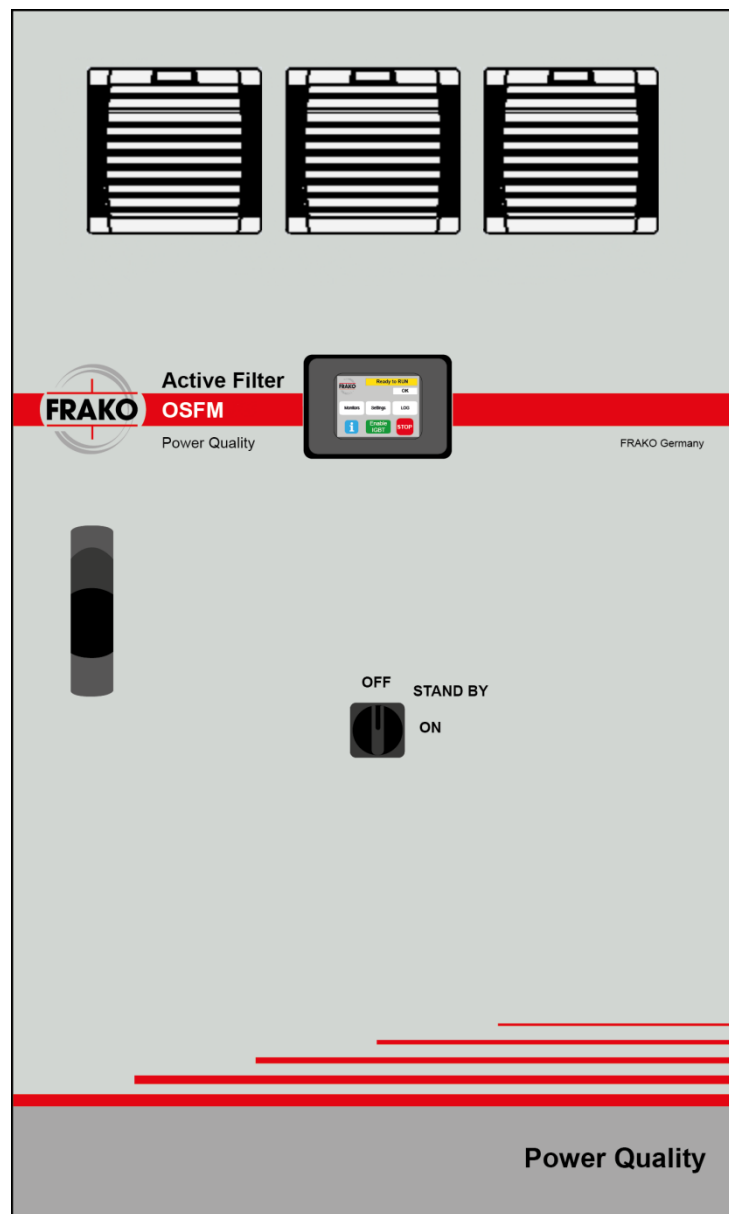




Active Filter OSFM

Installation and Operation Manual



Dear customer,

We would like to thank you for choosing the OSFM active filter.

This manual has been written to provide you with all the information, necessary to install and operate your OSFM active filter.

We remain at your disposal should you require any further details.

With kind regards

FRAKO Kondensatoren und Anlagenbau GmbH

Tscheulinstraße 21a

D-79331 Teningen

Phone +49-7641/453-0

Fax +49-7641/453-535

<http://www.frako.com>

E-mail: info@frako.com

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1 Scope of this manual

This manual applies to the OSFM active filters.


2 General safety instructions

Read this manual before installation and operation of OSFM active filters. Disregarding the instructions given in this manual may lead to severe damage to persons or property.

The following symbols and terms are used in this manual and in the active filter for emphasizing risks of damage to persons or property:


DANGER 	Follow the instructions to avoid situations which cause death or severe injuries due to electric shock by high voltage.
WARNING 	Follow the instructions to avoid situations which may cause death or severe injuries.
NOTICE	Follow the instructions to avoid damage to the unit or other property.

DANGER



Risk of death or severe injury due to electric shock when touching parts carrying high voltage inside the active filter which are accessible when the front door is open. The front door has to be locked with key. Only qualified personnel are allowed to conduct any tasks where the front door has to be opened. The safety instructions according to the EN 50110-1 have to be taken into account.

DANGER



Risk of death or severe injury due to electric shock from charged capacitors inside the active filter. Disconnect the device from the AC supply and wait for 5 minutes to allow any capacitive charge to be discharged through discharge resistors, before any maintenance or other work that involve working inside the active filter. Always verify by measurement that the capacitors have discharged.

3 Operation principle of OSFM active filter

OSFM active filters are power electronic devices connected in parallel with the load to be compensated. The device can be understood as controlled current source, which provides any kind of current waveform in real time. Active filter is equipped with an energy storage and control system, which enables it to inject required current to the network. When connected in parallel with the non-linear load, its harmonic currents are compensated and network is loaded with fundamental active current only.

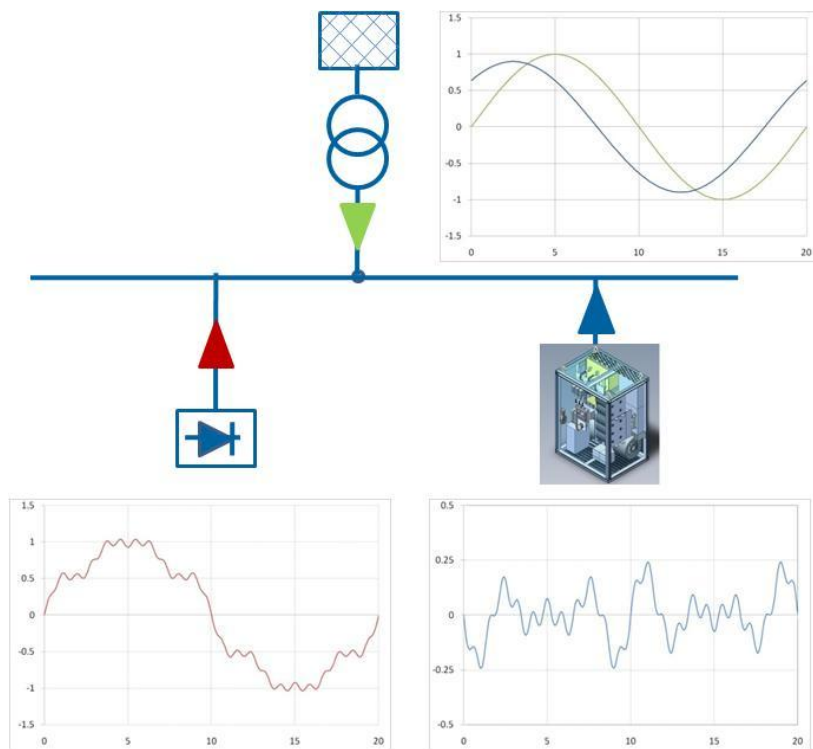


Figure 1. Operation principle of an active filter

4 OSFM active filter

4.1 General description of OSFM active filter

The OSFM active filters are designed for dynamic reactive power compensation, harmonic filtering and load balancing. The state-of-the-art controller, modern touch-screen user interface and modular technical design combine into a fast, reliable and compact device that is easy to operate. The construction principle is modular and devices with output ranges starting from 50 Amps upwards can be connected in parallel for a higher total output.



Figure 2. OSFM 50-400-3/-4, OSFM 60-400-3/-4 and OSFM 100-400-3/-4 (left), OSFM 150-400-3/-4 and OSFM 200-400-3 (right)

4.2 Operation modes of active filter

OSFM active filter has several operation modes thus the device can be easily tailored to solve specific power quality problems in the most economic manner.

4.2.1 Operation mode I – All harmonics

This operation mode is the most dynamic and offers real time compensation of all harmonics and fundamental reactive power. Also fundamental frequency active and reactive load is balanced in this mode. It is not recommended to use this mode if large harmonics of higher order exist since resonance effects may increase the harmonics.

4.2.2 Operation mode II – All harmonics but not fundamental frequency

This operation mode is the most dynamic and offers real time compensation of all harmonics. Fundamental frequency load balancing and reactive power compensation are excluded in this mode. It is not recommended to use this mode if large harmonics of higher order exist since resonance effects may increase the harmonics.

4.2.3 Operation mode III – Selectable

This operation mode offers possibility to select harmonic order to be compensated. Percentage of compensation degree for orders 1 ... 25 can be set (0 ... 100%) to each order individually. The selectable operation mode is typically used for compensating relatively stable harmonic problems. Fundamental frequency active load balancing is not done in this mode. The response time with this mode equals to fundamental frequency cycle time.

4.3 Main component identification and description

OSFM active filter has the following main components:

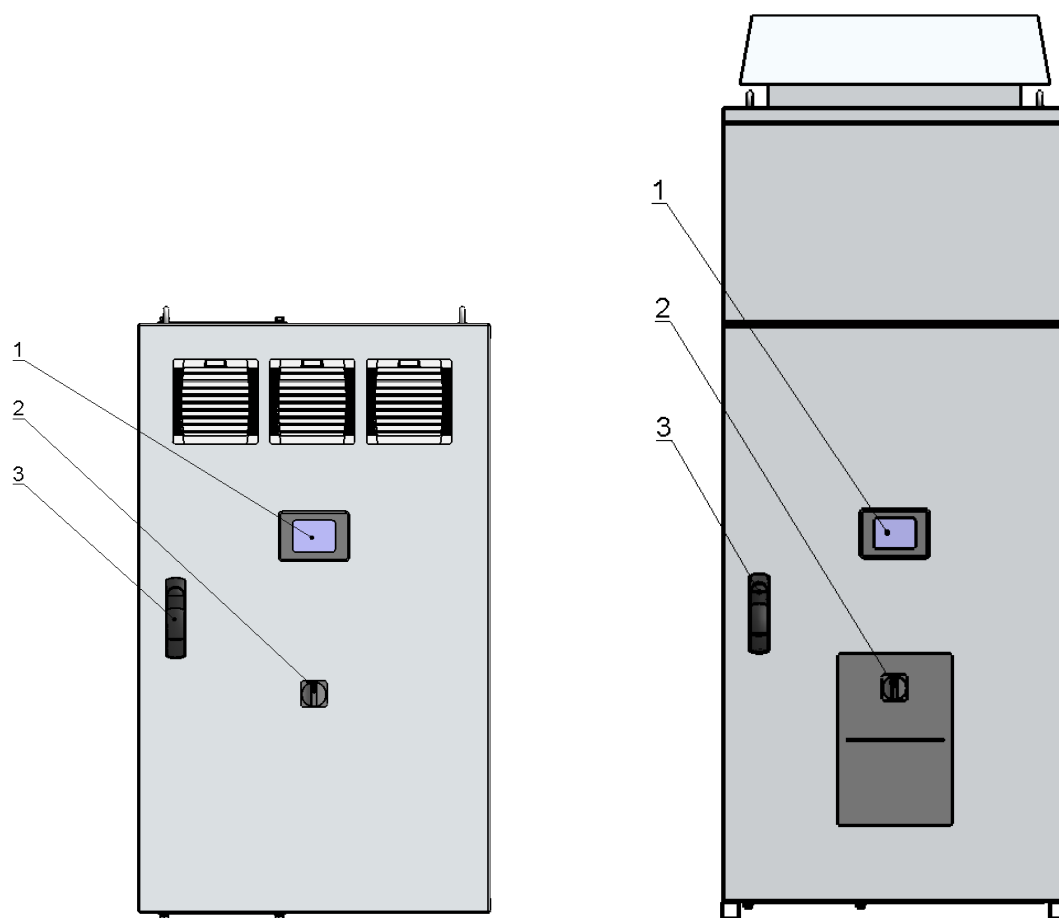


Figure 3. Front view OSFM 50-400-3/-4, OSFM 60-400-3/-4 and OSFM 100-400-3/-4 (left), OSFM 150-400-3/-4 and OSFM 200-400-3 (right)

1	HMI Touchscreen
2	ON / OFF Switch
3	Key lock handle

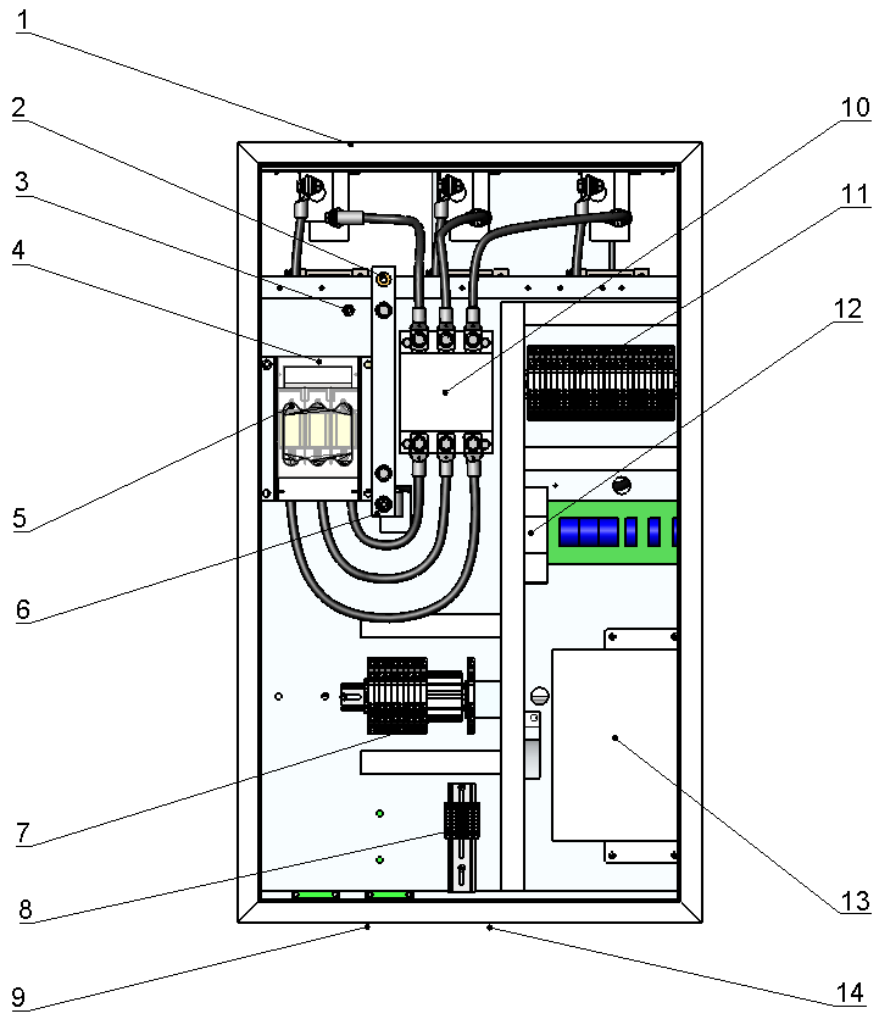


Figure 4. Main components of OSFM 50-400-3/-4, OSFM 60-400-3/-4 and OSFM 100-400-3/-4

1	Cable entry from top	8	X5: External CT terminals
2	Neutral cable from top	9	Cable entry from bottom
3	Grounding point (PE)	10	Main contactor
4	Power cable connection X2 L1,L2,L3 cables from top / bottom	11	Auxiliary fuses
5	Main fuses	12	Auxiliary power supply
6	Neutral cable from bottom	13	MCC control system
7	Auxiliary relays	14	Cooling air filter

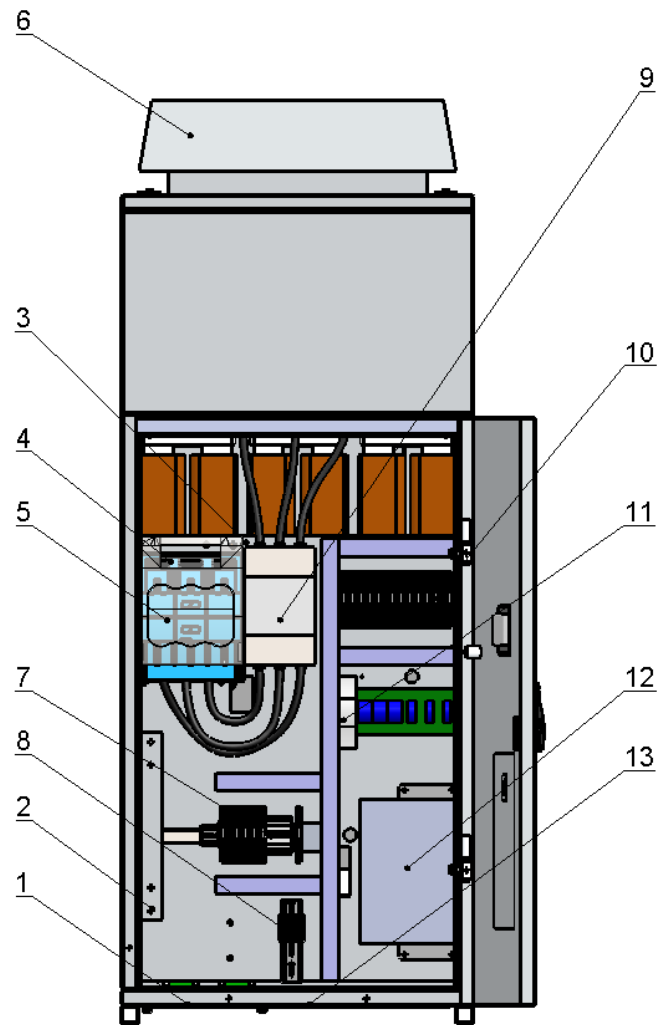


Figure 5. Main components of OSFM 150-400-3/-4 and OSFM 200-400-3

1	Cable entry from bottom	8	X5: External CT terminals
2	Neutral connection point	9	Main contactor
3	Grounding point (PE)	10	Auxiliary fuses
4	Power cable connection X2 L1,L2,L3 cables from bottom	11	Auxiliary power supply
5	Main fuses	12	MCC control system
6	Cooling fan	13	Cooling air filter
7	Auxiliary relays		

5 Delivery inspection and unpacking

OSFM active filters are delivered in truck freight packed and therefore they are not water proof. The sea worthy packing shall be provided on request. The packing and active filter shall be inspected immediately after receiving delivery. Possible damages due the transportation or missing items shall be reported to the freight transportation company at once.

The key lock handle is not locked at delivery. It can be opened by lifting the handles lower tip from the door so that the handle can be turned to the right. Two keys to lock the key lock handle are tied to a cable duct inside the unit at the bottom.

5.1 Unpacking and lifting the active filter units

The OSFM unit(s) shall be unpacked carefully. One OSFM 50-400-3/-4, OSFM 60-400-3/-4 or OSFM 100-400-3/-4 active filter unit weighs about 130 kg. One OSFM 150-400-3/-4 or OSFM 200-400-3 active filter unit weighs about 280 kg. After unpacking the unit can be lifted with four M8 lifting eyes, which are included in the delivery. Adequate lifting equipment shall be used and lifting must be done with four lifting eyes so that the load is evenly distributed for each eye.

