REVCON Optimizing your drive!

Product manual

RHF-5P and RHF-8P

High efficient double-stage passive harmonic filter

Power Range	4kW – 450kW
Voltage available	380V – 690V (50Hz / 60Hz)

Marine | Buildings | Oil & Gas | Water Treatment | General Industry

Version 01/2021

Contents

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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.
- These operating instructions shall ensure safe operation of and with the filter module REVCON® RHF. They contain security advices which must be observed and information which is necessary for an undisturbed operation of the units and for the exploitation of all advantages of the system.
- All persons who work on and with the filter module REVCON® RHF must have accessible the operating instructions, 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.

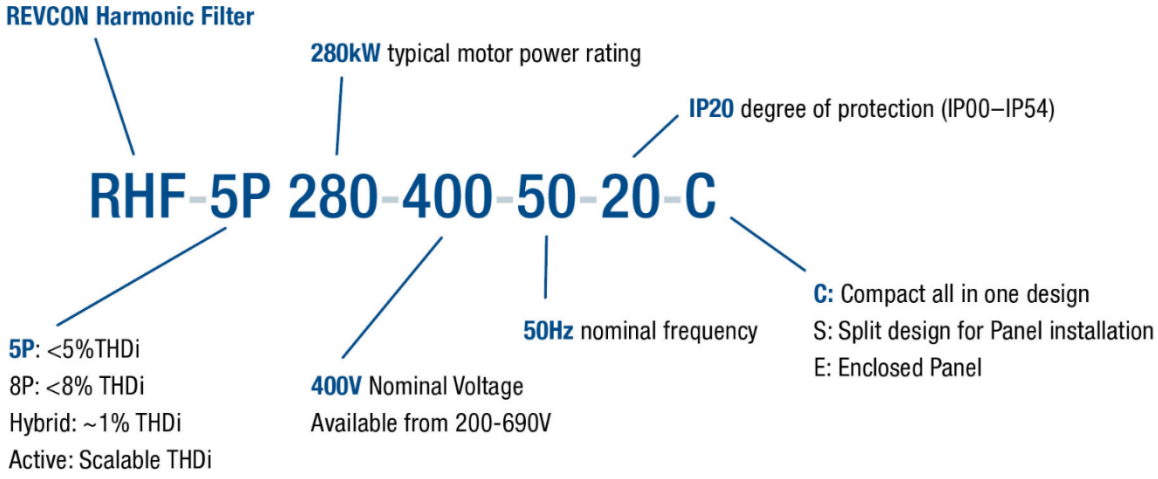
1.2 Uses terms and definitions

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-8P) 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.

1.4 Unit designation



Example: Nameplate RHF-8P 55-380-60-20-C:

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.
These safety instructions have to be kept!

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.

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 surroundings
Useful information and application notes		Information	**Note!**	Marks a generally, useful note, tip. If you follow it, you make the handling of the filter module easier

Table 1: Layout of the safety instructions

2.2 General safety guidelines

- These safety guidelines make no demand to be complete.
- In case of questions and problems please confer with a technician of our company.

- The filter module complies with the state of technology at date of delivery and is considered as reliable basically.

- The data of these operation instructions describe the characteristics of the products, without assuring them.

- The filter module may cause danger of risk for persons, the filter module itself and for other material assets, if

  non qualified staff are working on and with the filter module

  -the filter module is used improperly

- The Filter modules must be planned and commissioned so that they fulfil their intended function in a 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 represented procedural notes and circuit details in these operation instructions have to be understood analogously and have to be verified to assign ability to the current application.

- Operate the drive system only at perfect status.

- Changes to 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 installer of the plant must know the technical rules and guidelines and is responsible for the correct selection and arrangement of the electrical equipment .

- 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 is 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 .

STOP

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 non qualified staff must not work on and with the drive system .

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 wires

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

Connection:

- The connection has to be done 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 stop of the converter.

Stop!

If this connection is not made at all or at least analogously (for example via an PLC), the filter module may be damaged at constant overload operation.

Caution!

If this connection is not made at all or at least analogously (for example via na PLC) and the installation instructions (chapter 8) are not observed, this may lead to a thermal overload of the filter module and possibly to a smoke emission and/or a fire.

2.5 Remaining danger

Danger!

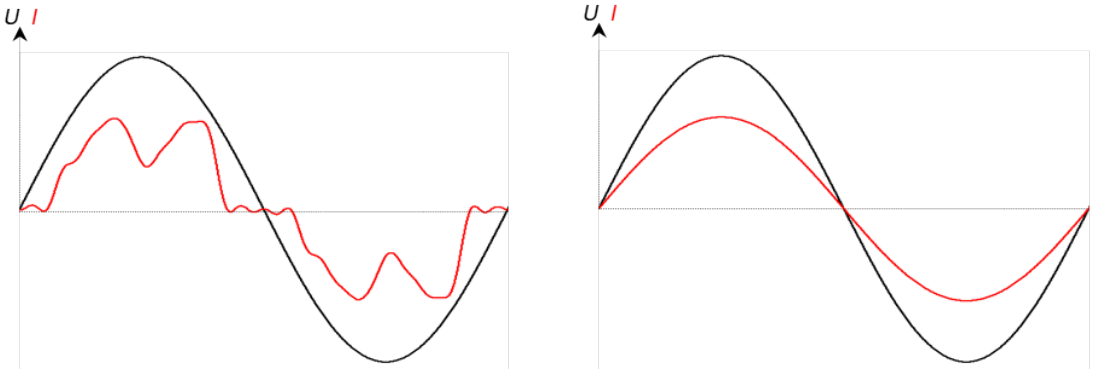
After switching off the electrical network, all connections could lead a dangerous contact voltage for up to 10 minutes!

3 Introduction into the subject harmonics

The following chapter gives you quick introduction into the topic of harmonic distortion. In order to give a more detailed picture, please visit the learning area of www.revcon.de or ask for the REVCON Harmonic Solution Guide.

3.1 Linear and non-linear loads

Ideally all loads and sources have a pure sinusoidal current waveform. But unfortunately the true waveform of most equipment is very different.
Electrical loads where the current is not proportional to the voltage are called non-linear loads. LiAnear loads are pure sinusoidal, and either resistive, inductive or capacitive. The most typical nonlinear load a 6-pulse rectifier as used with any standard Variable Frequency Drive (VFD).



The red signal in the first picture is showing the input-current-shape of a standard 6-Pulse drive with about 4% inductance and clearly, this is far away from sinus. Of course, the input-current-shape of any drive without inductance is significantly worse.

The red signal in the second picture I showing a clean input current such as achieved when using a RHF-5P

3.2 Evaluation of harmonic distortion

The ***THD*** Total Harmonic Distortion is the most used evaluation for harmonic distortion, and is defined for voltage ***THDv*** and current ***THDi,*** both typically consider the harmonics up to the 40th or 50th.

$$THDi = \frac{\sqrt{\sum_{n=2}^{n=40} I_n^2}}{I_1} \bullet 100\% = \frac{\sqrt{I_{h2}^2 + I_{h3}^2 + I_{h4}^2 + I_{h5}^2 + I_{h6}^2 + \cdots + I_{h40}^2}}{I_1} \bullet 100$$

Basically the *THD* is a good evaluation for Harmonic Distortion but it is not sufficient to give a full evaluation of the problems that may be caused by harmonics as individual limits must be taken into account.

3.3 The effect of harmonics in a power distribution system

In figure 2 a transformer is connected on the primary side to a common point of coupling PCC1 on the medium voltage supply. The transformer has an impedance Z_T und supplies a number of loads.
At a common coupling point PCCP2 all loads are connected. Each load is connected through wires that have the corresponding impedances Z_1, Z_2 und Z_3:

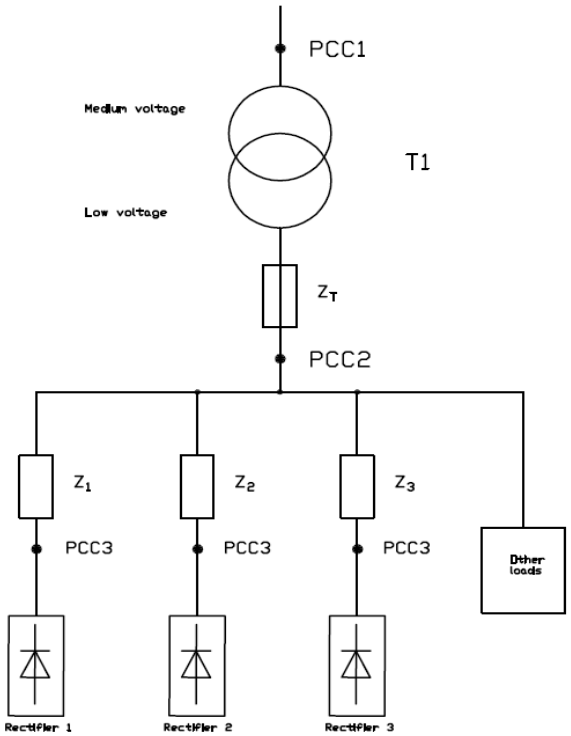


Figure 2: The effects of harmonics

Introduction

Harmonic currents drawn 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. Voltage distortion relates to system performance .It is not possible to determine the voltage distortion in the PCC knowing only the load's harmonic performance .

The configuration of the distribution system and the relevant impedances must be known to calculate the distortion in the PCC.
A commonly used term to describe the impedance of a grid is the short circuit ratio R_{sce}, 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

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

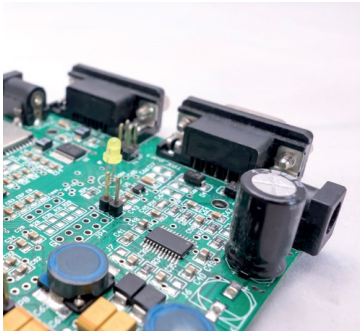
3.2 The negative effect of harmonics

Non-linear loads are causing various different problems. The most obvious one is that equipment such as VFD´s are causing harmonic currents that will increase the input current of the system. A three-phase VFD without any inductance will cause a *THDi* of about 105%, which will increase the input current *IRMS* by 43%.
Typically these harmonics have reactive characteristics, but this higher input current will require significant higher sizing of wires, protective devices and will also cause significant higher power losses in the system.

Ohm´s law teach us, $V = I \bullet Z$, which means that due to the impedance of the system, every harmonic current, will cause a distortion of the voltage. The impact of this voltage distortion *THDv* is diverse, and the most typical effect is overheat of transformer and PFC applications

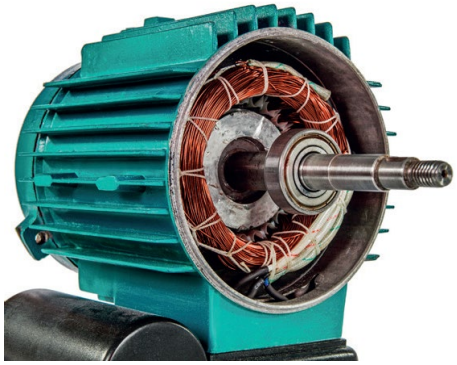
Transformers and PFC.

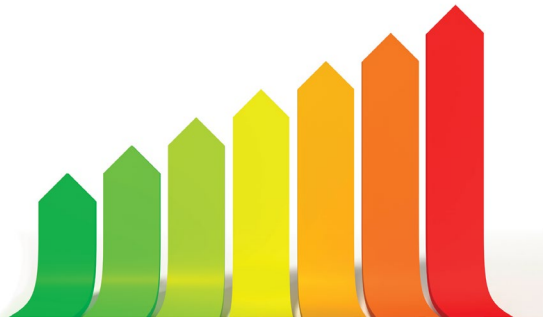
Significant increase of power loss on any inductances or capacity results in reduced rating, lower expected lifetime, lower efficiency or even damaged equipment



Electronic equipment usually have a rectifier with capacitor input, whose lifetime is significantly affected by voltage distortion. This results in immediate damage or significant reduced lifetime

Motors and Generators direct on line follow the connected frequency! Supply voltage with additional frequencies (harmonics) are lethal for both mechanical and electrical side





System Efficiency is directly affected by the harmonics as nearly all equipment and wires produce more heat when voltage distortion rises

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 limiting the 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, the transformer will, in this case, sized too small.
If the system should be retrofitted without changing the transformer, the harmonic distortion caused by two drives must be mitigated using RHF filters.

There are various harmonic mitigation 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: 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,:

Introduction

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).

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.

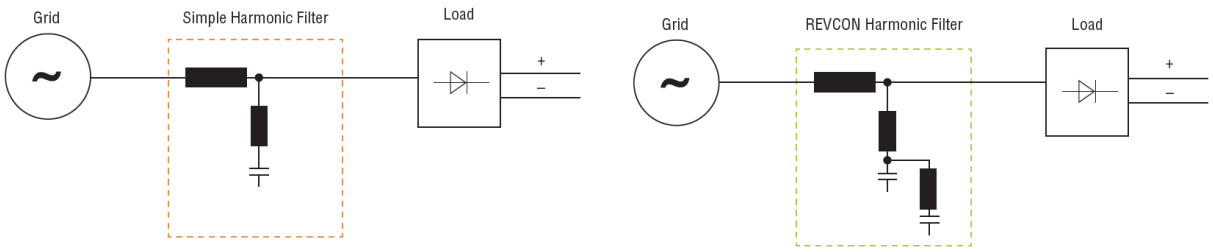
4 Introduction into the subject filter modules

4.1 Function principle REVCON RHF

The RHF-8P and RHF-5P are high efficient double-stage passive Harmonic Filter used to avoid mains distortion caused by non-linear loads such as variable frequency drives (VFDs).

The REVCON Harmonic Filter reduces the THDi of non-linear loads and sources to significantly below 5% (RHF-5P) or <8% (RHF-8P) even under realistic circumstances including imbalance and pre-distortion. This is necessary to reach various standards and recommendations, such as IEEE 519-2014. Typically, the filter reduces the THDi from 35% to ~3%, with a smooth damping across the full spectrum

Instead of using a simple drain circuit for the 5th Harmonic, both RHF-5P and 8P are using a double stage filter and specifies the performance by changing the main inductance value. The picture below verifies the internal structure of the RHF compared to a simple drain filter:



The three main advantages of this REVCON patented filter circuit are:

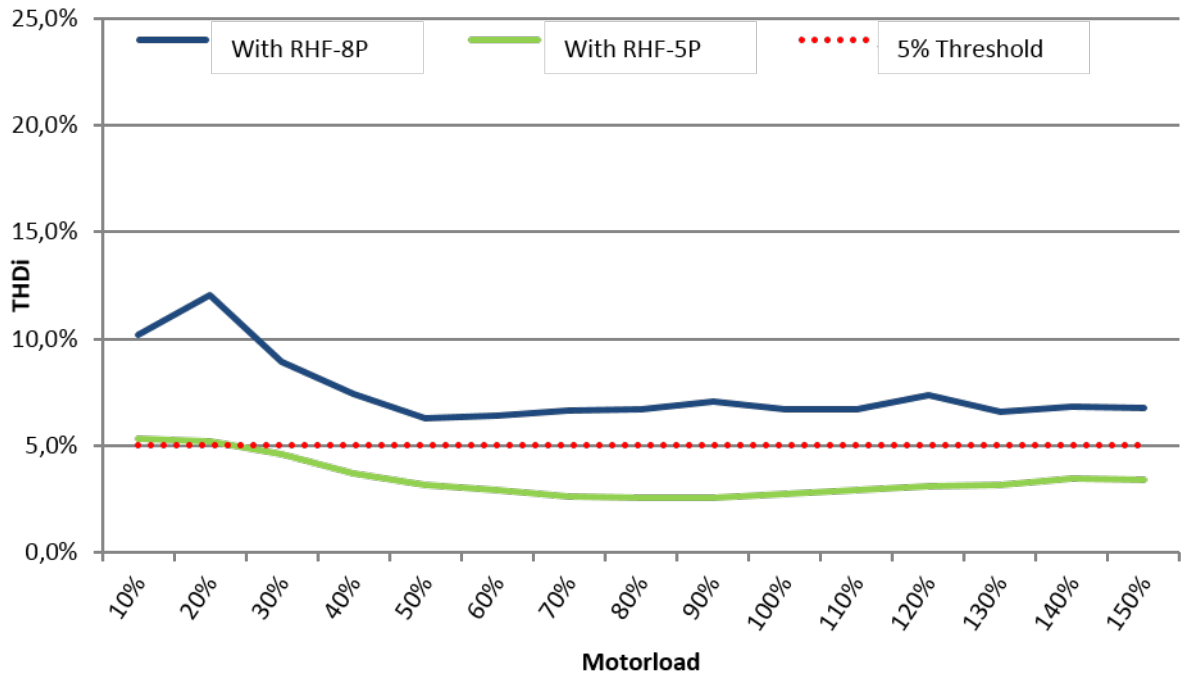
1. Performance:
   The RHF is designed to reach its stated performance in the field and not defined for unique simulated conditions. The double stage filter offers a smooth damping of all Harmonics, instead of focusing on the 5th Harmonic.

2. Full Drive Power:
   The RHF allows for 100% DC-Bus voltage at 100% drive load. This avoid further calculations and de-rating of the drive. (Drives connected to Simple Harmonic Filter may have up to 7% less power ratings)!

3. Efficiency:

Simple Harmonic Filter may add RC circuits in order to reach specified 5% THDi which leads to a significant lover efficiency. The RHF-5P double stage harmonic filter cause up to 70% less power loss than comparable <5% THDi solutions.

At partial load the THDI 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. The following table show some typical test results in part load on a standard 6-Pulse VFD.



4.2 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 chokes	Rectifier with RHF-8P and link choke	Rectifier with RHF-5P and link choke
>100 %	~40 %	<8 %	<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 4 shows the typical current waveform of a B6 bridge without RHF module:

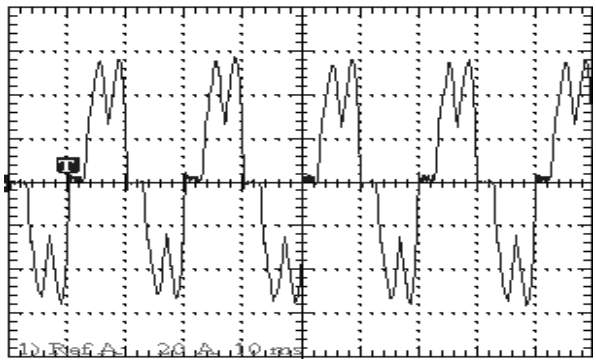


Figure 4: The Current waveform without RHF module

Figure 5 shows the typical current waveform of a B6 bridge with RHF module:

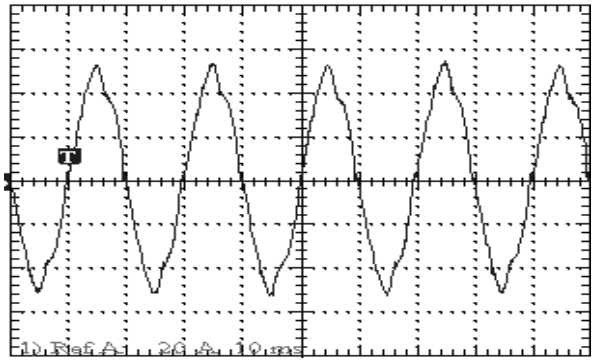


Figure 5: The Current waveform with RHF module

Figure 6 shows the Fourier analysis of the grid current by comparison:

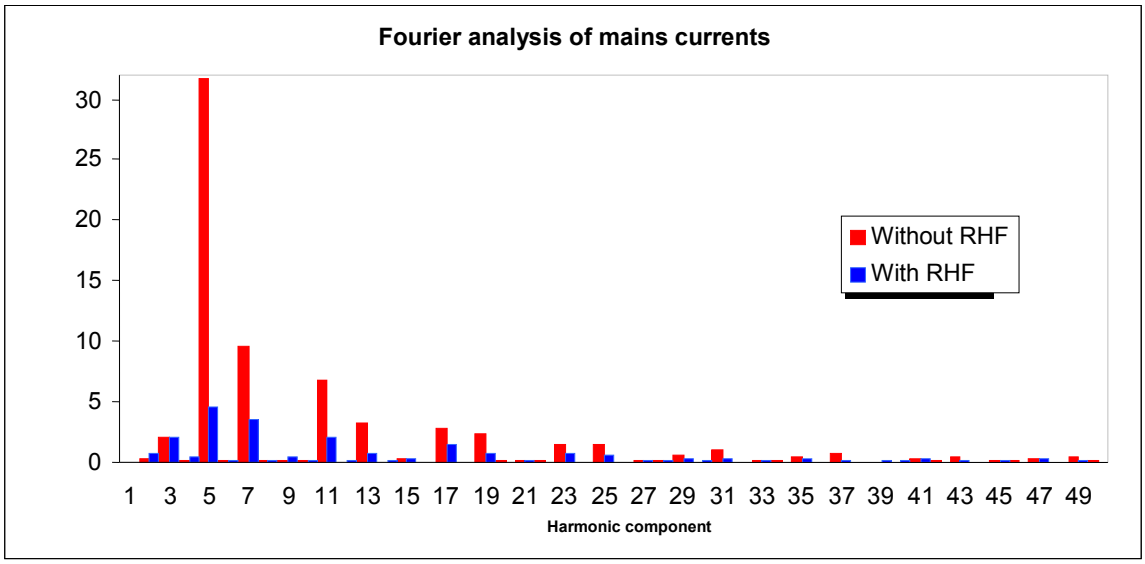


Figure 6: The Fourier analysis of the grid current

5 EU- directives / Declaration of conformity

5.1 What is the purpose of EU-directives?

The EU-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 EU-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 EU- directives will be confirmed by the mounting of a CE-marking. Within the EU there are no trade barriers for a CE-marked product.

Filter modules with CE-marking comply independently, exclusively the low voltage-standard. The filter modules are considered as inherently benign and therefore out of the scope of the EMC-standard (EMC directive 2014/30/EU).

5.3 EG-directive low voltage

Low voltage-directive (2014/35/EU)

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.

5.4 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
G5/5	RHF*
Power Conversion Equipment - UL 508C	RHF (460V, 600V)
Industrial Control Equipment - CSA-C22.2 No. 14	RHF (460V, 600V)

Table 2: Standards and permission

*further details on the G5/5 will follow soon

6 Selection of the right filter module and technical data

The RHF power range is defined based on standard IE3 Motor efficiency. Lower efficiency lead to higher input current on the RHF module. For some applications, e.g. when one filter is used for several drives, it can be required to calculate the individual input current of the RHF.

This should **not** to be confused with the classification of the frequency converter which is the output(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.

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

Do not oversize the RHF. The best harmonic performance is obtained at nominal filter load. Using an oversized filter will most likely result in worse THDI performance.

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 currents.

Stop!

If the RHF module is sized for a specified load and the motor is exchanged or modified afterwards, 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	90 kW
Efficiency of the motor	η_M	0,96
Efficiency of the frequency converter	η_{FC}	0,97
Efficiency of the RHF module	η_{RHF}	0,98

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

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

$$I_{RMS}= \frac{90\ kW}{400\ V * \sqrt{3} * 0{,}96 * 0{,}97 * 0{,}98}$$

$$I_{RMS} = 142{,}35\ A$$

In this case 150 A (90kW) must be chosen.

Note!

The true nominal current depends on the actual load; therefore it is lower than the nominal Data most often.

6.3 General Data / Operation conditions

Range	Data
Valid temperature range*	At transport of the device: -25°C...+70°C (following DIN EN 50178) At storage of the device: -25°C...+55°C (following DIN EN 50178) At operation of the device: -20°C...+45°C without power reduction 45°C...+60°C with power reduction
Stress of humidity*	Humidity class F without 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*	According to EN50178 (86kPa – 106kPa during operation)
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 3: General Data / Operation conditions

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

Figure 7 shows the Power reduction in dependence of the ambient temperature:

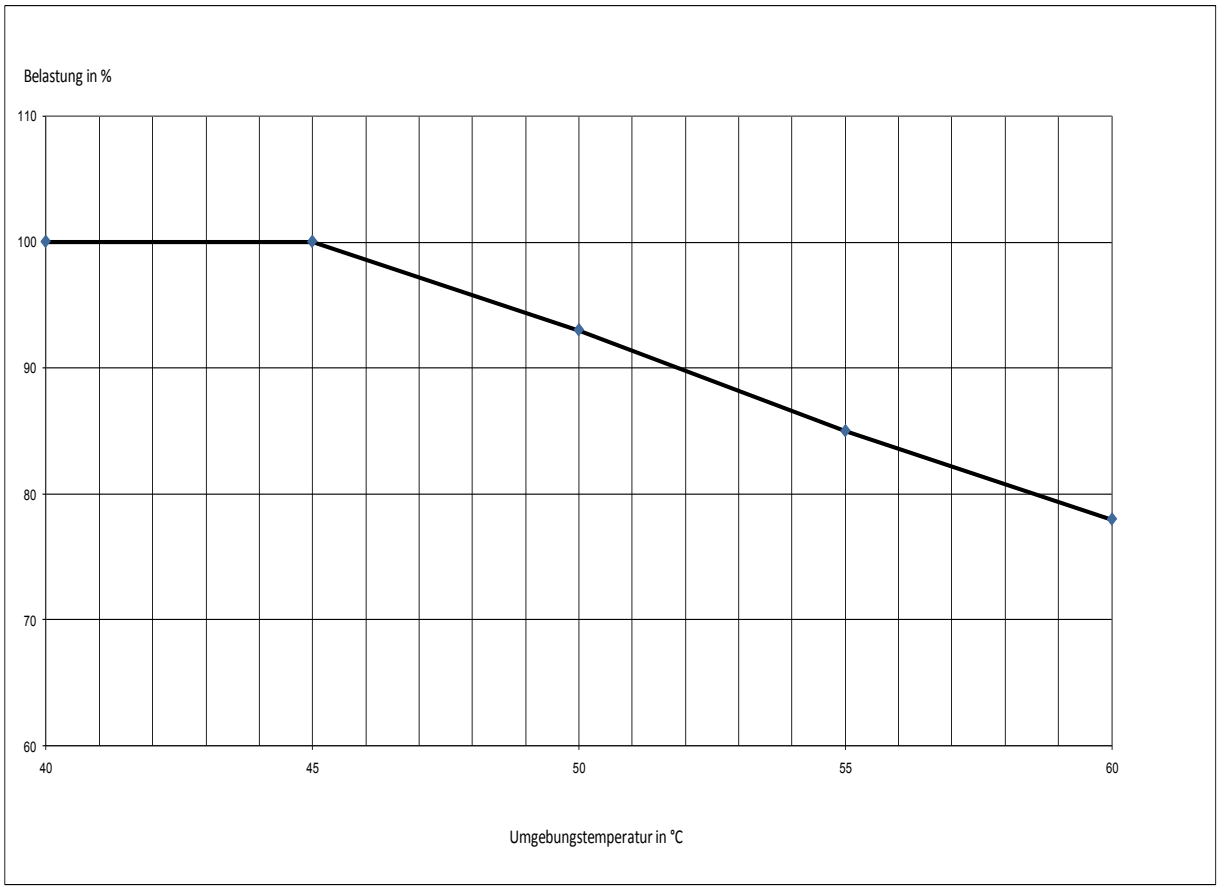


Figure 7: Power reduction in dependence of the ambient temperature

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]	$380 \leq U_N \leq 415$	$380 \leq U_N \leq 415$	$440 \leq U_N \leq 480$	500	600	690
Tolerance of the line-to-line line voltage	U_N[V]	$342 \leq U_N \leq 456$	$342 \leq U_N \leq 456$	$396 \leq U_N \leq 528$	$450 \leq U_N \leq 550$	$540 \leq U_N \leq 660$	$540 \leq U_N \leq 759$
Power frequency	f_N[Hz]	60 ± 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% / 8% **					
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 X1.3-X2.3: 200 m³ / h b) Installation size X3.3-X6.3: 350 m³ / h c) Installation size X7.3-X8.3: 700 m³ / h					
Power reduction	[%/K] [%/m]	See figure 7 1000m üNN < h ≤4000m üNN ⇒ 5%/1000m					

Table 4: Rating values

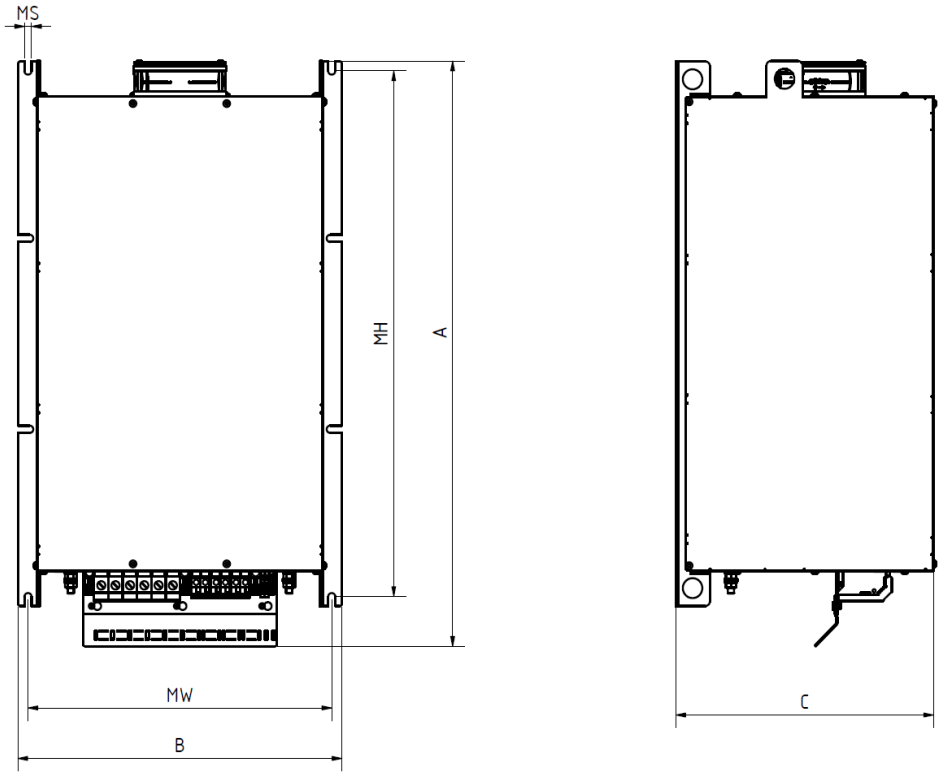
* Depended on the device type and design

** At observation of the following connecting conditions: THDv < 2%, standard conformable electrical networks

6.6 Available RHF size and current rating, weight and power loss

The indicated current values advert to the Input line current of the Filter. The following table gives a quick overview of the size.

