Radial Leaded Multilayer Ceramic Capacitors

HV Series, Radial, Conformally Coated, MIL-PRF-49467 Screened, 500 – 5,000 VDC (Industrial Grade)

Overview

KEMET's High Voltage HV MIL-PRF-49467 Screened Series are conformally coated radial leaded ceramic capacitors designed with C0G and X7R dielectrics which feature a 125°C maximum operating temperature. These devices are made using robust designs and screened to MIL-PRF-49467 Group A to meet the demands of higher reliability applications. Group B is available upon request. The ideal applications for these devices are high voltage power supplies, DC/DC conversion and well suited for timing, resonant, bypass, and decoupling applications. These high voltage capacitors are widely used in industries related to aerospace, semiconductors, telecommunications and power/grid.

The High Voltage HV MIL-PRF-49467 Screened Series is part of KEMET's Harsh Environment PME (Precious Metal Electrode) portfolio which is ideal for industrial and high reliability applications.

Benefits

- Operating temperature range of −55°C to +125°C
- High shock and vibration capability
- Capacitance range from 270 pF – 0.47 µF in X7R
- Capacitance range from 12 pF – 0.047 µF in C0G
- DC voltage ratings of 500 V, 600 V, 1 kV, 2 kV, 3 kV, 4 kV, 5 kV
- High thermal stability
- Encapsulation meets flammability standard UL 94 V–0

Applications

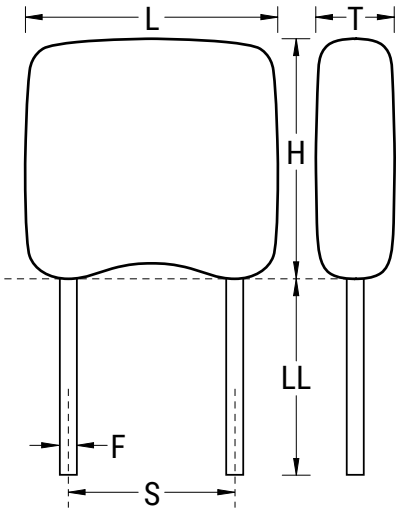
- Downhole exploration and mining
- Aerospace engine compartments
- Switch mode power supplies
- DC/DC Converters
- Measuring equipment
- Inverters
- High voltage coupling

Ordering Information

10	HV	60		R	102	K	C
Voltage	Series	Style/Size		Dielectric	Capacitance Code (pF)	Capacitance Tolerance[1]	Test Level
05 = 500 V 06 = 600 V 10 = 1,000 V 20 = 2,000 V 30 = 3,000 V 40 = 4,000 V 50 = 5,000 V	HV	60 61 62 63 64	65 66 68 69	P = BP C0G (NP0) R = BR (X7R) Z = BZ (X7R)	Two significant digits and number of zeros	J = ±5% (C0G only) K= ±10% M = ±20%	C = CSAM

[1] *Additional capacitance tolerance offerings may be available. Contact KEMET for details.*

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	60	0.250 (6.35)	0.220 (5.59)	0.200 (5.08)	0.170 (4.32)	0.025 +0.004/−0.002 (0.635 +0.102/−0.051)	1.25 (31.75)
	61	0.320 (8.13)	0.280 (7.11)	0.250 (6.35)	0.220 (5.59)		
	62	0.370 (9.40)	0.300 (7.62)	0.250 (6.35)	0.275 (6.99)		
	63	0.470 (11.94)	0.400 (10.16)	0.270 (6.89)	0.375 (9.53)		
	64	0.570 (14.48)	0.500 (12.70)	0.270 (6.89)	0.475 (12.07)		
	65	0.670 (17.02)	0.600 (15.24)	0.270 (6.89)	0.575 (14.61)		
	66	0.770 (19.56)	0.720 (18.29)	0.270 (6.89)	0.675 (17.15)		
	68	1.300 (33.02)	0.600 (15.24)	0.270 (6.89)	1.175 (29.84)		
	69	1.500 (38.10)	0.720 (18.29)	0.270 (6.89)	1.375 (34.92)		

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.