Only OSFM 150-400-3/-4 and OSFM 200-400-3: Before lifting, please open twelve screws on top of the roof fan and remove the collar of the fan. (see Figure 6)

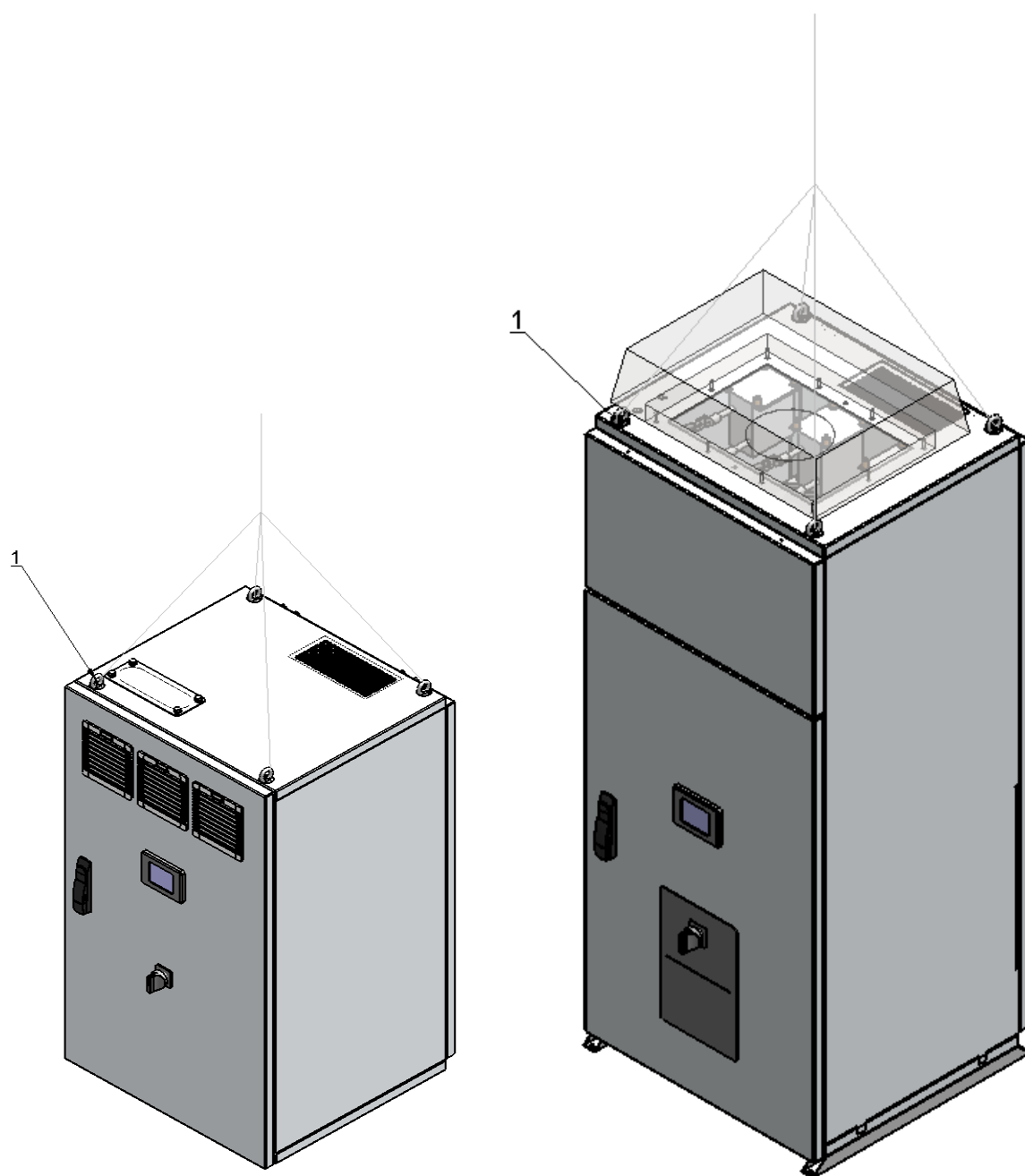


Figure 6. Lifting the OSFM active filter unit with 4x lifting eyes.

1	Lifting eyes (4pcs)
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5.2 Identification and serial number

OSFM active filter is identified in the rating plate located inside the front door.

The type marking has the format:

OSFM xxx-yyy-z

xxx	Compensation current in A
yyy	Rated Voltage in V
z	"3" – no compensation of neutral wire "4" – with compensation of neutral wire



Figure 7. OSFM rating plate.

5.3 Storage instructions

OSFM active filters have to be stored in dry and warm warehouse. Long term storage more than nine (9) months is not recommended. In case of longer storage period consulting FRAKO local distributor is recommended.

6 Installation

6.1 Applied standards, EMC and installation environment

The OSFM active filters are built according to relevant European directives (EMC directive, LVD). The applied safety standard is EN 50178, overvoltage category III. Active filter unit can only be used in electrical system specified in rating plate (see Figure 7).

NOTICE

Connecting OSFM active filter to mains voltage and frequency outside the rating of the active filter may cause irreversible damage to OSFM. Compare the parameters shown on the rating plate of the active filter to the actual system parameters and do not connect the unit if parameters do not match.

The applied EMC standards are EN 61000-6-2 and EN 61000-6-4 (Generic standards – Immunity / Emission standard for industrial environments). In environments with lower immunity limits high frequency interferences may occur when the active filter is in operation. In that case additional measures to mitigate the interferences have to be applied.

6.2 IP00 EMC

The OSFM active filters have been tested according to conditions described in item 6.1. Therefore it can be stated that the equipment inside the aluminium casing, from now on referred to as IP00 equipment, can fulfil the requirements of EMC equal to those that were applied to the whole device including the casing if installed into a casing or cubicle with interference mitigation properties equal or better than the casing provided by FRAKO. However, as the results are highly dependent on the casing, FRAKO does not guarantee any EMC compliance for equipment sold as IP00 equipment, and therefore the equipment does not carry a CE-mark.

6.3 Existing capacitors

Plain capacitors (e.g. capacitor banks without detuning reactors) must not be connected to the same installation as the active filter. Plain capacitor banks have to be switched off or changed to a capacitor bank with detuning reactors. Generally it is not recommended to have other compensation systems installed downstream of the active filter as stability issues may arise. If such installation cannot be avoided, the effect may be mitigated by subtracting the current flowing into the compensation system from the measurement of the active filter by the use of summation CT's.

NOTICE

Connecting OSFM active filters to installations comprising plain capacitors may result in resonance phenomena with unintended high current and voltages distortion which may cause damage to the connected devices or the active filter. Do not operate the OSFM active filter in case of resonance.

6.4 Installation environmental requirements of OSFM 50-400-3/-4, OSFM 60-400-3/-4, OSFM 100-400-3/-4, OSFM 150-400-3/-4 and OSFM 200-400-3

OSFM active filter units must be installed indoors in clean and dry location with ambient temperature always from +5 to +40°C with the air humidity max. 85 % (Climatic class 3K3, EN 50178).

The installation environment shall fulfil the pollution conditions of degree 2 (normally only non-conductive pollution occurs).

The installation location altitude must be less than 1000 meters above sea level. De-rating of the specified values takes place above 1000 meters elevation.

OSFM 50-400-3/-4, OSFM 60-400-3/-4 and OSFM 100-400-3/-4 must be installed on the wall in upright position with a wall mounting (optional available) support. The wall must be fire-

redundant and mechanically adequately rigid for bolting the units permanently with six suitable anchor bolts with size of M10.

OSFM 150-400-3/-4 and OSFM 200-400-3 must be installed on the floor on a mounting rack in upright position. The wall behind the filter must be fire redundant.

There has to be a minimum of 300 mm free space above and below the active filter units for cooling air circulation.

There has to be a minimum of 600 mm free space in front of the installed units for service space.

OSFM active filter units require cooling air with temperature below 40°C. The active filter unit generate heat losses and heat up the ambient air.

6.5 Dimensional drawings and Installation of OSFM 50-400-3/-4, OSFM 60-400-3/-4, OSFM 100-400-3/-4, OSFM 150-400-3/-4 and OSFM 200-400-3

Each OSFM 50-400-3/-4, OSFM 60-400-3/-4 and OSFM 100-400-3/-4 are installed on the wall with the use of wall mounting brackets and wall mounting supports (optional available).

Each OSFM 150-400-3/-4 and OSFM 200-400-3 is installed on the floor with a mounting rack.

OSFM 50-400-3/-4 consists of a single 50A unit.

Overall dimensions in mm: 600/W x 600/D x 1000/H.

Mass in kg: 130.

OSFM 60-400-3/-4 consists of a single 50A unit.

Overall dimensions in mm: 600/W x 600/D x 1000/H.

Mass in kg: 130.

OSFM 100-400-3/-4 consists of a single 100A unit.

Overall dimensions in mm: 600/W x 600/D x 1000/H.

Mass in kg: 130.

OSFM 150-400-3/-4 consists of a single 150 A unit.

Overall dimensions in mm: 600/W x 600/D x 2200/H (height with mounting rack).

Mass in kg: 280.

OSFM 200-400-3 consists of a single 200 A unit.

Overall dimensions in mm: 600/W x 600/D x 2200/H (height with mounting rack).

Mass in kg: 280.

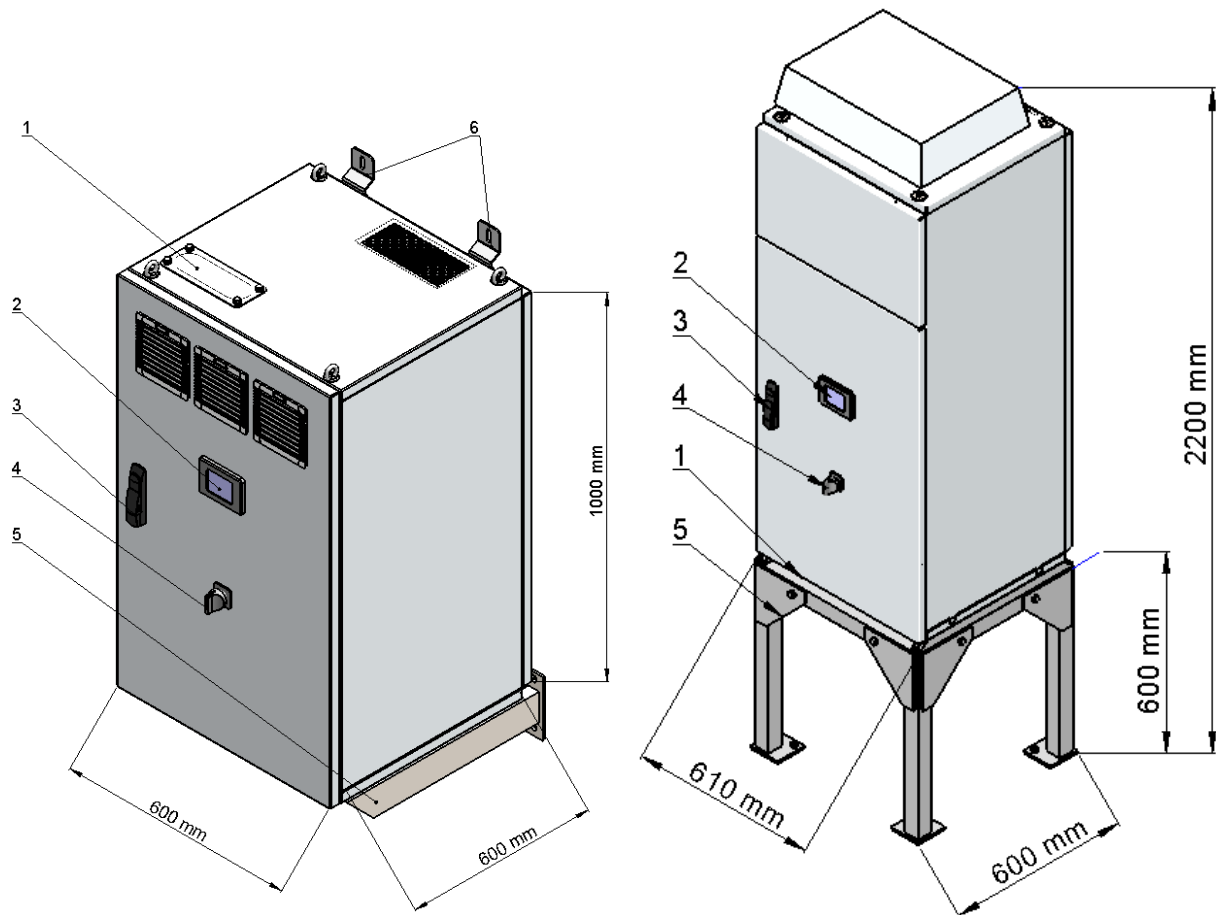


Figure 8. Dimensional drawing of OSFM 50-400-3/-4, OSFM 60-400-3/-4 and OSFM 100-400-3/-4 (left), OSFM 150-400-3/-4 and OSFM 200-400-3 (right).

1	Cable entry top or bottom: (OSFM 50-400-3/-4, OSFM 60-400-3/-4 and OSFM 100-400-3/-4) Cable entry from bottom (OSFM 150-400-3/-4 and OSFM 200-400-3)	4	ON / OFF Switch
2	HMI touch screen	5	Wall mounting supports (optional available) (OSFM 50-400-3/-4, OSFM 60-400-3/-4 and OSFM 100-400-3/-4) Floor mounting rack (OSFM 150-400-3/-4 and OSFM 200-400-3)
3	Key lock handle	6	Wall mounting brackets (optional available)

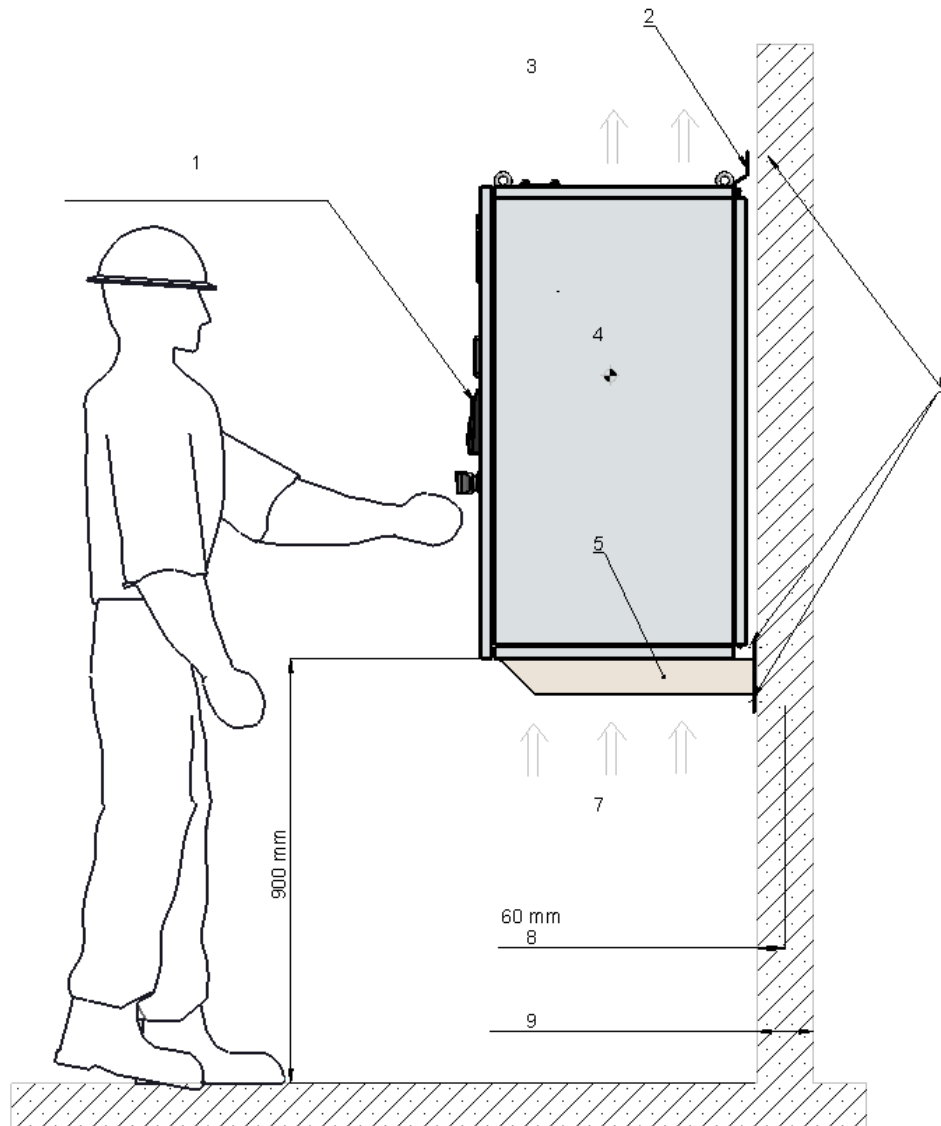


Figure 9. Wall mounted OSFM 50-400-3/-4, OSFM 60-400-3/-4 and OSFM 100-400-3/-4.

1	Door must be locked with key after energizing. Only electrically skilled personnel may operate the active filter. User's manual must be strictly followed.	6	Wedge anchor bolts M10x80 (6 pcs). Torque 35 Nm (concrete wall)
		7	Free space below min. 300 mm for air circulation
		8	Minimum anchor bolt embedded length 60mm, bore dia. 10 mm depth 75 mm
2	Wall mounting bracket (optional available)	9	Concrete wall
3	Free space above min. 300 mm for air circulation	10	NOTE: When installing active filter hanging on the wall the suitability and load-bearing capacity of the wall must be checked
4	Weight 130 kg		
5	Unit bolted on wall mounting support (optional available) with 4 pcs of M8x80 from below		

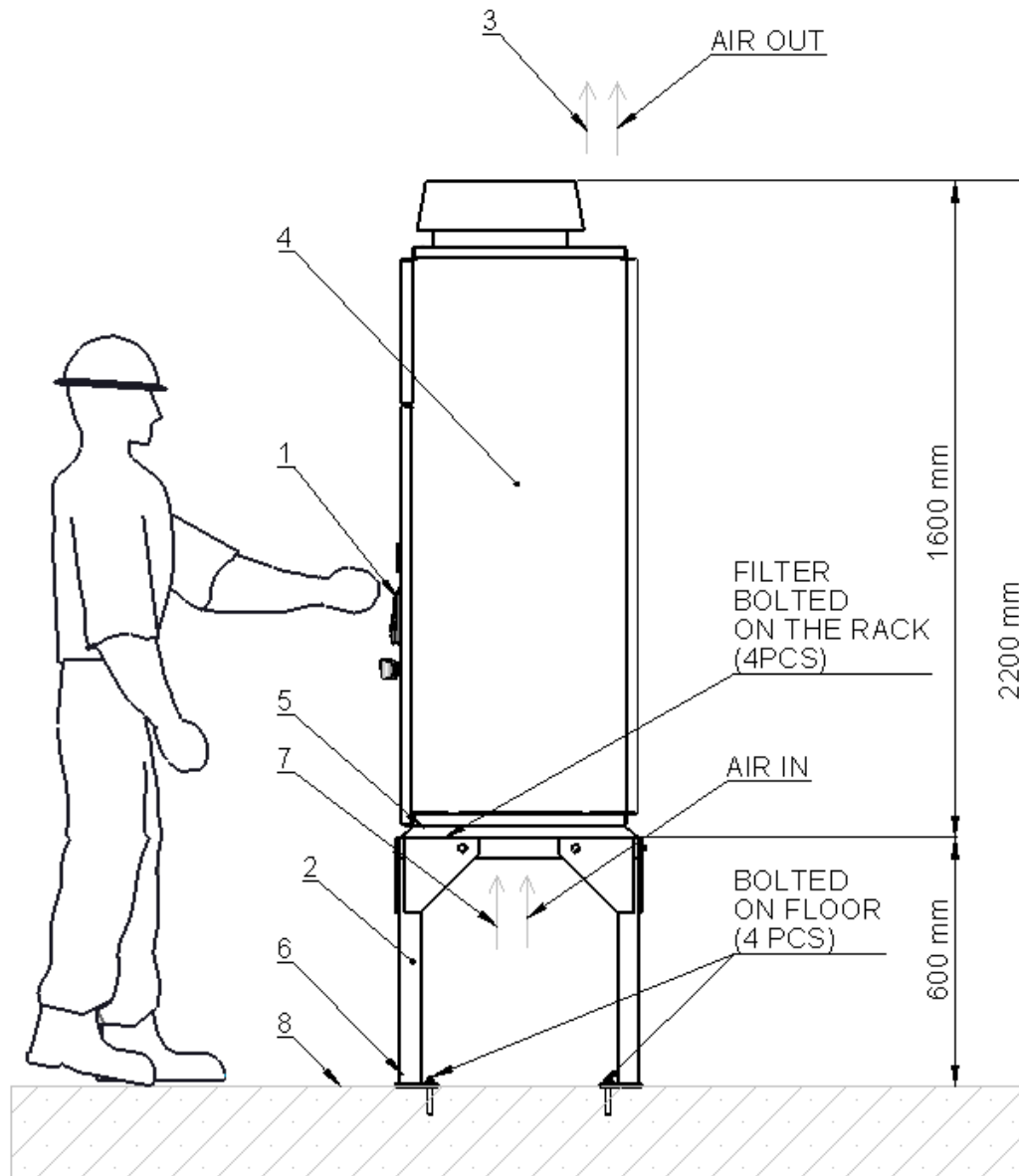


Figure 10. Floor mounted OSFM 150-400-3/-4 and OSFM 200-400-3 side view.

1	Door must be locked with key after energizing. Only electrically skilled personnel may operate the active filter. User's manual must be strictly followed.	6	Wedge anchor bolts M10x80 (4 pcs). Torque 35 Nm (concrete floor)
2	Floor mounting rack.	7	Free space below min. 300 mm for air circulation
3	Free space above min. 300 mm for air circulation	8	Minimum anchor bolt embedded length 60mm, bore dia. 10 mm depth 75 mm. The floor must be suitable for bolting and load-bearing capacity must be checked.
4	Weight 280 kg		
5	Unit bolted on floor mounting racket with 4 pcs of M8x40 .		

