Ecosine high power passive harmonic filter modules

- Compact cabinet filter for quick installation and easy commissioning
- Cost-effective enclosed passive harmonic filter
- 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>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal operating voltage</td>
<td>3x 380 to 480 VAC</td>
</tr>
<tr>
<td>Operating frequency</td>
<td>60 Hz +/-1 Hz</td>
</tr>
<tr>
<td>Total harmonic current distortion THID*</td>
<td>~5% @ rated power with Ldc&lt;br/&gt;&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 528 VAC</td>
</tr>
<tr>
<td>Nominal motor drive input power rating</td>
<td>300 to 500 HP</td>
</tr>
<tr>
<td>Efficiency</td>
<td>≥ 99% @ nominal line voltage and power</td>
</tr>
<tr>
<td>High potential test voltage</td>
<td>P -&gt; E 2500 VAC (2 sec)</td>
</tr>
<tr>
<td>Protection category</td>
<td>IP 23 for -E2 type filters&lt;br/&gt;IP 54 for -E5 type filters</td>
</tr>
<tr>
<td>Cooling</td>
<td>Forced air</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 +60°C fully operational&lt;br/&gt;+60°C to +90°C derated operation**&lt;br/&gt;-25°C to +80°C transport and storage</td>
</tr>
<tr>
<td>Flammability according 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

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

*** External UL-rated fuses required

### Approvals

- RoHS
- CE
- UL LISTED

### Typical application

Schaffner ECOsine filter cabinets 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 compact filter cabinets can be easily commissioned and quickly installed into existing designs without requiring an in-depth system analysis or highly trained specialists.

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 $L_d$, 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 below. 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 (-E2)

<table>
<thead>
<tr>
<th>Filter</th>
<th>Rated load power(^*) @ 460 VAC/60 Hz</th>
<th>Min. required (L_{DC}) [mH]</th>
<th>Min. required (L_{AC}) [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 3412-380-99-E2</td>
<td>300</td>
<td>0.202</td>
<td>0.074</td>
<td>1090</td>
<td>120</td>
<td>236</td>
</tr>
<tr>
<td>FN 3412-440-99-E2</td>
<td>350</td>
<td>0.173</td>
<td>0.081</td>
<td>1400</td>
<td>135</td>
<td>263</td>
</tr>
<tr>
<td>FN 3412-490-99-E2</td>
<td>400</td>
<td>0.151</td>
<td>0.058</td>
<td>1480</td>
<td>150</td>
<td>275</td>
</tr>
<tr>
<td>FN 3412-540-99-E2</td>
<td>450</td>
<td>0.134</td>
<td>0.052</td>
<td>1500</td>
<td>195</td>
<td>343</td>
</tr>
<tr>
<td>FN 3412-590-99-E2</td>
<td>500</td>
<td>0.121</td>
<td>0.048</td>
<td>1520</td>
<td>235</td>
<td>385</td>
</tr>
</tbody>
</table>

\(^*\) Power rating for motor drives with dc-link chokes. If no Ldc is 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 (-E5)

<table>
<thead>
<tr>
<th>Filter</th>
<th>Rated load power(^*) @ 460 VAC/60 Hz</th>
<th>Min. required (L_{DC}) [mH]</th>
<th>Min. required (L_{AC}) [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 3412-380-99-E5</td>
<td>300</td>
<td>0.202</td>
<td>0.074</td>
<td>1090</td>
<td>120</td>
<td>239</td>
</tr>
<tr>
<td>FN 3412-440-99-E5</td>
<td>350</td>
<td>0.173</td>
<td>0.081</td>
<td>1400</td>
<td>135</td>
<td>266</td>
</tr>
<tr>
<td>FN 3412-490-99-E5</td>
<td>400</td>
<td>0.151</td>
<td>0.058</td>
<td>1480</td>
<td>150</td>
<td>278</td>
</tr>
<tr>
<td>FN 3412-540-99-E5</td>
<td>450</td>
<td>0.134</td>
<td>0.052</td>
<td>1500</td>
<td>195</td>
<td>346</td>
</tr>
<tr>
<td>FN 3412-590-99-E5</td>
<td>500</td>
<td>0.121</td>
<td>0.048</td>
<td>1520</td>
<td>235</td>
<td>388</td>
</tr>
</tbody>
</table>

## 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

Filter cabinet

Dimensions of filter cabinets

Filter cabinet (IP 23)

<table>
<thead>
<tr>
<th>Model</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>FN 3412-380-99-E2</td>
<td>275</td>
<td>215</td>
<td>335</td>
<td>406</td>
</tr>
<tr>
<td>FN 3412-440-99-E2</td>
<td>275</td>
<td>215</td>
<td>335</td>
<td>406</td>
</tr>
<tr>
<td>FN 3412-490-99-E2</td>
<td>275</td>
<td>215</td>
<td>335</td>
<td>406</td>
</tr>
<tr>
<td>FN 3412-540-99-E2</td>
<td>475</td>
<td>415</td>
<td>535</td>
<td>606</td>
</tr>
<tr>
<td>FN 3412-590-99-E2</td>
<td>475</td>
<td>415</td>
<td>535</td>
<td>606</td>
</tr>
</tbody>
</table>

