

## T-Series with C<sup>3</sup> Technology, Radial and Axial, Ceramic Cased, High Temperature 260°C, 50 – 100 VDC (Industrial Grade)

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### Overview

KEMET's High Temperature T Series radial ceramic cased capacitors are designed with C0G and X7R dielectrics which feature a 260°C maximum operating temperature and patented C<sup>3</sup> technology which eliminates potential problems associated with conventional epoxy cased/potted capacitors.

These devices are ideal for power supplies, DC/DC conversion and well suited for timing, resonant, bypass, and decoupling applications. These capacitors are widely used in industries related to semiconductors, telecommunications, test/diagnostic equipment and power/grid.

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### Benefits

- Operating temperature range of -55°C to +260°C
- High shock and vibration capability
- Capacitance range from 680 pF – 5.65 µF in X7R
- Capacitance range from 10 pF – 0.15 µF in C0G
- DC voltage ratings of 50 V, 100 V
- High thermal stability
- Encapsulation meets flammability standard UL 94 V-0



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### Applications

- Downhole exploration and mining
- Aerospace engine compartments
- Electric ballast
- Measuring equipment
- Inverter power supply

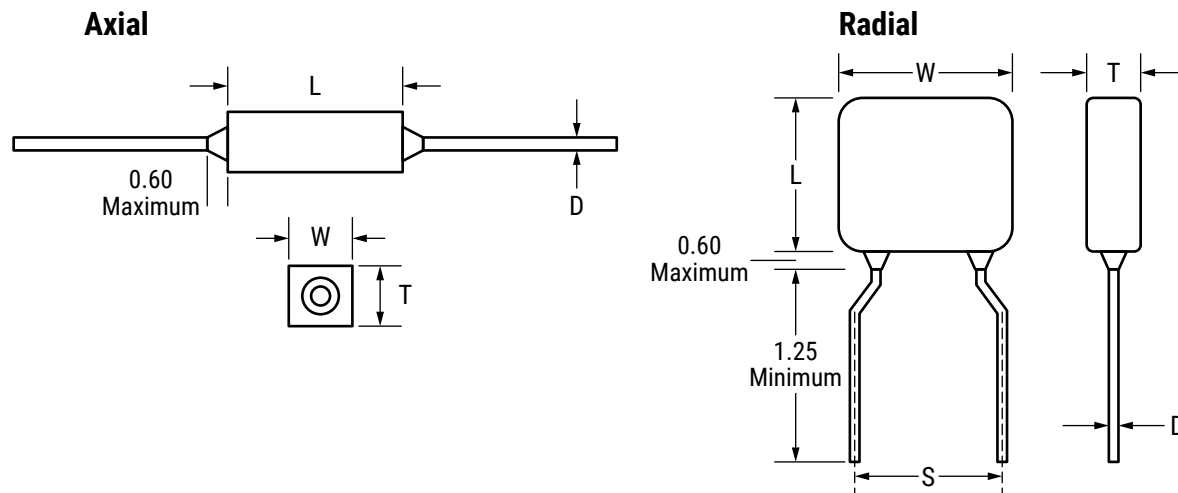
## Ordering Information

T	C	R	06	B	103	K	G	S	
Series	Dielectric	Lead Configuration	Style/ Size	Voltage Rating	Cap. Code	Capacitance Tolerance <sup>1</sup>	Lead Wire Barrier Layer <sup>2</sup>	Test Level	Packaging
T = High Temperature Axial and Radial Capacitors	C = C0G R = X7R	A = Axial R = Radial	Axial: 16 25 39 50 69 Radial: 05 06 07 08 09	B = 50 V D = 100 V S = Special	Two significant digits and number of zeros	J = ±5% K = ±10% M = ±20%	G = Gold coated W = Solder coated	S = KEMET standard screening A = MIL-PRF-20, Group A Test (COG) A = MIL-PRF-39014 (X7R) X = Special	Blank = Waffle Tray

<sup>1</sup> Additional capacitance tolerance offerings may be available. Contact KEMET for details.