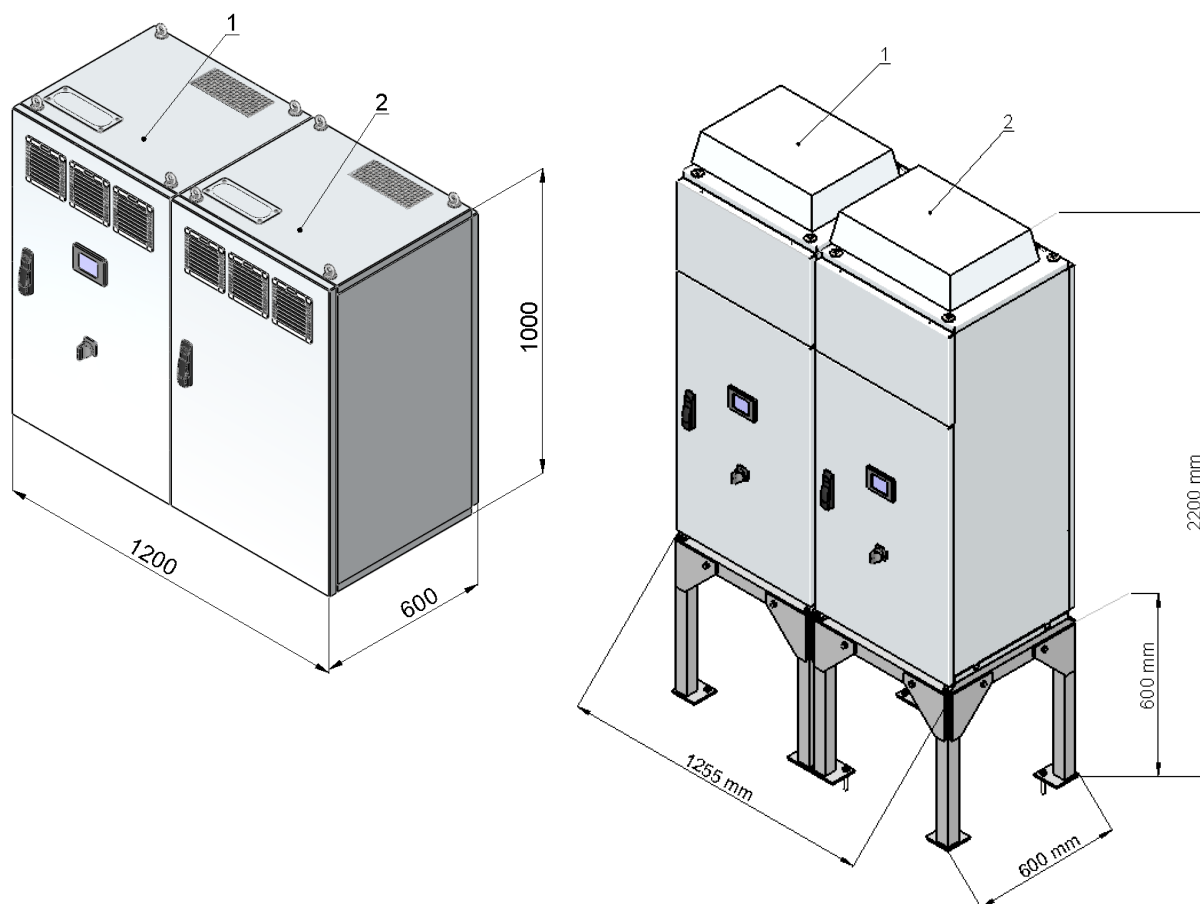


Figure 11 OSFM active filter parallel connection side by side.

1	Unit 1	2	Unit 2
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OSFM units can be installed one, two, three or four units in parallel.

OSFM 50-400-3/-4, OSFM 60-400-3/-4 and OSFM 100-400-3/-4 are installed on the wall with the use of wall mounting brackets and wall mounting supports (optional available) side by side.

OSFM 150-400-3/-4 and OSFM 200-400-3 are installed on the floor with a mounting rack (optional available) side by side.

6.6 Floor Rack OSFM

All OSFM filter can be bolted with the floor rack and bolted directly at the floor. If wall mounting is not possible, the floor rack mounting is recommended. The floor rack must be ordered separately and is available with the FRAKO – article number 92-01452.

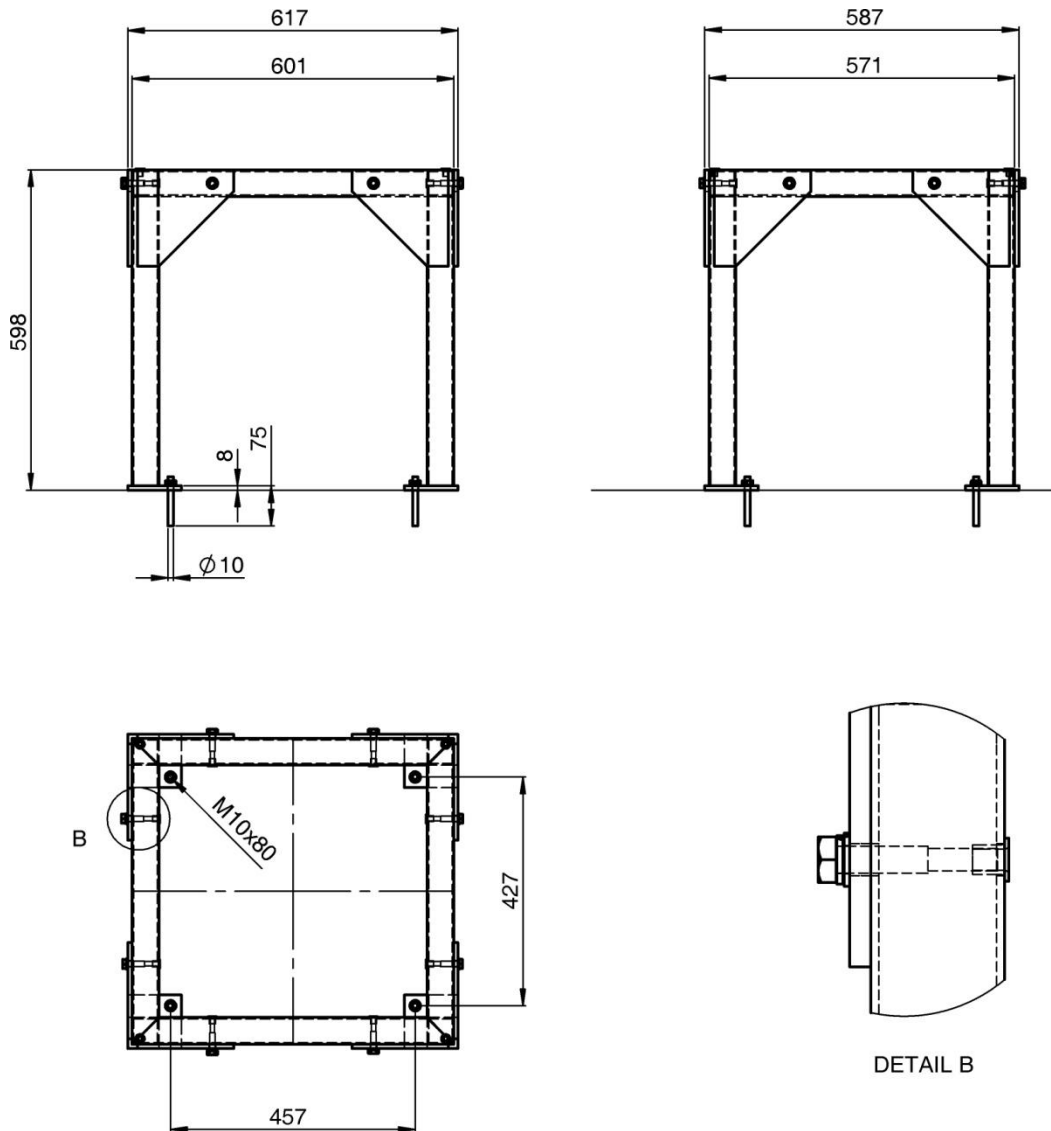


Figure 12 Dimensions floor rack OSFM

7 Electrical Installation

The OSFM active filter is an electrical device which can only be installed by a person with adequate qualifications in electrical installations. This person must have all the rights, permissions and licenses to do such work in the country of the final installation.

DANGER



Risk of death or severe injury due to electric shock when touching parts carrying high voltage inside the active filter which are accessible when the front door is open. The front door has to be locked with key when the electrical installation has been finished and the unit is energized. Only qualified personnel are allowed to conduct any tasks where the front door has to be opened. The safety instructions according to the EN 50110-1 have to be taken into account.

7.1 Power cables and termination

Each active filter unit shall be fed by a dedicated power cable. The power cable Cu – terminals are in NH fuse switch-disconnector. The terminal location has been shown in Figure 4. Phase sequence is L1, L2, L3 starting from the left hand side when facing the device. Power cable connection has been shown in Figure 13. The neutral cable terminal lug connection has been shown in Figure 14. Note that the neutral bus bar is aluminium and if connected with Cu cable lug a bimetal (Cu – Al) washer must be used between the cable lug and the bus bar so that the Al-side is facing the Al-bus bar and the Cu-side facing the cable lug.

In all OSFM (OSFM xxx-yyy-3 and OSFM xxx-yyy-4) the N conductor must be connected in any case, since the star voltage of 230V is required internally.

In case of TN-C –system, the PEN conductor must be connected to the PE-terminal together with minimum Cu 2,5mm² wire connected from PE to the N-terminal. Such connection is only permissible for 3-wire active filter (OSFM xxx-yyy-3) types.

4-wire active filters (OSFM xxx-yyy-4) provide compensation of currents in the neutral conductor which could be up to 3 times as large as the rated phase current of the active filter. Therefore the neutral cable must be dimensioned accordingly.

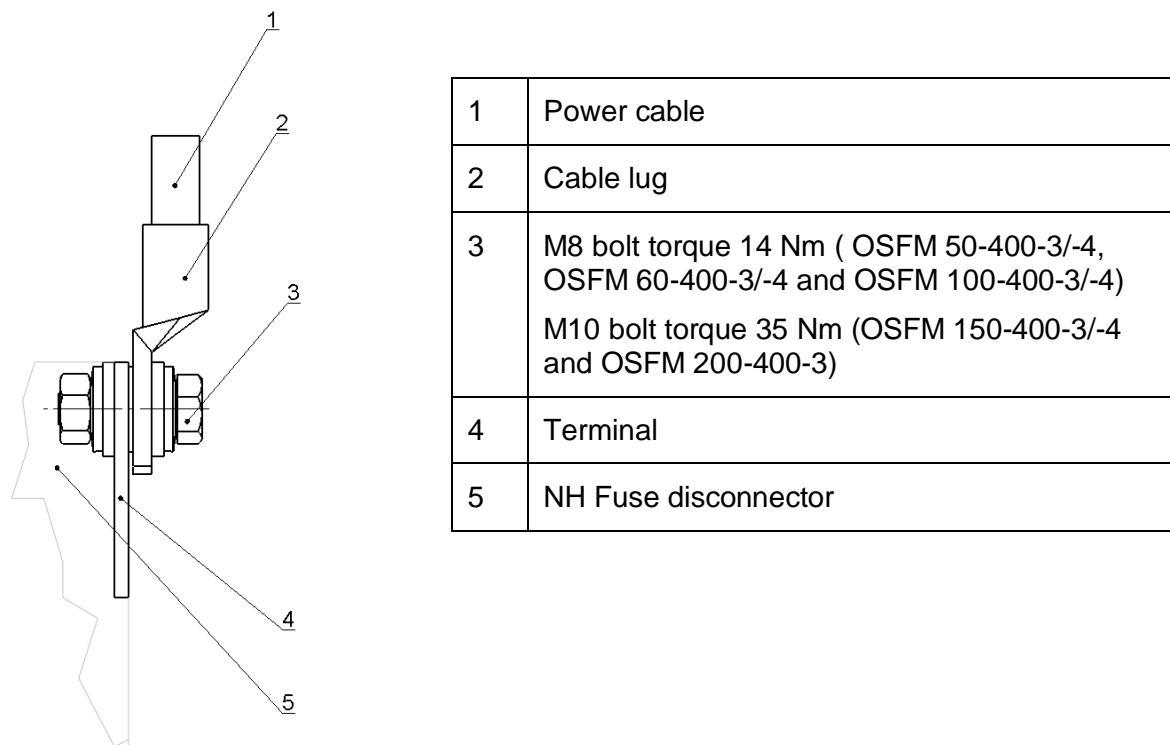


Figure 13. Power cable terminal lug connection.

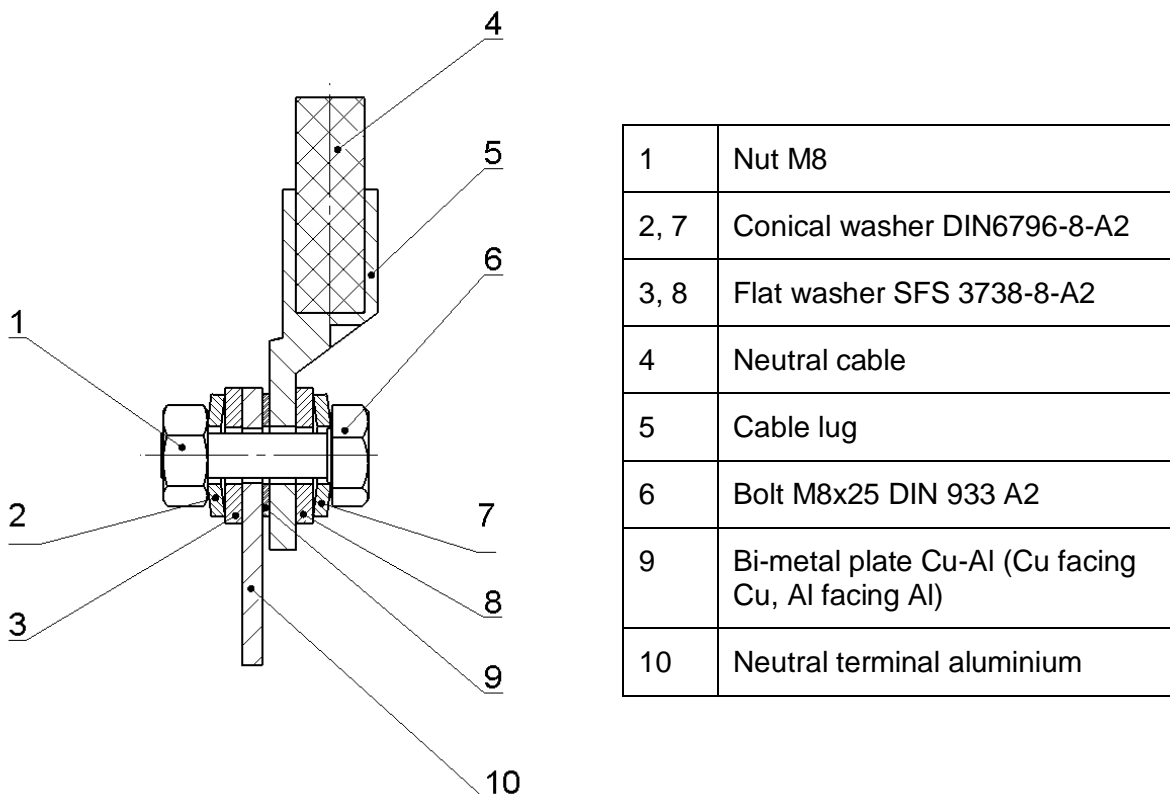


Figure 14. Neutral cable terminal lug connection.

The selection of the power cable shall be done based on the rating of the protective fuse and cable installation environment.

Table 1 Nominal currents and minimum protective gG fuses

OSFM Active Filter	Nominal current in phase wire	Minimum gG type fuse in phase	Nominal current in neutral wire
OSFM 50-400-3	50 A	125 A	-
OSFM 50-400-4	50 A	125 A	150 A
OSFM 60-400-3	60 A	125 A	-
OSFM 60-400-4	60 A	125 A	180 A
OSFM 100-400-3	100 A	125 A	-
OSFM 100-400-4	100 A	125 A	300 A
OSFM 150-400-3	150 A	250 A	-
OSFM 150-400-4	150 A	250 A	450A
OSFM 200-400-3	200 A	250 A	-

Minimum continuous current carrying capability of the feeder power cable is defined based on the protective fuse.

NOTICE

The installation environment and skin effect due to the harmonic current shall set additional de-rating requirements to the power cable. The de-rating factors of the power cable current carrying capability for different installation methods and environments have been defined in IEC 60364-5-52 “Selection and erection of electrical equipment –Wiring systems”.

The de-rating factor of the power cable current carrying capability due to the skin effect depends on power cable construction and assembly options. The guideline for the skin effect factor has been given in Table 2.

Table 2 Typical skin effect factors

Cross section mm²	Reduction factor Copper conductor	Reduction factor Aluminium conductor
50	0.951	0.978
70	0.912	0.960
95	0.864	0.932
120	0.818	0.903
150	0.770	0.865
185	0.712	0.825

240	0.646	0.769
300	0.590	0.711

NOTICE Consult cable manufacturer for your cable characteristic!

7.2 Earthing

DANGER



Risk of death or severe injuries due to short circuits and electric shock.

For safety reasons the earth point (PE) of the active filter must be connected to the protective earth point (PE) of the installation providing a reliable fixed connection. A minimum of 16mm² Cu conductor is recommended but local regulations should be fulfilled as well. In case of TN-C system, see item 7.1.

7.3 Current transformers and current signal

The current signals from the electric system have to be provided for OSFM active filter in order to allow the control system to define the required compensation current. Both open and closed loop connection are possible. Current transformer locations and connection terminals have been shown in the figures below.

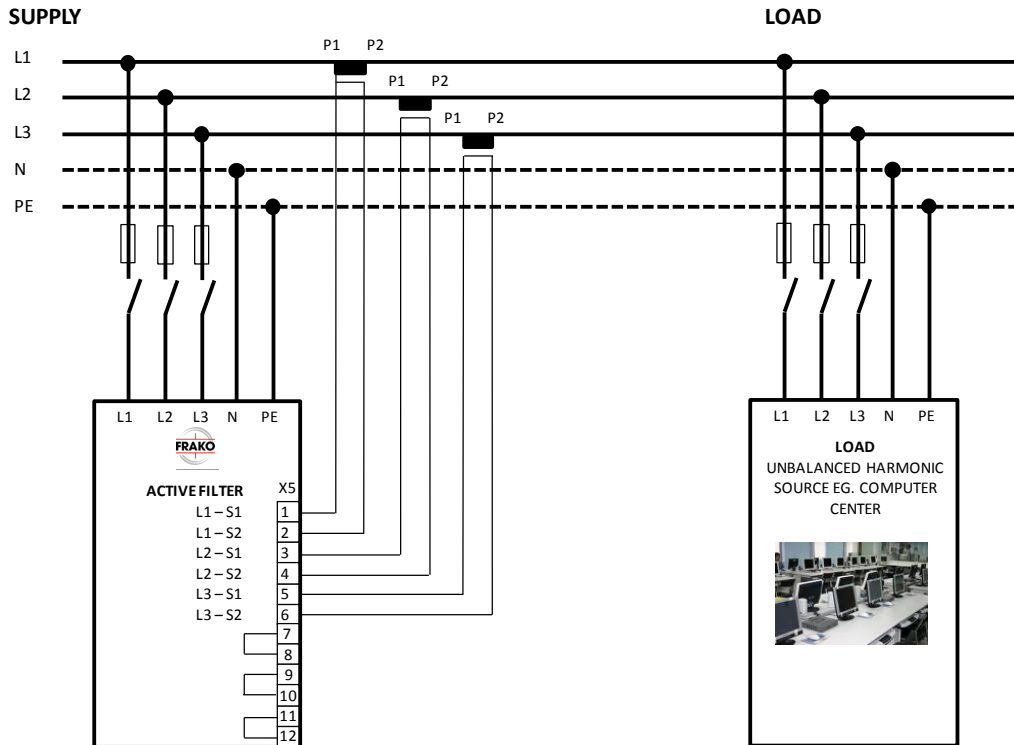


Figure 15. CT connection – three (3) CTs – Open loop

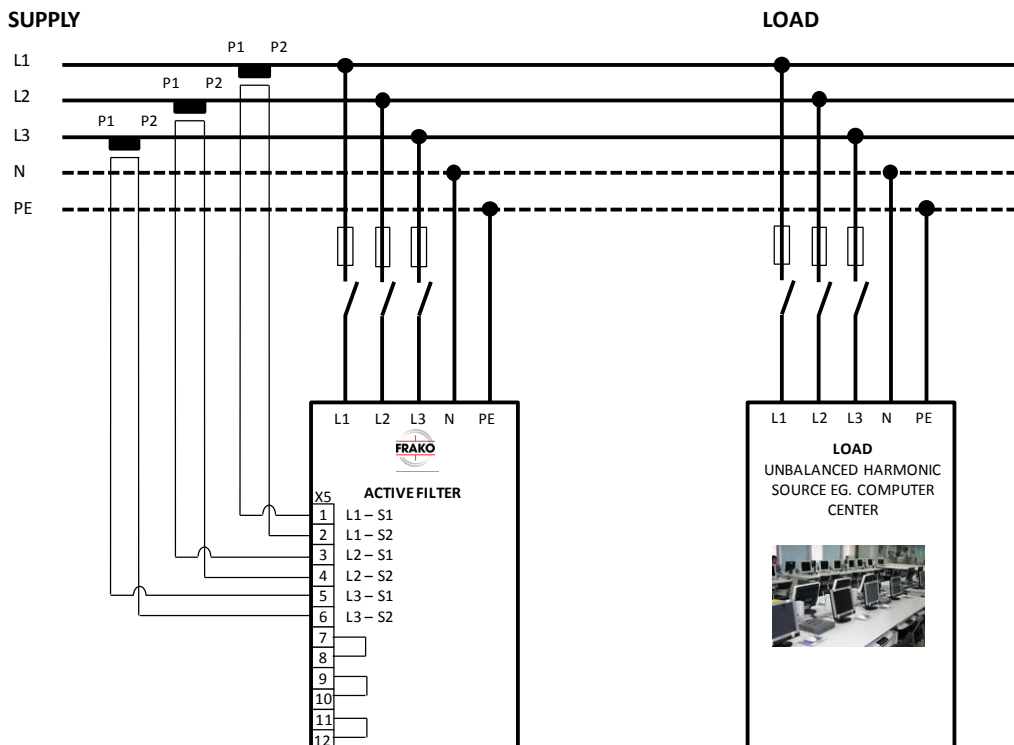


Figure 16. CT connection – three (3) CTs – Closed loop

7.4 Parallel connected units

Seven (7) units can be connected in parallel when operating in open loop configuration (CTs on the load side). Therefore one set of current transformers may feed current signals for all seven units. Internal current signals shall be connected in series as shown in Figure 17.

