

KEMET’s Flexible Termination (FT-CAP) Multilayer Ceramic Capacitor in Ultra-Stable X8R 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 KEMET’s 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 IR or short circuit failures.

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 by providing a complete portfolio of flex mitigation solutions. Combined with the stability of KEMET’s Ultra-Stable high temperature dielectric technology, these flex-robust devices are RoHS Compliant, offer up to 5 mm of flex-bend capability and feature a 150°C maximum operating temperature. Ultra-Stable X8R dielectric offers the same temperature capability as conventional X8R, but without the capacitance loss due to applied DC voltage. These devices exhibit no X8R capacitance and larger footprint devices that fail to offer capacitance stability. Capacitance change with respect to temperature is limited to ±15% from –55°C to +150°C.

In addition to Commercial Grade, Automotive Grade devices are available which meet the demanding Automotive Electronics Council's AEC-Q200 qualification requirements.



Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/ Grade (C-Spec)
	0603 0805 1206 1210 1812	X = Flexible Termination	Two significant digits + number of zeros.	B = ±0.10 pF C = ±0.25 pF D = ±0.5 pF F = ±1% G = ±2% J = ±5% K = ±10% M = ±20%	8 = 10 4 = 16 3 = 25 5 = 50 1 = 100	H = Ultra-Stable X8R	A = N/A	C = 100% Matte Sn L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

¹ Additional termination finish options may be available. Contact KEMET for details.

¹ SnPb termination finish option is not available on Automotive Grade product.

Commercial Grade¹	
Bulk Bag	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 Grade³	
7" Reel	AUTO
13" Reel/Unmarked	AUTO7411 (EIA 0603 and smaller case sizes) AUTO7210 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2 mm pitch ²	3190
13" Reel/Unmarked/2 mm 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.

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 dimension. 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. Please contact KEMET if you require a laser marked option. For more information see Capacitor Marking .

C_{fofPut}

- -55°C to +150°C operating temperature range
- Superior flex performance (up to 5 mm)
- Lead (Pb)-free, RoHS and REACH compliant
- EIA 0603, 0805, 1206, 1210, and 1812 case sizes
- DC voltage ratings of 10 V, 16 V, 25 V, 50 V and 100 V
- Capacitance offerings ranging from 0.5 pF to 0.22 µF
- Available capacitance tolerances of ±0.10 pf, ±0.25 pf, ±0.5 pf, ±1%, ±2%, ±5%, ±10%, and ±20%
- Extremely low ESR and ESL
- High thermal stability
- High ripple current capability
- No capacitance change with respect to applied rated DC voltage
- Non-polar device, minimizing installation concerns
- Commercial and Automotive (AEC-Q200) grades available
- 100% pure matte tin-plated termination finish allowing for excellent solderability
- SnPb plated termination finish option available upon request (5% Pb minimum)

Typical applications include decoupling, bypass, filtering and transient voltage suppression in critical and safety relevant circuits without (integrated) current limitation, including those subject to high levels of board flexure or temperature cycling.

KEMET Automotive Grade products meet or exceed the requirements outlined by the Automotive Electronics Council. Details regarding test methods and conditions are referenced in document AEC-Q200, Stress Test Qualification for Passive Components. These products are supported by a Product Change Notification (PCN) and Production Part Approval Process warrant (PPAP).

Automotive products offered through our distribution channel have been assigned an inclusive ordering code C-Spec, "AUTO". This C-Spec was developed in order to better serve small and medium-sized companies that prefer an automotive grade component without the requirement to submit a customer Source Controlled Drawing (SCD) or specification for review by a KEMET engineering specialist. This C-Spec is therefore not intended for use by KEMET's OEM Automotive customers and are not granted the same "privileges" as other automotive C-Specs. Customer PCN approval and PPAP request levels are limited (see details below).

Qspvdu!Di boh f!OpujRdbujpo!)QDO*

The KEMET Product Change Notification system is used to communicate primarily the following types of changes:

- Product/process changes that affect product form, fit, function, and/or reliability
- Changes in manufacturing site
- Product obsolescence

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	Process/Product change	Obsolescence*	
KEMET assigned ¹	Yes (with approval and sign off)	Yes	180 days minimum
AUTO	Yes (without approval)	Yes	90 days minimum

¹ KEMET assigned C-Specs require the submittal of a customer SCD or customer specification for review. For additional information contact KEMET.

