Radial Leaded Multilayer Ceramic Capacitors

HV Series, Radial, Conformally Coated, High Temperature 200°C, 500 – 4,000 VDC (Industrial Grade)

Overview

KEMET's High Voltage and High Temperature 200ºC HV Series radial conformally coated ceramic capacitors are designed specifically to withstand the severe shock and vibration conditions associated with deep-well and horizontal drilling activities and are well suited for use in aerospace engine compartments, geophysical probes, EV charging stations and defense applications.

Available in C0G and X7R dielectrics, these devices are well suited for timing, resonant, bypass, and decoupling applications.

Benefits

- Operating temperature range of –55°C to +200°C
- High shock and vibration capability
- Capacitance range from 820 pF – 0.1 µF in X7R
- Capacitance range from 10 pF – 0.047 µF in C0G
- DC voltage ratings of 500 V, 1 kV, 2 kV, 3 kV, 4 kV
- High thermal stability
- Encapsulation meets flammability standard UL 94 V–0
- High-temperature solder meets EIA RS-198, Method 302, Condition B

Applications

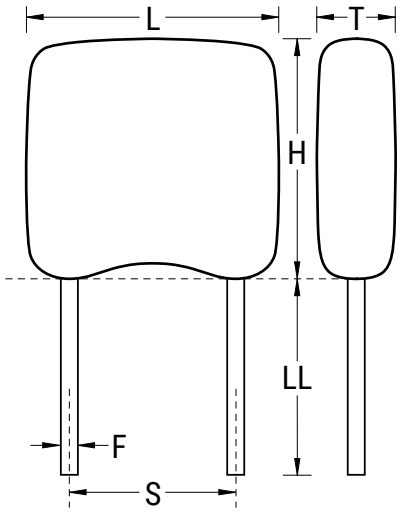
- Downhole exploration and mining
- Aerospace engine compartments
- Electric ballast
- Measuring equipment
- Inverter power supply

Ordering Information

10	HV	12	N	472	K	N	M	
Voltage	Series	Style/Size	Dielectric	Capacitance Code (pF)	Capacitance Tolerance[1]	Lead Wire Barrier Layer[2]	Test Level	Packaging
05 = 500 V 10 = 1,000 V 20 = 2,000 V 30 = 3,000 V 40 = 4,000 V	HV	10 11 12 13 14 15 16	B, W = X7R type N = C0G (NP0)	Two significant digits and number of zeros	J = ±5% K = ±10% M = ±20%	N = Nickel C = Copper	M = MIL-PRF-49467 Group A Screening	Blank = Waffle Tray

[1] *Additional capacitance tolerance offerings may be available. Contact KEMET for details.*
[2] *Please refer to the Construction section in the datasheet.*

Dimensions – Inches (Millimeters)



Series	Style/ Size	Length (L)	Height (H)	Thickness (T)	Lead Spacing ±0.030 (S)	Lead Diameter (F)	Lead Length Minimum (LL)
HV	10	0.250 (6.35)	0.220 (5.59)	0.150 (3.81)	0.170 (4.32)	0.025 +0.004/−0.002 (0.635 +0.102/−0.051)	0.125 (3.175)
	11	0.320 (8.13)	0.300 (7.62)	0.250 (6.35)	0.200 (5.08)		
	12	0.420 (10.67)	0.400 (10.16)	0.250 (6.35)	0.300 (7.62)		
	13	0.520 (13.21)	0.500 (12.7)	0.300 (7.62)	0.400 (10.16)		
	14	0.620 (15.75)	0.500 (12.7)	0.300 (7.62)	0.500 (12.7)		
	15	0.720 (18.29)	0.700 (17.78)	0.300 (7.62)	0.600 (15.24)		
	16	0.820 (20.83)	0.700 (17.78)	0.350 (8.89)	0.700 (17.78)		

Environmental Compliance

RoHS exemptions 7a & 7c-II apply to HV series parts that have nickel barrier layer leads.
All other parts are Not RoHS Compliant.

Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range:	−55°C to +200°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC):	X7R: ±15% (−55°C to +125°C), +15%/−40% (−55°C to 200°C) C0G: ±30 PPM/°C
Aging Rate (Maximum % Cap Loss/Decade Hour):	X7R: 2.0%/decade hour C0G: 0%
[1]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)
[2]Dissipation Factor (DF) Maximum Limit at 25°C:	X7R: 2.0% C0G: 0.15%
[3]Insulation Resistance (IR) Limit at 25°C:	1,000 MΩ microfarads or 100 GΩ (Rated voltage applied for 120±5 seconds)

[1] 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.
[2] See part number specification sheet for frequency and voltage for Capacitance, Dissipation Factor and TCC measurement conditions.
[3] 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
C0G	All	All	0.25	0.3% or ±0.50 pF	10% of Initial Limit
X7R	All	All	3.0	±20%	10% of Initial Limit

Table 1A – HV 200°C Series X7R Waterfall

Style		HV10			HV11			HV12			HV13			
Voltage		500	1k	2k	500	1k	2k	500	1k	2k	500	1k	2k	3k
Capacitance	Capacitance Code													
820 pf	821	X	X	X	X	X	X							
1,000 pf	102	X	X	X	X	X	X							
1,200 pf	122	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
1,800 pf	182	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
2,700 pf	272	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
3,900 pf	392	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
5,600 pf	562	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
8,200 pf	822	X	X		X	X	X	X	X	X	X	X	X	X
0.01 µF	103	X	X		X	X	X	X	X	X	X	X	X	X
0.012 µF	123	X			X	X	X	X	X	X	X	X	X	X
0.015 µF	153	X			X	X		X	X	X	X	X	X	X
0.018 µF	183	X			X	X		X	X	X	X	X	X	X
0.022 µF	223	X			X	X		X	X	X	X	X	X	X
0.027 µF	273	X			X	X		X	X	X	X	X	X	X
0.033 µF	333	X			X	X		X	X	X	X	X	X	
0.039 µF	393				X	X		X	X		X	X	X	
0.047 µF	473				X	X		X	X		X	X	X	
0.056 µF	563				X	X		X	X		X	X	X	
0.068 µF	683				X	X		X	X		X	X	X	
0.082 µF	823				X			X	X		X	X	X	
0.1 µF	104				X			X	X		X	X		
0.12 µF	124				X			X	X		X	X		
0.15 µF	154				X			X	X		X	X		
0.18 µF	184				X			X			X	X		
0.22 µF	224							X			X	X		
0.27 µF	274							X			X	X		
0.33 µF	334							X			X	X		
0.39 µF	394										X	X		
0.47 µF	474										X			
0.56 µF	564										X			
0.68 µF	684										X			
0.82 µF	824										X			
0.1 µF	105													
0.033 µF	333									X	X	X		X
0.039 µF	393									X	X	X		X
0.047 µF	473													X
0.056 µF	563													X
0.068 µF	683													X
0.082 µF	823													X
0.1 µF	104													X
Voltage		500	1k	2k	500	1k	2k	500	1k	2k	500	1k	2k	3k
Style		HV10			HV11			HV12			HV13			

Table 1A – HV 200°C Series X7R Waterfall cont.

Style		HV14					HV15					HV16				
Voltage		500	1k	2k	3k	4k	500	1k	2k	3k	4k	500	1k	2k	3k	4k
Capacitance	Capacitance Code															
1,800 pf	182											X	X	X	X	X
2,200 pf	222	X	X	X	X	X						X	X	X	X	X
2,700 pf	272	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
3,900 pf	392	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
5,600 pf	562	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
8,200 pf	822	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0.01 µF	103	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0.012 µF	123	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0.015 µF	153	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0.018 µF	183	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0.022 µF	223	X	X	X	X	X	X	X	X	X		X	X	X	X	X
0.027 µF	273	X	X	X	X	X	X	X	X	X		X	X	X		
0.033 µF	333	X	X	X	X		X	X	X	X		X	X	X		
0.039 µF	393	X	X	X	X		X	X	X	X		X	X	X		
0.047 µF	473	X	X	X			X	X	X			X	X	X		
0.056 µF	563	X	X	X			X	X	X			X	X	X		
0.068 µF	683	X	X	X			X	X	X			X	X	X		
0.082 µF	823	X	X	X			X	X	X			X	X	X		
0.1 µF	104	X	X	X			X	X	X			X	X	X		
0.12 µF	124	X	X				X	X				X	X			
0.15 µF	154	X	X				X	X				X	X			
0.18 µF	184	X	X				X	X				X	X			
0.22 µF	224	X	X				X	X				X	X			
0.27 µF	274	X	X				X	X				X	X			
0.33 µF	334	X	X				X	X				X	X			
0.39 µF	394	X	X				X	X				X	X			
0.47 µF	474	X					X	X				X	X			
0.56 µF	564	X					X					X	X			
0.68 µF	684	X					X					X				
0.82 µF	824	X					X					X				
0.1 µF	105	X					X					X				
Voltage		500	1k	2k	3k	4k	500	1k	2k	3k	4k	500	1k	2k	3k	4k
Style		HV14					HV15					HV16				

