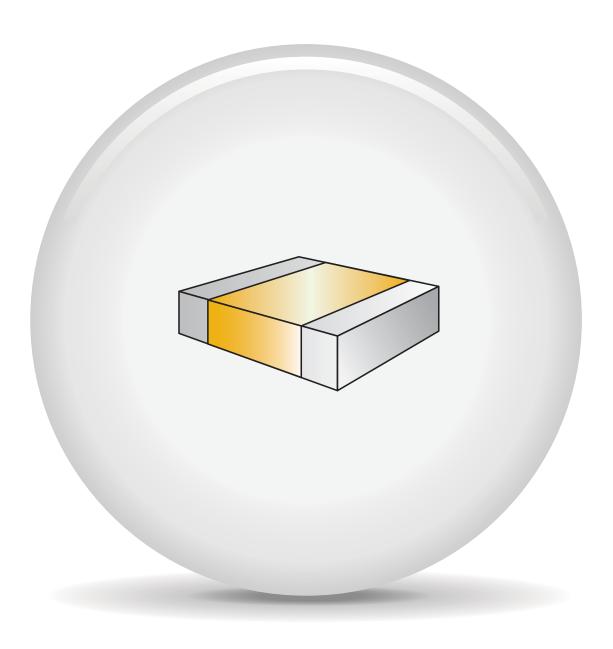
Surface Mount Multilayer Ceramic Capacitors

Commercial Grade



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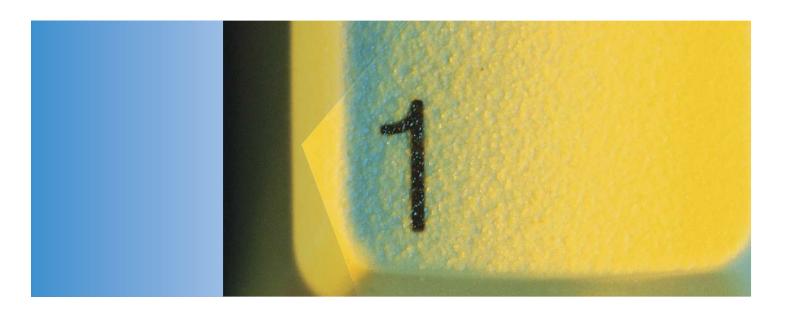
Commercial Grade



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One world, One source, One KEMET,

When you partner with KEMET, our entire global organization provides you with the coordinated service you need. No bouncing from supplier to supplier. No endless phone calls and web browsing. We're your single, integrated source for electronic component solutions worldwide.

Less hassles. More solutions.

Our commitment to product quality and on-time delivery has helped customers succeed for over 90 years. There's a reason KEMET components can be found in defense and aerospace equipment. Our reputation is built on a history of consistency, reliability and service.

The "Easy-to-Buy-From" company.

KEMET offers a level of responsiveness that far surpasses any other supplier. Our passion for customer service is evident throughout our global sales organization, which offers localized support bolstered by our worldwide logistics capabilities. Whether you need rush samples, technical assistance, in-person consultation, accelerated custom design, design collaboration or prototype services, we have a solution.



Made for you.

When you need custom products delivered on a tight schedule, you can trust KEMET. Get direct design consultation from global experts, who help you get the job done on time and within budget.

Working for a better world.

KEMET is dedicated to economically, environmentally and socially sustainable development. We've adopted the Electronic Industry Code of Conduct (EICC) to address all aspects of corporate responsibility. Our manufacturing facilities have won numerous environmental excellence awards and recognitions, and our supply chain is certified. We believe doing the right thing is in everyone's interest.

About KEMET.

KEMET Corporation is a leading global supplier of electronic components. We offer our customers the broadest selection of capacitor technologies in the industry across multiple dielectrics, along with an expanding range of electromechanical devices, and electromagnetic compatibility solutions. Our vision is to be the preferred supplier of electronic component solutions for customers demanding the highest standards of quality, delivery and service.

C0G Dielectric, 10 – 250 VDC (Commercial Grade)



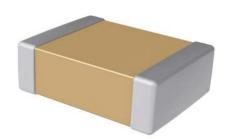
Overview

KEMET's COG dielectric features a 125°C maximum operating temperature and is considered "stable." The Electronics Components, Assemblies & Materials Association (EIA) characterizes COG dielectric as a Class I material. Components of this classification are temperature compensating and are suited for resonant circuit applications or those where Q

and stability of capacitance characteristics are required. C0G exhibits no change in capacitance with respect to time and voltage and boasts a negligible change in capacitance with reference to ambient temperature. Capacitance change is limited to ±30 ppm/°C from −55°C to +125°C.

Benefits

- -55°C to +125°C operating temperature range
- · Lead (Pb)-Free, RoHS, and REACH compliant
- EIA 0201, 0402, 0603, 0805, 1206, 1210, 1808, 1812, 1825, 2220, and 2225 case sizes
- DC voltage ratings of 10 V, 16 V, 25 V, 50 V, 100 V, 200 V and 250 V
- Capacitance offerings ranging from 0.5 pF up to 0.47 μF
- Available capacitance tolerances of ±0.10 pF, ±0.25 pF, ±0.5 pF, ±1%, ±2%, ±5%, ±10%, and ±20%
- · No piezoelectric noise
- · Extremely low ESR and ESL
- High thermal stability
- · High ripple current capability



Ordering Information

C	1206	С	104	J	3	G	Α	С	TU
Ceran	Case Size (L" x W")	Specification/ Series ¹	Capacitance Code (pF)	Capacitance Tolerance ²	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ³	Packaging/Grade (C-Spec)
	0201 0402 0603 0805 1206 1210 1808 1812 1825 2220 2225	C = Standard	Two significant digits + number of zeros. Use 9 for 1.0 – 9.9 pF Use 8 for 0.5 – .99 pF e.g., 2.2 pF = 229 e.g., 0.5 pF = 508	$B = \pm 0.10 \text{ pF}$ $C = \pm 0.25 \text{ pF}$ $D = \pm 0.5 \text{ pF}$ $F = \pm 1\%$ $G = \pm 2\%$ $J = \pm 5\%$ $K = \pm 10\%$ $M = \pm 20\%$	8 = 10 4 = 16 3 = 25 5 = 50 1 = 100 2 = 200 A = 250	G = COG	A = N/A	C = 100% Matte Sn	See "Packaging C-Spec Ordering Options Table" below

¹ Flexible termination option is available. Please see FT-CAP product bulletin C1062_C0G_FT-CAP_SMD

² Additional capacitance tolerance offerings may be available. Contact KEMET for details.

³ Additional termination finish options may be available. Contact KEMET for details.



Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec)
Bulk Bag/Unmarked	Not required (Blank)
7" Reel/Unmarked	TU
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2 mm pitch ²	7081
13" Reel/Unmarked/2 mm pitch ²	7082

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits cont'd

- Preferred capacitance solution at line frequencies and into the MHz range
- · No capacitance change with respect to applied rated DC voltage
- Negligible capacitance change with respect to temperature from −55°C to +125°C
- No capacitance decay with time
- · Non-polar device, minimizing installation concerns
- 100% pure matte tin-plated termination finish allowing for excellent solderability
- SnPb plated termination finish option available upon request (5% Pb minimum)

Applications

Typical applications include critical timing, tuning, circuits requiring low loss, circuits with pulse, high current, decoupling, bypass, filtering, transient voltage suppression, blocking and energy storage.

Qualification/Certification

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

Environmental Compliance

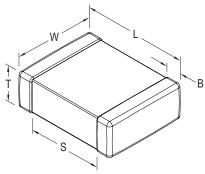
Lead (Pb)-Free, RoHS, and REACH compliant without exemptions.

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. The option to laser mark is not available on these devices. For more information see "Capacitor Marking".

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Dimensions – Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0201	0603	0.60 (.024) ± 0.03 (.001)	0.30 (.012) ± 0.03 (.001)		0.15 (.006) ± 0.05 (.002)	N/A	Colder Defleys Only
0402	1005	1.00 (.040) ± 0.05 (.002)	0.50 (.020) ± 0.05 (.002)		0.30 (.012) ± 0.10 (.004)	0.30 (.012)	Solder Reflow Only
0603	1608	1.60 (.063) ± 0.15 (.006)	0.80 (.032) ± 0.15 (.006)		0.35 (.014) ± 0.15 (.006)	0.70 (.028)	
0805	2012	2.00 (.079) ± 0.20 (.008)	1.25 (.049) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	Solder Wave or Solder Reflow
1206	3216	3.20 (.126) ± 0.20 (.008)	1.60 (.063) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)		Coldor Rollow
1210	3225	3.20 (.126) ± 0.20 (.008)	2.50 (.098) ± 0.20 (.008)	See Table 2 for Thickness	0.50 (0.02) ± 0.25 (.010)		
1808	4520	4.70 (.185) ± 0.50 (.020)	2.00 (.079) ± 0.20 (.008)	THIORITOGO	0.60 (.024) ± 0.35 (.014)		
1812	4532	4.50 (.177) ± 0.30 (.012)	3.20 (.126) ± 0.30 (.012)		0.60 (.024) ± 0.35 (.014)	N/A	Oalden Daffers Oak
1825	4564	4.50 (.177) ± 0.30 (.012)	6.40 (.252) ± 0.40 (.016)		0.60 (.024) ± 0.35 (.014)		Solder Reflow Only
2220	5650	5.70 (.224) ± 0.40 (.016)	5.00 (.197) ± 0.40 (.016)		0.60 (.024) ± 0.35 (.014)		
2225	5664	5.60 (.220) ± 0.40 (.016)	6.40 (.248) ± 0.40 (.016)		0.60 (.024) ± 0.35 (.014)		



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)	±30 ppm/°C
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	0%
¹ Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)
² Dissipation Factor (DF) Maximum Limit at 25°C	0.1%
³ Insulation Resistance (IR) Limit at 25°C	1,000 megohm microfarads or 100 G Ω (Rated voltage applied for 120 ±5 seconds at 25°C)

DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

Capacitance and Dissipation Factor (DF) measured under the following conditions:

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."

Post Environmental Limits

	High Temperature Life, Biased Humidity, Moisture Resistance												
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance								
C0G	All	All	0.5	0.3% or ±0.25 pF	10% of Initial Limit								

²Capacitance and dissipation factor (DF) measured under the following conditions:

¹ MHz ± 100 kHz and 1.0 Vrms ± 0.2 V if capacitance $\leq 1,000$ pF

¹ kHz ±50 Hz and 1.0 Vrms ±0.2 V if capacitance > 1,000 pF

 $^{{}^{3}}$ To obtain IR limit, divide M Ω - μ F value by the capacitance and compare to G Ω limit. Select the lower of the two limits.



Table 1A – Capacitance Range/Selection Waterfall (0201 – 1206 Case Sizes)

		Case Size/ Series	C0201C	C0402C	C0603C	C0805C	C1206C
Сар	Сар	Voltage Code	8 4 3	8 4 3 5 1 2 A	8 4 3 5 1 2 A	8 4 3 5 1 2 A	8 4 3 5 1 2 A
, J.,	Code	Rated Voltage (VDC)	10 10 25	10 10 10 250 250	10 16 25 50 100 200 250	10 16 25 50 100 200 250	10 16 10 10 20 250
		Capacitance Tolerance		Produc	ct Availability and Chi Table 2 for Chip Thick	p Thickness Codes	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
0.50 & 0.75 pF	508 & 758	B C D		BB BB BB BB	CF CF CF CF CF CF		
0.75 pF	758	BCD		BB BB BB BB	CF CF CF CF CF CF		
1.0 – 9.1 pF*	109 – 919*	BCD			CF CF CF CF CF CF	DN DN DN DN DN DN DN	
1.1 pF	119	B C D			CF CF CF CF CF CF CF CF		
1.2 pF	129	B C D			CF CF CF CF CF CF CF CF	DN	
1.3 pF	139 159	BCD			CF CF CF CF CF CF CF		EB EB EB EB EB EB EB
1.5 pF 1.6 pF	169	BCD			CF CF CF CF CF CF CF		
1.8 pF	189	BCD			CF CF CF CF CF CF CF		EB EB EB EB EB EB EB
2.0 pF	209	B C D			CF CF CF CF CF CF		EB EB EB EB EB EB
2.0 pf	229	BCD			CF CF CF CF CF CF	DN DN DN DN DN DN DN	
2.4 pF	249	BCD			CF CF CF CF CF CF		
2.4 pr 2.7 pF	279	BCD			CF CF CF CF CF CF		EB EB EB EB EB EB
3.0 pF	309	BCD			CF CF CF CF CF CF		
3.3 pF	339	B C D			CF CF CF CF CF CF		EB EB EB EB EB EB
3.6 pF	369	B C D			CF CF CF CF CF CF	DN DN DN DN DN DN DN	
3.9 pF	399	BCD			CF CF CF CF CF CF	DN DN DN DN DN DN DN	EB EB EB EB EB EB
4.3 pF	439	BCD			CF CF CF CF CF CF		EB EB EB EB EB EB
4.7 pF	479	BCD			CF CF CF CF CF CF	DN DN DN DN DN DN DN	
5.1 pF	519	BCD			CF CF CF CF CF CF		
5.6 pF	569	BCD			CF CF CF CF CF CF		
6.2 pF	629	BCD			CF CF CF CF CF CF		
6.8 pF	689	BCD			CF CF CF CF CF CF		
7.5 pF	759	BCD			CF CF CF CF CF CF		
8.2 pF	829	BCD			CF CF CF CF CF CF		EB EB EB EB EB EB
9.1 pF	919	BCD			CF CF CF CF CF CF		
10 pF	100	F G J K M	AB1 AB1 AB1	BB BB BB BB	CF CF CF CF CF CF		
11 pF	110	F G J K M			CF CF CF CF CF CF		
12 pF	120	F G J K M	AB ² AB ² AB ²	BB BB BB BB	CF CF CF CF CF CF	DN DN DN DN DN DN DN	EB EB EB EB EB EB
13 pF	130	F G J K M			CF CF CF CF CF CF	DN DN DN DN DN DN DN	EB EB EB EB EB EB
15 pF	150	F G J K M	AB ² AB ² AB ²	BB BB BB BB	CF CF CF CF CF CF	DN DN DN DN DN DN	EB EB EB EB EB EB
16 pF	160	F G J K M		BB BB BB BB	CF CF CF CF CF CF	DN DN DN DN DN DN DN	EB EB EB EB EB EB
18 pF	180		AB ² AB ² AB ²	BB BB BB BB	CF CF CF CF CF CF	DN DN DN DN DN DN DN	EB EB EB EB EB EB
20 pF	200	F G J K M		BB BB BB BB	CF CF CF CF CF CF	DN DN DN DN DN DN DN	EB EB EB EB EB EB
22 pF	220	F G J K M	AB ² AB ² AB ²	BB BB BB BB	CF CF CF CF CF CF	DM DM DM DM DN DN DN	EB EB EB EB EB EB EB
24 pF	240	F G J K M		BB BB BB BB	CF CF CF CF CF CF		
27 pF	270		AB ² AB ² AB ²		CF CF CF CF CF CF		
30 pF	300	F G J K M			CF CF CF CF CF CF		
33 pF	330		AB ² AB ² AB ²		CF CF CF CF CF CF		
36 pF	360	F G J K M		BB BB BB BB		DN DN DN DN DN DN DN	
39 pF	390					DN DN DN DN DN DN DN	
43 pF	430	F G J K M				DN DN DN DN DN DN	
47 pF	470					DN DN DN DN DN DN	
51 pF	510	F G J K M				DN DN DN DN DN DN	
56 pF	560					DN DN DN DN DN DN	
62 pF	620	F G J K M	[DN DN DN DN DN DN DN	
68 pF	680					DN DN DN DN DN DN	
75 pF	750	F G J K M				DN DN DN DN DN DN DN	
82 pF	820					DN DN DN DN DN DN DN	
91 pF	910	F G J K M	A D2 A D2 A D2	BB BB BB BB BB BB BB		DN DN DN DN DN DN DN	
100 pF	101	Rated Voltage (VDC)			250 00 00 00 00 00 00 00 00 00 00 00 00 0		
Сар	Cap Code	Voltage Code	8 4 3		8 4 3 5 1 2 A		
	Code	Case Size/Series	C0201C	C0402C	C0603C	C0805C	C1206C
		Julydan E24 dagada yaluga anly /i a 10 11 12 12 15 16 10 20 22 24 27 20 22				•	

^{*}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).

These products are protected under US Patents 7,172,985 & 7,670,981, other patents pending, and any foreign counterparts.

xx1 Available only in D, J, K,M tolerance

xx² Available only in J, K, M tolerance.



Table 1A - Capacitance Range/Selection Waterfall (0201 - 1206 Case Sizes) cont'd

		Case Size/ Series	CO	20	1C			C0	402	2C					C	0603C C0805C							C 1	120	6C								
Сар	Cap	Voltage Code	8	4	3	8	4	3	5	1	2	Α	8	4	3	5	1	2	Α	8	4	3	5	1	2	Α	8	4	3	5	1	2	Α
	Code	Rated Voltage (VDC)	10	91	25	9	9	25	20	100	200	250	ę	9	25	20	5	200	250	9	16	25	20	9		_	9	9	25	20	100	200	250
		Capacitance			,,,	-													<u> </u>												_	~	
		Tolerance									s	ee	Tak	ole :	2 fc	r C	hip	Th	ick	nes	s D	ime	ens	ion	ıs								
110 – 180 pF*	111 – 181*	F G J K M				BB				ВВ		BB	CF	CF		CF										N DN		EB					
200 – 270 pF* 300 pF	201 – 271* 301	F G J K M F G J K M				BB BB	BB BB			BB BB	BB BD	BB BD	CF CF	CF CF	CF CF	CF CF	CF CF	CF CF								N DN		EB EB			EB EB	EB EB	
330 pF	331	F G J K M				BB	BB				BD			CF			CF	CF								N DN							EB
360 pF	361	FGJKM				ВВ	BB		BB				CF	CF	CF	CF	CF	CF								N DN		EB		_	EB	EB	
390 pF	391	F G J K M				ВВ	ВВ		ВВ				CF	CF	CF	CF	CF	CF								ND N			1		EB		
430 pF	431	F G J K M				ВВ				ВВ			CF	CF	CF	CF	CF	CF								N DN			1		EB	EB	
470 pF	471 511	F G J K M				BB BB	BB BB			BB			CF CF	CF CF	CF CF	CF CF	CF CF	CF CF								P DP		EB	1	1	EB EB	EB EB	
510 pF 560 pF	561	F G J K M				ВВ	_	_	ВВ				CF	CF	_	_	CF	CF	_							N DN		_	_	_	_	EB	_
620 pF	621	F G J K M				BB	BB			BB			CF	CF	CF		CF	CF	1 -							N DN						EB	
680 pF	681	F G J K M				ВВ	ВВ			ВВ			CF	CF			CF	CF	1 -	DN	DN	DN	DN	DN	DN	ND N	EB	EB	EB	EB	EB	EB	EB
750 pF	751	F G J K M				ВВ	ВВ			BB			CF	CF	CF	CF	CF	CF								N DN					EB	EB	
820 pF	821	F G J K M					BB		_	BB			CF CF	CF	CF	CF	CF	CF CF		DN						N DN					EB	EB	_
910 pF 1,000 pF	911 102					BB BB	BB BB	- 1	- 1	BB BB			CF	CF CF	CF CF	CF CF	CF CF	CF		DN			1	1		P DP		EB EB			EB EB		EB EB
1,100 pF	112	F G J K M				BB		BB		טט			CF	CF	CF	CF	CF	CH		DN			1	1	1	N DN			1		EB		
1,200 pF	122	F G J K M				ВВ	BB						CF	CF	CF	CF	CF	СН		DN			1	1	1	N DN			1		EB		EB
1,300 pF	132	F G J K M				ВВ	_	_	ВВ				CF	CF	CF	CF	CF	СН	-	DP	DP	DP	DP	_	_	N DN		_	_	EB	EC	EC	EC
1,500 pF	152	F G J K M				ВВ	ВВ		BB				CF	CF			CF	CH	1 -	DP						N DN							EC
1,600 pF	162	F G J K M				BB	BB						CF	CF	CF	CF	CF	CH		DP	DP	DP DP	DP			ND N						ED	
1,800 pF 2,000 pF	182 202	F G J K M F G J K M				BB BB	BB BB						CF CF	CF CF	CF CF	CF CF	CF CF		CH							N DN			EB			ED	ED ED
2,200 pF	222	F G J K M					BB						CF	CF												N DN							EE
2,400 pF	242	FGJKM											CF	CF	CF	CF	CF			DN						N DN		EB					
2,700 pF	272	F G J K M											CF	CF	CF	CF	CF			DN						N DN					EC		EC
3,000 pF	302	F G J K M											CF	CF	CF	CF	CF			DP		DP	1	1	1	N DN		EC	1				EB
3,300 pF 3,600 pF	332 362	F G J K M F G J K M											CF CF	CF CF	CF CF	CF CF	CF CF			DP DP	DP DP	DP DP	DP DP	DN		N DN		EC	1		EE	EB	EB EB
3,900 pF	392	F G J K M											CF	CF	CF	CF	CF			DE		DE		_		P DP EC EC EC E			_		EB	_	
4,300 pF	432	F G J K M											CF	CF	CF	CF	CF			DE		DE		DN	DF	P DP EC EC EC EC			EC				
4,700 pF	472	F G J K M											CF	CF	CF	CF	CF			DE		DE				DP		EC					
5,100 pF	512	F G J K M											CF	CF	CF					DE		DE				DP		ED				EB	
5,600 pF 6,200 pF	562 622	F G J K M F G J K M											CF CF	CF CF	CF	CF CF				DN DN						P DP G DG						EB	EB EB
6,800 pF	682	F G J K M											CF	CF	CF	CF				DN						3 DG					EB	EB	1
7,500 pF	752	F G J K M											CF	CF	CF	0.				DN			1	1	1	3 DG		EB	1	1	EB	EB	
8,200 pF	822	F G J K M											CF	CF	CF					DN	DN	DN	DN	DN	DO	G DG			EC	1	EB		EC
9,100 pF	912	F G J K M											CF	CF	CF					DN		DN	_	_	_		EC		EC		EB		EC
10,000 pF	103	F G J K M											CF	CF										DP				ED					EC
12,000 pF 15,000 pF	123 153	F G J K M F G J K M											CF CF	CF CF							DN			DE			EB			EB	EB EB		ED
18,000 pF	183	F G J K M												Ji	Ji						DN			53							EB		
22,000 pF	223	F G J K M																		DP	DP	DP					EB	EB	EB	EB	EC	EH	EH
27,000 pF	273	F G J K M																			DF						EB	EB	EB	EB	EE		
33,000 pF	333	F G J K M																			DG						EB	EB	EB	EB	EE		
39,000 pF	393 473	F G J K M F G J K M																			DG							EC EC					
47,000 pF 56,000 pF	473 563	F G J K M											l							DG DG DG			ED			EU							
68,000 pF	683	F G J K M																										EF					
82,000 pF	823	F G J K M																									EH	EH	EH	EH			
0.10 µF	104	F G J K M									_																	EH					
	Can	Rated Voltage (VDC)		16	25	9	9	52	20	9	200	250	9	9	52		ş			9	16	25		ş		250	9	_	25		100	700	250
Сар	Cap Code	Voltage Code	8	_	3	8	4	3	5	1	2	Α	8	4	3	5	1	2	Α				8	4			1	2	Α				
		Case Size/Series	C)20 ⁻	1C			C0	402	2C					C	060	3C			C0805C			C1206C										

^{*}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). xx¹ Available only in D, J, K,M tolerance

xx² Available only in J, K, M tolerance.

These products are protected under US Patents 7,172,985 & 7,670,981, other patents pending, and any foreign counterparts.



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

		C	ase Se		ize/ s			C1	210	C			(C18	080		(C18	120		C1825C			(C22	200		(222	250		
Сар	Сар	٧	oltag	je C	ode	8	4	3	5	1	2	Α	5	1	2	Α	5	1	2	Α	5	1	2	Α	5	1	2	Α	5	1	2	Α
	Code	Rate	d Vol	Itage	(VDC)	2	16	25	20	5	200	250	20	9	200	250	20	19	200	250	20	100	200	250	20	9	200	250	20	100	200	250
		Ca	Capacitance Tolerance									Pro	Product Availability and Chip Thick See Table 2 for Chip Thickness Di								ickr	iess										
1.0 – 9.1 pF*	109 – 919*	ВС				FB	FB	FB	FB	FB	FB	FB	Ü					ШР				<u> </u>		0.0	Ï							
10 – 91 pF*	100 – 910*		F	1 - 1	J K M		FB	FB	FB	FB	FB	FB																				
100 – 300 pF*	101 – 301*		F		J K M		FB	FB	FB	FB	FB	FB																				
330 – 430 pF*	331 – 431*		F	171	J K M		FB FB	FB	FB FB	FB FB	FB	FB FB	LF LF	LF LF	LF LF	LF LF	CD.	CD	GB	CD												
470 – 910 pF* 1,000 pF	471 – 911* 102		F	-	J K M		FB	FB FB	FB	FB	FB FB	FB	LF	LF	LF	LF	GB GB	GB GB	GB	GB GB												
1,100 pF	112		F.	171	JKM		FB	FB	FB	FB	FB	FB	LF	LF	LF	LF	GB		GB	GB												
1,200 pF	122		F	1 1	J K M		FB	FB	FB	FB	FB	FB	LF	LF	LF	LF	GB		GB	GB	İ				İ							
1,300 pF	132		F	1 - 1	J K M		FB	FB	FB	FB	FC	FC	LF	LF	LF	LF	GB	GB	GB	GB												
1,500 pF	152		F	-	J K M		FB	FB	FB	FB	FE	FE	LF	LF	LF	LF	GB	GB	GB	GB												
1,600 pF	162		F	1 - 1	J K M		FB	FB	FB	FB	FE	FE	LF	LF	LF	LF	GB		GB	GB												
1,800 pF 2,000 pF	182 202		F	171	J K M		FB FB	FB FB	FB FB	FB FC	FE FE	FE FE	LF LF	LF LF	LF LF	LF LF	GB GB	GB GB	GB GB	GB GB												
2,200 pF	202		F	1 - 1	J K M		FB	FB	FB	FC	FG	FG	LF	LF	LF	LF	GB			GB												
2,400 pF	242		F	1 - 1	JKM		FB	FB	FB	FC	FC	FC	LF	LF	LF	LF	OB	0.5	OD	0.0												
2,700 pF	272		F		J K M		FB	FB	FB	FC	FC	FC	LF	LF	LF	LF	GB	GB	GB	GB												
3,000 pF	302		F	1 - 1	J K M		FB	FB	FB	FC	FF	FF	LF	LF																		
3,300 pF	332		F	1 - 1	J K M		FB	FB	FB	FF	FF	FF	LF	LF			GB	GB	GB	GB												
3,600 pF	362		F	- 1	JKN		FB	FB	FB	FF FF	FF	FF	LF	LF			O.D.	OD	OD.	0.0	un	I I I	LID	LID								
3,900 pF 4,300 pF	392 432		F	-	J K M		FB FB	FB FB	FB FB	FF	FF FF	FF FF	LF LF	LF LF			GB	GB	GB	GB	НВ	нв	НВ	НВ								
4,700 pF	472		F	1 - 1	J K M		FF	FF	FF	FG	FG	FG	LF	LF			GB	GB	GD	GD	HB	НВ	НВ	НВ					KE	KE	KE	KE
5,100 pF	512		F	1 - 1	J K M		FB	FB	FB	FG	FG	FG																	KE	KE	KE	KE
5,600 pF	562		F	G	J K M		FB	FB	FB	FG	FG	FG	İ				GB	GB	GH	GH	НВ	НВ	НВ	НВ					KE	KE	KE	KE
6,200 pF	622		F	-	J K M		FB	FB	FB	FG	FB	FB																	KE	KE	KE	KE
6,800 pF	682		F	1 - 1	J K M		FB	FB	FB	FG	FB	FB					GB	GB	GJ	GJ	НВ	НВ	НВ	НВ	JE	JE	JB		KE	KE	KE	KE
7,500 pF	752		F	1 - 1	J K M		FC	FC	FC	FC	FB	FB					O.D.	011	OD.	0.0	l IID			I I I	۱.,		In.		KE	KE	KE	KE
8,200 pF 9,100 pF	822 912		F	1 - 1	J K M		FC FE	FC FE	FC FE	FC FE	FB FB	FB FB	ł				GB	GH	GB	GB	НВ	нв	НВ	нв	JE	JE	JB		KE KE	KE KE	KE	KE
10,000 pF	103		 F	1 - 1	JKM		FF	FF	FF	FF	FB	FB					GB	GH	GB	GB	НВ	НВ	HE	HE	JE	JE	JB		KE	KE	KE	KE
12,000 pF	123		F	-	J K M		FG	FG	FG	FB	FB	FB					GB		GB	GB	НВ		HE		JE	JE	JB		KE	KE	KE	
15,000 pF	153		F	G	J K M	FG	FG	FG	FG	FB	FC	FC					GB	GB	GB	GB	НВ	НВ			JE	JE	JB		KE	KE	KE	KE
18,000 pF	183		F	1 - 1	J K M		FB	FB	FB	FB	FC	FC					GB		GB	GB	НВ	HE			JE	JE	JB		KE	KE		
22,000 pF	223		F	1 - 1	J K M		FB	FB	FB	FB	FF	FF					GB		GB	GB	НВ	HE			JE	JB	JB		KE	KE		
27,000 pF	273 333		F	-	J K M		FB FB	FB FB	FB FB	FB FB	FG FH	FG FH					GB GB		GB GB	GB GB	НВ	HG			JE JB	JB JB	JB JB		KE	KE		
33,000 pF 39,000 pF	393		F		JKN		FB	FB	FB	FE	FH	FH					GB		GB	GB					JB	JB	JB		KE			
47,000 pF	473		F	1 - 1	JKM		FB	FB	FB	FE	FJ	FJ					GB			GD					JB	JB	JB					
56,000 pF	563		F	1 - 1	J K M		FB	FB	FB	FF							GB			GD					JB	JB	JB					
68,000 pF	683		F		J K M		FB	FB	FC	FG							GB			GK					JB	JB	JB					
82,000 pF	823		F		J K M		FC	FC	FF	FH							GB		GM						JB	JB	JB					
0.10 µF	104				-	FE			FG	FM							GB		GM	GM					JB	JB	JD					
0.12 μF 0.15 μF	124 154				J K M			FG FH										GH GN							JB JB	JB JB	JD JG					
0.18 µF	184				J K M			FJ	1 IVI								GH								JB	JD						
0.22 µF	224		F	G	J K M	FK											GK								JB	JD						
0.27 µF	274		F	G	J K M	ı																			JB	JF						
0.33 µF	334		F	G	J K M	1																			JD	JG						
0.39 µF	394				J K M																				JG							
0.47 μF	474	┞			J K M	1	-		_	-	-	-	┝	-	-	-	_	-	-	-	<u> </u>	-	-	-	JG	-	-	-	_	-	-	0
	Сар	\vdash			(VDC)	1	-	22		Ť	200	250	. 50	100	200	250	. 50	100		250	, 50	100	200		. 20	19	200		1 50	_	200	
Сар	Code		oltag			8	4	3	5	1	2	Α	5	1	2	Α	5	1	2		A 5 1 2 A			5	1	2	_	5	1	2	Α	
			Se					<u> </u>	1210				L_'	C18	U&C		'	-18	1812C C1825C			C2220C					C2225C					

^{*}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). These products are protected under US Patents 7,172,985 & 7,670,981, other patents pending, and any foreign counterparts.



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

Thickness	Case	Thickness ±	Paper C	luantity ¹	Plastic Quantity						
Code	Size ¹	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel					
AB	0201	0.30 ± 0.03	15,000	0	0	0					
BB	0402	0.50 ± 0.05	10,000	50,000	0	0					
BD CF	0402 0603	0.55 ± 0.05	10,000 4,000	50,000	0	0					
CH	0603	0.80 ± 0.07 0.85 ± 0.07	4,000	15,000 10,000	0	0					
DM	0805	0.70 ± 0.07	4,000	15,000	0	0					
DN	0805	0.78 ± 0.10	4,000	15,000	Ŏ	ő					
DP	0805	0.90 ± 0.10	4,000	15,000	0	Ö					
DE	0805	1.00 ± 0.10	0	0	2,500	10,000					
DF	0805	1.10 ± 0.10	0	0	2,500	10,000					
DG	0805	1.25 ± 0.15	0	0	2,500	10,000					
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					
ED	1206	1.00 ± 0.10	0	0	2,500	10,000					
EE	1206	1.10 ± 0.10	0	0	2,500	10,000					
EF	1206	1.20 ± 0.15	0	0	2,500	10,000					
EH FB	1206 1210	1.60 ± 0.20 0.78 ± 0.10	0 0	0	2,000 4,000	8,000 10,000					
FC	1210	0.70 ± 0.10 0.90 ± 0.10	0	0	4,000	10,000					
FE	1210	1.00 ± 0.10	0	0	2,500	10,000					
FF	1210	1.10 ± 0.10	Ö	ő	2,500	10,000					
FG	1210	1.25 ± 0.15	Ö	Ö	2,500	10,000					
FH	1210	1.55 ± 0.15	0	0	2,000	8,000					
FM	1210	1.70 ± 0.20	0	0	2,000	8,000					
FJ	1210	1.85 ± 0.20	0	0	2,000	8,000					
FK	1210	2.10 ± 0.20	0	0	2,000	8,000					
NC	1706	1.00 ± 0.15	0	0	4,000	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					
GD GH	1812	1.25 ± 0.15	0	0	1,000	4,000					
GG	1812 1812	1.40 ± 0.15 1.55 ± 0.10	0 0	0	1,000 1,000	4,000 4,000					
GK	1812	1.60 ± 0.20	0	0	1,000	4,000					
GJ	1812	1.70 ± 0.20	Ő	ő	1,000	4,000					
GN	1812	1.70 ± 0.20	Ö	ŏ	1,000	4,000					
GM	1812	2.00 ± 0.20	0	0	500	2,000					
HB	1825	1.10 ± 0.15	0	Ö	1,000	4,000					
HE	1825	1.40 ± 0.15	0	0	1,000	4,000					
HG	1825	1.60 ± 0.20	0	0	1,000	4,000					
JB	2220	1.00 ± 0.15	0	0	1,000	4,000					
JD 	2220	1.30 ± 0.15	0			4,000					
JE	2220	1.40 ± 0.15	0	0	1,000	4,000 4,000					
JF IC	2220	1.50 ± 0.15	0	0 0 1,000 0 0 1,000							
JG JL	2220 2220	1.70 ± 0.15 2.00 ± 0.20	0			4,000 2,000					
KE	2225	1.40 ± 0.15	0	0							
			7" Reel								
Thickness Code	Case Size ¹	Thickness ± Range (mm)		l luantity¹		L Quantity					

Package quantity based on finished chip thickness specifications.

¹ If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Table 2B - Bulk Packaging Quantities

Doolee	ulu u Tuu o	Loose Pa	ackaging							
Раска	ging Type	Bulk Bag	(default)							
Packagi	ng C-Spec ¹	N/	/A ²							
Cas	e Size	Packaging Quantities (pieces/unit packaging)								
EIA (in)	Metric (mm)	Minimum	Maximum							
0402	1005									
0603	1608									
0805	2012		50,000							
1206	3216									
1210	3225	1								
1808	4520									
1812	4532									
1825	4564		20,000							
2220	5650									
2225	5664									

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

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



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

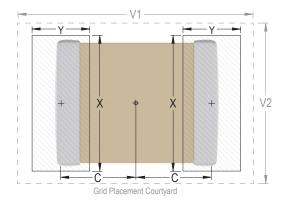
EIA Size Code	Metric Size Code		Maxi	sity Lev mum (M rotrusio	lost))		Medi	sity Lev an (Nor rotrusio)	Density Level C: Minimum (Least) Land Protrusion (mm)									
Oouc	Oouc	С	Y	Х	V1 V2		С	Υ	Х	V1	V2	С	Υ	Х	V1	V2					
0201	0603	0.38	0.56	0.52	1.80	1.00	0.33	0.46	0.42	1.50	0.80	0.28	0.36	0.32	1.20	0.60					
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	0.40	0.52	0.52	1.60	0.80					
0603	1608	0.90	1.15	1.10	4.00	2.10	0.80	0.95	1.00	3.10	1.50	0.60	0.75	0.90	2.40	1.20					
0805	2012	1.00	1.35	1.55	4.40	2.60	0.90	1.15	1.45	3.50	2.00	0.75	0.95	1.35	2.80	1.70					
1206	3216	1.60	1.35	1.90	5.60	2.90	1.50	1.15	1.80	4.70	2.30	1.40	0.95	1.70	4.00	2.00					
1210	3225	1.60	1.35	2.80	5.65	3.80	1.50	1.15	2.70	4.70	3.20	1.40	0.95	2.60	4.00	2.90					
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		2.60	1.50	6.80	7.20	7.30	2.50	1.30	6.70	6.50	7.00								

¹ 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

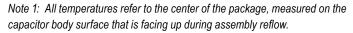
Recommended Soldering Technique:

- 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.

Drofile Feeture	Terminati	on Finish
Profile Feature	SnPb	100% Matte Sn
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum



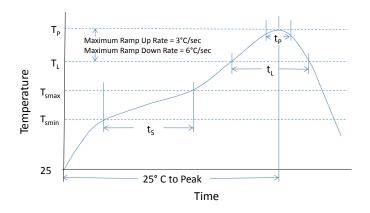




Table 4 – Performance & Reliability: Test Methods and Conditions

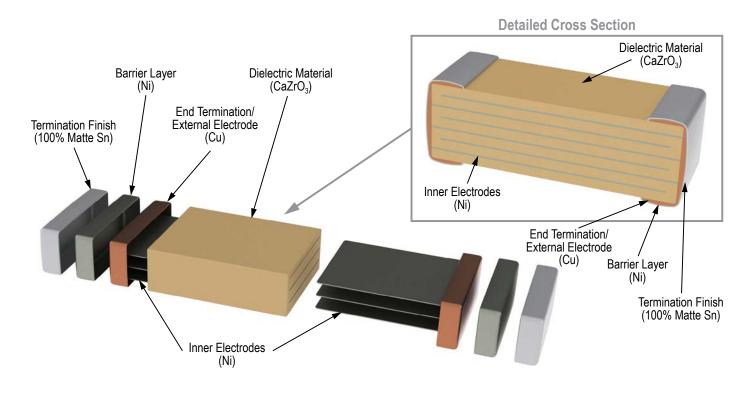
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Solderability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	J-31D-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Diagond Humaidite	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 +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
Vibration	MIL-STD-202 Method 204	5 g's for 20 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



Capacitor Marking (Optional):

Laser marking option is not available on:

- C0G, Ultra Stable X8R and Y5V dielectric devices
- EIA 0402 case size devices
- EIA 0603 case size devices with Flexible Termination option.
- · KPS Commercial and Automotive grade stacked devices.

These capacitors are supplied unmarked only.

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

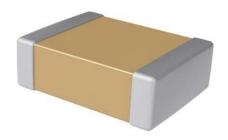
for frequency discriminating circuits where Q and stability of capacitance characteristics are not critical. X7R exhibits a predictable change in capacitance with respect to time and voltage and boasts a minimal change in capacitance with reference to ambient temperature. Capacitance change is limited to $\pm 15\%$ from -55° C to $+125^{\circ}$ 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% Pb 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 ¹	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/ Grade (C-Spec)
	0402 0603 0805 1206 1210 1808 1812 1825 2220 2225	C = Standard	Two significant digits + number of zeros.	J = ±5% K = ±10% M = ±20%	9 = 6.3 8 = 10 4 = 16 3 = 25 6 = 35 5 = 50 1 = 100 2 = 200 A = 250	R = X7R	A = N/A	C = 100% Matte Sn	See "Packaging C-Spec Ordering Options Table" below

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

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

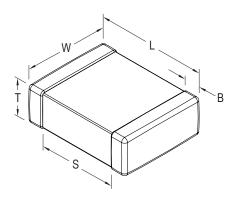


Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec)
Bulk Bag/Unmarked	Not required (Blank)
7" Reel/Unmarked	TU
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
7" Reel/Marked	TM
13" Reel/Marked	7040 (EIA 0603 and smaller case sizes) 7215 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2mm pitch ²	7081
13" Reel/Unmarked/2mm pitch ²	7082

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

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)		

For capacitance values ≥ 4.7 µF add 0.02 (0.001) to the width tolerance dimension and 0.10 (0.004) to the length tolerance dimension.

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. Please contact KEMET if you require a laser marked option. For more information see "Capacitor Marking".

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



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.

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%
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
² Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ± 1 seconds and charge/discharge not exceeding 50mA)
³ Dissipation Factor (DF) Maximum Limit @ 25°C	See Dissipation Factor Limit Table
⁴ Insulation Resistance (IR) Minimum Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ± 5 secs @ 25°C)

¹Regarding 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.

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

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance 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 μ F

⁴To obtain IR limit, divide MΩ- μ F value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



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 16 / 25	≥ 1.0 µF	20.0		
		< 16		7.5		
		16 / 25	< 2.2 µF	5.0		
		> 25	< 1.0 µF	3.0		
	0805	< 16				
		16 / 25	≥ 2.2 µF	20.0		
\/7D		> 25	≥ 1.0 µF		000/	10% of Initial
X7R		< 16		7.5	± 20%	Limit
		16 / 25	< 10 µF	5.0		
	4000	> 25	ĺ	3.0		
	1206	35 / 50	≥ 2.2 µF			
		< 16	> 40	20.0		
		16 / 25	≥10 µF			
		< 16		7.5		
		16 / 25	< 22 µF	5.0		
	1210	> 25		3.0		
		< 16	> 22 uE	20.0		
		16 / 25	≥ 22 µF	20.0		
		< 16		7.5		
	1808-2225	16 / 25	All	5.0		
		> 25		3.5		



Dissipation Factor (DF) Limit Table

EIA Case Size	Rated DC Voltage	Capacitance	Dissipation Factor (Maximum %)
	< 16	All	5.0
	16	All	3.5
0402	25	< 0.1 µF	3.5
	25	≥ 0.1 µF	10.0
	> 25	All	2.5
	< 16		5.0
	16 / 25	< 1.0 µF	3.5
0603	> 25		2.5
	< 16	≥ 1.0 µF	10.0
	16 / 25	≥ 1.0 μr	10.0
	< 16	< 2.2 µF	5.0
	16 / 25	\ 2.2 μΓ	3.5
0805	> 25	< 1.0 µF	2.5
0605	< 16	≥ 2.2 µF	
	16 / 25	≥ 2.2 μΓ	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	> 22E	10.0
	16 / 25	≥ 22 µF	10.0
	< 16		5.0
1808-2225	16 / 25	All	3.5
	> 25		2.5



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

		_	se Si erie			C)402	2C				C	060	3C						C	080	5C							C	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
	Code		d Volt (VDC)	age	6.3	10	16	25	50	6.3	10	16	25	20	100	200	6.3	10	16	25	35	50	100	200	250	6.3	10	16	25	35	50	100	200	250
		Сар	Tolera	nce		F	rod	luct	Ava	aila	bilit	y a	nd C	Chip	Th	ickı	nes	s Co	ode	s –	See	Tal	ole 2	2 fo	r Ch	nip 1	Thic	kne	ss	Dim	ens	ion	s	
10 - 20 pF*	100 - 200*	J	K	М	ВВ	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN		DN					DN		EB								
22 pF	220 240 - 910*	J	K	M	BB	BB	BB BB	BB BB	BB BB	CF CF	CF	CF	CF	CF	CF CF	CF CF	DM		DM					DN		EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	EB	EB EB	
24 - 91pF 100 - 150 pF**	101 - 151**	J	K K	M M	BB BB	BB BB	BB	BB	BB	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		EB	EB	EB	EB	EB	EB	EB EB	EB	
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	DN	EB								
1000pF	102	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							
1200 pF	122	J	K	M	ВВ	ВВ	ВВ	ВВ	ВВ	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN	DN	EB								
1500 pF	152	J	K	М	ВВ	ВВ	BB	ВВ	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN		DN	DN	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								
2200 pF 2700 pF	222 272	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	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB
3300 pF	332	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN		DN	DN	EB								
3900 pF	392	Ĵ	K	М	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN	DN	EB								
4700 pF	472	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							
5600 pF	562	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								
6800 pF	682	J	K	М	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN		DN	DN	EB								
8200 pF	822	J	K	M	BB	BB	BB	BB	BB	CF	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
10000 pF 12000 pF	103 123	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	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
15000 pF	153	J	K	M	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
18000 pF	183	J	K	М	ВВ	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DN	DN	_	DN	EB								
22000 pF	223	J	K	M	ВВ	ВВ	ВВ	ВВ	ВВ	CF	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DN	DN	DN	DN	ЕВ	EB							
27000 pF	273	J	K	M	ВВ	ВВ	ВВ	ВВ		CF	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DN	DP	DE		EB								
33000 pF	333	J	K	М	ВВ	BB	BB	BB		CF	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN			DE		EB								
39000 pF	393	J	K	M	BB	BB	BB BB	BB BB		CF CF	CF	CF	CF	CF	CF		DN	DN	DN DO	DN DO	DN DO	DN DO	_	DE		EB	EB	EB EB	EB EB	EB EB	EB EB	EC	EB	EB ED
47000 pF 56000 pF	473 563	J	K K	M M	BB BB	BB BB	BB	ВВ		CF	CF CF	CF	CF CF	CF	CF		DO DP	DO DP	DP	DP	DP	DP	DE DE	DG DG		EB EB	EB EB	EB	EB	EB	EB	EC EB	ED ED	ED
68000 pF	683	Ĵ	ĸ	М	BB	BB	BB			CF	CF	CF	CF	CF			DP	DP	DP	DP	DP	DP	DE	00		EB	ED	ED						
82000 pF	823	J	K	М	ВВ	ВВ	BB			CF	CF	CF	CF	CF			DP	DP	DP	DP	DP	DP	DE			EB	ED	ED						
0.1 µF	104	J	K	M	ВВ	ВВ	ВВ	BB¹		CF	CF	CF	CF	CF			DN	DN	DN	DN	DN	DN	DE			ЕВ	EB	EB	EB	EB	EB	EB	EM	EM
0.12 µF	124	J	K	M						CF	CF	CF	CF	CF			DN	DN	DN	DN	DP	DP	DG			EC	EG							
0.15 µF	154	J	K	M						CF	CF	CF	CF	CF			DN	DN	DN	DN	DP	DP	DG			EC	EG							
0.18 µF	184 224	J	K	M						CF CF	CF	CF CF	CF CF				DN	DN	DN	DN DN	DG DG	DG	DG DG			EC	EC EC	EC EC	EC EC	EC EC	EC EC	EC EC		
0.22 μF 0.27 μF	274	J	K K	M M						CF	CF CF	CF	CF				DN DP	DN DP	DN DP	DP	DP	DG DP	DG			EC EB	EB	EB	EB	EC	EC	EM		
0.33 µF	334	J	K	M						CF	CF	CF					DG	DG	DG	DG	DP	DP				EB	EB	EB	EB	EC	EC	EG		
0.39 µF	394	Ĵ	K	М	l					CF	CF	CF					DG	DG	DG	DG	DE	DE				EB	EB	EB	EB	EC	EC	EG		
0.47 µF	474	J	K	М						CF	CF		CG ¹				DG	DG	DG	DG	DE	DE				EC	EC	EC	EC	EC	EC	EG		
0.56 µF	564	J	K	М						1							DP	DP	DP	DG	DH	DH				ED	ED	ED	ED	EC	EC	EM		
0.68 µF	684	J	K	M													DP	DP	DP	DG	DH	DH				EE	EE	EE	EE	ED	ED	EM		
0.82 µF	824 105	J	K	M						CC1	CC1	CC1	CD1				DP	DP	DP	DG	DC1	DC1				EF	EF	EF	EF	ED	ED	EH		
1 μ⊦ 1.2 μF	105 125	J	K K	M M						CG.	CG¹	CG.	CD.					DP DE			DG.	DG.								ED EH		СП		
1.5 µF	155	J	K	M														DG												EH				
1.8 µF	185	Ĵ	K	М													DG	DG	DG							ED	ED	ED	EF	EH	EH			
2.2 µF	225	J	K	М						CG ¹	CG ¹							DG								EH	EH	EH1	EH1	EH	EH			
2.7 µF	275	J	K	М													_											EN	EH					
	Com		d Volt (VDC)		6.3	2	16	52	20	6.3	2	9	52	20	ş	200	6.3	5	9	52	32	20	_	200	250	6.3	9	16	52	35	20	100	200	250
Сар	Cap Code	Voltage Code 9 8 4 3 5					5	9 8 4 3 5 1 2					2 9 8 4 3 6 5 1 2 A						Α	A 9 8 4 3 6 5 1 2 A														
		Coop Size/					0402	2C				C	060	3C						C	080	5C							C,	1206	SC.			

^{*}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)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).

xx¹ Available only in K, M tolerance.

xx² Available only in M tolerance.



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

		_	se S erie	ize/ s		C)402	2C				C)60	3C						C	080	5C							C1	120	6C			
Сар	Сар	Volt	tage 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		Rated Voltage (VDC)		6.3	10	16	25	20	6.3	10	16	25	20	100	200	6.3	10	16	25	35	20	100	200	250	6.3	10	16	25	35	20	9	200	250
		Сар	Tolera	ance		F	rod	uct	Av	aila	bilit	y a	nd (hip	Th	ickı	nes	s Co	odes	s – :	See	Tak	ole 2	2 fo	r Ch	ip 1	Γhic	kne	ss	Dim	ens	ion	s	
3.3 µF	335	J	K	М																						ED	ED	ED	EΗ					
3.9 µF	395	J	K	M																						EF	EF	EF	EH					
4.7 μF	475	J	K	M													DG ¹	DG ¹	DG ¹							EH1	EH1	EH1	EH1	EH1	EH1			
5.6 µF	565	J	K	M																						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													DG ¹	DG ¹								EH	EH	EH	EH1					
22 μF	226	J	K	M																						EH1	EH1							
			ed Vol (VDC)		6.3	9	16	22	20	6.3	9	16	52	20	100	200	6.3	9	16	22	35	20	100	200	250	6.3	9	16	52	35	20	100	200	250
Сар	Cap Code	Volt	tage 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	Case Size/ Series			C0402C					C0603C						C0805C								C1206C										

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

	Con	_	se Si Serie				(C12	100	;			C1	808	BC		C1	1812	2C			C18	250			C2	222	0C		(C22	250	;
Cap	Cap	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	A
·	Code		ed Volt (VDC)		6.3	10	16	25	20	100	200	250	20	100	200	25	50	100	200	250	20	100	200	250	25	20	100	200	250	50	100	200	250
		Сар	Tolera	ince		Pr	odu	ct A	۱vai	labi	lity	and	d Ch	ip 1	Γhi	ckne	ss	Cod	les -	- Se	e T	able	2 f	or C	Chip	Th	ickr	ess	s Di	mer	nsio	ns	
10 - 91 pF*	100 - 910*	J	K	М	FB	FB	FB	FB	FB	FB	FB																						
11 pF	110	J	K	M	FB	FB	FB	FB	FB	FB	FB																						
12 pF	120	J	K	M	FB	FB	FB	FB	FB	FB	FB																						
13 pF	130	J	K	M	FB	FB	FB	FB	FB	FB	FB																						
15 pF	150	J	K	M	FB	FB	FB	FB	FB	FB	FB																						
16 pF	160	J	K	M	FB	FB	FB	FB	FB	FB	FB																			<u> </u>			
18 pF	180	J	K	M	FB	FB	FB	FB	FB	FB	FB																			<u> </u>			
20 pF	200	J	K	M	FB	FB	FB	FB	FB	FB	FB					1																	'
22 pF	220	J	K	M	FB	FB	FB	FB	FB	FB	FB					1																	'
24 pF	240	J	K	M	FB	FB	FB	FB	FB	FB	FB																						
27 pF	270	J	K	M	FB	FB	FB	FB	FB	FB	FB					1														l			
30 pF	300	J	K	M	FB	FB	FB	FB	FB	FB	FB					1														l			
33 pF	330	J	K	M	FB	FB	FB	FB	FB	FB	FB					1														l			
36 pF	360	J	K	M	FB	FB	FB	FB	FB	FB	FB					1														l			
39 pF	390	J	K	M	FB	FB	FB	FB	FB	FB	FB																			l			
43 pF	430	J	K	M	FB	FB	FB	FB	FB	FB	FB																						
47 pF	470	J	K	M	FB	FB	FB	FB	FB	FB	FB		l												l								
51 pF	510	J	K	M	FB	FB	FB	FB	FB	FB	FB					1														l			'
56 pF	560	J	K	M	FB	FB	FB	FB	FB	FB	FB																						
			ed Volt (VDC)		6.3	5	16	25	20	100	200	250	20	100	200	25	20	100	200	250	20	9	200	250	25	20	90	200	250	20	100	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	5	1	2	Α	3	5	1	2	Α	5	1	2	Α
	0000	-	se Si Serie:	-			(C12	10C	;			C1	808	зс		C,	1812	2C			C18	250	;		C	2220	С			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)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).

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

xx¹ Available only in K, M tolerance.

xx² Available only in M tolerance.



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

	0-1		se Si Serie				(C12 ²	100	;			C 1	1808	BC		C1	1812	2C		(C18	250			C2	222	0C		(C22	250	;
Сар	Cap Code	Vol	tage C	ode	9	8	4	3	5	1	2	A	5	1	2	3	5	1	2	A	5	1	2	Α	3	5	1	2	Α	5	1	2	Α
	Code	Rat	ed Volt (VDC)	age	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	100	200	250
		Сар	Tolera	nce		Pr	odu	ct A	lvai	labi	lity	and	d Ch	nip 1	Γhic	kne	ss (Cod	les ·	- Se	e T	able	2 f	or C	hip	Th	ickr	ness	s Di	men	sio	ns	
62 pF	620	J	K	М	FB	FB	FB	FB	FB	FB	FB																						
68 pF	680	J	K	M	FB	FB	FB	FB	FB	FB	FB																						
75 pF	750	J	K	M	FB	FB	FB	FB	FB	FB	FB																						
82 pF 91 pF	820 910	J	K	M M	FB FB	FB FB	FB FB	FB FB	FB FB	FB FB	FB FB																						
100 - 270 pF**	101 - 271**	J	K	M	FB	FB	FB	FB	FB	FB	FB																						
110 pF	111	J	K	M	FB	FB	FB	FB	FB	FB	FB																						
120 pF	121	Ĵ	K	М	FB	FB	FB	FB	FB	FB	FB		İ			İ									İ					İ			
130 pF	131	J	K	М	FΒ	FB	FB	FB	FB	FB	FB		İ			İ														İ			
150 pF	151	J	K	M	FB	FB	FB	FB	FB	FB	FB																						
180 pF	181	J	K	М	FB	FB	FB	FB	FB	FB	FB																						
220 pF	221	J	K	M	FB	FB	FB	FB	FB	FB	FB																						
270 pF	271	J	K	M	FB	FB	FB	FB	FB	FB	FB																						
330 pF	331	J	K	M	FB	FB	FB	FB	FB	FB	FB		LF LF	LF LF	LF LF																		
390 pF 470 - 1,200 pF**	391 471 - 122**	J	K	M	FB FB	FB FB	FB FB	FB FB	FB FB	FB FB	FB FB		LF	LF	LF	GB	GB	GB	GB														
560 pF	561	J	K	M	FB	FB	FB	FB	FB	FB	FB		LF	LF	LF	GB	GB	GB	GB														
680 pF	681	Ĵ	K	M	FB	FB	FB	FB	FB	FB	FB		LF	LF	LF	GB	GB	GB	GB											l			
820 pF	821	Ĵ	K	M	FB	FB	FB	FB	FB	FB	FB		LF	LF	LF	GB	GB	GB	GB														
1,000 pF	102	J	K	М	FB	FB	FB	FB	FB	FB	FB		LF	LF	LF	GB	GB	GB	GB						İ					İ			
1,200 pF	122	J	K	M	FB	FB	FB	FB	FB	FB	FB		LF	LF	LF	GB	GB	GB	GB														
1,500 pF	152	J	K	M	FB	FB	FB	FB	FB	FB	FE		LF	LF	LF	GB	GB	GB	GB														
1,800 pF	182	J	K	M	FB	FB	FB	FB	FB	FB	FE		LF	LF	LF	GB	GB	GB	GB														
2,200 pF	222	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LF	LF	LF	GB	GB	GB	GB														
2,700 pF	272	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LF	LF	LF	GB	GB	GB	GB														
3,300 pF	332 392	J	K	M	FB FB	FB FB	FB FB	FB FB	FB FB	FB FB	FB FB	FB FB	LF LF	LF LF		GB GB	GB GB	GB GB	GB GB		НВ	НВ	НВ										
3,900 pF 4,700 pF	472	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	LD	GB	GB	GB	GD		НВ	НВ	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	HB	НВ							KE	KE	KE	
6,800 pF	682	Ĵ	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	М	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	LD	GB	GB	GB	GB		НВ	НВ	НВ		JΕ	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		JE	JE	JE			KE	KE	KE	
15,000 pF	153	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	LD	GB	GB	GB	GB	GB	НВ	НВ			JE	JE	JE			KE	KE	KE	
18,000 pF	183	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	LD	GB	GB	GB	GB	GB	НВ	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	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 LD		GB GB	GB	GB GB	GB		НВ	НВ	НВ	HB	JE JB	JE JB	JE			KE KE	KE		
33,000 pF 39,000 pF	333 393	J	K	M	FB FB	FB FB	FB FB	FB FB	FB FB	FB FB	FB FB	FB FB	LD LD	LD		GB	GB GB	1	GB GB	GB	HB HB	HB HB	HB HB	HB HB	JB	JB	JB JB			VE			
47,000 pF	473	J.	K	M	FB	FB	FB	FB	FB		FC	FC	LD	LD		GB	GB	1	1		НВ	НВ	НВ	НВ		JB	JB						
56,000 pF	563	Ĵ	K	M	FB	FB	FB	FB	FB	FB	FC		LD			GB			GB		НВ		HB	HB	JB	JB	JB						
68,000 pF	683	J	K	M	FB	FB	FB	FB	FB	FB	FC	FC				GB	GB		GB						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		FD		FG				GB			GB						JC	JC	JC	JC	JC	KC			
0.12 μF	124	J	K	M	FB	FB	FB	FB	FB	FD	FH	FH	LD			GB	GB	GB	GB	GB	НВ	НВ	НВ	НВ	JC	JC	JC	JC	JC	KC	KC	KC	KC
		Rat	ed Volt (VDC)		6.3	9	16	25	20	100	200	250	20	9	200	25	20	9	200	250	20	9	200	250	25	20	9	200	250	20	100	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	5	1	2	Α	3	5	1	2	Α	5	1	2	Α
	Joue		se Si Serie:					C12	10C	:			C1	1808	3C		C,	1812	2C			C18	25C	;		C	2220	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)

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xx¹ Available only in K, M tolerance.

xx² Available only in M tolerance.



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

	Con		se S Serie				(C12	100	;			C1	808	ВС		C,	1812	2C			C18	250	;		C2	222	0C		(C22	250	
Cap	Сар	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	Rat	ed Volt (VDC)		6.3	10	16	25	20	100	200	250	20	100	200	25	20	100	200	250	20	100	200	250	25	20	100	200	250	20	100	200	250
		Сар	Tolera	ance				_				and	d Cr	ip 1	Γhic	kne											ickr		Di	mer			
0.15 µF	154	J	K	M	FC	FC		FC	FC	FD	FM	FM	LD			GB	GB				НВ		НВ	НВ	JC	JC	JC	JC	JC	KC		KC	KC
0.18 µF	184	J	K	M	FC	FC	FC	FC	FC	FD	FK	FK	LD			GB	GB	GB	GG		НВ	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	GG	НВ	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				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	GG	НВ	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		ΗВ	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	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			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	FH						GB	GB	GB			ΗВ				JC	JC				KB	KE	KE	KE
1.5 µF	155	J	K	M	FH	FH	FH	FH	FG	FM						GC	GC	GC			HC				JC	JC				KC			
1.8 µF	185	J	K	M	FΗ	FH	FH	FH	FG	FJ						GE	GE	GE			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							GJ	GJ	GJ												1			
3.3 µF	335	J	K	M	FF	FF	FF	FM	FM							GL	GL	GL															
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	K	M	FG	FG	FG	FM					İ			l					İ				İ								
8.2 µF	825	J	K	М	FH	FH	FH	FK																									
10 µF	106	J	K	M	FT¹	FT1	FT ¹	FS ¹	FS ¹				İ			GK					İ				JF	JO				İ			
12 µF	126	J	K	M	Ī								İ			İ					İ				İ					İ			
15 µF	156	J	K	М	FM	FM							ĺ			l					l				JO	JO							
18 µF	186	J	K	М									ĺ			İ					l				ĺ					İ			
22 µF	226	J	K	M	FS	FS	FS ¹	FS ¹																	JO								
47 µF	476	J	K	M	FS ¹																												
	_	Rat	ed Volt (VDC)		6.3	10	16	25	20	100	200	250	20	100	200	25	20	100	200	250	20	100	200	250	25	20	100	200	250	09	100	200	250
Cap	Cap	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	Ca	se Si Serie	ize/			•	C12		;				1808	3C			1812				C18		;		C2	2220			(C22		;

^{*}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)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).

xx¹ Available only in K, M tolerance.

xx² Available only in M tolerance.



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

			5 0	414 4	D I (1)	
Thickness	Case	Thickness ±	Paper Q			Quantity
Code	Size ¹	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
BB	0402	0.50 ± 0.05	10,000	50,000	0	0
CF CG	0603 0603	0.80 ± 0.07* 0.80 ± 0.10*	4,000 4,000	15,000 15,000	0	0
CD	0603	0.80 ± 0.10 0.80 ± 0.15	4,000	10,000	0	0
CJ	0603	$0.80 \pm 0.15^*$	4,000	15,000	Ö	Ö
DM	0805	0.70 ± 0.20*	4,000	15,000	0	0
DN	0805	0.78 ± 0.10*	4,000	15,000	0	0
DO DP	0805 0805	0.80 ± 0.10* 0.90 ± 0.10*	4,000 4,000	15,000 15,000	0 0	0 0
DE	0805	1.00 ± 0.10	0	0	2,500	10,000
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
DH	0805	1.25 ± 0.20	0	0	2,500	10,000
EB EC	1206 1206	0.78 ± 0.10 0.90 ± 0.10	4,000	10,000	4,000 4,000	10,000 10,000
EN EN	1206	0.90 ± 0.10 0.95 ± 0.10	0	0	4,000	10,000
ED	1206	1.00 ± 0.10	0	0	2,500	10,000
EE	1206	1.10 ± 0.10	0	0	2,500	10,000
EF EF	1206	1.20 ± 0.15	0	0	2,500	10,000
EP EM	1206 1206	1.20 ± 0.20 1.25 ± 0.15	0 0	0 0	2,500 2,500	10,000 10,000
EG	1206	1.60 ± 0.15	0	0	2,000	8,000
EH	1206	1.60 ± 0.20	0	0	2,000	8,000
FB	1210	0.78 ± 0.10	0	0	4,000	10,000
FC FD	1210 1210	0.90 ± 0.10	0 0	0	4,000 4,000	10,000 10,000
FE FE	1210	0.95 ± 0.10 1.00 ± 0.10	0	0	2,500	10,000
FF	1210	1.10 ± 0.10	Ö	Ö	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 FM	1210 1210	1.55 ± 0.15 1.70 ± 0.20	0	0	2,000 2,000	8,000 8,000
FJ	1210	1.85 ± 0.20	0	0	2,000	8,000
FT	1210	1.90 ± 0.20	0	0	2,000	8,000
FK	1210	2.10 ± 0.20	0	0	2,000	8,000
FS	1210	2.50 ± 0.30	0	0	1,000	4,000
NA NC	1706 1706	0.90 ± 0.10 1.00 ± 0.15	0 0	0 0	4,000 4,000	10,000 10,000
LD	1808	0.90 ± 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 GD	1812 1812	1.10 ± 0.10 1.25 ± 0.15	0	0	1,000 1,000	4,000 4,000
GE GE	1812	1.25 ± 0.15 1.30 ± 0.10	0	0	1,000	4,000
GH	1812	1.40 ± 0.15	Ö	0	1,000	4,000
GG	1812	1.55 ± 0.10	0	0	1,000	4,000
GK	1812	1.60 ± 0.20	0	0	1,000	4,000
GJ GL	1812 1812	1.70 ± 0.15 1.90 ± 0.20	0 0	0	1,000 500	4,000 2,000
GO	1812	2.50 ± 0.20	0	0	500	2,000
HB	1825	1.10 ± 0.15	0	0	1,000	4,000
HC	1825	1.15 ± 0.15	0	0	1,000	4,000
Thickness	Case	Thickness ±	7" Reel	13" Reel	7" Reel	13" Reel
Code	Size ¹	Range (mm)	Paper Q	uantity¹	Plastic (Quantity

Package quantity based on finished chip thickness specifications.

¹ If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Table 2A - Chip Thickness/Tape & Reel Packaging Quantities cont'd

Thickness	Case	Thickness ±	Paper Q	luantity ¹	Plastic (Quantity
Code	Size ¹	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
HD	1825	1.30 ± 0.15	0	0	1,000	4,000
HE	1825	1.40 ± 0.15	0	0	1,000	4,000
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
J F	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 ¹	Range (mm)	Paper Q	luantity¹	Plastic (Quantity

Package quantity based on finished chip thickness specifications.

Table 2B - Bulk Packaging Quantities

		Loose P	ackaging
Packag	ing Type	Bulk Bag	g (default)
Packagir	ng C-Spec ¹	N.	/A ²
Cas	e Size	Packaging Quantities	(pieces/unit packaging)
EIA (in)	Metric (mm)	Minimum	Maximum
0402	1005		
0603	1608		
0805	2012		50,000
1206	3216		
1210	3225	1	
1808	4520		
1812	4532		
1825	4564		20,000
2220	5650		
2225	5664		

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

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

¹ If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



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

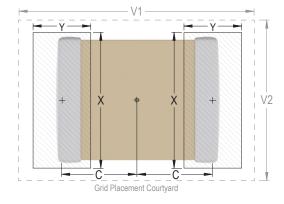
EIA Size Code	Metric Size Code	ı	Maxi	sity Lev mum (M rotrusio	Most))	ı	Media	sity Lev an (Nor rotrusio)	ı	Mini	sity Lev mum (L rotrusio)
		С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	Х	V1	V2
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	0.40	0.52	0.52	1.60	0.80
0603	1608	0.90	1.15	1.10	4.00	2.10	0.80	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

¹ 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

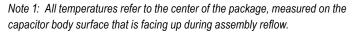
Recommended Soldering Technique:

- 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 _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum



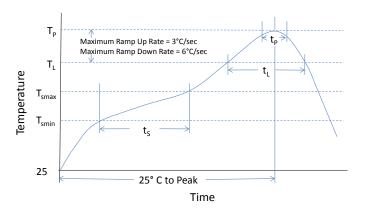




Table 4 – Performance & Reliability: Test Methods and Conditions

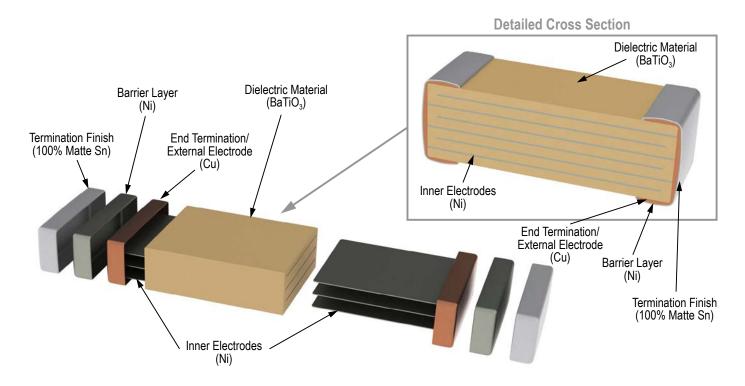
Stress	Reference		Test or Inspection M	ethod
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8	kg for 60 seconds.	
Board Flex	JIS-C-6429	Appendix 2, Note: Standard ter Flexible termination system – 3		inimum) for all except 3 mm for C0G.
		Magnification 50 X. Conditions		
0 11 137	L OTD OOG	a) Method B, 4 hours at 7	55°C, dry heat at 235°C	
Solderability	J-STD-002	b) Method B at 215°C ca	tegory 3	
		c) Method D, category 3	at 260°C	
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C	c). Measurement at 24 hours -	+/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Load Humidity: 1,000 hours 85 Measurement at 24 hours +/- 4 Low Volt Humidity: 1,000 hours Measurement at 24 hours +/- 4	hours after test conclusion. 85°C/85% RH and 1.5 V. Ad	
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a an Measurement at 24 hours +/- 4	d 7b not required. hours after test conclusion.	
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of Dwell time – 15 minutes. Air – A		imum transfer time – 20 seconds.
		1,000 hours at 125°C with 2 X	ated voltage applied excludin	g 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		ecure points at corners of op	Jse 8" X 5" PCB 0.031" thick 7 secure posite sides. Parts mounted within 2"
Mechanical Shock	MIL-STD-202 Method 213	Figure 1 of Method 213, Condit	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)



X5R Dielectric, 4 – 50 VDC (Commercial Grade)



Overview

KEMET's X5R dielectric features an 85°C maximum operating temperature and is considered "semi-stable." The Electronics Components, Assemblies & Materials Association (EIA) characterizes X5R dielectric as a Class II material. Components of this classification are fixed, ceramic dielectric capacitors suited for bypass and decoupling applications

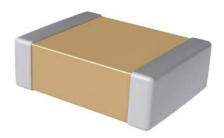
or for frequency discriminating circuits where Q and stability of capacitance characteristics are not critical. X5R exhibits a predictable change in capacitance with respect to time and voltage and boasts a minimal change in capacitance with reference to ambient temperature. Capacitance change is limited to $\pm 15\%$ from -55°C to +85°C.

Benefits

- -55°C to +85°C operating temperature range
- · Lead (Pb)-Free, RoHS and REACH compliant
- Temperature stable dielectric
- EIA 0201, 0402, 0603, 0805, 1206, 1210, and 1812 case sizes
- DC voltage ratings of 4 V, 6.3 V, 10 V, 16 V, 25 V, 35 V, and 50 V
- Capacitance offerings ranging from 0.01 μF to 100 μF
- Available capacitance tolerances of ±10% and ±20%
- Non-polar device, minimizing installation concerns
- 100% pure matte tin-plated termination finish allowing for excellent solderability

Applications

Typical applications include decoupling, bypass, and filtering.



Ordering Information

С	1206	С	107	M	9	Р	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec)
	0201 0402 0603 0805 1206 1210	C = Standard	Two significant digits + number of zeros.	K = ±10% M = ±20%	7 = 4 9 = 6.3 8 = 10 4 = 16 3 = 25 6 = 35 5 = 50	P = X5R	A = N/A	C = 100% Matte Sn	See "Packaging C-Spec Ordering Options Table" below

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

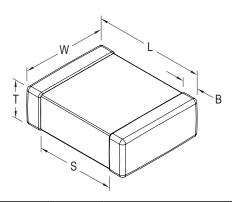


Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec)
Bulk Bag/Unmarked	Not required (Blank)
7" Reel/Unmarked	TU
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
7" Reel/Marked	TM
13" Reel/Marked	7040 (EIA 0603 and smaller case sizes) 7215 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2mm pitch ²	7081
13" Reel/Unmarked/2mm pitch ²	7082

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Dimensions - Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0201	0603	0.60 (0.024) ±0.03 (0.001)	0.30 (0.012) ±0.03 (0.001)		0.15 (0.006) ±0.05 (0.002)	N/A	Solder Reflow
0402¹	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)	Only
0603	1608	1.60 (0.063) ±0.15 (0.006)	0.80 (0.032) ±0.15 (0.006)	See Table 2 for	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)	Thickness	0.50 (0.02) ±0.25 (0.010)	0.75 (0.030)	Solder Wave or Solder Reflow
1206²	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)		
1210³	3225	3.20 (0.126) ±0.20 (0.008)	2.50 (0.098) ±0.20 (0.008)		0.50 (0.02) ±0.25 (0.010)	N/A	Solder Reflow Only

¹ For capacitance values ≥ 4.7 μF add 0.15 (0.006) to the width and length tolerance dimensions.

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. Please contact KEMET if you require a laser marked option. For more information see "Capacitor Marking".

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".

 $^{^2}$ For capacitance values \geq 22 μF add 0.10 (0.004) to the positive bandwidth tolerance dimension.

³ For capacitance values ≥ 22 µF add 0.10 (0.004) to the length and width tolerance dimension and add 0.15 (0.006) to the positive bandwidth 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.

Electrical Parameters/Characteristics

Item	Parameters/Characteristics	
Operating Temperature Range	−55°C to +85°C	
Capacitance Change with Reference to +25°C and 0 Vdc Applied (TCC)	±15%	
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	5.0%	
² Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ± 1 seconds and charge/discharge not exceeding 50mA)	
³ Dissipation Factor (DF) Maximum Limit @ 25°C	See Dissipation Factor Limit Table	
⁴Insulation Resistance (IR) Minimum Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ± 5 secs @ 25°C)	

¹Regarding 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.

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."

Post Environmental Limits

High Temperature Life, Biased Humidity, Moisture Resistance						
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance	
X5R	> 25	All	3.0	±20%	10% of Initial Limit	
	25	< 2.2 µF	7.5			
		≥ 2.2 µF	20.0			
	< 25	< 0.56 µF	7.5			
	< 25	≥ 0.56 µF	20.0			

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

¹ kHz ± 50 Hz and 1.0 ± 0.2 Vrms if capacitance $\leq 10 \,\mu\text{F}$

¹²⁰ Hz \pm 10 Hz and 0.5 \pm 0.1 Vrms if capacitance > 10 μ F

 $^{^4}$ To obtain IR limit, divide MΩ- μ F value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



Dissipation Factor Limit Table

Rated DC Voltage	Capacitance	Dissipation Factor (Maximum %)				
> 25	All	2.5				
25	< 2.2 µF	5.0				
25	≥ 2.2 µF	10.0				
< 25	< 0.56 µF	5.0				
< 25	≥ 0.56 µF	10.0				

Insulation Resistance Limit Table

EIA Case Size	1,000 Megohm Microfarads or 100 GΩ	500 Megohm Microfarads or 10 GΩ	100 Megohm Microfarads
0201	N/A	ALL	N/A
0402	< .012 µF	≥ .012 µF < 1.0 µF	≥ 1.0 µF
0603	< .047 µF	≥ .047 µf < 1.0 µF	≥ 1.0 µF
0805	< 0.15 µF	≥ 0.15 µF < 1.0 µF	≥ 1.0 µF
1206	< 0.47 µF	≥ 0.47 µF < 1.0 µF	≥ 1.0 µF
1210	< 0.39 µF	≥ 0.39 µF < 1.0 µF	≥ 1.0 µF
1812	< 2.2 µF	≥ 2.2 µF	N/A



Table 1 – Capacitance Range/Selection Waterfall (0201 – 0805 Case Sizes)

			Size/		C02	01C				C04	02C					C06	03C					C08	05C		
Capacitance	Capacitance	Voltag	e Code	7	9	8	4	7	9	8	4	3	5	7	9	8	4	3	5	7	9	8	4	3	5
	Code	Rated Volt	tage (VDC)	4	6.3	9	9	4	6.3	우	9	52	20	4	6.3	9	9	52	20	4	6.3	9	9	52	20
		Capac Toler	itance rance		P	rodu	t Ava	ailabi	lity a	nd C	nip Th	nickn	ess (Code	s – S	ee Ta	ble 2	for C	hip T	hick	ness	Dime	nsio	ıs	
10,000 pF	103	K	М	AB	AB	AB	AB	BB	BB	BB	BB														
12,000 pF	123	K	М					BB	BB	BB	BB														
15,000 pF	153	K	М					BB	BB	BB	BB														
18,000 pF	183	K	М					BB	BB	BB	BB														
22,000 pF	223	K	М					BB	BB	BB	BB														
27,000 pF	273	K	М					BB	BB	BB	BB														
33,000 pF	333	K	М					BB	BB	BB	BB														
39,000 pF	393	K	M					BB	BB	BB	BB														
47,000 pF	473	K	М	l				BB	BB	BB	BB														
56,000 pF	563	K	М	l				ВВ	BB	BB	ВВ									l					
68,000 pF	683	K	М					ВВ	BB	BB	BB														
82,000 pF	823	K	М					ВВ	BB	BB	BB														
0.10 µF	104	K	М	AB	AB			ВВ	BB	ВВ	ВВ			CG	CG	CG	CG	CG							
0.12 µF	124	K	М																						
0.15 µF	154	K	М																						
0.18 µF	184	K	М																						
0.22 µF	224	K	М	i				ВВ	BB					CG	CG	CG	CG								
0.27 µF	274	K	М	İ										CG	CG	CG	CG								
0.33 µF	334	K	M	i				i						CG	CG	CG	CG								
0.39 µF	394	K	М	i				i						CG	CG	CG	CG								
0.47 µF	474	K	M					ВВ	BB					CG	CG	CG	CG	CG		DG	DG	DG	DG	DG	
0.56 µF	564	K	M											CG	CG	CG	CG	- 00		DP	DP	DP	DP	DP	
0.68 µF	684	K	M											CG	CG	CG	CG			DP	DP	DP	DP	DE	
0.82 µF	824	K	M											CG	CG	CG	CG			DF	DF	DF	DF	DF	
1.0 µF	105	K	M					ВВ	BB	ВВ	ВВ			CG	CG	CG	CG	CJ		DP	DP	DP	DP	DG	DG
1.2 µF	125	K	M														00	- 00		DN	DN	DN	DN	50	50
1.5 µF	155	K	M	l				i						l						DN	DN	DN	DN		
1.8 µF	185	K	M	l				i												DP	DP	DP	DP		
2.2 µF	225	K	M					ВВ	ВВ	BB¹				CG	CG	CG	CG			DG	DG	DG	DG	DG	
2.7 µF	275	K	M					טט	טט	00				00	00	00	00			DL	DL	DL	DL	ЪО	
3.3 µF	335	K	M					BB¹						CG	CG					DL	DL	DL	DG		
3.9 µF	395	K	M					DD.							00					DG	DG	DG	DG		
3.9 μF 4.7 μF	475	K	M					BE¹	BE¹					CG	CG	CG				DG	DG	DG	DG	DG	
4.7 μF 5.6 μF	565	K	M					DL	DL						00	UG				DG	DG	DG	DG	DG	
6.8 µF	685	K	M																	DG	DG	DG			
8.2 µF	825	K	M																	100	DG	DG			
ο.2 μF 10 μF	106	K	M	l				BF¹	BF¹					CG ¹	CG ¹	CG ¹				DG	DG	DG	DG	DH	
10 µF 12 µF	126	K	M	l				DL.	DL.					المحاد	00	UG				المرا	טט	טט	טט	υп	
· ·	156	K	M																						
15 µF	186	K	M																						
18 µF																				DC	DG	DH1			
22 µ⊦ 47 µF	226 476	K	M					ł													DH ¹	טחי			
41 μΓ	4/0	K M Rated Voltage (VDC)		4	6.3	9	9	4	6.3	9	16	25	20	4	6.3	9	-91	25	20	4 DU.	6.3	9	91	25	20
	Capacitance			7	9	8	4	7	9	-	3	5	4	7	9	8		3	5	7	9	8	4	3	ىن 5
Capacitance	Code		e Code	_			4	1	9	8		J	4	<u> </u>	y		4	3	J		y			3	<u> </u>
		Case Size/Series			C02	01C				C04	02C					C06	03C					C08	05C		

xx1 Available only in M tolerance.



Table 1 – Capacitance Range/Selection Waterfall (1206 – 1812 Case Sizes)

		Case Ser			C	C12060	C				C12	10C			(C18120	
Capacitance	Capacitance	Voltage	e Code	9	8	4	3	5	9	8	4	3	6	5	3	6	5
Oupdonance	Code	Rated Volt	,	6.3	9	91	25	20	6.3	6	91	52	35	20	25	. 35	20
		Cap To						Chip T	hicknes	s Code	s – See	Table 2	for Chip	Thickn	ess Dim	ensions	3
0.27 μF	274	K	М	EB	EB	EB	EB										
0.33 µF	334	K	M	EB	EB	EB	EB										
0.39 μF	394	K	M	EB	EB	EB	EB		FD	FD	FD	FD	FD				
0.47 μF	474	K	М	EC	EC	EC	EC		FD	FD	FD	FD	FD				
0.56 µF	564	K	М	ED	ED	ED	ED		FD	FD	FD	FD	FD				
0.68 μF	684	K	M	EE	EE	EE	EE		FD	FD	FD	FD	FD				
0.82 μF	824	K	M	EF	EF	EF	EF		FF	FF	FF	FF	FF				
1.0 µF	105	K	M	EP	EP	EP	EP		FH	FH	FH	FH	FH	FH			
1.2 µF	125	K	M	EC	EC	EC	EC		FD	FD	FD	FD					
1.5 µF	155	K	M	EC	EC	EC	EC		FD	FD	FD	FD					
1.8 µF	185	K	M	EC	EC	EC	EC		FD	FD	FD	FD					
2.2 µF	225	K	M	EC	EC	EC	EC		FJ	FJ	FJ	FJ					
2.7 µF	275	K	М	EF	EF	EF	EF		FG	FG	FG	FG					
3.3 µF	335	К	М	EH	EH	EH	EH		FH	FH	FH	FH					
3.9 µF	395	К	М	ED	ED	ED	ED		FJ	FJ	FJ	FJ					
4.7 µF	475	K	М	EH	EH	EH	EH	EH	FT	FT	FT	FT					
5.6 µF	565	К	М	EK	EK	EH			FG	FG	FG	FE					
6.8 µF	685	К	М	EK	EK	EH			FJ	FJ	FJ	FJ					
8.2 µF	825	K	М	ED	ED	EH			FK	FK	FK	FG					
10 µF	106	K	M	EH	EH	EH	EH		FT	FT	FT	FT	FT	FS	GK		
12 µF	126	K	M						FD	FD	FG				J.,		
15 µF	156	K	M						FF	FF	FG						
18 µF	186	K	M						FG	FG	FH						
22 µF	226	K	M	EH	EH1	EH1			FS	FS	FS	FS					
47 µF	476	K	M	EH1	EH1				FS ¹	FS¹	FS¹						
100 µF	107	K	M	EH1					FS ¹	FS¹	FS ¹						
	-																
		Rated Voltage (VDC)		6.3	9	91	25	20	6.3	9	9	25	35	20	25	35	20
Capacitance	Capacitance Code Voltage Code		e Code	9	8	4	3	5	9	8	4	3	6	5	3	6	5
		Case Siz	e/Series	C1206C				C1210C						C1812C			

xx¹ Available only in M tolerance.



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

Thickness	Case	Thickness ±	Paper Q	uantity ¹	Plastic (Quantity
Code	Size ¹	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
AB	0201	0.30 ± 0.03	15,000	0	0	0
BB	0402	0.50 ± 0.05	10,000	50,000	0	0
BE	0402	0.50 ± 0.15	10,000	50,000	0	0
BF	0402	0.50 ± 0.20	10,000	50,000	0	0
CG	0603	0.80 ± 0.10 *	4,000	15,000	0	0
CJ	0603	0.80 ± 0.15*	4,000	15,000	0	0
DN	0805	0.78 ± 0.10*	4,000	15,000	0	0
DP	0805	0.90 ± 0.10*	4,000	15,000	0	0
DL	0805	0.95 ± 0.10	0	0	4,000	10,000
DE	0805	1.00 ± 0.10	0	0	2,500	10,000
DF	0805	1.10 ± 0.10	0	0	2,500	10,000
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
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
EK	1206	0.80 ± 0.10	0	0	2,000	8,000
EC	1206	0.90 ± 0.10	0	0	4,000	10,000
ED	1206	1.00 ± 0.10	0	0	2,500	10,000
EE	1206	1.10 ± 0.10	0	0	2,500	10,000
EF	1206	1.20 ± 0.15	0	0	2,500	10,000
EP	1206	1.20 ± 0.20	0	0	2,500	10,000
EH	1206	1.60 ± 0.20	0	0	2,000	8,000
FD	1210	0.95 ± 0.10	0	0	4,000	10,000
FE	1210	1.00 ± 0.10	0	0	2,500	10,000
FF	1210	1.10 ± 0.10	0	0	2,500	10,000
FG	1210	1.25 ± 0.15	0	0	2,500	10,000
FH	1210	1.55 ± 0.15	0	0	2,000	8,000
FJ	1210	1.85 ± 0.20	0	0	2,000	8,000
FT	1210	1.90 ± 0.20	0	0	2,000	8,000
FK	1210	2.10 ± 0.20	0	0	2,000	8,000
FS	1210	2.50 ± 0.30	0	0	1,000	4,000
GK	1812	1.60 ± 0.20	0	0	1,000	4,000
Thickness	Case	Thickness ±	7" Reel	13" Reel	7" Reel	13" Reel
Code	Size ¹	Range (mm)	Paper Q	uantity ¹	Plastic (Quantity

Package quantity based on finished chip thickness specifications.

¹ If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Table 2B - Bulk Packaging Quantities

Doolee	ulu u Tuu o	Loose Pa	ackaging					
Раска	ging Type	Bulk Bag	(default)					
Packagi	ng C-Spec ¹	N/A²						
Cas	e Size	Packaging Quantities ((pieces/unit packaging)					
EIA (in)	Metric (mm)	Minimum	Maximum					
0402	1005							
0603	1608							
0805	2012		50,000					
1206	3216							
1210	3225	1						
1808	4520							
1812	4532							
1825	4564		20,000					
2220	5650							
2225	5664							

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

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



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

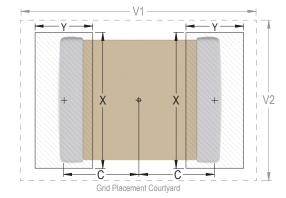
EIA Size Code	Metric Size Code	Density Level A: Maximum (Most) Land Protrusion (mm)				I	Media	sity Lev an (Nor rotrusio			Density Level C: Minimum (Least) Land Protrusion (mm)					
Code	Code	C	Y	Х	V1	V2	С	Y	X	V1	V2	С	Υ	Х	V1	V2
0201	0603	0.38	0.56	0.52	1.80	1.00	0.33	0.46	0.42	1.50	0.80	0.28	0.36	0.32	1.20	0.60
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	0.40	0.52	0.52	1.60	0.80
0603	1608	0.90	1.15	1.10	4.00	2.10	0.80	0.95	1.00	3.10	1.50	0.60	0.75	0.90	2.40	1.20
0805	2012	1.00	1.35	1.55	4.40	2.60	0.90	1.15	1.45	3.50	2.00	0.75	0.95	1.35	2.80	1.70
1206	3216	1.60	1.35	1.90	5.60	2.90	1.50	1.15	1.80	4.70	2.30	1.40	0.95	1.70	4.00	2.00
1210	3225	1.60	1.35	2.80	5.65	3.80	1.50	1.15	2.70	4.70	3.20	1.40	0.95	2.60	4.00	2.90
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

¹ 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

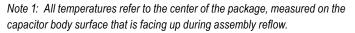
Recommended Soldering Technique:

- 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
Frome reature	SnPb	100% Matte Sn
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum



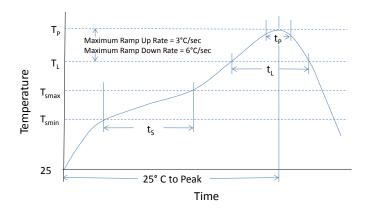




Table 4 – Performance & Reliability: Test Methods and Conditions

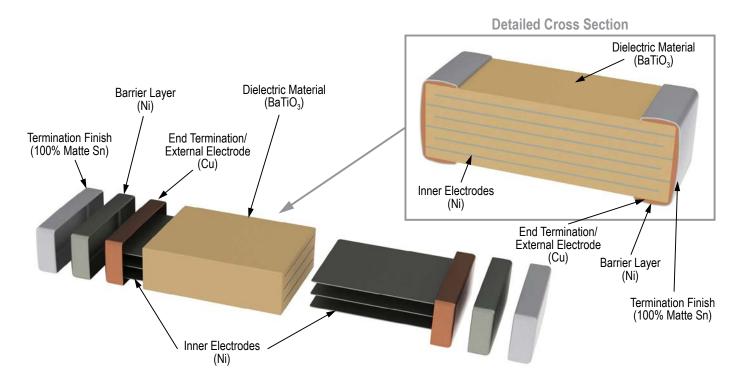
Stress	Reference	Test or Inspection Method								
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8	kg for 60 seconds.							
Board Flex	JIS-C-6429	Appendix 2, Note: Standard ter Flexible termination system – 3	mination system – 2.0 mm (n .0 mm (minimum).	ninimum) for all except 3 mm for C0G.						
		Magnification 50 X. Conditions	:							
Caldarah iliku	L CTD 000	a) Method B, 4 hours at 7	l55°C, dry heat at 235°C							
Solderability	J-STD-002	b) Method B at 215°C category 3								
		c) Method D, category 3	at 260°C							
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.								
Biased Humidity	MIL-STD-202 Method 103	Measurement at 24 hours +/- 4 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 +/- 4 hours after test conclusion. Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.							
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.								
Thermal Shock	MIL-STD-202 Method 107			ximum transfer time – 20 seconds. Dwell						
		1,000 hours at 85°C with 2 X rated voltage applied excluding the following:								
		Case Size	Capacitance	Applied Voltage						
		0402	≥ 0.22 µF							
High Temperature Life	MIL-STD-202 Method 108 /FIA-198	0603	≥ 1.0 µF							
	/EIA-190	0805	≥ 4.7 µF	1.5 X						
		1206	≥ 2.2 µF							
		1210	≥ 10 µF							
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, Condit	ion F.							
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.								

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature- reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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)



Z5U Dielectric, 50 – 100 VDC (Commercial Grade)



Overview

KEMET's Z5U dielectric features an 85°C maximum operating temperature and is considered "general-purpose." The Electronics Components, Assemblies & Materials Association (EIA) characterizes Z5U dielectric as a Class III material. Components of this classification are fixed, ceramic dielectric capacitors suited for bypass and decoupling or other applications in which dielectric losses, high insulation resistance and capacitance stability are not of major importance. Z5U exhibits a predictable change in capacitance with respect to time and voltage and displays wide variations in capacitance with reference to ambient temperature. Capacitance change is limited to +22%, -56% from +10°C to +85°C.

Benefits

- +10°C to +85°C operating temperature range
- · Lead (Pb)-Free, RoHS and REACH compliant
- EIA 0805, 1206, 1210, 1812, 1825, and 2225 case sizes
- · DC voltage ratings of 50 and 100 V
- Capacitance offerings ranging from 6,800 pF to 2.2 μF
- Available capacitance tolerances of ±20% and +80%/-20%
- Non-polar device, minimizing installation concerns
- 100% pure matte tin-plated termination finish allowing for excellent solderability

Applications

Typical applications include limited temperature, decoupling and bypass.



Ordering Information

С	1825	С	225	M	5	U	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec)
	0805 1206 1210 1812 1825 2225	C = Standard	Two significant digits + number of zeros	M = ±20% Z = +80%/-20	5 = 50 1 = 100	U = Z5U	A = N/A	C = 100% Matte Sn	See "Packaging C-Spec Ordering Options Table" below

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

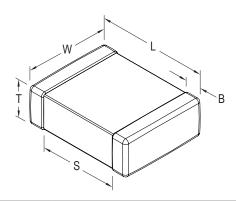


Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec)
Bulk Bag/Unmarked	Not required (Blank)
7" Reel/Unmarked	TU
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
7" Reel/Marked	TM
13" Reel/Marked	7040 (EIA 0603 and smaller case sizes) 7215 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2mm pitch ²	7081
13" Reel/Unmarked/2mm pitch ²	7082

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Dimensions – Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0805	2012	2.00 (.079) ± 0.20 (.008)	1.25 (.049) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	Solder Wave or
1206	3216	3.20 (.126) ± 0.20 (.008)	1.60 (.063) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)		Solder Reflow
1210	3225	3.20 (.126) ± 0.20 (.008)	2.50 (.098) ± 0.20 (.008)	See Table 2 for	0.50 (0.02) ± 0.25 (.010)		
1812	4532	4.50 (.177) ± 0.30 (.012)	3.20 (.126) ± 0.30 (.012)	Thickness	0.60 (.024) ± 0.35 (.014)	N/A	Caldan Daffass Only
1825	4564	4.50 (.177) ± 0.30 (.012)	6.40 (.252) ± 0.40 (.016)		0.60 (.024) ± 0.35 (.014)		Solder Reflow Only
2225	5664	5.60 (.220) ± 0.40 (.016)	6.40 (.248) ± 0.40 (.016)		0.60 (.024) ± 0.35 (.014)		

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. Please contact KEMET if you require a laser marked option. For more information see "Capacitor Marking".

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



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.

Electrical Parameters/Characteristics

ltem	Parameters/Characteristics				
Operating Temperature Range	-10°C to +85°C				
Capacitance Change with Reference to +25°C and 0 Vdc Applied (TCC)	+22%, -56%				
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	7.0%				
² Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ± 1 seconds and charge/discharge not exceeding 50mA)				
³ Dissipation Factor (DF) Maximum Limit @ 25°C	4.0%				
⁴Insulation Resistance (IR) Minimum Limit @ 25°C	100 megohm microfarads or $10G\Omega$ (Rated voltage applied for 120 ± 5 secs @ 25° C)				

¹Regarding 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.

 $1kHz \pm 50Hz$ and 1.0 ± 0.2 Vrms if capacitance ≤ $10\mu F$

120Hz \pm 10Hz and 0.5 \pm 0.1 Vrms if capacitance >10 μF

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

Post Environmental Limits

	High Temperature Life, Biased Humidity, Moisture Resistance								
Dielectric Rated DC Capacitance Dissipation Factor Capacitance Insulation Voltage Value (Maximum %) Shift Resistance									
Z5U	> 25	All	5.0		10% of Initial Limit				
250	25	All	7.5	±30%	10% of Initial Limit				

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

 $^{^4}$ To obtain IR limit, divide MΩ- μ F value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



Table 1 – Capacitance Range/Selection Waterfall (0805 – 2225 Case Sizes)

	Capacitance		Size/ ries	C08	05C	C12	.06C	C12	10C	C18	12C	C18	25C	C22	25C
Capacitance	Code	Voltag	Voltage Code Rated Voltage (VDC)		1	5	1	5	1	5	1	5	1	5	1
	Code	Rated Vol			100	50	100	50	100	50	100	50	100	50	100
		Capacitano	e Tolerance				roduct / See Tal								
6,800 pF	682	М	Z	DN	DN										
8,200 pF	822	M	Z	DN	DN										
10,000 pF	103	M	Z	DN	DN	EB	EB								
12,000 pF	123	M	Z	DN		EB	EB								
15,000 pF	153	M	Z	DN		EB	EB								
18,000 pF	183	М	Z	DN		EB	EB								
22,000 pF	223	М	Z	DN		EB	EB								
27,000 pF	273	М	Z	DN		EB	EB								
33,000 pF	333	M	Z	DN		EB	EB								
39,000 pF	393	М	Z	DN		EB	EC								
47,000 pF	473	M	Z	DN		EB	EC	FB	FB						
56,000 pF	563	M	Z	DP		EB	EB	FB	FB						
68,000 pF	683	M	Z	DP		EB	EB	FB	FB						
82,000 pF	823	М	Z	DP		EB	EB	FB	FC	GB	GB				
0.10 µF	104	М	Z	DN		EB	EB	FB	FD	GB	GB				
0.12 µF	124	М	Z			EC		FB	FD	GB	GB	l			
0.15 µF	154	М	Z			EC		FC	FD	GB	GB	İ		İ	
0.18 µF	184	М	Z			EC		FC		GB		НВ	НВ	İ	
0.22 µF	224	М	Z			EC		FC		GB		НВ	НВ	İ	
0.27 µF	274	М	Z			İ		FC		GB		НВ	НВ	İ	
0.33 µF	334	М	Z					FD		GB		НВ	НВ	KB	KC
0.39 µF	394	М	Z					FD		GB		НВ	НВ	КВ	KC
0.47 µF	474	М	Z					FD		GB		НВ		КВ	KC
0.56 µF	564	М	Z					FD		GC		НВ		КВ	
0.68 µF	684	М	Z					FD		GC		НВ		КВ	
0.82 µF	824	М	Z					FF		GE		НВ		КВ	
1.0 µF	105	М	Z			İ		FH		GE		НВ		КВ	
1.2 µF	125	М	Z			İ		İ		İ		НВ		КВ	
1.5 µF	155	М	Z			İ		İ		İ		нс		КC	
1.8 µF	185	М	Z			İ		İ		İ		HD		KD	
2.2 µF	225	М	Z									HF		KD	
		Rated Vol	tage (VDC)	50	100	50	100	50	100	50	100	50	100	50	100
Capacitance	Capacitance Code	Voltag	e Code	5	1	5	1	5	1	5	1	5	1	5	1
		Case Siz	e/Series	C08	05C	C12	06C	C12	10C	C18	12C	C18	25C	C22	25C



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

Thickness	Case	Thickness ±	Paper G	Quantity	Plastic (Quantity
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
DN	0805	0.78 ± 0.10	4,000	15,000	0	0
DP	0805	0.90 ± 0.10	4,000	15,000	0	0
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
FB	1210	0.78 ± 0.10	0	0	4,000	10,000
FC	1210	0.90 ± 0.10	0	0	4,000	10,000
FD	1210	0.95 ± 0.10	0	0	4,000	10,000
FF	1210	1.10 ± 0.10	0	0	2,500	10,000
FH	1210	1.55 ± 0.15	0	0	2,000	8,000
GB	1812	1.00 ± 0.10	0	0	1,000	4,000
GC	1812	1.10 ± 0.10	0	0	1,000	4,000
GE	1812	1.30 ± 0.10	0	0	1,000	4,000
HB	1825	1.10 ± 0.15	0	0	1,000	4,000
HC	1825	1.15 ± 0.15	0	0	1,000	4,000
HD	1825	1.30 ± 0.15	0	0	1,000	4,000
HF	1825	1.50 ± 0.15	0	0	1,000	4,000
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
Thickness	Case	Thickness ±	7" Reel	13" Reel	7" Reel	13" Reel
Code	Size	Range (mm)	Paper G	Quantity	Plastic (Quantity

Package quantity based on finished chip thickness specifications.

Table 2B - Bulk Packaging Quantities

Dookso	ing Type	Loose P	Loose Packaging				
Packag	jing Type	Bulk Bag	g (default)				
Packagii	ng C-Spec ¹	N.	/A ²				
Cas	e Size	Packaging Quantities	(pieces/unit packaging)				
EIA (in)	Metric (mm)	Minimum	Maximum				
0402	1005						
0603	1608						
0805	2012		50,000				
1206	3216						
1210	3225	1					
1808	4520						
1812	4532						
1825	4564		20,000				
2220	5650						
2225	5664						

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

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



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

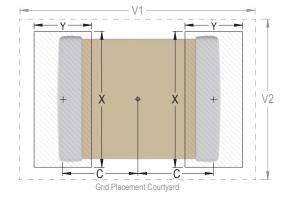
EIA Size Code	Metric Size Code	Density Level A: Maximum (Most) Land Protrusion (mm)				ı	Density Level B: Median (Nominal) Land Protrusion (mm)				Density Level C: Minimum (Least) Land Protrusion (mm)					
Code	Code	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	Х	V1	V2
0805	2012	1.00	1.35	1.55	4.40	2.60	0.90	1.15	1.45	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
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
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

¹ Only for capacitance values ≥ 22 μ 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

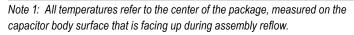
Recommended Soldering Technique:

- 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	
Frome reature	SnPb	100% Matte Sn	
Preheat/Soak			
Temperature Minimum (T _{Smin})	100°C	150°C	
Temperature Maximum (T _{Smax})	150°C	200°C	
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds	
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum	
Liquidous Temperature (T _L)	183°C	217°C	
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds	
Peak Temperature (T _P)	235°C	260°C	
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum	
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum	
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum	



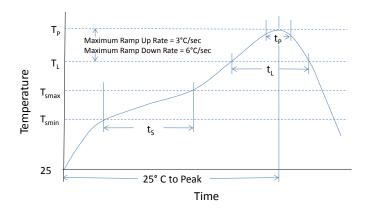




Table 4 – Performance & Reliability: Test Methods and Conditions

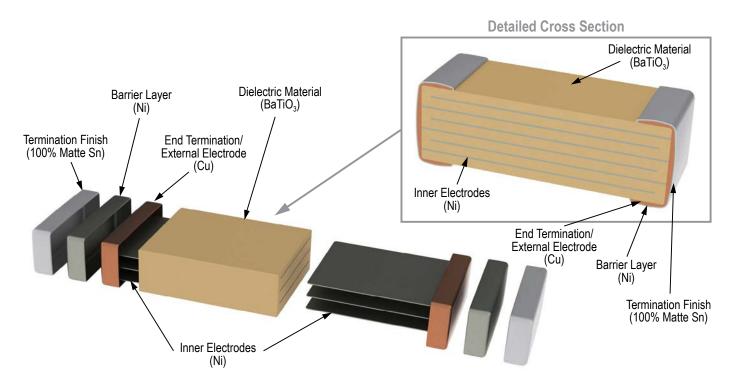
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Solderability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	J-51D-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Diagod Humidika	MII. CTD 202 Matha d 402	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
Vibration	MIL-STD-202 Method 204	5 g's for 20 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature- reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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)



Y5V Dielectric, 6.3 – 50 VDC (Commercial Grade)



Overview

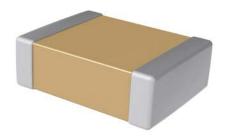
KEMET's Y5V dielectric features an 85°C maximum operating temperature and is considered "general-purpose." The Electronics Components, Assemblies & Materials Association (EIA) characterizes Y5V dielectric as a Class III material. Components of this classification are fixed, ceramic dielectric capacitors suited for bypass and decoupling or other applications in which dielectric losses, high insulation resistance and capacitance stability are not of major importance. Y5V exhibits a predictable change in capacitance with respect to time and voltage and displays wide variations in capacitance with reference to ambient temperature. Capacitance change is limited to +22%, -82% from -30°C to +85°C.

Benefits

- −30°C to +85°C operating temperature range
- · Lead (Pb)-Free, RoHS and REACH compliant
- EIA 0402, 0603, 0805, 1206, and 1210 case sizes
- DC voltage ratings of 6.3 V, 10 V, 16 V, 25 V, and 50 V
- Capacitance offerings ranging from 0.022 μF to 22 μF
- Available capacitance tolerance of +80%/-20%
- · Non-polar device, minimizing installation concerns
- 100% pure matte tin-plated termination finish that allowing for excellent solderability

Applications

Typical applications include limited temperature, decoupling and bypass.



Ordering Information

С	1210	С	226	Z	4	٧	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec)
	0402 0603 0805 1206 1210	C = Standard	Two significant digits + number of zeros	Z = +80%/-20% M = ±20%	9 = 6.3 8 = 10 4 = 16 3 = 25 5 = 50	V = Y5V	A = N/A	C = 100% Matte Sn	See "Packaging C-Spec Ordering Options Table" below

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

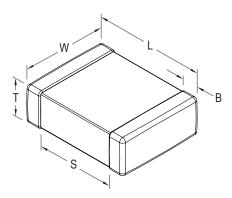


Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec)
Bulk Bag/Unmarked	Not required (Blank)
7" Reel/Unmarked	TU
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
7" Reel/Marked	TM
13" Reel/Marked	7040 (EIA 0603 and smaller case sizes) 7215 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2mm pitch ²	7081
13" Reel/Unmarked/2mm pitch ²	7082

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Dimensions – Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	T Thick- ness	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)	See Table 2 for Thickness	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)	NI/A	
1210	3225	3.20 (0.126) ±0.20 (0.008)	2.50 (0.098) ±0.20 (0.008)		0.50 (0.02) ±0.25 (0.010)	N/A	Solder Reflow Only

Qualification/Certification

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

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. Please contact KEMET if you require a laser marked option. For more information see "Capacitor Marking".

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Environmental Compliance

Lead (Pb)-Free, RoHS, and REACH compliant without exemptions.

Electrical Parameters/Characteristics

Item	Parameters/Characteristics				
Operating Temperature Range	-30°C to +85°C				
Capacitance Change with Reference to +25°C and 0 Vdc Applied (TCC)	+22%, -82%				
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	7.0%				
² Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ± 1 seconds and charge/discharge not exceeding 50mA)				
³ Dissipation Factor (DF) Maximum Limit @ 25°C	10% (6.3V & 10V), 7% (16V & 25V) and 5% (50V)				
⁴ Insulation Resistance (IR) Minimum Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ± 5 secs @ 25°C)				

¹Regarding 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.

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

Post Environmental Limits

	High Temperature Life, Biased Humidity, Moisture Resistance												
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance								
	> 25		7.5										
Y5V	16/25	All	10.0	±30%	10% of Initial Limit								
	< 16		15.0										

Insulation Resistance Limit Table

EIA Case Size	100 Megohm Microfarads or 10 GΩ	50 Megohm Microfarads or 10 GΩ
All	≥ 16 V	≤ 10 V

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

 $¹kHz \pm 50Hz$ and 1.0 ± 0.2 Vrms if capacitance ≤10 μ F

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

⁴To obtain IR limit, divide MΩ- μ F value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



Table 1 – Capacitance Range/Selection Waterfall (0402 – 1210 Case Sizes)

			Size/ ries	C	0402	2C		C 06	03C			C	080	5C			C.	1200	6C			C.	1210	C	
Capacitance	Capacitance	Voltag	e Code	9	8	4	9	8	4	3	9	8	4	3	5	9	8	4	3	5	9	8	4	3	5
Capacitance	Code	Rated Volt	tage (VDC)	6.3	2	9	6.3	2	9	52	6.3	2	9	52	20	6.3	2	9	25	20	6.3	9	16	52	20
		Capacitanc	e Tolerance										abilit for C												
22,000 pF	223	М	Z	BB	BB	BB	CF	CF	CF	CF	DN	DN	DN	DN	DN										
27,000 pF	273	М	Z	BB	BB	BB	CF	CF	CF	CF	DN	DN	DN	DN	DN										
33,000 pF	333	М	Z	BB	BB	BB	CF	CF	CF	CF	DN	DN	DN	DN	DN										
39,000 pF	393	М	Z	BB	BB	BB	CF	CF	CF	CF	DP	DP	DP	DP	DP										
47,000 pF	473	М	Z	BB	BB	BB	CF	CF	CF	CF	DO	DO	DO	DO	DO										
56,000 pF	563	M	Z	BB	ВВ	ВВ	CF	CF	CF	CF	DP	DP	DP	DP	DP										
68,000 pF	683	М	Z	BB	BB	BB	CF	CF	CF	CF	DP	DP	DP	DP	DP										
82,000 pF	823	M	Z	BB	ВВ	BB	CF	CF	CF	CF	DP	DP	DP	DP	DP										
0.10 µF	104	M	Z	BB	BB	BB	CG	CG	CG	CG	DN	DN	DN	DN	DN										
0.12 µF	124	M	Z				CG	CG	CG	CG	DN	DN	DN	DN											
0.15 µF	154	M	Z				CG	CG	CG	CG	DN	DN	DN	DN											
0.18 µF	184	M	Z				CG	CG	CG	CG	DN	DN	DN	DN	-										
0.22 µF	224	M	Z	BB			CG	CG	CG	CG	DN	DN	DN	DN	DG	EC	EC	EC	EC		FD	FD	FD	FD	FD
0.27 µF	274	M	Z				CG	CG	CG	CG	DN	DN	DN	DN		EB	EB	EB	EB		FD	FD	FD	FD	FD
0.33 µF	334	M	Z				CG	CG	CG	CG	DG	DG	DG	DG		EB	EB	EB	EB		FD	FD	FD	FD	FD
0.39 µF	394	M	Z	-			CG	CG	CG		DN	DN	DN	DN		EB	EB	EB	EB		FD	FD	FD	FD	FD
0.47 µF	474	M	Z	BB			CG	CG	CG		DG	DG	DG	DG		EC	EC	EC	EC		FD	FD	FD	FD	FD
0.56 µF	564	M	Z				CG	CG			DP	DP	DP	DP		EB	EB	EB	EB		FD	FD	FD	FD	FD
0.68 µF	684	M	Z				CG	CG			DP	DP	DP	DG		EB	EB	EB	EB		FD	FD	FD	FD	FD
0.82 µF	824	M	Z	20	DD		CG	CG	00	00	DG	DG	DG	DG	D0	EB	EB	EB	EB		FF	FF	FF	FF	FF
1.0 µF	105	M	Z	BB	BB		CG	CG	CG	CG	DP	DP	DP	DG	DG	EP	EP	EP	EP		FH	FH	FH	FH	FH
1.2 µF	125	M	Z								DN	DN	DN			EC EC	EC	EC			FD	FD	FD		
1.5 µF	155	M	Z								DN	DN	DN				EC	EC			FD	FD	FD		
1.8 µF	185	M	Z Z	BB	DD.						DP	DP	DP			ED	ED EC	ED			FD	FD	FD		
2.2 µF	225	M M	Z	BB	BB						DG DL	DG DL	DG			EC EH		EC EH			FJ FE	FJ FE	FJ FE		
3.3 µF	335 475	M M	Z								DG	DG	DG			EM ²	EH EM²	EM ²			FT	FT	FT		
4.7 µF	·		Z									DF	DG										FG		
5.6 µF	565 685	M M	Z	l			l				DF DG	DF				EJ EJ	EJ EJ	EJ			FG FH	FG FH	FH		
6.8 µF	106	M M	Z								DG	DG				EH	EH	EH	EH		FH ²	FH ²	FH ²		
10 μF 15 μF	156	M	Z								DG	DG					ELL				FH	FH	FH		
22 µF	226	M M	Z													EH	EH				FT ²	FT ²	FS	FS	
22 μι	220		tage (VDC)	6.3	9	16	6.3	9	16	25		5	9	25	20	6.3	6	16	25	20	6.3	9	9	25	20
0	Capacitance		e Code	9	8	4	9	8	4	3	ض 9	8	4	3	5	9	8	4	3	5	9	8	4	3	5
Capacitance	Code	Case					۲				Ť					C1206C			C1210C						
		Sei	ries		0402	<u>. </u>		C06	บงษ				0805	<u> </u>				1206					1210	<u> </u>	

xx² Only available in Z tolerance.



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

Thickness	Case	Thickness ±	Paper Q	uantity ¹	Plastic (Quantity
Code	Size ¹	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	$0.80 \pm 0.10^*$	4,000	15,000	0	0
DN	0805	0.78 ± 0.10*	4,000	15,000	0	0
DO	0805	0.80 ± 0.10 *	4,000	15,000	0	0
DP	0805	0.90 ± 0.10*	4,000	15,000	0	0
DL	0805	0.95 ± 0.10	0	0	4,000	10,000
DF	0805	1.10 ± 0.10	0	0	2,500	10,000
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
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
ED	1206	1.00 ± 0.10	0	0	2,500	10,000
EP	1206	1.20 ± 0.20	0	0	2,500	10,000
EM	1206	1.25 ± 0.15	0	0	2,500	10,000
EH	1206	1.60 ± 0.20	0	0	2,000	8,000
EJ	1206	1.70 ± 0.20	0	0	2,000	8,000
FD	1210	0.95 ± 0.10	0	0	4,000	10,000
FE	1210	1.00 ± 0.10	0	0	2,500	10,000
FF	1210	1.10 ± 0.10	0	0	2,500	10,000
FG	1210	1.25 ± 0.15	0	0	2,500	10,000
FH	1210	1.55 ± 0.15	0	0	2,000	8,000
FJ	1210	1.85 ± 0.20	0	0	2,000	8,000
FT	1210	1.90 ± 0.20	0	0	2,000	8,000
FS	1210	2.50 ± 0.30	0	0	1,000	4,000
Thickness	Case	Thickness ±	7" Reel	13" Reel	7" Reel	13" Reel
Code	Size ¹	Range (mm)	Paper Q	uantity¹	Plastic (Quantity

Package quantity based on finished chip thickness specifications.

¹ If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Table 2B - Bulk Packaging Quantities

Paulion	.	Loose Pa	ackaging		
Раскад	ing Type	Bulk Bag	(default)		
Packagir	ng C-Spec ¹	N/	/A ²		
Case	e Size	Packaging Quantities (pieces/unit packaging)		
EIA (in)	Metric (mm)	Minimum	Maximum		
0402	1005				
0603	1608				
0805	2012		50,000		
1206	3216				
1210	3225	1			
1808	4520] '			
1812	4532				
1825	4564		20,000		
2220	5650				
2225	5664				

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

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



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

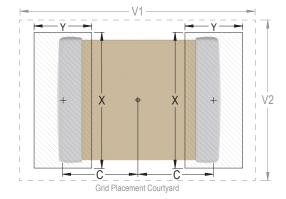
EIA Size Code	Metric Size Code	I	Maxi	sity Lev mum (N rotrusio	Most))	ı	Density Level B: Median (Nominal) Land Protrusion (mm)					Density Level C: Minimum (Least) Land Protrusion (mm)					
Oode	Oode	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Υ	X	V1	V2		
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	0.40	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		

¹ 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

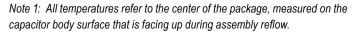
Recommended Soldering Technique:

- 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
Frome reature	SnPb	100% Matte Sn
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum



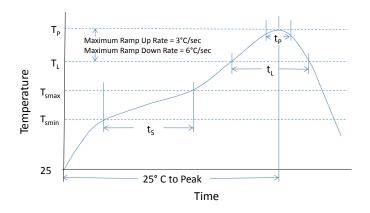




Table 4 – Performance & Reliability: Test Methods and Conditions

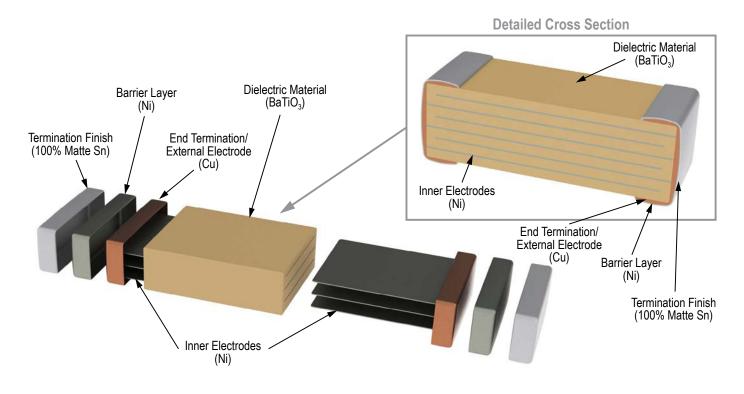
Stress	Reference	Test or Inspection Method					
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.					
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).					
		Magnification 50 X. Conditions:					
Solderability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C					
Solderability	J-31D-002	b) Method B @ 215°C category 3					
		c) Method D, category 3 @ 260°C					
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.					
Diagod Humidika	MII. CTD 202 Matha d 402	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.					
Biased Humidity	MIL-STD-202 Method 103	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.					
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.					
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.					
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.					
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.					
Vibration	MIL-STD-202 Method 204	5 g's for 20 min., 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, Condition F.					
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.					

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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):

Laser marking option is not available on:

- C0G, Ultra Stable X8R and Y5V dielectric devices
- EIA 0402 case size devices
- EIA 0603 case size devices with Flexible Termination option.
- KPS Commercial and Automotive grade stacked devices.

These capacitors are supplied unmarked only.

Capacitor Array, C0G Dielectric, 10 – 200 VDC (Commercial & Automotive Grade)



Overview

KEMET's Ceramic Chip Capacitor Array in C0G dielectric is an advanced passive technology where multiple capacitor elements are integrated into one common monolithic structure. Array technology promotes reduced placement costs and increased throughput. This is achieved by alternatively placing one device rather than two or four discrete devices. Use of capacitor arrays also saves board space which translates into increased board density and more functions per board. Arrays consume only a portion of the space required for standard chips resulting in savings in inventory and pick/place machine positions.

For added reliability, KEMET's Flexible Termination technology has been incorporated in order to provides superior flex performance. This technology was developed to address flex cracks, which are the primary failure mode of MLCCs and typically the result of excessive tensile and shear stresses produced during board flexure and thermal cycling. Flexible Termination technology inhibits the transfer of board stress to the rigid body of the MLCC, therefore mitigating flex cracks which can result in low IR or short circuit failures.

KEMET's COG dielectric features a 125°C maximum operating temperature and is considered "stable. "The Electronics Industries Alliance (EIA) characterizes C0G dielectric as a Class I material.

Components of this classification are temperature compensating and are suited for resonant circuit applications or those where Q and stability of capacitance characteristics are required. COG exhibits no change in capacitance with respect to time and voltage and boasts a negligible change in capacitance with reference to ambient temperature. Capacitance change is limited to ± 30 ppm/°C from -55°C to +125°C.

KEMET automotive grade array capacitors meet the demanding Automotive Electronics Council's AEC-Q200 qualification requirements.



Ordering Information

CA	06	4	X	104	K	4	G	Α	С	TU
Ceramic Array	Case Size (L" x W") ¹	Number of Capacitors	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/Grade (C-Spec)
	05 = 0508 06 = 0612	2 = 2 4 = 4	X = Flexible Termination	Two significant digits + number of zeros	J = ±5% K = ±10% M = ±20%	8 = 10 4 = 16 3 = 25 5 = 50 1 = 100 2 = 200	G = C0G	A = N/A	C = 100% Matte Sn L = SnPb (5% minimum Pb content)	See "Packaging C-Spec Ordering Options Table" below

All previous reference to metric case dimension "1632" has been replaced with an inch standard reference of "0612". Please reference all new designs using the "0612" nomenclature. "CA064" replaces "C1632" in the ordering code.

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

² SnPb termination finish option is not available on automotive grade product.



Packaging C-Spec Ordering Options Table

Packaging Type	Packaging/Grade Ordering Code (C-Spec)				
Commerc	ial Grade ¹				
Bulk Bag	Not Required (Blank)				
7" Reel/Unmarked	TU				
13" Reel (Embossed Plastic Tape) / Unmarked	7210				
Automotiv	ve Grade ²				
7" Reel	AUTO				
13" Reel/Embossed Plastic/Unmarked	AUTO7210				

Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- -55°C to +125°C operating temperature range
- Superior flex performance (up to 5 mm)
- Saves both circuit board and inventory space
- Reduces placement costs and increases throughput
- Lead (Pb)-Free, RoHS and REACH compliant
- EIA 0508 (2-element) and 0612 (4-element) case sizes
- DC voltage ratings of 10 V, 16 V, 25 V, 50 V, 100 V, and 200 V
- Capacitance offerings ranging from 10 pF to 2,200 pF

- 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% Pb minimum)
- Commercial and Automotive (AEC-Q200) grades available

Applications

Typical applications include those that can benefit from board area savings, cost savings and overall volumetric reduction such as telecommunications, computers, handheld devices and automotive. Flexible termination technology benefits applications subject to high levels of board flexure or temperature cycling.

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. The option to laser mark is not available on these devices. For more information see "Capacitor Marking".

² Reeling tape options (Paper or Plastic) are dependent on capacitor case size (L" x W") and thickness dimension. See "Chip Thickness/Tape & Reel Packaging Quantities" and "Tape & Reel Packaging Information".

² For additional Information regarding "AUTO" C-Spec options, see "Automotive C-Spec Information".

² All Automotive packaging C-Specs listed exclude the option to laser mark components. The option to laser mark is not available on these devices. For more information see "Capacitor Marking".



Automotive C-Spec Information

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

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

Product Change Notification (PCN)

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

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

KEMET Automotive	Customer Noti	Days prior to	
C-Spec	Process/Product change	Obsolescence*	implementation
KEMET assigned ¹	Yes (with approval and sign off)	Yes	180 days Minimum
AUTO	Yes (without approval)	Yes	90 days Minimum

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

Production Part Approval Process (PPAP)

The purpose of the Production Part Approval Process is:

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

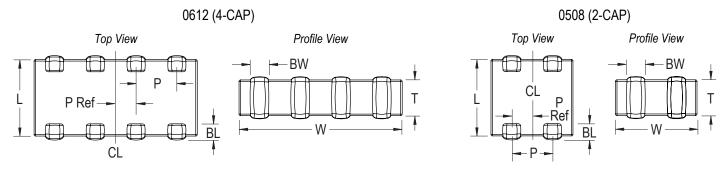
KEMET Automotive		PPAP (Product Part Approval Process) Level											
C-Spec	1	2	3	4	5								
KEMET assigned ¹	•	•	•	•	•								
AUTO	0		0										

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

- Part Number specific PPAP available
- Product family PPAP only



Dimensions – Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	BW Bandwidth	BL Bandlength	T Thickness	P Pitch	P Reference	
0508	1220	1.30 (0.051) ±0.15 (0.006)	2.10 (0.083) ±0.15 (0.006)	0.53 (0.021) ±0.08 (0.003)	0.30 (0.012) ±0.20 (0.008)	See Table 2 for	1.00 (0.039) ±0.10 (0.004)	0.50 (0.020) ±0.10 (0.004)	
0612	1632	1.60 (0.063) ±0.20 (0.008)	3.20 (0.126) ±0.20 (0.008)	0.40 (0.016) ±0.20 (0.008)	0.30 (0.012) ±0.20 (0.008)	Thickness	0.80 (0.031) ±0.10 (0.004)	0.40 (0.016) ±0.05 (0.002)	

Qualification/Certification

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

Automotive Grade products meet or exceed the requirements outlined by the Automotive Electronics Council. Details regarding test methods and conditions are referenced in document AEC–Q200, Stress Test Qualification for Passive Components. For additional information regarding the Automotive Electronics Council and AEC–Q200, please visit their website at www.aecouncil.com.

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)	±30 ppm/°C
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	0%
¹ Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)
² Dissipation Factor (DF) Maximum Limit @ 25°C	0.1%
³ Insulation Resistance (IR) Limit @ 25°C	1,000 megohm microfarads or 100 G Ω (Rated voltage applied for 120 ±5 seconds @ 25°C)

DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

Capacitance and Dissipation Factor (DF) measured under the following conditions:

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."

Post Environmental Limits

High Temperature Life, Biased Humidity, Moisture Resistance												
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance							
C0G	All	All	0.5	0.3% or ±0.25 pF	10% of Initial Limit							

²Capacitance and dissipation factor (DF) measured under the following conditions:

¹ MHz ±100 kHz and 1.0 Vrms ±0.2 V if capacitance ≤ 1,000 pF

¹ kHz ±50 Hz and 1.0 Vrms ±0.2 V if capacitance > 1,000 pF

 $^{{}^{3}}$ To obtain IR limit, divide M Ω - μ F value by the capacitance and compare to G Ω limit. Select the lower of the two limits.



Table 1 – Capacitance Range/Selection Waterfall (0508 – 0612 Case Sizes)

		Case	Size/S	Series	C050	8X (CA0	52X 2-C	ap Case	e Size)	C	:0612X (0	Case Size)				
	Capacitance	Vol	tage C	ode	8	4	3	5	1	8	4	3	5	1	2	
Capacitance	Code	Rate	Rated Voltage (VDC) Capacitance Tolerance			16	25	50	100	10	16	25	50	100	200	
10 pF	100	J	K	М						MA	MA	MA	MA	MA	MA	
12 pF	120	J	K	М						MA	MA	MA	MA	MA	MA	
15 pF	150	J	K	M						MA	MA	MA	MA	MA	MA	
18 pF	180	J	K	М						MA	MA	MA	MA	MA	MA	
22 pF	220	J	K	M						MA	MA	MA	MA	MA	MA	
27 pF	270 330	J	K K	M						MA	MA	MA	MA MA	MA	MA MA	
33 pF		ľ	1	M						MA	MA	MA		MA		
39 pF	390 470	J	K K	M M						MA MA	MA MA	MA MA	MA MA	MA MA	MA MA	
47 pF	470 560	J	K	M						MA MA	MA MA	MA	MA MA	MA		
56 pF	680	J	K	M						MA	MA	MA	MA	MA	MA MA	
68 pF	820	J	K	M						MA	MA	MA	MA	MA	MA	
82 pF 100 pF	101	J	K	M	PA	PA	PA	PA	PA	MA	MA	MA	MA	MA	IVIA	
120 pF	121	J	K	M	PA PA	PA PA	PA PA	PA PA	PA	MA MA	MA	MA	MA	MA		
150 pF	151	J	K	M	PA PA	PA	PA	PA	PA	MA	MA	MA	MA	MA		
180 pF	181	J	K	M	PA	PA	PA	PA	PA	MA	MA	MA	MA	MA		
220 pF	221	J	K	M	PA PA	PA	PA PA	PA	PA	MA	MA	MA	MA	IVIA		
270 pF	271	J	K	M	PA PA	PA	PA	PA	PA	MA	MA	MA	MA			
330 pF	331	J	K	M	PA PA	PA	PA PA	PA	PA	MA	MA	MA	MA			
390 pF	391	J	K	M	PA PA	PA	PA PA	PA	PA	MA	MA	MA	MA			
470 pF	471	J	K	M	PA	PA	PA	PA	PA	MA	MA	MA	MA			
560 pF	561	J	K	M	PA	PA	PA	PA	PA	IVIA	IVIA	IVIA	IVIA			
680 pF	681	J	K	M	PA	PA	PA	PA	PA							
820 pF	821	J	K	M	PA	PA	PA	PA	PA							
1,000 pF	102	J	K	M	PA	PA	PA	PA	PA							
1,100 pF	112	J	K	M	PA	PA	PA	PA	PA							
1,200 pF	122	J	K	M	PA	PA	PA	PA	PA							
1,300 pF	132	J	K	M	PA	PA	PA	PA	PA							
1,500 pF	152	J	K	M	PA	PA	PA	PA	PA							
1,600 pF	162	Ĵ	K	M I	PA	PA	PA	PA	PA							
1,800 pF	182	J	K	M	PA	PA	PA	PA	PA							
2,000 pF	202	Ĵ	K	M	PA	PA	PA	PA	PA							
2,200 pF	222	Ĵ	K	M	PA	PA	PA	PA	PA							
, ,		Rated	l Voltage	-	10	16	25	50	100	10	16	25	50	100	200	
Capacitance	Capacitance Code	Vo	oltage Co	de	8	4	3	5	1	8	4	3	5	1	2	
		Case	Size/S	eries	C050	8X (CA0	52X 2-C	ap Case	Size)		C0612X (CA064X	4-Cap C	ase Size	•)	

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).

These products are protected under US Patents 7,172,985 and 7,670,981, other patents pending, and any foreign counterparts.



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

	Thickness	ness Case	Thickness ±	Paper C	uantity	Plastic Quantity			
	Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel		
ſ	PA	0508	0.80 ± 0.10	0	0	4,000	10,000		
	MA	0612	0.80 ± 0.10	0	0	4,000	10,000		

Package quantity based on finished chip thickness specifications.

Table 2B - Bulk Packaging Quantities

Doolse	uina Tana	Loose Packaging						
Раска	ging Type	Bulk Bag (default) N/A² Packaging Quantities (pieces/unit packaging Minimum Maximum						
Packagi	ng C-Spec ¹	N/	/A²					
Cas	e Size	Packaging Quantities ((pieces/unit packaging)					
EIA (in)	Metric (mm)	Minimum	Maximum					
0402	1005							
0603	1608							
0805	2012		50,000					
1206	3216							
1210	3225	- - 1						
1808	4520	1						
1812	4532							
1825	4564		20,000					
2220	5650	1						
2225	5664	1						

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

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



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

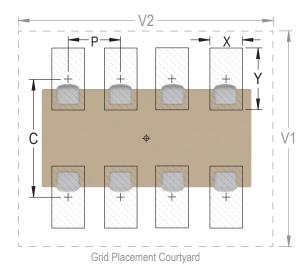
EIA SIZE CODE	METRIC SIZE CODE		Maxir	num (Level Most) on (m	Land			Media	n (No	Level minal) on (m	Land		Density Level C: Minimum (Least) Land Protrusion (mm)					
	OODL	С	Υ	Х	Р	V1	V2	С	Y	X	Р	V1	V2	С	Y	Х	Р	V1	V2
0508/CA052	1220	1.60	1.00	0.55	1.00	3.50	3.30	1.50	0.90	0.50	1.00	2.90	2.80	1.40	0.75	0.45	1.00	2.40	2.50
0612/CA064	1632	1.80	1.10	0.50	0.80	3.90	4.40	1.80	0.95	0.50	0.80	3.30	3.90	1.70	0.85	0.40	0.80	2.80	3.60

Density Level A: For low-density product applications. Provides a wider process window for reflow solder processes.

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 0612 case size.





Soldering Process

Recommended Soldering Technique:

· Solder reflow only

Recommended Reflow Soldering Profile:

KEMET's families of surface mount multilayer ceramic capacitors (SMD MLCCs) are compatible with wave (single or dual), convection, IR or vapor phase reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET's recommended profile conditions for convection and IR reflow reflect the profile conditions of the IPC/J-STD-020 standard for moisture sensitivity testing. These devices can safely withstand a maximum of three reflow passes at these conditions.

Profile Feature	Termination Finish			
Frome reature	SnPb	100% Matte Sn		
Preheat/Soak				
Temperature Minimum (T _{Smin})	100°C	150°C		
Temperature Maximum (T _{Smax})	150°C	200°C		
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds		
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum		
Liquidous Temperature (T _L)	183°C	217°C		
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds		
Peak Temperature (T _P)	235°C	260°C		
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum		
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum		
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum		

Note 1: All temperatures refer to the center of the package, measured on the capacitor body surface that is facing up during assembly reflow.

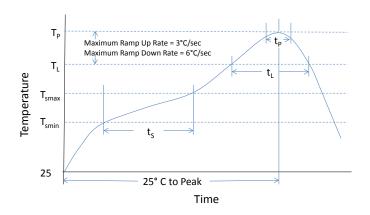




Table 4 - Performance & Reliability: Test Methods and Conditions

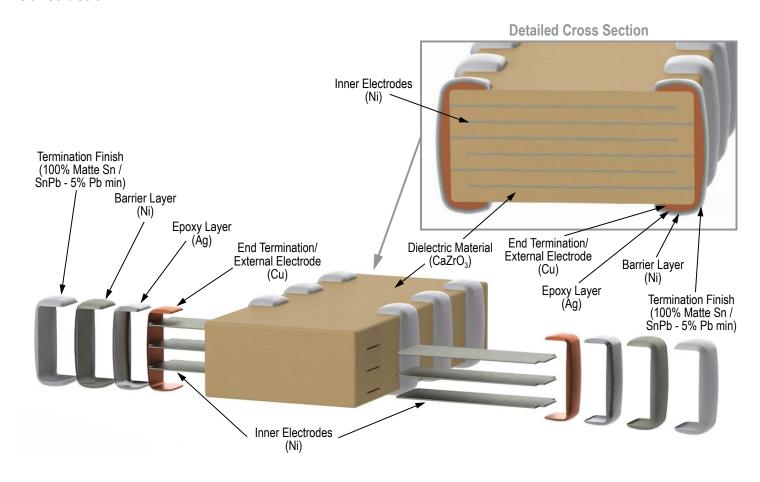
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Coldorability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	J-31D-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Did Hidit.	MII. OTD 000 M-H 1400	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
Vibration	MIL-STD-202 Method 204	5 g's for 20 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage & Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



Capacitor Marking (Optional):

Laser marking option is not available on:

- C0G, Ultra Stable X8R and Y5V dielectric devices
- EIA 0402 case size devices
- EIA 0603 case size devices with Flexible Termination option.
- KPS Commercial and Automotive grade stacked devices.

These capacitors are supplied unmarked only.

Capacitor Array, X7R Dielectric, 10 - 200 VDC (Commercial & Automotive Grade)



Overview

KEMET's Ceramic Chip Capacitor Array in X7R dielectric is an advanced passive technology where multiple capacitor elements are integrated into one common monolithic structure. Array technology promotes reduced placement costs and increased throughput. This is achieved by alternatively placing one device rather than two or four discrete devices. Use of capacitor arrays also saves board space which translates into increased board density and more functions per board. Arrays consume only a portion of the space required for standard chips resulting in savings in inventory and pick/place machine positions.

For added reliability, KEMET's Flexible Termination technology has been incorporated in order to provides superior flex performance. This technology was developed to address flex cracks, which are the primary failure mode of MLCCs and typically the result of excessive tensile and shear stresses produced during board flexure and thermal cycling. Flexible Termination technology inhibits the transfer of board stress to the rigid body of the MLCC, therefore mitigating flex cracks which can result in low IR or short circuit failures.

KEMET's X7R dielectric features a 125°C maximum operating temperature and is considered "temperature stable." The Electronics Industries Alliance (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.

KEMET automotive grade array capacitors meet the demanding Automotive Electronics Council's AEC-Q200 qualification requirements.



Ordering Information

CA	06	4	X	104	K	4	R	Α	С	TU
Ceramic Array	Case Size (L" x W") ¹	Number of Capacitors	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/Grade (C-Spec)
	05 = 0508 06 = 0612	2 = 2 4 = 4	X = Flexible Termination	Two significant digits + number of zeros	J = ±5% K = ±10% M = ±20%	8 = 10 4 = 16 3 = 25 5 = 50 1 = 100 2 = 200	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% minimum Pb content)	See "Packaging C-Spec Ordering Options Table" below

All previous reference to metric case dimension "1632" has been replaced with an inch standard reference of "0612". Please reference all new designs using the "0612" nomenclature. "CA064" replaces "C1632" in the ordering code.

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

² SnPb termination finish option is not available on automotive grade product.



Packaging C-Spec Ordering Options Table

Packaging Type	Packaging/Grade Ordering Code (C-Spec)							
Commercial Grade ¹								
Bulk Bag	Not Required (Blank)							
7" Reel/Unmarked	TU							
13" Reel (Embossed Plastic Tape) / Unmarked	7210							
Automotive Grade ²								
7" Reel	AUTO							
13" Reel/Embossed Plastic/Unmarked	AUTO7210							

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- -55°C to +125°C operating temperature range
- Superior flex performance (up to 5 mm)
- Saves both circuit board and inventory space
- Reduces placement costs and increases throughput
- Lead (Pb)-Free, RoHS and REACH compliant
- EIA 0508 (2-element) and 0612 (4-element) case sizes
- DC voltage ratings of 10 V, 16 V, 25 V, 50 V, 100 V, and 200 V
- Capacitance offerings ranging from 330 pF 0.22 μF

- Available capacitance tolerances of ±5%, ±10%, and ±20%
- · Non-polar device, minimizing installation concerns
- 100% pure matte tin-plated termination finish allowing for excellent solderability
- SnPb termination finish option available upon request (5% Pb minimum)
- Commercial and Automotive (AEC–Q200) grades available

Applications

Typical applications include those that can benefit from board area savings, cost savings and overall volumetric reduction such as telecommunications, computers, handheld devices and automotive. Flexible termination technology benefits applications subject to high levels of board flexure or temperature cycling.

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. The option to laser mark is not available on these devices. For more information see "Capacitor Marking".

² Reeling tape options (Paper or Plastic) are dependent on capacitor case size (L" x W") and thickness dimension. See "Chip Thickness/Tape & Reel Packaging Quantities" and "Tape & Reel Packaging Information".

² For additional Information regarding "AUTO" C-Spec options, see "Automotive C-Spec Information".

² All Automotive packaging C-Specs listed exclude the option to laser mark components. The option to laser mark is not available on these devices. For more information see "Capacitor Marking".



Automotive C-Spec Information

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

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

Product Change Notification (PCN)

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

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

KEMET Automotive	Customer Noti	Days prior to			
C-Spec	Process/Product change	Obsolescence*	implementation		
KEMET assigned ¹	Yes (with approval and sign off)	Yes	180 days Minimum		
AUTO	Yes (without approval)	Yes	90 days Minimum		

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

Production Part Approval Process (PPAP)

The purpose of the Production Part Approval Process is:

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

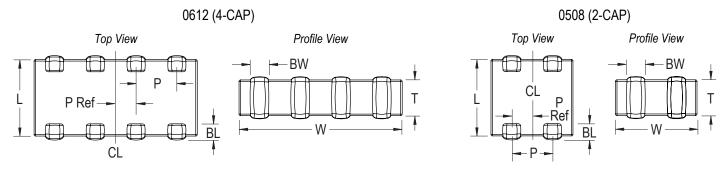
KEMET Automotive	PPAP (Product Part Approval Process) Level										
C-Spec	1	2	3	4	5						
KEMET assigned ¹	•	•	•	•	•						
AUTO	0		0								

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

- Part Number specific PPAP available
- Product family PPAP only



Dimensions – Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	BW Bandwidth	BL Bandlength	T Thickness	P Pitch	P Reference
0508	1220	1.30 (0.051) ±0.15 (0.006)	2.10 (0.083) ±0.15 (0.006)	0.53 (0.021) ±0.08 (0.003)	0.30 (0.012) ±0.20 (0.008)	See Table 2 for	1.00 (0.039) ±0.10 (0.004)	0.50 (0.020) ±0.10 (0.004)
0612	1632	1.60 (0.063) ±0.20 (0.008)	3.20 (0.126) ±0.20 (0.008)	0.40 (0.016) ±0.20 (0.008)	0.30 (0.012) ±0.20 (0.008)	Thickness	0.80 (0.031) ±0.10 (0.004)	0.40 (0.016) ±0.05 (0.002)

Qualification/Certification

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

Automotive Grade products meet or exceed the requirements outlined by the Automotive Electronics Council. Details regarding test methods and conditions are referenced in document AEC–Q200, Stress Test Qualification for Passive Components. For additional information regarding the Automotive Electronics Council and AEC–Q200, please visit their website at www.aecouncil.com.

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%
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
² Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ± 1 seconds and charge/discharge not exceeding 50mA)
³ Dissipation Factor (DF) Maximum Limit @ 25°C	See Dissipation Factor Limit Table
⁴ Insulation Resistance (IR) Minimum Limit @ 25°C	1,000 megohm microfarads or $100G\Omega$ (Rated voltage applied for 120 ± 5 secs @ 25° C)

¹Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

 $1kHz \pm 50Hz$ and 1.0 ± 0.2 Vrms if capacitance ≤ $10\mu F$

120Hz \pm 10Hz 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 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

Post Environmental Limits

High Temperature Life, Biased Humidity, Moisture Resistance											
Dielectric	Rated DC Voltage	Capacitance Value	Capacitance Shift	Insulation Resistance							
	< 16	All	7.5								
	16/25	All	5.0		10% of Initial Limit						
X7R	F0	≤ 0.02 µF	3.0	± 20%							
	50	> 0.02 µF	5.0								
	> 50	All	3.0								

Dissipation Factor Limit Table

Rated DC Voltage	Capacitance	Dissipation Factor (Maximum %)		
< 16	All	5.0		
16/25	All	3.5		
E0	≤ 0.022 µF	2.5		
50	> 0.022 µF	3.5		
> 50	All	2.5		

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

⁴To obtain IR limit, divide $M\Omega$ -μF value by the capacitance and compare to $G\Omega$ limit. Select the lower of the two limits.



Table 1 – Capacitance Range/Selection Waterfall (0508 – 0612 Case Sizes)

		Case	Size/S	eries	C05080	C/X (CA0	52C/X 2	-Cap Ca	se Size)	C06	612C/X (CA064C	/X 4-Ca	p Case S	Size)
	Capacitance	Vol	Itage Co	de	8	4	3	5	1	8	4	3	5	1	2
Capacitance Code			Voltage	(VDC)	10	16	25	50	100	10	16	25	50	100	200
	Ocac	Ca	pacitan	се		I			ailability						
			oleranc	_					2 for Ch						
330 pF	331	J	K	М	PA	PA	PA	PA	PA	MA	MA	MA	MA	MA	MA
390 pF	391	J	K	М	PA	PA	PA	PA	PA	MA	MA	MA	MA	MA	MA
470 pF	471	J	K	М	PA	PA	PA	PA	PA	MA	MA	MA	MA	MA	MA
560 pF	561	J	K	М	PA	PA	PA	PA	PA	MA	MA	MA	MA	MA	MA
680 pF	681	J	K	М	PA	PA	PA	PA	PA	MA	MA	MA	MA	MA	MA
820 pF	821	J	K	М	PA	PA	PA	PA	PA	MA	MA	MA	MA	MA	MA
1,000 pF	102	J	K	М	PA	PA	PA	PA	PA	MA	MA	MA	MA	MA	MA
1,200 pF	122	J	K	М	PA	PA	PA	PA	PA	MA	MA	MA	MA	MA	MA
1,500 pF	152	J	K	М	PA	PA	PA	PA	PA	MA	MA	MA	MA	MA	MA
1,800 pF	182	J	K	M	PA	PA	PA	PA	PA	MA	MA	MA	MA	MA	MA
2,200 pF	222	J	K	М	PA	PA	PA	PA	PA	MA	MA	MA	MA	MA	MA
2,700 pF	272	J	K	М	PA	PA	PA	PA	PA	MA	MA	MA	MA	MA	MA
3,300 pF	332	J	K	M	PA	PA	PA	PA	PA	MA	MA	MA	MA	MA	MA
3,900 pF	392	J	K	M	PA	PA	PA	PA	PA	MA	MA	MA	MA	MA	MA
4,700 pF	472	J	K	М	PA	PA	PA	PA	PA	MA	MA	MA	MA	MA	MA
5,600 pF	562	J	K	M	PA	PA	PA	PA		MA	MA	MA	MA	MA	MA
6,800 pF	682	J	K	M	PA	PA	PA	PA		MA	MA	MA	MA	MA	MA
8,200 pF	822	J	K	M	PA	PA	PA	PA		MA	MA	MA	MA	MA	MA
10,000 pF	103	J	K	M	PA	PA	PA	PA		MA	MA	MA	MA	MA	MA
12,000 pF	123	J	K	M	PA	PA	PA	PA		MA	MA	MA	MA	MA	
15,000 pF	153	J	K	М	PA	PA	PA	PA		MA	MA	MA	MA	MA	
18,000 pF	183	J	K	M	PA	PA	PA	PA		MA	MA	MA	MA	MA	
22,000 pF	223	J	K	М	PA	PA	PA	PA		MA	MA	MA	MA	MA	
27,000 pF	273	J	K	М	PA	PA	PA	PA		MA	MA	MA	MA		
33,000 pF	333	J	K	М	PA	PA	PA	PA		MA	MA	MA	MA		
39,000 pF	393	J	K	М	PA	PA	PA	PA		MA	MA	MA	MA		
47,000 pF	473	Ĵ	K	М	PA	PA	PA	PA		MA	MA	MA	MA		
56,000 pF	563	Ĵ	K	М	PA	PA	PA	PA		MA	MA	MA			
68,000 pF	683	J	K	M	PA	PA	PA	PA		MA	MA				
82,000 pF	823	J	K	M	PA	PA	PA	PA		MA	MA				
0.10 µF	104	Ĵ	K	M	PA	PA	PA	PA		MA	MA				
0.15 µF	154	J	K	M	PA										
0.22 µF	224	Ĵ	K	M	PA										
0.22 pi		Rated	Voltage		10	16	25	50	100	10	16	25	50	100	200
Capacitance	Capacitance		Itage Co	, ,	8	4	3	5	1	8	4	3	5	1	2
'	Code		Size/S		C0508	C0508C/X (CA052C/X 2-Cap Case Size)				C0612C/X (CA064C/X 4-Cap Case Size)					



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

Thickness	Case	Thickness ±	Paper C	Quantity	Plastic Quantity		
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel	
PA	0508	0.80 ± 0.10	0	0	4,000	10,000	
MA	0612	0.80 ± 0.10	0	0	4,000	10,000	

Package quantity based on finished chip thickness specifications.

Table 2B - Bulk Packaging Quantities

Deale	nina Tana	Loose P	ackaging							
Раска	ging Type	Bulk Bag	g (default)							
Packag	ing C-Spec ¹	N/A²								
Cas	se Size	Packaging Quantities (pieces/unit packaging								
EIA (in)	Metric (mm)	Minimum	Maximum							
0402	1005									
0603	1608									
0805	2012		50,000							
1206	3216									
1210	3225	1								
1808	4520	_								
1812	4532									
1825	4564		20,000							
2220	5650									
2225	5664									

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

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



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

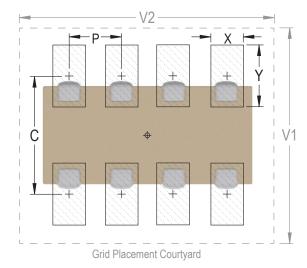
EIA SIZE CODE	METRIC SIZE CODE		Maxir	num (Level Most) on (m	Land			Media	n (No	Level minal) on (m	Land			Minin	ensity Level C: num (Least) Land rotrusion (mm)					
	OODL	С	Υ	X	P	V1	V2	С	Y	Х	P	V1	V2	С	Y	Х	Р	V1	V2		
0508/CA052	1220	1.60	1.00	0.55	1.00	3.50	3.30	1.50	0.90	0.50	1.00	2.90	2.80	1.40	0.75	0.45	1.00	2.40	2.50		
0612/CA064	1632	1.80	1.10	0.50	0.80	3.90	4.40	1.80	0.95	0.50	0.80	3.30	3.90	1.70	0.85	0.40	0.80	2.80	3.60		

Density Level A: For low-density product applications. Provides a wider process window for reflow solder processes.

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 0612 case size.





Soldering Process

Recommended Soldering Technique:

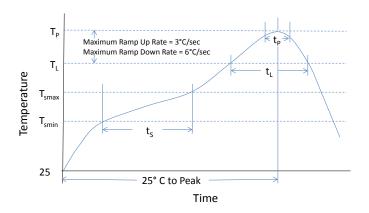
· Solder reflow only

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
Frome reature	SnPb	100% Matte Sn
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum

Note 1: All temperatures refer to the center of the package, measured on the capacitor body surface that is facing up during assembly reflow.



CC101_COMM_SMD • 7/7/2016



Table 4 - Performance & Reliability: Test Methods and Conditions

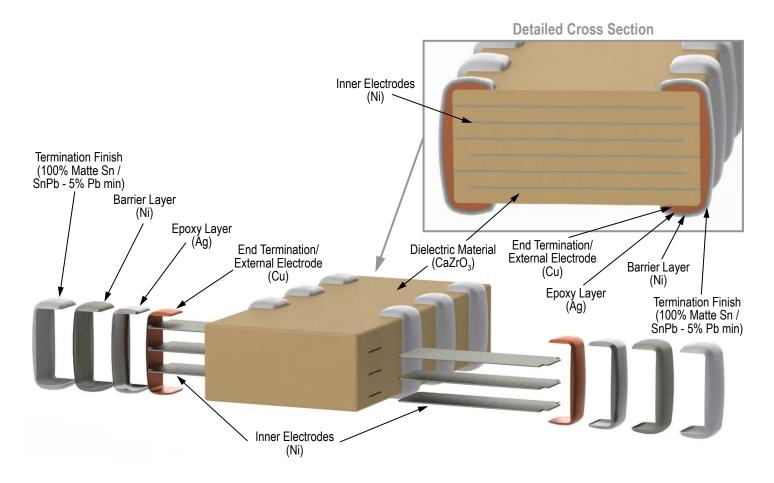
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Solderability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	J-31D-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion. Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
Vibration	MIL-STD-202 Method 204	5 g's for 20 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage & Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature- reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



Commercial Off-The-Shelf (COTS) for Higher Reliability Applications, C0G Dielectric, 10 – 250 VDC

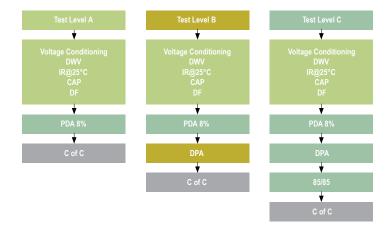


Overview

KEMET's COTS program is an extension of KEMET knowledge of high reliability test regimes and requirements. KEMET regularly supplies "up-screened" products by working with customer drawings and imposing specified design and test requirements. The COTS program offers the same high quality and high reliability components as up-screened products, but at a lower cost to the customer. This is accomplished by eliminating the need for customer-specific drawings to achieve the reliability level required for customer applications. A series of tests and inspections have been selected to provide the accelerated conditioning and 100% screening necessary to eliminate infant mortal failures from the population.

KEMET's COG dielectric features a 125°C maximum operating temperature and is considered "stable." The Electronics Components, Assemblies & Materials Association (EIA) characterizes COG dielectric as a Class I material. Components of this classification are temperature compensating and are suited for resonant circuit applications or those where Q and stability of capacitance characteristics are required. COG exhibits no change in capacitance with respect to time and voltage and boasts a negligible change in capacitance with reference to ambient temperature. Capacitance change is limited to ±30 ppm/°C from -55°C to +125°C.

All COTS testing includes voltage conditioning and post-electrical testing as per MIL–PRF–55681. For enhanced reliability, KEMET also provides the following test level options and conformance certifications:





Ordering Information

С	1206	T	104	K	5	G	A	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance ¹	Rated Voltage (VDC)	Dielectric	Failure Rate/Design	Termination Finish ²	Packaging/Grade (C-Spec)
	0402 0603 0805 1206 1210 1812 2220	T = COTS	Two significant digits + number of zeros Use 9 for 1.0 – 9.9 pF Use 8 for 0.5 – .99 pF ex. 2.2 pF = 229 ex. 0.5 pF = 508	$B = \pm 0.10 \text{ pF}$ $C = \pm 0.25 \text{ pF}$ $D = \pm 0.5 \text{ pF}$ $F = \pm 1\%$ $G = \pm 2\%$ $J = \pm 5\%$ $K = \pm 10\%$ $M = \pm 20\%$	8 = 10 4 = 16 3 = 25 6 = 35 5 = 50 1 = 100 2 = 200 A = 250	G = C0G	A = Testing per MIL-PRF- 55681 PDA 8% B= Testing per MIL-PRF- 55681 PDA 8%, DPA per EIA-469 C = Testing per MIL- PRF-55681 PDA 8%, DPA per EIA-469, Humidity per MIL-STD-202, Method 103, Condition A	C = 100% Matte Sn L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

¹ Additional capacitance tolerance offerings may be available. Contact KEMET for details.

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



Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec)
Bulk Bag/Unmarked	Not required (Blank)
7" Reel/Unmarked	TU
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2 mm pitch ²	7081
13" Reel/Unmarked/2 mm pitch ²	7082

Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- -55°C to +125°C operating temperature range
- Lead (Pb)-Free, RoHS and REACH compliant
- Voltage conditioning and post-electrical testing per MIL–PRF– 55681, Paragraph 4.8.3.1, Standard Voltage Conditioning
- Destructive Physical Analysis (DPA) per EIA–469
- Humidity, steady state, low voltage (85/85) per MIL–STD–202, Method 103, Condition A
- RoHS Compliant (excluding SnPb end metallization option)
- EIA 0402, 0603, 0805, 1206, 1210, 1812, and 2220 case sizes
- DC voltage ratings of 10 V, 16 V, 25 V, 50 V, 100 V, 200 V and 250 V
- Capacitance offerings ranging from 0.5 pF up to 0.47 μF
- Available capacitance tolerances of ±0.10 pF, ±0.25 pF, ±0.5 pF,
 SnPb end metallization option available upon request ±1%, ±2%, ±5%, ±10%, and ±20%

- · Certificate of compliance
- No piezoelectric noise
- Extremely low ESR and ESL
- High thermal stability
- · High ripple current capability
- · Preferred capacitance solution at line frequencies and into the MHz range
- No capacitance change with respect to applied rated DC voltage
- Negligible capacitance change with respect to temperature
- · No capacitance decay with time
- · Non-polar device, minimizing installation concerns
- (5% Pb minimum)

Applications

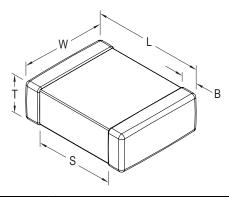
Typical applications include military, space quality and high reliability electronics.

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. The option to laser mark is not available on these devices. For more information see "Capacitor Marking".

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Dimensions – Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0402	1005	1.00 (.040) ± 0.05 (.002)	0.50 (.020) ± 0.05 (.002)		0.30 (.012) ± 0.10 (.004)	0.30 (.012)	Solder Reflow Only
0603	1608	1.60 (.063) ± 0.15 (.006)	0.80 (.032) ± 0.15 (.006)		0.35 (.014) ± 0.15 (.006)	0.70 (.028)	
0805	2012	2.00 (.079) ± 0.20 (.008)	1.25 (.049) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	Solder Wave or Solder Reflow
1206	3216	3.20 (.126) ± 0.20 (.008)	1.60 (.063) ± 0.20 (.008)	See Table 2 for Thickness	0.50 (0.02) ± 0.25 (.010)		
1210	3225	3.20 (.126) ± 0.20 (.008)	2.50 (.098) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)	N1/A	
1812	4532	4.50 (.177) ± 0.30 (.012)	3.20 (.126) ± 0.30 (.012)		0.60 (.024) ± 0.35 (.014)	N/A	Solder Reflow Only
2220	5650	5.70 (.224) ± 0.40 (.016)	5.00 (.197) ± 0.40 (.016)		0.60 (.024) ± 0.35 (.014)		

Qualification/Certification

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

Environmental Compliance

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)	±30 ppm/°C
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	0%
¹ Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)
² Dissipation Factor (DF) Maximum Limit @ 25°C	0.1%
³ Insulation Resistance (IR) Limit @ 25°C	1,000 megohm microfarads or 100 G Ω (Rated voltage applied for 120 ±5 seconds @ 25°C)

DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

Capacitance and Dissipation Factor (DF) measured under the following conditions:

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."

Post Environmental Limits

	High Temperatu	ıre Life, Biased	Humidity, Mois	ture Resistance	
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance
C0G	All	All	0.5	0.3% or ±0.25 pF	10% of Initial Limit

²Capacitance and dissipation factor (DF) measured under the following conditions:

¹ MHz ±100 kHz and 1.0 Vrms ±0.2 V if capacitance ≤ 1,000 pF

¹ kHz ± 50 Hz and 1.0 Vrms ± 0.2 V if capacitance > 1,000 pF

 $^{{}^{3}}$ To obtain IR limit, divide M Ω - μ F value by the capacitance and compare to G Ω limit. Select the lower of the two limits.



Table 1A – Capacitance Range/Selection Waterfall (0402 – 0805 Case Sizes)

		C	Cas	se	Si	ize	<u> </u>	Sei	rie	S			С	040	2T					С	0603	BT					С	080	5T		
	Сар				tag						8	4	3	5	1	2	Α	8	4	3	5	1	2	Α	8	4	3	5	1	2	Α
Capacitance	Code	Ra								C)	_	9	52	20	8	500	250	9	9	25	20	5	500	250	5	9	52	20	9	200	250
	Oouc	H	_		ра														ilabi						s Co	des					- 7
0.50.0.075	500.0.750	Ļ			olε	era	ınc	е				DD	DD	DD		S	ee Ta			_					nsior		DN	DN	DN	DN	DN
0.50 & 0.75 pF 1.0 - 9.1 pF*	508 & 758 109 - 919*	B B	1 -								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
10 - 91 pF*	100 - 910*			-	F	= (G	J	K	М	BB	BB	BB	BB				CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN
100 pF	101				F			J	K	М	BB	BB	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN
110 - 180 pF* 200 - 270 pF*	111 -181*				F	_		J	K	M	BB BB	BB BB	BB	BB	BB	BB	BB	CF	CF	CF CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN
300 pF	201 - 271* 301				F			J	K K	M M	BB	BB	BB BB	BB	BB	BB	BD	CF CF	CF CF	CF	CF	CF CF	CF	CF	DN DN	DN DN	DN DN	DN DN	DN DN	DN DN	DN DN
330 pF	331	İ			F			j	K	М	BB	BB	BB	BB	BB	BD	BD	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN
360 pF	361	İ			F	= (J	K	М	BB	BB	ВВ	ВВ	ВВ			CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN
390 pF	391				F	_	_	J	K	М	BB	BB	BB	BB	BB			CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN
430 pF	431				F			J	K	М	BB	BB	BB	BB	BB			CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN
470 pF 510 - 820 pF*	471 511 - 821*	l			F			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	DP DN	DP DN
910 pF	911	İ			F			J	K	М	BB	BB	BB	BB	BB			CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DP	DP	DP
1,000 pF	102	İ			F			J	K	М	BB	BB	BB	BB	BB			CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DP	DP	DP
1,100 pF	112				F	- 1		J	K	М	BB	BB	BB	BB				CF	CF	CF	CF	CF	CH	CH	DN	DN	DN	DN	DN	DN	DN
1,200 pF 1,300 pF	122 132				F		-	J	K K	M M	BB BB	BB BB	BB BB	BB BB				CF CF	CF CF	CF CF	CF CF	CF CF	CH	CH	DN DP	DN DP	DN DP	DN DP	DN DP	DN DN	DN DN
1,500 pF 1,500 pF	152				F			J	K K	М	BB	BB	BB	BB				CF	CF	CF	CF	CF	CH	CH	DP	DP	DP	DP	DP	DN	DN
1,600 pF	162	İ			F		_	J	K	М	BB	BB	BB					CF	CF	CF	CF	CF	CH	CH	DP	DP	DP	DP	DP	DN	DN
1,800 pF	182				F		G	J	K	М	BB	BB	BB					CF	CF	CF	CF	CF	СН	СН	DP	DP	DP	DP	DP	DN	DN
2,000 pF	202				F			J	K	М	BB	BB	BB					CF	CF	CF	CF	CF	CH	CH	DN	DN	DN	DN	DN	DN	DN
2,200 pF 2,400 pF	222 242				F		-	J	K K	M M	BB	BB	BB					CF CF	CF CF	CF CF	CF CF	CF CF	СН	СН	DN DN	DN DN	DN DN	DN DN	DN DN	DN DN	DN DN
2,400 pf 2,700 pF	272				F			J	K	М								CF	CF	CF	CF	CF			DN	DN	DN	DN	DN	DN	DN
3,000 pF	302				F	_		J	K	М								CF	CF	CF	CF	CF			DP	DP	DP	DP	DN	DN	DN
3,300 pF	332				F			J	K	М								CF	CF	CF	CF	CF			DP	DP	DP	DP	DN	DN	DN
3,600 pF	362				F			J	K	М								CF	CF	CF	CF	CF			DP	DP	DP	DP	DN	DP	DP
3,900 pF 4,300 pF	392 432				F			J	K K	M M								CF CF	CF CF	CF CF	CF CF	CF CF			DE DE	DE DE	DE	DE	DN DN	DP DP	DP DP
4,700 pF	472				F	_	_	J	K	М								CF	CF	CF	CF	CF			DE	DE	DE	DE	DN	DP	DP
5,100 pF	512	İ			F			J	K	М								CF	CF	CF	CF				DE	DE	DE	DE	DN	DP	DP
5,600 pF	562				F			J	K	М								CF	CF	CF	CF				DN	DN	DN	DN	DN	DP	DP
6,200 pF	622 682				F			J	K	М								CF CF	CF	CF CF	CF CF				DN	DN DN	DN	DN	DN DN	DG	DG DG
6,800 pF 7,500 pF	752				F		-	J	K K	M M								CF	CF CF	CF	CF				DN	DN	DN DN	DN	DN	DG DG	DG
8,200 pF	822				F	- 1	_	J	K	М								CF	CF	CF					DN	DN	DN	DN	DN	DG	DG
9,100 pF	912	ĺ			F		- 1	J	K	М								CF	CF	CF					DN	DN	DN	DN	DN		
10,000 pF	103				F		- 1	J	K	М								CF	CF	CF					DN	DN	DN	DN	DP		
12,000 pF	123 153				F	_	-	J	K K	M M								CF CF	CF	CF CF					DN	DN	DN DN	DN DP	DE		
15,000 pF 18,000 pF	183				F		-	J	K K	M								UF.	CF	UF					DN DN	DN	DN	DP	DG		
22,000 pF	223				F		-		K																DP	DP	DP	DF			
27,000 pF	273				F	= (G	J	K	М															DF	DF	DF				
33,000 pF	333				F	_			K																DG	DG	DG				
39,000 pF 47,000 pF	393 473				F		G G		K K																DG DG	DG DG	DG DG				
,ооорі	.,,,	Ra	ate	d '	Vo	_	_	_	_		9	9	25	20	9	200	250	9	9	25	20	9	200	250	9	96	25	20	9	200	250
Capacitance	Cap				ltag		<u> </u>	<u> </u>	_	-/	8	4	3	5	1	2	A	8	4	3	5	1	2	A	8	4	3	5	1	2	A
	Code	H							_	;		<u> </u>		0402		_	1.	Ť			0603				Ť			0805		_	
		<u> </u>	Case Size/Series										<u> </u>							l											

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91) KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).

These products are protected under US Patents 7,172,985 & 7,670,981, other patents pending, and any foreign counterparts.



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

			Ca	as	e S	Siz	e/	Se	rie	es			C	120	6T					С	1210)T				C18	12T		С	2220)T
	Сар	r		Vo	olta	age	e C	coc	le		8	4	3	5	1	2	Α	8	4	3	5	1	2	Α	5	1	2	Α	5	1	2
Capacitance	Code	ļ,				Ť				OC)	10	16	25	20	100	200	20	5	16	25	20	100	200	250	20	100	200	250	20	100	200
	Code	ŀ						inc		-	_	_	N	4,	7		duct										Ñ	8	4,	7	Ñ
								ce									ee Ta														
1.0 - 9.1 pF*	109 - 919*	T	3 (С	D			Ι.			EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB							
10 - 91 pF* 100 - 430 pF*	100 - 910* 101 - 431*					F F	G G	J	K		EB EB	EB EB	EB	EB EB	EB EB	EB EB	EB EB	FB FB	FB FB	FB FB	FB FB	FB FB	FB FB	FB FB							
470 - 910 pF*	471 - 911*					F	G	J	K		EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB			
1,000 pF	102	١				F	G	J	K		EB	EB	EB	EB	EB	EE	EE	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB			
1,100 pF	112	T				F	G	J	K		EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB			
1,200 pF	122	İ				F	G	J	K		EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB			
1,300 pF	132	İ				F	G	J	K	М	EB	EB	EB	EB	EC	EC	EC	FB	FB	FB	FB	FB	FC	FC	GB	GB	GB	GB	İ		
1,500 pF	152	İ			İ	F	G	J	K	М	EB	EB	EB	EB	ED	EC	EC	FB	FB	FB	FB	FB	FE	FE	GB	GB	GB	GB	İ		
1,600 pF	162	İ				F	G	J	K	М	EB	EB	EB	EB	ED	ED	ED	FB	FB	FB	FB	FB	FE	FE	GB	GB	GB	GB	Ī		
1,800 pF	182	ı				F	G	J	K	M	EB	EB	EB	EB	ED	ED	ED	FB	FB	FB	FB	FB	FE	FE	GB	GB	GB	GB			
2,000 pF	202					F	G	J	K	M	EB	EB	EB	EB	ED	ED	ED	FB	FB	FB	FB	FC	FE	FE	GB	GB	GB	GB			
2,200 pF	222					F	G	J	K		EB	EB	EB	EB	EE	EE	ED	FB	FB	FB	FB	FC	FG	FG	GB	GB	GB	GB			
2,400 pF	242					F	G	J	K		EB	EB	EB	EB	EC	EC	EC	FB	FB	FB	FB	FC	FC	FC							
2,700 pF	272					F	G	J	K		EB	EB	EB	EB	EC	EC	EC	FB	FB	FB	FB	FC	FC	FC	GB	GB	GB	GB			
3,000 pF	302					F	G	J	K		EC	EC	EC	EC	EC	EB	EB	FB	FB	FB	FB	FC	FF	FF	0.0	0.0	0.0	0.0			
3,300 pF	332					F	G	J	K		EC	EC	EC	EC	EE	EB	EB	FB	FB	FB	FB	FF	FF	FF	GB	GB	GB	GB			
3,600 pF	362					F F	G G	J	K		EC EC	EC	EC	EC EC	EE	EB EB	EB EB	FB	FB FB	FB FB	FB FB	FF FF	FF	FF	GB	GB	CD	GB			
3,900 pF 4,300 pF	392 432					F	G	J	K		EC	EC EC	EC	EC	EC	EB	EB	FB FB	FB	FB	FB	FF	FF FF	FF FF	GB	GB	GB	GB			
4,700 pF	472	H				F	G	J	K		EC	EC	EC	EC	EC	EB	EB	FF	FF	FF	FF	FG	FG	FG	GB	GB	GD	GD			
5,100 pF	512					F	G	J	K		ED	ED	ED	ED	ED	EB	EB	FB	FB	FB	FB	FG	FG	FG	GB	GB	GD	GD			
5,600 pF	562	ı				F	G	J	K		ED	ED	ED	ED	ED	EB	EB	FB	FB	FB	FB	FG	FG	FG	GB	GB	GH	GH			
6,200 pF	622	١				F	G	J	K		EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FG	FB	FB		05	0	011			
6,800 pF	682	ı				F	G	J	K		EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FG	FB	FB	GB	GB	GJ	GJ	JE	JE	JB
7,500 pF	752	Т		Т		F	G	J	K		EB	EB	EB	EB	EB	EB	EB	FC	FC	FC	FC	FC	FB	FB							
8,200 pF	822	İ				F	G	J	K	М	EC	EC	EC	EC	EB	EC	EC	FC	FC	FC	FC	FC	FB	FB	GB	GH	GB	GB	JE	JE	JB
9,100 pF	912	İ			İ	F	G	J	K	M	EC	EC	EC	EC	EB	EC	EC	FE	FE	FE	FE	FE	FB	FB	İ				İ		
10,000 pF	103					F	G	J	K	M	ED	ED	ED	ED	EB	EC	EC	FF	FF	FF	FF	FF	FB	FB	GB	GH	GB	GB	JE	JE	JB
12,000 pF	123					F	G	J	K	M	EB	EB	EB	EB	EB	ED	ED	FG	FG	FG	FG	FB	FB	FB	GB	GG	GB	GB	JE	JE	JB
15,000 pF	153					F	G	J	K		EB	EB	EB	EB	EB	EF	EF	FG	FG	FG	FG	FB	FC	FC	GB	GB	GB	GB	JE	JE	JB
18,000 pF	183	1				F	G	J	K		EB	EB	EB	EB	EB	EH	EH	FB	FB	FB	FB	FB	FC	FC	GB	GB	GB	GB	JE	JE	JB
22,000 pF	223					F	G	J	K		EB	EB	EB	EB	EC	EH	EH	FB	FB	FB	FB	FB	FF	FF	GB	GB	GB	GB	JE	JB	JB
27,000 pF	273					F	G	J	K		EB	EB	EB	EB	EE			FB	FB	FB	FB	FB	FG	FG	GB	GB	GB	GB	JE	JB	JB
33,000 pF	333					F	G	J	K		EB	EB	EB	EB	EE			FB	FB	FB	FB	FB	FH	FH	GB	GB	GB	GB	JB	JB	JB
39,000 pF	393					F F	G G	J	K		EC	EC	EC	EE	EH			FB	FB	FB FB	FB	FE	FH	FH	GB	GB	GB	GB	JB	JB	JB
47,000 pF 56,000 pF	473 563					F	G	J	K		EC ED	EC ED	EC ED	EF	EH			FB FB	FB FB	FB	FB FB	FE FF	FJ	FJ	GB GB	GB GB	GD GD	GD GD	JB JB	JB JB	JB JB
56,000 pF 68,000 pF	683					F	G	J	K		EF	EF	EF	EH				FB	FB	FB	FC	FG			GB	GB	GK	GK	JB	JB	JB
82,000 pF	823					F	G	J	K		EH	EH	EH	EH				FC	FC	FC	FF	FH			GB	GB	GM	GM	JВ	JB	JB
0.10 µF	104					F	G	J	K		EH	EH	EH					FE	FE	FE	FG	FM			GB	GD	GM	GM	JB	JB	JD
0.12 µF	124					F	G	J	K									FG	FG	FG	FH				GB	GH			JB	JB	JD
0.15 µF	154					F	G	J		M								FH	FH	FH	FM				GD	GN			JB	JB	JG
0.18 µF	184					F	G	J		M								FJ	FJ	FJ					GH				JB	JD	JG
0.22 µF	224					F	G	J		M								FK		FK					GK				JB	JD	JL
0.27 μF	274					F	G	J	K	M																			JB	JF	
0.33 μF	334					F	G	J		M																			JD	JG	
0.39 μF	394					F	G	J		M																			JG		
0.47 μF	474	+				F	G	J	K	М					+_	+_	 	├		-		_	_	_	<u> </u>	_	_	_	JG	_	_
	Сар	F	Rat	tec	V	olt	ag	je (VE	OC)	10	16	25	50	100	200	250	9	16	25	20	100	200	250	20	100	200	250	20	100	200
Capacitance	Code					8	4	3	5	1	2	Α	8	4	3	5	1	2	Α	5	1	2	Α	5	1	2					
			Case Size/Series							120	6T					C	1210	T				C18	12T		С	2220	T				

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91) KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).

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

Thickness	Case	Thickness ±	Paper Q	uantity¹	Plastic	Quantity
Code	Size ¹	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
BB	402	0.50 ± 0.05	10000	50000	0	0
BD	402	0.55 ± 0.05	10000	50000	0	0
CF	603	0.80 ± 0.07	4000	15000	0	0
CH	603	0.85 ± 0.07	4000	10000	0	0
DN DP	805 805	0.78 ± 0.10 0.90 ± 0.10	4000 4000	15000 15000	0	0
DE	0805	1.00 ± 0.10	4000	0	2,500	10,000
DF	0805	1.10 ± 0.10	0	0	2,500	10,000
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
EB	1206	0.78 ± 0.10	4,000	10,000	4,000	10,000
EC	1206	0.70 ± 0.10 0.90 ± 0.10	0	0	4,000	10,000
ED	1206	1.00 ± 0.10	0	Ö	2,500	10,000
EE	1206	1.10 ± 0.10	Ö	0	2,500	10,000
EF	1206	1.20 ± 0.15	0	0	2,500	10,000
EH	1206	1.60 ± 0.20	0	0	2,000	8,000
FB	1210	0.78 ± 0.10	0	0	4,000	10,000
FC	1210	0.90 ± 0.10	0	0	4,000	10,000
FE	1210	1.00 ± 0.10	0	0	2,500	10,000
FF	1210	1.10 ± 0.10	0	0	2,500	10,000
FG	1210	1.25 ± 0.15	0	0	2,500	10,000
FH	1210	1.55 ± 0.15	0	0	2,000	8,000
FM	1210	1.70 ± 0.20	0	0	2,000	8,000
FJ	1210	1.85 ± 0.20	0	0	2,000	8,000
FK	1210	2.10 ± 0.20	0	0	2,000	8,000
GB	1812	1.00 ± 0.10	0	0	1,000	4,000
GD	1812	1.25 ± 0.15	0	0	1,000	4,000
GH	1812	1.40 ± 0.15	0	0	1,000	4,000
GG	1812	1.55 ± 0.10	0	0	1,000	4,000
GK	1812	1.60 ± 0.20	0 0	0 0	1,000	4,000
GJ GN	1812 1812	1.70 ± 0.15	0	0	1,000 1,000	4,000 4,000
GN GM	1812	1.70 ± 0.20 2.00 ± 0.20	0	0	500	2,000
JB	2220	2.00 ± 0.20 1.00 ± 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
JG	2220	1.70 ± 0.15	0	0	1,000	4,000
JL	2220	2.00 ± 0.20	Ő	Ő	500	2,000
Thickness	Case	Thickness ±	7" Reel	13" Reel	7" Reel	13" Reel
Code	Size ¹	Range (mm)	Paper Q	uantity¹	Plastic	Quantity

Package quantity based on finished chip thickness specifications.

¹ If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Table 2B - Bulk Packaging Quantities

Paulion	.	Loose Pa	ackaging
Раскад	ing Type	Bulk Bag	(default)
Packagir	ng C-Spec ¹	N/	/A ²
Case	e Size	Packaging Quantities (pieces/unit packaging)
EIA (in)	Metric (mm)	Minimum	Maximum
0402	1005		
0603	1608		
0805	2012		50,000
1206	3216		
1210	3225	1	
1808	4520] '	
1812	4532		
1825	4564		20,000
2220	5650		
2225	5664		

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

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



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

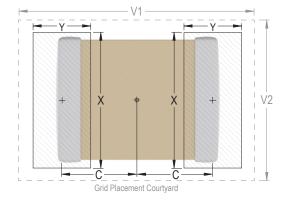
EIA Size Code	Metric Size Code		Maxi	sity Lev mum (M rotrusio	Most))		Medi	sity Lev an (Nor rotrusio	ninal))	Density Level C: Minimum (Least) Land Protrusion (mm)								
Oode	Ouc	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	X	V1	V2				
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	0.40	0.52	0.52	1.60	0.80				
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				
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				
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				

¹ 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

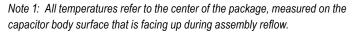
Recommended Soldering Technique:

- 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
Frome reature	SnPb	100% Matte Sn
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum



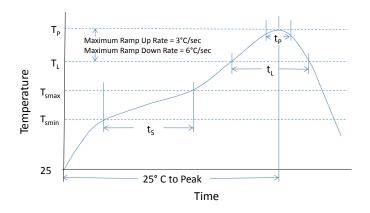




Table 4 - Performance & Reliability: Test Methods and Conditions

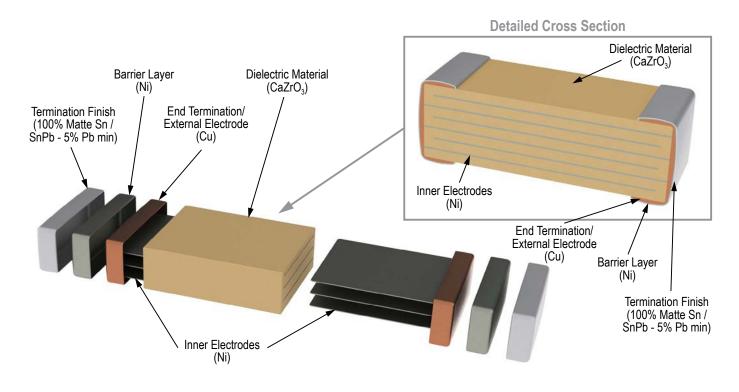
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Solderability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	J-31D-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion. Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
Vibration	MIL-STD-202 Method 204	5 g's for 20 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature- reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



Capacitor Marking (Optional):

Laser marking option is not available on:

- C0G, Ultra Stable X8R and Y5V dielectric devices
- EIA 0402 case size devices
- EIA 0603 case size devices with Flexible Termination option.
- KPS Commercial and Automotive grade stacked devices.

These capacitors are supplied unmarked only.

Commercial Off-The-Shelf (COTS) for Higher Reliability Applications, X7R Dielectric, 6.3 – 250 VDC

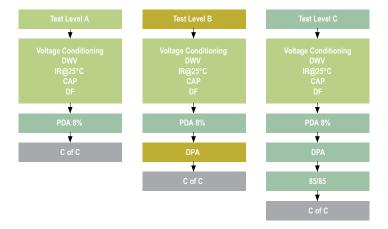


Overview

KEMET's COTS program is an extension of KEMET knowledge of high reliability test regimes and requirements. KEMET regularly supplies "up-screened" products by working with customer drawings and imposing specified design and test requirements. The COTS program offers the same high quality and high reliability components as up-screened products, but at a lower cost to the customer. This is accomplished by eliminating the need for customer-specific drawings to achieve the reliability level required for customer applications. A series of tests and inspections have been selected to provide the accelerated conditioning and 100% screening necessary to eliminate infant mortal failures from the population.

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.

All COTS testing includes voltage conditioning and post-electrical testing as per MIL–PRF–55681. For enhanced reliability, KEMET also provides the following test level options and conformance certifications:





Ordering Information

С	1210	T	104	K	5	R	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/Design	Termination Finish ¹	Packaging/Grade (C-Spec)
	0402 0603 0805 1206 1210 1812 2220	T = COTS	Two significant digits + number of zeros	J = ±5% K = ±10% M = ±20%	9 = 6.3 8 = 10 4 = 16 3 = 25 5 = 50 1 = 100 2 = 200 A = 250	R = X7R	A = Testing per MIL-PRF- 55681 PDA 8% B= Testing per MIL-PRF- 55681 PDA 8%, DPA per EIA-469 C = Testing per MIL-PRF- 55681 PDA 8%, DPA per EIA- 469, Humidity per MIL-STD-202, Method 103, Condition A	C = 100% Matte Sn L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

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



Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec)
Bulk Bag/Unmarked	Not required (Blank)
7" Reel/Unmarked	TU
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
7" Reel/Marked	TM
13" Reel/Marked	7040 (EIA 0603 and smaller case sizes) 7215 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2mm pitch ²	7081
13" Reel/Unmarked/2mm pitch ²	7082

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- -55°C to +125°C operating temperature range
- · Lead (Pb)-Free, RoHS and REACH compliant
- Voltage conditioning and post-electrical testing per MIL–PRF– 55681
- Destructive Physical Analysis (DPA) per EIA–469
- Biased humidity testing (85/85) per MIL-STD-202
- · Certificate of Compliance
- · Temperature stable dielectric
- EIA 0402, 0603, 0805, 1206, 1210, 1812, and 2220 case sizes

- DC voltage ratings of 6.3 V, 10 V, 16 V, 25 V, 50 V, 100 V, 200 V, and 250 V
- Capacitance offerings ranging from 10 pF to 22 μF
- Available capacitance tolerances of ±5%, ±10%, and ±20%
- · Non-polar device, minimizing installation concerns
- 100% pure matte tin-plated termination finish allowing for excellent solderability
- SnPb termination finish option available upon request (5% Pb minimum)

Applications

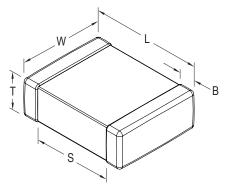
Typical applications include military, space quality and high reliability electronics.

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. Please contact KEMET if you require a laser marked option. For more information see "Capacitor Marking".

