

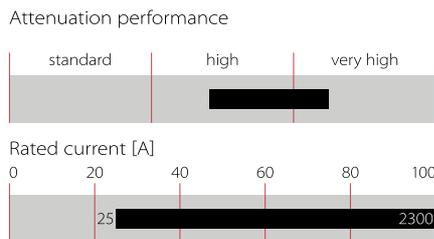
# EMC/EMI Filter for PV Inverters



- Reduces conducted emissions towards the solar panel
- Reduces the probability of EMI radiation off the solar panel
- Helps to prevent pre-mature panel aging because of HF leakage currents
- Helps to meet international EMC regulations for the entire PV system
- Most compact standard solution in the industry, optionally available without capacitors to ground (B types)
- New: up to 2300 A



### Performance indicators



## Technical specifications

|  |  |
|--|--|
| <b>Maximum continuous operating voltage</b>      | Max. 1200 VDC  |
| <b>Operating frequency</b>                       | DC   |
| <b>Rated currents</b>                            | 25 to 2300 A @ 55°C  |
| <b>High potential test voltage</b>               | P → E 3600 VDC for 2 sec<br>P → P 3000 VDC for 2 sec                             |
| <b>Protection category</b>                       | IP 20 (25 to 150 A types); IP 00 (250 to 2300 A types)                           |
| <b>Overload capability</b>                       | 4x rated current at switch on,<br>1.5x rated current for 1 minute, once per hour |
| <b>Temperature range (operation and storage)</b> | -40°C to +100°C (40/100/21)  |
| <b>Design corresponding to</b>                   | UL 1283, CSA 22.2 No. 8 1986, IEC/EN 60939                                       |
| <b>Flammability corresponding to</b>             | UL 94 V-2 or better  |
| <b>MTBF @ 55°C/1200 V (Mil-HB-217F)</b>          | min. 223,000 hours   |

### Approvals



FN 2200 are the most compact dedicated DC filters for PV inverters in the industry and therefore support the integration in the ever shrinking frame sizes of today's power electronics. All FN 2200 come in unsymmetrical housings, which help to prevent inverse installation and wrong electrical connection. Along with grid-side installed Schaffner AC EMC/EMI filters, FN 2200 are key to meet the stringent international standards for electromagnetic compatibility (EMC) like EN 61000-6-3 and -6-4 and help to ensure a reliable and fault-free operation of the entire PV system. FN 2200 are designed for very low power loss, to support overall PV system efficiency.

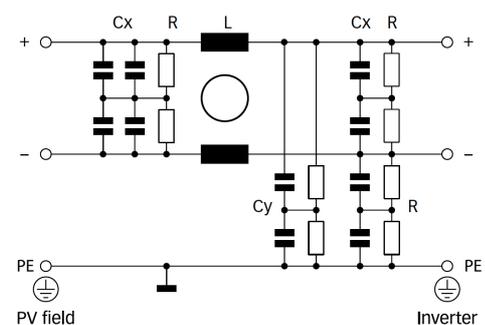
## Features and benefits

FN 2200 range of standard EMC/EMI filters is based on Schaffner's years of experience in custom filter design for the global photovoltaic (PV) inverter industry. Installed between the PV inverter and the solar panel, FN 2200 DC filters help to control conducted emissions on the panel side of the system and therefore significantly reduce the potential for high-frequency (HF) interference radiation off the panel. The filter also protects the solar panel from HF stray and leakage currents which can cause pre-mature aging in the PV modules.

## Typical applications

FN 2200 are primarily designed for PV inverters. However, they can potentially also be used in other DC applications within published specifications, like UPS, DC motor drives, or DC quick chargers.

