

# Output Filter for Motor Drives

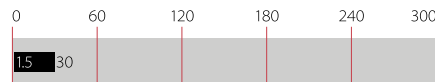


- Reduction of drive output voltage dv/dt
- Restriction of overvoltages on motor cables
- Reduction of motor temperature
- Increase of motor service life
- Improvement of system reliability

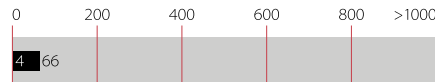


## Performance indicators

Typical motor power [kW]



Rated current [A]



## Technical specifications

|                                                  |                                                                                  |
|--------------------------------------------------|----------------------------------------------------------------------------------|
| <b>Nominal operating voltage</b>                 | 3x 500/288 VAC                                                                   |
| <b>Motor frequency</b>                           | 0 to 400 Hz (4 to 24 A)<br>0 to 200 Hz (33 to 66 A)                              |
| <b>Switching frequency</b>                       | 2 to 16 kHz                                                                      |
| <b>Rated currents</b>                            | 4 to 66 A @ 50°C                                                                 |
| <b>Motor cable length</b>                        | 80 m max. @ 16 kHz                                                               |
| <b>Voltage drop</b>                              | ≤10 V @ 50 Hz                                                                    |
| <b>Typical dv/dt reduction</b>                   | Factor 8 to 12                                                                   |
| <b>Typical reduction of overvoltages</b>         | ≤1000 V                                                                          |
| <b>High potential test voltage</b>               | P → E 2500 VDC for 2 sec<br>P → P 1100 VDC for 2 sec                             |
| <b>Protection category</b>                       | IP 20, if temperature auxiliary contact is connected with IP 20 faston connector |
| <b>Overload capability</b>                       | 1.4x rated current for 1 minute, every 15 minutes                                |
| <b>Temperature range (operation and storage)</b> | -25°C to +70°C (25/070/21)                                                       |
| <b>Flammability corresponding to</b>             | UL 94 V-2 or better                                                              |
| <b>Design corresponding to</b>                   | UL 1283, CSA 22.2 No. 8 1986, IEC/EN 60939                                       |
| <b>MTBF @ 50°C/400 V (Mil-HB-217F)</b>           | >100,000 hours                                                                   |

## Approvals

## RoHS

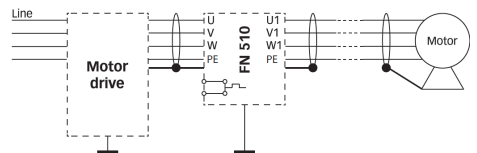
## Features and benefits

- Efficient reduction of high output voltage dv/dt from IGBT motor drives (as per DIN VDE 0530)
- Restriction of overvoltages caused by line reflections on motor cables (as per DIN VDE 0530)
- Protection of motor coil insulation from premature aging and destruction
- Significant increase of service life of electric motors
- High reliability and production up time for mission critical applications
- Less interference propagation towards neighboring equipment or lines
- Output filter with low impedance, ideal for processes requiring exceptional precision and reproducibility of movements
- IP 20 housing and touch-safe terminal blocks contribute to overall equipment safety
- Temperature monitoring and internal fan cooling protect the filter from thermal overload

## Typical applications

- Servo drives
- Close loop vector drives
- Motor drive applications with short to medium motor cable length
- Machinery comprising servo or torque motors
- Robots
- Pick and place machines
- Applications where sine wave filters are not applicable