Table 1A – HV X7R Waterfall

Case Size		HV60			HV61				HV62				HV63					HV64						HV65					HV66					HV68			HV69		
		Voltage																																					
Capacitance (pF)	Capacitance Code	500	1,000	2,000	600	1,000	2,000	3,000	600	1,000	2,000	3,000	600	1,000	2,000	3,000	4,000	500	1,000	2,000	3,000	4,000	5,000	1,000	2,000	3,000	4,000	5,000	1,000	2,000	3,000	4,000	5,000	3,000	4,000	5,000	3,000	4,000	5,000
270 pF	271	X	X	X																																		
330 pF	331	X	X	X																																		
390 pF	391	X	X	X																																		
470 pF	471	X	X	X																																		
560 pF	561	X	X	X	X	X	X	X																														
680 pF	681	X	X	X	X	X	X	X																														
820 pF	821	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	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	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	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	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	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	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	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	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	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5,000 pF	502	X	X		X	X	X		X	X	X		X	X	X	X	X	X	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	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	X	X	X	X	X	X	X	X	X	X	X	X	X
7,500 pF	752	X	X		X	X			X	X			X	X	X			X	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	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	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	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		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			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	X	
27,000 pF	273				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	
39,000 pF	393				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		
56,000 pF	563				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		
82,000 pF	823				X	X			X				X					X	X					X	X				X	X							X		
0.10 µF	104								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									
0.18 µF	184												X					X											X	X									
0.22 µF	224												X					X																					
0.27 µF	274												X					X																					
0.33 µF	334																	X																					
0.39 µF	394																	X																					
0.47 µF	474																	X																					
Capacitance (pF)	Capacitance Code	500	1,000	2,000	600	1,000	2,000	3,000	600	1,000	2,000	3,000	600	1,000	2,000	3,000	4,000	500	1,000	2,000	3,000	4,000	5,000	1,000	2,000	3,000	4,000	5,000	1,000	2,000	3,000	4,000	5,000	3,000	4,000	5,000	3,000	4,000	5,000
Case Size		Voltage																																				
		HV60			HV61				HV62				HV63					HV64						HV65					HV66					HV68			HV69		

Table 1B – HV C0G Waterfall

Case Size		HV60			HV61				HV62				HV63					HV64						HV65					HV66				
		Voltage																															
Capacitance (pF)	Capacitance Code	500	1,000	2,000	500	1,000	2,000	3,000	500	1,000	2,000	3,000	500	1,000	2,000	3,000	4,000	600	1,000	2,000	3,000	4,000	5,000	1,000	2,000	3,000	4,000	5,000	1,000	2,000	3,000	4,000	5,000
12 pF	120	X	X	X																												
15 pF	150	X	X	X																												
18 pF	180	X	X	X																												
22 pF	220	X	X	X	X	X	X	X																								
27 pF	270	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
33 pF	330	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
39 pF	390	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
47 pF	470	X	X	X	X	X	X	X	X	X	X	X	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	X	X	X	X	X	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	X	X	X	X	X	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	X	X	X	X	X	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	X	X	X	X	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	X	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	X	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	X	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	X	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	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	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	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	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	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	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	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	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	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	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	
3,300 pF	332				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	
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		
6,800 pF	682								X				X					X	X					X					X	X	X		
7,500 pF	752								X				X					X	X					X					X	X	X		
8,200 pF	822								X				X					X	X					X					X	X	X		
10,000 pF	103												X					X	X					X					X	X			
12,000 pF	123												X					X						X					X	X			
15,000 pF	153												X					X						X					X	X			
18,000 pF	183												X					X											X	X			
22,000 pF	223																	X											X	X			
27,000 pF	273																	X															
33,000 pF	333																	X															
39,000 pF	393																	X															
47,000 pF	473																	X															
Capacitance (pF)	Capacitance Code	500	1,000	2,000	500	1,000	2,000	3,000	500	1,000	2,000	3,000	500	1,000	2,000	3,000	4,000	600	1,000	2,000	3,000	4,000	5,000	1,000	2,000	3,000	4,000	5,000	1,000	2,000	3,000	4,000	5,000
Case Size		Voltage																															
		HV60			HV61				HV62				HV63					HV64						HV65					HV66				

