X7R Dielectric, 6.3 – 250 VDC (Commercial Grade)

Overview

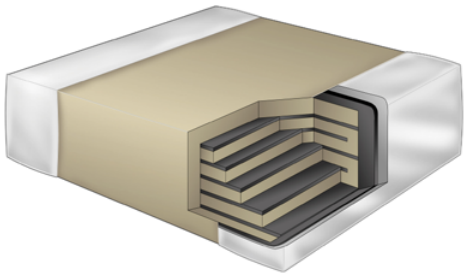
KEMET's X7R dielectric features a 125°C maximum operating temperature and is considered "temperature stable." The Electronics Components, Assemblies & Materials Association (EIA) characterizes X7R dielectric as a Class II material. Components of this classification are fixed, ceramic dielectric capacitors suited for bypass and decoupling applications or for frequency discriminating circuits where Q and stability of capacitance characteristics are not critical. X7R exhibits a predictable change in capacitance with respect to time and voltage and boasts a minimal change in capacitance with reference to ambient temperature. Capacitance change is limited to ±15% from -55°C to +125°C.

Benefits

- AEC–Q200 automotive qualified
- -55°C to +125°C operating temperature range
- Pb-Free and RoHS Compliant
- Temperature stable dielectric
- EIA 0402, 0603, 0805, 1206, 1210, 1812, and 2220 case sizes
- DC voltage ratings of 6.3 V, 10 V, 16 V, 25 V, 50 V, 100 V, 200 V and 250 V
- Capacitance offerings ranging from 10 pF to 22 µF
- Available capacitance tolerances of ±5%, ±10% and ±20%
- Non-polar device, minimizing installation concerns
- 100% pure matte tin-plated termination finish allowing for excellent solderability

Applications

Typical applications include decoupling, bypass, filtering and transient voltage suppression.



Ordering Information

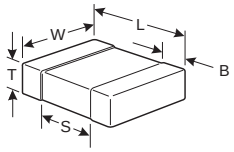
C	1206	C	106	M	4	R	A	C	TU
Ceramic	Case Size (L" x W")	Specification/ Series[1]	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Dielectric	Failure Rate/ Design	Termination Finish[2]	Packaging/Grade (C-Spec)[3]
	0402 0603 0805 1206 1210 1808 1812 1825 2220 2225	C = Standard	2 Sig. Digits + Number of Zeros	J = ±5% K = ±10% M = ±20%	9 = 6.3 V 8 = 10 V 4 = 16 V 3 = 25 V 6 = 35 V 5 = 50 V 1 = 100 V 2 = 200 V A = 250 V	R = X7R	A = N/A	C = 100% Matte Sn	Blank = Bulk TU = 7" Reel Unmarked TM = 7" Reel Marked

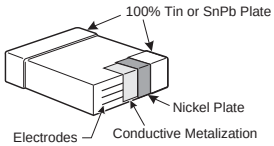
[1] Flexible termination option is available. Please see FT-CAP product bulletin C1013_X7R_FT-CAP_SMD.

[2] Additional termination finish options may be available. Contact KEMET for details.

[3] Additional reeling or packaging options may be available. Contact KEMET for details.

Dimensions – Millimeters (Inches)





EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0402	1005	1.00 (.040) ±0.05 (.002)	0.50 (.020) ±0.05 (.002)	See Table 2 for Thickness	0.30 (.012) ±0.10 (.004)	0.30 (.012)	Solder Reflow Only
0603	1608	1.60 (.063) ±0.15 (.006)	0.80 (.032) ±0.15 (.006)		0.35 (.014) ±0.15 (.006)	0.70 (.028)	Solder Wave or Solder Reflow
0805	2012	2.00 (.079) ±0.20 (.008)	1.25 (.049) ±0.20 (.008)		0.50 (0.02) ±0.25 (.010)	0.75 (.030)	
1206	3216	3.20 (.126) ±0.20 (.008)	1.60 (.063) ±0.20 (.008)		0.50 (0.02) ±0.25 (.010)	N/A	
1210	3225	3.20 (.126) ±0.20 (.008)	2.50 (.098) ±0.20 (.008)		0.50 (0.02) ±0.25 (.010)		Solder Reflow Only
1808	4520	4.70 (.185) ±0.50 (.020)	2.00 (.079) ±0.20 (.008)		0.60 (.024) ±0.35 (.014)		
1812	4532	4.50 (.177) ±0.30 (.012)	3.20 (.126) ±0.30 (.012)		0.60 (.024) ±0.35 (.014)		
1825	4564	4.50 (.177) ±0.30 (.012)	6.40 (.252) ±0.40 (.016)		0.60 (.024) ±0.35 (.014)		
2220	5650	5.70 (.224) ±0.40 (.016)	5.00 (.197) ±0.40 (.016)		0.60 (.024) ±0.35 (.014)		
2225	5664	5.60 (.220) ±0.40 (.016)	6.40 (.248) ±0.40 (.016)		0.60 (.024) ±0.35 (.014)		

Qualification/Certification

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

Environmental Compliance

Pb-Free and RoHS Compliant.

RoHS Compliant

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)	±15%
Aging Rate (Maximum % Cap Loss/Decade Hour)	3.0%
Dielectric Withstanding Voltage	250% of rated voltage (5 ±1 second and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limits @ 25°C	See Dissipation Factor (DF) Limits Table
Insulation Resistance (IR) Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ±5 seconds @ 25°C)

Regarding aging rate: Capacitance measurements (including tolerance) are indexed to a referee time of 48 or 1,000 hours. Please refer to a part number specific datasheet for referee time details.
To obtain IR limit, divide MΩ-µF value by the capacitance and compare to GΩ limit. Select the lower of the two limits.
Capacitance and dissipation factor (DF) measured under the following conditions:

1 kHz ±50 Hz and 1.0 ±0.2 Vrms if capacitance ≤ 10 µF

120 Hz ±10 Hz and 0.5 ±0.1 Vrms if capacitance > 10 µF

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."