### Typical electrical schematic



### Filter selection table

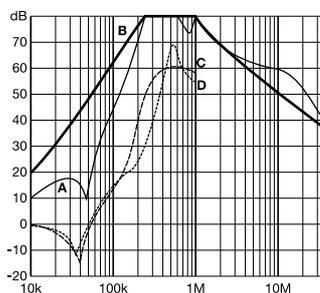
| Filter           | Rated current<br>@ 55°C (40°C) | Typical inverter<br>AC power rating* | Filter efficiency<br>@ 25°C/DC | Power loss<br>@ 25°C/DC | Input/Output<br>connections   |   | Weight |
|------------------|--------------------------------|--------------------------------------|--------------------------------|-------------------------|---|---|--------|
|                  | [A]                            | [kW]                                 | [%]                            | [W]                     |  |  | [kg]   |
| FN 2200-25-33    | 25 (28)                        | 10                                   | > 99.9                         | 8                       | -33   |   | 0.9    |
| FN 2200-50-34    | 50 (57)                        | 20                                   | > 99.9                         | 17                      | -34   |   | 1.6    |
| FN 2200-75-34    | 75 (86)                        | 30                                   | > 99.9                         | 18                      | -34   |   | 1.7    |
| FN 2200-100-35   | 100 (115)                      | 40                                   | > 99.9                         | 22                      | -35   |   | 2.7    |
| FN 2200-150-40   | 150 (173)                      | 60                                   | > 99.9                         | 31                      | -40   |   | 4.9    |
| FN 2200-250-99   | 250 (288)                      | 100                                  | > 99.9                         | 10                      |   | -99   | 5.0    |
| FN 2200-400-99   | 400 (460)                      | 150                                  | > 99.9                         | 16                      |   | -99   | 6.1    |
| FN 2200-600-99   | 600 (690)                      | 250                                  | > 99.9                         | 29                      |   | -99   | 6.5    |
| FN 2200-800-99   | 800 (920)                      | 350                                  | > 99.9                         | 26                      |   | -99   | 9.3    |
| FN 2200-1000-99  | 1000 (1150)                    | 400                                  | > 99.9                         | 40                      |   | -99   | 9.4    |
| FN 2200-1500-99  | 1500 (1600)                    | 500                                  | > 99.9                         | 45                      |   | -99   | 14.6   |
| FN 2200-2300-99  | 2300 (2500)                    | 800/1000                             | > 99.9                         | 400                     |   | -99   | 25.0   |
| FN 2200B-25-33   | 25 (28)                        | 10                                   | > 99.9                         | 8                       | -33   |   | 0.9    |
| FN 2200B-50-34   | 50 (57)                        | 20                                   | > 99.9                         | 17                      | -34   |   | 1.6    |
| FN 2200B-75-34   | 75 (86)                        | 30                                   | > 99.9                         | 18                      | -34   |   | 1.7    |
| FN 2200B-100-35  | 100 (115)                      | 40                                   | > 99.9                         | 22                      | -35   |   | 2.7    |
| FN 2200B-150-40  | 150 (173)                      | 60                                   | > 99.9                         | 31                      | -40   |   | 4.9    |
| FN 2200B-250-99  | 250 (288)                      | 100                                  | > 99.9                         | 10                      |   | -99   | 5.0    |
| FN 2200B-400-99  | 400 (460)                      | 150                                  | > 99.9                         | 16                      |   | -99   | 6.1    |
| FN 2200B-600-99  | 600 (690)                      | 250                                  | > 99.9                         | 29                      |   | -99   | 6.5    |
| FN 2200B-800-99  | 800 (920)                      | 350                                  | > 99.9                         | 26                      |   | -99   | 9.3    |
| FN 2200B-1000-99 | 1000 (1150)                    | 400                                  | > 99.9                         | 40                      |   | -99   | 9.4    |
| FN 2200B-1500-99 | 1500 (1600)                    | 500                                  | > 99.9                         | 45                      |   | -99   | 14.6   |
| FN 2200B-2300-99 | 2300 (2500)                    | 800/1000                             | > 99.9                         | 84                      |   | -99   | 25.0   |

\* Based on rated DC current of typical 3-phase PV inverters with 900 VDC input. Note: depending upon manufacturer and model, DC currents for a given PV inverter power can differ significantly. Filters with higher current ratings for large central inverters up to the MW range are available upon request.

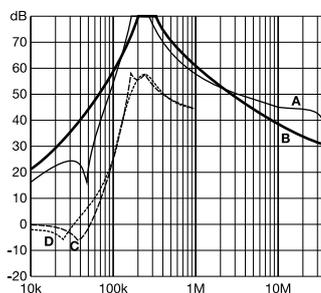
### Typical filter attenuation

Per CISPR 17; A=50 Ω/50 Ω sym; B=50 Ω/50 Ω asym; C=0.1 Ω/100 Ω sym; D=100 Ω/0.1 Ω sym

