Surface Mount Multilayer Ceramic Capacitors Commercial Grade



One world. One KEMET.





Table of Contents Page

Why Choose KEMET	4
------------------	---

Standard Products

C0G Dielectric, 10 – 200 VDC	6
X7R Dielectric, 6.3 – 250 VDC	
X5R Dielectric, 4 – 50 VDC	
Z5U Dielectric, 50 – 100 VDC	
Y5V Dielectric, 6.3 – 50 VDC	45
Capacitor Array, C0G Dielectric, 10 – 200 VDC	53
Capacitor Array, X7R Dielectric, 10 – 200 VDC	60
Commercial Off-the-Shelf (COTS) for Higher Reliability Applications, C0G Dielectric, 10 – 200 VDC	67
Commercial Off-the-Shelf (COTS) for Higher Reliability Applications, X7R Dielectric, 6.3 – 200 VDC	76
Telecom "Tip and Ring" X7R Dielectric, 250 VDC	

Flex Mitigation Solutions

Open Mode Design (FO-CAP), X7R Dielectric, 16 – 200 VDC	96
Floating Electrode Design (FE-CAP) X7R Dielectric, 6.3 – 250 VDC	105
Flexible Termination System (FT-CAP) C0G Dielectric, 10 – 200 VDC	114
Flexible Termination System (FT-CAP) X7R Dielectric, 6.3 – 250 VDC	123
High Voltage with Flexible Termination System (HV FT-CAP) X7R Dielectric, 500 – 3,000 VDC	133
Flexible Termination System (FT-CAP), Ultra-Stable X8R Dielectric, 25 – 100 VDC (Commercial & Automotive Grade)	143
Floating Electrode Design with Flexible Termination System (FF-CAP) X7R Dielectric, 6.3 – 250 VDC	151
KPS Series, X7R Dielectric, 10 – 250 VDC	160
KPS Series, High Voltage, X7R Dielectric, 500 – 630 VDC	171
KPS HT Series, High Temperature 150°C, X8L Dielectric, 10 VDC – 50 VDC	178

SnPb End Metallization

Commercial "L" Series, SnPb Termination, C0G Dielectric, 10 – 200 VDC	
Commercial "L" Series, SnPb Termination, X7R Dielectric, 6.3 – 250 VDC	195
Commercial Off-the-Shelf (COTS) for Higher Reliability Applications, C0G Dielectric, 10 – 200 VDC	205
Commercial Off-the-Shelf (COTS) for Higher Reliability Applications, X7R Dielectric, 6.3 – 200 VDC	214
High Temperature 150°C, Ultra Stable X8R Dielectric, 25 – 100 VDC	225
High Temperature 150°C, X8L Dielectric, 10 – 50 VDC	233
Telecom "Tip and Ring," X7R Dielectric, 250 VDC	242
Open Mode Design (FO-CAP), X7R Dielectric, 16 – 200 VDC	250
Floating Electrode Design (FE-CAP) X7R Dielectric, 6.3 – 250 VDC	259
Flexible Termination System (FT-CAP) X7R Dielectric, 6.3 – 250 VDC	
Floating Electrode Design with Flexible Termination System (FF-CAP) X7R Dielectric, 6.3 – 250 VDC	278



Bulk Capacitance Solutions (Stacked Capacitors)

KPS Series, X7R Dielectric, 10 – 250 VDC	287
KPS Series, High Voltage, X7R Dielectric, 500 – 630 VDC	298
KPS HT Series, High Temperature 150°C, X8L Dielectric, 10 VDC – 50 VDC	305
KEMET Power Solutions (KPS) MIL Series, Stacked Capacitors, 50 – 500 VDC	312

High Temperature

High Temperature 150°C, Ultra Stable X8R Dielectric, 25 – 100 VDC	335
High Temperature 150°C, X8L Dielectric, 10 – 50 VDC	343
High Temperature 200°C, C0G Dielectric, 10 – 200 VDC	352
Flexible Termination System (FT-CAP), Ultra-Stable X8R Dielectric, 25 - 100 VDC (Commercial & Automotive Grade)	361
KPS HT Series, High Temperature 150°C, X8L Dielectric, 10 VDC – 50 VDC	369
Pulse Detonation, High Voltage, High Temperature 200°C, C0G Dielectric, 500 – 2,000 VDC (Industrial Grade)	376

High Voltage

High Voltage C0G Dielectric, 500 – 3,000 VDC	383
High Voltage X7R Dielectric, 500 – 3,000 VDC	393
High Voltage with Flexible Termination System (HV FT-CAP), X7R Dielectric, 500 – 3,000 VDC	404
ArcShield™ Technology, High Voltage, X7R Dielectric, 500 – 1,000 VDC (Commercial & Automotive Grade)	414
KPS Series, High Voltage, X7R Dielectric, 500 – 630 VDC	423
KPS HV, Large Case, SM Series, C0G Dielectric, 500 – 10,000 VDC (Industrial Grade)	430
KPS HV, Large Case, SM Series, X7R Dielectric, 500 – 10,000 VDC (Industrial Grade)	440
Pulse Detonation, High Voltage, High Temperature 200°C, C0G Dielectric, 500 – 2,000 VDC (Industrial Grade)	451

Marking Information

Packaging Information	459
KPS Packaging Information	465
KEMET Corporation Sales Offices	470
Other KEMET Resources	471



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.



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
- RoHS 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, and 200 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, $\pm 1\%,$ $\pm 2\%,$ $\pm 5\%,$ $\pm 10\%,$ and $\pm 20\%$
- No piezoelectric noise
- Extremely low ESR and ESL
- · High thermal stability
- High ripple current capability

Ordering Information

 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% minimum)



С	1206	С	104	J	3	G	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series ¹	Capacitance Code (pF)	Capacitance Tolerance ²	Voltage	Dielectric	Failure Rate/ Design	Termination Finish ³	Packaging/Grade (C-Spec)⁴
	0201 0402 0603 0805 1206 1210 1808 1812 1825 2220 2225	C = Standard	2 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	Blank = Bulk TU = 7" Reel Unmarked

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.

⁴ 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
0201	0603	0.60 (.024) ± 0.03 (.001)	0.30 (.012) ± 0.03 (.001)		0.15 (.006) ± 0.05 (.002)	N/A	Soldor Boflow 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 Reliow 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 Thickness	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)	N/A	Calder Deflow Only
1825	4564	4.50 (.177) ± 0.30 (.012)	6.40 (.252) ± 0.40 (.016)	0.60 (.024) ± 0	0.60 (.024) ± 0.35 (.014)		Solder Reliow 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)		

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

RoHS Compliant.



Electrical Parameters/Characteristics

Item	Parameters/Characteristics		
Operating Temperature Range	-55°C to +125°C		
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±30 ppm/°C		
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	0.1%		
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 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

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			



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

	Can	Case Size / Series	C	:020	1C		(C04	020	0	1		(C06	03(C			(803	8050	C			(C12	060	;	
Capacitance	Cade	Voltage Code	8	4	3	8	4	3	5	1	2	8	4	3	5	1	2	8	4	3	5	1	2	8	4	3	5	1	2
-	Code	Rated Voltage (VDC)	Ę	9	25	9	16	25	50	<u></u>	200	ę	16	25	50	1 0	200	9	9	25	50	9	200	9	16	25	50	<u>ş</u>	200
		Capacitance Tolerance									Proc Se	uct e Ta	Avai ble 2	labil 2 for	ity a Chij	nd C 5 Thi	ckn	Thic ess l	kne Dime	ss C ensi	ode ons	s							
0.50 & 0.75 pF	508 & 758	BCD				BB	BB	BB	BB			CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC						
1.0 - 9.1 pF*	109 - 919*	BCD				BB	BB	BB	BB			CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
10 pF 11 nF	100	FGJK		AB	AB.	BB	BB	BB	BB			CB	CB	CB	CB	CB	CB							ED	ED	ED	EB	EB	ED
12 nF	120	FGJK				BB	BB	BB	BB			CB	CB	CB	CB	CB	CB				DC	DC		FR	FR	FB	FR	FB	FB
13 pF	130	FGJK	м			BB	BB	BB	BB			CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
15 pF	150	F G J K	M AE	² AB ²	AB ²	BB	BB	BB	BB			СВ	CB	СВ	СВ	CB	СВ	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
16 pF	160	F G J K	м			BB	BB	BB	BB			СВ	CB	CB	СВ	CB	СВ	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
18 pF	180	F G J K	M AE	² AB ²	AB ²	BB	BB	BB	BB			СВ	CB	CB	СВ	CB	СВ	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
20 pF	200	F G J K	м			BB	BB	BB	BB			СВ	CB	CB	СВ	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
22 pF	220	FGJK	M AE	² AB ²	AB ²	BB	BB	BB	BB			CB	CB	CB	CB	CB	CB	DE	DE	DE	DE	DC	DC	EB	EB	EB	EB	EB	EB
24 pF	240	FGJK	M	2 4 6 2		BB	BB	BB	BB			CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
27 pF	270	FGJK		AB	AB-	BB	BB	BB	BB			CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
30 pF 33 nF	300	FGJK		2 AB2		BB	BB	BB	BB			CB	CB	CB	CB	CB	CB							ED	EB	ED	ED	EB	EB
36 pF	360	F G J K	м		1.0	BB	BB	BB	BB			CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	FB	FB	FB	FB	FB	FB
39 pF	390	FGJK	M AE	² AB ²	AB ²	BB	BB	BB	BB			СВ	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
43 pF	430	F G J K	м			BB	BB	BB	BB			СВ	СВ	СВ	СВ	СВ	СВ	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
47 pF	470	F G J K	M AE	² AB ²	AB ²	BB	BB	BB	BB			СВ	CB	CB	СВ	CB	СВ	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
51 pF	510	F G J K	М			BB	BB	BB	BB			СВ	CB	CB	СВ	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
56 pF	560	FGJK	M AE	² AB ²	AB ²	BB	BB	BB	BB			CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
62 pF	620	FGJK	M			BB	BB	BB	BB			CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
68 pF	680 750	FGJK		AB	AB-	BB	BB	BB	BB			CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
75 pF 82 nF	750 820	FGJK		2 AB2		BB	BB	BB	BB			CB	CB	CB	CB	CB	CB							EB	EB	ED	EB	EB	EB
91 nF	910	F G J K	M		AD	BB	BB	BB	BB			CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	FR	FB	FB	FR	FB	FB
100 pF	101	FGJK		² AB ²	AB ²	BB	BB	BB	BB	BB	BB	СВ	CB	CB	CF	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
110 - 270 pF*	111 - 271*	FGJK	M			BB	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
300 pF	301	F G J K	М			BB	BB	BB	BB	BB	BD	СВ	CB	CB	СВ	CB	СВ	DC	DC	DC	DC	DC	DC	EΒ	EB	EB	EB	EB	EB
330 pF	331	F G J K	М			BB	BB	BB	BB	BB	BD	СВ	CB	CB	CF	CB	СВ	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
360 pF	361	FGJK	М			BB	BB	BB	BB	BB		CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
390 pF	391	FGJK	M			BB	BB	BB	BB	BB		CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
430 pF	431	FGJK				RR RR	BB	BB	BB	BB		CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
470 pr 510 pF	511	FGJK	M			BR	BB	BR	BR	BR		CB	CB	CB	CB	CB	CB							FR	FR	FR	ED FR	ED	ED
560 pF	561	FGJK	м			BB	BB	BB	BB	BB		CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
620 pF	621	FGJK	м			BB	BB	BB	BB	BB		CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
680 pF	681	F G J K	м			BB	BB	BB	BB	BB		СВ	CB	СВ	СВ	CB	СВ	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
750 pF	751	F G J K	м			BB	BB	BB	BB	BB		СВ	CB	CB	СВ	CB	СВ	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
820 pF	821	F G J K	м			BB	BB	BB	BB	BB		СВ	CB	CB	СВ	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
910 pF	911	FGJK	М			BB	BB	BB	BB	BB		СВ	CB	CB	CB	CB	CB	DC	DC	DC	DC	DD	DD	EB	EB	EB	EB	EB	EB
1,000 pF	102	FGJK	M			BB	BB	BB	BB	BB		CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DD	DD	EB	EB	EB	EB	EB	EB
1,100 pF	112	FGJK	M			BB	BB	BB	BB			CB	CB	CB	CB	CB	CH	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
1,200 pF	122	FGJK				BB	BB	BB	DD BB			CB	CB	CB	CB	CB	СН							EB	EB	EB	ED	EB	EB
1,500 pF	152	FGJK	M			BR	BB	BR	BR			CB	CB	CB	CB	CB	СН		סס	סט				FR	ED	ED	ED	ED	EC
1,600 pF	162	FGJK	м			BB	BB	BB				СВ	CB	CB	СВ	CB	СН	DD			DD	DD	DC	EB	EB	EB	EB	ED	ED
1,800 pF	182	FGJK	м			BB	BB	BB				СВ	CB	CB	CB	CB	СН	DD	DD	DD	DD	DD	DC	EB	EB	EB	EB	ED	ED
2,000 pF	202	F G J K	м			BB	BB	BB				СВ	CB	CB	СВ	CB	СН	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	ED	ED
2,200 pF	222	F G J K	М			BB	BB	BB				СВ	CB	CB	СВ	CB	СН	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EE	EE
2,400 pF	242	F G J K	M								-	СВ	CB	CB	CB	CB	-	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EC	EC
		Rated Voltage (VDC)	=	9	25	9	16	25	50	<u>6</u>	200	\$	16	25	50	<u>1</u> 0	200	9	16	25	50	6	200	\$	16	25	50	ģ	200
Capacitance	Cap Code	Voltage Code	8	4	3	8	4	3	5	1	2	8	4	3	5	1	2	8	4	3	5	1	2	8	4	3	5	1	2
		Case Size / Series		C020	1C			C04	02C					C06	03C					C08	305C					C12	06C		

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

	Con			Ca	ase Size / CO Series // CO	020)1	С			C0	4()2()				(C06	030	C				803	805	С				С	12(060	;							
Capacitance	Cap	Г		V	olta	age	Co	de			8	4		3	8	4	3	;	5	1	2	Τ	8	4	3	5	1	2	8	4	3	5	1	2	8	4	4	3	5	1	2
	Code		Ra	ated	J V	olta	age	(V	DC)	ę	16		25	10	16	35	3	50	100	200		9	16	25	50	10	200	ę	16	25	50	9	200	e	46	<u>e</u>	25	50	100	200
			(Ca T	pa ol(ici era	ta an	nc ce	e	-									Ρ	roc Se	duc e T	t / ak	Ava ble	ila 2 fe	bilit or C	ty a Chip	nd (Th	Chi ick	p Tł nes	nick s Di	nes me	s C nsi	ode	es							
2,700 pF	272	Ι			F	F	G	J	K	М												(СВ	СВ	CB	CB	CB		DC	DC	DC	DC	DC	DC	EB	E	BI	EB	EB	EC	EC
3,000 pF	302				F	F	G	J	K	М													CB	CB	CB	CB	CB		DD	DD	DD	DD	DC	DC	EC	E		EC	EC	EC	EB
3,300 pF	332						G	J	K	M													SB	CB	CB	CB	CB		סט				DC	DC	E			EC	EC	EE	EB
3,600 pF	302		P	T.				J	n k	IVI			T										שר	CB	CB	CB	CB												EC	EE	EB
3,900 pF	39Z 132								ĸ	M													D B	CB	CB	CB	CB												EC		ED
4,300 pF	472					F	G		ĸ	M													CB	CB	CB	CB	CB		DF	DE	DE	DF			FC			EC	FC.	FC	FB
5.100 pF	512					F	G .	j	ĸ	М													CB	CB	CB	CB			DE	DE	DE	DE	DC		ED		DI	ED	ED	ED	EB
5,600 pF	562				1	F	G	J	ĸ	М													СВ	CB	CB	CB			DC	DC	DC	DC	DC	DD	ED	E	DE	ED	ED	ED	EB
6,200 pF	622				F	F	G,	J	K	М												0	СВ	СВ	CB	CB			DC	DC	DC	DC	DC	DG	EB	E	B	EB	EB	EB	EB
6,800 pF	682				F	F	G,	J	ĸ	М													СВ	СВ	СВ	CB			DC	DC	DC	DC	DC	DG	EB	E	B	EB	EB	EB	EB
7,500 pF	752				F	F	G,	J	K	М													СВ	СВ	СВ				DC	DC	DC	DC	DC	DG	EB	E	B	EB	EB	EB	EB
8,200 pF	822				F	F	G,	J	K	М													СВ	СВ	CB				DC	DC	DC	DC	DC	DG	EC	: E	C E	EC	EC	EB	EC
9,100 pF	912				F	F	G,	J	K	М												(СВ	СВ	CB				DC	DC	DC	DC	DC		EC	E	C	EC	EC	EB	EC
10,000 pF	103				F	F	G	J	K	М												0	СВ	СВ	CB				DC	DC	DC	DC	DD		ED	E	D	ED	ED	EB	EC
12,000 pF	123				F	F	G ,	l	K	М													СВ	СВ	CB				DC	DC	DC	DC	DE		EB	E	B	EB	EB	EB	ED
15,000 pF	153				F	El	G	J	K	М													СВ	СВ	CB				DC	DC	DC	DD	DG		EB	E	B	EB	EB	EB	EF
18,000 pF	183				F	Εľ	G	J	K	М																			DC	DC	DC	DD			E	E	B	EB	EB	EB	EH
22,000 pF	223		ł.	÷		-	G	J	K	M			4	_					_			ł.	_						DD	DD	DD	DF			LEB	E	BI	EB	EB	EC	EH
27,000 pF	273				ľ		G	1	K	M																			DF	DF	DF					E	BI	EB	EB	EE	
33,000 pF	333							J	ĸ	M																			DG	DG	DG						BI	EB	EB	EE	
39,000 pF	393							1	n v	IVI M																				DG	DG				EC					EH	
47,000 pF	475							1	n k	IVI M																			DG	DG	DG									ЕП	
68,000 pF	683		T	T		F		1	r K	M			T									T																	EF		
82 000 pF	823					F	G		ĸ	M																											н Г	EH	FH		
0.10 µF	104					F	G	j	ĸ	M																									EH	ΙE	н	EH			
			Ra	ateo	1 V	olta	age	(V	DC)	ę	16		25	9	16	35	3	50	100	200		ę	16	25	50	1 0	200	ę	16	25	50	6	200	<u></u>	4	2	22	50	100	200
Capacitance	Cap			V	olta	age	Co	de			8	4		3	8	4	3	;	5	1	2	T	8	4	3	5	1	2	8	4	3	5	1	2	8	4	4	3	5	1	2
	Coue	C	a	se	Si	ze) :	Se	rie	es	С	020)1(С			CO	940)2C	;				(C06	030	;				COS	805	C		T		С	120	06C	;	

*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

 $xx^{\mathtt{2}}$ 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)

		Case Size / Series			C12 ⁻	10C			C	1808	C	С	1812	С	С	1825	SC	C	2220	C	C	2225	C
Capacitance	Сар	Voltage Code	8	4	3	5	1	2	5	1	2	5	1	2	5	1	2	5	1	2	5	1	2
	Code	Rated Voltage (VDC	\$	16	25	50	9	200	50	100	200	20	100	200	50	j 6	200	50	100	200	50	9	200
		Capacitance Tolerance							Prod Se	luct A e Tab	vailal le 2 fo	bility a br Chi	and C p Thio	hip Tl knes	nickno s Dim	ess Co Iensio	odes						
0.5 & 0.75 pF	508 & 758	BCD																					
1.0 - 9.1 pF*	109 - 919*	BCDECIK		FB	FB	FB	FB	FB															
100 - 300 pF*	100 - 310	F G J K	M FB	FB	FB	FB	FB	FB															
330 - 430 pF*	331 - 431*	F G J K	M FB	FB	FB	FB	FB	FB	LF	LF	LF												
470 - 910 pF*	471 - 911*	F G J K	M FB	FB	FB	FB	FB	FB	LF	LF	LF	GB	GB	GB									
1,000 pF	102	F G J K	M FB	FB	FB	FB	FB	FB	LF	LF	LF	GB	GB	GB									
1,100 pF	112	F G J K	M FB	FB	FB	FB	FB	FB	LF	LF	LF	GB	GB	GB									
1,200 pF	122	FGJK		FB	FB	FB	FB	FB				GB	GB	GB									
1,300 pF	152	FGJK		FB	FB	FB	FB	FE	LF	LF	LF	GB	GB	GB									
1,600 pF	162	FGJK	M FB	FB	FB	FB	FB	FE	LF	LF	LF	GB	GB	GB									
1,800 pF	182	F G J K	M FB	FB	FB	FB	FB	FE	LF	LF	LF	GB	GB	GB									
2,000 pF	202	F G J K	M FB	FB	FB	FB	FC	FE	LF	LF	LF	GB	GB	GB									
2,200 pF	222	F G J K	M FB	FB	FB	FB	FC	FG	LF	LF	LF	GB	GB	GB									
2,400 pF	242	F G J K	M FB	FB	FB	FB	FC	FC	LF	LF	LF												
2,700 pF	272	FGJK		FB	FB	FB	FC	FC			LF	GB	GB	GB									
3,000 pF	302	FGJK		FB	FB	FB	FC	FF				GB	GB	GB									
3 600 pF	362	FGJK	M FB	FB	FB	FB	FF	FF	IF	IF		00	00	00									
3,900 pF	392	F G J K	M FB	FB	FB	FB	FF	FF	LF	LF		GB	GB	GB	HB	HB	HB						
4,300 pF	432	F G J K	M FB	FB	FB	FB	FF	FF	LF	LF													
4,700 pF	472	F G J K	M FF	FF	FF	FF	FG	FG	LF	LF		GB	GB	GD	HB	HB	HB				KE	KE	KE
5,100 pF	512	F G J K	M FB	FB	FB	FB	FG	FG						~							KE	KE	KE
5,600 pF	562	FGJK		FB	FB	FB	FG	FG				GB	GB	GH	НВ	НВ	HB				KE	KE	KE
6,200 pF	682	FGJK		FB	FB	FB	FG	FB				GB	GB	GI	нв	нв	нв	IE	IE	IB	KE	KE	KE
7 500 pF	752	F G J K	M FC	FC	FC	FC	FC	FB				00	GD	GJ				JL	JL	10	KE	KE	KE
8,200 pF	822	F G J K	M FC	FC	FC	FC	FC	FB				GB	GH	GB	НВ	НВ	HB	JE	JE	JB	KE	KE	KE
9,100 pF	912	F G J K	M FE	FE	FE	FE	FE	FB													KE	KE	KE
10,000 pF	103	F G J K	M FF	FF	FF	FF	FF	FB				GB	GH	GB	HB	HB	HE	JE	JE	JB	KE	KE	KE
12,000 pF	123	FGJK	M FG	FG	FG	FG	FB	FB				GB	GG	GB	HB	HB	HE	JE	JE	JB	KE	KE	KE
15,000 pF	153	FGJK	MFG	FG	FG	FG	FB	FC				GB	GB	GB	HB	HB		JE	JE	JB	KE	KE	KE
18,000 pF	183	FGJK		FB	FB FB	FB	FB	FC				GB	GB	GB	НВ	HE		JE	JE	JB	KE	KE	
27,000 pF	273	F G J K	M FB	FB	FB	FB	FB	FG				GB	GB	GB	HB	HG		JE	JB	JB	KE	KE	
33.000 pF	333	F G J K	M FB	FB	FB	FB	FB	FH				GB	GB	GB				JB	JB	JB	KE		
39,000 pF	393	F G J K	M FB	FB	FB	FB	FE	FH				GB	GB	GB				JB	JB	JB			
47,000 pF	473	F G J K	M FB	FB	FB	FB	FE	FJ				GB	GB	GD				JB	JB	JB			
56,000 pF	563	FGJK	M FB	FB	FB	FB	FF					GB	GB	GD				JB	JB	JB			
68,000 pF	683	FGJK	M FB	FB	FB	FC	FG					GB	GB	GK				JB	JB	JB			
82,000 pF	823	FGJK		FC	FC	FF	FH					GB	GB	GM				JB	JB	JB			
0.10 µF	104	F G J K		FG	FG	FU	FIVI					GB	GH	Givi				JB	JD 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	М															JB	JF				
0.33 µF	334	F G J K	М															JD	JG				
0.39 µF	394	FGJK	M															JG				_	
υ.4/ μΓ	4/4			, vo	2		9	0		9	0		0	9			0	10	- 0	9			
		Rated voltage (VDC			ñ	ŭ,	2	50	č,	9	20	<u>ت</u>	9	20	- 10	9 9	20	5	9	20	č,	9 ,	20
Capacitance	Cap Code	Voltage Code	8	4	3	5	1	2	5	1	2	5	1	2	5	1	2	5	1	2	5	1	2
		Case Size / Series			C12	10C			C	;1808	C	10	;1812(3	(21825	C	C	2220	C	l C	22250	3

*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 2 – Chip Thickness/Packaging Quantities

Thickness	Case	Thickness ±	Paper C	Quantity	Plastic	Quantity
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
AB BB BD CB CF	0201 0402 0402 0603 0603	$\begin{array}{c} 0.30 \pm 0.03 \\ 0.50 \pm 0.05 \\ 0.55 \pm 0.05 \\ 0.80 \pm 0.07 \\ 0.80 \pm 0.07 \end{array}$	15,000 10,000 10,000 4,000 4,000	0 50,000 50,000 10,000 15,000	0 0 0 0	0 0 0 0
CH DE DC DD DF	0603 0805 0805 0805 0805 0805	$\begin{array}{c} 0.85 \pm 0.07 \\ 0.70 \pm 0.20 \\ 0.78 \pm 0.10 \\ 0.90 \pm 0.10 \\ 1.10 \pm 0.10 \end{array}$	4,000 4,000 4,000 4,000 0	10,000 10,000 10,000 10,000 0	0 0 0 0 2,500	0 0 0 0 10,000
DG EB EC ED EE	0805 1206 1206 1206 1206	$\begin{array}{c} 1.25 \pm 0.15 \\ 0.78 \pm 0.10 \\ 0.90 \pm 0.10 \\ 1.00 \pm 0.10 \\ 1.10 \pm 0.10 \end{array}$	0 4,000 0 0 0	0 10,000 0 0 0	2,500 4,000 4,000 2,500 2,500	10,000 10,000 10,000 10,000 10,000
EF EH FB FC FE	1206 1206 1210 1210 1210	$\begin{array}{c} 1.20 \pm 0.15 \\ 1.60 \pm 0.20 \\ 0.78 \pm 0.10 \\ 0.90 \pm 0.10 \\ 1.00 \pm 0.10 \end{array}$	0 0 0 0	0 0 0 0	2,500 2,000 4,000 4,000 2,500	10,000 8,000 10,000 10,000 10,000
FF FG FH FM FJ	1210 1210 1210 1210 1210 1210	$\begin{array}{c} 1.10 \pm 0.10 \\ 1.25 \pm 0.15 \\ 1.55 \pm 0.15 \\ 1.70 \pm 0.20 \\ 1.85 \pm 0.20 \end{array}$	0 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 8,000
FK NC LF GB GD	1210 1706 1808 1812 1812	$\begin{array}{c} 2.10 \pm 0.20 \\ 1.00 \pm 0.15 \\ 1.00 \pm 0.15 \\ 1.00 \pm 0.10 \\ 1.25 \pm 0.15 \end{array}$	0 0 0 0 0	0 0 0 0 0	2,000 4,000 2,500 1,000 1,000	8,000 10,000 10,000 4,000 4,000
GH GG GK GJ GN	1812 1812 1812 1812 1812 1812	$\begin{array}{c} 1.40 \pm 0.15 \\ 1.55 \pm 0.10 \\ 1.60 \pm 0.20 \\ 1.70 \pm 0.15 \\ 1.70 \pm 0.20 \end{array}$	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
GM HB HE HG JB	1812 1825 1825 1825 2220	$\begin{array}{c} 2.00 \pm 0.20 \\ 1.10 \pm 0.15 \\ 1.40 \pm 0.15 \\ 1.60 \pm 0.20 \\ 1.00 \pm 0.15 \end{array}$	0 0 0 0	0 0 0 0	500 1,000 1,000 1,000 1,000	2,000 4,000 4,000 4,000 4,000
JD JE JG JL	2220 2220 2220 2220 2220 2220	$\begin{array}{c} 1.30 \pm 0.15 \\ 1.40 \pm 0.15 \\ 1.50 \pm 0.15 \\ 1.70 \pm 0.15 \\ 2.00 \pm 0.20 \end{array}$	0 0 0 0	0 0 0 0	1,000 1,000 1,000 1,000 500	4,000 4,000 4,000 4,000 2,000
KE	2225	1.40 ± 0.15		0 12" Bool	1,000	4,000
Thickness Code	Case Size	Thickness ± Range (mm)	Paper G	Quantity	Plastic	Quantity

Package quantity based on finished chip thickness specifications.



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

EIA Size	Metric Size		Dens Maxi Land P	sity Lev imum (I rotrusio	vel A: Most) on (mm)		Dens Media Land P	sity Lev an (Nor rotrusio	vel B: ninal) on (mm)		Dens Minii Land Pi	sity Lev mum (L rotrusio	vel C: .east) on (mm)
ooue	ooue	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	X	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
1210 ¹	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 $\geq 22 \,\mu\text{F}$

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).



Soldering Process

Recommended Soldering Technique:

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

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020

Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 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:
Saldarability		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 +/- 2 hours after test conclusion.
Biased Humidity		Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
	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.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
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

Reference	lte	em	Material
A		Finish	100% Matte Sn
В	Termination System	Barrier Layer	Ni
С	-,	Base Metal	Cu
D	Inner El	lectrode	Ni
E	Dielectric	c Material	CaZrO ₃



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



Overview

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

Benefits

- -55°C to +125°C operating temperature range
- Pb-Free and RoHS Compliant
- Temperature stable dielectric

Ordering Information

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

Applications

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



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

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

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

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

Dimensions – Millimeters (Inches)





Electrodes / Conductive Metalization

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 ¹	3225	3.20 (.126) ±0.20 (.008)	2.50 (.098) ±0.20 (.008)	3) See Table 2	0.50 (0.02) ±0.25 (.010)		
1808	4520	4.70 (.185) ±0.50 (.020)	2.00 (.079) ±0.20 (.008)	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	Calder Deflaw Only
1825	4564	4.50 (.177) ±0.30 (.012)	6.40 (.252) ±0.40 (.016)		0.60 (.024) ±0.35 (.014)		Solder Reflow Uniy
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 \geq 12 μ F 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

Pb-Free and RoHS Compliant.





Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +125°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 second and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit @ 25°C	See Dissipation Factor (DF) Limits Table
Insulation Resistance (IR) Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ±5 seconds @ 25°C)

Regarding aging rate: Capacitance measurements (including tolerance) are indexed to a referee time of 48 or 1,000 hours. Please refer to a part number specific datasheet for referee time details.

To obtain IR limit, divide $M\Omega$ - μ F value by the capacitance and compare to G Ω 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 μ F

120 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."