## Typical electrical schematic



## Filter selection table

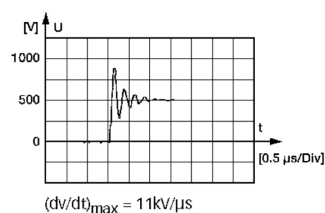
| Filter              | Rated current<br>@ 50°C<br>[A] | Typical motor<br>power rating*<br>[kW] | Typical<br>power loss**<br>[W] | Input/Output<br>connections | Weight<br>[kg] |
|---------------------|--------------------------------|----------------------------------------|--------------------------------|-----------------------------|----------------|
| <b>FN 510-4-29</b>  | 4                              | 1.5                                    | 90                             | -29                         | 2.1            |
| <b>FN 510-8-29</b>  | 8                              | 3.7                                    | 90                             | -29                         | 2.1            |
| <b>FN 510-12-29</b> | 12                             | 5.5                                    | 90                             | -29                         | 4              |
| <b>FN 510-16-29</b> | 16                             | 7.5                                    | 90                             | -29                         | 4.8            |
| <b>FN 510-24-33</b> | 24                             | 11                                     | 100                            | -33                         | 7.7            |
| <b>FN 510-33-33</b> | 33                             | 15                                     | 110                            | -33                         | 10             |
| <b>FN 510-50-34</b> | 50                             | 22                                     | 130                            | -34                         | 21             |
| <b>FN 510-66-34</b> | 66                             | 30                                     | 130                            | -34                         | 22             |

\* General purpose four-pole (1500 r/min) AC induction motor rated 400 V/50 Hz.

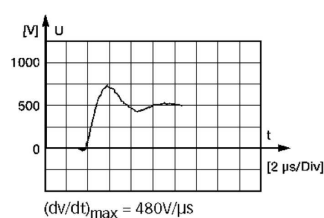
\*\*Power loss at 16 kHz switching frequency/80m motor cable length. Exact value depends upon the motor cable type and length, switching frequency and further stray parameters within the system.

## Typical measurement results

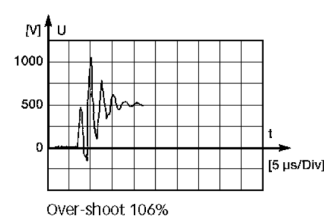
dv/dt without FN 510



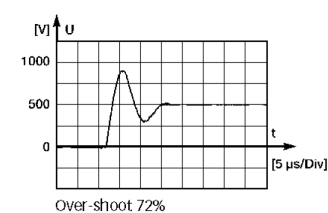
dv/dt with FN 510



Overvoltages without FN 510



Overvoltages with FN 510



dv/dt reduction: maximum dv/dt at the motor terminals, measured with the motor drive operating at 14 kHz switching frequency, 5 m of shielded cable, motor with 100% load.

Overvoltage limitation: maximum overvoltages at the motor terminals, measured with the motor drive operating at 14 kHz switching frequency, 80 m of shielded cable, motor idling.

## Typical application range at different operating conditions

The power loss in the filter depends mainly on the switching frequency ( $f_s$ ) of the motor drive and the length of the motor cable. FN 510 have been designed for an ambient temperature of 50°C.

Other conditions can, however, occur in practice. In such cases, care must be taken to limit the maximum cable length and/or the switching frequency of the motor drive, depending on the real ambient temperature conditions.

### FN 510 are designed for:

| Tamb. | Max. $f_s$ | Max. cable |
|-------|------------|------------|
| 50°C  | 10 kHz     | 80 m       |