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Dimensions – Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0402	1005	1.00 (.040) ± 0.05 (.002)	0.50 (.020) ± 0.05 (.002)		0.30 (.012) ± 0.10 (.004)	0.30 (.012)	Solder Reflow Only
0603	1608	1.60 (.063) ± 0.15 (.006)	0.80 (.032) ± 0.15 (.006)		0.35 (.014) ± 0.15 (.006)	0.70 (.028)	
0805	2012	2.00 (.079) ± 0.20 (.008)	1.25 (.049) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	Solder Wave or Solder Reflow
1206	3216	3.20 (.126) ± 0.20 (.008)	1.60 (.063) ± 0.20 (.008)	See Table 2 for Thickness	0.50 (0.02) ± 0.25 (.010)		
1210¹	3225	3.20 (.126) ± 0.20 (.008)	2.50 (.098) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)	NI/A	
1812	4532	4.50 (.177) ± 0.30 (.012)	3.20 (.126) ± 0.30 (.012)		0.60 (.024) ± 0.35 (.014)	N/A	Solder Reflow Only
2220	5650	5.70 (.224) ± 0.40 (.016)	5.00 (.197) ± 0.40 (.016)		0.60 (.024) ± 0.35 (.014)		

¹ For capacitance values ≥ 4.7 μ 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%
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
² Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ± 1 seconds and charge/discharge not exceeding 50mA)
³ Dissipation Factor (DF) Maximum Limit @ 25°C	5%(6.3V & 10V), 3.5%(16V & 25V) and 2.5%(50V to 250V)
⁴Insulation Resistance (IR) Minimum Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ± 5 secs @ 25°C)

¹Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

 $1kHz \pm 50Hz$ and 1.0 ± 0.2 Vrms if capacitance ≤ $10\mu F$

120Hz \pm 10Hz and 0.5 ± 0.1 Vrms if capacitance >10 μ F

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

Post Environmental Limits

	High Temperatu	ıre Life, Biased	Humidity, Moist	ture Resistance	
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance
	> 25		3.0		
X7R	16/25	All	5.0	±20%	10% of Initial Limit
	< 16		7.5		

Insulation Resistance Limit Table

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

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

⁴To obtain IR limit, divide MΩ- μ F value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



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

		_	se S erie			CO)40	2T				CO	603	3T					(C 08	051	•						C12	06T			
Capacitance	Сар	Volt	age C	ode	9	8	4	3	5	9	8	4	3	5	1	2	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	A
	Code		ed Vol	•	6.3	5	9	25	20	6.3	5	9	25	20	9	200	6.3	5	9	52	20	90	200	220	6.3	9	9	25	20	100	200	250
		Сар	acita	nce													bility or Ch								ļ							
10 – 91 pF*	100 – 910*	J	K	M	BB	ВВ	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN		EB	EB	EB	EB	EB	EB	EB	
100 – 150 pF**	101 – 151**	J	K	М	ВВ	ВВ	ВВ	ВВ	ВВ	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN		ЕВ	EB	EB	EB	EB	EB	EB	
180 – 820 pF** 1,000 pF	181 – 821** 102	J	K K	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	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	EB
1,200 pF	122	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
1,500 pF	152	J	K	М	ВВ	ВВ	ВВ	BB	ВВ	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN		DN	DN	DN	EB	EB	EB	EB	EB	EB	EB	EB
1,800 pF	182	J	K	M	ВВ	ВВ	ВВ	BB	ВВ	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN		DN	DN	DN	EB	EB	EB	EB	EB	EB	EB	EB
2,200 pF	222	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
2,700 pF 3,300 pF	272 332	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	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB
3,900 pF	392	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
4,700 pF	472	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
5,600 pF	562	J	K	M	ВВ	ВВ	ВВ	ВВ	ВВ	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN	EB	EB	EB	ЕВ	EB	EB	EB	EB
6,800 pF	682	J	K	М	BB	ВВ	ВВ	BB	ВВ	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN	EB	EB	EB	EB	EB	EB	EB	EB
8,200 pF	822	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF CF	DN	DN	DN	DN	DN	DN	DN	DN	EB	EB	EB	EB	EB	EB	EB	EB
10,000 pF 12,000 pF	103 123	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	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
15,000 pF	153	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF		DN	DN	DN	DN		DP	DN	DN	EB	EB	EB	EB	EB	EB	EB	EB
18,000 pF	183	J	K	М	ВВ	ВВ	BB	BB	BB	CF	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DP	DN	DN	EB	EB	EB	EB	EB	EB	EB	EB
22,000 pF	223	J	K	М	ВВ	ВВ	ВВ	BB	ВВ	CF	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DP	DN	DN	EB	EB	EB	EB	EB	EB	EB	EB
27,000 pF	273	J	K	M	BB	BB	BB	BB		CF	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DP	DE		EB	EB	EB	EB	EB	EB	EB	EB
33,000 pF 39,000 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	DP DP	DE DE		EB EB	EB EB	EB EB	EB EB	EB EB	EB EC	EB EB	EB EB
47,000 pF	473	J	K	M	BB	BB	BB	BB		CF	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DE	DG		EB	EB	EB	EB	EB	EC	ED	ED
56,000 pF	563	J	K	M	BB	BB	BB			CF	CF	CF	CF	CF	0.		DP	DP	DP	DP	DP	DE	DG		EB	EB	EB	EB	EB	EB	ED	ED
68,000 pF	683	J	K	М	ВВ	ВВ	ВВ			CF	CF	CF	CF	CF			DP	DP	DP	DP	DP	DE			EB	EB	EB	EB	EB	EB	ED	ED
82,000 pF	823	J	K	M	BB	ВВ	ВВ			CF	CF	CF	CF	CF			DP	DP	DP	DP	DP	DE			EB	EB	EB	EB	EB	EB	ED	ED
0.10 µF	104 124	J	K	M	BB	BB	BB			CF	CF CF	CF CF	CF CF	CF CF			DN	DN	DN	DN		DE			EB	EB EC	EB EC	EB EC	EB	EB EC	EM EG	EM
0.12 μF 0.15 μF	154	J	K K	M M						CF CF	CF	CF	CF	CF			DN DN	DN DN	DN DN	DN DN	DP DP	DG DG			EC EC	EC	EC	EC	EC	EC	EG	
0.18 μF	184	J	K	M						CF	CF	CF	CF	Oi			DN	DN	DN	DN	DP	DG			EC	EC	EC	EC	EC	EC	LO	
0.22 µF	224	J	K	М	İ					CF	CF	CF	CF				DN	DN	DN	DN	DP	DG			EC	EC	EC	EC	EC	EC		
0.27 μF	274	J	K	M						CF	CF	CF					DP	DP	DP	DP	DP				EB	EB	EB	EB	EC	EM		
0.33 µF	334	J	K	M						CF	CF	CF					DP	DP	DP	DP	DP				EB	EB	EB	EB	EC	EG		
0.39 µF 0.47 µF	394 474	J	K K	M						CF CF	CF CF	CF CF					DG DP	DG DP	DG DP	DG DP	DE DE				EB	EB	EB	EB	EC EC	EG EG		
0.47 μF 0.56 μF	564	J	K	M						0	01	OI .					DP	DP	DP	DG	DH				ED	ED	ED	ED	EC	LG		
0.68 µF	684	J	K	M						l							DP	DP	DP	DG	DH				EE	EE	EE	EE	ED			
0.82 μF	824	J	K	М													DP	DP	DP	DG					EF	EF	EF	EF	ED			
1.0 µF	105	J	K	M													DP	DP	DP	DG					EF	EF	EF	EG				
1.2 μF 1.5 μF	125 155	J	K K	M														DE DG							ED EF	ED EF	ED EF		EH			
1.5 µF 1.8 µF	155 185	J	K	M														DG							ED	ED	ED					
2.2 µF	225	J	K	M														DG							ED	ED		EF				
2.7 µF	275	J	K	M																					EN	EN	EN	EH				
3.3 µF	335	J	K	М																					ED	ED		EH				
3.9 µF	395 475	J	K	M																					EF	EF	EF					
4.7 μF 5.6 μF	475 565	J J	K K	M M						1															EF EH	EF EH		EH				
6.8 µF	685	J	K	M																					EH		EH					
·			ed Vol		6.3	9	9	25	20	6.3	9	9	25	20	100	200	6.3	9	9	25	20	100	200	250	6.3	ę	16	25	20	100	200	250
Capacitance	Cap				9	8	4	3	5	9	8	4	3	5	1	2	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	Α
	Code	Voltage Code Case Size/ Series		Ť		0402		_ •	Ť	_ ,		0603		'		Ť			C08		1		_ ^	Ť			C12		•		, A	

^{*}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)



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

	Case Size/ Series		CO)402	2T		C0603T								C0805T								C1206T							
Capacitance	Cap	Voltage Code	9	8	4	3	5	9	8	4	3	5	1	2	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	Α
Oupdoitance	Code	Rated Voltage (VDC)	6.3	9	16	25	20	6.3	10	16	25	50	100	200	6.3	9	16	25	20	100	200	250	6.3	10	16	25	50	100	200	250
		Capacitance Tolerance		Product Availability and Chip Thickness Codes See Table 2 for Chip Thickness Dimensions														,												
8.2 μF 10 μF	825 106	J K M J K M																					EH EH	EH EH	EH					
	Cap	Rated Voltage (VDC)	6.3	10	16	25	20	6.3	10	16	25	50	100	200	6.3	9	16	25	20	100	200	250	6.3	10	16	22	50	100	200	250
Capacitance	Code	Voltage Code	9	8	4	3	5	9	8	4	3	5	1	2	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	Α
		Case Size/ Series		С	0402	T		C0603T					C0805T								C1206T									

^{*}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)

Table 1B - Capacitance Range/Selection Waterfall (1210 - 2220 Case Sizes)

			se S erie	ize/ es				C12	210T				C1808T			C1812T					C18	25T			C2220T				
Canacitance	Can Cada	Volt	Voltage Code Rated Voltage (VDC) Capacitance		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
Capacitance	Cap Code	Rate			6.3	9	16	52	20	100	200	, 250	. 20	9	700	52	20	9	500	250	35	100	200	250	25	20	100	200	250
			lerar									Pi	rodu See	ct Av Table	allab 2 fo	ility a r Chi	and C p Thi	hip T	nıckı ss Di	ness mens	Code	es							
10 - 91 pF*	100 - 910*	J	K	М	FB	FB	FB	FB	FB	FB	FB																		
100 - 270 pF**	101 - 391**	J	K	M	FB	FB	FB	FB	FB	FB	FB		İ		İ	l													
330 pF	331	J	K	M	FB	FB	FB	FB	FB	FB	FB		LF	LF	LF	l													
390 pF	391	J	K	M	FB	FB	FB	FB	FB	FB	FB		LF	LF	LF														
470 - 820 pF**	471 - 821**	J	K	M	FB	FB	FB	FB	FB	FB	FB		LF	LF	LF	GB	GB	GB	GB										
1,000 pF	102	J	K	М	FB	FB	FB	FB	FB	FB	FB		LF	LF	LF	GB	GB	GB	GB										
1,200 pF	122	J	K	M	FB	FB	FB	FB	FB	FB	FB		LF	LF	LF	GB	GB	GB	GB										
1,500 pF	152	J	K	M	FB	FB	FB	FB	FB	FB	FE		LF	LF	LF	GB	GB	GB	GB										
1,800 pF	182	J	K	M	FB	FB	FB	FB	FB	FB	FE		LF	LF	LF	GB	GB	GB	GB										
2,200 pF	222	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LF	LF	LF	GB	GB	GB	GB										
2,700 pF	272	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LF	LF	LF	GB	GB	GB	GB										
3,300 pF	332	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LF	LF		GB	GB	GB	GB										
3,900 pF	392	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LF	LF		GB	GB	GB	GB										
4,700 pF	472	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD		GB	GB	GB	GD										
5,600 pF	562	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	İ	GB	GB	GB	GH										
6,800 pF	682	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD		GB	GB	GB	GB	GB					JE	JE	JE		
8,200 pF	822	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	İ	GB	GB	GB	GB	GB	İ				JE	JE	JE		
10,000 pF	103	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	İ	GB	GB	GB	GB	GB	İ				JE	JE	JE		
12,000 pF	123	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	İ	GB	GB	GB	GB	GB	İ				JE	JE	JE		
15,000 pF	153	J	K	М	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	İ	GB	GB	GB	GB	GB					JΕ	JE	JE		
18,000 pF	183	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD		GB	GB	GB	GB	GB					JE	JE	JE		
22,000 pF	223	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	İ	GB	GB	GB	GB	GB	НВ	НВ	НВ	НВ	JE	JE	JE		
27,000 pF	273	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	İ	GB	GB	GB	GB	GB	НВ	НВ	НВ	НВ	JE	JE	JE		
			d Vol		6.3	10	16	25	20	100	200	250	20	100	200	25	20	100	200	250	20	100	200	250	25	20	100	200	250
Capacitance	Cap	Volt	age C	Code	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
Code			Voltage Code Case Size/ Series			C1210T					C	1808	T	C1812T				C1825T				C2220T							

^{*}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)

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



Table 1B - Capacitance Range/Selection Waterfall (1210 - 2220 Case Sizes) cont'd

		Case Size/ Series		C1210T									1808	ВТ		С	1812	2T			C18	325T		C2220T					
Capacitance	Can Code	Volt	Voltage Code Rated Voltage (VDC)		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
Capacitance	cap code				6.3	10	16	25	20	100	200	250	20	100	200	25	20	100	200	250	20	100	200	250	25	20	100	200	250
			acita		Product Availability and Chip Thicknes See Table 2 for Chip Thickness Dimer																								
33,000 pF	333	<u>10</u>	leran K		FB	FB	FB	FB	FB	FB	FB	FB	See LD	LD	2 10	GB	GB	GB GB	GB	mens GB	HB	НВ	НВ	НВ	JB	JB	JB		
39,000 pF 39,000 pF	393	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		
47,000 pF	473	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		
56,000 pF	563	J	K	M	FB	FB	FB	FB	FB	FB	FC	FC	LD	LD		GB	GB	GB	GB	GB	НВ	HB	HB	HB	JB	JB	JB		. !
68,000 pF	683	J	K	M	FB	FB	FB	FB	FB	FB	FC	FC	LD	LD		GB	GB	GB	GB	GB	НВ	НВ	HB	HB	JB	JB	JB		
82,000 pF	823	J	K	M	FB	FB	FB	FB	FB	FC	FF	FF	LD	ł		GB	GB	GB	GB	GB	НВ	НВ	HB	HB	JB	JB	JC	JC	JC
0.10 µF	104	J	K	M	FB	FB	FB	FB	FB	FD	FG	FG	LD	ł		GB	GB	GB	GB	GB	НВ	HB	HB	HB	JB	JB	JC	JC	JC
0.10 μF 0.12 μF	104	J	K	M	FB	FB	FB	FB	FB	FD	FH	FH	LD			GB	GB	GB	GB	GB	НВ	НВ	НВ	НВ	JB	JB	JC	JC	JC
	154		K		FC	FC	FC	FC	FC	FD	FM	FM	LD			GB	GB	GB	GE	GE	НВ	НВ	НВ	НВ	JB	JB	JC	JC	JC
0.15 µF		J		M				FC	FC		FK	FK	LD			GB	GB	GB	GG	GG	НВ								
0.18 µF	184	J	K	M	FC	FC	FC			FD			LD	ł								НВ	НВ	HB	JB	JB	JC	JC	JC
0.22 µF	224	J	K	M	FC	FC	FC	FC	FC	FD	FK	FK		ł		GB	GB	GB	GG	GG	НВ	НВ	НВ	НВ	JB	JB	JC	JC	JC
0.27 µF	274	J	K	M	FC	FC	FC	FC	FC	FD						GB	GB	GG	GG	GG	НВ	НВ	НВ	НВ	JC	JC	JC	JC	JC
0.33 μF	334	J	K	M	FD	FD	FD	FD	FD	FD						GB	GB	GG	GG	GG	НВ	НВ	НВ	HB	JC	JC	JC	JC	JC
0.39 µF	394	J	K	M	FD	FD	FD	FD	FD	FD						GB	GB	GG	GG	GG	HD	HD	HD	HD	JC	JC	JC	JC	JC
0.47 µF	474	J	K	M	FD	FD	FD	FD	FD	FD						GB	GB	GG	GJ	GJ	HD	HD	HD	HD	JC	JC	JC	JC	JC
0.56 µF	564	J	K	M	FD	FD	FD	FD	FD	FF						GC	GC	GG			HD	HD	HD	HD	JC	JD	JD	JD	JD
0.68 µF	684	J	K	M	FD	FD	FD	FD	FD	FG						GC	GC	GG			HD	HD	HD	HD	JC	JD	JD	JD	JD
0.82 µF	824	J	K	M	FF	FF	FF	FF	FF	FL						GE	GE	GG			HF	HF	HF	HF	JC	JF	JF	JF	JF
1.0 µF	105	J	K	M	FH	FH	FH	FH	FH	FM						GE	GE	GG			HF	HF	HF	HF	JC	JF	JF	JF	JF
1.2 µF	125	J	K	M	FH	FH	FH	FH	FG																JC	JC			
1.5 µF	155	J	K	M	FH	FH	FH	FH	FG																JC	JC			
1.8 µF	185	J	K	M	FH	FH	FH	FH	FG																JD	JD			
2.2 µF	225	J	K	M	FJ	FJ	FJ	FJ	FG							GO	GO								JF	JF			
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	K	M	FG	FG	FG	FM																					
8.2 µF	825	J	K	M	FH	FH	FH	FK																					
10 µF	106	J	K	M	FH	FH	FH	FS								GK									JF	JO			
12 µF	126	J	K	M																									
15 µF	156	J	K	М																					JO				
18 µF	186	J	K	М	l								İ			İ					I				I				
22 µF	226	J	K	М	FS	FS								<u> </u>											JO				
			ed Vol	•	6.3	6	16	25	20	100	200	250	20	100	200	25	20	100	200	250	20	100	200	250	25	20	100	200	250
Capacitance	Сар		•		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
	Code Voltage Code Case Size/ Series						_	10T				Ť	1808		Ů	_	1812			Ľ		325T		Ľ	_	2220			

^{*}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)



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

Thickness	Case	Thickness ±	Paper Q	luantity ¹	Plastic (Quantity				
Code	Size ¹	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel				
BB CF DN DP DE	0402 0603 0805 0805 0805	0.50 ± 0.05 0.80 ± 0.07 0.78 ± 0.10 0.90 ± 0.10 1.00 ± 0.10	10,000 4,000 4,000 4,000 0	50,000 15,000 15,000 15,000 0	0 0 0 0 2,500	0 0 0 0 10,000				
DG DH EB EC EN	0805 0805 1206 1206 1206	1.25 ± 0.15 1.25 ± 0.20 0.78 ± 0.10 0.90 ± 0.10 0.95 ± 0.10	0 0 4,000 0 0	0 0 10,000 0 0	2,500 2,500 4,000 4,000 4,000	10,000 10,000 10,000 10,000 10,000				
ED EE EF EM EG	1206 1206 1206 1206 1206	1.00 ± 0.10 1.10 ± 0.10 1.20 ± 0.15 1.25 ± 0.15 1.60 ± 0.15	0 0 0 0	0 0 0 0	2,500 2,500 2,500 2,500 2,000	10,000 10,000 10,000 10,000 8,000				
EH FB FC FD FE FF	1206 1210 1210 1210 1210 1210	1.60 ± 0.20 0.78 ± 0.10 0.90 ± 0.10 0.95 ± 0.10 1.00 ± 0.10	0 0 0 0	0 0 0 0 0	2,000 4,000 4,000 4,000 2,500	8,000 10,000 10,000 10,000 10,000				
FG FL FH FM	1210 1210 1210 1210	1.10 ± 0.10 1.25 ± 0.15 1.40 ± 0.15 1.55 ± 0.15 1.70 ± 0.20	0 0 0 0	0 0 0 0	2,500 2,500 2,000 2,000 2,000	10,000 10,000 8,000 8,000 8,000				
FJ FK FS LD LF	1210 1210 1210 1808 1808	1.85 ± 0.20 2.10 ± 0.20 2.50 ± 0.30 0.90 ± 0.10 1.00 ± 0.15	0 0 0 0	0 0 0 0	2,000 2,000 1,000 2,500 2,500	8,000 8,000 4,000 10,000 10,000				
GB GC GD GE GH	1812 1812 1812 1812 1812	1.00 ± 0.10 1.10 ± 0.10 1.25 ± 0.15 1.30 ± 0.10 1.40 ± 0.15	0 0 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 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				
HD HF JB JC JD	1825 1825 2220 2220 2220	1.30 ± 0.15 1.50 ± 0.15 1.00 ± 0.15 1.10 ± 0.15 1.30 ± 0.15	0 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				
JE JF JO	2220 2220 2220	1.40 ± 0.15 1.50 ± 0.15 2.40 ± 0.15	0 0 0	0 0 0	1,000 1,000 500	4,000 4,000 2,000				
Thickness	Case	Thickness ±	7" Reel	13" Reel	7" Reel 13" Reel					
Code	Size ¹	Range (mm)	Paper Q	luantity ¹	Plastic Quantity					

Package quantity based on finished chip thickness specifications.

¹ If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Table 2B - Bulk Packaging Quantities

Doolooni	T	Loose Packaging								
Раскаді	ng Type	Bulk Bag (default)								
Packagin	g C-Spec ¹	N/A ²								
Case	Size	Packaging Quantities (pieces/unit packaging)								
EIA (in)	Metric (mm)	Minimum	Maximum							
0402	1005									
0603	1608									
0805	2012		50,000							
1206	3216									
1210	3225	1								
1808	4520	1								
1812	4532									
1825	4564		20,000							
2220	5650									
2225	5664									

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

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



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

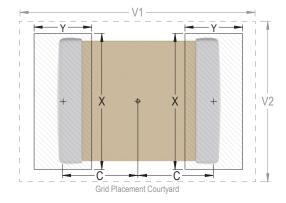
EIA Metric Size Size Code Code	Size		Maxi	sity Lev mum (M rotrusio	lost))		Media	sity Lev an (Nor rotrusio	ninal))	Density Level C: Minimum (Least) Land Protrusion (mm)						
	Oode	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	X	V1	V2		
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	0.40	0.52	0.52	1.60	0.80		
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		
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		
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		

¹ 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

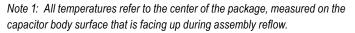
Recommended Soldering Technique:

- 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	Termination Finish			
Frome reature	SnPb	100% Matte Sn		
Preheat/Soak				
Temperature Minimum (T _{Smin})	100°C	150°C		
Temperature Maximum (T _{Smax})	150°C	200°C		
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds		
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum		
Liquidous Temperature (T _L)	183°C	217°C		
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds		
Peak Temperature (T _P)	235°C	260°C		
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum		
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum		
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum		



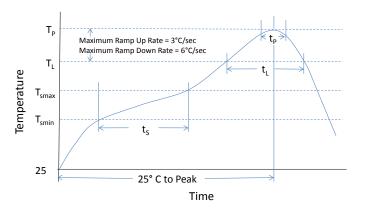




Table 4 – Performance & Reliability: Test Methods and Conditions

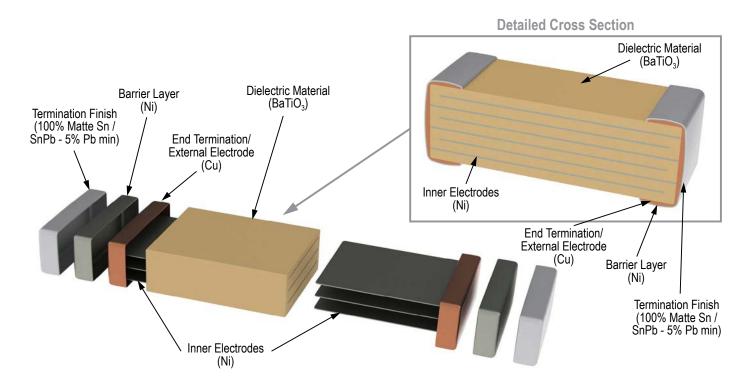
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Solderability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	J-31D-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion. Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
Vibration	MIL-STD-202 Method 204	5 g's for 20 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage & Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



Telecom "Tip and Ring," X7R Dielectric, 250 VDC (Commercial Grade)



Overview

KEMET's 250V DC Tip and Ring MLCCs in X7R dielectric are designed and rated for telecommunication ringer circuits where the capacitor is used to block -48V to -52V DC of line voltage and pass a 16-25 Hz AC signal pulse of 70 Vrms to 90 Vrms. Serving as an excellent replacement for high voltage leaded film devices, these smaller surface mount technology footprints save valuable board space which is critical when creating new designs.

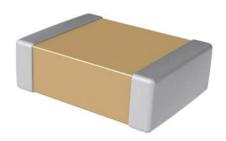
KEMET Tip and Ring capacitors feature a 125°C maximum operating temperature and are considered "temperature stable." The Electronics Industries Alliance (EIA) characterizes X7R dielectric as a Class II material. Components of this classification

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 dielectric 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.

These devices are able to withstand today's higher lead-free reflow processing temperatures and offer superior high frequency filtering characteristics and low ESR.

Benefits

- -55°C to +125°C operating temperature range
- · Lead (Pb)-Free, RoHS and REACH compliant
- EIA 0805, 1206, 1210, 1812, 1825, 2220, and 2225 case sizes
- DC voltage rating of 250 V
- Capacitance offerings ranging from 1,000 pF to 6.8 μF
- Available capacitance tolerances of ±10% and ±20%
- · Non-polar device, minimizing installation concerns
- 100% pure matte tin-plated termination finish that allows for excellent solderability
- SnPb termination finish option available upon request (5% Pb minimum)
- Flexible termination option available upon request



Ordering Information

С	1825	С	105	K	Α	R	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec)
	0805 1206 1210 1812 1825 2220 2225	C = Standard X = Flexible Termination	Two significant digits + number of zeros	J = ±5% K = ±10% M = ±20%	A = 250	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

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



Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec)
Bulk Bag/Unmarked	Not required (Blank)
7" Reel/Unmarked	TU
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
7" Reel/Marked	TM
13" Reel/Marked	7040 (EIA 0603 and smaller case sizes) 7215 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2mm pitch ²	7081
13" Reel/Unmarked/2mm pitch ²	7082

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Applications

Typical applications include telecommunication ringing circuits, switch mode power supply snubber circuits, high voltage DC blocking and high voltage coupling. Markets include telephone lines, analog and digital modems, facsimile machines, wireless base stations, cable and digital video recording set-top boxes, satellite dishes, high voltage power supply, DC/DC converters, and Ethernet, POS and ATM hardware.

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

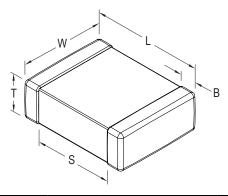
Lead (Pb)-Free, RoHS, and REACH compliant without exemptions (excluding SnPb termination finish option).

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. Please contact KEMET if you require a laser marked option. For more information see "Capacitor Marking".

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Dimensions – Millimeters (Inches) – Standard Termination



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0805	2012	2.00 (.079) ± 0.20 (.008)	1.25 (.049) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	Solder Wave or
1206	3216	3.20 (.126) ± 0.20 (.008)	1.60 (.063) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)		Solder Reflow
1210	3225	3.20 (.126) ± 0.20 (.008)	2.50 (.098) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)		
1812	4532	4.50 (.177) ± 0.30 (.012)	3.20 (.126) ± 0.30 (.012)	See Table 2 for Thickness	0.60 (.024) ± 0.35 (.014)	NI/A	
1825	4564	4.50 (.177) ± 0.30 (.012)	6.40 (.252) ± 0.40 (.016)		0.60 (.024) ± 0.35 (.014)	N/A	Solder Reflow Only
2220	5650	5.70 (.224) ± 0.40 (.016)	5.00 (.197) ± 0.40 (.016)		0.60 (.024) ± 0.35 (.014)	-	
2225	5664	5.60 (.220) ± 0.40 (.016)	6.40 (.248) ± 0.40 (.016)		0.60 (.024) ± 0.35 (.014)		

Dimensions – Millimeters (Inches) – Flexible Termination

EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0805	2012	2.00 (.079) ± 0.30 (.012)	1.25 (.049) ± 0.30 (.012)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	Solder Wave or
1206	3216	3.30 (.130) ± 0.40 (.016)	1.60 (.063) ± 0.35(.013)		0.60 (.024) ± 0.25 (.010)		Solder Reflow
1210	3225	3.30 (.130) ± 0.40 (.016)	2.60(.102) ± 0.30(.012)		0.60 (.024) ± 0.25 (.010)		
1812	4532	4.50 (.178) ± 0.40 (.016)	3.20 (.126) ± 0.30 (.012)	See Table 2 for Thickness	0.70 (.028) ± 0.35 (.014)	N1/A	
1825	4564	4.60 (.181) ± 0.40 (.016)	6.40 (.252) ± 0.40 (.016)	THIOMICOS	0.70 (.028) ± 0.35 (.014)	N/A	Solder Reflow Only
2220	5650	5.90 (.232) ± 0.75 (.030)	5.00 (.197) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)		
2225	5664	5.90 (.232) ± 0.75 (.030)	6.40 (.248) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)		



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%
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
² Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ± 1 seconds and charge/discharge not exceeding 50mA)
³ Dissipation Factor (DF) Maximum Limit @ 25°C	5%(6.3V & 10V), 3.5%(16V & 25V) and 2.5%(50V to 250V)
⁴ Insulation Resistance (IR) Minimum Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ± 5 secs @ 25°C)

Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

 $1kHz \pm 50Hz$ and 1.0 ± 0.2 Vrms if capacitance ≤ $10\mu F$

120Hz \pm 10Hz and 0.5 ± 0.1 Vrms if capacitance >10 μ F

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

Post Environmental Limits

High Temperature Life, Biased Humidity, Moisture Resistance							
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance		
	> 25		3.0				
X7R	16/25	All	5.0	±20%	10% of Initial Limit		
	< 16		7.5				

Insulation Resistance Limit Table

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

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

⁴To obtain IR limit, divide MΩ- μ F value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



Table 1 – Capacitance Range/Selection Waterfall (0805 – 2225 Case Sizes)

			se Siz Series		C0805C	C1206C	C1210C	C1812C	C1825C	C2220C	C2225C
Capacitance	Capacitance		Itage Co		Α	Α	Α	Α	Α	Α	Α
Capacitanoc	Code	Rated	Voltage	(VDC)	250	250	250	250	250	250	250
		Ca	pacita	nce		Produ See	uct Availabil Table 2 for	ity and Chip Chip Thickn	Thickness C ess Dimensi	codes ons	
180 pF	181	J	K	M	DR		10.0.0				
220 pF	221	J	K	M	DR						
270 pF	271	J	K	M	DR						
330 pF	331	J	K	M	DR						
390 pF	391 471	J	K K	M M	DR DR						
470 pF 560 pF	561	J	K	M	DR DR						
680 pF	681	J	K	M	DR						
820 pF	821	J	K	M	DR						
1,000 pF	102	Ĵ	K	M	DR	EQ				l	
1,200 pF	122	J	K	M	DR	EQ					
1,500 pF	152	J	K	M	DR	EQ					
1,800 pF	182	J	K	M	DR	EQ					
2,200 pF	222	J	K	M	DR	EQ	FN				
2,700 pF	272	J	K	M	DR	EQ	FN				
3,300 pF	332	J	K	M	DR	EQ	FN				
3,900 pF	392	J	K	M	DR	EQ	FN				
4,700 pF	472	J	K K	M	DR DR	EQ	FN				
5,600 pF 6,800 pF	562 682	J	K	M M	DR DR	EQ EQ	FN FN	GB			
8,200 pF	822	J	K	M	DR	EQ	FN	GB			
10,000 pF	103	J	K	M	DR	EQ	FN	GB			
12,000 pF	123	Ĵ	K	M	DR	EQ	FN	GB			
15,000 pF	153	Ĵ	K	M	DR	EQ	FN	GB			
18,000 pF	183	J	K	M	DR	EQ	FN	GB			
22,000 pF	223	J	K	М	DR	EQ	FN	GB	НВ		
27,000 pF	273	J	K	M		EQ	FN	GB	HB		
33,000 pF	333	J	K	M		EQ	FN	GB	HB		
39,000 pF	393	J	K	M		EQ	FN	GB	HB		
47,000 pF	473	J	K	M		ES	FQ	GB	HB		KC
56,000 pF 68,000 pF	563 683	J	K K	M M		ES ES	FQ FQ	GB GB	HB HB		KC KC
82,000 pF	823	J	K	M		ES ES	FQ FA	GB GB	HB HB	JC	KC KC
0.10 μF	104	J	K	M		EM EM	FZ	GB	нь НВ	JC JC	KC
0.12 µF	124	Ĵ	K	M			FU	GB	НВ	JC	KC
0.15 µF	154	J	K	M			FM	GE	HB	JC	KC
0.18 µF	184	J	K	М			FK	GG	НВ	JC	KC
0.22 μF	224	J	K	M			FK	GG	НВ	JC	KC
0.27 μF	274	J	K	M				GG	НВ	JC	KC
0.33 µF	334	J	K	М				GG	HB	JC	KC
0.39 µF	394	J	K	M				GG	HD	JC	KC
0.47 µF	474 564	J	K	M				GJ	HD	JC	KD
0.56 μF 0.68 μF	564 684	J	K K	M M					HD HD	JD JD	KD KD
0.80 µF 0.82 µF	824	J	K	M					HF	JF	KE KE
1.0 µF	105	J	K	M					HF	JF	KE
1.2 µF	125	J	K	М							KE
	Capacitance		Voltage		250	250	250	250	250	250	250
Capacitance	Code		Itage Co		A	A C42000	A C4240C	A C4040C	A 040050	A	A
		Lase	Size/S	eries	C0805C	C1206C	C1210C	C1812C	C1825C	C2220C	C2225C



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

Thickness	Case	Thickness ±	Paper G	Quantity	Plastic Quantity		
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel	
DR	0805	0.78 ± 0.20	0	0	4,000	10,000	
EQ	1206	0.78 ± 0.20	4,000	10,000	4,000	10,000	
ES	1206	1.00 ± 0.20	0	0	2,500	10,000	
EM	1206	1.25 ± 0.15	0	0	2,500	10,000	
FN	1210	0.78 ± 0.20	0	0	4,000	10,000	
FQ	1210	0.90 ± 0.20	0	0	4,000	10,000	
FA	1210	1.10 ± 0.15	0	0	2,500	10,000	
FZ	1210	1.25 ± 0.20	0	0	2,500	10,000	
FU	1210	1.55 ± 0.20	0	0	2,000	8,000	
FM	1210	1.70 ± 0.20	0	0	2,000	8,000	
FK	1210	2.10 ± 0.20	0	0	2,000	8,000	
GB	1812	1.00 ± 0.10	0	0	1,000	4,000	
GE	1812	1.30 ± 0.10	0	0	1,000	4,000	
GG	1812	1.55 ± 0.10	0	0	1,000	4,000	
GJ	1812	1.70 ± 0.15	0	0	1,000	4,000	
HB	1825	1.10 ± 0.15	0	0	1,000	4,000	
HD	1825	1.30 ± 0.15	0	0	1,000	4,000	
HF	1825	1.50 ± 0.15	0	0	1,000	4,000	
JC	2220	1.10 ± 0.15	0	0	1,000	4,000	
JD	2220	1.30 ± 0.15	0	0	1,000	4,000	
JF	2220	1.50 ± 0.15	0	0	1,000	4,000	
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 Quantity		Plastic Quantity		

Package quantity based on finished chip thickness specifications.



Table 2B - Bulk Packaging Quantities

Deale		Loose Packaging				
Раска(ging Type	Bulk Bag	g (default)			
Packagi	ing C-Spec ¹	N.	/A ²			
Cas	se Size	Packaging Quantities	(pieces/unit packaging)			
EIA (in)	Metric (mm)	Minimum	Maximum			
0402	1005		50,000			
0603	1608					
0805	2012					
1206	3216					
1210	3225	1				
1808	4520					
1812	4532					
1825	4564		20,000			
2220	5650					
2225	5664					

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

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



Table 3A – Land Pattern Design Recommendations per IPC-7351 – Standard Termination

EIA Metric Size Size Code 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)							
Oode	Oode	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	Х	V1	V2
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
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

¹ 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.

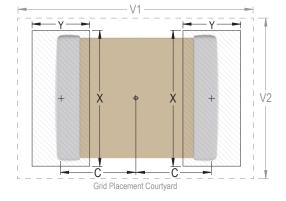




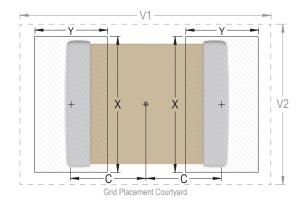
Table 3B – Land Pattern Design Recommendations per IPC-7351 – Flexible Termination

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)							
Code	Oue	С	Υ	X	V1	V2	С	Y	X	V1	V2	С	Υ	Х	V1	V2
0805	2012	0.99	1.44	1.66	4.47	2.71	0.89	1.24	1.56	3.57	2.11	0.79	1.04	1.46	2.42	1.81
1206	3216	1.59	1.62	2.06	5.85	3.06	1.49	1.42	1.96	4.95	2.46	1.39	1.22	1.86	4.25	2.16
1210	3225	1.59	1.62	3.01	5.90	4.01	1.49	1.42	2.91	4.95	3.41	1.39	1.22	2.81	4.25	3.11
1812	4532	2.30	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
1825	4564	2.15	1.80	6.90	7.10	7.90	2.05	1.60	6.80	6.20	7.30	1.95	1.40	6.70	5.50	7.00
2220	5650	2.85	2.10	5.50	8.80	6.50	2.75	1.90	5.40	7.90	5.90	2.65	1.70	5.30	7.20	5.60
2225	5664	2.85	2.10	6.90	8.80	7.90	2.75	1.90	6.80	7.90	7.30	2.65	1.70	6.70	7.20	7.00

Density Level A: For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes. KEMET only recommends wave soldering of EIA 0603, 0805 and 1206 case sizes.

Density Level B: For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes. **Density Level C:** For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC Standard 7351 (IPC–7351).

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





Soldering Process

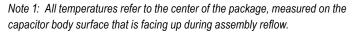
Recommended Soldering Technique:

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

Recommended Reflow Soldering Profile:

KEMET's families of surface mount multilayer ceramic capacitors (SMD MLCCs) are compatible with wave (single or dual), convection, IR or vapor phase reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET's recommended profile conditions for convection and IR reflow reflect the profile conditions of the IPC/J-STD-020 standard for moisture sensitivity testing. These devices can safely withstand a maximum of three reflow passes at these conditions.

Profile Feature	Terminati	on Finish	
Frome reature	SnPb	100% Matte Sn	
Preheat/Soak			
Temperature Minimum (T _{Smin})	100°C	150°C	
Temperature Maximum (T _{Smax})	150°C	200°C	
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds	
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum	
Liquidous Temperature (T _L)	183°C	217°C	
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds	
Peak Temperature (T _P)	235°C	260°C	
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum	
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum	
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum	



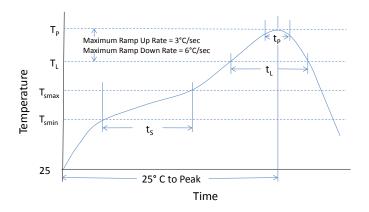




Table 4 – Performance & Reliability: Test Methods and Conditions

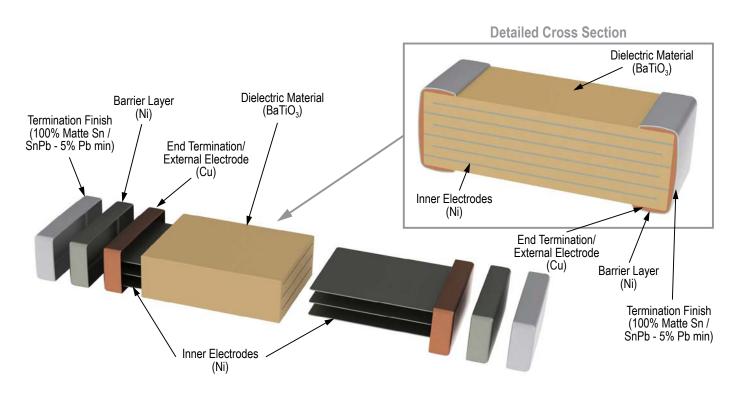
Stress	Reference	Test or Inspection Method			
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.			
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).			
		Magnification 50 X. Conditions:			
Solderability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C			
Solderability	J-31D-002	b) Method B @ 215°C category 3			
		c) Method D, category 3 @ 260°C			
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.			
Diagod Humidika	MII. CTD 202 Matha d 402	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.			
Biased Humidity	MIL-STD-202 Method 103	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.			
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.			
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.			
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.			
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.			
Vibration	MIL-STD-202 Method 204	5 g's for 20 min., 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, Condition F.			
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.			

Storage and Handling

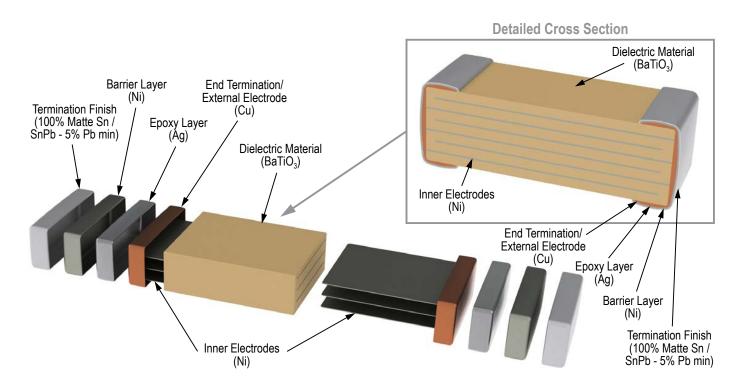
Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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 – Standard Termination



Construction – Flexible Termination



Open Mode Design (FO-CAP), X7R Dielectric, 16 – 200 VDC (Commercial & Automotive Grade)



Overview

KEMET's Ceramic Open Mode capacitor in X7R dielectric is designed to significantly minimize the probability of a low IR or short circuit condition when forced to failure in a board stress flex situation, thus reducing the potential for catastrophic failure. The Open Mode capacitor may experience a drop in capacitance; however, a short is unlikely because a crack will not typically propagate across counter electrodes within the device's "active area." Since there will not be any current leakage associated with a typical Open Mode flex crack, there is no localized heating and therefore little chance for a catastrophic and potentially costly failure event.

Driven by the demand for a more robust and reliable component, the Open Mode capacitor was designed for critical applications where higher operating temperatures and mechanical stress are a concern. These capacitors are widely used in automotive circuits as well as power supplies (input and output filters) and general electronic applications.

Concerned with flex cracks resulting from excessive tensile and shear stresses produced during board flexure and thermal cycling? These devices are available with KEMET's Flexible termination technology which inhibits the transfer of board stress to the rigid ceramic body, therefore mitigating flex cracks which can result in low IR or short circuit failures. Although flexible termination technology does not eliminate the potential for mechanical damage that may propagate during extreme

environmental and handling conditions, it does provide superior flex performance over standard termination systems. When combined with flexible termination technology these devices offer the ultimate level of protection against a low IR or short circuit condition. Open Mode devices compliment KEMET's Floating Electrode (FE-CAP) and Floating Electrode with Flexible Termination (FF-CAP) product lines by providing a fail-safe design optimized for mid to high range capacitance values. These devices exhibit a predictable change in capacitance with respect to time and voltage and boast a minimal change in capacitance with reference to ambient temperature. Capacitance change is limited to ±15% from -55°C to +125°C.



Ordering Information

С	1210	J	685	K	3	R	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec)
	0805 1206 1210 1812	F = Open Mode J = Open Mode with Flexible Termination	Two significant digits + number of zeros	K = ±10% M = ±20%	4 = 16 3 = 25 5 = 50 1 = 100 2 = 200	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

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

¹ SnPb termination finish option is not available on automotive grade product.



Packaging C-Spec Ordering Options Table

Packaging Type	Packaging/Grade Ordering Code (C-Spec)		
Commerc	ial Grade ¹		
Bulk Bag	Not Required (Blank)		
7" Reel/Unmarked	TU		
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)		
7" Reel/Marked	TM		
13" Reel/Marked	7040 (EIA 0603 and smaller case sizes) 7215 (EIA 0805 and larger case sizes)		
7" Reel/Unmarked/2 mm pitch ²	7081		
13" Reel/Unmarked/2 mm pitch ²	7082		
Automoti	ve Grade ³		
7" Reel	AUTO		
13" Reel/Unmarked	AUTO7411 (EIA 0603 and smaller case sizes) AUTO7210 (EIA 0805 and larger case sizes)		
7" Reel/Unmarked/2 mm pitch ²	3190		
13" Reel/Unmarked/2 mm pitch ²	3191		

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- -55°C to +125°C operating temperature range
- Open Mode/fail open design
- · Mid to high capacitance flex mitigation
- · Lead (Pb)-Free, RoHS and REACH compliant
- EIA 0805, 1206, 1210, and 1812 case sizes
- DC voltage ratings of 16 V, 25 V, 50 V, 100 V, and 200 V
- Capacitance offerings ranging from 1,000 pF to 6.8 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
- Commercial and Automotive (AEC–Q200) grades available
- SnPb termination finish option available upon request (5% Pb minimum)
- · Flexible termination option available upon request

Applications

Typical applications include input side filtering (power plane/bus), high current (battery line) and circuits that cannot be fused to open when short circuits occur due to flex cracks. Markets include automotive applications that are directly connected to the battery and/or involve conversion to a 42 V system and raw power input side filtering in power conversion.

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked.

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".

³ Reeling tape options (Paper or Plastic) are dependent on capacitor case size (L" x W") and thickness dimension. See "Chip Thickness/Tape & Reel Packaging Quantities" and "Tape & Reel Packaging Information".

³ For additional Information regarding "AUTO" C-Spec options, see "Automotive C-Spec Information".

³ All Automotive packaging C-Specs listed exclude the option to laser mark components. Please contact KEMET if you require a laser marked option. For more information see "Capacitor Marking".



Automotive C-Spec Information

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

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

Product Change Notification (PCN)

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

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

KEMET Automotive	Customer Noti	fication due to:	Days prior to implementation	
C-Spec	Process/Product change	Obsolescence*		
KEMET assigned ¹	Yes (with approval and sign off)	Yes	180 days Minimum	
AUTO	Yes (without approval)	Yes	90 days Minimum	

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

Production Part Approval Process (PPAP)

The purpose of the Production Part Approval Process is:

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

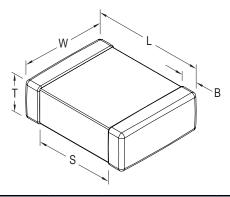
KEMET Automotive C-Spec	PPAP (Product Part Approval Process) Level							
	1	2	3	4	5			
KEMET assigned ¹	•	•	•	•	•			
AUTO	0		0					

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

- Part Number specific PPAP available
- Product family PPAP only



Dimensions – Millimeters (Inches) – Standard Termination



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique	
0805	2012	2.00 (.079) ± 0.20 (.008)	1.25 (.049) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	Solder Wave or	
1206	3216	3.20 (.126) ± 0.20 (.008)	1.60 (.063) ± 0.20 (.008)	See Table 2 for	0.50 (0.02) ± 0.25 (.010)		Solder Reflow	
1210	3225	3.20 (.126) ± 0.20 (.008)	2.50 (.098) ± 0.20 (.008)	Thickness	0.50 (0.02) ± 0.25 (.010)			
1812	4532	4.50 (.177) ± 0.30 (.012)	3.20 (.126) ± 0.30 (.012)		0.60 (.024) ± 0.35 (.014)		Solder Reflow Only	

Dimensions – Millimeters (Inches) – Flexible Termination

EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique	
0805	2012	2.00 (.079) ± 0.30 (.012)	1.25 (.049) ± 0.30 (.012)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	Solder Wave or Solder Reflow	
1206	3216	3.30 (.130) ± 0.40 (.016)	1.60 (.063) ± 0.35 (.013)	See Table 2 for	0.60 (.024) ± 0.25 (.010)			
1210	3225	3.30 (.130) ± 0.40 (.016)	2.60 (.102) ± 0.30 (.012)	Thickness	0.60 (.024) ± 0.25 (.010)			
1812	4532	4.50 (.178) ± 0.40 (.016)	3.20 (.126) ± 0.30 (.012)		0.70 (.028) ± 0.35 (.014)		Solder Reflow Only	

Qualification/Certification

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

Automotive Grade products meet or exceed the requirements outlined by the Automotive Electronics Council. Details regarding test methods and conditions are referenced in document AEC–Q200, Stress Test Qualification for Passive Components. For additional information regarding the Automotive Electronics Council and AEC–Q200, please visit their website at www.aecouncil.com.



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%
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
² Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ± 1 seconds and charge/discharge not exceeding 50mA)
³ Dissipation Factor (DF) Maximum Limit @ 25°C	5%(6.3V & 10V), 3.5%(16V & 25V) and 2.5%(50V to 250V)
⁴Insulation Resistance (IR) Minimum Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ± 5 secs @ 25°C)

¹Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

Post Environmental Limits

	High Temperature Life, Biased Humidity, Moisture Resistance									
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance					
	> 25		3.0							
X7R	16/25	All	5.0	±20%	10% of Initial Limit					
	< 16		7.5							

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

 $¹kHz \pm 50Hz$ and 1.0 ± 0.2 Vrms if capacitance ≤10 μ F

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

⁴To obtain IR limit, divide MΩ- μ F value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



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



Table 1 – Capacitance Range/Selection Waterfall (0805 – 1812 Case Sizes)

		Case Ser	Size/		С	0805	F			C	1206	F			С	1210	F			C18	312F	
Capacitance	Capacitance	Voltage	e Code	4	3	5	1	2	4	3	5	1	2	4	3	5	1	2	3	5	1	2
	Code	Rated Volt	age (VDC)	16	25	50	100	200	16	25	50	100	200	16	25	50	100	200	25	50	100	200
		Capac Toler						P						hip T								
1,000 pF	102	K	M	DP	DP	DP	DP	DP		labic	210	0,	J 1111	I	JJ D.		,,,,,,					
1,200 pF	122	K	M	DP	DP	DP	DP	DP														
1,500 pF	152	K	M	DP	DP	DP	DP	DP														
1,800 pF	182	K	M	DP	DP	DP	DP	DP														
2,200 pF	222	K	M	DP	DP	DP	DP	DP														
2,700 pF	272	K	M	DP	DP	DP	DP	DP														
3,300 pF	332	K	M	DP	DP	DP	DP	DP											1			
3,900 pF 4,700 pF	392 472	K K	M	DP DP	DP DP	DP DP	DP DP	DP DP														
4,700 pF 5,600 pF	562	K	M M	DP	DP	DP	DP	DP											ŀ			
6,800 pF	682	K	M	DP	DP	DP	DP	DP														
8,200 pF	822	K	M	DP	DP	DP	DP	DP														
10,000 pF	103	K	M	DP	DP	DP	DP	DP														
12,000 pF	123	K	M	DP	DP	DP	DP	DG	İ										İ			
15,000 pF	153	К	M	DP	DP	DP	DP	DG														
18,000 pF	183	К	M	DP	DP	DP	DP		EC	EC	EC	EC	EC									
22,000 pF	223	K	M	DP	DP	DP	DG		EC	EC	EC	EC	EC									
27,000 pF	273	K	M	DP	DP	DP	DG		EC	EC	EC	EC	EC									
33,000 pF	333	K	M	DP	DP	DP	DG		EC	EC	EC	EC	EC									
39,000 pF	393	K	M	DP	DP	DP	DG		EC	EC	EC	EC	EC									
47,000 pF	473	K	M	DP	DP	DP	DE		EC	EC	EC	EC	EG						GB	GB	GB	GB
56,000 pF	563	K	M	DP	DP DP	DP	D0		EC	EC	EC	EC	EG						GB	GB	GB	GB
68,000 pF 82,000 pF	683 823	K K	M M	DP DP	DP	DG DG	DG		EC EC	EC EC	EC EC	EC EC	EG EG	FD FD	FD FD	FD FD	FD FD	FD FD	GB GB	GB GB	GB GB	GB GB
62,000 pF 0.10 μF	104	K	M	DG	DG	DG			EC	EC	EC	EC	EG	FD	FD	FD	FD	FG	GB	GB	GB	GB
0.10 µF	124	K	M	DG	DG	DO			EC	EC	EC	EC	LO	FD	FD	FD	FD	FG	GB	GB	GB	GB
0.15 μF	154	K	M	DG	DG				EC	EC	EC	EG		FD	FD	FD	FD	FH	GB	GB	GB	GB
0.18 µF	184	K	M	DG	DG				EC	EC	EC	EG		FD	FD	FD	FD	FH	GB	GB	GB	GB
0.22 µF	224	К	М	DG	DP	DG			EC	EC	EC	ED		FD	FD	FD	FG	FS	GB	GB	GB	GC
0.27 µF	274	К	M	DP	DP				EC	EC	EC			FD	FD	FD	FG		GB	GB	GB	GF
0.33 µF	334	K	M	DP	DG				EG	EG	EG	EG		FD	FD	FD	FH		GB	GB	GB	GK
0.39 µF	394	K	M	DP	DG				EG	EG				FD	FD	FG	FH		GB	GB	GB	GL
0.47 µF	474	K	M	DE	DG				EG	EG	EC			FD	FD	FG	FJ		GB	GB	GC	
0.56 µF	564	K	М						EG					FD	FD	FG	FR		GB	GB	GD	
0.68 µF	684	K	M	DG					EG					FD	FG	FH	FR		GD	GD	GF	
0.82 µF	824	K	M						EG	F0	F			FD	FG	FH	FR		GD	GD	GK	
1.0 µF	105 125	K	M						EG	EC	EH			FD	FH	FJ	FS		GN	GN	GM	
1.2 µF 1.5 µF	125 155	K K	M M						1					FG FH					1			
1.5 μF 1.8 μF	185	K	M											FH								
2.2 µF	225	K	M						EC	EH				FJ	FM	FM						
2.7 μF	275	K	M						-					"								
3.3 µF	335	K	M											FM								
3.9 µF	395	K	M																			
4.7 µF	475	K	M						EH					FG	FM				GK	GK		
6.8 µF	685	K	M											FS	FS							
		Rated Volt	age (VDC)	16	25	50	100	200	16	25	50	100	200	16	25	50	100	200	25	50	100	200
Capacitance	Capacitance	Voltage	e Code	4	3	5	1	2	4	3	5	1	2	4	3	5	1	2	3	5	1	2
	Code	Case Ser	Size/ ies		C	0805	F			C	1206	F			C	1210	F			C18	312F	



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

Thickness	Case	Thickness ±	Paper G	Quantity	Plastic (Quantity
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
DP	0805	0.90 ± 0.10	4,000	15,000	0	0
DE	0805	1.00 ± 0.10	0	0	2,500	10,000
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
EC	1206	0.90 ± 0.10	0	0	4,000	10,000
ED	1206	1.00 ± 0.10	0	0	2,500	10,000
EG	1206	1.60 ± 0.15	0	0	2,000	8,000
EH	1206	1.60 ± 0.20	0	0	2,000	8,000
FD	1210	0.95 ± 0.10	0	0	4,000	10,000
FG	1210	1.25 ± 0.15	0	0	2,500	10,000
FH	1210	1.55 ± 0.15	0	0	2,000	8,000
FM	1210	1.70 ± 0.20	0	0	2,000	8,000
FJ	1210	1.85 ± 0.20	0	0	2,000	8,000
FR	1210	2.25 ± 0.20	0	0	2,000	8,000
FS	1210	2.50 ± 0.30	0	0	1,000	4,000
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
GF	1812	1.50 ± 0.10	0	0	1,000	4,000
GK	1812	1.60 ± 0.20	0	0	1,000	4,000
GN	1812	1.70 ± 0.20	0	0	1,000	4,000
GL	1812	1.90 ± 0.20	0	0	500	2,000
GM	1812	2.00 ± 0.20	0	0	500	2,000
Thickness	Case	Thickness ±	7" Reel	13" Reel	7" Reel	13" Reel
Code	Size	Range (mm)	Paper Quantity Plastic Quanti			

Package quantity based on finished chip thickness specifications.



Table 2B - Bulk Packaging Quantities

ъ		Loose P	ackaging	
Раскад	ing Type	Bulk Bag	(default)	
Packagir	ng C-Spec ¹	N/	/A ²	
Cas	e Size	Packaging Quantities (pieces/unit package		
EIA (in)	Metric (mm)	Minimum	Maximum	
0402	1005			
0603	1608			
0805	2012		50,000	
1206	3216			
1210	3225	1		
1808	4520			
1812	4532			
1825	4564		20,000	
2220	5650			
2225	5664			

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

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



Table 3A – Land Pattern Design Recommendations per IPC-7351 – Standard Termination

EIA Size Code	Metric Size Code	ı	Density Level A: Maximum (Most) Land Protrusion (mm))	ı	Density Level B: Median (Nominal) Land Protrusion (mm)					Density Level C: Minimum (Least) Land Protrusion (mm)				
Oodc	oodc	С	Y	Х	V1	V2	C Y X V1 V2			С	Υ	Х	V1	V2			
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	
1812	4532	2.15	1.60	3.60	6.90	4.60	2.05	2.05 1.40 3.50 6.00 4.00 1.95					1.20	3.40	5.30	3.70	

¹ 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.

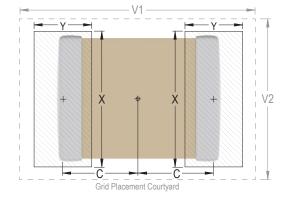




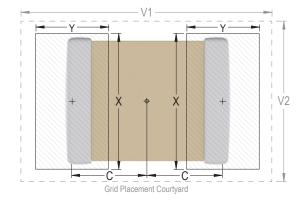
Table 3B – Land Pattern Design Recommendations per IPC-7351 – Flexible Termination

EIA Size Code	Metric Size Code	ı		sity Lev mum (N rotrusio	Most))	I	Density Level B: Median (Nominal) Land Protrusion (mm)				Density Level C: Minimum (Least) Land Protrusion (mm)					
Oouc	Jouc	С	Υ	Х	V1	V2	С	Y	Х	V1	V2	С	Υ	Х	V1	V2	
0805	2012	0.99	1.44	1.66	4.47	2.71	0.89	1.24	1.56	3.57	2.11	0.79	1.04	1.46	2.42	1.81	
1206	3216	1.59	1.62	2.06	5.85	3.06	1.49	1.42	1.96	4.95	2.46	1.39	1.22	1.86	4.25	2.16	
1210	3225	1.59	1.62	3.01	5.90	4.01	1.49	1.42	2.91	4.95	3.41	1.39	1.22	2.81	4.25	3.11	
1812	4532	2.10	1.80	3.60	7.00	4.60	2.00	1.60	3.50	6.10	4.00	1.90	1.40	3.40	5.40	3.70	

Density Level A: For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes. KEMET only recommends wave soldering of EIA 0603, 0805 and 1206 case sizes.

Density Level B: For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes. **Density Level C:** For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC Standard 7351 (IPC–7351).

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





Soldering Process

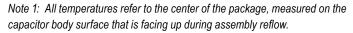
Recommended Soldering Technique:

- 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.

Drofile Feeture	Terminati	on Finish
Profile Feature	SnPb	100% Matte Sn
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum



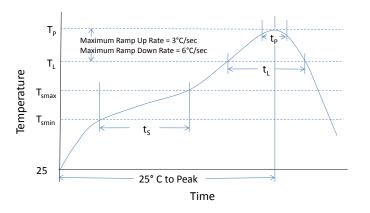




Table 4 - Performance & Reliability: Test Methods and Conditions

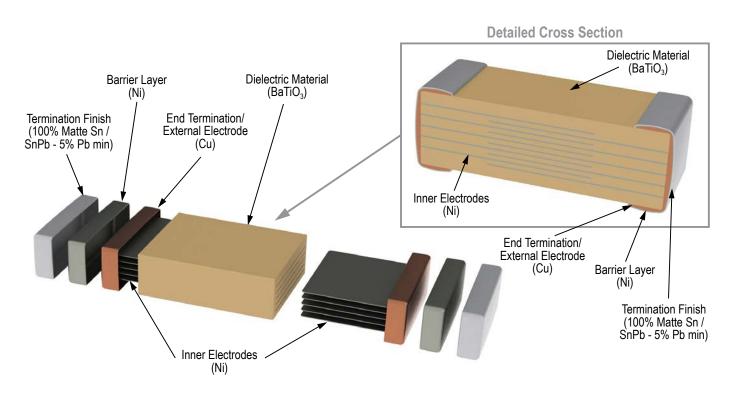
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Coldorability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	J-31D-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Did Hidit.	MII. OTD 000 M-H 1400	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
Vibration	MIL-STD-202 Method 204	5 g's for 20 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage and Handling

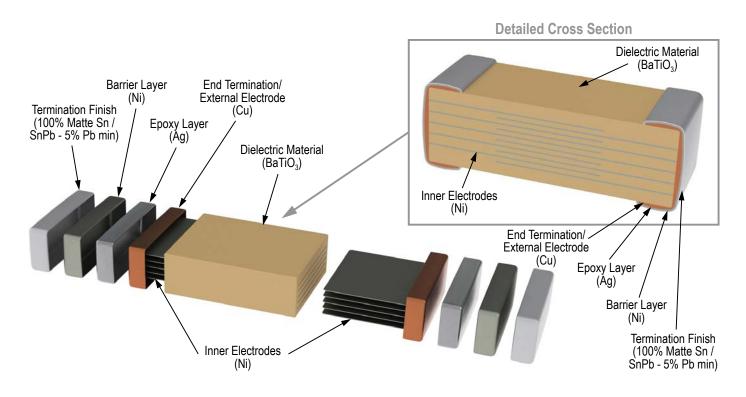
Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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 – Standard Termination



Construction – Flexible Termination



Floating Electrode Design (FE-CAP), X7R Dielectric, 6.3 – 250 VDC (Commercial & Automotive Grade)



Overview

KEMET's Floating Electrode (FE-CAP) multilayer ceramic capacitor in X7R dielectric utilizes a cascading internal electrode design configured to form multiple capacitors in series within a single monolithic structure. This unique configuration results in enhanced voltage and ESD performance over standard capacitor designs while allowing for a fail-open condition if mechanically damaged (cracked). If damaged, the device may experience a drop in capacitance but a short is unlikely. The FE-CAP is designed to reduce the likelihood of a low IR or short circuit condition and the chance for a catastrophic and potentially costly failure event.

Driven by the demand for a more robust and reliable component, the FE-CAP was designed for critical applications where higher operating temperatures and mechanical stress are a concern. These capacitors are manufactured in state of the art ISO/TS 16949:2009 certified facilities and are widely used in power supplies (input and output filters) and general electronic applications.

Combined with the stability of an X7R dielectric, the FE-CAP complements KEMET's "Open Mode" devices by providing a fail-safe design optimized for low to mid range capacitance values. These devices exhibit a predictable change in capacitance with respect to time and voltage and boast a minimal change in capacitance with reference to ambient temperature. Capacitance change is limited to ±15% from -55°C to +125°C.

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



Ordering Information

С	0805	S	104	K	5	R	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/ Grade (C-Spec)
	0402 0603 0805 1206 1210 1812	S = Floating Electrode	Two significant digits + number of zeros	J = ±5% K = ±10% M = ±20%	9 = 6.3 8 = 10 4 = 16 3 = 25 5 = 50 1 = 100 2 = 200 A = 250	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

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

¹ SnPb termination finish option is not available on automotive grade product.



Packaging C-Spec Ordering Options Table

Packaging Type	Packaging/Grade Ordering Code (C-Spec)
Commerc	ial Grade ¹
Bulk Bag	Not Required (Blank)
7" Reel/Unmarked	TU
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
7" Reel/Marked	TM
13" Reel/Marked	7040 (EIA 0603 and smaller case sizes) 7215 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2 mm pitch ²	7081
13" Reel/Unmarked/2 mm pitch ²	7082
Automotiv	ve Grade ³
7" Reel	AUTO
13" Reel/Unmarked	AUTO7411 (EIA 0603 and smaller case sizes) AUTO7210 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2 mm pitch ²	3190
13" Reel/Unmarked/2 mm pitch ²	3191

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- -55°C to +125°C operating temperature range
- Floating Electrode/fail open design
- · Low to mid capacitance flex mitigation
- Lead (Pb)-Free, RoHS and REACH compliant
- EIA 0402, 0603, 0805, 1206, 1210, and 1812 case sizes
- DC voltage ratings of 6.3 V, 10 V, 16 V, 25 V, 50 V, 100 V, 200 V, and 250 V
- Capacitance offerings ranging from 150 pF to 0.22 μF

- Available capacitance tolerances of ±5%, ±10%, and ±20%
- Commercial and Automotive (AEC-Q200) grades available
- · 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% Pb minimum)

Applications

Typical applications include circuits with a direct battery or power source connection, critical and safety relevant circuits without (integrated) current limitation and any application that is subject to high levels of board flexure or temperature cycling. Examples include raw power input side filtering (power plane/bus), high current applications (automobile battery line) and circuits that cannot be fused to open. Markets include consumer, medical, industrial (power supply), automotive, aerospace and telecom.

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked.

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".

³ Reeling tape options (Paper or Plastic) are dependent on capacitor case size (L" x W") and thickness dimension. See "Chip Thickness/Tape & Reel Packaging Quantities" and "Tape & Reel Packaging Information".

³ For additional Information regarding "AUTO" C-Spec options, see "Automotive C-Spec Information".

³ All Automotive packaging C-Specs listed exclude the option to laser mark components. Please contact KEMET if you require a laser marked option. For more information see "Capacitor Marking".



Automotive C-Spec Information

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

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

Product Change Notification (PCN)

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

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

KEMET Automotive	Customer Noti	Customer Notification due to:						
C-Spec	Process/Product change	Obsolescence*	implementation					
KEMET assigned ¹	Yes (with approval and sign off)	Yes	180 days Minimum					
AUTO	Yes (without approval)	Yes	90 days Minimum					

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

Production Part Approval Process (PPAP)

The purpose of the Production Part Approval Process is:

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

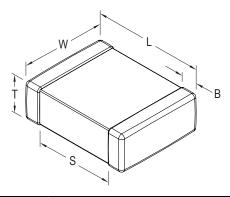
KEMET Automotive		PPAP (Product	Part Approval	Process) Level	
C-Spec	1	2	3	4	5
KEMET assigned ¹	•	•	•	•	•
AUTO	0		0		

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

- Part Number specific PPAP available
- Product family PPAP only



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 Onlv
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)	See Table 2 for	0.50 (0.02) ±0.25 (0.010)	0.75 (0.030)	Solder Wave or Solder Reflow
1206	3216	3.20 (.126) ±0.20 (.008)	1.60 (0.063) ± 0.20 (0.008)	Thickness	0.50 (0.02) ±0.25 (0.010)		
1210	3225	3.20 (.126) ±0.20 (.008)	2.50 (0.098) ± 0.20 (0.008)		0.50 (0.02) ±0.25 (0.010)	N/A	Solder Reflow
1812	4532	4.50 (.177) ±0.30 (.012)	3.20 (0.126) ± 0.30 (0.012)		0.60 (0.024) ±0.35 (0.014)		Only

Qualification/Certification

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

Automotive Grade products meet or exceed the requirements outlined by the Automotive Electronics Council. Details regarding test methods and conditions are referenced in document AEC–Q200, Stress Test Qualification for Passive Components. For additional information regarding the Automotive Electronics Council and AEC–Q200, please visit their website at www.aecouncil.com.

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%
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
² Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ± 1 seconds and charge/discharge not exceeding 50mA)
³ Dissipation Factor (DF) Maximum Limit @ 25°C	5%(6.3V & 10V), 3.5%(16V & 25V) and 2.5%(50V to 250V)
⁴ Insulation Resistance (IR) Minimum Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ± 5 secs @ 25°C)

Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

 $1kHz \pm 50Hz$ and 1.0 ± 0.2 Vrms if capacitance ≤ $10\mu F$

120Hz \pm 10Hz and 0.5 ± 0.1 Vrms if capacitance >10 μ F

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

Post Environmental Limits

High Temperature Life, Biased Humidity, Moisture Resistance												
Dielectric	Dielectric Rated DC Voltage		Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance							
	> 25		3.0									
X7R	16/25	All	5.0	±20%	10% of Initial Limit							
	< 16		7.5									

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

⁴To obtain IR limit, divide MΩ- μ F value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



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						



Table 1A – Capacitance Range/Selection Waterfall (0402 – 0805 Case Sizes)

		Case Size/ Series		C0402S						C0603S						C0805S								
Capacitance	Cap Code	Voltage Code Rated Voltage (VDC) Capacitance Tolerance		9	8	4	3	5	9	8	4	3	5	1	2	9	8	4	3	5	1	2	Α	
Oupdoitailoc				6.3	9	9	25	20	6.3	5	9	25	20	9	200	6.3	5	9	52	20	99	200	250	
									Product Availability and Chip Thio															
														hick										
150 pF	151	J	K	M	BB	BB	BB	BB	BB															
180 pF	181	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
220 pF	221	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
270 pF	271	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
330 pF	331	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
390 pF	391	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
470 pF	471	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
560 pF	561	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
680 pF	681	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
820 pF	821	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
1,000 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
1,200 pF	122	J	K	M						CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
1,500 pF	152	J	K	M						CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
1,800 pF	182	J	K	M						CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
2,200 pF	222	J	K	M						CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
2,700 pF	272	J	K	M						CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
3,300 pF	332	J	K	M						CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
3,900 pF	392	J	K	M						CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
4,700 pF	472	J	K	M						CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
5,600 pF	562	J	K	M						CF	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DN	DN	DN
6,800 pF	682	J	K	M						CF	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DN	DN	DN
8,200 pF	822	J	K	M						CF	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DN	DN	DN
10,000 pF	103	J	K	M						CF	CF	CF	CF	CF			DN	DN	DN	DN	DN	DN	DN	DN
12,000 pF	123	J	K	M						CF	CF	CF	CF	CF			DN	DN	DN	DN	DN	DN	DN	DN
15,000 pF	153	J	K	M						CF	CF	CF	CF	CF			DN	DN	DN	DN	DN	DP		
18,000 pF	183	J	K	M						CF	CF	CF	CF	CF			DN	DN	DN	DN	DN	DP		
22,000 pF	223	J	K	M						CF	CF	CF	CF	CF			DN	DN	DN	DN	DN	DP		
27,000 pF	273	J	K	M													DN	DN	DN	DN	DN			
33,000 pF	333	J	K	M													DN	DN	DN	DN	DN			
39,000 pF	393	J	K	M													DN	DN	DN	DN	DN			
47,000 pF	473	J	K	M													DN	DN	DN	DN	DN			
56,000 pF	563	J	K	M													DP	DP	DP	DP	DP			
68,000 pF	683	J	K	M													DP	DP	DP	DP	DP			
82,000 pF	823	J	K	M													DG	DG	DG	DG	DG			
0.10 µF	104	J	K	M													DG	DG	DG	DG	DG			
		Rated Voltage (VDC)		6.3	10	16	25	50	6.3	10	16	25	50	100	200	6.3	10	16	25	50	100	200	250	
Capacitance	Cap Code	Vol	tage C	ode	9	8	4	3	5	9	8	4	3	5	1	2	9	8	4	3	5	1	2	Α
	Code	Case Size/ Series		C0402S						C	0603	S				1		C08	058					



Table 1B - Capacitance Range/Selection Waterfall (1206 - 1812 Case Sizes)

			se Si Serie					C12	06S							C12	108					С	1812	!S	
Capacitance	Cap	Vol	tage C	ode	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	Α	3	5	1	2	Α
Capacitance	Code	Rat	ed Volt		6.3	9	9	25	20	9	200	250	6.3	2	9	55	20	8	200	250	25	20	5	200	250
		Ca	(VDC) pacitar			`_	L`							lity o	nd C	hip 1		•			L'``		_	7	7
			pacitai olerand													ckne									
1,000 pF	102	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB		J											
1,200 pF	122	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB									İ				
1,500 pF	152	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB									İ				
1,800 pF	182	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB									İ				
2,200 pF	222	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB	İ				
2,700 pF	272	J	K	М	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB					
3,300 pF	332	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB					
3,900 pF	392	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB					
4,700 pF	472	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB	1				
5,600 pF	562	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB	1				
6,800 pF	682	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB
8,200 pF	822	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB
10,000 pF	103	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB
12,000 pF	123	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB
15,000 pF	153	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB
18,000 pF	183	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB
22,000 pF	223	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB
27,000 pF	273	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB
33,000 pF	333	J	K	M	EB	EB	EB	EB	EB	EB			FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB
39,000 pF	393	J	K	M	EB	EB	EB	EB	EB	EC			FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB
47,000 pF	473	J	K	M	EB	EB	EB	EB	EB	EC			FB	FB	FB	FB	FB	FB	FC	FC	GB	GB	GB	GB	GB
56,000 pF	563	J	K	M	EB	EB	EB	EB	EB	EB			FB	FB	FB	FB	FB	FB	FC	FC	GB	GB	GB	GB	GB
68,000 pF	683	J	K	M	EB	EB	EB	EB	EB				FB	FB	FB	FB	FB	FB			GB	GB	GB	GB	GB
82,000 pF	823	J	K	M	EB	EB	EB	EB	EB				FB	FB	FB	FB	FB	FC			GB	GB	GB	GB	GB
0.10 µF	104	J	K	M	EB	EB	EB	EB	EB				FB	FB	FB	FB	FB	FC			GB	GB	GB	GB	GB
0.12 µF	124	J	K	M	EC	EC	EC	EC	EC				FB	FB	FB	FB	FB				GB	GB	GB	GB	GB
0.15 µF	154	J	K	M									FC	FC	FC	FC	FC				GB	GB	GB	GB	GB
0.18 µF	184	J	K	M									FC	FC	FC	FC	FC				GB	GB	GB	GB	GB
0.22 μF	224	J	K	M									FC	FC	FC	FC	FC				GB	GB	GB	GB	GB
			ed Volt	tage	6.3	9	9	52	20	100	200	250	6.3	9	9	52	20	100	200	250	55	20	9	200	250
Capacitance	Сар		tage C	ode	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	Α	3	5	1	2	Α
, April 100	Code	Ca	se Si Serie:	ze/					068				-			C12					_		1812	<u> </u>	



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

Thickness	Case	Thickness ±	Paper Q	luantity ¹	Plastic (Quantity	
Code	Size ¹	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	
DN	0805	0.78 ± 0.10*	4,000	15,000	0	0	
DP	0805	0.90 ± 0.10*	4,000	15,000	0	0	
DG	0805	1.25 ± 0.15	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	
FB	1210	0.78 ± 0.10	0	0	4,000	10,000	
FC	1210	0.90 ± 0.10	0	0	4,000	10,000	
GB	1812	1.00 ± 0.10	0	0	1,000	4,000	
Thickness	Case	Thickness ±	7" Reel	13" Reel	7" Reel	13" Reel	
Code	Size ¹	Range (mm)	Paper Q	uantity¹	Plastic Quantity		

Package quantity based on finished chip thickness specifications.

Table 2B - Bulk Packaging Quantities

Dankani	T	Loose Packaging				
Раскаді	ng Type	Bulk Bag (default)				
Packagin	g C-Spec ¹	N/	A^2			
Case	Size	Packaging Quantities (pieces/unit packaging)			
EIA (in)	Metric (mm)	Minimum	Maximum			
0402	1005		50,000			
0603	1608					
0805	2012					
1206	3216					
1210	3225	1				
1808	4520					
1812	4532					
1825	4564		20,000			
2220	5650					
2225	5664					

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

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

¹ If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



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

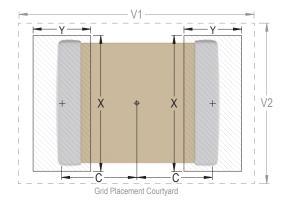
EIA Size Code	Metric Size Code	Density Level A: Maximum (Most) Land Protrusion (mm)					I	Density Level B: Median (Nominal) Land Protrusion (mm)					Density Level C: Minimum (Least) Land Protrusion (mm)				
Code	Code	C	Y	Х	V1	V2	С	Υ	X	V1	V2	С	Υ	Х	V1	V2	
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	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	
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	

¹ 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		
Frome reature	SnPb	100% Matte Sn		
Preheat/Soak				
Temperature Minimum (T _{Smin})	100°C	150°C		
Temperature Maximum (T _{Smax})	150°C	200°C		
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds		
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum		
Liquidous Temperature (T _L)	183°C	217°C		
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds		
Peak Temperature (T _P)	235°C	260°C		
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum		
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum		
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum		

Note 1: All temperatures refer to the center of the package, measured on the capacitor body surface that is facing up during assembly reflow.

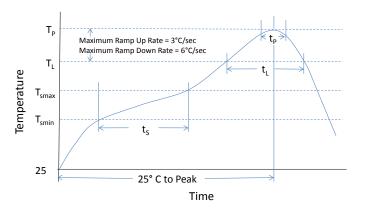




Table 4 – Performance & Reliability: Test Methods and Conditions

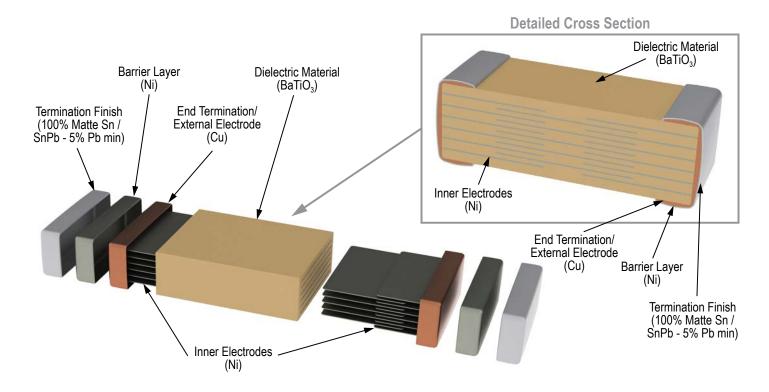
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Solderability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	J-31D-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Digged Llumidity	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 +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
Vibration	MIL-STD-202 Method 204	5 g's for 20 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



Flexible Termination System (FT-CAP), C0G Dielectric, 10 – 250 VDC (Commercial & Automotive Grade)



Overview

KEMET's Flexible Termination (FT-CAP) Multilayer Ceramic Capacitor in C0G dielectric incorporates a unique, flexible termination system that is integrated with KEMET's standard termination materials. A conductive silver epoxy is utilized between the base metal and nickel barrier layers of KEMET's standard termination system in order to establish pliability while maintaining terminal strength, solderability and electrical performance. This technology was developed in order to address the primary failure mode of MLCCs– flex cracks, which are typically the result of excessive tensile and shear stresses produced during board flexure and thermal cycling. Flexible termination technology inhibits the transfer of board stress to the rigid ceramic body, therefore mitigating flex cracks which can result in low IR or short circuit failures.

Although this technology does not eliminate the potential for mechanical damage that may propagate during extreme environmental and handling conditions, it does provide superior flex performance over standard termination systems. FT-CAP complements KEMET's Open Mode, Floating Electrode (FE-CAP), Floating Electrode with Flexible Termination (FF-CAP), and KEMET Power Solutions (KPS) product lines by providing a complete portfolio of flex mitigation solutions.

Combined with the stability of C0G dielectric and designed to accommodate all capacitance requirements, these flex-robust devices are RoHS Compliant, offer up to 5 mm of flex-bend capability and exhibit no change in capacitance with respect to time and voltage. Capacitance change with reference to ambient temperature is limited to ±30 ppm/°C from -55°C to +125°C.

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



Ordering Information

С	1206	X	563	J	3	G	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance ¹	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/Grade (C-Spec)
	0603 0805 1206 1210 1812 1825 2220 2225	X = Flexible Termination	Two significant digits + number of zeros. Use 9 for 1.0 – 9.9 pF Use 8 for 0.5 – .99 pF e.g., 2.2 pF = 229 e.g., 0.5 pF = 508	$B = \pm 0.10 \text{ pF}$ $C = \pm 0.25 \text{ pF}$ $D = \pm 0.5 \text{ pF}$ $F = \pm 1\%$ $G = \pm 2\%$ $J = \pm 5\%$ $K = \pm 10\%$ $M = \pm 20\%$	8 = 10 4 = 16 3 = 25 5 = 50 1 = 100 2 = 200 A = 250	G = C0G	A = N/A	C = 100% Matte Sn L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

¹ Additional capacitance tolerance offerings may be available. Contact KEMET for details.

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



Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec)
Bulk Bag/Unmarked	Not required (Blank)
7" Reel/Unmarked	TU
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
7" Reel/Unmarked / 2 mm pitch ²	7081
13" Reel/Unmarked / 2 mm pitch ²	7082

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- -55°C to +125°C operating temperature range
- Superior flex performance (up to 5 mm)
- Lead (Pb)-Free, RoHS and REACH compliant
- EIA 0603, 0805, 1206, 1210, 1812, 1825, 2220, and 2225 case sizes
- DC voltage ratings of 10 V, 16 V, 25 V, 50 V, 100 V, 200 V and 250 V
- Capacitance offerings ranging from 0.5 pF up to 0.47 μF
- Available capacitance tolerances of ±0.10pF, ±0.25 pF, ±0.5 pF, ±1%, ±2%, ±5%, ±10%, and ±20%
- · No piezoelectric noise
- · Extremely low ESR and ESL
- High thermal stability

- High ripple current capability
- Preferred capacitance solution at line frequencies and into the MHz range
- · No capacitance change with respect to applied rated DC voltage
- Negligible capacitance change with respect to temperature from –55°C to +125°C
- · Non-polar device, minimizing installation concerns
- 100% pure matte tin-plated termination finish allowing for excellent solderability
- Commercial & Automotive (AEC–Q200) Grades available
- SnPb termination finish option available upon request (5% Pb minimum)

Applications

Typical applications include critical timing, tuning, circuits requiring low loss, circuits with pulse, high current, decoupling, bypass, filtering, transient voltage suppression and blocking, as well as energy storage in critical and safety relevant circuits without (integrated) current limitation, including those subject to high levels of board flexure or temperature cycling.

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. The option to laser mark is not available on these devices. For more information see "Capacitor Marking".

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Automotive C-Spec Information

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

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

Product Change Notification (PCN)

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

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

KEMET Automotive	Customer Noti	Days prior to			
C-Spec	Process/Product change	Obsolescence*	implementation		
KEMET assigned ¹	Yes (with approval and sign off)	Yes	180 days Minimum		
AUTO	Yes (without approval)	Yes	90 days Minimum		

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

Production Part Approval Process (PPAP)

The purpose of the Production Part Approval Process is:

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

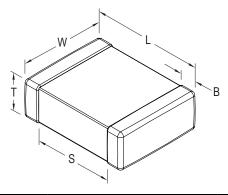
KEMET Automotive		PPAP (Product	t Part Approval Process) Level							
C-Spec	1	2	3	4	5					
KEMET assigned ¹	•	•	•	•	•					
AUTO	0		0							

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

- Part Number specific PPAP available
- Product family PPAP only



Dimensions – Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0603	1608	1.60 (.064) ± 0.17 (.007)	0.80 (.032) ±0.15 (.006)		0.45 (.018) ± 0.15 (.006)	0.58 (.023)	Solder Wave
0805	2012	2.00 (.079) ± 0.30 (.012)	1.25 (.049) ± 0.30 (.012)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	or
1206	3216	3.30 (.130) ± 0.40 (.016)	1.60 (.063) ± 0.35 (.013)		0.60 (.024) ± 0.25 (.010)		Solder Reflow
1210	3225	3.30 (.130) ± 0.40 (.016)	2.60 (.102) ± 0.30 (.012)	See Table 2 for	0.60 (.024) ± 0.25 (.010)		
1812	4532	4.50 (.178) ± 0.40 (.016)	3.20 (.126) ± 0.30 (.012)	Thickness	0.70 (.028) ± 0.35 (.014)	NI/A	
1825	4564	4.60 (.181) ± 0.40 (.016)	6.40 (.252) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)	N/A	Solder Reflow Only
2220	5650	5.90 (.232) ± 0.75 (.030)	5.00 (.197) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)		
2225	5664	5.90 (.232) ± 0.75 (.030)	6.40 (.248) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)		

Qualification/Certification

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

Automotive Grade products meet or exceed the requirements outlined by the Automotive Electronics Council. Details regarding test methods and conditions are referenced in document AEC–Q200, Stress Test Qualification for Passive Components. For additional information regarding the Automotive Electronics Council and AEC–Q200, please visit their website at www.aecouncil.com.

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)	±30 ppm/°C				
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	0%				
¹ Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)				
² Dissipation Factor (DF) Maximum Limit at 25°C	0.1%				
³ Insulation Resistance (IR) Limit at 25°C	1,000 megohm microfarads or 100 G Ω (Rated voltage applied for 120 ±5 seconds at 25°C)				

¹DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

Capacitance and Dissipation Factor (DF) measured under the following conditions:

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."

Post Environmental Limits

High Temperature Life, Biased Humidity, Moisture Resistance								
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance			
C0G	All	All	0.5	0.3% or ±0.25 pF	10% of Initial Limit			

²Capacitance and dissipation factor (DF) measured under the following conditions:

¹ MHz ± 100 kHz and 1.0 Vrms ± 0.2 V if capacitance $\leq 1,000$ pF

¹ kHz ±50 Hz and 1.0 Vrms ±0.2 V if capacitance > 1,000 pF

 $^{{}^{3}}$ To obtain IR limit, divide M Ω - μ F value by the capacitance and compare to G Ω limit. Select the lower of the two limits.



Table 1A – Capacitance Range/Selection Waterfall (0603 – 1206 Case Sizes)

			Case Size/Series					C	060	3X					C	080	5X					C	1206	6X						
0	Сар			Vo	oltag	e Co	de			8	4	3	5	1	2	Α	8	4	3	5	1	2	Α	8	4	3	5	1	2	Α
Capacitance	Code			Rated	Vol	tage	(VDC	;)		10	16	25	20	100	200	250	9	16	25	20	100	200	250	9	16	25	20	100	200	250
			С	apaci	itanc	е То	leran	се						Р					ity a Chip		•				Code	s				
0.50 & 0.75 pF	508 & 758	В	С	D						CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR		UIIS					
1.0 - 9.1 pF*	109 - 919*	В	С	D	_					CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	EQ	EQ	EQ	EQ	EQ	EQ	EQ
10 - 91 pF*	100 - 910*				F	G	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	EQ	EQ	EQ	EQ	EQ	EQ	EQ
100 pF 110 - 180 pF*	101 111 - 181*	ł			F	G	J	K	M M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ
200 - 300 pF*	201 - 301*				F	G	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	EQ	EQ	EQ	EQ	EQ	EQ	EQ
330 pF	331	i			F	G	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	EQ	EQ	EQ	EQ	EQ	EQ	EQ
360 pF	361	İ			F	G	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	EQ	EQ	EQ	EQ	EQ	EQ	EQ
390 pF	391	İ			F	G	J	K	М	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	EQ	EQ	EQ	EQ	EQ	EQ	EQ
430 pF	431				F	G	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	EQ	EQ	EQ	EQ	EQ	EQ	EQ
470 pF	471				F	G	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DD	DD	EQ	EQ	EQ	EQ	EQ	EQ	EQ
510 pF	511	ŀ			F	G	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	EQ	EQ	EQ	EQ	EQ	EQ	EQ
560 pF 620 pF	561 621	l			F	G	J	K	M M	CJ	CJ	CJ	Cl	CJ	CJ	CJ	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ
680 pF	681	l			F	G	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	EQ	EQ	EQ	EQ	EQ	EQ	EQ
750 pF	751				F	G	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	EQ	EQ	EQ	EQ	EQ	EQ	EQ
820 pF	821	İ			F	G	J	K	М	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	EQ	EQ	EQ	EQ	EQ	EQ	EQ
910 pF	911	İ			F	G	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DD	DD	DD	EQ	EQ	EQ	EQ	EQ	EQ	EQ
1,000 pF	102				F	G	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DD	DD	DD	EQ	EQ	EQ	EQ	EQ	EQ	EQ
1,100 pF	112				F	G	J	K	M	CJ	CJ	CJ	CJ	CJ	CH	CH	DR	DR	DR	DR	DR	DR	DR	EQ	EQ	EQ	EQ	EQ	EQ	EQ
1,200 pF	122	ŀ			F	G	J	K	M	CJ	CJ	CJ	CJ	CJ	CH	CH	DR	DR	DR	DR	DR	DR	DR	EQ	EQ	EQ	EQ	EQ	EQ	EQ
1,300 pF 1,500 pF	132 152	l			F	G	J	K	M	CJ	CJ	Cl	CJ	CJ	CH	CH	DD	DD DD	DD DD	DD DD	DD DD	DR DR	DR DR	EQ EQ	EQ EQ	EQ EQ	EQ EQ	ER ES	ER ER	ER ER
1,600 pF	162	i			F	G	J	K	M	CJ	CJ	CJ	CJ	CJ	CH	CH	DD	DD	DD	DD	DD	DR	DR	EQ	EQ	EQ	EQ	ES	ES	ES
1,800 pF	182	İ			F	G	J	K	M	CJ	CJ	CJ	CJ	CJ	CH	CH	DD	DD	DD	DD	DD	DR	DR	EQ	EQ	EQ	EQ	ES	ES	ES
2,000 pF	202				F	G	J	K	М	CJ	CJ	CJ	CJ	CJ	СН	СН	DR	DR	DR	DR	DR	DR	DR	EQ	EQ	EQ	EQ	ES	ES	ES
2,200 pF	222				F	G	J	K	M	CJ	CJ	CJ	CJ	CJ	CH	CH	DR	DR	DR	DR	DR	DR	DR	EQ	EQ	EQ	EQ	ET	ET	ET
2,400 pF	242				F	G	J	K	M	CJ	CJ	CJ	CJ	CJ			DR	DR	DR	DR	DR	DR	DR	EQ	EQ	EQ	EQ	ER	ER	ER
2,700 pF	272	l			F	G	J	K	M	CJ	CJ	CJ	CJ	CJ			DR	DR	DR	DR	DR	DR	DR	EQ	EQ	EQ	EQ	ER	ER	ER
3,000 pF 3,300 pF	302 332				F	G	J	K	M	CJ	CJ	CJ	CJ	CJ			DD	DD	DD DD	DD DD	DR DR	DR DR	DR DR	ER ER	ER ER	ER ER	ER ER	ER ET	EQ EQ	EQ EQ
3,600 pF	362	i			F	G	J	K	M	CJ	CJ	CJ	CJ	CJ			DD	DD	DD	DD	DR	DD	DD	ER	ER	ER	ER	ET	EQ	EQ
3,900 pF	392	İ			F	G	J	K	M	CJ	CJ	CJ	CJ	CJ			DS	DS	DS	DS	DR	DD	DD	ER	ER	ER	ER	EF	EQ	EQ
4,300 pF	432	İ			F	G	J	K	M	CJ	CJ	CJ	CJ	CJ			DS	DS	DS	DS	DR	DD	DD	ER	ER	ER	ER	ER	EQ	EQ
4,700 pF	472				F	G	J	K	M	CJ	CJ	CJ	CJ	CJ			DS	DS	DS	DS	DR	DD	DD	ER	ER	ER	ER	ER	EQ	EQ
5,100 pF	512				F	G	J	K	M	CJ	CJ	CJ	CJ				DS	DS	DS	DS	DR	DD	DD	ES	ES	ES	ES	ES	EQ	EQ
5,600 pF	562				F	G	J	K	M	CJ	CJ	CJ	CJ				DR	DR	DR	DR	DR	DD	DD	ES	ES	ES	ES	ES	EQ	EQ
6,200 pF	622 682	l			F	G	J	K	M	CJ	CJ	Cl	CJ				DR	DR DR	DR	DR	DR	DG DG	DG	EQ EQ	EQ	EQ EQ	EQ	EQ	EQ EQ	EQ EQ
6,800 pF 7,500 pF	752	ł			F	G	J	K	M	CJ	CJ	CJ	CJ				DR DR	DR	DR DR	DR DR	DR DR	DG	DG DG	EQ	EQ EQ	EQ	EQ EQ	EQ EQ	EQ	EQ
8,200 pF	822				F	G	J	K	M	CJ	CJ	CJ					DR	DR	DR	DR	DR	DG	DG	ER	ER	ER	ER	EQ	ER	ER
9,100 pF	912				F	G	J	K	M	CJ	CJ	CJ					DR	DR	DR	DR	DR			ER	ER	ER	ER	EQ	ER	ER
10,000 pF	103				F	G	J	K	М	CJ	CJ	CJ					DR	DR	DR	DR	DD			ES	ES	ES	ES	EQ	ER	ER
12,000 pF	123				F	G	J	K	М	CJ	CJ	CJ					DR	DR	DR	DR	DS			EQ	EQ	EQ	EQ	EQ	ES	ES
15,000 pF	153				F	G	J	K	M	CJ	CJ	CJ					DR	DR	DR	DD	DG			EQ	EQ	EQ	EQ	EQ	EF	EF
18,000 pF	183				F	G	J	K	M								DR	DR	DR	DD				EQ	EQ	EQ	EQ	EQ	EH	EH
22,000 pF 27,000 pF	223 273	l			F	G	J	K	M M								DD DF	DD DF	DD DF	DF				EQ EQ	EQ EQ	EQ EQ	EQ EQ	ER ET	EH	EH
33,000 pF	333	l			F	G	ا. ا	K	M								DG	DG	DG					EQ	EQ	EQ	EQ	ET		
39,000 pF	393	l			F	G	J	K	M								DG	DG	DG					ER	ER	ER	ET	EH		
47,000 pF	473				F	G	J	K	M								DG	DG						ER	ER	ER	ET	EH		
56,000 pF	563				F	G	J	K	M															ES	ES	ES	EF			
68,000 pF	683				F	G	J	K	M															EF	EF	EF	EH			
82,000 pF	823				F	G	J	K	M															EH	EH	EH	EH			
0.10 μF	104			Rated	•	G	(VDC	:) :)	M	10	91	55	20	100	200	250	9	9	55	20	100	200	250	<u>태</u>	9F EH	EH 22	20	9	200	250
Capacitance	Сар				oltag	Ť	•	•1		8	4	3	5	1	2	Ä	8	4	3	5	1	2	7 A	8	4	3	5	1	2	- 7 3
	Code		_	ase				25		°	4		0603			_ A	⊦ °	4	l	o 0805			_ A	⊦°	4		1206			А
		Ь_		ase	312	_e/3	6110	- 5					000						U	0000							1200			

^{*}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) These products are protected under US Patents 7,172,985 and 7,670,981, other patents pending, and any foreign counterparts.



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

			Case Size/Series					C	121	0X				C18	12X	(C18	25X	(C22	220)	(C22	25)	Z				
0 "	Cap			Vo	ltag	e Co	de			8	4	3	5	1	2	Α	5	1	2	Α	5	1	2	Α	5	1	2	Α	5	1	2	Α
Capacitance	Code		R	ated	Volt	tage	(VD	C)		9	16	25	20	19	200	250	20	100	200	250	20	100	200	250	22	19	200	250	20	100	200	250
			Ca	paci	tanc	е То	lerai	ıce							Pro	duc			bili	ty a			Thi	ckn			des					
1.0 - 9.1 pF*	109 - 919*	В	С	D						FN	FN	FN	FN	FN	FN	FN	abi	e z i	or c	Chip	1 111	CKII	ess	וווט	nen:	SIOI	15					
10 - 91 pF*	100 - 910*				F	G	J	K	М	FN	FN	FN	FN	FN	FN	FN	İ												İ			
100 - 430 pF*	101 - 431*				F	G	J	K	M	FN	FN	FN	FN	FN	FN	FN																
470 - 910 pF*	471 - 911*				F	G	J	K	M	FN	FN	FN	FN	FN	FN	FN	GB	GB	GB	GB												
1,000 pF	102				F	G	J	K	M	FN	FN	FN	FN	FN	FN	FN	GB	GB	GB	GB												
1,100 pF	112				F	G	J	K	M	FN	FN	FN	FN	FN	FN	FN	GB	GB	GB	GB												
1,200 pF	122				F	G	J	K	M	FN	FN	FN	FN	FN	FN	FN	GB	GB	GB	GB												
1,300 pF	132				F	G	J	K	M	FN	FN	FN	FN	FN	FQ	FQ	GB	GB	GB	GB												
1,500 pF	152 162	ł			F	G	J	K	M	FN FN	FN FN	FN	FN FN	FN FN	FE FE	FE FE	GB GB	GB GB	GB GB	GB GB									ł			
1,600 pF 1,800 pF	182				F	G	J	K	M	FN	FN	FN	FN	FN	FE	FE	GB	GB	GB	GB												
2,000 pF	202				F	G	J	K	M	FN	FN	FN	FN	FQ	FE	FE	GB	GB	GB	GB												
2,200 pF	202				F	G	J	K	M	FN	FN	FN	FN	FQ	FZ	FZ	GB	GB	GB	GB									i			
2,400 pF	242				F	G	J	K	M	FN	FN	FN	FN	FQ	FQ	FQ		OB	OB	OB												
2,700 pF	272				F	G	J	K	M	FN	FN	FN	FN	FQ	FQ	FQ	GB	GB	GB	GB												
3,000 pF	302				F	G	J	K	М	FN	FN	FN	FN	FQ	FA	FA																
3,300 pF	332	İ			F	G	J	K	M	FN	FN	FN	FN	FA	FA	FA	GB	GB	GB	GB					İ				İ			
3,600 pF	362	l			F	G	J	K	M	FN	FN	FN	FN	FA	FA	FA	ĺ												ĺ			
3,900 pF	392				F	G	J	K	M	FN	FN	FN	FN	FA	FA	FA	GB	GB	GB	GB	НВ	НВ	НВ	НВ								
4,300 pF	432				F	G	J	K	М	FN	FN	FN	FN	FA	FA	FA																
4,700 pF	472				F	G	J	K	M	FA	FA	FA	FA	FZ	FZ	FZ	GB	GB	GD	GD	НВ	НВ	HB	НВ					KE	KE	KE	KE
5,100 pF	512				F	G	J	K	M	FN	FN	FN	FN	FZ	FZ	FZ	۱												KE	KE	KE	KE
5,600 pF	562				F	G	J	K	M	FN	FN	FN	FN	FZ	FZ	FZ	GB	GB	GH	GH	НВ	НВ	НВ	НВ					KE	KE	KE	KE
6,200 pF 6,800 pF	622				F	G	J	K	M	FN	FN	FN	FN	FZ	FN	FN		OD			un	LID	un	LID	۱.,		I.D.		KE	KE	KE	KE
7,500 pF	682 752				F	G	J	K	M	FN FQ	FN FQ	FN	FN FQ	FZ FQ	FN	FN FN	GB	GB	GJ	GJ	НВ	НВ	НВ	НВ	JE	JE	JB		KE	KE	KE	KE KE
8,200 pF	822				F	G	J	K	M	FQ	FQ	FQ	FQ	FQ	FN	FN	GB	GH	GB	GB	НВ	НВ	НВ	НВ	JE	JE	JB		KE	KE	KE	KE
9,100 pF	912				F	G	J	K	M	FE	FE	FE	FE	FE	FN	FN	55	011	OB	OB	110	1110	110	110	"-	02	0.5		KE	KE	KE	KE
10,000 pF	103				F	G	j	K	M	FA	FA	FA	FA	FA	FN	FN	GB	GH	GB	GB	НВ	НВ	HE	HE	JE	JE	JB		KE	KE	KE	KE
12,000 pF	123	İ			F	G	j	K	M	FZ	FZ	FZ	FZ	FN	FN	FN	GB	GG	GB	GB	НВ	НВ	HE	HE	JE	JE	JB		KE	KE	KE	KE
15,000 pF	153				F	G	J	K	М	FZ	FZ	FZ	FZ	FN	FQ	FQ	GB	GB	GB	GB	НВ	НВ			JE	JE	JB		KE	KE	KE	KE
18,000 pF	183				F	G	J	K	М	FN	FN	FN	FN	FN	FQ	FQ	GB	GB	GB	GB	НВ	HE			JE	JE	JB		KE	KE		
22,000 pF	223				F	G	J	K	M	FN	FN	FN	FN	FN	FA	FA	GB	GB	GB	GB	НВ	HE			JE	JB	JB		KE	KE		
27,000 pF	273				F	G	J	K	M	FN	FN	FN	FN	FN	FZ	FZ	GB	GB	GB	GB	НВ	HG			JE	JB	JB		KE	KE		
33,000 pF	333				F	G	J	K	M	FN	FN	FN	FN	FN	FU	FU	GB	GB	GB	GB					JB	JB	JB		KE			
39,000 pF	393	1			F	G	J	K	M	FN	FN	FN	FN	FE	FU	FU	GB	GB	GB	GB					JB	JB	JB		1			
47,000 pF 56,000 pF	473 563				F	G	J	K	M	FN FN	FN FN	FN	FN FN	FE FA	FJ	FJ	GB GB	GB GB	GD GD	GD GD					JB JB	JB JB	JB JB		1			
68,000 pF	683	1			F	G	J	K	M	FN	FN	FN	FQ	FZ			GB	GB	GK	GK					JB	JB	JB		1			
82,000 pF	823	l			F	G	J	K	M	FQ	FQ	FQ	FA	FU			GB	GB		GM					JB	JB	JB		1			
0.10 µF	104				F	G	J	K	M	FE	FE	FE	FZ	FM			GB	GD	-	GM					JB	JB	JD					
0.12 µF	124				F	G	J	K	М	FZ	FZ	FZ	FU				GB	GH							JB	JB	JD					
0.15 µF	154				F	G	J	K	М	FU	FU	FU	FM				GD	GN							JB	JB	JG					
0.18 µF	184				F	G	J	K	M	FJ	FJ						GH								JB	JD	JG					
0.22 µF	224				F	G	J	K		FK	FK	FK					GK								JB	JD						
0.27 µF	274				F	G	J	K	M																JB	JF			1			
0.33 µF	334				F	G	J	K	M																JD	JG			l			
0.39 µF	394 474	1			F	G	J	K	M M																JG JG				1			
0.47 μF	4/4	\vdash		ated			_		IVI	9	16	52	20	9	200	250	20	9	200	250	20	100	200	250	20	ş	_	200	20	100	200	250
Canacitanas	Сар		- K		oltag			٠,		8	4	3	5	1	2		5	1	2	5 A	5	1	2	75 A	5	1		2	5	1	2	7 A
Capacitance	Code		C:	ase				es		Ļ	-		1210			_^	 	_ <u>'</u> C18		_		_ <u>'</u> C18					220X			_		
				436	J12	-0/0	,611						1211					- 10				J 10								<u> </u>		

^{*}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) These products are protected under US Patents 7,172,985 and 7,670,981, other patents pending, and any foreign counterparts.



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

		T	Donor O	uontitu1	Diagtic (Quantity
Thickness	Case	Thickness ±	Paper Q		Plastic (
Code	Size ¹	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
CJ	0603	0.80 ± 0.15	4,000	15,000	0	0
CH	0603	0.85 ± 0.07	4,000	10,000	0	0
DR DD	0805 0805	0.78 ± 0.20 0.90 ± 0.10	0	0	4,000 4,000	10,000 10,000
DS	0805	1.00 ± 0.10	0	0	2,500	10,000
DF	0805	1.10 ± 0.10	0	0	2,500	10,000
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
EQ	1206	0.78 ± 0.20	4,000	10,000	4,000	10,000
ER	1206	0.90 ± 0.20	0	0	4,000	10,000
ES	1206	1.00 ± 0.20	0	0	2,500	10,000
ET	1206	1.10 ± 0.20	0	0	2,500	10,000
EF EH	1206 1206	1.20 ± 0.15 1.60 ± 0.20	0	0	2,500 2,000	10,000 8,000
FN	1210	0.78 ± 0.20	0	0	4,000	10,000
FQ	1210	0.90 ± 0.20	0	ő	4,000	10,000
FE	1210	1.00 ± 0.10	0	0	2,500	10,000
FA	1210	1.10 ± 0.15	0	0	2,500	10,000
FZ	1210	1.25 ± 0.20	0	0	2,500	10,000
FU	1210	1.55 ± 0.20	0	0	2,000	8,000
FM FJ	1210 1210	1.70 ± 0.20 1.85 ± 0.20	0	0	2,000 2,000	8,000 8,000
FK FK	1210	2.10 ± 0.20	0	0	2,000	8,000
GB	1812	1.00 ± 0.10	0	0	1,000	4,000
GD	1812	1.25 ± 0.15	Ö	Ö	1,000	4,000
GH	1812	1.40 ± 0.15	0	0	1,000	4,000
GG	1812	1.55 ± 0.10	0	0	1,000	4,000
GK	1812	1.60 ± 0.20	0	0	1,000	4,000
GJ	1812	1.70 ± 0.15	0	0	1,000	4,000
GN GM	1812 1812	1.70 ± 0.20 2.00 ± 0.20	0 0	0 0	1,000 500	4,000 2,000
HB	1825	2.00 ± 0.20 1.10 ± 0.15	0	0	1,000	4,000
HE	1825	1.40 ± 0.15	0	0	1,000	4,000
HG	1825	1.60 ± 0.20	Ö	Ö	1,000	4,000
JB	2220	1.00 ± 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
JG KE	2220 2225	1.70 ± 0.15 1.40 ± 0.15	0 0	0 0	1,000 1,000	4,000 4,000
Thickness	Case	Thickness ±	7" Reel	13" Reel	7" Reel	13" Reel
Code	Size ¹	Range (mm)	Paper Q			L Quantity

Package quantity based on finished chip thickness specifications.

¹ If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Table 2B - Bulk Packaging Quantities

Doolee	ulu u Tuu o	Loose Pa	ackaging					
Раска	ging Type	Bulk Bag	(default)					
Packagi	ng C-Spec ¹	N/A²						
Cas	e Size	Packaging Quantities ((pieces/unit packaging)					
EIA (in)	Metric (mm)	Minimum	Maximum					
0402	1005							
0603	1608							
0805	2012		50,000					
1206	3216							
1210	3225	1						
1808	4520							
1812	4532							
1825	4564		20,000					
2220	5650							
2225	5664							

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

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



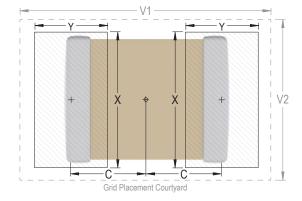
Table 3 – Chip Capacitor Land Pattern Design Recommendations per IPC-7351 (mm)

EIA Size Code	Metric Size Code		Density Level A: Maximum (Most) Land Protrusion (mm)					Media	sity Lev an (Nor rotrusio)	Density Level C: Minimum (Least) Land Protrusion (mm)					
Oode	Oode	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	X	V1	V2	
0603	1608	0.85	1.25	1.10	4.00	2.10	0.75	1.05	1.00	3.10	1.50	0.65	0.85	0.90	2.40	1.20	
0805	2012	0.99	1.44	1.66	4.47	2.71	0.89	1.24	1.56	3.57	2.11	0.79	1.04	1.46	2.42	1.81	
1206	3216	1.59	1.62	2.06	5.85	3.06	1.49	1.42	1.96	4.95	2.46	1.39	1.22	1.86	4.25	2.16	
1210	3225	1.59	1.62	3.01	5.90	4.01	1.49	1.42	2.91	4.95	3.41	1.39	1.22	2.81	4.25	3.11	
1812	4532	2.30	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	
1825	4564	2.15	1.80	6.90	7.10	7.90	2.05	1.60	6.80	6.20	7.30	1.95	1.40	6.70	5.50	7.00	
2220	5650	2.85	2.10	5.50	8.80	6.50	2.75	1.90	5.40	7.90	5.90	2.65	1.70	5.30	7.20	5.60	
2225	5664	2.85	2.10	6.90	8.80	7.90	2.75	1.90	6.80	7.90	7.30	2.65	1.70	6.70	7.20	7.00	

Density Level A: For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes. KEMET only recommends wave soldering of EIA 0603, 0805, and 1206 case sizes.

Density Level B: For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes. **Density Level C:** For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC Standard 7351 (IPC–7351).

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





Soldering Process

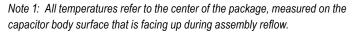
Recommended Soldering Technique:

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

Recommended Reflow Soldering Profile:

KEMET's families of surface mount multilayer ceramic capacitors (SMD MLCCs) are compatible with wave (single or dual), convection, IR or vapor phase reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET's recommended profile conditions for convection and IR reflow reflect the profile conditions of the IPC/J-STD-020 standard for moisture sensitivity testing. These devices can safely withstand a maximum of three reflow passes at these conditions.

Profile Feature	Terminati	on Finish
Frome reature	SnPb	100% Matte Sn
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum



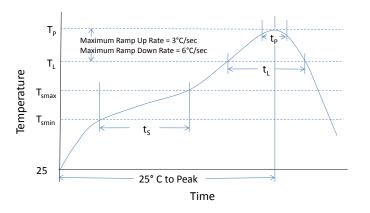




Table 4 – Performance & Reliability: Test Methods and Conditions

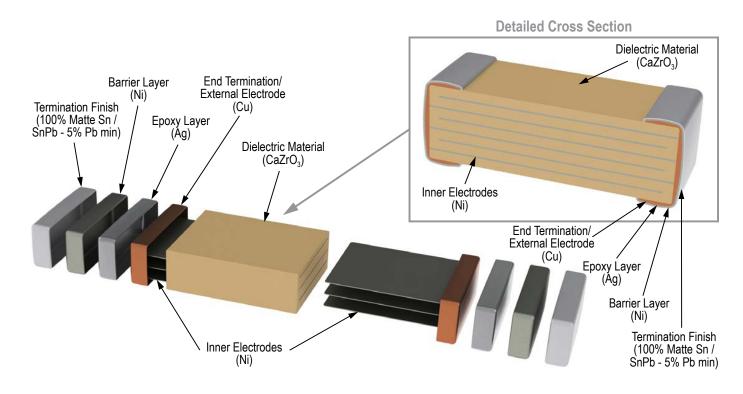
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Coldorability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	J-31D-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.
D: 111 :15	MII. 0TD 000 M II. 1400	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
Vibration	MIL-STD-202 Method 204	5 g's for 20 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



Capacitor Marking (Optional):

Laser marking option is not available on:

- C0G, Ultra Stable X8R and Y5V dielectric devices
- EIA 0402 case size devices
- EIA 0603 case size devices with Flexible Termination option.
- KPS Commercial and Automotive grade stacked devices.

These capacitors are supplied unmarked only.

Flexible Termination System (FT-CAP), X7R Dielectric, 6.3 – 250 VDC (Commercial Grade)



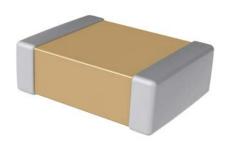
Overview

KEMET's Flexible Termination (FT-CAP) multilayer ceramic capacitor in X7R dielectric incorporates a unique, flexible termination system that is integrated with KEMET's standard termination materials. A conductive silver epoxy is utilized between the base metal and nickel barrier layers of KEMET's standard termination system in order to establish pliability while maintaining terminal strength, solderability and electrical performance. This technology was developed in order to address the primary failure mode of MLCCs– flex cracks, which are typically the result of excessive tensile and shear stresses produced during board flexure and thermal cycling. Flexible termination technology inhibits the transfer of board stress to the rigid ceramic body, therefore mitigating flex cracks which can result in low IR or short circuit failures.

Although this technology does not eliminate the potential for mechanical damage that may propagate during extreme environmental and handling conditions, it does provide superior flex performance over standard termination systems. FT-CAP complements KEMET's Open Mode, Floating Electrode (FE-CAP), Floating Electrode with Flexible Termination (FF-CAP) and KEMET Power Solutions (KPS) product lines by providing a complete portfolio of flex mitigation solutions.

Combined with the stability of an X7R dielectric and designed to accommodate all capacitance requirements, these flex-robust devices are RoHS-compliant, offer up to 5 mm of flex-bend capability and exhibit a predictable change in capacitance with respect to time and voltage. Capacitance change with reference to ambient temperature is limited to ±15% from -55°C to +125°C.

In addition to commercial grade, automotive grade devices are available which meet the demanding Automotive Electronics Council's AEC–Q200 qualification requirements.



Ordering Information

С	1206	Х	106	K	4	R	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec) ²
	0603 0805 1206 1210 1808 1812 1825 2220 2225	X = Flexible Termination	Two significant digits + number of zeros	J = ±5% K = ±10% M = ±20%	9 = 6.3 8 = 10 4 = 16 3 = 25 5 = 50 1 = 100 2 = 200 A = 250	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

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



Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec)
Bulk Bag/Unmarked	Not required (Blank)
7" Reel/Unmarked	TU
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
7" Reel/Marked	TM
13" Reel/Marked	7040 (EIA 0603 and smaller case sizes) 7215 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2mm pitch ²	7081
13" Reel/Unmarked/2mm pitch ²	7082

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- -55°C to +125°C operating temperature range
- Superior flex performance (up to 5 mm)
- High capacitance flex mitigation
- · Lead (Pb)-Free, RoHS and REACH compliant
- EIA 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, 50 V, 100 V, 200 V, and 250 V

- Capacitance offerings ranging from 180 pF to 22 μF
- Available capacitance tolerances of ±5%, ±10%, and ±20%
- Automotive (AEC-Q200) grade available
- · 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% Pb minimum)

Applications

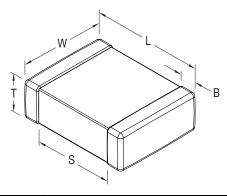
Typical applications include circuits with a direct battery or power source connection, critical and safety relevant circuits without (integrated) current limitation and any application that is subject to high levels of board flexure or temperature cycling. Examples include raw power input side filtering (power plane/bus), high current applications (automobile battery line) and circuits that cannot be fused to open. Markets include consumer, medical, industrial (power supply), automotive, aerospace and telecom.

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. Please contact KEMET if you require a laser marked option. For more information see "Capacitor Marking".

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Dimensions – Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0603	1608	1.60 (.063) ± 0.17 (.007)	0.80 (.032) ± 0.15 (.006)		0.45 (.018) ± 0.15 (.006)	0.58 (.023)	Solder Wave
0805	2012	2.00 (.079) ± 0.30 (.012)	1.25 (.049) ± 0.30 (.012)		$0.50 (0.02) \pm 0.25 (.010)$	0.75 (.030)	or
1206	3216	3.30 (.130) ± 0.40 (.016)	1.60 (.063) ± 0.35 (.013)		0.60 (.024) ± 0.25 (.010)		Solder Reflow
1210	3225	3.30 (.130) ± 0.40 (.016)	2.60 (.102) ± 0.30 (.012)		0.60 (.024) ± 0.25 (.010)		
1808	4520	4.70 (.185) ± 0.50 (.020)	2.00 (.079) ± 0.20 (.008)	See Table 2 for Thickness	0.70 (.028) ± 0.35 (.014)		
1812	4532	4.50 (.178) ± 0.40 (.016)	3.20 (.126) ± 0.30 (.012)		0.70 (.028) ± 0.35 (.014)	N/A	Solder Reflow
1825	4564	4.60 (.181) ± 0.40 (.016)	6.40 (.252) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)		Only
2220	5650	5.90 (.232) ± 0.75 (.030)	5.00 (.197) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)		
2225	5664	5.90 (.232) ± 0.75 (.030)	6.40 (.248) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)		

Qualification/Certification

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

Environmental Compliance

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%
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
² Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ± 1 seconds and charge/discharge not exceeding 50mA)
³ Dissipation Factor (DF) Maximum Limit @ 25°C	5%(6.3V & 10V), 3.5%(16V & 25V) and 2.5%(50V to 250V)
⁴ Insulation Resistance (IR) Minimum Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ± 5 secs @ 25°C)

¹Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

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

120Hz \pm 10Hz and 0.5 ± 0.1 Vrms if capacitance >10 μ F

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

Post Environmental Limits

	High Temperatu	ire Life, Biased	Humidity, Moist	ture Resistance	
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance
	> 25		3.0		
X7R	16/25	All	5.0	±20%	10% of Initial Limit
	< 16		7.5		

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

⁴To obtain IR limit, divide MΩ- μ F value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



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



Table 1A – Capacitance Range/Selection Waterfall (0603 – 1210 Case Sizes)

	0	_	se S erie				C	060	3X						C08	05)	(C12	06)	(C12	210X	(
Сар	Cap		age C		9	8	4	3	5	1	2	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	Α
	Oout		d Volt (VDC)		6.3	2	16	25	20	9	200	6.3	2	16	25	20	9	200	250	6.3	10	16	25	20	5	200	250	6.3	2	16	25	20	9	200	250
100 5	404	Сар	Tolera		0.1	0.1	_	_	_	_	_				<u> </u>				_	es -	- Se	e Ta	able	2 f	or C	hip	Thi	ckn	ess	Dir	nen	sior	าร		
180 pF 220 pF	181 221	J	K K	M	Cl	Cl	CJ	Cl	CJ	CJ	CJ	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR																
270 pF	271	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR																ĺ
330 pF 390 pF	331 391	J	K K	M M	Cl	Cl	CJ	Cl	Cl	Cl	Cl	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR																
470 pF 560 pF	471 561	J	K K	M M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	EQ	EQ	EQ	EQ	EQ											
680 pF	681	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR																l
820 pF	821	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR	_	F0		F0	F0	F0	F0	F0								
1,000 pF 1,200 pF	102 122	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	EQ EQ	EQ EQ	EQ	EQ EQ	EQ EQ	EQ EQ	EQ	EQ EQ								
1,500 pF	152	J	K	М	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ								
1,800 pF 2,200 pF	182 222	J	K K	M M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	FN	FN	FN	FN	FN	FN	FN	FN
2,700 pF	272	J	K	М	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN							
3,300 pF 3,900 pF	332 392	J	K K	M	Cl	CJ	CJ	CJ	CJ	CJ	CJ	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	FN FN	FN FN	FN FN	FN FN	FN FN	FN FN	FN FN	FN FN
4,700 pF	472	J	K	М	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN							
5,600 pF 6,800 pF	562 682	J	K K	M	CJ	CJ	CJ	CJ	CJ	Cl	Cl	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	FN FN	FN FN	FN FN	FN FN	FN FN	FN FN	FN FN	FN FN
8,200 pF	822	J	K	М	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN							
10,000 pF 12,000 pF	103 123	J	K K	M M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	FN FN	FN FN	FN FN	FN FN	FN FN	FN FN	FN FN	FN FN
15,000 pF	153	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ		DR	DR	DR	DR	DR	DD	DR	DR	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN							
18,000 pF 22,000 pF	183 223	J	K K	M M	CJ	CJ	CJ	CJ	CJ	CJ		DR DR	DR DR	DR DR	DR DR	DR DR	DD DD	DR DR	DR DR	EQ EQ	EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	FN FN	FN FN	FN FN	FN FN	FN FN	FN FN	FN FN	FN FN
27,000 pF	273	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ		DR	DR	DR	DR	DR	DD	DS	DK	EQ	EQ EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN
33,000 pF	333	J	K	М	CJ	CJ	CJ	CJ	CJ	CJ		DR	DR	DR	DR	DR	DD	DS		EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN							
39,000 pF 47,000 pF	393 473	J	K K	M	CJ	Cl	CJ	Cl	CJ	CJ		DR DR	DR DR	DR DR	DR DR	DR DR	DD DS	DS DG		EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	ER ER	EQ ES	EQ ES	FN FN	FN FN	FN FN	FN FN	FN FN	FN FN	FN FQ	FN FQ
56,000 pF	563	J	K	М	CJ	CJ	CJ	CJ	CJ			DD	DD	DD	DD	DD	DS	DG		EQ	EQ	EQ	EQ	EQ	EQ	ES	ES	FN	FN	FN	FN	FN	FN	FQ	FQ
68,000 pF 82,000 pF	683 823	J	K K	M	CJ	CJ	CJ	CJ	CJ			DD	DD DD	DD DD	DD DD	DD DD	DS DS			EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	ES ES	ES ES	FN FN	FN FN	FN FN	FN FN	FN FN	FN FQ	FQ FA	FQ FA
0.10 µF	104	J	K	М	CJ	CJ	CJ	CJ	CJ			DR	DR	DR	DR	DR	DS			EQ	EQ	EQ	EQ	EQ	EQ	EM	EM	FN	FN	FN	FN	FN	FX	FZ	FZ
0.12 µF 0.15 µF	124 154	J	K K	M	CJ	CJ	CJ	CJ	CJ			DR DR	DR DR	DR DR	DR DR	DD DD	DG DG			ER ER	ER ER	ER ER	ER ER	ER ER	ER ER	EU		FN FQ	FN FQ	FN FQ	FN FQ	FN	FX FX	FU FM	FU FM
0.18 µF	184	J	K	М	CJ	CJ	CJ	CJ				DR	DR	DR	DR	DG	DG			ER	ER	ER	ER	ER	ER			FQ	FQ	FQ	FQ	FQ	FX	FK	FK
0.22 µF 0.27 µF	224 274	J	K K	M	CJ	CJ	CJ	CJ				DR DD	DR DD	DR DD	DR DD	DG DD	DG			ER EQ	ER EQ	ER EQ	ER EQ	ER ER	ER EM			FQ FQ	FQ FQ	FQ FQ	FQ FQ	FQ FQ	FX FX	FK	FK
0.33 µF	334	J	K	М	CJ	CJ	CJ					DG	DG	DG	DG	DD				EQ	EQ	EQ	EQ	ER	EU			FΧ	FX	FX	FX	FX	FX		
0.39 µF 0.47 µF	394 474	J	K K	M	CJ	Cl	CJ					DG DG	DG	DG DG	DG	DS DS				EQ ER	EQ ER	EQ ER	EQ ER	ER ER	EU			FX FX	FX FX	FX FX	FX FX	FX FX	FX FX		
0.56 µF	564	J	K	M								DD	DD	DD	DG	DH				ES	ES	ES	ES	ER				FX	FX	FX	FX	FX	FA		
0.68 μF 0.82 μF	684 824	J	K K	M M								DD DD	DD DD		DG DG	DH				ET EF	ET EF	ET EF	ET EF	ES ES				FX FA	FX FA	FX FA	FX FA	FX FA	FZ FL		
1.0 µF	105	J	K	M								DD	DD	DD	DG					EF	EF	EF	EU	ES				FU	FU	FU	FU	FU	FM		
1.2 μF 1.5 μF	125 155	J	K K	M M								DS	DS DG							ES EF	ES EF	ES EF	EU	EH				FU FU	FU FU	FU FU	FU FU	FZ FZ			
1.8 µF	185	J	K	M									DG							ES	ES	ES	EF	EH				FU	FU	FU	FU	FZ			
2.2 μF 2.7 μF	225 275	J	K K	M								DG	DG	DG						ES EN	ES EN	ES	EF	EH				FJ FE	FJ FE	FJ FE	FJ F7	FZ FU			
3.3 µF	335	J	K	M																ES	ES	EN ES	EH					FA	FA	FA	FZ FM	FM			
3.9 µF	395	J	K	M																EF	EF	EF	EH					FZ	FZ	FZ	FZ	FK			
4.7 μF 5.6 μF	475 565	J	K K	M M																EF EH	EF EH	EF EH	EH					FQ FA	FQ FA	FQ FA	FZ FU	FS			
			d Volt (VDC)		6.3	9	16	25	20	ę	200	6.3	9	16	25	20	100	200	250	6.3	9	16	25	20	ę	200	250	6.3	9	16	25	20	100	200	250
Сар	Cap Code	Volt	age C	ode	9	8	4	3	5	1	2	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	Α
			se Si erie				C	060	3X						C08	05X	ζ <u></u>						C12	06X							C12	210X			



Table 1A - Capacitance Range/Selection Waterfall (0603 - 1210 Case Sizes) cont'd

			se S erie	ize/			C	060	3X					(C08	05)	(C12	(60	(C12	10)	(
Сар	Cap		age C	ode	9	8	4	3	5	1	2	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	Α
oup.	Code	Nate	d Vol		6.3	10	16	25	20	100	200	6.3	10	16	25	20	100	200	250	6.3	10	16	25	20	100	200	250	6.3	9	16	25	20	100	200	250
		Сар	Toler	ance			Pı	rodi	uct	Ava	ilab	ility	and	d Cr	nip '	Γhic	kne	ss (Cod	es-	- Se	е Та	able	2 f	or C	hip	Thi	ckn	ess	Din	nen	sior	าร		
6.8 µF	685	J	K	М																EH	EH	EH						FZ	FZ	FZ	FM				
8.2 µF	825	J	K	M	İ															EΗ	EH	EH						FU	FU	FU	FK				l
10 µF	106	J	K	M	İ															EΗ	EH	EH						FU	FU	FU	FS				l
12 µF	126	J	K	M	İ																							İ							l
15 µF	156	J	K	M	İ																							İ							l
18 µF	186	J	K	M																															
22 µF	226	J	K	M	l																							FS	FS						
	_		d Vol	•	6.3	9	16	25	20	9	200	6.3	10	16	25	20	100	200	250	6.3	10	16	25	20	100	200	250	6.3	9	16	25	20	100	200	250
Cap	Cap Code	Volt	age C	ode	9	8	4	3	5	1	2	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	Α
	Joue		se S erie				C	060	3X						C08	05X							C12	06X							C12	10X			

Table 1B - Capacitance Range/Selection Waterfall (1808 - 2225 Case Sizes)

	0		se S erie	ize/		C18	08X			С	1812	X			C18	25X			С	2220	X			C22	25X	
Cap	Cap	Volt	age C	ode	5	1	2	Α	3	5	1	2	Α	5	1	2	Α	3	5	1	2	Α	5	1	2	Α
•	Code		ed Vol		50	100	200	250	25	50	100	200	250	50	100	200	250	25	50	100	200	250	50	100	200	250
			Toler			P	roduc	t Ava	ailabi	lity a	nd Cl	nip Tl	hickn	ess C	Code	s – Se	ee Tal	ble 2	for C	hip T	hickr	ness	L Dime	nsior	าร	
4,700 pF	472	J	K	М	LD	LD	LD													•						
5,600 pF	562	J	K	M	LD	LD	LD																İ			
6,800 pF	682	J	K	M	LD	LD	LD		GB	GB	GB	GB	GB													
8,200 pF	822	J	K	M	LD	LD	LD		GB	GB	GB	GB	GB													
10,000 pF	103	J	K	M	LD	LD	LD		GB	GB	GB	GB	GB													
12,000 pF	123	J	K	M	LD	LD	LD		GB	GB	GB	GB	GB													
15,000 pF	153	J	K	M	LD	LD	LD		GB	GB	GB	GB	GB													
18,000 pF	183	J	K	M	LD	LD	LD		GB	GB	GB	GB	GB													
22,000 pF	223	J	K	M	LD	LD			GB	GB	GB	GB	GB	HB	HB	HB	HB									
27,000 pF	273	J	K	M	LD	LD			GB	GB	GB	GB	GB	НВ	HB	НВ	НВ									
33,000 pF	333	J	K	M	LD	LD			GB	GB	GB	GB	GB	НВ	HB	HB	HB						ļ			
39,000 pF	393	J	K	M	LD	LD			GB	GB	GB	GB	GB	НВ	НВ	НВ	НВ									
47,000 pF	473	J	K	M	LD	LD			GB	GB	GB	GB	GB	НВ	НВ	НВ	НВ						KC	KC	KC	KC
56,000 pF	563	J	K	M	LD	LD			GB	GB	GB	GB	GB	HB	HB	HB	HB						KC	KC	KC	KC
68,000 pF	683	J	K	M	LD				GB	GB	GB	GB	GB	HB	НВ	НВ	НВ						KC	KC	KC	KC
82,000 pF	823	J	K	M	LD				GB	GB	GB	GB	GB	HB	HB	HB	HB	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.10 µF	104	J	K	M	LD				GB	GB	GB	GB	GB	HB	HB	HB	HB	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.12 µF	124	J	K	M	LD				GB	GB	GB	GB	GB	HB	HB	HB	HB	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.15 µF	154	J	K	M	LD				GB	GB	GB	GE	GE	HB	HB	HB	HB	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.18 µF	184	J	K	M	LD				GB	GB GB	GB GB	GF	GG GG	HB HB	HB HB	HB HB	HB	JC	JC	JC	JC	JC	KC	KC KC	KC KC	KC KC
0.22 µF 0.27 µF	224 274	J	K	M M					GB GB	GB	GG	GG GG	GG	HB	HB	НВ	HB HB	JC	JC	JC	JC	JC	KC KB	KC	KC	KC
	334	J	K	M					GB	GB	GG	GG	GG	HB	HB	HB	HB	JC	JC	JC	JC	JC	KB	KC	KC	KC
0.33 µF 0.39 µF	394		K	M					GB	GB	GG	GG	GG	нв НВ	нв НВ	HD	HD	JC	JC	JC	JC	JC	KB	KC	KC	KC
0.39 μF 0.47 μF	474	J	K	M					GB	GB	GG	GJ	GJ	НВ	НВ	HD	HD	JC	JC	JC	JC	JC	KB	KC	KD	KD
0.47 µF	564	J	K	M					GC	GC	GG	GJ	GJ	нв НВ	HD	HD	HD	JC	JC	JC	JD	JD	KB	KC	KD	KD
0.56 μF 0.68 μF	684	J	K	M					GC	GC	GG			нв НВ	HD	HD	HD	JC	JC	JD	JD	JD	KB	KC	KD	KD
0.82 uF	824	J	K	M					GE	GE	GG			HB	HF	HF	HF	JC	JC	JF	JF	JF	KB	KC	KE	KE
1.0 µF	105	J	K	M					GE	GE	GG			HB	HF	HF	HF	JC	JC	JF	JF	JF	KB	KD	KE	KE
1.0 µF	125	J	K	M					OL.	OL				HB	'''	'''	'''	JC	JC	01	01	01	KB	KE	KE	KE
p.	1.20	Ů	d Vol		20	9	200	250	25	20	100	200	250	20	9	200	250	25	20	9	200	250	20	9	500	250
	6		(VDC)													_										
Сар	Cap Code		age C		5	1	2	Α	3	5	1	2	Α	5	1	2	Α	3	5	1	2	Α	5	1	2	Α
			se S erie	-		C18	08X			С	1812	X			C18	25X			С	2220	x			C22	25X	



Table 1B - Capacitance Range/Selection Waterfall (1808 - 2225 Case Sizes) cont'd

		Case Size/ Series		C18	08X			С	1812	X			C18	25X			С	2220	X			C22	25X	
Сар	Cap	Voltage Code	5	1	2	Α	3	5	1	2	A	5	1	2	Α	3	5	1	2	Α	5	1	2	Α
Oup	Code	Rated Voltage (VDC)	20	100	200	250	25	20	100	200	250	20	100	200	250	25	20	100	200	250	20	100	200	250
		Cap Tolerance		Р	roduc	ct Ava	ailabi	lity a	nd C	hip T	hickn	ess (Code	s – S	ee Ta	ble 2	for C	hip T	hick	ness	Dime	nsio	าร	
1.5 μF 1.8 μF	155 185	J K M J K M										HC HD				JC JD	JC JD				KC KD			
2.2 µF	225	JKM	i									HF				JF	JF				KD			
2.7 µF	275	JKM	i													01	01							
3.3 µF	335	JKM	İ																					
3.9 µF	395	J K M																						
4.7 µF	475	JKM					GK	GK																
5.6 µF	565	J K M																						
6.8 µF	685	JKM																						
8.2 µF	825	J K M																						
10 μF	106	J K M					GK									JF	JO							
12 µF	126	J K M																						
15 µF	156	J K M														JO	JO							
18 μF 22 μF	186 226	J K M J K M	ŀ													JO								
μι	220	Rated Voltage																						
		(VDC)	20	100	200	250	25	20	100	200	250	20	100	200	250	25	22	100	200	250	22	100	200	250
Сар	Cap	Voltage Code	5	1	2	Α	3	5	1	2	Α	5	1	2	Α	3	5	1	2	Α	5	1	2	Α
	Code	Case Size/ Series		C18	08X			C	1812	x			C18	25X			С	2220	X			C22	25X	



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

Thickness	Case	Thickness ±	Paper Q	luantity ¹	Plastic (Quantity
Code	Size ¹	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
CJ	0603	0.80 ± 0.15	4,000	15,000	0	0
DR	0805	0.78 ± 0.20	0	0	4,000	10,000
DD	0805	0.90 ± 0.10	0	0	4,000	10,000
DS DG	0805 0805	1.00 ± 0.20 1.25 ± 0.15	0	0	2,500 2,500	10,000 10,000
DH	0805	1.25 ± 0.20	0	0	2,500	10,000
EQ	1206	0.78 ± 0.20	4,000	10,000	4,000	10,000
ER	1206	0.90 ± 0.20	0	0	4,000	10,000
EN	1206	0.95 ± 0.10	0	0	4,000	10,000
ES	1206	1.00 ± 0.20	0	0	2,500	10,000
ET	1206	1.10 ± 0.20	0	0	2,500	10,000
EF	1206	1.20 ± 0.15	0	0	2,500	10,000
EM	1206	1.25 ± 0.15	0	0	2,500	10,000
EH	1206	1.60 ± 0.20	0	0	2,000	8,000
EU	1206	1.60 ± 0.25	0	0	2,000	8,000
FN	1210	0.78 ± 0.20	0	0	4,000	10,000
FQ	1210	0.90 ± 0.20	0	0	4,000	10,000
FX	1210	0.95 ± 0.20	0	0	4,000	10,000
FE	1210	1.00 ± 0.10	0	0	2,500	10,000
FA	1210	1.10 ± 0.15	0	0	2,500	10,000
FZ	1210	1.25 ± 0.20	0	0	2,500	10,000
FL	1210	1.40 ± 0.15	0	0	2,000	8,000
FU	1210	1.55 ± 0.20	0	0	2,000	8,000
FM	1210	1.70 ± 0.20	0	0	2,000	8,000
FJ	1210	1.85 ± 0.20	0	0	2,000	8,000
FK	1210	2.10 ± 0.20	0	0	2,000	8,000
FS	1210	2.50 ± 0.30	0	0	1,000	4,000
LD	1808	0.90 ± 0.10	0	0	2,500	10,000
GB	1812	1.00 ± 0.10	0	0	1,000	4,000
GC	1812	1.10 ± 0.10	0	0	1,000	4,000
GE GF GG	1812 1812 1812	1.30 ± 0.10 1.30 ± 0.10 1.50 ± 0.10 1.55 ± 0.10	0 0 0	0 0 0	1,000 1,000 1,000	4,000 4,000 4,000
GK	1812	1.60 ± 0.20	0	0	1,000	4,000
GJ	1812	1.70 ± 0.15	0	0	1,000	4,000
HB	1825	1.10 ± 0.15	0	0	1,000	4,000
HC	1825	1.15 ± 0.15	0	0	1,000	4,000
HD	1825	1.30 ± 0.15	0	0	1,000	4,000
HF	1825	1.50 ± 0.15	0	0	1,000	4,000
JC	2220	1.10 ± 0.15	0	0 0 0	1,000	4,000
JD	2220	1.30 ± 0.15	0		1,000	4,000
JF	2220	1.50 ± 0.15	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		1,000	4,000
Thickness Code	Case Size ¹	Thickness ± Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
	0.26	rango (iiiii)	Paper Q	luantity ¹	Plastic (Quantity

Package quantity based on finished chip thickness specifications.

¹ If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Table 2B - Bulk Packaging Quantities

Deale		Loose P	ackaging
Раска(ging Type	Bulk Bag	g (default)
Packagi	ing C-Spec ¹	N.	/A ²
Cas	se Size	Packaging Quantities	(pieces/unit packaging)
EIA (in)	Metric (mm)	Minimum	Maximum
0402	1005		
0603	1608		
0805	2012		50,000
1206	3216		
1210	3225	1	
1808	4520		
1812	4532		
1825	4564		20,000
2220	5650		
2225	5664		

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

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



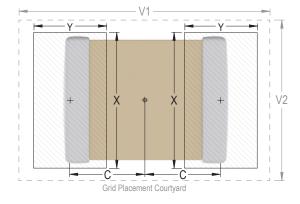
Table 3 – Chip Capacitor Land Pattern Design Recommendations per IPC-7351

EIA Size Code	Metric Size Code	ı		sity Lev mum (N	Most))		Medi	sity Lev an (Nor rotrusio)		Mini	sity Lev mum (L rotrusio)
Code	Oue	С	Y	X	V1	V2	С	Υ	Х	V1	V2	С	Υ	Х	V1	V2
0603	1608	0.85	1.25	1.10	4.00	2.10	0.75	1.05	1.00	3.10	1.50	0.65	0.85	0.90	2.40	1.20
0805	2012	0.99	1.44	1.66	4.47	2.71	0.89	1.24	1.56	3.57	2.11	0.79	1.04	1.46	2.42	1.81
1206	3216	1.59	1.62	2.06	5.85	3.06	1.49	1.42	1.96	4.95	2.46	1.39	1.22	1.86	4.25	2.16
1210	3225	1.59	1.62	3.01	5.90	4.01	1.49	1.42	2.91	4.95	3.41	1.39	1.22	2.81	4.25	3.11
1808	4520	2.30	1.75	2.30	7.40	3.30	2.20	1.55	2.20	6.50	2.70	2.10	1.35	2.10	5.80	2.40
1812	4532	2.10	1.80	3.60	7.00	4.60	2.00	1.60	3.50	6.10	4.00	1.90	1.40	3.40	5.40	3.70
1825	4564	2.15	1.80	6.90	7.10	7.90	2.05	1.60	6.80	6.20	7.30	1.95	1.40	6.70	5.50	7.00
2220	5650	2.85	2.10	5.50	8.80	6.50	2.75	1.90	5.40	7.90	5.90	2.65	1.70	5.30	7.20	5.60
2225	5664	2.85	2.10	6.90	8.80	7.90	2.75	1.90	6.80	7.90	7.30	2.65	1.70	6.70	7.20	7.00

Density Level A: For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes. KEMET only recommends wave soldering of EIA 0603, 0805, and 1206 case sizes.

Density Level B: For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes. **Density Level C:** For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC Standard 7351 (IPC–7351).

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





Soldering Process

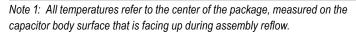
Recommended Soldering Technique:

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

Recommended Reflow Soldering Profile:

KEMET's families of surface mount multilayer ceramic capacitors (SMD MLCCs) are compatible with wave (single or dual), convection, IR or vapor phase reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET's recommended profile conditions for convection and IR reflow reflect the profile conditions of the IPC/J-STD-020 standard for moisture sensitivity testing. These devices can safely withstand a maximum of three reflow passes at these conditions.

Profile Feature	Terminati	on Finish
Frome reature	SnPb	100% Matte Sn
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum



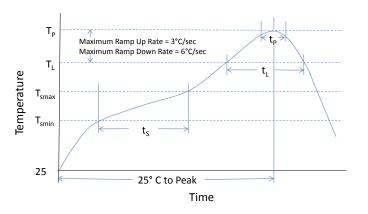




Table 4 - Performance & Reliability: Test Methods and Conditions

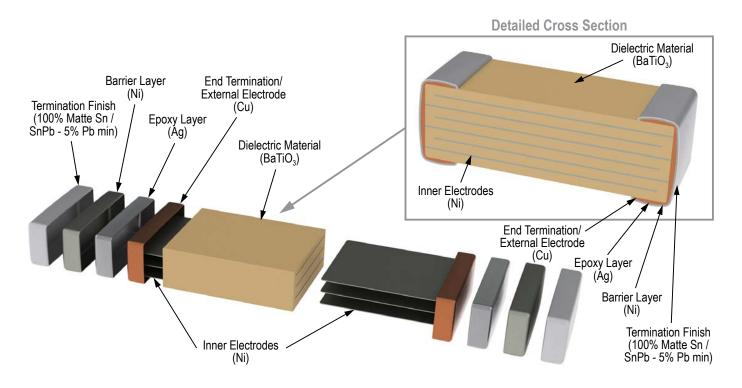
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Coldorability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	J-31D-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Did Hidit.	MII. OTD 000 M-H 1400	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
Vibration	MIL-STD-202 Method 204	5 g's for 20 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



Floating Electrode Design with Flexible Termination System (FF-CAP), X7R Dielectric, 6.3 – 250 VDC (Commercial & Automotive Grade)

Overview

KEMET's Floating Electrode with Flexible Termination capacitor (FF-CAP) combines two existing KEMET technologies- Floating Electrode and Flexible Termination. The floating electrode component utilizes a cascading internal electrode design configured to form multiple capacitors in series within a single monolithic structure. This unique configuration results in enhanced voltage and ESD performance over standard capacitor designs while allowing for a fail-open condition if mechanically damaged (cracked). The flexible termination component utilizes a conductive silver epoxy between the base metal and nickel barrier layers of KEMET's standard termination system in order to establish pliability while maintaining terminal strength, solderability and electrical performance. Both technologies address the primary failure mode of MLCCs- flex cracks, which are typically the result of excessive tensile and shear stresses produced during board flexure and thermal cycling.

Although neither technology can eliminate the potential for mechanical damage that may propagate during extreme environmental and/or handling conditions, the combination of these two technologies provide the ultimate level of protection against a low IR or short circuit condition. The FF-CAP complements KEMET's Open Mode, Floating Electrode (FE-CAP), Flexible Termination (FT-CAP) and KEMET Power Solutions (KPS)

product lines by providing an ultimate fail-safe design optimized for low to mid range capacitance values. These devices exhibit a predictable change in capacitance with respect to time and voltage and boast a minimal change in capacitance with reference to ambient temperature. Capacitance change is limited to $\pm 15\%$ from -55° C to $+125^{\circ}$ C.

Electronic Components

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



Ordering Information

С	0805	Y	104	K	5	R	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/ Grade (C-Spec)
	0603 0805 1206 1210 1812	Y = Floating Electrode with Flexible Termination	Two significant digits + number of zeros	J = ±5% K = ±10% M = ±20%	9 = 6.3 8 = 10 4 = 16 3 = 25 5 = 50 1 = 100 2 = 200 A = 250	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

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

¹ SnPb termination finish option is not available on automotive grade product.



Packaging C-Spec Ordering Options Table

Packaging Type	Packaging/Grade Ordering Code (C-Spec)				
Commercial Grade ¹					
Bulk Bag	Not Required (Blank)				
7" Reel/Unmarked	TU				
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)				
7" Reel/Marked	TM				
13" Reel/Marked	7040 (EIA 0603 and smaller case sizes) 7215 (EIA 0805 and larger case sizes)				
7" Reel/Unmarked/2 mm pitch ²	7081				
13" Reel/Unmarked/2 mm pitch ²	7082				
Automotive Grade ³					
7" Reel	AUTO				
13" Reel/Unmarked	AUTO7411 (EIA 0603 and smaller case sizes) AUTO7210 (EIA 0805 and larger case sizes)				
7" Reel/Unmarked/2 mm pitch ²	3190				
13" Reel/Unmarked/2 mm pitch ²	3191				

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- -55°C to +125°C operating temperature range
- Superior flex performance (up to 5 mm)
- · Floating Electrode/fail open design
- Low to mid capacitance flex mitigation
- · Lead (Pb)-Free, RoHS and REACH compliant
- EIA 0603, 0805, 1206, 1210, and 1812 case sizes
- DC voltage ratings of 6.3 V, 10 V, 16 V, 25 V, 50 V, 100 V, 200 V, and 250 V

- Capacitance offerings ranging from 180 pF to 0.22 μF
- Available capacitance tolerances of ±5%, ±10%, and ±20%
- Commercial & Automotive (AEC–Q200) grades available
- 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% Pb minimum)

Applications

Typical applications include circuits with a direct battery or power source connection, critical and safety relevant circuits without (integrated) current limitation and any application that is subject to high levels of board flexure or temperature cycling. Examples include raw power input side filtering (power plane/bus), high current applications (automobile battery line) and circuits that cannot be fused to open. Markets include consumer, medical, industrial (power supply), automotive, aerospace and telecom.

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked.

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".

³ Reeling tape options (Paper or Plastic) are dependent on capacitor case size (L" x W") and thickness dimension. See "Chip Thickness/Tape & Reel Packaging Quantities" and "Tape & Reel Packaging Information".

³ For additional Information regarding "AUTO" C-Spec options, see "Automotive C-Spec Information".

³ All Automotive packaging C-Specs listed exclude the option to laser mark components. Please contact KEMET if you require a laser marked option. For more information see "Capacitor Marking".



Automotive C-Spec Information

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

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

Product Change Notification (PCN)

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

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

KEMET Automotive	Customer Noti	Days prior to		
C-Spec	Process/Product change	Obsolescence*	implementation	
KEMET assigned ¹	Yes (with approval and sign off)	Yes	180 days Minimum	
AUTO	Yes (without approval)	Yes	90 days Minimum	

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

Production Part Approval Process (PPAP)

The purpose of the Production Part Approval Process is:

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

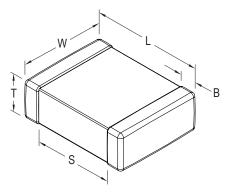
KEMET Automotive C-Spec	PPAP (Product Part Approval Process) Level				
	1	2	3	4	5
KEMET assigned ¹	•	•	•	•	•
AUTO	0		0		

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

- Part Number specific PPAP available
- Product family PPAP only



Dimensions – Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0603	1608	1.60 (.063) ± 0.17 (.007)	0.80 (.032) ± 0.15 (.006)		0.45 (.018) ± 0.15 (.006)	0.58 (.023)	
0805	2012	2.00 (.079) ± 0.30 (.012)	1.25 (.049) ± 0.30 (.012)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	Solder Wave or Solder Reflow
1206	3216	3.30 (.130) ± 0.40 (.016)	1.60 (.063) ± 0.35 (.013)	See Table 2 for Thickness	0.60 (.024) ± 0.25 (.010)		
1210	3225	3.30 (.130) ± 0.40 (.016)	2.60 (.102) ± 0.30 (.012)		0.60 (.024) ± 0.25 (.010)	N/A	Solder Reflow
1812	4532	4.50 (.178) ± 0.40 (.016)	3.20 (.126) ± 0.30 (.012)		0.70 (.028) ± 0.35 (.014)		Only

Qualification/Certification

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

Automotive Grade products meet or exceed the requirements outlined by the Automotive Electronics Council. Details regarding test methods and conditions are referenced in document AEC–Q200, Stress Test Qualification for Passive Components. For additional information regarding the Automotive Electronics Council and AEC–Q200, please visit their website at www.aecouncil.com.

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%
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
² Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ± 1 seconds and charge/discharge not exceeding 50mA)
³ Dissipation Factor (DF) Maximum Limit @ 25°C	5%(6.3V & 10V), 3.5%(16V & 25V) and 2.5%(50V to 250V)
⁴Insulation Resistance (IR) Minimum Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ± 5 secs @ 25°C)

¹Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

 $1kHz \pm 50Hz$ and 1.0 ± 0.2 Vrms if capacitance ≤ $10\mu F$

120Hz \pm 10Hz and 0.5 ± 0.1 Vrms if capacitance >10 μ F

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

Post Environmental Limits

	High Temperature Life, Biased Humidity, Moisture Resistance												
Dielectric	Dielectric Rated DC Capacitance Dissipation Factor Capacitance Insulation (Maximum %) Shift Resistance												
	> 25		3.0										
X7R	16/25	All	5.0	±20%	10% of Initial Limit								
	< 16		7.5										

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

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

⁴To obtain IR limit, divide MΩ- μ F value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



Table 1A – Capacitance Range/Selection Waterfall (0603 – 0805 Case Sizes)

			se Siz Series	3				0603								05Y			
Capacitance	Capacitance	Vo	Itage Co	de	9	8	4	3	5	1	2	9	8	4	3	5	1	2	Α
Capacitance	Code	Ra	ited Volta (VDC)	ige	6.3	5	9	25	20	100	200	6.3	5	9	25	20	100	200	250
			apacitance Product Availability and Chip Thickness Codes Tolerance See Table 2 for Chip Thickness Dimensions																
180 pF	181	J	K	М	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
220 pF	221	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
270 pF	271	J	K	М	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
330 pF	331	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
390 pF	391	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
470 pF	471	J	K	М	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
560 pF	561	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
680 pF	681	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
820 pF	821	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
1,000 pF	102	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
1,200 pF	122	J	K	М	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
1,500 pF	152	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
1,800 pF	182	J	K	М	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
2,200 pF	222	J	K	М	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
2,700 pF	272	J	K	М	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
3,300 pF	332	J	K	М	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
3,900 pF	392	J	K	М	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
4,700 pF	472	J	K	М	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
5,600 pF	562	J	K	М	CJ	CJ	CJ	CJ	CJ	CJ		DR	DR	DR	DR	DR	DR	DR	DR
6,800 pF	682	J	K	М	CJ	CJ	CJ	CJ	CJ	CJ		DR	DR	DR	DR	DR	DR	DR	DR
8,200 pF	822	J	K	М	CJ	CJ	CJ	CJ	CJ	CJ		DR	DR	DR	DR	DR	DR	DR	DR
10,000 pF	103	J	К	М	CJ	CJ	CJ	CJ	CJ			DR	DR	DR	DR	DR	DR	DR	DR
12,000 pF	123	j	K	М	CJ	CJ	CJ	CJ	CJ			DR	DR	DR	DR	DR	DR	DR	DR
15,000 pF	153	Ĵ	K	М	CJ	CJ	CJ	CJ	CJ			DR	DR	DR	DR	DR	DD		
18,000 pF	183	Ĵ	K	М	CJ	CJ	CJ	CJ	CJ			DR	DR	DR	DR	DR	DD		
22,000 pF	223	J	K	М	CJ	CJ	CJ	CJ	CJ			DR	DR	DR	DR	DR	DD		
27,000 pF	273	Ĵ	K	М	"							DR	DR	DR	DR	DR			
33,000 pF	333	Ĵ	K	M	l							DR	DR	DR	DR	DR			
39,000 pF	393	Ĵ	K	M	l							DR	DR	DR	DR	DR			
47,000 pF	473	Ĵ	K	M	l							DR	DR	DR	DR	DR			
56,000 pF	563	Ĵ	K	M								DD	DD	DD	DD	DD			
68,000 pF	683	Ĵ	K	M								DD	DD	DD	DD	DD			
82,000 pF	823	J	K	M								DG	DG	DG	DG	DG			
0.10 µF	104	.1	K	M								DG	DG	DG	DG	DG			
0.10 μ1	101	Ra	ted Volta		6.3	6	9	55	20	9	200	6.3	9	9	25	20	100	200	250
Capacitance	Capacitance	Va	(VDC)	de	9	8	4	3	5	1	2	9	8	4	3	5	1	2	A
2 3 2 4 0 1 1 1 1 0 0	Code	Voltage Code Case Size/Series		ا ا	9 8 4 3 5 1 2 C0603Y				9 8 4 3 5 1 2 A C0805Y										



Table 1B - Capacitance Range/Selection Waterfall (1206 - 1812 Case Sizes)

			se Si Serie					C12	06Y							C12	10Y					С	1812	Υ	
Capacitance	Cap	Vol	tage C	ode	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	Α	3	5	1	2	Α
Capacitanic	Code	Rat	ed Volt	age	6.3	9	16	25	50	100	200	250	6.3	9	16	25	20	100	200	250	25	50	100	200	250
			acita							Pr	oduc	t Ava	ilabi	lity a	nd C	hip T	hick ss Di	ness	Cod	es					
1,000 pF	102	J	К	М	EQ	EQ	EQ	EQ	EQ	EQ	EQ.	EQ	_ 101	<u> </u>	7 1111	JKIIC.	JU D.		510110						
1,200 pF	122	j	K	M	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ													
1,500 pF	152	J	K	M	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ													
1,800 pF	182	Ĵ	K	M	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ													
2,200 pF	222	Ĵ	K	M	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN					
2,700 pF	272	J	K	М	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN					
3,300 pF	332	Ĵ	K	М	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN					
3,900 pF	392	Ĵ	K	M	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN					
4,700 pF	472	Ĵ	K	M	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN					
5,600 pF	562	Ĵ	K	М	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN					
6,800 pF	682	J	K	М	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN	GB	GB	GB	GB	GB
8,200 pF	822	Ĵ	K	M	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN	GB	GB	GB	GB	GB
10,000 pF	103	Ĵ	K	M	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN	GB	GB	GB	GB	GB
12,000 pF	123	Ĵ	K	M	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN	GB	GB	GB	GB	GB
15,000 pF	153	Ĵ	K	М	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN	GB	GB	GB	GB	GB
18,000 pF	183	Ĵ	K	М	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN	GB	GB	GB	GB	GB
22,000 pF	223	Ĵ	K	М	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN	GB	GB	GB	GB	GB
27,000 pF	273	Ĵ	K	М	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN	GB	GB	GB	GB	GB
33,000 pF	333	Ĵ	K	М	EQ	EQ	EQ	EQ	EQ	EQ	LQ	LQ	FN	FN	FN	FN	FN	FN	FN	FN	GB	GB	GB	GB	GB
39,000 pF	393	Ĵ	K	М	EQ	EQ	EQ	EQ	EQ	ER			FN	FN	FN	FN	FN	FN	FN	FN	GB	GB	GB	GB	GB
47,000 pF	473	Ĵ	K	M	EQ	EQ	EQ	EQ	EQ	ER			FN	FN	FN	FN	FN	FN	FQ	FQ	GB	GB	GB	GB	GB
56,000 pF	563	J	K	M	EQ	EQ	EQ	EQ	EQ	EQ			FN	FN	FN	FN	FN	FN	FQ	FQ	GB	GB	GB	GB	GB
68,000 pF	683	J	K	M	EQ	EQ	EQ	EQ	EQ	LQ			FN	FN	FN	FN	FN	FN	1 0	١ ٧	GB	GB	GB	GB	GB
82,000 pF	823	J	K	M	EQ	EQ	EQ	EQ	EQ				FN	FN	FN	FN	FN	FQ			GB	GB	GB	GB	GB
0.10 µF	104	J	K	M	EQ	EQ	EQ	EQ	EQ				FN	FN	FN	FN	FN	FX			GB	GB	GB	GB	GB
0.10 µF	124	J	K	M	ER	ER	ER	ER	ER				FN	FN	FN	FN	FN	17			GB	GB	GB	GB	GB
0.12 μΓ 0.15 μF	154	J	K	M	-'`	LIV	LIV	LIV	LIV				FQ	FQ	FQ	FQ	FQ				GB	GB	GB	GB	GB
0.18 µF	184	J	K	M									FQ	FQ	FQ	FQ	FQ				GB	GB	GB	GB	GB
0.10 µF	224	J	K	M									FQ	FQ	FQ	FQ	FQ				GB	GB	GB	GB	GB
V.22 pi		۱	- '`		<u>س</u>	_			_	_	-	-					_		-	-			_	_	_
	0	Rated Voltage (VDC)		9	9	16	25	20	19	200	250	6.3	9	9	25	20	19	200	250	25	20	9	200	250	
Capacitance	Cap Code				9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	Α	3	5	1	2	Α
	Code Case Size/ Series							C12	06Y							C12	10Y					С	1812	Υ	



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

Thickness	Case	Thickness ±	Paper Q	luantity ¹	Plastic (Quantity
Code	Size ¹	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
CJ	0603	0.80 ± 0.15	4,000	15,000	0	0
DR	0805	0.78 ± 0.20	0	0	4,000	10,000
DD	0805	0.90 ± 0.10	0	0	4,000	10,000
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
EQ	1206	0.78 ± 0.20	4,000	10,000	4,000	10,000
ER	1206	0.90 ± 0.20	0	0	4,000	10,000
FN	1210	0.78 ± 0.20	0	0	4,000	10,000
FQ	1210	0.90 ± 0.20	0	0	4,000	10,000
FX	1210	0.95 ± 0.20	0	0	4,000	10,000
GB	1812	1.00 ± 0.10	0	0	1,000	4,000
Thickness			7" Reel	13" Reel	7" Reel	13" Reel
Code	Size ¹	Range (mm)	Paper Q	luantity¹	Plastic (Quantity

Package quantity based on finished chip thickness specifications.

Table 2B - Bulk Packaging Quantities

Doolsoo	ing Tone	Loose Pa	ackaging				
Раскад	ing Type	Bulk Bag (default)					
Packagir	ng C-Spec ¹	N/	'A²				
Cas	e Size	Packaging Quantities (pieces/unit packaging)				
EIA (in)	Metric (mm)	Minimum	Maximum				
0402	1005						
0603	1608						
0805	2012		50,000				
1206	3216						
1210	3225	1					
1808	4520] '					
1812	4532						
1825	4564		20,000				
2220	5650						
2225	5664						

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

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

¹ If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



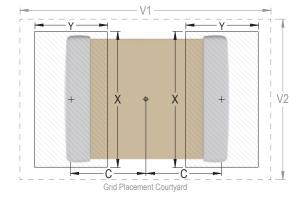
Table 3 - Chip Capacitor Land Pattern Design Recommendations per IPC-7351

EIA Size Code	Metric Size Code	Density Level A: Maximum (Most) Land Protrusion (mm)						Media	sity Lev an (Nor rotrusio)	Density Level C: Minimum (Least) Land Protrusion (mm)					
Oouc	Oodc	C	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	X	V1	V2	
0603	1608	0.85	1.25	1.10	4.00	2.10	0.75	1.05	1.00	3.10	1.50	0.65	0.85	0.90	2.40	1.20	
0805	2012	0.99	1.44	1.66	4.47	2.71	0.89	1.24	1.56	3.57	2.11	0.79	1.04	1.46	2.42	1.81	
1206	3216	1.59	1.62	2.06	5.85	3.06	1.49	1.42	1.96	4.95	2.46	1.39	1.22	1.86	4.25	2.16	
1210	3225	1.59	1.62	3.01	5.90	4.01	1.49	1.42	2.91	4.95	3.41	1.39	1.22	2.81	4.25	3.11	
1812	4532	2.10	1.80	3.60	7.00	4.60	2.00	1.60	3.50	6.10	4.00	1.90	1.40	3.40	5.40	3.70	

Density Level A: For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes. KEMET only recommends wave soldering of EIA 0603, 0805 and 1206 case sizes.

Density Level B: For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes. **Density Level C:** For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC Standard 7351 (IPC–7351).

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





Soldering Process

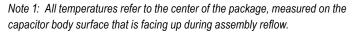
Recommended Soldering Technique:

- 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		
Frome reature	SnPb	100% Matte Sn		
Preheat/Soak				
Temperature Minimum (T _{Smin})	100°C	150°C		
Temperature Maximum (T _{Smax})	150°C	200°C		
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds		
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum		
Liquidous Temperature (T _L)	183°C	217°C		
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds		
Peak Temperature (T _P)	235°C	260°C		
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum		
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum		
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum		



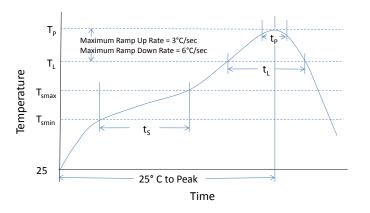




Table 4 – Performance & Reliability: Test Methods and Conditions

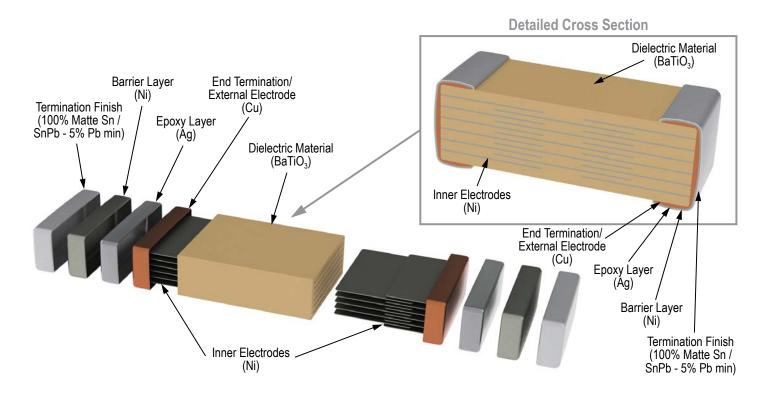
Stress	Reference	Test or Inspection Method						
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.						
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).						
		Magnification 50 X. Conditions:						
Solderability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C						
Solderability	J-31D-002	b) Method B @ 215°C category 3						
		c) Method D, category 3 @ 260°C						
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.						
Dia and Houseldite	MII. OTD 000 M-H 4 400	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.						
Biased Humidity	MIL-STD-202 Method 103	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.						
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.						
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.						
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.						
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.						
Vibration	MIL-STD-202 Method 204	5 g's for 20 min., 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, Condition F.						
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.						

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



Flexible Termination System (FT-CAP), Ultra-Stable X8R Dielectric, 25 – 100 VDC (Commercial & Automotive Grade)



Overview

KEMET's Flexible Termination (FT-CAP) Multilayer Ceramic Capacitor in Ultra-Stable X8R dielectric incorporates a unique, flexible termination system that is integrated with KEMET's standard termination materials. A conductive silver epoxy is utilized between the base metal and nickel barrier layers of KEMET's standard termination system in order to establish pliability while maintaining terminal strength, solderability and electrical performance. This technology was developed in order to address the primary failure mode of MLCCs– flex cracks, which are typically the result of excessive tensile and shear stresses produced during board flexure and thermal cycling. Flexible termination technology inhibits the transfer of board stress to the rigid ceramic body, therefore mitigating flex cracks which can result in low IR or short circuit failures.

Although this technology does not eliminate the potential for mechanical damage that may propagate during extreme environmental and handling conditions, it does provide superior flex performance over standard termination systems. FT-CAP complements KEMET's Open Mode, Floating Electrode (FE-CAP), Floating Electrode with Flexible Termination (FF-CAP), and KEMET Power Solutions (KPS) product lines by providing a complete portfolio of flex mitigation solutions.

Combined with the stability of KEMET's Ultra-Stable high temperature dielectric technology, these flex-robust devices are RoHS Compliant, offer up to 5 mm of flex-bend capability and feature a 150°C maximum operating temperature. Ultra-Stable X8R dielectric offers the same temperature capability as conventional X8R but without the capacitance loss due to applied DC voltage. These devices exhibit no change in capacitance with respect to voltage and boast a minimal change in capacitance with reference to ambient temperature. They are also suitable replacements for higher capacitance and larger footprint devices that fail to offer capacitance stability. Capacitance change with respect to temperature is limited to ±15% from -55°C to +150°C.

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



Ordering Information

С	1206	Х	104	J	3	Н	Α	С	AUTO
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Reated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec)
	0603 0805 1206 1210 1812	X = Flexible Termination	Two significant digits + number of zeros.	F = ±1% G = ±2% J = ±5% K = ±10% M = ±20%	3 = 25 5 = 50 1 = 100	H = Ultra- Stable X8R	A = N/A	C = 100% Matte Sn L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

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

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



Packaging C-Spec Ordering Options Table

Packaging Type	Packaging/Grade Ordering Code (C-Spec)				
Commerc	ial Grade ¹				
Bulk Bag	Not Required (Blank)				
7" Reel/Unmarked	TU				
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)				
7" Reel/Unmarked/2 mm pitch ²	7081				
13" Reel/Unmarked/2 mm pitch ²	7082				
Automoti	ve Grade ³				
7" Reel	AUTO				
13" Reel/Unmarked	AUTO7411 (EIA 0603 and smaller case sizes) AUTO7210 (EIA 0805 and larger case sizes)				
7" Reel/Unmarked/2 mm pitch ²	3190				
13" Reel/Unmarked/2 mm pitch ²	3191				

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- −55°C to +150°C operating temperature range
- Superior flex performance (up to 5 mm)
- · Lead (Pb)-Free, RoHS and REACH compliant
- EIA 0603, 0805, 1206, 1210, and 1812 case sizes
- DC voltage ratings of 25 V, 50 V, and 100 V
- Capacitance offerings ranging from 430 pF to 0.22 μF
- Available capacitance tolerances of ±1%, ±2%, ±5%, ±10%, and ±20%
- Extremely low ESR and ESL

- · High thermal stability
- High ripple current capability
- No capacitance change with respect to applied rated DC voltage
- · Non-polar device, minimizing installation concerns
- Commercial & Automotive (AEC-Q200) Grades available
- 100% pure matte tin-plated termination finish allowing for excellent solderability
- SnPb plated termination finish option available upon request (5% Pb minimum)

Applications

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

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked.

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".

³ Reeling tape options (Paper or Plastic) are dependent on capacitor case size (L" x W") and thickness dimension. See "Chip Thickness/Tape & Reel Packaging Quantities" and "Tape & Reel Packaging Information".

³ For additional Information regarding "AUTO" C-Spec options, see "Automotive C-Spec Information".

³ All Automotive packaging C-Specs listed exclude the option to laser mark components. Please contact KEMET if you require a laser marked option. For more information see "Capacitor Marking".

Automotive C-Spec Information

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

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

Product Change Notification (PCN)

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

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

KEMET Automotive	Customer Noti	Days prior to			
C-Spec	Process/Product change	Obsolescence*	implementation		
KEMET assigned ¹	Yes (with approval and sign off)	Yes	180 days Minimum		
AUTO	Yes (without approval)	Yes	90 days Minimum		

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

Production Part Approval Process (PPAP)

The purpose of the Production Part Approval Process is:

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

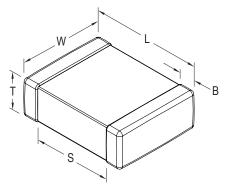
KEMET Automotive	PPAP (Product Part Approval Process) Level										
C-Spec	1	2	3	4	5						
KEMET assigned ¹	•	•	•	•	•						
AUTO	0		0								

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

- Part Number specific PPAP available
- Product family PPAP only



Dimensions – Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique	
0603	1608	1.60 (0.063) ± 0.17 (0.007)	0.80 (0.032) ± 0.15 (0.006)		0.45 (0.018) ±0.15 (0.006)	0.58 (0.023)	Solder Wave	
0805	2012	2.00 (0.079) ± 0.30 (0.012)	2) 1.25 (0.049) ± 0.30 (0.012)		0.50 (0.02) ±0.25 (0.010)	0.75 (0.030)	or	
1206	3216	3.30 (0.130) ± 0.40 (0.016)	1.60 (0.063) ± 0.35 (0.013)	See Table 2 for Thickness	0.60 (0.024) ±0.25 (0.010)		Solder Reflow	
1210	3225	3.30 (0.130) ± 0.40 (0.016)			0.60 (0.024) ± 0.25 (0.010)	N/A	Solder Reflow	
1812	4532	4.50 (0.178) ± 0.40 (0.016)	3.20 (0.126) ± 0.30 (0.012)		0.70 (0.028) ±0.35 (0.014)		Only	

Qualification/Certification

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

Automotive Grade products meet or exceed the requirements outlined by the Automotive Electronics Council. Details regarding test methods and conditions are referenced in document AEC–Q200, Stress Test Qualification for Passive Components. For additional information regarding the Automotive Electronics Council and AEC–Q200, please visit their website at www.aecouncil.com.

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 +150°C				
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%				
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	0%				
¹ Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50mA)				
² Dissipation Factor (DF) Maximum Limit @ 25°C	2.5%				
³ Insulation Resistance (IR) Minimum Limit @ 25°C	1,000 megohm microfarads or 100 GΩ (Rated voltage applied for 120 ±5 seconds @ 25°C)				

¹DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

Post Environmental Limits

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

²Capacitance and dissipation factor (DF) measured under the following conditions:

¹ MHz ± 100 kHz and 1.0 ± 0.2 Vrms if capacitance $\leq 1,000$ pF

¹ kHz \pm 50 Hz and 1.0 \pm 0.2 Vrms if capacitance > 1,000 pF

 $^{{}^{3}}$ To obtain IR limit, divide M Ω - μ F value by the capacitance and compare to G Ω limit. Select the lower of the two limits.



Table 1A – Capacitance Range/Selection Waterfall (0603 – 1812 Case Sizes)

		Ca	ise S	Size	/Seri	ies	(0603	X	C	0805	X	(1206	Χ	(C1210	X	C18	12X
Capacitance	Capacitance		Volt	age C	ode		3	5	1	3	5	1	3	5	1	3	5	1	5	1
Capacitance	Code	F	Rated \	/oltag	e (VD0	C)	25	20	100	25	20	100	25	20	100	25	20	100	20	9
		Ca	apacita	nce T	oleran	ıce					ct Ava						Codes	•		
430 pF	431	F	G	J	K	М	CJ	CJ	CJ		Tubio		<u> </u>		000 5		10110			
470 pF	471	F	G	J	K	M	CJ	CJ	CJ											
510 pF	511	F	G	J	K	M	CJ	CJ	CJ											
560 pF 620 pF	561 621	F	G	J	K	M	CJ	Cl	Cl							1				
680 pF	681	F	G	J	K	M	CJ	CJ	CJ											
750 pF	751	F	G	J	K	M	CJ	CJ	CJ							ł				
820 pF	821	F	G	Ĵ	K	M	CJ	CJ	CJ							l			i	
910 pF	911	F	G	Ĵ	K	M	CJ	CJ	CJ				i			i			i	
1,000 pF	102	F	G	Ĵ	K	M	CJ	CJ	CJ							İ				
1,100 pF	112	F	G	J	K	M	CJ	CJ	CJ											
1,200 pF	122	F	G	J	K	М	CJ	CJ	CJ							İ				
1,300 pF	132	F	G	J	K	M	CJ	CJ	CJ							İ				
1,500 pF	152	F	G	J	K	M	CJ	CJ	CJ							İ				
1,600 pF	162	F	G	J	K	M	CJ	CJ	CJ	İ						İ				
1,800 pF	182	F	G	J	K	М	CJ	CJ	CJ											
2,000 pF	202	F	G	J	K	M	CJ	CJ	CJ	DR	DR	DR								
2,200 pF	222	F	G	J	K	M	CJ	CJ	CJ	DR	DR	DR				1				
2,400 pF	242	F	G	J	K	M	CJ	CJ	CJ	DR	DR	DR				1				
2,700 pF	272	F	G	J	K	M	CJ	CJ	CJ	DR	DR	DR								
3,000 pF	302	F	G	J	K	M	CJ	CJ	CJ	DR	DR	DR								
3,300 pF	332	F	G	J	K	M	CJ	CJ	CJ	DR	DR	DR								
3,600 pF	362	F	G	J	K	M	CJ	CJ	CJ	DR	DR	DR								
3,900 pF	392	F	G	J	K	M	CJ	CJ	CJ	DR	DR	DR								
4,300 pF	432	F	G	J	K	M	CJ	CJ	CJ	DR	DR	DR								
4,700 pF	472	F	G	J	K	M	CJ	CJ	CJ	DR	DR	DR				1				
5,100 pF 5,600 pF	512 562	F F	G	J	K	M M	Cl	Cl		DR DR	DR DR	DR DR				1				
6,200 pF	622	F	G	J	K	M	CJ	CJ		DR	DR	DR				ł				
6,800 pF	682	F	G	J	K	M	CJ	CJ		DR	DR	DR	EQ	EQ	EQ	l			ł	
7,500 pF	752	F	G	J	K	M	CJ	03		DR	DR	DR	EQ	EQ	EQ					
8,200 pF	822	F	G	J	K	M	CJ			DR	DR	DR	EQ	EQ	EQ	i				
9,100 pF	912	F	G	Ĵ	K	M	CJ			DR	DR	DR	EQ	EQ	EQ	İ				
10,000 pF	103	F	G	J	K	M	CJ			DR	DR	DD	EQ	EQ	EQ	i				
12,000 pF	123	F	G	J	K	M				DR	DR	DS	EQ	EQ	EQ	FN	FN	FN		
15,000 pF	153	F	G	J	K	М	l .			DR	DD	DG	EQ	EQ	EQ	FN	FN	FN	GB	GB
18,000 pF	183	F	G	J	K	M				DR	DD		EQ	EQ	EQ	FN	FN	FN	GB	GB
22,000 pF	223	F	G	J	K	M	1			DD	DF		EQ	EQ	ER	FN	FN	FN	GB	GB
27,000 pF	273	F	G	J	K	M				DF			EQ	EQ	ET	FN	FN	FN	GB	GB
33,000 pF	333	F	G	J	K	M				DG			EQ	EQ	ET	FN	FN	FN	GB	GB
47,000 pF	473	F	G	J	K	M							ER	ET	EH	FN	FN	FE	GB	GB
56,000 pF	563	F	G	J	K	M							ES	EF	EH	FN	FN	FA	GB	GB
68,000 pF	683	F	G	J	K	M							EF	EH		FN	FQ	FZ	GB	GB
82,000 pF 100,000 pF	823 104	F	G	J	K	M							EH EH	EH		FQ FE	FA FZ	FU FM	GB GB	GB GD
120,000 pF	104	F	G	J	K	M							En			FZ	FU	LIN	GB	GH
150,000 pF	154	F	G	J	K	M										FU	FM		GD	GN
180,000 pF	184	F	G	J	K	M										FJ	I IVI		GH	GIN
220,000 pF	224	l 'F	G	J,	K	M										''			GK	
220,000 pi		⊢∸	Rated \	/oltag	_		52	20	5	52	20	19	52	20	100	52	20	5	20	9
Capacitance	Capacitance Code			age C		•	3	5	1	3	5	1	3	5	1	3	5	1	5	1
	Code	С	ase S	Size	Seri	es	(0603	X	(0805	X	(21206	X	·	C1210	X	C18	12X



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

Thickness	Case	Thickness ±	Paper Q	luantity ¹	Plastic (Quantity		
Code	Size ¹	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel		
CJ	0603	0.80 ± 0.15	4,000	15,000	0	0		
DR	0805	0.78 ± 0.20	0	0	4,000	10,000		
DD	0805	0.90 ± 0.10	0	0	4,000	10,000		
DS	0805	1.00 ± 0.20	0	0	2,500	10,000		
DF	0805	1.10 ± 0.10	0	0	2,500	10,000		
DG	0805	1.25 ± 0.15	0	0	2,500	10,000		
EQ	1206	0.78 ± 0.20	4,000	10,000	4,000	10,000		
ER	1206	0.90 ± 0.20	0	0	4,000	10,000		
ES	1206	1.00 ± 0.20	0	0	2,500	10,000		
ET	1206	1.10 ± 0.20	0	0	2,500	10,000		
EF	1206	1.20 ± 0.15	0	0	2,500	10,000		
EH	1206	1.60 ± 0.20	0	0	2,000	8,000		
FN	1210	0.78 ± 0.20	0	0	4,000	10,000		
FQ	1210	0.90 ± 0.20	0	0	4,000	10,000		
FE	1210	1.00 ± 0.10	0	0	2,500	10,000		
FA	1210	1.10 ± 0.15	0	0	2,500	10,000		
FZ	1210	1.25 ± 0.20	0	0	2,500	10,000		
FU	1210	1.55 ± 0.20	0	0	2,000	8,000		
FM	1210	1.70 ± 0.20	0	0	2,000	8,000		
FJ	1210	1.85 ± 0.20	0	0	2,000	8,000		
GB	1812	1.00 ± 0.10	0	0	1,000	4,000		
GD	1812	1.25 ± 0.15	0	0	1,000	4,000		
GH	1812	1.40 ± 0.15	0	0	1,000	4,000		
GK	1812	1.60 ± 0.20	0	0	1,000	4,000		
GN	1812	1.70 ± 0.20	0	0	1,000	4,000		
Thickness	ness Case Thickness ±		7" Reel	13" Reel	7" Reel	13" Reel		
Code	Size ¹	Range (mm)	Paper Q	luantity¹	Plastic (Plastic Quantity		

Package quantity based on finished chip thickness specifications.

¹ If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Table 2B - Bulk Packaging Quantities

Paulion	.	Loose Packaging					
Раскад	ing Type	Bulk Bag	(default)				
Packagir	ng C-Spec ¹	N/	/A ²				
Case	e Size	Packaging Quantities (pieces/unit packaging)				
EIA (in)	Metric (mm)	Minimum	Maximum				
0402	1005						
0603	1608		50,000				
0805	2012						
1206	3216						
1210	3225	1					
1808	4520] '					
1812	4532						
1825	4564		20,000				
2220	5650						
2225	5664						

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

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



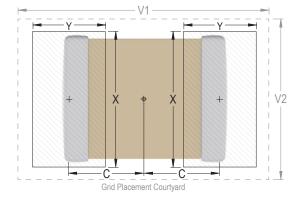
Table 3 – Chip Capacitor Land Pattern Design Recommendations per IPC-7351 (mm)

EIA Size Code	Metric Size Code	Density Level A: Maximum (Most) Land Protrusion (mm)					ı	Media	sity Lev an (Nor rotrusio)	Density Level C: Minimum (Least) Land Protrusion (mm)				
Oouc	Oodc	C	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	X	V1	V2
0603	1608	0.85	1.25	1.10	4.00	2.10	0.75	1.05	1.00	3.10	1.50	0.65	0.85	0.90	2.40	1.20
0805	2012	0.99	1.44	1.66	4.47	2.71	0.89	1.24	1.56	3.57	2.11	0.79	1.04	1.46	2.42	1.81
1206	3216	1.59	1.62	2.06	5.85	3.06	1.49	1.42	1.96	4.95	2.46	1.39	1.22	1.86	4.25	2.16
1210	3225	1.59	1.62	3.01	5.90	4.01	1.49	1.42	2.91	4.95	3.41	1.39	1.22	2.81	4.25	3.11
1812	4532	2.10	1.80	3.60	7.00	4.60	2.00	1.60	3.50	6.10	4.00	1.90	1.40	3.40	5.40	3.70

Density Level A: For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes. KEMET only recommends wave soldering of EIA 0603, 0805, and 1206 case sizes.

Density Level B: For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes. **Density Level C:** For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC Standard 7351 (IPC–7351).

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





Soldering Process

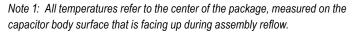
Recommended Soldering Technique:

- 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		
Frome reature	SnPb	100% Matte Sn		
Preheat/Soak				
Temperature Minimum (T _{Smin})	100°C	150°C		
Temperature Maximum (T _{Smax})	150°C	200°C		
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds		
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum		
Liquidous Temperature (T _L)	183°C	217°C		
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds		
Peak Temperature (T _P)	235°C	260°C		
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum		
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum		
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum		



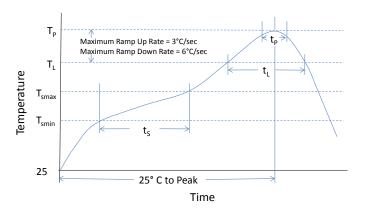




Table 4 – Performance & Reliability: Test Methods and Conditions

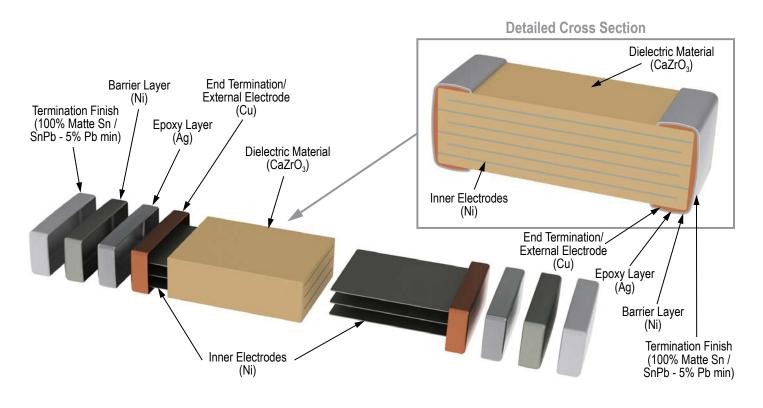
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Solderability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	0-010-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +150°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Load Humidity: 1,000 hours 85°C/85%RH and rated voltage. Add 100K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
ĺ		Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours. +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	−55°C/+150. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 150°C with 2 X rated voltage applied.
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 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



Capacitor Marking (Optional):

Laser marking option is not available on:

- C0G, Ultra Stable X8R and Y5V dielectric devices
- EIA 0402 case size devices
- EIA 0603 case size devices with Flexible Termination option.
- · KPS Commercial and Automotive grade stacked devices.

These capacitors are supplied unmarked only.

High Temperature 150°C, X8L Dielectric, 10 – 50 VDC (Commercial & Automotive Grade)



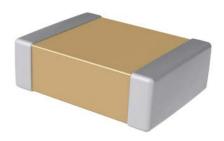
Overview

KEMET's X8L dielectric features a 150°C maximum operating temperature and is considered "general purpose high temperature." These components are fixed, ceramic dielectric capacitors suited for high temperature bypass and decoupling applications or frequency discriminating circuits where Q and stability of capacitance characteristics are not critical. X8L exhibits a predictable change in capacitance with respect to time and voltage and boasts a minimal change in capacitance with reference to ambient temperature up to 125°C. Beyond 125°C X8L displays a wider variation in capacitance. Capacitance change is limited to ±15% from -55°C to +125°C and +15, -40% from 125°C to 150°C.

Driven by the demand for a more robust and reliable component, X8L dielectric capacitors were developed for critical applications where reliability at higher operating temperatures are a concern. These capacitors are widely used in automotive circuits as well as general high temperature applications. Concerned with flex cracks resulting from excessive tensile and shear stresses produced during board flexure and thermal cycling? These devices are available with KEMET's Flexible termination technology which inhibits the transfer of board

stress to the rigid ceramic body, therefore mitigating flex cracks which can result in low IR or short circuit failures. Although flexible termination technology does not eliminate the potential for mechanical damage that may propagate during extreme environmental and handling conditions, it does provide superior flex performance over standard termination systems.

In addition to commercial grade, automotive grade devices are available and meet the demanding Automotive Electronics Council's AEC–Q200 qualification requirements.



Ordering Information

С	1210	X	106	K	8	N	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series ¹	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/Grade (C-Spec)
	0402 0603 0805 1206 1210	C = Standard X = Flexible Termination	Two significant digits + number of zeros	J = ±5% K = ±10% M = ±20%	8 = 10 4 = 16 3 = 25 5 = 50	N = X8L	A = N/A	C = 100% Matte Sn L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

¹ The flexible termination option is not available on EIA 0402 case size product. "C" must be used in the 6th character position when ordering this case size.

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

² SnPb termination finish option is not available on Automotive Grade product.



Packaging C-Spec Ordering Options Table

Packaging Type	Packaging/Grade Ordering Code (C-Spec)				
Commerc	ial Grade ¹				
Bulk Bag	Not Required (Blank)				
7" Reel/Unmarked	TU				
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)				
7" Reel/Marked	TM				
13" Reel/Marked	7040 (EIA 0603 and smaller case sizes) 7215 (EIA 0805 and larger case sizes)				
7" Reel/Unmarked/2 mm pitch ²	7081				
13" Reel/Unmarked/2 mm pitch ²	7082				
Automoti	ve Grade ³				
7" Reel	AUTO				
13" Reel/Unmarked	AUTO7411 (EIA 0603 and smaller case sizes) AUTO7210 (EIA 0805 and larger case sizes)				
7" Reel/Unmarked/2 mm pitch ²	3190				
13" Reel/Unmarked/2 mm pitch ²	3191				

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- -55°C to +150°C operating temperature range
- · Lead (Pb)-Free, RoHS and REACH compliant
- EIA 0402, 0603, 0805, 1206, and 1210 case sizes
- DC voltage ratings of 10 V, 16 V, 25 V, and 50 V
- Capacitance offerings ranging from 0.012 μF to 10 μF
- Available capacitance tolerances of ±5%, ±10%, and ±20%
- Commercial & Automotive (AEC–Q200) grades available

- 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% Pb minimum)
- · Flexible termination option available upon request

Applications

Typical applications include use in extreme environments such as down-hole oil exploration, under-hood automotive, military and aerospace.

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked.

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".

³ Reeling tape options (Paper or Plastic) are dependent on capacitor case size (L" x W") and thickness dimension. See "Chip Thickness/Tape & Reel Packaging Quantities" and "Tape & Reel Packaging Information".

³ For additional Information regarding "AUTO" C-Spec options, see "Automotive C-Spec Information".

³ All Automotive packaging C-Specs listed exclude the option to laser mark components. Please contact KEMET if you require a laser marked option. For more information see "Capacitor Marking".



Automotive C-Spec Information

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

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

Product Change Notification (PCN)

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

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

KEMET Automotive	Customer Noti	Days prior to				
C-Spec	Process/Product change	Obsolescence*	implementation			
KEMET assigned ¹	Yes (with approval and sign off)	Yes	180 days Minimum			
AUTO	Yes (without approval)	Yes	90 days Minimum			

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

Production Part Approval Process (PPAP)

The purpose of the Production Part Approval Process is:

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

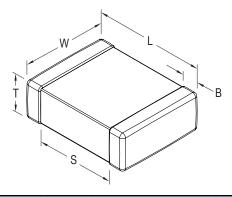
KEMET Automotive	PPAP (Product Part Approval Process) Level												
C-Spec	1	2	3	4	5								
KEMET assigned ¹	•	•	•	•	•								
AUTO	0		0										

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

- Part Number specific PPAP available
- Product family PPAP only



Dimensions – Standard Termination – 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)	See Table 2 for Thickness	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)	NI/A	
1210	3225	3.20 (0.126) ±0.20 (0.008)	2.50 (0.098) ±0.20 (0.008)		0.50 (0.02) ±0.25 (0.010)	N/A	Solder Reflow Only

Dimensions – Flexible Termination – Millimeters (Inches)

EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0603	1608	1.60 (0.063) ±0.17 (0.007)	0.80 (0.032) ±0.15 (0.006)		0.45 (0.018) ±0.15 (0.006)	0.58 (0.023)	Solder Wave
0805	2012	2.00 (0.079) ±0.30 (0.012)	1.25 (0.049) ±0.30 (0.012)	See Table 2	0.50 (0.020) ±0.25 (0.010)	0.75 (0.030)	or
1206	3216	3.30 (0.130) ±0.40 (0.016)	1.60 (0.063) ±0.35 (0.013)	for Thickness	0.60 (0.024) ±0.25 (0.010)	NI/A	Solder Reflow
1210	3225	3.30 (0.130) ±0.40 (0.016)	2.60 (0.102) ±0.30(0.012)		0.60 (0.024) ±0.25 (0.010)	N/A	Solder Reflow Only

Qualification/Certification

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

Automotive Grade products meet or exceed the requirements outlined by the Automotive Electronics Council. Details regarding test methods and conditions are referenced in document AEC–Q200, Stress Test Qualification for Passive Components. For additional information regarding the Automotive Electronics Council and AEC–Q200, please visit their website at www.aecouncil.com.