Insulation Resistance Limit Table (X7R Dielectric)

EIA Case Size	1,000 Megohm Microfarads or 100 GΩ	500 Megohm Microfarads or 10 GΩ
0201	N/A	ALL
0402	< .012 µF	≥ .012 µF
0603	< .047 µF	≥ .047 µF
0805	< .047 µF	≥ .047 µF
1206	< 0.22 µF	≥ 0.22 µF
1210	< 0.39 µF	≥ 0.39 µF
1808	ALL	N/A
1812	< 2.2 µF	≥ 2.2 µF
1825	ALL	N/A
2220	< 10 µF	≥ 10 µF
2225	ALL	N/A

Dissipation Factor (DF) Limits Table

EIA Case Size	Rated DC Voltage	Capacitance	Dissipation Factor
0402	< 16	All	5.0%
	16/25		3.5%
	> 25		2.5%
0603	< 16	< 1.0 uF	5.0%
	16/25		3.5%
	> 25		2.5%
	< 16	≥ 1.0 uF	10.0%
	16/25		
0805	< 16	≤ 2.2 µF	5.0%
	16/25		3.5%
	> 25	< 1.0 µF	2.5%
	< 16	> 2.2 µF	10.0%
	16/25		
	> 25	≥ 1.0 µF	
1206	< 16	< 10 µF	5.0%
	16/25		3.5%
	> 25		2.5%
	< 16	≥ 10 µF	10.0%
	16/25		
1210	< 16	< 22 µF	5.0%
	16/25		3.5%
	> 25		2.5%
	< 16	≥ 22 µF	10.0%
	16/25		
1812-2225	< 16	All	5.0%
	16/25		3.5%
	> 25		2.5%

Post Environmental Limits

High Temperature Life, Biased Humidity, Moisture Resistance						
Dielectric	Case Size	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance
X7R	0402	< 16	All	7.5	±20%	10% of Initial Limit
		16/25		5.0		
		> 25		3.0		
	0603	< 16	< 1.0 uF	7.5		
		16/25		5.0		
		> 25		3.0		
		< 16	≥ 1.0 uF	20.0		
		16/25				
	0805	< 16	≤ 2.2 µF	7.5		
		16/25		5.0		
		> 25	< 1.0 µF	3.0		
		< 16	> 2.2 µF	20.0		
		16/25				
		> 25	≥ 1.0 µF			
	1206	< 16	< 10 µF	7.5		
		16/25		5.0		
		> 25		3.0		
		< 16	≥ 10 µF	20.0		
		16/25				
	1210	< 16	< 22 µF	7.5		
		16/25		5.0		
		> 25		3.0		
		< 16	≥ 22 µF	20.0		
		16/25				
	1808 – 2225	< 16	All	7.5		
		16/25		5.0		
		> 25		3.0		

Table 1A – Capacitance Range/Selection Waterfall (0402 – 1206 Case Sizes)

Cap	Cap Code	Series			C0402					C0603							C0805									C1206								
		Voltage Code			9	8	4	3	5	9	8	4	3	5	1	2	9	8	4	3	6	5	1	2	A	9	8	4	3	6	5	1	2	A
		Voltage DC			6.3	10	16	25	50	6.3	10	16	25	50	100	200	6.3	10	16	25	35	50	100	200	250	6.3	10	16	25	35	50	100	200	250
		Cap Tolerance			Product Availability and Chip Thickness Codes - See Table 2 for Chip Thickness Dimensions																														
10 - 91 pF	100-910	J	K	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC		EB	EB	EB	EB	EB	EB	EB	EB	
100 - 150 pF	101-820	J	K	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC		EB	EB	EB	EB	EB	EB	EB	EB	
180 - 820 pF	181	J	K	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	
1000-10000 pF	102-103	J	K	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	EB
12000 pF	123	J	K	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	EB
15000 pF	153	J	K	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	EB
18000 pF	183	J	K	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	EB
22000 pF	223	J	K	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	EB
27000 pF	273	J	K	M	BB	BB	BB	BB		CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DD	DE		EB	EB	EB	EB	EB	EB	EB	EB	EB
33000 pF	333	J	K	M	BB	BB	BB	BB		CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DD	DE		EB	EB	EB	EB	EB	EB	EB	EB	EB
39000 pF	393	J	K	M	BB	BB	BB	BB		CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DD	DE		EB	EB	EB	EB	EB	EB	EC	EB	EB
47000 pF	473	J	K	M	BB	BB	BB	BB		CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DE	DG		EB	EB	EB	EB	EB	EB	EC	ED	ED
56000 pF	563	J	K	M	BB	BB	BB			CB	CB	CB	CB	CB			DD	DD	DD	DD	DD	DD	DE	DG		EB	EB	EB	EB	EB	EB	EB	ED	ED
68000 pF	683	J	K	M	BB	BB	BB			CB	CB	CB	CB	CB			DD	DD	DD	DD	DD	DD	DE			EB	EB	EB	EB	EB	EB	EB	ED	ED
82000 pF	823	J	K	M	BB	BB	BB			CB	CB	CB	CB	CB			DD	DD	DD	DD	DD	DD	DE			EB	EB	EB	EB	EB	EB	EB	ED	ED
0.1 uF	104	J	K	M	BB	BB	BB			CB	CB	CB	CB	CB			DC	DC	DC	DC	DC	DC	DE			EB	EB	EB	EB	EB	EB	EB	EM	EM
0.12 uF	124	J	K	M						CB	CB	CB	CB	CB			DC	DC	DC	DC	DD	DD	DG			EC	EC	EC	EC	EC	EC	EC	EG	
0.15 uF	154	J	K	M						CB	CB	CB	CB	CD			DC	DC	DC	DC	DD	DD	DG			EC	EC	EC	EC	EC	EC	EC	EG	
0.18 uF	184	J	K	M						CB	CB	CB	CB				DC	DC	DC	DC	DG	DG	DG			EC	EC	EC	EC	EC	EC	EC		
0.22 uF	224	J	K	M						CB	CB	CB	CD				DC	DC	DC	DC	DG	DG	DG			EC	EC	EC	EC	EC	EC	EC		
0.27 uF	274	J	K	M						CB	CB	CB					DD	DD	DD	DD	DD	DD				EB	EB	EB	EB	EC	EC	EM		
0.33 uF	334	J	K	M						CB	CB	CB					DG	DG	DG	DG	DD	DD				EB	EB	EB	EB	EC	EC	EG		
0.39 uF	394	J	K	M						CB	CB	CB					DG	DG	DG	DG	DE	DE				EB	EB	EB	EB	EC	EC	EG		
0.47 uF	474	J	K	M						CB	CB	CB					DD	DD	DD	DD	DE	DE				EC	EC	EC	EC	EC	EC	EG		
0.56 uF	564	J	K	M													DD	DD	DD	DG	DH	DH				ED	ED	ED	ED	EC	EC			
0.68 uF	684	J	K	M													DD	DD	DD	DG	DH	DH				EE	EE	EE	EE	ED	ED			
0.82 uF	824	J	K	M													DD	DD	DD	DG						EF	EF	EF	EF	ED	ED			
1 uF	105	J	K	M						CC[2]	CC[2]	CC[2]	CD[2]				DD	DD	DD	DG	DG[2]	DG[2]				EF	EF	EF	EG	ED	ED			
1.2 uF	125	J	K	M													DE	DE	DE							ED	ED	ED	EG	EH	EH			
1.5 uF	155	J	K	M													DG	DG	DG							ED	ED	ED	EG	EH	EH			
1.8 uF	185	J	K	M													DG	DG	DG							ED	ED	ED	EF	EH	EH			
2.2 uF	225	J	K	M													DG	DG	DG							ED	ED	ED	EF	EH	EH			
2.7 uF	275	J	K	M																						EN	EN	EN	EH					
3.3 uF	335	J	K	M																						ED	ED	ED	EH	EH				
3.9 uF	395	J	K	M																						EF	EF	EF	EH					
4.7 uF	475	J	K	M													DG[2]	DG[2]	DG[2]							EF	EF	EF	EH					
5.6 uF	565	J	K	M																						EH	EH	EH						
6.8 uF	685	J	K	M																						EH	EH	EH						
8.2 uF	825	J	K	M																						EH	EH	EH						
10 uF	106	J	K	M													DG[2]	DG[2]								EH	EH	EH	EH[2]					
12 uF	126	J	K	M																														
15 uF	156	J	K	M																														
18 uF	186	J	K	M																														
22 uF	226	J	K	M																						EH[1]	EH[1]							
47 uF	476	J	K	M																														
Cap	Cap Code	Voltage DC			6.3	10	16	25	50	6.3	10	16	25	50	100	200	6.3	10	16	25	35	50	100	200	250	6.3	10	16	25	35	50	100	200	250
		Voltage Code			9	8	4	3	5	9	8	4	3	5	1	2	9	8	4	3	6	5	1	2	A	9	8	4	3	6	5	1	2	A
		Series			C0402					C0603							C0805									C1206								