<sup>2</sup> Please refer to the Construction section in the datasheet.

## Dimensions – Inches (Millimeters)



Series	Lead Configuration	Style/ Size	Length (L)	Width (W)	Thickness (T)	Lead Spacing ±0.030 (S)	Lead Diameter (F)	Lead Length Minimum (LL)
T	Axial	16	0.170 (4.32)	0.080 (2.03)	0.080 (2.03)		0.020 ±0.002 (0.508 ±0.051)	
		25	0.270 (6.86)	0.100 (2.54)	0.100 (2.54)			
		39	0.400 (10.16)	0.150 (3.81)	0.150 (3.81)			
		50	0.520 (13.21)	0.265 (6.73)	0.160 (4.06)		0.025 ±0.002 (0.635 ±0.051)	
		69	0.720 (18.29)	0.370 (9.40)	0.160 (4.06)			
	Radial	05	0.200 (5.08)	0.200 (5.08)	0.100 (2.54)	0.200 ±0.030 (5.08 ±0.76)	0.020 ±0.002 (0.508 ±0.051)	
		06	0.300 (7.62)	0.300 (7.62)	0.100 (2.54)	0.200 ±0.030 (5.08 ±0.76)		
		07	0.300 (7.62)	0.300 (7.62)	0.150 (3.81)	0.200 ±0.030 (5.08 ±0.76)		
		08	0.500 (12.70)	0.500 (12.70)	0.100 (2.54)	0.400 ±0.030 (10.16 ±0.76)	0.025 ±0.002 (0.635 ±0.051)	
		09	0.500 (12.70)	0.500 (12.70)	0.150 (3.81)	0.400 ±0.030 (10.16 ±0.76)		

## Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range:	-55°C to +125°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC):	X7R: ±15% COG: ±30 PPM/°C
Aging Rate (Maximum % Cap Loss/Decade Hour):	X7R: 2.0%/decade hour COG: 0%
<sup>1</sup> Dielectric Withstanding Voltage:	150% of rated voltage for voltage rating of 500 V ≤ V < 1,000 V 120% of rated voltage for voltage rating of ≥ 1,000 V (5±1 seconds and charge/discharge not exceeding 50 mA at 25°C)
<sup>2</sup> Dissipation Factor (DF) Maximum Limit at 25°C:	X7R: 2.0% COG: 0.15%
<sup>3</sup> Insulation Resistance (IR) Limit at 25°C:	1,000 MΩ microfarads or 100 GΩ (Rated voltage applied for 120 ±5 seconds)

<sup>1</sup> DWV is the voltage a capacitor can withstand (survive) for a short period of time.

It exceeds the nominal and continuous working voltage of the capacitor.

<sup>2</sup> See part number specification sheet for frequency and voltage for Capacitance, Dissipation Factor and TCC measurement conditions.

<sup>3</sup> To obtain IR limit, divide MΩ-μF value by the capacitance and compare to GΩ limit. Select the lower of the two limits.

Note: When measuring capacitance, it is important to ensure the set voltage level is held constant. The HP4284 and Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON."

## Post Environmental Limits

Dielectric	Rated DC Voltage	Capacitance Value	DF (%)	Capacitance Shift	IR
COG	All	All	0.25	0.3% or ±0.50 pF	10% of Initial Limit
X7R	All	All	3.0	±20%	10% of Initial Limit

## Packaging Quantities

Style	Waffle Pack Quantity	Style	Waffle Pack Quantity
TCR05	56	TCA16	25
TRR05	56	TRA16	25
TCR06	28	TCA25	25
TRR06	28	TRA25	25
TCR07	28	TCA39	25
TRR07	28	TRA39	25
TCR08	20	TCA50	25
TRR08	20	TRA50	25
TCR09	20	TCA69	25
TRR09	20	TRA69	25

