

Lower Voltage Ceramic Singlelayer DC Disc Capacitors 1 kV_{DC} to 3 kV_{DC} Low Dissipation Factor


RoHS
COMPLIANT

FEATURES

- Low losses
- High stability
- Low DF minimizes self heating at HF
- Ideal for high switching to 100 kHz
- Radial leads
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

APPLICATIONS

- Switching power supplies
- HF ballast
- Snubber and HV circuits

DESIGN

The capacitors consist of a ceramic disc of which both sides are silver-plated. Connection leads are made of tinned copper having diameters of 0.022" (0.51 mm) or 0.025" (0.64 mm).

The capacitors may be supplied with radial kinked or straight leads having lead spacing of 0.250" (6.35 mm) or 0.375" (9.5 mm).

The standard tolerances are $\pm 5\%$, $\pm 10\%$.

Coating is made of flammable retardant epoxy resin in accordance with "UL 94 V-0".

CAPACITANCE RANGE

10 pF to 6800 pF

RATED VOLTAGE

1000 V_{DC} (500 V_{RMS})
 2000 V_{DC} (1000 V_{RMS})
 3000 V_{DC} (1500 V_{RMS})

DIELECTRIC STRENGTH BETWEEN LEADS

Component test, 100 % test at production line:

1000 V_{DC} 2500 V_{DC}, 2 s
 2000 V_{DC} 4000 V_{DC}, 2 s
 3000 V_{DC} 6000 V_{DC}, 2 s

CERAMIC DIELECTRIC

C0G, N1500, N2000, N2200, N2500, N2800 (Class 1)

| QUICK REFERENCE DATA | | | |
|----------------------------|--|------|------|
| DESCRIPTION | VALUE | | |
| Ceramic Class | 1 | | |
| Ceramic Dielectric | C0G, N1500, N2000, N2200, N2500, N2800 | | |
| Voltage (V _{DC}) | 1000 | 2000 | 3000 |
| Min. Capacitance (pF) | 10 | 10 | 10 |
| Max. Capacitance (pF) | 6800 | 6800 | 4700 |
| Mounting | Radial | | |

INSULATION RESISTANCE

Min. 50 000 MΩ

TOLERANCE ON CAPACITANCE

$\pm 5\%$, $\pm 10\%$

DISSIPATION FACTOR

0.1 % max. at 1 kHz; 1 V

CATEGORY TEMPERATURE RANGE

-55 °C to +125 °C

CLIMATIC CATEGORY ACC. TO EN 60068-1

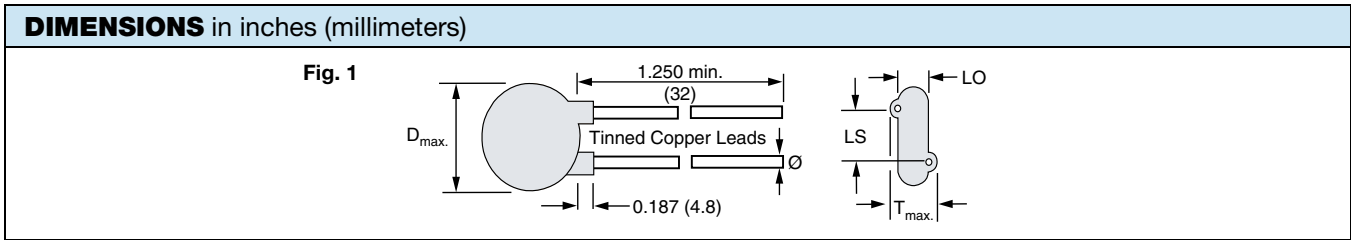
55/125/21

OPERATING TEMPERATURE RANGE

-55 °C to +105 °C ⁽¹⁾

Note

⁽¹⁾ For explanation about the difference of operating temperature range and temperature characteristic of capacitance, please see www.vishay.com/doc?48299