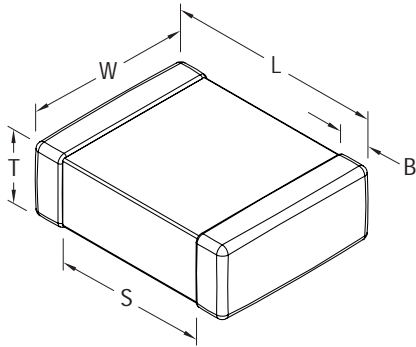
The purpose of the Production Part Approval Process is:

- To ensure that supplier can meet the manufacturability and quality requirements for the purchased parts.
- To provide the evidence that all customer engineering design record and specification requirements are properly understood and fulfilled by the manufacturing organization.
- To demonstrate that the established manufacturing process has the potential to produce the part.

	1	2	3	4	5
KEMET assigned ¹					
AUTO					

¹ KEMET assigned C-Specs require the submittal of a customer SCD or customer specification for review. For additional information contact KEMET.

Part number specific PPAP available
 Product family PPAP only



0603	1608	1.60 (0.063) ±0.17 (0.007)	0.80 (0.032) ±0.15 (0.006)	See Table 2 for Thickness	0.45 (0.018) ±0.15 (0.006)	0.58 (0.023)	Solder Wave or Solder Reflow
0805	2012	2.00 (0.079) ±0.30 (0.012)	1.25 (0.049) ±0.30 (0.012)		0.50 (0.02) ±0.25 (0.010)	0.75 (0.030)	
1206	3216	3.30 (0.130) ±0.40 (0.016)	1.60 (0.063) ±0.35 (0.013)		0.60 (0.024) ±0.25 (0.010)	N/A	Solder Reflow Only
1210	3225	3.30 (0.130) ±0.40 (0.016)	2.60 (0.102) ±0.30 (0.012)		0.60 (0.024) ±0.25 (0.010)		
1812	4532	4.50 (0.178) ±0.40 (0.016)	3.20 (0.126) ±0.30 (0.012)		0.70 (0.028) ±0.35 (0.014)		

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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 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.

Lead (Pb)-free, RoHS, and REACH compliant without exemptions (excluding SnPb termination finish option).

Operating Temperature Range	-55°C to +150°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%
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 50mA)
² Dissipation Factor (DF) Maximum Limit at 25°C	2.5%
³ Insulation Resistance (IR) Minimum Limit at 25°C	1,000 MΩ μF or 100 GΩ (Rated voltage applied for 120 ±5 seconds at 25°C)

