

#### **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  $\pm 15\%$  from -55°C to +125°C.

# **Benefits**

- -55°C to +125°C operating temperature range
- · Lead (Pb)-Free, RoHS, and REACH Compliant
- Temperature stable dielectric

**Ordering Information** 

- EIA 0402, 0603, 0805, 1206, 1210, 1808, 1812, 1825, 2220, and 2225 case sizes
- DC voltage ratings of 6.3 V, 10 V, 16 V, 25 V, 35 V, 50 V, 100 V, 200 V, and 250 V
- Capacitance offerings ranging from 10 pF to 47  $\mu\text{F}$
- Available capacitance tolerances of  $\pm 5\%$ ,  $\pm 10\%$ , and  $\pm 20\%$
- Non-polar device, minimizing installation concerns
- 100% pure matte tin-plated termination finish allowing for excellent solderability
- SnPb termination finish option available upon request (5% minimum)

#### С С Μ R С TU 1206 106 4 Α Specification/ Case Size Capacitance Capacitance Failure Rate/ Packaging/Grade Ceramic Voltage Dielectric Termination Finish<sup>2</sup> (L" x W") Series<sup>1</sup> Code (pF) Tolerance Design (C-Spec)<sup>3</sup> 0402 2 significant J = ±5% 9 = 6.3 V R = X7R C = 100% Matte Sn Blank = Bulk C = Standard A = N/A0603 digits + number $K = \pm 10\%$ 8 = 10 V TU = 7" Reel 0805 of zeros $M = \pm 20\%$ 4 = 16 V Unmarked 1206 3 = 25 V TM = 7" Reel 1210 6 = 35 V Marked 1808 5 = 50 V 1812 1 = 100 V 1825 2 = 200 V 2220 A = 250 V 2225

<sup>1</sup> Flexible termination option is available. Please see FT-CAP product bulletin C1013\_X7R\_FT-CAP\_SMD.

<sup>2</sup> Additional termination finish options may be available. Contact KEMET for details.

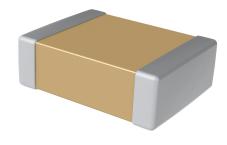
<sup>3</sup> Additional reeling or packaging options may be available. Contact KEMET for details.

<sup>3</sup> The terms "Marked" and "Unmarked" pertain to laser marking option of components.

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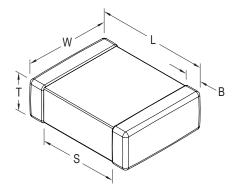
# **Applications**

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



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#### **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 (0.040) ±0.05 (0.002)	0.50 (0.020) ±0.05 (0.002)		0.30 (0.012) ±0.10 (0.004)	0.30 (0.012)	Solder Reflow Only
0603	1608	1.60 (0.063) ±0.15 (0.006)	0.80 (0.032) ±0.15 (0.006)		0.35 (0.014) ±0.15 (0.006)	0.70 (0.028)	
0805	2012	2.00 (0.079) ±0.20 (0.008)	1.25 (0.049) ±0.20 (0.008)		0.50 (0.02) ±0.25 (0.010)	0.75 (0.030)	Solder Wave or Solder Reflow
1206	3216	3.20 (0.126) ±0.20 (0.008)	1.60 (0.063) ±0.20 (0.008)		0.50 (0.02) ±0.25 (0.010)		
1210 <sup>1</sup>	3225	3.20 (0.126) ±0.20 (0.008)	2.50 (0.098) ±0.20 (0.008)	See Table 2	0.50 (0.02) ±0.25 (0.010)		
1808	4520	4.70 (0.185) ±0.50 (0.020)	2.00 (0.079) ±0.20 (0.008)	for Thickness	0.60 (0.024) ±0.35 (0.014)		
1812	4532	4.50 (0.177) ±0.30 (0.012)	3.20 (0.126) ±0.30 (0.012)		0.60 (0.024) ±0.35 (0.014)	N/A	Solder Reflow
1825	4564	4.50 (0.177) ±0.30 (0.012)	6.40 (0.252) ±0.40 (0.016)		0.60 (0.024) ±0.35 (0.014)		Only
2220	5650	5.70 (0.224) ±0.40 (0.016)	5.00 (0.197) ±0.40 (0.016)		0.60 (0.024) ±0.35 (0.014)		
2225	5664	5.60 (0.220) ±0.40 (0.016)	6.40 (0.248) ±0.40 (0.016)		0.60 (0.024) ±0.35 (0.014)		

<sup>1</sup> For capacitance values  $\geq$  4.7  $\mu$ F add 0.02 (0.001) to the width tolerance dimension and 0.10 (0.004) to the length tolerance dimension.

# **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**

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





### **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 % Capacitance Loss/Decade Hour)	3.0%
Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 second and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit @ 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  $M\Omega$ - $\mu$ F value by the capacitance and compare to  $G\Omega$  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  $\leq$  10  $\mu$ F

120 Hz ±10 Hz and 0.5 ±0.1 Vrms if capacitance > 10  $\mu$ F

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	< 0.012 µF	≥ 0.012 µF
0603	< 0.047 µF	≥ 0.047 µF
0805	< 0.15 µF	≥ 0.15 µF
1206	< 0.47 µF	≥ 0.47 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 (Maximum %)
	< 16		5.0
0402	16 / 25	All	3.5
	> 25		2.5
	< 16		5.0
	16 / 25	< 1.0 µF	3.5
0603	> 25		2.5
	< 16	> 1 0 ⊑	10.0
	16 / 25	≥ 1.0 µF	10.0
	< 16	< 0.0 ···F	5.0
	16 / 25	< 2.2 µF	3.5
0805	> 25	< 1.0 µF	2.5
0005	< 16	<b>&gt; 2 2 ∪ Γ</b>	
	16 / 25	≥ 2.2 µF	10.0
	> 25	≥ 1.0 µF	
	< 16		5.0
	16 / 25	< 10 µF	3.5
1206	> 25		2.5
1200	35 / 50	≥ 2.2 µF	10.0
	< 16	≥ 10 µF	10.0
	16 / 25	≥ 10 µr	10.0
	< 16		5.0
	16 / 25	< 22 µF	3.5
1210	> 25		2.5
	< 16	≥ 22 µF	10.0
	16 / 25	- 22 μr	10.0
	< 16		5.0
1808-2225	16 / 25	All	3.5
	> 25		2.5