Enclosure Size	Height A [mm]	Width B [mm]	Depth C [mm]	Height MH [mm]	Width MW [mm]	Mount MS [mm]
X0.3	285	71	265	273	50	5.5
X1.3	343	190.5	205	277.8	163	6.8
X2.3	454.5	232	247.5	382	205	6,8
X3.3	593.5	378	242	523	353	9
X4.3	621.5	378	338.5	554	353	9
X5.3	737	418	336	661	392	9
X6.3	764	418	405	661	392	9
X7.3	957	468	451	780	443	9
X8.3	957	468	513.5	780	443	9



Technical data and dimension diagrams

380V / 60Hz / 8% THDi

Revcon Filter RHF-8P	Order code	Input current [A]	max current [A]	Motor size*	Filter encl.	Weight [kg]	Power-loss [W]
RHF-8P 1.1-380-60-20-C	25001100	2.2	3.3	1.1kW	X0.3	6	33
RHF-8P 2.2-380-60-20-C	25001101	4.2	6.3	2.2kW	X0.3	9	62
RHF-8P 4.0-380-60-20-C	25001102	7.3	11	4.0kW	X1.3	14	82
RHF-8P 5.5-380-60-20-C	25001103	10	15	5.5kW	X1.3 if	14	93
RHF-8P 7.5-380-60-20-C	25001104	14	21	7.5kW	X1.3 ef	15	103
RHF-8P 11-380-60-20-C	25001105	22	33	11kW	X2.3 if	21	191
RHF-8P 15-380-60-20-C	25001106	27	41	15kW	X2.3 if	24	209
RHF-8P 18.5-380-60-20-C	25001107	32	48	18.5kW	X3.3 if	33	203
RHF-8P 22-380-60-20-C	25001108	38	57	22kW	X3.3 if	37	212
RHF-8P 30-380-60-20-C	25001109	52	78	30kW	X3.3 if	39	244
RHF-8P 37-380-60-20-C	25001110	63	95	37kW	X4.3 if	44	322
RHF-8P 45-380-60-20-C	25001111	76	114	45kW	X4.3 ef	56	354
RHF-8P 55-380-60-20-C	25001112	92	138	55kW	X5.3 ef	62	398
RHF-8P 75-380-60-20-C	25001113	125	188	75kW	X5.3 ef	74	458
RHF-8P 90-380-60-20-C	25001114	150	225	90kW	X6.3 if	85	662
RHF-8P 110-380-60-20-C	25001115	182	273	110kW	X6.3 if	102	713
RHF-8P 132-380-60-20-C	25001116	217	326	132kW	X7.3 if	119	804
RHF-8P 160-380-60-20-C	25001117	262	393	160kW	X7.3 if	136	845
RHF-8P 185-380-60-20-C	25001118	304	456	185kW	X8.3 if	142	892
RHF-8P 200-380-60-20-C	25001119	328	492	200kW	X8.3 ef	163	1115
RHF-8P 220-380-60-20-C	25001120	360	540	220kW	X8.3 ef	185	1235
RHF-8P 250-380-60-20-C	25001121	410	615	250kW	X8.3 ef	205	1266
RHF-8P 280-380-60-20-C	25001122	460	690	280kW	X8.3 ef	205	1424

380V / 60Hz / 5% THDi

Revcon Filter RHF-5P	Order code	Input current [A]	max current [A]	Motor size*	Filter encl.	Weight [kg]	Power-loss [W]
RHF-5P 1.1-380-60-20-C	25002100	2.2	3.3	1.1kW	X0.3	6	44
RHF-5P 2.2-380-60-20-C	25002101	4.2	6.3	2.2kW	X0.3	9	73
RHF-5P 4.0-380-60-20-C	25002102	7.3	11	4.0kW	X1.3 if	18	102
RHF-5P 5.5-380-60-20-C	25002103	10	15	5.5kW	X1.3 if	18	131
RHF-5P 7.5-380-60-20-C	25002104	14	21	7.5kW	X1.3 ef	19	169
RHF-5P 11-380-60-20-C	25002105	22	33	11kW	X2.3 ef	29	243
RHF-5P 15-380-60-20-C	25002106	27	41	15kW	X2.3 ef	33	283
RHF-5P 18.5-380-60-20-C	25002107	32	48	18.5kW	X3.3 if	52	305
RHF-5P 22-380-60-20-C	25002108	38	57	22kW	X3.3 if	53	366
RHF-5P 30-380-60-20-C	25002109	52	78	30kW	X3.3 if	58	452
RHF-5P 37-380-60-20-C	25002110	63	95	37kW	X4.3 if	76	542
RHF-5P 45-380-60-20-C	25002111	76	114	45kW	X4.3 ef	98	658
RHF-5P 55-380-60-20-C	25002112	92	138	55kW	X5.3 ef	104	717
RHF-5P 75-380-60-20-C	25002113	125	188	75kW	X5.3 ef	106	812
RHF-5P 90-380-60-20-C	25002114	150	225	90kW	X6.3 ef	126	932
RHF-5P 110-380-60-20-C	25002115	182	273	110kW	X6.3 ef	135	1020
RHF-5P 132-380-60-20-C	25002116	217	326	132kW	X7.3 if	172	1134
RHF-5P 160-380-60-20-C	25002117	262	393	160kW	X7.3 if	206	1228
RHF-5P 185-380-60-20-C	25002118	304	456	185kW	X8.3 if	221	1346
RHF-5P 200-380-60-20-C	25002119	328	492	200kW	X8.3 ef	230	1450
RHF-5P 220-380-60-20-C	25002120	360	540	220kW	X8.3 ef	265	1500
RHF-5P 250-380-60-20-C	25002121	410	615	250kW	X8.3 ef	272	1530
RHF-5P 280-380-60-20-C	25002122	460	690	280kW	X8.3 ef	273	1718

Technical data and dimension diagrams

400V / 50Hz / 8% THDi

Revcon Filter RHF-5P	Order code	Input current [A]	max current [A]	Motor size*	Filter encl.	Weight [kg]	Power-loss [W]
RHF-8P 1.1-400-50-20-C	25001000	2.2	3.3	1.1kW	X0.3	6	33
RHF-8P 2.2-400-50-20-C	25001001	4.2	6.3	2.2kW	X0.3	9	62
RHF-8P 4.0-400-50-20-C	25001002	7.3	11	4.0kW	X1.3 if	18	82
RHF-8P 5.5-400-50-20-C	25001003	10	15	5.5kW	X1.3 if	14	93
RHF-8P 7.5-400-50-20-C	25001004	14	21	7.5kW	X1.3 ef	15	103
RHF-8P 11-400-50-20-C	25001005	22	33	11kW	X2.3 if	21	191
RHF-8P 15-400-50-20-C	25001006	27	41	15kW	X2.3 if	24	209
RHF-8P 18.5-400-50-20-C	25001007	32	48	18.5kW	X3.3 if	33	203
RHF-8P 22-400-50-20-C	25001008	38	57	22kW	X3.3 if	37	212
RHF-8P 30-400-50-20-C	25001009	52	78	30kW	X3.3 if	39	244
RHF-8P 37-400-50-20-C	25001010	63	95	37kW	X4.3 if	44	322
RHF-8P 45-400-50-20-C	25001011	76	114	45kW	X4.3 ef	56	354
RHF-8P 55-400-50-20-C	25001012	92	138	55kW	X5.3 ef	62	398
RHF-8P 75-400-50-20-C	25001013	125	188	75kW	X5.3 ef	74	458
RHF-8P 90-400-50-20-C	25001014	150	225	90kW	X6.3 if	85	662
RHF-8P 110-400-50-20-C	25001015	182	273	110kW	X6.3 if	102	713
RHF-8P 132-400-50-20-C	25001016	217	326	132kW	X7.3 if	119	804
RHF-8P 160-400-50-20-C	25001017	262	393	160kW	X7.3 if	136	845
RHF-8P 185-400-50-20-C	25001018	304	456	185kW	X8.3 if	142	892
RHF-8P 200-400-50-20-C	25001019	328	492	200kW	X8.3 if	163	1115
RHF-8P 220-400-50-20-C	25001020	360	540	220kW	X8.3 ef	185	1235
RHF-8P 250-400-50-20-C	25001021	410	615	250kW	X8.3 ef	205	1266
RHF-8P 280-400-50-20-C	25001022	460	690	280kW	X8.3 ef	205	1424

400V / 50Hz / 5% THDi

Revcon Filter RHF-5P	Order code	Input current [A]	max current [A]	Motor size*	Filter encl.	Weight [kg]	Power-loss [W]
RHF-5P 1.1-400-50-20-C	25002000	2.2	3.3	1.1kW	X0.3	6	44
RHF-5P 2.2-400-50-20-C	25002001	4.2	6.3	2.2kW	X0.3	9	73
RHF-5P 4.0-400-50-20-C	25002002	7.3	11	4.0kW	X1.3 if	18	102
RHF-5P 5.5-400-50-20-C	25002003	10	15	5.5kW	X1.3 if	18	131
RHF-5P 7.5-400-50-20-C	25002004	14	21	7.5kW	X1.3 ef	19	169
RHF-5P 11-400-50-20-C	25002005	22	33	11kW	X2.3 ef	29	243
RHF-5P 15-400-50-20-C	25002006	27	41	15kW	X2.3 ef	33	283
RHF-5P 18.5-400-50-20-C	25002007	32	48	18.5kW	X3.3 if	52	305
RHF-5P 22-400-50-20-C	25002008	38	57	22kW	X3.3 if	53	366
RHF-5P 30-400-50-20-C	25002009	52	78	30kW	X3.3 if	58	452
RHF-5P 37-400-50-20-C	25002010	63	95	37kW	X4.3 if	76	542
RHF-5P 45-400-50-20-C	25002011	76	114	45kW	X4.3 ef	98	658
RHF-5P 55-400-50-20-C	25002012	92	138	55kW	X5.3 ef	104	717
RHF-5P 75-400-50-20-C	25002013	125	188	75kW	X5.3 ef	106	812
RHF-5P 90-400-50-20-C	25002014	150	225	90kW	X6.3 ef	126	932
RHF-5P 110-400-50-20-C	25002015	182	273	110kW	X6.3 ef	135	1020
RHF-5P 132-400-50-20-C	25002016	217	326	132kW	X7.3 if	172	1134
RHF-5P 160-400-50-20-C	25002017	262	393	160kW	X7.3 if	206	1228
RHF-5P 185-400-50-20-C	25002018	304	456	185kW	X8.3 if	221	1346
RHF-5P 200-400-50-20-C	25002019	328	492	200kW	X8.3 ef	230	1450
RHF-5P 220-400-50-20-C	25002020	360	540	220kW	X8.3 ef	265	1500
RHF-5P 250-400-50-20-C	25002021	410	615	250kW	X8.3 ef	272	1530
RHF-5P 280-400-50-20-C	25002022	460	690	280kW	X8.3 ef	273	1718

Technical data and dimension diagrams

460V / 60Hz / 8% THDi

Revcon Filter RHF-8P	Order code	Input current [A]	max current [A]	Motor size*	Filter encl.	Weight [kg]	Power-loss [W]
RHF-8P 5.5-460-60-20-C	25001053	10,0	15,0	5.5kW	X1.3 if	14	93
RHF-8P 7.5-460-60-20-C	25001054	14,0	21,0	7.5kW	X1.3 ef	15	103
RHF-8P 11-460-60-20-C	25001055	19,0	28,5	11kW	X2.3 if	21	191
RHF-8P 15-460-60-20-C	25001056	25,0	37,5	15kW	X2.3 if	24	209
RHF-8P 18.5-460-60-20-C	25001057	31,0	46,5	18.5kW	X3.3 if	33	203
RHF-8P 22-460-60-20-C	25001058	36,0	54,0	22kW	X3.3 if	37	212
RHF-8P 30-460-60-20-C	25001059	48,0	72,0	30kW	X3.3 if	39	244
RHF-8P 37-460-60-20-C	25001060	55,0	82,5	37kW	X4.3 if	44	295
RHF-8P 45-460-60-20-C	25001061	66,0	99,0	45kW	X4.3 ef	56	311
RHF-8P 55-460-60-20-C	25001062	77,0	115,5	55kW	X5.3 ef	62	323
RHF-8P 75-460-60-20-C	25001063	105,0	157,5	75kW	X5.3 ef	74	408
RHF-8P 90-460-60-20-C	25001064	125,0	187,5	90kW	X6.3 if	85	537
RHF-8P 110-460-60-20-C	25001065	150,0	225,0	110kW	X6.3 if	85	543
RHF-8P 132-460-60-20-C	25001066	180,0	270,0	132kW	X6.3 if	102	556
RHF-8P 160-460-60-20-C	25001067	217,0	325,5	160kW	X7.3 if	119	755
RHF-8P 185-460-60-20-C	25001068	252,0	378,0	185kW	X7.3 if	142	732
RHF-8P 200-460-60-20-C	25001069	280,0	420,0	200kW	X7.3 if	142	813
RHF-8P 220-460-60-20-C	25001070	300,0	450,0	220kW	X7.3 ef	163	942
RHF-8P 250-460-60-20-C	25001071	340,0	510,0	250kW	X7.3 ef	163	1068
RHF-8P 280-460-60-20-C	25001072	380,0	570,0	280kW	X7.3 ef	172	1115
RHF-8P 315-460-60-20-C	25001073	436,0	654,0	315kW	X8.3 ef	205	1482

460V / 60Hz / 5% THDi

Revcon Filter RHF-5P	Order code	Input current [A]	max current [A]	Motor size*	Filter encl.	Weight [kg]	Power-loss [W]
RHF-5P 5.5-460-60-20-C	25002053	10,0	15,0	5.5kW	X1.3 if	14	131
RHF-5P 7.5-460-60-20-C	25002054	14,0	21,0	7.5kW	X1.3 ef	15	169
RHF-5P 11-460-60-20-C	25002055	19,0	28,5	11kW	X2.3 ef	21	243
RHF-5P 15-460-60-20-C	25002056	25,0	37,5	15kW	X2.3 ef	24	283
RHF-5P 18.5-460-60-20-C	25002057	31,0	46,5	18.5kW	X3.3 if	33	305
RHF-5P 22-460-60-20-C	25002058	36,0	54,0	22kW	X3.3 if	37	366
RHF-5P 30-460-60-20-C	25002059	48,0	72,0	30kW	X3.3 if	39	452
RHF-5P 37-460-60-20-C	25002060	55,0	82,5	37kW	X4.3 if	44	497
RHF-5P 45-460-60-20-C	25002061	66,0	99,0	45kW	X4.3 ef	56	595
RHF-5P 55-460-60-20-C	25002062	77,0	115,5	55kW	X5.3 ef	62	581
RHF-5P 75-460-60-20-C	25002063	105,0	157,5	75kW	X5.3 ef	74	723
RHF-5P 90-460-60-20-C	25002064	125,0	187,5	90kW	X6.3 ef	85	756
RHF-5P 110-460-60-20-C	25002065	150,0	225,0	110kW	X6.3 ef	85	764
RHF-5P 132-460-60-20-C	25002066	180,0	270,0	132kW	X6.3 ef	102	795
RHF-5P 160-460-60-20-C	25002067	217,0	325,5	160kW	X7.3 if	119	1065
RHF-5P 185-460-60-20-C	25002068	252,0	378,0	185kW	X8.3 if	142	1063
RHF-5P 200-460-60-20-C	25002069	280,0	420,0	200kW	X8.3 if	142	1182
RHF-5P 220-460-60-20-C	25002070	300,0	450,0	220kW	X8.3 ef	163	1225
RHF-5P 250-460-60-20-C	25002071	340,0	510,0	250kW	X8.3 ef	163	1389
RHF-5P 280-460-60-20-C	25002072	380,0	570,0	280kW	X8.3 ef	172	1450
RHF-5P 315-460-60-20-C	25002073	436,0	654,0	315kW	X8.3 ef	205	1792

Technical data and dimension diagrams

600V / 60Hz / 5% THDi

Revcon Filter RHF-5P	Order code	Input current [A]	max current [A]	Motor size*	Filter encl.	Weight [kg]	Power-loss [W]
RHF-5P 11-600-60-20-C	25002205	15	23	11kW	X3.3 if	42	268
RHF-5P 15-600-60-20-C	25002206	18	27	15kW	X3.3 if	50	280
RHF-5P 18.5-600-60-20-C	25002207	20	30	18.5kW	X3.3 if	50	305
RHF-5P 22-600-60-20-C	25002208	24	36	22kW	X3.3 ef	52	366
RHF-5P 30-600-60-20-C	25002209	36	54	30kW	X4.3 ef	82	544
RHF-5P 37-600-60-20-C	25002210	40	60	37kW	X5.3 ef	96	600
RHF-5P 45-600-60-20-C	25002211	50	75	45kW	X5.3 ef	96	658
RHF-5P 55-600-60-20-C	25002212	58	87	55kW	X5.3 ef	104	717
RHF-5P 75-600-60-20-C	25002213	77	116	75kW	X6.3 ef	130	812
RHF-5P 90-600-60-20-C	25002214	109	164	90kW	X6.3 ef	168	1050
RHF-5P 110-600-60-20-C	25002215	128	192	110kW	X6.3 ef	197	1164
RHF-5P 132-600-60-20-C	25002216	155	233	132kW	X7.3 ef	220	1228
RHF-5P 160-600-60-20-C	25002217	170	255	160kW	X7.3 ef	228	1280
RHF-5P 185-600-60-20-C	25002218	197	296	185kW	X7.3 ef	228	1346
RHF-5P 200-600-60-20-C	25002219	210	315	200kW	X8.3 ef	261	1400
RHF-5P 220-600-60-20-C	25002220	240	360	220kW	X8.3 ef	261	1450
RHF-5P 250-600-60-20-C	25002221	260	390	250kW	X8.3 ef	297	1650
RHF-5P 280-600-60-20-C	25002222	296	444	280kW	X8.3 ef	297	1792

600V / 60Hz / 8% THDi

Revcon Filter RHF-5P	Order code	Input current [A]	max current [A]	Motor size*	Filter encl.	Weight [kg]	Power-loss [W]
RHF-8P 11-600-60-20-C	25001205	15	23	11kW	X3.3 if	25	194
RHF-8P 15-600-60-20-C	25001206	18	27	15kW	X3.3 if	36	198
RHF-8P 18.5-600-60-20-C	25001207	20	30	18.5kW	X3.3 if	36	203
RHF-8P 22-600-60-20-C	25001208	24	36	22kW	X3.3 ef	40	212
RHF-8P 30-600-60-20-C	25001209	36	54	30kW	X4.3 ef	52	322
RHF-8P 37-600-60-20-C	25001210	40	60	37kW	X5.3 ef	56	328
RHF-8P 45-600-60-20-C	25001211	50	75	45kW	X5.3 ef	56	344
RHF-8P 55-600-60-20-C	25001212	58	87	55kW	X5.3 ef	62	398
RHF-8P 75-600-60-20-C	25001213	77	116	75kW	X6.3 ef	74	458
RHF-8P 90-600-60-20-C	25001214	109	164	90kW	X6.3 ef	105	713
RHF-8P 110-600-60-20-C	25001215	128	192	110kW	X6.3 ef	123	834
RHF-8P 132-600-60-20-C	25001216	155	233	132kW	X7.3 ef	136	845
RHF-8P 160-600-60-20-C	25001217	170	255	160kW	X7.3 ef	142	860
RHF-8P 185-600-60-20-C	25001218	197	296	185kW	X7.3 ef	142	892
RHF-8P 200-600-60-20-C	25001219	210	315	200kW	X8.3 ef	163	975
RHF-8P 220-600-60-20-C	25001220	240	360	220kW	X8.3 ef	163	1115
RHF-8P 250-600-60-20-C	25001221	260	390	250kW	X8.3 ef	205	1175
RHF-8P 280-600-60-20-C	25001222	296	444	280kW	X8.3 ef	205	1228
RHF-8P 315-600-60-20-C	25001223	366	549	315kW	X8.3 ef	228	1482
RHF-8P 355-600-60-20-C	25001224	394	591	355kW	X8.3 ef	261	1792

Technical data and dimension diagrams

690V / 50Hz / 5% THDi

Revcon Filter RHF-5P	Order code	Input current [A]	max current [A]	Motor size*	Filter encl.	Weight [kg]	Power-loss [W]
RHF-5P 15-690-50-20-C	25002156	15	23	15kW	X3.3 if	42	268
RHF-5P 18.5-690-50-20-C	25002157	19	29	18.5kW	X3.3 if	50	305
RHF-5P 22-690-50-20-C	25002158	24	36	22kW	X3.3 ef	50	366
RHF-5P 30-690-50-20-C	25002159	29	44	30kW	X4.3 ef	52	452
RHF-5P 37-690-50-20-C	25002160	35	53	37kW	X4.3 ef	82	544
RHF-5P 45-690-50-20-C	25002161	46	69	45kW	X5.3 ef	96	658
RHF-5P 55-690-50-20-C	25002162	58	87	55kW	X5.3 ef	96	717
RHF-5P 75-690-50-20-C	25002163	70	105	75kW	X6.3 ef	104	812
RHF-5P 90-690-50-20-C	25002164	84	126	90kW	X6.3 ef	130	932
RHF-5P 110-690-50-20-C	25002165	101	152	110kW	X6.3 ef	168	1050
RHF-5P 132-690-50-20-C	25002166	128	192	132kW	X6.3 ef	197	1164
RHF-5P 160-690-50-20-C	25002167	146	219	160kW	X7.3 ef	220	1228
RHF-5P 185-690-50-20-C	25002168	168	252	185kW	X7.3 ef	228	1300
RHF-5P 200-690-50-20-C	25002169	180	270	200kW	X7.3 ef	228	1322
RHF-5P 220-690-50-20-C	25002170	198	297	220kW	X7.3 ef	261	1346
RHF-5P 250-690-50-20-C	25002171	240	360	250kW	X8.3 ef	261	1450
RHF-5P 280-690-50-20-C	25002172	260	390	280kW	X8.3 ef	297	1620
RHF-5P 315-690-50-20-C	25002173	290	435	315kW	X8.3 ef	297	1792

690V / 50Hz / 8% THDi

Revcon Filter RHF-5P	Order code	Input current [A]	max current [A]	Motor size*	Filter encl.	Weight [kg]	Power-loss [W]
RHF-8P 15-690-50-20-C	25001156	15	23	15kW	X3.3 if	25	194
RHF-8P 18.5-690-50-20-C	25001157	19	29	18.5kW	X3.3 if	36	203
RHF-8P 22-690-50-20-C	25001158	24	36	22kW	X3.3 ef	40	212
RHF-8P 30-690-50-20-C	25001159	29	44	30kW	X4.3 ef	42	244
RHF-8P 37-690-50-20-C	25001160	35	53	37kW	X4.3 ef	52	322
RHF-8P 45-690-50-20-C	25001161	46	69	45kW	X5.3 ef	56	344
RHF-8P 55-690-50-20-C	25001162	58	87	55kW	X5.3 ef	62	398
RHF-8P 75-690-50-20-C	25001163	70	105	75kW	X6.3 ef	74	458
RHF-8P 90-690-50-20-C	25001164	84	126	90kW	X6.3 ef	85	662
RHF-8P 110-690-50-20-C	25001165	101	152	110kW	X6.3 ef	105	713
RHF-8P 132-690-50-20-C	25001166	128	192	132kW	X6.3 ef	123	834
RHF-8P 160-690-50-20-C	25001167	146	219	160kW	X7.3 ef	136	845
RHF-8P 185-690-50-20-C	25001168	168	252	185kW	X7.3 ef	142	870
RHF-8P 200-690-50-20-C	25001169	180	270	200kW	X7.3 ef	142	880
RHF-8P 220-690-50-20-C	25001170	198	297	220kW	X7.3 ef	142	892
RHF-8P 250-690-50-20-C	25001171	240	360	250kW	X7.3 ef	163	1115
RHF-8P 280-690-50-20-C	25001172	260	390	280kW	X8.3 ef	205	1180
RHF-8P 315-690-50-20-C	25001173	290	435	315kW	X8.3 ef	205	1370
RHF-8P 355-690-50-20-C	25001174	320	480	355kW	X8.3 ef	228	1482
RHF-8P 400-690-50-20-C	25001175	362	543	400kW	X8.3 ef	228	1482
RHF-8P 450-690-50-20-C	25001176	405	608	450kW	X8.3 ef	261	1792

6.7 Cable cross section

When wiring 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 fact today therr are still many compensation plants without chokes used although the actual guidelines are in conflict with this fact.. The problems, which can occur in connection with a compensation plant without chokes, are manifold:

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

Rising of resonances is not determined whether an operation itself causes harmonic distortions. Decisive for the risk to encounter a resonance is the compensation power at the transformer. The risk of a resonance will rise together with the compensation power and is influenced by the harmonic load of the medium voltage level, which is transmitted by the transformer and effects the low-voltage level.
Limit exceeding, caused by resonance lifting, may particularly bedetected especially for the 5th harmonic.

6.9 Connections

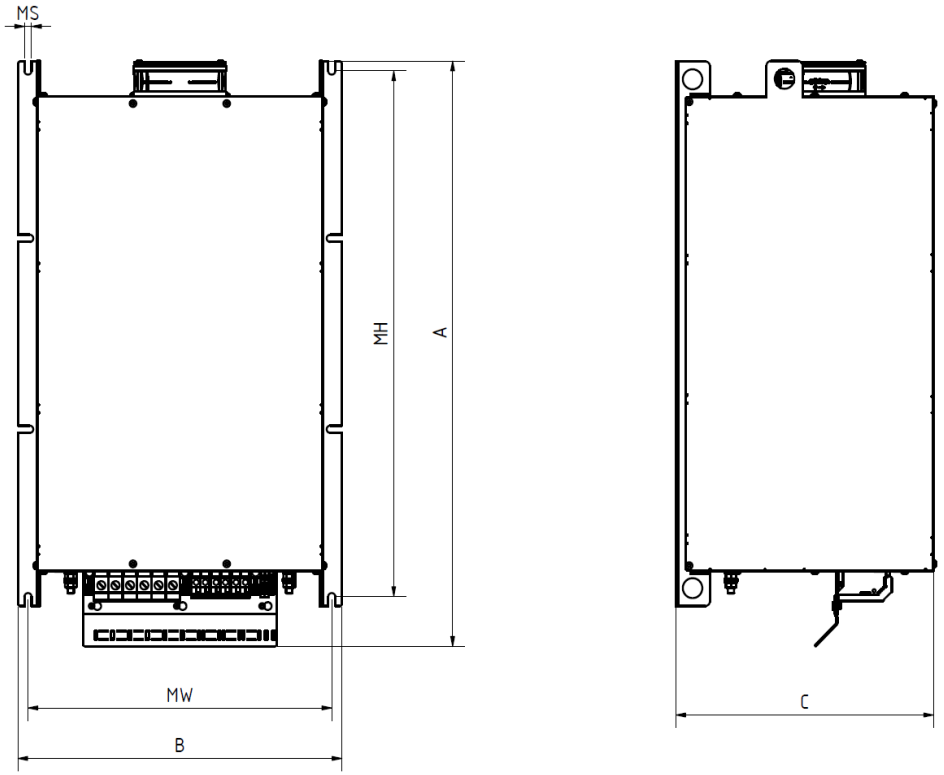
enclosure	terminals X1 and X2 (main connection)			terminals X3 and X4 (capacitor disconnect)		
Type	Cable cross selections [mm² (AWG/MCM)]	Termination	Torque [Nm (in-lb)]	cable cross selections [mm² (AWG/MCM)]	Termination	Torque [Nm (in-lb)]
X1.3	0,5-10 (20-8)	Cable end sleeve	1,6 (14.2) +/- 10%	0,5-4 (20-12)	Cable end sleeve	0,8 (7.1) +/- 10%
X2.3	1,5-16 (16-6)		2,4 (21.2) +/- 10%	0,5-4 (20-12)		0,8 (7.1) +/- 10%
X3.3	1,5-25 (16-4)		3,5 (31) +/- 10%	1,5-16 (16-6)		2,4 (21.2) +/- 10%
X4.3	1,5-50 (16-1-1/0)		4 (35.4) +/- 10%	1,5-25 (16-4)		3,5 (31) +/- 10%
X5.3	10-70 (8-2/0)		5 (44.3) +/- 10%	1,5-25 (16-4)		3,5 (31) +/- 10%
X6.3	2,5-95 (14-3/0)	Cable lug M8	10 (88.5) +/- 10%	1,5-50 (16-1-1/0)		4 (35.4) +/- 10%
X7.3	25-300 (4-600)	Cable lug M16	50 (442.5) +/- 10%	16-150 (6-300)		18 (159.3) +/- 10%
X8.3	25-300 (4-600)	Cable lug M16	50 (442.5) +/- 10%	16-150 (6-300)		18 (159.3) +/- 10%

enclosure	terminals a and b (temperature supervision)			PE	
Type	cable cross selections [mm² (AWG/MCM)]	Termination	Torque [Nm (in-lb)]	Type	Torque [Nm (in-lb)]
X1.3	0,5-4 (20-12)	Cable end sleeve	0,8 (7.1) +/- 10%	M6	4,5 (40) +/- 10%
X2.3				M6	4,5 (40) +/- 10%
X3.3				M8	10 (88.5) +/- 10%
X4.3				M8	10 (88.5) +/- 10%
X5.3				M8	10 (88.5) +/- 10%
X6.3				M8	10 (88.5) +/- 10%
X7.3				M12	40 (354) +/- 10%
X8.3				M12	40 (354) +/- 10%

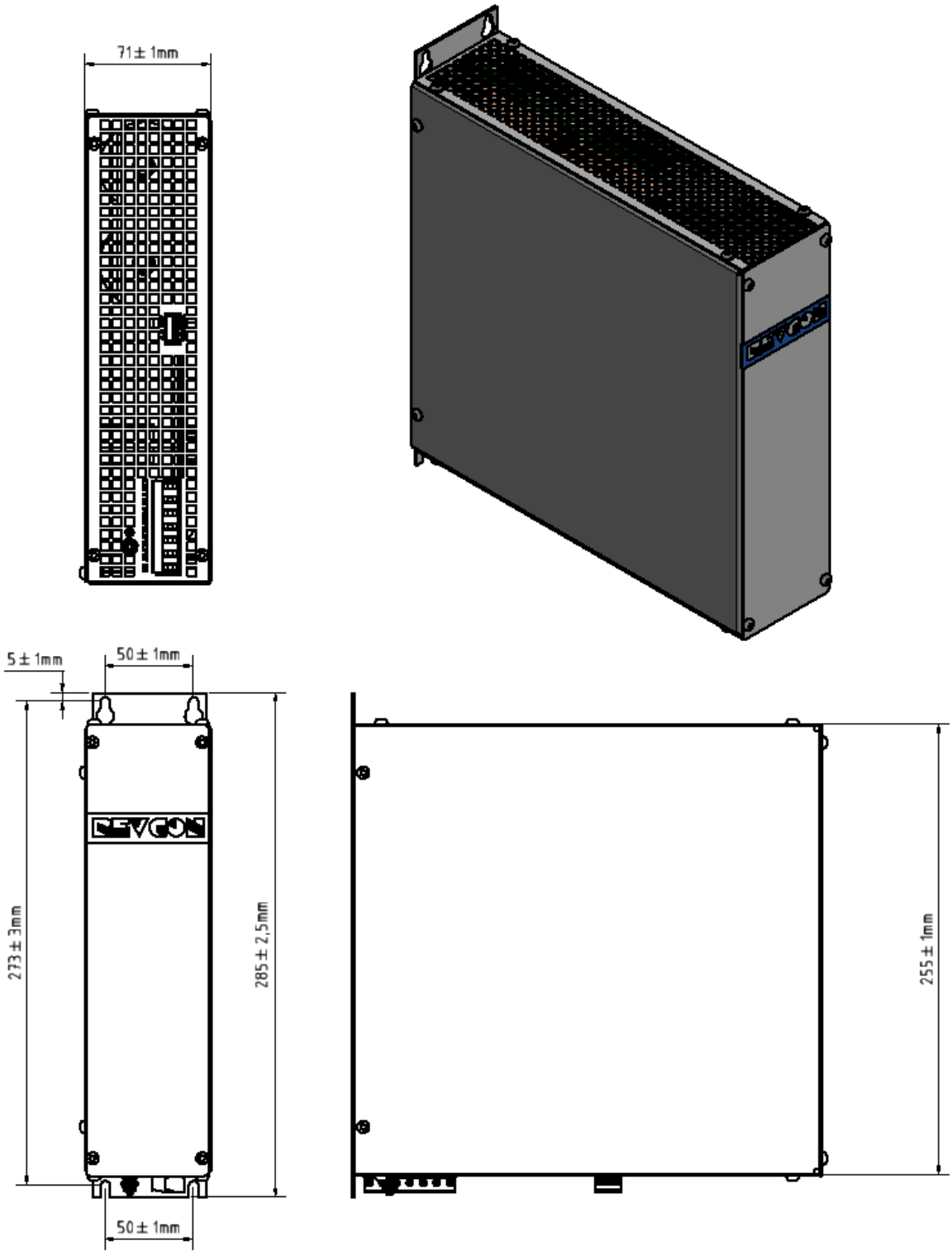
6.11 Dimension diagrams

The following table gives a quick overview of the RHF size. The following pages show more detailed drawings.

