System components for assembly and retrofitting

THF\textsubscript{star}, installation in the transformer star point

The third harmonic filter THF\textsubscript{star} is both economical and compact solution to be used in highly concentrated third harmonic currents. The filter is mitigating third harmonic current and emission voltage towards the line side. The filter can be installed near the transformer station in universal outdoor enclosure, in empty field of the transformer station, in main switchboard or as a separate unit. The third harmonic filter THF\textsubscript{star} is installed in the neutral or PEN conductor between the non-earthed transformer star point and the neutral busbar of the main switchboard.

**DIMENSIONING:** According to the supply transformer.
**PROTECTION:** The protection unit THFS\_ shall be used, when the thermal unbalance current exceeds the THF-rating and when the TN-S-system needs to be monitored.

THF, installation in TN-S system in the neutral conduction of the distribution panel

The third harmonic filter THF or THF\textsubscript{star} is designed for mitigating third harmonic current and emission voltage towards the line side of the common coupling or group in the TN-S-system. The filter is installed in the outgoing group of TN-S-system, in the outgoing neutral conductor of an UPS-device or in the lighting panel in centralised compensation. The filter is installed in the neutral conductor, while the measuring transformer is installed to the PE-conductor. Prior to the installation, the purity of TN-S-system in the group needs to be measured. The N and PE-conductor of the outgoing group shall not be connected. This condition shall always be monitored. In TN-S-system we recommend to assemble the THF\textsubscript{star} filter between the transformer star point and and neutral conductor. In this case there is no 150 Hz voltage between neutral and PE-conductor.

**DIMENSIONING:** According to the supply transformer or fuse.
**PROTECTION:** The protection unit THFS\_ shall be used, when the thermal unbalance current exceeds the THF-rating and when the TN-S-system needs to be monitored.
Versatile assembly options

The filter can be installed near the transformer station in universal outdoor enclosure, in empty field of the transformer station, in main switchboard or as a separate unit. The filters are suitable for assembly and retrofitting.

Benefits of the new THF star filter:

- More effective mitigation
- Smaller resistance and fundamental impedance
- Higher short-circuit capacity
- 50 % smaller size resulting in halved space need
- More economical
- Easy to install
- Less maintenance work
- Flexible component assembly
- Accommodating in narrow series succession or flat pack
- Only three frame sizes cover area from 250A...2000kVA

Check THF star filters

Installation and commissioning:
The installation of THF star is in theory easy but in practice certain points have to be checked:

- Ensure by measurement that there is no parallel current path to the filter
- Check up also the possible influence of parallel transformers or generators
- Ensure that the filter is installed in the right location. The neutral conductor from the star point of the transformer is the recommended place.
- Check up that the current measurement is right. The CT shall always measure the sum of all neutral and earth currents of the network.
- Check up the relay setting of the protection unit.
- Check up that there is no largely dimmer loads.
Read mounting instruction 34THF1S
EASY TO INSTALL:
- N in - N out
- Current transformer in the right place
- Auxiliary voltage supply simple or redundant
- IMPORTANT: Eliminate any parallel current path

See Mounting Instructions 34 THF1 and THF1S and check list.
Selection and dimensioning of the THF product range

Third harmonic filters THFstar and THF

The size of the THF-filters is selected according to the supply transformer or back up fuses. The protection unit needs to be used, in case the dimensioning exceeds the thermal rating of the filter.

The basis of dimensioning is that the filter withstands the 150Hz voltage and the fundamental neutral current generated by the phase unbalance.

The THFstar filters are tested according to the highest possible short circuit current or back up fuse.

The filter is not suitable for applications including largely dimmer loads. Please consult with us.

The filter is not suitable for applications including largely dimmer loads. Please consult with us.

Installation to the transformer star point, enclosed filters and system components, THFstar

The new generation third harmonic filter THFstar is designed for small size and economical solutions to places, which are especially exposed by third harmonic currents. The filter can be installed outdoor in vicinity of transformer stations, as retrofitting to existing transformer station or as additional field of main switchboard. It is recommended to install the filter THFstar in PEN-conductor, whenever possible, equipped with appropriate protection unit THF1S.

