

Active Harmonic Filter SYSTEM ELECTRIC AHF 100-3 User manual (vers. 1.0)



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1 SAFETY



ONLY A COMPETENT ELECTRICIAN MAY CARRY OUT THE ELECTRICAL INSTALLATION

	= DANGEROUS VOLTAGE
	= WARNING or CAUTION
	= HOT SURFACE – RISK OF BURN



In case you are in doubt about your ability to perform installation or commissioning, do not proceed. Contact your local SE partner for advice.

1.1 Warnings

	1	The SE AHF 100 is meant for fixed installations only.
	2	Do not perform any measurements when the SE AHF 100 is connected to the mains.
	3	Do not perform any voltage withstand tests on any part of the SE AHF 100. This may damage the SE AHF 100.
	4	The SE AHF 100 has a large capacitive leakage current.
	5	The earth leakage current of the SE AHF 100 exceeds 3.5 mA AC. According to standard EN61800-5-1, a reinforced protective ground connection must be ensured. See chapter 1.4.
	6	SE AHF 100 can only be installed in grounded systems.
	7	Only spare parts delivered by SE Electronics Oy may be used.
	8	Do not touch any components of the circuit boards. Static voltage discharge may damage the components.
	9	 When running, the sides and the bottom of the AHF are burning hot.  Do not touch with hands! Therefore it MUST NOT be mounted onto a surface which is not fireproof.
	10	Welding of the cabinet might risk sensitive components in the converter. Ensure that no earthing currents can flow through any part of the converter.

1.2 Safety instructions

	1	The inside components and circuit boards of the SE AHF 100 are live when input terminals L1 L2 L3 are connected to the mains. Coming into contact with this voltage is extremely dangerous and may cause death or severe injury.
	2	Always disconnect the SE AHF 100 from the mains before doing any work on the SE AHF 100. After disconnecting the SE AHF 100 from mains, wait for cooling fan to stop. Wait 5 more minutes before doing any work on the SE AHF 100 connections. Do not even open the cabinet door or cover before this time has expired. Always ensure absence of voltage before starting any electrical work!
	3	The control I/O-terminals are isolated from the mains potential. However, the relay outputs and other I/O-terminals may have dangerous control voltages present even when the mains terminals are not powered.
	4	Before any contact is made to inside parts of the SE AHF 100, measure and make sure that there is no dangerous voltage present on L1 L2 L3 connections.
	5	Make sure that the front cover and the cable connection box cover are closed before connecting the SE AHF 100 to the mains.

NOTE! If a fault protection relay is used, it must be of at least type B, preferably B+ (according to EN 50178), with a trip level of 300 mA. This is for fire protection, not for touch protection in grounded systems.

1.3 Warning symbols

For your own safety, please pay special attention to the instructions marked with the following symbols:

	= <i>Dangerous voltage</i>
	= <i>General warning</i>
	= <i>Hot surface – Risk of burn</i>

1.4 Earthing

The SE AHF 100 must always be earthed with an earthing conductor connected to the earthing connection.

The earth leakage current of the SE AHF 100 exceeds 3.5 mA AC. According to EN61800-5-1, the following conditions for the associated protective circuit shall be satisfied:

The protective conductor shall have a cross-sectional area of half of the cross section of the mains conductor = at least 25 mm² Cu through its total run.

Note that the SE AHF 100 does not include such earth fault protection, which is intended for personal safety.

Due to the high capacitive currents present in the SE AHF 100, fault current protective switches may not function properly.

2 INTRODUCTION

2.1 About this manual

This manual consists of operation and installation instructions for SE AHF 100. It also describes the features and operation of the product and provides important safety information.

2.2 Compliance

2.2.1 CE Marking

The CE Marking on the product guarantees the free movement of the product within the EEA (European Economic Area).

SE AHF 100 carry the CE label as a proof of compliance with the Low Voltage Directive (LVD) and the Electro Magnetic Compatibility (EMC).

2.2.2 EMC Directive

The EMC Directive provides that the electrical apparatus must not excessively disturb the environment they are used in and, on the other hand, it shall have an adequate level of immunity toward other disturbances from the same environment.

The SE AHDcomplies with the following EMC guidelines:

EN/IEC 61000-6-2, Industrial level: Immunity standard for industrial environments.

EN/IEC 61000-6-3, Domestic level: Emission standard for residential, commercial and light-industrial environments

2.2.3 Supplier's declaration of conformity

The following page presents the Supplier's Declaration of Conformity assuring the compliance of SE AHF 100 with the EMC and the LVD directives.



EU DECLARATION OF CONFORMITY

We

Company: SYSTEM ELECTRIC Power Quality GmbH

Address: Odenwaldstr. 4
63589 Linsengericht
Germany

Hereby declare that the product

Product name: Active harmonic filter

Model designation: SE AHF 100

has been designed and manufactured in accordance with the following standards:

Safety: EN 61800-5-1 (2007)

EMC: EN 61000-6-2 (Industrial Immunity)
EN 61000-6-3 (Domestic Emission)

and conforms to the relevant safety provisions of the Low Voltage Directive 2006/95/EC and EMC directive 2004/108/EC.

It is ensured through internal measures and quality control that product conforms at all times to the requirements of the current directives and the relevant standards.

Linsengericht, 26 March 2015

Josef Karl
Managing Director

3 TERMS AND ABBREVIATIONS

Term/Abbreviation	Explanation
cover	There are two covers: One protecting the power connections (cable connection box cover), the other hiding the control and CT connections (front cover).
CT	current transformer, current sensor
I/O connections	digital in- and output connections for ON/OFF/RESET input, Current Limit and Fault output
Supplier	SYSTEM ELECTRIC Power Quality GmbH
SE AHF 100	Active harmonic filter SE AHF 100

4 RECEIPT OF DELIVERY, STORAGE AND TRANSPORTATION

4.1 Receipt of delivery

After unpacking the product check that no signs of transport damages are to be found on the product and that the delivery is complete.

If the SE AHF 100 has been damaged during the transportation, please contact primarily the cargo insurance company or the carrier.

If the delivery does not correspond to your order, contact the supplier immediately.

4.2 Storage and transportation (in the protected package)

If the SE AHF 100 is kept in storage or transported before use, make sure that the ambient conditions are acceptable, see chapter 6.1.3.

The storing environment should also be free from dust and moisture. If there is dust in the air, the converter should be well protected to make sure dust does not get into the SE AHF 100.

The storage area must be located indoors.

If the filter has been left more than 2 years without operation, please contact the party having sold you the SE AHF 100.

For lifting instructions, see chapter 7.1 Wall mounting.

5 WARRANTY, DISCLAIMERS

The Supplier is not responsible for the use of SE AHF 100 against the instructions.

All specifications and information are subject to changes without further notice.

Only manufacturing defects are covered by the warranty. The Supplier assumes no responsibility for damages caused during or resulting from transport, receipt of the delivery, installation, commissioning or use.

The Supplier shall in no event and under no circumstances be held responsible for damages and failures resulting from misuse, wrong installation, unacceptable ambient temperature, dust, corrosive substances or operation outside the rated specifications. Neither can the Supplier be held responsible for consequential damages.

The Supplier's time of warranty is 18 months from the delivery or 12 months from the commissioning whichever expires first (General Conditions Orgalime S2012).

The local distributor may grant a warranty time different from the above. This warranty time shall be specified in the distributor's sales and warranty terms. The Supplier assumes no responsibility for any other warranties than that granted by the Supplier itself.

In all matters concerning the warranty, please contact first the party having sold you the SE AHF 100.

6 TECHNICAL INFORMATION

6.1 Technical description

6.1.1 Introduction

SE AHF 100 is an active filter, which can be used to filter network harmonic currents. The SE AHF 100 is designed for **both industrial and commercial** environments.

6.1.2 Technical data

Electrical data	
Compensation current capacity	100 A
Mains nominal voltage	208 V, 400 V, 440 V, 480 V +/- 10 % (exception: 480V +5%)
Nominal frequency	50/60Hz
Number of phases	3
Connection type	3 phase without neutral for the mains connection + PE neutral connection is needed for the control circuits
Switching frequency	10 kHz
Modularity	parallel connectable without limitation
Response time	<1 ms
Current measurements	3 x 200A/5A / 3VA CT inputs
Power dissipation	<3% of the rated power
Noise level	<80 dB
I/O connections	
Potential free relay contact	Fault, 24Vdc/ 230 Vac, 2A
	Current Limit, 24Vdc /230Vac, 2A
Digital input	ON/OFF/RESET
Mechanical data	
Dimensions (wxhxd) in mm	285 x 919 x 344
Weight (kg)	58
Cooling	forced air cooled
Operation temperature/ Cooling air temperature	-10C-+40C
Enclosure	IP 20
Standards	
EMC immunity	EN 61000-6-2
EMC emissions	EN 61000-6-3
Electrical safety	EN 61800-5-1
Protections and warnings	
Protections	Inverter overtemp Mains overvoltage Phase fault Overcurrent DC-link overvoltage LCL/CAP overvoltage Inductor overtemp
Warnings	Mains undervoltage Current limit

6.1.3 Ambient conditions

The SE AHF 100 is suitable for indoor wall-mount installation, in a well-ventilated area without dust and excessive aggressive gases where the ambient operating conditions do not exceed the following values:

Ambient operating temperature/Cooling air temperature	-10°C...+40°C
Storage/transportation temperature (in the protected package)	-40°C...+70°C
Relative humidity	0 - 95% RH, non-condensing, non-corrosive, no dripping water
Cooling air required	650 m ³ /h
Air quality / chemical vapours	IEC 721-3-3, SE AHF 100 in operation, class 3C2 ^(a)
Air quality / mechanical particles	IEC 721-3-3, SE AHF 100 in operation, class 3S2 ^(b)
Altitude	100% load capacity (no derating) 1000m 1% derating for each 100m above 1000m; max. 3000 m
Vibration	50 ... 150 Hz, EN50178 / EN60068-2-6
Shock	EN50178, EN60068-2-27. Storage and shipping max 15G/11ms (in the protected package).