NOTICE Note that parallel operation in closed loop configuration (CTs on supply side) is not possible!

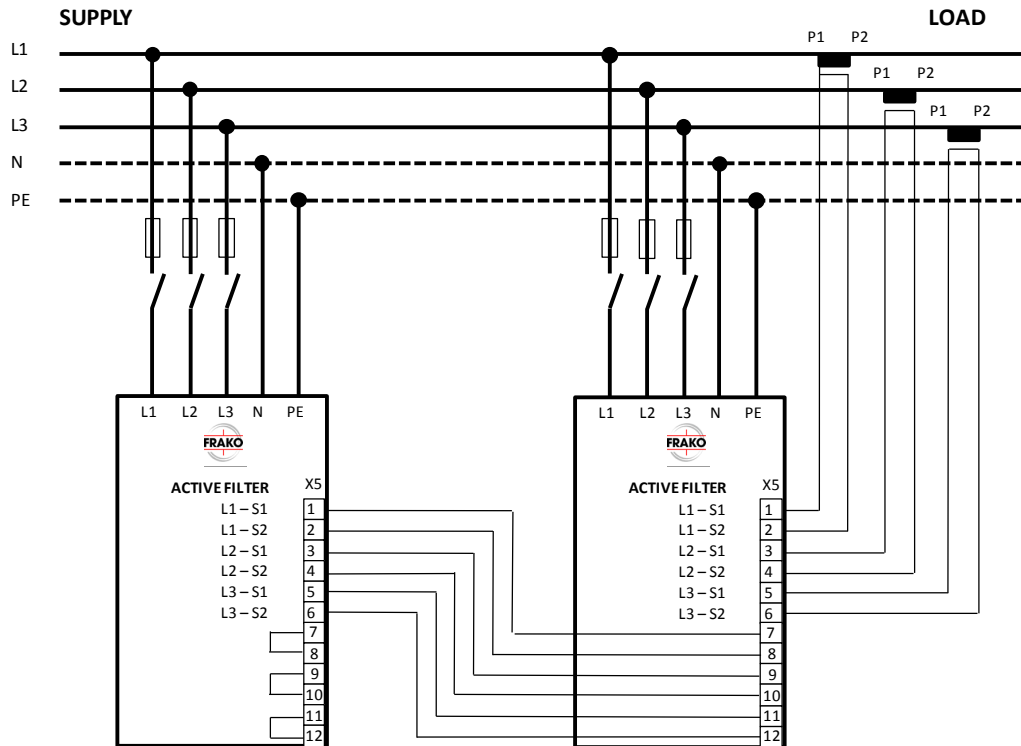


Figure 17. CT connection – parallel connected active filters

7.5 Nominal rating of current transformers

The current signals shall be provided by current transformers having nominal current rating xxxx / 5A or xxxx / 1A. 5A secondary is recommended for best accuracy.

The harmonic compensation performance is dependent on the accuracy of the current transformers. The minimum accuracy class shall be 1.0 and in case compensation performance is critical better accuracy class is recommended. The primary rating of the CTs should be chosen according to maximum primary RMS current excluding transients. The crest factor of the load current should also be taken into account. The maximum crest factor of the CT input is 2, so uprating of CTs may have to be done in case of even higher crest factor of the load current. As this also has an effect on the filtering performance, the rating should be done carefully.

Table 3 OSFM active filter burden for current transformers

Parallel Units	1	2	3	4	5	6	7	
Total burden At 1A	0.01	0.04	0.06	0.09	0.11	0.14	0.16	VA at 1 A
Total burden At 5A	0.25	0.73	1.22	1.71	2.20	2.68	3.17	VA at 5 A

7.6 Current signal cable and terminals

The current signals shall be connected to terminal block X5:1 - 12. The terminal block X5 has been located in the bottom of the cubicle as shown in Figure 4. In case of last parallel connected active filter unit or case of single unit the terminals X5:7-8, 9-10 and 11-12 shall be shorted. The cable type for the current signals shall be MCMK or similar type protected and shielded cable. The cable duct shall be type KPK or similar. The cable shield shall be connected to the cubicle frame potential as via cable duct. Terminals in block X5 are suitable for the cables maximum cross section 4 mm². Maximum tightening torque is 1.2 Nm.

DANGER



Risk of death or severe injury due to electric shock if the current transformers are connected incorrectly. If CT secondary cable is to be disconnected when primary circuit of the main CT is conducting current, the secondary of the CTs must be short circuited so that low impedance current paths for the secondary currents are always existing, otherwise fatal voltages may appear on the conductors and/or terminals and irreversible damage may be caused. Never open a live secondary circuit!

8 Human machine interface

A touch screen panel PC is used as the Human Machine Interface (HMI). The touch screen user interface allows user to control the logical operations of the active filter, like initializing start or stop sequences. Communication between the unit and panel PC is done via Ethernet. When the active filter is to be integrated into a network, this can be done with the help of an additional industrial switch (optional).

8.1 Using the HMI graphical touch screen user interface

Touch screen user interface is used by directly touching buttons visible on the screen. Touch of the on screen button is noticed by the running program. To indicate a successful touch of a button, the button on the screen will go through a short “button pressed” -sequence. In the “button pressed” -sequence the image of the button is changed so that background colour of the button changes to darker. Figure 18 presents the button when it is in normal state and not pressed down, Figure 19 presents a button when it is pressed down.



Figure 18. Start button up.



Figure 19. Start button pressed down.

It doesn't need much force, just a slight touch with little pressure, to press the buttons on the user interface. Using too much force will break the screen! Use fingers, fingertips or preferably fingernail to touch the buttons on the screen. Also other blunt objects can be used for touching like non colouring or otherwise harmful objects, like wrong end of a pencil. The smaller the area which is pressed down, the better the touch screen panel will recognize the touch.



Figure 20. Back button

In any of the opened views in the software, except *Main view*, the view can be closed by pressing the back arrow on the upper right corner (Figure 20. Back button).

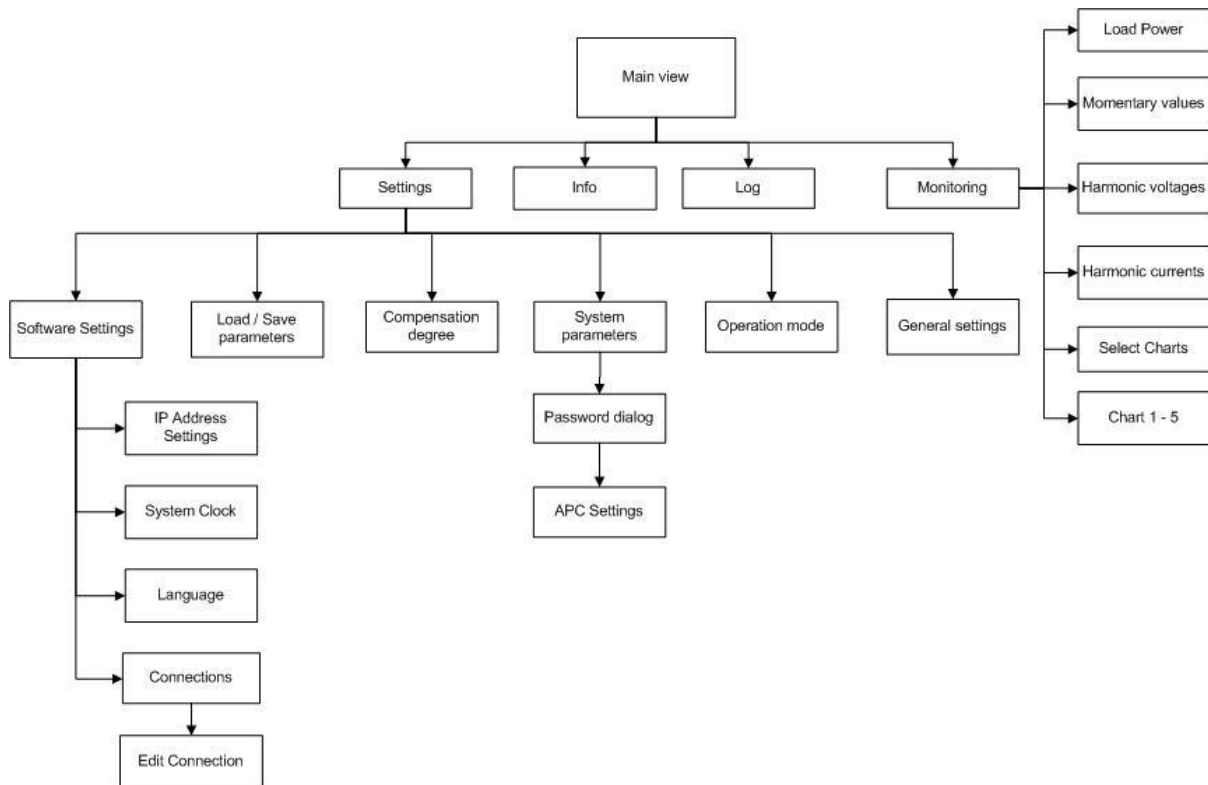


Figure 21. Structure of the HMI touch screen user interface.

8.2 General

The user interface has different views. In these views user can observe and handle different parameters and variables of the active filter and the HMI software. The user interface always shows the current status of the unit. This is shown in the main view as a text and with a coloured background; in other views only the coloured boxes are there to indicate the current status of the unit. Boxes are always positioned so that the Main views top box is the left one in other views and the lower box is the right one in other views.

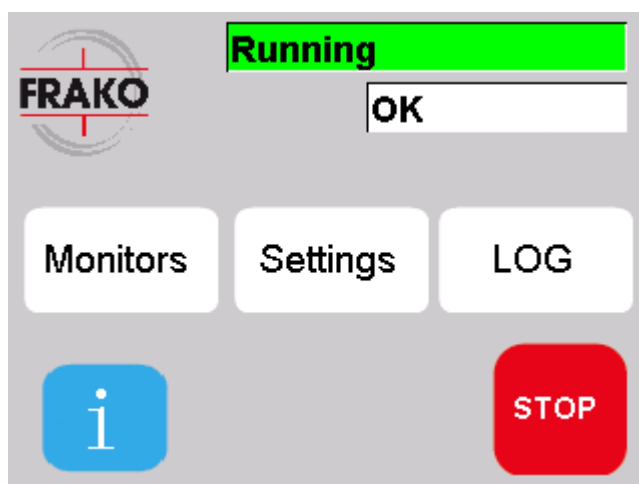


Figure 22. Main view. Status Running and system OK.

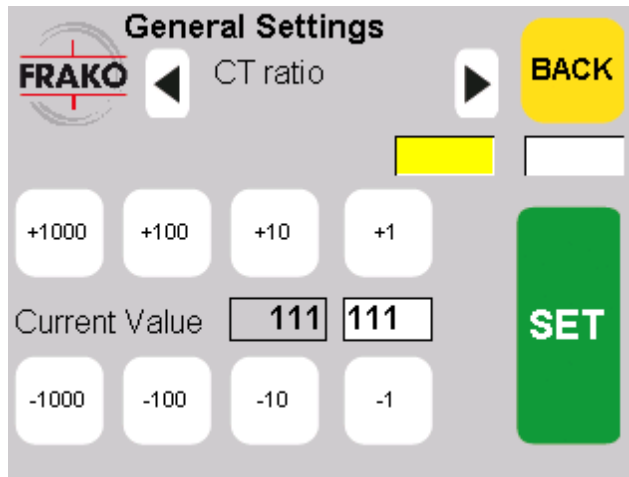


Figure 23. General settings view. Status Ready to run and system OK.

8.2.1 Different states of the active filter

Upper notice field

	Status	Background colour	Explanation
1	Ready to run	Yellow	The unit is ready for starting.
2	Start up	Yellow	This is the indication for the first step of the start-up sequence.
3	Pre-charging	Yellow	This is the second step in start-up sequence.
4	IGBT's ready to run	Yellow	This is the third step in the start-up sequence.
5	Running	Green	The unit is running.
6	Discharging	Yellow	Discharging DC-link capacitors (lasts for 3 min).
7	Trip	Red	Trip has occurred
8	Com error	Red	Internal communication error
9	Disconnected	Red	Internal communication error

Lower notice field

	Status	Background colour	Explanation
1	OK	White	Everything is OK.
2	Alarm	Yellow	Indication of an alarm.
3	Trip	Red	Indication of trip

8.3 Main view

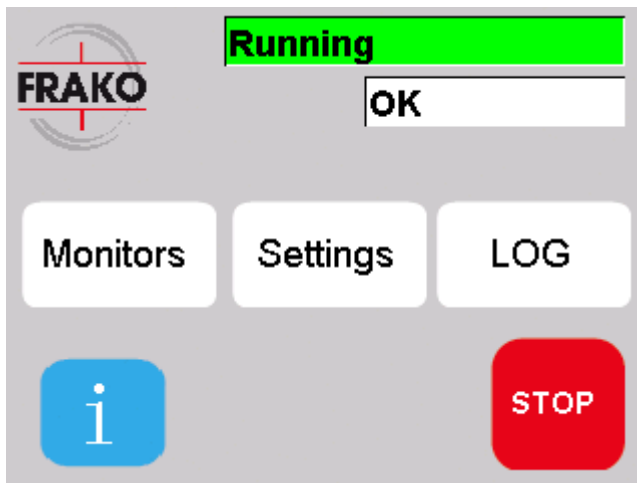


Figure 24. Main view.

Main view is opened as the device starts. In the *Main view* user can control the unit, start or stop by pressing *Start / Stop* -button. User can also observe the current state of the unit from the *Main view*; state is shown on the top in the text fields.

In case of a trip, both of the top text fields are on red background and text *Trip* can be read from them. In case of an alarm, the upper text field still shows the status of the units and the lower text field has a yellow background and text *Alarms* on it. In case of an unsolvable internal error *Com Error* text is shown on both text fields. As the status of the unit changes, the background colour as well as the text changes to represent the current status.

User can navigate to other views by pressing the buttons on the screen. The options for opening new views in the main view are *Settings*, *Log*, *Information* and *Monitoring*. *Start*-button is only visible, when the units are in *Ready to run-state*, otherwise *Stop*-button is visible. Pressing *Start* -button will start the active filters starting sequence and gets the active filters up and running. *Stop* -button is visible when the active filters are running and by pressing *Stop* -button user can stop them. If the units are tripped and *Trip* is visible, the *Stop* -button is only visible.

Button	Explanation
Start / Stop	<i>Start</i> -button starts and <i>Stop</i> –button stops the unit. <i>Start</i> –button is visible only when the unit is in <i>Ready to run</i> -state. <i>Stop</i> –button is otherwise visible. In case of an error button is greyed.
Settings	<i>Settings</i> –button opens a new <i>Settings</i> view.
Log	<i>Log</i> –button opens a new <i>Log</i> view.
Monitoring	<i>Monitoring</i> –button opens a new <i>Monitoring</i> view.
i	<i>i</i> button opens <i>Information</i> view.

8.4 Software Information view

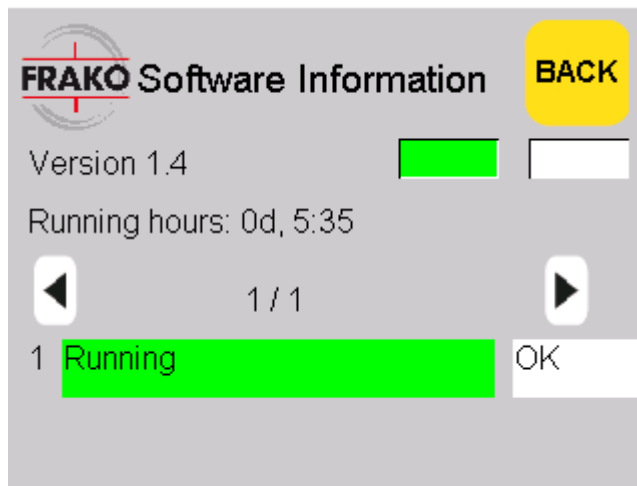


Figure 25. Information view.

Software Information - view tells the current version of the HMI software. In the view there is also information about how long the active filter has been in *Running* –state (accumulated running hours count since commissioning).

8.5 Settings view

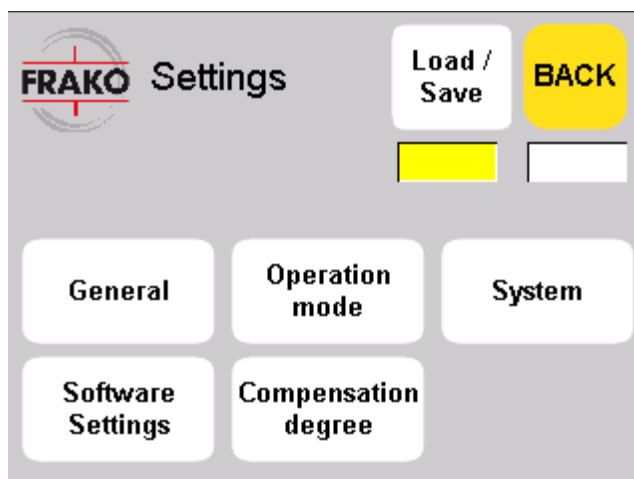


Figure 26. Settings -view.

In the *Settings* -view user can open different setting views. The visible buttons and the available views depend on the current state of the active filters. *Compensation degree* – button is only visible when the *Operation mode* is *Selectable*. When the active filter is in *Running* –state *Load / Save* –button is not available.

Button	Explanation
General	<i>General</i> –button opens <i>General</i> settings view.
Operation mode	<i>Operation mode</i> –button opens <i>Operation Mode</i> Settings view.
Load / Save	<i>Load / Save</i> –button opens <i>Load / Save</i> view.
System	<i>System</i> –button opens <i>Password</i> view, where by entering correct password authorized person can access <i>System parameters</i> view.
Compensation degree	<i>Compensation degree</i> –button opens <i>Compensation degree</i> view. Button is only visible when the <i>Operation mode</i> <i>Selectable</i> is selected in <i>Operation mode</i> view.
Software settings	<i>Software settings</i> –button opens <i>Software settings</i> view.