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	< 0.047 µF	≥ 0.047 µF
1206	< 0.22 µF	≥ 0.22 µF
1210	< 0.39 µF	≥ 0.39 µF
1808	ALL	N/A
1812	< 2.2 µF	≥ 2.2 µF
1825	ALL	N/A
2220	< 10 µF	≥ 10 µF
2225	ALL	N/A



Dissipation Factor (DF) Limits Table

EIA Case Size	Rated DC Voltage	Capacitance	Dissipation Factor
	< 16		5.0%
0402	16/25	All	3.5%
	> 25		2.5%
	< 16		5.0%
	16/25	< 1.0 uF	3.5%
0603	> 25		2.5%
	< 16	>10 ⊏	10.00/
	16/25	≥ 1.0 UF	10.0%
	< 16	< 0.0 ···F	5.0%
	16/25	≥ 2.2 µr	3.5%
0005	> 25	< 1.0 µF	2.5%
0005	< 16	<u>>))</u>	
	16/25	> 2.2 µr	10.0%
	> 25	≥ 1.0 µF	
	< 16		5.0%
	16/25	< 10 µF	3.5%
1206	> 25		2.5%
	< 16	> 10 ∪F	10.00/
	16/25	≥ 10 µr	10.0%
	< 16		5.0%
	16/25	< 22 µF	3.5%
1210	> 25		2.5%
	< 16	> 22 uE	10.0%
	16/25	<i>22</i> μΓ	10.0%
	< 16		5.0%
1812 – 2225	16/25	All	3.5%
	> 25		2.5%

Post Environmental Limits

	High Tempe	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 uF	5.0		
	0603	> 25		3.0		
		< 16	> 1 0 uE	20.0		
		16/25	≥ 1.0 uF	20.0		
		< 16	< 2 2 JE	7.5		
		16/25	≤ 2.2 μr	5.0		
	0905	> 25	< 1.0 µF	3.0		
	0005	< 16	> 2 2 uE			
		16/25	> 2.2 μr	20.0		
X7R		> 25	≥ 1.0 µF		±20%	10% of Initial Limit
		< 16		7.5		
		16/25	< 10 µF	5.0		
	1206	> 25		3.0		
		< 16	> 10 UE	20.0		
		16/25	≥ 10 µr	20.0		
		< 16		7.5		
		16/25	< 22 µF	5.0		
	1210	> 25		3.0		
		< 16	> 00 ∪F	20.0		
		16/25	≥ 22 μF	20.0		
		< 16		7.5		
	1808 – 2225	16/25	All	5.0		
		> 25		3.0		



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

		Cal S	o Si erie	ze / es		C)40	2C				C)60	3C						C	080	5C							C	120	6C			
Сар	Cap	Volt	age C	Code	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	A
	Code	Rate	d Vol (VDC	ltage)	6.3	9	16	25	50	6.3	10	16	25	50	100	200	6.3	9	16	25	35	50	10	200	250	6.3	9	16	25	35	50	10	200	250
		Cap	Toler	ance					Pro	duct	Ava	ilab	ility	and	Chip	Thio	kne	ss C	ode	s – S	ee T	able	2 fo	r Ch	ip T	nickı	ness	Dim	ensi	ions				
10 - 91 pF* 100 - 150 pF** 180 - 820 pF** 1000pF	100 - 910* 101 - 151** 181 - 821** 102	J J J	K K K	M M M	BB BB BB	BB BB BB	BB BB BB	BB BB BB	BB BB BB	CB CB CB CB	CB CB CB CB	CB CB CB CB	CB CB CB CB	CB CB CB CF	CB CB CB CB	CB CB CB CF	DC DC DC DC	DC DC	EB EB EB	EB EB EB EB	EB EB EB EB	EB EB EB EB	EB EB EB EB	EB EB EB	EB EB EB	EB EB EB	EB							
1200 pF 1500 pF	122	J	K	M	BB	BB	BB	BB	BB	CB	CB CB	CB	CB	CB	CB	CB	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	EB							
1800 pF	182	J	К	М	BB	BB	BB	BB	BB	CB	СВ	CB	CB	CB	CB	CB	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	EB							
2200 pF 2700 pF	222 272	J	K	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CF	CB	CB	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	EB							
3300 pF	332	J	К	М	BB	BB	BB	BB	BB	СВ	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	EB													
3900 pF 4700 pF	392 472	J	K	M	BB	BB	BB	BB	BB	CB	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	EB													
5600 pF	562	J	K	M	BB	BB	BB	BB	BB	CB	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	EB													
6800 pF	682	J	K	M	BB	BB	BB	BB	BB	CB	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	EB													
8200 pF 10000 pF	103	J	ĸ	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CF	CB	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	EB							
12000 pF	123	J	К	М	BB	BB	BB	BB	BB	СВ	СВ	СВ	СВ	СВ	СВ		DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	EB							
15000 pF 18000 pF	153 183	J	K	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB											EB	EB	EB	EB FB	EB	EB	EB	EB FB	EB
22000 pF	223	J	ĸ	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CF	CF		DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	EB							
27000 pF	273	J	K	M	BB	BB	BB	BB		CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DD	DE		EB	EB	EB	EB	EB	EB	EB	EB	EB
39000 pF	393	J	K	M	BB	BB	BB	BB		СВ	СВ	СВ	CF	СВ	СВ		DC	DC	DC	DC	DC	DC	DD	DE		EB	EB	EB	EB	EB	EB	EC	EB	EB
47000 pF	473	J	К	М	BB	BB	BB	BB		СВ	СВ	СВ	СВ	CF	CB		DC	DC	DC	DC	DC	DC	DE	DG		EB	EB	EB	EB	EB	EB	EC	ED	ED
56000 pF 68000 pF	563 683	J	K	M	BB	BB	BB			CB	CB	CB	CB	CB			DD	DD	DD	DD	DD	DD	DE	DG		EB	EB	EB	EB	EB FB	EB	EB	ED FD	ED FD
82000 pF	823	J	ĸ	M	BB	BB	BB			CB	CB	CB	CB	CB			DD	DD	DD	DD	DD	DD	DE			EB	EB	EB	EB	EB	EB	EB	ED	ED
0.1 µF	104	J	K	M	BB	BB	BB			CB	CB	CF	CB	CF			DC	DC	DC	DC	DC	DC	DE			EB	EB	EB	EB	EB	EB	EB	EM	EM
0.12 µF 0.15 µF	124	J	K	M						СВ	CB	CB	CB	CB			DC	DC	DC	DC	DD	DD	DG			EC	EC	EC	EC	EC	EC	EC	EG	
0.18 µF	184	J	K	M						CB	CB	CB	CB				DC	DC	DC	DC	DG	DG	DG			EC	EC	EC	EC	EC	EC	EC		
0.22 µF 0.27 µF	224 274	J	K	M						CB	CB	CB	CB				DC	DC		DC	DG	DG	DG			EC FB	EC FB	EC	EC	EC EC	EC	EC		
0.33 µF	334	J	ĸ	M						CB	CB	CB					DG	DG	DG	DG	DD	DD				EB	EB	EB	EB	EC	EC	EG		
0.39 µF	394	J	K	M						CB	CB	CB					DG	DG	DG	DG	DE	DE				EB	EB	EB	EB	EC	EC	EG		
0.47 µF 0.56 µF	564	J	K	M						СВ	СБ	СБ					DD	DD	DD	DG	DH	DH				ED	ED	ED	ED	EC	EC	EG		
0.68 µF	684	J	K	M													DD	DD	DD	DG	DH	DH				EE	EE	EE	EE	ED	ED			
0.82 µ⊦ 1 µF	824 105	J	K	M						CC1	CC1	CC1	CD1					DD		DG	DG ¹	DG ¹				EF	EF	EF	EG	ED	ED			
1.2 µF	125	J	K	М													DE	DE	DE							ED	ED	ED	EG	EH	EH			
1.5 µF	155 185	J	K	M													DG	DG	DG							ED	ED	ED	EG	EH	EH			
2.2 µF	225	J	K	M													DG	DG	DG							ED	ED	ED	EF	EH	EH			
2.7 µF	275	J	K	M																						EN	EN	EN	EH					
3.3 µF 3.9 µF	335	J	K	M																						EF	EF	EF	EH					
4.7 µF	475	J	К	М													DG1	DG1	DG1							EF	EF	EF	EH					
5.6 µF	565 685	J	K	M																						EH	EH	EH						
8.2 µF	825	J	K	M																						EH	EH	EH						
10 μF 22 μF	106 226	J	K	M													DG1	DG ¹								EH FH ²	EH FH ²	EH	EH1					
p.		Rate	d Vol (VDC	ltage)	6.3	9	16	25	50	6.3	10	16	25	50	100	200	6.3	6	16	25	35	50	100	200	250	6.3	ę	16	25	35	50	100	200	250
Сар	Cap Code	Volt	age C	Code	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	A
		Case Size / Series C0402C					С	0603	SC						С	080	5C							С	1206	iC								

*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) xx¹ Available only in K, M tolerance.

xx² Available only in M tolerance.



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

0	Сар	(s s	Cas Size Serie	e / es		•		C12	100	;			C	1808	BC		C	1812	2C			C18	250	;		C	222(OC		(C22	250	;
Сар	Code	Volt	age (Code	9	8	4	3	5	1	2	A	5	1	2	3	5	1	2	A	5	1	2	A	3	5	1	2	A	5	1	2	Α
		Rate	(VDC	itage ;)	6.3	9	16	25	50	5	200	250	50	100	200	25	50	100	200	250	20	100	200	250	25	50	10	200	250	50	é	200	250
		Cap	Toler	rance					Pro	duct	Ava	ilabi	lity a	nd C	hip 1	hick	nes	s Co	des -	- See	Tab	le 2 f	or C	hip T	hick	ness	Dim	ensi	ons				
10 - 91 pF*	100 - 910*	J	K	M	FB	FB	FB	FB	FB	FB	FB																						
100 - 270 pF**	101 - 271**	J	K	M	FB	FB	FB	FB	FB	FB	FB																						
330 pF	331	J	K	M	FB	FB	FB	FB	FB	FB	FB																						
390 pr 470 - 1 200 pF**	471 - 122**	J	ĸ	M	FR	FB	FR	FB	FR	FR	FB			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	к	м	FB	FB	FB	FB	FB	FB	FB	FB	LF	LF	LF	GB	GB	GB	GB														
2,700 pF	272	J	К	M	FB	FB	FB	FB	FB	FB	FB	FB	LF	LF	LF	GB	GB	GB	GB														
3,300 pF	332	J	K	М	FB	FB	FB	FB	FB	FB	FB	FB	LF	LF		GB	GB	GB	GB														
3,900 pF	392	J	K	М	FB	FB	FB	FB	FB	FB	FB	FB	LF	LF		GB	GB	GB	GB		HB	HB	HB										
4,700 pF	472	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	LD	GB	GB	GB	GD		HB	HB	HB							KE	KE	KE	
5,600 pF	562	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	LD	GB	GB	GB	GH	0.0	HB	HB	HB							KE	KE	KE	
6,800 pF	682	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB		LD	LD	GB	GB	GB	GB	GB	HB	HB	HB		JE	JE	JE			KE	KE	KE	
8,200 pF	822	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB		LD		GB	GB	GB	GB	GB	НВ	HB	НВ		JE	JE	JE			KE	KE	KE	
12,000 pF	103	J	K	M	FR	FR	FB	FR	FR	FR	FR	FB				GB	GB	GB	GB	GB	ПВ	нв	HE		JE	JE	JE			KE	KE	KE	
15,000 pF	153		ĸ	M	FB	FR	FB	FB	FR	FB	FB	FB				GB	GB	GB	GB	GB	HB	HB			JE	JE	JE			KE	KE	KE	
18,000 pF	183	J	ĸ	M	FB	FB	FB	FB	FB	FB	FB	FB				GB	GB	GB	GB	GB	НВ	HF			JE	JE	JE			KF	KE		
22,000 pF	223	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD		GB	GB	GB	GB	GB	HB	HB	НВ	НВ	JE	JE	JE			KE	KE		
27,000 pF	273	J	K	М	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD		GB	GB	GB	GB	GB	HB	HB	HB	HB	JE	JE	JE			KE	KE		
33,000 pF	333	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD		GB	GB	GB	GB	GB	HB	HB	HB	HB	JB	JB	JB			KE			
39,000 pF	393	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD		GB	GB	GB	GB	GB	HB	HB	HB	HB	JB	JB	JB						
47,000 pF	473	J	K	M	FB	FB	FB	FB	FB	FB	FC	FC	LD	LD		GB	GB	GB	GB	GB	HB	HB	HB	HB	JB	JB	JB						
56,000 pF	563	J	K	М	FB	FB	FB	FB	FB	FB	FC	FC	LD	LD		GB	GB	GB	GB	GB	HB	HB	HB	HB	JB	JB	JB						
68,000 pF	683	J	K	M	FB	FB	FB	FB	FB	FB	FC	FC	LD			GB	GB	GB	GB	GB	HB	HB	HB	HB	JB	JB	JB						
82,000 pF	823	J	K	M	FB	FB	FB	FB	FB	FC	FF	FF	LD			GB	GB	GB	GB	GB	HB	HB	HB	HB	JC	JC	JC	JC	JC				
0.10 µF	104	J	K	M	FB	FB	FB	FB	FB	FD	FG	FG				GB	GB	GB	GB	GB	НВ	HB	HB	HB	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.12 µF	124	J	K	M	FB	FB	FB	FB	FB	FD						GB	GB	GB	GB	GB	НВ	HB	НВ	НВ	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.15 µF	104	J	ĸ	M	FC	FC	FC	FC	FC	FD						GB	GB	GB	GE	GE	пв	пв	пв	пв	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.10 µl	224	J	K	M	FC	FC	FC	FC	FC	FD						GB	GB	GB	GG	GG	HR	HR	HR	HR		10	10	JC	JC	KC	KC	KC	KC
0.27 µF	274	J	ĸ	M	FC	FC	FC	FC	FC	FD						GB	GB	GG	GG	GG	HB	HB	HB	HB	JC	JC	JC	JC	JC	KB	KC	KC	KC
0.33 µF	334	J	K	M	FD	FD	FD	FD	FD	FD						GB	GB	GG	GG	GG	HB	HB	HB	HB	JC	JC	JC	JC	JC	KB	KC	KC	KC
0.39 µF	394	J	К	М	FD	FD	FD	FD	FD	FD						GB	GB	GG	GG	GG	ΗВ	HB	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	ΗВ	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			ΗВ	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			ΗВ	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			HB	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			HB	HF	HF	HF	JC	JC	JF	JF	JF	KB	KD	KE	KE
1.2 µF	125	J	K	M	FH	FH	FH	FH	FG												HB				JC	JC				KB	KE	KE	KE
1.5 µF	155	J	ĸ	M	FH	FH	FH	FH	FG												HD				JC	JC				KC.			
1.0 µi	100	Rate	ed Vo	Itage			9	5	0	2	8	20		0	8	5	•	0	8	02		0	8	20	5	0	0	8	02	0	2	8	20
			(VDC	;)	ف	- -	- -	7	5	¥	5	5	2	¥	2(2	¥	5	5	2	¥	2	5	7	5	¥	2	5	5	¥	5	5
Сар	Cap Code	Volt	age (Code	9	8	4	3	5	1	2	Α	5	1	2	3	5	1	2	A	5	1	2	Α	3	5	1	2	Α	5	1	2	Α
		Ca	se Si Serie	ize / s				C12	3 5 1 2 A 5 1 C1210C C180				1808	с		C	1812	C			C18	25C			C	2220	C			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)

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

	Cap		Cas Size Serie	e e / es				C12	100	;			C,	180	BC		C	1812	2 C			C18	250)		C	2220	OC		(C22	250	•
Сар	Code	Vol	tage	Code	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
		Rat	ed Vo (VDC	ltage ;)	6.3	10	16	25	50	100	200	250	50	100	200	25	50	100	200	250	50	100	200	250	25	50	100	200	250	50	100	200	250
		Cap	Tole	rance					Pro	duct	Ava	ilabi	lity a	nd C	hip 1	Thick	nes	s Coo	des -	- See	Tab	le 2 f	or C	hip T	Thick	ness	Dim	ensi	ons				
2.2 µF	225	J	K	М	FJ	FJ	FJ	FJ	FG	FT ¹						GO	GO	G01			HF				JF	JF				KD			
2.7 µF	275	J	K	M	FE	FE	FE	FG	FH																								
3.3 µF	335	J	K	M	FF	FF	FF	FM	FM																								
3.9 µF	395	J	K	M	FG	FG	FG	FG	FK																								
4.7 µF	475	J	K	M	FC	FC	FC	FG	FS							GK	GK								JF	JF							
5.6 µF	565	J	K	М	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	М	FH	FH	FH	FS								GK									JF	JO							
15 µF	156	J	K	M	FM	FM																			JO	JO							
22 µF	226	J	K	М	FS	FS	FS²	FS ²																	JO								
47 µF	476	J	K	М	FS²																												
		Rat	ed Vo (VDC	ltage :)	6.3	10	16	25	50	100	200	250	50	100	200	25	50	100	200	250	50	100	200	250	25	50	100	200	250	50	100	200	250
Сар	Cap Code	Vol	tage	Code	9	8	4	3	5	1	2	A	5	1	2	3	5	1	2	Α	5	1	2	A	3	5	1	2	A	5	1	2	Α
-	-	Ca	ise S Serie	ize / s				C12	10C				с	1808	C		С	1812	C			C18	25C			С	2220	C			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)

xx¹ Available only in K, M tolerance.

xx² Available only in M tolerance.

Table 2 – Chip Thickness/Packaging Quantities

Thickness	Case	Thickness ±	Paper C	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
СВ	0603	0.80 ± 0.07	4,000	10,000	0	0
CF	0603	0.80 ± 0.07	4,000	15,000	0	0
CC	0603	0.80 ± 0.10	4,000	10,000	0	0
CD	0603	0.80 ± 0.15	4,000	10,000	0	0
DC	0805	0.78 ± 0.10	4,000	10,000	0	0
DD	0805	0.90 ± 0.10	4,000	10,000	0	0
DE	0805	1.00 ± 0.10	0	0	2,500	10,000
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
DH	0805	1.25 ± 0.20	0	0	2,500	10,000
EB	1206	0.78 ± 0.10	4,000	10,000	4,000	10,000
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
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 2 – Chip Thickness/Packaging Quantities cont'd

Thickness	Case	Thickness ±	Paper C	Quantity	Plastic	Quantity
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
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
	1210	0.95 ± 0.10 1.00 ± 0.10	0	0	4,000	10,000
	1210	1.00 ± 0.10 1.10 ± 0.10	0	0	2,500	10,000
FG	1210	1.10 ± 0.10 1.25 ± 0.15	0	0	2,500	10,000
FL	1210	1.40 ± 0.15	0 0	0	2,000	8.000
FH	1210	1.55 ± 0.15	0	0	2,000	8,000
FM	1210	1.70 ± 0.20	0	0	2,000	8,000
FJ	1210	1.85 ± 0.20	0	0	2,000	8,000
FT	1210	1.90 ± 0.20	0	0	1,500	4,000
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	1/06	1.00 ± 0.15	0	0	4,000	10,000
	1808	0.90 ± 0.10 1.00 ± 0.15	0	0	2,500	10,000
	1812	1.00 ± 0.15 1.00 ± 0.10	0	0	2,500	10,000
GC	1812	1.00 ± 0.10 1.10 ± 0.10	0	0	1,000	4,000
GD	1812	1.10 ± 0.10 1.25 ± 0.15	0	0	1,000	4,000
GE	1812	1.30 ± 0.10	Ő	Ő	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
	1020	1.10 ± 0.15	0	0	1,000	4,000
	1825	1.30 ± 0.13 1.40 ± 0.15	0	0	1,000	4,000
HE	1825	1.40 ± 0.15 1.50 ± 0.15	0	0	1,000	4,000
JB	2220	1.00 ± 0.15	Ő	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
	2225	1.10 ± 0.15 1.20 ± 0.15	0		1,000	4,000
	2220	1.30 ± 0.15 1.40 ± 0.15	0	0	1,000	4,000
		1.70 ± 0.10	7" Beel	12" Deel	7" Beel	42" Deel
Thickness	Case Size	Thickness ± Range (mm)	/ Reei	13 Reel	/ Keel	13 Reel
Jue	0120	itange (iiiii)	Paper C	Quantity	Plastic	Quantity

Package quantity based on finished chip thickness specifications.



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

EIA Size Code	Metric Size Code		Dens Maxi Land P	sity Lev mum (I rotrusio	vel A: Most) on (mm)		Dens Media Land Pi	sity Lev an (Nor rotrusio	vel B: ninal) on (mm)		Dens Minii Land Pi	sity Lev num (L rotrusio	el C: east) on (mm)
		С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	X	V1	V2
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	0.40	0.52	0.52	1.60	0.80
0603	1608	0.90	1.15	1.10	4.00	2.10	0.80	0.95	1.00	3.10	1.50	0.60	0.75	0.90	2.40	1.20
0805	2012	1.00	1.35	1.55	4.40	2.60	0.90	1.15	1.45	3.50	2.00	0.75	0.95	1.35	2.80	1.70
1206	3216	1.60	1.35	1.90	5.60	2.90	1.50	1.15	1.80	4.70	2.30	1.40	0.95	1.70	4.00	2.00
1210	3225	1.60	1.35	2.80	5.65	3.80	1.50	1.15	2.70	4.70	3.20	1.40	0.95	2.60	4.00	2.90
1210 ¹	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 \geq 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).



Soldering Process

Recommended Soldering Technique:

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

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020

Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 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:
Soldorability		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 +/- 2 hours after test conclusion.
Riased 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 +/- 2 hours after test conclusion.
Diased Humany		Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
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

Reference	lt	em	Material
А		Finish	100% Matte Sn
В	Termination System	Barrier Layer	Ni
С	,	Base Metal	Cu
D	Inner E	Electrode	Ni
E	Dielectri	ic Material	BaTiO ₃



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



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
- · Pb-Free and RoHS Compliant
- Temperature stable dielectric
- EIA 0201, 0402, 0603, 0805, 1206, and 1210 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 μ F to 100 μ F
- Available capacitance tolerances of $\pm 10\%$ and $\pm 20\%$
- 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	М	9	Р	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec) ²
	0201 0402 0603 0805 1206 1210	C = Standard	2 Significant Digits + Number of Zeros	K = ±10% M = ±20%	7 = 4 V 9 = 6.3 V 8 = 10 V 4 = 16 V 3 = 25 V 6 = 35 V 5 = 50 V	P = X5R	A = N/A	C = 100% Matte Sn	Blank = Bulk TU = 7" Reel Unmarked TM = 7" Reel Marked

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

² Additional reeling or packaging options may be available. Contact KEMET for details.



Dimensions – Millimeters (Inches)





Conductive Metalization Electrodes

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	Soldor Boflow 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 Reliow Only
0603	1608	1.60 (.063) ± 0.15 (.006)	0.80 (.032) ± 0.15 (.006)	See Table 2 for	0.35 (.014) ± 0.15 (.006)	0.70 (.028)	
0805	2012	2.00 (.079) ± 0.20 (.008)	1.25 (.049) ± 0.20 (.008)	Thickness	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)	N1/A	
1210 ¹	3225	3.20 (.126) ± 0.20 (.008)	2.50 (.098) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)	IN/A	Solder Reflow Only

¹ For capacitance values \geq 22 μ F 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

Pb-Free and RoHS Compliant.





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%
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	4.0%
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	See Dissipation Factor Limit Table
Insulation Resistance (IR) Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ±5 seconds @ 25°C)

Regarding aging rate: Capacitance measurements (including tolerance) are indexed to a referee time of 48 or 1,000 hours. Please refer to a part number specific datasheet for referee time details.

To obtain IR limit, divide $M\Omega$ - μ F value by the capacitance and compare to G Ω 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 μ F

120 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."

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							
VED	25	All	7.5	. 000/	10% of Initial Limit					
Xor	< 25	< 0.56 µF	7.5	±20%						
	< 25	≥ 0.56 µF	12.0							

Dissipation Factor Limit Table

Rated DC Voltage	Capacitance	Dissipation Factor				
50 – 200 V	All	3%				
25 V	All	5%				
< 25 V	< 0.56 µF	5%				
< 25 V	≥ 0.56 µF	10%				

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	< 0.047 µF	≥ 0.047 µF				
1206	< 0.22 µF	≥ 0.22 µF				
1210	< 0.39 µF	≥ 0.39 µF				



Table 1 – Capacitance Range/Selection Waterfall (1005 – 1210 Case Sizes)

		Case Sei	Size / ries	(C02	201	С		C	:04	02	С			C	C 06	03	С			(208	805	С			C 1	20	6C			(C12	100	2	
Can	Сар	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	9	8	4	3	5	9	8	4	3	6	5
oup	Code	Rated (VI	Voltage DC)	4	6.3	9	16	4	6.3	10	16	25	50	4	6.3	9	16	25	50	4	6.3	9	16	25	50	6.3	9	16	25	50	6.3	9	16	25	35	50
		Сар То	lerance					Pr	odu	ct A	vail	abili	ity a	nd (Chip	Thi	ickn	ess	Co	des	– Se	e Ta	able	2 fo	r Cł	nip T	hic	knes	ss D	ime	nsic	ons				
10,000 pF	103	К	М	AB	AB	AB	AB	BB	BB	BB	BB																				1					
12,000 pF	123	K	М					BB	BB	BB	BB																									
15,000 pF	153	K	M					BB	BB	BB	BB																									
18,000 pF	183	ĸ	IVI M					BB	BB	RR	RR																									
22,000 pF	223	ĸ	M					BB	BB	BB	BB																									
33 000 pF	333	ĸ	M					BB	BB	BB	BB																									
39.000 pF	393	ĸ	м					BB	BB	BB	BB																									
47,000 pF	473	ĸ	М					BB	BB	BB	BB																									
56,000 pF	563	к	М					BB	BB	BB	BB																									
68,000 pF	683	K	М					BB	BB	BB	BB																									
82,000 pF	823	К	М					BB	BB	BB	BB																									
0.10 µF	104	K	М	AB	AB			BB	BB	BB	BB																									
0.22 µF	224	К	М					BB	BB																											
0.27 µF	274	K	М											CC	CC	CC	CC									EB	EB	EB	EB							
0.33 µF	334	К	М											CC	CC	CC	CC									EB	EB	EB	EB							
0.39 µF	394	K	М											CC	CC	CC	CC									EB	EB	EB	EB		FD	FD	FD	FD	FD	
0.47 µF	474	K	M					BB	BB					CC	CC	CC	CC			DC	DC		DC	DC		EC	EC	EC	EC		FD	FD	FD	FD	FD	
0.56 µF	564	ĸ	M												CC	CC										ED	ED	ED	ED		FD	FD	FD	FD	FD	
0.68 µF	684	ĸ	M											00	00	00	00			DE	DE	DE	DE	DE			EE	EE	EE		FD	FD	FD	FD	FD	
0.62 μF	024	ĸ						DD	DD	рр								00																		сu
1.0 µF	105	ĸ	M					DD	DD	DD					00			00						DG	DG	EC.	EF EC	EF EC	EG			FD	FD	FD	гп	гп
1.5 µF	155	ĸ	M																				DC			FC	FC	FC	FC		FD	FD	FD	FD		
1.8 µF	185	ĸ	м																	DD	DD		DD			EC	EC	EC	EC		FD	FD	FD	FD		
2.2 µF	225	ĸ	M					BB ¹	BB ¹	BB ¹				СС	СС	СС	СС			DG	DG	DG	DG			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					BB ¹						CC1	CC1					DL	DL	DL	DG			EH	EH	EH	EH		FH	FH	FH	FH		
3.9 µF	395	к	М																	DG	DG	DG	DG			ED	ED	ED	ED		FJ	FJ	FJ	FJ		
4.7 µF	475	К	М					BC ¹						СС	CC	CC				DG	DG	DH	DH	DG		EH	EH	EH	EH	EH	FK	FK	FK	FK		
5.6 µF	565	K	М																	DG	DG	DG				EK	EK	EH			FG	FG	FG	FE		
6.8 µF	685	K	М																	DG	DG	DG				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											CC1	CC1					DG	DG	DG	DG			I EH	EH	EH	EH		FT	FT	FT	FH	۲ľ	
12 µF	126	K	M																												IFD'	FD	FG			
15 µ⊢ 18 µE	100	ĸ		L																1													FG			
10 µr	226	ĸ	M																	DO		1				En	EU1					FU		EG1		
22 μΓ 47 μF	476	ĸ	M	L																DH	DG	1				EH1	EH1				ES1	ES1	ES ¹	1.0		
100 uF	107	ĸ	м	L																[]	50					EH1					FS ¹	FS	FS ¹			
		Rated (VI	Voltage DC)	4	6.3	\$	16	4	6.3	6	16	25	50	4	6.3	\$	16	25	20	4	6.3	6	16	25	50	6.3	9	16	25	50	6.3	9	16	25	35	50
Can	Can Code	Voltag	, e Code	7	9	8	4	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
	cap couc	Case Sei	Size / ries	ŀ	C02	2010	;			C04	02C	;				C06	03C	;		ŀ		COS	305C	;		Ĺ	C	1200	6C		Ĺ		C12	10C		

xx¹ Available only in M tolerance.



Table 2 –	Chip	Thickness/F	Packaging	Quantities
-----------	------	-------------	-----------	------------

Thickness	Case	Thickness ±	Paper C	Quantity	Plastic Quantity				
Code	Size	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			
BC	0402	0.50 ± 0.10	10,000	50,000	0	0			
CC	0603	0.80 ± 0.10	4,000	10,000	0	0			
DC	0805	0.78 ± 0.10	4,000	10,000	0	0			
DD	0805	0.90 ± 0.10	4,000	10,000	0	0			
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			
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			
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	1,500	4,000			
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	Range (mm)	Paper G	Quantity	Plastic Quantity				

Package quantity based on finished chip thickness specifications.



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

EIA Size	Metric Size			Dens Medi Land P	sity Lev an (Nor rotrusio	vel B: ninal) on (mm)	Density Level C: Minimum (Least) Land Protrusion (mm)								
Code	Code	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	X	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
1210 ¹	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 $\geq 22 \, \mu F$

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

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



Soldering Process

Recommended Soldering Technique:

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

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020

Table 4 – Performance & Reliability: Test Methods and Conditions

Stress Reference		Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 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:
Caldarability		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
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 2 hours after test conclusion.
Dissed Humidity		Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Blased Humidity	MIL-SID-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.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
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

Reference	lt	em	Material		
А		Finish	100% Matte Sn		
В	Termination System	Barrier Layer	Ni		
С		Base Metal	Cu		
D	Inner E	Ni			
E	Dielectri	BaTiO₃			



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


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
- · Pb-Free and RoHS 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	М	5	U	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/Grade (C-Spec) ²
	0805 1206 1210 1812 1825 2225	C = Standard	2 Significant Digits + Number of Zeros	M = ±20% Z = +80%/ -20	5 = 50 V 1 = 100 V	U = Z5U	A = N/A	C = 100% Matte Sn	Blank = Bulk TU = 7" Reel Unmarked TM = 7" Reel Marked

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

² 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
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	Colder Doflow Only
1825	4564	4.50 (.177) ± 0.30 (.012)	6.40 (.252) ± 0.40 (.016)		0.60 (.024) ± 0.35 (.014)		Solder Reliow Only
2225	5664	5.60 (.220) ± 0.40 (.016)	6.40 (.248) ± 0.40 (.016)		0.60 (.024) ± 0.35 (.014)		

Qualification/Certification

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

Environmental Compliance

Pb-Free and RoHS Compliant.





Electrical Parameters/Characteristics

Item	Parameters/Characteristics			
Operating Temperature Range	-10°C to +85°C			
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	+22%, -56%			
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	7.0%			
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	4.0%			
Insulation Resistance (IR) Limit @ 25°C	100 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 48 or 1,000 hours. Please refer to a part number specific datasheet for referee time details.

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 μF

120 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."

Post Environmental Limits

High Temperature Life, Biased Humidity, Moisture Resistance									
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance				
7511	> 25	All	5.0	. 200/	100/ of Initial Limit				
200	25	All	7.5	±30%	10% of milliar Limit				



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

	Conscitones	Case Size / Series		C08	805C	C12	206C	C12	10C	C18	312C	C18	25C	C22	25C
Capacitance			Voltage Code		1	5	1	5	1	5	1	5	1	5	1
-	Code	Rated Volt	tage (VDC)	50	100	50	100	50	100	50	100	50	100	50	100
		Capacitanc	e Tolerance		Product Availability and Chip Thickness Codes										
6.800 pE	682		7	DC	DC		See la	01e 2 to	r Chip I	nickne	ss Dime	ensions	<u> </u>		
8,000 pl	822	M	7												
10,200 pi	103	M	7			ED	ED								
12,000 pF	103	M	7		DC										
12,000 pl	123	M	7												
18,000 pF	193	M	7	DC											
22 000 pF	223	M	7												
22,000 pr 27,000 pF	223	M	7			EB	EB								
27,000 pl 33,000 pF	213	M	7			EB	EB								
39.000 pF	393	M	7	DC		FR	EC								
47 000 pF	473	M	7	DC		FR	EC	FR	FR						
56 000 pF	563	M	7	סס		FR	FR	FR	FR						
68 000 pF	683	M	7	מס		FR	FR	FR	FR						
82 000 pF	823	M	7	מס		FR	FR	FR	FC	GB	GB				
0.10 µF	104	M	7	DC		FR	FR	FR	FD	GB	GB				
0.10 ul	104	M	7	00		EC		FR	FD	GB	GB				
0.12 ur	154	M	7			EC		FC	FD	GB	GB				
0.18 uF	184	M	7			EC		FC		GB		HR	HB		
0.10 ur	224	M	7			EC		FC		GB		HB	HB		
0.22 ul	274	M	7					FC		GB		HB	HB		
0.33 uE	334	M	7					FD		GB		HB	HB	KB	KC
0.39 uF	394	M	7					FD		GB		HB	HB	KB	KC
0.00 ur	474	M	7					FD		GB		HB		KB	KC
0.56 uF	564	м	7					FD		GC		НВ		KB	i i i i i i i i i i i i i i i i i i i
0.68 uF	684	M	7					FD		GC		НВ		KB	
0.82 uF	824	M	Z					FF		GE		HB		KB	
1.0 uF	105	м	z					FH		GE		НВ		KB	
1.2 uF	125	м	z									НВ		KB	
1.5 uF	155	м	z									НС		кс	
1.8 uF	185	м	z									HD		KD	
2.2 uF	225	М	Z									HF		KD	
		Rated Volt	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
	0000	Case Siz	e / Series	C08	805C	C12	206C	C12	10C	C18	312C	C18	25C	C22	25C



Thickness	Case	Thickness ±	Paper C	Quantity	Plastic (Quantity	
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel	
DC	0805	0.78 ± 0.10	4,000	10,000	0	0	
DD	0805	0.90 ± 0.10	4,000	10,000	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 C	Paper Quantity		Quantity	

Table 2 – Chip Thickness/Packaging Quantities

Package quantity based on finished chip thickness specifications.



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

EIA Size	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)						
Code	Code	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	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
1210 ¹	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 $\geq 22 \, \mu F$

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

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



Soldering Process

Recommended Soldering Technique:

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

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020

Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 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:
Soldorability		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 +/- 2 hours after test conclusion.
Discod Llumiditu		Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Blased 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.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
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

Reference	lt	Material	
А		Finish	100% Matte Sn
В	Termination	Barrier Layer	Ni
С	- ,	Base Metal	Cu
D	Inner E	Electrode	Ni
E	Dielectri	ic Material	BaTiO ₃



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



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
- Pb-Free and RoHS 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	V	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec) ²
	0402 0603 0805 1206 1210	C = Standard	2 Significant Digits + Number of Zeros	Z = +80%/ -20%	9 = 6.3 V 8 = 10 V 4 = 16 V 3 = 25 V 5 = 50 V	V = Y5V	A = N/A	C = 100% Matte Sn	Blank = Bulk TU = 7" Reel Unmarked

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

²Additional 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)		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)	See Table 2 for Thickness	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)	N1/A	
1210	3225	3.20 (.126) ± 0.20 (.008)	2.50 (.098) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.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.

Environmental Compliance

Pb-Free and RoHS Compliant.





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%
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	7.0%
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	10% (6.3 and 10 V), 7% (16 and 25 V) and 5% (50 V)
Insulation Resistance (IR) Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ±5 seconds @ 25°C)

Regarding aging rate: Capacitance measurements (including tolerance) are indexed to a referee time of 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 \pm 50 Hz and 1.0 \pm 0.2 Vrms

120 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."