**Table 1A – T Series COG Waterfall**

Type		AXIAL (TCA)										RADIAL (TCR)									
Style		16		25		39		50		69		05		06		07		08		09	
Voltage		50	100	50	100	50	100	50	100	50	100	50	100	50	100	50	100	50	100	50	100
Capacitance	Capacitance Code																				
5.6 pF	569											X	X								
6.8 pF	689											X	X								
8.2 pF	829											X	X								
10 pF	100	X	X									X	X								
12 pF	120	X	X									X	X								
15 pF	150	X	X									X	X								
18 pF	180	X	X									X	X								
22 pF	220	X	X									X	X								
27 pF	270	X	X									X	X								
33 pF	330	X	X									X	X								
39 pF	390	X	X									X	X								
47 pF	470	X	X									X	X								
56 pF	560	X	X	X	X							X	X								
68 pF	680	X	X	X	X							X	X								
82 pF	820	X	X	X	X							X	X								
100 pF	101	X	X	X	X							X	X								
120 pF	121	X	X	X	X							X	X								
150 pF	151	X	X	X	X							X	X								
180 pF	181	X	X	X	X	X	X					X	X								
220 pF	221	X	X	X	X	X	X					X	X								
270 pF	271	X	X	X	X	X	X					X	X	X	X	X	X	X	X	X	X
330 pF	331	X	X	X	X	X	X					X	X	X	X	X	X	X	X	X	X
390 pF	391	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X
470 pF	471	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X
560 pF	561	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X
680 pF	681	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X
820 pF	821			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1,000 pF	102			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1,200 pF	122			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1,500 pF	152			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1,800 pF	182			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2,200 pF	222			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2,700 pF	272			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3,300 pF	332			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3,900 pF	392			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4,700 pF	472			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5,600 pF	562					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6,800 pF	682					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
8,200 pF	822					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
10,000 pF	103					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
12,000 pF	123					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
15,000 pF	153					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
18,000 pF	183							X	X	X	X			X	X	X	X	X	X	X	X
22,000 pF	223							X	X	X	X			X	X	X	X	X	X	X	X
27,000 pF	273							X	X	X	X			X	X	X	X	X	X	X	X
33,000 pF	333							X	X	X	X			X	X	X	X	X	X	X	X
39,000 pF	393							X	X	X	X					X	X	X	X	X	X
47,000 pF	473									X	X					X	X	X	X	X	X
56,000 pF	563									X	X					X	X	X	X	X	X
68,000 pF	683									X	X					X	X	X	X	X	X
82,000 pF	823									X	X							X	X	X	X
0.1 uF	104									X	X							X	X	X	X
0.12 uF	124									X	X									X	X
0.15 uF	154									X	X									X	X
Voltage		50	100	50	100	50	100	50	100	50	100	50	100	50	100	50	100	50	100	50	100
Style		16		25		39		50		69		05		06		07		08		09	
Type		Axial (TCA)										Radial (TCR)									