Remarks:

^(a) Locations with normal levels of contaminants, experienced in urban areas with industrial activities scattered over the whole area, or with heavy traffic.

^(b) Locations without special precautions to minimize the presence of sand or dust, but not situated in proximity to sand or dust sources.

The filter installation must be indoor and it should be taken into account that the protection class is IP20.

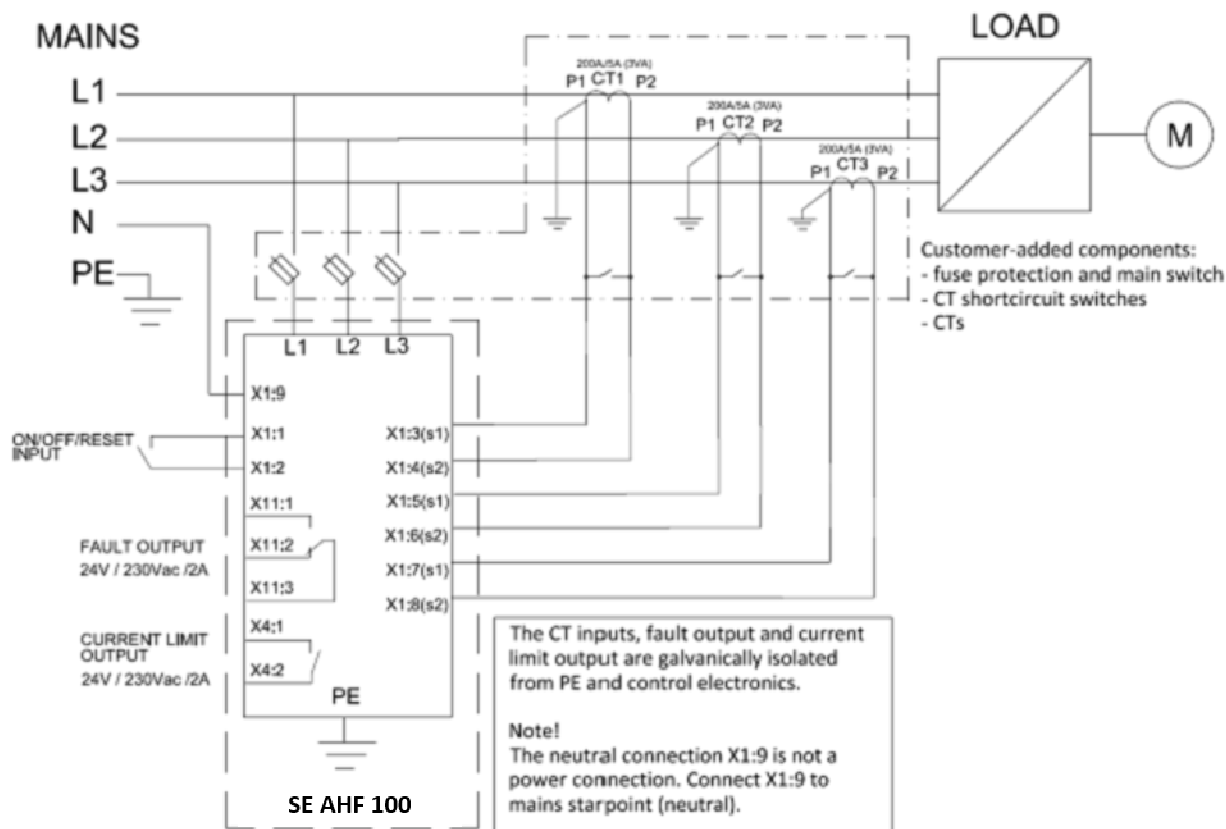


WARNING: Conductive dust may cause damage to this equipment. Ensure that the filter is installed in a room where no conductive dust is present.

6.1.4 Operational description and functions

6.1.4.1 Overall functional description

The SE AHF 100 is designed to compensate harmonic currents (3rd -50th order) drawn from the mains. The SE AHF 100 measures the load harmonic currents with three current sensors CT1 - CT3 (see block diagram below) and injects opposite polarity harmonic currents of the same amplitude into the mains thus minimizing the amount of harmonic currents drawn from the mains.



6.1.4.2 Control functions, input I/O

The SE AHF 100 ON/OFF/RESET states are controlled by a digital input, which is connected to the X1:1-2 I/O connector.

When a fault occurs, or when the SE AHF 100 is controlled to be in the OFF state, the potential-free output relay contact X11:1-3 closes and X11:2-3 opens.

If no fault is active, regardless of the ON/OFF state of the SE AHF 100, the contact X11:1-3 is open and the contact X11:2-3 is closed.

If the fault is resettable, it can be reset by changing the ON/OFF/RESET digital input from ON to OFF to ON. The reset happens when the input turns from OFF to ON.

See block diagram in chapter 6.1.4.1.

6.1.4.3 Output I/O, indicator LEDs

When the SE AHF 100 has to limit its harmonic compensation current, X4:1-2 is activated (contact closes).

When a fault occurs, one or more LEDs light up on the front cover. The fault causes and corrective actions are explained in the relevant chapter further below.

See block diagram in chapter 6.1.4.1.

6.1.4.4 Current transformers, mains and the neutral for control circuitry

In order to put the SE AHF 100 into operating condition, three load current sensors CT1 – CT3, the ON/OFF/RESET input, the protective earth and the AC mains cables L1-L3 have to be connected. The mains N cable is connected to the control electronics.

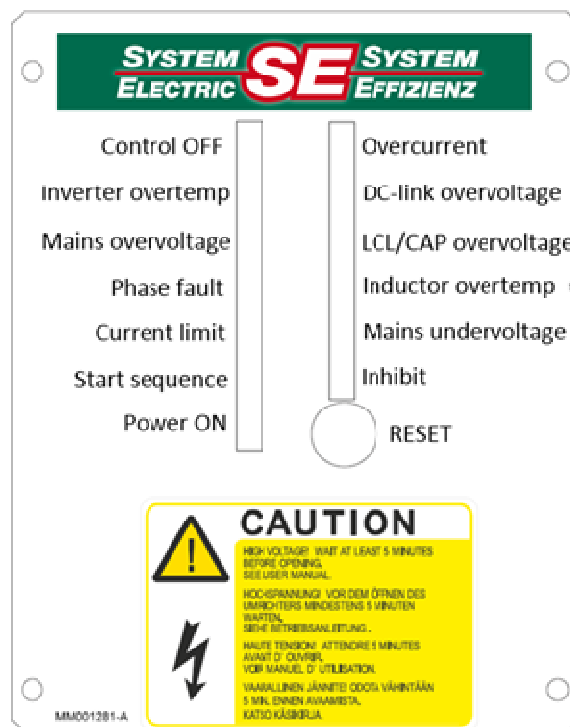
The neutral is not needed for the mains circuitry, but a thin cross section (1.5 mm²) neutral connection is needed for the control circuits of the SE AHF 100.

See block diagram in chapter 6.1.4.1.

6.2 Control of SE AHF 100

6.2.1 LED indicators

The LED indicators give you information on both fault and normal situations. For corrective actions and more detailed information see chapter 9 MAINTENANCE.



LED indication	LED status and colour	Meaning
Control OFF	on (red)	SE AHF 100 switched off
	off	normal operation
	blinking (red)	see text for LCL/CAP overvoltage
Inverter overtemp	on (red)	SE AHF 100 stopped, inverter temperature limit exceeded
	off	normal operation
Mains overvoltage	on (red)	SE AHF 100 stopped, mains nominal voltage exceeded
	off	normal operation
Phase fault	on (red)	SE AHF 100 stopped due to missing phase or abnormally low (less than 50% of nominal) mains voltage
	off	normal operation
Current limit	on (yellow)	SE AHF 100 has reached its maximum output current, or the inverter temperature is abnormally high.
	off	normal operation
Start sequence	on (yellow)	SE AHF 100 just connected to mains which normally starts the pre-charging or mains voltage abnormally low. SE AHF 100 stopped
	off	normal operation
Power ON	on (green)	normal operation
	off	no auxiliary power
Overcurrent	on (red)	SE AHF 100 stopped due to abnormal overcurrent
	off	normal operation
DC-link overvoltage	on (red)	SE AHF 100 stopped, DC-link voltage limit exceeded
	off	normal operation

LED indication	LED status and colour	Meaning
LCL/CAP overvoltage	on (red)	SE AHF 100 stopped, DC-link capacitor overvoltage or LCL filter capacitor overvoltage (if Control OFF LED is blinking (1Hz) at the same time)
	off	normal operation
Inductor overtemp	on (red)	SE AHF 100 stopped, internal inductor temperature limit exceeded.
	off	normal operation
Mains undervoltage	on (yellow)	SE AHF 100 stopped. Mains voltage abnormally low (less than 80% of nominal).
	off	normal operation
Inhibit	on (yellow)	SE AHF 100 stopped
	off	normal operation

6.2.2 Control interface - inputs and outputs

The control connections are the following:

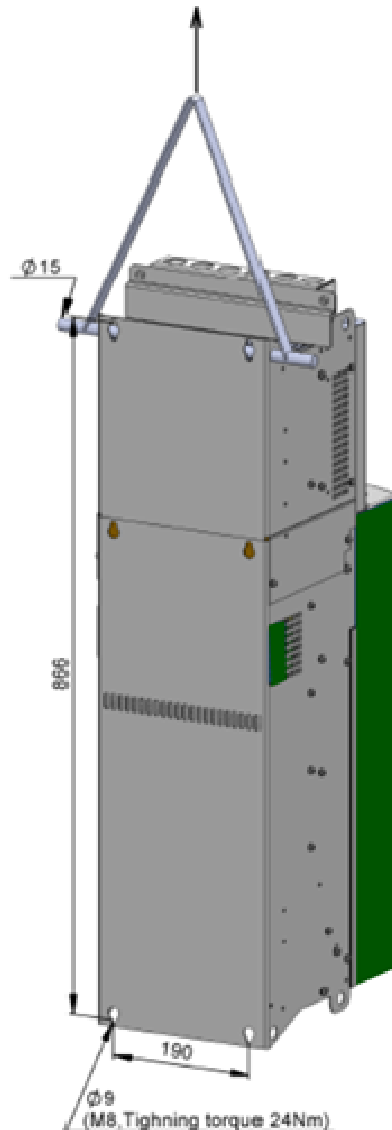
X1 control input terminal		technical information	specification
1	+24Vdc out	on/off/reset control voltage	max 50mA
2	on/off/reset input	on/off/reset input	Uin max 24Vdc+10%
3	CT1 s1	L1 load current transformer input galvanically isolated from PE and control electronics	3VA 200/5A recommended cable cross-section 2.5mm2
4	CT1 s2		
5	CT2 s1	L2 load current transformer input galvanically isolated from PE and control electronics	
6	CT2 s2		
7	CT3 s1	L3 load current transformer input galvanically isolated from PE and control electronics	
8	CT3 s2		

X4 current limit output terminal		technical information	specification
1-2	NO relay contact	Current limit output. Potential free relay contact, galvanically isolated from PE and control electronics. This contact is closed when current limit is activated.	2A / 24Vdc / 230 Vac

X11 fault output		technical information	specification
1	NO relay contact	Fault output. Potential free relay contact, galvanically isolated from PE and control electronics. Contact 1-3 closes when any fault is active.	2A / 24Vdc / 230 Vac
2	NC relay contact		
3	COM		

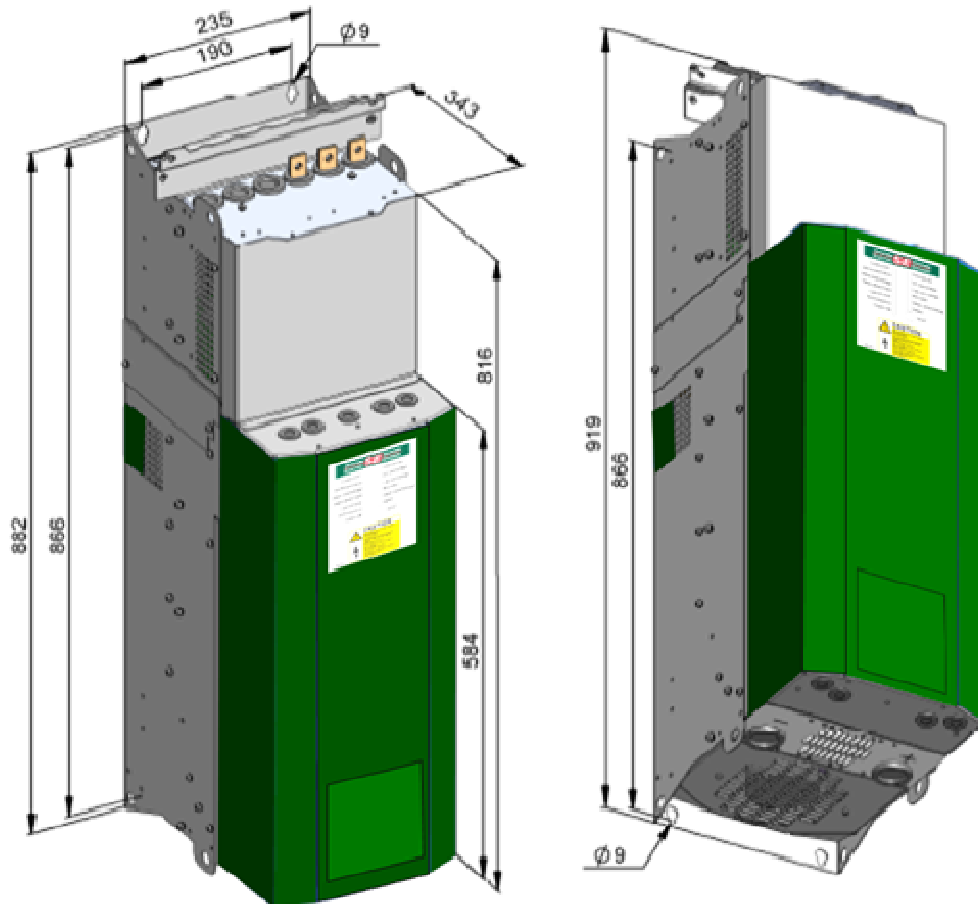
7 MECHANICAL INSTALLATION

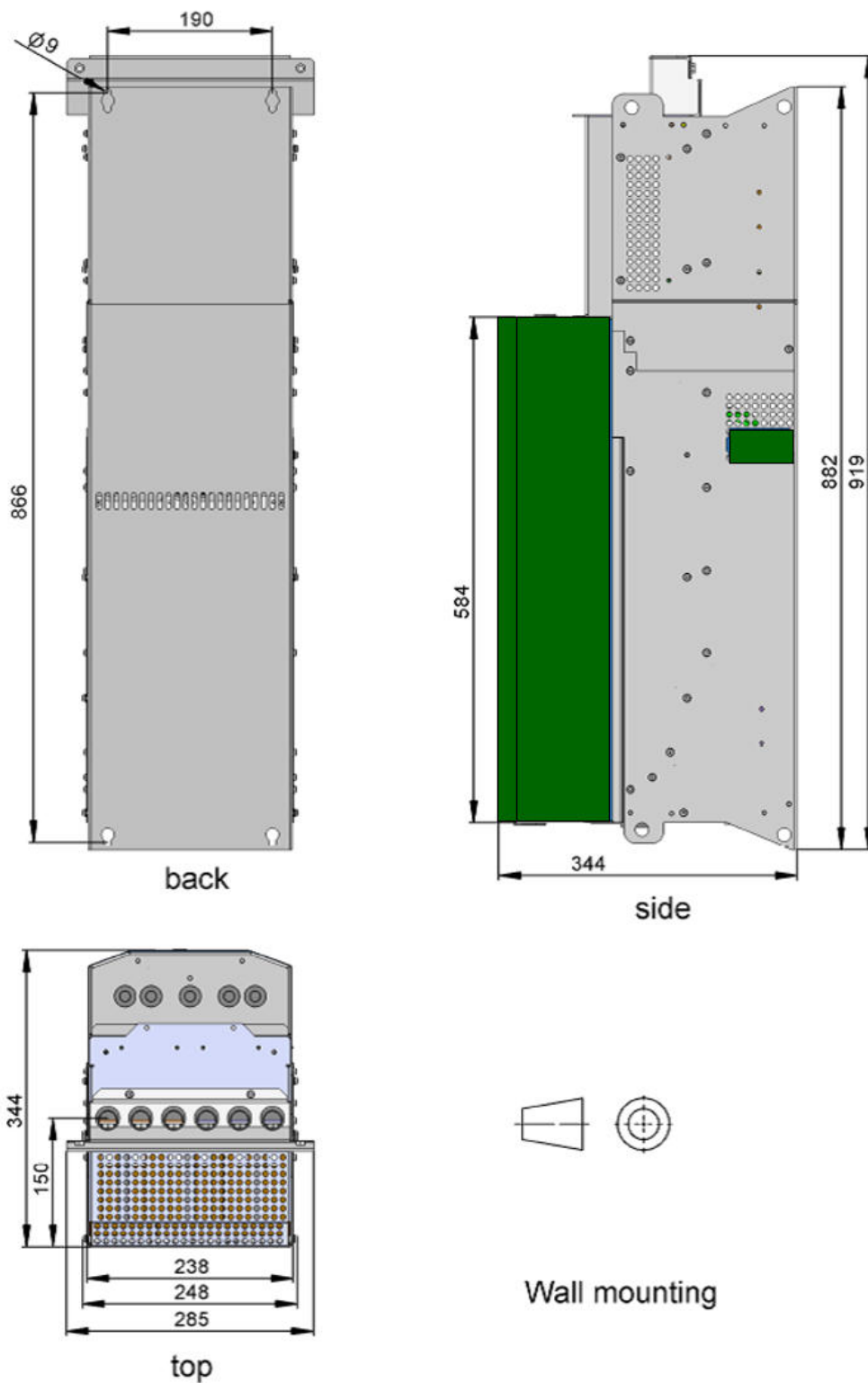
Please note that the filter equipment weighs approximately 58 kg. Care should be taken to ensure that correct handling facilities are used. The SE AHF 100 may only be lifted with a steel bar as shown in the picture below. The steel bar (cross section 15 mm) must be put through the holes on top of the filter. The filter may NOT be lifted with hooks but only with the steel bar (otherwise risk of deformation/bending). Also NEVER lift the filter using any blue part, only the grey structure and its lifting holes are designed for lifting.