Enclosure Size	Height A [mm]	Width B [mm]	Depth C [mm]	Height MH [mm]	Width MW [mm]	Mount MS [mm]
X0.3	285	71	265	273	50	5.5
X1.3 if/ef	343	190.5	205	277.8	163	6.8
X2.3 if/ef	454.5	232	247.5	382	205	6,8
X3.3 if/ef	593.5	378	242	523	353	9
X4.3 if/ef	621.5	378	338.5	554	353	9
X5.3 if/ef	737	418	336	661	392	9
X6.3 if/ef	764	418	405	661	392	9
X7.3 if/ef	957	468	451	780	443	9
X8.3 if/ef	957	468	513.5	780	443	9

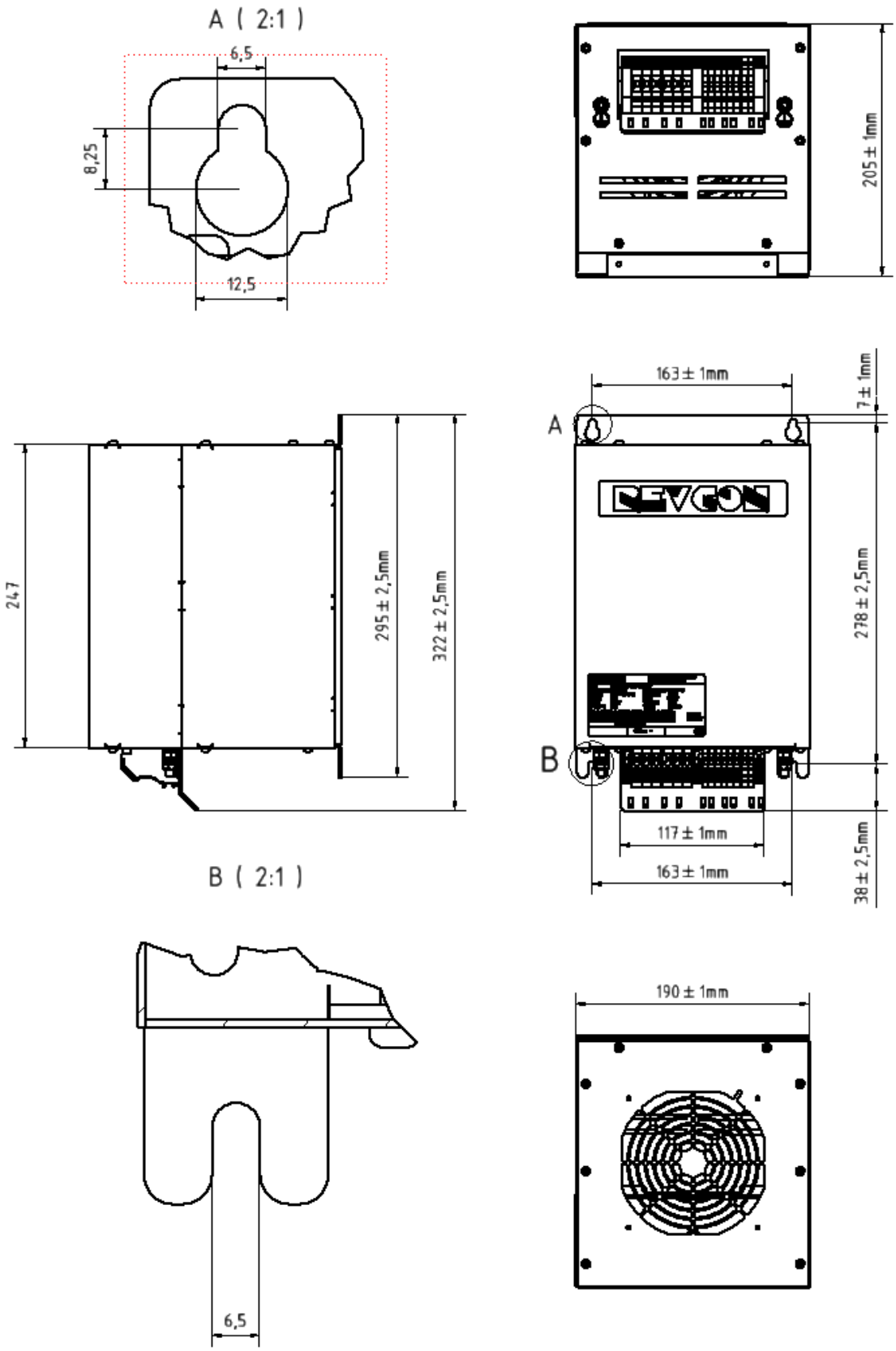


Enclosure X0.3 IP20

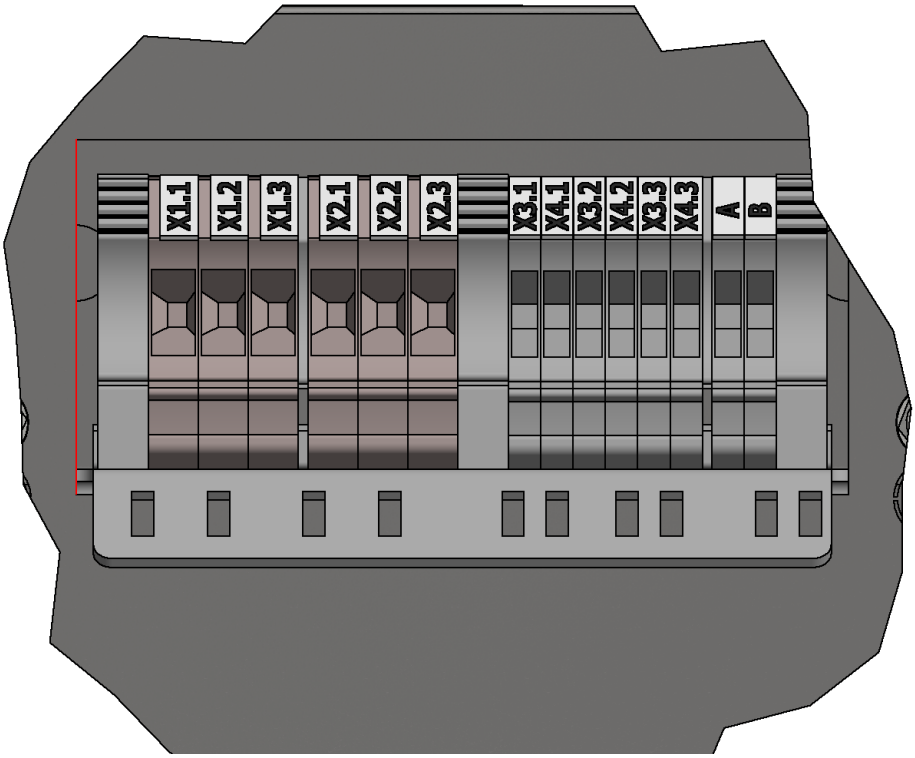


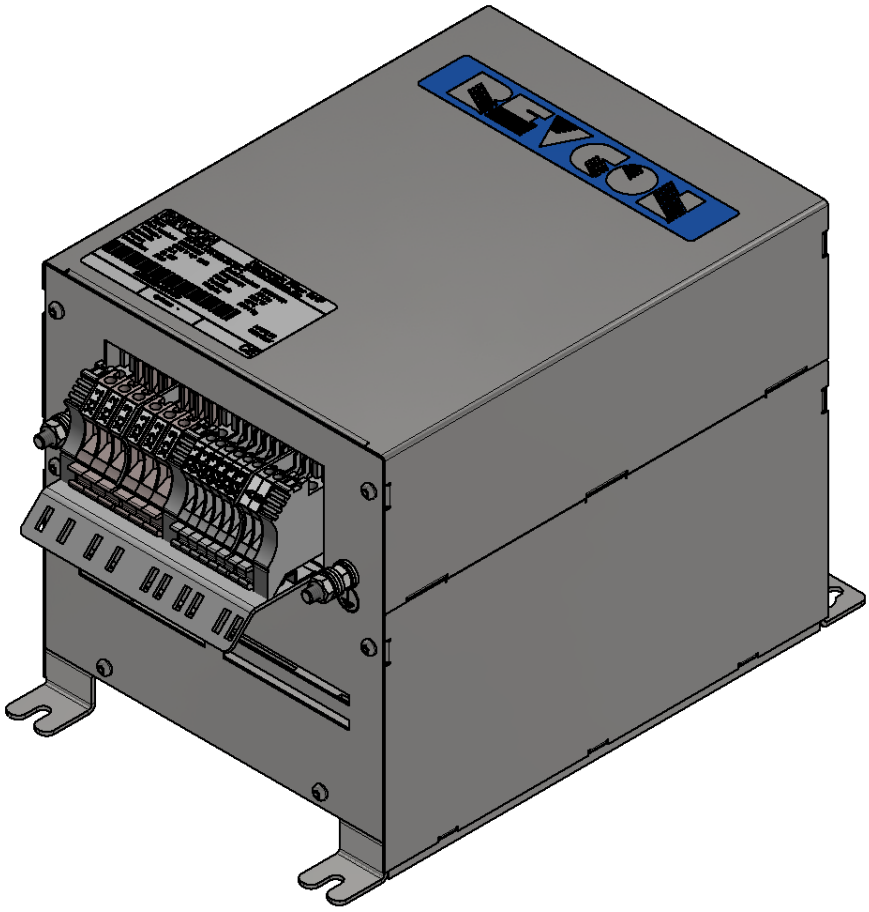
RHF Enclosure X0.3

Enclosure X1.3 if IP20 (fan placed on inside or not required)



RHF Enclosure X1.3 if

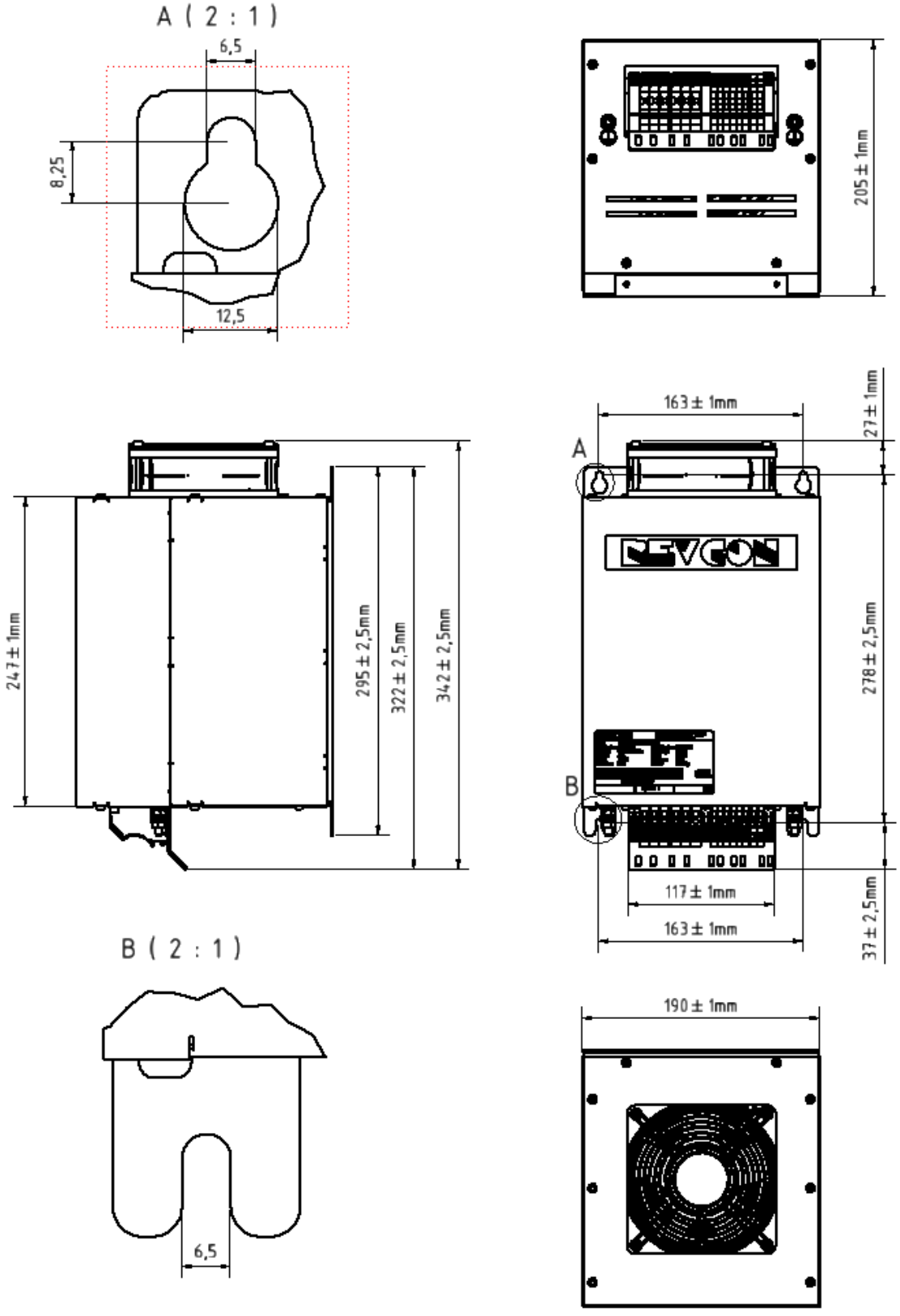




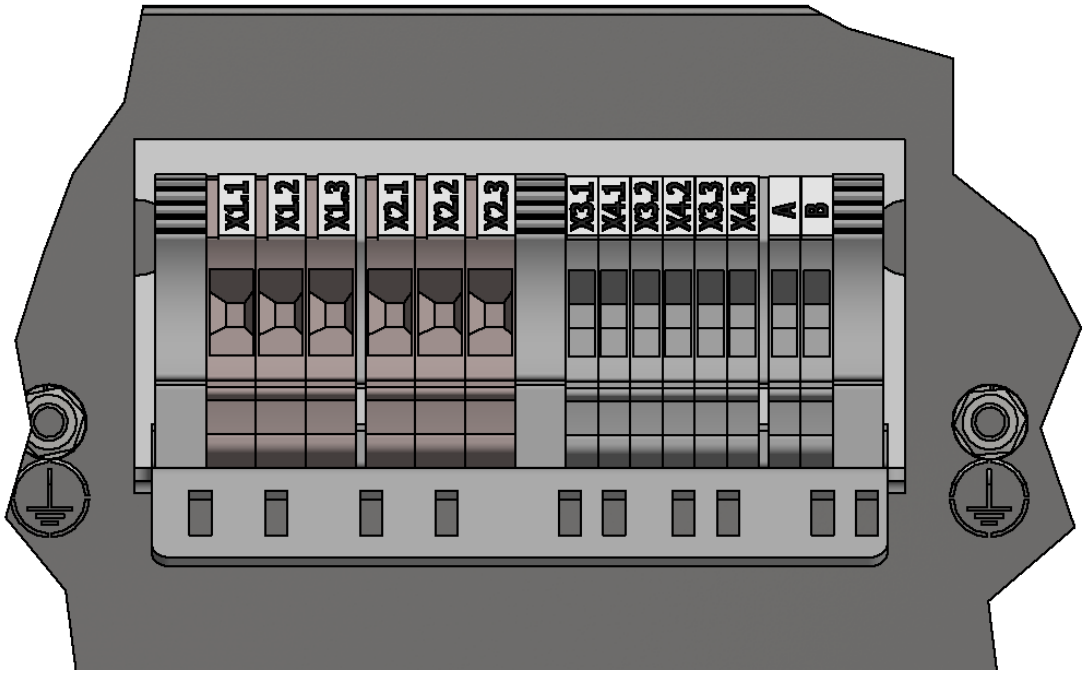
RHF Enclosure X1.3 if

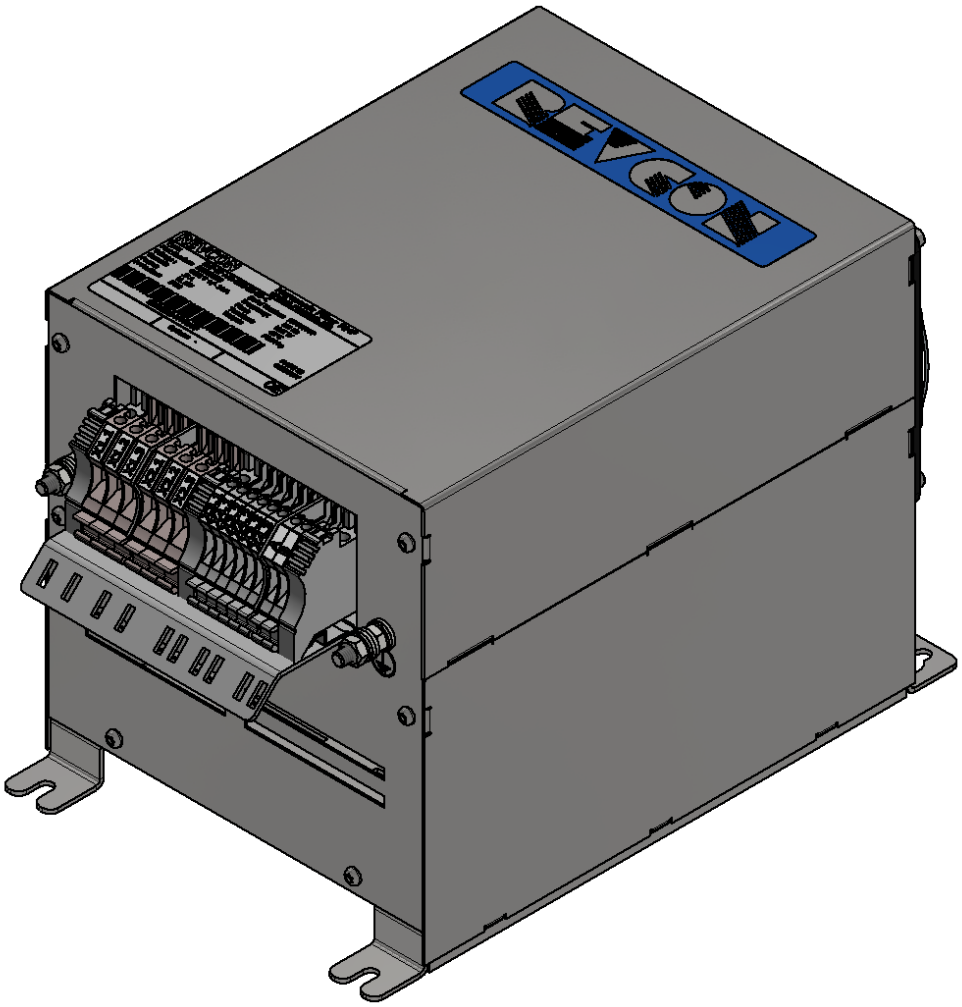
Installation

Enclosure X1.3 ef IP20 (fan placed on outside)



RHF Enclosure X1.3 ef

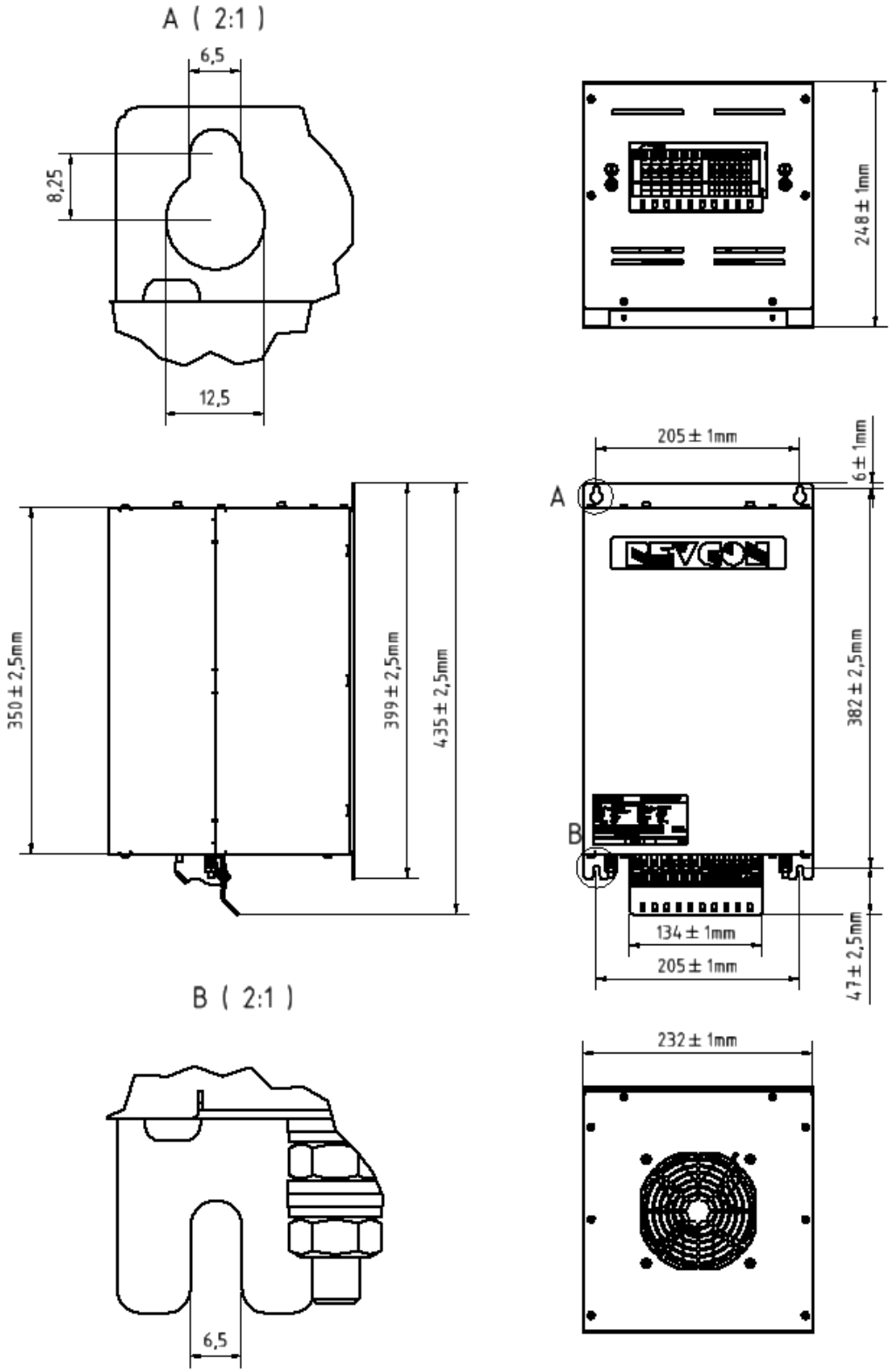




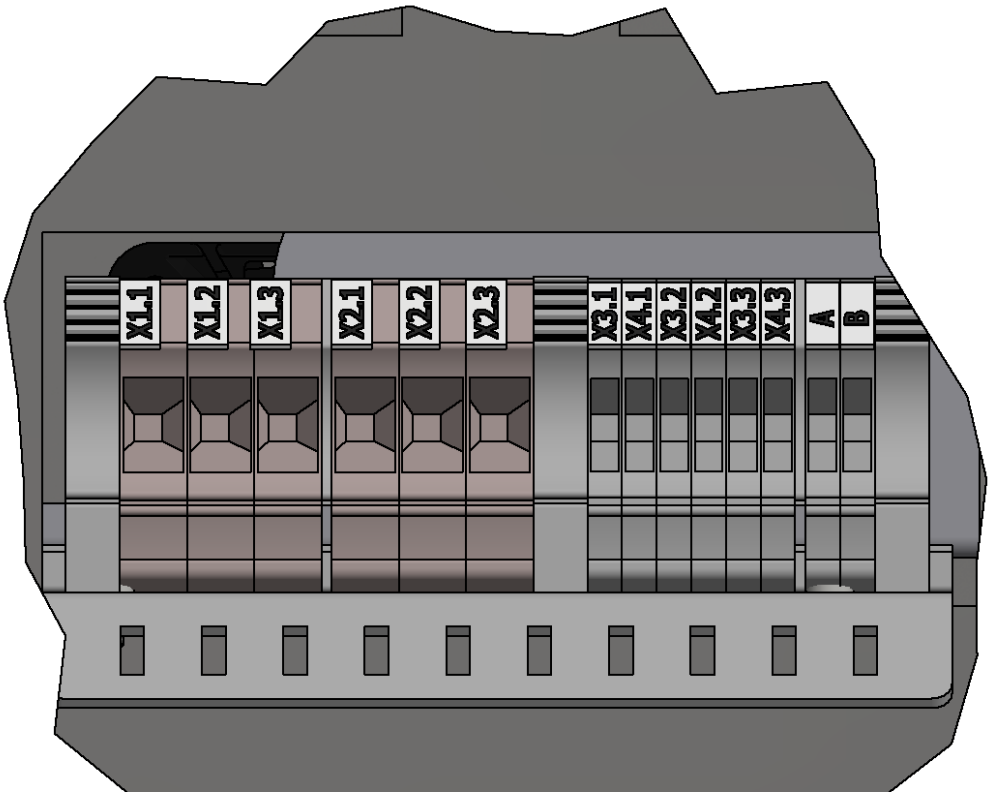
RHF Enclosure X1.3 ef

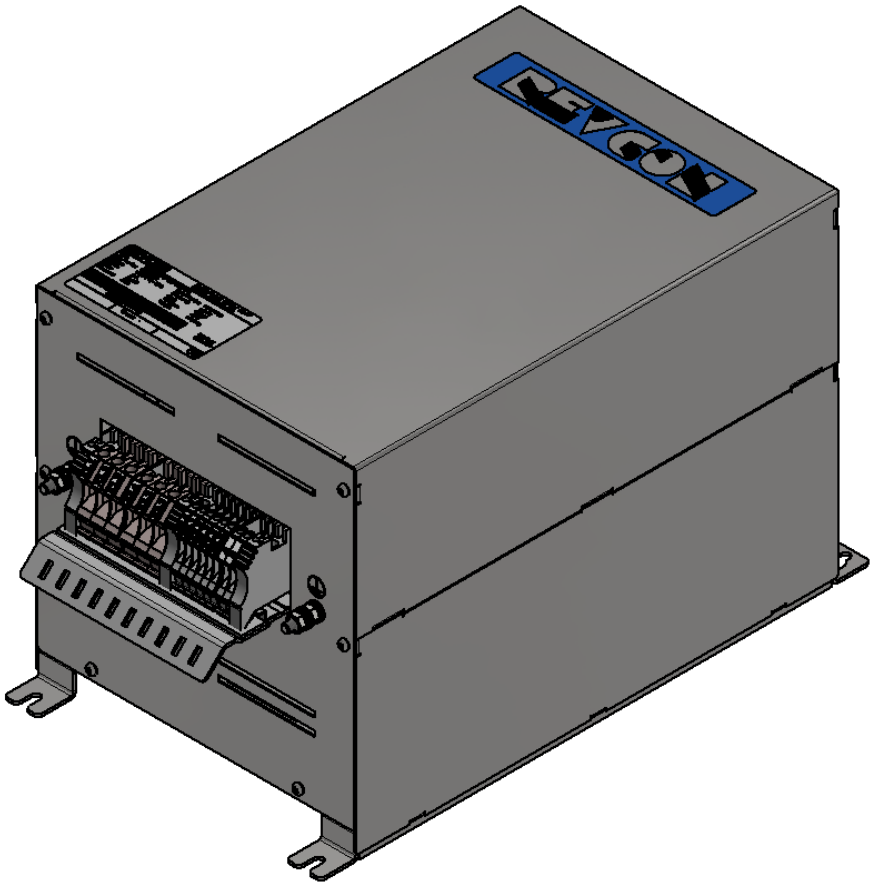
Installation

Enclosure X2.3 if IP20 (fan placed on inside)



