

## Large Current VFS9V Series

### ■ Features

VFS9V series is designed for surge protection of the power supply. It protects electric circuits from surge such as static electricity and suppresses EMI noise. Its large capacitance value enables high insertion loss for EMI noise.

### ■ Applications

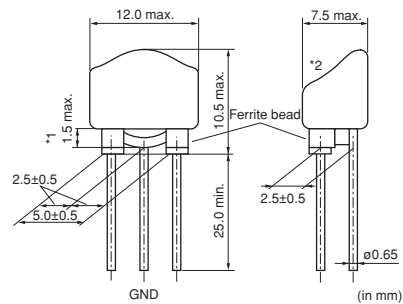
For circuit protection and noise suppression in electronics equipment such as computers and DC motors, and in electronics systems installed in cars such as car audio equipment and engine controllers.

### ■ Supplement

Diameter of lead is 0.6mm for taping type.  
 Taping type is three terminal in-line arrangement.



VFS9V Series



\*1 Coating extending on leads does not exceed the tangent line. Exposed electrode, if any, is covered by solder, etc.  
 \*2 If there is a hole in the top of the filter, the ferrite bead should not be exposed.

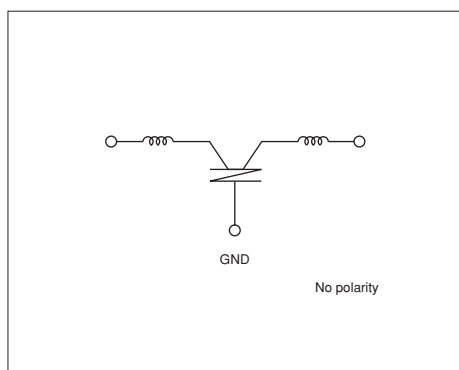
Part Number	Rated Voltage (Vdc)	Rated Current (A)	Varistor Voltage (Vdc)	Capacitance (pF)	Operating Temperature Range
VFS9VD31B223	12	7	22 ±20%	22000 +50/-20%	-40 to 100°C

Rated current is 7A for bulk type and 6A for taping type.

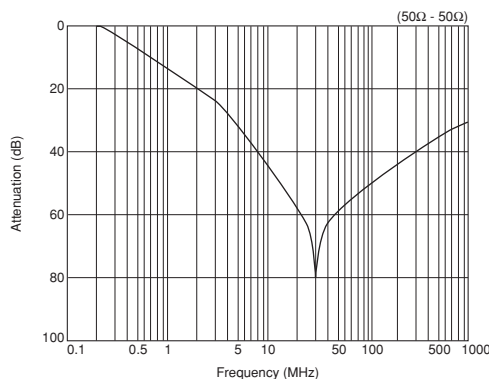
Rated current of taping type is 6A because the diameter of the lead is 0.6mm and its lead layout is the in-line type.

Please refer to Part Numbering for Type and Length of Lead.