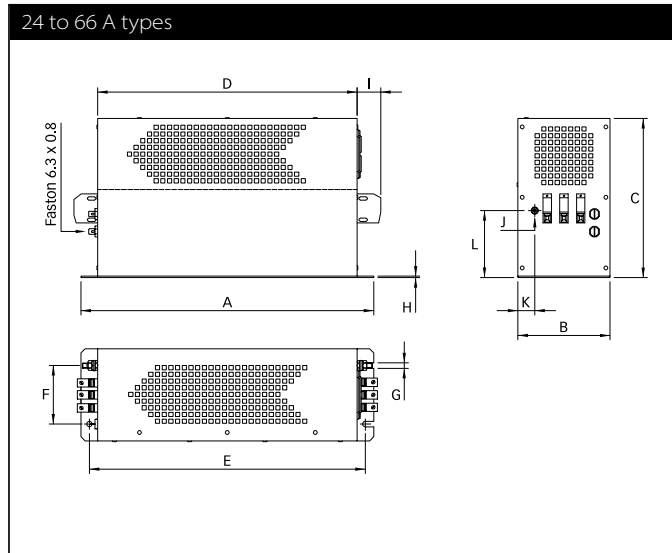
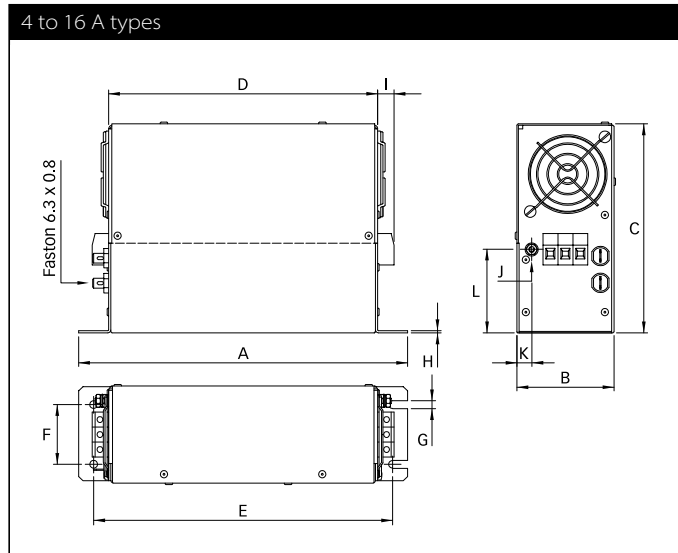
### Possible application, e.g.:

| 50°C | 16 kHz | 50 m |
|------|--------|------|
| 40°C | 16 kHz | 80 m |

## Temperature monitoring function

The temperature monitoring device opens a potential-free contact in the case of filter overtemperature (>120°C). The maximum switching capability is 5 A/240 V. The switch can be used, for example, in the input of a CNC controller or as the trip of a circuit breaker in order to interrupt the mains power supply.

## Mechanical data



## Dimensions

|          | 4 A  | 8 A  | 12 A | 16 A | 24 A | 33 A | 50 A | 66 A |
|----------|------|------|------|------|------|------|------|------|
| <b>A</b> | 220  | 220  | 260  | 260  | 350  | 350  | 470  | 470  |
| <b>B</b> | 65   | 65   | 85   | 85   | 110  | 110  | 140  | 140  |
| <b>C</b> | 140  | 140  | 160  | 160  | 190  | 190  | 235  | 235  |
| <b>D</b> | 180  | 180  | 220  | 220  | 310  | 310  | 420  | 420  |
| <b>E</b> | 200  | 200  | 240  | 240  | 330  | 330  | 440  | 440  |
| <b>F</b> | 40   | 40   | 60   | 60   | 70   | 70   | 100  | 100  |
| <b>G</b> | 5.3  | 5.3  | 6.5  | 6.5  | 6.5  | 6.5  | 8.3  | 8.3  |
| <b>H</b> | 1.5  | 1.5  | 1.5  | 1.5  | 2    | 2    | 5    | 5    |
| <b>I</b> | 10.9 | 10.9 | 10.9 | 10.9 | 25   | 25   | 39   | 39   |
| <b>J</b> | M4   | M4   | M4   | M4   | M6   | M6   | M8   | M8   |
| <b>K</b> | 10   | 10   | 12.5 | 12.5 | 20   | 20   | 20   | 20   |
| <b>L</b> | 56   | 56   | 65   | 65   | 80   | 80   | 125  | 125  |

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

## Filter input/output connector cross sections

|                           | -29               | -33                | -34                |
|---------------------------|-------------------|--------------------|--------------------|
|                           |                   |                    |                    |
| <b>Solid wire</b>         | 6 mm <sup>2</sup> | 16 mm <sup>2</sup> | 35 mm <sup>2</sup> |
| <b>Flex wire</b>          | 4 mm <sup>2</sup> | 10 mm <sup>2</sup> | 25 mm <sup>2</sup> |
| <b>AWG type wire</b>      | AWG 10            | AWG 6              | AWG 2              |
| <b>Recommended torque</b> | 0.6-0.8 Nm        | 1.5-1.8 Nm         | 4.0-4.5 Nm         |

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

For additional information please ask for FN 510 installation instructions and the Schaffner application note „Output Filters for Use with Frequency Inverters in Motor Drive Applications“.



