Ecosine high power passive harmonic filter modules for system integration

- Modular and highly compact filter concept
- Cost-effective open panel design for cabinet integration
- Optimized for motor drives with DC-link chokes
- Helps to comply with international power quality standards
- Supports an efficient utilization of electrical system capacity
- Filters for diode rectifiers

**Technical specifications**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal operating voltage</td>
<td>3x 380 to 500 VAC</td>
</tr>
<tr>
<td>Operating frequency</td>
<td>50 Hz +/- 1 Hz</td>
</tr>
<tr>
<td>Total harmonic current distortion THID*</td>
<td>~5% @ rated power with LDC</td>
</tr>
<tr>
<td></td>
<td>&lt;15% @ derated power without LDC</td>
</tr>
<tr>
<td>Total demand distortion TDD</td>
<td>According to IEEE-519</td>
</tr>
<tr>
<td>Voltage tolerance range</td>
<td>3x 342 to 550 VAC</td>
</tr>
<tr>
<td>Nominal motor drive input power rating</td>
<td>200 to 400 kW</td>
</tr>
<tr>
<td>Efficiency</td>
<td>≥99% @ nominal line voltage and power</td>
</tr>
<tr>
<td>Protection category</td>
<td>IP 00</td>
</tr>
<tr>
<td>Cooling</td>
<td>Forced air, to be provided by the installer/integrator</td>
</tr>
<tr>
<td>Overload capability</td>
<td>1.6x rated current for 1 minute, once per hour</td>
</tr>
<tr>
<td>Ambient temperature range</td>
<td>-25°C to +40°C fully operational</td>
</tr>
<tr>
<td></td>
<td>+40°C to +55°C derated operation**</td>
</tr>
<tr>
<td></td>
<td>-25°C to +80°C transport and storage</td>
</tr>
<tr>
<td>Flammability corresponding to</td>
<td>UL 94V-2 or better</td>
</tr>
<tr>
<td>Design corresponding to</td>
<td>UL 508c, EN 61558-2-20, CE (LVD 2006/95/EC)</td>
</tr>
<tr>
<td>SCCR***</td>
<td>100 kA</td>
</tr>
<tr>
<td>Earthing System</td>
<td>TN, TT, IT</td>
</tr>
</tbody>
</table>

* System requirements: THVD <2%, line voltage unbalance <1%

** Note: performance specifications in this brochure refer to six-pulse diode rectifiers

** derated = I_{nominal} \times (T_{max} - T_{amb})/(T_{max} - T_{nominal}) = I_{nominal} \times (55°C - T_{amb})/15°C

*** External UL-rated fuses required

**Typical application**

Schaffner ecosine filters can be applied to virtually any kind of power electronics with front-end six-pulse rectifiers, where harmonic current distortion needs to be reduced to defined limits. The high power filter modules are particularly suitable when no room for packaged filters is available. The Schaffner solution can conveniently be incorporated into cabinets, which allow the filter components to be wired along with the overall electrical wiring job and to be cooled by jointly utilizing the overall cooling concept.

Typical applications include higher power AC and DC motor drives with either six diode used e.g. in HVAC, water/wastewater, oil & gas, or mission critical factory automation equipment. In addition, ecosine filters can help to reduce thermal and electrical overload caused by harmonic currents in installations involving UPS, high power rectifiers and other non-linear three-phase power supplies.
**Performance characteristics**

**THID – Total harmonic current distortion**

Ecosine high power passive harmonic filter performance is optimized for rectifiers/motor drives with a dc-link choke. In such applications, a THID of roughly 5% can be expected. The use of a dc-link choke is highly recommended. In a system without \( L_{\text{DC}} \), the filter module has to be derated to max. 70% of its nominal power rating. In such applications, a THID of 10…15% can be expected.

**Displacement power factor**

At full load, ecosine filters yield unity power factor. At lower load levels, the capacitive current into the power capacitors of the trap circuit cause a leading displacement power factor. This is the case with all types of passive filters with large capacitors. However, compared to traditional filters the useful range of Schaffner ecosine is much extended (\( \cos \phi > 0.9 \) from 35 to 100% of rated load).

Ecosine filters allow for trap disconnect at light load to avoid low DPF situations if required. This feature can be provided by the installer using a capacitor contactor of suitable size for the trap circuit.