**Table 1B – T Series X7R Waterfall**

Type		AXIAL (TRA)										RADIAL (TRR)									
Style		16		25		39		50		69		05		06		07		08		09	
Voltage		50	100	50	100	50	100	50	100	50	100	50	100	50	100	50	100	50	100	50	100
Capacitance	Capacitance Code																				
100 pF	101	X	X	X	X							X	X								
120 pF	121	X	X	X	X							X	X								
150 pF	151	X	X	X	X							X	X								
180 pF	181	X	X	X	X	X	X					X	X								
220 pF	221	X	X	X	X	X	X					X	X								
270 pF	271	X	X	X	X	X	X					X	X	X	X	X	X				
330 pF	331	X	X	X	X	X	X					X	X	X	X	X	X				
390 pF	391	X	X	X	X	X	X	X	X			X	X	X	X	X	X				
470 pF	471	X	X	X	X	X	X	X	X			X	X	X	X	X	X				
560 pF	561	X	X	X	X	X	X	X	X			X	X	X	X	X	X				
680 pF	681	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X
820 pF	821	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1,000 pF	102	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1,200 pF	122	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1,500 pF	152	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1,800 pF	182	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2,200 pF	222	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2,700 pF	272	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3,300 pF	332	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3,900 pF	392	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4,700 pF	472	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5,600 pF	562	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6,800 pF	682	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
8,200 pF	822	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
10,000 pF	103	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
12,000 pF	123	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
15,000 pF	153	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
18,000 pF	183			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
22,000 pF	223			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
27,000 pF	273			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
33,000 pF	333			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
39,000 pF	393			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
47,000 pF	473			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
56,000 pF	563			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
68,000 pF	683			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
82,000 pF	823			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0.1 uF	104			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0.12 uF	124			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0.15 uF	154					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0.18 uF	184					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0.22 uF	224					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0.27 uF	274					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0.33 uF	334					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0.39 uF	394							X	X	X	X	X	X	X	X	X	X	X	X	X	X
0.47 uF	474							X	X	X	X	X	X	X	X	X	X	X	X	X	X
0.56 uF	564							X	X	X	X	X	X	X	X	X	X	X	X	X	X
0.68 uF	684							X	X	X	X	X	X	X	X	X	X	X	X	X	X
0.82 uF	824							X	X	X	X		X	X	X	X	X	X	X	X	X
1 uF	105							X	X	X	X		X	X	X	X	X	X	X	X	X
1.2 uF	125							X	X	X	X				X	X	X	X	X	X	X
1.5 uF	155							X	X	X	X				X	X	X	X	X	X	X
1.8 uF	185							X	X	X	X				X	X	X	X	X	X	X
2 uF	205							X	X	X	X						X	X	X	X	X
2.2 uF	225									X	X						X	X	X	X	X
2.7 uF	275									X	X						X	X	X	X	X
3.3 uF	335									X	X						X	X	X	X	X
3.9 uF	395																X	X	X	X	X
Voltage		50	100	50	100	50	100	50	100	50	100	50	100	50	100	50	100	50	100	50	100
Style		16		25		39		50		69		05		06		07		08		09	
Type		Axial (TRA)										Radial (TRR)									

