

## 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**

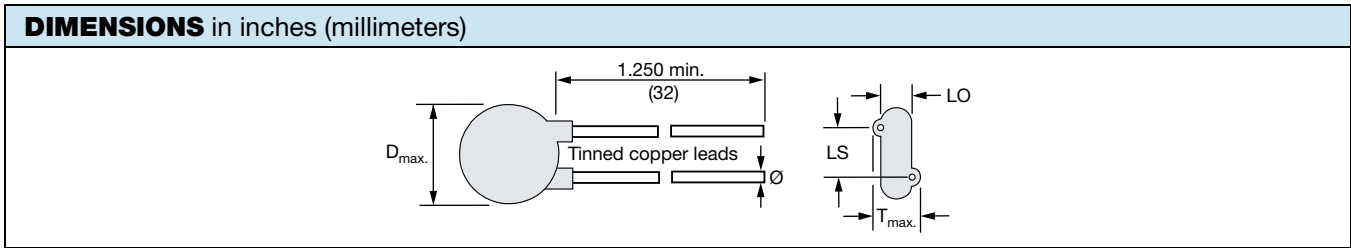
25/085/21

**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)



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			0.175 (4.4)		0.075 (1.9)			564R20TST68
1000		0.400 (10.2)	0.083 (2.1)		564R20TSD10			
1500		0.460 (11.7)	0.160 (4.1)		0.063 (1.6)			564R20TSD15
1800			0.170 (4.3)		0.055 (1.4)			564R20TSD18
2200					0.067 (1.7)			564R20TSD22
3300					0.063 (1.6)			564R20TSD33
3900					0.075 (1.9)			564R20TSD39
4700			0.680 (17.3)		0.375 (9.5)			0.071 (1.8)
<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)
<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)
<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
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	0.400 (10.2)	0.190 (4.8)	0.375 (9.5)	0.079 (2.0)	20	0.032 (0.81)	564R30TST68
1000			0.490 (12.5)		0.091 (2.3)			564R30TSD10
1500			0.185 (4.7)		0.087 (2.2)			564R30TSD15
1800			0.530 (13.5)		0.079 (2.0)			564R30TSD18
2200			0.180 (4.6)		0.075 (1.9)			564R30TSD22
2700		0.620 (15.7)	0.083 (2.1)	564R30TSD27				
3300		0.185 (4.7)	0.075 (1.9)	564R30TSD33				
3900		0.720 (18.3)	0.087 (2.2)	564R30TSD39				
4700		0.175 (4.4)	0.075 (1.9)	564R30TSD47				
6800		0.900 (22.9)	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)			0.083 (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)	0.091 (2.3)	564R30TSSD39				
4700		0.790 (20.0)	0.190 (4.8)	564R30TSSD47				
5600		0.900 (22.9)	0.205 (5.2)	564R30TSSD56				
6800		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)			0.098 (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		0.620 (15.7)	0.195 (5.0)	0.091 (2.3)	564R30GAD47			
6800		0.720 (18.3)	0.200 (5.1)	0.102 (2.6)	564R30GAD68			
8200		0.720 (18.3)	0.265 (6.7)	0.087 (2.2)	564R30GAD82			
0.020 μF	0.900 (22.9)	0.240 (6.1)	0.087 (2.2)	22	0.025 (0.64)	565R30GASS20		
0.033 μF				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

