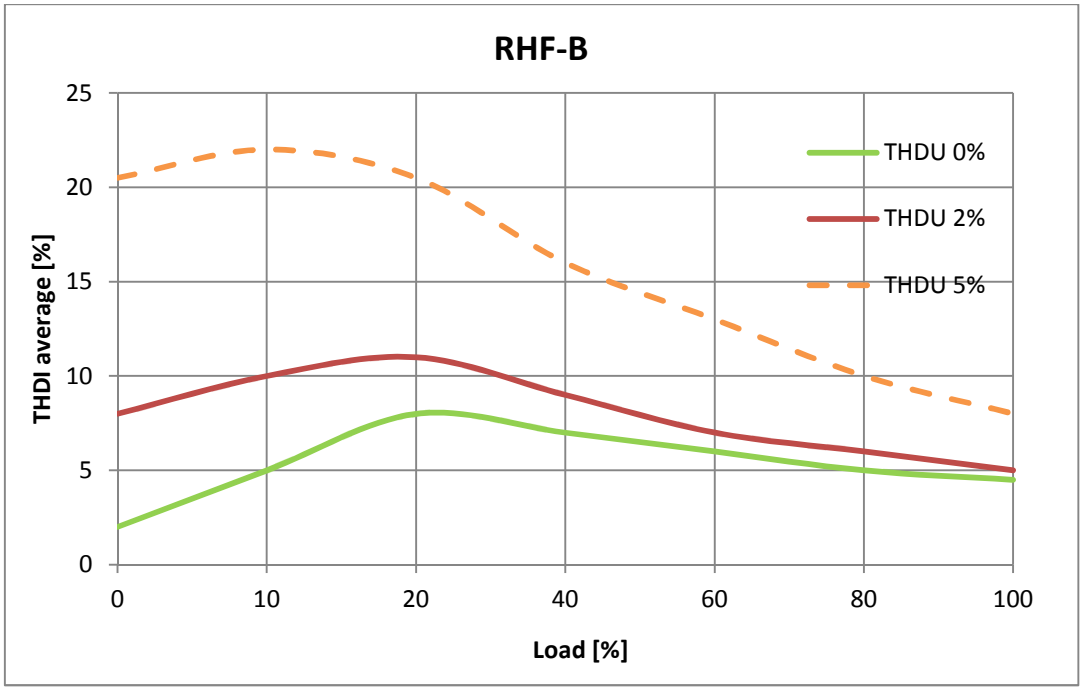


Figure 2: RHF-B

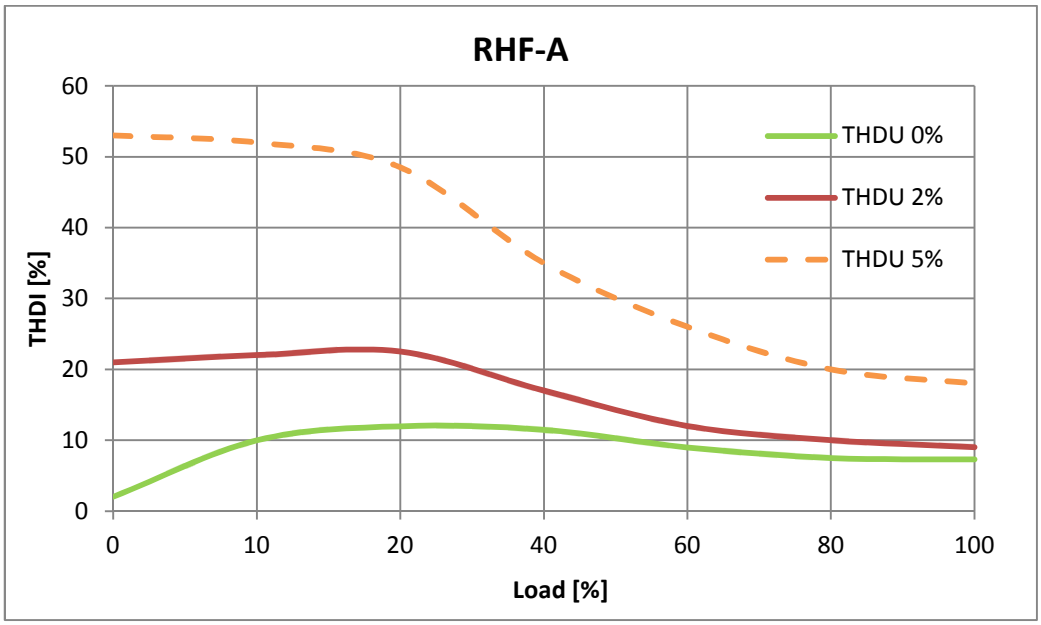


Figure 3: RHF-A

The Performance at 10% THDU has not been plotted. The filters have been tested and can operate at 10% THDU but the filter performance can no longer be guaranteed. The filter performance also deteriorates with the unbalance of the supply. The typical performance is shown in the graphs below:

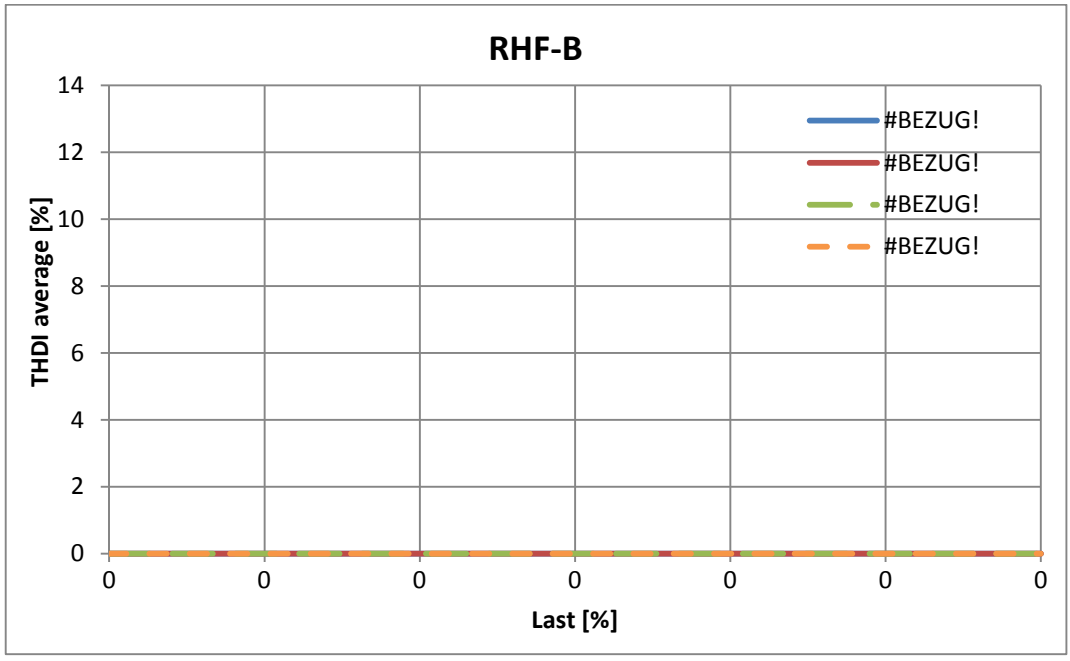


Figure 4: RHF-B

Introduction

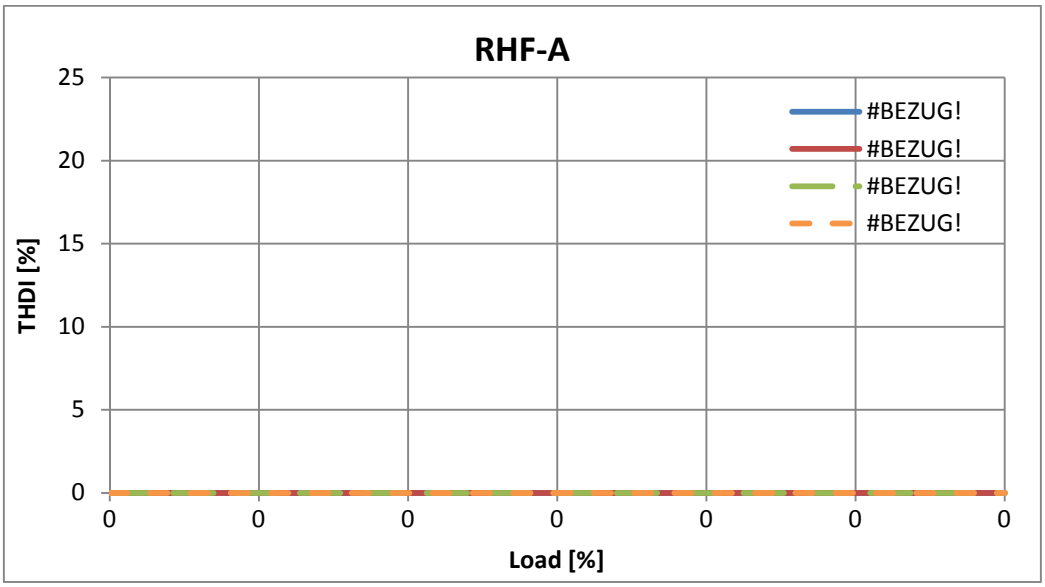


Figure 5: RHF-A

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 REVCON® RHF it is about a passive filter module.
It is not aligned 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 RHF- A	Rectifier with RHF- B	Rectifier with RHF- A and link choke	Rectifier with RHF-B and link choke
80 %	40 %	< 16 %	< 10 %	< 10 %	< 5 %

The passive harmonic Rectifier REVCON® RHF features an effective, inexpensive and very efficient (η = 99,5%) means, to reduce network loads with harmonics.

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

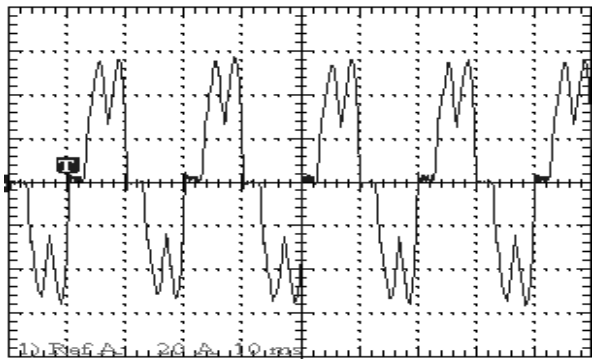


Figure 6: The Current waveform without RHF module

Introduction

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

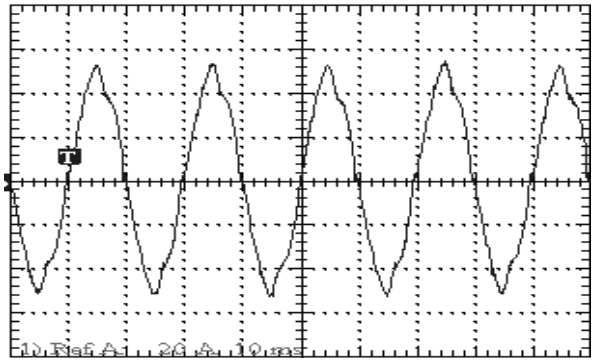


Figure 7: The Current waveform with RHF module

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

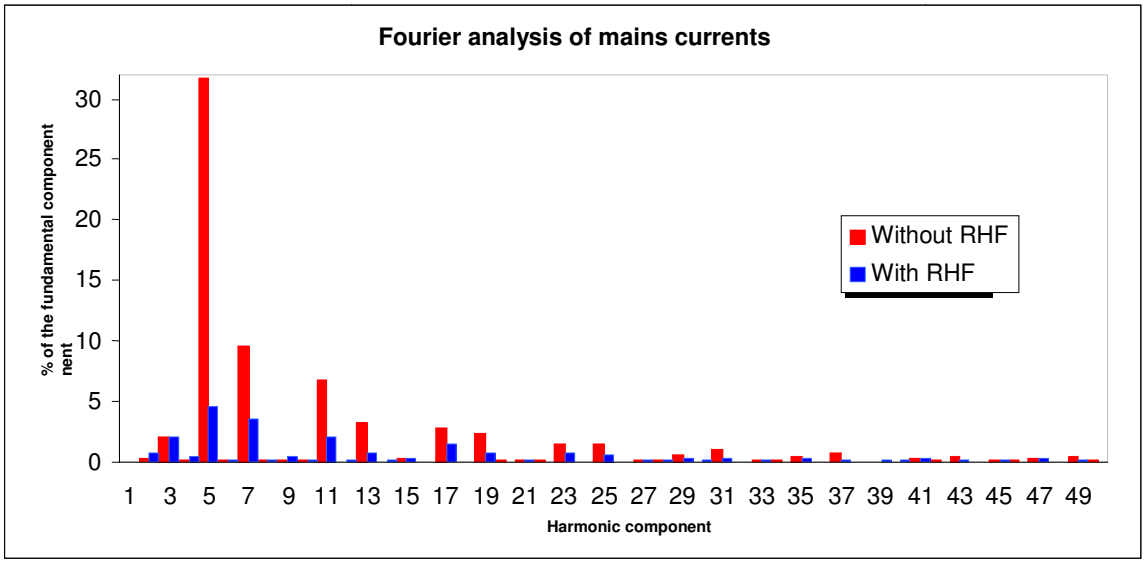


Figure 8: The Fourier analysis of the grid current

5 EG- directives / Declaration of conformity

5.1 What is the purpose of EG-directives?

The EG-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?

CE

After an already made Conformity valuation method the accordance with the requirements of the EG- directives will be confirmed by the mounting of a CE-marking. Within the EG 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/EG).

5.3 EG-directive low voltage

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

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- directives

EG-declaration of conformity

in terms of the EG-directive low voltage (73/23/EWG)

Changed by: CE - directive (93/68/EWG)
CE - directive (2006/95/EG)

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

ELTROPLAN-REVCON Elektrotechnische Anlagen GmbH,
Edisonstraße 3, D-59199 Bönen

Considered standards:

Standard	
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/EWG)
Replaced by: EMC-directive (2004/108/EG)

General:

The objective target describes article 4 (2004/108/EG), 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.

EG-declaration by the manufacturer

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

The listed REVCON® 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.

**ELTROPLAN- REVCON Elektrotechnische Anlagen GmbH,
Edisonstraße 3, D-59199 Bönen**

5.5 EG-directive on machinery

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

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/EG)

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

**ELTROPLAN-REVCON Elektrotechnische Anlagen GmbH,
Edisonstraße 3, D-59199 Bönen**

The operation of the filter module REVCON® RHF is prohibited as long as it is determined, that the machine, in which it should be installed, conforms to the regulations of the EG-directive machines.

EG- directives

5.6 Standards and permission

Standard	Range
IEC/EN 61000-3-2	RHF
IEC/EN 61000-3-12	RHF
IEC/EN 61000-3-4	RHF
IEC/EN 61000-2-2	RHF
IEC/EN 61000-2-4	RHF
IEEE 519	RHF
G5/4	RHF
Power Conversion Equipment - UL 508C	RHF (460V, 600V)
Industrial Control Equipment - CSA-C22.2 No. 14	RHF (460V, 600V)

Table 3: Standards and permission

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 φ. 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 RHF 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 RHF filter module must be dimensioned with the sum of the calculated line input current.

Stop!

STOP

Is the RHF 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.

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 oft he RHF module	η_{RHF}	0,98

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

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

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

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

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 ≤ 15% (10%) at type RHF-A (RHF-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 REVCON® RHF A/B to typically ≤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 REVCON® RHF-B to typically ≤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.

