



**THE DATASHEET OF
564R60GAQ47**



Lower Voltage Ceramic Singlelayer DC Disc Capacitors 2 kV_{DC} to 7.5 kV_{DC}


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

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 μ F

RATED VOLTAGE

 2 kV_{DC}
 3 kV_{DC}
 6 kV_{DC}
 7.5 kV_{DC}
DIELECTRIC STRENGTH BETWEEN LEADS

Component test, 100 % test at product line:

 2 kV_{DC} 3600 V_{DC}, 2 s
 3 kV_{DC} 5000 V_{DC}, 2 s
 6 kV_{DC} 10 500 V_{DC}, 2 s
 7.5 kV_{DC} 11 250 V_{DC}, 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 _{DC})	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_{DC} min. 10 000 M Ω
 3 kV_{DC} min. 50 000 M Ω ⁽¹⁾
 6 kV_{DC} min. 75 000 M Ω
 7.5 kV_{DC} min. 200 000 M Ω
Note
⁽¹⁾ Exemption: 565R30GASS33 min. 25 000 M Ω
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

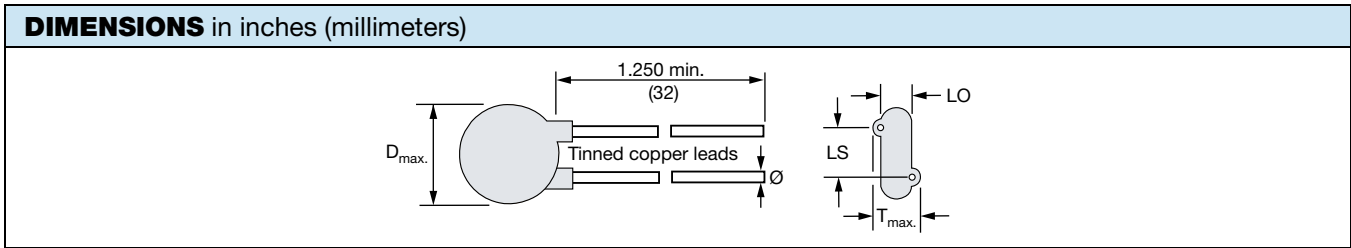
-25 °C to +85 °C

CLIMATIC CATEGORY ACC. TO EN 60068-1

25/085/21

OPERATING TEMPERATURE RANGE

 -25 °C to +105 °C ⁽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 2 kV _{DC}									
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		ORDERING CODE	
						AWG	INCH (mm)		
X7R									
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)					564R20TST22	
330			0.170 (4.3)					564R20TST33	
470			0.185 (4.7)					564R20TST47	
560			0.175 (4.4)					564R20TST56	
680			0.175 (4.4)					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)
Y5S									
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)		0.091 (2.3)			564R20TSSD56	
Y5U									
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	
Z5U									
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
Y5V									
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 _{DC}									
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		ORDERING CODE	
						AWG	INCH (mm)		
U2J (N750)									
10	± 20	0.330 (8.4)	0.210 (5.3)	0.250 (6.4)	0.110 (2.8)	20	0.032 (0.81)	564R30GAQ10	
R3L (N2200)									
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	
X5F									
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	
X5R									
330	± 20	0.330 (8.4)	0.175 (4.4)	0.250 (6.4)	0.075 (1.9)	20	0.032 (0.81)	564R30GAT33	
X5S									
470	± 20	0.330 (8.4)	0.175 (4.4)	0.250 (6.4)	0.075 (1.9)	20	0.032 (0.81)	564R30GAT47	
X7R									
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)	0.091 (2.3)	0.079 (2.0)	20	0.032 (0.81)	564R30TST68	
1000			0.185 (4.7)					0.087 (2.2)	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			0.185 (4.7)	0.083 (2.1)				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)				564R30TSD47	
6800		0.900 (22.9)	0.185 (4.7)	0.087 (2.2)				564R30TSD68	
Y5S									
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)
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)	0.190 (4.8)	0.091 (2.3)	564R30TSSD47				
5600		0.900 (22.9)	0.205 (5.2)	0.102 (2.6)	564R30TSSD56				
6800					564R30TSSD68				
Y5U									
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	
Z5U									
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					0.091 (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					0.087 (2.2)			564R30GAD82	
0.020 µF	0.720 (18.3)	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 _{DC}								
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		ORDERING CODE
						AWG	INCH (mm)	
C0G (NP0)								
10	± 20	0.400 (10.2)	0.220 (5.6)	0.375 (9.5)	0.122 (3.1)	20	0.032 (0.81)	564R60GAQ10
U2J (N750)								
22	± 20	0.460 (11.7)	0.240 (6.1)	0.375 (9.5)	0.142 (3.6)	20	0.032 (0.81)	564R60GAQ22
R3L (N2200)								
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
X5F								
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
X5S								
330	± 20	0.400 (10.2)	0.260 (6.6)	0.375 (9.5)	0.161 (4.1)	20	0.032 (0.81)	564R60GAT33
Y5U								
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
Z5U								
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

