



Why Would You Need Servo Motor/VFD dV/dt EMI filter?

Simply, to prolong life of your motors, to control electrical noise level (EMI) in your equipment, and to reduce electrical overstress to your devices. All of that can be accomplished by highly effective, small and easy-to-install SF series filters. These filters do the following:

- Reshape the edges of drive pulses
- Reduce ground currents
- Increase life of bearings
- Lower common mode and differential EMI
- Reduce drive temperature

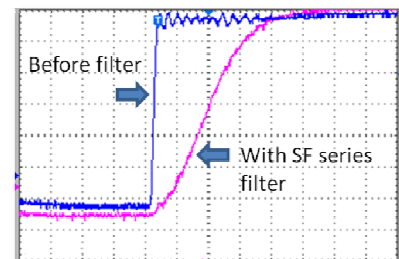
SF Series EMI Filters Make Drive Pulse Edges Smoother

Servo motors and variable frequency drives (VFD) are driven by the pulses with edges as short as few nanoseconds (few billionths of a second). Such sharp edges cause leakage currents through the motor's bearings damaging them - this is called EDM - Electric Discharge Machining. The damage spreads, eventually causing bearing failure, requiring expensive motor repair or replacement.

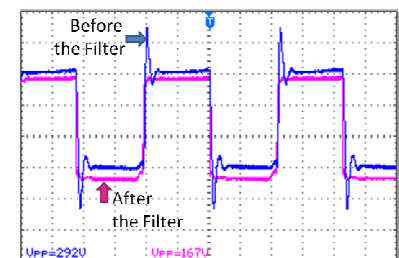
SF series filters improve reliability of motors by "stretching" these edges 20...30 times without any sacrifice on motor's performance or efficiency.

SF Series EMI Filters Reduce Overvoltage

Sharp pulse edges create "ringing" in long wires to the motor. Resulting overvoltage causes further damage to the bearings and to the cables themselves. SF series filters greatly reduce ringing and overvoltage by reshaping drive pulse edges.



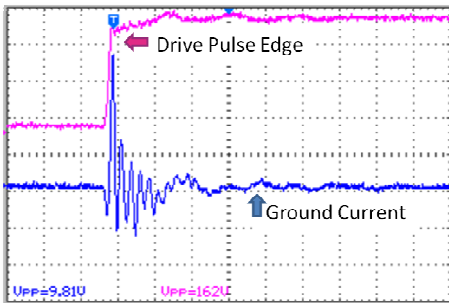
SF Series Filters "Stretch" Pulse Edges



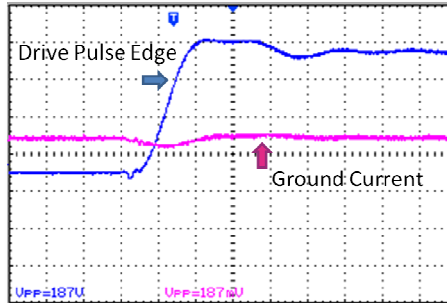
SF Series Filters Reduce Overvoltage

SF Series Filters Reduce Ground Currents

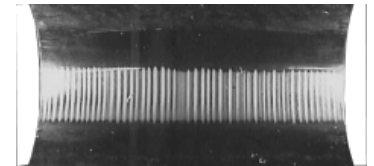
High-frequency ground current caused by sharp edges of drive pulses causes significant ground current in the equipment, damaging motors themselves and polluting the entire tool with electrical noise. Patent-pending SF series filters go beyond just reshaping drive pulses, further reducing ground currents to insignificant levels as seen in the figures below. As seen, ground current dropped more than 50 times when SF-series filter is installed.