| ORDERING INFORMATION, CERAMIC 1 kV_{DC} LOW DISSIPATION FACTOR | | | | | | | | | | | |
|---|--------------|--|---|---|--|-----------|--------------|------|------------------|-------------|-------------|
| C (pF) | TOL. (%) | D _{max.} DIAMETER INCH (mm) | T _{max.} THICKNESS INCH (mm) | LS LEAD SPACE INCH (mm) ± 1 mm | LO LEAD OFFSET INCH (mm) ± 0.5 mm | WIRE SIZE | | FIG. | ORDERING CODE | | |
| | | | | | | AWG | INCH (mm) | | | | |
| COG (NP0) | | | | | | | | | | | |
| 10 | ± 5 | 0.250 (6.4) | 0.156 (4.0) | 0.250 (6.4) | 0.043 (1.1) | 22 | 0.025 (0.64) | 1 | 561R1DF0Q10 | | |
| 12 | | | | | 0.051 (1.3) | | | | 561R1DF0Q12 | | |
| N1500 | | | | | | | | | | | |
| 22 | ± 5 | 0.250 (6.4) | 0.156 (4.0) | 0.250 (6.4) | 0.043 (1.1) | 22 | 0.025 (0.64) | 1 | 561R1DF0Q22 | | |
| 47 | | | | | 0.071 (1.8) | | | | 561R1DF0Q47 | | |
| 56 | | | | | 0.055 (1.4) | | | | 561R1DF0Q56 | | |
| 68 | | | | | 0.059 (1.5) | | | | 561R1DF0Q68 | | |
| 82 | | | | | 0.047 (1.2) | | | | 561R1DF0Q82 | | |
| N2200 | | | | | | | | | | | |
| 33 | ± 10 | 0.250 (6.4) | 0.156 (4.0) | 0.250 (6.4) | 0.043 (1.1) | 22 | 0.025 (0.64) | 1 | 561R1DF0Q33 | | |
| N2000 | | | | | | | | | | | |
| 100 | ± 10 | 0.250 (6.4) | 0.156 (4.0) | 0.250 (6.4) | 0.059 (1.5) | 22 | 0.025 (0.64) | 1 | 561R1DF0T10 | | |
| 120 | | | | | 0.055 (1.4) | | | | 561R1DF0T12 | | |
| 150 | | | | | 0.043 (1.1) | | | | 561R1DF0T15 | | |
| 180 | | | | | 0.043 (1.1) | | | | 561R1DF0T18 | | |
| N2500 | | | | | | | | | | | |
| 220 | ± 10 | 0.250 (6.4) | 0.156 (4.0) | 0.250 (6.4) | 0.059 (1.5) | 22 | 0.025 (0.64) | 1 | 561R1DF0T22 | | |
| 270 | | | | | 0.043 (1.1) | | | | 561R1DF0T27 | | |
| N2800 | | | | | | | | | | | |
| 330 | ± 10 | 0.250 (6.4) | 0.156 (4.0) | 0.250 (6.4) | 0.047 (1.2) | 22 | 0.025 (0.64) | 1 | 561R1DF0T33 | | |
| 390 | | | | | 0.047 (1.2) | | | | 561R1DF0T39 | | |
| 470 | | | | | 0.290 (7.4) | | | | 0.059 (1.5) | 561R1DF0T47 | |
| 560 | | | | | | | | | 0.055 (1.4) | 561R1DF0T56 | |
| 680 | | | | | | | | | 0.047 (1.2) | 561R1DF0T68 | |
| 820 | | | | | | | | | 0.043 (1.1) | 561R1DF0T82 | |
| 1000 | | 0.370 (9.4) | | | 0.055 (1.4) | | | | 561R1DF0D10 | | |
| 1200 | | | | | 0.047 (1.2) | | | | 561R1DF0D12 | | |
| 1500 | | | | | 0.047 (1.2) | | | | 561R1DF0D15 | | |
| 1800 | | | | | 0.051 (1.3) | | | | 561R1DF0D18 | | |
| 2200 | | | | | 0.047 (1.2) | | | | 561R1DF0D22 | | |
| 2700 | | | | | 0.047 (1.2) | | | | 561R1DF0D27 | | |
| 3300 | | 0.530 (13.5) | | | 0.047 (1.2) | | | | 561R1DF0D33 | | |
| 3900 | | 0.560 (14.2) | | | 0.047 (1.2) | | | | 561R1DF0D39 | | |
| 4700 | | 0.630 (16.0) | | | 0.156 (4.0) | | | | 0.375 (9.5) | 0.047 (1.2) | 561R1DF0D47 |
| 5600 | | | | | | | | | | 0.047 (1.2) | 561R1DF0D56 |
| 6800 | 0.047 (1.2) | | 561R1DF0D68 | | | | | | | | |
| 6800 | 0.760 (19.3) | | 0.047 (1.2) | 561R1DF0D68 | | | | | | | |