8.5.1 General Settings view

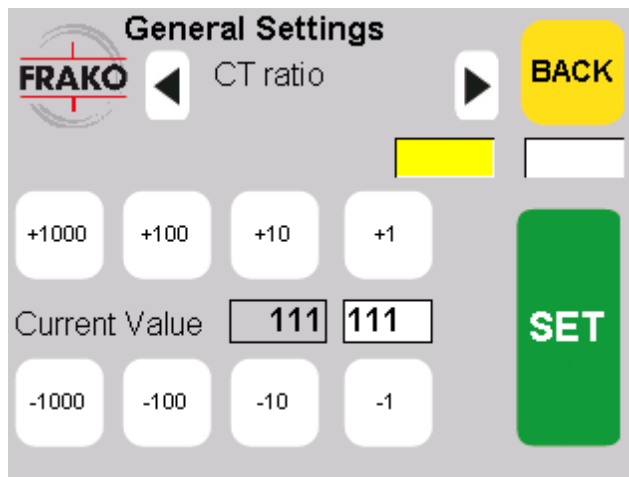


Figure 27. General settings -view.

In the *General* –view user can change the basic settings of the unit. User can select the setting wanted to be adjusted by pressing *Previous* (arrow left) or *Next* (arrow right) –buttons to browse through the available general settings. The left text field value on the screen represents the value currently on the active filter’s parameters, the value on the right text field with white background is the value to be set, when the *SET*–button is pressed.

When the desired setting to be adjusted is found, user can increase or decrease the value of the setting by pressing the + and - -buttons on the lower part of the view. Depending on the current parameter that is to be changed different numbers of add- and decrease-buttons are visible. These buttons indicate how much and on how big scale the values can be changed, for example if the maximum value for the current parameter is 1000 and minimum value is 0 and the smallest step might be 1. Then there might be +1, -1, +10, -10, +100, -100, +1000 and -1000 –buttons visible for easy parameter value change.

To set a new value for the current visible parameter on the active filter, press the + and - – buttons to get the desired value to the right user text field on the middle of the screen. The value on the text field changes when user adds or decreases the value of the setting. When the desired parameter value is visible on the right text field pressing the *SET*–button will set the new value to the active filters. This opens a new small dialog *Setting parameters* which is visible as long as it takes to set the new value. When the value on the left text field has changed to be the same value as the value on right text field the parameter set has been successful.

The General settings that can be changed are:

	Parameter	Value range	Resolution
1	Total installed current	50...2000A	1
2	CT ratio	1...5000	1
3	IGBTs ON / OFF	ON / OFF	

Button	Explanation
Previous	<i>Previous</i> (arrow left) button changes visible parameter to previous.
Next	<i>Next</i> (arrow right) button changes visible parameter to next.
SET	<i>SET</i> –button sets the current visible parameter’s user value to the active filter.
+ xx	+ xx –button increases the user value with the amount of xx.
- xx	- xx –button decreases the user with the amount of xx.

8.6 Operation mode settings view

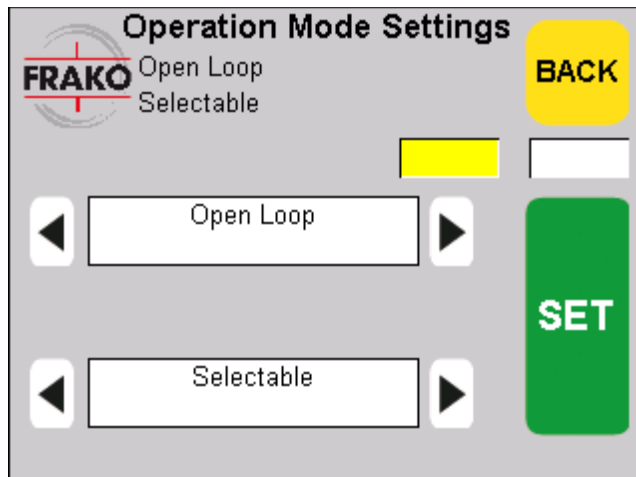


Figure 28. Operation mode settings -view.

In the *Operation mode settings* view user can adjust the operating mode of the unit. On the view there are six different buttons.

There are four different text fields on the dialog. The upper two text fields under the *Operation Mode Settings* header show the current active settings on the active filter. The lower two text fields show the settings that will be set on the active filter's parameters when user sets them by pressing the *SET*-button. To find the desired settings for the unit, user can browse through different options by pressing the *Previous (arrow left)* and *Next (arrow right)* - buttons on the view.

If the selectable option is selected and is set on the unit, a new *Compensation degree view* is opened, where user can select the levels for every compensation degree.

The mode *Test Mode* turns the active filter into a harmonic generator which injects harmonics of a 6-pulse rectifier (e.g. frequency converter) into the network. The magnitude of the current can be set by the *CT ratio* setting (General settings -> CT ratio). Scaling is such that the value 360 in *CT ratio* setting equals ~100Arms of harmonic current.

The selectable parameters are:

Upper field:

- Open Loop
 - CTs are located at the load side (see 7.3)
- Closed Loop
 - CTs are located at network side (see 7.3)
- Test Mode
 - Active filter acts as harmonic generator

Lower field:

- All harmonics (see 4.2)
- All but no fundamental (see 4.2)
- Selectable (see 4.2)

Button	Explanation
Upper Previous	Changes the upper parameter to previous.
Upper Next	Changes the upper parameter to next.
Lower Previous	Changes the lower parameter to previous.
Lower Next	Changes the lower parameter to next.
SET	SET -button the sets the current user parameter selection to active filter. If <i>Selectable</i> mode is selected a new <i>Compensation degree</i> view is opened.

8.7 Compensation degree view

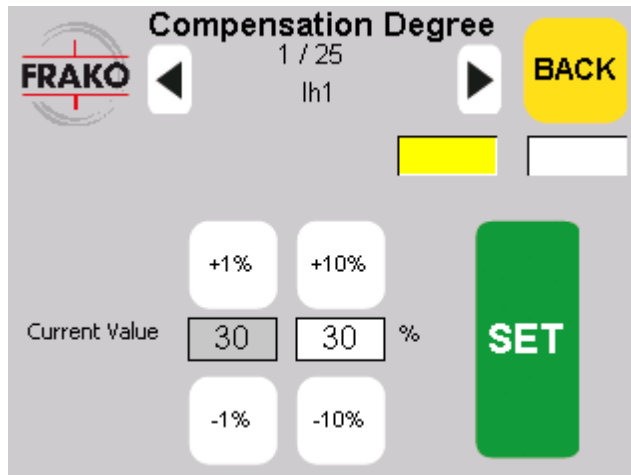


Figure 29. Compensation degree view.

Compensation degree view will only be available in the Settings view, if *Operation mode Selectable* is selected.

In the *Compensation degree* view user can adjust different *compensation degree* for each harmonic as percentage.

To select different compensation degrees to be adjusted, user must press *Previous* (Arrow left) or *Next* (Arrow right) -buttons to find the wanted parameter. The name of the current visible value to be adjusted can be seen on the top of the view under the x / 25 indication. Parameters available for selection are lh1...lh25. The x / 25 indicates which page is currently visible.

On the middle of the view, the text field on the left indicates the value on the active filter of the currently visible parameter. The text field on the right is the user value, which can be changed by pressing the + and – buttons and set to the unit by pressing the *SET* –button. When the user value has been set to the active filter, the text field on the left will change its value to the same value as is in the user text field. This is when the parameter has been successfully set.

To change the value of the selected parameters user value user must press the different + and – buttons. This will change the value of the user value.

Button	Explanation
Previous	Previous (arrow left) –button changes the visible parameter to previous.
Next	Next (Arrow right) –button changes the visible parameter to next.
SET	SET –button sets the current user value visible to the active filter.
+ xx / -xx	+xx / - xx –buttons add or decrease the user value.

8.8 Load / Save parameters view

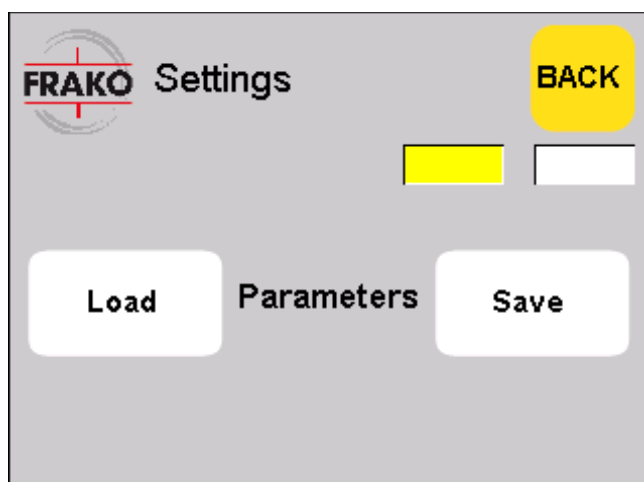


Figure 30. Load / Save parameters -view

In the *Load / Save parameters* -view user can load previously created parameter state to the unit and save the current parameter state to the unit. These functions are available in states *Ready to run* and *Trip*.

As the user presses the *Save* –button, the active filter will internally save current parameters into its internal memory.

As the user presses the *Load* -button, the active filter will internally load parameter values from its internal memory.

NOTICE Note that changed parameters that were not saved using the **Save**-button will be lost during power outage or power cycling using the ON/OFF switch. Always save settings after commissioning!

Button	Explanation
Load	Load Parameters button will load previously saved parameters from the active filters memory to use.
Save	Save Parameters button will save parameter to active filters memory.

8.9 Software Settings

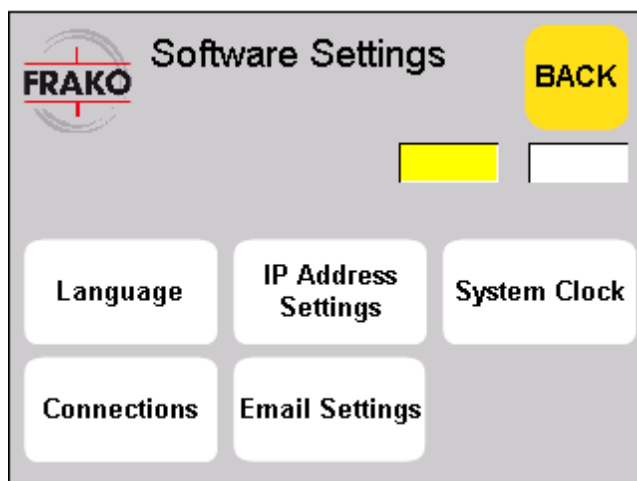


Figure 31. Software Settings

In the *Software Settings* view user can open different software setting related views, *Language*, *IP Address Settings*, *System Clock* and *Connections*.

Button	Explanation
Language	Opens Language selection view.
IP Address Settings	Opens IP Address settings view.
System Clock	Opens System Clock set view.
Connections	Opens Connection settings view.
Email Settings	Opens Email settings view

8.9.1 Language

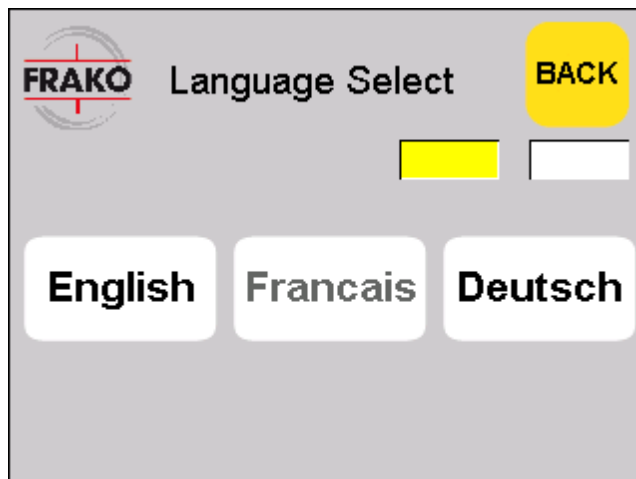


Figure 32. Language Select

In the Language Select view user can select the language of the user interface. There are different languages available. Language will change when user presses the button of the wanted language.

8.9.2 IP Address Settings

When the active filter is to be integrated into a network, an additional industrial switch (optional) is needed.

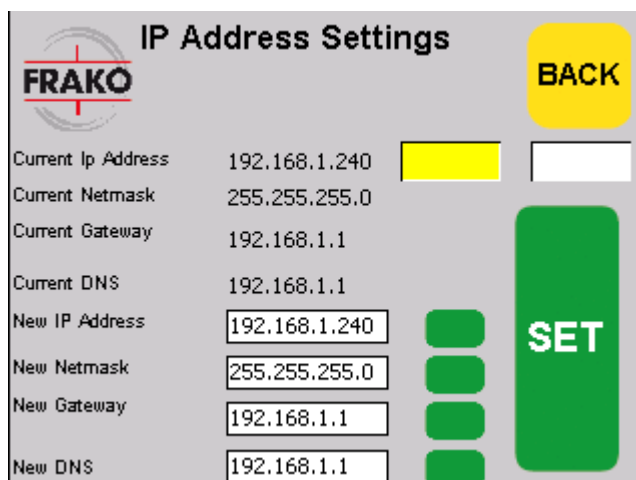


Figure 33. IP Address Settings

In the IP Address settings view user can change different IP Address related parameters, these parameters change the settings of the HMI touch screen panel PC. User can change

IP Address setting, *Netmask* settings, *Gateway* settings and *DNS* settings. The edit view of desired parameter is opened by pressing the *Green* -button on the right of the *New IP Address*, *New Netmask*, *New Gateway* or *New DNS*. When the desired values are set on the *New IP Address*, *New Netmask*, *New Gateway* and *New DNS* fields, user can set the new parameters active to the HMI Panel PC by pressing the *SET* -button.

Button	Explanation
First green button	Opens Edit IP Address view.
Second green button	Opens Edit Netmask view.
Third green button	Opens Edit Gateway view.
Fourth green button	Opens Edit DNS view
SET	Sets the New IP Address, New Netmask, New Gateway, New DNS settings to HMI panel's active settings.

8.9.2.1 IP Address / Netmask / Gateway / DNS Edit view



Figure 34. IP Address / Netmask / Gateway / DNS edit view

In this edit view user can edit the value of the selected parameter. When the parameter value is correct the value of the text field will be returned to IP Address Settings view to *New IP Address*, *New Netmask* or *New Gateway* text field when OK is pressed. If user doesn't want to make any changes then Cancel is pressed.

Button	Explanation
Number buttons	Adds number to text field.
.	Adds dot to text field.
<	Backspace, removes last character from the text field.
OK	Returns the IP Address / Netmask / Gateway value on the text field to IP Address settings view.
Cancel	Returns to IP Address settings view without changes.

8.9.3 System Clock view

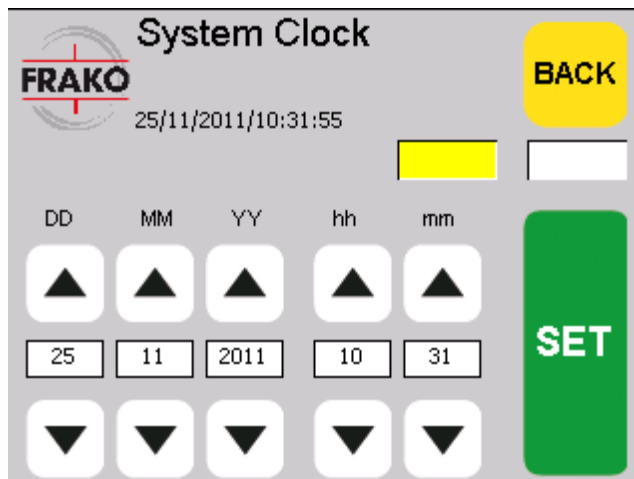


Figure 35. System Clock

In the System Clock view user can change the time on the software. The different time values are changed by pressing the + and – buttons. When the desired time value is visible on the *DD*, *MM*, *YY*, *hh* and *mm* text fields *SET*–button is pressed to set the time to the software.

Button	Explanation
+ / -	Adds or decreases one value.
SET	SETS the value on the YY, MM, DD, hh, mm to be the system time.

8.9.4 Connections view

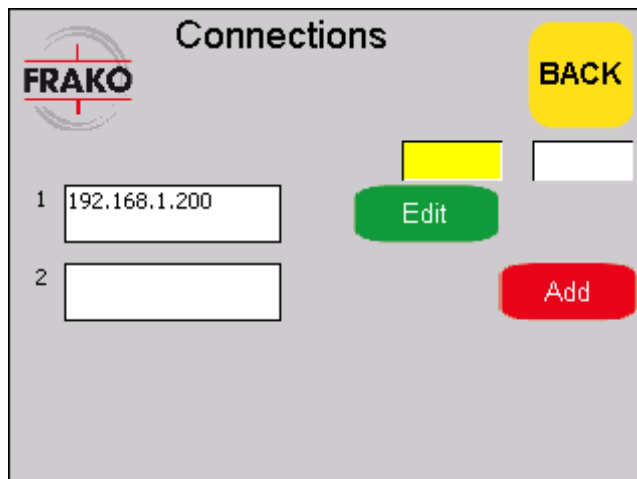


Figure 36. Connections view

In the Connections view user can change the parameters of the connections to Active Filters. There is always at least one connection. By pressing the *Edit* button next to an existing connection *Edit Connection* view is opened for user to edit the address of that connection. If *Add*–button is pressed next to an empty text field a new *Add Connection* view is opened for entering a new connection to active filter.

Button	Explanation
Edit	Opens Edit Connection view
Add	Opens Add Connection view
E / D	Enables / Disables the connection

Del	Delete connection
Units 1..4 and Units 5..7	Opens page with 1..4 connections or connections 5..7

8.9.4.1 Edit Connection view



Figure 37. Edit Connection view

In the *Edit Connection* view user can edit connection's *IP Address* value. This is done by pressing the number and backspace buttons. When the desired value is on the text field *OK* -button is pressed and the value is then set. If user wants to go back from the view without doing any changes *Cancel* -button is pressed.

Button	Explanation
Number buttons	Adds number to text field
Dot	Adds dot to text field
<	Backspace, removes last character from the text field.
Cancel	Returns to Connections view without any changes.
OK	Returns to Connections view and sets the user made changes.

8.9.5 Email Settings

When the active filter is to be integrated into a network, an additional industrial switch (optional) is needed.

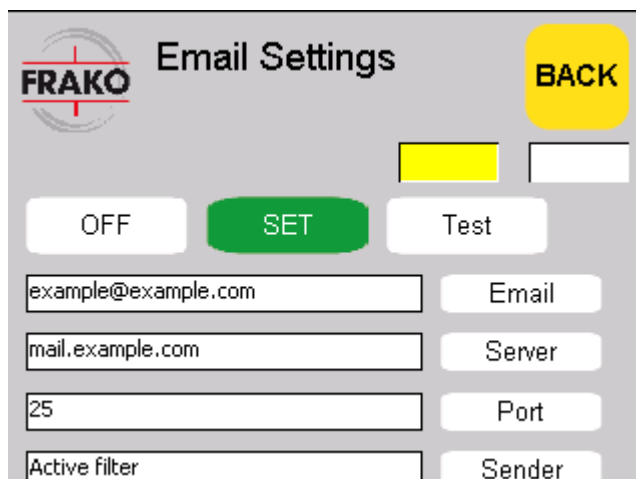


Figure 38. Email Settings view

In the *Email Settings* view user can edit user interface software's email settings. If the email sending is set on the user interface program will send *TRIP* information message to given email address if a TRIP occurs.

In *Email Settings* the view the email sending is set on by pressing the *ON/OFF* –button, whichever text is visible means that this is the selection active. If ON text is visible, then the sending is on.

The email sending properties can be changed through different email setting edit views; user can open these views by pressing *Email*, *Server*, *Port* or *Sender* buttons. When there are changes made to email settings that setting's background will turn into yellow until the new parameter is set. This means that user can go to all the different email setting views and change the settings. When the desired settings are visible on the text fields the *SET* button is pressed and the yellow background of the changed settings will turn into white and the parameters are set.

Figure 39. Email settings view, one parameter changed

The email settings and connection can be tested when the correct email settings are set by pressing the *Test* button. The test email message is sent immediately to the given address. If the settings and connection are OK, the message should be found in the receivers email box.

NOTE: If the connection is not OK or email settings are not OK, the Email sending should be in OFF mode, otherwise if an TRIP occurs the user interface program will slow down occasionally.

Button	Explanation
ON/OFF	Sets the Email sending ON or OFF, whichever reads on the button means that mode is selected.
SET	Sets the new settings visible on the setting fields active on the software.
Test	Sends a test message to the given email address.
Email	Opens Email Address edit dialog.
Server	Opens Server address edit dialog.
Port	Opens Port number edit dialog.
Sender	The name of the sender visible to the email receiver.

8.9.5.1 Email address



Figure 40. Email Address edit view

In the *Email Address* edit view user can edit the target address of the alert email messages. The editing is done by inserting the address into the text field. As the correct address has been written on the field, user can return back to *Email Settings* view to set the new address active.

