High Voltage with Flexible Termination System (HV FT-CAP), C0G Dielectric, 500 – 10,000 VDC (Commercial Grade)

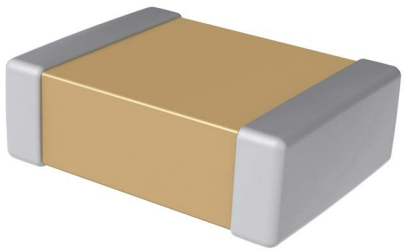
Overview

KEMET's High Voltage with Flexible Termination (HV FT-CAP) surface mount MLCCs in C0G dielectric address the primary failure mode of MLCCs–flex cracks. These devices utilize a pliable and conductive silver epoxy between the base metal and nickel barrier layers of the termination system which 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.

Flexible termination technology provides superior flex performance over standard termination systems. C0G (NP0) dielectric capacitors exhibit no change in capacitance with respect to time and voltage and boasts a negligible change in capacitance with reference to ambient temperature. Capacitance change is limited to ±30ppm/°C from −55°C to +125°C. These devices exhibit low ESR at high frequencies and find conventional use as snubbers or filters in applications such as switching power supplies and lighting ballasts.

Benefits

- Operating temperature range of −55°C to +125°C
- Superior flex performance (up to 5 mm)
- Capacitance offerings ranging from 1 pF to 120 nF
- DC voltage ratings of 500 V, 630 V, 1 KV, 1.5 KV, 2 KV, 2.5 KV, 3 KV and 10KV
- EIA 0603, 0805, 1206, 1210, 1808, 1812, 1825, 2220 and 2225
- Extremely low ESR and ESL
- High ripple current capability
- No capacitance shift with voltage
- Negligible capacitance shift with respect to temperature
- No piezoelectric noise
- Lead (Pb)-Free, RoHS and REACH compliant



Applications

- High frequency power converters
- Wide bandgap (WBG), silicon carbide (SiC) and gallium nitride (GaN) systems
- Snubber (high dV/dT)
- Resonant circuits (LLC, Wireless Charging, etc)
- Timing
- Filtering

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Ordering Information

C	2225	X	393	J	C	G	A	C	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance[1]	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish[2]	Packaging/Grade (C-Spec)
	0603 0805 1206 1210 1808 1812 1825 2220 2225	X = Flexible Termination	Two significant digits and 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%	C = 500 B = 630 D = 1,000 F = 1,500 G = 2,000 Z = 2,500 H = 3,000 K = 10,000	G = C0G	A = N/A	C = 100% Matte Sn L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table"

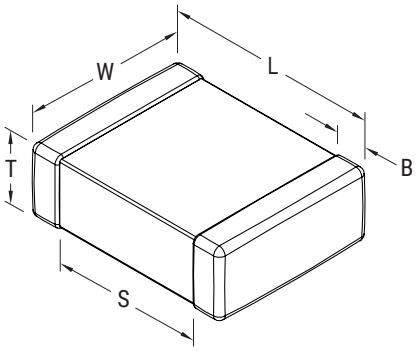
[1] Additional capacitance tolerance offerings may be available. Contact KEMET for details.
[2] Additional termination finish options may be available. Contact KEMET for details.

Packaging C-Spec Ordering Options Table

Packaging Type[1]	Packaging/Grade Ordering Code (C-Spec)
Commercial Grade[1]	
Bulk Bag	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/2mm pitch[2]	7081
13" Reel/Unmarked/2mm 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 2mm 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 2mm 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. The option to laser mark is not available on these devices. For more information see "Capacitor Marking".

Dimensions – Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0603	1608	1.60 (0.063) ±0.15 (0.006)	0.80 (0.032) ±0.15 (0.006)	See Table 2 for Thickness	0.35 (0.014) ±0.15 (0.006)	0.70 (0.028)	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	
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)		Solder Reflow Only
1808	4520	4.70 (0.185) ±0.50 (0.020)	2.00 (0.079) ±0.20 (0.008)		0.70 (0.028) ±0.35 (0.014)		
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)		
1825	4564	4.60 (0.181) ±0.40 (0.016)	6.40 (0.252) ±0.40 (0.016)		0.70 (0.028) ±0.35 (0.014)		
2220	5650	5.90 (0.232) ±0.75 (0.030)	5.00 (0.197) ±0.40 (0.016)		0.70 (0.028) ±0.35 (0.014)		
2225	5664	5.90 (0.232) ±0.75 (0.030)	6.40 (0.248) ±0.40 (0.016)		0.70 (0.028) ±0.35 (0.014)		

Qualification/Certification

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

Environmental Compliance

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

Table 1A – Capacitance Range/Selection Waterfall (0603 – 1808 Case Sizes)