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

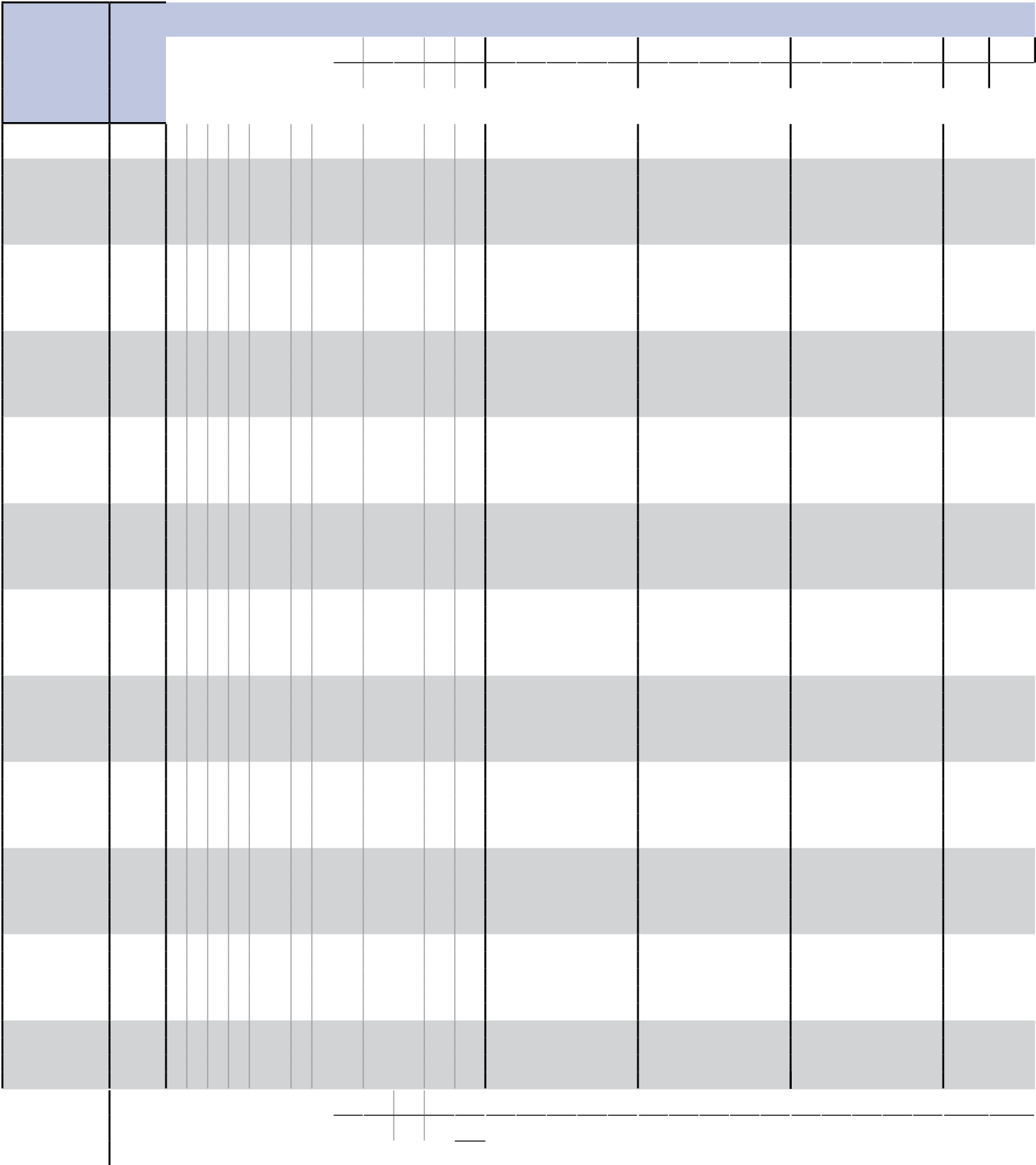
1 MHz ±100 kHz and $1.0 \pm 0.2 V_{rms}$ if capacitance $< 1,000$ pF.

1 kHz ±50 Hz and $1.0 \pm 0.2 V_{rms}$ if capacitance $> 1,000$ pF.

³ To obtain IR limit, divide M -μF value by the capacitance and compare to G 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 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance
Ultra-Stable X8R	All	All	3.0	0.3% or ±0.25 pF	10% of Initial Limit



CJ	0603	0.80 ±0.15*	4,000	15,000	0	0
DR	0805	0.78 ±0.20	0	0	4,000	10,000
DD	0805	0.90 ±0.10	0	0	4,000	10,000
DS	0805	1.00 ±0.20	0	0	2,500	10,000
DF	0805	1.10 ±0.10	0	0	2,500	10,000
DG	0805	1.25 ±0.15	0	0	2,500	10,000
EQ	1206	0.78 ±0.20	4,000	10,000	4,000	10,000
ER	1206	0.90 ±0.20	0	0	4,000	10,000
ES	1206	1.00 ±0.20	0	0	2,500	10,000
ET	1206	1.10 ±0.20	0	0	2,500	10,000
EF	1206	1.20 ±0.15	0	0	2,500	10,000
EH	1206	1.60 ±0.20	0	0	2,000	8,000
FN	1210	0.78 ±0.20	0	0	4,000	10,000
FQ	1210	0.90 ±0.20	0	0	4,000	10,000
FE	1210	1.00 ±0.10	0	0	2,500	10,000
FA	1210	1.10 ±0.15	0	0	2,500	10,000
FZ	1210	1.25 ±0.20	0	0	2,500	10,000
FU	1210	1.55 ±0.20	0	0	2,000	8,000
FM	1210	1.70 ±0.20	0	0	2,000	8,000
FJ	1210	1.85 ±0.20	0	0	2,000	8,000
GB	1812	1.00 ±0.10	0	0	1,000	4,000
GD	1812	1.25 ±0.15	0	0	1,000	4,000
GH	1812	1.40 ±0.15	0	0	1,000	4,000
GG	1812	1.55 ±0.10	0	0	1,000	4,000
GK	1812	1.60 ±0.20	0	0	1,000	4,000
GN	1812	1.70 ±0.20	0	0	1,000	4,000