xx[1] Available only in M tolerance.

xx[2] Available only in K, M tolerance.

Table 1B – Capacitance Range/Selection Waterfall (1210 – 2225 Case Sizes)

Cap	Cap Code	Series	C1210								C1808			C1812					C1825				C2220					C2225			
		Voltage Code	9	8	4	3	5	1	2	A	5	1	2	3	5	1	2	A	5	1	2	A	3	5	1	2	A	5	1	2	A
		Voltage DC	6.3	10	16	25	50	100	200	250	50	100	200	25	50	100	200	250	50	100	200	250	25	50	100	200	250	50	100	200	250
		Cap Tolerance	Product Availability and Chip Thickness Codes - See Table 2 for Chip Thickness Dimensions																												
10 - 91 pF	100-910	J K M	FB	FB	FB	FB	FB	FB	FB																						
100 - 270 pF	101-271	J K M	FB	FB	FB	FB	FB	FB	FB																						
330 pF	331	J K M	FB	FB	FB	FB	FB	FB	FB		LF	LF	LF																		
390 pF	391	J K M	FB	FB	FB	FB	FB	FB	FB		LF	LF	LF																		
470 - 1,200 pF	471-122	J K M	FB	FB	FB	FB	FB	FB	FB		LF	LF	LF	GB	GB	GB	GB														
1,500 pF	152	J K M	FB	FB	FB	FB	FB	FB	FE		LF	LF	LF	GB	GB	GB	GB														
1,800 pF	182	J K M	FB	FB	FB	FB	FB	FB	FE		LF	LF	LF	GB	GB	GB	GB														
2,200 pF	222	J K M	FB	FB	FB	FB	FB	FB	FB	FB	LF	LF	LF	GB	GB	GB	GB														
2,700 pF	272	J K M	FB	FB	FB	FB	FB	FB	FB	FB	LF	LF	LF	GB	GB	GB	GB														
3,300 pF	332	J K M	FB	FB	FB	FB	FB	FB	FB	FB	LF	LF		GB	GB	GB	GB														
3,900 pF	392	J K M	FB	FB	FB	FB	FB	FB	FB	FB	LF	LF		GB	GB	GB	GB		HB	HB	HB										
4,700 pF	472	J K M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	LD	GB	GB	GB	GD		HB	HB	HB							KE	KE	KE	
5,600 pF	562	J K M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	LD	GB	GB	GB	GH		HB	HB	HB							KE	KE	KE	
6,800 pF	682	J K M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	LD	GB	GB	GB	GB	GB	HB	HB	HB		JE	JE	JE			KE	KE	KE	
8,200 pF	822	J K M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	LD	GB	GB	GB	GB	GB	HB	HB	HB		JE	JE	JE			KE	KE	KE	
10,000 pF	103	J K M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	LD	GB	GB	GB	GB	GB	HB	HB	HE		JE	JE	JE			KE	KE	KE	
12,000 pF	123	J K M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	LD	GB	GB	GB	GB	GB	HB	HB	HE		JE	JE	JE			KE	KE	KE	
15,000 pF	153	J K M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	LD	GB	GB	GB	GB	GB	HB	HB			JE	JE	JE			KE	KE	KE	
18,000 pF	183	J K M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	LD	GB	GB	GB	GB	GB	HB	HE			JE	JE	JE			KE	KE		
22,000 pF	223	J K M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD		GB	GB	GB	GB	GB	HB	HB	HB	HB	JE	JE	JE			KE	KE		
27,000 pF	273	J K M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD		GB	GB	GB	GB	GB	HB	HB	HB	HB	JE	JE	JE			KE	KE		
33,000 pF	333	J K M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD		GB	GB	GB	GB	GB	HB	HB	HB	HB	JB	JB	JB			KE			
39,000 pF	393	J K M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD		GB	GB	GB	GB	GB	HB	HB	HB	HB	JB	JB	JB						
47,000 pF	473	J K M	FB	FB	FB	FB	FB	FB	FC	FC	LD	LD		GB	GB	GB	GB	GB	HB	HB	HB	HB	JB	JB	JB						
56,000 pF	563	J K M	FB	FB	FB	FB	FB	FB	FC	FC	LD	LD		GB	GB	GB	GB	GB	HB	HB	HB	HB	JB	JB	JB						
68,000 pF	683	J K M	FB	FB	FB	FB	FB	FB	FC	FC	LD			GB	GB	GB	GB	GB	HB	HB	HB	HB	JB	JB	JB						
82,000 pF	823	J K M	FB	FB	FB	FB	FB	FC	FF	FF	LD			GB	GB	GB	GB	GB	HB	HB	HB	HB	JC	JC	JC	JC	JC				
0.10 uF	104	J K M	FB	FB	FB	FB	FB	FD	FG	FG	LD			GB	GB	GB	GB	GB	HB	HB	HB	HB	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.12 uF	124	J K M	FB	FB	FB	FB	FB	FD			LD			GB	GB	GB	GB	GB	HB	HB	HB	HB	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.15 uF	154	J K M	FC	FC	FC	FC	FC	FD			LD			GB	GB	GB	GE	GE	HB	HB	HB	HB	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.18 uF	184	J K M	FC	FC	FC	FC	FC	FD			LD			GB	GB	GB	GG	GG	HB	HB	HB	HB	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.22 uF	224	J K M	FC	FC	FC	FC	FC	FD						GB	GB	GB	GG	GG	HB	HB	HB	HB	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.27 uF	274	J K M	FC	FC	FC	FC	FC	FD						GB	GB	GG	GG	GG	HB	HB	HB	HB	JC	JC	JC	JC	JC	KB	KC	KC	KC
0.33 uF	334	J K M	FD	FD	FD	FD	FD	FD						GB	GB	GG	GG	GG	HB	HB	HB	HB	JC	JC	JC	JC	JC	KB	KC	KC	KC
0.39 uF	394	J K M	FD	FD	FD	FD	FD	FD						GB	GB	GG	GG	GG	HB	HB	HD	HD	JC	JC	JC	JC	JC	KB	KC	KC	KC
0.47 uF	474	J K M	FD	FD	FD	FD	FD	FD						GB	GB	GG	GJ	GJ	HB	HB	HD	HD	JC	JC	JC	JC	JC	KB	KC	KD	KD
0.56 uF	564	J K M	FD	FD	FD	FD	FD	FF						GC	GC	GG			HB	HD	HD	HD	JC	JC	JC	JD	JD	KB	KC	KD	KD
0.68 uF	684	J K M	FD	FD	FD	FD	FD	FG						GC	GC	GG			HB	HD	HD	HD	JC	JC	JD	JD	JD	KB	KC	KD	KD
0.82 uF	824	J K M	FF	FF	FF	FF	FF	FL						GE	GE	GG			HB	HF	HF	HF	JC	JC	JF	JF	JF	KB	KC	KE	KE
1.0 uF	105	J K M	FH	FH	FH	FH	FH	FM						GE	GE	GG			HB	HF	HF	HF	JC	JC	JF	JF	JF	KB	KD	KE	KE
1.2 uF	125	J K M	FH	FH	FH	FH	FG												HB				JC	JC				KB	KE	KE	KE
1.5 uF	155	J K M	FH	FH	FH	FH	FG												HC				JC	JC				KC			
1.8 uF	185	J K M	FH	FH	FH	FH	FG												HD				JD	JD				KD			
2.2 uF	225	J K M	FJ	FJ	FJ	FJ	FG	FT[2]						GO	GO	GO[2]			HF				JF	JF				KD			
2.7 uF	275	J K M	FE	FE	FE	FG	FH																								
3.3 uF	335	J K M	FF	FF	FF	FM	FM																								
3.9 uF	395	J K M	FG	FG	FG	FG	FK																								
4.7 uF	475	J K M	FC	FC	FC	FG	FS							GK	GK																
5.6 uF	565	J K M	FF	FF	FF	FH																									
Cap	Cap Code	Voltage DC	6.3	10	16	25	50	100	200	250	50	100	200	25	50	100	200	250	50	100	200	250	25	50	100	200	250	50	100	200	250
		Voltage Code	9	8	4	3	5	1	2	A	5	1	2	3	5	1	2	A	5	1	2	A	3	5	1	2	A	5	1	2	A
		Series	C1210								C1808			C1812					C1825				C2220					C2225			