Capacitance	Cap Code	Case Size/Series	C0603X			C0805X			C1206X					C1210X					C1808X						
		Voltage Code	C	B	D	C	B	D	C	B	D	F	G	C	B	D	F	G	C	B	D	F	G	Z	H
		Rated Voltage (VDC)	500	630	1000	500	630	1000	500	630	1000	1500	2000	500	630	1000	1500	2000	500	630	1000	1500	2000	2500	3000
		Capacitance Tolerance	Product Availability and Chip Thickness Codes See Table 2 for Chip Thickness Dimensions																						
1.0 - 9.1 pF*	109 - 169*	B C D				DG	DG	DG											LB	LB	LB	LB	LB	LB	LB
10 pF	100	F G J K M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
11 pF	110	F G J K M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
12 pF	120	F G J K M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
13 pF	130	F G J K M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
15 pF	150	F G J K M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
16 pF	160	F G J K M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
18 pF	180	F G J K M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
20 pF	200	F G J K M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
22 pF	220	F G J K M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
24 pF	240	F G J K M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
27 pF	270	F G J K M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
30 pF	300	F G J K M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
33 pF	330	F G J K M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
36 pF	360	F G J K M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
39 pF	390	F G J K M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
43 pF	430	F G J K M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
47 pF	470	F G J K M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
51 pF	510	F G J K M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
56 pF	560	F G J K M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
62 pF	620	F G J K M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
68 pF	680	F G J K M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
75 pF	750	F G J K M				DG	DG	DG	ES	ES	ES	ES	EF	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
82 pF	820	F G J K M				DG	DG	DG	ES	ES	ES	ES	EF	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
91 pF	910	F G J K M				DG	DG	DG	ES	ES	ES	ES	EF	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
100 pF	101	F G J K M	CJ	CJ	CJ	DG	DG	DG	ES	ES	ES	ES	EF	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LC	LB
110 pF	111	F G J K M	CJ	CJ	CJ	DG	DG	DG	ES	ES	ES	ES	EU	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LC	LB
120 pF	121	F G J K M	CJ	CJ	CJ	DG	DG	DG	ES	ES	ES	ES	EU	FZ	FZ	FZ	FM	FM	LA	LA	LA	LA	LB	LC	LB
130 pF	131	F G J K M	CJ	CJ	CJ	DG	DG	DG	ES	ES	ES	ES	EU	FZ	FZ	FZ	FM	FM	LA	LA	LA	LA	LB	LC	LC
150 pF	151	F G J K M	CJ	CJ	CJ	DG	DG	DG	ES	ES	ES	EF	EU	FZ	FZ	FZ	FM	FM	LA	LA	LA	LA	LB	LC	LC
160 pF	161	F G J K M	CJ	CJ	CJ	DG	DG	DG	ES	ES	ES	EF	EU	FZ	FZ	FZ	FM	FM	LA	LA	LA	LA	LC	LC	LC
180 pF	181	F G J K M	CJ	CJ	CJ	DG	DG	DG	ES	ES	ES	EF	EU	FZ	FZ	FZ	FM	FM	LA	LA	LA	LA	LC	LC	LC
200 pF	201	F G J K M	CJ	CJ	CJ	DG	DG	DG	ES	ES	ES	EF	EU	FZ	FZ	FZ	FM	FM	LA	LA	LA	LA	LC	LC	
220 pF	221	F G J K M	CJ	CJ	CJ	DG	DG	DG	ES	ES	ES	EU	EU	FZ	FZ	FZ	FM	FM	LA	LA	LA	LA	LC	LC	
240 pF	241	F G J K M	CJ	CJ		DG	DG	DG	ES	ES	ES	EU	EU	FZ	FZ	FZ	FM	FM	LA	LA	LA	LB	LC	LC	
270 pF	271	F G J K M	CJ	CJ		DG	DG	DG	ES	ES	ES	EU	EU	FZ	FZ	FZ	FK	FK	LA	LA	LA	LB	LC	LC	
300 pF	301	F G J K M	CJ	CJ		DG	DG	DC	ES	ES	EF	EU		FZ	FZ	FZ	FK	FK	LA	LA	LA	LB	LC	LC	
330 pF	331	F G J K M	CJ	CJ		DG	DG	DC	ES	ES	EF	EU		FZ	FZ	FZ	FK	FK	LA	LA	LA	LB	LC	LC	
360 pF	361	F G J K M	CJ	CJ		DG	DG	DC	ES	ES	EF	EU		FZ	FZ	FZ	FK	FS	LA	LA	LA	LB	LA	LC	
390 pF	391	F G J K M	CJ	CJ		DG	DG	DC	ES	ES	EF	EU		FZ	FZ	FZ	FK	FS	LA	LA	LA	LB	LA	LC	
430 pF	431	F G J K M	CJ	CJ		DG	DG	DD	ES	ES	EF	EU		FZ	FM	FM	FS	FS	LA	LB	LB	LC	LA		
470 pF	471	F G J K M	CJ	CJ		DG	DG	DD	ES	ES	EU	EU		FZ	FM	FM	FS	FS	LA	LB	LB	LC	LA		
510 pF	511	F G J K M	CJ	CJ		DG	DG	DD	ES	ES	EU	EU		FZ	FM	FM	FS	FS	LA	LB	LB	LC	LB		
560 pF	561	F G J K M	CJ	CJ		DG	DG	DG	ES	ES	EU	EU		FZ	FM	FM	FS	FS	LA	LB	LB	LC	LB		
620 pF	621	F G J K M	CJ	CJ		DG	DG	DG	ES	ES	EU			FZ	FM	FM	FS	FS	LA	LB	LB	LA	LC		
680 pF	681	F G J K M	CJ	CJ		DG	DG	DG	ES	ES	EU			FZ	FM	FM	FS	FS	LB	LB	LB	LA	LC		
750 pF	751	F G J K M				DG	DG	DG	ES	EF	EU			FZ	FM	FM	FM		LB	LB	LB	LA			
820 pF	821	F G J K M				DG	DG	DG	ES	EF	EU			FZ	FM	FM	FM		LB	LB	LB	LA			
910 pF	911	F G J K M				DC	DC		ES	EF	EU			FM	FM	FM	FY		LB	LB	LB	LA			
1,000 pF	102	F G J K M				DC	DC		ES	EF	EU			FM	FM	FM	FY		LB	LB	LB	LB			
Capacitance	Cap Code	Rated Voltage (VDC)	500	630	1000	500	630	1000	500	630	1000	1500	2000	500	630	1000	1500	2000	500	630	1000	1500	2000	2500	3000
		Voltage Code	C	B	D	C	B	D	C	B	D	F	G	C	B	D	F	G	C	B	D	F	G	Z	H
		Case Size/Series	C0603X			C0805X			C1206X					C1210X					C1808X						

**Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, and 91)*
KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).
These products are protected under US Patents 7,172,985 and 7,670,981, other patents pending, and any foreign counterparts.

Table 1A – Capacitance Range/Selection Waterfall (0603 – 1808 Case Sizes) cont.

Capacitance	Cap Code	Case Size/Series	C0603X			C0805X			C1206X					C1210X					C1808X						
		Voltage Code	C	B	D	C	B	D	C	B	D	F	G	C	B	D	F	G	C	B	D	F	G	Z	H
		Rated Voltage (VDC)	500	630	1000	500	630	1000	500	630	1000	1500	2000	500	630	1000	1500	2000	500	630	1000	1500	2000	2500	3000
		Capacitance Tolerance	Product Availability and Chip Thickness Codes See Table 2 for Chip Thickness Dimensions																						
1,100 pF	112	F G J K M				DC	DC		EF	EU	ED			FM	FK	FK	FS		LC	LC	LC	LB			
1,200 pF	122	F G J K M				DC	DC		EF	EU	ED			FM	FK	FK	FS		LC	LC	LC	LC			
1,300 pF	132	F G J K M				DC	DC		EF	EU	ED			FM	FS	FS			LC	LC	LC	LC			
1,500 pF	152	F G J K M				DD	DD		EF	EU	ED			FK	FS	FS			LC	LC	LC	LC			
1,600 pF	162	F G J K M				DD	DD		EF	EU	ED			FK	FS	FS			LC	LC	LC				
1,800 pF	182	F G J K M				DG	DG		EF	EU	EF			FK	FS	FS			LC	LC	LC				
2,000 pF	202	F G J K M				DG	DG		EU	EQ	EF			FK	FL	FS			LC	LA	LB				
2,200 pF	222	F G J K M				DG	DG		EU	EQ	EF			FK	FL	FS			LC	LA	LB				
2,400 pF	242	F G J K M				DG	DG		EU	EQ	EU			FS	FL	FS			LC	LA	LB				
2,700 pF	272	F G J K M				DG	DG		EU	EQ	EU			FS	FL	FS			LC	LA	LC				
3,000 pF	302	F G J K M							EQ	EQ				FS	FL	FF			LA	LA	LA				
3,300 pF	332	F G J K M							EQ	EQ				FS	FM	FG			LA	LA	LA				
3,600 pF	362	F G J K M							ER	ER				FL	FM	FG			LA	LB	LA				
3,900 pF	392	F G J K M							ER	ER				FL	FY	FL			LA	LB	LA				
4,300 pF	432	F G J K M							ES	ES				FM	FY	FL			LA	LC	LA				
4,700 pF	472	F G J K M							ES	ES				FM	FY	FM			LA	LC	LB				
5,100 pF	512	F G J K M							EE	EE				FY	FS	FM			LA	LB	LB				
5,200 pF	562	F G J K M							EF	EF				FY	FS	FM			LB	LC	LC				
6,200pF	622	F G J K M							EF	EF				FY	FE	FY			LC	LC	LC				
6,800pF	682	F G J K M							EU	EU				FY	FE	FY			LC	LC	LC				
7,500pF	752	F G J K M							EU	EU				FS	FF	FS			LA	LA					
8,200pF	822	F G J K M							EU	EU				FS	FF	FS			LA	LA					
9,100 pF	912	F G J K M							EU	EU				FF	FF	FS			LA	LA					
10,000 pF	103	F G J K M							EU	EU				FG	FG	FS			LA	LA					
12,000 pF	123	F G J K M							EU					FG	FG	FM			LA	LA					
15,000 pF	153	F G J K M							EU					FM	FM	FS			LB	LB					
18,000 pF	183	F G J K M												FM	FM	FS			LC	LC					
22,000 pF	223	F G J K M												FY	FY	FS									
27,000 pF	273	F G J K M												FS	FS										
33,000 pF	333	F G J K M												FS	FS										
Capacitance	Cap Code	Rated Voltage (VDC)	500	630	1000	500	630	1000	500	630	1000	1500	2000	500	630	1000	1500	2000	500	630	1000	1500	2000	2500	3000
		Voltage Code	C	B	D	C	B	D	C	B	D	F	G	C	B	D	F	G	C	B	D	F	G	Z	H
		Case Size/Series	C0603X			C0805X			C1206X					C1210X					C1808X						

**Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, and 91)*
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Table 1B – Capacitance Range/Selection Waterfall (1812 – 2225 Case Sizes)