Post Environmental Limits

High Temperature Life, Biased Humidity, Moisture Resistance													
Dielectric	Rated DC Voltage	Rated DC Capacitance Dissipation Factor Capacitance Insulation Voltage Value (Maximum %) Shift Resistant											
	> 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



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

		Case Ser	Size / ries	С	0402	2C		C06	03C			С	0805	5C			С	1206	SC			С	1210	C	
Canacitance	Сар	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
oupuonunoe	Code	Rated \ (VI	Voltage DC)	6.3	9	16	6.3	9	16	25	6.3	9	16	25	50	6.3	9	16	25	50	6.3	6	16	25	50
		Capac	itance							P	roduc	t Ava	ilabili	ty and	d Chip	Thic	kness	Code	es						
22.000 pF	223	M	Z	BB	BB	BB	СВ	СВ	СВ	СВ	DC	DC	2 for (DC	DC	iess D	imen	sions							
27,000 pF	273	М	Z	BB	BB	BB	СВ	СВ	СВ	СВ	DC	DC	DC	DC	DC										
33,000 pF	333	М	Z	BB	BB	BB	СВ	СВ	CB	СВ	DC	DC	DC	DC	DC										
39,000 pF	393	М	Z	BB	BB	BB	CB	CB	CB	CB	DD	DD	DD	DD	DD										
47,000 pF	473	M	Z	BB	BB	BB	CB	CB	CB	CB	DD	DD	DD	DD	DD										
56,000 pF	503	M	Z 7	BR BR	BB	BB	CB	CB	CB	CB	עט	עט	םם	םם	םם										
82 000 pF	823	M	7	BR	BR	BR	CB	CB	CB	CB	םם	םם	םם	םם	םם										
0.10 µF	104	M	z	BB	BB	BB	CC	CC	CC	CC	DC	DC	DC	DC	DC										
0.12 µF	124	M	z				CC	CC	CC	CC	DC	DC	DC	DC											
0.15 µF	154	М	Z				CC	CC	CC	CC	DC	DC	DC	DC											
0.18 µF	184	М	Z				CC	CC	CC	CC	DC	DC	DC	DC											
0.22 µF	224	М	Z	BB			CC	CC	CC	CC	DC	DC	DC	DC	DG	EC	EC	EC	EC		FD	FD	FD	FD	FD
0.27 µF	274	М	Z				CC	CC	CC	CC	DC	DC	DC	DC		EB	EB	EB	EB		FD	FD	FD	FD	FD
0.33 µF	334	M	Z 7					CC	CC	CC	DC	DC	DC	DC		EB	EB	EB	EB		FD	FD	FD	FD	FD
0.39 µF	394 171	M	7	BB												EB	ED	ED	ED						
0.56 µF	564	M	7					00	00			סס				FB	FB	FB	FB		FD	FD	FD	FD	FD
0.68 µF	684	M	z				CC	CC			DE	DE	DE	DE		EB	EB	EB	EB		FD	FD	FD	FD	FD
0.82 µF	824	М	Z				СС	СС			DG	DG	DG	DG		EB	EB	EB	EB		FF	FF	FF	FF	FF
1.0 µF	105	М	Z	BB	BB		CC	CC	CC	CC	DG	DG	DG	DG	DG	EF	EF	EF	EG		FH	FH	FH	FH	FH
1.2 µF	125	М	Z								DC	DC	DC			EC	EC	EC			FD	FD	FD		
1.5 µF	155	M	Z								DC	DC	DC			EC	EC	EC			FD	FD	FD		
1.8 µF	185	M	Z									DD	DD			ED	ED	ED			FD	FD	FD		
2.2 µF	225	M	Z 7	RR	BB						DG	DG	DG			EL	EE	EE			FD	FD	FD		
3.3 μF 4 7 μF	475	M	7									DG	DG			En	EM	EF			FG	FG	FG		
5.6 uF	565	M	z								DF	DF				EJ	EJ	EJ			FG	FG	FG		
6.8 µF	685	М	z								DG	DG				EJ	EJ				FH	FH	FH		
10 µF	106	М	Z								DG	DG				EH	EH	EH	EH		FH	FH	FH		
15 µF	156	М	Z																		FH	FH	FH		
22 µF	226	М	Z													EH	EH				FT	FT	FS	FH	
		Rated \ (VI	Voltage DC)	6.3	10	16	6.3	10	16	25	6.3	9	16	25	50	6.3	9	16	25	50	6.3	9	16	25	50
Capacitance	Cap Code	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
		Case Ser	Size / ries	C	:0402	C		C06	03C			c	0805	С			C	C1206	с			(C1210	0	



Thickness	Case	Thickness ±	Paper C	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
CB	0603	0.80 ± 0.07	4,000	10,000	0	0
CC	0603	0.80 ± 0.10	4,000	10,000	0	0
DC	0805	0.78 ± 0.10	4,000	10,000	0	0
DD	0805	0.90 ± 0.10	4,000	10,000	0	0
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
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
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
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
FT	1210	1.90 ± 0.20	0	0	1,500	4,000
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	Range (mm)	Paper C	Quantity	Plastic	Quantity

Table 2 – Chip Thickness/Packaging Quantities

Package quantity based on finished chip thickness specifications.



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

EIA Size	Metric Size	Density Level A: Maximum (Most) Land Protrusion (mm)						Dens Medi Land P	sity Lev an (Nor rotrusio	vel B: ninal) on (mm)	Density Level C: Minimum (Least) Land Protrusion (mm)					
oouc	oouc	С	C Y X V1 V2					Y	X	V1	V2	С	Y	X	V1	V2	
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	0.40	0.52	0.52	1.60	0.80	
0603	1608	0.90	1.15	1.10	4.00	2.10	0.80	0.95	1.00	3.10	1.50	0.60	0.75	0.90	2.40	1.20	
0805	2012	1.00	1.35	1.55	4.40	2.60	0.90	1.15	1.45	3.50	2.00	0.75	0.95	1.35	2.80	1.70	
1206	3216	1.60	1.35	1.90	5.60	2.90	1.50	1.15	1.80	4.70	2.30	1.40	0.95	1.70	4.00	2.00	
1210	3225	1.60	1.35	2.80	5.65	3.80	1.50	1.15	2.70	4.70	3.20	1.40	0.95	2.60	4.00	2.90	
1210 ¹	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 \geq 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).



Soldering Process

Recommended Soldering Technique:

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

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020

Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method					
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.					
Board Flex	JIS-C-6429	Appendix 2, Note: 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:					
Colderability		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 +/- 2 hours after test conclusion.					
Biased Humidity		Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.					
Blased Humidity	MIL-SID-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.					
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.					
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.					
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.					
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.					
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

Reference	lt	Material	
А		Finish	100% Matte Sn
В	Termination Svstem	Barrier Layer	Ni
С	,	Base Metal	Cu
D	Inner E	Electrode	Ni
E	Dielectri	ic Material	BaTiO ₃



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



Overview

KEMET's Ceramic Chip Capacitor Array in COG 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.

KEMET's C0G dielectric features a 125°C maximum operating temperature and is considered "stable."The Electronics

Industries Alliance (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.

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

Benefits

- -55°C to +125°C operating temperature range
- · Saves both circuit board and inventory space
- Reduces placement costs and increases throughput
- RoHS Compliant
- EIA 0508 (2-element) and 0612 (4-element) case sizes



Ordering Information

СА	06	4	С	104	К	4	G	Α	С	TU
Ceramic Array	Case Size (L" x W") ¹	Number of Capacitors	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/Grade (C-Spec) ³
	05 = 0508 06 = 0612	2 = 2 4 = 4	C = Standard X = Flexible Termination	2 Significant Digits + Number of Zeros	J = ±5% K = ±10% M = ±20%	8 = 10 V 4 = 16 V 3 = 25 V 5 = 50 V 1 = 100 V 2 = 200 V	G = C0G	A = N/A	C = 100% Matte Sn L = SnPb (5% minimum)	Blank = Bulk TU = 7" Reel Unmarked AUTO = Automotive Grade

¹ 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.

^{2,3} SnPb termination finish option is not available on automotive grade product.

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



Dimensions – Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	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)

Benefits cont'd

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

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

Pb-Free and RoHS Compliant (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%
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	0.1%
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 Ω 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 Vrms ±0.2 V if capacitance \leq 1,000 pF

1 kHz \pm 50 Hz and 1.0 Vrms \pm 0.2 V 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 Voltage Value (Maximum %) Shift Resistance											
C0G	All	All	0.5	0.3% or ±0.25 pF	10% of Initial Limit							



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

		Ca	ase Siz Series	ze / S	C0508	3 (CA05	2C 2-C	ap Caso	e Size)	C0	C0612 (CA064C 4-Cap Case Size)						
0	Capacitance	Vo	ltage Co	ode	8	4	3	5	1	8	4	3	5	1	2		
Capacitance	Code	Rated	Voltage	(VDC)	10	16	25	50	100	10	16	25	50	100	200		
				\	-		_										
		Capaci	tance To	lerance		See Table 2 for Chip Thickness Dimensions											
10 pF	100	J	K	M						MA	MA	MA	MA	MA	MA		
12 pF	120	J	K	M						MA	MA	MA	MA	MA	MA		
15 pF	150	J	K	M						MA	MA	MA	MA	MA	MA		
18 pF	180	J	K	M						MA	MA	MA	MA	MA	MA		
22 pF	220	J	K	M						MA	MA	MA	MA	MA	MA		
27 pF	270	J	K	M						MA	MA	MA	MA	MA	MA		
33 pF	330	J	K	M						MA	MA	MA	MA	MA	MA		
39 pF	390	J	K	M						MA	MA	MA	MA	MA	MA		
47 pF	470	J	K	M						MA	MA	MA	MA	MA	MA		
56 pF	560	J	K	M						MA	MA	MA	MA	MA	MA		
68 pF	680	J	K	M						MA	MA	MA	MA	MA	MA		
82 pF	820	J	K	M	DA				D A	MA	MA	MA	MA	MA	MA		
100 pF	101	J	K	M	PA	PA	PA	PA	PA	MA	MA	MA	MA	MA			
120 pF	121	J	ĸ	IVI	PA	PA	PA	PA	PA	MA	IVIA	MA	MA	IVIA			
150 pF	151	J	ĸ	IVI		PA	PA	PA	PA	MA	MA	IVIA	MA	IVIA			
100 pF	101	J	r v			PA DA		PA			IVIA	IVIA	IVIA	IVIA			
220 pF	221	J	r k					PA DA		MA	IVIA MA		MA				
270 pF	2/1	J	ĸ							MA	IVIA MA	MA	MA				
300 pF	301	J	r k	M						MA	MA	MA	MA				
470 pF	471	J	ĸ	M				DA PA		MA	MA	MA	MA				
470 pi	561	J		M						IVI/A	IVIA	IVIA	IVIA				
680 pF	681	1	K	M													
820 pF	821	1	ĸ	M													
1 000 pF	102	ŭ	ĸ	M	PΔ	PΔ	PΔ	PΔ	PΔ								
1 100 pF	112	,	ĸ	M	PA	PA	PA	PA	PA								
1,100 pF	122	J	ĸ	M	PA	PA	PA	PA	PA								
1,200 pF	132	J	ĸ	M	PA	PA	PA	PA	PA								
1,500 pF	152	Ĵ	ĸ	M	PA	PA	PA	PA	PA								
1,600 pF	162	Ĵ	ĸ	M	PA	PA	PA	PA	PA								
1.800 pF	182	J	K	M	PA	PA	PA	PA	PA								
2,000 pF	202	J	К	M	PA	PA	PA	PA	PA								
2,200 pF	222	J	К	M	PA	PA	PA	PA	PA								
		Rateo	d Voltage	(VDC)	10	16	25	50	100	10	16	25	50	100	200		
Capacitance	Capacitance Code	V	oltage Co	de	8	4	3	5	1	8	4	3	5	1	2		
	Capacitance Code Voltage Code Case Size / Series					C0508			C0612								

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 2 – Chip Thickness/Packaging Quantities

Thickness Case	Case	Thickness ±	Paper G	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 3 – Chip Capacitor Array Land Pattern Design Recommendations per IPC-7351

EIA 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	С	Y	X	Р	V1	V2	C	Y	X	Р	V1	V2	С	Y	X	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).



Soldering Process

Recommended Soldering Technique:

Solder reflow only

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020



Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 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:
Saldarability		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 +/- 2 hours after test conclusion.
Disco d Ulumidit.		Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Blased Humidity	MIL-SID-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.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
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

Reference	lt	em	Material
А		Finish	100% Matte Sn
В	Termination System	Barrier Layer	Ni
С		Base Metal	Cu
D	Inner E	Ni	
E	Dielectri	CaZrO ₃	



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

Construction – Flexible Termination

Reference	lt	em	Material
А		Finish	100% Matte Sn
В	Termination System	Barrier Layer	Ni
С		Epoxy Layer	Ag
D		Base Metal	Cu
E	Inner E	Electrode	Ni
F	Dielectri	CaZrO ₃	



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



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.

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.

Benefits

- -55°C to +125°C operating temperature range
- Saves both circuit board and inventory space
- Reduces placement costs and increases throughput
- RoHS 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



Ordering Information

CA	06	4	С	104	К	4	R	Α	С	TU
Ceramic Array	Case Size (L" x W") ¹	Number of Capacitors	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/Grade (C-Spec) ³
	05 = 0508 06 = 0612	2 = 2 4 = 4	C = Standard X = Flexible Termination	2 Significant Digits + Number of Zeros	J = ±5% K = ±10% M = ±20%	8 = 10 V 4 = 16 V 3 = 25 V 5 = 50 V 1 = 100 V 2 = 200 V	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% minimum)	Blank = Bulk TU = 7" Reel Unmarked TM = 7" Reel Marked AUTO = Automotive Grade

¹ 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.

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

^{2,3} SnPb termination finish option is not available on automotive grade product.

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



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)

Benefits cont'd

- Capacitance offerings ranging from 330 pF 0.22 μF
- Available capacitance tolerances of $\pm 5\%$, $\pm 10\%$, and $\pm 20\%$
- Non-polar device, minimizing installation concerns
- 100% pure matte tin-plated termination finish allowing for excellent solderability
- SnPb termination finish option available upon request (5% minimum)
- · Flexible termination option available upon request
- 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.

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

Pb-Free and RoHS Compliant (excluding SnPb termination finish option).



Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +125°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC	±15%
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit @ 25°C	5%(10 V), 3.5%(16 V and 25 V) and 2.5%(50 V to 200 V)
Insulation Resistance (IR) Limit @ 25°C	1,000 megohm microfarads or 100 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.

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 \pm 50 Hz and 1.0 \pm 0.2 Vrms if capacitance \leq 10 μ F

120 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."

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 Limi							
	< 16		7.5									



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

		Case	Size / S	Series	C0508	8 (CA05	2C 2-C	ap Case	e Size)	C0612 (CA064C 4-Cap Case Size)						
	Capacitance	Vo	oltage Co	de	8	4	3	5	1	8	4	3	5	1	2	
Capacitance	Code	Rateo	d Voltage	(VDC)	10	16	25	50	100	10	16	25	50	100	200	
		Ca	apacitan	ce			F	Product A	vailability	and Chi	p Thickne	ss Code	S	1		
220 - 5	204		oleranc	e	DA	DA	DA	See lab	hip Thick	ness Dim	ensions					
330 pF	331	J	ĸ	IVI	PA	PA	PA	PA	PA	MA	MA	MA	MA	MA	MA	
390 pF	391	J	ĸ	IVI	PA	PA	PA	PA	PA	MA	MA	MA	MA	MA	MA	
470 pF	4/1	J	ĸ	IVI	PA	PA	PA	PA	PA	MA	MA	IVIA	MA	MA	MA	
560 pF	100	J	ĸ	IVI	PA	PA	PA	PA	PA	MA	IVIA	IVIA	MA	MA	MA	
680 pF	001	J	ĸ	IVI	PA	PA	PA	PA	PA	MA	IVIA	MA	MA	MA		
820 pF	821	J	ĸ		PA	PA	PA	PA	PA	MA	MA	IVIA	MA	MA		
1,000 pF	102	J	ĸ	M	PA	PA	PA	PA	PA	MA	MA	MA	MA	MA		
1,200 pF	122	J	ĸ	M	PA	PA	PA	PA	PA	MA	MA	MA	MA	MA		
1,500 pF	152	J	ĸ	M	PA	PA	PA	PA	PA	MA	MA	MA	MA	MA		
1,800 pF	182	J	ĸ	M	PA	PA	PA	PA	PA	MA	MA	MA	MA	MA		
2,200 pF	222	J	K	M	PA	PA	PA	PA	PA	MA	MA	MA	MA	MA		
2,700 pF	272	J	K	M	PA	PA	PA	PA	PA	MA	MA	MA	MA	MA		
3,300 pF	332	J	K	M	PA	PA	PA	PA	PA	MA	MA	MA	MA	MA		
3,900 pF	392	J	K	M	PA	PA	PA	PA	PA	MA	MA	MA	MA	MA		
4,700 pF	472	J	K	M	PA	PA	PA	PA	PA	MA	MA	MA	MA	MA		
5,600 pF	562	J	K	M	PA	PA	PA	PA		MA	MA	MA	MA			
6,800 pF	682	J	K	M	PA	PA	PA	PA		MA	MA	MA	MA			
8,200 pF	822	J	K	M	PA	PA	PA	PA		MA	MA	MA	MA			
10,000 pF	103	J	K	M	PA	PA	PA	PA		MA	MA	MA	MA			
12,000 pF	123	J	K	M	PA	PA	PA	PA		MA	MA	MA	MA			
15,000 pF	153	J	K	M	PA	PA	PA	PA		MA	MA	MA	MA			
18,000 pF	183	J	K	M	PA	PA	PA	PA		MA	MA	MA	MA			
22,000 pF	223	J	K	M	PA	PA	PA	PA		MA	MA	MA	MA			
27,000 pF	273	J	K	M	PA	PA	PA	PA		MA	MA	MA				
33,000 pF	333	J	K	M	PA	PA	PA	PA		MA	MA	MA				
39,000 pF	393	J	K	M	PA	PA	PA	PA		MA	MA	MA				
47,000 pF	473	J	K	M	PA	PA	PA	PA		MA	MA	MA				
56,000 pF	563	J	K	M	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 uF	104	J	K	M	PA	PA	PA	PA		MA	MA					
0.15 uF	154	J	K	M	PA											
0.22 uF	224	J	K	M	PA											
		Rated	d Voltage	(VDC)	10	16	25	50	100	10	16	25	50	100	200	
Capacitance	Capacitance Code Voltage Code		8 4 3 5 1				8 4 3 5 1 2									
		Case	e Size / S	eries		C0508					C0612					

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

EIA 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	С	Y	X	Р	V1	V2	C	Y	X	Р	V1	V2	С	Y	X	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).



Soldering Process

Recommended Soldering Technique:

Solder reflow only

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020



Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 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:
Soldorability		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 +/- 2 hours after test conclusion.
Biased Humidity	MIL_STD_202 Method 103	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Diasca Haimarty		Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
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

Reference	lt	Material					
А		Finish	100% Matte Sn				
В	Termination Svstem	Barrier Layer	Ni				
С	,	Base Metal	Cu				
D	Inner E	Inner Electrode					
E	Dielectri	BaTiO ₃					



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

Construction – Flexible Termination

Reference	lt	Material	
А		Finish	100% Matte Sn
В	Termination	Barrier Layer	Ni
С	System	Epoxy Layer	Ag
D		Base Metal	Cu
E	Inner E	Ni	
F	Dielectr	ic Material	BaTiO ₃



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



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 $\pm 30 \text{ ppm/}^{\circ}\text{C}$ 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:





С	1206	Т	104	K	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) ³
	0402 0603 0805 1206 1210 1812 2220	T = COTS	2 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 V 4 = 16 V 3 = 25 V 6 = 35 V 5 = 50 V 1 = 100 V 2 = 200 V	G = COG	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% minimum)	Blank = Bulk TU = 7" Reel Unmarked TM = 7" Reel Marked

Ordering Information

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

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

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



Dimensions – Millimeters (Inches)





Electrodes / Conductive Metalization

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)		

Benefits

- -55°C to +125°C operating temperature range
- 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
- · Certificate of compliance
- · 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, and 200 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
- 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
- SnPb end metallization option available upon request (5% minimum)

Applications

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



Qualification/Certification

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

Environmental Compliance

Pb-Free and RoHS Compliant.



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)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit @ 25°C	0.1%
Insulation Resistance (IR) Limit @ 25°C	1,000 megohm microfarads or 100 GΩ (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 Ω 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 Vrms ±0.2 V if capacitance \leq 1,000 pF

1 kHz \pm 50 Hz and 1.0 Vrms \pm 0.2 V 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						
COG	All	All	0.5	0.3% or ±0.25 pF	10% of Initial Limit						



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

		C	Cas	se S	Siz	e /	Se	rie	s	C0402C						C0603C					C0805C						
0	Сар			Vo	ltag	e Co	ode			8	4	3	5	1	2	8	4	3	5	1	2	8	4	3	5	1	2
Capacitance	Code		Ra	ted	Volt	tage	e (VI	DC)		10	16	35	20 2	100	200	9	16	25	50	100	200	9	16	25	50	100	200
				Са		itar	ice					,		,	Prod	uct Ava	ailabili	ty and	l Chip	Thick	ness C	odes			·		
0.50 & 0.75 pF	508 & 758	В	С	D		anc	,c			BB	BB	BB	BB		000	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC
1.0 - 9.1 pF*	109 - 919*	В	С	D						BB	BB	BB	BB			СВ	СВ	CB	CB	CB	СВ	DC	DC	DC	DC	DC	DC
10 - 91 pF*	100 - 910*				F	G	J	K	M	BB	BB	BB	BB			CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC
100 pF	101					G	J	K	M	BB	BB	BB	BB	BB	BB	CB	CB	CB	CF	CB	CB		DC	DC	DC	DC	DC
300 pF	301				F	G	J	ĸ	M	BB	BB	BB	BB	BB	BD	CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC
330 pF	331				F	G	J	ĸ	м	BB	BB	BB	BB	BB	BD	CB	CB	CB	CF	CB	CB	DC	DC	DC	DC	DC	DC
360 pF	361				F	G	J	K	M	BB	BB	BB	BB	BB		CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC
390 pF	391				F	G	J	К	М	BB	BB	BB	BB	BB		СВ	СВ	СВ	СВ	СВ	СВ	DC	DC	DC	DC	DC	DC
430 pF	431				F	G	J	Κ	М	BB	BB	BB	BB	BB		СВ	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC
470 pF	471				F	G	J	K	М	BB	BB	BB	BB	BB		CB	CB	СВ	CB	CB	CB	DC	DC	DC	DC	DC	DD
510 - 820 pF*	511 - 821*				F	G	J	K	М	BB	BB	BB	BB	BB		CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC
910 pF	911				F	G	J	K	M	BB	BB	BB	BB	BB		CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DD	DD
1,000 pF	102					G	J	K	M	BB	BB	BB	BB	BB		CB	CB	CB	CB	CB	CB		DC	DC	DC	DD	
1,100 pF	112				F	G	J	n K	M	BB	BB	BB	BB			CB	CB	CB	CB	CB	СН				DC		DC
1,200 pF	132				F	G	J	ĸ	M	BB	BB	BB	BB			CB	CB	CB	CB	CB	СН	00	מס		מס	סס	DC
1.500 pF	152				F	G	J	ĸ	м	BB	BB	BB	BB			СВ	CB	CB	CB	CB	СН	DD	DD	DD	DD	DD	DC
1,600 pF	162				F	G	J	к	М	BB	BB	BB				СВ	СВ	CB	CB	СВ	СН	DD	DD	DD	DD	DD	DC
1,800 pF	182				F	G	J	Κ	М	BB	BB	BB				СВ	СВ	CB	CB	СВ	СН	DD	DD	DD	DD	DD	DC
2,000 pF	202				F	G	J	Κ	М	BB	BB	BB				СВ	СВ	CB	СВ	CB	СН	DC	DC	DC	DC	DC	DC
2,200 pF	222				F	G	J	K	М	BB	BB	BB				СВ	СВ	CB	CB	CB	СН	DC	DC	DC	DC	DC	DC
2,400 pF	242				F	G	J	K	М							CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC
2,700 pF	272				E	G	J	K	M							CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC
3,000 pF	302				F	G	J	ĸ	IVI							CB	CB	CB	CB	CB		עע	עט	עט	עט	DC	DC
3,300 pF 3,600 pF	362				F	G	J	ĸ	M							CB	CB	CB	CB	CB		ם חח	םם	םם	ם סס		
3.900 pF	392				F	G	J	ĸ	м							CB	CB	CB	CB	CB		DE	DE	DE	DE	DC	DD
4,300 pF	432				F	G	J	K	Μ							CB	CB	CB	CB	CB		DE	DE	DE	DE	DC	DD
4,700 pF	472				F	G	J	Κ	М							СВ	СВ	CB	СВ	СВ		DE	DE	DE	DE	DC	DD
5,100 pF	512				F	G	J	Κ	М							CB	CB	CB	CB			DE	DE	DE	DE	DC	DD
5,600 pF	562				F	G	J	K	М							СВ	CB	CB	CB			DC	DC	DC	DC	DC	DD
6,200 pF	622				F	G	J	K	М							CB	CB	CB	CB			DC	DC	DC	DC	DC	DG
6,800 pF	682				۱F.	G	J	K	M							CB	CB	CB	СВ			DC	DC	DC	DC	DC	DG
7,500 pF	752				F	G	J	ĸ	M							CB	CB	CB					DC	DC	DC	DC	DG
0,200 pF 9,100 pF	022				F	G	J	ĸ	M								CB	CB									DG
10 000 pF	103				F	G	J	ĸ	M							CB	CB	CB						DC	DC		
12,000 pF	123				F	G	J	K	М							CB	CB	CB				DC	DC	DC	DC	DE	
15,000 pF	153				F	G	J	к	М							СВ	СВ	СВ				DC	DC	DC	DD	DG	
18,000 pF	183				F	G	J	Κ	М													DC	DC	DC	DD		
22,000 pF	223				F	G	J	Κ	М													DD	DD	DD	DF		
27,000 pF	273				F	G	J	K	М													DF	DF	DF			
33,000 pF	333				F	G	J	K	М													DG	DG	DG			
39,000 pF	393				F	G	J	ĸ	M													DG	DG	DG			
47,000 pr	410		Rat	ted		tane	ر VI) و	<u>n</u> DC)	IVI	10	16	75	9	8	8	ē	16	25	20	8	00	<u>9</u>	16	55 25	20	8	00
Capacitance	Cap Code	⊢		Vol	Itao	e Co	ode			8	4	3	5	1	2	8	4	3	5	1	2	8	4	3	5	1	2
			С	ase	Siz	e / S	Serie	es		-		C04	102C	1		-		C06	03C			-]	C08	05C		

*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 (1206 – 2220 Case Sizes)

		Case S	Size / Series		C12	206C					C12	10C			С	1812	C	C	2220	C
	Cap	Vo	oltage Code	8	4 3	5	1	2	8	4	3	5	1	2	5	1	2	3	1	2
Capacitance	Code	Rated	d Voltage (VDC)	9	16 אר	2 2	0	200	10	16	25	50	100	200	50	6	200	50	100	200
		Ca	apacitance				F	Produ	ct Ava	ilabili	ty and	Chip	Thick	ness	Codes	;		l		
		T	Tolerance					See	Table	<u>2 for (</u>	Chip T	hickn	ess Di	mens	ions					
1.0 - 9.1 pF*	109 - 919*	B C D				EB	EB	EB	FB	FB	FB	FB	FB	FB						
100 - 430 pF*	100 - 910		FGJKM			FR	FR	FR	FR	FB	FB	FB	FB	FB						
470 - 910 pF*	471 - 911*		FGJKM	FR F	B FB	FB	FB	FB	FB	FB	FB	FB	FB	FR	GB	GB	GB			
1.000 pF	102		FGJKM	EB E	B EB	EB	EB	EE	FB	FB	FB	FB	FB	FB	GB	GB	GB			
1,100 pF	112		F G J K M	EB E	B EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	GB	GB	GB			
1,200 pF	122		F G J K M	EB E	B EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	GB	GB	GB			
1,300 pF	132		F G J K M	EB E	B EB	EB	EC	EC	FB	FB	FB	FB	FB	FC	GB	GB	GB			
1,500 pF	152		F G J K M	EB E	B EB	EB	ED	EC	FB	FB	FB	FB	FB	FE	GB	GB	GB			
1,600 pF	162		F G J K M	EB E	B EB	EB	ED	ED	FB	FB	FB	FB	FB	FE	GB	GB	GB			
1,800 pF	182		FGJKM	EB E	B EB	EB	ED	ED	FB	FB	FB	FB	FB	FE	GB	GB	GB			
2,000 pF	202		FGJKM	EB E	B EB	EB	ED	ED	FB	FB	FB	FB	FC	FE	GB	GB	GB			
2,200 pF	222		FGJKM	EB E	B EB	EB	EE	ED	FB	FB	FB	FB	FC	FG	GB	GB	GB			
2,400 pF	242		FGJKM	EB E		EB	EC	EC	FB	FB	FB	FB	FC	FC		CD	CD			
2,700 pF	212		FGJKM			ED	EC	ED		FD ED	FD	FD ED	FC	FC	GB	GB	GB			
3,300 pF	332		FGJKM	FC F		FC	FF	FB	FR	FB	FB	FR	FF	FF	GB	GB	GB			
3 600 pF	362		FGJKM	FC F		FC	FF	FB	FB	FB	FB	FB	FF	FF	00		00			
3.900 pF	392		FGJKM	EC E	C EC	EC	EF	EB	FB	FB	FB	FB	FF	FF	GB	GB	GB			
4,300 pF	432		F G J K M	EC E	C EC	EC	EC	EB	FB	FB	FB	FB	FF	FF			-			
4,700 pF	472		F G J K M	EC E	C EC	EC	EC	EB	FF	FF	FF	FF	FG	FG	GB	GB	GD			
5,100 pF	512		F G J K M	ED E	D ED	ED	ED	EB	FB	FB	FB	FB	FG	FG						
5,600 pF	562		F G J K M	ED E	D ED	ED	ED	EB	FB	FB	FB	FB	FG	FG	GB	GB	GH			
6,200 pF	622		F G J K M	EB E	B EB	EB	EB	EB	FB	FB	FB	FB	FG	FB						
6,800 pF	682		F G J K M	EB E	B EB	EB	EB	EB	FB	FB	FB	FB	FG	FB	GB	GB	GJ	JE	JE	JB
7,500 pF	752		FGJKM	EB E	B EB	EB	EB	EB	FC	FC	FC	FC	FC	FB						
8,200 pF	822		FGJKM	EC E		EC	EB	EC	FC	FC	FC	FC	FC	FB	GB	GH	GB	JE	JE	JB
9,100 pF	912		FGJKM					EC		FE					GP	СЦ	CP	16	16	ю
12,000 pF	103		FGJKM			FR		ED	FG	FG	FG	FG	FR	FB	GB	GC	GB	JE	JE	JD IR
15,000 pF	153		F G J K M	FR F	B FB	FB	FB	FF	FG	FG	FG	FG	FB	FC	GB	GB	GB	JE	JE	JB
18.000 pF	183		FGJKM	EB E	B EB	EB	EB	EH	FB	FB	FB	FB	FB	FC	GB	GB	GB	JE	JE	JB
22,000 pF	223		F G J K M	EB E	B EB	EB	EC	EH	FB	FB	FB	FB	FB	FF	GB	GB	GB	JE	JB	JB
27,000 pF	273		F G J K M	EB E	B EB	EB	EE		FB	FB	FB	FB	FB	FG	GB	GB	GB	JE	JB	JB
33,000 pF	333		F G J K M	EB E	B EB	EB	EE		FB	FB	FB	FB	FB	FH	GB	GB	GB	JB	JB	JB
39,000 pF	393		F G J K M	EC E	C EC	EE	EH		FB	FB	FB	FB	FE	FH	GB	GB	GB	JB	JB	JB
47,000 pF	473		F G J K M	EC E	C EC	EE	EH		FB	FB	FB	FB	FE	FJ	GB	GB	GD	JB	JB	JB
56,000 pF	563		F G J K M	ED E	D ED	EF			FB	FB	FB	FB	FF		GB	GB	GD	JB	JB	JB
68,000 pF	683		FGJKM	EF E		EH			FB	FB	FB	FC	FG		GB	GB	GK	JB	JB	JB
82,000 pF	823		FGJKM	EH E		EH			FC	FC	FC	FF	FH		GB	GB	GM	JB	JB	JB
0.10 µF	104		FGJKM						FE	FE	FE	FG EL	FIVI		GB	GD	GIVI	JB	JD	JD
0.12 µF	124		FGJKM						FH	FH	FH	FI			GD	GN		JD	JB	JD
0.13 µľ	184		FGJKM						EI	E.I	EL	1 101			GH	UN		JB	JD	JG
0.22 µF	224		FGJKM						FK	FK	FK				GK			JB	JD	JL
0.27 µF	274		F G J K M															JB	JF	
0.33 µF	334		FGJKM															JD	JG	
0.39 µF	394		FGJKM															JG		
0.47 µF	474		F G J K M															JG		
	C	Rated	d Voltage (VDC)	9	16 25	50	<u>10</u>	200	9	16	25	50	100	200	50	<u>10</u>	200	20	100	200
Capacitance	Cap Code	Vo	oltage Code	8	4 3	5	1	2	8	4	3	5	1	2	5	1	2	3	1	2
		Case	e Size / Series		C12	206C					C12	10C			(:18120)	C	22200)

*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 2 – Chip Thickness/Packaging Quantities

Thickness	Case	Thickness ±	Paper C	Quantity	Plastic (Quantity		
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel		
BB BD CB CF CH	402 402 603 603 603	$\begin{array}{c} 0.50 \pm 0.05 \\ 0.55 \pm 0.05 \\ 0.80 \pm 0.07 \\ 0.80 \pm 0.07 \\ 0.85 \pm 0.07 \end{array}$	10000 10000 4000 4000 4000	50000 50000 10000 15000 10000	0 0 0 0	0 0 0 0		
DE DC DD DF DG	0805 0805 0805 0805 0805 0805	0.00 ± 0.07 0.70 ± 0.20 0.78 ± 0.10 0.90 ± 0.10 1.10 ± 0.10 1.25 ± 0.15	4,000 4,000 4,000 0 0	10,000 10,000 10,000 0 0	0 0 0 2,500 2,500	0 0 0 10,000 10,000		
EB EC ED EE EF	1206 1206 1206 1206 1206	$\begin{array}{c} 0.78 \pm 0.10 \\ 0.90 \pm 0.10 \\ 1.00 \pm 0.10 \\ 1.10 \pm 0.10 \\ 1.20 \pm 0.15 \end{array}$	4,000 0 0 0 0	10,000 0 0 0 0	4,000 4,000 2,500 2,500 2,500 2,500	10,000 10,000 10,000 10,000 10,000 10,000		
EH FB FC FE FF	1206 1210 1210 1210 1210	$\begin{array}{c} 1.60 \pm 0.20 \\ 0.78 \pm 0.10 \\ 0.90 \pm 0.10 \\ 1.00 \pm 0.10 \\ 1.10 \pm 0.10 \end{array}$	0 0 0 0	0 0 0 0	2,000 4,000 2,500 2,500	8,000 10,000 10,000 10,000 10,000		
FG FH FM FJ FK	1210 1210 1210 1210 1210 1210	$\begin{array}{c} 1.25 \pm 0.15 \\ 1.55 \pm 0.15 \\ 1.70 \pm 0.20 \\ 1.85 \pm 0.20 \\ 2.10 \pm 0.20 \end{array}$	0 0 0 0	0 0 0 0	2,500 2,000 2,000 2,000 2,000	10,000 8,000 8,000 8,000 8,000		
GB GD GH GG GK	1812 1812 1812 1812 1812 1812	$\begin{array}{c} 1.00 \pm 0.10 \\ 1.25 \pm 0.15 \\ 1.40 \pm 0.15 \\ 1.55 \pm 0.10 \\ 1.60 \pm 0.20 \end{array}$	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		
GJ GN GM JB JD	1812 1812 1812 2220 2220	$\begin{array}{c} 1.70 \pm 0.15 \\ 1.70 \pm 0.20 \\ 2.00 \pm 0.20 \\ 1.00 \pm 0.15 \\ 1.30 \pm 0.15 \end{array}$	0 0 0 0	0 0 0 0	1,000 1,000 500 1,000 1,000	4,000 4,000 2,000 4,000 4,000		
JE JF JG JL	2220 2220 2220 2220 2220	$\begin{array}{c} 1.40 \pm 0.15 \\ 1.50 \pm 0.15 \\ 1.70 \pm 0.15 \\ 2.00 \pm 0.20 \end{array}$	0 0 0 0	0 0 0 0	1,000 1,000 1,000 500	4,000 4,000 4,000 2,000		
Thickness Code	Case Size	Thickness ± Range (mm)	7" Reel Paper C	13" Reel Quantity	7" Reel 13" Reel Plastic Quantity			

Package quantity based on finished chip thickness specifications.