Button	Explanation
< >	Changes the special characters visible on the buttons under the text field.
Clear	Clears the text field.
<--	Backspace
1..9 and a...m -buttons	Enters the selected character to the text field
^	Shift
	Spacebar

8.9.5.2 Server address

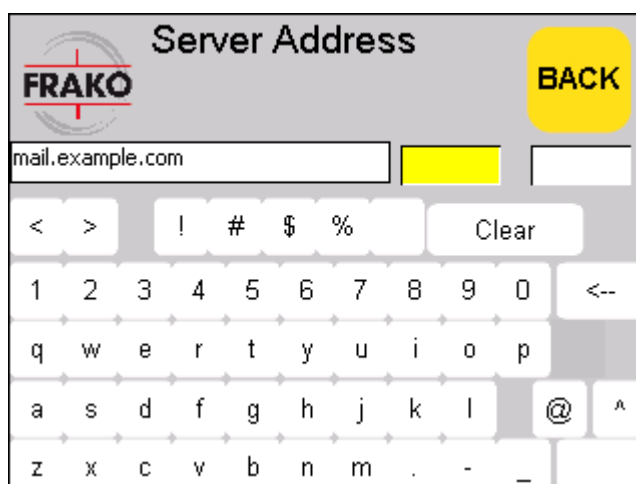


Figure 41. Email server address edit view

In the *Server Address* view user can set the Email transfer server by editing the text visible on the field. As the correct address has been written on the field, user can return back to *Email Settings* view to set the new address active.

Button	Explanation
< >	Changes the special characters visible on the buttons under the text field.
Clear	Clears the text field.
<--	Backspace
1..9 and a...m -buttons	Enters the selected character to the text field
^	Shift
	Spacebar

8.9.5.3 Port number

Figure 42. Email server port number edit view

In the *Port number* view user can edit the Email Server port which is to be used by entering the correct value into the text field. As the correct address has been written on the field, user can return back to *Email Settings* view to set the new address active.

Button	Explanation
1..9	Enters the number on the button to the text field.
<	Backspace

8.9.5.4 Sender name

Figure 43. Email sender name edit view

In the *Sender name* view user can set the Email senders name which will be visible to the email message receiver. As the correct address has been written on the field, user can return back to *Email Settings* view to set the new address active.

Button	Explanation
< >	Changes the special characters visible on the buttons under the text field.
Clear	Clears the text field.
<--	Backspace
1..9 and a...m -buttons	Enters the selected character to the text field
^	Shift
	Spacebar

8.10 Event monitoring

There are four categories that the events system is monitoring:

1. Normal events give information when operations such as **start** and **stop** sequence have taken place.
2. Informative alarms give information when operations such as **ac voltage high** have been noticed but ac voltage has returned back to normal operation level.
3. Action alarms, such as **IGBT temperature high**, shall limit output current in order to get IGBT temperature back to normal operation range.
4. Trips, such as **IGBT temperature max**, shall cause system trip. In this case the operator needs to clear out the reason for the trip and acknowledge error before re-starting.

All of these events can be observed in the *Log view*. When a *Trip* or *Alarm* is active or has been active but has not yet been acknowledged there is a message shown in the status text fields of *Main view* and *Monitoring view*.

In case of power outage or power cycling using the ON/OFF switch the event and trip log will be cleared. The event list is recorded into internal flash memory and the complete event list since commissioning can be retrieved by FRAKO specialist.

8.10.1 Log view

In the *Log view* user can see what *alarms* and *trips have been raised* and browse all events that have taken place. *Events*, *trips* and *alarms* will be shown on the large white text field on the dialog. By pressing *ALARMS*, *TRIPS* or *EVENTS* –button the text field will show information according to the selection. The header text tells which of the three is currently visible.

8.10.1.1 Alarm Log view

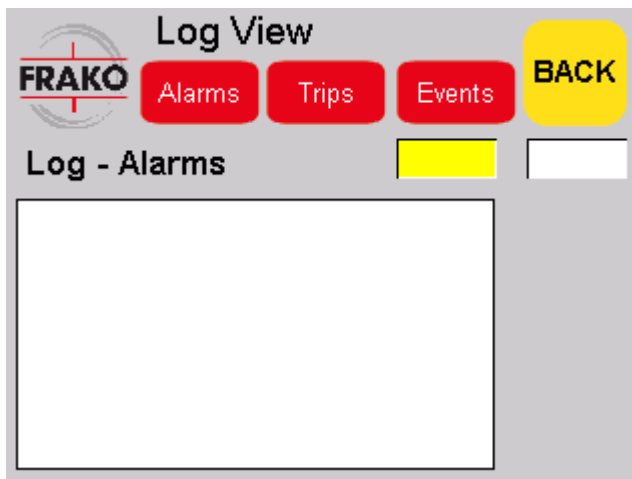


Figure 44. Alarms – log.

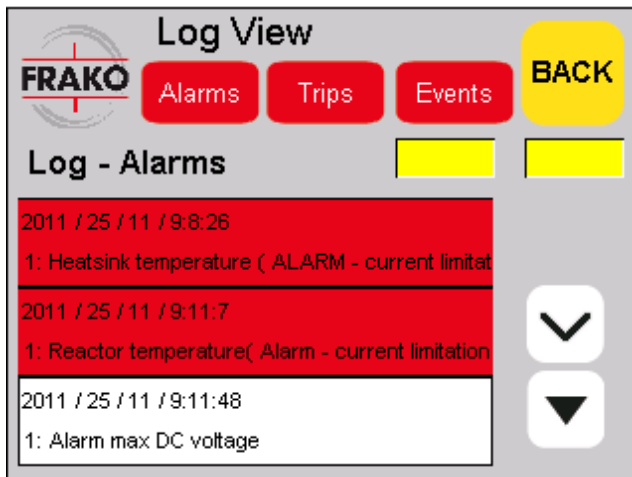


Figure 45. Alarms –log with active and non-active alarms.

When the Alarms log is visible the text LOG – ALARMS (Figure 44) is visible on the top of the white text field. If there are any alarms active, the name of those alarms and the time when they have occurred will be presented on red background. Alarms that have been active, but are not anymore active are presented on a white background.

To browse through the alarms user can press *UP ARROW* or *DOWN ARROW* –buttons, if they are visible. If *UP ARROW* –button is not visible, there are no more alarms up on the list. When the *DOWN ARROW* –button is not visible, it means that there are no more alarms down on the list. Otherwise pressing *UP ARROW* or *DOWN ARROW* –buttons will move the list one up or down.

To acknowledge the alarms user must press the *ACK* –button when the *Alarms view* is active. Every alarm will be cleared on the text field and alarm status of the program will be cleared. After pressing the *ACK* –button the Alarms that have not been fixed out on the unit will be raised again and are visible after a moment.

8.10.1.2 Trip Log

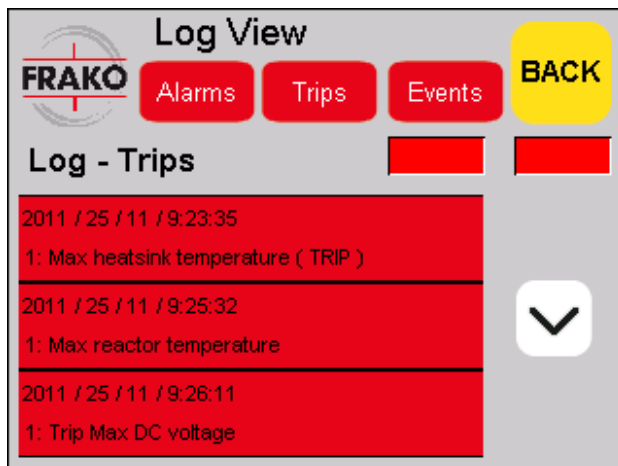


Figure 46. Log - Trips. One trip active.

When the Trip log is visible a text LOG – TRIPS is visible on the top of the white text field. All the active trips are presented on a red background. User can press *UP ARROW* or *DOWN ARROW* -buttons to see if there are more trips on the list (only when the *UP ARROW* or *DOWN ARROW* -buttons are visible). When the reason for the trip is fixed user can acknowledge the trips by pressing *ACK* –button. This will try to clear the trips on the unit, if the trips don't clear out the active Trips will return to be visible in a few moments and the state changes back to TRIP.

8.10.1.3 Event Log

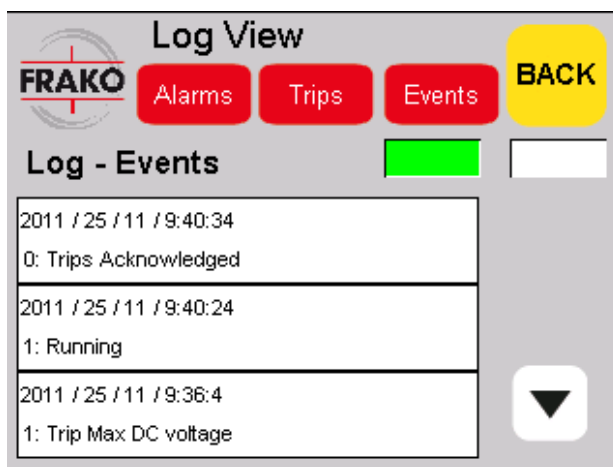


Figure 47. Log - Events.

All the events such as starting, stopping, trips and alarms will be shown on the event log. User can browse through the event list by pressing *UP ARROW* or *DOWN ARROW* –buttons when there are more events than can fit on the list at the same time (only if the arrow buttons are visible).

Button	Explanation
Alarms	Shows Alarms list in the black text field.
Trips	Shows Trips list in the black text field.
Events	Shows Events list in the black text field.
Up Arrow	Moves the current visible list one up.
Down Arrow	Moves the current visible list one down.
V	Acknowledges the current visible list, Alarms or Trips.

8.11 Power quality monitoring

Control and protection system on the active filter analyses and calculates power quality parameters from the measured voltage and current signals. Different power quality parameters can be observed at the *Monitors* views when the system is running. User can select five parameters for recording and saving in the HMI memory. The parameters aren't saved into persistent memory, so if the HMI is to be rebooted or the entire active filter is shut down, the recorded data will be lost.

The user interface updates power quality parameters from the Control and protection system in one second intervals.

The recorded data for the selected parameters is saved in both *Day* mode and *Month* mode. In the *Day* mode the data is saved so that the highest value from every three second period is saved. The Day mode shows in the chart view the selected parameters performance during the last 24 hours in three second accuracy.

The *Month* mode saves parameters from the period of one month. The accuracy is one minute. The parameters are saved so that the highest value of the one minute period is saved as the value shown on chart.

8.11.1 Monitoring

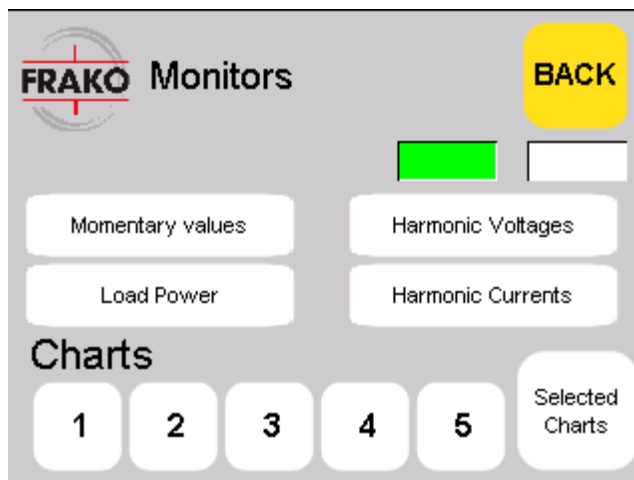


Figure 48. Monitors view.

In the *Monitors* view user can go to different power quality monitoring views to observe how the active filter is performing.

Button	Explanation
Chart 1...5	Opens a chart view.
Selected Charts	Opens a Select Charts view
Harmonic Currents	Opens Harmonic currents view.
Harmonic Voltages	Opens Harmonic voltages view.
Momentary Values	Opens Momentary values view.
Load Power	Opens Load Power view

8.11.2 Chart 1...5

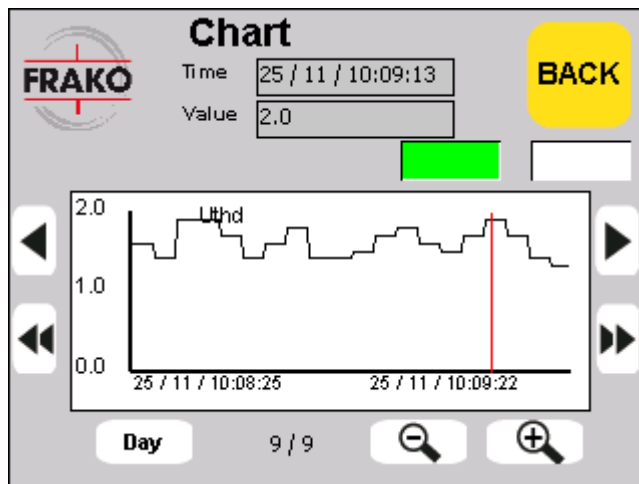


Figure 49. Chart -dialog.

In the *Chart* views user can observe chosen parameters history trend chart. There are five different chart views, all the views are similar otherwise but each of them show history of a parameter selected for that particular view. In other words, each of the views show a parameters history selected for that chart view. Read more about the selection of a parameter for a chart in the next chapter (8.11.3 – Select Charts).

Chart data for the selected parameters are recorded and stored automatically; data is recorded for each parameter for about one month's time span. This data can then be observed closely in the *Chart* view. There are two modes for chart to be viewed in, Day and Month. The chart view is currently in that mode which reads on the top of the *Day / Month* button.

In the chart view user can move the chart by pressing the *left and right arrows* one pixel at a time, using the *double arrows* user can move more at a time. The arrow buttons move the red line on the trend chart, which is basically a pointer for user. The value of the trend chart at the position of the red line can be observed on the top of the chart in the *value* text field, also the time of the value can be observed in the *time* text field. Moving the red line left and right, user can see the value of the wanted period of time on the trend chart. If there are parameters left or right of the visible chart, moving the red line to left or right on the screen and continuing to press left or right will show the values currently hidden on the left or right.

User can observe more precisely the chart by zooming in or zooming out on the trend. The red line is used as the centre point for the zooming, so user should move the red line first to the position where more precise information is wanted and then press the zoom buttons. The plus button is for zooming in and the minus button is for zooming out.

By default when *Chart* view is opened the dialog shows the most recent value on the screen also the zoom factor is the lowest so that all the values can be seen at once. The zoom factor is between 1 / 9 and 9 / 9, one is the lowest factor and nine is the highest.

Button	Explanation
Zoom in	Zooms the chart in.
Zoom out	Zooms the chart out.
Left Arrow / Double Left	Moves chart left one pixel / 15 pixels.
Right Arrow / Double Right	Moves chart right one pixel / 15 pixels.
Day / month	Changes chart between day and month views.

8.11.3 Select charts

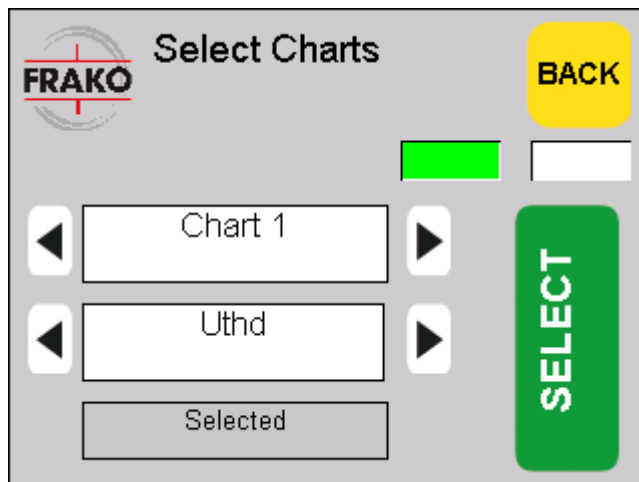


Figure 50. Select charts view.

In the *Select charts* view user can select the parameters to be recorded for observation in the *Chart* –views.

To select to which chart user wants a certain parameter to be recorded to the *Previous chart* (*Left arrow*) and *Next chart* (*Right arrow*) –buttons are used. The text field between the buttons indicates which chart is currently selected.

To change the power quality parameter selected, the *Previous parameter* (*Left arrow*) and *Next parameter* (*Right arrow*) –buttons are used. The text field between the buttons indicates which parameter is currently selected.

To select the parameter to be observed for the selected chart *Select* –button is pressed. The value of the text field on the left of the *Select* –button indicates whether the current parameter is selected for the current selected chart, then the text reads *Selected* otherwise that parameter isn't selected for current selected chart.

When a recorded parameter is changed for a chart, all the previous data of the previous recorded parameter will be lost!

Button	Explanation
Previous chart (Left arrow)	Changes chart to previous.
Next chart (Right arrow)	Changes chart to next one.
Previous parameter (left arrow)	Changes parameter to be recorded to previous.
Next parameter (right arrow)	Changes parameter to be recorded to next one.
Select	Selects current visible parameter to be recorded to the visible chart.

Selectable parameters for recording	
$I_{thd} / \% (L1)$	Active filter current L1 RMS
$I_h 1..25 / A (L1)$	Active filter current L2 RMS
$U_{thd} / \% (L1)$	Active filter current L3 RMS
$U_h 2..25 / A (L1)$	DC voltage HI
Phase L1 Voltage at PCC (N/A)	DC voltage LO
Phase L2 Voltage at PCC (N/A)	Cubicle temperature
Phase L3 Voltage at PCC (N/A)	Heatsink temperature
Phase to phase L12 voltage at PCC (N/A)	Heatsink 2 temperature (N/A)

Phase to phase L23 voltage at PCC (N/A)	Heatsink 3 temperature (N/A)
Phase to phase L31 voltage at PCC (N/A)	Load current L1
Active Power at PCC (N/A)	Load current L2
Reactive Power at PCC (N/A)	Load current L3
Flicker at PCC (N/A)	Load current d-axis (dc-component)
Phase L1 voltage RMS	Load current q-axis (dc-component)
Phase L2 voltage RMS	Load active power L1
Phase L3 voltage RMS	Load active power L2
Phase to phase L12 voltage at APC (N/A)	Load active power L3
Phase to phase L23 voltage at APC (N/A)	Load reactive power L1
Phase to phase L31 voltage at APC (N/A)	Load reactive power L2
	Load reactive power L3

8.11.4 Harmonic currents

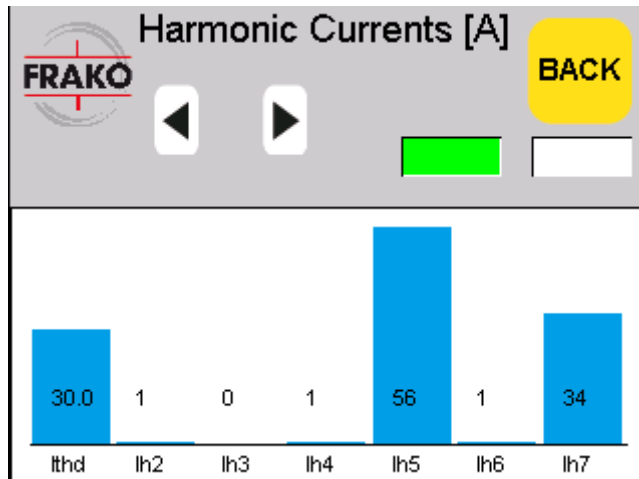


Figure 51. Harmonic currents view.

In the *Harmonic currents* view user can observe the current status of different harmonic currents. By pressing *Previous* (Left arrow) or *Next* (Right arrow) –buttons user can browse through different pages where current values of harmonic currents are shown in bar form as well as in numbers.

Button	Explanation
Left arrow	Previous Harmonics page.
Right Arrow	Next Harmonics page.

8.11.5 Harmonic voltages

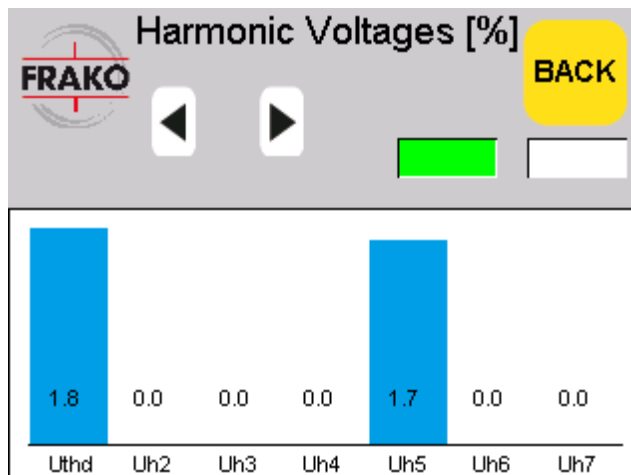


Figure 52. Harmonic voltages -view.