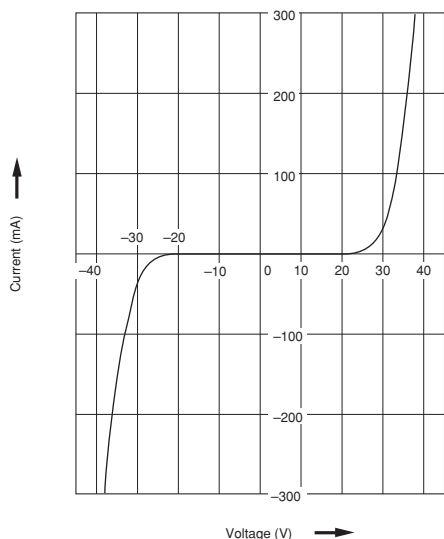
### ■ Equivalent Circuit



### ■ Insertion Loss Characteristics



### ■ Voltage - Current Characteristics

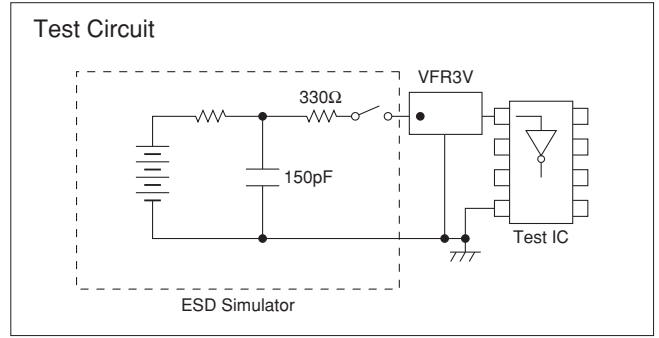


## Noise Suppression Effect of VFR/VFS Series

### ■ Example of IC Protection (VFR3V)

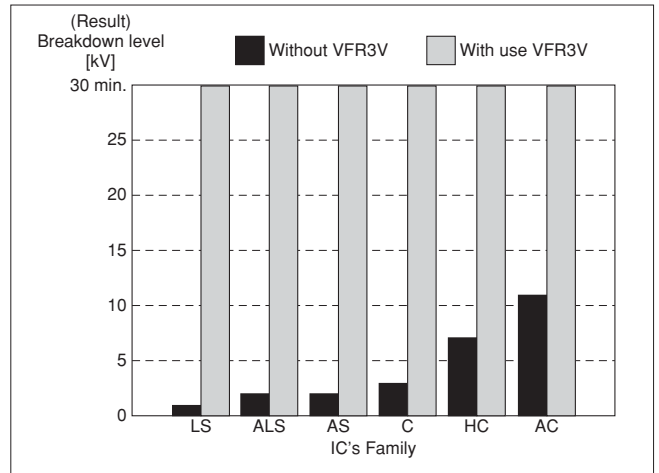
#### ● Testing Method

1. Put ESD surge to IC (7404 family) input terminal with ESD simulator based on IEC 801-2.
2. Check IC's operation.
3. If IC's operation is normal, increase ESD voltage in 1kV steps.
4. Continue above steps 1 to 3 till IC's operation becomes abnormal.

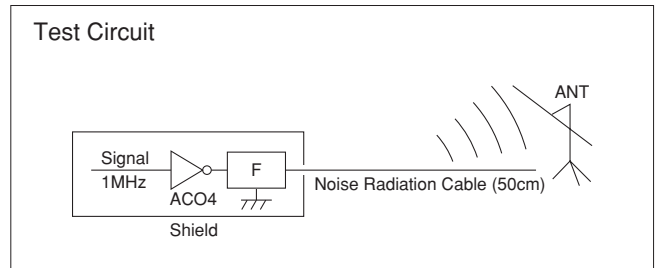


#### ● Result

Varistor VFR3V can protect IC from ESD.



### ■ Example of EMI Suppression Effect



Type of Filter	EMI Suppression Effect
Before Countermeasures (No Filters)	
Using VFR3VD31E131T51	

Ferrite Beads Inductors

Disc Type EMIFIL®

EMIGUARD® (EMIFIL® with Varistor Function)

Common Mode Choke Coils

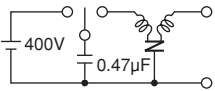
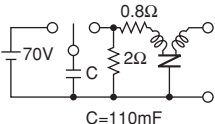
⚠Caution / Notice

Soldering and Mounting

Packaging

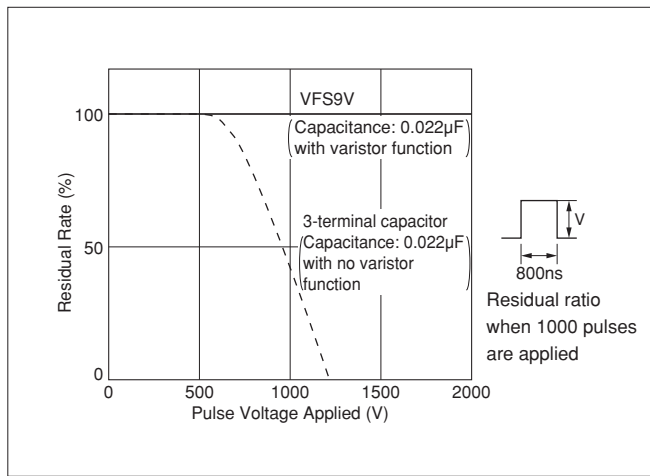
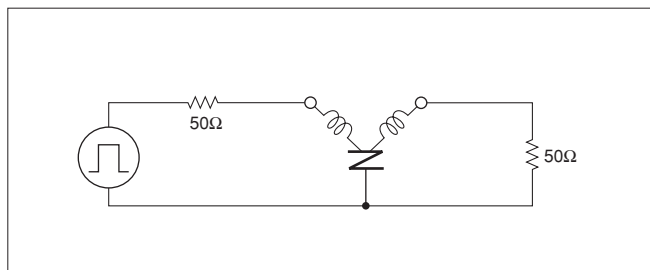
## Noise Suppression Effect of VFR/VFS Series