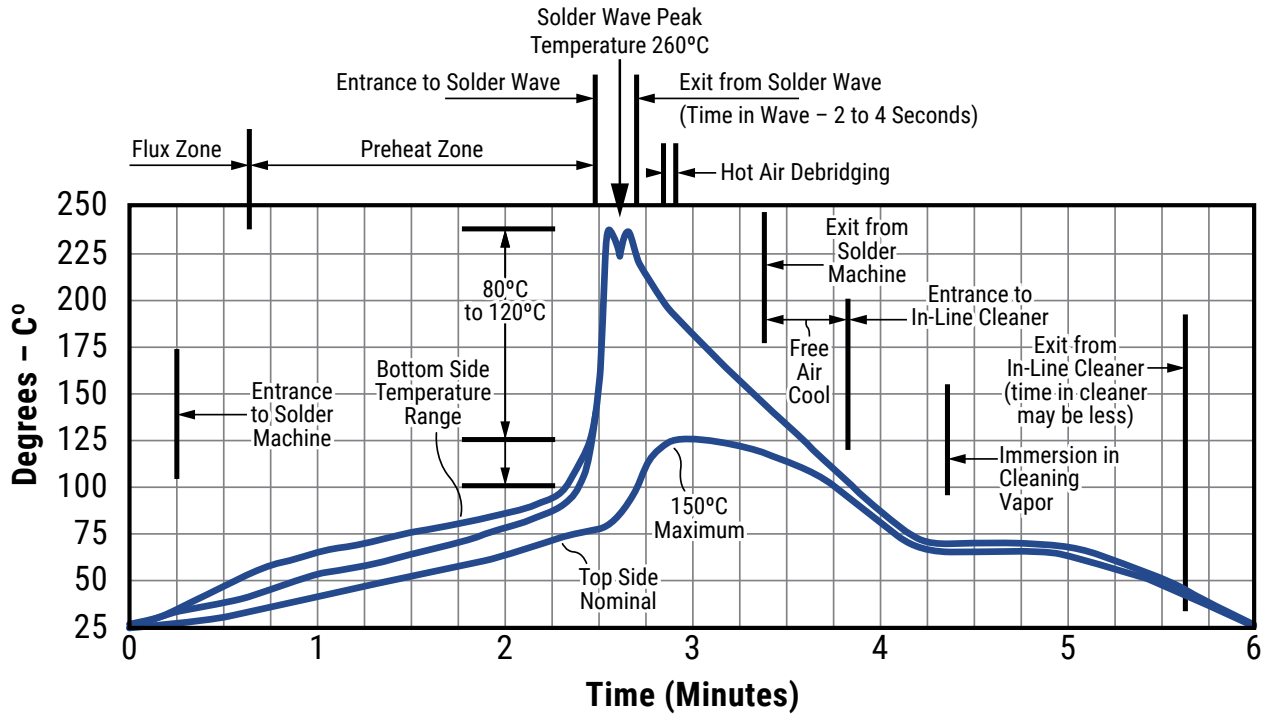
## Soldering Process

### Recommended Soldering Technique:

- Solder Wave
- Hand Soldering (Manual)

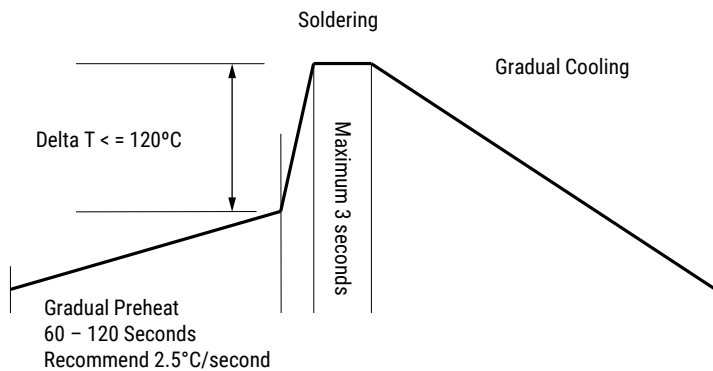
### Recommended Soldering Profile:

- Optimum Wave Solder Profile



- Hand Soldering (Manual)

### Manual Solder Profile with Pre-heating



KEMET recommends following the guidelines and techniques outlined in technical bulletins F2103 and F9207.