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 +150°C				
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15% (-55°C to 125°C), +15, -40% (125°C to 150°C)				
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%				
² Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)				
³ Dissipation Factor (DF) Maximum Limit @ 25°C	3.5% (≤ 16V) and 2.5% (≥ 25V)				
⁴ Insulation Resistance (IR) Minimum Limit @ 25°C	500 megohm microfarads or 10 GΩ (Rated voltage applied for 120 ±5 seconds @ 25°C)				

Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

 $1kHz \pm 50Hz$ and 1.0 ± 0.2 Vrms if capacitance ≤ $10\mu F$

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

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

Post Environmental Limits

	High Temperature Life, Biased Humidity, Moisture Resistance												
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance								
VOI	≥ 25	All	3.0	±20%	10% of Initial Limit								
X8L	≤ 16	All	5.0	±2U%									

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

⁴To obtain IR limit, divide MΩ- μ F value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



Insulation Resistance Limit Table (X8L Dielectric)

EIA Case Size	1,000 Megohm Microfarads or 100 GΩ	500 Megohm Microfarads or 10 GΩ					
0201	N/A	ALL					
0402	< .012 µF	≥ .012 µF					
0603	< .047 µF	≥ .047 µF					
0805	< 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					



Table 1 – Capacitance Range/Selection Waterfall (0402 – 1210 Case Sizes)

	Сар		se Si Series			C04	02C			C	0603	BC			C	080	5C			C1206C					С	1210	C	
Cap	Code	Vo	Itage Co	de	9	8	4	3	9	8	4	3	5	9	8	4	3	5	9	8	4	3	5	9	8	4	3	5
	Oode	Rated	Voltage	(VDC)	6.3	10	16	25	6.3	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50
		Capacit	ance To	lerance		Pro	duc	t Av	ailab	ility	and	Chi	o Thi	ckn	ess (Code	es So	ee Ta	ble	2 for	Chi	p Th	ickn	ess	Dime	ensid	ons	
12,000 pF	123	J	K	М	BB	BB	BB	BB																				
15,000 pF	153	J	K	M	BB	BB	BB	BB																				
18,000 pF	183	J	K	M	BB	BB	BB	BB																				
22,000 pF	223	J	K	M	BB	BB	BB	BB																				
27,000 pF	273	J	K	M	BB	BB																						
33,000 pF	333	J	K	M	BB	BB																						
39,000 pF	393	J	K	М	ВВ	BB								l					l									
47,000 pF	473	J	K	М	ВВ	ВВ			CF	CF	CF	CF	CF	l					l									
56,000 pF	563	J	K	М	İ																							
68,000 pF	683	J	K	М	İ				İ					İ					İ					İ				
82,000 pF	823	J	K	М																								
0.10 µF	104	J	K	М					CF	CF	CF	CF							İ									
0.12 µF	124	J	K	М					CF	CF	CF	CF							İ									
0.15 µF	154	J	К	М	i				CF	CF	CF	CF		DG	DG	DG	DG	DG	İ									
0.18 µF	184	J	К	М	i				CF	CF				DG	DG	DG	DG	DG	İ									
0.22 µF	224	J	K	М					CF	CF				DP	DP	DP	DP	DG										
0.27 µF	274	J	К	м	İ				i -					DP	DP	DP	DP		İ									
0.33 µF	334	J	K	М	İ				İ					DP	DP	DP	DP		İ									
0.39 µF	394	J	K	М	İ				İ					DE	DE	DE	DE		İ					FD	FD	FD	FD	FD
0.47 µF	474	J	K	М	İ				İ					DE	DE	DE	DE		EG	EG	EG	EG	EG	FD	FD	FD	FD	FD
0.56 µF	564	J	K	М										DG	DG	DH	DH							FF	FF	FF	FF	FF
0.68 µF	684	J	К	М	i									DG	DG	DH	DH		İ					FG	FG	FG	FG	FG
0.82 µF	824	J	К	М	i									DG	DG	DG			İ					FL	FL	FL	FL	FL
1.0 µF	105	J	K	M										DG	DG	DG			ED	ED	ED	ED		FM	FM	FM	FM	FM
1.2 µF	125	J	K	M															EH	EH	EH	EH		FG	FG	FG	FG	
1.5 µF	155	J	K	M															EH	EH	EH	EH		FG	FG	FG	FG	
1.8 µF	185	J	K	М.	İ														EF	EF	EH	EH		FG	FG	FG	FG	
2.2 µF	225	J	K	M	l				l					İ					EF.	EF.	EH	EH		FG	FG	FG	FG	
2.7 µF	275	Ĵ	K	М	i				i					İ					EH	EH	EH			FG	FG	FH	FH	
3.3 µF	335	J	K	M	1									l					EH	EH	EH			FM	FM	FM	FM	
3.9 µF	395	J	K	M															EH	EH	EH			FG	FG	FK	FK	
4.7 μF	475	J	K	M															EH	EH	EH			FG	FG	FS	FS	
5.6 µF	565	J	K	M																				FH	FH	FH	. 0	
6.8 µF	685	J	K	M																				FM	FM	FM		
8.2 µF	825	J	K	M																				FK	FK	FK		
10 μF	106	J	K	M																				FS	FS	FS		
ΙΟ μι	100		Voltage		6.3	10	16	25	6.3	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50
Сар	Сар		Itage Co	·	9	8	4	3	9	8	4	3	5	9	8	4	3	5	9	8	4	3	5	9	8	4	3	5
- 500	Code		Size/Se		Ť	_	02C			_	06030			Ť		C0805			۲	_	C1206	_		۲	_	 C12100		



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

Thickness	Case	Thickness ±	Paper Q	luantity ¹	Plastic (Quantity		
Code	Size ¹	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		
DP	0805	0.90 ± 0.10	4,000	15,000	0	0		
DE	0805	1.00 ± 0.10	0	0	2,500	10,000		
DG	0805	1.25 ± 0.15	0	0	2,500	10,000		
DH	0805	1.25 ± 0.20	0	0	2,500	10,000		
ED	1206	1.00 ± 0.10	0	0	2,500	10,000		
EF	1206	1.20 ± 0.15	0	0	2,500	10,000		
EG	1206	1.60 ± 0.15	0	0	2,000	8,000		
EH	1206	1.60 ± 0.20	0	0	2,000	8,000		
FD	1210	0.95 ± 0.10	0	0	4,000	10,000		
FF	1210	1.10 ± 0.10	0	0	2,500	10,000		
FG	1210	1.25 ± 0.15	0	0	2,500	10,000		
FL	1210	1.40 ± 0.15	0	0	2,000	8,000		
FH	1210	1.55 ± 0.15	0	0	2,000	8,000		
FM	1210	1.70 ± 0.20	0	0	2,000	8,000		
FK	1210	2.10 ± 0.20	0	0	2,000	8,000		
FS	1210	2.50 ± 0.30	0	0	1,000	4,000		
Thickness	Case	Thickness ±	7" Reel	13" Reel	7" Reel	13" Reel		
Code	Size ¹	Range (mm)	Paper Q	luantity¹	Plastic Quantity			

Package quantity based on finished chip thickness specifications.

Table 2B - Bulk Packaging Quantities

Deales	in a Tour	Loose P	Loose Packaging					
Раскад	jing Type	Bulk Bag	g (default)					
Packagir	ng C-Spec ¹	N.	/A²					
Cas	e Size	Packaging Quantities	(pieces/unit packaging)					
EIA (in)	Metric (mm)	Minimum	Maximum					
0402	1005							
0603	1608		50,000					
0805	2012							
1206	3216							
1210	3225	1						
1808	4520							
1812	4532							
1825	4564		20,000					
2220	5650							
2225	5664							

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

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

¹ If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Table 3A – Land Pattern Design Recommendations per IPC-7351 – Standard Termination

EIA Size Code	Metric Size Code	l and Protrusion (mm)					ı	Media	sity Lev an (Nor rotrusio)	Density Level C: Minimum (Least) Land Protrusion (mm)				
3040	5 000	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	0.99	1.44	1.66	4.47	2.71	0.89	1.24	1.56	3.57	2.11	0.79	1.04	1.46	2.42	1.81
1206	3216	1.59	1.62	2.06	5.85	3.06	1.49	1.42	1.96	4.95	2.46	1.39	1.22	1.86	4.25	2.16
1210	3225	1.59	1.62	3.01	5.90	4.01	1.49	1.42	2.91	4.95	3.41	1.39	1.22	2.81	4.25	3.11

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.

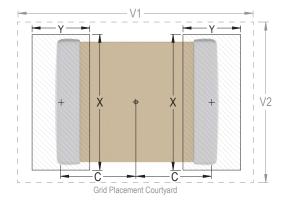




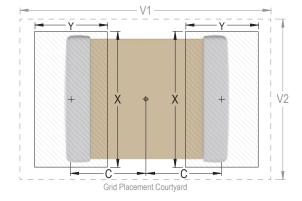
Table 3B – Land Pattern Design Recommendations per IPC-7351 – Flexible Termination

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)				
3040	0000	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	X	V1	V2
0603	1608	0.85	1.25	1.10	4.00	2.10	0.75	1.05	1.00	3.10	1.50	0.65	0.85	0.90	2.40	1.20
0805	2012	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	1.65	1.90	5.90	2.90	1.50	1.45	1.80	5.00	2.30	1.40	1.25	1.70	4.30	2.00
1210	3225	1.60	1.65	2.80	5.90	3.80	1.50	1.45	2.70	5.00	3.20	1.40	1.25	2.60	4.30	2.90

Density Level A: For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes. KEMET only recommends wave soldering of EIA 0603, 0805 and 1206 case sizes.

Density Level B: For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes. **Density Level C:** For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC Standard 7351 (IPC–7351).

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





Soldering Process

Recommended Soldering Technique:

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

Recommended Reflow Soldering Profile:

KEMET's families of surface mount multilayer ceramic capacitors (SMD MLCCs) are compatible with wave (single or dual), convection, IR or vapor phase reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET's recommended profile conditions for convection and IR reflow reflect the profile conditions of the IPC/J-STD-020 standard for moisture sensitivity testing. These devices can safely withstand a maximum of three reflow passes at these conditions.

Profile Feature	Termination Finish						
Frome reature	SnPb	100% Matte Sn					
Preheat/Soak							
Temperature Minimum (T _{Smin})	100°C	150°C					
Temperature Maximum (T _{Smax})	150°C	200°C					
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds					
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum					
Liquidous Temperature (T _L)	183°C	217°C					
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds					
Peak Temperature (T _P)	235°C	260°C					
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum					
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum					
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum					

Note 1: All temperatures refer to the center of the package, measured on the capacitor body surface that is facing up during assembly reflow.

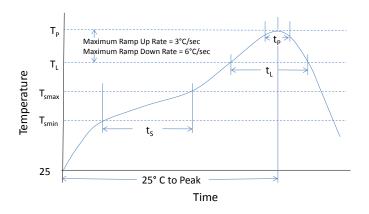




Table 4 - Performance & Reliability: Test Methods and Conditions

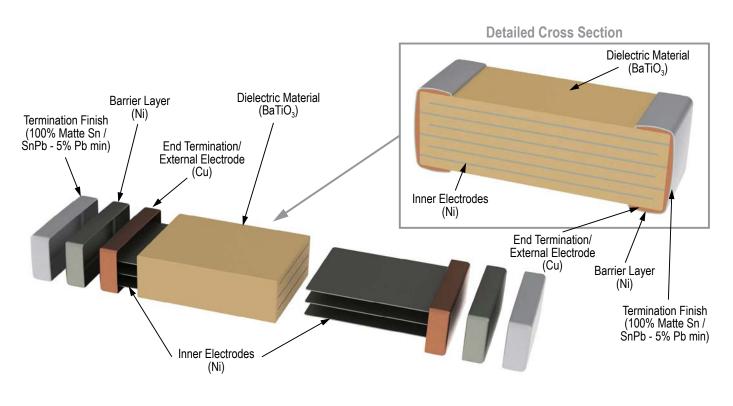
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Solderability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Golderability	0-010-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +150°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Load Humidity: 1,000 hours 85°C/85%RH and rated voltage. Add 100K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
,		Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance MIL-STD-202 Method 106		t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours. +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	−55°C/+150. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 150°C with 2 X rated voltage applied.
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 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage and Handling

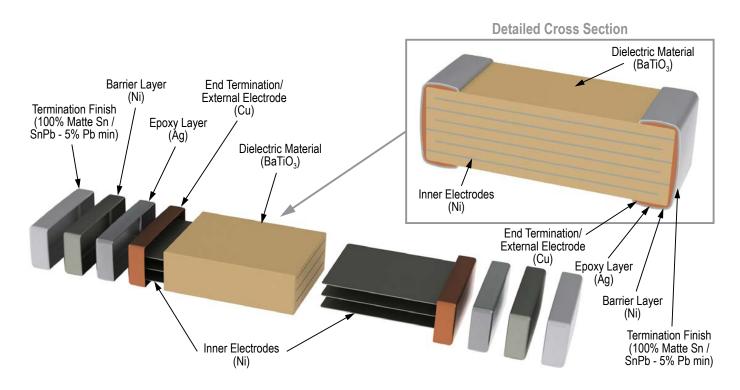
Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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 – Standard Termination



Construction – Flexible Termination



High Voltage with Flexible Termination System (HV FT-CAP), C0G Dielectric, 500 – 3,000 VDC (Commercial Grade)



Overview

KEMET's High Voltage with Flexible Termination (HV FT-CAP) surface mount MLCCs in C0G dielectric address the primary failure mode of MLCCs—flex cracks, which are typically the result of excessive tensile and shear stresses produced during board flexure and thermal cycling. Featuring several of the highest CV (capacitance/voltage) values available in the industry, these devices utilize a pliable and conductive silver epoxy between the base metal and nickel barrier layers of the termination system. The addition of this epoxy layer inhibits the transfer of board stress to the rigid ceramic body, therefore mitigating flex cracks which can result in low IR or short circuit failures. Although flexible termination technology does not eliminate the potential for mechanical damage that may propagate during extreme environmental and handling conditions, it does provide superior flex performance over standard termination systems.

KEMET's high voltage surface mount MLCCs in C0G dielectric feature a 125°C maximum operating temperature and offer the most stable voltage and temperature performance of all ceramic dielectric materials. C0G (NP0) dielectric capacitors exhibit no change in capacitance with respect to time and voltage and boasts a negligible change in capacitance with reference to ambient temperature. Capacitance change is limited to ±30ppm/°C from -55°C to +125°C.

These devices exhibit low ESR at high frequencies and find conventional use as snubbers or filters in applications such as switching power supplies and lighting ballasts. Their exceptional performance at high frequencies has made high voltage MLCC's the preferred dielectric choice of design engineers worldwide. In addition to their use in power supplies, these capacitors are widely used in industries related to automotive (hybrid), telecommunications, medical, military, aerospace, semiconductors and test/diagnostic equipment.

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



Ordering Information

С	2225	X	393	J	С	G	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance ¹	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/Grade (C-Spec)
	0805 1206 1210 1808 1812 1825 2220 2225	X= Flexible Termination	Two significant digits + number of zeros.	B = ±0.10 pF C = ±0.25 pF D = ±0.5 pF F = ±1% G = ±2% J = ±5% K = ±10% M = ±20%	C = 500 B = 630 D = 1,000 F = 1,500 G = 2,000 Z = 2,500 H = 3,000	G = C0G	A = N/A	C = 100% Matte Sn L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

¹ Additional capacitance tolerance offerings may be available. Contact KEMET for details.

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



Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec)
Bulk Bag/Unmarked	Not required (Blank)
7" Reel/Unmarked	TU
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2 mm pitch ²	7081
13" Reel/Unmarked/2 mm pitch ²	7082

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- -55°C to +125°C operating temperature range
- Superior flex performance (up to 5 mm)
- Lead (Pb)-Free, RoHS, and REACH compliant
- EIA 0805, 1206, 1210, 1808, 1812, 1825, 2220 and 2225 case sizes
- DC voltage ratings of 500 V, 630 V, 1 KV, 1.5 KV, 2 KV, 2.5 KV and 3 KV
- Capacitance offerings ranging from 1 pF to 39 nF
- Available capacitance tolerances of ±0.10 pF, ±0.25 pF, ±0.5 pF, ±1%, ±2%, ±5%, ±10% and ±20%
- · No piezoelectric noise
- Extremely low ESR & ESL
- High thermal stability

- High ripple current capability
- Preferred capacitance solution at line frequencies & into the MHz range
- No capacitance change with respect to applied rated DC voltage
- Negligible capacitance change with respect to temperature from –55°C to +125°C
- No capacitance decay with time
- · Non-polar device, minimizing installation concerns
- · Automotive (AEC-Q200) grade available
- 100% pure matte tin-plated termination finish allowing for excellent solderability
- SnPb plated termination finish option available upon request (5% Pb minimum)

Applications

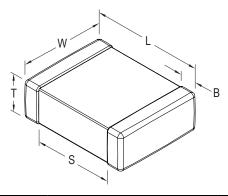
Typical applications include switch mode power supplies (input filters, resonators, tank circuits, snubbed circuits, output filters), high voltage coupling and DC blocking, lighting ballasts, voltage multiplier circuits, DC/DC converters and coupling capacitors in Ćuk converters. Markets include power supply, LCD fluorescent backlight ballasts, HID lighting, telecom equipment, industrial and medical equipment/control, LAN/WAN interface, analog and digital modems, and automotive.

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. The option to laser mark is not available on these devices. For more information see "Capacitor Marking".

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Dimensions – Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0805	2012	2.00 (.079) ± 0.30 (.012)	1.25 (.049) ± 0.30 (.012)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	Solder Wave or
1206	3216	3.30 (.130) ± 0.40 (.016)	1.60 (.063) ± 0.35 (.013)		0.60 (.024) ± 0.25 (.010)		Solder Reflow
1210	3225	3.30 (.130) ± 0.40 (.016)	2.60 (.102) ± 0.30 (.012)		0.60 (.024) ± 0.25 (.010)		
1808	4520	4.70 (.185) ± 0.50 (.020)	2.00 (.079) ± 0.20 (.008)	See Table 2 for	0.70 (.028) ± 0.35 (.014)		
1812	4532	4.50 (.178) ± 0.40 (.016)	3.20 (.126) ± 0.30 (.012)	Thickness	0.70 (.028) ± 0.35 (.014)	N/A	Caldan Daffass Only
1825	4564	4.60 (.181) ± 0.40 (.016)	6.40 (.252) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)		Solder Reflow Only
2220	5650	5.90 (.232) ± 0.75 (.030)	5.00 (.197) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)		
2225	5664	5.90 (.232) ± 0.75 (.030)	6.40 (.248) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)		

Qualification/Certification

Commercial Grade products are subject to internal qualification. Details regarding test methods and conditions are referenced in Table 4, Performance and 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)	±30 ppm/°C
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	0%
¹ Dielectric Withstanding Voltage (DWV)	150% of rated voltage for voltage rating of < 1,000 V 120% of rated voltage for voltage rating of ≥ 1,000 V (5 ±1 seconds and charge/discharge not exceeding 50 mA)
² Dissipation Factor (DF) Maximum Limit at 25°C	0.1%
³ Insulation Resistance (IR) Limit at 25°C	1,000 megohm microfarads or 100 G Ω (500 VDC applied for 120 ± 5 seconds at 25°C)

¹ DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

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."

Post Environmental Limits

	High Temperatu	re Life, Biased	Humidity, Moist	ture Resistance	
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance
C0G	All	All	0.5	0.3% or ±0.25 pF	10% of Initial Limit

² Capacitance and dissipation factor (DF) measured under the following conditions:

¹ MHz ± 100 kHz and 1.0 Vrms ± 0.2 V if capacitance $\leq 1,000$ pF

¹ kHz ± 50 Hz and 1.0 Vrms ± 0.2 V if capacitance > 1,000 pF

 $^{{}^{3}}$ To obtain IR limit, divide M Ω - μ F value by the capacitance and compare to G Ω limit. Select the lower of the two limits.



Table 1A – Capacitance Range/Selection Waterfall (0805 – 1808 Case Sizes)

			Ca	ise	Siz	ze/S	Se	ries	3	С	080	5X		С	1206	6X			С	1210	OX				C	180	8X		
				Vo	ltag	e Co	de			С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	Z	Н
Capacitance	Cap Code		R	Rated	l Volt	tage	(VI	DC)		200	630	1000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	2500	3000
		C	ana	cit	anc	_ _ T	ole	rar	ICE	"				Pro	duc	t Av	ailal	oility	and	d Ch	ip Th	nick	ness	s Co	des	_	_ 7		m
1.0 - 9.1 pF*	109 - 169*	В	<u>. </u>	D	1110	· ·		, a		DG	DG	DG		S	ee T	able	2 fc	or Ch	nip T	hick	cnes	s Di	men LB	LB	LB	LB	LB	LB	LB
1.0 - 9.1 pr 10 pF	109 - 109			0	F	G	J	K	М	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
11 pF	110	ĺ			F	G	J	K	М	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
12 pF	120	l			F	G	J	K	М	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
13 pF	130				F	G	J	K	M	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
15 pF	150	l			F	G	J	K	M	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
16 pF	160 180				F	G	J	K	M	DG DG	DG DG	DG DG	ES ES	ES ES	ES ES	ES ES	ES ES	FM FM	FM FM	FM FM	FM FM	FM FM	LB LB	LB LB	LB LB	LB LB	LB LB	LB LB	LB LB
18 pF 20 pF	200				F	G	J	K	M	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
22 pF	220	l			F	G	J	K	M	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
24 pF	240				F	G	J	K	М	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
27 pF	270				F	G	J	K	М	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
30 pF	300				F	G	J	K	М	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
33 pF	330				F	G	J	K	М	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
36 pF	360 390				F	G	J	K	M	DG	DG	DG	ES ES	ES ES	ES ES	ES ES	ES ES	FM FM	FM	FM FM	FM FM	FM FM	LB	LB	LB	LB	LB	LB	LB LB
39 pF 43 pF	430	l			F	G	J	K	M	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
47 pF	470				F	G	J	K	M	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
51 pF	510	İ			F	G	J	K	М	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
56 pF	560	İ			F	G	J	K	М	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
62 pF	620				F	G	J	K	М	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
68 pF	680				F	G	J	K	М	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
75 pF	750	l			F	G	J	K	M	DG	DG	DG	ES	ES	ES	ES	EF	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
82 pF 91 pF	820 910				F	G	J	K	M	DG DG	DG DG	DG DG	ES ES	ES ES	ES ES	ES ES	EF EF	FM FM	FM FM	FM FM	FM FM	FM FM	LB LB	LB LB	LB LB	LB LB	LB	LB LB	LB LB
100 pF	101				F	G	J	K	M	DG	DG	DG	ES	ES	ES	ES	EF	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LC	LB
110 pF	111	l			F	G	J	K	M	DG	DG	DG	ES	ES	ES	ES	EU	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LC	LB
120 pF	121	İ			F	G	J	K	М	DG	DG	DG	ES	ES	ES	ES	EU	FZ	FZ	FZ	FM	FM	LA	LA	LA	LA	LB	LC	LB
130 pF	131	l			F	G	J	K	М	DG	DG	DG	ES	ES	ES	ES	EU	FZ	FZ	FZ	FM	FM	LA	LA	LA	LA	LB	LC	LC
150 pF	151	L			F	G	J	K	М	DG	DG	DG	ES	ES	ES	EF	EU	FZ	FZ	FZ	FM	FM	LA	LA	LA	LA	LB	LC	LC
160 pF	161				F	G	J	K	M	DG	DG	DG	ES	ES	ES	EF	EU	FZ	FZ	FZ	FM	FM	LA	LA	LA	LA	LC	LC	LC
180 pF	181 201				F	G	J	K	M	DG DG	DG DG	DG DG	ES ES	ES ES	ES ES	EF EF	EU	FZ FZ	FZ FZ	FZ FZ	FM FM	FM FM	LA	LA	LA	LA	LC	LC	LC
200 pF 220 pF	221				F	G	J	K	M	DG	DG	DG	ES	ES	ES	EU	EU	FZ	FZ	FZ	FM	FM	LA	LA	LA	LA	LC	LC	
240 pF	241				F	G	J	K	M	DG	DG	DG	ES	ES	ES	EU	EU	FZ	FZ	FZ	FM	FM	LA	LA	LA	LB	LC	LC	
270 pF	271	П		П	F	G	J	K	М	DG	DG	DG	ES	ES	ES	EU	EU	FZ	FZ	FZ	FK	FK	LA	LA	LA	LB	LC	LC	
300 pF	301				F	G	J	K	М	DG	DG		ES	ES	EF	EU		FZ	FZ	FZ	FK	FK	LA	LA	LA	LB	LC	LC	
330 pF	331				F	G	J	K	М	DG	DG		ES	ES	EF	EU		FZ	FZ	FZ	FK	FK	LA	LA	LA	LB	LC	LC	
360 pF	361				F	G	J	K	M	DG	DG		ES	ES	EF	EU		FZ	FZ	FZ	FK	FS	LA	LA	LA	LB	LA	LC	
390 pF 430 pF	391 431				F	G	J	K	M	DG	DG		ES	ES	EF EF	EU		FZ FZ	FZ FM	FZ FM	FK FS	FS FS	LA	LA	LA	LB	LA	LC	
470 pF	471				F	G	J	K	M	DG	DG		ES	ES	EU	EU		FZ	FM	FM	FS	FS	LA	LB	LB	LC	LA		
510 pF	511				F	G	J	K	M	DG	DG		ES	ES	EU	EU		FZ	FM	FM	FS	FS	LA	LB	LB	LC	LB		
560 pF	561				F	G	J	K	М	DG	DG		ES	ES	EU	EU		FZ	FM	FM	FS	FS	LA	LB	LB	LC	LB		
620 pF	621				F	G	J	K	М	DG			ES	ES				FZ	FM	FM	FS	FS	LA	LB	LB	LA	LC		
680 pF	681				F	G	J	K	М	DG			ES	ES	EU			FZ	FM	FM	FS	FS	LB	LB	LB	LA	LC		
750 pF	751				F	G	J	K	M	DG DG			ES	EF EF	EU			FZ	FM	FM			LB	LB LB	LB	LA			
820 pF 910 pF	821 911				F	G	J	K	M	الم			ES ES	EF	EU			FZ FM	FM FM	FM FM	FM FY		LB LB	LB	LB LB	LA			
1,000 pF	102	l			F	G	J	K	M				ES	EF	EU			FM	FM	FM	FY		LB	LB	LB	LB			
.,v p.			F	Rated			(VI			200	630	1000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	2500	3000
Capacitance	Cap Code				oltag	_	<u> </u>	,		C	В	D	C	В	D	F	G	C	В	D	F	G	C	В	D	F	G	Z	Н
		Г	C	ase				ies		C	080	5X		C	1206	X			С	1210	X			1	C	1808	3X		
	<u> </u>							-55			233																		

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).



Table 1A - Capacitance Range/Selection Waterfall (0805 - 1808 Case Sizes) cont'd

		(Cas	e S	ize	/Se	ries	6	С	080	5X		C.	1206	6X			С	1210	X				С	180	8X		
				Volta	ge C	ode			С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	Z	Н
Capacitance	Cap Code		Rat	ted V	oltag	e (VI	OC)		200	630	1000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	2500	3000
		Ca	pac	itan	се	Tole	erar	ıce					Pro S	duc ee T	t Av	ailal 2 fc	bility or Cl	and nip T	d Ch	ip Tl	nick s Di	ness men	s Co sior	des IS				
1,100 pF	112			F	١,٠		K	М				EF	EU				FM	FK	FK	FS		LC	LC	LC	LB			
1,200 pF	122			F	: 0	i J	K	M	l			EF	EU				FM	FK	FK	FS		LC	LC	LC	LC			
1,300 pF	132			F	: (i J	K	M	l			EF	EU				FM	FS	FS			LC	LC	LC	LC			
1,500 pF	152			F	1 -	i J	K	M	l			EF	EU				FK	FS	FS			LC	LC	LC	LC			
1,600 pF	162			F	: (i J	K	M				EF	EU				FK	FS	FS			LC	LC	LC				
1,800 pF	182			F	: (i J	K	M				EF	EU				FK	FS	FS			LC	LC	LC				
2,000 pF	202			F	: 0	i J	K	M	l			EU	EQ				FK	FL	FS			LC	LA	LB				
2,200 pF	222	İ		F	: (i J	K	M	İ			EU	EQ				FK	FL	FS			LC	LA	LB				
2,400 pF	242	i I		F	: 0	i J	K	M	İ			EU	EQ				FS	FL	FS			LC	LA	LB				
2,700 pF	272	i		F	: (i J	K	М	İ			EU	EQ				FS	FL	FS			LC	LA	LC				
3,000 pF	302			F	: (J	K	M	İ			EQ	EQ				FS	FL				LA	LA					
3,300 pF	332			F	: 0	J	K	M	İ			EQ	EQ				FS	FM				LA	LA					
3,600 pF	362			F	: 0	J	K	M	İ			ER	ER				FL	FM				LA	LB					
3,900 pF	392	i		F	: 0	J	K	М	İ			ER	ER				FL	FY				LA	LB					
4,300 pF	432	i		F	: 0	J	K	М	İ			ES	ES				FM	FY				LA	LC					
4,700 pF	472			F	: (j J	K	М				ES	ES				FM	FY				LA	LC					
5,100 pF	512	i		l F	: 0	i J	K	М	İ			İ					FY	FS				LA						
5,200 pF	562			F	: 0	i J	K	М	İ			l					FY	FS				LB						
6,200pF	622			F	: 0	i J	K	М	İ			l					FY	FE				LC						
6,800pF	682	i		F	: (i J	K	М	İ			İ					FY	FE				LC						
7,500pF	752			F	: (J	K	М									FS											
8,200pF	822			F			K	М	i								FS											
			Rat	ted V	oltag	e (VI	OC)		200	630	1000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	2500	3000
Capacitance	Cap Code			Volta	ge C	ode			С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	z	Н
			Cas	se S	ize	Ser	ies		С	080	5X		С	1206	Σ			С	1210	X				С	180	вх		

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).



Table 1B - Capacitance Range/Selection Waterfall (1812 - 2225 Case Sizes)

		Case Size/Series			C 1	812	2X					C 1	825	δX					C2	222	0X					C2	222	 5X		
	Сар	Voltage Code	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н	С	В	D	F	G	z	Н	С	В	D	F	G	z	Н
Сар	Code	Rated Voltage (VDC)	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	100	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
		Capacitance	2	•	=	==	7	7	૿ૼ	Pro	odu	ct A	vai	abi	lity	and	Cr	ip 1	Γhic	kne	ss	Cod	les			=	=		15	36
10 pF	100	Tolerance F G J K M	GK	GK	GK	GK	GK	GK	GK		see	Tab	ie z	101	Cn	рі	JK	JK	SS [JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
11 pF	110	F G J K M		GK	GK	GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
12 pF	120	F G J K M	GK	GK	GK	GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
13 pF	130	F G J K M	GK	GK	GK	GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
15 pF	150	F G J K M	GK	GK	GK	GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
16 pF	160	F G J K M	GK	GK	GK	GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF KF	KF	KF KF	KF	KF	KF	KF
18 pF 20 pF	180 200	F G J K M F G J K M	GK GK	GK GK	GK GK	GK GK	GK GK	GK GK	GK GK								JK JK	JK JK	JK JK	JK JK	JK JK	JK JK	JK JK	KF	KF KF	KF	KF KF	KF KF	KF KF	KF KF
20 pF 22 pF	220	F G J K M	GK	GK	GK	GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
24 pF	240	F G J K M	GK	GK	GK	GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
27 pF	270	F G J K M	GK	GK	GK	GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
30 pF	300	F G J K M	GK	GK	GK	GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
33 pF	330	F G J K M	GK	GK	GK	GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
36 pF	360	F G J K M	GK	GK	GK	GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
39 pF	390	F G J K M	GK	GK	GK	GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
43 pF	430	F G J K M	GK	GK	GK	GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
47 pF	470	F G J K M	GK	GK	GK	GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
51 pF	510	F G J K M	GK	GK	GK	GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
56 pF 62 pF	560 620	F G J K M	GK GK	GK GK	GK GK	GK GK	GK GK	GK GK	GK GK								JK JK	JK JK	JK JK	JK JK	JK JK	JK JK	JK JK	KF KF	KF KF	KF KF	KF KF	KF KF	KF KF	KF KF
68 pF	680	F G J K M	GK	GK	GK	GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
75 pF	750	F G J K M	GK	GK	GK	GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
82 pF	820	F G J K M	GK	GK	GK	GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
91 pF	910	F G J K M	GK	GK	GK	GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
100 pF	101	F G J K M	GK	GK	GK	GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
110 pF	111	F G J K M	GK	GK	GK	GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
120 pF	121	F G J K M	GK	GK	GK	GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
130 pF	131	F G J K M	GK	GK	GK	GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
150 pF	151	F G J K M	GK		GK	GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
160 pF	161	F G J K M	GK	GK	GK	GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
180 pF	181	F G J K M F G J K M	GK	GK	GK	GK	GK	GK	GK GM								JK	JK	JK	JK JK	JK	JK	JK JK	KF KF	KF KF	KF KF	KF KF	KF KF	KF KF	KF KF
200 pF 220 pF	201 221	F G J K M	GH GH	GH GH	GH GH	GH GH	GH GH	GK GK	GM								JK JK	JK JK	JK JK	JK	JK JK	JK JK	JK	KF	KF	KF	KF	KF	KF	KF
240 pF	241	F G J K M	GH	GH	GH	GH	GH	GK	GM								JK	JK	JK	JK	JK	JK	JK	KE	KE	KE	KE	KE	KE	KF
270 pF	271	F G J K M	GH	GH	GH	GH	GH	GK	GM								JK	JK	JK	JK	JK	JK	JK	KE	KE	KE	KE	KE	KE	KF
300 pF	301	F G J K M			GH	GH	GH	GK	GM								JK	JK	JK	JK	JK	JK	JK	KE	KE	KE	KE		KE	KF
330 pF	331	F G J K M	GH		GH	GH	GH	GK	GO								JE	JE	JE	JE	JE	JK	JK	KE	KE	KE	KE		KE	KF
360 pF	361	F G J K M	GK	GK	GK	GK	GH	GK	GO								JE	JE	JE	JE	JE	JK	JK	KE	KE	KE	KE	KE	KE	KF
390 pF	391	F G J K M	GK	GK	GK	GK	GK	GK	GO								JE	JE	JE	JE	JE	JK	JK	KE	KE	KE	KE	KE	KE	KF
430 pF	431	F G J K M	GK	GK	GK	GK	GK	GK								HJ	JE	JE	JE	JE	JE	JK	JE	KE	KE	KE	KE	KE	KE	KF
470 pF	471	F G J K M					GK	GK								HJ	JE	JE	JE	JE	JE	JK	JK	KF	KF	KF	KF	KE	KE	KF
510 pF	511					GK										HJ	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF			KF
560 pF 620 pF	561 621		GH	GH		GK										HJ	JK	JK	JK	JK	JK	JK	JL	KF	KF	KF	KF			KF
620 pF 680 pF	621 681		GH													HK HK	JK JE	JK JE	JK JE	JK JK	JK JK	JK JK	JL JL	KF KF	KF KF	KF KF	KF KF			KH KH
750 pF	751	F G J K M		GH				00								TIK	JE	JE	JE	JK	JK	JK	JL	KE	KE	KE	KF			KH
820 pF	821	F G J K M				GK											JE	JE	JE	JK	JK	JK	JN	KE	KE	KE	KF		KF	KJ
910 pF	911	F G J K M															JE	JK	1	JK	JK	JK	JN			KE		KE		KJ
1,000 pF	102	F G J K M	GH	GH	GH	GH	GM										JE	JK	1	JK	JK	JK	JN		1	KE			KF	KJ
1,100 pF	112	F G J K M	GH	GK	GK	GH	GO								HJ		JE	JK	JK	JK	JK	JK		KE				KF	KF	
		Rated Voltage (VDC)	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
Сар	Cap Code	Voltage Code	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н	С	В	D	F	G	Z		С	В	D	F	G	Z	Н
		Case Size/Series			C1	1812	2X					C1	825	X					C	2220	X					C	222	5X		

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).



Table 1B - Capacitance Range/Selection Waterfall (1812 - 2225 Case Sizes) cont'd

		Case Size/Series			C1	1812	2X					C 1	82	5X					C2	222	0X					C2	222	5X		
	Cap	Voltage Code	С	В	D	F	G	z	н	С	В	D	F	G	z	Н	С	В	D	F	G	z	Н	С	В	D	F	G	z	н
Сар	Code	Rated Voltage (VDC)	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
		Capacitance Tolerance								Pro	odu See	ct A	vai	labi	lity	and	l Ch	ip 1 kne	Thic ss E	kne	ss (Cod	es							
1,200 pF	122	F G J K M	GH	GK	GK	GH	GO								HJ		JE	JK	JK	JK	JK	JL		KE	KE	KE	KF	KF	KF	
1,300 pF	132	F G J K M	GH	GK	GK	GH	GO							HE	HJ		JE	JK	JK	JK	JE	JL		KE	KE	KE	KF	KF	KH	
1,500 pF	152	F G J K M	GK	GK	GK	GK	GO							HE	HK		JE	JK	JK	JK	JE	JL		KE	KE	KE	KF	KF	KH	
1,600 pF	162	F G J K M	GK	GK	GK	GK								HG	HK		JE	JK	JK	JK	JE	JL		KE	KE	KE	KF	KE	KH	
1,800 pF	182	F G J K M	GK	GK	GK	GM								HG			JE	JK	JK	JK	JE	JN		KE	KE	KE	KF	KE	KH	
2,000 pF	202	F G J K M	GK	GK	GK	GM							HE	HJ			JE	JK	JK	JE	JK			ΚE	KE	KE	KF	KE	KJ	
2,200 pF	222	F G J K M	GK	GK	GK	GO							HE	HJ			JE	JK	JK	JΕ	JK			ΚE	KE	KE	KF	KF	KJ	
2,400 pF	242	F G J K M	GK	GH	GK	GO							HE	HJ			JK	JK	JK	JΕ	JL			ΚE	KE	KE	KE	KH		
2,700 pF	272	F G J K M	GK	GH	GK	GO							HE	нк			JK	JK	JK	JE	JL			KE	KE	KE	KE	KH		
3,000 pF	302	FGJKM	GK	GH	GK								HE	нк			JK	JK	JK	JE	JL			KE	KE	KE	KE	KH		
3,300 pF	332	F G J K M	GK	GH	GK								HG				JK	JK	JK	JK	JN			KE	KE	KE	KE	KJ		
3,600 pF	362	F G J K M	GK	GH	GM								HG				JK	JK	JK	JK	JN			KE	KF	KF	KF	KJ		
3,900 pF	392	FGJKM	GК	GH	GM								HJ				JK	JK	JK	JK	JN			KE	KF	KF	KF	KJ		
4,300 pF	432	F G J K M	GН	GH	GO								HJ				JK	JK	JK	JK				KE	KF	KF	KF			
4,700 pF	472	F G J K M	GH	GH	GO								HJ				JK	JK	JK	JL				KE	KF	KF	КН			
5,100 pF	512	F G J K M			GO						HE	HG	НК				JK	JK	JK	JL				KE	KF	KF	КН			
5,600 pF	562	F G J K M			GO						HE	HG	нк				JK	JK	JK	JN				KE	KF	KF	кн			
6,200 pF	622	F G J K M									HE	HG					JK	JE	JE	JN				KE	KF	KF	KJ			
6,800 pF	682	F G J K M		GM							HE	HJ					JK	JE	JK	JN				KE	KF	KF	KJ			
7,500 pF	752	F G J K M									HE	HJ					JК	JE	JK					KF	KE	KF				
8,200 pF	822	F G J K M									HE	HJ					JK	JE	JL					KF	KE	KF				
9,100 pF	912	F G J K M								HE	HG	НК					JE	JE	JL					KF	KE	КН				
10,000 pF	103	F G J K M	-							HE	HG	НК					JE	JE	JL					KF	KE	KH				
12,000 pF	123	F G J K M									HG						JE	JK	JN					KE	KE	KH				
15,000 pF	153		GO							HE	HJ						JE	JL	• • •					KE	KF	KJ				
18,000 pF	183	F G J K M								HG	HK						JE	JL						KE	KH					
22,000 pF	223	F G J K M								HJ							JK	JN						KF	KJ					
27,000 pF	273	F G J K M								HJ							JL	JN						KF	KJ					
33,000 pF	333	F G J K M								HK							JN	011						KH	110					
39,000 pF	393	F G J K M								1111							011							KJ						
33,000 pi	000		 	-	_	_	0	_	0	_	_	0	_	_	•	0	-		_	_	0	0	-			0	0	-	0	
	Сар	Rated Voltage (VDC)	200	630	1000	1500	2000	2500	3000	200	630	100	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
Сар	Cap Code	Voltage Code	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н
		Case Size/Series			C,	1812	2X					C,	182	5X					C	2220	0X					C	222	5X		

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).



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

Thickness	Case	Thickness ±	Paper G	Quantity	Plastic (Quantity
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
ES	1206	1.00 ± 0.20	0	0	2,500	10,000
EF	1206	1.20 ± 0.15	0	0	2,500	10,000
EU	1206	1.60 ± 0.25	0	0	2,000	8,000
EQ	1206	0.78 ± 0.20	4000	10000	4,000	10,000
ER	1206	0.90 ± 0.20	0	0	4,000	10,000
FE	1210	1.00 ± 0.10	0	0	2,500	10,000
FZ	1210	1.25 ± 0.20	0	0	2,500	10,000
FL	1210	1.40 ± 0.15	0	0	2,000	8,000
FM	1210	1.70 ± 0.20	0	0	2,000	8,000
FY	1210	2.00 ± 0.20	0	0	2,000	8,000
FK	1210	2.10 ± 0.20	0	0	2,000	8,000
FS	1210	2.50 ± 0.30	0	0	1,000	4,000
LA	1808	1.40 ± 0.15	0	0	1,000	4,000
LB	1808	1.60 ± 0.15	0	0	1,000	4,000
LC	1808	2.00 ± 0.15	0	0	1,000	4,000
GH	1812	1.40 ± 0.15	0	0	1,000	4,000
GK	1812	1.60 ± 0.20	0	0	1,000	4,000
GM	1812	2.00 ± 0.20	0	0	500	2,000
GO	1812	2.50 ± 0.20	0	0	500	2,000
HE	1825	1.40 ± 0.15	0	0	1,000	4,000
HG	1825	1.60 ± 0.20	0	0	1,000	4,000
HJ	1825	2.00 ± 0.20	0	0	500	2,000
HK	1825	2.50 ± 0.20	0	0	500	2,000
JE	2220	1.40 ± 0.15	0	0	1,000	4,000
JK	2220	1.60 ± 0.20	0	0	1,000	4,000
JL	2220	2.00 ± 0.20	0	0	500	2,000
JN	2220	2.50 ± 0.20	0	0	500	2,000
KE	2225	1.40 ± 0.15	0	0	1,000	4,000
KF	2225	1.60 ± 0.20	0	0	1,000	4,000
KH	2225	2.00 ± 0.20	0	0	500	2,000
KJ	2225	2.50 ± 0.20	0	0	500	2,000
Thickness	Case	Thickness ±	7" Reel	13" Reel	7" Reel	13" Reel
Code	Size	Range (mm)	Paper C	luantity	Plastic (Quantity

Package quantity based on finished chip thickness specifications.



Table 2B - Bulk Packaging Quantities

Doolean	don Torre	Loose P	ackaging
Раска	ging Type	Bulk Bag	g (default)
Packagii	ng C-Spec ¹	N	/A ²
Cas	e Size	Packaging Quantities	(pieces/unit packaging)
EIA (in)	Metric (mm)	Minimum	Maximum
0402	1005		
0603	1608		
0805	2012		50,000
1206	3216		
1210	3225	1	
1808	4520] '	
1812	4532		
1825	4564		20,000
2220	5650		
2225	5664		

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

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



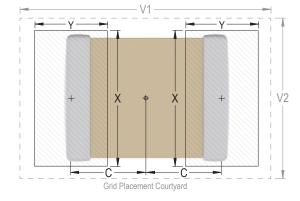
Table 3 - Chip Capacitor Land Pattern Design Recommendations per IPC-7351

EIA Size Code	Metric Size Code	I	Maxi	sity Lev mum (M rotrusio	lost))	I	Media	sity Lev an (Nor rotrusio)	I	Mini	sity Lev mum (L rotrusio	east))
Code	Code	С	Y	Х	V1	V2	С	Y	Х	V1	V2	С	Υ	Х	V1	V2
0805	2012	0.99	1.44	1.66	4.47	2.71	0.89	1.24	1.56	3.57	2.11	0.79	1.04	1.46	2.42	1.81
1206	3216	1.59	1.62	2.06	5.85	3.06	1.49	1.42	1.96	4.95	2.46	1.39	1.22	1.86	4.25	2.16
1210	3225	1.59	1.62	3.01	5.90	4.01	1.49	1.42	2.91	4.95	3.41	1.39	1.22	2.81	4.25	3.11
1808	4520	2.30	1.75	2.30	7.40	3.30	2.20	1.55	2.20	6.50	2.70	2.10	1.35	2.10	5.80	2.40
1812	4532	2.10	1.80	3.60	7.00	4.60	2.00	1.60	3.50	6.10	4.00	1.90	1.40	3.40	5.40	3.70
1825	4564	2.15	1.80	6.90	7.10	7.90	2.05	1.60	6.80	6.20	7.30	1.95	1.40	6.70	5.50	7.00
2220	5650	2.85	2.10	5.50	8.80	6.50	2.75	1.90	5.40	7.90	5.90	2.65	1.70	5.30	7.20	5.60
2225	5664	2.85	2.10	6.90	8.80	7.90	2.75	1.90	6.80	7.90	7.30	2.65	1.70	6.70	7.20	7.00

Density Level A: For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes. KEMET only recommends wave soldering of EIA 0603, 0805 and 1206 case sizes.

Density Level B: For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes. **Density Level C:** For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC Standard 7351 (IPC–7351).

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





Soldering Process

Recommended Soldering Technique:

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

Recommended Reflow Soldering Profile:

KEMET's families of surface mount multilayer ceramic capacitors (SMD MLCCs) are compatible with wave (single or dual), convection, IR or vapor phase reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET's recommended profile conditions for convection and IR reflow reflect the profile conditions of the IPC/J-STD-020 standard for moisture sensitivity testing. These devices can safely withstand a maximum of three reflow passes at these conditions.

Profile Feature	Terminati	on Finish
Frome reature	SnPb	100% Matte Sn
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum

Note 1: All temperatures refer to the center of the package, measured on the capacitor body surface that is facing up during assembly reflow.

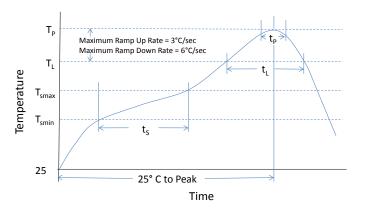




Table 4 – Performance & Reliability: Test Methods and Conditions

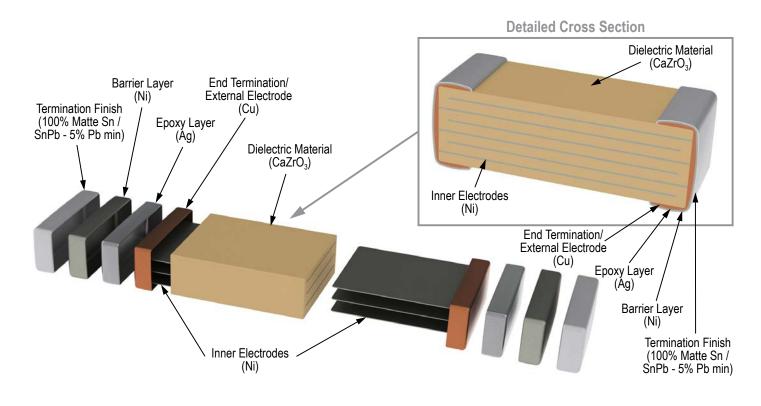
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Solderability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	J-31D-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Load Humidity: 1,000 hours 85°C/85% RH and 200 VDC maximum. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 1.2 X rated voltage applied.
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 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



Capacitor Marking (Optional):

Laser marking option is not available on:

- C0G, Ultra Stable X8R and Y5V dielectric devices
- EIA 0402 case size devices
- EIA 0603 case size devices with Flexible Termination option.
- · KPS Commercial and Automotive grade stacked devices.

These capacitors are supplied unmarked only.

High Voltage with Flexible Termination System (HV FT-CAP) X7R Dielectric, 500 – 3,000 VDC (Commercial Grade)



Overview

KEMET's High Voltage with Flexible Termination (HV FT-CAP) surface mount MLCCs in X7R dielectric address the primary failure mode of MLCCs– flex cracks, which are typically the result of excessive tensile and shear stresses produced during board flexure and thermal cycling. Featuring several of the highest CV (capacitance/voltage) values available in the industry, these devices utilize a pliable and conductive silver epoxy between the base metal and nickel barrier layers of the termination system. The addition of this epoxy layer inhibits the transfer of board stress to the rigid ceramic body, therefore mitigating flex cracks which can result in low IR or short circuit failures. Although flexible termination technology does not eliminate the potential for mechanical damage that may propagate during extreme environmental and handling conditions, it does provide superior flex performance over standard termination systems.

The HV FT-CAP offers low leakage current, exhibits low ESR at high frequencies and finds conventional use as snubbers or filters in applications such as switching power supplies and lighting ballasts. Their exceptional performance at high frequencies has made them a preferred choice of design engineers worldwide. In addition to their use in power supplies, these capacitors are widely used in industries related to automotive(hybrid), telecommunications, medical, military, aerospace, semiconductors and test/diagnostic equipment.

Combined with the stability of an X7R dielectric and designed to accommodate all capacitance requirements, these flex-robust devices are RoHS-compliant, offer up to 5 mm of flex-bend capability and exhibits a predictable change in capacitance with respect to time and voltage. Capacitance change with reference to ambient temperature is limited to ±15% from -55°C to +125°C.

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



Ordering Information

С	1210	X	154	K	С	R	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec)
	0603 0805 1206 1210 1808 1812 1825 2220 2225	X = Flexible Termination	Two significant digits + number of zeros.	J = ±5% K = ±10% M = ±20%	C = 500 B = 630 D = 1,000 F = 1,500 G = 2,000 Z = 2,500 H = 3,000	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

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



Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec)
Bulk Bag/Unmarked	Not required (Blank)
7" Reel/Unmarked	TU
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
7" Reel/Marked	TM
13" Reel/Marked	7040 (EIA 0603 and smaller case sizes) 7215 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2mm pitch ²	7081
13" Reel/Unmarked/2mm pitch ²	7082

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- −55°C to +125°C operating temperature range
- · Industry-leading CV values
- Superior flex performance (up to 5 mm)
- Exceptional performance at high frequencies
- Lead (Pb)-Free, RoHS and REACH compliant
- EIA 0603, 0805, 1206, 1210, 1808, 1812, 1825, 2220, and 2225 case sizes
- DC voltage ratings of 500 V, 630 V, 1 KV, 1.5 KV, 2 KV, 2.5 KV, and 3 KV

- Capacitance offerings ranging from 10 pF to 560 nF
- Available capacitance tolerances of ±5%, ±10% or ±20%
- Low ESR and ESL
- · Non-polar device, minimizing installation concerns
- Automotive (AEC–Q200) Grade available
- 100% pure matte tin-plated termination finish allowing for excellent solderability
- SnPb plated termination finish option available upon request (5% Pb minimum)

Applications

Typical applications include switch mode power supplies (input filters, resonators, tank circuits, snubber circuits, output filters), high voltage coupling and DC blocking, lighting ballasts, voltage multiplier circuits, DC/DC converters and coupling capacitors in Ćuk converters. Markets include power supply, LCD fluorescent backlight ballasts, HID lighting, telecom equipment, industrial and medical equipment/control, LAN/WAN interface, analog and digital modems, and automotive (electric and hybrid vehicles, charging stations and lighting applications).

Application Note

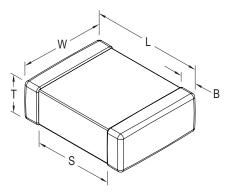
X7R dielectric is not recommended for AC line filtering or pulse applications. These capacitors and/or the assembled circuit board containing these capacitors may require a protective surface coating to prevent external surface arcing.

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. Please contact KEMET if you require a laser marked option. For more information see "Capacitor Marking".

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Dimensions – Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0603	1608	1.60 (.063) ± 0.17 (.007)	0.80 (.032) ± 0.15 (.006)		0.45 (.018) ± 0.15 (.006)	0.58 (.023)	
0805	2012	2.00 (.079) ± 0.30 (.012)	1.25 (.049) ± 0.30 (.012)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	Solder Wave or Solder Reflow
1206	3216	3.30 (.130) ± 0.40 (.016)	1.60 (.063) ± 0.35 (.013)		0.60 (.024) ± 0.25 (.010)		
1210	3225	3.30 (.130) ± 0.40 (.016)	2.60 (.102) ± 0.30 (.012)		0.60 (.024) ± 0.25 (.010)		
1808	4520	4.70 (.185) ± 0.50 (.020)	2.00 (.079) ± 0.20 (.008)	See Table 2 for Thickness	0.70 (.028) ± 0.35 (.014)		
1812	4532	4.50 (.178) ± 0.40 (.016)	3.20 (.126) ± 0.30 (.012)		0.70 (.028) ± 0.35 (.014)	N/A	Colden Defley, Only
1825	4564	4.60 (.181) ± 0.40 (.016)	6.40 (.252) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)		Solder Reflow Only
2220	5650	5.90 (.232) ± 0.75 (.030)	5.00 (.197) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)		
2225	5664	5.90 (.232) ± 0.75 (.030)	6.40 (.248) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)		

Qualification/Certification

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

Environmental Compliance

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%
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
² Dielectric Withstanding Voltage (DWV)	150% of rated voltage for voltage rating of < 1000V 120% of rated voltage for voltage rating of ≥ 1000V (5 ± 1 seconds and charge/discharge not exceeding 50mA)
³ Dissipation Factor (DF) Maximum Limit @ 25°C	2.5%
⁴Insulation Resistance (IR) Minimum Limit @ 25°C	See Insulation Resistance Limit Table (500VDC applied for 120 ± 5 secs @ 25°C)

Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

 $1kHz \pm 50Hz$ and 1.0 ± 0.2 Vrms if capacitance ≤ $10\mu F$

120Hz \pm 10Hz and 0.5 ± 0.1 Vrms if capacitance >10 μ F

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

Post Environmental Limits

	High Temperatu	ıre Life, Biased	Humidity, Mois	ture Resistance	
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (%)	Capacitance Shift	Insulation Resistance
	> 25		3.0		
X7R	16/25	All	5.0	±20%	10% of Initial Limit
	< 16		7.5		

Insulation Resistance Limit Table (X7R Dielectric)

EIA Case Size	1,000 Megohm Microfarads or 100 GΩ	100 Megohm Microfarads or 10 GΩ
0603	N/A	All
0805	< 0.0039 µF	≥ 0.0039 µF
1206	< 0.012 µF	≥ 0.012 µF
1210	< 0.033 µF	≥ 0.033 µF
1808	< 0.018 µF	≥ 0.018 µF
1812	< 0.027 µF	≥ 0.027 µF
≥ 1825	All	N/A

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

 $^{^4}$ To obtain IR limit, divide MΩ-μF value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



Table 1A – Capacitance Range/Selection Waterfall (0603 – 1812 Case Sizes)

			se Si Serie		C)60	3X	C	080	5X		C1	200	6X			Cí	1210	X				C 1	808	BX					C1	1812	2X		
Сар	Cap	Vol	Itage C	ode	С	В	D	С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н
Oup	Code	Rat	ted Volt (VDC)	tage	200	630	1000	200	630	1000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
			pacitar olerand					duc			abili	ity a				· ·					See							nes						,,
10 pF	100	J	K	M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK		GK	GK		GK	GK
11 pF 12 pF	110 120	J	K	M M				DG	DG DG	DG DG	ES ES	ES ES	ES ES	ES ES	ES ES	FM FM	FM FM	FM FM	FM FM	FM FM	LB LB	LB LB	LB LB	LB LB	LB LB	LB LB	LB LB	GK GK	GK GK	GK GK	GK GK	GK GK	GK GK	GK GK
13 pF	130	J	K	M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK	GK	GK	GK	GK	GK	GK
15 pF	150	J	K	M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK			GK	GK	GK	GK
16 pF 18 pF	160 180	J	K	M				DG DG	DG DG	DG DG	ES ES	ES ES	ES ES	ES ES	ES ES	FM FM	FM FM	FM FM	FM FM	FM FM	LB LB	LB LB	LB LB	LB LB	LB LB	LB LB	LB LB	GK GK		GK GK	GK GK	GK GK	GK GK	GK GK
20 pF	200	J	K	M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK		GK	GK	GK	GK	GK
22 pF	220	J	K	M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK		GK	GK	GK	GK	GK
24 pF	240	J	K	М				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK		GK	GK	GK	GK	GK
27 pF	270	J	K	M	ļ			DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK				GK	GK	GK
30 pF 33 pF	300 330	J	K	M M				DG	DG DG	DG DG	ES ES	ES ES	ES ES	ES ES	ES ES	FM FM	FM FM	FM FM	FM FM	FM FM	LB LB	LB LB	LB LB	LB LB	LB LB	LB LB	LB LB	GK GK	GK GK	GK GK	GK GK	GK GK	GK GK	GK GK
36 pF	360	J	K	M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK	GK	GK	GK	GK	GK	GK
39 pF	390	J	K	M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK	GK	GK	GK	GK	GK	GK
43 pF	430	J	K	М				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK	GK	GK	GK	GK	GK	GK
47 pF	470	J	K	M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK		GK	GK	GK	GK	GK
51 pF 56 pF	510 560	J	K	M				DG DG	DG DG	DG DG	ES ES	ES ES	ES ES	ES ES	ES ES	FM FM	FM FM	FM FM	FM FM	FM FM	LB LB	LB LB	LB LB	LB LB	LB LB	LB LB	LB LB	GK GK	GK GK	GK GK	GK GK	GK GK	GK GK	GK GK
62 pF	620	J	K	M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK		GK	GK	GK	GK	GK
68 pF	680	J	K	М				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK		_		GK	GK	GK
75 pF	750	J	K	М				DG	DG	DG	ES	ES	ES	ES	EF	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK	GK	GK	GK	GK	GK	GK
82 pF	820	J	K	M				DG	DG	DG	ES	ES	ES	ES ES	EF	FM	FM	FM	FM	FM	LB	LB LB	LB LB	LB LB	LB LB	LB LB	LB LB	GK	GK	GK	GK	GK	GK	GK
91 pF 100 pF	910 101	J	K	M				DG DG	DG DG	DG DG	ES ES	ES ES	ES ES	ES	EF EF	FM FM	FM FM	FM FM	FM FM	FM FM	LB LB	LB	LB	LB	LB	LC	LB	GK GK		GK GK	GK GK	GK GK	GK GK	GK GK
110 pF	111	J	K	M				DG	DG	DG	ES	ES	ES	ES	EU	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LC	LB	GK	GK	GK	GK	GK	GK	GK
120 pF	121	J	K	M				DG	DG	DG	ES	ES	ES	ES	EU	FM	FM	FM	FM	FM	LA	LA	LA	LA	LB	LC	LB	GG	GG	GG	GG	GG	GG	GK
130 pF	131	J	K	M				DG	DG	DG	ES	ES	ES	ES	EU	FZ	FZ	FZ	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK	GK	GK	GK	GK	GK	GK
150 pF 180 pF	151 181	J	K	M				DG DG	DG DG	DG DG	ES ES	ES ES	ES ES	EF EF	EU	FZ FZ	FZ FZ	FZ FZ	FM FM	FM FM	LB LB	LB LB	LB LB	LB LB	LB LB	LB LB	LB LB	GK GK	GK GK	GK GK	GK GK	GK GK	GK GK	GK GK
220 pF	221	J	K	M				DG	DG	DG	ES	ES	ES	EF	EF	FZ	FZ	FZ	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK	GK	_	GK	GK	GK	GK
270 pF	271	J	K	M	İ			DG	DG	DG	ES	ES	ES	EF	EF	FZ	FZ	FZ	FK	FK	LC	LC	LC	LC	LC	LC	LC	GK	GK	GK	GK	GK	GK	GK
330 pF	331	J	K	M				DG	DG	DG	ES	ES	EF	EF	EF	FZ	FZ	FZ	FK	FK	LC	LC	LC	LC	LC	LC	LC	GK	GK	GK	GK	GK	GK	GK
390 pF	391	J	K	M	ŀ			DG	DG	DG	ES	ES	EF	EF	EF	FZ	FZ	FZ	FK	FS	LB	LB	LB	LB	LB	LB	LC	GK	GK	GK	GK	GK	GK	GK
470 pF 560 pF	471 561	J	K	M M				DG DG	DG DG	DG DG	ES ES	ES ES	EF EF	EF EF	EF EF	FZ FL	FM FL	FM FL	FS FL	FS FL	LB LB	LB LB	LB LB	LB LB	LB LB	LB LB	LC	GK GH	GK GH	GK GH	GK GH	GK GH	GK GK	GK GK
680 pF	681	J	K	M				DG	DG	DG	ES	ES	EF	EF	EF	FL	FL	FL	FL	FL	LA	LA	LA	LA	LB	LC	LC	GH	GH	GH	GH	GH	GK	GK
820 pF	821	J	K	М	1			DG	DG	DG	ES	ES	ES	EF	EF	FL	FL	FL	FL	FL	LA	LA	LA	LA	LB	LC	LC	GH	GH	GH	GH	GH	GK	GK
1,000 pF	102	J	K	M	CG		CG	DG	DG	DG	ES	ES	ES	EF	EF	FL	FL	FL	FL	FL	LA	LA	LA	LA	LB	LC	LC	GH	GH	GH	GH	GH	GK	GK
1,200 pF 1,500 pF	122 152	J J	K	M	CG CG	CG		DG DG	DG DG	DG	ES	ES ES	ES	EU	EU	FL FL	FL FL	FL FL	FL FL	FM FM	LB	LB LB	LB	LB	LC	LA		GH				GH GH	GK	GK
1,800 pF	182	J	K	M	CG	UG			DG			ES	ES	EU	EU	FL	FL	FL	FL	FM	LB	LB	LB	LB	LC	LC		GH		GH				
2,200 pF	222	J	K	M	CG				DG			ES	ES	EU	EU	FL	FL	FL	FL	FM	LA	LA	LA	LB	LC	LC		GH					GK	
2,700 pF	272	J	K	М	CG					DG	ES	ES	ES	EU		FL	FL	FL	FL	FM	LA	LA	LA	LB	LC			GH	GH	GH		GK		
3,300 pF	332	J	K	M	CG					DG	_	ES	ES	EU		FL	FL	FL	FL	FM	LA	LA	LA	LB	LA			GH		GH				
3,900 pF 4,700 pF	392 472	J J	K	M	CG			DG DG	DG DG	DG DG	ES ES	ES ES	ES ES	EU		FL FL	FL FL	FL FL	FL FL	FK FK	LA	LA LA	LA LA	LB LB	LB			GH GH		GH GH		GK GH		
5,600 pF	562	J	K	M						DG	ES	EF	EF	EF		FL	FL	FL	FM	FK	LA	LB	LB	LC				GH		GH	GK			
6,800 pF	682	J	K	М	1			DG	DG		EF	EF	EF	EF		FL	FL	FL	FM	FS	LA	LB	LB	LC				GH	GH	GH	GK	GM		
8,200 pF	822	J	K	M				_	DG		EF	EU	EU	EF		FL	FL	FL	FK		LA	LB	LB	LC				GH		GH				
10,000 pF 12,000 pF	103 123	J	K	M					DG DG		EF EU	EU EJ	EU EJ	EU		FL FL	FL FL	FL FL	FK FK		LA LA	LB LC	LB LC	LC LB				GH		GH GK		GO		
12,000 μΓ	123	Rat	ted Volt	tage	200	630	1000	200	630	1000	200	630	1000	1500	2000	500	630	1000	1500	2000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
Сар	Cap	Vol	(VDC) Itage C		C	В	D	C C	В	D	C	В	D	F	G	C	В	D	F	G G	C	В	D	F	G	Z	 			Z	بة H			
·	Code	Ca	se Si Serie:	ze/	C0603X				0805				1206					1210						1808							1812			
			oer ie:	J																														



Table 1A - Capacitance Range/Selection Waterfall (0603 - 1812 Case Sizes) cont'd

		C		Siz		CO)60	3X	C	080	5X		C,	120	6X			C	1210	OX				C1	180	8X					C1	1812	2X		
Con	Cap	١v	oltag	je Co	de	С	В	D	С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	н
Сар	Code	R		Volta DC)	ige	200	630	1000	200	630	1000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
				citano rance				Pro	du	ct A	vail	abil	ity a	nd	Chi	p Tł	ick	nes	s C	ode	s - S	See	Tab	le 2	for	Chi	p T	hick	nes	s D	ime	nsi	ons		
15,000 pF	153	J		K	М				DG			EU	EJ	EJ			FL	FL	FL	FL		LA	LC	LC	LC				GH		GK				
18,000 pF	183	J		K	М				DG			EJ	EJ	EJ			FL	FL	FL	FM		LA	LE	LE					GH		GK				
22,000 pF	223	J		K	М				DG			EJ	EJ	EJ			FL	FM	FM	FM		LA	LE	LE					GH		GK				
27,000 pF	273	J		K	М				ł			EJ	EJ				FM	FK	FK	FK		LA	LA	LA					GH	GB	GB	GO			
33,000 pF	333	J		K	M							EJ	EJ				FM	FZ	FU	FS FS		LC	LA	LA					GH	GB	GB	GO			
39,000 pF 47,000 pF	393 473	J		K K	M M							EJ EJ					FK FK	FZ FU	FU FK	15		LC	LA	LA LB					GH GH	GB GB	GB GC				
47,000 pF 56,000 pF	563	J		K	M							EJ					FZ	FU	FK			LC	LA	LB					GH	GB	GE				
62,000 pF	623	J	_	r K	M							EJ					FZ	FK	FS			LA	LA	LC					GK	GB	GE				
68,000 pF	683	J		K	M							EJ					FZ	FK	FS			LA	LA	LC					GE	GE	GE				
82,000 pF	823	١		K	M							LJ					FU	FK	13			LA	LC	LC					GB	GE	GK				
0.10 µF	104	.1		K	M				ł								FK	FS				LA	LC						GB	GH	GJ				
0.10 µF	124	J		K	М												FK					LA							GE	GK	00				
0.15 µF	154	J		K	М												FK					LB							GE	GN					
0.18 µF	184	Ĵ		K	М							i																	GF	0					
0.22 µF	224	j		K	М																								GJ						
0.27 µF	274	J		ĸ	М							İ										İ							GL						
0.33 µF	334	J		K	М				İ			İ										İ							GS						
		R		Volta	ige	200	630	1000	200	630	100	200	630	100	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
Сар	Cap	v		je Co	de	С	В	D	С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	z	Н	С	В	D	F	G	z	н
	Code		ase	Siz	ze/	_	0603		H	080	_			1200	-		•		1210						1808				Ť		_	1812	_		



Table 1B – Capacitance Range/Selection Waterfall (1825 – 2225 Case Sizes)

			se Si Series				С	1825	iΧ					C	2220	X					C	2225	δX		
Canacitanas	Cap	Vo	Itage Co	ode	С	В	D	F	G	z	Н	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н
Capacitance	Code	Rated	Voltage	(VDC)	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
			apacitan Foleranc	e	Pro	duct		ilabi	lity a	nd C	hip 1	Thick	ness	Coc	des -	See	Tabl	e 2 f	or Cl	nip T	hickı	ness	Dim	ensi	ons
470 pF	471	J	K	М	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK							
560 pF	561	J	K	M	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK							
680 pF	681	J	K	M	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
820 pF	821	J	K	M	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
1,000 pF	102	J	K	M	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
1,200 pF	122	J	K	M	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
1,500 pF	152	J	K	M	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
1,800 pF	182	J	K	M	HE	HE	HE	HE	HE	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
2,200 pF	222	J	K	M	HE	HE	HE	HE	HE	HG	HG	JE	JE	JE	JE	JE	JK	JK	KF	KF	KF	KF	KF	KF	KF
2,700 pF	272	J	K	M	HE	HE	HE	HE	HE	HG	HG	JE	JE	JE	JE	JE	JK	JK	KE	KE	KE	KE	KE	KF	KE
3,300 pF	332	J	K	M	HE	HE	HE	HE	HE	HG	HG	JE	JE	JE	JE	JE	JK	JE	KE	KE	KE	KE	KE	KF	KE
3,900 pF	392	J	K	M	HE	HE	HE	HE	HE	HG		JE	JE	JE	JE	JE	JK	JE	KE	KE	KE	KE	KE	KF	KE
4,700 pF	472	J	K	M	HE	HE	HE	HE	HE	HG		JE	JE	JE	JE	JK	JE	JE	KE	KE	KE	KE	KE	KF	KE
5,600 pF	562	J	K	M	HE	HE	HE	HE	HE	HG		JE	JE	JE	JE	JK	JE	JE	KE	KE	KE	KE	KE	KF	KE
6,800 pF	682	J	K	M	HE	HE	HE	HE	HE	HJ		JE	JE	JE	JE	JK	JE	JE	KE	KE	KE	KE	KF	KE	KE
8,200 pF	822	J	K	M	HE	HE	HE	HE	HE	HJ		JE	JE	JE	JE	JK	JK	JK	KE	KE	KE	KE	KF	KF	KF
10,000 pF	103	J	K	M	HE	HE	HE	HE	HJ	HK		JE	JE	JE	JE	JL	JL	JL	KE	KE	KE	KE	KF	KH	KH
12,000 pF	123	J	K	M	HE	HE	HE	HG	HJ			JE	JK	JK	JK	JL	JL	JL	KE	KE	KE	KE	KF	KH	KH
15,000 pF	153	J	K	M	HE	HE	HE	HG	HK			JE	JK	JK	JK	JN	JN	JN	KE	KE	KE	KE	KF	KJ	KJ
18,000 pF	183	J	K	M	HE	HE	HE	HG				JE	JK	JK	JK	JN			KE	KE	KE	KE	KH		
22,000 pF	223	J	K	M	HE	HG	HG	HG				JE	JK	JK	JK	JN			KE	KF	KF	KF	KJ		
27,000 pF	273	J	K	M	HE	HG	HG	HG				JE	JK	JK	JK				KE	KF	KF	KF	KJ		
33,000 pF	333	J	K	M	HE	HG	HG	HE				JE	JK	JK	JK				KE	KF	KF	KF			
39,000 pF	393	J	K	M	HE	HG	HG	HG				JE	JK	JK	JE				KE	KF	KF	KF			
47,000 pF	473	J	K	M	HE	HG	HG	HJ				JE	JK	JK	JK				KE	KF	KF	KF			
56,000 pF	563	J	K	M	HE	HG	HG	HJ				JE	JE	JE	JL				KE	KF	KF	KF			
62,000 pF	623	J	K	M	HG	HG	HG	HK				JE	JE	JE	JL				KF	KF	KF	KH			
68,000 pF	683	J	K	M	HG	HJ	HJ	HK				JE	JK	JK	JL				KE	KF	KF	KJ			
82,000 pF	823	J	K	M	HG	HJ	HJ					JE	JL	JL	JN				KE	KF	KF	KJ			
0.10 µF	104	J	K	M	HG	HK	HK					JE	JN	JN					KE	KH	KH	KJ			
0.12 µF	124	J	K	M	HG	HE						JE	JN	JN					KE	KH	KH				
0.15 µF	154	J	K	M	HG	HE						JK	JE						KF	KJ	KJ				
0.18 µF	184	J	K	M	HG	HG						JK	JE						KF	KE					
0.22 µF	224	J	K	M	HG	HJ						JK	JK						KF	KF					
0.27 µF	274	J	K	M	HJ	HJ						JK	JL						KF	KH					
0.33 μF	334	J	K	M	HJ							JL	JN						KF	KH					
0.39 µF	394	J	K	M	HK							JN							KH	KJ					
0.47 µF	474	J	K	M								JN							KH	KJ					
0.56 μF	564	J	K	М															KJ						
		Rated Voltage (VDC)			200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
Capacitance	Cap Code		Voltage Code			В	D	F	G	Z	Н	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н
			se Si Series				С	1825	X					С	2220	X					С	2225	X		



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

			Daman O		Disatis (D
Thickness	Case	Thickness ±	Paper Q	uantity ¹	Plastic (Juantity
Code	Size ¹	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
CG	0603	0.80 ± 0.10	4,000	15,000	0	0
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
ES	1206	1.00 ± 0.20	0	0	2,500	10,000
EF	1206	1.20 ± 0.15	0	0	2,500	10,000
EU	1206	1.60 ± 0.25	0	0	2,000	8,000
EJ	1206	1.70 ± 0.20	0	0	2,000	8,000
FZ	1210	1.25 ± 0.20	0	0	2,500	10,000
FL	1210	1.40 ± 0.15	0	0	2,000	8,000
FU	1210	1.55 ± 0.20	0	0	2,000	8,000
FM	1210	1.70 ± 0.20	0	0	2,000	8,000
FK	1210	2.10 ± 0.20	0	0	2,000	8,000
FS	1210	2.50 ± 0.30	0	0	1,000	4,000
LE	1808	1.00 ± 0.10	0	0	2,500	10,000
LA	1808	1.40 ± 0.15	0	0	1,000	4,000
LB	1808	1.60 ± 0.15	0	0	1,000	4,000
LC	1808	2.00 ± 0.15	0	0	1,000	4,000
GB	1812	1.00 ± 0.10	0	0	1,000	4,000
GC	1812	1.10 ± 0.10	0	0	1,000	4,000
GE	1812	1.30 ± 0.10	0	0	1,000	4,000
GH	1812	1.40 ± 0.15	0	0	1,000	4,000
GF	1812	1.50 ± 0.10	0	0	1,000	4,000
GG	1812	1.55 ± 0.10	0	0	1,000	4,000
GK	1812	1.60 ± 0.20	0	0	1,000	4,000
GJ	1812	1.70 ± 0.15	0	0	1,000	4,000
GN	1812	1.70 ± 0.20	0	0	1,000	4,000
GL	1812	1.90 ± 0.20	0	0	500	2,000
GM	1812	2.00 ± 0.20	0	0	500	2,000
GS	1812	2.10 ± 0.20	0	0	500	2,000
GO	1812	2.50 ± 0.20	0	0	500	2,000
HE	1825	1.40 ± 0.15	0	0	1,000	4,000
HG	1825	1.60 ± 0.20	0	_	1,000	4,000
HJ HK	1825	2.00 ± 0.20	0	0 0	500	2,000
JE	1825 2220	2.50 ± 0.20	0 0	0	500 1,000	2,000
JE JK	2220	1.40 ± 0.15	0	0		4,000 4,000
JK JL	2220	1.60 ± 0.20 2.00 ± 0.20		0	1,000 500	
JN JN	2220	2.50 ± 0.20 2.50 ± 0.20	0 0	0	500	2,000 2,000
KE	2220	2.50 ± 0.20 1.40 ± 0.15	0	0	1,000	4,000
KF	2225	1.40 ± 0.15 1.60 ± 0.20	0	0	1,000	4,000
KH	2225	2.00 ± 0.20	0	0	500	2,000
KJ	2225	2.50 ± 0.20 2.50 ± 0.20	0	0	500	2,000
			7" Reel	13" Reel	7" Reel	13" Reel
Thickness Code	Case Size ¹	Thickness ± Range (mm)		uantity ¹		Quantity
					1	

Package quantity based on finished chip thickness specifications.

¹ If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Table 2B - Bulk Packaging Quantities

Deale		Loose P	ackaging
Раска(ging Type	Bulk Bag	g (default)
Packagi	ing C-Spec ¹	N.	/A ²
Cas	se Size	Packaging Quantities	(pieces/unit packaging)
EIA (in)	Metric (mm)	Minimum	Maximum
0402	1005		
0603	1608		
0805	2012		50,000
1206	3216		
1210	3225	1	
1808	4520		
1812	4532		
1825	4564		20,000
2220	5650		
2225	5664		

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

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



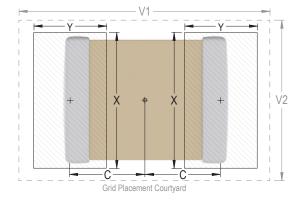
Table 3 - Chip Capacitor Land Pattern Design Recommendations per IPC-7351

EIA Size Code	Metric Size Code	I	Maxi	sity Lev mum (M rotrusio)	ı	Media	sity Lev an (Nor rotrusio)		Mini	sity Lev mum (L rotrusio)
Code	Code	C	Y	Х	V1	V2	С	Υ	Х	V1	V2	С	Υ	Х	V1	V2
0603	1608	0.85	1.25	1.10	4.00	2.10	0.75	1.05	1.00	3.10	1.50	0.65	0.85	0.90	2.40	1.20
0805	2012	0.99	1.44	1.66	4.47	2.71	0.89	1.24	1.56	3.57	2.11	0.79	1.04	1.46	2.42	1.81
1206	3216	1.59	1.62	2.06	5.85	3.06	1.49	1.42	1.96	4.95	2.46	1.39	1.22	1.86	4.25	2.16
1210	3225	1.59	1.62	3.01	5.90	4.01	1.49	1.42	2.91	4.95	3.41	1.39	1.22	2.81	4.25	3.11
1808	4520	2.30	1.75	2.30	7.40	3.30	2.20	1.55	2.20	6.50	2.70	2.10	1.35	2.10	5.80	2.40
1812	4532	2.10	1.80	3.60	7.00	4.60	2.00	1.60	3.50	6.10	4.00	1.90	1.40	3.40	5.40	3.70
1825	4564	2.15	1.80	6.90	7.10	7.90	2.05	1.60	6.80	6.20	7.30	1.95	1.40	6.70	5.50	7.00
2220	5650	2.85	2.10	5.50	8.80	6.50	2.75	1.90	5.40	7.90	5.90	2.65	1.70	5.30	7.20	5.60
2225	5664	2.85	2.10	6.90	8.80	7.90	2.75	1.90	6.80	7.90	7.30	2.65	1.70	6.70	7.20	7.00

Density Level A: For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes. KEMET only recommends wave soldering of EIA 0603, 0805 and 1206 case sizes.

Density Level B: For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes. **Density Level C:** For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC Standard 7351 (IPC–7351).

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





Soldering Process

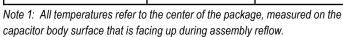
Recommended Soldering Technique:

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

Recommended Reflow Soldering Profile:

KEMET's families of surface mount multilayer ceramic capacitors (SMD MLCCs) are compatible with wave (single or dual), convection, IR or vapor phase reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET's recommended profile conditions for convection and IR reflow reflect the profile conditions of the IPC/J-STD-020 standard for moisture sensitivity testing. These devices can safely withstand a maximum of three reflow passes at these conditions.

Profile Feature	Termination Finish						
Frome reature	SnPb	100% Matte Sn					
Preheat/Soak							
Temperature Minimum (T _{Smin})	100°C	150°C					
Temperature Maximum (T _{Smax})	150°C	200°C					
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds					
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum					
Liquidous Temperature (T _L)	183°C	217°C					
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds					
Peak Temperature (T _P)	235°C	260°C					
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum					
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum					
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum					



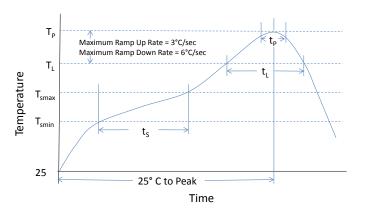




Table 4 – Performance & Reliability: Test Methods and Conditions

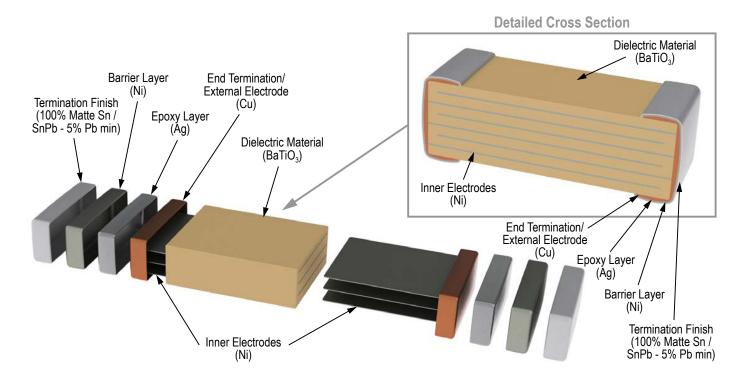
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Solderability	J-STD-002	a) Method B, 4 hours at 155°C, dry heat at 235°C
Solderability	J-31D-002	b) Method B at 215°C category 3
		c) Method D, category 3 at 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Diggod Humidity	MIL-STD-202 Method 103	Load Humidity: 1,000 hours 85°C/85% RH and 200 VDC maximum. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Metriod 103	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 1.2 X rated voltage applied.
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 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



ArcShield™ Technology, High Voltage, X7R Dielectric, 500 – 1,000 VDC (Commercial & Automotive Grade)



Overview

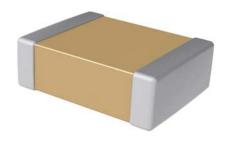
KEMET ArcShield high voltage surface mount capacitors in X7R dielectric are designed for use in high voltage applications susceptible to surface arcing (arc-over discharge).

The phenomenon of surface arcing is caused by a high voltage gradient between the two termination surfaces or between one of the termination surfaces and the counter internal electrode structure within the ceramic body. It occurs most frequently at application voltages that meet or exceed 300 V, in high humidity environments, and in chip sizes with minimal bandwidth separation (creepage distance). This phenomenon can either damage surrounding components or lead to a breakdown of the dielectric material, ultimately resulting in a short-circuit condition (catastrophic failure mode).

Patented ArcShield technology features KEMET's highly reliable base metal dielectric system combined with a unique internal shield electrode structure that is designed to suppress an arc-over event while increasing available capacitance. Developed on the principle of a partial Faraday cage, this internal system offers unrivaled performance and reliability when compared to external surface coating technologies.

For added reliability, KEMET's Flexible Termination technology is an available option that provides superior flex performance over standard termination systems. This technology was developed to address flex cracks, which are the primary failure mode of MLCCs and typically the result of excessive tensile and shear stresses produced during board flexure and thermal cycling. Flexible Termination technology inhibits the transfer of board stress to the rigid body of the MLCC, therefore mitigating flex cracks which can result in low IR or short circuit failures.

KEMET's ArcShield high voltage surface mount MLCCs are available in Automotive Grade, which undergo stricter testing protocol and inspection criteria. Whether under-hood or incabin, these devices are designed for mission and safety-critical automotive circuits or applications requiring proven, reliable performance in harsh environments. Automotive Grade devices meet the demanding Automotive Electronics Council's AEC-Q200 qualification requirements.



Ordering Information

С	0603	W	392	K	С	R	Α	С	TU	
Cerami	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/ Grade (C-Spec) ²	
	0603 0805 1206 1210 1808 1812 1825 2220 2225	V = ArcShield W = ArcShield with Flexible Termination	Two significant digits + number of zeros.	J = ±5% K = ±10% M = ±20%	C = 500 B = 630 D = 1,000	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% PB minimum)	See "Packaging C-Spec Ordering Options Table" below	

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

^{1, 2} SnPb termination finish option is not available on Automotive Grade product.

² Additional reeling or packaging options may be available. Contact KEMET for details.



Packaging C-Spec Ordering Options Table

Packaging Type	Packaging/Grade Ordering Code (C-Spec)
Commerc	cial Grade ¹
Bulk Bag	Not Required (Blank)
7" Reel/Unmarked	TU
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
7" Reel/Marked	TM
13" Reel/Marked	7040 (EIA 0603 and smaller case sizes) 7215 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2 mm pitch ²	7081
13" Reel/Unmarked/2 mm pitch ²	7082
Automot	ive Grade ³
7" Reel	AUTO
13" Reel/Unmarked	AUTO7411 (EIA 0603 and smaller case sizes) AUTO7210 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2 mm pitch ²	3190
13" Reel/Unmarked/2 mm pitch ²	3191

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- · Patented technology
- · Permanent internal arc protection
- Protective surface coating not required
- · Base metal electrode (BME) dielectric system
- Industry leading CV values
- -55°C to +125°C operating temperature range
- Exceptional performance at high frequencies
- · Lead (Pb)-Free, RoHS and REACH compliant
- EIA 0603, 0805, 1206, 1210, 1808, 1812, 1825, 2220 and 2225 case sizes
- DC voltage ratings of 500 V, 630 V and 1 KV

- Capacitance offerings ranging from 1,000 pF to 560 nF
- Available capacitance tolerances of ±5%, ±10% and ±20%
- Low ESR & ESL
- · Non-polar device, minimizing installation concerns
- Commercial & Automotive (AEC-Q200) grades available
- 100% pure matte tin-plated termination finish allowing for excellent solderability
- SnPb plated termination finish option available upon request (5% Pb minimum)
- · Flexible Termination option available upon request

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked.

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".

³ Reeling tape options (Paper or Plastic) are dependent on capacitor case size (L" x W") and thickness dimension. See "Chip Thickness/Tape & Reel Packaging Quantities" and "Tape & Reel Packaging Information".

³ For additional Information regarding "AUTO" C-Spec options, see "Automotive C-Spec Information".

³ All Automotive packaging C-Specs listed exclude the option to laser mark components. Please contact KEMET if you require a laser marked option. For more information see "Capacitor Marking".



Automotive C-Spec Information

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

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

Product Change Notification (PCN)

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

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

KEMET Automotive	Customer Noti	fication due to:	Days prior to		
C-Spec	Process/Product change	Obsolescence*	implementation		
KEMET assigned ¹	Yes (with approval and sign off)	Yes	180 days Minimum		
AUTO	Yes (without approval)	Yes	90 days Minimum		

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

Production Part Approval Process (PPAP)

The purpose of the Production Part Approval Process is:

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

KEMET Automotive	PPAP (Product Part Approval Process) Level												
C-Spec	1	2	3	4	5								
KEMET assigned ¹	•	•	•	•	•								
AUTO	0		0										

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

- Part Number specific PPAP available
- Product family PPAP only



Applications

Typical applications include switch mode power supplies (input filters, resonators, tank circuits, snubber circuits, output filters), high voltage coupling and DC blocking, lighting ballasts, voltage multiplier circuits, DC/DC converters and coupling capacitors in Ćuk converters. Markets include power supply, LCD fluorescent backlight ballasts, HID lighting, telecom equipment, industrial and medical equipment/control, LAN/ WAN interface, analog and digital modems, and automotive (electric and hybrid vehicles, charging stations and lighting) applications.

Application Notes

X7R dielectric is not recommended for AC line filtering or pulse applications.

Qualification/Certification

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

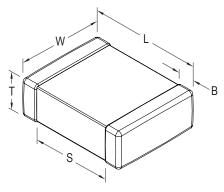
Automotive Grade products meet or exceed the requirements outlined by the Automotive Electronics Council. Details regarding test methods and conditions are referenced in document AEC-Q200, Stress Test Qualification for Passive Components. For additional information regarding the Automotive Electronics Council and AEC-Q200, please visit their website at www.aecouncil.com.

Environmental Compliance

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



Dimensions – Millimeters (Inches) – Standard Termination



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

Dimensions – Millimeters (Inches) – Flexible Termination

EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique	
0603	1608	1.60 (.064) ± 0.17 (.007)	0.80 (.032) ± 0.15 (.006)		0.45 (.018) ± 0.15 (.006)	0.58 (.023)		
0805	2012	2.00 (.079) ± 0.30 (.012)	1.25 (.049) ± 0.30 (.012)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	Solder Wave or Solder Reflow	
1206	3216	3.30 (.130) ± 0.40 (.016)	1.60 (.063) ± 0.35 (.013)		0.60 (.024) ± 0.25 (.010)			
1210	3225	3.30 (.130) ± 0.40 (.016)	2.60 (.102) ± 0.30 (.012)	See Table 2 for Thickness	0.60 (.024) ± 0.25 (.010)	N/A		
1808	4520	4.70 (.185) ± 0.50 (.020)	2.00 (.079) ± 0.20 (.008)		0.70 (.028) ± 0.35 (.014)			
1812	4532	4.50 (.178) ± 0.40 (.016)	3.20 (.126) ± 0.30 (.012)		0.70 (.028) ± 0.35 (.014)			
1825	4564	4.60 (.181) ± 0.40 (.016)	6.40 (.252) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)		Solder Reflow Only	
2220	5650	5.90 (.232) ± 0.75 (.030)	5.00 (.197) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)			
2225	5664	5.90 (.232) ± 0.75 (.030)	6.40 (.248) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)			



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%						
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%						
² Dielectric Withstanding Voltage (DWV)	150% of rated voltage for voltage rating of < 1000V 120% of rated voltage for voltage rating of ≥ 1000V (5 ± 1 seconds and charge/discharge not exceeding 50mA)						
³ Dissipation Factor (DF) Maximum Limit @ 25°C	2.5%						
⁴Insulation Resistance (IR) Minimum Limit @ 25°C	100 megohm microfarads or 10GΩ (500VDC applied for 120 ± 5 secs @ 25°C)						

Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

 $1kHz \pm 50Hz$ and 1.0 ± 0.2 Vrms if capacitance ≤ $10\mu F$

120Hz \pm 10Hz 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 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

Post Environmental Limits

	High Temperature Life, Biased Humidity, Moisture Resistance												
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance								
	> 25		3.0										
X7R	16/25	All	5.0	±20%	10% of Initial Limit								
	< 16		7.5										

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

⁴To obtain IR limit, divide MΩ- μ F value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



Table 1 – Capacitance Range/Selection Waterfall (0603 – 1812 Case Sizes)

			se S erie	ize/	CO	603V	N/V	COS	305V	N/V	C12	206V	V/V	C12	210V	V/V	C18	308V	N/V	C18	812V	N/V	C182	5W/V	C222	0W/V	C222	5W/V
Сар	Cap	Vol	tage C	ode	С	В	D	С	В	D	С	В	D	С	В	D	С	В	D	С	В	D	С	В	С	В	С	В
Oup	Code		ed Vol		500	630	1000	500	630	1000	500	630	1000	500	630	1000	500	630	1000	500	630	1000	500	630	500	630	500	630
			oacita	-		l							Prod	luct	Δva	ilahi	litv	and	Chi	n Th	ickn	ess	Codes		ļ			
			oleran																				ions					
1,000 pF	102	J	K	М	CG	CG	CG																					
1,200 pF	122	J	K	M	CG	CG																						
1,500 pF	152 182	J	K	M	CG CG	CG																						
1,800 pF 2,200 pF	222	J	K	M	CG			DG	DG	DG																		
2,200 pf	272	J	K	M	CG			DG	DG	DG																		
3,300 pF	332	J	K	M	CG			DG	DG	DG										i								
3,900 pF	392	J	K	M	CG			DG	DG	DG																		
4,700 pF	472	J	K	M				DG	DG	DG																		j
5,600 pF	562	J	K	M				DG	DG																			
6,800 pF	682	J	K	M				DG	DG																			
8,200 pF	822	J	K	M				DG	DG																			
10,000 pF 12,000 pF	103 123	J	K K	M				DG DG	DG DG		EJ	EJ	EJ															
15,000 pF	153	J	K	M	ł			DG	DG		EJ	EJ	EJ	ł														
18,000 pF	183	J	K	M				DG			EJ	EJ	EJ				LE	LE	LE									
22,000 pF	223	J	K	M	l			DG			EJ	EJ	EJ	FZ	FZ	FZ	LE	LE	LE	i								
27,000 pF	273	J	K	M	İ						EJ	EJ		FZ	FZ	FZ	LA	LA	LA	GB	GB	GB			İ			
33,000 pF	333	J	K	М	İ						EJ	EJ		FZ	FZ	FU	LA	LA	LA	GB	GB	GB						
39,000 pF	393	J	K	M							EJ			FZ	FZ	FU	LA	LA	LA	GB	GB	GB						
47,000 pF	473	J	K	M							EJ			FZ	FU	FK	LA	LA	LB	GB	GB	GC						
56,000 pF	563	J	K	M							EJ			FZ	FU	FK	LA	LA	LB	GB	GB	GE						
62,000 pF	623	J	K	M							EJ			FZ	FK	FS FS	LA	LA	LC	GB GE	GB GE	GE GE						
68,000 pF 82,000 pF	683 823	J	K	M M							EJ			FZ FU	FK FK	15	LA LA	LA LC	LC	GB	GE	GE						
0.10 µF	104	J	K	M										FK	FS		LA	LC		GB	GH	GJ						
0.10 µF	124	J	K	M	l									FK	. 0		LA	-0		GE	GK	30	HE	HE				
0.15 µF	154	J	K	M	l						l			FK			LB			GE	GN		HE	HE	JE	JE		
0.18 µF	184	J	K	М	l						ĺ									GF			HE	HG	JE	JE	KF	KE
0.22 µF	224	J	K	М																GJ			HE	HJ	JK	JK	KE	KF
0.27 µF	274	J	K	М																GL			HJ	HJ	JK	JL	KF	KH
0.33 µF	334	J	K	M																GS			HJ		JL	JN	KF	KH
0.39 µF	394	J	K	M																			HK		JN		KH	KJ
0.47 μF 0.56 μF	474 564	J	K	M M																ł					JN		KH KJ	KJ
υ.συ μΓ	JU4	-	ed Vol																									
			(VDC		500	630	1000	500	630	1000	500	630	1000	500	630	1000	500	630	1000	500	630	1000	500	630	500	630	500	630
Cap	Cap Code	Vol	tage C	ode	С	В	D	С	В	D	С	В	D	С	В	D	С	В	D	С	В	D	С	В	С	В	С	В
	Code	Ca	se S	ize/	CO	603V	N/V	CO	305V	N/V	C11	206V	V/V	C11	210V	V/V	C11	808V	N/V	C1	812V	N/V	C182	5W/V	C222	ow/v	C222	5W/V
			<u>erie</u>	S	_ 55					., v			J, V			-, •			., v		J . Z V	J, ¥	0.102					· · · · · ·

These products are protected under US Patent 8,885,319 B2, other patents pending, and any foreign counterparts.



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

Thickness	Case	Thickness ±	Paper Q	uantity ¹	Plastic (Quantity		
Code	Size ¹	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel		
CG	0603	0.80 ± 0.10	4,000	15,000	0	0		
DG	0805	1.25 ± 0.15	0	0	2,500	10,000		
EJ	1206	1.70 ± 0.20	0	0	2,000	8,000		
FZ	1210	1.25 ± 0.20	0	0	2,500	10,000		
FU	1210	1.55 ± 0.20	0	0	2,000	8,000		
FK	1210	2.10 ± 0.20	0	0	2,000	8,000		
FS	1210	2.50 ± 0.30	0	0	1,000	4,000		
LE	1808	1.00 ± 0.10	0	0	2,500	10,000		
LA	1808	1.40 ± 0.15	0	0	1,000	4.000		
LB	1808	1.60 ± 0.15	0	0	1,000	4,000		
LC	1808	2.00 ± 0.15	0	0	1,000	4,000		
GB	1812	1.00 ± 0.10	0	0	1,000	4,000		
GE	1812	1.30 ± 0.10	0	0	1,000	4,000		
GC	1812	1.10 ± 0.10	0	0	1,000	4,000		
GH	1812	1.40 ± 0.15	0	0	1,000	4,000		
GF	1812	1.50 ± 0.10	0	0	1,000	4,000		
GK	1812	1.60 ± 0.20	0	0	1,000	4,000		
GJ	1812	1.70 ± 0.15	0	0	1,000	4,000		
GN	1812	1.70 ± 0.20	0	0	1,000	4,000		
GL	1812	1.90 ± 0.20	0	0	500	2,000		
GS	1812	2.10 ± 0.20	0	0	500	2,000		
HE HE	1825	1.40 ± 0.15	0	0	1,000	4,000		
HG	1825	1.60 ± 0.20	0	0	1,000	4,000		
HJ	1825	2.00 ± 0.20	0	0	500	2,000		
HK	1825	2.50 ± 0.20	0	0	500	2,000		
JE	2220	1.40 ± 0.15	0	0	1,000	4,000		
JK	2220	1.60 ± 0.20	0	0	1,000	4,000		
JL	2220	2.00 ± 0.20	0	0	500	2,000		
JN	2220	2.50 ± 0.20	0	0	500	2,000		
KE	2225	1.40 ± 0.15	0	0	1,000	4,000		
KF	2225	1.60 ± 0.20	0	0	1,000	4,000		
KH	2225	2.00 ± 0.20	0	0	500	2,000		
KJ	2225	2.50 ± 0.20	0	0	500	2,000		
Thickness	Case	Thickness ±	7" Reel	13" Reel	7" Reel 13" Reel			
Code	Size ¹	Range (mm)	Paper Q	uantity¹	Plastic (Quantity		

Package quantity based on finished chip thickness specifications.

¹ If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Table 2B - Bulk Packaging Quantities

Dooloo	ulu u Tuu o	Loose Packaging							
Раска	ging Type	Bulk Bag (default)							
Packagi	ng C-Spec ¹	N/A ²							
Cas	e Size	Packaging Quantities (pieces/unit packaging)							
EIA (in)	Metric (mm)	Minimum	Maximum						
0402	1005								
0603	1608								
0805	2012		50,000						
1206	3216								
1210	3225	1							
1808	4520								
1812	4532								
1825	4564		20,000						
2220	5650								
2225	5664								

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

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



Table 3A – Land Pattern Design Recommendations per IPC-7351 – Standard Termination

EIA Metric Size Size Code Code	Size	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	Х	V1	V2	С	Υ	X	V1	V2	
0603	1608	0.90	1.15	1.10	4.00	2.10	0.80	0.95	1.00	3.10	1.50	0.60	0.75	0.90	2.40	1.20
0805	2012	1.00	1.35	1.55	4.40	2.60	0.90	1.15	1.45	3.50	2.00	0.75	1.50	1.35	2.80	1.70
1206	3216	1.60	1.35	1.90	5.60	2.90	1.50	1.15	1.80	4.70	2.30	1.40	0.95	1.70	4.00	2.00
1210	3225	1.60	1.35	2.80	5.65	3.80	1.50	1.15	2.70	4.70	3.20	1.40	0.95	2.60	4.00	2.90
1808	4520	2.30	1.75	2.30	7.40	3.30	2.20	1.55	2.20	6.50	2.70	2.10	1.35	2.10	5.80	2.40
1812	4532	2.15	1.60	3.60	6.90	4.60	2.05	1.40	3.50	6.00	4.00	1.95	1.20	3.40	5.30	3.70
1825	4564	2.15	1.60	6.90	6.90	7.90	2.05	1.40	6.80	6.00	7.30	1.95	1.20	6.70	5.30	7.00
2220	5650	2.75	1.70	5.50	8.20	6.50	2.65	1.50	5.40	7.30	5.90	2.55	1.30	5.30	6.60	5.60
2225	5664	2.70	1.70	6.90	8.10	7.90	2.60	1.50	6.80	7.20	7.30	2.50	1.30	6.70	6.50	7.00

Density Level A: For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes. KEMET only recommends wave soldering of EIA 0603, 0805 and 1206 case sizes.

Density Level B: For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes. **Density Level C:** For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC Standard 7351 (IPC–7351).

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

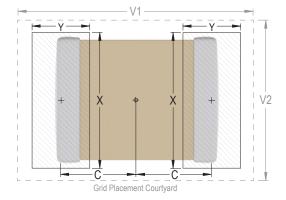




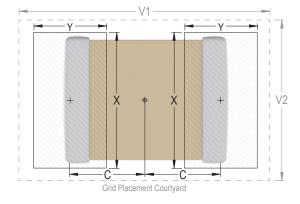
Table 3B – Land Pattern Design Recommendations per IPC-7351 – Flexible Termination

EIA Metric Size Size Code Code	Size	Density Level A: Maximum (Most) Land Protrusion (mm)					I	Media	sity Lev an (Nor rotrusio			Density Level C: Minimum (Least) Land Protrusion (mm)					
	С	Υ	Х	V1	V2	С	Υ	Х	V1	V2	С	Υ	Х	V1	V2		
0603	1608	0.85	1.25	1.10	4.00	2.10	0.75	1.05	1.00	3.10	1.50	0.65	0.85	0.90	2.40	1.20	
0805	2012	0.99	1.44	1.66	4.47	2.71	0.89	1.24	1.56	3.57	2.11	0.79	1.04	1.46	2.42	1.81	
1206	3216	1.59	1.62	2.06	5.85	3.06	1.49	1.42	1.96	4.95	2.46	1.39	1.22	1.86	4.25	2.16	
1210	3225	1.59	1.62	3.01	5.90	4.01	1.49	1.42	2.91	4.95	3.41	1.39	1.22	2.81	4.25	3.11	
1808	4520	2.30	1.75	2.30	7.40	3.30	2.20	1.55	2.20	6.50	2.70	2.10	1.35	2.10	5.80	2.40	
1812	4532	2.10	1.80	3.60	7.00	4.60	2.00	1.60	3.50	6.10	4.00	1.90	1.40	3.40	5.40	3.70	
1825	4564	2.15	1.80	6.90	7.10	7.90	2.05	1.60	6.80	6.20	7.30	1.95	1.40	6.70	5.50	7.00	
2220	5650	2.85	2.10	5.50	8.80	6.50	2.75	1.90	5.40	7.90	5.90	2.65	1.70	5.30	7.20	5.60	
2225	5664	2.85	2.10	6.90	8.80	7.90	2.75	1.90	6.80	7.90	7.30	2.65	1.70	6.70	7.20	7.00	

Density Level A: For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes. KEMET only recommends wave soldering of EIA 0603, 0805 and 1206 case sizes.

Density Level B: For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes. **Density Level C:** For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC Standard 7351 (IPC–7351).

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





Soldering Process

Recommended Soldering Technique:

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

Recommended Reflow Soldering Profile:

KEMET's families of surface mount multilayer ceramic capacitors (SMD MLCCs) are compatible with wave (single or dual), convection, IR or vapor phase reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET's recommended profile conditions for convection and IR reflow reflect the profile conditions of the IPC/J-STD-020 standard for moisture sensitivity testing. These devices can safely withstand a maximum of three reflow passes at these conditions.

Profile Feature	Terminati	on Finish		
Profile realure	SnPb	100% Matte Sn		
Preheat/Soak				
Temperature Minimum (T _{Smin})	100°C	150°C		
Temperature Maximum (T _{Smax})	150°C	200°C		
Time (t_S) from T_{Smin} to T_{Smax}	60 – 120 seconds	60 – 120 seconds		
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum		
Liquidous Temperature (T _L)	183°C	217°C		
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds		
Peak Temperature (T _P)	235°C	260°C		
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum		
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum		
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum		

Note 1: All temperatures refer to the center of the package, measured on the capacitor body surface that is facing up during assembly reflow.

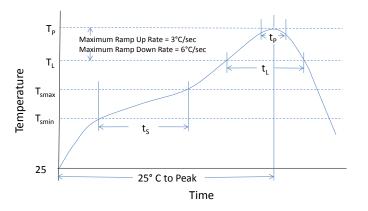




Table 4 – Performance & Reliability: Test Methods and Conditions

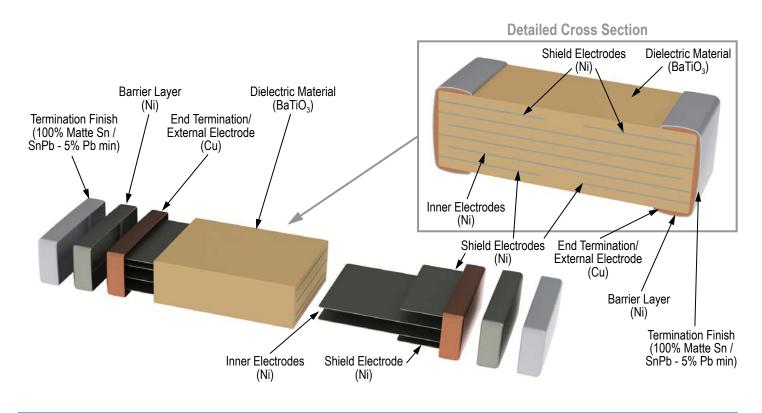
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Solderability	J-STD-002	a) Method B, 4 hours at 155°C, dry heat at 235°C
Solderability	J-31D-002	b) Method B at 215°C category 3
		c) Method D, category 3 at 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Diggod Humidity	MIL-STD-202 Method 103	Load Humidity: 1,000 hours 85°C/85% RH and 200 VDC maximum. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Metriod 103	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 1.2 X rated voltage applied.
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 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage & Handling

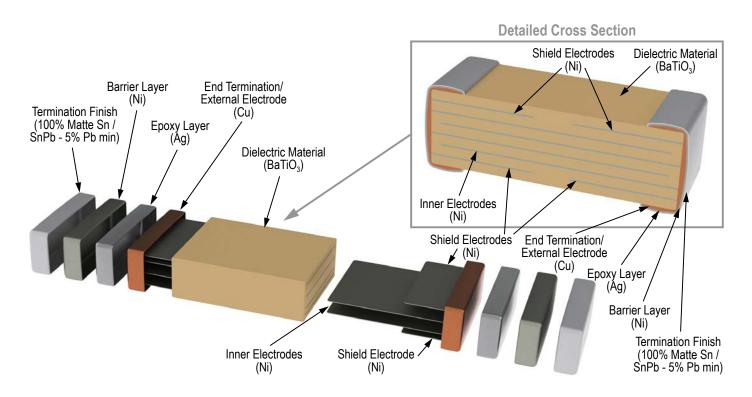
Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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 – Standard Termination



Construction – Flexible Termination



KPS Series, X7R Dielectric, 10 – 250 VDC (Commercial Grade)



Overview

KEMET Power Solutions (KPS) Commercial Series stacked capacitors utilize a proprietary lead-frame technology to vertically stack one or two multilayer ceramic chip capacitors into a single compact surface mount package. The attached lead-frame mechanically isolates the capacitor/s from the printed circuit board, therefore offering advanced mechanical and thermal stress performance. Isolation also addresses concerns for audible, microphonic noise that may occur when a bias voltage is applied. A two chip stack offers up to double the capacitance in the same or smaller design footprint when compared to traditional surface mount MLCCs devices. Providing up to 10 mm

of board flex capability, KPS Series capacitors are environmentally friendly and in compliance with RoHS legislation. Available in X7R dielectric, these devices are capable of Pb-Free reflow profiles and provide lower ESR, ESL and higher ripple current capability when compared to other dielectric solutions.

Combined with the stability of an X7R dielectric, KEMET's KPS Series devices exhibit a predictable change in capacitance with respect to time and voltage and boast 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
- Reliable and robust termination system
- EIA 1210, 1812, and 2220 case sizes
- DC voltage ratings of 10 V, 16 V, 25 V, 50 V, 100 V, and 250 V
- Capacitance offerings ranging from 0.1 μF up to 47 μF
- Available capacitance tolerances of ±10% and ±20%
- · Higher capacitance in the same footprint
- · Potential board space savings
- · Advanced protection against thermal and mechanical stress
- · Provides up to 10 mm of board flex capability
- · Reduces audible, microphonic noise
- · Extremely low ESR and ESL



Ordering Information

С	2220	С	106	M	5	R	2	С	7186
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance ¹	Rated Voltage (VDC)	Dielectric	Failure Rate/Design	Leadframe Finish ²	Packaging/Grade (C-Spec)
	1210 1812 2220	C = Standard	Two significant digits + number of zeros	K = ±10% M = ±20%	8 = 10 4 = 16 3 = 25 5 = 50 1 = 100 A = 250	R = X7R	1 = KPS Single Chip Stack 2 = KPS Double Chip Stack	C = 100% Matte Sn	See "Packaging C-Spec Ordering Options Table" below

¹ Double chip stacks ("2" in the 13th character position of the ordering code) are only available in M (±20%) capacitance tolerance. Single chip stacks ("1" in the 13th character position of the ordering code) are available in K (±10%) or M (±20%) tolerances.

² Additional leadframe finish options may be available. Contact KEMET for details.



Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec) ²
7" Reel (Embossed Plastic Tape) / Unmarked	7186
13" Reel (Embossed Plastic Tape) / Unmarked	7289

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. The option to laser mark is not available on these devices. For more information see "Capacitor Marking".

Benefits cont'd

- · Lead (Pb)-Free, RoHS and REACH compliant
- Capable of Pb-Free reflow profiles

- Non-polar device, minimizing installation concerns
- Tantalum and electrolytic alternative

Applications

Typical applications include smoothing circuits, DC/DC converters, power supplies (input/output filters), noise reduction (piezoelectric/mechanical), circuits with a direct battery or power source connection, critical and safety relevant circuits without (integrated) current limitation and any application that is subject to high levels of board flexure or temperature cycling. Markets include industrial, military, automotive and telecom.

Qualification/Certification

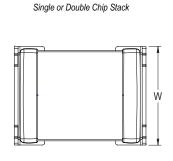
Commercial Grade products are subject to internal qualification. Details regarding test methods and conditions are referenced in Table 4, Performance & Reliability.

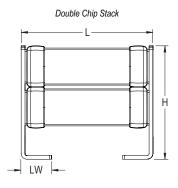
Environmental Compliance

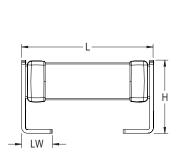
Lead (Pb)-Free, RoHS, and REACH compliant without exemptions.



Dimensions – Millimeters (Inches)







Single Chip Stack

Number of Chips	EIA Size Code	Metric Size Code	L Length	W Width	H Height	LW Lead Width	Mounting Technique
	1210	3225	3.50 (.138) ±0.30 (.012)	2.60 (.102) ±0.30 (.012)	3.35 (.132) ±0.10 (.004)	0.80 (.032) ±0.15 (.006)	
Single	1812	4532	5.00 (.197) ±0.50 (.020)	3.50 (.138) ±0.50 (.020)	2.65 (.104) ±0.35 (.014)	1.10 (.043) ±0.30 (.012)	
	2220	5650	6.00 (.236) ±0.50 (.020)	5.00 (.197) ±0.50 (.020)	3.50 (.138) ±0.30 (.012)	1.60 (.063) ±0.30 (.012)	Solder Reflow
	1210	3225	3.50 (.138) ±0.30 (.012)	2.60 (.102) ±0.30 (.012)	6.15 (.242) ±0.15 (.006)	0.80 (.031) ±0.15 (.006)	Only
Double	1812	4532	5.00 (.197) ±0.50 (.020)	3.50 (.138) ±0.50 (.020)	5.00 (.197) ±0.50 (.020)	1.10 (.043) ±0.30 (.012)	
	2220	5650	6.00 (.236) ±0.50 (.020)	5.00 (.197) ±0.50 (.020)	5.00 (.197) ±0.50 (.020)	1.60 (.063) ±0.30 (.012)	

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%
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
² Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ± 1 seconds and charge/discharge not exceeding 50mA)
³ Dissipation Factor (DF) Maximum Limit @ 25°C	5%(10V), 3.5%(16V & 25V) and 2.5%(50V to 250V)
⁴Insulation Resistance (IR) Minimum Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ± 5 secs @ 25°C)

¹Regarding 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.

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."

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

¹ kHz ± 50 Hz and 1.0 ± 0.2 Vrms if capacitance $\leq 10 \,\mu\text{F}$

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

⁴To obtain IR limit, divide MΩ- μ F value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



Post Environmental Limits

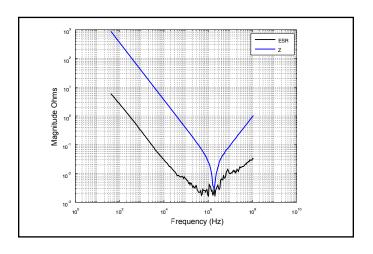
High Temperature Life, Biased Humidity, Moisture Resistance											
Dielectric	Capacitance Shift	Insulation Resistance									
	> 25		3.0								
X7R	16/25	All	5.0	±20%	10% of Initial Limit						
	< 16		7.5								

Insulation Resistance Limit Table

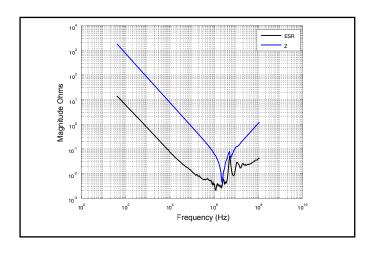
EIA Case Size	1,000 Megohm Microfarads or 100 GΩ	500 Megohm Microfarads or 10 GΩ
1210	< 0.39 µF	≥ 0.39 µF
1812	< 2.2 µF	≥ 2.2 µF
2220	< 10 µF	≥ 10 µF

Electrical Characteristics

Z and ESR C1210C475M5R1C



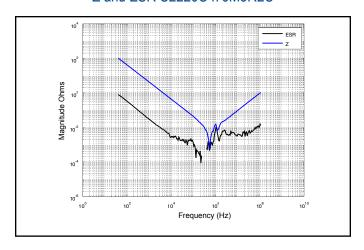
Z and ESR C2220C225MAR2C



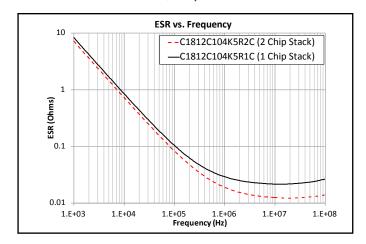


Electrical Characteristics

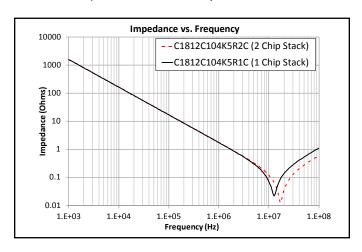
Z and ESR C2220C476M3R2C



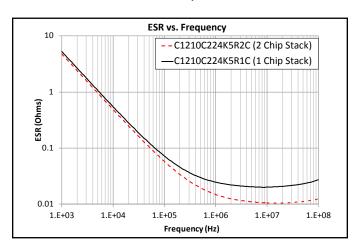
ESR - 1812, .10 μ F, 50 V X7R



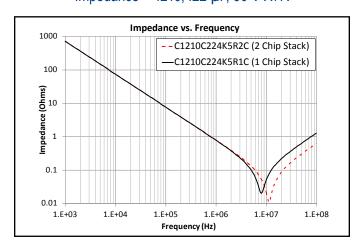
Impedance – 1812, .10 μ F, 50 V X7R



 $ESR - 1210, .22 \mu F, 50 V X7R$



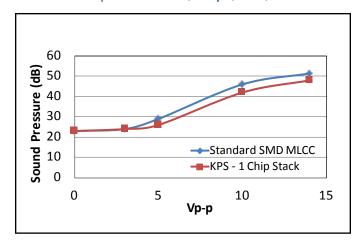
Impedance - 1210, .22 μF , 50 V X7R



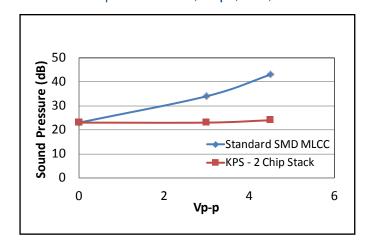


Electrical Characteristics cont'd

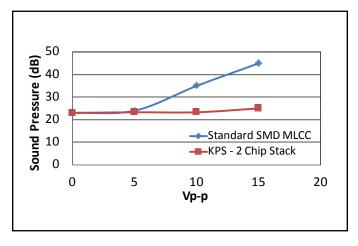
Microphonics – 1210, 4.7 μF, 50 V, X7R



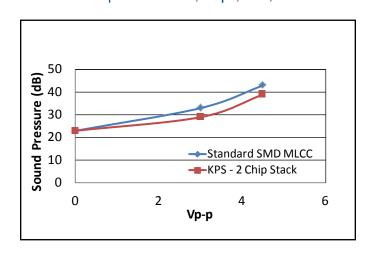
Microphonics – 2220, 22 μF, 50 V, X7R



Microphonics – 2220, 47 μ F, 25 V, X7R

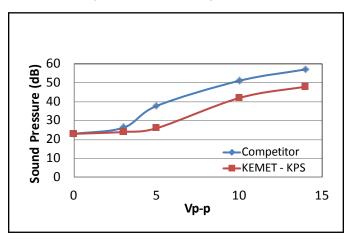


Microphonics – 1210, 22 μF, 25 V, X7R

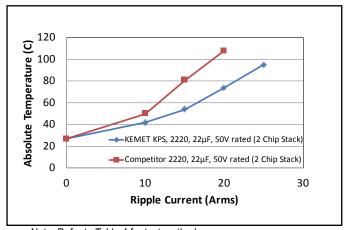


Competitive Comparision

Microphonics – 1210, 4.7 μF, 50 V, X7R



Ripple Current (Arms) 2220, 22 µF, 50 V

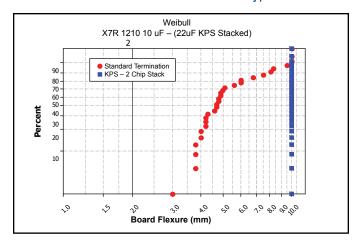


Note: Refer to Table 4 for test method.

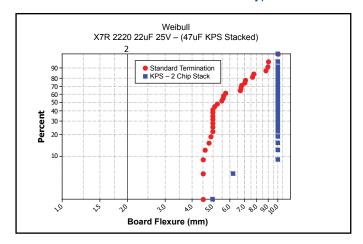


Electrical Characteristics cont'd

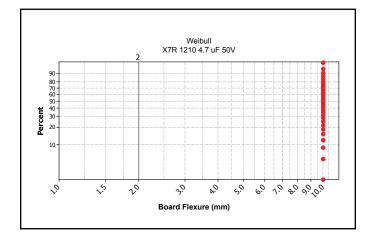
Board Flex vs. Termination Type



Board Flex vs. Termination Type



Board Flexure to 10 mm



Board Flexure to 10 mm

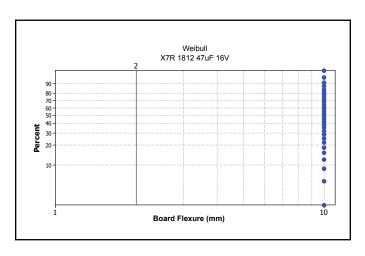




Table 1 – Capacitance Range/Selection Waterfall (1210 – 2220 Case Sizes)

		Case Siz	e/Series			C1	210C				(C1812	2C			C	2220	С	
	Сар	Voltag	e Code	8	4	3	5	1	Α	4	3	5	1	Α	4	3	5	1	Α
Capacitance	Code	Rated Volt	age (VDC)	10	16	25	50	100	250	16	25	50	100	250	16	25	50	100	250
	Oodc	Capacitanc	e Tolerance			,	ļ.							kness Dimens	Codes ions				
,						Sin	gle C	hip St	ack										
0.10 µF	104	K	М	FV	FV	FV	FV	FV	FV	GP	GP	GP	GP	GP	JP	JP	JP	JP	JP
0.22 µF	224	K	M	FV	FV	FV	FV	FV		GP	GP	GP	GP	GP	JP	JP	JP	JP	JP
0.47 μF	474	K	M	FV	FV	FV	FV	FV		GP	GP	GP	GP	GP	JP	JP	JP	JP	JP
1.0 µF	105	К	M	FV	FV	FV	FV	FV		GP	GP	GP	GP		JP	JP	JP	JP	JP
2.2 µF	225	К	M	FV	FV	FV	FV	FV		GP	GP	GP			JP	JP	JP	JP	
3.3 µF	335	K	М	FV	FV	FV	FV			GP	GP	GP			JP	JP	JP	JP	
4.7 µF	475	K	М	FV	FV	FV	FV			GP	GP	GP			JP	JP	JP		
10 μF	106	K	М	FV	FV	FV				GP	GP				JP	JP	JP		
15 μF	156	K	М	FV											JP	JP			
22 μF	226	K	M	FV											JP	JP			
						Dou	uble C	Chip S	tack										
0.10 µF	104		M	FW	FW	FW	FW	FW	FW	GR	GR	GR	GR	GR	JR	JR	JR	JR	JR
0.22 µF	224		M	FW	FW	FW	FW	FW	FW	GR	GR	GR	GR	GR	JR	JR	JR	JR	JR
0.47 μF	474		M	FW	FW	FW	FW	FW		GR	GR	GR	GR	GR	JR	JR	JR	JR	JR
1.0 µF	105		M	FW	FW	FW	FW	FW		GR	GR	GR	GR	GR	JR	JR	JR	JR	JR
2.2 µF	225		M	FW	FW	FW	FW	FW		GR	GR	GR	GR		JR	JR	JR	JR	JR
3.3 µF	335		M	FW	FW	FW	FW	FW		GR	GR	GR	GR		JR	JR	JR	JR	
4.7 µF	475		M	FW	FW	FW	FW	FW		GR	GR	GR			JR	JR	JR	JR	
10 µF	106		M	FW	FW	FW	FW			GR	GR	GR			JR	JR	JR		
22 μF	226		M	FW	FW	FW				GR	GR				JR	JR	JR		
33 μF	336		М	FW											JR	JR			
47 μF	476		M	FW											JR	JR			
	0	Rated Volt	age (VDC)	10	16	25	50	100	250	16	25	50	100	250	16	25	50	100	250
Capacitance	Сар	Voltag	e Code	8	4	3	5	1	Α	4	3	5	1	Α	4	3	5	1	Α
	Code	Case Siz	e/Series			C1	210C				(C1812	2C			C	2220	С	

These products are protected under US Patent 8,331,078 other patents pending, and any foreign counterparts.

Table 2 – Chip Thickness/Tape & Reel Packaging Quantities

Thickness	Case	Thickness ±	Paper G	Quantity	Plastic (Quantity
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
FV	1210	3.35 ± 0.10	0	0	600	2,000
FW	1210	6.15 ± 0.15	0	0	300	1,000
GP	1812	2.65 ± 0.35	0	0	500	2,000
GR	1812	5.00 ± 0.50	0	0	400	1,700
JP	2220	3.50 ± 0.30	0	0	300	1,300
JR	2220	5.00 ± 0.50	0	0	200	800
Thickness	Case	Thickness ±	7" Reel	13" Reel	7" Reel	13" Reel
Code	Size	Range (mm)	Paper C	Quantity	Plastic (Quantity

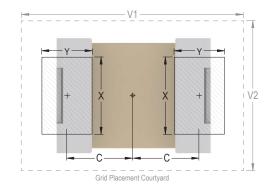
Package quantity based on finished chip thickness specifications.



Table 3 – KPS Land Pattern Design Recommendations (mm)

EIA SIZE CODE	METRIC SIZE	Media	n (Nom	inal) La	nd Prot	rusion
0052	CODE	С	Υ	Х	V1	V2
1210	3225	1.50	1.14	1.75	5.05	3.40
1812	4532	2.20	1.35	2.87	6.70	4.50
2220	5650	2.69	2.08	4.78	7.70	6.00

Image at right based on an EIA 1210 case size.



Soldering Process

KEMET's KPS Series devices are compatible with IR reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET's recommended profile conditions for IR reflow reflect the profile conditions of the IPC/J–STD–020D standard for moisture sensitivity testing.

To prevent degradation of temperature cycling capability, care must be taken to prevent solder from flowing into the inner side of the lead frames (inner side of "J" lead in contact with the circuit board).

After soldering, the capacitors should be air cooled to room temperature before further processing. Forced air cooling is not recommended.

Hand soldering should be performed with care due to the difficulty in process control. If performed, care should be taken to avoid contact of the soldering iron to the capacitor body. The iron should be used to heat the solder pad, applying solder between the pad and the lead, until reflow occurs. Once reflow occurs, the iron should be removed immediately. (Preheating is required when hand soldering to avoid thermal shock.)

Profile Feature	SnPb Assembly	Pb-Free Assembly
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax})	60 – 120 seconds	60 – 120 seconds
Ramp-up Rate (T _L to T _P)	3°C/seconds maximum	3°C/seconds maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	250°C
Time within 5°C of Maximum Peak Temperature (t _p)	20 seconds maximum	10 seconds maximum
Ramp-down Rate $(T_P \text{ to } T_L)$	6°C/seconds maximum	6°C/seconds maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum

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

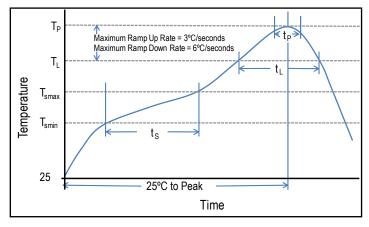




Table 4 - Performance & Reliability: Test Methods and Conditions

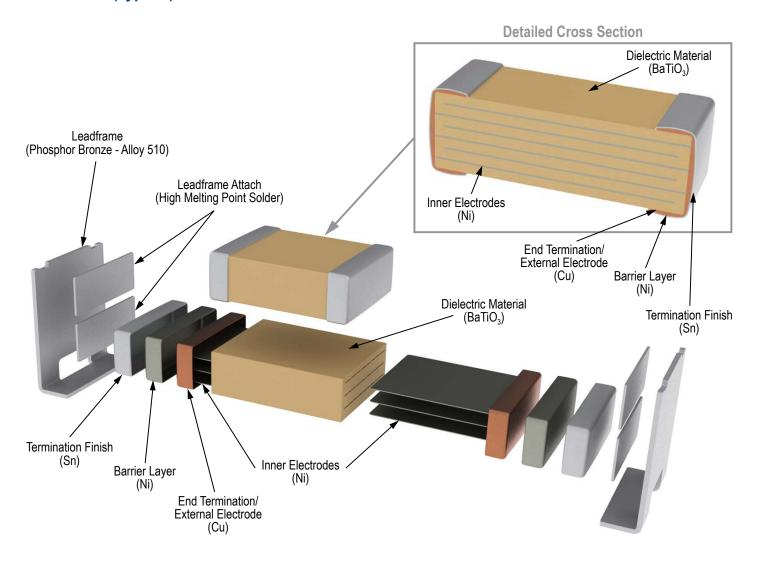
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 5.0 mm minimum
		Magnification 50 X. Conditions:
Caldanahilitu	J-STD-002	a) Method B, 4 hours at 155°C, dry heat at 235°C
Solderability	J-51D-002	b) Method B at 215°C category 3
		c) Method D, category 3 at 250°C
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Biacoa Frannak,	mile of b loc mounds for	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air-Air.
High Temperature Life	MIL-STD-202 Method 108	1,000 hours at 125°C with 1.5X rated voltage applied.
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 .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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage & Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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)



Product Marking

Laser marking option is not available on:

- C0G, Ultra Stable X8R and Y5V dielectric devices
- EIA 0402 case size devices
- EIA 0603 case size devices with Flexible Termination option.
- · KPS Commercial and Automotive grade stacked devices.

These capacitors are supplied unmarked only.

KPS Series, High Voltage, X7R Dielectric, 500 – 630 VDC (Commercial Grade)



Overview

KEMET Power Solutions (KPS) High Voltage stacked capacitors utilize a proprietary lead-frame technology to vertically stack one or two multilayer ceramic chip capacitors into a single compact surface mount package. The attached lead-frame mechanically isolates the capacitor(s) from the printed circuit board, thereby offering advanced mechanical and thermal stress performance. Isolation also addresses concerns for audible microphonic noise that may occur when a bias voltage is applied. A two-chip stack offers up to double the capacitance in the same or smaller design footprint when compared to traditional surface mount MLCC devices. Providing up to 10 mm of board flex capability, KPS Series High Voltage capacitors are environmentally friendly and in compliance with RoHS legislation.

KEMET's KPS Series devices in X7R dielectric exhibit a predictable change in capacitance with respect to time and voltage, and boast a minimal change in capacitance with reference to ambient temperature. Capacitance change is limited to ±15% from -55°C to +125°C. These devices are capable of Pb-Free reflow profiles and provide lower ESR, ESL and higher ripple current capability when compared to other dielectric solutions.

Conventional uses include both snubbers and filters in applications such as switching power supplies and lighting ballasts. Their exceptional performance at high frequencies has made high voltage ceramic capacitors the preferred dielectric choice of design engineers worldwide. In addition to their use in power supplies, these capacitors are widely used in industries related to automotive (hybrid), telecommunications, medical, military, aerospace, semiconductors, and test/diagnostic equipment.

Benefits

- -55°C to +125°C operating temperature range
- Reliable and robust termination system
- EIA 2220 case size
- DC voltage ratings of 500 V and 630 V
- Capacitance offerings ranging from 0.047 μF up to 1.0 μF
- Available capacitance tolerances of ±10% and ±20%
- · Higher capacitance in the same footprint
- · Potential board space savings



Ordering Information

С	2220	С	105	M	С	R	2	С	7186
Ceramic	Case Size (L"x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance ¹	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Leadframe Finish ²	Packaging/Grade (C-Spec)
	2220	C = Standard	Two significant digits + number of zeros.	K = ±10% M = ±20%	C = 500 B = 630	R = X7R	1 = KPS Single Chip Stack 2 = KPS Double Chip Stack	C = 100% Matte Sn	See "Packaging C-Spec Ordering Options Table" below

¹ Double chip stacks ("2" in the 13th character position of the ordering code) are only available in M (±20%) capacitance tolerance. Single chip stacks ("1" in the 13th character position of the ordering code) are available in K (±10%) or M (±20%) tolerances.

² Additional leadframe finish options may be available. Contact KEMET for details.



Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec) ²
7" Reel (Embossed Plastic Tape)/Unmarked	7186
13" Reel (Embossed Plastic Tape)/Unmarked	7289

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. The option to laser mark is not available on these devices. For more information see "Capacitor Marking".

Benefits cont'd

- Advanced protection against thermal and mechanical stress
- Provides up to 10 mm of board flex capability
- · Reduces audible microphonic noise
- Extremely low ESR and ESL

- Lead (Pb)-Free, RoHS and REACH compliant
- Capable of Pb-Free reflow profiles
- Non-polar device, minimizing installation concerns
- Film alternative

Applications

Typical applications include switch mode power supplies (input filters, resonators, tank circuits, snubber circuits, output filters), high voltage coupling and DC blocking, lighting ballasts, voltage multiplier circuits, DC/DC converters and coupling capacitors in Ćuk converters. Markets include power supply, LCD fluorescent backlight ballasts, HID lighting, telecom equipment, industrial and medical equipment/control, LAN/WAN interface, analog and digital modems, and automotive (electric and hybrid vehicles, charging stations and lighting applications).

Application Note

X7R dielectric is not recommended for AC line filtering or pulse applications.

Qualification/Certification

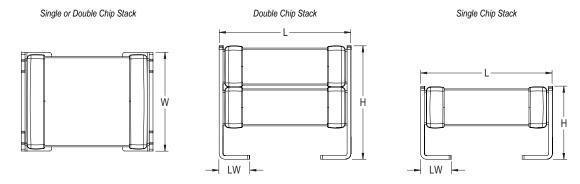
Commercial Grade products are subject to internal qualification. Details regarding test methods and conditions are referenced in Table 4, Performance and Reliability.

Environmental Compliance

Lead (Pb)-Free, RoHS, and REACH compliant without exemptions.



Dimensions – Millimeters (Inches)



Number of Chips	EIA Size Code	Metric Size Code	L Length	W Width	H Height	LW Lead Width	Mounting Technique
Single	2220	5650	6.00 (0.236) ±0.50 (0.020)	5.00 (.197) ±0.50 (.020)	3.50 (.138) ±0.30 (.012)	1.60 (.063) ±0.30 (.012)	Caldan Dafface Only
Double	2220	5650	6.00 (0.236) ±0.50 (0.020)	5.00 (.197) ±0.50 (.020)	5.00 (.197) ±0.50 (.020)	1.60 (.063) ±0.30 (.012)	Solder Reflow Only

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%
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
² Dielectric Withstanding Voltage (DWV)	150% of rated voltage for voltage rating of < 1000V 120% of rated voltage for voltage rating of ≥ 1000V (5 ± 1 seconds and charge/discharge not exceeding 50mA)
³ Dissipation Factor (DF) Maximum Limit @ 25°C	2.5%
⁴Insulation Resistance (IR) Minimum Limit @ 25°C	See Insulation Resistance Limit Table (500VDC applied for 120 ± 5 secs @ 25°C)

Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

 $1kHz \pm 50Hz$ and 1.0 ± 0.2 Vrms if capacitance ≤ $10\mu F$

120Hz \pm 10Hz and 0.5 ± 0.1 Vrms if capacitance >10 μ F

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

⁴To obtain IR limit, divide MΩ- μ F value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



Post Environmental Limits

High Temperature Life, Biased Humidity, Moisture Resistance						
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance	
	> 25		3.0			
X7R	16/25	All	5.0	±20%	10% of Initial Limit	
	< 16		7.5			

Insulation Resistance Limit Table

EIA Case Size	1,000 Megohm Microfarads or 100 GΩ	100 Megohm Microfarads or 10 GΩ
0805	< 0.0039 µF	≥ 0.0039 µF
1206	< 0.012 µF	≥ 0.012 µF
1210	< 0.033 µF	≥ 0.033 µF
1808	< 0.018 µF	≥ 0.018 µF
1812	< 0.027 µF	≥ 0.027 µF
≥ 1825	All	N/A



Table 1 – Capacitance Range/Selection Waterfall (2220 Case Sizes)

			ze/Series	C2220C			
		Voltage	e Code	С	В	D	
Capacitance	Capacitance	Rated Volt	age (VDC)	500	630	1000	
	Code	Capacitance Tolerance		Product Availability and Chip Thicknes Codes – See Table 2 for Chip Thicknes Dimensions			
Single Chip Stack							
0.047 µF	473	K	M	JP	JP		
0.10 µF	104	K	M	JP	JP		
0.15 μF	154	K	M	JP	JP		
0.22 µF	224	K	M	JP	JP		
0.33 μF	334	K	M	JP			
0.47 μF	474	K	M	JP			
		Double	Chip Stack	k			
0.10 µF	104		M	JR	JR		
0.22 μF	224		M	JR	JR		
0.33 μF	334		M	JR	JR		
0.47 μF	474		M	JR	JR		
0.68 µF	684		M	JR			
1.0 µF	105		M	JR			
	0	Rated Volt	age (VDC)	500	630	1000	
Capacitance	Capacitance	Voltage	Voltage Code C		В	D	
	Code	Case Siz	Case Size/Series		C2220C		

These products are protected under US Patent 8,331,078 other patents pending, and any foreign counterparts.

Table 2 – Chip Thickness/Tape & Reel Packaging Quantities

Thickness	Case	Thickness ±	Thickness ± Paper Quantity			Plastic Quantity	
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel	
JP	2220	3.50 ± 0.30	0	0	300	1,300	
JR	2220	5.00 ± 0.50	0	0	200	800	

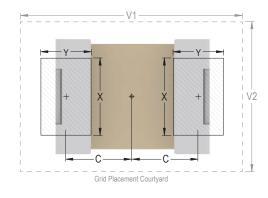
Package quantity based on finished chip thickness specifications.



Table 3 – KPS Land Pattern Design Recommendations (mm)

EIA SIZE	CODE SIZE `				nd Prot	rusion
OODL	CODE	С	Y	Х	V1	V2
1210	3225	1.50	1.14	1.75	5.05	3.40
1812	4532	2.20	1.35	2.87	6.70	4.50
2220	5650	2.69	2.08	4.78	7.70	6.00

Image at right based on an EIA 1210 case size.



Soldering Process

KEMET's KPS Series devices are compatible with IR reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET's recommended profile conditions for IR reflow reflect the profile conditions of the IPC/J–STD–020D standard for moisture sensitivity testing.

To prevent degradation of temperature cycling capability, care must be taken to prevent solder from flowing into the inner side of the lead frames (inner side of "J" lead in contact with the circuit board).

After soldering, the capacitors should be air cooled to room temperature before further processing. Forced air cooling is not recommended.

Hand soldering should be performed with care due to the difficulty in process control. If performed, care should be taken to avoid contact of the soldering iron to the capacitor body. The iron should be used to heat the solder pad, applying solder between the pad and the lead, until reflow occurs. Once reflow occurs, the iron should be removed immediately. (Preheating is required when hand soldering to avoid thermal shock.)

Profile Feature	SnPb Assembly	Pb-Free Assembly
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax})	60 – 120 seconds	60 – 120 seconds
Ramp-up Rate (T _L to T _P)	3°C/seconds maximum	3°C/seconds maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	250°C
Time within 5°C of Maximum Peak Temperature (t _p)	20 seconds maximum	10 seconds maximum
Ramp-down Rate (T _P to T _L)	6°C/seconds maximum	6°C/seconds maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum

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

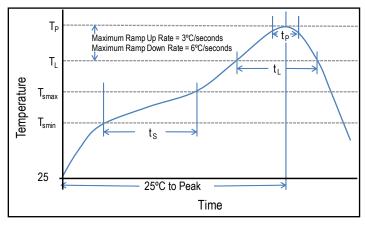




Table 4 - Performance & Reliability: Test Methods and Conditions

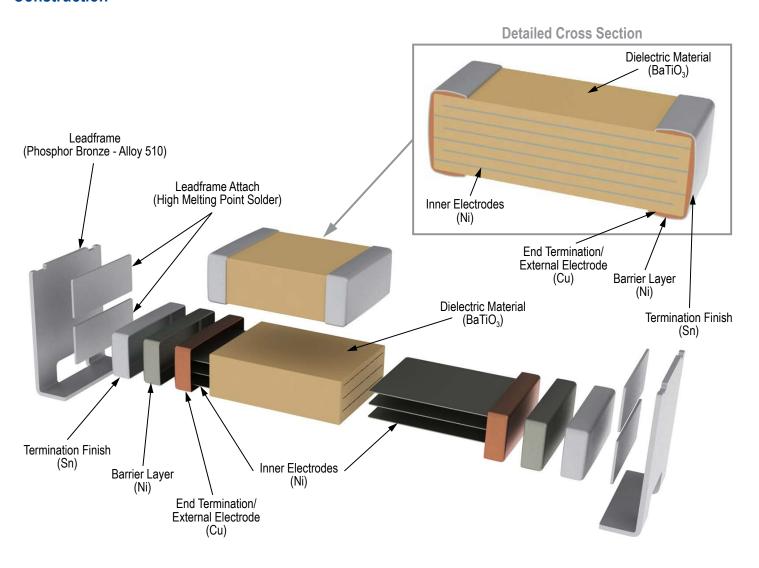
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 5.0 mm minimum
		Magnification 50 X. Conditions:
Caldarahilitu	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	J-51D-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 250°C
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Diggod Llumidity	MIL OTD 000 Marks at 400	Load Humidity: 1,000 hours 85°C/85% RH and 200 VDC maximum. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air-Air.
High Temperature Life	MIL-STD-202 Method 108	1,000 hours at 125°C with rated voltage applied.
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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



Product Marking

Laser marking option is not available on:

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

These capacitors are supplied unmarked only.

KPS HT Series, **High Temperature 150°C**, **X8L Dielectric**, 10 – 50 VDC (Commercial & Automotive Grade)



Overview

KEMET Power Solutions High Temperature (KPS HT) stacked capacitors utilize a proprietary lead-frame technology to vertically stack one or two multilayer ceramic chip capacitors into a single compact surface mount package. The attached lead-frame mechanically isolates the capacitor(s) from the printed circuit board, thereby offering advanced mechanical and thermal stress performance. Isolation also addresses concerns for audible, microphonic noise that may occur when a bias voltage is applied. A two-chip stack offers up to double the capacitance in the same or smaller design footprint when compared to traditional surface mount MLCC devices. Providing up to 10 mm of board flex capability, KPS Series capacitors are environmentally friendly and in compliance with

RoHS legislation. Combined with X8L dielectric, these devices are capable of reliable operation up to 150°C and are well suited for high temperature filtering, bypass and decoupling applications.

X8L exhibits a predictable change in capacitance with respect to time and voltage, and boasts a minimal change in capacitance with reference to ambient temperature up to 125°C. Beyond 125°C, X8L displays a wider variation in capacitance. Capacitance change is limited to ±15% from -55°C to +125°C and +15, -40% from 125°C to 150°C.

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

Benefits

- -55°C to +150°C operating temperature range
- Reliable and robust termination system
- EIA 1210 and 2220 case sizes
- DC voltage ratings of 10 V, 16 V, 25 V, and 50 V
- Capacitance offerings ranging from 0.47 μF up to 47 μF
- Available capacitance tolerances of ±10% and ±20%
- · Higher capacitance in the same footprint
- · Potential board space savings
- · Advanced protection against thermal and mechanical stress
- · Provides up to 10 mm of board flex capability



Ordering Information

C	2220	С	476	M	8	N	2	С	7186
Ceramic	Case Size (L"x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance ¹	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Leadframe Finish ²	Packaging/Grade (C-Spec)
	1210 2220	C = Standard	Two significant digits + number of zeros.	K = ±10% M = ±20%	8 = 10 4 = 16 3 = 25 5 = 50	N = X8L	1 = KPS Single Chip Stack 2 = KPS Double Chip Stack	C = 100% Matte Sn	See "Packaging C-Spec Ordering Options Table" below

¹ Double chip stacks ("2" in the 13th character position of the ordering code) are only available in M (±20%) capacitance tolerance. Single chip stacks ("1" in the 13th character position of the ordering code) are available in K (±10%) or M (±20%) tolerances.

² Additional leadframe finish options may be available. Contact KEMET for details.



Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec) ²			
Commerc	ial Grade			
7" Reel (Embossed Plastic Tape)/Unmarked	7186			
13" Reel (Embossed Plastic Tape)/Unmarked	7289			
Automoti	ve Grade			
7" Reel (Embossed Plastic Tape)/Unmarked	AUTO			
13" Reel (Embossed Plastic Tape)/Unmarked	AUTO7289			

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. The option to laser mark is not available on these devices. For more information see "Capacitor Marking".

Benefits

- · Reduces audible, microphonic noise
- · Extremely low ESR and ESL
- · Lead (Pb)-Free, RoHS and REACH compliant
- · Capable of Pb-Free reflow profiles

- Non-polar device, minimizing installation concerns
- · Tantalum and electrolytic alternative
- · Commercial & Automotive (AEC-Q200) grades available

Applications

Typical applications include smoothing circuits, DC/DC converters, power supplies (input/output filters), noise reduction (piezoelectric/mechanical), circuits with a direct battery or power source connection, critical and safety relevant circuits without (integrated) current limitation and any application that is subject to extreme environments such as high temperature, high levels of board flexure and/or temperature cycling. Markets include industrial, aerospace, automotive, and telecom.

Qualification/Certification

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

Automotive Grade products meet or exceed the requirements outlined by the Automotive Electronics Council. Details regarding test methods and conditions are referenced in document AEC–Q200, Stress Test Qualification for Passive Components. For additional information regarding the Automotive Electronics Council and AEC–Q200, please visit their website at www.aecouncil.com.

Environmental Compliance

Lead (Pb)-Free, RoHS, and REACH compliant without exemptions.

² For additional Information regarding "AUTO" C-Spec options, see "Automotive C-Spec Information".



Automotive C-Spec Information

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

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

Product Change Notification (PCN)

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

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

KEMET Automotive	Customer Noti	fication due to:	Days prior to
C-Spec	Process/Product change	Obsolescence*	implementation
KEMET assigned ¹	Yes (with approval and sign off)	Yes	180 days Minimum
AUTO	Yes (without approval)	Yes	90 days Minimum

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

Production Part Approval Process (PPAP)

The purpose of the Production Part Approval Process is:

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

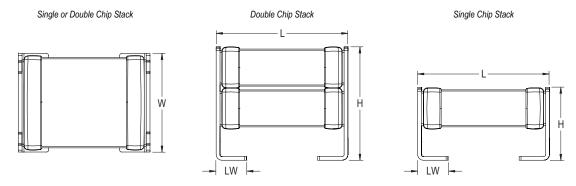
KEMET Automotive		PPAP (Product Part Approval Process) Level										
C-Spec	1	2	3	4	5							
KEMET assigned ¹	•	•	•	•	•							
AUTO	0		0									

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

- Part Number specific PPAP available
- Product family PPAP only



Dimensions – Millimeters (Inches)



Chip Stack	EIA Size Code	Metric Size Code	L Length	W Width	H Height	LW Lead Width	Mounting Technique
Cinalo	1210	3225	3.50 (.138) ±0.30 (.012)	2.60 (.102) ±0.30 (.012)	3.35 (.132) ±0.10 (.004)	0.80 (.032) ±0.15 (.006)	
Single	2220	5650	6.00 (.236) ±0.50 (.020)	5.00 (.197) ±0.50 (.020)	3.50 (.138) ±0.30 (.012)	1.60 (.063) ±0.30 (.012)	Solder Reflow
Davible	1210	3225	3.50 (.138) ±0.30 (.012)	2.60 (.102) ±0.30 (.012)	6.15 (.242) ±0.15 (.006)	0.80 (.031) ±0.15 (.006)	Only
Double	2220	5650	6.00 (.236) ±0.50 (.020)	5.00 (.197) ±0.50 (.020)	5.00 (.197) ±0.50 (.020)	1.60 (.063) ±0.30 (.012)	

Electrical Parameters/Characteristics

Item	Parameters/Characteristics		
Operating Temperature Range	−55°C to +150°C		
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15% (-55°C to 125°C), +15, -40% (125°C to 150°C)		
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%		
² Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)		
³ Dissipation Factor (DF) Maximum Limit @ 25°C	3.5% (≤ 16V) and 2.5% (≥ 25V)		
⁴ Insulation Resistance (IR) Minimum Limit @ 25°C	500 megohm microfarads or 10 G Ω (Rated voltage applied for 120 ±5 seconds @ 25°C)		

Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

1kHz \pm 50Hz and 1.0 \pm 0.2 Vrms if capacitance \leq 10 μF

120Hz \pm 10Hz 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 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

⁴To obtain IR limit, divide MΩ- μ F value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



Post Environmental Limits

	High Temperature Life, Biased Humidity, Moisture Resistance								
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance				
X8L	≥ 25	All	3.0	±20%	100/ of Initial Limit				
AOL	≤ 16	All	5.0	±20%	10% of Initial Limit				

Table 1 – Capacitance Range/Selection Waterfall (1210 – 2220 Case Sizes)

		Case Size/S	eries			C12	10C					C22	20C		
Capacitance	Cap	Voltage Cod	le	8	4	3	5	1	Α	8	4	3	5	1	Α
Capacitanice	Code	Rated Voltage (VDC)	10	16	25	50	100	250	10	16	25	50	100	250
		Capacitance Tol	erance		Produ	ct Availab	ility and C	hip Thickr	ness Code	s – See Ta	ble 2 for C	hip Thick	ness Dime	nsions	
					Single	Chip	Stack								
0.47 µF	474	K	M	FV	FV	FV	FV								
1.0 µF	105	K	M	FV	FV	FV	FV								
2.2 µF	225	K	M	FV	FV	FV				JP	JP	JP			
3.3 µF	335	K	M	FV	FV	FV				JP	JP	JP			
4.7 µF	475	K	M	FV	FV	FV				JP	JP	JP			
10 μF	106	K	M							JP	JP	JP			
15 µF	156	K	M							JP					
22 µF	226	K	M							JP					
					Double	e Chip	Stack								
1.0 µF	105		M	FW	FW	FW	FW								
2.2 µF	225		M	FW	FW	FW	FW								
3.3 µF	335		M	FW	FW	FW									
4.7 μF	475		М	FW	FW	FW				JR	JR	JR			
10 µF	106		M	FW	FW	FW				JR	JR	JR			
22 µF	226		М							JR	JR	JR			
33 µF	336		M							JR					
47 µF	476		M							JR					
·		Rated Voltage (VDC)	10	16	25	50	100	250	10	16	25	50	100	250
Capacitance	Cap	Voltage Cod	le	8	4	3	5	1	Α	8	4	3	5	1	Α
	Code	Case Size/S	eries			C12	10C					C22	20C		

These products are protected under US Patent 8,331,078 other patents pending, and any foreign counterparts.

Table 2 - Chip Thickness/Tape & Reel Packaging Quantities

	Thickness	Case	Thickness ±	Thickness ± Paper Quantity		Plastic (Quantity
	Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
ĺ	FV	1210	3.35 ± 0.10	0	0	600	2,000
1	FW	1210	6.15 ± 0.15	0	0	300	1,000
-	JP	2220	3.50 ± 0.30	0	0	300	1,300
1	JR	2220	5.00 ± 0.50	0	0	200	800

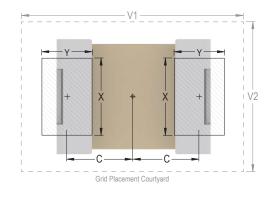
Package quantity based on finished chip thickness specifications.



Table 3 – KPS Land Pattern Design Recommendations (mm)

EIA SIZE CODE	METRIC SIZE	SIZE Median (Nominal) Land Protrusion								
0052	CODE	С	Υ	Х	V1	V2				
1210	3225	1.50	1.14	1.75	5.05	3.40				
2220	5650	2.69	2.08	4.78	7.70	6.00				

Image at right based on an EIA 1210 case size.



Soldering Process

KEMET's KPS Series devices are compatible with IR reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET's recommended profile conditions for IR reflow reflect the profile conditions of the IPC/J–STD–020D standard for moisture sensitivity testing.

To prevent degradation of temperature cycling capability, care must be taken to prevent solder from flowing into the inner side of the lead frames (inner side of "J" lead in contact with the circuit board).

After soldering, the capacitors should be air cooled to room temperature before further processing. Forced air cooling is not recommended.

Hand soldering should be performed with care due to the difficulty in process control. If performed, care should be taken to avoid contact of the soldering iron to the capacitor body. The iron should be used to heat the solder pad, applying solder between the pad and the lead, until reflow occurs. Once reflow occurs, the iron should be removed immediately. (Preheating is required when hand soldering to avoid thermal shock.)

Profile Feature	SnPb Assembly	Pb-Free Assembly
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax})	60 – 120 seconds	60 – 120 seconds
Ramp-up Rate (T _L to T _P)	3°C/seconds maximum	3°C/seconds maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	250°C
Time within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	10 seconds maximum
Ramp-down Rate $(T_p \text{ to } T_L)$	6°C/seconds maximum	6°C/seconds maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum

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

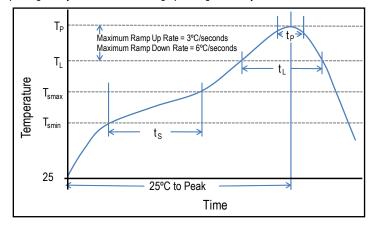




Table 4 – Performance & Reliability: Test Methods and Conditions

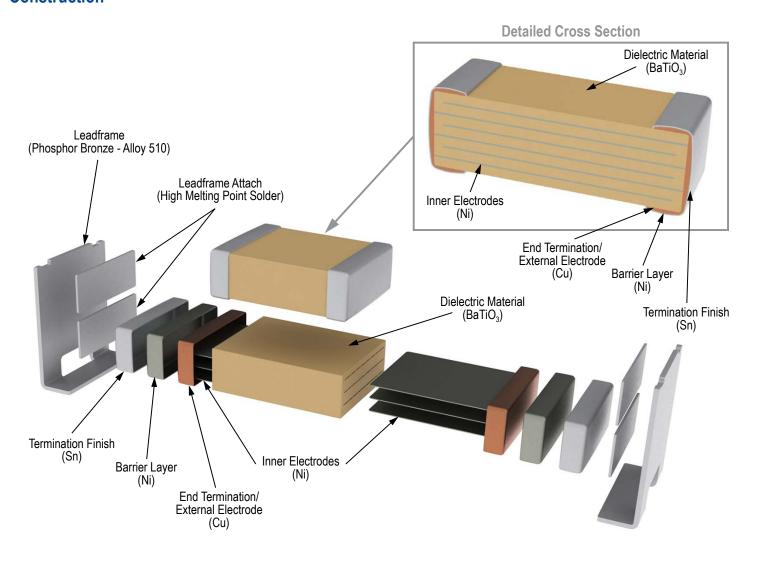
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 5.0 mm minimum
		Magnification 50 X. Conditions:
Coldorability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	J-51D-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 250°C
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +150°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Diagond Humaidit.	MII –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 +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	−55°C/+150°C. Note: Number of cycles required- 300, maximum transfer time- 20 seconds, Dwell time- 15 minutes. Air-Air.
High Temperature Life	MIL-STD-202 Method 108	1,000 hours at 150°C with rated voltage applied.
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 .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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage & Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



Product Marking

Laser marking option is not available on:

- C0G, Ultra Stable X8R and Y5V dielectric devices
- EIA 0402 case size devices
- EIA 0603 case size devices with Flexible Termination option.
- · KPS Commercial and Automotive grade stacked devices.

These capacitors are supplied unmarked only.

Commercial "L" Series, SnPb Termination, C0G Dielectric 10 – 250 VDC (Commercial Grade)



Overview

KEMET's Commercial "L" Series with Tin/Lead Termination surface mount capacitors in C0G dielectric are designed to meet the needs of critical applications where tin/lead end metallization is required. KEMET's tin/lead electroplating process is designed to meet a 5% minimum lead content and address concerns for a more robust and reliable lead containing termination system. As the bulk of the electronics industry moves towards RoHS compliance, KEMET continues to provide tin/lead terminated products for military, aerospace and industrial applications and will ensure customers have a stable and long-term source of supply.

KEMET's COG dielectric features a 125°C maximum operating temperature and is considered "stable." The Electronics Components, Assemblies & Materials Association (EIA) characterizes COG dielectric as a Class I material. Components of this classification are temperature compensating and are suited for resonant circuit applications or those where Q and stability of capacitance characteristics are required. COG exhibits no change in capacitance with respect to time and voltage and boasts a negligible change in capacitance with reference to ambient temperature. Capacitance change is limited to ±30 ppm/°C from -55°C to +125°C.

Benefits

- -55°C to +125°C operating temperature range
- · Reliable and robust termination system
- EIA 0402, 0603, 0805, 1206, 1210, 1808, 1812, 1825, 2220, and 2225 case sizes
- DC voltage ratings of 10 V, 16 V, 25 V, 50 V, 100 V, 200 V and 250 V
- Capacitance offerings ranging from 0.5 pF up to 0.47 μF
- Available capacitance tolerances of ±0.10 pF, ±0.25 pF, ±0.5 pF, ±1%, ±2%, ±5%, ±10%, and ±20%



Ordering Information

С	1206	С	104	J	3	G	Α	L	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance ¹	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/Grade (C-Spec)
	0402 0603 0805 1206 1210 1808 1812 1825 2220 2225	C = Standard	Two significant digits + number of zeros. Use 9 for 1.0 – 9.9 pF Use 8 for 0.5 – .99 pF ex. 2.2 pF = 229 ex. 0.5 pF = 508		8 = 10 4 = 16 3 = 25 5 = 50 1 = 100 2 = 200 A = 250	G = COG	A = N/A	L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

¹ Additional capacitance tolerance offerings may be available. Contact KEMET for details.

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



Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec)
Bulk Bag/Unmarked	Not required (Blank)
7" Reel/Unmarked	TU
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2 mm pitch ²	7081
13" Reel/Unmarked/2 mm pitch ²	7082

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits cont'd

- · No piezoelectric noise
- · Extremely low ESR and ESL
- · High thermal stability
- · High ripple current capability
- Preferred capacitance solution at line frequencies and into the MHz range
- Negligible capacitance change with respect to temperature from -55°C to +125°C
- No capacitance change with respect to applied rated DC voltage
- · No capacitance decay with time
- · Non-polar device, minimizing installation concerns
- SnPb plated termination finish (5% Pb minimum)
- · Flexible termination option available upon request
- Available for other surface mount products, additional dielectrics and higher voltage ratings upon request

Applications

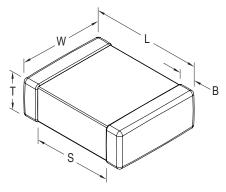
Typical applications include military, aerospace and other high reliability applications.

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. The option to laser mark is not available on these devices. For more information see "Capacitor Marking".

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Dimensions – Millimeters (Inches)



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

Qualification/Certification

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

Environmental Compliance

These devices do not meet RoHS criteria due to the concentration of Lead (Pb) in the termination finish



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)	±30 ppm/°C
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	0%
¹ Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)
² Dissipation Factor (DF) Maximum Limit @ 25°C	0.1%
³ Insulation Resistance (IR) Limit @ 25°C	1,000 megohm microfarads or 100 G Ω (Rated voltage applied for 120 ±5 seconds @ 25°C)

¹ DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

Capacitance and Dissipation Factor (DF) measured under the following conditions:

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."

Post Environmental Limits

	High Temperatu	ıre Life, Biased	Humidity, Mois	ture Resistance	
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance
C0G	All	All	0.5	0.3% or ±0.25 pF	10% of Initial Limit

²Capacitance and dissipation factor (DF) measured under the following conditions:

¹ MHz ±100 kHz and 1.0 Vrms ±0.2 V if capacitance ≤ 1,000 pF

¹ kHz ±50 Hz and 1.0 Vrms ±0.2 V if capacitance > 1,000 pF

 $^{{}^{3}}$ To obtain IR limit, divide M Ω - μ F value by the capacitance and compare to G Ω limit. Select the lower of the two limits.



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

	0	Case Size/ Series			CO	402	2C					C	060	3C					CO	80	5C					C 1	1206	6C		
Cap	Cap	Voltage Code	8	4	3	5	1	2	Α	8	4	3	5	1	2	Α	8	4	3	5	1	2	Α	8	4	3	5	1	2	Α
	Code	Rated Voltage (VDC)	9	16	25	20	100	200	250	10	16	25	20	9	200	250	ę	16	25	20	100	200	250	9	16	25	20	9	200	250
		Capacitance Tolerance										p Tł		nes	s C	ode				le 2		_		nick	nes	s Di	ime	nsio		
0.50 & 0.75 pF	508 & 758 109 – 919*	B C D	BB BB	BB BB	BB BB	BB BB				CF CF	CF CF	CF CF	CF CF	CF CF	CF	CF CF	DN DN	DN DN	DN DN	DN	DN	DN	DN	EB	EB	ГП	ГР	EB	EB	ГП
1.0 – 9.1 pF* 10 – 20 pF*	109 – 919	F G J K M	BB	BB	BB	BB				CF	CF	CF	CF	CF	CF CF	CF	DN	DN	DN	DN DN	DN DN	DN DN	DN DN	EB	EB	EB EB	EB EB	EB	EB	EB EB
22 pF	220	F G J K M	BB	BB	BB	BB				CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	EB						
24 – 91 pF*	240 – 910*	F G J K M	ВВ	ВВ	ВВ	ВВ				CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	EB						
100 pF	101	F G J K M	BB	BB	ВВ	ВВ	ВВ	BB	ВВ	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	EB						
110 – 180 pF*	111 – 181*	F G J K M F G J K M	BB	BB	BB	BB	BB	BB	BB	CF	CF CF	CF	CF	CF	CF	CF CF	DN DN	DN	DN	DN	DN	DN	DN	EB	EB	EB	EB	EB	EB	EB EB
200 – 270 pF 300 pF	201 – 271* 301	F G J K M	BB BB	BB BB	BB BB	BB BB	BB BB	BB BD	BB BD	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	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	EB
330 pF	331	F G J K M	BB	BB	BB	BB	BB	BD	BD	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	EB						
360 pF	361	F G J K M	ВВ	ВВ	ВВ	ВВ	ВВ			CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	EB						
390 pF	391	F G J K M	ВВ	ВВ	ВВ	ВВ	ВВ			CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	EB						
430 pF	431	F G J K M	BB	BB	BB	BB	BB			CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	EB						
470 pF 510 pF	471 511	F G J K M F G J K 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	DP DN	DP DN	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB
560 pF	561	F G J K M	BB	BB	BB	BB	BB			CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	EB						
620 pF	621	F G J K M		BB	BB	BB	BB			CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	EB						
680 pF	681	F G J K M	ВВ	ВВ	ВВ	ВВ	ВВ			CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	EB						
750 pF	751	F G J K M	ВВ	ВВ	ВВ	ВВ	ВВ			CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	EB						
820 pF	821	F G J K M	BB	BB	BB	BB	BB			CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	EB						
910 pF	911 102	F G J K M F G J K 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	DP DP	DP DP	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB
1,000 pF 1,100 pF	112	F G J K M	BB	BB	BB	BB	DD			CF	CF	CF	CF	CF	CH	CH	DN	DN	DN	DN	DN	DN	DN	EB	EB	EB	EB	EB	EB	EB
1,200 pF	122	F G J K M	BB	BB	BB	BB				CF	CF	CF	CF	CF	CH	CH	DN	DN	DN	DN	DN	DN	DN	EB	EB	EB	EB	EB	EB	EB
1,300 pF	132	F G J K M	ВВ	ВВ	ВВ	ВВ				CF	CF	CF	CF	CF	СН	СН	DP	DP	DP	DP	DP	DN	DN	EB	EB	EB	EB	EC	EC	EC
1,500 pF	152	F G J K M	ВВ	ВВ	ВВ	ВВ				CF	CF	CF	CF	CF	CH	CH	DP	DP	DP	DP	DP	DN	DN	EB	EB	EB	EB	ED	EC	EC
1,600 pF	162	F G J K M	BB	BB	BB					CF	CF	CF	CF	CF	CH	CH	DP	DP	DP	DP	DP	DN	DN	EB	EB	EB	EB	ED	ED	ED
1,800 pF 2,000 pF	182 202	F G J K M F G J K M	BB BB	BB BB	BB BB					CF CF	CF CF	CF CF	CF CF	CF CF	CH	CH	DP DN	DP DN	DP DN	DP DN	DP DN	DN DN	DN DN	EB EB	EB EB	EB EB	EB EB	ED ED	ED ED	ED ED
2,000 pr 2,200 pF	202	F G J K M	BB	BB	BB					CF	CF	CF	CF	CF	CH	CH	DN	DN	DN	DN	DN	DN	DN	EB	EB	EB	EB	EE	EE	EE
2,400 pF	242	F G J K M								CF	CF	CF	CF	CF	0	0	DN	EB	EB	EB	EB	EC	EC	EC						
2,700 pF	272	F G J K M								CF	CF	CF	CF	CF			DN	EB	EB	EB	EB	EC	EC	EC						
3,000 pF	302	F G J K M								CF	CF	CF	CF	CF			DP	DP	DP	DP	DN	DN	DN	EC	EC	EC	EC	EC	EB	EB
3,300 pF	332	F G J K M								CF CF	CF	CF	CF	CF			DP	DP	DP	DP	DN	DN	DN	EC EC	EC	EC	EC	EE	EB	EB EB
3,600 pF 3,900 pF	362 392	F G J K M F G J K M								CF	CF CF	CF CF	CF CF	CF CF			DP DE	DP DE	DP DE	DP DE	DN DN	DP DP	DP DP	EC	EC EC	EC EC	EC EC	EE EF	EB EB	EB
4,300 pF	432	F G J K M								CF	CF	CF	CF	CF			DE	DE	DE	DE	DN	DP	DP	EC	EC	EC	EC	EC	EB	EB
4,700 pF	472	F G J K M								CF	CF	CF	CF	CF			DE	DE	DE	DE	DN	DP	DP	EC	EC	EC	EC	EC	EB	EB
5,100 pF	512	F G J K M								CF	CF	CF	CF				DE	DE	DE	DE	DN	DP	DP	ED	ED	ED	ED	ED	EB	EB
5,600 pF	562	F G J K M								CF	CF	CF	CF				DN	DN	DN	DN	DN	DP	DP	ED	ED	ED	ED	ED	EB	EB
6,200 pF	622	F G J K M								CF	CF	CF	CF				DN	DN	DN	DN	DN	DG	DG	EB	EB	EB	EB	EB	EB	EB
6,800 pF 7,500 pF	682 752	F G J K M F G J K M								CF	CF CF	CF CF	CF				DN	DN	DN DN	DN DN	DN DN	DG DG	DG DG	EB FR	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB
8,200 pF	822	F G J K M								CF	CF	CF					DN	DN	DN	DN		DG			EC	EC	EC	EB	EC	EC
9,100 pF	912	F G J K M								CF	CF	CF					DN	DN	DN	DN				EC	EC	EC	EC	EB	EC	EC
10,000 pF	103	F G J K M								CF	CF	CF					DN	DN	DN	DN	DP			ED	ED	ED	ED	EB	EC	EC
12,000 pF	123	F G J K M F G J K M								CF	CF	CF					DN	DN	DN	DN	DE			EB	EB	EB	EB	EB	ED	ED
15,000 pF 18,000 pF	153 183	F G J K M F G J K M								CF	CF	CF					DN DN	DN DN	DN DN	DP DP	DG			EB EB	EB EB	EB EB	EB EB	EB EB	EF EH	EF EH
22,000 pF	223	F G J K M															DP	DP	DP	DF				EB	EB	EB	EB	EC	EH	
27,000 pF	273	F G J K M															DF	DF	DF					EB	EB	EB	EB	EE		
	Com	Rated Voltage (VDC)	9	16	25	20	100	200	250	10	9	25	20	9	200	250	9	9	25	20	100	200	250	9	16	25	20	100	200	250
Сар	Cap Code	Voltage Code	8	4	3	5	1	2	Α	8	4	3	5	1	2	Α	8	4	3	5	1	2	Α	8	4	3	5	1	2	Α
		Case Size/Series			CO	402	2C					C	060	ЗС					C	808	C					C,	1206	3C		
		L					_					_	_																	

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).

These products are protected under US Patents 7,172,985 and 7,670,981, other patents pending, and any foreign counterparts.



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

	Сар	Case Size/ Series			C)402	2C					CO)60	3C					C	080	5C				C1206C							
Cap	Code	Voltage Code	8	4	3	5	1	2	Α	8	4	3	5	1	2	Α	8	4	3	5	1	2	Α	8	4	3	5	1	2	Α		
	Coue	Rated Voltage (VDC)	10	16	25	20	100	200	250	10	16	25	20	100	200	250	9	16	25	20	100	200	250	10	16	25	20	100	200	250		
		Capacitance Tolerance		Pro	odu	ct A	vail	abil	ity a	and	Chi	p Th	nick	nes	s C	ode	s – \$	See	Tab	le 2	for	Chi	p TI	nick	nes	s Di	ime	nsio	ns			
33,000 pF	333	F G J K M															DG	DG	DG					EB	EB	EB	EB	EE				
39,000 pF	393	F G J K M															DG	DG	DG					EC	EC	EC	EE	EH				
47,000 pF	473	F G J K M															DG	DG	DG					EC	EC	EC	EE	EH				
56,000 pF	563	F G J K M															İ							ED	ED	ED	EF					
68,000 pF	683	F G J K M																						EF	EF	EF	EH					
82,000 pF	823	F G J K M								İ							İ							EΗ	EH	EH	EH					
0.10 µF	104	F G J K M								İ							İ							EΗ	EH	EH						
68,000 pF	683	F G J K M								İ							İ							EF	EF	EF	EH					
82,000 pF	823	F G J K M								İ							İ							EΗ	EH	EH	EH					
0.10 µF	104	F G J K M																						EH	EH	EH						
		Rated Voltage (VDC)	9	9	25	20	9	200	250	10	16	25	20	9	200	250	ę	9	25	22	ē	200	250	ę	9	25	20	100	200	250		
Сар	Cap Code	Voltage Code	8	4	3	5	1	2	A	8	4	3	5	1	2	A	8	4	3	5	1	2	A	8	4	3	5			Α		
		Case Size/Series			C	0402	2C					C	0603	3C					C	080	5C					C,	1206	SC.				

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

				C				Siz						C	121	10	С				C18	308	С			C18	120	;		C18	250			C2:	220	С		(C22	250	
	Сар	H		_				es			+				Τ.	_		_		_	T.		T	\exists	_	_			_				_		Τ.	Τ.	+	_			
Cap		L			OII	ag	e (Coc	1e		4	8	4	3	5		1	2	A	5	1	2	_	<u> </u>	5	1	2	A	5	1	2	A	5	1	2			5	1	2	A
	Code		Ra	ate	d١	/ol	taç	ge (VE	C)	1	은	16	25	5	3	9	200	250	20	9	200		220	50	9	200	250	50	5	200	250	20	90	5	}	72O	20	100	200	250
		Г	(Ca	p	ac	it	an	C	•										Pr	odu	ct A	va	ila 2 f	bili	ty a	nd (Chip	Th	ickn	less	Co sior	des								
1.0 – 9.1 pF*	109 – 919*	I F	(0		-	a	110	_		+	FB	FB	FB	FE	3	FB	FB	FB	È	-	Iak	16	- 1	01 (JIII P	, , , , , ,	ICKI	1633	Dii	11611	3101	13				Т				
10 – 91 pF*	100 – 910*	٦	T			F	G	<u>،</u> ا	J I	۸ N		FB	FB	FB	FE		FB	FB	FB																						
100 – 300 pF*	101 – 301*	L				F	G				- 1	FB	FB	FB	FE		FB	FB	FB																						
330 – 430 pF*	331 – 431*	L				F	G					FB	FB	FB	FE		FB	FB	FB	LF	LF	LF	: L	.F																	
470 – 910 pF*	471 – 911*	L				F	G	3	Ш	۲ N	Л	FB	FB	FB	FE	3	FB	FB	FB	LF	LF	LF	L	.F	GB	GB	GB	GB													
1,000 pF	102	Т	Т	Т		F	G	_	_	< N	Л	FB	FB	FB	FE	3	FB	FB	FB	LF	LF	LF	L	.F	GB	GB	GB	GB							Т						
1,100 pF	112	ı				F	G	3	ı	۲ N	Л	FB	FB	FB	FE	3	FB	FB	FB	LF	LF	LF	L	.F	GB	GB	GB	GB													
1,200 pF	122	ı				F	G	3	ı	۲ N	Л	FB	FB	FB	FE	3	FB	FB	FB	LF	LF	LF	L	.F	GB	GB	GB	GB													
1,300 pF	132	ı				F	G	3	ı	۱)	Л	FB	FB	FB	FE		FB	FC	FC	LF	LF	LF	L	.F	GB	GB	GB	GB													
1,500 pF	152					F	G)	ı	۱)	Л	FB	FB	FB	FE		FB	FE	FE	LF	LF	LF	L	.F	GB	GB	GB	GB													
1,600 pF	162	L				F	G)	Ш	۱)	Л	FB	FB	FB	FE		FB	FE	FE	LF	LF			.F	GB	GB	GB	GB													
1,800 pF	182	L				F	G)	Ш	۱)	Л	FB	FB	FB	FE		FB	FE	FE	LF	LF	LF	L	.F	GB	GB	GB	GB													
2,000 pF	202	L				F	G)	Ш	۱)	Л	FB	FB	FB	FE		FC	FE	FE	LF	LF			.F	GB	GB	GB	GB													
2,200 pF	222	L				F	G	i J	Ш	۱)	Л	FB	FB	FB	FE		FC	FG	FG	LF	LF			.F	GB	GB	GB	GB													
2,400 pF	242	L				F	G	i J			_	FB	FB	FB	FE		FC	FC	FC	LF	LF	_	_	.F																	
2,700 pF	272	ı				F	G	i J			- 1	FB	FΒ	FB	FE	- 1	FC	FC	FC	LF	LF	LF	L	.F	GB	GB	GB	GB													
3,000 pF	302	ı				F	G	i J			- 1	FB	FΒ	FB	FE		FC	FF	FF	LF	LF			- 1																	
3,300 pF	332	ı				F	G	i J	۱þ	۱)			FΒ	FB	FE	- 1	FF	FF	FF	LF	LF			- 1	GB	GB	GB	GB													
3,600 pF	362	ı				F	G					FB	FB	FB	FE	- 1	FF	FF	FF	LF	LF			- 1																	
3,900 pF	392	L				F	G		_	_	_	FB	FB	FB	FE		FF	FF	FF	LF	LF				GB	GB	GB	GB	НВ	HB	НВ	HB									
4,300 pF	432	L				F	G	1 1		< N			FB	FB	FE		FF	FF	FF	LF	LF																				
4,700 pF	472	L				F	G) (J I	K N	Л	FF	FF	FF	FF		FG	FG	FG	LF	LF	_		_	GB	-		GD	НВ		_	HB					_	KE	KE	KE	KE
		L	Ra	ate	d١	/ol	taç	ge (VE	C)		9	16	25	5	3	100	200	250	20	100	200		220	20	9	700	250	20	ş	200	250	20	9	5		0C7	20	100	200	250
Сар	Cap Code		Voltage Code			8	4	3	5		1	2	A	5	1	2	1	A	5	1	2	Α	5	1	2	Α	5	1	2	1	۱ [5	1	2	Α						
		Case Size/Series			<u> </u>			C	121	100	c				C1	808	С			C18	12C	:		C18	250	;		C2	220	С		(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)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).

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

		Case Size/ Series			C.	1210	C				C18	080	;		C18	120	;		C18	250	;	(C22	200	;		C22	25 C	,
Сар	Cap	Voltage Code	8	4	3	5	1	2	Α	5	1	2	Α	5	1	2	Α	5	1	2	Α	5	1	2	Α	5	1	2	Α
Cap	Code	Rated Voltage (VDC)	9	16	25	20	ş	200	250	20	\$	200	250	20	ş	200	250	20	\$	200	250	20	19	200	250	20	\$	200	250
		Capacitance							.,,	Pro	duc	t A	aila	bili	ty a	nd (Chip	Thi	ickn	ess	Co	des		.,	.,,			.,	
5 400 5	540	Tolerance		- FD					F0		ee i	abi	e 2 1	or c	nıp	In	ickn	ess	DIN	nen	sior	IS				145	1/5	L/E	1/5
5,100 pF	512	F G J K M		FB	FB	FB	FG	FG	FG						OD	011	011	LID	LID	LID	un					KE	KE	KE	KE
5,600 pF	562	F G J K M		FB	FB FB	FB	FG	FG	FG					GB	GB	GH	GH	HR	НВ	НВ	НВ					KE	KE	KE	KE
6,200 pF	622	F G J K M		FB		FB	FG	FB	FB						0.0	0.1	0.1									KE	KE	KE	KE
6,800 pF	682	F G J K M		FB	FB	FB	FG	FB	FB					GB	GB	GJ	GJ	НВ	НВ	НВ	НВ	JE	JE	JB		KE	KE	KE	KE
7,500 pF	752	F G J K M		FC	FC	FC	FC	FB	FB							0.0	0.0									KE	KE	KE	KE
8,200 pF	822	F G J K M		FC	FC	FC	FC	FB	FB					GB	GH	GB	GB	НВ	НВ	НВ	НВ	JE	JE	JB		KE	KE	KE	KE
9,100 pF	912	F G J K M		FE	FE	FE	FE	FB	FB					۱												KE	KE	KE	KE
10,000 pF	103	F G J K M		FF	FF	FF	FF	FB	FB					GB	GH	GB	_	НВ	НВ	HE	HE	JE	JE	JB		KE	KE	KE	KE
12,000 pF	123	F G J K M		FG	FG	FG	FB	FB	FB					GB	GG	GB	1 -	НВ	НВ	HE	HE	JE	JE	JB		KE	KE	KE	KE
15,000 pF	153	F G J K M		FG	FG	FG	FB	FC	FC					GB	GB	GB	GB	НВ	НВ			JE	JE	JB		KE	KE	KE	KE
18,000 pF	183	F G J K M		FB	FB	FB	FB	FC	FC					GB	GB	GB	GB	НВ	HE			JE	JE	JB		KE	KE		
22,000 pF	223	F G J K M		FB	FB	FB	FB	FF	FF					GB	GB	GB	GB	НВ	HE			JE	JB	JB		KE	KE		
27,000 pF	273	F G J K M		FB	FB	FB	FB	FG	FG					GB	GB	GB	GB	НВ	HG			JE	JB	JB		KE	KE		
33,000 pF	333	F G J K M		FB	FB	FB	FB	FH	FH					GB	GB	GB	GB					JB	JB	JB		KE			ļ
39,000 pF	393	F G J K M		FB	FB	FB	FE	FH	FH					GB	GB	GB	GB					JB	JB	JB					
47,000 pF	473			FB	FB	FB	FE	FJ	FJ					GB	GB	GD	GD					JB	JB	JB					ļ
56,000 pF	563			FB	FB	FB	FF							GB	GB	GD	GD					JB	JB	JB					
68,000 pF	683	F G J K M		FB	FB	FC	FG							GB	GB	GK	GK					JB	JB	JB					
82,000 pF	823	F G J K M		FC	FC	FF	FH							GB	GB		GM					JB	JB	JB					
0.10 µF	104	F G J K M	FE	FE	FE	FG	FM							GB		GM	GM					JB	JB	JD					
0.12 µF	124	F G J K M	FG	FG	FG	FH								GB	GH							JB	JB	JD					
0.15 µF	154	F G J K M	FH	FH	FH	FM								GD	GN							JB	JB	JG					
0.18 µF	184	F G J K M	FJ	FJ	FJ									GH								JB	JD	JG					
0.22 µF	224	F G J K M	FK	FK	FK									GK								JB	JD	JL					
0.27 µF	274	F G J K M	I											İ								JB	JF			Ī			
0.33 µF	334	F G J K M	I											İ								JD	JG			Ī			
0.39 µF	394	F G J K M	I											İ								JG				l			
0.47 µF	474	F G J K M												l								JG							
	_	Rated Voltage (VDC)	9	16	25	20	100	200	250	20	100	200	250	50	100	200	250	20	100	200	250	20	100	200	250	50	100	200	250
Сар	Cap Code	Voltage Code	8	4	3	5	1	2	Α	5	1	2	Α	5	1	2	Α	5	1	2	Α	5	1	2	Α	5	1	2	Α
		Case Size/Series			C.	1210	C				C18	08C			C18	12C			C18	25C			C22	20C			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)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).

These products are protected under US Patents 7,172,985 and 7,670,981, other patents pending, and any foreign counterparts.



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

Thickness	Case	Thickness ±	Paper Q	uantity ¹	Plastic (Quantity
Code	Size ¹	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
BB	0402	0.50 ± 0.05	10,000	50,000	0	0
BD	0402	0.55 ± 0.05	10,000	50,000	0	0
CF CH	0603 0603	0.80 ± 0.07 0.85 ± 0.07	4,000 4,000	15,000 10,000	0	0
DN	0805	0.03 ± 0.07 0.78 ± 0.10	4,000	15,000	0	0
DP	0805	0.90 ± 0.10	4,000	15,000	Ö	0
DE	0805	1.00 ± 0.10	0	0	2,500	10,000
DF	0805	1.10 ± 0.10	0	0	2,500	10,000
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
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
ED	1206	1.00 ± 0.10	0	0	2,500	10,000
EE	1206	1.10 ± 0.10	0	0	2,500	10,000
EF EH	1206 1206	1.20 ± 0.15 1.60 ± 0.20	0 0	0	2,500 2,000	10,000 8,000
FB	1210	0.78 ± 0.10	0	0	4,000	10,000
FC	1210	0.70 ± 0.10 0.90 ± 0.10	0	ő	4,000	10,000
FE	1210	1.00 ± 0.10	Ö	ő	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
FH	1210	1.55 ± 0.15	0	0	2,000	8,000
FM	1210	1.70 ± 0.20	0	0	2,000	8,000
FJ	1210	1.85 ± 0.20	0	0	2,000	8,000
FK	1210	2.10 ± 0.20	0	0	2,000	8,000
NC	1706	1.00 ± 0.15	0	0	4,000	10,000
LF GB	1808 1812	1.00 ± 0.15 1.00 ± 0.10	0 0	0	2,500 1,000	10,000 4,000
GD	1812	1.25 ± 0.15	0	0	1,000	4,000
GH	1812	1.40 ± 0.15	Ő	ő	1,000	4,000
GG	1812	1.55 ± 0.10	Ö	Ö	1,000	4,000
GK	1812	1.60 ± 0.20	0	0	1,000	4,000
GJ	1812	1.70 ± 0.15	0	0	1,000	4,000
GN	1812	1.70 ± 0.20	0	0	1,000	4,000
GM	1812	2.00 ± 0.20	0	0	500	2,000
HB	1825	1.10 ± 0.15	0	0	1,000	4,000
HE	1825	1.40 ± 0.15	0 0	0 0	1,000	4,000
HG JB	1825 2220	1.60 ± 0.20 1.00 ± 0.15	0	0	1,000 1,000	4,000 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	Ö	1,000	4,000
JG	2220	1.70 ± 0.15	0	0	1,000	4,000
JL	2220	2.00 ± 0.20	0	0	500	2,000
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.