# **Post Environmental Limits**

	High Tempo	erature Life, E	Biased Humid	lity, Moisture	Resistance	
Dielectric	Case Size	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance
		< 16		7.5		
	0402	16 / 25	All	5.0		
		> 25		3.0		
		< 16		7.5		
		16 / 25	< 1.0 µF	5.0		
	0603	> 25		3.0		
		< 16	≥ 1.0 µF	20.0		
		16 / 25	≥ 1.0 µr	20.0		
		< 16	< 2.2 µF	7.5		
		16 / 25	×2.2 μr	5.0		
	0805	> 25	< 1.0 µF	3.0		
	0005	< 16	> 2 2F			
		16 / 25	≥ 2.2 µF	20.0		
X7R		> 25	≥ 1.0 µF		± 20%	10% of Initial
		< 16		7.5	± 20 %	Limit
		16 / 25	< 10 µF	5.0		
	1206	> 25		3.0		
	1200	35 / 50	≥ 2.2 µF			
		< 16	≥10 µF	20.0		
		16 / 25	≥ 10 μr			
		< 16		7.5		
		16 / 25	< 22 µF	5.0		
	1210	> 25		3.0		
		< 16	> 00 ··E	20.0		
		16 / 25	≥ 22 µF	20.0		
		< 16		7.5		
	1808-2225	16 / 25	All	5.0		
		> 25		3.5		



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

	_		se Si erie			C	0402	2C				C	)60	3C						C	080	5C							<b>C</b> 1	1200	6C			
Сар	Сар	Volt	age C	ode	9	8	4	3	5	9	8	4	3	5	1	2	9	8	4	3	6	5	1	2	Α	9	8	4	3	6	5	1	2	Α
oup	Code		ed Volt (VDC)	age	6.3	9	16	25	50	6.3	9	16	25	50	100	200	6.3	9	16	25	35	50	10	200	250	6.3	9	16	25	35	50	100	200	250
			Tolera	ince		F	Prod	luct	Ava	aila	bilit	y aı	nd (	Chip	o Th	ickı	nes	s Co	de	s – :	See	Tat	ole 2	2 fo	r Ch	ip 1	Thic	kne	ss	Dim	ens	ion	s	
10 – 20 pF*	100 – 200*	J	Κ	М	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF		DN			DN			DN		EB	EB	EB	EB	EB	EB	EB	EB	
22 pF	220	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DM	DM						DN		EB	EB	EB	EB	EB	EB	EB	EB	
24 – 91 pF 100 – 150 pF**	240 – 910* 101 – 151**	J J	K K	M M	BB BB	BB BB	BB BB	BB BB	BB BB	CF CF	CF CF	CF CF	CF CF	CF CF	CF CF	CF CF	DN DN	DN DN	DN DN	DN DN	DN DN	DN DN		DN DN		EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	
180 – 130 př 180 – 820 pF**	181 – 821**	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN		DN	DN	DN	EB	EB	EB	EB	EB	EB	EB	EB	
1000 pF	102	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN		DN	DN	DN		DN	DN	DN	EB	EB	EB	EB	EB	EB	EB	EB	EB
1200 pF	122	J	К	М	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN	DN	EB	EB	EB	EB	EB	EB	EB	EB	EB
1500 pF	152	J	К	М	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN	DN	EB	EB	EB	EB	EB	EB	EB	EB	EB
1800 pF	182	J	Κ	М	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN		DN	DN	DN	EB	EB	EB	EB	EB	EB	EB	EB	EB
2200 pF	222	J	K	М	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	_	DN	DN	DN	DN	EB	EB	EB	EB	EB	EB	EB	EB	EB
2700 pF	272	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN		DN	DN	DN	DN	EB	EB	EB	EB	EB	EB	EB	EB	EB
3300 pF 3900 pF	332 392	J J	K K	M M	BB BB	BB BB	BB BB	BB BB	BB BB	CF CF	CF CF	CF CF	CF CF	CF CF	CF CF	CF CF	DN DN	DN DN	DN DN	DN DN	DN DN	DN DN	DN DN	DN DN	DN DN									EB EB
3900 pF 4700 pF	392 472	J	ĸ	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN	DN									EB
5600 pF	562	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN		DN	DN	DN		EB         EB<				EB			
6800 pF	682	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN		DN	DN	DN		DN	DN	DN		EB         EB<			EB				
8200 pF	822	J	К	М	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN		DN	DN	DN		EBEDEBEBEBEBEBEBEBEBEBEBEBEBED <td>EB</td>			EB				
10000 pF	103	J	Κ	М	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN	DN	EB	EB	EB	EB	EB	EB	EB	EB	EB
12000 pF	123	J	Κ	М	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DN	DN	DN	DN		EB <t< td=""><td>EB</td></t<>			EB				
15000 pF	153	J	Κ	М	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DN	DN	DN	DN	EB         EB         EB         EB         EB         EB         EB         EB           EB         EB         EB         EB         EB         EB         EB         EB         EB           EB         EB         EB         EB         EB         EB         EB         EB         EB           EB <td>EB</td>			EB					
18000 pF	183	J	K	М	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF		DN	DN	DN	DN		DN	DN	DN	DN	EB         EB         EB         EB         EB         EB         EB           EB         EB         EB         EB         EB         EB         EB         EB			EB					
22000 pF	223	J	K	М	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DN	DN	DN	DN		EB         EB         EB         EB         EB         EB         EB         EB			EB				
27000 pF 33000 pF	273 333	J J	K K	M M	BB BB	BB BB	BB BB	BB BB		CF CF	CF CF	CF CF	CF CF	CF CF	CF CF		DN DN	DN DN	DN DN	DN DN	DN DN	DN DN	DP DP	DE DE			EB         EB<			EB EB				
39000 pF	393	J	K	M	BB	BB	BB	BB		CF	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DN	DP	DE			EB         EB<				EB			
47000 pF	473	J	K	M	BB	BB	BB	BB		CF	CF	CF	CF	CJ	CF		DO	DO	DO	DO	DO	_	DE	DG			EB         EB<				ED			
56000 pF	563	J	ĸ	M	BB	BB	BB			CF	CF.	CF.	CF	CF			DP	DP	DP	DP	DP	DP	DE	DG			EB     <				ED			
68000 pF	683	J	К	М	BB	BB	BB			CF	CF	CF	CF	CF			DP	DP	DP	DP	DP	DP	DE				EB         EB<				ED			
82000 pF	823	J	К	М	BB	BB	BB			CF	CF	CF	CF	CF			DP	DP	DP	DP	DP	DP	DE			EB	EB         EB<				ED			
0.1 µF	104	J	Κ	М	BB	BB	BB			CF	CF	CF	CF	CF			DN	DN	DN	DN	DN	DN	DE			EB         EB         EB         EB         EB         EB         ED           EB         EB         EB         EB         EB         EB         EB         ED           EC         EC         EC         EC         EC         EC         EC         EC           EC         EC         EC         EC         EC         EC         EC         EC			EM					
0.12 µF	124	J	K	М						CF	CF	CF	CF	CF			DN	DN	DN	DN	DP	DP	DG			EB         EB         EB         EB         EB         EB         ED           EB         EB         EB         EB         EB         EB         ED         ED           ED         EB         EB         EB         EB         EB         ED         ED           EC         EC         EC         EC         EC         EC         EC         EC								
0.15 µF	154	J	K	M						CF	CF	CF	CF	CF			DN	DN	DN	DN	DP	DP	DG										EG	
0.18 µF	184 224	J	K K	M						CF CF	CF CF	CF	CF CF				DN DN	DN	DN	DN DN		DG	DG											
0.22 μF 0.27 μF	224 274	J	ĸ	M M						CF	CF	CF CF	UF				DP	DN DP	DN DP	DN	DG DP	DG DP	DG											
0.27 µľ 0.33 µF	334	J	K	M						CF	CF	CF					DG	-	DG	DG	DP	DP					_					_		
0.39 µF	394	J	K	M	1					CF	CF	CF					DG		DG	DG	DE	DE												
0.47 µF	474	Ĵ	ĸ	M	L					CF	CF	CF					DG		DG	DG	DE	DE												
0.56 µF	564	J	К	М													DP	DP	DP	DG	DH	DH												
0.68 µF	684	J	К	М													DP	DP	DP	DG	DH	DH								_				
0.82 µF	824	J	K	М													DP	DP	DP	DG														
1 µF	105	J	K	М						CG1	CG1	CG1	CD1							DG	DG <sup>1</sup>	DG <sup>1</sup>				EP	EP	EP	EP			EH1		
1.2 µF	125	J	K	M														DE								ED ED ED EG EH EH								
1.5 μF 1.8 μF	155 185	J	K K	M M														DG DG								ED ED ED EG EH EH ED ED ED EG EH EH								
1.8 μF 2.2 μF	225	J	ĸ K	M						CG <sup>1</sup>	CG1							DG		DG1						EH				EH				
2.2 μi 2.7 μF	275	J	K	M							00							0	00	00						EN		EN						
3.3 µF	335	Ĵ	ĸ	M																						ED		ED						
3.9 µF	395	J	к	М	1																					EF	EF	EF	EH					
4.7 μF	475	J	Κ	М													DG <sup>1</sup>	DG <sup>1</sup>	DG <sup>1</sup>							EH	EH	EH	EH1	EH1	EH1			
			ed Volt (VDC)	age	6.3	10	16	25	50	6.3	10	16	25	50	100	200	6.3	10	16	25	35	50	100	200	250					250				
Cap	Cap	Volt	age C	ode	9	8	4	3	5	9	8	4	3	5	1	2	9	8	4	3	6	5	1	2	Α	9 8 4 3 6 5 1 2				Α				
	Code	Cas	se Si Serie	ze/	ŀ		0402						060																					