DIMENSIONING: According to the supply transformer

PROTECTION: Protection unit THFS1_S, 50Hz and 150 Hz measurement according to the mounting instruction

Network | Rated current of the transformer A | Transformer size kVA | THFS500US1 | THFS630S1 | THFS630U1 | THFS1000S1 | THFS1000U1 | THFS1600S1 | THFS1600U1 | THFS1600S1x2 | THFS1600U1x2 | THFS630A1x2 |
--- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
TN-C, TN-S | 800 | 630 | 900 | 630 | 1250 | 1000 | 2500 | 1600 | 3200 | 2000 |

Note: System components in brochure THFS 2 GB

Network | Rated current of the group fuse A | THF25NV | THF63NV | THF125NV | THF160NV | THF125NLV + THF125N
--- | --- | --- | --- | --- | --- | --- |
TN-S | 25 | 63 | 125 | 160 | 250 |

Note: System components in brochure THFS 2 GB

Installation for distribution boards in TN-S-system, enclosed filter and system components, THF

THF filters are designed in TN-S-systems to provide selective mitigation of isolated groups with local or central compensation. The THF is normally installed in the load side neutral output of UPS-devise. THF is dimensioned according to the group fuses. In case the dimensioning is below 100% it is recommended to use additional protection unit. The filter types THF 25...160NV include guard units to keep track of the PE-current in the area of 4...10 A.

DIMENSIONING: According to the group fuse- rated current = rated current of the fuse link

PROTECTION: Guard unit (\_V), 150Hz measurement from PE-conductor of the group

Network | Rated current of the group fuse A | THF25NV | THF63NV | THF125NV | THF160NV | THF125NLV + THF125N
--- | --- | --- | --- | --- | --- | --- |
TN-S | 25 | 63 | 125 | 160 | 250 |

Note: System components in brochure THFS 2 GB

Low Voltage Products
Technical data

Technical characteristics of the THFstar third harmonic filters

<table>
<thead>
<tr>
<th>Type</th>
<th>THFS400A1</th>
<th>THFS630A1</th>
<th>THFS1000A1</th>
</tr>
</thead>
<tbody>
<tr>
<td>System voltage V</td>
<td>400/415</td>
<td>400/415</td>
<td>400/415</td>
</tr>
<tr>
<td>Rated continuous thermal current Ith of the filter</td>
<td>400</td>
<td>630</td>
<td>1000</td>
</tr>
<tr>
<td>Resistance R mohm</td>
<td>0,5</td>
<td>0,3</td>
<td>0,2</td>
</tr>
<tr>
<td>Impedance Z 50 Hz mohm</td>
<td>40</td>
<td>20</td>
<td>13</td>
</tr>
<tr>
<td>Impedance Z 150 Hz ohm</td>
<td>5</td>
<td>2,2</td>
<td>1,5</td>
</tr>
<tr>
<td>Power loss with 100% phase balance - lamp load/W</td>
<td>54</td>
<td>66</td>
<td>75</td>
</tr>
<tr>
<td>Power loss with 100% phase balance - PC-load/W</td>
<td>60</td>
<td>76</td>
<td>87</td>
</tr>
<tr>
<td>Power loss with 10% imbalance current - lamp load/W</td>
<td>121</td>
<td>178</td>
<td>235</td>
</tr>
<tr>
<td>Power loss with 10% imbalance current - PC-load/W</td>
<td>137</td>
<td>221</td>
<td>268</td>
</tr>
<tr>
<td>Power loss worst case unbalance current - lamp load/W</td>
<td>848</td>
<td>1296</td>
<td>1578</td>
</tr>
<tr>
<td>Power loss worst case unbalance current - PC-load/W</td>
<td>1035</td>
<td>1552</td>
<td>2086</td>
</tr>
</tbody>
</table>