Table 1B – HV 200°C Series C0G Waterfall

Style		HV10			HV11				HV12				HV13			
Voltage		500	1k	2k	500	1k	2k	3k	500	1k	2k	3k	500	1k	2k	3k
Capacitance	Capacitance Code															
10 pf	100		X													
12 pf	120		X													
15 pf	150		X	X												
18 pf	180		X	X												
22 pf	220		X	X			X	X								
27 pf	270	X	X	X			X	X			X	X				
33 pf	330	X	X	X			X	X			X	X				
39 pf	390	X	X	X	X	X	X	X			X	X				
47 pf	470	X	X	X	X	X	X	X	X	X	X	X				
56 pf	560	X	X	x	X	X	X	X	X	X	X	X				
68 pf	680	X	X	X	X	X	X	X	X	X	X	X				
82 pf	820	X	X	X	X	X	X	X	X	X	X	X				
100 pf	101	X	X	X	X	X	X	X	X	X	X	X		X	X	X
120 pf	121	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
150 pf	151	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
180 pf	181	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
220 pf	221	X	X	X	X	X	X	X	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
330 pf	331	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
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
820 pf	821	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
1,200 pf	122	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
1,800 pf	182	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
2,700 pf	272	X			X	X			X	X	X		X	X	X	X
3,300 pf	332				X	X			X	X	X		X	X	X	X
3,900 pf	392				X	X			X	X	X		X	X	X	X
4,700 pf	472				X	X			X	X	X		X	X	X	X
5,600 pf	562								X	X			X	X	X	
6,800 pf	682								X	X			X	X	X	
8,200 pf	822								X				X	X	X	
0.01 µF	103								X				X	X		
0.012 µF	123												X	X		
0.015 µF	153												X	X		
Voltage		500	1k	2k	500	1k	2k	3k	500	1k	2k	3k	500	1k	2k	3k
Style		HV10			HV11				HV12				HV13			

Table 1B – HV 200°C Series C0G Waterfall cont.

Style		HV14					HV15					HV16				
Voltage		500	1k	2k	3k	4k	500	1k	2k	3k	4k	500	1k	2k	3k	4k
Capacitance	Capacitance Code															
82 pf	820					X										
100 pf	101			X	X	X						X	X	X	X	X
120 pf	121			X	X	X						X	X	X	X	X
150 pf	151	X	X	X	X	X						X	X	X	X	X
180 pf	181	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
220 pf	221	X	X	X	X	X	X	X	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
330 pf	331	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
470 pf	471	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
680 pf	681	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
1,000 pf	102	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
1,500 pf	152	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	
2,200 pf	222	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	
3,300 pf	332	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	
4,700 pf	472	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	
6,800 pf	682	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	
0.01 µF	103	X	X	X			X	X	X	X		X	X	X	X	
0.012 µF	123	X	X				X	X	X			X	X	X		
0.015 µF	153	X	X				X	X	X			X	X	X		
0.018 µF	183	X	X				X	X	X			X	X	X		
0.022 µF	223	X	X				X	X				X	X	X		
0.027 µF	273						X	X				X	X			
0.033 µF	333						X	X				X	X			
0.039 µF	393						X	X				X	X			
0.047 µF	473						X	X				X	X			
Voltage		500	1k	2k	3k	4k	500	1k	2k	3k	4k	500	1k	2k	3k	4k
Style		HV14					HV15					HV16				

Packaging Quantities

Style	Waffle Pack Quantity
HV 10	56
HV 11	28
HV 12	28
HV 13	28
HV 14	20
HV 15	20
HV 16	20