\*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) \*\*Capacitance range Includes E12 decade values only. (i.e., 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68 and 82)

xx<sup>1</sup> Available only in K, M tolerance.

xx<sup>2</sup> Available only in M tolerance.



# Table 1A – Capacitance Range/Selection Waterfall (0402 – 1206 Case Sizes) cont'd

			se S erie	ize/ s		С	)402	2C				С	)60:	3C						С	)80	5C							C1	200	6C			
Сар	Сар	Volt	age C	ode	9	8	4	3	5	9	8	4	3	5	1	2	9	8	4	3	6	5	1	2	Α	9	8	4	3	6	5	1	2	Α
oup	Code		ed Vol (VDC)		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
		Сар	Tolera	ance		F	Prod	uct	Ava	aila	bilit	y a	nd C	hip	Th	ickr	nes	s Co	de	s – \$	See	Tab	ole 2	2 foi	r Ch	ip 1	Thic	kne	ss l	Dim	ens	ion	s	
5.6 μF 6.8 μF 8.2 μF 10 μF 22 μF	565 685 825 106 226	) J J	K K K K K	M M M M													DG¹	DG1								EH EH EH EH EH <sup>2</sup>	EH EH EH EH EH <sup>2</sup>	EH EH EH	EH1					
			ed Vol (VDC)		6.3	\$	16	25	50	6.3	\$	9	25	50	100	200	6.3	9	9	25	35	50	9	200	250	6.3	9	9	25	35	50	100	200	250
Сар	Cap Code	Volt	age C	ode	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	Α
			se S erie	-		C	0402	2C				C	0603	SC						С	080	5C							C	206	6C			