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

EIA Size Code	Metric Size		Dens Maxi Land P	sity Lev mum (I rotrusio	vel A: Most) on (mm)		Dens Medi Land P	sity Lev an (Nor rotrusio	vel B: ninal) on (mm)		Dens Minii Land P	sity Lev mum (L rotrusio	vel C: .east) on (mm)
oouc	oouc	C	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	X	V1	V2
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	0.40	0.52	0.52	1.60	0.80
0603	1608	0.90	1.15	1.10	4.00	2.10	0.80	0.95	1.00	3.10	1.50	0.60	0.75	0.90	2.40	1.20
0805	2012	1.00	1.35	1.55	4.40	2.60	0.90	1.15	1.45	3.50	2.00	0.75	0.95	1.35	2.80	1.70
1206	3216	1.60	1.35	1.90	5.60	2.90	1.50	1.15	1.80	4.70	2.30	1.40	0.95	1.70	4.00	2.00
1210	3225	1.60	1.35	2.80	5.65	3.80	1.50	1.15	2.70	4.70	3.20	1.40	0.95	2.60	4.00	2.90
1210 ¹	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 \geq 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).



Soldering Process

Recommended Soldering Technique:

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

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020



Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 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		a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	3-310-002	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 +/- 2 hours after test conclusion.
Biased Humidity	MIL_STD_202 Method 103	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Diased Humany		Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
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

Reference	lt	em	Material
А		Finish	100% Matte Sn
В	Termination Svstem	Barrier Layer	Ni
С	- ,	Base Metal	Cu
D	Inner E	Electrode	Ni
E	Dielectri	ic Material	CaZrO ₃



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



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 $\pm 15\%$ from -55°C to +125°C.

Ordering Information

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:



С	1210	Т	104	K	5	R	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Dielectric	Failure Rate/Design	Termination Finish ¹	Packaging/Grade (C-Spec) ²
	0402 0603 0805 1206 1210 1812 2220	T = COTS	2 Significant Digits + Number of Zeros	J = ±5% K = ±10% M = ±20%	9 = 6.3 V 8 = 10 V 4 = 16 V 3 = 25 V 5 = 50 V 1 = 100 V 2 = 200 V A = 250 V	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% minimum)	Blank = Bulk TU = 7" Reel Unmarked TM = 7" Reel Marked

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

² Additional reeling or packaging options may be available. Contact KEMET for details.



Dimensions – Millimeters (Inches)





Electrodes / Conductive Metalization

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 ¹	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 \geq 12 μ F add 0.02 (0.001) to the width tolerance dimension

Benefits

- -55°C to +125°C operating temperature range
- Pb-Free and RoHS 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 $\pm 5\%$, $\pm 10\%$, and $\pm 20\%$
- · Non-polar device, minimizing installation concerns
- 100% pure matte tin-plated termination finish allowing for excellent solderability
- SnPb termination finish option available upon request (5% minimum)

Applications

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



Qualification/Certification

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

Environmental Compliance

Pb-Free and RoHS Compliant (excluding SnPb termination finish option).



Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +125°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit @ 25°C	5% (6.3 and 10 V), 3.5% (16 and 25 V) and 2.5% (50 V to 250 V)
Insulation Resistance (IR) Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ±5 seconds @ 25°C)

Regarding aging rate: Capacitance measurements (including tolerance) are indexed to a referee time of 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 \pm 50 Hz and 1.0 \pm 0.2 Vrms if capacitance \leq 10 μ 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 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	< 0.047 µF	≥ 0.047 µF
1206	< 0.22 µF	≥ 0.22 µF
1210	< 0.39 µF	≥ 0.39 µF
1808	ALL	N/A
1812	< 2.2 µF	≥ 2.2 µF
1825	ALL	N/A
2220	< 10 µF	≥ 10 µF
2225	ALL	N/A



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

		Cas S	se Si Serie	ize / es		CO	402	2C				C0	603	3C					C	208	05C	;					C	212	06C	;		
Canacitance	Сар	Vol	tage C	ode	9	8	4	3	5	9	8	4	3	5	1	2	9	8	4	3	5	1	2	A	9	8	4	3	5	1	2	A
Oupuonuneo	Code	Rate	ed Vol (VDC)	tage)	6.3	9	16	25	50	6.3	9	9	25	50	1 0	200	6.3	9	16	25	50	1 0	200	250	6.3	9	16	25	50	0	200	250
		Cap	pacita	ince									Pr	oduc	ct Av	vaila	l bility	and	Chi	p Th	ickn	ess	Code	es		<u> </u>				I		
10 91 pE*	100 . 910*		bleran	M	BB	BB	BB	DB	DB	CB	CB	CB	CB	See I	CB	e 2 te			hicki	ness	Dim	nens	ions		ER	ER	EB	EB	EB	EB	EB	
100 - 150 pF**	101 - 151**	J	K	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC		EB	EB	EB	EB	EB	EB	EB	
180 - 820 pF**	181 - 820**	J	ĸ	М	BB	BB	BB	BB	BB	СВ	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	
1,000 pF	102	J	К	М	BB	BB	BB	BB	BB	СВ	СВ	СВ	СВ	CF	СВ	CF	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB
1,200 pF	122	J	K	М	BB	BB	BB	BB	BB	СВ	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB
1,500 pF	152	J	K	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB
1,800 pF	182	J	K	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CR	CR	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB
2,200 pr 2,700 pF	222	J	ĸ	M	BB	BB	BB	BD	BB	CB	CB	CB	CB		CE	CB									ED	FR	FR	FR	ED	FR	FR	FR
3,300 pF	332		K	M	BB	BB	BB	RB	RB	CB	CB	CB	CB	CB	CB	CB		DC			DC				FB	FB	FB	FB	FB	FB	FB	FB
3.900 pF	392	J	K	М	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB
4,700 pF	472	J	K	М	BB	BB	BB	BB	BB	СВ	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB
5,600 pF	562	J	К	М	BB	BB	BB	BB	BB	СВ	СВ	СВ	СВ	CB	СВ	СВ	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB
6,800 pF	682	J	К	М	BB	BB	BB	BB	BB	СВ	CB	CB	CB	CB	СВ	СВ	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB
8,200 pF	822	J	K	М	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB
10,000 pF	103	J	K	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CF	CF	СВ	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB
12,000 pF	123	J	K	M	BB	BB	BB	BB	BR	CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DC	DC	EB ED	EB	EB	EB	ER	FR	EB	EB
15,000 pF 18,000 pF	183	J	K	M	BD	BB	BD	BD	DD RR	CB	CB	CB	CB	CB	CB			DC			DC	ם חח	DC			ED	FR		FR	FR	EB	
22 000 pF	223	Ĵ	K	M	BB	BB	BB	RB	RB	CB	CB	CB	CB	CF	CF		DC	DC		DC	DC	סט	DC		FB	EB	EB	EB	FB	FB	EB	EB
27.000 pF	273	J	K	М	BB	BB	BB	BB	00	CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DD	DE	00	EB	EB	EB	EB	EB	EB	EB	EB
33,000 pF	333	J	K	М	BB	BB	BB	BB		СВ	СВ	СВ	CF	СВ	СВ		DC	DC	DC	DC	DC	DD	DE		EB	EB	EB	EB	EB	EB	EB	EB
39,000 pF	393	J	K	М	BB	BB	BB	BB		СВ	СВ	СВ	СВ	СВ	СВ		DC	DC	DC	DC	DC	DD	DE		EB	EB	EB	EB	EB	EC	EB	EB
47,000 pF	473	J	K	М	BB	BB	BB	BB		СВ	CB	CB	CB	CF	CB		DC	DC	DC	DC	DC	DE	DG		EB	EB	EB	EB	EB	EC	ED	ED
56,000 pF	563	J	K	M	BB	BB	BB			CB	CB	CB	CB	CB			DD	DD	DD	DD	DD	DE	DG		EB	EB	EB	EB	EB	EB	ED	ED
68,000 pF	683	J	K	M	BB	BB	BB			CB	CB	CB	CB				DD	DD	00	טט	DD	DE			EB	EB	EB	EB	EB	EB	ED	ED
02,000 pr 0.10 µF	023	J	K	M	BD	BB	BD			CB	CB	CE	CE	CE				DC							FR	FR	FR		FR	FR	ED	ED
0.12 µF	124	Ĵ	K	M						CB	CB	CB	CB	CB			DC	DC	DC	DC	DD	DG			EC	EC	EC	EC	EC	EC	EG	Livi
0.15 µF	154	J	K	М						CB	CB	CB	CB	CB			DC	DC	DC	DC	DD	DG			EC	EC	EC	EC	EC	EC	EG	
0.18 µF	184	J	K	М						СВ	CB	CB	CB				DC	DC	DC	DC	DD	DG			EC	EC	EC	EC	EC	EC		
0.22 µF	224	J	K	М						СВ	CB	CB	CB				DC	DC	DC	DC	DD	DG			EC	EC	EC	EC	EC	EC		
0.27 µF	274	J	K	М						СВ	CB	CB					DD	DD	DD	DD	DD				EB	EB	EB	EB	EC	EM		
0.33 µF	334	J	K	М						CB	CB	CB					DD	DD	DD	DD	DD				EB	EB	EB	EB	EC	EG		
0.39 µF	394	J	K	M						CB	CB	CB					DG	DG	DG	DG	DE				EB	EB	EB	EB	EC	EG		
0.47 µr	4/4	J	ĸ	M						СВ	CB	CB					ם ח	ם	ם		DE					EU			EU FC	EG	1 /	
0.50 µi	684		K	M													חח		ם ח	DG	DH				FF	FF	FF	FF	FD		1 /	
0.82 µF	824	Ĵ	K	M													DD	DD	DD	DG	0				EF	EF	EF	EF	ED		1 /	
1.0 µF	105	J	ĸ	М													DD	DD	DD	DG					EF	EF	EF	EG	ED		1 /	
1.2 µF	125	J	K	М													DE	DE	DE						ED	ED	ED	EG	EH			
1.5 µF	155	J	K	М													DG	DG	DG						EF	EF	EF	EG	EH			
1.8 µF	185	J	K	М													DG	DG	DG						ED	ED	ED	EF	EH			
2.2 µF	225	J	K	M													DG	DG	DG						ED	ED	ED	EF	EH			
2./µ⊦ 2.3.µE	2/5	J	K	M																					EN	EN	EN 5D	EH			_	
3.3 µr 3.9 µF	300	J	K	M																					FF		FF	FH			1 /	
4.7 µF	475	J	K	M																					EF	EF	EF	EH			1 /	
P.		Rate	ed Vol	tage	6.3	÷	16	25	50	6.3	10	16	25	50	8	00	6.3	6	16	25	50	8	00	250	6.3	9	16	25	50	8	00	50
Capacitance	Cap Code	Volt	(VDC)	ode	-	8	4	3	5	_ ٩	8	4	3	5	1	2	- ۹	8	4	3	5	1	2	Δ	_ ٩	8	4	3	5	1	2	
	00000	101	uge o	Jouc	Ľ		-		•	<u> </u>	•	-	<u> </u>	_		-	L,	U	-		<u> </u>	•	-	^	Ļ		-		<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

		Cas	se S Serie	ize / es		CO)402	2C				CO	603	3C					(208	050	2					C	C12	06C	,		
Canacitanco	Сар	Vo	ltage (ode	9	8	4	3	5	9	8	4	3	5	1	2	9	8	4	3	5	1	2	A	9	8	4	3	5	1	2	Α
Capacitance	Code	Rat	ted Voltage (VDC) pacitance olerance			9	16	25	50	6.3	9	16	25	50	100	200	6.3	9	16	25	50	100	200	250	6.3	10	16	25	50	100	200	250
		Ca To	pacita olerar	ance ice									Pr	odu See	ct Av Tabl	vaila e 2 fe	bility or Ch	and and	Chi hick	p Th ness	ickn Din	ess nens	Cod ions	es								
5.6 µF	565	J	K	М																					EH	EH	EH					
6.8 µF	685	J	K	M																					EH	EH	EH					
8.2 µF	825	J	K	M																					EH	EH	EH					
10 µF	106	J	K	M																					EH	EH	EH					
	Can	Rat	ed Vo (VDC	ltage)	6.3	10	16	25	50	6.3	10	16	25	50	100	200	6.3	10	16	25	50	100	200	250	6.3	10	16	25	50	100	200	250
Capacitance	Code	Vo	ltage (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
			Serie	s		C	0402	C				C	0603	C	,					C08	05C							C12)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 – 2220 Case Sizes)

		Cas	se Si Serie	ze / s				C12	10C					С	1812	2C			C18	25C			C	2220	C	
Consoitonoo	Сар	Vo	tage C	ode	9	8	4	3	5	1	2	A	3	5	1	2	A	5	1	2	A	3	5	1	2	A
Capacitance	Code	Rat	ed Volt (VDC)	age	6.3	10	16	25	50	100	200	250	25	50	100	200	250	50	100	200	250	25	50	100	200	250
		Ca	oacita oleran	nce ce							Р	roduc See 1	t Ava able 2	ilabili 2 for (ty and Chip T	l Chip hickr	o Thic ness D	kness)imen	Code sions	es						
10 - 91 pF*	100 - 910*	J	K	M	FB	FB	FB	FB	FB	FB	FB															
100 - 390 pF**	101 - 391**	J	K	M	FB	FB	FB	FB	FB	FB	FB															
470 - 820 pF**	471 - 821**	J	K	M	FB	FB	FB	FB	FB	FB	FB		GB	GB	GB	GB										
560 pF	561	J	K	M	FB	FB	FB	FB	FB	FB	FB		GB	GB	GB	GB										
680 pF	681	J	K	M	FB	FB	FB	FB	FB	FB	FB		GB	GB	GB	GB										
820 pF	821	J	K	M	FB	FB	FB	FB	FB	FB	FB		GB	GB	GB	GB										
1,000 pF	102	J	K	M	FB	FB	FB	FB	FB	FB	FB		GB	GB	GB	GB										
1,200 pF	122	J	K	M	FB	FB	FB	FB	FB	FB	FB		GB	GB	GB	GB										
1,500 pF	152	J	K	M	FB	FB	FB	FB	FB	FB	FE		GB	GB	GB	GB										
1,800 pF	182	J	K	М	FB	FB	FB	FB	FB	FB	FE		GB	GB	GB	GB										
2,200 pF	222	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB										
2,700 pF	272	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB										
3,300 pF	332	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB										
3,900 pF	392	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB										
4,700 pF	472	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GD										
5,600 pF	562	J	K	М	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GH										
6,800 pF	682	J	K	М	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB					JE	JE	JE		
8,200 pF	822	J	K	М	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB					JE	JE	JE		
10,000 pF	103	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB					JE	JE	JE		
	Can	Rat	ed Volt (VDC)	age	6.3	10	16	25	50	100	200	250	25	50	100	200	250	50	100	200	250	25	50	100	200	250
Capacitance	Code	Vo	tage C	ode	9	8	4	3	5	1	2	A	3	5	1	2	Α	5	1	2	Α	3	5	1	2	Α
			Series	5				C12	10C					C	C1812	С			C18	25C			C	2220	0	

*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 – 2220 Case Sizes) cont'd

		Cas	ISE Size / Series					C12	10C					С	1812	2C			C18	25C			C	2220	IC	
Canacitanaa	Сар	Vo	ltage C	ode	9	8	4	3	5	1	2	Α	3	5	1	2	A	5	1	2	Α	3	5	1	2	Α
Capacitance	Code	Rat	ted Vol (VDC)	tage	6.3	6	16	25	50	100	200	250	25	50	100	200	250	50	100	200	250	25	20	100	200	250
		Ca To	pacita oleran	ince ice							Р	roduc See 1	t Ava able	ilabili 2 for (ty and Chip T	l Chip hickr) Thic less D	kness)imen	s Cod sions	es						
12,000 pF	123	J	K	М	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB					JE	JE	JE		
15,000 pF	153	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB					JE	JE	JE		
18,000 pF	183	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB					JE	JE	JE		
22,000 pF	223	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB	HB	HB	HB	HB	JE	JE	JE		
27,000 pF	273	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB	HB	HB	HB	HB	JE	JE	JE		
33,000 pF	333	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB	НВ	HB	HB	HB	JB	JB	JB		
39,000 pF	393	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB	НВ	HB	HB	HB	JB	JB	JB		
47,000 pF	473	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB	НВ	HB	HB	HB	JB	JB	JB		
56,000 pF	563	J	K	M	FB	FB	FB	FB	FB	FB	FC	FC	GB	GB	GB	GB	GB	HB	HB	HB	HB	JB	JB	JB		
68,000 pF	683	J	K	M	FB	FB	FB	FB	FB	FB	FC	FC	GB	GB	GB	GB	GB	HB	HB	HB	HB	JB	JB	JB		
82,000 pF	823	J	K	M	FB	FB	FB	FB	FB	FC	FF	FF	GB	GB	GB	GB	GB	HB	HB	HB	HB	JB	JB	JC	JC	JC
0.10 µF	104	J	K	M	FB	FB	FB	FB	FB	FD	FG	FG	GB	GB	GB	GB	GB	HB	HB	HB	HB	JB	JB	JC	JC	JC
0.12 µF	124	J	K	M	FB	FB	FB	FB	FB	FD			GB	GB	GB	GB	GB	HB	HB	HB	HB	JB	JB	JC	JC	JC
0.15 µF	154	J	K	M	FC	FC	FC	FC	FC	FD			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			GB	GB	GB	GG	GG	HB	HB	HB	HB	JB	JB	JC	JC	JC
0.22 µF	224	J	K	M	FC	FC	FC	FC	FC	FD			GB	GB	GB	GG	GG	HB	HB	HB	HB	JB	JB	JC	JC	JC
0.27 µF	274	J	K	M	FC	FC	FC	FC	FC	FD			GB	GB	GG	GG	GG	HB	HB	HB	HB	JC	JC	JC	JC	JC
0.33 µF	334	J	K	M	FD	FD	FD	FD	FD	FD			GB	GB	GG	GG	GG	HB	HB	HB	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			
15 µF	156	J	K	M																		JO				
22 µF	226	J	K	M	FS	FS																JO				
	Can	Rat	ted Vol (VDC)	tage	6.3	9	16	25	50	100	200	250	25	50	100	200	250	50	100	200	250	25	50	100	200	250
Capacitance	Code	Vo	ltage C	ode	9	8	4	3	5	1	2	A	3	5	1	2	A	5	1	2	A	3	5	1	2	Α
			Serie	S				C12	10C					(C1812	С			C18	25C			C	;2220	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) **Capacitance range Includes E12 decade values only. (i.e., 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68 and 82)



Table 2 – Chip Thickness/Packaging Quantities

Thickness	Case	Thickness ±	Paper C	Quantity	Plastic Quantity		
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel	
BB CB	0402 0603	0.50 ± 0.05 0.80 ± 0.07 $0.80 \pm 0.07^*$	10,000 4,000 4,000	50,000 10,000 15,000	0 0	0 0	
DE DC	0805 0805	0.30 ± 0.07 0.70 ± 0.20 0.78 ± 0.10	4,000 4,000 4,000	10,000 10,000 10,000	0	0	
DD DG DH EB EC	0805 0805 0805 1206 1206	$\begin{array}{c} 0.90 \pm 0.10 \\ 1.25 \pm 0.15 \\ 1.25 \pm 0.20 \\ 0.78 \pm 0.10 \\ 0.90 \pm 0.10 \end{array}$	4,000 0 4,000	10,000 0 10,000	0 2,500 2,500 4,000 4 000	0 10,000 10,000 10,000 10,000	
EN ED EE EF EM	1206 1206 1206 1206 1206	0.95 ± 0.10 1.00 ± 0.10 1.10 ± 0.10 1.20 ± 0.15 1.25 ± 0.15	0 0 0 0	0 0 0 0	4,000 2,500 2,500 2,500 2,500	10,000 10,000 10,000 10,000 10,000	
EG EH FB FC FD	1206 1206 1210 1210 1210	1.60 ± 0.10 1.60 ± 0.15 1.60 ± 0.20 0.78 ± 0.10 0.90 ± 0.10 0.95 ± 0.10	0 0 0 0	0 0 0 0	2,000 2,000 4,000 4,000 4,000	8,000 8,000 10,000 10,000 10,000	
FE FF FG FL FH	1210 1210 1210 1210 1210 1210	$\begin{array}{c} 1.00 \pm 0.10 \\ 1.00 \pm 0.10 \\ 1.10 \pm 0.10 \\ 1.25 \pm 0.15 \\ 1.40 \pm 0.15 \\ 1.55 \pm 0.15 \end{array}$	0 0 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 8,000 8,000	
FM FJ FK FS GB	1210 1210 1210 1210 1210 1812	1.70 ± 0.20 1.85 ± 0.20 2.10 ± 0.20 2.50 ± 0.30 1.00 ± 0.10	0 0 0 0 0	0 0 0 0 0	2,000 2,000 2,000 1,000 1,000	8,000 8,000 8,000 4,000 4,000	
GC GD GE GH GG	1812 1812 1812 1812 1812 1812	$\begin{array}{c} 1.10 \pm 0.10 \\ 1.25 \pm 0.15 \\ 1.30 \pm 0.10 \\ 1.40 \pm 0.15 \\ 1.55 \pm 0.10 \end{array}$	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	
GK GJ HB HD	1812 1812 1812 1825 1825	$\begin{array}{c} 1.60 \pm 0.20 \\ 1.70 \pm 0.15 \\ 2.50 \pm 0.20 \\ 1.10 \pm 0.15 \\ 1.30 \pm 0.15 \end{array}$	0 0 0 0 0	0 0 0 0 0	1,000 1,000 500 1,000 1,000	4,000 4,000 2,000 4,000 4,000	
HF JB JC JD JE JF	1825 2220 2220 2220 2220 2220 2220	$\begin{array}{c} 1.50 \pm 0.15 \\ 1.00 \pm 0.15 \\ 1.10 \pm 0.15 \\ 1.30 \pm 0.15 \\ 1.40 \pm 0.15 \\ 1.50 \pm 0.15 \end{array}$	0 0 0 0	0 0 0 0	1,000 1,000 1,000 1,000 1,000 1,000	4,000 4,000 4,000 4,000 4,000 4,000	
ĴŌ	2220	2.40 ± 0.15	Ő	Ő	500	2,000	
Thickness Case Code Size		Thickness ± Range (mm)	7" Reel	13" Reel	7" Reel 13" Reel		
			Paper G	auditity	Plastic	auditity	

Package quantity based on finished chip thickness specifications.



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

EIA Size Code	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)					
oout	oouc	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	X	V1	V2
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	0.40	0.52	0.52	1.60	0.80
0603	1608	0.90	1.15	1.10	4.00	2.10	0.80	0.95	1.00	3.10	1.50	0.60	0.75	0.90	2.40	1.20
0805	2012	1.00	1.35	1.55	4.40	2.60	0.90	1.15	1.45	3.50	2.00	0.75	0.95	1.35	2.80	1.70
1206	3216	1.60	1.35	1.90	5.60	2.90	1.50	1.15	1.80	4.70	2.30	1.40	0.95	1.70	4.00	2.00
1210	3225	1.60	1.35	2.80	5.65	3.80	1.50	1.15	2.70	4.70	3.20	1.40	0.95	2.60	4.00	2.90
1210 ¹	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 \geq 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).





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.

Drofilo Fosturo	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 $(T_L \text{ to } T_P)$	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T_L)	183°C	217°C
Time Above Liquidous (t_L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T _P)	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t _P)	20 seconds maximum	30 seconds maximum
Ramp-Down Rate $(T_P \text{ to } T_L)$	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum

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





Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection 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:
Soldorability		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 +/- 2 hours after test conclusion.
Piacod Humidity	MIL STD 202 Mothed 103	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Biased Humidity		Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
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.



Overview

KEMET's 250 V DC Tip and Ring MLCCs in X7R dielectric are designed and rated for telecommunication ringer circuits where the capacitor is used to block -48 V to -52 V 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 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 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 $\pm 15\%$ 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
- · Pb-Free and RoHS 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

Ordering Information

- SnPb termination finish option available upon request (5% minimum)
- · Flexible termination option available upon request



С	1825	С	105	K	Α	R	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec) ²
	0805 1206 1210 1812 1825 2220 2225	C = Standard X = Flexible Termination	2 Significant Digits + Number of Zeros	J = ±5% K = ±10% M = ±20%	A = 250 V	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% minimum)	Blank = Bulk TU = 7" Reel Unmarked TM = 7" Reel Marked

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

² 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
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) ± 0.20 (.008)	1.25 (.049) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	Solder Wave or
1206	3216	3.30 (.130) ± 0.40 (.016)	1.60 (.063) ± 0.20 (.008)		0.60 (.024) ± 0.25 (.010)		Solder Reflow
1210	3225	3.30 (.130) ± 0.40 (.016)	2.50 (.098) ± 0.20 (.008)		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)		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)		



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

Pb-Free and RoHS Compliant (excluding SnPb termination finish option).



Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +125°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit @ 25°C	5% (6.3 and 10 V), 3.5% (16 and 25 V) and 2.5% (50 to 250 V)
Insulation Resistance (IR) Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ±5 seconds @ 25°C)

Regarding aging rate: Capacitance measurements (including tolerance) are indexed to a referee time of 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

120 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."



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	< 0.047 µF	≥ 0.047 µF
1206	< 0.22 µF	≥ 0.22 µF
1210	< 0.39 µF	≥ 0.39 µF
1808	ALL	N/A
1812	< 2.2 µF	≥ 2.2 µF
1825	ALL	N/A
2220	< 10 µF	≥ 10 µF
2225	ALL	N/A



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

	Conscitones	Ca	se Siz Series	ze /	C0805C	C1206C	C1210C	C1812C	C1825C	C2220C	C2225C
Capacitance	Capacitance	Vo	ltage Co	de	Α	A	А	Α	A	A	Α
	Code	Rated	Voltage	(VDC)	250	250	250	250	250	250	250
		Capacit	ance To	lerance		F	Product Availab	ility and Chip T	hickness Code	es	
180 pF	181	J	K	М	DC						
220 pF	221	J	К	M	DC						
270 pF	271	J	K	M	DC						
330 pF	331	J	K	M	DC						
390 pF	391	J	K	M	DC						
470 pF	4/1	J	K	IVI M	DC						
560 pF	501	J	ĸ	IVI M	DC						
820 pF	821	J	ĸ	M	DC						
1000 pF	102		ĸ	M	DC	FB					
1200 pF	122	J	K	M	DC	EB					
1500 pF	152	J	K	M	DC	EB					
1800 pF	182	J	К	M	DC	EB					
2200 pF	222	J	К	M	DC	EB	FB				
2700 pF	272	J	К	M	DC	EB	FB				
3300 pF	332	J	K	M	DC	EB	FB				
3900 pF	392	J	К	M	DC	EB	FB				
4700 pF	472	J	K	M	DC	EB	FB				
5600 pF	562	J	K	M	DC	EB	FB				
6800 pF	682	J	K	M	DC	EB	FB	GB			
8200 pF	822	J	K	IVI M	DC	EB	FB	GB			
10000 pF	103	J	ĸ	IVI	DC	EB	FB	GB			
12000 pF 15000 pF	123	J	ĸ	M	DC	ED	FB	GB			
18000 pF	183		ĸ	M	DC	FB	FB	GB			
22000 pF	223	J	K	M	DC	EB	FB	GB	НВ		
27000 pF	273	J	к	м		EB	FB	GB	НВ		
33000 pF	333	J	К	M		EB	FB	GB	НВ		
39000 pF	393	J	К	M		EB	FB	GB	HB		
47000 pF	473	J	К	M		ED	FC	GB	HB		
56000 pF	563	J	К	M		ED	FC	GB	HB		
68000 pF	683	J	K	M		ED	FC	GB	HB		
82000 pF	823	J	K	M		ED	FF	GB	HB	JC	140
0.1 µF	104	J	K	M		EM	FG	GB	HB	JC	KC
0.12 µF	124	J	K	IVI N4				GB	НВ	10	KC
0.13 µi	184		K	M				GG	HR		KC
0.22 µF	224		K	M				GG	HB	JC	KC
0.27 uF	274	Ĵ	K	M				GG	НВ	JC	KC
0.33 µF	334	J	K	M				GG	НВ	JC	KC
0.39 µF	394	J	K	M				GG	HD	JC	KC
0.47 µF	474	J	К	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 μF 1.2 μF	105	J	K K	M					HF	J⊦	KE KE
		Rated	Voltage	(VDC)	250	250	250	250	250	250	250
Capacitance	Capacitance Code	Vo	ltage Co	de	A	A	A	A	A	A	A
		Case	Size / S	eries	C0805C	C1206C	C1210C	C1812C	C1825C	C2220C	C2225C

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

Thickness	Case	Thickness ±	Paper C	Quantity	Plastic (Quantity
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
DC	0805	0.78 ± 0.10	4,000	10,000	0	0
EB	1206	0.78 ± 0.10	4,000	10,000	4,000	10,000
ED	1206	1.00 ± 0.10	0	0	2,500	10,000
EM	1206	1.25 ± 0.15	0	0	2,500	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
FF	1210	1.10 ± 0.10	0	0	2,500	10,000
FG	1210	1.25 ± 0.15	0	0	2,500	10,000
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 ± Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
Code	Size		Paper C	Quantity	Plastic (Quantity

Table 2 – Chip Thickness/Packaging Quantities

Package quantity based on finished chip thickness specifications.

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

EIA Size	Metric Size		Dens Maxi Land P	sity Lev mum (M rotrusic	rel A: /lost) on (mm)		Dens Medi Land P	sity Lev an (Nor rotrusio	vel B: ninal) on (mm))	Density Level C: Minimum (Least) Land Protrusion (mm)					
Code	Code	Code C Y X V1 V2 C					С	C Y X V1 V2				С	Y	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	
1210 ¹	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 \geq 22 μ F





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

EIA Size Code	Metric Size	c Density Level A: Maximum (Most) Land Protrusion (mm)						Dens Media Land P	sity Lev an (Nor rotrusio	vel B: ninal) on (mm)	Density Level C: Minimum (Least) Land Protrusion (mm)					
ooue	ooue	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	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	0.80	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	
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.				2.75	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).



Soldering Process

Recommended Soldering Technique:

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

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020



Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 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:
Saldarability		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
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 2 hours after test conclusion.
Discod Llumiditu		Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Blased 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.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
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

Reference	lt	em	Material					
А	Termination	Finish	100% Matte Sn	SnPb (5% min)				
В		Barrier Layer	Ni					
С	- ,	Base Metal	Cu					
D	Inner E	Electrode	Ni					
E	Dielectri	c Material	BaTiO ₃					



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

Construction – Flexible Termination

Reference	lt	em	Material					
А	Termination System	Finish	100% Matte Sn	SnPb (5% min)				
В		Barrier Layer	Ni					
С		Epoxy Layer	Ag					
D		Base Metal	Cu					
E	Inner E	lectrode	Ni					
F	Dielectri	c Material	BaTiO₃					



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



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 $\pm 15\%$ from -55° C to $\pm 125^{\circ}$ C.



Ordering Information

С	1210	J	685	К	3	R	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec) ²
	0805 1206 1210 1812	F = Open Mode J = Open Mode with Flexible Termination	2 Significant Digits + Number of Zeros	K = ±10% M = ±20%	4 = 16 V 3 = 25 V 5 = 50 V 1 = 100 V 2 = 200 V	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% minimum)	Blank = Bulk TU = 7" Reel Unmarked TM = 7" Reel Marked AUTO = Automotive Grade

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.



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)	N/A	Calder Deflaw Only
1812	4532	4.50 (.177) ± 0.30 (.012)	3.20 (.126) ± 0.30 (.012)		0.60 (.024) ± 0.35 (.014)		Solder Reliow Uniy



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) ± 0.20 (.008)	1.25 (.049) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	Solder Wave or
1206	3216	3.30 (.130) ± 0.40 (.016)	1.60 (.063) ± 0.20 (.008)	See Table 2 for	0.60 (.024) ± 0.25 (.010)		Solder Reflow
1210	3225	3.30 (.130) ± 0.40 (.016)	2.50 (.098) ± 0.20 (.008)	Thickness	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

Benefits

- -55°C to +125°C operating temperature range
- Open Mode/fail open design
- Mid to high capacitance flex mitigation
- Pb-Free and RoHS 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% 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.

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

Pb-Free and RoHS Compliant (excluding SnPb termination finish option).



Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +125°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit @ 25°C	5% (6.3 and 10 V), 3.5% (16 and 25 V) and 2.5% (50 to 250 V)
Insulation Resistance (IR) Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ±5 seconds @ 25°C)

Regarding aging rate: Capacitance measurements (including tolerance) are indexed to a referee time of 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 μF

120 Hz ±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 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		3.0									
X7R	16/25	All	5.0	±20%	10% of Initial Limi							
	< 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	< 0.047 µF	≥ 0.047 µF
1206	< 0.22 µF	≥ 0.22 µF
1210	< 0.39 µF	≥ 0.39 µF
1808	ALL	N/A
1812	< 2.2 µF	≥ 2.2 µF
1825	ALL	N/A
2220	< 10 µF	≥ 10 µF
2225	ALL	N/A



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

	0	Case Sei	Size / ries		С	0805	öF			С	1206	βF		C1210F C1812F					12F			
Capacitance	Сар	Voltag	e Code	4	3	5	1	2	4	3	5	1	2	4	3	5	1	2	3	5	1	2
	Code	Rated Vol	tage (VDC)	16	25	50	100	200	16	25	50	100	200	16	25	50	100	200	25	50	100	200
		Capac Tole	itance rance		l	1	1		Pr	oduct See Ta	Availa	ability for Ch	and C ip Thio	hip Th kness	icknes Dime	s Cod	es	1		ļ	1	
1,000 pF	102	К	М	DD	DD	DD	DD	DD						<u> </u>								
1,200 pF	122	K	M	DD	DD	DD	DD	DD														
1,500 pF	152	K	M	DD	DD	DD	DD	DD														
1,800 pF	182	K	M																			
2,200 pF	222	ĸ	IVI	00	00	00		עט														
2,700 pF 3 300 pE	212	r k	IVI M	םם	םם	םם	םם	ם חם														
3,000 pF	302	ĸ	M	סס	םם	םם	חח	םם														
4 700 pF	472	ĸ	M	סס	םם	םם	חס	םם														
5,600 pF	562	ĸ	M	סס	םם	מס	םם	םם														
6 800 pF	682	K	M	סס	סס	סס	מס	מס														
8,200 pF	822	к	M	DD	DD	DD	DD	DD														
10.000 pF	103	K	M	DD	DD	DD	DD	DD														
12,000 pF	123	к	М	DD	DD	DD	DD	DG														
15,000 pF	153	К	М	DD	DD	DD	DD	DG											1			
18,000 pF	183	К	М	DD	DD	DD	DD		EC	EC	EC	EC	EC									
22,000 pF	223	К	М	DD	DD	DD	DG		EC	EC	EC	EC	EC									
27,000 pF	273	К	М	DD	DD	DD	DG		EC	EC	EC	EC	EC									
33,000 pF	333	К	М	DD	DD	DD	DG		EC	EC	EC	EC	EC									
39,000 pF	393	К	М	DD	DD	DD	DG		EC	EC	EC	EC	EC									
47,000 pF	473	К	М	DD	DD	DD	DE		EC	EC	EC	EC	EG						GB	GB	GB	GB
56,000 pF	563	К	М	DD	DD	DD			EC	EC	EC	EC	EG						GB	GB	GB	GB
68,000 pF	683	K	M	DD	DD	DG	DG		EC	EC	EC	EC	EG	FD	FD	FD	FD	FD	GB	GB	GB	GB
82,000 pF	823	K	M	DD	DD	DG			EC	EC	EC	EC	EG	FD	FD	FD	FD	FD	GB	GB	GB	GB
0.10 µF	104	K	M	DG	DG	DG			EC	EC	EC	EC	EG	FD	FD	FD	FD	FG	GB	GB	GB	GB
0.12 µF	124	ĸ	IVI M	DG	DG				EC	EC	EC	EC		FD	FD	FD	FD	FG	GB	GB	GB	GB
0.15 µF	104	r k	IVI M		DG					EC	EC	EG							GB	GB	GB	GB
0.10 µF	224	ĸ	IVI M	DG		DC				EC							FD		GD	GD	GB	GC
0.22 µi 0.27 µF	224	ĸ	M	חס	חס	DG			EC	EC	FC			FD	FD	FD	FG	10	GB	GB	GB	GE
0.33 µE	334	ĸ	M	מס	DG				FG	EG	FG	FG		FD	FD	FD	FH		GB	GB	GB	GK
0.39 µF	394	ĸ	M	סס	DG				FG	FG				FD	FD	FG	FH		GB	GB	GB	GI
0.47 µF	474	к	M	DE	DG				EG	EG	EC			FD	FD	FG	FJ		GB	GB	GC	02
0.56 µF	564	K	M						EG					FD	FD	FG	FR		GB	GB	GD	
0.68 µF	684	к	М	DG					EG					FD	FG	FH	FR		GD	GD	GF	
0.82 µF	824	К	М						EG					FD	FG	FH	FR		GD	GD	GK	
1.0 µF	105	К	М						EG	EC	EH			FD	FH	FJ	FS		GN	GN	GM	
1.2 µF	125	К	М											FG								
1.5 µF	155	К	М											FH								
1.8 µF	185	К	М											FH								
2.2 µF	225	К	М						EC	EH				FJ	FM	FM						
3.3 µF	335	K	М											FM								
4.7 µF	475	K	M						EH					FG	FM				GK	GK		
6.8 µF	685	K Dete 11/1		40	05	50	400	200	40	05	50	400	200	FS	FS	50	400	200	05	50	400	200
		Rated Vol	tage (VDC)	16	25	50	100	200	16	25	50	100	200	16	25	50	100	200	25	50	100	200
Capacitance	Cap Code	Voltag	e Code	4	3	5	1	2	4	3	5	1	2	4	3	5	1	2	3	5	1	2
	Case Siz	e / Series		(C0805	F			(C1206	F				C1210I	F			C1812F			



Thickness	Case	Thickness ±	Paper Quantity		Plastic (Quantity
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
DD	0805	0.90 ± 0.10	4,000	10,000	0	0
DE	0805	1.00 ± 0.10	0	0	2,500	10,000
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
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 3A – Land Pattern Design Recommendations per IPC–7351 – Standard Termination

EIA Size	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)				
oouc	oouc	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	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
1210 ¹	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 $\geq 22 \,\mu F$

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

Density Level B: For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes.

Density Level C: For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC Standard 7351 (IPC–7351).



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

EIA Size Code	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)						
oouc	oouc	С	Y	X	V1	V2	C	Y	X	V1	V2	С	Y	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	0.80	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
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).



Soldering Process

Recommended Soldering Technique:

• Solder wave or solder reflow for EIA case sizes 0603, 0805 and 1206

• All other EIA case sizes are limited to solder reflow only

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020



Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 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:
Colderability		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 +/- 2 hours after test conclusion.
Disco d Ulumidit.		Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Blased 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.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
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

Reference	lt	em	Material				
А		Finish	100% Matte Sn	SnPb (5% min)			
В	Termination System	Barrier Layer	Ni				
С		Base Metal	Cu				
D	Inner E	Electrode	Ni				
E	Dielectri	c Material	BaTiO ₃				



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

Construction – Flexible Termination

Reference	lt	em	Material		
А		Finish	100% Matte Sn	SnPb (5% min)	
В	Termination	Barrier Layer	Ni		
С	System	Epoxy Layer	Ag		
D		Base Metal	Cu		
E	Inner E	lectrode	Ni		
F	Dielectri	c Material	BaTiO ₃		



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



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 $\pm 15\%$ 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	К	5	R	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec) ²
	0402 0603 0805 1206 1210 1812	S = Floating Electrode	2 Significant Digits + Number of Zeros	J = ±5% K = ±10% M = ±20%	$\begin{array}{c} 9 = 6.3 \ V \\ 8 = 10 \ V \\ 4 = 16 \ V \\ 3 = 25 \ V \\ 5 = 50 \ V \\ 1 = 100 \ V \\ 2 = 200 \ V \\ A = 250 \ V \end{array}$	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% minimum)	Blank = Bulk TU = 7" Reel Unmarked TM = 7" Reel Marked

¹Additional 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.



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)	See Table 2 for	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)	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)	N/A	
1812	4532	4.50 (.177) ± 0.30 (.012)	3.20 (.126) ± 0.30 (.012)		0.60 (.024) ± 0.35 (.014)		Solder Reflow Unly

Benefits

- -55°C to +125°C operating temperature range
- · Floating Electrode/fail open design
- · Low to mid capacitance flex mitigation
- Pb-Free and RoHS 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% 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.



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

Pb-Free and RoHS Compliant (excluding SnPb termination finish option).



Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +125°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit @ 25°C	5% (6.3 and 10 V), 3.5% (16 and 25 V) and 2.5% (50 to 250 V)
Insulation Resistance (IR) Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ±5 seconds @ 25°C)

Regarding aging rate: Capacitance measurements (including tolerance) are indexed to a referee time of 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 μ F

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

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



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	< 0.047 µF	≥ 0.047 µF
1206	< 0.22 µF	≥ 0.22 µF
1210	< 0.39 µF	≥ 0.39 µF
1808	ALL	N/A
1812	< 2.2 µF	≥ 2.2 µF
1825	ALL	N/A
2220	< 10 µF	≥ 10 µF
2225	ALL	N/A


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

		Cas	se Si Serie	ize / es		С	0402	S				С	0603	S						C08	05S			
Consoitanos	Сар	Vol	tage C	ode	9	8	4	3	5	9	8	4	3	5	1	2	9	8	4	3	5	1	2	A
Capacitance	Code	Rat	ed Vol (VDC)	tage	6.3	10	16	25	50	6.3	10	16	25	50	100	200	6.3	10	16	25	50	100	200	250
		Ca	pacita	nce							Produ	uct Av	ailabil	ity and	d Chip	Thick	ness (Codes						
450 - 5	454	Т	oleran	ce	DD	DD	DD	DD			See	Table	2 for	Chip T	hickn	ess Di	<u>mensi</u>	ons						
150 pF	101	J	ĸ	IVI M	BB	BB	BB	BB	BB	CD	CP	CP	CP	CP	CP	CP	DC	DC	DC	DC	DC	DC	DC	DC
220 pF	221	J	K	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB	CB								
220 pi 270 pF	221	1	ĸ	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB	CB								
270 pi 330 pE	271	J		M							CB	CB	CB		CB	CB								
300 pF	301	J	ĸ	M		DD					CB	CB	CB		CB	CB		DC		DC			DC	
390 pr	171	J		M																				
470 pr	4/1	J																		DC		DC	DC	DC
500 pr	601	J	R R																	DC		DC	DC	DC
000 pF	001	J	r v									CB			CB	CB								
020 pr	021	J	r.	IVI	DD	DD	DD	DD	DD	CB	CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DC
1,000 pF	102	J	r.		вв	вв	вв	BB	BB		CB	CB	CB		CB					DC	DC		DC	
1,200 pF	122	J	r.	IVI							CB OD	CB			CB	CB		DC	DC	DC	DC	DC	DC	DC
1,500 pF	152	J	ĸ	IVI						CB	CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DC
1,800 pF	182	J	ĸ	IVI						CB	CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DC
2,200 pF	222	J	K	IM						CB	CB	CB	CB	CF	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC
2,700 pF	272	J	K	M						CB	CB	CB	CB	CB	CF	CB	DC	DC	DC	DC	DC	DC	DC	DC
3,300 pF	332	J	K	M						CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC
3,900 pF	392	J	K	M						CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC
4,700 pF	472	J	K	M						CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC
5,600 pF	562	J	K	M						СВ	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DC	DC
6,800 pF	682	J	K	M						СВ	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DC	DC
8,200 pF	822	J	K	M						СВ	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DC	DC
10,000 pF	103	J	K	M						СВ	СВ	CB	CB	CF			DC	DC	DC	DC	DC	DC	DC	DC
12,000 pF	123	J	K	M						СВ	CB	CB	CB	CB			DC	DC	DC	DC	DC	DC	DC	DC
15,000 pF	153	J	K	M						CB	CB	CB	CB	CB			DC	DC	DC	DC	DC	DD		
18,000 pF	183	J	K	M						СВ	CB	CB	CB	CB			DC	DC	DC	DC	DC	DD		
22,000 pF	223	J	K	M						СВ	CB	CB	CB	CB			DC	DC	DC	DC	DC	DD		
27,000 pF	273	J	K	M													DC	DC	DC	DC	DC			
33,000 pF	333	J	K	M													DC	DC	DC	DC	DC			
39,000 pF	393	J	K	M													DC	DC	DC	DC	DC			
47,000 pF	473	J	K	M													DC	DC	DC	DC	DC			
56,000 pF	563	J	K	M													DD	DD	DD	DD	DD			
68,000 pF	683	J	K	M													DD	DD	DD	DD	DD			
82,000 pF	823	J	K	M													DG	DG	DG	DG	DG			
0.10 µF	104	J	K	M													DG	DG	DG	DG	DG			
		Rat	ed Vol (VDC)	tage	6.3	9	16	25	50	6.3	9	16	25	50	100	200	6.3	9	16	25	50	100	200	250
Capacitance	Cap	Vol	tage C	ode	9	8	4	3	5	9	8	4	3	5	1	2	9	8	4	3	5	1	2	A
	Code	Ca	ise Si Serie	ze / s		(C0402	S	1			. (C0603	S		1				C08	05S		1	



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

		Ca	se Si Serie	ze / s				C12	06S							C12	10S					С	1812	S	
Canacitance	Сар	Vo	ltage 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	ted Voli	age	6.3	9	16	25	50	100	200	250	6.3	9	16	25	50	100	200	250	25	50	100	200	250
		Ca	pacita	nce						Pr	oduc	t Ava	ilabi	litv a	nd C	; hip 1	l Fhick	ness	Coc	les					I
		Т	oleran	ce							See T	able	2 for	Chi	o Thi	ckne	ss D	imen	sion	s					
1,000 pF	102	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB													
1,200 pF	122	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB													
1,500 pF	152	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB													
1,800 pF	182	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB													
2,200 pF	222	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB					
2,700 pF	212	J	ĸ		EB	EB	EB	EB	EB	EB	EB	EB		FB	FB			FB	FB	FB					
3,300 pF	332	J	ĸ		EB	EB	EB	EB	EB	EB	EB	EB		FB	FB			FB	FB						
3,900 pF	392	J	n k																						
4,700 pF	472	J																							
5,000 pT	682	1	K	M		ED	ED	ED	ED	ED	ED	ED		ED	ED	ED	ED	ED	ED	ED	GP	CP	GP	GP	CP
8,200 pF	822	1 J	K	M	FR	FR	EB	EB	EB	EB	EB	EB	FR	FB	FB	FR	FR	FR	FR	FB	GB	GB	GB	GB	GB
10,200 pi	103	1 J	K	M	FR	EB	EB	EB	EB	EB	EB	EB	FR	FB	FB	FR	FR	FR	FR	FB	GB	GB	GB	GB	GB
12,000 pF	103	ı ı	K	M	FR	EB	EB	EB	EB	EB	FR	EB	FR	FB	FR	FR	FR	FR	FR	FB	GB	GB	GB	GB	GB
12,000 pl 15,000 pF	153	ı ı	K	M	FR	EB	EB	EB	EB	EB	FR	EB	FR	FB	FR	FR	FR	FR	FB	FB	GB	GB	GB	GB	GB
18,000 pF	183		K	M	FB	FR	FR	FB	FB	FR	FB	FB	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB
22 000 pF	223	, i	ĸ	M	FB	FR	FR	FR	FB	FR	FB	FB	FR	FB	FR	FR	FB	FB	FB	FB	GB	GB	GB	GB	GB
27,000 pF	273	, i	ĸ	M	FB	FR	FR	FR	FB	FR	FB	FB	FR	FB	FR	FR	FR	FB	FB	FB	GB	GB	GB	GB	GB
33 000 pF	333	,	ĸ	M	FR	FR	FR	FR	FR	FR			FR	FR	FR	FB	FR	FB	FB	FB	GB	GB	GB	GB	GB
39 000 pF	393	Ĵ	ĸ	M	FB	FB	FB	FB	FB	FC			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	К	М	EB	EB	EB	EB	EB				FB	FB	FB	FB	FB	FD			GB	GB	GB	GB	GB
0.12 µF	124	J	K	М	EC	EC	EC	EC	EC				FB	FB	FB	FB	FB				GB	GB	GB	GB	GB
0.15 µF	154	J	K	М									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	М									FC	FC	FC	FC	FC				GB	GB	GB	GB	GB
		Rat	ted Voli (VDC)	age	6.3	9	16	25	50	100	200	250	6.3	9	16	25	50	100	200	250	25	50	100	200	250
Capacitance	Cap	Vo	Itage C	ode	9	8	4	3	5	1	2	A	9	8	4	3	5	1	2	A	3	5	1	2	A
	Code	Ca	se Si Serie	ze / s		1	L	C12	06S	<u> </u>		L		1	I	C12	10S	1	I	I		С	1812	S	I



Thickness	Case	Thickness ±	Paper C	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
СВ	0603	0.80 ± 0.07	4,000	10,000	0	0
CF	0603	0.80 ± 0.07	4,000	15,000	0	0
DC	0805	0.78 ± 0.10	4,000	10,000	0	0
DD	0805	0.90 ± 0.10	4,000	10,000	0	0
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
FD	1210	0.95 ± 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	Range (mm)	Paper C	Quantity	Plastic (Quantity

Table 2 – Chip Thickness/Packaging Quantities

Package quantity based on finished chip thickness specifications.

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

EIA Size	Metric Size		Dens Maxi Land P	sity Lev imum (I rotrusio	rel A: Most) on (mm)		Dens Media Land P	sity Lev an (Nor rotrusio	vel B: ninal) on (mm)		Dens Minii Land P	sity Lev num (L rotrusio	rel C: .east) on (mm)
Code	Code	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	X	V1	V2
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	0.40	0.52	0.52	1.60	0.80
0603	1608	0.90	1.15	1.10	4.00	2.10	0.80	0.95	1.00	3.10	1.50	0.60	0.75	0.90	2.40	1.20
0805	2012	1.00	1.35	1.55	4.40	2.60	0.90	1.15	1.45	3.50	2.00	0.75	0.95	1.35	2.80	1.70
1206	3216	1.60	1.35	1.90	5.60	2.90	1.50	1.15	1.80	4.70	2.30	1.40	0.95	1.70	4.00	2.00
1210	3225	1.60	1.35	2.80	5.65	3.80	1.50	1.15	2.70	4.70	3.20	1.40	0.95	2.60	4.00	2.90
1210 ¹	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 \geq 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).





Soldering Process

Recommended Soldering Technique:

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

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020

Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 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:
Colderability		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
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 2 hours after test conclusion.
Discod Llumidity		Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Blased Humidity	MIL-SID-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.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
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

Reference	lt	em	Mate	erial
A		Finish	100% Matte Sn	SnPb (5% min)
В	Termination Svstem	Barrier Layer	Ν	li
С	- ,	Base Metal	C	u
D	Inner E	Electrode	Ν	li
E	Dielectri	c Material	Bal	īO ₃



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



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) ³
	0603 0805 1206 1210 1812 1825 2220 2225	X = Flexible Termination	2 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% minimum)	Blank = Bulk TU = 7" Reel Unmarked AUTO = Automotive Grade 7" Reel Unmarked

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

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

^{2,3} SnPb termination finish option is not available on Automotive Grade product.

³Additional 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
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) ±0.20 (.008)	1.25 (.049) ±0.20 (.008)		0.50 (0.02) ±0.25 (.010)	0.75 (.030)	or
1206	3216	3.30 (.130) ±0.40 (.016)	1.60 (.063) ±0.20 (.008)		0.60 (.024) ±0.25 (.010)		Solder Reflow
1210	3225	3.30 (.130) ±0.40 (.016)	2.50 (.098) ±0.20 (.008)	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)		

Benefits

- -55°C to +125°C operating temperature range
- Superior flex performance (up to 5 mm)
- · Pb-Free and RoHS 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, and 200 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% 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.



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

Pb-Free and RoHS Compliant (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%
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	0.1%
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 \pm 100 kHz and 1.0 \pm 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

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														
COG	All	All	0.5	0.3% or ±0.25 pF	10% of Initial Limit									



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

Capacitane Capacitane Visualiza (Visualiza				С	ase	Siz	e / S	Ser	ies				C06	603X					C08	05X					C12	06X		
Carbonic Transfer CarbonicTransfer CarbonicTransfer	Conseitones	Can Cada			V	oltag	e Co	de			8	4	3	5	1	2	8	4	3	5	1	2	8	4	3	5	1	2
Ubb Ubb / Ubb Ubb / Ubb Ubb<	Capacitance	Cap Code			Rated	d Volt	age	VDC)		9	16	25	50	100	200	9	16	25	50	100	200	9	16	25	50	100	200
0.08.07 pr 500 477				(Capac	itanc	e Tol	eran	ce						Pı	oduc See T	t Ava able 2	ilabili 2 for C	ty and Chip T	l Chip hickr) Thic	kness)imen	s Cod	es				
11.3 + 3p-2 100-310 ² 100-30 ²	0.50 & 0.75 pF	508 & 758	В	С	D						CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC						
month month F G J K M CC CC CC CC CC<	1.0 - 9.1 pF*	109 - 919*	В	C	D	F	G		ĸ	м	CB	CB	CB	CB	CB	CB		DC	DC		DC	DC	EB	EB	EB	EB	EB	EB
1110-180 pf 211-30* F G J K M C <thc< th=""> <thc< th=""> C</thc<></thc<>	100 pF	101				F	G	J	K	M	CB	CB	CB	CF	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
200-300 pF 201-301* F G J K N 0 C <thc< th=""> C C</thc<>	110 - 180 pF*	111 - 181*				F	G	J	K	М	СВ	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
330 pr 331 F 0 3 N N 0	200 - 300 pF*	201 - 301*				F	G	J	K	M	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
339 pF 331 1 F 0 J K M C C C C<	330 pF 360 pF	331				F	G	J	K	M	CB	CB	CB	CF	CB	CB							EB FR	EB	EB FR	EB FR	EB FR	EB FR
470 pF 471 pF 6 3 X X N C6 C6 <thc6< th=""> <thc6< th=""> C6</thc6<></thc6<>	390 pF	391				F	G	J	K	M	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
471 F G J K M CB CB CB CB CB CB EB EB<	430 pF	431				F	G	J	K	М	СВ	CB	СВ	CB	СВ	СВ	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
Solpr Solpr <th< td=""><td>470 pF</td><td>471</td><td></td><td></td><td></td><td>F</td><td>G</td><td>J</td><td>K</td><td>M</td><td>CB</td><td>CB</td><td>CB</td><td>CB</td><td>CB</td><td>CB</td><td>DC</td><td>DC</td><td>DC</td><td>DC</td><td>DC</td><td>DD</td><td>EB</td><td>EB</td><td>EB</td><td>EB</td><td>EB</td><td>EB</td></th<>	470 pF	471				F	G	J	K	M	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DD	EB	EB	EB	EB	EB	EB
S210 pf S211 F G J K M GS CS CS CS CS CS	510 pF	561				F	G	J	K	M	CB	CB	CB	CB	CB	CB							FR	FR	EB FR	EB FR	EB FB	EB FR
681 F 6 J K M C	620 pF	621				F	G	J	K	M	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
750 pF 751 F 6 J K M B CB CB CB CB	680 pF	681				F	G	J	K	Μ	СВ	CB	CB	CB	СВ	СВ	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
B21 F G J K M B CB	750 pF	751				F	G	J	K	M	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	820 pF 910 pF	821 911				F	G	J	K	M	CB	CB	CB	CB	CB	CB							EB	EB	EB	EB	EB	EB
1100 pF 112 110 pF 112 F G J K M CB	1.000 pF	102				F	G	J	K	M	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DD	DD	EB	EB	EB	EB	EB	EB
1200 pF 122 F G J K M CB CB CB CB CB<	1,100 pF	112				F	G	J	K	М	СВ	CB	CB	CB	CB	СН	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
1300 pF 132 F 6 J K M CB CB CB CB EB EB <t< td=""><td>1,200 pF</td><td>122</td><td></td><td></td><td></td><td>F</td><td>G</td><td>J</td><td>K</td><td>М</td><td>СВ</td><td>CB</td><td>CB</td><td>CB</td><td>CB</td><td>СН</td><td>DC</td><td>DC</td><td>DC</td><td>DC</td><td>DC</td><td>DC</td><td>EB</td><td>EB</td><td>EB</td><td>EB</td><td>EB</td><td>EB</td></t<>	1,200 pF	122				F	G	J	K	М	СВ	CB	CB	CB	CB	СН	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	1,300 pF	132				F	G	J	K	M	CB	CB	CB	CB	CB	CH	DD	DD	DD	DD	DD	DC	EB	EB	EB	EB	EC	EC
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	1,500 pF	152				F	G	J	ĸ	M	CB	CB	CB	CB	CB	СН	ם ח	ם מם	ם חח	ם חח	םם		EB FR	EB	EB FR	EB FR	ED	EC FD
2000 pF 202 F G J K M CB	1,800 pF	182				F	G	J	K	M	CB	CB	CB	CB	CB	CH	DD	DD	DD	DD	DD	DC	EB	EB	EB	EB	ED	ED
2220 F G J K M CB EB	2,000 pF	202				F	G	J	K	Μ	СВ	CB	CB	CB	СВ	СН	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	ED	ED
2400 pi 242 F G J K M CB CB CB CD DC DC <thdc< th=""> DC <thdc< th=""> <thdc< td="" th<=""><td>2,200 pF</td><td>222</td><td></td><td></td><td></td><td>F</td><td>G</td><td>J</td><td>K</td><td>M</td><td>CB</td><td>CB</td><td>CB</td><td>CB</td><td>CB</td><td>СН</td><td>DC</td><td>DC</td><td>DC</td><td>DC</td><td>DC</td><td>DC</td><td>EB</td><td>EB</td><td>EB</td><td>EB</td><td>EE</td><td>EE</td></thdc<></thdc<></thdc<>	2,200 pF	222				F	G	J	K	M	CB	CB	CB	CB	CB	СН	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EE	EE
21/2 3.00 F 6 J K M C6 C6 C6 C6 D0	2,400 pF	242				F	G	J	K	M	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EC	EC
3,300 pF 332 332 F G J K M CB CB CB CB DD DD DD DD DD DD DC EC	2,700 pF	302				F	G	J	K	M	CB	CB	CB	CB	CB								FC	FC	FC	FC	FC	FB
3800 pF 382 F G J K M CB CB <t< td=""><td>3,300 pF</td><td>332</td><td></td><td></td><td></td><td>F</td><td>G</td><td>J</td><td>K</td><td>M</td><td>CB</td><td>CB</td><td>CB</td><td>CB</td><td>CB</td><td></td><td>DD</td><td>DD</td><td>DD</td><td>DD</td><td>DC</td><td>DC</td><td>EC</td><td>EC</td><td>EC</td><td>EC</td><td>EE</td><td>EB</td></t<>	3,300 pF	332				F	G	J	K	M	CB	CB	CB	CB	CB		DD	DD	DD	DD	DC	DC	EC	EC	EC	EC	EE	EB
3.900 pF 382 F G J K M CB CB CB CB CB CB CB DE	3,600 pF	362				F	G	J	K	Μ	СВ	CB	CB	CB	CB		DD	DD	DD	DD	DC	DD	EC	EC	EC	EC	EE	EB
4,300 pF 472 F G J K M CB CB CB DE 6,200 pF <	3,900 pF	392				F	G	J	K	M	CB	CB	CB	CB	CB		DE	DE	DE	DE	DC	DD	EC	EC	EC	EC	EF	EB
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	4,300 pF 4 700 nF	432				F	G	J	K	M	CB	CB	CB	CB	CB			DE	DE	DE		םם	FC	EC FC	EC FC	EC FC	EC FC	EB FR
5600 pF 562 562 F G J K M CB CB CB CD DC	5,100 pF	512			_	F	G	J	K	M	CB	CB	CB	CB	0.0		DE	DE	DE	DE	DC	DD	ED	ED	ED	ED	ED	EB
6.200 pF 622 F G J K M CB CB CB CB CD DC	5,600 pF	562				F	G	J	K	M	СВ	CB	CB	CB			DC	DC	DC	DC	DC	DD	ED	ED	ED	ED	ED	EB
6.800 pF 6.800 pF 6.80 pF <td>6,200 pF</td> <td>622</td> <td></td> <td></td> <td></td> <td>F</td> <td>G</td> <td>J</td> <td>K</td> <td>M</td> <td>CB</td> <td>CB</td> <td>CB</td> <td>CB</td> <td></td> <td></td> <td>DC</td> <td>DC</td> <td>DC</td> <td>DC</td> <td>DC</td> <td>DG</td> <td>EB</td> <td>EB</td> <td>EB</td> <td>EB</td> <td>EB</td> <td>EB</td>	6,200 pF	622				F	G	J	K	M	CB	CB	CB	CB			DC	DC	DC	DC	DC	DG	EB	EB	EB	EB	EB	EB
8,000 pF 822 F G J K M CB <	6,800 pF 7,500 pF	082 752				F	G	J	ĸ	M	CB	CB	CB	CB								DG	EB FR	EB	EB FR	EB FR	EB FR	EB FR
9,100 pF 912 F G J K M CB CB CB CB DC DC DC DC	8,200 pF	822				F	G	J	K	M	CB	CB	CB				DC	DC	DC	DC	DC	DG	EC	EC	EC	EC	EB	EC
10.000 pF 103 F G J K M CB CB CB CD DC DC DC DC DD	9,100 pF	912				F	G	J	K	Μ	СВ	CB	CB				DC	DC	DC	DC	DC		EC	EC	EC	EC	EB	EC
12,000 pF 123 F G J K M CB CB CB CB DC DD	10,000 pF	103				F	G	J	K	M	CB	CB	CB				DC	DC	DC	DC	DD		ED	ED	ED	ED	EB	EC
10000 pF 1000 pF 183 F G J K M OD OD OD DC DC DC DC DD	12,000 pF 15,000 pF	123				F	G	J	ĸ	M	CB	CB	CB								DG		EB FR	EB	EB FR	EB FR	EB FR	ED FF
22,000 pF 223 Z F G J K M L L L DD DD DD DF L L EB	18,000 pF	183			_	F	G	J	K	M		00					DC	DC	DC	DD	00		EB	EB	EB	EB	EB	EH
27,000 pF 273 333 333 333 F G J K M L L L DF	22,000 pF	223				F	G	J	K	M							DD	DD	DD	DF			EB	EB	EB	EB	EC	EH
33,000 pF 333 F G J K M - - - DG DG <t< td=""><td>27,000 pF</td><td>273</td><td></td><td></td><td></td><td>F</td><td>G</td><td>J</td><td>K</td><td>M</td><td></td><td></td><td></td><td></td><td></td><td></td><td>DF</td><td>DF</td><td>DF</td><td></td><td></td><td></td><td>EB</td><td>EB</td><td>EB</td><td>EB</td><td>EE</td><td></td></t<>	27,000 pF	273				F	G	J	K	M							DF	DF	DF				EB	EB	EB	EB	EE	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	33,000 pF	333				F	G	J	K	M							DG	DG	DG				EB	EB	EB	EB	EE	
56,000 pF 563 F G J K M J L <th< td=""><td>47,000 pF</td><td>473</td><td></td><td></td><td></td><td>F</td><td>G</td><td>J</td><td>K</td><td>M</td><td></td><td></td><td></td><td></td><td></td><td></td><td>DG</td><td>DG</td><td>DG</td><td></td><td></td><td></td><td>EC</td><td>EC</td><td>EC</td><td>EE</td><td>EH</td><td></td></th<>	47,000 pF	473				F	G	J	K	M							DG	DG	DG				EC	EC	EC	EE	EH	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	56,000 pF	563				F	G	J	K	M													ED	ED	ED	EF		
82,000 pr 823 F G J K M - - - - - - EH	68,000 pF	683				F	G	J	K	М													EF	EF	EF	EH		
Capacitance	82,000 pF	823				F	G	J	K	M													EH	EH	EH	EH		
Capacitance Cap Code Solution (Code)	0.10 μΗ	104			Rater		G age	VDC))	IVI	_ ₽	16	25	20	8	8	2	16	25	20	8	00	EH ₽	£H 9	25 H	20	8	00
Case Size / Series C0603X C0805X C1206X	Canacitance	Can Code	⊢		V	oltan	- Co	100	/		8	4	3	5	- -	2	8	4	3	5	- 1	2	8	4	3	5	÷	~ 2
	oupuolitanoe				Case Size / Series							17	COF	503X	L '	<u> </u>	ľ	*	C08	05X		-		-	C12	06X	•	-

*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)