7.1 Wall mounting

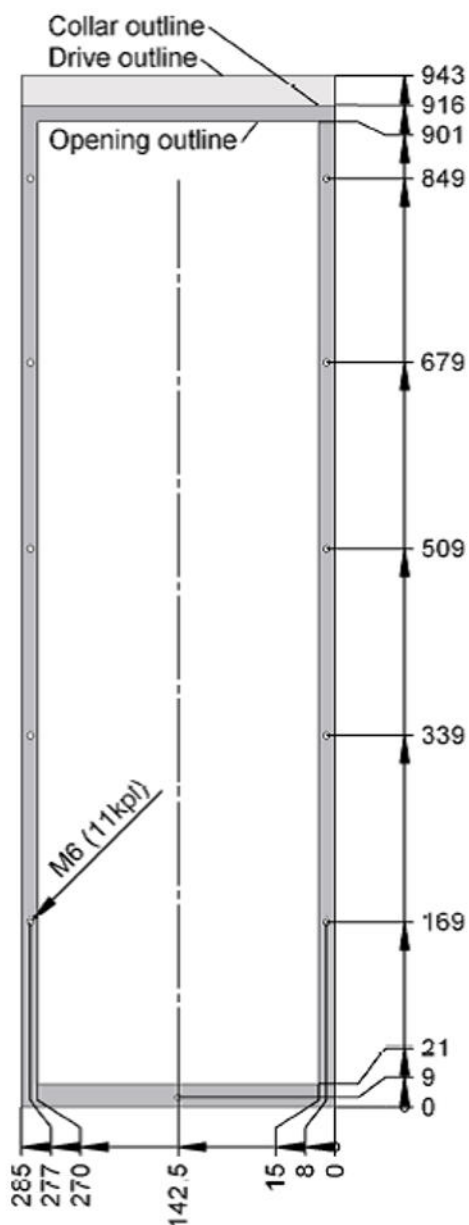
The SE AHF 100 must be mounted in vertical position on the wall or on the back plane of a cabinet. The wall on which the filter unit is mounted must be able to support the weight of the filter, which is approx. 58 kg. Enough free space must be reserved around the SE AHF 100 in order to guarantee proper cooling (see chapter 7.3). Also the SE AHF 100 identification tag should always remain readable to ensure proper identification during the life of the SE AHF 100. To ensure safe mounting, the use of an even mounting plane is required. Fastening must be done with four M8 (steel 8.8) bolts. The dimensions of the SE AHF 100 with IP20 enclosure is shown in the picture below:



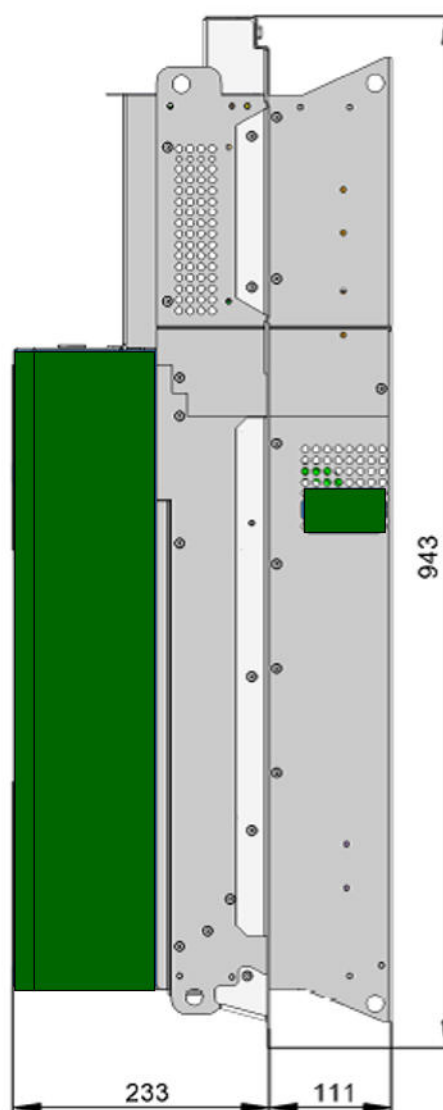


7.2 Flange mounting

The AHF can also be recessed into the cabinet wall or similar surface. A special flange mount option is available for this purpose. For an example of a flange-mounted SE AHF 100, see pictures below. Observe the mounting instructions given in chapter 7.1 Wall mounting.



Flange mounting cutout



Flange mounting

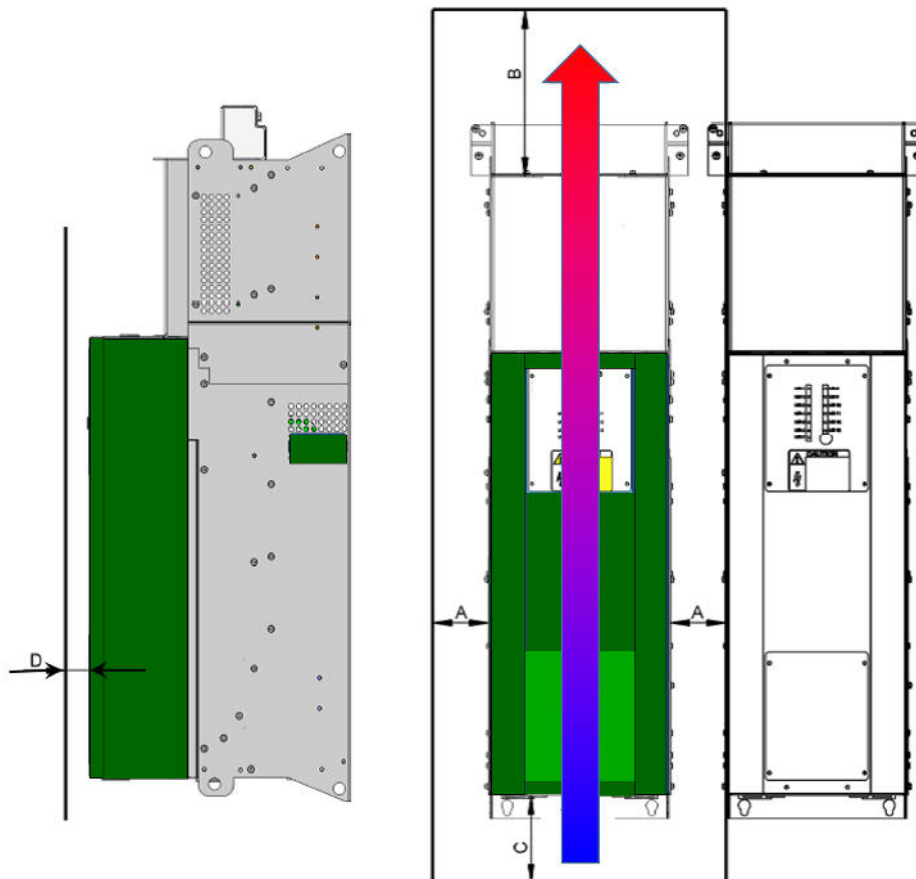
7.3 Cooling

Enough free space shall be left around the SE AHF 100 to ensure sufficient air circulation, cooling as well as maintenance. You will find the required dimensions for free space in the picture below.

If a filter system consists of more than one filter unit, the units should be installed next to each other. If several units are mounted above each other the required free space equals $b + c$. Moreover, the outlet air used for cooling by the lower unit must be directed away from the air intake of the upper unit. The amount of cooling air required is indicated below.

Also make sure that the temperature of the cooling air does not exceed the maximum ambient temperature of the SE AHF 100. Please ensure that the air used for cooling does not contain conductive particles, significant amounts of dust, or corrosive or otherwise harmful gases. The cooling air intake temperature must not exceed the operating temperature.

Cooling air required is 650 m³/h (air quality IEC 721-3-3).



A = 80 mm	free space to both sides of the SE AHF 100/ free space between two SE AHF 100
B = 300 mm	free space above the SE AHF 100
C = 200 mm	free space underneath the SE AHF 100
D = 30 mm	free space in front of SE AHF 100

8 Electrical installation



WARNING: The SE AHF 100 is able to operate on mains voltages 208 V, 400 V, 440 V, 480 V with a tolerance range of +/- 10 % (480V +5%). Since operation at the upper limits of voltage and temperature may reduce its life expectancy, the SE AHF 100 should not be connected to systems for which it is known that over voltages +15% will be sustained indefinitely. Excessive voltage levels may lead to filter damage.

WARNING: The SE AHF 100 is not designed to be connected to systems where one phase serves as neutral.

The SE AHF 100 must be connected to the mains in parallel with the loads which are drawing harmonic current from the AC mains.

WARNING: The SE AHF 100 does not incorporate protective power line fuses. Hence the customer has to ensure that the feeding cables to each filter are adequately protected taking into account the filter rating and the cable section used.

Basic filter functionality can be obtained after connection of:

- Ground (PE) (per enclosure)
- Three power cables L1-L3. The power lines must be protected by appropriately sized fuses.
- 3 CTs 200A/5A/burden 3VA (max 7m) one per phase to be connected to filter unit
- Neutral (1.5 mm²) for control circuits.
- I/O connection for ON/OFF/RESET input
- I/O connections for Fault and Current Limit outputs
- Parallel units: The CTs have to be selected depending on the number of parallel CTs. See chapter 8.2 below for details on parallel units and their connection.

8.1 Power connections

8.1.1 Selection of the power cable size

Several types of power cable can be used to connect the filter to the mains. Local regulations and habits often determine the user's choice. Note however that due to the internal EMC filter of the SE AHF 100, there is not more radiated emission than specified in the specified EMC EN norm through the mains connection. Consequently, there is no need for special screening of the mains connection cables.

8.1.2 Making the power connections

Remember to use contact treatment grease in aluminium power connections, e.g. electrolube CG70.



Warning

Proceed as follows:

Before starting the installation, check that none of the components of the SE AHF 100 are live.

