# 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**

- -55°C to +125°C operating temperature range
- · Lead (Pb)-Free, RoHS, and REACH Compliant
- Temperature stable dielectric
- 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 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
- SnPb termination finish option available upon request (5% minimum)

#### **Applications**

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



## **Ordering Information**

С	1206	С	106	M	4	R	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series <sup>1</sup>	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Dielectric	Failure Rate/ Design	Termination Finish <sup>2</sup>	Packaging/Grade (C-Spec) <sup>3</sup>
	0402 0603 0805 1206 1210 1808 1812 1825 2220 2225	C = Standard	2 significant 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

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

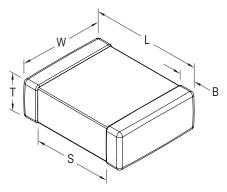
<sup>&</sup>lt;sup>2</sup> Additional termination finish options may be available. Contact KEMET for details.

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

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



## **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)		
1210¹	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>&</sup>lt;sup>1</sup> For capacitance values ≥ 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).



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 % 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  $\pm 50$  Hz and 1.0  $\pm 0.2$  Vrms if capacitance  $\leq 10 \mu F$ 

120 Hz  $\pm 10$  Hz and 0.5  $\pm 0.1$  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	> 4.0	40.0
	16 / 25	≥ 1.0 µF	10.0
	< 16	100.5	5.0
	16 / 25	< 2.2 μF	3.5
0005	> 25	< 1.0 µF	2.5
0805	< 16	> 0.0	
	16 / 25	≥ 2.2 µF	10.0
	> 25	≥ 1.0 µF	
	< 16		5.0
	16 / 25	< 10 µF	3.5
1206	> 25		2.5
1206	35 / 50	≥ 2.2 µF	10.0
	< 16	> 40	40.0
	16 / 25	≥10 µF	10.0
	< 16		5.0
	16 / 25	< 22 µF	3.5
1210	> 25		2.5
	< 16	> 22⊏	10.0
	16 / 25	≥ 22 µF	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	> 4.0	20.0		
		16 / 25	≥ 1.0 µF	20.0		
		< 16	400F	7.5		
		16 / 25	< 2.2 µF	5.0		
	0805	> 25	< 1.0 µF	3.0		
	0005	< 16	> 0 0 5			
		16 / 25	≥ 2.2 µF	20.0		
V7D		> 25	≥ 1.0 µF		. 000/	10% of Initial
X7R		< 16		7.5	± 20%	Limit
		16 / 25	< 10 µF	5.0		
	4000	> 25		3.0		
	1206	35 / 50	≥ 2.2 µF			
		< 16	> 405	20.0		
		16 / 25	≥ 10 µF			
		< 16		7.5		
		16 / 25	< 22 µF	5.0		
	1210	> 25		3.0		
		< 16	. 00 5	00.0		
		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)