xx[1] Available only in M tolerance.

xx[2] Available only in K, M tolerance.

Table 1B – Capacitance Range/Selection Waterfall (1210 – 2225 Case Sizes) cont'd

Cap	Cap Code	Series	C1210								C1808			C1812					C1825				C2220					C2225			
		Voltage Code	9	8	4	3	5	1	2	A	5	1	2	3	5	1	2	A	5	1	2	A	3	5	1	2	A	5	1	2	A
		Voltage DC	6.3	10	16	25	50	100	200	250	50	100	200	25	50	100	200	250	50	100	200	250	25	50	100	200	250	50	100	200	250
		Cap Tolerance	Product Availability and Chip Thickness Codes - See Table 2 for Chip Thickness Dimensions																												
6.8 uF	685	J K M	FG	FG	FG	FM																									
8.2 uF	825	J K M	FH	FH	FH	FK																									
10 uF	106	J K M	FH	FH	FH	FS								GK									JF	JO							
12 uF	126	J K M																													
15 uF	156	J K M	FM	FM																			JO	JO							
18 uF	186	J K M																													
22 uF	226	J K M	FS	FS	FS[1]	FS[1]																	JO								
47 uF	476	J K M	FS[2]																												
Cap	Cap Code	Voltage DC	6.3	10	16	25	50	100	200	250	50	100	200	25	50	100	200	250	50	100	200	250	25	50	100	200	250	50	100	200	250
		Voltage Code	9	8	4	3	5	1	2	A	5	1	2	3	5	1	2	A	5	1	2	A	3	5	1	2	A	5	1	2	A
		Series	C1210								C1808			C1812					C1825				C2220					C2225			

xx[1] Available only in M tolerance.

xx[2] Available only in K, M tolerance.