**DC-link voltage**

Ecosine harmonic filters have a very low impact on the dc-link voltage of the motor drive. The voltage variation as function of the load is represented in the performance diagram beside. Tolerances are kept narrow in order to ensure that motor drives do not suffer from noise tripping because of under- or over-voltage conditions.
### Filter selection table (50 Hz) @ 400 VAC

<table>
<thead>
<tr>
<th>Filter</th>
<th>Rated load power* @400 V/50 Hz [kW]</th>
<th>Min. required L&lt;sub&gt;DC&lt;/sub&gt; [mH]</th>
<th>Min. required L&lt;sub&gt;AC&lt;/sub&gt; [mH]</th>
<th>Typ. power loss @ rated load [W]</th>
<th>Weight choke module [kg]</th>
<th>Weight total [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>FN 3410-380-99-O</td>
<td>200</td>
<td>0.205</td>
<td>0.073</td>
<td>1040</td>
<td>120</td>
<td>140</td>
</tr>
<tr>
<td>FN 3410-470-99-O</td>
<td>250</td>
<td>0.164</td>
<td>0.058</td>
<td>1370</td>
<td>135</td>
<td>157</td>
</tr>
<tr>
<td>FN 3410-580-99-O</td>
<td>315</td>
<td>0.131</td>
<td>0.049</td>
<td>1540</td>
<td>160</td>
<td>187</td>
</tr>
<tr>
<td>FN 3410-650-99-O</td>
<td>355</td>
<td>0.115</td>
<td>0.043</td>
<td>1550</td>
<td>215</td>
<td>247</td>
</tr>
<tr>
<td>FN 3410-710-99-O</td>
<td>400</td>
<td>0.102</td>
<td>0.037</td>
<td>1680</td>
<td>250</td>
<td>285</td>
</tr>
</tbody>
</table>

* Power rating for motor drives with dc-link chokes or ac line chokes, the minimum required L<sub>DC</sub> and L<sub>AC</sub> are specified in the table. If the minimum required L<sub>DC</sub> or L<sub>AC</sub> are not available, load power of the filter has to be de-rated to 70% of the specified value above. In this case, the THD will be between 10-15%.

### Filter selection table (50 Hz) @ 500 VAC

<table>
<thead>
<tr>
<th>Filter</th>
<th>Rated load power* @500 V/50 Hz [kW]</th>
<th>Min. required L&lt;sub&gt;DC&lt;/sub&gt; [mH]</th>
<th>Min. required L&lt;sub&gt;AC&lt;/sub&gt; [mH]</th>
<th>Typ. power loss @ rated load [W]</th>
<th>Weight choke module [kg]</th>
<th>Weight total [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>FN 3410-380-99-O</td>
<td>250</td>
<td>0.257</td>
<td>0.097</td>
<td>1040</td>
<td>120</td>
<td>140</td>
</tr>
<tr>
<td>FN 3410-580-99-O</td>
<td>355</td>
<td>0.180</td>
<td>0.063</td>
<td>1540</td>
<td>160</td>
<td>187</td>
</tr>
<tr>
<td>FN 3410-650-99-O</td>
<td>400</td>
<td>0.160</td>
<td>0.057</td>
<td>1550</td>
<td>215</td>
<td>247</td>
</tr>
<tr>
<td>FN 3410-710-99-O</td>
<td>450</td>
<td>0.142</td>
<td>0.052</td>
<td>1680</td>
<td>250</td>
<td>285</td>
</tr>
</tbody>
</table>

### Scope of delivery

<table>
<thead>
<tr>
<th>Filter</th>
<th>Power [kW]</th>
<th>Freq. [Hz]</th>
<th>Rectifier</th>
<th>Chokes module</th>
<th>Capacitor modules Modules</th>
<th>Caps</th>
<th>Damper module</th>
<th>Installation manual</th>
</tr>
</thead>
<tbody>
<tr>
<td>FN 3410-380-99-O</td>
<td>200</td>
<td>50</td>
<td>Diode</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>√</td>
</tr>
<tr>
<td>FN 3410-470-99-O</td>
<td>250</td>
<td>50</td>
<td>Diode</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>1</td>
<td>√</td>
</tr>
<tr>
<td>FN 3410-580-99-O</td>
<td>315</td>
<td>50</td>
<td>Diode</td>
<td>1</td>
<td>2</td>
<td>8</td>
<td>1</td>
<td>√</td>
</tr>
<tr>
<td>FN 3410-650-99-O</td>
<td>355</td>
<td>50</td>
<td>Diode</td>
<td>1</td>
<td>3</td>
<td>9</td>
<td>1</td>
<td>√</td>
</tr>
<tr>
<td>FN 3410-710-99-O</td>
<td>400</td>
<td>50</td>
<td>Diode</td>
<td>1</td>
<td>3</td>
<td>10</td>
<td>1</td>
<td>√</td>
</tr>
</tbody>
</table>