	Com		se Si erie			C	040	2C				C	)60	3C				1		C	080	5C							C'	1200	6C			
Сар	Cap Code	_	tage C		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		ed Volt (VDC)	tage	6.3	9	16	25	20	6.3	5	16	25	20	100	200	6.3	우	16	25	35	20	100	200	250	6.3	9	16	25	35	20	100	200	250
		Сар	Tolera	ance		F	Prod	luct	Αv	aila	bilit	y a	nd (	Chip	Th	ickı	nes	s Co	de	s – :	See	Tal	ole 2	2 foi	r Ch	nip 1	Γhic	kne	ss	Dim	ens	ion	s	
10 – 20 pF*	100 – 200*	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN						DN			EB	EB	EB	EB	EB	EB	EB	EB	
22 pF 24 – 91 pF	220 240 – 910*	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	DM DN	DM DN	DM DN	DM DN	DM DN	DM DN	DN DN	DN DN		EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	
100 – 150 pF**	101 – 151**	Ĵ	K	M	ВВ	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	
180 – 820 pF**	181 – 821**	J	K	М	ВВ	ВВ	ВВ	ВВ	ВВ	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN		ЕВ	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	DN	DN	EB	EB	EB	EB	EB	EB	EB	EB	EB
1200 pF 1500 pF	122 152	J	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	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB
1800 pF	182	J	K	M	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
2200 pF	222	J	K	M	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
2700 pF	272	J	K	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
3300 pF	332	J	K	М	ВВ	ВВ	ВВ	ВВ	ВВ	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
3900 pF	392	J	K	M	ВВ	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
4700 pF	472	J	K	M	ВВ	BB	BB	ВВ	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
5600 pF	562	J	K	M	BB	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	EB EB
6800 pF 8200 pF	682 822	J	K K	M M	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						
10000 pF	103	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF		DN	DN		DN	DN	DN	DN	DN	DN	DN EB					EB			
12000 pF	123	Ĵ	K	М	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	0.	DN	DN	DN	DN	DN	DN	DN	DN	DN	N EB EB EB EB EB EB EB EB N EB EB EB EB EB EB EB N EB EB EB EB EB EB EB EB N EB					EB			
15000 pF	153	J	K	М	ВВ	ВВ	ВВ	ВВ	ВВ	CF	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DN	DN	DN	DN	N EB EB EB EB EB EB EB EB N EB				EB	ЕВ			
18000 pF	183	J	K	М	ВВ	ВВ	BB	ВВ	ВВ	CF	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DN	DN	DN	DN	EB EB EB EB EB EB EB EE EB EB EB EB EB E					EB			
22000 pF	223	J	K	М	ВВ	ВВ	BB	ВВ	BB	CF	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DN	DN		DN	EB EB EB EB EB EB EB EE					EB			
27000 pF	273	J	K	M	BB	BB	BB	BB		CF	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DN	DP	DE		EB E				EB				
33000 pF	333 393	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 EB EB EC				EB EB				
39000 pF 47000 pF	473	J	K	M	BB	BB	BB	BB		CF	CF	CF	CF	CJ	CF		DO	DO	DO	DIN	DO	DO	DE	DG		EB EB EB EB EB EC E					ED			
56000 pF	563	J	K	M	BB	BB	BB			CF	CF	CF	CF	CF	01		DP	DP	DP	DP	DP	DP	DE	DG		EB         EB         EB         EB         EB         EC         EE           EB         EB         EB         EB         EB         EC         EC           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         EB         EB         EB         EB         EB					ED			
68000 pF	683	J	K	М	ВВ	BB	BB			CF	CF	CF	CF	CF			DP	DP	DP	DP	DP	DP	DE			EB				ED				
82000 pF	823	J	K	М	ВВ	ВВ	ВВ			CF	CF	CF	CF	CF			DP	DP	DP	DP	DP	DP	DE			EB EB EB EB EB EB EB ED ED EB			ED	ED				
0.1 µF	104	J	K	М	ВВ	ВВ	BB			CF	CF	CF	CF	CF			DN	DN	DN	DN	DN	DN	DE				_	_	_			_		EM
0.12 µF	124	J	K	М						CF	CF	CF	CF	CF			DN	DN	DN	DN	DP	DP	DG											
0.15 µF	154	J	K	M						CF	CF	CF	CF	CF			DN	DN	DN	DN	DP	DP	DG										EG	
0.18 µF 0.22 µF	184 224	J	K K	M M						CF CF	CF CF	CF CF	CF				DN DN	DN DN	DN DN	DN DN	DG DG	DG DG	DG DG			EC EC	EC EC	EC EC	EC EC	EC EC	EC EC	EC EC		
0.22 μΓ 0.27 μF	274	J	K	M	ł					CF	CF	CF	Oi				DP	DP	DP	DP	DP	DP	טפ			EB	EB	EB	EB	EC	EC	EM		
0.33 µF	334	J	K	М						CF	CF	CF					DG	DG		DG	DP	DP				EB	EB	EB	EB	EC	EC	EG		
0.39 µF	394	J	K	М	İ					CF	CF	CF					DG	DG	DG	DG	DE	DE				ЕВ	EB	EB	EB	EC	EC	EG		
0.47 µF	474	J	K	М						CF	CF	CF					DG	DG	DG	DG	DE	DE				EC	EC	EC	EC	EC	EC	EG		
0.56 µF	564	J	K	М													DP	DP	DP	DG	DH	DH				ED	ED	ED	ED	EC	EC			
0.68 µF	684	J	K	M													DP	DP	DP	DG	DH	DH				EE	EE	EE	EE	ED	ED			
0.82 µF	824 105	J	K K	M						CG1	CG <sup>1</sup>	CG1	CD1				DP	DP DP	DP	DG	DG1	DG1				EF	EF	EF	EF	ED	ED	ЕЦ1		
1 μF 1.2 μF	105	J	K	M						CG.	CG.	CG.	CD.					DE		טט	DG.	DG.				EP EP EP ED ED EH1 ED ED ED EG EH EH								
1.5 µF	155	J	K	M														DG								ED ED ED EG EH EH ED ED ED EF EH EH								
1.8 µF	185	J	K	М														DG																
2.2 µF	225	J	K	М						CG <sup>1</sup>	CG <sup>1</sup>						DG	DG	DG	DG <sup>1</sup>						EH	EH	EH1	EH1	EH				
2.7 µF	275	J	K	М																						EN		EN						
3.3 µF	335	J	K	M																								ED						
3.9 μF 4.7 μF	395 475	J	K K	M M													חפיו חפיו	DG¹	DG1									EF		EH1	FH1			
τ., μι	713	Pate	ed Volt		<del>  _</del>				-	_	_	-			_							_		_		_	_						_	ᅱ
	Сар		(VDC)		6.3		9	_	-	6.3	2	19	52		100	200	6.3	-	9	52		20	100		. 250	6.3	-	9	52		20	100	200	-
Сар	Code		tage C		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
			se Si erie			C	0402	2C				C	060	3C						C	080	5C							C,	1206	6C			