Table 2 – Chip Thickness/Packaging Quantities

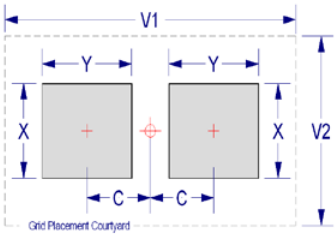
Thickness Code	Case Size	Thickness ± Range (mm)	Paper Quantity		Plastic Quantity	
			7" Reel	13" Reel	7" Reel	13" Reel
BB	0402	0.50 ± 0.05	10,000	50,000	0	0
CB	0603	0.80 ± 0.07	4,000	10,000	0	0
CC	0603	0.80 ± 0.07	4,000	10,000	0	0
CD	0603	0.80 ± 0.15	4,000	10,000	0	0
DC	0805	0.78 ± 0.10	4,000	10,000	0	0
DD	0805	0.90 ± 0.10	4,000	10,000	0	0
DE	0805	1.00 ± 0.10	0	0	2,500	10,000
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
DH	0805	1.25 ± 0.20	0	0	2,500	10,000
EB	1206	0.78 ± 0.10	4,000	10,000	4,000	10,000
EG	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
EN	1206	0.95 ± 0.10	0	0	4,000	10,000
ED	1206	1.00 ± 0.10	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
EM	1206	1.25 ± 0.15	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
FT	1210	0.78 ± 0.10	0	0	4,000	10,000
FC	1210	0.90 ± 0.10	0	0	4,000	10,000
FD	1210	0.95 ± 0.10	0	0	4,000	10,000
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
FH	1210	1.55 ± 0.15	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
FK	1210	2.10 ± 0.20	0	0	2,000	8,000
FS	1210	2.50 ± 0.20	0	0	1,000	4,000
NA	1706	0.90 ± 0.10	0	0	4,000	10,000
LD	1808	0.90 ± 0.10	0	0	2,500	10,000
GB	1812	1.00 ± 0.10	0	0	1,000	4,000
GO	1812	1.00 ± 0.10	0	0	1,000	4,000
GC	1812	1.10 ± 0.10	0	0	1,000	4,000
GE	1812	1.30 ± 0.10	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
GJ	1812	1.70 ± 0.15	0	0	1,000	4,000
HB	1825	1.10 ± 0.15	0	0	1,000	4,000
HC	1825	1.15 ± 0.15	0	0	1,000	4,000
HD	1825	1.30 ± 0.15	0	0	1,000	4,000
HF	1825	1.50 ± 0.15	0	0	1,000	4,000
JC	2220	1.10 ± 0.15	0	0	1,000	4,000
JD	2220	1.30 ± 0.15	0	0	1,000	4,000
JF	2220	1.50 ± 0.15	0	0	1,000	4,000
JO	2220	2.40 ± 0.15	0	0	500	2,000
KB	2225	1.00 ± 0.15	0	0	1,000	4,000
KC	2225	1.10 ± 0.15	0	0	1,000	4,000
KD	2225	1.30 ± 0.15	0	0	1,000	4,000
KE	2225	1.40 ± 0.15	0	0	1,000	4,000
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 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
01005	0402	0.33	0.46	0.43	1.60	0.90	0.28	0.36	0.33	1.30	0.70	0.23	0.26	0.23	1.00	0.50
0201	0603	0.38	0.56	0.52	1.80	1.00	0.33	0.46	0.42	1.50	0.80	0.28	0.36	0.32	1.20	0.60
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	0.40	0.52	0.52	1.60	0.80
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	1.00	1.35	1.55	4.40	2.60	0.90	1.15	1.45	3.50	2.00	0.75	0.95	1.35	2.80	1.70
1206	3216	1.60	1.35	1.90	5.60	2.90	1.50	1.15	1.80	4.70	2.30	1.40	0.95	1.70	4.00	2.00
1210	3225	1.60	1.35	2.80	5.65	3.80	1.50	1.15	2.70	4.70	3.20	1.40	0.95	2.60	4.00	2.90
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	2.15	1.60	3.60	6.90	4.60	2.05	1.40	3.50	6.00	4.00	1.95	1.20	3.40	5.30	3.70
1825	4564	2.15	1.60	6.90	6.90	7.90	2.05	1.40	6.80	6.00	7.30	1.95	1.20	6.70	5.30	7.00
2220	5650	2.75	1.70	5.50	8.20	6.50	2.65	1.50	5.40	7.30	5.90	2.55	1.30	5.30	6.60	5.60
2225	5664	2.70	1.70	6.90	8.10	7.90	2.60	1.50	6.80	7.20	7.30	2.50	1.30	6.70	6.50	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).



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 Soldering Profile:
- KEMET recommends following the guidelines outlined in IPC/JEDEC J–STD–020

Table 4 – Performance & Reliability: Test Methods and Conditions

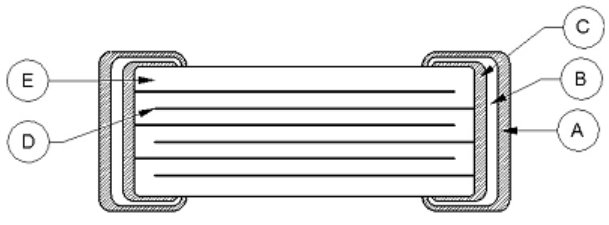
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS–C–6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS–C–6429	Appendix 2, Note: 2 mm (minimum) for all except 3 mm for C0G.
Solderability	J–STD–002	Magnification 50 X. Conditions:
		a) Method B, 4 hours @ 155°C, dry heat @ 235°C
		b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
Temperature Cycling	JESD22 Method JA–104	1,000 Cycles (-55°C to +125°C), Measurement at 24 hours. +/- 2 hours after test conclusion.
Biased Humidity	MIL–STD–202 Method 103	Load Humidity: 1,000 hours 85°C/85% RH and Rated Voltage. Add 100 K ohm resistor. Measurement at 24 hours. +/- 2 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. +/- 2 hours after test conclusion.
Moisture Resistance	MIL–STD–202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours. +/- 2 hours after test conclusion.
Thermal Shock	MIL–STD–202 Method 107	-55°C/+125°C. Note: Number of cycles required-300, maximum transfer time-20 seconds, dwell time-15 minutes. Air-Air.
High Temperature Life	MIL–STD–202 Method 108 /EIA–198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL–STD–202 Method 108	150°C, 0 VDC, for 1,000 hours.
Mechanical Shock	MIL–STD–202 Method 213	Figure 1 of Method 213, Condition F.
Resistance to Solvents	MIL–STD–202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage & 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

