Radial Leaded Multilayer Ceramic Capacitors

HP Series Radial, Conformally Coated, High Temperature, 200°C, 25 – 200 VDC (Industrial Grade)

Overview

KEMET's High Temperature 200ºC HP 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, hybrid and electric automotive motor drives 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 1 nF – 4.7 uF in X7R
- Capacitance range from 180 pF – 0.12 uF in C0G
- DC voltage ratings of 25 V, 50 V, 100 V, 200 V
- High thermal stability
- Encapsulation meets flammability standard UL 94V–0
- High-temperature solder meets EIA RS–198, Method 302, Condition B

Applications

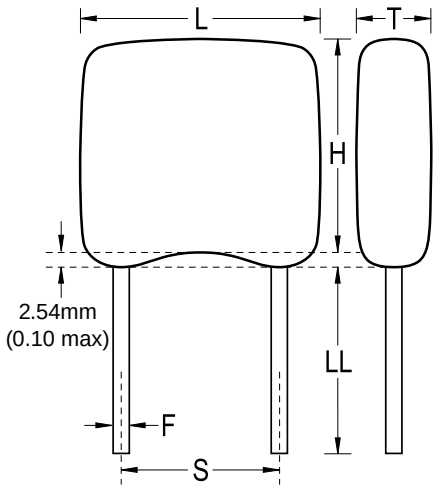
- Downhole exploration and mining
- Aerospace engine compartments
- Electric ballast
- Measuring equipment
- Inverter power supply

Ordering Information

HP	06	A	W	472	K	N	
Series	Style/Size	Voltage	Dielectric	Capacitance Code (pF)	Capacitance Tolerance[1]	Lead Wire Barrier Layer[2]	Packaging
HP	05 55 06 08 09	A = 25 V B = 50 V C = 100 V D = 200 V	B, W = X7R type N = C0G (NP0)	Two significant digits and number of zeros	J = ±5% K = ±10% M = ±20%	N = Nickel C = Copper	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)	Spacing ±0.030 (S)	Lead Diameter (F)	Lead Length Minimum (LL)
HP	05	0.200 (5.08)	0.200 (5.08)	0.100 (2.54)	0.100 (2.54)	0.025 +0.004/−0.002 (0.635 +0.102/−0.051)	1.25 (31.75)
	55	0.200 (5.08)	0.200 (5.08)	0.100 (2.54)	0.200 (5.08)		
	06	0.300 (7.62)	0.300 (7.62)	0.150 (3.81)	0.200 (5.08)		
	08	0.500 (12.70)	0.500 (12.70)	0.250 (6.35)	0.400 (10.16)		
	09	0.700 (17.78)	0.400 (10.16)	0.200 (5.08)	0.500 (12.70)		

Table 1A – HP Series C0G Waterfall

Style		HP05				HP55				HP06				HP08				HP09			
Voltage		25	50	100	200	25	50	100	200	25	50	100	200	25	50	100	200	25	50	100	200
Capacitance	Capacitance Code																				
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								
470 pF	471	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								
680 pF	681	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				
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
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
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	X
0.015 µF	153									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
0.022 µF	223									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
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
0.056 µF	563													X	X	X	X	X	X	X	X
0.068 µF	683													X	X	X	X	X	X	X	X
0.082 µF	823													X	X	X	X	X	X	X	X
0.1 µF	104													X	X	X	X	X	X	X	
0.12 µF	124													X	X	X	X				
Voltage		25	50	100	200	25	50	100	200	25	50	100	200	25	50	100	200	25	50	100	200
Style		HP05				HP55				HP06				HP08				HP09			