		Bulk Bag (default)	
Packaging C-Spec ¹		N/A ²	
EIA (in)	Metric (mm)	Minimum	Maximum
0402	1005	1	50,000
0603	1608		
0805	2012		
1206	3216		
1210	3225		
1808	4520		20,000
1812	4532		
1825	4564		
2220	5650		
2225	5664		

¹ The "Packaging C-Spec" is a 4 to 8 digit code which identifies the packaging type and/or product grade. When ordering, the proper code must be included in the 15th through 22nd character positions of the ordering code. See "Ordering Information" section of this document for further details. Commercial grade product ordered without a packaging C-Spec will default to our standard "Bulk Bag" packaging. Contact KEMET if you require a bulk bag packaging option for Automotive grade products.

² A packaging C-Spec (see note 1 above) is not required for "Bulk Bag" packaging (excluding Anti-Static Bulk Bag and automotive grade products). The 15th through 22nd character positions of the ordering code should be left blank. All products ordered without a packaging C-Spec will default to our standard "Bulk Bag" packaging.

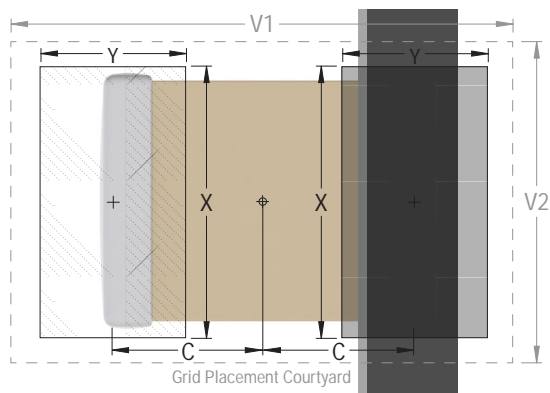
		E f o t j u z ! M f w f m ! B ; !					E f o t j u z ! M f w f m ! C ; !					E f o t j u z ! M f w f m ! D ; !				
0603	1608	0.85	1.25	1.10	4.00	2.10	0.75	1.05	1.00	3.10	1.50	0.65	0.85	0.90	2.40	1.20
0805	2012	0.99	1.44	1.66	4.47	2.71	0.89	1.24	1.56	3.57	2.11	0.79	1.04	1.46	2.42	1.81
1206	3216	1.59	1.62	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: For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes. KEMET only recommends wave soldering of EIA 0603, 0805, and 1206 case sizes.

Density Level B: For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes.

Density Level C: For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC Standard 7351 (IPC 7351).

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



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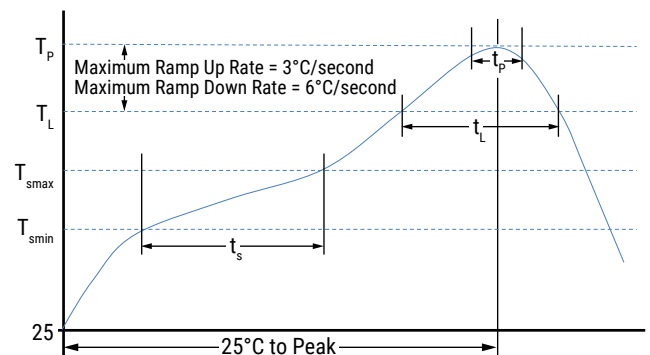
- Solder wave or solder reflow for EIA case sizes 0603, 0805 and 1206
- All other EIA case sizes are limited to solder reflow only

Sfdpn n foefe!SfCpx!Tpme fsjoh!QspPmf;

KEMET's 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. KEMET's 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.