¹ If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Table 2B - Bulk Packaging Quantities

Doolee	ulu u Tuu o	Loose Pa	ackaging		
Раска	ging Type	Bulk Bag	(default)		
Packagi	ng C-Spec ¹	N/	/A ²		
Cas	e Size	Packaging Quantities ((pieces/unit packaging)		
EIA (in)	Metric (mm)	Minimum	Maximum		
0402	1005				
0603	1608				
0805	2012		50,000		
1206	3216				
1210	3225	1			
1808	4520				
1812	4532				
1825	4564		20,000		
2220	5650				
2225	5664				

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

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



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

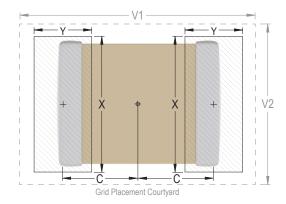
EIA Size Code	Metric Size Code	Density Level A: Maximum (Most) Land Protrusion (mm)						Media	sity Lev an (Nor rotrusio)	Density Level C: Minimum (Least) Land Protrusion (mm)				
Oouc	Oodc	C	Y	Х	V1	V2	С	Y	X	V1	V2	С	Υ	X	V1	V2
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	0.40	0.52	0.52	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

¹ 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

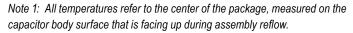
Recommended Soldering Technique:

- 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		
Profile realure	SnPb	100% Matte Sn		
Preheat/Soak				
Temperature Minimum (T _{Smin})	100°C	150°C		
Temperature Maximum (T _{Smax})	150°C	200°C		
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds		
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum		
Liquidous Temperature (T _L)	183°C	217°C		
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds		
Peak Temperature (T _P)	235°C	260°C		
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum		
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum		
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum		



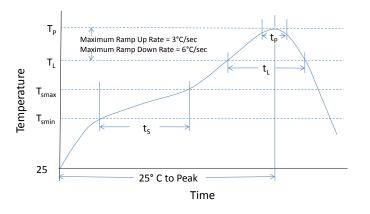




Table 4 - Performance & Reliability: Test Methods and Conditions

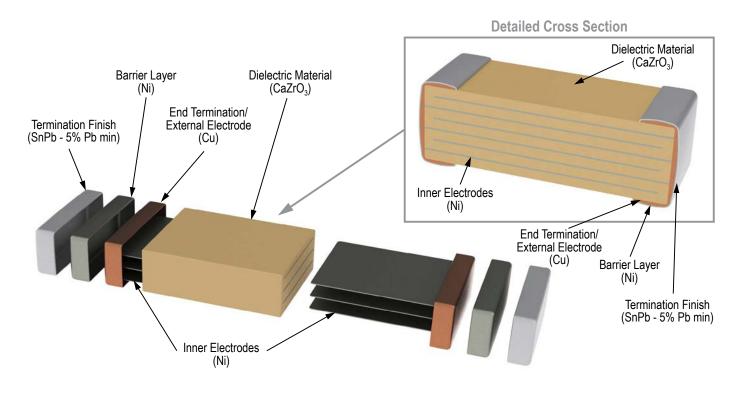
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Solderability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Colderability	0-010-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion. Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor.
Moisture Resistance	MIL-STD-202 Method 106	Measurement at 24 hours +/- 4 hours after test conclusion. t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
Vibration	MIL-STD-202 Method 204	5 g's for 20 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



Capacitor Marking (Optional):

Laser marking option is not available on:

- C0G, Ultra Stable X8R and Y5V dielectric devices
- EIA 0402 case size devices
- EIA 0603 case size devices with Flexible Termination option.
- KPS Commercial and Automotive grade stacked devices.

These capacitors are supplied unmarked only.

Commercial "L" Series, SnPb Termination, X7R Dielectric 6.3V – 250 VDC (Commercial Grade)



Overview

KEMET's Commercial "L" Series with Tin/Lead Termination surface mount capacitors in X7R dielectric are designed to meet the needs of critical applications where tin/lead end metallization is required. KEMET's tin/lead electroplating process is designed to meet a 5% minimum lead content and address concerns for a more robust and reliable lead containing termination system. As the bulk of the electronics industry moves towards RoHS compliance, KEMET continues to provide tin/lead terminated products for military, aerospace and industrial applications and will ensure customers have a stable and long-term source of supply.

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
- · Temperature stable dielectric
- Reliable and robust termination system
- 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, 50 V, 100 V, 200 V, and 250 V



Ordering Information

С	1210	С	226	K	8	R	Α	L	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec)
	0402 0603 0805 1206 1210 1808 1812 1825 2220 2225	C = Standard	Two Significant Digits + Number of Zeros	J = ±5% K = ±10% M = ±20%	9 = 6.3 8 = 10 4 = 16 3 = 25 6 = 35 5 = 50 1 = 100 2 = 200 A = 250	R = X7R	A = N/A	L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

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



Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec)
Bulk Bag/Unmarked	Not required (Blank)
7" Reel/Unmarked	TU
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
7" Reel/Marked	TM
13" Reel/Marked	7040 (EIA 0603 and smaller case sizes) 7215 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2mm pitch ²	7081
13" Reel/Unmarked/2mm pitch ²	7082

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits cont'd

- Capacitance offerings ranging from 10 pF to 22 μF
- Available capacitance tolerances of ±5%, ±10%, and ±20%
- · Non-polar device, minimizing installation concerns
- SnPb plated termination finish (5% Pb minimum)
- · Flexible termination option available upon request
- · Available for other surface mount products, additional dielectrics and higher voltage ratings upon request

Applications

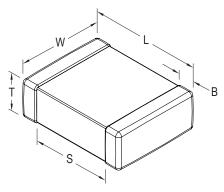
Typical applications include military, aerospace and other high reliability applications.

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. Please contact KEMET if you require a laser marked option. For more information see "Capacitor Marking".

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Dimensions – Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0402	1005	1.00 (.040) ± 0.05 (.002)	0.50 (.020) ± 0.05 (.002)		0.30 (.012) ± 0.10 (.004)	0.30 (.012)	Solder Reflow Only
0603	1608	1.60 (.063) ± 0.15 (.006)	0.80 (.032) ± 0.15 (.006)		0.35 (.014) ± 0.15 (.006)	0.70 (.028)	
0805	2012	2.00 (.079) ± 0.20 (.008)	1.25 (.049) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	Solder Wave or Solder Reflow
1206	3216	3.20 (.126) ± 0.20 (.008)	1.60 (.063) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)		
1210¹	3225	3.20 (.126) ± 0.20 (.008)	2.50 (.098) ± 0.20 (.008)	See Table 2 for	0.50 (0.02) ± 0.25 (.010)		
1808	4520	4.70 (.185) ± 0.50 (.020)	2.00 (.079) ± 0.20 (.008)	Thickness	0.60 (.024) ± 0.35 (.014)		
1812	4532	4.50 (.177) ± 0.30 (.012)	3.20 (.126) ± 0.30 (.012)		0.60 (.024) ± 0.35 (.014)	N/A	
1825	4564	4.50 (.177) ± 0.30 (.012)	6.40 (.252) ± 0.40 (.016)		0.60 (.024) ± 0.35 (.014)		Solder Reflow Only
2220	5650	5.70 (.224) ± 0.40 (.016)	5.00 (.197) ± 0.40 (.016)		0.60 (.024) ± 0.35 (.014)		
2225	5664	5.60 (.220) ± 0.40 (.016)	6.40 (.248) ± 0.40 (.016)		0.60 (.024) ± 0.35 (.014)		

 $^{^{1}}$ For capacitance values ≥ 12 μF add 0.02 (0.001) to the width 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

These devices do not meet RoHS criteria due to the concentration of Lead (Pb) in the termination finish



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%
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
² Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ± 1 seconds and charge/discharge not exceeding 50mA)
³ Dissipation Factor (DF) Maximum Limit @ 25°C	5%(6.3V & 10V), 3.5%(16V & 25V) and 2.5%(50V to 250V)
⁴Insulation Resistance (IR) Minimum Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ± 5 secs @ 25°C)

Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

 $1kHz \pm 50Hz$ and 1.0 ± 0.2 Vrms if capacitance ≤ $10\mu F$

120Hz \pm 10Hz and 0.5 ± 0.1 Vrms if capacitance >10 μ F

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

Post Environmental Limits

	High Temperature Life, Biased Humidity, Moisture Resistance										
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance						
	> 25		3.0								
X7R	16/25	All	5.0	±20%	10% of Initial Limit						
	< 16		7.5								

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

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

⁴To obtain IR limit, divide MΩ- μ F value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



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

			se S erie	ize/		C)402	2C				C)60	3C						C	080	5C							C	120	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
Сар	Code		d Vol	-	6.3	9	16	25	20	6.3	5	16	52	20	9	200	6.3	9	16	25	35	20	100	200	250	6.3	9	9	52	35	20	9	200	250
		Cap	(VDC) pacita pleran	nce	-					_																_				Dim				
10 – 91 pF*	100 – 910*	J	K	М	ВВ	ВВ	ВВ	ВВ	ВВ	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN		EB	EB	EB	EB	EB	EB	EB	EB	
100 – 150 pF**	101 – 151**	J	K	M	BB	BB	BB	ВВ	ВВ	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN			EB	EB	EB	EB	EB	EB	EB	EB	
180 – 820 pF**	181 – 821** 102	J	K K	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	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	EB
1000pF 1200 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		EB	EB	EB	EB	EB	EB	EB	EB	EB
1500 pF	152	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
1800 pF	182	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
2200 pF	222	J	K	M	ВВ	ВВ	BB	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
2700 pF	272	J	K	M	ВВ	BB	ВВ	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	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
3900 pF	392	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
4700 pF 5600 pF	472 562	J J	K K	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
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	DN	EB	EB	EB	EB	EB	EB	EB	EB	EB
8200 pF	822	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
10000 pF	103	J	K	М	ВВ	ВВ	BB	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
12000 pF	123	J	K	M	ВВ	BB	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	EB	EB
15000 pF	153	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DN		1	DN	EB	EB	EB	EB	EB	EB	EB	EB	EB
18000 pF	183	J	K	M	BB	BB	BB	BB	BB BB	CF	CF CF	CF	CF	CF	CF CF		DN	DN	DN	DN	DN	DN	DN	1	DN	EB	EB	EB	EB	EB	EB	EB	EB	EB EB
22000 pF 27000 pF	223 273	J	K	M	BB BB	BB BB	BB BB	BB BB	ВВ	CF CF	CF	CF CF	CF CF	CF CF	CF		DN DN	DN DN	DN DN	DN DN	DN DN	DN DN	DN DP	DN DE	DN	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	EB
33000 pF	333	J	K	M	BB	BB	BB	BB		CF	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DN	DP	DE		EB	EB	EB	EB	EB	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	EB	EB	EB	EC	EB	EB
47000 pF	473	J	K	М	ВВ	ВВ	ВВ	ВВ		CF	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DN	DE	DG		EB	EB	EB	EB	EB	EB	EC	ED	ED
56000 pF	563	J	K	M	ВВ	ВВ	ВВ			CF	CF	CF	CF	CF			DP	DP	DP	DP	DP	DP	DE	DG		EB	EB	EB	EB	EB	EB	EB	ED	ED
68000 pF	683	J	K	M	BB	BB	BB			CF	CF	CF	CF	CF			DP	DP	DP	DP	DP	DP	DE			EB	EB	EB	EB	EB	EB	EB	ED	ED
82000 pF	823	J	K	M	BB	BB	BB			CF	CF	CF	CF	CF			DP	DP	DP	DP	DP	DP	DE			EB	EB	EB	EB	EB	EB	EB	ED	ED
0.1 μF 0.12 μF	104 124	J	K K	M	BB	BB	BB			CF CF	CF CF	CF CF	CF CF	CF CF			DN DN	DN DN	DN DN	DN DN	DN DP	DN DP	DE DG			EB EC	EB	EB EC	EB	EB	EB EC	EB	EM EG	EM
0.12 μT 0.15 μF	154	J	K	M						CF	CF	CF	CF	CF			DN	DN	DN	DN	DP	DP	DG			EC	EC	EC	EC	EC	EC	EC	EG	
0.18 µF	184	J	K	M						CF	CF	CF	CF	0.			DN	DN	DN	DN	DG	DG	DG			EC	EC	EC	EC	EC	EC	EC		
0.22 µF	224	J	K	М	l					CF	CF	CF	CF				DN	DN	DN	DN	DG	DG	DG			EC	EC	EC	EC	EC	EC	EC		
0.27 μF	274	J	K	M						CF	CF	CF					DP	DP	DP	DP	DP	DP				EB	EB	EB	EB	EC	EC	EM		
0.33 μF	334	J	K	M						CF	CF	CF					DG	DG	DG	DG	DP	DP				EB	EB	EB	EB	EC	EC	EG		
0.39 µF	394	J	K	M						CF	CF	CF					DG	DG	DG	DG	DE	DE				EB	EB	EB	EB	EC	EC	EG		
0.47 μF 0.56 μF	474 564	J	K K	M						CF	CF	CF					DG DP	DG DP	DG DP	DG DG	DE DH	DE DH				EC ED	EC ED	EC ED	EC ED	EC	EC EC	EG		
0.68 μF	684	J	K	M													DP	DP	DP	DG	DH	DH				EE	EE	EE	EE	ED	ED			
0.82 µF	824	Ĵ	K	M	l												DP	DP	DP	DG						EF	EF	EF	EF	ED	ED			
1 μF	105	J	K	М													DP	DP	DP	DG						EF	EF	EF	EH	ED	ED			
1.2 µF	125	J	K	М														DE								ED	ED	ED	EG		EH			
1.5 µF	155	J	K	M														DG								ED	ED	ED	EG					
1.8 μF 2.2 μF	185 225	J	K K	M														DG DG								ED ED	ED ED	ED ED	EF EF		EH			
2.2 μF 2.7 μF	225 275	J J	K	M													DG	DG	DG							EN	EN		EH	CH	CH			
3.3 µF	335	J	K	M																						ED	ED		EH					
3.9 µF	395	Ĵ	K	M	l												l									EF	EF	EF	EH					
4.7 µF	475	J	K	М																						EF	EF	EF	EH					
5.6 µF	565	J	K	M																						EH	EH							
6.8 µF	685	J	K	M																						EH	EH							
8.2 μF 10 μF	825 106	J	K K	M																						EH	EH							
	0.5.		ed Vol (VDC)		6.3	2	9	25	20	6.3	9	9	52	20	ş	200	6.3	9	9	25	35	20	5	200	250	6.3	9	9	25	35	20	ş	200	250
Сар	Cap Code		age 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		C0805C									1200	6C								

 $^{^*}$ 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)



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

			se S Serie				(C12	100	;			C 1	808	3C		C 1	1812	2C		(C18	25C	;		C2	222	0C		(<u></u>	250	
	Сар		tage C		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
Сар	Code		ed Vol	tage	6.3	9	16	25	20	100	200	250	20	100	200	25	20	9	200	250	20	100	200	250	25	20	9	200	250	20	9	200	250
			pacita	nce		Pr	odı	ıct A	٩vai	ilab		and	d Cł	nip 7	Γhic	kne	ss (Cod		 - Se	e T	able		or C	l :hip	Thi	ickr	ness	Dir	l mer	ısio	ns	
10 – 91 pF*	100 – 910*	J	oleran K	M M	FB	FB	FB	FB	FB	FB	FB														Ė								
100 – 270 pF**	101 – 271**	J	K	М	FB	FB	FB	FB	FB	FB	FB														İ								
330 pF	331	J	K	M	FB	FB	FB	FB	FB	FB	FB		LF	LF	LF																		
390 pF	391	J	K	M	FB	FB	FB	FB	FB	FB	FB		LF	LF	LF																		
	471 – 122**	J	K	M	FB	FB	FB	FB	FB	FB	FB		LF	LF	LF	GB	GB		-														
1,500 pF	152	J	K	M	FB	FB	FB	FB	FB	FB	FE		LF	LF	LF	GB	GB	GB	GB														
1,800 pF	182	J	K	M	FB	FB	FB	FB	FB	FB	FE		LF	LF	LF	GB	GB	GB	GB														
2,200 pF	222	J	K	M	FB FB	FB	FB	FB	FB	FB	FB FB	FB FB	LF LF	LF LF	LF LF	GB GB	GB GB	GB	GB														
2,700 pF	272 332	J	K	M M	FB	FB FB	FB FB	FB FB	FB FB	FB FB	FB	FB	LF	LF	LF	GB	GB	GB GB	GB GB														
3,300 pF 3,900 pF	392	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LF	LF		GB	GB	GB	GB		НВ	НВ	НВ										
4,700 pF	472	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	LD	GB	GB	GB	GD		НВ	НВ	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	HB	HB	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	М	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	НВ	НВ			JE	JE	JE			KE	KE	KE	
18,000 pF	183	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	LD	GB	GB	GB	GB	GB	НВ	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	НВ	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		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	HB	HB	HB	JB	JB	JB			KE			
39,000 pF	393	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD		GB	GB	GB	GB	GB	НВ	НВ	НВ	НВ	JB	JB	JB						
47,000 pF	473	J	K	M	FB	FB	FB	FB	FB	FB	FC	FC	LD	LD		GB	GB	GB	GB	GB	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	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	HB	HB	HB	HB	JB	JB	JB	10	10				
82,000 pF	823 104	J	K	M M	FB FB	FB FB	FB FB	FB FB	FB FB	FC FD	FF FG	FF FG	LD LD			GB GB	GB GB	GB GB	GB GB	GB GB	HB HB	HB HB	HB HB	HB HB	JC	JC	JC JC	JC	JC JC	KC	KC	KC	KC
0.10 μF 0.12 μF	124	J	K	M	FB	FB	FB	FB	FB	FD	FH	FH	LD			GB	GB	GB	GB	GB	НВ	НВ	НВ	НВ	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.12 μΓ 0.15 μF	154	J	K	M	FC	FC	FC	FC	FC	FD	FM	FM	LD			GB	GB	GB	GE	GE	НВ	HB	НВ	HB	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.18 µF	184	J	K	M	FC	FC	FC	FC	FC	FD	FK	FK	LD			GB	GB	GB	GG			HB	НВ	HB	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.22 µF	224	Ĵ	K	M	FC	FC	FC	FC	FC	FD	FK					GB	GB	GB	GG		НВ	НВ	НВ	НВ	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.27 µF	274	Ĵ	K	M	FC	FC	FC	FC	FC	FD						GB	GB				НВ	НВ	НВ	НВ	JC	JC	JC	JC	JC	KB	KC	KC	KC
0.33 µF	334	J	K	М	FD	FD	FD	FD	FD	FD						GB	GB		GG		НВ	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		НВ	НВ	HD	HD	JC	JC	JC	JC	JC	KB	KC	KC	KC
0.47 µF	474	J	K	М	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	KΒ	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	М	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												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 FJ	FG							GO	GO				HD				JD JF	JD JF				KD			
2.2 μF 2.7 μF	225 275	J	K	M	FJ FE	FJ FE	FJ FE	FG	FG FH							GU	GO				HF				JF	JF				KD			
2.7 μF 3.3 μF	335	J	K	M	FF	FF	FF	FM	FM																								
3.9 µF	395	,]	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	Ĵ	K	M	FF	FF	FF	FH	. •																	-							
6.8 µF	685	J	K	M	FG		FG									ĺ									İ					ĺ			
8.2 µF	825	J	K	М	FH	_	FH	FK																									
		Rat	ed Vol		6.3	9	16	25	50	100	200	250	20	100	200	25	50	9	200	250	50	100	200	250	25	50	100	200	250	50	100	200	250
Com	Сар	Vo	(VDC) Itage C		9	_	4	3	5	1	2	7	5	1	2	3	5	1	2	Α	5	1	2	7	3	5	1	2	A .	5	1	2	A
Сар	Code		se Si		Ļ						_	,,			_	Ť				٠,				_	Ť				′`				
			Serie					C12	10C				C'	1808	sc —		C1	1812	2C		C1825C				C	2220	UC		l '	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)



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

			se S Serie	ize/ es			(C12	100	;			C,	180	BC		C1	1812	2C			C18	250	;		C2	222	C			C22	250	;
	Cap	Vol	tage (Code	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
Сар	Code	Rat	ed Vo	•	6.3	9	9	25	20	100	200	250	20	100	200	25	20	100	200	250	20	100	200	250	25	20	100	200	250	20	100	200	250
			pacita olerar			Pr	odı	ıct A	٩va	ilab	ility	an	d CI	hip '	Thic	kne	ss	Cod	les	– Se	e T	able	2 f	or C	hip	Thi	ckn	ess	Dii	ner	isio	ns	
10 μF	106	J	K	M	FH ¹	FH¹	FH¹	FS								GK									JF	JO							
12 µF	126	J	K	M	İ																												
15 µF	156	J	K	M	FM	FM																			JO	JO							
18 µF	186	J	K	M	İ																												
22 µF	226	J	K	M	FS	FS																			JO								
		Rat	ed Vo (VDC	•	6.3	9	9	25	20	9	200	250	50	100	200	25	20	9	200	250	20	90	200	250	25	20	100	200	250	20	9	200	250
Сар	Cap Code	Vol	Itage (Code	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 S Serie					C12	10C	;			С	1808	3C		C.	1812	2C			C18	25C	;		C2	2220	С			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)

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

Thickness	Case	Thickness ±	Paper Q	uantity¹	Plastic (Quantity
Code	Size ¹	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
DN	0805	0.78 ± 0.10	4,000	15,000	0	0
DP	0805	0.90 ± 0.10	4,000	15,000	0	0
DE	0805	1.00 ± 0.10	0	0	2,500	10,000
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
DH	0805	1.25 ± 0.20	0	0	2,500	10,000
EB	1206	0.78 ± 0.10	4,000	10,000	4,000	10,000
EC	1206	0.90 ± 0.10	0	0	4,000	10,000
EN	1206	0.95 ± 0.10	0	0	4,000	10,000
ED	1206	1.00 ± 0.10	0	0	2,500	10,000
EE	1206	1.10 ± 0.10	0	0	2,500	10,000
EF	1206	1.20 ± 0.15	0	0	2,500	10,000
EM	1206	1.25 ± 0.15	0	0	2,500	10,000
EG	1206	1.60 ± 0.15	0	0	2,000	8,000
EH	1206	1.60 ± 0.20	0	0	2,000	8,000
FB	1210	0.78 ± 0.10	0	0	4,000	10,000
FC	1210	0.90 ± 0.10	0	0	4,000	10,000
FD	1210	0.95 ± 0.10	0	0	4,000	10,000
FE	1210	1.00 ± 0.10	0	0	2,500	10,000
FF	1210	1.10 ± 0.10	0	0	2,500	10,000
FG	1210	1.25 ± 0.15	0	0	2,500	10,000
FL	1210	1.40 ± 0.15	0	0	2,000	8,000
FH	1210	1.55 ± 0.15	0	0	2,000	8,000
Thickness	Case	Thickness ±	7" Reel	13" Reel	7" Reel	13" Reel
Code	Size ¹	Range (mm)	Paper Q	uantity¹	Plastic (Quantity

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

Package quantity based on finished chip thickness specifications.

1 If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Table 2A - Chip Thickness/Tape & Reel Packaging Quantities cont'd

Thickness	Case	Thickness ±	Paper Q	uantity ¹	Plastic (Quantity
Code	Size ¹	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
FM	1210	1.70 ± 0.20	0	0	2,000	8,000
FJ	1210	1.85 ± 0.20	0	0	2,000	8,000
FK	1210	2.10 ± 0.20	0	0	2,000	8,000
FS	1210	2.50 ± 0.30	0	0	1,000	4,000
NA	1706	0.90 ± 0.10	0	0	4,000	10,000
NC	1706	1.00 ± 0.15	0	0	4,000	10,000
LD	1808	0.90 ± 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 ± 0.15	0	0	1,000	4,000
GG	1812	1.55 ± 0.10	0	0	1,000	4,000
GK	1812	1.60 ± 0.20	0	0	1,000	4,000
GJ	1812	1.70 ± 0.15	0	0	1,000	4,000
GO	1812	2.50 ± 0.20	0	0	500	2,000
HB	1825	1.10 ± 0.15	0	0	1,000	4,000
HC	1825	1.15 ± 0.15	0	0	1,000	4,000
HD	1825	1.30 ± 0.15	0	0	1,000	4,000
HE	1825	1.40 ± 0.15	0	0	1,000	4,000
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 ¹	Range (mm)	Paper Q	uantity¹	Plastic (Quantity

Package quantity based on finished chip thickness specifications.

1 If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Table 2B - Bulk Packaging Quantities

Doolee	ulu u Tuu o	Loose Pa	ackaging
Раска	ging Type	Bulk Bag	(default)
Packagi	ng C-Spec ¹	N/	/A ²
Cas	e Size	Packaging Quantities ((pieces/unit packaging)
EIA (in)	Metric (mm)	Minimum	Maximum
0402	1005		
0603	1608		
0805	2012		50,000
1206	3216		
1210	3225	1	
1808	4520		
1812	4532		
1825	4564		20,000
2220	5650		
2225	5664		

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

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



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

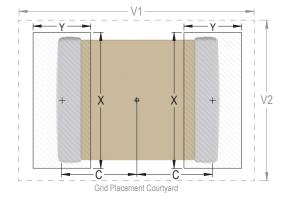
EIA Size Code	Metric Size Code	ı	Maxi	sity Lev mum (M rotrusio	lost))		Media	sity Lev an (Nor rotrusio)		Mini	sity Lev mum (L rotrusio)
Oodc	Oouc	С	Y	Х	V1	V2	С	Y	X	V1	V2	С	Y	Х	V1	V2
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	0.40	0.52	0.52	1.60	0.80
0603	1608	0.90	1.15	1.10	4.00	2.10	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

¹ 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

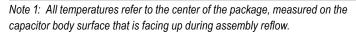
Recommended Soldering Technique:

- 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
Frome reature	SnPb	100% Matte Sn
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum



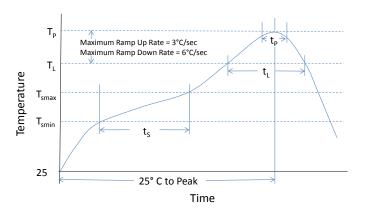




Table 4 - Performance & Reliability: Test Methods and Conditions

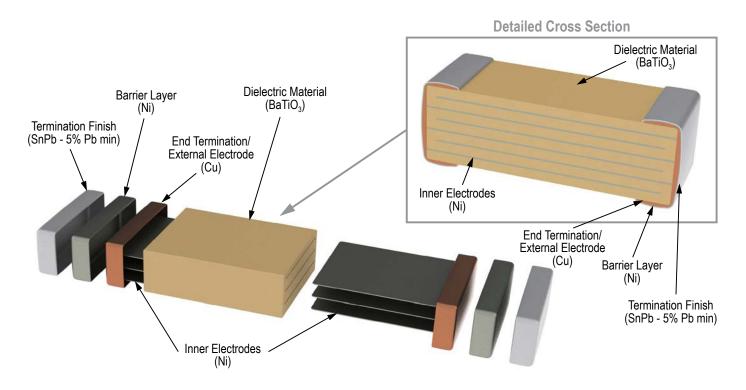
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Solderability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	0-31D-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion. Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
Vibration	MIL-STD-202 Method 204	5 g's for 20 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



Commercial "L" Series, SnPb Termination, X5R Dielectric 4 – 50 VDC (Commercial Grade)



Overview

KEMET's Commercial "L" Series with Tin/Lead Termination surface mount capacitors in X5R dielectric are designed to meet the needs of critical applications where tin/lead end metallization is required. KEMET's tin/lead electroplating process is designed to meet a 5% minimum lead content and address concerns for a more robust and reliable lead containing termination system. As the bulk of the electronics industry moves towards RoHS compliance, KEMET continues to provide tin/lead terminated products for military, aerospace and industrial applications and will ensure customers have a stable and long-term source of supply.

KEMET's X5R dielectric features an 85°C maximum operating temperature and is considered "semi-stable." The Electronics Industries Alliance (EIA) characterizes X5R 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. X5R 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 +85°C.

Benefits

- -55°C to +85°C operating temperature range
- · Temperature stable dielectric
- · Reliable & robust termination system
- EIA 0402, 0603, 0805, 1206, and 1210 case sizes
- $\bullet\,$ DC voltage ratings of 4 V, 6.3 V, 10 V, 16 V, 25 V, 35 V, and 50 V
- Capacitance offerings ranging from 12 nF to 22 μF
- Available capacitance tolerances of ±10% and ±20%
- Non-polar device, minimizing installation concerns
- SnPb plated termination finish (5% Pb minimum)
- SnPb plated termination finish option is available on other surface mount product series upon request.

Applications

Typical applications include decoupling, bypass, and filtering. Markets include military, aerospace and industrial.



Ordering Information

С	1210	С	106	K	4	Р	Α	L	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec)
	0402 0603 0805 1206 1210	C = Standard	Two significant digits + number of zeros.	K = ±10% M = ±20%	7 = 4 9 = 6.3 8 = 10 4 = 16 3 = 25 6 = 35 5 = 50	P = X5R	A = N/A	L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

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

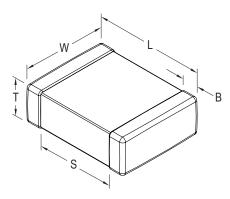


Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec)
Bulk Bag/Unmarked	Not required (Blank)
7" Reel/Unmarked	TU
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
7" Reel/Marked	TM
13" Reel/Marked	7040 (EIA 0603 and smaller case sizes) 7215 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2mm pitch ²	7081
13" Reel/Unmarked/2mm pitch ²	7082

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

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)	See Table 2 for Thickness	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	3225	3.20 (0.126) ±0.20 (0.008)	2.50 (0.098) ±0.20 (0.008)		0.50 (0.02) ±0.25 (0.010)	N/A	Solder Reflow Only

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. Please contact KEMET if you require a laser marked option. For more information see "Capacitor Marking".

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



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

These devices do not meet RoHS criteria due to the concentration of Lead (Pb) in the termination finish.

Electrical Parameters/Characteristics

Item	Parameters/Characteristics						
Operating Temperature Range	−55°C to +85°C						
Capacitance Change with Reference to +25°C and 0 Vdc Applied (TCC)	±15%						
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	5.0%						
² Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ± 1 seconds and charge/discharge not exceeding 50mA)						
³ Dissipation Factor (DF) Maximum Limit @ 25°C	See Dissipation Factor Limit Table						
⁴Insulation Resistance (IR) Minimum Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ± 5 secs @ 25°C)						

¹ 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.

1 kHz ± 50 Hz and 1.0 ± 0.2 Vrms if capacitance $\leq 10 \,\mu\text{F}$

120 Hz \pm 10 Hz and 0.5 \pm 0.1 Vrms if capacitance > 10 μ 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."

Post Environmental Limits

	High Temperature Life, Biased Humidity, Moisture Resistance									
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance					
	> 25	All	3.0							
	25	< 2.2 µF	7.5							
X5R	25	≥ 2.2 µF	20.0	±20%	10% of Initial Limit					
	< 25	< 0.56 µF	7.5							
	< 25	≥ 0.56 µF	20.0							

² DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³ Capacitance and dissipation factor (DF) measured under the following conditions:

⁴ To obtain IR limit, divide M Ω -μF value by the capacitance and compare to G Ω limit. Select the lower of the two limits.



Dissipation Factor Limit Table

Rated DC Voltage	Capacitance	Dissipation Factor (Maximum %)
> 25	All	2.5
25	< 2.2 µF	5.0
25	≥ 2.2 µF	10.0
< 25	< 0.56 µF	5.0
< 25	≥ 0.56 µF	10.0

Insulation Resistance Limit Table

EIA Case Size	1,000 Megohm Microfarads or 100 GΩ	500 Megohm Microfarads or 10 GΩ	100 Megohm Microfarads
0201	N/A	ALL	N/A
0402	< .012 µF	≥ .012 µF < 1.0 µF	≥ 1.0 µF
0603	< .047 µF	≥ .047 µf < 1.0 µF	≥ 1.0 µF
0805	< 0.15 µF	≥ 0.15 µF < 1.0 µF	≥ 1.0 µF
1206	< 0.47 µF	≥ 0.47 µF < 1.0 µF	≥ 1.0 µF
1210	< 0.39 µF	≥ 0.39 µF < 1.0 µF	≥ 1.0 µF
1812	< 2.2 µF	≥ 2.2 µF	N/A



Table 1 – Capacitance Range/Selection Waterfall (0402 – 1210 Case Sizes)

	0-4		Size/		(C 04	020	;			(C 06	030	;			(208	050	;			C 1	20	6C			(C12	100	;	
Сар	Сар	Voltag	e Code	7	9	8	4	3	5	7	9	8	4	3	5	7	9	8	4	3	5	9	8	4	3	5	9	8	4	3	6	5
·	Code	Rated \ (VI	Voltage DC)	4	6.3	5	16	25	20	4	6.3	10	16	25	20	4	6.3	9	16	25	20	6.3	9	16	25	20	6.3	9	16	52	35	20
		Cap To					_	odu	ct A	aila	bility	/ and	d Ch	ip Th	ickr	ness	Coc	les -	- See	Tab	le 2	for (Chip	Thic	ckne	ss D	ime	nsio	ns		_	
12,000 pF	123	K	M	BB	BB	BB	BB																									
15,000 pF 18,000 pF	153 183	K K	M M	BB BB	BB BB	BB BB	BB BB																									
22,000 pF	223	K	M	BB	BB	BB	BB																									
27,000 pF	273	K	M	BB	BB	BB	BB																									
33,000 pF	333	K	M	ВВ	BB	BB	BB																									
39,000 pF	393	K	M	ВВ	BB	BB	BB																				i					
47,000 pF	473	К	М	ВВ	ВВ	ВВ	ВВ																				i					
56,000 pF	563	K	М	ВВ	ВВ	ВВ	ВВ															İ					İ					
68,000 pF	683	K	М	ВВ	ВВ	ВВ	ВВ																									
82,000 pF	823	K	М	ВВ	ВВ	ВВ	BB																									
0.10 µF	104	K	M	ВВ	BB	BB	BB																									
0.12 µF	124	K	М																													
0.15 µF	154	K	М																													
0.18 µF	184	K	М																													
0.22 µF	224	K	M							00		00																				
0.27 µF	274	K	M							CG	CG	CG	CG									EB	EB	EB	EB							
0.33 µF	334	K	M							CG	CG	CG	CG									EB EB	EB	EB	EB							
0.39 µF	394 474	K K	M M							CG CG	CG CG	CG CG	CG CG			DN	DN	DN	DN	DN		EC	EB EC	EB EC	EB EC		FD FD	FD FD	FD FD	FD FD	FD FD	FD FD
0.47 µF 0.56 µF	564	K	M							CG	CG	CG				DP	DN DP	DP	DP	DP		ED	ED	ED	ED		FD	FD	FD	FD	FD	FD
0.56 μF 0.68 μF	684	K	M							CG	CG	CG	CG			DE	DE	DE	DE	DE		EE	EE	EE	EE		FD	FD	FD	FD	FD	FD
0.82 μF	824	K	M							CG	CG	CG	CG			DF	DF	DF	DF	DF		EF	EF	EF	EF		FF	FF	FF	FF	FF	FF
1.0 μF	105	K	M							CG		CG				DG	DG		DG	DG		EF	EF	EF	EH		FH	FH	FH	FH	FH	FH
1.2 µF	125	K	M	Ī							00	00				DN	DN		DN			EC.	EC	EC.	EC		FD	FD	FD	FD		
1.5 µF	155	K	M													DN	DN	DN	DN			EC	EC	EC	EC		FD	FD	FD	FD		
1.8 µF	185	K	М													DP	DP	DP	DP			EC	EC	EC	EC		FD	FD	FD	FD		
2.2 µF	225	K	М													DP	DP	DP	DP			EE	EE	EE	EE		FG	FG	FG	FG		
2.7 µF	275	К	М													DL	DL	DL	DL			EF	EF	EF	EF		FG	FG	FG	FG		
3.3 µF	335	К	М	İ												DE	DE	DE	DH			EΗ	EH	EH	EH		FΗ	FH	FH	FH	FM	FM
3.9 µF	395	K	М													DH	DH	DH	DH			EH	EH	EH	EH		FJ	FJ	FJ	FJ	FK	FK
4.7 μF	475	K	М													DH	DH	DH	DG			EH	EH	EH	EH		FK	FK	FK	FE	FS	FS
5.6 µF	565	К	М													DH	DH	DH				EK	EK	EH			FG	FG	FG	FE		
6.8 µF	685	K	М													DH	DH	DH				EK	EK	EH			FJ	FJ	FJ	FJ		
8.2 μF	825	K	М																			ED	ED	EH			FK	FK	FK	FG		
10 µF	106	K	М																			EH	EH	EH			FK	FK	FK	FH		
12 µF	126	K	М																													
15 µF	156	K	М																													
18 µF	186	K	M																								.	F.,				
22 µF	226	K	М	\vdash							_		_	\vdash	\dashv							\vdash					ΓĦ	FH	гJ		_	\dashv
			Voltage DC)	4	6.3	9	9	52	20	4	6.3	9	16	22	20	4	6.3	9	9	52	20	6.3	2	16	52	20	6.3	2	16	52	32	20
Capacitance	Cap Code	Voltag	e Code	7	9	8	3	5	4	7	9	8	4	3	5	7	9	8	4	3	5	9	8	4	3	5	9	8	4	3	6	5
			Size/ ries			C04	102C					C06	03C					C08	05C				С	1206	6C				C12	10C		



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

Thickness	Case	Thickness ±	Paper Q	uantity ¹	Plastic (Quantity
Code	Size ¹	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
BB	0402	0.50 ± 0.05	10,000	50,000	0	0
CG	0603	0.80 ± 0.10	4,000	15,000	0	0
DN	0805	0.78 ± 0.10	4,000	15,000	0	0
DP	0805	0.90 ± 0.10	4,000	15,000	0	0
DL	0805	0.95 ± 0.10	0	0	4,000	10,000
DE	0805	1.00 ± 0.10	0	0	2,500	10,000
DF	0805	1.10 ± 0.10	0	0	2,500	10,000
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
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
EK	1206	0.80 ± 0.10	0	0	2,000	8,000
EC	1206	0.90 ± 0.10	0	0	4,000	10,000
ED	1206	1.00 ± 0.10	0	0	2,500	10,000
EE	1206	1.10 ± 0.10	0	0	2,500	10,000
EF	1206	1.20 ± 0.15	0	0	2,500	10,000
EH	1206	1.60 ± 0.20	0	0	2,000	8,000
FD	1210	0.95 ± 0.10	0	0	4,000	10,000
FE	1210	1.00 ± 0.10	0	0	2,500	10,000
FF	1210	1.10 ± 0.10	0	0	2,500	10,000
FG	1210	1.25 ± 0.15	0	0	2,500	10,000
FH	1210	1.55 ± 0.15	0	0	2,000	8,000
FM	1210	1.70 ± 0.20	0	0	2,000	8,000
FJ	1210	1.85 ± 0.20	0	0	2,000	8,000
FK	1210	2.10 ± 0.20	0	0	2,000	8,000
FS	1210	2.50 ± 0.30	0	0	1,000	4,000
Thickness	Case	Thickness ±	7" Reel	13" Reel	7" Reel	13" Reel
Code	Size ¹	Range (mm)	•	luantity ¹	Plastic (Quantity

Package quantity based on finished chip thickness specifications.

¹ If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Table 2B - Bulk Packaging Quantities

Deale		Loose P	ackaging
Раска(ging Type	Bulk Bag	g (default)
Packagi	ing C-Spec ¹	N.	/A ²
Cas	se Size	Packaging Quantities	(pieces/unit packaging)
EIA (in)	Metric (mm)	Minimum	Maximum
0402	1005		
0603	1608		
0805	2012		50,000
1206	3216		
1210	3225	1	
1808	4520		
1812	4532		
1825	4564		20,000
2220	5650		
2225	5664		

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

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



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

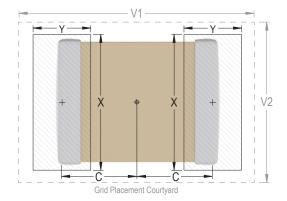
EIA Size Code	Metric Size Code	ı	Density Level A: Maximum (Most) Land Protrusion (mm) Density Level B: Median (Nominal) Land Protrusion (mm)						Density Level C: Minimum (Least) Land Protrusion (mm)							
Oode	Oode	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Υ	X	V1	V2
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	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

¹ 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

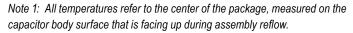
Recommended Soldering Technique:

- 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
Profile realure	SnPb	100% Matte Sn
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum



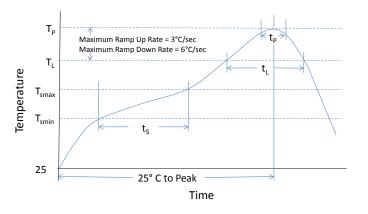




Table 4 - Performance & Reliability: Test Methods and Conditions

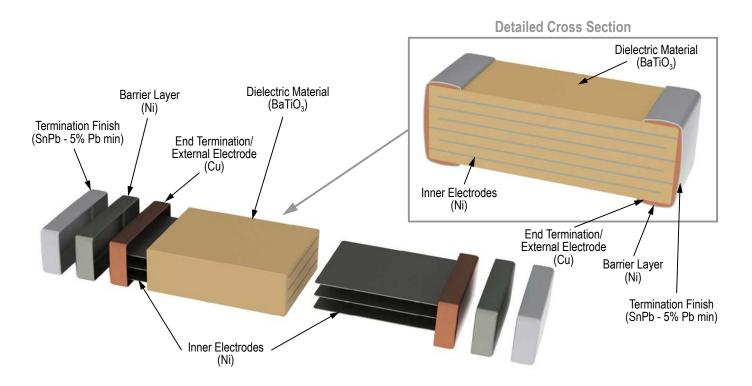
Stress	Reference		Test or Inspection M	ethod							
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.									
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system $-2.0 \ \text{mm}$ (minimum) for all except 3 mm for C0G. Flexible termination system $-3.0 \ \text{mm}$ (minimum).									
		Magnification 50 X. Conditions:									
Caldarah iliku	L CTD 000	a) Method B, 4 hours at 7	l55°C, dry heat at 235°C								
Solderability	J-STD-002	b) Method B at 215°C ca	tegory 3								
		c) Method D, category 3	at 260°C								
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C	c). Measurement at 24 hours	+/- 4 hours after test conclusion.							
Biased Humidity	MIL-STD-202 Method 103	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion. Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.									
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.									
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air – Air.									
		1,000 hours at 85°C with 2 X rated voltage applied excluding the following:									
		Case Size	Capacitance	Applied Voltage							
		0402	≥ 0.22 µF								
High Temperature Life	MIL-STD-202 Method 108 /FIA-198	0603	≥ 1.0 µF								
	/EIA-190	0805	≥ 4.7 µF	1.5 X							
		1206	≥ 2.2 µF								
		1210	≥ 10 µF								
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, Condition F.									
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, (OKEM Clean or equivalent.								

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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)



Commercial Off-The-Shelf (COTS) for Higher Reliability Applications, C0G Dielectric, 10 – 250 VDC

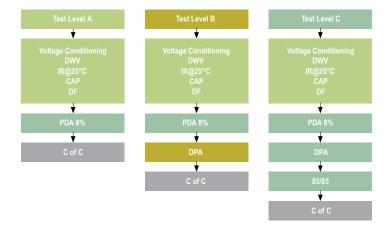


Overview

KEMET's COTS program is an extension of KEMET knowledge of high reliability test regimes and requirements. KEMET regularly supplies "up-screened" products by working with customer drawings and imposing specified design and test requirements. The COTS program offers the same high quality and high reliability components as up-screened products, but at a lower cost to the customer. This is accomplished by eliminating the need for customer-specific drawings to achieve the reliability level required for customer applications. A series of tests and inspections have been selected to provide the accelerated conditioning and 100% screening necessary to eliminate infant mortal failures from the population.

KEMET's COG dielectric features a 125°C maximum operating temperature and is considered "stable." The Electronics Components, Assemblies & Materials Association (EIA) characterizes COG dielectric as a Class I material. Components of this classification are temperature compensating and are suited for resonant circuit applications or those where Q and stability of capacitance characteristics are required. COG exhibits no change in capacitance with respect to time and voltage and boasts a negligible change in capacitance with reference to ambient temperature. Capacitance change is limited to ±30 ppm/°C from −55°C to +125°C.

All COTS testing includes voltage conditioning and post-electrical testing as per MIL–PRF–55681. For enhanced reliability, KEMET also provides the following test level options and conformance certifications:





Ordering Information

С	1206	Т	104	K	5	G	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance ¹	Rated Voltage (VDC)	Dielectric	Failure Rate/Design	Termination Finish ²	Packaging/Grade (C-Spec)
	0402 0603 0805 1206 1210 1812 2220	T = COTS	Two significant digits + number of zeros Use 9 for 1.0 – 9.9 pF Use 8 for 0.5 – .99 pF ex. 2.2 pF = 229 ex. 0.5 pF = 508	$B = \pm 0.10 \text{ pF}$ $C = \pm 0.25 \text{ pF}$ $D = \pm 0.5 \text{ pF}$ $F = \pm 1\%$ $G = \pm 2\%$ $J = \pm 5\%$ $K = \pm 10\%$ $M = \pm 20\%$	8 = 10 4 = 16 3 = 25 6 = 35 5 = 50 1 = 100 2 = 200 A = 250	G = C0G	A = Testing per MIL-PRF- 55681 PDA 8% B= Testing per MIL-PRF- 55681 PDA 8%, DPA per EIA-469 C = Testing per MIL- PRF-55681 PDA 8%, DPA per EIA-469, Humidity per MIL-STD-202, Method 103, Condition A	C = 100% Matte Sn L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

¹ Additional capacitance tolerance offerings may be available. Contact KEMET for details.

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



Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec)
Bulk Bag/Unmarked	Not required (Blank)
7" Reel/Unmarked	TU
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2 mm pitch ²	7081
13" Reel/Unmarked/2 mm pitch ²	7082

Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- -55°C to +125°C operating temperature range
- Lead (Pb)-Free, RoHS and REACH compliant
- Voltage conditioning and post-electrical testing per MIL–PRF– 55681, Paragraph 4.8.3.1, Standard Voltage Conditioning
- Destructive Physical Analysis (DPA) per EIA–469
- Humidity, steady state, low voltage (85/85) per MIL–STD–202, Method 103, Condition A
- RoHS Compliant (excluding SnPb end metallization option)
- EIA 0402, 0603, 0805, 1206, 1210, 1812, and 2220 case sizes
- DC voltage ratings of 10 V, 16 V, 25 V, 50 V, 100 V, 200 V and 250 V
- Capacitance offerings ranging from 0.5 pF up to 0.47 μF
- Available capacitance tolerances of ±0.10 pF, ±0.25 pF, ±0.5 pF,
 SnPb end metallization option available upon request ±1%, ±2%, ±5%, ±10%, and ±20%

- · Certificate of compliance
- No piezoelectric noise
- Extremely low ESR and ESL
- High thermal stability
- · High ripple current capability
- · Preferred capacitance solution at line frequencies and into the MHz range
- No capacitance change with respect to applied rated DC voltage
- Negligible capacitance change with respect to temperature
- · No capacitance decay with time
- · Non-polar device, minimizing installation concerns
- (5% Pb minimum)

Applications

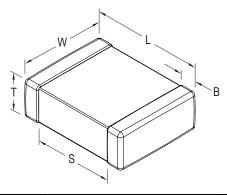
Typical applications include military, space quality and high reliability electronics.

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. The option to laser mark is not available on these devices. For more information see "Capacitor Marking".

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Dimensions – Millimeters (Inches)



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

Qualification/Certification

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

Environmental Compliance

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)	±30 ppm/°C
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	0%
¹ Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)
² Dissipation Factor (DF) Maximum Limit @ 25°C	0.1%
³ Insulation Resistance (IR) Limit @ 25°C	1,000 megohm microfarads or 100 G Ω (Rated voltage applied for 120 ±5 seconds @ 25°C)

DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

Capacitance and Dissipation Factor (DF) measured under the following conditions:

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."

Post Environmental Limits

High Temperature Life, Biased Humidity, Moisture Resistance													
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance								
C0G	All	All	0.5	0.3% or ±0.25 pF	10% of Initial Limit								

²Capacitance and dissipation factor (DF) measured under the following conditions:

¹ MHz ±100 kHz and 1.0 Vrms ±0.2 V if capacitance ≤ 1,000 pF

¹ kHz ±50 Hz and 1.0 Vrms ±0.2 V if capacitance > 1,000 pF

 $^{{}^{3}}$ To obtain IR limit, divide M Ω - μ F value by the capacitance and compare to G Ω limit. Select the lower of the two limits.



Table 1A – Capacitance Range/Selection Waterfall (0402 – 0805 Case Sizes)

		С	Case Size/Series					S	C0402T									C	0603	BT					С	0805				
	Сар	Voltage Code					8	4	3	5	1	2	Α	8	4	3	5	1	2	Α	8	4	3	5	1	2	Α			
Capacitance	Code	Rated Voltage (VDC)			C)	<u> </u>	9	52	22	5	200	220	10	19	, 25	20	5	7 200	250	9	19	52	20	100	200	250				
		Capacitance				_	_	7	.c	=												7	2	=	~	7;				
		Tolerance						Product Availability and Chip Thickness Codes See Table 2 for Chip Thickness Dimensions																						
0.50 & 0.75 pF	508 & 758	В	С	D						BB	BB	BB	BB				CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN
1.0 - 9.1 pF* 10 - 91 pF*	109 - 919* 100 - 910*	В	С	D	F	G	J	K	М	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
100 pF	100 - 310				F	G	J	K	М	BB	BB	BB	BB	ВВ	BB	ВВ	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN
110 - 180 pF*	111 -181*				F	G	J	K	М	BB	BB	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN
200 - 270 pF*	201 - 271*				F	G	J	K	М	BB	BB	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN
300 pF	301				F	G	J	K	М	BB	BB	BB	BB	BB	BD	BD	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN
330 pF	331				F	G	J	K	M	BB	BB	BB	BB	BB	BD	BD	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN
360 pF 390 pF	361 391				F F	G G	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
430 pF	431				F	G	J	K	M	BB	BB	BB	BB	BB			CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN
470 pF	471				F	G	J	K	М	BB	BB	BB	BB	BB			CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DP	DP
510 - 820 pF*	511 - 821*				F	G	J	K	М	ВВ	BB	ВВ	ВВ	BB			CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN
910 pF	911				F	G	J	K	М	BB	BB	BB	BB	BB			CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DP	DP	DP
1,000 pF	102				F	G	J	K	М	BB	BB	BB	BB	BB			CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DP	DP	DP
1,100 pF 1,200 pF	112 122				F	G G	J	K	M M	BB BB	BB BB	BB BB	BB BB				CF CF	CF CF	CF CF	CF CF	CF CF	CH	CH	DN DN	DN DN	DN DN	DN DN	DN DN	DN DN	DN DN
1,300 pF	132				F	G	J	K	М	BB	BB	BB	BB				CF	CF	CF	CF	CF	CH	CH	DP	DP	DP	DP	DP	DN	DN
1,500 pF	152				F	G	J	K	M	BB	BB	BB	BB				CF	CF	CF	CF	CF	CH	CH	DP	DP	DP	DP	DP	DN	DN
1,600 pF	162				F	G	J	K	М	BB	BB	BB					CF	CF	CF	CF	CF	CH	CH	DP	DP	DP	DP	DP	DN	DN
1,800 pF	182				F	G	J	K	М	BB	BB	BB					CF	CF	CF	CF	CF	CH	CH	DP	DP	DP	DP	DP	DN	DN
2,000 pF	202				F	G	J	K	М	BB	BB	BB					CF	CF	CF	CF	CF	CH	CH	DN	DN	DN	DN	DN	DN	DN
2,200 pF	222				F	G	J	K	М	BB	BB	BB					CF	CF	CF	CF	CF	CH	СН	DN	DN	DN	DN	DN	DN	DN
2,400 pF 2,700 pF	242 272				F F	G G	J	K K	M M								CF CF	CF CF	CF CF	CF CF	CF CF			DN DN	DN DN	DN DN	DN DN	DN DN	DN DN	DN DN
3,000 pF	302				F	G	J	K	M								CF	CF	CF	CF	CF			DP	DP	DP	DP	DN	DN	DN
3,300 pF	332				F	G	J	K	М	İ							CF	CF	CF	CF	CF			DP	DP	DP	DP	DN	DN	DN
3,600 pF	362				F	G	J	ĸ	М	İ							CF	CF	CF	CF	CF			DP	DP	DP	DP	DN	DP	DP
3,900 pF	392				F	G	J	K	М								CF	CF	CF	CF	CF			DE	DE	DE	DE	DN	DP	DP
4,300 pF	432				F	G	J	K	М								CF	CF	CF	CF	CF			DE	DE	DE	DE	DN	DP	DP
4,700 pF 5,100 pF	472 512				F	G G	J	K K	M M	ŀ							CF CF	CF CF	CF CF	CF CF	CF			DE	DE DE	DE DE	DE DE	DN DN	DP DP	DP DP
5,600 pF	562				F	G	J	K	M								CF	CF	CF	CF				DN	DN	DN	DN	DN	DP	DP
6,200 pF	622				F	G	J	K	М								CF	CF	CF	CF				DN	DN	DN	DN	DN	DG	DG
6,800 pF	682				F	G	J	K	М								CF	CF	CF	CF				DN	DN	DN	DN	DN	DG	DG
7,500 pF	752				F	G	J	K	М								CF	CF	CF					DN	DN	DN	DN	DN	DG	DG
8,200 pF	822				F	G	J	K	М								CF	CF	CF					DN	DN	DN	DN	DN	DG	DG
9,100 pF 10.000 pF	912 103				F	G G	J	K	M M								CF CF	CF CF	CF CF					DN DN	DN DN	DN DN	DN DN	DN DP		
12,000 pF	123				F	G	J	K	M								CF	CF	CF					DN	DN	DN	DN	DE		
15,000 pF	153				F	G	J	K	M								CF	CF	CF					DN	DN	DN	DP	DG		
18,000 pF	183				F	G	J	K	М															DN	DN	DN	DP			
22,000 pF	223				F	G	J	K																DP	DP	DP	DF			
27,000 pF	273					G	J																	DF	DF	DF				
33,000 pF 39,000 pF	333 393				F	G G	J	K K																DG	DG DG	DG DG				
47,000 pF	473					G																		DG	DG	DG				
·		Ra	te	d V	_	_		$\overline{}$		ę	9	25	20	ş	200	250	10	9	25	20	9	200	250	ę	9	25	20	9	200	250
Capacitance	Cap Code		٧	olt	ag	e C	od	le		8	4	3	5	1	2	Α	8	4	3	5	1	2	Α	8	4	3	5	1	2	Α
	Joue		Cas	se :	Siz	e/\$	Ser	ies	;			С	0402	2T			C0603T							C0805T						

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).

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

			Case Size/Series					C	120	6T					С	1210)T				C18	12T		С	2220)T					
	Сар	r		Vo	olta	age	e C	coc	le		8	4	3	5	1	2	Α	8	4	3	5	1	2	Α	5	1	2	Α	5	1	2
Capacitance	Code	ļ,				Ť				OC)	10	16	25	20	100	200	20	5	16	25	20	100	200	250	20	100	200	250	20	100	200
	Code	ŀ								,	_	_	N	4,	7		7										Ñ	8	4,	7	Ñ
					To																										
1.0 - 9.1 pF*	109 - 919*	T	3 (С	D			Ι.			EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB							
10 - 91 pF* 100 - 430 pF*	100 - 910* 101 - 431*					F F	G G	J	K		EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	FB FB	FB FB	FB FB	FB FB	FB FB	FB FB	FB FB							
470 - 910 pF*	471 - 911*					F	G	J	K		EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB			
1,000 pF	102	١				F	G	J	K		EB	EB	EB	EB	EB	EE	EE	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB			
1,100 pF	112	T				F	G	J	K		EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB			
1,200 pF	122	İ				F	G	J	K		EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB			
1,300 pF	132	İ				F	G	J	K	М	EB	EB	EB	EB	EC	EC	EC	FB	FB	FB	FB	FB	FC	FC	GB	GB	GB	GB	İ		
1,500 pF	152	İ			İ	F	G	J	K	М	EB	EB	EB	EB	ED	EC	EC	FB	FB	FB	FB	FB	FE	FE	GB	GB	GB	GB	İ		
1,600 pF	162	İ				F	G	J	K	М	EB	EB	EB	EB	ED	ED	ED	FB	FB	FB	FB	FB	FE	FE	GB	GB	GB	GB	Ī		
1,800 pF	182	ı				F	G	J	K	M	EB	EB	EB	EB	ED	ED	ED	FB	FB	FB	FB	FB	FE	FE	GB	GB	GB	GB			
2,000 pF	202					F	G	J	K	M	EB	EB	EB	EB	ED	ED	ED	FB	FB	FB	FB	FC	FE	FE	GB	GB	GB	GB			
2,200 pF	222					F	G	J	K		EB	EB	EB	EB	EE	EE	ED	FB	FB	FB	FB	FC	FG	FG	GB	GB	GB	GB			
2,400 pF	242					F	G	J	K		EB	EB	EB	EB	EC	EC	EC	FB	FB	FB	FB	FC	FC	FC							
2,700 pF	272					F	G	J	K		EB	EB	EB	EB	EC	EC	EC	FB	FB	FB	FB	FC	FC	FC	GB	GB	GB	GB			
3,000 pF	302					F	G	J	K		EC	EC	EC	EC	EC	EB	EB	FB	FB	FB	FB	FC	FF	FF	0.0	0.0	0.0	0.0			
3,300 pF	332					F	G	J	K		EC	EC	EC	EC	EE	EB	EB	FB	FB	FB	FB	FF	FF	FF	GB	GB	GB	GB			
3,600 pF	362					F F	G G	J	K		EC EC	EC	EC	EC EC	EE	EB EB	EB EB	FB	FB FB	FB FB	FB FB	FF FF	FF	FF	GB	GB	CD	GB			
3,900 pF 4,300 pF	392 432					F	G	J	K		EC	EC EC	EC	EC	EC	EB	EB	FB FB	FB	FB	FB	FF	FF FF	FF FF	GB	GB	GB	GB			
4,700 pF	472	H				F	G	J	K		EC	EC	EC	EC	EC	EB	EB	FF	FF	FF	FF	FG	FG	FG	GB	GB	GD	GD			
5,100 pF	512					F	G	J	K		ED	ED	ED	ED	ED	EB	EB	FB	FB	FB	FB	FG	FG	FG	GB	GB	GD	GD			
5,600 pF	562	ı				F	G	J	K		ED	ED	ED	ED	ED	EB	EB	FB	FB	FB	FB	FG	FG	FG	GB	GB	GH	GH			
6,200 pF	622	١				F	G	J	K		EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FG	FB	FB		05	0				
6,800 pF	682	ı				F	G	J	K		EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FG	FB	FB	GB	GB	GJ	GJ	JE	JE	JB
7,500 pF	752	Т		Т		F	G	J	K		EB	EB	EB	EB	EB	EB	EB	FC	FC	FC	FC	FC	FB	FB							
8,200 pF	822	İ				F	G	J	K	М	EC	EC	EC	EC	EB	EC	EC	FC	FC	FC	FC	FC	FB	FB	GB	GH	GB	GB	JE	JE	JB
9,100 pF	912	İ			İ	F	G	J	K	M	EC	EC	EC	EC	EB	EC	EC	FE	FE	FE	FE	FE	FB	FB	İ				İ		
10,000 pF	103					F	G	J	K	M	ED	ED	ED	ED	EB	EC	EC	FF	FF	FF	FF	FF	FB	FB	GB	GH	GB	GB	JE	JE	JB
12,000 pF	123					F	G	J	K	M	EB	EB	EB	EB	EB	ED	ED	FG	FG	FG	FG	FB	FB	FB	GB	GG	GB	GB	JE	JE	JB
15,000 pF	153					F	G	J	K		EB	EB	EB	EB	EB	EF	EF	FG	FG	FG	FG	FB	FC	FC	GB	GB	GB	GB	JE	JE	JB
18,000 pF	183	1				F	G	J	K		EB	EB	EB	EB	EB	EH	EH	FB	FB	FB	FB	FB	FC	FC	GB	GB	GB	GB	JE	JE	JB
22,000 pF	223					F	G	J	K		EB	EB	EB	EB	EC	EH	EH	FB	FB	FB	FB	FB	FF	FF	GB	GB	GB	GB	JE	JB	JB
27,000 pF	273					F	G	J	K		EB	EB	EB	EB	EE			FB	FB	FB	FB	FB	FG	FG	GB	GB	GB	GB	JE	JB	JB
33,000 pF	333					F	G	J	K		EB	EB	EB	EB	EE			FB	FB	FB	FB	FB	FH	FH	GB	GB	GB	GB	JB	JB	JB
39,000 pF	393					F F	G G	J	K		EC	EC	EC	EE	EH			FB	FB	FB FB	FB	FE	FH	FH	GB	GB	GB	GB	JB	JB	JB
47,000 pF 56,000 pF	473 563					F	G	J	K		EC ED	EC ED	EC	EF	EH			FB FB	FB FB	FB	FB FB	FE FF	FJ	FJ	GB GB	GB GB	GD GD	GD GD	JB JB	JB JB	JB JB
56,000 pF 68,000 pF	683					F	G	J	K		EF	EF	EF	EH				FB	FB	FB	FC	FG			GB	GB	GK	GK	JB	JB	JB
82,000 pF	823					F	G	J	K		EH	EH	EH	EH				FC	FC	FC	FF	FH			GB	GB	GM	GM	JВ	JB	JB
0.10 µF	104					F	G	J	K		EH	EH	EH					FE	FE	FE	FG	FM			GB	GD	GM	GM	JB	JB	JD
0.12 µF	124					F	G	J	K									FG	FG	FG	FH				GB	GH			JB	JB	JD
0.15 µF	154					F	G	J		M								FH	FH	FH	FM				GD	GN			JB	JB	JG
0.18 µF	184					F	G	J		M								FJ	FJ	FJ					GH				JB	JD	JG
0.22 µF	224					F	G	J		M								FK		FK					GK				JB	JD	JL
0.27 μF	274					F	G	J	K	M																			JB	JF	
0.33 μF	334					F	G	J		M																			JD	JG	
0.39 μF	394					F	G	J		M																			JG		
0.47 μF	474	+				F	G	J	K	М					+_	+_	 	├		-		_	_	_	<u> </u>	_	_	_	JG	_	_
	Сар	F	Rat	tec	V	olt	ag	je (VE	OC)	10	16	25	50	100	200	250	9	16	25	20	100	200	250	20	100	200	250	20	100	200
Capacitance	Code	L		V	olta	age	e C	oc	le		8	4	3	5	1	2	Α	8	4	3	5	1	2	Α	5	1	2	Α	5	1	2
			С	as	e S	Siz	e/s	Sei	rie	s				120	6T					C	1210	T				C18	12T		С	2220	T

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

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

Thickness	Case	Thickness ±	Paper Q	uantity¹	Plastic	Quantity
Code	Size ¹	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
BB	402	0.50 ± 0.05	10000	50000	0	0
BD	402	0.55 ± 0.05	10000	50000	0	0
CF	603	0.80 ± 0.07	4000	15000	0	0
CH	603	0.85 ± 0.07	4000	10000	0	0
DN DP	805 805	0.78 ± 0.10 0.90 ± 0.10	4000 4000	15000 15000	0	0
DE	0805	1.00 ± 0.10	4000	0	2,500	10,000
DF	0805	1.10 ± 0.10	0	0	2,500	10,000
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
EB	1206	0.78 ± 0.10	4,000	10,000	4,000	10,000
EC	1206	0.70 ± 0.10 0.90 ± 0.10	0	0	4,000	10,000
ED	1206	1.00 ± 0.10	0	Ö	2,500	10,000
EE	1206	1.10 ± 0.10	Ö	0	2,500	10,000
EF	1206	1.20 ± 0.15	0	0	2,500	10,000
EH	1206	1.60 ± 0.20	0	0	2,000	8,000
FB	1210	0.78 ± 0.10	0	0	4,000	10,000
FC	1210	0.90 ± 0.10	0	0	4,000	10,000
FE	1210	1.00 ± 0.10	0	0	2,500	10,000
FF	1210	1.10 ± 0.10	0	0	2,500	10,000
FG	1210	1.25 ± 0.15	0	0	2,500	10,000
FH	1210	1.55 ± 0.15	0	0	2,000	8,000
FM	1210	1.70 ± 0.20	0	0	2,000	8,000
FJ	1210	1.85 ± 0.20	0	0	2,000	8,000
FK	1210	2.10 ± 0.20	0	0	2,000	8,000
GB	1812	1.00 ± 0.10	0	0	1,000	4,000
GD	1812	1.25 ± 0.15	0	0	1,000	4,000
GH	1812	1.40 ± 0.15	0	0	1,000	4,000
GG	1812	1.55 ± 0.10	0	0	1,000	4,000
GK	1812	1.60 ± 0.20	0 0	0 0	1,000	4,000
GJ GN	1812 1812	1.70 ± 0.15	0	0	1,000 1,000	4,000 4,000
GN GM	1812	1.70 ± 0.20 2.00 ± 0.20	0	0	500	2,000
JB	2220	2.00 ± 0.20 1.00 ± 0.15	0	0	1,000	4,000
JD 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
JG	2220	1.70 ± 0.15	0	0	1,000	4,000
JL	2220	2.00 ± 0.20	Ő	Ő	500	2,000
Thickness	Case	Thickness ±	7" Reel	13" Reel	7" Reel	13" Reel
Code	Size ¹	Range (mm)	Paper Q	uantity¹	Plastic	Quantity

Package quantity based on finished chip thickness specifications.

¹ If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Table 2B - Bulk Packaging Quantities

Doolee	ulu u Tuu o	Loose Pa	ackaging
Раска	ging Type	Bulk Bag	(default)
Packagi	ng C-Spec ¹	N/	/A ²
Cas	e Size	Packaging Quantities ((pieces/unit packaging)
EIA (in)	Metric (mm)	Minimum	Maximum
0402	1005		
0603	1608		
0805	2012		50,000
1206	3216		
1210	3225	1	
1808	4520		
1812	4532		
1825	4564		20,000
2220	5650		
2225			

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

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



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

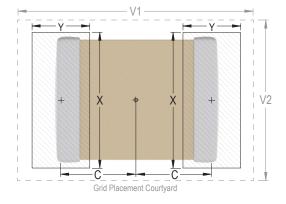
EIA Size Code	Metric Size Code	Density Level A: Maximum (Most) Land Protrusion (mm)					ı	Media	sity Lev an (Nor rotrusio)	Density Level C: Minimum (Least) Land Protrusion (mm)				
Oode	Oode	С	Y	Х	V1	V2	С	Y	X	V1	V2	С	Y	X	V1	V2
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	0.40	0.52	0.52	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
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
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

¹ 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

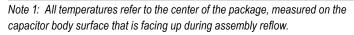
Recommended Soldering Technique:

- 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
Frome reature	SnPb	100% Matte Sn
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum



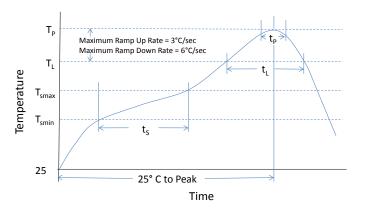




Table 4 - Performance & Reliability: Test Methods and Conditions

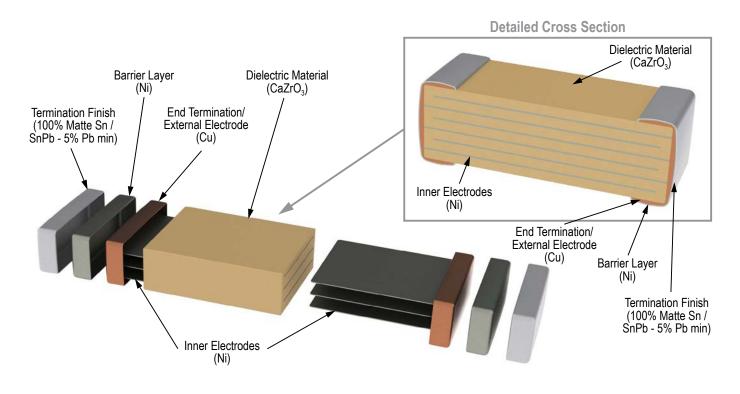
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Solderability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	J-31D-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion. Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
Vibration	MIL-STD-202 Method 204	5 g's for 20 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



Capacitor Marking (Optional):

Laser marking option is not available on:

- C0G, Ultra Stable X8R and Y5V dielectric devices
- EIA 0402 case size devices
- EIA 0603 case size devices with Flexible Termination option.
- KPS Commercial and Automotive grade stacked devices.

These capacitors are supplied unmarked only.

Commercial Off-The-Shelf (COTS) for Higher Reliability Applications, X7R Dielectric, 6.3 – 250 VDC

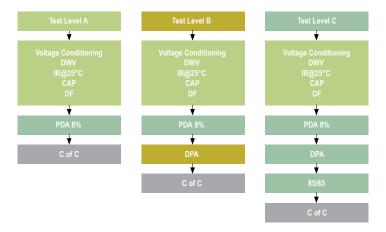


Overview

KEMET's COTS program is an extension of KEMET knowledge of high reliability test regimes and requirements. KEMET regularly supplies "up-screened" products by working with customer drawings and imposing specified design and test requirements. The COTS program offers the same high quality and high reliability components as up-screened products, but at a lower cost to the customer. This is accomplished by eliminating the need for customer-specific drawings to achieve the reliability level required for customer applications. A series of tests and inspections have been selected to provide the accelerated conditioning and 100% screening necessary to eliminate infant mortal failures from the population.

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.

All COTS testing includes voltage conditioning and post-electrical testing as per MIL–PRF–55681. For enhanced reliability, KEMET also provides the following test level options and conformance certifications:





Ordering Information

С	1210	T	104	K	5	R	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/Design	Termination Finish ¹	Packaging/Grade (C-Spec)
	0402 0603 0805 1206 1210 1812 2220	T = COTS	Two significant digits + number of zeros	J = ±5% K = ±10% M = ±20%	9 = 6.3 8 = 10 4 = 16 3 = 25 5 = 50 1 = 100 2 = 200 A = 250	R = X7R	A = Testing per MIL-PRF- 55681 PDA 8% B= Testing per MIL-PRF- 55681 PDA 8%, DPA per EIA-469 C = Testing per MIL-PRF- 55681 PDA 8%, DPA per EIA- 469, Humidity per MIL-STD-202, Method 103, Condition A	C = 100% Matte Sn L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

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



Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec)
Bulk Bag/Unmarked	Not required (Blank)
7" Reel/Unmarked	TU
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
7" Reel/Marked	TM
13" Reel/Marked	7040 (EIA 0603 and smaller case sizes) 7215 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2mm pitch ²	7081
13" Reel/Unmarked/2mm pitch ²	7082

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- -55°C to +125°C operating temperature range
- · Lead (Pb)-Free, RoHS and REACH compliant
- Voltage conditioning and post-electrical testing per MIL–PRF– 55681
- Destructive Physical Analysis (DPA) per EIA–469
- Biased humidity testing (85/85) per MIL-STD-202
- · Certificate of Compliance
- Temperature stable dielectric
- EIA 0402, 0603, 0805, 1206, 1210, 1812, and 2220 case sizes

- DC voltage ratings of 6.3 V, 10 V, 16 V, 25 V, 50 V, 100 V, 200 V, and 250 V
- Capacitance offerings ranging from 10 pF to 22 μF
- Available capacitance tolerances of ±5%, ±10%, and ±20%
- · Non-polar device, minimizing installation concerns
- 100% pure matte tin-plated termination finish allowing for excellent solderability
- SnPb termination finish option available upon request (5% Pb minimum)

Applications

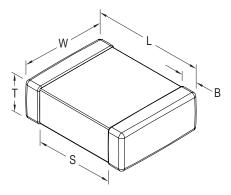
Typical applications include military, space quality and high reliability electronics.

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. Please contact KEMET if you require a laser marked option. For more information see "Capacitor Marking".

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Dimensions – Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0402	1005	1.00 (.040) ± 0.05 (.002)	0.50 (.020) ± 0.05 (.002)		0.30 (.012) ± 0.10 (.004)	0.30 (.012)	Solder Reflow Only
0603	1608	1.60 (.063) ± 0.15 (.006)	0.80 (.032) ± 0.15 (.006)		0.35 (.014) ± 0.15 (.006)	0.70 (.028)	
0805	2012	2.00 (.079) ± 0.20 (.008)	1.25 (.049) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	Solder Wave or Solder Reflow
1206	3216	3.20 (.126) ± 0.20 (.008)	1.60 (.063) ± 0.20 (.008)	See Table 2 for Thickness	0.50 (0.02) ± 0.25 (.010)		
1210¹	3225	3.20 (.126) ± 0.20 (.008)	2.50 (.098) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)	NI/A	
1812	4532	4.50 (.177) ± 0.30 (.012)	3.20 (.126) ± 0.30 (.012)		0.60 (.024) ± 0.35 (.014)	N/A	Solder Reflow Only
2220	5650	5.70 (.224) ± 0.40 (.016)	5.00 (.197) ± 0.40 (.016)		0.60 (.024) ± 0.35 (.014)		

¹ For capacitance values ≥ 4.7 μ 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%
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
² Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ± 1 seconds and charge/discharge not exceeding 50mA)
³ Dissipation Factor (DF) Maximum Limit @ 25°C	5%(6.3V & 10V), 3.5%(16V & 25V) and 2.5%(50V to 250V)
⁴Insulation Resistance (IR) Minimum Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ± 5 secs @ 25°C)

Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

 $1kHz \pm 50Hz$ and 1.0 ± 0.2 Vrms if capacitance ≤ $10\mu F$

120Hz \pm 10Hz and 0.5 ± 0.1 Vrms if capacitance >10 μ F

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

Post Environmental Limits

	High Temperature Life, Biased Humidity, Moisture Resistance									
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance					
	> 25		3.0							
X7R	16/25	All	5.0	±20%	10% of Initial Limit					
	< 16		7.5							

Insulation Resistance Limit Table

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

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

⁴To obtain IR limit, divide MΩ- μ F value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



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

			se S erie			CO)402	2T				CO	603	BT					(C 08	05T							C12	061	-		
Capacitance	Сар	Volt	age C	ode	9	8	4	3	5	9	8	4	3	5	1	2	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	Α
	Code		ed Vol		6.3	5	16	25	20	6.3	10	16	25	20	9	200	6.3	5	16	25	20	100	200	250	6.3	9	16	25	20	9	200	250
		Сар	acita	nce													bility															
10 – 91 pF*	100 – 910*	.J	leran K	M	BB	ВВ	BB	BB	ВВ	CF	CF	CF	CF	CF	CF	CF	DN DN	DN	DN	DN	DN	DN	DN		EB	EB	EB	EB	EB	EB	EB	
100 – 150 pF**	101 – 151**	J	K	M	ВВ	ВВ	ВВ	ВВ	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN		DN	DN		EB	EB	EB	EB	EB	EB	EB	
180 – 820 pF**	181 – 821**	J	K	M	BB	ВВ	ВВ	ВВ	ВВ	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN		DN	DN		EB	EB	EB	EB	EB	EB	EB	
1,000 pF	102 122	J	K	M	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	EB EB	EB EB	EB	EB	EB EB	EB EB	EB EB	EB EB
1,200 pF 1,500 pF	152	J	K K	M	BB	BB BB	BB BB	BB	BB	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
1,800 pF	182	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
2,200 pF	222	J	K	М	ВВ	ВВ	ВВ	ВВ	ВВ	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN		DN	DN	DN	EB	EB	EB	EB	EB	EB	EB	EB
2,700 pF	272	J	K	M	ВВ	ВВ	ВВ	ВВ	ВВ	CF	CF	CF	CF	CF	CF	CF	DN	DN		DN	DN	DN	DN	DN	EB	EB	EB	EB	EB	EB	EB	EB
3,300 pF	332	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
3,900 pF 4,700 pF	392 472	J J	K K	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	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB
5,600 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	EB	EB	EB	EB	EB
6,800 pF	682	J	K	M	ВВ	BB	ВВ	ВВ	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN		DN	DN	DN	EB	EB	EB	EB	EB	EB	EB	EB
8,200 pF	822	J	K	M	ВВ	ВВ	ВВ	ВВ	ВВ	CF	CF	CF	CF	CF	CF	CF	DN	DN		DN		DN	DN	DN	EB	EB	EB	EB	EB	EB	EB	EB
10,000 pF	103	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
12,000 pF 15,000 pF	123 153	J J	K K	M	BB BB	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 DP	DN DN	DN DN	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB	EB EB
18,000 pF	183	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DP	DN	DN	EB	EB	EB	EB	EB	EB	EB	EB
22,000 pF	223	Ĵ	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DP	DN	DN	EB	EB	EB	EB	EB	EB	EB	EB
27,000 pF	273	J	K	М	ВВ	ВВ	ВВ	ВВ		CF	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DP	DE		EB	EB	EB	EB	EB	EB	EB	EB
33,000 pF	333	J	K	М	ВВ	ВВ	ВВ	ВВ		CF	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DP	DE		EB	EB	EB	EB	EB	EB	EB	EB
39,000 pF	393 473	J	K K	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	DP	DE DG		EB EB	EB EB	EB EB	EB EB	EB EB	EC EC	EB ED	EB ED
47,000 pF 56,000 pF	563	J J	K	M	BB	BB	BB	ВВ		CF	CF	CF	CF	CF	CF		DP	DP	DP	DN DP	DN DP	DE DE	DG		EB	EB	EB	EB	EB	EB	ED	ED
68,000 pF	683	J	K	M	BB	BB	BB			CF	CF	CF	CF	CF			DP	DP	DP	DP	DP	DE	50		EB	EB	EB	EB	EB	EB	ED	ED
82,000 pF	823	J	K	M	ВВ	ВВ	ВВ			CF	CF	CF	CF	CF			DP	DP	DP	DP	DP	DE			EB	EB	EB	EB	EB	EB	ED	ED
0.10 µF	104	J	K	M	ВВ	ВВ	ВВ			CF	CF	CF	CF	CF			DN	DN	DN	DN	DN	DE			EB	EB	EB	EB	EB	EB	EM	EM
0.12 µF	124	J	K	M						CF	CF	CF	CF	CF			DN	DN	DN	DN	DP	DG			EC	EC	EC	EC	EC	EC	EG	
0.15 μF 0.18 μF	154 184	J	K K	M						CF CF	CF CF	CF CF	CF CF	CF			DN	DN	DN DN	DN DN	DP DP	DG DG			EC	EC EC	EC	EC	EC EC	EC	EG	
0.22 μF	224	J	K	M						CF	CF	CF	CF				DN	DN	DN	DN	DP	DG			EC	EC	EC	EC	EC	EC		
0.27 µF	274	J	K	М	İ					CF	CF	CF					DP	DP	DP	DP	DP				EB	EB	EB	EB	EC	EM		
0.33 μF	334	J	K	M						CF	CF	CF					DP	DP	DP	DP	DP				EB	EB	EB	EB	EC	EG		
0.39 µF	394	J	K	M						CF	CF CF	CF CF					DG	DG		DG	DE				EB	EB	EB	EB	EC	EG		
0.47 μF 0.56 μF	474 564	J	K K	M						CF	CF	CF					DP DP	DP DP	DP DP	DP DG	DE DH				EC ED	EC ED	EC ED	EC ED	EC EC	EG		
0.68 μF	684	J	K	M													DP	DP	DP	DG	DH				EE	EE	EE	EE	ED			
0.82 µF	824	J	K	M													DP	DP	DP	DG					EF	EF	EF	EF	ED			
1.0 µF	105	J	K	М													DP	DP		DG					EF	EF	EF	EG	ED			
1.2 µF	125	J	K	M														DE DG							ED EF	ED EF	ED	EG EG	EH			
1.5 μF 1.8 μF	155 185	J	K K	M														DG							ED	ED						
2.2 μF	225	J	K	M													DG	DG	DG						ED	ED	ED					
2.7 µF	275	J	K	М																					EN	EN	EN	EH				
3.3 µF	335	J	K	М																					ED	ED		EH				
3.9 µF	395 475	J	K	M																					EF EF	EF		EH				
4.7 μF 5.6 μF	475 565	J	K K	M																					EH	EH						
6.8 µF	685	Ĵ	K	M																					EH	EH	EH					
			ed Vol		6.3	ę	9	25	50	6.3	9	16	25	20	100	200	6.3	ę	9	25	20	100	200	250	6.3	9	16	25	20	100	200	250
Capacitance	Cap		age C		9	8	4	3	5	9	8	4	3	5	1	2	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	Α
	Code	Ca	se Si Series	ze/	Ť		0402		_ ,				0603		•		_	_ ,	-7	C08		•		_^	_			C12		<u>'</u>		

^{*}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)



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

		Case Size/ Series		CO)402	2 T				CO)60	3T					(C08	051						C	C12	06T			
Capacitance	Cap	Voltage Code	9	8	4	3	5	9	8	4	3	5	1	2	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	Α
Capacitance	Code	Rated Voltage (VDC)	6.3	9	16	25	20	6.3	9	16	25	20	100	200	6.3	9	16	25	20	100	200	250	6.3	10	16	25	20	100	200	250
		Capacitance Tolerance									Pr	odu See	ct Av Tabl	aila e 2 fo	bility or Ch	and	Chi hick	p Th ness	ickn Din	ess iens	Code ions	es								
8.2 μF 10 μF	825 106	J K M J K M																					EH EH	EH EH	EH					
	Сар	Rated Voltage (VDC)	6.3	10	16	22	20	6.3	10	16	25	20	100	200	6.3	9	16	25	20	100	200	250	6.3	10	16	25	50	100	200	250
Capacitance	Code	Voltage Code	9	8	4	3	5	9	8	4	3	5	1	2	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	Α
		Case Size/ Series		С	0402	Т				С	0603	T						C08	05T							C12	06T			

^{*}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)

Table 1B - Capacitance Range/Selection Waterfall (1210 - 2220 Case Sizes)

			se S erie	ize/				C12	210T				C.	1808	ВТ		С	1812	2T			C18	25T	•		C	2220	Τ	
Canacitanco	Can Cada	Volt	age 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
Capacitance	Cap Code		d Vol		6.3	9	16	25	20	100	200	250	20	100	200	25	20	100	200	250	20	100	200	250	25	20	100	200	250
			acita lerar									Pi	rodu See	t Ava	ailab 2 fo	ility a r Chi	and C p Thi	hip T ckne	hicki ss Di	ness mens	Code	es							
10 - 91 pF*	100 - 910*	J	K	M	FB	FB	FB	FB	FB	FB	FB																		
100 - 270 pF**	101 - 391**	J	K	M	FB	FB	FB	FB	FB	FB	FB																		
330 pF	331	J	K	M	FB	FB	FB	FB	FB	FB	FB		LF	LF	LF														
390 pF	391	J	K	M	FB	FB	FB	FB	FB	FB	FB		LF	LF	LF														
470 - 820 pF**	471 - 821**	J	K	M	FB	FB	FB	FB	FB	FB	FB		LF	LF	LF	GB	GB	GB	GB										
1,000 pF	102	J	K	M	FB	FB	FB	FB	FB	FB	FB		LF	LF	LF	GB	GB	GB	GB										
1,200 pF	122	J	K	M	FB	FB	FB	FB	FB	FB	FB		LF	LF	LF	GB	GB	GB	GB										
1,500 pF	152	J	K	M	FB	FB	FB	FB	FB	FB	FE		LF	LF	LF	GB	GB	GB	GB										
1,800 pF	182	J	K	M	FB	FB	FB	FB	FB	FB	FE		LF	LF	LF	GB	GB	GB	GB		l								
2,200 pF	222	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LF	LF	LF	GB	GB	GB	GB		İ				İ				
2,700 pF	272	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LF	LF	LF	GB	GB	GB	GB										
3,300 pF	332	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LF	LF	İ	GB	GB	GB	GB		Ī								
3,900 pF	392	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LF	LF	İ	GB	GB	GB	GB		Ī								
4,700 pF	472	J	K	М	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	İ	GB	GB	GB	GD		i								
5,600 pF	562	J	K	М	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	İ	GB	GB	GB	GH		i								
6,800 pF	682	J	К	М	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD		GB	GB	GB	GB	GB					JE	JE	JE		
8,200 pF	822	j	К	М	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	İ	GB	GB	GB	GB	GB	İ				JΕ	JE	JE		
10,000 pF	103	j	K	М	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	İ	GB	GB	GB	GB	GB	i				JE	JE	JE		
12,000 pF	123	Ĵ	K	М	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	İ	GB	GB	GB	GB	GB	İ				JE	JE	JE		
15,000 pF	153	Ĵ	K	М	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	İ	GB	GB	GB	GB	GB	İ				JE	JE	JE		
18,000 pF	183	J	K	М	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD		GB	GB	GB	GB	GB					JE	JE	JE		
22,000 pF	223	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		
27,000 pF	273	Ĵ	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD		GB	GB	GB	GB	GB	НВ	НВ	НВ	НВ	JE	JE	JE		
7			d Vol		6.3	9	16	25	20	100	200	250	20	100	200	25	20	100	200	250	20	100	200	250	25	20	100	200	250
Capacitance	Cap Code	Volt	age 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
	Code		se Si Serie					C12	10T				C	1808	T		C	1812	Т			C18	325T			С	2220	T	

^{*}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)

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



Table 1B - Capacitance Range/Selection Waterfall (1210 - 2220 Case Sizes) cont'd

			se S erie	ize/				C12	:10T				C	1808	ВТ		С	1812	2T			C18	251	•		C	222()T	
Capacitance	Can Code	Volt	age C	Code	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
Oupuonunce	Cap Coue		ed Vol (VDC))	6.3	10	16	25	20	100	200	250	20	100	200	25	20	100	200	250	50	100	200	250	25	20	100	200	250
			acita Ieran									Pi	rodu	ct Ava	ailab	ility a	and C	hip 1	hick	ness	Code	es							
33,000 pF	333	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	2 10	GB	GB	GB	GB	GB	HB	НВ	НВ	НВ	JB	JB	JB		
39,000 pF	393	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		
47,000 pF	473	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		
56,000 pF	563	Ĵ	K	M	FB	FB	FB	FB	FB	FB	FC	FC	LD	LD		GB	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	НВ	JB	JB	JB		
82,000 pF	823	J	K	M	FB	FB	FB	FB	FB	FC	FF	FF	LD	i		GB	GB	GB	GB	GB	НВ	НВ	НВ	НВ	JB	JB	JC	JC	JC
0.10 µF	104	J	K	M	FB	FB	FB	FB	FB	FD	FG	FG	LD	l		GB	GB	GB	GB	GB	НВ	НВ	НВ	НВ	JB	JB	JC	JC	JC
0.10 µF	124	J	K	M	FB	FB	FB	FB	FB	FD	FH	FH	LD			GB	GB	GB	GB	GB	НВ	HB	HB	HB	JB	JB	JC	JC	JC
0.12 μΓ 0.15 μF	154	J	K	M	FC	FC	FC	FC	FC	FD	FM	FM	LD			GB	GB	GB	GE	GE	HB	HB	HB	HB	JB	JB	JC	JC	JC
0.18 µF	184	J	K	M	FC	FC	FC	FC	FC	FD	FK	FK	LD	i		GB	GB	GB	GG	GG	HB	HB	HB	HB	JB	JB	JC	JC	JC
0.10 μl 0.22 μF	224	J	K	M	FC	FC	FC	FC	FC	FD	FK	FK	LD			GB	GB	GB	GG	GG	НВ	HB	HB	HB	JB	JB	JC	JC	JC
0.22 μΓ 0.27 μF	274	J	K	M	FC	FC	FC	FC	FC	FD	I IX	I IX				GB	GB	GG	GG	GG	НВ	HB	HB	HB	JC	JC	JC	JC	JC
0.27 µF 0.33 µF	334	J	K	M	FD	FD	FD	FD	FD	FD						GB	GB	GG	GG	GG	НВ	НВ	НВ	НВ	JC	JC	JC	JC	JC
0.33 µF 0.39 µF	394	J	K	M	FD	FD	FD	FD	FD	FD			l	ł		GB	GB	GG	GG	GG	HD	HD	HD	HD	JC	JC	JC	JC	JC
0.39 μF 0.47 μF	474	J	K	M	FD	FD	FD	FD	FD	FD				ł		GB	GB	GG	GJ	GJ	HD	HD	HD	HD	JC	JC	JC	JC	JC
0.47 µF 0.56 µF	564	J	K	M	FD	FD	FD	FD	FD	FF			l	l		GC	GC	GG	GJ	GJ	ΗD	HD	HD	HD	JC	JD	JD	JD	JD
	684	J	K	M	FD	FD	FD	FD	FD	FG						GC	GC	GG			HD	HD	HD	HD	JC	JD	JD	JD	JD
0.68 µF	824	J	K		FF	FF	FF	FF	FF	FL						GE	GE	GG			HF	HF	HF	HF	JC	JF	JF		JF
0.82 µF				M	FH			FH		FM				ł		GE	GE	GG			HF	HF	HF	HF			JF	JF JF	JF
1.0 µF	105	J	K	M		FH	FH		FH	FIVI				ł		GE	GE	GG			HF	HF	HF	HF	JC	JF	JF	JF	JF
1.2 µF	125	J	K	M	FH	FH	FH	FH	FG																JC	JC			
1.5 µF	155	J	K	M	FH	FH	FH	FH	FG												ŀ				JC	JC			
1.8 µF	185	J	K	M	FH	FH	FH	FH	FG																JD	JD			
2.2 µF	225	J	K	M	FJ	FJ	FJ	FJ	FG							GO	GO								JF	JF			
2.7 µF	275	J	K	M	FE	FE	FE	FG	FH																ŀ				
3.3 µF	335	J	K	M	FF	FF	FF	FM	FM												ļ.								
3.9 µF	395	J	K	M	FG	FG	FG	FG	FK												l				l				
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	K	M	FG	FG	FG	FM																					
8.2 µF	825	J	K	M	FH	FH	FH	FK																	l	l			
10 μF	106	J	K	M	FH	FH	FH	FS								GK									JF	JO			
12 μF	126	J	K	M																									
15 µF	156	J	K	M											l						l				JO				
18 μF	186	J	K	M	l _																				١.				
22 μF	226	J	K	M	FS	FS							<u> </u>			<u> </u>									JO				
			ed Vol (VDC)		6.3	9	16	25	20	9	200	250	20	100	200	25	20	100	200	250	20	9	200	250	25	20	100	200	250
Capacitance	Cap Code	Volt	age C	Code	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
	Ooue		se Si Serie					C12	10T				C	1808	T		C	1812	T			C18	325T			(2220	Т	

^{*}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)



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

Thickness	Case	Thickness ±	Paper C	luantity ¹	Plastic (Quantity
Code	Size ¹	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
BB CF DN DP DE	0402 0603 0805 0805 0805	0.50 ± 0.05 0.80 ± 0.07 0.78 ± 0.10 0.90 ± 0.10 1.00 ± 0.10	10,000 4,000 4,000 4,000 0	50,000 15,000 15,000 15,000 0	0 0 0 0 2,500	0 0 0 0 10,000
DG DH EB EC EN	0805 0805 1206 1206 1206	1.25 ± 0.15 1.25 ± 0.20 0.78 ± 0.10 0.90 ± 0.10 0.95 ± 0.10	0 0 4,000 0 0	0 0 10,000 0 0	2,500 2,500 4,000 4,000 4,000	10,000 10,000 10,000 10,000 10,000
ED EE EF EM EG EH	1206 1206 1206 1206 1206 1206	1.00 ± 0.10 1.10 ± 0.10 1.20 ± 0.15 1.25 ± 0.15 1.60 ± 0.15	0 0 0 0	0 0 0 0	2,500 2,500 2,500 2,500 2,000 2,000	10,000 10,000 10,000 10,000 8,000 8,000
FB FC FD FE FF	1210 1210 1210 1210 1210 1210	1.60 ± 0.20 0.78 ± 0.10 0.90 ± 0.10 0.95 ± 0.10 1.00 ± 0.10 1.10 ± 0.10	0 0 0 0 0	0 0 0 0 0	4,000 4,000 4,000 4,000 2,500 2,500	0,000 10,000 10,000 10,000 10,000
FG FL FH FM	1210 1210 1210 1210	1.25 ± 0.15 1.40 ± 0.15 1.55 ± 0.15 1.70 ± 0.20	0 0 0 0	0 0 0 0	2,500 2,000 2,000 2,000	10,000 8,000 8,000 8,000
FJ FK FS LD LF	1210 1210 1210 1808 1808	1.85 ± 0.20 2.10 ± 0.20 2.50 ± 0.30 0.90 ± 0.10 1.00 ± 0.15	0 0 0 0 0	0 0 0 0	2,000 2,000 1,000 2,500 2,500	8,000 8,000 4,000 10,000 10,000
GB GC GD GE GH	1812 1812 1812 1812 1812	1.00 ± 0.10 1.10 ± 0.10 1.25 ± 0.15 1.30 ± 0.10 1.40 ± 0.15	0 0 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 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
HD HF JB JC JD	1825 1825 2220 2220 2220	1.30 ± 0.15 1.50 ± 0.15 1.00 ± 0.15 1.10 ± 0.15 1.30 ± 0.15	0 0 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
JE JF JO	2220 2220 2220	1.40 ± 0.15 1.50 ± 0.15 2.40 ± 0.15	0 0 0	0 0 0	1,000 1,000 500	4,000 4,000 2,000
Thickness	Case	Thickness ±	7" Reel	13" Reel	7" Reel	13" Reel
Code	Size ¹	Range (mm)	Paper C	luantity ¹	Plastic (Quantity

Package quantity based on finished chip thickness specifications.

¹ If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Table 2B - Bulk Packaging Quantities

Paulion	.	Loose Pa	ackaging
Раскад	ing Type	Bulk Bag	(default)
Packagir	ng C-Spec ¹	N/	/A ²
Case	e Size	Packaging Quantities (pieces/unit packaging)
EIA (in)	Metric (mm)	Minimum	Maximum
0402	1005		
0603	1608		
0805	2012		50,000
1206	3216		
1210	3225	1	
1808	4520] '	
1812	4532		
1825	4564		20,000
2220	5650		
2225	5664		

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

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



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

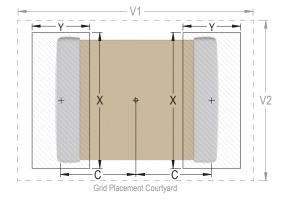
EIA Size Code	Metric Size Code		Maxi	sity Lev mum (I rotrusio	lost))		Media	sity Lev an (Nor rotrusio	ninal))			sity Lev mum (L rotrusio	east))
Code	Code	С	Υ	Х	V1	V2	С	Y	X	V1	V2	С	Y	X	V1	V2
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	0.40	0.52	0.52	1.60	0.80
0603	1608	0.90	1.15	1.10	4.00	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
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
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

¹ 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

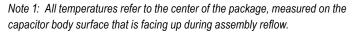
Recommended Soldering Technique:

- 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
Frome reature	SnPb	100% Matte Sn
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum



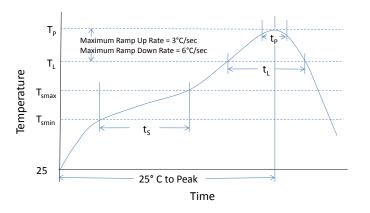




Table 4 – Performance & Reliability: Test Methods and Conditions

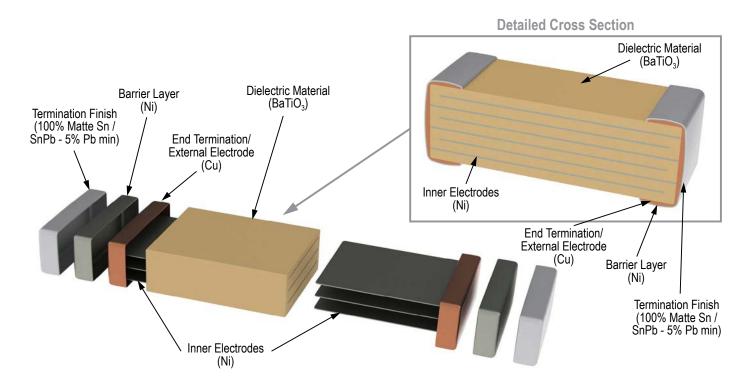
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Solderability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	J-31D-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion. Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
Vibration	MIL-STD-202 Method 204	5 g's for 20 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage & Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



High Temperature 150°C, Ultra-Stable X8R Dielectric, 25 – 100 VDC (Commercial & Automotive Grade)



Overview

KEMET's Ultra-Stable X8R dielectric features a 150°C maximum operating temperature, offering the latest in high temperature dielectric technology and reliability for extreme temperature applications. It offers the same temperature capability as conventional X8R, but without the capacitance loss due to applied DC voltage. Ultra-Stable X8R exhibits no change in capacitance with respect to voltage and boasts a minimal change in capacitance with reference to ambient temperature. It is a suitable replacement for higher capacitance and larger footprint devices that fail to offer capacitance stability. Capacitance change with respect to temperature is limited to ±15% from -55°C to +150°C.

Driven by the demand for a more robust and reliable component, Ultra-Stable X8R dielectric capacitors were developed for critical applications where reliability and capacitance stability at higher operating temperatures are a concern. These capacitors are widely used in automotive circuits as well as general high temperature applications.

In addition to commercial grade, automotive grade devices are available and meet the demanding Automotive Electronics Council's AEC–Q200 qualification requirements.



Ordering Information

С	1210	С	184	K	3	Н	Α	С	AUTO
Ceramic	Case Size (L" x W")	Specification/ Series ¹	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/Grade (C-Spec)
	0402 0603 0805 1206 1210 1812	C = Standard	Two significant digits + number of zeros		3 = 25 5 = 50 1 = 100	H = Ultra Stable X8R	A = N/A	C = 100% Matte Sn L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

¹ Flexible termination option is available. Please see FT-CAP product bulletin C1013_X8R_FT-CAP_SMD

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

² SnPb termination finish option is not available on automotive grade product.



Packaging C-Spec Ordering Options Table

Packaging Type	Packaging/Grade Ordering Code (C-Spec)
Commerc	ial Grade ¹
Bulk Bag	Not Required (Blank)
7" Reel/Unmarked	TU
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2 mm pitch ²	7081
13" Reel/Unmarked/2 mm pitch ²	7082
Automotiv	ve Grade ³
7" Reel	AUTO
13" Reel/Unmarked	AUTO7411 (EIA 0603 and smaller case sizes) AUTO7210 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2 mm pitch ²	3190
13" Reel/Unmarked/2 mm pitch ²	3191

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- −55°C to +150°C operating temperature range
- Lead (Pb)-Free, RoHS and REACH compliant
- EIA 0402, 0603, 0805, 1206, 1210, and 1812 case sizes
- DC voltage ratings of 25 V, 50 V, and 100 V
- Capacitance offerings ranging from 100 pF to 0.22 μF
- Available capacitance tolerances of ±1%, ±2%, ±5%, ±10%, and ±20%
- · Extremely low ESR and ESL
- High thermal stability

- · High ripple current capability
- No capacitance change with respect to applied rated DC voltage
- Non-polar device, minimizing installation concerns
- Offered in both commercial and automotive grades
- 100% pure matte tin-plated termination finish that allowing for excellent solderability.
- SnPb plated termination finish option available upon request (5% Pb minimum)

Applications

Typical applications include decoupling, bypass and filtering in extreme environments such as down-hole oil exploration, under-hood automotive, military and aerospace.

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked.

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".

³ Reeling tape options (Paper or Plastic) are dependent on capacitor case size (L" x W") and thickness dimension. See "Chip Thickness/Tape & Reel Packaging Quantities" and "Tape & Reel Packaging Information".

³ For additional Information regarding "AUTO" C-Spec options, see "Automotive C-Spec Information".

³ All Automotive packaging C-Specs listed exclude the option to laser mark components. Please contact KEMET if you require a laser marked option. For more information see "Capacitor Marking".



Automotive C-Spec Information

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

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

Product Change Notification (PCN)

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

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

KEMET Automotive	Customer Noti	fication due to:	Days prior to
C-Spec	Process/Product change	Obsolescence*	implementation
KEMET assigned ¹	Yes (with approval and sign off)	Yes	180 days Minimum
AUTO	Yes (without approval)	Yes	90 days Minimum

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

Production Part Approval Process (PPAP)

The purpose of the Production Part Approval Process is:

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

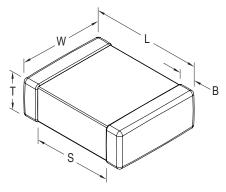
KEMET Automotive		PPAP (Product Part Approval Process) Level											
C-Spec	1	2	3	4	5								
KEMET assigned ¹	•	•	•	•	•								
AUTO	0		0										

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

- Part Number specific PPAP available
- Product family PPAP only



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)	See Table 2 for	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)	Thickness	0.50 (0.02) ±0.25 (0.010)		
1210	3225	3.20 (0.126) ±0.20 (0.008)	2.50 (0.098) ±0.20 (0.008)		0.50 (0.02) ±0.25 (0.010)	N/A	O-ld D-fl O-l-
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)		Solder Reflow Only

Qualification/Certification

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

Automotive Grade products meet or exceed the requirements outlined by the Automotive Electronics Council. Details regarding test methods and conditions are referenced in document AEC–Q200, Stress Test Qualification for Passive Components. For additional information regarding the Automotive Electronics Council and AEC–Q200, please visit their website at www.aecouncil.com.

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 +150°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	0%
Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit @ 25°C	2.5%
Insulation Resistance (IR) Limit @ 25°C	1,000 megohm microfarads or 100 G Ω (Rated voltage applied for 120 ±5 seconds @ 25°C)

To obtain IR limit, divide $M\Omega$ - μ 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 MHz ± 100 kHz and 1.0 ± 0.2 Vrms if capacitance $\leq 1,000$ pF.

1 kHz ± 50 Hz and 1.0 ± 0.2 Vrms if capacitance > 1,000 pF

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."

Post Environmental Limits

High Temperature Life, Biased Humidity, Moisture Resistance												
Dielectric	Dielectric Rated DC Capacitance Dissipation Factor Capacitance Insulation (Maximum %) Shift Resistance											
Ultra-Stable X8R	All	All	3.0	0.3% or ±0.25 pf	10% of Initial Limit							



Table 1 – Capacitance Range/Selection Waterfall (0402 – 1812 Case Sizes)

100 pF 110 pF 110 pF 120 pF 130 pF 150 pF	Cap Code			age C	Code							С					1206			1210			12C
110 pF 120 pF 130 pF	101		V hate				3	5	1	3	5	1	3	5	1	3	5	1	3	5	1	5	1
110 pF 120 pF 130 pF			atcu v	oltag/	je (VD	(C)	25	20	100	25	50	100	25	20	100	25	20	100	25	20	100	50	100
110 pF 120 pF 130 pF		Cap	oacita	nce T	Tolera	nce									and C p Thic								
120 pF 130 pF		F	G	J	K	M M	BB BB	BB BB	BB BB														
130 pF	111 121	F	G G	J	K	M	BB	BB	BB														
150 pF	131	F	G	J	K	М	BB	BB	BB														
	151	F	G	J	K	М	BB	BB	BB														
160 pF 180 pF	161 181	F	G G	J	K	M M	BB BB	BB BB	BB BB														
200 pF	201	F	G	J	K	M	BB	BB	BB														
220 pF	221	F	G	J	K	М	BB	BB	BB	İ													
240 pF	241	F	G	J	K	М	BB	BB	BB														
270 pF	271 301	F F	G G	J	K	M M	BB BB	BB BB	BB BB														
300 pF 330 pF	331	F	G	J	K	M	BB	BB	BB														
360 pF	361	F	G	J	K	М	BB	BB	BB														
390 pF	391	F	G	J	K	М	BB	BB	BB														
430 pF	431	F	G	J	K	M M	BB BB	BB BB	BB BB	CF CF	CF CF	CF CF											
470 pF 510 pF	471 511	F	G G	J	K	M	BB	BB	BB	CF	CF	CF											
560 pF	561	F	G	J	K	М	ВВ	BB	BB	CF	CF	CF				İ							
620 pF	621	F	G	J	K	М	BB	BB	BB	CF	CF	CF											
680 pF	681 751	F	G G	J	K	M M	BB BB	BB BB	BB BB	CF CF	CF CF	CF CF											
750 pF 820 pF	821	F	G	J	K	M	BB	BB	BB	CF	CF	CF											
910 pF	911	F	G	J	K	М	BB	BB	BB	CF	CF	CF											
1,000 pF	102	F	G	J	K	М	BB	BB	BB	CF	CF	CF											
1,100 pF 1,200 pF	112 122	F	G G	J	K	M M	BB BB	BB BB		CF CF	CF CF	CF CF											
1,200 pF 1,300 pF	132	F	G	J	K	M	BB	BB		CF	CF	CF											
1,500 pF	152	F	G	J	K	М	BB	BB		CF	CF	CF											
1,600 pF	162	F	G	J	K	М				CF	CF	CF											
1,800 pF 2,000 pF	182 202	F F	G G	J	K K	M M				CF CF	CF CF	CF CF	DN	DN	DN								
2,000 pF 2,200 pF	202	F	G	J	K	M				CF	CF	CF	DN	DN	DN								
2,400 pF	242	F	G	J	K	М				CF	CF	CF	DN	DN	DN								
2,700 pF	272	F	G	J	K	М				CF	CF	CF	DN	DN	DN								
3,000 pF 3,300 pF	302 332	F	G	J	K	M M				CF CF	CF CF	CF CF	DN DN	DN DN	DN DN								
3,600 pF	362	F	G	J	K	M				CF	CF	CF	DN	DN	DN								
3,900 pF	392	F	G	J	K	М				CF	CF	CF	DN	DN	DN	İ							
4,300 pF	432	F	G	J	K	М				CF	CF	CF	DN	DN	DN								
4,700 pF 5,100 pF	472 512	F	G	J	K	M M				CF CF	CF CF	CF	DN DN	DN DN	DN DN								
5,600 pF	562	F	G	J	K	M				CF	CF		DN	DN	DN								
6,200 pF	622	F	G	J	K	М				CF	CF		DN	DN	DN								
6,800 pF	682	F	G	J	K	M M				CF CF	CF		DN	DN	DN DN	EB EB	EB	EB					
7,500 pF 8,200 pF	752 822	F	G	J	K	M				CF			DN DN	DN DN	DN	EB	EB EB	EB EB					
9,100 pF	912	F	G	J	K	М				CF			DN	DN	DN	EB	EB	EB	İ				
10,000 pF	103	F	G	J	K	М				CF			DN	DN	DP	EB	EB	EB					
12,000 pF 15,000 pF	123 153	F	G	J	K	M M							DN DN	DN DP	DE DG	EB EB	EB EB	EB EB	FB FB	FB FB	FB FB	GB	GB
18,000 pF	183	F	G	J	K	M							DN	DP	DG	EB	EB	EB	FB	FB	FB	GB	GB
22,000 pF	223	F	G	J	K	М							DP	DF		EB	EB	EC	FB	FB	FB	GB	GB
27,000 pF	273	F	G	J	K	M							DF			EB	EB	EE	FB	FB	FB	GB	GB
33,000 pF	333	F	G V	Jolean	K IO (V/D	W	25	20	190	25	20	9	DG 22	20	9	25 EB	EB 05	100 EE	FB 52	FB 05	FB 001	GB 05	GB 001
Capacitance	Capacitance Cap Voltage (VDC) Voltage Code		3	5	1	3	5	1	3	5	1	3	5	1	3	5	1	5	1				
	Code	Ca	se S			ies		0402		-	0603		 	0805		-	1206		<u> </u>	C1210			12C



Table 1 - Capacitance Range/Selection Waterfall (0402 - 1812 Case Sizes) cont'd

		Case Size/ Series		C0402C		C	C0603C		C0805C		C1206C		С	C1210C		C18	12C						
Capacitance	Cap		Volt	age (Code		3	5	1	3	5	1	3	5	1	3	5	1	3	5	1	5	1
•	Code	Ra	ited \	/oltag	ge (VI	OC)	25	20	100	25	20	19	25	20	10	25	20	19	25	20	19	20	100
		Сар	Product Availability and Chip Thickness Codes See Table 2 for Chip Thickness Dimensions																				
47,000 pF	473	F	G	J	K	М										EC	EE	EH	FB	FB	FE	GB	GB
56,000 pF	563	F	G	J	K	M										ED	EF	EH	FB	FB	FF	GB	GB
68,000 pF	683	F	G	J	K	M										EF	EH		FB	FC	FG	GB	GB
82,000 pF	823	F	G	J	K	M										EH	EH		FC	FF	FH	GB	GB
100,000 pF	104	F	G	J	K	M										EH			FE	FG	FM	GB	GD
120,000 pF	124	F	G	J	K	M													FG	FH		GB	GH
150,000 pF	154	F	G	J	K	M													FH	FM		GD	GN
180,000 pF	184	F	G	J	K	M													FJ			GH	
220,000 pF	224	F	G	J	K	M																GK	
	Rated Voltage (VDC)		25	20	9	25	20	ş	25	20	9	25	20	5	25	20	5	20	9				
Capacitance	Cap Code		Volt	age (Code		3	5	1	3	5	1	3	5	1	3	5	1	3	5	1	5	1
		Ca	se S	Size	/Ser	ies	C	0402	С	C	0603	С	C	0805	С	C	1206	С	C	1210	С	C18	12C

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

Thickness	Case	Thickness ±	Paper Q	uantity ¹	Plastic (Quantity		
Code	Size ¹	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		
DN	0805	0.78 ± 0.10	4,000	15,000	0	0		
DP	0805	0.90 ± 0.10	4,000	15,000	0	0		
DE	0805	1.00 ± 0.10	0	0	2,500	10,000		
DF	0805	1.10 ± 0.10	0	0	2,500	10,000		
DG	0805	1.25 ± 0.15	0	0	2,500	10,000		
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		
ED	1206	1.00 ± 0.10	0	0	2,500	10,000		
EE	1206	1.10 ± 0.10	0	0	2,500	10,000		
EF	1206	1.20 ± 0.15	0	0	2,500	10,000		
EH	1206	1.60 ± 0.20	0	0	2,000	8,000		
FB	1210	0.78 ± 0.10	0	0	4,000	10,000		
FC	1210	0.90 ± 0.10	0	0	4,000	10,000		
FE	1210	1.00 ± 0.10	0	0	2,500	10,000		
FF	1210	1.10 ± 0.10	0	0	2,500	10,000		
FG	1210	1.25 ± 0.15	0	0	2,500	10,000		
FH	1210	1.55 ± 0.15	0	0	2,000	8,000		
FM	1210	1.70 ± 0.20	0	0	2,000	8,000		
FJ	1210	1.85 ± 0.20	0	0	2,000	8,000		
GB	1812	1.00 ± 0.10	0	0	1,000	4,000		
GD	1812	1.25 ± 0.15	0	0	1,000	4,000		
GH	1812	1.40 ± 0.15	0	0	1,000	4,000		
GK	1812	1.60 ± 0.20	0	0	1,000	4,000		
GN	1812	1.70 ± 0.20	0	0	1,000	4,000		
Thickness	Case	Thickness ±	7" Reel	13" Reel	7" Reel 13" Reel			
Code	Size ¹	Range (mm)	Paper Q	uantity¹	Plastic Quantity			

 ${\it Package quantity based on finished chip thickness specifications.}$

¹ If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Table 2B - Bulk Packaging Quantities

Paulion	.	Loose Pa	ackaging					
Раскад	ing Type	Bulk Bag (default)						
Packagir	ng C-Spec ¹	N/A ²						
Case	e Size	Packaging Quantities (pieces/unit packaging)					
EIA (in)	Metric (mm)	Minimum	Maximum					
0402	1005		50,000					
0603	1608							
0805	2012							
1206	3216							
1210	3225	1						
1808	4520] '						
1812	4532							
1825	4564		20,000					
2220	5650							
2225	5664							

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

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



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

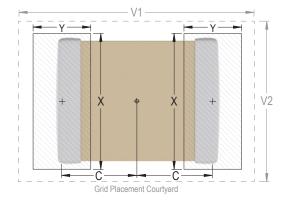
EIA Size Code	Metric Size Code	Density Level A: Maximum (Most) Land Protrusion (mm)						Media	sity Lev an (Non rotrusio			Density Level C: Minimum (Least) Land Protrusion (mm)				
Oode	Oode	С	Y	Х	V1 V2		С	Y	X	V1	V2	С	Y	X	V1	V2
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	0.40	0.52	0.52	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
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

¹ 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

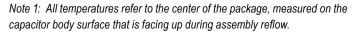
Recommended Soldering Technique:

- 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
Frome reature	SnPb	100% Matte Sn
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum



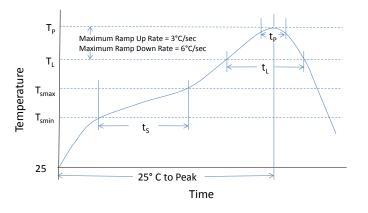




Table 4 – Performance & Reliability: Test Methods and Conditions

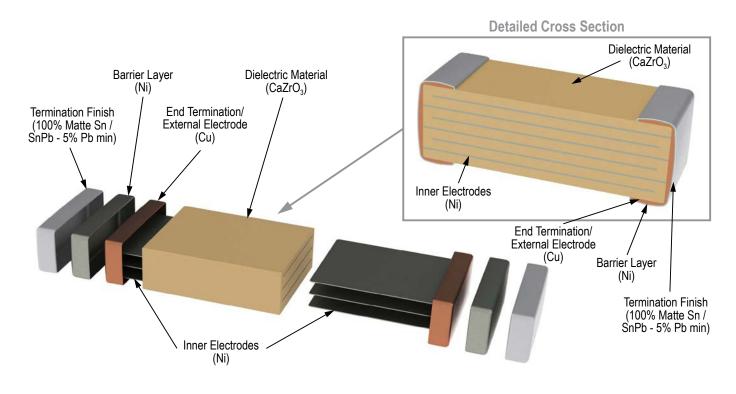
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Solderability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	J-31D-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +150°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MII –STD–202 Method 103	Load Humidity: 1,000 hours 85°C/85%RH and rated voltage. Add 100K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Blasea Flamilarty	WILL OTD ZOZ WICKHOU 100	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours. +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	−55°C/+150. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 150°C with 2 X rated voltage applied.
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 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



Capacitor Marking (Optional):

Laser marking option is not available on:

- C0G, Ultra Stable X8R and Y5V dielectric devices
- EIA 0402 case size devices
- EIA 0603 case size devices with Flexible Termination option.
- KPS Commercial and Automotive grade stacked devices.

These capacitors are supplied unmarked only.

High Temperature 150°C, X8L Dielectric, 10 – 50 VDC (Commercial & Automotive Grade)



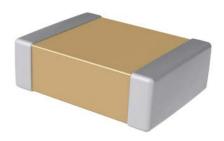
Overview

KEMET's X8L dielectric features a 150°C maximum operating temperature and is considered "general purpose high temperature." These components are fixed, ceramic dielectric capacitors suited for high temperature bypass and decoupling applications or frequency discriminating circuits where Q and stability of capacitance characteristics are not critical. X8L exhibits a predictable change in capacitance with respect to time and voltage and boasts a minimal change in capacitance with reference to ambient temperature up to 125°C. Beyond 125°C X8L displays a wider variation in capacitance. Capacitance change is limited to ±15% from -55°C to +125°C and +15, -40% from 125°C to 150°C.

Driven by the demand for a more robust and reliable component, X8L dielectric capacitors were developed for critical applications where reliability at higher operating temperatures are a concern. These capacitors are widely used in automotive circuits as well as general high temperature applications. Concerned with flex cracks resulting from excessive tensile and shear stresses produced during board flexure and thermal cycling? These devices are available with KEMET's Flexible termination technology which inhibits the transfer of board

stress to the rigid ceramic body, therefore mitigating flex cracks which can result in low IR or short circuit failures. Although flexible termination technology does not eliminate the potential for mechanical damage that may propagate during extreme environmental and handling conditions, it does provide superior flex performance over standard termination systems.

In addition to commercial grade, automotive grade devices are available and meet the demanding Automotive Electronics Council's AEC–Q200 qualification requirements.



Ordering Information

С	1210	X	106	K	8	N	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series ¹	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/Grade (C-Spec)
	0402 0603 0805 1206 1210	C = Standard X = Flexible Termination	Two significant digits + number of zeros	J = ±5% K = ±10% M = ±20%	8 = 10 4 = 16 3 = 25 5 = 50	N = X8L	A = N/A	C = 100% Matte Sn L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

¹ The flexible termination option is not available on EIA 0402 case size product. "C" must be used in the 6th character position when ordering this case size.

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

² SnPb termination finish option is not available on Automotive Grade product.



Packaging C-Spec Ordering Options Table

Packaging Type	Packaging/Grade Ordering Code (C-Spec)					
Commercial Grade ¹						
Bulk Bag Not Required (Blank)						
7" Reel/Unmarked	TU					
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)					
7" Reel/Marked	TM					
13" Reel/Marked	7040 (EIA 0603 and smaller case sizes) 7215 (EIA 0805 and larger case sizes)					
7" Reel/Unmarked/2 mm pitch ²	7081					
13" Reel/Unmarked/2 mm pitch ²	7082					
Automotive Grade ³						
7" Reel	AUTO					
13" Reel/Unmarked	AUTO7411 (EIA 0603 and smaller case sizes) AUTO7210 (EIA 0805 and larger case sizes)					
7" Reel/Unmarked/2 mm pitch ²	3190					
13" Reel/Unmarked/2 mm pitch ²	3191					

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- -55°C to +150°C operating temperature range
- · Lead (Pb)-Free, RoHS and REACH compliant
- EIA 0402, 0603, 0805, 1206, and 1210 case sizes
- DC voltage ratings of 10 V, 16 V, 25 V, and 50 V
- Capacitance offerings ranging from 0.012 μF to 10 μF
- Available capacitance tolerances of ±5%, ±10%, and ±20%
- Commercial & Automotive (AEC–Q200) grades available

- 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% Pb minimum)
- · Flexible termination option available upon request

Applications

Typical applications include use in extreme environments such as down-hole oil exploration, under-hood automotive, military and aerospace.

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked.

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".

³ Reeling tape options (Paper or Plastic) are dependent on capacitor case size (L" x W") and thickness dimension. See "Chip Thickness/Tape & Reel Packaging Quantities" and "Tape & Reel Packaging Information".

³ For additional Information regarding "AUTO" C-Spec options, see "Automotive C-Spec Information".

³ All Automotive packaging C-Specs listed exclude the option to laser mark components. Please contact KEMET if you require a laser marked option. For more information see "Capacitor Marking".



Automotive C-Spec Information

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

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

Product Change Notification (PCN)

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

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

KEMET Automotive	Customer Noti	Days prior to	
C-Spec	Process/Product change	Obsolescence*	implementation
KEMET assigned ¹	Yes (with approval and sign off)	Yes	180 days Minimum
AUTO	Yes (without approval)	Yes	90 days Minimum

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

Production Part Approval Process (PPAP)

The purpose of the Production Part Approval Process is:

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

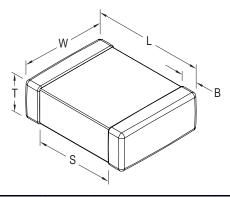
KEMET Automotive	PPAP (Product Part Approval Process) Level					
C-Spec	1	2	3	4	5	
KEMET assigned ¹	•	•	•	•	•	
AUTO	0		0			

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

- Part Number specific PPAP available
- Product family PPAP only



Dimensions – Standard Termination – 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)	NI/A	
1210	3225	3.20 (0.126) ±0.20 (0.008)	2.50 (0.098) ±0.20 (0.008)		0.50 (0.02) ±0.25 (0.010)	- N/A	Solder Reflow Only

Dimensions – Flexible Termination – Millimeters (Inches)

EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0603	1608	1.60 (0.063) ±0.17 (0.007)	0.80 (0.032) ±0.15 (0.006)		0.45 (0.018) ±0.15 (0.006)	0.58 (0.023)	Solder Wave
0805	2012	2.00 (0.079) ±0.30 (0.012)	1.25 (0.049) ±0.30 (0.012)	See Table 2	0.50 (0.020) ±0.25 (0.010)	0.75 (0.030)	or
1206	3216	3.30 (0.130) ±0.40 (0.016)	1.60 (0.063) ±0.35 (0.013)	for Thickness	0.60 (0.024) ±0.25 (0.010)	NI/A	Solder Reflow
1210	3225	3.30 (0.130) ±0.40 (0.016)	2.60 (0.102) ±0.30(0.012)		0.60 (0.024) ±0.25 (0.010)	N/A	Solder Reflow Only

Qualification/Certification

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

Automotive Grade products meet or exceed the requirements outlined by the Automotive Electronics Council. Details regarding test methods and conditions are referenced in document AEC–Q200, Stress Test Qualification for Passive Components. For additional information regarding the Automotive Electronics Council and AEC–Q200, please visit their website at www.aecouncil.com.



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 +150°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15% (-55°C to 125°C), +15, -40% (125°C to 150°C)
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
² Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)
³ Dissipation Factor (DF) Maximum Limit @ 25°C	3.5% (≤ 16V) and 2.5% (≥ 25V)
⁴ Insulation Resistance (IR) Minimum Limit @ 25°C	500 megohm microfarads or 10 GΩ (Rated voltage applied for 120 ±5 seconds @ 25°C)

Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

 $1kHz \pm 50Hz$ and 1.0 ± 0.2 Vrms if capacitance ≤ $10\mu F$

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

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

Post Environmental Limits

	High Temperatu	ire Life, Biased	Humidity, Moist	ture Resistance	
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance
X8L	≥ 25	All	3.0		100/ of Initial Limit
AOL	≤ 16	All	5.0	±20%	10% of Initial Limit

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

⁴To obtain IR limit, divide MΩ- μ F value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



Insulation Resistance Limit Table (X8L Dielectric)

EIA Case Size	1,000 Megohm Microfarads or 100 GΩ	500 Megohm Microfarads or 10 GΩ
0201	N/A	ALL
0402	< .012 µF	≥ .012 µF
0603	< .047 µF	≥ .047 µF
0805	< 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



Table 1 – Capacitance Range/Selection Waterfall (0402 – 1210 Case Sizes)

	Сар		se Si			C04	02C			C	0603	BC			C	080	5C			C	1206	6C			C	1210	C	
Cap	Code	Vo	Itage Co	de	9	8	4	3	9	8	4	3	5	9	8	4	3	5	9	8	4	3	5	9	8	4	3	5
	Code	Rated	Voltage	(VDC)	6.3	10	16	25	6.3	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50
		Capacit	tance To	lerance		Pro	duc	t Av	ailab	ility	and	Chip	Thi	ickne	ess (Code	es Se	ee Ta	ble	2 for	Chi	p Th	ickn	ess l	Dime	ensid	ons	
12,000 pF	123	J	K	М	BB	BB	BB	BB																				
15,000 pF	153	J	K	M	BB	BB	BB	BB						İ					l									
18,000 pF	183	J	K	M	BB	BB	BB	BB																				
22,000 pF	223	J	K	M	BB	BB	BB	BB																				
27,000 pF	273	J	K	M	BB	BB																						
33,000 pF	333	J	K	М	ВВ	BB																						
39,000 pF	393	J	K	М	ВВ	ВВ								İ					l									
47,000 pF	473	J	K	М	ВВ	ВВ			CF	CF	CF	CF	CF	İ					İ					İ				
56,000 pF	563	J	K	М	İ									İ					l									
68,000 pF	683	Ĵ	K	M	1									l					l					l				
82,000 pF	823	J	K	М																								
0.10 µF	104	J	K	М	i				CF	CF	CF	CF		i					İ									
0.12 µF	124	Ĵ	K	М					CF	CF	CF	CF		i					l									
0.15 µF	154	Ĵ	K	М					CF	CF	CF	CF		DG	DG	DG	DG	DG	l									
0.18 µF	184	Ĵ	K	M					CF	CF	0.	٥.		DG	DG	DG	DG	DG	l									
0.22 µF	224	Ĵ	K	М					CF	CF				DP	DP	DP	DP	DG										
0.27 µF	274	Ĵ	K	М	i				٠.	٥.				DP	DP	DP	DP		l									
0.33 µF	334	Ĵ	K	M	i									DP	DP	DP	DP		l									
0.39 µF	394	Ĵ	K	M	i									DE.	DE	DE	DE		l					FD	FD	FD	FD	FD
0.47 µF	474	Ĵ	K	M	i									DE	DE	DE	DE		EG	EG	EG	EG	EG	FD	FD	FD	FD	FD
0.56 µF	564	Ĵ	K	M										DG	DG	DH	DH							FF	FF	FF	FF	FF
0.68 µF	684	J	K	M										DG	DG	DH	DH							FG	FG	FG	FG	FG
0.82 µF	824	Ĵ	K	M										DG	DG	DG	DII							FL	FL	FL	FL	FL
1.0 µF	105	J	K	M										DG	DG	DG			ED	ED	ED	ED		FM	FM	FM	FM	FM
1.0 µr 1.2 µF	125	J	K	M										100	00	ВО			EH	EH	EH	EH		FG	FG	FG	FG	I IVI
1.2 µI 1.5 µF	155	J	K	M															EH	EH	EH	EH		FG	FG	FG	FG	
1.5 µF 1.8 µF	185	J	K	M	l														EF	EF	EH	EH		FG	FG	FG	FG	
2.2 µF	225	J	K	M	l														EF	EF	EH	EH		FG	FG	FG	FG	
2.2 µF 2.7 µF	275	J	K	M	l														EH	EH	EH	L11		FG	FG	FH	FH	
	335	J	K	M	l														EH	EH	EH			FM	FM	FM	FM	
3.3 µF	335	-																	EH	EH	EH			FG	FM	FK		
3.9 µF	475	J	K	M M															EH	EH	EH			FG	FG	FS	FK FS	
4.7 µF	475 565																		EH	EH	EH			FH	FH	FH	15	
5.6 µF		J	K	M																								
6.8 µF	685 825	J	K	M																				FM	FM	FM		
8.2 µF		J	K	M																				FK	FK	FK		
10 μF	106	J	K	M	-	40	40			40	40				40	40	0.5		1	40	40			FS	FS	FS	0.5	
	Сар		Voltage	·	6.3	10	16	25	6.3	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50
Сар	Code		Itage Co		9	8	4	3	9	8	4	3	5	9	8	4	3	5	9	8	4	3	5	9	8	4	3	5
		Case	e Size/Se	eries		C04	02C				0603	<u> </u>				C0805	С				C1206	С				C1210		



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

Thickness	Case	Thickness ±	Paper Q	uantity ¹	Plastic (Quantity
Code	Size ¹	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
DP	0805	0.90 ± 0.10	4,000	15,000	0	0
DE	0805	1.00 ± 0.10	0	0	2,500	10,000
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
DH	0805	1.25 ± 0.20	0	0	2,500	10,000
ED	1206	1.00 ± 0.10	0	0	2,500	10,000
EF	1206	1.20 ± 0.15	0	0	2,500	10,000
EG	1206	1.60 ± 0.15	0	0	2,000	8,000
EH	1206	1.60 ± 0.20	0	0	2,000	8,000
FD	1210	0.95 ± 0.10	0	0	4,000	10,000
FF	1210	1.10 ± 0.10	0	0	2,500	10,000
FG	1210	1.25 ± 0.15	0	0	2,500	10,000
FL	1210	1.40 ± 0.15	0	0	2,000	8,000
FH	1210	1.55 ± 0.15	0	0	2,000	8,000
FM	1210	1.70 ± 0.20	0	0	2,000	8,000
FK	1210	2.10 ± 0.20	0	0	2,000	8,000
FS	1210	2.50 ± 0.30	0	0	1,000	4,000
Thickness	Case	Thickness ±	7" Reel	13" Reel	7" Reel	13" Reel
Code	Size ¹	Range (mm)	Paper Q	uantity¹	Plastic (Quantity

Package quantity based on finished chip thickness specifications.

Table 2B - Bulk Packaging Quantities

Deales	in a Tour	Loose P	ackaging					
Раскад	jing Type	Bulk Bag (default)						
Packagir	ng C-Spec ¹	N/A²						
Cas	e Size	Packaging Quantities (pieces/unit packaging)						
EIA (in)	Metric (mm)	Minimum	Maximum					
0402	1005							
0603	1608							
0805	2012		50,000					
1206	3216							
1210	3225	1						
1808	4520							
1812	4532							
1825	4564		20,000					
2220	5650							
2225	5664							

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

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

¹ If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Table 3A – Land Pattern Design Recommendations per IPC-7351 – Standard Termination

EIA Size Code	Metric Size Code		Maxi	sity Lev mum (I rotrusio	Most))		Media	sity Lev an (Nor rotrusio)	Density Level C: Minimum (Least) Land Protrusion (mm)						
3040	Jour	С	Υ	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	0.99	1.44	1.66	4.47	2.71	0.89	1.24	1.56	3.57	2.11	0.79	1.04	1.46	2.42	1.81		
1206	3216	1.59	1.62	2.06	5.85	3.06	1.49	1.42	1.96	4.95	2.46	1.39	1.22	1.86	4.25	2.16		
1210	3225	1.59	1.62	3.01	5.90	4.01	1.49	1.42	2.91	4.95	3.41	1.39	1.22	2.81	4.25	3.11		

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.

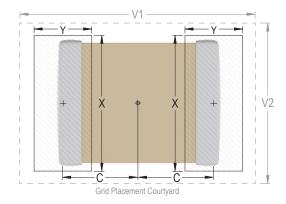




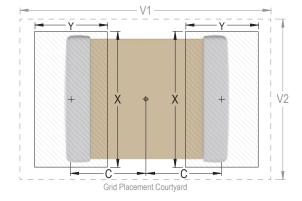
Table 3B – Land Pattern Design Recommendations per IPC-7351 – Flexible Termination

EIA Size Code	Metric Size Code	I	Maxi	sity Lev mum (I rotrusio	Most))	I	Media	sity Lev an (Nor rotrusio)	Density Level C: Minimum (Least) Land Protrusion (mm)					
Jour	0000	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	X	V1	V2	
0603	1608	0.85	1.25	1.10	4.00	2.10	0.75	1.05	1.00	3.10	1.50	0.65	0.85	0.90	2.40	1.20	
0805	2012	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	1.65	1.90	5.90	2.90	1.50	1.45	1.80	5.00	2.30	1.40	1.25	1.70	4.30	2.00	
1210	3225	1.60	1.65	2.80	5.90	3.80	1.50	1.45	2.70	5.00	3.20	1.40	1.25	2.60	4.30	2.90	

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
Frome reature	SnPb	100% Matte Sn
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum

Note 1: All temperatures refer to the center of the package, measured on the capacitor body surface that is facing up during assembly reflow.

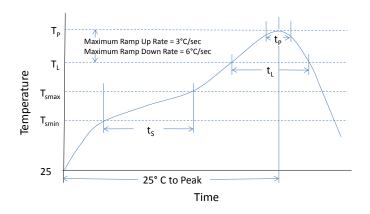




Table 4 - Performance & Reliability: Test Methods and Conditions

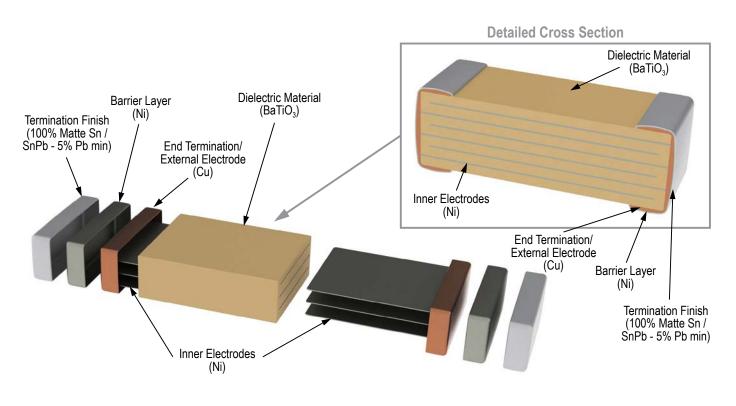
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Solderability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Golderability	0-010-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +150°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Load Humidity: 1,000 hours 85°C/85%RH and rated voltage. Add 100K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
ĺ		Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours. +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	−55°C/+150. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 150°C with 2 X rated voltage applied.
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 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage and Handling

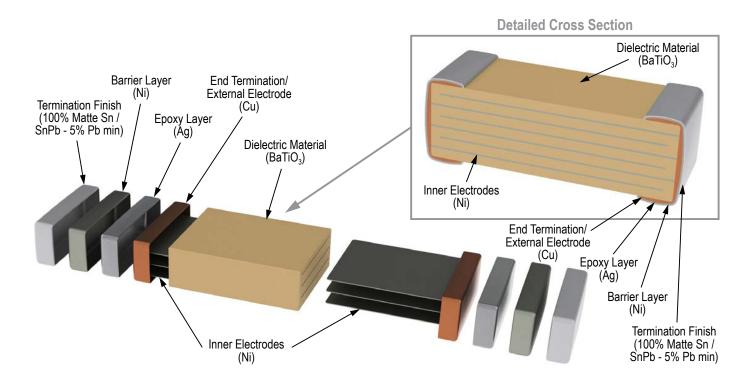
Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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 – Standard Termination



Construction – Flexible Termination



Telecom "Tip and Ring," X7R Dielectric, 250 VDC (Commercial Grade)



Overview

KEMET's 250V DC Tip and Ring MLCCs in X7R dielectric are designed and rated for telecommunication ringer circuits where the capacitor is used to block -48V to -52V DC of line voltage and pass a 16-25 Hz AC signal pulse of 70 Vrms to 90 Vrms. Serving as an excellent replacement for high voltage leaded film devices, these smaller surface mount technology footprints save valuable board space which is critical when creating new designs.

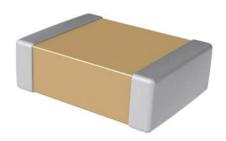
KEMET Tip and Ring capacitors feature a 125°C maximum operating temperature and are considered "temperature stable." The Electronics Industries Alliance (EIA) characterizes X7R dielectric as a Class II material. Components of this classification

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 dielectric 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.

These devices are able to withstand today's higher lead-free reflow processing temperatures and offer superior high frequency filtering characteristics and low ESR.

Benefits

- -55°C to +125°C operating temperature range
- · Lead (Pb)-Free, RoHS and REACH compliant
- EIA 0805, 1206, 1210, 1812, 1825, 2220, and 2225 case sizes
- DC voltage rating of 250 V
- Capacitance offerings ranging from 1,000 pF to 6.8 μF
- Available capacitance tolerances of ±10% and ±20%
- · Non-polar device, minimizing installation concerns
- 100% pure matte tin-plated termination finish that allows for excellent solderability
- SnPb termination finish option available upon request (5% Pb minimum)
- Flexible termination option available upon request



Ordering Information

С	1825	С	105	K	Α	R	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec)
	0805 1206 1210 1812 1825 2220 2225	C = Standard X = Flexible Termination	Two significant digits + number of zeros	J = ±5% K = ±10% M = ±20%	A = 250	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

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



Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec)
Bulk Bag/Unmarked	Not required (Blank)
7" Reel/Unmarked	TU
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
7" Reel/Marked	TM
13" Reel/Marked	7040 (EIA 0603 and smaller case sizes) 7215 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2mm pitch ²	7081
13" Reel/Unmarked/2mm pitch ²	7082

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Applications

Typical applications include telecommunication ringing circuits, switch mode power supply snubber circuits, high voltage DC blocking and high voltage coupling. Markets include telephone lines, analog and digital modems, facsimile machines, wireless base stations, cable and digital video recording set-top boxes, satellite dishes, high voltage power supply, DC/DC converters, and Ethernet, POS and ATM hardware.

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

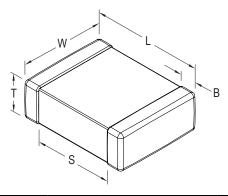
Lead (Pb)-Free, RoHS, and REACH compliant without exemptions (excluding SnPb termination finish option).

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. Please contact KEMET if you require a laser marked option. For more information see "Capacitor Marking".

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Dimensions – Millimeters (Inches) – Standard Termination



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique	
0805	2012	2.00 (.079) ± 0.20 (.008)	1.25 (.049) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	Solder Wave or	
1206	3216	3.20 (.126) ± 0.20 (.008)	1.60 (.063) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)		Solder Reflow	
1210	3225	3.20 (.126) ± 0.20 (.008)	2.50 (.098) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)			
1812	4532	4.50 (.177) ± 0.30 (.012)	3.20 (.126) ± 0.30 (.012)	See Table 2 for Thickness	0.60 (.024) ± 0.35 (.014)	- NI/A		
1825	4564	4.50 (.177) ± 0.30 (.012)	6.40 (.252) ± 0.40 (.016)		0.60 (.024) ± 0.35 (.014)	N/A	Solder Reflow Only	
2220	5650	5.70 (.224) ± 0.40 (.016)	5.00 (.197) ± 0.40 (.016)		0.60 (.024) ± 0.35 (.014)			
2225	5664	5.60 (.220) ± 0.40 (.016)	6.40 (.248) ± 0.40 (.016)		0.60 (.024) ± 0.35 (.014)			

Dimensions – Millimeters (Inches) – Flexible Termination

EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique	
0805	2012	2.00 (.079) ± 0.30 (.012)	1.25 (.049) ± 0.30 (.012)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	Solder Wave or	
1206	3216	3.30 (.130) ± 0.40 (.016)	1.60 (.063) ± 0.35(.013)		0.60 (.024) ± 0.25 (.010)		Solder Reflow	
1210	3225	3.30 (.130) ± 0.40 (.016)	2.60(.102) ± 0.30(.012)		0.60 (.024) ± 0.25 (.010)	_		
1812	4532	4.50 (.178) ± 0.40 (.016)	3.20 (.126) ± 0.30 (.012)	See Table 2 for Thickness	0.70 (.028) ± 0.35 (.014)			
1825	4564	4.60 (.181) ± 0.40 (.016)	6.40 (.252) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)	N/A	Solder Reflow Only	
2220	5650	5.90 (.232) ± 0.75 (.030)	5.00 (.197) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)			
2225	5664	5.90 (.232) ± 0.75 (.030)	6.40 (.248) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)			



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%			
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%			
² Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ± 1 seconds and charge/discharge not exceeding 50mA)			
³ Dissipation Factor (DF) Maximum Limit @ 25°C	5%(6.3V & 10V), 3.5%(16V & 25V) and 2.5%(50V to 250V)			
⁴Insulation Resistance (IR) Minimum Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ± 5 secs @ 25°C)			

¹Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

 $1kHz \pm 50Hz$ and 1.0 ± 0.2 Vrms if capacitance ≤ $10\mu F$

120Hz \pm 10Hz and 0.5 ± 0.1 Vrms if capacitance >10 μ F

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

Post Environmental Limits

	High Temperature Life, Biased Humidity, Moisture Resistance									
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance					
	> 25		3.0							
X7R	16/25	All	5.0	±20%	10% of Initial Limit					
	< 16		7.5							

Insulation Resistance Limit Table

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				

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

⁴To obtain IR limit, divide MΩ- μ F value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



Table 1 – Capacitance Range/Selection Waterfall (0805 – 2225 Case Sizes)

	Conscitones		se Siz Series		C0805C	C1206C	C1210C	C1812C	C1825C	C2220C	C2225C				
Capacitance	Capacitance	Vo	ltage Co	de	Α	Α	Α	Α	Α	A	Α				
	Code	Rated	Voltage	(VDC)	250	250	250	250	250	250	250				
		Ca	pacita	nce		Product Availability and Chip Thickness Codes See Table 2 for Chip Thickness Dimensions									
180 pF	181	J	K	M	DR										
220 pF	221	J	K	M	DR										
270 pF	271	J	K	M	DR										
330 pF	331	J	K	M	DR										
390 pF	391	J	K	M	DR										
470 pF	471	J	K	M	DR										
560 pF	561	J	K	M	DR										
680 pF	681	J	K	M	DR										
820 pF	821	J	K	M	DR										
1,000 pF	102 122	J	K	M	DR DR	EQ EQ									
1,200 pF 1,500 pF	152	J	K	M M	DR DR	EQ EQ									
1,500 pF 1,800 pF	182	J	K	M	DR DR	EQ EQ									
2,200 pF	222	J	K	M	DR	EQ	FN								
2,700 pF	272	J	K	M	DR	EQ	FN								
3,300 pF	332	J	K	M	DR	EQ	FN								
3,900 pF	392	Ĵ	K	M	DR	EQ	FN			1					
4,700 pF	472	Ĵ	K	М	DR	EQ	FN								
5,600 pF	562	Ĵ	К	М	DR	EQ	FN								
6,800 pF	682	J	К	М	DR	EQ	FN	GB							
8,200 pF	822	J	K	M	DR	EQ	FN	GB							
10,000 pF	103	J	K	M	DR	EQ	FN	GB							
12,000 pF	123	J	K	M	DR	EQ	FN	GB							
15,000 pF	153	J	K	M	DR	EQ	FN	GB							
18,000 pF	183	J	K	M	DR	EQ	FN	GB							
22,000 pF	223	J	K	M	DR	EQ	FN	GB	HB						
27,000 pF	273	J	K	M		EQ	FN	GB	HB						
33,000 pF	333	J	K	М		EQ	FN	GB	НВ						
39,000 pF	393	J	K	M		EQ	FN	GB	HB		140				
47,000 pF	473	J	K	M		ES	FQ	GB	HB		KC				
56,000 pF	563 683	J	K K	M M		ES ES	FQ FQ	GB GB	HB HB		KC KC				
68,000 pF 82,000 pF	823	J	K	M		ES ES	FQ FA	GB GB	HB HB	JC	KC KC				
0.10 µF	104	J	K	M		ES EM	FZ FZ	GB GB	HB	JC JC	KC				
0.10 μF	124	J	K	M		LIVI	FU	GB	HB	JC JC	KC				
0.15 μF	154	J	K	M			FM	GE	HB	JC	KC				
0.18 µF	184	Ĵ	K	M			FK	GG	НВ	JC	KC				
0.22 µF	224	J	K	M			FK	GG	НВ	JC	KC				
0.27 µF	274	J	K	М				GG	НВ	JC	KC				
0.33 µF	334	J	K	М				GG	НВ	JC	KC				
0.39 µF	394	J	K	М				GG	HD	JC	KC				
0.47 μF	474	J	K	M				GJ	HD	JC	KD				
0.56 µF	564	J	K	М					HD	JD	KD				
0.68 μF	684	J	K	M					HD	JD	KD				
0.82 µF	824	J	K	M					HF	JF	KE				
1.0 μF 1.2 μF	105 125	J	K K	M M					HF	JF	KE KE				
	Conseitance	Rated	Voltage	(VDC)	250	250	250	250	250	250	250				
Capacitance	Capacitance Code	.	Itage Co		Α	Α	Α	Α	Α	A	Α				
		Case	Size/S	eries	C0805C	C1206C	C1210C	C1812C	C1825C	C2220C	C2225C				



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

Thickness	Case	Thickness ±	Paper G	Quantity	Plastic (Quantity	
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel	
DR	0805	0.78 ± 0.20	0	0	4,000	10,000	
EQ	1206	0.78 ± 0.20	4,000	10,000	4,000	10,000	
ES	1206	1.00 ± 0.20	0	0	2,500	10,000	
EM	1206	1.25 ± 0.15	0	0	2,500	10,000	
FN	1210	0.78 ± 0.20	0	0	4,000	10,000	
FQ	1210	0.90 ± 0.20	0	0	4,000	10,000	
FA	1210	1.10 ± 0.15	0	0	2,500	10,000	
FZ	1210	1.25 ± 0.20	0	0	2,500	10,000	
FU	1210	1.55 ± 0.20	0	0	2,000	8,000	
FM	1210	1.70 ± 0.20	0	0	2,000	8,000	
FK	1210	2.10 ± 0.20	0	0	2,000	8,000	
GB	1812	1.00 ± 0.10	0	0	1,000	4,000	
GE	1812	1.30 ± 0.10	0	0	1,000	4,000	
GG	1812	1.55 ± 0.10	0	0	1,000	4,000	
GJ	1812	1.70 ± 0.15	0	0	1,000	4,000	
HB	1825	1.10 ± 0.15	0	0	1,000	4,000	
HD	1825	1.30 ± 0.15	0	0	1,000	4,000	
HF	1825	1.50 ± 0.15	0	0	1,000	4,000	
JC	2220	1.10 ± 0.15	0	0	1,000	4,000	
JD	2220	1.30 ± 0.15	0	0	1,000	4,000	
JF	2220	1.50 ± 0.15	0	0	1,000	4,000	
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 2B - Bulk Packaging Quantities

Deale		Loose P	Loose Packaging				
Раска(ging Type	Bulk Bag	g (default)				
Packagi	ing C-Spec ¹	N.	/A ²				
Cas	se Size	Packaging Quantities	(pieces/unit packaging)				
EIA (in)	Metric (mm)	Minimum	Maximum				
0402	1005						
0603	1608		50,000				
0805	2012						
1206	3216						
1210	3225	1					
1808	4520						
1812	4532						
1825	4564		20,000				
2220	5650						
2225	5664						

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

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



Table 3A – Land Pattern Design Recommendations per IPC-7351 – Standard Termination

EIA Size Code	Size Size Land Protr			mum (N	Most))	Density Level B: Median (Nominal) Land Protrusion (mm)				Density Level C: Minimum (Least) Land Protrusion (mm)					
Oode	Oode	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	Х	V1	V2
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
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

¹ 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.

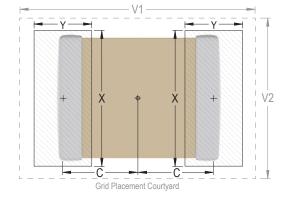




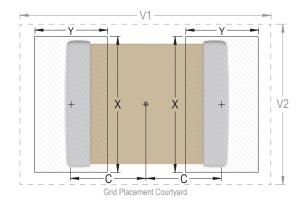
Table 3B – Land Pattern Design Recommendations per IPC-7351 – Flexible Termination

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)						
Code	Code	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Υ	Х	V1	V2
0805	2012	0.99	1.44	1.66	4.47	2.71	0.89	1.24	1.56	3.57	2.11	0.79	1.04	1.46	2.42	1.81
1206	3216	1.59	1.62	2.06	5.85	3.06	1.49	1.42	1.96	4.95	2.46	1.39	1.22	1.86	4.25	2.16
1210	3225	1.59	1.62	3.01	5.90	4.01	1.49	1.42	2.91	4.95	3.41	1.39	1.22	2.81	4.25	3.11
1812	4532	2.30	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
1825	4564	2.15	1.80	6.90	7.10	7.90	2.05	1.60	6.80	6.20	7.30	1.95	1.40	6.70	5.50	7.00
2220	5650	2.85	2.10	5.50	8.80	6.50	2.75	1.90	5.40	7.90	5.90	2.65	1.70	5.30	7.20	5.60
2225	5664	2.85	2.10	6.90	8.80	7.90	2.75	1.90	6.80	7.90	7.30	2.65	1.70	6.70	7.20	7.00

Density Level A: For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes. KEMET only recommends wave soldering of EIA 0603, 0805 and 1206 case sizes.

Density Level B: For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes. **Density Level C:** For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC Standard 7351 (IPC–7351).

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





Soldering Process

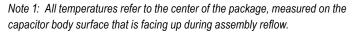
Recommended Soldering Technique:

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

Recommended Reflow Soldering Profile:

KEMET's families of surface mount multilayer ceramic capacitors (SMD MLCCs) are compatible with wave (single or dual), convection, IR or vapor phase reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET's recommended profile conditions for convection and IR reflow reflect the profile conditions of the IPC/J-STD-020 standard for moisture sensitivity testing. These devices can safely withstand a maximum of three reflow passes at these conditions.

Profile Feature	Terminati	on Finish		
Frome reature	SnPb	100% Matte Sn		
Preheat/Soak				
Temperature Minimum (T _{Smin})	100°C	150°C		
Temperature Maximum (T _{Smax})	150°C	200°C		
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds		
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum		
Liquidous Temperature (T _L)	183°C	217°C		
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds		
Peak Temperature (T _P)	235°C	260°C		
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum		
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum		
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum		



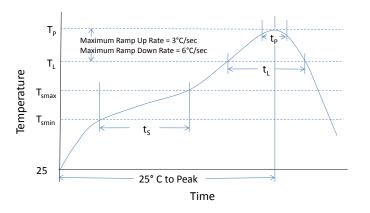




Table 4 – Performance & Reliability: Test Methods and Conditions

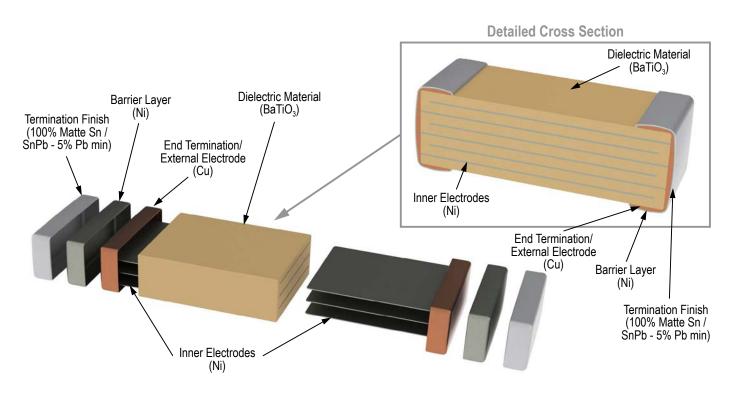
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Solderability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	J-31D-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.
D: 111 · 151	MII. OTD 000 M II. 1400	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
Vibration	MIL-STD-202 Method 204	5 g's for 20 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage and Handling

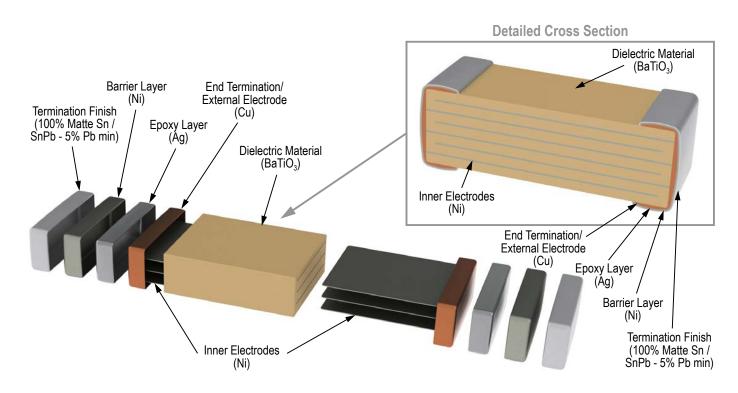
Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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 – Standard Termination



Construction – Flexible Termination



Open Mode Design (FO-CAP), X7R Dielectric, 16 – 200 VDC (Commercial & Automotive Grade)



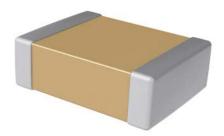
Overview

KEMET's Ceramic Open Mode capacitor in X7R dielectric is designed to significantly minimize the probability of a low IR or short circuit condition when forced to failure in a board stress flex situation, thus reducing the potential for catastrophic failure. The Open Mode capacitor may experience a drop in capacitance; however, a short is unlikely because a crack will not typically propagate across counter electrodes within the device's "active area." Since there will not be any current leakage associated with a typical Open Mode flex crack, there is no localized heating and therefore little chance for a catastrophic and potentially costly failure event.

Driven by the demand for a more robust and reliable component, the Open Mode capacitor was designed for critical applications where higher operating temperatures and mechanical stress are a concern. These capacitors are widely used in automotive circuits as well as power supplies (input and output filters) and general electronic applications.

Concerned with flex cracks resulting from excessive tensile and shear stresses produced during board flexure and thermal cycling? These devices are available with KEMET's Flexible termination technology which inhibits the transfer of board stress to the rigid ceramic body, therefore mitigating flex cracks which can result in low IR or short circuit failures. Although flexible termination technology does not eliminate the potential for mechanical damage that may propagate during extreme

environmental and handling conditions, it does provide superior flex performance over standard termination systems. When combined with flexible termination technology these devices offer the ultimate level of protection against a low IR or short circuit condition. Open Mode devices compliment KEMET's Floating Electrode (FE-CAP) and Floating Electrode with Flexible Termination (FF-CAP) product lines by providing a fail-safe design optimized for mid to high range capacitance values. These devices exhibit a predictable change in capacitance with respect to time and voltage and boast a minimal change in capacitance with reference to ambient temperature. Capacitance change is limited to ±15% from -55°C to +125°C.



Ordering Information

С	1210	J	685	K	3	R	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec)
	0805 1206 1210 1812	F = Open Mode J = Open Mode with Flexible Termination	Two significant digits + number of zeros	K = ±10% M = ±20%	4 = 16 3 = 25 5 = 50 1 = 100 2 = 200	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

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

¹ SnPb termination finish option is not available on automotive grade product.



Packaging C-Spec Ordering Options Table

Packaging Type	Packaging/Grade Ordering Code (C-Spec)							
Commercial Grade ¹								
Bulk Bag	Not Required (Blank)							
7" Reel/Unmarked	TU							
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)							
7" Reel/Marked	TM							
13" Reel/Marked	7040 (EIA 0603 and smaller case sizes) 7215 (EIA 0805 and larger case sizes)							
7" Reel/Unmarked/2 mm pitch ²	7081							
13" Reel/Unmarked/2 mm pitch ²	7082							
Automoti	ve Grade ³							
7" Reel	AUTO							
13" Reel/Unmarked	AUTO7411 (EIA 0603 and smaller case sizes) AUTO7210 (EIA 0805 and larger case sizes)							
7" Reel/Unmarked/2 mm pitch ²	3190							
13" Reel/Unmarked/2 mm pitch ²	3191							

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- -55°C to +125°C operating temperature range
- Open Mode/fail open design
- · Mid to high capacitance flex mitigation
- Lead (Pb)-Free, RoHS and REACH compliant
- EIA 0805, 1206, 1210, and 1812 case sizes
- DC voltage ratings of 16 V, 25 V, 50 V, 100 V, and 200 V
- Capacitance offerings ranging from 1,000 pF to 6.8 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
- Commercial and Automotive (AEC–Q200) grades available
- SnPb termination finish option available upon request (5% Pb minimum)
- · Flexible termination option available upon request

Applications

Typical applications include input side filtering (power plane/bus), high current (battery line) and circuits that cannot be fused to open when short circuits occur due to flex cracks. Markets include automotive applications that are directly connected to the battery and/or involve conversion to a 42 V system and raw power input side filtering in power conversion.

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked.

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".

³ Reeling tape options (Paper or Plastic) are dependent on capacitor case size (L" x W") and thickness dimension. See "Chip Thickness/Tape & Reel Packaging Quantities" and "Tape & Reel Packaging Information".

³ For additional Information regarding "AUTO" C-Spec options, see "Automotive C-Spec Information".

³ All Automotive packaging C-Specs listed exclude the option to laser mark components. Please contact KEMET if you require a laser marked option. For more information see "Capacitor Marking".



Automotive C-Spec Information

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

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

Product Change Notification (PCN)

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

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

KEMET Automotive	Customer Noti	fication due to:	Days prior to			
C-Spec	Process/Product change	Obsolescence*	implementation			
KEMET assigned ¹	Yes (with approval and sign off)	Yes	180 days Minimum			
AUTO	Yes (without approval)	Yes	90 days Minimum			

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

Production Part Approval Process (PPAP)

The purpose of the Production Part Approval Process is:

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

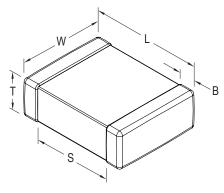
KEMET Automotive	PPAP (Product Part Approval Process) Level											
C-Spec	1	2	3	4	5							
KEMET assigned ¹	•	•	•	•	•							
AUTO	0		0									

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

- Part Number specific PPAP available
- Product family PPAP only



Dimensions – Millimeters (Inches) – Standard Termination



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	T B Thickness Bandwidth		Mounting Technique	
0805	2012	2.00 (.079) ± 0.20 (.008)	1.25 (.049) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	Solder Wave or	
1206	3216	3.20 (.126) ± 0.20 (.008)	1.60 (.063) ± 0.20 (.008)	See Table 2 for	$0.50 (0.02) \pm 0.25 (.010)$		Solder Reflow	
1210	3225	3.20 (.126) ± 0.20 (.008)	2.50 (.098) ± 0.20 (.008)	Thickness	0.50 (0.02) ± 0.25 (.010)	N/A	Colder Defless Only	
1812	4532	4.50 (.177) ± 0.30 (.012)	3.20 (.126) ± 0.30 (.012)		0.60 (.024) ± 0.35 (.014)		Solder Reflow Only	

Dimensions – Millimeters (Inches) – Flexible Termination

EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique	
0805	2012	2.00 (.079) ± 0.30 (.012)	1.25 (.049) ± 0.30 (.012)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	Solder Wave or Solder Reflow	
1206	3216	3.30 (.130) ± 0.40 (.016)	1.60 (.063) ± 0.35 (.013)	See Table 2 for	0.60 (.024) ± 0.25 (.010)			
1210	3225	3.30 (.130) ± 0.40 (.016)	2.60 (.102) ± 0.30 (.012)	Thickness	0.60 (.024) ± 0.25 (.010)	N/A	Solder Reflow Only	
1812	4532	4.50 (.178) ± 0.40 (.016)	3.20 (.126) ± 0.30 (.012)		0.70 (.028) ± 0.35 (.014)			

Qualification/Certification

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

Automotive Grade products meet or exceed the requirements outlined by the Automotive Electronics Council. Details regarding test methods and conditions are referenced in document AEC–Q200, Stress Test Qualification for Passive Components. For additional information regarding the Automotive Electronics Council and AEC–Q200, please visit their website at www.aecouncil.com.



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%
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
² Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ± 1 seconds and charge/discharge not exceeding 50mA)
³ Dissipation Factor (DF) Maximum Limit @ 25°C	5%(6.3V & 10V), 3.5%(16V & 25V) and 2.5%(50V to 250V)
⁴Insulation Resistance (IR) Minimum Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ± 5 secs @ 25°C)

¹Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

Post Environmental Limits

High Temperature Life, Biased Humidity, Moisture Resistance										
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Insulation Resistance						
	> 25		3.0							
X7R	16/25	All	5.0	±20%	10% of Initial Limit					
	< 16		7.5							

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

 $¹kHz \pm 50Hz$ and 1.0 ± 0.2 Vrms if capacitance ≤10 μ F

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

⁴To obtain IR limit, divide MΩ- μ F value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



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				



Table 1 – Capacitance Range/Selection Waterfall (0805 – 1812 Case Sizes)

		Case Ser	Size/ ies		С	0805	F			C	1206	F			С	1210	F			C1812F			
Capacitance	Capacitance	Voltage	e Code	4	3	5	1	2	4	3	5	1	2	4	3	5	1	2	3	5	1	2	
•	Code	Rated Volt	age (VDC)	16	25	50	100	200	16	25	50	100	200	16	25	50	100	200	25	50	100	200	
		Capac Toler	itance ance											hip T									
1,000 pF	102	K	M	DP	DP	DP	DP	DP															
1,200 pF	122	K	M	DP	DP	DP	DP	DP															
1,500 pF	152	K	M	DP	DP	DP	DP	DP															
1,800 pF	182	K	M	DP	DP	DP	DP	DP															
2,200 pF	222	K	M	DP	DP	DP	DP	DP															
2,700 pF	272	K	M	DP	DP	DP	DP	DP															
3,300 pF	332	K	M	DP DP	DP DP	DP DP	DP DP	DP DP															
3,900 pF	392	K	M				DP																
4,700 pF	472	K	M	DP DP	DP DP	DP DP	DP	DP DP															
5,600 pF	562	K	M M	DP	DP	DP		DP															
6,800 pF 8,200 pF	682 822	K K	M	DP	DP	DP	DP DP	DP															
10,000 pF	103	K	M	DP	DP	DP	DP	DP															
12,000 pF	123	K	M	DP	DP	DP	DP	DG															
15,000 pF	153	K	M	DP	DP	DP	DP	DG															
18,000 pF	183	K	M	DP	DP	DP	DP	DO	EC	EC	EC	EC	EC										
22,000 pF	223	K	M	DP	DP	DP	DG		EC	EC	EC	EC	EC										
27,000 pF	273	K	M	DP	DP	DP	DG		EC	EC	EC	EC	EC										
33,000 pF	333	K	M	DP	DP	DP	DG		EC	EC	EC	EC	EC										
39,000 pF	393	K	M	DP	DP	DP	DG		EC	EC	EC	EC	EC										
47,000 pF	473	K	M	DP	DP	DP	DE		EC	EC	EC	EC	EG						GB	GB	GB	GB	
56,000 pF	563	K	M	DP	DP	DP			EC	EC	EC	EC	EG						GB	GB	GB	GB	
68,000 pF	683	K	M	DP	DP	DG	DG		EC	EC	EC	EC	EG	FD	FD	FD	FD	FD	GB	GB	GB	GB	
82,000 pF	823	К	М	DP	DP	DG			EC	EC	EC	EC	EG	FD	FD	FD	FD	FD	GB	GB	GB	GB	
0.10 µF	104	К	М	DG	DG	DG			EC	EC	EC	EC	EG	FD	FD	FD	FD	FG	GB	GB	GB	GB	
0.12 µF	124	К	М	DG	DG				EC	EC	EC	EC		FD	FD	FD	FD	FG	GB	GB	GB	GB	
0.15 µF	154	К	M	DG	DG				EC	EC	EC	EG		FD	FD	FD	FD	FH	GB	GB	GB	GB	
0.18 µF	184	К	M	DG	DG				EC	EC	EC	EG		FD	FD	FD	FD	FH	GB	GB	GB	GB	
0.22 µF	224	К	M	DG	DP	DG			EC	EC	EC	ED		FD	FD	FD	FG	FS	GB	GB	GB	GC	
0.27 μF	274	К	M	DP	DP				EC	EC	EC			FD	FD	FD	FG		GB	GB	GB	GF	
0.33 µF	334	K	M	DP	DG				EG	EG	EG	EG		FD	FD	FD	FH		GB	GB	GB	GK	
0.39 µF	394	K	M	DP	DG				EG	EG				FD	FD	FG	FH		GB	GB	GB	GL	
0.47 μF	474	K	M	DE	DG				EG	EG	EC			FD	FD	FG	FJ		GB	GB	GC		
0.56 μF	564	K	M						EG					FD	FD	FG	FR		GB	GB	GD		
0.68 µF	684	K	M	DG					EG					FD	FG	FH	FR		GD	GD	GF		
0.82 µF	824	K	M						EG					FD	FG	FH	FR		GD	GD	GK		
1.0 µF	105	K	M	l					EG	EC	EH			FD	FH	FJ	FS		GN	GN	GM		
1.2 µF	125	K	M											FG									
1.5 µF	155	K	M											FH									
1.8 µF	185	K	M											FH									
2.2 µF	225	K	M						EC	EH				FJ	FM	FM							
2.7 µF	275	K	M																				
3.3 µF	335	K	M											FM									
3.9 µF	395	K	M						F					F0	E14				OK	CI			
4.7 µF	475 685	K K	M M						EH					FG FS	FM FS				GK	GK			
6.8 µF	085		age (VDC)	16	25	50	100	200	16	25	50	100	200	16	25	50	100	200	25	50	100	200	
	Capacitance		e Code	4	3	5	1	2	4	3	5	1	2	4	3	5	1	2	3	5	1	200	
Capacitance	Code		Size/	<u> </u>					┤					+									
			ies			0805	F				1206	F			c	1210	F			C18	12F		



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

Thickness	Case	Thickness ±	Paper G	Quantity	Plastic (Quantity		
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel		
DP	0805	0.90 ± 0.10	4,000	15,000	0	0		
DE	0805	1.00 ± 0.10	0	0	2,500	10,000		
DG	0805	1.25 ± 0.15	0	0	2,500	10,000		
EC	1206	0.90 ± 0.10	0	0	4,000	10,000		
ED	1206	1.00 ± 0.10	0	0	2,500	10,000		
EG	1206	1.60 ± 0.15	0	0	2,000	8,000		
EH	1206	1.60 ± 0.20	0	0	2,000	8,000		
FD	1210	0.95 ± 0.10	0	0	4,000	10,000		
FG	1210	1.25 ± 0.15	0	0	2,500	10,000		
FH	1210	1.55 ± 0.15	0	0	2,000	8,000		
FM	1210	1.70 ± 0.20	0	0	2,000	8,000		
FJ	1210	1.85 ± 0.20	0	0	2,000	8,000		
FR	1210	2.25 ± 0.20	0	0	2,000	8,000		
FS	1210	2.50 ± 0.30	0	0	1,000	4,000		
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		
GF	1812	1.50 ± 0.10	0	0	1,000	4,000		
GK	1812	1.60 ± 0.20	0	0	1,000	4,000		
GN	1812	1.70 ± 0.20	0	0	1,000	4,000		
GL	1812	1.90 ± 0.20	0	0	500	2,000		
GM	1812	2.00 ± 0.20	0	0	500	2,000		
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 2B - Bulk Packaging Quantities

Doolean		Loose Packaging					
Раска	jing Type	Bulk Bag	(default)				
Packagii	ng C-Spec ¹	N/	/A ²				
Cas	e Size	Packaging Quantities ((pieces/unit packaging)				
EIA (in)	Metric (mm)	Minimum	Maximum				
0402	1005						
0603	1608		50,000				
0805	2012						
1206	3216						
1210	3225	1					
1808	4520] '					
1812	4532						
1825	4564		20,000				
2220	5650						
2225	5664						

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

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



Table 3A – Land Pattern Design Recommendations per IPC-7351 – Standard Termination

	Metric Size	Density Level A: Maximum (Most) Land Protrusion (mm)				Density Level B: Median (Nominal) Land Protrusion (mm)					Density Level C: Minimum (Least) Land Protrusion (mm)					
	oodc	C	Y	Х	V1	V2	С	Y	X	V1	V2	С	Υ	X	V1	V2
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
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

¹ 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.

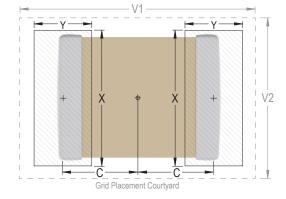




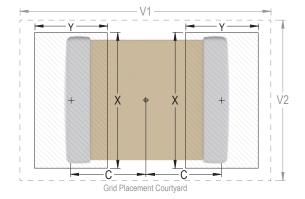
Table 3B – Land Pattern Design Recommendations per IPC-7351 – Flexible Termination

EIA Metri Size Size Code 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)				
Oode	Oouc	С	Υ	Х	V1	V2	С	Y	Х	V1	V2	С	Υ	Х	V1	V2	
0805	2012	0.99	1.44	1.66	4.47	2.71	0.89	1.24	1.56	3.57	2.11	0.79	1.04	1.46	2.42	1.81	
1206	3216	1.59	1.62	2.06	5.85	3.06	1.49	1.42	1.96	4.95	2.46	1.39	1.22	1.86	4.25	2.16	
1210	3225	1.59	1.62	3.01	5.90	4.01	1.49	1.42	2.91	4.95	3.41	1.39	1.22	2.81	4.25	3.11	
1812	4532	2.10	1.80	3.60	7.00	4.60	2.00	1.60	3.50	6.10	4.00	1.90	1.40	3.40	5.40	3.70	

Density Level A: For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes. KEMET only recommends wave soldering of EIA 0603, 0805 and 1206 case sizes.

Density Level B: For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes. **Density Level C:** For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC Standard 7351 (IPC–7351).

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





Soldering Process

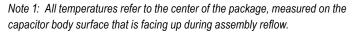
Recommended Soldering Technique:

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

Recommended Reflow Soldering Profile:

KEMET's families of surface mount multilayer ceramic capacitors (SMD MLCCs) are compatible with wave (single or dual), convection, IR or vapor phase reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET's recommended profile conditions for convection and IR reflow reflect the profile conditions of the IPC/J-STD-020 standard for moisture sensitivity testing. These devices can safely withstand a maximum of three reflow passes at these conditions.

Profile Feature	Termination Finish					
Frome reature	SnPb	100% Matte Sn				
Preheat/Soak						
Temperature Minimum (T _{Smin})	100°C	150°C				
Temperature Maximum (T _{Smax})	150°C	200°C				
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds				
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum				
Liquidous Temperature (T _L)	183°C	217°C				
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds				
Peak Temperature (T _P)	235°C	260°C				
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum				
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum				
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum				



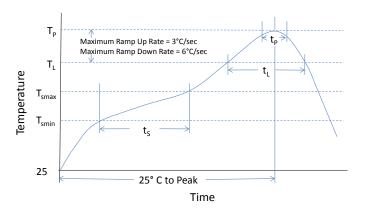




Table 4 - Performance & Reliability: Test Methods and Conditions

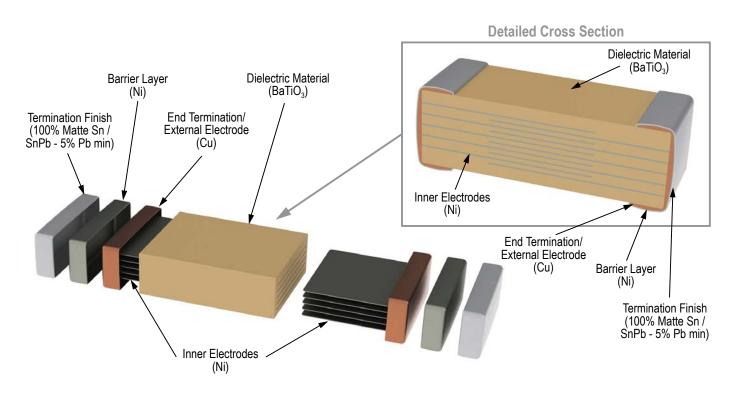
Stress	Reference	Test or Inspection Method						
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.						
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).						
		Magnification 50 X. Conditions:						
Solderability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C						
Solderability	J-31D-002	b) Method B @ 215°C category 3						
		c) Method D, category 3 @ 260°C						
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.						
Digged 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 +/- 4 hours after test conclusion.						
Biased Humidity	MIL-STD-202 Method 103	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.						
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.						
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.						
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.						
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.						
Vibration	MIL-STD-202 Method 204	5 g's for 20 min., 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, Condition F.						
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.						

Storage and Handling

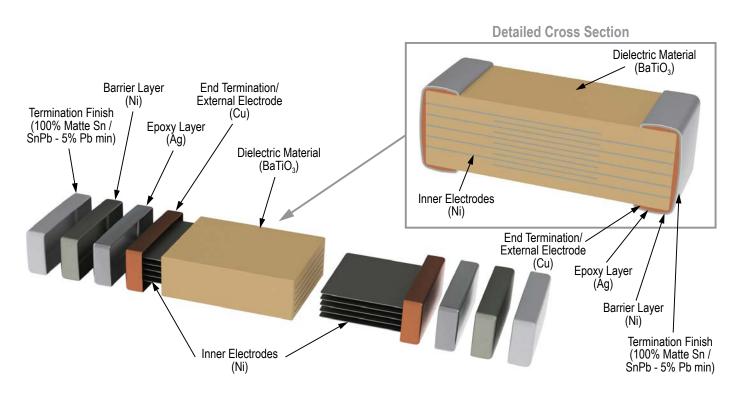
Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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 – Standard Termination



Construction – Flexible Termination



Floating Electrode Design (FE-CAP), X7R Dielectric, 6.3 – 250 VDC (Commercial & Automotive Grade)



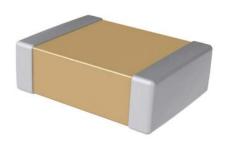
Overview

KEMET's Floating Electrode (FE-CAP) multilayer ceramic capacitor in X7R dielectric utilizes a cascading internal electrode design configured to form multiple capacitors in series within a single monolithic structure. This unique configuration results in enhanced voltage and ESD performance over standard capacitor designs while allowing for a fail-open condition if mechanically damaged (cracked). If damaged, the device may experience a drop in capacitance but a short is unlikely. The FE-CAP is designed to reduce the likelihood of a low IR or short circuit condition and the chance for a catastrophic and potentially costly failure event.

Driven by the demand for a more robust and reliable component, the FE-CAP was designed for critical applications where higher operating temperatures and mechanical stress are a concern. These capacitors are manufactured in state of the art ISO/TS 16949:2009 certified facilities and are widely used in power supplies (input and output filters) and general electronic applications.

Combined with the stability of an X7R dielectric, the FE-CAP complements KEMET's "Open Mode" devices by providing a fail-safe design optimized for low to mid range capacitance values. These devices exhibit a predictable change in capacitance with respect to time and voltage and boast a minimal change in capacitance with reference to ambient temperature. Capacitance change is limited to ±15% from -55°C to +125°C.

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



Ordering Information

С	0805	S	104	K	5	R	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/ Grade (C-Spec)
	0402 0603 0805 1206 1210 1812	S = Floating Electrode	Two significant digits + number of zeros	J = ±5% K = ±10% M = ±20%	9 = 6.3 8 = 10 4 = 16 3 = 25 5 = 50 1 = 100 2 = 200 A = 250	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

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

¹ SnPb termination finish option is not available on automotive grade product.



Packaging C-Spec Ordering Options Table

Packaging Type	Packaging/Grade Ordering Code (C-Spec)
Commerc	ial Grade ¹
Bulk Bag	Not Required (Blank)
7" Reel/Unmarked	TU
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
7" Reel/Marked	TM
13" Reel/Marked	7040 (EIA 0603 and smaller case sizes) 7215 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2 mm pitch ²	7081
13" Reel/Unmarked/2 mm pitch ²	7082
Automoti	ve Grade ³
7" Reel	AUTO
13" Reel/Unmarked	AUTO7411 (EIA 0603 and smaller case sizes) AUTO7210 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2 mm pitch²	3190
13" Reel/Unmarked/2 mm pitch ²	3191

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- -55°C to +125°C operating temperature range
- Floating Electrode/fail open design
- · Low to mid capacitance flex mitigation
- Lead (Pb)-Free, RoHS and REACH compliant
- EIA 0402, 0603, 0805, 1206, 1210, and 1812 case sizes
- DC voltage ratings of 6.3 V, 10 V, 16 V, 25 V, 50 V, 100 V, 200 V, and 250 V
- Capacitance offerings ranging from 150 pF to 0.22 μF

- Available capacitance tolerances of ±5%, ±10%, and ±20%
- Commercial and Automotive (AEC–Q200) grades available
- · 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% Pb minimum)

Applications

Typical applications include circuits with a direct battery or power source connection, critical and safety relevant circuits without (integrated) current limitation and any application that is subject to high levels of board flexure or temperature cycling. Examples include raw power input side filtering (power plane/bus), high current applications (automobile battery line) and circuits that cannot be fused to open. Markets include consumer, medical, industrial (power supply), automotive, aerospace and telecom.

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked.

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".

³ Reeling tape options (Paper or Plastic) are dependent on capacitor case size (L" x W") and thickness dimension. See "Chip Thickness/Tape & Reel Packaging Quantities" and "Tape & Reel Packaging Information".

³ For additional Information regarding "AUTO" C-Spec options, see "Automotive C-Spec Information".

³ All Automotive packaging C-Specs listed exclude the option to laser mark components. Please contact KEMET if you require a laser marked option. For more information see "Capacitor Marking".



Automotive C-Spec Information

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

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

Product Change Notification (PCN)

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

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

KEMET Automotive	Customer Noti	fication due to:	Days prior to
C-Spec	Process/Product change	implementation	
KEMET assigned ¹	Yes (with approval and sign off)	Yes	180 days Minimum
AUTO	Yes (without approval)	Yes	90 days Minimum

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

Production Part Approval Process (PPAP)

The purpose of the Production Part Approval Process is:

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

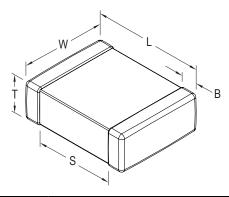
KEMET Automotive		PPAP (Product Part Approval Process) Level												
C-Spec	1	2	3	4	5									
KEMET assigned ¹	•	•	•	•	•									
AUTO	0		0											

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

- Part Number specific PPAP available
- Product family PPAP only



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 Onlv
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)	See Table 2 for	0.50 (0.02) ±0.25 (0.010)	0.75 (0.030)	Solder Wave or Solder Reflow
1206	3216	3.20 (.126) ±0.20 (.008)	1.60 (0.063) ± 0.20 (0.008)	Thickness	0.50 (0.02) ±0.25 (0.010)		
1210	3225	3.20 (.126) ±0.20 (.008)	2.50 (0.098) ± 0.20 (0.008)		0.50 (0.02) ±0.25 (0.010)	N/A	Solder Reflow
1812	4532	4.50 (.177) ±0.30 (.012)	3.20 (0.126) ± 0.30 (0.012)		0.60 (0.024) ±0.35 (0.014)		Only

Qualification/Certification

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

Automotive Grade products meet or exceed the requirements outlined by the Automotive Electronics Council. Details regarding test methods and conditions are referenced in document AEC–Q200, Stress Test Qualification for Passive Components. For additional information regarding the Automotive Electronics Council and AEC–Q200, please visit their website at www.aecouncil.com.

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%
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
² Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ± 1 seconds and charge/discharge not exceeding 50mA)
³ Dissipation Factor (DF) Maximum Limit @ 25°C	5%(6.3V & 10V), 3.5%(16V & 25V) and 2.5%(50V to 250V)
⁴Insulation Resistance (IR) Minimum Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ± 5 secs @ 25°C)

Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

 $1kHz \pm 50Hz$ and 1.0 ± 0.2 Vrms if capacitance ≤ $10\mu F$

120Hz \pm 10Hz and 0.5 ± 0.1 Vrms if capacitance >10 μ F

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

Post Environmental Limits

	High Temperatu	ıre Life, Biased	Humidity, Moist	ture Resistance	•
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance
	> 25		3.0		
X7R	16/25	All	5.0	±20%	10% of Initial Limit
	< 16		7.5		

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

⁴To obtain IR limit, divide MΩ- μ F value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



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



Table 1A – Capacitance Range/Selection Waterfall (0402 – 0805 Case Sizes)

			se S Serie			С	0402	!S				С	0603	S						C08	05S			
Capacitance	Cap	Vol	Itage C	ode	9	8	4	3	5	9	8	4	3	5	1	2	9	8	4	3	5	1	2	Α
Capacitance	Code	Rat	ed Vol		6.3	10	16	25	50	6.3	9	16	25	50	100	200	6.3	9	16	25	50	100	200	250
			pacita	nce														ness Codes imensions						
150 pF	151	<u> </u>	oleran K	Ce M	BB	BB	BB	BB	BB	50	ee Ia	bie 2	tor C	nip i	nicki	ness	Dime	nsio	ns					
180 pF	181	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
220 pF	221	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
270 pF	271	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
330 pF	331	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
390 pF	391	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
470 pF	471	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
560 pF	561	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
680 pF	681	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
820 pF	821	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
	102	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
1,000 pF	102	J			ВВ	DD	DD	DD	DD	CF	CF	CF	CF	CF	CF	CF								
1,200 pF			K	M													DN	DN	DN	DN	DN	DN	DN	DN
1,500 pF	152	J	K	M						CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
1,800 pF	182	J	K	M						CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
2,200 pF	222	J	K	M						CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
2,700 pF	272	J	K	M						CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
3,300 pF	332	J	K	M						CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
3,900 pF	392	J	K	M						CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
4,700 pF	472	J	K	M						CF	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	DN	DN
5,600 pF	562	J	K	M						CF	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DN	DN	DN
6,800 pF	682	J	K	M						CF	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DN	DN	DN
8,200 pF	822	J	K	M						CF	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DN	DN	DN
10,000 pF	103	J	K	M						CF	CF	CF	CF	CF			DN	DN	DN	DN	DN	DN	DN	DN
12,000 pF	123	J	K	M						CF	CF	CF	CF	CF			DN	DN	DN	DN	DN	DN	DN	DN
15,000 pF	153	J	K	M						CF	CF	CF	CF	CF			DN	DN	DN	DN	DN	DP		
18,000 pF	183	J	K	M						CF	CF	CF	CF	CF			DN	DN	DN	DN	DN	DP		
22,000 pF	223	J	K	M						CF	CF	CF	CF	CF			DN	DN	DN	DN	DN	DP		
27,000 pF	273	J	K	M													DN	DN	DN	DN	DN			
33,000 pF	333	J	K	M													DN	DN	DN	DN	DN			
39,000 pF	393	J	K	M													DN	DN	DN	DN	DN			
47,000 pF	473	J	K	M													DN	DN	DN	DN	DN			
56,000 pF	563	J	K	M													DP	DP	DP	DP	DP			
68,000 pF	683	J	K	M													DP	DP	DP	DP	DP			
82,000 pF	823	J	K	M													DG	DG	DG	DG	DG			
0.10 µF	104	J	K	М													DG	DG	DG	DG	DG			
		Rat	ed Vol		6.3	6	9	25	20	6.3	5	9	25	20	100	200	6.3	5	16	25	20	90	200	250
Capacitance	Cap Code	Vol	Itage C		9	8	4	3	5	9	8	4	3	5	1	2	9	8	4	3	5	1	2	Α
	Joue		se Si Serie			С	0402	s				C	0603	S			C0805S			,				



Table 1B - Capacitance Range/Selection Waterfall (1206 - 1812 Case Sizes)

			se Si Serie					C12	06S							C12	108					С	1812	!S	
Capacitance	Cap	Vol	tage C	ode	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	Α	3	5	1	2	Α
Capacitance	Code	Rat		Voltage F: 0 9 9 7 2 8 7 9 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0										20	25	20	5	200	250						
		Ca	(VDC) pacitar			`_	L`							lity o	nd C	hip 1		•			L'``		_	7	7
			pacitai olerand													ckne									
1,000 pF	102	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB		J											
1,200 pF	122	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB									İ				
1,500 pF	152	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB									İ				
1,800 pF	182	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB									İ				
2,200 pF	222	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB	İ				
2,700 pF	272	J	K	М	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB					
3,300 pF	332	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB					
3,900 pF	392	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB					
4,700 pF	472	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB	1				
5,600 pF	562	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB	1				
6,800 pF	682	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB
8,200 pF	822	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB
10,000 pF	103	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB
12,000 pF	123	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB
15,000 pF	153	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB
18,000 pF	183	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB
22,000 pF	223	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB
27,000 pF	273	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB
33,000 pF	333	J	K	M	EB	EB	EB	EB	EB	EB			FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB
39,000 pF	393	J	K	M	EB	EB	EB	EB	EB	EC			FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB
47,000 pF	473	J	K	M	EB	EB	EB	EB	EB	EC			FB	FB	FB	FB	FB	FB	FC	FC	GB	GB	GB	GB	GB
56,000 pF	563	J	K	M	EB	EB	EB	EB	EB	EB			FB	FB	FB	FB	FB	FB	FC	FC	GB	GB	GB	GB	GB
68,000 pF	683	J	K	M	EB	EB	EB	EB	EB				FB	FB	FB	FB	FB	FB			GB	GB	GB	GB	GB
82,000 pF	823	J	K	M	EB	EB	EB	EB	EB				FB	FB	FB	FB	FB	FC			GB	GB	GB	GB	GB
0.10 µF	104	J	K	M	EB	EB	EB	EB	EB				FB	FB	FB	FB	FB	FC			GB	GB	GB	GB	GB
0.12 µF	124	J	K	M	EC	EC	EC	EC	EC				FB	FB	FB	FB	FB				GB	GB	GB	GB	GB
0.15 µF	154	J	K	M									FC	FC	FC	FC	FC				GB	GB	GB	GB	GB
0.18 µF	184	J	K	M									FC	FC	FC	FC	FC				GB	GB	GB	GB	GB
0.22 μF	224	J	K	M									FC	FC	FC	FC	FC				GB	GB	GB	GB	GB
			ed Volt	tage	6.3 10 16 25 25 50				200	250	6.3	9	9	52	20	100	200	250	55	20	19	200	250		
Capacitance	Сар		tage C	ode	9 8 4 3 5 1 2 A				9 8 4 3 5 1 2 A					Α	3	5	1	2	Α						
, April 100	Code	Ca	se Si Serie:	ze/		C1206S					-			C12					C1812S						



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

Thickness	Case	Thickness ±	Paper Q	luantity ¹	Plastic (Quantity		
Code	Size ¹	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		
DN	0805	0.78 ± 0.10*	4,000	15,000	0	0		
DP	0805	0.90 ± 0.10*	4,000	15,000	0	0		
DG	0805	1.25 ± 0.15	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		
FB	1210	0.78 ± 0.10	0	0	4,000	10,000		
FC	1210	0.90 ± 0.10	0	0	4,000	10,000		
GB	1812	1.00 ± 0.10	0	0	1,000	4,000		
Thickness	Case	Thickness ±	7" Reel	13" Reel	7" Reel	13" Reel		
Code	Size ¹	Range (mm)	Paper Q	uantity¹	Plastic Quantity			

Package quantity based on finished chip thickness specifications.