Table 1B – HP Series X7R Waterfall

Style		HP05				HP55				HP06				HP08				HP09			
Voltage		25	50	100	200	25	50	100	200	25	50	100	200	25	50	100	200	25	50	100	200
Capacitance	Capacitance Code																				
1,000 pF	102	X	X	X	X	X	X	X	X												
1,200 pF	122	X	X	X	X	X	X	X	X												
1,500 pF	152	X	X	X	X	X	X	X	X												
1,800 pF	182	X	X	X	X	X	X	X	X												
2,200 pF	222	X	X	X	X	X	X	X	X												
2,700 pF	272	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	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				
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	X	X	X	X
0.022 µF	223	X	X	X		X	X	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	X	X	X	X	X	X	X
0.033 µF	333	X	X	X		X	X	X		X	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	X	X	X	X	X	X	X
0.047 µF	473	X	X	X		X	X	X		X	X	X	X	X	X	X	X	X	X	X	X
0.056 µF	563	X	X	X		X	X	X		X	X	X	X	X	X	X	X	X	X	X	X
0.068 µF	683	X	X	X		X	X	X		X	X	X	X	X	X	X	X	X	X	X	X
0.082 µF	823	X	X	X		X	X	X		X	X	X	X	X	X	X	X	X	X	X	X
0.1 µF	104									X	X	X	X	X	X	X	X	X	X	X	X
0.12 µF	124									X	X	X	X	X	X	X	X	X	X	X	X
0.15 µF	154									X	X	X	X	X	X	X	X	X	X	X	X
0.18 µF	184									X	X	X	X	X	X	X	X	X	X	X	X
0.22 µF	224									X	X	X	X	X	X	X	X	X	X	X	X
0.27 µF	274									X	X	X	X	X	X	X	X	X	X	X	X
0.33 µF	334									X	X	X	X	X	X	X	X	X	X	X	X
0.39 µF	394									X	X	X	X	X	X	X	X	X	X	X	X
0.47 µF	474									X	X	X		X	X	X	X	X	X	X	X
0.56 µF	564									X	X	X		X	X	X	X	X	X	X	X
0.68 µF	684									X	X	X		X	X	X	X	X	X	X	X
0.82 µF	824													X	X	X	X	X	X	X	X
1 µF	105													X	X	X	X	X	X	X	X
1.2 µF	125													X	X	X	X	X	X	X	X
1.5 µF	155													X	X	X	X	X	X	X	
1.8 µF	185													X	X	X	X	X	X	X	
2.2 µF	225													X	X	X	X	X	X	X	
2.7 µF	275													X	X	X	X	X	X	X	
3.3 µF	335													X	X	X	X				
3.9 µF	395													X	X	X	X				
4.7 µF	475													X	X	X	X				
Voltage		25	50	100	200	25	50	100	200	25	50	100	200	25	50	100	200	25	50	100	200
Style		HP05				HP55				HP06				HP08				HP09			