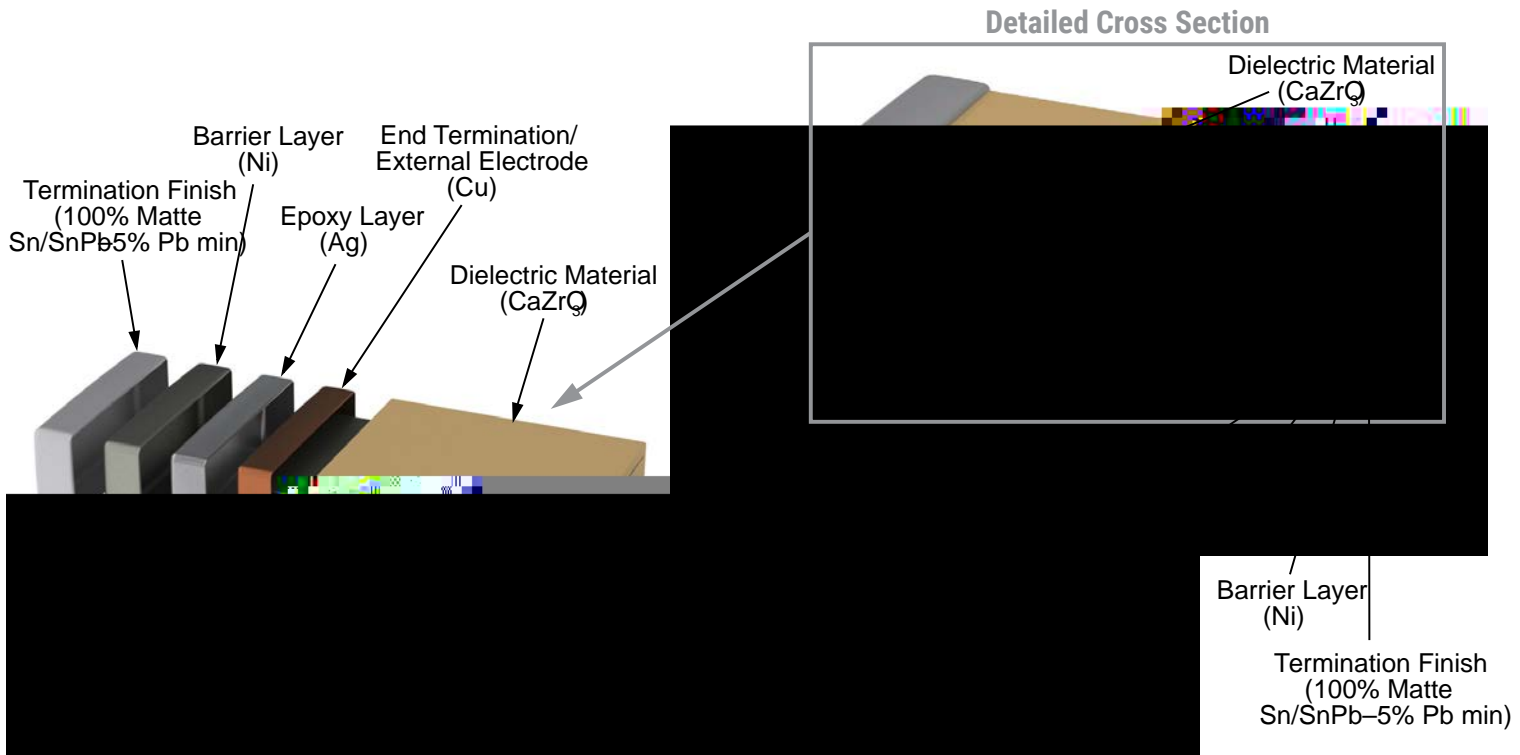
QspPmf!Gfbuvsf		
	SnPb	100% Matte Sn
Temperature Minimum (T_{Smin})	100°C	150°C
Temperature Maximum (T_{Smax})	150°C	200°C
Time (t_s) from T_{Smin} to T_{Smax}	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate (T_L to T_p)	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T_L)	183°C	217°C
Time Above Liquidous (t_L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T_p)	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t_p)	20 seconds maximum	30 seconds maximum
Ramp-Down Rate (T_p to T_L)	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum

Note: All temperatures refer to the center of the package, measured on the capacitor body surface that is facing up during assembly reflow.