| ORDERING INFORMATION, CERAMIC 2 kV _{DC} LOW DISSIPATION FACTOR | | | | | | | | | |
|---|-------------|--|---|---|--|-----------|--------------|------|------------------|
| C (pF) | TOL. (%) | D _{max.} DIAMETER INCH (mm) | T _{max.} THICKNESS INCH (mm) | LS LEAD SPACE INCH (mm) ± 1 mm | LO LEAD OFFSET INCH (mm) ± 0.5 mm | WIRE SIZE | | FIG. | ORDERING CODE |
| | | | | | | AWG | INCH (mm) | | |
| N1500 | | | | | | | | | |
| 33 | ± 5 | 0.290 (7.4) | 0.195 (5.0) | 0.250 (6.4) | 0.098 (2.5) | 20 | 0.032 (0.81) | 1 | 564R2DF0Q33 |
| 39 | | | 0.180 (4.6) | | 0.083 (2.1) | | | | 564R2DF0Q39 |
| 47 | | | 0.170 (4.3) | | 0.071 (1.8) | | | | 564R2DF0Q47 |
| N2000 | | | | | | | | | |
| 56 | ± 5 | 0.290 (7.4) | 0.210 (5.3) | 0.250 (6.4) | 0.110 (2.8) | 20 | 0.032 (0.81) | 1 | 564R2DF0Q56 |
| 68 | | | 0.190 (4.8) | | 0.091 (2.3) | | | | 564R2DF0Q68 |
| 82 | | | 0.175 (4.5) | | 0.075 (1.9) | | | | 564R2DF0Q82 |
| 100 | | | 0.170 (4.3) | | 0.071 (1.8) | | | | 564R2DF0T10 |
| N2500 | | | | | | | | | |
| 120 | ± 10 | 0.290 (7.4) | 0.185 (4.7) | 0.250 (6.4) | 0.087 (2.2) | 20 | 0.032 (0.81) | 1 | 564R2DF0T12 |
| 150 | | | 0.170 (4.3) | | 0.071 (1.8) | | | | 564R2DF0T15 |
| 180 | | | 0.185 (4.7) | | 0.071 (1.8) | | | | 564R2DF0T18 |
| 270 | | 0.330 (8.4) | 0.170 (4.3) | | 0.079 (2.0) | | | | 564R2DF0T27 |
| 470 | | 0.400 (10.2) | 0.170 (4.3) | | 0.075 (1.9) | | | | 564R2DF0T47 |
| N2800 | | | | | | | | | |
| 220 | ± 10 | 0.290 (7.4) | 0.170 (4.3) | 0.250 (6.4) | 0.087 (2.2) | 20 | 0.032 (0.81) | 1 | 564R2DF0T22 |
| 330 | | 0.330 (8.4) | 0.185 (4.7) | | 0.083 (2.1) | | | | 564R2DF0T33 |
| 390 | | 0.330 (8.4) | 0.175 (4.5) | | 0.075 (1.9) | | | | 564R2DF0T39 |
| 560 | | 0.400 (10.2) | 0.185 (4.7) | | 0.087 (2.2) | | | | 564R2DF0T56 |
| 680 | | 0.400 (10.2) | 0.170 (4.3) | | 0.075 (1.9) | | | | 564R2DF0T68 |
| 820 | | 0.430 (10.9) | 0.175 (4.5) | | 0.075 (1.9) | | | | 564R2DF0T82 |
| 1000 | | 0.460 (11.7) | 0.170 (4.3) | | 0.075 (1.9) | | | | 564R2DF0D10 |
| 1500 | | 0.530 (13.5) | | | 0.071 (1.8) | | | | 564R2DF0D15 |
| 1800 | | 0.560 (14.2) | 0.170 (4.3) | 0.071 (1.8) | 564R2DF0D18 | | | | |
| 2200 | | 0.680 (17.3) | 0.180 (4.6) | 0.375 (9.5) | 0.083 (2.1) | | | | 564R2DF0D22 |
| 2300 | | | 0.175 (4.5) | | 0.079 (2.0) | | | | 564R2DF0D23 |
| 2400 | | | 0.175 (4.5) | | 0.075 (1.9) | | | | 564R2DF0D24 |
| 2700 | | | | | 0.071 (1.8) | | | | 564R2DF0D27 |
| 3300 | | 0.720 (18.3) | 0.170 (4.3) | | 0.071 (1.8) | | | | 564R2DF0D33 |
| 3900 | | 0.790 (20.1) | | | 0.075 (1.9) | | | | 564R2DF0D39 |
| 4700 | | 0.900 (22.9) | 0.180 (4.6) | | 0.083 (2.1) | | | | 564R2DF0D47 |
| 5600 | | 0.900 (22.9) | 0.170 (4.3) | | 0.075 (1.9) | | | | 564R2DF0D56 |
| 6800 | | 0.950 (24.1) | 0.170 (4.3) | 0.071 (1.8) | 564R2DF0D68 | | | | |