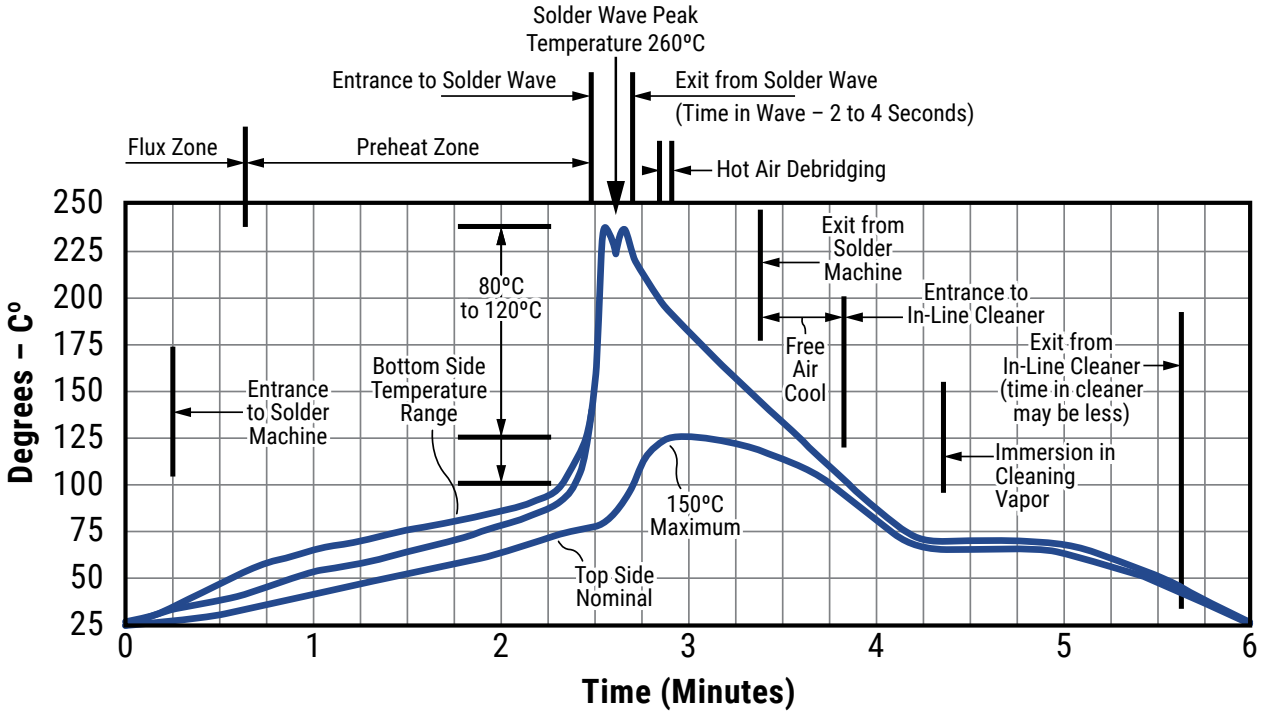
Packaging Quantities

Style	Waffle Pack Quantity
HP 05	28
HP 55	28
HP 06	28
HP 08	28
HP 09	20

Soldering Process

Recommended Soldering Technique:
- Solder Wave
- Hand Soldering (Manual)

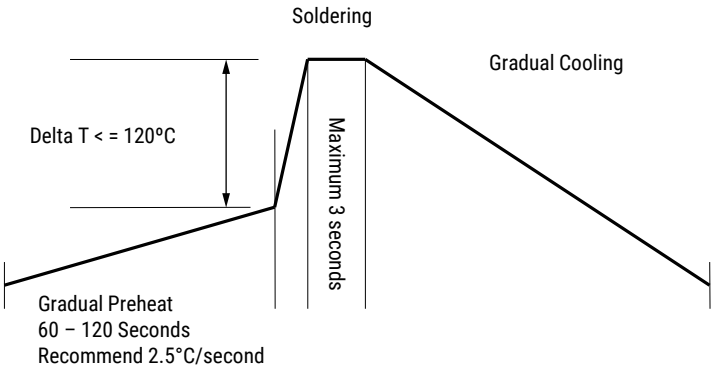
Recommended Soldering Profile:
- Optimum Wave Solder Profile



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	
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 Vrms C > 100 pF: 1 kHz ±100 Hz and 1.0 ±0.2 Vrms *See part number specification sheet for frequency and voltage	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 *See part number specification sheet for frequency and voltage	X7R: 2.0% C0G: 0.15%
Insulation Resistance (IR)	MIL-STD-202 Method 302	Apply rated voltage for 120 seconds at 25°C	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. 100 GΩ or 1,000 Megohm-microfarad, whichever is less.
Temperature Coefficient of Capacitance (TCC)	KEMET Internal	C0G: 0 ppm/°C ±30 ppm/°C X7R: ±15% (−55°C to +125°C), +15%/−40% (−55°C to 200°C) *See part number specification sheet for frequency and voltage	Within Specification
Dielectric Withstanding Voltage (DWV)	KEMET Internal	250% of rated voltage (5±1 seconds and charge/discharge not exceeding 50 mA)	Withstand test voltage without insulation breakdown or damage.