**Table 2 – Performance & Reliability: Test Methods and Conditions**

Stress	Reference	Test Condition	Limits
Visual & Mechanical	KEMET Internal	No defects that may affect performance (10X)	Dimensions according KEMET Spec Sheet
Capacitance (Cap)	MIL-STD-202 Method 305	C ≤ 100 pF: 1 MHz ± 100 kHz and 1.0 ± 0.2 V <sub>RMS</sub> C > 100 pF: 1 kHz ± 100 Hz and 1.0 ± 0.2 V <sub>RMS</sub>	Dimensions according KEMET Spec Sheet
Dissipation Factor (DF)	KEMET Internal	C ≤ 100 pF: 1 MHz ± 100 kHz and 1.0 ± 0.2 V <sub>RMS</sub> C > 100 pF: 1 kHz ± 100 Hz and 1.0 ± 0.2 V <sub>RMS</sub>	X7R: 2.5% C0G: 0.15%
Insulation Resistance (IR)	MIL-STD-202 Method 302	Test potential: 500 V DC between capacitor element terminals Surge current: limited to 30mA Special condition: If failure at relative humidity of ≥ 50%, IR may be measured again at a relative humidity of less than 50%	Within Specification To obtain IR limit, divide MΩ-μF value by the capacitance and compare to GΩ limit. Select the lower of the two limits.  At 25°C: 100,000 megohms or 1,000 Megohm-microfarad, whichever is less. At 125°C: 10,000 megohms or 100 Megohm-microfarad, whichever is less.
Temperature Coefficient of Capacitance (TCC)	KEMET Internal	C0G: 0 ppm/°C ± 30 ppm/°C X7R (R or Z): ±15%	Within Specification
Temperature Coefficient of Capacitance at Applied Voltage (TCVC)	KEMET Internal	C0G: 0 ppm/°C ± 30 ppm/°C X7R: +15%/-70%	C0G: Within Specification X7R: Within KEMET Specification limits
Dielectric Withstanding Voltage (DWV)	KEMET Internal	150% of rated voltage for voltage rating of 500 V ≤ V < 1,000 V 120% of rated voltage for voltage rating of ≥ 1,000 V (5 ± 1 seconds and charge/discharge not exceeding 50 mA at 25°C)	Cap: Initial Limit DF: Initial Limit IR: Initial Limit  Withstand test voltage without insulation breakdown or damage.
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	KEMET Internal	Capacitance measurements (including tolerance) are indexed to a referee time of 48 or 1,000 hours. Please refer to a part number specific datasheet for referee time details.	Please refer to a part number specification sheet for specific Aging rate
Terminal Strength	MIL-STD-202 Method 211	Applied force: 5 pounds (2.3 kg)	No evidence of mechanical damage
Solderability	MIL-STD-202 Method 208	Condition: 4 hours ± 15 minutes at 155°C dry bake apply all methods Test 245 ± 5°C (SnPb & Pb-Free)	Visual Inspection. 95% coverage on termination. No leaching

**Table 2 – Performance & Reliability: Test Methods and Conditions cont.**

Stress	Reference	Test Condition	Limits
Temperature Cycling	JESD22 Method JA-104	Test condition A (5 cycles) except that in step 3, sample units shall be tested at +125°C.	Measurement at 24 hours ±4 hours after test conclusion. Cap: Initial Limit DF: Initial Limit IR: Initial Limit
Moisture Resistance	MIL-STD-202 Method 106	Number of cycles required 10, 24 hours per cycle. Steps 7a and 7b not required	Visual examination: No mechanical damage. Marking shall remain legible  Measurement at 24 hours ±4 hours after test conclusion. Within Post Environmental Limits Cap: X7R: Change not to exceed ±10% of initial measured value Cap: C0G: ±0.5 percent or 5 pF, whichever is greater, of initial measured value IR: 10% of Initial Limit of the initial +25°C requirement
Thermal Shock	MIL-STD-202 Method 107	Number of cycles required 5, (-55°C to 125°C) Dwell time 15 minutes.	Cap: Initial Limit DF: Initial Limit IR: Initial Limit
High Temperature Life	MIL-STD-202 Method 108	2,000 hours at +125°C, +4°C, -0°C. With rated voltage, ±5 percent.	Within Post Environmental Limits Visual examination: No mechanical damage. Marking shall remain legible. IR: (at +25°C): Shall not be less than 30 percent of the value specified IR: (at elevated ambient temperature): Shall not be less than 30 percent of the value specified
Storage Life		1,000 hours at 125°C, Unpowered	
Vibration	MIL-STD-202 Method 204	5 g's for 20 minutes, 12 cycles each of 3 orientations. Test from 10 – 2,000 Hz	Cap: Initial Limit DF: Initial Limit IR: Initial Limit
Mechanical Shock	MIL-STD-202 Method 213	1,500 g's 0.5 ms Half-sine, Velocity Change 15.4 feet/second (Condition F)	Cap: Initial Limit DF: Initial Limit IR: Initial Limit
Resistance to Solvents	MIL-STD-202 Method 215	Add Aqueous wash chemical OKEMCLEAN (A 6% concentrated Oakite cleaner) or equivalent. Do not use banned solvents	Capacitors shall be visually examined for evidence of mechanical damage and marking.