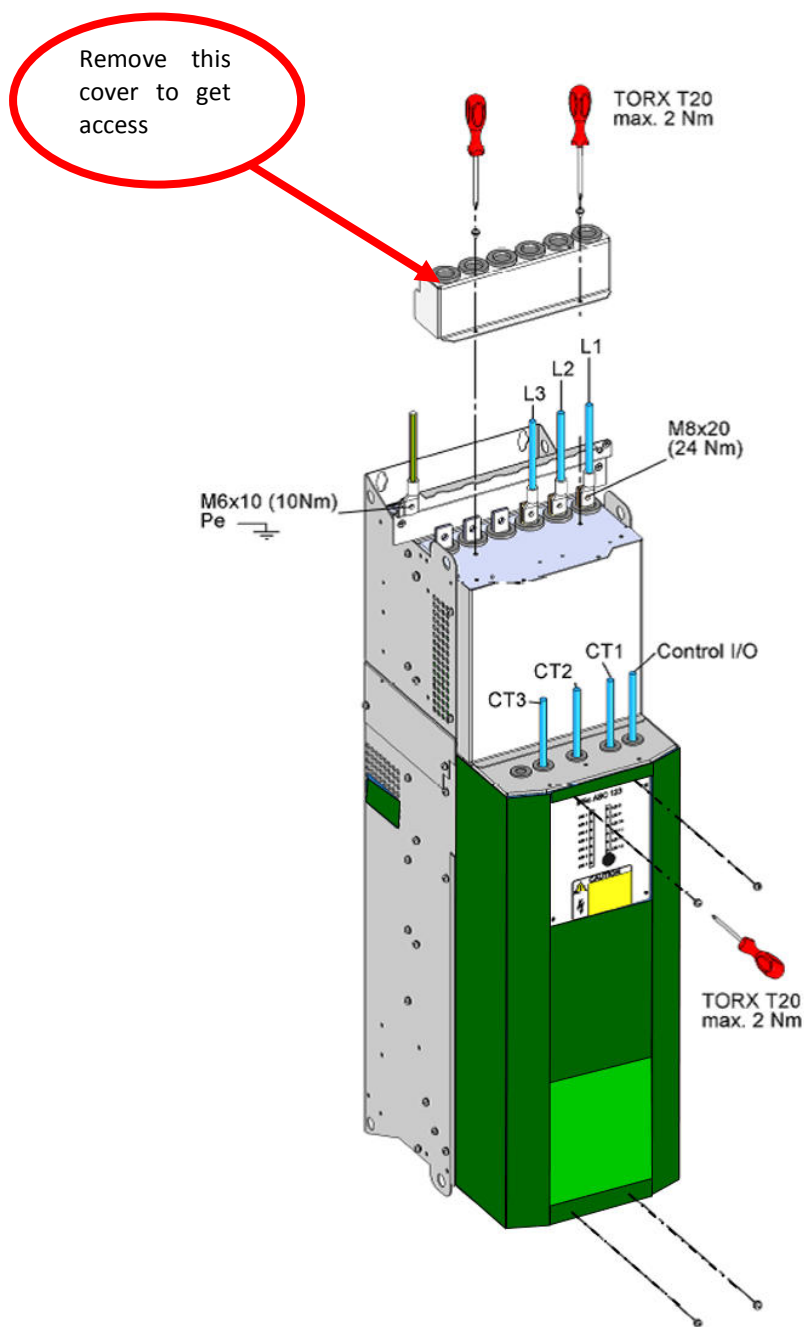
Power connections:

The voltage phase rotation at the SE AHF 100 power supply terminals must be clockwise.



WARNING: Applying voltage to the SE AHF 100 to check the phase rotation may only be done after ensuring that the mains voltage level is acceptable for the filter operation and after it has been found that the filter is not mechanically nor electrically damaged.

The connections are shown below. You need to lift the cover marked with the red arrow:



Connections and covers

1. Power connections for L1, L2 ,L3 are 3 aluminium busbars (including M8 nut) at the top of the SE AHF 100.
2. Protect earth (PE) point (including M6 nut).

The cable and fuse sizes are listed below:

Power connections	recommended cross section 50mm ² /Cu
Earthing cable	min. 25 mm ² Cu
Mains fuse ampere rating and type	125A gG

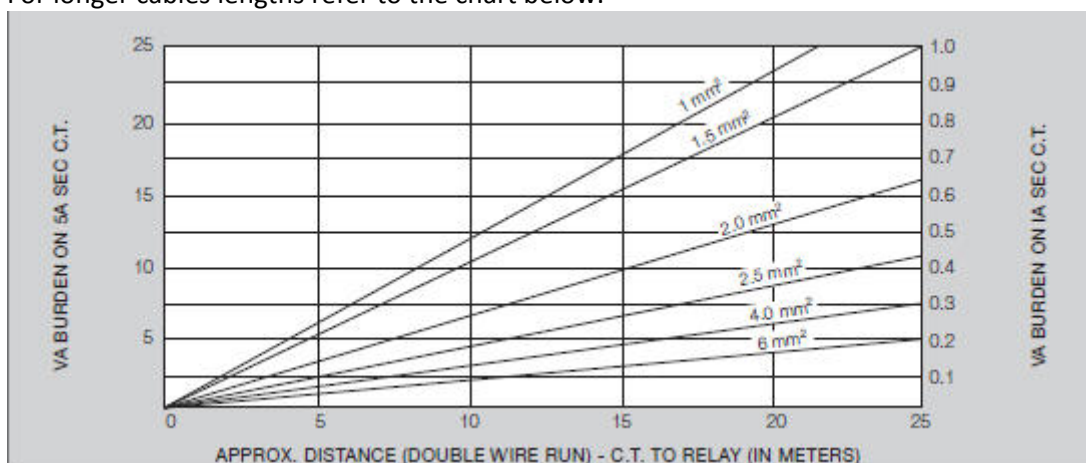
8.2 Current transformers

8.2.1 Selection of current transformers and current transformer cables

Each SE AHF 100 unit in a filter system has to monitor the load current in order to determine the harmonic load and function correctly. This is done by three current transformers (CTs). For proper operation of the SE AHF 100 standard accuracy CTs with the following minimum specifications have to be used:

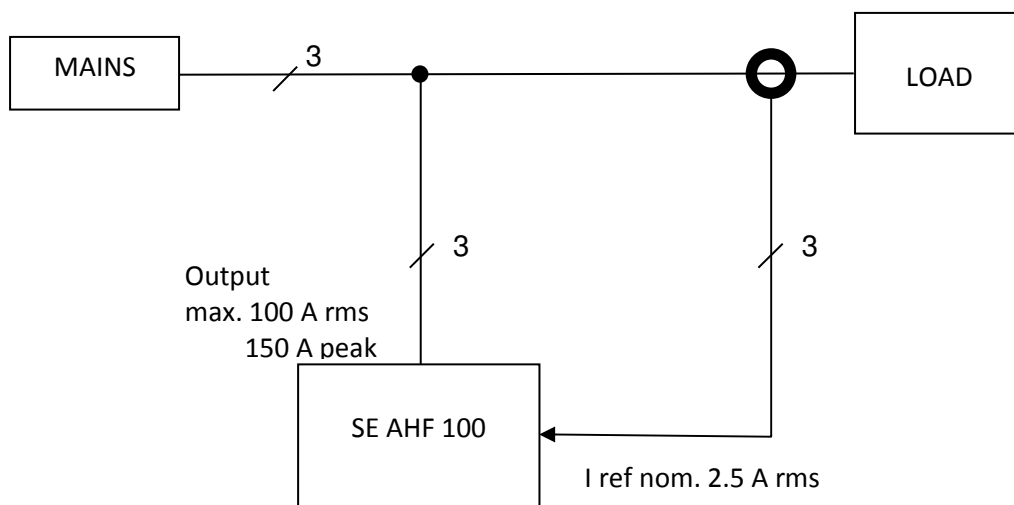
- accuracy :class 0.5
- current transformer ratio 200A/5A (recommendation for single unit)
- burden : 3VA (for single unit , max. 7 m distance (with 2.5 mm² cables))
- burden for complete filter system (6 units) is 7.5 VA. Maximum 7m cables excluding interconnection cables between the filter units.

For longer cables lengths refer to the chart below:



It is strongly recommended that the three CTs have the same characteristics.

The continuous RMS current reference signal from the load current transformers allowed for the SE AHF 100 is 2.5 A rms. At this current reference, the SE AHF 100 produces a 100 A rms (max. 150 A peak) output current.



CTs for compensation ratio 1:1	
Number of SE AHF 100	CT
1	200 A/5 A
2	400 A/5 A
3	600 A/5 A
4	800 A/5 A
5	1000 A/5 A
6	1200 A/5 A

8.2.2 Current transformer installation and connection

The location of the CTs is critical to ensure the proper operation of the active filter. The CTs are the “eyes” of the filter and it will react in accordance with the information supplied by them.



WARNING: Special care has to be taken for the connection and location of the CTs: wrong CT installation is the most common source of problems found at the commissioning stage.

WARNING: In a filter system consisting of more than one SE AHF 100 unit, the same CT information has to be supplied to all the units. This must be done through a daisy chain connection configuration.

By default, the SE AHF 100 is provided with CT terminals that are not shorted.

WARNING: When connecting the CTs of a live system to the SE AHF 100, the secondaries of the CTs have to be shorted. Failure to do so may result in CT explosion and consequent damage to the installation and/or to the SE AHF 100 unit. Once the connections to the filter have been made, the shorting links must be removed.

The basic rules for successful CT installation are given next (see block diagram in chapter 6.1.4.1):

- The three filter CTs have to be positioned for **open loop control**, i.e. the CT must monitor the load current.
- The CTs must be positioned in the correct direction around the power cable: the P1 (K) side should be in the direction of the supply and the P2 (L) side should be in the direction of the load.
- Each CT must have its own guard circuit, i.e. one terminal of each CTs secondary terminal (S1 (k) or S2 (l)) should be earthed. Once a terminal is chosen (e.g. S1 (k)-terminal), the same terminal should be earthed for all the CTs.

The basic CT connection for a single unit active filter is shown in the block diagram in chapter 6.1.4.1 Overall functional description.

The CT connection terminal X1 is located below the front cover. Remove the four M4 Torx T5 screws shown in the left picture below in order to lift the front cover vertically upwards and to remove it. The location of the X1-terminal below the front cover and the numbering is shown in the two pictures on the right.