6.4 General Data / Operation conditions

Range	Data
Valid temperature range*	At transport of the device: -25℃...+70℃ (following DIN EN 50178) At storage of the device: -25℃...+55℃ (following DIN EN 50178) At operation of the device: -20℃...+45℃ without power reduction 45℃...+60℃ with power reduction
Stress of humidity*	Humidity class F without condensation (5% - 85% relatively humidity)
Environment: Resonance search	Base standard: DIN EN 60068-2-6 Test specification: 5 Hz,150 Hz, 3 directions (0,5 g, 0,1 g, 0,5 g)
Environment: Sine vibration test	Base standard: DIN EN 60068-2-6 Test specification: (5 Hz-13,2 Hz)-150 Hz 2 mm peak to peak 0,7 g
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 and 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
Transport: Random vibration test	Base standard: DIN EN 60068-2-64 Base standard: DIN EN 30786-2
Transport: Mechanical shock test	Base standard: DIN EN 60068-2-27 Base standard: DIN EN 30786-2
Protection class	IP 20 (at RHF and external power choke IP 00)
Approvals	CE: Low- voltage directive

Table 4: 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:

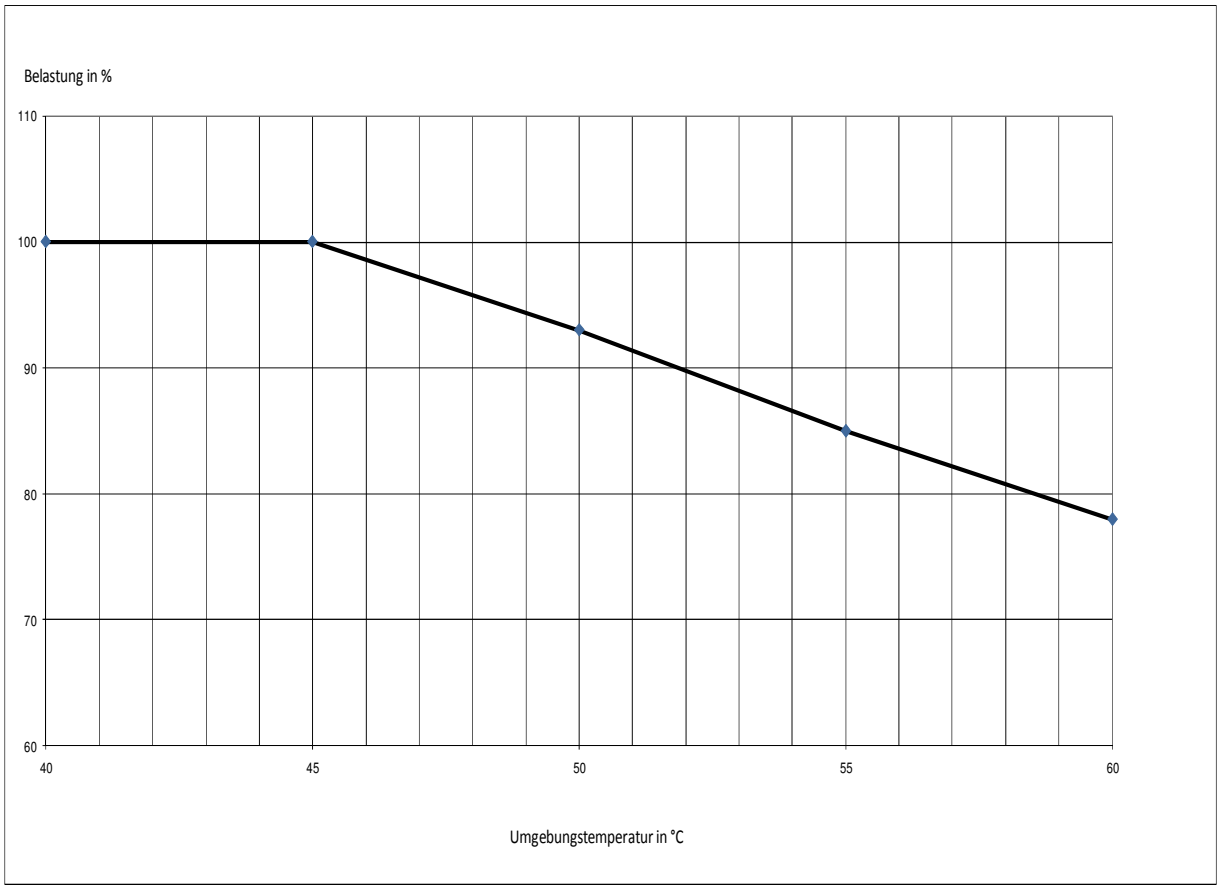


Figure 9: Power reduction in dependence of the ambient temperature

Technical data and dimension diagrams

6.5 Rating values

Device series		RHF 380V	RHF 400V	RHF 460V	RHF 500V	RHF 600V	RHF 690V
Nominal range of the line-to-line line voltage	U_N[V]	380	380 ≤ U_N ≤ 415	440 ≤ U_N ≤ 480	500	600	690
Tolerance of the line-to-line line voltage	U_N[V]	342 ≤ U_N ≤ 418	342 ≤ U_N ≤ 456	396 ≤ U_N ≤ 528	450 ≤ U_N ≤ 550	540 ≤ U_N ≤ 660	540 ≤ U_N ≤ 759
Power frequency	f_N[Hz]	60 ± 2 %	50 ± 2 %	60 ± 2 %	50 ± 2 %	60 ± 2 %	50 ± 2 %
Overload ability		1,5					
* Efficiency	η[%]	ca. 98,5-99,5					
** THD I	[%]	5-16					
cos φ		at 75% I_N 0,85 cap. at 100% I_N 0,99 cap. at 150% I_N 1,0 cap.					
* Cooling air requirement	m³ / h	a) Installation size X1-X2: 200 m³ / h b) Installation size X3-X6: 350 m³ / h c) Installation size X7-X8: 700 m³ / h					
Power reduction	[%/K] [%/m]	See figure 5 1000m üNN < h ≤4000m üNN ⇒ 5%/1000m					

Table 5: 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 Item numbers and ampacity RHF

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

REVCON® - type	Item number RHF-A / RHF-B	Current I_{RMS} 100% [A] AC	Current I_{RMS} 150% [A] AC 1 min in 10 min
RHF- A/B 10-380-60-20 A	25010040 / 25020040	10	15,0
RHF- A/B 14-380-60-20 A	25010041 / 25020041	14	21,0
RHF- A/B 22-380-60-20 A	25010042 / 25020042	22	33,0
RHF- A/B 29-380-60-20 A	25010043 / 25020043	29	43,5
RHF- A/B 35-380-60-20 A	25010044 / 25020044	35	52,5
RHF- A/B 43-380-60-20 A	25010045 / 25020045	43	64,5
RHF- A/B 58-380-60-20 A	25010046 / 25020046	58	87,0
RHF- A/B 72-380-60-20 A	25010047 / 25020047	72	108,0
RHF- A/B 86-380-60-20 A	25010048 / 25020048	86	129,0
RHF- A/B 101-380-60-20 A	25010049 / 25020049	101	151,5
RHF- A/B 144-380-60-20 A	25010050 / 25020050	144	216,0
RHF- A/B 180-380-60-20 A	25010051 / 25020051	180	270,0
RHF- A/B 217-380-60-20 A	25010052 / 25020052	217	325,5
RHF- A/B 252-380-60-20 A	25010053 / 25020053	252	378,0
RHF- A/B 304-380-60-20 A	25010054 / 25020054	304	456,0
RHF- A/B 325-380-60-20 A	25010055 / 25020055	325	487,5
RHF- A/B 380-380-60-20 A	25010056 / 25020056	380	570,0
RHF- A/B 433-380-60-20 A	25010057 / 25020057	433	649,5

Table 6: Item numbers and Ampacity at nominal voltage 380V 60Hz

Technical data and dimension diagrams

Nominal voltage 400V 50Hz

REVCON® - type	Item number RHF-A / RHF-B	Current I_{RMS} 100% [A] AC	Current I_{RMS} 150% [A] AC 1 min in 10 min
RHF- A/B 10-400-50-20 A	25010000 / 25020000	10	15,0
RHF- A/B 14-400-50-20 A	25010001 / 25020001	14	21,0
RHF- A/B 22-400-50-20 A	25010002 / 25020002	22	33,0
RHF- A/B 29-400-50-20 A	25010003 / 25020003	29	43,5
RHF- A/B 35-400-50-20 A	25010004 / 25020004	35	52,5
RHF- A/B 43-400-50-20 A	25010005 / 25020005	43	64,5
RHF- A/B 58-400-50-20 A	25010006 / 25020006	58	87,0
RHF- A/B 72-400-50-20 A	25010007 / 25020007	72	108,0
RHF- A/B 86-400-50-20 A	25010008 / 25020008	86	129,0
RHF- A/B 101-400-50-20 A	25010009 / 25020009	101	151,5
RHF- A/B 144-400-50-20 A	25010010 / 25020010	144	216,0
RHF- A/B 180-400-50-20 A	25010011 / 25020011	180	270,0
RHF- A/B 217-400-50-20 A	25010012 / 25020012	217	325,5
RHF- A/B 252-400-50-20 A	25010013 / 25020013	252	378,0
RHF- A/B 304-400-50-20 A	25010014 / 25020014	304	456,0
RHF- A/B 325-400-50-20 A	25010015 / 25020015	325	487,5
RHF- A/B 380-400-50-20 A	25010016 / 25020016	380	570,0
RHF- A/B 433-400-50-20 A	25010017 / 25020017	433	649,5

Table 7: Item numbers and Ampacity at nominal voltage 400V 50Hz

Nominal voltage 460V 60Hz

REVCON® - type	Item number RHF-A / RHF-B	Current I_{RMS} 100% [A] AC	Current I_{RMS} 150% [A] AC 1 min in 10 min
RHF- A/B 10-460-60-20 A	25010020 / 25020020	10	15,0
RHF- A/B 14-460-60-20 A	25010021 / 25020021	14	21,0
RHF- A/B 19-460-60-20 A	25010022 / 25020022	19	29,0
RHF- A/B 25-460-60-20 A	25010023 / 25020023	25	37,5
RHF- A/B 31-460-60-20 A	25010024 / 25020024	31	46,5
RHF- A/B 36-460-60-20 A	25010025 / 25020025	36	54,0
RHF- A/B 48-460-60-20 A	25010026 / 25020026	48	72,0
RHF- A/B 60-460-60-20 A	25010027 / 25020027	60	90,0
RHF- A/B 73-460-60-20 A	25010028 / 25020028	73	109,5
RHF- A/B 95-460-60-20 A	25010029 / 25020029	95	142,5
RHF- A/B 118-460-60-20 A	25010030 / 25020030	118	177,0
RHF- A/B 154-460-60-20 A	25010031 / 25020031	154	231,0
RHF- A/B 183-460-60-20 A	25010032 / 25020032	183	274,5
RHF- A/B 231-460-60-20 A	25010033 / 25020033	231	346,5
RHF- A/B 291-460-60-20 A	25010034 / 25020034	291	436,5
RHF- A/B 355-460-60-20 A	25010035 / 25020035	355	532,5
RHF- A/B 380-460-60-20 A	25010036 / 25020036	380	570,0
RHF- A/B 436-460-60-20 A	25010037 / 25020037	436	654,0

Table 8: Item numbers and Ampacity at nominal voltage 460V 60Hz

Nominal voltage 500V 50Hz

REVCON® - type	Item number RHF-A / RHF-B	Current I_{RMS} 100% [A] AC	Current I_{RMS} 150% [A] AC 1 min in 10 min
RHF- A/B 15-500-50-20 A	25010080 / 25020080	15	22,5
RHF- A/B 20-500-50-20 A	25010081 / 25020081	20	30,0
RHF- A/B 24-500-50-20 A	25010082 / 25020082	24	36,0
RHF- A/B 29-500-50-20 A	25010083 / 25020083	29	43,5
RHF- A/B 36-500-50-20 A	25010084 / 25020084	36	54,0
RHF- A/B 50-500-50-20 A	25010085 / 25020085	50	75,0
RHF- A/B 58-500-50-20 A	25010086 / 25020086	58	87,0
RHF- A/B 77-500-50-20 A	25010087 / 25020087	77	115,5
RHF- A/B 87-500-50-20 A	25010088 / 25020088	87	130,5
RHF- A/B 109-500-50-20 A	25010089 / 25020089	109	163,5
RHF- A/B 128-500-50-20 A	25010090 / 25020090	128	192,0
RHF- A/B 155-500-50-20 A	25010091 / 25020091	155	232,5
RHF- A/B 197-500-50-20 A	25010092 / 25020092	197	295,5
RHF- A/B 240-500-50-20 A	25010093 / 25020093	240	360,0
RHF- A/B 298-500-50-20 A	25010094 / 25020094	298	447,0
RHF- A 366-500-50-20 A	25010095	366	549,0
RHF- A 395-500-50-20 A	25010096	395	592,5

Table 9: Item numbers and Ampacity at nominal voltage 500V 50Hz

Nominal voltage 600V 60Hz

REVCON® - type	Item number RHF-A / RHF-B	Current I_{RMS} 100% [A] AC	Current I_{RMS} 150% [A] AC 1 min in 10 min
RHF- A/B 15-600-60-20 A	25010100 / 25020100	15	22,5
RHF- A/B 20-600-60-20 A	25010101 / 25020101	20	30,0
RHF- A/B 24-600-60-20 A	25010102 / 25020102	24	36,0
RHF- A/B 29-600-60-20 A	25010103 / 25020103	29	43,5
RHF- A/B 36-600-60-20 A	25010104 / 25020104	36	54,0
RHF- A/B 50-600-60-20 A	25010105 / 25020105	50	75,0
RHF- A/B 58-600-60-20 A	25010106 / 25020106	58	87,0
RHF- A/B 77-600-60-20 A	25010107 / 25020107	77	115,5
RHF- A/B 87-600-60-20 A	25010108 / 25020108	87	130,5
RHF- A/B 109-600-60-20 A	25010109 / 25020109	109	163,5
RHF- A/B 128-600-60-20 A	25010110 / 25020110	128	192,0
RHF- A/B 155-600-60-20 A	25010111 / 25020111	155	232,5
RHF- A/B 197-600-60-20 A	25010112 / 25020112	197	295,5
RHF- A/B 240-600-60-20 A	25010113 / 25020113	240	360,0
RHF- A/B 296-600-60-20 A	25010114 / 25020114	296	444,0
RHF- A 366-600-60-20 A	25010115	366	549,0
RHF- A 395-600-60-20 A	25010116	395	592,5

Table 10: Item numbers and Ampacity at nominal voltage 600V 60Hz

Technical data and dimension diagrams

Nominal voltage 690V 50Hz

REVCON® - type		Item number RHF-A / RHF-B	Current I_{RMS} 100% [A] AC	Current I_{RMS} 150% [A] AC 1 min in 10 min
RHF- A/B	15-690-50-20 A	25010060 / 25020060	15	22,5
RHF- A/B	20-690-50-20 A	25010061 / 25020061	20	30,0
RHF- A/B	24-690-50-20 A	25010062 / 25020062	24	36,0
RHF- A/B	29-690-50-20 A	25010063 / 25020063	29	43,5
RHF- A/B	36-690-50-20 A	25010064 / 25020064	36	54,0
RHF- A/B	50-690-50-20 A	25010065 / 25020065	50	69,0
RHF- A/B	58-690-50-20 A	25010066 / 25020066	58	87,0
RHF- A/B	77-690-50-20 A	25010067 / 25020067	77	115,5
RHF- A/B	87-690-50-20 A	25010068 / 25020068	87	130,5
RHF- A/B	109-690-50-20 A	25010069 / 25020069	109	163,5
RHF- A/B	128-690-50-20 A	25010070 / 25020070	128	192,0
RHF- A/B	155-690-50-20 A	25010071 / 25020071	155	232,5
RHF- A/B	197-690-50-20 A	25010072 / 25020072	197	295,5
RHF- A/B	240-690-50-20 A	25010073 / 25020073	240	360,0
RHF- A/B	296-690-50-20 A	25010074 / 25020074	296	444,0
RHF- A	366-690-50-20 A	25010075	366	549,0
RHF- A	395-690-50-20 A	25010076	395	592,5

Table 11: Item numbers and Ampacity at nominal voltage 690V 50Hz

6.7 Cable cross section

At usage of a RHF-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.