<sup>\*</sup>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)

<sup>\*\*</sup>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		CO	)402	2C				C	)60	3C						CO	080	5C							C1	206	6C			
Сар	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
Oup	Code		d Vol		6.3	10	16	25	50	6.3	10	16	25	20	100	200	6.3	9	16	25	35	20	9	200	250	6.3	9	16	25	35	20	100	200	250
		Сар	Tolera	ance		P	rod	luct	Ava	ailal	bilit	y a	nd C	hip	Th	ickı	nes	s Co	ode	s – \$	See	Tab	ole 2	2 fo	r Ch	nip T	Thic	kne	ss I	Dim	ens	ion	s	
5.6 µF	565	J	K	М																						EH	EH	EH						
6.8 µF	685	J	K	M																						EH	EH	EH						
8.2 µF	825	J	K	M																						EH	EH	EH						
10 µF	106	J	K	M													DG¹	DG <sup>1</sup>								EH	EH	EH	EH1					
22 µF	226	J	K	M																						EH²	EH²							
			d Vol (VDC)		6.3	9	16	25	50	6.3	10	16	25	50	100	200	6.3	9	16	22	35	20	100	200	250	6.3	9	16	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	Α	9	8	4	3	6	5	1	2	Α
	2340	Cas S		C	)402	2C				C	060	3C						C	080	5C							C1	206	SC_					

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

	Con		se S Serie				(	C12	100	;			C1	808	BC		C1	1812	2C		(	C18	250	;		C2	222	0C		(	C22	250	;
Cap	Cap	Vo	ltage C	ode	9	8	4	3	5	1	2	Α	5	1	2	3	5	1	2	Α	5	1	2	Α	3	5	1	2	Α	5	1	2	Α
	Code	Rat	ed Volt (VDC)		6.3	9	16	25	20	100	200	250	20	100	200	25	20	9	200	250	20	100	200	250	25	20	100	200	250	20	100	200	250
		Cap	Tolera	ance		Pr	odu	ct A	۱vai	labi	ility	and	l Ch	ip 1	hic	kne	ss	Cod	les ·	– Se	e Ta	able	2 f	or C	Chip	Th	ickr	ness	s Di	mer	sio	ns	
10 – 91 pF*	100 – 910*	J	K	М	FB	FB	FB	FB	FB	FB	FB																						
100 – 270 pF**	101 – 271**	J	K	M	FB	FB	FB	FB	FB	FB	FB																			İ			
330 pF	331	J	K	M	FB	FB	FB	FB	FB	FB	FB		LF	LF	LF						İ				İ					l			
390 pF	391	J	K	M	FB	FB	FB	FB	FB	FB	FB		LF	LF	LF						ĺ									l			
470 - 1,200 pF**	471 – 122**	J	K	M	FB	FB	FB	FB	FB	FB	FB		LF	LF	LF	GB	GB	GB	GB											l			
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											l			
2,200 pF	222	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LF	LF	LF	GB	GB	GB	GB											l			
2,700 pF	272	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LF	LF	LF	GB	GB	GB	GB		İ				l					l			
3,300 pF	332	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LF	LF		GB	GB	GB	GB											l			
3,900 pF	392	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LF	LF		GB	GB	GB	GB		НВ	НВ	НВ							l			
4,700 pF	472	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	LD	GB	GB	GB	GD		НВ	HB	НВ							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		НВ	НВ	НВ							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	НВ	НВ	НВ		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	НВ	НВ	НВ		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	НВ	НВ	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	НВ	НВ	HE		JΕ	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	ΗВ	НВ			JΕ	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	ΗВ	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	ΗВ	НВ	НВ	НВ	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	НВ	НВ	НВ	НВ	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	НВ	НВ	НВ	НВ	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	НВ	НВ	НВ	НВ	JB	JB	JB						
		Rat	ed Vol		6.3	5	16	25	20	100	200	250	20	100	200	25	20	100	200	250	50	100	200	250	25	20	100	200	250	50	100	200	250
Сар	Cap Code	Vo	tage C	ode	9	8	4	3	5	1	2	Α	5	1	2	3	5	1	2	Α	5	1	2	Α	3	5	1	2	Α	5	1	2	Α
	Code		se Si Serie					C12	10C				C1	808	3C		C,	1812	2C		C1825C					C	2220	OC		(	C22	25C	;