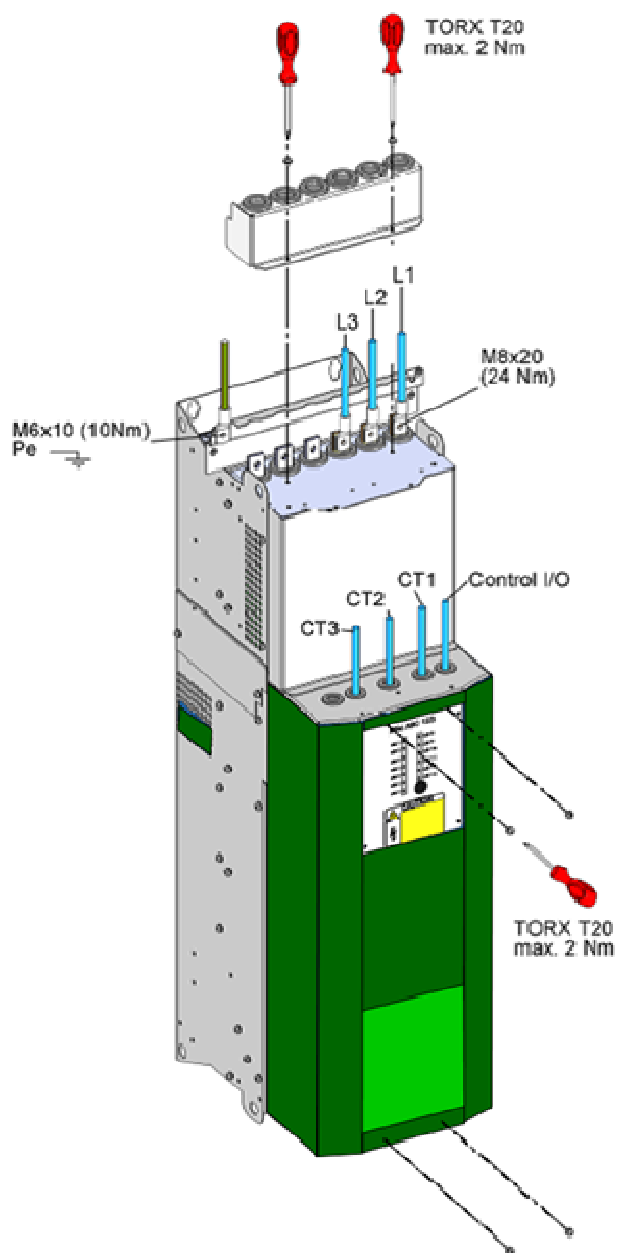
four M4 Torx T5 screws

X1 connection terminal for CTs



X1 numbering

In the picture below, you can see the closed SE AHF 100.



Connections and covers

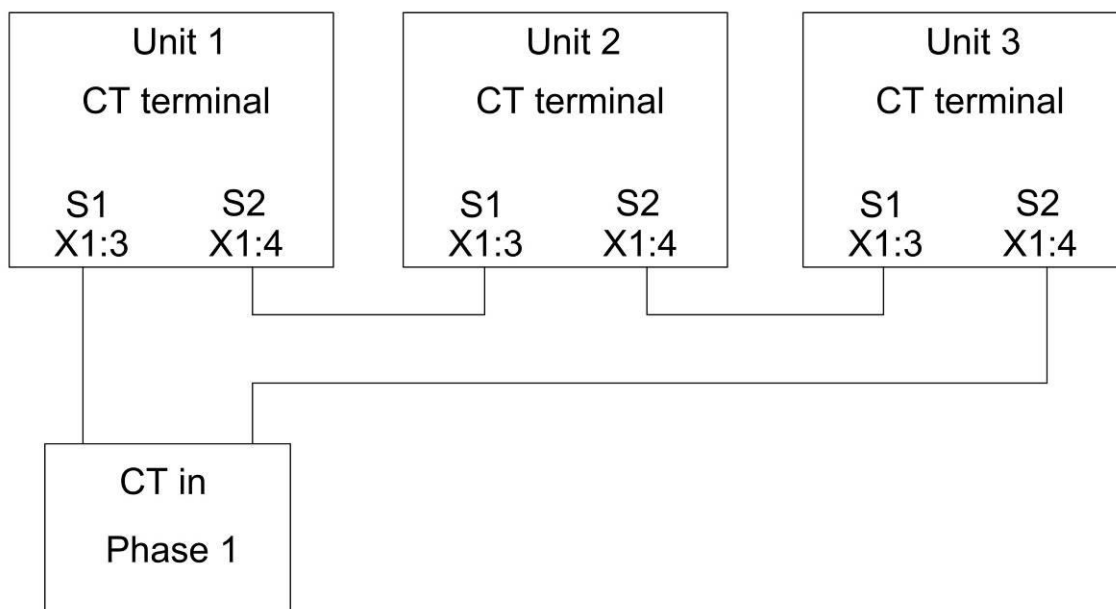
8.2.3 Current transformer cable interconnection



WARNING: Failure to connect the CTs to all units in a filter system in an appropriate way will result in filter malfunctioning and possibly severe damage of the unit.

In a multi-unit SE AHF 100 system, all units have to be supplied with the CT-measurement results. In order to do this the CTs have to be cabled to each unit in a daisy chain fashion. The connection principle is shown in the figure below for the CT of phase 1 which is fed to three (up to six allowed) SE AHF 100 units. The same approach has to be implemented for the other phases too.

The principle of the CT interconnection circuit for multi-unit filters is shown below:



8.3 Control connections

The control cable sizes and types are listed below:

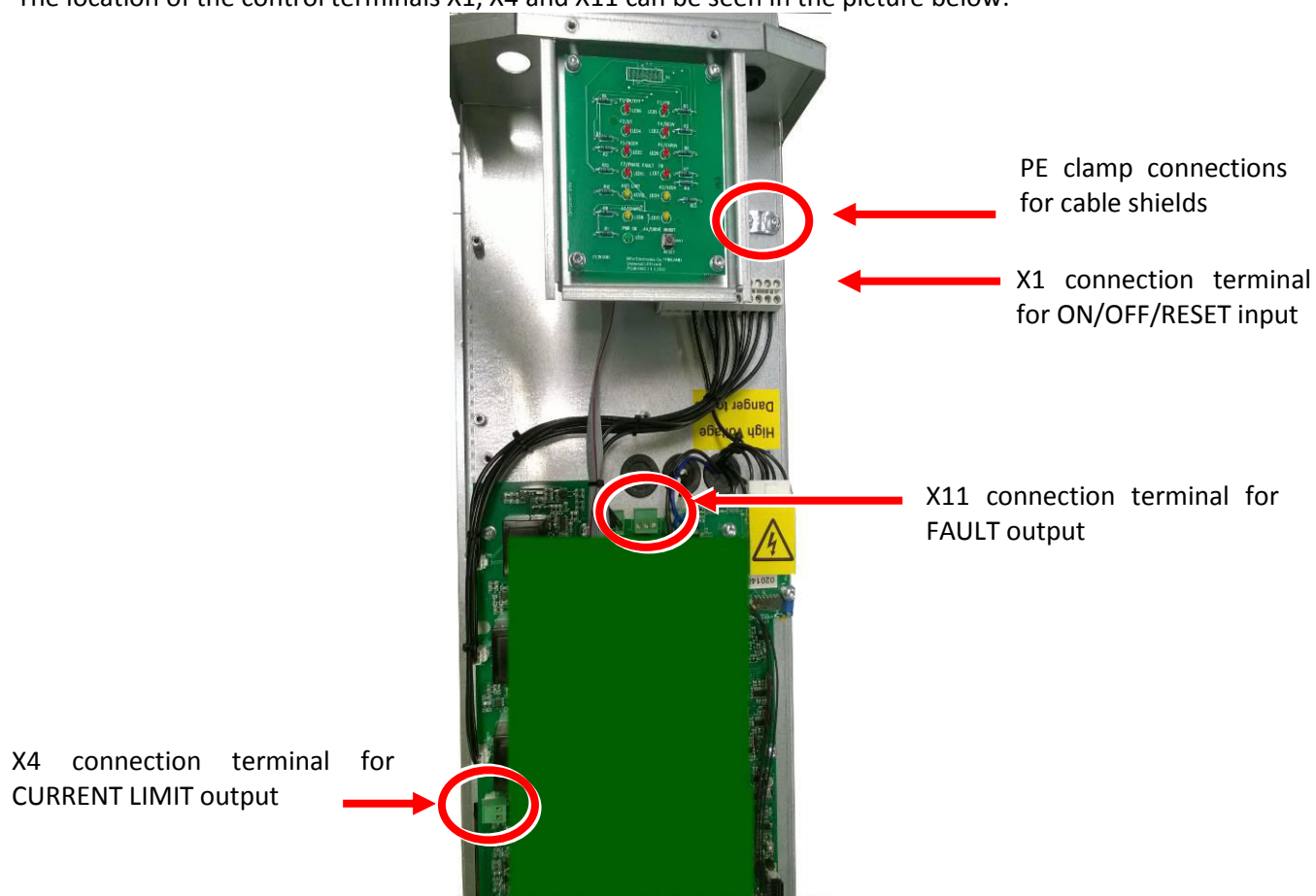
Control connectors	Connection method: screw terminals X1 : Cross section: 0.5 mm ² - 4 mm ² X4, X11 : 0.25 mm ² - 2.5 mm ²
PE connectors	clamp connection
Cable type for control cable	Screened cable equipped with low impedance shield

Proceed as follows:

The control cable terminals are located under the front cover. Remove the four M4 Torx T5 screws shown in the picture below in order to lift the front cover vertically upwards and to remove it.