Cap	Cap Code	Case Size/ Series	C1812X							C1825X							C2220X							C2225X							
		Voltage Code	C	B	D	F	G	Z	H	C	B	D	F	G	Z	H	C	B	D	F	G	Z	H	C	B	D	F	G	Z	H	K
		Rated Voltage (VDC)	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000	10000
		Capacitance Tolerance	Product Availability and Chip Thickness Codes See Table 2 for Chip Thickness Dimensions																												
10 pF	100	F G J K M	GB	GB	GB	GB	GB	GB	GB								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	
11 pF	110	F G J K M	GB	GB	GB	GB	GB	GB	GB								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	
12 pF	120	F G J K M	GB	GB	GB	GB	GB	GB	GB								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	
13 pF	130	F G J K M	GB	GB	GB	GB	GB	GB	GB								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	
15 pF	150	F G J K M	GB	GB	GB	GB	GB	GB	GB								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	
16 pF	160	F G J K M	GB	GB	GB	GB	GB	GB	GB								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	
18 pF	180	F G J K M	GB	GB	GB	GB	GB	GB	GB								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	
20 pF	200	F G J K M	GB	GB	GB	GB	GB	GB	GB								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	
22 pF	220	F G J K M	GB	GB	GB	GB	GB	GB	GB								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	
24 pF	240	F G J K M	GB	GB	GB	GB	GB	GB	GB								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	
27 pF	270	F G J K M	GB	GB	GB	GB	GB	GB	GB								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	
30 pF	300	F G J K M	GB	GB	GB	GB	GB	GB	GB								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	
33 pF	330	F G J K M	GB	GB	GB	GB	GB	GB	GB								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	
36 pF	360	F G J K M	GB	GB	GB	GB	GB	GB	GB								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	
39 pF	390	F G J K M	GB	GB	GB	GB	GB	GB	GB								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	
43 pF	430	F G J K M	GB	GB	GB	GB	GB	GB	GB								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	
47 pF	470	F G J K M	GB	GB	GB	GB	GB	GB	GB								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	KE
51 pF	510	F G J K M	GB	GB	GB	GB	GB	GB	GB								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	KE
56 pF	560	F G J K M	GB	GB	GB	GB	GB	GB	GB								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	KE
62 pF	620	F G J K M	GB	GB	GB	GB	GB	GB	GB								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	KF
68 pF	680	F G J K M	GB	GB	GB	GB	GB	GB	GB								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	KF
75 pF	750	F G J K M	GB	GB	GB	GB	GB	GB	GB								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	KF
82 pF	820	F G J K M	GB	GB	GB	GB	GB	GB	GB								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	KF
91 pF	910	F G J K M	GD	GD	GD	GD	GD	GD	GD								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	KH
100 pF	101	F G J K M	GD	GD	GD	GD	GD	GD	GD								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	KH
110 pF	111	F G J K M	GD	GD	GD	GD	GD	GD	GD								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	KJ
120 pF	121	F G J K M	GD	GD	GD	GD	GD	GD	GD								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	KJ
130 pF	131	F G J K M	GD	GD	GD	GD	GD	GD	GD								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	KJ
150 pF	151	F G J K M	GD	GD	GD	GD	GD	GD	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	
160 pF	161	F G J K M	GD	GD	GD	GD	GD	GD	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	
180 pF	181	F G J K M	GD	GD	GD	GD	GD	GD	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	
200 pF	201	F G J K M	GD	GD	GD	GD	GD	GD	GM								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	
220 pF	221	F G J K M	GB	GB	GB	GB	GB	GD	GM								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF	
240 pF	241	F G J K M	GB	GB	GB	GB	GB	GD	GM								JK	JK	JK	JK	JK	JK	JK	KE	KE	KE	KE	KE	KE	KF	
270 pF	271	F G J K M	GB	GB	GB	GB	GB	GH	GM								JK	JK	JK	JK	JK	JK	JK	KE	KE	KE	KE	KE	KE	KF	
300 pF	301	F G J K M	GB	GB	GB	GB	GB	GH	GM								JK	JK	JK	JK	JK	JK	JK	KE	KE	KE	KE	KE	KE	KF	
330 pF	331	F G J K M	GB	GB	GB	GB	GB	GH	GO								JE	JE	JE	JE	JE	JK	JK	KE	KE	KE	KE	KE	KE	KF	
360 pF	361	F G J K M	GB	GB	GB	GB	GD	GK	GO								JE	JE	JE	JE	JE	JK	JK	KE	KE	KE	KE	KE	KE	KF	
390 pF	391	F G J K M	GB	GB	GB	GB	GD	GK	GO								JE	JE	JE	JE	JE	JK	JK	KE	KE	KE	KE	KE	KE	KF	
430 pF	431	F G J K M	GB	GB	GB	GB	GD	GK								HJ	JE	JE	JE	JE	JE	JK	JE	KE	KE	KE	KE	KE	KE	KF	
470 pF	471	F G J K M	GB	GB	GB	GB	GD	GK								HJ	JE	JE	JE	JE	JE	JK	JK	KF	KF	KF	KF	KE	KE	KF	
510 pF	511	F G J K M	GB	GB	GB	GD	GH	GM								HJ	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KE	KE	KF	
560 pF	561	F G J K M	GB	GB	GB	GD	GH	GM								HJ	JK	JK	JK	JK	JK	JK	JL	KF	KF	KF	KF	KE	KE	KF	
620 pF	621	F G J K M	GB	GB	GB	GD	GH	GM								HK	JK	JK	JK	JK	JK	JK	JL	KF	KF	KF	KF	KE	KF	KH	
680 pF	681	F G J K M	GB	GB	GB	GD	GH	GO								HK	JE	JE	JE	JK	JK	JK	JL	KF	KF	KF	KF	KE	KF	KH	
750 pF	751	F G J K M	GB	GB	GB	GD	GK										JE	JE	JE	JK	JK	JK	JL	KE	KE	KE	KF	KE	KF	KH	
820 pF	821	F G J K M	GB	GB	GB	GD	GK										JE	JE	JE	JK	JK	JK	JN	KE	KE	KE	KF	KE	KF	KJ	
910 pF	911	F G J K M	GB	GB	GB	GH	GM										JE	JK	JK	JK	JK	JK	JN	KE	KE	KE	KF	KE	KF	KJ	
1,000 pF	102	F G J K M	GB	GB	GB	GH	GM										JE	JK	JK	JK	JK	JK	JN	KE	KE	KE	KF	KE	KF	KJ	
1,100 pF	112	F G J K M	GB	GB	GB	GH	GO								HJ		JE	JK	JK	JK	JK	JK		KE	KE	KE	KF	KF	KF		
Cap	Cap Code	Rated Voltage (VDC)	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000	10000
		Voltage Code	C	B	D	F	G	Z	H	C	B	D	F	G	Z	H	C	B	D	F	G	Z	H	C	B	D	F	G	Z	H	K
		Case Size/Series	C1812X							C1825X							C2220X							C2225X							

**Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, and 91)*
KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).
These products are protected under US Patents 7,172,985 and 7,670,981, other patents pending, and any foreign counterparts.

Table 1B – Capacitance Range/Selection Waterfall (1812 – 2225 Case Sizes) cont.

