

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 M Ω

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

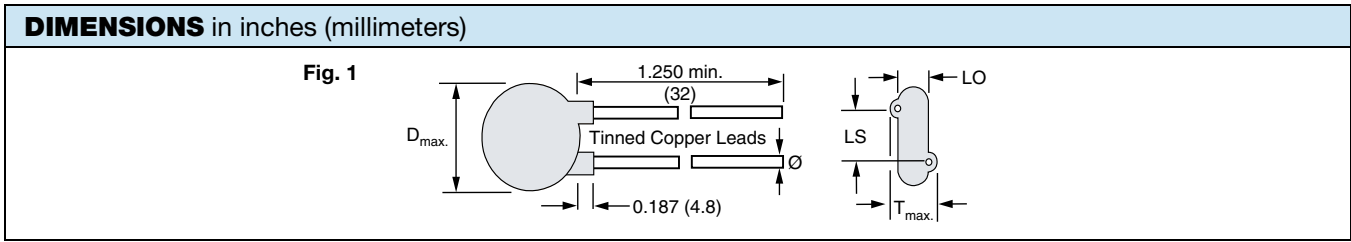
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OPERATING TEMPERATURE RANGE

-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)	0.156 (4.0)	0.250 (6.4)	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		0.047 (1.2)	561R1DF0D33							
3900		0.560 (14.2)	0.156 (4.0)	0.375 (9.5)	0.047 (1.2)				561R1DF0D39	
4700					0.047 (1.2)				561R1DF0D47	
5600					0.047 (1.2)				561R1DF0D56	
6800	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)	0.083 (2.1)	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)					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

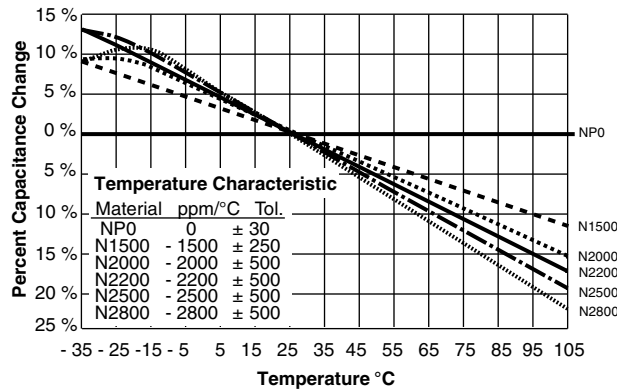
TAPE AND REEL OPTIONS

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



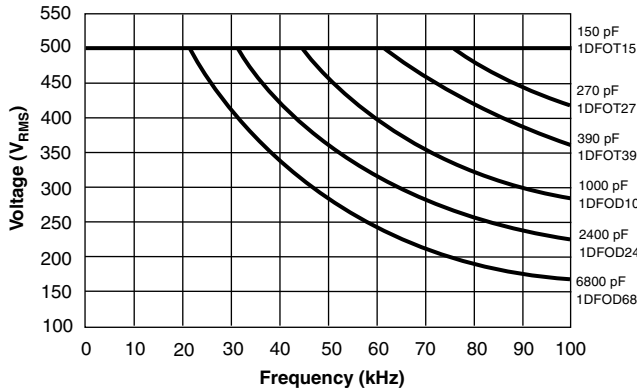
CAPACITANCE CHANGE VS. TEMPERATURE (TYPICAL)

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

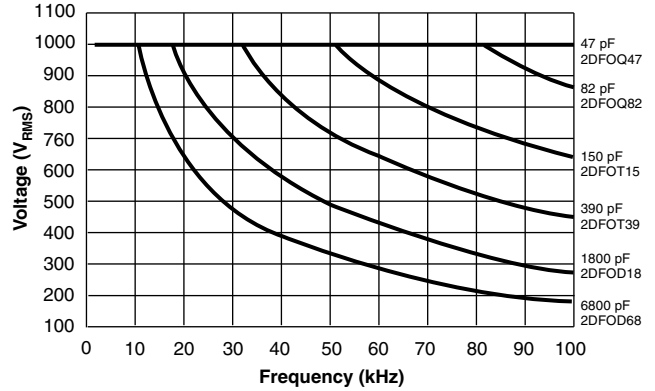


POWER RATING

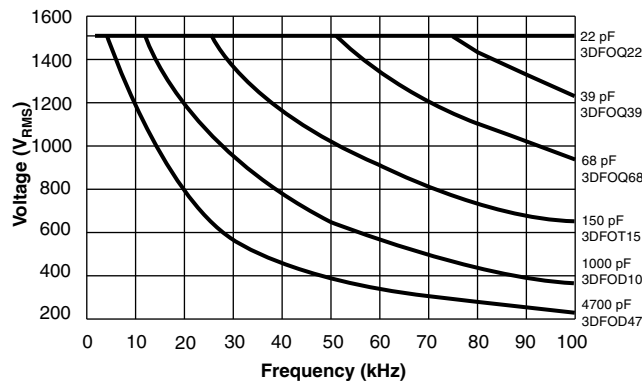
1DFO Series 500 V_{RMS} Low DF



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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