Ubcmf!5!δ!Qfsgpsn bodf! ' !Sfmjbcjmjuz;!Uf tu!N fu i pet! ' !Dpoejujpot

Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for COG. Flexible termination system – 3.0 mm (minimum).
Solderability	J-STD-002	Magnification 50 X. Conditions:
		a) Method B, 4 hours at 155°C, dry heat at 235°C
		b) Method B at 215°C category 3
		c) Method D, category 3 at 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +150°C). Measurement at 24 hours ±4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Load humidity: 1,000 hours 85°C/85%RH and rated voltage. Add 100K ohm 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 K ohm resistor. Measurement at 24 hours ±4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours. ±4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	



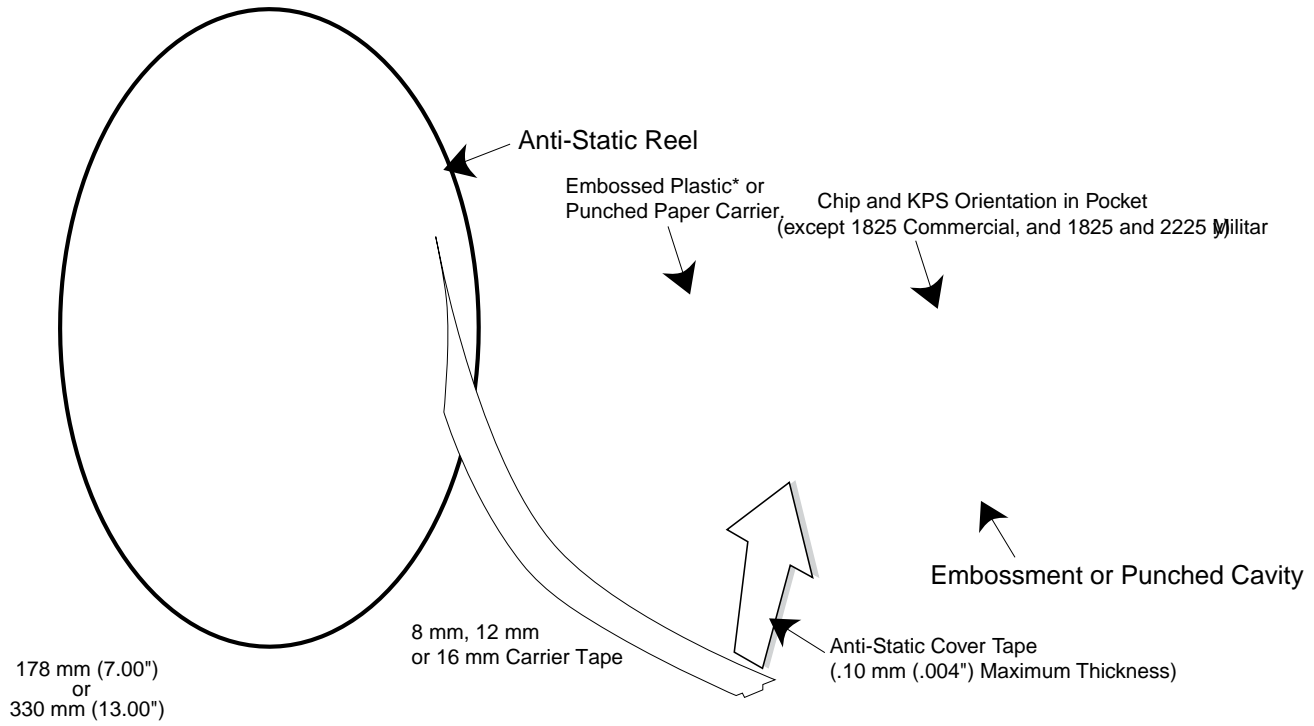
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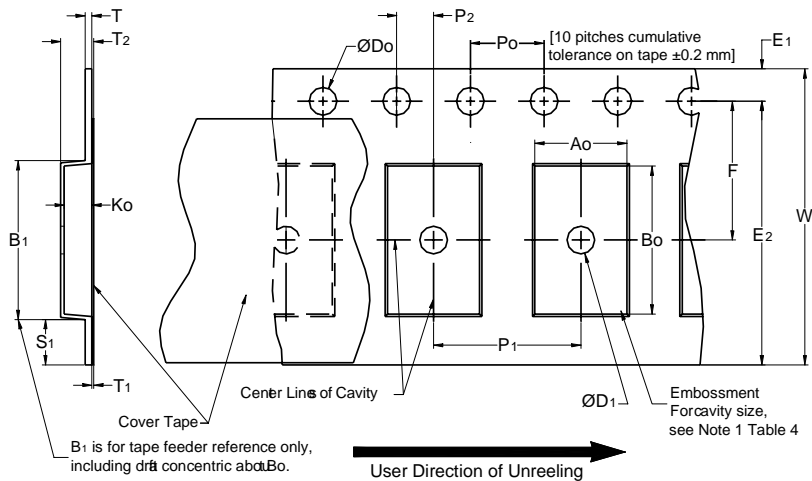
Laser marking option is not available on:

- COG, Ultra Stable X8R and Y5V dielectric devices.
- EIA 0402 case size devices.
- EIA 0603 case size devices with Flexible Termination option.
- KPS Commercial and Automotive grade stacked devices.

These capacitors are supplied unmarked only.

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.



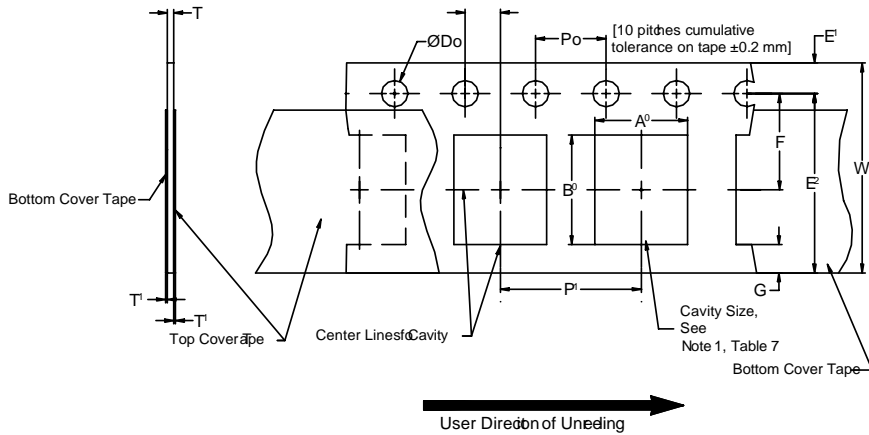


Metric will govern

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									

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)	

- The embossment hole location shall be measured from the sprocket hole controlling the location of the embossment. Dimensions of embossment location and hole location shall be applied independent of each other.
- The tape with or without components shall pass around R without damage (see Figure 6).
- If $S_1 < 1.0$ mm, there may not be enough area for cover tape to be properly applied (see EIA Standard 481 paragraph 4.3 section b).
- B_1 dimension is a reference dimension for tape feeder clearance only.
- The cavity defined by A_0 , B_0 and K_0 shall surround the component with sufficient clearance that:
 - the component does not protrude above the top surface of the carrier tape.
 - the component can be removed from the cavity in a vertical direction without mechanical restriction, after the top cover tape has been removed.
 - rotation of the component is limited to 20° maximum for 8 and 12 mm tapes and 10° maximum for 16 mm tapes (see Figure 3).
 - lateral movement of the component is restricted to 0.5 mm maximum for 8 and 12 mm wide tape and to 1.0 mm maximum for 16 mm tape (see Figure 4).
 - for KPS product, A_0 and B_0 are measured on a plane 0.3 mm above the bottom of the pocket.
 - see addendum in EIA Standard 481 for standards relating to more precise taping requirements.



Metric will govern

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)
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)			

- The cavity defined by A_0 , B_0 and T shall surround the component with sufficient clearance that:
 - the component does not protrude beyond either surface of the carrier tape.
 - the component can be removed from the cavity in a vertical direction without mechanical restriction, after the top cover tape has been removed.
 - rotation of the component is limited to 20° maximum (see Figure 3).
 - lateral movement of the component is restricted to 0.5 mm maximum (see Figure 4).
 - see addendum in EIA Standard 481 for standards relating to more precise taping requirements.
- The tape with or without components shall pass around R without damage (see Figure 6).