Cap	Cap Code	Case Size/ Series	C1812X							C1825X							C2220X							C2225X							
		Voltage Code	C	B	D	F	G	Z	H	C	B	D	F	G	Z	H	C	B	D	F	G	Z	H	C	B	D	F	G	Z	H	K
		Rated Voltage (VDC)	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000	10000
		Capacitance Tolerance	Product Availability and Chip Thickness Codes See Table 2 for Chip Thickness Dimensions																												
1,200 pF	122	F G J K M	GB	GB	GB	GH	GO								HJ		JE	JK	JK	JK	JK	JL		KE	KE	KE	KF	KF	KF		
1,300 pF	132	F G J K M	GB	GB	GB	GH	GO							HE	HJ		JE	JK	JK	JK	JE	JL		KE	KE	KE	KF	KF	KH		
1,500 pF	152	F G J K M	GB	GB	GB	GK	GO							HE	HK		JE	JK	JK	JK	JE	JL		KE	KE	KE	KF	KF	KH		
1,600 pF	162	F G J K M	GB	GD	GD	GK								HG	HK		JE	JK	JK	JK	JE	JL		KE	KE	KE	KF	KE	KH		
1,800 pF	182	F G J K M	GB	GD	GD	GM								HG			JE	JK	JK	JK	JE	JN		KE	KE	KE	KF	KE	KH		
2,000 pF	202	F G J K M	GB	GH	GH	GM							HE	HJ			JE	JK	JK	JE	JK			KE	KE	KE	KF	KE	KJ		
2,200 pF	222	F G J K M	GB	GH	GH	GO							HE	HJ			JE	JK	JK	JE	JK			KE	KE	KE	KF	KF	KJ		
2,400 pF	242	F G J K M	GB	GH	GK	GO							HE	HJ			JK	JK	JK	JE	JL			KE	KE	KE	KE	KH			
2,700 pF	272	F G J K M	GB	GH	GK	GO							HE	HK			JK	JK	JK	JE	JL			KE	KE	KE	KE	KH			
3,000 pF	302	F G J K M	GB	GH	GK								HE	HK			JK	JK	JK	JE	JL			KE	KE	KE	KE	KH			
3,300 pF	332	F G J K M	GB	GH	GK								HG				JK	JK	JK	JK	JN			KE	KE	KE	KE	KJ			
3,600 pF	362	F G J K M	GB	GH	GM								HG				JK	JK	JK	JK	JN			KE	KF	KF	KF	KJ			
3,900 pF	392	F G J K M	GB	GH	GM								HJ				JK	JK	JK	JK	JN			KE	KF	KF	KF	KJ			
4,300 pF	432	F G J K M	GH	GH	GO								HJ				JK	JK	JK	JK				KE	KF	KF	KF				
4,700 pF	472	F G J K M	GH	GH	GO								HJ				JK	JK	JK	JL				KE	KF	KF	KH				
5,100 pF	512	F G J K M	GH	GK	GO						HE	HG	HK				JK	JK	JK	JL				KE	KF	KF	KH				
5,600 pF	562	F G J K M	GH	GK	GO						HE	HG	HK				JK	JK	JK	JN				KE	KF	KF	KH				
6,200 pF	622	F G J K M	GH	GK	GH						HE	HG					JK	JE	JE	JN				KE	KF	KF	KJ				
6,800 pF	682	F G J K M	GH	GM	GH						HE	HJ					JK	JE	JK	JN				KE	KF	KF	KJ				
7,500 pF	752	F G J K M	GH	GM	GK						HE	HJ					JK	JE	JK					KF	KE	KF					
8,200 pF	822	F G J K M	GK	GO	GK						HE	HJ					JK	JE	JL					KF	KE	KF					
9,100 pF	912	F G J K M	GM	GO	GM					HE	HG	HK					JE	JE	JL					KF	KE	KH					
10,000 pF	103	F G J K M	GM	GO	GM					HE	HG	HK					JE	JE	JL					KF	KE	KH					
12,000 pF	123	F G J K M	GO	GH	GO					HE	HG	HE					JE	JK	JN					KE	KE	KH					
15,000 pF	153	F G J K M	GO	GH	GO					HE	HJ	HE					JE	JL	JE					KE	KF	KJ					
18,000 pF	183	F G J K M	GH	GH						HG	HK	HG					JE	JL	JE					KE	KH	KE					
22,000 pF	223	F G J K M	GH	GH						HJ	HE	HJ					JK	JN	JK					KF	KJ	KF					
27,000 pF	273	F G J K M	GK	GK						HJ	HE	HK					JL	JN	JL					KF	KJ	KH					
33,000 pF	333	F G J K M	GM	GM						HK	HE	HK					JN	JE	JN					KH	KE	KH					
39,000 pF	393	F G J K M	GO	GO						HE	HE						JE	JE						KJ	KE	KJ					
47,000 pF	473	F G J K M	GO	GO						HE	HE						JE	JE						KE	KE						
56,000 pF	563	F G J K M								HG	HG						JK	JK						KE	KE						
68,000 pF	683	F G J K M								HJ	HJ						JL	JL						KF	KF						
82,000 pF	823	F G J K M								HK	HK						JL	JL						KH	KH						
0.1 µF	104	F G J K M								HK	HK						JN	JN						KH	KH						
0.12 µF	124	F G J K M																						KJ	KJ						
Cap	Cap Code	Rated Voltage (VDC)	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000	10000
		Voltage Code	C	B	D	F	G	Z	H	C	B	D	F	G	Z	H	C	B	D	F	G	Z	H	C	B	D	F	G	Z	H	K
		Case Size/Series	C1812X							C1825X							C2220X							C2225X							

**Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, and 91)*
KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).
These products are protected under US Patents 7,172,985 and 7,670,981, other patents pending, and any foreign counterparts.

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

Thickness Code	Case Size	Thickness ± Range (mm)	Paper Quantity		Plastic Quantity	
			7" Reel	13" Reel	7" Reel	13" Reel
CJ	603	0.80 ± 0.15*	4,000	15,000	0	0
DC	805	0.78 ± 0.10	0	0	4,000	10,000
DD	805	0.90 ± 0.10	0	0	4,000	10,000
DG	805	1.25 ± 0.15	0	0	2,500	10,000
EQ	1206	0.78 ± 0.20	0	0	4,000	10,000
ER	1206	0.90 ± 0.20	0	0	4,000	10,000
ED	1206	1.00 ± 0.10	0	0	2,500	10,000
ES	1206	1.00 ± 0.20	0	0	2,500	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
EU	1206	1.60 ± 0.25	0	0	2,000	8,000
FZ	1210	1.25 ± 0.20	0	0	2,500	10,000
FM	1210	1.70 ± 0.20	0	0	2,000	8,000
FE	1210	1.00 ± 0.10	0	0	2,500	10,000
FF	1210	1.10 ± 0.10	0	0	2,500	10,000
FG	1210	1.25 ± 0.15	0	0	2,500	10,000
FL	1210	1.40 ± 0.15	0	0	2,000	8,000
FY	1210	2.00 ± 0.20	0	0	2,000	8,000
FK	1210	2.10 ± 0.20	0	0	2,000	8,000
FS	1210	2.50 ± 0.30	0	0	1,000	4,000
LA	1808	1.40 ± 0.15	0	0	1,000	4,000
LB	1808	1.60 ± 0.15	0	0	1,000	4,000
LC	1808	2.00 ± 0.15	0	0	1,000	4,000
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
GK	1812	1.60 ± 0.20	0	0	1,000	4,000
GM	1812	2.00 ± 0.20	0	0	500	2,000
GO	1812	2.50 ± 0.20	0	0	500	2,000
HE	1825	1.40 ± 0.15	0	0	1,000	4,000
HG	1825	1.60 ± 0.20	0	0	1,000	4,000
HJ	1825	2.00 ± 0.20	0	0	500	2,000
HK	1825	2.50 ± 0.20	0	0	500	2,000
JE	2220	1.40 ± 0.15	0	0	1,000	4,000
JK	2220	1.60 ± 0.20	0	0	1,000	4,000
JL	2220	2.00 ± 0.20	0	0	500	2,000
JN	2220	2.50 ± 0.20	0	0	500	2,000
KE	2225	1.40 ± 0.15	0	0	1,000	4,000
KF	2225	1.60 ± 0.20	0	0	1,000	4,000
KH	2225	2.00 ± 0.20	0	0	500	2,000
KJ	2225	2.50 ± 0.20	0	0	500	2,000
Thickness Code	**Case Size**	**Thickness ± Range (mm)**	**7" Reel**	**13" Reel**	**7" Reel**	**13" Reel**
			Paper Quantity		**Plastic Quantity**	

Package quantity based on finished chip thickness specifications.