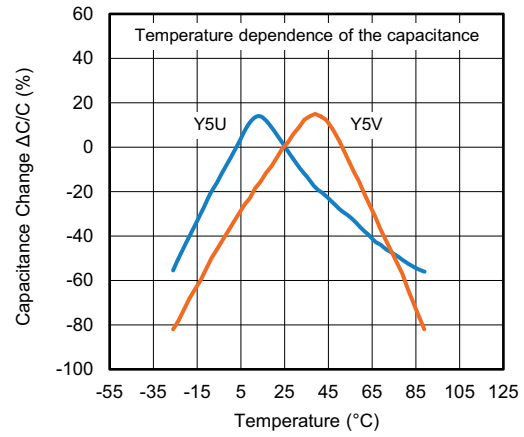
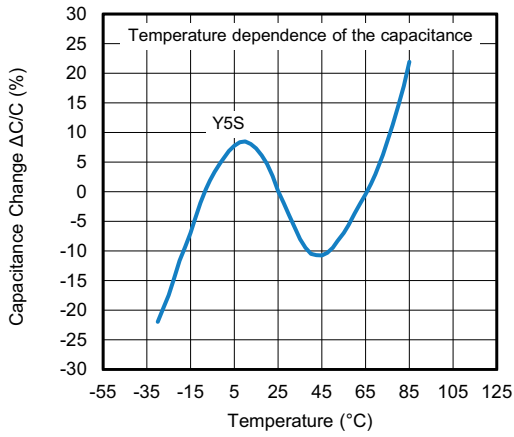
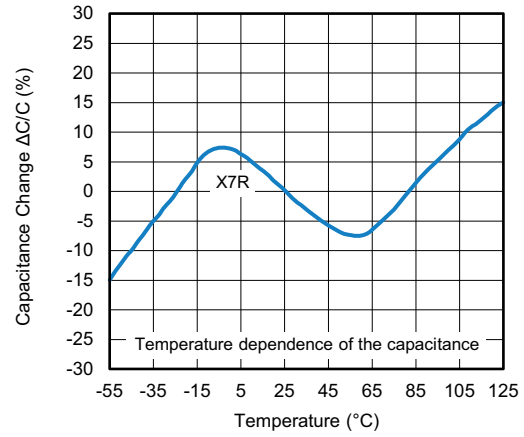
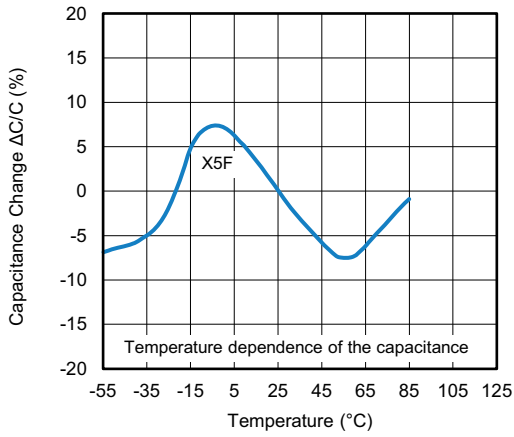
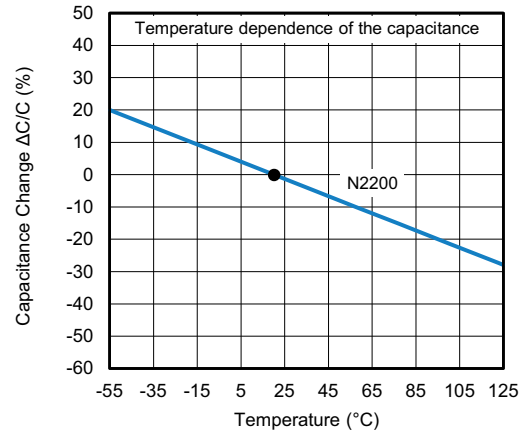
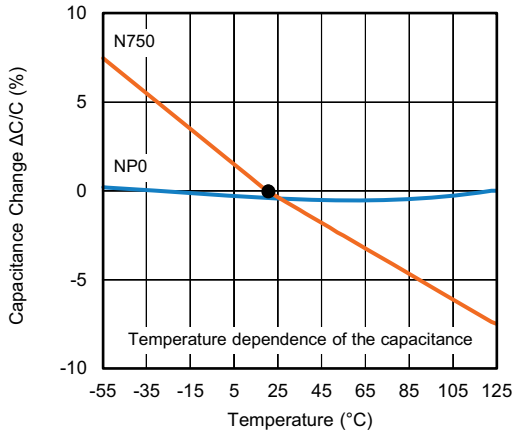
ORDERING INFORMATION, CERAMIC 7.5 kV <sub>DC</sub>								
C (pF)	TOL. (%)	D <sub>max.</sub> DIAMETER INCH (mm)	T <sub>max.</sub> THICKNESS INCH (mm)	LS LEAD SPACE INCH (mm) ± 1 mm	LO LEAD OFFSET INCH (mm) ± 0.5 mm	WIRE SIZE		ORDERING CODE
						AWG	INCH (mm)	
<b>X5F</b>								
100	± 20	0.530 (13.5)	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.

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



## **Disclaimer**

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Hyperlinks included in this datasheet may direct users to third-party websites. These links are provided as a convenience and for informational purposes only. Inclusion of these hyperlinks does not constitute an endorsement or an approval by Vishay of any of the products, services or opinions of the corporation, organization or individual associated with the third-party website. Vishay disclaims any and all liability and bears no responsibility for the accuracy, legality or content of the third-party website or for that of subsequent links.

Vishay products are not designed for use in life-saving or life-sustaining applications or any application in which the failure of the Vishay product could result in personal injury or death unless specifically qualified in writing by Vishay. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.