Flexible Termination System (FT-CAP), U2J Dielectric, 10 – 50 VDC (Commercial & Automotive Grade)

Overview

The KEMET Flexible Termination (FT-CAP) Multilayer Ceramic Capacitor in U2J dielectric incorporates a unique, flexible termination system that is integrated with KEMET's standard termination materials. A conductive silver epoxy is utilized between the base metal and nickel barrier layers of the KEMET standard termination system in order to establish pliability while maintaining terminal strength, solderability and electrical performance. This technology was developed in order to address the primary failure mode of MLCCs – flex cracks, which are typically the result of excessive tensile and shear stresses produced during board flexure and thermal cycling. Flexible termination technology inhibits the transfer of board stress to the rigid ceramic body, therefore mitigating flex cracks which can result in low insulation resistance (IR) or short circuit failures. KEMET automotive grade capacitors meet the demanding Automotive Electronics Council's AEC-Q200 qualification requirements.

Although this technology does not eliminate the potential for mechanical damage that may propagate during extreme environmental and handling conditions, it does provide superior flex performance over standard termination systems. FT-CAP complements KEMET's Open Mode, Floating Electrode (FE-CAP), Floating Electrode with Flexible Termination (FF-CAP), and KEMET Power Solutions (KPS) product lines provide a complete portfolio of flex mitigation solutions.

Combined with the stability of U2J dielectric and designed to accommodate all capacitance requirements, these flex-robust devices are RoHS compliant, offer up to 5 mm of flex-bend capability and capacitance change limited to −750 ±20 ppm/°C from −55°C to +125°C. These devices are lead-free, RoHS and REACH compliant without exception and are capable of withstanding multiple passes through a lead-free solder reflow profile.

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Ordering Information

C	1206	X	104	J	3	J	A	C	TU
Ceramic	Case Size (L" x W")	Specificatdigits – number of zeros.	F = ±1% G = ±2% J = ±5% K = ±10% M = ±20%	8 = 10 4 = 16 3 = 25 5 = 50	J = U2J	A = N/A	C = 100% Matte Sn	See "Packaging C-Spec Ordering Options Table" below	

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

Packaging C-Spec Ordering Options Table

Packaging Type[1]	Packaging/Grade Ordering Code (C-Spec)
Commercial Grade[1]	
Bulk Bag/Unmarked	Not required (Blank)
7" Reel/Unmarked	TU
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2 mm pitch[2]	7081
13" Reel/Unmarked/2 mm pitch[2]	7082
Automotive Grade[3]	
7" Reel	AUTO
13" Reel/Unmarked	AUTO7411 (EIA 0603 and smaller case sizes) AUTO7210 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2mm pitch[2]	3190
13" Reel/Unmarked/2mm pitch[2]	3191

[1] Default packaging is "Bulk Bag." An ordering code C-Spec is not required for "Bulk Bag" packaging.
[1] The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. The option to laser mark is not available on these devices. For more information see "Capacitor Marking."
[2] The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information."
[3] Reeling tape options (paper or plastic) are dependent on capacitor case size (l" x w") and thickness dimensions. See "Chip Thickness/Tape & Reel Packaging Quantities" and "Tape & Reel Packaging Information."
[3] For additional information regarding "AUTO" C-Spec options, see "Automotive C-Spec Information."
[3] All automotive packaging C-Specs listed exclude the option to laser mark components. The option to laser mark is not available on these devices. For more information see "Capacitor Marking."

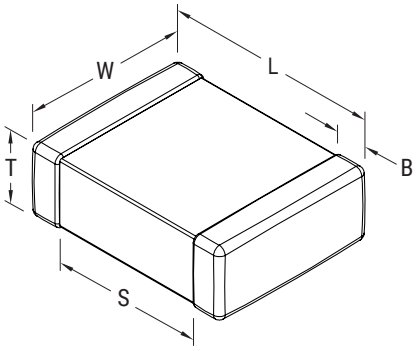
Benefits

- AEC–Q200 automotive qualified
- Low dissipation factor DF < 0.1%
- Low noise solution similar to C0G
- Low ESR and ESL
- High thermal stability
- High ripple current capability
- Preferred capacitance solution at line frequencies and into the MHz range
- Retains over 99% of nominal capacitance at full rated voltage
- Small predictable and linear capacitance change with respect to temperature
- Operating temperature range of −55°C to +125°C
- Capacitance up to 470 nF
- DC voltage ratings up to 50 V
- Lead (Pb)-free, RoHS and REACH compliant
- Non-polar device, minimizing installation concerns
- 100% pure matte Tin-plated termination finish allowing for excellent solderability

Applications

Typical applications include critical timing, tuning, circuits requiring low loss, circuits with pulse, high current, decoupling, bypass, filtering, transient voltage suppression and blocking, as well as energy storage in critical and safety relevant circuits without (integrated) current limitation, including those subject to high levels of board flexure or temperature cycling.

