DC-Busbar EMC/RFI Filter for EV charging applications

- Designed for usage in EV charging applications
- Ultra-compact filter
- Multiple performance options
- Design acc. to EV charging safety standards

### Technical specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum continuous operating voltage</td>
<td>1000 VDC (FN222X, FN224X) 500 VDC (FN223X)</td>
</tr>
<tr>
<td>Operating frequency</td>
<td>DC</td>
</tr>
<tr>
<td>Rated currents</td>
<td>150 to 600 A @ 55 °C</td>
</tr>
<tr>
<td>Overload capability</td>
<td>6x rated current for 1 sec, once per hour 1.5x rated current for 1 minute, once per hour</td>
</tr>
<tr>
<td>Climatic class</td>
<td>40/100/21 acc. to IEC 60608-1</td>
</tr>
<tr>
<td>Temperature range (operation and storage)</td>
<td>-40 °C to +100 °C (with current derating &gt;55 °C)</td>
</tr>
<tr>
<td>High potential test voltage</td>
<td>DC+ -&gt; DC- 3600 VDC for 2 s (FN222X, FN224X)* DC+ -&gt; DC- 2000 VDC for 2 s (FN223X)* DC+/-DC- -&gt; PE 5000 VDC for 2 s (FN222X, FN224X)* DC+/-DC- -&gt; PE 2500 VDC for 2 s (FN223X)*</td>
</tr>
<tr>
<td>Pollution degree</td>
<td>PD 3 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>DC+/-DC- to PE: 4000 V (FN223X) / 6000 V (FN222X, FN224X); DC+ to DC-: 2000 V; acc. to IEC 61000-4-5</td>
</tr>
<tr>
<td>Altitude</td>
<td>up to 2000 m no derating applies. Above 2000 m derating acc. to IEC 60664-1 applies</td>
</tr>
<tr>
<td>Protection category</td>
<td>P00 acc. to IEC 60529</td>
</tr>
<tr>
<td>Vibration and shock</td>
<td>3M12 (operation) acc. to IEC 60721-3-3</td>
</tr>
<tr>
<td>Flammability corresponding to</td>
<td>Plastics: UL 94 V-0</td>
</tr>
<tr>
<td>MTBF</td>
<td>&gt; 300,000 hours</td>
</tr>
<tr>
<td>Cooling</td>
<td>Natural convection AN</td>
</tr>
<tr>
<td>Certified to</td>
<td>UL 69039-3, IEC 60939-3, CSA 22.2 No. 8-13</td>
</tr>
<tr>
<td>Output connections</td>
<td>Ni-plated busbars</td>
</tr>
</tbody>
</table>

### Features and benefits

- FN222X, FN223X and FN224X series of filters provide state-of-the-art EMI attenuation with a choice of three performance levels
- The filters are built to fit perfectly to high power EV charging applications
- The shape allows a convenient and space-saving installation
- Fulfills the requirements in IEC/EN 61851-23 Electric vehicle conductive charging system
- Fulfills the requirements in UL 2202 Electric Vehicle (EV) Charging System Equipment
- FN224X offers voltage and performance ratings of FN222X on a smaller footprint

### Typical applications

- High Power EV DC charging beyond HPC350 (500 A @ 920 V)
- Two voltage levels (500 VDC and 1000 VDC) for CHAdeMO and CCS

### Approvals & Compliances

- UL
- CE
- RoHS
- UKCA
- C
- UL

### Typical electrical schematic

*High potential test voltage: Repetition with max. 80% of specified values
## Filter selection table

<table>
<thead>
<tr>
<th>Filter</th>
<th>Rated current @55°C @25°C/DC</th>
<th>Capacitance*</th>
<th>total equiv. capacitance to PE</th>
<th>Resistance*</th>
<th>Typical power dissipation @25°C/DC</th>
<th>Weight approx.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[A] [nF] to PE</td>
<td>CY1</td>
<td>CY2</td>
<td>RX</td>
<td>RY</td>
<td>[MOhm]</td>
</tr>
<tr>
<td>1000 VDC - compact housing style</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High performance:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FN2220-150-99-C2222-R99</td>
<td>150</td>
<td>330</td>
<td>330</td>
<td>990</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>FN2220-300-99-C2222-R99</td>
<td>300</td>
<td>330</td>
<td>330</td>
<td>990</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>FN2220-450-99-C2222-R99</td>
<td>450</td>
<td>330</td>
<td>330</td>
<td>990</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>FN2220-600-99-C2222-R99</td>
<td>600</td>
<td>330</td>
<td>330</td>
<td>990</td>
<td>10</td>
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<tr>
<td>Very high performance:</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>FN2221-600-99-C2222-R99</td>
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<td>330</td>
<td>330</td>
<td>990</td>
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<tr>
<td>500 VDC - compact housing style</td>
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<tr>
<td>High performance:</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FN2230-150-99-C2022-R99</td>
<td>150</td>
<td>150</td>
<td>330</td>
<td>960</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>FN2230-300-99-C2022-R99</td>
<td>300</td>
<td>150</td>
<td>330</td>
<td>960</td>
<td>10</td>
<td>10</td>
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<tr>
<td>FN2230-450-99-C2022-R99</td>
<td>450</td>
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<td>330</td>
<td>960</td>
<td>10</td>
<td>10</td>
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<tr>
<td>FN2230-600-99-C2022-R99</td>
<td>600</td>
<td>150</td>
<td>330</td>
<td>960</td>
<td>10</td>
<td>10</td>
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<tr>
<td>Very high performance:</td>
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<tr>
<td>FN2231-600-99-C2022-R99</td>
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<td>150</td>
<td>330</td>
<td>960</td>
<td>10</td>
<td>10</td>
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<td>1000 VDC - slim housing style</td>
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<td></td>
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<tr>
<td>High performance:</td>
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<tr>
<td>FN2240-150-99-C2222-R99</td>
<td>150</td>
<td>330</td>
<td>330</td>
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<tr>
<td>FN2240-300-99-C2222-R99</td>
<td>300</td>
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<td>330</td>
<td>990</td>
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<tr>
<td>FN2240-450-99-C2222-R99</td>
<td>450</td>
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<td>330</td>
<td>990</td>
<td>10</td>
<td>10</td>
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<tr>
<td>FN2240-600-99-C2222-R99</td>
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<td>330</td>
<td>330</td>
<td>990</td>
<td>10</td>
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<tr>
<td>Very high performance:</td>
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<td></td>
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<td></td>
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<tr>
<td>FN2241-600-99-C2222-R99</td>
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<td>330</td>
<td>330</td>
<td>990</td>
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</tr>
</tbody>
</table>