Without Filter



With SF Series Filter



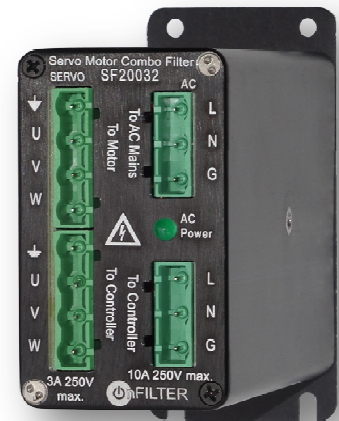
Motor Bearing Damage - "Racetrack" or "Fluting" - Due to Ground EMI Currents

Comprehensive Approach for Servo Motors and VFD

Patent-pending SF series combo filter SF20032 uniquely provides independent dual filtering of EMI on both AC line and drive circuit, providing complete EMI suppression of servo motors and variable-frequency drives. This saves cost and, importantly, physical space in very tight environment inside equipment.

Why SF Series Filters are a Better Solution

EMI in servo motors and VFD is a serious issue damaging motors and creating multitude of other problems. There are various approaches in the industry today, including so-called "reactors" (inductors in series with the motor drive) and mechanical attachments to the motor. Reactors offer very marginal reduction of EMI (many times worse than SF series filters), while mechanical attachments do not really reduce EMI at all - they let high-frequency current leak from drive shaft to ground, actually increasing EMI in the tool, as well as raise questions about their longevity and individual fitness to a specific motor.



Combo Filter SF20032 for Both Drive and AC Filtering

SF series filters are the best solution to protect your motors from damage and to manage EMI in your equipment. SF series filters are ETL Recognized, CE approved and RoHS compliant. They are made in the USA.

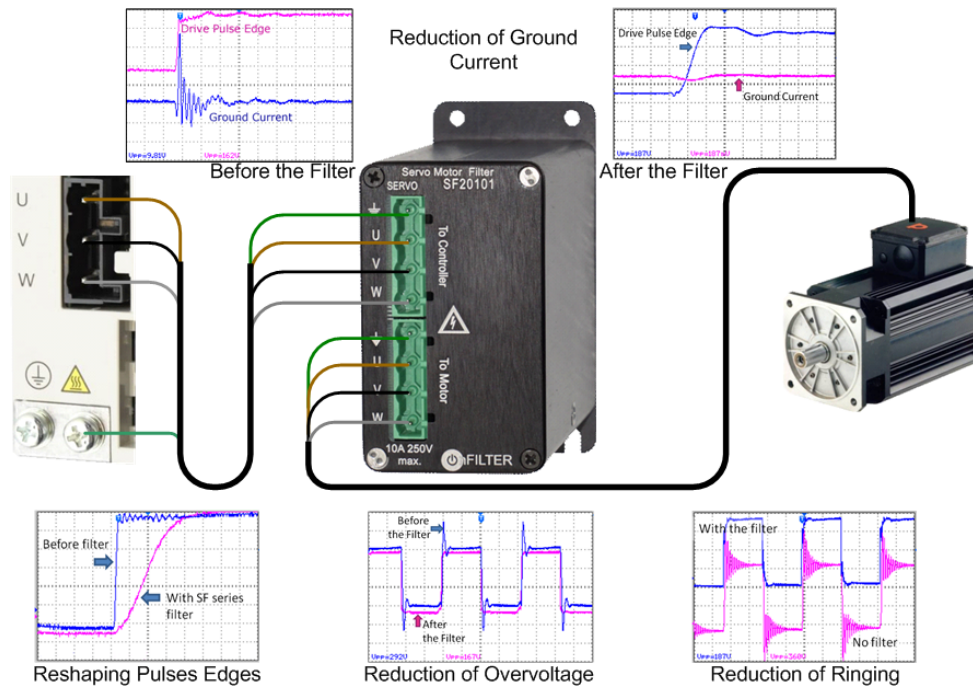
Typical Applications of SF Series Filters

SF series filters help anywhere you want to protect your motors, increase their reliability and reduce EMI in your equipment. Some of typical applications are:

- **Industrial robotics:** anywhere servo motors and VFD are used
- **Semiconductor manufacturing:** EOS and errors reduction in IC Handlers, wire bonders, die attach
- **Electronic assembly:** EOS and errors reduction pick-and-place tools, lead trimmers
- **Aerospace/military:** increasing reliability of assembled equipment by reducing EOS

Connecting SF-series Filters

Connecting SF series filters is straight-forward - follow the diagram below. Properly connecting all four wires, including ground, is imperative for proper motor operation and for best EMI performance.