Dimensions – Millimeters (Inches)



Qualification/Certification

Commercial grade products are subject to internal qualification. Details regarding test methods and conditions are referenced in Table 4, Performance & Reliability.

Automotive grade products meet or exceed the requirements outlined by the Automotive Electronics Council. Details regarding test methods and conditions are referenced in the document AEC–Q200, Stress Test Qualification for Passive Components. For additional information regarding the Automotive Electronics Council and AEC–Q200, please visit their website at www.aecouncil.com.

Environmental Compliance

Lead (Pb)-free, RoHS, and REACH compliant without exemptions.

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)	−750 ±120 ppm/°C
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	0.1%
Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit at 25°C	0.1%
Insulation Resistance (IR) Limit at 25°C	1,000 MΩ µF or 100 GΩ (Rated voltage applied for 120 ±5 seconds at 25°C)

T

Capacitance and dissipation factor (DF) measured under the following conditions:

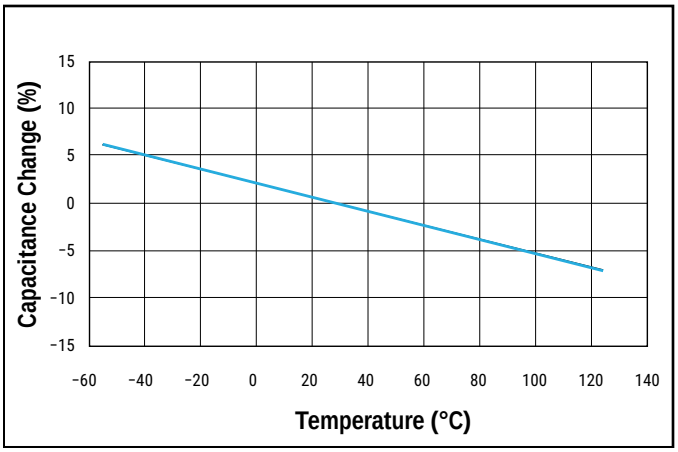
1 MHz ±100 kHz and 1.0 V_{rms}

1 kHz ±50 Hz and 1.0 V_{rms} ±0.2 V if capacitance > 1,000 pF

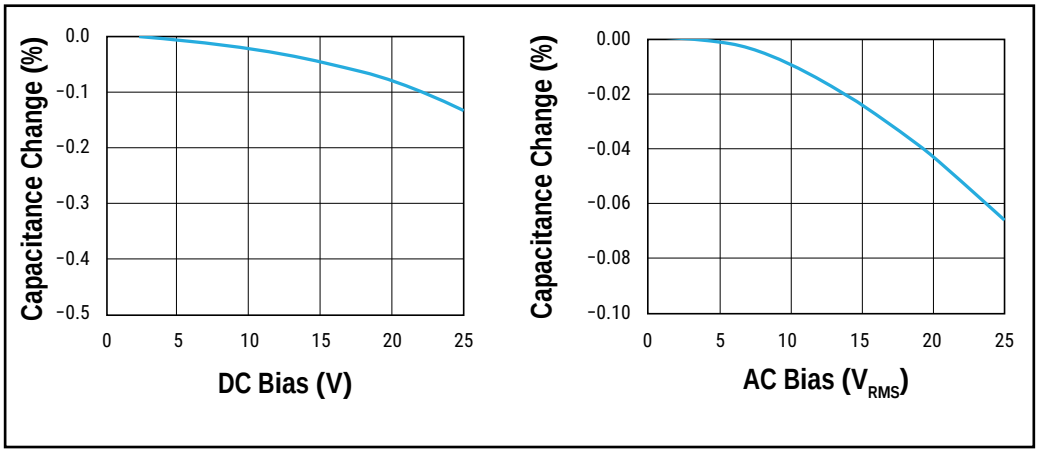
Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 and Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON."

Electrical Characteristics (Typical)

Capacitance vs. Temperature (TCC)



DC & AC Bias Effective Capacitance



Post Environmental Limits

High Temperature Life, Biased Humidity, Moisture Resistance					
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance
U2J	All	All	0.5	0.3% or ±0.25 pF	10% of Initial limit

Table 1A – Capacitance Range/Selection Waterfall (0603 – 1812 Case Sizes)