6.9 Electrical operating conditions RHF

Nominal voltage 380V 60Hz

REVCON® - type RHF-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 12: Electrical operating conditions 380V 60Hz RHF-A

Nominal voltage 380V 60Hz

REVCON® - type RHF-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 13: Electrical operating conditions 380V 60Hz RHF-B

* Locking torque of the electrical network and converter terminal clamp

** CS ≙ Cable end sleeve, CL ≙ Cable lug

Nominal voltage 400V 50Hz

REVCON® - type RHF-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 14: Electrical operating conditions 400V 50Hz RHF-A

Nominal voltage 400V 50Hz

REVCON® - type RHF-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 15: Electrical operating conditions 400V 50Hz RHF-B

* Locking torque of the electrical network and converter terminal clamp

** CS ≙ Cable end sleeve, CL ≙ Cable lug

Technical data and dimension diagrams

Nominal voltage 460V 60Hz

REVCON® - type RHF-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 16: Electrical operating conditions 460V 60Hz RHF-A

Nominal voltage 460V 60Hz

REVCON® - type RHF-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 17: Electrical operating conditions 460V 60Hz RHF-B

* Locking torque of the electrical network and converter terminal clamp

** CS ≙ Cable end sleeve, CL ≙ Cable lug

Nominal voltage 500V 50Hz

REVCON® - type RHF-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 18: Electrical operating conditions 500V 50Hz RHF-A

Nominal voltage 500V 50Hz

REVCON® - type RHF-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 19: Electrical operating conditions 500V 50Hz RHF-B

* Locking torque of the electrical network and converter terminal clamp

** CS ≙ Cable end sleeve, CL ≙ Cable lug

Technical data and dimension diagrams

Nominal voltage 600V 60Hz

REVCON® - type RHF-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 20: Electrical operating conditions 600V 60Hz RHF-A

Nominal voltage 600V 60Hz

REVCON® - type RHF-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 21: Electrical operating conditions 600V 60Hz RHF-B

* Locking torque of the electrical network and converter terminal clamp

** CS ≙ Cable end sleeve, CL ≙ Cable lug

Nominal voltage 690V 50Hz

REVCON® - type RHF-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 22: Electrical operating conditions 690V 50Hz RHF-A

Nominal voltage 690V 50Hz

REVCON® - type RHF-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 23: Electrical operating conditions 690V 50Hz RHF-B

* Locking torque of the electrical network and converter terminal clamp

** CS ≙ Cable end sleeve, CL ≙ 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 24: The external dimensions of the filter modules with external fan

6.10 Allocation of the fans

Nominal voltage 380V 60Hz RHF-A

REVCON® - type RHF-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 25: Fans at nominal voltage 380V 60Hz type RHF-A

Nominal voltage 380V 60Hz RHF-B

REVCON® - type RHF-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 26: Fans at nominal voltage 380V 60Hz type RHF-B

Technical data and dimension diagrams

Nominal voltage 400V 50Hz RHF-A

REVCON® - type RHF-A-	Fan	Number	Power loss P [W]	Air mass V [m^3/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 27: Fans at nominal voltage 400V 50Hz type RHF-A

Nominal voltage 400V 50Hz RHF-B

REVCON® - type RHF-B-	Fan	Number	Power loss P [W]	Air mass V [m^3/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 28: Fans at nominal voltage 400V 50Hz type RHF-B

Nominal voltage 460V 60Hz RHF-A

REVCON® - type RHF-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 29: Fans at nominal voltage 460V 60Hz type RHF-A

Nominal voltage 460V 60Hz RHF-B

REVCON® - type RHF-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 30: Fans at nominal voltage 460V 60Hz type RHF-B

Technical data and dimension diagrams

Nominal voltage 500V 50Hz RHF-A

REVCON® - type RHF-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 31: Fans at nominal voltage 500V 50Hz type RHF-A

Nominal voltage 500V 50Hz RHF-B

REVCON® - type RHF-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 32: Fans at nominal voltage 500V 50Hz type RHF-B

Nominal voltage 600V 60Hz RHF-A

REVCON® - type RHF-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 33: Fans at nominal voltage 600V 60Hz type RHF-A

Nominal voltage 600V 60Hz RHF-A

REVCON® - type RHF-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 34: Fans at nominal voltage 600V 60Hz type RHF-B

Technical data and dimension diagrams

Nominal voltage 690V 50Hz RHF-A

REVCON® - type RHF-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 35: Fans at nominal voltage 690V 50Hz type RHF-A

Nominal voltage 690V 50Hz RHF-B

REVCON® - type RHF-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 36: Fans at nominal voltage 690V 50Hz type RHF-B