**Remark:** wiring material, cabinet/enclosure and fan(s) are not included in the scope of delivery.

### Application

Ecosine filters are best installed directly at the input of 6-pulse rectifiers. It is possible to connect several non-linear loads (e.g. motor drives) in parallel. In this case the rating of the filter must match the sum of the power ratings of loads connected to it.
# Mechanical data

## Chokes module

![Diagram of chokes module](image)

<table>
<thead>
<tr>
<th>Dimensions of chokes module</th>
<th>200 kW</th>
<th>250 kW</th>
<th>315 kW</th>
<th>355 kW</th>
<th>400 kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>390 ±1</td>
<td>390 ±1</td>
<td>390 ±1</td>
<td>590 ±1</td>
<td>590 ±1</td>
</tr>
<tr>
<td>B</td>
<td>227 ±2</td>
<td>212 ±2</td>
<td>227 ±2</td>
<td>248 ±2</td>
<td>268 ±2</td>
</tr>
<tr>
<td>C</td>
<td>&lt;620</td>
<td>&lt;725</td>
<td>&lt;725</td>
<td>&lt;750</td>
<td>&lt;750</td>
</tr>
<tr>
<td>D</td>
<td>335 ±1</td>
<td>335 ±1</td>
<td>335 ±1</td>
<td>535 ±1</td>
<td>535 ±1</td>
</tr>
<tr>
<td>E</td>
<td>175</td>
<td>175</td>
<td>175</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>F</td>
<td>M10 +1</td>
<td>M10 +1</td>
<td>M10 +1</td>
<td>M10 +1</td>
<td>M10 +1</td>
</tr>
<tr>
<td>G</td>
<td>&lt;300</td>
<td>&lt;300</td>
<td>&lt;300</td>
<td>&lt;300</td>
<td>&lt;300</td>
</tr>
<tr>
<td>H</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>I</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>J</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td>K</td>
<td>200 ±5</td>
<td>240 ±5</td>
<td>240 ±5</td>
<td>290 ±5</td>
<td>290 ±5</td>
</tr>
<tr>
<td>L</td>
<td>195 ±5</td>
<td>240 ±5</td>
<td>240 ±5</td>
<td>200 ±5</td>
<td>210 ±5</td>
</tr>
<tr>
<td>M</td>
<td>25 ±3</td>
<td>35 ±3</td>
<td>35 ±3</td>
<td>35 ±3</td>
<td>35 ±3</td>
</tr>
<tr>
<td>N</td>
<td>100</td>
<td>120</td>
<td>120</td>
<td>140</td>
<td>140</td>
</tr>
<tr>
<td>O</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>70</td>
<td>80</td>
</tr>
<tr>
<td>Weight</td>
<td>~120 kg</td>
<td>~135 kg</td>
<td>~160 kg</td>
<td>~215 kg</td>
<td>~250 kg</td>
</tr>
</tbody>
</table>

All dimensions in mm; 1 inch = 25.4 mm
PE bolt M10
Tolerances according: ISO 2768-m (EN 22768-m)
Installation

Detailed installation and wiring instructions as well as cooling requirements can be found in the Installation Manual available from every Schaffner sales point or from www.myecosine.com.

Important

Forced cooling is required for the thermal management of the magnetic components. Needed fan(s) are not in the scope of delivery. Cooling devices have to be properly selected and installed by the systems integrator. Please consult the Schaffner installation manual for cooling requirement details.

Please visit www.schaffner.com to find more details on filter connectors.

<table>
<thead>
<tr>
<th>Filters 50 Hz</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>FN 3410-380-99-O</td>
<td>&lt; 145</td>
</tr>
<tr>
<td>FN 3410-470-99-O</td>
<td>&lt; 145</td>
</tr>
<tr>
<td>FN 3410-580-99-O</td>
<td>&lt; 145</td>
</tr>
<tr>
<td>FN 3410-650-99-O</td>
<td>&lt; 160</td>
</tr>
<tr>
<td>FN 3410-710-99-O</td>
<td>&lt; 160</td>
</tr>
</tbody>
</table>
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