Book-style EMC/RFI Filter for regenerative drive application

<table>
<thead>
<tr>
<th>Features and benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>FN 3840 series of filters provides state-of-the-art EMI attenuation based on an innovative filter topology. They help to ensure compliance with Class C2 or even C1 limits.</td>
</tr>
<tr>
<td>The filters are built to fit perfectly to regenerative drive applications with LCL filters.</td>
</tr>
<tr>
<td>Internal thermocouples ensure reliability and thermal shutdown capabilities.</td>
</tr>
<tr>
<td>The slim book-style shape allows a convenient and space-saving installation next to inverters, converters or motor drives.</td>
</tr>
<tr>
<td>The filters offer very high saturation performance, bundled with best EMI performance.</td>
</tr>
<tr>
<td>Fulfills the requirements in IEC/EN 61800-5-1 for electric strength, clearance and creepage.</td>
</tr>
<tr>
<td>Fulfills the requirements in IEC/EN 60204-1 for insulation resistance, electric strength, clearance and creepage.</td>
</tr>
<tr>
<td>Fulfills the requirements in IEC/EN 62477-1 for electric strength, clearance and creepage.</td>
</tr>
</tbody>
</table>

**Typical applications**

- Regenerative drives in combination with LCL filters
- Active infeed converter (AIC)
- Active front end (AFE) variable frequency drives (VFD)
- Three-phase variable speed drives (VSD) and power drive systems (PDS)
- Renewable energy
- Machine tool and machinery equipment
- Process automation equipment

**Technical specifications**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum continuous operating voltage</td>
<td>3x 530/305 VAC</td>
</tr>
<tr>
<td>Operating frequency</td>
<td>DC to 60 Hz</td>
</tr>
<tr>
<td>Rated currents</td>
<td>25 to 380 A @50°C</td>
</tr>
<tr>
<td>Overload capability</td>
<td>6x rated current for 1 sec, once per hour; 1.6x rated current for 1 minute, once per hour</td>
</tr>
<tr>
<td>Climatic class</td>
<td>40/100/21 acc. to IEC 60068-1</td>
</tr>
<tr>
<td>Temperature range (operation and storage)</td>
<td>-40°C to +100°C (with current derating &gt;50°C)</td>
</tr>
<tr>
<td>High potential test voltage</td>
<td>P -&gt; E 2550 VDC for 2 s</td>
</tr>
<tr>
<td></td>
<td>P -&gt; P 2550 VDC for 2 s</td>
</tr>
<tr>
<td></td>
<td>TS/TS' -&gt; E 2550 VDC for 2 s</td>
</tr>
<tr>
<td></td>
<td>TS/TS' -&gt; P 2550 VDC for 2 s</td>
</tr>
<tr>
<td>Pollution degree</td>
<td>2 acc. IEC 60664-1</td>
</tr>
<tr>
<td>Overvoltage category</td>
<td>II acc. IEC 60664-1</td>
</tr>
<tr>
<td>Surge withstand</td>
<td>2kV (P-P) / 4kV (P - E) acc. to IEC 6100-4-5</td>
</tr>
<tr>
<td>Altitude</td>
<td>up to 2000m no derating applies. Above 2000m derating acc. to IEC 60664-1 applies</td>
</tr>
<tr>
<td>Design corresponding to</td>
<td>UL 60939-3, IEC 60939-3</td>
</tr>
<tr>
<td>Compliance with insulation requirement</td>
<td>&gt; 1MOhm acc. to IEC 60204-1</td>
</tr>
<tr>
<td>Protection category</td>
<td>IP 20 (terminal block versions) and IP00 (busbar versions) acc. to IEC 60529-1</td>
</tr>
<tr>
<td>Vibration and shock</td>
<td>3Ma (operation) acc. to IEC 60721-3-3</td>
</tr>
<tr>
<td>Flammability corresponding to</td>
<td>Terminals: UL 94 V-0</td>
</tr>
<tr>
<td>MTBF</td>
<td>&gt; 300,000 hours</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Approval &amp; Compliances</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE RoHS</td>
</tr>
<tr>
<td>UL</td>
</tr>
</tbody>
</table>

**Typical electrical schematic (please refer to page 2 for further details)**
## Filter selection table

<table>
<thead>
<tr>
<th>Filter</th>
<th>Rated current</th>
<th>Typical drive power rating*</th>
<th>Leakage current**</th>
<th>DC Resistance</th>
<th>Typical Power Dissipation</th>
<th>Terminal Type</th>
<th>Weight</th>
<th>Thermal Switch***</th>
</tr>
</thead>
<tbody>
<tr>
<td>FN3840-25-33-C35-R65</td>
<td>25</td>
<td>15</td>
<td>4.3</td>
<td>9.5</td>
<td>22</td>
<td>-33</td>
<td>2.5</td>
<td>180</td>
</tr>
<tr>
<td>FN3840-50-53-C35-R65</td>
<td>50</td>
<td>30</td>
<td>4.3</td>
<td>5</td>
<td>43</td>
<td>-53</td>
<td>3.5</td>
<td>180</td>
</tr>
<tr>
<td>FN3840-80-34-C45-R65</td>
<td>80</td>
<td>45</td>
<td>7.7</td>
<td>1.5</td>
<td>40</td>
<td>-34</td>
<td>5.7</td>
<td>180</td>
</tr>
<tr>
<td>FN3840-160-40-C45-R65</td>
<td>160</td>
<td>90</td>
<td>7.7</td>
<td>0.4</td>
<td>40</td>
<td>-40</td>
<td>7.9</td>
<td>180</td>
</tr>
<tr>
<td>FN3840-250-99-C2835-R67</td>
<td>250</td>
<td>150</td>
<td>10.7</td>
<td>0.1</td>
<td>26</td>
<td>-99</td>
<td>4.3</td>
<td>150</td>
</tr>
<tr>
<td>FN3840-380-99-C2835-R67</td>
<td>380</td>
<td>200</td>
<td>10.7</td>
<td>0.07</td>
<td>33</td>
<td>-99</td>
<td>4.5</td>
<td>150</td>
</tr>
</tbody>
</table>