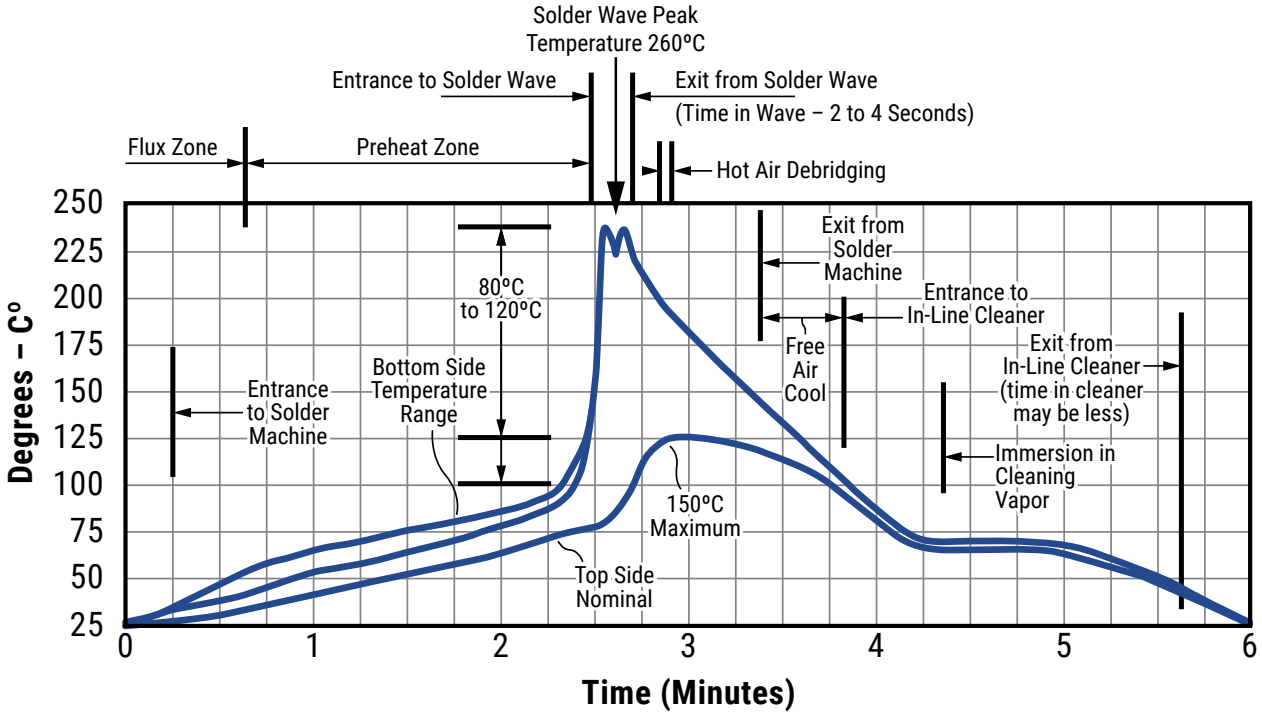
Soldering Process

Recommended Soldering Technique:

- Solder Wave
- Hand Soldering (Manual)

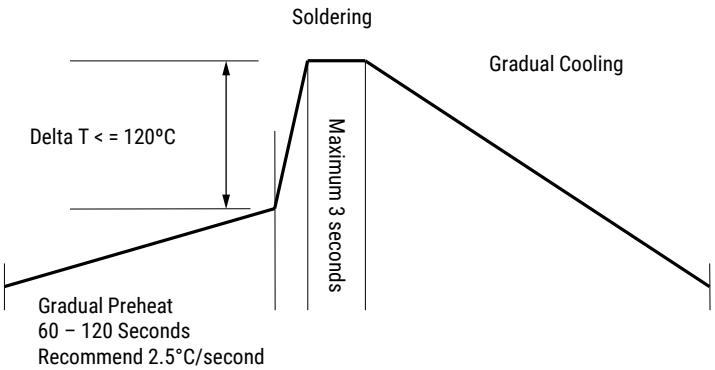
Recommended Soldering Profile:

- 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 or Inspection Method	Limits
Visual and 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 Vrms C > 100 pF: 1 kHz ±100 Hz and 1.0 ±0.2 Vrms	Dimensions according KEMET Spec Sheet
Dissipation Factor (DF)	KEMET Internal	C ≤ 100 pF: 1 MHz ± 100 kHz and 1.0 ±0.2 Vrms C > 100 pF: 1 kHz ±100 Hz and 1.0 ±0.2 Vrms	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: ±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)	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	Visual Inspection. 95% coverage on termination. No leaching
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (–55°C to +125°C) 2 - 3 cycles per hour Soak Time: 1 or 5 minutes	Measurement at 24 hours ±4 hours after test conclusion. Cap: Initial Limit DF: Initial Limit IR: Initial Limit

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

Stress	Reference	Test or Inspection Method	Limits
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	20 g's for 8 hours, 3 orientations. Test from 10 – 2,000 Hz	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 DF: Initial Limit IR: Initial Limit
Mechanical Shock	MIL-STD-202 Method 213	100 g's 6 ms Sawtooth, Velocity Change 9.7 feet/ second (Condition I)	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.

Packaging Quantities

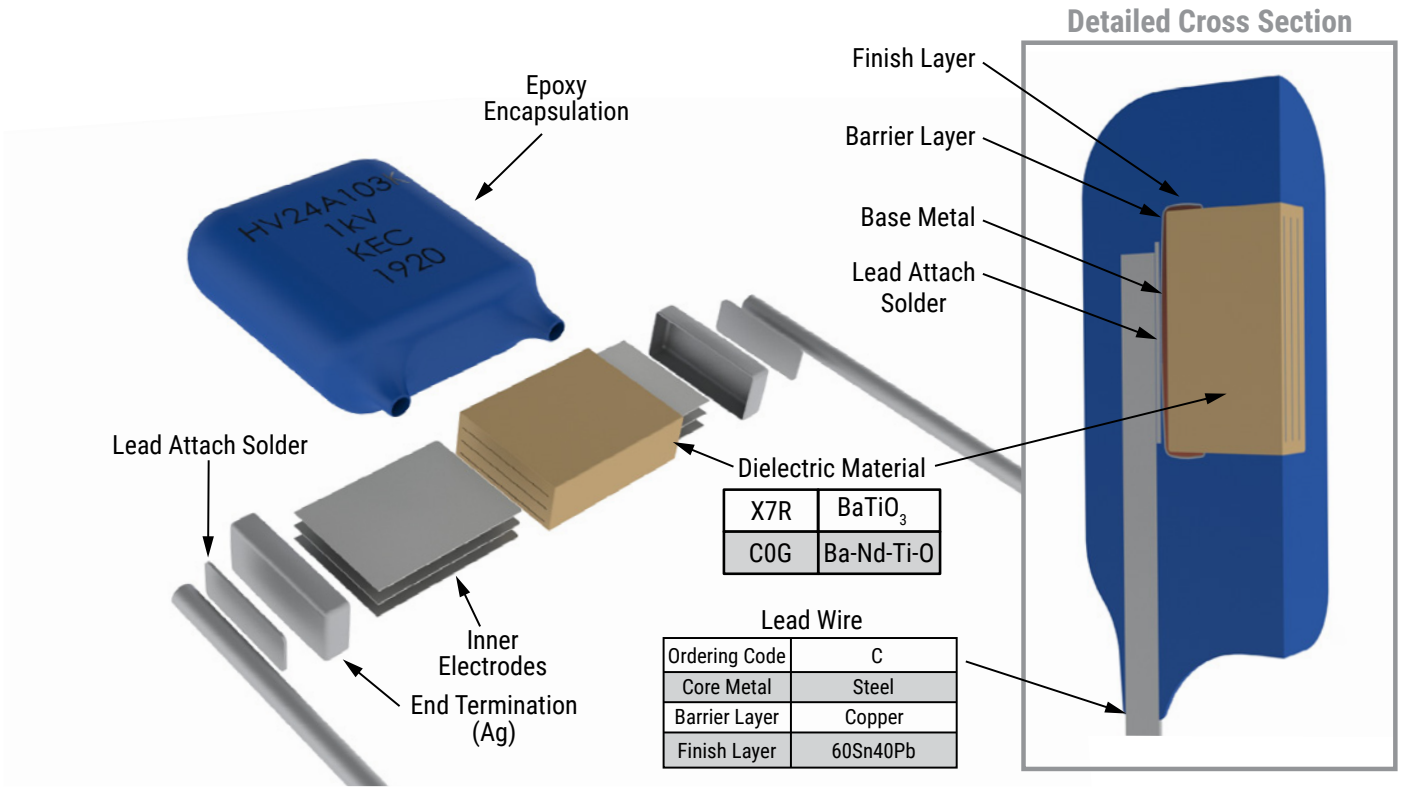
Style	Waffle Pack Quantity
HV60	28
HV61	28
HV62	28
HV63	28
HV64	20
HV65	20
HV66	20
HV68	4
HV69	4

