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

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 MΩ
3 kV_{DC} min. 50 000 MΩ (1)
6 kV_{DC} min. 75 000 MΩ
7.5 kV_{DC} min. 200 000 MΩ

Note

(1) Exemption: 565R30GASS33 min. 25 000 MΩ

TOLERANCE ON CAPACITANCE

± 10 %, ± 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

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

RoHS COMPLIANT

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 ± 10 % or ± 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 µF

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)

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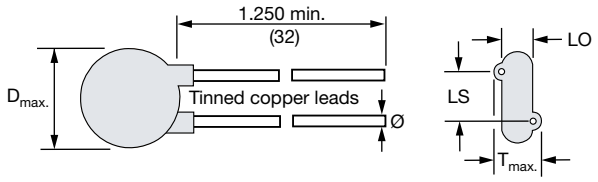
DIMENSIONS in inches (millimeters)



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 AWG	WIRE SIZE INCH (mm)	ORDERING CODE
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)		0.071 (1.8)			564R20TST22
330					0.075 (1.9)			564R20TST33
470			0.170 (4.3)		0.063 (1.6)			564R20TST47
560			0.185 (4.7)		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		0.530 (13.5)			0.063 (1.6)			564R20TSD33
3900		0.680 (17.3)			0.075 (1.9)			564R20TSD39
4700				0.375 (9.5)	0.071 (1.8)			564R20TSD47
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)	0.375 (9.5)	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)	0.170 (4.3)		0.075 (1.9)			564R20GAD47
6800		0.560 (14.2)		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

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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 AWG	WIRE SIZE INCH (mm)	ORDERING CODE
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					0.083 (2.1)			564R30GAT39
680	± 10		0.180 (4.6)		0.079 (2.0)			564R30TST68
1000		0.400 (10.2)	0.190 (4.8)		0.091 (2.3)			564R30TSD10
1500		0.490 (12.5)	0.185 (4.7)					564R30TSD15
1800		0.530 (13.5)			0.087 (2.2)			564R30TSD18
2200			0.180 (4.6)		0.079 (2.0)			564R30TSD22
2700		0.620 (15.7)	0.185 (4.7)		0.083 (2.1)			564R30TSD27
3300			0.170 (4.3)	0.375 (9.5)	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)						564R30TSSD18
2200		0.530 (13.5)			0.087 (2.2)			564R30TSSD22
2700		0.560 (14.2)	0.185 (4.7)					564R30TSSD27
3300		0.620 (15.7)		0.375 (9.5)	0.083 (2.1)			564R30TSSD33
3900		0.680 (17.3)			0.087 (2.2)			564R30TSSD39
4700					0.091 (2.3)			564R30TSSD47
5600		0.790 (20.0)	0.190 (4.8)					564R30TSSD56
6800		0.900 (22.9)	0.205 (5.2)		0.102 (2.6)			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)	0.195 (5.0)	0.250 (6.4)	0.098 (2.5)	20	0.032 (0.81)	564R30GAD10
1500		0.360 (9.1)	0.190 (4.8)		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				0.375 (9.5)	0.091 (2.3)			564R30GAD39
4700		0.620 (15.7)	0.195 (5.0)					564R30GAD47
6800		0.720 (18.3)	0.200 (5.1)		0.102 (2.6)			564R30GAD68
8200								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

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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.