VALUES WITH PROTECTION UNIT

| Transformer size with protection unit | kVA    | 630 | 1000 | 1600 |
| Rated current of transformer A        | 900    | 1400 | 2300 |
| Max harmonis voltage / 40V 150 Hz V   | 40     | 40   | 40   |
| Max incoming fuse in phase at 50 kA   | 800    |      |      |
| prospective short circuit A           | 0,2    | 0,2  | 0,2  |
| Max duration of short circuit s       |        |      |      |
| Protection unit THF1S_ THF1S_ THF1S_ |        |      |      |
| Current transformer                    |        |
| KORE06F1-400/1                       | KORE06F1-750/1 | KORE06F1-1250/1 |

VALUES WITHOUT PROTECTION UNIT

| Max incoming fuse in phase A | 400 | 630 | 800 |
| Transformer size with kVA    | 315 | 400 | 500 |

*1) Tested with worst case overcurrent 1,6 time 400A fuse by 2 h

Specification of harmonic filter

Example THFstar

- **Type**: THFS 1600 S1
- **Rated voltage**: 400V
- **Dimensioning according to the transformer size**: 1600 kVA.
- **Removes the third harmonic current from the phase and neutral conductor**.
- **Dimensioning current / Max continuous current**: 2250A / 800A.
- **Dimensioning voltage**: 40V 150Hz.
- **The filter allows subsequent increasing of the harmonic load without retrofitting**.
- **Short circuit dimensioning according to max. available short circuit of transformer**.
- **The filter is stand along type and not influencing on the power factor compensation**.
- **The filter is not influencing on carrier- wave-line**.
- **Main incoming breaker**: Max. time delay: 0,2 s
- **Terminations**: Max six cables of 300mm²
- **The filter is equipped with by-pass switch for commisioning**.

**Stand along enclosure**:
- indoor use IP30
- outdoor use IP34

**Accommodation**:
- In the vicinity of transformer station
- Retrofitting to the transformer station
- In the main switchboard

The THFstar removes typically 95% of the third harmonic current from the whole network from line and load side independent of the magnitude of the third harmonic current. For example the neutral current reduces from 450A down to 25A and in the phase conductors from 150A to 10A. The same mitigation prevails in the whole network from the transformer windings to the lamps and computers. The magnetic field from the construction and earthing wiring reduces typically by 50% due to mitigation of the vagabonding currents (50% of magnetic field usually of 150 Hz origin).

The iron, copper and resistance losses reduce the temperature and noise level of the supply transformer doubling the lifetime of the transformer by every 8 degrees C. The filter reduces the resistance losses (I²R).

For example: before (450A)² x 0,1 Ω = 2025 W, filter installed (25A)² x 0,1 Ω = 62,5 W (other losses not included).

The filter includes protection unit, which limit the 50Hz unbalance current and 150Hz fault current.
THF protective units

The purpose of a THF protective unit is

- to limit a 50Hz voltage drop to the desired level
- to prevent overload of THF filter
- to protect the network if the THF unit is damaged

Types of THF protective units:

1. Enclosed type, THF 1S
   - Complete type includes Amp-meter, all pilot lights and TEST-switch installed in an IP44 enclosure.
   - Contactor K1 and current transformer T1 must be ordered and connected separately. See connecting diagrams, page 6.

2. Non-enclosed module, THF 1BS
   - The pilot lights, TEST-switch, RESET-pushbutton and Amp-meter must be ordered and connected separately as well as contactor K1 and current transformer T1. See connecting diagrams, page 7.

Amp-meter (Included in enclosed type THF 1S)

The Amp-meter is connected to the secondary circuit of the T1 current transformer. It is equipped with a %-scale where 100% indication corresponds to the nominal primary current of the T1 Current transformer. When the THF-filter is connected, the meter primarily indicates the 50Hz unbalance current which runs in the N/PE wire. When the THF-filter is bypassed, the meter primarily indicates the third harmonic current.

The pilot light functions

<table>
<thead>
<tr>
<th>Pilot light</th>
<th>OK</th>
<th>Test</th>
<th>By Pass</th>
<th>50/60Hz</th>
<th>150/180Hz</th>
<th>Error 50/60Hz</th>
<th>Error 150/180Hz</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>THF and the protective unit are O.K.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>The setting value of the 50/60Hz unbalance current exceeded - THF by-passed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>The setting value of the 3. harmonic current exceeded - THF by-passed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>'OK' - pilot light blown. THF switched ON and protective unit is working</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A fuse in a protective unit is blown</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>THF switched ON and a protective unit is not working</td>
</tr>
</tbody>
</table>

Light is ON

Light is OFF
Connecting diagrams / Enclosed protective unit THF 1S

Note: Connection of loads shall be between L1-L3 and N-conductors shall be made after installing point of the Third Harmonic Filter (THF).

