

## 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**

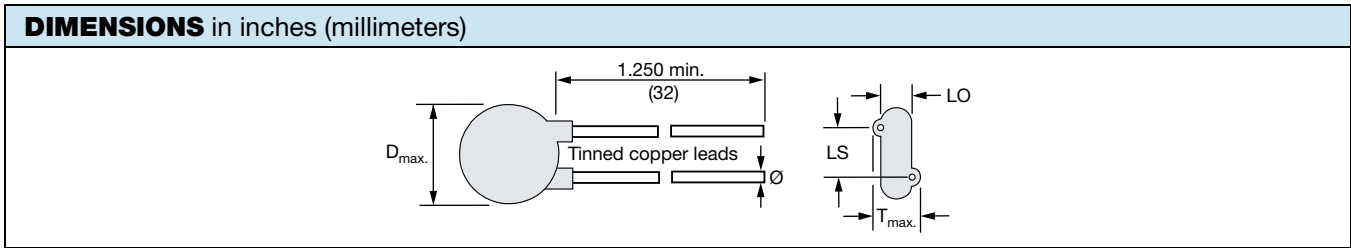
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**OPERATING TEMPERATURE RANGE**

-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)	0.160 (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					0.063 (1.6)			564R20TSD33
3900					0.075 (1.9)			564R20TSD39
4700					0.680 (17.3)			0.375 (9.5)
<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)
<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	0.330 (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)	564R30TSD39
4700										0.175 (4.4)	0.075 (1.9)
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)			0.185 (4.7)			0.083 (2.1)	564R30TSSD22		
2700		0.560 (14.2)							0.087 (2.2)	564R30TSSD27	
3300		0.620 (15.7)	0.375 (9.5)	0.091 (2.3)	564R30TSSD33						
3900		0.680 (17.3)			0.087 (2.2)			564R30TSSD39			
4700		0.790 (20.0)			0.091 (2.3)			564R30TSSD47			
5600		0.900 (22.9)	0.205 (5.2)	0.102 (2.6)	564R30TSSD56						
6800					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					564R30GAD39						
4700		0.620 (15.7)	0.195 (5.0)	0.091 (2.3)	564R30GAD47						
6800		0.720 (18.3)	0.200 (5.1)	0.375 (9.5)	0.102 (2.6)			564R30GAD68			
8200								564R30GAD82			
0.020 μF	0.265 (6.7)					0.087 (2.2)	22	0.025 (0.64)	565R30GASS20		
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

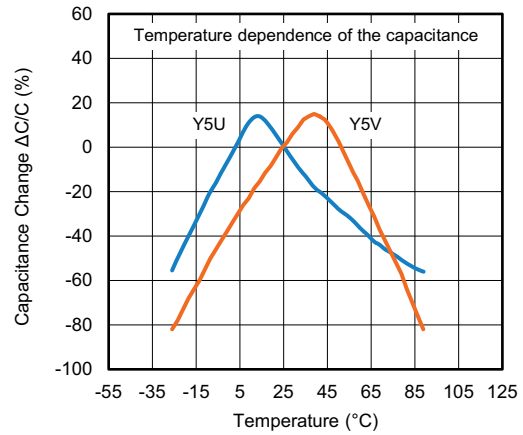
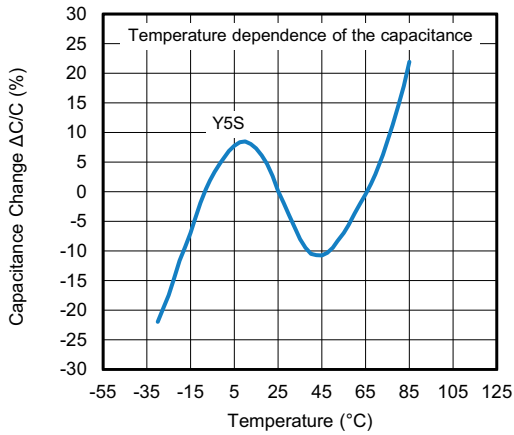
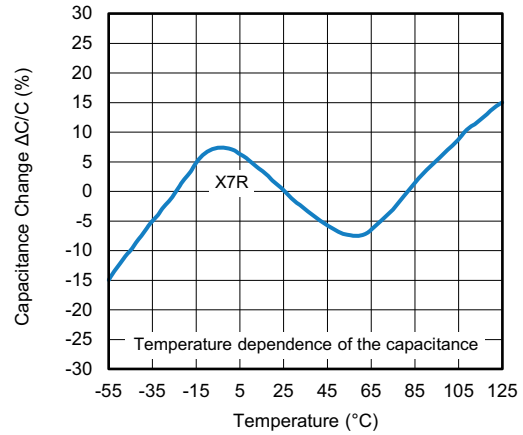
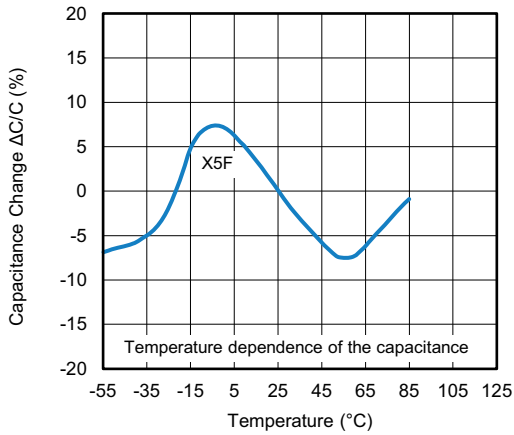
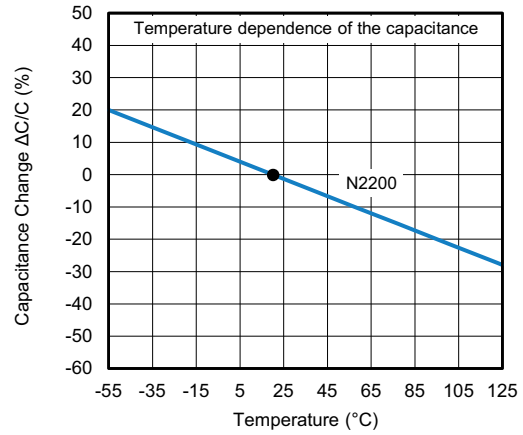
ORDERING INFORMATION, CERAMIC 7.5 kV <sub>DC</sub>								
C (pF)	TOL. (%)	D <sub>max.</sub> DIAMETER INCH (mm)	T <sub>max.</sub> THICKNESS INCH (mm)	LS LEAD SPACE INCH (mm) ± 1 mm	LO LEAD OFFSET INCH (mm) ± 0.5 mm	WIRE SIZE		ORDERING CODE
						AWG	INCH (mm)	
<b>X5F</b>								
100	± 20	0.530 (13.5)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

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



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