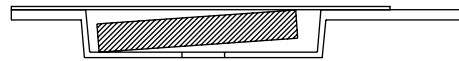
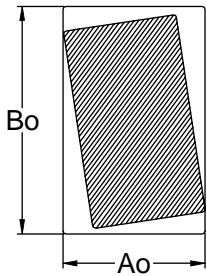
2/!Dpwfs!Ubqf!Csfb!Gpsdf; 1.0 kg minimum.

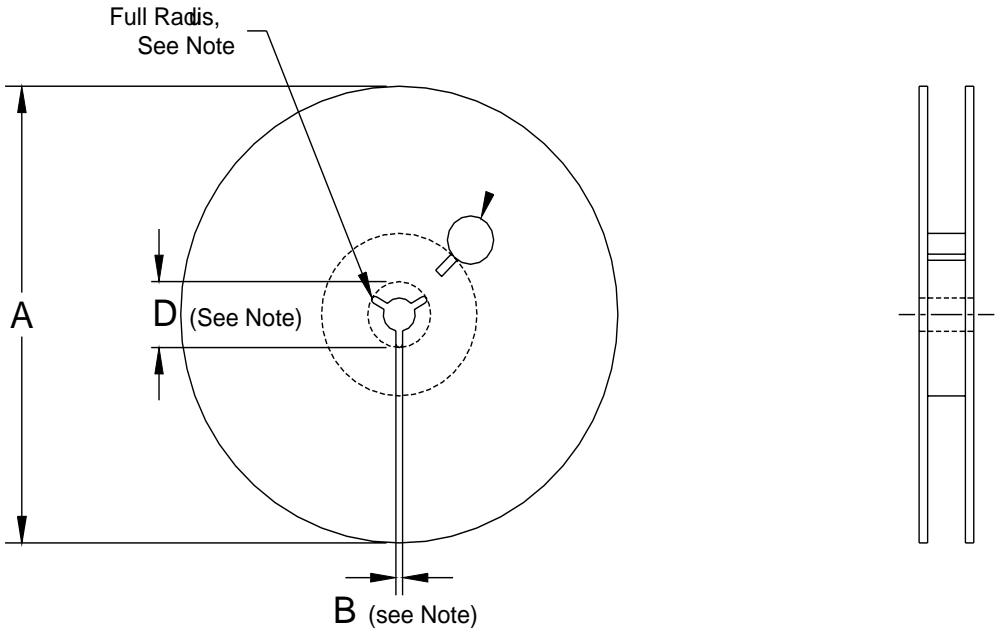
3/!Dpwfs!Ubqf!Qf f!Tusfohu i;!The total peel strength of the cover tape from the carrier tape shall be:

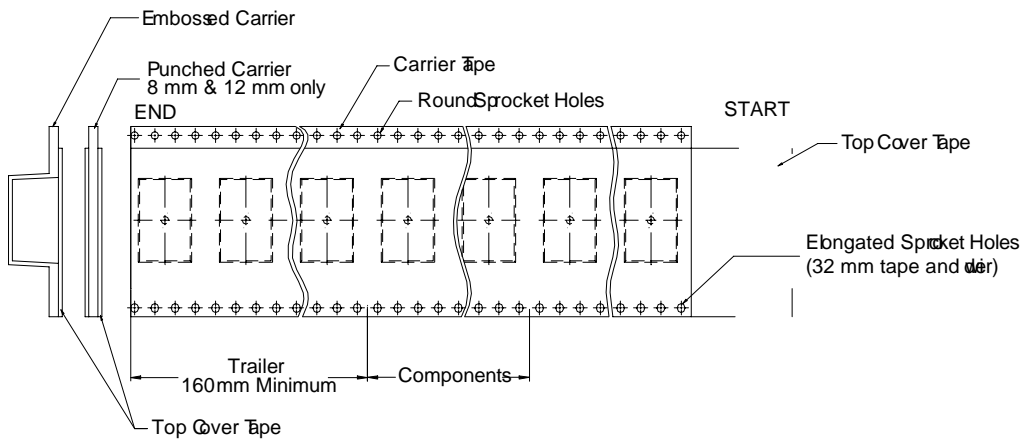
8 mm	0.1 to 1.0 Newton (10 to 100 gf)
12 and 16 mm	0.1 to 1.3 Newton (10 to 130 gf)

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.

4/!Mbc f!joh; 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.*







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