<sup>\*</sup>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)

<sup>\*\*</sup>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 1B - Capacitance Range/Selection Waterfall (1210 - 2225 Case Sizes) cont'd

	Com		se S Serie				(	C12	100	;			C1	808	BC		C1	1812	2C			C18	250	;		C2	222	0C		(	C22	250	
Cap	Cap Code	Vol	tage C	ode	9	8	4	3	5	1	2	Α	5	1	2	3	5	1	2	Α	5	1	2	Α	3	5	1	2	Α	5	1	2	Α
	Code		ed Volt (VDC)		6.3	10	16	25	20	100	200	250	50	100	200	25	20	100	200	250	20	100	200	250	25	20	100	200	250	20	5	200	250
		Сар	Tolera	ance		Pr	odu	ct A	lvai	labi	lity	and	d Ch	ip 1	Γhio	ckne	ss	Cod	les ·	- Se	e T	able	2 f	or C	Chip	Thi	ickr	ness	) Di	mer	nsio	ns	
47,000 pF	473	J	K	М	FB	FB	FB	FB	FB	FB	FC	FC	LD	LD		GB	GB	GB	GB	GB	НВ	НВ	НВ	НВ	JB	JB	JB						
56,000 pF	563	J	K	M	FB	FB	FB	FB	FB	FB	FC	FC	LD	LD		GB	GB	GB	GB	-	НВ	НВ	НВ	НВ	JB	JB	JB						
68,000 pF	683	J	K	M	FB	FB	FB	FB	FB	FB	FC	FC	LD			GB	GB	GB	GB	GB	НВ	НВ	НВ	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	НВ	НВ	НВ	НВ	JC	JC	JC	JC	JC				
0.10 µF	104	J	K	M	FB	FB	FB	FB	FB	FD	FG	FG	LD			GB	GB	GB	GB	GB	НВ	НВ	НВ	НВ	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.12 μF	124	J	K	M	FB	FB	FB	FB	FB	FD			LD			GB	GB	GB	GB	GB	НВ	НВ	НВ	НВ	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.15 µF	154	J	K	M	FC	FC	FC	FC	FC	FD			LD			GB	GB	GB	GE	GE	НВ	НВ	НВ	НВ	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.18 μF	184	J	K	M	FC	FC	FC	FC	FC	FD			LD			GB	GB	GB	GG			НВ	НВ	НВ	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.22 μF	224	J	K	M	FC	FC	FC	FC	FC	FD	FK	FK				GB	GB	GB	GG			НВ	НВ	НВ	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.27 µF	274	J	K	M	FC	FC	FC	FC	FC	FD						GB	GB	GG	GG	GG		НВ	НВ	НВ	JC	JC	JC	JC	JC	KB	KC	KC	KC
0.33 µF	334	J	K	M	FD	FD	FD	FD	FD	FD						GB	GB	GG	GG			НВ	НВ	НВ	JC	JC	JC	JC	JC	KB	KC	KC	KC
0.39 μF	394	J	K	M	FD	FD	FD	FD	FD	FD						GB	GB	GG	GG		НВ	НВ	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	GJ	НВ	НВ	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			НВ	HD	HD	HD	JC	JC	JC	JD	JD	KB	KC	KD	KD
0.68 µF	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
0.82 µF	824	J	K	M	FF	FF	FF	FF	FF	FL						GE	GE	GG			НВ	HF	HF	HF	JC	JC	JF	JF	JF	KB	KC	KE	KE
1.0 µF	105	J	K	M	FH	FH	FH	FH	FH	FM						GE	GE	GG			НВ	HF	HF	HF	JC	JC	JF	JF	JF	KB	KD	KE	KE
1.2 µF	125	J	K	M	FH	FH	FH	FH	FG												НВ				JC	JC				KB	KE	KE	KE
1.5 µF	155	J	K	M	FH	FH	FH	FH	FG												НС				JC	JC				KC			
1.8 µF	185	J	K	M	FH	FH	FH	FH	FG							l					HD				JD	JD				KD			
2.2 µF	225	J	K	M	FJ	FJ	FJ	FJ	FG	FT¹						GO	GO	GO1			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								1									1								
6.8 µF	685	J	K	M	FG	FG	FG	FM																									
8.2 µF	825	J	K	M	FH	FH	FH	FK								l																	
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	FS²											-					_									_			
			ed Volt (VDC)		6.3	10	16	25	20	100	200	250	20	100	200	25	20	5	200	250	20	5	200	250	25	20	5	200	250	20	9	200	250
Сар	Cap Code	Vol	tage C	ode	9	8	4	3	5	1	2	Α	5	1	2	3	5	1	2	Α	A 5 1 2 A		Α	3	5	1	2	Α	5	1	2	Α	
	Code		se Si Serie					C12	10C				C1	1808	зс		C,	1812	2C		C1825C			;		C2	2220	OC			C22	250	;