RHF Enclosure X2.3 if

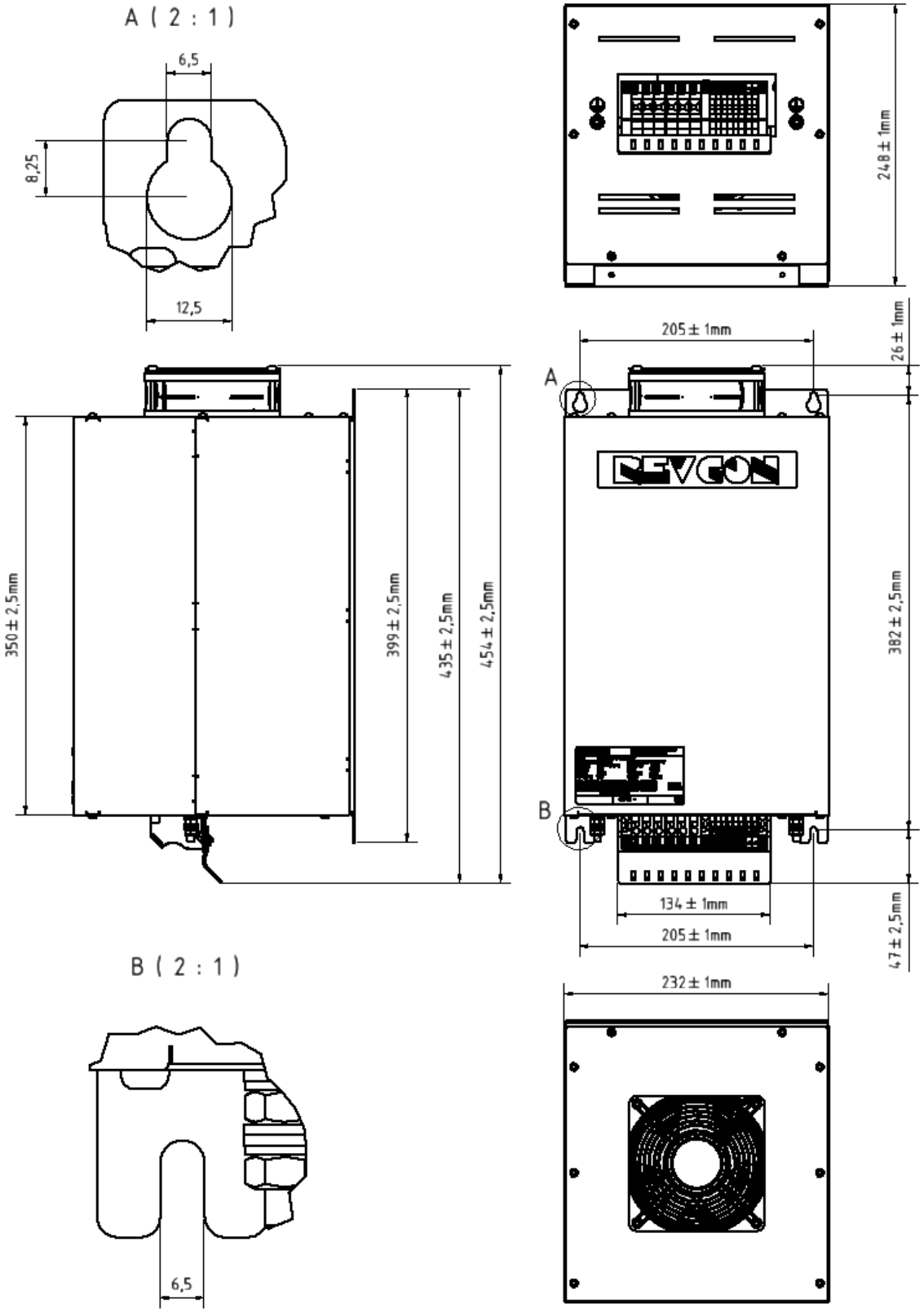




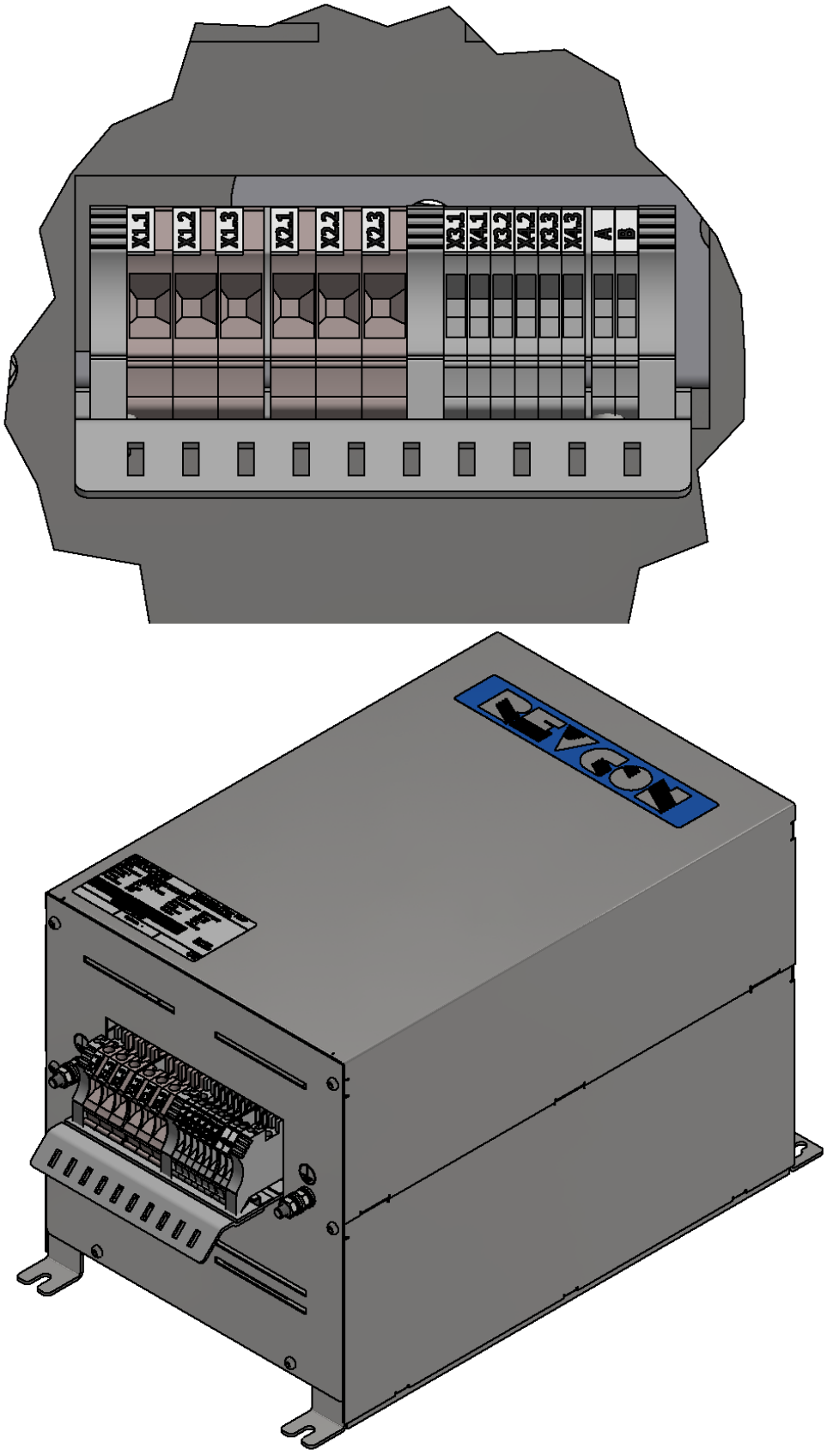
RHF Enclosure X2.3 if

Enclosure X2.3 ef IP20 (fan placed on outside)

Installation

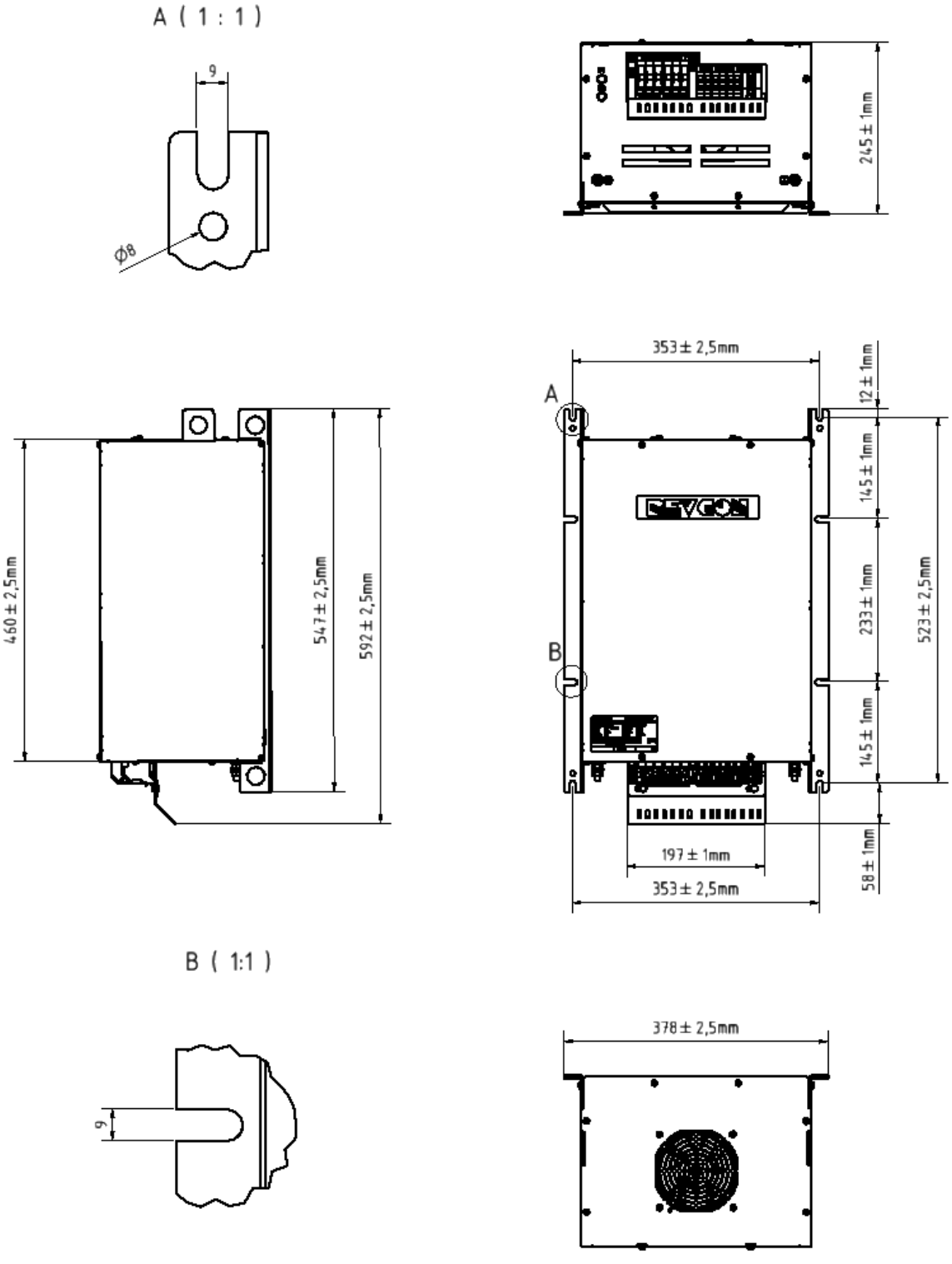


RHF Enclosure X2.3 ef

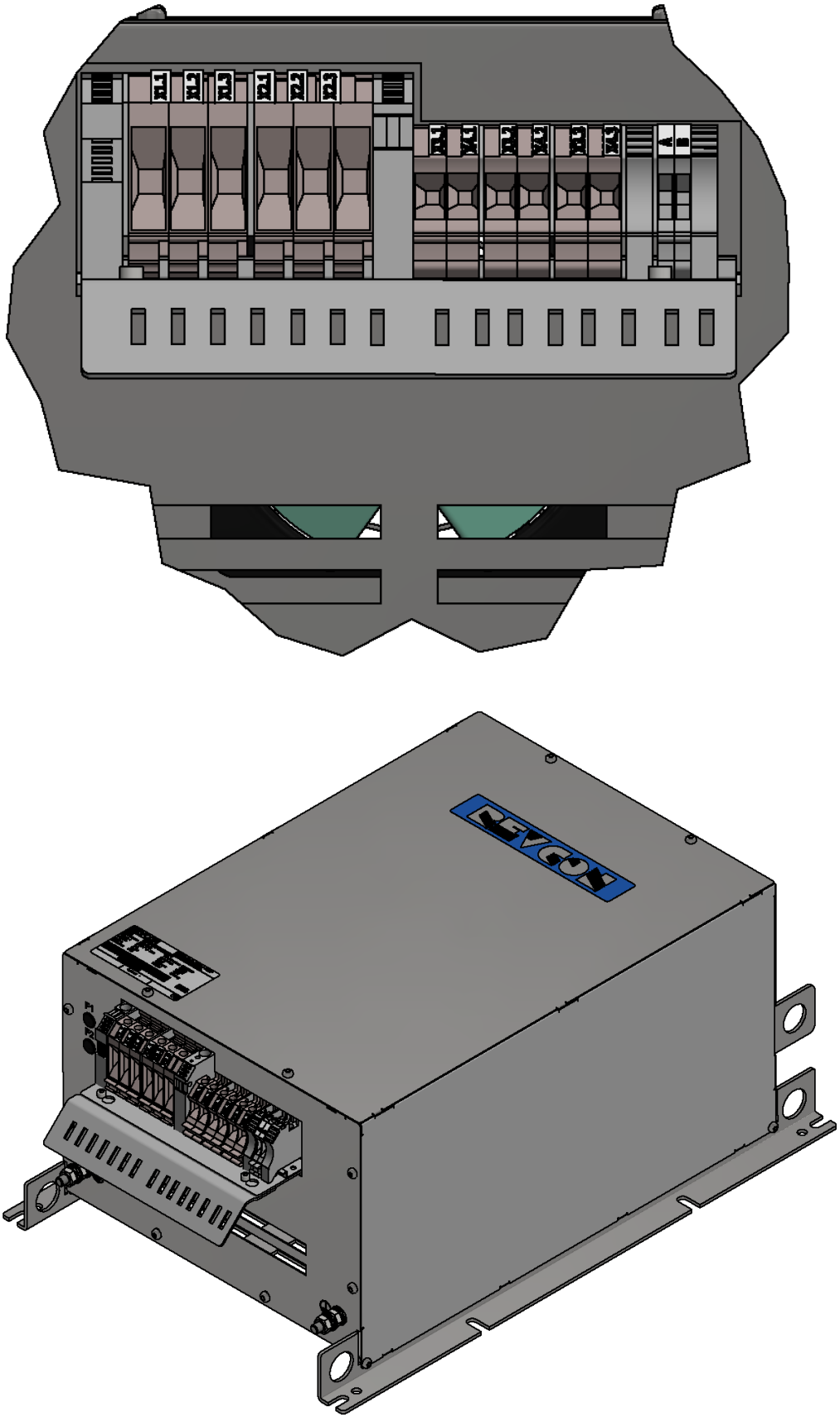


RHF Enclosure X2.3 ef

Enclosure X3.3 if IP20 (fan placed on inside)

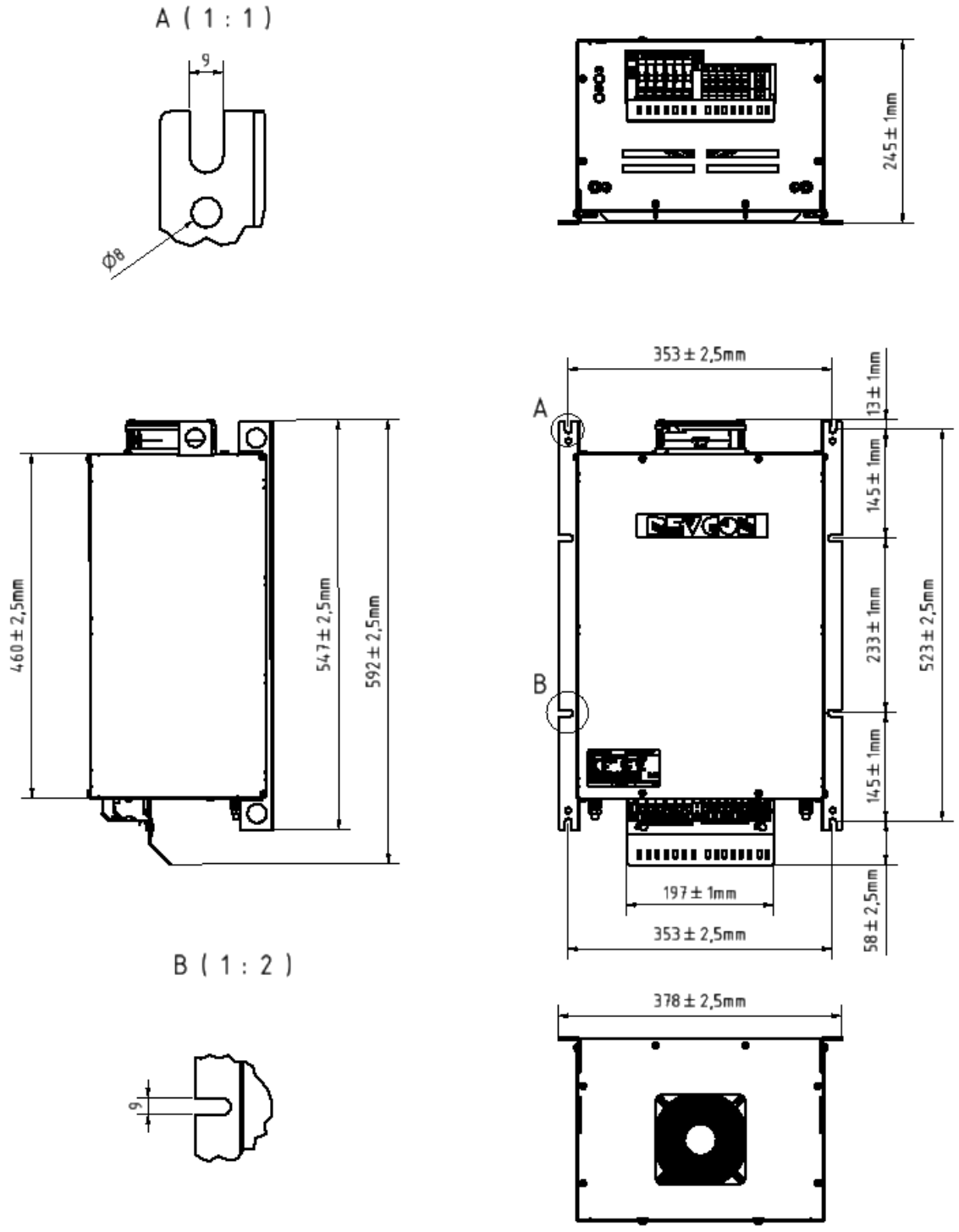


RHF Enclosure X3.3 if

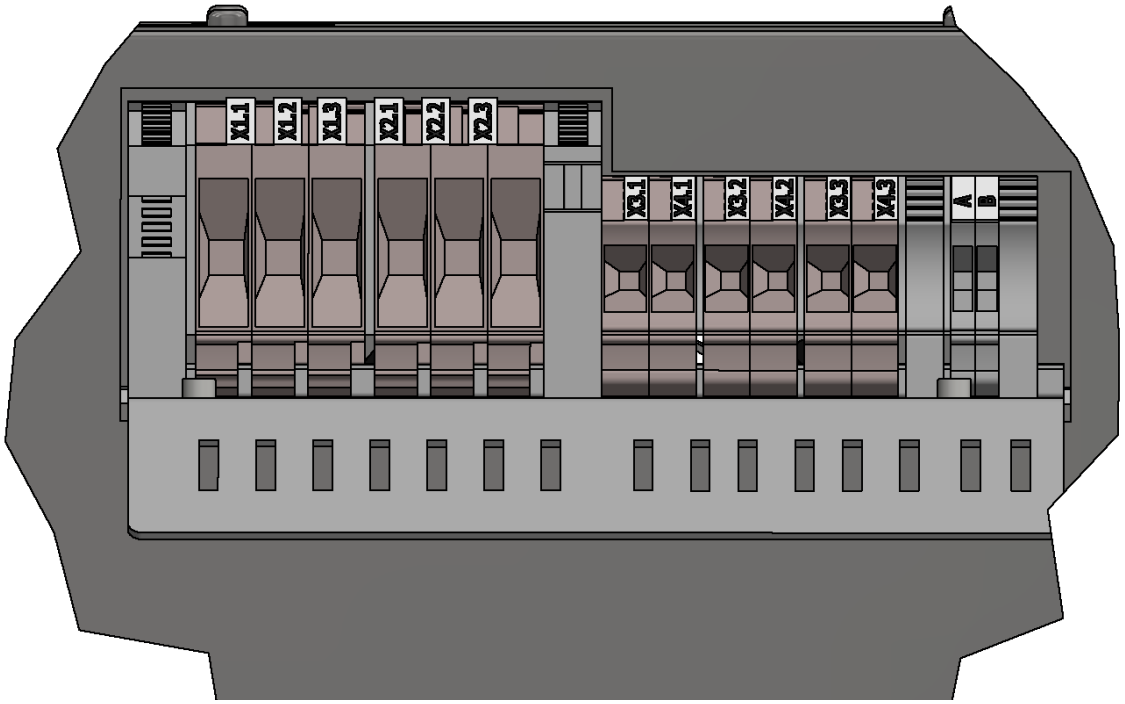


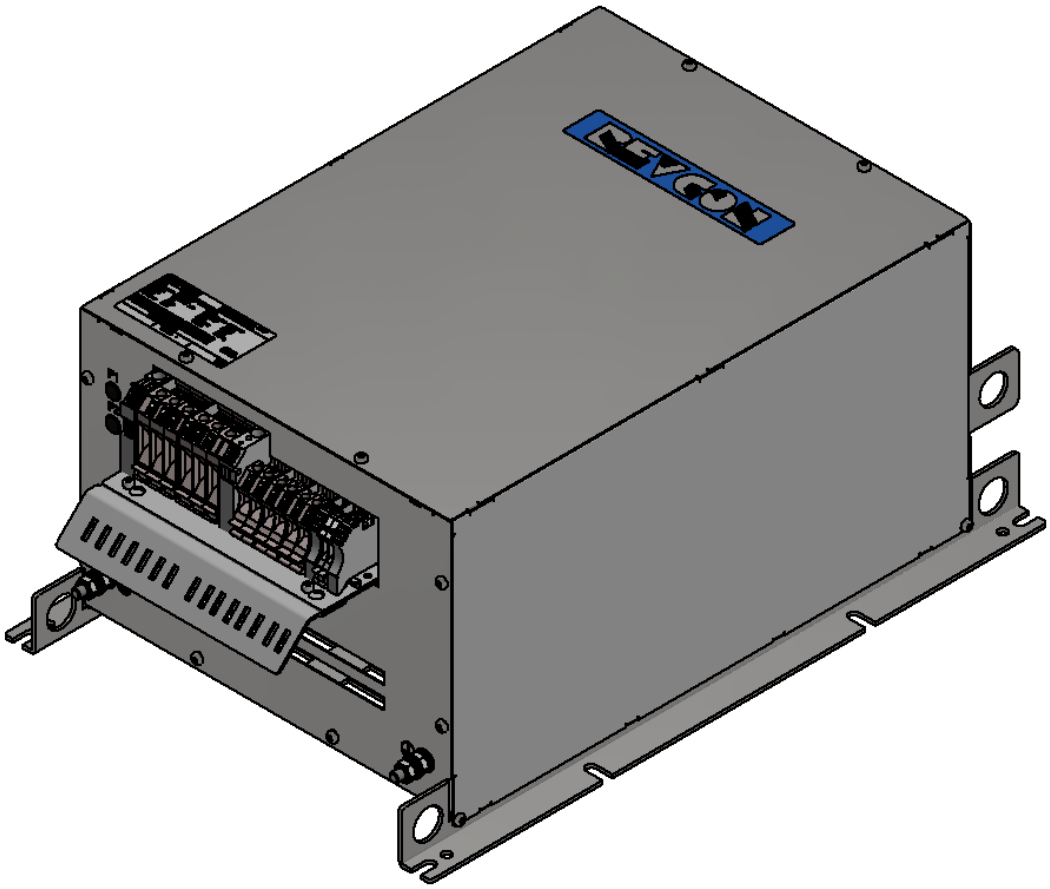
RHF Enclosure X3.3 if

Enclosure X3.3 ef IP20 (fan placed on outside)



RHF Enclosure X3.3 ef

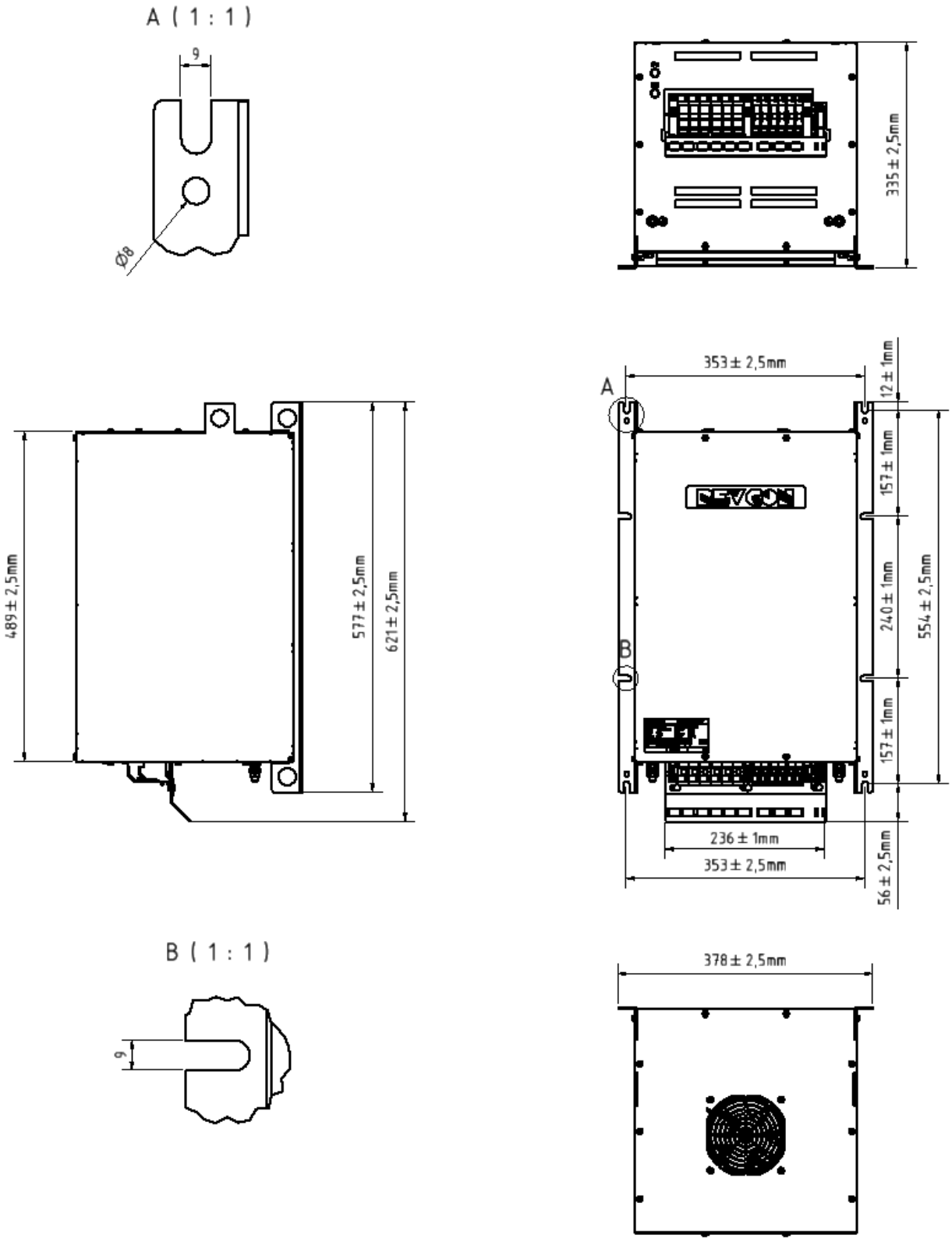




RHF Enclosure X3.3 ef

Installation

Enclosure X4.3 if IP20 (fan placed on inside)