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

	Con		se Si Serie				(	C12	100	•			<b>C</b> 1	808	BC		C1	1812	2C		(	C18	250	0		C	222	0C		(	C22	250	)
Сар	Сар	Vol	tage Co	ode	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
P	Code		ed Volt	age	6.3	10	16	25	50	<u>10</u>	200	250	50	<u>6</u>	200	25	20	ĝ	200	250	50	<u>1</u> 0	200	250	25	20	6	200	250	20	100	200	250
			(VDC)																														~
		Сар	Tolera	nce							_	and	1 Ch	ip 1	Thic	kne	ss	Cod	les	- Se	e T	able	e 2 f	or (	Chip	Th	ickı	ness	s Di	mer	isio	ns	
10 – 91 pF*	100 – 910*	J	K	М	FB	FB	FB	FB	FB	FB	FB																						
100 – 270 pF**	101 – 271**	J	K	М	FB	FB	FB	FB	FB	FB	FB																						
330 pF	331	J	K	М	FB	FB	FB	FB	FB	FB	FB		LF	LF	LF																		
390 pF	391	J	K	М	FB	FB	FB	FB	FB	FB	FB		LF	LF	LF																		
470 – 1,200 pF**	471 – 122**	J	K	М	FB	FB	FB	FB	FB	FB	FB		LF	LF	LF	GB		GB															
1,500 pF	152	J	K	М	FB	FB	FB	FB	FB	FB	FE		LF	LF	LF	GB	-	GB	GB														
1,800 pF	182	J	K	М	FB	FB	FB	FB	FB	FB	FE		LF	LF	LF	GB	GB	GB	GB														
2,200 pF	222	J	K	М	FB	FB	FB	FB	FB	FB	FB	FB	LF	LF	LF	GB	GB	GB	GB														
2,700 pF	272	J	K	М	FB	FB	FB	FB	FB	FB	FB	FB	LF	LF	LF	GB	GB	GB	GB														
3,300 pF	332	J	K	М	FB	FB	FB	FB	FB	FB	FB	FB	LF	LF		GB	GB	GB	GB														
3,900 pF	392	J	K	М	FB	FB	FB	FB	FB	FB	FB	FB	LF	LF		GB	GB	GB	GB		HB	HB	HB										
4,700 pF	472	J	K	М	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	М	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	М	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	М	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	М	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	М	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	1
15,000 pF	153	J	K	М	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	LD	GB	GB	GB	GB	GB	HB	HB			JE	JE	JE			KE	KE	KE	1
18,000 pF	183	J	K	Μ	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	LD	GB	GB	GB	GB	GB	HB	HE			JE	JE	JE			KE	KE		1
22,000 pF	223	J	K	М	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD		GB	GB	GB	GB	GB	ΗВ	HB	HB	HB	JE	JE	JE			KE	KE		1
27,000 pF	273	J	K	М	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	М	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	М	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD		GB	GB	GB	GB	GB	ΗВ	HB	HB	HB	JB	JB	JB						
		Rat	ed Volt (VDC)	age	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
Сар	Cap Code	Vol	tage Co	ode	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
	5046		se Si Series	-			(	C12	10C				C1	808	BC		C,	1812	2C			C18	250	;		C	222	0C			C22	25C	;

\*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) \*\*Capacitance range Includes E12 decade values only. (i.e., 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68 and 82)

 $xx^1$  Available only in K, M tolerance.

 $xx^2$  Available only in M tolerance.



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

	0		se S Serie				(	C12	100	;			<b>C</b> 1	808	BC		<b>C</b> 1	812	2C		(	C18	250	)		C2	222	0C		(	C22	250	;
Сар	Сар	Vol	tage C	ode	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	Α
	Code	Rat	ed Voli (VDC)		6.3	9	16	25	50	100	200	250	50	100	200	25	50	100	200	250	50	100	200	250	25	50	100	200	250	50	90	200	250
		Cap	Tolera	ance		Pr	odu	ct A	Vai	labi	lity	and	d Ch	ip T	Thic	kne	ss (	Cod	les ·	- Se	e Ta	able	2 f	or C	Chip	Th	ickı	ies	s Di	mei	nsio	ns	
47,000 pF	473	J	K	М	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	ΗВ	HB	HB	HB	JB	JB	JB						
68,000 pF	683	J	K	М	FB	FB	FB	FB	FB	FB	FC	FC	LD			GB	GB	GB	GB	GB	ΗВ	HB	HB	HB	JB	JB	JB						
82,000 pF	823	J	К	М	FB	FB	FB	FB	FB	FC	FF	FF	LD			GB	GB	GB	GB	GB	ΗВ	НВ	НВ	НВ	JC	JC	JC	JC	JC	1			
0.10 µF	104	J	к	М	FB	FB	FB	FB	FB	FD	FG	FG	LD			GB	GB	GB	GB	GB	НВ	НВ	НВ	НВ	JC	JC	JC	JC	JC	кс	KC	KC	кс
0.12 µF	124	Ĵ	K	M	FB	FB	FB	FB	FB	FD			LD			GB	GB	GB	GB	GB	НВ	HB	HB	HB	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.15 µF	154	Ĵ	ĸ	M	FC	FC	FC	FC	FC	FD			LD			GB	GB	GB	GE	GE	НВ	HB	HB	HB	JC	JC	JC	JC	JC	КС	KC	KC	KC
0.18 µF	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 µF	224	ŭ	K	M	FC	FC	FC	FC	FC	FD	FK	FK				GB	GB	GB	GG	GG	НВ	HB	HB	HB	JC	JC	JC	JC	JC	кс	KC	KC	KC
0.27 µF	274	Ĵ	K	M	FC	FC	FC	FC	FC	FD						GB	GB			GG	НВ	HB	HB	HB	JC	JC	JC	JC	JC	KB	KC	KC	KC
0.33 µF	334	Ĵ	K	M	FD	FD	FD	FD	FD	FD						GB	GB		GG	GG	НВ	HB	HB	HB	JC	JC	JC	JC	JC	КВ	KC	KC	KC
0.39 µF	394	J	K	M	FD	FD	FD	FD	FD	FD						GB	GB			GG	НВ	HB	HD	HD	JC	JC	JC	JC	JC	KB	KC	KC	KC
0.47 µF	474	J	K	M	FD	FD	FD	FD	FD	FD						GB	GB	GG	GJ		НВ	HB	HD	HD	JC	JC	JC	JC	JC	KB	KC	KD	KD
0.56 µF	564	J	K	M	FD	FD	FD	FD	FD	FF						GC	GC	GG	05	05	НВ	HD	HD	HD	JC	JC	JC	JD	JD	KB	KC	KD	KD
	684	J	K	M	FD	FD	FD	FD	FD	FG						GC	GC	GG			НВ	HD	HD	HD	JC	JC	JD	JD	JD	KB	KC	KD	KD
0.68 µF	824		K		FF	FF	FF	FD	FF	FL						GE	GE	GG			НВ		HF	HF	JC	JC	JF	JF	JF			KE	
0.82 µF		J		M						FM						GE	-	GG				HF	HF				JF		JF	KB	KC	1	KE
1.0 µF	105	J	K	M	FH	FH	FH	FH	FH	FIVI				_		GE	GE	GG			HB	HF	HF	HF	JC	JC	JF	JF	JF	KB	KD	KE	KE
1.2 µF	125	J	K	M	FH	FH	FH	FH	FG												HB				JC	JC				KB	KE	KE	KE
1.5 µF	155	J	K	M	FH	FH	FH	FH	FG												HC				JC	JC				KC			
1.8 µF	185	J	K	M	FH	FH	FH	FH	FG												HD				JD	JD				KD			
2.2 µF	225	J	K	M	FJ	FJ	FJ	FJ	FG	FT1						GO	GO	GO			HF				JF	JF				KD			
2.7 µF	275	J	K	M	FE	FE	FE	FG	FH																								
3.3 µF	335	J	K	M	FF	FF	FF	FM	FM																								
3.9 µF	395	J	K	M	FG	FG	FG	FG	FK																								
4.7 μF	475	J	K	M	FC	FC	FC	FG	FS							GK	GK								JF	JF							
5.6 µF	565	J	K	M	FF	FF	FF	FH																									
6.8 µF	685	J	К	М	FG	FG	FG	FM																									
8.2 µF	825	J	K	M	FH	FH	FH	FK																									
10 µF	106	J	K	M	FY	FY	FY	FS	FS <sup>1</sup>							GK									JF	JO							
12 µF	126	J	K	M																													
15 µF	156	J	K	M	FM	FM																			JO	JO							
18 µF	186	J	K	M																													
22 µF	226	J	K	M	FS	FS	FS <sup>1</sup>	FS <sup>2</sup>																	JO								
47 µF	476	J	K	M	FS <sup>2</sup>																												
		Rat	ed Voli (VDC)		6.3	9	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	Сар	Vol	tage C		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
	Code	Ca	se Si Serie	ize/				-	10C					808				1812				C18					222	-		<u> </u>	1	25C	