6.11 Dimension diagrams

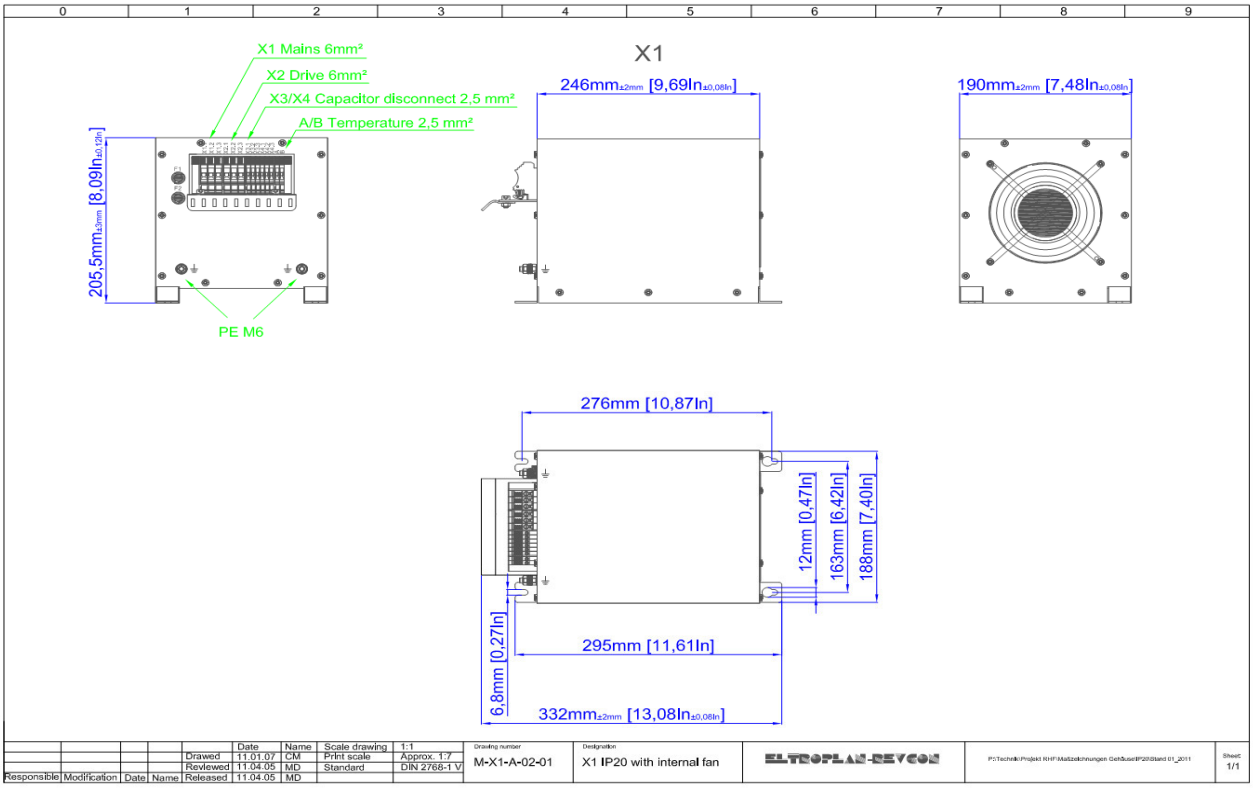


Figure 10: Dimension diagram configuration X1 internal fan

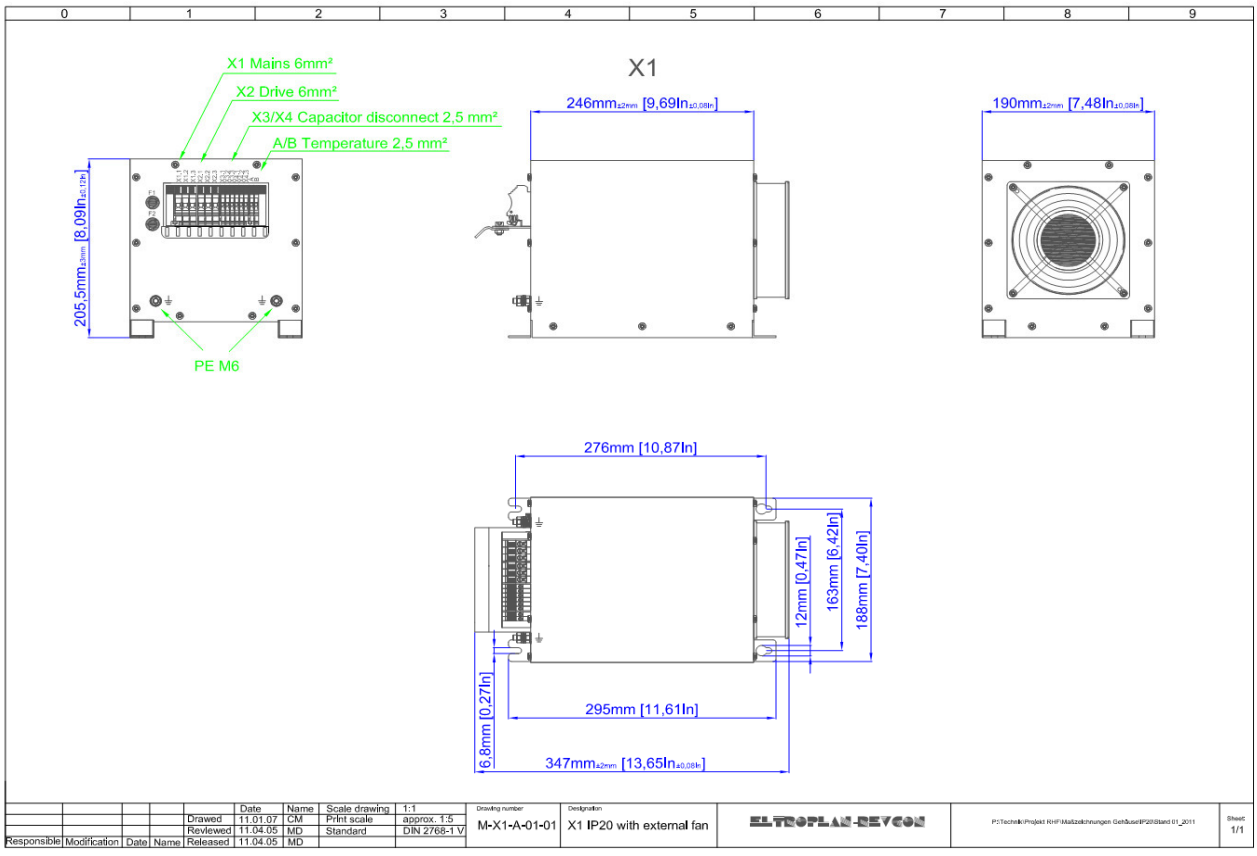


Figure 11: Dimension diagram configuration X1 external fan

Technical data and dimension diagrams

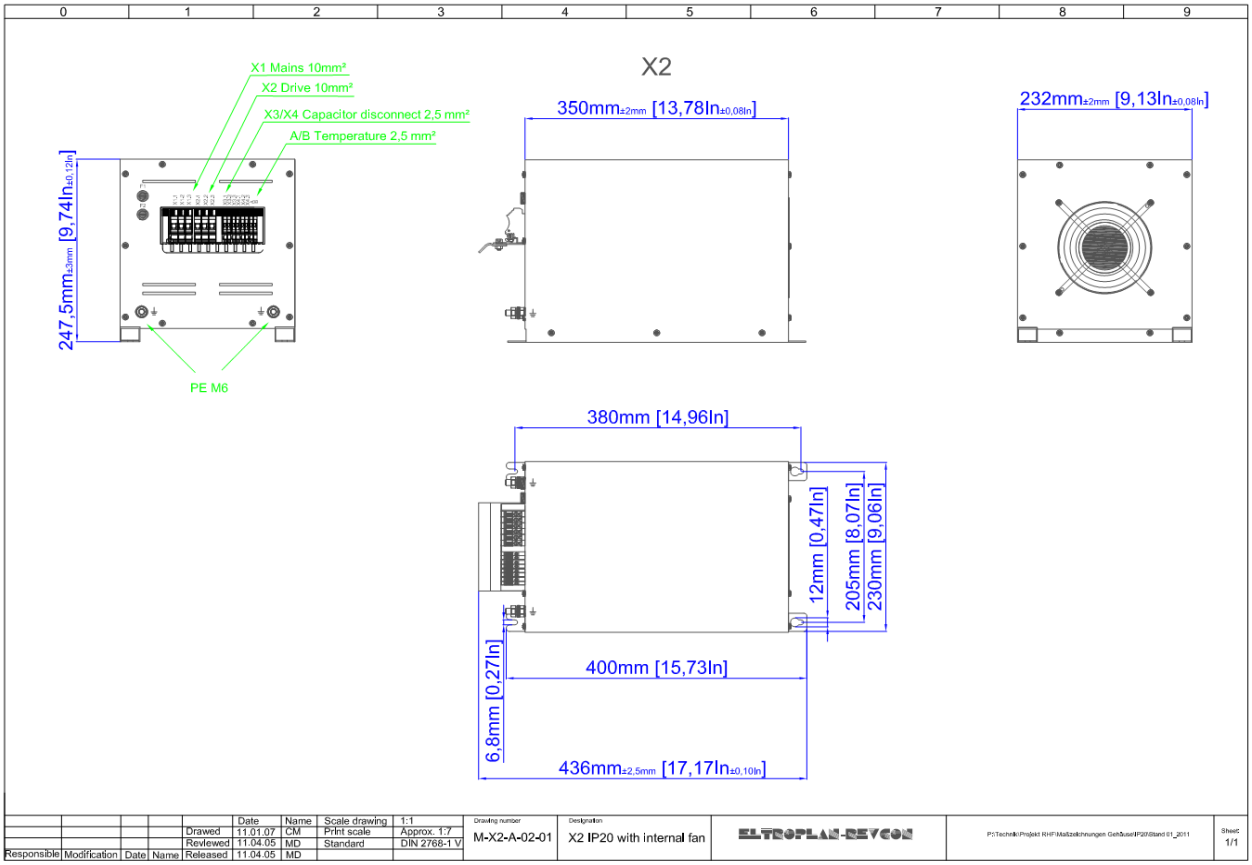


Figure 12: Dimension diagram configuration X2 internal fan

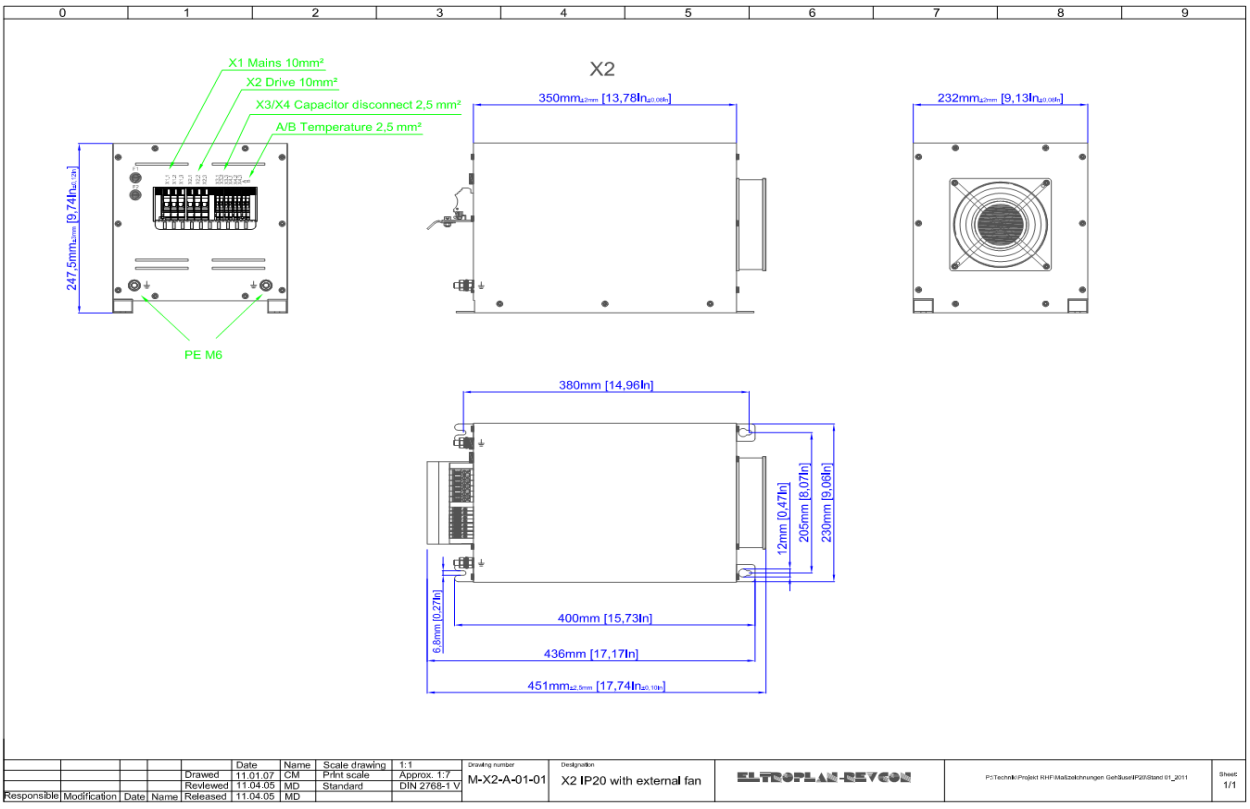


Figure 13: Dimension diagram configuration X2 external fan

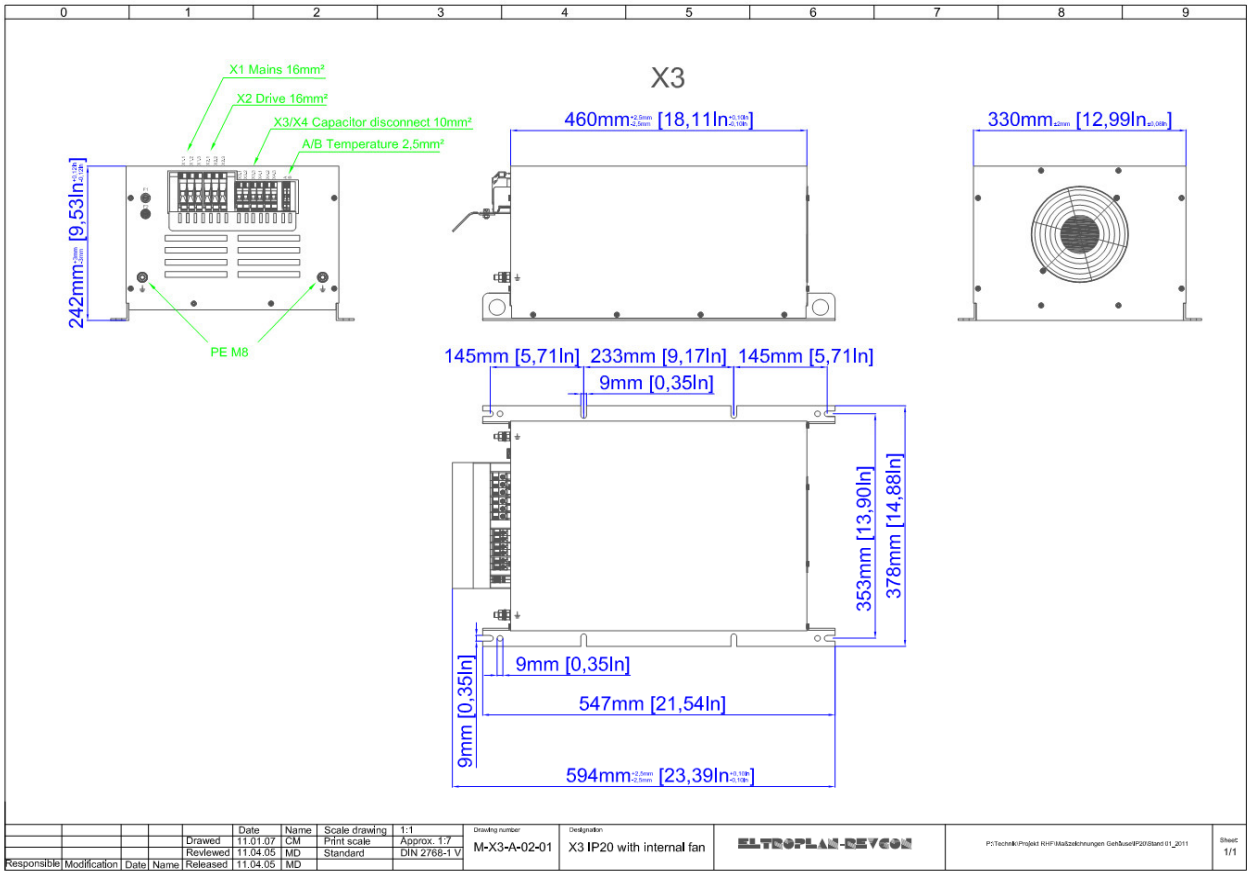


Figure 14: Dimension diagram configuration X3 internal fan

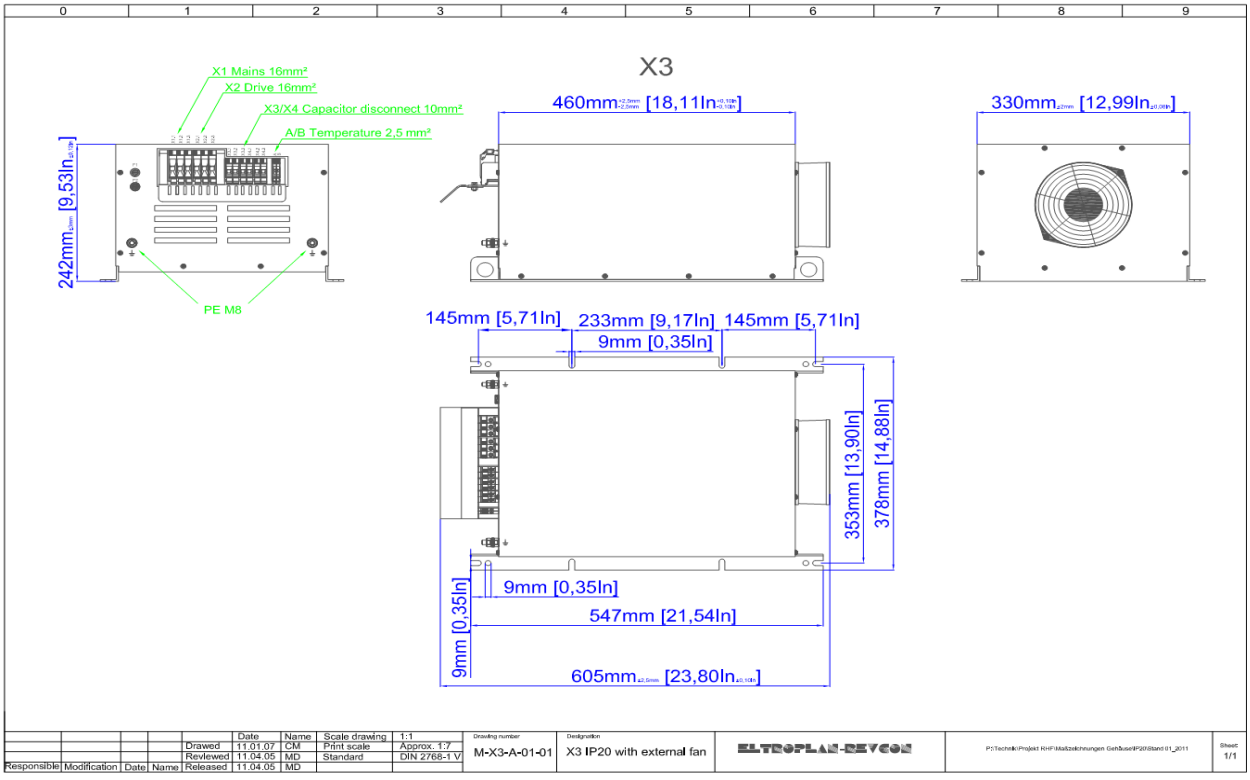


Figure 15: Dimension diagram configuration X3 external fan

Technical data and dimension diagrams

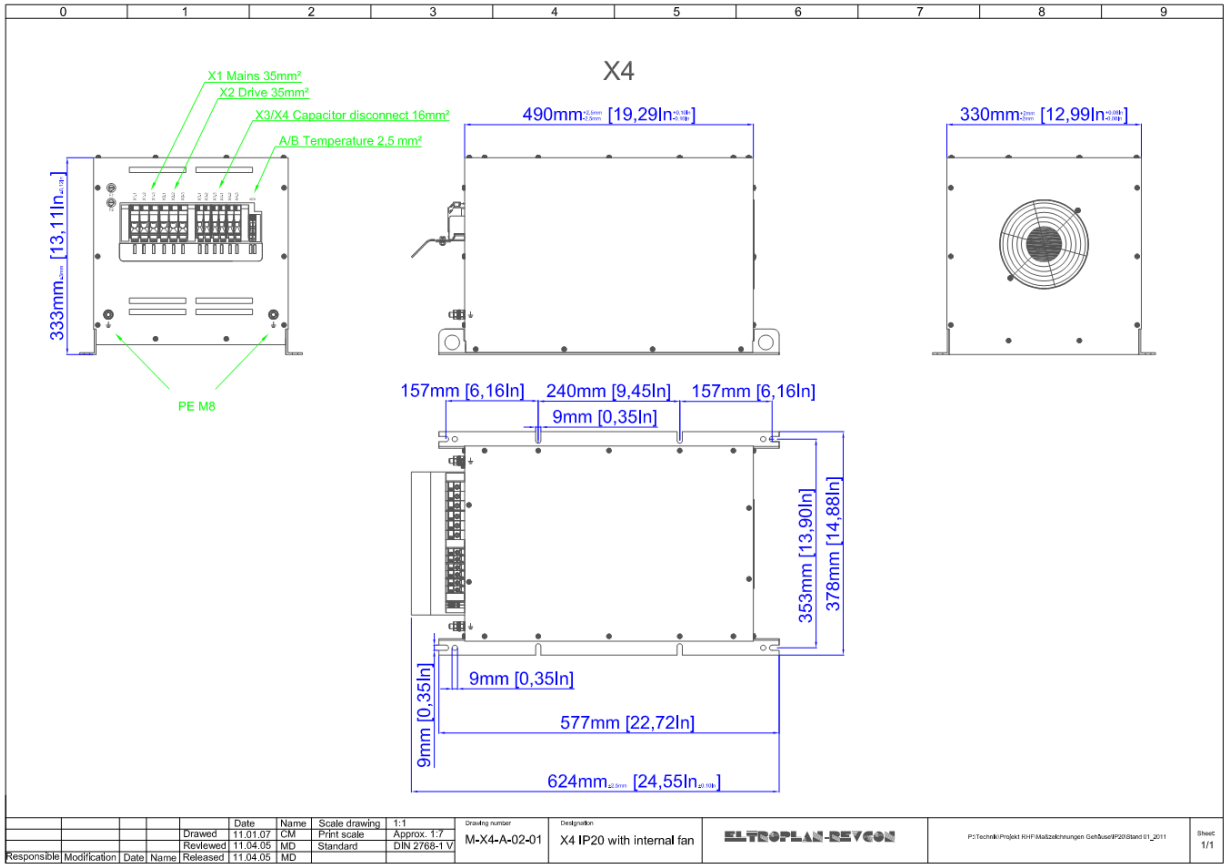


Figure 16: Dimension diagram configuration X4 internal fan

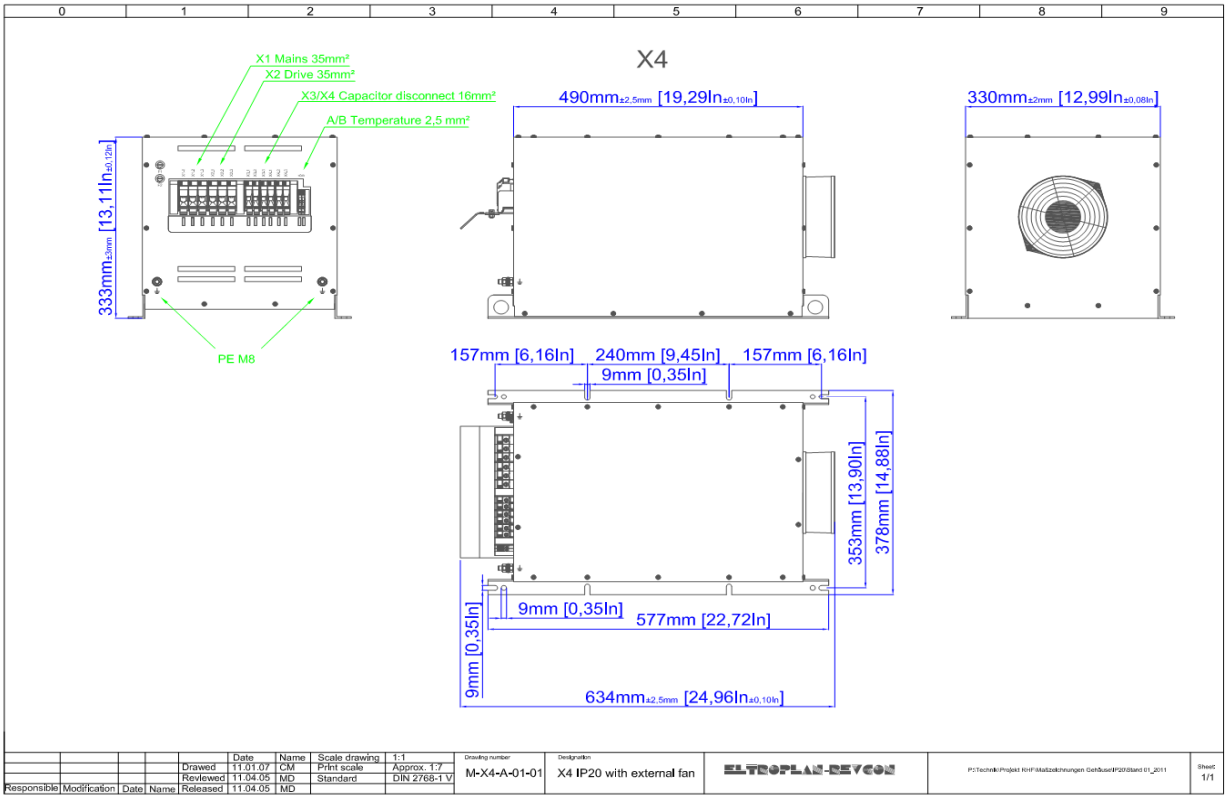


Figure 17: Dimension diagram configuration X4 external fan

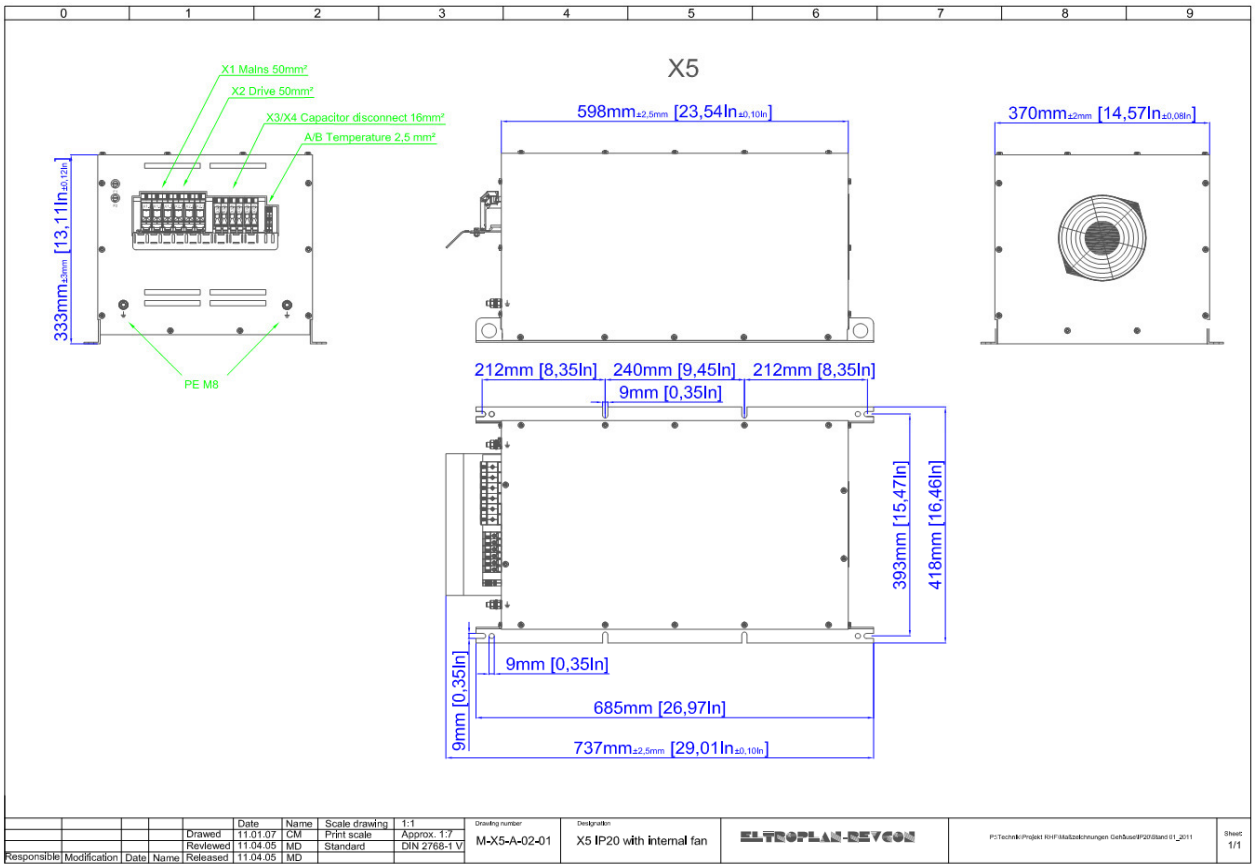