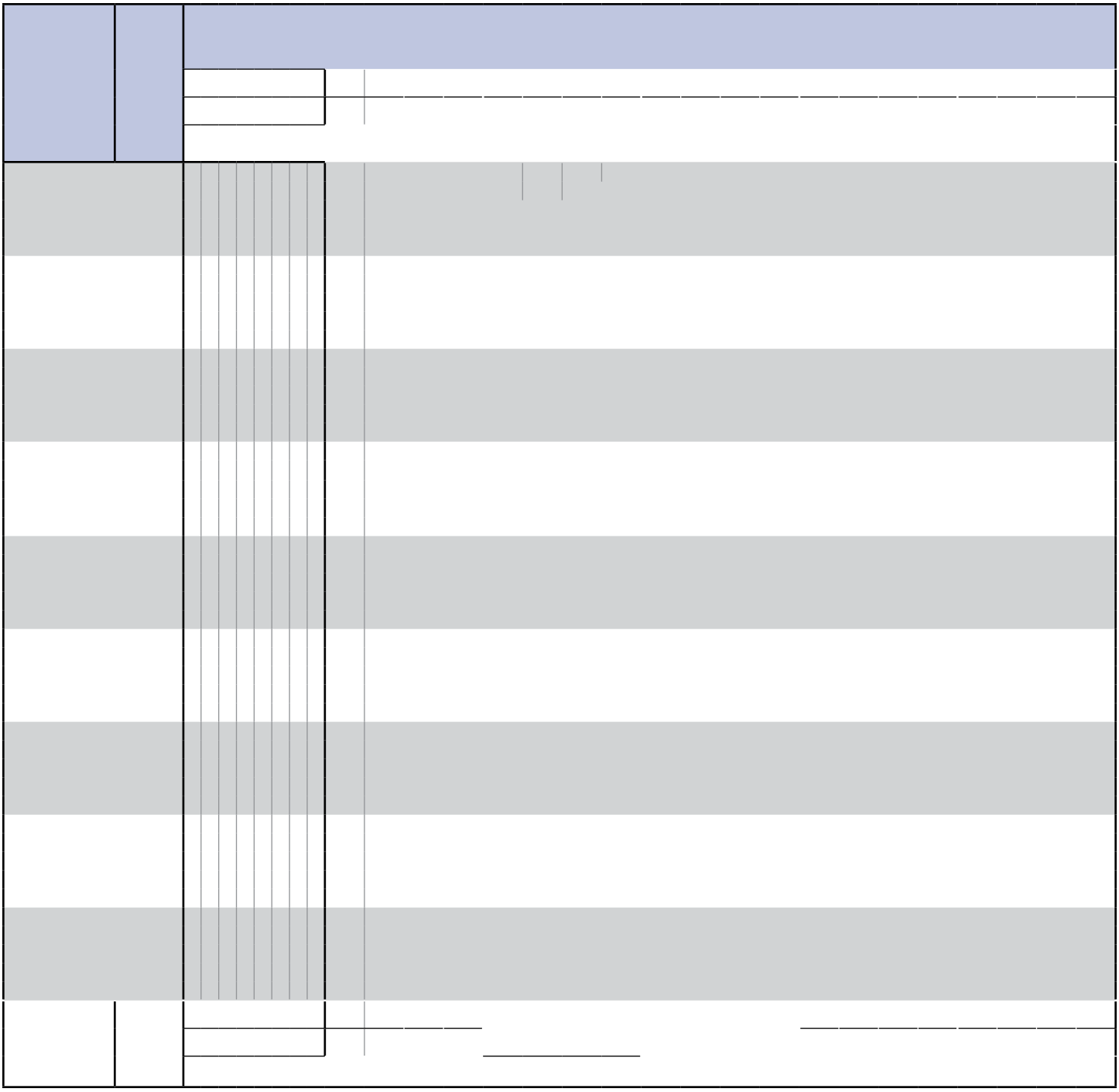


Table 2A – Chip Thickness/Tape & Reel Packaging Quantities

Thickness Code	Case Size[1]	Thickness ± Range (mm)	Paper Quantity[1]		Plastic Quantity	
			7" Reel	13" Reel	7" Reel	13" Reel
CF	0603	0.80 ±0.07*	4,000	15,000	0	0
DC	0805	0.78 ±0.10	0	0	4,000	10,000
DD	0805	0.90 ±0.10	0	0	4,000	10,000
DG	0805	1.25 ±0.15	0	0	2,500	10,000
EB	1206	0.78 ±0.10	4,000	10,000	4,000	10,000
EC	1206	0.90 ±0.10	0	0	4,000	10,000
EE	1206	1.10 ±0.10	0	0	2,500	10,000
EF	1206	1.20 ±0.15	0	0	2,500	10,000
EP	1206	1.20 ±0.20	0	0	2,500	10,000
EH	1206	1.60 ±0.20	0	0	2,000	8,000
FB	1210	0.78 ±0.10	0	0	4,000	10,000
FC	1210	0.90 ±0.10	0	0	4,000	10,000
FE	1210	1.00 ±0.10	0	0	2,500	10,000
FG	1210	1.25 ±0.15	0	0	2,500	10,000
FH	1210	1.55 ±0.15	0	0	2,000	8,000
FM	1210	1.70 ±0.20	0	0	2,000	8,000
GB	1812	1.00 ±0.10	0	0	1,000	4,000
GC	1812	1.10 ±0.10	0	0	1,000	4,000
GH	1812	1.40 ±0.15	0	0	1,000	4,000
GK	1812	1.60 ±0.20	0	0	1,000	4,000
Thickness Code	Case Size[1]	Thickness ± Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
			Paper Quantity[1]		Plastic Quantity	