\*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) \*\*Capacitance range Includes E12 decade values only. (i.e., 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68 and 82)

xx<sup>1</sup> Available only in K, M tolerance.

xx<sup>2</sup> Available only in M tolerance.



# Table 2 – Chip Thickness/Packaging Quantities

Thickness	Case	Thickness ±	Paper G	Quantity	Plastic (	Quantity
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
BB	0402	0.50 ± 0.05	10,000	50,000	0	0
CF	0603	0.80 ± 0.07*	4,000	15,000	0	0
CG	0603	0.80 ± 0.10*	4,000	15,000	0	0
CD	0603	0.80 ± 0.15	4,000	10,000	0	0
CJ DM	0603	$0.80 \pm 0.15^*$	4,000	15,000	0 0	0 0
DM	0805 0805	0.70 ± 0.20* 0.78 ± 0.10*	4,000 4,000	15,000 15,000	0	0
DO	0805	$0.70 \pm 0.10$ $0.80 \pm 0.10^*$	4,000	15,000	0	0
DP	0805	$0.90 \pm 0.10^{*}$	4,000	15,000	0	0
DE	0805	$1.00 \pm 0.10$	0	0	2,500	10,000
DG	0805	$1.25 \pm 0.15$	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
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	$1.00 \pm 0.10$	0	0	2,500	10,000
EE	1206	$1.10 \pm 0.10$	0	0	2,500	10,000
EF	1206	1.20 ± 0.15	0	0	2,500	10,000
EP	1206	1.20 ± 0.20	0	0	2,500	10,000
EM EG	1206 1206	1.25 ± 0.15 1.60 ± 0.15	0	0	2,500 2,000	10,000 8,000
EH	1206	$1.60 \pm 0.13$ $1.60 \pm 0.20$	0	0	2,000	8,000
FB	1200	$0.78 \pm 0.10$	0	0	4,000	10,000
FC	1210	$0.90 \pm 0.10$	Ő	Ő	4,000	10,000
FD	1210	$0.95 \pm 0.10$	Ő	Ő	4,000	10,000
FE	1210	$1.00 \pm 0.10$	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	$1.70 \pm 0.20$	0	0	2,000	8,000
FJ	1210	1.85 ± 0.20	0	0	2,000	8,000
FT FY	1210 1210	$1.90 \pm 0.20$	0 0	0 0	1,500 2,000	4,000
FT	1210	2.00 ± 0.20 2.10 ± 0.20	0	0	2,000	8,000 8,000
FS	1210	$2.10 \pm 0.20$ 2.50 ± 0.30	0	0	1,000	4,000
NA	1706	$0.90 \pm 0.10$	0	0	4,000	10,000
NC	1706	$1.00 \pm 0.15$	Ő	Ő	4,000	10,000
LD	1808	$0.90 \pm 0.10$	0	0	2,500	10,000
LF	1808	1.00 ± 0.15	0	0	2,500	10,000
GB	1812	1.00 ± 0.10	0	0	1,000	4,000
GC	1812	1.10 ± 0.10	0	0	1,000	4,000
GD	1812	1.25 ± 0.15	0	0	1,000	4,000
GE	1812	1.30 ± 0.10	0	0	1,000	4,000
GH	1812	$1.40 \pm 0.15$	0	0	1,000	4,000
GG GK	1812 1812	1.55 ± 0.10 1.60 ± 0.20	0 0	0	1,000 1,000	4,000 4,000
GJ	1812	$1.60 \pm 0.20$ $1.70 \pm 0.15$	0	0	1,000	4,000 4,000
GO	1812	$2.50 \pm 0.20$	0	0	500	2,000
HB	1825	$1.10 \pm 0.15$	Ő	Ő	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
HE	1825	1.40 ± 0.15	0	0	1,000	4,000
Thickness	Case	Thickness ±	7" Reel	13" Reel	7" Reel	13" Reel
Code	Size	Range (mm)	Paper C	Quantity	Plastic (	Quantity
	I	l	· ·	-		-

Package quantity based on finished chip thickness specifications.

Thickness	Case	Thickness ±	Paper C	Quantity	Plastic (	Quantity
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
HF	1825	1.50 ± 0.15	0	0	1,000	4,000
JB	2220	1.00 ± 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
JE	2220	1.40 ± 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	Case	Thickness ±	7" Reel	13" Reel	7" Reel	13" Reel
Code	Size	Range (mm)	Paper C	Quantity	Plastic (	Quantity

# Table 2 – Chip Thickness/Packaging Quantities cont'd

Package quantity based on finished chip thickness specifications.