Filter cabinet (IP 54)

<table>
<thead>
<tr>
<th>Model</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>FN 3412-380-99-ES</td>
<td>275</td>
<td>215</td>
<td>335</td>
<td>406</td>
</tr>
<tr>
<td>FN 3412-440-99-ES</td>
<td>275</td>
<td>215</td>
<td>335</td>
<td>406</td>
</tr>
<tr>
<td>FN 3412-490-99-ES</td>
<td>275</td>
<td>215</td>
<td>335</td>
<td>406</td>
</tr>
<tr>
<td>FN 3412-540-99-ES</td>
<td>475</td>
<td>415</td>
<td>535</td>
<td>606</td>
</tr>
<tr>
<td>FN 3412-590-99-ES</td>
<td>475</td>
<td>415</td>
<td>535</td>
<td>606</td>
</tr>
</tbody>
</table>

All dimensions in mm; 1 inch = 25.4 mm
Tolerances according: ISO 2768-c (EN 22768-c)
Headquarters, global innovation and development

Schaffner Group
Nordstrasse 11
4542 Luterbach
T +41 32 681 66 26
info@schaffner.com
www.schaffner.com

Sales and application centers

China
Schaffner EMC Ltd. Shanghai
T20-3 C, No 565 Chuangye Road,
Pudong district
201201 Shanghai
T +86 21 3813 9500
ccchina@schaffner.com
www.schaffner.com.cn

Finland
Schaffner Oy
Sauvonrinne 19 H
08500 Lohja
T +358 50 468 7284
finlandsales@schaffner.com

France
Schaffner EMC S.A.S.
16-20 Rue Louis Rameau
95875 Bezons
T +33 1 34 34 30 60
F +33 1 39 47 02 28
francesales@schaffner.com

Germany
Schaffner Deutschland GmbH
Schoempelrenstrasse 128
76185 Karlsruhe
T +49 721 56910
F +49 721 569110
germanysales@schaffner.com

India
Schaffner India Pvt. Ltd
REGUS WORLD TRADE CENTRE
WTC, 22nd Floor Unit No 2238, Brigade
Gateway Campus, 26/1, Dr. Rajkumar Road
Malleshwararam (W)
560055 Bangalore
T +91 80 67935355
indiasales@schaffner.com

Italy
Schaffner EMC S.r.l.
Via Ticino, 30
20900 Monza (MB)
T +39 039 21 41 070
italysales@schaffner.com

Japan
Schaffner EMC K.K.
1-32-12, Kamiuma, Setagaya-ku
7F Mitsui-seimei Sangenjaya Bldg.
154-0011 Tokyo
T +81 3 5712 3650
F +81 3 5712 3651
japansales@schaffner.com
www.schaffner.jp

Singapore
Schaffner EMC Pte Ltd.
#05-09, Kg Ubi Ind. Estate
408705 Singapore
T +65 6377 3283
F +65 6377 3281
singaporesales@schaffner.com

Spain
Schaffner EMC España
Calle Calendula 93, Miniparc III, Edificio E
El Soto de Moraleja, Alcobendas
28109 Madrid
T +34 917 912 900
F +34 917 912 901
spainsales@schaffner.com

Switzerland
Schaffner EMV AG
Nordstrasse 11
4542 Luterbach
T +41 32 681 66 26
switzerlandsales@schaffner.com

Germany
Schaffner Deutschland GmbH
Schoempelrenstrasse 128
76185 Karlsruhe
T +49 721 56910
F +49 721 569110
germanysales@schaffner.com

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Via Ticino, 30
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El Soto de Moraleja, Alcobendas
28109 Madrid
T +34 917 912 900
F +34 917 912 901
spainsales@schaffner.com

Switzerland
Schaffner EMV AG
Nordstrasse 11
4542 Luterbach
T +41 32 681 66 26
switzerlandsales@schaffner.com

Germany
Schaffner Deutschland GmbH
Schoempelrenstrasse 128
76185 Karlsruhe
T +49 721 56910
F +49 721 569110
germanysales@schaffner.com

Italy
Schaffner EMC S.r.l.
Via Ticino, 30
20900 Monza (MB)
T +39 039 21 41 070
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154-0011 Tokyo
T +81 3 5712 3650
F +81 3 5712 3651
japansales@schaffner.com
www.schaffner.jp

Singapore
Schaffner EMC Pte Ltd.
#05-09, Kg Ubi Ind. Estate
408705 Singapore
T +65 6377 3283
F +65 6377 3281
singaporesales@schaffner.com

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