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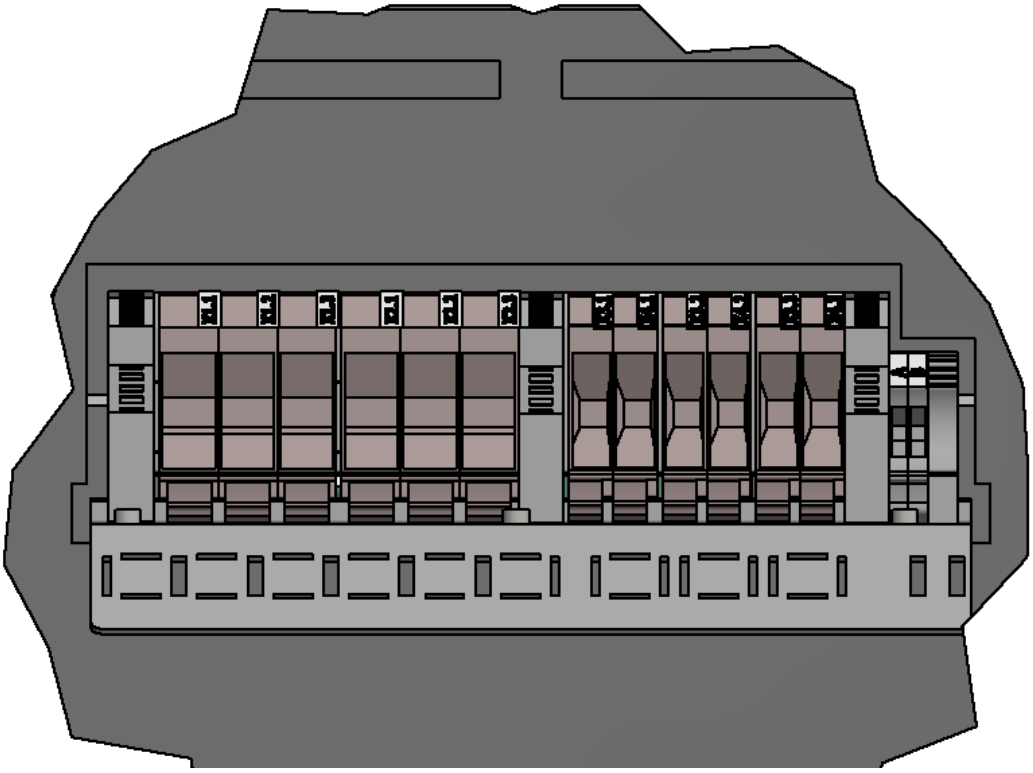
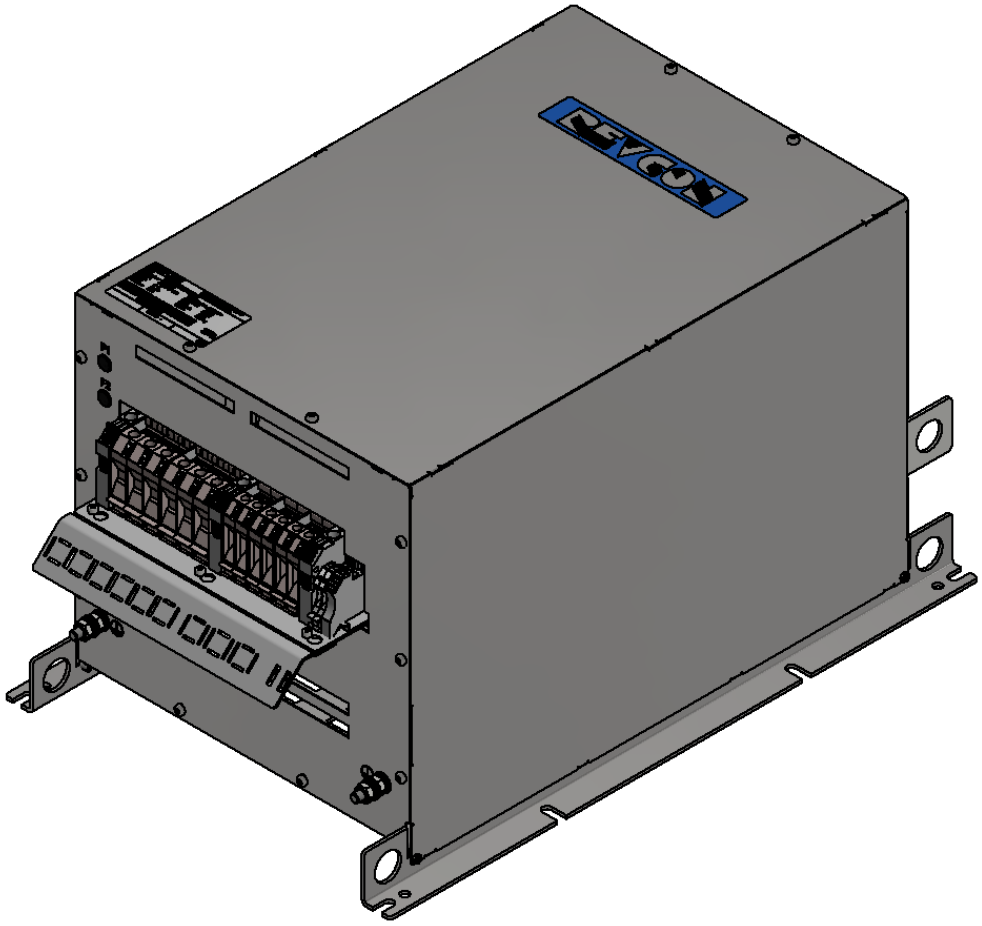
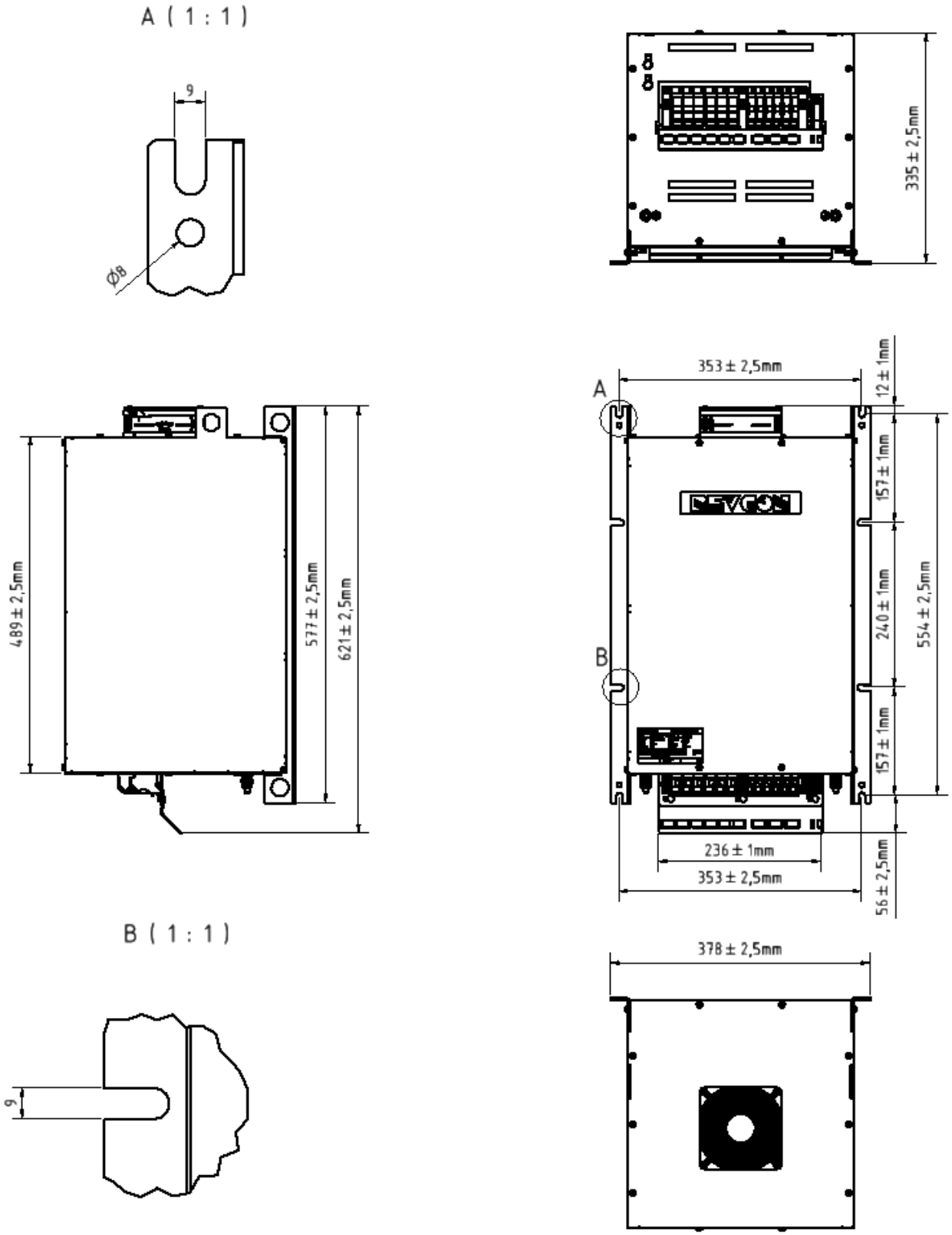




RHF Enclosure X4.3 if

Installation

Enclosure X4.3 ef IP20 (fan placed on outside)



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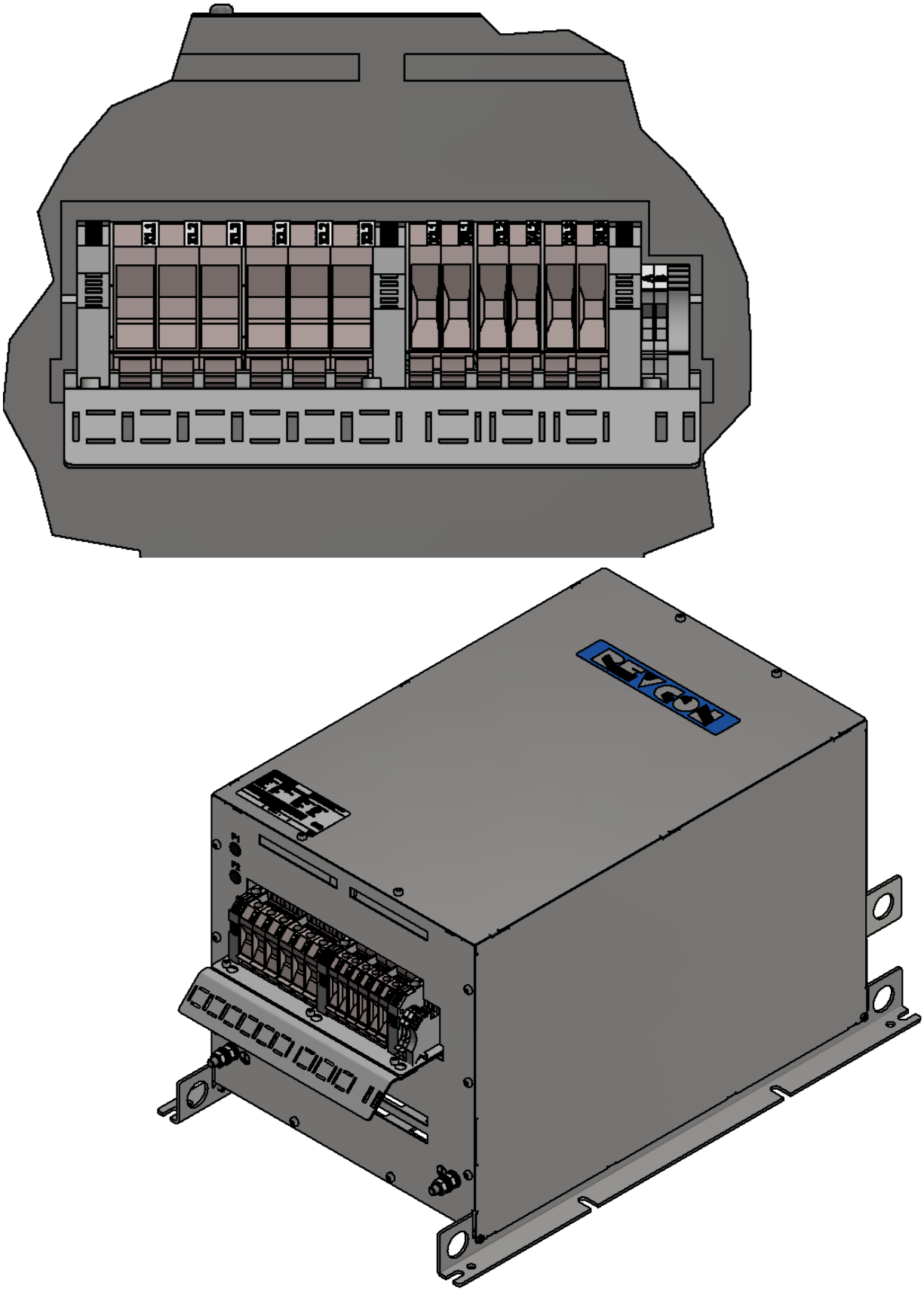
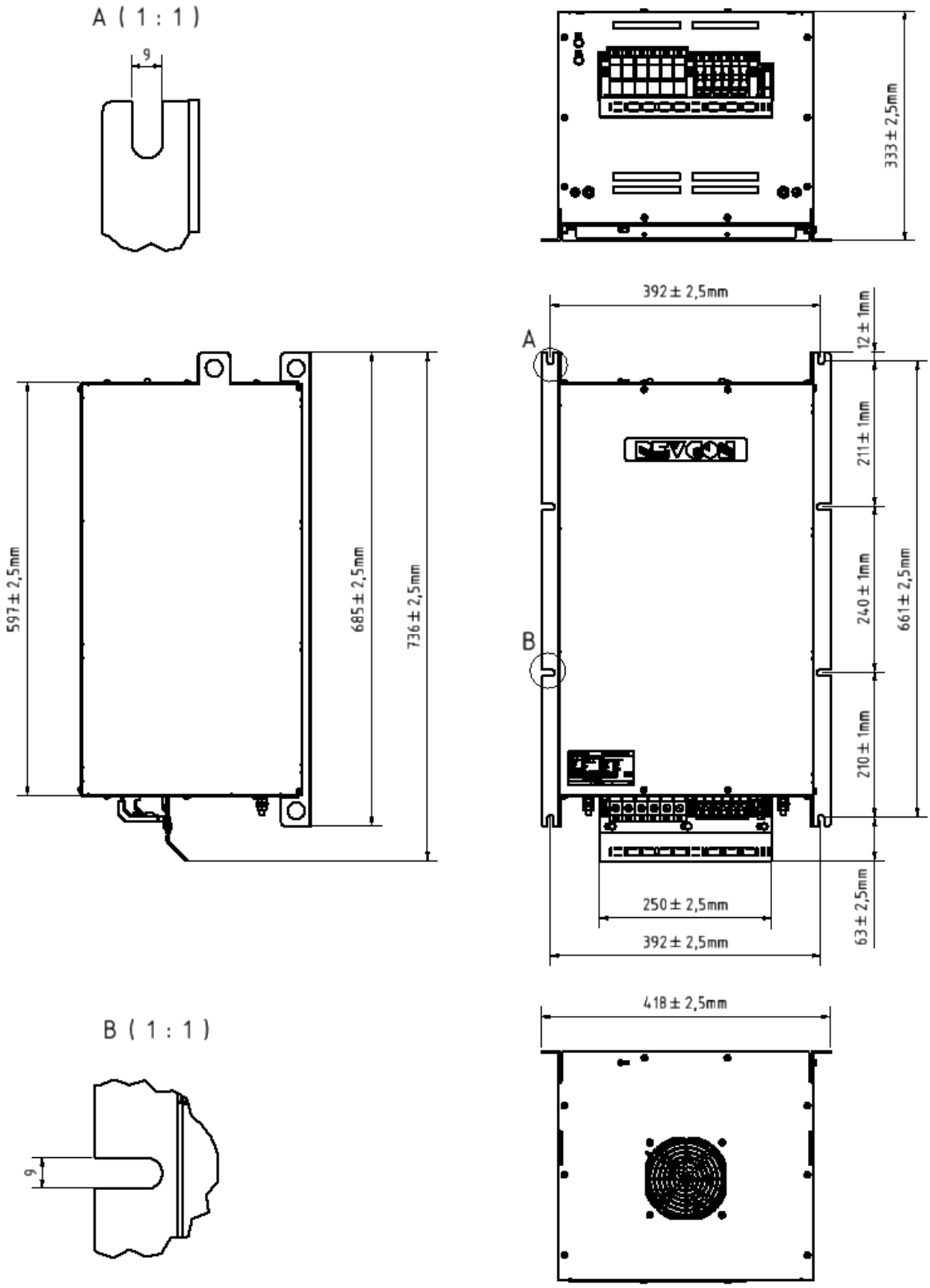


RHF Enclosure X4.3 ef

Enclosure X5.3 if IP20 (fan placed on inside)



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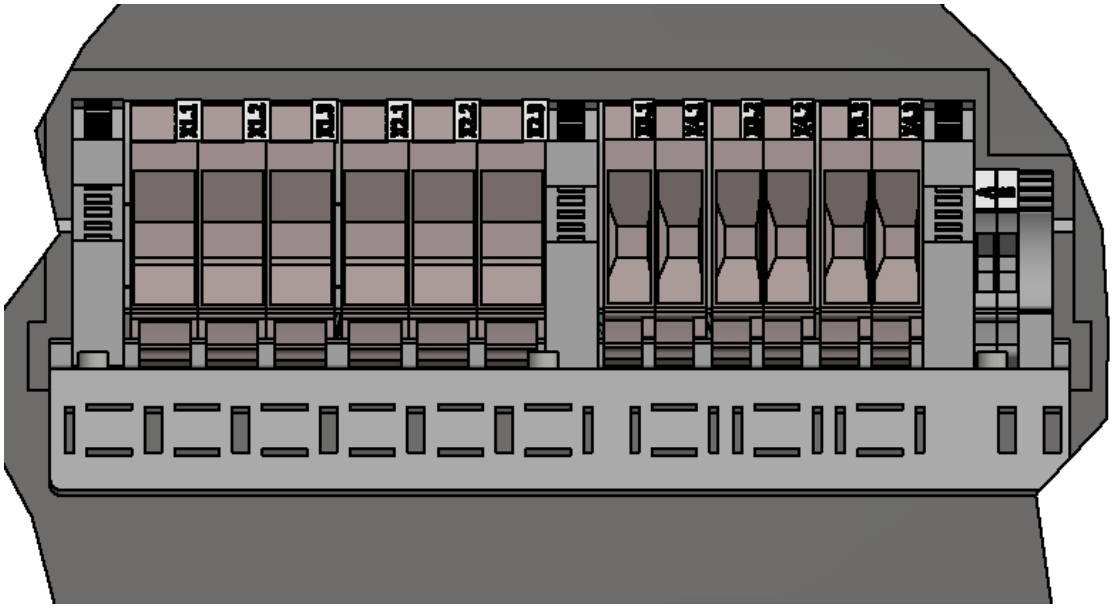
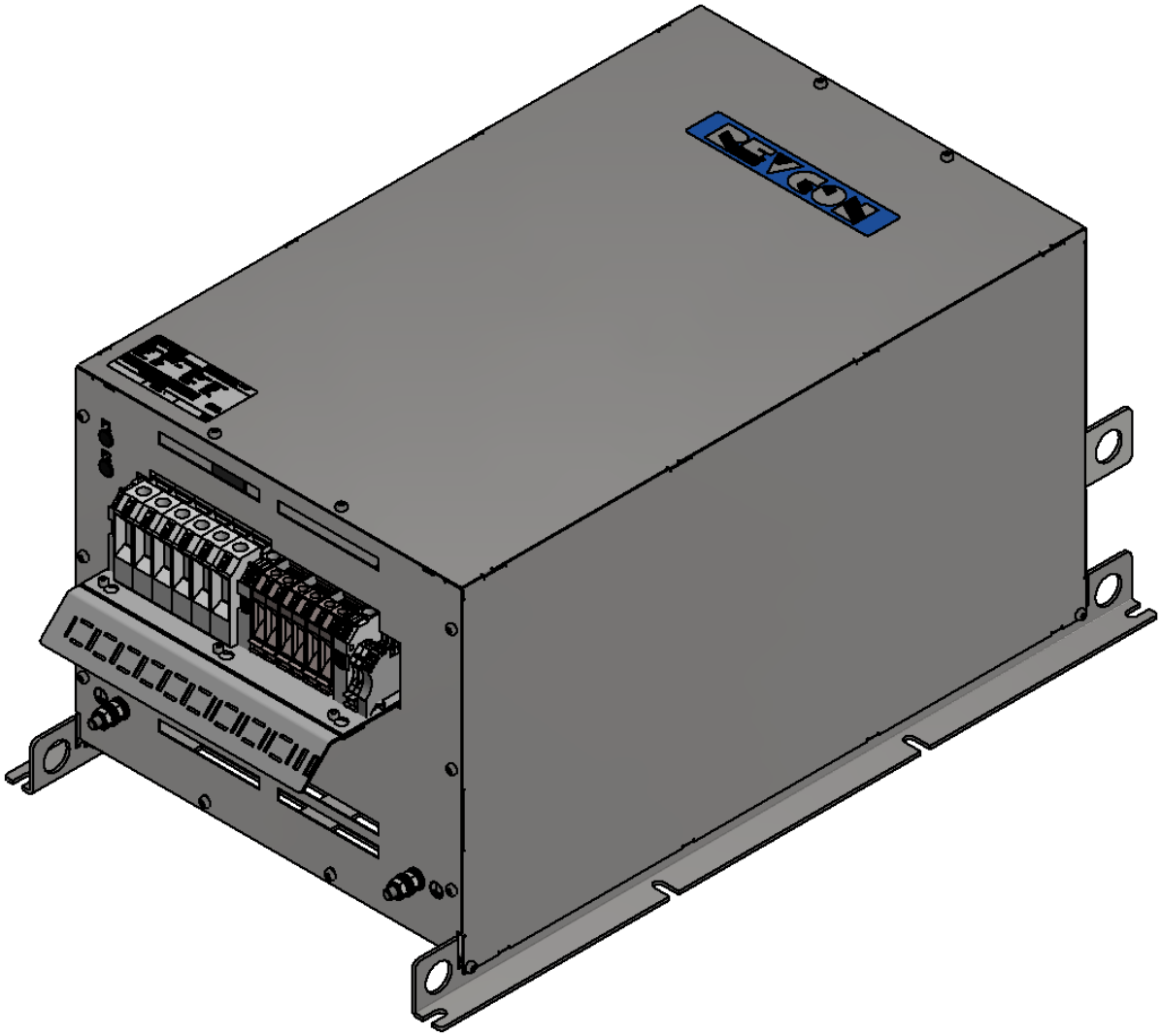
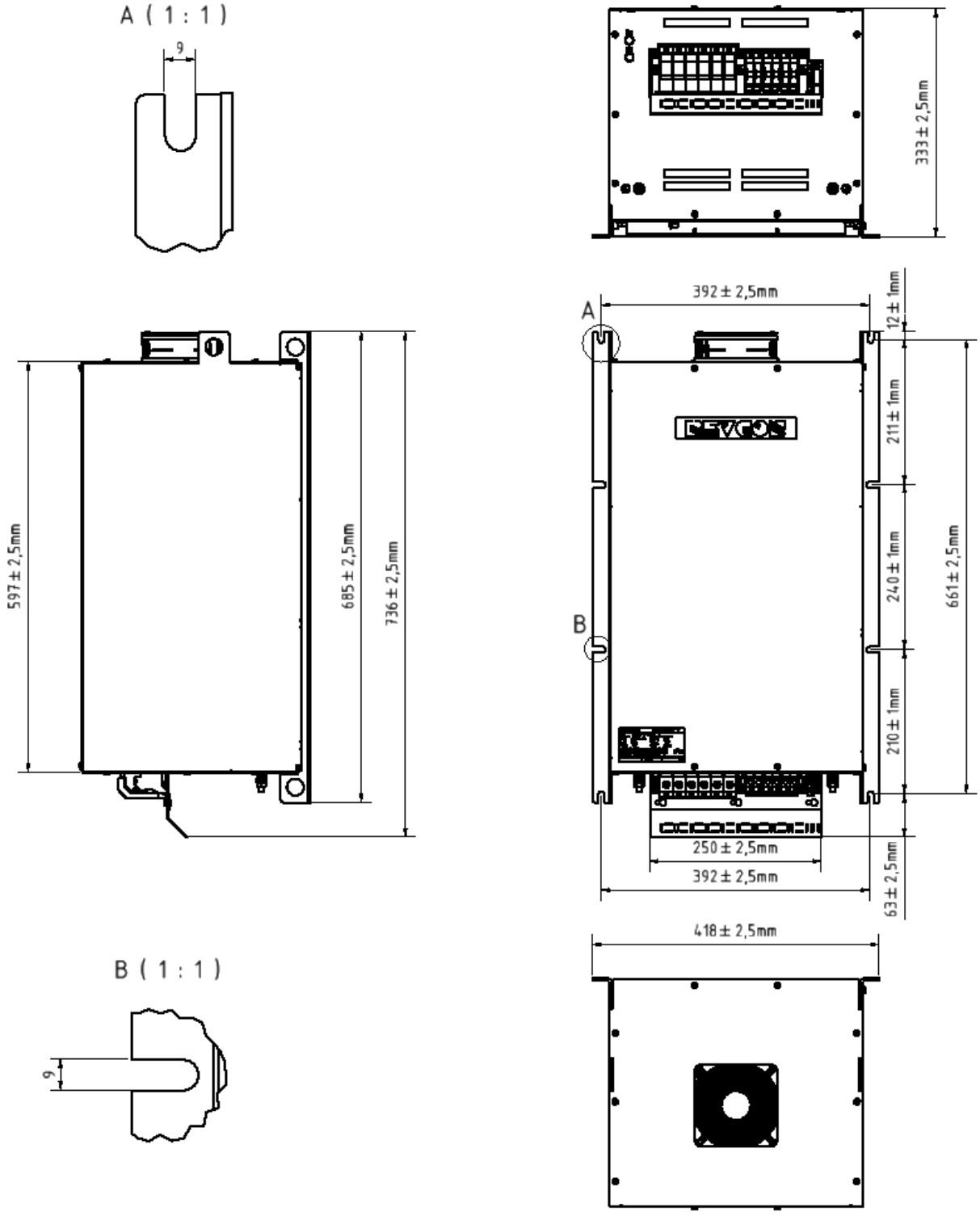




RHF Enclosure X5.3 if

Installation

Enclosure X5.3 ef IP20 (fan placed on outside)



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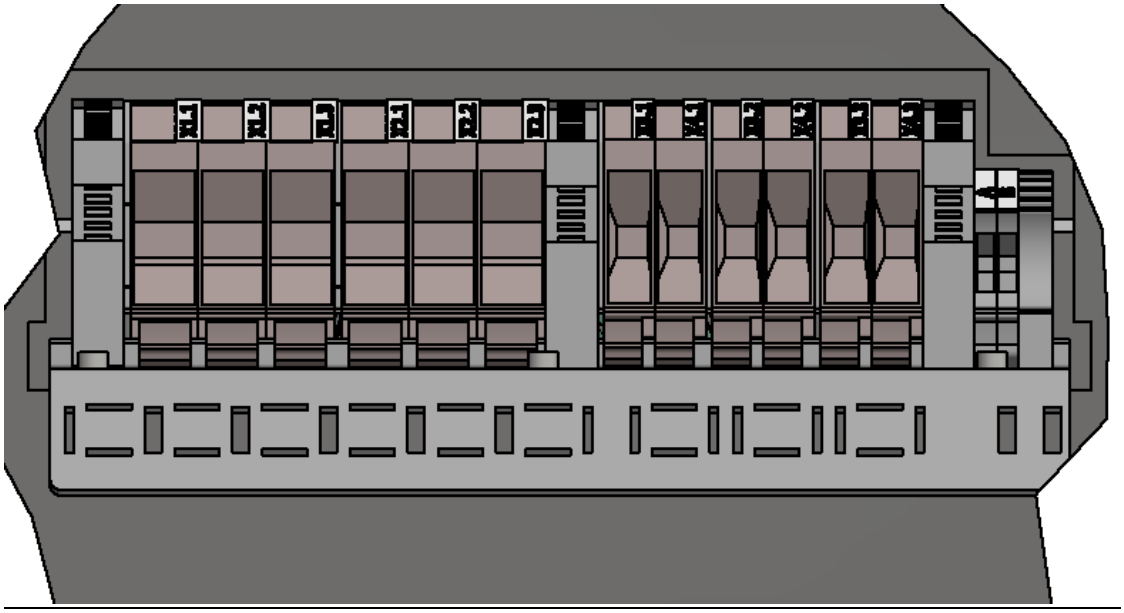
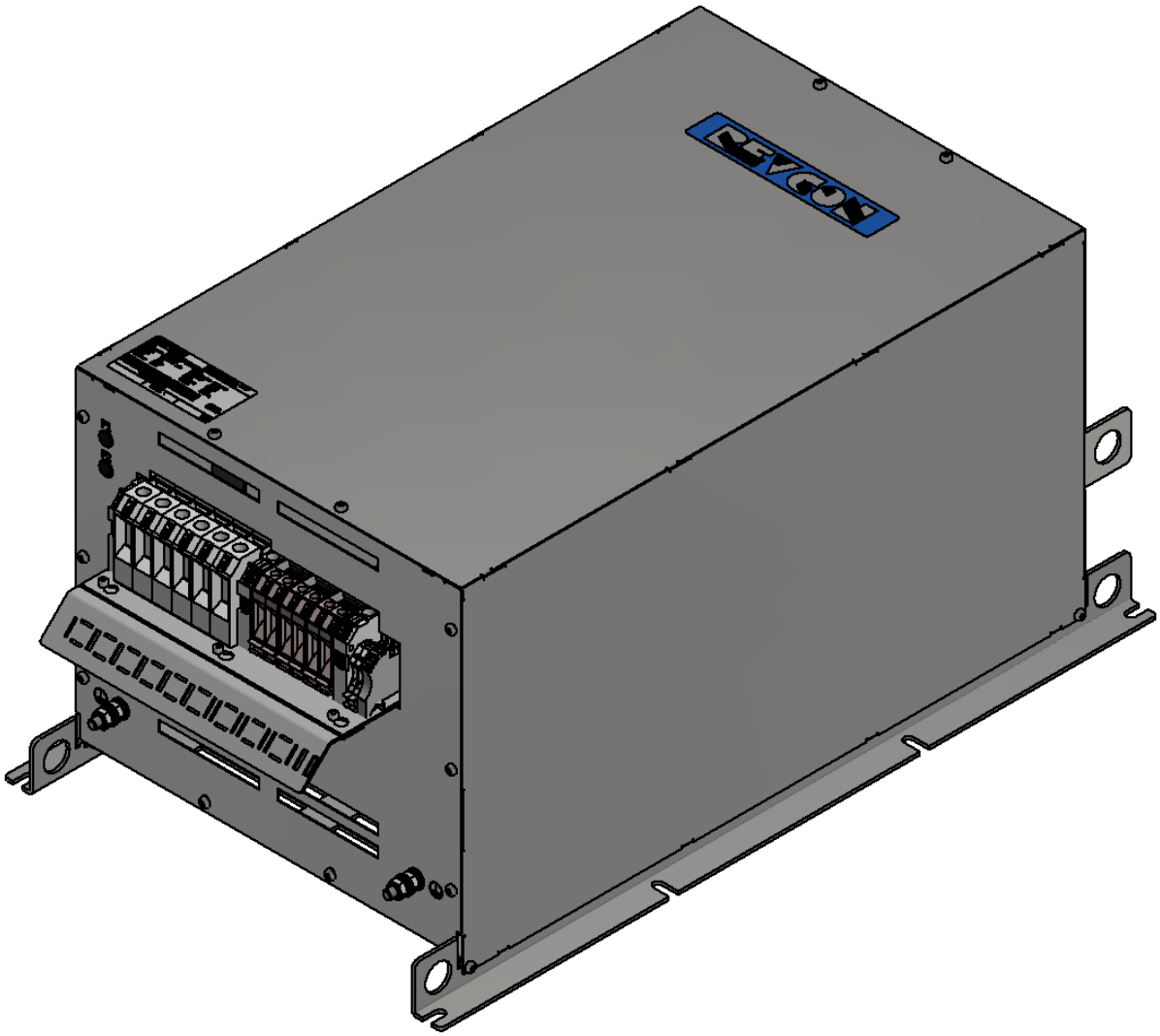
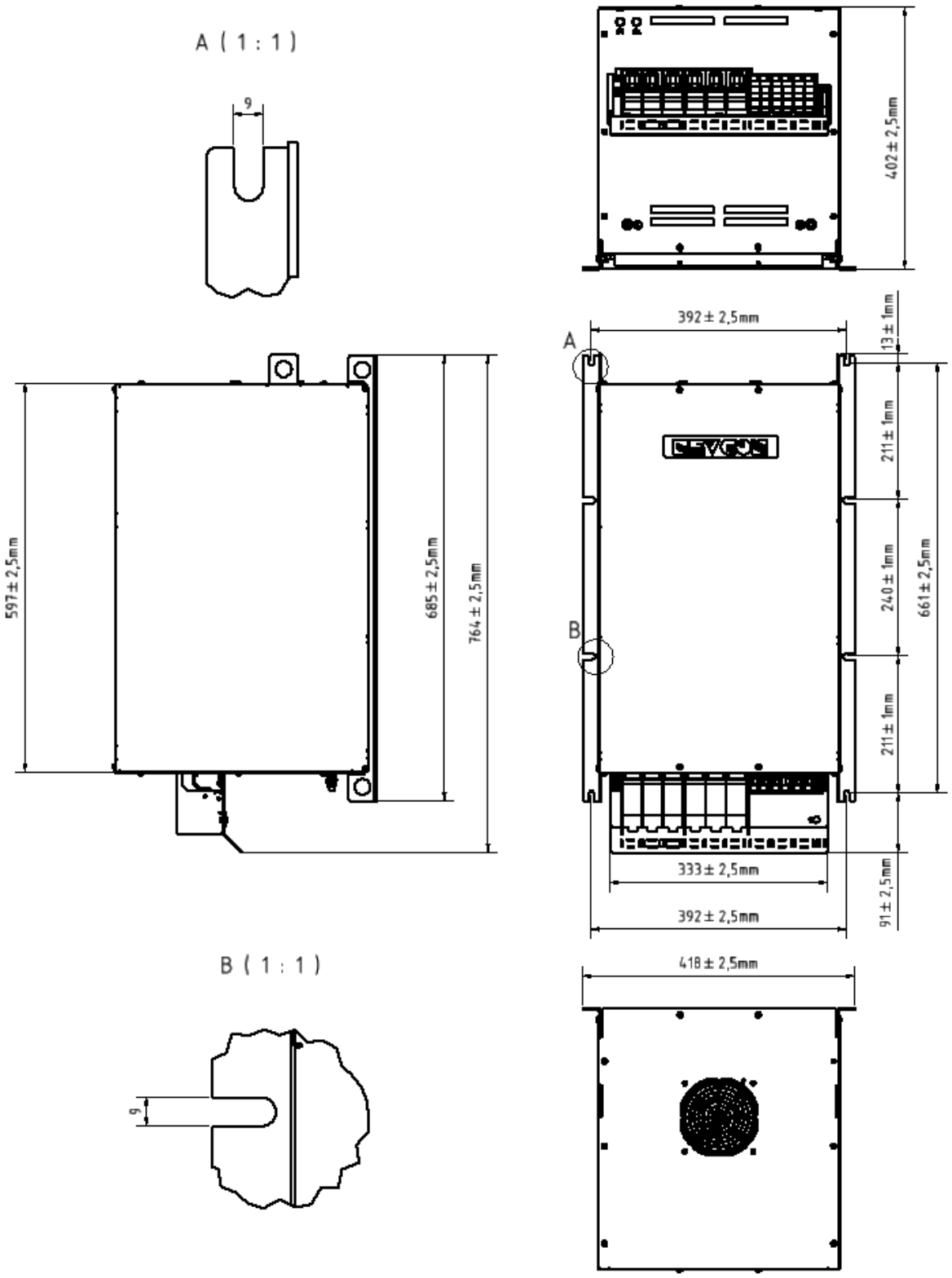