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

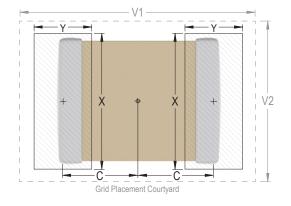
EIA Size Code	Metric Size Code		Maxi	sity Lev mum (I rotrusio	Nost)	)	Density Level B: Median (Nominal) Land Protrusion (mm)				Density Level C: Minimum (Least) Land Protrusion (mm)					
		С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	X	V1	V2
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	0.40	0.52	0.52	1.60	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
1210 <sup>1</sup>	3225	1.50	1.60	2.90	5.60	3.90	1.40	1.40	2.80	4.70	3.30	1.30	1.20	2.70	4.00	3.00
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

#### <sup>1</sup> Only for capacitance values $\geq$ 22 $\mu$ F

**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:**

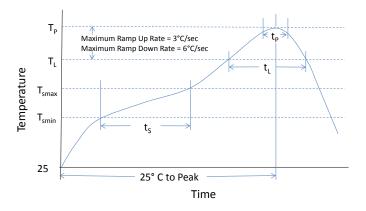
- Solder wave or solder reflow for EIA case sizes 0603, 0805 and 1206
- · All other EIA case sizes are limited to solder reflow only

#### **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	Terminati	on Finish
	SnPb	100% Matte Sn
Preheat/Soak		
Temperature Minimum (T <sub>Smin</sub> )	100°C	150°C
Temperature Maximum (T <sub>Smax</sub> )	150°C	200°C
Time (t <sub>s</sub> ) from $T_{Smin}$ to $T_{Smax}$	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate $(T_L \text{ to } T_P)$	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 <sub>P</sub> )	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t <sub>P</sub> )	20 seconds maximum	30 seconds maximum
Ramp-Down Rate $(T_P \text{ to } T_L)$	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

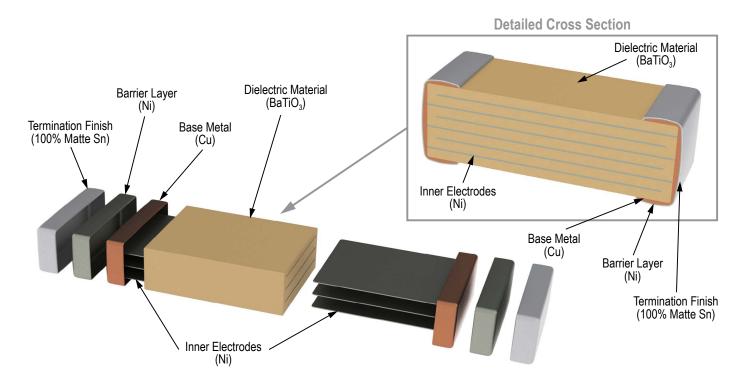
Stress	Reference		Test or Inspection M	lethod					
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8	Appendix 1, Note: Force of 1.8 kg for 60 seconds.						
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).							
		Magnification 50 X. Conditions	:						
		a) Method B, 4 hours @	155°C, dry heat @ 235°C						
Solderability	J-STD-002	b) Method B @ 215°C ca	ategory 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	Measurement at 24 hours +/- 2 Low Volt Humidity: 1,000 hours	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 Dwell time – 15 minutes. Air –		imum transfer time – 20 seconds.					
		1,000 hours at 125°C with 2 X	X rated voltage applied excluding the following:						
	MIL-STD-202 Method 108	Case Size	Capacitance	Applied Voltage					
High Temperature Life	/EIA-198	0603 & 0805	≥ 1.0 µF	- 1.5 X					
		1206 & 1210	≥ 10 µF	1.5 X					
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.							
Vibration	MIL-STD-202 Method 204	5 g's for 20 minutes, 12 cycles each of 3 orientations. Note: Use 8" X 5" PCB 0.031" thick 7 secure points on one long side and 2 secure points at corners of opposite sides. Parts mounted within 2" from any secure point. Test from 10 – 2,000 Hz							
Mechanical Shock	MIL-STD-202 Method 213	Figure 1 of Method 213, Condi	ion 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 40°C 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 (Typical)**





# **Capacitor Marking (Optional):**

These surface mount multilayer ceramic capacitors are normally supplied unmarked. If required, they can be marked as an extra cost option. Marking is available on most KEMET devices but must be requested using the correct ordering code identifier(s). If this option is requested, two sides of the ceramic body will be laser marked with a "K" to identify KEMET, followed by two characters (per EIA–198 - see table below) to identify the capacitance value. EIA 0603 case size devices are limited to the "K" character only.

Laser marking option is <u>not</u> 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.
- · X7R dielectric products in capacitance values outlined below

EIA Case Size	Metric Size Code	Capacitance
0603	1608	≤ 170 pF
0805	2012	≤ 150 pF
1206	3216	≤ 910 pF
1210	3225	≤ 2,000 pF
1808	4520	≤ 3,900 pF
1812	4532	≤ 6,700 pF
1825	4564	≤ 0.018 µF
2220	5650	≤ 0.027 µF
2225	5664	≤ 0.033 µF

Marking appears in legible contrast. Illustrated below is an example of an MLCC with laser marking of "KA8", which designates a KEMET device with rated capacitance of 100  $\mu$ F. Orientation of marking is vendor optional.