In the *Harmonic voltages* view user can observe the current status of different harmonic voltages of input phase L1. By pressing *Left arrow* or *Right arrow* –buttons user can browse through different pages where current values of harmonic voltages are shown in bar form as well as in numbers.

Button	Explanation
Left arrow	Previous Harmonics page.
Right Arrow	Next Harmonics page.

8.11.6 Momentary values

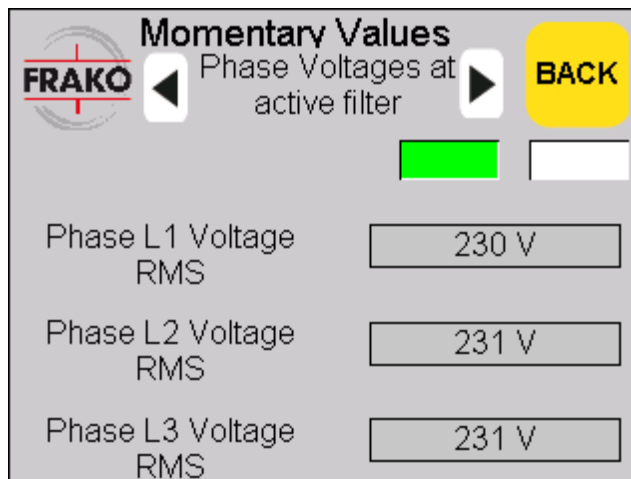


Figure 53. Momentary values -view.

In the *Momentary values* –view user can observe different parameters and their current values on the unit. By pressing *Left arrow* or *Right arrow* –buttons user can browse through the different pages to see different parameters and values.

Page 1: Phase Voltages at active filter
Phase L1 Voltage RMS
Phase L2 Voltage RMS
Phase L3 Voltage RMS
Page 2: Active filter compensation
Active filter current L1 RMS

Active filter current L2 RMS
Active filter current L3 RMS
Page 3: DC Voltage, Cubicle temp
DC Voltage HI
DC Voltage LO
Cubicle temperature
Page 4: Heatsink temperatures
Heatsink temperature

Button	Explanation
Left arrow	Previous momentary values page.
Right Arrow	Next momentary values page.

8.11.7 Load Power

Load Active Power kW		Load Reactive Power KVAR	
PL1	55.0	QL1	38.5
PL2	50.0	QL2	35.0
PL3	52.0	QL3	36.4
Total	157.0	Total	109.9

Figure 54. Load Power -view.


In the Load Power view, user can observe values of different Load Power parameters.

9 Commissioning

NOTICE Note that in Closed Loop –configuration the CT-ratio and location must be exactly correct! Also CT orientation must be correct and the secondary **MUST NOT** be short circuited when starting active filtering! Otherwise serious damage may be caused to active filter!

NOTICE Connecting OSFM active filter to mains voltage and frequency outside the rating of the active filter may cause irreversible damage to OSFM. Compare the parameters shown on the rating plate of the active filter to the actual system parameters and do not switch on the unit if parameters do not match.

It is recommended to have a 3 phase power analyser with harmonic measurement available during commissioning.

1. Check that electrical connection is correct.
 - a. Power cable is connected , Phase sequence (sequence L1, L2, L3) and phase sequence (default: right-system) properly connected (see Chapter 7.1). Check the cable cross-section based on the used fuse.
 - b. External fuses are connected and correct size (see chapter 7.1).
 - c. Current transformer are connected, phase sequence and directions are correct (see chapter 7.3).
2. Turn the 3-stage main switch from **OFF** to **Standby** position.
 - a. Wait until HMI main page appears. (boot)
3. Set the desired language, date and time
 - a. Main menu: **Settings -> General Settings-> Language**
 - b. Main menu: **Settings -> General Settings-> Date and Time**
4. Set IGBT's Parameter to **OFF**
 - a. Select **Settings->General settings** (see chapter 8.5.1).
 - i. Check that **IGBTs ON/OFF** setting is at **OFF** position. Save the parameter with set button.
5. Turn the switch to run position, fans shall start blowing.
6. Clear Trip log
 - a. select **LOG -> TRIP->** select **TRIP** event and press  (acknowledge) button (see chapter 8.10.1.2).
7. Parameterise the active filter unit according to your application:
 - a. Select **Settings->General settings** (see chapter 8.5.1).
 - i. Give values for "Total installed current" (eg OSFM 150-400-4) value in the OSFM = 150, (2x in parallel OSFM 150-400-4) value in the OSFM = 300
 - ii. Enter the CT ratio. (e.g. CT 1000:5) value in the OSFM = 200

- iii. Check that **IGBTs ON/OFF** setting is at **OFF** position.
 - b. Select **Settings->Operation mode** (see chapter 8.6).
 - i. Select **Open loop** or **Closed loop** according to your external current transformer location (see chapter 7.3).
 - ii. Select **All harmonics** or **Selectable** according to your application.
 - c. When **Selectable** operation mode is used the harmonics have to be selected.
 - i. Select **Settings->Compensation degree**. Select which harmonics and the percentage to be compensated. (see chapter 8.7).
8. Save parameters:
 - a. Select **Settings->Load / Save parameters** (see chapter 8.8).
9. Go back to the Main view. It should look like Figure 55 (Unit is ready to run).
10. Press **Start**.
 - a. DC link shall be charged but IGBTs shall NOT start to switch.
11. Check that measured momentary values are correct:
 - a. Select **Monitoring-> Momentary values** (see Figure 53). Especially check the following values:
 - i. Check that **Phase voltages at active filter** are within normal range.
 - ii. Check that DC-voltages **HI** and **LO** are in the range of 250-350V and symmetrical (within 15V) and stable.
 - iii. Check that **Active filter current** is <2A for all phases.
12. Check that measured Load Power is correct:
 - a. Select **Monitoring-> Load Power** (see chapter 8.11.7).
 - i. For symmetric loads the readings of all three phases should be positive and approx. of the same size.
 - ii. Compare with measurements of 3 phase power analyser. If readings of active and reactive power do not match, check current transformer installation (CT ratio, terminals, phase sequence and rotation) - see chapters 7.3 till 7.6.
13. Enable IGBTs:
 - a. Set **Settings -> General settings -> IGBTs ON/OFF** to **ON** position. Active filter should start operating.
14. Check that measured momentary values are correct:
 - a. Select **Monitoring-> Momentary values** (see Figure 53). Especially check the following values:
 - i. Check that DC-voltages **HI** and **LO** are in the range of 375V and symmetrical (mostly within 30V). Properties of load current may cause variation in DC voltages which is normal.
15. Check correct operation of the active filter with a 3 phase power analyser.
16. Set monitoring properties:

- a. Select **Monitors -> Selected charts** to choose variables for trend recording (see chapter 10.4).

17. Save IGBT setting:

- a. Stop active filter by selecting **Main view -> STOP**.
- b. Select **Settings->Load / Save parameters** (see chapter 8.8).

18. Start active filter:

- a. Active filter can be started / stopped with the main view buttons from here on.

10 Operation

This operation chapter covers topics regarding the basic operation and basic usage of the active filters.

10.1 Start-up sequence

Pre-conditions:

To get the active filter running, the unit must be in *Ready to run* -state and no *Trips* active.

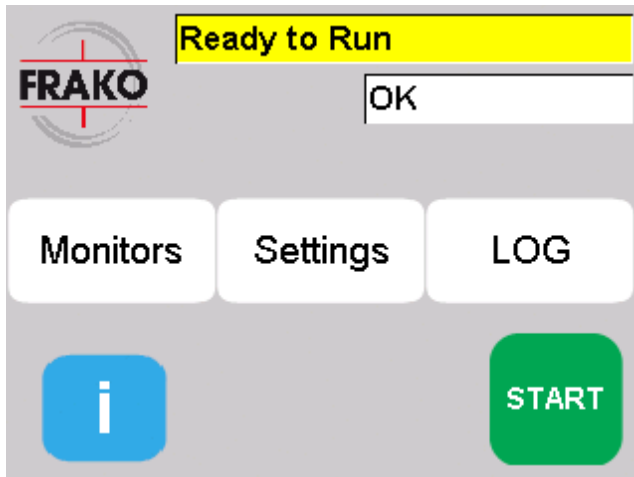


Figure 55. Main view, unit is ready to run.

User actions:

When the active filter is in *Ready to run* –state the *Start* –button is visible. In the main view user must press the *Start* –button to begin the start-up sequence. The unit will go through different states until the *Running* –state is on. When the *Running* text is visible on the status text field the unit is up and running.

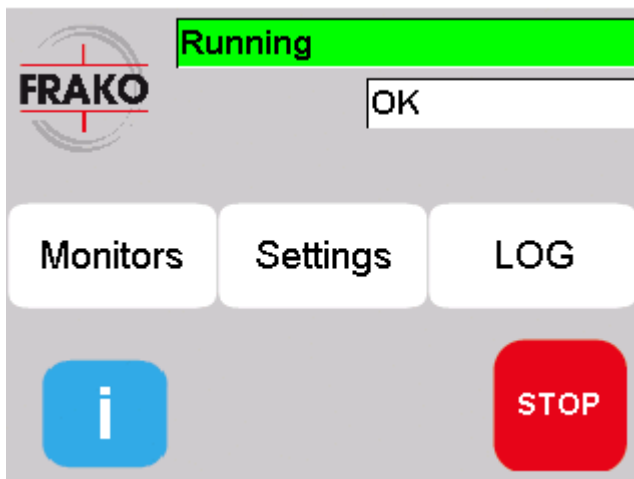


Figure 56. Main view, unit is Running.

Result:

Active filter is running and the unit's state is *Running*.

10.2 Stop sequence

Pre-conditions:

Active filter can be stopped at any time when the unit isn't already stopped. This means that the unit is running or is going through the start-up sequence. In these states the *Stop* –button is visible (see Figure 56. Main view, unit is Running.).

User actions:

When the unit isn't in *Ready to run* –state, in the main screen the *Stop* –button is visible. In the main view user must press the *Stop* –button to stop the unit from running. Pressing of the *Stop* button will start stop sequence. This stage includes discharging of the DC-link capacitors which takes 3 minutes. When the sequence is ready *Ready to run* –text becomes visible on the status text field. The unit is stopped.

Result:

Unit is in *Ready to run* –state and is not running. (Figure 55. Main view, unit is ready to run.)

10.3 Operation mode selection

Pre-conditions:

The active filter is in the *Ready to Run* –state.

User actions:

In the main view user must press the *Settings* –button to open the *Settings view*.

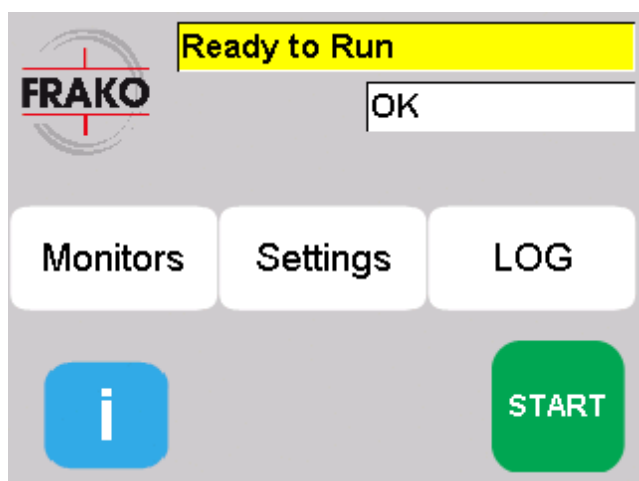


Figure 57. Main view.

In the *Settings* –view press the *Operation mode settings* –button, this will open *Operation mode settings* view.

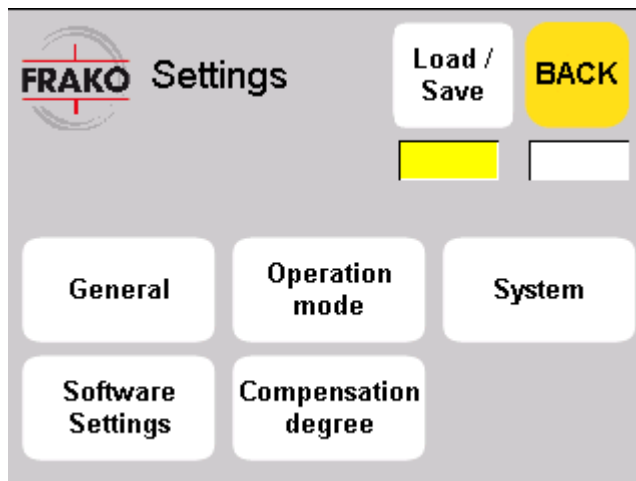


Figure 58. Settings -view.

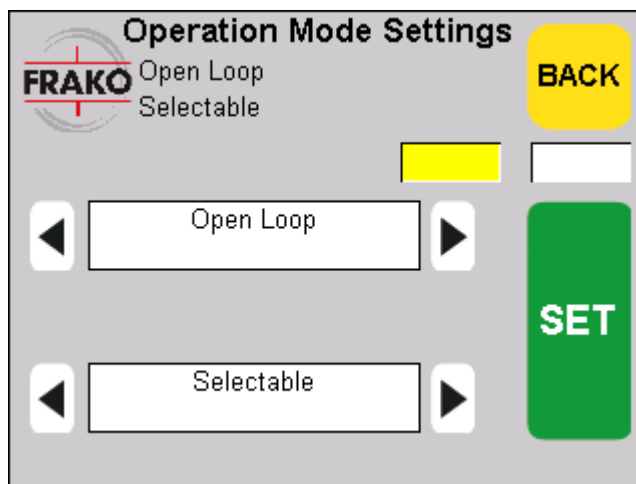


Figure 59. Operation mode settings -view.

There are four text fields on the view. The upper two under the *New Settings* header, show the user selected parameters that will be sent to the unit when the *SET* –button is pressed. The text fields under the *Current Settings* show the currently active parameters on the unit.

To set new parameters:

The parameter change is done by first selecting the desired parameters by pressing the *Previous* (Left arrow) and *Next* (Right arrow) –buttons on the right of the *New Settings* text fields. Pressing the buttons will change the text in the user selected parameter text field on the left of the buttons.

When the desired parameters are set on the user parameters text fields they can be send to the unit by pressing *SET* -button. After pressing the *SET* –button the *Current Settings* text fields should change to the same as the *New Settings* text field text to indicate successful parameter set.

If user selects *Selectable* parameter, then when *SET* –button is pressed a *Compensation degree* -view will open.

The selectable parameters are:

Upper field:

- Open Loop

- Closed Loop
- Test mode

Lower field:

- All harmonics
- All but no fundamental
- Selectable

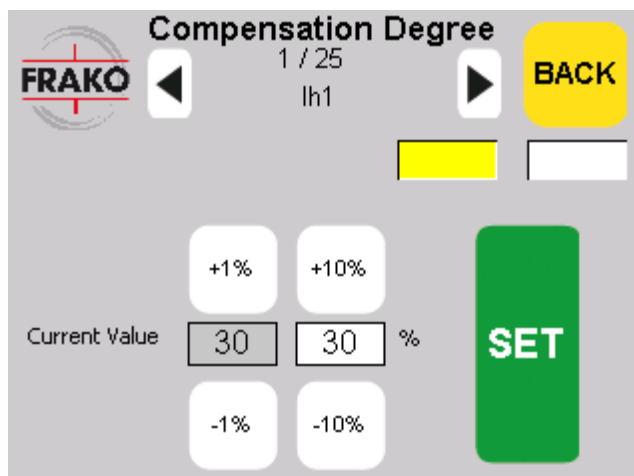


Figure 60. Compensation degree -view.

In the *Compensation degree* –view the user can set the degree of compensation for different parameters.

Result:

The desired *Operation mode* and possibly compensation parameters are set to the active filter. Note that changed parameters should be saved by the user (see chapter 8.8).

10.4 Power quality parameter selection and storage

Pre-conditions:

The user interface program must be in the *Main view*.

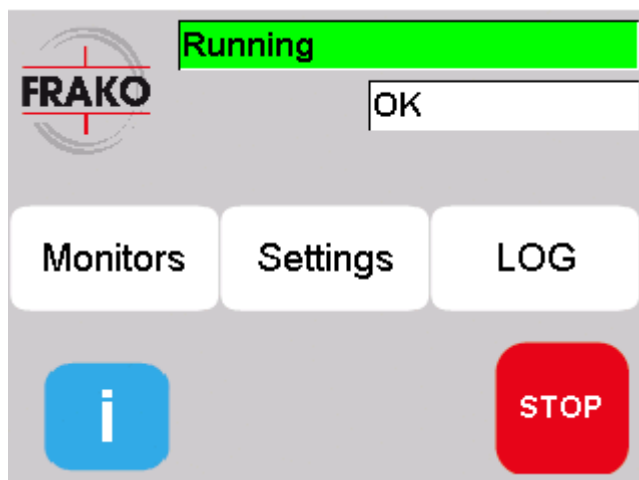


Figure 61. Main view.

User actions:

In the main screen press the *MONITORS* –button to open the *MONITORS* view.

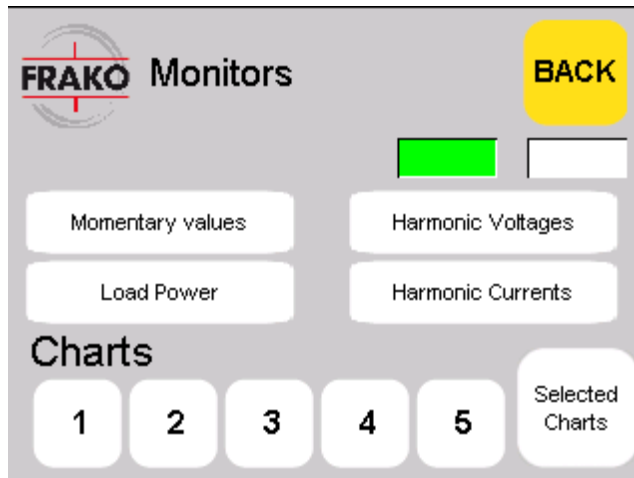


Figure 62. Monitors view.

In the *MONITORS* view user can

- Open a chart view to observe by pressing *Chart 1...5* –button.
- Select parameters to save and to be observed in the chart views by pressing *Select Charts*
- Open a bar chart view to observe Harmonic voltages or Harmonic currents by pressing *Harmonic voltages* or *Harmonic currents* –button.
- Open a momentary values view to observe different momentary values by pressing *Momentary values* –button.

To select a quality parameter to be recorded:

In the *MONITORS* view user presses *Select charts* –button. This opens a *SELECT CHARTS* –view. In this view user can select parameters that the program will follow and record its parameters. By pressing *Previous chart (arrow left)* or *Next chart (arrow right)* –buttons you can select to which chart you want your parameter to be saved. Between the buttons you can see which chart is currently selected (Chart 1...5). To select parameter for the chart press *Previous parameter (arrow left)* and *Next parameter (arrow right)* –buttons to go through the parameter options. The parameter currently active can be seen in between the parameter buttons. To select the current active parameter to be followed and recorded for the current active chart *SELECT* –button is pressed. When the current parameter is selected for the current selected chart there is a text “Selected” on the lowest text field.

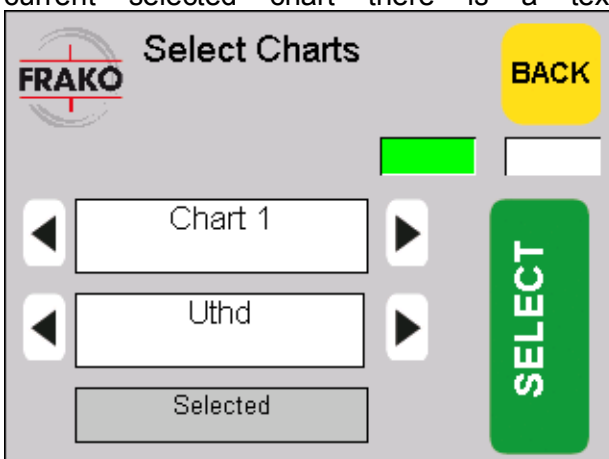


Figure 63. Select charts view.

The program is always recording five parameters. It saves data for 1 month period. This data can be observed in the chart views. When the parameter is changed from one to another, all the previously recorded data for that particular chart will be lost.

Result:

User has selected the desired parameters for recording and observing.

10.5 Alarm and trip handling

10.5.1 Alarms

In a case of an alarm or a trip on the unit the user interface program will inform this by showing text “Alarm” on the status text fields on the main view or in the smaller status boxes in other views.

10.5.2 Alarm and Trip acknowledgement

When the problem that resulted as an alarm or trip is fixed, the *Alarms* or *Trip* notification can be acknowledged and erased.