			С	ase	Siz	e / 3	Ser	ies				C12	210X	,		C	1812	2X	С	1825	5X	C	2220	DX	C	2225	σX
0				١	/oltag	e Co	de			8	4	3	5	1	2	5	1	2	5	1	2	5	1	2	5	1	2
Capacitance	Cap Code			Rate	d Vol	tage	(VDC)		9	16	25	50	100	200	50	100	200	50	100	200	50	100	200	50	100	200
				Capa	itanc	e To	leran	ce						Pr	oduci	t Avai	labili	ty and	d Chip	Thic	knes	s Coo	des		•	,	
1.0 - 9.1 pF*	109 - 919*	В	C	; D						FB	FB	FB	FB	FB	FB					10331			3				
10 - 91 pF*	100 - 910*				F	G	J	K	M	FB	FB	FB	FB	FB	FB												
100 - 430 pF*	101 - 431*				F	G	J	K	M	FB	FB	FB	FB	FB	FB	0.0	0.5	0.0									
470 - 910 pF*	4/1 - 911*					G	J	K	M	FB	FB	FB	FB	FB	FB	GB	GB	GB									
1,000 pF	102				F	G	J	K	M	FB	FB	FB	FB	FB	FB	GB	GB	GB									
1,200 pF	122				F	G	J	ĸ	M	FB	FB	FB	FB	FB	FB	GB	GB	GB									
1.300 pF	132				F	G	Ĵ	ĸ	M	FB	FB	FB	FB	FB	FC	GB	GB	GB									
1,500 pF	152				F	G	J	к	M	FB	FB	FB	FB	FB	FE	GB	GB	GB									
1,600 pF	162				F	G	J	K	Μ	FB	FB	FB	FB	FB	FE	GB	GB	GB									
1,800 pF	182				F	G	J	K	Μ	FB	FB	FB	FB	FB	FE	GB	GB	GB									
2,000 pF	202				F	G	J	K	M	FB	FB	FB	FB	FC	FE	GB	GB	GB									
2,200 pF	222				F	G	J	K	M	FB	FB	FB	FB	FC	FG	GB	GB	GB									
2,400 pF	242				F	G	J	K	M	FB	FB	FB	FB	FC	FC		0.0	0.0									
2,700 pF	272				F	G	J	K	M	FB	FB	FB	FB	FC	FC	GB	GB	GB									
3,000 pF	302					G	J	ĸ	M	FB	FB	FB	FB	FC		GP	GP	GP									
3,500 pr 3,600 pF	362				F	G	J	ĸ	M	FR	FR	FR	FR	FF	FF	GD	GD	GD									
3 900 pF	392				F	G	J	ĸ	M	FB	FB	FB	FB	FF	FF	GB	GB	GB	НВ	НВ	НВ						
4.300 pF	432				F	G	Ĵ	ĸ	M	FB	FB	FB	FB	FF	FF	00		00	110								
4,700 pF	472				F	G	J	K	M	FF	FF	FF	FF	FG	FG	GB	GB	GD	HB	HB	HB				KE	KE	KE
5,100 pF	512				F	G	J	K	M	FB	FB	FB	FB	FG	FG										KE	KE	KE
5,600 pF	562				F	G	J	K	M	FB	FB	FB	FB	FG	FG	GB	GB	GH	HB	HB	HB				KE	KE	KE
6,200 pF	622				F	G	J	K	M	FB	FB	FB	FB	FG	FB										KE	KE	KE
6,800 pF	682				F	G	J	K	M	FB	FB	FB	FB	FG	FB	GB	GB	GJ	HB	HB	HB	JE	JE		KE	KE	KE
7,500 pF	752				F	G	J	K	M	FC	FC	FC	FC	FC	FB										KE	KE	KE
8,200 pF	822				F	G	J	K	M	FC	FC	FC	FC	FC	FB	GB	GH		НВ	HB	HB	JE	JE		KE	KE	KE
9,100 pF	912				F	G	J	K	M	FE	FE	FE	FE	FE	FB		011								KE	KE	KE
10,000 pF	103					G	J	ĸ	M				FF		FB	GB	GH		нв	НВ	HE	JE	JE		KE	KE	KE
12,000 pr 15,000 pF	153				F	G	J	K	M	FG	FG	FG	FG	FR	FC	GB	GB		HR	HR	11	JE	JE		KE	KE	KE
18 000 pF	183				F	G	J	ĸ	M	FB	FB	FB	FB	FB	FC	GB	GB		HB	HF		JE	JF		KF	KE	I.L
22.000 pF	223				F	G	Ĵ	K	M	FB	FB	FB	FB	FB	FF	GB	GB		НВ	HE		JE	JB		KE	KE	
27,000 pF	273				F	G	J	K	M	FB	FB	FB	FB	FB	FG	GB	GB		HB	HG		JE	JB		KE	KE	
33,000 pF	333				F	G	J	К	M	FB	FB	FB	FB	FB	FH	GB	GB					JB	JB		KE		
39,000 pF	393				F	G	J	K	Μ	FB	FB	FB	FB	FE	FH	GB	GB					JB	JB				
47,000 pF	473				F	G	J	K	M	FB	FB	FB	FB	FE	FJ	GB	GB					JB	JB				
56,000 pF	563				F	G	J	K	M	FB	FB	FB	FB	FF		GB	GB					JB	JB				
68,000 pF	683				F	G	J	K	M	FB	FB	FB	FC	FG		GB	GB					JB	JB				
82,000 pF	823				F	G	J	K	M	FC	FC	FC	FF	FH		GB	GB					JB	JB				
0.10 µF	104				F	G	J	ĸ	M	FG	FG	FG	FG	FIVI		GB	GD					JB IB	JB				
0.12 µ1 0.15 µF	154				F	G	J	ĸ	M	FH	FH	FH	FM			GD	GN					JB	JB				
0.18 µF	184				F	G	J	ĸ	M	EJ	EJ	EJ				GH						JB					
0.22 µF	224				F	G	J	K	M	FK	FK	FK				GK						JB	JD				
0.27 µF	274				F	G	J	K	М													JB	JF				
0.33 µF	334				F	G	J	K	M													JD	JG				
0.39 µF	394				F	G	J	K	M													JG					
0.47 µF	474				F	G	J	K	Μ			ļ		ļ								JG					
			Rated Voltage (VDC)				16	25	50	- 19	200	50	9	200	50	100	200	50	<u>10</u>	200	50	100	200				
Capacitance	Capacitance Code		Voltage Code 8 4			4	3	5	1	2	5	1	2	5	1	2	5	1	2	5	1	2					
			Case Size / Series					C12	210X				C1812	Х		1825	X	0	2220	X		2225	X				

*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 2 – Chip Thickness/Packaging Quantities

Thickness	Case	Thickness ±	Paper C	Quantity	Plastic	Quantity
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
CB CF CH DC	0603 0603 0603 0805 0805	$\begin{array}{c} 0.80 \pm 0.07 \\ 0.80 \pm 0.07 \\ 0.85 \pm 0.07 \\ 0.78 \pm 0.10 \\ 0.90 \pm 0.10 \end{array}$	4,000 4,000 4,000 0	10,000 15,000 10,000 0	0 0 4,000 4.000	0 0 10,000
DE DF DG EB FC	0805 0805 0805 1206 1206	$\begin{array}{c} 0.30 \pm 0.10 \\ 1.00 \pm 0.10 \\ 1.10 \pm 0.10 \\ 1.25 \pm 0.15 \\ 0.78 \pm 0.10 \\ 0.90 \pm 0.10 \end{array}$	0 0 0 4,000 0	0 0 0 10,000 0	2,500 2,500 2,500 2,500 4,000 4,000	10,000 10,000 10,000 10,000 10,000
ED EE EF EH FB	1206 1206 1206 1206 1206 1210	$\begin{array}{c} 1.00 \pm 0.10 \\ 1.00 \pm 0.10 \\ 1.20 \pm 0.15 \\ 1.60 \pm 0.20 \\ 0.78 \pm 0.10 \end{array}$	0 0 0 0 0	0 0 0 0 0	2,500 2,500 2,500 2,000 4,000	10,000 10,000 10,000 8,000 10,000
FC FE FF FG FH	1210 1210 1210 1210 1210 1210	$\begin{array}{c} 0.90 \pm 0.10 \\ 1.00 \pm 0.10 \\ 1.10 \pm 0.10 \\ 1.25 \pm 0.15 \\ 1.55 \pm 0.15 \end{array}$	0 0 0 0	0 0 0 0 0	4,000 2,500 2,500 2,500 2,500 2,000	10,000 10,000 10,000 10,000 8,000
FM FJ FK GB GD	1210 1210 1210 1812 1812	$\begin{array}{c} 1.70 \pm 0.20 \\ 1.85 \pm 0.20 \\ 2.10 \pm 0.20 \\ 1.00 \pm 0.10 \\ 1.25 \pm 0.15 \end{array}$	0 0 0 0	0 0 0 0 0	2,000 2,000 2,000 1,000 1,000	8,000 8,000 8,000 4,000 4,000
GH GG GK GJ GN	1812 1812 1812 1812 1812 1812	1.40 ± 0.15 1.55 ± 0.10 1.60 ± 0.20 1.70 ± 0.15 1.70 ± 0.20	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
HB HE JB JD	1825 1825 1825 2220 2220	$\begin{array}{c} 1.10 \pm 0.15 \\ 1.40 \pm 0.15 \\ 1.60 \pm 0.20 \\ 1.00 \pm 0.15 \\ 1.30 \pm 0.15 \end{array}$	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 JG KE	2220 2220 2220 2225	$\begin{array}{c} 1.40 \pm 0.15 \\ 1.50 \pm 0.15 \\ 1.70 \pm 0.15 \\ 1.40 \pm 0.15 \end{array}$	0 0 0 0	0 0 0 0	1,000 1,000 1,000 1,000	4,000 4,000 4,000 4,000
Thickness Code	Case Size	Thickness ± Range (mm)	7" Reel Paper C	13" Reel Quantity	7" Reel Plastic	13" Reel Quantity

Package quantity based on finished chip thickness specifications.



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

EIA Size Code	Metric Size		Dens Maxi Land P	sity Lev mum (I rotrusio	vel A: Most) on (mm)		Dens Media Land Pi	sity Lev an (Nor rotrusio	vel B: ninal) on (mm)		Dens Minii Land P	sity Lev mum (L rotrusio	vel C: east) on (mm)
oout	oouc	C	Y	X	V1	V2	C	Y	X	V1	V2	C	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	0.80	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
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).



Soldering Process

Recommended Soldering Technique:

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

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020



Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 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:
Saldarability		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 +/- 2 hours after test conclusion.
Disco d Ulumidit.		Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Blased Humidity	MIL-SID-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.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
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

Reference	lt	em	Material
А		Finish	100% Matte Sn
В	Termination	Barrier Layer	Ni
С	System	Epoxy Layer	Ag
D		Base Metal	Cu
E	Inner E	Electrode	Ni
F	Dielectri	ic Material	CaZrO ₃



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



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 5mm 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 $\pm 15\%$ 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	X	106	K	4	R	Α	С	AUTO
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec) ²
	0603 0805 1206 1210 1808 1812 1825 2220 2225	X = Flexible Termination	2 significant digits + number of zeros	J = ±5% K = ±10% M = ±20%	9 = 6.3 V 8 = 10 V 4 = 16 V 3 = 25 V 5 = 50 V 1 = 100 V 2 = 200 V A = 250 V	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% minimum)	Blank = Bulk TU = 7" Reel Unmarked TM = 7" Reel Marked AUTO = Automotive Grade 7" Reel Unmarked

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.



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) ± 0.20 (.008)	1.25 (.049) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	or
1206	3216	3.30 (.130) ± 0.40 (.016)	1.60 (.063) ± 0.20 (.008)		0.60 (.024) ± 0.25 (.010)		Solder Reflow
1210 ¹	3225	3.30 (.130) ± 0.40 (.016)	2.50 (.098) ± 0.20 (.008)		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)		

¹ For capacitance values \geq 12 μ F add 0.02 (0.001) to the width tolerance dimension

Benefits

- -55°C to +125°C operating temperature range
- Superior flex performance (up to 5 mm)
- High capacitance flex mitigation
- · Pb-Free and RoHS 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 μ F
- 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% min)
- Commercial and Automotive (AEC-Q200) grades available

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.



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

Pb-Free and RoHS Compliant (excluding SnPb termination finish option).



Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +125°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit @ 25°C	5% (6.3 and 10 V), 3.5% (16 and 25 V) and 2.5% (50 to 250 V)
Insulation Resistance (IR) Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ±5 seconds @ 25°C)

Regarding aging rate: Capacitance measurements (including tolerance) are indexed to a referee time of 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 μF

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 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	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	< 0.047 µF	≥ 0.047 µF
1206	< 0.22 µF	≥ 0.22 µF
1210	< 0.39 µF	≥ 0.39 µF
1808	ALL	N/A
1812	< 2.2 µF	≥ 2.2 µF
1825	ALL	N/A
2220	< 10 µF	≥ 10 µF
2225	ALL	N/A



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

		Cas S	e Si erie	ize / es			C	060	3X					(C08	805)	K					(C12	06)	(C12	210)	(
Сар	Сар	Volt	age C	ode	9	8	4	3	5	1	2	9	8	4	3	5	1	2	A	9	8	4	3	5	1	2	A	9	8	4	3	5	1	2	A
	Code	Rate	d Vol	tage	6.3	9	16	25	50	<u>1</u> 0	200	6.3	₽	16	25	50	10	200	250	6.3	9	16	25	50	100	200	250	6.3	9	16	25	50	1 0	200	250
		Cap	Toler	ance					F	Prod	uct /	Avail	abili	ty ar	d Cl	nip T	hick	ness	s Coo	des -	- See	e Tab	le 2	for C	hip '	Thic	knes	s Di	men	sion	s				
180 pF	181	J	K	M	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC																
220 pF 270 pF	221 271	J	K K	M	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC																
330 pF	331	J	K	M	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC																
390 pF 470 pF	391 471	J	K K	M	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB											
560 pF	561	J	К	М	СВ	СВ	СВ	СВ	СВ	СВ	СВ	DC	DC	DC	DC	DC	DC	DC	DC																
680 pF 820 pF	681 821	J	K	M	CB	CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DC																
1,000 pF	102	J	K	M	CB	CB	CB	CB	CF	CB	CF	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB								
1,200 pF	122	J	K	M	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB								
1,500 pF 1,800 pF	182	J	ĸ	M	СВ	СВ	CB	CB	CB	СВ	СВ	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB								
2,200 pF	222	J	К	М	СВ	СВ	СВ	СВ	CF	СВ	СВ	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB
2,700 pF 3 300 pF	272	J	K	M	CB	CB	CB	CB	CB	CF	CB		DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	FB FB	FB	FB	FB	FB	FB	FB	FB
3,900 pF	392	J	K	M	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB
4,700 pF	472	J	K	M	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB
6,800 pF	682	J	K	M	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB
8,200 pF	822	J	K	М	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB
10,000 pF 12,000 pF	103 123	J	K K	M	CB	CB	CB	CB	CF CB	CF	CB		DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB
15,000 pF	153	J	K	M	CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DD	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB
18,000 pF	183	J	K	M	CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DD	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB
27,000 pF	273	J	K	M	CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DD	DE		EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB
33,000 pF	333	J	K	M	CB	CB	CB	CF	CB	CB		DC	DC	DC	DC	DC	DD	DE		EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB
39,000 pF 47,000 pF	393 473	J	ĸ	M	CB	CB	CB	CB	CF	CB		DC	DC	DC	DC	DC	DD	DE		EB	EB	EB	EB	EB	EC	ED	ED	FB	FB	FB	FB	FB	FB	FC	FD
56,000 pF	563	J	K	М	CB	CB	CB	CB	CB			DD	DD	DD	DD	DD	DE	DG		EB	EB	EB	EB	EB	EB	ED	ED	FB	FB	FB	FB	FB	FB	FC	FC
68,000 pF 82.000 pF	683 823	J	K K	M	CB	CB	CB	CB	CF CB								DE			EB	EB	EB	EB	EB	EB	ED	ED	FB	FB	FB	FB	FB	FC	FC FF	FC
0.10 µF	104	J	K	M	CB	CB	CF	CF	CF			DC	DC	DC	DC	DC	DE			EB	EB	EB	EB	EB	EB	EM	EM	FB	FB	FB	FB	FB	FD	FG	FG
0.12 µF	124	J	K	M	CB	CB	CB	CB	CB			DC	DC	DC	DC	DD	DG			EC	EC	EC	EC	EC	EC	EG		FB	FB	FB	FB	FB	FD		
0.18 µF	184	J	K	M	CB	CB	CB	CB				DC	DC	DC	DC	DG	DG			EC	EC	EC	EC	EC	EC			FC	FC	FC	FC	FC	FD		
0.22 µF	224	J	K	M	CB	CB	CB	CD				DC	DC	DC	DC	DG	DG			EC	EC	EC	EC	EC	EC			FC	FC	FC	FC	FC	FD		
0.27 μF 0.33 μF	334	J	ĸ	M	CB	CB	CB					DG	DD	DD	DD	DD				EB	EB	EB	EB	EC	EM			FD	FD	FD	FD	FD	FD		
0.39 µF	394	J	К	М	СВ	СВ	CB					DG	DG	DG	DG	DE				EB	EB	EB	EB	EC	EG			FD	FD	FD	FD	FD	FD		
0.47 µF	474 564	J	K	M	CB	CB	СВ					DG	DG	DG	DG	DE				EC FD	EC	EC	EC	EC	EG			FD	FD	FD	FD	FD	FD		
0.68 µF	684	J	K	M								DD	DD	DD	DG	DH				EE	EE	EE	EE	ED				FD	FD	FD	FD	FD	FG		
0.82 µF	824	J	K	M								DD	DD	DD	DG					EF	EF	EF	EF	ED				FF	FF	FF	FF	FF	FL		
1.2 μF	125	J	K	M								DE	DE	DE	00					ED	ED	ED	EG	EH				FH	FH	FH	FH	FG	1.141		
1.5 µF	155	J	K	M								DG	DG	DG						EF	EF	EF	EG	EH				FH	FH	FH	FH	FG			
1.8 µ⊦ 2.2 µF	185 225	J	K K	M								DG	DG	DG						ED	ED	ED	EF	EH				FJ	FJ	FJ	FJ	FG			
2.7 µF	275	J	Κ	М									-	-						ΕN	EN	EN	EH					FE	FE	FE	FG	FH			
3.3 µF	335 395	J	ĸ	M																ED FF	ED FF	ED	EH					FF	FF	FF	FM	FM			
4.7 μF	475	J	K	M																EF	EF	EF	EH					FC	FC	FC	FG	FS			
5.6 µF	565	J	K	M																EH	EH	EH						FF	FF	FF	FH				
8.2 μF	825	J	ĸ K	M																EH	EH	EH						FH	FH	FH	FIN				
		Rate	ed Vol (VDC)	tage)	6.3	6.3 10 16 25 50 50 100 6.3 6.3				10	16	25	50	100	200	250	6.3	9	16	25	50	100	200	250	6.3	10	16	25	50	100	200	250			
Сар	Cap Code	Volt	age C	ode	9	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			
		Cas	se Si Serie	ze / s			С	0603	3X						C08	05X							C12	06X							C12	210X			

© KEMET Electronics Corporation • P.O. Box 5928 • Greenville, SC 29606 (864) 963-6300 • www.kemet.com



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

		Case Size / Series			С)60	3X					(C08	05)	((C12	06)	((C12	10X	[
Cap	Сар	Voltage Code	9	8	4	3	5	1	2	9	8	4	3	5	1	2	A	9	8	4	3	5	1	2	A	9	8	4	3	5	1	2	Α
••••	Code	Rated Voltage (VDC)	6.3	9	16	25	50	100	200	6.3	10	16	25	50	100	200	250	6.3	9	16	25	50	100	200	250	6.3	10	16	25	50	100	200	250
		Cap Tolerance					F	Prod	uct A	Avail	abili	ty ar	d Cl	nip T	hick	ness	; Co	des -	- See	e Tab	le 2	for C	Chip	Thic	knes	s Di	men	sion	s				
10 μF 22 μF	106 226	JKM JKM																EH	EH	EH						FH FS	FH FS	FH	FS				
		Rated Voltage (VDC)	6.3	10	16	25	50	100	200	6.3	10	16	25	50	100	200	250	6.3	10	16	25	50	100	200	250	6.3	10	16	25	50	100	200	250
Сар	Code	Voltage Code	9	8	4	3	5	1	2	9	8	4	3	5	1	2	A	9	8	4	3	5	1	2	A	9	8	4	3	5	1	2	Α
	Coue	Case Size / Series			С	0603	SX						C08	05X							C12	06X							C12	10X			

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

	Cap Cap		e Si erie	ize / es		C18	08X			С	1812	X			C18	25X			С	2220	X			C22	25X	
Сар	Сар	Volt	age C	ode	5	1	2	A	3	5	1	2	Α	5	1	2	Α	3	5	1	2	Α	5	1	2	Α
	Code	Rate	ed Vol (VDC)	tage)	50	100	200	250	25	50	100	200	250	50	100	200	250	25	50	100	200	250	50	100	200	250
		Cap	Toler	ance				Proc	uct A	vailabi	ility an	d Chi	p Thic	kness	Codes	s – Se	e Table	e 2 for	Chip ⁻	Thickn	ess D	imens	ions			
4,700 pF	472	J	K	М	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			GB	GB	GB	GB	GB													
18,000 pF	183	J	K	M					GB	GB	GB	GB	GB													
22,000 pF	223	J	ĸ						GB	GB	GB	GB	GB	НВ	HB	НВ	НВ									
27,000 pF 33,000 pF	213	J	ĸ	M					GB	GB	GB	GB	GB	HB	HB	HB	HB									
39,000 pr	303	J	ĸ	M					GB	GB	GB	GB	GB	HR	HR	HR	HR									
47 000 pF	473	J	ĸ	M					GB	GB	GB	GB	GB	HB	HB	HB	HB						кс	KC	KC	KC
56 000 pF	563	Ĵ	ĸ	M					GB	GB	GB	GB	GB	HB	HB	HB	HB						КС	KC	KC	KC
68,000 pF	683	Ĵ	K	M	LD				GB	GB	GB	GB	GB	HB	HB	HB	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	к	м	LD				GB	GB	GB	GB	GB	HB	НВ	HB	НВ	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.12 µF	124	J	К	М	LD				GB	GB	GB	GB	GB	HB	HB	HB	НВ	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.15 µF	154	J	к	М	LD				GB	GB	GB	GE	GE	HB	HB	HB	НВ	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.18 µF	184	J	К	M	LD				GB	GB	GB	GF	GG	HB	HB	HB	HB	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.22 µF	224	J	Κ	M					GB	GB	GB	GG	GG	HB	HB	HB	HB	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.27 µF	274	J	K	M					GB	GB	GG	GG	GG	HB	HB	HB	HB	JC	JC	JC	JC	JC	KB	KC	KC	KC
0.33 µF	334	J	Κ	M					GB	GB	GG	GG	GG	HB	HB	HB	HB	JC	JC	JC	JC	JC	KB	KC	KC	KC
0.39 µF	394	J	K	M					GB	GB	GG	GG	GG	HB	HB	HD	HD	JC	JC	JC	JC	JC	KB	KC	KC	KC
0.47 µF	474	J	K	M					GB	GB	GG	GJ	GJ	HB	HB	HD	HD	JC	JC	JC	JC	JC	KB	KC	KD	KD
0.56 µF	564	J	K	M					GC	GC	GG			HB	HD	HD	HD	JC	JC	JC	JD	JD	KB	KC	KD	KD
0.68 µF	684	J	K	M					GC	GC	GG			HB	HD	HD	HD	JC	JC	JD	JD	JD	KB	KC	KD	KD
0.82 µF	824	J	K	M					GE	GE	GG			HB	HF	HF	HF	JC	JC	JF	JF	JF	KB	KC	KE	KE
1.0µ⊢ 1.0µ⊢	105	J	K	M					GE	GE	GG			HB	HF	HF	HF	JC	JC	JF	JF	J⊦	KB	KD	KE	KE
1.2 µF	125	J	ĸ	M										HB				JC	JC				KC	KE	KE	KE
1.5 µP	185	J	K	M										нр				JC	10				KD			
2.2 µF	225	5	K	M										HE				JE	JE				KD			
2.2 μι 47 μΕ	475	.1	K	M					GK	GK								01	01				ND			
10 µF	106	J	K	M					GK	OI								JE	.10							
15 µF	156	J	K	M					OIL									JO	JO							
22 µF	226	J	к	М														JO								
		Rate		tage	50	100	200	250	25	50	100	200	250	50	100	200	250	25	50	100	200	250	50	100	200	250
6	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	Α
Сар	Code	Cape Voltage Code Code Case Size / Series				C18	08X			(C1812)	(-	C18	25X		-	. (C2220)	(C22	25X	

© KEMET Electronics Corporation • P.O. Box 5928 • Greenville, SC 29606 (864) 963-6300 • www.kemet.com



Table 2 – Chip Thickness/Packaging Quantities

Thickness	Case	Thickness ±	ness ± Paper Quantity Plastic					
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel		
CB	0603	0.80 ± 0.07	4,000	10,000	0	0		
CF	0603	$0.80 \pm 0.07^*$	4,000	15,000	0	0		
CD	0603	0.80 ± 0.15	4,000	10,000	0	0		
DC	0805	0.78 ± 0.10	0	0	4,000	10,000		
DD	0805	0.90 ± 0.10	0	0	4,000	10,000		
DE	0805	1.00 ± 0.10	0	0	2,500	10,000		
DG	0805	1.25 ± 0.15	0	0	2,500	10,000		
	1206	1.23 ± 0.20	4 000	10 000	2,500	10,000		
ED	1200	0.70 ± 0.10 0.00 ± 0.10	4,000	10,000	4,000	10,000		
EU EN	1200	0.95 ± 0.10	0	0	4,000	10,000		
FD	1200	1.00 ± 0.10	Ő	Ő	2,500	10,000		
FF	1206	1.10 + 0.10	Ő	Ő	2,500	10,000		
EF	1206	1.20 ± 0.15	Ő	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		
	1210	1.55 ± 0.15 1.70 ± 0.20	0	0	2,000	8,000		
FI	1210	1.70 ± 0.20 1.85 ± 0.20	0	0	2,000	8,000		
FK	1210	210 ± 0.20	0	0	2,000	8,000		
FS	1210	2.50 ± 0.20	Ő	Ő	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	1812	1.30 ± 0.10	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		
HB	1020	1.10 ± 0.15 1.15 ± 0.15	0	0	1,000	4,000		
	1825	1.15 ± 0.15 1.30 ± 0.15	0	0	1,000	4,000		
HE	1825	1.50 ± 0.15 1.50 + 0.15	0	0	1,000	4,000		
JC	2220	1.10 ± 0.15	Ő	0 0	1.000	4.000		
JD	2220	1.30 ± 0.15	0	0	1,000	4,000		
JF	2220	1.50 ± 0.15	0	0	1,000	4,000		
JO	2220	2.40 ± 0.15	0	0	500	2,000		
KB	2225	1.00 ± 0.15	0	0	1,000	4,000		
KC	2225	1.10 ± 0.15	0	0	1,000	4,000		
KD	2225	1.30 ± 0.15	0	0	1,000	4,000		
KE	2225	1.40 ± 0.15	0	0	1,000	4,000		
Thickness	Case	Thickness ±	7" Reel	13" Reel	7" Reel	13" Reel		
Code	Size	Range (mm)	Paper C	Quantity	Plastic	Quantity		

Package quantity based on finished chip thickness specifications.



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

EIA Size	Metric Size		Dens Maxi Land P	sity Lev imum (I rotrusio	rel A: Most) on (mm)		Dens Medi Land P	sity Lev an (Nor rotrusio	vel B: ninal) on (mm)	Density Level C: Minimum (Least) Land Protrusion (mm)						
Code	Code	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	0.80	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		
1808	4520	2.25	1.85	2.30	7.40	3.30	2.15	1.65	2.20	6.50	2.70	2.05	1.45	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).



Soldering Process

Recommended Soldering Technique:

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

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020



Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 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:
Colderability		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 +/- 2 hours after test conclusion.
Disco d Ulumidit.		Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Blased 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.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
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

Reference	lt	em	Material					
А		Finish	100% Matte Sn	SnPb (5% min)				
В	Termination	Barrier Layer	1	Ni				
С	System	Epoxy Layer	oxy Layer Ag					
D		Base Metal	C	Cu				
E	Inner E	lectrode	1	Ni				
F	Dielectri	c Material	BaTiO ₃					



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

High Voltage with Flexible Termination System (HV FT-CAP) X7R Dielectric, 500 – 3,000 VDC (Commercial & Automotive 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 $\pm 15\%$ from -55° C to $+125^{\circ}$ C.

Electronic Components

Automotive Grade is available for applications requiring proven, reliable performance in harsh environments. Whether under-hood or in-cabin, these capacitors are designed for mission and safety critical automotive circuits. Stricter testing protocol and inspection criteria have been established for automotive grade products in recognition of potentially harsh environmental conditions. KEMET automotive grade series capacitors 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	Voltage	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec) ²
	0805 1206 1210 1808	X = Flexible Termination	2 Significant Digits + Number of Zeros	J = ±5% K = ±10% M = ±20%	C = 500 V B = 630 V D = 1,000 V F = 1,500 V	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% min)	Blank = Bulk TU = 7" Reel Unmarked TM = 7" Reel Marked
	1812 1825 2220 2225				G = 2,000 V Z = 2,500 V H = 3,000 V			C = 100% Matte Sn	AUTO = Automotive Grade 7" Reel Unmarked

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.



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	3.30 (.130) ± 0.40 (.016)	1.60 (.063) ± 0.20 (.008)		0.60 (.024) ± 0.25 (.010)		Solder Reflow
1210	3225	3.30 (.130) ± 0.40 (.016)	2.50 (.098) ± 0.20 (.008)		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	Solder Beflow Only
1825	4564	4.60 (.181) ± 0.40 (.016)	6.40 (.252) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)		Solder Reliow 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)		

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
- · Pb-Free and RoHS 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 130 pF to 0.33 μF
- Available capacitance tolerances of ±5%, ±10% or ±20%
- Low ESR and ESL
- · Non-polar device, minimizing installation concerns
- · Commercial and 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% 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.

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

Pb-Free and RoHS Compliant (excluding SnPb termination finish option).



Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +125°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
Dielectric Withstanding Voltage	150% of rated voltage for voltage rating of < 1,000 V 120% of rated voltage for voltage rating of \ge 1,000 V (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	See Insulation Resistance Limit Table (500 VDC applied for 120 ±5 <i>seconds</i> @ 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 \pm 50 Hz and 1.0 ± 0.2 Vrms if capacitance \leq 10 μF

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 (%)	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
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	All



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

		Cas S	se Si Serie	ze / s	С)80	5X		C 1	200	6X			C1	210	X				C1	808	3X					C1	812	2X		
Capacitance	Сар	Vol	tage C	ode	c	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	Η
oupuontanoo	Code	Rat	ed Volt	age	500	630	1000	500	630	1000	1500	2000	500	630	1000	1500	2000	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000
		Ca	pacitar	nce			-						Pro	duct	Avai	labi	lity a	nd C	hip T	hick	nes	s Co	des								
		T	olerand	ce				_					Se	e Ta	ble 2	? for	Chip) Thic	kne	ss Di	imer	sior	ns								
120 pF 130 pF	121	J	K	M	DG	DG	DG											IR	IR	IB	IB	IB	IB	IB	GG	GG	GG	GG	GG	GG	
150 pF	151	J	ĸ	M	DG	DG	DG											LB	LB	LB	LB	LB	LB	LB							
180 pF	181	J	К	М	DG	DG	DG											LB	LB	LB	LB	LB	LB	LB							
220 pF	221	J	K	М	DG	DG	DG	EG	EG	EG	EG	EG						LB	LB	LB	LB	LB	LB	LB	GK	GK	GK	GK	GK	GK	GK
270 pF	271	J	K	М	DG	DG	DG	EG	EG	EG	EG	EG						LC	LC	LC	LC	LC	LC	LC	GK	GK	GK	GK	GK	GK	GK
330 pF	331	J	K	М	DG	DG	DG	EG	EG	EG	EG	EG						LC	LC	LC	LC	LC	LC	LC	GK	GK	GK	GK	GK	GK	GK
390 pF	391	J	K	M	DG	DG	DG	EG	EG	EG	EG	EG						LB	LB	LB	LB	LB	LB	LC	GK	GK	GK	GK	GK	GK	GK
470 pF	4/1	J	K	M	DG	DG	DG					EG	-	-	-	-	-		LB	LB	LB	LB	LB	LC	GK	GK	GK	GK	GK	GK	GK
560 pF	501	J	ĸ	M	DG	DG	DG	EF	EF	EF	EF	EG	FL	FL	FL	FL	FL	LB	LB	LB	LB	LB	LB	LC	GH	GH	GH	GH	GH	GK	GK
820 pF	821	J	ĸ	M		DG	DG		FF	EF	FF	EG	FL	FL	FL	FL	FL								СН	GH	GH	СН	СН	GK	GK
1 000 pF	1021	J	K	M		DG	DG	FF	FF	FF	FF	EG	FI	FI	FI	FL	FI					IR			GH	GH	GH	GH	GH	GK	GK
1,000 pF	122	Ĵ	ĸ	M	DG	DG	DG	FF	FF	FF	EG.	FG	FI	FI	FI	FI	FM	IB	IB	IB	IB	IC	IA	10	GH	GH	GH	GH	GH	GK	GK
1.500 pF	152	Ĵ	K	M	DG	DG	DG	EF	EF	EF	EG	EG	FL	FL	FL	FL	FM	LB	LB	LB	LB	LC	LB		GH	GH	GH	GH	GH	GK	0.11
1,800 pF	182	J	K	М	DG	DG	DG	EF	EF	EF	EG	EG	FL	FL	FL	FL	FM	LB	LB	LB	LB	LC	LC		GH	GH	GH	GH	GH	GK	
2,000 pF	202	J	К	M	DG	DG	DG	EF	EF	EF	EG	EG	FL	FL	FL	FL	FM	LA	LA	LA	LB	LC	LC		GH	GH	GH	GH	GH	GK	
2,200 pF	222	J	K	M	DG	DG	DG	EF	EF	EF	EG	EG	FL	FL	FL	FL	FM	LA	LA	LA	LB	LC	LC		GH	GH	GH	GH	GH	GK	
2,700 pF	272	J	K	M	DG	DG	DG	EF	EF	EF	EG		FL	FL	FL	FL	FM	LA	LA	LA	LB	LC			GH	GH	GH	GH	GK	GM	
3,300 pF	332	J	K	М	DG	DG	DG	EF	EF	EF	EG		FL	FL	FL	FL	FM	LA	LA	LA	LB	LA			GH	GH	GH	GH	GK	GM	
3,900 pF	392	J	K	M	DG	DG	DG	EF	EF	EF	EG		FL	FL	FL	FL	FK	LA	LA	LA	LB	LB			GH	GH	GH	GH	GK	GO	
4,700 pF	472	J	K	M	DG	DG	DG	EF	EF	EF	EG		FL	FL	FL	FL	FK	LA	LA	LA	LB	LC			GH	GH	GH	GH	GH	GO	
5,600 pF	562	J	K	M	DG	DG		EF	EF	EF			FL	FL	FL	FM	FK	LA	LB	LB	LC				GH	GH	GH	GK	GK		
6,800 pF	082	J	ĸ			DG		EG	EG	EG						FIVI	15		LB	LB					GH	GH	GH	GK	GM		
0,200 pF	103	J	ĸ	M		DG		EG	EG	EG	EG		FL	FL	FL	FK				LD					СН	GH	GH	GK	GIVI		
12 000 pF	103		ĸ	M	DG			FG	E.I	E.I			FI	FI	FI	FK			IC	IC	IB				GH	GK	GK	GK	00		
15.000 pF	153	Ĵ	ĸ	M	100			EG	EJ	EJ			FL	FL	FL	FL		LA	LC	LC	LC				GH	GK	GK	GH			
18,000 pF	183	J	K	M				EJ	EJ	EJ			FL	FL	FL	FM		LA	LE	LE					GH	GK	GK	GM			
22,000 pF	223	J	K	M				EJ	EJ	EJ			FL	FM	FM	FM		LA	LE	LE					GH	GK	GK	GM			
27,000 pF	273	J	K	M				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	393	J	K	M				EJ					FK	FG	FH	FS		LC	LA	LA					GH	GB	GB				
47,000 pF	473	J	K	M				EJ					FK	FH	FK			LC	LA	LB					GH	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				EJ					FG	FK	FS				LA	LC					GE	GE	GE				
02,000 pF	023	J	r k	M										EQ												GE	GN				
0.10 µl	104	.1	ĸ	M									FK	10											GF	GK	00				
0.15 µF	154	J	K	M									FK					LB							GE	GN					
0.18 µF	184	J	K	M																					GF						
0.22 µF	224	J	K	М																					GJ						
0.27 µF	274	J	K	М																					GL						
0.33 µF	334	J	K	M																					GS						
		Rat	ed Volt (VDC)	age	500	630	1000	500	630	1000	1500	2000	500	630	1000	1500	2000	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000
Capacitance	Cap Code	Vol	tage C	ode	c	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	Z	H	c	В	D	F	G	z	Н
		Case	Case Size / Series				х		С	1206	х			С	1210	(С	1808	x					С	1812	x		

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 (1825 – 2225 Case Sizes)

		Ca	Case Size / C1825X C2220X										C	2225	X										
Canacitance	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
oapacitance	Code	Rated	Voltage	(VDC)	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000
		Ca 1	apacitan Foleranc	ice e					Product Availability and Chip Thickness Coo See Table 2 for Chip Thickness Dimension								odes ns								
470 pF	471	J	K	M	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	к	М	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	к	М	HE	HE	HE	HE	HE	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
2,000 pF	202	J	к	М	HE	HE	HE	HE	HE	HG	HG	JE	JE	JE	JE	JE	JK	JK	KF	KF	KF	KF	KF	KF	KF
2,200 pF	222	J	к	М	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	М	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	к	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	к	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	к	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	к	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	К	М	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	к	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	к	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	к	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	к	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	М	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	к	M	HE	HG	HG	HE				JE	JK	JK	JK				KE	KF	KF	KF			
39,000 pF	393	J	к	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	к	M	HE	HG	HG	HJ				JE	JE	JE	JL				KE	KF	KF	KF			
62,000 pF	623	J	к	M	HG	HG	HG	HK				JE	JE	JE	JL				KF	KF	KF	KH			
68,000 pF	683	J	к	M	HG	HJ	HJ	HK				JE	JK	JK	JL				KE	KF	KF	KJ			
82,000 pF	823	J	к	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							JE	JN	JN					KE	KH	KH				
0.15 µF	154	J	K	M	HG							JK							KF	KJ	KJ				
0.18 µF	184	J	K	M	HG							JK							KF						
0.22 µF	224	J	K	M	HG														KF						
		Rated	Voltage	(VDC)	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000
Capacitance	Cap Code	Vo	ltage Co	ode	С	В	D	F	G	z	Н	С	В	D	F	G	z	н	С	В	D	F	G	z	Н
		Case	C1825X						C2220X					C2225X											

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 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
DG EF EG EJ EG	0805 1206 1206 1206 1210	$1.25 \pm 0.15 \\ 1.20 \pm 0.15 \\ 1.60 \pm 0.15 \\ 1.70 \pm 0.20 \\ 1.25 \pm 0.15 \\ 1.51 \\ $	0 0 0 0	0 0 0 0	2,500 2,500 2,000 2,000 2,500	10,000 10,000 8,000 8,000 10,000
FL FH FM FK FS	1210 1210 1210 1210 1210 1210	1.20 ± 0.13 1.40 ± 0.15 1.55 ± 0.15 1.70 ± 0.20 2.10 ± 0.20 2.50 ± 0.30	0 0 0 0 0	0 0 0 0 0	2,000 2,000 2,000 2,000 2,000 1,000	8,000 8,000 8,000 8,000 4,000
LE LA LB LC GB	1808 1808 1808 1808 1808 1812	$\begin{array}{c} 1.00 \pm 0.10 \\ 1.40 \pm 0.15 \\ 1.60 \pm 0.15 \\ 2.00 \pm 0.15 \\ 1.00 \pm 0.10 \end{array}$	0 0 0 0 0	0 0 0 0 0	2,500 1,000 1,000 1,000 1,000	10,000 4,000 4,000 4,000 4,000 4,000
GC GE GG GH GF	1812 1812 1812 1812 1812 1812	$\begin{array}{c} 1.10 \pm 0.10 \\ 1.30 \pm 0.10 \\ 1.55 \pm 0.10 \\ 1.40 \pm 0.15 \\ 1.50 \pm 0.10 \end{array}$	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
GK GJ GN GL GM	1812 1812 1812 1812 1812 1812	$\begin{array}{c} 1.60 \pm 0.20 \\ 1.70 \pm 0.15 \\ 1.70 \pm 0.20 \\ 1.90 \pm 0.20 \\ 2.00 \pm 0.20 \end{array}$	0 0 0 0	0 0 0 0	1,000 1,000 1,000 500 500	4,000 4,000 4,000 2,000 2,000
GS GO HE HG HJ	1812 1812 1825 1825 1825	$\begin{array}{c} 2.10 \pm 0.20 \\ 2.50 \pm 0.20 \\ 1.40 \pm 0.15 \\ 1.60 \pm 0.20 \\ 2.00 \pm 0.20 \end{array}$	0 0 0 0	0 0 0 0	500 500 1,000 1,000 500	2,000 2,000 4,000 4,000 2,000
HK JE JK JL JN	1825 2220 2220 2220 2220 2220	$2.50 \pm 0.20 \\ 1.40 \pm 0.15 \\ 1.60 \pm 0.20 \\ 2.00 \pm 0.20 \\ 2.50 \pm 0.20$	0 0 0 0	0 0 0 0 0	500 1,000 500 500 500	2,000 4,000 2,000 2,000 2,000
KE KF KH KJ	2225 2225 2225 2225 2225	$\begin{array}{c} 1.40 \pm 0.15 \\ 1.60 \pm 0.20 \\ 2.00 \pm 0.20 \\ 2.50 \pm 0.20 \end{array}$	0 0 0 0	0 0 0 0	1,000 1,000 500 500	4,000 4,000 2,000 2,000
Thickness Code	Thickness Case Thickness ± Code Size Range (mm)		7" Reel Paper G	13" Reel	7" Reel Plastic	13" Reel Quantity

Package quantity based on finished chip thickness specifications.