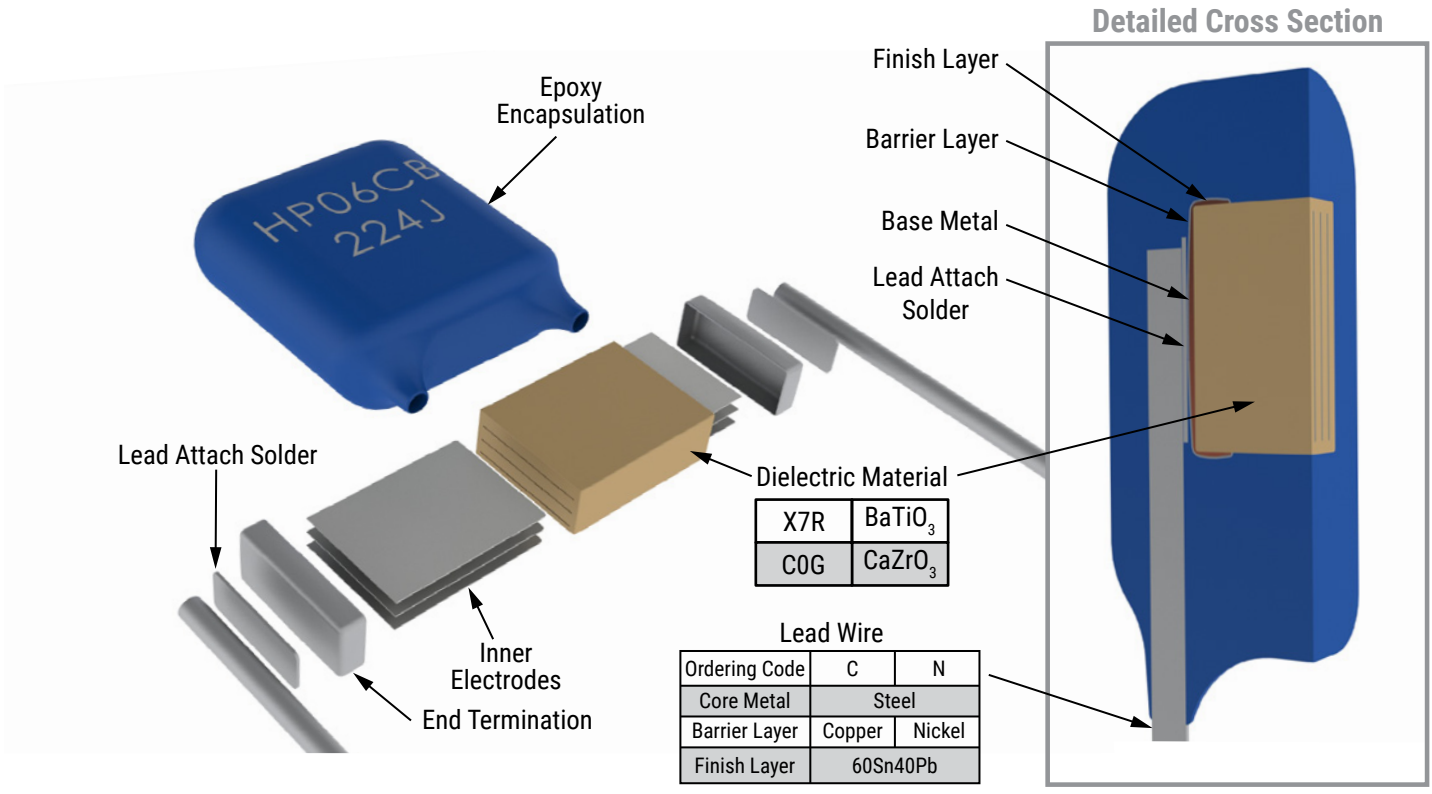
Table 2 – Performance & Reliability: Test Methods and Conditions cont.