* Typical power rating at 400 VAC with cos phi=0.85. The exact value depends upon the efficiency of the drive, the motor and the entire application.

** Standardized calculated leakage current acc. IEC 60939 under normal operating conditions.

*** Normally closed thermal protector switch, 250VAC / 24VDC, 6.3A (with cos phi 0.6); reverse switching temperature = switching temp - 50K.

### Typical electrical schematic (≤160A)

![Typical electrical schematic (≤160A)](image)

### Typical electrical schematic (≥250A)

![Typical electrical schematic (≥250A)](image)

Tolerances apply: L +50%/-30%, C ±20%, R ±10%

### Typical filter attenuation

Per CISPR 17: symmetrical 50 Ω/50 Ω -> Differential Mode (DM); asymmetrical 50 Ω/50 Ω -> Common Mode (CM)

![Typical filter attenuation](image)


**Typical application**

System diagram of an Active Front End (AFE) application

![System diagram of an Active Front End (AFE) application](image)

**Frequency response**

Frequency response at different values of the grid inductance. The grid inductance is calculated with details mentioned at each graph. Each figure represents the normalized admittance transfer function between the grid current, \( i_g \), and the converter voltage \( u_s \). At low frequencies, the equivalent admittance is inversely proportional to the total DC resistance of the grid, and EMI and LCL filters (\( R_{GRID} + R_{EMI} + R_{LCL} \)), which is dominated mainly by the LCL filter \( R_{LCL} \).

FN3840-25-33-C35-R65
400 VAC/50 Hz, 250 kVA trafo with \( u_k \) of (1) 1%, (2) 2%, (3) 3%, (4) 4%, (5) 5% and 50m cable.

![Frequency response graph](image)

FN3840-50-53-C35-R65
400 VAC/50 Hz, 250 kVA trafo with \( u_k \) of (1) 1%, (2) 2%, (3) 3%, (4) 4%, (5) 5% and 50m cable.

![Frequency response graph](image)

FN3840-80-34-C45-R65
400 VAC/50 Hz, 250 kVA trafo with \( u_k \) of (1) 1%, (2) 2%, (3) 3%, (4) 4%, (5) 5% and 50m cable.

![Frequency response graph](image)

FN3840-160-40-C45-R65
400 VAC/50 Hz, 315 kVA trafo with \( u_k \) of (1) 1%, (2) 2%, (3) 3%, (4) 4%, (5) 5% and 50m cable.

![Frequency response graph](image)

FN3840-250-99-C2835-R67
400 VAC/50 Hz, 500 kVA trafo with \( u_k \) of (1) 1%, (2) 2%, (3) 3%, (4) 4%, (5) 5% and 50m cable.

![Frequency response graph](image)

FN3840-380-99-C2835-R67
400 VAC/50 Hz, 630 kVA trafo with \( u_k \) of (1) 1%, (2) 2%, (3) 3%, (4) 4%, (5) 5% and 50m cable.

![Frequency response graph](image)
Damping resistor losses vs switching frequency

Typical losses at different values of the AFE-LCL L1 inductor with rated voltage (530 VAC/60 Hz) and differing grid inductance: (25A->95μH; 50A->95μH; 80A-> 95μH; 160A->79μH; 250A->57μH; 380A->50μH).

The highlighted gray area represents a non-operating area. Operating the filter in this area may cause overheating and damage to the filter, and may activate the temperature switch.

FN3840-25-33-C35-R65  FN3840-50-53-C35-R65  FN3840-80-34-C45-R65


Mechanical data for filters with terminal blocks

FN3840-25-33-CXX-RYY  FN3840-50-53-CXX-RYY
Filter input/output connector cross sections

-33
Solid wire
0.5-16 mm²
Flex wire
0.5-10 mm²
Flex wire AWG
AWG 22-6
Recommended torque
1.5-1.8 Nm

-53
0.5-16 mm²
0.5-16 mm²
AWG 20-4
2.0-2.3 Nm

-34
6-35 mm²
6-25 mm²
AWG 6-2
4.0-4.5 Nm

-40
25-95 mm²
25-95 mm²
AWG 0-4/0
17-20 Nm

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

Mechanical data for filters with busbar connection

FN3840-80-34-CXX-RYY

FN3840-160-40-CXX-RYY

FN3840-250-99-CXXXX-RYY

FN3840-380-99-CXXXX-RYY
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