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	1	50,000
0805	2012		
1206	3216		
1210	3225		
1808	4520		20,000
1812	4532		
1825	4564		
2220	5650		
2225	5664		

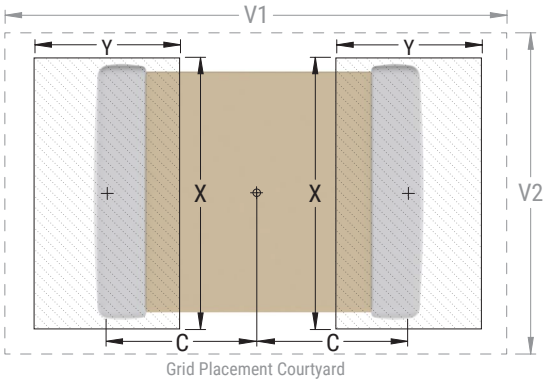
[1] *The "Packaging C-Spec" is a 4 to 8 digit code which identifies the packaging type and/or product grade. When ordering, the proper code must be included in the 15th through 22nd character positions of the ordering code. See "Ordering Information" section of this document for further details. Commercial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

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

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	0.90	1.15	1.10	4.00	2.10	0.80	0.95	1.00	3.10	1.50	0.60	0.75	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
1808	4520	2.30	1.75	2.30	7.40	3.30	2.20	1.55	2.20	6.50	2.70	2.10	1.35	2.10	5.80	2.40
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
1825	4564	2.15	1.80	6.90	7.10	7.90	2.05	1.60	6.80	6.20	7.30	1.95	1.40	6.70	5.50	7.00
2220	5650	2.85	2.10	5.50	8.80	6.50	2.75	1.90	5.40	7.90	5.90	2.65	1.70	5.30	7.20	5.60
2225	5664	2.85	2.10	6.90	8.80	7.90	2.75	1.90	6.80	7.90	7.30	2.65	1.70	6.70	7.20	7.00

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.



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:

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.

Profile Feature	Termination Finish	
	SnPb	100% Matte Sn
Preheat/Soak		
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 1: All temperatures refer to the center of the package, measured on the capacitor body surface that is facing up during assembly reflow.

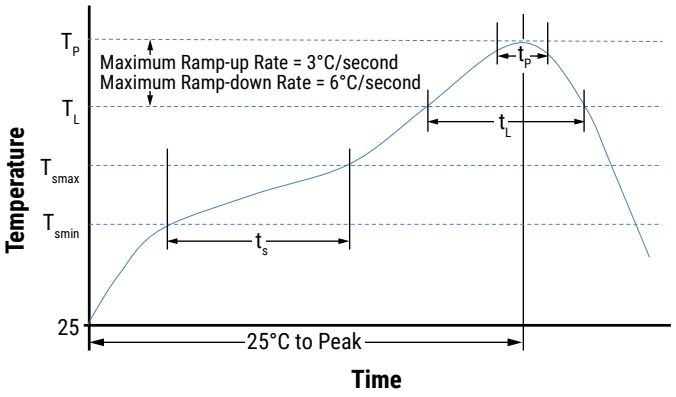


Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test Condition	Limits
Visual and Mechanical	KEMET Internal	No defects that may affect performance (10X)	Dimensions according KEMET Spec Sheet
Capacitance (Cap)	KEMET Internal	C ≤ 1,000 pF Frequency: 1 MHz ±100 kHz Voltage*:1.0 V_{rms} ±0.2 V C > 1,000 pF Frequency: 1 kHz ±50 Hz Voltage: 1.0 V_{rms} ±0.2 V * See part number specification sheet for voltage	Within Tolerance
Dissipation Factor (DF)	KEMET Internal	C ≤ 1,000 pF Frequency: 1 MHz ±100 kHz Voltage*:1.0 V_{rms} ±0.2 V C > 1,000 pF Frequency: 1 kHz ±50 Hz Voltage: 1.0 V_{rms} ±0.2 V * See part number specification sheet for voltage	Within Specification Dissipation factor (DF) maximum limit at 25°C = 0.1%
Insulation Resistance (IR)	KEMET Internal	500 VDC applied for 120 ±5 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. 1,000 megohm microfarads or 100 GΩ.
Temperature Coefficient of Capacitance (TCC)	KEMET Internal	Capacitance change with reference to +25°C and 0 VDC applied. * See part number specification sheet for voltage Step / Temperature (°C): 1 – +25°C 2 – −55°C 3 – +25°C (Reference Temperature) 4 – +125°C	Within Specification: ±30 ppm / °C

Table 4 – Performance & Reliability: Test Methods and Conditions cont.

<table>
<tr><th>Stress</th><th>Reference</th><th>Test Condition</th><th>Limits</th></tr>
<tr><td>Dielectric Withstanding Voltage (DWV)</td><td>KEMET Internal</td><td>See Dielectric Withstanding Voltage (DWV) Table
(5 ±1 seconds and charge/discharge not exceeding 50 mA)
<table>
<tr><th>EIA Case Size</th><th>500 V</th><th>630 V</th><th>≥ 1,000 V</th></tr>
<tr><td>0603</td><td rowspan="10">150% of rated voltage</td><td>130% of rated voltage</td><td rowspan="10">120% of rated voltage</td></tr>
<tr><td>0805</td><td>< 620pF 150% of rated voltage
≥ 620pF 130% of rated voltage</td></tr>
<tr><td>1206</td><td>< 5.1nF 150% of rated voltage
≥ 5.1nF 130% of rated voltage</td></tr>
<tr><td>1210</td><td>< 7.5nF 150% of rated voltage
≥ 7.5nF 130% of rated voltage</td></tr>
<tr><td>1808</td><td>< 5.1nF 150% of rated voltage
≥ 5.1nF 130% of rated voltage</td></tr>
<tr><td>1812</td><td>< 12nF 150% of rated voltage
≥ 12nF 130% of rated voltage</td></tr>
<tr><td>1825</td><td>< 22nF 150% of rated voltage
≥ 22nF 130% of rated voltage</td></tr>
<tr><td>2220</td><td>< 27nF 150% of rated voltage
≥ 27nF 130% of rated voltage</td></tr>
<tr><td>2225</td><td>< 33nF 150% of rated voltage
≥ 33nF 130% of rated voltage</td></tr>
</table></td><td>Cap: Initial Limit
DF: Initial Limit
IR: Initial Limit

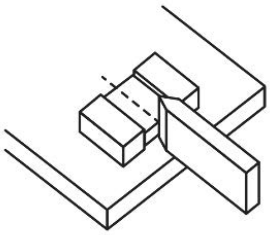
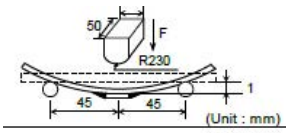
Withstand test voltage without insulation breakdown or damage.</td></tr>
<tr><td>Aging Rate (Maximum % Capacitance Loss/Decade Hour)</td><td>KEMET Internal</td><td>Maximum % capacitance loss/decade hour</td><td>0% Loss/Decade Hour</td></tr>
<tr><td>Terminal Strength</td><td>KEMET Internal</td><td>Shear stress test per specific case size,
Time: 60 ±1 second.
<table><tr><th>Case Size</th><th>Force</th></tr><tr><td>0603</td><td>5N</td></tr><tr><td>0805</td><td>9N</td></tr><tr><td>≥ 1206</td><td>18N</td></tr></table></td><td>No evidence of mechanical damage</td></tr>
<tr><td>Board Flex</td><td>AEC-Q200-005</td><td>Standard Termination System 2.0 mm
Flexible Termination System 3.0 mm
Test Time: 60 ±5 seconds
Ramp Time: 1 mm/second