Redundant duplex supply of auxiliary voltage.
Connecting diagrams / Open type protective unit THF 1BS

Note: When mounting Amp-meter P1, the connection between X1.2 and X2.2 must be disconnected. The connection of loads shall be between L1-L3 and N-conductors shall be made after installing point of the Third Harmonic Filter (THF).

Redundant duplex supply of auxiliary voltage.
Third harmonic filters THF<sub>star</sub> and THF

Ordering information

Technical information

Third harmonic filters  THF<sub>star</sub>

Components for installation to transformer star point.

<table>
<thead>
<tr>
<th>Transformer size [kVA]</th>
<th>Dimensions Narrow combination B x D x H [mm]</th>
<th>Dimensions Flat combination B x D x H [mm]</th>
<th>Type</th>
<th>Order Code</th>
<th>Weight [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>630 900</td>
<td>400 x 500 x 350</td>
<td>800 x 350 x 350</td>
<td>THF 400A1</td>
<td>160</td>
<td></td>
</tr>
<tr>
<td>1000 1410</td>
<td>400 x 500 x 500</td>
<td>800 x 350 x 500</td>
<td>THF 630A1</td>
<td>225</td>
<td></td>
</tr>
<tr>
<td>1600 2250</td>
<td>400 x 500 x 700</td>
<td>800 x 350 x 700</td>
<td>THF 1000A1</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>2000 2800</td>
<td>400 x 500 x 500x2</td>
<td>800 x 350 x 500x2</td>
<td>THF 630A1x2</td>
<td>225x2</td>
<td></td>
</tr>
</tbody>
</table>

Third harmonic filters  THF

Installation in TN-S system in the neutral conduction of the distribution panel

<table>
<thead>
<tr>
<th>Size of feeding [A]</th>
<th>Connecting cable (Cu) [mm²] / [Cu]</th>
<th>Dimensions B x D x H [mm]</th>
<th>Protection degree</th>
<th>Type</th>
<th>Order Code</th>
<th>Weight [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>63</td>
<td>16</td>
<td>350 x 145 x 415</td>
<td>IP00</td>
<td>THF 63NB</td>
<td>28</td>
<td></td>
</tr>
</tbody>
</table>

Protection unit

<table>
<thead>
<tr>
<th>Back up fuse</th>
<th>Terminals [mm²] / [Cu]</th>
<th>Dimensions B x D x H [mm]</th>
<th>Protection degree</th>
<th>Type</th>
<th>Order Code</th>
<th>Weight [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open type</td>
<td>10A</td>
<td>350 x 150 x 190</td>
<td>IP00</td>
<td>THF 1BS</td>
<td>1SCA022457R7560</td>
<td>4.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>400 x 150 x 100</td>
<td></td>
<td>THF 1BSMNS</td>
<td>1SCA022437R8010</td>
<td>4.6</td>
</tr>
<tr>
<td>Enclosed</td>
<td>10A</td>
<td>350 x 150 x 400</td>
<td>IP44</td>
<td>THF 1S</td>
<td>1SCA022468R9360</td>
<td>15</td>
</tr>
</tbody>
</table>

