

## Lower Voltage Ceramic Singlelayer DC Disc Capacitors 2 kV<sub>DC</sub> to 7.5 kV<sub>DC</sub>


**RoHS**  
COMPLIANT

**FEATURES**

- Low losses
- High capacitance in small sizes
- High stability
- Radial leads
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

**APPLICATIONS**

- Lighting ballasts
- SMPS
- DC and pulse high voltage

**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 0.025" (0.64 mm) or 0.032" (0.81 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) or 0.500" (12.7 mm).

The standard tolerances are  $\pm 10\%$  or  $\pm 20\%$ .

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

**CAPACITANCE RANGE**

 10 pF to 0.10  $\mu$ F

**RATED VOLTAGE**

 2 kV<sub>DC</sub>  
 3 kV<sub>DC</sub>  
 6 kV<sub>DC</sub>  
 7.5 kV<sub>DC</sub>
**DIELECTRIC STRENGTH BETWEEN LEADS**

Component test, 100 % test at product line:

 2 kV<sub>DC</sub>      3600 V<sub>DC</sub>, 2 s  
 3 kV<sub>DC</sub>      5000 V<sub>DC</sub>, 2 s  
 6 kV<sub>DC</sub>      10 500 V<sub>DC</sub>, 2 s  
 7.5 kV<sub>DC</sub>    11 250 V<sub>DC</sub>, 2 s

**CERAMIC DIELECTRIC**

 C0G, U2J, R3L (Class 1)  
 X7R, X5F, X5S, Y5S, Y5U, Y5V, Z5U (Class 2)

QUICK REFERENCE DATA						
DESCRIPTION	VALUE					
Ceramic class	1		2			
Ceramic dielectric	U2J, R3L	C0G, U2J, R3L	X7R, Y5S, Y5U, Z5U, Y5V	X5F, X5R, X5S, X7R, Y5S, Y5U, Z5U	X5F, X5S, Y5U, Z5U	X5F, Y5U, Z5U
Voltage (V <sub>DC</sub> )	3000	6000	2000	3000	6000	7500
Min. capacitance (pF)	10	10	100	47	100	100
Max. capacitance (pF)	33	47	100 000	33 000	10 000	2500
Mounting	Radial					

**INSULATION RESISTANCE**

 2 kV<sub>DC</sub>      min. 10 000 M $\Omega$   
 3 kV<sub>DC</sub>      min. 50 000 M $\Omega$  <sup>(1)</sup>  
 6 kV<sub>DC</sub>      min. 75 000 M $\Omega$   
 7.5 kV<sub>DC</sub>    min. 200 000 M $\Omega$ 
**Note**
<sup>(1)</sup> Exemption: 565R30GASS33 min. 25 000 M $\Omega$ 
**TOLERANCE ON CAPACITANCE**
 $\pm 10\%$ ,  $\pm 20\%$ , -20 % to +80 %

**DISSIPATION FACTOR**

 Class 1: 0.2 % max. at 1 MHz; 1 V  
 Class 2: 2.0 % max. at 1 kHz; 1 V

**CATEGORY TEMPERATURE RANGE**

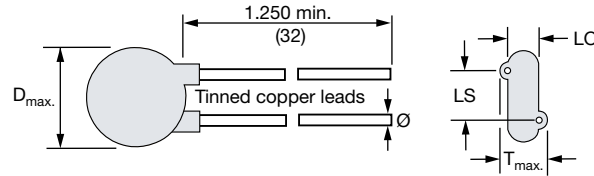
-25 °C to +85 °C

**CLIMATIC CATEGORY ACC. TO EN 60068-1**

25/085/21

**OPERATING TEMPERATURE RANGE**

 -25 °C to +105 °C <sup>(1)</sup>
**Note**
<sup>(1)</sup> For explanation about the difference of operating temperature range and temperature characteristic of capacitance, please see [www.vishay.com/doc?48299](http://www.vishay.com/doc?48299)