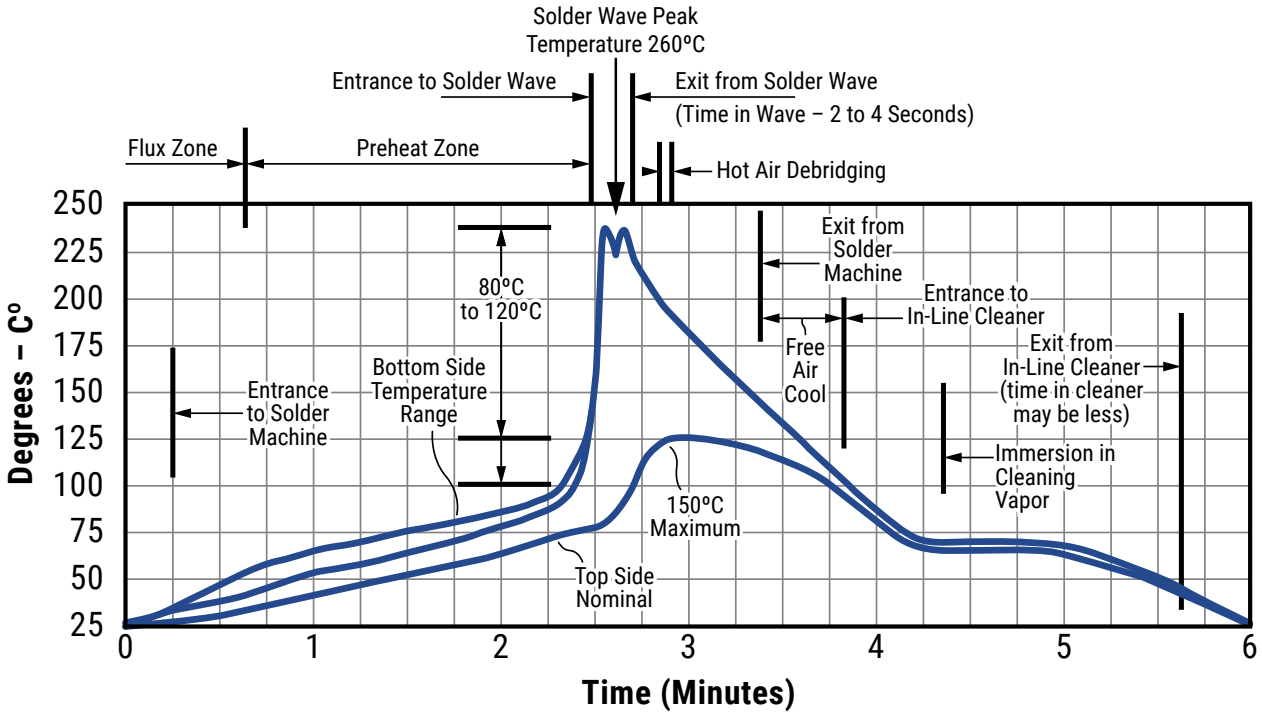
Soldering Process

Recommended Soldering Technique:

- Solder Wave
- Hand Soldering (Manual)

Recommended Soldering Profile:

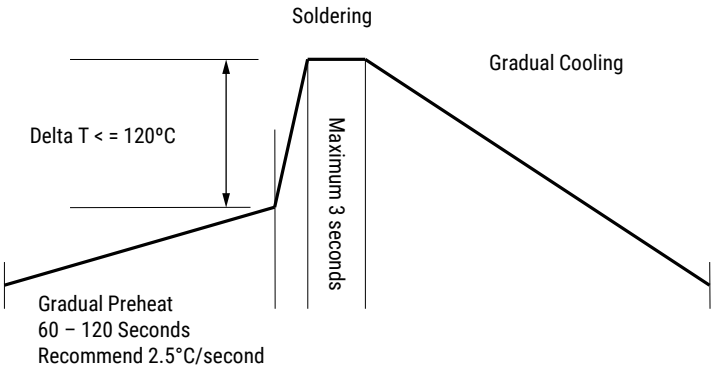
- Optimum Wave Solder Profile



Soldering Process cont.