Figure 18: Dimension diagram configuration X5 internal fan

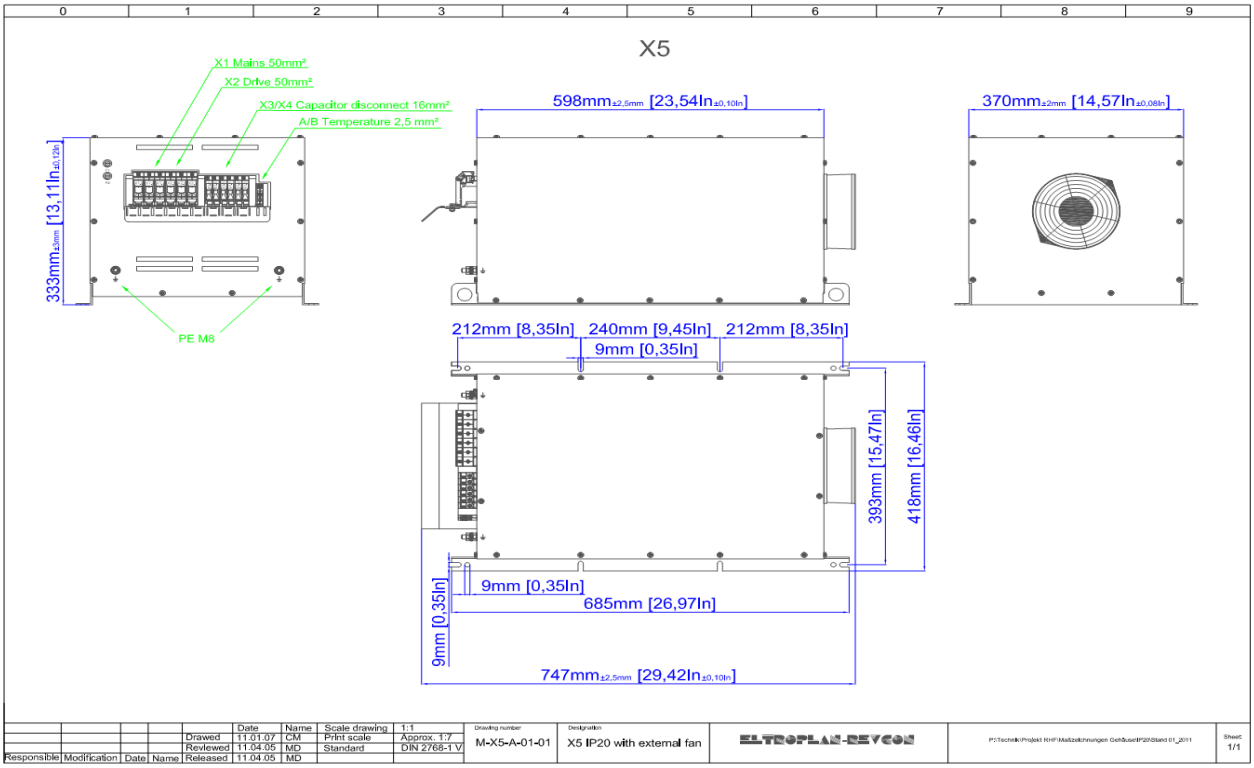


Figure 19: Dimension diagram configuration X5 external fan

Technical data and dimension diagrams

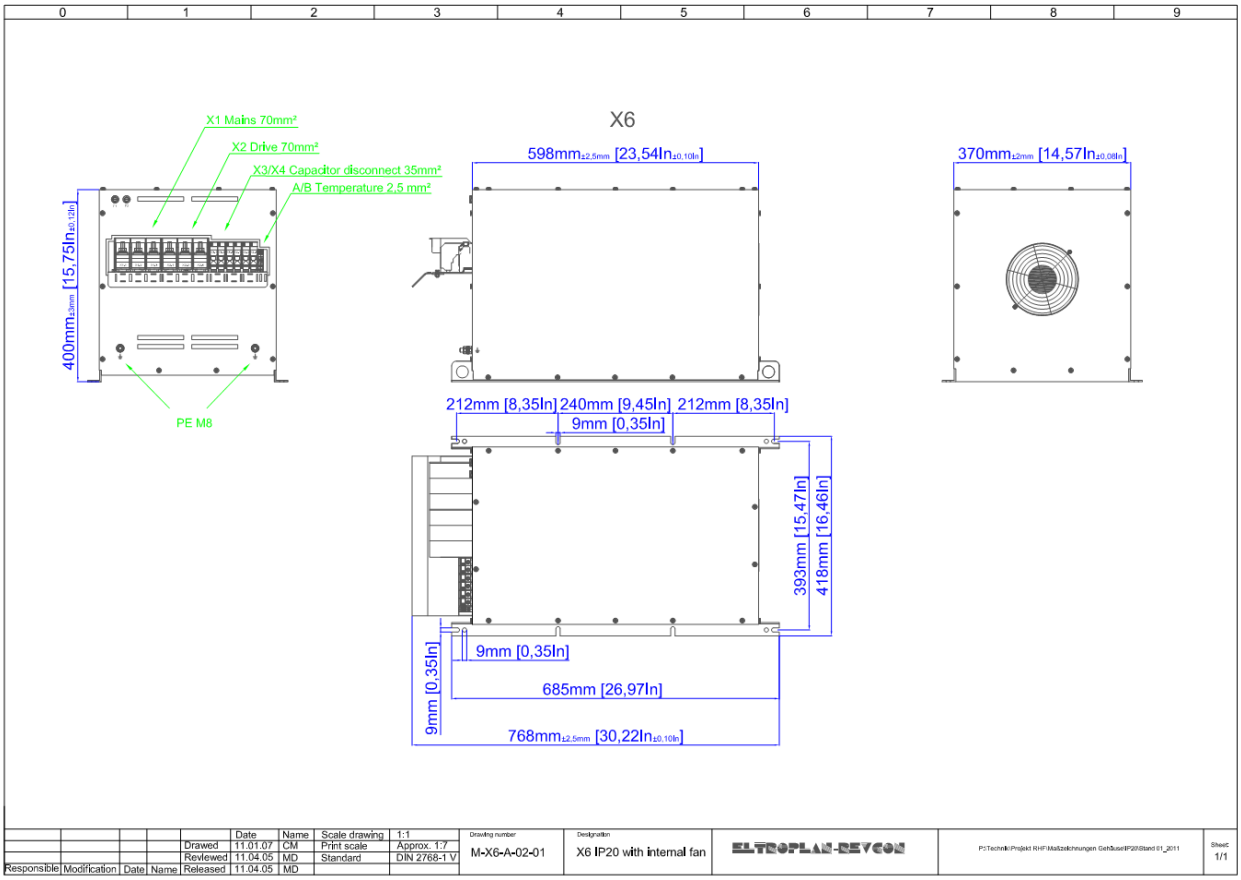


Figure 20: Dimension diagram configuration X6 internal fan

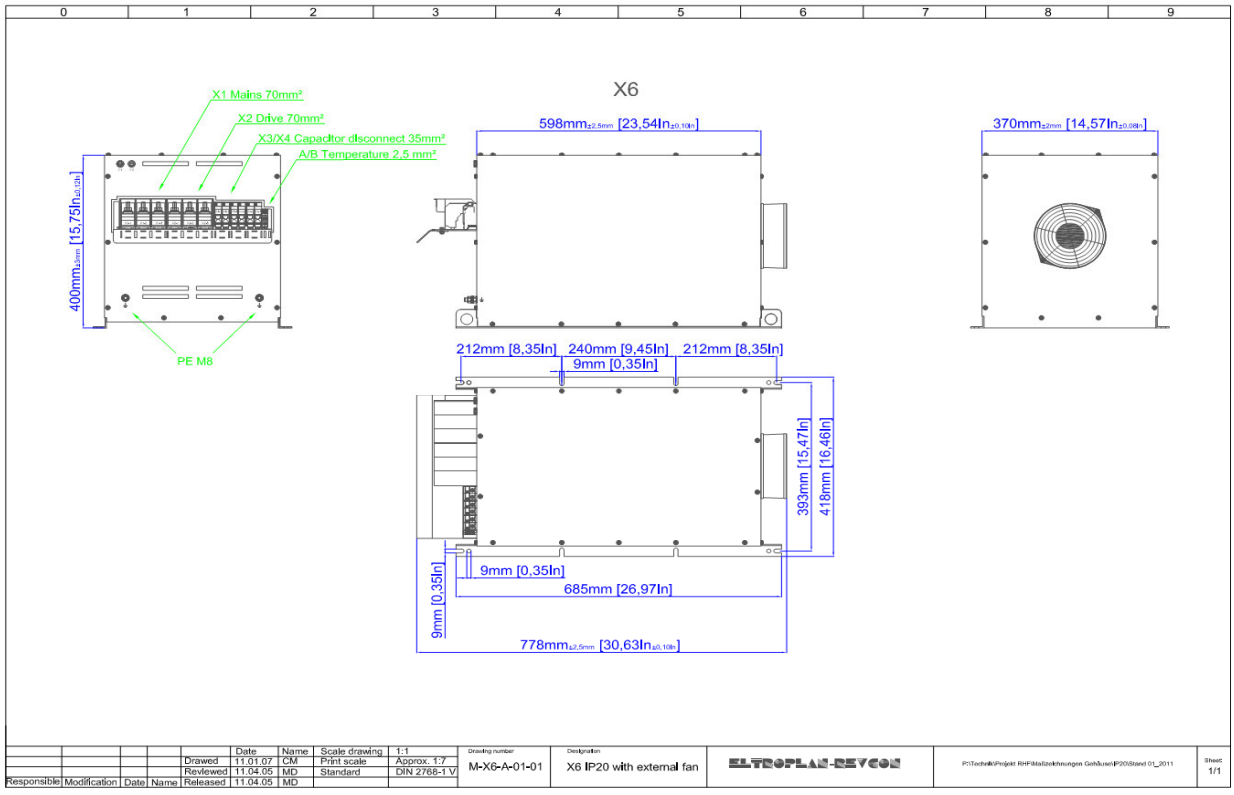


Figure 21: Dimension diagram configuration X6 external fan

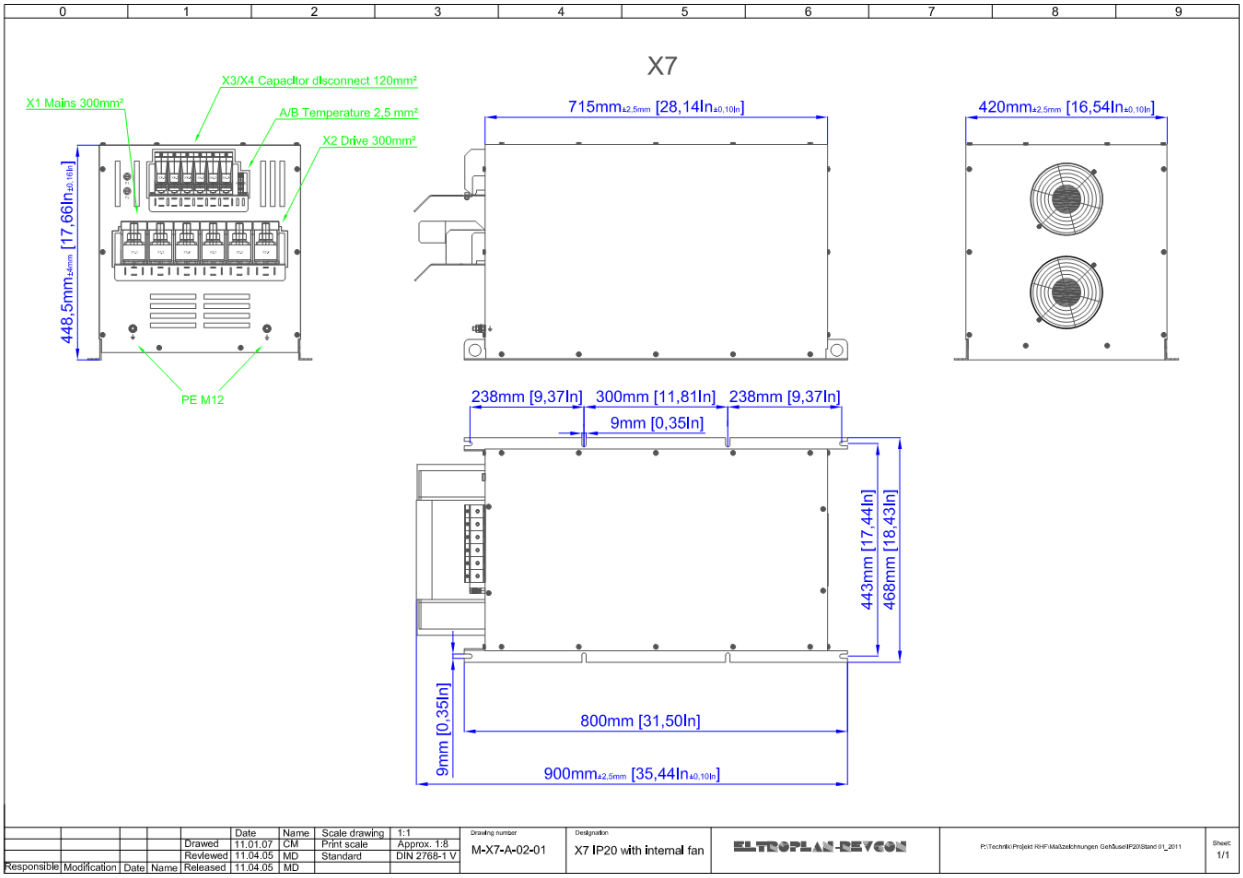


Figure 22: Dimension diagram configuration X7 internal fan

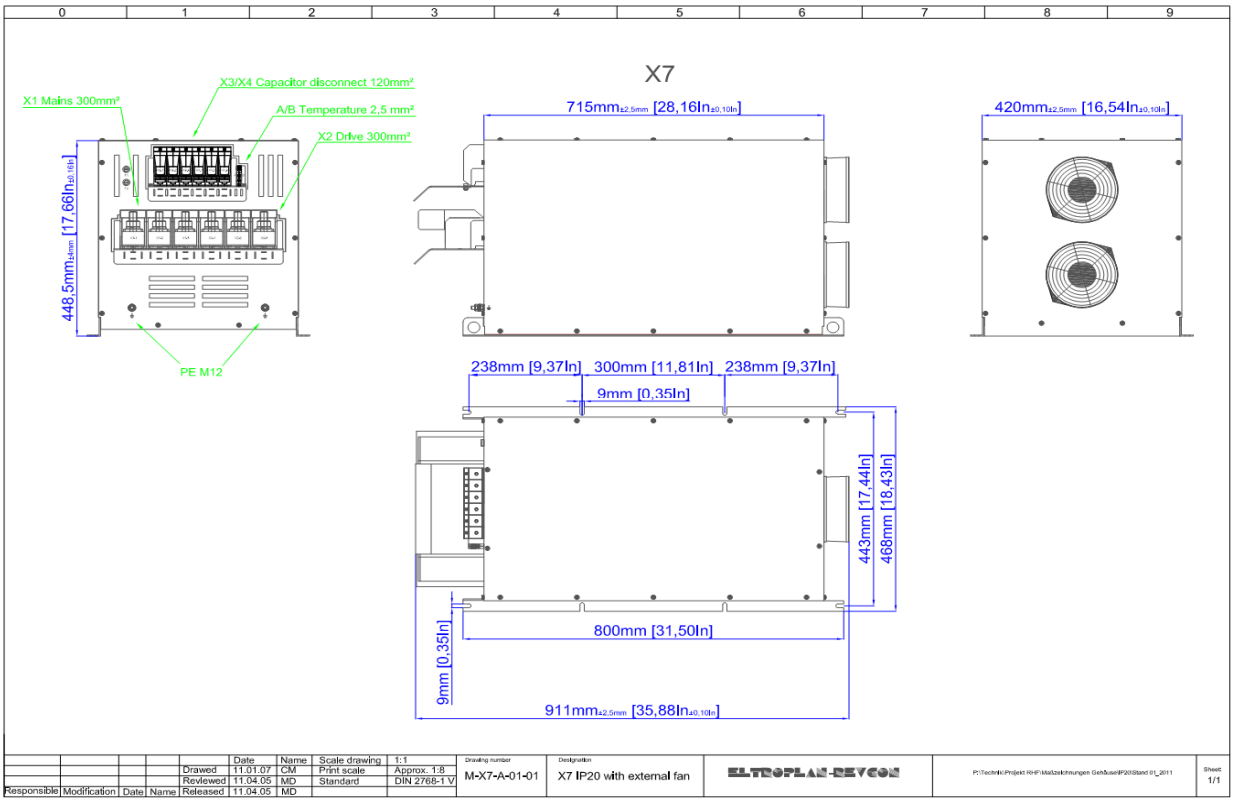


Figure 23: Dimension diagram configuration X7 external fan

Technical data and dimension diagrams

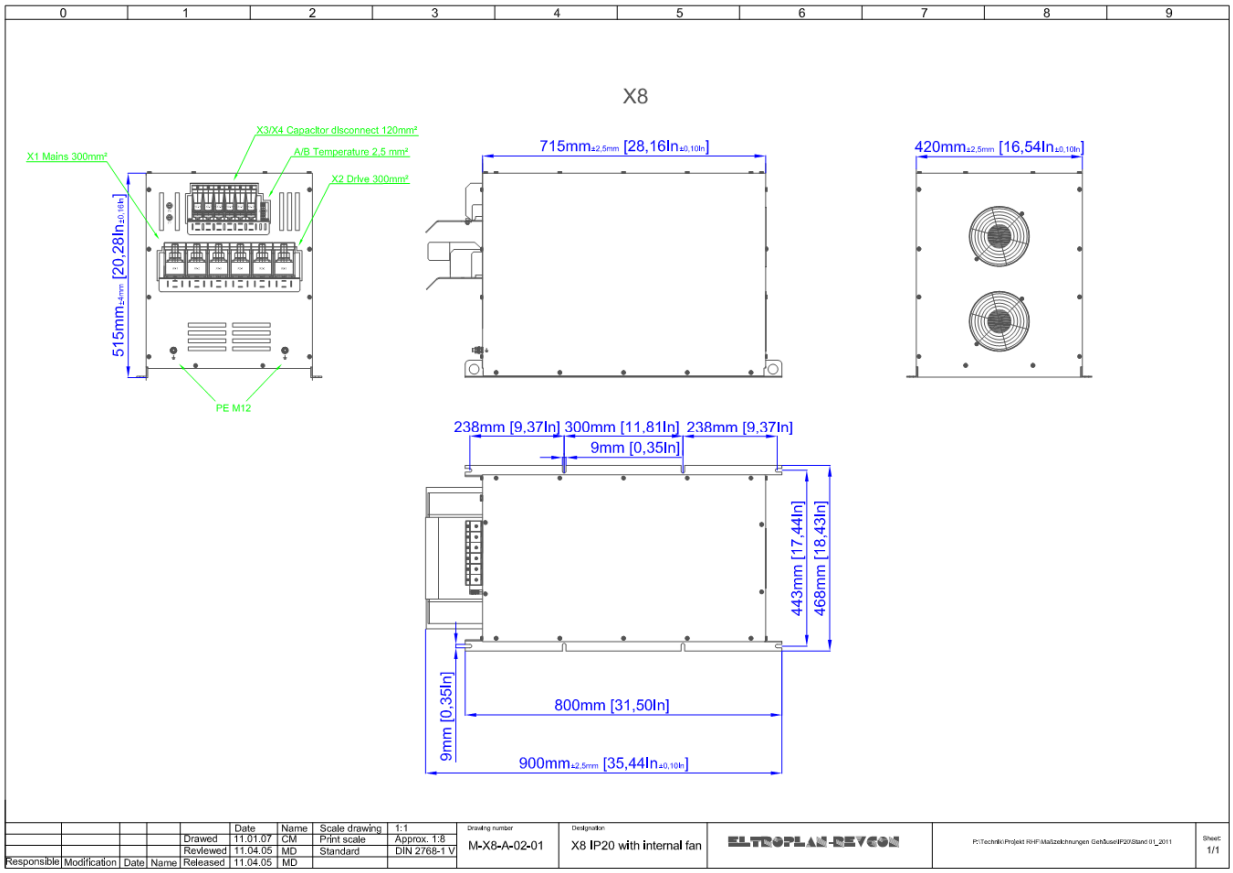


Figure 24: Dimension diagram configuration X8 internal fan

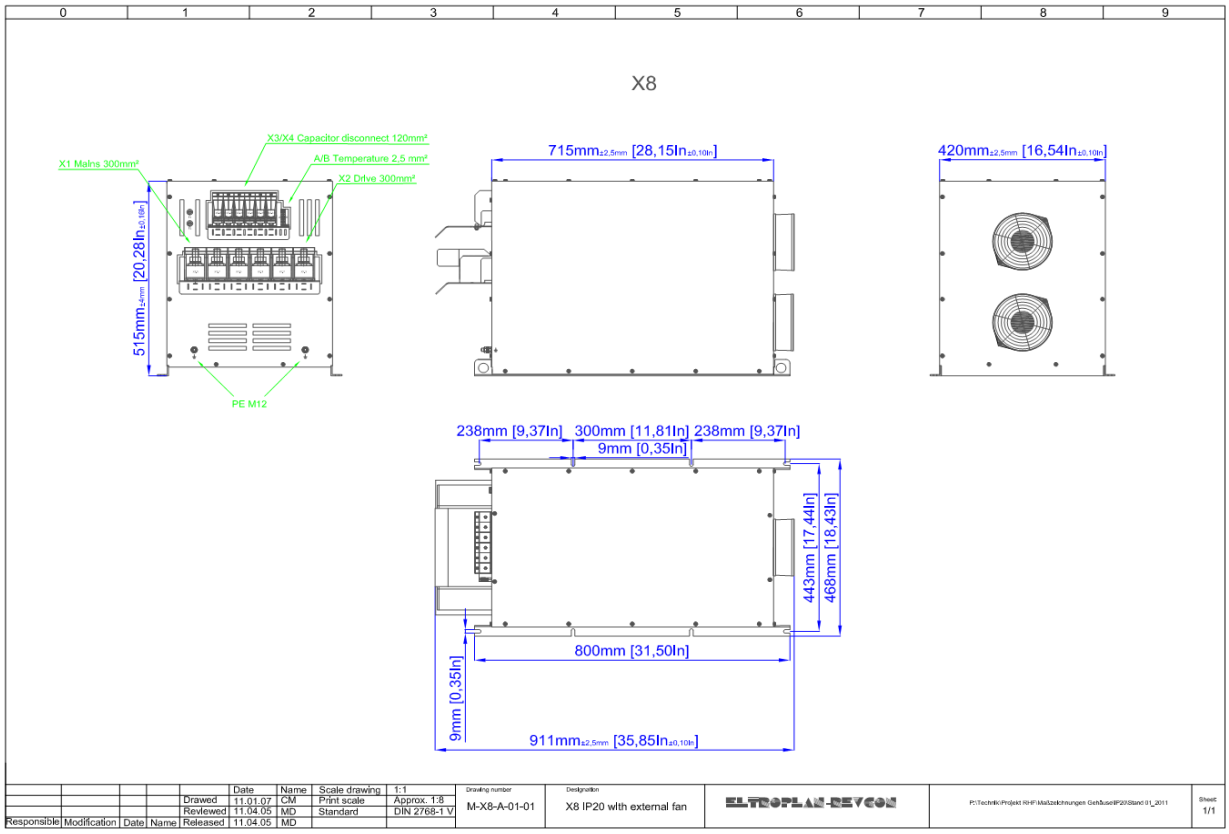


Figure 25: Dimension diagram configuration X8 external fan

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.

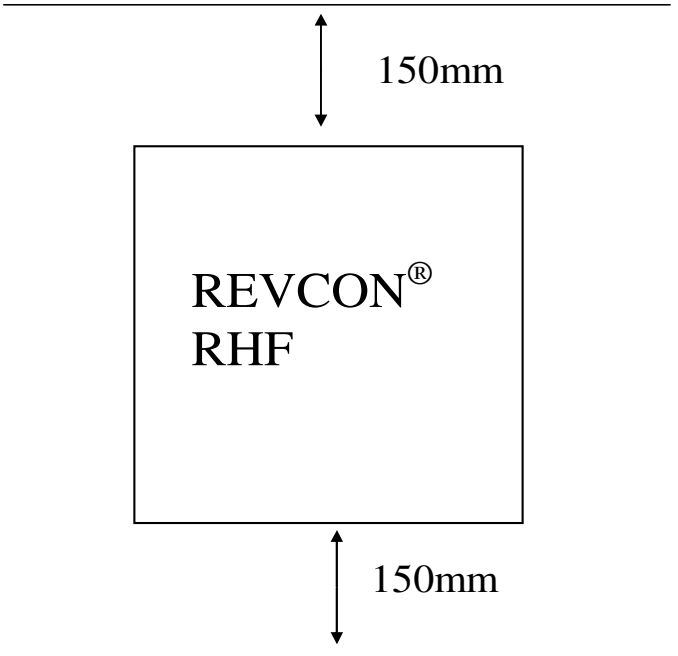


Figure 26: 150mm free space above and below