| ORDERING INFORMATION, CERAMIC 3 kV _{DC} LOW DISSIPATION FACTOR | | | | | | | | | | |
|---|-------------|--|---|---|--|-----------|--------------|------|------------------|-------------|
| C (pF) | TOL. (%) | D _{max.} DIAMETER INCH (mm) | T _{max.} THICKNESS INCH (mm) | LS LEAD SPACE INCH (mm) ± 1 mm | LO LEAD OFFSET INCH (mm) ± 0.5 mm | WIRE SIZE | | FIG. | ORDERING CODE | |
| | | | | | | AWG | INCH (mm) | | | |
| N1500 | | | | | | | | | | |
| 10 | ± 5 | 0.290 (7.4) | 0.185 (4.7) | 0.250 (6.4) | 0.087 (2.2) | 20 | 0.032 (0.81) | 1 | 564R3DF0Q10 | |
| 27 | | | 0.220 (5.6) | | 0.122 (3.1) | | | | 564R3DF0Q27 | |
| 33 | | | 0.195 (5.0) | | 0.098 (2.5) | | | | 564R3DF0Q33 | |
| 39 | | | 0.190 (4.8) | | 0.094 (2.4) | | | | 564R3DF0Q39 | |
| 47 | | | 0.330 (8.4) | | 0.225 (5.7) | | | | 0.126 (3.2) | 564R3DF0Q47 |
| N2200 | | | | | | | | | | |
| 12 | ± 5 | 0.290 (7.4) | 0.210 (5.3) | 0.250 (6.4) | 0.110 (2.8) | 20 | 0.032 (0.81) | 1 | 564R3DF0Q12 | |
| 22 | | 0.330 (8.4) | 0.210 (5.3) | | 0.110 (2.8) | | | | 564R3DF0Q22 | |
| N2000 | | | | | | | | | | |
| 56 | ± 5 | 0.290 (7.4) | 0.210 (5.3) | 0.250 (6.4) | 0.110 (2.8) | 20 | 0.032 (0.81) | 1 | 564R3DF0Q56 | |
| 68 | | | 0.190 (4.8) | | 0.098 (2.5) | | | | 564R3DF0Q68 | |
| 82 | | | 0.185 (4.7) | | 0.091 (2.3) | | | | 564R3DF0Q82 | |
| N2500 | | | | | | | | | | |
| 100 | ± 10 | 0.290 (7.4) | 0.205 (5.2) | 0.250 (6.4) | 0.106 (2.7) | 20 | 0.032 (0.81) | 1 | 564R3DF0T10 | |
| 120 | | 0.290 (7.4) | 0.190 (4.8) | | 0.091 (2.3) | | | | 564R3DF0T12 | |
| 220 | | 0.330 (8.4) | 0.190 (4.8) | | 0.091 (2.3) | | | | 564R3DF0T22 | |
| N2800 | | | | | | | | | | |
| 150 | ± 10 | 0.290 (7.4) | 0.200 (5.1) | 0.250 (6.4) | 0.091 (2.3) | 20 | 0.032 (0.81) | 1 | 564R3DF0T15 | |
| 180 | | 0.290 (7.4) | 0.190 (4.8) | | 0.091 (2.3) | | | | 564R3DF0T18 | |
| 270 | | 0.330 (8.4) | 0.205 (5.2) | | 0.110 (2.8) | | | | 564R3DF0T27 | |
| 330 | | 0.330 (8.4) | 0.190 (4.8) | | 0.091 (2.3) | | | | 564R3DF0T33 | |
| 390 | | 0.400 (10.2) | 0.215 (5.5) | | 0.102 (2.6) | | | | 564R3DF0T39 | |
| 470 | | 0.400 (10.2) | 0.195 (5.0) | | 0.087 (2.2) | | | | 564R3DF0T47 | |
| 560 | | 0.430 (10.9) | 0.200 (5.1) | | 0.102 (2.6) | | | | 564R3DF0T56 | |
| 680 | | 0.460 (11.7) | 0.195 (5.0) | | 0.087 (2.2) | | | | 564R3DF0T68 | |
| 820 | | 0.490 (12.5) | 0.195 (5.0) | | 0.102 (2.6) | | | | 564R3DF0T82 | |
| 1000 | | 0.530 (13.5) | 0.190 (4.8) | 0.091 (2.3) | 564R3DF0D10 | | | | | |
| 1200 | | 0.560 (14.2) | 0.190 (4.8) | 0.375 (9.5) | 0.091 (2.3) | | | | 564R3DF0D12 | |
| 1500 | | 0.620 (15.8) | | | 0.091 (2.3) | | | | 564R3DF0D15 | |
| 1800 | | 0.680 (17.3) | | | 0.098 (2.5) | | | | 564R3DF0D18 | |
| 2200 | | 0.720 (18.3) | | | 0.094 (2.4) | | | | 564R3DF0D22 | |
| 2700 | | 0.790 (20.1) | | | 0.190 (4.8) | | | | 0.087 (2.2) | 564R3DF0D27 |
| 3300 | | 0.900 (22.9) | | | 0.200 (5.1) | | | | 0.102 (2.6) | 564R3DF0D33 |
| 4700 | | 0.950 (24.1) | 0.185 (4.7) | 0.087 (2.2) | 564R3DF0D47 | | | | | |