**DIMENSIONS** in inches (millimeters)

**ORDERING INFORMATION, CERAMIC 2 kV<sub>DC</sub>**

C (pF)	TOL. (%)	D <sub>max.</sub> DIAMETER INCH (mm)	T <sub>max.</sub> THICKNESS INCH (mm)	LS LEAD SPACE INCH (mm) ± 1 mm	LO LEAD OFFSET INCH (mm) ± 0.5 mm	WIRE SIZE		ORDERING CODE				
						AWG	INCH (mm)					
<b>X7R</b>												
100	± 10	0.330 (8.4)	0.190 (4.8)	0.250 (6.4)	0.075 (1.9)	20	0.032 (0.81)	564R20TST10				
220			0.180 (4.6)		0.071 (1.8)			564R20TST22				
330			0.170 (4.3)		0.075 (1.9)			564R20TST33				
470			0.185 (4.7)		0.063 (1.6)			564R20TST47				
560			0.175 (4.4)		0.087 (2.2)			564R20TST56				
680		0.400 (10.2)	0.175 (4.4)		0.075 (1.9)			564R20TST68				
1000			0.160 (4.1)		0.083 (2.1)			564R20TSD10				
1500			0.460 (11.7)		0.170 (4.3)			0.063 (1.6)	564R20TSD15			
1800								0.055 (1.4)	564R20TSD18			
2200								0.067 (1.7)	564R20TSD22			
3300		0.530 (13.5)	0.063 (1.6)		564R20TSD33							
3900		0.680 (17.3)	0.170 (4.3)		0.075 (1.9)			564R20TSD39				
4700					0.375 (9.5)			0.071 (1.8)	564R20TSD47			
<b>Y5S</b>												
1000		± 20	0.330 (8.4)		0.175 (4.4)			0.250 (6.4)	0.067 (1.7)	20	0.032 (0.81)	564R20TSSD10
2200	0.460 (11.7)		0.170 (4.3)	0.071 (1.8)	564R20TSSD22							
5600	0.790 (20.0)		0.190 (4.8)	0.375 (9.5)	0.091 (2.3)	564R20TSSD56						
<b>Y5U</b>												
1000	± 20	0.330 (8.4)	0.170 (4.3)	0.250 (6.4)	0.067 (1.7)	20	0.032 (0.81)	564R20GAD10				
1500		0.330 (8.4)	0.170 (4.3)		0.071 (1.8)			564R20GAD15				
<b>Z5U</b>												
1800	± 20	0.360 (9.1)	0.170 (4.3)	0.250 (6.4)	0.071 (1.8)	20	0.032 (0.81)	564R20GAD18				
2200		0.400 (10.2)	0.175 (4.4)		0.075 (1.9)			564R20GAD22				
3300		0.430 (10.9)			0.071 (1.8)			564R20GAD33				
4700		0.530 (13.5)			0.075 (1.9)			564R20GAD47				
6800		0.560 (14.2)	0.170 (4.3)		0.375 (9.5)			0.067 (1.7)	564R20GAD68			
<b>Y5V</b>												
0.01 μF	± 20	0.620 (15.7)	0.170 (4.3)	0.375 (9.5)	0.067 (1.7)	20	0.032 (0.81)	564R20GASS10				
0.05 μF		0.950 (24.1)	0.174 (4.4)		0.067 (1.7)			20	564R20GAS50			
0.10 μF		0.950 (24.1)	0.240 (6.1)		0.067 (1.7)	22	0.025 (0.64)	565R20GAP10				