Table 2B – Bulk Packaging Quantities

Dookoo	na Tuna	Loose Pa	ackaging					
Packagi	ng Type	Bulk Bag (default)						
Packagin	g C-Spec ¹	N/A ²						
Case	Size	Packaging Quantities (pieces/unit packaging						
EIA (in)	Metric (mm)	Minimum	Maximum					
0402	1005							
0603	1608							
0805	2012		50,000					
1206	3216							
1210	3225	1						
1808	4520							
1812	4532							
1825	4564		20,000					
2220	5650							
2225	5664							

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

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

¹ If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



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

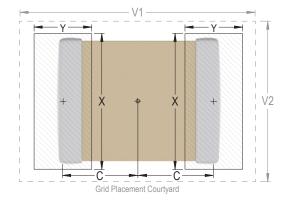
EIA Size	Size Size Code Code Land Protrusion (mm)						I	Media	sity Lev an (Non rotrusio			Density Level C: Minimum (Least) Land Protrusion (mm)					
Code	Code	C	Y	Х	V1	V2	С	Υ	X	V1	V2	С	Υ	Х	V1	V2	
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	0.40	0.52	0.52	1.60	0.80	
0603	1608	0.90	1.15	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	
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	

¹ 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

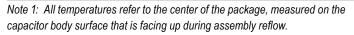
Recommended Soldering Technique:

- 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
Frome reature	SnPb	100% Matte Sn
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum



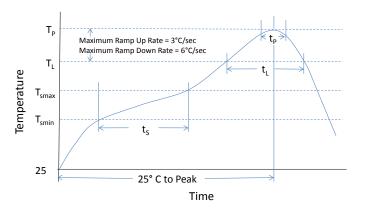




Table 4 – Performance & Reliability: Test Methods and Conditions

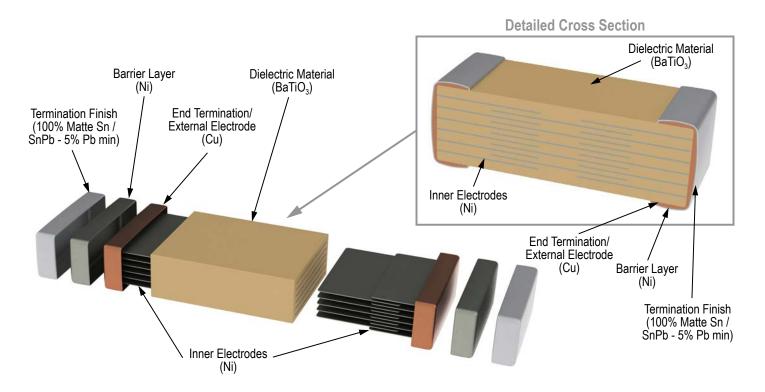
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Solderability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	J-31D-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Dia and Houseldite	MII. OTD 000 M-H 4 400	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
Vibration	MIL-STD-202 Method 204	5 g's for 20 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



Flexible Termination System (FT-CAP), X7R Dielectric, 6.3 – 250 VDC (Commercial Grade)



Overview

KEMET's Flexible Termination (FT-CAP) multilayer ceramic capacitor in X7R dielectric incorporates a unique, flexible termination system that is integrated with KEMET's standard termination materials. A conductive silver epoxy is utilized between the base metal and nickel barrier layers of KEMET's standard termination system in order to establish pliability while maintaining terminal strength, solderability and electrical performance. This technology was developed in order to address the primary failure mode of MLCCs– flex cracks, which are typically the result of excessive tensile and shear stresses produced during board flexure and thermal cycling. Flexible termination technology inhibits the transfer of board stress to the rigid ceramic body, therefore mitigating flex cracks which can result in low IR or short circuit failures.

Although this technology does not eliminate the potential for mechanical damage that may propagate during extreme environmental and handling conditions, it does provide superior flex performance over standard termination systems. FT-CAP complements KEMET's Open Mode, Floating Electrode (FE-CAP), Floating Electrode with Flexible Termination (FF-CAP) and KEMET Power Solutions (KPS) product lines by providing a complete portfolio of flex mitigation solutions.

Combined with the stability of an X7R dielectric and designed to accommodate all capacitance requirements, these flex-robust devices are RoHS-compliant, offer up to 5 mm of flex-bend capability and exhibit a predictable change in capacitance with respect to time and voltage. Capacitance change with reference to ambient temperature is limited to ±15% from -55°C to +125°C.

In addition to commercial grade, automotive grade devices are available which meet the demanding Automotive Electronics Council's AEC–Q200 qualification requirements.



Ordering Information

С	1206	Х	106	K	4	R	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec) ²
	0603 0805 1206 1210 1808 1812 1825 2220 2225	X = Flexible Termination	Two significant digits + number of zeros	J = ±5% K = ±10% M = ±20%	9 = 6.3 8 = 10 4 = 16 3 = 25 5 = 50 1 = 100 2 = 200 A = 250	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

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



Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec)
Bulk Bag/Unmarked	Not required (Blank)
7" Reel/Unmarked	TU
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
7" Reel/Marked	TM
13" Reel/Marked	7040 (EIA 0603 and smaller case sizes) 7215 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2mm pitch ²	7081
13" Reel/Unmarked/2mm pitch ²	7082

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- -55°C to +125°C operating temperature range
- Superior flex performance (up to 5 mm)
- High capacitance flex mitigation
- · Lead (Pb)-Free, RoHS and REACH compliant
- EIA 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, 50 V, 100 V, 200 V, and 250 V

- Capacitance offerings ranging from 180 pF to 22 μF
- Available capacitance tolerances of ±5%, ±10%, and ±20%
- Automotive (AEC-Q200) grade available
- · 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% Pb minimum)

Applications

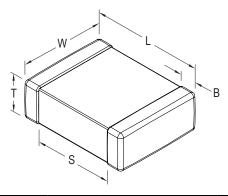
Typical applications include circuits with a direct battery or power source connection, critical and safety relevant circuits without (integrated) current limitation and any application that is subject to high levels of board flexure or temperature cycling. Examples include raw power input side filtering (power plane/bus), high current applications (automobile battery line) and circuits that cannot be fused to open. Markets include consumer, medical, industrial (power supply), automotive, aerospace and telecom.

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. Please contact KEMET if you require a laser marked option. For more information see "Capacitor Marking".

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Dimensions – Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0603	1608	1.60 (.063) ± 0.17 (.007)	0.80 (.032) ± 0.15 (.006)		0.45 (.018) ± 0.15 (.006)	0.58 (.023)	Solder Wave
0805	2012	2.00 (.079) ± 0.30 (.012)	1.25 (.049) ± 0.30 (.012)		$0.50 (0.02) \pm 0.25 (.010)$	0.75 (.030)	or
1206	3216	3.30 (.130) ± 0.40 (.016)	1.60 (.063) ± 0.35 (.013)		0.60 (.024) ± 0.25 (.010)		Solder Reflow
1210	3225	3.30 (.130) ± 0.40 (.016)	2.60 (.102) ± 0.30 (.012)		0.60 (.024) ± 0.25 (.010)		
1808	4520	4.70 (.185) ± 0.50 (.020)	2.00 (.079) ± 0.20 (.008)	See Table 2 for Thickness	0.70 (.028) ± 0.35 (.014)		
1812	4532	4.50 (.178) ± 0.40 (.016)	3.20 (.126) ± 0.30 (.012)		0.70 (.028) ± 0.35 (.014)	N/A	Solder Reflow
1825	4564	$44 4.60 \ (.181) \pm 0.40 \ (.016) 6.40 \ (.252) \pm 0.40 \ (.016)$ $0.70 \ (.028) \pm 0.35 \ (.014)$		Only			
2220	5650		0.70 (.028) ± 0.35 (.014)				
2225	5664	5.90 (.232) ± 0.75 (.030)	6.40 (.248) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)		

Qualification/Certification

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

Environmental Compliance

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%
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
² Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ± 1 seconds and charge/discharge not exceeding 50mA)
³ Dissipation Factor (DF) Maximum Limit @ 25°C	5%(6.3V & 10V), 3.5%(16V & 25V) and 2.5%(50V to 250V)
⁴Insulation Resistance (IR) Minimum Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ± 5 secs @ 25°C)

¹Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

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

120Hz \pm 10Hz and 0.5 ± 0.1 Vrms if capacitance >10 μ F

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

Post Environmental Limits

	High Temperatu	ire Life, Biased	Humidity, Moist	ture Resistance	
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance
	> 25		3.0		
X7R	16/25	All	5.0	±20%	10% of Initial Limit
	< 16		7.5		

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

⁴To obtain IR limit, divide MΩ- μ F value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



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



Table 1A – Capacitance Range/Selection Waterfall (0603 – 1210 Case Sizes)

		_	se S erie				C	060	3X						C08	305)	(C12	06)	(C12	210)	(
Сар	Cada	Volt	age C	ode	9	8	4	3	5	1	2	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	Α
	Code		d Vol (VDC)		6.3	9	16	25	20	ş	200	6.3	5	16	25	20	9	200	250	6.3	10	16	25	20	ş	200	250	6.3	9	16	25	20	100	200	250
		Сар	Toler	ance			Pı	rod	uct A	Ava	ilab	ility	an	d CI	nip '	Thic	kne	ss	Cod	es -	- Se	е Та	able	2 f	or C	hip	Thi	ckn	ess	Dir	nen	sior	าร		
180 pF 220 pF	181 221	J J	K K	M M	Cl	CJ	CJ	CJ	CJ	CJ	CJ	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR																
270 pF	271	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR																
330 pF 390 pF	331 391	J	K K	M	Cl	CJ	CJ	CJ	CJ	CJ	CJ	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR																
470 pF	471	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR		EQ	EQ	EQ	EQ	EQ											
560 pF 680 pF	561 681	J	K K	M	Cl	CJ	CJ	CJ	CJ	CJ	Cl	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR																
820 pF	821	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR																
1,000 pF 1,200 pF	102 122	J	K K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ								
1,500 pF	152	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ								
1,800 pF 2,200 pF	182 222	J	K K	M M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	FN	FN	FN	FN	FN	FN	FN	FN
2,700 pF	272	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN
3,300 pF 3,900 pF	332 392	J	K K	M M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	FN FN	FN FN	FN FN	FN FN	FN FN	FN FN	FN FN	FN FN
4,700 pF	472	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR		EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN
5,600 pF 6,800 pF	562	J J	K K	M M	Cl	CJ	CJ	CJ	CJ	CJ	CJ	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	DR DR	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	FN FN	FN FN	FN FN	FN FN	FN FN	FN FN	FN FN	FN FN
8,200 pF	682 822	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN
10,000 pF	103	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN
12,000 pF 15,000 pF	123 153	J	K K	M	Cl	CJ	CJ	CJ	CJ	CJ		DR DR	DR DR	DR DR	DR DR	DR DR	DR DD	DR DR	DR DR	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	FN FN	FN FN	FN FN	FN FN	FN FN	FN FN	FN FN	FN FN
18,000 pF	183	J	K	М	CJ	CJ	CJ	CJ	CJ	CJ		DR	DR	DR	DR	DR	DD		DR	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN
22,000 pF 27,000 pF	223 273	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ		DR DR	DR DR	DR DR	DR DR	DR DR	DD DD	DR DS	DR	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	FN FN	FN FN	FN FN	FN FN	FN FN	FN FN	FN FN	FN FN
33,000 pF	333	J	K	М	CJ	CJ	CJ	CJ	CJ	CJ		DR	DR	DR	DR	DR	DD	DS		EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN
39,000 pF 47,000 pF	393 473	J	K K	M	Cl	Cl	CJ	CJ	CJ	Cl		DR DR	DR DR	DR DR	DR DR	DR DR	DD DS	DS DG		EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	ER ER	EQ ES	EQ ES	FN FN	FN FN	FN FN	FN FN	FN	FN FN	FN FQ	FN FQ
56,000 pF	563	J	K	M	CJ	CJ	CJ	CJ	CJ			DD	DD	DD	DD	DD	DS	DG		EQ	EQ	EQ	EQ	EQ	EQ	ES	ES	FN	FN	FN	FN	FN	FN	FQ	FQ
68,000 pF 82,000 pF	683 823	J	K K	M	CJ	CJ	CJ	CJ	CJ			DD DD	DD DD	DD DD	DD DD	DD DD	DS DS			EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	EQ EQ	ES ES	ES ES	FN FN	FN FN	FN FN	FN FN	FN FN	FN FQ	FQ FA	FQ FA
0.10 µF	104	J	K	M	CJ	CJ	CJ	CJ	CJ			DR	DR	DR	DR	DR	DS			EQ	EQ	EQ	EQ	EQ	EQ	EM	EM	FN	FN	FN	FN	FN	FX	FZ	FZ
0.12 μF 0.15 μF	124 154	J	K K	M	CJ	CJ	CJ	CJ	CJ			DR DR	DR DR	DR DR	DR DR	DD DD	DG DG			ER ER	ER ER	ER ER	ER ER	ER ER	ER ER	EU		FN FQ	FN FQ	FN	FN FQ	FN FQ	FX FX	FU FM	FU FM
0.13 μF 0.18 μF	184	J	K	M	CJ	CJ	CJ	CJ	03			DR	DR	DR	DR	DG	DG			ER	ER	ER	ER	ER	ER			FQ	FQ	FQ	FQ	FQ	FX	FK	FK
0.22 µF	224	J	K	M	CJ	CJ	CJ	CJ				DR	DR	DR	DR	DG	DG			ER	ER	ER	ER	ER	ER			FQ FQ	FQ	FQ	FQ	FQ	FX	FK	FK
0.27 µF 0.33 µF	274 334	J	K K	M	Cl	CJ	CJ					DD DG	DD DG	DD DG	DD DG	DD DD				EQ EQ	EQ EQ	EQ EQ	EQ EQ	ER ER	EU			FX	FQ FX	FQ FX	FQ FX	FQ FX	FX FX		
0.39 µF	394	J	K	M	CJ	CJ	CJ					DG			DG	DS				EQ	EQ	EQ	EQ	ER	EU			FX	FX	FX	FX	FX	FX		
0.47 μF 0.56 μF	474 564	J	K K	M	CJ	CJ	CJ								DG DG					ER ES	ER ES	ER ES	ER ES	ER ER	EU			FX	FX FX	FX FX	FX FX	FX FX	FX FA		
0.68 µF	684	J	K	M								DD	DD	DD	DG					ΕT	ET	ET	ET	ES				FX	FX	FX	FX	FX	FZ		
0.82 μF 1.0 μF	824 105	J	K K	M										DD DD						EF EF	EF EF	EF EF	EF EU	ES ES				FA FU	FA FU	FA FU	FA FU	FA FU	FL FM		
1.2 µF	125	J	K	M								DS	DS	DS						ES	ES	ES	EU	EH				FU	FU	FU	FU	FZ			
1.5 μF 1.8 μF	155 185	J	K K	M									DG DG							EF ES	EF ES	EF ES	EU EF	EH				FU FU	FU FU	FU FU	FU FU	FZ FZ			
2.2 µF	225	J	K	М									DG							ES	ES	ES	EF	EH				FJ	FJ	FJ	FJ	FZ			
2.7 μF 3.3 μF	275 335	J	K K	M																EN ES		EN ES	EH					FE FA	FE FA	FE FA	FZ FM	FU FM			
3.9 µF	395	J	K	М																EF	EF	EF	EH					FZ	FZ	FZ	FZ	FK			
4.7 μF 5.6 μF	475 565	J	K K	M																EF EH	EF EH	EF EH	EH					FQ FA		FQ FA		FS			
			d Vol	tage	6.3	9	9	25	20	9	200	6.3	ę	9	25	20	100	200	250	6.3	9	9	25	20	9	200	250	6.3	$\overline{}$		52	20	100	200	250
Сар	Cap		age C		9	8	4	3	5	1	2	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	Α	9	-	4	3	5	1	2	Α
	Code	Cas	se S erie	ize/			C	060	3X	-			-	-	C08	305X	<u> </u>						C12	06X						1	C12	10X			



Table 1A - Capacitance Range/Selection Waterfall (0603 - 1210 Case Sizes) cont'd

			se S erie	ize/			C	060	3X					(C08	05)	(C12	(60	(C12	10)	(
Сар	Cap		age C	ode	9	8	4	3	5	1	2	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	Α
oup.	Code	Nate	d Vol		6.3	10	16	25	20	100	200	6.3	10	16	25	20	100	200	250	6.3	10	16	25	20	100	200	250	6.3	9	16	25	20	100	200	250
		Сар	Toler	ance			Pı	rodi	uct	Ava	ilab	ility	and	d Cr	nip '	Γhic	kne	ss (Cod	es-	- Se	е Та	able	2 f	or C	hip	Thi	ckn	ess	Din	nen	sior	าร		
6.8 µF	685	J	K	М																EH	EH	EH						FZ	FZ	FZ	FM				
8.2 µF	825	J	K	M	İ															EΗ	EH	EH						FU	FU	FU	FK				l
10 µF	106	J	K	M	İ															EΗ	EH	EH						FU	FU	FU	FS				l
12 µF	126	J	K	M	İ																							İ							l
15 µF	156	J	K	M	İ																							İ							l
18 µF	186	J	K	M																															
22 µF	226	J	K	M	l																							FS	FS						
	_		d Vol	•	6.3	9	16	25	20	9	200	6.3	10	16	25	20	100	200	250	6.3	10	16	25	20	100	200	250	6.3	9	16	25	20	100	200	250
Сар	Cap Code	Volt	age C	ode	9	8	4	3	5	1	2	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	Α
	Code Case Size/ Series						C	060	3X						C08	05X							C12	06X							C12	10X			

Table 1B - Capacitance Range/Selection Waterfall (1808 - 2225 Case Sizes)

			se S erie	ize/		C18	08X			С	1812	X			C18	25X			С	2220	X			C22	25X	
Cap	Сар	Volt	age C	ode	5	1	2	Α	3	5	1	2	Α	5	1	2	Α	3	5	1	2	Α	5	1	2	A
	Code		d Vol		50	100	200	250	25	20	100	200	250	50	100	200	250	25	20	100	200	250	50	100	200	250
		-	Toler			Р	roduc	ct Ava	ailabi	lity a	nd Cl	nip TI	hickn	ess C	Code	s – Se	ee Ta	ble 2	for C	hip T	hickı	ness	Dime	nsio	าร	
4,700 pF	472	J	K	M	LD	LD	LD					•								•						
5,600 pF	562	J	K	M	LD	LD	LD																			
6,800 pF	682	J	K	M	LD	LD	LD		GB	GB	GB	GB	GB													
8,200 pF	822	J	K	M	LD	LD	LD		GB	GB	GB	GB	GB													
10,000 pF	103	J	K	M	LD	LD	LD		GB	GB	GB	GB	GB													
12,000 pF	123	J	K	M	LD	LD	LD		GB	GB	GB	GB	GB													
15,000 pF	153	J	K	M	LD	LD	LD		GB	GB	GB	GB	GB													
18,000 pF	183	J	K	M	LD	LD	LD		GB	GB	GB	GB	GB													
22,000 pF	223	J	K	M	LD	LD			GB	GB	GB	GB	GB	НВ	HB	HB	HB									
27,000 pF	273	J	K	M	LD	LD			GB	GB	GB	GB	GB	НВ	HB	НВ	HB									
33,000 pF	333	J	K	M	LD	LD			GB	GB	GB	GB	GB	НВ	HB	HB	HB						ļ			
39,000 pF	393	J	K	M	LD	LD			GB	GB	GB	GB	GB	НВ	НВ	НВ	НВ									
47,000 pF	473	J	K	M	LD	LD			GB	GB	GB	GB	GB	НВ	НВ	НВ	НВ						KC	KC	KC	KC
56,000 pF	563	J	K	M	LD	LD			GB	GB	GB	GB	GB	HB	HB	HB	HB						KC	KC	KC	KC
68,000 pF	683	J	K	M	LD				GB	GB	GB	GB	GB	НВ	НВ	НВ	HB						KC	KC	KC	KC
82,000 pF	823	J	K	M	LD				GB	GB	GB	GB	GB	HB	HB	HB	HB	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.10 µF	104	J	K	M	LD				GB	GB	GB	GB	GB	HB	HB	HB	HB	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.12 µF	124	J	K	M	LD				GB	GB	GB	GB	GB	HB	HB	HB	HB	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.15 µF	154 184	J	K	M	LD				GB	GB	GB	GE	GE	HB	HB	HB	HB	JC	JC	JC	JC	JC	KC	KC	KC KC	KC
0.18 µF		J	K	M	LD				GB	GB GB	GB GB	GF	GG GG	HB HB	HB	HB HB	HB HB	JC	JC	JC	JC	JC	KC	KC KC	KC	KC KC
0.22 μF 0.27 μF	224 274	J	K	M M					GB GB	GB	GG	GG GG	GG	нв НВ	HB HB	НВ	HB	JC	JC	JC	JC	JC	KC KB	KC	KC	KC
	334	_	K	M					GB	GB	GG	GG	GG	HB	HB	HB	HB	JC	JC	JC	JC	JC	KB	KC	KC	KC
0.33 µF 0.39 µF	394	J	K K	M					GB	GB	GG	GG	GG	нв НВ	нв НВ	HD	HD	JC	JC	JC	JC	JC	KB	KC	KC	KC
0.39 µF	474	J	K	M					GB	GB	GG	GJ	GJ	нв НВ	НВ	HD	HD	JC	JC	JC	JC	JC	KB	KC	KD	KD
0.47 µF 0.56 µF	564	J	K	M					GC	GC	GG	GJ	GJ	НВ	HD	HD	HD	JC	JC	JC	JD	JD	KB	KC	KD	KD
0.56 µF	684	J	K	M					GC	GC	GG			нв НВ	HD	HD	HD	JC	JC	JD	JD	JD	KB	KC	KD	KD
0.82 uF	824	J	K	M					GE	GE	GG			НВ	HF	HF	HF	JC	JC	JF	JF	JF	KB	KC	KE	KE
1.0 µF	105	J	K	M					GE	GE	GG			HB	HF	HF	HF	JC	JC	JF	JF	JF	KB	KD	KE	KE
1.0 µF	125	J	K	M						OL	00			HB	'''	'''	'''	JC	JC	01	01	"	KB	KE	KE	KE
		Rate	d Vol			-	-	-	<u></u>	_	-	-	0		-	-	-			-	-	-				_
			(VDC		20	9	200	250	25	20	100	200	250	20	19	200	250	25	20	9	200	250	20	5	200	250
Сар	Cap Code	Volt	age C	ode	5	1	2	Α	3	5	1	2	Α	5	1	2	Α	3	5	1	2	Α	5	1	2	Α
	Joue		se S erie	-		C18	X80			C	1812	x			C18	25X				2220	x			C22	25X	



Table 1B - Capacitance Range/Selection Waterfall (1808 - 2225 Case Sizes) cont'd

		Case Size/ Series		C18	08X			С	1812	X			C18	25X			С	2220	X			C22	25X	
Сар	Cap	Voltage Code	5	1	2	Α	3	5	1	2	A	5	1	2	Α	3	5	1	2	Α	5	1	2	Α
Oup	Code	Rated Voltage (VDC)	20	100	200	250	25	20	100	200	250	50	100	200	250	25	20	100	200	250	20	100	200	250
		Cap Tolerance		Р	roduc	ct Ava	ailabi	lity a	nd C	hip T	hickn	ess (Code	s – S	ee Ta	ble 2	for C	hip T	hick	ness	Dime	nsio	าร	
1.5 μF 1.8 μF	155 185	J K M J K M										HC HD				JC JD	JC JD				KC KD			
2.2 µF	225	JKM	i									HF				JF	JF				KD			
2.7 µF	275	JKM	i													01	01							
3.3 µF	335	JKM	İ																					
3.9 µF	395	J K M																						
4.7 µF	475	JKM					GK	GK																
5.6 µF	565	J K M																						
6.8 µF	685	JKM																						
8.2 µF	825	J K M																						
10 μF	106	J K M					GK									JF	JO							
12 µF	126	J K M																						
15 µF	156	J K M														JO	JO							
18 μF 22 μF	186 226	J K M J K M	ŀ													JO								
μι	220	Rated Voltage																						
		(VDC)	20	100	200	250	25	20	100	200	250	20	100	200	250	25	22	100	200	250	22	100	200	250
Сар	Cap	Voltage Code	5	1	2	Α	3	5	1	2	Α	5	1	2	Α	3	5	1	2	Α	5	1	2	Α
	Code	Case Size/ Series		C18	08X			С	1812	x			C18	25X			С	2220	X			C22	25X	



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

Thickness	Case	Thickness ±	Paper Q	luantity ¹	Plastic (Quantity
Code	Size ¹	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
CJ	0603	0.80 ± 0.15	4,000	15,000	0	0
DR	0805	0.78 ± 0.20	0	0	4,000	10,000
DD	0805	0.90 ± 0.10	0	0	4,000	10,000
DS DG	0805 0805	1.00 ± 0.20 1.25 ± 0.15	0	0	2,500 2,500	10,000 10,000
DH	0805	1.25 ± 0.20	0	0	2,500	10,000
EQ	1206	0.78 ± 0.20	4,000	10,000	4,000	10,000
ER	1206	0.90 ± 0.20	0	0	4,000	10,000
EN	1206	0.95 ± 0.10	0	0	4,000	10,000
ES	1206	1.00 ± 0.20	0	0	2,500	10,000
ET	1206	1.10 ± 0.20	0	0	2,500	10,000
EF	1206	1.20 ± 0.15	0	0	2,500	10,000
EM	1206	1.25 ± 0.15	0	0	2,500	10,000
EH	1206	1.60 ± 0.20	0	0	2,000	8,000
EU	1206	1.60 ± 0.25	0	0	2,000	8,000
FN	1210	0.78 ± 0.20	0	0	4,000	10,000
FQ	1210	0.90 ± 0.20	0	0	4,000	10,000
FX	1210	0.95 ± 0.20	0	0	4,000	10,000
FE	1210	1.00 ± 0.10	0	0	2,500	10,000
FA	1210	1.10 ± 0.15	0	0	2,500	10,000
FZ	1210	1.25 ± 0.20	0	0	2,500	10,000
FL	1210	1.40 ± 0.15	0	0	2,000	8,000
FU	1210	1.55 ± 0.20	0	0	2,000	8,000
FM	1210	1.70 ± 0.20	0	0	2,000	8,000
FJ	1210	1.85 ± 0.20	0	0	2,000	8,000
FK	1210	2.10 ± 0.20	0	0	2,000	8,000
FS	1210	2.50 ± 0.30	0	0	1,000	4,000
LD	1808	0.90 ± 0.10	0	0	2,500	10,000
GB	1812	1.00 ± 0.10	0	0	1,000	4,000
GC	1812	1.10 ± 0.10	0	0	1,000	4,000
GE GF GG	1812 1812 1812	1.30 ± 0.10 1.30 ± 0.10 1.50 ± 0.10 1.55 ± 0.10	0 0 0	0 0 0	1,000 1,000 1,000	4,000 4,000 4,000
GK	1812	1.60 ± 0.20	0	0	1,000	4,000
GJ	1812	1.70 ± 0.15	0	0	1,000	4,000
HB	1825	1.10 ± 0.15	0	0	1,000	4,000
HC	1825	1.15 ± 0.15	0	0	1,000	4,000
HD	1825	1.30 ± 0.15	0	0	1,000	4,000
HF	1825	1.50 ± 0.15	0	0	1,000	4,000
JC	2220	1.10 ± 0.15	0	0 0 0	1,000	4,000
JD	2220	1.30 ± 0.15	0		1,000	4,000
JF	2220	1.50 ± 0.15	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		1,000	4,000
Thickness Code	Case Size ¹	Thickness ± Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
	0.26	rango (iiiii)	Paper Q	luantity ¹	Plastic (Quantity

Package quantity based on finished chip thickness specifications.

¹ If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Table 2B - Bulk Packaging Quantities

ъ		Loose Packaging				
Раскад	ing Type	Bulk Bag	(default)			
Packagir	ng C-Spec ¹	N/	/A ²			
Cas	e Size	Packaging Quantities (pieces/unit packa				
EIA (in)	Metric (mm)	Minimum	Maximum			
0402	1005					
0603	1608					
0805	2012		50,000			
1206	3216					
1210	3225	1				
1808	4520					
1812	4532					
1825	4564		20,000			
2220	5650					
2225	5664					

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

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



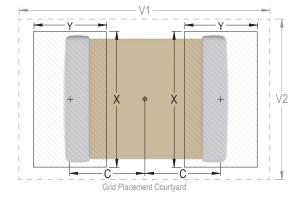
Table 3 - Chip Capacitor Land Pattern Design Recommendations per IPC-7351

EIA Size Code	Metric Size Code	ı	Density Level A: Maximum (Most) Land Protrusion (mm)				Density Level B: Median (Nominal) Land Protrusion (mm)			Density Level C: Minimum (Least) Land Protrusion (mm)						
Code	Oue	С	Y	X	V1	V2	С	Υ	Х	V1	V2	С	Υ	Х	V1	V2
0603	1608	0.85	1.25	1.10	4.00	2.10	0.75	1.05	1.00	3.10	1.50	0.65	0.85	0.90	2.40	1.20
0805	2012	0.99	1.44	1.66	4.47	2.71	0.89	1.24	1.56	3.57	2.11	0.79	1.04	1.46	2.42	1.81
1206	3216	1.59	1.62	2.06	5.85	3.06	1.49	1.42	1.96	4.95	2.46	1.39	1.22	1.86	4.25	2.16
1210	3225	1.59	1.62	3.01	5.90	4.01	1.49	1.42	2.91	4.95	3.41	1.39	1.22	2.81	4.25	3.11
1808	4520	2.30	1.75	2.30	7.40	3.30	2.20	1.55	2.20	6.50	2.70	2.10	1.35	2.10	5.80	2.40
1812	4532	2.10	1.80	3.60	7.00	4.60	2.00	1.60	3.50	6.10	4.00	1.90	1.40	3.40	5.40	3.70
1825	4564	2.15	1.80	6.90	7.10	7.90	2.05	1.60	6.80	6.20	7.30	1.95	1.40	6.70	5.50	7.00
2220	5650	2.85	2.10	5.50	8.80	6.50	2.75	1.90	5.40	7.90	5.90	2.65	1.70	5.30	7.20	5.60
2225	5664	2.85	2.10	6.90	8.80	7.90	2.75	1.90	6.80	7.90	7.30	2.65	1.70	6.70	7.20	7.00

Density Level A: For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes. KEMET only recommends wave soldering of EIA 0603, 0805, and 1206 case sizes.

Density Level B: For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes. **Density Level C:** For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC Standard 7351 (IPC–7351).

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





Soldering Process

Recommended Soldering Technique:

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

Recommended Reflow Soldering Profile:

KEMET's families of surface mount multilayer ceramic capacitors (SMD MLCCs) are compatible with wave (single or dual), convection, IR or vapor phase reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET's recommended profile conditions for convection and IR reflow reflect the profile conditions of the IPC/J-STD-020 standard for moisture sensitivity testing. These devices can safely withstand a maximum of three reflow passes at these conditions.

Profile Feature	Termination Finish				
Frome reature	SnPb	100% Matte Sn			
Preheat/Soak					
Temperature Minimum (T _{Smin})	100°C	150°C			
Temperature Maximum (T _{Smax})	150°C	200°C			
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds			
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum			
Liquidous Temperature (T _L)	183°C	217°C			
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds			
Peak Temperature (T _P)	235°C	260°C			
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum			
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum			
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum			

Note 1: All temperatures refer to the center of the package, measured on the capacitor body surface that is facing up during assembly reflow.

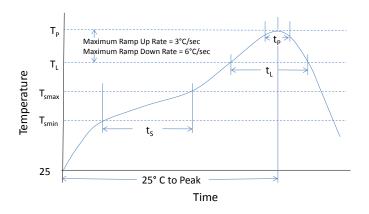




Table 4 - Performance & Reliability: Test Methods and Conditions

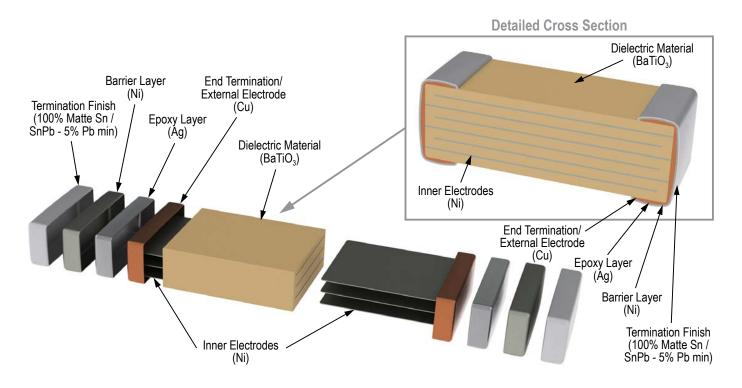
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Solderability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	J-31D-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.
D: 111 · 151	MII. OTD 000 M II. 1400	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
Vibration	MIL-STD-202 Method 204	5 g's for 20 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



Floating Electrode Design with Flexible Termination System (FF-CAP), X7R Dielectric, 6.3 – 250 VDC (Commercial & Automotive Grade)

Overview

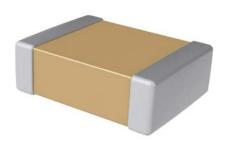
KEMET's Floating Electrode with Flexible Termination capacitor (FF-CAP) combines two existing KEMET technologies- Floating Electrode and Flexible Termination. The floating electrode component utilizes a cascading internal electrode design configured to form multiple capacitors in series within a single monolithic structure. This unique configuration results in enhanced voltage and ESD performance over standard capacitor designs while allowing for a fail-open condition if mechanically damaged (cracked). The flexible termination component utilizes a conductive silver epoxy between the base metal and nickel barrier layers of KEMET's standard termination system in order to establish pliability while maintaining terminal strength, solderability and electrical performance. Both technologies address the primary failure mode of MLCCs- flex cracks, which are typically the result of excessive tensile and shear stresses produced during board flexure and thermal cycling.

Although neither technology can eliminate the potential for mechanical damage that may propagate during extreme environmental and/or handling conditions, the combination of these two technologies provide the ultimate level of protection against a low IR or short circuit condition. The FF-CAP complements KEMET's Open Mode, Floating Electrode (FE-CAP), Flexible Termination (FT-CAP) and KEMET Power Solutions (KPS)

product lines by providing an ultimate fail-safe design optimized for low to mid range capacitance values. These devices exhibit a predictable change in capacitance with respect to time and voltage and boast a minimal change in capacitance with reference to ambient temperature. Capacitance change is limited to $\pm 15\%$ from -55° C to $\pm 125^{\circ}$ C.

Electronic Components

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



Ordering Information

С	0805	Y	104	K	5	R	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/ Grade (C-Spec)
	0603 0805 1206 1210 1812	Y = Floating Electrode with Flexible Termination	Two significant digits + number of zeros	J = ±5% K = ±10% M = ±20%	9 = 6.3 8 = 10 4 = 16 3 = 25 5 = 50 1 = 100 2 = 200 A = 250	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

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

¹ SnPb termination finish option is not available on automotive grade product.



Packaging C-Spec Ordering Options Table

Packaging Type	Packaging/Grade Ordering Code (C-Spec)		
Commerc	ial Grade ¹		
Bulk Bag	Not Required (Blank)		
7" Reel/Unmarked	TU		
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)		
7" Reel/Marked	TM		
13" Reel/Marked	7040 (EIA 0603 and smaller case sizes) 7215 (EIA 0805 and larger case sizes)		
7" Reel/Unmarked/2 mm pitch ²	7081		
13" Reel/Unmarked/2 mm pitch ²	7082		
Automoti	ve Grade ³		
7" Reel	AUTO		
13" Reel/Unmarked	AUTO7411 (EIA 0603 and smaller case sizes) AUTO7210 (EIA 0805 and larger case sizes)		
7" Reel/Unmarked/2 mm pitch ²	3190		
13" Reel/Unmarked/2 mm pitch ²	3191		

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- -55°C to +125°C operating temperature range
- Superior flex performance (up to 5 mm)
- · Floating Electrode/fail open design
- Low to mid capacitance flex mitigation
- · Lead (Pb)-Free, RoHS and REACH compliant
- EIA 0603, 0805, 1206, 1210, and 1812 case sizes
- DC voltage ratings of 6.3 V, 10 V, 16 V, 25 V, 50 V, 100 V, 200 V, and 250 V

- Capacitance offerings ranging from 180 pF to 0.22 μF
- Available capacitance tolerances of ±5%, ±10%, and ±20%
- · Commercial & Automotive (AEC-Q200) grades available
- 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% Pb minimum)

Applications

Typical applications include circuits with a direct battery or power source connection, critical and safety relevant circuits without (integrated) current limitation and any application that is subject to high levels of board flexure or temperature cycling. Examples include raw power input side filtering (power plane/bus), high current applications (automobile battery line) and circuits that cannot be fused to open. Markets include consumer, medical, industrial (power supply), automotive, aerospace and telecom.

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked.

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".

³ Reeling tape options (Paper or Plastic) are dependent on capacitor case size (L" x W") and thickness dimension. See "Chip Thickness/Tape & Reel Packaging Quantities" and "Tape & Reel Packaging Information".

³ For additional Information regarding "AUTO" C-Spec options, see "Automotive C-Spec Information".

³ All Automotive packaging C-Specs listed exclude the option to laser mark components. Please contact KEMET if you require a laser marked option. For more information see "Capacitor Marking".



Automotive C-Spec Information

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

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

Product Change Notification (PCN)

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

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

KEMET Automotive	Customer Noti	Customer Notification due to:				
C-Spec	Process/Product change	Obsolescence*	implementation			
KEMET assigned ¹	Yes (with approval and sign off)	Yes	180 days Minimum			
AUTO	Yes (without approval)	Yes	90 days Minimum			

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

Production Part Approval Process (PPAP)

The purpose of the Production Part Approval Process is:

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

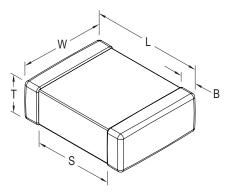
KEMET Automotive	PPAP (Product Part Approval Process) Level									
C-Spec	1	2	3	4	5					
KEMET assigned ¹	•	•	•	•	•					
AUTO	0		0							

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

- Part Number specific PPAP available
- Product family PPAP only



Dimensions – Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0603	1608	1.60 (.063) ± 0.17 (.007)	0.80 (.032) ± 0.15 (.006)		0.45 (.018) ± 0.15 (.006)	0.58 (.023)	
0805	2012	2.00 (.079) ± 0.30 (.012)	1.25 (.049) ± 0.30 (.012)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	Solder Wave or Solder Reflow
1206	3216	3.30 (.130) ± 0.40 (.016)	1.60 (.063) ± 0.35 (.013)	See Table 2 for Thickness	0.60 (.024) ± 0.25 (.010)		
1210	3225	3.30 (.130) ± 0.40 (.016)	2.60 (.102) ± 0.30 (.012)		0.60 (.024) ± 0.25 (.010)	N/A	
1812	4532	4.50 (.178) ± 0.40 (.016)	3.20 (.126) ± 0.30 (.012)		0.70 (.028) ± 0.35 (.014)		Only

Qualification/Certification

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

Automotive Grade products meet or exceed the requirements outlined by the Automotive Electronics Council. Details regarding test methods and conditions are referenced in document AEC–Q200, Stress Test Qualification for Passive Components. For additional information regarding the Automotive Electronics Council and AEC–Q200, please visit their website at www.aecouncil.com.

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%
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
² Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ± 1 seconds and charge/discharge not exceeding 50mA)
³ Dissipation Factor (DF) Maximum Limit @ 25°C	5%(6.3V & 10V), 3.5%(16V & 25V) and 2.5%(50V to 250V)
⁴ Insulation Resistance (IR) Minimum Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ± 5 secs @ 25°C)

Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

 $1kHz \pm 50Hz$ and 1.0 ± 0.2 Vrms if capacitance ≤ $10\mu F$

120Hz \pm 10Hz and 0.5 ± 0.1 Vrms if capacitance >10 μ F

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

Post Environmental Limits

High Temperature Life, Biased Humidity, Moisture Resistance										
Dielectric	ctric Rated DC Capacitance Dissipation Factor Capacitance Insulation Voltage Value (Maximum %) Shift Resistance									
	> 25		3.0							
X7R	16/25	All	5.0	±20%	10% of Initial Limit					
	< 16		7.5							

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

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

⁴To obtain IR limit, divide MΩ- μ F value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



Table 1A – Capacitance Range/Selection Waterfall (0603 – 0805 Case Sizes)

			se Siz Series	3			1	0603								05Y			
Capacitance	Capacitance	Vo	Itage Co	de	9	8	4	3	5	1	2	9	8	4	3	5	1	2	Α
Capacitance	Code	Ra	ted Volta (VDC)	ige	6.3	5	9	25	20	100	200	6.3	5	9	25	20	100	200	250
			pacita: oleran						duct A										
180 pF	181	J	K	М	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
220 pF	221	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
270 pF	271	J	K	М	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
330 pF	331	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
390 pF	391	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
470 pF	471	J	K	М	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
560 pF	561	J	K	М	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
680 pF	681	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
820 pF	821	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
1,000 pF	102	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
1,200 pF	122	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
1,500 pF	152	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
1,800 pF	182	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
2,200 pF	222	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
2,700 pF	272	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
3,300 pF	332	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
3,900 pF	392	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
4,700 pF	472	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR
5,600 pF	562	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ		DR	DR	DR	DR	DR	DR	DR	DR
6,800 pF	682	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ		DR	DR	DR	DR	DR	DR	DR	DR
8,200 pF	822	J	K	M	CJ	CJ	CJ	CJ	CJ	CJ		DR	DR	DR	DR	DR	DR	DR	DR
10,000 pF	103	J	K	M	CJ	CJ	CJ	CJ	CJ			DR	DR	DR	DR	DR	DR	DR	DR
12,000 pF	123	J	K	М	CJ	CJ	CJ	CJ	CJ			DR	DR	DR	DR	DR	DR	DR	DR
15,000 pF	153	J	K	М	CJ	CJ	CJ	CJ	CJ			DR	DR	DR	DR	DR	DD		
18,000 pF	183	J	K	М	CJ	CJ	CJ	CJ	CJ			DR	DR	DR	DR	DR	DD		
22,000 pF	223	J	K	М	CJ	CJ	CJ	CJ	CJ			DR	DR	DR	DR	DR	DD		
27,000 pF	273	J	K	М	İ							DR	DR	DR	DR	DR			
33,000 pF	333	J	K	М	l							DR	DR	DR	DR	DR			
39,000 pF	393	J	K	М	l							DR	DR	DR	DR	DR			
47,000 pF	473	J	K	М	l							DR	DR	DR	DR	DR			
56,000 pF	563	J	K	М								DD	DD	DD	DD	DD			
68,000 pF	683	J	K	М								DD	DD	DD	DD	DD			
82,000 pF	823	J	K	М								DG	DG	DG	DG	DG			
0.10 µF	104	J	K	М								DG	DG	DG	DG	DG			
		Ra	ted Volta	ige	6.3	9	16	25	20	100	200	6.3	9	16	25	20	100	200	250
Capacitance	Capacitance Code	Vo	Itage Co	de	9	8	4	3	5	1	2	9	8	4	3	5	1	2	Α
-	Code	Case	Size/S	Series	İ	C0603Y						C0805Y							



Table 1B – Capacitance Range/Selection Waterfall (1206 – 1812 Case Sizes)

			se S Serie					C12	06Y				C1210Y							C1812Y					
Capacitance	Cap	Vol	ltage C	ode	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	A	3	5	1	2	Α
Oupacitarioc	Code	Rat	ed Vol		6.3	6	16	25	20	100	200	250	6.3	6	16	25	20	100	200	250	25	50	100	200	250
		Car	(VDC) acita		H		ļ	ļ	ļ				ilabi	litv a	nd C	hin 1	 hick								
			lerar								See 1	able					ss Di								
1,000 pF	102	J	K	М	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ													
1,200 pF	122	J	K	M	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ													
1,500 pF	152	J	K	M	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ													
1,800 pF	182	J	K	M	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ													
2,200 pF	222	J	K	M	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN					
2,700 pF	272	J	K	M	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN					
3,300 pF	332	J	K	M	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN					
3,900 pF	392	J	K	M	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN					
4,700 pF	472	J	K	M	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN					
5,600 pF	562	J	K	M	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN					
6,800 pF	682	J	K	M	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN	GB	GB	GB	GB	GB
8,200 pF	822	J	K	M	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN	GB	GB	GB	GB	GB
10,000 pF	103	J	K	M	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN	GB	GB	GB	GB	GB
12,000 pF	123	J	K	M	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN	GB	GB	GB	GB	GB
15,000 pF	153	J	K	M	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN	GB	GB	GB	GB	GB
18,000 pF	183	J	K	M	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN	GB	GB	GB	GB	GB
22,000 pF	223	J	K	M	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN	GB	GB	GB	GB	GB
27,000 pF	273	J	K	M	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN	FN	FN	FN	FN	GB	GB	GB	GB	GB
33,000 pF	333	J	K	M	EQ	EQ	EQ	EQ	EQ	EQ			FN	FN	FN	FN	FN	FN	FN	FN	GB	GB	GB	GB	GB
39,000 pF	393	J	K	M	EQ	EQ	EQ	EQ	EQ	ER			FN	FN	FN	FN	FN	FN	FN	FN	GB	GB	GB	GB	GB
47,000 pF	473	J	K	M	EQ	EQ	EQ	EQ	EQ	ER			FN	FN	FN	FN	FN	FN	FQ	FQ	GB	GB	GB	GB	GB
56,000 pF	563	J	K	M	EQ	EQ	EQ	EQ	EQ	EQ			FN	FN	FN	FN	FN	FN	FQ	FQ	GB	GB	GB	GB	GB
68,000 pF	683	J	K	M	EQ	EQ	EQ	EQ	EQ				FN	FN	FN	FN	FN	FN			GB	GB	GB	GB	GB
82,000 pF	823	J	K	M	EQ	EQ	EQ	EQ	EQ				FN	FN	FN	FN	FN	FQ			GB	GB	GB	GB	GB
0.10 µF	104	J	K	M	EQ	EQ	EQ	EQ	EQ				FN	FN	FN	FN	FN	FX			GB	GB	GB	GB	GB
0.12 µF	124	J	K	M	ER	ER	ER	ER	ER				FN	FN	FN	FN	FN				GB	GB	GB	GB	GB
0.15 µF	154	J	K	M									FQ	FQ	FQ	FQ	FQ				GB	GB	GB	GB	GB
0.18 µF	184	J	K	M									FQ	FQ	FQ	FQ	FQ				GB	GB	GB	GB	GB
0.22 µF	224	J	K	M									FQ	FQ	FQ	FQ	FQ				GB	GB	GB	GB	GB
		Rated Voltage (VDC)			6.3	2	9	25	20	5	200	250	6.3	2	9	22	20	5	200	250	25	20	9	200	250
Capacitance	Cap Code	Vol	ltage C	ode	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	Α	3	5	1	2	Α
	Soue		se Si Serie					C12	06Y							C12	10Y					С	1812	Y	



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

Thickness	Case	Thickness ±	Paper Q	luantity ¹	Plastic Quantity				
Code	Size ¹	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel			
CJ	0603	0.80 ± 0.15	4,000	15,000	0	0			
DR	0805	0.78 ± 0.20	0	0	4,000	10,000			
DD	0805	0.90 ± 0.10	0	0	4,000	10,000			
DG	0805	1.25 ± 0.15	0	0	2,500	10,000			
EQ	1206	0.78 ± 0.20	4,000	10,000	4,000	10,000			
ER	1206	0.90 ± 0.20	0	0	4,000	10,000			
FN	1210	0.78 ± 0.20	0	0	4,000	10,000			
FQ	1210	0.90 ± 0.20	0	0	4,000	10,000			
FX	1210	0.95 ± 0.20	0	0	4,000	10,000			
GB	1812	1.00 ± 0.10	0	0	1,000	4,000			
Thickness	Case	Thickness ±	7" Reel	13" Reel	7" Reel	13" Reel			
Code	Size ¹	Range (mm)	Paper Q	luantity¹	Plastic Quantity				

Package quantity based on finished chip thickness specifications.

Table 2B - Bulk Packaging Quantities

Destas	to a Torre	Loose Packaging						
Раскад	jing Type	Bulk Bag (default)						
Packagir	ng C-Spec ¹	N/	'A²					
Cas	e Size	Packaging Quantities (pieces/unit packaging)					
EIA (in)	Metric (mm)	Minimum	Maximum					
0402	1005							
0603	1608		50,000					
0805	2012							
1206	3216							
1210	3225	1						
1808	4520	l l						
1812	4532							
1825	4564		20,000					
2220	5650							
2225	5664							

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

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

¹ If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



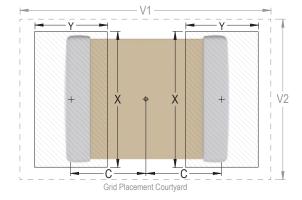
Table 3 - Chip Capacitor Land Pattern Design Recommendations per IPC-7351

EIA Size Code	Metric Size Code	ı	Maxi	sity Lev mum (N rotrusio	lost))	ı	Media	sity Lev an (Nor rotrusio			Density Level C: Minimum (Least) Land Protrusion (mm)						
Oode	Oode	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	Х	V1	V2		
0603	1608	0.85	1.25	1.10	4.00	2.10	0.75	1.05	1.00	3.10	1.50	0.65	0.85	0.90	2.40	1.20		
0805	2012	0.99	1.44	1.66	4.47	2.71	0.89	1.24	1.56	3.57	2.11	0.79	1.04	1.46	2.42	1.81		
1206	3216	1.59	1.62	2.06	5.85	3.06	1.49	1.42	1.96	4.95	2.46	1.39	1.22	1.86	4.25	2.16		
1210	3225	1.59	1.62	3.01	5.90	4.01	1.49	1.42	2.91	4.95	3.41	1.39	1.22	2.81	4.25	3.11		
1812	4532	2.10	1.80	3.60	7.00	4.60	2.00	1.60	3.50	6.10	4.00	1.90	1.40	3.40	5.40	3.70		

Density Level A: For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes. KEMET only recommends wave soldering of EIA 0603, 0805 and 1206 case sizes.

Density Level B: For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes. **Density Level C:** For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC Standard 7351 (IPC–7351).

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





Soldering Process

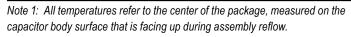
Recommended Soldering Technique:

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

Recommended Reflow Soldering Profile:

KEMET's families of surface mount multilayer ceramic capacitors (SMD MLCCs) are compatible with wave (single or dual), convection, IR or vapor phase reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET's recommended profile conditions for convection and IR reflow reflect the profile conditions of the IPC/J-STD-020 standard for moisture sensitivity testing. These devices can safely withstand a maximum of three reflow passes at these conditions.

Profile Feature	Termination Finish							
Frome reature	SnPb	100% Matte Sn						
Preheat/Soak								
Temperature Minimum (T _{Smin})	100°C	150°C						
Temperature Maximum (T _{Smax})	150°C	200°C						
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds						
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum						
Liquidous Temperature (T _L)	183°C	217°C						
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds						
Peak Temperature (T _P)	235°C	260°C						
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum						
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum						
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum						



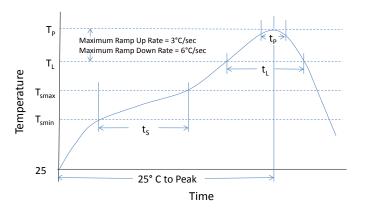




Table 4 – Performance & Reliability: Test Methods and Conditions

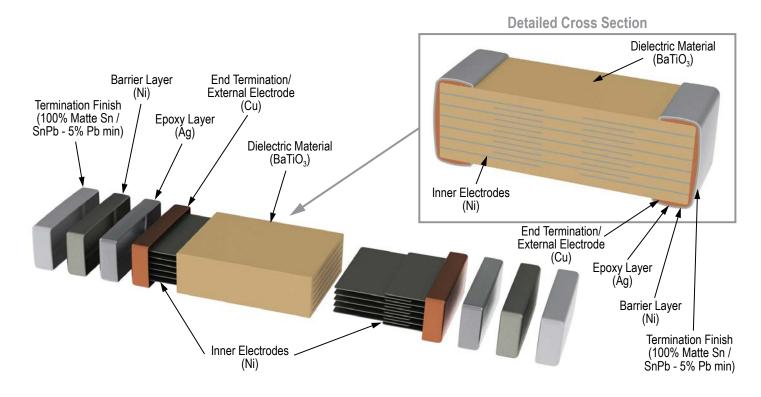
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Coldorability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	J-31D-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Diagonal III	MII. OTD 000 M-H 1400	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
Vibration	MIL-STD-202 Method 204	5 g's for 20 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



HV-HT Series, High Voltage, High Temperature 200°C, C0G Dielectric, 500 – 2,000 VDC (Industrial Grade)



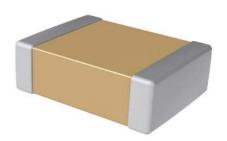
Overview

KEMET's High Voltage-High Temperature (HV-HT) series surface mount C0G Multilayer Ceramic Capacitors (MLCCs) are constructed of a robust and proprietary base metal electrode (BME) dielectric system that offers industry-leading performance at extreme temperatures. These surface mountable devices feature a 200°C maximum operating temperature and are specifically designed to withstand the demands of harsh industrial environments such as oil exploration and automotive/ avionics engine compartment circuitry. They also offer higher and more uniform breakdown voltage performance than competitive products, resulting in increased yields in customer field applications. When dealing with expensive high temperature circuitry and systems, higher yields can quickly result in significant cost savings.

KEMET's HV-HT series MLCCs are temperature compensating and are suited for resonant circuit applications or those where Q and stability of capacitance characteristics are required. They exhibit no change in capacitance with respect to time and voltage and boast a negligible change in capacitance with

reference to ambient temperature. Capacitance change is limited to ±30ppm/°C from -55°C to +200°C. In addition, these capacitors exhibit high insulation resistance with low dissipation factor at elevated temperatures up to 200°C. They also exhibit low ESR at high frequencies and offer superior volumetric efficiency over competitive high temperature precious metal electrode (PME) and base metal electrode (BME) dielectric system devices.

These devices are Lead (Pb)-Free, RoHS and REACH compliant without the need of any exemptions.



Ordering Information

С	2225	Н	393	J	C	G	Α	С	TU
Cerami	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance ¹	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/Grade (C-Spec)
	0805 1206 1210 1808 1812 1825 2220 2225 2824 3040 3640 4540	H = High Temperature (200°C)	Two significant digits + number of zeros.	B = ±0.10 pF C = ±0.25 pF D = ±0.5 pF F = ±1% G = ±2% J = ±5% K = ±10% M = ±20%	C = 500 B = 630 D = 1,000 F = 1,500 G = 2,000	G = C0G	A = N/A	C = 100% Matte Sn L = SnPb (5% Pb min.) E = Gold (Au) 1.97 – 11.8 µin F = Gold (Au) 30 – 50 µin G = Gold (Au) 100 µin min.	See "Packaging C-Spec Ordering Options Table" below

¹ Additional capacitance tolerance offerings may be available. Contact KEMET for details.

² Gold(Au) termination finish options are not available on 2824, 3040, 3640 and 4540 case sizes.



Packaging C-Spec Ordering Options Table

Termination Finish Options	Packaging Type/Options	Packaging Ordering Code (C-Spec)
	Standard Packaging – Unmarked ³	
	Bulk Bag	Blank ¹
	Waffle Tray ²	7292
	7" Tape & Reel	TU
C = 100% Matte Sn	13" Reel	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
L = SnPb (5% Pb min.)	7" Tape & Reel/2 mm pitch4	7081
F = Gold (Àu) 30 – 50 μin G = Gold (Au) 100 μin min.	7" Tape & Reel – 50 pcs	T050
	7" Tape & Reel – 100 pcs	T100
	7" Tape & Reel – 250 pcs	T250
	7" Tape & Reel – 500 pcs	T500
	7" Tape & Reel – 1,000 pcs	T1K0
	Moisture Sensitive Packaging⁵ – Unmarked	3
	Waffle Tray ²	7282
	7" Tape & Reel	7130
E = Gold (Au) 1.97 – 11.8 μin	7" Tape & Reel – 50 pcs	
F = Gold (Au) 30 – 50 μin	7" Tape & Reel – 100 pcs	
G = Gold (Au) 100 μin min.	7" Tape & Reel – 250 pcs	Contact KEMET ⁶
	7" Tape & Reel – 500 pcs	
	7" Tape & Reel – 1,000 pcs	

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

¹ "Bulk Bag" packaging option is not available for Gold (Au) termination finish options and case sizes larger than 2225 (5664 Metric).

² "Waffle Tray" packaging option is not available for case sizes larger than 2225 (5664 Metric).

³ The terms "Marked" and "Unmarked" pertain to laser marking option of components. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. The option to laser mark is not available on these devices.

³ Reeling quantities are dependent upon chip size and thickness dimension. When ordering using the "T1K0" packaging option, 1812 thru 2225 case size devices with chip thickness of ≥ 1.9mm (nominal) may be shipped on multiple 7" reels or a single 13" reel. Additional reeling or packaging options may be available. Contact KEMET for details.

⁴ The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".

⁵ Moisture sensitive packaging is required for Gold (Au) termination option "E" (1.97 – 11.8 μin)

⁶ Additional reeling or packaging options may be available. Contact KEMET for details.



Benefits

- Operating temperature range of -55°C to +200°C
- · Lead (Pb)-Free, RoHS, and REACH compliant
- EIA 0805, 1206, 1210, 1808, 1812, 1825, 2220, 2225, 2824, 3040, 3640 and 4540 case sizes
- DC voltage ratings of 500 V, 630 V, 1 KV, 1.5 KV, and 2 KV
- Capacitance offerings ranging from 1 pF to 0.150 μF
- Available capacitance tolerances of ±0.10 pF, ±0.25 pF, ±0.5 pF, ±1%, ±2%, ±5%, ±10%, and ±20%
- · No piezoelectric noise
- Extremely low ESR & ESL
- · High thermal stability
- High ripple current capability

- No capacitance change with respect to applied rated DC voltage
- Negligible capacitance change with respect to temperature from -55°C to +125°C
- No capacitance decay with time
- Non-polar device, minimizing installation concerns
- 100% pure matte tin-plated termination finish allowing for excellent solderability
- SnPb plated termination finish option available upon request (5% Pb minimum)
- Gold (Au), Tin/Lead (Sn/Pb) and 100% pure matte Tin (Sn) termination finishes available

Applications

Typical applications include critical timing, tuning, circuits requiring low loss, circuits with pulse, high current, switch mode power supplies (input filters, resonators, tank circuits, snubbed circuits, output filters), high voltage coupling, DC blocking and voltage multiplier circuits in extreme environments such as down-hole exploration, aerospace engine compartments and geophysical probes. Markets include power supply, HID lighting, industrial equipment/control, automotive, aerospace, and munitions.

Qualification/Certification

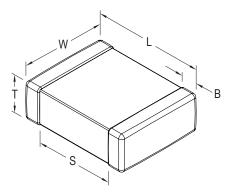
High temperature (200°C) Industrial grade products meet or exceed the requirements outlined in Table 4, Performance & Reliability. Qualification packages are available for review and download on our website at www.kemet.com/hightemp

Environmental Compliance

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



Dimensions – Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0805	2012	2.00 (.079) ± 0.20 (.008)	1.25 (.049) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	"Solder Wave or
1206	3216	3.20 (.126) ± 0.20 (.008)	1.60 (.063) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)		Solder Reflow"
1210	3225	3.20 (.126) ± 0.20 (.008)	2.50 (.098) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)		
1808	4520	4.70 (.185) ± 0.50 (.020)	2.00 (.079) ± 0.20 (.008)		0.60 (.024) ± 0.35 (.014)		
1812	4532	4.50 (.177) ± 0.30 (.012)	3.20 (.126) ± 0.30 (.012)		0.60 (.024) ± 0.35 (.014)		
1825	4564	4.50 (.177) ± 0.30 (.012)	6.40 (.252) ± 0.40 (.016)	See Table 2 for	0.60 (.024) ± 0.35 (.014)		
2220	5650	5.70 (.224) ± 0.40 (.016)	5.00 (.197) ± 0.40 (.016)	Thickness	0.60 (.024) ± 0.35 (.014)	N/A	Calden Deflass Only
2225	5664	5.60 (.220) ± 0.40 (.016)	6.40 (.248) ± 0.40 (.016)		0.60 (.024) ± 0.35 (.014)		Solder Reflow Only
2824	7260	7.10 (.280) ± 0.40 (.016)	6.10 (.240) ± 0.40 (.016)		1.27 (.050) ± 0.40 (.016)		
3040	7610	7.60 (.300) ± 0.40 (.016)	10.20 (.402) ± 0.40 (.016)		1.27 (.050) ± 0.40 (.016)		
3640	9210	9.10 (.358) ± 0.40 (.016)	10.20 (.402) ± 0.40 (.016)		1.27 (.050) ± 0.40 (.016)		
4540	-	11.40 (.449) ± 0.40 (.016)	10.20 (.402) ± 0.40 (.016)		1.27 (.050) ± 0.40 (.016)		



Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +200°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±30 ppm/°C (up to +200°C)
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	0%
¹ Dielectric Withstanding Voltage (DWV)	150% of rated voltage for voltage rating of < 1000 V 120% of rated voltage for voltage rating of ≥ 1000 V (5 ±1 seconds and charge/discharge not exceeding 50 mA)
² Dissipation Factor (DF) Maximum Limit @ 25°C	0.1%
³ Insulation Resistance (IR) Minimum Limit @ 25°C	1000 megohm microfarads or 100 GΩ (500 VDC applied for 120 ±5 secs @ 25°C)

DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

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."

Post Environmental Limits

	High Temperatu	re Life, Biased	Humidity, Moist	ture Resistance	
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance
C0G	All	All	0.5	0.3% or ±0.25 pF	10% of Initial Limit

² Capacitance and dissipation factor (DF) measured under the following conditions:

¹ MHz ±100 kHz and 1.0 Vrms ±0.2 V if capacitance ≤ 1,000 pF

¹ kHz ± 50 Hz and 1.0 Vrms ±0.2 V if capacitance > 1,000 pF

 $^{^3}$ To obtain IR limit, divide M Ω - μ F value by the capacitance and compare to G Ω limit. Select the lower of the two limits.



Table 1A – Capacitance Range/Selection Waterfall (0805 – 1808 Case Sizes)

*Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).

		Ca	ase S	Size	/Se	ries	6	С	0805	H		C	1206	Н			С	1210	Н			С	1808	Н	
	Сар		Vol	tage C	ode			С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
Capacitance	Code	F	Rated	Voltag	e (V	DC)		200	630	1000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000
	0000		Сар	acita	anc					_	l .	Prod	uct A	vaila	bilit	y and	l Chi	p Thi	ickne	ess C	odes			_	2
1.0 - 9.1 pF*	109 - 919*	ВС		lerai	ıce			DG	DG	DG		See	e Tab	le 2	for C	hip T	hick	ness	Dim	ensi	LB	LB	LB	LB	LB
1.0 - 9.1 pi 10 pF - 47pF*	109 - 919	ВС		FG	i J	K	М	DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB
51 pF	510			FG	3 J	K	М	DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB
56 pF	560			F	3 J	K	M	DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB
62 pF	620			F		K	M	DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB
68 pF	680			F		K	M	DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB
75 pF	750			F			M	DG	DG	DG	ED	ED	ED	ED	EF	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB
82 pF	820			F			M	DG	DG	DG	ED	ED	ED	ED	EF	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB
91 pF	910			F			M	DG	DG	DG	ED	ED	ED	ED	EF	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB
100 pF	101			F	_		M	DG	DG	DG	ED	ED	ED	ED	EF	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB
110 pF	111			F			M	DG	DG	DG	ED	ED	ED	ED	EG	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB
120 pF	121			F		K	M	DG	DG	DG	ED	ED	ED	ED	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LB
130 pF 150 pF	131 151			F G			M	DG DG	DG DG	DG DG	ED ED	ED ED	ED ED	ED EF	EG EG	FG FG	FG FG	FG FG	FM FM	FM FM	LA LA	LA LA	LA LA	LA LA	LB LB
150 pF 160 pF	161					K	M	DG	DG		ED	ED	ED	EF	EG	FG	FG	FG							LC
180 pF	181			F C		K	M	DG	DG	DG DG	ED	ED	ED	EF	EG	FG	FG	FG	FM FM	FM FM	LA LA	LA	LA	LA LA	LC
200 pF	201			F			M	DG	DG	DG	ED	ED	ED	EF	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LC
220 pF	221			F		K	M	DG	DG	DG	ED	ED	ED	EG	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LC
240 pF	241			F			M	DG	DG	DG	ED	ED	ED	EG	EG	FG	FG	FG	FM	FM	LA	LA	LA	LB	LC
270 pF	271			F G		K	M	DG	DG	DG	ED	ED	ED	EG	EG	FG	FG	FG	FK	FK	LA	LA	LA	LB	LC
300 pF	301			F		_	M	DG	DG		ED	ED	EF	EG		FG	FG	FG	FK	FK	LA	LA	LA	LB	LC
330 pF	331			F		K	М	DG	DG		ED	ED	EF	EG		FG	FG	FG	FK	FK	LA	LA	LA	LB	LC
360 pF	361			FG	3 J	K	М	DG	DG		ED	ED	EF	EG		FG	FG	FG	FK	FS	LA	LA	LA	LB	LA
390 pF	391			F	3 J	K	M	DG	DG		ED	ED	EF	EG		FG	FG	FG	FK	FS	LA	LA	LA	LB	LA
430 pF	431			F	3 J	K	M	DG	DG		ED	ED	EF	EG		FG	FM	FM	FS	FS	LA	LB	LB	LC	LA
470 pF	471			F		K	M	DG	DG		ED	ED	EG	EG		FG	FM	FM	FS	FS	LA	LB	LB	LC	LA
510 pF	511			F			M	DG	DG		ED	ED	EG	EG		FG	FM	FM	FS	FS	LA	LB	LB	LC	LB
560 pF	561			F		K	M	DG	DG		ED	ED	EG	EG		FG	FM	FM	FS	FS	LA	LB	LB	LC	LB
620 pF	621			F			M	DG			ED	ED	EG			FG	FM	FM	FS	FS	LA	LB	LB	LA	LC
680 pF	681			F	_	K	M	DG			ED	ED	EG			FG	FM	FM	FS	FS	LB	LB	LB	LA	LC
750 pF	751			F			M	DG			ED	EF	EG			FG	FM	FM	FM		LB	LB	LB	LA	
820 pF 910 pF	821 911			F G		K	M	DG			ED ED	EF EF	EG EG			FG FM	FM FM	FM FM	FM FY		LB LB	LB LB	LB LB	LA LA	
1,000 pF	102			F G		K	M				ED	EF	EG			FM	FM	FM	FY		LB	LB	LB	LA	
1,000 pF 1,100 pF	112			F			M				EF	EG	EG			FM	FK	FK	FS		LC	LC	LC	LB	
1,200 pF	122			F		K	M				EF	EG				FM	FK	FK	FS		LC	LC	LC	LC	
1,300 pF	132			F	1 -	K	M				EF	EG				FM	FS	FS			LC	LC	LC	LC	
1,500 pF	152			F		K	M	İ			EF	EG				FK	FS	FS			LC	LC	LC	LC	
1,600 pF	162			FG	J	K	М	l			EF	EG				FK	FS	FS			LC	LC	LC		
1,800 pF	182			FG	-	K	М				EF	EG				FK	FS	FS			LC	LC	LC		
2,000 pF	202			FG			М				EG					FK	FL	FS			LC	LA	LB		
2,200 pF	222			FG		K	M				EG					FK	FL	FS			LC	LA	LB		
2,400 pF	242			F			M				EG					FS	FL	FS			LC	LA	LB		
2,700 pF	272			F		K	M				EG					FS	FL	FS			LC	LA	LC		
3,000 pF	302			F G		_	M									FS FS	FL				LA	LA			
3,300 pF 3,600 pF	332 362			F 0		K	M									FL	FM FM				LA LA	LA LB			
3,900 pF 3,900 pF	302 392			F		K	M									FL	FY				LA	LB			
4,300 pF	432			F		K	M				l					FM	FY				LA	LC			
4,700 pF	472			F 0		K										FM	FY				LA	LC			
·	0.5.75			200	630	1000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000				
Capacitance	Cap Code				С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G			
		С	ase					С	0805	Н		С	1206	Н	1		С	1210	Н	-		C	1808	Н	
		<u> </u>																							



Table 1A - Capacitance Range/Selection Waterfall (0805 - 1808 Case Sizes) cont'd

		Case Size/Series	C	0805	Н		С	1206	Н			C	1210	Н			C	1808	Н	
	Сар	Voltage Code	С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
Capacitance	Code	Rated Voltage (VDC)	200	630	1000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000
		Capacitance Tolerance					Prod See	uct A	vaila le 2 1	bilit	y and hip T	l Chi _l hick	p Thi ness	ckne Dim	ss C ensid	odes ons	•			
5,100 pF	512	F G J K M									FY	FS				LA				
5,600 pF	562	F G J K M									FY	FS				LB				
6,200pF	622	F G J K M									FY					LC				
6,800pF	682	F G J K M									FY					LC				
7,500pF	752	F G J K M									FS									
8,200 pF	822	F G J K M									FS									
	Con	Rated Voltage (VDC)	200	630	1000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000
Capacitance	Cap Code	Voltage Code	С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
		Case Size/Series	С	0805	Н		С	1206	Н			С	1210	Н			С	1808	Н	

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).



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

		Case Size/Ser							1812	2H			С	1825	5H			C	2220)H			C	2225	Н	
	Сар		Volt	age C	ode		С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
Capacitance	Code	R	ated V	/oltag	e (VD	C)	200	630	1000	1500	2000	500	630	1000	1500	2000	200	630	1000	1500	2000	500	630	1000	1500	2000
	0000	\vdash	Cap						_	_		<u> </u>					<u> </u>				Cod			_	_	7
		L	Tol	erar	nce							See	Tabl	e 2 f	or Ci	hip T	hick	nes	s Dir	nens	sions					
10 pF - 47pF* 51 pF	100 - 470* 510	F	G	J	K	M M	GK GK	GK GK	GK GK	GK GK	GK GK	HG	HG	HG HG	HG HG	HG HG	JK JK	JK JK	JK JK	JK JK	JK JK	KF KF	KF KF	KF KF	KF KF	KF KF
56 pF	560	F	G	J	K	M	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
62 pF	620	F	G	Ĵ	K	М	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
68 pF	680	F	G	J	K	М	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
75 pF	750	F	G	J	K	М	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
82 pF	820	F	G	J	K	M	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
91 pF	910	F	G	J	K	M	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
100 pF	101	F	G	J	K	M	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
110 pF	111	F	G	J	K	М	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
120 pF	121	F	G	J	K	М	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
130 pF	131	F	G	J	K	M	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
150 pF	151 161	F	G	J	K	M M	GK GK	GK GK	GK GK	GK GK	GK GK	HG	HG HG	HG HG	HG	HG	JK JK	JK JK	JK JK	JK JK	JK JK	KF KF	KF KF	KF KF	KF KF	KF KF
160 pF 180 pF	181	F	G	J	K	M	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
200 pF	201	F	G	J	K	M	GH	GH	GH	GH	GH	HE	HE	HE	HE	HE	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
220 pF	221	l F	G	Ĵ	K	М	GH	GH	GH	GH	GH	HE	HE	HE	HE	HE	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
240 pF	241	F	G	J	К	M	GH	GH	GH	GH	GH	HE	HE	HE	HE	HE	JK	JK	JK	JK	JK	KE	KE	KE	KE	KE
270 pF	271	F	G	J	K	M	GH	GH	GH	GH	GH	HE	HE	HE	HE	HE	JK	JK	JK	JK	JK	KE	KE	KE	KE	KE
300 pF	301	F	G	J	K	M	GH	GH	GH	GH	GH	HE	HE	HE	HE	HE	JK	JK	JK	JK	JK	KE	KE	KE	KE	KE
330 pF	331	F	G	J	K	M	GH	GH	GH	GH	GH	HE	HE	HE	HE	HE	JE	JE	JE	JE	JE	KE	KE	KE	KE	KE
360 pF	361	F	G	J	K	M	GK	GK	GK	GK	GH	HE	HE	HE	HE	HE	JE	JE	JE	JE	JE	KE	KE	KE	KE	KE
390 pF	391	F	G	J	K	М	GK	GK	GK	GK	GK	HE	HE	HE	HE	HE	JE	JE	JE	JE	JE	KE	KE	KE	KE	KE
430 pF	431	F	G	J	K	М	GK	GK	GK	GK	GK	HE	HE	HE	HE	HE	JE	JE	JE	JE	JE	KE	KE	KE	KE	KE
470 pF	471 511	F	G	J	K	M M	GK	GK	GK GH	GK	GK	HE	HE	HE	HE	HE	JE	JE	JE	JE JK	JE	KF KF	KF KF	KF KF	KF KF	KE KE
510 pF 560 pF	561	F	G	J	K	M	GH GH	GH	GH	GK GK	GH GH	HE	HE	HE	HE	HG	JK JK	JK JK	JK JK	JK	JK JK	KF	KF	KF	KF	KE
620 pF	621	F	G	J	K	M	GH	GH	GH	GK	GH	HE	HE	HE	HE	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KE
680 pF	681	l F	G	J	K	M	GH	GH	GH	GK	GH	HE	HE	HE	HE	HG	JE	JE	JE	JK	JK	KF	KF	KF	KF	KE
750 pF	751	F	G	J	K	М	GH	GH	GH	GK	GK	HE	HE	HE	HG	HG	JE	JE	JE	JK	JK	KE	KE	KE	KF	KE
820 pF	821	F	G	J	K	M	GH	GH	GH	GK	GK	HE	HE	HE	HG	HG	JE	JE	JE	JK	JK	KE	KE	KE	KF	KE
910 pF	911	F	G	J	K	M	GH	GH	GH	GH	GM	HE	HE	HE	HG	HG	JE	JK	JK	JK	JK	KE	KE	KE	KF	KE
1,000 pF	102	F	G	J	K	M	GH	GH	GH	GH	GM	HE	HE	HE	HG	HG	JE	JK	JK	JK	JK	KE	KE	KE	KF	KE
1,100 pF	112	F	G	J	K	M	GH	GK	GK	GH	GO	HE	HE	HE	HG	HG	JE	JK	JK	JK	JK	KE	KE	KE	KF	KF
1,200 pF	122	F	G	J	K	М	GH	GK	GK	GH	GO	HE	HE	HE	HG	HG	JE	JK	JK	JK	JK	KE	KE	KE	KF	KF
1,300 pF	132	F	G	J	K	M	GH	GK	GK	GH	GO	HE	HE	HE	HG	HE	JE	JK	JK	JK	JE	KE	KE	KE	KF	KF
1,500 pF	152 162	F	G	J	K	M M	GK GK	GK GK	GK GK	GK GK	GO	HE	HE	HE	HG HG	HE	JE	JK JK	JK JK	JK JK	JE JE	KE KE	KE KE	KE KE	KF KF	KF KE
1,600 pF 1,800 pF	182	F	G	J	K	M	GK	GK	GK	GM		HE	HG	HG	HG	HG	JE JE	JK	JK	JK	JE	KE	KE	KE	KF	KE
2,000 pF	202	F	G	J	K	M	GK	GK	GK	GM		HE	HG	HG	HE	HJ	JE	JK	JK	JE	JK	KE	KE	KE	KF	KE
2,200 pF	222	F	G	J	K	М	GK	GK	GK	GO		HE	HG	HG	HE	HJ	JE	JK	JK	JE	JK	KE	KE	KE	KF	KF
2,400 pF	242	F	G	J	K	М	GK	GH	GK	GO		HE	HG	HG	HE	HJ	JK	JK	JK	JE	JL	KE	KE	KE	KE	KH
2,700 pF	272	F	G	J	K	М	GK	GH	GK	GO		HE	HG	HG	HE	HK	JK	JK	JK	JE	JL	KE	KE	KE	KE	KH
3,000 pF	302	F	G	J	K	М	GK	GH	GK			HG	HG	HG	HE	HK	JK	JK	JK	JE	JL	KE	KE	KE	KE	KH
3,300 pF	332	F	G	J	K	М	GK	GH	GK			HG	HG	HG	HG		JK	JK	JK	JK	JN	KE	KE	KE	KE	KJ
3,600 pF	362	F	G	J	K	М	GK	GH	GM			HG	HG	HG	HG		JK	JK	JK	JK	JN	KE	KF	KF	KF	KJ
3,900 pF	392	F	G	J	K	М	GK	GH	GM			HG	HG	HG	HJ		JK	JK	JK	JK	JN	KE	KF	KF	KF	KJ
4,300 pF 4,700 pF	432 472	F	G	J	K	M	GH GH	GH GH	GO GO			HG HG	HG	HG HG	HJ HJ		JK JK	JK JK	JK JK	JK JL		KE KE	KF KF	KF KF	KF KH	
4,700 pF	4/2					200	630	1000	1500	2000	200	630	1000	1500 ∃	2000	200	630	1000	1500	2000	200	630 7	1000	1500 3	2000	
Capacitance	Cap Code					C	9 B	D	F	07 G	C	9 B	D	F F	07 G	C	В	D	F F	02 G	C	B	D	F F	02 G	
	Code	C	Voltage Code C Case Size/Series				Ė		1812		_	Ė		1825		<u> </u>	Ė		2220			Ė		2225		_
			.55	,12G/	JU11	. .	<u> </u>		1012					1020	,,,,					,,,					••	

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).



Table 1B - Capacitance Range/Selection Waterfall (1812 - 2225 Case Sizes) cont'd

		Ca	se S	Size	/Ser	ies		С	1812	H.			C	182	5H			C	2220	H			C	2225	Н	
	Сар		Vol	tage C	ode		С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
Capacitance	Code	R	ated \	/oltag	e (VD	C)	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000
				acita Ierai)									bility or Cl											,
5,100 pF	512	F	G	J	K	М	GH	GK	GO			HG	HE	HG	HK		JK	JK	JK	JL		KE	KF	KF	KH	
5,600 pF	562	F	G	J	K	M	GH	GK	GO			HG	HE	HG	HK		JK	JK	JK	JN		KE	KF	KF	KH	
6,200pF	622	F	G	J	K	M	GH	GK				HG	HE	HG			JK	JE	JE	JN		KE	KF	KF	KJ	
6,800pF	682	F	G	J	K	M	GH	GM				HG	HE	HJ			JK	JE	JK	JN		KE	KF	KF	KJ	
7,500pF	752	F	G	J	K	M	GH	GM				HG	HE	HJ			JK	JE	JK			KF	KE	KF		
8,200 pF	822	F	G	J	K	M	GK	GO				HG	HE	HJ			JK	JE	JL			KF	KE	KF		
9,100 pF	912						GM	GO				HE	HG	HK			JE	JE	JL			KF	KE	KH		
10,000 pF	103						GM	GO				HE	HG	HK			JE	JE	JL			KF	KE	KH		
12,000 pF	123						GO					HE	HG				JE	JK	JN			KE	KE	KH		
15,000 pF	153						GO					HE	HJ				JE	JL				KE	KF	KJ		
18,000 pF	183											HG	HK				JE	JL				KE	KH			
22,000 pF	223											HJ					JK	JN				KF	KJ			
27,000 pF	273											HJ					JL	JN				KF	KJ			
33,000 pF	333											HK					JN					KH				
39,000 pF	393																					KJ				
	Сар	R	ated \	/oltag	e (VD	C)	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000
Capacitance	Code		Vol	tage C	ode		С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
		Ca	se S	Size/	Seri	ies		С	1812	Н			С	1825	Н			С	2220	Н			С	2225	Н	

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

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Table 1C - Capacitance Range/Selection Waterfall (2824 - 4540 Case Sizes)

			se Siz Series			С	2824	ΙΗ			C	3040	Н			C	3640	Н			C	4540	Н	
Capacitance	Cap	Vo	Itage Co	de	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
	Code	Vo	Rated Itage (VD)C)	200	630	1000	1500	2000	200	630	1000	1500	2000	500	630	1000	1500	2000	500	630	1000	1500	2000
		C	apacitan	ce						Prod	uct A	vaila	bilit	y and	Chi	p Thi	ickne	ss C	ode	S	<u> </u>	ļ		
10 - 2,000 pF	100 - 202	J	Folerance K	M						<u>See</u>	Tab	le 2 1	for C	hip T	<u>hick</u>	ness	Dim	ensi	ons	_				
2,200 pF	222	J	K	M	TA	TA	TA	TA	TA															
2,400 pF	242	j	K	M	IA.	IA.	IA.	IA.	IA.	l														
2,700 pF	272	Ĵ	K	М	TA	TA	TA	TA	TA															
3,000 pF	302	J	K	М																				
3,300 pF	332	J	K	М	TA	TA	TA	TA	TA	QB	QB	QB	QB	QB										
3,600 pF	362	J	K	М																				
3,900 pF	392	J	K	M	TA	TA	TA	TA	TB	QB	QB	QB	QB	QB	MA	MA	MA	MA	MA					
4,300 pF	432	J	K	M																				
4,700 pF	472	J	K	М	TA	TA	TA	TB	ТВ	QB	QB	QB	QB	QB	MA	MA	MA	MA	MA	SA	SA	SA	SA	SA
5,100 pF	512	J	K	M	Τ.	т.	Τ.	TD	то.	0.0	00	0.0	0.0	0.0						0.4	0.4	0.4	0.4	0.4
5,600 pF 6,200 pF	562 622	J J	K K	M M	TA	TA	TA	TB	TC	QB	QB	QB	QB	QB	MA	MA	MA	MA	MA	SA	SA	SA	SA	SA
6,200 pF 6,800 pF	682	J	K	M	TA	TA	TA	ТВ		QB	QB	QB	QB	QC	l _{MA}	MA	MA	МА	MA	SA	SA	SA	SA	SA
7,500 pF	752	J	K	M	IA	IA	IA	ID		Q D	QD	QD	QD	QC	IVIA	IVIA	IVIA	IVIA	IVIA) SA	SA	SA	SA	SA
8,200 pF	822	J	K	M	TA	TA	TA	TC		QB	QB	QB	QC	QC	MA	MA	MA	MA	МВ	SA	SA	SA	SA	SA
9,100 pF	912	Ĵ	K	M	.,,	.,,	.,,			""	<u> </u>	42	40	40							0, 1	0, 1	0, 1	0,1
10,000 pF	103	J	К	М	TA	TA	TA			QB	QB	QB	QC	QD	MA	MA	MA	MA	MB	SA	SA	SA	SA	SB
12,000 pF	123	J	K	М	TA	TA	TA			QB	QB	QB	QD		MA	MA	MA	MB	MB	SA	SA	SA	SA	SB
15,000 pF	153	J	K	М	TA	TA	TB			QB	QB	QB	QD		MA	MA	MA	MB	MC	SA	SA	SA	SB	SB
18,000 pF	183	J	K	М	TA	TA	TB			QB	QB	QB			MA	MA	MA	MC		SA	SA	SA	SB	SC
22,000 pF	223	J	K	М	TA	TB	TC			QB	QB	QC			MA	MA	MA			SA	SA	SA	SB	
27,000 pF	273	J	K	М	TA	TB				QB	QB	QC			MA	MA	MA			SA	SA	SA	SC	
33,000 pF	333	J	K	M	TB	TB				QB	QC	QC			MA	MA	MB			SA	SA	SA		
39,000 pF 47,000 pF	393 473	J J	K K	M M	TB TB	TC				QB QB	QC QC	QD			MA MA	MA MB	MB MC			SA SA	SA SA	SB SB		
47,000 pF 56,000 pF	563	J	K	M	TC					QC	QD				MA	MB	IVIC			SA	SA	SB		
68,000 pF	683	J	K	M	'					QC QC	QD				MB	MC				SA	SB	SC		
82.000 pf	823	j	K	M						QC	٧٥				MB	IVIO				SA	SB			
0.1 µF	104	Ĵ	K	M						QD					MC					SB	SC			
0.12 µF	124	J	K	М	ĺ					-					MC					SB				
0.15 µF	154	J	K	М																SC				
		Rated	Voltage	(VDC)	500	630	1000	1500	2000	500	630	1000	1500	2000	500	630	1000	1500	2000	500	630	1000	1500	2000
Capacitance	Сар	Vo	Itage Co	de	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
Supuoituilos	Code		Size/S			С	2824	Н			С	3040	Н	-	C3640H						С	4540	Н	

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).



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

Thickness	Case	Thickness ±	Paper C	Quantity	Plastic (Quantity
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
ED	1206	1.00 ± 0.10	0	0	2,500	10,000
EF	1206	1.20 ± 0.15	0	0	2,500	10,000
EG	1206	1.60 ± 0.15	0	0	2,000	8,000
FG	1210	1.25 ± 0.15	0	0	2,500	10,000
FL	1210	1.40 ± 0.15	0	0	2,000	8,000
FM	1210	1.70 ± 0.20	0	0	2,000	8,000
FY	1210	2.00 ± 0.20	0	0	2,000	8,000
FK	1210	2.10 ± 0.20	0	0	2,000	8,000
FS	1210	2.50 ± 0.30	0	0	1,000	4,000
LA	1808	1.40 ± 0.15	0	0	1,000	4,000
LB	1808	1.60 ± 0.15	0	0	1,000	4,000
LC	1808	2.00 ± 0.15	0	0	1,000	4,000
GH	1812	1.40 ± 0.15	0	0	1,000	4,000
GK	1812	1.60 ± 0.20	0	0	1,000	4,000
GM	1812	2.00 ± 0.20	0	0	500	2,000
GO	1812	2.50 ± 0.20	0	0	500	2,000
HE	1825	1.40 ± 0.15	0	0	1,000	4,000
HG	1825	1.60 ± 0.20	0	0	1,000	4,000
HJ	1825	2.00 ± 0.20	0	0	500	2,000
HK	1825	2.50 ± 0.20	0	0	500	2,000
JE	2220	1.40 ± 0.15	0	0	1,000	4,000
JK	2220	1.60 ± 0.20	0	0	1,000	4,000
JL	2220	2.00 ± 0.20	0	0	500	2,000
JN	2220	2.50 ± 0.20	0	0	500	2,000
KE	2225	1.40 ± 0.15	0	0	1,000	4,000
KF	2225	1.60 ± 0.20	0	0	1,000	4,000
KH	2225	2.00 ± 0.20	0	0	500	2,000
KJ	2225	2.50 ± 0.20	0	0	500	2,000
TA	2824	1.40 ± 0.15	0	0	750	2,500
TB	2824	2.00 ± 0.20	0	0	300	2,000
TC	2824	2.50 ± 0.20	0	0	300	2,000
QB	3040	1.40 ± 0.15	0	0	500	1,650
QC	3040	2.00 ± 0.20	0	0	500	1,650
QD	3040	2.50 ± 0.20	0	0	350	1,400
MA	3640	1.40 ± 0.15	0	0	250	1,550
MB	3640	2.00 ± 0.20	0	0	250	1,550
MC SA	3640 4540	2.50 ± 0.20	0 0	0	250	1,550
SA SB	4540 4540	1.40 ± 0.15 2.00 ± 0.20	0	0	200 200	1,500 1,500
SC	4540 4540	2.00 ± 0.20 2.50 ± 0.20	0	0	200	1,500
			7" Reel	13" Reel	7" Reel	13" Reel
Thickness Code	Case Size	Thickness ± Range (mm)				
			Paper C	Quantity	Plastic	Quantity

Package quantity based on finished chip thickness specifications.



Table 2B – Bulk Packaging Quantities

	Daalaasias 7		Loose Pa	ackaging	Secure P	Secure Packaging				
	Packaging 1	ype	Bulk Bag	(default)	2" x 2" Waffle Pack/Tray3					
	Packaging C-S	Spec ¹	N/	'A²	7282	7292				
Case Size		Chip Thickness	Packaging	Packaging Quantities (pieces/unit packaging)						
EIA (in)	Metric (mm)	(mm)	Minimum	Maximum	Minimum	Maximum				
0402	1005					368				
0603	1608	All				368				
0805	2012			50.000		100				
1206	3216	≤ 1.25 (nominal)		50,000		126				
1206	3216	> 1.25 (nominal)				50				
1210	3225		1		1	80				
1808	4520					50				
1812	4532	All				42				
1825	4564	All		20,000		20				
2220	5650					20				
2225	5664					20				

¹ The "Packaging C-Spec" is a 4-digit code which identifies the packaging type. When ordering, the proper code must be included in the 15th through 18th character positions of the ordering code. See "Ordering Information" section of this document for further details. Product ordered without a packaging C-Spec will default to our standard "bulk bag" packaging.

² A packaging C-Spec (see note 1 above) is not required For "bulk bag" packaging (excluding Anti-Static Bulk Bag). The 15th through 18th character positions of the ordering code should be left blank. All product ordered without a packaging C-Spec will default to out standard "bulk bag" packaging.

³ Also commonly referred to as "Chip Carrier" or "Molded Tray". All tray packaging options offer static protection.



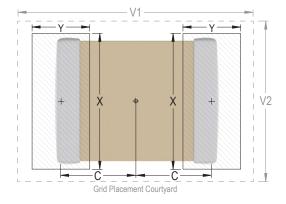
Table 3 - Chip Capacitor Land Pattern Design Recommendations per IPC-7351

EIA Size Code	Metric Size	Size Land Protrusion (mm)					Density Level B: Median (Nominal) Land Protrusion (mm)						Density Level C: Minimum (Least) Land Protrusion (mm)				
Oode	Oode	С	Υ	Х	V1	V2	С	Υ	Х	V1	V2	С	Υ	Х	V1	V2	
0805	2012	1.00	1.35	1.55	4.40	2.60	0.90	1.15	1.45	3.50	2.00	0.75	0.95	1.35	2.80	1.70	
1206	3216	1.60	1.35	1.90	5.60	2.90	1.50	1.15	1.80	4.70	2.30	1.40	0.95	1.70	4.00	2.00	
1210	3225	1.60	1.35	2.80	5.65	3.80	1.50	1.15	2.70	4.70	3.20	1.40	0.95	2.60	4.00	2.90	
1808	4520	2.30	1.75	2.30	7.40	3.30	2.20	1.55	2.20	6.50	2.70	2.10	1.35	2.10	5.80	2.40	
1812	4532	2.15	1.60	3.60	6.90	4.60	2.05	1.40	3.50	6.00	4.00	1.95	1.20	3.40	5.30	3.70	
1825	4564	2.15	1.60	6.90	6.90	7.90	2.05	1.40	6.80	6.00	7.30	1.95	1.20	6.70	5.30	7.00	
2220	5650	2.75	1.70	5.50	8.20	6.50	2.65	1.50	5.40	7.30	5.90	2.55	1.30	5.30	6.60	5.60	
2225	5664	2.70	1.70	6.90	8.10	7.90	2.60	1.50	6.80	7.20	7.30	2.50	1.30	6.70	6.50	7.00	
2824	7260	3.45	1.70	6.60	9.60	7.60	3.35	1.50	6.50	8.70	7.00	3.25	1.30	6.40	8.00	6.70	
3040	7610	3.70	1.70	10.70	10.10	11.70	3.60	1.50	10.60	9.20	11.10	3.50	1.30	10.50	8.50	10.80	
3640	9210	4.45	1.70	10.70	11.60	11.70	4.35	1.50	10.60	10.70	11.10	4.25	1.30	10.50	10.00	10.80	
4540	-	5.60	1.70	10.70	13.90	11.70	5.50	1.50	10.60	13.00	11.10	5.40	1.30	10.50	12.30	10.80	

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

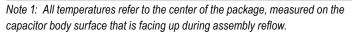
Recommended Soldering Technique:

- 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			
Frome reature	SnPb	100% Matte Sn			
Preheat/Soak					
Temperature Minimum (T _{Smin})	100°C	150°C			
Temperature Maximum (T _{Smax})	150°C	200°C			
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds			
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum			
Liquidous Temperature (T _L)	183°C	217°C			
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds			
Peak Temperature (T _P)	235°C	260°C			
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum			
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum			
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum			



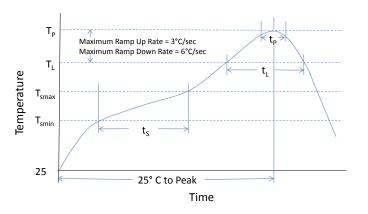




Table 4 – Performance & Reliability: Test Methods and Conditions

	Product Qualification Test Plan				
Reliability.	/Environmental Tests per MIL-STD-202//JESD22				
Load Humidity	85°C/85%RH and 200 VDC maximum, 1,000 Hours				
Low Voltage Humidity	85°C/85%RH, 1.5V, 1,000 Hours				
Temperature Cycling	−55°C to +200°C, 50 Cycles				
Thermal Shock	−55°C to +150°C, 20 seconds transfer, 15 minute dwell, 300 Cycles				
Moisture Resistance	Cycled Temp/RH 0 V, 10 cycles @ 24 hours each				
Physical, Mech	anical & Process Tests per MIL-STD 202/JIS-C-6429				
Resistance to Solvents	Include Aqueous wash chemical – OKEM Clean or equivalent				
Mechanical Shock and Vibration	Method 213: Figure 1, Condition F Method 204: 5 gs for 20 minutes, 12 cycles				
Resistance to Soldering Heat	Condition B, no per-heat of samples, Single Wave Solder				
Terminal Strength	Force of 1.8 kg for 60 seconds				
Board Flex	Appendix 2, Note: 3.0 mm (minimum)				

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature— reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 40°C and maximum storage humidity not exceed 70% relative humidity. In addition, 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 the time frame outlined in the table below:

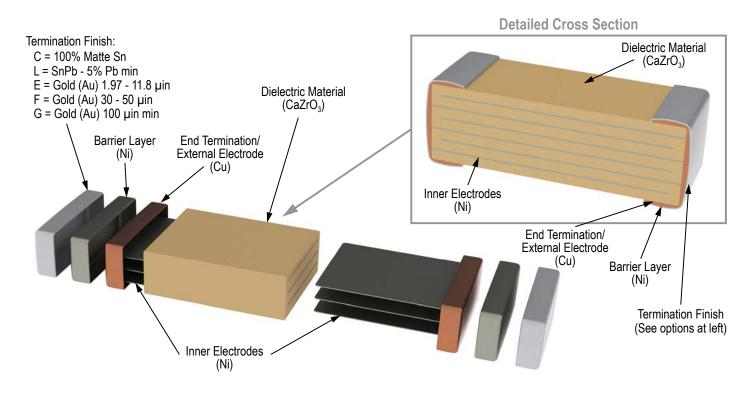
Termination Finish	Termination Finish Ordering Code ¹	Storage Life
100% Matte Tin (Sn)	С	1.5 years upon receipt
SnPb (5% Pb min.)	L	1.5 years upon receipt
Gold (Au) 1.97 – 11.8 μin²	E	6 months upon receipt ²
Gold (Au) 30 – 50 μin	F	1.5 years upon receipt
Gold (Au) 100 µin min.	G	1.5 years upon receipt

¹ The fourteenth (14th) character position of the KEMET part number is assigned to identify and/or define the termination finish. For more information, see "Ordering Information" section of this document.

² Gold plating option "E" devices should remain in its factory sealed moisture sensitive packaging during storage. If the factory sealed packaging is disturbed please store any remaining packaged components in a dry box container to prevent oxidation of the termination finish.



Construction (Typical)



Capacitor Marking (Optional):

Laser marking option is not available on:

- C0G, Ultra Stable X8R and Y5V dielectric devices
- EIA 0402 case size devices
- EIA 0603 case size devices with Flexible Termination option.
- KPS Commercial and Automotive grade stacked devices.

These capacitors are supplied unmarked only.

KPS Series, X7R Dielectric, 10 – 250 VDC (Commercial Grade)



Overview

KEMET Power Solutions (KPS) Commercial Series stacked capacitors utilize a proprietary lead-frame technology to vertically stack one or two multilayer ceramic chip capacitors into a single compact surface mount package. The attached lead-frame mechanically isolates the capacitor/s from the printed circuit board, therefore offering advanced mechanical and thermal stress performance. Isolation also addresses concerns for audible, microphonic noise that may occur when a bias voltage is applied. A two chip stack offers up to double the capacitance in the same or smaller design footprint when compared to traditional surface mount MLCCs devices. Providing up to 10 mm

of board flex capability, KPS Series capacitors are environmentally friendly and in compliance with RoHS legislation. Available in X7R dielectric, these devices are capable of Pb-Free reflow profiles and provide lower ESR, ESL and higher ripple current capability when compared to other dielectric solutions.

Combined with the stability of an X7R dielectric, KEMET's KPS Series devices exhibit a predictable change in capacitance with respect to time and voltage and boast 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
- Reliable and robust termination system
- EIA 1210, 1812, and 2220 case sizes
- DC voltage ratings of 10 V, 16 V, 25 V, 50 V, 100 V, and 250 V
- Capacitance offerings ranging from 0.1 μF up to 47 μF
- Available capacitance tolerances of ±10% and ±20%
- · Higher capacitance in the same footprint
- · Potential board space savings
- · Advanced protection against thermal and mechanical stress
- · Provides up to 10 mm of board flex capability
- · Reduces audible, microphonic noise
- · Extremely low ESR and ESL



Ordering Information

С	2220	С	106	M	5	R	2	С	7186
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance ¹	Rated Voltage (VDC)	Dielectric	Failure Rate/Design	Leadframe Finish ²	Packaging/Grade (C-Spec)
	1210 1812 2220	C = Standard	Two significant digits + number of zeros	K = ±10% M = ±20%	8 = 10 4 = 16 3 = 25 5 = 50 1 = 100 A = 250	R = X7R	1 = KPS Single Chip Stack 2 = KPS Double Chip Stack	C = 100% Matte Sn	See "Packaging C-Spec Ordering Options Table" below

¹ Double chip stacks ("2" in the 13th character position of the ordering code) are only available in M (±20%) capacitance tolerance. Single chip stacks ("1" in the 13th character position of the ordering code) are available in K (±10%) or M (±20%) tolerances.

² Additional leadframe finish options may be available. Contact KEMET for details.



Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec) ²					
7" Reel (Embossed Plastic Tape) / Unmarked	7186					
13" Reel (Embossed Plastic Tape) / Unmarked	7289					

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. The option to laser mark is not available on these devices. For more information see "Capacitor Marking".

Benefits cont'd

- · Lead (Pb)-Free, RoHS and REACH compliant
- Capable of Pb-Free reflow profiles

- Non-polar device, minimizing installation concerns
- Tantalum and electrolytic alternative

Applications

Typical applications include smoothing circuits, DC/DC converters, power supplies (input/output filters), noise reduction (piezoelectric/mechanical), circuits with a direct battery or power source connection, critical and safety relevant circuits without (integrated) current limitation and any application that is subject to high levels of board flexure or temperature cycling. Markets include industrial, military, automotive and telecom.

Qualification/Certification

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

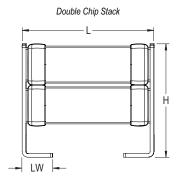
Environmental Compliance

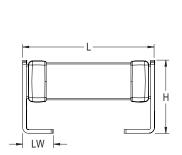
Lead (Pb)-Free, RoHS, and REACH compliant without exemptions.



Dimensions – Millimeters (Inches)







Single Chip Stack

Number of Chips	EIA Size Code	Metric Size Code	L Length	W Width	H Height	LW Lead Width	Mounting Technique
	1210	3225	3.50 (.138) ±0.30 (.012)	2.60 (.102) ±0.30 (.012)	3.35 (.132) ±0.10 (.004)	0.80 (.032) ±0.15 (.006)	
Single	1812	4532	5.00 (.197) ±0.50 (.020)	3.50 (.138) ±0.50 (.020)	2.65 (.104) ±0.35 (.014)	1.10 (.043) ±0.30 (.012)	
2220	5650	6.00 (.236) ±0.50 (.020)	5.00 (.197) ±0.50 (.020)	3.50 (.138) ±0.30 (.012)	1.60 (.063) ±0.30 (.012)	Solder Reflow	
	1210	3225	3.50 (.138) ±0.30 (.012)	2.60 (.102) ±0.30 (.012)	6.15 (.242) ±0.15 (.006)	0.80 (.031) ±0.15 (.006)	Only
Double	1812	4532	5.00 (.197) ±0.50 (.020)	3.50 (.138) ±0.50 (.020)	5.00 (.197) ±0.50 (.020)	1.10 (.043) ±0.30 (.012)	
2220	2220	5650	6.00 (.236) ±0.50 (.020)	5.00 (.197) ±0.50 (.020)	5.00 (.197) ±0.50 (.020)	1.60 (.063) ±0.30 (.012)	

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%						
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%						
² Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ± 1 seconds and charge/discharge not exceeding 50mA)						
³ Dissipation Factor (DF) Maximum Limit @ 25°C	5%(10V), 3.5%(16V & 25V) and 2.5%(50V to 250V)						
⁴Insulation Resistance (IR) Minimum Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ± 5 secs @ 25°C)						

¹Regarding 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.

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."

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

¹ kHz ± 50 Hz and 1.0 ± 0.2 Vrms if capacitance $\leq 10 \,\mu\text{F}$

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

⁴To obtain IR limit, divide MΩ- μ F value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



Post Environmental Limits

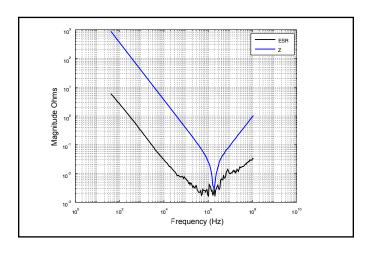
High Temperature Life, Biased Humidity, Moisture Resistance												
Dielectric	Rated DC Voltage			Capacitance Shift	Insulation Resistance							
	> 25		3.0									
X7R	16/25 All		5.0	±20%	10% of Initial Limit							
	< 16		7.5									

Insulation Resistance Limit Table

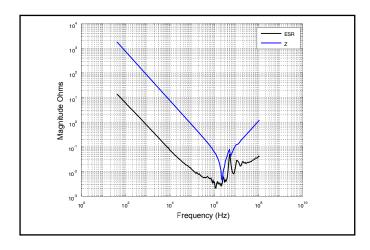
EIA Case Size	1,000 Megohm Microfarads or 100 GΩ	500 Megohm Microfarads or 10 GΩ					
1210	< 0.39 µF	≥ 0.39 µF					
1812	< 2.2 µF	≥ 2.2 µF					
2220	< 10 µF	≥ 10 µF					

Electrical Characteristics

Z and ESR C1210C475M5R1C



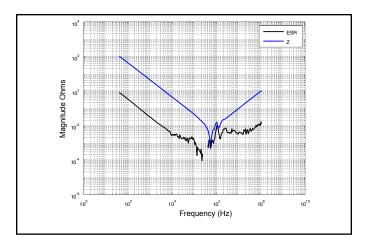
Z and ESR C2220C225MAR2C



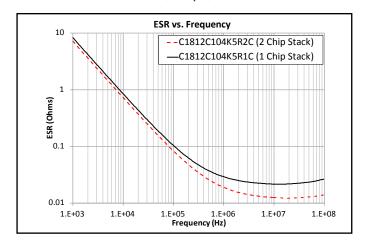


Electrical Characteristics

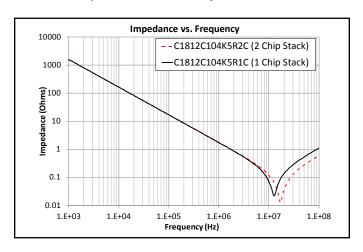
Z and ESR C2220C476M3R2C



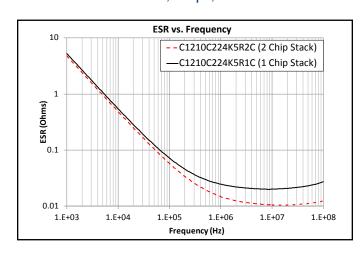
ESR - 1812, .10 μ F, 50 V X7R



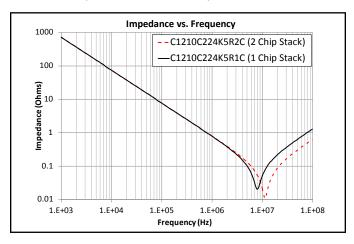
Impedance – 1812, .10 μ F, 50 V X7R



 $ESR - 1210, .22 \mu F, 50 V X7R$



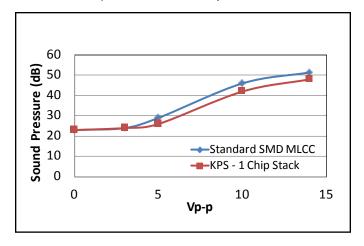
Impedance - 1210, .22 μF , 50 V X7R



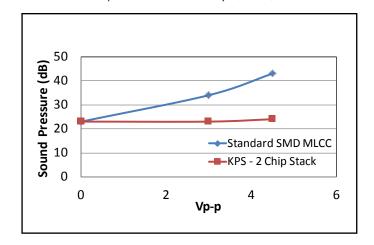


Electrical Characteristics cont'd

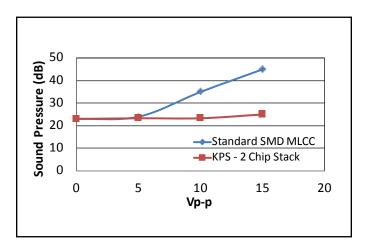
Microphonics – 1210, 4.7 μF, 50 V, X7R



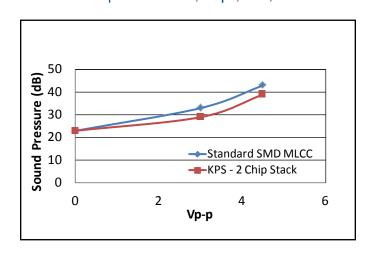
Microphonics – 2220, 22 μF, 50 V, X7R



Microphonics – 2220, 47 μF, 25 V, X7R

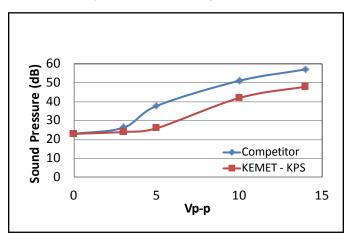


Microphonics – 1210, 22 μF, 25 V, X7R

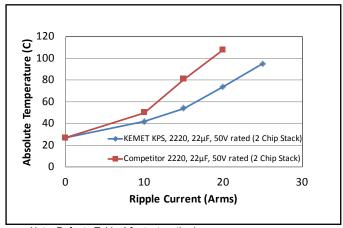


Competitive Comparision

Microphonics – 1210, 4.7 μF, 50 V, X7R



Ripple Current (Arms) 2220, 22 μ F, 50 V

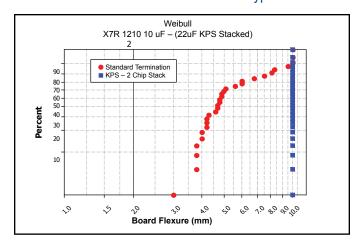


Note: Refer to Table 4 for test method.

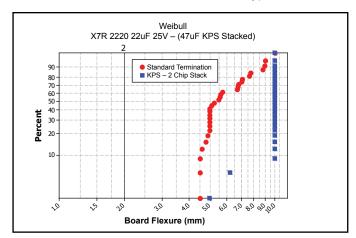


Electrical Characteristics cont'd

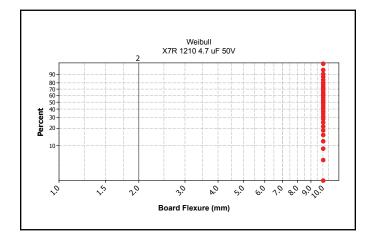
Board Flex vs. Termination Type



Board Flex vs. Termination Type



Board Flexure to 10 mm



Board Flexure to 10 mm

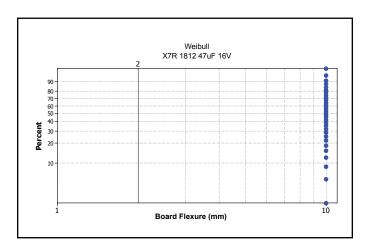




Table 1 – Capacitance Range/Selection Waterfall (1210 – 2220 Case Sizes)

		Case Siz	ze/Series			C1	210C				(C1812	2C			C2220C				
	Сар	Voltag	Voltage Code		4	3	5	1	Α	4	3	5	1	Α	4	3	5	1	Α	
Capacitance	Code	Rated Voltage (VDC		10	16	25	50	100	250	16	25	50	100	250	16	25	50	100	250	
Jour		Capacitanc	Product Availability and Chip Thickness Codes See Table 2 for Chip Thickness Dimensions																	
						Sin	gle C	hip St	ack											
0.10 µF	104	K	М	FV	FV	FV	FV	FV	FV	GP	GP	GP	GP	GP	JP	JP	JP	JP	JP	
0.22 μF	224	K	M	FV	FV	FV	FV	FV		GP	GP	GP	GP	GP	JP	JP	JP	JP	JP	
0.47 µF	474	K	M	FV	FV	FV	FV	FV		GP	GP	GP	GP	GP	JP	JP	JP	JP	JP	
1.0 µF	105	К	M	FV	FV	FV	FV	FV		GP	GP	GP	GP		JP	JP	JP	JP	JP	
2.2 µF	225	K	M	FV	FV	FV	FV	FV		GP	GP	GP			JP	JP	JP	JP		
3.3 µF	335	K	M	FV	FV	FV	FV			GP	GP	GP			JP	JP	JP	JP		
4.7 µF	475	K	M	FV	FV	FV	FV			GP	GP	GP			JP	JP	JP			
10 μF	106	K	M	FV	FV	FV				GP	GP				JP	JP	JP			
15 μF	156	K	M	FV											JP	JP				
22 µF	226	K	M	FV											JP	JP				
						Dou	uble C	Chip S	tack											
0.10 µF	104		M	FW	FW	FW	FW	FW	FW	GR	GR	GR	GR	GR	JR	JR	JR	JR	JR	
0.22 µF	224		M	FW	FW	FW	FW	FW	FW	GR	GR	GR	GR	GR	JR	JR	JR	JR	JR	
0.47 µF	474		M	FW	FW	FW	FW	FW		GR	GR	GR	GR	GR	JR	JR	JR	JR	JR	
1.0 µF	105		M	FW	FW	FW	FW	FW		GR	GR	GR	GR	GR	JR	JR	JR	JR	JR	
2.2 µF	225		M	FW	FW	FW	FW	FW		GR	GR	GR	GR		JR	JR	JR	JR	JR	
3.3 µF	335		M	FW	FW	FW	FW	FW		GR	GR	GR	GR		JR	JR	JR	JR		
4.7 µF	475		M	FW	FW	FW	FW	FW		GR	GR	GR			JR	JR	JR	JR		
10 μF	106		M	FW	FW	FW	FW			GR	GR	GR			JR	JR	JR			
22 µF	226		M	FW	FW	FW				GR	GR				JR	JR	JR			
33 µF	336		M	FW											JR	JR				
47 μF	476		M	FW											JR	JR				
	0	Rated Volt	tage (VDC)	10	16	25	50	100	250	16	25	50	100	250	16	25	50	100	250	
Capacitance	Сар	Voltag	e Code	8	4	3	5	1	Α	4	3	5	1	Α	4	3	5	1	Α	
Capacitance	Code	Case Siz	ze/Series			C1	210C					C1812	2C			C	2220	С		

These products are protected under US Patent 8,331,078 other patents pending, and any foreign counterparts.

Table 2 – Chip Thickness/Tape & Reel Packaging Quantities

Thickness	Case	Thickness ±	Paper G	Quantity	Plastic Quantity		
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel	
FV	1210	3.35 ± 0.10	0	0	600	2,000	
FW	1210	6.15 ± 0.15	0	0	300	1,000	
GP	1812	2.65 ± 0.35	0	0	500	2,000	
GR	1812	5.00 ± 0.50	0	0	400	1,700	
JP	2220	3.50 ± 0.30	0	0	300	1,300	
JR	2220	5.00 ± 0.50	0	0	200	800	
Thickness	Case Thickness ± Range (mm)	Thickness ±	7" Reel	13" Reel	7" Reel	13" Reel	
Code		Range (mm)	Paper Quantity		Plastic Quantity		

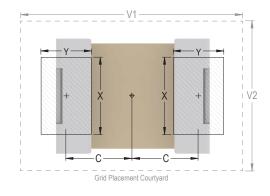
Package quantity based on finished chip thickness specifications.



Table 3 – KPS Land Pattern Design Recommendations (mm)

EIA SIZE CODE	METRIC SIZE	Median (Nominal) Land Protrusion						
OODL	CODE	С	Y	Х	V1	V2		
1210	3225	1.50	1.14	1.75	5.05	3.40		
1812	4532	2.20	1.35	2.87	6.70	4.50		
2220	5650	2.69	2.08	4.78	7.70	6.00		

Image at right based on an EIA 1210 case size.



Soldering Process

KEMET's KPS Series devices are compatible with IR reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET's recommended profile conditions for IR reflow reflect the profile conditions of the IPC/J–STD–020D standard for moisture sensitivity testing.

To prevent degradation of temperature cycling capability, care must be taken to prevent solder from flowing into the inner side of the lead frames (inner side of "J" lead in contact with the circuit board).

After soldering, the capacitors should be air cooled to room temperature before further processing. Forced air cooling is not recommended.

Hand soldering should be performed with care due to the difficulty in process control. If performed, care should be taken to avoid contact of the soldering iron to the capacitor body. The iron should be used to heat the solder pad, applying solder between the pad and the lead, until reflow occurs. Once reflow occurs, the iron should be removed immediately. (Preheating is required when hand soldering to avoid thermal shock.)

Profile Feature	SnPb Assembly	Pb-Free Assembly	
Preheat/Soak			
Temperature Minimum (T _{Smin})	100°C	150°C	
Temperature Maximum (T _{Smax})	150°C	200°C	
Time (t_s) from T_{smin} to T_{smax})	60 – 120 seconds	60 – 120 seconds	
Ramp-up Rate (T _L to T _P)	3°C/seconds maximum	3°C/seconds maximum	
Liquidous Temperature (T _L)	183°C	217°C	
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds	
Peak Temperature (T _P)	235°C	250°C	
Time within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	10 seconds maximum	
Ramp-down Rate $(T_p \text{ to } T_L)$	6°C/seconds maximum	6°C/seconds maximum	
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum	

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

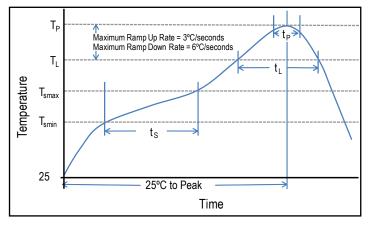




Table 4 - Performance & Reliability: Test Methods and Conditions

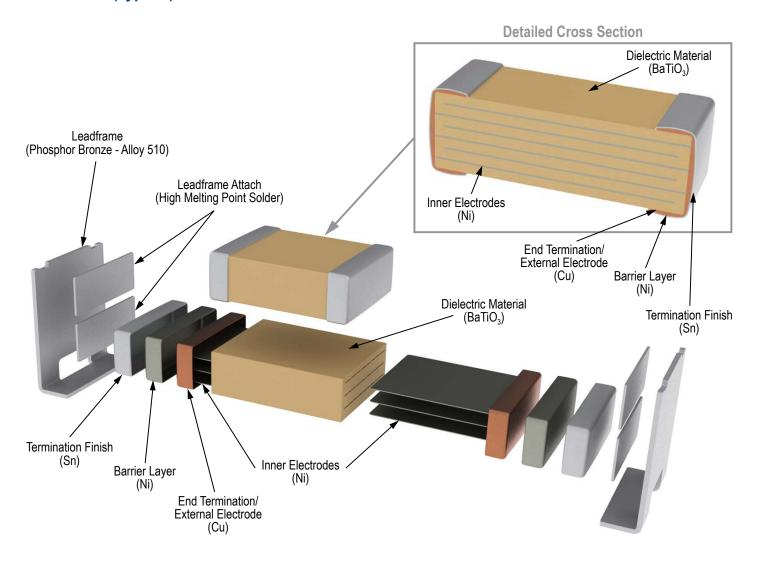
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 5.0 mm minimum
		Magnification 50 X. Conditions:
Caldarahilitu	J-STD-002	a) Method B, 4 hours at 155°C, dry heat at 235°C
Solderability	J-51D-002	b) Method B at 215°C category 3
		c) Method D, category 3 at 250°C
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Biacoa Hamaity	WILL OTD 202 WIGHIOU 100	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air-Air.
High Temperature Life	MIL-STD-202 Method 108	1,000 hours at 125°C with 1.5X rated voltage applied.
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 .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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage & Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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)



Product Marking

Laser marking option is not available on:

- C0G, Ultra Stable X8R and Y5V dielectric devices
- EIA 0402 case size devices
- EIA 0603 case size devices with Flexible Termination option.
- · KPS Commercial and Automotive grade stacked devices.

These capacitors are supplied unmarked only.

KPS Series, High Voltage, X7R Dielectric, 500 – 630 VDC (Commercial Grade)



Overview

KEMET Power Solutions (KPS) High Voltage stacked capacitors utilize a proprietary lead-frame technology to vertically stack one or two multilayer ceramic chip capacitors into a single compact surface mount package. The attached lead-frame mechanically isolates the capacitor(s) from the printed circuit board, thereby offering advanced mechanical and thermal stress performance. Isolation also addresses concerns for audible microphonic noise that may occur when a bias voltage is applied. A two-chip stack offers up to double the capacitance in the same or smaller design footprint when compared to traditional surface mount MLCC devices. Providing up to 10 mm of board flex capability, KPS Series High Voltage capacitors are environmentally friendly and in compliance with RoHS legislation.

KEMET's KPS Series devices in X7R dielectric exhibit a predictable change in capacitance with respect to time and voltage, and boast a minimal change in capacitance with reference to ambient temperature. Capacitance change is limited to ±15% from -55°C to +125°C. These devices are capable of Pb-Free reflow profiles and provide lower ESR, ESL and higher ripple current capability when compared to other dielectric solutions.

Conventional uses include both snubbers and filters in applications such as switching power supplies and lighting ballasts. Their exceptional performance at high frequencies has made high voltage ceramic capacitors the preferred dielectric choice of design engineers worldwide. In addition to their use in power supplies, these capacitors are widely used in industries related to automotive (hybrid), telecommunications, medical, military, aerospace, semiconductors, and test/diagnostic equipment.

Benefits

- -55°C to +125°C operating temperature range
- Reliable and robust termination system
- EIA 2220 case size
- DC voltage ratings of 500 V and 630 V
- Capacitance offerings ranging from 0.047 μF up to 1.0 μF
- Available capacitance tolerances of ±10% and ±20%
- · Higher capacitance in the same footprint
- · Potential board space savings



Ordering Information

С	2220	С	105	M	С	R	2	С	7186
Ceramic	Case Size (L"x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance ¹	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Leadframe Finish ²	Packaging/Grade (C-Spec)
	2220	C = Standard	Two significant digits + number of zeros.	K = ±10% M = ±20%	C = 500 B = 630	R = X7R	1 = KPS Single Chip Stack 2 = KPS Double Chip Stack	C = 100% Matte Sn	See "Packaging C-Spec Ordering Options Table" below

¹ Double chip stacks ("2" in the 13th character position of the ordering code) are only available in M (±20%) capacitance tolerance. Single chip stacks ("1" in the 13th character position of the ordering code) are available in K (±10%) or M (±20%) tolerances.

² Additional leadframe finish options may be available. Contact KEMET for details.



Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec) ²		
7" Reel (Embossed Plastic Tape)/Unmarked	7186		
13" Reel (Embossed Plastic Tape)/Unmarked	7289		

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. The option to laser mark is not available on these devices. For more information see "Capacitor Marking".

Benefits cont'd

- Advanced protection against thermal and mechanical stress
- Provides up to 10 mm of board flex capability
- · Reduces audible microphonic noise
- Extremely low ESR and ESL

- · Lead (Pb)-Free, RoHS and REACH compliant
- Capable of Pb-Free reflow profiles
- Non-polar device, minimizing installation concerns
- Film alternative

Applications

Typical applications include switch mode power supplies (input filters, resonators, tank circuits, snubber circuits, output filters), high voltage coupling and DC blocking, lighting ballasts, voltage multiplier circuits, DC/DC converters and coupling capacitors in Ćuk converters. Markets include power supply, LCD fluorescent backlight ballasts, HID lighting, telecom equipment, industrial and medical equipment/control, LAN/WAN interface, analog and digital modems, and automotive (electric and hybrid vehicles, charging stations and lighting applications).

Application Note

X7R dielectric is not recommended for AC line filtering or pulse applications.

Qualification/Certification

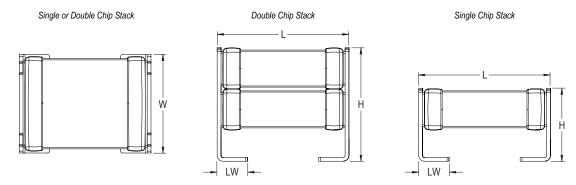
Commercial Grade products are subject to internal qualification. Details regarding test methods and conditions are referenced in Table 4, Performance and Reliability.

Environmental Compliance

Lead (Pb)-Free, RoHS, and REACH compliant without exemptions.



Dimensions – Millimeters (Inches)



Number of Chips	EIA Size Code	Metric Size Code	L Length	W Width	H Height	LW Lead Width	Mounting Technique
Single	2220	5650	6.00 (0.236) ±0.50 (0.020)	5.00 (.197) ±0.50 (.020)	3.50 (.138) ±0.30 (.012)	1.60 (.063) ±0.30 (.012)	Caldan Dafface Only
Double	2220	5650	6.00 (0.236) ±0.50 (0.020)	5.00 (.197) ±0.50 (.020)	5.00 (.197) ±0.50 (.020)	1.60 (.063) ±0.30 (.012)	Solder Reflow Only

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%
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
² Dielectric Withstanding Voltage (DWV)	150% of rated voltage for voltage rating of < 1000V 120% of rated voltage for voltage rating of ≥ 1000V (5 ± 1 seconds and charge/discharge not exceeding 50mA)
³ Dissipation Factor (DF) Maximum Limit @ 25°C	2.5%
⁴ Insulation Resistance (IR) Minimum Limit @ 25°C	See Insulation Resistance Limit Table (500VDC applied for 120 ± 5 secs @ 25°C)

Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

 $1kHz \pm 50Hz$ and 1.0 ± 0.2 Vrms if capacitance ≤ $10\mu F$

120Hz \pm 10Hz and 0.5 ± 0.1 Vrms if capacitance >10 μ F

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

⁴To obtain IR limit, divide MΩ- μ F value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



Post Environmental Limits

High Temperature Life, Biased Humidity, Moisture Resistance								
Dielectric	Rated DC Voltage	Capacitance Shift	Insulation Resistance					
	> 25		3.0					
X7R	16/25	All	5.0	±20%	10% of Initial Limit			
	< 16		7.5					

Insulation Resistance Limit Table

EIA Case Size	1,000 Megohm Microfarads or 100 GΩ	100 Megohm Microfarads or 10 GΩ
0805	< 0.0039 µF	≥ 0.0039 µF
1206	< 0.012 µF	≥ 0.012 µF
1210	< 0.033 µF	≥ 0.033 µF
1808	< 0.018 μF	≥ 0.018 µF
1812	< 0.027 µF	≥ 0.027 µF
≥ 1825	All	N/A



Table 1 – Capacitance Range/Selection Waterfall (2220 Case Sizes)

		Case Siz	ze/Series	C2220C			
		Voltage Code		С	В	D	
Capacitance	Capacitance	Rated Volt	age (VDC)	500	630	1000	
	Code	Capacitance Tolerance		Product Availability and Chip Thickness Codes – See Table 2 for Chip Thickness Dimensions			
	Single Chip Stack						
0.047 µF	473	K	M	JP	JP		
0.10 µF	104	K	M	JP	JP		
0.15 μF	154	K	M	JP	JP		
0.22 μF	224	K	M	JP	JP		
0.33 μF	334	K	M	JP			
0.47 μF	474	K M		JP			
		Double	Chip Stack	k			
0.10 µF	104		M	JR	JR		
0.22 μF	224		M	JR	JR		
0.33 μF	334		M	JR	JR		
0.47 μF	474		M	JR	JR		
0.68 µF	684		M	JR			
1.0 µF	105		M	JR			
	0	Rated Volt	age (VDC)	500	630	1000	
Capacitance	Capacitance	Voltage	e Code	С	В	D	
oupuonumoo	Code	Case Size/Series			C2220C		

These products are protected under US Patent 8,331,078 other patents pending, and any foreign counterparts.

Table 2 – Chip Thickness/Tape & Reel Packaging Quantities

Thickness	Case	Case Thickness ± Range (mm)	Paper C	Quantity	Plastic Quantity	
Code	Code Size		7" Reel	13" Reel	7" Reel	13" Reel
JP	2220	3.50 ± 0.30	0	0	300	1,300
JR	2220	5.00 ± 0.50	0	0	200	800

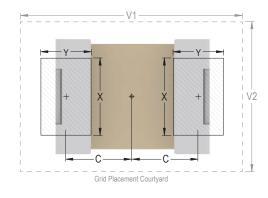
Package quantity based on finished chip thickness specifications.



Table 3 – KPS Land Pattern Design Recommendations (mm)

EIA SIZE CODE	METRIC SIZE	Media	Median (Nominal) Land Protrusion				
OODL	CODE	С	Y	Х	V1	V2	
1210	3225	1.50	1.14	1.75	5.05	3.40	
1812	4532	2.20	1.35	2.87	6.70	4.50	
2220	5650	2.69	2.08	4.78	7.70	6.00	

Image at right based on an EIA 1210 case size.



Soldering Process

KEMET's KPS Series devices are compatible with IR reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET's recommended profile conditions for IR reflow reflect the profile conditions of the IPC/J–STD–020D standard for moisture sensitivity testing.

To prevent degradation of temperature cycling capability, care must be taken to prevent solder from flowing into the inner side of the lead frames (inner side of "J" lead in contact with the circuit board).

After soldering, the capacitors should be air cooled to room temperature before further processing. Forced air cooling is not recommended.

Hand soldering should be performed with care due to the difficulty in process control. If performed, care should be taken to avoid contact of the soldering iron to the capacitor body. The iron should be used to heat the solder pad, applying solder between the pad and the lead, until reflow occurs. Once reflow occurs, the iron should be removed immediately. (Preheating is required when hand soldering to avoid thermal shock.)

Profile Feature	SnPb Assembly	Pb-Free Assembly	
Preheat/Soak			
Temperature Minimum (T _{Smin})	100°C	150°C	
Temperature Maximum (T _{Smax})	150°C	200°C	
Time (t_s) from T_{smin} to T_{smax})	60 - 120 seconds	60 – 120 seconds	
Ramp-up Rate (T _L to T _P)	3°C/seconds maximum	3°C/seconds maximum	
Liquidous Temperature (T _L)	183°C	217°C	
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds	
Peak Temperature (T _P)	235°C	250°C	
Time within 5°C of Maximum Peak Temperature (t _p)	20 seconds maximum	10 seconds maximum	
Ramp-down Rate $(T_P \text{ to } T_L)$	6°C/seconds maximum	6°C/seconds maximum	
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum	

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

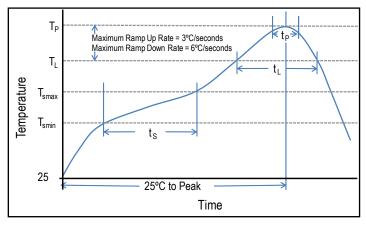




Table 4 – Performance & Reliability: Test Methods and Conditions

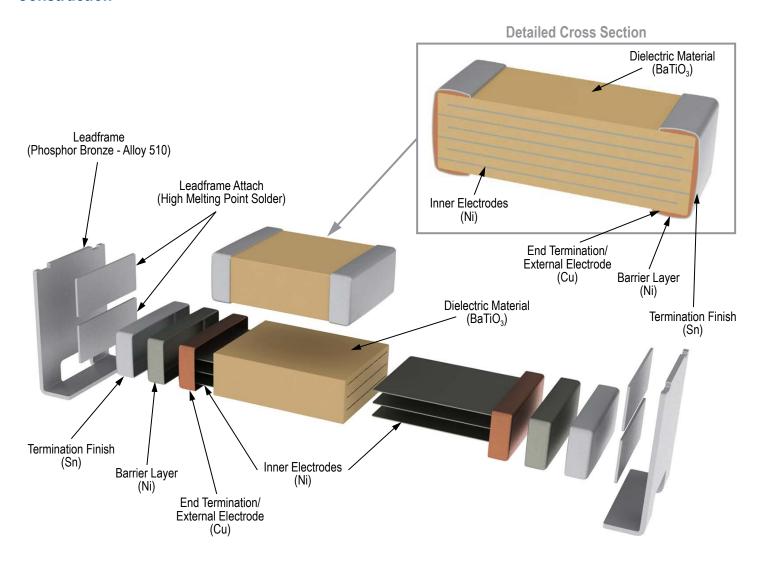
Stress	Reference	Test or Inspection Method		
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.		
Board Flex	JIS-C-6429	Appendix 2, Note: 5.0 mm minimum		
Solderability	J-STD-002	Magnification 50 X. Conditions:		
		a) Method B, 4 hours @ 155°C, dry heat @ 235°C		
		b) Method B @ 215°C category 3		
		c) Method D, category 3 @ 250°C		
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.		
Biased Humidity	MIL-STD-202 Method 103	Load Humidity: 1,000 hours 85°C/85% RH and 200 VDC maximum. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.		
		Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.		
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.		
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air-Air.		
High Temperature Life	MIL-STD-202 Method 108	1,000 hours at 125°C with rated voltage applied.		
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 secu 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, Condition F.		
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.		

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



Product Marking

Laser marking option is not available on:

- C0G, Ultra Stable X8R and Y5V dielectric devices
- EIA 0402 case size devices
- EIA 0603 case size devices with Flexible Termination option.
- · KPS Commercial and Automotive grade stacked devices.

These capacitors are supplied unmarked only.

KPS HT Series, High Temperature 150°C, X8L Dielectric, 10 – 50 VDC (Commercial & Automotive Grade)



Overview

KEMET Power Solutions High Temperature (KPS HT) stacked capacitors utilize a proprietary lead-frame technology to vertically stack one or two multilayer ceramic chip capacitors into a single compact surface mount package. The attached lead-frame mechanically isolates the capacitor(s) from the printed circuit board, thereby offering advanced mechanical and thermal stress performance. Isolation also addresses concerns for audible, microphonic noise that may occur when a bias voltage is applied. A two-chip stack offers up to double the capacitance in the same or smaller design footprint when compared to traditional surface mount MLCC devices. Providing up to 10 mm of board flex capability, KPS Series capacitors are environmentally friendly and in compliance with

RoHS legislation. Combined with X8L dielectric, these devices are capable of reliable operation up to 150°C and are well suited for high temperature filtering, bypass and decoupling applications.

X8L exhibits a predictable change in capacitance with respect to time and voltage, and boasts a minimal change in capacitance with reference to ambient temperature up to 125°C. Beyond 125°C, X8L displays a wider variation in capacitance. Capacitance change is limited to ±15% from -55°C to +125°C and +15, -40% from 125°C to 150°C.

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

Benefits

- -55°C to +150°C operating temperature range
- Reliable and robust termination system
- EIA 1210 and 2220 case sizes
- DC voltage ratings of 10 V, 16 V, 25 V, and 50 V
- Capacitance offerings ranging from 0.47 μF up to 47 μF
- Available capacitance tolerances of ±10% and ±20%
- · Higher capacitance in the same footprint
- · Potential board space savings
- · Advanced protection against thermal and mechanical stress
- · Provides up to 10 mm of board flex capability



Ordering Information

С	2220	С	476	M	8	N	2	С	7186
Ceramic	Case Size (L"x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance ¹	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Leadframe Finish ²	Packaging/Grade (C-Spec)
	1210 2220	C = Standard	Two significant digits + number of zeros.	K = ±10% M = ±20%	8 = 10 4 = 16 3 = 25 5 = 50	N = X8L	1 = KPS Single Chip Stack 2 = KPS Double Chip Stack	C = 100% Matte Sn	See "Packaging C-Spec Ordering Options Table" below

¹ Double chip stacks ("2" in the 13th character position of the ordering code) are only available in M (±20%) capacitance tolerance. Single chip stacks ("1" in the 13th character position of the ordering code) are available in K (±10%) or M (±20%) tolerances.

² Additional leadframe finish options may be available. Contact KEMET for details.



Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec) ²			
Commerc	ial Grade			
7" Reel (Embossed Plastic Tape)/Unmarked	7186			
13" Reel (Embossed Plastic Tape)/Unmarked	7289			
Automoti	ve Grade			
7" Reel (Embossed Plastic Tape)/Unmarked	AUTO			
13" Reel (Embossed Plastic Tape)/Unmarked	AUTO7289			

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. The option to laser mark is not available on these devices. For more information see "Capacitor Marking".

Benefits

- · Reduces audible, microphonic noise
- · Extremely low ESR and ESL
- · Lead (Pb)-Free, RoHS and REACH compliant
- · Capable of Pb-Free reflow profiles

- Non-polar device, minimizing installation concerns
- · Tantalum and electrolytic alternative
- · Commercial & Automotive (AEC-Q200) grades available

Applications

Typical applications include smoothing circuits, DC/DC converters, power supplies (input/output filters), noise reduction (piezoelectric/mechanical), circuits with a direct battery or power source connection, critical and safety relevant circuits without (integrated) current limitation and any application that is subject to extreme environments such as high temperature, high levels of board flexure and/or temperature cycling. Markets include industrial, aerospace, automotive, and telecom.

Qualification/Certification

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

Automotive Grade products meet or exceed the requirements outlined by the Automotive Electronics Council. Details regarding test methods and conditions are referenced in document AEC–Q200, Stress Test Qualification for Passive Components. For additional information regarding the Automotive Electronics Council and AEC–Q200, please visit their website at www.aecouncil.com.

Environmental Compliance

Lead (Pb)-Free, RoHS, and REACH compliant without exemptions.

² For additional Information regarding "AUTO" C-Spec options, see "Automotive C-Spec Information".



Automotive C-Spec Information

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

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

Product Change Notification (PCN)

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

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

KEMET Automotive	Customer Noti	fication due to:	Days prior to
C-Spec	Process/Product change	Obsolescence*	implementation
KEMET assigned ¹	Yes (with approval and sign off)	Yes	180 days Minimum
AUTO	Yes (without approval)	Yes	90 days Minimum

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

Production Part Approval Process (PPAP)

The purpose of the Production Part Approval Process is:

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

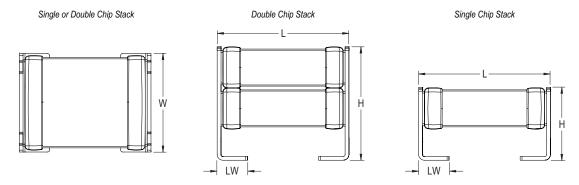
KEMET Automotive		PPAP (Product Part Approval Process) Level									
C-Spec	1	2	3	4	5						
KEMET assigned ¹	•	•	•	•	•						
AUTO	0		0								

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

- Part Number specific PPAP available
- Product family PPAP only



Dimensions – Millimeters (Inches)



Chip Stack	EIA Size Code	Metric Size Code	L Length	W Width	H Height	LW Lead Width	Mounting Technique
Cinalo	1210	3225	3.50 (.138) ±0.30 (.012)	2.60 (.102) ±0.30 (.012)	3.35 (.132) ±0.10 (.004)	0.80 (.032) ±0.15 (.006)	
Single	2220	5650	6.00 (.236) ±0.50 (.020)	5.00 (.197) ±0.50 (.020)	3.50 (.138) ±0.30 (.012)	1.60 (.063) ±0.30 (.012)	Solder Reflow
Davible	1210	3225	3.50 (.138) ±0.30 (.012)	2.60 (.102) ±0.30 (.012)	6.15 (.242) ±0.15 (.006)	0.80 (.031) ±0.15 (.006)	Only
Double	2220	5650	6.00 (.236) ±0.50 (.020)	5.00 (.197) ±0.50 (.020)	5.00 (.197) ±0.50 (.020)	1.60 (.063) ±0.30 (.012)	

Electrical Parameters/Characteristics

Item	Parameters/Characteristics		
Operating Temperature Range	−55°C to +150°C		
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15% (-55°C to 125°C), +15, -40% (125°C to 150°C)		
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%		
² Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)		
³ Dissipation Factor (DF) Maximum Limit @ 25°C	3.5% (≤ 16V) and 2.5% (≥ 25V)		
⁴ Insulation Resistance (IR) Minimum Limit @ 25°C	500 megohm microfarads or 10 G Ω (Rated voltage applied for 120 ±5 seconds @ 25°C)		

Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

1kHz \pm 50Hz and 1.0 \pm 0.2 Vrms if capacitance \leq 10 μF

120Hz \pm 10Hz 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 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

⁴To obtain IR limit, divide MΩ- μ F value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



Post Environmental Limits

High Temperature Life, Biased Humidity, Moisture Resistance										
Dielectric	Dielectric Rated DC Capacitance Dissipation Factor Capacitance Insulation Voltage Value (Maximum %) Shift Resistance									
X8L	≥ 25	All	3.0	±20%	10% of Initial Limit					
AOL	≤ 16	All	5.0	±20%	10% Of Initial Limit					

Table 1 – Capacitance Range/Selection Waterfall (1210 – 2220 Case Sizes)

		Case Size/S	eries			C12	10C					C22	20C		
Capacitance	Cap Code	Voltage Cod	le	8	4	3	5	1	Α	8	4	3	5	1	Α
Capacitanice		Rated Voltage (VDC)	10	16	25	50	100	250	10	16	25	50	100	250
		Capacitance Tol	erance		Produ	ct Availab	ility and C	hip Thickr	ness Code	s – See Ta	ble 2 for C	hip Thick	ness Dime	nsions	
					Single	Chip	Stack								
0.47 µF	474	K	M	FV	FV	FV	FV								
1.0 µF	105	K	M	FV	FV	FV	FV								
2.2 µF	225	K	M	FV	FV	FV				JP	JP	JP			
3.3 µF	335	K	M	FV	FV	FV				JP	JP	JP			
4.7 µF	475	K	M	FV	FV	FV				JP	JP	JP			
10 μF	106	K	M							JP	JP	JP			
15 µF	156	K	M							JP					
22 µF	226	K	M							JP					
					Double	e Chip	Stack								
1.0 µF	105		М	FW	FW	FW	FW								
2.2 µF	225		M	FW	FW	FW	FW								
3.3 µF	335		M	FW	FW	FW									
4.7 μF	475		М	FW	FW	FW				JR	JR	JR			
10 µF	106		M	FW	FW	FW				JR	JR	JR			
22 µF	226		М							JR	JR	JR			
33 µF	336		M							JR					
47 µF	476		M							JR					
·		Rated Voltage (VDC)	10	16	25	50	100	250	10	16	25	50	100	250
Capacitance	Cap	Voltage Cod	le	8	4	3	5	1	Α	8	4	3	5	1	Α
	Code	Case Size/S	eries			C12	10C					C22	20C		

These products are protected under US Patent 8,331,078 other patents pending, and any foreign counterparts.

Table 2 – Chip Thickness/Tape & Reel Packaging Quantities

Thickness	Case	Thickness ±	Paper C	Quantity	Plastic (Quantity
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
FV	1210	3.35 ± 0.10	0	0	600	2,000
FW	1210	6.15 ± 0.15	0	0	300	1,000
JP	2220	3.50 ± 0.30	0	0	300	1,300
JR	2220	5.00 ± 0.50	0	0	200	800

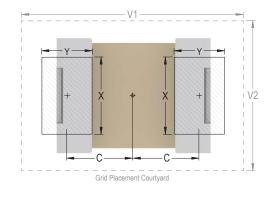
Package quantity based on finished chip thickness specifications.



Table 3 – KPS Land Pattern Design Recommendations (mm)

EIA SIZE CODE	METRIC SIZE	inal) La	nd Prot	rusion		
0052	CODE	С	Υ	Х	V1	V2
1210	3225	1.50	1.14	1.75	5.05	3.40
2220	5650	2.69	2.08	4.78	7.70	6.00

Image at right based on an EIA 1210 case size.



Soldering Process

KEMET's KPS Series devices are compatible with IR reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET's recommended profile conditions for IR reflow reflect the profile conditions of the IPC/J–STD–020D standard for moisture sensitivity testing.

To prevent degradation of temperature cycling capability, care must be taken to prevent solder from flowing into the inner side of the lead frames (inner side of "J" lead in contact with the circuit board).

After soldering, the capacitors should be air cooled to room temperature before further processing. Forced air cooling is not recommended.

Hand soldering should be performed with care due to the difficulty in process control. If performed, care should be taken to avoid contact of the soldering iron to the capacitor body. The iron should be used to heat the solder pad, applying solder between the pad and the lead, until reflow occurs. Once reflow occurs, the iron should be removed immediately. (Preheating is required when hand soldering to avoid thermal shock.)

Profile Feature	SnPb Assembly	Pb-Free Assembly
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax})	60 – 120 seconds	60 – 120 seconds
Ramp-up Rate (T _L to T _P)	3°C/seconds maximum	3°C/seconds maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	250°C
Time within 5°C of Maximum Peak Temperature (t _p)	20 seconds maximum	10 seconds maximum
Ramp-down Rate $(T_p \text{ to } T_L)$	6°C/seconds maximum	6°C/seconds maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum

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

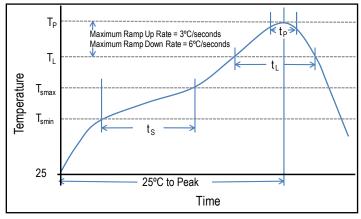




Table 4 – Performance & Reliability: Test Methods and Conditions

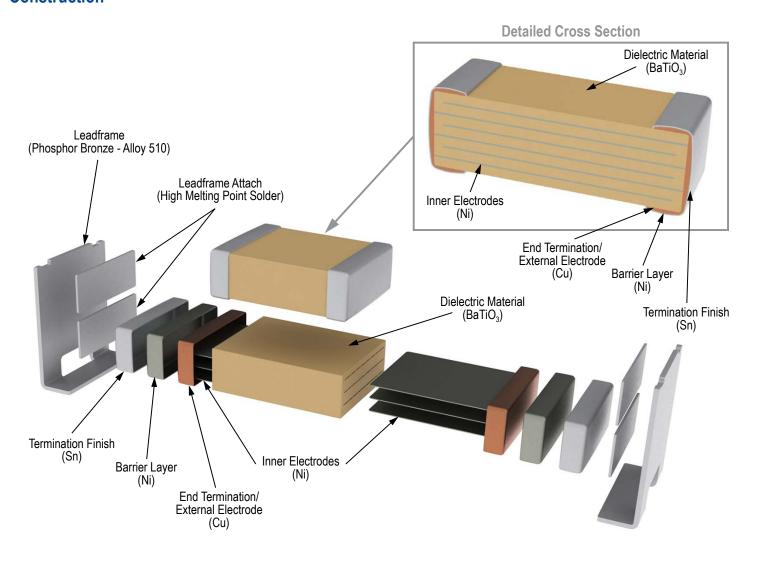
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 5.0 mm minimum
		Magnification 50 X. Conditions:
Caldarahilitu	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	J-51D-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 250°C
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +150°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Digged Humidity	MII –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 +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	−55°C/+150°C. Note: Number of cycles required- 300, maximum transfer time- 20 seconds, Dwell time- 15 minutes. Air-Air.
High Temperature Life	MIL-STD-202 Method 108	1,000 hours at 150°C with rated voltage applied.
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 .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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage & Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



Product Marking

Laser marking option is not available on:

- C0G, Ultra Stable X8R and Y5V dielectric devices
- EIA 0402 case size devices
- EIA 0603 case size devices with Flexible Termination option.
- · KPS Commercial and Automotive grade stacked devices.

These capacitors are supplied unmarked only.

KPS MIL Series, SMPS Stacked Capacitors, MIL-PRF-49470, CHARGED: DSCC 87106, 25 – 1,000 VDC (Commercial, Military, & Space Grades)

Overview

KEMET Power Solutions (KPS) MIL Series ceramic stacked capacitors are available in commercial, military and space grades and are well suited for standard and high reliability switch mode power supply (SMPS) and pulse energy applications. Qualified under performance specification MIL–PRF–49470, our military and space grade products meet or exceed the requirements outlined by DSCC (Defense Supply Center, Columbus) and are available in both B (standard reliability) & T (high reliability) product levels. MIL–PRF–49470 was developed as part of a cooperative effort between the U.S. Military, NASA and SMPS suppliers to produce a robust replacement to cancelled DSCC Drawing 87106.

The KPS MIL Series is constructed using large chip multilayer ceramic capacitors (MLCCs), horizontally stacked and secured to a lead-frame termination system using a high melting point (HMP) solder alloy. The lead frame isolates the MLCCs from the printed circuit board (PCB) while establishing a parallel circuit configuration. Mechanically isolating the capacitors from the PCB improves mechanical and thermal stress performance, while the parallel circuit configuration allows for bulk capacitance in the same or smaller design footprint.

Electronic Components

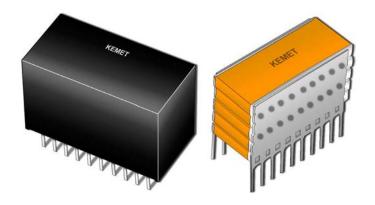
Available in BX, BR, BQ, and X7R dielectrics, these devices are available in encapsulated and unencapsulated styles in both surface mountable and through-hole configurations. Their low Equivalent Series Resistance (ESR) and Equivalent Series Inductance (ESL) make them ideally suited for input and output filtering of power supply as well as snubber applications. The encapsulated styles are primarily used where increased mechanical and environmental protection is required, such as in avionics systems.

Benefits

- -55°C to +125°C operating temperature range
- · High frequency performance
- · Bulk capacitance in a reduced footprint
- MIL-PRF-49470 QPL
- Military Case Codes 3, 4 and 5
- Space Grade available ("T" Level)
- DSCC approved (87106)
- · Commercial/Industrial Grade available
- · Customer specific requirements available
- · Low ESR and ESL
- High thermal stability
- · High ripple current capability
- Higher reliability than aluminum electrolytic or tantalum
- · Available encapsulated or unencapsulated

Applications

- Military
- Space
- · Industrial
- Input and output filtering on power supplies often found on "capacitor banks"
- Snubber circuits
- Radar filtering (28 V/microwave burst)





MIL-PRF-49470 Ordering Information

M49470	R	01	474	K	C	N
Performance Specification Indicating MIL-PRF-494701	Dielectric Classification/ Characteristic ²	Performance Specification Sheet Number (Indicating MIL–PRF–49470/1) ³	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Lead Configuration ⁴
M49470 = B level T49470 = T level A "T" prefix is used in place of the "M" for T level product.	Q = BQ R = BR X = BX	01 = Unencapsulated 02 = Encapsulated	Two significant digits + number of zeros	J = ±5% K = ±10% M = ±20%	A = 50 B = 100 C = 200 E = 500	N = Straight Pin L = Formed "L" M = Formed "L" J = Formed "J" K = Formed "J"

¹ Indicates performance and reliability requirements. "B" level represents standard reliability."T" level represents high reliability.

KPS MIL Series, SMPS Stacks Ordering Information

(Do not use this ordering code if a QPL MIL-SPEC part type is required. Please order using MIL-SPEC ordering code. Details regarding MIL-PRF-49470 QPL ordering information is outlined above.)

L1	R	N	30	С	106	K	S	12	
Product Family ¹	Dielectric Classification/ Characteristic ²	(Configurations	Case Size/ Case Code (CC)	Rated Voltage (VDC)	Capacitance Code (pF)	Capacitance Tolerance	Testing Option ⁴	Maximum Dimensio	•
L1 = Unencapsulated L2 = Encapsulated	Q = BQ R = BR X = BX W = X7R	N = Straight L = Formed "L" M = Formed "L" J = Formed "J" K = Formed "J"	50 = CC 5	5 = 50	Two significant digits + number of zeros	J = ±5% K = ±10% M = ±20%	B = M49470 "B" Level T = M49470 "T" Level C = DSCC87106 S = Commercial X = Non-Standard (Customer Specific Requirements)	Unencapsulated 12 = 0.12" 24 = 0.24" 36 = 0.36" 48 = 0.48" 65 = 0.65"	Encapsulated 27 = 0.27" 39 = 0.39" 53 = 0.53" 66 = 0.66" 80 = 0.80"

¹, ⁴ Test level option "T" is not available on encapsulated stacked devices, i.e., MIL–PRF–49470/2. If a QPL MIL–Spec part type is required, please order using the MIL–Spec ordering code.

Ordering Information Requirements per DSCC Drawing 87106

DSCC Drawing 87106 was cancelled on 01/03/2005. Customers can continue to order per 87106 requirements using the original DSCC ordering code,i.e., 87106–001. When available, MIL–PRF–49470 devices are preferred over DSCC Drawing 87106. The MIL–PRF–49470 military specification product provides additional quality assurance provisions that are not required by the DSCC drawing. These extra provisions create a more robust replacement.

¹ Please refer to performance specification sheet MIL–PRF–49470 for details regarding test levels. The latest revision of the specification sheet is available through DSCC.

^{1,3} Test level option "T" is not available on encapsulated stacked devices (i.e. MIL-PRF-49470/2).

² Dielectric classification and characteristic details are outlined in the "Electrical Parameters" section of this document.

⁴Lead configuration and dimension details are outlined in the "Dimensions" section of this document.

² Dielectric classification and characteristic details are outlined in the "Electrical Parameters" section of this document.

³ Lead configuration and dimension details are outlined in the "Dimensions" section of this document. Additional lead configurations may be available. Contact KEMET for details.

⁴ Indicates performance and reliability requirements. Testing option details are outlined in the "Performance & Reliability" section of this document.

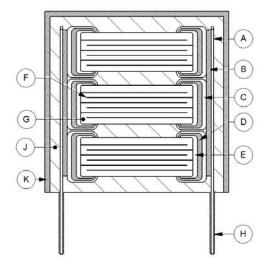
⁴ Please refer to performance specification sheet MIL–PRF–49470 for additional details regarding test levels. The latest revision of the specification sheet is available through DSCC.

⁴ DSCC Drawing 87106 was cancelled on 01/03/2005. MIL-PRF-49470 capacitors are preferred over DSCC Drawing 87106 capacitors.

⁵ Maximum height dimensions are provided in product tables 1A, 1B, and 1C of this document



Construction



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

Reference	Item	Material	
Α	Leadframe	Phosphor Bronze – Alloy 510	
В	Leadframe Attach Solder	Sn10, Pt	o88, Ag2
С		SnPb (4% minimum)	
D	Termination System ¹	Ni	Solderable Silver
E		Ag	
F	Electrode	Pd	Ag
G	Dielectric	ВаТ	TiO ³
Н	Lead Solder	Sn60,	Pb40
J	F 1.0.2	Molding Compound	
К	Encapsulation ²	Diallyl-Phthalate (DAP)	

¹ KEMET reserves the right to construct these devices using either of the termination systems outlined.

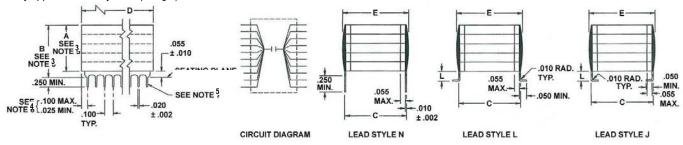
² Encapsulated product only, i.e., MIL–PRF–49470/2 and L2 product families.



Unencapsulated (M49470/1 & L1) Product Dimensions – Inches (Millimeters)

Case Code	C Lead Spacing ±0.025 (0.635)	E Length ±0.010 (0.250)	D Width Minimum	D Width Maximum	A Height Maximum	Seating Plane ¹ ±0.010 (0.250)	Number of Leads per Side	Mounting Technique
3	0.450 (11.43)	0.500 (12.70)	0.950 (24.13)	1.075 (27.30)	Refer to tables 1A &		10	
4	0.400 (10.16)	0.440 (11.18)	0.350 (8.89)	0.425 (10.80)	1C for specific	0.055 (1.40)	4	Solder reflow only
5	0.250 (6.35)	0.300 (7.62)	0.224 (5.69)	0.275 (6.98)	maximum A dimension		3	

¹ Only applies to lead style "N" (straight).



- 1. Unless otherwise specified, tolerances are ±0.010" (0.25 mm).
- 2. Metric equivalents for C, D and E dimensions are provided for general information only.
- 3. For maximum B dimension, add 0.065" (1.65 mm) to the appropriate A dimension. For all lead styles, the number of chips is determined by the capacitance and voltage rating.
- 4. For case code 5, dimensions shall be 0.100" (2.54 mm) maximum and 0.012" (0.30 mm) minimum.
- 5. Lead alignment within pin rows shall be within ±0.005" (0.13 mm).

Unencapsulated & Encapsulated Lead Configurations – Inches (Millimeters)

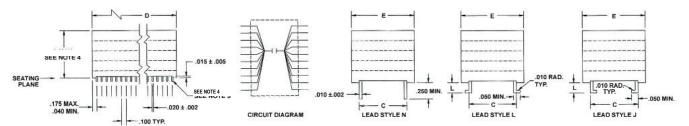
Lead Style Symbol	Lead Style	L Lead Length
N	(N) Straight	0.250 Minimum (6.35)
L	(L) Formed	0.070 ± 0.010 (1.78 ±0.25)
M		0.045 ± 0.010 (1.14 ±0.25)
J	(J) Formed	0.070 ± 0.010 (1.78 ±0.25)
К		0.045 ± 0.010 (1.14 ±0.25)

Additional lead configurations may be available. Contact KEMET for details.



Encapsulated (M49470/2 & L2) Product Dimensions – Inches (Millimeters)

Case Code	C Lead Spacing ±0.025 (0.635)	E Length Maximum	D Width ±0.635 (±0.025)	A Height	Number of Leads per Side	Mounting Technique
3	0.450 (11.43)	0.580 (14.73)	1.155 (29.34)	Refer to table 1B for	10	Solder reflow only
4	0.400 (10.16)	0.485 (12.32)	0.485 (12.32)	specific maximum A dimension	4	
5	0.250 (6.35)	0.355 (9.02)	0.355 (9.02)		3	



- 1. Dimensions are in inches.
- 2. Metric equivalents are given for general information only.
- 3. Unless otherwise specified, tolerances are ±0.010" (0.25 mm).
- 4. Lead alignment within pin rows shall be within ±0.005" (0.13 mm).

Unencapsulated & Encapsulated Lead Configurations – Inches (Millimeters)

Lead Style Symbol	Lead Style	L Lead Length
N	(N) Straight	0.250 Minimum (6.35)
L	(L) Formed	0.070 ± 0.010 (1.78 ±0.25)
М		0.045 ± 0.010 (1.14 ±0.25)
J	(J) Formed	0.070 ± 0.010 (1.78 ±0.25)
K		0.045 ± 0.010 (1.14 ±0.25)

Additional lead configurations may be available. Contact KEMET for details.



Qualification Inspection Per MIL-PRF-49470

Inspection	Test Method Paragraph			
Group I				
Thermal shock and voltage conditioning	4.8.5			
Gro	up II			
Visual and mechanical Inspection	4.8.4			
Gro	up III			
Low temperature storage	4.8.23			
Barometric pressure	4.8.9			
Terminal strength	4.8.10			
Group IV				
Voltage-temperature limits	4.8.13.1			
Vibration, high frequency	4.8.14			
Immersion	4.8.15			
Gro	up V			
Shock, specified pulse	4.8.16			
Resistance to soldering heat	4.8.17			
Moisture resistance	4.8.18			
Grou	υρ VI			
DPA (T level only)	4.8.19			
Group VII				
Humidity, steady state, low voltage (T level only)	4.8.21			
Grou	p VIII			
Life	4.8.22			

Environmental Compliance

These devices do not meet RoHS criteria



Electrical Parameters/Performance Characteristics: BQ Dielectric

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +125°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%
Capacitance Change with Reference to +25°C and 100% Rated VDC Applied	+15%, -50%
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	1%
Dielectric Withstanding Voltage (DWV)	250% of rated DC voltage for voltage rating < 500 V 150% of rated DC voltage for voltage rating of 500 V (5 ±1 seconds and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit at 25°C	2.5%
Insulation Resistance (IR) Limit at 25°C	1,000 megohm microfarads (minimum) or 100 G Ω
Insulation Resistance (IR) Limit at 125°C	100 megohm microfarads (minimum) or 10 $G\Omega$

Regarding aging rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

To obtain IR limit, divide $M\Omega$ - μ 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 ±100 Hz at 1.0 Vrms ±0.2 Vrms (open circuit voltage).

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."

Electrical Parameters/Performance Characteristics: BR Dielectric

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +125°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%
Capacitance Change with Reference to +25°C and 100% Rated VDC Applied	+15%, -40%
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	1%
Dielectric Withstanding Voltage (DWV)	250% of rated DC voltage for voltage rating < 500 V 150% of rated DC voltage for voltage rating of 500 V (5 ±1 seconds and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit at 25°C	2.5%
Insulation Resistance (IR) Limit at 25°C	1,000 megohm microfarads (minimum) or 100 GΩ
Insulation Resistance (IR) Limit at 125°C	100 megohm microfarads (minimum) or 10 GΩ

Regarding aging rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

To obtain IR limit, divide $M\Omega$ - μ 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 ±100 Hz at 1.0 Vrms ±0.2 Vrms (open circuit voltage).

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."



Electrical Parameters/Performance Characteristics: BX Dielectric

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +125°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%
Capacitance Change with Reference to +25°C and 100% Rated VDC Applied	+15%, -25%
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	1%
Dielectric Withstanding Voltage (DWV)	250% of rated DC voltage for voltage rating < 500 V 150% of rated DC voltage for voltage rating of 500 V (5 ±1 seconds and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit at 25°C	2.5%
Insulation Resistance (IR) Limit at 25°C	1000 megohm microfarads (minimum) or 100 GΩ
Insulation Resistance (IR) Limit at 125°C	100 megohm microfarads (minimum) or 10 $G\Omega$

Regarding aging rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1000 hours.

To obtain IR limit, divide $M\Omega$ - μ 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 ±100 Hz at 1.0 Vrms ±0.2 Vrms (open circuit voltage).

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."

Electrical Parameters/Performance Characteristics: X7R Dielectric

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 seconds and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit at 25°C	3.5% (25 V) and 2.5% (50 V to 200 V)
Insulation Resistance (IR) Limit at 25°C	1,000 megohm microfarads or 100 G Ω (Rated voltage applied for 120 ±5 seconds at 25°C)

Regarding aging rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1000 hours.

To obtain IR limit, divide $M\Omega$ - μ 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 $\leq 10 \mu F$.

20 Hz ± 10 Hz and 0.5 ± 0.1 Vrms if capacitance > 10 μ 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."



Table 1A - MIL-PRF-49470/1, Product Selection 50 - 200 VDC

MIL-PRF-49470/1 Unencapsulated, Horizontally Stacked						
MIL-PRF-49470 P/N ¹	Capacitance	Case	Height A	Capacitance	Lead	KEMET P/N ¹
	(µF)	Code	inch (mm)	Tolerance	Configuration	
		50 VI	DC – BX Dielect	ric		
(1)49470X01105(2)A(3)	1	5	0.120 (3.05)	K, M	N, L, M, J, K	L1X(3)505105(2)(4)12
(1)49470X01125(2)A(3)	1.2	5	0.120 (3.05)	K, M	N, L, M, J, K	L1X(3)505125(2)(4)12
(1)49470X01155(2)A(3)	1.5	5	0.240 (6.10)	K, M	N, L, M, J, K	L1X(3)505155(2)(4)24
(1)49470X01185(2)A(3)	1.8	5	0.240 (6.10)	K, M	N, L, M, J, K	L1X(3)505185(2)(4)24
(1)49470X01225(2)A(3)	2.2	5	0.240 (6.10)	K, M	N, L, M, J, K	L1X(3)505225(2)(4)24
(1)49470X01275(2)A(3)	2.7	5	0.360 (9.14)	K, M	N, L, M, J, K	L1X(3)505275(2)(4)36
(1)49470X01335(2)A(3)	3.3 3.9	5	0.360 (9.14) 0.480 (12.19)	K, M	N, L, M, J, K	L1X(3)505335(2)(4)36
(1)49470X01475(2)A(3) (1)49470X01395(2)A(3)	3.9	5 5	0.480 (12.19)	K, M K, M	N, L, M, J, K N, L, M, J, K	L1X(3)505475(2)(4)48 L1X(3)505395(2)(4)48
(1)49470X01595(2)A(3) (1)49470X01565(2)A(3)	5.6	5	0.460 (12.19)	K, M	N, L, M, J, K N, L, M, J, K	L1X(3)505565(2)(4)65
(1)49470X01505(2)A(3) (1)49470X01685(2)A(3)	6.8	4	0.360 (9.14)	K, M	N, L, M, J, K N, L, M, J, K	L1X(3)405685(2)(4)36
(1)49470X01805(2)A(3)	8.2	4	0.360 (9.14)	K, M	N, L, M, J, K N, L, M, J, K	L1X(3)405825(2)(4)36
(1)49470X01023(2)A(3)	10	4	0.480 (12.19)	K, M	N, L, M, J, K	L1X(3)405106(2)(4)48
(1)49470X01126(2)A(3)	12	4	0.480 (12.19)	K, M	N, L, M, J, K	L1X(3)405126(2)(4)48
(1)49470X01156(2)A(3)	15	4	0.650 (16.51)	K, M	N, L, M, J, K	L1X(3)405156(2)(4)65
(1)49470X01186(2)A(3)	18	3	0.240 (6.10)	K, M	N, L, M, J, K	L1X(3)305186(2)(4)24
(1)49470X01226(2)A(3)	22	3	0.360 (9.14)	K, M	N, L, M, J, K	L1X(3)305226(2)(4)36
(1)49470X01276(2)A(3)	27	3	0.360 (9.14)	K, M	N, L, M, J, K	L1X(3)305276(2)(4)36
(1)49470X01336(2)A(3)	33	3	0.360 (9.14)	K, M	N, L, M, J, K	L1X(3)305336(2)(4)36
(1)49470X01396(2)A(3)	39	3	0.480 (12.19)	K, M	N, L, M, J, K	L1X(3)305396(2)(4)48
(1)49470X01476(2)A(3)	47	3	0.650 (16.51)	K, M	N, L, M, J, K	L1X(3)305476(2)(4)65
		100 V	DC – BX Dielec	tric		
(1)49470X01684(2)B(3)	0.68	5	0.120 (3.05)	K, M	N, L, M, J, K	L1X(3)501684(2)(4)12
(1)49470X01824(2)B(3)	0.82	5	0.240 (6.10)	K, M	N, L, M, J, K	L1X(3)501824(2)(4)24
(1)49470X01105(2)B(3)	1	5	0.240 (6.10)	K, M	N, L, M, J, K	L1X(3)501105(2)(4)24
(1)49470X01125(2)B(3)	1.2	5	0.240 (6.10)	K, M	N, L, M, J, K	L1X(3)501125(2)(4)24
(1)49470X01155(2)B(3)	1.5	5	0.360 (9.14)	K, M	N, L, M, J, K	L1X(3)501155(2)(4)36
(1)49470X01185(2)B(3)	1.8	5	0.360 (9.14)	K, M	N, L, M, J, K	L1X(3)501185(2)(4)36
(1)49470X01225(2)B(3)	2.2	5	0.480 (12.19)	K, M	N, L, M, J, K	L1X(3)501225(2)(4)48
(1)49470X01275(2)B(3)	2.7	5	0.480 (12.19)	K, M	N, L, M, J, K	L1X(3)501275(2)(4)48
(1)49470X01335(2)B(3)	3.3 3.9	5 4	0.650 (16.51)	K, M	N, L, M, J, K	L1X(3)501335(2)(4)65
(1)49470X01395(2)B(3) (1)49470X01475(2)B(3)	4.7	4	0.360 (9.14) 0.360 (9.14)	K, M K, M	N, L, M, J, K N, L, M, J, K	L1X(3)401395(2)(4)36 L1X(3)401475(2)(4)36
(1)49470X01475(2)B(3) (1)49470X01565(2)B(3)	5.6	4	0.480 (12.19)	K, M	N, L, M, J, K N, L, M, J, K	L1X(3)401565(2)(4)48
(1)49470X01303(2)B(3)	6.8	4	0.480 (12.19)	K, M	N, L, M, J, K N, L, M, J, K	L1X(3)401685(2)(4)48
(1)49470X01003(2)B(3)	8.2	4	0.460 (12.19)	K, M	N, L, M, J, K N, L, M, J, K	L1X(3)401825(2)(4)65
(1)49470X01023(2)B(3)	10	3	0.240 (6.10)	K, M	N, L, M, J, K	L1X(3)301106(2)(4)24
(1)49470X01126(2)B(3)	12	3	0.240 (6.10)	K, M	N, L, M, J, K	L1X(3)301126(2)(4)24
(1)49470X01156(2)B(3)	15	3	0.360 (9.14)	K, M	N, L, M, J, K	L1X(3)301156(2)(4)36
(1)49470X01186(2)B(3)	18	3	0.360 (9.14)	K, M	N, L, M, J, K	L1X(3)301186(2)(4)36
(1)49470X01226(2)B(3)	22	3	0.480 (12.19)	K, M	N, L, M, J, K	L1X(3)301226(2)(4)48
(1)49470X01276(2)B(3)	27	3	0.650 (16.51)	K, M	N, L, M, J, K	L1X(3)301276(2)(4)65
		200 V	DC – BR Dielec			, , ,
(1)49470R01474(2)C(3)	0.47	5	0.240 (6.10)	K, M	N, L, M, J, K	L1R(3)502474(2)(4)24
(1)49470R01564(2)C(3)	0.56	5	0.240 (6.10)	K, M	N, L, M, J, K	L1R(3)502564(2)(4)24
(1)49470R01684(2)C(3)	0.68	5	0.360 (9.14)	K, M	N, L, M, J, K	L1R(3)502684(2)(4)36
(1)49470R01824(2)C(3)	0.82	5	0.360 (9.14)	K, M	N, L, M, J, K	L1R(3)502824(2)(4)36
(1)49470R01105(2)C(3)	1	5	0.480 (12.19)	K, M	N, L, M, J, K	L1R(3)502105(2)(4)48
MIL-PRF-49470 P/N ¹	Capacitance (µF)	Case Code	Height A inch (mm)	Capacitance Tolerance	Lead Configuration	KEMET P/N ¹

¹ Complete P/N requires additional characters in the numbered positions provided in order to indicate product level (B level or T level), capacitance tolerance and lead configuration. For each numbered position, available options are as follows:

⁽¹⁾ Test level character "M" for B level, or "T" for T level (MIL-PRF-49470/1 part number only).

⁽²⁾ Capacitance tolerance character " K" or " M".

⁽³⁾ Lead style character " N", "L", "M", "J" or "K".

⁽⁴⁾ Test level character "B" for B level, or "T" for T level (KEMET part number only).



Table 1A - MIL-PRF-49470 /1, Product Selection 200 - 500 VDC cont'd

	MIL-PRF-49470/1 Unencapsulated, Horizontally Stacked							
MIL-PRF-49470 P/N ¹	Capacitance (µF)	Case Code	Height A inch (mm)	Capacitance Tolerance	Lead Configuration	KEMET P/N ¹		
(1)49470R01125(2)C(3)	1.2	5	0.480 (12.19)	K, M	N, L, M, J, K	L1R(3)502125(2)(4)48		
(1)49470R01155(2)C(3)	1.5	5	0.650 (16.51)	K, M	N, L, M, J, K	L1R(3)502155(2)(4)65		
(1)49470R01185(2)C(3)	1.8	4	0.360 (9.14)	K, M	N, L, M, J, K	L1R(3)402185(2)(4)36		
(1)49470R01225(2)C(3)	2.2	4	0.360 (9.14)	K, M	N, L, M, J, K	L1R(3)402225(2)(4)36		
(1)49470R01275(2)C(3)	2.7	4	0.480 (12.19)	K, M	N, L, M, J, K	L1R(3)402275(2)(4)48		
(1)49470R01335(2)C(3)	3.3	4	0.480 (12.19)	K, M	N, L, M, J, K	L1R(3)402335(2)(4)48		
(1)49470R01395(2)C(3)	3.9	4	0.650 (16.51)	K, M	N, L, M, J, K	L1R(3)402395(2)(4)65		
(1)49470R01475(2)C(3)	4.7	3	0.240 (6.10)	K, M	N, L, M, J, K	L1R(3)302475(2)(4)24		
(1)49470R01565(2)C(3)	5.6	3	0.240 (6.10)	K, M	N, L, M, J, K	L1R(3)302565(2)(4)24		
(1)49470R01685(2)C(3)	6.8	3	0.360 (9.14)	K, M	N, L, M, J, K	L1R(3)302685(2)(4)36		
(1)49470R01825(2)C(3)	8.2	3	0.360 (9.14)	K, M	N, L, M, J, K	L1R(3)302825(2)(4)36		
(1)49470R01106(2)C(3)	10	3	0.480 (12.19)	K, M	N, L, M, J, K	L1R(3)302106(2)(4)48		
(1)49470R01126(2)C(3)	12	3	0.650 (16.51)	K, M	N, L, M, J, K	L1R(3)302126(2)(4)65		
	500 VDC – BQ Dielectric							
(1)49470Q01154(2)E(3)	0.15	5	0.120 (3.05)	K, M	N, L, M, J, K	L1Q(3)50C154(2)(4)12		
(1)49470Q01184(2)E(3)	0.18	5	0.240 (6.10)	K, M	N, L, M, J, K	L1Q(3)50C184(2)(4)24		
(1)49470Q01224(2)E(3)	0.22	5	0.240 (6.10)	K, M	N, L, M, J, K	L1Q(3)50C224(2)(4)24		
(1)49470Q01274(2)E(3)	0.27	5	0.240 (6.10)	K, M	N, L, M, J, K	L1Q(3)50C274(2)(4)24		
(1)49470Q01334(2)E(3)	0.33	5	0.360 (9.14)	K, M	N, L, M, J, K	L1Q(3)50C334(2)(4)36		
(1)49470Q01394(2)E(3)	0.39	5	0.360 (9.14)	K, M	N, L, M, J, K	L1Q(3)50C394(2)(4)36		
(1)49470Q01474(2)E(3)	0.47	5	0.360 (9.14)	K, M	N, L, M, J, K	L1Q(3)50C474(2)(4)36		
(1)49470Q01564(2)E(3)	0.56	5	0.480 (12.19)	K, M	N, L, M, J, K	L1Q(3)50C564(2)(4)48		
(1)49470Q01684(2)E(3)	0.68	5	0.650 (16.51)	K, M	N, L, M, J, K	L1Q(3)50C684(2)(4)65		
(1)49470Q01824(2)E(3)	0.82	4	0.360 (9.14)	K, M	N, L, M, J, K	L1Q(3)40C824(2)(4)36		
(1)49470Q01105(2)E(3)	1	4	0.360 (9.14)	K, M	N, L, M, J, K	L1Q(3)40C105(2)(4)36		
(1)49470Q01125(2)E(3)	1.2	4	0.360 (9.14)	K, M	N, L, M, J, K	L1Q(3)40C125(2)(4)36		
(1)49470Q01155(2)E(3)	1.5	4	0.480 (12.19)	K, M	N, L, M, J, K	L1Q(3)40C155(2)(4)48		
(1)49470Q01185(2)E(3)	1.8	4	0.650 (16.51)	K, M	N, L, M, J, K	L1Q(3)40C185(2)(4)65		
(1)49470Q01225(2)E(3)	2.2	3	0.240 (6.10)	K, M	N, L, M, J, K	L1Q(3)30C225(2)(4)24		
(1)49470Q01275(2)E(3)	2.7	3	0.360 (9.14)	K, M	N, L, M, J, K	L1Q(3)30C275(2)(4)36		
(1)49470Q01335(2)E(3)	3.3	3	0.360 (9.14)	K, M	N, L, M, J, K	L1Q(3)30C335(2)(4)36		
(1)49470Q01395(2)E(3)	3.9	3	0.360 (9.14)	K, M	N, L, M, J, K	L1Q(3)30C395(2)(4)36		
(1)49470Q01475(2)E(3)	4.7	3	0.480 (12.19)	K, M	N, L, M, J, K	L1Q(3)30C475(2)(4)48		
(1)49470Q01565(2)E(3)	5.6	3	0.650 (16.51)	K, M	N, L, M, J, K	L1Q(3)30C565(2)(4)65		
MIL-PRF-49470 P/N ¹	Capacitance (µF)	Case Code	Height A inch (mm)	Capacitance Tolerance	Lead Configuration	KEMET P/N 1		

¹ Complete P/N requires additional characters in the numbered positions provided in order to indicate product level (B level or T level), capacitance tolerance and lead configuration. For each numbered position, available options are as follows:

⁽¹⁾ Test level character "M" for B level, or "T" for T level (MIL-PRF-49470/1 part number only).

⁽²⁾ Capacitance tolerance character " K" or " M".

⁽³⁾ Lead style character " N", "L", "M", "J" or "K".

⁽⁴⁾ Test level character "B" for B level, or "T" for T level (KEMET part number only).



Table 1B - MIL-PRF-49470/2, Product Selection 50 - 200 VDC

MIL-PRF-49470/2 Encapsulated, Horizontally Stacked								
MIL-PRF-49470 P/N ¹	Capacitance (µF)	Case Code	Height A inch (mm)	Capacitance Tolerance	Lead Configuration	KEMET P/N 1		
50 VDC – BX Dielectric								
M49470X02125(1)A(2)	1.2	5	0.270 (6.86)	K, M	N, L, M, J, K	L2X(2)505125(1)B27		
M49470X02155(1)A(2)	1.5	5	0.390 (9.91)	K, M	N, L, M, J, K	L2X(2)505155(1)B39		
M49470X02185(1)A(2)	1.8	5	0.390 (9.91)	K, M	N, L, M, J, K	L2X(2)505185(1)B39		
M49470X02225(1)A(2)	2.2	5	0.390 (9.91)	K, M	N, L, M, J, K	L2X(2)505225(1)B39		
M49470X02275(1)A(2)	2.7	5 5	0.530 (13.46)	K, M	N, L, M, J, K	L2X(2)505275(1)B53		
M49470X02335(1)A(2) M49470X02475(1)A(2)	3.3 3.9	5 5	0.530 (13.46) 0.660 (16.76)	K, M K, M	N, L, M, J, K N, L, M, J, K	L2X(2)505335(1)B53 L2X(2)505475(1)B66		
M49470X023475(1)A(2) M49470X02395(1)A(2)	4.7	5	0.660 (16.76)	K, M	N, L, M, J, K N, L, M, J, K	L2X(2)505395(1)B66		
M49470X02555(1)A(2)	5.6	5	0.800 (20.32)	K, M	N, L, M, J, K	L2X(2)505565(1)B80		
M49470X02685(1)A(2)	6.8	4	0.530 (13.46)	K, M	N, L, M, J, K	L2X(2)405685(1)B53		
M49470X02825(1)A(2)	8.2	4	0.530 (13.46)	K, M	N, L, M, J, K	L2X(2)405825(1)B53		
M49470X02106(1)A(2)	10	4	0.660 (16.76)	K, M	N, L, M, J, K	L2X(2)405106(1)B66		
M49470X02126(1)A(2)	12	4	0.660 (16.76)	K, M	N, L, M, J, K	L2X(2)405126(1)B66		
M49470X02156(1)A(2)	15	4	0.800 (20.32)	K, M	N, L, M, J, K	L2X(2)405156(1)B80		
M49470X02186(1)A(2)	18	3	0.390 (9.91)	K, M	N, L, M, J, K	L2X(2)305186(1)B39		
M49470X02226(1)A(2)	22	3	0.530 (13.46)	K, M	N, L, M, J, K	L2X(2)305226(1)B53		
M49470X02276(1)A(2)	27	3	0.530 (13.46)	K, M	N, L, M, J, K	L2X(2)305276(1)B53		
M49470X02336(1)A(2)	33	3	0.530 (13.46)	K, M	N, L, M, J, K	L2X(2)305336(1)B53		
M49470X02396(1)A(2) M49470X02476(1)A(2)	39 47	3	0.660 (16.76) 0.800 (20.32)	K, M K, M	N, L, M, J, K	L2X(2)305396(1)B66 L2X(2)305476(1)B80		
M49470X02470(1)A(2)	41				N, L, M, J, K	L2X(2)303476(1)B60		
		100	VDC – BX Diele	ctric				
M49470X02684(1)B(2)	0.68	5	0.270 (6.86)	K, M	N, L, M, J, K	L2X(2)501684(1)B27		
M49470X02824(1)B(2)	0.82	5	0.390 (9.91)	K, M	N, L, M, J, K	L2X(2)501824(1)B39		
M49470X02105(1)B(2)	1	5	0.390 (9.91)	K, M	N, L, M, J, K	L2X(2)501105(1)B39		
M49470X02125(1)B(2)	1.2	5	0.390 (9.91)	K, M	N, L, M, J, K	L2X(2)501125(1)B39		
M49470X02155(1)B(2)	1.5	5	0.530 (13.46)	K, M	N, L, M, J, K	L2X(2)501155(1)B53		
M49470X02185(1)B(2)	1.8	5	0.530 (13.46)	K, M	N, L, M, J, K	L2X(2)501185(1)B53		
M49470X02225(1)B(2)	2.2	5	0.660 (16.76)	K, M	N, L, M, J, K	L2X(2)501225(1)B66		
M49470X02275(1)B(2)	2.7 3.3	5 5	0.660 (16.76)	K, M	N, L, M, J, K	L2X(2)501275(1)B66		
M49470X02335(1)B(2) M49470X02395(1)B(2)	3.9	5 4	0.800 (20.32) 0.530 (13.46)	K, M K, M	N, L, M, J, K N, L, M, J, K	L2X(2)501335(1)B80 L2X(2)401395(1)B53		
M49470X02393(1)B(2) M49470X02475(1)B(2)	4.7	4	0.530 (13.46)	K, M	N, L, M, J, K	L2X(2)401395(1)B53		
M49470X02565(1)B(2)	5.6	4	0.660 (16.76)	K, M	N, L, M, J, K	L2X(2)401565(1)B66		
M49470X02685(1)B(2)	6.8	4	0.660 (16.76)	K, M	N, L, M, J, K	L2X(2)401685(1)B66		
M49470X02825(1)B(2)	8.2	4	0.800 (20.32)	K, M	N, L, M, J, K	L2X(2)401825(1)B80		
M49470X02106(1)B(2)	10	3	0.390 (9.91)	K, M	N, L, M, J, K	L2X(2)301106(1)B39		
M49470X02126(1)B(2)	12	3	0.390 (9.91)	K, M	N, L, M, J, K	L2X(2)301126(1)B39		
M49470X02156(1)B(2)	15	3	0.530 (13.46)	K, M	N, L, M, J, K	L2X(2)301156(1)B53		
M49470X02186(1)B(2)	18	3	0.530 (13.46)	K, M	N, L, M, J, K	L2X(2)301186(1)B53		
M49470X02226(1)B(2)	22	3	0.660 (16.76)	K, M	N, L, M, J, K	L2X(2)301226(1)B66		
M49470X02276(1)B(2)	27	3	0.800 (20.32)	K, M	N, L, M, J, K	L2X(2)301276(1)B80		
		200	VDC – BR Diele	ctric				
M49470R02474(1)C(2)	0.47	5	0.390 (9.91)	K, M	N, L, M, J, K	L2R(2)502474(1)B39		
M49470R02564(1)C(2)	0.56	5	0.390 (9.91)	K, M	N, L, M, J, K	L2R(2)502564(1)B39		
M49470R02684(1)C(2)	0.68	5	0.530 (13.46)	K, M	N, L, M, J, K	L2R(2)502684(1)B53		
M49470R02824(1)C(2)	0.82	5	0.530 (13.46)	K, M	N, L, M, J, K	L2R(2)502824(1)B53		
M49470R02105(1)C(2)	1 1	5	0.660 (16.76)	K, M	N, L, M, J, K	L2R(2)502105(1)B66		
M49470R02125(1)C(2)	1.2	5	0.660 (16.76)	K, M	N, L, M, J, K	L2R(2)502125(1)B66		
M49470R02155(1)C(2)	1.5	5 4	0.800 (20.32)	K, M	N, L, M, J, K	L2R(2)502155(1)B80		
M49470R02185(1)C(2) M49470R02225(1)C(2)	1.8 2.2	4	0.530 (13.46) 0.530 (13.46)	K, M K, M	N, L, M, J, K N, L, M, J, K	L2R(2)402185(1)B53 L2R(2)402225(1)B53		
MIL-PRF-49470 P/N ¹	Capacitance (µF)	Case Code	Height A inch (mm)	Capacitance Tolerance	Lead Configuration	KEMET P/N 1		

¹ Complete P/N requires additional characters in the numbered positions provided in order to indicate capacitance tolerance and lead configuration. For each numbered position, available options are as follows:

⁽¹⁾ Capacitance tolerance character " K" or " M".