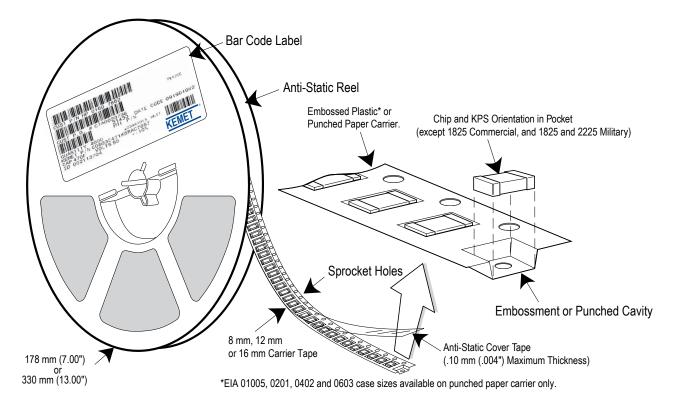
# Capacitor Marking (Optional) cont'd

		Capacit	ance (p	F) For V	Various	Alpha/	Numera	l Identifi	ers				
						Numera	al						
Alpha	9	0	1	2	3	4	5	6	7	8			
Character		Capacitance (pF)											
A	0.1	10	10	100	1,000	10,000	100,000	1,000,000	10,000,000	100,000,000			
В	0.11	1.1	11	110	1,100	11,000	110,000	1,100,000	11,000,000	110,000,000			
С	0.12	12	12	120	1,200	12,000	120,000	1,200,000	12,000,000	120,000,000			
D	0.13	13	13	130	1,300	13,000	130,000	1,300,000	13,000,000	130,000,000			
E	0.15	15	15	150	1,500	15,000	150,000	1,500,000	15,000,000	150,000,000			
F	0.16	16	16	160	1,600	16,000	160,000	1,600,000	16,000,000	160,000,000			
G	0.18	18	18	180	1,800	18,000	180,000	1,800,000	18,000,000	180,000,000			
Н	0.2	20	20	200	2,000	20,000	200,000	2,000,000	20,000,000	200,000,000			
J	0.22	22	22	220	2,200	22,000	220,000	2,200,000	22,000,000	220,000,000			
К	0.24	2.4	24	240	2,400	24,000	240,000	2,400,000	24,000,000	240,000,000			
L	0.27	2.7	27	270	2,700	27,000	270,000	2,700,000	27,000,000	270,000,000			
М	0.3	30	30	300	3,000	30,000	300,000	3,000,000	30,000,000	300,000,000			
N	0.33	33	33	330	3,300	33,000	330,000	3,300,000	33,000,000	330,000,000			
Р	0.36	36	36	360	3,600	36,000	360,000	3,600,000	36,000,000	360,000,000			
Q	0.39	39	39	390	3,900	39,000	390,000	3,900,000	39,000,000	390,000,000			
R	0.43	4 3	43	430	4,300	43,000	430,000	4,300,000	43,000,000	430,000,000			
S	0.47	4.7	47	470	4,700	47,000	470,000	4,700,000	47,000,000	470,000,000			
Т	0.51	5.1	51	510	5,100	51,000	510,000	5,100,000	51,000,000	510,000,000			
U	0.56	56	56	560	5,600	56,000	560,000	5,600,000	56,000,000	560,000,000			
V	0.62	62	62	620	6,200	62,000	620,000	6,200,000	62,000,000	620,000,000			
W	0.68	68	68	680	6,800	68,000	680,000	6,800,000	68,000,000	680,000,000			
Х	0.75	75	75	750	7,500	75,000	750,000	7,500,000	75,000,000	750,000,000			
Y	0.82	8 2	82	820	8,200	82,000	820,000	8,200,000	82,000,000	820,000,000			
Z	0.91	9.1	91	910	9,100	91,000	910,000	9,100,000	91,000,000	910,000,000			
а	0.25	2 5	25	250	2,500	25,000	250,000	2,500,000	25,000,000	250,000,000			
b	0.35	35	35	350	3,500	35,000	350,000	3,500,000	35,000,000	350,000,000			
d	0.4	4 0	40	400	4,000	40,000	400,000	4,000,000	40,000,000	400,000,000			
e	0.45	4 5	45	450	4,500	45,000	450,000	4,500,000	45,000,000	450,000,000			
f	0.5	50	50	500	5,000	50,000	500,000	5,000,000	50,000,000	500,000,000			
m	0.6	60	60	600	6,000	60,000	600,000	6,000,000	60,000,000	600,000,000			
n	0.7	70	70	700	7,000	70,000	700,000	7,000,000	70,000,000	700,000,000			
t	0.8	80	80	800	8,000	80,000	800,000	8,000,000	80,000,000	800,000,000			
у	0.9	90	90	900	9,000	90,000	900,000	9,000,000	90,000,000	900,000,000			

**Electronic Components** 

# 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.

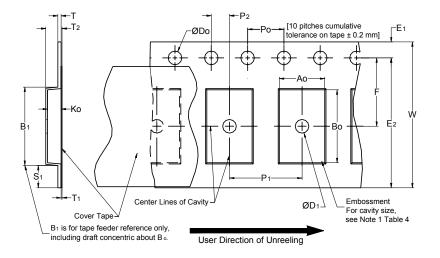


# Table 5 – Carrier Tape Configuration, Embossed Plastic & Punched Paper (mm)

		Embosse	ed Plastic	Punche	d Paper
EIA Case Size	Tape size (W)*	7" Reel	13" Reel	7" Reel	13" Reel
		Pitch	(P <sub>1</sub> )*	Pitch	(P <sub>1</sub> )*
01005 – 0402	8			2	2
0603	8			4	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 & 2220	16	12	12		
Array 0508 & 0612	8	4	4		

\*Refer to Figures 1 & 2 for W and P<sub>1</sub> carrier tape reference locations. \*Refer to Tables 6 & 7 for tolerance specifications.

# Figure 1 – Embossed (Plastic) Carrier Tape Dimensions



# Table 6 – Embossed (Plastic) Carrier Tape Dimensions

Metric will govern

			Constant Dim	ensions — Mi	llimeters (Incl	nes)			
Tape Size	D <sub>0</sub>	D <sub>1</sub> Minimum Note 1	E <sub>1</sub>	P <sub>0</sub>	P <sub>2</sub>	R Reference Note 2	S <sub>1</sub> Minimum Note 3	T Maximum	T₁ Maximum
8 mm		1.0 (0.039)				25.0 (0.984)			
12 mm	1.5 +0.10/-0.0 (0.059 +0.004/-0.0)	1.5	1.75 ±0.10 (0.069 ±0.004)	4.0 ±0.10 (0.157 ±0.004)	2.0 ±0.05 (0.079 ±0.002)	30	0.600 (0.024)	0.600 (0.024)	0.100 (0.004)
16 mm		(0.059)				(1.181)			
			Variable Dime	ensions — Mil	limeters (Inch	ies)			
Tape Size	Pitch	B <sub>1</sub> Maximum Note 4	E <sub>2</sub> Minimum	F	P <sub>1</sub>	T <sub>2</sub> Maximum	W Maximum	A <sub>0</sub> ,B <sub>0</sub>	& K <sub>0</sub>
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)		
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)	Not	ie 5
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 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 6).