[1] *If ordering using the 2 mm Tape & Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information."*

Table 2B – Bulk Packaging Quantities

Packaging Type		Loose Packaging	
		Bulk Bag (default)	
Packaging C-Spec[1]		N/A[2]	
Case Size		Packaging Quantities (pieces/unit packaging)	
EIA (in)	Metric (mm)	Minimum	Maximum
0603	1608		

Table 3 – Chip Capacitor Land Pattern Design Recommendations per IPC–7351 (mm)

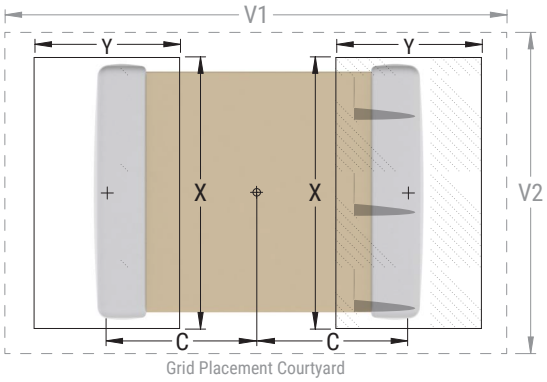
EIA Size Code	Metric Size Code	Density Level A: Maximum (Most) Land Protrusion (mm)					Density Level B: Median (Nominal) Land Protrusion (mm)					Density Level C: Minimum (Least) Land Protrusion (mm)				
		C	Y	X	V1	V2	C	Y	X	V1	V2	C	Y	X	V1	V2
0603	1608	0.85	1.25	1.10	4.00	2.10	0.75	1.05	1.00	3.10	1.50	0.65	0.85	0.90	2.40	1.20
0805	2012	0.99	1.44	1.66	4.47	2.71	0.89	1.24	1.56	3.57	2.11	0.79	1.04	1.46	2.42	1.81
1206	3216	1.59	1.62	2.06	5.85	3.06	1.49	1.42	1.96	4.95	2.46	1.39	1.22	1.86	4.25	2.16
1210	3225	1.59	1.62	3.01	5.90	4.01	1.49	1.42	2.91	4.95	3.41	1.39	1.22	2.81	4.25	3.11
1812	4532	2.10	1.80	3.60	7.00	4.60	2.00	1.60	3.50	6.10	4.00	1.90	1.40	3.40	5.40	3.70

Density Level A: *solder processes. KEMET only recommends wave soldering of EIA 0603, 0805, and 1206 case sizes.*

Density Level B:

Density Level C: *For high component density product applications. Before adapting the minimum land pattern variations the user should perform*

Image below based on Density Level B for an EIA 1210 case size.



Soldering Process

Recommended Soldering Technique:

- Solder wave or solder reflow for EIA case sizes 0603, 0805 and 1206
- All other EIA case sizes are limited to solder reflow only

Recommended Reflow Soldering Profile:

The KEMET families of surface mount multilayer ceramic capacitors (SMD MLCCs) are compatible with wave (single or dual), convection, IR or vapor phase reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. The KEMET recommended profile conditions for convection and IR reflow reflect the profile conditions of the IPC/J-STD-020 standard for moisture sensitivity testing. These devices can safely withstand a maximum of three reflow passes at these conditions.