## Storage & Handling

The un-mounted storage life of a leaded ceramic capacitor is dependent upon storage and atmospheric conditions as well as packaging materials. While the ceramic chips enveloped under the epoxy coating themselves are quite robust in most environments, solderability of the wire lead on the final epoxy-coated product will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature and exposure to direct sunlight—reels may soften or warp, and tape peel force may increase.

KEMET recommends storing the un-mounted capacitors in their original packaging, in a location away from direct sunlight, and where the temperature and relative humidity do not exceed 40 degrees centigrade and 70% respectively. For optimum solderability, capacitor stock should be used promptly, preferably within 18 months of receipt. For applications requiring pre-tinning of components, storage life may be extended if solderability is verified. Before cleaning, bonding or molding these devices, it is important to verify that your process does not affect product quality and performance. KEMET recommends testing and evaluating the performance of a cleaned, bonded or molded product prior to implementing and/or qualifying any of these processes.

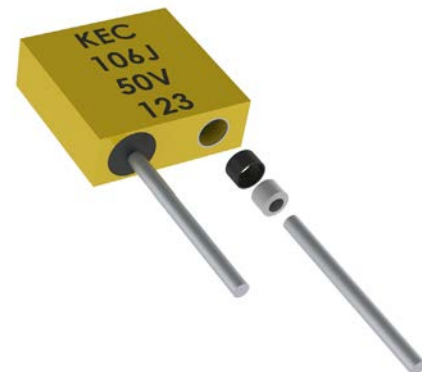
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## Construction

Axial

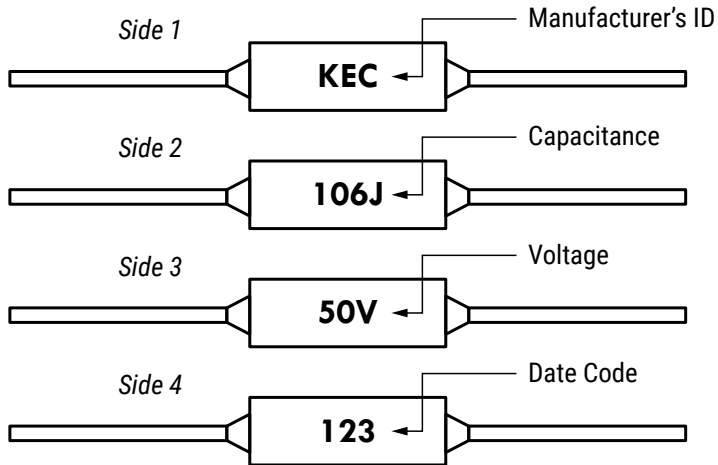


Radial

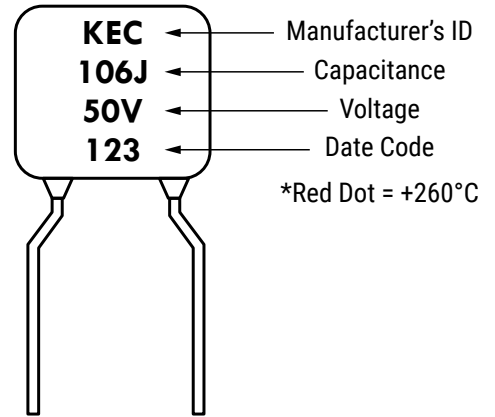


## Marking

### Axial



### Radial



## KEMET Electronics Corporation Sales Offices

For a complete list of our global sales offices, please visit [www.kemet.com/sales](http://www.kemet.com/sales).

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### Disclaimer

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Although KEMET designs and manufactures its products to the most stringent quality and safety standards, given the current state of the art, isolated component failures may still occur. Accordingly, customer applications which require a high degree of reliability or safety should employ suitable designs or other safeguards (such as installation of protective circuitry or redundancies) in order to ensure that the failure of an electrical component does not result in a risk of personal injury or property damage.

Although all product-related warnings, cautions and notes must be observed, the customer should not assume that all safety measures are indicated or that other measures may not be required.

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