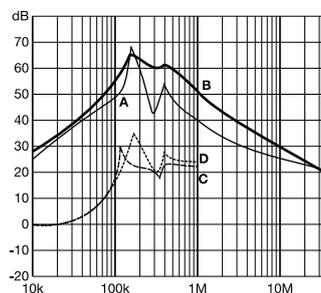
25 to 75 A types



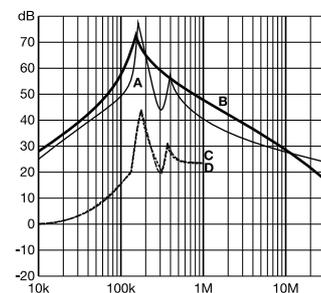
100 to 150 A types



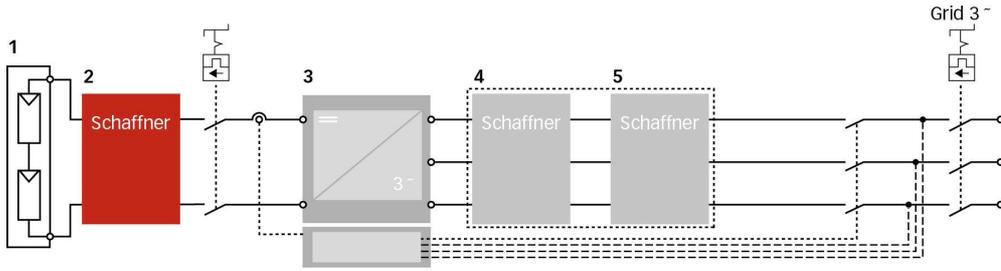
250 A types



400 to 2300 A types



### Typical block schematic

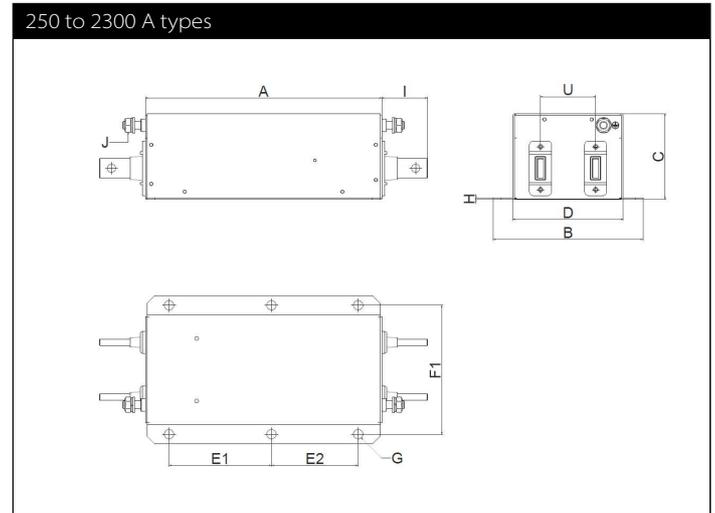
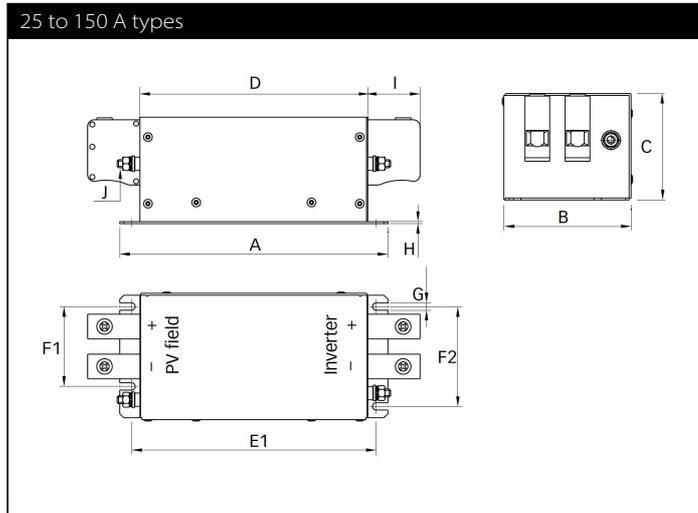


1 PV modules  
2 Schaffner FN 2200

3 Central Inverter  
4 Schaffner magnetic components

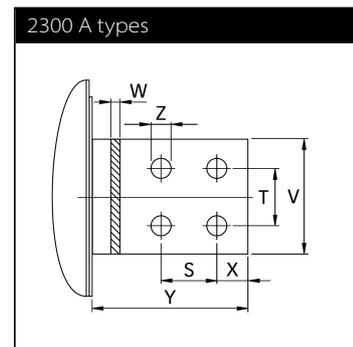
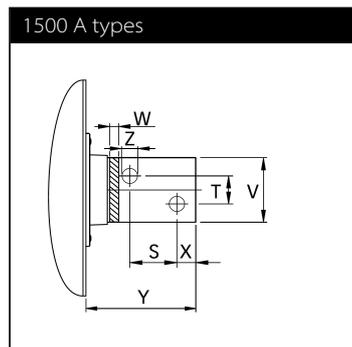
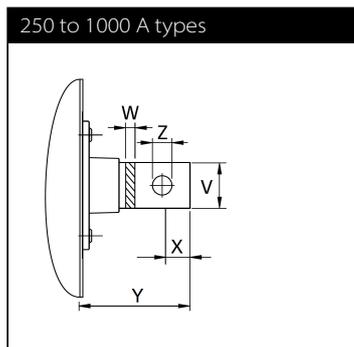
5 Schaffner AC EMC/EMI filter