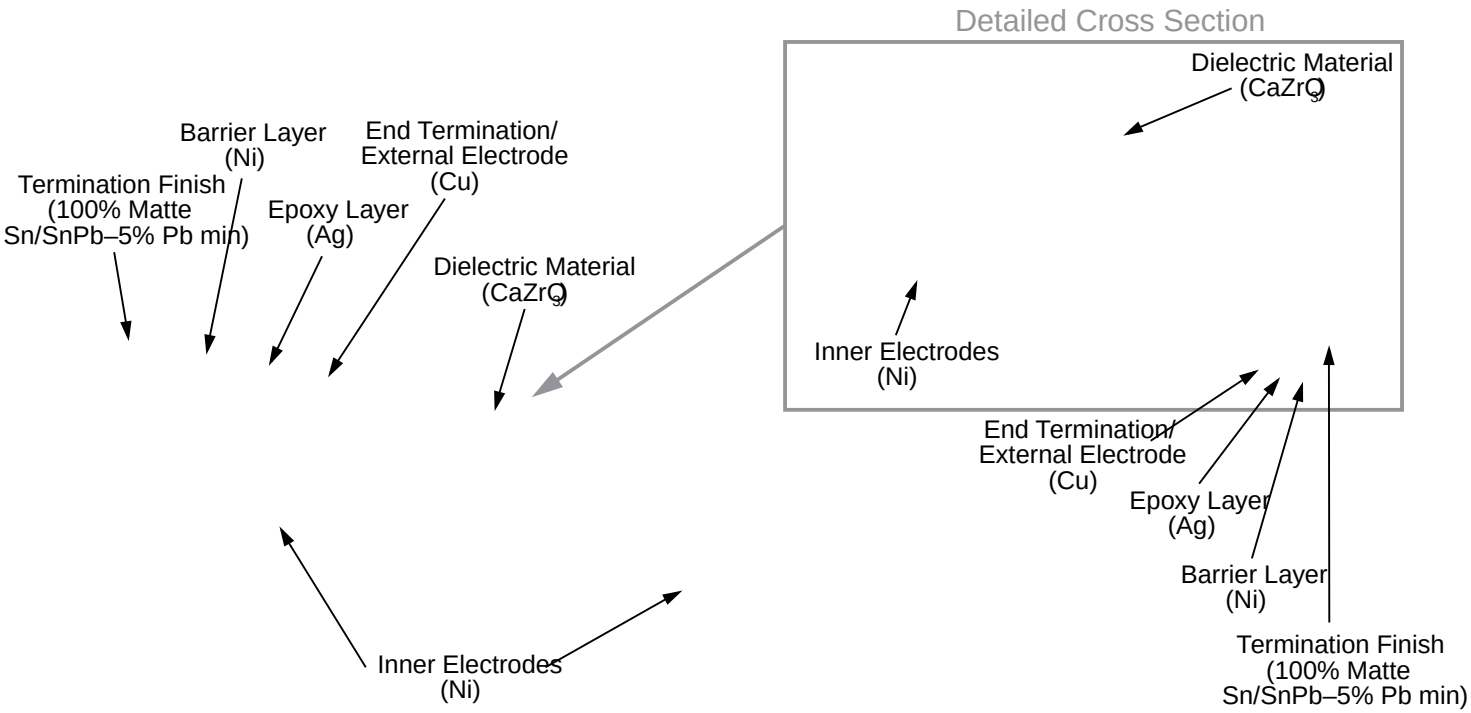
Table 4 – Performance & Reliability: Test Methods and Conditions

<table>
<tr><th>Stress</th><th>Reference</th><th>Test or Inspection Method</th></tr>
<tr><td>Terminal Strength</td><td>JIS–C–6429</td><td>Appendix 1, Note:
<table>
<tr><th>Package Size (L" x W")</th><th>Force</th><th>Duration</th></tr>
<tr><td>0402</td><td>5 N (0.51 kg)</td><td rowspan="3">60 seconds</td></tr>
<tr><td>0603</td><td>10 N (1.02 kg)</td></tr>
<tr><td>≥ 0805</td><td>18 N (1.83 kg)</td></tr>
</table></td></tr>
<tr><td>Board Flex</td><td>JIS–C–6429</td><td>Appendix 2, Note: 3.0 mm (minimum)</td></tr>
<tr><td rowspan="4">Solderability</td><td rowspan="4">J–STD–002</td><td>Magnification 50 X Conditions:</td></tr>
<tr><td>a) Method B, 4 hours at 155°C, dry heat at 235°C</td></tr>
<tr><td>b) Method B, at 215°C, category 3</td></tr>
<tr><td>c) Method D, at 260°C, category 3</td></tr>
<tr><td>Temperature Cycling</td><td>JESD22 Method JA-104</td><td>1,000 cycles (–55°C to +125°C). Measurement at 24 hours ±4 hours after test conclusion.</td></tr>
<tr><td rowspan="2">Biased Humidity</td><td rowspan="2">MIL-STD-202 Method 103</td><td>Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours ±4 hours after test conclusion.</td></tr>
<tr><td>Low Volt Humidity: 1,000 hours 85C°/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours ±4 hours after test conclusion.</td></tr>
<tr><td>Moisture Resistance</td><td>MIL-STD-202 Method 106</td><td>t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours ±4 hours after test conclusion.</td></tr>
<tr><td>Thermal Shock</td><td>MIL-STD-202 Method 107</td><td>–55°C/+125°C. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air – air.</td></tr>
<tr><td>High Temperature Life</td><td>MIL-STD-202 Method 108/EIA -198</td><td>1,000 hours at 125°C with 2 X rated voltage applied.</td></tr>
<tr><td>Storage Life</td><td>MIL-STD-202 Method 108</td><td>125°C, 0 VDC for 1,000 hours.</td></tr>
<tr><td>Vibration</td><td>MIL-STD-202 Method 204</td><td>5 G's for 20 minutes, 12 cycles each of 3 orientations. Note: Use 8" X 5" PCB 0.031" 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 – 2,000 Hz</td></tr>
<tr><td>Mechanical Shock</td><td>MIL-STD-202 Method 213</td><td>Figure 1 of Method 213, Condition F.</td></tr>
<tr><td>Resistance to Solvents</td><td>MIL-STD-202 Method 215</td><td>Add aqueous wash chemical, OKEM clean or equivalent.</td></tr>
</table>

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability 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 – reels may soften or warp, and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 40ºC and maximum storage humidity not exceed 70% relative humidity. Temperature fluctuations should be minimized to avoid condensation on the parts and atmospheres should be free of chlorine and sulfur bearing compounds. For optimized solderability chip stock should be used promptly, preferably within 1.5 years of receipt.