3. If S<sub>1</sub> < 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, dimension is a reference dimension for tape feeder clearance only.

5. The cavity defined by  $A_{\alpha}$ ,  $B_{\alpha}$  and  $K_{\alpha}$  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).

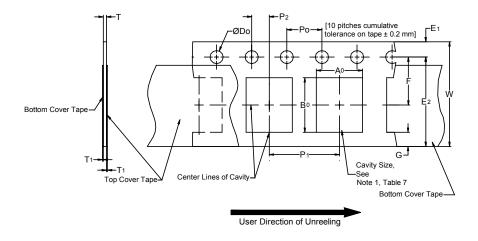
(d) lateral movement of the component is restricted to 0.5 mm maximum for 8 and 12 mm wide tape and to 1.0 mm maximum for 16 mm tape (see Figure 4).

(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 <sub>0</sub>	E <sub>1</sub>	P <sub>0</sub>	P <sub>2</sub>	T₁ 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 <sub>1</sub>	T Maximum	W Maximum	A <sub>0</sub> B <sub>0</sub>			
8 mm	Half (2 mm)	6.25	3.5 ±0.05	2.0 ±0.05 (0.079 ±0.002)	1.1	8.3 (0.327)	Note 1			
8 mm	Single (4 mm)	(0.246)	(0.138 ±0.002)	4.0 ±0.10 (0.157 ±0.004)	(0.098)	8.3 (0.327)	NOLE I			

1. The cavity defined by  $A_{\alpha}$ ,  $B_{\alpha}$  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).



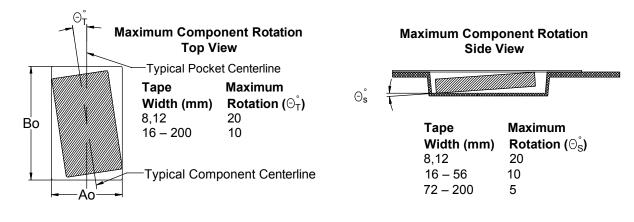
# **Packaging Information Performance Notes**

- 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:

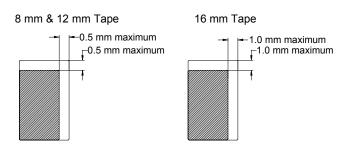
Tape Width	Peel Strength
8 mm	0.1 to 1.0 Newton (10 to 100 gf)
12 and 16 mm	0.1 to 1.3 Newton (10 to 130 gf)

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

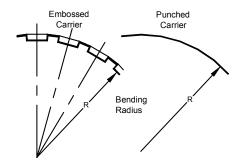
### **Figure 3 – Maximum Component Rotation**



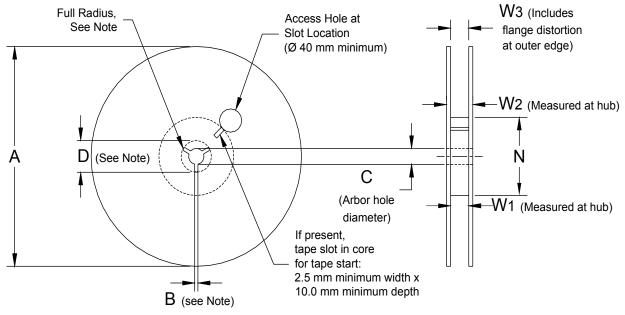
# Figure 4 – Maximum Lateral Movement



# Figure 5 – Bending Radius



# Figure 6 – Reel Dimensions



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

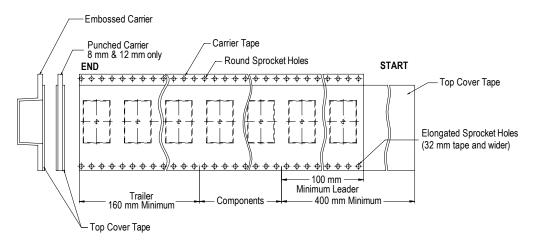
# Table 8 – Reel Dimensions

Metric will govern

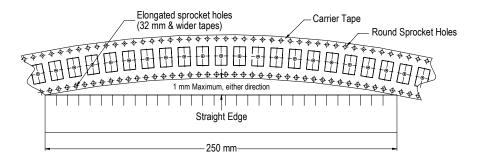
	Constant Dimensions — Millimeters (Inches)									
Tape Size	A	B Minimum	С	D Minimum						
8 mm	178 ±0.20									
12 mm	(7.008 ±0.008) or	1.5 (0.059)	13.0 +0.5/-0.2 (0.521 +0.02/-0.008)	20.2 (0.795)						
16 mm	- 330 ±0.20 (13.000 ±0.008)	()	()	(						
	Variable	Dimensions — Millimeter	rs (Inches)							
Tape Size	N Minimum	W <sub>1</sub>	W <sub>2</sub> Maximum	W <sub>3</sub>						
8 mm		8.4 +1.5/-0.0 (0.331 +0.059/-0.0)	14.4 (0.567)							
12 mm	50 (1.969)	12.4 +2.0/-0.0 (0.488 +0.078/-0.0)	18.4 (0.724)	Shall accommodate tape width without interference						
16 mm		16.4 +2.0/-0.0 (0.646 +0.078/-0.0)	22.4 (0.882)							



# Figure 7 – Tape Leader & Trailer Dimensions

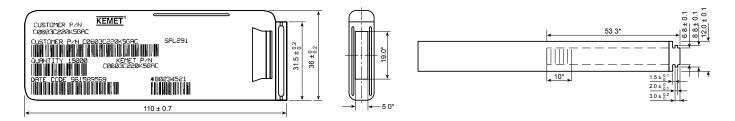


# Figure 8 – Maximum Camber



# Bulk Cassette Packaging (Ceramic Chips Only)

Meets Dimensional Requirements IEC–286 and EIAJ 7201 Unit mm \*Reference



# **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 Pieces/Cassette
0402	1005	1.0 ±0.05	0.5 ±0.05	0.2 to 0.4	0.3	0.5 ±0.05	50,000
0603	1608	1.6 ±0.07	0.8 ±0.07	0.2 to 0.5	0.7	0.8 ±0.07	15,000

Surface Mount Multilayer Ceramic Chip Capacitors (SMD MLCCs) – X7R Dielectric, 6.3 – 250 VDC (Commercial Grade)



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