Connection Diagram of SF-Series Motor Filter

Placement of the filters

Place SF series motor filter close to the motor controller, not to the motor itself. This way the often-long cables going to the motor won't have as much noise and won't pollute the entire tool with EMI. In addition, this would reduce ringing of the signal because parasitic complex impedance of the cables would have much lesser effect on the filtered signal. The best place for a filter is inside the cabinet next to or

as close as possible to the motor controller. Filters can be installed on metal panel or on DIN rails.

Selecting proper voltage and current rating of the filter

The main parameters for selecting proper model are motor voltage and current rating. The motor controller may have higher rating than the motor itself - follow motor's rating since the motor cannot normally consume more current than for which it is rated. The best way to discover what the ratings are is to at the label on the motor - it should have all the necessary information. E-mail us the photo of the label if in doubt. Figure to the right shows a typical label on the motor with the ratings of 200V and 2A - for this motor use SF20031 or SF20032 filters. They are both rated for 250V 3A for motor.

It is prudent to leave some headroom for current, especially for VFD.

Some motors are specified for normal and peak current. If you happen to have motor's specification, look at **Ratings** and/or in **Specifications** section. As long as "instantaneous peak current" in the motor's

specification is no higher than twice the normal rated current, use normal rated current as a guide. In case of doubt contact us having your motor label and/or model number or specification ready.



Typical label on the motor

Will the filters alter performance of the motor?

Performance of your motor will not be negatively affected by a properly-selected and installed filter. The SF series filters modify only the sharp edges of drive pulses and do not alter frequency, width of amplitude of the original drive pulses themselves. More than that, "smoother" pulsed without strong overshoots and ringing reduce motor's heat dissipation, prolong life of motor's bearing and reduce other unwanted artifacts of sharp pulse edges.

What kind of filters are SF Series - dV/dt or sinewave?

dV/dt filters modify edges of drive pulses making them "smoother" and remove most of ringing and overshoots, otherwise leaving drive pulses intact. Sinewave filters convert drive pulses into a sinewave signal. Both filters, properly implemented, reduce EMI issues related to pulse drive, however their applications and properties are not universal. Sinewave filters work only with some of VFD (variable frequency drives) - they cannot be used with servo motors. While sinewave filters provide better EMI reduction for VFD, they are also bulkier and generally more expensive. dV/dt filters work with all pulse drives - servo motors and VFD - and are more compact and are less expensive.

OnFILTER' SF series filters are dV/dt type which can work with all drives - servo and VFD.

How do servo motors and VFD work?

Both motors utilize pulsed signal to drive motors. The drive pulses' width is being modulated to control either position (for servo motors) or speed (for VFD).

Servo motors are used for precision movement and accurate positioning of robotic arms and alike. They can rotate only up for 180 degrees. Servo motors utilize closed-loop control - a position sensor (encoder) installed on the motor provides feedback to a motor controller which at the end governs motor's shaft rotational angle. It is important to understand that a servo motor works even when it is not moving - it still maintains its precise position.

The speed of variable-frequency drives (VFD) is controlled largely by the width of drive pulses and other parameters.

Why OnFILTER' SF series filters are better than any other solution on the market?

Pulse-driven motors present several EMI-related problems and there is a number of products on the market addressing some of them:

Effectiveness of Different Solution to VFD/Servo Motor EMI-Related Problems

Effectiveness of Solution	Optimized Cabling	Insulated Bearings	Rotor Shaft Grounding	Ferrite Clamp	Reactor	Filter
Bearing Damage						
Overvoltage						
EMI Ground Current						
EMI Level in Equipment						

How to Order

You can order SF series filters directly from us (we accept major credit cards and PayPal, as well as company's P.O.s) or through our authorized distributors - look them up on our [web site](#).

Installation and Cost of Ownership Issues

Ease of Implementation						
Maintenance-Free						