* Tolerances apply: Capacitance: ±20%, Resistance: ±10%

### Product selector*

**FN22rs-ttt-uu-Cvvzz-Rxy**

**xy** – X-capacitor discharger resistor: x = RX / y = RY (e.g. -R99)
- 9: 10 Mohm

**vvzz** – Y-capacitor option: vv = Y-capacitor CY1 / zz = Y-capacitor CY2 (e.g. -C2222)
- 22: 330 nF
- 20: 150 nF

**uu** – Electrical connection
- 99: Ni-plated busbar connection

**ttt** – Rated current
- 150: 150 A
- 300: 300 A
- 450: 450 A
- 600: 600 A

**s** – Performance
- 0: High performance (recommended for most applications)
- 1: Very high performance
- 2: Standard performance (on request)

**r** – Version
- 2: 1000 V – compact housing style
- 3: 500 V – compact housing style
- 4: 1000 V – slim housing style

*Filter can be adapted to specific requirements. Variations of resistor and capacitor values available on request.
Typical electrical schematic FN222X and FN224X (up to 1000 VDC)

Typical electrical schematic FN223X (up to 500 VDC)

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

FN2220-ttt-uu-C2222-Rxy and FN2240-ttt-uu-C2222-Rxy
High Performance

FN2221-ttt-uu-C2222-Rxy and FN2241-ttt-uu-C2222-Rxy
Very High Performance

FN2230-ttt-uu-C2022-Rxy
High Performance

FN2231-ttt-uu-C2022-Rxy
Very High Performance
### Dimensions*

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>FN222X and FN223X</th>
<th>FN224X</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>150 A</td>
<td>300 A</td>
</tr>
<tr>
<td>A</td>
<td>145</td>
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<tr>
<td>B</td>
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<tr>
<td>C</td>
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<td>U</td>
<td>48</td>
<td>48</td>
</tr>
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<td>V</td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td>W</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>X</td>
<td>10</td>
<td>125</td>
</tr>
<tr>
<td>Z</td>
<td>9</td>
<td>11</td>
</tr>
</tbody>
</table>

* All dimensions in mm. For dimensions without stated tolerances: ISO 2768-m/EN 22768-m applies.
Headquarters, global innovation and development

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

Sales and application centers

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

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

France
Schaffner EMC S.A.S.
16-20 Rue Louis Rameau
95875 Beaumont
T +33 1 34 34 30 60
francesales@schaffner.com

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

India
Schaffner India Pvt. Ltd
REGUS WORLD TRADE CENTRE
WTC, 2nd Floor Unit No 2238, Brigade Gateway Campus, 26/1, Dr. Rajkumar Road Malleshwaram (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.
Taiji-Seimei Sangenjaya Bldg.
1-32-12, Kansuiama, Setagaya-ku
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
Industrie Nord
Nordstrasse 11e
4542 Luterbach
T +41 32 681 66 26
switzerlandsales@schaffner.com

Taiwan
Schaffner EMV Ltd.
20 Floor-2, No 97, Section 1, XinTai 5th Road
22175 Xizhi District New Taipei City 22175
T +886 2 2697 5500
F +886 2 2697 5533
taiwansales@schaffner.com
www.schaffner.com.tw

United Kingdom
Schaffner Ltd.
1, Oakmede Place
Binfield
RG42 4JF Berkshire
T +44 118 9770070
F +44 118 9792969
uksales@schaffner.com

USA
Schaffner EMC Inc.
52 Mayfield Avenue
Edison, New Jersey
T +1 732 225 9533
F +1 732 225 4789
usasales@schaffner.com
www.schaffnerusa.com

To find your local partner within Schaffner’s global network: www.schaffner.com

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