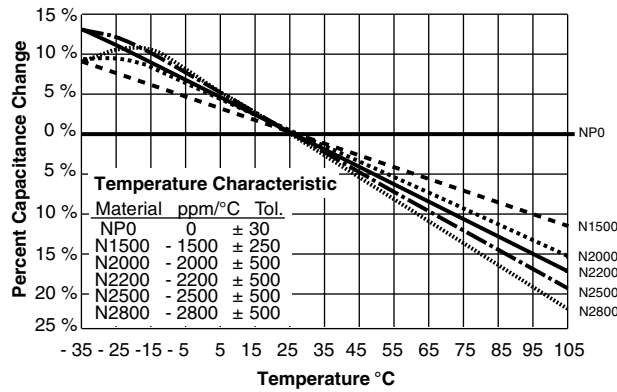
TAPE AND REEL OPTIONS

Part number codes and specifications for tape and reel packaging are found in the general information document www.vishay.com/doc?23140.



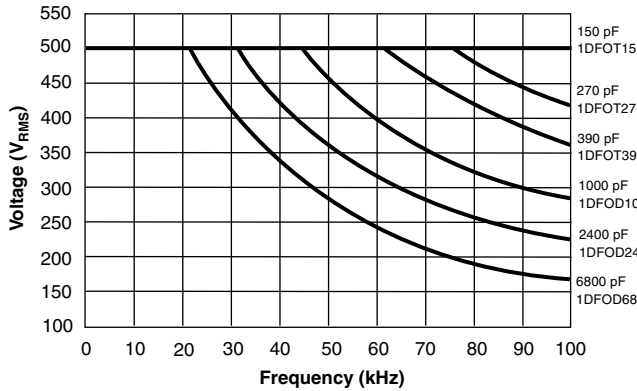
CAPACITANCE CHANGE VS. TEMPERATURE (TYPICAL)