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

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.

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 23). 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 23 shows the correct mounting of the filter module:

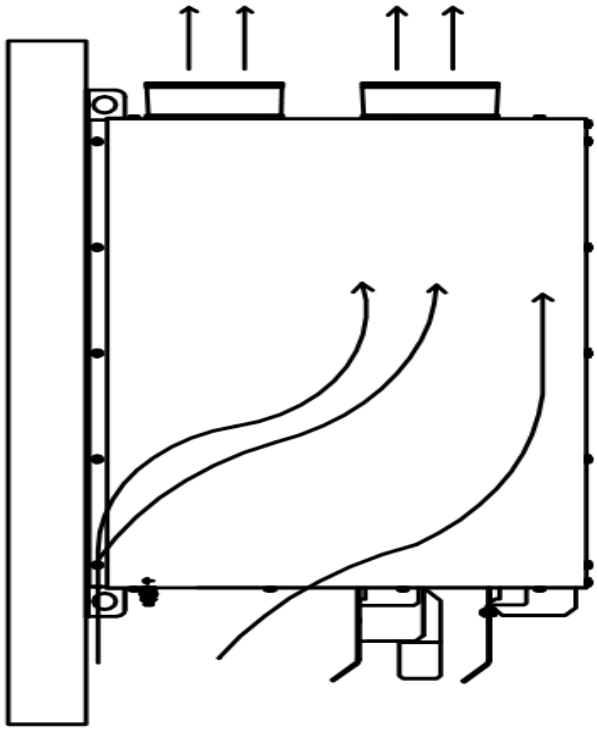


Figure 27: The correct mounting of the filter module

8 Electrical installation

8.1 Network configuration / Net conditions

Danger!

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 37: Network configuration / Net conditions

Stop!

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

8.2 Operation principle RHF

The REVCON RHF consists of a main inductor L_0 and a two-stage absorption circuit.

The absorption circuit eliminates harmonics starting at the fifth order and is specific for the designed supply frequency.

The filter performance in terms of THDI varies as a function of the load.

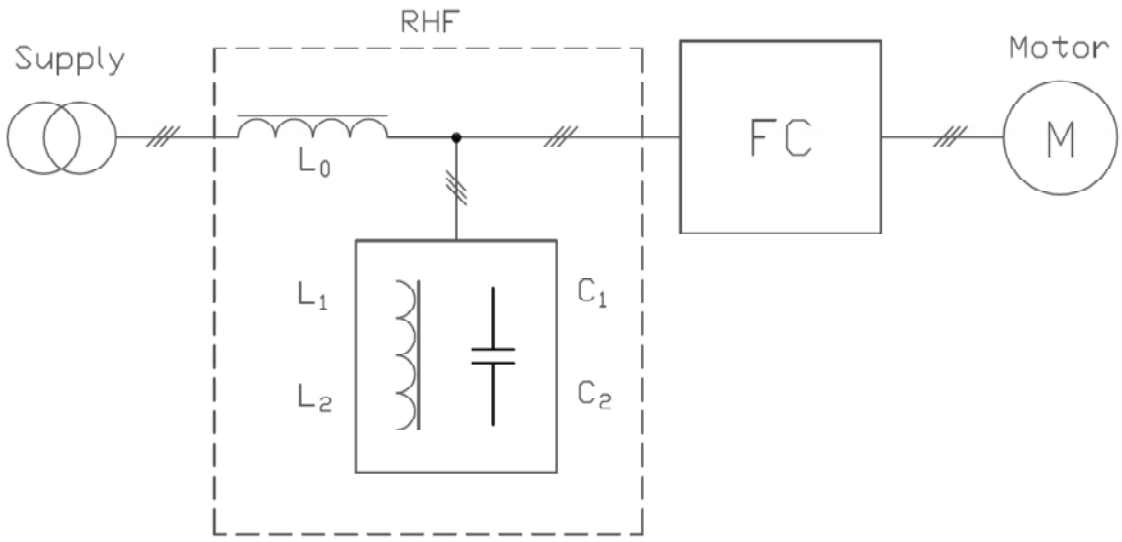


Figure 28: Operation principle RHF

Danger!