</td><td>No evidence of mechanical damage</td></tr>
<tr><td>Solderability</td><td>J-STD-002</td><td>Condition: 4 hours ± 15 minutes at 155°C dry bake
apply all methods
Test 245 ±5°C (SnPb & Pb-Free)</td><td>Visual Inspection. 95% coverage on termination. No leaching</td></tr>
<tr><td>Temperature Cycling</td><td>JESD22 Method JA-104</td><td>1,000 cycles (–55°C to +125°C)
2 – 3 cycles per hour
Soak Time 1 or 5 minutes</td><td>Measurement at 24 hours ±4 hours after test conclusion.
Cap: Initial Limit
DF: Initial Limit
IR: Initial Limit</td></tr>
</table>

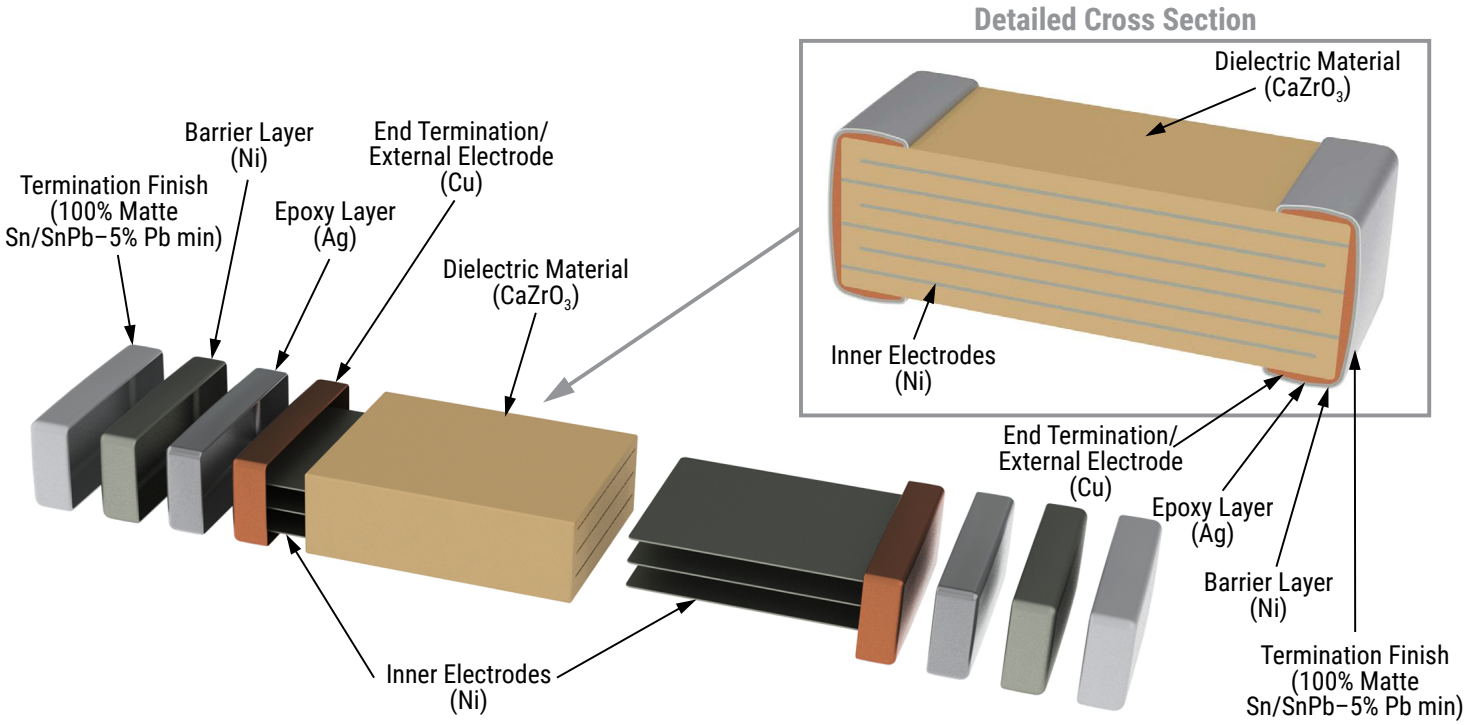
Table 4 – Performance & Reliability: Test Methods and Conditions cont.

Stress	Reference	Test Condition	Limits
Biased Humidity	MIL-STD-202 Method 103	Load Humidity: 1,000 hours 85°C/85% RH and 200 VDC maximum Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V.	Measurement at 24 hours ±4 hours after test conclusion. Within Post Environmental Limits Cap: ±0.3% or ±0.25 pF shift IR: 10% of Initial Limit DF Limits Maximum: 0.5%
Moisture Resistance	MIL-STD-202 Method 106	Number of Cycles Required: 10, 24 hours per cycle. Steps 7a and 7b not required	Cap: Initial Limit DF: Initial Limit IR: Initial Limit
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	1,000 hours at 125°C with 1.2 X rated voltage applied.	Within Post Environmental Limits Cap: ±0.3% or ±0.25 pF shift DF Limits Maximum: 0.5% IR: 10% of Initial Limit
Storage Life		1,000 hours at 150°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	1,500 g's 0.5 millisecond Half-sine, Velocity Change: 15.4 feet/second (Condition F)	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.	Visual Inspection 10X Readable marking, no decoloration or stains. No physical damage.

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



Capacitor Marking (Optional)

Laser marking option is not available on:

- C0G, 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.

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.

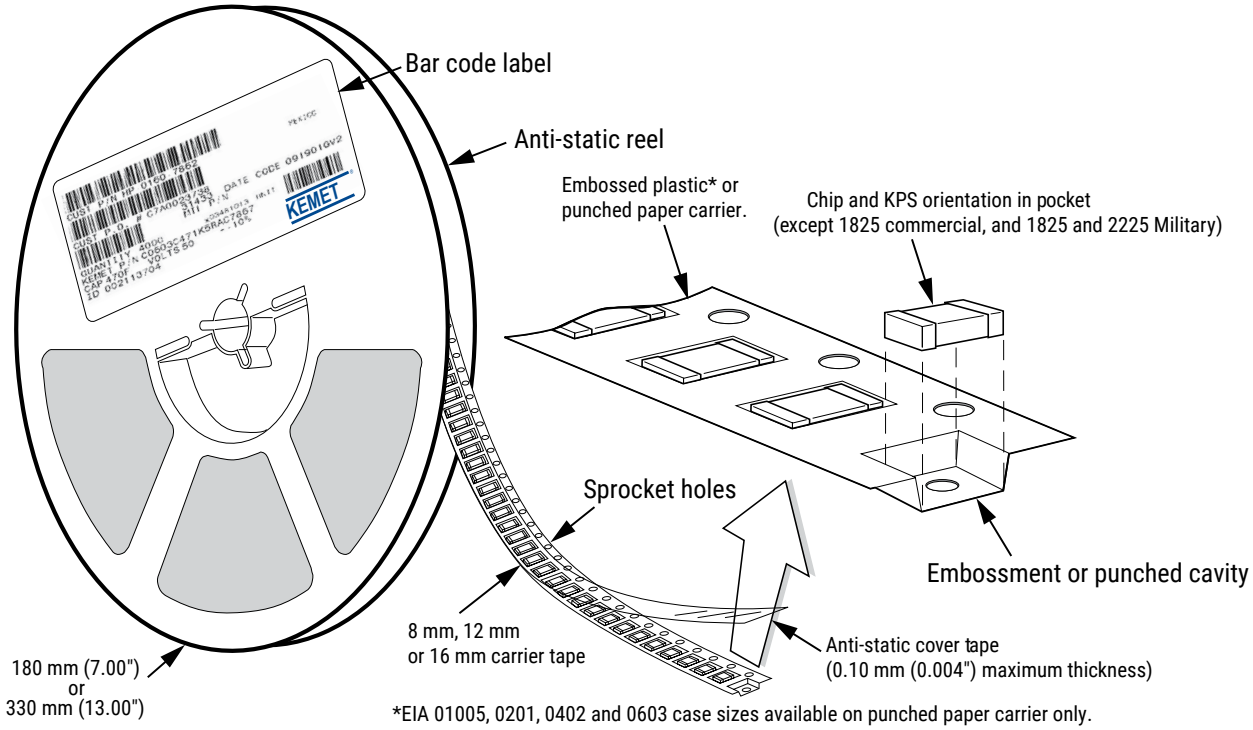


Table 5 – Carrier Tape Configuration, Embossed Plastic & Punched Paper (mm)