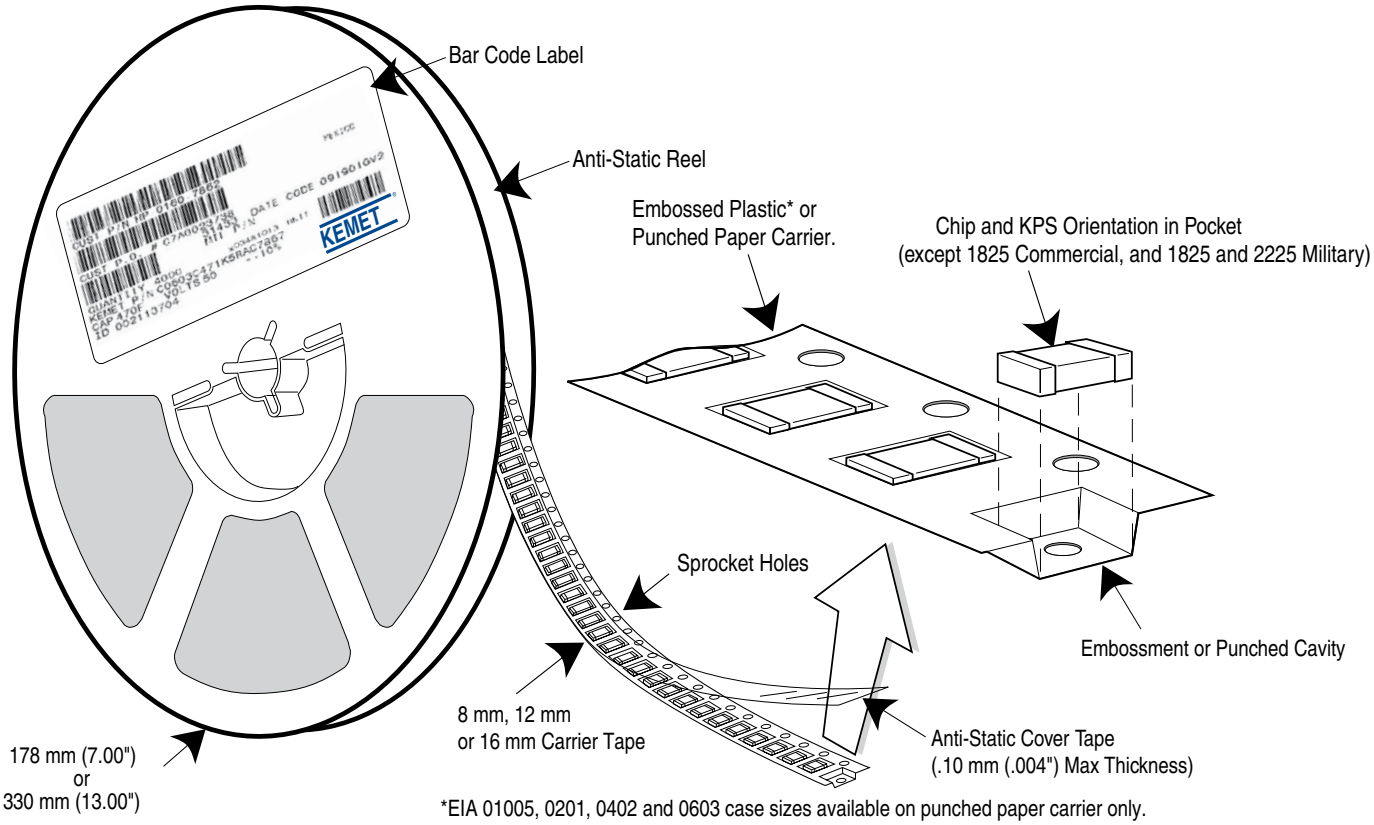
Reference	Item		Material
A	Termination System	Finish	100% Matte Sn
B		Barrier Layer	Ni
C		Base metal	Cu
D	Inner Electrode		Ni
E	Dielectric Material		$BaTiO_3$



Note: Image is exaggerated in order to clearly identify all components of construction.

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.



*EIA 01005, 0201, 0402 and 0603 case sizes available on punched paper carrier only.

Table 5 – Carrier Tape Configuration (mm)

EIA Case Size	Tape Size (W)*	Lead Space (P_1)*
01005 – 0402	8	2
0603 – 1210	8	4
1805 – 1808	12	4
≥ 1812	12	8
KPS 1210	12	8
KPS 1812 & 2220	16	12
Array 0508 & 0612	8	4

**Refer to Figure 1 for W and P_1 carrier tape reference locations.*
**Refer to Table 6 for tolerance specifications.*

Figure 1 – Embossed (Plastic) Carrier Tape Dimensions

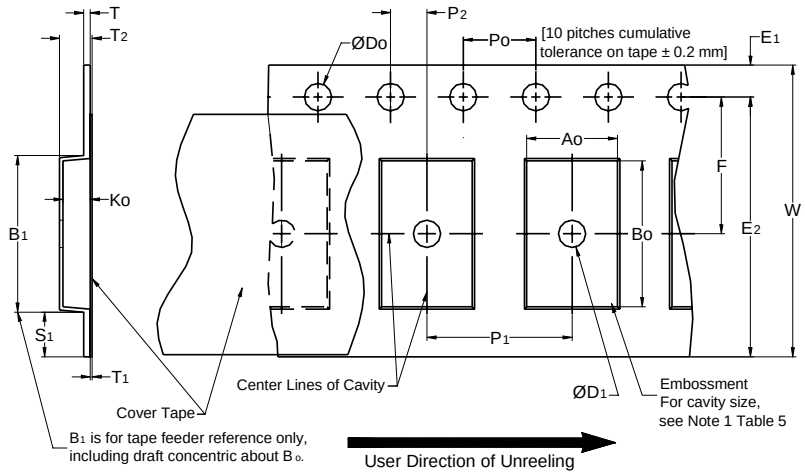


Table 6 – Embossed (Plastic) Carrier Tape Dimensions

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) & 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)	5.5 ±0.05 (0.217 ±0.002)	8.0 ±0.10 (0.315 ±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 embossment location and hole location shall be applied independent of each other.

2. The tape with or without components shall pass around R without damage (see Figure 5).

3. 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).

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 Series 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

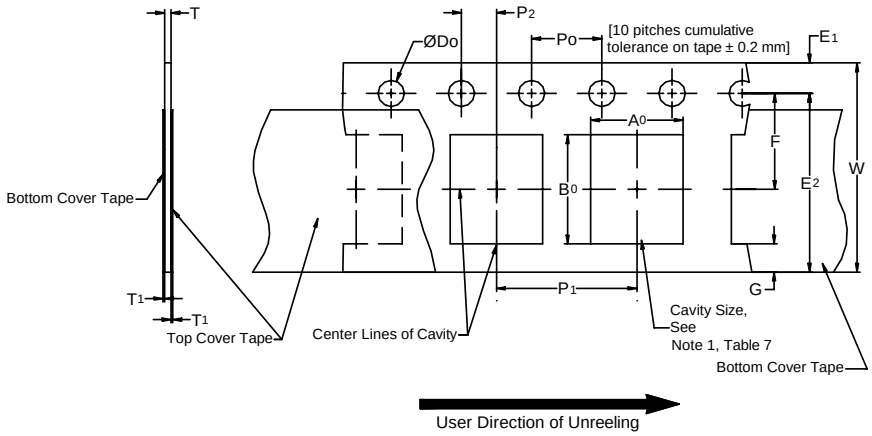


Table 7 – Punched (Paper) Carrier Tape Dimensions

Metric will govern

Constant Dimensions — Millimeters (Inches)							
Tape Size	D_0	E_1	P_0	P_2	T_1 Max	G Minimum	R Ref. 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.
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 5).