Construction



'ETEGMXSV 1EVOMRK 3TXMSREP

0EWIV QEVOMRK STXMSR MW RSX EZEMPEFPI SR

- C0G, U2J, Ultra Stable X8R and Y5V dielectric devices
- EIA 0402 case size devices
-)-% GEWI WM^I HIZMGIW [MXL ½I\MFPI XIVQMREXMSR STXMSR
- /47 GSQQIVGMEP ERH EYXSQSXMZI KVEHI WXEGOIH HIZMGIW

These capacitors are supplied unmarked only.

Tape & Reel Packaging Information

KEMET offers multilayer ceramic chip capacitors packaged in 8, 12 and 16 mm tape on 7" and 13" reels in accordance with EIA Standard 481. This packaging system is compatible with all tape-fed automatic pick and place systems. See Table 2 for details on reeling quantities for commercial chips.

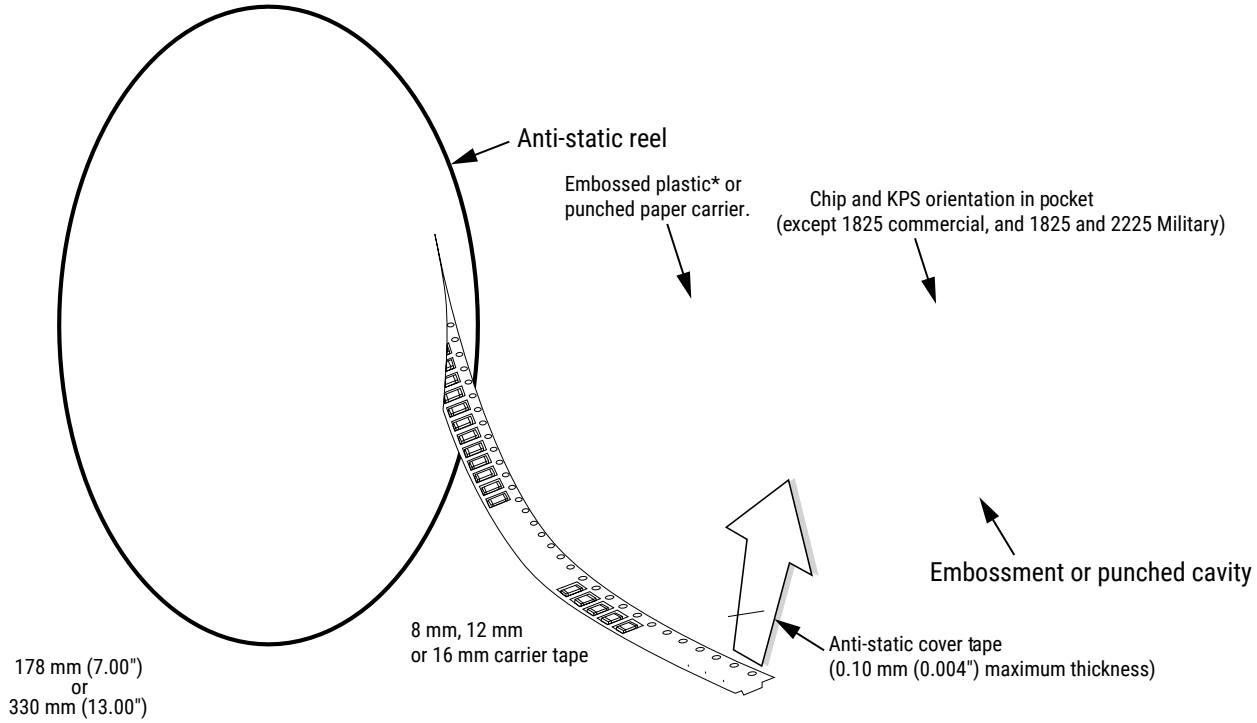


Figure 1 – Embossed (Plastic) Carrier Tape Dimensions

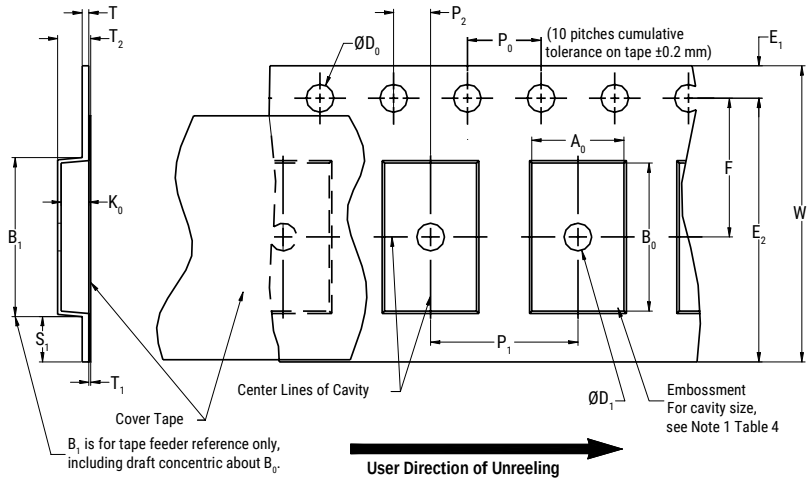


Table 6 – Embossed (Plastic) Carrier Tape Dimensions

Metric will govern

Constant Dimensions — Millimeters (Inches)									
Tape Size	D_0	D_1 Minimum Note 1	E_1	P_0	P_2	R Reference Note 2	S_1 Minimum Note 3	T Maximum	T_1 Maximum
8 mm	1.5 +0.10/−0.0 (0.059 +0.004/−0.0)	1.0 (0.039)	1.75 ±0.10 (0.069 ±0.004)	4.0 ±0.10 (0.157 ±0.004)	2.0 ±0.05 (0.079 ±0.002)	25.0 (0.984)	0.600 (0.024)	0.600 (0.024)	0.100 (0.004)
12 mm		1.5 (0.059)				30 (1.181)			
16 mm									

Variable Dimensions — Millimeters (Inches)								
Tape Size	Pitch	B_1 Maximum Note 4	E_2 Minimum	F	P_1	T_2 Maximum	W Maximum	A_0,B_0 & K_0
8 mm	Single (4 mm)	4.35 (0.171)	6.25 (0.246)	3.5 ±0.05 (0.138 ±0.002)	4.0 ±0.10 (0.157 ±0.004)	2.5 (0.098)	8.3 (0.327)	Note 5