EIA Case Size	Tape Size (W)*	Embossed Plastic		Punched Paper	
		7" Reel	13" Reel	7" Reel	13" Reel
		Pitch (P_1)*		Pitch (P_1)*	
01005 – 0402	8			2	2
0603	8			2/4	2/4
0805	8	4	4	4	4
1206 – 1210	8	4	4	4	4
1805 – 1808	12	4	4		
≥ 1812	12	8	8		
KPS 1210	12	8	8		
KPS 1812 and 2220	16	12	12		
Array 0612	8	4	4		

**Refer to Figures 1 and 2 for W and P_1 carrier tape reference locations.*
**Refer to Tables 6 and 7 for tolerance specifications.*

New 2 mm Pitch Reel Options*

Packaging Ordering Code (C-Spec)	Packaging Type/Options
C-3190	Automotive grade 7" reel unmarked
C-3191	Automotive grade 13" reel unmarked
C-7081	Commercial grade 7" reel unmarked
C-7082	Commercial grade 13" reel unmarked

** 2 mm pitch reel only available for 0603 EIA case size.*
2 mm pitch reel for 0805 EIA case size under development.

Benefits of Changing from 4 mm to 2 mm Pitching Spacing

- Lower placement costs.
- Double the parts on each reel results in fewer reel changes and increased efficiency.
- Fewer reels result in lower packaging, shipping and storage costs, reducing waste.

Figure 1 – Embossed (Plastic) Carrier Tape Dimensions

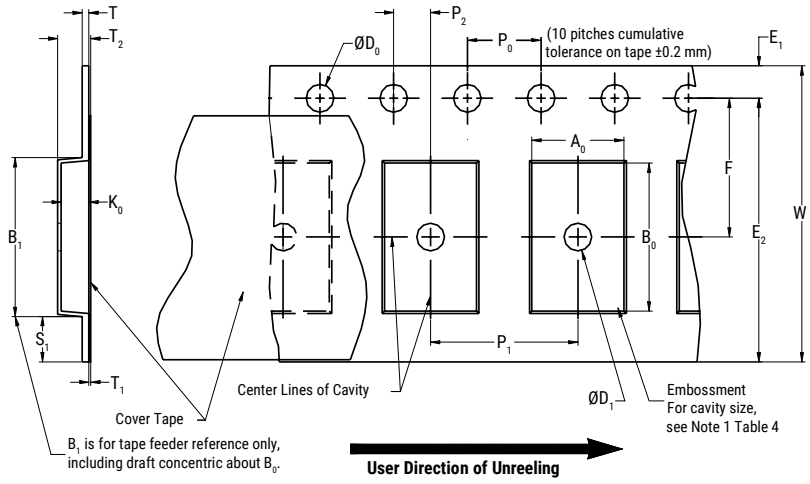


Table 6 – Embossed (Plastic) Carrier Tape Dimensions

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 hole location shall be measured from the sprocket hole controlling the location of the embossment. Dimensions of the embossment location and the hole location shall be applied independently of each other.

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

3. If S_1 < 1.0 mm, there may not be enough area for a cover tape to be properly applied (see EIA Standard 481, paragraph 4.3, section b.)

4. B_1 dimension is a reference dimension for tape feeder clearance only.

5. The cavity defined by A_0, B_0 and K_0 shall surround the component with sufficient clearance that:

(a) the component does not protrude above the top 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 for 8 and 12 mm tapes and 10° maximum for 16 mm tapes (see Figure 3.)

(d) 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.)

(e) for KPS product, A_0 and B_0 are measured on a plane 0.3 mm above the bottom of the pocket.

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

Figure 2 – Punched (Paper) Carrier Tape Dimensions

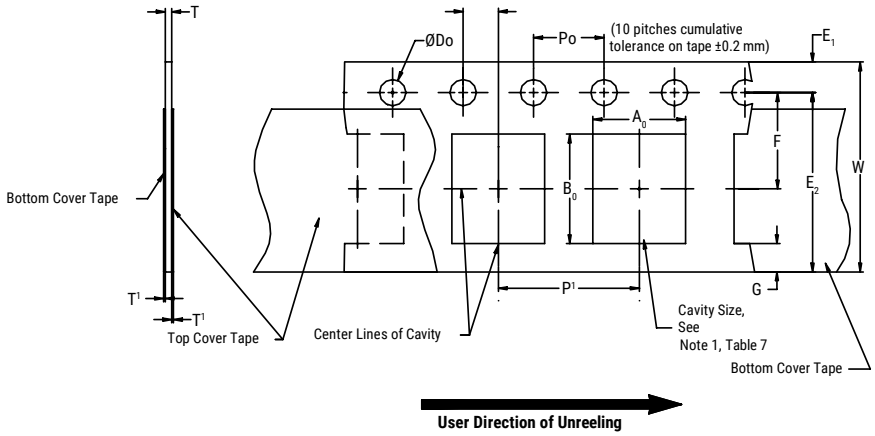


Table 7 – Punched (Paper) Carrier Tape Dimensions

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)	

1. The cavity defined by A_0, B_0 and T shall surround the component with sufficient clearance that:

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.)