The location of the control terminals X1, X4 and X11 can be seen in the picture below:



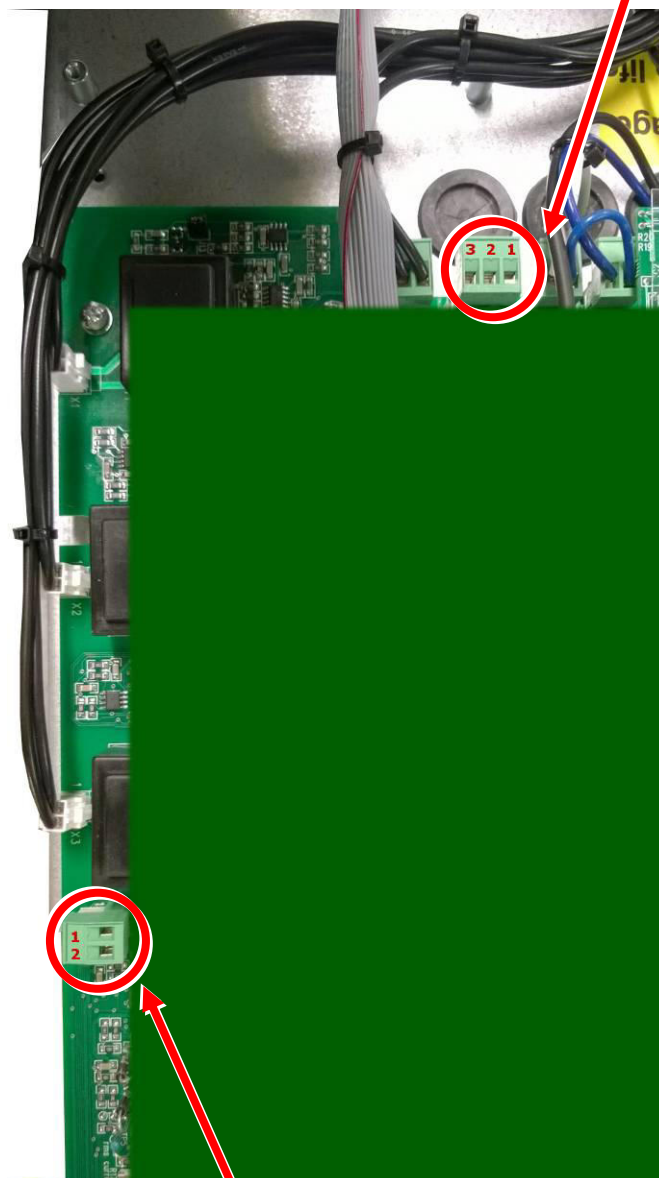
Grounding of the control cable shield from current transformer shields is done to PE terminals.

Check that the control signal connectors are well connected before closing the front cover of the SE AHF 100. The pictures below show the numbering of the X1, X4 and X11 terminals:

X11 numbering



X1 numbering



X4 numbering

9 MAINTENANCE

9.1 Preventive maintenance

In normal conditions, SE AHF 100 is maintenance-free. However, regular maintenance is recommended to ensure a trouble-free operation and a long lifetime of the SE AHF 100. We recommend to follow the table below for maintenance intervals.

Maintenance interval	Maintenance action
24 months (if unit stored)	Please contact the party having sold you the SE AHF 100 after a storage period longer than 24 months.
6-24 months (depending on the environment)	• Check the tightness of the mains and I/O terminals. • Check the operation of cooling fans, check for corrosion on the terminals, bus bars and other surfaces • Check the cooling air filters in case of cabinet installation
4 -7 years	• Change the cooling fans
5 - 10 years	• Change DC bus capacitors

9.2 Corrective maintenance

The corrective maintenance procedure is described in the following chapters:

9.2.1 Fault occurrence

9.2.2 Fault remedial procedure

9.2.3 LED-specific corrective maintenance actions

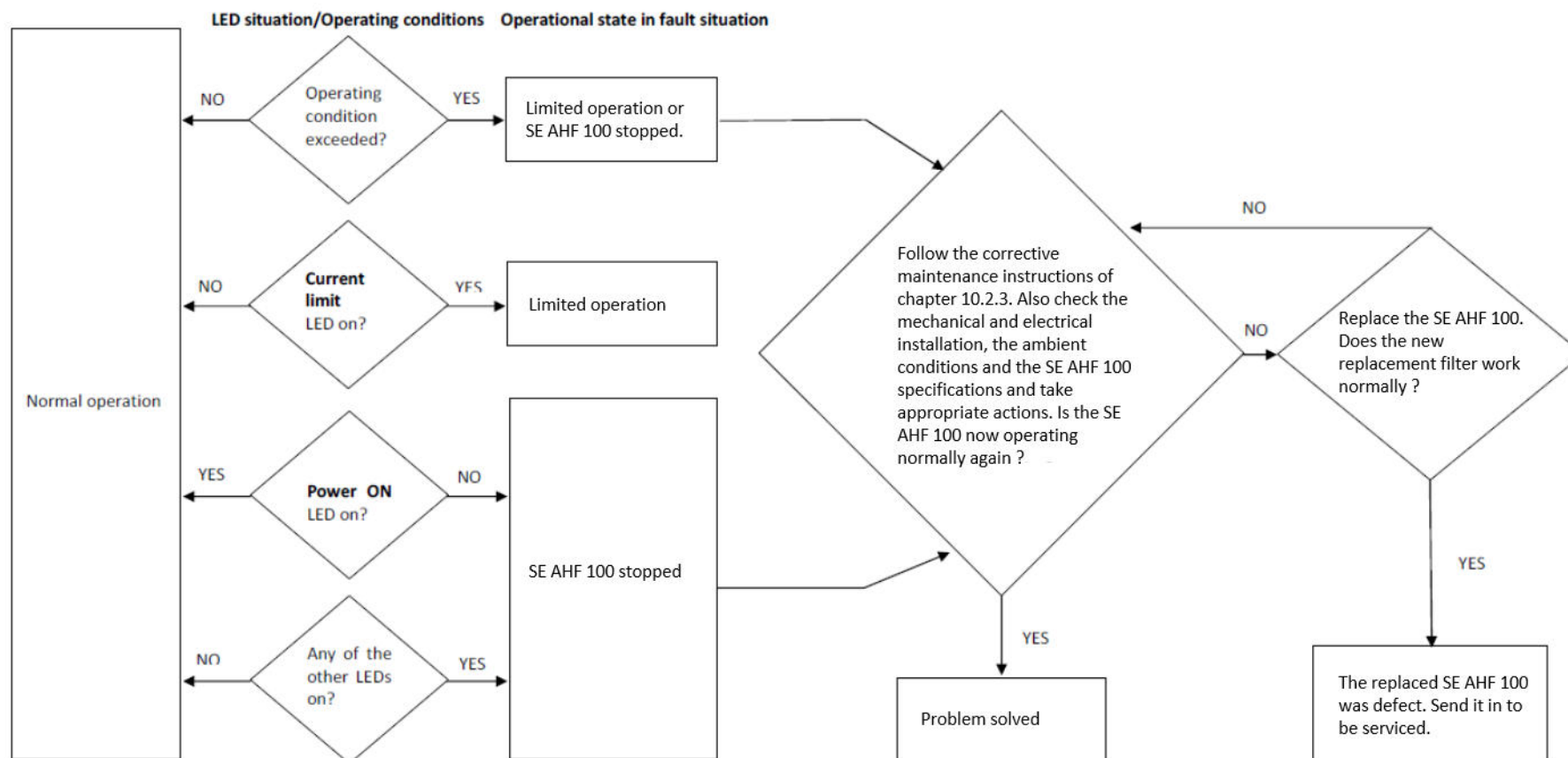
Further instructions on individual maintenance steps are found in the next chapters:

9.2.4 Reset

9.2.5 Sending in a defect SE AHF 100

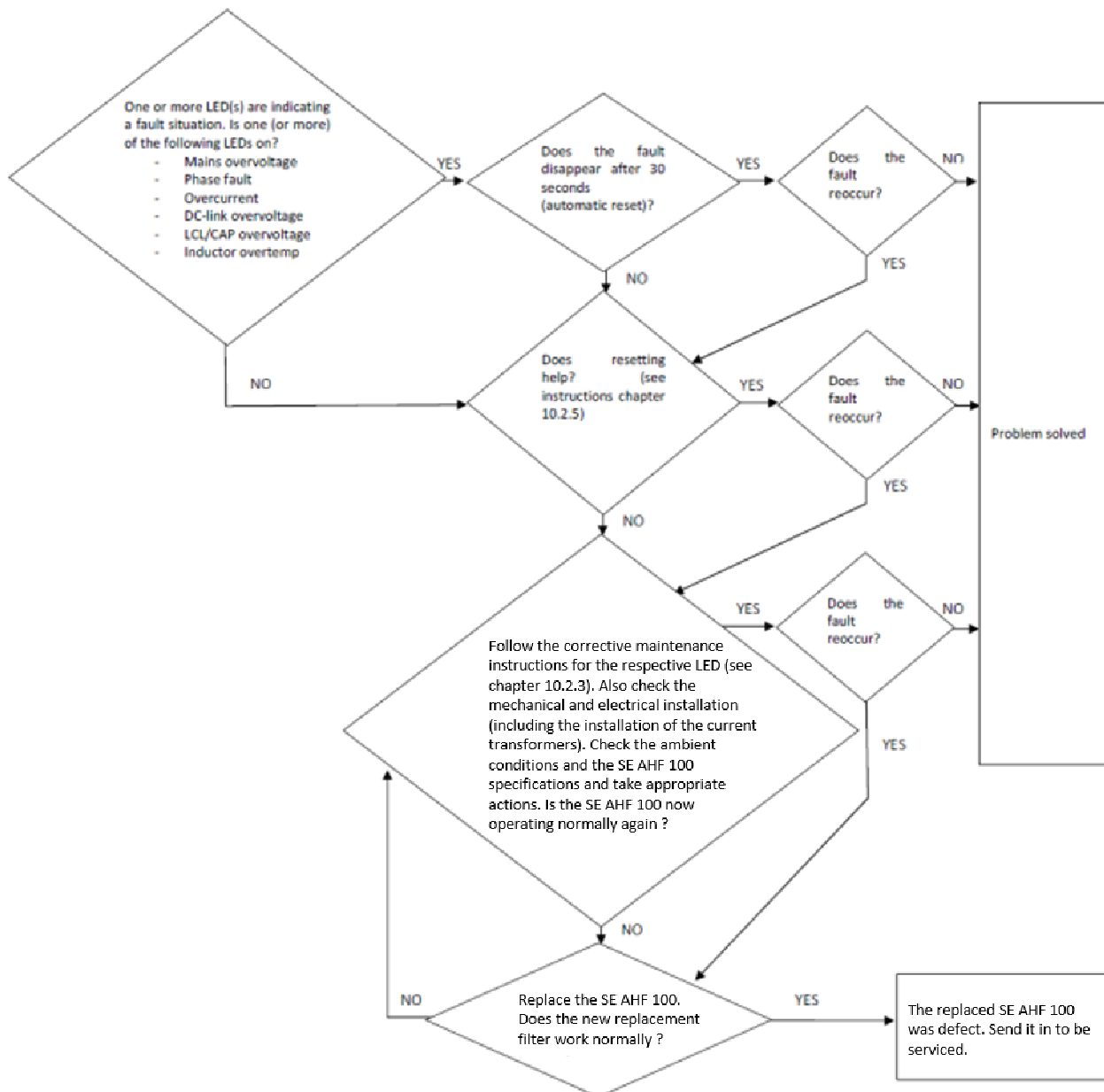
9.2.1 Fault occurrence

When a fault occurs, this is indicated by one or more LED lights on the front cover of the SE AHF 100. The operational meaning of the LEDs and the general corrective maintenance procedure is shown in the diagram below:



9.2.2 Fault remedial procedure

When the diagram in chapter 9.2.1 tells you that there is a fault situation, proceed as follows:



9.2.3 LED-specific corrective maintenance actions

Follow the fault remedial procedure of chapter 9.2.2. Corrective actions for each LED are listed below:

LED indication	Operational state	Criteria to be fulfilled for LED indication	Corrective actions
Control OFF	SE AHF 100 stopped	SE AHF 100 has been switched off (control input).	Follow instructions for ON/OFF/RESET control input. Check wiring of the control input if needed.
Inverter overtemp	SE AHF 100 stopped	Overtemperature limit of the inverter exceeded	- Decrease the cooling air temperature (max. 40 °C) - Make sure that there are no obstructions for cooling air availability (min. 650 m³/h). Are the cabinet air filters clean and free of dirt? - Check that the cooling fan is working correctly
Mains overvoltage	SE AHF 100 stopped	Case 1): Mains voltage exceeded nominal voltage by 15 % or more. OR Case 2): Voltage/current resonance between mains and SE AHF 100.	Case 1): Check that the mains voltage is within the SE AHF 100-specific limits. Case 2): If the spare SE AHF 100 does not help, please consult your system specialist.
Phase fault	SE AHF 100 stopped	Mains voltage decreased to less than 50 % of the nominal voltage or a phase is missing.	- Check that the mains voltage is within the specified limits. - Check SE AHF 100 input fuses if the mains voltage is within the specified limits.
Current limit	limited operation: SE AHF 100 has reached its maximum output current	Two possible limitation situations: Case 1): peak current limitation reached, i.e. 150 A pk OR Case 2): compensation current capacity reached, i.e. limitation to 100 A rms (if the inverter temperature is normal) OR if the inverter temperature is abnormal (more than 80°C), the current is limited below 100 A rms. The limitation can drop it as low as to 10 A rms, if the inverter temperature remains abnormal.	- Measure SE AHF 100 line currents and verify that over 150A peak or 100 Arms currents are not present. If peak currents over specified 150A or 100 Arms are present, decrease SE AHF 100 loading by installing parallel SE AHF 100 unit. - decrease the cooling air temperature (max. 40 °C) - make sure that there are no obstructions for cooling air availability (min. 650 m³/h) - check that the cooling fan is working correctly

LED indication	Operational state	Criteria to be fulfilled for LED indication	Corrective actions
Start sequence	Pre-charge ongoing, SE AHF 100 stopped	Case 1): SE AHF 100 was just connected to mains OR Case 2): mains undervoltage	Case 1): LED goes off automatically after a few seconds. This is normal operation, no action needed. Case 2): Follow corrective actions for mains undervoltage.
Power ON	SE AHF 100 is connected to mains	Case 1): If this LED is on, this is normal operation. OR Case 2): If this LED is off, it may be that the SE AHF 100 is not connected to the mains.	Case 1): No action needed. Case 2): Check that the SE AHF 100 is connected to the mains. If this is the case and still the LED is off, remove the SE AHF 100 and send it to be serviced.
Overcurrent	SE AHF 100 stopped	200 A peak current exceeded. This is due to Case 1): voltage/current resonance between mains and SE AHF 100 OR Case 2): SE AHF 100 internal failure	Case 1): Measure SE AHF 100 line currents and verify that over 150A peak currents are not present. If peak currents over specified 150A are present, decrease SE AHF 100 loading by installing parallel SE AHF 100 unit. Case 2): Send the faulty SE AHF 100 to be serviced.
DC-link overvoltage	SE AHF 100 stopped	Internal DC voltage limit exceeded Case 1): sudden load increase/decrease OR Case 2): SE AHF 100 internal fault	Case 1): Wait and see whether the SE AHF 100 does an automatic fault reset. If this does not happen, short load current inputs CT1-CT3 and try a manual fault reset. Case 2): If the fault cannot be reset, there is an internal fault in the SE AHF 100. Send the faulty SE AHF 100 to be serviced.
LCL/CAP overvoltage	SE AHF 100 stopped	Case 1) LED on continuously and Control OFF LED is NOT blinking means DC-link capacitor overvoltage. OR Case 2) LED is on continuously and the control OFF LED is blinking (1 Hz): There is LCL filter capacitor overvoltage due to voltage/current resonance between mains and SE AHF 100.	Case 1): - Wait and see (30 sec.) whether the SE AHF 100 does an automatic fault reset. - If resetting helps, measure the currents of all three phases and check that they are identical within +/- 10 %. - If the fault cannot be reset, there is an internal fault in the SE AHF 100. Send the faulty SE AHF 100 to be serviced. Case 2): If the LCL fault occurs repeatedly, (several automatic resets or manual reset), the mains state must be investigated with an appropriate mains

LED indication	Operational state	Criteria to be fulfilled for LED indication	Corrective actions
			analyzer. Probably there is the need to install passive filtering to the mains in order to get rid of the resonance phenomena. Contact your system specialist in this case.
Inductor overtemp	SE AHF 100 stopped	The internal inductors of the SE AHF 100 are overheated.	- Decrease the cooling air temperature (max. 40 °C). - Make sure that there are no obstructions for cooling air availability (min. 650 m³/h). Are the cabinet air filters clean and free of dirt? - Check that the cooling fan is working correctly. - If the above mentioned points are OK, measure AHF line currents and verify that over 150A peak currents are not present. If peak currents over specified 150A is present, decrease AHF loading by installing parallel AHF unit.
Mains undervoltage	SE AHF 100 stopped	Mains voltage decreased to less than 80 % of the nominal voltage.	- When the mains voltage exceeds again 85 % of the nominal voltage, the SE AHF 100 starts working normally again.
Inhibit	SE AHF 100 stopped	Case 1): There is some fault indicated by the fault LEDs. OR Case 2): SE AHF 100 has been switched off (I/O input at OFF state). OR Case 3): Pre-charge ongoing (start sequence not finished)	Case 1): Follow corrective actions for fault in question. Case 2): Follow instructions for ON/OFF/RESET control input. Check cabling of control input if needed. Case 3): Normal operation, no action needed. LED goes off automatically after a few seconds.

9.2.4 Reset

Follow the fault remedial procedure as described in chapter 9.2.2.

When you need to do a fault reset, proceed as follows:

Via control I/O (ON/OFF/RESET control input):

RESET: first activate OFF, then ON

ON: contact closed

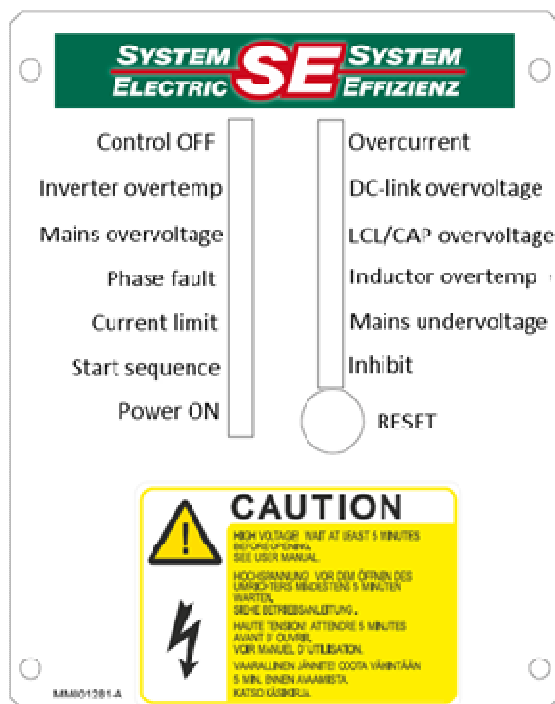
OFF: contact open

The reset happens when the input turns from OFF to ON.

OR:

Manual reset over LED panel:

Press the Reset button. This resets all resettable faults.



9.2.5 Sending in a defect SE AHF 100

Follow the fault remedial procedure as described in chapter 9.2.2.

When you have replaced an SE AHF 100, send in the defect one to be serviced. Provide SE with all the relevant information, i.e. filter serial number and type, status of the control LEDs at the time of the failure and a short description of the abnormal behaviour of the SE AHF 100.

Please contact the company that sold you the SE AHF 100 for delivery address details.