<sup>\*</sup>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)

<sup>\*\*</sup>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 CF CG CD	0402 0603 0603 0603	0.50 ± 0.05 0.80 ± 0.07* 0.80 ± 0.10* 0.80 ± 0.15	10,000 4,000 4,000 4,000	50,000 15,000 15,000 10,000	0 0 0 0	0 0 0 0
CJ DM DN DO	0603 0805 0805 0805	0.80 ± 0.15* 0.70 ± 0.20* 0.78 ± 0.10* 0.80 ± 0.10*	4,000 4,000 4,000 4,000	15,000 15,000 15,000 15,000	0 0 0 0	0 0 0 0
DP DE DG DH	0805 0805 0805 0805	$0.90 \pm 0.10^{*}$ $1.00 \pm 0.10$ $1.25 \pm 0.15$ $1.25 \pm 0.20$	4,000 0 0 0	15,000 0 0 0	0 2,500 2,500 2,500	0 10,000 10,000 10,000
EB EC EN ED	1206 1206 1206 1206	$0.78 \pm 0.10$ $0.90 \pm 0.10$ $0.95 \pm 0.10$ $1.00 \pm 0.10$	4,000 0 0 0	10,000 0 0 0	4,000 4,000 4,000 2,500	10,000 10,000 10,000 10,000
EE EF EP EM	1206 1206 1206 1206	1.10 ± 0.10 1.20 ± 0.15 1.20 ± 0.20 1.25 ± 0.15	0 0 0 0	0 0 0 0	2,500 2,500 2,500 2,500	10,000 10,000 10,000 10,000
EG EH FB FC FD	1206 1206 1210 1210 1210	$1.60 \pm 0.15$ $1.60 \pm 0.20$ $0.78 \pm 0.10$ $0.90 \pm 0.10$ $0.95 \pm 0.10$	0 0 0 0 0	0 0 0 0 0	2,000 2,000 4,000 4,000 4,000	8,000 8,000 10,000 10,000 10,000
FE FF FG FL FH	1210 1210 1210 1210 1210	$1.00 \pm 0.10$ $1.10 \pm 0.10$ $1.25 \pm 0.15$ $1.40 \pm 0.15$ $1.55 \pm 0.15$	0 0 0 0	0 0 0 0	2,500 2,500 2,500 2,000 2,000	10,000 10,000 10,000 8,000 8,000
FM FJ FT FY FK	1210 1210 1210 1210 1210	$1.70 \pm 0.20$ $1.85 \pm 0.20$ $1.90 \pm 0.20$ $2.00 \pm 0.20$ $2.10 \pm 0.20$	0 0 0 0	0 0 0 0 0	2,000 2,000 1,500 2,000 2,000	8,000 8,000 4,000 8,000 8,000
FS NA NC LD LF	1210 1706 1706 1808 1808	$2.50 \pm 0.30$ $0.90 \pm 0.10$ $1.00 \pm 0.15$ $0.90 \pm 0.10$ $1.00 \pm 0.15$	0 0 0 0	0 0 0 0	1,000 4,000 4,000 2,500 2,500	4,000 10,000 10,000 10,000 10,000
GB GC GD GE GH	1812 1812 1812 1812 1812	$1.00 \pm 0.10$ $1.10 \pm 0.10$ $1.25 \pm 0.15$ $1.30 \pm 0.10$ $1.40 \pm 0.15$	0 0 0 0	0 0 0 0	1,000 1,000 1,000 1,000 1,000	4,000 4,000 4,000 4,000 4,000
GG GK GJ GO HB	1812 1812 1812 1812 1812 1825	1.55 ± 0.10 1.60 ± 0.20 1.70 ± 0.15 2.50 ± 0.20 1.10 ± 0.15	0 0 0 0	0 0 0 0	1,000 1,000 1,000 500 1,000	4,000 4,000 4,000 2,000 4,000
HC HD HE	1825 1825 1825 1825	1.10 ± 0.13 1.15 ± 0.15 1.30 ± 0.15 1.40 ± 0.15	0 0 0	0 0 0	1,000 1,000 1,000	4,000 4,000 4,000
Thickness Code	Case Size	Thickness ± Range (mm)	7" Reel Paper G	13" Reel Quantity	7" Reel Plastic (	13" Reel Quantity

Package quantity based on finished chip thickness specifications.