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



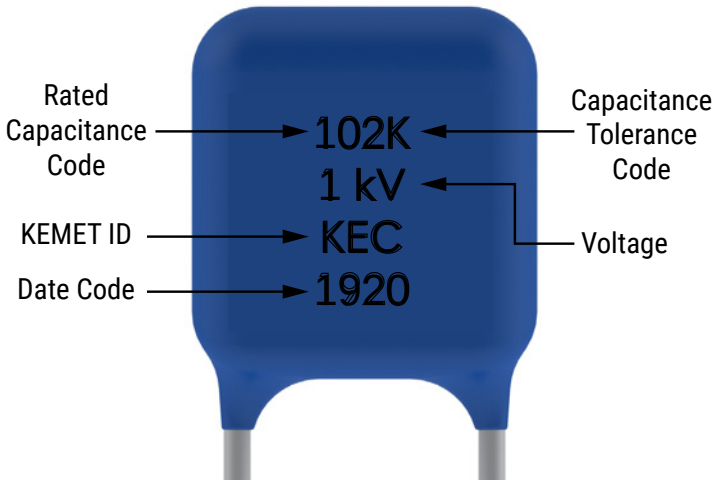
X7R	$BaTiO_3$
C0G	Ba-Nd-Ti-O

Lead Wire

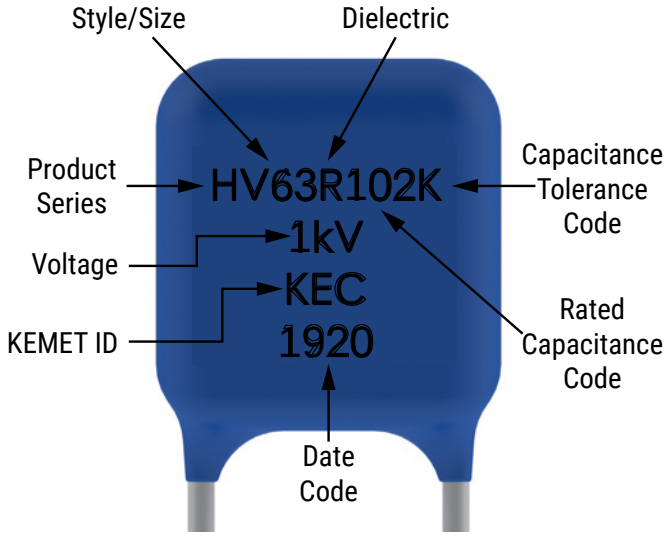
Ordering Code	C
Core Metal	Steel
Barrier Layer	Copper
Finish Layer	60Sn40Pb

Marking

HV60, HV61



All Other Sizes



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

Environmental Compliance

Industrial PME (precious metal electrode) part types are not RoHS compliant.

KEMET Electronics Corporation Sales Offices

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

Disclaimer

YAGEO Corporation and its affiliates do not recommend the use of commercial or automotive grade products for high reliability applications or manned space flight.

All product specifications, statements, information and data (collectively, the "Information") in this datasheet are subject to change. The customer is responsible for checking and verifying the extent to which the Information contained in this publication is applicable to an order at the time the order is placed. All Information given herein is believed to be accurate and reliable, but it is presented without guarantee, warranty, or responsibility of any kind, expressed or implied.

Statements of suitability for certain applications are based on KEMET Electronics Corporation's ("KEMET") knowledge of typical operating conditions for such applications, but are not intended to constitute – and KEMET specifically disclaims – any warranty concerning suitability for a specific customer application or use. The Information is intended for use only by customers who have the requisite experience and capability to determine the correct products for their application. Any technical advice inferred from this Information or otherwise provided by KEMET with reference to the use of KEMET's products is given gratis, and KEMET assumes no obligation or liability for the advice given or results obtained.

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.