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

8.3 Wiring diagram RHF

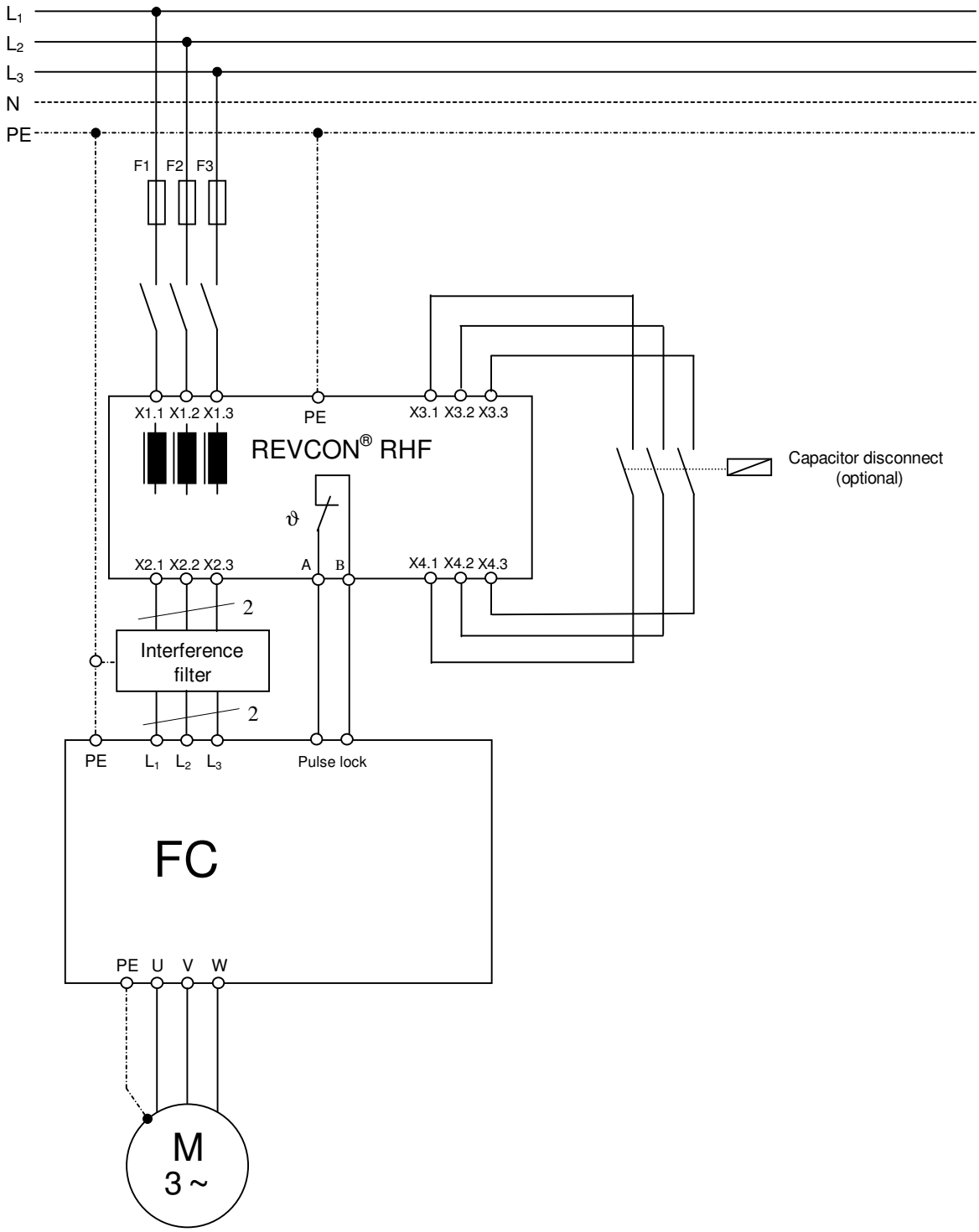


Figure 29: The Wiring of the filter module REVCON® RHF to a frequency converter

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.

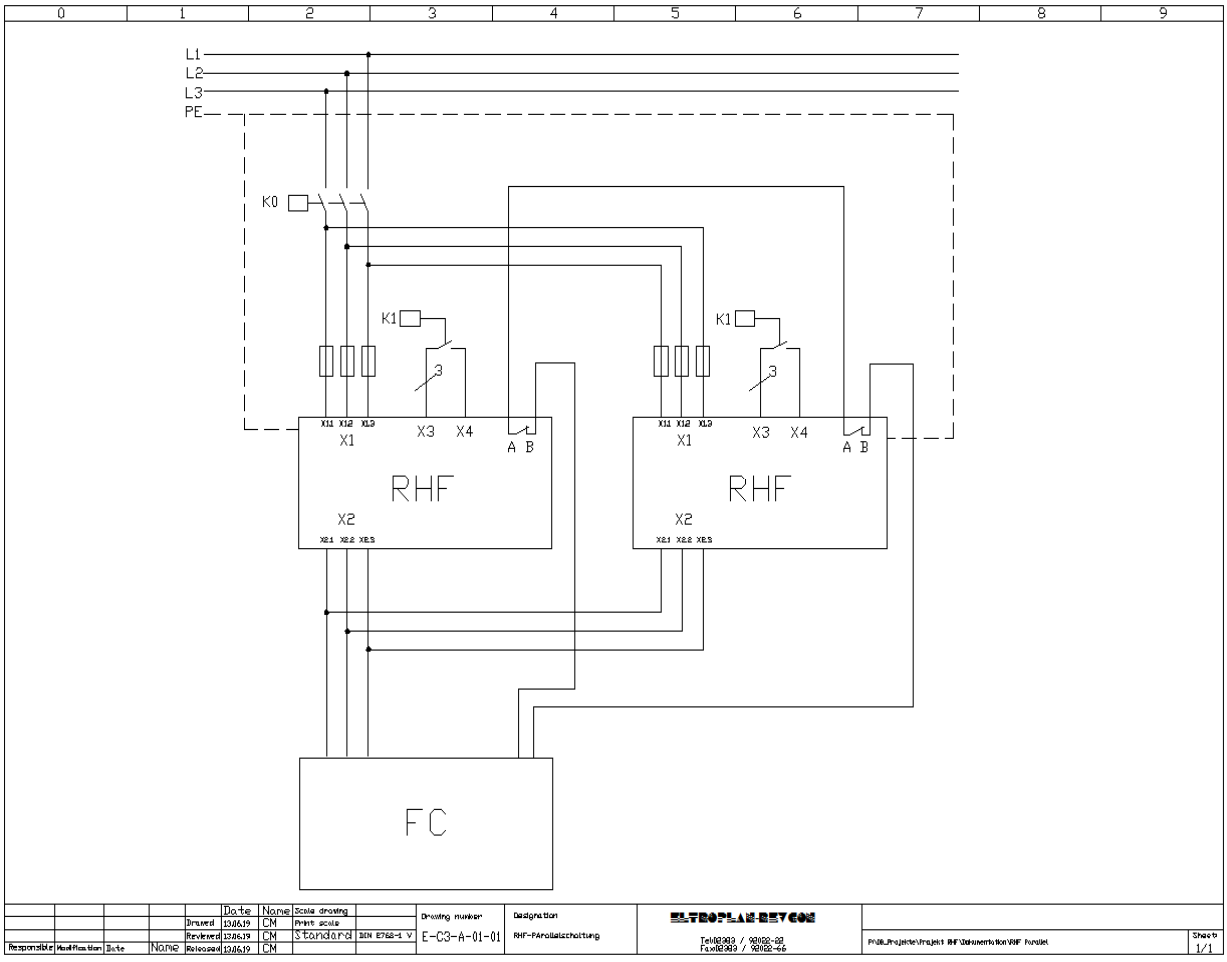


Figure 30: The connection in parallel of filter modules

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.

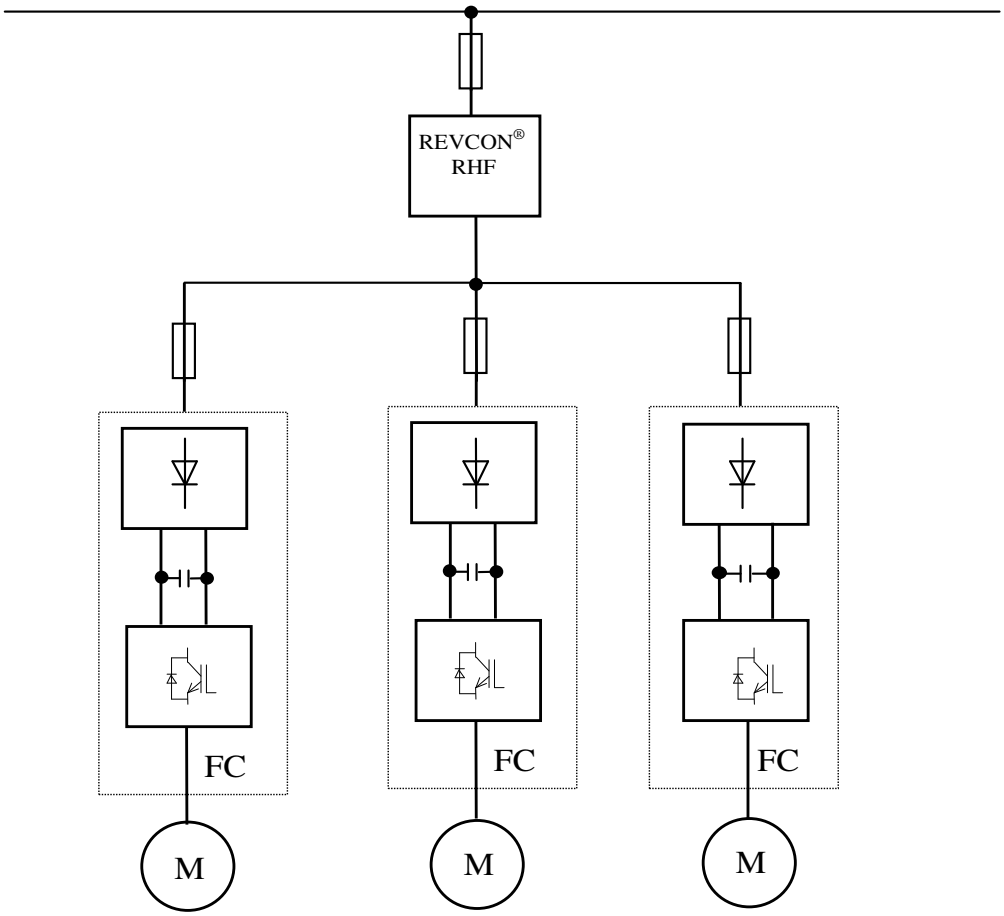


Figure 31: The connection in parallel of frequency converters

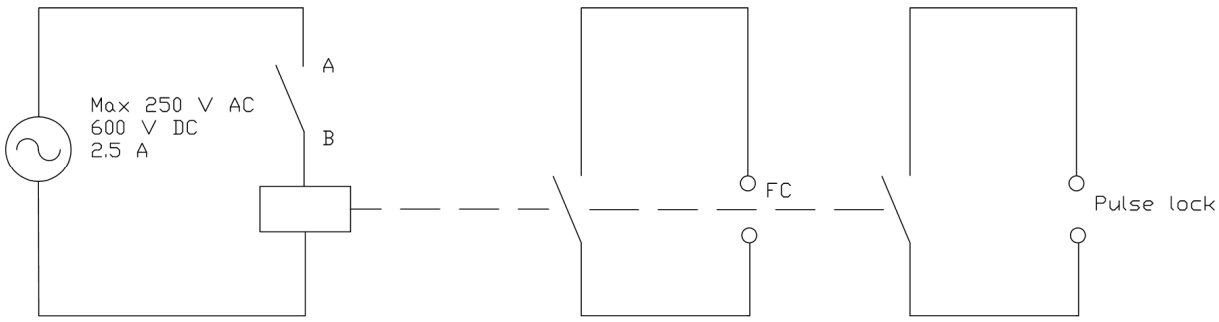


Figure 32: Galvanic isolated switch

8.4 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.

8.5 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 37 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 38: 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 38 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	10	35
20	14	35
24	19	50
29	25	50
36	31	63
50	36	80
58	48	125
77	60 / 73	160
87	95	250
109	118	250
128	154	250
155	183	315
197	-	350
240	231	400
296	291	500
366	355	630
395	380	630

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.

8.6 Installation in a CE- typical drive system

General information	• 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	• Connect filter modules extensive to the earthed mounting plate: – 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: – 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	• Metallic cable connections ensure an extensive connection of the shield with the enclosure • At contactors and clamps in the shielded lines: - Interconnect the shields of the three connected lines and also connect extensive with the mounting plate • At power lines among the interference filter and the drive system longer as 300mm: - 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: - Connect the shield beeline to the shield connections.
Grounding	• Ground all metallic electrically conductive Components (feedback 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: - 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 centimeters.

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.

8.8 Installation of a EMC- conform electrical enclosure

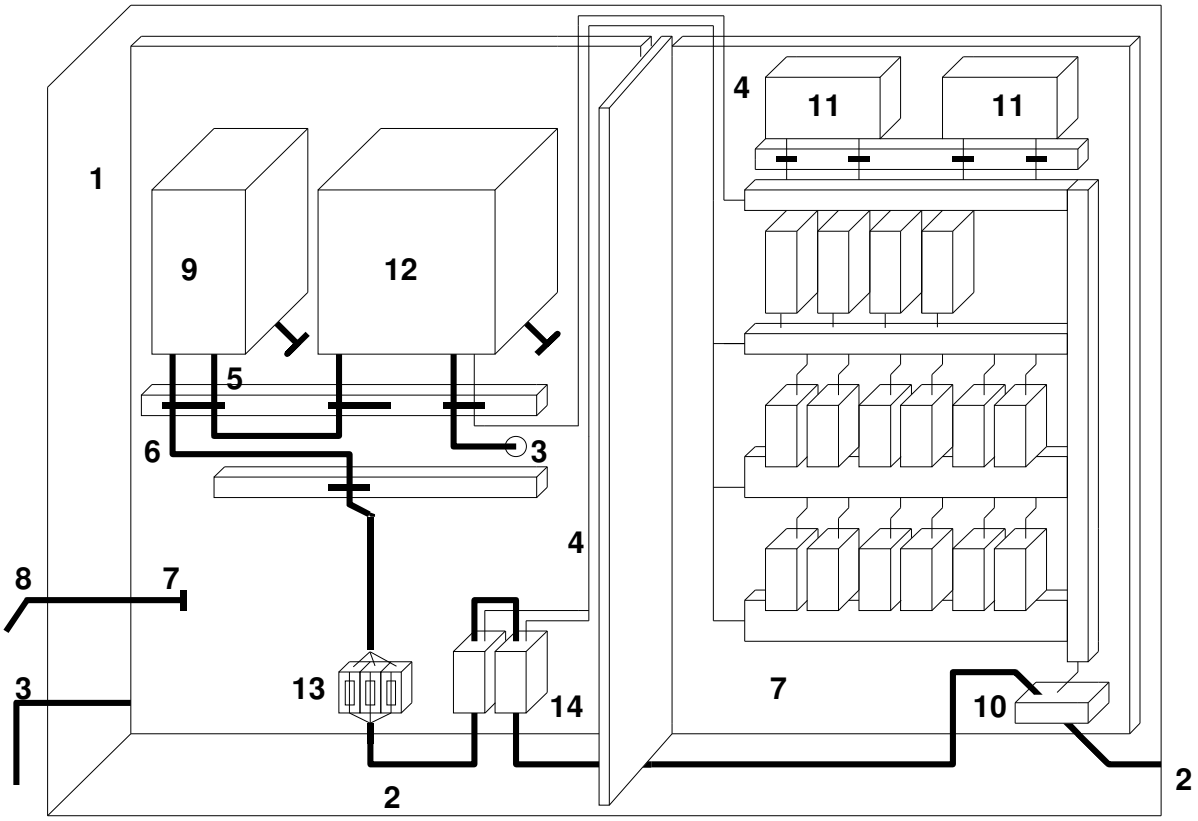


Figure 33: EMC-conform electrical enclosure

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

9 Commissioning

Danger!

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

Danger!

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

Danger!

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

10 Capacitor disconnection

In no load conditions (standby-operation) the frequency converter current is negligible. The main current drawn at standby operation at the input of the harmonic filter is a purely capacitive reactive current which flows through the capacitor of the harmonic filter. This reactive current component corresponds typically to ca. 20-25% of the specified nominal harmonic filter current (depending on the respective harmonic filter type). The power factor of the drive is at this condition very low and changes, depending on the load, to one.