Table 2 – Chip Thickness/Packaging Quantities cont'd

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

Package quantity based on finished chip thickness specifications.



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

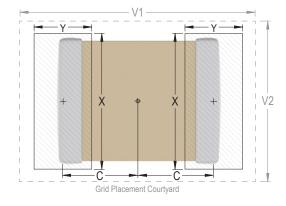
EIA Size Code	Metric Size Code	Density Level A: Maximum (Most) Land Protrusion (mm)			Density Level B: Median (Nominal) Land Protrusion (mm)				Density Level C: Minimum (Least) Land Protrusion (mm)							
		С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	X	V1	V2
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	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
1210¹	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>&</sup>lt;sup>1</sup> Only for capacitance values ≥ 22 μF

**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**

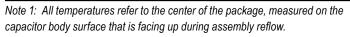
#### **Recommended Soldering Technique:**

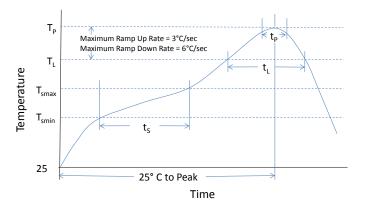
- Solder wave or solder reflow for EIA case sizes 0603, 0805 and 1206
- · All other EIA case sizes are limited to solder reflow only

#### **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 $(t_s)$ from $T_{smin}$ to $T_{smax}$	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate (T <sub>L</sub> to T <sub>P</sub> )	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T <sub>L</sub> )	183°C	217°C
Time Above Liquidous (t <sub>L</sub> )	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 <sub>P</sub> to T <sub>L</sub> )	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum







## Table 4 – Performance & Reliability: Test Methods and Conditions

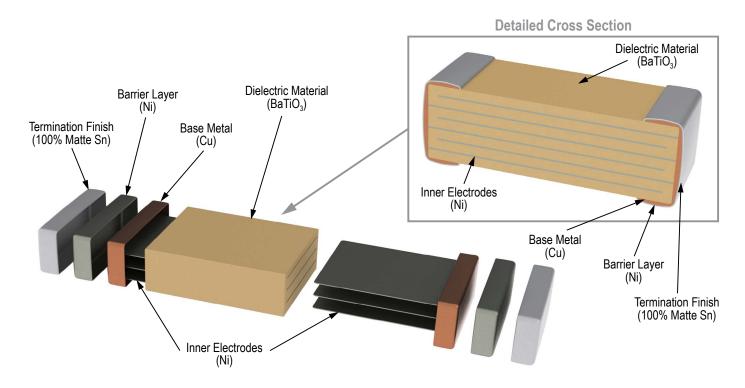
Stress	Reference		Test or Inspection Method							
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8	Appendix 1, Note: Force of 1.8 kg for 60 seconds.							
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).								
		Magnification 50 X. Conditions	:							
0-14	L OTD OOO	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	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		of cycles required – 300. Max	imum transfer time – 20 seconds.						
		1,000 hours at 125°C with 2 X	rated voltage applied excludi	ng 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 A						
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	tion 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

2225

- 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

5664

 $\leq 0.033 \, \mu F$ 

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 µF. Orientation of marking is vendor optional.





# Capacitor Marking (Optional) cont'd

		Capacit	ance (p	F) For				<u>l Identifi</u>	ers			
Alpha						Numera						
Character	9	0	1	2	3	4	5	6	7	8		
Cilaracter	Capacitance (pF)											
Α	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		
Е	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		
M	0.3	3 0	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	7 5	75	750	7,500	75,000	750,000	7,500,000	75,000,000	750,000,000		
Υ	0.82	82	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	25	25	250	2,500	25,000	250,000	2,500,000	25,000,000	250,000,000		
b	0.35	3 5	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		
е	0.45	4 5	45	450	4,500	45,000	450,000	4,500,000	45,000,000	450,000,000		
f	0.5	5 0	50	500	5,000	50,000	500,000	5,000,000	50,000,000	500,000,000		
m	0.6	6 0	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	8 0	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		