ORDERING INFORMATION, CERAMIC 3 kV <sub>DC</sub>										
C (pF)	TOL. (%)	D <sub>max.</sub> DIAMETER INCH (mm)	T <sub>max.</sub> THICKNESS INCH (mm)	LS LEAD SPACE INCH (mm) ± 1 mm	LO LEAD OFFSET INCH (mm) ± 0.5 mm	WIRE SIZE		ORDERING CODE		
						AWG	INCH (mm)			
<b>U2J (N750)</b>										
10	± 20	0.330 (8.4)	0.210 (5.3)	0.250 (6.4)	0.110 (2.8)	20	0.032 (0.81)	564R30GAQ10		
<b>R3L (N2200)</b>										
22	± 20	0.330 (8.4)	0.200 (5.1)	0.250 (6.4)	0.102 (2.6)	20	0.032 (0.81)	564R30GAQ22		
27			0.190 (4.8)		0.091 (2.3)			564R30GAQ27		
33			0.170 (4.3)		0.071 (1.8)			564R30GAQ33		
<b>X5F</b>										
56	± 20	0.330 (8.4)	0.190 (4.8)	0.250 (6.4)	0.091 (2.3)	20	0.032 (0.81)	564R30GAQ56		
68			0.200 (5.1)		0.102 (2.6)			564R30GAQ68		
270			0.180 (4.6)		0.083 (2.1)			564R30GAT27		
<b>X5R</b>										
330	± 20	0.330 (8.4)	0.175 (4.4)	0.250 (6.4)	0.075 (1.9)	20	0.032 (0.81)	564R30GAT33		
<b>X5S</b>										
470	± 20	0.330 (8.4)	0.175 (4.4)	0.250 (6.4)	0.075 (1.9)	20	0.032 (0.81)	564R30GAT47		
<b>X7R</b>										
47	± 20	0.330 (8.4)	0.230 (5.8)	0.250 (6.4)	0.130 (3.3)	20	0.032 (0.81)	564R30GAQ47		
100			0.180 (4.6)		0.083 (2.1)			564R30GAT10		
150			0.190 (4.8)		0.091 (2.3)			564R30GAT15		
220			0.175 (4.4)		0.075 (1.9)			564R30GAT22		
390			0.180 (4.6)		0.083 (2.1)			564R30GAT39		
680	± 10	0.330 (8.4)	0.180 (4.6)	0.250 (6.4)	0.079 (2.0)	20	0.032 (0.81)	564R30TST68		
1000			0.400 (10.2)		0.190 (4.8)			0.091 (2.3)	564R30TSD10	
1500			0.490 (12.5)		0.185 (4.7)			0.087 (2.2)	564R30TSD15	
1800			0.530 (13.5)		0.180 (4.6)			0.079 (2.0)	564R30TSD18	
2200								0.079 (2.0)	564R30TSD22	
2700			0.620 (15.7)		0.185 (4.7)			0.083 (2.1)	564R30TSD27	
3300								0.170 (4.3)	0.075 (1.9)	564R30TSD33
3900								0.720 (18.3)	0.185 (4.7)	0.087 (2.2)
4700			0.175 (4.4)		0.075 (1.9)					564R30TSD47
6800			0.185 (4.7)		0.087 (2.2)					564R30TSD68
<b>Y5S</b>										
1000	± 20	0.400 (10.2)	0.190 (4.8)	0.250 (6.4)	0.098 (2.5)	20	0.032 (0.81)	564R30TSSD10		
1500		0.460 (11.7)			0.091 (2.3)			564R30TSSD15		
1800		0.490 (12.4)			0.087 (2.2)			564R30TSSD18		
2200		0.530 (13.5)			0.185 (4.7)			0.083 (2.1)	564R30TSSD22	
2700		0.560 (14.2)							0.087 (2.2)	564R30TSSD27
3300		0.620 (15.7)	0.087 (2.2)	564R30TSSD33						
3900		0.680 (17.3)	0.190 (4.8)	0.375 (9.5)	0.091 (2.3)			564R30TSSD39		
4700					0.091 (2.3)			564R30TSSD47		
5600					0.790 (20.0)			0.190 (4.8)	0.091 (2.3)	564R30TSSD56
6800		0.900 (22.9)	0.205 (5.2)	0.102 (2.6)	564R30TSSD68					
<b>Y5U</b>										
680	± 20	0.330 (8.4)	0.175 (4.4)	0.250 (6.4)	0.075 (1.9)	20	0.032 (0.81)	564R30GAT68		
0.010 μF		0.720 (18.3)	0.185 (4.7)	0.375 (9.5)	0.091 (2.3)			564R30GAS10		
<b>Z5U</b>										
1000	± 20	0.330 (8.4)	0.190 (4.8)	0.250 (6.4)	0.098 (2.5)	20	0.032 (0.81)	564R30GAD10		
1500		0.360 (9.1)			0.091 (2.3)			564R30GAD15		
1800		0.400 (10.2)			0.098 (2.5)			564R30GAD18		
2200		0.430 (10.9)			0.091 (2.3)			564R30GAD22		
2700		0.460 (11.7)			0.200 (5.1)			0.098 (2.5)	564R30GAD27	
3300		0.530 (13.5)	0.185 (4.7)	0.087 (2.2)	564R30GAD33					
3900					0.620 (15.7)			0.195 (5.0)	0.091 (2.3)	564R30GAD39
4700									0.091 (2.3)	564R30GAD47
6800		0.720 (18.3)	0.200 (5.1)	0.375 (9.5)	0.102 (2.6)			564R30GAD68		
8200					0.102 (2.6)			564R30GAD82		
0.020 μF					0.265 (6.7)			0.087 (2.2)	22	0.025 (0.64)
0.033 μF		0.900 (22.9)	0.240 (6.1)	0.087 (2.2)	22			0.025 (0.64)	565R30GASS33	