RHF Enclosure X5.3 ef

Installation

Enclosure X6.3 if IP20 (fan placed on inside)



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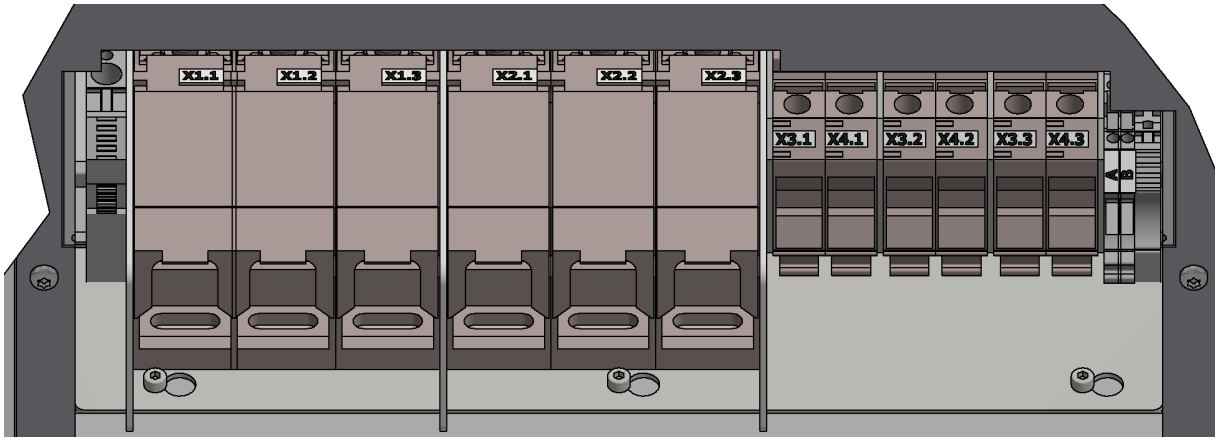
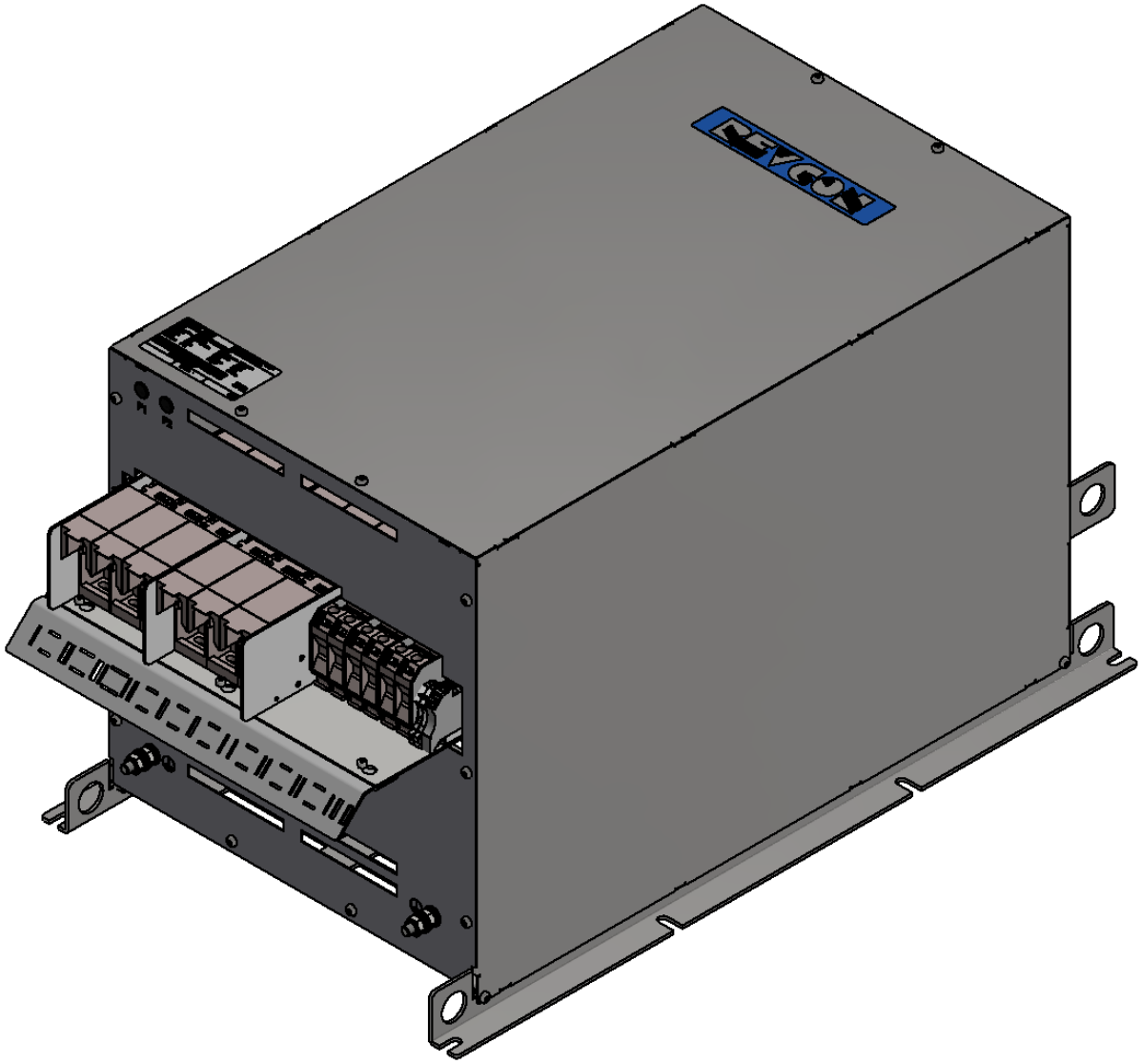
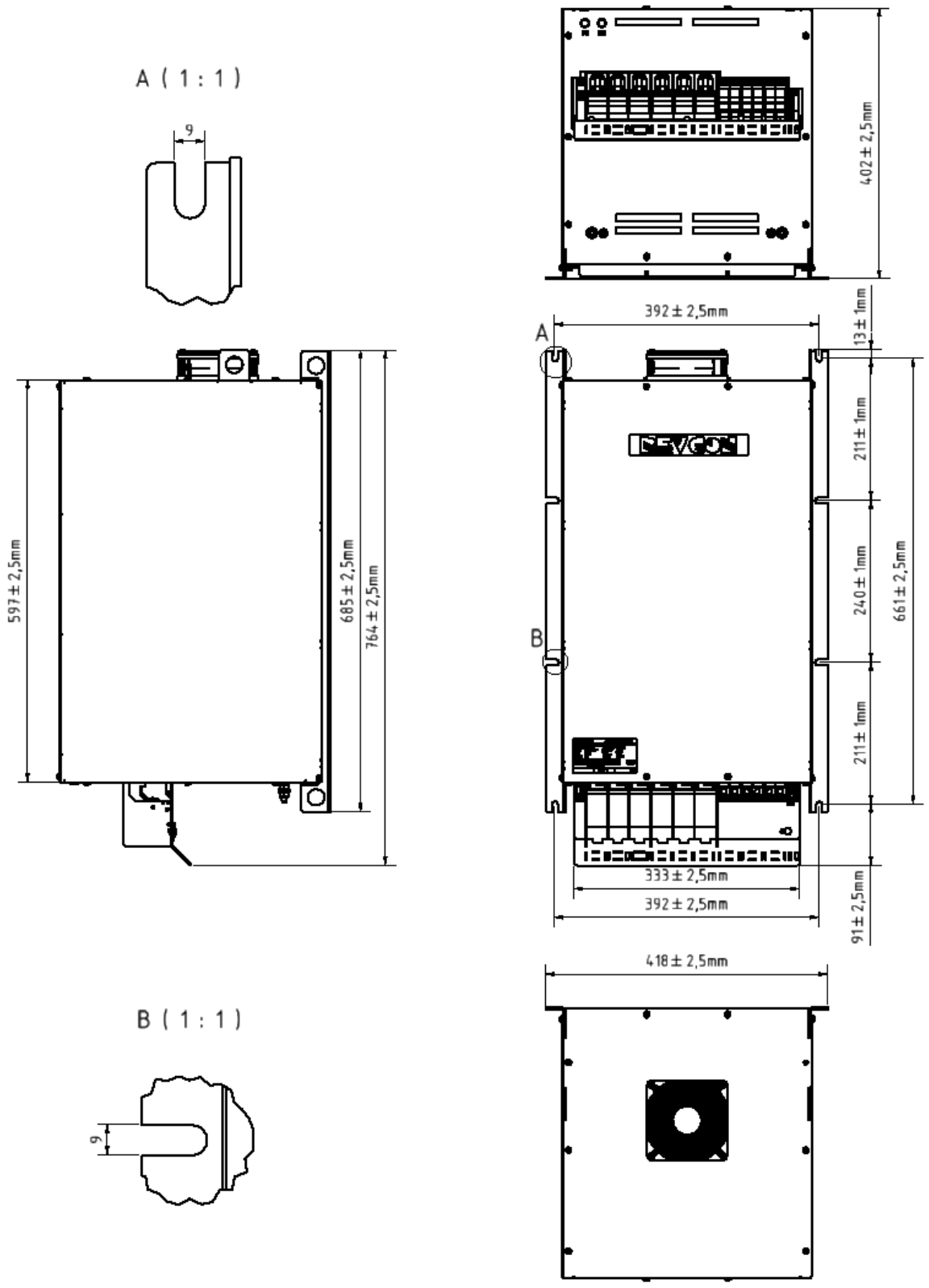


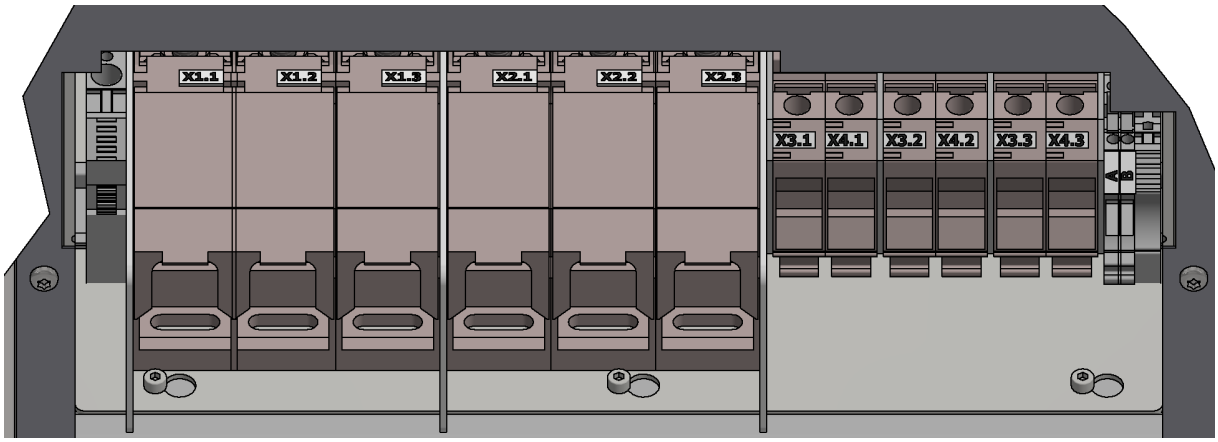


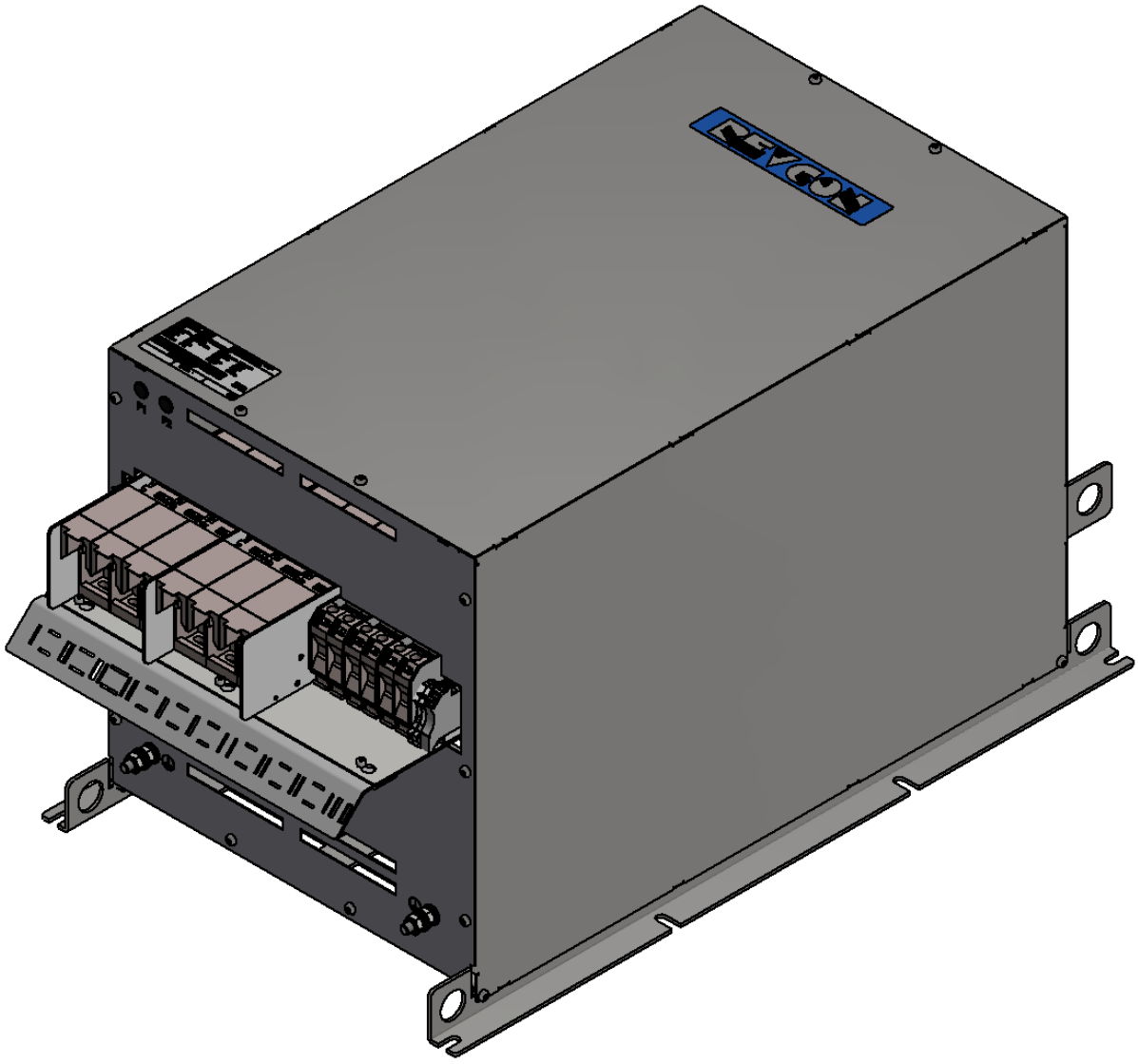
RHF Enclosure X6.3 if

Enclosure X6.3 ef IP20 (fan placed on outside)



RHF Enclosure X6.3 ef

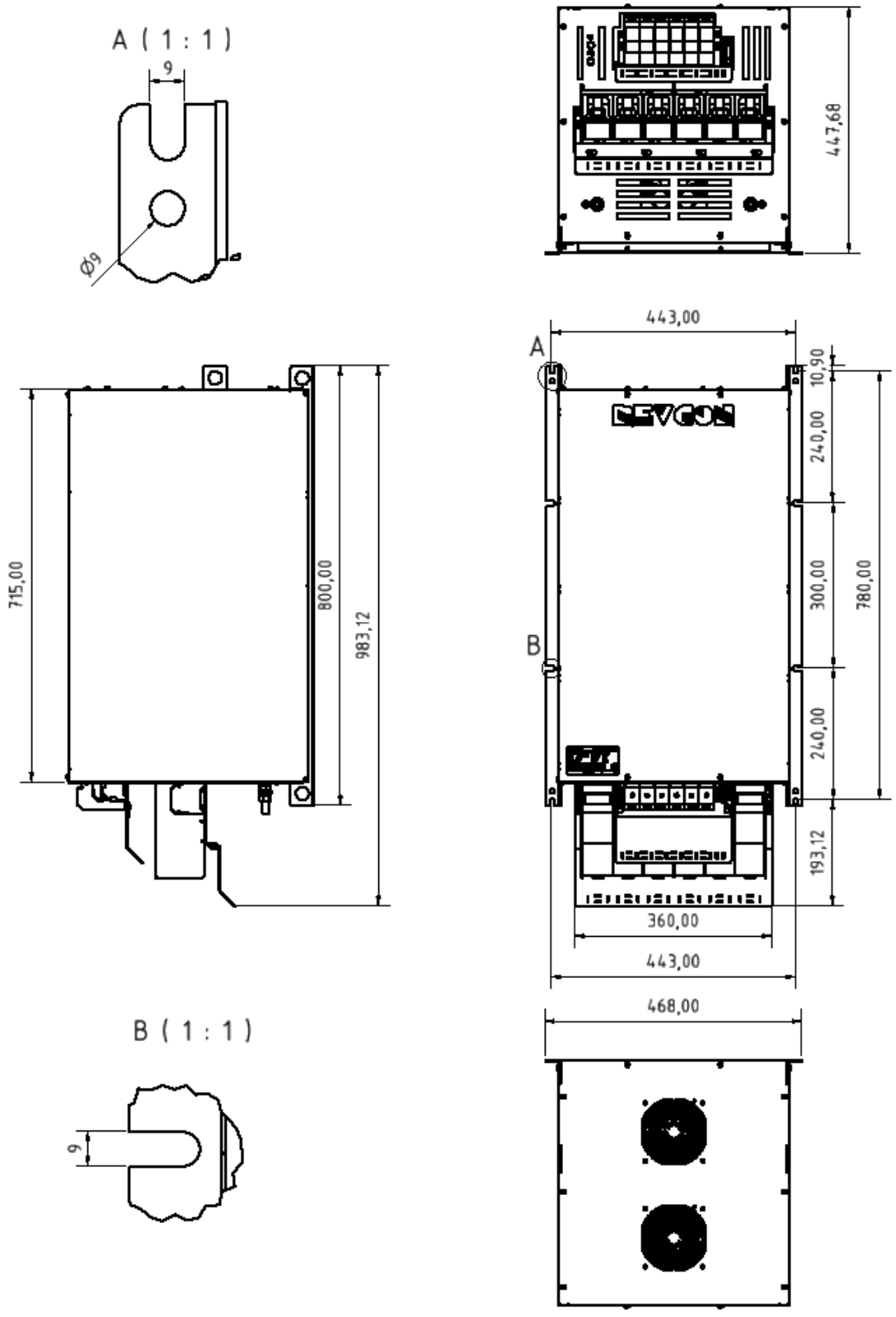




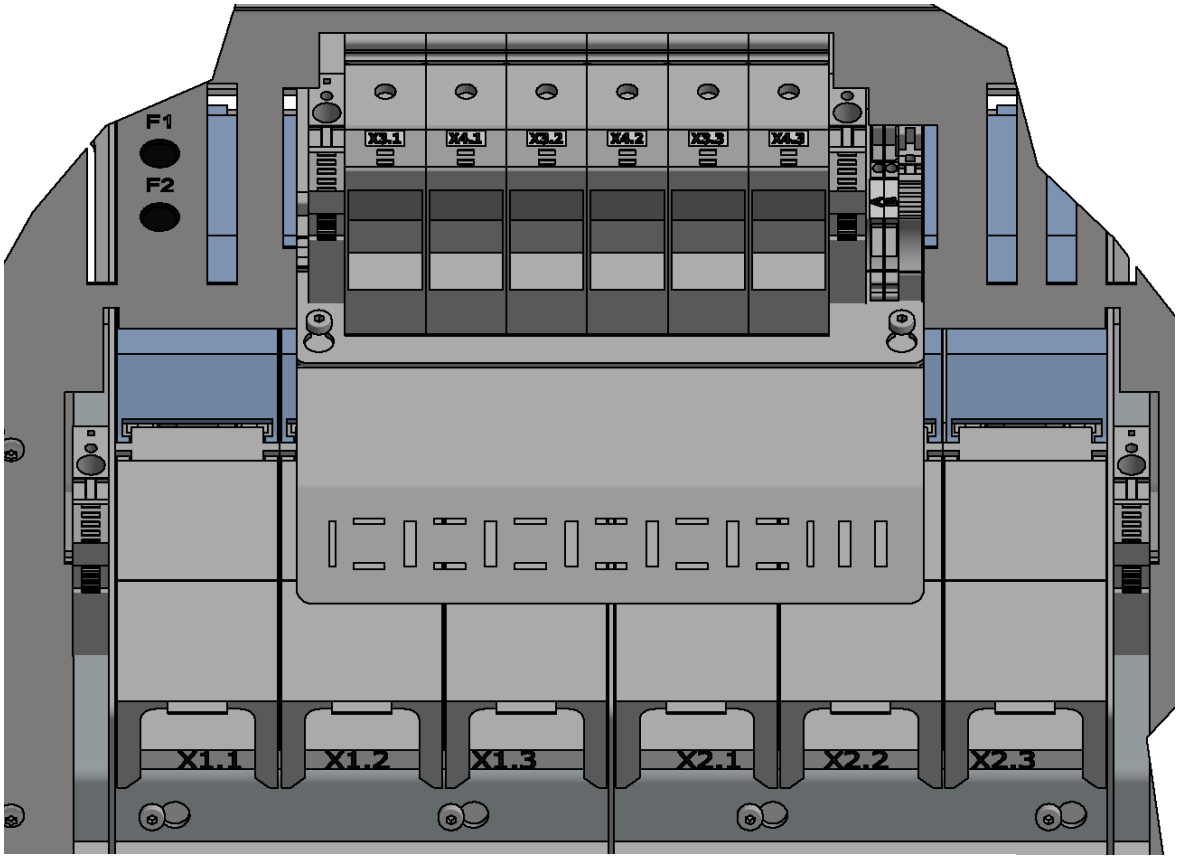
RHF Enclosure X6.3 ef

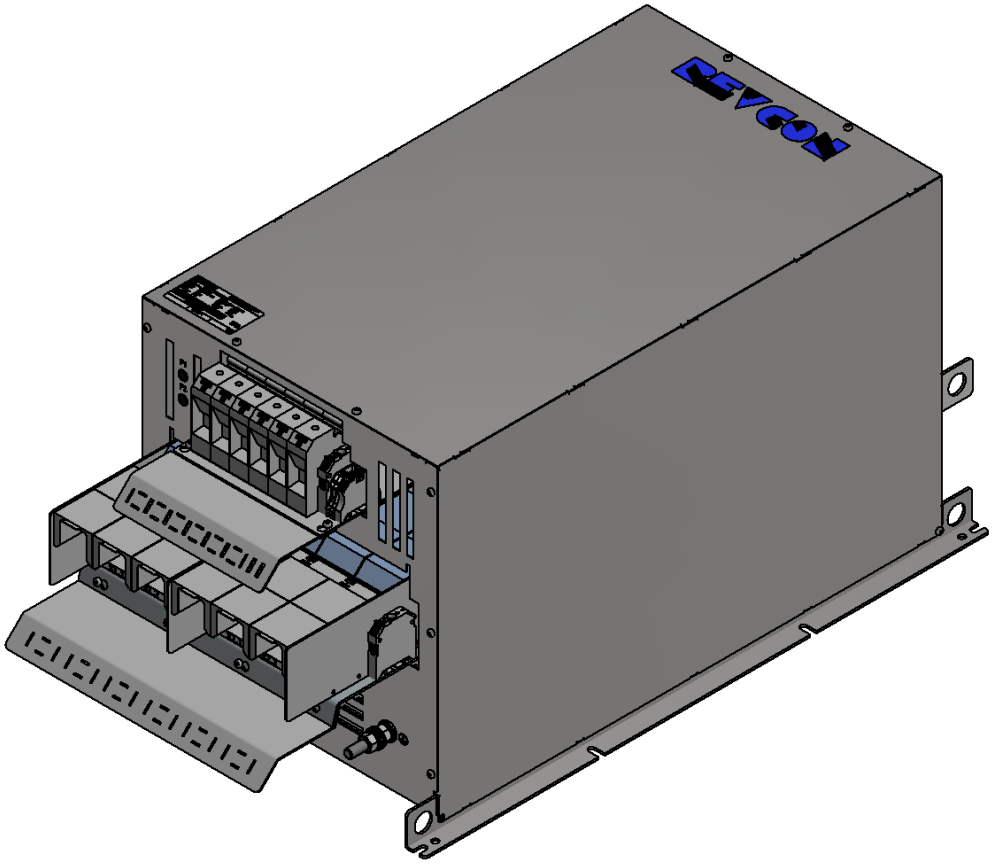
Installation

Enclosure X7.3 if IP20 (fan placed on inside)



RHF Enclosure X7.3 if

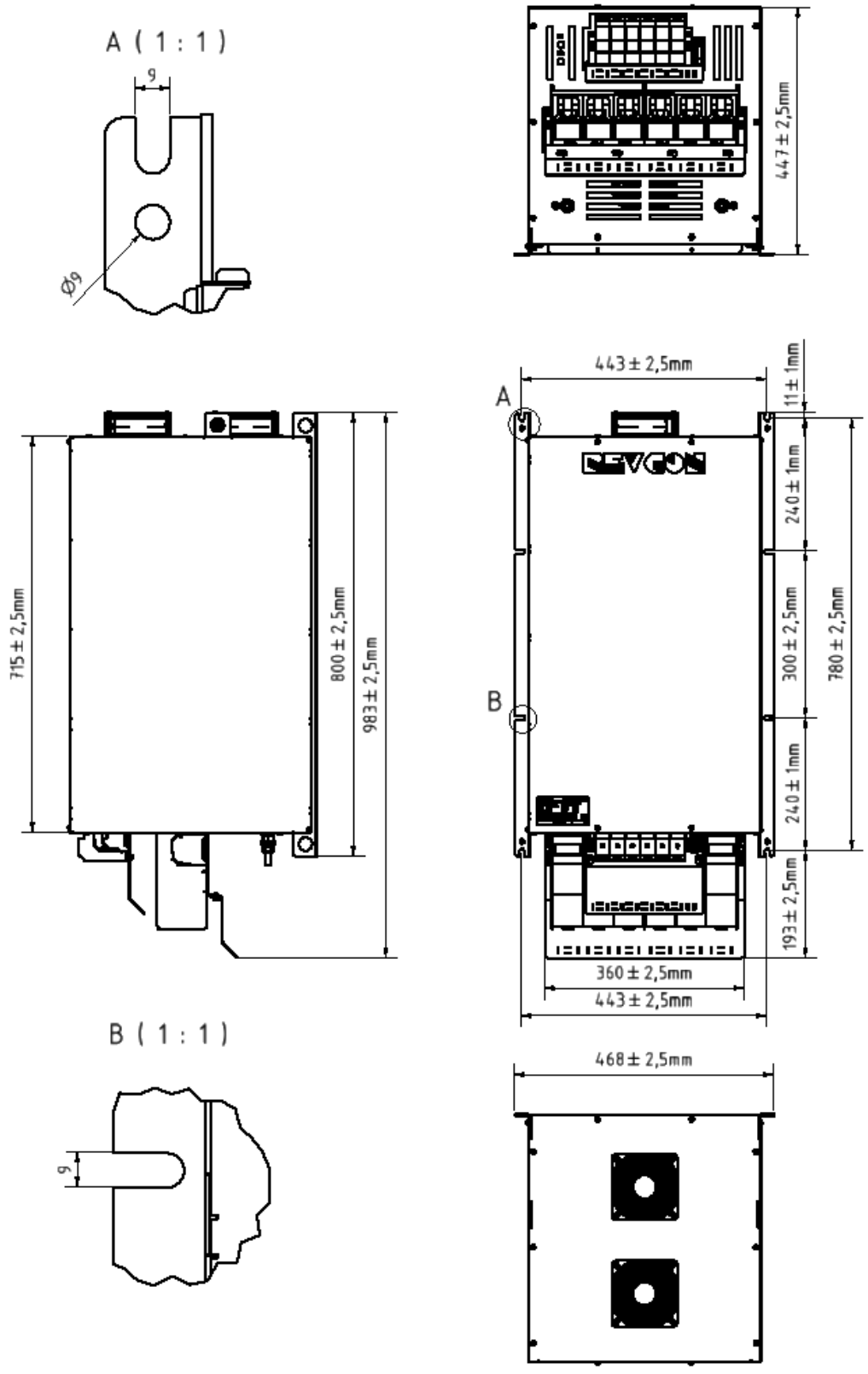




RHF Enclosure X7.3 if

Installation

Enclosure X7.3 ef IP20 (fan placed on outside)