### ■ Features (VFS9V)

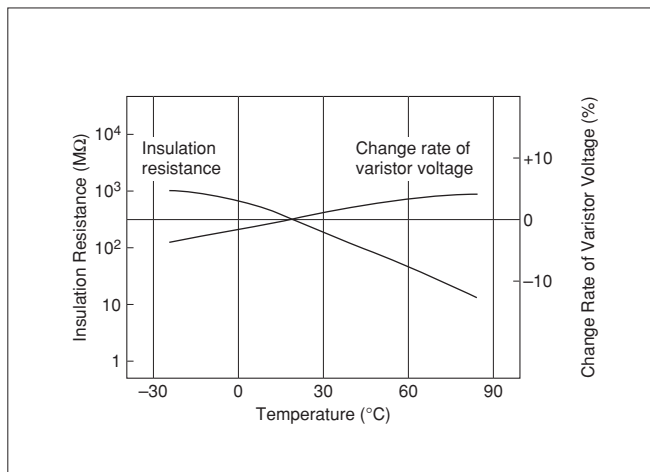
Items	Test methods	Rated values										
Overload	1.4 times the varistor voltage ( $V_1$ ) is applied for 5 minutes at room temperature.	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr style="background-color: #eee;"> <th style="width: 50%;">Items</th> <th style="width: 50%;">Specifications</th> </tr> </thead> <tbody> <tr> <td>Rated Capacitance Change</td> <td>Within <math>\pm 15\%</math></td> </tr> <tr> <td>Insulation Resistance</td> <td>500k<math>\Omega</math> min.</td> </tr> <tr> <td>Rated of Change in Varistor Voltage <math>V_1^*</math></td> <td>Within <math>\pm 15\%</math></td> </tr> <tr> <td>Voltage Rate</td> <td>1.30 max.</td> </tr> </tbody> </table> <p><small>*<math>V_1</math>: Voltage when 1mA is applied</small></p>	Items	Specifications	Rated Capacitance Change	Within $\pm 15\%$	Insulation Resistance	500k $\Omega$ min.	Rated of Change in Varistor Voltage $V_1^*$	Within $\pm 15\%$	Voltage Rate	1.30 max.
Items	Specifications											
Rated Capacitance Change	Within $\pm 15\%$											
Insulation Resistance	500k $\Omega$ min.											
Rated of Change in Varistor Voltage $V_1^*$	Within $\pm 15\%$											
Voltage Rate	1.30 max.											
Surge Test (1)	At room temperature, Surges are applied $10^5$ times every 2 seconds. Then after 1 or 2 hours, the sample is measured. 											
Surge Test (2)	At room temperature, the capacitor "C" is charged with 70V, then discharged to apply the voltage to the sample. Tested once (resuming JASO A-1). 											
High Temperature Load	At a temperature of $85 \pm 3^\circ\text{C}$ , the varistor voltage $V_1$ is continuously applied to the sample for 1000 to 1024 hours. Then it is left at room temperature, for 4 to 24 hours before measuring.											

### ■ Pulse-Voltage Breakdown Characteristic (VFS9V)

VFS9V EMIGUARD® use a self healing varistor- capacitor, so that it can be used under a 500 to 600V surge that would break conventional disc type EMI filters. As shown in the figure below EMIGUARD® withstands 2000V impulses applied 1000 times.



### ■ Temperature Characteristics of Varistor Voltage - Insulation Resistance (VFS9V)



Continued on the following page. ↗

## Noise Suppression Effect of VFR/VFS Series

Continued from the preceding page.

### ■Noise Absorption Effect of EMIGUARD® (VFS9V)

Type of Filter	EMI Suppression Effect	Description
without EMIGUARD®		Waveform when EMIGUARD® is not used. (Surge from a noise simulator.)
with EMIGUARD® 		Waveform after the noise passed through EMIGUARD®. Little noise is recorded.

### ■Comparative Data (VFS9V)

#### 1. Absorption of quick-rising, high-frequency noise (10ns/div, 100V/div)

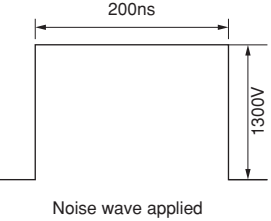
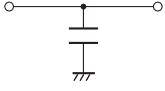
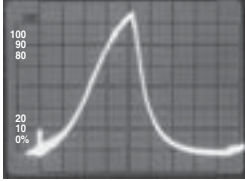
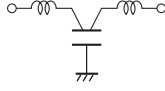
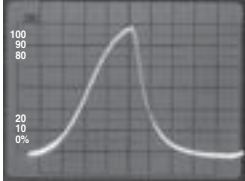

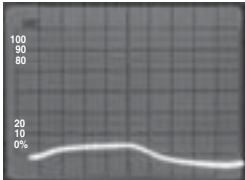
Type of Filter	EMI Suppression Effect	Description
Without Filters		
Conventional varistor 		As with the two-terminal capacitor
Two-terminal capacitor (with varistor function) 		The two-terminal capacitor is influenced by lead line inductance, leaving behind some of the rising and falling edges. The residual noise can cause the system to malfunction.
VFS9V 		The three-terminal structure eliminates most of the lead line inductance. This allows VFS9V to completely absorb the rising and falling edges of the applied pulses.

Continued on the following page.

## Noise Suppression Effect of VFR/VFS Series

☐ Continued from the preceding page.

### 2. Absorption of wide-pulse noise (50ns/div, 200V/div)

Type of Filter	EMI Suppression Effect	Description
Without Filters		
Two-terminal capacitor	 	In capacitors the voltage of the residual surge (1300V) is higher than that of the above example. The wave height is almost the same as the original.
Three-terminal capacitor (with ferrite bead)	 	Conventional EMI filters do not work for wide-pulse noise because the capacitors are saturated. In this example, the residual 1200V surge can cause the system to break down.
VFS9V	 	Bypassing the high voltage to the ground suppresses the voltage.