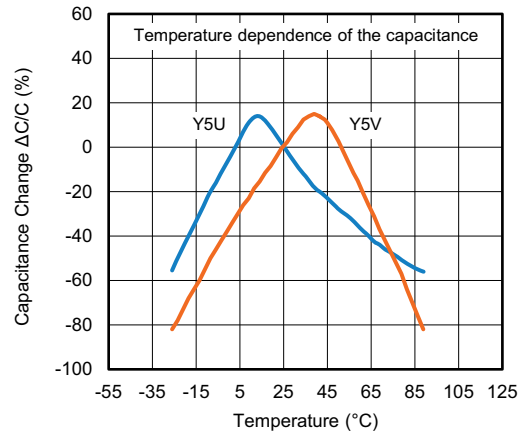
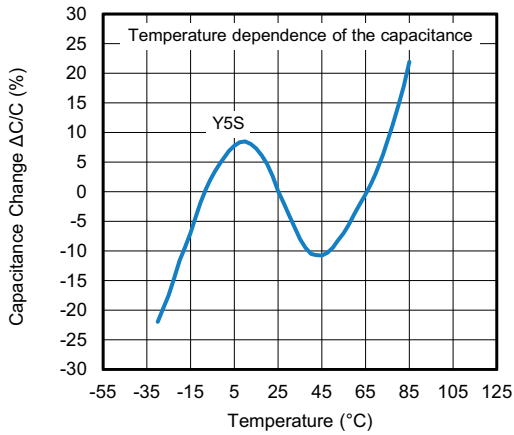
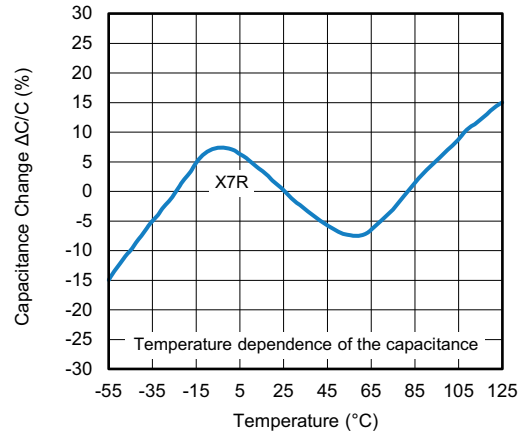
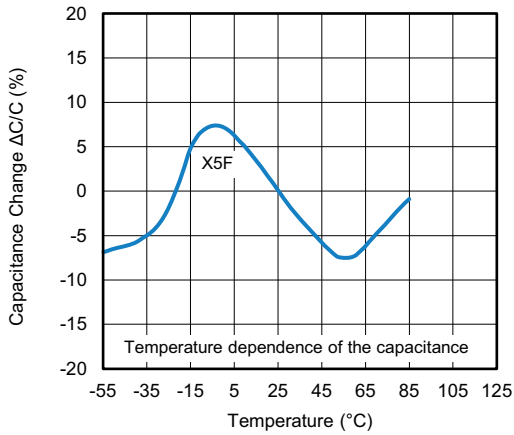
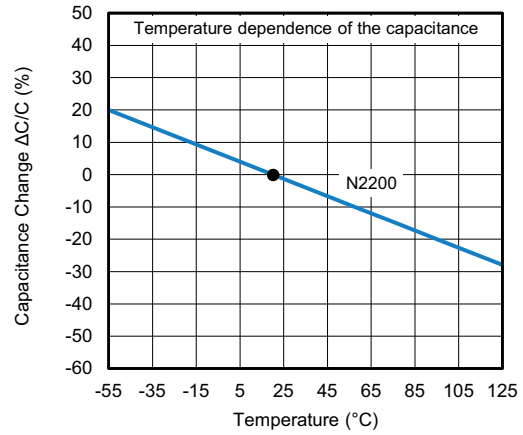
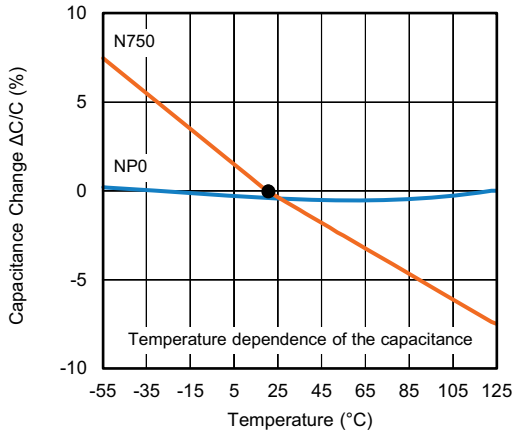
ORDERING INFORMATION, CERAMIC 7.5 kV _{DC}								
C (pF)	TOL. (%)	D _{max.} DIAMETER INCH (mm)	T _{max.} THICKNESS INCH (mm)	LS LEAD SPACE INCH (mm) ± 1 mm	LO LEAD OFFSET INCH (mm) ± 0.5 mm	WIRE SIZE		ORDERING CODE
						AWG	INCH (mm)	
X5F								
100	± 20	0.530 (13.5)	0.310 (7.9)	0.500 (12.7)	0.181 (4.6)	20	0.032 (0.81)	564R75GAT10
470		0.620 (15.7)	0.270 (6.9)		0.161 (4.1)			564R75GAT47
Y5U								
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
Z5U								
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

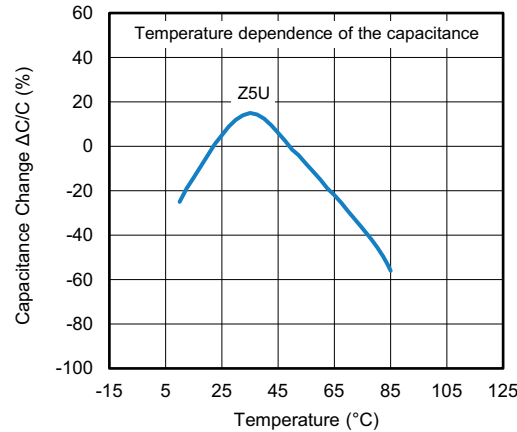
TAPE AND REEL OPTIONS

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



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).

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.

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	www.vishay.com/doc?23140



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-  Alternative Solution
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