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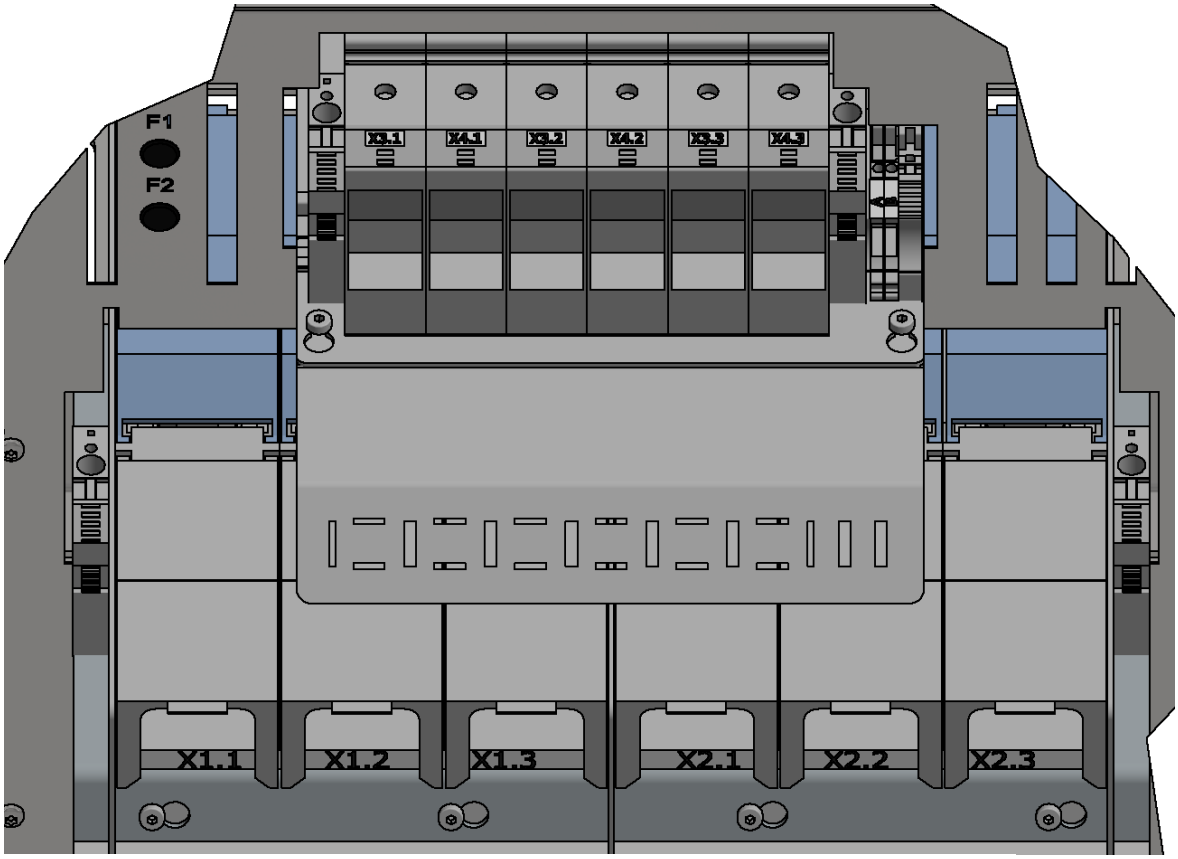
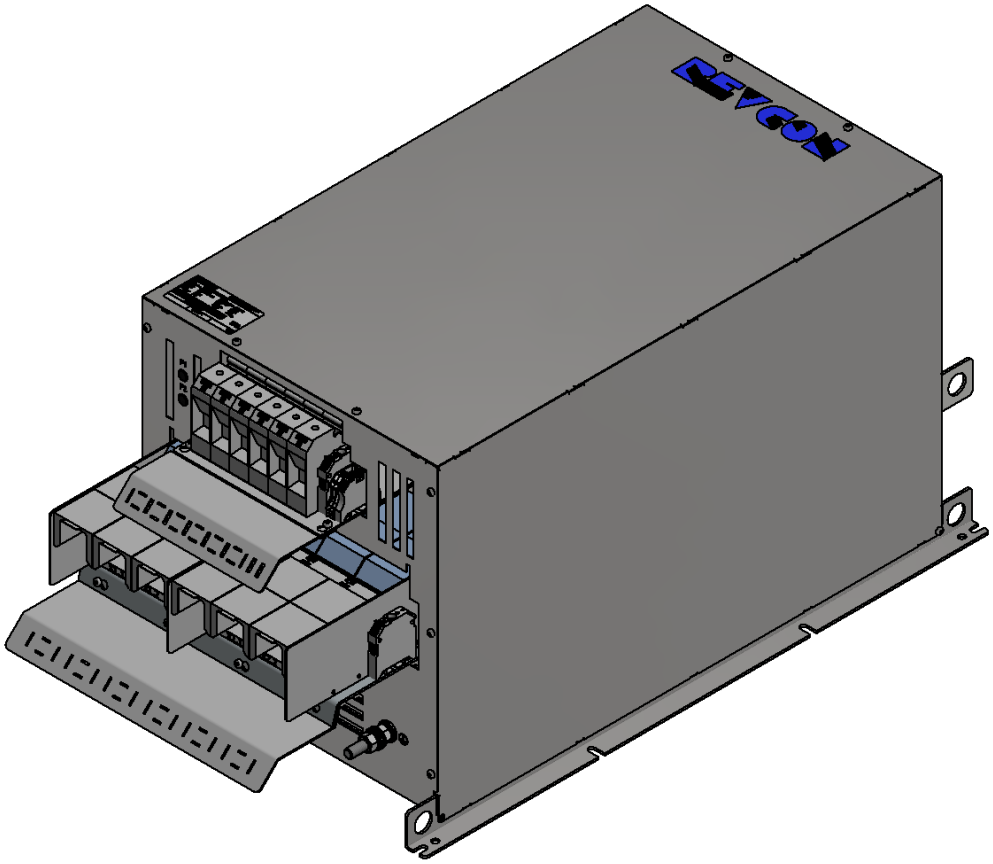
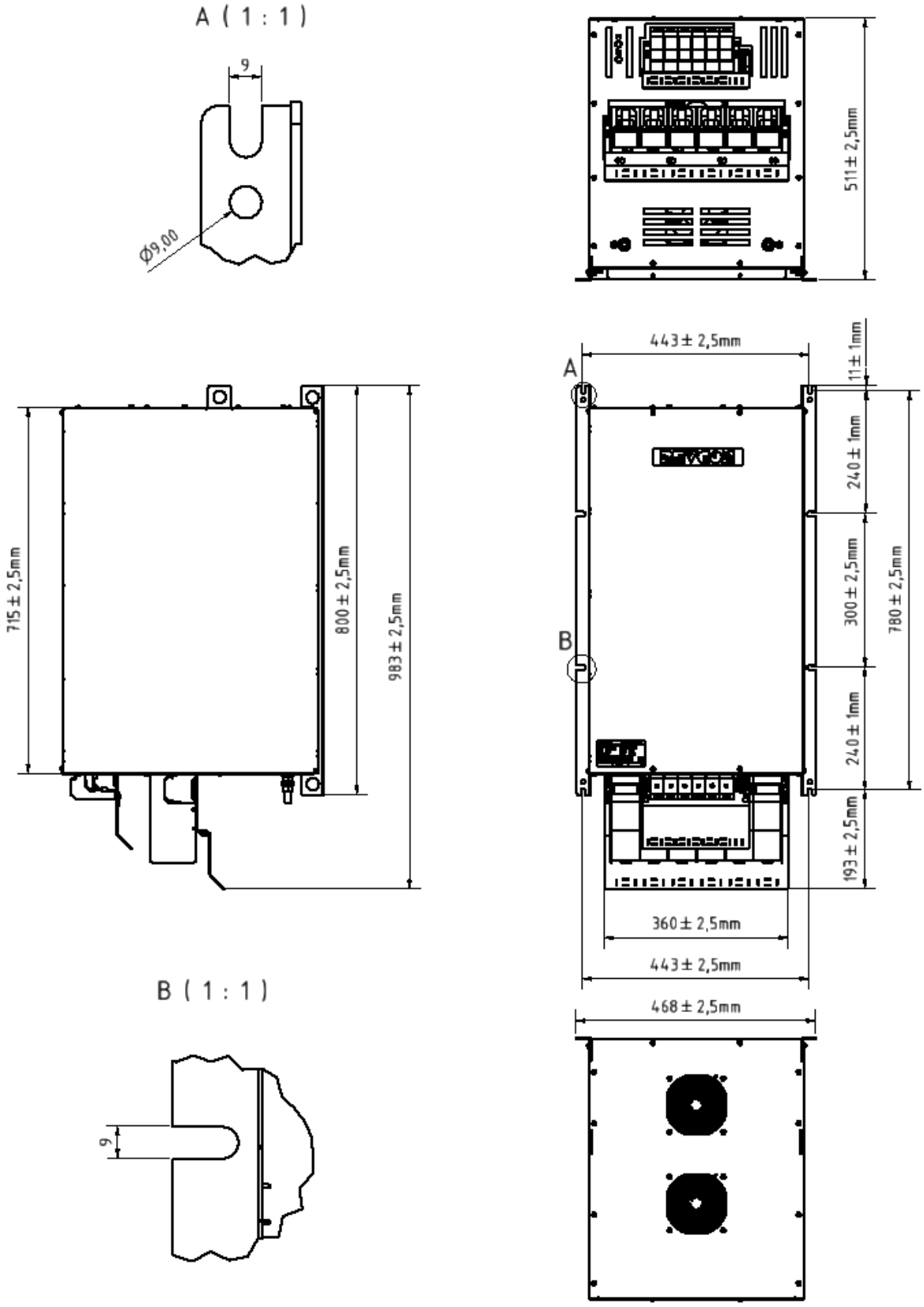




RHF Enclosure X7.3 ef

Installation

Enclosure X8.3 if IP20 (fan placed on inside)



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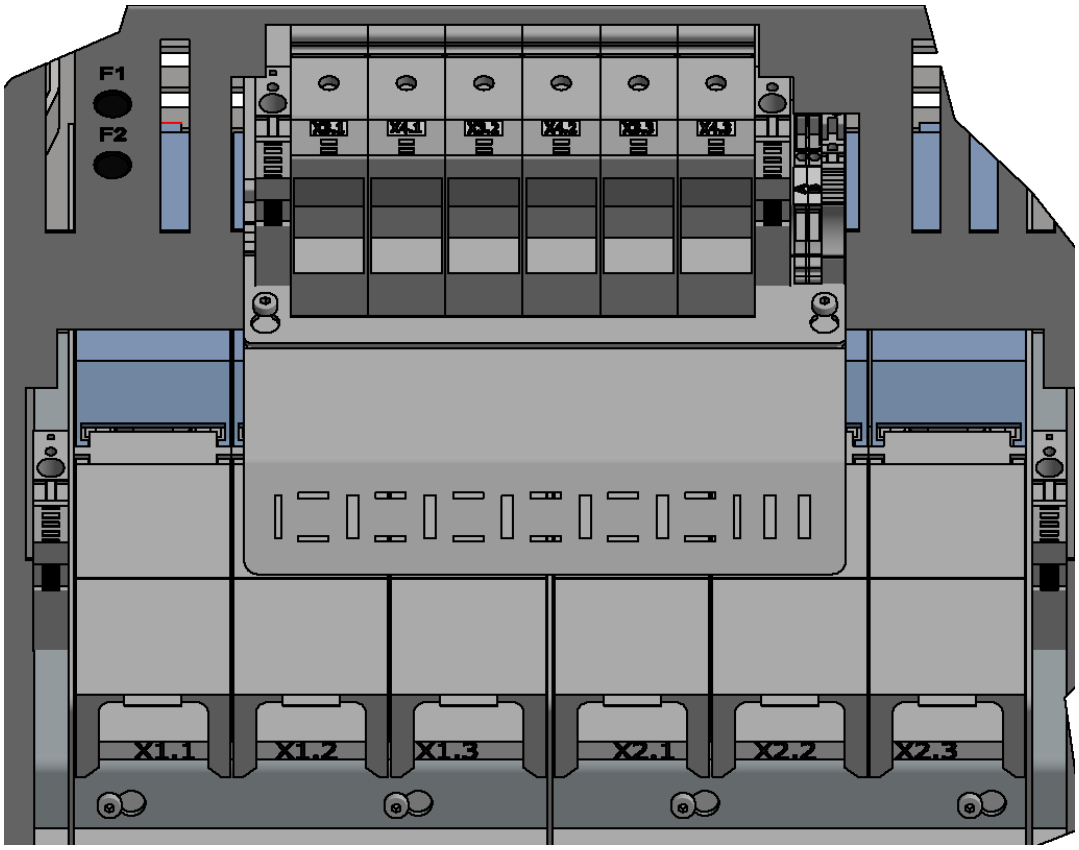
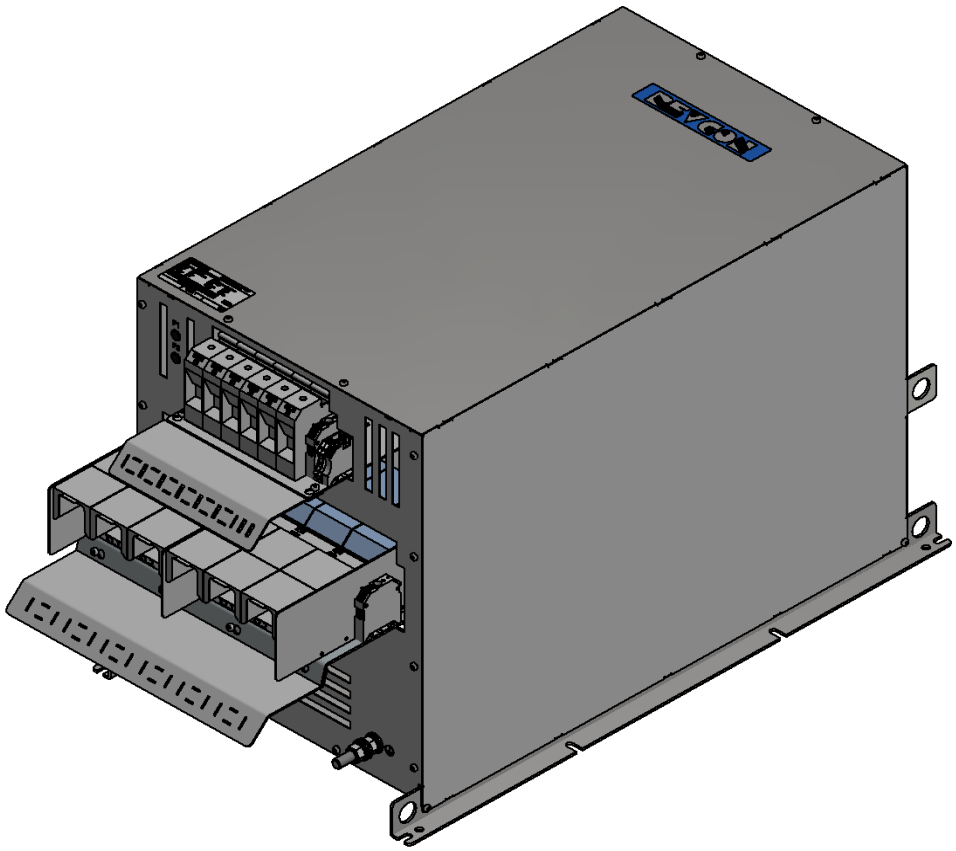
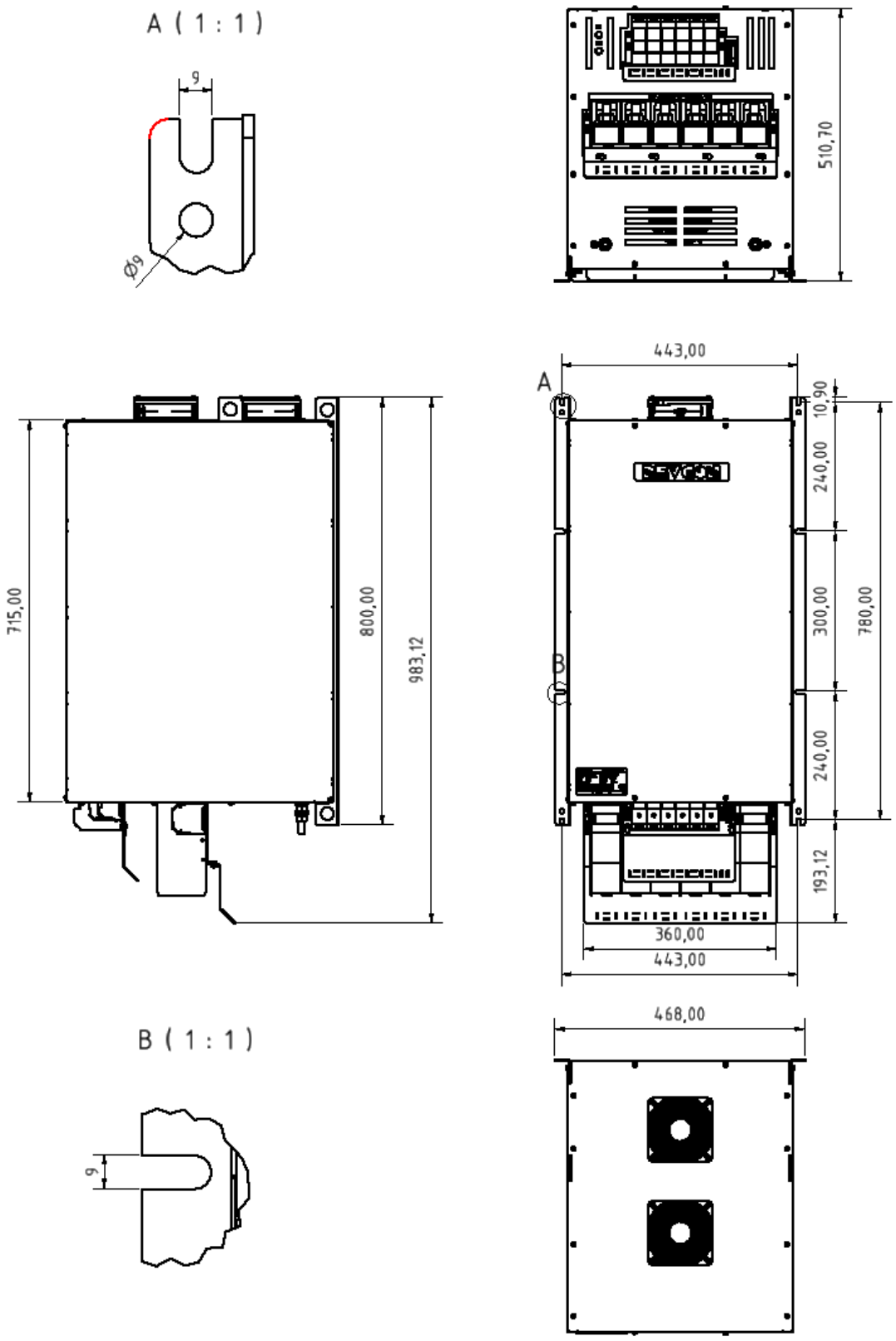




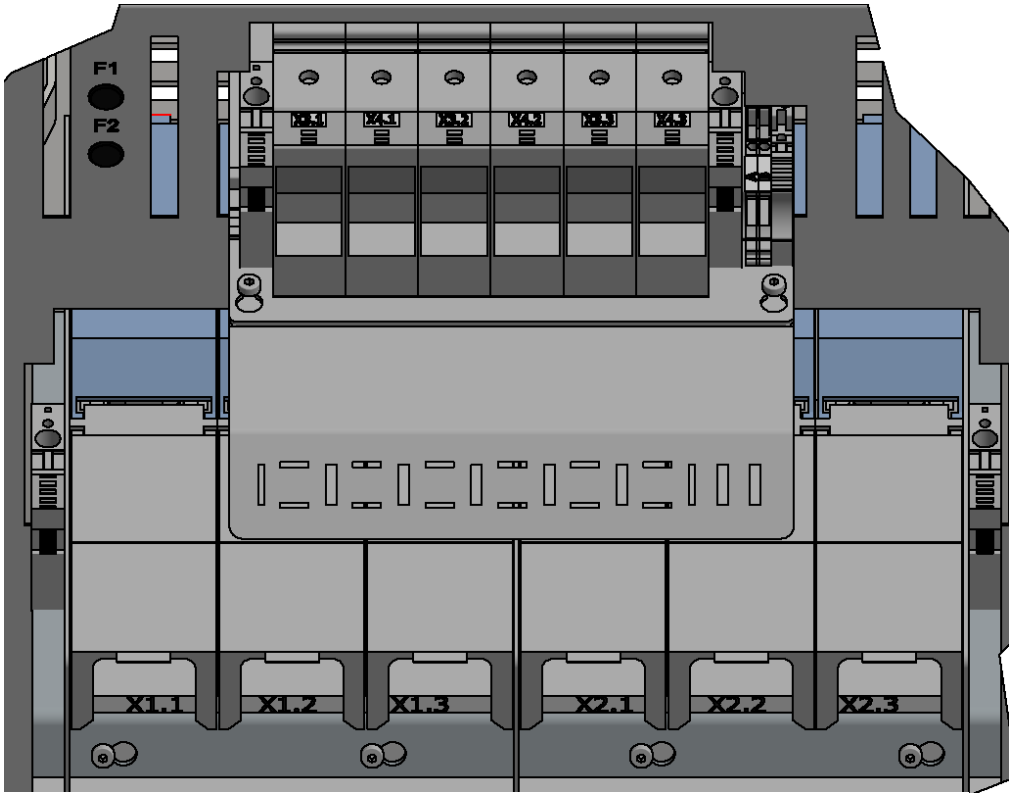
RHF Enclosure X8.3 if

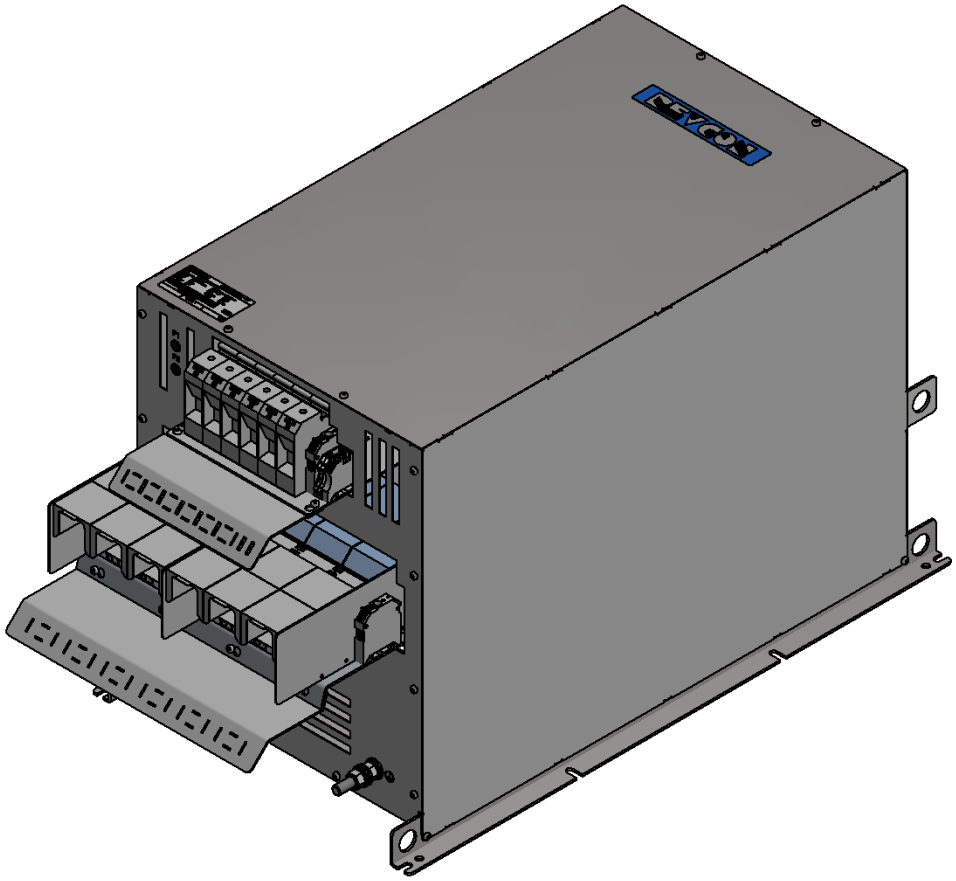
Installation

Enclosure X8.3 ef IP20 (fan placed on outside)



RHF Enclosure X8.3 ef





RHF Enclosure X8.3 ef

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 24).

- 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.

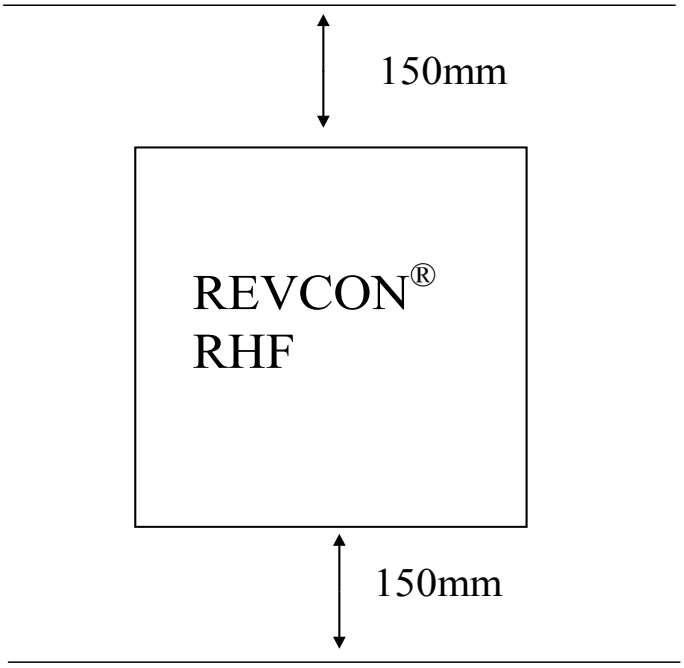


Figure 3: 150mm free space above and below

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 terminals must be placed at the bottom. When assembling the device within an electrical enclosure it must be ensured, that the dissipation heat in the electrical enclosure is discharged adequately. The air temperature of 45°C in direct proximity of the device must not be exceeded. The air input- 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.

When mounting external of a cabinet it is recommended to use the mounting plates (accessories) and mounting 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 to diminish the danger of overheating of filter module and surrounding components.

If other heat sources for example the frequency converter are installed in the same enclosure, the heat that is generated by both components must be considered when sizing 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 25). 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 25 shows the correct mounting of the filter module:

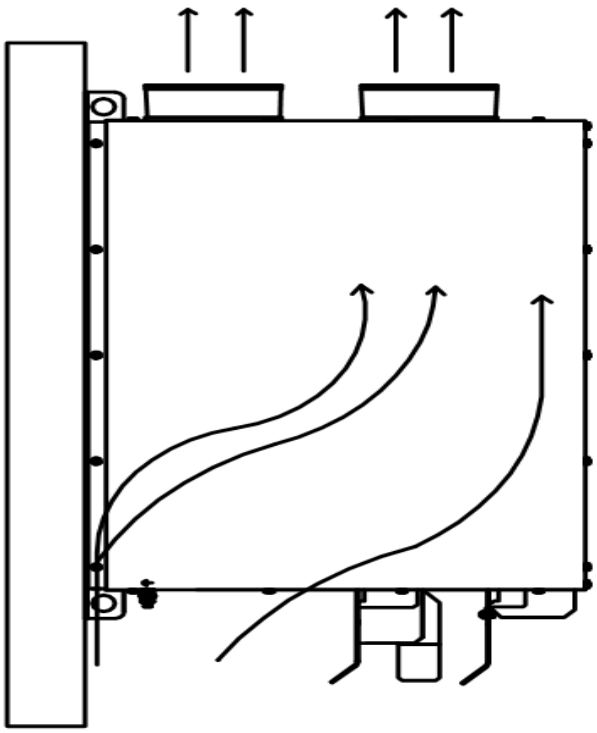


Figure 4: The correct mounting of the filter module

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 5: Network configuration / Net conditions

Stop!

At adverse ambient conditions (THD U >5%, Δf>2 Hz, unbalanced networks >3%) durability shortening of the components could occur .

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.

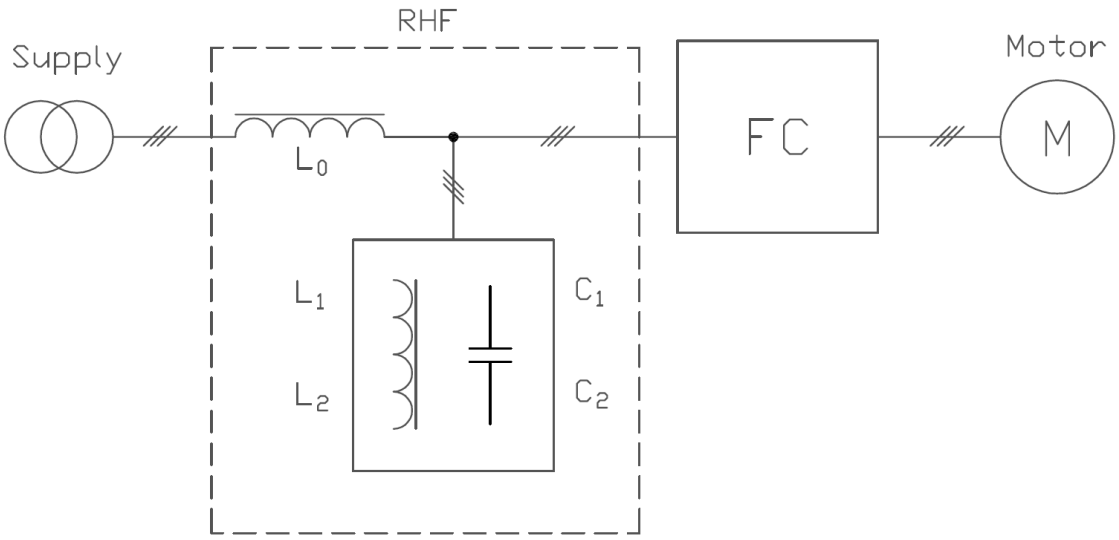


Figure 5: Operation principle RHF

Danger!