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
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (–55°C to +200°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
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 (C0G): ±0.3% or ±0.25 pF shift Cap(X7R): ±20% IR: 10% of Initial Limit DF Limits Maximum (C0G): 0.25 % DF Limits Maximum (X7R): 3 %
Thermal Shock	MIL-STD-202 Method 107	Number of cycles required 5, (-55°C to 150°C) Dwell time 15 minutes.	Cap: Initial Limit DF: Initial Limit IR: Initial Limit
High Temperature Life	MIL-STD-202 Method 108	1,000 hours at + 200°C, +4°C, -0°C. with rated voltage, ±5 percent.	Measurement at 24 hours +/- 4 hours after test conclusion. Within Post Environmental Limits Cap (C0G): ±0.3% or ±0.25 pF shift Cap(X7R): ±20% IR: 10% of Initial Limit DF Limits Maximum (C0G): 0.25 % DF Limits Maximum (X7R): 3 %
Storage Life		1,000 hours at 200°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	100 g's 6 ms Half-sine, Velocity Change 12.3 feet/second (Condition C)	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.

Construction



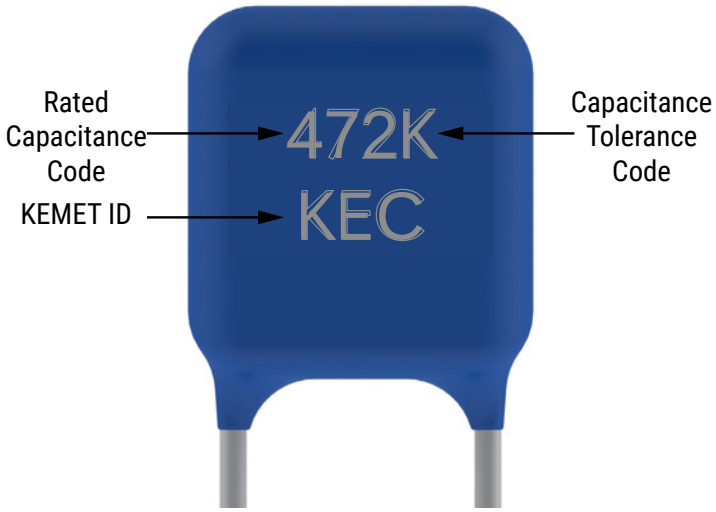
X7R	$BaTiO_3$
C0G	$CaZrO_3$

Lead Wire

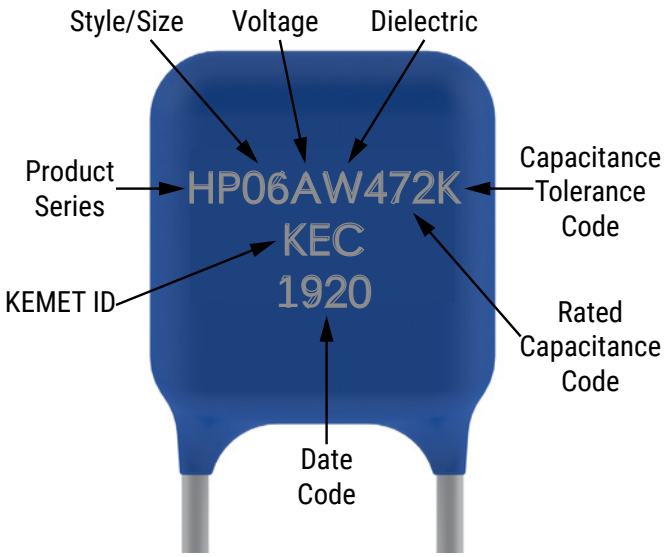
Ordering Code	C	N
Core Metal	Steel	
Barrier Layer	Copper	Nickel
Finish Layer	60Sn40Pb	

Marking

HP05, HP55



HP06, HP08, HP09



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

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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.