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 2 – Maximum Component Rotation

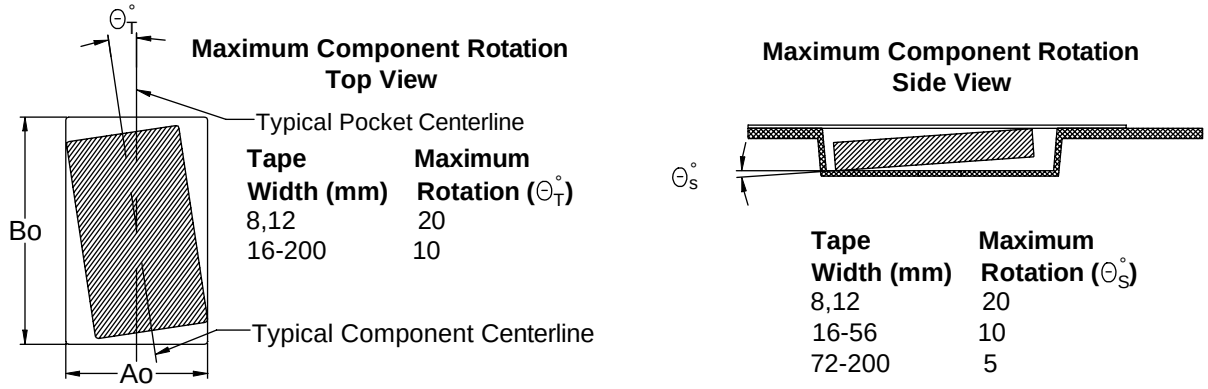


Figure 3 – Maximum Lateral Movement

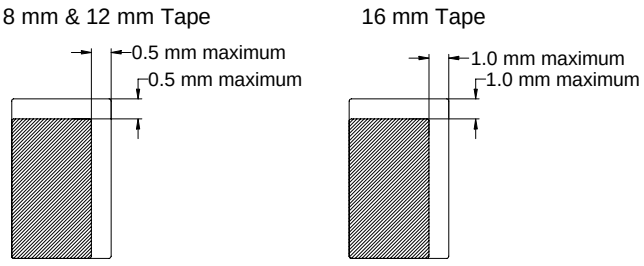


Figure 4 – Bending Radius

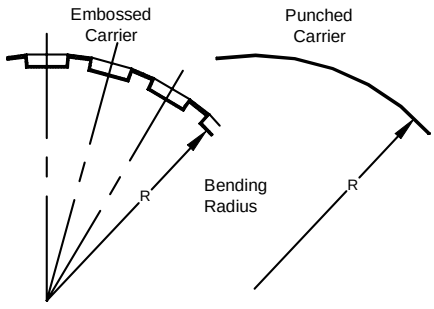
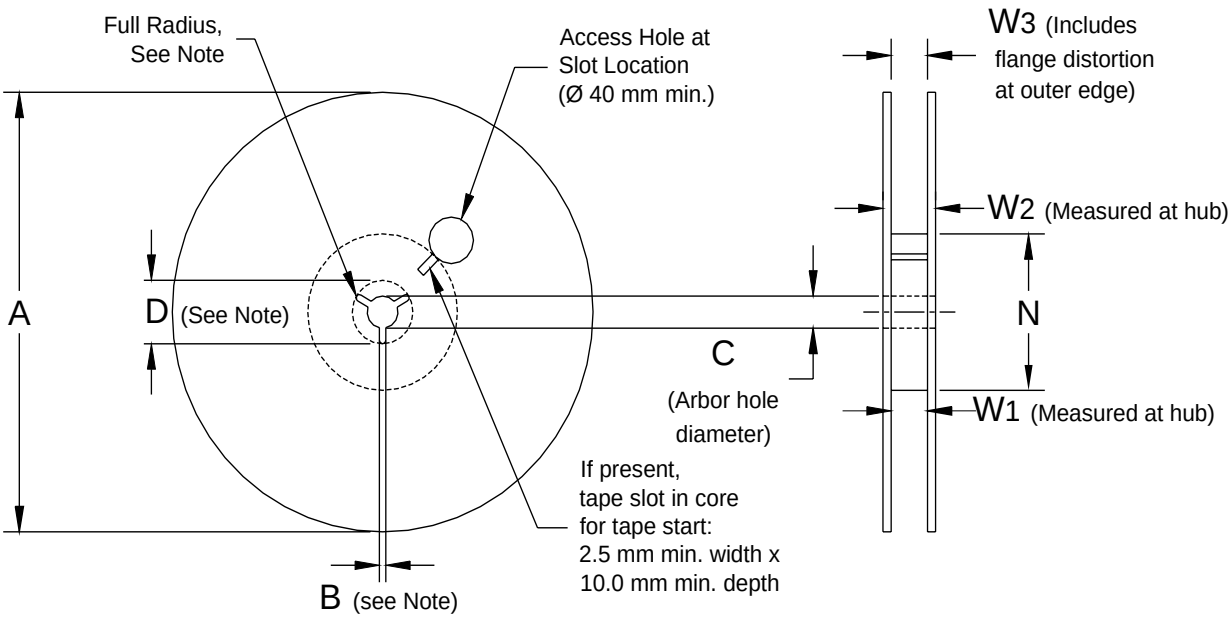