Pre-conditions:

Program is in the main view and alarm or trip is active. Whether alarms or trips are currently active can be observed from the status text fields on the main view or in the smaller status boxes in other views.

User actions:

In the main view open *Log* view by pressing *Log* –button.



Figure 64. Main view.

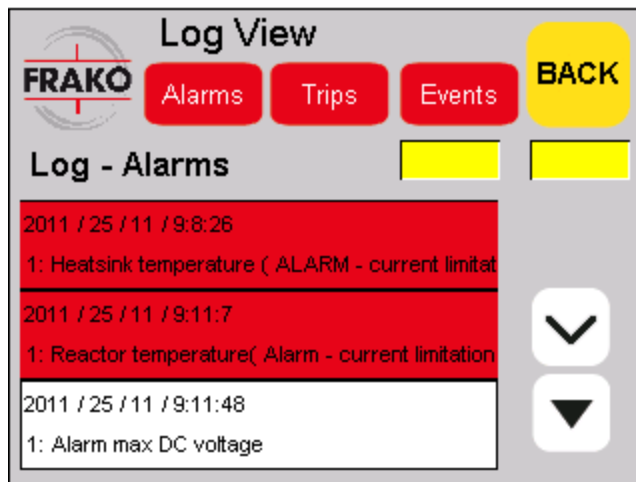


Figure 65. Log view.

In the *Log view* the currently active *Alarms* or *Trips* can be observed by pressing either *Alarms* or *Trips* button, this will change the text field list to alarm or trip log lists. The active alarms and trips are shown with red background, alarms and trips that are not anymore active but are not yet acknowledged are on white background.

To acknowledge the *Alarms*, make sure your current view is the *Alarms* log view and press *ACK* button. If the acknowledgement is successful the alarms should clear out from the text field list completely.

To acknowledge the *Trips*, make sure your current view is the *Trips* log view and press *ACK* button. If the acknowledgement is successful the trips should clear out from the text field list completely. If the reasons for Trips to be raised are not fixed, the same Trips will become back active in a few seconds.

Result:

Trips or alarms are acknowledged.

10.5.3 Restarting after trip acknowledgement

After the reason for raised *Trips* have been fixed and Trips have been acknowledged the unit can be started again. There are no special operations needed.

10.5.4 Restarting after power outage

In case the mains power is interrupted the active filter must be turned off (main switch turned to position 0) and then restarted. Otherwise the internal error acknowledgement procedure may prevent active filter from starting filtering.

11 Maintenance

The air filter must be changed frequently. The interval of this maintenance is strongly dependent on the environment pollution level. When the air filter is getting dirty it may limit the performance of the IGBT cooling. In this case the output current of the active filter unit is limited and an ALARM is generated.

The recommended maintenance interval is one year. The yearly maintenance should include:

- Replacing the air filter
- Checking the operation of the cooling fans

- Checking the event log
- Checking the general operation of the filter

Note that in case the environment pollution level is high, the air filter might need replacement more frequently than once a year. In dirty environments the air filter should be checked once every 3 months.

Replacement filters are available from FRAKO Kondensatoren- und Anlagenbau GmbH.

12 Trouble shooting

In case the OSFM gives a trip with indication “Trip high ripple current”, check the following points:

- Compensation mode (open/closed loop) is according to CT location
- In case of closed loop configuration CT ratio setting is correct

In case the OSFM xxx-yyy-3 generates unbalanced reactive currents in no-load conditions, check that input phase rotation is correct (L1, L2, L3). If not, swap two input phases and check that the phase sequence of CT connections is respectively.

In case the OSFM xxx-yyy-4 trips immediately after setting IGBTs to ON position giving the indication “Trip Max DC voltage”, check that input phase rotation is correct (L1, L2, L3). If not, swap two input phases and check that the phase sequence of CT connections is respectively.

In case the active filter seems to work correctly (errors acknowledged correctly, goes into “Running” state), but does not generate filtering current, check that the start-up procedure was done according to the instructions of chapter 9 (Commissioning). If the main switch is turned immediately from position 0 (OFF) to position 2 (ON), the internal error acknowledgement may prevent the active filter from starting filtering. At least a short pause (min. 10 s) should remain between states 1 (Stand by) and 2 (ON).

13 Life cycle management

The active filters are environmentally friendly devices with overall positive impact on the nature. Active filters reduce energy consumption and have positive impact on the processes, where electrical energy plays a key role in the productivity. In the design and manufacturing special attention has been paid to minimize material waste and energy consumption to achieve minimal impact on the environment.

The design allows interchange of those components, which life cycle is shorter than the designed complete life cycle of the product. Following of the detailed operation and maintenance instructions of this manual will increase the expected lifetime of the product. Careful consideration has been applied in material selection to reach high degree of recycling at the end of the lifetime of active filter.

14 Technical specification

14.1 OSFM 50-400-3

Rated voltage	400V \pm 10%		
Rated frequency	50Hz or 60Hz		
Rated output current phases	L1, L2, L3:50A _{RMS} , 125A _{peak}		
Rated output current neutral	-		
Number of input phases	3 Phases + neutral + PE		
Protection degree	IP 21		
Cooling	AF		
Compliance with standards	EN 61000-6-2, EN 61000-6-4, EN 50178		
Controller	Real time digital control with FFT		
Response time	100us (All harmonics) / 16,6/20ms (Selectable)		
Harmonic range	1..50 (50..2500Hz/50Hz, 60..3000Hz/60Hz)		
CT requirement	Class 1 or better. Crest factor to be taken into account when choosing CT rating (CF of OSFM 2,5) x/1A or x/5A (5A recommended)		
Dimensions (WxDxH), mm	600x600x1000		
Weight	130 kg		
Heat losses into ambient	\leq 1.3 kW		
Audible noise	67dB typically at rated load		
Main circuit fuses	NH 00 gL/gG 125A		
Auxiliary circuit fuses	Ferraz FR10AM50V8 500V~ aM 10x38 8A I1=120kA		
Climatic cond. (EN50178)	Ambient temperature	Relative humidity	Air pressure
Operation	5...40°C (Class 3K3)	5..85% (Class 3K3)	86..106kPa (Class 3K3)
Storage	-25...55°C (Class 1K4)	5..95% (Class 1K3)	86..106kPa (Class 1K4)
Transportation	-25...70°C (Class 2K3)	95% (Class 2K3)	70..106kPa (Class 2K3)
Pollution degree (EN 50178)	2		
Communications interfaces	RS-232 (Modbus RTU), Ethernet (Modbus TCP)		

14.2 OSFM 50-400-4

Rated voltage	400V $\pm 10\%$		
Rated frequency	50Hz or 60Hz		
Rated output current phases	L1, L2, L3:50A _{RMS} , 125A _{peak}		
Rated output current neutral	150A		
Number of input phases	3 Phases + neutral + PE		
Protection degree	IP 21		
Cooling	AF		
Compliance with standards	EN 61000-6-2, EN 61000-6-4, EN 50178		
Controller	Real time digital control with FFT		
Response time	100us (All harmonics) / 16,6/20ms (Selectable)		
Harmonic range	1..50 (50..2500Hz/50Hz, 60..3000Hz/60Hz)		
CT requirement	Class 1 or better. Crest factor to be taken into account when choosing CT rating (CF of OSFM 2,5) x/1A or x/5A (5A recommended)		
Dimensions (WxDxH), mm	600x600x1000		
Weight	130 kg		
Heat losses into ambient	≤ 1.3 kW		
Audible noise	67dB typically at rated load		
Main circuit fuses	NH 00 gL/gG 125A		
Auxiliary circuit fuses	Ferraz FR10AM50V8 500V~ aM 10x38 8A I1=120kA		
Climatic cond. (EN50178)	Ambient temperature	Relative humidity	Air pressure
Operation	5...40°C (Class 3K3)	5..85% (Class 3K3)	86..106kPa (Class 3K3)
Storage	-25...55°C (Class 1K4)	5..95% (Class 1K3)	86..106kPa (Class 1K4)
Transportation	-25...70°C (Class 2K3)	95% (Class 2K3)	70..106kPa (Class 2K3)
Pollution degree (EN 50178)	2		
Communications interfaces	RS-232 (Modbus RTU), Ethernet (Modbus TCP)		

14.3 OSFM 60-400-3

Rated voltage	400V \pm 10%		
Rated frequency	50Hz or 60Hz		
Rated output current (I_{rated})	L1, L2, L3:60A _{RMS} , 125A _{peak}		
Number of input phases	3 Phases + neutral + PE		
Protection degree	IP 21		
Cooling	AF		
Compliance with standards	EN 61000-6-2, EN 61000-6-4, EN 50178		
Controller	Real time digital control with FFT		
Response time	100us (All harmonics) / 16,6/20ms (Selectable)		
Harmonic range	1..50 (50..2500Hz/50Hz, 60..3000Hz/60Hz)		
CT requirement	Class 1 or better. Crest factor to be taken into account when choosing CT rating (CF of OSFM 2,5) \times 1A or \times 5A (5A recommended)		
Dimensions (WxDxH), mm	600x600x1000		
Weight	130 kg		
Heat losses into ambient	\leq 1.3 kW		
Audible noise	67dB typically at rated load		
Main circuit fuses	NH 00 gL/gG 125A		
Auxiliary circuit fuses	Ferraz FR10AM50V8 500V~ aM 10x38 8A I1=120kA		
Climatic cond. (EN50178)	Ambient temperature	Relative humidity	Air pressure
Operation	5...40°C (Class 3K3)	5..85% (Class 3K3)	86..106kPa (Class 3K3)
Storage	-25...55°C (Class 1K4)	5..95% (Class 1K3)	86..106kPa (Class 1K4)
Transportation	-25...70°C (Class 2K3)	95% (Class 2K3)	70..106kPa (Class 2K3)
Pollution degree (EN 50178)	2		
Communications interfaces	RS-232 (Modbus RTU), Ethernet (Modbus TCP)		

14.4 OSFM 60-400-4

Rated voltage	400V $\pm 10\%$		
Rated frequency	50Hz or 60Hz		
Rated output current (I_{rated})	L1, L2, L3:60A _{RMS} , 180A _{peak} N: 3x I_{rated}		
Number of input phases	3 Phases + neutral + PE		
Protection degree	IP 21		
Cooling	AF		
Compliance with standards	EN 61000-6-2, EN 61000-6-4, EN 50178		
Controller	Real time digital control with FFT		
Response time	100us (All harmonics) / 16,6/20ms (Selectable)		
Harmonic range	1..50 (50..2500Hz/50Hz, 60..3000Hz/60Hz)		
CT requirement	Class 1 or better. Crest factor to be taken into account when choosing CT rating (CF of OSFM 2,5) x/1A or x/5A (5A recommended)		
Dimensions (WxDxH), mm	600x600x1000		
Weight	130 kg		
Heat losses into ambient	≤ 1.3 kW		
Audible noise	67dB typically at rated load		
Main circuit fuses	NH 00 gL/gG 125A		
Auxiliary circuit fuses	Ferraz FR10AM50V8 500V~ aM 10x38 8A I1=120kA		
Climatic cond. (EN50178)	Ambient temperature	Relative humidity	Air pressure
Operation	5...40°C (Class 3K3)	5..85% (Class 3K3)	86..106kPa (Class 3K3)
Storage	-25...55°C (Class 1K4)	5..95% (Class 1K3)	86..106kPa (Class 1K4)
Transportation	-25...70°C (Class 2K3)	95% (Class 2K3)	70..106kPa (Class 2K3)
Pollution degree (EN 50178)	2		
Communications interfaces	RS-232 (Modbus RTU), Ethernet (Modbus TCP)		

14.5 OSFM 100-400-3

Rated voltage	400V \pm 10%		
Rated frequency	50Hz or 60Hz		
Rated output current phases	L1, L2, L3: 100 A _{RMS} , 250 A _{peak}		
Rated output current neutral	-		
Switching frequency	10 kHz		
Number of input phases	3 Phases + neutral + PE		
Protection degree	IP 21		
Cooling	AF		
Compliance with standards	EN 61000-6-2, EN 61000-6-4, EN 50178		
Controller	Real time digital control with FFT		
Response time	100us (All harmonics) / 16,6/20ms (Selectable)		
Harmonic range	1..50 (50..2500Hz/50Hz, 60..3000Hz/60Hz)		
Current transformer (CT) requirements	Class 1 or better CT secondary nominal current 1 A or 5 A (5 A recommended)		
Dimensions (WxDxH), mm	600x600x1000		
Weight	130 kg		
Heat losses into ambient	\leq 1.3 kW		
Audible noise	67dB typically at rated load		
Main circuit fuses	NH 00 gL/gG 125A		
Auxiliary circuit fuses	Ferraz FR10AM50V8 500V~ aM 10x38 8A I1=120kA		
Climatic cond. (EN50178)	Ambient temperature	Relative humidity	Air pressure
Operation	5...40°C (Class 3K3)	5..85% (Class 3K3)	86..106kPa (Class 3K3)
Storage	-25...55°C (Class 1K4)	5..95% (Class 1K3)	86..106kPa (Class 1K4)
Transportation	-25...70°C (Class 2K3)	95% (Class 2K3)	70..106kPa (Class 2K3)
Pollution degree (EN 50178)	2		
Communications interfaces	-		

14.6 OSFM 100-400-4

Rated voltage	400V \pm 10%		
Rated frequency	50Hz or 60Hz		
Rated output current phases	L1, L2, L3: 100 A _{RMS} , 250 A _{peak}		
Rated output current neutral	300 A _{RMS}		
Switching frequency	10 kHz		
Number of input phases	3 Phases + neutral + PE		
Protection degree	IP 21		
Cooling	AF		
Compliance with standards	EN 61000-6-2, EN 61000-6-4, EN 50178		
Controller	Real time digital control with FFT		
Response time	100us (All harmonics) / 16,6/20ms (Selectable)		
Harmonic range	1..50 (50..2500Hz/50Hz, 60..3000Hz/60Hz)		
Current transformer (CT) requirements	Class 1 or better CT secondary nominal current 1 A or 5 A (5 A recommended)		
Dimensions (WxDxH), mm	600x600x1000		
Weight	130 kg		
Heat losses into ambient	\leq 1.3 kW		
Audible noise	67dB typically at rated load		
Main circuit fuses	NH 00 gL/gG 125A		
Auxiliary circuit fuses	Ferraz FR10AM50V8 500V~ aM 10x38 8A I1=120kA		
Climatic cond. (EN50178)	Ambient temperature	Relative humidity	Air pressure
Operation	5...40°C (Class 3K3)	5..85% (Class 3K3)	86..106kPa (Class 3K3)
Storage	-25...55°C (Class 1K4)	5..95% (Class 1K3)	86..106kPa (Class 1K4)
Transportation	-25...70°C (Class 2K3)	95% (Class 2K3)	70..106kPa (Class 2K3)
Pollution degree (EN 50178)	2		
Communications interfaces	-		

14.7 OSFM 150-400-3

Rated voltage	400V \pm 10%		
Rated frequency	50Hz or 60Hz		
Rated output current phases	L1, L2, L3: 150 A _{RMS} , 375 A _{peak}		
Rated output current neutral	-		
Switching frequency	10 kHz		
Number of input phases	3 Phases + neutral + PE		
Protection degree	IP 21		
Cooling	AF		
Compliance with standards	EN 61000-6-2, EN 61000-6-4, EN 50178		
Controller	Real time digital control with FFT		
Response time	100us (All harmonics) / 16,6/20ms (Selectable)		
Harmonic range	1..50 (50..2500Hz/50Hz, 60..3000Hz/60Hz)		
Current transformer (CT) requirements	Class 1 or better CT secondary nominal current 1 A or 5 A (5 A recommended)		
Dimensions (WxDxH), mm	600x600x1600		
Weight	280 kg		
Heat losses into ambient	\leq 4.5 kW		
Audible noise	70 dB typically at rated load		
Main circuit fuses	NH 1 gL/gG 250 A		
Auxiliary circuit fuses	Ferraz FR10AM50V8 500V~ aM 10x38 8A I ₁ =120kA		
Climatic cond. (EN50178)	Ambient temperature	Relative humidity	Air pressure
Operation	5...40°C	5..85% (Class 3K3)	86..106kPa (Class 3K3)
Storage	-25...55°C (Class 1K4)	5..95% (Class 1K3)	86..106kPa (Class 1K4)
Transportation	-25...70°C (Class 2K3)	95% (Class 2K3)	70..106kPa (Class 2K3)
Pollution degree (EN 50178)	2		
Communications interfaces	RS-232 (Modbus RTU), Ethernet (Modbus TCP)		

14.8 OSFM 150-400-4

Rated voltage	400V $\pm 10\%$		
Rated frequency	50Hz or 60Hz		
Rated output current phases	L1, L2, L3:150A _{RMS} , 375A _{peak} N: 3x I _{rated}		
Rated output current neutral	450 A _{RMS}		
Switching frequency	10 kHz		
Number of input phases	3 Phases + neutral + PE		
Protection degree	IP 21		
Cooling	AF		
Compliance with standards	EN 61000-6-2, EN 61000-6-4, EN 50178		
Controller	Real time digital control with FFT		
Response time	100us (All harmonics) / 16,6/20ms (Selectable)		
Harmonic range	1..50 (50..2500Hz/50Hz, 60..3000Hz/60Hz)		
Current transformer (CT) requirements	Class 1 or better. Crest factor to be taken into account when choosing CT rating (CF of OSFM 2.0) x/1A or x/5A (5A recommended)		
Dimensions (WxDxH), mm	600x600x1600		
Weight	280 kg		
Heat losses into ambient	≤ 4.5 kW		
Audible noise	70 dB typically at rated load		
Main circuit fuses	NH 1 gL/gG 250 A		
Auxiliary circuit fuses	Ferraz FR10AM50V8 500V~ aM 10x38 8A I ₁ =120kA		
Climatic cond. (EN50178)	Ambient temperature	Relative humidity	Air pressure
Operation	5...40°C	5..85% (Class 3K3)	86..106kPa (Class 3K3)
Storage	-25...55°C (Class 1K4)	5..95% (Class 1K3)	86..106kPa (Class 1K4)
Transportation	-25...70°C (Class 2K3)	95% (Class 2K3)	70..106kPa (Class 2K3)
Pollution degree (EN 50178)	2		
Communications interfaces	RS-232 (Modbus RTU), Ethernet (Modbus TCP)		

14.9 OSFM 200-400-3

Rated voltage	400V \pm 10%		
Rated frequency	50Hz or 60Hz		
Rated output current (I_{rated})	L1, L2, L3:200A _{RMS} , 400A _{peak}		
Number of input phases	3 Phases + neutral + PE		
Protection degree	IP 21		
Cooling	AF		
Compliance with standards	EN 61000-6-2, EN 61000-6-4, EN 50178		
Controller	Real time digital control with FFT		
Response time	100us (All harmonics) / 16,6/20ms (Selectable)		
Harmonic range	1..50 (50..2500Hz/50Hz, 60..3000Hz/60Hz)		
CT requirement	Class 1 or better. Crest factor to be taken into account when choosing CT rating (CF of OSFM 2,0) x/1A or x/5A (5A recommended)		
Dimensions (WxDxH), mm	600x600x1600		
Weight	280 kg		
Heat losses into ambient	\leq 4.5 kW		
Audible noise	70dB typically at rated load		
Main circuit fuses	NH 01 gL/gG 250A		
Auxiliary circuit fuses	Ferraz FR10AM50V8 500V~ aM 10x38 8A I1=120kA		
Climatic cond. (EN50178)	Ambient temperature	Relative humidity	Air pressure
Operation	5...40°C	5..85% (Class 3K3)	86..106kPa (Class 3K3)
Storage	-25...55°C (Class 1K4)	5..95% (Class 1K3)	86..106kPa (Class 1K4)
Transportation	-25...70°C (Class 2K3)	95% (Class 2K3)	70..106kPa (Class 2K3)
Pollution degree (EN 50178)	2		
Communications interfaces	RS-232 (Modbus RTU), Ethernet (Modbus TCP)		

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Kondensatoren- und Anlagenbau GmbH



Tscheulinstr. 21a · 79331 Teningen · Germany

Tel. +49-7641-453-0 · Fax. +49-7641-453-545

www.frako.com · E-Mail: info@frako.com

Management: Peter Herbst

Commercial Register:

County Court Freiburg i. Br. Commercial Registry number 701 735

Bank accounts:

Deutsche Bank AG Acc. No. 219 2383 Bank Code 653 700 75

IBAN No.: DE 02 6537 0075 0219 2383 00 BIC/SWIFT Code: DEUT DE SS 653

Sparkasse Freiburg - Nördlicher Breisgau Acc.No. 200 70 553 Bank Code 680 501 01

IBAN No.: DE 73 6805 0101 0020 0705 53 BIC/SWIFT Code: FRSP DE 66