## **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.

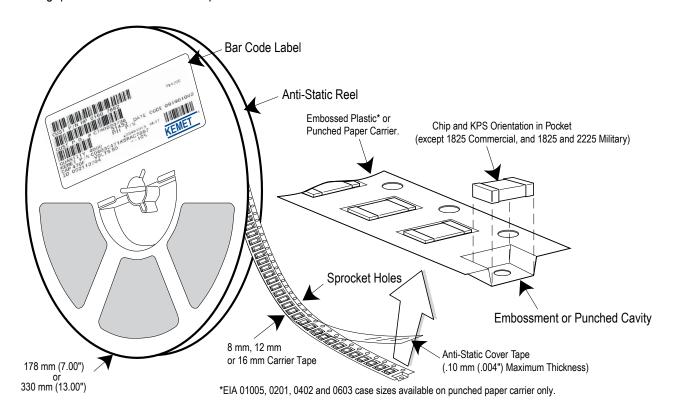


Table 5 – Carrier Tape Configuration, Embossed Plastic & Punched Paper (mm)

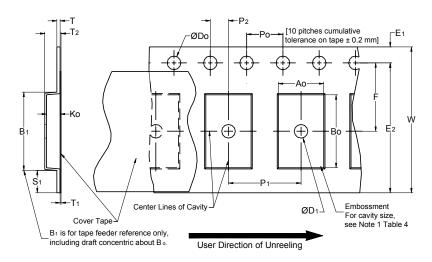
	Tape size (W)*	Embosse	ed Plastic	Punche	d Paper	
EIA Case Size		7" Reel	13" Reel	7" Reel	13" Reel	
		Pitch	(P <sub>1</sub> )*	Pitch (P <sub>1</sub> )*		
01005 – 0402	8			2	2	
0603	8			4	4	
0805	8	4	4	4	4	
1206 – 1210	8	4	4	4	4	
1805 – 1808	12	4	4			
≥ 1812	12	8	8			
KPS 1210	12	8	8			
KPS 1812 & 2220	16	12	12			
Array 0508 & 0612	8	4	4			

<sup>\*</sup>Refer to Figures 1 & 2 for W and P, carrier tape reference locations.

<sup>\*</sup>Refer to Tables 6 & 7 for tolerance specifications.



## Figure 1 – Embossed (Plastic) Carrier Tape Dimensions



## Table 6 – Embossed (Plastic) Carrier Tape Dimensions

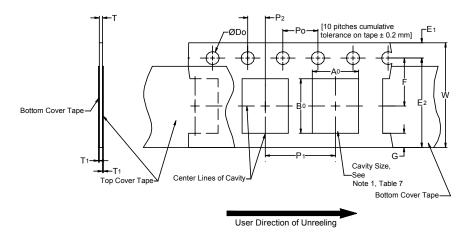
Metric will govern

	Constant Dimensions — Millimeters (Inches)										
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	T <sub>1</sub> 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	es)					
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	e 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  $S_1 < 1.0$  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, dimension is a reference dimension for tape feeder clearance only.
- 5. The cavity defined by A<sub>n</sub>, B<sub>n</sub> and K<sub>n</sub> 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<sub>0</sub> and B<sub>0</sub> 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>o</sub>	E <sub>1</sub>	P <sub>0</sub>	P <sub>2</sub>	T <sub>1</sub> 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	$A_0B_0$			
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)	Note 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**

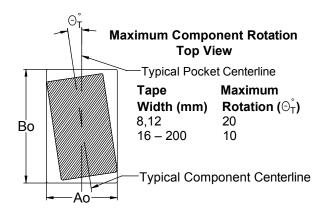
- 1. Cover Tape Break Force: 1.0 Kg minimum.
- 2. Cover Tape Peel Strength: The total peel strength of the cover tape from the carrier tape shall be:

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° to 180° from the plane of the carrier tape. During peeling, the carrier and/or cover tape shall be pulled at a velocity of 300 ±10 mm/minute.

3. Labeling: Bar code labeling (standard or custom) shall be on the side of the reel opposite the sprocket holes. Refer to EIA Standards 556 and 624.