ORDERING INFORMATION, CERAMIC 6 kV <sub>DC</sub>								
C (pF)	TOL. (%)	D <sub>max.</sub> DIAMETER INCH (mm)	T <sub>max.</sub> THICKNESS INCH (mm)	LS LEAD SPACE INCH (mm) ± 1 mm	LO LEAD OFFSET INCH (mm) ± 0.5 mm	WIRE SIZE		ORDERING CODE
						AWG	INCH (mm)	
<b>C0G (NP0)</b>								
10	± 20	0.400 (10.2)	0.220 (5.6)	0.375 (9.5)	0.122 (3.1)	20	0.032 (0.81)	564R60GAQ10
<b>U2J (N750)</b>								
22	± 20	0.460 (11.7)	0.240 (6.1)	0.375 (9.5)	0.142 (3.6)	20	0.032 (0.81)	564R60GAQ22
<b>R3L (N2200)</b>								
33	± 20	0.400 (10.2)	0.230 (5.8)	0.375 (9.5)	0.130 (3.3)	20	0.032 (0.81)	564R60GAQ33
47		0.460 (11.7)			0.126 (3.2)			564R60GAQ47
<b>X5F</b>								
100	± 20	0.400 (10.2)	0.240 (6.1)	0.375 (9.5)	0.142 (3.6)	20	0.032 (0.81)	564R60GAT10
220			0.265 (6.7)		0.165 (4.2)			564R60GAT22
<b>X5S</b>								
330	± 20	0.400 (10.2)	0.260 (6.6)	0.375 (9.5)	0.161 (4.1)	20	0.032 (0.81)	564R60GAT33
<b>Y5U</b>								
470	± 20	0.400 (10.2)	0.290 (7.4)	0.375 (9.5)	0.193 (4.9)	20	0.032 (0.81)	564R60GAT47
560			0.240 (6.1)		0.142 (3.6)			564R60GAT56
<b>Z5U</b>								
1000	± 20	0.400 (10.2)	0.270 (6.9)	0.375 (9.5)	0.173 (4.4)	20	0.032 (0.81)	564R60GAD10
1500		0.460 (11.7)	0.280 (7.1)		0.157 (4.0)			564R60GAD15
2200		0.530 (13.5)	0.240 (6.1)		0.142 (3.6)			564R60GAD22
3300		0.620 (15.7)	0.260 (6.6)		0.169 (4.3)			564R60GAD33
4700		0.790 (20.0)			0.161 (4.1)			564R60GAD47
0.010 μF		0.950 (24.1)	0.250 (6.4)		0.150 (3.8)			564R60GAS10