Other system components

<table>
<thead>
<tr>
<th>Transformer size [kVA]</th>
<th>Rated current [A/400V]</th>
<th>Transformer</th>
<th>By-pass contactor</th>
<th>By-pass switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>315</td>
<td>440</td>
<td>KORE06F1 250/1THF</td>
<td>A145</td>
<td>OETL200K3</td>
</tr>
<tr>
<td>400</td>
<td>560</td>
<td>KORE06F1 250/1THF</td>
<td>A210</td>
<td>OETL200K3</td>
</tr>
<tr>
<td>500</td>
<td>700</td>
<td>KORE06F1 300/1THF</td>
<td>A210</td>
<td>OETL315K3</td>
</tr>
<tr>
<td>630</td>
<td>900</td>
<td>KORE06F1 400/1THF</td>
<td>A210</td>
<td>OETL400K3</td>
</tr>
<tr>
<td>800</td>
<td>1130</td>
<td>KORE06F1 500/1THF</td>
<td>A300</td>
<td>OETL400K3</td>
</tr>
<tr>
<td>1000</td>
<td>1410</td>
<td>KORE06F1 750/1THF</td>
<td>AF400</td>
<td>OETL630K3</td>
</tr>
<tr>
<td>1250</td>
<td>1700</td>
<td>KORE06F1 1000/1</td>
<td>AF580</td>
<td>OETL630K3</td>
</tr>
<tr>
<td>1600</td>
<td>2250</td>
<td>KORE06F1 1250/1</td>
<td>AF580</td>
<td>OETL800K3</td>
</tr>
<tr>
<td>2000</td>
<td>2820</td>
<td>KORE06F1 1500/1</td>
<td>AF750</td>
<td>OETL1000K3</td>
</tr>
</tbody>
</table>
Installation examples

TN-S-system, where the original cabling to the transformer star point need to be displaced to fundamentally same position in the N-conductor of the main switchboard. THF installation.

TN-C-S system
Alternative installation examples when using THF with protection unit(_S) or THF with guard unit(_V).

TN-S system
Alternative installation example when using THF with protection unit(_S) or THF with guard unit(_V).

1) In this installation model, the current transformer need to measure both N- and PE-current, unless additional guard unit is used.
**Installation examples**

**Installation of THF on starpoint of a transformer**

For the third harmonic current, THF-unit disconnects the N-conductor. Bypassing of the third harmonic current through other routes should be avoided.

**Installation rules:**
1. THF is intended for installation between points A and B
2. Earthing is allowed only after point B.
3. To ensure that no other earthing exists between point A and the starpoint, the insulation resistance Re between points A and B must be measured.
4. Re > 50 kΩ (usually Re > 1 MΩ)
5. If there is a thin earthing wire between points A and the starpoint, all third harmonic currents in the PEN-conductor without THF, (e.g. 1000A) go through this wire. Risk of fire!

**Transformer and generator connected parallel**

**Installation rules:**
1. One THF is intended for installation between points A1 and B1, and the other between points A2 and B2
2. Earthing is allowed only after points B1 and B2
3. Re > 50 kΩ (1 MΩ) between A1-B1 and A2-B2

**Note**
"Generator with open pole rotor generates third harmonic current"

**Installation of one single THF on starpoint of parallel connected transformers**

**Installation rules:**
1. One THF is intended for installation between points A1 and B1, and the other unit between points A2 and B2
2. Earthing is allowed only after points B1 and B2
3. Re > 50 kΩ (1 MΩ) between points A1-B1 and A2-B2
4. The protection unit should bypass both THF-units at the same time. The filter is not suitable for applications including largely dimmer loads. Please consult with us.

**Installation of the THF on a UPS-network**

**Installation of THF on starpoints of parallel connected transformers**

**Installation rules:**
1. One THF is intended for installation between points A1 and B1, and the other between points A2 and B2
2. Earthing is allowed only after points B1 and B2
3. Re > 50 kΩ (1 MΩ) between points A1-B1 and A2-B2
4. The protection unit should bypass both THF-units at the same time. The filter is not suitable for applications including largely dimmer loads. Please consult with us.
Enclosed third harmonic filters THF<sub>star</sub>
Dimensions

THFS400A1 Narrow combination

THFS400A1 Flat combination
Enclosed third harmonic filters $\text{THF}_{\text{star}}$

Dimensions

**THFS630A1 Narrow combination**

**THFS630A1 Flat combination**
Enclosed third harmonic filters THF<sub>star</sub>

Dimensions

THFS1000A1 Narrow Combination

THFS1000A1 Flat combination
The technical data and dimensions are valid at the time of printing. We reserve the right to subsequent alterations.

The operations of the manufacturing plant have been certified.