⁽²⁾ Lead style character " N", "L", "M", "J" or "K".



Table 1B - MIL-PRF-49470 /2, Product Selection 200 - 500 VDC cont'd

	MIL-PRF-49470/2 Encapsulated, Horizontally Stacked						
MIL-PRF-49470 P/N ¹	Capacitance (µF)	Case Code	Height A inch (mm)	Capacitance Tolerance	Lead Configuration	KEMET P/N ¹	
M49470R02275(1)C(2)	2.7	4	0.660 (16.76)	K, M	N, L, M, J, K	L2R(2)402275(1)B66	
M49470R02335(1)C(2)	3.3	4	0.660 (16.76)	K, M	N, L, M, J, K	L2R(2)402335(1)B66	
M49470R02395(1)C(2)	3.9	4	0.800 (20.32)	K, M	N, L, M, J, K	L2R(2)402395(1)B80	
M49470R02475(1)C(2)	4.7	3	0.390 (9.91)	K, M	N, L, M, J, K	L2R(2)302475(1)B39	
M49470R02565(1)C(2)	5.6	3	0.390 (9.91)	K, M	N, L, M, J, K	L2R(2)302565(1)B39	
M49470R02685(1)C(2)	6.8	3	0.530 (13.46)	K, M	N, L, M, J, K	L2R(2)302685(1)B53	
M49470R02825(1)C(2)	8.2	3	0.530 (13.46)	K, M	N, L, M, J, K	L2R(2)302825(1)B53	
M49470R02106(1)C(2)	10	3	0.660 (16.76)	K, M	N, L, M, J, K	L2R(2)302106(1)B66	
M49470R02126(1)C(2)	12	3	0.800 (20.32)	K, M	N, L, M, J, K	L2R(2)302126(1)B80	
	500 VDC – BQ Dielectric						
M49470Q02154(1)E(2)	0.15	5	0.270 (6.86)	K, M	N, L, M, J, K	L2Q(2)50C154(1)B27	
M49470Q02184(1)E(2)	0.18	5	0.390 (9.91)	K, M	N, L, M, J, K	L2Q(2)50C184(1)B39	
M49470Q02224(1)E(2)	0.22	5	0.390 (9.91)	K, M	N, L, M, J, K	L2Q(2)50C224(1)B39	
M49470Q02274(1)E(2)	0.27	5	0.390 (9.91)	K, M	N, L, M, J, K	L2Q(2)50C274(1)B39	
M49470Q02334(1)E(2)	0.33	5	0.530 (13.46)	K, M	N, L, M, J, K	L2Q(2)50C334(1)B53	
M49470Q02394(1)E(2)	0.39	5	0.530 (13.46)	K, M	N, L, M, J, K	L2Q(2)50C394(1)B53	
M49470Q02474(1)E(2)	0.47	5	0.530 (13.46)	K, M	N, L, M, J, K	L2Q(2)50C474(1)B53	
M49470Q02564(1)E(2)	0.56	5	0.660 (16.76)	K, M	N, L, M, J, K	L2Q(2)50C564(1)B66	
M49470Q02684(1)E(2)	0.68	5	0.800 (20.32)	K, M	N, L, M, J, K	L2Q(2)50C684(1)B80	
M49470Q02824(1)E(2)	0.82	4	0.530 (13.46)	K, M	N, L, M, J, K	L2Q(2)40C824(1)B53	
M49470Q02105(1)E(2)	1	4	0.530 (13.46)	K, M	N, L, M, J, K	L2Q(2)40C105(1)B53	
M49470Q02125(1)E(2)	1.2	4	0.530 (13.46)	K, M	N, L, M, J, K	L2Q(2)40C125(1)B53	
M49470Q02155(1)E(2)	1.5	4	0.660 (16.76)	K, M	N, L, M, J, K	L2Q(2)40C155(1)B66	
M49470Q02185(1)E(2)	1.8	4	0.800 (20.32)	K, M	N, L, M, J, K	L2Q(2)40C185(1)B80	
M49470Q02225(1)E(2)	2.2	3	0.390 (9.91)	K, M	N, L, M, J, K	L2Q(2)30C225(1)B39	
M49470Q02275(1)E(2)	2.7	3	0.530 (13.46)	K, M	N, L, M, J, K	L2Q(2)30C275(1)B53	
M49470Q02335(1)E(2)	3.3	3	0.530 (13.46)	K, M	N, L, M, J, K	L2Q(2)30C335(1)B53	
M49470Q02395(1)E(2)	3.9	3	0.530 (13.46)	K, M	N, L, M, J, K	L2Q(2)30C395(1)B53	
M49470Q02475(1)E(2)	4.7	3	0.660 (16.76)	K, M	N, L, M, J, K	L2Q(2)30C475(1)B66	
M49470Q02565(1)E(2)	5.6	3	0.800 (20.32)	K, M	N, L, M, J, K	L2Q(2)30C565(1)B80	
M49470Q02565(1)E(2)	5.6	3	0.800 (20.32)	K, M	N, L, M, J, K	L2Q(2)30C565(1)B65	
MIL-PRF-49470 P/N ¹	Capacitance (µF)	Case Code	Height A inch (mm)	Capacitance Tolerance	Lead Configuration	KEMET P/N 1	

¹ Complete P/N requires additional characters in the numbered positions provided in order to indicate capacitance tolerance and lead configuration. For each numbered position, available options are as follows:

⁽¹⁾ Capacitance tolerance character " K" or " M".

⁽²⁾ Lead style character " N", "L", "M", "J" or "K".



Table 1C - Product Selection 25 VDC

	Capacitance		Height A inch	Capacitance	Lead
KEMET P/N ¹	(μF)	Case Code	(mm)	Tolerance	Configuration
		25 VDC – BX Dielec	etric		
L1X(1)503824(2)(3)12	0.82	5	0.120 (3.05)	K, M	N, L, M, J, K
L1X(1)503105(2)(3)12	1	5	0.120 (3.05)	K, M	N, L, M, J, K
L1X(1)503125(2)(3)12	1.2	5	0.120 (3.05)	K, M	N, L, M, J, K
L1X(1)503155(2)(3)12	1.5	5	0.120 (3.05)	K, M	N, L, M, J, K
L1X(1)503185(2)(3)24	1.8	5	0.240 (6.10)	K, M	N, L, M, J, K
L1X(1)403225(2)(3)12	2.2	4	0.120 (3.05)	K, M	N, L, M, J, K
L1X(1)503225(2)(3)24	2.2	5	0.240 (6.10)	K, M	N, L, M, J, K
L1X(1)503255(2)(3)24	2.5	5	0.240 (6.10)	K, M	N, L, M, J, K
L1X(1)403275(2)(3)12	2.7	4	0.120 (3.05)	K, M	N, L, M, J, K
L1X(1)503275(2)(3)24	2.7	5	0.240 (6.10)	K, M	N, L, M, J, K
L1X(1)403335(2)(3)12	3.3	4	0.120 (3.05)	K, M	N, L, M, J, K
L1X(1)503335(2)(3)36	3.3	5	0.360 (9.14)	K, M	N, L, M, J, K
L1X(1)403395(2)(3)12	3.9	4	0.120 (3.05)	K, M	N, L, M, J, K
L1X(1)503395(2)(3)36	3.9	5	0.360 (9.14)	K, M	N, L, M, J, K
L1X(1)403475(2)(3)12	4.7	4	0.120 (3.05)	K, M	N, L, M, J, K
L1X(1)503475(2)(3)36	4.7	5	0.360 (9.14)	K, M	N, L, M, J, K
L1X(1)403565(2)(3)24	5.6	4	0.240 (6.10)	K, M	N, L, M, J, K
L1X(1)503565(2)(3)48	5.6	5	0.480 (12.19)	K, M	N, L, M, J, K
L1X(1)403605(2)(3)24	6	4	0.240 (6.10)	K, M	N, L, M, J, K
L1X(1)503605(2)(3)48	6	5	0.480 (12.19)	K, M	N, L, M, J, K
L1X(1)303685(2)(3)12	6.8	3 4	0.120 (3.05)	K, M	N, L, M, J, K
L1X(1)403685(2)(3)24	6.8		0.240 (6.10)	K, M	N, L, M, J, K
L1X(1)503685(2)(3)65	6.8 7.5	5 4	0.650 (16.51) 0.240 (6.10)	K, M K, M	N, L, M, J, K N, L, M, J, K
L1X(1)403755(2)(3)24	7.5	5	0.650 (16.51)	K, M	N, L, M, J, K N, L, M, J, K
L1X(1)503755(2)(3)65 L1X(1)303825(2)(3)12	8.2	3	0.120 (3.05)	K, M	N, L, M, J, K N, L, M, J, K
L1X(1)403825(2)(3)12 L1X(1)403825(2)(3)24	8.2	4	0.120 (3.03)	K, M	N, L, M, J, K N, L, M, J, K
L1X(1)303106(2)(3)12	10	3	0.120 (3.05)	K, M	N, L, M, J, K
L1X(1)403106(2)(3)24	10	4	0.240 (6.10)	K, M	N, L, M, J, K
L1X(1)303116(2)(3)12	11	3	0.120 (3.05)	K, M	N, L, M, J, K
L1X(1)303126(2)(3)12	12	3	0.120 (3.05)	K, M	N, L, M, J, K
L1X(1)403126(2)(3)36	12	4	0.360 (9.14)	K, M	N, L, M, J, K
L1X(1)303156(2)(3)12	15	3	0.120 (3.05)	K, M	N, L, M, J, K
L1X(1)403156(2)(3)36	15	4	0.360 (9.14)	K, M	N, L, M, J, K
L1X(1)303166(2)(3)24	16	3	0.240 (6.10)	K, M	N, L, M, J, K
L1X(1)403166(2)(3)48	16	4	0.480 (12.19)	K, M	N, L, M, J, K
L1X(1)303186(2)(3)24	18	3	0.240 (6.10)	K, M	N, L, M, J, K
L1X(1)403186(2)(3)48	18	4	0.480 (12.19)	K, M	N, L, M, J, K
L1X(1)303206(2)(3)24	20	3	0.240 (6.10)	K, M	N, L, M, J, K
L1X(1)403206(2)(3)48	20	4	0.480 (12.19)	K, M	N, L, M, J, K
L1X(1)303226(2)(3)24	22	3	0.240 (6.10)	K, M	N, L, M, J, K
L1X(1)403226(2)(3)65	22	4	0.650 (16.51)	K, M	N, L, M, J, K
L1X(1)403246(2)(3)65	24	4	0.650 (16.51)	K, M	N, L, M, J, K
L1X(1)303276(2)(3)24	27	3	0.240 (6.10)	K, M	N, L, M, J, K
L1X(1)303306(2)(3)24	30	3	0.240 (6.10)	K, M	N, L, M, J, K
L1X(1)303306(2)(3)36	30	3	0.360 (9.14)	K, M	N, L, M, J, K
L1X(1)303336(2)(3)36	33	3	0.360 (9.14)	K, M	N, L, M, J, K
L1X(1)303396(2)(3)36	39	3	0.360 (9.14)	K, M	N, L, M, J, K
L1X(1)303456(2)(3)36	45	3	0.360 (9.14)	K, M	N, L, M, J, K
L1X(1)303506(2)(3)48	50	3	0.480 (12.19)	K, M	N, L, M, J, K
L1X(1)303546(2)(3)48	54	3	0.480 (12.19)	K, M	N, L, M, J, K
L1X(1)303606(2)(3)48	60	3	0.480 (12.19)	K, M	N, L, M, J, K
			Height A		

¹ Complete part number requires additional characters in the numbered positions provided in order to indicate testing option, capacitance tolerance and lead configuration. For each numbered position, available options are as follows:

⁽¹⁾ Lead style character " N", "L", "M", "J" or "K".

⁽²⁾ Capacitance tolerance character " K" or " M".

⁽³⁾ Testing option character "S" for Commercial, or "X" for non-standard (customer specific).



Table 1C - Commercial/Non-Standard - Product Selection 25 - 50 VDC cont'd

Commercial/Non-S	tandard – Cust	omer Specific	Unencapsulate	d, Horizontally	Stacked
KEMET P/N ¹	Capacitance (µF)	Case Code	Height A inch (mm)	Capacitance Tolerance	Lead Configuration
L1X(1)303666(2)(3)65	66	3	0.650 (16.51)	K, M	N, L, M, J, K
L1X(1)303726(2)(3)65	72	3	0.650 (16.51)	K, M	N, L, M, J, K
L1X(1)303756(2)(3)65	75	3	0.650 (16.51)	K, M	N, L, M, J, K
		50 VDC – BX Diele	etric		
L1X(1)505824(2)(3)12	0.82	5	0.120 (3.05)	K, M	N, L, M, J, K
L1X(1)505105(2)(3)12	1	5	0.120 (3.05)	K, M	N, L, M, J, K
L1X(1)505125(2)(3)12	1.2	5	0.120 (3.05)	K, M	N, L, M, J, K
L1X(1)505155(2)(3)12	1.5	5	0.120 (3.05)	K, M	N, L, M, J, K
L1X(1)505185(2)(3)24	1.8	5	0.240 (6.10)	K, M	N, L, M, J, K
L1X(1)405225(2)(3)12	2.2	4	0.120 (3.05)	K, M	N, L, M, J, K
L1X(1)505225(2)(3)24	2.2 2.5	5 5	0.240 (6.10)	K, M K, M	N, L, M, J, K
L1X(1)505255(2)(3)24	1		0.240 (6.10)		N, L, M, J, K
L1X(1)405275(2)(3)12 L1X(1)505275(2)(3)24	2.7 2.7	4 5	0.120 (3.05) 0.240 (6.10)	K, M K, M	N, L, M, J, K N, L, M, J, K
L1X(1)505275(2)(3)24 L1X(1)505275(2)(3)36	2.7	5	0.240 (6.10)	K, M	N, L, M, J, K N, L, M, J, K
L1X(1)4053273(2)(3)12	3.3	4	0.120 (3.05)	K, M	N, L, M, J, K
L1X(1)505335(2)(3)12 L1X(1)505335(2)(3)36	3.3	5	0.360 (9.14)	K, M	N, L, M, J, K
L1X(1)405395(2)(3)12	3.9	4	0.120 (3.05)	K, M	N, L, M, J, K
L1X(1)505395(2)(3)36	3.9	5	0.360 (9.14)	K, M	N, L, M, J, K
L1X(1)405475(2)(3)12	4.7	4	0.120 (3.05)	K, M	N, L, M, J, K
L1X(1)505475(2)(3)36	4.7	5	0.360 (9.14)	K, M	N, L, M, J, K
L1X(1)405565(2)(3)24	5.6	4	0.240 (6.10)	K, M	N, L, M, J, K
L1X(1)505565(2)(3)48	5.6	5	0.480 (12.19)	K, M	N, L, M, J, K
L1X(1)405605(2)(3)24	6	4	0.240 (6.10)	K, M	N, L, M, J, K
L1X(1)505605(2)(3)48	6	5	0.480 (12.19)	K, M	N, L, M, J, K
L1X(1)305685(2)(3)12	6.8	3	0.120 (3.05)	K, M	N, L, M, J, K
L1X(1)405685(2)(3)24	6.8	4	0.240 (6.10)	K, M	N, L, M, J, K
L1X(1)505685(2)(3)65	6.8	5	0.650 (16.51)	K, M	N, L, M, J, K
L1X(1)405755(2)(3)24	7.5	4	0.240 (6.10)	K, M	N, L, M, J, K
L1X(1)505755(2)(3)65	7.5	5	0.650 (16.51)	K, M	N, L, M, J, K
L1X(1)305825(2)(3)12	8.2	3	0.120 (3.05)	K, M	N, L, M, J, K
L1X(1)405825(2)(3)24	8.2	4	0.240 (6.10)	K, M	N, L, M, J, K
L1X(1)305106(2)(3)12	10	3	0.120 (3.05)	K, M	N, L, M, J, K
L1X(1)405106(2)(3)24	10	4	0.240 (6.10)	K, M	N, L, M, J, K
L1X(1)305116(2)(3)12	11	3	0.120 (3.05)	K, M	N, L, M, J, K
L1X(1)305126(2)(3)12	12 12	3 4	0.120 (3.05)	K, M	N, L, M, J, K
L1X(1)405126(2)(3)36 L1X(1)305156(2)(3)12	15	3	0.360 (9.14) 0.120 (3.05)	K, M K, M	N, L, M, J, K N, L, M, J, K
L1X(1)405156(2)(3)36	15	1 1	0.360 (9.14)	K, M	N, L, M, J, K
L1X(1)305166(2)(3)34	16	3	0.240 (6.10)	K, M	N, L, M, J, K N, L, M, J, K
L1X(1)405166(2)(3)48	16	4	0.480 (12.19)	K, M	N, L, M, J, K
L1X(1)305186(2)(3)44	18	3	0.240 (6.10)	K, M	N, L, M, J, K
L1X(1)405186(2)(3)48	18	4	0.480 (12.19)	K, M	N, L, M, J, K
L1X(1)305206(2)(3)24	20	3	0.240 (6.10)	K, M	N, L, M, J, K
L1X(1)405206(2)(3)48	20	4	0.480 (12.19)	K, M	N, L, M, J, K
L1X(1)305226(2)(3)24	22	3	0.240 (6.10)	K, M	N, L, M, J, K
L1X(1)405226(2)(3)65	22	4	0.650 (16.51)	K, M	N, L, M, J, K
L1X(1)405246(2)(3)65	24	4	0.650 (16.51)	K, M	N, L, M, J, K
L1X(1)305276(2)(3)24	27	3	0.240 (6.10)	K, M	N, L, M, J, K
L1X(1)305306(2)(3)24	30	3	0.240 (6.10)	K, M	N, L, M, J, K
L1X(1)305336(2)(3)36	33	3	0.360 (9.14)	K, M	N, L, M, J, K
L1X(1)305396(2)(3)36	39	3	0.360 (9.14)	K, M	N, L, M, J, K
L1X(1)305456(2)(3)36	45	3	0.360 (9.14)	K, M	N, L, M, J, K
KEMET P/N 1	Capacitance (μF)	Case Code	Height A inch (mm)	Capacitance Tolerance	Lead Configuration

¹ Complete part number requires additional characters in the numbered positions provided in order to indicate testing option, capacitance tolerance and lead configuration. For each numbered position, available options are as follows:

⁽¹⁾ Lead style character " N", "L", "M", "J" or "K".

⁽²⁾ Capacitance tolerance character " K" or " M".

⁽³⁾ Testing option character "S" for Commercial, or "X" for non-standard (customer specific).



Table 1C - Commercial/Non-Standard - Product Selection 50 - 100 VDC cont'd

Commercial/Non-St	andard – Cust	omer Specific	Unencapsulate	d, Horizontally	Stacked
	Capacitance		Height A inch	Capacitance	Lead
KEMET P/N ¹	(μF)	Case Code	(mm)	Tolerance	Configuration
L1X(1)305506(2)(3)48	50	3	0.480 (12.19)	K, M	N, L, M, J, K
L1X(1)305546(2)(3)48	54	3	0.480 (12.19)	K, M	N, L, M, J, K
L1X(1)305606(2)(3)48	60	3	0.480 (12.19)	K, M	N, L, M, J, K
L1X(1)305666(2)(3)65	66	3	0.650 (16.51)	K, M	N, L, M, J, K
L1X(1)305726(2)(3)65	72	3	0.650 (16.51)	K, M	N, L, M, J, K
L1X(1)305756(2)(3)65	75	3	0.650 (16.51)	K, M	N, L, M, J, K
		100 VDC – BR Dielec			
L1R(1)501564(2)(3)12	0.56	5	0.120 (3.05)	K, M	N, L, M, J, K
L1R(1)501684(2)(3)12	0.68	5	0.120 (3.05)	K, M	N, L, M, J, K
L1R(1)501754(2)(3)12	0.75	5	0.120 (3.05)	K, M	N, L, M, J, K
L1R(1)501824(2)(3)12	0.82	5	0.120 (3.05)	K, M	N, L, M, J, K
L1R(1)501105(2)(3)12	1	5	0.120 (3.05)	K, M	N, L, M, J, K
L1R(1)501125(2)(3)12	1.2	5	0.120 (3.05)	K, M	N, L, M, J, K
L1R(1)401155(2)(3)12	1.5	4	0.120 (3.05)	K, M	N, L, M, J, K
L1R(1)501155(2)(3)24	1.5	5	0.240 (6.10)	K, M	N, L, M, J, K
L1R(1)401185(2)(3)12	1.8	4	0.120 (3.05)	K, M	N, L, M, J, K
L1R(1)501185(2)(3)24	1.8	5	0.240 (6.10)	K, M	N, L, M, J, K
L1R(1)401225(2)(3)12	2.2	4	0.120 (3.05)	K, M	N, L, M, J, K
L1R(1)501225(2)(3)24	2.2	5	0.240 (6.10)	K, M	N, L, M, J, K
L1R(1)501255(2)(3)24	2.5	5	0.240 (6.10)	K, M	N, L, M, J, K
L1R(1)401275(2)(3)12	2.7	4	0.120 (3.05)	K, M	N, L, M, J, K
L1R(1)501275(2)(3)36	2.7	5	0.360 (9.14)	K, M	N, L, M, J, K
L1R(1)401335(2)(3)12	3.3	4	0.120 (3.05)	K, M	N, L, M, J, K
L1R(1)501335(2)(3)36	3.3	5	0.360 (9.14)	K, M	N, L, M, J, K
L1R(1)401395(2)(3)12	3.9	4	0.120 (3.05)	K, M	N, L, M, J, K
L1R(1)501395(2)(3)48	3.9	5	0.480 (12.19)	K, M	N, L, M, J, K
L1R(1)401475(2)(3)24	4.7	4	0.240 (6.10)	K, M	N, L, M, J, K
L1R(1)501475(2)(3)48	4.7	5	0.480 (12.19)	K, M	N, L, M, J, K
L1R(1)301565(2)(3)12	5.6	3	0.120 (3.05)	K, M	N, L, M, J, K
L1R(1)401565(2)(3)24	5.6	4	0.240 (6.10)	K, M	N, L, M, J, K
L1R(1)501565(2)(3)65	5.6	5	0.650 (16.51)	K, M	N, L, M, J, K
L1R(1)301605(2)(3)12	6	3	0.120 (3.05)	K, M	N, L, M, J, K
L1R(1)401605(2)(3)24	6	4	0.240 (6.10)	K, M	N, L, M, J, K
L1R(1)501605(2)(3)65	6	5	0.650 (16.51)	K, M	N, L, M, J, K
L1R(1)301605(2)(3)03 L1R(1)301685(2)(3)12	6.8	3	0.120 (3.05)	K, M	N, L, M, J, K
	6.8	3	0.120 (5.05)		
L1R(1)401685(2)(3)24	7.5	4	` '	K, M K, M	N, L, M, J, K
L1R(1)401755(2)(3)24	7.5 8.2	3	0.240 (6.10)		N, L, M, J, K
L1R(1)301825(2)(3)12	8.2 8.2	3 4	0.120 (3.05)	K, M	N, L, M, J, K
L1R(1)401825(2)(3)36	10	3	0.360 (9.14)	K, M	N, L, M, J, K
L1R(1)301106(2)(3)12		٨	0.120 (3.05)	K, M	N, L, M, J, K
L1R(1)401106(2)(3)36	10	3	0.360 (9.14)	K, M	N, L, M, J, K
L1R(1)301116(2)(3)12	11		0.120 (3.05)	K, M	N, L, M, J, K
L1R(1)301126(2)(3)24	12	3	0.240 (6.10)	K, M	N, L, M, J, K
L1R(1)401126(2)(3)48	12	4	0.480 (12.19)	K, M	N, L, M, J, K
L1R(1)301156(2)(3)24	15 15	3	0.240 (6.10)	K, M	N, L, M, J, K
L1R(1)401156(2)(3)48	15	4	0.480 (12.19)	K, M	N, L, M, J, K
L1R(1)301166(2)(3)24	16	3	0.240 (6.10)	K, M	N, L, M, J, K
L1R(1)401166(2)(3)65	16	4	0.650 (16.51)	K, M	N, L, M, J, K
L1R(1)301186(2)(3)24	18	3	0.240 (6.10)	K, M	N, L, M, J, K
L1R(1)401186(2)(3)65	18	4	0.650 (16.51)	K, M	N, L, M, J, K
L1R(1)301206(2)(3)24	20	3	0.240 (6.10)	K, M	N, L, M, J, K
L1R(1)301226(2)(3)36	22	3	0.360 (9.14)	K, M	N, L, M, J, K
L1R(1)301276(2)(3)36	27	3	0.360 (9.14)	K, M	N, L, M, J, K
KEMET P/N ¹	Capacitance (µF)	Case Code	Height A inch (mm)	Capacitance Tolerance	Lead Configuration

¹ Complete part number requires additional characters in the numbered positions provided in order to indicate testing option, capacitance tolerance and lead configuration. For each numbered position, available options are as follows:

⁽¹⁾ Lead style character " N", "L", "M", "J" or "K".

⁽²⁾ Capacitance tolerance character " K" or " M".

⁽³⁾ Testing option character "S" for Commercial, or "X" for non-standard (customer specific).



Table 1C - Commercial/Non-Standard - Product Selection 100 - 200 VDC cont'd

Commercial/Non-S	tandard – Cust	omer Specific	Unencapsulate	d, Horizontally	Stacked
	Capacitance		Height A inch	Capacitance	Lead
KEMET P/N ¹	(μF)	Case Code	(mm)	Tolerance	Configuration
L1R(1)301306(2)(3)36	30	3	0.360 (9.14)	K, M	N, L, M, J, K
L1R(1)301336(2)(3)48	33	3	0.480 (12.19)	K, M	N, L, M, J, K
L1R(1)301396(2)(3)48	39	3	0.480 (12.19)	K, M	N, L, M, J, K
L1R(1)301456(2)(3)65	45	3	0.650 (16.51)	K, M	N, L, M, J, K
L1R(1)301506(2)(3)65	50	3	0.650 (16.51)	K, M	N, L, M, J, K
		200 VDC – BQ Diele	ctric		
L1Q(1)502334(2)(3)12	0.33	5	0.120 (3.05)	K, M	N, L, M, J, K
L1Q(1)502394(2)(3)12	0.39	5	0.120 (3.05)	K, M	N, L, M, J, K
L1Q(1)502474(2)(3)12	0.47	5	0.120 (3.05)	K, M	N, L, M, J, K
L1Q(1)502564(2)(3)12	0.56	5	0.120 (3.05)	K, M	N, L, M, J, K
L1Q(1)502684(2)(3)12	0.68	5	0.120 (3.05)	K, M	N, L, M, J, K
		5	· · ·	K, M	
L1Q(1)502754(2)(3)12	0.75		0.120 (3.05)		N, L, M, J, K
L1Q(1)402824(2)(3)12	0.82	4	0.120 (3.05)	K, M	N, L, M, J, K
L1Q(1)502824(2)(3)24	0.82	5	0.240 (6.10)	K, M	N, L, M, J, K
L1Q(1)402105(2)(3)12	1	4	0.120 (3.05)	K, M	N, L, M, J, K
L1Q(1)502105(2)(3)24	1	5	0.240 (6.10)	K, M	N, L, M, J, K
L1Q(1)402125(2)(3)12	1.2	4	0.120 (3.05)	K, M	N, L, M, J, K
L1Q(1)502125(2)(3)24	1.2	5	0.240 (6.10)	K, M	N, L, M, J, K
L1Q(1)402155(2)(3)12	1.5	4	0.120 (3.05)	K, M	N, L, M, J, K
L1Q(1)502155(2)(3)36	1.5	5	0.360 (9.14)	K, M	N, L, M, J, K
L1Q(1)402185(2)(3)12	1.8	4	0.120 (3.05)	K, M	N, L, M, J, K
L1Q(1)502185(2)(3)36	1.8	5	0.360 (9.14)	K, M	N, L, M, J, K
L1Q(1)402225(2)(3)24	2.2	4	0.240 (6.10)	K, M	N, L, M, J, K
	2.2	5	1 ' '	K, M	
L1Q(1)502225(2)(3)48			0.480 (12.19)		N, L, M, J, K
L1Q(1)302245(2)(3)12	2.4	3	0.120 (3.05)	K, M	N, L, M, J, K
L1Q(1)502255(2)(3)48	2.5	5	0.480 (12.19)	K, M	N, L, M, J, K
L1Q(1)302275(2)(3)12	2.7	3	0.120 (3.05)	K, M	N, L, M, J, K
L1Q(1)402275(2)(3)24	2.7	4	0.240 (6.10)	K, M	N, L, M, J, K
L1Q(1)502275(2)(3)48	2.7	5	0.480 (12.19)	K, M	N, L, M, J, K
L1Q(1)302335(2)(3)12	3.3	3	0.120 (3.05)	K, M	N, L, M, J, K
L1Q(1)402335(2)(3)24	3.3	4	0.240 (6.10)	K, M	N, L, M, J, K
L1Q(1)502335(2)(3)65	3.3	5	0.650 (16.51)	K, M	N, L, M, J, K
L1Q(1)302365(2)(3)12	3.6	3	0.120 (3.05)	K, M	N, L, M, J, K
L1Q(1)302395(2)(3)12	3.9	3	0.120 (3.05)	K, M	N, L, M, J, K
L1Q(1)402395(2)(3)24	3.9	4	0.240 (6.10)	K, M	N, L, M, J, K
L1Q(1)302475(2)(3)12	4.7	3	0.120 (3.05)	K, M	N, L, M, J, K
L1Q(1)402475(2)(3)36	4.7	4	0.360 (9.14)	K, M	N, L, M, J, K
L1Q(1)302565(2)(3)12	5.6	3	0.120 (3.05)	K, M	N, L, M, J, K N, L, M, J, K
	5.6	3	1 ' '		
L1Q(1)402565(2)(3)36		4	0.360 (9.14)	K, M	N, L, M, J, K
L1Q(1)302605(2)(3)12	6	3	0.120 (3.05)	K, M	N, L, M, J, K
L1Q(1)402605(2)(3)36	6	4	0.360 (9.14)	K, M	N, L, M, J, K
L1Q(1)302685(2)(3)24	6.8	3	0.240 (6.10)	K, M	N, L, M, J, K
L1Q(1)402685(2)(3)48	6.8	4	0.480 (12.19)	K, M	N, L, M, J, K
L1Q(1)402755(2)(3)48	7.5	4	0.480 (12.19)	K, M	N, L, M, J, K
L1Q(1)302825(2)(3)24	8.2	3	0.240 (6.10)	K, M	N, L, M, J, K
L1Q(1)402825(2)(3)65	8.2	4	0.650 (16.51)	K, M	N, L, M, J, K
L1Q(1)302106(2)(3)24	10	3	0.240 (6.10)	K, M	N, L, M, J, K
L1Q(1)402106(2)(3)65	10	4	0.650 (16.51)	K, M	N, L, M, J, K
L1Q(1)302116(2)(3)24	11	3	0.240 (6.10)	K, M	N, L, M, J, K
L1Q(1)302176(2)(3)24 L1Q(1)302126(2)(3)36	12	3	0.360 (9.14)	K, M	N, L, M, J, K
			1 ' '		
L1Q(1)302156(2)(3)36	15	3	0.360 (9.14)	K, M	N, L, M, J, K
L1Q(1)302166(2)(3)36	16	3	0.360 (9.14)	K, M	N, L, M, J, K
L1Q(1)302186(2)(3)48	18	3	0.480 (12.19)	K, M	N, L, M, J, K
KEMET P/N 1	Capacitance (µF)	Case Code	Height A inch (mm)	Capacitance Tolerance	Lead Configuration

¹ Complete part number requires additional characters in the numbered positions provided in order to indicate testing option, capacitance tolerance and lead configuration. For each numbered position, available options are as follows:

⁽¹⁾ Lead style character " N", "L", "M", "J" or "K".

⁽²⁾ Capacitance tolerance character " K" or " M".

⁽³⁾ Testing option character "S" for Commercial, or "X" for non-standard (customer specific).



Table 1C - Commercial/Non-Standard - Product Selection 200 - 630 VDC cont'd

Commercial/Non-St	tandard – Cust	omer Specific	Unencapsulate	d, Horizontally	Stacked
	Capacitance		Height A inch	Capacitance	Lead
KEMET P/N ¹	(μF)	Case Code	(mm)	Tolerance	Configuration
L1Q(1)302206(2)(3)48	20	3	0.480 (12.19)	K, M	N, L, M, J, K
L1Q(1)302226(2)(3)48	22	3	0.480 (12.19)	K, M	N, L, M, J, K
L1Q(1)302276(2)(3)65	27	3	0.650 (16.51)	K, M	N, L, M, J, K
		500 VDC - X7R Diele	ctric		
L1W(1)50C124(2)(3)12	0.12	5	0.120 (3.05)	K, M	N, L, M, J, K
L1W(1)50C154(2)(3)12	0.15	5	0.120 (3.05)	K, M	N, L, M, J, K
L1W(1)50C184(2)(3)12	0.18	5	0.120 (3.05)	K, M	N, L, M, J, K
L1W(1)50C224(2)(3)12	0.22	5	0.120 (3.05)	K, M	N, L, M, J, K
L1W(1)50C274(2)(3)12	0.27	5	0.120 (3.05)	K, M	N, L, M, J, K
L1W(1)50C334(2)(3)24	0.33	5	0.240 (6.10)	K, M	N, L, M, J, K
L1W(1)40C394(2)(3)12	0.39	4	0.120 (3.05)	K, M	N, L, M, J, K
L1W(1)50C394(2)(3)24	0.39	5	0.240 (6.10)	K, M	N, L, M, J, K
L1W(1)40C474(2)(3)12	0.47	4	0.120 (3.05)	K, M	N, L, M, J, K
L1W(1)50C474(2)(3)24	0.47	5	0.240 (6.10)	K, M	N, L, M, J, K
L1W(1)50C564(2)(3)24	0.56	5	0.240 (6.10)	K, M	N, L, M, J, K
L1W(1)40C684(2)(3)12	0.68	4	0.120 (3.05)	K, M	N, L, M, J, K
L1W(1)50C684(2)(3)36	0.68	5 5	0.360 (9.14)	K, M	N, L, M, J, K
L1W(1)50C754(2)(3)36	0.75	5	0.360 (9.14)	K, M	N, L, M, J, K
L1W(1)40C824(2)(3)12	0.82	4	0.120 (3.05)	K, M	N, L, M, J, K
L1W(1)50C824(2)(3)36	0.82	5	0.360 (9.14)	K, M	N, L, M, J, K
L1W(1)30C105(2)(3)12	1	3 4	0.120 (3.05)	K, M	N, L, M, J, K
L1W(1)40C105(2)(3)24	1	4 5	0.240 (6.10)	K, M	N, L, M, J, K
L1W(1)50C105(2)(3)48	1 1.2		0.480 (12.19)	K, M	N, L, M, J, K
L1W(1)30C125(2)(3)12	1.2	3	0.120 (3.05) 0.240 (6.10)	K, M	N, L, M, J, K
L1W(1)40C125(2)(3)24	1.2	5	· '	K, M	N, L, M, J, K
L1W(1)50C125(2)(3)65	1.5	3	0.650 (16.51)	K, M K, M	N, L, M, J, K
L1W(1)30C155(2)(3)12 L1W(1)40C155(2)(3)24	1.5	4	0.120 (3.05) 0.240 (6.10)	K, M	N, L, M, J, K N, L, M, J, K
L1W(1)40C155(2)(3)24 L1W(1)50C155(2)(3)65	1.5	5	0.650 (16.51)	K, M	N, L, M, J, K
L1W(1)40C185(2)(3)36	1.8	J J	0.360 (9.14)	K, M	N, L, M, J, K
L1W(1)30C225(2)(3)12	2.2	3	0.120 (3.05)	K, M	N, L, M, J, K
L1W(1)40C225(2)(3)36	2.2	4	0.360 (9.14)	K, M	N, L, M, J, K
L1W(1)30C245(2)(3)12	2.4	3	0.120 (3.05)	K, M	N, L, M, J, K
L1W(1)30C275(2)(3)12	2.7	3	0.120 (3.05)	K, M	N, L, M, J, K
L1W(1)40C275(2)(3)48	2.7	4	0.480 (12.19)	K, M	N, L, M, J, K
L1W(1)30C335(2)(3)24	3.3	3	0.240 (6.10)	K, M	N, L, M, J, K
L1W(1)40C335(2)(3)48	3.3	4	0.480 (12.19)	K, M	N, L, M, J, K
L1W(1)30C365(2)(3)24	3.6	3	0.240 (6.10)	K, M	N, L, M, J, K
L1W(1)30C395(2)(3)24	3.9	3	0.240 (6.10)	K, M	N, L, M, J, K
L1W(1)40C395(2)(3)65	3.9	4	0.650 (16.51)	K, M	N, L, M, J, K
L1W(1)30C475(2)(3)24	4.7	3	0.240 (6.10)	K, M	N, L, M, J, K
L1W(1)30C565(2)(3)24	5.6	3	0.240 (6.10)	K, M	N, L, M, J, K
L1W(1)30C605(2)(3)24	6	3	0.240 (6.10)	K, M	N, L, M, J, K
L1W(1)30C685(2)(3)36	6.8	3	0.360 (9.14)	K, M	N, L, M, J, K
L1W(1)30C825(2)(3)36	8.2	3	0.360 (9.14)	K, M	N, L, M, J, K
L1W(1)30C106(2)(3)48	10	3	0.480 (12.19)	K, M	N, L, M, J, K
L1W(1)30C116(2)(3)65	11	3	0.650 (16.51)	K, M	N, L, M, J, K
L1W(1)30C126(2)(3)65	12	3	0.650 (16.51)	K, M	N, L, M, J, K
		630 VDC – X7R Diele			
L1W(1)50B683(2)(3)12	0.068	5	0.120 (3.05)	K, M	N, L, M, J, K
L1W(1)40B104(2)(3)12	0.1	4	0.120 (3.05)	K, M	N, L, M, J, K
L1W(1)50B104(2)(3)12	0.1	5	0.120 (3.05)	K, M	N, L, M, J, K
			Height A	i	
KEMET P/N ¹	Capacitance (µF)	Case Code	inch (mm)	Capacitance Tolerance	Lead Configuration

¹ Complete part number requires additional characters in the numbered positions provided in order to indicate testing option, capacitance tolerance and lead configuration. For each numbered position, available options are as follows:

⁽¹⁾ Lead style character " N", "L", "M", "J" or "K".

⁽²⁾ Capacitance tolerance character " K" or " M".

⁽³⁾ Testing option character "S" for Commercial, or "X" for non-standard (customer specific).



Table 1C - Commercial/Non-Standard - Product Selection 630 - 1,000 VDC cont'd

Commercial/Non-St	andard – Cust	omer Specific I	Jnencapsulate State	d, Horizontally	Stacked
	Capacitance		Height A inch	Capacitance	Lead
KEMET P/N ¹	(µF)	Case Code	(mm)	Tolerance	Configuration
L1W(1)50B124(2)(3)12	0.12	5	0.120 (3.05)	K, M	N, L, M, J, K
L1W(1)50B154(2)(3)12	0.15	5	0.120 (3.05)	K, M	N, L, M, J, K
L1W(1)50B184(2)(3)24	0.18	5	0.240 (6.10)	K, M	N, L, M, J, K
L1W(1)30B224(2)(3)12	0.22	3	0.120 (3.05)	K, M	N, L, M, J, K
L1W(1)40B224(2)(3)12	0.22	4	0.120 (3.05)	K, M	N, L, M, J, K
L1W(1)50B224(2)(3)24	0.22	5	0.240 (6.10)	K, M	N, L, M, J, K
L1W(1)50B274(2)(3)24	0.27	5	0.240 (6.10)	K, M	N, L, M, J, K
L1W(1)30B334(2)(3)12	0.33	3	0.120 (3.05)	K, M	N, L, M, J, K
L1W(1)50B334(2)(3)36	0.33	5	0.360 (9.14)	K, M	N, L, M, J, K
L1W(1)40B394(2)(3)12	0.39	4	0.120 (3.05)	K, M	N, L, M, J, K
	0.39	5	0.360 (9.14)	K, M	
L1W(1)50B394(2)(3)36			, ,		N, L, M, J, K
L1W(1)30B474(2)(3)12	0.47	3	0.120 (3.05)	K, M	N, L, M, J, K
L1W(1)40B474(2)(3)24	0.47	4	0.240 (6.10)	K, M	N, L, M, J, K
L1W(1)50B474(2)(3)36	0.47	5	0.360 (9.14)	K, M	N, L, M, J, K
L1W(1)50B564(2)(3)48	0.56	5	0.480 (12.19)	K, M	N, L, M, J, K
L1W(1)30B684(2)(3)12	0.68	3	0.120 (3.05)	K, M	N, L, M, J, K
L1W(1)40B684(2)(3)24	0.68	4	0.240 (6.10)	K, M	N, L, M, J, K
L1W(1)50B684(2)(3)65	0.68	5	0.650 (16.51)	K, M	N, L, M, J, K
L1W(1)50B754(2)(3)65	0.75	5	0.650 (16.51)	K, M	N, L, M, J, K
L1W(1)40B824(2)(3)24	0.82	4	0.240 (6.10)	K, M	N, L, M, J, K
L1W(1)30B105(2)(3)12	1	3	0.120 (3.05)	K, M	N, L, M, J, K
L1W(1)40B105(2)(3)36	1	4	0.360 (9.14)	K, M	N, L, M, J, K
L1W(1)30B125(2)(3)12	1.2	3	0.120 (3.05)	K, M	N, L, M, J, K
L1W(1)40B125(2)(3)36	1.2	4	0.360 (9.14)	K, M	N, L, M, J, K
L1W(1)30B155(2)(3)30	1.5	3	0.120 (3.05)	K, M	N, L, M, J, K
		3	· ·		
L1W(1)40B155(2)(3)48	1.5	4	0.480 (12.19)	K, M	N, L, M, J, K
L1W(1)40B185(2)(3)48	1.8	4	0.480 (12.19)	K, M	N, L, M, J, K
L1W(1)30B225(2)(3)24	2.2	3	0.240 (6.10)	K, M	N, L, M, J, K
L1W(1)40B225(2)(3)65	2.2	4	0.650 (16.51)	K, M	N, L, M, J, K
L1W(1)30B245(2)(3)24	2.4	3	0.240 (6.10)	K, M	N, L, M, J, K
L1W(1)30B275(2)(3)24	2.7	3	0.240 (6.10)	K, M	N, L, M, J, K
L1W(1)30B335(2)(3)36	3.3	3	0.360 (9.14)	K, M	N, L, M, J, K
L1W(1)30B365(2)(3)36	3.6	3	0.360 (9.14)	K, M	N, L, M, J, K
L1W(1)30B395(2)(3)36	3.9	3	0.360 (9.14)	K, M	N, L, M, J, K
L1W(1)30B475(2)(3)36	4.7	3	0.360 (9.14)	K, M	N, L, M, J, K
L1W(1)30B565(2)(3)48	5.6	3	0.480 (12.19)	K, M	N, L, M, J, K
L1W(1)30B605(2)(3)65	6	3	0.650 (16.51)	K, M	N, L, M, J, K
L1W(1)30B685(2)(3)65	6.8	3	0.650 (16.51)	K, M	N, L, M, J, K
	0.0	1,000 VDC – X7R Diele		,	., _,, ,,
L1W(1)50D473(2)(3)12	0.047	5	0.120 (3.05)	K, M	N, L, M, J, K
L1W(1)50D683(2)(3)12	0.068	5	0.120 (3.05)	K, M	N, L, M, J, K
L1W(1)30D104(2)(3)12	0.1	3	0.120 (3.05)	K, M	N, L, M, J, K
L1W(1)40D104(2)(3)12	0.1	1	0.120 (3.05)	K, M	N, L, M, J, K
		4	0.120 (3.05)		
L1W(1)50D104(2)(3)24	0.1	5		K, M	N, L, M, J, K
L1W(1)50D124(2)(3)24	0.12	5	0.240 (6.10)	K, M	N, L, M, J, K
L1W(1)50D154(2)(3)36	0.15	5	0.360 (9.14)	K, M	N, L, M, J, K
L1W(1)50D184(2)(3)36	0.18	5	0.360 (9.14)	K, M	N, L, M, J, K
L1W(1)30D224(2)(3)12	0.22	3	0.120 (3.05)	K, M	N, L, M, J, K
L1W(1)40D224(2)(3)12	0.22	4	0.120 (3.05)	K, M	N, L, M, J, K
L1W(1)50D224(2)(3)36	0.22	5	0.360 (9.14)	K, M	N, L, M, J, K
L1W(1)50D274(2)(3)48	0.27	5	0.480 (12.19)	K, M	N, L, M, J, K
L1W(1)30D334(2)(3)12	0.33	3	0.120 (3.05)	K, M	N, L, M, J, K
L1W(1)50D334(2)(3)65	0.33	5	0.650 (16.51)	K, M	N, L, M, J, K
KEMET P/N 1	Capacitance (µF)	Case Code	Height A	Capacitance Tolerance	Lead Configuration
REWEI P/N	Gapacitalice (µr)	Case Code	inch (mm)	Capacitance rolerance	Leau Comiguration

¹ Complete part number requires additional characters in the numbered positions provided in order to indicate testing option, capacitance tolerance and lead configuration. For each numbered position, available options are as follows:

⁽¹⁾ Lead style character " N", "L", "M", "J" or "K".

⁽²⁾ Capacitance tolerance character " K" or " M".

⁽³⁾ Testing option character "S" for Commercial, or "X" for non-standard (customer specific).



Table 1C - Commercial/Non-Standard - Product Selection 1,000 VDC cont'd

Commercial/Non-S	Commercial/Non-Standard – Customer Specific Unencapsulated, Horizontally Stacked						
KEMET P/N ¹	Capacitance (µF)	Case Code	Height A inch (mm)	Capacitance Tolerance	Lead Configuration		
L1W(1)40D394(2)(3)24	0.39	4	0.240 (6.10)	K, M	N, L, M, J, K		
L1W(1)50D394(2)(3)65	0.39	5	0.650 (16.51)	K, M	N, L, M, J, K		
L1W(1)30D474(2)(3)12	0.47	3	0.120 (3.05)	K, M	N, L, M, J, K		
L1W(1)40D474(2)(3)24	0.47	4	0.240 (6.10)	K, M	N, L, M, J, K		
L1W(1)30D684(2)(3)12	0.68	3	0.120 (3.05)	K, M	N, L, M, J, K		
L1W(1)40D684(2)(3)36	0.68	4	0.360 (9.14)	K, M	N, L, M, J, K		
L1W(1)40D824(2)(3)48	0.82	4	0.480 (12.19)	K, M	N, L, M, J, K		
L1W(1)30D105(2)(3)24	1	3	0.240 (6.10)	K, M	N, L, M, J, K		
L1W(1)40D105(2)(3)65	1	4	0.650 (16.51)	K, M	N, L, M, J, K		
L1W(1)30D125(2)(3)24	1.2	3	0.240 (6.10)	K, M	N, L, M, J, K		
L1W(1)30D155(2)(3)36	1.5	3	0.360 (9.14)	K, M	N, L, M, J, K		
L1W(1)30D225(2)(3)36	2.2	3	0.360 (9.14)	K, M	N, L, M, J, K		
L1W(1)30D245(2)(3)48	2.4	3	0.480 (12.19)	K, M	N, L, M, J, K		
L1W(1)30D275(2)(3)48	2.7	3	0.480 (12.19)	K, M	N, L, M, J, K		
L1W(1)30D335(2)(3)65	3.3	3	0.650 (16.51)	K, M	N, L, M, J, K		
KEMET P/N ¹	Capacitance (μF)	Case Code	Height A inch (mm)	Capacitance Tolerance	Lead Configuration		

¹ Complete part number requires additional characters in the numbered positions provided in order to indicate testing option, capacitance tolerance and lead configuration. For each numbered position, available options are as follows:

⁽¹⁾ Lead style character " N", "L", "M", "J" or "K".

⁽²⁾ Capacitance tolerance character " K" or " M".

⁽³⁾ Testing option character "S" for Commercial, or "X" for non-standard (customer specific).



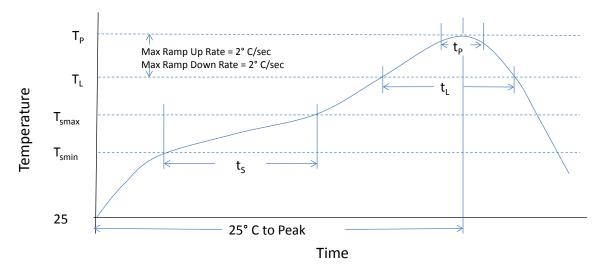
Soldering Process

The capacitors and assemblies outlined in this specification sheet are susceptible to thermal shock damage due to their large ceramic mass. Temperature profiles used should provide adequate temperature rise and cool-down time to prevent damage from thermal shock. In general, KEMET recommends against hand soldering for these types of large ceramic devices.

Recommended Soldering Technique:

Solder reflow only

Recommended Reflow Soldering Profile:



Profile Feature	Sn-Pb Assembly		
Preheat/Soak			
Temperature Minimum (T _{Smin})	100°C		
Temperature Maximum (T _{Smax})	150°C		
Time (t_s) from T_{smin} to T_{smax})	60-90 seconds		
Ramp-up rate $(T_L \text{ to } T_P)$	2°C/seconds		
Liquidous temperature (T _L)	183°C		
Time above liquidous (t _L)	95 seconds		
Peak Temperature (T _P)	240°C		
Time within 5°C of maximum peak temperature (t _P)	5 seconds		
Ramp-down rate (T _P to T _L)	2°C/seconds		
Time 25° C to peak temperature	3.5 minutes		

Note 1: All temperatures refer to the center of the package, measured on the package body surface that is facing up during assembly reflow

Preheating and Reflow Profile Notes:

Due to differences in the coefficient of thermal expansion for the different materials of construction, it is critical to monitor and control the heating and cooling rates during the soldering process. During the reflow soldering process, the maximum recommended heating and cooling rate (dT/dt) is 4°C/second. To ensure optimal component reliability, KEMET's recommended heating and cooling rate is 2°C/second. After soldering, the capacitors should be air cooled to room temperature

before further processing. Forced air cooling is not recommended.



Table 4 – Performance & Reliability: Test Methods and Conditions

		Test Level Option							
Inspection	Inspection Test Method		MIL-PRF-49470 T Level (T)	DSSC Drawing 87106 (C) ¹	Commercial (S)	Non-Standard (X) ²			
In-Process Inspection									
Ultrasonic Scanning (C-SAM)	Meet EIA-469 Criteria		Yes (per lot)	Not required	Not required	Optional per Source Controlled Drawing (SCD)			
DPA Analysis	EIA-469	Not required							
In-Process Visual Inspection	MIL-PRF-49470 Method 4.8.3								
Group A Requirements									
Thermal Shock	MIL-STD-202 Method 107	Yes (5 cycles)	Yes (20 cycles)	Yes (5 cycles)		Ontional non			
Voltage Conditioning ≤ 200 V 500 V	MIL-PRF-49470 Method 4.8.5.2 200%V _R at125°C 120%V _R at125°C	-PRF-49470 thod 4.8.5.2 Yes (96 hours Yes (168 hours %V _R at125°C minimum) minimum)		Yes (96 hours minimum)	Not	Optional per Source Controlled Drawing (SCD)			
Visual and Mechanical Inspection	MIL-PRF-49470 Method 4.8.4	Yes (per lot)		Yes (per lot)	required	Yes (per lot)			
Solderability	MIL-STD-202 Method 208	Yes (per Inspection lot)	Yes (per lot)	Yes (per inspection lot)		Optional per Source Controlled			
DPA Analysis	EIA-469	Not required		Not required		Drawing (SCD)			
		Group B Req	uirements						
Voltage-Temperature Limits (TCVC)	MIL-PRF-49470 Method 4.8.13.2		Yes (periodic) Yes (per lot)	Yes (periodic)					
Resistance to Solvents	MIL-STD-202 Method 215								
Terminal Strength	MIL-STD-202 Method 211	Ves (periodic)							
Resistance to Soldering Heat	MIL-STD-202 Method 210	Yes (periodic)							
Moisture Resistance	MIL-STD-202 Method 106			Not required	Optional per Source Controlled				
Marking Legibility	MIL-PRF-49470 Method 4.8.4.1				required	Drawing (SCD)			
Low Voltage Humidity Testing	MIL-STD-202 Method 103	Not required		Not required Yes (periodic)					
Life Test ≤ 200 V 500 V	MIL-STD-202 Method 108 200%V _R at125°C 120%V _R at125°C	Yes (periodic)							
Thermal Shock	MIL-STD-202 Method 107	Not required		Not required					
		KEMET Req	uirements						
Visual and Mechanical Inspection (100%)	KEMET Standard	Yes	Yes	Yes	Yes	Yes			
Voltage Conditioning									

¹ As per discretionary statement outlined in cancelled DSCC Drawing 87106, KEMET will not perform Group B inspections on a per lot basis. KEMET 87106 orders may include a standard certificate of compliance stating compliance to the 87106 requirements, specifically conformance to Group B inspections. Please contact KEMET for additional details

² Non-standard test level option is designated to satisfy customer specific testing requirements that may deviate from those stated in a Mil-Spec or DSCC drawing.



Product Marking

Capacitors shall be marked with KEMET's name, trademark or (CAGE) code, date, capacitance and capacitance tolerance codes. The date code shall consist of the year and week. For example, the third week of 2011 would be 1103 using a 4-digit date code or 103 using a 3-digit date code. At the option of the manufacturer, the date code may be placed on a separate line. Full marking shall be included on the package.

JT	
12345	
106K	
1103	

Case code 4 or 5 example

MIL-PRF-49470

Capacitor marking will include "JAN" or "J."

Case codes 4 and 5 shall be marked with the following sequence of information:

J brand (1 digit), product level designator ("B" or "T")

Manufacturer's identification (1 to 5 digits)

Capacitance code (3 digits) and capacitance tolerance (1 digit)

Date code (3 or 4 digits)

Case code 3 shall either be fully marked or partially marked like case code 4 or 5 parts at the option of KEMET.

DSCC 87106

Marking shall be in accordance with MIL-STD-1285, except the parts shall be marked with the part number as specified in paragraph 1.2 of DSCC Drawing 87106 with the manufacturer's name or code and date code minimum. Case sizes 4 and 5 shall be marked with coded capacitance and tolerance minimum. Full marking shall be included on the package.

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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.

Packaging

Shipping Container Packaging Quantities						
Case Code Small Box Quantity¹ (7.5" x 7.5") Large Box Quantity¹ (13.0" x 13						
3	28	104				
4	36	144				
5	64	225				

¹ Minimum order value applies. Contact KEMET for details.



Application Notes

Notice of KEMET MIL-PRF-49470 Qualified Products Listing (QPL) Status.

KEMET is qualified to supply MIL–PRF–49470/1 unencapsulated X7R Case Codes 3, 4, & 5 ceramic SMPS capacitors in DC voltage ratings of 50 V, 100 V, 200 V, and 500 V. This qualification includes both "B" and "T" test levels.

KEMET is also qualified to supply MIL–PRF–49470/2 encapsulated X7R Case Codes 3, 4, & 5 ceramic SMPS capacitors in DC voltage ratings of 50 V, 100 V, 200 V, and 500 V. This qualification includes "B" level testing only.

Notice of Cancellation: DSCC Drawing 87106 was cancelled on January 3rd 2005. MIL-PRF-49470 parts are preferred and direct replacements.

MIL-PRF-49470 capacitors are preferred over DSCC 87106 capacitors. The MIL-PRF-49470 specification was developed as part of a cooperative effort between the U.S. Military, NASA and the switch mode power supply capacitor manufacturers to produce a robust direct replacement for the DSCC drawing. The military specification product provides additional quality assurance provisions that are NOT required by the DSCC drawing. Two product levels are offered in MIL-PRF-49470: the standard "B" level and the high reliability "T" level. Some of the benefits of the MIL-PRF-49470 product over the 87106 product include the following: Formal qualification process (QPL established), MIL-STD-790 compliance, DSCC audits, routine qualification maintenance testing, i.e., life testing, group A percent defective allowed (PDA) specified, and prohibiting the mixing of chips from different production lots within a single SMPS capacitor stack lot.

MIL—PRF—49470 "T" Level product is recommended for all high reliability applications. MIL—PRF—49470 "T" level product requires the following in-process inspections and additional group A and B screening inspections that are not part of the normal "B" level flow: In-process screening that includes non-destructive internal examination (chip level) and destructive physical analysis (chip level), group A destructive physical analysis (finished stack level), group B lot specific humidity, steady-state, low voltage (lot sample test), and group B lot specific thermal shock and life test (lot sample test).

For additional information regarding KEMET MIL-PRF-49470 QPL status or cancellation of DSCC Drawing 87106, please visit the DSCC website at: www.dscc.dla.mil.

High Temperature 150°C, Ultra-Stable X8R Dielectric, 25 – 100 VDC (Commercial & Automotive Grade)

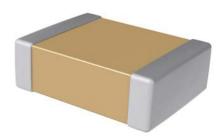


Overview

KEMET's Ultra-Stable X8R dielectric features a 150°C maximum operating temperature, offering the latest in high temperature dielectric technology and reliability for extreme temperature applications. It offers the same temperature capability as conventional X8R, but without the capacitance loss due to applied DC voltage. Ultra-Stable X8R exhibits no change in capacitance with respect to voltage and boasts a minimal change in capacitance with reference to ambient temperature. It is a suitable replacement for higher capacitance and larger footprint devices that fail to offer capacitance stability. Capacitance change with respect to temperature is limited to ±15% from -55°C to +150°C.

Driven by the demand for a more robust and reliable component, Ultra-Stable X8R dielectric capacitors were developed for critical applications where reliability and capacitance stability at higher operating temperatures are a concern. These capacitors are widely used in automotive circuits as well as general high temperature applications.

In addition to commercial grade, automotive grade devices are available and meet the demanding Automotive Electronics Council's AEC–Q200 qualification requirements.



Ordering Information

С	1210	С	184	K	3	Н	Α	С	AUTO
Ceramic	Case Size (L" x W")	Specification/ Series ¹	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/Grade (C-Spec)
	0402 0603 0805 1206 1210 1812	C = Standard	Two significant digits + number of zeros		3 = 25 5 = 50 1 = 100	H = Ultra Stable X8R	A = N/A	C = 100% Matte Sn L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

¹ Flexible termination option is available. Please see FT-CAP product bulletin C1013_X8R_FT-CAP_SMD

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

² SnPb termination finish option is not available on automotive grade product.



Packaging C-Spec Ordering Options Table

Packaging Type	Packaging/Grade Ordering Code (C-Spec)		
Commerc	ial Grade ¹		
Bulk Bag	Not Required (Blank)		
7" Reel/Unmarked	TU		
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)		
7" Reel/Unmarked/2 mm pitch ²	7081		
13" Reel/Unmarked/2 mm pitch ²	7082		
Automotiv	ve Grade ³		
7" Reel	AUTO		
13" Reel/Unmarked	AUTO7411 (EIA 0603 and smaller case sizes) AUTO7210 (EIA 0805 and larger case sizes)		
7" Reel/Unmarked/2 mm pitch ²	3190		
13" Reel/Unmarked/2 mm pitch ²	3191		

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- −55°C to +150°C operating temperature range
- Lead (Pb)-Free, RoHS and REACH compliant
- EIA 0402, 0603, 0805, 1206, 1210, and 1812 case sizes
- DC voltage ratings of 25 V, 50 V, and 100 V
- Capacitance offerings ranging from 100 pF to 0.22 μF
- Available capacitance tolerances of ±1%, ±2%, ±5%, ±10%, and ±20%
- · Extremely low ESR and ESL
- High thermal stability

- · High ripple current capability
- No capacitance change with respect to applied rated DC voltage
- · Non-polar device, minimizing installation concerns
- Offered in both commercial and automotive grades
- 100% pure matte tin-plated termination finish that allowing for excellent solderability.
- SnPb plated termination finish option available upon request (5% Pb minimum)

Applications

Typical applications include decoupling, bypass and filtering in extreme environments such as down-hole oil exploration, under-hood automotive, military and aerospace.

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked.

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".

³ Reeling tape options (Paper or Plastic) are dependent on capacitor case size (L" x W") and thickness dimension. See "Chip Thickness/Tape & Reel Packaging Quantities" and "Tape & Reel Packaging Information".

³ For additional Information regarding "AUTO" C-Spec options, see "Automotive C-Spec Information".

³ All Automotive packaging C-Specs listed exclude the option to laser mark components. Please contact KEMET if you require a laser marked option. For more information see "Capacitor Marking".



Automotive C-Spec Information

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

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

Product Change Notification (PCN)

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

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

KEMET Automotive	Customer Noti	Days prior to	
C-Spec	Process/Product change	Obsolescence*	implementation
KEMET assigned ¹	Yes (with approval and sign off)	Yes	180 days Minimum
AUTO	Yes (without approval)	Yes	90 days Minimum

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

Production Part Approval Process (PPAP)

The purpose of the Production Part Approval Process is:

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

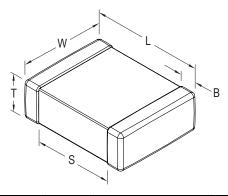
KEMET Automotive	PPAP (Product Part Approval Process) Level					
C-Spec	1	2	3	4	5	
KEMET assigned ¹	•	•	•	•	•	
AUTO	0		0			

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

- Part Number specific PPAP available
- Product family PPAP only



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)	See Table 2 for	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)	Thickness	0.50 (0.02) ±0.25 (0.010)		
1210	3225	3.20 (0.126) ±0.20 (0.008)	2.50 (0.098) ±0.20 (0.008)		0.50 (0.02) ±0.25 (0.010)	N/A	Caldas Daffaux Only
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)		Solder Reflow Only

Qualification/Certification

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

Automotive Grade products meet or exceed the requirements outlined by the Automotive Electronics Council. Details regarding test methods and conditions are referenced in document AEC–Q200, Stress Test Qualification for Passive Components. For additional information regarding the Automotive Electronics Council and AEC–Q200, please visit their website at www.aecouncil.com.

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 +150°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	0%
Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit @ 25°C	2.5%
Insulation Resistance (IR) Limit @ 25°C	1,000 megohm microfarads or 100 G Ω (Rated voltage applied for 120 ±5 seconds @ 25°C)

To obtain IR limit, divide $M\Omega$ - μ 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 MHz ± 100 kHz and 1.0 ± 0.2 Vrms if capacitance $\leq 1,000$ pF.

1 kHz ± 50 Hz and 1.0 ± 0.2 Vrms if capacitance > 1,000 pF

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."

Post Environmental Limits

High Temperature Life, Biased Humidity, Moisture Resistance											
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance						
Ultra-Stable X8R	All	All	3.0	0.3% or ±0.25 pf	10% of Initial Limit						



Table 1 – Capacitance Range/Selection Waterfall (0402 – 1812 Case Sizes)

100 pF 110 pF 110 pF 120 pF 130 pF 150 pF	Cap Code			age C	Code	Case Size/ Series						С					1206			1210			12C
110 pF 120 pF 130 pF	101		V hate				3	5	1	3	5	1	3	5	1	3	5	1	3	5	1	5	1
110 pF 120 pF 130 pF			atcu v	oltag/	je (VD	(C)	25	20	100	25	50	100	25	20	100	25	20	100	25	20	100	50	100
110 pF 120 pF 130 pF		Cap	oacita	nce T	Tolera	nce									and C p Thic								
120 pF 130 pF		F	G	J	K	M M	BB BB	BB BB	BB BB														
130 pF	111 121	F F	G G	J	K	M	BB	BB	BB														
150 pF	131	F	G	J	K	М	BB	BB	BB														
	151	F	G	J	K	М	BB	BB	BB														
160 pF 180 pF	161 181	F	G G	J	K	M M	BB BB	BB BB	BB BB														
200 pF	201	F	G	J	K	M	BB	BB	BB														
220 pF	221	F	G	J	K	М	BB	BB	BB	İ													
240 pF	241	F	G	J	K	М	BB	BB	BB														
270 pF	271 301	F F	G G	J	K	M M	BB BB	BB BB	BB BB														
300 pF 330 pF	331	F	G	J	K	M	BB	BB	BB														
360 pF	361	F	G	J	K	М	BB	BB	BB														
390 pF	391	F	G	J	K	М	BB	BB	BB														
430 pF	431	F	G	J	K	M M	BB BB	BB BB	BB BB	CF CF	CF CF	CF CF											
470 pF 510 pF	471 511	F	G G	J	K	M	BB	BB	BB	CF	CF	CF											
560 pF	561	F	G	J	K	М	ВВ	BB	BB	CF	CF	CF				İ							
620 pF	621	F	G	J	K	М	BB	BB	BB	CF	CF	CF											
680 pF	681 751	F	G G	J	K	M M	BB BB	BB BB	BB BB	CF CF	CF CF	CF CF											
750 pF 820 pF	821	F	G	J	K	M	BB	BB	BB	CF	CF	CF											
910 pF	911	F	G	J	K	М	BB	BB	BB	CF	CF	CF											
1,000 pF	102	F	G	J	K	М	BB	BB	BB	CF	CF	CF											
1,100 pF 1,200 pF	112 122	F F	G G	J	K	M M	BB BB	BB BB		CF CF	CF CF	CF CF											
1,200 pF 1,300 pF	132	F	G	J	K	M	BB	BB		CF	CF	CF											
1,500 pF	152	F	G	J	K	М	BB	BB		CF	CF	CF											
1,600 pF	162	F	G	J	K	М				CF	CF	CF											
1,800 pF 2,000 pF	182 202	F F	G G	J	K K	M M				CF CF	CF CF	CF CF	DN	DN	DN								
2,000 pF 2,200 pF	202	F	G	J	K	M				CF	CF	CF	DN	DN	DN								
2,400 pF	242	F	G	J	K	М				CF	CF	CF	DN	DN	DN								
2,700 pF	272	F	G	J	K	М				CF	CF	CF	DN	DN	DN								
3,000 pF 3,300 pF	302 332	F	G	J	K	M M				CF CF	CF CF	CF CF	DN DN	DN DN	DN DN								
3,600 pF	362	F	G	J	K	M				CF	CF	CF	DN	DN	DN								
3,900 pF	392	F	G	J	K	М				CF	CF	CF	DN	DN	DN	İ							
4,300 pF	432	F	G	J	K	М				CF	CF	CF	DN	DN	DN								
4,700 pF 5,100 pF	472 512	F F	G	J	K	M M				CF CF	CF CF	CF	DN DN	DN DN	DN DN								
5,600 pF	562	F	G	J	K	M				CF	CF		DN	DN	DN								
6,200 pF	622	F	G	J	K	М				CF	CF		DN	DN	DN								
6,800 pF	682	F	G	J	K	M M				CF CF	CF		DN	DN	DN DN	EB EB	EB	EB					
7,500 pF 8,200 pF	752 822	F	G	J	K	M				CF			DN DN	DN DN	DN	EB	EB EB	EB EB					
9,100 pF	912	F	G	J	K	М				CF			DN	DN	DN	EB	EB	EB	İ				
10,000 pF	103	F	G	J	K	М				CF			DN	DN	DP	EB	EB	EB					
12,000 pF 15,000 pF	123 153	F	G	J	K	M M							DN DN	DN DP	DE DG	EB EB	EB EB	EB EB	FB FB	FB FB	FB FB	GB	GB
18,000 pF	183	F	G	J	K	M							DN	DP	DG	EB	EB	EB	FB	FB	FB	GB	GB
22,000 pF	223	F	G	J	K	М							DP	DF		EB	EB	EC	FB	FB	FB	GB	GB
27,000 pF	273	F	G	J	K	M							DF			EB	EB	EE	FB	FB	FB	GB	GB
33,000 pF	333	F	G V	Jolean	K IO (V/D	W	25	20	100	25	20	9	DG 22	20	9	25 EB	EB 05	100 EE	FB 52	FB 05	FB 001	GB 05	GB 001
Capacitance	Сар	Ka	ted V	oitag age C))	3	5	1	3	5	1	3	5	1	3	5	1	3	5	1	5	1
	Capacitance		se S			ies		0402		-	0603		 	0805		-	1206		<u> </u>				12C



Table 1 - Capacitance Range/Selection Waterfall (0402 - 1812 Case Sizes) cont'd

				se S Serie		/	C	0402	C.	С	0603	С	C	0805	С	C	1206	С	C	1210	С	C18	12C
Capacitance	Cap		Volt	tage (Code		3	5	1	3	5	1	3	5	1	3	5	1	3	5	1	5	1
	Code	Ra	Rated Voltage (VDC)		25	20	100	25	20	19	25	20	10	25	20	19	25	20	19	20	100		
		Сар	acita	ance '	Tolera	ance									and C p Thic								
47,000 pF	473	F	G	J	K	М										EC	EE	EH	FB	FB	FE	GB	GB
56,000 pF	563	F	G	J	K	M										ED	EF	EH	FB	FB	FF	GB	GB
68,000 pF	683	F	G	J	K	M										EF	EH		FB	FC	FG	GB	GB
82,000 pF	823	F	G	J	K	M										EH	EH		FC	FF	FH	GB	GB
100,000 pF	104	F	G	J	K	M										EH			FE	FG	FM	GB	GD
120,000 pF	124	F	G	J	K	M													FG	FH		GB	GH
150,000 pF	154	F	G	J	K	M													FH	FM		GD	GN
180,000 pF	184	F	G	J	K	M													FJ			GH	
220,000 pF	224	F	G	J	K	M																GK	
	_	Ra	Rated Voltage (VDC)		25	20	100	25	20	9	25	20	9	25	20	9	25	20	9	50	100		
Capacitance	Cap Code		Volt	tage (Code		3	5	1	3	5	1	3	5	1	3	5	1	3	5	1	5	1
	5546	Ca			Case Size/Series		C	0402	С	С	0603	С	C	0805	С	(1206	С	(1210	С	C18	12C

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

Thickness	Case	Thickness ±	Paper Q	uantity ¹	Plastic (Quantity
Code	Size ¹	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
DN	0805	0.78 ± 0.10	4,000	15,000	0	0
DP	0805	0.90 ± 0.10	4,000	15,000	0	0
DE	0805	1.00 ± 0.10	0	0	2,500	10,000
DF	0805	1.10 ± 0.10	0	0	2,500	10,000
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
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
ED	1206	1.00 ± 0.10	0	0	2,500	10,000
EE	1206	1.10 ± 0.10	0	0	2,500	10,000
EF	1206	1.20 ± 0.15	0	0	2,500	10,000
EH	1206	1.60 ± 0.20	0	0	2,000	8,000
FB	1210	0.78 ± 0.10	0	0	4,000	10,000
FC	1210	0.90 ± 0.10	0	0	4,000	10,000
FE	1210	1.00 ± 0.10	0	0	2,500	10,000
FF	1210	1.10 ± 0.10	0	0	2,500	10,000
FG	1210	1.25 ± 0.15	0	0	2,500	10,000
FH	1210	1.55 ± 0.15	0	0	2,000	8,000
FM	1210	1.70 ± 0.20	0	0	2,000	8,000
FJ	1210	1.85 ± 0.20	0	0	2,000	8,000
GB	1812	1.00 ± 0.10	0	0	1,000	4,000
GD	1812	1.25 ± 0.15	0	0	1,000	4,000
GH	1812	1.40 ± 0.15	0	0	1,000	4,000
GK	1812	1.60 ± 0.20	0	0	1,000	4,000
GN	1812	1.70 ± 0.20	0	0	1,000	4,000
Thickness	Case	Thickness ±	7" Reel	13" Reel	7" Reel	13" Reel
Code	Size ¹	Range (mm)	Paper Q	luantity¹	Plastic (Quantity

 ${\it Package quantity based on finished chip thickness specifications.}$

¹ If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Table 2B - Bulk Packaging Quantities

Doolee	ulu u Tuu o	Loose Pa	ackaging				
Раска	ging Type	Bulk Bag (default)					
Packagi	ng C-Spec ¹	N/A²					
Cas	e Size	Packaging Quantities ((pieces/unit packaging)				
EIA (in)	Metric (mm)	Minimum	Maximum				
0402	1005						
0603	1608		50,000				
0805	2012						
1206	3216						
1210	3225	1					
1808	4520						
1812	4532						
1825	4564		20,000				
2220	5650						
2225	5664						

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

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



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

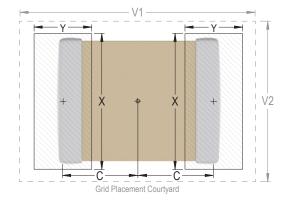
EIA Size Code	Metric Size Code	Land Protrusion (mm) Land Protrusion (mm)							Density Level C: Minimum (Least) Land Protrusion (mm)							
Oode	Oode	С	Y	Х	V1	V2	С	C Y X V1 V2					Y	X	V1	V2
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	0.40	0.52	0.52	1.60	0.80
0603	1608	0.90	1.15	1.10	4.00	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
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

¹ 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

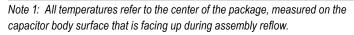
Recommended Soldering Technique:

- 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
Frome reature	SnPb	100% Matte Sn
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum



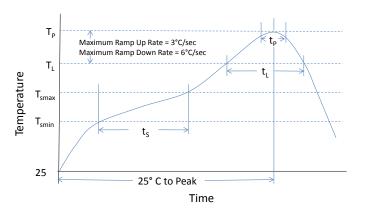




Table 4 – Performance & Reliability: Test Methods and Conditions

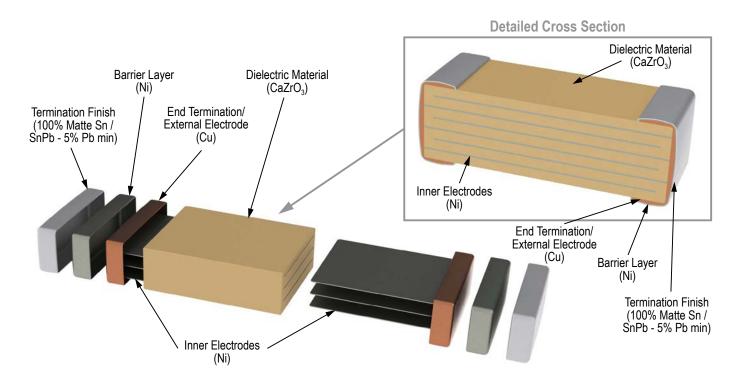
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Solderability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	J-31D-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +150°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MII –STD–202 Method 103	Load Humidity: 1,000 hours 85°C/85%RH and rated voltage. Add 100K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Blasea Flamilarty	WILL OTD ZOZ WICKHOU 100	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours. +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	−55°C/+150. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 150°C with 2 X rated voltage applied.
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 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



Capacitor Marking (Optional):

Laser marking option is not available on:

- C0G, Ultra Stable X8R and Y5V dielectric devices
- EIA 0402 case size devices
- EIA 0603 case size devices with Flexible Termination option.
- KPS Commercial and Automotive grade stacked devices.

These capacitors are supplied unmarked only.

High Temperature 150°C, X8L Dielectric, 10 – 50 VDC (Commercial & Automotive Grade)



Overview

KEMET's X8L dielectric features a 150°C maximum operating temperature and is considered "general purpose high temperature." These components are fixed, ceramic dielectric capacitors suited for high temperature bypass and decoupling applications or frequency discriminating circuits where Q and stability of capacitance characteristics are not critical. X8L exhibits a predictable change in capacitance with respect to time and voltage and boasts a minimal change in capacitance with reference to ambient temperature up to 125°C. Beyond 125°C X8L displays a wider variation in capacitance. Capacitance change is limited to ±15% from -55°C to +125°C and +15, -40% from 125°C to 150°C.

Driven by the demand for a more robust and reliable component, X8L dielectric capacitors were developed for critical applications where reliability at higher operating temperatures are a concern. These capacitors are widely used in automotive circuits as well as general high temperature applications. Concerned with flex cracks resulting from excessive tensile and shear stresses produced during board flexure and thermal cycling? These devices are available with KEMET's Flexible termination technology which inhibits the transfer of board

stress to the rigid ceramic body, therefore mitigating flex cracks which can result in low IR or short circuit failures. Although flexible termination technology does not eliminate the potential for mechanical damage that may propagate during extreme environmental and handling conditions, it does provide superior flex performance over standard termination systems.

In addition to commercial grade, automotive grade devices are available and meet the demanding Automotive Electronics Council's AEC–Q200 qualification requirements.



Ordering Information

С	1210	X	106	K	8	N	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series ¹	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/Grade (C-Spec)
	0402 0603 0805 1206 1210	C = Standard X = Flexible Termination	Two significant digits + number of zeros	J = ±5% K = ±10% M = ±20%	8 = 10 4 = 16 3 = 25 5 = 50	N = X8L	A = N/A	C = 100% Matte Sn L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

¹ The flexible termination option is not available on EIA 0402 case size product. "C" must be used in the 6th character position when ordering this case size.

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

² SnPb termination finish option is not available on Automotive Grade product.



Packaging C-Spec Ordering Options Table

Packaging Type	Packaging/Grade Ordering Code (C-Spec)					
Commerc	ial Grade ¹					
Bulk Bag	Not Required (Blank)					
7" Reel/Unmarked	TU					
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)					
7" Reel/Marked	TM					
13" Reel/Marked	7040 (EIA 0603 and smaller case sizes) 7215 (EIA 0805 and larger case sizes)					
7" Reel/Unmarked/2 mm pitch ²	7081					
13" Reel/Unmarked/2 mm pitch ²	7082					
Automoti	ve Grade ³					
7" Reel	AUTO					
13" Reel/Unmarked	AUTO7411 (EIA 0603 and smaller case sizes) AUTO7210 (EIA 0805 and larger case sizes)					
7" Reel/Unmarked/2 mm pitch ²	3190					
13" Reel/Unmarked/2 mm pitch ²	3191					

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- -55°C to +150°C operating temperature range
- · Lead (Pb)-Free, RoHS and REACH compliant
- EIA 0402, 0603, 0805, 1206, and 1210 case sizes
- DC voltage ratings of 10 V, 16 V, 25 V, and 50 V
- Capacitance offerings ranging from 0.012 μF to 10 μF
- Available capacitance tolerances of ±5%, ±10%, and ±20%
- Commercial & Automotive (AEC–Q200) grades available

- 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% Pb minimum)
- · Flexible termination option available upon request

Applications

Typical applications include use in extreme environments such as down-hole oil exploration, under-hood automotive, military and aerospace.

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked.

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".

³ Reeling tape options (Paper or Plastic) are dependent on capacitor case size (L" x W") and thickness dimension. See "Chip Thickness/Tape & Reel Packaging Quantities" and "Tape & Reel Packaging Information".

³ For additional Information regarding "AUTO" C-Spec options, see "Automotive C-Spec Information".

³ All Automotive packaging C-Specs listed exclude the option to laser mark components. Please contact KEMET if you require a laser marked option. For more information see "Capacitor Marking".



Automotive C-Spec Information

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

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

Product Change Notification (PCN)

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

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

KEMET Automotive	Customer Noti	fication due to:	Days prior to
C-Spec	Process/Product change	Obsolescence*	implementation
KEMET assigned ¹	Yes (with approval and sign off)	Yes	180 days Minimum
AUTO	Yes (without approval)	Yes	90 days Minimum

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

Production Part Approval Process (PPAP)

The purpose of the Production Part Approval Process is:

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

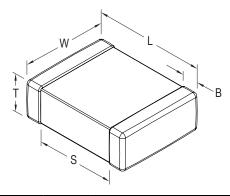
KEMET Automotive	PPAP (Product Part Approval Process) Level											
C-Spec	1	2	3	4	5							
KEMET assigned ¹	•	•	•	•	•							
AUTO	0		0									

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

- Part Number specific PPAP available
- Product family PPAP only



Dimensions – Standard Termination – 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)	See Table 2 for Thickness	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)	N/A	
1210	3225	3.20 (0.126) ±0.20 (0.008)	2.50 (0.098) ±0.20 (0.008)		0.50 (0.02) ±0.25 (0.010)	IN/A	Solder Reflow Only

Dimensions – Flexible Termination – Millimeters (Inches)

EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0603	1608	1.60 (0.063) ±0.17 (0.007)	0.80 (0.032) ±0.15 (0.006)		0.45 (0.018) ±0.15 (0.006)	0.58 (0.023)	Solder Wave
0805	2012	2.00 (0.079) ±0.30 (0.012)	1.25 (0.049) ±0.30 (0.012)	See Table 2	0.50 (0.020) ±0.25 (0.010)	0.75 (0.030)	or
1206	3216	3.30 (0.130) ±0.40 (0.016)	1.60 (0.063) ±0.35 (0.013)	for Thickness	0.60 (0.024) ±0.25 (0.010)	NI/A	Solder Reflow
1210	3225	3.30 (0.130) ±0.40 (0.016)	2.60 (0.102) ±0.30(0.012)		0.60 (0.024) ±0.25 (0.010)	N/A	Solder Reflow Only

Qualification/Certification

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

Automotive Grade products meet or exceed the requirements outlined by the Automotive Electronics Council. Details regarding test methods and conditions are referenced in document AEC–Q200, Stress Test Qualification for Passive Components. For additional information regarding the Automotive Electronics Council and AEC–Q200, please visit their website at www.aecouncil.com.



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 +150°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15% (-55°C to 125°C), +15, -40% (125°C to 150°C)
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
² Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)
³ Dissipation Factor (DF) Maximum Limit @ 25°C	3.5% ($\leq 16V$) and 2.5% ($\geq 25V$)
⁴ Insulation Resistance (IR) Minimum Limit @ 25°C	500 megohm microfarads or 10 G Ω (Rated voltage applied for 120 ±5 seconds @ 25°C)

Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

 $1kHz \pm 50Hz$ and 1.0 ± 0.2 Vrms if capacitance ≤ $10\mu F$

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

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

Post Environmental Limits

High Temperature Life, Biased Humidity, Moisture Resistance											
Dielectric Rated DC Capacitance Dissipation Factor Capacitance Insulation Resistance											
VOI	≥ 25	All	3.0	±20%	100/ of Initial Limit						
X8L	≤ 16	All	5.0	±2U%	10% of Initial Limit						

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

⁴To obtain IR limit, divide MΩ- μ F value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



Insulation Resistance Limit Table (X8L Dielectric)

EIA Case Size	1,000 Megohm Microfarads or 100 GΩ	500 Megohm Microfarads or 10 GΩ
0201	N/A	ALL
0402	< .012 µF	≥ .012 µF
0603	< .047 µF	≥ .047 µF
0805	< 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



Table 1 – Capacitance Range/Selection Waterfall (0402 – 1210 Case Sizes)

			se Si Series			C04	02C			C	0603	BC			C	080	5C			C	1206	SC			C	1210	C	
Сар	Cap Code	Vol	Itage Co	ode	9	8	4	3	9	8	4	3	5	9	8	4	3	5	9	8	4	3	5	9	8	4	3	5
	Code	Rated	Voltage	(VDC)	6.3	10	16	25	6.3	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50
		Capacit	ance To	olerance		Pro	duc	t Av	ailab	ility	and	Chip	Thi	ickn	ess (Code	es So	ee Ta	ble :	2 for	Chi	p Th	ickn	ess l	Dime	ensid	ons	
12,000 pF	123	J	K	М	ВВ	BB	BB	BB																				
15,000 pF	153	J	K	M	BB	BB	BB	BB																				
18,000 pF	183	J	K	M	BB	BB	BB	BB																				
22,000 pF	223	J	K	M	BB	BB	BB	BB																				
27,000 pF	273	J	K	M	BB	BB																						
33,000 pF	333	J	K	M	BB	BB													l									
39,000 pF	393	J	K	M	BB	BB													l									
47,000 pF	473	J	K	M	BB	BB			CF	CF	CF	CF	CF						l									
56,000 pF	563	J	K	M																								
68,000 pF	683	J	K	M																								
82,000 pF	823	J	K	M																								
0.10 µF	104	J	K	M					CF	CF	CF	CF																
0.12 µF	124	J	K	M					CF	CF	CF	CF																
0.15 µF	154	J	K	M					CF	CF	CF	CF		DG	DG	DG	DG	DG										
0.18 µF	184	J	K	M					CF	CF				DG	DG	DG	DG	DG										
0.22 µF	224	J	K	M					CF	CF				DP	DP	DP	DP	DG	l									
0.27 µF	274	J	K	M										DP	DP	DP	DP		l									
0.33 µF	334	J	K	M										DP	DP	DP	DP		l									
0.39 µF	394	J	K	M										DE	DE	DE	DE							FD	FD	FD	FD	FD
0.47 µF	474	J	K	M										DE	DE	DE	DE		EG	EG	EG	EG	EG	FD	FD	FD	FD	FD
0.56 µF	564	J	K	M										DG	DG	DH	DH							FF	FF	FF	FF	FF
0.68 µF	684	J	K	M										DG	DG	DH	DH							FG	FG	FG	FG	FG
0.82 µF	824	J	K	M										DG	DG	DG								FL	FL	FL	FL	FL
1.0 µF	105	J	K	M										DG	DG	DG			ED	ED	ED	ED		FM	FM	FM	FM	FM
1.2 µF	125	J	K	M															EH	EH	EH	EH		FG	FG	FG	FG	
1.5 µF	155	J	K	M															EH	EH	EH	EH		FG	FG	FG	FG	
1.8 µF	185	J	K	M															EF	EF	EH	EH		FG	FG	FG	FG	
2.2 µF	225	J	K	M															EF	EF	EH	EH		FG	FG	FG	FG	
2.7 µF	275	J	K	M															EH	EH	EH			FG	FG	FH	FH	
3.3 µF	335	J	K	M															EH	EH	EH			FM	FM	FM	FM	
3.9 µF	395	J	K	M															EH	EH	EH			FG	FG	FK	FK	
4.7 µF	475	J	K	M															EH	EH	EH			FG	FG	FS	FS	
5.6 µF	565	J	K	M																				FH	FH	FH		
6.8 µF	685	J	K	M																				FM	FM	FM		
8.2 µF	825	J	K	M																				FK	FK	FK		
10 µF	106	J	K	М																				FS	FS	FS		
	0	Rated	Voltage	(VDC)	6.3	10	16	25	6.3	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50
Сар	Cap Code	Vol	Itage Co	ode	9	8	4	3	9	8	4	3	5	9	8	4	3	5	9	8	4	3	5	9	8	4	3	5
		Case	Size/S	eries		C04	02C				0603					C0805	С			(21206	С				C1210	:	



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

Thickness	Case	Thickness ±	Paper Q	uantity ¹	Plastic (Quantity
Code	Size ¹	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
DP	0805	0.90 ± 0.10	4,000	15,000	0	0
DE	0805	1.00 ± 0.10	0	0	2,500	10,000
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
DH	0805	1.25 ± 0.20	0	0	2,500	10,000
ED	1206	1.00 ± 0.10	0	0	2,500	10,000
EF	1206	1.20 ± 0.15	0	0	2,500	10,000
EG	1206	1.60 ± 0.15	0	0	2,000	8,000
EH	1206	1.60 ± 0.20	0	0	2,000	8,000
FD	1210	0.95 ± 0.10	0	0	4,000	10,000
FF	1210	1.10 ± 0.10	0	0	2,500	10,000
FG	1210	1.25 ± 0.15	0	0	2,500	10,000
FL	1210	1.40 ± 0.15	0	0	2,000	8,000
FH	1210	1.55 ± 0.15	0	0	2,000	8,000
FM	1210	1.70 ± 0.20	0	0	2,000	8,000
FK	1210	2.10 ± 0.20	0	0	2,000	8,000
FS	1210	2.50 ± 0.30	0	0	1,000	4,000
Thickness	Case	Thickness ±	7" Reel	13" Reel	7" Reel	13" Reel
Code	Size ¹	Range (mm)	Paper Q	uantity¹	Plastic (Quantity

Package quantity based on finished chip thickness specifications.

Table 2B – Bulk Packaging Quantities

Deales	to a T and	Loose P	ackaging
Раскад	ing Type	Bulk Bag	(default)
Packagir	ng C-Spec ¹	N.	/A ²
Cas	e Size	Packaging Quantities	(pieces/unit packaging)
EIA (in)	Metric (mm)	Minimum	Maximum
0402	1005		
0603	1608		
0805	2012		50,000
1206	3216		
1210	3225	1	
1808	4520		
1812	4532		
1825	4564		20,000
2220	5650		
2225	5664		

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

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

¹ If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Table 3A – Land Pattern Design Recommendations per IPC-7351 – Standard Termination

EIA Size Code	Metric Size Code		Maxi	sity Lev mum (I rotrusio	Most)		Media	sity Lev an (Nor rotrusio)	Density Level C: Minimum (Least) Land Protrusion (mm)					
3040	Jour	С	Υ	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	0.99	1.44	1.66	4.47	2.71	0.89	1.24	1.56	3.57	2.11	0.79	1.04	1.46	2.42	1.81
1206	3216	1.59	1.62	2.06	5.85	3.06	1.49	1.42	1.96	4.95	2.46	1.39	1.22	1.86	4.25	2.16
1210	3225	1.59	1.62	3.01	5.90	4.01	1.49	1.42	2.91	4.95	3.41	1.39	1.22	2.81	4.25	3.11

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.

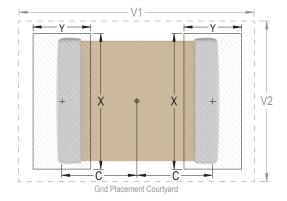




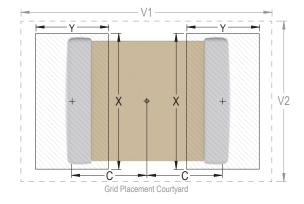
Table 3B – Land Pattern Design Recommendations per IPC-7351 – Flexible Termination

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)					
Jour	0000	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	X	V1	V2	
0603	1608	0.85	1.25	1.10	4.00	2.10	0.75	1.05	1.00	3.10	1.50	0.65	0.85	0.90	2.40	1.20	
0805	2012	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	1.65	1.90	5.90	2.90	1.50	1.45	1.80	5.00	2.30	1.40	1.25	1.70	4.30	2.00	
1210	3225	1.60	1.65	2.80	5.90	3.80	1.50	1.45	2.70	5.00	3.20	1.40	1.25	2.60	4.30	2.90	

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

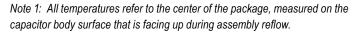
Recommended Soldering Technique:

- 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
Frome reature	SnPb	100% Matte Sn
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum



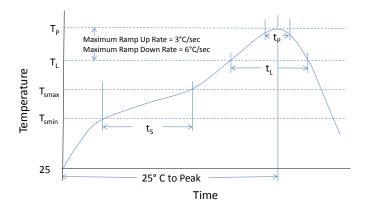




Table 4 - Performance & Reliability: Test Methods and Conditions

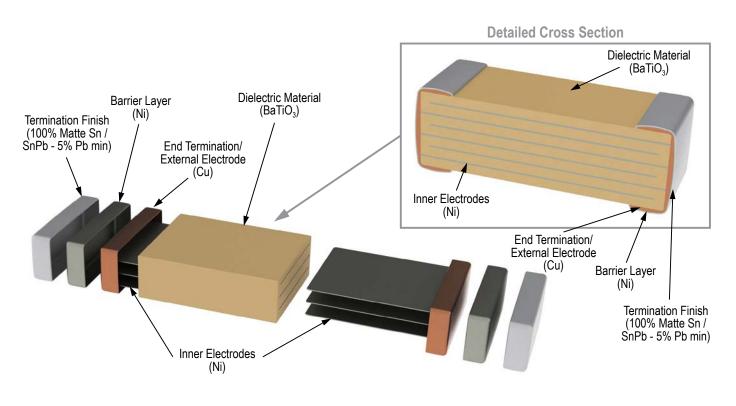
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Solderability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Golderability	0-010-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +150°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Load Humidity: 1,000 hours 85°C/85%RH and rated voltage. Add 100K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion. Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at
		24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours. +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	−55°C/+150. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 150°C with 2 X rated voltage applied.
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 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage and Handling

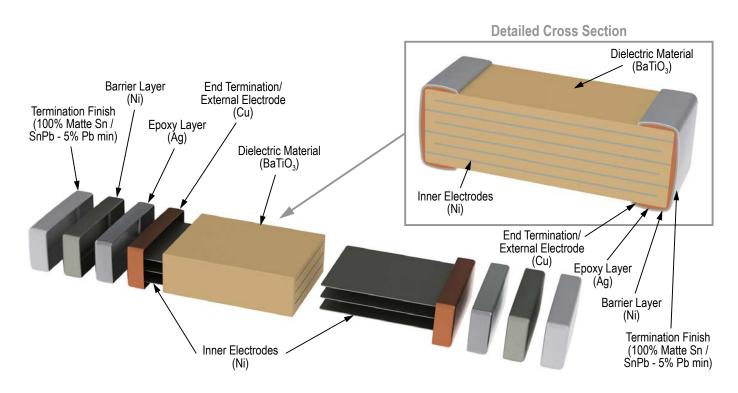
Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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 – Standard Termination



Construction – Flexible Termination



High Temperature 175°C, X7R Dielectric, 16 – 200 VDC (Industrial Grade)



Overview

KEMET's High Temperature X7R Dielectric capacitors are formulated and designed for extreme temperature applications. Constructed of a robust and proprietary base metal electrode (BME) dielectric system, these devices are capable of reliable operation in temperatures up to 175°C. Providing an attractive combination of performance and robustness in general high temperature applications, High Temperature X7R dielectric capacitors are well suited for high temperature bypass and decoupling applications or frequency discriminating circuits where Q and stability of capacitance characteristics are not critical. They exhibit a predictable change in capacitance with respect to time, voltage and temperature up to 175°C.



Ordering Information

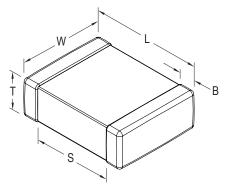
С	1210	R	225	K	3	R	Α	С	T050
Ceramic	Case Size ¹ (L" x W")	Specification/ Series ¹	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish	Packaging/Grade (C-Spec) ²
	0402 0603 0805 1206 1210 1812	G = 175°C with standard termination R = 175°C w/ Flexible Termination	First two digits represent significant figures. Third digit specifies number of zeros.	J = ±5% K = ±10% M = ±20%	4 = 16 3 = 25 5 = 50 1 = 100 2 = 200	R = X7R	A = N/A	C = 100% Matte Sn	Blank = Bulk 7292 = Waffle Pack/Tray TU = 7" Reel - Unmarked (full reel quantity) T050 = 50 pieces/7" Reel - Unmarked T100 = 100 pieces/7" Reel - Unmarked T250 = 250 pieces/7" Reel - Unmarked T500 = 500 pieces/7" Reel - Unmarked T1K0 = 1,000 pieces/Reel - Unmarked

¹ Flexible termination option is only available in 0603 (1608 metric) and larger case sizes.

² Reeling quantities are dependent upon chip size and thickness dimension. When ordering using the "T1K0" packaging option, 1812 case size devices with chip thickness of ≥ 1.9 mm (nominal) may be shipped on multiple 7" reels or a single 13" reel. The term "Unmarked" pertains to laser marking of components. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. Additional reeling or packaging options may be available. Contact KEMET for details.



Dimensions – Millimeters (Inches) – Standard Termination



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)	Solder Wave
0805	2012	2.00 (0.079) ±0.20 (0.008)	1.25 (0.049) ±0.20 (0.008)	See Table 2	0.50 (0.02) ± 0.25 (0.010)	0.75 (0.030)	or
1206	3216	3.20 (0.126) ±0.20 (0.008)	1.60 (0.063) ±0.20 (0.008)	for Thickness	0.50 (0.02) ± 0.25 (0.010)		Solder Reflow
1210	3225	3.20 (0.126) ±0.20 (0.008)	2.50 (0.098) ±0.20 (0.008)		0.50 (0.02) ± 0.25 (0.010)	N/A	Solder Reflow Only
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)		Solder Reflow Only

Dimensions – Millimeters (Inches) – Flexible Termination

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



Overview cont'd

Concerned with flex cracks resulting from excessive stresses produced during board flexure and thermal cycling? These devices are available with KEMET's Flexible termination technology which inhibits the transfer of board stress to the rigid ceramic body, therefore mitigating flex cracks which can result in low IR or short circuit failures. Although flexible termination technology does not eliminate the potential for mechanical damage that may propagate during extreme environmental and

handling conditions, it does provide superior flex performance over standard termination systems.

KEMET's High Temperature X7R surface mount MLCCs are manufactured in state of the art ISO/TS 16949:2009 certified facilities and are proven to function reliably in harsh, high temperature and high humidity, down-hole environments.

Benefits

- Operating temperature range of -55°C to +175°C
- Voltage derating <u>not</u> required
- · Lead (Pb)-Free, RoHS and REACH compliant
- Base metal electrode (BME) dielectric system
- EIA 0402, 0603, 0805, 1206, 1210 and 1812 case sizes
- DC voltage ratings of 16 V, 25 V, 50 V, 100 V & 200 V
- Capacitance offerings ranging from 2.7 nF to 3.3 μF
- Available capacitance tolerances of ±5%, ±10% & ±20%
- · Non-polar device, minimizing installation concerns
- 100% pure matte tin-plated termination finish allowing for excellent solderability
- Flexible termination option available upon request

Applications

Typical applications include decoupling, bypass, filtering and transient voltage suppression in extreme environments such as down-hole exploration, aerospace engine compartments and geophysical probes.

Application Notes

X7R dielectric is not recommended for AC line filtering or pulse applications.

Voltage derating of these capacitors is not required for application temperatures up to 175°C.

Qualification/Certification

High temperature Industrial grade products meet or exceed the requirements outlined Table 4, Performance & Reliability. Qualification packages are available upon request.



Environmental Compliance

Lead (Pb)-Free, RoHS, and REACH compliant without exemptions.

Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range	−55°C to +175°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15% (-55°C to +125°C) beyond 125°C see "Capacitance vs. Temperature Performance" plot - Reference Only
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	<3.0%
Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit at 25°C	See Dissipation Factor Limit Table
Insulation Resistance (IR) Limit at 25°C	1,000 megohm microfarads or 100 G Ω (Rated voltage applied for 120 \pm 5 secs at 25°C)

Regarding aging rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

To obtain IR limit, divide $M\Omega$ - μ 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 $\leq 10~\mu F$

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."

Dissipation Factor Limit Table

Rated DC Voltage	Dissipation Factor
16/25	3.5%
>25	2.5%

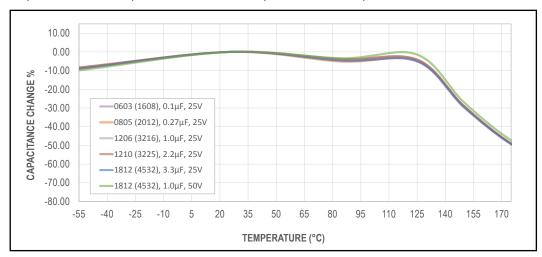
Post Environmental Limits

High Temperature Life, Biased Humidity, Moisture Resistance											
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance						
X7R	16/25	All	5.0	± 20%	100/ of Initial Limit						
AIR	>25	All	3.0	± 20%	10% of Initial Limit						

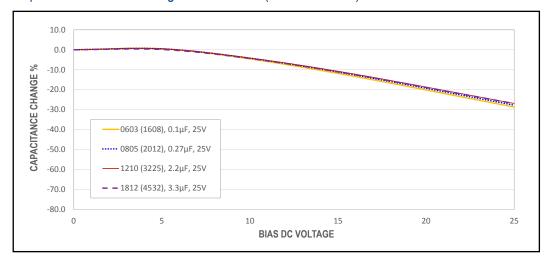


Electrical Characteristics

Capacitance vs. Temperature Performance (-55°C to +175°C)



Capacitance vs. Bias Voltage Performance (25 VDC Rated)



Capacitance vs. Bias Voltage Performance (1812 Case Size, 1.0 µF, 50 VDC Rated)

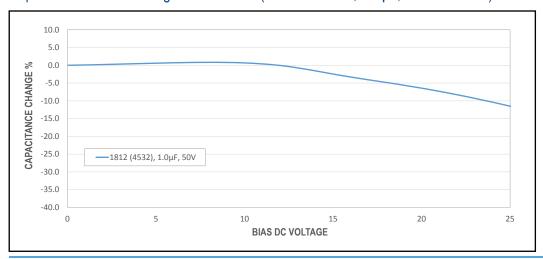




Table 1 – Capacitance Range/Selection Waterfall (0402 – 1812 Case Sizes)

			se Si Serie			C04	02G		CO	6030	G/R	CO	8050	G/R	C1	2060	G/R	C1	2100	S/R		C181	2G/F	2
Capacitance	Cap Code	Volt	tage C	ode	4	3	5	1	3	5	1	3	5	1	3	5	1	3	5	1	3	5	1	2
Capacitance	Cap Code		ed Volt (VDC)	age	16	25	50	100	25	50	100	25	50	100	25	50	100	25	50	100	25	50	100	200
			acita Ieran							Prod Se	luct A	Availa ole 2	abilit for C	y and	d Chi hick	p Thi ness	ckne Dime	ss Co ensid	odes ns					
2700 pF	272	J	K	М	BB	BB	BB																	
3300 pF	332	J	K	М	BB	BB	BB																	
3900 pF	392	J	K	M	BB	BB	BB																	
4700 pF	472	J	K	M	BB	BB	BB																	
5600 pF	562	J	K	M	BB	BB	BB																	
6800 pF	682	J	K	M	BB	BB	BB																	
8200 pF	822	J	K	M	BB	BB	BB																	
10000 pF	103	J	K	M	BB	BB	BB		1												l			
12000 pF	123	J	K	М	ВВ	ВВ																		
15000 pF	153	J	K	М	ВВ	ВВ															l			
18000 pF	183	J	K	М	ВВ	BB			CF	CF														
22000 pF	223	J	K	М	ВВ	BB			CF	CF														
27000 pF	273	J	K	М					CF	CF								Ī			İ			
33000 pF	333	J	K	М					CF	CF											Ī			
39000 pF	393	J	K	М					CF	CF								İ			İ			
47000 pF	473	J	К	М	ВВ				CF	CF		DN	DN											
56000 pF	563	j	K	м					CF	CF		DN	DN		i			İ			GN	GN	GN	GN
68000 pF	683	j	K	м					CF	CF		DN	DN		i			İ			i -			
82000 pF	823	j	K	м					CF	CF		DN	DN		i			İ			İ			
0.1 µF	104	j	K	М					CF	CF		DN	DN		ED	ED		i			GM	GM	GM	GM
0.12 µF	124	J	K	М					CF			DP	DP		ED	ED								
0.15 µF	154	J	K	М					CF			DP	DP		ED	ED		İ			İ			
0.18 µF	184	J	K	М								DF	DF		ED	ED		FE	FE		İ			
0.22 µF	224	J	K	M					i			DG	DG		EP	EP		FE	FE		GB	GB		
0.27 µF	274	J	K	M					i			DG	DG		EP.	EP		FF	FF		GB	GB		
0.33 µF	334	J	K	M								DP			EJ	EJ		FF	FF		GB	GB		
0.39 µF	394	Ĵ	K	M					i			DP			EJ	EJ		FG	FG		GB	GB		
0.47 μF	474	Ĵ	K	M					1			DG			EJ	EJ		FG	FG		GB	GB		
0.56 µF	564	Ĵ	K	M					l			DG			EP			FH	FH		GB	GB		
0.68 µF	684	Ĵ	K	М					1			DG			EJ			FM	FM		GC	GC		
0.82 µF	824	J	K	M								٦			EJ			FK	FK		GE	GE		
1 μF	105	J	K	M											EJ			FK	FK		GH	GH		
1.2 µF	125	J	K	M														FH			GJ	GJ		
1.5 µF	155	J	K	M														FM			GL	GL		
1.8 µF	185	J.	K	M														FK			GE	JL		
2.2 µF	225	J	K	M														FK			GG			
2.7 µF	275	J	K	M					l			l						l ''`			GJ			
3.3 µF	335	j	K	М					l			l									GL			
υ.υ μι		Rate	ed Volt		16	25	50	100	25	50	100	25	50	100	25	50	100	25	50	100	25	50	100	200
Canacitanas	Can Cada	1/-1	(VDC)		4	3			-		-					-	1		5	1	-			-
Capacitance	Cap Code		tage C		4	٠	5	1	3	5	1	3	5	1	3	5	1	3	5	1	3	5	1	2
			se Si Serie:			C04	02G		CO	6036	3/R	CO	8050	3/R	C1	2060	3/R	C1	2100	S/R		C181	2G/F	₹



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
DN	0805	0.78 ± 0.10*	4,000	15,000	0	0
DP	0805	0.90 ± 0.10*	4,000	15,000	0	0
DF	0805	1.10 ± 0.10	0	0	2,500	10,000
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
ED	1206	1.00 ± 0.10	0	0	2,500	10,000
EP	1206	1.20 ± 0.20	0	0	2,500	10,000
EJ	1206	1.70 ± 0.20	0	0	2,000	8,000
FE	1210	1.00 ± 0.10	0	0	2,500	10,000
FF	1210	1.10 ± 0.10	0	0	2,500	10,000
FG	1210	1.25 ± 0.15	0	0	2,500	10,000
FH	1210	1.55 ± 0.15	0	0	2,000	8,000
FM	1210	1.70 ± 0.20	0	0	2,000	8,000
FK	1210	2.10 ± 0.20	0	0	2,000	8,000
GB	1812	1.00 ± 0.10	0	0	1,000	4,000
GC	1812	1.10 ± 0.10	0	0	1,000	4,000
GE	1812	1.30 ± 0.10	0	0	1,000	4,000
GH	1812	1.40 ± 0.15	0	0	1,000	4,000
GG	1812	1.55 ± 0.10	0	0	1,000	4,000
GJ	1812	1.70 ± 0.15	0	0	1,000	4,000
GN	1812	1.70 ± 0.20	0	0	1,000	4,000
GL	1812	1.90 ± 0.20	0	0	500	2,000
GM	1812	2.00 ± 0.20	0	0	500	2,000
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 3A – Land Pattern Design Recommendations per IPC-7351 – Standard Termination

EIA Size Code	Metric Size Code		Maxi	sity Lev mum (N	Most))		Media	sity Lev an (Nor rotrusio			Density Level C: Minimum (Least) Land Protrusion (mm)					
Code	Code	С	Υ	Х	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	
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	

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.

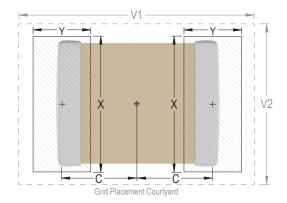




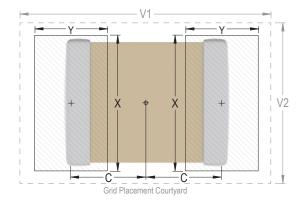
Table 3B – Land Pattern Design Recommendations per IPC-7351 – Flexible Termination

EIA Size Code	Metric Size Code	ı	Maxi	sity Lev mum (I rotrusio	Most)	ı	Media	sity Lev an (Nor rotrusio			Density Level C: Minimum (Least) Land Protrusion (mm)					
Oode	Oode	С	Y	X	V1	V2	С	Y	Х	V1	V2	С	Y	Х	V1	V2
0603	1608	0.85	1.25	1.10	4.00	2.10	0.75	1.05	1.00	3.10	1.50	0.65	0.85	0.90	2.40	1.20
0805	2012	0.99	1.44	1.66	4.47	2.71	0.89	1.24	1.56	3.57	2.11	0.79	1.04	1.46	2.42	1.81
1206	3216	1.59	1.62	2.06	5.85	3.06	1.49	1.42	1.96	4.95	2.46	1.39	1.22	1.86	4.25	2.16
1210	3225	1.59	1.62	3.01	5.90	4.01	1.49	1.42	2.91	4.95	3.41	1.39	1.22	2.81	4.25	3.11
1812	4532	2.10	1.80	3.60	7.00	4.60	2.00	1.60	3.50	6.10	4.00	1.90	1.40	3.40	5.40	3.70

Density Level A: For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes. KEMET only recommends wave soldering of EIA 0603, 0805 and 1206 case sizes.

Density Level B: For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes. **Density Level C:** For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC Standard 7351 (IPC–7351).

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





Soldering Process

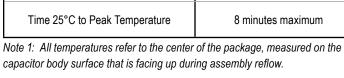
Recommended Soldering Technique:

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

Recommended Reflow Soldering Profile:

KEMET's families of surface mount multilayer ceramic capacitors (SMD MLCCs) are compatible with wave (single or dual), convection, IR or vapor phase reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET's recommended profile conditions for convection and IR reflow reflect the profile conditions of the IPC/J-STD-020 standard for moisture sensitivity testing. These devices can safely withstand a maximum of three reflow passes at these conditions.

Profile Feature	Termination Finish					
Trome readure	100% Matte Sn					
Preheat/Soak						
Temperature Minimum (T _{Smin})	150°C					
Temperature Maximum (T _{Smax})	200°C					
Time (t_s) from T_{Smin} to T_{Smax}	60 – 120 seconds					
Ramp-Up Rate (T _L to T _P)	3°C/second maximum					
Liquidous Temperature (T _L)	217°C					
Time Above Liquidous (t _L)	60 – 150 seconds					
Peak Temperature (T _P)	260°C					
Time Within 5°C of Maximum Peak Temperature (t _P)	30 seconds maximum					
Ramp-Down Rate (T _P to T _L)	6°C/second maximum					
Time 25°C to Peak Temperature	8 minutes maximum					



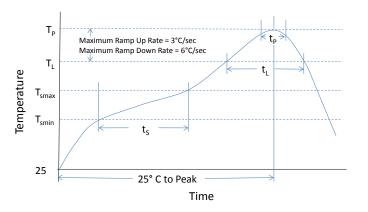




Table 4 - Performance & Reliability: Test Methods and Conditions

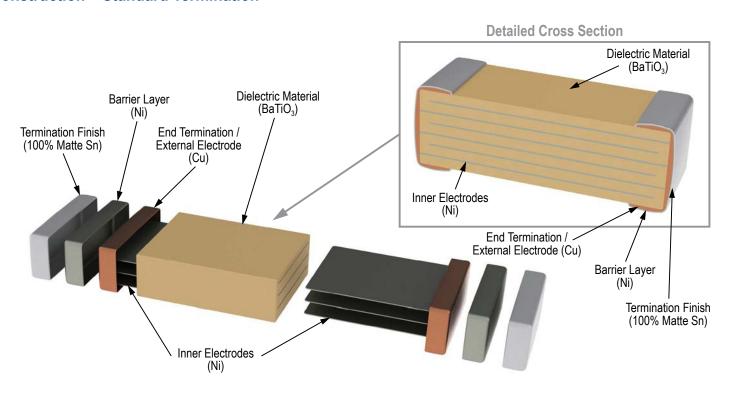
Stress	Reference	Test or Inspection Method					
		Appendix 1, Note:					
	JIS-C-6429	Package Size Force Duration					
Terminal Strength		0402 5 N (0.51 kg) 60 seconds					
		0603 10 N (1.02 kg)					
		≥ 0805 18 N (1.83 kg)					
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).					
	J-STD-002	Magnification 50 X. Conditions:					
Solderability		a) Method B, 4 hours at 155°C, dry heat at 235°C					
Solderability		b) Method B at 215°C category 3					
		c) Method D, category 3 at 260°C					
Temperature Cycling	KEMET defined	50 cycles (-55°C to +220°C). Measurement at 24 hours +/- 4 hours after test conclusion.					
Did Hoosidit.	MII. OTD 000 M-H 1 400	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.					
Biased Humidity	MIL-STD-202 Method 103	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.					
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.					
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 175°C with 2 X rated voltage applied.					
Storage Life	KEMET defined	200°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, Condition F.					
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.					

Storage and Handling

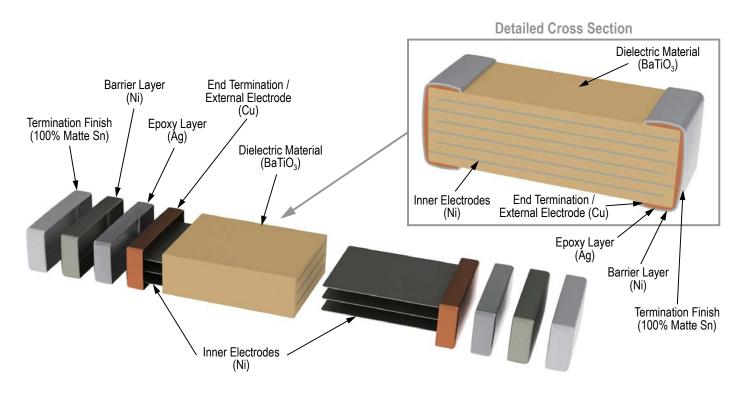
Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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 – Standard Termination



Construction – Flexible Termination



High Temperature 200°C, C0G Dielectric, 10 – 200 VDC (Industrial Grade)



Overview

KEMET's High Temperature surface mount C0G Multilayer Ceramic Capacitors (MLCCs) are constructed of a robust and proprietary C0G/NP0 base metal electrode (BME) dielectric system that offers industry-leading performance at extreme temperatures up to 200°C. These devices are specifically designed to withstand the demands of harsh industrial environments such as down-hole oil exploration and automotive/ avionics engine compartment circuitry.

KEMET's High Temperature C0G capacitors are temperature compensating and are well suited for resonant circuit applications or those where Q and stability of capacitance characteristics are required. They exhibit no change in capacitance with respect to time and voltage and boast a negligible change in capacitance with reference to ambient temperature. Capacitance change is limited to ± 30ppm/ °C from -55°C to +200°C. In addition, these capacitors exhibit high insulation resistance with low dissipation factor at elevated

temperatures up to 200°C. They also exhibit low ESR at high frequencies and offer greater volumetric efficiency over competitive high temperature precious metal electrode (PME) and BME ceramic capacitor devices.

These devices are Lead (Pb)-Free, RoHS and REACH compliant without the need of any exemptions.



Ordering Information

С	1210	Н	124	J	5	G	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance ¹	Voltage	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/Grade (C-Spec)
	0402 0603 0805 1206 1210 1812 2220	H = High Temperature (200°C)	Two significant digits + number of zeros. Use 9 for 1.0 – 9.9 pF Use 8 for 0.5 – .99 pF e.g., 2.2 pF = 229 e.g., 0.5 pF = 508	$B = \pm 0.10 \text{ pF}$ $C = \pm 0.25 \text{ pF}$ $D = \pm 0.5 \text{ pF}$ $F = \pm 1\%$ $G = \pm 2\%$ $J = \pm 5\%$ $K = \pm 10\%$ $M = \pm 20\%$	8 = 10 V 4 = 16 V 3 = 25 V 5 = 50 V 1 = 100 V 2 = 200 V	G = COG	A = N/A	C = 100% Matte Sn L = SnPb (5% Pb minimum) E = Gold (Au) 1.97 – 11.8 µin F = Gold (Au) 30 – 50 µin G = Gold (Au) 100 µin minimum	See "Packaging C-Spec Ordering Options Table" below

¹ Additional capacitance tolerance offerings may be available. Contact KEMET for details.

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



Packaging C-Spec Ordering Options Table

Termination Finish Options	Packaging Type/Options	Packaging Ordering Code (C-Spec)				
Standard Packaging – Unmarked³						
	Bulk Bag	Blank ¹				
	Waffle Tray ²	7292				
	7" Tape & Reel	TU				
C = 100% Matte Sn	13" Reel	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)				
L = SnPb (5% Pb min.)	7" Tape & Reel/2 mm pitch ⁴	7081				
F = Gold (Au) 30 – 50 µin G = Gold (Au) 100 µin minimum	7" Tape & Reel – 50 pieces	T050				
	7" Tape & Reel – 100 pieces	T100				
	7" Tape & Reel – 250 pieces	T250				
	7" Tape & Reel – 500 pieces	T500				
	7" Tape & Reel – 1,000 pieces	T1K0				
	Moisture Sensitive Packaging ⁵ – Unmarked ⁵	3				
	Waffle Tray ²	7282				
	7" Tape & Reel	7130				
E = Gold (Au) 1.97 – 11.8 μin	7" Tape & Reel – 50 pieces					
F = Gold (Au) 30 – 50 µin	7" Tape & Reel – 100 pieces					
G = Gold (Au) 100 μin minimum	7" Tape & Reel – 250 pieces	Contact KEMET ⁶				
	7" Tape & Reel – 500 pieces					
	7" Tape & Reel – 1,000 pieces					

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- -55°C to +200°C operating temperature range
- Lead (Pb)-Free, RoHS and REACH compliant
- EIA 0402, 0603, 0805, 1206, 1210, 1812, and 2220 case sizes
- DC voltage ratings of 10 V, 16 V, 25 V, 50 V, 100 V, and 200 V
- Capacitance offerings ranging from 0.5 pF up to 470 nF
- Available capacitance tolerances of ±0.10 pF, ±0.25 pF, ±0.5 pF, ±1%, ±2%, ±5%, ±10% or ±20%
- · No piezoelectric noise
- Extremely low ESR and ESL
- · High thermal stability
- · High ripple current capability

- Preferred capacitance solution at line frequencies and into the MHz range
- · No capacitance change with respect to applied rated DC voltage
- Negligible capacitance change with respect to temperature from -55°C to +200°C
- No capacitance decay with time
- · Non-polar device, minimizing installation concerns
- 100% pure matte tin-plated termination finish allowing for excellent solderability
- Gold (Au), Tin/Lead (Sn/Pb) and 100% pure matte Tin (Sn) termination finishes available

^{1 &}quot;Bulk Bag" packaging option is not available for Gold (Au) termination finish options and case sizes larger than 2225 (5664 Metric).

² "Waffle Tray" packaging option is not available for case sizes larger than 2225 (5664 Metric).

³ The terms "Marked" and "Unmarked" pertain to laser marking option of components. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. The option to laser mark is not available on these devices.

³ Reeling quantities are dependent upon chip size and thickness dimension. When ordering using the "T1K0" packaging option, 1812 thru 2225 case size devices with chip thickness of ≥ 1.9 mm (nominal) may be shipped on multiple 7" reels or a single 13" reel. Additional reeling or packaging options may be available. Contact KEMET for details.

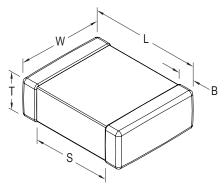
⁴ The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".

⁵ Moisture sensitive packaging is required for Gold (Au) termination option "E" (1.97 – 11.8 μin)

⁶ Additional reeling or packaging options may be available. Contact KEMET for details.



Dimensions – Millimeters (Inches)



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

Applications

Typical applications include critical timing, tuning, circuits requiring low loss, circuits with pulse, high current, decoupling, bypass, filtering, transient voltage suppression, blocking and energy storage for use in extreme environments such as down-hole exploration, aerospace engine compartments and geophysical probes.

Qualification/Certification

High temperature (200°C) Industrial grade products meet or exceed the requirements outlined in Table 4, Performance & Reliability. Qualification packages are available for review and download on our website at www.kemet.com/hightemp

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 +200°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±30 ppm/°C (up to 200°C)
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	0%
¹ Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)
² Dissipation Factor (DF) Maximum Limit @ 25°C	0.1%
³ Insulation Resistance (IR) Minimum Limit @ 25°C	1,000 megohm microfarads or 100 GΩ (Rated voltage applied for 120 ±5 seconds @ 25°C)

¹DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON."

Post Environmental Limits

	High Temperature Life, Biased Humidity, Moisture Resistance											
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance							
C0G	All	All	0.5	0.3% or ±0.25 pF	10% of Initial Limit							

²Capacitance and dissipation factor (DF) measured under the following conditions:

¹ MHz ±100 kHz and 1.0 ±0.2 Vrms if capacitance ≤ 1,000 pF

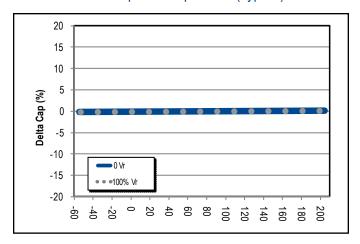
¹ kHz ±50 Hz and 1.0 ±0.2 Vrms if capacitance > 1,000 pF

 $^{^3}$ To obtain IR limit, divide M Ω - μ F value by the capacitance and compare to G Ω limit. Select the lower of the two limits.

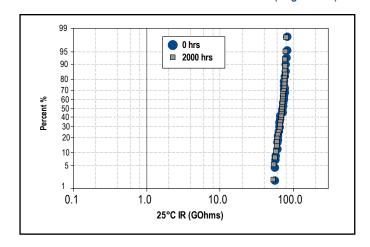


Electrical Characteristics

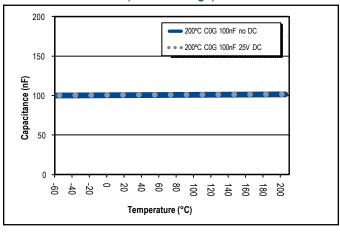
Delta Cap vs. Temperature (Typical)



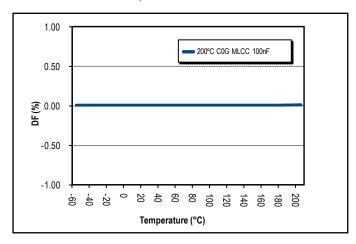
C1210H104J1GAC - Life Test IR Distribution (Lognormal)



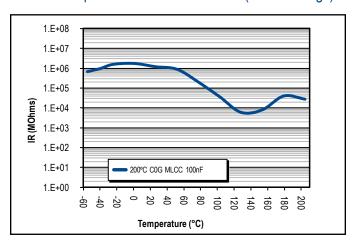
Capacitance vs. Temperature with 25 V DC Bias (Rated Voltage)



DF vs. Temperature without DC Bias.



IR vs. Temperature with 25 V DC Bias (Rated Voltage)



BME vs. PME/IR vs. Temperature with 25 V DC Bias (Rated Voltage)

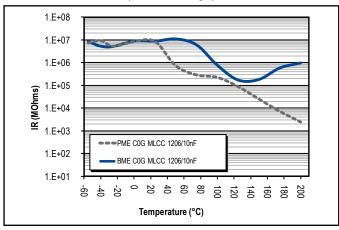




Table 1A – Capacitance Range/Selection Waterfall (0402 – 1206 Case Sizes)

		(Cas	se S	Siz	e / :	Se	rie	S		C)40	2H				C 06	03F	1				C08	05H	1				C12	206F	1	
Consoitence	Cap			Vo	ltag	e Co	de			8	4	3	5	1	8	4	3	5	1	2	8	4	3	5	1	2	8	4	3	5	1	2
Capacitance	Code		R	ated	Volt	age	(VD	C)		9	16	52	20	100	9	16	25	20	100	200	9	9	22	20	9	200	9	9	25	20	100	200
		Ca	ара	cita	nc	e To	ole	ran	се							odu See																
0.5 & 0.75 pF	508 & 758	В	С	D						ВВ	BB	BB	BB		CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN						
1.0 - 9.0 pF*	109 - 919*	В	С	D						BB	ВВ	BB	BB		CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	EB	EB	EB	EB	EB	EB
10 - 91 pF*	100 - 910*				F F	G	J	K	M	BB	BB	BB	BB	DD.	CF	CF	CF	CF	CF	CF	DN	DN	DN	DN	DN	DN	EB	EB	EB	EB	EB	EB
100 - 180 pF* 200 - 430 pF*	101 - 181* 201 - 431*				F	G G	J J	K K	M	BB BB	BB BB	BB BB	BB BB	BB	CF CF	CF	CF CF	CF CF	CF CF	CF	DN DN	DN DN	DN DN	DN	DN DN	DN	EB EB	EB EB	EB EB	EB	EB EB	EB EB
470 pF	471				F	G	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DP	EB	EB	EB	EB	EB	EB
510 pF	511				F	G	j	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DN	EB	EB	EB	EB	EB	EB
560 pF	561	İ			F	G	j	K	М	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DN	EB	EB	EB	EB	EB	EB
620 pF	621	İ			F	G	J	K	М	ВВ	BB	ВВ	ВВ	ВВ	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DN	EB	EB	EB	EB	EB	EB
680 pF	681	İ			F	G	J	K	М	ВВ	BB	ВВ	ВВ	ВВ	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DN	EB	EB	EB	EB	EB	EB
750 pF	751				F	G	J	K	М	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DN	EB	EB	EB	EB	EB	EB
820 pF	821				F	G	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF		DN	DN	DN	DN	DN	DN	EB	EB	EB	EB	EB	EB
910 pF	911				F	G	J	K	М	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF		DN	DN	DN	DN	DP	DP	EB	EB	EB	EB	EB	EB
1,000 pF	102				F	G	J	K	M	BB	BB	BB	BB	BB	CF	CF	CF	CF	CF		DN	DN	DN	DN	DP	DP	EB	EB	EB	EB	EB	EE
1,100 pF	112 122				F	G	J	K K	M	BB	BB	BB	BB		CF	CF	CF CF	CF CF	CF		DN	DN	DN	DN	DN		EB	EB EB	EB EB	EB	EB EB	EB EB
1,200 pF 1,300 pF	132				F	G	J	r K	M	BB	BB BB	BB BB	BB BB		CF	CF	CF	CF	CF		DP	DN DP	DN DP	DN DP	DN DP		EB EB	EB	EB	EB	EC	EC
1,500 pF	152				F	G	J	K	M	BB	BB	BB	BB		CF	CF	CF	CF	CF		DP	DP	DP	DP	DP		EB	EB	EB	EB	ED	EC
1,600 pF	162	l			F	G	j	K	M	"					CF	CF	CF	CF	CF		DP	DP	DP	DP	DP		EB	EB	EB	EB	ED	ED
1,800 pF	182	İ			F	G	J	K	М	İ					CF	CF	CF	CF	CF		DP	DP	DP	DP	DP		EB	EB	EB	EB	ED	ED
2,000 pF	202	İ			F	G	J	K	М						CF	CF	CF	CF	CF		DN	DN	DN	DN	DN		EB	EB	EB	EB	ED	ED
2,200 pF	222				F	G	J	K	М						CF	CF	CF	CF	CF		DN	DN	DN	DN	DN		EB	EB	EB	EB	EE	EE
2,400 pF	242				F	G	J	K	М						CF	CF	CF	CF	CF		DN	DN	DN	DN	DN		EB	EB	EB	EB	EC	EC
2,700 pF	272				F	G	J	K	M						CF	CF	CF	CF	CF		DN	DN	DN	DN	DN		EB	EB	EB	EB	EC	EC
3,000 pF	302				F	G	J	K	M						CF	CF	CF	CF	CF		DP	DP	DP	DP	DN		EC	EC	EC	EC	EC	
3,300 pF 3,600 pF	332 362				F F	G G	J	K K	M						CF CF	CF CF	CF CF	CF	CF		DP DP	DP DP	DP DP	DP DP	DN		EC	EC EC	EC EC	EC	EE	
3,900 pF	392				F	G	J	K	M						CF	CF	CF	CF	CF		DE	DE	DE	DE	DN		EC	EC	EC	EC	EF	
4,300 pF	432				F	G	j	K	M						CF	CF	CF	CF	CF		DE	DE	DE	DE	DN		EC	EC	EC	EC	EC	
4,700 pF	472	İ			F	G	Ĵ	K	М						CF	CF	CF	CF	CF		DE	DE	DE	DE	DN		EC	EC	EC	EC	EC	
5,100 pF	512				F	G	J	K	М						CF	CF	CF	CF			DE	DE	DE	DE	DN		ED	ED	ED	ED	ED	
5,600 pF	562				F	G	J	K	M						CF	CF	CF	CF			DN	DN	DN	DN	DN		ED	ED	ED	ED	ED	
6,200 pF	622				F	G	J	K	M						CF	CF	CF	CF			DN	DN	DN	DN	DN		EB	EB	EB	EB	EB	
6,800 pF	682				F	G	J	K	M						CF	CF	CF	CF			DN	DN	DN	DN	DN		EB	EB	EB	EB	EB	
7,500 pF	752				F	G	J	K	M						CF	CF	CF				DN	DN	DN	DN	DN		EB	EB	EB	EB	EB	
8,200 pF	822				F F	G	J	K	M						CF	CF	CF				DN	DN	DN	DN	DN		EC	EC	EC	EC	EB	
9,100 pF 10,000 pF	912 103				F	G G	J J	K K	M						CF CF	CF	CF CF				DN DN	DN DN	DN DN	DN DN	DN DP		EC ED	EC ED	EC ED	EC ED	EB EB	
12,000 pF	123				F	G	J	K	M						OI.	Ci	Ci				DN	DN	DN	DN	DE		EB	EB	EB	EB	EB	
15,000 pF	153	l			F	G	J	K	M	l											DN	DN	DN	DP	DG		EB	EB	EB	EB	EB	
18,000 pF	183				F	G	J	K	M												DN	DN	DN	DP			EB	EB	EB	EB	EB	
22,000 pF	223				F	G	J	K	М												DP	DP	DP	DF			EB	ЕВ	EB	EB	EC	
27,000 pF	273				F	G	J	K	М														DF				EB	EB	EB	EB	EE	
33,000 pF	333				F	G	J	K	М													DG					EB	EB	EB	EB	EE	
39,000 pF	393				F	G	J	K	M													DG					EC	EC		EE	EH	
47,000 pF	473				F	G	J	K	M												DG	DG	DG				EC	EC	EC		EH	
56,000 pF 68,000 pF	563 683				F	G G	J	K K	M	l																	ED EF	ED EF	ED EF	EF EH		
82,000 pF	823	l			F	G	J	r K	M	l																	EH	EH	1			
0.10 µF	104	l			F	G	J	K		l											l						EH	EH	EH			
F			R	ated	Volt	_	_			2	16	25	22	9	2	9	25	20	9	200	2	9	25	20	9	200	2	9	25	20	5	200
Capacitance	Cap					e Co	_			8	4	3	5	1	8	4	3	5	1	2	8	4	3	5	1	2	8	4	3	5	1	2
-	Code		Ca	se :	Siz	e / 9	Ser	ies	;	t	C	040	2H				COA	03H	<u> </u>				COR	05H			Ħ		C12	206H		
			<u>Ja</u>	56 (J.Z			.03		Щ							500	, , , , , ,	·		Щ			JJ17					U 12	.001		

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).



Table 1B - Capacitance Range/Selection Waterfall (1210 - 2220 Case Sizes)

Capacitance	Cap	Case Size / Series C1210H C1812H										C2220H															
Сараспапсе				Vo	oltage	e Cod	le			8	4	3	5	1	2	8	4	3	5	1	2	8	4	3	5	1	2
	Code			Rated	d Volt	age (VDC)			10	16	25	50	100	200	10	16	25	20	100	200	9	16	25	20	100	200
			С	apac	itanc	e Tole	eranc	е														ess nens					
0.5 & 0.75 pF	508 & 758	В	С	D																							
1.0 - 9.1 pF*	109 - 919*	В	С	D						FB	FB	FB	FB	FB	FB												
10 - 91 pF*	100 - 910*				F	G	J	K	M	FB	FB	FB	FB	FB	FB												
100 - 910 pF*	101 - 911*				F	G	J	K	М	FB	FB	FB	FB	FB	FB												
1,000 pF	102				F	G	J	K	M	FB	FB	FB	FB	FB	FB												
1,100 pF	112				F	G	J	K	М	FB	FB	FB	FB	FB	FB												
1,200 pF	122				F	G	J	K	M	FB	FB	FB	FB	FB	FB												
1,300 pF	132				F	G	J	K	М	FB	FB	FB	FB	FB	FC												
1,500 pF	152				F	G	J	K	М	FB	FB	FB	FB	FB	FE												
1,600 pF	162				F	G	J	K	M	FB	FB	FB	FB	FB	FE												
1,800 pF	182				F	G	J	K	M	FB	FB	FB	FB	FB	FE												
2,000 pF	202				F	G	J	K	M	FB	FB	FB	FB FB	FC	FE												
2,200 pF	222				F	G	J	K	M	FB	FB	FB FB	FB FB	FC FC	FG												
2,400 pF	242 272				F F	G	J	K	M M	FB FB	FB FB	FB FB	FB FB	FC	FC FC												
2,700 pF 3,000 pF	302				F	G G	J	K K	M	FB	FB	FB	FB	FC	FF												
3,300 pF	332				F	G	J	K	M	FB	FВ	FВ	FB	FF	FF												
3,600 pF	362				F	G	J	K	M	FB	FB	FВ	FB	FF	FF												
3,900 pF	392				F	G	J	K	M	FB	FB	FВ	FB	FF	FF												
4,300 pF	432				F	G	J	K	M	FB	FB	FB	FB	FF	FF												
4,700 pF	472				F	G	J	K	M	FF	FF	FF	FF	FG	FG												
5,100 pF	512				F	G	J	K	M	FB	FB	FB	FB	FG	FG												
5,600 pF	562				F	G	J	K	M	FB	FB	FB	FB	FG	FG												
6,200 pF	622				F	G	J	K	M	FB	FB	FB	FB	FG													
6,800 pF	682				F	G	J	K	M	FB	FB	FB	FB	FG													
7,500 pF	752				F	G	J	K	М	FC	FC	FC	FC	FC													
8,200 pF	822				F	G	J	K	М	FC	FC	FC	FC	FC								İ					
9,100 pF	912				F	G	J	K	М	FE	FE	FE	FE	FE								İ					
10,000 pF	103				F	G	J	K	М	FF	FF	FF	FF	FF								İ					
12,000 pF	123				F	G	J	K	М	FG	FG	FG	FG	FB								İ					
15,000 pF	153				F	G	J	K	M	FG	FG	FG	FG	FB		GB	GB	GB	GB	GB							
18,000 pF	183				F	G	J	K	М	FB	FB	FB	FB	FB		GB	GB	GB	GB	GB							
22,000 pF	223				F	G	J	K	М	FB	FB	FB	FB	FB		GB	GB	GB	GB	GB							
27,000 pF	273				F	G	J	K	М	FB	FB	FB	FB	FB		GB	GB	GB	GB	GB							
33,000 pF	333				F	G	J	K	М	FB	FB	FB	FB	FB		GB	GB	GB	GB	GB							
39,000 pF	393				F	G	J	K	М	FB	FB	FB	FB	FE		GB	GB	GB	GB	GB							
47,000 pF	473				F	G	J	K	M	FB	FB	FB	FB	FE		GB	GB	GB	GB	GB							
56,000 pF	563				F	G	J	K	М	FB	FB	FB	FB	FF		GB	GB	GB	GB	GB							
68,000 pF	683				F	G	J	K	M	FB	FB	FB	FC	FG		GB	GB	GB	GB	GB							
82,000 pF	823				F	G	J	K	M	FC	FC	FC	FF	FH		GB	GB	GB	GB	GB							
0.10 µF	104				F	G G	J	K	M	FE	FE	FE	FG	FM		GB	GB	GB	GB	GD							
0.12 µF	124					_	J	K	M	FG FH	FG FH	FG FH	FH			GB GD	GB GD	GB	GB GD	GH							
0.15 μF 0.18 μF	154 184				F F	G G	J J	K K	M M	гп	гП	гп	FM			GH	GH	GD GH	GH	GN							
0.18 µF 0.22 µF	224				F	G	J	K	M							GK	GK	GK	GK								
0.22 μF 0.47 μF	474				F	G	J	K	M							GIV	GIV	GIV	GIV			JJ	JJ	JJ	JJ		
ν.τι μι	717			10	9	25	20	9	200	10	-9-	25	20	9	200	6	9	25 5	20 20	100	200						
Capacitance C	Cap Code				oltage	_				8	4	3	5	1	2	8	4	3	5	1	2	8	4	3	5	1	2
		Case Size / Series						C12						C18						C22							

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).



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

Thickness	Case	Thickness ±	Paper C	luantity ¹	Plastic (Quantity
Code	Size ¹	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
DN	0805	0.78 ± 0.10	4,000	15,000	0	0
DP	0805	0.90 ± 0.10	4,000	15,000	0	0
DE	0805	1.00 ± 0.10	0	0	2,500	10,000
DF	0805	1.10 ± 0.10	0	0	2,500	10,000
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
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
ED	1206	1.00 ± 0.10	0	0	2,500	10,000
EE	1206	1.10 ± 0.10	0	0	2,500	10,000
EF	1206	1.20 ± 0.15	0	0	2,500	10,000
EH	1206	1.60 ± 0.20	0	0	2,000	8,000
FB	1210	0.78 ± 0.10	0	0	4,000	10,000
FC	1210	0.90 ± 0.10	0	0	4,000	10,000
FE	1210	1.00 ± 0.10	0	0	2,500	10,000
FF	1210	1.10 ± 0.10	0	0	2,500	10,000
FG	1210	1.25 ± 0.15	0	0	2,500	10,000
FH	1210	1.55 ± 0.15	0	0	2,000	8,000
FM	1210	1.70 ± 0.20	0	0	2,000	8,000
GB	1812	1.00 ± 0.10	0	0	1,000	4,000
GD	1812	1.25 ± 0.15	0	0	1,000	4,000
GH	1812	1.40 ± 0.15	0	0	1,000	4,000
GK	1812	1.60 ± 0.20	0	0	1,000	4,000
GN	1812	1.70 ± 0.20	0	0	1,000	4,000
JJ	2220	2.20 ± 0.15	0	0	500	2,000
Thickness	Case	Thickness ±	7" Reel	13" Reel	7" Reel	13" Reel
Code	Size ¹	Range (mm)	Paper C	uantity¹	Plastic (Quantity

Package quantity based on finished chip thickness specifications.

¹ If ordering using the 2mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2mm pitch option see "Tape & Reel Packaging Information".



Table 2B – Bulk Packaging Quantities

	Doolsoning T		Loose Pa	ackaging	Secure P	ackaging		
	Packaging 1	ype	Bulk Bag	(default)	2" x 2" Waffl	e Pack/Tray³		
	Packaging C-S	Spec ¹	N/	'A²	7282	7292		
Case	Size	Chip Thickness	Packaging	Quantities ((pieces/unit packaging)			
EIA (in)	Metric (mm)	(mm)	Minimum	Maximum	Minimum	Maximum		
0402	1005					368		
0603	1608	All				368		
0805	2012			E0 000		100		
1206	3216	≤ 1.25 (nominal)		50,000		126		
1206	3216	> 1.25 (nominal)				50		
1210	3225		1		1	80		
1808	4520					50		
1812	4532	All				42		
1825	4564	All		20,000		20		
2220	5650					20		
2225	5664					20		

¹ The "Packaging C-Spec" is a 4-digit code which identifies the packaging type. When ordering, the proper code must be included in the 15th through 18th character positions of the ordering code. See "Ordering Information" section of this document for further details. Product ordered without a packaging C-Spec will default to our standard " bulk bag" packaging.

² A packaging C-Spec (see note 1 above) is not required For "bulk bag" packaging (excluding Anti-Static Bulk Bag). The 15th through 18th character positions of the ordering code should be left blank. All product ordered without a packaging C-Spec will default to out standard "bulk bag" packaging.

³ Also commonly referred to as "Chip Carrier" or "Molded Tray". All tray packaging options offer static protection.



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

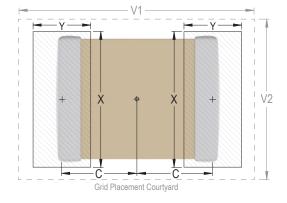
EIA Size Code	Metric Size Code	I	Density Level A: Maximum (Most) Land Protrusion (mm) C Y X V1 V2					Medi	sity Lev an (Nor rotrusio			Density Level C: Minimum (Least) Land Protrusion (mm)							
Code	Code	С	Y	X	V1	V2	С	Υ	X	V1	V2	С	Υ	Х	V1	V2			
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	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			
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			
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			

¹ 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

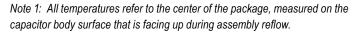
Recommended Soldering Technique:

- 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
Frome reature	SnPb	100% Matte Sn
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum



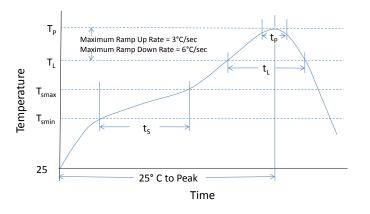




Table 4 - Performance & Reliability: Test Methods and Conditions

Product Qualification Test Plan									
Reliability	/Environmental Tests per MIL–STD–202//JESD22								
High Temperature Life	200°C rated voltage 1,000 hours								
Load Humidity	85°C /85%RH rated voltage 1,000 hours								
Low Voltage Humidity	85°C /85%RH, 1.5 V, 1,000 hours								
Temperature Cycling	−55°C to +200°C, 50 Cycles								
Thermal Shock	−55°C to +150°C, 20 seconds transfer, 15 minute dwell, 300 cycles								
Moisture Resistance	Cycled Temp/RH 0 V, 10 cycles @ 24 hours each								
Physical, Mech	anical & Process Tests per MIL–STD 202/JIS–C–6429								
Resistance to Solvents	Include Aqueous wash chemical, OKEM Clean or equivalent								
Mechanical Shock and Vibration	Method 213: Figure 1, Condition F Method 204: 5 gs for 20 minutes 12 cycles								
Resistance to Soldering Heat	Condition B, no per-heat of samples, Single Wave Solder								
Terminal Strength	Force of 1.8 kg for 60 seconds								
Board Flex	Appendix 2, Note: 3.0 mm (minimum)								

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 40°C and maximum storage humidity not exceed 70% relative humidity. In addition, 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 the time frame outlined in the table below:

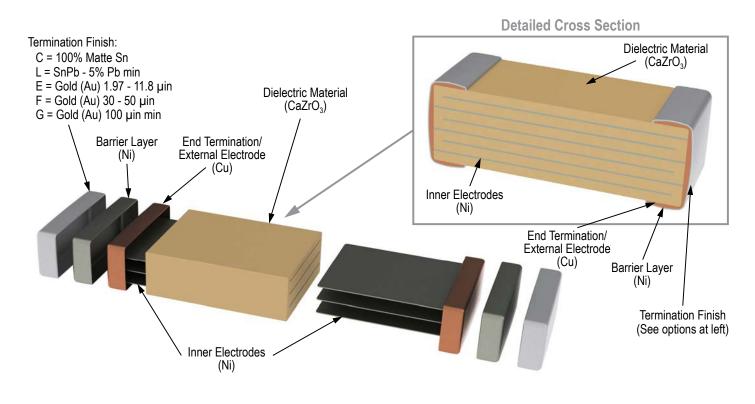
Termination Finish	Termination Finish Ordering Code ¹	Storage Life
100% Matte Tin (Sn)	С	1.5 years upon receipt
SnPb (5% Pb min.)	L	1.5 years upon receipt
Gold (Au) 1.97 – 11.8 μin²	Е	6 months upon receipt ²
Gold (Au) 30 – 50 μin	F	1.5 years upon receipt
Gold (Au) 100 µin min.	G	1.5 years upon receipt

¹ The fourteenth (14th) character position of the KEMET part number is assigned to identify and/or define the termination finish. For more information, see "Ordering Information" section of this document.

² Gold plating option "E" devices should remain in its factory sealed moisture sensitive packaging during storage. If the factory sealed packaging is disturbed please store any remaining packaged components in a dry box container to prevent oxidation of the termination finish.



Construction



Capacitor Marking (Optional):

Laser marking option is not available on:

- C0G, Ultra Stable X8R and Y5V dielectric devices
- EIA 0402 case size devices
- EIA 0603 case size devices with Flexible Termination option.
- KPS Commercial and Automotive grade stacked devices.

These capacitors are supplied unmarked only.

HV-HT Series, High Voltage, High Temperature 200°C, C0G Dielectric, 500 – 2,000 VDC (Industrial Grade)



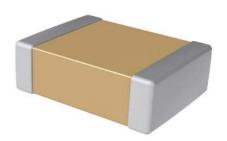
Overview

KEMET's High Voltage-High Temperature (HV-HT) series surface mount C0G Multilayer Ceramic Capacitors (MLCCs) are constructed of a robust and proprietary base metal electrode (BME) dielectric system that offers industry-leading performance at extreme temperatures. These surface mountable devices feature a 200°C maximum operating temperature and are specifically designed to withstand the demands of harsh industrial environments such as oil exploration and automotive/ avionics engine compartment circuitry. They also offer higher and more uniform breakdown voltage performance than competitive products, resulting in increased yields in customer field applications. When dealing with expensive high temperature circuitry and systems, higher yields can quickly result in significant cost savings.

KEMET's HV-HT series MLCCs are temperature compensating and are suited for resonant circuit applications or those where Q and stability of capacitance characteristics are required. They exhibit no change in capacitance with respect to time and voltage and boast a negligible change in capacitance with

reference to ambient temperature. Capacitance change is limited to ±30ppm/°C from -55°C to +200°C. In addition, these capacitors exhibit high insulation resistance with low dissipation factor at elevated temperatures up to 200°C. They also exhibit low ESR at high frequencies and offer superior volumetric efficiency over competitive high temperature precious metal electrode (PME) and base metal electrode (BME) dielectric system devices.

These devices are Lead (Pb)-Free, RoHS and REACH compliant without the need of any exemptions.



Ordering Information

С	2225	Н	393	J	С	G	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance ¹	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/Grade (C-Spec)
	0805 1206 1210 1808 1812 1825 2220 2225 2824 3040 3640 4540	H = High Temperature (200°C)	Two significant digits + number of zeros.	B = ±0.10 pF C = ±0.25 pF D = ±0.5 pF F = ±1% G = ±2% J = ±5% K = ±10% M = ±20%	C = 500 B = 630 D = 1,000 F = 1,500 G = 2,000	G = C0G	A = N/A	C = 100% Matte Sn L = SnPb (5% Pb min.) E = Gold (Au) 1.97 – 11.8 µin F = Gold (Au) 30 – 50 µin G = Gold (Au) 100 µin min.	See "Packaging C-Spec Ordering Options Table" below

¹ Additional capacitance tolerance offerings may be available. Contact KEMET for details.

² Gold(Au) termination finish options are not available on 2824, 3040, 3640 and 4540 case sizes.



Packaging C-Spec Ordering Options Table

Termination Finish Options	Packaging Type/Options	Packaging Ordering Code (C-Spec)
	Standard Packaging – Unmarked ³	
	Bulk Bag	Blank ¹
	Waffle Tray ²	7292
	7" Tape & Reel	TU
C = 100% Matte Sn	13" Reel	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
L = SnPb (5% Pb min.)	7" Tape & Reel/2 mm pitch4	7081
F = Gold (Au) 30 – 50 μin G = Gold (Au) 100 μin min.	7" Tape & Reel – 50 pcs	T050
	7" Tape & Reel – 100 pcs	T100
	7" Tape & Reel – 250 pcs	T250
	7" Tape & Reel – 500 pcs	T500
	7" Tape & Reel – 1,000 pcs	T1K0
	Moisture Sensitive Packaging⁵ – Unmarked	3
	Waffle Tray ²	7282
	7" Tape & Reel	7130
E = Gold (Au) 1.97 – 11.8 μin	7" Tape & Reel – 50 pcs	
F = Gold (Au) 30 – 50 µin	7" Tape & Reel – 100 pcs	
G = Gold (Au) 100 μin min.	7" Tape & Reel – 250 pcs	Contact KEMET ⁶
	7" Tape & Reel – 500 pcs	
	7" Tape & Reel – 1,000 pcs	

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

¹ "Bulk Bag" packaging option is not available for Gold (Au) termination finish options and case sizes larger than 2225 (5664 Metric).

² "Waffle Tray" packaging option is not available for case sizes larger than 2225 (5664 Metric).

³ The terms "Marked" and "Unmarked" pertain to laser marking option of components. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. The option to laser mark is not available on these devices.

³ Reeling quantities are dependent upon chip size and thickness dimension. When ordering using the "T1K0" packaging option, 1812 thru 2225 case size devices with chip thickness of \geq 1.9mm (nominal) may be shipped on multiple 7" reels or a single 13" reel. Additional reeling or packaging options may be available. Contact KEMET for details.

⁴ The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".

⁵ Moisture sensitive packaging is required for Gold (Au) termination option "E" (1.97 – 11.8 μin)

⁶ Additional reeling or packaging options may be available. Contact KEMET for details.



Benefits

- Operating temperature range of -55°C to +200°C
- · Lead (Pb)-Free, RoHS, and REACH compliant
- EIA 0805, 1206, 1210, 1808, 1812, 1825, 2220, 2225, 2824, 3040, 3640 and 4540 case sizes
- DC voltage ratings of 500 V, 630 V, 1 KV, 1.5 KV, and 2 KV
- Capacitance offerings ranging from 1 pF to 0.150 μF
- Available capacitance tolerances of ±0.10 pF, ±0.25 pF, ±0.5 pF, ±1%, ±2%, ±5%, ±10%, and ±20%
- · No piezoelectric noise
- Extremely low ESR & ESL
- · High thermal stability
- High ripple current capability

- No capacitance change with respect to applied rated DC voltage
- Negligible capacitance change with respect to temperature from -55°C to +125°C
- No capacitance decay with time
- Non-polar device, minimizing installation concerns
- 100% pure matte tin-plated termination finish allowing for excellent solderability
- SnPb plated termination finish option available upon request (5% Pb minimum)
- Gold (Au), Tin/Lead (Sn/Pb) and 100% pure matte Tin (Sn) termination finishes available

Applications

Typical applications include critical timing, tuning, circuits requiring low loss, circuits with pulse, high current, switch mode power supplies (input filters, resonators, tank circuits, snubbed circuits, output filters), high voltage coupling, DC blocking and voltage multiplier circuits in extreme environments such as down-hole exploration, aerospace engine compartments and geophysical probes. Markets include power supply, HID lighting, industrial equipment/control, automotive, aerospace, and munitions.

Qualification/Certification

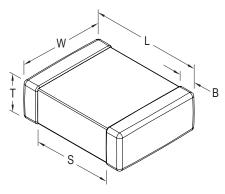
High temperature (200°C) Industrial grade products meet or exceed the requirements outlined in Table 4, Performance & Reliability. Qualification packages are available for review and download on our website at www.kemet.com/hightemp

Environmental Compliance

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



Dimensions – Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0805	2012	2.00 (.079) ± 0.20 (.008)	1.25 (.049) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	"Solder Wave or
1206	3216	3.20 (.126) ± 0.20 (.008)	1.60 (.063) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)		Solder Reflow"
1210	3225	3.20 (.126) ± 0.20 (.008)	2.50 (.098) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)		
1808	4520	4.70 (.185) ± 0.50 (.020)	2.00 (.079) ± 0.20 (.008)		0.60 (.024) ± 0.35 (.014)		
1812	4532	4.50 (.177) ± 0.30 (.012)	3.20 (.126) ± 0.30 (.012)		0.60 (.024) ± 0.35 (.014)		
1825	4564	4.50 (.177) ± 0.30 (.012)	6.40 (.252) ± 0.40 (.016)	See Table 2 for	0.60 (.024) ± 0.35 (.014)		
2220	5650	5.70 (.224) ± 0.40 (.016)	5.00 (.197) ± 0.40 (.016)	Thickness	0.60 (.024) ± 0.35 (.014)	N/A	Caldan Daffass Only
2225	5664	5.60 (.220) ± 0.40 (.016)	6.40 (.248) ± 0.40 (.016)		0.60 (.024) ± 0.35 (.014)		Solder Reflow Only
2824	7260	7.10 (.280) ± 0.40 (.016)	6.10 (.240) ± 0.40 (.016)		1.27 (.050) ± 0.40 (.016)		
3040	7610	7.60 (.300) ± 0.40 (.016)	10.20 (.402) ± 0.40 (.016)		1.27 (.050) ± 0.40 (.016)		
3640	9210	9.10 (.358) ± 0.40 (.016)	10.20 (.402) ± 0.40 (.016)		1.27 (.050) ± 0.40 (.016)		
4540	-	11.40 (.449) ± 0.40 (.016)	10.20 (.402) ± 0.40 (.016)		1.27 (.050) ± 0.40 (.016)		



Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +200°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±30 ppm/°C (up to +200°C)
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	0%
¹ Dielectric Withstanding Voltage (DWV)	150% of rated voltage for voltage rating of < 1000 V 120% of rated voltage for voltage rating of ≥ 1000 V (5 ±1 seconds and charge/discharge not exceeding 50 mA)
² Dissipation Factor (DF) Maximum Limit @ 25°C	0.1%
³ Insulation Resistance (IR) Minimum Limit @ 25°C	1000 megohm microfarads or 100 GΩ (500 VDC applied for 120 ±5 secs @ 25°C)

DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

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."

Post Environmental Limits

	High Temperatu	ıre Life, Biased	Humidity, Moist	ture Resistance	
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance
C0G	All	All	0.5	0.3% or ±0.25 pF	10% of Initial Limit

² Capacitance and dissipation factor (DF) measured under the following conditions:

¹ MHz ±100 kHz and 1.0 Vrms ±0.2 V if capacitance ≤ 1,000 pF

¹ kHz ± 50 Hz and 1.0 Vrms ±0.2 V if capacitance > 1,000 pF

 $^{^3}$ To obtain IR limit, divide M Ω - μ F value by the capacitance and compare to G Ω limit. Select the lower of the two limits.



Table 1A – Capacitance Range/Selection Waterfall (0805 – 1808 Case Sizes)

*Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).

			Ca	se	Siz	:e/S	Ser	ies	,	С	0805	iН		С	1206	H			С	1210	Н			С	1808	Н	
	Сар			Vo	ltag	e Co	de			С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
Capacitance	Code		F	Rated	Volt	age	(VD	C)		200	630	1000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000
	0000	┝		Ca		•	•	•		<u> </u>				Prod	uct A	vaila	abilit	v and	l Chi	p Thi	ickne	ess C	odes				7
40.04.5*	400 040*			To	oler						D0	D.O.	1	Sec	e Tab	le 2	for C	hip T	hick	ness	Dim	ensi	ons		1.0	1.0	
1.0 - 9.1 pF* 10 pF - 47pF*	109 - 919* 100 - 470*	В	С	D	F	G	J	K	М	DG	DG DG	DG DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB LB	LB LB	LB LB	LB LB	LB LB
51 pF	510	i			F	G	J	K	M	DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB
56 pF	560	i			F	G	J	K	М	DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB
62 pF	620	İ			F	G	J	K	М	DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB
68 pF	680				F	G	J	K	М	DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB
75 pF	750				F	G	J	K	M	DG	DG	DG	ED	ED	ED	ED	EF	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB
82 pF	820				F	G	J	K	М	DG	DG	DG	ED	ED	ED	ED	EF	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB
91 pF	910				F	G	J	K	M	DG	DG	DG	ED	ED	ED	ED	EF	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB
100 pF 110 pF	101 111				F	G	J	K	M	DG	DG DG	DG	ED ED	ED ED	ED ED	ED ED	EF EG	FM FM	FM FM	FM FM	FM FM	FM FM	LB LB	LB LB	LB	LB LB	LB LB
120 pF	121	ł			F	G	J	K	M	DG	DG	DG	ED	ED	ED	ED	EG	FG	FG	FG	FM	FM	LB	LA	LA	LA	LB
130 pF	131				F	G	J	K	M	DG	DG	DG	ED	ED	ED	ED	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LB
150 pF	151				F	G	J	K	M	DG	DG	DG	ED	ED	ED	EF	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LB
160 pF	161	İ			F	G	J	K	М	DG	DG	DG	ED	ED	ED	EF	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LC
180 pF	181				F	G	J	K	М	DG	DG	DG	ED	ED	ED	EF	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LC
200 pF	201				F	G	J	K	M	DG	DG	DG	ED	ED	ED	EF	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LC
220 pF	221	l			F	G	J	K	M	DG	DG	DG	ED	ED	ED	EG	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LC
240 pF	241				F	G	J	K	М	DG	DG	DG	ED	ED	ED	EG	EG	FG	FG	FG	FM	FM	LA	LA	LA	LB	LC
270 pF	271				F	G	J	K	М	DG	DG	DG	ED	ED	ED	EG	EG	FG	FG	FG	FK	FK	LA	LA	LA	LB	LC
300 pF	301	ŀ			F	G	J	K	M	DG	DG		ED	ED	EF	EG		FG	FG	FG	FK	FK	LA	LA	LA	LB	LC
330 pF 360 pF	331 361	ł			F	G	J	K	M	DG DG	DG DG		ED ED	ED ED	EF EF	EG EG		FG FG	FG FG	FG FG	FK FK	FK FS	LA LA	LA LA	LA LA	LB LB	LC LA
390 pF	391	ł			F	G	J	K	M	DG	DG		ED	ED	EF	EG		FG	FG	FG	FK	FS	LA	LA	LA	LB	LA
430 pF	431	ł			F	G	J	K	M	DG	DG		ED	ED	EF	EG		FG	FM	FM	FS	FS	LA	LB	LB	LC	LA
470 pF	471				F	G	J	K	M	DG	DG		ED	ED	EG	EG		FG	FM	FM	FS	FS	LA	LB	LB	LC	LA
510 pF	511	i			F	G	J	K	М	DG	DG		ED	ED	EG	EG		FG	FM	FM	FS	FS	LA	LB	LB	LC	LB
560 pF	561	İ			F	G	J	K	М	DG	DG		ED	ED	EG	EG		FG	FM	FM	FS	FS	LA	LB	LB	LC	LB
620 pF	621	l			F	G	J	K	М	DG			ED	ED	EG			FG	FM	FM	FS	FS	LA	LB	LB	LA	LC
680 pF	681				F	G	J	K	М	DG			ED	ED	EG			FG	FM	FM	FS	FS	LB	LB	LB	LA	LC
750 pF	751				F	G	J	K	М	DG			ED	EF	EG			FG	FM	FM	FM		LB	LB	LB	LA	
820 pF	821	ŀ			F	G	J	K	M	DG			ED	EF	EG			FG	FM	FM	FM		LB	LB	LB	LA	
910 pF 1,000 pF	911 102	ł			F	G	J	K	M				ED ED	EF EF	EG EG			FM FM	FM FM	FM FM	FY FY		LB LB	LB LB	LB LB	LA LB	
1,100 pF	112	ł			F	G	J	K	M				EF	EG	LG			FM	FK	FK	FS		LC	LC	LC	LB	
1,200 pF	122				F	G	J	K	M				EF	EG				FM	FK	FK	FS		LC	LC	LC	LC	
1,300 pF	132	ĺ			F	G	J	K	M	l			EF	EG				FM	FS	FS	-		LC	LC	LC	LC	
1,500 pF	152	1			F	G	J	K	М				EF	EG				FK	FS	FS			LC	LC	LC	LC	
1,600 pF	162	1			F	G	J	K	М				EF	EG				FK	FS	FS			LC	LC	LC		
1,800 pF	182				F	G	J	K	М				EF	EG				FK	FS	FS			LC	LC	LC		
2,000 pF	202				F	G	J	K	M				EG					FK	FL	FS			LC	LA	LB		
2,200 pF	222				F	G	J	K	M				EG EG					FK FS	FL	FS			LC	LA LA	LB LB		
2,400 pF 2,700 pF	242 272				F	G G	J	K	M				EG					FS	FL FL	FS FS			LC	LA	LC		
3,000 pF	302				F	G	J	K	M				20					FS	FL	13			LA	LA	LU		
3,300 pF	332				F	G	J	K	M									FS	FM				LA	LA			
3,600 pF	362	ĺ			F	G	J	K	М	l			İ					FL	FM				LA	LB			
3,900 pF	392				F	G	J	K	М									FL	FY				LA	LB			
4,300 pF	432	1			F	G	J	K	М									FM	FY				LA	LC			
4,700 pF	472	⊬			F	G	J	K	М			_	_		_	_	_	FM	FY	_	_	_	LA	LC	_	_	_
	Cap		F	Rated	Volt	age	(VD	C)		200	630	1000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000
Capacitance	Code			Vo	ltag	e Co	de			С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
			C	ase	Siz	e/S	eri	es		C	0805	H		С	1206	Н			С	1210	Н			С	1808	Н	



Table 1A - Capacitance Range/Selection Waterfall (0805 - 1808 Case Sizes) cont'd

		Case Size/Series	C	0805	Н		С	1206	Н			C	1210	Н			C	1808	Н	
	Сар	Voltage Code	С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
Capacitance	Code	Rated Voltage (VDC)	200	630	1000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000
		Capacitance Tolerance					Prod See	uct A	vaila le 2	bilit	y and hip T	l Chi _l hick	p Thi ness	ckne Dim	ss C ensid	odes ons	•			
5,100 pF	512	F G J K M									FY	FS				LA				
5,600 pF	562	F G J K M									FY	FS				LB				
6,200pF	622	F G J K M									FY					LC				
6,800pF	682	F G J K M									FY					LC				
7,500pF	752	F G J K M									FS									
8,200 pF	822	F G J K M									FS									
	Can	Rated Voltage (VDC)	200	630	1000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000
Capacitance	Cap Code	Voltage Code	С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
		Case Size/Series	С	0805	Н		С	1206	Н			С	1210	Н			С	1808	Н	

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).



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

		Ca	se S	Size	/Ser	ies		С	1812	2H			C	1825	5H			C	2220	DH			C	2225	5H	
	Cap		Volt	age C	ode		С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
Capacitance	Code	R	ated V	/oltag	e (VD	C)	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000
	0000		Сар	acita	ance		"		_	_		odu	ct A	/aila	bility	, and	l I Chi	p Th	ickr	iess	Cod	es			_	7
10 pF - 47pF*	100 - 470*	Ļ		erai	$\overline{}$		OV	OV	OV	GK	GK	See	Tabl HG	e 2 fo			hick				sions		KF	KF	KF	KF
51 pF	510	F	G	J	K	M M	GK GK	GK GK	GK GK	GK	GK	HG	HG	HG	HG HG	HG HG	JK	JK JK	JK JK	JK JK	JK JK	KF KF	KF	KF	KF	KF
56 pF	560	F	G	J	K	М	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
62 pF	620	F	G	J	K	M	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
68 pF	680	F	G	J	K	M	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
75 pF	750	F	G	J	K	М	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
82 pF	820	F	G	J	K	M	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
91 pF 100 pF	910 101	F	G	J	K	M M	GK GK	GK GK	GK GK	GK GK	GK GK	HG HG	HG HG	HG HG	HG HG	HG HG	JK JK	JK JK	JK JK	JK JK	JK JK	KF KF	KF KF	KF KF	KF KF	KF KF
110 pF	111	F	G	J	K	M	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
120 pF	121	F	G	J	K	М	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
130 pF	131	F	G	J	K	М	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
150 pF	151	F	G	J	K	M	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
160 pF	161	F	G	J	K	M	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
180 pF	181	F	G	J	K	М	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
200 pF	201	F	G	J	K	M	GH	GH	GH	GH	GH	HE	HE	HE	HE	HE	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
220 pF	221	F	G	J	K	М	GH	GH	GH	GH	GH	HE	HE	HE	HE	HE	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
240 pF	241 271	F	G	J	K	M	GH	GH	GH	GH GH	GH	HE	HE	HE	HE	HE	JK	JK	JK	JK	JK JK	KE KE	KE	KE KE	KE KE	KE KE
270 pF 300 pF	301	F	G	J	K	M M	GH GH	GH	GH	GH	GH	HE HE	HE	HE	HE	HE	JK JK	JK JK	JK JK	JK JK	JK	KE	KE KE	KE	KE	KE
330 pF	331	F	G	J	K	M	GH	GH	GH	GH	GH	HE	HE	HE	HE	HE	JE	JE	JE	JE	JE	KE	KE	KE	KE	KE
360 pF	361	F	G	J	K	M	GK	GK	GK	GK	GH	HE	HE	HE	HE	HE	JE	JE	JE	JE	JE	KE	KE	KE	KE	KE
390 pF	391	F	G	J	K	М	GK	GK	GK	GK	GK	HE	HE	HE	HE	HE	JE	JE	JE	JE	JE	KE	KE	KE	KE	KE
430 pF	431	F	G	J	K	M	GK	GK	GK	GK	GK	HE	HE	HE	HE	HE	JE	JE	JE	JE	JE	KE	KE	KE	KE	KE
470 pF	471	F	G	J	K	M	GK	GK	GK	GK	GK	HE	HE	HE	HE	HE	JE	JE	JE	JE	JE	KF	KF	KF	KF	KE
510 pF	511	F	G	J	K	M	GH	GH	GH	GK	GH	HE	HE	HE	HE	HE	JK	JK	JK	JK	JK	KF	KF	KF	KF	KE
560 pF	561	F	G	J	K	M	GH	GH	GH	GK	GH	HE	HE	HE	HE	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KE
620 pF	621	F	G	J	K	M	GH	GH	GH	GK	GH	HE	HE	HE	HE	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KE
680 pF 750 pF	681 751	F	G	J	K	M M	GH GH	GH	GH	GK GK	GH GK	HE HE	HE	HE	HE	HG HG	JE JE	JE JE	JE JE	JK JK	JK JK	KF KE	KF KE	KF KE	KF KF	KE KE
820 pF	821	F	G	J	K	M	GH	GH	GH	GK	GK	HE	HE	HE	HG	HG	JE	JE	JE	JK	JK	KE	KE	KE	KF	KE
910 pF	911	F	G	Ĵ	K	М	GH	GH	GH	GH	GM	HE	HE	HE	HG	HG	JE	JK	JK	JK	JK	KE	KE	KE	KF	KE
1,000 pF	102	F	G	J	K	М	GH	GH	GH	GH	GM	HE	HE	HE	HG	HG	JE	JK	JK	JK	JK	KE	KE	KE	KF	KE
1,100 pF	112	F	G	J	K	M	GH	GK	GK	GH	GO	HE	HE	HE	HG	HG	JE	JK	JK	JK	JK	KE	KE	KE	KF	KF
1,200 pF	122	F	G	J	K	M	GH	GK	GK	GH	GO	HE	HE	HE	HG	HG	JE	JK	JK	JK	JK	KE	KE	KE	KF	KF
1,300 pF	132	F	G	J	K	М	GH	GK	GK	GH	GO	HE	HE	HE	HG	HE	JE	JK	JK	JK	JE	KE	KE	KE	KF	KF
1,500 pF	152	F	G	J	K	M	GK	GK	GK	GK	GO	HE	HE	HE	HG	HE	JE	JK	JK	JK	JE	KE	KE	KE	KF	KF
1,600 pF 1,800 pF	162 182	F	G	J	K	M M	GK GK	GK GK	GK GK	GK GM		HE	HG HG	HG HG	HG HG	HG HG	JE JE	JK JK	JK JK	JK JK	JE JE	KE KE	KE KE	KE KE	KF KF	KE KE
2,000 pF	202	F	G	J	K	M	GK	GK	GK	GM		HE	HG	HG	HE	HJ	JE	JK	JK	JE	JK	KE	KE	KE	KF	KE
2,200 pF	222	F	G	J	K	M	GK	GK	GK	GO		HE	HG	HG	HE	HJ	JE	JK	JK	JE	JK	KE	KE	KE	KF	KF
2,400 pF	242	F	G	J	K	М	GK	GH	GK	GO		HE	HG	HG	HE	HJ	JK	JK	JK	JE	JL	KE	KE	KE	KE	KH
2,700 pF	272	F	G	J	K	М	GK	GH	GK	GO		HE	HG	HG	HE	HK	JK	JK	JK	JE	JL	KE	KE	KE	KE	KH
3,000 pF	302	F	G	J	K	М	GK	GH	GK			HG	HG	HG	HE	HK	JK	JK	JK	JE	JL	KE	KE	KE	KE	KH
3,300 pF	332	F	G	J	K	М	GK	GH	GK			HG	HG	HG	HG		JK	JK	JK	JK	JN	KE	KE	KE	KE	KJ
3,600 pF	362	F	G	J	K	М	GK	GH	GM			HG	HG	HG	HG		JK	JK	JK	JK	JN	KE	KF	KF	KF	KJ
3,900 pF	392	F	G	J	K	M	GK	GH	GM GO			HG	HG	HG	HJ		JK	JK	JK	JK	JN	KE	KF	KF	KF	KJ
4,300 pF 4,700 pF	432 472	F	G	J	K	M M	GH GH	GH GH	GO			HG HG	HG HG	HG HG	HJ HJ		JK JK	JK JK	JK JK	JK JL		KE KE	KF KF	KF KF	KF KH	
4,700 μι	472		ated V	_			200	630	1000	1500	2000	200	630	1000	1500	2000	500	630	1000	1500	2000	500	630 =	1000	1500	2000
Capacitance	Cap Code			age C	<u> </u>	,	C	В	D	F	G	C	В	D	F	G	C	В	D	F	G	C	В	D	F	G
		C	ase S	Size/	Seri	es		С	1812	H			С	1825	Н			С	2220	Н			С	2225	Н	
						- -											L								•	

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).



Table 1B - Capacitance Range/Selection Waterfall (1812 - 2225 Case Sizes) cont'd

		Ca	se S	Size	/Ser	ies		С	1812	H.			C	182	5H			C	2220	Н			C	2225	iΗ	
	Сар		Vol	tage C	ode		С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
Capacitance	Code	R	ated \	/oltag	e (VD	C)	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000
				acita Ierai)									bility or Cl											
5,100 pF	512	F	G	J	K	М	GH	GK	GO			HG	HE	HG	HK		JK	JK	JK	JL		KE	KF	KF	KH	
5,600 pF	562	F	G	J	K	M	GH	GK	GO			HG	HE	HG	HK		JK	JK	JK	JN		KE	KF	KF	KH	
6,200pF	622	F	G	J	K	M	GH	GK				HG	HE	HG			JK	JE	JE	JN		KE	KF	KF	KJ	
6,800pF	682	F	G	J	K	M	GH	GM				HG	HE	HJ			JK	JE	JK	JN		KE	KF	KF	KJ	
7,500pF	752	F	G	J	K	M	GH	GM				HG	HE	HJ			JK	JE	JK			KF	KE	KF		
8,200 pF	822	F	G	J	K	M	GK	GO				HG	HE	HJ			JK	JE	JL			KF	KE	KF		
9,100 pF	912						GM	GO				HE	HG	HK			JE	JE	JL			KF	KE	KH		
10,000 pF	103						GM	GO				HE	HG	HK			JE	JE	JL			KF	KE	KH		
12,000 pF	123						GO					HE	HG				JE	JK	JN			KE	KE	KH		
15,000 pF	153						GO					HE	HJ				JE	JL				KE	KF	KJ		
18,000 pF	183											HG	HK				JE	JL				KE	KH			
22,000 pF	223											HJ					JK	JN				KF	KJ			
27,000 pF	273											HJ					JL	JN				KF	KJ			
33,000 pF	333											HK					JN					KH				
39,000 pF	393																					KJ				
	Сар	R	ated \	/oltag	e (VD	C)	200	630	1000	1500	2000	500	630	1000	1500	2000	500	630	1000	1500	2000	200	630	1000	1500	2000
Capacitance	Code		Vol	tage C	ode		С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
		Ca	se S	Size/	Seri	ies		С	1812	Н			С	1825	Н			С	2220	Н			С	2225	Н	

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).



Table 1C - Capacitance Range/Selection Waterfall (2824 - 4540 Case Sizes)

				,																				
			ise Siz Series			C	2824	Н			С	3040	Н			С	3640	Н			C	4540	Н	
Capacitance	Cap	Vo	Itage Co	de	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
	Code	Vo	Rated Itage (VD	OC)	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	500	630	1000	1500	2000
			apacitan												Chi					5				
10 - 2,000 pF	100 - 202	J	Folerance K	M	├─					See	lab	1e 2 1	ror C	nip i	hick	ness	חוט	ensi	ons	_				
2,200 pF	222	J	K	M	TA	TA	TA	TA	TA															
2,400 pF	242	J	K	M	1/	IA.	IA.	IA.	IA.															
2,700 pF	272	J	K	M	TA	TA	TA	TA	TA															
3,000 pF	302	J	K	M	1/	IA.	IA.	IA.	IA.															
3,300 pF	332	J	K	M	TA	TA	TA	TA	TA	QB	QB	QB	QB	QB										
3,600 pF	362	J	K	M	I IA	IA	IA	IA	IA	QD	QD	QD	QD	QD										
3,900 pF	392	J	K	M	TA	TA	TA	TA	ТВ	QB	QB	QB	QB	QB	МА	MA	MA	МА	MA					
4.300 pF	432	J	K	M	'^	IA.	I IA	IA.	10	QD	QD	QD	QD	QD	IVIA	IVIA	IVIA	IVIA	IVIA					
4,700 pF	472	J	K	M	TA	TA	TA	ТВ	ТВ	QB	QB	QB	QB	QB	МА	MA	MA	МА	MA	SA	SA	SA	SA	SA
5,100 pF	512	J	K	M	1/	IA.	IA.	10	10	QD	QD	QD	QD	QD	IVIA	IVIA	IVIA	IVIA	IVIA	0.7	0.7	JOA.	0.7	J.A
5,600 pF	562	J	K	M	TA	TA	TA	ТВ	TC	QB	QB	QB	QB	QB	MA	MA	MA	MA	MA	SA	SA	SA	SA	SA
6,200 pF	622	Ĵ	K	M	1/1	1/1	171	10	10	QD	QD	QD	QD	QD	IVI/ \	IVIZ	IVIZ	IVIZ	IVIZ	0/1	O/ C	O/ C	0,1	O/ C
6,800 pF	682	J	K	M	TA	TA	TA	ТВ		QB	QB	QB	QB	QC	МА	MA	MA	MA	MA	SA	SA	SA	SA	SA
7,500 pF	752	J	K	M	1/	IA.	IA.	טו		QD	QD	QD	QD	QU	IVIA	IVIA	IVIA	IVIA	IVIA	J 0A	J.A.	UA.	0.7	J.A
8,200 pF	822	Ĵ	K	M	TA	TA	TA	TC		QB	QB	QB	QC	QC	MA	MA	MA	MA	МВ	SA	SA	SA	SA	SA
9,100 pF	912	J	K	M	1/1	171	171	10		QD	QD	QD	QU	QU	IVI/ (IVIZ	IVI/ \	IVIZ	IVID	0/1	O/ t	O/ C	O/ C	O/ C
10,000 pF	103	Ĵ	K	М	TA	TA	TA			QB	QB	QB	QC	QD	МА	MA	MA	MA	МВ	SA	SA	SA	SA	SB
12,000 pF	123	Ĵ	K	М	TA	TA	TA			QB	QB	QB	QD	QD	MA	MA	MA	MB	MB	SA	SA	SA	SA	SB
15,000 pF	153	Ĵ	K	М	TA	TA	TB			QB	QB	QB	QD		MA	MA	MA	MB	MC	SA	SA	SA	SB	SB
18,000 pF	183	Ĵ	K	M	TA	TA	TB			QB	QB	QB	~_		MA	MA	MA	MC		SA	SA	SA	SB	SC
22,000 pF	223	J	K	М	TA	TB	TC			QB	QB	QC			MA	MA	MA			SA	SA	SA	SB	
27,000 pF	273	Ĵ	K	M	TA	TB				QB	QB	QC			MA	MA	MA			SA	SA	SA	SC	
33,000 pF	333	Ĵ	K	M	ТВ	TB				QB	OC	QC			MA	MA	MB			SA	SA	SA		
39,000 pF	393	Ĵ	K	M	ТВ	TC				QB	OC.	QD			MA	MA	MB			SA	SA	SB		
47,000 pF	473	J	K	М	ТВ					QB	QC				MA	MB	MC			SA	SA	SB		
56,000 pF	563	J	K	M	TC					QC	QD				MA	MB				SA	SA	SB		
68,000 pF	683	Ĵ	K	М	•					QC	QD				МВ	MC				SA	SB	SC		
82,000 pF	823	Ĵ	K	М	l					QC					MB	•				SA	SB			
0.1 µF	104	J	K	М	İ					QD					MC					SB	SC			
0.12 µF	124	J	К	М	İ										MC					SB				
0.15 µF	154	J	K	М																SC				
		Rated	Voltage	(VDC)	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000
	Сар																			 				
Capacitance	Cap	Vo	Itage Co	de	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
		Case	Size/S	eries		С	2824	Н			С	3040	Н			С	3640	Н			С	4540	Н	

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).



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

Thickness	Case	Thickness ±	Paper G	Quantity	Plastic (Quantity
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
ED	1206	1.00 ± 0.10	0	0	2,500	10,000
EF	1206	1.20 ± 0.15	0	0	2,500	10,000
EG	1206	1.60 ± 0.15	0	0	2,000	8,000
FG	1210	1.25 ± 0.15	0	0	2,500	10,000
FL	1210	1.40 ± 0.15	0	0	2,000	8,000
FM	1210	1.70 ± 0.20	0	0	2,000	8,000
FY	1210	2.00 ± 0.20	0	0	2,000	8,000
FK FS	1210 1210	2.10 ± 0.20	0 0	0 0	2,000 1,000	8,000
LA	1808	2.50 ± 0.30 1.40 ± 0.15	0	0	1,000	4,000 4,000
LA LB	1808	1.40 ± 0.15 1.60 ± 0.15	0	0	1,000	4,000
LC	1808	2.00 ± 0.15	0	0	1,000	4,000
GH	1812	1.40 ± 0.15	0	0	1,000	4,000
GK	1812	1.60 ± 0.10	0	0	1,000	4,000
GM	1812	2.00 ± 0.20	0	0	500	2,000
GO	1812	2.50 ± 0.20	Ö	Ö	500	2,000
HE	1825	1.40 ± 0.15	Ö	Ö	1,000	4,000
HG	1825	1.60 ± 0.20	0	0	1,000	4,000
HJ	1825	2.00 ± 0.20	0	0	500	2,000
HK	1825	2.50 ± 0.20	0	0	500	2,000
JE	2220	1.40 ± 0.15	0	0	1,000	4,000
JK	2220	1.60 ± 0.20	0	0	1,000	4,000
JL	2220	2.00 ± 0.20	0	0	500	2,000
JN	2220	2.50 ± 0.20	0	0	500	2,000
KE	2225	1.40 ± 0.15	0	0	1,000	4,000
KF	2225	1.60 ± 0.20	0	0	1,000	4,000
KH	2225	2.00 ± 0.20	0	0	500	2,000
KJ	2225	2.50 ± 0.20	0	0	500	2,000
TA	2824	1.40 ± 0.15	0	0	750	2,500
TB	2824 2824	2.00 ± 0.20	0 0	0 0	300 300	2,000
TC QB	2824 3040	2.50 ± 0.20 1.40 ± 0.15	0	0	500 500	2,000 1,650
QB QC	3040	1.40 ± 0.15 2.00 ± 0.20	0	0	500	1,650
QD QD	3040	2.50 ± 0.20 2.50 ± 0.20	0	0	350	1,400
MA	3640	1.40 ± 0.15	0	0	250	1,550
MB	3640	2.00 ± 0.20	0	0	250	1,550
MC	3640	2.50 ± 0.20	Ŏ	Ö	250	1,550
SA	4540	1.40 ± 0.15	Ö	Ö	200	1,500
SB	4540	2.00 ± 0.20	Ö	Ö	200	1,500
SC	4540	2.50 ± 0.20	0	0	200	1,500
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 2B – Bulk Packaging Quantities

	Daalaasias 7		Loose Pa	ackaging	Secure P	ackaging
	Packaging 1	ype	Bulk Bag	(default)	2" x 2" Waffl	e Pack/Tray³
	Packaging C-S	Spec ¹	N/	'A²	7282	7292
Case	Size	Chip Thickness	Packaging	Quantities (pieces/unit p	ackaging)
EIA (in)	Metric (mm)	(mm)	Minimum	Maximum	Minimum	Maximum
0402	1005					368
0603	1608	All				368
0805	2012			50.000		100
1206	3216	≤ 1.25 (nominal)		50,000		126
1206	3216	> 1.25 (nominal)				50
1210	3225		1		1	80
1808	4520					50
1812	4532	All				42
1825	4564	All		20,000		20
2220	5650					20
2225	5664					20

¹ The "Packaging C-Spec" is a 4-digit code which identifies the packaging type. When ordering, the proper code must be included in the 15th through 18th character positions of the ordering code. See "Ordering Information" section of this document for further details. Product ordered without a packaging C-Spec will default to our standard "bulk bag" packaging.

² A packaging C-Spec (see note 1 above) is not required For "bulk bag" packaging (excluding Anti-Static Bulk Bag). The 15th through 18th character positions of the ordering code should be left blank. All product ordered without a packaging C-Spec will default to out standard "bulk bag" packaging.

³ Also commonly referred to as "Chip Carrier" or "Molded Tray". All tray packaging options offer static protection.