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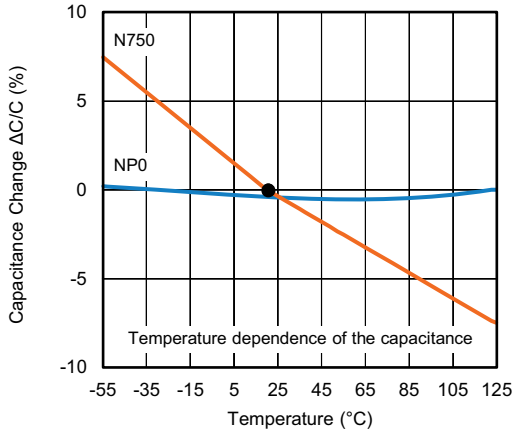
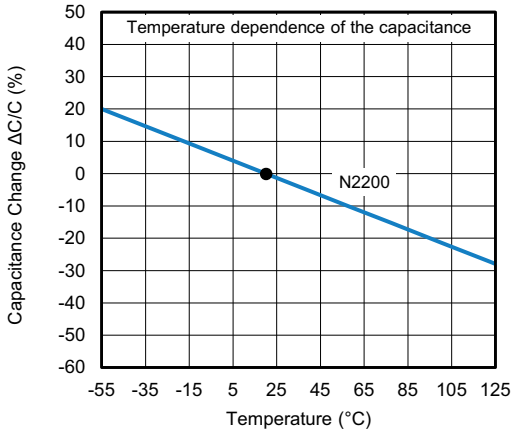
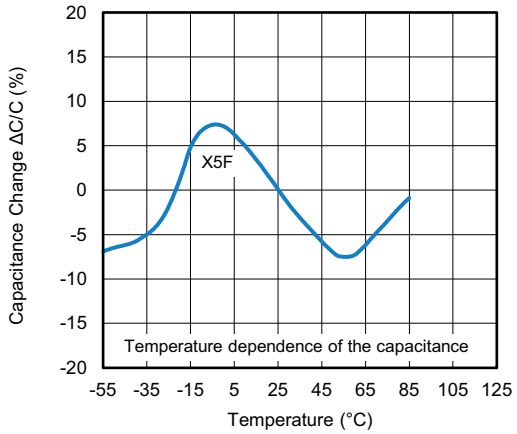
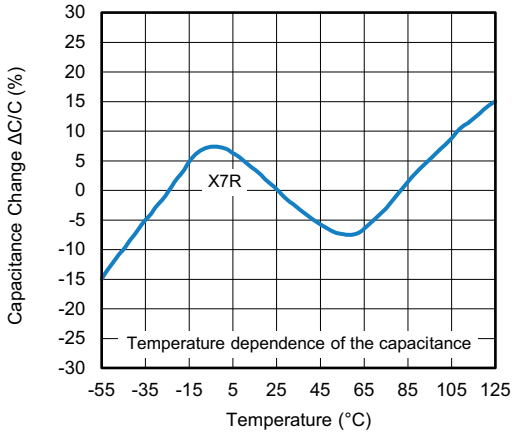
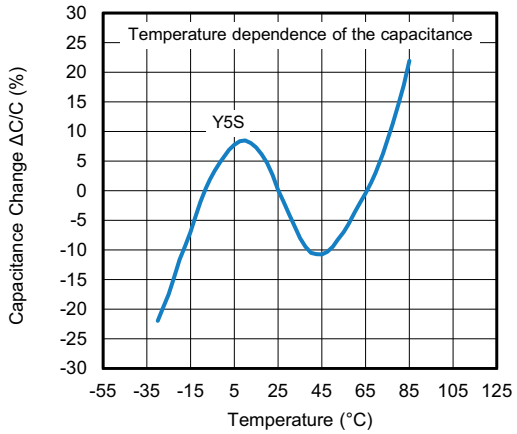
CAPACITANCE CHANGE VS. TEMPERATURE (TYPICAL)

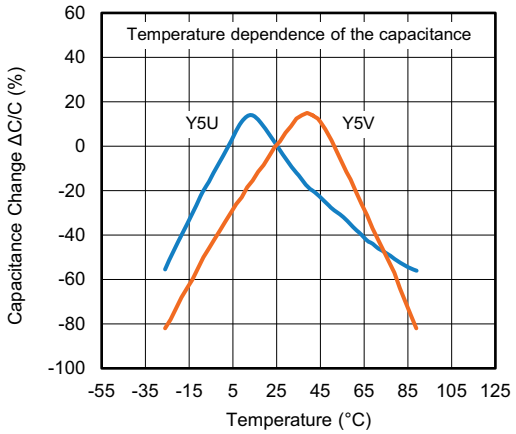












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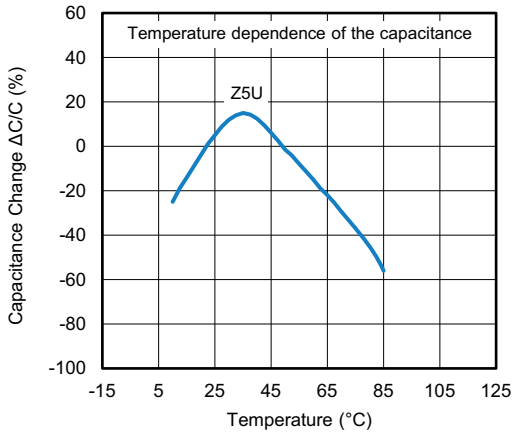

STORAGE

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

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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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