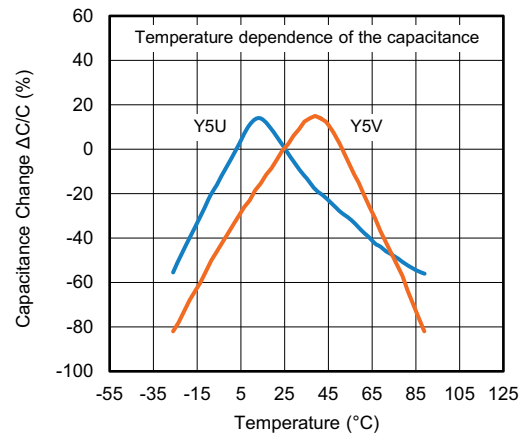
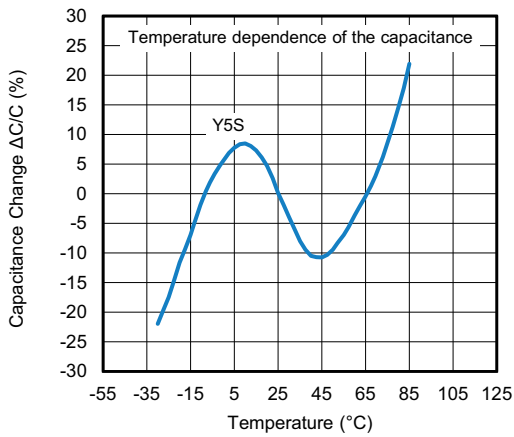
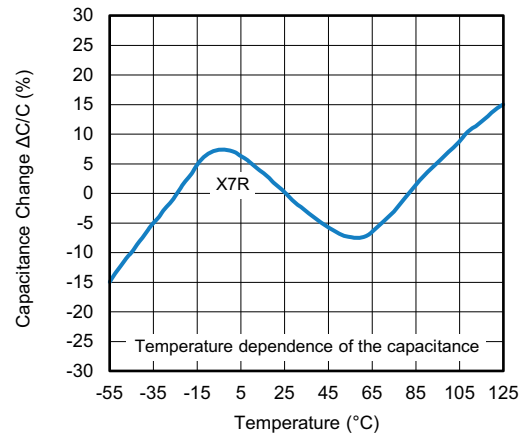
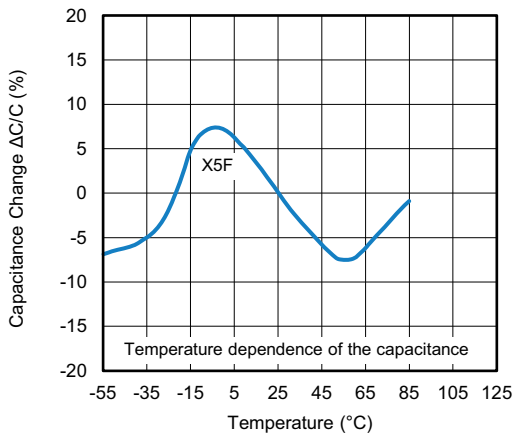
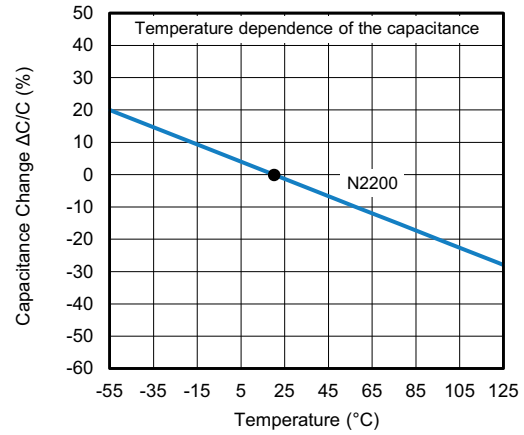
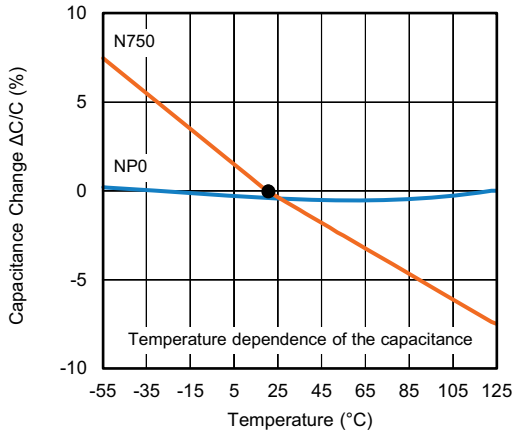
ORDERING INFORMATION, CERAMIC 7.5 kV <sub>DC</sub>								
C (pF)	TOL. (%)	D <sub>max.</sub> DIAMETER INCH (mm)	T <sub>max.</sub> THICKNESS INCH (mm)	LS LEAD SPACE INCH (mm) ± 1 mm	LO LEAD OFFSET INCH (mm) ± 0.5 mm	WIRE SIZE		ORDERING CODE
						AWG	INCH (mm)	
<b>X5F</b>								
100	± 20	0.530 (13.5)	0.310 (7.9)	0.500 (12.7)	0.181 (4.6)	20	0.032 (0.81)	564R75GAT10
470		0.620 (15.7)	0.270 (6.9)		0.161 (4.1)			564R75GAT47
<b>Y5U</b>								
1000	+ 80 / - 20	0.620 (15.7)	0.320 (8.1)	0.500 (12.7)	0.181 (4.6)	20	0.032 (0.81)	564R75GAD10
<b>Z5U</b>								
2500	+ 80 / - 20	0.620 (15.7)	0.280 (7.1)	0.500 (12.7)	0.181 (4.6)	20	0.032 (0.81)	564R75GAD25