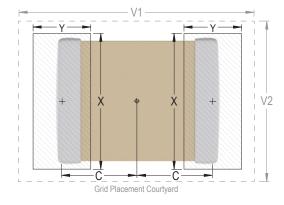
Table 3 – Chip Capacitor Land Pattern Design Recommendations per IPC-7351

EIA Size Code	Metric Size Code	I	Maxi	sity Lev mum (M rotrusio	Most))	I	Media	sity Lev an (Nor rotrusio)			sity Lev mum (L rotrusio	east))
Oode	Oode	С	Υ	Х	V1	V2	С	Y	Х	V1	V2	С	Υ	Х	V1	V2
0805	2012	1.00	1.35	1.55	4.40	2.60	0.90	1.15	1.45	3.50	2.00	0.75	0.95	1.35	2.80	1.70
1206	3216	1.60	1.35	1.90	5.60	2.90	1.50	1.15	1.80	4.70	2.30	1.40	0.95	1.70	4.00	2.00
1210	3225	1.60	1.35	2.80	5.65	3.80	1.50	1.15	2.70	4.70	3.20	1.40	0.95	2.60	4.00	2.90
1808	4520	2.30	1.75	2.30	7.40	3.30	2.20	1.55	2.20	6.50	2.70	2.10	1.35	2.10	5.80	2.40
1812	4532	2.15	1.60	3.60	6.90	4.60	2.05	1.40	3.50	6.00	4.00	1.95	1.20	3.40	5.30	3.70
1825	4564	2.15	1.60	6.90	6.90	7.90	2.05	1.40	6.80	6.00	7.30	1.95	1.20	6.70	5.30	7.00
2220	5650	2.75	1.70	5.50	8.20	6.50	2.65	1.50	5.40	7.30	5.90	2.55	1.30	5.30	6.60	5.60
2225	5664	2.70	1.70	6.90	8.10	7.90	2.60	1.50	6.80	7.20	7.30	2.50	1.30	6.70	6.50	7.00
2824	7260	3.45	1.70	6.60	9.60	7.60	3.35	1.50	6.50	8.70	7.00	3.25	1.30	6.40	8.00	6.70
3040	7610	3.70	1.70	10.70	10.10	11.70	3.60	1.50	10.60	9.20	11.10	3.50	1.30	10.50	8.50	10.80
3640	9210	4.45	1.70	10.70	11.60	11.70	4.35	1.50	10.60	10.70	11.10	4.25	1.30	10.50	10.00	10.80
4540	-	5.60	1.70	10.70	13.90	11.70	5.50	1.50	10.60	13.00	11.10	5.40	1.30	10.50	12.30	10.80

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

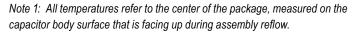
Recommended Soldering Technique:

- 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.

Drofile Feeture	Terminati	on Finish
Profile Feature	SnPb	100% Matte Sn
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum



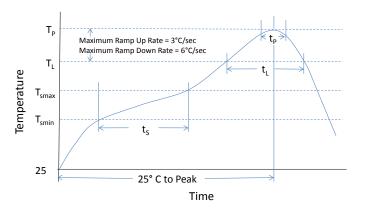




Table 4 – Performance & Reliability: Test Methods and Conditions

Product Qualification Test Plan							
Reliability	/Environmental Tests per MIL–STD–202//JESD22						
Load Humidity	85°C/85%RH and 200 VDC maximum, 1,000 Hours						
Low Voltage Humidity	85°C/85%RH, 1.5V, 1,000 Hours						
Temperature Cycling	-55°C to +200°C, 50 Cycles						
Thermal Shock	-55°C to +150°C, 20 seconds transfer, 15 minute dwell, 300 Cycles						
Moisture Resistance	Cycled Temp/RH 0 V, 10 cycles @ 24 hours each						
Physical, Mech	nanical & Process Tests per MIL-STD 202/JIS-C-6429						
Resistance to Solvents	Include Aqueous wash chemical – OKEM Clean or equivalent						
Mechanical Shock and Vibration	Method 213: Figure 1, Condition F Method 204: 5 gs for 20 minutes, 12 cycles						
Resistance to Soldering Heat	Condition B, no per-heat of samples, Single Wave Solder						
Terminal Strength	Force of 1.8 kg for 60 seconds						
Board Flex	Appendix 2, Note: 3.0 mm (minimum)						

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature— reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 40°C and maximum storage humidity not exceed 70% relative humidity. In addition, 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 the time frame outlined in the table below:

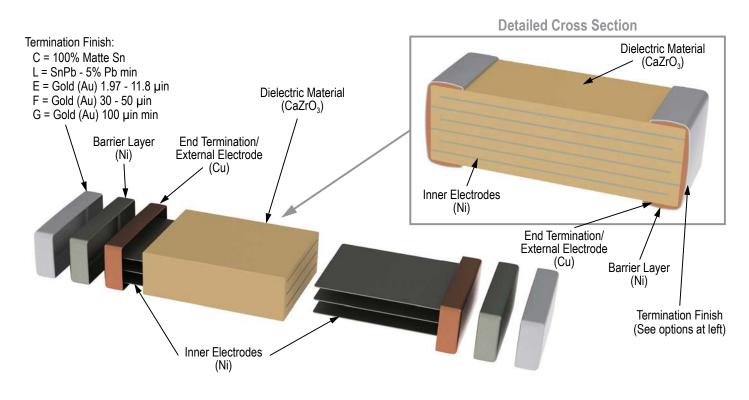
Termination Finish	Termination Finish Ordering Code ¹	Storage Life
100% Matte Tin (Sn)	С	1.5 years upon receipt
SnPb (5% Pb min.)	L	1.5 years upon receipt
Gold (Au) 1.97 – 11.8 μin²	Е	6 months upon receipt ²
Gold (Au) 30 – 50 μin	F	1.5 years upon receipt
Gold (Au) 100 µin min.	G	1.5 years upon receipt

¹ The fourteenth (14th) character position of the KEMET part number is assigned to identify and/or define the termination finish. For more information, see "Ordering Information" section of this document.

² Gold plating option "E" devices should remain in its factory sealed moisture sensitive packaging during storage. If the factory sealed packaging is disturbed please store any remaining packaged components in a dry box container to prevent oxidation of the termination finish.



Construction (Typical)



Capacitor Marking (Optional):

Laser marking option is not available on:

- C0G, Ultra Stable X8R and Y5V dielectric devices
- EIA 0402 case size devices
- EIA 0603 case size devices with Flexible Termination option.
- KPS Commercial and Automotive grade stacked devices.

These capacitors are supplied unmarked only.

Flexible Termination System (FT-CAP), Ultra-Stable X8R Dielectric, 25 – 100 VDC (Commercial & Automotive Grade)



Overview

KEMET's Flexible Termination (FT-CAP) Multilayer Ceramic Capacitor in Ultra-Stable X8R dielectric incorporates a unique, flexible termination system that is integrated with KEMET's standard termination materials. A conductive silver epoxy is utilized between the base metal and nickel barrier layers of KEMET's standard termination system in order to establish pliability while maintaining terminal strength, solderability and electrical performance. This technology was developed in order to address the primary failure mode of MLCCs– flex cracks, which are typically the result of excessive tensile and shear stresses produced during board flexure and thermal cycling. Flexible termination technology inhibits the transfer of board stress to the rigid ceramic body, therefore mitigating flex cracks which can result in low IR or short circuit failures.

Although this technology does not eliminate the potential for mechanical damage that may propagate during extreme environmental and handling conditions, it does provide superior flex performance over standard termination systems. FT-CAP complements KEMET's Open Mode, Floating Electrode (FE-CAP), Floating Electrode with Flexible Termination (FF-CAP), and KEMET Power Solutions (KPS) product lines by providing a complete portfolio of flex mitigation solutions.

Combined with the stability of KEMET's Ultra-Stable high temperature dielectric technology, these flex-robust devices are RoHS Compliant, offer up to 5 mm of flex-bend capability and feature a 150°C maximum operating temperature. Ultra-Stable X8R dielectric offers the same temperature capability as conventional X8R but without the capacitance loss due to applied DC voltage. These devices exhibit no change in capacitance with respect to voltage and boast a minimal change in capacitance with reference to ambient temperature. They are also suitable replacements for higher capacitance and larger footprint devices that fail to offer capacitance stability. Capacitance change with respect to temperature is limited to ±15% from -55°C to +150°C.

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



Ordering Information

С	1206	X	104	J	3	Н	Α	С	AUTO
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Reated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec)
	0603 0805 1206 1210 1812	X = Flexible Termination	Two significant digits + number of zeros.	$F = \pm 1\%$ $G = \pm 2\%$ $J = \pm 5\%$ $K = \pm 10\%$ $M = \pm 20\%$	3 = 25 5 = 50 1 = 100	H = Ultra- Stable X8R	A = N/A	C = 100% Matte Sn L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

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

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



Packaging C-Spec Ordering Options Table

Packaging Type	Packaging/Grade Ordering Code (C-Spec)				
Commerc	ial Grade ¹				
Bulk Bag	Not Required (Blank)				
7" Reel/Unmarked	TU				
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)				
7" Reel/Unmarked/2 mm pitch ²	7081				
13" Reel/Unmarked/2 mm pitch ²	7082				
Automoti	ve Grade ³				
7" Reel	AUTO				
13" Reel/Unmarked	AUTO7411 (EIA 0603 and smaller case sizes) AUTO7210 (EIA 0805 and larger case sizes)				
7" Reel/Unmarked/2 mm pitch ²	3190				
13" Reel/Unmarked/2 mm pitch ²	3191				

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- −55°C to +150°C operating temperature range
- Superior flex performance (up to 5 mm)
- · Lead (Pb)-Free, RoHS and REACH compliant
- EIA 0603, 0805, 1206, 1210, and 1812 case sizes
- DC voltage ratings of 25 V, 50 V, and 100 V
- Capacitance offerings ranging from 430 pF to 0.22 μF
- Available capacitance tolerances of ±1%, ±2%, ±5%, ±10%, and ±20%
- Extremely low ESR and ESL

- · High thermal stability
- High ripple current capability
- No capacitance change with respect to applied rated DC voltage
- · Non-polar device, minimizing installation concerns
- Commercial & Automotive (AEC-Q200) Grades available
- 100% pure matte tin-plated termination finish allowing for excellent solderability
- SnPb plated termination finish option available upon request (5% Pb minimum)

Applications

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

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked.

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".

³ Reeling tape options (Paper or Plastic) are dependent on capacitor case size (L" x W") and thickness dimension. See "Chip Thickness/Tape & Reel Packaging Quantities" and "Tape & Reel Packaging Information".

³ For additional Information regarding "AUTO" C-Spec options, see "Automotive C-Spec Information".

³ All Automotive packaging C-Specs listed exclude the option to laser mark components. Please contact KEMET if you require a laser marked option. For more information see "Capacitor Marking".



Automotive C-Spec Information

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

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

Product Change Notification (PCN)

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

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

KEMET Automotive	Customer Noti	Customer Notification due to:							
C-Spec	Process/Product change	Obsolescence*	implementation						
KEMET assigned ¹	Yes (with approval and sign off)	Yes	180 days Minimum						
AUTO	Yes (without approval)	Yes	90 days Minimum						

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

Production Part Approval Process (PPAP)

The purpose of the Production Part Approval Process is:

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

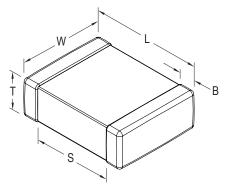
KEMET Automotive		PPAP (Product Part Approval Process) Level										
C-Spec	1	2	3	4	5							
KEMET assigned ¹	•	•	•	•	•							
AUTO	0		0									

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

- Part Number specific PPAP available
- Product family PPAP only



Dimensions – Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0603	1608	1.60 (0.063) ± 0.17 (0.007)	0.80 (0.032) ± 0.15 (0.006)		0.45 (0.018) ±0.15 (0.006)	0.58 (0.023)	Solder Wave
0805	2012	2.00 (0.079) ± 0.30 (0.012)	1.25 (0.049) ± 0.30 (0.012)		0.50 (0.02) ±0.25 (0.010)	0.75 (0.030)	or
1206	3216	3.30 (0.130) ± 0.40 (0.016)	1.60 (0.063) ± 0.35 (0.013)	See Table 2 for Thickness	0.60 (0.024) ±0.25 (0.010)		Solder Reflow
1210	3225	3.30 (0.130) ± 0.40 (0.016)	2.60 (0.102) ± 0.30 (0.012)	1	0.60 (0.024) ± 0.25 (0.010)	N/A	Solder Reflow
1812	4532	4.50 (0.178) ± 0.40 (0.016)	3.20 (0.126) ± 0.30 (0.012)		0.70 (0.028) ±0.35 (0.014)		Only

Qualification/Certification

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

Automotive Grade products meet or exceed the requirements outlined by the Automotive Electronics Council. Details regarding test methods and conditions are referenced in document AEC–Q200, Stress Test Qualification for Passive Components. For additional information regarding the Automotive Electronics Council and AEC–Q200, please visit their website at www.aecouncil.com.

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 +150°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	0%
¹ Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50mA)
² Dissipation Factor (DF) Maximum Limit @ 25°C	2.5%
³ Insulation Resistance (IR) Minimum Limit @ 25°C	1,000 megohm microfarads or 100 GΩ (Rated voltage applied for 120 ±5 seconds @ 25°C)

¹DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

Post Environmental Limits

High Temperature Life, Biased Humidity, Moisture Resistance										
Dielectric Rated DC Capacitance Dissipation Factor Capacitance Insulation (Maximum %) Shift Resistance										
Ultra-Stable X8R	All	All	3.0	0.3% or ±0.25 pF	10% of Initial Limit					

²Capacitance and dissipation factor (DF) measured under the following conditions:

¹ MHz ± 100 kHz and 1.0 ± 0.2 Vrms if capacitance $\leq 1,000$ pF

¹ kHz \pm 50 Hz and 1.0 \pm 0.2 Vrms if capacitance > 1,000 pF

 $^{{}^{3}}$ To obtain IR limit, divide M Ω - μ F value by the capacitance and compare to G Ω limit. Select the lower of the two limits.



Table 1A – Capacitance Range/Selection Waterfall (0603 – 1812 Case Sizes)

		Ca	ise S	Size	/Seri	ies	(0603	X	C	0805	X	(1206	Χ	(C1210	X	C18	12X
Capacitance	Capacitance		Vol	age C	ode		3	5	1	3	5	1	3	5	1	3	5	1	5	1
Capacitance	Code	F	Rated \	/oltag	e (VD0	C)	25	20	100	25	20	100	25	20	100	25	20	100	20	9
		Ca	apacita	nce T	oleran	ıce					ct Ava						Codes	•		
430 pF	431	F	G	J	K	М	CJ	CJ	CJ		Tubio		<u> </u>		000 5		10110			
470 pF	471	F	G	J	K	M	CJ	CJ	CJ											
510 pF	511	F	G	J	K	M	CJ	CJ	CJ											
560 pF 620 pF	561 621	F	G	J	K	M	CJ	Cl	Cl							1				
680 pF	681	F	G	J	K	M	CJ	CJ	CJ											
750 pF	751	F	G	J	K	M	CJ	CJ	CJ							ł				
820 pF	821	F	G	Ĵ	K	M	CJ	CJ	CJ							l			i	
910 pF	911	F	G	Ĵ	K	M	CJ	CJ	CJ				i			i			i	
1,000 pF	102	F	G	Ĵ	K	M	CJ	CJ	CJ							İ				
1,100 pF	112	F	G	J	K	M	CJ	CJ	CJ											
1,200 pF	122	F	G	J	K	М	CJ	CJ	CJ							İ				
1,300 pF	132	F	G	J	K	M	CJ	CJ	CJ							İ				
1,500 pF	152	F	G	J	K	M	CJ	CJ	CJ							İ				
1,600 pF	162	F	G	J	K	M	CJ	CJ	CJ	İ						İ				
1,800 pF	182	F	G	J	K	М	CJ	CJ	CJ											
2,000 pF	202	F	G	J	K	M	CJ	CJ	CJ	DR	DR	DR								
2,200 pF	222	F	G	J	K	M	CJ	CJ	CJ	DR	DR	DR				1				
2,400 pF	242	F	G	J	K	M	CJ	CJ	CJ	DR	DR	DR				1				
2,700 pF	272	F	G	J	K	M	CJ	CJ	CJ	DR	DR	DR								
3,000 pF	302	F	G	J	K	M	CJ	CJ	CJ	DR	DR	DR								
3,300 pF	332	F	G	J	K	M	CJ	CJ	CJ	DR	DR	DR								
3,600 pF	362	F	G	J	K	M	CJ	CJ	CJ	DR	DR	DR								
3,900 pF	392	F	G	J	K	M	CJ	CJ	CJ	DR	DR	DR								
4,300 pF	432	F	G	J	K	M	CJ	CJ	CJ	DR	DR	DR								
4,700 pF	472	F	G	J	K	M	CJ	CJ	CJ	DR	DR	DR				1				
5,100 pF 5,600 pF	512 562	F F	G	J	K	M M	Cl	Cl		DR DR	DR DR	DR DR				1				
6,200 pF	622	F	G	J	K	M	CJ	CJ		DR	DR	DR				ł				
6,800 pF	682	F	G	J	K	M	CJ	CJ		DR	DR	DR	EQ	EQ	EQ	l			ł	
7,500 pF	752	F	G	J	K	M	CJ	03		DR	DR	DR	EQ	EQ	EQ					
8,200 pF	822	F	G	J	K	M	CJ			DR	DR	DR	EQ	EQ	EQ	i				
9,100 pF	912	F	G	Ĵ	K	M	CJ			DR	DR	DR	EQ	EQ	EQ	İ				
10,000 pF	103	F	G	J	K	M	CJ			DR	DR	DD	EQ	EQ	EQ	i				
12,000 pF	123	F	G	J	K	M				DR	DR	DS	EQ	EQ	EQ	FN	FN	FN		
15,000 pF	153	F	G	J	K	М	l .			DR	DD	DG	EQ	EQ	EQ	FN	FN	FN	GB	GB
18,000 pF	183	F	G	J	K	M				DR	DD		EQ	EQ	EQ	FN	FN	FN	GB	GB
22,000 pF	223	F	G	J	K	M	1			DD	DF		EQ	EQ	ER	FN	FN	FN	GB	GB
27,000 pF	273	F	G	J	K	M				DF			EQ	EQ	ET	FN	FN	FN	GB	GB
33,000 pF	333	F	G	J	K	M				DG			EQ	EQ	ET	FN	FN	FN	GB	GB
47,000 pF	473	F	G	J	K	M							ER	ET	EH	FN	FN	FE	GB	GB
56,000 pF	563	F	G	J	K	M							ES	EF	EH	FN	FN	FA	GB	GB
68,000 pF	683	F	G	J	K	M							EF	EH		FN	FQ	FZ	GB	GB
82,000 pF 100,000 pF	823 104	F	G	J	K	M							EH EH	EH		FQ FE	FA FZ	FU FM	GB GB	GB GD
120,000 pF	104	F	G	J	K	M										FZ	FU	LIN	GB	GH
150,000 pF	154	F	G	J	K	M										FU	FM		GD	GN
180,000 pF	184	F	G	J	K	M										FJ	I IVI		GH	GIN
220,000 pF	224	l 'F	G	J,	K	M										''			GK	
220,000 pi		ا	Rated \	/oltag	_		52	20	5	52	20	19	52	20	100	52	20	5	20	9
Capacitance	Capacitance Code			age C		•	3	5	1	3	5	1	3	5	1	3	5	1	5	1
	Code	С	ase S	Size	Seri	es	(0603	X	(0805	X	(21206	X	·	C1210	X	C18	12X



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

Thickness	Case	Thickness ±	Paper Q	uantity ¹	Plastic (Quantity
Code	Size ¹	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
CJ	0603	0.80 ± 0.15	4,000	15,000	0	0
DR	0805	0.78 ± 0.20	0	0	4,000	10,000
DD	0805	0.90 ± 0.10	0	0	4,000	10,000
DS	0805	1.00 ± 0.20	0	0	2,500	10,000
DF	0805	1.10 ± 0.10	0	0	2,500	10,000
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
EQ	1206	0.78 ± 0.20	4,000	10,000	4,000	10,000
ER	1206	0.90 ± 0.20	0	0	4,000	10,000
ES	1206	1.00 ± 0.20	0	0	2,500	10,000
ET	1206	1.10 ± 0.20	0	0	2,500	10,000
EF	1206	1.20 ± 0.15	0	0	2,500	10,000
EH	1206	1.60 ± 0.20	0	0	2,000	8,000
FN	1210	0.78 ± 0.20	0	0	4,000	10,000
FQ	1210	0.90 ± 0.20	0	0	4,000	10,000
FE	1210	1.00 ± 0.10	0	0	2,500	10,000
FA	1210	1.10 ± 0.15	0	0	2,500	10,000
FZ	1210	1.25 ± 0.20	0	0	2,500	10,000
FU	1210	1.55 ± 0.20	0	0	2,000	8,000
FM	1210	1.70 ± 0.20	0	0	2,000	8,000
FJ	1210	1.85 ± 0.20	0	0	2,000	8,000
GB	1812	1.00 ± 0.10	0	0	1,000	4,000
GD	1812	1.25 ± 0.15	0	0	1,000	4,000
GH	1812	1.40 ± 0.15	0	0	1,000	4,000
GK	1812	1.60 ± 0.20	0	0	1,000	4,000
GN	1812	1.70 ± 0.20	0	0	1,000	4,000
Thickness	Case	Thickness ±	7" Reel	13" Reel	7" Reel	13" Reel
Code	Size ¹	Range (mm)	Range (mm) Paper Quantity ¹ Plastic Qua			

Package quantity based on finished chip thickness specifications.

¹ If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Table 2B - Bulk Packaging Quantities

Doolee	ulu u Tuu o	Loose Pa	Loose Packaging				
Раска	ging Type	Bulk Bag	(default)				
Packagi	ng C-Spec ¹	N/	/A ²				
Cas	e Size	Packaging Quantities ((pieces/unit packaging)				
EIA (in)	Metric (mm)	Minimum	Maximum				
0402	1005						
0603	1608						
0805	2012		50,000				
1206	3216						
1210	3225	1					
1808	4520						
1812	4532						
1825	4564		20,000				
2220	5650						
2225	5664	1					

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

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



Table 3 – Chip Capacitor Land Pattern Design Recommendations per IPC-7351 (mm)

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	Х	V1	V2
0603	1608	0.85	1.25	1.10	4.00	2.10	0.75	1.05	1.00	3.10	1.50	0.65	0.85	0.90	2.40	1.20
0805	2012	0.99	1.44	1.66	4.47	2.71	0.89	1.24	1.56	3.57	2.11	0.79	1.04	1.46	2.42	1.81
1206	3216	1.59	1.62	2.06	5.85	3.06	1.49	1.42	1.96	4.95	2.46	1.39	1.22	1.86	4.25	2.16
1210	3225	1.59	1.62	3.01	5.90	4.01	1.49	1.42	2.91	4.95	3.41	1.39	1.22	2.81	4.25	3.11
1812	4532	2.10	1.80	3.60	7.00	4.60	2.00	1.60	3.50	6.10	4.00	1.90	1.40	3.40	5.40	3.70

Density Level A: For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes. KEMET only recommends wave soldering of EIA 0603, 0805, and 1206 case sizes.

Density Level B: For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes. **Density Level C:** For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC Standard 7351 (IPC–7351).

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

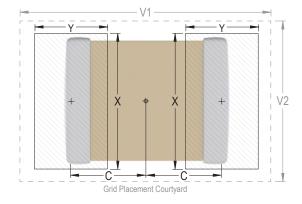




Table 3 – Chip Capacitor Land Pattern Design Recommendations per IPC-7351

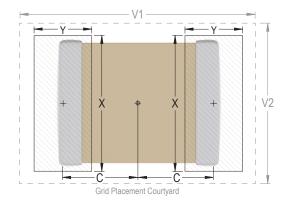
EIA Size Code	Metric Size Code	Density Level A: Maximum (Most) Land Protrusion (mm)					Density Level B: Median (Nominal) Land Protrusion (mm)					Density Level C: Minimum (Least) Land Protrusion (mm)				
		С	Y	Х	V1	V2	С	Y	X	V1	V2	С	Y	Х	V1	V2
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	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
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

¹ 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

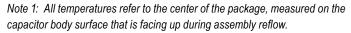
Recommended Soldering Technique:

- 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
Profile realure	SnPb	100% Matte Sn
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum



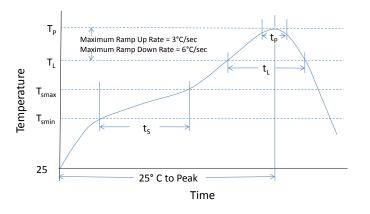




Table 4 - Performance & Reliability: Test Methods and Conditions

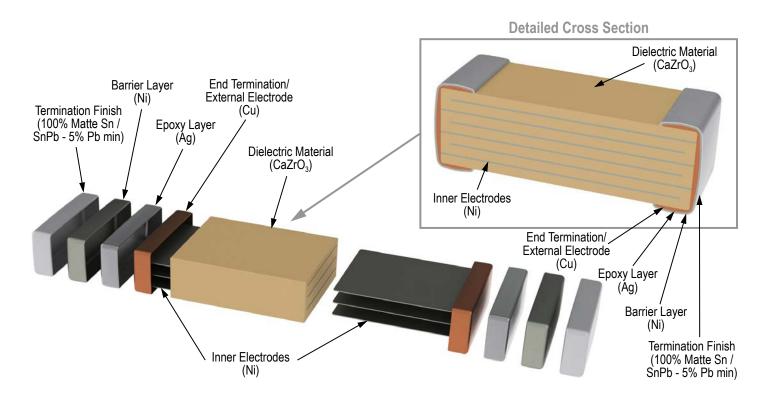
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Solderability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Golderability	0-010-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +150°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Load Humidity: 1,000 hours 85°C/85%RH and rated voltage. Add 100K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
ĺ		Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours. +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	−55°C/+150. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 150°C with 2 X rated voltage applied.
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 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



Capacitor Marking (Optional):

Laser marking option is not available on:

- C0G, Ultra Stable X8R and Y5V dielectric devices
- EIA 0402 case size devices
- EIA 0603 case size devices with Flexible Termination option.
- · KPS Commercial and Automotive grade stacked devices.

These capacitors are supplied unmarked only.

KPS HT Series, **High Temperature 150°C**, **X8L Dielectric**, 10 – 50 VDC (Commercial & Automotive Grade)



Overview

KEMET Power Solutions High Temperature (KPS HT) stacked capacitors utilize a proprietary lead-frame technology to vertically stack one or two multilayer ceramic chip capacitors into a single compact surface mount package. The attached lead-frame mechanically isolates the capacitor(s) from the printed circuit board, thereby offering advanced mechanical and thermal stress performance. Isolation also addresses concerns for audible, microphonic noise that may occur when a bias voltage is applied. A two-chip stack offers up to double the capacitance in the same or smaller design footprint when compared to traditional surface mount MLCC devices. Providing up to 10 mm of board flex capability, KPS Series capacitors are environmentally friendly and in compliance with

RoHS legislation. Combined with X8L dielectric, these devices are capable of reliable operation up to 150°C and are well suited for high temperature filtering, bypass and decoupling applications.

X8L exhibits a predictable change in capacitance with respect to time and voltage, and boasts a minimal change in capacitance with reference to ambient temperature up to 125°C. Beyond 125°C, X8L displays a wider variation in capacitance. Capacitance change is limited to ±15% from -55°C to +125°C and +15, -40% from 125°C to 150°C.

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

Benefits

- -55°C to +150°C operating temperature range
- Reliable and robust termination system
- EIA 1210 and 2220 case sizes
- DC voltage ratings of 10 V, 16 V, 25 V, and 50 V
- Capacitance offerings ranging from 0.47 μF up to 47 μF
- Available capacitance tolerances of ±10% and ±20%
- · Higher capacitance in the same footprint
- · Potential board space savings
- · Advanced protection against thermal and mechanical stress
- · Provides up to 10 mm of board flex capability



Ordering Information

С	2220	С	476	M	8	N	2	С	7186
Ceramic	Case Size (L"x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance ¹	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Leadframe Finish ²	Packaging/Grade (C-Spec)
	1210 2220	C = Standard	Two significant digits + number of zeros.	K = ±10% M = ±20%	8 = 10 4 = 16 3 = 25 5 = 50	N = X8L	1 = KPS Single Chip Stack 2 = KPS Double Chip Stack	C = 100% Matte Sn	See "Packaging C-Spec Ordering Options Table" below

¹ Double chip stacks ("2" in the 13th character position of the ordering code) are only available in M (±20%) capacitance tolerance. Single chip stacks ("1" in the 13th character position of the ordering code) are available in K (±10%) or M (±20%) tolerances.

² Additional leadframe finish options may be available. Contact KEMET for details.



Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec) ²				
Commerc	ial Grade				
7" Reel (Embossed Plastic Tape)/Unmarked	7186				
13" Reel (Embossed Plastic Tape)/Unmarked	7289				
Automoti	ve Grade				
7" Reel (Embossed Plastic Tape)/Unmarked	AUTO				
13" Reel (Embossed Plastic Tape)/Unmarked	AUTO7289				

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. The option to laser mark is not available on these devices. For more information see "Capacitor Marking".

Benefits

- · Reduces audible, microphonic noise
- · Extremely low ESR and ESL
- · Lead (Pb)-Free, RoHS and REACH compliant
- · Capable of Pb-Free reflow profiles

- Non-polar device, minimizing installation concerns
- · Tantalum and electrolytic alternative
- Commercial & Automotive (AEC-Q200) grades available

Applications

Typical applications include smoothing circuits, DC/DC converters, power supplies (input/output filters), noise reduction (piezoelectric/mechanical), circuits with a direct battery or power source connection, critical and safety relevant circuits without (integrated) current limitation and any application that is subject to extreme environments such as high temperature, high levels of board flexure and/or temperature cycling. Markets include industrial, aerospace, automotive, and telecom.

Qualification/Certification

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

Automotive Grade products meet or exceed the requirements outlined by the Automotive Electronics Council. Details regarding test methods and conditions are referenced in document AEC–Q200, Stress Test Qualification for Passive Components. For additional information regarding the Automotive Electronics Council and AEC–Q200, please visit their website at www.aecouncil.com.

Environmental Compliance

Lead (Pb)-Free, RoHS, and REACH compliant without exemptions.

² For additional Information regarding "AUTO" C-Spec options, see "Automotive C-Spec Information".



Automotive C-Spec Information

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

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

Product Change Notification (PCN)

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

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

KEMET Automotive	Customer Noti	fication due to:	Days prior to		
C-Spec	Process/Product change	Obsolescence*	implementation		
KEMET assigned ¹	Yes (with approval and sign off)	Yes	180 days Minimum		
AUTO	Yes (without approval)	Yes	90 days Minimum		

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

Production Part Approval Process (PPAP)

The purpose of the Production Part Approval Process is:

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

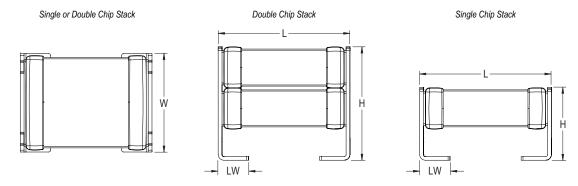
KEMET Automotive		PPAP (Product Part Approval Process) Level										
C-Spec	1	2	3	4	5							
KEMET assigned ¹	•	•	•	•	•							
AUTO	0		0									

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

- Part Number specific PPAP available
- Product family PPAP only



Dimensions – Millimeters (Inches)



Chip Stack	EIA Size Code	Metric Size Code	L Length	W Width	H Height	LW Lead Width	Mounting Technique
Cinalo	1210	3225	3.50 (.138) ±0.30 (.012)	2.60 (.102) ±0.30 (.012)	3.35 (.132) ±0.10 (.004)	0.80 (.032) ±0.15 (.006)	
Single	2220	5650	6.00 (.236) ±0.50 (.020)	5.00 (.197) ±0.50 (.020)	3.50 (.138) ±0.30 (.012)	1.60 (.063) ±0.30 (.012)	Solder Reflow
Daubla	1210	3225	3.50 (.138) ±0.30 (.012)	2.60 (.102) ±0.30 (.012)	6.15 (.242) ±0.15 (.006)	0.80 (.031) ±0.15 (.006)	Only
Double	2220	5650	6.00 (.236) ±0.50 (.020)	5.00 (.197) ±0.50 (.020)	5.00 (.197) ±0.50 (.020)	1.60 (.063) ±0.30 (.012)	

Electrical Parameters/Characteristics

Item	Parameters/Characteristics			
Operating Temperature Range	-55°C to +150°C			
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15% (-55°C to 125°C), +15, -40% (125°C to 150°C)			
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%			
² Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)			
³ Dissipation Factor (DF) Maximum Limit @ 25°C	3.5% ($\leq 16V$) and 2.5% ($\geq 25V$)			
⁴ Insulation Resistance (IR) Minimum Limit @ 25°C	500 megohm microfarads or 10 G Ω (Rated voltage applied for 120 ±5 seconds @ 25°C)			

Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

1kHz \pm 50Hz and 1.0 \pm 0.2 Vrms if capacitance \leq 10 μF

120Hz \pm 10Hz 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 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

⁴To obtain IR limit, divide MΩ- μ F value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



Post Environmental Limits

	High Temperature Life, Biased Humidity, Moisture Resistance											
Dielectric Rated DC Capacitance Dissipation Factor Capacitance Insulation (Maximum %) Shift Resistance												
VOI	≥ 25		3.0	±20%	100/ of Initial Limit							
X8L	≤ 16	All	5.0	±20%	10% of Initial Limit							

Table 1 – Capacitance Range/Selection Waterfall (1210 – 2220 Case Sizes)

		Case Size/S	eries			C12	10C					C22	20C		
Capacitance	Cap	Voltage Cod	le	8	4	3	5	1	Α	8	4	3	5	1	Α
Capacitanice	Code	Rated Voltage (VDC)	10	16	25	50	100	250	10	16	25	50	100	250
		Capacitance Tol	erance		Produ	ct Availab	ility and C	hip Thickr	ness Code	s – See Ta	ble 2 for C	hip Thick	ness Dime	nsions	
					Single	Chip	Stack								
0.47 µF	474	K	M	FV	FV	FV	FV								
1.0 µF	105	K	M	FV	FV	FV	FV								
2.2 µF	225	K	M	FV	FV	FV				JP	JP	JP			
3.3 µF	335	K	M	FV	FV	FV				JP	JP	JP			
4.7 µF	475	K	M	FV	FV	FV				JP	JP	JP			
10 μF	106	K	M							JP	JP	JP			
15 µF	156	K	M							JP					
22 µF	226	K	M							JP					
					Double	e Chip	Stack								
1.0 µF	105		M	FW	FW	FW	FW								
2.2 µF	225		M	FW	FW	FW	FW								
3.3 µF	335		M	FW	FW	FW									
4.7 μF	475		M	FW	FW	FW				JR	JR	JR			
10 µF	106		M	FW	FW	FW				JR	JR	JR			
22 µF	226		М							JR	JR	JR			
33 µF	336		M							JR					
47 µF	476		M							JR					
·		Rated Voltage (VDC)	10	16	25	50	100	250	10	16	25	50	100	250
Capacitance	Cap	Voltage Cod	le	8	4	3	5	1	Α	8	4	3	5	1	Α
	Code	Case Size/S	eries			C12	10C					C22	20C		

These products are protected under US Patent 8,331,078 other patents pending, and any foreign counterparts.

Table 2 - Chip Thickness/Tape & Reel Packaging Quantities

Thickness Case		Thickness ±	Paper C	Quantity	Plastic (Quantity
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
FV	1210	3.35 ± 0.10	0	0	600	2,000
FW	1210	6.15 ± 0.15	0	0	300	1,000
JP	2220	3.50 ± 0.30	0	0	300	1,300
JR	2220	5.00 ± 0.50	0	0	200	800

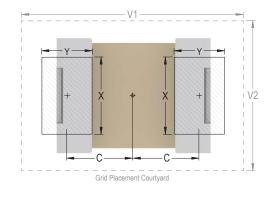
Package quantity based on finished chip thickness specifications.



Table 3 – KPS Land Pattern Design Recommendations (mm)

EIA SIZE CODE	METRIC SIZE	Media	n (Nom	inal) La	nd Prot	rusion
0052	CODE	С	Υ	Х	V1	V2
1210	3225	1.50	1.14	1.75	5.05	3.40
2220	5650	2.69	2.08	4.78	7.70	6.00

Image at right based on an EIA 1210 case size.



Soldering Process

KEMET's KPS Series devices are compatible with IR reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET's recommended profile conditions for IR reflow reflect the profile conditions of the IPC/J–STD–020D standard for moisture sensitivity testing.

To prevent degradation of temperature cycling capability, care must be taken to prevent solder from flowing into the inner side of the lead frames (inner side of "J" lead in contact with the circuit board).

After soldering, the capacitors should be air cooled to room temperature before further processing. Forced air cooling is not recommended.

Hand soldering should be performed with care due to the difficulty in process control. If performed, care should be taken to avoid contact of the soldering iron to the capacitor body. The iron should be used to heat the solder pad, applying solder between the pad and the lead, until reflow occurs. Once reflow occurs, the iron should be removed immediately. (Preheating is required when hand soldering to avoid thermal shock.)

Profile Feature	SnPb Assembly	Pb-Free Assembly
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax})	60 – 120 seconds	60 – 120 seconds
Ramp-up Rate (T _L to T _P)	3°C/seconds maximum	3°C/seconds maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	250°C
Time within 5°C of Maximum Peak Temperature (t _p)	20 seconds maximum	10 seconds maximum
Ramp-down Rate (T _P to T _L)	6°C/seconds maximum	6°C/seconds maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum

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

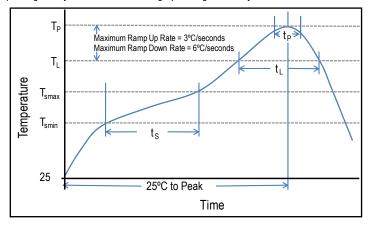




Table 4 – Performance & Reliability: Test Methods and Conditions

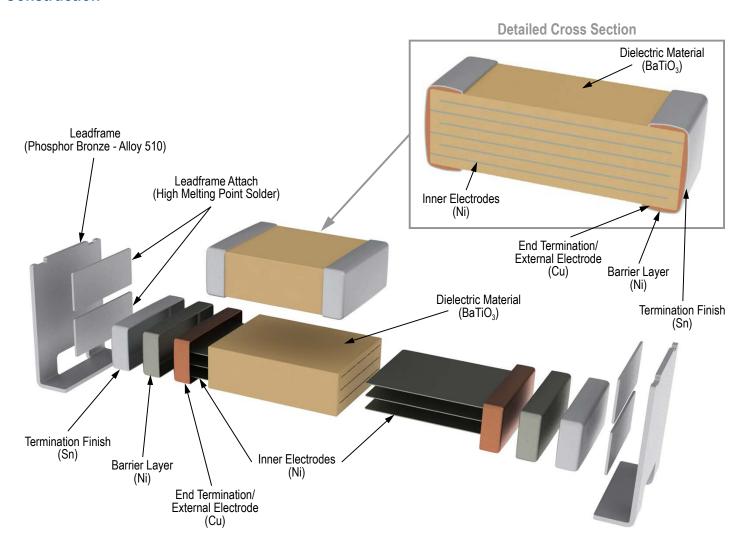
Stress	Reference	Test or Inspection Method				
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.				
Board Flex	JIS-C-6429	Appendix 2, Note: 5.0 mm minimum				
		Magnification 50 X. Conditions:				
Coldorability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C				
Solderability	J-51D-002	b) Method B @ 215°C category 3				
		c) Method D, category 3 @ 250°C				
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +150°C). Measurement at 24 hours +/- 4 hours after test conclusion.				
Discord Houseidite	MIL CTD 202 Method 102	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.				
Biased Humidity	MIL-STD-202 Method 103	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.				
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.				
Thermal Shock	MIL-STD-202 Method 107	−55°C/+150°C. Note: Number of cycles required- 300, maximum transfer time- 20 seconds, Dwell time- 15 minutes. Air-Air.				
High Temperature Life	MIL-STD-202 Method 108	1,000 hours at 150°C with rated voltage applied.				
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 .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, Condition F.				
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.				

Storage & Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



Product Marking

Laser marking option is not available on:

- C0G, Ultra Stable X8R and Y5V dielectric devices
- EIA 0402 case size devices
- EIA 0603 case size devices with Flexible Termination option.
- · KPS Commercial and Automotive grade stacked devices.

These capacitors are supplied unmarked only.

Pulse Discharge, High Voltage, High Temperature 200°C C0G Dielectric, 1,000 VDC – 3,500 VDC (Industrial Grade)



Overview

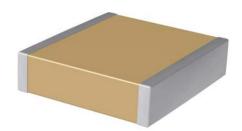
KEMET's Industrial Grade Pulse Discharge Series surface mount capacitors in C0G Dielectric deliver reliable high voltage and high temperature performance required for operation in harsh environments, specifically discharge circuitry.

Constructed of a robust and proprietary base metal electrode (BME) dielectric system, these devices offer industry-leading performance relative to capacitance and case size. KEMET Pulse Discharge capacitors average greater than 30% higher breakdown voltage than competitive precious metal electrode (PME) devices with similar capacitance & voltage ratings.

Designed for down-hole oil exploration and perforation, these devices feature a 200°C maximum operating temperature. The Electronics Industries Alliance (EIA) characterizes C0G dielectric as a Class I material. Components of this classification are temperature compensating and are suited for resonant

circuit applications or those where Q and stability of capacitance characteristics are required. Pulse Discharge series capacitors in C0G dielectric exhibit no change in capacitance with respect to time and voltage and boast a negligible change in capacitance with reference to ambient temperature. These devices retain high insulation resistance with low dissipation factor at elevated temperatures up 200°C.

KEMET's Pulse Discharge surface mount MLCCs are manufactured in state-of-the-art ISO/TS 16949:2009 certified facilities and are proven to function reliably in harsh, high temperature and high humidity, down-hole environments.



Ordering Information

С	2824	Н	393	K	U	G	W	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Dielectric Withstanding Voltage (VDC) ¹	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/Grade (C-Spec) ³
	2824 3040 3640 4540	H = High Temp (200°C)	Two significant digits + number of zeros	J = ±5% K = ±10% M = ±20%	D = 1,000 U = 1,250 G = 2,000 H = 3,000 V = 3,500	G = C0G	W = Pulse Discharge	C = 100% Matte Sn L = SnPb (5% Pb min.)	See "Packaging C-Spec Ordering Options Table" below

¹ DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor. See waterfall table for working voltage.

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

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



Packaging C-Spec Ordering Options Table

Packaging Type/Options ¹	Packaging Ordering Code (C-Spec) ²
7" Reel (Embossed Plastic Tape)/Unmarked	TU
13" Reel (Embossed Plastic Tape)/Unmarked	7210
Reel (Embossed Plastic Tape)/Unmarked - 50 pieces	T050
Reel (Embossed Plastic Tape)/Unmarked - 100 pieces	T100
Reel (Embossed Plastic Tape)/Unmarked - 250 pieces	T250
Reel (Embossed Plastic Tape)/Unmarked - 500 pieces	T500
Reel (Embossed Plastic Tape)/Unmarked - 1,000 pieces	T1K0

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of components. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. The option to laser mark is not available on these devices.

Benefits

- Operating temperature range of −55°C to +200°C
- · Lead (Pb)-Free, RoHS and REACH compliant
- · Base metal technology
- · Higher UVBD capability than competitive dielectric technologies
- Capacitance offerings ranging from 2.2 nF up to 150 nF
- Available capacitance tolerances of ±5%, ±10% or ±20%
- · Extremely low ESR and ESL
- High thermal stability

- · High ripple current capability
- No capacitance change with respect to applied rated DC voltage
- Negligible capacitance change with respect to temperature from -55°C to +200°C
- · No capacitance decay with time
- · Non-polar device, minimizing installation concerns
- 100% pure matte tin-plated termination finish allowing for excellent solderability

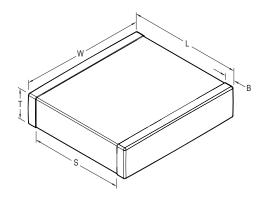
Applications

Typical applications include high temperature discharge circuits for munitions and down-hole oil exploration/perforation.

²Reeling quantities are dependent upon chip size and thickness dimension. When ordering using the "Txxx" packaging ordering codes (C-Specs) outlined above, product may be shipped on multiple 7" reels or a single 13" reel. Additional reeling or packaging options may be available. Contact KEMET for details.



Dimensions – Millimeters (Inches)



Size Code	L Length	W Width	T Thickness Maximum	B Bandwidth	S Separation Minimum	Mounting Technique
2824	7.10 ± 0.40 (0.280 ± 0.016)	6.10 ± 0.40 (0.240 ± 0.016)				
3040	7.60 ± 0.40 (0.300 ± 0.016)	10.20 ± 0.40 (0.402 ± 0.016)	See Table 2	1.27 ± 0.40	N1/A	Solder
3640	9.10 ± 0.40 (0.358 ± 0.016)	10.20 ± 0.40 (0.402 ± 0.016)	See Table 2	(0.050 ± 0.016)	N/A	Reflow Only
4540	11.40 ± 0.40 (0.449 ± 0.016)	10.20 ± 0.40 (0.402 ± 0.016)				

Qualification/Certification

Industrial grade pulse discharge products are subject to internal qualification. Details regarding test methods and conditions are referenced in Table 4, Performance and Reliability.

Environmental Compliance

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



Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +200°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±30 ppm/°C
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	0%
¹ Dielectric Withstanding Voltage (DWV)	See product selection table (product waterfall) for available ratings
² Dissipation Factor (DF) Maximum Limit @ 25°C	0.1%
³ Insulation Resistance (IR) Minimum Limit @ 25°C	1,000 megohm microfarads or 100 GΩ (500 VDC applied for 120 ±5 seconds @ 25°C)

¹DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor. ²Capacitance and dissipation factor (DF) measured under the following conditions:

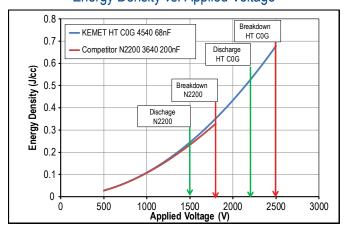
Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 and Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON."

Post Environmental Limits

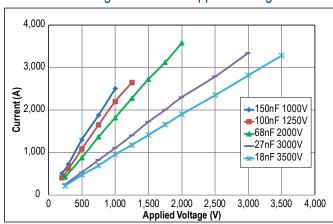
	High Temperature Life, Biased Humidity, Moisture Resistance									
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance					
C0G	All	All	0.5	0.3% or ±0.25 pF	10% of Initial Limit					

Electrical Characteristics

Energy Density vs. Applied Voltage



Discharge Current vs. Applied Voltage



¹ MHz ±100 kHz and 1.0 Vrms ±0.2 V if capacitance ≤ 1,000 pF

¹ kHz ± 50 Hz and 1.0 Vrms ±0.2 V if capacitance > 1,000 pF

 $^{{}^{3}}$ To obtain IR limit, divide M Ω - μ F value by the capacitance and compare to G Ω limit. Select the lower of the two limits.



Table 1 – Pulse Discharge Series, Capacitance Range Waterfall

			se Siz Series			C	2824	Н			C	3040	Н			С	3640	Н			С	4540	DΗ	
		Vo	Itage Cod	de	D	U	G	Н	٧	D	U	G	н	V	D	U	G	Н	V	D	U	G	Н	٧
Capacitance	Cap Code		Dielectric Withstanding Voltage (DWV)			1250	2000	3000	3500	1000	1250	2000	3000	3500	1000	1250	2000	3000	3500	1000	1250	2000	3000	3500
		Wor	king Volt	age	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000
		Capacit	tance Tol	erance											d Chi hick					s				
1,800 pF	182	J	K	М																				
2,000 pF	202	J	K	M																				
2,200 pF	222	J	K	M	TA	TA	TA	TA	TA															
2,700 pF	272	J	K	M	TA	TA	TA	TA	TA															
3,300 pF	332	J	K	M	TA	TA	TA	TA	TA	QB	QB	QB	QB	QB										
3,900 pF	392	J	K	M	TA	TA	TA	TA	TB	QB	QB	QB	QB	QB	MA	MA	MA	MA	MA					
4,700 pF	472	J	K	M	TA	TA	TA	TB	TB	QB	QB	QB	QB	QB	MA	MA	MA	MA	MA	SA	SA	SA	SA	SA
5,600 pF	562	J	K	M	TA	TA	TA	TB	TC	QB	QB	QB	QB	QB	MA	MA	MA	MA	MA	SA	SA	SA	SA	SA
6,800 pF	682	J	K	M	TA	TA	TA	TB		QB	QB	QB	QB	QC	MA	MA	MA	MA	MA	SA	SA	SA	SA	SA
8,200 pF	822	J	K	M	TA	TA	TA	TC		QB	QB	QB	QC	QC	MA	MA	MA	MA	MB	SA	SA	SA	SA	SA
10,000 pF	103	J	K	M	TA	TA	TA			QB	QB	QB	QC	QD	MA	MA	MA	MA	MB	SA	SA	SA	SA	SB
12,000 pF	123	J	K	M	TA	TA	TA			QB	QB	QB	QD		MA	MA	MA	MB	MB	SA	SA	SA	SA	SB
15,000 pF	153	J	K	M	TA	TA	TB			QB	QB	QB	QD		MA	MA	MA	MB	MC	SA	SA	SA	SB	SB
18,000 pF	183	J	K	M	TA	TA	TB			QB	QB	QB			MA	MA	MA	MC		SA	SA	SA	SB	SC
22,000 pF	223	J	K	M	TA	TB	TC			QB	QB	QC			MA	MA	MA			SA	SA	SA	SB	
27,000 pF	273	J	K	M	TA	TB				QB	QB	QC			MA	MA	MA			SA	SA	SA	SC	
33,000 pF	333	J	K	M	TB	TB				QB	QC	QC			MA	MA	MB			SA	SA	SA		
39,000 pF	393	J	K	M	TB	TC				QB	QC	QD			MA	MA	MB			SA	SA	SB		
47,000 pF	473	J	K	M	TB					QB	QC				MA	MB	MC			SA	SA	SB		
56,000 pF	563	J	K	M	TC					QC	QD				MA	MB				SA	SA	SB		
68,000 pF	683	J	K	M						QC	QD				MB	MC				SA	SB	SC		
82,000 pF	823	J	K	M						QC					MB					SA	SB			
0.10 µF	104	J	K	M						QD					MC					SB	SC			
0.12 µF	124	J	K	M											MC					SB				
0.15 µF	154	J	K	M																SC				
		Wor	king Volt	age	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	500	630	1000	1500	2000
Capacitance	Сар		ric Withstanding		1000	1250	2000	3000	3500	1000	1250	2000	3000	3500	1000	1250	2000	3000	3500	1000	1250	2000	3000	3500
- = = = = = = = = = = = = = = = = = = =	Code	Vo	Itage Cod	de	D	U	G	Н	٧	D	U	G	Н	٧	D	U	G	Н	٧	D	U	G	Н	٧
		Case	Size/S	eries		С	2824	Н			С	3040	Н			С	3640	Н			С	4540	Н	



Table 2 – Chip Thickness/Tape & Reel Packaging Quantities

Thickness	Case	Thickness ±	Paper C	Quantity	Plastic (Quantity		
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel		
TA	2824	1.40 ± 0.15	0	0	750	2,500		
TB	2824	2.00 ± 0.20	0	0	300	2,000		
TC	2824	2.50 ± 0.20	0	0	300	2,000		
QB	3040	1.40 ± 0.15	0	0	500	1,650		
QC	3040	2.00 ± 0.20	0	0	500	1,650		
QD	3040	2.50 ± 0.20	0	0	350	1,400		
MA	3640	1.40 ± 0.15	0	0	250	1,550		
MB	3640	2.00 ± 0.20	0	0	250	1,550		
MC	3640	2.50 ± 0.20	0	0	250	1,550		
SA	4540	1.40 ± 0.15	0	0	200	1,500		
SB	4540	2.00 ± 0.20	0	0	200	1,500		
SC	4540	2.50 ± 0.20	0	0	200	1,500		
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

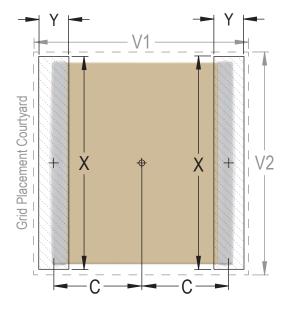
Size Code (In.)	Metric Size Code	Density Level A: Maximum (Most) Land Protrusion (mm)						Medi	sity Lev an (Nor rotrusio	ninal))	Density Level C: Minimum (Least) Land Protrusion (mm)					
(1111)	0040	С	Υ	Х	V1	V2	С	Υ	X	V1	V2	С	Υ	Х	V1	V2	
2824	7260	3.45	1.70	6.60	9.60	7.60	3.35	1.50	6.50	8.70	7.00	3.25	1.30	6.40	8.00	6.70	
3040	7610	3.70	1.70	10.70	10.10	11.70	3.60	1.50	10.60	9.20	11.10	3.50	1.30	10.50	8.50	10.80	
3640	9210	4.45	1.70	10.70	11.60	11.70	4.35	1.50	10.60	10.70	11.10	4.25	1.30	10.50	10.00	10.80	
4540	-	5.60	1.70	10.70	13.90	11.70	5.50	1.50	10.60	13.00	11.10	5.40	1.30	10.50	12.30	10.80	

Density Level A: For low-density product applications. Provides a wider process window for reflow solder processes.

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 a 3640 case size.





Soldering Process

Recommended Soldering Technique:

· 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			
Frome reature	SnPb	100% Matte Sn			
Preheat/Soak					
Temperature Minimum (T _{Smin})	100°C	150°C			
Temperature Maximum (T _{Smax})	150°C	200°C			
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds			
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum			
Liquidous Temperature (T _L)	183°C	217°C			
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds			
Peak Temperature (T _P)	235°C	260°C			
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum			
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum			
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum			

Note 1: All temperatures refer to the center of the package, measured on the capacitor body surface that is facing up during assembly reflow.

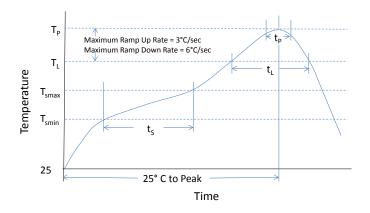




Table 4 – Performance & Reliability: Test Methods and Conditions

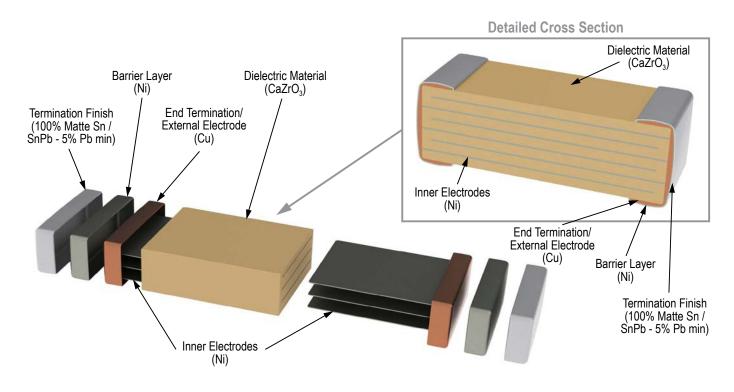
	Product Qualification Test Plan
Reliability	/Environmental Tests per MIL–STD–202//JESD22
Load Humidity	85°C/85%RH and 200 VDC maximum, 1,000 Hours
Low Voltage Humidity	85°C/85%RH, 1.5V, 1,000 Hours
Temperature Cycling	-55°C to +200°C, 50 Cycles
Thermal Shock	-55°C to +150°C, 20 seconds transfer, 15 minute dwell, 300 Cycles
Moisture Resistance	Cycled Temp/RH 0 V, 10 cycles @ 24 hours each
Physical, Mech	nanical & Process Tests per MIL-STD 202/JIS-C-6429
Resistance to Solvents	Include Aqueous wash chemical – OKEM Clean or equivalent
Mechanical Shock and Vibration	Method 213: Figure 1, Condition F Method 204: 5 gs for 20 minutes, 12 cycles
Resistance to Soldering Heat	Condition B, no per-heat of samples, Single Wave Solder
Terminal Strength	Force of 1.8 kg for 60 seconds
Board Flex	Appendix 2, Note: 3.0 mm (minimum)

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



Capacitor Marking (Optional):

Laser marking option is not available on:

- C0G, Ultra Stable X8R and Y5V dielectric devices
- EIA 0402 case size devices
- EIA 0603 case size devices with Flexible Termination option.
- KPS Commercial and Automotive grade stacked devices.

These capacitors are supplied unmarked only.

Packaging

Please contact KEMET for details regarding available packaging options.

High Voltage C0G Dielectric, 500 – 3,000 VDC (Commercial Grade)



Overview

KEMET's High Voltage surface mount MLCCs in C0G dielectric feature a 125°C maximum operating temperature and are considered "stable." The Electronics Industries Alliance (EIA) characterizes C0G dielectric as a Class I material. Components of this classification are temperature compensating and are suited for resonant circuit applications or those where Q and stability of capacitance characteristics are required. C0G exhibits no change in capacitance with respect to time and voltage and boasts a negligible change in capacitance with reference to ambient temperature. Capacitance change is limited to ±30ppm/°C from -55°C to +125°C.

These devices exhibit low ESR at high frequencies and find conventional use as snubbers or filters in applications such as switching power supplies and lighting ballasts. Their exceptional performance at high frequencies has made high voltage MLCC's the preferred dielectric choice of design engineers worldwide. In addition to their use in power supplies, these capacitors are widely used in industries related to automotive(hybrid), telecommunications, medical, military, aerospace, semiconductors and test/diagnostic equipment.

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



Ordering Information

С	1210	С	332	J	C	G	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance ¹	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/ Grade (C-Spec)
	0805 1206 1210 1808 1812 1825 2220 2225 2824 3040 3640 4540	C = Standard	Two significant digits + number of zeros.	B = ±0.10 pF C = ±0.25 pF D = ±0.5 pF F = ±1% G = ±2% J = ±5% K = ±10% M = ±20%	C = 500 B = 630 D = 1,000 F = 1,500 G = 2,000 Z = 2,500 H = 3,000	G = C0G	A = N/A	C = 100% Matte Sn L = SnPb (5% Pb min.)	See "Packaging C-Spec Ordering Options Table" below

¹ Additional capacitance tolerance offerings may be available. Contact KEMET for details.

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



Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec)
Bulk Bag/Unmarked	Not required (Blank)
7" Reel/Unmarked	TU
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2 mm pitch ²	7081
13" Reel/Unmarked/2 mm pitch ²	7082

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- Operating temperature range of -55°C to +125°C
- Lead (Pb)-Free, RoHS and REACH compliant
- EIA 0805, 1206, 1210, 1808, 1812, 1825, 2220, 2225, 2824, 3040, 3640 and 4540 case sizes
- DC voltage ratings of 500 V, 630 V, 1 KV, 1.5 KV, 2 KV, 2.5 KV, and 3 KV
- Capacitance offerings ranging from 1 pF to 0.150 μF
- Available capacitance tolerances of ±0.10 pF, ±0.25 pF, ±0.5 pF, ±1%, ±2%, ±5%, ±10%, and ±20%
- No piezoelectric noise
- Extremely low ESR and ESL
- High thermal stability
- · High ripple current capability

- Preferred capacitance solution at line frequencies & into the MHz range
- No capacitance change with respect to applied rated DC voltage
- Negligible capacitance change with respect to temperature from -55°C to +125°C
- · No capacitance decay with time
- · Non-polar device, minimizing installation concerns
- Automotive (AEC-Q200) grade available
- 100% pure matte tin-plated termination finish allowing for excellent solderability
- SnPb plated termination finish option available upon request (5% Pb minimum)

Applications

Typical applications include switch mode power supplies (input filters, resonators, tank circuits, snubbed circuits, output filters), high voltage coupling and DC blocking, lighting ballasts, voltage multiplier circuits, DC/DC converters and coupling capacitors in Ćuk converters. Markets include power supply, LCD fluorescent backlight ballasts, HID lighting, telecom equipment, industrial and medical equipment/control, LAN/WAN interface, analog and digital modems, and automotive.

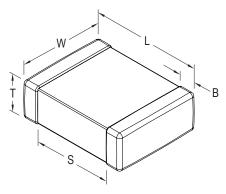
¹ "Bulk Bag" packaging option is not available for case sizes larger than 2225 (5664 Metric).

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. The option to laser mark is not available on these devices. For more information see "Capacitor Marking".

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Dimensions – Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0805	2012	2.00 (.079) ± 0.20 (.008)	1.25 (.049) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	"Solder Wave or
1206	3216	3.20 (.126) ± 0.20 (.008)	1.60 (.063) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)		Solder Reflow"
1210	3225	3.20 (.126) ± 0.20 (.008)	2.50 (.098) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)		
1808	4520	4.70 (.185) ± 0.50 (.020)	2.00 (.079) ± 0.20 (.008)		0.60 (.024) ± 0.35 (.014)		
1812	4532	4.50 (.177) ± 0.30 (.012)	3.20 (.126) ± 0.30 (.012)		0.60 (.024) ± 0.35 (.014)		
1825	4564	4.50 (.177) ± 0.30 (.012)	6.40 (.252) ± 0.40 (.016)	See Table 2 for	0.60 (.024) ± 0.35 (.014)		
2220	5650	5.70 (.224) ± 0.40 (.016)	5.00 (.197) ± 0.40 (.016)	Thickness	0.60 (.024) ± 0.35 (.014)	N/A	Caldan Daffass Only
2225	5664	5.60 (.220) ± 0.40 (.016)	6.40 (.248) ± 0.40 (.016)		0.60 (.024) ± 0.35 (.014)		Solder Reflow Only
2824	7260	7.10 (.280) ± 0.40 (.016)	6.10 (.240) ± 0.40 (.016)		1.27 (.050) ± 0.40 (.016)		
3040	7610	7.60 (.300) ± 0.40 (.016)	10.20 (.402) ± 0.40 (.016)		1.27 (.050) ± 0.40 (.016)		
3640	9210	9.10 (.358) ± 0.40 (.016)	10.20 (.402) ± 0.40 (.016)		1.27 (.050) ± 0.40 (.016)		
4540	-	11.40 (.449) ± 0.40 (.016)	10.20 (.402) ± 0.40 (.016)		1.27 (.050) ± 0.40 (.016)		

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)	±30 ppm/°C
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	0%
¹ Dielectric Withstanding Voltage (DWV)	150% of rated voltage for voltage rating of < 1,000 V 120% of rated voltage for voltage rating of ≥ 1,000 V (5 ±1 seconds and charge/discharge not exceeding 50 mA)
² Dissipation Factor (DF) Maximum Limit at 25°C	0.1%
³ Insulation Resistance (IR) Limit at 25°C	1,000 megohm microfarads or 100 GΩ (500 VDC applied for 120 ±5 seconds at 25°C)

¹DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

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."

Post Environmental Limits

	High Temperatu	ıre Life, Biased	Humidity, Mois	ture Resistance	
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance
C0G	All	All	0.5	0.3% or ±0.25 pF	10% of Initial Limit

²Capacitance and dissipation factor (DF) measured under the following conditions:

¹ MHz ±100 kHz and 1.0 Vrms ±0.2 V if capacitance ≤ 1,000 pF

¹ kHz ± 50 Hz and 1.0 Vrms ± 0.2 V if capacitance > 1,000 pF

 $^{{}^{3}}$ To obtain IR limit, divide M Ω - μ F value by the capacitance and compare to G Ω limit. Select the lower of the two limits.



Table 1A – Capacitance Range/Selection Waterfall (0805 – 1808 Case Sizes)

		Case Size/Series	С	0805	C		C,	1206	C			С	1210	C				С	1808	C		
	Сар	Voltage Code	С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	Z	Н
Capacitance	Code	Rated Voltage (VDC)	200	630	1000	500	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	2500	3000
		Capacitance					F	rod	ıct A	vaila			Chi	p Thi	ickne					.,,		(-)
1.0 - 9.1 pF*	109 - 919*	Tolerance	DG	DG	DG			Sec	Tab	le 2 f	or C	hip T	hick	ness	Dim	ensi LB	LB	LB	LB	LB	LB	
1.0 - 9.1 pF 10 pF - 47pF*	109 - 919	F G J K M	DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	
11 pF	110	F G J K M	DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	
12 pF	120	F G J K M	DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	
13 pF	130	F G J K M	DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	
15 pF	150	F G J K M	DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	
16 pF	160		DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	
18 pF	180	F G J K M	DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	
20 pF	200	F G J K M	DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	
22 pF	220	F G J K M	DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	
24 pF	240	F G J K M	DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	
27 pF	270	F G J K M	DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	
30 pF	300	F G J K M	DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	
33 pF	330	F G J K M	DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	
36 pF	360	F G J K M	DG	DG DG	DG DG	ED ED	ED	ED ED	ED	ED ED	FM	FM	FM FM	FM	FM FM	LB	LB LB	LB LB	LB	LB LB	LB	
39 pF 43 pF	390 430		DG DG	DG	DG	ED	ED ED	ED	ED ED	ED	FM FM	FM FM	FM	FM FM	FM	LB LB	LB	LB	LB LB	LB	LB LB	
43 pF 47 pF	470	F G J K M	DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	
51 pF	510	F G J K M	DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	
56 pF	560	F G J K M	DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	
62 pF	620	F G J K M	DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	
68 pF	680	F G J K M	DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	
75 pF	750	F G J K M	DG	DG	DG	ED	ED	ED	ED	EF	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	
82 pF	820	F G J K M	DG	DG	DG	ED	ED	ED	ED	EF	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	
91 pF	910	F G J K M	DG	DG	DG	ED	ED	ED	ED	EF	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	
100 pF	101	F G J K M	DG	DG	DG	ED	ED	ED	ED	EF	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LC	
110 pF	111	F G J K M	DG	DG	DG	ED	ED	ED	ED	EG	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LC	
120 pF	121	F G J K M	DG	DG	DG	ED	ED	ED	ED	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LB	LC	
130 pF	131		DG	DG	DG	ED	ED	ED	ED	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LB	LC	
150 pF	151	F G J K M	DG	DG	DG	ED	ED	ED	EF	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LB	LC	
160 pF	161	F G J K M	DG	DG	DG	ED	ED	ED	EF	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LC	LC	
180 pF	181	F G J K M	DG	DG	DG	ED	ED	ED	EF	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LC	LC	
200 pF	201	F G J K M	DG	DG	DG	ED	ED	ED	EF	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LC	LC	
220 pF	221	F G J K M	DG	DG	DG	ED	ED	ED	EG	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LC	LC	
240 pF	241	F G J K M	DG	DG	DG DG	ED	ED	ED	EG	EG EG	FG	FG	FG	FM	FM	LA	LA	LA	LB	LC	LC	
270 pF	271		DG	DG	DG	ED	ED	ED	EG EG	EG	FG	FG	FG FG	FK	FK	LA	LA	LA	LB	LC	LC	
300 pF 330 pF	301 331	F G J K M F G J K M	DG DG	DG DG		ED ED	ED ED	EF EF	EG		FG FG	FG FG	FG	FK FK	FK FK	LA LA	LA LA	LA LA	LB LB	LC LC	LC LC	
360 pF	361	F G J K M	DG	DG		ED	ED	EF	EG		FG	FG	FG	FK	FS	LA	LA	LA	LB	LA	LC	
390 pF	391	F G J K M	DG	DG		ED	ED	EF	EG		FG	FG	FG	FK	FS	LA	LA	LA	LB	LA	LC	
430 pF	431	F G J K M	DG	DG		ED	ED	EF	EG		FG	FM	FM	FS	FS	LA	LB	LB	LC	LA		
470 pF	471	F G J K M	DG	DG		ED	ED	EG	EG		FG	FM	FM	FS	FS	LA	LB	LB	LC	LA		
510 pF	511	F G J K M	DG	DG		ED	ED	EG	EG		FG	FM	FM	FS	FS	LA	LB	LB	LC	LB		
560 pF	561	F G J K M	DG	DG		ED	ED	EG	EG		FG	FM	FM	FS	FS	LA	LB	LB	LC	LB		
620 pF	621	F G J K M	DG			ED	ED	EG			FG	FM	FM	FS	FS	LA	LB	LB	LA	LC		
680 pF	681	F G J K M	DG			ED	ED	EG			FG	FM	FM	FS	FS	LB	LB	LB	LA	LC		
750 pF	751	F G J K M	DG			ED	EF	EG			FG	FM	FM	FM		LB	LB	LB	LA			
820 pF	821	F G J K M	DG			ED	EF	EG			FG	FM	FM	FM		LB	LB	LB	LA			
910 pF	911	F G J K M				ED	EF	EG			FM	FM	FM	FY		LB	LB	LB	LA			
1,000 pF	102	F G J K M				ED	EF	EG			FM	FM	FM	FY		LB	LB	LB	LB			
1,100 pF	112	F G J K M		-	0	EF_	EG	•	0	0	FM	FK	FK O	FS	0	LC	LC	LC	LB 0	•	0	•
Compatitions	Сар	Rated Voltage (VDC)	200	630	1000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	2500	3000
Capacitance	Code	Voltage Code	С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	Z	Н
		Case Size/Series	С	0805	С		С	1206	<u>c</u>			С	1210	<u>c</u>				С	1808	<u>c</u>		

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).



Table 1A - Capacitance Range/Selection Waterfall (0805 - 1808 Case Sizes) cont'd

		C	ase	e S	ize	e/S	eri	ies		C	0805	iC		С	1206	C			С	1210	C				С	1808	C		
	Сар		,	Volta	age	Cod	de			С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	Z	н
Capacitance	Code		Rate	ed V	olta	ige ((VD(C)	İ	200	630	1000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	100	1500	2000	2500	3000
			С	apa	acit	tar	ıce		Ť					<u> </u>	Prod	uct A	vaila	bilit	y and	d Chi	p Th	ickne	ess C	ode	S				
				Tol	<u>era</u>	anc	е		┙						See	Tab	le 2 1	or C	hip T	hick	ness	Dim	ensi	ons					
1,200 pF	122			- 1		G	J		И				EF	EG				FM	FK	FK	FS		LC	LC	LC	LC			
1,300 pF	132					G	J	K N	И				EF	EG				FM	FS	FS			LC	LC	LC	LC			
1,500 pF	152				F	G	J	K N	И				EF	EG				FK	FS	FS			LC	LC	LC	LC			
1,600 pF	162					G	J		И				EF	EG				FK	FS	FS			LC	LC	LC				
1,800 pF	182			1 1		G	J	.	И				EF	EG				FK	FS	FS			LC	LC	LC				
2,000 pF	202			1 1		G	J	.	И				EG	EB				FK	FL	FS			LC	LA	LB				
2,200 pF	222			1 1		G	J		И				EG	EB				FK	FL	FS			LC	LA	LB				
2,400 pF	242			1 '		G	J	.	И				EG	EB				FS	FL	FS			LC	LA	LB				
2,700 pF	272					G	J		И				EG	EB				FS	FL	FS			LC	LA	LC				
3,000 pF	302				F	G	J	K N	И				EB	EB				FS	FL				LA	LA					
3,300 pF	332					G	J	K N	И				EB	EB				FS	FM				LA	LA					
3,600 pF	362				F	G	J	K N	И				EC	EC				FL	FM				LA	LB					
3,900 pF	392				F	G	J	K N	И				EC	EC				FL	FY				LA	LB					
4,300 pF	432			_		G	J		И				ED	ED				FM	FY				LA	LC					
4,700 pF	472					G	J		И				ED	ED				FM	FY				LA	LC					
5,100 pF	512					G	J		И									FY	FS				LA						
5,600 pF	562			1 1		G	J		И									FY	FS				LB						
6,200pF	622					G	J		И									FY	FE				LC						
6,800pF	682					G	J		И									FY	FE				LC						
7,500pF	752					G	J		И									FS											
8,200 pF	822				F	G	J	K N	И									FS											
	Cap		Rate	ed V	olta	ige ((VD(C)		200	630	1000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	2500	3000
Capacitance	Cap		-	Volta	age	Cod	de		I	С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	Z	Н
		(Case Size/Series		С	0805	C		C	1206	C			С	1210	С				С	1808	С							

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).



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

			Case Size/ Series						C'	1812	2C					C 1	182	5C					C2	222	0C					C2	222	5C		
Capacitance	Сар						С	В	D	F	G	z	Н	С	В	D	F	G	z	Н	С	В	D	F	G	z	Н	С	В	D	F	G	z	Н
Capacitance	Code	R	ated \			DC)	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
		H		pacita	· ·		-			_	7	7	က	Pr	odu	ct A	vai	labi	lity	and	Cr	nip 1	Γhic	kne	SS	Coc	les			_	_	7	7	<u>س</u>
10 pF - 47pF*	100 - 470*	F	G	olera	ice K	М	GK	GK	GK	CK	GK	GK	CK	HG			HG		Ch HG	ip T HG	hic JK	kne JK	SS [JK	ens JK	JK	S JK	KF	KF	KF	KF	KF	KF	KF
11 pF	110	F	G	J	K	M	GK	GK	GK	GK		GK		HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
12 pF	120	F	G	J	K	М	GK	GK	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
13 pF	130	F	G	J	K	M	GK	GK	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
15 pF	150	F	G	J	K	M	GK	GK	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
16 pF	160	F	G	J	K	M	GK	GK	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
18 pF	180 200	F	G	J	K	M	GK GK	GK GK	GK GK	GK GK	GK GK	GK GK	GK GK	HG HG	HG HG	HG HG	HG HG	HG HG	HG HG	HG HG	JK JK	JK JK	JK JK	JK JK	JK JK	JK JK	JK JK	KF KF	KF KF	KF KF	KF KF	KF KF	KF KF	KF KF
20 pF 22 pF	200	F	G	J	K	M	GK	GK	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
24 pF	240	F	G	J	K	M	GK	GK	GK	GK	GK	GK				HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
27 pF	270	F	G	J	K	M	GK	GK	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
30 pF	300	F	G	J	K	M	GK	GK	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
33 pF	330	F	G	J	K	M	GK	GK	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
36 pF	360	F	G	J	K	M	GK	GK	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
39 pF	390	F	G	J	K	M	GK	GK	GK	GK GK	GK	GK GK	GK	HG HG	HG HG	HG HG	HG HG	HG HG	HG HG	HG HG	JK	JK	JK JK	JK JK	JK JK	JK JK	JK JK	KF KF	KF KF	KF KF	KF KF	KF KF	KF KF	KF KF
43 pF 47 pF	430 470	F	G	J	K	M	GK GK	GK GK	GK GK	GK	GK GK	GK	GK GK	HG	HG	HG	HG	HG	HG	HG	JK JK	JK JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
51 pF	510	F	G	J	K	M	GK	GK	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
56 pF	560	F	G	J	K	M	GK	GK	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
62 pF	620	F	G	J	K	М	GK	GK	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
68 pF	680	F	G	J	K	M	GK	GK	GK	GK	GK	GK	GK	HG	HG		HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
75 pF	750	F	G	J	K	M	GK	GK	GK	GK	GK	GK		HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
82 pF	820	F	G	J	K	M	GK	GK	GK	GK	GK	GK GK	GK	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
91 pF 100 pF	910 101	F	G	J	K	M	GK GK	GK GK	GK GK	GK GK	GK GK	GK	GK GK	HG HG	HG HG	HG HG	HG HG	HG HG	HG HG	HG HG	JK JK	JK JK	JK JK	JK JK	JK JK	JK JK	JK JK	KF KF	KF KF	KF KF	KF KF	KF KF	KF KF	KF KF
110 pF	111	F	G	J	K	M	GK	GK	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
120 pF	121	F	G	J	K	M	GK	GK	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
130 pF	131	F	G	J	K	M	GK	GK	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
150 pF	151	F	G	J	K	M	GK	GK	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
160 pF	161	F	G	J	K	M	GK	GK	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
180 pF 200 pF	181 201	F	G	J	K	M	GK GH	GK GH	GK GH	GK GH	GK GH	GK GK	GK GM	HG HE	HG HE	HG HE	HG HE	HG HE	HG HE	HG HG	JK JK	JK JK	JK JK	JK JK	JK JK	JK JK	JK JK	KF KF	KF KF	KF KF	KF KF	KF KF	KF KF	KF KF
220 pF	221	F	G	J	K	M	GH	GH	GH	GH	GH	GK	GM	HE	HE	HE	HE	HE	HE	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
240 pF	241	F	G	J	K	M	GH	GH	GH	GH	GH	GK	GM	HE	HE	HE	HE	HE	HE	HG	JK	JK	JK	JK	JK	JK	JK	KE	KE	KE	KE	KE	KE	KF
270 pF	271	F	G	J	K	M	GH	GH	GH	GH	GH	GK	GM	HE	HE	HE	HE	HE	HE	HG	JK	JK	JK	JK	JK	JK	JK	KE	KE	KE	KE	KE	KE	KF
300 pF	301	F	G	J	K	М	GH	GH	GH	GH	GH	GK	GM	HE	HE	HE	HE	HE	HE	HG	JK	JK	JK	JK	JK	JK	JK	KE	KE	KE	KE	KE	KE	KF
330 pF	331	F	G	J	K	M	GH		GH	GH	GH	GK	GO	HE	HE	HE	HE	HE	HE	HG	JE	JE	JE	JE	JE	JK	JK	KE	KE	KE	KE	KE	KE	KF
360 pF	361	F	G	J	K	M	GK	GK	GK	GK	GH	GK	GO		HE	HE	HE	HE	HE	HG	JE	JE	JE	JE	JE	JK	JK	KE	KE	KE	KE	KE	KE	KF
390 pF 430 pF	391 431	F	G	J	K	M	GK	GK GK	GK GK	GK	GK GK	GK GK	GO	HE	HE	HE	HE	HE	HE	HG HJ	JE JE	JE JE	JE JE	JE JE	JE JE	JK JK	JK JE	KE KE	KE	KE	KE KE	KE KE	KE KE	KF KF
470 pF	471	F	G	J	K	M	GK GK	_		_	GK	_		HE	HE		HE		HE	HJ	JE	JE	JE	JE	JE	JK	JK	KF	KF	KF	KF	KE		KF
510 pF	511	F	G	J	K	M					GH			HE	HE	HE	HE		HE	HJ	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KE	KE	KF
560 pF	561	F	G	J	K	М					GH			HE	HE				HE	HJ	JK	JK	JK	JK	JK	JK	JL	KF	KF	KF	KF	KE	KE	KF
620 pF	621	F	G	J	K	M	GH	GH	GH	GK	GH	GM		HE	HE					HK	JK	JK	JK	JK	JK	JK	JL	KF	KF	KF	KF	KE	KF	KH
680 pF	681	F	G	J	K	M					GH	GO		HE	HE		HE		HG	HK	JE	JE	JE	JK	JK	JK	JL	KF	KF	KF	KF	KE	KF	KH
750 pF	751	F	G	J	K	M		GH	1		1			HE	HE		HG		HG		JE	JE	JE	JK	JK	JK	JL	KE		KE	KF	KE	KF	KH
820 pF 910 pF	821 911	F	G	J	K	M		GH			GM							HG HG			JE JE	JE JK	JE JK	JK JK	JK JK	JK JK	JN JN			KE KE		KE KE	KF	KJ
910 pr	311		ated \	_			500		1000	1500	2000		3000	200 ∃	630	1000	1500	2000	2500		200 ⊞	630	1000	1500	2000	2500 5	_	200	630	1000	1500 7	2000	2500 3	3000
Capacitance	Cap				Code		С	_	D	F	G	Z	Н	С	В	D	F	G	Z	Н								С	В	D	F	G	Z	Н
,	Code	Ca	ase S	Size	/Sei	ries			С	1812	2C					C,	182	5C					C2	2220	0C					C	222	5C		

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).



Table 1B - Capacitance Range/Selection Waterfall (1812 - 2225 Case Sizes) cont'd

			Cas	se S		e/				C1	181	2C					C1	82	5C					C2	222	0C					C	222	5C		
Capacitance	Cap		Vol	tage	Cod	—— е		С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н	С	В	D	F	G	z	Н	С	В	D	F	G	z	Н
Capacitance	Code	R	ated \				C)	200	630	1000	1500	2000	2500	3000	200	630	100	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
					tance		_		_	_	_	7	7	က					_							288			"		_	_	7	7	
		L	To	olera												<u>See</u>	Tab	le 2		<u>Ch</u>		hic				ens	ions	<u> </u>							
1,000 pF	102	F	G	J	K		М		GH			GM			HE	HE	HE	HG	HG	HG		JE	JK	JK	JK	JK	JK	JN		KE	KE	KF	KE	KF	KJ
1,100 pF	112	F	G	J	K	_	М	GH	GK	GK	GH	GO			HE	HE	HE	HG	HG	HJ		JE	JK	JK	JK	JK	JK		KE	KE	KE	KF	KF	KF	
1,200 pF	122	F	G	J	K		М	GH	GK	GK	GH	GO			HE	HE	HE	HG	HG	HJ		JE	JK	JK	JK	JK	JL		KE	KE	KE	KF	KF	KF	
1,300 pF	132	F	G	J	K		М	GH	GK	GK	GH	GO			HE	HE	HE	HG	HE	HJ		JE	JK	JK	JK	JE	JL		KE	KE	KE	KF	KF	KH	
1,500 pF	152	F	G	J	K		М	GK	GK	GK	GK	GO			HE	HE	HE	HG	HE	HK		JE	JK	JK	JK	JE	JL		KE	KE	KE	KF	KF	KH	
1,600 pF	162	F	G	J	K		М	GK	GK	GK	GK				HE	HG	HG	HG	HG	HK		JE	JK	JK	JK	JE	JL		KE	KE	KE	KF	KE	KH	
1,800 pF	182	F	G	J	K	_	М	GK	GK		GM				HE	HG	HG	HG	HG			JE	JK	JK	JK	JE	JN		KE	KE	KE	KF	KE	KH	
2,000 pF	202	F	G	J	K		М	GK	GK		GM				HE	HG	HG	HE	HJ			JE	JK	JK	JE	JK			KE	KE	KE	KF	KE	KJ	
2,200 pF	222	F	G	J	K		М	GK	GK	GK	GO				HE	HG	HG	HE	HJ			JE	JK	JK	JE	JK			KE	KE	KE	KF	KF	KJ	
2,400 pF	242	F	G	J	K		М	GK	GH	GK	GO				HE	HG	HG	HE	HJ			JK	JK	JK	JE	JL			KE	KE	KE	KE	KH		
2,700 pF	272	F	G	J	K		М	GK	GH	GK	GO				HE	HG	HG	HE	HK			JK	JK	JK	JE	JL			KE	KE	KE	KE	KH		
3,000 pF	302	F	G	J	K		М	GK	GH	GK					HG	HG	HG	HE	HK			JK	JK	JK	JE	JL			KE	KE	KE	KE	KH		
3,300 pF	332	F	G	J	K		М	GK	GH	GK					HG	HG	HG	HG				JK	JK	JK	JK	JN			KE	KE	KE	KE	KJ		
3,600 pF	362	F	G	J	K		М	GK	GH	GM					HG	HG	HG	HG				JK	JK	JK	JK	JN			KE	KF	KF	KF	KJ		
3,900 pF	392	F	G	J	K		М	GK	GH	GM					HG	HG	HG	HJ				JK	JK	JK	JK	JN			KE	KF	KF	KF	KJ		
4,300 pF	432	F	G	J	K		М	GH	GH	GO					HG	HG	HG	HJ				JK	JK	JK	JK				KE	KF	KF	KF			
4,700 pF	472	F	G	J	K		М	GH	GH	GO					HG	HG	HG	HJ				JK	JK	JK	JL				KE	KF	KF	KH			
5,100 pF	512	F	G	J	K		М	GH	GK	GO					HG	HE	HG	HK				JK	JK	JK	JL				KE	KF	KF	KH			
5,600 pF	562	F	G	J	K		М	GH	GK	GO					HG	HE	HG	HK				JK	JK	JK	JN				KE	KF	KF	KH			
6,200pF	622	F	G	J	K		М	GH	GK						HG	HE	HG					JK	JE	JE	JN				KE	KF	KF	KJ			
6,800pF	682	F	G	J	K		М	GH	GM						HG	HE	HJ					JK	JE	JK	JN				KE	KF	KF	KJ			
7,500pF	752	F	G	J	k		М	GH	GM						HG	HE	HJ					JK	JE	JK					KF	KE	KF				
8,200 pF	822	F	G	J	K		М	GK	GO						HG	HE	HJ					JK	JE	JL					KF	KE	KF				
9,100 pF	912	F	G	J	K		М	GM	GO						HE	HG	HK					JE	JE	JL					KF	KE	KH				
10,000 pF	103	F	G	J	K		М	GM							HE	HG	HK					JE	JE	JL					KF	KE	KH				
12,000 pF	123	F	G	J	K		М	GO							HE	HG						JE	JK	JN					KE	KE	KH				
15,000 pF	153	F	G	J	K		М	GO							HE	HJ						JE	JL	011					KE	KF	KJ				
18,000 pF	183	F	G	J	K	_	M	30							HG	HK						JE	JL						KE	KH	110				
22,000 pF	223	F	G	J	K		M								HJ	7111						JK	JN						KF	KJ					
27,000 pF 27,000 pF	273	F	G	J	K		М								HJ							JL	JN						KF	KJ					
33,000 pF	333	F	G	J	K		М								HK							JN	JIN						KH	IVJ					
39,000 pF 39,000 pF	393	F	G	J	K		M								' I'							JIN							КJ						
59,000 pi	000	Ė		J						-	-	-	0	-	 _	_	-	-	-	-	-	 _		-	-	-	-	-	_	_	-	-	-	-	-
		R	ated \	/olta	ige (\	VD(C)	200	630	1000	1500	2000	2500	3000	200	630	100	1500	2000	2500	3000	200	630	100	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
Capacitance	Cap Code		Vol	tage	Cod	е		С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н
	Coue	Ca	se S	Size	e/Se	eri	es			C,	181	2C					C,	1825	SC.			C2220C							C	222	5C				

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)
KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).



Table 1C – Capacitance Range/Selection Waterfall (2824 – 4540 Case Sizes)

			ise Siz Series			С	2824	IC			C	3040	C			C	3640	C			C	4540	C	
Capacitance	Сар	Vo	Itage Co	de	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
	Code	Vo	Rated Itage (VI)C)	500	630	1000	1500	2000	500	630	1000	1500	2000	200	630	1000	1500	2000	500	630	1000	1500	2000
		C	apacitan	ce										y and						5				
10 - 2,000 pF	100 - 202	J	Folerance K	e M						See	lab	1e 2 1	or C	hip T	nick	ness	DIM	ensi	ons					
2,200 pF	222	J	K	M	TA	TA	TA	TA	TA															
2,400 pF	242	J	K	M																				
2,700 pF	272	J	K	M	TA	TA	TA	TA	TA	ļ														
3,000 pF 3,300 pF	302 332	J	K K	M M	TA	TA	TA	TA	TA	QB	QB	QB	QB	QB										
3,600 pF	362	J	K	M	IA	IA	IA	IA	IA	QB	QВ	QВ	QB	QB										
3,900 pF	392	Ĵ	K	M	TA	TA	TA	TA	ТВ	QB	QB	QB	QB	QB	МА	MA	MA	MA	MA					
4,300 pF	432	J	K	M	İ					"					İ									
4,700 pF	472	J	K	M	TA	TA	TA	TB	TB	QB	QB	QB	QB	QB	MA	MA	MA	MA	MA	SA	SA	SA	SA	SA
5,100 pF	512	J	K	M	_,	Τ.	т.		то.	0.0	0.0	0.0	0.0	0.0							0.4	0.4	0.4	0.4
5,600 pF 6,200 pF	562 622	J	K K	M M	TA	TA	TA	TB	TC	QB	QB	QB	QB	QB	MA	MA	MA	MA	MA	SA	SA	SA	SA	SA
6,800 pF	682	J	K	M	TA	TA	TA	ТВ		QB	QB	QB	QB	QC	MA	MA	MA	MA	MA	SA	SA	SA	SA	SA
7,500 pF	752	Ĵ	K	M	"`	.,,	.,,			\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	QD	QD	Q.D	40	11117	.,,,	1417 (11/1/	1417 (0,1	0,1	O/ C	0,1	0,1
8,200 pF	822	J	K	М	TA	TA	TA	TC		QB	QB	QB	QC	QC	MA	MA	MA	MA	MB	SA	SA	SA	SA	SA
9,100 pF	912	J	K	M																				
10,000 pF	103	J	K	M	TA	TA	TA			QB	QB	QB	QC	QD	MA	MA	MA	MA	MB	SA	SA	SA	SA	SB
12,000 pF 15,000 pF	123 153	J	K K	M M	TA TA	TA TA	TA TB			QB QB	QB QB	QB QB	QD QD		MA MA	MA MA	MA MA	MB MB	MB MC	SA SA	SA SA	SA SA	SA SB	SB SB
18,000 pF	183	J	K	M	TA	TA	TB			QB	QB	QB	QD		MA	MA	MA	MC	IVIC	SA	SA	SA	SB	SC
22,000 pF	223	Ĵ	K	M	TA	ТВ	TC			QB	QB	QC			MA	MA	MA			SA	SA	SA	SB	
27,000 pF	273	J	K	M	TA	ТВ				QB	QB	QC			MA	MA	MA			SA	SA	SA	SC	
33,000 pF	333	J	K	M	ТВ	TB				QB	QC	QC			MA	MA	MB			SA	SA	SA		
39,000 pF	393	J	K	M	TB	TC				QB	QC	QD			MA	MA	MB			SA	SA	SB		
47,000 pF 56,000 pF	473 563	J	K K	M M	TB TC					QB QC	QC QD				MA MA	MB MB	MC			SA SA	SA SA	SB SB		
68,000 pF	683	J	K	M	10					QC QC	QD QD				MB	MC				SA	SB	SC		
82,000 pF	823	J	K	M						QC	Q.D				MB					SA	SB			
0.1 µF	104	J	K	M						QD					MC					SB	SC			
0.12 μF	124	J	K	М											MC					SB				
0.15 μF	154	J	K	M																SC			_	
		Rated	Voltage	(VDC)	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000
Capacitance	Cap Code	Vo	Itage Co	de	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
	Code	Case	Case Size/Series			С	2824	С			С	3040	С			С	3640	С			С	4540	С	

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)
KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).



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

Thickness	Case	Thickness ±	Paper G	Quantity	Plastic (Quantity
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
EB	1206	0.78 ± 0.10	4000	10000	4,000	10,000
EC	1206	0.90 ± 0.10	0	0	4,000	10,000
ED	1206	1.00 ± 0.10	0	0	2,500	10,000
EF	1206	1.20 ± 0.15	0	0	2,500	10,000
EG	1206	1.60 ± 0.15	0	0	2,000	8,000
FE	1210	1.00 ± 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
FM FY	1210 1210	1.70 ± 0.20 2.00 ± 0.20	0	0	2,000 2,000	8,000 8,000
FK	1210	2.00 ± 0.20 2.10 ± 0.20	0	0	2,000	8,000
FS	1210	2.50 ± 0.20 2.50 ± 0.30	0	0	1,000	4,000
LA	1808	1.40 ± 0.15	Ö	Ő	1,000	4,000
LB	1808	1.60 ± 0.15	Ö	Ö	1,000	4,000
LC	1808	2.00 ± 0.15	0	0	1,000	4,000
GH	1812	1.40 ± 0.15	0	0	1,000	4,000
GK	1812	1.60 ± 0.20	0	0	1,000	4,000
GM	1812	2.00 ± 0.20	0	0	500	2,000
GO	1812	2.50 ± 0.20	0	0	500	2,000
HE	1825	1.40 ± 0.15	0	0	1,000	4,000
HG	1825	1.60 ± 0.20	0	0	1,000	4,000
HJ	1825	2.00 ± 0.20	0	0	500	2,000
HK	1825	2.50 ± 0.20	0	0	500	2,000
JE	2220	1.40 ± 0.15	0	0	1,000	4,000
JK	2220	1.60 ± 0.20	0	0	1,000	4,000
JL JN	2220 2220	2.00 ± 0.20 2.50 ± 0.20	0 0	0 0	500 500	2,000 2,000
KE	2225	1.40 ± 0.15	0	0	1,000	4,000
KF	2225	1.60 ± 0.13	0	0	1,000	4,000
KH	2225	2.00 ± 0.20	0	0	500	2,000
KJ	2225	2.50 ± 0.20	Ö	Ö	500	2,000
TA	2824	1.40 ± 0.15	Ö	Ö	750	2,500
TB	2824	2.00 ± 0.20	0	0	300	2,000
TC	2824	2.50 ± 0.20	0	0	300	2,000
QB	3040	1.40 ± 0.15	0	0	500	1,650
QC	3040	2.00 ± 0.20	0	0	500	1,650
QD	3040	2.50 ± 0.20	0	0	350	1,400
MA	3640	1.40 ± 0.15	0	0	250	1,550
MB	3640	2.00 ± 0.20	0	0	250	1,550
MC	3640	2.50 ± 0.20	0	0	250	1,550
SA SB	4540 4540	1.40 ± 0.15	0	0	200	1,500
SC	4540 4540	2.00 ± 0.20 2.50 ± 0.20	0	0	200 200	1,500 1,500
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 2B - Bulk Packaging Quantities

Doolson	T	Loose Pa	ackaging
Раскад	ing Type	Bulk Bag	(default)
Packagin	g C-Spec ¹	N/	'A²
Case	Size	Packaging Quantities (pieces/unit packaging)
EIA (in)	Metric (mm)	Minimum	Maximum
0402	1005		
0603	1608		
0805	2012		50,000
1206	3216		
1210	3225	1	
1808	4520		
1812	4532		
1825	4564		20,000
2220	5650		
2225	5664		

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

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



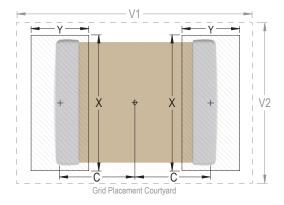
Table 3 - Chip Capacitor Land Pattern Design Recommendations per IPC-7351

EIA Size Code	Metric Size Code	Density Level A: Maximum (Most) Land Protrusion (mm)				Density Level B: Median (Nominal) Land Protrusion (mm)				Density Level C: Minimum (Least) Land Protrusion (mm)						
		С	Y	Х	V1	V2	С	Υ	X	V1	V2	С	Υ	X	V1	V2
0805	2012	1.00	1.35	1.55	4.40	2.60	0.90	1.15	1.45	3.50	2.00	0.75	0.95	1.35	2.80	1.70
1206	3216	1.60	1.35	1.90	5.60	2.90	1.50	1.15	1.80	4.70	2.30	1.40	0.95	1.70	4.00	2.00
1210	3225	1.60	1.35	2.80	5.65	3.80	1.50	1.15	2.70	4.70	3.20	1.40	0.95	2.60	4.00	2.90
1808	4520	2.30	1.75	2.30	7.40	3.30	2.20	1.55	2.20	6.50	2.70	2.10	1.35	2.10	5.80	2.40
1812	4532	2.15	1.60	3.60	6.90	4.60	2.05	1.40	3.50	6.00	4.00	1.95	1.20	3.40	5.30	3.70
1825	4564	2.15	1.60	6.90	6.90	7.90	2.05	1.40	6.80	6.00	7.30	1.95	1.20	6.70	5.30	7.00
2220	5650	2.75	1.70	5.50	8.20	6.50	2.65	1.50	5.40	7.30	5.90	2.55	1.30	5.30	6.60	5.60
2225	5664	2.70	1.70	6.90	8.10	7.90	2.60	1.50	6.80	7.20	7.30	2.50	1.30	6.70	6.50	7.00
2824	7260	3.45	1.70	6.60	9.60	7.60	3.35	1.50	6.50	8.70	7.00	3.25	1.30	6.40	8.00	6.70
3040	7610	3.70	1.70	10.70	10.10	11.70	3.60	1.50	10.60	9.20	11.10	3.50	1.30	10.50	8.50	10.80
3640	9210	4.45	1.70	10.70	11.60	11.70	4.35	1.50	10.60	10.70	11.10	4.25	1.30	10.50	10.00	10.80
4540	-	5.60	1.70	10.70	13.90	11.70	5.50	1.50	10.60	13.00	11.10	5.40	1.30	10.50	12.30	10.80

Density Level A: For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes. KEMET only recommends wave soldering of EIA 0603, 0805 and 1206 case sizes.

Density Level B: For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes. **Density Level C:** For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC Standard 7351 (IPC–7351).

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





Soldering Process

Recommended Soldering Technique:

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

Recommended Reflow Soldering Profile:

KEMET's families of surface mount multilayer ceramic capacitors (SMD MLCCs) are compatible with wave (single or dual), convection, IR or vapor phase reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET's recommended profile conditions for convection and IR reflow reflect the profile conditions of the IPC/J-STD-020 standard for moisture sensitivity testing. These devices can safely withstand a maximum of three reflow passes at these conditions.

Profile Feature	Termination Finish					
Frome reature	SnPb	100% Matte Sn				
Preheat/Soak						
Temperature Minimum (T _{Smin})	100°C	150°C				
Temperature Maximum (T _{Smax})	150°C	200°C				
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds				
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum				
Liquidous Temperature (T _L)	183°C	217°C				
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds				
Peak Temperature (T _P)	235°C	260°C				
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum				
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum				
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum				

Note 1: All temperatures refer to the center of the package, measured on the capacitor body surface that is facing up during assembly reflow.

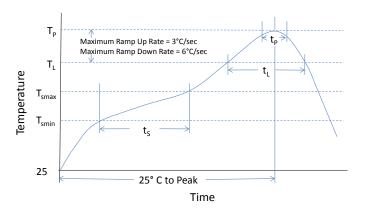




Table 4 - Performance & Reliability: Test Methods and Conditions

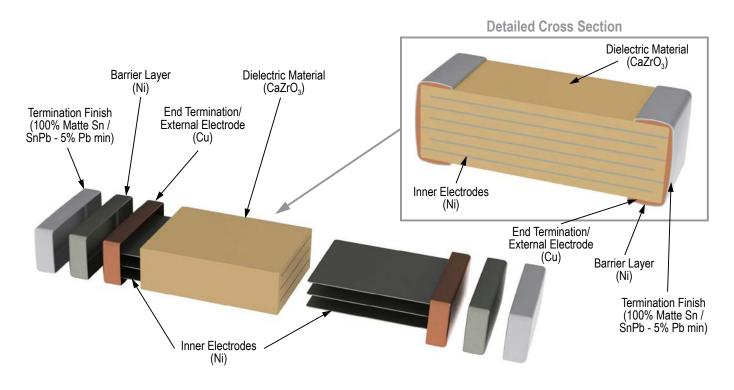
Stress	Reference	Test or Inspection Method					
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.					
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).					
		Magnification 50 X. Conditions:					
Solderability	J-STD-002	a) Method B, 4 hours at 155°C, dry heat at 235°C					
Solderability	J-31D-002	b) Method B at 215°C category 3					
		c) Method D, category 3 at 260°C					
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.					
Diggod Humidity	MIL-STD-202 Method 103	Load Humidity: 1,000 hours 85°C/85% RH and 200 VDC maximum. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.					
Biased Humidity	MIL-STD-202 Metriod 103	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.					
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.					
Thermal Shock	MIL-STD-202 Method 107	-55° C/+125°C. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air – Air.					
High Temperature Life	MIL-STD-202 Method 108	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 1.2 X rated voltage applied.					
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 min., 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, Condition F.					
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.					

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



Capacitor Marking (Optional):

Laser marking option is not available on:

- C0G, Ultra Stable X8R and Y5V dielectric devices
- EIA 0402 case size devices
- EIA 0603 case size devices with Flexible Termination option.
- KPS Commercial and Automotive grade stacked devices.

These capacitors are supplied unmarked only.

High Voltage X7R Dielectric, 500 – 3,000 VDC (Commercial Grade)



Overview

KEMET's High Voltage surface mount MLCCs in X7R Dielectric feature a 125°C maximum operating temperature and are considered "temperature stable." The Electronics Industries Alliance (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.

Available in a variety of case sizes and industry leading CV values (capacitance/voltage), these devices exhibit low leakage current and low ESR at high frequencies. Conventional uses include both snubbers and filters in applications such as switching power supplies and lighting ballasts. Their exceptional performance at high frequencies has made high voltage MLCC's the preferred dielectric choice of design engineers worldwide. In addition to their use in power supplies, these capacitors

are widely used in industries related to automotive (hybrid), telecommunications, medical, military, aerospace, semiconductors and test/diagnostic equipment.

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



Ordering Information

С	1210	С	154	K	С	R	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec)
	0603 0805 1206 1210 1808 1812 1825 2220 2225	C = Standard	Two significant digits + number of zeros.	J = ±5% K = ±10% M = ±20%	C = 500 B = 630 D = 1,000 F = 1,500 G = 2,000 Z = 2,500 H = 3,000	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

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



Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec)
Bulk Bag/Unmarked	Not required (Blank)
7" Reel/Unmarked	TU
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
7" Reel/Marked	TM
13" Reel/Marked	7040 (EIA 0603 and smaller case sizes) 7215 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2mm pitch ²	7081
13" Reel/Unmarked/2mm pitch ²	7082

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- -55°C to +125°C operating temperature range
- · Industry-leading CV values
- Exceptional performance at high frequencies
- · Lead (Pb)-Free, RoHS and REACH compliant
- EIA 0603, 0805, 1206, 1210, 1808, 1812, 1825, 2220, and 2225 case sizes
- DC voltage ratings of 500 V, 630 V, 1 KV, 1.5 KV, 2 KV, 2.5 KV, and 3 KV
- Capacitance offerings ranging from 10 pF to 560 nF

- Available capacitance tolerances of ±5%, ±10%, and ±20%
- · Low ESR and ESL
- Non-polar device, minimizing installation concerns
- Automotive (AEC–Q200) Grade available
- 100% pure matte tin-plated termination finish allowing for excellent solderability
- SnPb plated termination finish option available upon request (5% Pb minimum)

Applications

Typical applications include switch mode power supplies (input filters, resonators, tank circuits, snubber circuits, output filters), high voltage coupling and DC blocking, lighting ballasts, voltage multiplier circuits, DC/DC converters and coupling capacitors in Ćuk converters. Markets include power supply, LCD fluorescent backlight ballasts, HID lighting, telecom equipment, industrial and medical equipment/control, LAN/WAN interface, analog and digital modems, and automotive (electric and hybrid vehicles, charging stations and lighting applications).

Application Note

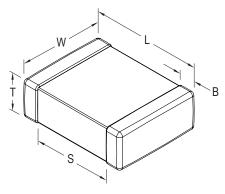
X7R dielectric is not recommended for AC line filtering or pulse applications. These capacitors and/or the assembled circuit board containing these capacitors may require a protective surface coating to prevent external surface arcing.

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. Please contact KEMET if you require a laser marked option. For more information see "Capacitor Marking".

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Dimensions – Millimeters (Inches)



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

Qualification/Certification

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

Environmental Compliance

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%
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
² Dielectric Withstanding Voltage (DWV)	150% of rated voltage for voltage rating of < 1000V 120% of rated voltage for voltage rating of ≥ 1000V (5 ± 1 seconds and charge/discharge not exceeding 50mA)
³ Dissipation Factor (DF) Maximum Limit @ 25°C	2.5%
⁴ Insulation Resistance (IR) Minimum Limit @ 25°C	See Insulation Resistance Limit Table (500VDC applied for 120 ± 5 secs @ 25°C)

¹Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

 $1kHz \pm 50Hz$ and 1.0 ± 0.2 Vrms if capacitance ≤ $10\mu F$

120Hz \pm 10Hz and 0.5 ± 0.1 Vrms if capacitance >10 μ F

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

Post Environmental Limits

	High Temperatu	ıre Life, Biased	Humidity, Moist	ture Resistance	
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance
	> 25		3.0		
X7R	16/25	All	5.0	±20%	10% of Initial Limit
	< 16		7.5		

Insulation Resistance Limit Table (X7R Dielectric)

EIA Case Size	1,000 Megohm Microfarads or 100 GΩ	100 Megohm Microfarads or 10 GΩ
0603	N/A	All
0805	< 0.0039 µF	≥ 0.0039 µF
1206	< 0.012 µF	≥ 0.012 µF
1210	< 0.033 µF	≥ 0.033 µF
1808	< 0.018 µF	≥ 0.018 µF
1812	< 0.027 µF	≥ 0.027 µF
≥ 1825	All	N/A

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

 $^{^4}$ To obtain IR limit, divide MΩ-μF value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



Table 1A – Capacitance Range/Selection Waterfall (0603 – 1812 Case Sizes)

			se Si Serie		C)60	3C	CO	805	5C		C 1	200	6C			C 1	210	C				C1	808	BC					C 1	1812	2C																																																																																																																																																																																																		
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Table 1A - Capacitance Range/Selection Waterfall (0603 - 1812 Case Sizes) cont'd

			se : Seri	Size/ es	C	060	3C	CI	080	5C		C1	120	6C			C1	210	OC				C,	180	8C					C,	181	2C		
Con	Cap	V	ltage	Code	С	В	D	С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н
Сар	Code	Ra	ted V (VD	oltage C)	200	630	1000	200	630	1000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
			apaci Tolera				Pro	du	ct A	vail	abil	ity a	and	Chi	p Tł	nick	nes	s C	ode	s - S	See	Tab	le 2	for	Chi	ip T	hick	nes	s D	ime	nsi	ons		
15,000 pF	153	J	K	М				DG			EG	EJ	EJ			FL	FL	FL	FL		LA	LC	LC	LC				GH		GK				
18,000 pF	183	J	K	M				DG			EJ	EJ	EJ			FL	FL	FL	FM		LA	LE	LE					GH		GK				
22,000 pF	223	J	K	M				DG			EJ	EJ	EJ			FL	FM		FM		LA	LE	LE					GH	-	GK	-			
27,000 pF	273	J	K	M		1					EJ	EJ				FM	FK	FK	FK		LA	LA	LA					GH	GB	GB	GO			
33,000 pF	333	J	K	M							EJ	EJ				FM	FG	FH	FS		LC	LA	LA					GH	GB	GB	GO			
39,000 pF 47,000 pF	393 473	J	K	M		1		l			EJ EJ					FK FK	FG FH	FH FK	FS		LC	LA LA	LA LB					GH GH	GB GB	GB GC				
56,000 pF	563	J	K	M							EJ					FG	FH	FK			LC	LA	LB					GH	GB	GE				
62,000 pF	623	J	K	M							EJ					FG	FK	FS			LA	LA	LC					GK	GB	GE				
68,000 pF	683	J	K	M		l					EJ					FG	FK	FS			LA	LA	LC					GE	GE	GE				
82,000 pF	823	J	K	M							LJ					FH	FK	13			LA	LC	LC					GB	GE	GK				
0.10 µF	104	.l	K	M												FK	FS				LA	LC						GB	GH	GJ				
0.12 µF	124	J	K	M												FK					LA							GE	GK					
0.15 µF	154	J	K	M												FK					LB							GE	GN					
0.18 µF	184	J	K	М		l	i	l																				GF						
0.22 µF	224	J	K	М	İ	l	İ	İ			İ					İ					l							GJ						
0.27 µF	274	J	K	М	İ	l	İ	İ			İ					İ					l							GL						
0.33 µF	334	J	K	M	l		l									l												GS						
		Ra	ted V	oltage	200	630	1000	200	630	1000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
Сар	Cap	V		Code	С	В	D	С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	Z	Н	С	В	D	F	G	z	Н
	Code			Size/					080				1200					1210						180							1812			

Table 1B – Capacitance Range/Selection Waterfall (1825–2225 Case Sizes)

			se Si Serie				С	1825	5C					C	2220	C					С	222	5C		
Consoitones	Cap	Vo	Itage C	ode	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н
Capacitance	Code	Rated	Voltage	e (VDC)	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
			apacita: olerano		Pro	duc	t Ava	ilabi	lity a	nd C	hip 1	Thick	nes	s Co	des -	- See	Tab	le 2 f	or Cl	hip T	hick	ness	Dim	ensi	ons
100 pF	101	J	K	M	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
110 pF	111	J	K	M	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
120 pF	121	J	K	M	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
130 pF	131	J	K	M	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
150 pF	151	J	K	M	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
180 pF	181	J	K	M	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
220 pF	221	J	K	M	HE	HE	HE	HE	HE	HE	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
270 pF	271	J	K	M	HE	HE	HE	HE	HE	HE	HG	JK	JK	JK	JK	JK	JK	JK	KE	KE	KE	KE	KE	KE	KF
330 pF	331	J	K	M								JE	JE	JE	JE	JE	JK	JK	KE	KE	KE	KE	KE	KE	KF
390 pF	391	J	К	М								JE	JE	JE	JE	JE	JK	JK	KE	KE	KE	KE	KE	KE	KF
470 pF	471	J	K	M	HG	HG	HG	HG	HG	HG	HG	JE	JE	JE	JE	JE	JK	JK	KF	KF	KF	KF	KE	KE	KF
560 pF	561	J	K	M	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KE	KE	KF
680 pF	681	J	K	M	HG	HG	HG	HG	HG	HG	HG	JE	JE	JE	JK	JK	JK	JK	KF	KF	KF	KF	KE	KF	KF
820 pF	821	J	K	M	HG	HG	HG	HG	HG	HG	HG	JE	JE	JE	JK	JK	JK	JK	KE	KE	KE	KF	KE	KF	KF
		Rated	Voltage	e (VDC)	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
Capacitance	Cap Code	Vo	Itage C	ode	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н
-	Code	de Voltage Code Case Size/ Series					С	1825	C	1				С	2220	С					С	2225	C		



Table 1B - Capacitance Range/Selection Waterfall (1825 - 2225 Case Sizes) cont'd

			se Si Serie				С	1825	iC .					С	2220	C					C	2225	5C		
Capacitance	Сар	Vo	Itage Co	ode	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н
Capacitance	Code	Rated	Voltage	(VDC)	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
			apacitar Foleranc		Pro	duc	Ava	ilabi	lity a	nd C	hip 1	hick	nes	s Co	des -	- See	Tab	le 2 f	or Cl	nip T	hick	ness	Dim	ensi	ons
1,000 pF	102	J	K	М	HG	HG	HG	HG	HG	HG	HG	JE	JK	JK	JK	JK	JK	JK	KE	KE	KE	KF	KE	KF	KF
1,200 pF	122	J	K	M	HG	HG	HG	HG	HG	HG	HG	JE	JK	JK	JK	JK	JK	JK	KE	KE	KE	KF	KF	KF	KF
1,500 pF	152	J	K	M	HG	HG	HG	HG	HG	HG	HG	JE	JK	JK	JK	JK	JK	JK	KE	KE	KE	KF	KF	KF	KF
1,800 pF	182	J	K	M	HE	HE	HE	HE	HE	HG	HG	JE	JK	JK	JK	JK	JK	JK	KE	KE	KE	KF	KF	KF	KF
2,200 pF	222	J	K	M	HE	HE	HE	HE	HE	HG	HG	JE	JK	JK	JE	JE	JK	JK	KF	KE	KE	KF	KF	KF	KF
2,700 pF	272	J	K	M	HE	HE	HE	HE	HE	HG		JK	JK	JK	JE	JE	JK	JK	KE	KE	KE	KE	KE	KF	KE
3,300 pF	332	J	K	M	HE	HE	HE	HE	HE	HG		JK	JK	JK	JE	JE	JK	JE	KE	KE	KE	KE	KE	KF	KE
3,900 pF	392	J	K	M	HE	HE	HE	HE	HE	HG		JK	JK	JK	JE	JE	JK	JE	KE	KF	KF	KE	KE	KF	KE
4,700 pF	472	J	K	M	HE	HE	HE	HE	HE	HG		JK	JK	JK	JE	JK	JE	JE	KE	KF	KF	KE	KE	KF	KE
5,600 pF	562	J	K	M	HE	HE	HE	HE	HE	HG		JK	JK	JK	JE	JK	JE	JE	KE	KF	KF	KE	KE	KF	KE
6,800 pF	682	J	K	M	HE	HE	HE	HE	HE	HJ		JK	JE	JE	JE	JK	JE	JE	KE	KF	KF	KE	KF	KE	KE
8,200 pF	822	J	K	М	HE	HE	HE	HE	HE	HJ		JK	JE	JE	JE	JK	JK	JK	KF	KE	KE	KE	KF	KF	KF
10,000 pF	103	J	K	М	HE	HE	HE	HE	HJ	НК		JE	JE	JE	JE	JL	JL	JL	KF	KE	KE	KE	KF	KH	KH
12,000 pF	123	J	K	М	HE	HE	HE	HG	HJ			JΕ	JK	JK	JK	JL	JL	JL	KE	KE	KE	KE	KF	КН	КН
15,000 pF	153	j	K	М	HE	HE	HE	HG	HK			JΕ	JK	JK	JK	JL	JN	JN	KE	KE	KE	KE	KF	KJ	KJ
18,000 pF	183	Ĵ	K	M	HE	HE	HE	HG				JE	JK	JK	JK	JN			KE	KE	KE	KE	KH		
22,000 pF	223	J	K	M	HE	HG	HG	HG				JE	JK	JK	JK	JN			KE	KF	KF	KF	KJ		
27,000 pF	273	J	К	М	HE	HG	HG	HG				JE	JK	JK	JK				KE	KF	KF	KF	KJ		
33,000 pF	333	j	K	M	HE	HG	HG	HE				JE	JK	JK	JK				KE	KF	KF	KF			
39,000 pF	393	j	K	M	HE	HG	HG	HG				JE	JK	JK	JE				KE	KF	KF	KF			
47,000 pF	473	Ĵ	K	M	HE	HG	HG	HJ				JE	JK	JK	JK				KE	KF	KF	KF			
56,000 pF	563	J	K	M	HE	HG	HG	HJ				JE	JE	JE	JL				KE	KF	KF	KF			
62,000 pF	623	Ĵ	K	M	HG	HG	HG	HK				JE	JE	JE	JL				KE	KF	KF	KH			
68,000 pF	683	Ĵ	K	M	HG	HJ	HJ	HK				JE	JK	JK	JL				KE	KF	KF	KJ			
82,000 pF	823	Ĵ	K	M	HG	HJ	HJ					JE	JL	JL	JN				KE	KF	KF	KJ			
0.10 µF	104	l j	K	M	HG	HK	HK					JE	JN	JN	011				KE	KH	KH	KJ			
0.10 µF	124	J	K	M	HG	HE	1111					JE	JN	JN					KE	KH	KH	110			
0.12 μΓ 0.15 μF	154	J	K	M	HG	HE						JK	JE	UIV					KF	KJ	KJ				
0.13 μF	184	j	K	M	HG	HG						JK	JE						KF	KE	110				
0.10 μl 0.22 μF	224	j	K	M	HG	HJ						JK	JK						KF	KF					
0.22 μF 0.27 μF	274	J	K	M	HJ	HJ						JK	JL						KF	KH					
0.27 μF 0.33 μF	334	J	K	M	НJ	110						JL	JN						KF	KH					
0.39 µF	394	J	K	M	HK							JN	JIN						KH	КЛ					
0.39 μF 0.47 μF	394 474	J	K	M	IIIN							JN							KH	KJ					
0.47 μF 0.56 μF	564	١	K	M	l							JIN							КJ	ΝJ					
υ.ου με	304	J	Ι Λ	IVI	_	_	-	-			-	_	_	-	-	-		-		_		-		-	-
	Con	Rated	Voltage	(VDC)	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
Capacitance	Cap Code		Itage Co		С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н
			se Si Series				С	1825	C					С	2220	С					С	2225	C		



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

Thickness	Case	Thickness ±	Paper Q	uantity ¹	Plastic (Quantity
Code	Size ¹	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
CG	0603	0.80 ± 0.10	4,000	15,000	0	0
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
ED	1206	1.00 ± 0.10	0	0	2,500	10,000
EF	1206	1.20 ± 0.15	0	0	2,500	10,000
EG	1206	1.60 ± 0.15	0	0	2,000	8,000
EJ	1206	1.70 ± 0.20	0	0	2,000	8,000
FG	1210	1.25 ± 0.15	0	0	2,500	10,000
FL	1210	1.40 ± 0.15	0	0	2,000	8,000
FH	1210	1.55 ± 0.15	0	0	2,000	8,000
FM	1210	1.70 ± 0.20	0	0	2,000	8,000
FK	1210	2.10 ± 0.20	0	0	2,000	8,000
FS	1210	2.50 ± 0.30	0	0	1,000	4,000
LE	1808	1.00 ± 0.10	0	0	2,500	10,000
LA	1808	1.40 ± 0.15	0	0	1,000	4,000
LB	1808	1.60 ± 0.15	0	0	1,000	4,000
LC	1808	2.00 ± 0.15	0	0	1,000	4,000
GB	1812	1.00 ± 0.10	0	0	1,000	4,000
GC	1812	1.10 ± 0.10	0	0	1,000	4,000
GE	1812	1.30 ± 0.10	0	0	1,000	4,000
GH	1812	1.40 ± 0.15	0	0	1,000	4,000
GF	1812	1.50 ± 0.10	0	0	1,000	4,000
GK	1812	1.60 ± 0.20	0	0	1,000	4,000
GJ	1812	1.70 ± 0.15	0	0	1,000	4,000
GN	1812	1.70 ± 0.20	0	0	1,000	4,000
GL	1812	1.90 ± 0.20	0	0	500	2,000
GM	1812	2.00 ± 0.20	0	0	500	2,000
GS	1812	2.10 ± 0.20	0	0	500	2,000
GO	1812	2.50 ± 0.20	0	0	500	2,000
HE	1825	1.40 ± 0.15	0	0	1,000	4,000
HG	1825 1825	1.60 ± 0.20	0	0	1,000	4,000
HJ HK	1825	2.00 ± 0.20	0	0	500 500	2,000
JE	2220	2.50 ± 0.20 1.40 ± 0.15	0	0	1,000	2,000 4,000
JE JK	2220		0	0		
JK JL	2220	1.60 ± 0.20	0	0	1,000 500	4,000 2,000
JN	2220	2.00 ± 0.20 2.50 ± 0.20	0	0	500	2,000
KE	2220 2225	2.50 ± 0.20 1.40 ± 0.15	0	0	1,000	2,000 4,000
KF	2225	1.40 ± 0.15 1.60 ± 0.20	0	0	1,000	4,000
KH	2225	2.00 ± 0.20	0	0	500	2,000
КЛ	2225	2.50 ± 0.20 2.50 ± 0.20	0	0	500	2,000
Thickness	Case	Thickness ±	7" Reel	13" Reel	7" Reel	13" Reel
Code	Size ¹	Range (mm)	Paper Q	uantity¹	Plastic (Quantity

Package quantity based on finished chip thickness specifications.

¹ If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Table 2B - Bulk Packaging Quantities

Deale		Loose P	ackaging
Раска(ging Type	Bulk Bag	g (default)
Packagi	ing C-Spec ¹	N.	/A ²
Cas	se Size	Packaging Quantities	(pieces/unit packaging)
EIA (in)	Metric (mm)	Minimum	Maximum
0402	1005		
0603	1608		
0805	2012		50,000
1206	3216		
1210	3225	1	
1808	4520		
1812	4532		
1825	4564		20,000
2220	5650		
2225	5664		

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

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



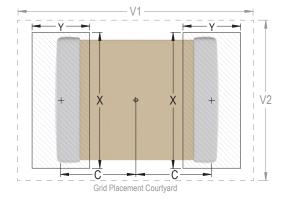
Table 3 – Chip Capacitor Land Pattern Design Recommendations per IPC-7351

EIA Size Code	Metric Size Code		Maxi	sity Lev mum (N	Most))		Media	sity Lev an (Nor rotrusio)		Mini	sity Lev mum (L rotrusio)
Code	Oue	С	Y	X	V1	V2	С	Y	Х	V1	V2	С	Υ	Х	V1	V2
0603	1608	0.90	1.15	1.10	4.00	2.10	0.80	0.95	1.00	3.10	1.50	0.60	0.75	0.90	2.40	1.20
0805	2012	1.00	1.35	1.55	4.40	2.60	0.90	1.15	1.45	3.50	2.00	0.75	1.50	1.35	2.80	1.70
1206	3216	1.60	1.35	1.90	5.60	2.90	1.50	1.15	1.80	4.70	2.30	1.40	0.95	1.70	4.00	2.00
1210	3225	1.60	1.35	2.80	5.65	3.80	1.50	1.15	2.70	4.70	3.20	1.40	0.95	2.60	4.00	2.90
1808	4520	2.30	1.75	2.30	7.40	3.30	2.20	1.55	2.20	6.50	2.70	2.10	1.35	2.10	5.80	2.40
1812	4532	2.15	1.60	3.60	6.90	4.60	2.05	1.40	3.50	6.00	4.00	1.95	1.20	3.40	5.30	3.70
1825	4564	2.15	1.60	6.90	6.90	7.90	2.05	1.40	6.80	6.00	7.30	1.95	1.20	6.70	5.30	7.00
2220	5650	2.75	1.70	5.50	8.20	6.50	2.65	1.50	5.40	7.30	5.90	2.55	1.30	5.30	6.60	5.60
2225	5664	2.70	1.70	6.90	8.10	7.90	2.60	1.50	6.80	7.20	7.30	2.50	1.30	6.70	6.50	7.00

Density Level A: For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes. KEMET only recommends wave soldering of EIA 0603, 0805 and 1206 case sizes.

Density Level B: For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes. **Density Level C:** For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC Standard 7351 (IPC–7351).

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





Soldering Process

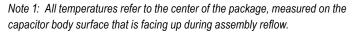
Recommended Soldering Technique:

- 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
Frome reature	SnPb	100% Matte Sn
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum



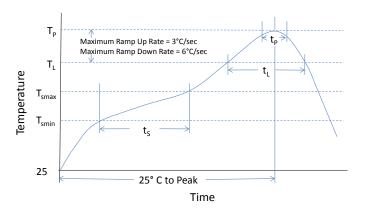




Table 4 - Performance & Reliability: Test Methods and Conditions

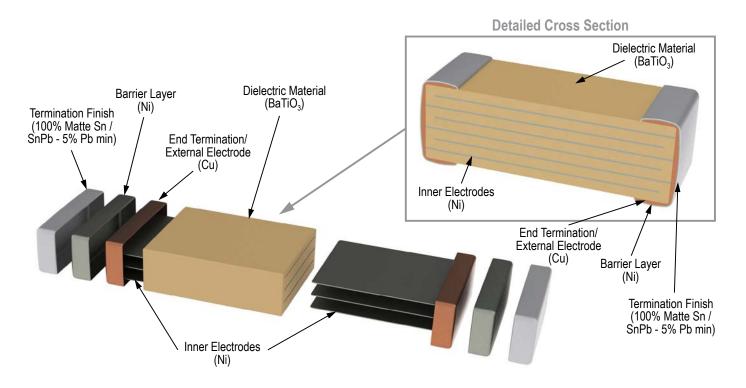
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Solderability	J-STD-002	a) Method B, 4 hours at 155°C, dry heat at 235°C
Solderability	J-31D-002	b) Method B at 215°C category 3
		c) Method D, category 3 at 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Digged Llumidity	MIL-STD-202 Method 103	Load Humidity: 1,000 hours 85°C/85% RH and 200 VDC maximum. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 1.2 X rated voltage applied.
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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



High Voltage with Flexible Termination System (HV FT-CAP) X7R Dielectric, 500 – 3,000 VDC (Commercial Grade)



Overview

KEMET's High Voltage with Flexible Termination (HV FT-CAP) surface mount MLCCs in X7R dielectric address the primary failure mode of MLCCs—flex cracks, which are typically the result of excessive tensile and shear stresses produced during board flexure and thermal cycling. Featuring several of the highest CV (capacitance/voltage) values available in the industry, these devices utilize a pliable and conductive silver epoxy between the base metal and nickel barrier layers of the termination system. The addition of this epoxy layer inhibits the transfer of board stress to the rigid ceramic body, therefore mitigating flex cracks which can result in low IR or short circuit failures. Although flexible termination technology does not eliminate the potential for mechanical damage that may propagate during extreme environmental and handling conditions, it does provide superior flex performance over standard termination systems.

The HV FT-CAP offers low leakage current, exhibits low ESR at high frequencies and finds conventional use as snubbers or filters in applications such as switching power supplies and lighting ballasts. Their exceptional performance at high frequencies has made them a preferred choice of design engineers worldwide. In addition to their use in power supplies, these capacitors are widely used in industries related to automotive(hybrid), telecommunications, medical, military, aerospace, semiconductors and test/diagnostic equipment.

Combined with the stability of an X7R dielectric and designed to accommodate all capacitance requirements, these flex-robust devices are RoHS-compliant, offer up to 5 mm of flex-bend capability and exhibits a predictable change in capacitance with respect to time and voltage. Capacitance change with reference to ambient temperature is limited to ±15% from -55°C to +125°C.

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



Ordering Information

C	1210	X	154	K	C	R	Α	С	TU
Cera	mic Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec)
	0603 0805 1206 1210 1808 1812 1825 2220 2225	X = Flexible Termination	Two significant digits + number of zeros.	J = ±5% K = ±10% M = ±20%	C = 500 B = 630 D = 1,000 F = 1,500 G = 2,000 Z = 2,500 H = 3,000	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

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



Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec)
Bulk Bag/Unmarked	Not required (Blank)
7" Reel/Unmarked	TU
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
7" Reel/Marked	TM
13" Reel/Marked	7040 (EIA 0603 and smaller case sizes) 7215 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2mm pitch ²	7081
13" Reel/Unmarked/2mm pitch ²	7082

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- −55°C to +125°C operating temperature range
- · Industry-leading CV values
- Superior flex performance (up to 5 mm)
- Exceptional performance at high frequencies
- Lead (Pb)-Free, RoHS and REACH compliant
- EIA 0603, 0805, 1206, 1210, 1808, 1812, 1825, 2220, and 2225 case sizes
- DC voltage ratings of 500 V, 630 V, 1 KV, 1.5 KV, 2 KV, 2.5 KV, and 3 KV

- Capacitance offerings ranging from 10 pF to 560 nF
- Available capacitance tolerances of ±5%, ±10% or ±20%
- Low ESR and ESL
- Non-polar device, minimizing installation concerns
- Automotive (AEC–Q200) Grade available
- 100% pure matte tin-plated termination finish allowing for excellent solderability
- SnPb plated termination finish option available upon request (5% Pb minimum)

Applications

Typical applications include switch mode power supplies (input filters, resonators, tank circuits, snubber circuits, output filters), high voltage coupling and DC blocking, lighting ballasts, voltage multiplier circuits, DC/DC converters and coupling capacitors in Ćuk converters. Markets include power supply, LCD fluorescent backlight ballasts, HID lighting, telecom equipment, industrial and medical equipment/control, LAN/WAN interface, analog and digital modems, and automotive (electric and hybrid vehicles, charging stations and lighting applications).

Application Note

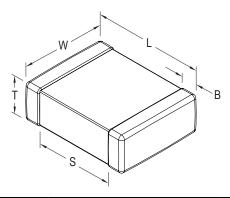
X7R dielectric is not recommended for AC line filtering or pulse applications. These capacitors and/or the assembled circuit board containing these capacitors may require a protective surface coating to prevent external surface arcing.

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. Please contact KEMET if you require a laser marked option. For more information see "Capacitor Marking".

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Dimensions – Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0603	1608	1.60 (.063) ± 0.17 (.007)	0.80 (.032) ± 0.15 (.006)		0.45 (.018) ± 0.15 (.006)	0.58 (.023)	
0805	2012	2.00 (.079) ± 0.30 (.012)	1.25 (.049) ± 0.30 (.012)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	Solder Wave or Solder Reflow
1206	3216	3.30 (.130) ± 0.40 (.016)	1.60 (.063) ± 0.35 (.013)		0.60 (.024) ± 0.25 (.010)		
1210	3225	3.30 (.130) ± 0.40 (.016)	2.60 (.102) ± 0.30 (.012)		0.60 (.024) ± 0.25 (.010)		
1808	4520	4.70 (.185) ± 0.50 (.020)	2.00 (.079) ± 0.20 (.008)	See Table 2 for Thickness	0.70 (.028) ± 0.35 (.014)		
1812	4532	4.50 (.178) ± 0.40 (.016)	3.20 (.126) ± 0.30 (.012)		0.70 (.028) ± 0.35 (.014)	N/A	Oaldes Daffass Oals
1825	4564	4.60 (.181) ± 0.40 (.016)	6.40 (.252) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)		Solder Reflow Only
2220	5650	5.90 (.232) ± 0.75 (.030)	5.00 (.197) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)		
2225		5.90 (.232) ± 0.75 (.030)	6.40 (.248) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)		

Qualification/Certification

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

Environmental Compliance

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%
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
² Dielectric Withstanding Voltage (DWV)	150% of rated voltage for voltage rating of < 1000V 120% of rated voltage for voltage rating of ≥ 1000V (5 ± 1 seconds and charge/discharge not exceeding 50mA)
³ Dissipation Factor (DF) Maximum Limit @ 25°C	2.5%
⁴Insulation Resistance (IR) Minimum Limit @ 25°C	See Insulation Resistance Limit Table (500VDC applied for 120 ± 5 secs @ 25°C)

Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

 $1kHz \pm 50Hz$ and 1.0 ± 0.2 Vrms if capacitance ≤ $10\mu F$

120Hz \pm 10Hz and 0.5 ± 0.1 Vrms if capacitance >10 μ F

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

Post Environmental Limits

	High Temperatu	ıre Life, Biased	Humidity, Mois	ture Resistance	
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (%)	Capacitance Shift	Insulation Resistance
	> 25		3.0		
X7R	16/25	All	5.0	±20%	10% of Initial Limit
	< 16		7.5		

Insulation Resistance Limit Table (X7R Dielectric)

EIA Case Size	1,000 Megohm Microfarads or 100 GΩ	100 Megohm Microfarads or 10 GΩ
0603	N/A	All
0805	< 0.0039 µF	≥ 0.0039 µF
1206	< 0.012 µF	≥ 0.012 µF
1210	< 0.033 µF	≥ 0.033 µF
1808	< 0.018 µF	≥ 0.018 µF
1812	< 0.027 µF	≥ 0.027 µF
≥ 1825	All	N/A

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

 $^{^4}$ To obtain IR limit, divide MΩ-μF value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



Table 1A – Capacitance Range/Selection Waterfall (0603 – 1812 Case Sizes)

			se Si Serie		C)60	3X	C	080	5X		C1	200	6X			Cí	1210	X				C 1	808	BX					C1	1812	2X		
Сар	Cap	Vol	Itage C	ode	С	В	D	С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н
Oup	Code	Rat	ted Volt (VDC)	tage	200	630	1000	200	630	1000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
			pacitar olerand					duc			abili	ity a				· ·					See							nes						,,
10 pF	100	J	K	M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK		GK	GK		GK	GK
11 pF 12 pF	110 120	J	K	M M				DG	DG DG	DG DG	ES ES	ES ES	ES ES	ES ES	ES ES	FM FM	FM FM	FM FM	FM FM	FM FM	LB LB	LB LB	LB LB	LB LB	LB LB	LB LB	LB LB	GK GK	GK GK	GK GK	GK GK	GK GK	GK GK	GK GK
13 pF	130	J	K	M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK	GK	GK	GK	GK	GK	GK
15 pF	150	J	K	M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK			GK	GK	GK	GK
16 pF 18 pF	160 180	J	K	M				DG DG	DG DG	DG DG	ES ES	ES ES	ES ES	ES ES	ES ES	FM FM	FM FM	FM FM	FM FM	FM FM	LB LB	LB LB	LB LB	LB LB	LB LB	LB LB	LB LB	GK GK		GK GK	GK GK	GK GK	GK GK	GK GK
20 pF	200	J	K	M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK		GK	GK	GK	GK	GK
22 pF	220	J	K	M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK		GK	GK	GK	GK	GK
24 pF	240	J	K	М				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK		GK	GK	GK	GK	GK
27 pF	270	J	K	M	ļ			DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK				GK	GK	GK
30 pF 33 pF	300 330	J	K	M M				DG	DG DG	DG DG	ES ES	ES ES	ES ES	ES ES	ES ES	FM FM	FM FM	FM FM	FM FM	FM FM	LB LB	LB LB	LB LB	LB LB	LB LB	LB LB	LB LB	GK GK	GK GK	GK GK	GK GK	GK GK	GK GK	GK GK
36 pF	360	J	K	M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK	GK	GK	GK	GK	GK	GK
39 pF	390	J	K	M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK	GK	GK	GK	GK	GK	GK
43 pF	430	J	K	М				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK	GK	GK	GK	GK	GK	GK
47 pF	470	J	K	M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK		GK	GK	GK	GK	GK
51 pF 56 pF	510 560	J	K	M				DG DG	DG DG	DG DG	ES ES	ES ES	ES ES	ES ES	ES ES	FM FM	FM FM	FM FM	FM FM	FM FM	LB LB	LB LB	LB LB	LB LB	LB LB	LB LB	LB LB	GK GK	GK GK	GK GK	GK GK	GK GK	GK GK	GK GK
62 pF	620	J	K	M				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK		GK	GK	GK	GK	GK
68 pF	680	J	K	М				DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK		_		GK	GK	GK
75 pF	750	J	K	М				DG	DG	DG	ES	ES	ES	ES	EF	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK	GK	GK	GK	GK	GK	GK
82 pF	820	J	K	M				DG	DG	DG	ES	ES	ES	ES ES	EF	FM	FM	FM	FM	FM	LB	LB LB	LB LB	LB LB	LB LB	LB LB	LB LB	GK	GK	GK	GK	GK	GK	GK
91 pF 100 pF	910 101	J	K	M				DG DG	DG DG	DG DG	ES ES	ES ES	ES ES	ES	EF EF	FM FM	FM FM	FM FM	FM FM	FM FM	LB LB	LB	LB	LB	LB	LC	LB	GK GK		GK GK	GK GK	GK GK	GK GK	GK GK
110 pF	111	J	K	M				DG	DG	DG	ES	ES	ES	ES	EU	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LC	LB	GK	GK	GK	GK	GK	GK	GK
120 pF	121	J	K	M				DG	DG	DG	ES	ES	ES	ES	EU	FM	FM	FM	FM	FM	LA	LA	LA	LA	LB	LC	LB	GG	GG	GG	GG	GG	GG	GK
130 pF	131	J	K	M				DG	DG	DG	ES	ES	ES	ES	EU	FZ	FZ	FZ	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK	GK	GK	GK	GK	GK	GK
150 pF 180 pF	151 181	J	K	M				DG DG	DG DG	DG DG	ES ES	ES ES	ES ES	EF EF	EU	FZ FZ	FZ FZ	FZ FZ	FM FM	FM FM	LB LB	LB LB	LB LB	LB LB	LB LB	LB LB	LB LB	GK GK	GK GK	GK GK	GK GK	GK GK	GK GK	GK GK
220 pF	221	J	K	M				DG	DG	DG	ES	ES	ES	EF	EF	FZ	FZ	FZ	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK	GK	_	GK	GK	GK	GK
270 pF	271	J	K	M	İ			DG	DG	DG	ES	ES	ES	EF	EF	FZ	FZ	FZ	FK	FK	LC	LC	LC	LC	LC	LC	LC	GK	GK	GK	GK	GK	GK	GK
330 pF	331	J	K	M				DG	DG	DG	ES	ES	EF	EF	EF	FZ	FZ	FZ	FK	FK	LC	LC	LC	LC	LC	LC	LC	GK	GK	GK	GK	GK	GK	GK
390 pF	391	J	K	M	ŀ			DG	DG	DG	ES	ES	EF	EF	EF	FZ	FZ	FZ	FK	FS	LB	LB	LB	LB	LB	LB	LC	GK	GK	GK	GK	GK	GK	GK
470 pF 560 pF	471 561	J	K	M M				DG DG	DG DG	DG DG	ES ES	ES ES	EF EF	EF EF	EF EF	FZ FL	FM FL	FM FL	FS FL	FS FL	LB LB	LB LB	LB LB	LB LB	LB LB	LB LB	LC	GK GH	GK GH	GK GH	GK GH	GK GH	GK GK	GK GK
680 pF	681	J	K	M				DG	DG	DG	ES	ES	EF	EF	EF	FL	FL	FL	FL	FL	LA	LA	LA	LA	LB	LC	LC	GH	GH	GH	GH	GH	GK	GK
820 pF	821	J	K	М	1			DG	DG	DG	ES	ES	ES	EF	EF	FL	FL	FL	FL	FL	LA	LA	LA	LA	LB	LC	LC	GH	GH	GH	GH	GH	GK	GK
1,000 pF	102	J	K	M	CG		CG	DG	DG	DG	ES	ES	ES	EF	EF	FL	FL	FL	FL	FL	LA	LA	LA	LA	LB	LC	LC	GH	GH	GH	GH	GH	GK	GK
1,200 pF 1,500 pF	122 152	J J	K	M	CG CG	CG		DG DG	DG DG	DG	ES	ES ES	ES	EU	EU	FL FL	FL FL	FL FL	FL FL	FM FM	LB	LB LB	LB	LB	LC	LA		GH				GH GH	GK	GK
1,800 pF	182	J	K	M	CG	UG			DG			ES	ES	EU	EU	FL	FL	FL	FL	FM	LB	LB	LB	LB	LC	LC		GH		GH				
2,200 pF	222	J	K	M	CG				DG			ES	ES	EU	EU	FL	FL	FL	FL	FM	LA	LA	LA	LB	LC	LC		GH					GK	
2,700 pF	272	J	K	М	CG					DG	ES	ES	ES	EU		FL	FL	FL	FL	FM	LA	LA	LA	LB	LC			GH	GH	GH		GK		
3,300 pF	332	J	K	M	CG					DG	_	ES	ES	EU		FL	FL	FL	FL	FM	LA	LA	LA	LB	LA			GH		GH				
3,900 pF 4,700 pF	392 472	J J	K	M	CG			DG DG	DG DG	DG DG	ES ES	ES ES	ES ES	EU		FL FL	FL FL	FL FL	FL FL	FK FK	LA	LA LA	LA LA	LB LB	LB			GH GH		GH GH		GK GH		
5,600 pF	562	J	K	M						DG	ES	EF	EF	EF		FL	FL	FL	FM	FK	LA	LB	LB	LC				GH		GH	GK			
6,800 pF	682	J	K	М	1			DG	DG		EF	EF	EF	EF		FL	FL	FL	FM	FS	LA	LB	LB	LC				GH	GH	GH	GK	GM		
8,200 pF	822	J	K	M				_	DG		EF	EU	EU	EF		FL	FL	FL	FK		LA	LB	LB	LC				GH		GH				
10,000 pF 12,000 pF	103 123	J	K	M					DG DG		EF EU	EU EJ	EU EJ	EU		FL FL	FL FL	FL FL	FK FK		LA LA	LB LC	LB LC	LC LB				GH		GH GK		GO		
12,000 μΓ	123	Rat	ted Volt	tage	200	630	1000	200	630	1000	200	630	1000	1500	2000	500	630	1000	1500	2000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
Сар	Cap				C	В	D	C C	В	D	C	В	D	F	G	C	В	D	F	G G	C	В	D	F	G	Z	H H	C	В	D	F	G	Z	بة H
·	Code	Ca	se Si Serie:	ze/		060			0805				1206					1210						1808							1812			
			oer ie:	J	Ь																													



Table 1A - Capacitance Range/Selection Waterfall (0603 - 1812 Case Sizes) cont'd

		C		Siz		CO)60	3X	C	080	5X		C,	120	6X			C	1210	OX				C1	180	8X					C1	1812	2X		
Con	Cap	١v	oltag	je Co	de	С	В	D	С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	н
Сар	Code	R		Volta DC)	ige	200	630	1000	200	630	1000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
				citano rance				Pro	du	ct A	vail	abil	ity a	nd	Chi	p Tł	ick	nes	s C	ode	s - S	See	Tab	le 2	for	Chi	p T	hick	nes	s D	ime	nsi	ons		
15,000 pF	153	J		K	М				DG			EU	EJ	EJ			FL	FL	FL	FL		LA	LC	LC	LC				GH		GK				
18,000 pF	183	J		K	М				DG			EJ	EJ	EJ			FL	FL	FL	FM		LA	LE	LE					GH		GK				
22,000 pF	223	J		K	М				DG			EJ	EJ	EJ			FL	FM	FM	FM		LA	LE	LE					GH		GK				
27,000 pF	273	J		K	М				ł			EJ	EJ				FM	FK	FK	FK		LA	LA	LA					GH	GB	GB	GO			
33,000 pF	333	J		K	M							EJ	EJ				FM	FZ	FU	FS FS		LC	LA	LA					GH	GB	GB	GO			
39,000 pF 47,000 pF	393 473	J		K K	M M							EJ EJ					FK FK	FZ FU	FU FK	15		LC	LA	LA LB					GH GH	GB GB	GB GC				
47,000 pF 56,000 pF	563	J		K	M							EJ					FZ	FU	FK			LC	LA	LB					GH	GB	GE				
62,000 pF	623	J	_	r K	M							EJ					FZ	FK	FS			LA	LA	LC					GK	GB	GE				
68,000 pF	683	J		K	M							EJ					FZ	FK	FS			LA	LA	LC					GE	GE	GE				
82,000 pF	823	١		K	M							LJ					FU	FK	13			LA	LC	LC					GB	GE	GK				
0.10 µF	104	.1		K	M				ł								FK	FS				LA	LC						GB	GH	GJ				
0.10 µF	124	J		K	М												FK					LA							GE	GK	00				
0.15 µF	154	J		K	М												FK					LB							GE	GN					
0.18 µF	184	Ĵ		K	М							İ																	GF	0					
0.22 µF	224	j		K	М																								GJ						
0.27 µF	274	J		ĸ	М							İ										İ							GL						
0.33 µF	334	J		K	М				İ			İ										İ							GS						
		R		Volta	ige	200	630	1000	200	630	100	200	630	100	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
Сар	Cap	v		je Co	de	С	В	D	С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	z	Н	С	В	D	F	G	z	н
	Code		ase	Siz	ze/	_	0603		H	080	_			1200	-		•		1210						1808				Ť		_	1812	_		



Table 1B – Capacitance Range/Selection Waterfall (1825 – 2225 Case Sizes)

			se Si Series				С	1825	iΧ					C	2220	X					C	2225	iΧ		
Consoitenes	Cap	Vo	Itage Co	ode	С	В	D	F	G	z	Н	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н
Capacitance	Code	Rated	Voltage	(VDC)	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
			apacitan Foleranc	e	Pro	duct		ilabi	lity a	nd C	hip 1	Thick	ness	Coc	des -	See	Tabl	e 2 f	or Cl	nip T	hickı	ness	Dim	ensi	ons
470 pF	471	J	K	М	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK							
560 pF	561	J	K	M	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK							
680 pF	681	J	K	M	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
820 pF	821	J	K	M	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
1,000 pF	102	J	K	M	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
1,200 pF	122	J	K	M	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
1,500 pF	152	J	K	M	HG	HG	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
1,800 pF	182	J	K	M	HE	HE	HE	HE	HE	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
2,200 pF	222	J	K	M	HE	HE	HE	HE	HE	HG	HG	JE	JE	JE	JE	JE	JK	JK	KF	KF	KF	KF	KF	KF	KF
2,700 pF	272	J	K	M	HE	HE	HE	HE	HE	HG	HG	JE	JE	JE	JE	JE	JK	JK	KE	KE	KE	KE	KE	KF	KE
3,300 pF	332	J	K	M	HE	HE	HE	HE	HE	HG	HG	JE	JE	JE	JE	JE	JK	JE	KE	KE	KE	KE	KE	KF	KE
3,900 pF	392	J	K	M	HE	HE	HE	HE	HE	HG		JE	JE	JE	JE	JE	JK	JE	KE	KE	KE	KE	KE	KF	KE
4,700 pF	472	J	K	M	HE	HE	HE	HE	HE	HG		JE	JE	JE	JE	JK	JE	JE	KE	KE	KE	KE	KE	KF	KE
5,600 pF	562	J	K	M	HE	HE	HE	HE	HE	HG		JE	JE	JE	JE	JK	JE	JE	KE	KE	KE	KE	KE	KF	KE
6,800 pF	682	J	K	M	HE	HE	HE	HE	HE	HJ		JE	JE	JE	JE	JK	JE	JE	KE	KE	KE	KE	KF	KE	KE
8,200 pF	822	J	K	M	HE	HE	HE	HE	HE	HJ		JE	JE	JE	JE	JK	JK	JK	KE	KE	KE	KE	KF	KF	KF
10,000 pF	103	J	K	M	HE	HE	HE	HE	HJ	HK		JE	JE	JE	JE	JL	JL	JL	KE	KE	KE	KE	KF	KH	KH
12,000 pF	123	J	K	M	HE	HE	HE	HG	HJ			JE	JK	JK	JK	JL	JL	JL	KE	KE	KE	KE	KF	KH	KH
15,000 pF	153	J	K	M	HE	HE	HE	HG	HK			JE	JK	JK	JK	JN	JN	JN	KE	KE	KE	KE	KF	KJ	KJ
18,000 pF	183	J	K	M	HE	HE	HE	HG				JE	JK	JK	JK	JN			KE	KE	KE	KE	KH		
22,000 pF	223	J	K	M	HE	HG	HG	HG				JE	JK	JK	JK	JN			KE	KF	KF	KF	KJ		
27,000 pF	273	J	K	M	HE	HG	HG	HG				JE	JK	JK	JK				KE	KF	KF	KF	KJ		
33,000 pF	333	J	K	M	HE	HG	HG	HE				JE	JK	JK	JK				KE	KF	KF	KF			
39,000 pF	393	J	K	M	HE	HG	HG	HG				JE	JK	JK	JE				KE	KF	KF	KF			
47,000 pF	473	J	K	M	HE	HG	HG	HJ				JE	JK	JK	JK				KE	KF	KF	KF			
56,000 pF	563	J	K	M	HE	HG	HG	HJ				JE	JE	JE	JL				KE	KF	KF	KF			
62,000 pF	623	J	K	M	HG	HG	HG	HK				JE	JE	JE	JL				KF	KF	KF	KH			
68,000 pF	683	J	K	M	HG	HJ	HJ	HK				JE	JK	JK	JL				KE	KF	KF	KJ			
82,000 pF	823	J	K	M	HG	HJ	HJ					JE	JL	JL	JN				KE	KF	KF	KJ			
0.10 µF	104	J	K	M	HG	HK	HK					JE	JN	JN					KE	KH	KH	KJ			
0.12 µF	124	J	K	M	HG	HE						JE	JN	JN					KE	KH	KH				
0.15 µF	154	J	K	M	HG	HE						JK	JE						KF	KJ	KJ				
0.18 µF	184	J	K	M	HG	HG						JK	JE						KF	KE					
0.22 µF	224	J	K	M	HG	HJ						JK	JK						KF	KF					
0.27 µF	274	J	K	M	HJ	HJ						JK	JL						KF	KH					
0.33 μF	334	J	K	M	HJ							JL	JN						KF	KH					
0.39 µF	394	J	K	M	HK							JN							KH	KJ					
0.47 µF	474	J	K	M								JN							KH	KJ					
0.56 μF	564	J	K	М															KJ						
		Rated	Rated Voltage (VDC)			630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
Capacitance	Cap Code		Itage Co		С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н
			se Si Series				С	1825	X					С	2220	X					С	2225	X		



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

Thickness	Case	Thickness ±	Paper Q	luantity ¹	Plastic (Quantity		
Code	Size ¹	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel		
CG	0603	0.80 ± 0.10	4,000	15,000	0	0		
DG	0805	1.25 ± 0.15	0	0	2,500	10,000		
ES	1206	1.00 ± 0.20	0	0	2,500	10,000		
EF	1206	1.20 ± 0.15	0	0	2,500	10,000		
EU	1206	1.60 ± 0.25	0	0	2,000	8,000		
EJ	1206	1.70 ± 0.20	0	0	2,000	8,000		
FZ	1210	1.25 ± 0.20	0	0	2,500	10,000		
FL	1210	1.40 ± 0.15	0	0	2,000	8,000		
FU	1210	1.55 ± 0.20	0	0	2,000	8,000		
FM	1210	1.70 ± 0.20	0	0	2,000	8,000		
FK	1210	2.10 ± 0.20	0	0	2,000	8,000		
FS	1210	2.50 ± 0.30	0	0	1,000	4,000		
LE	1808	1.00 ± 0.10	0	0	2,500	10,000		
LA	1808	1.40 ± 0.15	0	0	1,000	4,000		
LB	1808	1.60 ± 0.15	0	0	1,000	4,000		
LC	1808	2.00 ± 0.15	0	0	1,000	4,000		
GB	1812	1.00 ± 0.10	0	0	1,000	4,000		
GC	1812	1.10 ± 0.10	0	0	1,000	4,000		
GE	1812	1.30 ± 0.10	0	0	1,000	4,000		
GH	1812	1.40 ± 0.15	0	0	1,000	4,000		
GF	1812	1.50 ± 0.10	0	0	1,000	4,000		
GG	1812	1.55 ± 0.10	0	0	1,000	4,000		
GK	1812	1.60 ± 0.20	0	0	1,000	4,000		
GJ	1812	1.70 ± 0.15	0	0	1,000	4,000		
GN	1812	1.70 ± 0.20	0	0	1,000	4,000		
GL	1812	1.90 ± 0.20	0	0	500	2,000		
GM	1812	2.00 ± 0.20	0	0	500	2,000		
GS	1812	2.10 ± 0.20	0	0	500	2,000		
GO	1812	2.50 ± 0.20	0	0	500	2,000		
HE	1825	1.40 ± 0.15	0	0	1,000	4,000		
HG	1825	1.60 ± 0.20	0	0	1,000	4,000		
HJ	1825	2.00 ± 0.20	0	0	500	2,000		
HK	1825	2.50 ± 0.20	0	0	500	2,000		
JE	2220	1.40 ± 0.15	0	0	1,000	4,000		
JK	2220	1.60 ± 0.20	0	0	1,000	4,000		
JL	2220	2.00 ± 0.20	0	0	500	2,000		
JN KE	2220	2.50 ± 0.20	0 0	0 0	500	2,000		
KE KF	2225 2225	1.40 ± 0.15	0	0	1,000	4,000		
I KH	2225 2225	1.60 ± 0.20 2.00 ± 0.20	0	0	1,000 500	4,000		
KH KJ	2225	2.50 ± 0.20 2.50 ± 0.20	0	0	500	2,000 2,000		
			7" Reel	13" Reel	7" Reel	2,000 13" Reel		
Thickness Code	Case Size ¹	Thickness ± Range (mm)				1		
			Paper Q	uantity¹	Plastic (Quantity		

Package quantity based on finished chip thickness specifications.

¹ If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Table 2B - Bulk Packaging Quantities

ъ		Loose P	ackaging
Раскад	ing Type	Bulk Bag	(default)
Packagir	ng C-Spec ¹	N/	/A ²
Cas	e Size	Packaging Quantities ((pieces/unit packaging)
EIA (in)	Metric (mm)	Minimum	Maximum
0402	1005		
0603	1608		
0805	2012		50,000
1206	3216		
1210	3225	1	
1808	4520		
1812	4532		
1825	4564		20,000
2220	5650		
2225	5664		

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

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



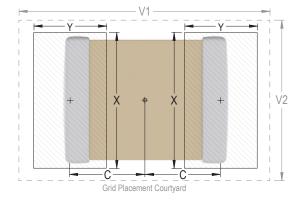
Table 3 - Chip Capacitor Land Pattern Design Recommendations per IPC-7351

EIA Size Code	Metric Size Code		Maxi	sity Lev mum (M	Most))		Media	sity Lev an (Nor rotrusio			Density Level C: Minimum (Least) Land Protrusion (mm)									
Code	Code	С	Υ	Х	V1	V2	С	Υ	Х	V1	V2	С	Υ	Х	V1	V2					
0603	1608	0.85	1.25	1.10	4.00	2.10	0.75	1.05	1.00	3.10	1.50	0.65	0.85	0.90	2.40	1.20					
0805	2012	0.99	1.44	1.66	4.47	2.71	0.89	1.24	1.56	3.57	2.11	0.79	1.04	1.46	2.42	1.81					
1206	3216	1.59	1.62	2.06	5.85	3.06	1.49	1.42	1.96	4.95	2.46	1.39	1.22	1.86	4.25	2.16					
1210	3225	1.59	1.62	3.01	5.90	4.01	1.49	1.42	2.91	4.95	3.41	1.39	1.22	2.81	4.25	3.11					
1808	4520	2.30	1.75	2.30	7.40	3.30	2.20	1.55	2.20	6.50	2.70	2.10	1.35	2.10	5.80	2.40					
1812	4532	2.10	1.80	3.60	7.00	4.60	2.00	1.60	3.50	6.10	4.00	1.90	1.40	3.40	5.40	3.70					
1825	4564	2.15	1.80	6.90	7.10	7.90	2.05	1.60	6.80	6.20	7.30	1.95	1.40	6.70	5.50	7.00					
2220	5650	2.85	2.10	5.50	8.80	6.50	2.75	1.90	5.40	7.90	5.90	2.65	1.70	5.30	7.20	5.60					
2225	5664	2.85	2.10	6.90	8.80	7.90	2.75	1.90	6.80	7.90	7.30	2.65	1.70	6.70	7.20	7.00					

Density Level A: For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes. KEMET only recommends wave soldering of EIA 0603, 0805 and 1206 case sizes.

Density Level B: For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes. **Density Level C:** For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC Standard 7351 (IPC–7351).

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





Soldering Process

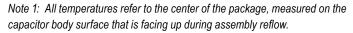
Recommended Soldering Technique:

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

Recommended Reflow Soldering Profile:

KEMET's families of surface mount multilayer ceramic capacitors (SMD MLCCs) are compatible with wave (single or dual), convection, IR or vapor phase reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET's recommended profile conditions for convection and IR reflow reflect the profile conditions of the IPC/J-STD-020 standard for moisture sensitivity testing. These devices can safely withstand a maximum of three reflow passes at these conditions.

Profile Feature	Terminati	on Finish
Profile realure	SnPb	100% Matte Sn
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum



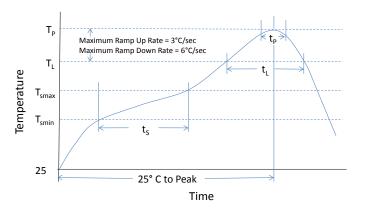




Table 4 – Performance & Reliability: Test Methods and Conditions

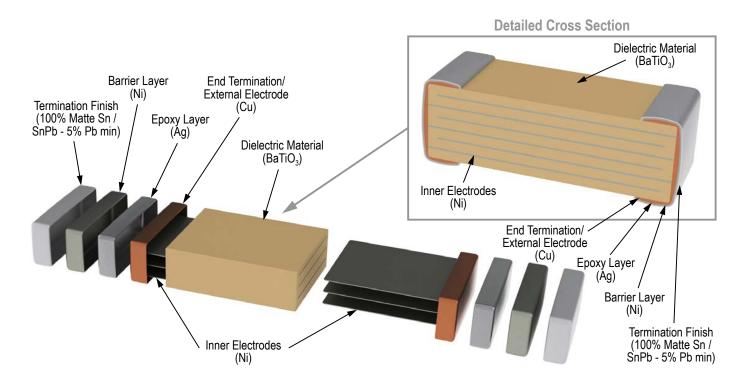
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Solderability	J-STD-002	a) Method B, 4 hours at 155°C, dry heat at 235°C
Solderability	J-31D-002	b) Method B at 215°C category 3
		c) Method D, category 3 at 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Diggod Humidity	MIL-STD-202 Method 103	Load Humidity: 1,000 hours 85°C/85% RH and 200 VDC maximum. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Metriod 103	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 1.2 X rated voltage applied.
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 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



High Voltage with Flexible Termination System (HV FT-CAP), C0G Dielectric, 500 – 3,000 VDC (Commercial Grade)



Overview

KEMET's High Voltage with Flexible Termination (HV FT-CAP) surface mount MLCCs in C0G dielectric address the primary failure mode of MLCCs—flex cracks, which are typically the result of excessive tensile and shear stresses produced during board flexure and thermal cycling. Featuring several of the highest CV (capacitance/voltage) values available in the industry, these devices utilize a pliable and conductive silver epoxy between the base metal and nickel barrier layers of the termination system. The addition of this epoxy layer inhibits the transfer of board stress to the rigid ceramic body, therefore mitigating flex cracks which can result in low IR or short circuit failures. Although flexible termination technology does not eliminate the potential for mechanical damage that may propagate during extreme environmental and handling conditions, it does provide superior flex performance over standard termination systems.

KEMET's high voltage surface mount MLCCs in C0G dielectric feature a 125°C maximum operating temperature and offer the most stable voltage and temperature performance of all ceramic dielectric materials. C0G (NP0) dielectric capacitors exhibit no change in capacitance with respect to time and voltage and boasts a negligible change in capacitance with reference to ambient temperature. Capacitance change is limited to ±30ppm/°C from -55°C to +125°C.

These devices exhibit low ESR at high frequencies and find conventional use as snubbers or filters in applications such as switching power supplies and lighting ballasts. Their exceptional performance at high frequencies has made high voltage MLCC's the preferred dielectric choice of design engineers worldwide. In addition to their use in power supplies, these capacitors are widely used in industries related to automotive (hybrid), telecommunications, medical, military, aerospace, semiconductors and test/diagnostic equipment.

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



Ordering Information

С	2225	X	393	J	С	G	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance ¹	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/Grade (C-Spec)
	0805 1206 1210 1808 1812 1825 2220 2225	X= Flexible Termination	Two significant digits + number of zeros.	B = ±0.10 pF C = ±0.25 pF D = ±0.5 pF F = ±1% G = ±2% J = ±5% K = ±10% M = ±20%	C = 500 B = 630 D = 1,000 F = 1,500 G = 2,000 Z = 2,500 H = 3,000	G = C0G	A = N/A	C = 100% Matte Sn L = SnPb (5% Pb minimum)	See "Packaging C-Spec Ordering Options Table" below

¹ Additional capacitance tolerance offerings may be available. Contact KEMET for details.

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



Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec)
Bulk Bag/Unmarked	Not required (Blank)
7" Reel/Unmarked	TU
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2 mm pitch ²	7081
13" Reel/Unmarked/2 mm pitch ²	7082

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- -55°C to +125°C operating temperature range
- Superior flex performance (up to 5 mm)
- Lead (Pb)-Free, RoHS, and REACH compliant
- EIA 0805, 1206, 1210, 1808, 1812, 1825, 2220 and 2225 case sizes
- DC voltage ratings of 500 V, 630 V, 1 KV, 1.5 KV, 2 KV, 2.5 KV and 3 KV
- Capacitance offerings ranging from 1 pF to 39 nF
- Available capacitance tolerances of ±0.10 pF, ±0.25 pF, ±0.5 pF, ±1%, ±2%, ±5%, ±10% and ±20%
- · No piezoelectric noise
- Extremely low ESR & ESL
- High thermal stability

- High ripple current capability
- Preferred capacitance solution at line frequencies & into the MHz range
- · No capacitance change with respect to applied rated DC voltage
- Negligible capacitance change with respect to temperature from –55°C to +125°C
- No capacitance decay with time
- · Non-polar device, minimizing installation concerns
- · Automotive (AEC-Q200) grade available
- 100% pure matte tin-plated termination finish allowing for excellent solderability
- SnPb plated termination finish option available upon request (5% Pb minimum)

Applications

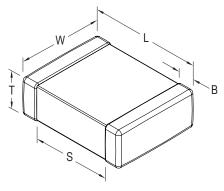
Typical applications include switch mode power supplies (input filters, resonators, tank circuits, snubbed circuits, output filters), high voltage coupling and DC blocking, lighting ballasts, voltage multiplier circuits, DC/DC converters and coupling capacitors in Ćuk converters. Markets include power supply, LCD fluorescent backlight ballasts, HID lighting, telecom equipment, industrial and medical equipment/control, LAN/WAN interface, analog and digital modems, and automotive.

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. The option to laser mark is not available on these devices. For more information see "Capacitor Marking".

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Dimensions – Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0805	2012	2.00 (.079) ± 0.30 (.012)	1.25 (.049) ± 0.30 (.012)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	Solder Wave or
1206	3216	3.30 (.130) ± 0.40 (.016)	1.60 (.063) ± 0.35 (.013)		0.60 (.024) ± 0.25 (.010)		Solder Reflow
1210	3225	3.30 (.130) ± 0.40 (.016)	2.60 (.102) ± 0.30 (.012)		0.60 (.024) ± 0.25 (.010)		
1808	4520	4.70 (.185) ± 0.50 (.020)	2.00 (.079) ± 0.20 (.008)	See Table 2 for	0.70 (.028) ± 0.35 (.014)		
1812	4532	4.50 (.178) ± 0.40 (.016)	3.20 (.126) ± 0.30 (.012)	Thickness	0.70 (.028) ± 0.35 (.014)	N/A	Calden Deflass Only
1825	4564	4.60 (.181) ± 0.40 (.016)	6.40 (.252) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)		Solder Reflow Only
2220	5650	5.90 (.232) ± 0.75 (.030)	5.00 (.197) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)		
2225	5664	5.90 (.232) ± 0.75 (.030)	6.40 (.248) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)		

Qualification/Certification

Commercial Grade products are subject to internal qualification. Details regarding test methods and conditions are referenced in Table 4, Performance and 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)	±30 ppm/°C
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	0%
¹ Dielectric Withstanding Voltage (DWV)	150% of rated voltage for voltage rating of < 1,000 V 120% of rated voltage for voltage rating of ≥ 1,000 V (5 ±1 seconds and charge/discharge not exceeding 50 mA)
² Dissipation Factor (DF) Maximum Limit at 25°C	0.1%
³ Insulation Resistance (IR) Limit at 25°C	1,000 megohm microfarads or 100 G Ω (500 VDC applied for 120 ± 5 seconds at 25°C)

¹ DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

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."

Post Environmental Limits

	High Temperatu	ıre Life, Biased	Humidity, Mois	ture Resistance	
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance
C0G	All	All	0.5	0.3% or ±0.25 pF	10% of Initial Limit

² Capacitance and dissipation factor (DF) measured under the following conditions:

¹ MHz ± 100 kHz and 1.0 Vrms ± 0.2 V if capacitance $\leq 1,000$ pF

¹ kHz ± 50 Hz and 1.0 Vrms ± 0.2 V if capacitance > 1,000 pF

 $^{{}^{3}}$ To obtain IR limit, divide M Ω - μ F value by the capacitance and compare to G Ω limit. Select the lower of the two limits.



Table 1A – Capacitance Range/Selection Waterfall (0805 – 1808 Case Sizes)

			Ca	ise	Siz	ze/S	Se	ries	3	С	080	5X		С	1206	6X			С	1210	OX			C1808X					
				Vo	ltag	e Co	de			С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	Z	Н
Capacitance	Cap Code		R	Rated	l Volt	tage	(VI	DC)		200	630	1000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	2500	3000
		C	ana	cit	anc	_ _ T	ole	rar	ICE	"				Pro	duc	t Av	ailal	oility	and	d Ch	ip Th	nick	ness	s Co	des	_	_ 7		m
1.0 - 9.1 pF*	109 - 169*	В	<u>. </u>	D	1110	· ·		, a		DG	DG	DG		S	ee T	able	2 fc	or Ch	nip T	hick	cnes	s Di	men LB	LB	LB	LB	LB	LB	LB
1.0 - 9.1 pr 10 pF	109 - 109			0	F	G	J	K	М	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
11 pF	110	ĺ			F	G	J	K	М	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
12 pF	120	l			F	G	J	K	М	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
13 pF	130				F	G	J	K	M	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
15 pF	150	l			F	G	J	K	M	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
16 pF	160 180				F	G	J	K	M	DG DG	DG DG	DG DG	ES ES	ES ES	ES ES	ES ES	ES ES	FM FM	FM FM	FM FM	FM FM	FM FM	LB LB	LB LB	LB LB	LB LB	LB LB	LB LB	LB LB
18 pF 20 pF	200				F	G	J	K	M	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
22 pF	220	l			F	G	J	K	M	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
24 pF	240				F	G	J	K	М	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
27 pF	270				F	G	J	K	М	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
30 pF	300				F	G	J	K	М	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
33 pF	330				F	G	J	K	М	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
36 pF	360 390				F	G	J	K	M	DG	DG	DG	ES ES	ES ES	ES ES	ES ES	ES ES	FM FM	FM	FM FM	FM FM	FM FM	LB	LB	LB	LB	LB	LB	LB LB
39 pF 43 pF	430	l			F	G	J	K	M	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
47 pF	470				F	G	J	K	M	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
51 pF	510	İ			F	G	J	K	М	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
56 pF	560	İ			F	G	J	K	М	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
62 pF	620				F	G	J	K	М	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
68 pF	680				F	G	J	K	М	DG	DG	DG	ES	ES	ES	ES	ES	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
75 pF	750	l			F	G	J	K	M	DG	DG	DG	ES	ES	ES	ES	EF	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
82 pF 91 pF	820 910				F	G	J	K	M	DG DG	DG DG	DG DG	ES ES	ES ES	ES ES	ES ES	EF EF	FM FM	FM FM	FM FM	FM FM	FM FM	LB LB	LB LB	LB LB	LB LB	LB	LB LB	LB LB
100 pF	101				F	G	J	K	M	DG	DG	DG	ES	ES	ES	ES	EF	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LC	LB
110 pF	111	l			F	G	J	K	M	DG	DG	DG	ES	ES	ES	ES	EU	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LC	LB
120 pF	121	İ			F	G	J	K	М	DG	DG	DG	ES	ES	ES	ES	EU	FZ	FZ	FZ	FM	FM	LA	LA	LA	LA	LB	LC	LB
130 pF	131	l			F	G	J	K	М	DG	DG	DG	ES	ES	ES	ES	EU	FZ	FZ	FZ	FM	FM	LA	LA	LA	LA	LB	LC	LC
150 pF	151	L			F	G	J	K	М	DG	DG	DG	ES	ES	ES	EF	EU	FZ	FZ	FZ	FM	FM	LA	LA	LA	LA	LB	LC	LC
160 pF	161				F	G	J	K	M	DG	DG	DG	ES	ES	ES	EF	EU	FZ	FZ	FZ	FM	FM	LA	LA	LA	LA	LC	LC	LC
180 pF	181 201				F	G	J	K	M	DG DG	DG DG	DG DG	ES ES	ES ES	ES ES	EF EF	EU	FZ FZ	FZ FZ	FZ FZ	FM FM	FM FM	LA	LA	LA	LA	LC	LC	LC
200 pF 220 pF	221				F	G	J	K	M	DG	DG	DG	ES	ES	ES	EU	EU	FZ	FZ	FZ	FM	FM	LA	LA	LA	LA	LC	LC	
240 pF	241				F	G	J	K	M	DG	DG	DG	ES	ES	ES	EU	EU	FZ	FZ	FZ	FM	FM	LA	LA	LA	LB	LC	LC	
270 pF	271	П		П	F	G	J	K	М	DG	DG	DG	ES	ES	ES	EU	EU	FZ	FZ	FZ	FK	FK	LA	LA	LA	LB	LC	LC	
300 pF	301				F	G	J	K	М	DG	DG		ES	ES	EF	EU		FZ	FZ	FZ	FK	FK	LA	LA	LA	LB	LC	LC	
330 pF	331				F	G	J	K	М	DG	DG		ES	ES	EF	EU		FZ	FZ	FZ	FK	FK	LA	LA	LA	LB	LC	LC	
360 pF	361				F	G	J	K	M	DG	DG		ES	ES	EF	EU		FZ	FZ	FZ	FK	FS	LA	LA	LA	LB	LA	LC	
390 pF 430 pF	391 431				F	G	J	K	M	DG	DG		ES	ES	EF EF	EU		FZ FZ	FZ FM	FZ FM	FK FS	FS FS	LA	LA	LA	LB	LA	LC	
470 pF	471				F	G	J	K	M	DG	DG		ES	ES	EU	EU		FZ	FM	FM	FS	FS	LA	LB	LB	LC	LA		
510 pF	511				F	G	J	K	M	DG	DG		ES	ES	EU	EU		FZ	FM	FM	FS	FS	LA	LB	LB	LC	LB		
560 pF	561				F	G	J	K	М	DG	DG		ES	ES	EU	EU		FZ	FM	FM	FS	FS	LA	LB	LB	LC	LB		
620 pF	621				F	G	J	K	М	DG			ES	ES				FZ	FM	FM	FS	FS	LA	LB	LB	LA	LC		
680 pF	681				F	G	J	K	М	DG			ES	ES	EU			FZ	FM	FM	FS	FS	LB	LB	LB	LA	LC		
750 pF	751				F	G	J	K	M	DG DG			ES	EF EF	EU			FZ	FM	FM			LB	LB LB	LB	LA			
820 pF 910 pF	821 911				F	G	J	K	M	الم			ES ES	EF	EU			FZ FM	FM FM	FM FM	FM FY		LB LB	LB	LB LB	LA			
1,000 pF	102	l			F	G	J	K	M				ES	EF	EU			FM	FM	FM	FY		LB	LB	LB	LB			
.,v p.		 				200	630	1000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	2500	3000				
Capacitance	Cap Code					C	В	D	C	В	D	F	G	C	В	D	F	G	C	В	D	F	G	Z	Н				
		Г					C0805X							C1210X				C1808X											
	<u> </u>		Case Size/Series C					233																					

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).



Table 1A - Capacitance Range/Selection Waterfall (0805 - 1808 Case Sizes) cont'd

			Cas	se S	Siz	:e/S	Ser	ies	5	С	080	5X		C	120	6X			С	1210	X		C1808X							
				Vol	ltag	e Co	de			С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	Z	н	
Capacitance	Cap Code		Ra	ated '	Volt	age	(VD	C)		500 630 1000 500 630 1000 1500 2000								200	630	1000	1500	2000	200	630	1000	1500	2000	2500	3000	
		Са	ра	cita	nc	e To	ole	ran	се					Pro S	duc ee T	t Av	ailal 2 fc	oility or Cl	/ and	l Ch	ip TI (nes	nick s Di	ness men	s Co sior	des IS					
1,100 pF	112				F	G	J	K	М				EF	EU				FM	FK	FK	FS		LC	LC	LC	LB				
1,200 pF	122				F	G	J	K	M				EF	EU				FM	FK	FK	FS		LC	LC	LC	LC				
1,300 pF	132				F	G	J	K	M				EF	EU				FM	FS	FS			LC	LC	LC	LC				
1,500 pF	152				F	G	J	K	M				EF	EU				FK	FS	FS			LC	LC	LC	LC				
1,600 pF	162				F	G	J	K	M				EF	EU				FK	FS	FS			LC	LC	LC					
1,800 pF	182				F	G	J	K	M				EF	EU				FK	FS	FS			LC	LC	LC					
2,000 pF	202				F	G	J	K	M				EU	EQ				FK	FL	FS			LC	LA	LB					
2,200 pF	222				F	G	J	K	M				EU	EQ				FK	FL	FS			LC	LA	LB					
2,400 pF	242				F	G	J	K	M	l			EU	EQ				FS	FL	FS			LC	LA	LB					
2,700 pF	272				F	G	J	K	M				EU	EQ				FS	FL	FS			LC	LA	LC					
3,000 pF	302				F	G	J	K	М				EQ	EQ				FS	FL				LA	LA						
3,300 pF	332				F	G	J	K	M				EQ	EQ				FS	FM				LA	LA						
3,600 pF	362				F	G	J	K	M				ER	ER				FL	FM				LA	LB						
3,900 pF	392				F	G	J	K	М				ER	ER				FL	FY				LA	LB						
4,300 pF	432				F	G	J	K	М				ES	ES				FM	FY				LA	LC						
4,700 pF	472				F	G	J	Κ	М				ES	ES				FM	FY				LA	LC						
5,100 pF	512	i			F	G	J	K	М	İ								FY	FS				LA							
5,200 pF	562				F	G	J	K	М	l			l					FY	FS				LB							
6,200pF	622				F	G	J	K	М	l			l					FY	FE				LC							
6,800pF	682	l l			F	G	J	K	М	l			l					FY	FE				LC							
7,500pF	752				F	G	J	K	М									FS												
8,200pF	822				F	G	J	K	М									FS												
			1 0 0 11 111					200	630	1000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	2500	3000			
Capacitance	Cap Code		Voltage Code C									C B D F G					C B D F G Z				Н									
								080	5X		С	1206	SX_			С	1210	X				С	1808	ЗХ						

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).



Table 1B - Capacitance Range/Selection Waterfall (1812 - 2225 Case Sizes)

		Case Size/Series			C1	812	2X					C 1	825	5X			C2220X				C2225X									
	Сар	Voltage Code	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н	С	В	D	F	G	z	Н	С	В	D	F	G	Z	Н
Сар	Code	Rated Voltage (VDC)	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	100	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
		Capacitance	2		=	=	7	7	ૹ	Pro	odu	ct A	vai	labi	lity	and	Cr	ip '	Γhic	kne	ss	Cod	les	٦.		=	#		7	36
10 pF	100	Tolerance F G J K M	GK	GK	GK	GK	GK	GK	GK		ee	Iab	ie z	TOF	Cn	ір і	JK	JK	SS [JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
11 pF	110	F G J K M		GK		GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
12 pF	120	F G J K M	GK	GK		GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
13 pF	130	F G J K M	GK	GK		GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
15 pF	150	F G J K M	GK	GK		GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
16 pF	160	F G J K M	GK	GK		GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF KF	KF	KF KF	KF	KF	KF	KF
18 pF 20 pF	180 200	F G J K M F G J K M	GK GK	GK GK		GK GK	GK GK	GK GK	GK GK								JK JK	JK JK	JK JK	JK JK	JK JK	JK JK	JK JK	KF	KF KF	KF	KF KF	KF KF	KF KF	KF KF
20 pF 22 pF	220	F G J K M	GK	GK		GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
24 pF	240	F G J K M	GK	GK		GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
27 pF	270	F G J K M	GK	GK		GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
30 pF	300	F G J K M	GK	GK		GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
33 pF	330	F G J K M	GK	GK	GK	GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
36 pF	360	F G J K M	GK	GK	GK	GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
39 pF	390	F G J K M	GK	GK		GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
43 pF	430	F G J K M	GK	GK		GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
47 pF	470	F G J K M	GK	GK	GK	GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
51 pF	510	F G J K M	GK	GK		GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF		KF
56 pF 62 pF	560 620	F G J K M	GK GK	GK GK		GK GK	GK GK	GK GK	GK GK								JK JK	JK JK	JK JK	JK JK	JK JK	JK JK	JK JK	KF KF	KF KF	KF KF	KF KF	KF KF	KF KF	KF KF
68 pF	680	F G J K M	GK	GK		GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
75 pF	750	F G J K M	GK	GK		GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
82 pF	820	F G J K M	GK	GK		GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
91 pF	910	F G J K M	GK	GK		GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
100 pF	101	F G J K M	GK	GK		GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
110 pF	111	F G J K M	GK	GK	GK	GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
120 pF	121	F G J K M	GK	GK	GK	GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
130 pF	131	F G J K M	GK	GK		GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
150 pF	151	F G J K M	GK			GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
160 pF	161	F G J K M	GK	GK		GK	GK	GK	GK								JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
180 pF	181	F G J K M F G J K M	GK	GK		GK	GK	GK	GK GM								JK	JK	JK	JK JK	JK	JK	JK JK	KF KF	KF KF	KF KF	KF KF	KF KF	KF KF	KF KF
200 pF 220 pF	201 221	F G J K M	GH GH	GH GH		GH GH	GH GH	GK GK	GM								JK JK	JK JK	JK JK	JK	JK JK	JK JK	JK	KF	KF	KF	KF	KF	KF	KF
240 pF	241	F G J K M	GH	GH			GH	GK	GM								JK	JK	JK	JK	JK	JK	JK	KE	KE	KE	KE	KE	KE	KF
270 pF	271	F G J K M	GH	GH		GH	GH	GK	GM								JK	JK	JK	JK	JK	JK	JK	KE	KE	KE	KE	KE	KE	KF
300 pF	301	F G J K M				GH	GH	GK	GM								JK	JK	JK	JK	JK	JK	JK	KE	KE	KE	KE		KE	KF
330 pF	331	F G J K M	GH			GH	GH	GK	GO								JE	JE	JE	JE	JE	JK	JK	KE	KE	KE	KE			KF
360 pF	361	F G J K M	GK	GK		GK	GH	GK	GO								JE	JE	JE	JE	JE	JK	JK	KE	KE	KE	KE	KE	KE	KF
390 pF	391	F G J K M	GK	GK	GK	GK	GK	GK	GO								JΕ	JE	JE	JE	JE	JK	JK	KE	KE	KE	KE	KE		KF
430 pF	431	F G J K M	GK	GK		GK	GK	GK								HJ	JE	JE	JE	JE	JE	JK	JE	KE	KE	KE	KE	KE		KF
470 pF	471	F G J K M						GK								HJ	JE	JE	JE	JE	JE	JK	JK	KF	KF	KF	KF	KE	KE	KF
510 pF	511					GK										HJ	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF			KF
560 pF 620 pF	561 621		GH	GH		GK										HJ HK	JK JK	JK JK	JK JK	JK JK	JK JK	JK JK	JL JL	KF KF	KF KF	KF KF	KF KF			KF KH
680 pF	621 681		GH													HK		JE	JE	JK	JK	JK	JL	KF	KF		KF			KH
750 pF	751	F G J K M		GH				00								TIIN	JE	JE	JE	JK	JK	JK	JL	KE	KE	KE	KF			KH
820 pF	821	F G J K M				GK											JE	JE	JE	JK	JK	JK	JN	KE	KE	KE	KF			KJ
910 pF	911	F G J K M															JE	JK	1	JK	JK	JK	JN			KE		KE		KJ
1,000 pF	102	F G J K M	GH	GH	GH	GH	GM										JE	JK	1	JK	JK	JK	JN		1	KE				KJ
1,100 pF	112	F G J K M	GH	GK		GH	GO								HJ		JE	JK	JK	JK	JK	JK		KE	KE				KF	
		Rated Voltage (VDC)	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
Сар	Cap Code	Voltage Code	С	В	D	F	G	Z	Н	С	В	D	F	G	z	Н	С	В	D	F	G	z		С	В	D	F	G		Н
		Case Size/Series			C1	1812	X					C1825X C2220X							C2220X			C2225X								

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).



Table 1B - Capacitance Range/Selection Waterfall (1812 - 2225 Case Sizes) cont'd

		Case Size/Series			C1	1812	2X					C 1	82	5X			C2220X								C2	222	5X			
	Cap	Voltage Code	С	В	D	F	G	z	н	С	В	D	F	G	z	Н	С	В	D	F	G	z	Н	С	В	D	F	G	z	н
Сар	Code	Rated Voltage (VDC)	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
		Capacitance Tolerance		Product Availability and See Table 2 for Chip Th							l Ch	ip 1 kne	hic	kne	ss (Cod	es													
1,200 pF	122	F G J K M	GH	GK	GK	GH	GO								HJ		JE	JK	JK	JK	JK	JL		KE	KE	KE	KF	KF	KF	
1,300 pF	132	F G J K M	GH	GK	GK	GH	GO							HE	HJ		JE	JK	JK	JK	JE	JL		KE	KE	KE	KF	KF	KH	
1,500 pF	152	F G J K M	GK	GK	GK	GK	GO							HE	HK		JE	JK	JK	JK	JE	JL		KE	KE	KE	KF	KF	KH	
1,600 pF	162	F G J K M	GK	GK	GK	GK								HG	HK		JE	JK	JK	JK	JE	JL		KE	KE	KE	KF	KE	KH	
1,800 pF	182	F G J K M	GK	GK	GK	GM								HG			JE	JK	JK	JK	JE	JN		KE	KE	KE	KF	KE	KH	
2,000 pF	202	F G J K M	GK	GK	GK	GM							ΗE	HJ			JE	JK	JK	JE	JK			ΚE	KE	KE	KF	KE	KJ	
2,200 pF	222	F G J K M	GK	GK	GK	GO							HE	HJ			JE	JK	JK	JΕ	JK			ΚE	KE	KE	KF	KF	KJ	
2,400 pF	242	F G J K M	GK	GH	GK	GO							HE	HJ			JK	JK	JK	JΕ	JL			ΚE	KE	KE	KE	KH		
2,700 pF	272	F G J K M	GK	GH	GK	GO							HE	нк			JK	JK	JK	JE	JL			KE	KE	KE	KE	KH		
3,000 pF	302	FGJKM	GK	GH	GK								HE	нк			JK	JK	JK	JE	JL			KE	KE	KE	KE	KH		
3,300 pF	332	F G J K M	GK	GH	GK								HG				JK	JK	JK	JK	JN			KE	KE	KE	KE	KJ		
3,600 pF	362	FGJKM	GK	GH	GM								HG				JK	JK	JK	JK	JN			KE	KF	KF	KF	KJ		
3,900 pF	392	FGJKM	GК	GH	GM								HJ				JK	JK	JK	JK	JN			KE	KF	KF	KF	KJ		
4,300 pF	432	F G J K M	GН	GH	GO								HJ				JK	JK	JK	JK				KE	KF	KF	KF			
4,700 pF	472	F G J K M	GH	GH	GO								HJ				JK	JK	JK	JL				KE	KF	KF	КН			
5,100 pF	512	F G J K M			GO						HE	HG	НК				JK	JK	JK	JL				KE	KF	KF	КН			
5,600 pF	562	F G J K M			GO						HE	HG	нк				JK	JK	JK	JN				KE	KF	KF	кн			
6,200 pF	622	F G J K M	GН	GK							HE	HG					JK	JE	JE	JN				KE	KF	KF	KJ			
6,800 pF	682	F G J K M		GM							HE	HJ					JK	JE	JK	JN				KE	KF	KF	KJ			
7,500 pF	752	F G J K M									HE	HJ					JК	JE	JK					KF	KE	KF				
8,200 pF	822	F G J K M									HE	HJ					JK	JE	JL					KF	KE	KF				
9,100 pF	912	F G J K M								HE	HG	НК					JE	JE	JL					KF	KE	КН				
10,000 pF	103	F G J K M	-							HE	HG	НК					JE	JE	JL					KF	KE	KH				
12,000 pF	123	F G J K M									HG						JE	JK	JN					KE	KE	KH				
15,000 pF	153		GO							HE	HJ						JE	JL	• • •					KE	KF	KJ				
18,000 pF	183	F G J K M								HG	HK						JE	JL						KE	KH					
22,000 pF	223	F G J K M								HJ							JK	JN						KF	KJ					
27,000 pF	273	F G J K M								HJ							JL	JN						KF	KJ					
33,000 pF	333	F G J K M								HK							JN	011						KH	110					
39,000 pF	393	F G J K M															011							KJ						
33,000 pi	000		 	-	_	_	0	_	0	_	_	0	_	_	•	0	-		_	_	0	0	_			0	0	-	0	
	Сар	Rated Voltage (VDC)	200	630	1000	1500	2000	2500	3000	200	630	100	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
Сар	Cap Code	Voltage Code	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н	C B D F G Z H C B			D	F	G	Z	Н						
		Case Size/Series			C,	1812	2X					C,	182	5X			C2220X						C	C2225X						

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).