### Mechanical data



**Note:** all FN 2200 provide unsymmetrical mounting hole patterns to prevent inverse filter installation in the field. (Dimensions E1 E2 and F1/F2)

### Busbar connections



## Dimensions

|           | 25 A  | 50 A  | 75 A  | 100 A | 150 A | 250 A | 400 A  | 600 A  | 800 A | 1000 A | 1500 A | 2300 A |
|-----------|-------|-------|-------|-------|-------|-------|--------|--------|-------|--------|--------|--------|
| <b>A</b>  | 170   | 200   | 200   | 220   | 250   | 300   | 300    | 300    | 300   | 300    | 300    | 400    |
| <b>B</b>  | 80    | 95    | 95    | 125   | 140   | 180   | 190    | 190    | 200   | 200    | 200    | 250    |
| <b>C</b>  | 65    | 80    | 80    | 95    | 115   | 110   | 110    | 110    | 140   | 140    | 150    | 180    |
| <b>D</b>  | 140   | 170   | 170   | 190   | 220   | 130   | 140    | 140    | 150   | 150    | 150    | 195    |
| <b>E1</b> | 152.5 | 182.5 | 182.5 | 202.5 | 232.5 | 130   | 130    | 130    | 130   | 130    | 130    | 190    |
| <b>E2</b> |       |       |       |       |       | 110   | 110    | 110    | 110   | 110    | 110    | 150    |
| <b>F1</b> | 45    | 60    | 60    | 80    | 100   | 155   | 165    | 165    | 175   | 175    | 175    | 225    |
| <b>F2</b> | 60    | 75    | 75    | 100   | 120   |       |        |        |       |        |        |        |
| <b>G</b>  | 5.5   | 5.5   | 5.5   | 5.5   | 5.5   | Ø 12  | Ø 12   | Ø 12   | Ø 12  | Ø 12   | Ø 12   | Ø 12   |
| <b>H</b>  | 1     | 1.5   | 1.5   | 1.5   | 2     | 2     | 2      | 2      | 3     | 3      | 3      | 3      |
| <b>I</b>  | 25    | 39    | 39    | 45    | 51    | 58    | 58     | 58     | 65    | 65     | 110    | 100    |
| <b>J</b>  | M5    | M6    | M6    | M8    | M10   | M10   | M10    | M10    | M12   | M12    | M12    | M16    |
| <b>S</b>  |       |       |       |       |       |       |        |        |       |        | 43     | 35     |
| <b>T</b>  |       |       |       |       |       |       |        |        |       |        | 26     | 35     |
| <b>U</b>  |       |       |       |       |       | 70    | 70     | 70     | 70    | 70     | 70     | 100    |
| <b>V</b>  |       |       |       |       |       | 20    | 25     | 25     | 40    | 40     | 60     | 70     |
| <b>W</b>  |       |       |       |       |       | 5     | 6      | 8      | 8     | 8      | 10     | 15     |
| <b>X</b>  |       |       |       |       |       | 15    | 15     | 15     | 20    | 20     | 17     | 20     |
| <b>Y</b>  |       |       |       |       |       | 58    | 58     | 58     | 65    | 65     | 110    | 100    |
| <b>Z</b>  |       |       |       |       |       | Ø 9   | Ø 10.5 | Ø 10.5 | Ø 14  | Ø 14   | Ø 14   | Ø 14   |

All dimensions in mm; 1 inch = 25.4 mm  
Tolerances according: ISO 2768-m/EN 22768-m

## Filter input/output connector cross sections

|                           | -33   | -34   | -35   | -40   |
|---------------------------|---|---|---|---|
|                           |  |  |  |  |
| <b>Solid wire</b>         | 16 mm <sup>2</sup>  | 35 mm <sup>2</sup>  | 50 mm <sup>2</sup>  | 95 mm <sup>2</sup>  |
| <b>Flex wire</b>          | 10 mm <sup>2</sup>  | 25 mm <sup>2</sup>  | 50 mm <sup>2</sup>  | 95 mm <sup>2</sup>  |
| <b>AWG type wire</b>      | AWG 6   | AWG 2   | AWG 1/0   | AWG 4/0   |
| <b>Recommended torque</b> | 1.5-1.8 NM  | 4.0-4.5 NM  | 7-8 NM  | 17-20 NM  |

Please visit [www.schaffner.com](http://www.schaffner.com) to find more details on filter connectors.



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