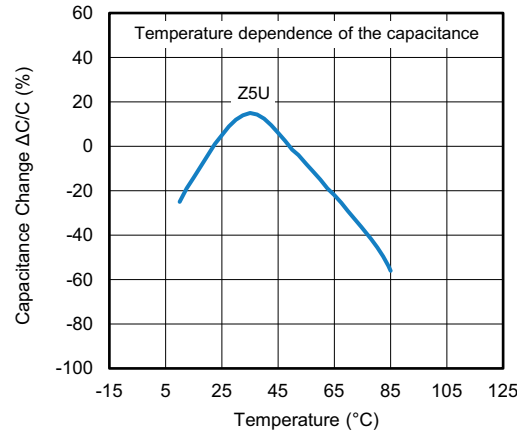
**TAPE AND REEL OPTIONS**

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



### CAPACITANCE CHANGE VS. TEMPERATURE (TYPICAL)





## 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](http://www.vishay.com/doc?23140)).

## SOLDERING

<b>SOLDERING SPECIFICATIONS</b>		
Soldering test for capacitors with wire leads: (according to IEC 60068-2-20, solder bath method)		
	<b>SOLDERABILITY</b>	<b>RESISTANCE TO SOLDERING HEAT</b>
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.

**OPERATING TEMPERATURE AND SELF-GENERATED HEAT**

Keep the surface temperature of a capacitor below the upper limit of its rated operating temperature range. Be sure to take into account the heat generated by the capacitor itself. When the capacitor is used in a high frequency, pulse, or similar application, it may have self-generated heat due to dielectric dissipation.

Temperature increase due to self-generated heating should not exceed 20 °C while operating at an atmosphere temperature of 25 °C.

When measuring, the surface temperature, make sure that the capacitor is not affected by radiant, conductive and convective heat by its surroundings. Excessive heat may lead to thermo-mechanical deterioration of the capacitor's characteristics and reliability.

RELATED DOCUMENTS	
General Information	<a href="http://www.vishay.com/doc?23140">www.vishay.com/doc?23140</a>



## Disclaimer

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