Figure 6 – Reel Dimensions



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

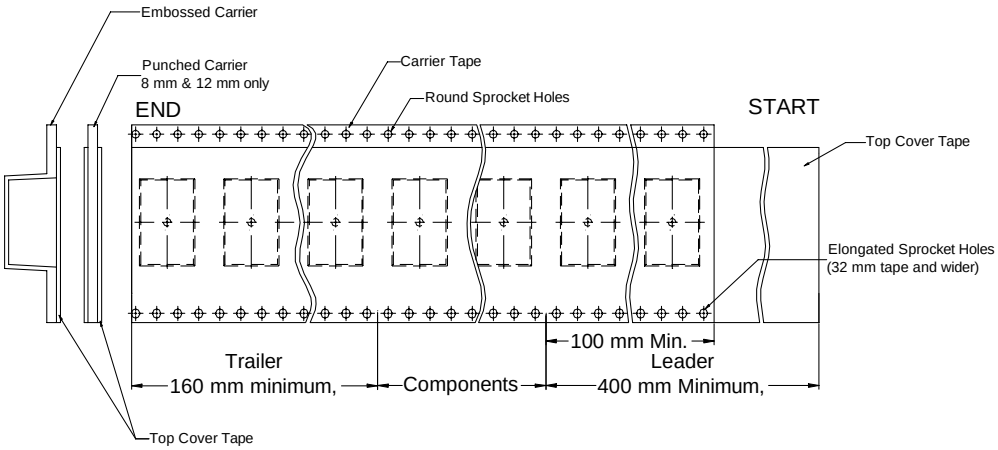


Figure 8 – Maximum Camber

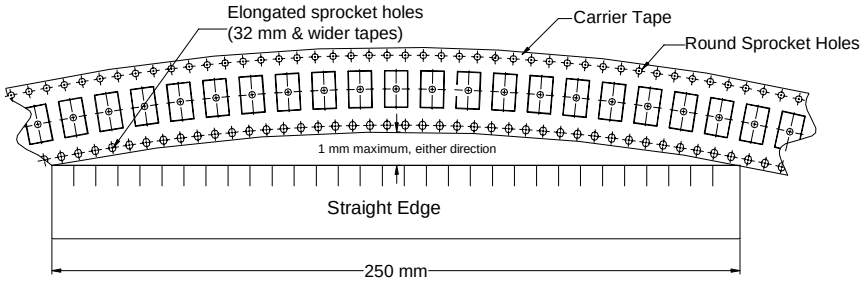


Figure 9 – Bulk Cassette Packaging (Ceramic Chips Only)

Meets Dimensional Requirements IEC-286 and EIAJ 7201

*Unit mm *Reference*

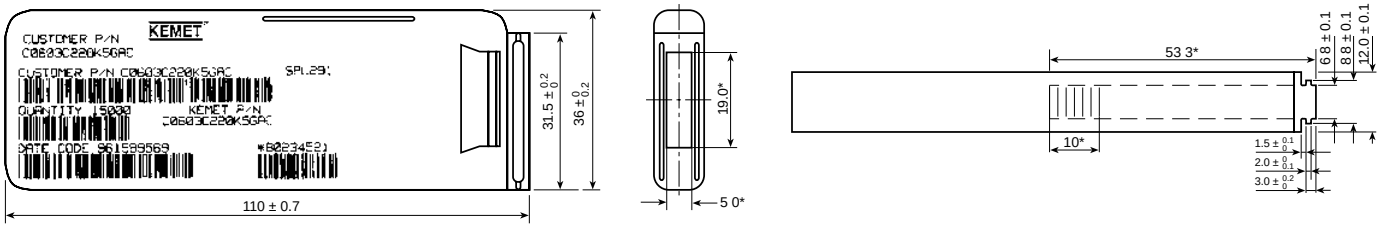


Table 9 – Capacitor Dimensions for Bulk Cassette

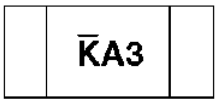
Cassette Packaging – Millimeters

EIA Size Code	Metric Size Code	L Length	W Width	B Bandwidth	S Separation minimum	T Thickness	Number of Pcs/Cassette
0402	1005	1.0 ± 0.05	0.5 ± 0.05	0.2 to 0.4	0.3	0.5 ± .05	50,000
0603	1608	1.6 ± 0.07	0.8 ± 0.07	0.2 to 0.5	0.7	0.8 ± .07	15,000

Table 10 – Capacitor Marking

Laser marking is available as an extra-cost option for most KEMET ceramic chips. Such marking is two sided, and includes a K to identify KEMET, followed by two characters (per EIA-198) to identify the capacitance value. Note that marking is not available for any Y5V chip. In addition, the 0603 marking option is limited to the K only. (Marking Optional – Not Available for 0402 Size)

Numeral / Alpha Character	Capacitance (pF) For Various Numeral Identifiers								
	9	0	1	2	3	4	5	6	7
A	0.1	1	10	100	1000	10000	100000	1000000	10000000
B	0.11	1.1	11	110	1100	11000	110000	1100000	11000000
C	0.12	1.2	12	120	1200	12000	120000	1200000	12000000
D	0.13	1.3	13	130	1300	13000	130000	1300000	13000000
E	0.15	1.5	15	150	1500	15000	150000	1500000	15000000
F	0.16	1.6	16	160	1600	16000	160000	1600000	16000000
G	0.18	1.8	18	180	1800	18000	180000	1800000	18000000
H	0.2	2	20	200	2000	20000	200000	2000000	20000000
J	0.22	2.2	22	220	2200	22000	220000	2200000	22000000
K	0.24	2.4	24	240	2400	24000	240000	2400000	24000000
L	0.27	2.7	27	270	2700	27000	270000	2700000	27000000
M	0.3	3	30	300	3000	30000	300000	3000000	30000000
N	0.33	3.3	33	330	3300	33000	330000	3300000	33000000
P	0.36	3.6	36	360	3600	36000	360000	3600000	36000000
Q	0.39	3.9	39	390	3900	39000	390000	3900000	39000000
R	0.43	4.3	43	430	4300	43000	430000	4300000	43000000
S	0.47	4.7	47	470	4700	47000	470000	4700000	47000000
T	0.51	5.1	51	510	5100	51000	510000	5100000	51000000
U	0.56	5.6	56	560	5600	56000	560000	5600000	56000000
V	0.62	6.2	62	620	6200	62000	620000	6200000	62000000
W	0.68	6.8	68	680	6800	68000	680000	6800000	68000000
X	0.75	7.5	75	750	7500	75000	750000	7500000	75000000
Y	0.82	8.2	82	820	8200	82000	820000	8200000	82000000
Z	0.91	9.1	91	910	9100	91000	910000	9100000	91000000
a	0.25	2.5	25	250	2500	25000	250000	2500000	25000000
b	0.35	3.5	35	350	3500	35000	350000	3500000	35000000
d	0.4	4	40	400	4000	40000	400000	4000000	40000000
e	0.45	4.5	45	450	4500	45000	450000	4500000	45000000
f	0.5	5	50	500	5000	50000	500000	5000000	50000000
m	0.6	6	60	600	6000	60000	600000	6000000	60000000
n	0.7	7	70	700	7000	70000	700000	7000000	70000000
t	0.8	8	80	800	8000	80000	800000	8000000	80000000
y	0.9	9	90	900	9000	90000	900000	9000000	90000000



Example shown is 1,000 pF capacitor

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