12 mm	Single (4 mm) and double (8 mm)	8.2 (0.323)	10.25 (0.404)	5.5 ±0.05 (0.217 ±0.002)	8.0 ±0.10 (0.315 ±0.004)	4.6 (0.181)	12.3 (0.484)	
16 mm	Triple (12 mm)	12.1 (0.476)	14.25 (0.561)	7.5 ±0.05 (0.138 ±0.002)	12.0 ±0.10 (0.157 ±0.004)	4.6 (0.181)	16.3 (0.642)	

1. The embossment h. T0.15.4)

Figure 2 – Punched (Paper) Carrier Tape Dimensions

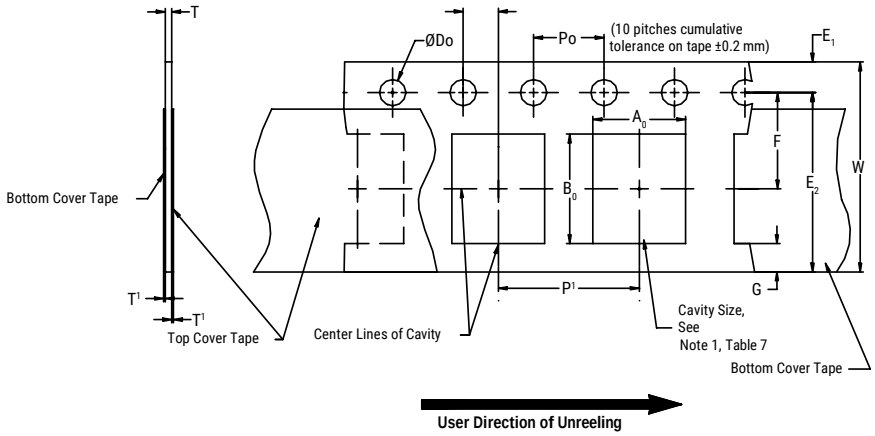


Table 7 – Punched (Paper) Carrier Tape Dimensions

Metric will govern

Constant Dimensions — Millimeters (Inches)							
Tape Size	D_0	E_1	P_0	P_2	T_1 Maximum	G Minimum	R Reference Note 2
8 mm	1.5 +0.10 -0.0 (0.059 +0.004 -0.0)	1.75 ±0.10 (0.069 ±0.004)	4.0 ±0.10 (0.157 ±0.004)	2.0 ±0.05 (0.079 ±0.002)	0.10 (0.004) maximum	0.75 (0.030)	25 (0.984)

Variable Dimensions — Millimeters (Inches)							
Tape Size	Pitch	E2 Minimum	F	P_1	T Maximum	W Maximum	A_0 B_0
8 mm	Half (2 mm)	6.25 (0.246)	3.5 ±0.05 (0.138 ±0.002)	2.0 ±0.05 (0.079 ±0.002)	1.1 (0.098)	8.3 (0.327)	Note 1
8 mm	Single (4 mm)			4.0 ±0.10 (0.157 ±0.004)		8.3 (0.327)	

$_{0}$, B_0

a) the component does not protrude beyond either surface of the carrier tape.

b) the component can be removed from the cavity in a vertical direction without mechanical restriction, after the top cover tape has been removed.

c) rotation of the component is limited to 20° maximum (see Figure 3.)

d) lateral movement of the component is restricted to 0.5 mm maximum (see Figure 4.)

e) see addendum in EIA Standard 481 for standards relating to more precise taping requirements.