The following graphs show typical values for the true power factor of a RHF-A and RHF-B:

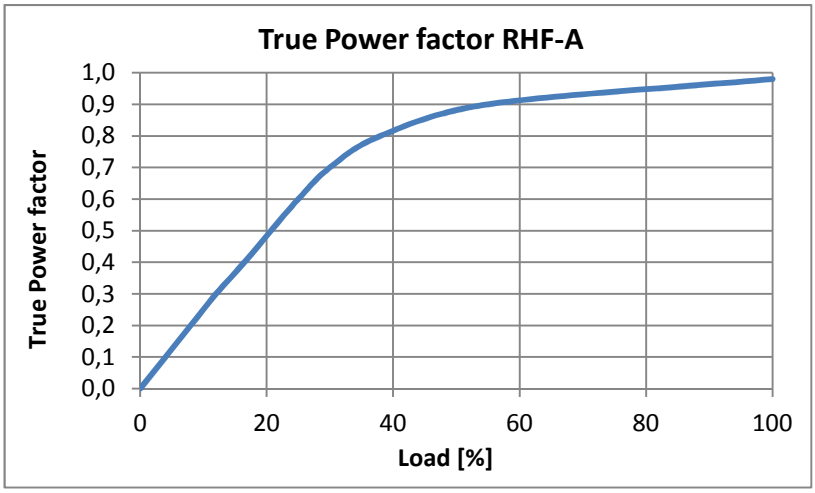


Figure 34: Typical power factor of a RHF-A

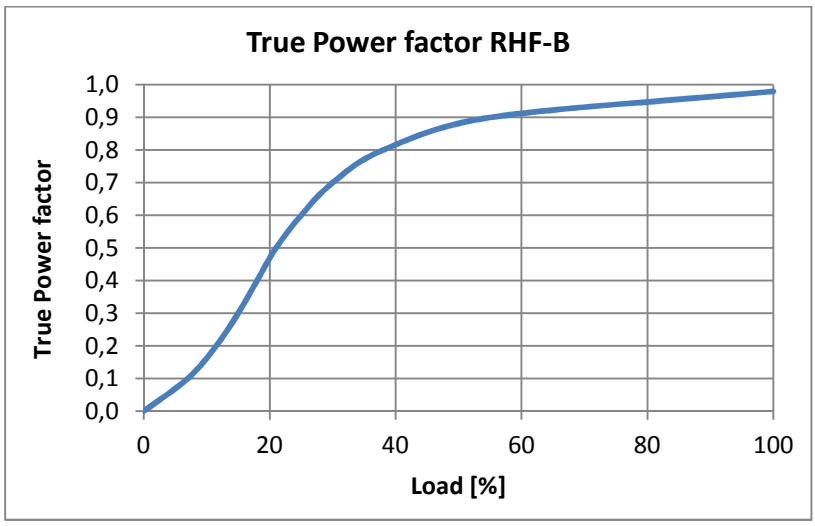


Figure 35: Typical power factor of a RHF-B

To reduce this reactive current and to prevent an overcompensation of the mains it is recommended to disconnect this reactive current at standby operation. This reactive current can be disconnected by a contactor At the on the filter installed terminals X3 and X4 this reactive current can be disconnected by a contactor (these terminals are bridged ex works). Depending of the short-circuit power, an in the most industrial mains commercial AC3 contactor can be used for the disconnection. **The power of the AC3 contactor should be minimum 50% of the nominal power of the filter.** This contactor can be connected and disconnected, depending on the drive performance, to a load of maximal 30%.

It must be waited for 25 seconds before the Restart, until the capacitors are discharged completely.

To ensure dynamic cycles of operation the C-disconnection can occur by the capacitor contactors. The connection of the capacitors can then occur to a maximal power of 30% without holding time!

For drives that are operated on generators (e.g. ship applications) capacitor contactors are recommended generally.

Table 39 shows the nominal power of the contactor depending on the nominal current:

Nominal current 380-415 V 50,60 Hz [A]	Nominal current 440-480 V 60 Hz [A]	Contactor Nominal power [kvar]	Nominal current 500-690V 50,60 Hz [A]	Contactor Nominal power [kvar]
10	10	1	15	5
14	14	2	20	6
22	19	4	24	9
29	25	6	29	10
35	31	7	36	13
43	36	7	50	17
58	48	9	58	19
72	60	11	77	24
86	73	15	87	28
101	95	17	109	34
144	118	22	128	48
180	154	29	155	48
217	183	36	197	62
252	231	44	240	68
304	291	51	296	95
325	355	58	366	109
380	380	66	395	123
433	436	88		

Table 40: The nominal power of the contactor

Capacitor disconnection

Figure 32 shows a typical application of the capacitor disconnection:

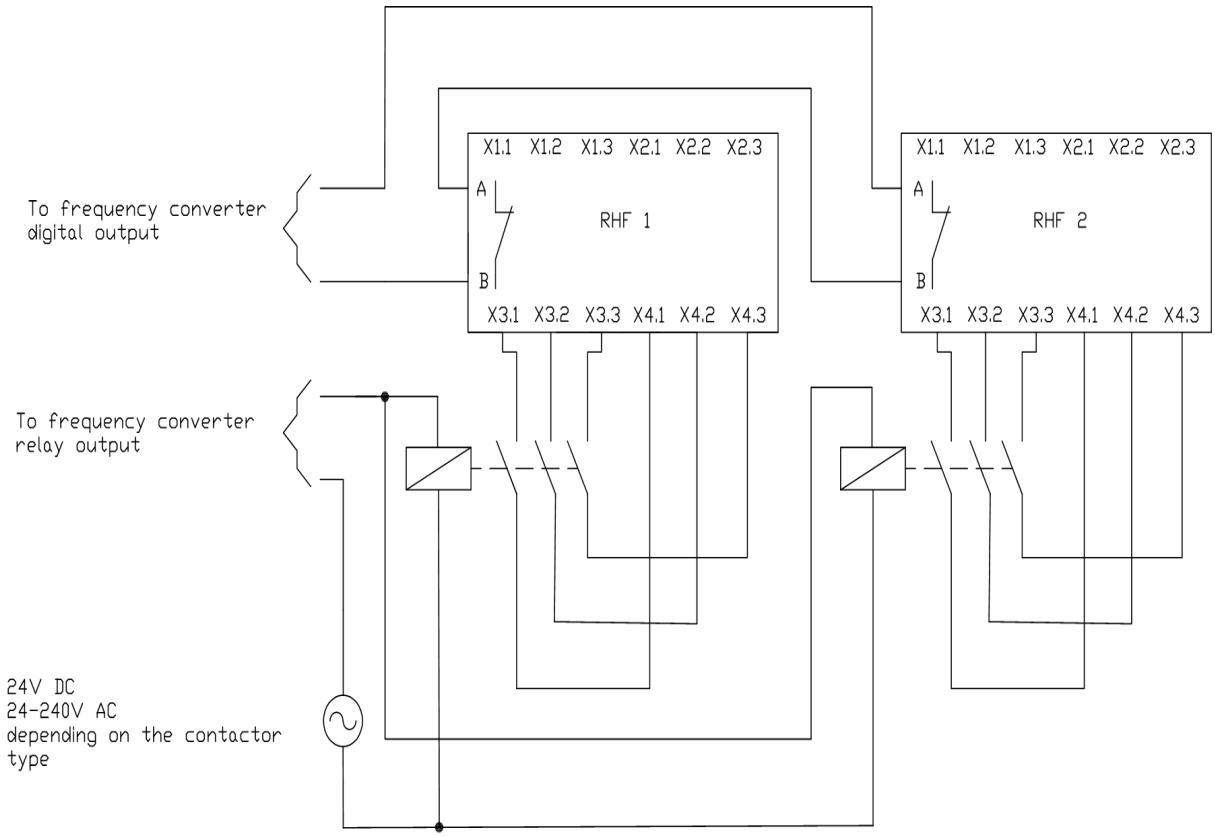


Figure 36: Typical application of the capacitor disconnection

11 Option Nema 1- enclosure

The option IP21 / Nema1 enclosure- equipments are available in two options: (Only version AC3)

- Version 1: Without capacitor-contactor disconnection
- Version 2: With capacitor-contactor disconnection

IP21 / Nema1 enclosure- equipments are listed in the following tables:

Version 1:

Enclosure	Designation	Item number	Weight [kg]
X1	IP21 NEMA X1	25080000	2,5
X2	IP21 NEMA X2	25080001	3,5
X3	IP21 NEMA X3	25080002	5
X4	IP21 NEMA X4	25080003	6,5
X5	IP21 NEMA X5	25080004	7
X6	IP21 NEMA X6	25080005	9
X7	IP21 NEMA X7	25080006	14
X8	IP21 NEMA X8	25080007	17

Table 41: IP21 Version 1

Version 2:

Enclosure	Designation	Item number	Weight [kg]
X1	IP21 NEMA X1	25080020	5,5
X2	IP21 NEMA X2	25080021	6,7
X3	IP21 NEMA X3	25080022	8
X4	IP21 NEMA X4	25080023	9,5
X5	IP21 NEMA X5	25080024	11
X6	IP21 NEMA X6	25080025	15,5
X7	IP21 NEMA X7	25080026	20,5
X8	IP21 NEMA X8	25080027	23,5
X8	IP21 NEMA X8-CI250	25080028	27,5

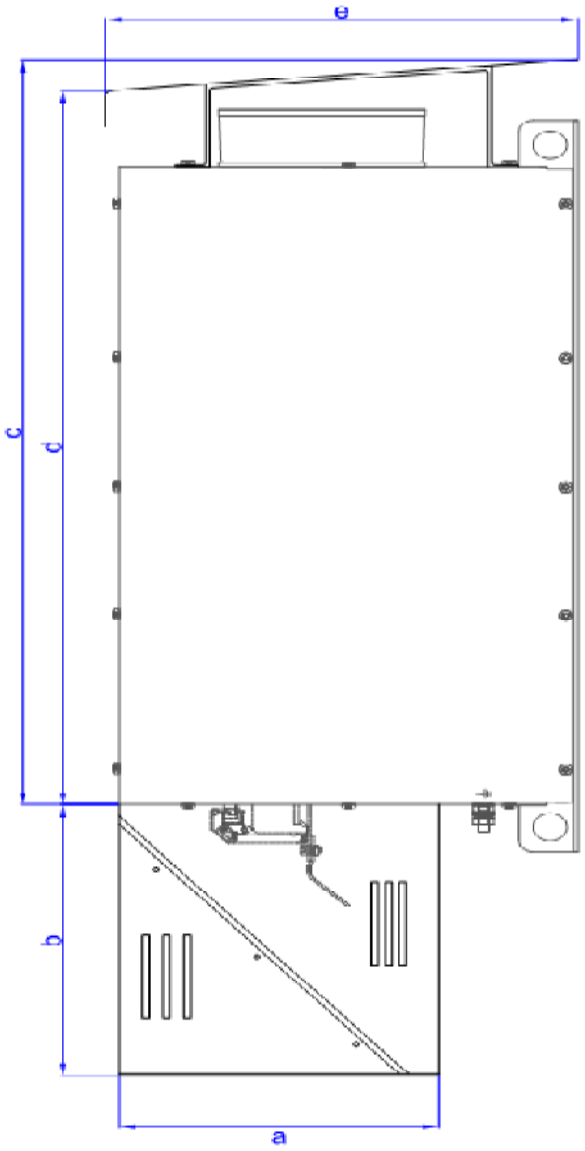
Table 42: IP21 Version 2

Options

Dimensions Nema1:

Enclosure size	Width [mm]	a [mm]	b [mm]	c [mm]	d [mm]	e [mm]
X1	190	120	160	329,5	344,5	215,5
X2	232	190	180	433,5	448,5	257,5
X3	330	145	210	543,5	558,5	252,0
X4	330	230	230	573,5	588,5	343,0
X5	370	230	250	681,5	696,5	343,0
X6	370	300	270	681,5	696,5	410,0
X7	420	300	320	796,5	811,5	458,5
X8	420	400	350	796,5	811,5	553,0

Table 43: IP21 External ventilator



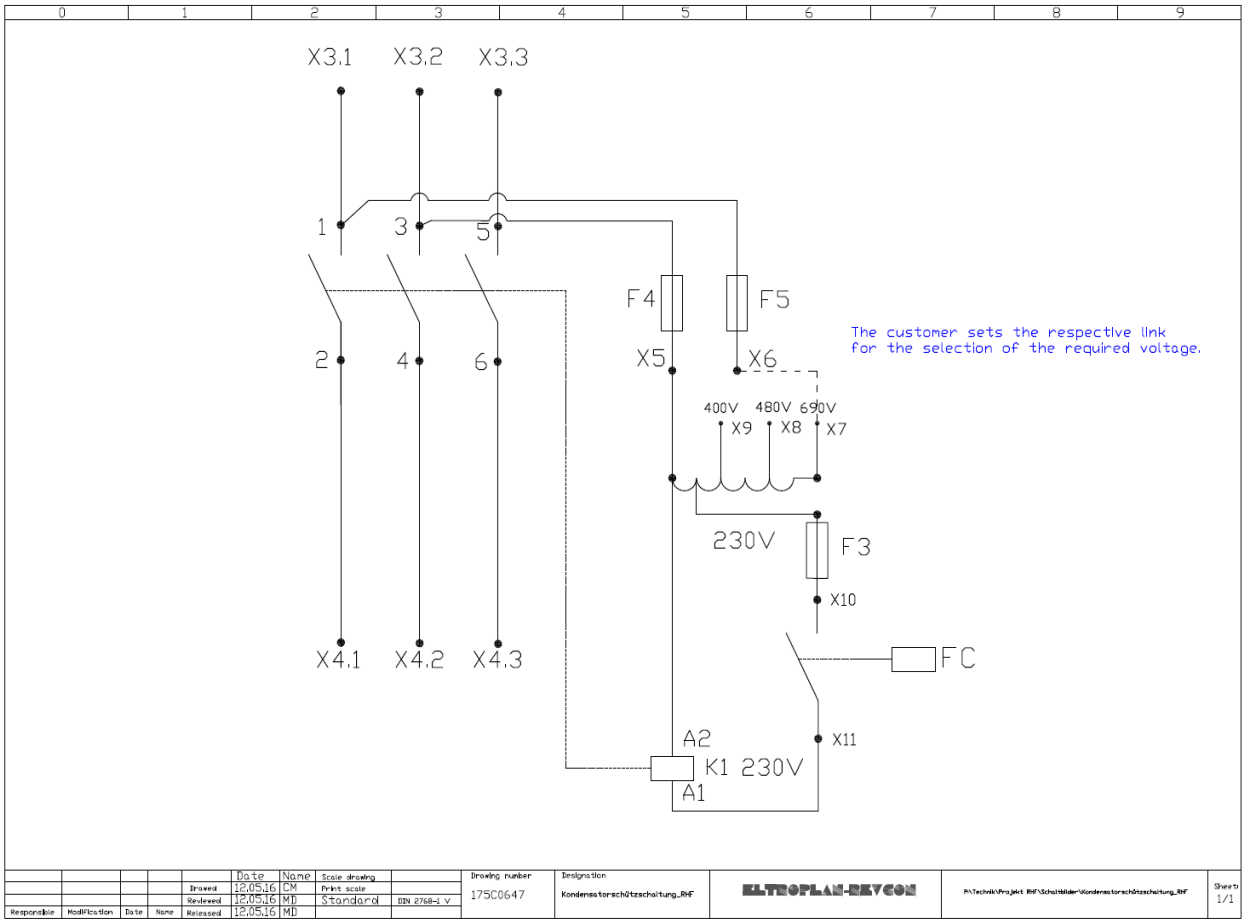


Figure 37: Capacitor-contactor connection RHF

Danger!

The contactor should be switched up to maximal 30 % of the output power!

Danger!

25 seconds must be waited before the Restart until the filter is discharged!

12 REVCON® product overview

1. REVCON® SVC

Power feedback units for short time operation

(Crane systems, discontinuous centrifugal, etc.)

2. REVCON® SVCD

Power feedback units for continuous operation

(Engine test beds, escalators, wind energy plants, elevators etc.)

3. REVCON® DCV

Power supply- and feedback unit

For multiple motor applications with dynamic alternation of loads)

4. REVCON® OSKM

Harmonics compensation module to reduce the harmonics loading

(In preparation)

5. REVCON® PFU

Power feedback units for plants for extraction of regenerative Energy (Wind- / hydraulic power plants etc.). In connection with a durable excited Generator is no drive controller necessary!

6. REVCON® HSTV

Boost-converter for the generation of an increased direct current link voltage for the torque increasing in over- synchronous range of speeds

7. REVCON® EDC

Power supply module for multiple motor applications (supply of multiple drive controller) without generator- operation

8. REVCON® SKS

Filter module for the generation of sinusoidal line currents (THD I 10-16% according to the feed back unit and the load). Can be combined with REVCON SVC, SVCD, DCV, CDCV and PFU and with the most commercial converters!

9. REVCON® RHF

Filter module for the generation of sinusoidal line currents (THD I 5-16% according to the frequency converter and the load). Filter module of the newest generation with smaller dimensions and reduced weight and better performance

All products are available for 400V line voltage, the most also for 230V, 400V, 460V, 500V, 600V and 690V! According to the product power from 4 to 440kW can be transmitted, whereby the most products are appropriate for parallel connection, so that power ratings until the megawatt range can be achieved!

< TECHNICAL CHANGES RESERVED >

ISSUE STATUS 13/09

14 Index and directory

14.1 List of figures

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14.2 List of tables