Incorrect wiring may disturb the drive controller.

8.3 Wiring diagram RHF

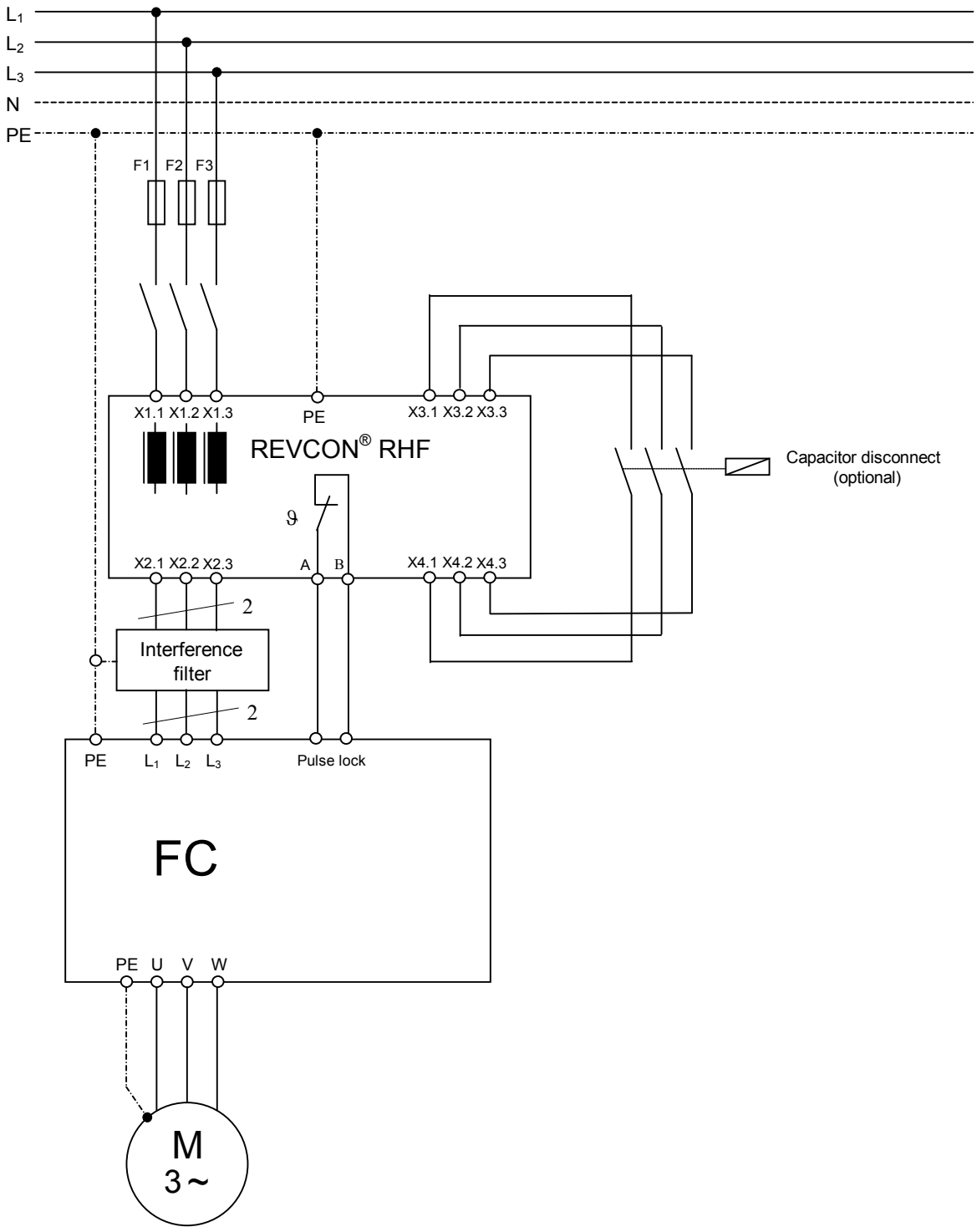


Figure 6: The Wiring of the filter module REVCON® RHF to a frequency converter

Stop!

It is not allowed to run filter modules with nominal current of less than 217A in parallel .

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

- The current and the power of the frequency converter must comply with the equivalent sums of the filter modules.

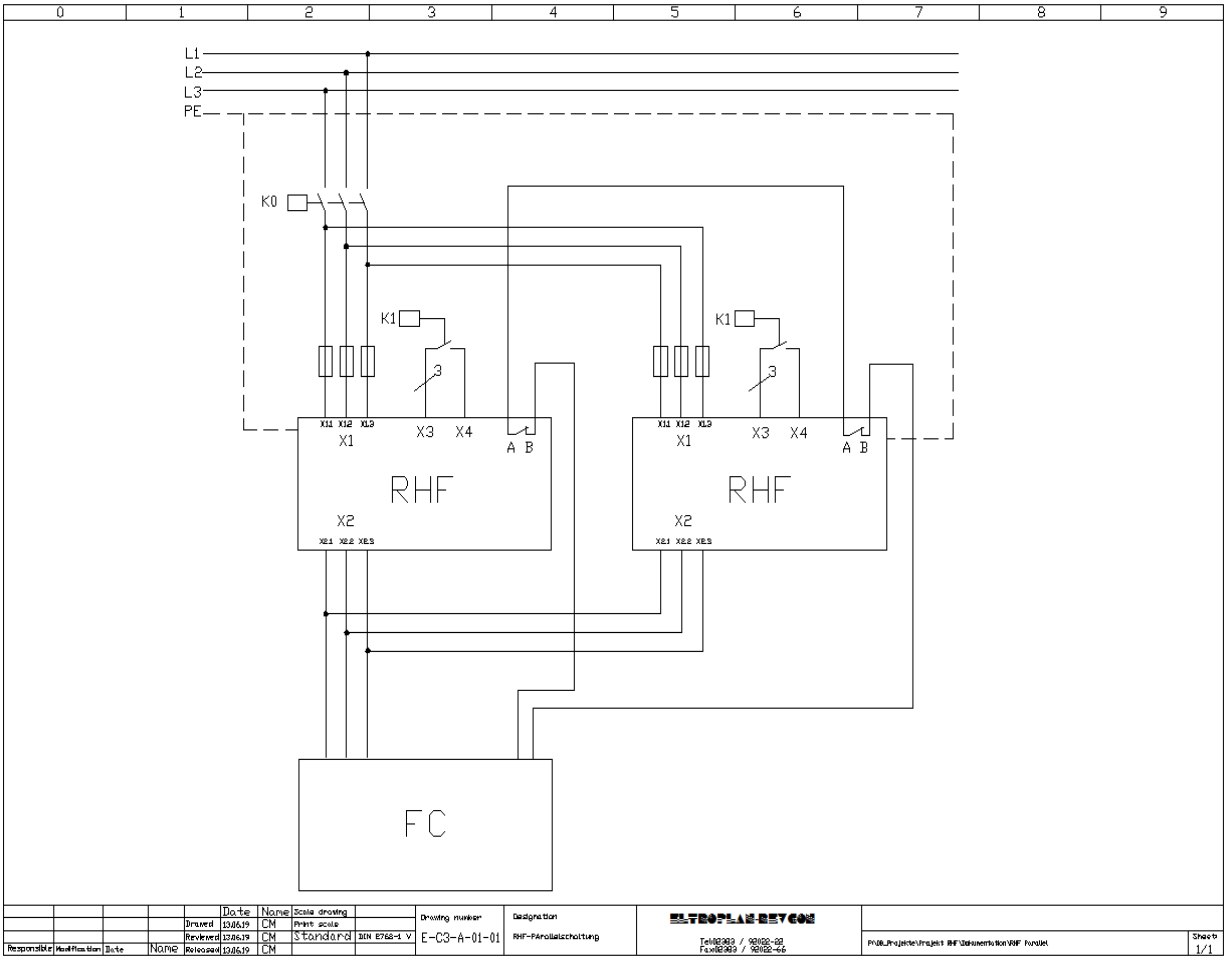


Figure 7: The connection in parallel of filter modules

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 equivalent data of the filter module.

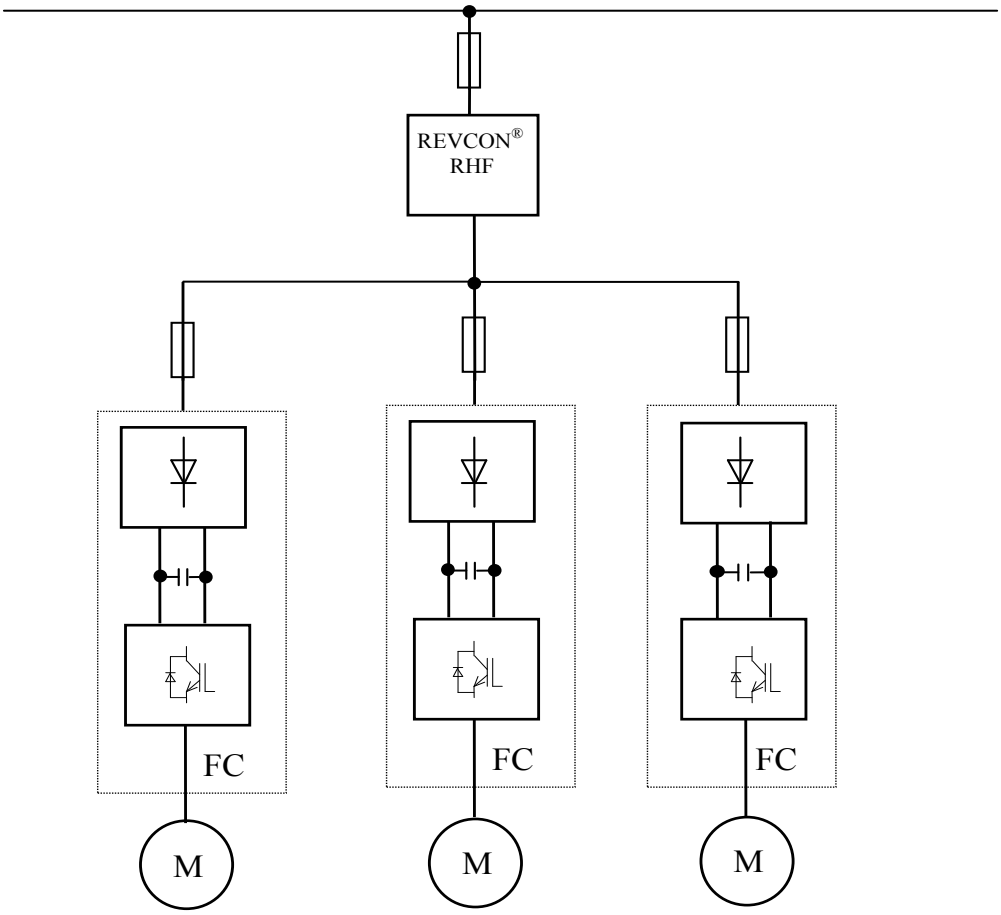


Figure 8: The connection in parallel of frequency converters

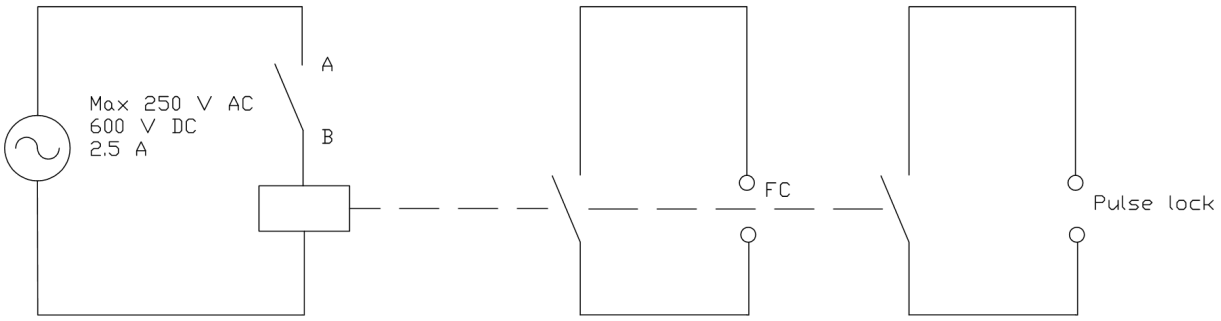


Figure 9: Galvanic isolated switch

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 done as short and induction less as possible.
- To be compliant with 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 done with three phases (active wires).
- Connect the protective conductor of the input lead at the earth bolt of the device.

8.5 Fuses

To protect the installation against electrical hazard and fire hazard all filter modules must be protected against short circuit- and overcurrent following the national / international regulations. At the same the installation shall meet the regulations stated in the manual of the considered drive brand.

For UL and CSA certified filter, type J fuses are mandatory with the maximum current rating as per table below

filter power	460V (60Hz) Type J	600V (60Hz) Type J
5.5kW	20,0	n.a.
7.5kW	35,0	n.a.
11kW	35,0	35,0
15kW	50,0	35,0
18.5kW	50,0	35,0
22kW	60,0	50,0
30kW	80,0	63,0
37kW	125,0	80,0
45kW	150,0	80,0
55kW	250,0	125,0
75kW	250,0	160,0
90kW	300,0	250,0
110kW	300,0	250,0
132kW	350,0	315,0
160kW	400,0	350,0
185kW	600,0	350,0
200kW	600,0	400,0
220kW	600,0	400,0
250kW	600,0	500,0
280kW	600,0	500,0
315kW	600,0	630,0
355kW	n.a.	630,0

Table 6: 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 of lines is important:

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 resistive 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 grounding- 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 connect 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 similar) always must beconnected to suppressor elements like varistors, RC-circuits or protective diodes.
Make all connections as 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

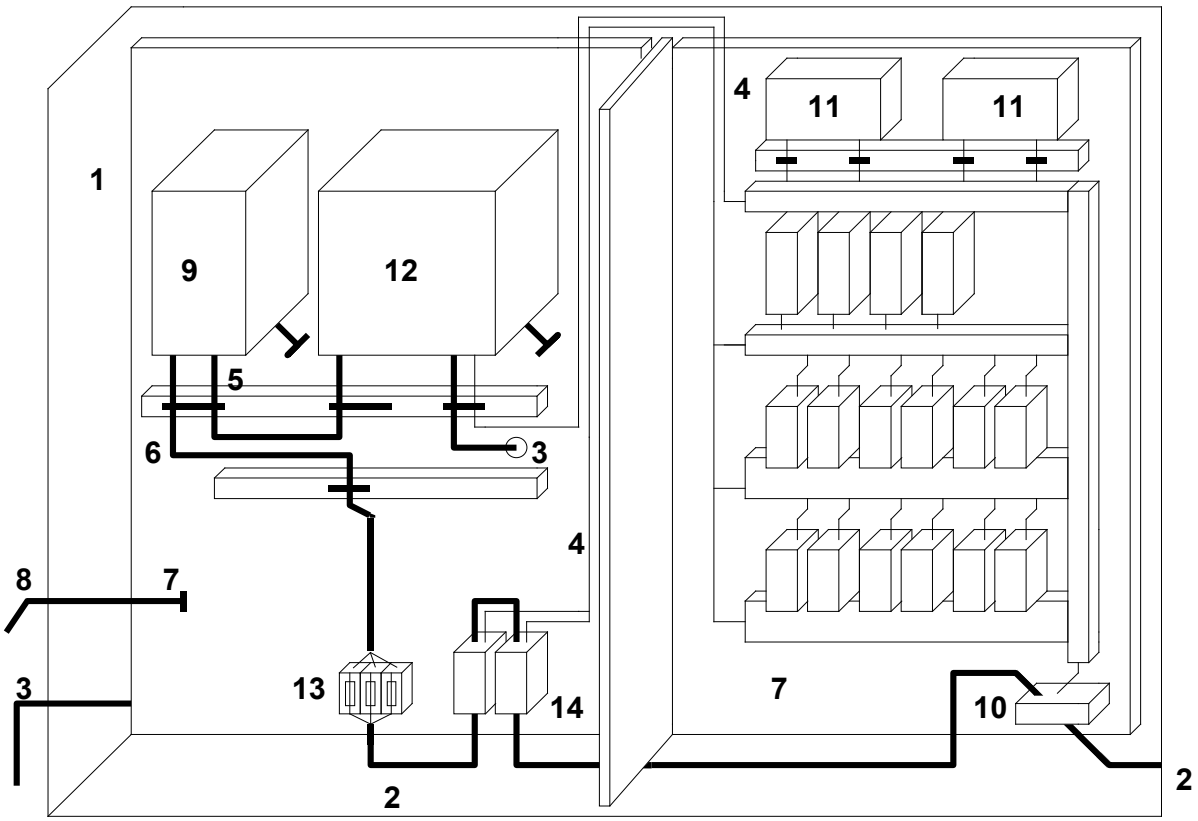


Figure 10: EMC-conform electrical enclosure

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

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

9 Commissioning

Danger!

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

Danger!

In case of an incorrect wiring a disturbance of the drive controller may occur.

Danger!

If (e.g. duringcommissioning) only a provisional power supply is provided, which does not comply with the in this operating instruction specified data (for example: chapter 3) it is strongly recommende to disconnect the filter circuit.

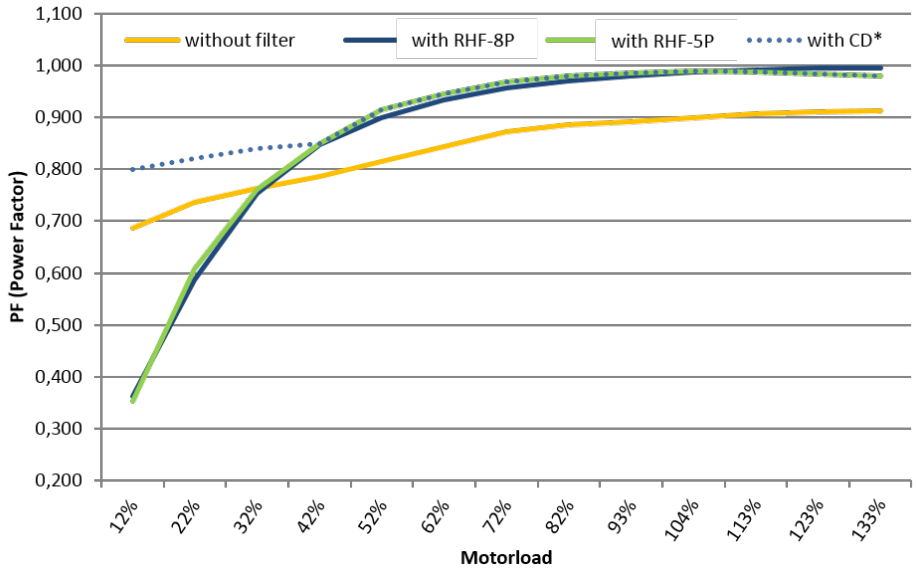
9.1 First switching-on

- 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-8P and RHF-5P:



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 which must replace the short circuit wires between terminals X3 and X4 . Depending on the short-circuit power in the most industrial mains supplies a 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%.

Wait 25 seconds before restarting until the capacitors are discharged completely.

To ensure dynamic cycles of operation the C-disconnection may be done with special capacitor contactors. In this case the connection of the capacitors may be done to a maximal power of 30% without holding time!

For drives operating on generators (e.g. ship applications) capacitor contactors are recommended in general.

Figure 34 shows a typical application of the capacitor disconnection:

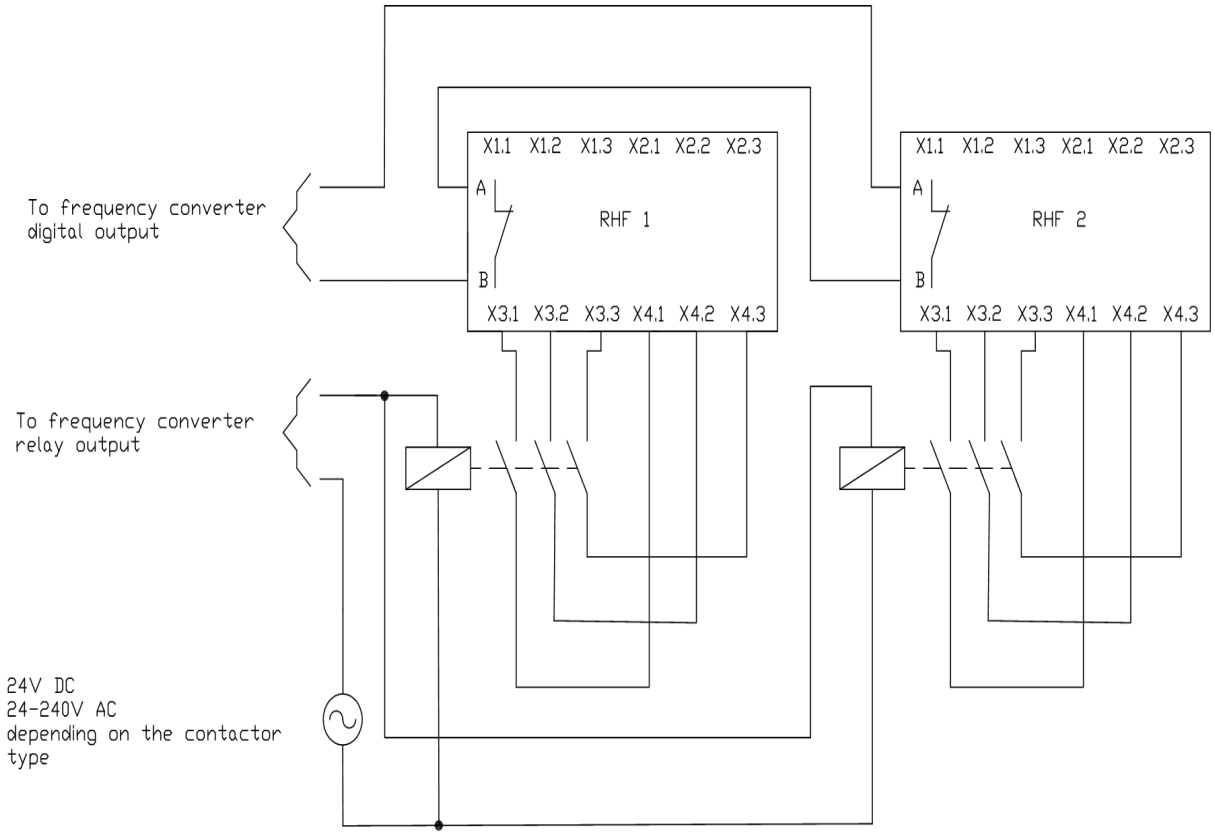


Figure 11: Typical application of the capacitor disconnection

11 Option Nema 1- IP21 enclosure

The option IP21 / Nema1 enclosure- is available in two versions:

- Version 1: Without capacitor-contactor disconnection
- Version 2: With capacitor-contactor disconnection(Only AC3)

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

Version 1:

Enclosure	Designation	Item number	Weight [kg]
X1.3	IP21 NEMA X1	25080030	2,5
X2.3	IP21 NEMA X2	25080031	3,5
X3.3	IP21 NEMA X3	25080032	5
X4.3	IP21 NEMA X4	25080033	6,5
X5.3	IP21 NEMA X5	25080034	7
X6.3	IP21 NEMA X6	25080035	9
X7.3	IP21 NEMA X7	25080036	14
X8.3	IP21 NEMA X8	25080037	17

Table 7: IP21 Version 1

Version 2:

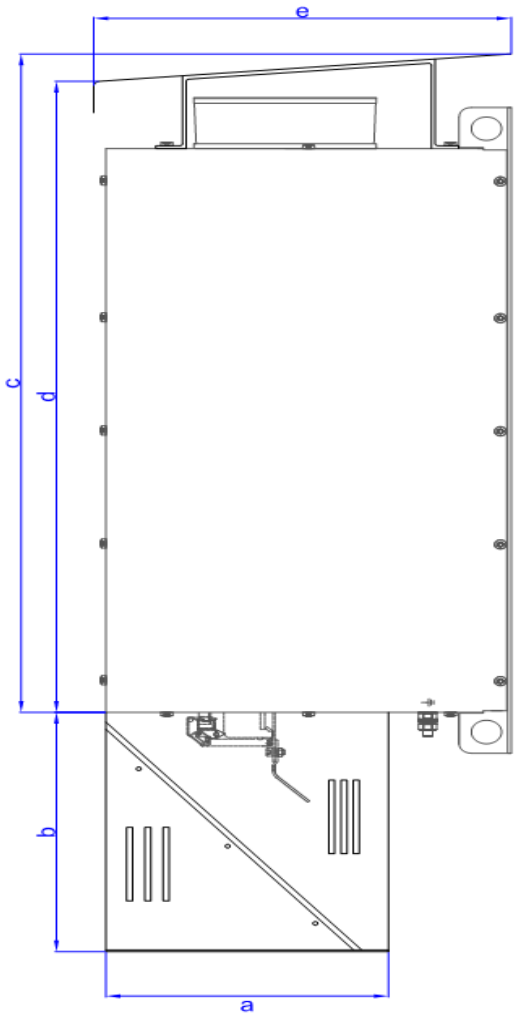
Enclosure	Designation	Item number	Weight [kg]
X1.3	IP21 NEMA X1 CI009	25080050	5,5
X2.3	IP21 NEMA X2 CI016	25080051	6,7
X3.3	IP21 NEMA X3 CI030	25080052	8
X4.3	IP21 NEMA X4 CI045	25080053	9,5
X5.3	IP21 NEMA X5 CI061	25080054	11
X6.3	IP21 NEMA X6 CI098	25080055	15,5
X7.3	IP21 NEMA X7 M225	25080056	20,5
X8.3	IP21 NEMA X8 M225	25080057	23,5
X8.3	IP21 NEMA X8 M225	25080058	27,5

Table 8: IP21 Version 2

Dimensions Nema1:

Enclosure size	Width [mm]	a [mm]	b [mm]	c [mm]	d [mm]	e [mm]
X1.3	190	120	160	329,5	344,5	215,5
X2.3	232	190	180	433,5	448,5	257,5
X3.3	330	145	210	543,5	558,5	252,0
X4.3	330	230	230	573,5	588,5	343,0
X5.3	370	230	250	681,5	696,5	343,0
X6.3	370	300	270	681,5	696,5	410,0
X7.3	420	300	320	796,5	811,5	458,5
X8.3	420	400	350	796,5	811,5	553,0

Table 9: IP21 Dimensions Nema1



Options

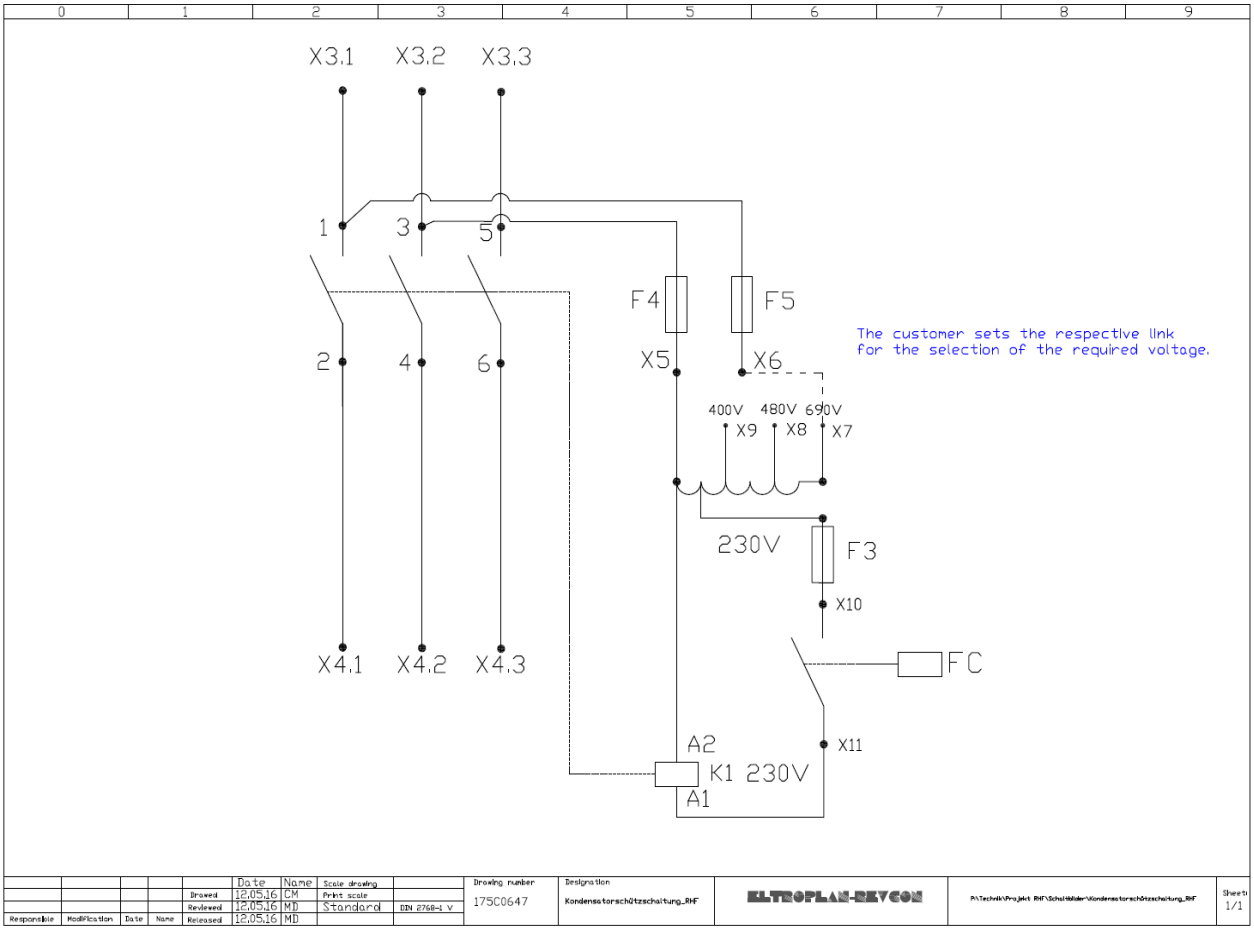


Figure 12: -CD option inside the NEMA-box

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® RLD

Power feedback units for short time operation

(Crane systems, discontinuous centrifugal, etc.)

2. REVCON® RHD

Power feedback units for continuous operation

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

3. REVCON® RFE

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® RHF

REVCON Harmonic Filter – Available as Active Passive or Hybrid Solutions.

13 Contact

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