2. The tape with or without components shall pass around R without damage (see Figure 6.)

Packaging Information Performance Notes

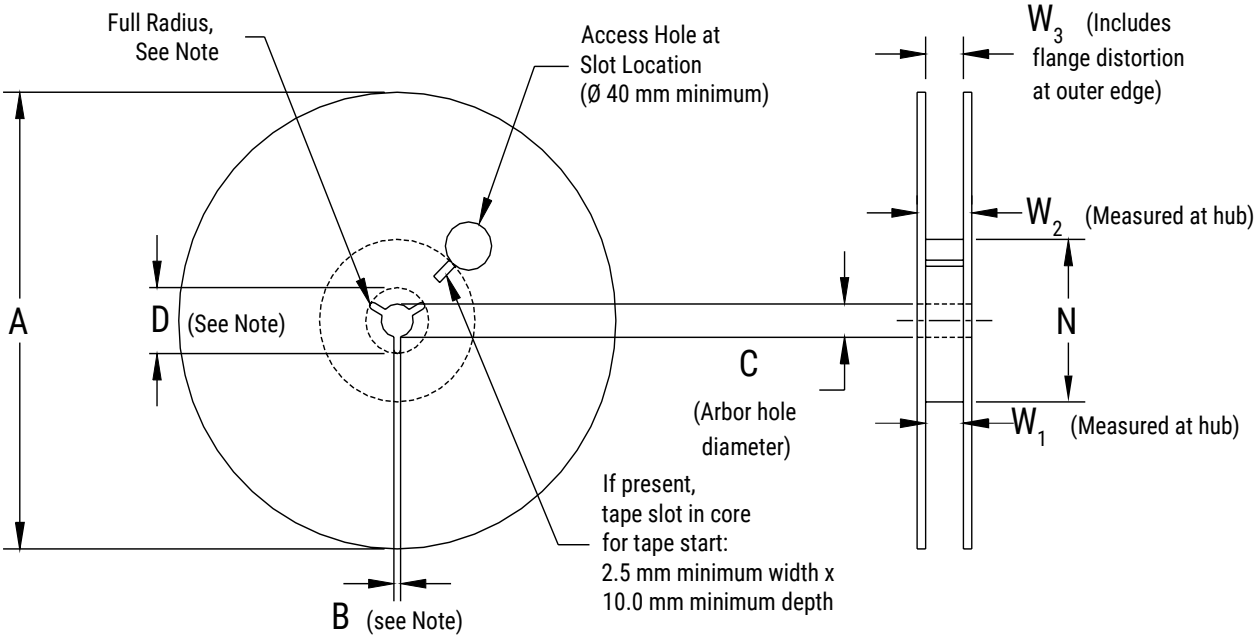
1. Cover Tape Break Force: 1.0 kg minimum.
2. Cover Tape Peel Strength: The total peel strength of the cover tape from the carrier tape shall be:

Tape Width	Peel Strength
8 mm	0.1 to 1.0 newton (10 to 100 gf)
12 and 16 mm	0.1 to 1.3 newton (10 to 130 gf)

The direction of the pull shall be opposite the direction of the carrier tape travel. The pull angle of the carrier tape shall be 165° to 180° from the plane of the carrier tape. During peeling, the carrier and/or cover tape shall be pulled at a velocity of 300 ±10 mm/minute.
3. Labeling: Bar code labeling (standard or custom) shall be on the side of the reel opposite the sprocket holes. *Refer to EIA Standards 556 and 624*.

Figure 3 – Maximum Component Rotation

Figure 6 – Reel Dimensions



Note: Drive spokes optional; if used, dimensions B and D shall apply.

Table 8 – Reel Dimensions

Metric will govern

Constant Dimensions — Millimeters (Inches)				
Tape Size	A	B Minimum	C	D Minimum
8 mm	178 ±0.20 (7.008 ±0.008) or 330 ±0.20 (13.000 ±0.008)	1.5 (0.059)	13.0 +0.5/−0.2 (0.521 +0.02/−0.008)	20.2 (0.795)
12 mm				
16 mm				

Variable Dimensions — Millimeters (Inches)				
Tape Size	N Minimum	W_1	W_2 Maximum	W_3
8 mm	50 (1.969)	8.4 +1.5/−0.0 (0.331 +0.059/−0.0)	14.4 (0.567)	Shall accommodate tape width without interference
12 mm		12.4 +2.0/−0.0 (0.488 +0.078/−0.0)	18.4 (0.724)	
16 mm		16.4 +2.0/−0.0 (0.646 +0.078/−0.0)	22.4 (0.882)	

Figure 7 – Tape Leader & Trailer Dimensions

KEMET Electronics Corporation Sales O ces

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

Disclaimer

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