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

Thickness	Case	Thickness ±	Paper G	Quantity	Plastic (Quantity		
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel		
DG	0805	1.25 ± 0.15	0	0	2,500	10,000		
ES	1206	1.00 ± 0.20	0	0	2,500	10,000		
EF	1206	1.20 ± 0.15	0	0	2,500	10,000		
EU	1206	1.60 ± 0.25	0	0	2,000	8,000		
EQ	1206	0.78 ± 0.20	4000	10000	4,000	10,000		
ER	1206	0.90 ± 0.20	0	0	4,000	10,000		
FE	1210	1.00 ± 0.10	0	0	2,500	10,000		
FZ	1210	1.25 ± 0.20	0	0	2,500	10,000		
FL	1210	1.40 ± 0.15	0	0	2,000	8,000		
FM	1210	1.70 ± 0.20	0	0	2,000	8,000		
FY	1210	2.00 ± 0.20	0	0	2,000	8,000		
FK	1210	2.10 ± 0.20	0	0	2,000	8,000		
FS	1210	2.50 ± 0.30	0	0	1,000	4,000		
LA	1808	1.40 ± 0.15	0	0	1,000	4,000		
LB	1808	1.60 ± 0.15	0	0	1,000	4,000		
LC	1808	2.00 ± 0.15	0	0	1,000	4,000		
GH	1812	1.40 ± 0.15	0	0	1,000	4,000		
GK	1812	1.60 ± 0.20	0	0	1,000	4,000		
GM	1812	2.00 ± 0.20	0	0	500	2,000		
GO	1812	2.50 ± 0.20	0	0	500	2,000		
HE	1825	1.40 ± 0.15	0	0	1,000	4,000		
HG	1825	1.60 ± 0.20	0	0	1,000	4,000		
HJ	1825	2.00 ± 0.20	0	0	500	2,000		
HK	1825	2.50 ± 0.20	0	0	500	2,000		
JE	2220	1.40 ± 0.15	0	0	1,000	4,000		
JK	2220	1.60 ± 0.20	0	0	1,000	4,000		
JL	2220	2.00 ± 0.20	0	0	500	2,000		
JN	2220	2.50 ± 0.20	0	0	500	2,000		
KE	2225	1.40 ± 0.15	0	0	1,000	4,000		
KF	2225	1.60 ± 0.20	0	0	1,000	4,000		
KH	2225	2.00 ± 0.20	0	0	500	2,000		
KJ	2225	2.50 ± 0.20	0 7" Reel	0 13" Reel	500 7" Reel	2,000 13" Reel		
Thickness Code	Case Size	Thickness ± Range (mm)	Paper G	Quantity	Plastic Quantity			

Package quantity based on finished chip thickness specifications.



Table 2B - Bulk Packaging Quantities

Deale		Loose Packaging								
Раска(ging Type	Bulk Bag (default)								
Packagi	ing C-Spec ¹	N.	/A ²							
Cas	se Size	Packaging Quantities	(pieces/unit packaging)							
EIA (in)	Metric (mm)	Minimum	Maximum							
0402	1005									
0603	1608									
0805	2012		50,000							
1206	3216									
1210	3225	1								
1808	4520									
1812	4532									
1825	4564		20,000							
2220	5650									
2225	5664									

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

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



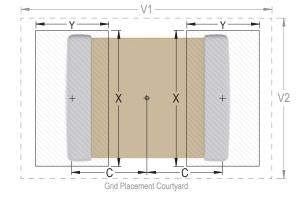
Table 3 - Chip Capacitor Land Pattern Design Recommendations per IPC-7351

EIA Size Code	Metric Size Code	I	Maxi	sity Lev mum (M rotrusio	Most))		Medi	sity Lev an (Nor rotrusio)	Density Level C: Minimum (Least) Land Protrusion (mm)						
Code Code		С	Y	X	V1	V2	С	Υ	Х	V1	V2	С	Υ	Х	V1	V2		
0805	2012	0.99	1.44	1.66	4.47	2.71	0.89	1.24	1.56	3.57	2.11	0.79	1.04	1.46	2.42	1.81		
1206	3216	1.59	1.62	2.06	5.85	3.06	1.49	1.42	1.96	4.95	2.46	1.39	1.22	1.86	4.25	2.16		
1210	3225	1.59	1.62	3.01	5.90	4.01	1.49	1.42	2.91	4.95	3.41	1.39	1.22	2.81	4.25	3.11		
1808	4520	2.30	1.75	2.30	7.40	3.30	2.20	1.55	2.20	6.50	2.70	2.10	1.35	2.10	5.80	2.40		
1812	4532	2.10	1.80	3.60	7.00	4.60	2.00	1.60	3.50	6.10	4.00	1.90	1.40	3.40	5.40	3.70		
1825	4564	2.15	1.80	6.90	7.10	7.90	2.05	1.60	6.80	6.20	7.30	1.95	1.40	6.70	5.50	7.00		
2220	5650	2.85	2.10	5.50	8.80	6.50	2.75	1.90	5.40	7.90	5.90	2.65	1.70	5.30	7.20	5.60		
2225	5664	2.85	2.10	6.90	8.80	7.90	2.75	1.90	6.80	7.90	7.30	2.65	1.70	6.70	7.20	7.00		

Density Level A: For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes. KEMET only recommends wave soldering of EIA 0603, 0805 and 1206 case sizes.

Density Level B: For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes. **Density Level C:** For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC Standard 7351 (IPC–7351).

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





Soldering Process

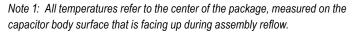
Recommended Soldering Technique:

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

Recommended Reflow Soldering Profile:

KEMET's families of surface mount multilayer ceramic capacitors (SMD MLCCs) are compatible with wave (single or dual), convection, IR or vapor phase reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET's recommended profile conditions for convection and IR reflow reflect the profile conditions of the IPC/J-STD-020 standard for moisture sensitivity testing. These devices can safely withstand a maximum of three reflow passes at these conditions.

Profile Feature	Terminati	on Finish
Frome reature	SnPb	100% Matte Sn
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum



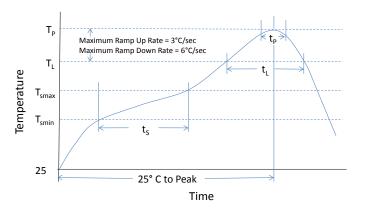




Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 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:
Solderability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	J-31D-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Diggod Humidity	MIL-STD-202 Method 103	Load Humidity: 1,000 hours 85°C/85% RH and 200 VDC maximum. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Metriod 103	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55° C/+125°C. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 1.2 X rated voltage applied.
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 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

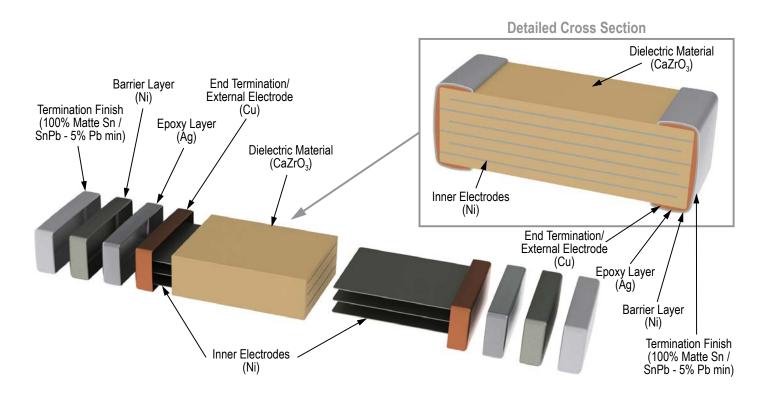
Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature- reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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.

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Construction



Capacitor Marking (Optional):

Laser marking option is not available on:

- C0G, Ultra Stable X8R and Y5V dielectric devices
- EIA 0402 case size devices
- EIA 0603 case size devices with Flexible Termination option.
- · KPS Commercial and Automotive grade stacked devices.

These capacitors are supplied unmarked only.

ArcShield™ Technology, High Voltage, X7R Dielectric, 500 – 1,000 VDC (Commercial & Automotive Grade)



Overview

KEMET ArcShield high voltage surface mount capacitors in X7R dielectric are designed for use in high voltage applications susceptible to surface arcing (arc-over discharge).

The phenomenon of surface arcing is caused by a high voltage gradient between the two termination surfaces or between one of the termination surfaces and the counter internal electrode structure within the ceramic body. It occurs most frequently at application voltages that meet or exceed 300 V, in high humidity environments, and in chip sizes with minimal bandwidth separation (creepage distance). This phenomenon can either damage surrounding components or lead to a breakdown of the dielectric material, ultimately resulting in a short-circuit condition (catastrophic failure mode).

Patented ArcShield technology features KEMET's highly reliable base metal dielectric system combined with a unique internal shield electrode structure that is designed to suppress an arc-over event while increasing available capacitance. Developed on the principle of a partial Faraday cage, this internal system offers unrivaled performance and reliability when compared to external surface coating technologies.

For added reliability, KEMET's Flexible Termination technology is an available option that provides superior flex performance over standard termination systems. This technology was developed to address flex cracks, which are the primary failure mode of MLCCs and typically the result of excessive tensile and shear stresses produced during board flexure and thermal cycling. Flexible Termination technology inhibits the transfer of board stress to the rigid body of the MLCC, therefore mitigating flex cracks which can result in low IR or short circuit failures.

KEMET's ArcShield high voltage surface mount MLCCs are available in Automotive Grade, which undergo stricter testing protocol and inspection criteria. Whether under-hood or incabin, these devices are designed for mission and safety-critical automotive circuits or applications requiring proven, reliable performance in harsh environments. Automotive Grade devices meet the demanding Automotive Electronics Council's AEC-Q200 qualification requirements.



Ordering Information

С	0603	W	392	K	С	R	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/ Grade (C-Spec) ²
	0603 0805 1206 1210 1808 1812 1825 2220 2225	V = ArcShield W = ArcShield with Flexible Termination	Two significant digits + number of zeros.	J = ±5% K = ±10% M = ±20%	C = 500 B = 630 D = 1,000	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% PB minimum)	See "Packaging C-Spec Ordering Options Table" below

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

^{1, 2} SnPb termination finish option is not available on Automotive Grade product.

² Additional reeling or packaging options may be available. Contact KEMET for details.



Packaging C-Spec Ordering Options Table

Packaging Type	Packaging/Grade Ordering Code (C-Spec)
Commerc	ial Grade ¹
Bulk Bag	Not Required (Blank)
7" Reel/Unmarked	TU
13" Reel/Unmarked	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
7" Reel/Marked	TM
13" Reel/Marked	7040 (EIA 0603 and smaller case sizes) 7215 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2 mm pitch ²	7081
13" Reel/Unmarked/2 mm pitch ²	7082
Automotiv	ve Grade ³
7" Reel	AUTO
13" Reel/Unmarked	AUTO7411 (EIA 0603 and smaller case sizes) AUTO7210 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2 mm pitch ²	3190
13" Reel/Unmarked/2 mm pitch ²	3191

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

Benefits

- · Patented technology
- · Permanent internal arc protection
- Protective surface coating not required
- · Base metal electrode (BME) dielectric system
- Industry leading CV values
- -55°C to +125°C operating temperature range
- Exceptional performance at high frequencies
- · Lead (Pb)-Free, RoHS and REACH compliant
- EIA 0603, 0805, 1206, 1210, 1808, 1812, 1825, 2220 and 2225 case sizes
- DC voltage ratings of 500 V, 630 V and 1 KV

- Capacitance offerings ranging from 1,000 pF to 560 nF
- Available capacitance tolerances of ±5%, ±10% and ±20%
- Low ESR & ESL
- · Non-polar device, minimizing installation concerns
- Commercial & Automotive (AEC-Q200) grades available
- 100% pure matte tin-plated termination finish allowing for excellent solderability
- SnPb plated termination finish option available upon request (5% Pb minimum)
- · Flexible Termination option available upon request

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked.

² The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".

³ Reeling tape options (Paper or Plastic) are dependent on capacitor case size (L" x W") and thickness dimension. See "Chip Thickness/Tape & Reel Packaging Quantities" and "Tape & Reel Packaging Information".

³ For additional Information regarding "AUTO" C-Spec options, see "Automotive C-Spec Information".

³ All Automotive packaging C-Specs listed exclude the option to laser mark components. Please contact KEMET if you require a laser marked option. For more information see "Capacitor Marking".



Automotive C-Spec Information

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

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

Product Change Notification (PCN)

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

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

KEMET Automotive	Customer Noti	fication due to:	Days prior to
C-Spec	Process/Product change	Obsolescence*	implementation
KEMET assigned ¹	Yes (with approval and sign off)	Yes	180 days Minimum
AUTO	Yes (without approval)	Yes	90 days Minimum

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

Production Part Approval Process (PPAP)

The purpose of the Production Part Approval Process is:

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

KEMET Automotive		PPAP (Product Part Approval Process) Level													
C-Spec	1	2	3	4	5										
KEMET assigned ¹	•	•	•	•	•										
AUTO	0		0												

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

- Part Number specific PPAP available
- Product family PPAP only



Applications

Typical applications include switch mode power supplies (input filters, resonators, tank circuits, snubber circuits, output filters), high voltage coupling and DC blocking, lighting ballasts, voltage multiplier circuits, DC/DC converters and coupling capacitors in Ćuk converters. Markets include power supply, LCD fluorescent backlight ballasts, HID lighting, telecom equipment, industrial and medical equipment/control, LAN/ WAN interface, analog and digital modems, and automotive (electric and hybrid vehicles, charging stations and lighting) applications.

Application Notes

X7R dielectric is not recommended for AC line filtering or pulse applications.

Qualification/Certification

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

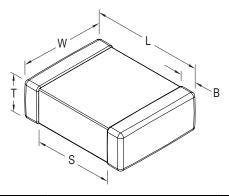
Automotive Grade products meet or exceed the requirements outlined by the Automotive Electronics Council. Details regarding test methods and conditions are referenced in document AEC-Q200, Stress Test Qualification for Passive Components. For additional information regarding the Automotive Electronics Council and AEC-Q200, please visit their website at www.aecouncil.com.

Environmental Compliance

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



Dimensions – Millimeters (Inches) – Standard Termination



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

Dimensions – Millimeters (Inches) – Flexible Termination

EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique	
0603	1608	1.60 (.064) ± 0.17 (.007)	0.80 (.032) ± 0.15 (.006)		0.45 (.018) ± 0.15 (.006)	0.58 (.023)		
0805	2012	2.00 (.079) ± 0.30 (.012)	1.25 (.049) ± 0.30 (.012)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	Solder Wave or Solder Reflow	
1206	3216	3.30 (.130) ± 0.40 (.016)	1.60 (.063) ± 0.35 (.013)		0.60 (.024) ± 0.25 (.010)			
1210	3225	3.30 (.130) ± 0.40 (.016)	2.60 (.102) ± 0.30 (.012)		0.60 (.024) ± 0.25 (.010)			
1808	4520	4.70 (.185) ± 0.50 (.020)	2.00 (.079) ± 0.20 (.008)	See Table 2 for Thickness	0.70 (.028) ± 0.35 (.014)			
1812	4532	4.50 (.178) ± 0.40 (.016)	3.20 (.126) ± 0.30 (.012)		0.70 (.028) ± 0.35 (.014)	N/A	Oalder Daffers Oak	
1825	4564	4.60 (.181) ± 0.40 (.016)	6.40 (.252) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)		Solder Reflow Only	
2220	5650	5.90 (.232) ± 0.75 (.030)	5.00 (.197) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)			
2225	5664	5.90 (.232) ± 0.75 (.030)	6.40 (.248) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)			



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%
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
² Dielectric Withstanding Voltage (DWV)	150% of rated voltage for voltage rating of < 1000V 120% of rated voltage for voltage rating of ≥ 1000V (5 ± 1 seconds and charge/discharge not exceeding 50mA)
³ Dissipation Factor (DF) Maximum Limit @ 25°C	2.5%
⁴Insulation Resistance (IR) Minimum Limit @ 25°C	100 megohm microfarads or 10GΩ (500VDC applied for 120 ± 5 secs @ 25°C)

¹Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

 $1kHz \pm 50Hz$ and 1.0 ± 0.2 Vrms if capacitance ≤ $10\mu F$

120Hz \pm 10Hz 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 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

Post Environmental Limits

	High Temperature Life, Biased Humidity, Moisture Resistance													
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance									
	> 25		3.0											
X7R	16/25	All	5.0	±20%	10% of Initial Limit									
	< 16		7.5											

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

⁴To obtain IR limit, divide MΩ- μ F value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



Table 1 – Capacitance Range/Selection Waterfall (0603 – 1812 Case Sizes)

			se S erie	ize/	CO	603V	N/V	COS	305V	N/V	C12	206V	V/V	C12	210V	V/V	C18	308V	N/V	C18	812V	N/V	C182	5W/V	C222	0W/V	C222	5W/V	
Сар	Cap	Vol	tage C	ode	С	В	D	С	В	D	С	В	D	С	В	D	С	C B D		С	В	D	С	В	С	В	С	В	
Oup	Code		ed Vol		500	630	1000	500	630	1000	500	630	1000	500	630	1000	500	630	1000	500	630	1000	500	630	500	630	500	630	
			oacita	-		l							Prod	luct	Δva	ilahi	litv	and	Chi	n Th	ickn	ess	Codes		ļ				
		Tolerance				See Table 2 for Chip Thickness Dimensions																							
1,000 pF	102	J	K	М	CG	CG	CG																						
1,200 pF	122	J	K	M	CG	CG																							
1,500 pF	152 182	J	K	M	CG CG	CG																							
1,800 pF 2,200 pF	222	J	K	M	CG			DG	DG	DG																			
2,200 pf	272	J	K	M	CG			DG	DG	DG																			
3,300 pF	332	J	K	M	CG			DG	DG	DG										i									
3,900 pF	392	J	K	M	CG			DG	DG	DG																			
4,700 pF	472	J	K	M				DG	DG	DG																		j	
5,600 pF	562	J	K	M				DG	DG																				
6,800 pF	682	J	K	M				DG	DG																				
8,200 pF	822	J	K	M				DG	DG																				
10,000 pF 12,000 pF	103 123	J	K K	M				DG DG	DG DG		EJ	EJ	EJ																
15,000 pF	153	J	K	M	ł			DG	DG		EJ	EJ	EJ	ł															
18,000 pF	183	J	K	M				DG			EJ	EJ	EJ				LE	LE	LE										
22,000 pF	223	J	K	M	l			DG			EJ	EJ	EJ	FZ	FZ	FZ	LE	LE	LE	i									
27,000 pF	273	J	K	М	İ						EJ	EJ		FZ	FZ	FZ	LA	LA	LA	GB	GB	GB			İ				
33,000 pF	333	J	K	М	İ						EJ	EJ		FZ	FZ	FU	LA	LA	LA	GB	GB	GB							
39,000 pF	393	J	K	M							EJ			FZ	FZ	FU	LA	LA	LA	GB	GB	GB							
47,000 pF	473	J	K	M							EJ			FZ	FU	FK	LA	LA	LB	GB	GB	GC							
56,000 pF	563	J	K	M							EJ			FZ	FU	FK	LA	LA	LB	GB	GB	GE							
62,000 pF	623	J	K	M							EJ			FZ	FK	FS FS	LA	LA	LC	GB GE	GB GE	GE GE							
68,000 pF 82,000 pF	683 823	J	K	M M							EJ			FZ FU	FK FK	15	LA LA	LA LC	LC	GB	GE	GE							
0.10 µF	104	J	K	M										FK	FS		LA	LC		GB	GH	GJ							
0.10 µF	124	J	K	M	l									FK	. 0		LA	-0		GE	GK	30	HE	HE					
0.15 µF	154	J	K	M	l						l			FK			LB			GE	GN		HE	HE	JE	JE			
0.18 µF	184	J	K	М	l						İ									GF			HE	HG	JE	JE	KF	KE	
0.22 µF	224	J	K	М																GJ			HE	HJ	JK	JK	KE	KF	
0.27 µF	274	J	K	М																GL			HJ	HJ	JK	JL	KF	KH	
0.33 µF	334	J	K	M																GS			HJ		JL	JN	KF	KH	
0.39 µF	394	J	K	M																			HK		JN		KH	KJ	
0.47 μF 0.56 μF	474 564	J	K	M																ł					JN		KH KJ	KJ	
υ.συ μΓ	JU4	-	ed Vol																										
			(VDC		500	630	1000	500	630	1000	500	630	1000	500	630	1000	500	630	1000	500	630	1000	500	630	500	630	500	630	
Cap	Cap Code	Vol	tage C	ode	С	В	D	С	В	D	С	В	D	С	В	D	С	В	D	С	В	D	С	В	С	В	С	В	
	Code	Ca	se S	ize/	CO	603V	N/V	CO	305V	N/V	C11	206V	V/V	C11	210V	V/V	C11	808V	N/V	C1	812V	N/V	C182	5W/V	C222	ow/v	C222	5W/V	
			<u>erie</u>	S	_ 55					., v			J, V			-, •			., v		J . Z V	J, ¥	0.102					· · · · · ·	

These products are protected under US Patent 8,885,319 B2, other patents pending, and any foreign counterparts.

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).



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

Thickness	Case	Thickness ±	Paper Q	uantity ¹	Plastic (Quantity
Code	Size ¹	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
CG	0603	0.80 ± 0.10	4,000	15,000	0	0
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
EJ	1206	1.70 ± 0.20	0	0	2,000	8,000
FZ	1210	1.25 ± 0.20	0	0	2,500	10,000
FU	1210	1.55 ± 0.20	0	0	2,000	8,000
FK	1210	2.10 ± 0.20	0	0	2,000	8,000
FS	1210	2.50 ± 0.30	0	0	1,000	4,000
LE	1808	1.00 ± 0.10	0	0	2,500	10,000
LA	1808	1.40 ± 0.15	0	0	1,000	4,000
LB	1808	1.60 ± 0.15	0	0	1,000	4,000
LC	1808	2.00 ± 0.15	0	0	1,000	4,000
GB	1812	1.00 ± 0.10	0	0	1,000	4,000
GE	1812	1.30 ± 0.10	0	0	1,000	4,000
GC	1812	1.10 ± 0.10	0	0	1,000	4,000
GH	1812	1.40 ± 0.15	0	0	1,000	4,000
GF	1812	1.50 ± 0.10	0	0	1,000	4,000
GK	1812	1.60 ± 0.20	0	0	1,000	4,000
GJ	1812	1.70 ± 0.15	0	0	1,000	4,000
GN	1812	1.70 ± 0.20	0	0	1,000	4,000
GL	1812	1.90 ± 0.20	0	0	500	2,000
GS	1812	2.10 ± 0.20	0	0	500	2,000
HE	1825	1.40 ± 0.15	0	0	1,000	4,000
HG	1825	1.60 ± 0.20	0	0	1,000	4,000
HJ	1825	2.00 ± 0.20	0	0	500	2,000
HK	1825	2.50 ± 0.20	0	0	500	2,000
JE	2220	1.40 ± 0.15	0	0	1,000	4,000
JK	2220	1.60 ± 0.20	0	0	1,000	4,000
JL	2220	2.00 ± 0.20	0	0	500	2,000
JN	2220	2.50 ± 0.20	0	0	500	2,000
KE	2225	1.40 ± 0.15	0	0	1,000	4,000
KF	2225	1.60 ± 0.20	0	0	1,000	4,000
KH	2225	2.00 ± 0.20	0	0	500	2,000
KJ	2225	2.50 ± 0.20	0	0	500	2,000
Thickness	Case	Thickness ±	7" Reel	13" Reel	7" Reel	13" Reel
Code	Size ¹	Range (mm)	Paper Q	uantity¹	Plastic (Quantity

Package quantity based on finished chip thickness specifications.

¹ If ordering using the 2 mm Tape and Reel pitch option, the packaging quantity outlined in the table above will be doubled. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".



Table 2B - Bulk Packaging Quantities

Doolee	ulu u Tuu o	Loose Pa	Loose Packaging				
Раска	ging Type	Bulk Bag	(default)				
Packagi	ng C-Spec ¹	N/	/A ²				
Cas	e Size	Packaging Quantities ((pieces/unit packaging)				
EIA (in)	Metric (mm)	Minimum	Maximum				
0402	1005						
0603	1608		50,000				
0805	2012						
1206	3216						
1210	3225	1					
1808	4520						
1812	4532						
1825	4564		20,000				
2220	5650						
2225	5664						

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

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



Table 3A – Land Pattern Design Recommendations per IPC-7351 – Standard Termination

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)							
Code	Code	C	Y	Х	V1	V2	С	Υ	X	V1	V2	С	Υ	Х	V1	V2
0603	1608	0.90	1.15	1.10	4.00	2.10	0.80	0.95	1.00	3.10	1.50	0.60	0.75	0.90	2.40	1.20
0805	2012	1.00	1.35	1.55	4.40	2.60	0.90	1.15	1.45	3.50	2.00	0.75	1.50	1.35	2.80	1.70
1206	3216	1.60	1.35	1.90	5.60	2.90	1.50	1.15	1.80	4.70	2.30	1.40	0.95	1.70	4.00	2.00
1210	3225	1.60	1.35	2.80	5.65	3.80	1.50	1.15	2.70	4.70	3.20	1.40	0.95	2.60	4.00	2.90
1808	4520	2.30	1.75	2.30	7.40	3.30	2.20	1.55	2.20	6.50	2.70	2.10	1.35	2.10	5.80	2.40
1812	4532	2.15	1.60	3.60	6.90	4.60	2.05	1.40	3.50	6.00	4.00	1.95	1.20	3.40	5.30	3.70
1825	4564	2.15	1.60	6.90	6.90	7.90	2.05	1.40	6.80	6.00	7.30	1.95	1.20	6.70	5.30	7.00
2220	5650	2.75	1.70	5.50	8.20	6.50	2.65	1.50	5.40	7.30	5.90	2.55	1.30	5.30	6.60	5.60
2225	5664	2.70	1.70	6.90	8.10	7.90	2.60	1.50	6.80	7.20	7.30	2.50	1.30	6.70	6.50	7.00

Density Level A: For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes. KEMET only recommends wave soldering of EIA 0603, 0805 and 1206 case sizes.

Density Level B: For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes. **Density Level C:** For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC Standard 7351 (IPC–7351).

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

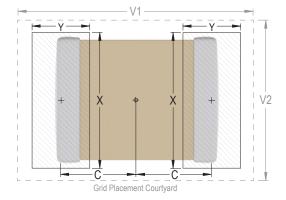




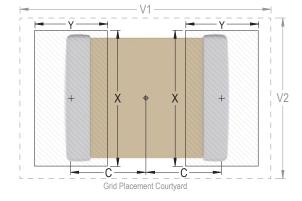
Table 3B – Land Pattern Design Recommendations per IPC-7351 – Flexible Termination

EIA Size Code	Metric Size Code	Density Level A: Maximum (Most) Land Protrusion (mm)			ı	Density Level B: Median (Nominal) Land Protrusion (mm)			Density Level C: Minimum (Least) Land Protrusion (mm)							
Code	Code	С	Υ	X	V1	V2	С	Y	X	V1	V2	С	Y	X	V1	V2
0603	1608	0.85	1.25	1.10	4.00	2.10	0.75	1.05	1.00	3.10	1.50	0.65	0.85	0.90	2.40	1.20
0805	2012	0.99	1.44	1.66	4.47	2.71	0.89	1.24	1.56	3.57	2.11	0.79	1.04	1.46	2.42	1.81
1206	3216	1.59	1.62	2.06	5.85	3.06	1.49	1.42	1.96	4.95	2.46	1.39	1.22	1.86	4.25	2.16
1210	3225	1.59	1.62	3.01	5.90	4.01	1.49	1.42	2.91	4.95	3.41	1.39	1.22	2.81	4.25	3.11
1808	4520	2.30	1.75	2.30	7.40	3.30	2.20	1.55	2.20	6.50	2.70	2.10	1.35	2.10	5.80	2.40
1812	4532	2.10	1.80	3.60	7.00	4.60	2.00	1.60	3.50	6.10	4.00	1.90	1.40	3.40	5.40	3.70
1825	4564	2.15	1.80	6.90	7.10	7.90	2.05	1.60	6.80	6.20	7.30	1.95	1.40	6.70	5.50	7.00
2220	5650	2.85	2.10	5.50	8.80	6.50	2.75	1.90	5.40	7.90	5.90	2.65	1.70	5.30	7.20	5.60
2225	5664	2.85	2.10	6.90	8.80	7.90	2.75	1.90	6.80	7.90	7.30	2.65	1.70	6.70	7.20	7.00

Density Level A: For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes. KEMET only recommends wave soldering of EIA 0603, 0805 and 1206 case sizes.

Density Level B: For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes. **Density Level C:** For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC Standard 7351 (IPC–7351).

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





Soldering Process

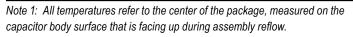
Recommended Soldering Technique:

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

Recommended Reflow Soldering Profile:

KEMET's families of surface mount multilayer ceramic capacitors (SMD MLCCs) are compatible with wave (single or dual), convection, IR or vapor phase reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET's recommended profile conditions for convection and IR reflow reflect the profile conditions of the IPC/J-STD-020 standard for moisture sensitivity testing. These devices can safely withstand a maximum of three reflow passes at these conditions.

Profile Feature	Terminati	on Finish	
Frome reature	SnPb	100% Matte Sn	
Preheat/Soak			
Temperature Minimum (T _{Smin})	100°C	150°C	
Temperature Maximum (T _{Smax})	150°C	200°C	
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds	
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum	
Liquidous Temperature (T _L)	183°C	217°C	
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds	
Peak Temperature (T _P)	235°C	260°C	
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum	
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum	
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum	



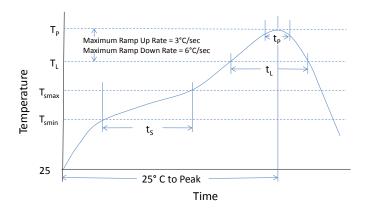




Table 4 – Performance & Reliability: Test Methods and Conditions

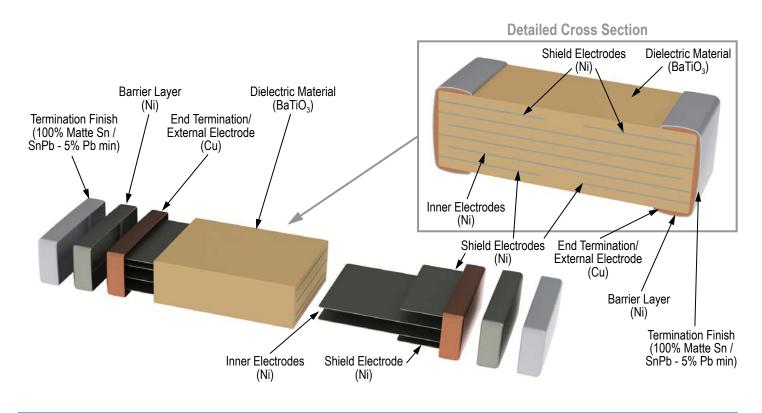
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Solderability	J-STD-002	a) Method B, 4 hours at 155°C, dry heat at 235°C
Solderability	J-31D-002	b) Method B at 215°C category 3
		c) Method D, category 3 at 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Diagod Humidity	MIL-STD-202 Method 103	Load Humidity: 1,000 hours 85°C/85% RH and 200 VDC maximum. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Metriod 103	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 1.2 X rated voltage applied.
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 min., 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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage & Handling

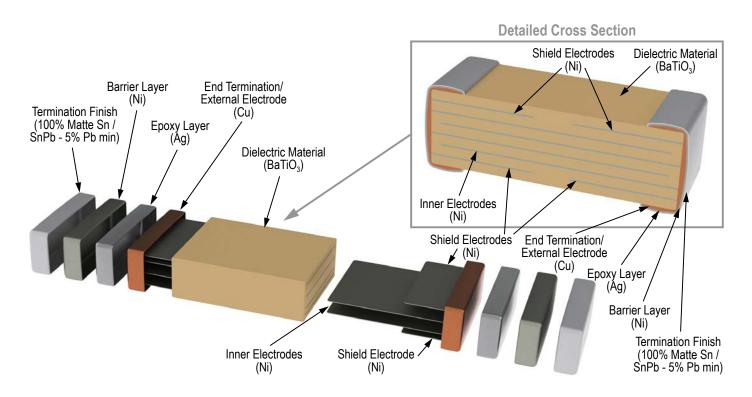
Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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 – Standard Termination



Construction – Flexible Termination



KPS Series, High Voltage, X7R Dielectric, 500 – 630 VDC (Commercial Grade)



Overview

KEMET Power Solutions (KPS) High Voltage stacked capacitors utilize a proprietary lead-frame technology to vertically stack one or two multilayer ceramic chip capacitors into a single compact surface mount package. The attached lead-frame mechanically isolates the capacitor(s) from the printed circuit board, thereby offering advanced mechanical and thermal stress performance. Isolation also addresses concerns for audible microphonic noise that may occur when a bias voltage is applied. A two-chip stack offers up to double the capacitance in the same or smaller design footprint when compared to traditional surface mount MLCC devices. Providing up to 10 mm of board flex capability, KPS Series High Voltage capacitors are environmentally friendly and in compliance with RoHS legislation.

KEMET's KPS Series devices in X7R dielectric exhibit a predictable change in capacitance with respect to time and voltage, and boast a minimal change in capacitance with reference to ambient temperature. Capacitance change is limited to ±15% from -55°C to +125°C. These devices are capable of Pb-Free reflow profiles and provide lower ESR, ESL and higher ripple current capability when compared to other dielectric solutions.

Conventional uses include both snubbers and filters in applications such as switching power supplies and lighting ballasts. Their exceptional performance at high frequencies has made high voltage ceramic capacitors the preferred dielectric choice of design engineers worldwide. In addition to their use in power supplies, these capacitors are widely used in industries related to automotive (hybrid), telecommunications, medical, military, aerospace, semiconductors, and test/diagnostic equipment.

Benefits

- -55°C to +125°C operating temperature range
- Reliable and robust termination system
- EIA 2220 case size
- DC voltage ratings of 500 V and 630 V
- Capacitance offerings ranging from 0.047 μF up to 1.0 μF
- Available capacitance tolerances of ±10% and ±20%
- · Higher capacitance in the same footprint
- · Potential board space savings



Ordering Information

C	2220	С	105	M	C	R	2	С	7186
Ceramic	Case Size (L"x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance ¹	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Leadframe Finish ²	Packaging/Grade (C-Spec)
	2220	C = Standard	Two significant digits + number of zeros.	K = ±10% M = ±20%	C = 500 B = 630	R = X7R	1 = KPS Single Chip Stack 2 = KPS Double Chip Stack	C = 100% Matte Sn	See "Packaging C-Spec Ordering Options Table" below

¹ Double chip stacks ("2" in the 13th character position of the ordering code) are only available in M (±20%) capacitance tolerance. Single chip stacks ("1" in the 13th character position of the ordering code) are available in K (±10%) or M (±20%) tolerances.

² Additional leadframe finish options may be available. Contact KEMET for details.



Packaging C-Spec Ordering Options Table

Packaging Type ¹	Packaging/Grade Ordering Code (C-Spec) ²
7" Reel (Embossed Plastic Tape)/Unmarked	7186
13" Reel (Embossed Plastic Tape)/Unmarked	7289

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. The option to laser mark is not available on these devices. For more information see "Capacitor Marking".

Benefits cont'd

- Advanced protection against thermal and mechanical stress
- Provides up to 10 mm of board flex capability
- · Reduces audible microphonic noise
- · Extremely low ESR and ESL

- · Lead (Pb)-Free, RoHS and REACH compliant
- Capable of Pb-Free reflow profiles
- Non-polar device, minimizing installation concerns
- Film alternative

Applications

Typical applications include switch mode power supplies (input filters, resonators, tank circuits, snubber circuits, output filters), high voltage coupling and DC blocking, lighting ballasts, voltage multiplier circuits, DC/DC converters and coupling capacitors in Ćuk converters. Markets include power supply, LCD fluorescent backlight ballasts, HID lighting, telecom equipment, industrial and medical equipment/control, LAN/WAN interface, analog and digital modems, and automotive (electric and hybrid vehicles, charging stations and lighting applications).

Application Note

X7R dielectric is not recommended for AC line filtering or pulse applications.

Qualification/Certification

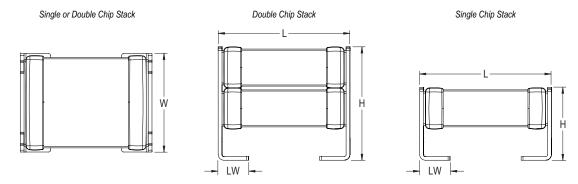
Commercial Grade products are subject to internal qualification. Details regarding test methods and conditions are referenced in Table 4, Performance and Reliability.

Environmental Compliance

Lead (Pb)-Free, RoHS, and REACH compliant without exemptions.



Dimensions – Millimeters (Inches)



Number of Chips	EIA Size Code	Metric Size Code	L Length	W Width	H Height	LW Lead Width	Mounting Technique
Single	2220	5650	6.00 (0.236) ±0.50 (0.020)	5.00 (.197) ±0.50 (.020)	3.50 (.138) ±0.30 (.012)	1.60 (.063) ±0.30 (.012)	Caldan Dafface Only
Double	2220	5650	6.00 (0.236) ±0.50 (0.020)	5.00 (.197) ±0.50 (.020)	5.00 (.197) ±0.50 (.020)	1.60 (.063) ±0.30 (.012)	Solder Reflow Only

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%			
¹ Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%			
² Dielectric Withstanding Voltage (DWV)	150% of rated voltage for voltage rating of < 1000V 120% of rated voltage for voltage rating of ≥ 1000V (5 ± 1 seconds and charge/discharge not exceeding 50mA)			
³ Dissipation Factor (DF) Maximum Limit @ 25°C	2.5%			
⁴ Insulation Resistance (IR) Minimum Limit @ 25°C	See Insulation Resistance Limit Table (500VDC applied for 120 ± 5 secs @ 25°C)			

Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

 $1kHz \pm 50Hz$ and 1.0 ± 0.2 Vrms if capacitance ≤ $10\mu F$

120Hz \pm 10Hz and 0.5 ± 0.1 Vrms if capacitance >10 μ F

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

²DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

³Capacitance and dissipation factor (DF) measured under the following conditions:

⁴To obtain IR limit, divide MΩ- μ F value by the capacitance and compare to GΩ limit. Select the lower of the two limits.



Post Environmental Limits

High Temperature Life, Biased Humidity, Moisture Resistance							
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance		
	> 25		3.0				
X7R	16/25	All	5.0	±20%	10% of Initial Limit		
	< 16		7.5				

Insulation Resistance Limit Table

EIA Case Size	1,000 Megohm Microfarads or 100 GΩ	100 Megohm Microfarads or 10 GΩ
0805	< 0.0039 µF	≥ 0.0039 µF
1206	< 0.012 µF	≥ 0.012 µF
1210	< 0.033 µF	≥ 0.033 µF
1808	< 0.018 µF	≥ 0.018 µF
1812	< 0.027 µF	≥ 0.027 µF
≥ 1825	All	N/A



Table 1 – Capacitance Range/Selection Waterfall (2220 Case Sizes)

		Case Siz	e/Series		C2220C						
		Voltage	e Code	С	В	D					
Capacitance	Capacitance	Rated Volt	age (VDC)	500	630	1000					
	Code	Capacitanc	e Tolerance	Product Availability and Chip Thickness Codes – See Table 2 for Chip Thickness Dimensions							
		Single									
0.047 μF	473	K	M	JP	JP						
0.10 µF	104	K	M	JP	JP						
0.15 μF	154	K	M	JP	JP						
0.22 μF	224	K	M	JP	JP						
0.33 μF	334	K	M	JP							
0.47 μF	474	K	M	JP							
		Double	Chip Stac	k							
0.10 μF	104		M	JR	JR						
0.22 μF	224		M	JR	JR						
0.33 μF	334		M	JR	JR						
0.47 μF	474		M	JR	JR						
0.68 μF	684		M	JR							
1.0 µF	105		M	JR							
	0	Rated Volt	age (VDC)	500	630	1000					
Capacitance	Capacitance	Voltage	e Code	С	В	D					
	Code	Case Siz	e/Series	C2220C							

These products are protected under US Patent 8,331,078 other patents pending, and any foreign counterparts.

Table 2 – Chip Thickness/Tape & Reel Packaging Quantities

Thickness	Case	Thickness ±	Paper C	Quantity	Plastic Quantity					
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel				
JP	2220	3.50 ± 0.30	0	0	300	1,300				
JR	2220	5.00 ± 0.50	0	0	200	800				

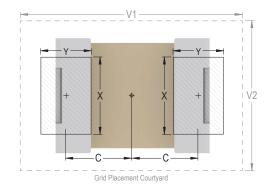
Package quantity based on finished chip thickness specifications.



Table 3 – KPS Land Pattern Design Recommendations (mm)

EIA SIZE CODE	METRIC SIZE	Media	n (Nom	inal) La	nd Prot	rusion
OODL	CODE	С	Y	X	V1	V2
1210	3225	1.50	1.14	1.75	5.05	3.40
1812	4532	2.20	1.35	2.87	6.70	4.50
2220	5650	2.69	2.08	4.78	7.70	6.00

Image at right based on an EIA 1210 case size.



Soldering Process

KEMET's KPS Series devices are compatible with IR reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET's recommended profile conditions for IR reflow reflect the profile conditions of the IPC/J–STD–020D standard for moisture sensitivity testing.

To prevent degradation of temperature cycling capability, care must be taken to prevent solder from flowing into the inner side of the lead frames (inner side of "J" lead in contact with the circuit board).

After soldering, the capacitors should be air cooled to room temperature before further processing. Forced air cooling is not recommended.

Hand soldering should be performed with care due to the difficulty in process control. If performed, care should be taken to avoid contact of the soldering iron to the capacitor body. The iron should be used to heat the solder pad, applying solder between the pad and the lead, until reflow occurs. Once reflow occurs, the iron should be removed immediately. (Preheating is required when hand soldering to avoid thermal shock.)

Profile Feature	SnPb Assembly	Pb-Free Assembly
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax})	60 – 120 seconds	60 – 120 seconds
Ramp-up Rate (T _L to T _P)	3°C/seconds maximum	3°C/seconds maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	250°C
Time within 5°C of Maximum Peak Temperature (t _p)	20 seconds maximum	10 seconds maximum
Ramp-down Rate $(T_P \text{ to } T_L)$	6°C/seconds maximum	6°C/seconds maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum

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

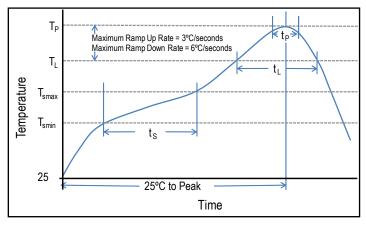




Table 4 – Performance & Reliability: Test Methods and Conditions

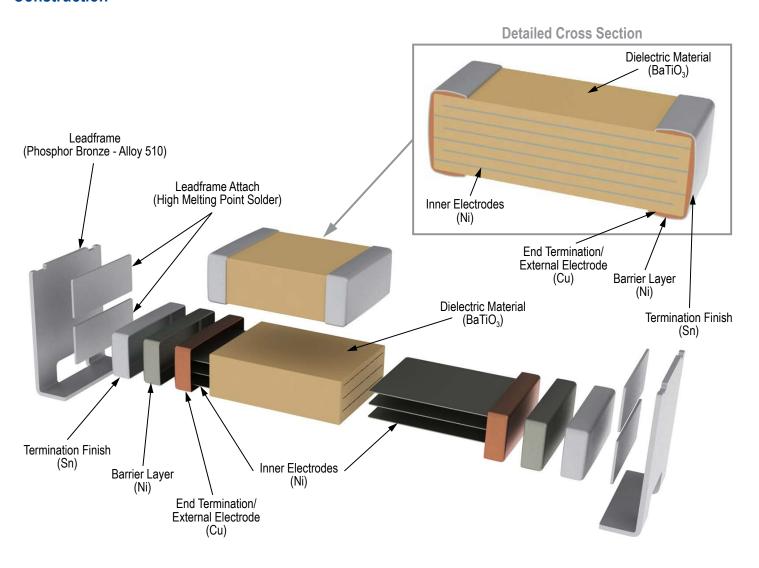
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 5.0 mm minimum
		Magnification 50 X. Conditions:
Coldorability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	J-51D-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 250°C
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +125°C). Measurement at 24 hours +/- 4 hours after test conclusion.
Diagond Humaidit.	MII –STD–202 Method 103	Load Humidity: 1,000 hours 85°C/85% RH and 200 VDC maximum. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 4 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Measurement at 24 hours +/- 4 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air-Air.
High Temperature Life	MIL-STD-202 Method 108	1,000 hours at 125°C with rated voltage applied.
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, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



Product Marking

Laser marking option is not available on:

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

These capacitors are supplied unmarked only.

KPS HV, Large Case, SM Series, C0G Dielectric, 500 – 10,000 VDC (Industrial Grade)



Overview

KPS HV (KEMET Power Solutions, High Voltage), Large Case (≥ 1515), SM Series capacitors in C0G dielectric are designed to meet robust performance standards required in higher reliability industrial applications. Utilizing lead-frame technology, SM Series devices isolate the multilayer ceramic chip component from the printed circuit board providing advanced mechanical and thermal stress performance. Isolation of the chip component also addresses concerns for audible, microphonic noise that may occur when a bias voltage is applied. Although this technology does not eliminate the potential for mechanical damage that may propagate during extreme environmental and handling conditions, it does demonstrate superior performance over non-isolating systems. Available in both formed "L" and "J" lead configurations, SM

Series devices offer up to 10 mm of board flex capability and exhibit lower ESR, ESL and higher current discharge capability when compared to other dielectric solutions.

Combined with the stability of an COG dielectric, KEMET's High Voltage SM Series devices exhibit no change in capacitance with respect to time and voltage and boasts a negligible change in capacitance with reference to ambient temperature. Capacitance change is limited to ±30 ppm/°C from -55°C to +125°C.

KEMET's Industrial Grade products offer additional screening options for higher reliability applications. Both Group A and Group B testing/inspection options per MIL–PRF–49467 are available for the SM Series.

Benefits

- -55°C to +125°C operating temperature range
- Large Case Sizes (≥ 1515)
- · Formed "L" or "J" leadframe configurations.
- Group A and B screening per MIL-PRF-49467 available
- · Reliable and robust leadframe termination system
- DC voltage ratings of 500 V, 1 KV, 2 KV, 3 KV, 4 KV, 5 KV, 7.5 KV, and 10 KV
- Capacitance offerings ranging from 10 pF up to 0.39 μF



Ordering Information

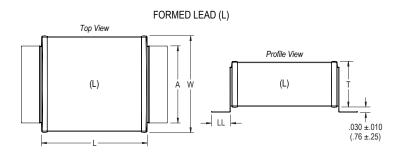
SM	120	N	472	J	501	В	М
Style	/Size	Dielectric	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Lead Configuration ¹	Testing/ Inspection Option ²
SM20 SM21 SM22 SM23 SM24 SM25 SM26	SM30 SM31 SM33 SM34 SM35 SM36	N = C0G	2 significant digits + number of zeros	J = ±5% K = ±10% M = ±20%	501 = 500 102 = 1,000 202 = 2,000 302 = 3,000 402 = 4,000 502 = 5,000 752 = 7,500 103 = 10,000	A = Formed "L" B = Formed "J"	Blank = None M = Group A per MIL-PRF-49467

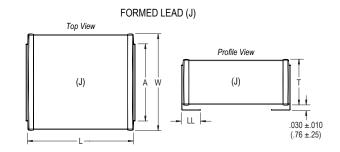
¹ Standard lead configuration is formed "J". If the appropriate character is excluded from the ordering code, the assumed lead configuration will be formed "J".

² Group B testing/inspection option per MIL-PRF-49467 is available upon request. Please contact KEMET for ordering details.



Dimensions – Inches (Millimeters)





Style/ Size	L Length	W Width	T Thickness Maximum	A Lead Width Maximum	LL Lead Length (Formed "L")	LL Lead Length (Formed "J")
SM20	$0.150 \pm 0.015 (3.81 \pm 0.38)$	$0.150 \pm 0.015 (3.81 \pm 0.38)$	0.130 (3.30)			0.040 0.040
SM21	$0.200 \pm 0.020 (5.08 \pm 0.51)$	$0.200 \pm 0.020 (5.08 \pm 0.51)$	0.180 (4.57)	0.100 (2.54)		0.040 ±0.010 (1.02 ±0.25)
SM22	$0.250 \pm 0.020 (6.35 \pm 0.51)$	$0.200 \pm 0.020 (5.08 \pm 0.51)$	0.160 (4.57)			(1.02 ±0.20)
SM23	$0.350 \pm 0.030 (8.89 \pm 0.76)$	$0.300 \pm 0.030 \ (7.62 \pm 0.76)$		0.200 (5.08)		
SM24	0.450 ± 0.030 (11.43 ± 0.76)	$0.400 \pm 0.030 (10.20 \pm 0.76)$	0.000 (5.50)	0.300 (7.62)		
SM25	$0.550 \pm 0.030 (14.00 \pm 0.76)$	0.500 ± 0.030 (12.70 ± 0.76)	0.220 (5.59)	0.400 (10.20)]	
SM26	0.650 ± 0.030 (16.50 ± 0.76)	0.600 ± 0.030 (15.20 ± 0.76)		0.500 (12.70)	0.100 ±0.020 (2.54 ±0.51)	
SM30	0.300 ± 0.030 (7.62 ± 0.76)	0.150 ± 0.015 (3.81 ± 0.38)	0.140 (3.55)	0.400 (0.54)	(2.34 ±0.31)	0.100 ±0.020
SM31	$0.400 \pm 0.030 (10.20 \pm 0.76)$	0.200 ± 0.020 (5.08 ± 0.51)	0.130 (3.30)	0.100 (2.54)		(2.54 ±0.51)
SM33	0.700 ± 0.030 (17.08 ± 0.76)	$0.300 \pm 0.030 \ (7.62 \pm 0.76)$	0.180 (4.57)	0.200 (5.08)		
SM34	0.900 ± 0.030 (22.90 ± 0.76)	0.400 ± 0.030 (10.20 ± 0.76)		0.300 (7.62)	1	
SM35	1.100 ± 0.030 (27.90 ± 0.76)	0.500 ± 0.030 (12.70 ± 0.76)	0.220 (5.59)	0.400 (10.2)	1	
SM36	$1.350 \pm 0.030 (33.00 \pm 0.76)$	0.600 ± 0.030 (15.20 ± 0.76)		0.500 (12.7)	1	

Benefits cont'd

- Advanced protection against thermal and mechanical stress
- · Provides up to 10 mm of board flex capability
- · Reduces audible, microphonic noise

- · Low ESR and ESL
- · Non-polar device, minimizing installation concerns
- Silver plated copper alloy leadframe termination system

Applications

Typical applications include switch mode power supplies (input filters, resonators, tank circuits, snubber circuits, output filters), high voltage coupling and DC blocking, voltage multiplier circuits, DC/DC converters and coupling capacitors in Ćuk converters, noise reduction (piezoelectric/mechanical), circuits with a direct battery or power source connection, critical and safety relevant circuits without (integrated) current limitation and any application that is subject to high levels of board flexure or temperature cycling. Markets include power supply, LCD fluorescent backlight ballasts, HID lighting, telecom equipment, industrial and medical equipment/control and Military.



Qualification/Certification

Industrial Grade products are subject to internal qualification. Details regarding test methods and conditions are referenced in Table 3, Performance & Reliability.

Environmental Compliance

RoHS Compliant with Exemption(s)

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)	±30 ppm/°C
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	0%
Dielectric Withstanding Voltage (DWV)	150% of rated voltage for voltage rating of ≤ 1,250 VDC 120% of rated voltage for voltage rating of > 1,250 VDC (5 ±1 seconds and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit @ 25°C	0.15%
Insulation Resistance (IR) Limit @ 25°C	1,000 megohm microfarads or 100 G Ω (Rated voltage DC applied for 120 ±5 seconds @ 25°C for voltage rating of \leq 500 VDC) (500 VDC applied for 120 ±5 seconds @ 25°C for voltage rating of $>$ 500 VDC)

To obtain IR limit, divide $M\Omega$ - μ 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:

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."

Post Environmental Limits

	High Temperatu	ıre Life, Biased	Humidity, Mois	ture Resistance	
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance
C0G	All	All	0.5	0.3% or ±0.25 pF	10% of Initial Limit

¹ MHz ±100 kHz and 1.0 Vrms ±0.2 V if capacitance ≤ 100 pF

¹ kHz ± 50 Hz and 1.0 Vrms ± 0.2 V if capacitance > 100 pF



Table 1A – Capacitance Range/Selection Waterfall SM20 – SM24 Style/Size

Ctulo/Cizo		CI	120			SN	124			CI	122				SM2	2				CIV	124			
Style/Size		SIV	120			SIV	IZ I	Dime	l ensior			(mm)		•	SIVIZ	J				SIV	124			
		0 150 -	± 0.015			0 200 -	± 0.020				± 0.020	١ /	Ī	0.3	50 ± 0.	030		Г		0 450 -	± 0.030)		i
Length		(3.81 :	± 0.38)				± 0.51)				± 0.51)	,		(8.	89 ± 0.	.76)				(11.43	± 0.76)			
Width			± 0.015 ± 0.38)				± 0.020 ± 0.51))			± 0.020 ± 0.51))			00 ± 0. 62 ± 0.						± 0.030 ± 0.76)			
Thickness Maximum			130 30)				80 57)				180 57)				0.220 (5.59)						220 59)			
Lead Width		0.1	100			0.1	00			0.1	100				0.200					0.3	300			
Maximum Lead Length			54) ± 0.020	1			54) <u>+</u> 0.020	1			54) ± 0.020)		0.1	(5.08) 00 ± 0 .	020					62) ± 0.020			
"L" Š		(2.54	± 0.51)			(2.54 :	± 0.51)			(2.54	± 0.51)			(2.	54 ± 0.	.51)				(2.54 :	± 0.51)			
Lead Length "J"			± 0.010 ± 0.25))			± 0.010 ± 0.25))			± 0.010 ± 0.25))			00 ± 0. 54 ± 0.						± 0.020 ± 0.51))		
									COG	Diele	ectric													
Voltage Code	501	102	202	302	501	102	202	302	501	102	202	302	501	102	202	302	402	501	102	202	302	402	502	
Voltage DC	500	1 K	2 K	3 K	500	1 K	2 K	3 K	500	1 K	2 K	3 K	500	1 K	2 K	3 K	4 K	500	1 K	2 K	3 K	4 K	5 K	Capacitance Tolerance
Capacitance										(Capac	itance	e Cod	le										
22 pF 27 pF							220 270	220 270														270	270	
33 pF							330	330	330	330	330	330										330	330	
39 pF	390 470	390 470	390 470	390 470	390 470	390 470	390 470	390 470	390 470	390 470	390 470	390 470										390 470	390 470	
47 pF 56 pF	560	560	560	560	560	560	560	560	560	560	560	560						560	560	560	560	560	560	
68 pF	680	680	680	680	680	680	680	680	680	680	680	680						680	680	680	680	680	680	
82 pF 100 pF	820 101	820 101	820 101	820 101	820 101	820 101	820 101	820 101	820 101	820 101	820 101	820 101	820 101	820 101	820 101	820	820 101	820 101	820 101	820 101	820 101	820 101	820 101	
120 pF	121	121	121	121	121	121	121	121	121	121	121	121	121	121	121	121	121	121	121	121	121	121	121	
150 pF	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151	
180 pF 220 pF	181 221	181 221	181 221	181 221	181 221	181 221	181 221	181 221	181 221	181 221	181 221	181 221	181 221	181 221	181 221	181 221	181 221	181 221	181 221	181 221	181 221	181 221	181 221	
270 pF	271	271	271	271	271	271	271	271	271	271	271	271	271	271	271	271	271	271	271	271	271	271	271	
330 pF	331 391	331 391	331 391		331 391	331 391	331 391	331 391	331 391	331 391	331 391	331 391	331 391	331 391	331 391	331 391	331 391	331 391	331 391	331	331 391	331 391	331 391	
390 pF 470 pF	471	471	471		471	471	471	471	471	471	471	471	471	471	471	471	471	471	471	391 471	471	471	471	
560 pF	561	561	561		561	561	561	561	561	561	561	561	561	561	561	561	561	561	561	561	561	561	561	
680 pF 820 pF	681 821	681 821	681 821		681 821	681 821	681 821		681 821	681 821	681 821	681 821	681 821	681 821	681 821	681 821	681	681 821	681 821	681 821	681 821	681 821	681 821	
1,000 pF	102	102	021		102	102	102		102	102	102	102	102	102	102	102		102	102	102	102	102	102	
1,200 pF	122	122			122	122	122		122	122	122	122	122	122	122	122		122	122	122	122	122	122	J, K, M, P, Z
1,500 pF 1,800 pF	152 182	152 182			152 182	152 182	152 182		152 182	152 182	152 182		152 182	152 182	152 182	152 182		152 182	152 182	152 182	152 182	152	152	
2,200 pF	222	222			222	222	102		222	222	222		222	222	222	222		222	222	222	222			
2,700 pF	272	272			272	272			272	272	272		272	272	272			272	272	272	272			
3,300 pF 3,900 pF					332 392	332 392			332 392	332 392	332		332 392	332 392	332 392			332 392	332 392	332 392	332 392			
4,700 pF					472	472			472	472			472	472	472			472	472	472	472			
5,600 pF 6,800 pF									562 682	562 682			562 682	562 682	562			562 682	562 682	562 682				
8,200 pF									822	002			822	822				822	822	822				
0.01 µF									103				103	103				103	103	103				
0.012 μF 0.015 μF									123 153				123 153	123 153				123 153	123 153					
0.018 µF									183				183					183	183					
0.022 µF													223					223	223					
0.027 μF 0.033 μF													273 333					273 333	273 333					
0.039 µF																		393	393					
0.047 µF 0.039 µF																		473 393	473					
0.039 μΓ 0.047 μF																		473						



Table 1B - Capacitance Range/Selection Waterfall SM25 - SM31 Style/Size

Style/Size			SI/	125					SI.	126					SM3	n				SN	121			
Style/Size			SIV	IZJ				Dim			ohac	(mm)		`	SIVIS	U				SIV				
	П		0 550 -	± 0.030)		г			± 0.030	ches	(111111)	П	0.3	00 ± 0.	030		г		0.400 :	+ 0 030)		İ
Length			(14.00	± 0.76))				(16.50	± 0.76)			(7.	62 ± 0.	76)				(10.20	± 0.76)		
Width				± 0.030 ± 0.76)						± 0.030 ± 0.76					50 ± 0. 81 ± 0.					0.200 :	± 0.020 ± 0.51)			
Thickness			0.2	220					0.2	220			0.140						0.1	30				
Maximum Lead Width			(5. 0.4	59) 100						59) 500					(3.55)						30) 100			
Maximum				.20)						.70)					(2.54)						54)			
Lead Length "L"				± 0.020 ± 0.51)						± 0.020 ± 0.51))				00 ± 0. 54 ± 0.					0.100 = (2.54 :	± 0.020 ± 0.51)			
Lead Length "J"				± 0.020 ± 0.51)						± 0.020 ± 0.51))				00 ± 0. 54 ± 0.					0.100 =	± 0.020 ± 0.51))		
J			(2.04.	1 0.51)						Diele	ectric		<u> </u>	(2.	J4 ± 0.	.01)				(2.04.	1 0.01)			
Voltage Code	501	102	202	302	402	502	501	102	202	302	402	502	501	102	202	302	402	501	102	202	302	402	502	
Voltage DC	500	1 K	2 K	3 K	4 K	5 K	-	_	_	_	_		_	_	_	_	_	-	_	_	_	_		Capacitance Tolerance
Capacitance										(Capac	itance	e Cod	е										Tolerance
10 pF																	100							
12 pF 15 pF													150	150	150	150	120 150							
18 pF													180	180	180	180	180							
22 pF 27 pF													220 270	220 270	220 270	220 270	220 270	270	270	270	270	220 270	220 270	
33 pF													330	330	330	330	330	330	330	330	330	330	330	
39 pF 47 pF													390 470	390 470	390 470	390 470	390 470	390 470	390 470	390 470	390 470	390 470	390 470	
56 pF													560	560	560	560	560	560	560	560	560	560	560	
68 pF 82 pF													680 820	680 820	680 820	680 820	680 820	680 820	680 820	680 820	680 820	680 820	680 820	
100 pF											101	101	101	101	101	101	101	101	101	101	101	101	101	
120 pF											121	121	121	121	121	121	121	121	121	121	121	121	121	
150 pF 180 pF			181	181	181	181	181	181	181	181	151 181	151 181	151 181	151 181	151 181	151 181		151 181	151 181	151 181	151 181	151 181	151 181	
220 pF	074	074	221	221	221	221	221	221	221	221	221	221	221	221	221	221		221	221	221	221			
270 pF 330 pF	271 331	271 331	271 331	271 331	271 331	271 331	271 331	271 331	271 331	271 331	271 331	271 331	271 331	271 331	271 331	271 331		271 331	271 331	271 331	271 331			
390 pF	391	391	391	391	391	391	391	391	391	391	391	391	391	391	391	391		391	391	391	391			
470 pF 560 pF	471 561	471 561	471 561	471 561	471 561	471 561	471 561	471 561	471 561	471 561	471 561	471 561	471 561	471 561	471 561	471 561		471 561	471 561	471 561	471 561			
680 pF	681	681	681	681	681	681	681	681	681	681	681	681	681	681	681	681		681	681	681	681			
820 pF 1,000 pF	821 102	821 102	821 102	821 102	821 102	821 102	821 102	821 102	821 102	821 102	821 102	821 102	821 102	821 102	821 102			821 102	821 102	821 102	821 102			J, K, M, P, Z
1,200 pF	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122			122	122	122	122			
1,500 pF 1,800 pF	152 182	152 182	152 182	152 182	152 182	152 182	152 182	152 182	152 182	152 182	152 182	152 182	152 182	152 182	152 182			152 182	152 182	152 182	152			
2,200 pF	222	222	222	222	102	102	222	222	222	222	222	222	222	222	102			222	222	222				
2,700 pF 3,300 pF	272 332	272 332	272 332	272 332			272 332	272 332	272 332	272 332	272 332	272 332	272 332	272 332				272 332	272 332	272 332				
3,900 pF	392	392	392	392			392	392	392	392	392	392	392	392				392	392	392				
4,700 pF 5,600 pF	472 562	472 562	472 562	472 562			472 562	472 562	472 562	472 562			472 562	472 562				472 562	472 562	472 562				
6,800 pF	682	682	682	302			682	682	682	682			302	302				682	682	302				
8,200 pF	822 103	822	822				822	822 103	822 103	822								822 103	822 103					
0.01 μF 0.012 μF	103	103 123	103 123				103 123	103	103									103	103					
0.015 μF	153	153					153	153	153									153						
0.018 μF 0.022 μF	183	183 223					183 223	183 223	183 223									183 223						
0.027 μF	273	273					273	273										273						
0.033 µF 0.039 µF	333 393	333 393					333	333 393										333						
0.047 µF	473	473					473	473																
0.056 μF 0.068 μF							563 683	563 683																



Table 1C - Capacitance Range/Selection Waterfall SM33 - SM35 Style/Size

Style/Size				SM3	3						SN	//34							SI	M35				
								Dim	nensio	ons –	inche	s (mn	1)											
Length				700 ± 0							0.900									± 0.03				
			<u>.</u>	7.08 ± 0							0.400	± 0.76 ± 0.03								± 0.76 ± 0.03				
Width			(7	.62 ± 0								± 0.76	i)						· -	± 0.76	6)			
Thickness Maximum				0.180								220 .59)								220 .59)				
Lead Width				0.200								300								400				
Maximum Lead Length			0.1	(5.08) 0 ± 001								.62) ± 0.020)							0.2) ± 0.02	0			
"L" Š			(2	.54 ± 0).51)						(2.54	± 0.51))						(2.54	± 0.51)			
Lead Length "J"				100 ± 0 .54 ± 0								± 0.020 ± 0.51)								± 0.02 ± 0.51				
									C0	G Die						<u> </u>					-			
Voltage Code	501	102	202	302	402	502	752	501	102	202	302	402	502	752	103	501	102	202	302	402	502	752	103	
Voltage DC	500	1 K	2 K	3 K	4 K	5 K	7.5 K	500	1 K	2 K	3 K	4 K	5 K	7.5 K	10 K	500	1 K	2 K	3 K	4 K	5 K	7.5 K	10 K	Capacitance Tolerance
Capacitance				,							Сара	citano	e Cod	e e				,						Tolerance
27 pF						270	270																	
33 pF 39 pF						330 390	330 390							390	390									
47 pF						470	470					470	470	470	470								470	
56 pF 68 pF						560 680	560 680	680	680	560 680	560 680	560 680	560 680	560 680	560 680									
82 pF	820	820	820	820	820	820	820	820	820	820	820	820	820	820	820									
100 pF	101	101	101	101	101	101	101	101	101	101	101	101	101	101	101									
120 pF 150 pF	121	121 151	121 151	121 151	121 151	121 151	121 151	121 151	121 151	121 151	121 151	121 151	121 151	121 151	121 151	151	151	151	151	151	151	151		
180 pF	181	181	181	181	181	181	181	181	181	181	181	181	181	181	181	181	181	181	181	181	181	181		
220 pF 270 pF	221 271 271	221 271	221 271	221	221 271	221 271	221 271	221 271	221 271	221 271	221 271	221 271	221 271	221 271	221	221 271								
330 pF	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331		
390 pF	391	391	391	391	391	391	391	391	391	391	391	391	391	391	391	391	391	391	391	391	391	391		
470 pF 560 pF	471 561 561	471 561	471 561	471 561	471 561	471 561	471 561	471 561	471 561	471 561	471 561	471 561	471 561	471 561	471 561	471 561								
680 pF	681	681	681	681	681	681	681	681	681	681	681	681	681	681		681	681	681	681	681	681	681		
820 pF 1,000 pF	821	821 102	821 102	821 102	821 102	821 102	821 102	821 102	821 102	821 102	821 102	821 102	821 102	821 102		821 102	821 102	821 102	821 102	821 102	821 102	821 102	102	
1,200 pF	122	122	122	122	122	122	102	122	122	122	122	122	122	102		122	122	122	122	122	122	122	102	
1,500 pF 1,800 pF	152 182	152 182	152 182	152 182	152 182	152 182		152 182	152 182	152 182	152 182	152 182	152 182			152 182	152 182	152 182	152 182	152 182	152 182	152 182		
2,200 pF	222	222	222	222	222	222		222	222	222	222	222	222			222	222	222	222	222	222	102		
2,700 pF	272	272	272	272	272	272		272	272	272	272	272	272			272	272	272	272	272	272			J, K, M, P, Z
3,300 pF 3,900 pF	332	332 392	332 392	332 392				332 392	332 392	332 392	332 392					332 392	332 392	332 392	332 392	332 392	332			
4,700 pF	472	472	472	472				472	472	472	472					472	472	472	472	002	002			
5,600 pF 6,800 pF	562 682	562 682	562 682	562 682				562 682	562 682	562 682	562 682					562 682	562 682	562 682	562 682					
8,200 pF	822	822	822	002				822	822	822	822					822	822	822	822					
0.01 µF	103	103	103					103	103	103	103					103	103	103	103					
0.012 μF 0.015 μF	123 153	123 153	123 153					123 153	123 153	123 153	123 153					123 153	123 153	123 153	123 153					
0.018 µF	183	183	183					183	183	183						183	183	183	183					
0.022 μF 0.027 μF	223 273	223 273						223 273	223 273	223						223	223 273	223 273	223					
0.033 µF	333	333						333	333							333	333	333						
0.039 μF 0.047 μF	393 473	393 473						393 473	393 473							393 473	393 473	393 473						
0.047 μF 0.056 μF	563	4/3						563	563							563	563	4/3						
0.068 µF	683							683								683	683							
0.082 μF 0.1 μF	823 104							823 104								823 104	823 104							
0.12 µF								124								124	124							
0.15 μF 0.18 μF								154								154 184	154							
0.22 µF																224								
0.27 μF																274								



Table 1D – Capacitance Range/Selection Waterfall SM36 Style/Size

Style/Size				SN	136				
Dimensions – inches (mm)									
Length	1.350 ± 0.030								
Length		(33.00 ± 0.76)							
Width		0.600 ± 0.030 (15.20 ± 0.76)							
Thickness		0.220							
Maximum Lead Width	-	(5.59) 0.500							
Maximum		0.500 (12.7)							
Lead Length		0.100 ± 0.020							
Lead Length		$(2.54 \pm 0.51) \\ 0.100 \pm 0.020$							
"J" "J"		(2.54 ± 0.51) COG Dielectric							
Voltage Code	501	102	202	302	402	502	752	103	
Voltage Code Voltage DC	500	102 1K	202 2K	302 3K	402 4K	502 5K	7.5K	_	Capacitance
Capacitance	500	IN		acita			7.5K	IUN	Tolerance
120 pF			Cap	acital	121	121	121		
150 pF	151	151	151	151	151	151	151		
180 pF	181	181	181	181	181	181	181		
220 pF 270 pF	221 271	221 271	221 271	221 271	221 271	221	221		
330 pF	331	331	331	331	331	331	331		
390 pF	391	391	391	391	391	391	391		
470 pF	471	471	471	471	471	471	471		
560 pF 680 pF	561 681	561 681	561 681	561 681	561 681	561 681	561 681		
820 pF	821	821	821	821	821	821	821		
1,000 pF	102	102	102	102	102	102	102	102	
1,200 pF	122	122	122	122	122	122	122		
1,500 pF 1,800 pF	152 182	152 182	152 182	152 182	152 182	152 182	152 182	152	
2,200 pF	222	222	222	222	222	222	222		
2,700 pF	272	272	272	272	272	272	272		
3,300 pF	332	332	332	332	332	332	332		
3,900 pF 4,700 pF	392 472	392 472	392 472	392 472	392 472	392 472			
5,600 pF	562	562	562	562	562	562			
6,800 pF	682	682	682	682	682	682			J, K, M, P, Z
8,200 pF	822	822	822	822	822				
0.01 μF 0.012 μF	103 123	103 123	103 123	103 123	103				
0.015 µF	153	153	153	153					
0.018 µF	183	183	183	183					
0.022 μF 0.027 μF	223	223 273	223 273	223 273					
0.027 μF 0.033 μF	333	333	333	333					
0.039 µF	393	393	393						
0.047 µF	473	473	473						
0.056 μF 0.068 μF	563 683	563 683	563						
0.082 μF	823	823							
0.1 µF	104	104							
0.12 μF 0.15 μF	124 154	124 154							
0.15 μF 0.18 μF	184	134							
0.22 µF	224								
0.27 µF	274								
0.33 μF 0.39 μF	334 394								



Table 2 – Chip Thickness/Packaging Quantities

Series	Style/Size	Tray Quantity Minimum ¹	Tray Quantity Maximum ¹	
	SM20			
SM	SM21			
	SM22			
	SM23			
	SM24		50	
	SM25			
	SM26	1		
	SM30			
	SM31			
	SM33		25	
	SM34			
	SM35		10	
	SM36			

¹ Minimum order value applies. Contact KEMET for details.

Soldering Process

The capacitors and assemblies outlined in this specification sheet are susceptible to thermal shock damage due to their large ceramic mass. Temperature profiles used should provide adequate temperature rise and cool-down time to prevent damage from thermal shock. In general, KEMET recommends against hand soldering for these types of large ceramic devices.

Recommended Soldering Technique:

· Solder reflow only

Preheating and Reflow Profile Notes:

Due to differences in the coefficient of thermal expansion for the different materials of construction, it is critical to monitor and control the heating and cooling rates during the soldering process. During the reflow soldering process, the maximum recommended heating and cooling rate (dT/dt) is 4°C/second. To ensure optimal component reliability, KEMET's recommended heating and cooling rate is 2°C/second. After soldering, the capacitors should be air cooled to room temperature before further processing. Forced air cooling is not recommended.

Recommended Reflow Soldering Profile:

Profile Feature	SnPb Assembly		
Preheat/Soak			
Temperature Minimum (T _{Smin})	100°C		
Temperature Maximum (T _{Smax})	150°C		
Time (t_s) from T_{smin} to T_{smax})	60 – 90 seconds		
Ramp-up Rate (T _L to T _P)	2°C/seconds		
Liquidous Temperature (T _L)	183°C		
Time Above Liquidous (t _L)	95 seconds		
Peak Temperature (T _P)	240°C		
Time within 5°C of Maximum Peak Temperature (t _p)	5 seconds		
Ramp-down Rate $(T_p \text{ to } T_L)$	2°C/seconds		
Time 25°C to Peak Temperature	3.5 minutes		

Note 1: All temperatures refer to the center of the package, measured on the package body surface that is facing up during assembly reflow.

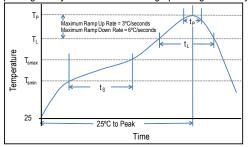




Table 3 – Performance & Reliability: Test Methods and Conditions

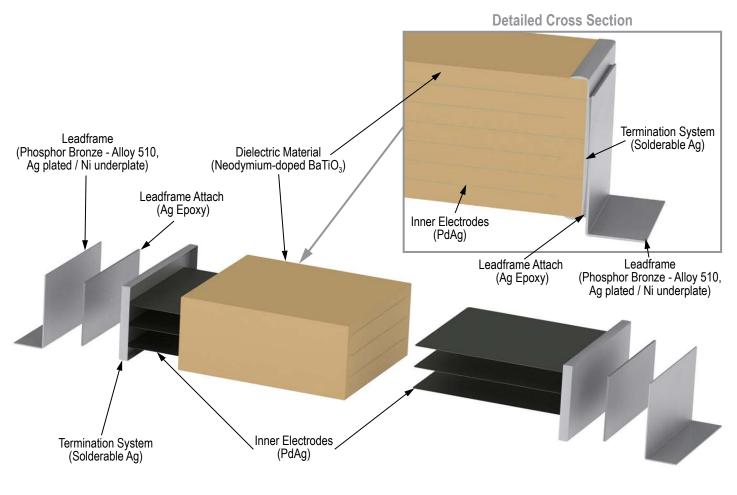
Stress	Reference	Test or Inspection Method
Board Flex	JIS-C-6429	Appendix 2, Note: 2 mm (minimum) for all except 3 mm for C0G.
Solderability		Magnification 50 X. Conditions:
	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
		b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
		1,000 cycles (-55°C to +125°C). Measurement at 24 hours +/- 2 hours after test conclusion.
Biased Humidity		Load Humidity: 1,000 hours 85°C/85% RH and 300 VDC Maximum Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
	MIL-STD-202 Method 103	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.
		t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. D14 dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA -198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC, for 1,000 hours.
Vibration	MIL-STD-202 Method 204	5 g for 20 minutes, 12 cycles each of 3 orientations. Note: Use 8 "X5" 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.
Resistance to Soldering Heat	MIL-STD-202 Method 210	Condition B. No preheat of samples. Note: single wave solder – procedure 2.
Terminal Strength	MIL-STD-202 Method 211	Conditions A (2.3 kg or 5 lbs).
Mechanical Shock	MIL-STD-202 Method 213	Figure 1 of Method 213, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



Product Marking

Product marking is an extra-cost option. These devises will be supplied unmarked unless otherwise specified and/or requested. For more detailed information regarding marked product and how to request this option, please contact KEMET.

KPS HV, Large Case, SM Series, X7R Dielectric, 500 – 10,000 VDC (Industrial Grade)



Overview

KPS HV (KEMET Power Solutions, High Voltage), Large Case (≥ 1515), SM Series capacitors in X7R dielectric are designed to meet robust performance standards required in higher reliability industrial applications. Utilizing lead-frame technology, SM Series devices isolate the multilayer ceramic chip component from the printed circuit board providing advanced mechanical and thermal stress performance. Isolation of the chip component also addresses concerns for audible, microphonic noise that may occur when a bias voltage is applied. Although this technology does not eliminate the potential for mechanical damage that may propagate during extreme environmental and handling conditions, it does demonstrate superior performance over non-isolating systems. Available in both formed "L" and "J" lead configurations, SM Series devices offer up to 10 mm of board

flex capability and exhibit lower ESR, ESL and higher current discharge capability when compared to other dielectric solutions.

Combined with the stability of an X7R dielectric, KEMET's High Voltage SM Series devices exhibit a predictable change in capacitance with respect to time and voltage and boast a minimal change in capacitance with reference to ambient temperature. Capacitance change is limited to ±15% from -55°C to +125°C.

KEMET's Industrial grade products offer additional screening options for higher reliability applications. Both Group A and Group B testing/inspection options per MIL–PRF–49467 are available for the SM Series.

Benefits

- -55°C to +125°C operating temperature range
- Large Case Sizes (≥ 1515)
- · Formed "L" or "J" leadframe configurations
- Group A and B screening per MIL-PRF-49467 available
- · Reliable and robust leadframe termination system
- DC voltage ratings of 500 V, 1 KV, 2 KV, 3 KV, 4 KV, 5 KV, 7.5 KV, and 10 KV
- Capacitance offerings ranging from 150 pF up to 5.6 μF



Ordering Information

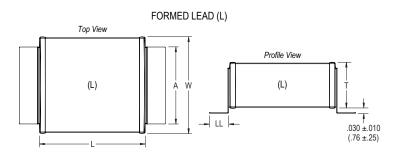
SM	20	В	153	K	501	В	M
Style	/Size	Dielectric	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Lead Configuration ¹	Testing/ Inspection Option ²
SM20 SM21 SM22 SM23 SM24 SM25 SM26	SM30 SM31 SM33 SM34 SM35 SM36	B = X7R	Two significant digits + number of zeros	K = ±10% M = ±20%	501 = 500 102 = 1,000 202 = 2,000 302 = 3,000 402 = 4,000 502 = 5,000 752 = 7,500 103 = 10,000	A = Formed "L" B = Formed "J"	Blank = None M = Group A per MIL-PRF-49467

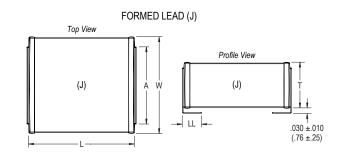
¹ Standard lead configuration is formed "J". If the appropriate character is excluded from the ordering code, the assumed lead configuration will be formed "J".

² Group B testing/inspection option per MIL–PRF–49467 is available upon request. Please contact KEMET for ordering details.



Dimensions – Inches (Millimeters)





Style/ Size	L Length	W Width	T Thickness Max.	A Lead Width Max.	LL Lead Length (Formed "L")	LL Lead Length (Formed "J")	
SM20	$0.150 \pm 0.015 (3.81 \pm 0.38)$	$0.150 \pm 0.015 (3.81 \pm 0.38)$	0.130 (3.30)			0.040 0.040	
SM21	$0.200 \pm 0.020 (5.08 \pm 0.51)$	$0.200 \pm 0.020 (5.08 \pm 0.51)$	0 100 (4 57)	0.100 (2.54)		0.040 ± 0.010 (1.02 ± 0.25)	
SM22	$0.250 \pm 0.020 (6.35 \pm 0.51)$	$0.200 \pm 0.020 (5.08 \pm 0.51)$	0.180 (4.57)			(1.02 ± 0.20)	
SM23	$0.350 \pm 0.030 \ (8.89 \pm 0.76)$	$0.300 \pm 0.030 \ (7.62 \pm 0.76)$		0.200 (5.08)			
SM24	0.450 ± 0.030 (11.43 ± 0.76)	$0.400 \pm 0.030 (10.20 \pm 0.76)$	0.000 (5.50)	0.300 (7.62)			
SM25	$0.550 \pm 0.030 (14.00 \pm 0.76)$	$0.500 \pm 0.030 (12.70 \pm 0.76)$	0.220 (5.59)	0.400 (10.20)			
SM26	$0.650 \pm 0.030 (16.50 \pm 0.76)$	$0.600 \pm 0.030 (15.20 \pm 0.76)$		0.500 (12.70)	0.100 ± 0.020 (2.54 ± 0.51)		
SM30	$0.300 \pm 0.030 \ (7.62 \pm 0.76)$	0.150 ± 0.015 (3.81 ± 0.38)	0.140 (3.55)	0.400 (0.54)	(2.54 ± 0.51)	0.100 ± 0.020	
SM31	0.400 ± 0.030 (10.20 ± 0.76)	$0.200 \pm 0.020 (5.08 \pm 0.51)$	0.130 (3.30)	0.100 (2.54)		(2.54 ± 0.51)	
SM33	0.700 ± 0.030 (17.08 ± 0.76)	$0.300 \pm 0.030 \ (7.62 \pm 0.76)$	0.180 (4.57)	0.200 (5.08)			
SM34	0.900 ± 0.030 (22.90 ± 0.76)	0.400 ± 0.030 (10.20 ± 0.76)		0.300 (7.62)	1		
SM35	1.100 ± 0.030 (27.90 ± 0.76)	0.500 ± 0.030 (12.70 ± 0.76)	0.220 (5.59)	0.400 (10.2)	1		
SM36	1.350 ± 0.030 (33.00 ± 0.76)	0.600 ± 0.030 (15.20 ± 0.76)		0.500 (12.7)			

Benefits cont'd

- Advanced protection against thermal and mechanical stress
- · Provides up to 10 mm of board flex capability
- · Reduces audible, microphonic noise

- · Low ESR and ESL
- · Non-polar device, minimizing installation concerns
- Silver plated copper alloy leadframe termination system

Applications

Typical applications include switch mode power supplies (input filters, resonators, tank circuits, snubber circuits, output filters), high voltage coupling and DC blocking, voltage multiplier circuits, DC/DC converters and coupling capacitors in Ćuk converters, noise reduction (piezoelectric/mechanical), circuits with a direct battery or power source connection, critical and safety relevant circuits without (integrated) current limitation and any application that is subject to high levels of board flexure or temperature cycling. Markets include power supply, LCD fluorescent backlight ballasts, HID lighting, telecom equipment, industrial and medical equipment/control and Military.



Qualification/Certification

Industrial Grade products are subject to internal qualification. Details regarding test methods and conditions are referenced in Table 3, Performance & Reliability.

Environmental Compliance

RoHS Compliant with Exemption(s)

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)	150% of rated voltage for voltage rating of ≤ 1,250 VDC 120% of rated voltage for voltage rating of > 1,250 VDC (5 ±1 seconds and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit @ 25°C	2.5%
Insulation Resistance (IR) Limit @ 25°C	1,000 megohm microfarads or 100 GΩ (Rated voltage DC applied for 120 ±5 seconds @ 25°C for voltage rating of ≤ 500 VDC) (500 VDC applied for 120 ±5 seconds @ 25°C for voltage rating of > 500 VDC)

Regarding aging rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

To obtain IR limit, divide $M\Omega$ - μ 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:

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."

Post Environmental Limits

Hig	h Temperature Life	e, Biased Humidity	, Moisture Resista	nce
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift
X7R	All	All	3.0	±20%

¹ kHz ±50 Hz and 1.0 Vrms ±0.2 V if capacitance > 100 pF



Table 1A – Capacitance Range/Selection Waterfall SM20 – SM24 Style/Size

Style/Size		SM2	0	SM21				SN	122			,	SM2	3				SN	124				
							Di	mens	ions -	- inche	es (mi	m)											
Length		50 ± 0. .81 ± 0.			0.200 =)		0.250 :	± 0.020 ± 0.51)				50 ± 0. 89 ± 0.						± 0.030 ± 0.76)			
Width	0.1	50 ± 0. .81 ± 0.	.015		0.200 =	± 0.020)		0.200 :	± 0.020 ± 0.51)			0.3	00 ± 0. 62 ± 0.	030				0.400 :	± 0.030 ± 0.76))		
Thickness Maximum	1	0.130 (3.30)				80			0.1	180 57)			(**	0.220 (5.59)	/				0.2	220 59)	<u> </u>		
Lead Width		0.100			0.1	00			0.1	00				0.200					0.3	300			
Maximum Lead Length		(2.54) 00 ± 0	.020		0.100 ±		1		0.100 =	54) ± 0.020				(5.08) 00 ± 0					0.100 :	62) ± 0.020			
"L" Lead Length	0.0	0.54 ± 0.0 0.040 ± 0.0	.010		0.040 =	± 0.010)			± 0.010			0.10	54 ± 0.00	020				0.100 :	± 0.51) ± 0.020			
"J" ["]	(1.	.02 ± 0.	.25)		(1.02 ±	± 0.25)		<u> </u>	<u> </u>	± 0.25) electr	ic	<u> </u>	(2.	54 ± 0.	51)				(2.54	± 0.51)			
Voltage Code	501	102	202	501	102	202	302	501		202	_	501	102	202	302	402	501	102	202	302	402	502	
Voltage DC	500	1 K	2 K	500	1 K	2 K	3 K	500	1 K	2 K	3 K	500	1 K	2 K	3 K	4 K	500	1 K	2 K	3 K	4 K	5 K	Capacitance Tolerance
Capacitance										Cap	oacita	nce C	ode										1010141100
330 pF 390 pF 470 pF 560 pF 680 pF 820 pF 1,000 pF	331 391 471 561 681 821 102	331 391 471 561 681 821 102	331 391 471 561 681 821 102	821 102	821 102	821 102	821 102	681 821 102	681 821 102	681 821 102	681 821 102	102	102	102	102	102	102	102	102	102	102	102	
1,200 pF 1,500 pF 1,800 pF 2,200 pF 2,700 pF 3,300 pF 3,900 pF 4,700 pF 5,600 pF 6,800 pF 8,200 pF 0.01 µF	122 152 182 222 272 332 392 472 562 682 822 103 123	122 152 182 222 272 332 392 472 562 682 822 103 123	122 152 182 222 272 332 392	122 152 182 222 272 332 392 472 562 682 822 103 123	122 152 182 222 272 332 392 472 562 682 822 103 123	122 152 182 222 272 332 392 472 562 682 822 103 123	122 152 182 222 272 332 392 472	122 152 182 222 272 332 392 472 562 682 822 103 123	122 152 182 222 272 332 392 472 562 682 822 103 123	122 152 182 222 272 332 392 472 562 682 822 103 123	122 152 182 222 272 332 392 472 562	122 152 182 222 272 332 392 472 562 682 822 103 123	122 152 182 222 272 332 392 472 562 682 822 103 123	122 152 182 222 272 332 392 472 562 682 822 103 123	122 152 182 222 272 332 392 472 562 682 822 103 123	122 152 182 222 272 332 392 472 562 682	122 152 182 222 272 332 392 472 562 682 822 103 123	122 152 182 222 272 332 392 472 562 682 822 103 123	122 152 182 222 272 332 392 472 562 682 822 103 123	122 152 182 222 272 332 392 472 562 682 822 103 123	122 152 182 222 272 332 392 472 562 682 822 103 123	122 152 182 222 272 332 392 472 562 682	
0.015 µF 0.018 µF 0.022 µF 0.027 µF 0.033 µF 0.039 µF 0.047 µF 0.056 µF 0.068 µF 0.12 µF 0.15 µF 0.15 µF 0.15 µF 0.22 µF 0.27 µF 0.33 µF 0.39 µF 0.47 µF 0.56 µF 0.68 µF 0.68 µF 0.82 µF	153 183 223 273 333 393 473 563 683 823	153 183 223		153 183 223 273 333 393 473 563 683 823 104 124 154 184	153 183 223 333 393 473 563 683			153 183 223 333 393 473 563 683 823 104 124 154 184 224 274	153 183 223 333 393 473 563 683 823 104	153		153 183 223 333 473 563 683 823 104 124 154 184 224 274 334 394 474 564	153 183 223 273 333 393 473 563 683 823 104 124 154 184 224 274	153 183 223 273 333	153		153 183 223 373 333 393 473 563 683 823 104 124 154 184 224 274 334 474 684 684 684 105 125	153 183 223 333 393 473 563 683 823 104 124 154 184 224 274 334 394 474	153 183 223 333 393 473 563 683 823 104	153 183 223 273 333			K, M



Table 1B - Capacitance Range/Selection Waterfall SM25 - SM31 Style/Size

Style/Size			SN	125					SN	126					SM3	0				SN	//31			
	-							Dime	ensior	ns – ir	nches	(mm)												
Length				± 0.030						± 0.030					00 ± 0						± 0.030			
			·	± 0.76) ± 0.030						± 0.76 ± 0.030				<u> </u>	62 ± 0. 50 ± 0.						± 0.76) ± 0.020			
Width Thickness			·	± 0.76) 220						± 0.76)			(3.	81 ± 0. 0.140						± 0.51) 130			
Maximum				59)						59)					(3.55)						.30)			
Lead Width Maximum				100 .20)						500 .70)					0.100 (2.54)						100 .54)			
Lead Length				.20) ± 0.020)					.70) ± 0.020)			0.1	(2.54) 00 ± 0.						± 0.020)		
"L" Lead Length			·	± 0.51) ± 0.020						± 0.51) ± 0.020					54 ± 0 00 ± 0						± 0.51) ± 0.020			
"J"				± 0.020						± 0.020 ± 0.51)					54 ± 0						± 0.020 ± 0.51)			
		,							X7R	Diele	ectric													
Voltage Code	501	102	202	302	402	502	501	102	202	302	402	502	501	102	202	302	402	501	102	202	302	402	502	0
Voltage DC	500	1 K	2 K	3 K	4 K	5 K	500	1 K	2 K	3 K	4 K	5 K	500	1 K	2 K	3 K	4 K	500	1 K	2 K	3 K	4 K	5 K	Capacitance Tolerance
Capacitance										(Capac	itance	e Cod	e 151	151	151	151							
180 pF 220 pF 270 pF 330 pF 390 pF 470 pF 560 pF 680 pF 820 pF 1,000 pF													181 221 271 331 391 471 561 681 821	181 221 271 331 391 471 561 681 821 102	181 221 271 331 391 471 561 681 821	181 221 271 331 391 471 561 681 821	181 221 271 331 391 471 561 681 821 102	681 821 102	681 821 102	681 821 102	681 821 102	681 821 102	681 821 102	
1,000 pF 1,200 pF 1,500 pF 1,800 pF 2,200 pF 2,700 pF 3,300 pF 4,700 pF 5,600 pF 6,800 pF	222 272 332 392 472 562 682	222 272 332 392 472 562 682	222 272 332 392 472 562 682	222 272 332 392 472 562 682	222 272 332 392 472 562 682	222 272 332 392 472 562 682	222 272 332 392 472 562 682	222 272 332 392 472 562 682	222 272 332 392 472 562 682	222 272 332 392 472 562 682	392 472 562 682	392 472 562 682	102 122 152 182 222 272 332 392 472 562 682	102 122 152 182 222 272 332 392 472 562 682	102 122 152 182 222 272 332 392 472 562 682	102 122 152 182 222 272 332	102 122 152	102 122 152 182 222 272 332 392 472 562 682	102 122 152 182 222 272 332 392 472 562 682	102 122 152 182 222 272 332 392 472 562 682	102 122 152 182 222 272 332 392 472 562 682	102 122 152 182 222 272 332 392	102 122 152	
8,200 pF 0.01 µF 0.012 µF 0.015 µF 0.018 µF 0.022 µF 0.027 µF 0.033 µF 0.039 µF 0.047 µF 0.056 µF 0.068 µF 0.082 µF 0.12 µF 0.12 µF	822 103 123 153 183 223 273 333 393 473 563 683 823 104	822 103 123 153 183 223 273 333 393 473 563 683 823 104 124 154	822 103 123 153 183 223 273 333 393 473 563 683 823 104	822 103 123 153 183 223 273 333 393 473	822 103 123 153	822 103	822 103 123 153 183 223 273 333 393 473 563 683 823 104 124 154	822 103 123 153 183 223 273 333 393 473 563 683 823 104 124 154	822 103 123 153 183 223 273 333 393 473 563 683 823 104 124 154	822 103 123 153 183 223 273 333 393 473 563 683 823 104	822 103 123 153 183 223 273 333	822 103 123 153	822 103 123 153 183 223 273 333 393 473 563 683 823 104 124 154	822 103 123 153 183 223 273 333 393 473 563	822 103			822 103 123 153 183 223 273 333 393 473 563 683 823 104 124 154	822 103 123 153 183 223 273 333 393 473 563 683 823 104	822 103 123 153 183 223	822			K, M
0.18 µF 0.18 µF 0.22 µF 0.27 µF 0.33 µF 0.39 µF 0.47 µF 0.56 µF 0.68 µF	154 184 224 274 334 394 474 564 684 824	184 224 274 334 394 474					184 184 224 274 334 394 474 564 684 824	184 224 274 334 394 474 564 684 824	184				184					184 184 224 274 334 394						



Table 1B - Capacitance Range/Selection Waterfall SM25 - SM31 Style/Size cont'd

Style/Size			SI	M25					SN	/126				5	SM3()				SM	31			
								Dime	ensior	ns – ir	nches	(mm)												
Length				± 0.030						± 0.030	-				00 ± 0. 62 ± 0.					0.400 ±				
Width				± 0.030						± 0.030	-				50 ± 0. 81 ± 0.					0.200 ±				
Thickness Maximum			-	220 .59)						220 .59)	,				0.140 (3.55)	,				0.13				
Lead Width Maximum			-	400 0.20)				0.500 (12.70)						0.100 (2.54)										
Lead Length "L"				± 0.020 ± 0.51)	-		0.100 ± 0.020 (2.54 ± 0.51)						0.100 ± 0.020 (2.54 ± 0.51)					0.100 ± 0.020 (2.54 ± 0.51)						
Lead Length "J"				± 0.020 ± 0.51)	-				0.100 ± 0.020 (2.54 ± 0.51)						00 ± 0. 54 ± 0.					0.100 ± (2.54 ±				
								Х		R Diele	ectric													
Voltage Code	501	102	2 202	302	402	502	501	102	202	302	402	502	501	102	202	302	402	501	102	202	302	402	502	
Voltage DC	500	1 K	(2 K	3 K	4 K	5 K	500	1 K	2 K	3 K	4 K	5 K	500	1 K	2 K	3 K	4 K	500	1 K	2 K	3 K	4 K	5 K	Capacitance Tolerance
Capacitance										(Capac	itance	e Cod	е										1010141100
1.0 μF 1.2 μF 1.5 μF 1.8 μF	105 125 155 185						105 125 155 185	105																К, М
2.2 μF 2.7 μF 2.9 μF							225 275 295																	



Table 1C - Capacitance Range/Selection Waterfall SM33 - SM35 Style/Size

Style/Size				SM3	33						SN	//34							SI	M35				
	_							Dim	ensio	ns – i	nches	s (mr	1)											
Length				700 ± 0							0.900	± 0.03	0							± 0.03				
Length				7.08 ±							`	± 0.76								± 0.76				
Width				300 ± (7.62 ± (± 0.03 ± 0.76							0.500 (12.70	± 0.03 £ 0.76				
Thickness Maximum				0.180								220	,							220 .59)	,			
Lead Width				(4.57 0.20								.59) 300								400				
Maximum				(5.08	3)						(7	.62)							(1	0.2)				
Lead Length "L"				100 ± (2.54 ± (± 0.02 ± 0.51								± 0.02 ± 0.51				
Lead Length			0.1	100 ± 0	0.020						0.100	± 0.02	0						0.100	± 0.02	0			
"J" ⁻	_		(2	2.54 ± (0.51)	_			V7[R Diel		± 0.51)				_		(2.54	± 0.51)			
Voltage Code	E01	102	202	202	402	E02	752	501					E02	752	102	E01	102	202	202	402	E02	752	103	
Voltage Code Voltage DC	 		_	_	_		7.5 K	-				-	_		-	_	_	_	-	-	_			Capacitance
	500	ıĸ	2 N	3 N	4 N	σĸ	7.5 K	1900	ıĸ						IUK	1500	ın	2 N	3 N	4 N	σĸ	7.5 K	א טו	Tolerance
Capacitance 820 pF	821	821	821	821	821	821	821	Г			Japa	citano	ce Co	ue										
1,000 pF	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102								102	
1,200 pF	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122								122	
1,500 pF	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152								152	
1,800 pF	182	182	182 222	182 222	182 222	182 222	182 222	182 222	182 222	182 222	182 222	182 222	182 222	182 222	182								182 222	
2,200 pF 2,700 pF	272	222 272	272	272	272	272	272	272	272	272	272	272	272	272	272								272	
3,300 pF	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	
3,900 pF	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	
4,700 pF	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	
5,600 pF	562	562	562	562	562	562		562	562	562	562	562	562	562	562	562	562	562	562	562	562	562	562	
6,800 pF 8,200 pF	682 822	682 822	682 822	682 822	682 822	682		682 822	682 822	682 822	682 822	682 822	682 822	682		682 822	682 822	682 822	682 822	682 822	682 822	682 822	682	
0.01 µF	103	103	103	103	103			103	103	103	103	103	103			103	103	103	103	103	103	103		
0.012 µF	123	123	123	123	123			123	123	123	123	123	123			123	123	123	123	123	123			
0.015 µF	153	153	153	153				153	153	153	153	153	153			153	153	153	153	153	153			
0.018 µF	183	183	183	183				183	183	183	183	183	183			183	183	183	183	183	183			
0.022 μF 0.027 μF	223 273	223 273	223	223 273				223 273	223 273	223 273	223	223	223			223	223	223	223 273	223 273	223 273			
0.027 µF 0.033 µF	333	333	333	333				333	333	333	333	333				333	333	333	333	333	213			
0.039 µF	393	393	393	393				393	393	393	393	000				393	393	393	393	393				
0.047 µF	473	473	473					473	473	473	473					473	473	473	473	473				
0.056 µF	563	563	563					563	563	563	563					563	563	563	563					K, M
0.068 µF	683	683	683 823					683 823	683 823	683 823	683 823					683 823	683	683 823	683 823					,
0.082 μF 0.1 μF	823 104	823 104	023					104	104	104	023					104	823	104	104					
0.12 μF	124	124						124	124	124						124	124	124	104					
0.15 µF	154	154						154	154	154						154	154	154						
0.18 µF	184	184						184	184	184						184	184	184						
0.22 µF	224	224						224	224	224						224	224	224						
0.27 μF 0.33 μF	274 334	274 334						274 334	274 334	274						274 334	274 334	274						
0.39 μF	394	394						394	394							394	394							
0.47 μF	474	474						474	474							474	474							
0.56 μF	564	564						564	564							564	564							
0.68 µF	684	684						684	684							684	684							
0.82 μF 1.0 μF	824 105							824 105	824 105							824 105	824 105							
1.0 µF	125							125	,,,,							125	125							
1.5 µF	155							155								155								
1.8 µF								185								185								
2.2 μF 2.7 μF								225								225 275								
2.7 μF 2.9 μF																295								
3.3 µF								İ								335								
3.9 µF								l								395								



Table 1D – Capacitance Range/Selection Waterfall SM36 Style/Size

Style/Size				SI	M36				
	imens	sions	– incl	nes (r	nm)				
Length				1.350	± 0.03				
Width				•	$0.76 \pm 0.76 \pm 0.03$				
) ± 0.76	6)			
Thickness Maximum					.220 .59)				
Lead Width Maximum					500 2.7)				
Lead Length				0.100	± 0.02				
Lead Length					± 0.51				
"J"		/7D D			± 0.51)			
Voltage Code	_		ielect		402	502	750	402	ĺ
Voltage Code Voltage DC	501 500		202 2 K		402 4 K	_	752 7.5 K	103	Capacitance
Capacitance	500	ıĸ			ance (7.5 K	IUK	Tolerance
1,500 pF			Ca	pacito	ance v	Joue		152	
1,800 pF								182	
2,200 pF 2,700 pF								222 272	
3,300 pF								332	
3,900 pF 4,700 pF	472	472	472	472	472	472	472	392 472	
5,600 pF	562	562	562	562	562	562	562	562	
6,800 pF	682	682	682	682	682	682	682	682	
8,200 pF 0.01 µF	822 103	822 103	822 103	822 103	822 103	822 103	822 103	822 103	
0.012 μF	123	123	123	123	123	123	123	100	
0.015 μF	153	153	153	153	153	153	153		
0.018 μF 0.022 μF	183 223	183 223	183 223	183 223	183	183 223	183 223		
0.027 µF	273	273	273	273	273	273			
0.033 µF	333	333	333 393	333	333	333			
0.039 μF 0.047 μF	393 473	393 473	473	393 473	393 473				
0.056 µF	563	563	563	563	563				
0.068 μF 0.082 μF	683 823	683 823	683 823	683 823	683				
0.002 μ1 0.1 μF	104	104	104	104					K, M, P, Z
0.12 µF	124	124	124	124					
0.15 μF 0.18 μF	154 184	154 184	154 184	154					
0.10 µF	224	224	224						
0.27 µF	274	274	274						
0.33 μF 0.39 μF	334 394	334 394	334						
0.47 µF	474	474							
0.56 µF	564 684	564 684							
0.68 μF 0.82 μF	824	824							
1.0 µF	105	105							
1.2 μF 1.5 μF	125 155	125 155							
1.8 µF	185	185							
2.2 µF	225	225							
2.7 µF 2.9 µF	275 295								
3.3 µF	335								
3.9 µF	395 475								
4.7 μF 5.6 μF	565								



Table 2 – Chip Thickness/Packaging Quantities

Series	Style/Size	Tray Quantity Minimum ¹	Tray Quantity Maximum ¹				
	SM20						
	SM21						
	SM22						
	SM23						
	SM24		50				
	SM25						
SM	SM26	1					
	SM30						
	SM31						
	SM33		25				
	SM34						
	SM35	10					
	SM36						

¹ Minimum order value applies. Contact KEMET for details.

Soldering Process

The capacitors and assemblies outlined in this specification sheet are susceptible to thermal shock damage due to their large ceramic mass. Temperature profiles used should provide adequate temperature rise and cool-down time to prevent damage from thermal shock. In general, KEMET recommends against hand soldering for these types of large ceramic devices.

Recommended Soldering Technique:

· Solder reflow only

Preheating and Reflow Profile Notes:

Due to differences in the coefficient of thermal expansion for the different materials of construction, it is critical to monitor and control the heating and cooling rates during the soldering process. During the reflow soldering process, the maximum recommended heating and cooling rate (dT/dt) is 4°C/second. To ensure optimal component reliability, KEMET's recommended heating and cooling rate is 2°C/second. After soldering, the capacitors should be air cooled to room temperature before further processing. Forced air cooling is not recommended.

Recommended Reflow Soldering Profile:

Profile Feature	SnPb Assembly					
Preheat/Soak						
Temperature Minimum (T _{Smin})	100°C					
Temperature Maximum (T _{Smax})	150°C					
Time (t_s) from T_{smin} to T_{smax})	60 – 90 seconds					
Ramp-up Rate (T _L to T _P)	2°C/seconds					
Liquidous Temperature (T _L)	183°C					
Time Above Liquidous (t _L)	95 seconds					
Peak Temperature (T _P)	240°C					
Time within 5°C of Maximum Peak Temperature (t _p)	5 seconds					
Ramp-down Rate $(T_p \text{ to } T_L)$	2°C/seconds					
Time 25°C to Peak Temperature	3.5 minutes					

Note 1: All temperatures refer to the center of the package, measured on the package body surface that is facing up during assembly reflow.

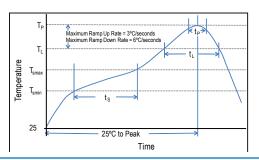




Table 3 – Performance & Reliability: Test Methods and Conditions

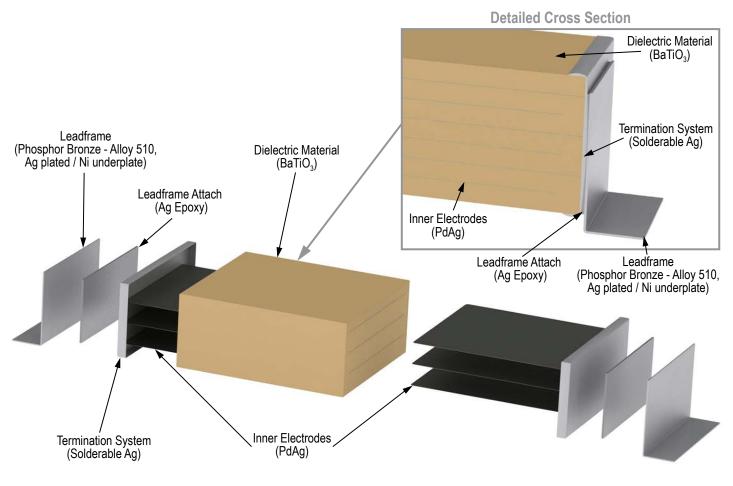
Stress	Reference	Test or Inspection Method
Board Flex	JIS-C-6429	Appendix 2, Note: 2 mm (minimum) for all except 3 mm for C0G.
		Magnification 50 X. Conditions:
		a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	J-STD-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
		1,000 cycles (-55°C to +125°C). Measurement at 24 hours +/- 2 hours after test conclusion.
		Load Humidity: 1,000 hours 85°C/85% RH and 300 VDC Maximum Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	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.
		t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. D14 dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA -198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC, for 1,000 hours.
Vibration	MIL-STD-202 Method 204	5 g for 20 minutes, 12 cycles each of 3 orientations. Note: Use 8 "X5" 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.
Resistance to Soldering Heat	MIL-STD-202 Method 210	Condition B. No preheat of samples. Note: single wave solder – procedure 2.
Terminal Strength	MIL-STD-202 Method 211	Conditions A (2.3 kg or 5 lbs).
Mechanical Shock	MIL-STD-202 Method 213	Figure 1 of Method 213, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical, OKEM Clean or equivalent.

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



Product Marking

Product marking is an extra-cost option. These devises will be supplied unmarked unless otherwise specified and/or requested. For more detailed information regarding marked product and how to request this option, please contact KEMET.

HV-HT Series, High Voltage, High Temperature 200°C, C0G Dielectric, 500 – 2,000 VDC (Industrial Grade)



Overview

KEMET's High Voltage-High Temperature (HV-HT) series surface mount C0G Multilayer Ceramic Capacitors (MLCCs) are constructed of a robust and proprietary base metal electrode (BME) dielectric system that offers industry-leading performance at extreme temperatures. These surface mountable devices feature a 200°C maximum operating temperature and are specifically designed to withstand the demands of harsh industrial environments such as oil exploration and automotive/ avionics engine compartment circuitry. They also offer higher and more uniform breakdown voltage performance than competitive products, resulting in increased yields in customer field applications. When dealing with expensive high temperature circuitry and systems, higher yields can quickly result in significant cost savings.

KEMET's HV-HT series MLCCs are temperature compensating and are suited for resonant circuit applications or those where Q and stability of capacitance characteristics are required. They exhibit no change in capacitance with respect to time and voltage and boast a negligible change in capacitance with

reference to ambient temperature. Capacitance change is limited to ±30ppm/°C from -55°C to +200°C. In addition, these capacitors exhibit high insulation resistance with low dissipation factor at elevated temperatures up to 200°C. They also exhibit low ESR at high frequencies and offer superior volumetric efficiency over competitive high temperature precious metal electrode (PME) and base metal electrode (BME) dielectric system devices.

These devices are Lead (Pb)-Free, RoHS and REACH compliant without the need of any exemptions.



Ordering Information

С	2225	Н	393	J	С	G	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance ¹	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/Grade (C-Spec)
	0805 1206 1210 1808 1812 1825 2220 2225 2824 3040 3640 4540	H = High Temperature (200°C)	Two significant digits + number of zeros.	B = ±0.10 pF C = ±0.25 pF D = ±0.5 pF F = ±1% G = ±2% J = ±5% K = ±10% M = ±20%	C = 500 B = 630 D = 1,000 F = 1,500 G = 2,000	G = C0G	A = N/A	C = 100% Matte Sn L = SnPb (5% Pb min.) E = Gold (Au) 1.97 – 11.8 µin F = Gold (Au) 30 – 50 µin G = Gold (Au) 100 µin min.	See "Packaging C-Spec Ordering Options Table" below

¹ Additional capacitance tolerance offerings may be available. Contact KEMET for details.

² Gold(Au) termination finish options are not available on 2824, 3040, 3640 and 4540 case sizes.



Packaging C-Spec Ordering Options Table

Termination Finish Options	Packaging Type/Options	Packaging Ordering Code (C-Spec)
	Standard Packaging – Unmarked ³	
	Bulk Bag	Blank ¹
	Waffle Tray ²	7292
	7" Tape & Reel	TU
C = 100% Matte Sn	13" Reel	7411 (EIA 0603 and smaller case sizes) 7210 (EIA 0805 and larger case sizes)
L = SnPb (5% Pb min.)	7" Tape & Reel/2 mm pitch4	7081
F = Gold (Àu) 30 – 50 μin G = Gold (Au) 100 μin min.	7" Tape & Reel – 50 pcs	T050
	7" Tape & Reel – 100 pcs	T100
	7" Tape & Reel – 250 pcs	T250
	7" Tape & Reel – 500 pcs	T500
	7" Tape & Reel – 1,000 pcs	T1K0
	Moisture Sensitive Packaging⁵ – Unmarked	3
	Waffle Tray ²	7282
	7" Tape & Reel	7130
E = Gold (Au) 1.97 – 11.8 μin	7" Tape & Reel – 50 pcs	
F = Gold (Au) 30 – 50 μin	7" Tape & Reel – 100 pcs	
G = Gold (Au) 100 μin min.	7" Tape & Reel – 250 pcs	Contact KEMET ⁶
	7" Tape & Reel – 500 pcs	
	7" Tape & Reel – 1,000 pcs	

¹ Default packaging is "Bulk Bag". An ordering code C-Spec is not required for "Bulk Bag" packaging.

¹ "Bulk Bag" packaging option is not available for Gold (Au) termination finish options and case sizes larger than 2225 (5664 Metric).

² "Waffle Tray" packaging option is not available for case sizes larger than 2225 (5664 Metric).

³ The terms "Marked" and "Unmarked" pertain to laser marking option of components. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. The option to laser mark is not available on these devices.

³ Reeling quantities are dependent upon chip size and thickness dimension. When ordering using the "T1K0" packaging option, 1812 thru 2225 case size devices with chip thickness of \geq 1.9mm (nominal) may be shipped on multiple 7" reels or a single 13" reel. Additional reeling or packaging options may be available. Contact KEMET for details.

⁴ The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".

⁵ Moisture sensitive packaging is required for Gold (Au) termination option "E" (1.97 – 11.8 μin)

⁶ Additional reeling or packaging options may be available. Contact KEMET for details.



Benefits

- Operating temperature range of −55°C to +200°C
- · Lead (Pb)-Free, RoHS, and REACH compliant
- EIA 0805, 1206, 1210, 1808, 1812, 1825, 2220, 2225, 2824, 3040, 3640 and 4540 case sizes
- DC voltage ratings of 500 V, 630 V, 1 KV, 1.5 KV, and 2 KV
- Capacitance offerings ranging from 1 pF to 0.150 μF
- Available capacitance tolerances of ±0.10 pF, ±0.25 pF, ±0.5 pF, ±1%, ±2%, ±5%, ±10%, and ±20%
- · No piezoelectric noise
- Extremely low ESR & ESL
- · High thermal stability
- High ripple current capability

- No capacitance change with respect to applied rated DC voltage
- Negligible capacitance change with respect to temperature from -55°C to +125°C
- No capacitance decay with time
- Non-polar device, minimizing installation concerns
- 100% pure matte tin-plated termination finish allowing for excellent solderability
- SnPb plated termination finish option available upon request (5% Pb minimum)
- Gold (Au), Tin/Lead (Sn/Pb) and 100% pure matte Tin (Sn) termination finishes available

Applications

Typical applications include critical timing, tuning, circuits requiring low loss, circuits with pulse, high current, switch mode power supplies (input filters, resonators, tank circuits, snubbed circuits, output filters), high voltage coupling, DC blocking and voltage multiplier circuits in extreme environments such as down-hole exploration, aerospace engine compartments and geophysical probes. Markets include power supply, HID lighting, industrial equipment/control, automotive, aerospace, and munitions.

Qualification/Certification

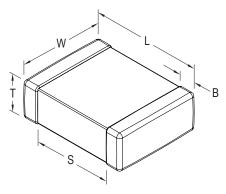
High temperature (200°C) Industrial grade products meet or exceed the requirements outlined in Table 4, Performance & Reliability. Qualification packages are available for review and download on our website at www.kemet.com/hightemp

Environmental Compliance

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



Dimensions – Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0805	2012	2.00 (.079) ± 0.20 (.008)	1.25 (.049) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	"Solder Wave or
1206	3216	3.20 (.126) ± 0.20 (.008)	1.60 (.063) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)		Solder Reflow"
1210	3225	3.20 (.126) ± 0.20 (.008)	2.50 (.098) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)		
1808	4520	4.70 (.185) ± 0.50 (.020)	2.00 (.079) ± 0.20 (.008)		0.60 (.024) ± 0.35 (.014)		
1812	4532	4.50 (.177) ± 0.30 (.012)	3.20 (.126) ± 0.30 (.012)		0.60 (.024) ± 0.35 (.014)		
1825	4564	4.50 (.177) ± 0.30 (.012)	6.40 (.252) ± 0.40 (.016)	See Table 2 for	0.60 (.024) ± 0.35 (.014)		
2220	5650	5.70 (.224) ± 0.40 (.016)	5.00 (.197) ± 0.40 (.016)	Thickness	0.60 (.024) ± 0.35 (.014)	N/A	Caldan Daffass Only
2225	5664	5.60 (.220) ± 0.40 (.016)	6.40 (.248) ± 0.40 (.016)		0.60 (.024) ± 0.35 (.014)		Solder Reflow Only
2824	7260	7.10 (.280) ± 0.40 (.016)	6.10 (.240) ± 0.40 (.016)		1.27 (.050) ± 0.40 (.016)		
3040	7610	7.60 (.300) ± 0.40 (.016)	10.20 (.402) ± 0.40 (.016)		1.27 (.050) ± 0.40 (.016)		
3640	9210	9.10 (.358) ± 0.40 (.016)	10.20 (.402) ± 0.40 (.016)		1.27 (.050) ± 0.40 (.016)		
4540	-	11.40 (.449) ± 0.40 (.016)	10.20 (.402) ± 0.40 (.016)		1.27 (.050) ± 0.40 (.016)		



Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +200°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±30 ppm/°C (up to +200°C)
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	0%
¹ Dielectric Withstanding Voltage (DWV)	150% of rated voltage for voltage rating of < 1000 V 120% of rated voltage for voltage rating of ≥ 1000 V (5 ±1 seconds and charge/discharge not exceeding 50 mA)
² Dissipation Factor (DF) Maximum Limit @ 25°C	0.1%
³ Insulation Resistance (IR) Minimum Limit @ 25°C	1000 megohm microfarads or 100 GΩ (500 VDC applied for 120 ±5 secs @ 25°C)

DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

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."

Post Environmental Limits

	High Temperatu	ıre Life, Biased	Humidity, Mois	ture Resistance											
Dielectric	Dielectric Rated DC Capacitance Dissipation Factor Capacitance Insulation (Maximum %) Shift Resistance														
C0G	All	All	0.5	0.3% or ±0.25 pF	10% of Initial Limit										

² Capacitance and dissipation factor (DF) measured under the following conditions:

¹ MHz ±100 kHz and 1.0 Vrms ±0.2 V if capacitance ≤ 1,000 pF

¹ kHz ± 50 Hz and 1.0 Vrms ±0.2 V if capacitance > 1,000 pF

 $^{^3}$ To obtain IR limit, divide M Ω - μ F value by the capacitance and compare to G Ω limit. Select the lower of the two limits.



Table 1A – Capacitance Range/Selection Waterfall (0805 – 1808 Case Sizes)

*Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).

			Ca	se	Siz	:e/S	Ser	ies	,	С	0805	iН		C	1206	H			С	1210	Н			С	1808	Н	
	Сар			Vo	ltag	e Co	de			С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
Capacitance	Code		F	Rated	Volt	age	(VD	C)		200	630	1000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000
	0000	┝		Ca		•	•	•		<u> </u>				Prod	uct A	vaila	abilit	v and	l Chi	p Thi	ickne	ess C	odes				7
40.04.5*	400 040*			To	oler						D0	D.O.	1	Sec	e Tab	le 2	for C	hip T	hick	ness	Dim	ensi	ons		1.0	1.0	
1.0 - 9.1 pF* 10 pF - 47pF*	109 - 919* 100 - 470*	В	С	D	F	G	J	K	М	DG	DG DG	DG DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB LB	LB LB	LB LB	LB LB	LB LB
51 pF	510	i			F	G	J	K	M	DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB
56 pF	560	i			F	G	J	K	М	DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB
62 pF	620	İ			F	G	J	K	М	DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB
68 pF	680				F	G	J	K	M	DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB
75 pF	750				F	G	J	K	M	DG	DG	DG	ED	ED	ED	ED	EF	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB
82 pF	820				F	G	J	K	М	DG	DG	DG	ED	ED	ED	ED	EF	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB
91 pF	910				F	G	J	K	M	DG	DG	DG	ED	ED	ED	ED	EF	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB
100 pF 110 pF	101 111				F	G	J	K	M	DG	DG DG	DG	ED ED	ED ED	ED ED	ED ED	EF EG	FM FM	FM FM	FM FM	FM FM	FM FM	LB LB	LB LB	LB	LB LB	LB LB
120 pF	121	ł			F	G	J	K	M	DG	DG	DG	ED	ED	ED	ED	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LB
130 pF	131				F	G	J	K	M	DG	DG	DG	ED	ED	ED	ED	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LB
150 pF	151				F	G	J	K	M	DG	DG	DG	ED	ED	ED	EF	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LB
160 pF	161	İ			F	G	J	K	М	DG	DG	DG	ED	ED	ED	EF	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LC
180 pF	181				F	G	J	K	М	DG	DG	DG	ED	ED	ED	EF	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LC
200 pF	201				F	G	J	K	M	DG	DG	DG	ED	ED	ED	EF	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LC
220 pF	221	l			F	G	J	K	М	DG	DG	DG	ED	ED	ED	EG	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LC
240 pF	241				F	G	J	K	М	DG	DG	DG	ED	ED	ED	EG	EG	FG	FG	FG	FM	FM	LA	LA	LA	LB	LC
270 pF	271				F	G	J	K	М	DG	DG	DG	ED	ED	ED	EG	EG	FG	FG	FG	FK	FK	LA	LA	LA	LB	LC
300 pF	301	ŀ			F	G	J	K	M	DG	DG		ED	ED	EF	EG		FG	FG	FG	FK	FK	LA	LA	LA	LB	LC
330 pF 360 pF	331 361	ł			F	G	J	K	M	DG DG	DG DG		ED ED	ED ED	EF EF	EG EG		FG FG	FG FG	FG FG	FK FK	FK FS	LA LA	LA LA	LA LA	LB LB	LC LA
390 pF	391	ł			F	G	J	K	M	DG	DG		ED	ED	EF	EG		FG	FG	FG	FK	FS	LA	LA	LA	LB	LA
430 pF	431	ł			F	G	J	K	M	DG	DG		ED	ED	EF	EG		FG	FM	FM	FS	FS	LA	LB	LB	LC	LA
470 pF	471				F	G	J	K	M	DG	DG		ED	ED	EG	EG		FG	FM	FM	FS	FS	LA	LB	LB	LC	LA
510 pF	511	i			F	G	J	K	М	DG	DG		ED	ED	EG	EG		FG	FM	FM	FS	FS	LA	LB	LB	LC	LB
560 pF	561	İ			F	G	J	K	М	DG	DG		ED	ED	EG	EG		FG	FM	FM	FS	FS	LA	LB	LB	LC	LB
620 pF	621	l			F	G	J	K	М	DG			ED	ED	EG			FG	FM	FM	FS	FS	LA	LB	LB	LA	LC
680 pF	681				F	G	J	K	М	DG			ED	ED	EG			FG	FM	FM	FS	FS	LB	LB	LB	LA	LC
750 pF	751				F	G	J	K	М	DG			ED	EF	EG			FG	FM	FM	FM		LB	LB	LB	LA	
820 pF	821	ŀ			F	G	J	K	M	DG			ED	EF	EG			FG	FM	FM	FM		LB	LB	LB	LA	
910 pF 1,000 pF	911 102	ł			F	G	J	K	M				ED ED	EF EF	EG EG			FM FM	FM FM	FM FM	FY FY		LB LB	LB LB	LB LB	LA LB	
1,100 pF	112	ł			F	G	J	K	M				EF	EG	LG			FM	FK	FK	FS		LC	LC	LC	LB	
1,200 pF	122				F	G	J	K	M				EF	EG				FM	FK	FK	FS		LC	LC	LC	LC	
1,300 pF	132	ĺ			F	G	J	K	M	l			EF	EG				FM	FS	FS	-		LC	LC	LC	LC	
1,500 pF	152	1			F	G	J	K	М				EF	EG				FK	FS	FS			LC	LC	LC	LC	
1,600 pF	162	1			F	G	J	K	М				EF	EG				FK	FS	FS			LC	LC	LC		
1,800 pF	182				F	G	J	K	М				EF	EG				FK	FS	FS			LC	LC	LC		
2,000 pF	202				F	G	J	K	M				EG					FK	FL	FS			LC	LA	LB		
2,200 pF	222				F	G	J	K	M				EG EG					FK FS	FL	FS			LC	LA LA	LB LB		
2,400 pF 2,700 pF	242 272				F	G G	J	K	M				EG					FS	FL FL	FS FS			LC	LA	LC		
3,000 pF	302				F	G	J	K	M				20					FS	FL	13			LA	LA	LU		
3,300 pF	332				F	G	J	K	M									FS	FM				LA	LA			
3,600 pF	362	ĺ			F	G	J	K	М	l			İ					FL	FM				LA	LB			
3,900 pF	392				F	G	J	K	М									FL	FY				LA	LB			
4,300 pF	432	1			F	G	J	K	М									FM	FY				LA	LC			
4,700 pF	472	⊬			F	G	J	K	М			_	_		_	_	_	FM	FY	_	_	_	LA	LC	_	_	_
	Cap		F	Rated	Volt	age	(VD	C)		200	630	1000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000
Capacitance	Code			Vo	ltag	e Co	de			С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
			C	ase	Siz	e/S	eri	es		C	0805	H		С	1206	Н			С	1210	Н			С	1808	Н	



Table 1A - Capacitance Range/Selection Waterfall (0805 - 1808 Case Sizes) cont'd

		Case Size/Series	C	0805	Н		С	1206	Н			C	1210	Н			C	1808	Н	
	Сар	Voltage Code	С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
Capacitance	Code	Rated Voltage (VDC)	200	630	1000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000
		Capacitance Tolerance					Prod See	uct A	vaila le 2 1	bilit	y and hip T	l Chi _l hick	p Thi ness	ckne Dim	ss C ensid	odes ons	•			
5,100 pF	512	F G J K M									FY	FS				LA				
5,600 pF	562	F G J K M									FY	FS				LB				
6,200pF	622	F G J K M									FY					LC				
6,800pF	682	F G J K M									FY					LC				
7,500pF	752	F G J K M									FS									
8,200 pF	822	F G J K M									FS									
	Can	Rated Voltage (VDC)	200	630	1000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000
Capacitance	Cap Code	Voltage Code	С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
		Case Size/Series	С	0805	Н		С	1206	Н			С	1210	Н			С	1808	Н	

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).



Table 1B - Capacitance Range/Selection Waterfall (1812 - 2225 Case Sizes)

		Ca	se S	Size	/Ser	ies		C	1812	H.			C	1825	5H			C	2220	H			C	2225	iН	
	Сар		Volt	age C	ode		С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
Capacitance	Code	R	ated V	/oltag	e (VD	C)	90	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000
	Oode		Сар				47		-	~		odu												-	~	2
			Tol	erai								See	Tabl	e 2 fo	or Ci	hip T	hick	nes	s Din	nens	ions					
10 pF - 47pF*	100 - 470* 510	F	G	J	K	M	GK	GK	GK	GK GK	GK GK	HG HG	HG HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF KF	KF	KF KF	KF KF
51 pF 56 pF	560	F	G	J	K	M	GK GK	GK GK	GK GK	GK	GK	HG	HG	HG HG	HG HG	HG HG	JK JK	JK JK	JK JK	JK JK	JK JK	KF KF	KF	KF KF	KF	KF
62 pF	620	l F	G	J	K	M	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
68 pF	680	F	G	J	K	М	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
75 pF	750	F	G	J	K	М	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
82 pF	820	F	G	J	K	M	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
91 pF	910	F	G	J	K	M	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
100 pF	101	F	G	J	K	M	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
110 pF 120 pF	111 121	F	G	J	K	M	GK GK	GK GK	GK GK	GK GK	GK GK	HG	HG HG	HG HG	HG HG	HG	JK JK	JK JK	JK JK	JK JK	JK JK	KF KF	KF KF	KF KF	KF KF	KF KF
130 pF	131	F	G	J	K	M	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
150 pF	151	l F	G	J	K	M	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
160 pF	161	F	G	J	K	M	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
180 pF	181	F	G	J	K	М	GK	GK	GK	GK	GK	HG	HG	HG	HG	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
200 pF	201	F	G	J	K	M	GH	GH	GH	GH	GH	HE	HE	HE	HE	HE	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
220 pF	221	F	G	J	K	M	GH	GH	GH	GH	GH	HE	HE	HE	HE	HE	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF
240 pF	241	F	G	J	K	M	GH	GH	GH	GH	GH	HE	HE	HE	HE	HE	JK	JK	JK	JK	JK	KE	KE	KE	KE	KE
270 pF 300 pF	271	F	G	J	K	M	GH	GH	GH	GH	GH	HE	HE	HE	HE	HE	JK	JK	JK	JK	JK	KE	KE	KE	KE	KE
300 pF 330 pF	301 331	F	G	J	K	M	GH	GH	GH	GH	GH	HE	HE	HE	HE	HE	JK JE	JK JE	JK JE	JK JE	JK JE	KE	KE	KE	KE KE	KE
360 pF	361	l 'F	G	J	K	M	GK	GK	GK	GK	GH	HE	HE	HE	HE	HE	JE	JE	JE	JE	JE	KE	KE	KE	KE	KE
390 pF	391	l F	G	J	K	M	GK	GK	GK	GK	GK	HE	HE	HE	HE	HE	JE	JE	JE	JE	JE	KE	KE	KE	KE	KE
430 pF	431	F	G	J	K	М	GK	GK	GK	GK	GK	HE	HE	HE	HE	HE	JE	JE	JE	JE	JE	KE	KE	KE	KE	KE
470 pF	471	F	G	J	K	M	GK	GK	GK	GK	GK	HE	HE	HE	HE	HE	JE	JE	JE	JE	JE	KF	KF	KF	KF	KE
510 pF	511	F	G	J	K	M	GH	GH	GH	GK	GH	HE	HE	HE	HE	HE	JK	JK	JK	JK	JK	KF	KF	KF	KF	KE
560 pF	561	F	G	J	K	M	GH	GH	GH	GK	GH	HE	HE	HE	HE	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KE
620 pF	621	F	G	J	K	M	GH	GH	GH	GK	GH	HE	HE	HE	HE	HG	JK	JK	JK	JK	JK	KF	KF	KF	KF	KE
680 pF 750 pF	681 751	F	G	J	K	M	GH GH	GH	GH	GK GK	GH GK	HE	HE	HE	HE HG	HG	JE JE	JE JE	JE JE	JK JK	JK JK	KF KE	KF KE	KF KE	KF KF	KE KE
820 pF	821	F	G	J	K	M	GH	GH	GH	GK	GK	HE	HE	HE	HG	HG	JE	JE	JE	JK	JK	KE	KE	KE	KF	KE
910 pF	911	l F	G	J	K	M	GH	GH	GH	GH	GM	HE	HE	HE	HG	HG	JE	JK	JK	JK	JK	KE	KE	KE	KF	KE
1,000 pF	102	F	G	J	K	М	GH	GH	GH	GH	GM	HE	HE	HE	HG	HG	JE	JK	JK	JK	JK	KE	KE	KE	KF	KE
1,100 pF	112	F	G	J	K	M	GH	GK	GK	GH	GO	HE	HE	HE	HG	HG	JE	JK	JK	JK	JK	KE	KE	KE	KF	KF
1,200 pF	122	F	G	J	K	M	GH	GK	GK	GH	GO	HE	HE	HE	HG	HG	JE	JK	JK	JK	JK	KE	KE	KE	KF	KF
1,300 pF	132	F	G	J	K	M	GH	GK	GK	GH	GO	HE	HE	HE	HG	HE	JE	JK	JK	JK	JE	KE	KE	KE	KF	KF
1,500 pF 1,600 pF	152 162	F	G	J	K	M	GK GK	GK GK	GK GK	GK GK	GO	HE	HE HG	HE HG	HG HG	HE	JE JE	JK JK	JK JK	JK JK	JE JE	KE KE	KE KE	KE KE	KF KF	KF KE
1,800 pF	182	F	G	J	K	M	GK	GK	GK	GM		HE	HG	HG	HG	HG	JE	JK	JK	JK	JE	KE	KE	KE	KF	KE
2,000 pF	202	l 'F	G	J	K	M	GK	GK	GK	GM		HE	HG	HG	HE	HJ	JE	JK	JK	JE	JK	KE	KE	KE	KF	KE
2,200 pF	222	F	G	J	K	M	GK	GK	GK	GO		HE	HG	HG	HE	HJ	JE	JK	JK	JE	JK	KE	KE	KE	KF	KF
2,400 pF	242	F	G	J	K	М	GK	GH	GK	GO		HE	HG	HG	HE	HJ	JK	JK	JK	JE	JL	KE	KE	KE	KE	KH
2,700 pF	272	F	G	J	K	М	GK	GH	GK	GO		HE	HG	HG	HE	HK	JK	JK	JK	JE	JL	KE	KE	KE	KE	KH
3,000 pF	302	F	G	J	K	M	GK	GH	GK			HG	HG	HG	HE	HK	JK	JK	JK	JE	JL	KE	KE	KE	KE	KH
3,300 pF	332	F	G	J	K	M	GK	GH	GK			HG	HG HG	HG	HG		JK	JK	JK	JK	JN	KE	KE	KE	KE	KJ
3,600 pF 3,900 pF	362 392	F	G	J	K	M	GK GK	GH GH	GM GM			HG HG	HG	HG HG	HG HJ		JK JK	JK JK	JK JK	JK JK	JN JN	KE KE	KF KF	KF KF	KF KF	KJ KJ
4,300 pF	432	F	G	J	K	M	GH	GH	GO			HG	HG	HG	HJ		JK	JK	JK	JK	OIN.	KE	KF	KF	KF	110
4,700 pF	472	F	G	Ĵ	K	M	GH	GH	GO			HG	HG	HG	HJ		JK	JK	JK	JL		KE	KF	KF	KH	
		R	ated \	/oltag	e (VD	C)	200	630	1000	1500	2000	200	630	1000	1500	2000	200	C B D E G			200	630	1000	1500	2000	
Capacitance	Cap Code		Volt	age C	ode		С	В	D	F	G	С	В	D	F	G	С	В				С	В	D	F	G
		Ca	Case Size/Series				c	1812	Н			c	1825	Н			c	2220	Н			С	2225	Н		

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).



Table 1B - Capacitance Range/Selection Waterfall (1812 - 2225 Case Sizes) cont'd

		Ca	se S	Size	/Ser	ies		С	1812	2H			C	1825	δH			C	2220	H			C	2225	Н	
	Сар		Vol	tage C	ode		С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
Capacitance	Code	R	ated \	/oltag	e (VD	C)	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000
			Cap To	acita lerar)						odu See														
5,100 pF	512	F	G	J	K	М	GH	GK	GO			HG	HE	HG	HK		JK	JK	JK	JL		KE	KF	KF	KH	
5,600 pF	562	F	G	J	K	M	GH	GK	GO			HG	HE	HG	HK		JK	JK	JK	JN		KE	KF	KF	KH	
6,200pF	622	F	G	J	K	M	GH	GK				HG	HE	HG			JK	JE	JE	JN		KE	KF	KF	KJ	
6,800pF	682	F	G	J	K	M	GH	GM				HG	HE	HJ			JK	JE	JK	JN		KE	KF	KF	KJ	
7,500pF	752	F	G	J	K	M	GH	GM				HG	HE	HJ			JK	JE	JK			KF	KE	KF		
8,200 pF	822	F	G	J	K	M	GK	GO				HG	HE	HJ			JK	JE	JL			KF	KE	KF		
9,100 pF	912						GM	GO				HE	HG	HK			JE	JE	JL			KF	KE	KH		
10,000 pF	103						GM	GO				HE	HG	HK			JE	JE	JL			KF	KE	KH		
12,000 pF	123						GO					HE	HG				JE	JK	JN			KE	KE	KH		
15,000 pF	153						GO					HE	HJ				JE	JL				KE	KF	KJ		
18,000 pF	183						İ					HG	HK				JE	JL				KE	KH			
22,000 pF	223											HJ					JK	JN				KF	KJ			
27,000 pF	273											HJ					JL	JN				KF	KJ			
33,000 pF	333											НК					JN					KH				
39,000 pF	393											İ										KJ				
	Сар	R	ated \	/oltag	e (VD	C)	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000
Capacitance	Code		Vol	tage C	ode		С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
		Ca	ase S	Size/	Seri	ies		С	1812	Н			С	1825	Н			C	2220	Н			С	2225	Н	

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

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Table 1C - Capacitance Range/Selection Waterfall (2824 - 4540 Case Sizes)

				,																				
			ise Siz Series			C	2824	Н			С	3040	Н			С	3640	Н			C	4540	Н	
Capacitance	Cap	Vo	Itage Co	de	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
	Code	Vo	Rated Itage (VD	OC)	200	630	1000	1500	2000	200	630	1000	1500	2000	500	630	1000	1500	2000	500	630	1000	1500	2000
			apacitan												Chi					5				
10 - 2,000 pF	100 - 202	J	Folerance K	M	├─					See	lab	1e 2 1	ror C	nip i	hick	ness	חוט	ensi	ons	_				
2,200 pF	222	J	K	M	TA	TA	TA	TA	TA															
2,400 pF	242	J	K	M	1/	IA.	IA.	IA.	IA.															
2,700 pF	272	J	K	M	TA	TA	TA	TA	TA															
3,000 pF	302	J	K	M	1/	IA.	IA.	IA.	IA.															
3,300 pF	332	J	K	M	TA	TA	TA	TA	TA	QB	QB	QB	QB	QB										
3,600 pF	362	J	K	M	I IA	IA	IA	IA	IA	QD	QD	QD	QD	QD										
3,900 pF	392	J	K	M	TA	TA	TA	TA	ТВ	QB	QB	QB	QB	QB	МА	MA	MA	МА	MA					
4.300 pF	432	J	K	M	'^	IA.	I IA	IA.	10	QD	QD	QD	QD	QD	IVIA	IVIA	IVIA	IVIA	IVIA					
4,700 pF	472	J	K	M	TA	TA	TA	ТВ	ТВ	QB	QB	QB	QB	QB	МА	MA	MA	МА	MA	SA	SA	SA	SA	SA
5,100 pF	512	J	K	M	1/	1/	IA.	10	10	QD	QD	QD	QD	QD	IVIA	IVIA	IVIA	IVIA	IVIA	0.7	0.7	JOA.	0.7	J.A
5,600 pF	562	J	K	M	TA	TA	TA	ТВ	TC	QB	QB	QB	QB	QB	MA	MA	MA	MA	MA	SA	SA	SA	SA	SA
6,200 pF	622	Ĵ	K	M	1/1	1/1	171	10	10	QD	QD	QD	QD	QD	IVI/ \	IVIZ	IVI/ (IVIZ	IVIZ	0/1	O/ t	O/ C	O/ C	O/ C
6,800 pF	682	J	K	M	TA	TA	TA	ТВ		QB	QB	QB	QB	QC	МА	MA	MA	MA	MA	SA	SA	SA	SA	SA
7,500 pF	752	J	K	M	1/	IA.	IA.	טו		QD	QD	QD	QD	QU	IVIA	IVIA	IVIA	IVIA	IVIA	J 0A	J.A.	UA.	0.7	J.A
8,200 pF	822	Ĵ	K	M	TA	TA	TA	TC		QB	QB	QB	QC	QC	MA	MA	MA	MA	МВ	SA	SA	SA	SA	SA
9,100 pF	912	J	K	M	1/1	171	171	10		QD	QD	QD	QU	QU	IVI/ (IVIZ	IVI/ \	IVIZ	IVID	0/1	O/ t	O/ C	O/ C	O/ C
10,000 pF	103	Ĵ	K	М	TA	TA	TA			QB	QB	QB	QC	QD	МА	MA	MA	MA	МВ	SA	SA	SA	SA	SB
12,000 pF	123	Ĵ	K	М	TA	TA	TA			QB	QB	QB	QD	QD	MA	MA	MA	MB	MB	SA	SA	SA	SA	SB
15,000 pF	153	Ĵ	K	M	TA	TA	TB			QB	QB	QB	QD		MA	MA	MA	MB	MC	SA	SA	SA	SB	SB
18,000 pF	183	Ĵ	K	М	TA	TA	TB			QB	QB	QB	~_		MA	MA	MA	MC		SA	SA	SA	SB	SC
22,000 pF	223	J	K	М	TA	TB	TC			QB	QB	QC			MA	MA	MA			SA	SA	SA	SB	
27,000 pF	273	Ĵ	K	M	TA	TB				QB	QB	QC			MA	MA	MA			SA	SA	SA	SC	
33,000 pF	333	Ĵ	K	M	ТВ	TB				QB	OC	QC			MA	MA	MB			SA	SA	SA		
39,000 pF	393	Ĵ	K	M	ТВ	TC				QB	OC.	QD			MA	MA	MB			SA	SA	SB		
47,000 pF	473	J	K	М	ТВ					QB	QC				MA	MB	MC			SA	SA	SB		
56,000 pF	563	J	K	M	TC					QC	QD				MA	MB				SA	SA	SB		
68,000 pF	683	Ĵ	K	М						QC	QD				MB	MC				SA	SB	SC		
82,000 pF	823	Ĵ	K	M	l					QC					MB	•				SA	SB			
0.1 µF	104	J	K	М	İ					QD					MC					SB	SC			
0.12 µF	124	J	К	М	İ										MC					SB				
0.15 µF	154	J	K	М																SC				
		Rated	Voltage	(VDC)	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000
	Сар																			-				
Capacitance	Cap	Vo	Itage Co	de	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
		Case	Size/S	eries		С	2824	Н			С	3040	Н			С	3640	Н			С	4540	Н	

^{*}Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).



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

Thickness	Case	Thickness ±	Paper G	Quantity	Plastic (Quantity
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
ED	1206	1.00 ± 0.10	0	0	2,500	10,000
EF 50	1206	1.20 ± 0.15	0	0	2,500	10,000
EG	1206	1.60 ± 0.15	0 0	0 0	2,000	8,000
FG FL	1210 1210	1.25 ± 0.15	0	0	2,500 2,000	10,000 8,000
FM FM	1210	1.40 ± 0.15 1.70 ± 0.20	0	0	2,000	8,000
FY	1210	2.00 ± 0.20	0	0	2,000	8,000
FK	1210	2.00 ± 0.20 2.10 ± 0.20	0	0	2,000	8,000
FS	1210	2.10 ± 0.20 2.50 ± 0.30	0	0	1,000	4,000
LA	1808	1.40 ± 0.15	0	0	1,000	4,000
LB	1808	1.60 ± 0.15	0	Ö	1,000	4,000
LC	1808	2.00 ± 0.15	Ö	Ŏ	1,000	4,000
GH	1812	1.40 ± 0.15	Ö	ŏ	1,000	4,000
GK	1812	1.60 ± 0.20	0	Ö	1,000	4,000
GM	1812	2.00 ± 0.20	0	Ö	500	2,000
GO	1812	2.50 ± 0.20	Ö	Ö	500	2,000
HE	1825	1.40 ± 0.15	0	0	1,000	4,000
HG	1825	1.60 ± 0.20	0	0	1,000	4,000
HJ	1825	2.00 ± 0.20	0	0	500	2,000
HK	1825	2.50 ± 0.20	0	0	500	2,000
JE	2220	1.40 ± 0.15	0	0	1,000	4,000
JK	2220	1.60 ± 0.20	0	0	1,000	4,000
JL	2220	2.00 ± 0.20	0	0	500	2,000
JN	2220	2.50 ± 0.20	0	0	500	2,000
KE	2225	1.40 ± 0.15	0	0	1,000	4,000
KF	2225	1.60 ± 0.20	0	0	1,000	4,000
KH	2225	2.00 ± 0.20	0	0	500	2,000
KJ	2225	2.50 ± 0.20	0	0	500	2,000
TA	2824	1.40 ± 0.15	0	0	750	2,500
TB	2824	2.00 ± 0.20	0	0	300	2,000
TC	2824	2.50 ± 0.20	0	0	300	2,000
QB	3040	1.40 ± 0.15	0	0	500	1,650
QC	3040	2.00 ± 0.20	0	0	500	1,650
QD	3040	2.50 ± 0.20	0	0	350	1,400
MA	3640	1.40 ± 0.15	0	0	250	1,550
MB	3640	2.00 ± 0.20	0	0	250	1,550
MC	3640	2.50 ± 0.20	0 0	0 0	250	1,550
SA SB	4540 4540	1.40 ± 0.15 2.00 ± 0.20	0	0	200 200	1,500 1,500
SC	4540	2.50 ± 0.20 2.50 ± 0.20	0	0	200	1,500 1,500
			7" Reel	13" Reel	7" Reel	13" Reel
Thickness Code	Case Size	Thickness ± Range (mm)		Quantity		Quantity
			rapel C		riastic (<u> </u>

Package quantity based on finished chip thickness specifications.



Table 2B – Bulk Packaging Quantities

	Doolsoning T		Loose Pa	ackaging	Secure P	ackaging
	Packaging 1	ype	Bulk Bag	(default)	2" x 2" Waffl	e Pack/Tray³
	Packaging C-S	Spec ¹	N/	'A²	7282	7292
Case	Size	Chip Thickness	Packaging	Quantities (pieces/unit p	ackaging)
EIA (in)	Metric (mm)	(mm)	Minimum	Maximum	Minimum	Maximum
0402	1005					368
0603	1608	All				368
0805	2012			E0 000		100
1206	3216	≤ 1.25 (nominal)		50,000		126
1206	3216	> 1.25 (nominal)				50
1210	3225		1		1	80
1808	4520					50
1812	4532	All				42
1825	4564	All		20,000		20
2220	5650					20
2225	5664					20

¹ The "Packaging C-Spec" is a 4-digit code which identifies the packaging type. When ordering, the proper code must be included in the 15th through 18th character positions of the ordering code. See "Ordering Information" section of this document for further details. Product ordered without a packaging C-Spec will default to our standard "bulk bag" packaging.

² A packaging C-Spec (see note 1 above) is not required For "bulk bag" packaging (excluding Anti-Static Bulk Bag). The 15th through 18th character positions of the ordering code should be left blank. All product ordered without a packaging C-Spec will default to out standard "bulk bag" packaging.

³ Also commonly referred to as "Chip Carrier" or "Molded Tray". All tray packaging options offer static protection.



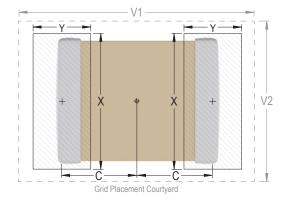
Table 3 - Chip Capacitor Land Pattern Design Recommendations per IPC-7351

EIA Size Code	Metric Size Code	Density Level A: Maximum (Most) Land Protrusion (mm)					I	Medi	sity Lev an (Nor rotrusio	ninal))	Density Level C: Minimum (Least) Land Protrusion (mm)					
Oode	Oode	С	Y	X	V1	V2	С	Υ	Х	V1	V2	С	Υ	Х	V1	V2	
0805	2012	1.00	1.35	1.55	4.40	2.60	0.90	1.15	1.45	3.50	2.00	0.75	0.95	1.35	2.80	1.70	
1206	3216	1.60	1.35	1.90	5.60	2.90	1.50	1.15	1.80	4.70	2.30	1.40	0.95	1.70	4.00	2.00	
1210	3225	1.60	1.35	2.80	5.65	3.80	1.50	1.15	2.70	4.70	3.20	1.40	0.95	2.60	4.00	2.90	
1808	4520	2.30	1.75	2.30	7.40	3.30	2.20	1.55	2.20	6.50	2.70	2.10	1.35	2.10	5.80	2.40	
1812	4532	2.15	1.60	3.60	6.90	4.60	2.05	1.40	3.50	6.00	4.00	1.95	1.20	3.40	5.30	3.70	
1825	4564	2.15	1.60	6.90	6.90	7.90	2.05	1.40	6.80	6.00	7.30	1.95	1.20	6.70	5.30	7.00	
2220	5650	2.75	1.70	5.50	8.20	6.50	2.65	1.50	5.40	7.30	5.90	2.55	1.30	5.30	6.60	5.60	
2225	5664	2.70	1.70	6.90	8.10	7.90	2.60	1.50	6.80	7.20	7.30	2.50	1.30	6.70	6.50	7.00	
2824	7260	3.45	1.70	6.60	9.60	7.60	3.35	1.50	6.50	8.70	7.00	3.25	1.30	6.40	8.00	6.70	
3040	7610	3.70	1.70	10.70	10.10	11.70	3.60	1.50	10.60	9.20	11.10	3.50	1.30	10.50	8.50	10.80	
3640	9210	4.45	1.70	10.70	11.60	11.70	4.35	1.50	10.60	10.70	11.10	4.25	1.30	10.50	10.00	10.80	
4540	-	5.60	1.70	10.70	13.90	11.70	5.50	1.50	10.60	13.00	11.10	5.40	1.30	10.50	12.30	10.80	

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

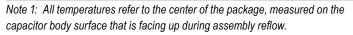
Recommended Soldering Technique:

- 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
Frome reature	SnPb	100% Matte Sn
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum



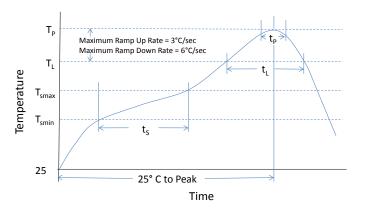




Table 4 – Performance & Reliability: Test Methods and Conditions

	Product Qualification Test Plan
Reliability	/Environmental Tests per MIL–STD–202//JESD22
Load Humidity	85°C/85%RH and 200 VDC maximum, 1,000 Hours
Low Voltage Humidity	85°C/85%RH, 1.5V, 1,000 Hours
Temperature Cycling	−55°C to +200°C, 50 Cycles
Thermal Shock	−55°C to +150°C, 20 seconds transfer, 15 minute dwell, 300 Cycles
Moisture Resistance	Cycled Temp/RH 0 V, 10 cycles @ 24 hours each
Physical, Mech	anical & Process Tests per MIL-STD 202/JIS-C-6429
Resistance to Solvents	Include Aqueous wash chemical – OKEM Clean or equivalent
Mechanical Shock and Vibration	Method 213: Figure 1, Condition F Method 204: 5 gs for 20 minutes, 12 cycles
Resistance to Soldering Heat	Condition B, no per-heat of samples, Single Wave Solder
Terminal Strength	Force of 1.8 kg for 60 seconds
Board Flex	Appendix 2, Note: 3.0 mm (minimum)

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature— reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 40°C and maximum storage humidity not exceed 70% relative humidity. In addition, 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 the time frame outlined in the table below:

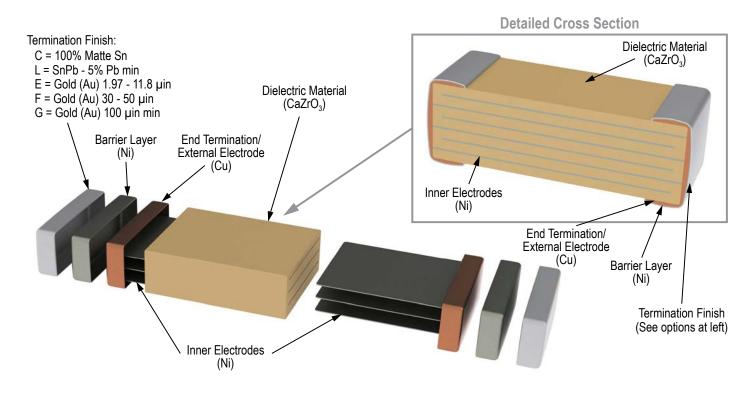
Termination Finish	Termination Finish Ordering Code ¹	Storage Life
100% Matte Tin (Sn)	С	1.5 years upon receipt
SnPb (5% Pb min.)	L	1.5 years upon receipt
Gold (Au) 1.97 – 11.8 μin²	E	6 months upon receipt ²
Gold (Au) 30 – 50 μin	F	1.5 years upon receipt
Gold (Au) 100 µin min.	G	1.5 years upon receipt

¹ The fourteenth (14th) character position of the KEMET part number is assigned to identify and/or define the termination finish. For more information, see "Ordering Information" section of this document.

² Gold plating option "E" devices should remain in its factory sealed moisture sensitive packaging during storage. If the factory sealed packaging is disturbed please store any remaining packaged components in a dry box container to prevent oxidation of the termination finish.



Construction (Typical)



Capacitor Marking (Optional):

Laser marking option is not available on:

- C0G, Ultra Stable X8R and Y5V dielectric devices
- EIA 0402 case size devices
- EIA 0603 case size devices with Flexible Termination option.
- KPS Commercial and Automotive grade stacked devices.

These capacitors are supplied unmarked only.

Pulse Discharge, High Voltage, High Temperature 200°C C0G Dielectric, 1,000 VDC – 3,500 VDC (Industrial Grade)



Overview

KEMET's Industrial Grade Pulse Discharge Series surface mount capacitors in C0G Dielectric deliver reliable high voltage and high temperature performance required for operation in harsh environments, specifically discharge circuitry.

Constructed of a robust and proprietary base metal electrode (BME) dielectric system, these devices offer industry-leading performance relative to capacitance and case size. KEMET Pulse Discharge capacitors average greater than 30% higher breakdown voltage than competitive precious metal electrode (PME) devices with similar capacitance & voltage ratings.

Designed for down-hole oil exploration and perforation, these devices feature a 200°C maximum operating temperature. The Electronics Industries Alliance (EIA) characterizes C0G dielectric as a Class I material. Components of this classification are temperature compensating and are suited for resonant

circuit applications or those where Q and stability of capacitance characteristics are required. Pulse Discharge series capacitors in C0G dielectric exhibit no change in capacitance with respect to time and voltage and boast a negligible change in capacitance with reference to ambient temperature. These devices retain high insulation resistance with low dissipation factor at elevated temperatures up 200°C.

KEMET's Pulse Discharge surface mount MLCCs are manufactured in state-of-the-art ISO/TS 16949:2009 certified facilities and are proven to function reliably in harsh, high temperature and high humidity, down-hole environments.



Ordering Information

С	2824	Н	393	K	U	G	W	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Dielectric Withstanding Voltage (VDC) ¹	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/Grade (C-Spec) ³
	2824 3040 3640 4540	H = High Temp (200°C)	Two significant digits + number of zeros	J = ±5% K = ±10% M = ±20%	D = 1,000 U = 1,250 G = 2,000 H = 3,000 V = 3,500	G = C0G	W = Pulse Discharge	C = 100% Matte Sn L = SnPb (5% Pb min.)	See "Packaging C-Spec Ordering Options Table" below

¹ DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor. See waterfall table for working voltage.

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

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



Packaging C-Spec Ordering Options Table

Packaging Type/Options ¹	Packaging Ordering Code (C-Spec) ²
7" Reel (Embossed Plastic Tape)/Unmarked	TU
13" Reel (Embossed Plastic Tape)/Unmarked	7210
Reel (Embossed Plastic Tape)/Unmarked - 50 pieces	T050
Reel (Embossed Plastic Tape)/Unmarked - 100 pieces	T100
Reel (Embossed Plastic Tape)/Unmarked - 250 pieces	T250
Reel (Embossed Plastic Tape)/Unmarked - 500 pieces	T500
Reel (Embossed Plastic Tape)/Unmarked - 1,000 pieces	T1K0

¹ The terms "Marked" and "Unmarked" pertain to laser marking option of components. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. The option to laser mark is not available on these devices.

Benefits

- Operating temperature range of -55°C to +200°C
- · Lead (Pb)-Free, RoHS and REACH compliant
- · Base metal technology
- · Higher UVBD capability than competitive dielectric technologies
- Capacitance offerings ranging from 2.2 nF up to 150 nF
- Available capacitance tolerances of ±5%, ±10% or ±20%
- · Extremely low ESR and ESL
- High thermal stability

- · High ripple current capability
- No capacitance change with respect to applied rated DC voltage
- Negligible capacitance change with respect to temperature from –55°C to +200°C
- · No capacitance decay with time
- · Non-polar device, minimizing installation concerns
- 100% pure matte tin-plated termination finish allowing for excellent solderability

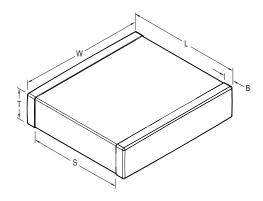
Applications

Typical applications include high temperature discharge circuits for munitions and down-hole oil exploration/perforation.

²Reeling quantities are dependent upon chip size and thickness dimension. When ordering using the "Txxx" packaging ordering codes (C-Specs) outlined above, product may be shipped on multiple 7" reels or a single 13" reel. Additional reeling or packaging options may be available. Contact KEMET for details.



Dimensions – Millimeters (Inches)



Size Code	L Length	W Width	T Thickness Maximum	B Bandwidth	S Separation Minimum	Mounting Technique
2824	7.10 ± 0.40 (0.280 ± 0.016)	6.10 ± 0.40 (0.240 ± 0.016)				
3040	7.60 ± 0.40 (0.300 ± 0.016)	10.20 ± 0.40 (0.402 ± 0.016)	See Table 2	1.27 ± 0.40	N/A	Solder
3640	9.10 ± 0.40 (0.358 ± 0.016)	10.20 ± 0.40 (0.402 ± 0.016)	See Table 2	(0.050 ± 0.016)	IN/A	Reflow Only
4540	11.40 ± 0.40 (0.449 ± 0.016)	10.20 ± 0.40 (0.402 ± 0.016)				

Qualification/Certification

Industrial grade pulse discharge products are subject to internal qualification. Details regarding test methods and conditions are referenced in Table 4, Performance and Reliability.

Environmental Compliance

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



Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +200°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±30 ppm/°C
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	0%
¹ Dielectric Withstanding Voltage (DWV)	See product selection table (product waterfall) for available ratings
² Dissipation Factor (DF) Maximum Limit @ 25°C	0.1%
³ Insulation Resistance (IR) Minimum Limit @ 25°C	1,000 megohm microfarads or 100 GΩ (500 VDC applied for 120 ±5 seconds @ 25°C)

¹DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor. ²Capacitance and dissipation factor (DF) measured under the following conditions:

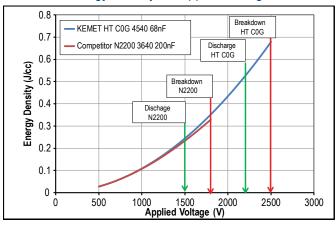
Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 and Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON."

Post Environmental Limits

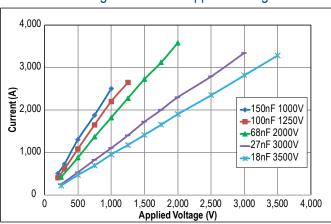
	High Temperature Life, Biased Humidity, Moisture Resistance												
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance								
C0G	All	All	0.5	0.3% or ±0.25 pF	10% of Initial Limit								

Electrical Characteristics

Energy Density vs. Applied Voltage



Discharge Current vs. Applied Voltage



¹ MHz ±100 kHz and 1.0 Vrms ±0.2 V if capacitance ≤ 1,000 pF

¹ kHz \pm 50 Hz and 1.0 Vrms \pm 0.2 V if capacitance > 1,000 pF

 $^{^3}$ To obtain IR limit, divide M Ω - μ F value by the capacitance and compare to G Ω limit. Select the lower of the two limits.



Table 1 – Pulse Discharge Series, Capacitance Range Waterfall

			se Siz Series			C	2824	Н			C	3040	Н			С	3640	Н			С	4540	Н	
		Vo	Itage Co	de	D	U	G	Н	٧	D	U	G	Н	٧	D	U	G	Н	٧	D	U	G	Н	V
Capacitance	Cap Code		ic Withst tage (DW		1000	1250	2000	3000	3500	1000	1250	2000	3000	3500	1000	1250	2000	3000	3500	1000	1250	2000	3000	3500
		Wor	king Volt	age	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000
		Capacit	tance Tol	erance					l						d Chi hick					S				
1,800 pF	182	J	K	М																				
2,000 pF	202	J	K	M																				
2,200 pF	222	J	K	M	TA	TA	TA	TA	TA															
2,700 pF	272	J	K	M	TA	TA	TA	TA	TA															
3,300 pF	332	J	K	M	TA	TA	TA	TA	TA	QB	QB	QB	QB	QB										
3,900 pF	392	J	K	M	TA	TA	TA	TA	TB	QB	QB	QB	QB	QB	MA	MA	MA	MA	MA					
4,700 pF	472	J	K	M	TA	TA	TA	TB	TB	QB	QB	QB	QB	QB	MA	MA	MA	MA	MA	SA	SA	SA	SA	SA
5,600 pF	562	J	K	M	TA	TA	TA	TB	TC	QB	QB	QB	QB	QB	MA	MA	MA	MA	MA	SA	SA	SA	SA	SA
6,800 pF	682	J	K	M	TA	TA	TA	TB		QB	QB	QB	QB	QC	MA	MA	MA	MA	MA	SA	SA	SA	SA	SA
8,200 pF	822	J	K	M	TA	TA	TA	TC		QB	QB	QB	QC	QC	MA	MA	MA	MA	MB	SA	SA	SA	SA	SA
10,000 pF	103	J	K	M	TA	TA	TA			QB	QB	QB	QC	QD	MA	MA	MA	MA	MB	SA	SA	SA	SA	SB
12,000 pF	123	J	K	M	TA	TA	TA			QB	QB	QB	QD		MA	MA	MA	MB	MB	SA	SA	SA	SA	SB
15,000 pF	153	J	K	M	TA	TA	TB			QB	QB	QB	QD		MA	MA	MA	MB	MC	SA	SA	SA	SB	SB
18,000 pF	183	J	K	M	TA	TA	TB			QB	QB	QB			MA	MA	MA	MC		SA	SA	SA	SB	SC
22,000 pF	223	J	K	M	TA	ТВ	TC			QB	QB	QC			MA	MA	MA			SA	SA	SA	SB	
27,000 pF	273	J	K	M	TA	ТВ				QB	QB	QC			MA	MA	MA			SA	SA	SA	SC	
33,000 pF	333	J	K	М	ТВ	ТВ				QB	QC	QC			MA	MA	MB			SA	SA	SA		
39,000 pF	393	J	K	M	ТВ	TC				QB	QC	QD			MA	MA	MB			SA	SA	SB		
47,000 pF	473	j	К	М	ТВ					QB	QC				МА	МВ	МС			SA	SA	SB		
56,000 pF	563	j	К	М	тс					QC	QD				МА	МВ				SA	SA	SB		
68,000 pF	683	J	К	М	İ					QC	QD				МВ	мс				SA	SB	sc		
82,000 pF	823	J	K	М						QC					MB					SA	SB			
0.10 µF	104	J	K	М						QD					MC					SB	SC			
0.12 µF	124	J	K	М											MC					SB				
0.15 µF	154	J	K	М																SC				
	-	Wor	king Volt	ane	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000
Capacitance	Cap Dielectric Withst Voltage (DW		1000	1250	2000	3000	3500	1000	1250	2000	3000	3500	1000	1250	2000	3000	3500	100	1250	2000	3000	3500		
Capacitanos	Code		Itage Co		D	U	G	Н	٧	D	U	G	Н	٧	D	U	G	Н	٧	D	U	G	Н	٧
		Case	Size/S	eries		С	2824	Н			С	3040	Н			С	3640	Н			С	4540	Н	



Table 2 – Chip Thickness/Tape & Reel Packaging Quantities

Thickness	Case	Thickness ±	Paper C	Quantity	Plastic (Quantity
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
TA	2824	1.40 ± 0.15	0	0	750	2,500
TB	2824	2.00 ± 0.20	0	0	300	2,000
TC	2824	2.50 ± 0.20	0	0	300	2,000
QB	3040	1.40 ± 0.15	0	0	500	1,650
QC	3040	2.00 ± 0.20	0	0	500	1,650
QD	3040	2.50 ± 0.20	0	0	350	1,400
MA	3640	1.40 ± 0.15	0	0	250	1,550
MB	3640	2.00 ± 0.20	0	0	250	1,550
MC	3640	2.50 ± 0.20	0	0	250	1,550
SA	4540	1.40 ± 0.15	0	0	200	1,500
SB	4540	2.00 ± 0.20	0	0	200	1,500
SC	4540	2.50 ± 0.20	0	0	200	1,500
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

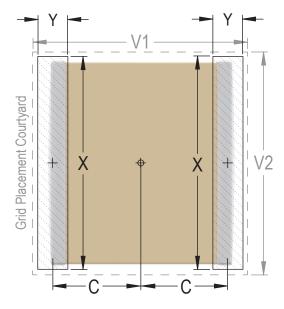
Size Code (In.)	Metric Size Code	e Land Protrusion (mm)						Media	sity Lev an (Non rotrusio	ninal))	Density Level C: Minimum (Least) Land Protrusion (mm)						
(1111)	oodc	С	Υ	Х	V1	V2	С	Υ	X	V1	V2	С	Υ	X	V1	V2		
2824	7260	3.45	1.70	6.60	9.60	7.60	3.35	1.50	6.50	8.70	7.00	3.25	1.30	6.40	8.00	6.70		
3040	7610	3.70	1.70	10.70	10.10	11.70	3.60	1.50	10.60	9.20	11.10	3.50	1.30	10.50	8.50	10.80		
3640	9210	4.45	1.70	10.70	11.60	11.70	4.35	1.50	10.60	10.70	11.10	4.25	1.30	10.50	10.00	10.80		
4540	-	5.60	1.70	10.70	13.90	11.70	5.50	1.50	10.60	13.00	11.10	5.40	1.30	10.50	12.30	10.80		

Density Level A: For low-density product applications. Provides a wider process window for reflow solder processes.

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 a 3640 case size.





Soldering Process

Recommended Soldering Technique:

· Solder reflow only

Recommended Reflow Soldering Profile:

KEMET's families of surface mount multilayer ceramic capacitors (SMD MLCCs) are compatible with wave (single or dual), convection, IR or vapor phase reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET's recommended profile conditions for convection and IR reflow reflect the profile conditions of the IPC/J-STD-020 standard for moisture sensitivity testing. These devices can safely withstand a maximum of three reflow passes at these conditions.

Profile Feature	Termination Finish	
	SnPb	100% Matte Sn
Preheat/Soak		
Temperature Minimum (T _{Smin})	100°C	150°C
Temperature Maximum (T _{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate (T _L to T _P)	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T _L)	183°C	217°C
Time Above Liquidous (t _L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum
Ramp-Down Rate (T _P to T _L)	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum

Note 1: All temperatures refer to the center of the package, measured on the capacitor body surface that is facing up during assembly reflow.

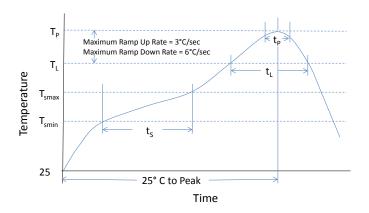




Table 4 - Performance & Reliability: Test Methods and Conditions

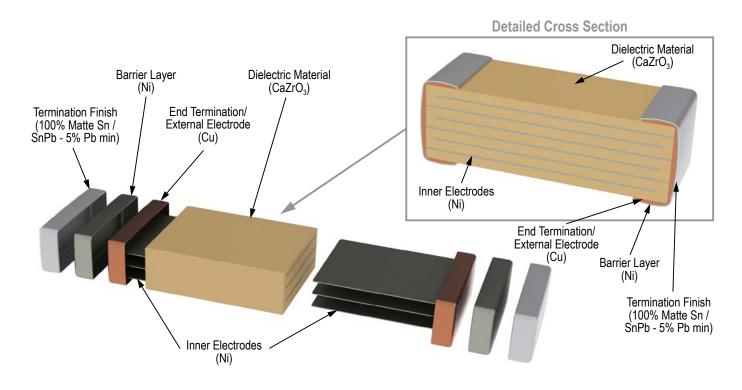
Product Qualification Test Plan		
Reliability/Environmental Tests per MIL-STD-202//JESD22		
Load Humidity	85°C/85%RH and 200 VDC maximum, 1,000 Hours	
Low Voltage Humidity	85°C/85%RH, 1.5V, 1,000 Hours	
Temperature Cycling	-55°C to +200°C, 50 Cycles	
Thermal Shock	-55°C to +150°C, 20 seconds transfer, 15 minute dwell, 300 Cycles	
Moisture Resistance	Cycled Temp/RH 0 V, 10 cycles @ 24 hours each	
Physical, Mechanical & Process Tests per MIL-STD 202/JIS-C-6429		
Resistance to Solvents	Include Aqueous wash chemical – OKEM Clean or equivalent	
Mechanical Shock and Vibration	Method 213: Figure 1, Condition F Method 204: 5 gs for 20 minutes, 12 cycles	
Resistance to Soldering Heat	Condition B, no per-heat of samples, Single Wave Solder	
Terminal Strength	Force of 1.8 kg for 60 seconds	
Board Flex	Appendix 2, Note: 3.0 mm (minimum)	

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 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



Capacitor Marking (Optional):

Laser marking option is not available on:

- C0G, Ultra Stable X8R and Y5V dielectric devices
- EIA 0402 case size devices
- EIA 0603 case size devices with Flexible Termination option.
- KPS Commercial and Automotive grade stacked devices.

These capacitors are supplied unmarked only.

Packaging

Please contact KEMET for details regarding available packaging options.



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 μ F. Orientation of marking is vendor optional.





Capacitor Marking (Optional) cont'd

Capacitance (pF) For Various Alpha/Numeral Identifiers										
Alpha		0	4			Numera	1	0	7	
Character	9	0	1	2	3	4	5	6	7	8
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
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	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	3 6	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
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	7 0	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 – Surface Mount Devices

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.

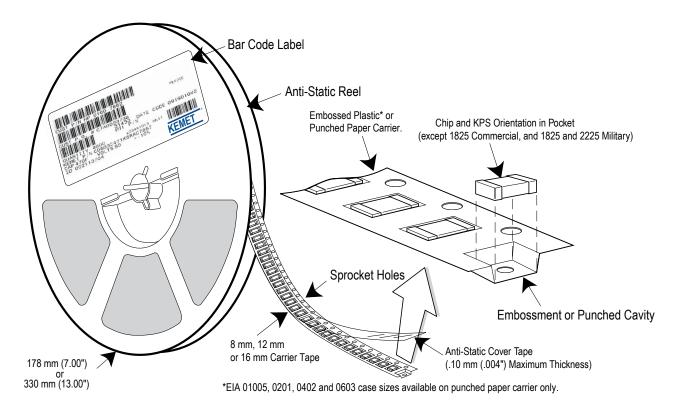


Table 5 – Carrier Tape Configuration, Embossed Plastic & Punched Paper (mm)

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

^{*}Refer to Figures 1 & 2 for W and P, carrier tape reference locations.

New 2 mm Pitch Reel Options*

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

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

Benefits of Changing from 4 mm to 2 mm Pitching Spacing

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

^{*}Refer to Tables 6 & 7 for tolerance specifications.



Figure 1 – Embossed (Plastic) Carrier Tape Dimensions

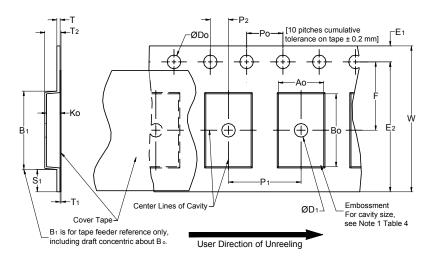


Table 6 – Embossed (Plastic) Carrier Tape Dimensions

	Constant Dimensions — Millimeters (Inches)									
Tape Size	D ₀	D ₁ Minimum Note 1	E ₁	P ₀	P ₂	R Reference Note 2	S ₁ Minimum Note 3	T Maximum	T ₁ Maximum	
8 mm		1.0 (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 ₁ Maximum Note 4	E ₂ Minimum	F	P ₁	T ₂ Maximum	W Maximum	A ₀ ,B ₀	. & K ₀	
8 mm	Single (4 mm)	4.35 (0.171)	6.25 (0.246)	3.5 ±0.05 (0.138 ±0.002)	4.0 ±0.10 (0.157 ±0.004)	2.5 (0.098)	8.3 (0.327)			
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)	Note 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 S₄ < 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_{α} , B_{α} and K_{α} 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

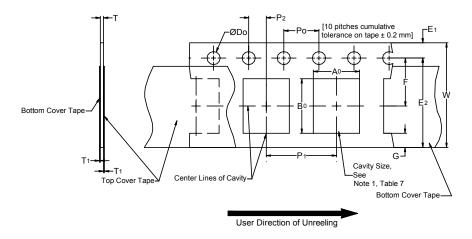


Table 7 – Punched (Paper) Carrier Tape Dimensions

	Constant Dimensions — Millimeters (Inches)									
Tape Size	D ₀	E ₁	P ₀	P ₂	T ₁ Maximum	G Minimum	R Reference Note 2			
8 mm	1.5 +0.10 -0.0 (0.059 +0.004 -0.0)	1.75 ±0.10 (0.069 ±0.004)	4.0 ±0.10 (0.157 ±0.004)	2.0 ±0.05 (0.079 ±0.002)	0.10 (0.004) Maximum	0.75 (0.030)	25 (0.984)			
	Variable Dimensions — Millimeters (Inches)									
Tape Size	Pitch	E2 Minimum	F	P ₁	T Maximum	W Maximum	A_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_n , B_n 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

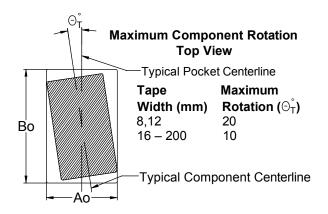
- 1. Cover Tape Break Force: 1.0 Kg minimum.
- 2. Cover Tape Peel Strength: The total peel strength of the cover tape from the carrier tape shall be:

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



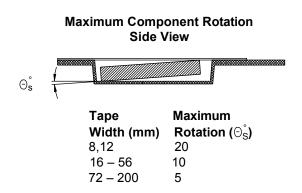


Figure 4 – Maximum Lateral Movement

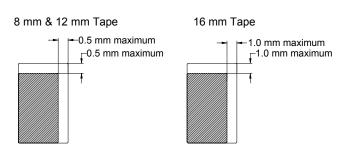


Figure 5 - Bending Radius

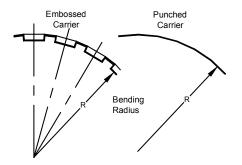
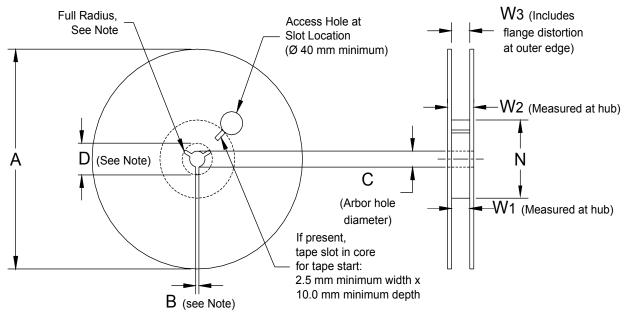




Figure 6 – Reel Dimensions



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

Table 8 - Reel Dimensions

	Constant Dimensions — Millimeters (Inches)							
Tape Size	A	B Minimum	С	D Minimum				
8 mm	178 ±0.20							
12 mm	(7.008 ±0.008)	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_1	W ₂ Maximum	W ₃				
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

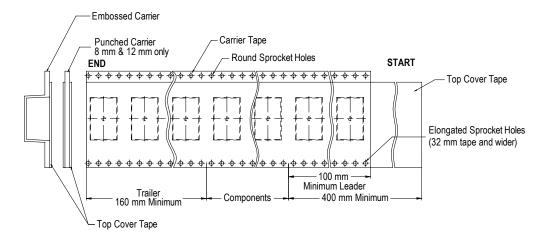
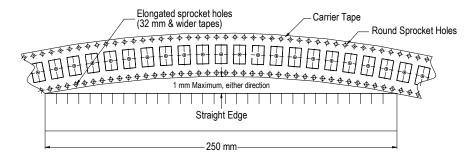


Figure 8 – Maximum Camber





Tape & Reel Packaging Information – KPS Devices

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.

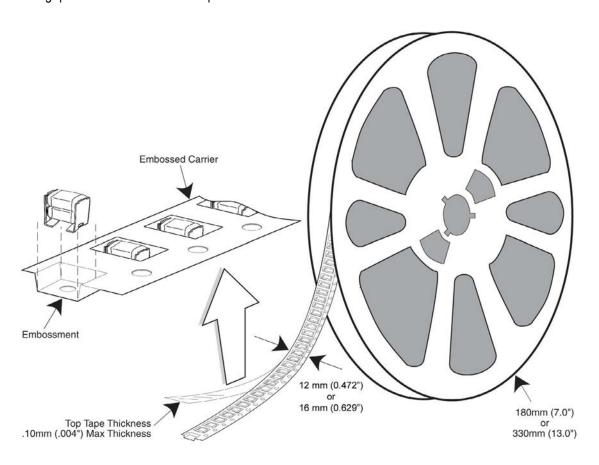


Table 5 – Carrier Tape Configuration – Embossed Plastic (mm)

EIA Case Size	Tape Size (W)*	Pitch (P ₁)*
01005 – 0402	8	2
0603 – 1210	8	4
1805 – 1808	12	4
≥ 1812	12	8
KPS 1210	12	8
KPS 1812 & 2220	16	12
Array 0508 & 0612	8	4

^{*}Refer to Figure 1 for W and P, carrier tape reference locations.

^{*}Refer to Table 5 for tolerance specifications.



Figure 1 – Embossed (Plastic) Carrier Tape Dimensions

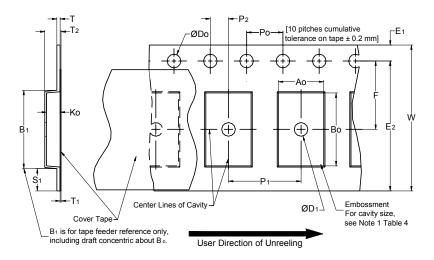


Table 6 – Embossed (Plastic) Carrier Tape Dimensions

	Constant Dimensions — Millimeters (Inches)									
Tape Size	D ₀	D ₁ Minimum Note 1	E ₁	P ₀	P ₂	R Reference Note 2	S ₁ Minimum Note 3	T Maximum	T ₁ Maximum	
8 mm		1.0 (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 ₁ Maximum Note 4	E ₂ Minimum	F	P ₁	T ₂ Maximum	W Maximum	A_0,B_0	& K ₀	
8 mm	Single (4 mm)	4.35 (0.171)	6.25 (0.246)	3.5 ±0.05 (0.138 ±0.002)	4.0 ±0.10 (0.157 ±0.004)	2.5 (0.098)	8.3 (0.327)			
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)	Note 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 5).
- 3. If S, < 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_0 , B_0 and K_0 shall surround the component with sufficient clearance that:
 - (a) the component does not protrude above the top surface of the carrier tape.
 - (b) the component can be removed from the cavity in a vertical direction without mechanical restriction, after the top cover tape has been removed.
 - (c) rotation of the component is limited to 20° maximum for 8 and 12 mm tapes and 10° maximum for 16 mm tapes (see Figure 2).
 - (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 3).
 - (e) for KPS Series product, A_a and B_a 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.



Packaging Information Performance Notes

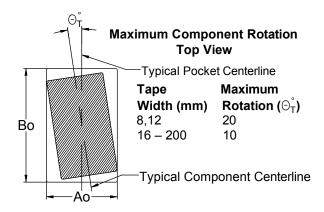
- 1. Cover Tape Break Force: 1.0 Kg minimum.
- 2. Cover Tape Peel Strength: The total peel strength of the cover tape from the carrier tape shall be:

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

The direction of the pull shall be opposite the direction of the carrier tape travel. The pull angle of the carrier tape shall be 165° to 180° from the plane of the carrier tape. During peeling, the carrier and/or cover tape shall be pulled at a velocity of 300 ± 10 mm/minute.

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

Figure 2 – Maximum Component Rotation



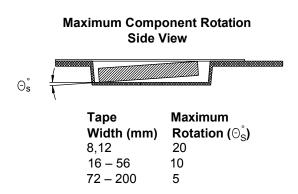


Figure 3 – Maximum Lateral Movement

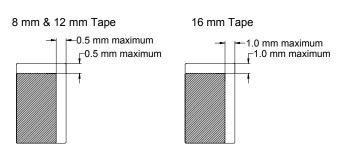


Figure 4 - Bending Radius

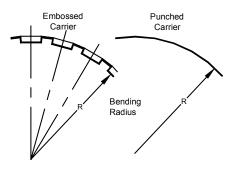
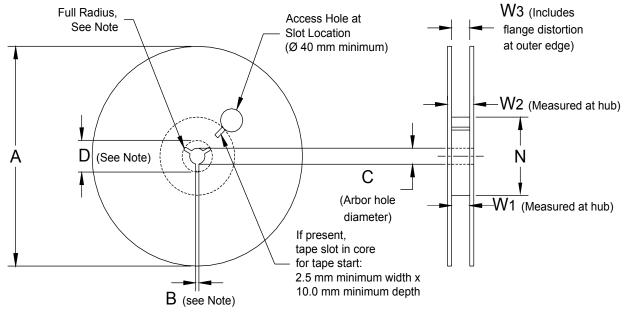




Figure 5 – Reel Dimensions



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

Table 7 - Reel Dimensions

	Constant Dimensions — Millimeters (Inches)								
Tape Size	A	B Minimum	С	D Minimum					
8 mm	178 ±0.20								
12 mm	(7.008 ±0.008)	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 ₁	W ₂ Maximum	W_3					
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 6 - Tape Leader & Trailer Dimensions

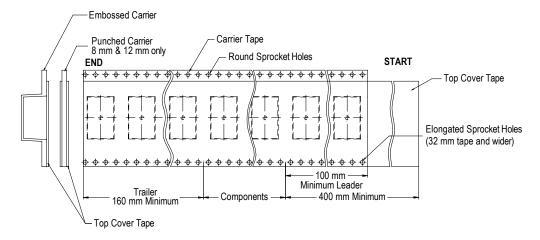
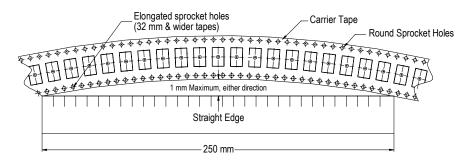


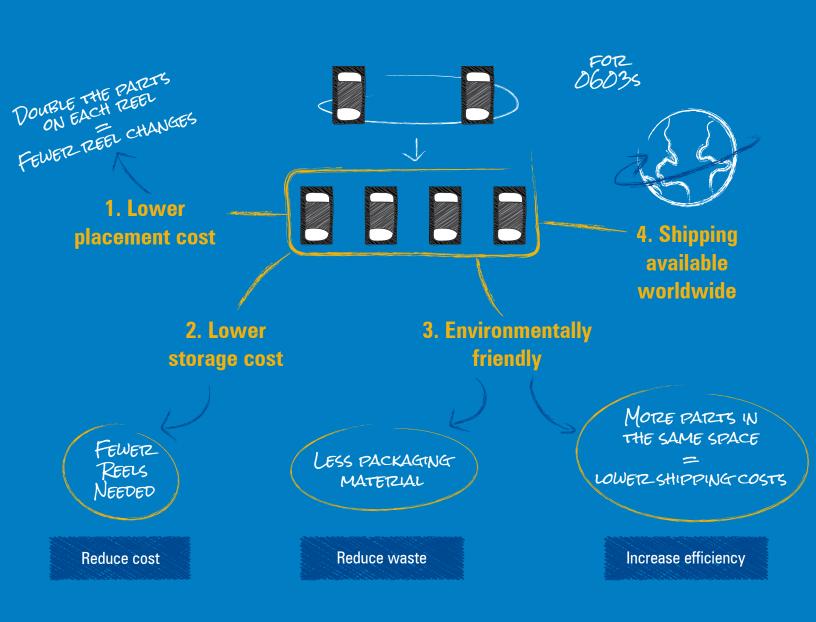
Figure 7 – Maximum Camber





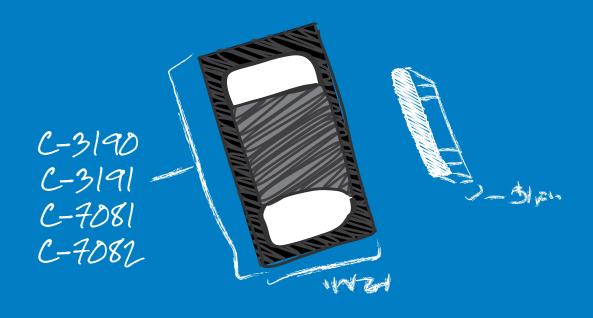


BENEFITS OF CHANGING FROM 4 MM TO 2 MM PITCH SPACING ON CERAMIC REELS





PART TYPE DESCRIPTION



C-3190 = Automotive grade 7" reel unmarked

C-3191 = Automotive grade 13" reel unmarked

C-7081 = Commercial grade 7" reel unmarked

C-7082 = Commercial grade 13" reel unmarked

Coming soon: 0805 EIA case size under development



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