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

EIA Size Code	Metric Size Code	etric 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	C	Y	X	V1	V2	С	Y	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	0.80	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
1808	4520	2.25	1.85	2.30	7.40	3.30	2.15	1.65	2.20	6.50	2.70	2.05	1.45	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).



Soldering Process

Recommended Soldering Technique:

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

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020



Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method					
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.					
Board Flex	JIS-C-6429	Appendix 2, Note: 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:					
Calderability		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					
Temperature Cycling JESD22 Method JA		1,000 cycles (-55°C to +125°C). Measurement at 24 hours +/- 2 hours after test conclusion.					
Dissed Humidity	MIL STD 202 Method 102	Load Humidity: 1,000 hours 85°C/85% RH and 200 VDC maximum. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.					
Blased 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.					
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.					
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air – Air.					
High Temperature Life	MIL-STD-202 Method 108	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

Reference	lt	em	Material		
A		Finish	100% Matte Sn	SnPb (5% min)	
В	Termination System	Barrier Layer	Ni		
С		Epoxy Layer	Ag		
D		Base Metal	Cu		
E	Inner E	lectrode	Ni		
F	Dielectri	c Material	BaTiO₃		



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



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 $\pm 15\%$ 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	Voltage	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec) ²
	0603 0805 1206 1210 1812	X = Flexible Termination	2 significant digits + number of zeros.	$F = \pm 1\%$ $G = \pm 2\%$ $J = \pm 5\%$ $K = \pm 10\%$ $M = \pm 20\%$	3 = 25 V 5 = 50 V 1 = 100 V	H = Ultra- Stable X8R	A = N/A	C = 100% Matte Sn L = SnPb (5% minimum)	Blank = Bulk TU = 7" Reel Unmarked AUTO = Automotive Grade 7" Reel Unmarked

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.

²Additional 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
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) ±0.20 (.008)	1.25 (.049) ±0.20 (.008)		0.50 (0.02) ±0.25 (.010)	0.75 (.030)	or
1206	3216	3.30 (.130) ±0.40 (.016)	1.60 (.063) ±0.20 (.008)	See Table 2 for Thickness	0.60 (.024) ±0.25 (.010)		Solder Reflow
1210	3225	3.30 (.130) ± 0.40 (.016)	2.50 (.098) ± 0.20 (.008)		0.60 (.024) ± 0.25 (.010)	N/A	Caldea Daflaw Only
1812	4532	4.50 (.178) ±0.40 (.016)	3.20 (.126) ±0.30 (.012)		0.70 (.028) ±0.35 (.014)		Solder Reflow Only

Benefits

- -55°C to +150°C operating temperature range
- Superior flex performance (up to 5 mm)
- · Pb-Free and RoHS 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% 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.


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

Pb-Free and RoHS Compliant (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 \pm 100 kHz and 1.0 \pm 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

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	2.5	0.3% or ±0.25 pF	10% of Initial Limit			



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

		Ca	se S	ize	/ Sei	ries	C	:0603	С	C	0805	С	C	1206	С	C	:12100	0	C18	12C
0	Capacitance		Vol	tage C	Code		3	5	1	3	5	1	3	5	1	3	5	1	5	1
Capacitance	Code	F	Rated N	/oltag	je (VD	C)	25	20	100	25	50	100	25	50	100	25	50	100	50	100
		Ca	apacita	ance 1	Tolerar	nce				Pr	oduct /	Availab	ility and	Chip T	hickne	ss Cod	es			
430 pF	431	F	G	J	K	М	СВ	CB	CB					IIICKIIC	<u>33 Dilli</u>					
470 pF	471	F	G	J	K	M	СВ	CB	CB											
510 pF	511	F	G	J	K	M	СВ	CB	CB											
560 pF	561	F	G	J	K	M	СВ	CB	CB											
620 pF	621	F	G	J	K	M	CB	CB	CB											
680 pF	681	F	G	J	K	M	CB	CB	CB											
750 pF	751	F	G	J	K	M	CB	CB	CB											
820 pF	821	F	G	J	K	M	CB	CB	CB											
910 pF	911	F	G	J	K	M	CB	CB	CB											
1,000 pF	102		G	J	K	M	CB	CB	CB								_			
1,100 pF	112		G	J	K	M	CB	CB	CB											
1,200 pF	122		G	J	ĸ			CB	CB											
1,300 pF	152		G	J	r k			CB	CB											
1,500 pF	152		G	J	r k			CB	CB											
1,000 pl	182	F	G	J	K	M	CB	CB	CB											
2,000 pF	202	F	G		ĸ	M	CB	CB	CB	DC	DC	DC								
2,000 pF	202	F	G	J	ĸ	M	CB	CB	CB	DC	DC	DC								
2,200 pF	242	F	G	J	ĸ	M	CB	CB	CB	DC	DC	DC								
2,700 pF	272	F	G	Ĵ	K	M	СВ	CB	CB	DC	DC	DC								
3.000 pF	302	F	G	J	K	M	СВ	CB	CB	DC	DC	DC								
3,300 pF	332	F	G	J	К	м	СВ	СВ	СВ	DC	DC	DC								
3,600 pF	362	F	G	J	K	М	СВ	СВ	СВ	DC	DC	DC								
3,900 pF	392	F	G	J	K	M	СВ	CB	СВ	DC	DC	DC								
4,300 pF	432	F	G	J	K	M	СВ	CB	CB	DC	DC	DC								
4,700 pF	472	F	G	J	K	M	CB	CB	CB	DC	DC	DC								
5,100 pF	512	F	G	J	K	M	СВ	CB		DC	DC	DC								
5,600 pF	562	F	G	J	K	M	СВ	CB		DC	DC	DC								
6,200 pF	622	F	G	J	K	M	CB	CB		DC	DC	DC								
6,800 pF	682	F	G	J	K	M	CB	CB		DC	DC	DC	EB	EB	EB					
7,500 pF	752	F	G	J	K	M	CB			DC	DC	DC	EB	EB	EB					
8,200 pF	822	F	G	J	K	M	CB			DC	DC	DC	EB	EB	EB					
9,100 pF	912	F	G	J	K	M	CB			DC	DC	DC	EB	EB	EB					
10,000 pF	103	I F	G	J	K	M	СВ			DC	DC	DD	EB	EB	EB					
12,000 pF	123		G	J	K	M				DC	DC	DE	EB	EB	EB	FB	FB	FB	0.0	00
15,000 pF	153		G	J	K	M					םם	DG	EB	EB	EB	FB	FB	FB	GB	GB
18,000 pF	183		G	J	ĸ									EB	EB		FB	FB	GB	GB
22,000 pF	223		G	J	r k						DF								GB	GB
27,000 pi 33,000 pF	213		G	1	K	M								EB		FB	FR	FB	GB	GB
47.000 pF	473	F	G	1	K	M				DO			EC	FF	EH	FB	FB	FE	GB	GB
56 000 pF	563	F	G		ĸ	M							FD	FF	FH	FB	FB	FF	GB	GB
68 000 pF	683	F	G	Ĵ	ĸ	M							FF	EH		FB	FC	FG	GB	GB
82.000 pF	823	F	G	Ĵ	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	М										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	
		F	Rated Voltage (VDC) K G G K G G K G						100	50	100									
Capacitance	Capacitance Code		Vol	tage C	Code		3	5	1	3	5	1	3	5	1	3	5	1	5	1
			Case S	Size /	Serie	s	1	C0603C	;	(C0805C	;		C1206C	;		C1210C		C18	12C



Table 2 – Chip Thickness/Packaging Quantities

Thickness	Case	Thickness ±	Paper Quantity		Plastic (Quantity
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
СВ	0603	0.80 ± 0.07	4,000	10,000	0	0
DC	0805	0.78 ± 0.10	0	0	4,000	10,000
DD	0805	0.90 ± 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
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	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 (mm)

EIA Size	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)					
oouc	oouc	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	0.80	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
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).



Soldering Process

Recommended Soldering Technique:

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

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020



Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 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		a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	3-310-002	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 +/- 2 hours after test conclusion.
Pieced Humidity	MIL STD 202 Method 102	Load Humidity: 1,000 hours 85°C/85%RH and rated voltage. Add 100K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Blased 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.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours. +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+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

Reference	lt	em	Material
А		Finish	100% Matte Sn
В	Termination	Barrier Layer	Ni
С	System	Epoxy Layer	Ag
D		Base Metal	Cu
E	Inner E	Ni	
F	Dielectri	ic Material	CaZrO ₃



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

F 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 ±15% from -55°C to +125°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	К	5	R	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec) ²
	0603 0805 1206 1210 1812	Y = Floating Electrode with Flexible Termination	2 Significant Digits + Number of Zeros	J = ±5% K = ±10% M = ±20%	9 = 6.3 V 8 = 10 V 4 = 16 V 3 = 25 V 5 = 50 V 1 = 100 V 2 = 200 V A = 250 V	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% minimum)	Blank = Bulk TU = 7" Reel Unmarked TM = 7" Reel Marked

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.



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)		
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 Solder Reflow	
1206	3216	3.30 (.130) ± 0.40 (.016)	1.60 (.063) ± 0.20 (.008)	See Table 2 for Thickness	0.60 (.024) ± 0.25 (.010)			
1210	3225	3.30 (.130) ± 0.40 (.016)	2.50 (.098) ± 0.20 (.008)		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	

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
- Pb-Free and RoHS 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 $\pm 5\%$, $\pm 10\%$, and $\pm 20\%$
- · 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% 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.



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

Pb-Free and RoHS Compliant (excluding SnPb termination finish option).



Electrical Parameters/Characteristics

Item	Parameters/Characteristics				
Operating Temperature Range	-55°C to +125°C				
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%				
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%				
Dielectric Withstanding Voltage	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)				
Dissipation Factor (DF) Maximum Limit @ 25°C	5% (6.3 and 10 V), 3.5% (16 and 25 V) and 2.5% (50 to 250 V)				
Insulation Resistance (IR) Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ±5 seconds @ 25°C)				

Regarding aging rate: Capacitance measurements (including tolerance) are indexed to a referee time of 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 μ F

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

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



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		10% of Initial Limit			
X7R	16/25	All	5.0	±20%				
	< 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	< 0.047 µF	≥ 0.047 µF
1206	< 0.22 µF	≥ 0.22 µF
1210	< 0.39 µF	≥ 0.39 µF
1808	ALL	N/A
1812	< 2.2 µF	≥ 2.2 µF
1825	ALL	N/A
2220	< 10 µF	≥ 10 µF
2225	ALL	N/A



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

		Ca	se Siz Series	ze / S			C	C0603	Y			C0805Y								
Canacitanco	Сар	Va	ltage Co	de	9	8	4	3	5	1	2	9	8	4	3	5	1	2	Α	
Capacitance	Code	Ra	ted Volta (VDC)	age	6.3	9	16	25	50	100	200	6.3	9	16	25	50	100	200	250	
		Ca	pacita	nce ce				Pr	oduct See Ta	Availa ble 2 f	bility for Chi	and Cl	hip Th kness	icknes Dime	ss Cod nsion	les s				
180 pF	181	J	K	M	СВ	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	
220 pF	221	J	К	M	СВ	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	
270 pF	271	J	K	M	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	
330 pF	331	J	K	M	СВ	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	
390 pF	391	J	K	M	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	
470 pF	471	J	K	M	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	
560 pF	561	J	K	M	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	
680 pF	681	J	K	M	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	
820 pF	821	J	K	M	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	
1,000 pF	102	J	K	M	CB	CB	CB	CB	CF	CB	CF	DC	DC	DC	DC	DC	DC	DC	DC	
1,200 pF	122	J	K	M	СВ	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	
1,500 pF	152	J	K	M	СВ	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	
1,800 pF	182	J	K	M	СВ	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	
2,200 pF	222	J	K	M	СВ	CB	CB	CB	CF	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	
2,700 pF	272	J	K	M	СВ	CB	CB	CB	CB	CF	CB	DC	DC	DC	DC	DC	DC	DC	DC	
3,300 pF	332	J	K	M	СВ	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	
3,900 pF	392	J	K	M	СВ	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	
4,700 pF	472	J	K	M	СВ	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	
5,600 pF	562	J	K	M	СВ	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DC	DC	
6,800 pF	682	J	K	M	СВ	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DC	DC	
8,200 pF	822	J	K	M	CB	CB	CB	CB	CB	СВ		DC	DC	DC	DC	DC	DC	DC	DC	
10,000 pF	103	J	K	M	CB	CB	CB	CB	CF			DC	DC	DC	DC	DC	DC	DC	DC	
12,000 pF	123	J	K	M	CB	CB	CB	CB	CB			DC	DC	DC	DC	DC	DC	DC	DC	
15,000 pF	153	J	K	M	CB	CB	CB	CB	CB			DC	DC	DC	DC	DC	DD			
18,000 pF	183	J	K	M	CB	CB	CB	CB	CB			DC	DC	DC	DC	DC	DD			
22,000 pF	223	J	K	M	СВ	СВ	СВ	СВ	CB			DC	DC	DC	DC	DC	סט			
27,000 pF	273	J	K	M								DC	DC	DC	DC	DC				
33,000 pF	333	J	K	M								DC	DC	DC	DC	DC				
39,000 pF	393	J	K	M								DC	DC	DC	DC	DC				
47,000 pF	4/3	J	K	M								DC	DC	DC	DC	DC				
56,000 pF	563	J	K	M									DD	DD	DD	DD				
68,000 pF	683	J	K	M									DD	DD	DD	DD				
82,000 pF	823	J	K	M								DG	DG	DG	DG	DG				
υ.ιυ με	104	J	ĸ	IVI					_		_	DG	DG	DG	DG	DG				
		Rated Voltage (VDC)			6.3	9	16	25	50	100	200	6.3	9	16	25	50	100	200	250	
Capacitance	Cap Code	de Voltage Code			9 8 4 3 5 1 2						9 8 4 3 5 1 2 A									
		Ca	Case Size / Series			C0603Y								C0805Y						



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

		Cas	se S Serie	ize / es	C1206Y								C1210Y							С	1812	Y						
Canacitance	Сар	Vol	tage C	ode	9	8	4	3	5	1	2	A	9	8	4	3	5	1	2	A	3	5	1	2	Α			
Capacitance	Code	Rat	ed Vol (VDC)	tage)	6.3	6	16	25	50	100	200	250	6.3	9	16	25	50	100	200	250	25	50	100	200	250			
		Cap To	acita lerar	ance 1ce						Pr	oduc See 1	ct Ava Fable	ailabi 2 for	ility a r Chi	and C p Thi	hip 1 ckne	'hick ss Di	ness men	Cod sions	es S								
1,000 pF	102	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB																
1,200 pF	122	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB																
1,500 pF	152	J	K	IVI	EB	EB	EB	EB	EB	EB	EB	EB																
1,800 pF	182	J	ĸ	IVI M	EB	EB	EB	EB	EB	EB	EB	EB	ED.	гр	гр	FD	гр	гр	гр	FD								
2,200 pF	222	J	ĸ	IVI	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB								
2,700 pF	212	J	n v																									
3,300 pF	33Z 202	J	r v	IVI M																								
3,900 pF	39Z 470	J																										
4,700 pF	47Z 562	J	ĸ	M																								
5,000 pF	682	J	ĸ	M		ED	ED	ED	ED	ED	ED	ED	ED	ED	ED	ED	ED	ED	ED	ED	GR	CP	CP	GR	GP			
8,000 pl	822	J		M																	GB	CP	CP	CP	GB			
0,200 pi 10,000 pE	1022	J		M																	GB	CP	CP	CP	GB			
12,000 pl	103	1		M																	GB	CP	GB	CP	GB			
12,000 pl 15,000 pE	123	1		M																	GB	CP	GB	CP	CP			
18,000 pl	193	J	K K	M																	GD	GB	GB	GB	GD			
22,000 pF	222	1	K K	M																	CP	CP	CP	CP	CP CP			
22,000 pl 27,000 pE	223	1	K K	M																	GD	CP	CP	CP	CP			
27,000 pl 33,000 pE	213	1	k K	M																	CP	CP	CP	CP	CP			
30,000 pl	303	1	k K	M																	CP	CP	CP	CP	CP			
47,000 pF	/73	J	K K	M		ED	ED	ED	ED	EC			ED	ED	ED	ED	ED	ED	FC	FC	GB	GB	GB	GB	GB			
56 000 pF	563	J	ĸ	M	EB	EB	EB	EB	EB	EB			FR	FB	FR	FR	FR	FR	FC	FC	GB	GB	GB	GB	GB			
68 000 pF	683		ĸ	M	FR	EB	EB	EB	EB	LD			FR	FR	FR	FR	FR	FR	10	10	GB	GB	GB	GB	GB			
82 000 pF	823	J J	ĸ	M	FR	FR	FR	FR	FR				FR	FR	FR	FR	FR	FC			GB	GB	GB	GB	GB			
0.10 µF	104	ŭ	ĸ	M	FR	FR	FR	FR	FR				FR	FR	FR	FR	FR	FD			GB	GB	GB	GB	GB			
0.12 µF	124	J	ĸ	M	FC	FC	FC	FC	FC				FB	FB	FB	FB	FB	10			GB	GB	GB	GB	GB			
0.15 µF	154	Ĵ	ĸ	M	[_]				20				FC	FC	FC	FC	FC				GB	GB	GB	GB	GB			
0.18 µF	184	Ĵ	ĸ	M									FC	FC	FC	FC	FC				GB	GB	GB	GB	GB			
0.22 µF	224	Ĵ	ĸ	M									FC	FC	FC	FC	FC				GB	GB	GB	GB	GB			
		Rat	ed Vol	tage	6.3	10	16	25	50	100	200	250	6.3	-10	16	25	20	100	200	250	25	20	100	200	250			
Canacitanco	Сар	Vel	tane	ode	•	8	Λ	2	5	1	2	Δ	٥	8	Λ	2	5	1	2	Δ	2	5	1	2	Δ			
Capacitance	Code	Ca	so Si		-	5 0 4 5 5 1 Z A					~																	
		5	Case Size / Series			Case Size / Series					C12	06Y							C12	10Y					С	1812	Y	



Thickness	Case	Thickness ±	Paper G	Quantity	Plastic (Quantity
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
CB	0603	0.80 ± 0.07	4,000	10,000	0	0
CF	0603	0.80 ± 0.07	4,000	15,000	0	0
DC	0805	0.78 ± 0.10	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
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
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	Range (mm)	Paper C	Juantity	Plastic (Quantity

Table 2 – Chip Thickness/Packaging Quantities

Package quantity based on finished chip thickness specifications.

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

EIA Size	EIA Metric Den Size Size Land P)		Dens Medi Land P	sity Lev an (Nor rotrusio	vel B: ninal) on (mm)	Density Level C: Minimum (Least) Land Protrusion (mm)						
ooue	ooue	С	Y	X	V1	V2	C	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	1.00	1.35	1.55	4.40	2.60	0.90	1.15	1.45	3.50	2.00	0.80	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		
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).





Soldering Process

Recommended Soldering Technique:

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

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020

Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 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:
Colderability		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
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 2 hours after test conclusion.
Discod Llumidity		Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Blased Humidity	MIL-SID-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.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
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

Reference	lt	em	Mate	erial				
A		Finish	100% Matte Sn	SnPb (5% min)				
В	Termination	Barrier Layer	Ni					
С	System	Epoxy Layer Ag						
D		Base Metal	C	ü				
E	Inner E	lectrode	Ν	li				
F	Dielectri	c Material	BaTiO ₃					



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

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 $\pm 15\%$ 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 μ F up to 47 μ F
- Available capacitance tolerances of $\pm 10\%$ and $\pm 20\%$
- 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
- Pb-Free and RoHS Compliant
- · Capable of Pb-Free reflow profiles
- Non-polar device, minimizing installation concerns
- · Tantalum and electrolytic alternative



Ordering Information

С	2210	С	106	М	5	R	2	С	7186
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance ¹	Voltage	Dielectric	Failure Rate/Design	Leadframe Finish ²	Packaging/Grade (C-Spec) ³
	1210 1812 2220	C = Standard	2 significant digits + number of zeros	K = ±10% M = ±20%	8 = 10 V 4 = 16 V 3 = 25 V 5 = 50 V 1 = 100 V A = 250 V	R = X7R	1 = KPS Single Chip Stack 2 = KPS Double Chip Stack	C = 100% Matte Sn	7186 = 7" Reel Unmarked 7289 = 13" Reel Unmarked

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.

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



Dimensions – Millimeters (Inches)



-LW

-LW

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)	

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

Pb-Free and RoHS Compliant.





Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +125°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit @ 25°C	5%(10 V), 3.5%(16 V and 25 V) and 2.5%(50 V to 250 V)
Insulation Resistance (IR) Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ±5 seconds @ 25°C)

Regarding aging rate: Capacitance measurements (including tolerance) are indexed to a referee time of 48 or 1,000 hours. Please refer to a part number specific datasheet for referee time details.

To obtain IR limit, divide $M\Omega$ - 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 μF

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

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

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
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 C2220C476M3R2C



Z and ESR C2220C225MAR2C





Electrical Characteristics cont'd

ESR - 1812, .10 µF, 50 V X7R



$ESR-1210,\,.22~\mu\text{F},\,50$ V X7R



Impedance - 1812, .10 µF, 50 V X7R



Impedance – 1210, .22 $\mu\text{F},$ 50 V X7R





Electrical Characteristics cont'd

Microphonics – 1210, 4.7 μF , 50 V, X7R



Microphonics – 2220, 47 μF , 25 V, X7R



Competitive Comparision

Microphonics - 1210, 4.7 µF, 50 V, X7R



Microphonics - 2220, 22 µF, 50 V, X7R



Microphonics – 1210, 22 $\mu\text{F},$ 25 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 Flexure to 10 mm



Board Flex vs. Termination Type



Board Flexure to 10 mm





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

		Case Siz	e / Series			C1	210C			C1812C					C2220C				
	Can	Voltag	e Code	8	4	3	5	1	A	4	3	5	1	A	4	3	5	1	A
Capacitance	Code	Rated Volt	tage (VDC)	10	16	25	50	100	250	16	25	50	100	250	16	25	50	100	250
		Capacitanc	e Tolerance					Рі	oduct A See Tab	vailabi le 2 for	lity an Chip 1	d Chip Fhickn	Thickn ess Din	ess Cod nensions	les s				
						Sin	gle C	hip St	tack										
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	К	M	FV	FV	FV	FV	FV		GP	GP	GP	GP	GP	JP	JP	JP	JP	JP
0.47 µF	474	К	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	К	M	FV	FV	FV	FV			GP	GP	GP			JP	JP	JP	JP	
4.7 µF	475	К	M	FV	FV	FV	FV			GP	GP	GP			JP	JP	JP		
10 µF	106	К	M	FV	FV	FV				GP	GP				JP	JP	JP		
15 µF	156	К	M	FV											JP	JP			
22 µF	226	K	M	FV											JP	JP			
33 µF	336	K	M																
47 µF	476	K	M																
100 µF	107	K	M																
						Doι	uble (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			
100 µF	107		М																
220 µF	227		м																
		Rated Volt	tage (VDC)	10	16	25	50	100	250	16	25	50	100	250	16	25	50	100	250
Capacitance	Сар	Voltage Code			4	3	5	1	A	4	3	5	1	A	4	3	5	1	A
Capacitanoo	Code	Case Siz	Case Size / 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/Packaging Quantities

Thickness	kness Case Thickn		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 Code	Case Thic Size Ran	Thickness ±	7" Reel	13" Reel	7" Reel	13" Reel
		Range (mm)	Paper Quantity		Plastic	Quantity

Package quantity based on finished chip thickness specifications.



EIA SIZE	METRIC SIZE	Median (Nominal) Land Protrusion						
CODL	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		

Table 3 – KPS Land Pattern Design Recommendations (mm)

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_{min} to T_{max})	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:
Colderability		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 @ 250°C
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +125°C). Measurement at 24 hours +/- 2 hours after test conclusion.
Discod Humidity	MIL STD 202 Method 102	Load Humidity: 1,000 hours 85°C/85% RH and 200 VDC maximum. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Blased 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.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air-Air.
High Temperature Life	MIL-STD-202 Method 108	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 .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

Reference	ltem	Material
A	Leadframe	Phosphor Bronze – Alloy 510
В	Leadframe Attach	HMP Solder
С		Cu
D	Termination	Ni
E		Sn
F	Inner Electrode	Ni
G	Dielectric Material	BaTiO ₃



Note: Image is exaggerated in order to clearly identify all components of construction. HMP = High Melting Point

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.



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. 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°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.

KEMET's KPS Series devices in X7R dielectric exhibit a

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 $\pm 10\%$ and $\pm 20\%$
- · 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
- Pb-Free and RoHS Compliant
- · Capable of Pb-Free reflow profiles
- Non-polar device, minimizing installation concerns
- Film alternative



Ordering Information

С	2220	С	105	М	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) ³
	2220	C = Standard	2 significant digits + number of zeros.	K = ±10% M = ±20%	C = 500 V B = 630 V	R = X7R	1 = KPS Single Chip Stack 2 = KPS Double Chip Stack	C = 100% Matte Sn	7186 = 7" Reel Unmarked 7289 = 13" Reel Unmarked

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.

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



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)	Colder Deflow 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 Reliow 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 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

Pb-Free and RoHS Compliant.



Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +125°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
Dielectric Withstanding Voltage (DWV)	150% of rated voltage for voltage rating of < 1,000 V 120% of rated voltage for voltage rating of \ge 1,000 V (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	See Insulation Resistance Limit Table (500 VDC applied for 120 ±5 seconds @ 25°C)

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

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

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

1 kHz ±50 Hz and 1.0 ±0.2 Vrms if capacitance \leq 10 μ F

120 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."

Post Environmental Limits

High Temperature Life, Biased Humidity, Moisture Resistance								
Dielectric	Dielectric Rated DC Voltage Capacitance Value Dissipation Factor (Maximum %)				Insulation Resistance			
	> 25		3.0		10% of Initial Limit			
X7R	16/25	All	5.0	±20%				
	< 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 Size / 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		p Thickness p Thickness
Single Ch				(
0.047 µF	473	К	M	JP	JP	
0.10 µF	104	К	M	JP	JP	
0.15 µF	154	K	M	JP	JP	
0.22 µF	224	К	М	JP	JP	
0.33 µF	334	K	М	JP		
0.47 µF	474	K M		JP		
		Double	Chip Stac	k		
0.10 µF	104		М	JR	JR	
0.22 µF	224		M	JR	JR	
0.33 µF	334		М	JR	JR	
0.47 µF	474		M	JR	JR	
0.68 µF	664		M	JR		
1.0 µF	105		M	JR		
		Rated Volt	age (VDC)	500	630	1000
Capacitance	Capacitance	Voltag	e Code	С	В	D
Oapacitance	Code	Case Size / Series		C2220C		

Table 2 – Chip Thickness/Packaging Quantities

Thickness Case		Thickness ±	Paper C	Quantity	Plastic Quantity	
Code	Code Size Range	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 Patterr	ו Design Recommendations (ا	mm)
----------------------------	-----------------------------	-----

EIA SIZE	METRIC SIZE	Median (Nominal) Land Protru				nal) Land Protrusion	
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	



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_{min} to T_{max})	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	ppendix 2, Note: 5.0 mm minimum			
		Magnification 50 X. Conditions:			
Calderahility		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 @ 250°C			
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +125°C). Measurement at 24 hours +/- 2 hours after test conclusion.			
Discond Llumiditu	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 +/- 2 hours after test conclusion.			
Blased Humidity		Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.			
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.			
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air-Air.			
High Temperature Life	MIL-STD-202 Method 108	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

Reference	ltem	Material
A	Leadframe	Phosphor Bronze – Alloy 510
В	Leadframe Attach	HMP Solder
С		Cu
D	Termination	Ni
E		Sn
F	Inner Electrode	Ni
G	Dielectric Material	BaTiO ₃



Note: Image is exaggerated in order to clearly identify all components of construction. HMP = High Melting Point

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 VDC – 50 VDC (Commercial & Automotive Grade)

Electronic Components

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 \pm 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 $\pm 10\%$ and $\pm 20\%$
- · Higher capacitance in the same footprint
- · Potential board space savings

Ordering Information

C

- · 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
- Pb-Free and RoHS Compliant
- · Capable of Pb-Free reflow profiles
- Non-polar device, minimizing installation concerns
- Tantalum and electrolytic alternative
- Commercial & Automotive (AEC-Q200) grades available



С	2220	С	476	М	4	Ν	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	Packaging/Grade (C-Spec)
	1210 2220	C = Standard	2 significant digits + number of zeros.	K = ±10% M = ±20%	8 = 10 V 4 = 16 V 3 = 25 V 5 = 50 V	N = X8L	1 = KPS Single Chip Stack 2 = KPS Double Chip Stack	C = 100% Matte Sn	7186 = 7" Reel Unmarked 7289 = 13" Reel Unmarked AUTO = Automotive Grade 7" Reel Unmarked AUTO7289 = Automotive Grade 13" Reel Unmarked

¹ Double chip stacks ("2" in the 13th character position of the ordering code) are only available in M (±20%) capacitance tolerance.

One world. One KEMET

© KEMET Electronics Corporation • P.O. Box 5928 • Greenville, SC 29606 (864) 963-6300 • www.kemet.com



Dimensions – Millimeters (Inches)



Chip Stack	EIA Size Code	Metric Size Code	L Length	W Width	H Height	LW Lead Width	Mounting Technique
Single	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
Double	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)	

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

Pb-Free and RoHS Compliant.



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)
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 @ 25°C	3.5% (10 V and 16 V) and 2.5% (25 V and 50 V)
Insulation Resistance (IR) 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.

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

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

1 kHz \pm 50 Hz and 1.0 \pm 0.2 Vrms.