## Headquarters, global innovation and development

### Switzerland

#### Schaffner Group

Nordstrasse 11  
4542 Luterbach  
T +41 32 681 66 26  
[info@schaffner.com](mailto:info@schaffner.com)  
[www.schaffner.com](http://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  
[cschina@schaffner.com](mailto:cschina@schaffner.com)  
[www.schaffner.com.cn](http://www.schaffner.com.cn)

### Finland

#### Schaffner Oy

Sauvonrinne 19 H  
08500 Lohja  
T +358 50 468 7284  
[finlandsales@schaffner.com](mailto: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](mailto:francesales@schaffner.com)

### Germany

#### Schaffner Deutschland GmbH

Schoemperlenstrasse 12B  
76185 Karlsruhe  
T +49 721 56910  
F +49 721 569110  
[germanysales@schaffner.com](mailto: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  
Malleshwaram (W)  
560055 Bangalore  
T +91 80 67935355  
[indiasales@schaffner.com](mailto:indiasales@schaffner.com)

### Italy

#### Schaffner EMC S.r.l.

Via Ticino, 30  
20900 Monza (MB)  
T +39 039 21 41 070  
[italysales@schaffner.com](mailto: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](mailto:japansales@schaffner.com)  
[www.schaffner.jp](http://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](mailto:singaporesales@schaffner.com)

### Spain

#### Schaffner EMC España

Calle Caléndula 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](mailto:spainsales@schaffner.com)

### Sweden

#### Schaffner EMC AB

Tegeluddsvägen 76, 2tr  
115 28 Stockholm  
T +46 8 5050 2425  
[swedensales@schaffner.com](mailto:swedensales@schaffner.com)  
[www.schaffner.com](http://www.schaffner.com)

### Switzerland

#### Schaffner EMV AG

Nordstrasse 11  
4542 Luterbach  
T +41 32 681 66 26  
[switzerlandsales@schaffner.com](mailto:switzerlandsales@schaffner.com)

### Taiwan R.O.C.

#### 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](mailto:taiwansales@schaffner.com)  
[www.schaffner.com.tw](http://www.schaffner.com.tw)

### Thailand

#### Schaffner EMC Co. Ltd.

Northern Region Industrial Estate  
67 Moo 4 Tambon Ban Klang  
Amphur Muang P.O. Box 14  
51000 Lamphun  
T +66 53 58 11 04  
F +66 53 58 10 19  
[thailandsales@schaffner.com](mailto:thailandsales@schaffner.com)

### United Kingdom

#### Schaffner Ltd.

5 Ashville Way, Molly Millars Lane  
Wokingham  
RG41 2PL Berkshire  
T +44 118 9770070  
F +44 118 9792969  
[uksales@schaffner.com](mailto:uksales@schaffner.com)

### USA

#### Schaffner EMC Inc.

52 Mayfield Avenue  
08837 Edison, New Jersey  
T +1 800 367 5566  
T +1 732 225 9533  
F +1 732 225 4789  
[usasales@schaffner.com](mailto:usasales@schaffner.com)  
[www.schaffnerusa.com](http://www.schaffnerusa.com)

#### Schaffner North America

6722 Thirlane Road  
24019 Roanoke, Virginia  
T +1 276 228 7943  
F +1 276 228 7953

#### Schaffner North America

823 Fairview Road  
24382 Wytheville, Virginia  
T +1 276 228 7943  
F +1 276 228 7258

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Тел: +7 (812) 336 43 04 (многоканальный)

Email: [org@lifeelectronics.ru](mailto:org@lifeelectronics.ru)

[www.lifeelectronics.ru](http://www.lifeelectronics.ru)