## Figure 3 – Maximum Component Rotation



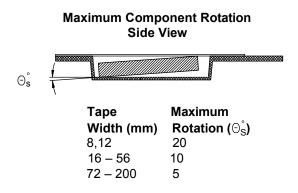


Figure 4 – Maximum Lateral Movement

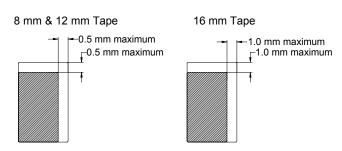


Figure 5 - Bending Radius

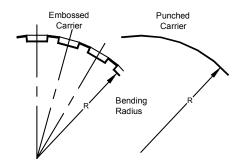
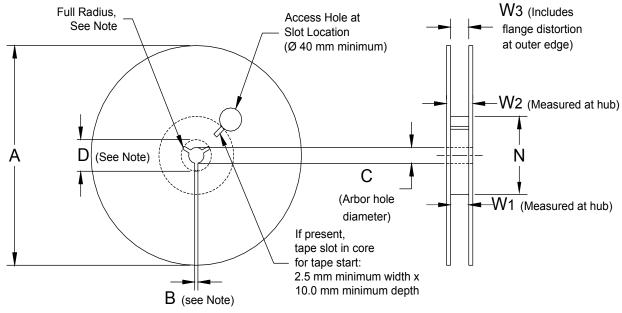




Figure 6 – Reel Dimensions



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

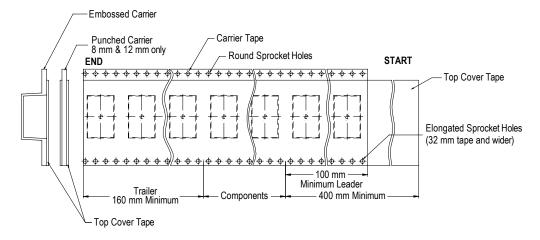
Table 8 - Reel Dimensions

Metric will govern

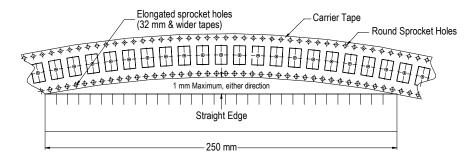
	Constant Dimensions — Millimeters (Inches)									
Tape Size	A	B Minimum	С	D Minimum						
8 mm	178 ±0.20									
12 mm	(7.008 ±0.008) or	1.5 (0.059)	13.0 +0.5/-0.2 (0.521 +0.02/-0.008)	20.2 (0.795)						
16 mm	330 ±0.20 (13.000 ±0.008)	,	,	,						
	Variable	Dimensions — Millimeter	s (Inches)					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

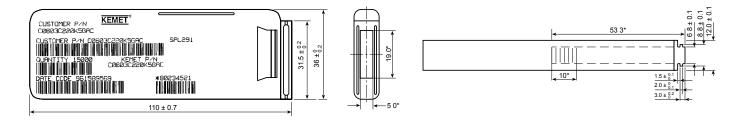


## Figure 8 – Maximum Camber



## **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



# **KEMET Corporation World Headquarters**

2835 KEMET Way Simpsonville, SC 29681

Mailing Address: P.O. Box 5928 Greenville, SC 29606

www.kemet.com Tel: 864-963-6300 Fax: 864-963-6521

#### **Corporate Offices**

Fort Lauderdale, FL Tel: 954-766-2800

#### **North America**

#### Southeast

Lake Mary, FL Tel: 407-855-8886

#### **Northeast**

Wilmington, MA Tel: 978-658-1663

#### Central

Novi, MI

Tel: 248-306-9353

#### West

Milpitas, CA Tel: 408-433-9950

#### Mexico

Guadalajara, Jalisco Tel: 52-33-3123-2141

#### Europe

#### **Southern Europe**

Paris, France Tel: 33-1-4646-1006

Sasso Marconi, Italy Tel: 39-051-939111

#### **Central Europe**

Landsberg, Germany Tel: 49-8191-3350800

Kamen, Germany Tel: 49-2307-438110

#### **Northern Europe**

Bishop's Stortford, United Kingdom Tel: 44-1279-460122

Espoo, Finland

Tel: 358-9-5406-5000

#### **Asia**

#### **Northeast Asia**

Hong Kong

Tel: 852-2305-1168

Shenzhen, China Tel: 86-755-2518-1306

Beijing, China

Tel: 86-10-5829-1711

Shanghai, China Tel: 86-21-6447-0707

Taipei, Taiwan Tel: 886-2-27528585

#### **Southeast Asia**

Singapore

Tel: 65-6586-1900

Penang, Malaysia Tel: 60-4-6430200

Bangalore, India Tel: 91-806-53-76817

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Although all product—related warnings, cautions and notes must be observed, the customer should not assume that all safety measures are indicted or that other measures may not be required.