- 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

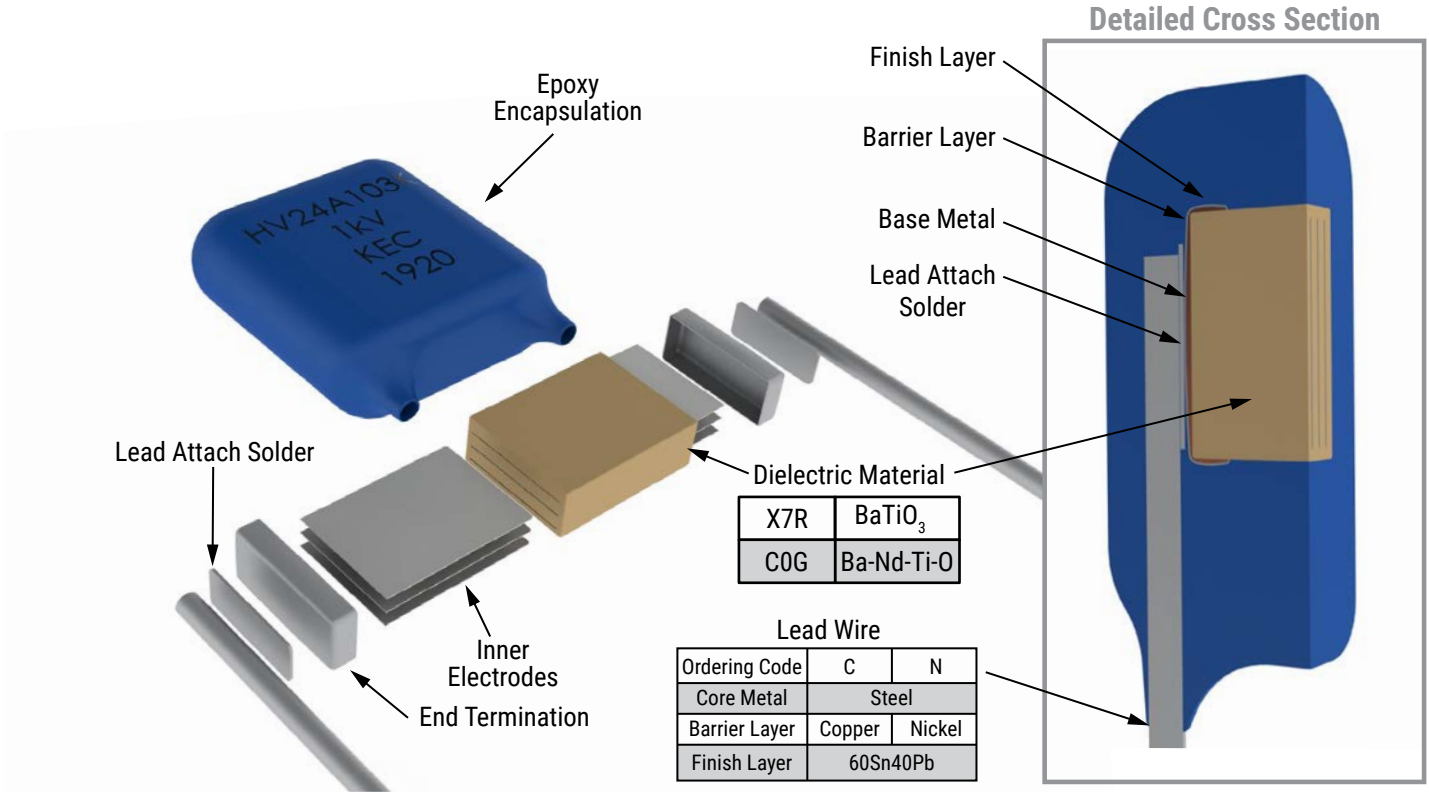
Stress	Reference	Test or Inspection Method
Solderability	J–STD–002	Method A at 235°C, category 3
Temperature Cycling	JESD22 Method JA–104	50 cycles (–55°C to 220°C), measurement at 24 ±4 hours after test conclusion. 30 minutes maximum dwell time at each temperature extreme. 8 minutes maximum transition time.
Biased Humidity	MIL–STD–202 Method 103	Load humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 kΩ resistor. Measurement at 24 hours ±4 hours after test conclusion.
		Low volt humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 kΩ resistor. Measurement at 24 hours ±4 hours after test conclusion.
Immersion	MIL–STD–202 Method 104	Test condition B
Storage Life	MIL–STD–202 Method 108	Unpowered 1,000 hours at 200°C. Measurement at 24 hours ±4 hours after test conclusion. IR Measurement at 150°C
High Temperature Life	MIL–STD–202 Method 108	1,000 hours at 200°C with rated voltage applied.
High Temperature Lead Pull	KEMET Internal	Peel to Failure (200°C): 4 lbs (1.84 kg) minimum
Vibration	MIL–STD–202 Method 204	5g for 20 minutes, 12 cycles each of 3 orientations. Note: Use 8" X 5" PCB. 031" thick 7 secure points on one long side and 2 secure points at corners of opposite sides. Parts mounted within 2" from any secure point. Test from 10 – 2000 Hz.
Resistance to Soldering Heat	MIL–STD–202 Method 210	Test Condition B, Solder dip. Note: no preheat of samples.
Terminal Strength	MIL–STD–202 Method 211	Test Condition A. 454 g for 5 – 10 seconds; Bend test at 227 g, 3 bends
Mechanical Shock	MIL–STD–202 Method 213	Test Condition C. Figure 1 of Method 213.
Resistance to Solvents	MIL–STD–202 Method 215	Add aqueous wash chemical – OKEM Clean or equivalent.