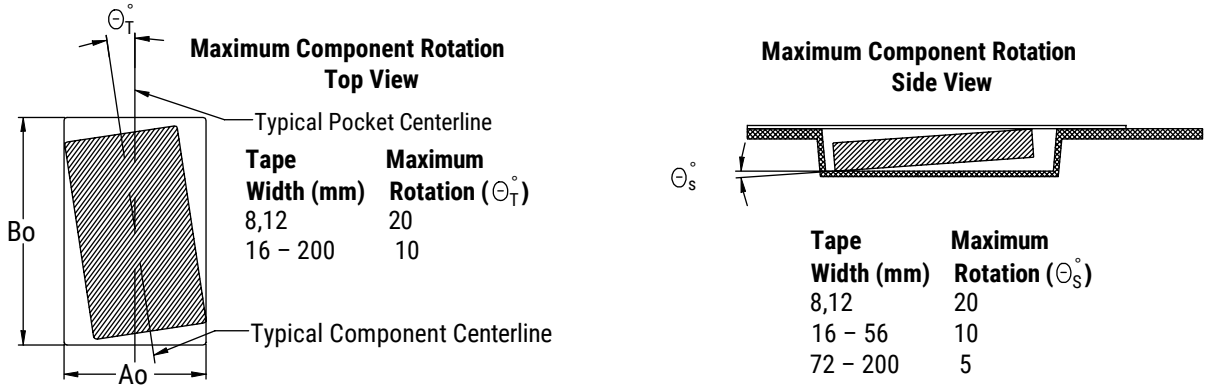
Packaging Information Performance Notes

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



Tape Width (mm)	Maximum Rotation (Θ_T°)
8,12	20
16 – 200	10

Tape Width (mm)	Maximum Rotation (Θ_S°)
8,12	20
16 – 56	10
72 – 200	5

Figure 4 – Maximum Lateral Movement

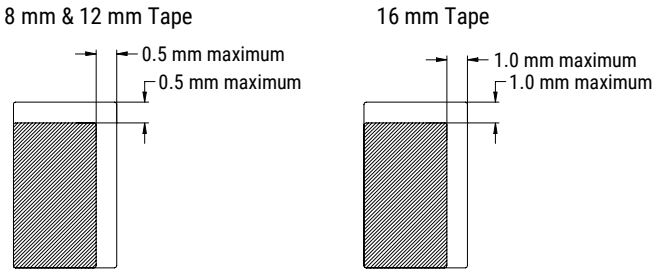


Figure 5 – Bending Radius

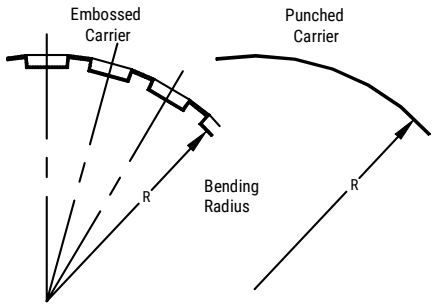
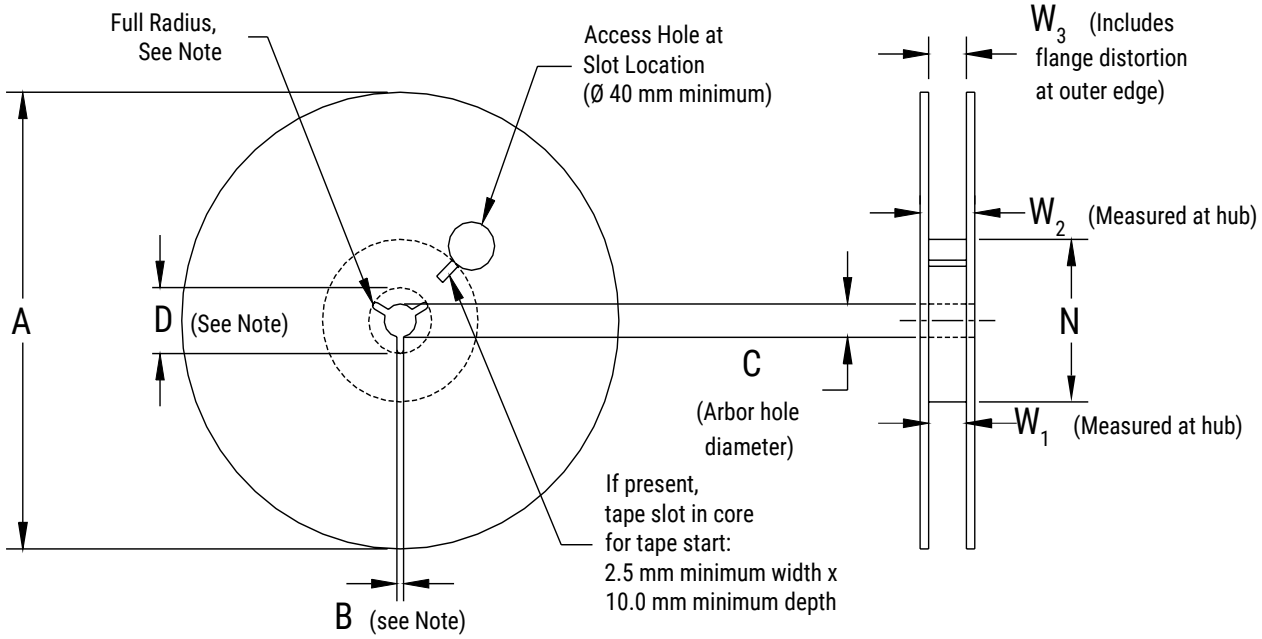


Figure 6 – Reel Dimensions



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

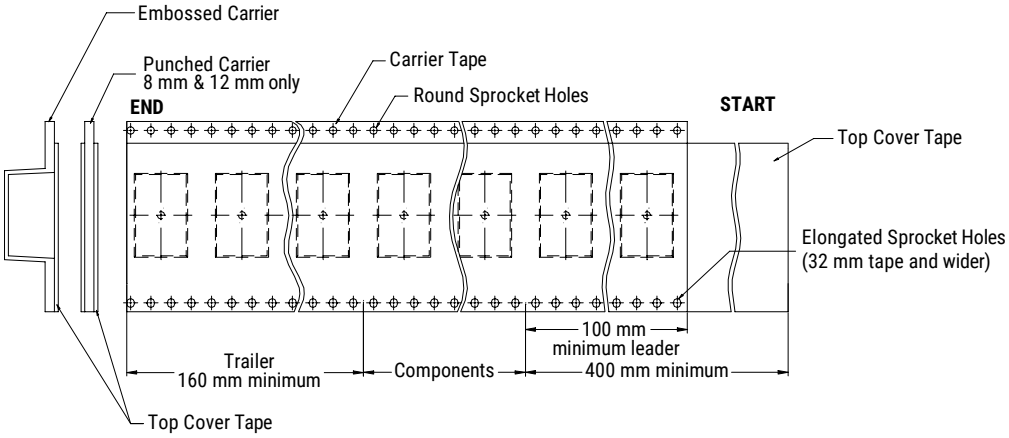
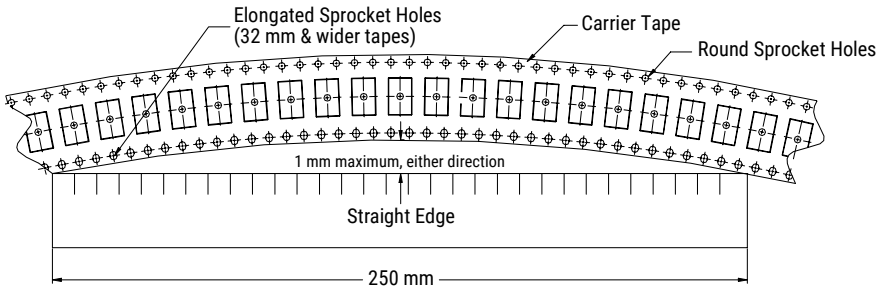


Figure 8 – Maximum Camber



Application Guide

Solder Fluxes and Cleaning

The use of water-soluble fluxes provides advantages of excellent solderability due to high activation. However, these fluxes contain organic acids that can induce arcing under high DC or AC voltages. Notable problem areas are underneath the MLCC where flux can be trapped between the ceramic material and PCB. It is therefore critical that PCBs are properly cleaned to remove all flux residue to maintain reliability.

Coating for High Voltage MLCCs

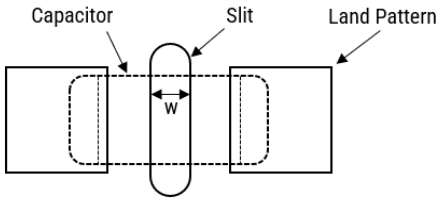
For MLCC ratings ≥1500V, it is recommended to apply a conformal coating to MLCC to prevent surface arcing. To reduce possibility of inducing cracks in the MLCC, select a coating with thermal expansions close to that of the MLCC.

Dielectric	CTE (ppm/°C)
Class II $BaTiO_3$	10.7
Class I $CaZrO_3$	9.8

Slits in PCB

It is recommended to apply a slit in the PCB under the MLCC to improve washing of flux residue that may get trapped underneath. In some cases, it is not possible to slit entirely through the PCB due to underlying metal planes. It is also acceptable to apply a recessed slit under the MLCC which will also promote cleaning.

- Recommended for case sizes ≥1206
- The width (w) of the slit should be 1mm
- Length of the slit should be as short as possible to prevent damaging the MLCC due to mechanical stress of the PCB.
- Slits also reduce the risk of solder balls under MLCC which decreased the creepage distance.



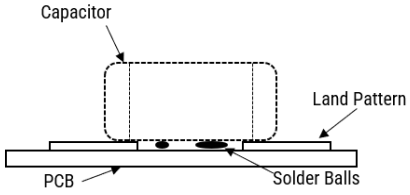
Solder Resist

If a slit cannot be applied as above, it is recommended to not use solder resist directly under the MLCC. The use of solder resist material reduces the distance between MLCC ceramic material and PCB thus making it difficult to clean.

Solder Balls

Improper reflow techniques and/or improper washing can induce solder balls under or adjacent to the MLCC. Solder balls reduce the creepage distance between the MLCC terminations and increase the risk of arcing or damage to the ceramic material. To reduce the risk of solder balls:

- Follow KEMET's solder recommendations as outlined in the datasheet.
- If performing a cleaning procedure, properly clean the PCB per KEMET's cleaning recommendations.
- Add slit to the PCB as shown above.



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