Temperature Characteristics for 1DFO, 2DFO & 3DFO Series

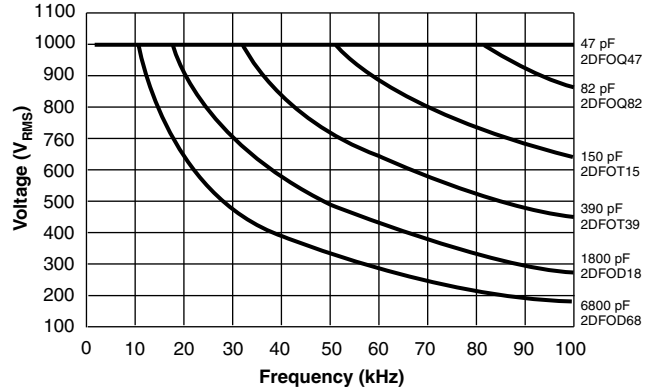


POWER RATING

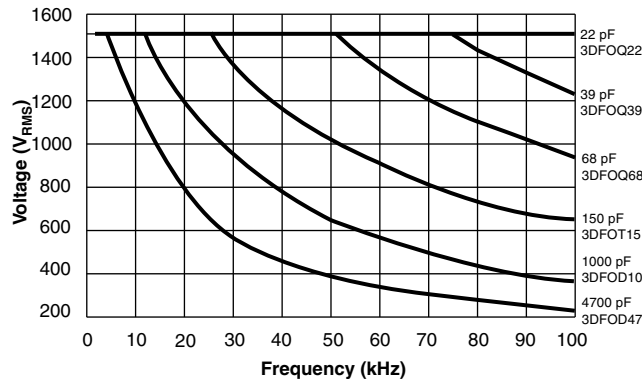
1DFO Series 500 V_{RMS} Low DF



2DFO Series 1000 V_{RMS} Low DF



3DFO Series 1500 V_{RMS} Low DF



Notes

- Power ratings are based on still air 60 °C ambient with additional 30 °C rise due to self heating. Thermal effects such as forced air cooling, component encapsulation or other heat-sinking techniques will alter ratings. Actual circuit for application recommended
- For convenience, power rating charts are shown to 100 kHz. Higher frequency operation is permissible with appropriate derating. Consult us for application suggestions



STORAGE

The capacitors must not be stored in a corrosive atmosphere, where sulphide or chloride gas, acid, alkali or salt are present. Exposure of the components to moisture, should be avoided. The solderability of the leads is not affected by storage of up to 24 months (temperature +10 °C to +40 °C, relative humidity up to 60 % RH). Class 2 ceramic dielectric capacitors are also subject to aging see general information (www.vishay.com/doc?23140).

SOLDERING

| SOLDERING SPECIFICATIONS | | |
|--|----------------------|-------------------------------------|
| Soldering test for capacitors with wire leads: (according to IEC 60068-2-20, solder bath method) | | |
| | SOLDERABILITY | RESISTANCE TO SOLDERING HEAT |
| Soldering temperature | (235 ± 5) °C | (260 ± 5) °C |
| Soldering duration | (2 ± 0.5) s | (10 ± 1) s |
| Distance from component body | ≥ 2 mm | ≥ 5 mm |

SOLDERING RECOMMENDATIONS

Ceramic capacitors are very sensitive to rapid changes in temperature (thermal shock) therefore the solder heat resistance specification (see table above) should not be exceeded. Exposing the capacitor to excessive heating may result in thermal shocks that can crack the ceramic body. Similarly, excessive heating can cause the internal solder junction to melt.

When soldering radial leaded ceramic capacitors with a soldering iron, it should be performed under the following conditions and should not exceed:

- Maximum temperature of iron-tip: 400 °C
- Maximum soldering iron wattage: 50 W
- Maximum soldering time: 3.5 s

Failure to follow the above cautions may result, in worst case, in short circuit or cause fuming or thermo-mechanical damage when the product is used.

Leaded ceramic capacitors are not designed for reflow process or dipping the body into a solder melt.

CLEANING

The components should be cleaned immediately following the soldering operation with vapor degreasers.

CLEANING (ULTRASONIC CLEANING)

To perform ultrasonic cleaning, observe the following conditions:

- Maximum rinse bath capacity output: 20 W/liter
- Maximum rinsing time: 300 s
- Do not vibrate the PCB/PWB directly
- Excessive ultrasonic cleaning may lead to mechanical damage

SOLVENT RESISTANCE

The coating and marking of the capacitors are resistant to the following test method:

IEC 60068-2-45 (method XA)

MOUNTING

We do not recommend modifying the lead terminals, e.g. bending or cropping. This action could break the coating or crack the ceramic insert. In order to avoid such failures we are offering different lead wire designs (e.g. straight, inline, inside crimp, outside crimp etc.) If however, the lead must be modified in any way, we recommend support of the lead with a clamping fixture next to the coating. If a defined product stop is required for mounting on a PCB, a mechanically formed product stop or a mounting tool should be used.

OPERATING VOLTAGE

In case the voltage is applied to the circuit, starting as well as stopping, may generate irregular voltage for a transit period because of resonance or switching. Be sure to use a capacitor with a rated voltage range that includes these irregular voltages.

| RELATED DOCUMENTS | |
|--------------------------|--|
| General Information | www.vishay.com/doc?23140 |



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