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.

Construction



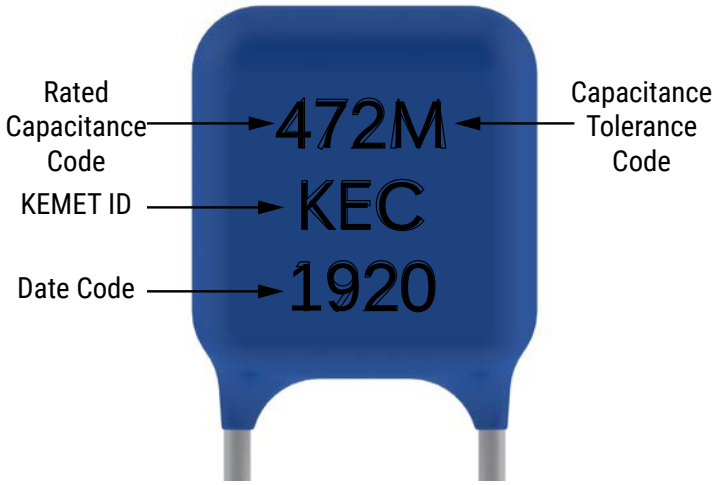
X7R	$BaTiO_3$
C0G	Ba-Nd-Ti-O

Lead Wire

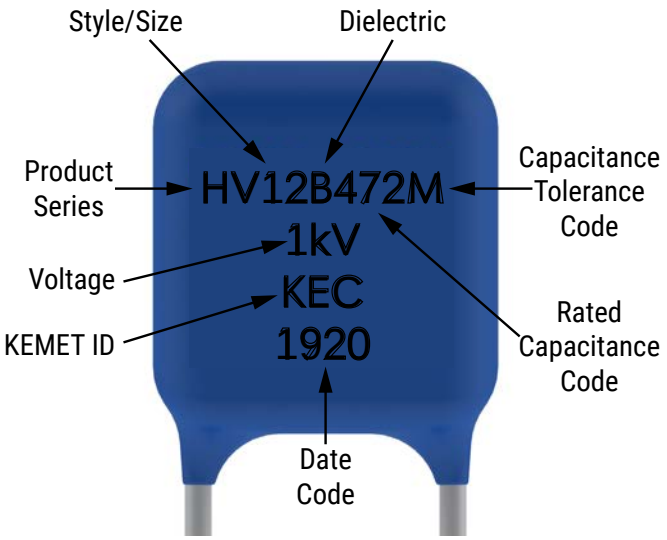
Ordering Code	C	N
Core Metal	Steel	
Barrier Layer	Copper	Nickel
Finish Layer	60Sn40Pb	

Marking

HV10, HV11



All Other Sizes



Date Code	
19	20
Manufacturing Year: 19 = 2019	Manufacturing Week: 20 = Week 20 (of manufacturing calendar year)

KEMET Electronics Corporation Sales Offices

For a complete list of our global sales offices, please visit www.kemet.com/sales.

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