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 Shift	Insulation Resistance					
	> 25		3.0					
X8L	16 / 25	All	5.0	±20%	10% of Initial Limit			
	10		7.5					


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

		Case	Size / S	Series			C12	10C			C2220C									
Canacitance	Сар	v	oltage Co	de	8	4	3	5	1	Α	8	4	3	5	1	Α				
oapacitance	Code	Rate	d Voltage	(VDC)	10	16	25	50	100	250	10	16	25	50	100	250				
		Capac	itance Tol	erance		Produ	ct Availab	ility and C	hip Thickn	iess Code	s – See Ta	ble 2 for C	hip Thickr	ness Dime	nsions					
						Single	e 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		К	M							JP									
						Double 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			M							JR	JR	JR							
33 µF	336			M							JR									
47 µF	476			M							JR									
		Rate	Rated Voltage (VDC)			16	25	50	100	250	10	16	25	50	100	250				
Capacitance	Сар	Voltage Code		8	4	3	5	1	Α	8	4	3	5	1	Α					
	Code	Case	Size / S	Series			C12	10C			C2220C									

These products are protected under US Patent 8,331,078 other patents pending, and any foreign counterparts.

Table 2 – Chip Thickness/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	METRIC SIZE	Media	n (Nom	inal) La	nd Prot	rusion
OODL	CODE	С	Y	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



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_{min} to T_{max})	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:
Calderahilitu		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 @ 250°C
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +150°C). Measurement at 24 hours +/- 2 hours after test conclusion.
Discod Utersidite		Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Blased 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.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+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

Reference	ltem	Material
А	Leadframe	Phosphor Bronze – Alloy 510
В	Leadframe Attach	HMP Solder
С		Cu
D	Termination	Ni
E		Sn
F	Inner Electrode	Ni
G	Dielectric Material	BaTiO ₃



Note: Image is exaggerated in order to clearly identify all components of construction. HMP = High Melting Point

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 – 200 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 \pm 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, and 200 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	Voltage	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/Grade (C-Spec) ³
	0402 0603 0805 1206 1210 1808 1812 1825 2220 2225	C = Standard	2 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	L = SnPb (5% minimum)	Blank = Bulk TU = 7" Reel Unmarked

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

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

³Additional 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)		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	Osldan Daffarra Orala
1825	4564	4.50 (.177) ± 0.30 (.012)	6.40 (.252) ± 0.40 (.016)		0.60 (.024) ± 0.35 (.014)		Solder Reflow Unly
2220	5650	5.70 (.224) ± 0.40 (.016)	5.00 (.197) ± 0.40 (.016)	1	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)		

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% 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.



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 Pb containment 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%
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	0.1%
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 Vrms ± 0.2 V if capacitance \leq 1,000 pF

1 kHz \pm 50 Hz and 1.0 Vrms \pm 0.2 V 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								
C0G	All	All	0.5	0.3% or ±0.25 pF	10% of Initial Limit								



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

	Can	Case Size / Series	C0402C							(C06	03C					C08	05C	;		C1206C					
Capacitance	Code	Voltage Code	8	4	3	5	1	2	8	4	3	5	1	2	8	4	3	5	1	2	8	4	3	5	1	2
	oouc	Rated Voltage (VDC)	9	9	32	2	9	5	9	9	25	50	100	200	9	16	25	50	100	200	9	16	25	50	<u>6</u>	200
		Capacitance Tolerance			Proc	luct	Avail	abilit	y an	d Ch	nip Tl	hickn	ess (Code	s – S	ee Ta	ble 2	for C	hip T	hick	ness	Dime	ensio	ns		
0.50 & 0.75 pF	508 & 758	B C D	BB	BB E	BB E	B			CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC						
1.0 - 9.1 pF* 10 - 20 pF*	109 - 919*	E G J K M	BB	BB E	SB E	B			CB	CB	CB	CB	CB	CB							EB	FR	FB	FR	EB FB	FB
22 pF	220	F G J K M	BB	BB E	BB E	B			CB	CB	CB	CB	CB	CB	DE	DE	DE	DE	DC	DC	EB	EB	EB	EB	EB	EB
24 - 91 pF*	240 - 910*	F G J K M	BB	BB E	BB B	В		0	СВ	СВ	СВ	СВ	СВ	СВ	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
100 pF	101	F G J K M	BB	BB E	BB E	BE	BB E	BB C	СВ	CB	CB	CF	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
110 - 270 pF*	111 - 271*	FGJKM	BB	BB	BB B	B E	BB E			CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
300 pF 330 nF	301	FGJKM	BB	BB E		B B	BB E		DB	CB	CB	CE	CB	CB							EB	FR	EB	FR	EB FR	EB
360 pF	361	F G J K M	BB	BB	BB B	BE	BB		CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
390 pF	391	F G J K M	BB	BB E	BB B	BE	BB	C	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
430 pF	431	F G J K M	BB	BB E	BB B	BE	BB	C	В	CB	СВ	СВ	СВ	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
470 pF	471	F G J K M	BB	BB	BB B	BE	BB	C	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DD	EB	EB	EB	EB	EB	EB
510 pF	511	FGJKM	BB	BB F	SB B	BE	BB		B B	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
620 pF	621	F G J K M	BB	BB F	BB F	B	BB		CB	CB	CB	CB	CB	CB		DC	DC	DC	DC		FB	FB	FB	FB	FB	FB
680 pF	681	F G J K M	BB	BB	BB B	B	BB		CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
750 pF	751	F G J K M	BB	BB E	BB B	BE	BB		СВ	CB	СВ	СВ	СВ	СВ	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
820 pF	821	FGJKM	BB	BB E	BB B	BE	BB	C	СВ	CB	СВ	CB	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
910 pF	911	F G J K M	BB	BB E	BB B	BE	BB	0	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DD	DD	EB	EB	EB	EB	EB	EB
1,000 pF	102	FGJKM	BB	BB B		B B	вв		B B	CB	CB	CB	CB	СН							EB	EB	EB	EB	EB	EB
1,200 pF	122	FGJKM	BB	BB E	BB B	B			CB	CB	CB	CB	CB	CH	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
1,300 pF	132	FGJKM	BB	BB E	BB B	B		C	B	CB	CB	CB	CB	CH	DD	DD	DD	DD	DD	DC	EB	EB	EB	EB	EC	EC
1,500 pF	152	F G J K M	BB	BB E	BB B	В		C	В	CB	СВ	СВ	СВ	СН	DD	DD	DD	DD	DD	DC	EB	EB	EB	EB	ED	EC
1,600 pF	162	F G J K M	BB	BB	BB			C	B	CB	CB	CB	CB	CH	DD	DD	DD	DD	DD	DC	EB	EB	EB	EB	ED	ED
1,800 pF	182	F G J K M	BB	BB	BB					CB	CB	CB	CB	CH	DD	DD	DD	DD	DD	DC	EB	EB	EB	EB	ED	ED
2,000 pF	202	FGJKM	BB	BB I					CB	CB	CB	CB	CB	СН							FR	FR	FR	FR	ED	FF
2,400 pF	242	F G J K M							СВ	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EC	EC
2,700 pF	272	F G J K M						C	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EC	EC
3,000 pF	302	F G J K M						0	СВ	CB	СВ	CB	СВ		DD	DD	DD	DD	DC	DC	EC	EC	EC	EC	EC	EB
3,300 pF	332	F G J K M							CB	CB	CB	CB	CB		DD	DD	DD	DD	DC	DC	EC	EC	EC	EC	EE	EB
3,600 pF	362	FGJKM							SB	CB	CB	CB	CB						DC	םם	EC	EC	EC	EC	EE	EB
4 300 pF	432	F G J K M							CB	CB	CB	CB	CB		DE	DE	DE	DE	DC		FC	EC	FC	FC	FC	FB
4,700 pF	472	F G J K M							CB	CB	CB	CB	CB		DE	DE	DE	DE	DC	DD	EC	EC	EC	EC	EC	EB
5,100 pF	512	F G J K M							СВ	СВ	СВ	СВ			DE	DE	DE	DE	DC	DD	ED	ED	ED	ED	ED	EB
5,600 pF	562	FGJKM						C	СВ	СВ	СВ	CB			DC	DC	DC	DC	DC	DD	ED	ED	ED	ED	ED	EB
6,200 pF	622	FGJKM						C	CB	CB	CB	CB			DC	DC	DC	DC	DC	DG	EB	EB	EB	EB	EB	EB
6,800 pF	752	FGJKM							B	CB	CB	CB								DG	EB	EB	EB	EB	EB	EB
8.200 pF	822	F G J K M							CB	CB	CB				DC	DC	DC	DC	DC	DG	EC	EC	EC	EC	EB	EC
9,100 pF	912	FGJKM						C	B	CB	CB				DC	DC	DC	DC	DC		EC	EC	EC	EC	EB	EC
10,000 pF	103	F G J K M						0	СВ	CB	СВ				DC	DC	DC	DC	DD		ED	ED	ED	ED	EB	EC
12,000 pF	123	F G J K M						0	CB	CB	CB				DC	DC	DC	DC	DE		EB	EB	EB	EB	EB	ED
15,000 pF	153	F G J K M							;в	CB	СВ							DD	DG		EB	EB	EB	EB	EB	EF
22 000 pF	223	F G J K M														חס	חם	DF			FR	FR	FR	FR	ED FC	FH
27,000 pF	273	F G J K M													DF	DF	DF				EB	EB	EB	EB	EE	
33,000 pF	333	F G J K M													DG	DG	DG				EB	EB	EB	EB	EE	
		Rated Voltage (VDC)	9	16	25	2	100	200	9	16	25	50	100	200	9	16	25	50	100	200	9	16	25	50	100	200
Capacitance	Cap Code	Voltage Code	8	4	3	5	2	1	8	4	3	5	1	2	8	4	3	5	1	2	8	4	3	5	1	2
		Case Size / Series		(20402	С					C06	03C					C08	05C					C12	06C		

*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

Capacitance Ca	Can	Case Size / Series	C0402C						C0603C						C0805C							C1206C				
Capacitance	Codo	Voltage Code	8	4	3	5	1	2	8	4	3	5	1	2	8	4	3	5	1	2	8	4	3	5	1	2
	Coue	Rated Voltage (VDC)	9	16	25	50	100	200	10	16	25	50	100	200	9	16	25	50	100	200	9	16	25	50	100	200
		Capacitance Tolerance			Р	roduc	t Ava	ailabi	lity a	nd Cł	nip Tl	hickn	ess (Code	s – S	ee Ta	ble 2	for C	hip T	hick	ness	Dime	nsior	าร		
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																			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																			EH	EH	EH	EH		
0.10 µF	104	F G J K M																			EH	EH	EH			
		Rated Voltage (VDC)	10	16	25	50	100	200	10	16	25	50	100	200	10	16	25	50	100	200	10	16	25	50	100	200
Capacitance	Cap Code	Voltage Code	8	4	3	5	2	1	8	4	3	5	1	2	8	4	3	5	1	2	8	4	3	5	1	2
	ooue	Case Size / Series			C04	02C					C06	03C					C08	05C					C12	06C		

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

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

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

		С	ase Size / Series						es			C12	10C			C	1808	3C	C	1812	C	C	1825	5C	C	2220	OC	C	225	C
	Сар			Vo	ltag	je C	ode	;		8	4	3	5	1	2	5	1	2	5	1	2	5	1	2	3	1	2	5	1	2
Capacitance	Code		Ra	ted	Vol	taq	e (V	DC			<u>ې</u> د	25	2	3 8	200	50	6		20	8	00	50	8	00	20	8	500	50	8	00
					-					1						Prod	uct A	vailal	ı silitv a	and C	hin Tl	hickne	èss C	odes					`	
		C	apa	acit	and	ce T	ole	rar	ce							Se	e Tab	le 2 fo	or Chi	p Thio	knes	s Dim	ensio	ons						
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 - 300 pF*	101 - 301*				F	G	J	K	M	FB	FB	FB	FB	FB	FB															
330 - 430 pF*	331 - 431*				F	G	J	K	M	FB	FB	FB	FB	FB	FB	LF	LF	LF												
470 - 910 pF*	471 - 911*				F	G	J	K	M	FB	FB	FB	FB	FB	FB	LF	LF	LF	GB	GB	GB									
1,000 pF	102				F	G	J	K	M	FB	FB	FB	FB	FB	FB	LF	LF	LF	GB	GB	GB									
1,100 pF	112				F	G	J	K	M	FB	FB	FB	FB	FB	FB	LF	LF	LF	GB	GB	GB									
1,200 pF	122				F	G	J	K	M	FB	FB	FB	FB	FB	FB	LF	LF	LF	GB	GB	GB									
1,300 pF	132				F	G	J	K	M	FB	FB	FB	FB	FB	FC	LF	LF	LF	GB	GB	GB									
1,500 pF	152				F	G	J	K	: M	FB	FB	FB	FB	FB	FE	LF	LF	LF	GB	GB	GB									
1,600 pF	162				F	G	J	K	M	FB	FB	FB	FB	FB	FE	LF	LF	LF	GB	GB	GB									
1,800 pF	182				F	G	J	K	M	FB	FB	FB	FB	FB	FE	LF	LF	LF	GB	GB	GB									
2,000 pF	202				F	G	J	K	M	FB	FB	FB	FB	FC	FE	LF	LF	LF	GB	GB	GB									
2,200 pF	222				F	G	J	K	M	FB	FB	FB	FB	FC	FG	LF	LF	LF	GB	GB	GB									
2,400 pF	242				F	G	J	K	M	FB	FB	FB	FB	FC	FC	LF	LF	LF												
2,700 pF	272				F	G	J	K	M	FB	FB	FB	FB	FC	FC	LF	LF	LF	GB	GB	GB									
3,000 pF	302				F	G	J	K	M	FB	FB	FB	FB	FC	FF	LF	LF													
3,300 pF	332				F	G	J	K	M	FB	FB	FB	FB	FF	FF	LF	LF		GB	GB	GB									
3,600 pF	362				F	G	J	K	M	FB	FB	FB	FB	FF	FF	LF	LF													
3,900 pF	392				F	G	J	K	M	FB	FB	FB	FB	FF	FF	LF	LF		GB	GB	GB	HB	HB	HB						
4,300 pF	432				F	G	J	K	M	FB	FB	FB	FB	FF	FF	LF	LF													
4,700 pF	472				F	G	J	K	M	FF	FF	FF	FF	FG	FG	LF	LF		GB	GB	GD	HB	HB	HB				KE	KE	KE
			Ra	ted	Vol	tag	e (V	DC			9 9	25	20	100	200	50	100	200	50	100	200	50	100	200	50	100	200	50	100	200
Capacitance	Cap Code			Vo	ltag	je C	ode	•		8	4	3	5	1	2	5	1	2	5	1	2	5	1	2	3	1	2	5	1	2
			Ca	Voltage Code Case Size / Series						C12	10C			C	1808	C	C	:1812	c	C	1825	С	C	2220	с	С	2225	5		

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

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



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

			Ca	se	e Size / Series					C12	210C	, ,		C	1808	SC	С	1812	C	С	1825	5C	C	2220	C	C	2225	C			
0	Сар	Г		١	/olta	age	Co	de			8	4	3	5	1	2	5	1	2	5	1	2	5	1	2	3	1	2	5	1	2
Capacitance	Code	Г	F	ate	d V	olta	ge	(V	DC)		9	16	25	50	100	200	50	100	200	50	100	200	50	100	200	50	100	200	50	10	200
		E		Ca	apa	aci	taı	nc	е							Pro	duct	Ava	ilabi	lity a	nd C	hip	Thic	knes	s Co	des					
		4		1	ol	era	ind	ce		_						S	ee Ta	ble	2 for	Chip	o Thi	ckne	ess D	lime	nsior	าร					
5,100 pF	512					F	G	J	K	M	FB	FB	FB	FB	FG	FG													KE	KE	KE
5,600 pF	562					F	G	J	K	M	FB	FB	FB	FB	FG	FG				GB	GB	GH	НВ	HB	НВ				KE	KE	KE
6,200 pF	622					F	G	J	K	M	FB	FB	FB	FB	FG	FB													KE	KE	KE
6,800 pF	682					F	G	J	K	M	FB	FB	FB	FB	FG	FB				GB	GB	GJ	НВ	НВ	НВ	JE	JE	JB	KE	KE	KE
7,500 pF	752					F	G	J	K	M	FC	FC	FC	FC	FC	FB													KE	KE	KE
8,200 pF	822						G	J	K	M	FC	FC	FC	FC	FC	FB				GB	GH	GB	нв	НВ	НВ	JE	JE	JB	KE	KE	KE
9,100 pF	912	÷		4			G	J	K	M	FE	FE	FE	FE	FE	FB					011	0.0							KE	KE	KE
10,000 pF	103						G	J	K	M			FF FO	FF FO		FB				GB	GH	GB	HB	HB	HE	JE	JE	JB	KE	KE	KE
12,000 pF	123						G	J	K	M	FG	FG	FG	FG	FB	FB				GB	GG	GB	HB	HB	HE	JE	JE	JB	KE	KE	KE
15,000 pF	153						G	J	K	M	FG	FG	FG	FG	FB	FC				GB	GB	GB	HB	HB		JE	JE	JB	KE	KE	KE
18,000 pF	183						G	J	K	M	I FB	FB	FB	FB	FB	FC				GB	GB	GB	HB	HE		JE	JE	JB	KE	KE	
22,000 pF	223						G	J	K	M	I FB	FB	FB	FB	FB	FF				GB	GB	GB	HB	HE		JE	JB	JB	KE	KE	
27,000 pF	2/3						G	J	K		1 FB	FB	FB	FB	FB	FG				GB	GB	GB	нв	HG		JE	JB	JB	KE	KE	
33,000 pF	333						G	J	K		1 FB	FB	FB	FB	FB	FH				GB	GB	GB				JB	JB	JB	KE		
39,000 pF	393						G	J	K		1 FB	FB	FB	FB	FE	FH				GB	GB	GB				JB	JB	JB			
47,000 pF	4/3						G	J	K		FB	FB	FB	FB		FJ				GB	GB	GD				JB	JB	JB			
56,000 pF	503	÷		1			G	J	K	IV	FB	FB	FB	FB	FF					GB	GB	GD				JB	JB	JB		_	
68,000 pF	003						G	J	K		FB	FB	FB	FC	FG					GB	GB	GK				JB	JB	JB			
82,000 pF	823						G	J	K			FC			FH					GB	GB	GM				JB	JB	JB			
0.10 µF	104							J	K			FE	FE	FG	FIVI					GB	GD	GIVI				JB	JB	JD			
0.12 µF	124							J	r k			FG	FG							GB	GH					JB	JB	JD			
0.15 µF	104	T.						J	n k	IV.				FIVI						GD	GN					JB	JB	JG			
0.10 µF	104							J	n			FJ														JB	JD	JG			
0.22 µF	224							J												GR						JD	JD	JL			
0.27 µF	214							J																		JD	JF				
0.35 µF	204							J																		10	10				
0.39 µF	394 //7/	÷				F	G	J	K	M																JG					
0.17 μ1		t					5	0.0	 >	10	-	9	5	0		0		0	8		0	8		0	8		0	8		0	0
	Can	⊢	F	ate	dV	olta	ge	(V	JC)			-	ñ	5	9	50	2	9	20	2	9	20	2	9	20	5	9	20	2	9	20
Capacitance	Code	L		١	olta	age	Co	de			8	4	3	5	1	2	5	1	2	5	1	2	5	1	2	3	1	2	5	1	2
			Ca	ise	Si	ize	15	Se	rie	s			C12	210C			C	1808	C	C	1812	С	C	1825	C	C	2220	С	C	2225	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).

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



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
BD	0402	0.55 ± 0.05	10,000	50,000	0	0
CB	0603	0.80 ± 0.07	4,000	10,000	0	0
CF	0603	0.80 ± 0.07	4,000	15,000	0	0
CH	0603	0.85 ± 0.07	4,000	10,000	0	0
DE	0805	0.70 ± 0.20	4,000	10,000	0	0
	0805	0.78 ± 0.10	4,000	10,000	0	0
	0805	0.90 ± 0.10	4,000	10,000	2 500	
	0805	1.10 ± 0.10 1.25 ± 0.15	0	0	2,500	10,000
FB	1206	0.78 ± 0.10	4 000	10,000	2,500	10,000
FC	1200	0.90 ± 0.10	0,000	0	4,000	10,000
FD	1206	1.00 ± 0.10	Ő	Ő	2 500	10,000
EE	1206	1.10 ± 0.10	Ő	Ő	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 1.00 ± 0.15	0	0	2,000	10,000
GB	1812	1.00 ± 0.13 1.00 ± 0.10	0	0	2,300	10,000
GD	1812	1.00 ± 0.10 1.25 + 0.15	0	0	1,000	4,000
GH	1812	1.20 ± 0.10 1.40 ± 0.15	0	0	1,000	4,000
GG	1812	1.55 ± 0.10	Ő	Ő	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	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	0	1,000	4,000
JE	2220	1.40 ± 0.15	0	0	1,000	4,000
JF	2220	1.50 ± 0.15 1.70 ± 0.15	0	0	1,000	4,000
JG	2220	1.70 ± 0.13 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.



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

EIA Size	Metric Size		Dens Maxi Land P	sity Lev imum (f rotrusio	rel A: Most) on (mm)		Dens Media Land P	sity Lev an (Nor rotrusio	/el B: ninal) on (mm)		Dens Minir Land Pr	sity Lev mum (L rotrusio	rel C: .east) on (mm)
oouc	oouc	С	Y	X	V1	V2	C	Y	X	V1	V2	С	Y	X	V1	V2
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	0.40	0.52	0.52	1.60	0.80
0603	1608	0.90	1.15	1.10	4.00	2.10	0.80	0.95	1.00	3.10	1.50	0.60	0.75	0.90	2.40	1.20
0805	2012	1.00	1.35	1.55	4.40	2.60	0.90	1.15	1.45	3.50	2.00	0.75	0.95	1.35	2.80	1.70
1206	3216	1.60	1.35	1.90	5.60	2.90	1.50	1.15	1.80	4.70	2.30	1.40	0.95	1.70	4.00	2.00
1210	3225	1.60	1.35	2.80	5.65	3.80	1.50	1.15	2.70	4.70	3.20	1.40	0.95	2.60	4.00	2.90
1210 ¹	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 \geq 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).



Soldering Process

Recommended Soldering Technique:

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

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020



Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 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:
Soldorability		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 +/- 2 hours after test conclusion.
Riased Humidity	MIL_STD_202 Method 103	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Diased Humaity		Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
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

Reference	lt	em	Material
А		Finish	SnPb (5% minimum)
В	Termination Svstem	Barrier Layer	Ni
С	- ,	Base Metal	Cu
D	Inner E	Ni	
E	Dielectri	CaZrO ₃	



Note: Image is exaggerated in order to clearly identify all components of 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 \pm 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
- Capacitance offerings ranging from 10 pF to 22 μF
- Available capacitance tolerances of ±5%, ±10%, and ±20%



Ordering Information

С	1206	С	226	К	8	R	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec) ²
	0402 0603 0805 1206 1210 1808 1812 1825 2220 2225	C = Standard	2 Significant Digits + Number of Zeros	J = ±5% K = ±10% M = ±20%	9 = 6.3 V 8 = 10 V 4 = 16 V 3 = 25 V 6 = 35 V 5 = 50 V 1 = 100 V 2 = 200 V A = 250 V	R = X7R	A = N/A	L = SnPb (5% minimum)	Blank = Bulk TU = 7" Reel Unmarked TM = 7" Reel Marked

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

² 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)		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)		Solder Renow
1210 ¹	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	Colder Deflow Only
1825	4564	4.50 (.177) ± 0.30 (.012)	6.40 (.252) ± 0.40 (.016)		0.60 (.024) ± 0.35 (.014)		Solder Reliow 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 \geq 12 μ F add 0.02 (0.001) to the width tolerance dimension

Benefits cont'd

- Non-polar device, minimizing installation concerns
- · SnPb plated termination finish (5% 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.

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 Pb containment 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%
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 @ 25°C	5% (6.3 and 10 V), 3.5% (16 and 25 V) and 2.5% (50 to 250 V)
Insulation Resistance (IR) Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ±5 seconds @ 25°C)

Regarding aging rate: Capacitance measurements (including tolerance) are indexed to a referee time of 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 μ F

120 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."

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	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	< 0.047 µF	≥ 0.047 µF
1206	< 0.22 µF	≥ 0.22 µF
1210	< 0.39 µF	≥ 0.39 µF
1808	ALL	N/A
1812	< 2.2 µF	≥ 2.2 µF
1825	ALL	N/A
2220	< 10 µF	≥ 10 µF
2225	ALL	N/A



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

		C S S	Cas Size Size	e e / es		C	040	2C				C	060	3C						C	080	5C							С	120	6C			
Capacitance	Cap	Volt	age (Code	9	8	4	3	5	9	8	4	3	5	1	2	9	8	4	3	6	5	1	2	A	9	8	4	3	6	5	1	2	Α
	Code	Rate	ed Vo	Itage	6.3	9	16	25	50	6.3	9	16	25	50	10	200	6.3	9	16	25	35	50	9	200	250	6.3	9	16	25	35	50	10	200	250
		Ca	pacita	ance					Pro	ı duct	Δva	ilahi	litv :	and	Chin	Thi	l 		ode	s – S	See T	Table	2 fc	nr Ch	in T	l hick	nes	s Din	neng	ions				
10 - 91 pF*	100 - 910*	T T C	lerar K	M	BB	BB	BB	BB	BB	СВ	CB	CB	СВ	СВ	СВ	СВ	DC	DC	DC		DC	DC	DC	DC		EB	EB	EB	EB	EB	EB	EB	EB	
100 - 150 pF**	101 - 151**	J	К	М	BB	BB	BB	BB	BB	СВ	СВ	СВ	CB	СВ	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC		EB	EB	EB	EB	EB	EB	EB	EB	
180 - 820 pF**	181 - 821**	J	K	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	ED
1200 pF	102	J	K	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB	CB										FB	FB	FB	FB	FR	FR	FB	EB	FR
1500 pF	152	J	K	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	EB
1800 pF	182	J	К	M	BB	BB	BB	BB	BB	СВ	СВ	CB	CB	СВ	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	EB
2200 pF	222	J	K	M	BB	BB	BB	BB	BB	СВ	СВ	СВ	CB	CF	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	EB
2700 pF	272	J	K	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CF	CB	DC	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	EB
3300 pF 3900 pF	332	J	ĸ	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC		DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	EB
4700 pF	472	J	K	M	BB	BB	BB	BB	BB	СВ	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	EB
5600 pF	562	J	K	М	BB	BB	BB	BB	BB	СВ	СВ	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	EB
6800 pF	682	J	K	M	BB	BB	BB	BB	BB	СВ	СВ	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	EB
8200 pF	822	J	K	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	EB
12000 pF	103	J	ĸ	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CR	CB	CB										FR	FR	FR	FR	FR	EB	EB	EB	FR
15000 pF	153	Ĵ	ĸ	M	BB	BB	BB	BB	BB	СВ	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	EB
18000 pF	183	J	К	M	BB	BB	BB	BB	BB	СВ	СВ	СВ	CB	СВ	CB		DC	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	EB
22000 pF	223	J	K	М	BB	BB	BB	BB	BB	СВ	СВ	СВ	CB	CF	CF		DC	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	EB
27000 pF	273	J	K	M	BB	BB	BB	BB		CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DD	DE		EB	EB	EB	EB	EB	EB	EB	EB	EB
33000 pF 39000 pF	333	J	K	M	BB	BB	BB	BB		CB	CB	CB	CF	CB	CB					DC			סט	DE		EB	EB	EB	EB	EB	EB	EB	EB	EB
47000 pF	473	J	K	M	BB	BB	BB	BB		СВ	CB	CB	CB	CF	CB		DC	DC	DC	DC	DC	DC	DE	DG		EB	EB	EB	EB	EB	EB	EC	ED	ED
56000 pF	563	J	K	M	BB	BB	BB			СВ	CB	CB	CB	CB			DD	DD	DD	DD	DD	DD	DE	DG		EB	EB	EB	EB	EB	EB	EB	ED	ED
68000 pF	683	J	K	М	BB	BB	BB			СВ	СВ	СВ	CB	CF			DD	DD	DD	DD	DD	DD	DE			EB	EB	EB	EB	EB	EB	EB	ED	ED
82000 pF	823	J	K	M	BB	BB	BB			CB	CB	CB	CB	CB			DD	DD	DD	DD	DD	DD	DE			EB	EB	EB	EB	EB	EB	EB	ED	ED
0.1 µF	104	J	K	M	RR	RR	RR			CB	CB	CF	CB	CF									DE			EC	EC	EB	EB	EB	EC	EC	EM	EM
0.12 µr	154	J	K	M						СВ	CB	CB	CB	CB			DC	DC	DC	DC	DD	DD	DG			EC	EC	EC	EC	EC	EC	EC	EG	
0.18 µF	184	J	K	М						CB	CB	CB	CB	-			DC	DC	DC	DC	DG	DG	DG			EC	EC	EC	EC	EC	EC	EC	-	
0.22 µF	224	J	K	М						СВ	CB	CB	CB				DC	DC	DC	DC	DG	DG	DG			EC	EC	EC	EC	EC	EC	EC		
0.27 µF	274	J	K	M						CB	CB	CB					DD	DD	DD	DD	DD	DD				EB	EB	EB	EB	EC	EC	EM		
0.33 µF	334	J	ĸ	M						CB	CB	CB					DG	DG	DG	DG						FR	EB	FR	FR	EC	EC	EG		
0.47 µF	474	J	K	M						CB	CB	CB					DG	DG	DG	DG	DE	DE				EC	EC	EC	EC	EC	EC	EG		
0.56 µF	564	J	К	M													DD	DD	DD	DG	DH	DH				ED	ED	ED	ED	EC	EC			
0.68 µF	684	J	K	M													DD	DD	DD	DG	DH	DH				EE	EE	EE	EE	ED	ED			
0.82 µF	824	J	K	M													DD	DD	DD	DG						EF	EF	EF	EF	ED	ED			
1 µF	105	J	ĸ	M														DE	DE	DG						EP	EP	EP	EG	EU	EU			
1.5 µF	155	J	K	M													DG	DG	DG							ED	ED	ED	EG	EH	EH			
1.8 µF	185	J	K	М	1												DG	DG	DG							ED	ED	ED	EF	EH	EH			
2.2 µF	225	J	K	М													DG	DG	DG							ED	ED	ED	EF	EH	EH			
2.7 µF	275	J	K	M																						EN	EN	EN	EH					
3.3 µF	395	J	K	M																						FF	FF	FF	FH					
4.7 µF	475	Ĵ	K	M																						EF	EF	EF	EH					
5.6 µF	565	J	K	М																						EH	EH	EH						
6.8 µF	685	J	K	M																						EH	EH	EH						
8.2 µF	825	J	K	M																						EH	EH	EH						
ιο με	100	Rate	ed Vo	Itage	m.	•	9	5	•	<i>m</i> .	•	9	5	•	8	8	e.	•	9	5	5	•	2	2	20	n n	0	9	5	5	•	8	8	20
Canacitanas	Сар	V-14	(VDC	;) ()	ن م	~	-	7 2	ۍ ت	ف م	-	-	5 2	ء ت	¥	2(-	-	2	°	5	¥	<u>،</u> 20	5	ن و م	- -	-	~ ^	°	ت ت	¥ ∡	2(5
Capacitance	Code	Ca	Voltage Code Case Size /			ŏ	4	<u> </u>	5	1 9	ŏ	4	<u> </u>) ³	1	2	а	ð	4	<u>ئ</u> م	0)))	1	2	A	1 9	ŏ	4	<u>3</u>	0) ³	1	2	A
			Serie	s		С	0402	20				C	0603	SC						C	080	DC				[0	;1206	C			

*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)

	Can	C S S	Cas Size erie	e / es			(C12	100	;			C,	1808	BC		C	1812	2C			C18	250)		C	222	0 C		(222	250	;
Capacitance	Code	Volt	age (Code	9	8	4	3	5	1	2	A	5	1	2	3	5	1	2	A	5	1	2	A	3	5	1	2	A	5	1	2	A
		Rate	ed Vo (VDC	ltage ;)	6.3	9	16	25	20	10	200	250	50	100	200	25	50	1 0	200	250	50	100	200	250	25	50	10 10	200	250	50	100	200	250
		Сар	acita	ance					Prod	uct	Avail	abili	ity aı	nd Cl	hip T	, hick	ness	s Cod	des -	- See	• Tab	le 2 i	for C	hip ⁻	Thicl	knes	s Dir	nens	sions	5			
10 - 91 pF*	100 - 910*	J	K	M	FB	FB	FB	FB	FB	FB	FB																						
100 - 270 pF**	101 - 271**	J	K	M	FB	FB	FB	FB	FB	FB	FB																						
330 pF 390 nF	331	J	ĸ	M	FB	FB	FB	FB	FB	FB	FB																						
470 - 1.200 pF**	471 - 122**	J	K	M	FB	FB	FB	FB	FB	FB	FB		LF	LF	LF	GB	GB	GB	GB														
1,500 pF	152	J	K	М	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	GB	GB	GB	GB														
3,300 pF	332	J	ĸ	M	FB	FB	FB	FB	FB	FB	FB	FB				GB	GB	GB	GB		HR	HR	HR										
4.700 pF	472	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	LD	GB	GB	GB	GD		HB	HB	HB							KE	KE	KE	
5,600 pF	562	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	LD	GB	GB	GB	GH		HB	HB	HB							KE	KE	KE	
6,800 pF	682	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	LD	GB	GB	GB	GB	GB	НВ	HB	HB		JE	JE	JE			KE	KE	KE	
8,200 pF	822	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD	LD	GB	GB	GB	GB	GB	HB	HB	HB		JE	JE	JE			KE	KE	KE	
10,000 pF	103	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB				GB	GB	GB	GB	GB	HB	HB	HE		JE	JE	JE			KE	KE	KE	
12,000 pF	123	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB				GB	GB	GB	GB	GB	HR	HB	HE		JE	JE	JE			KE	KE	KE	
18,000 pF	183	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB				GB	GB	GB	GB	GB	HB	HF			JF	JE	JE			KF	KE	NL.	
22,000 pF	223	Ĵ	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD		GB	GB	GB	GB	GB	HB	HB	ΗВ	НВ	JE	JE	JE			KE	KE		
27,000 pF	273	J	K	М	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD		GB	GB	GB	GB	GB	HB	HB	HB	HB	JE	JE	JE			KE	KE		
33,000 pF	333	J	K	Μ	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD		GB	GB	GB	GB	GB	HB	HB	HB	HB	JB	JB	JB			KE			
39,000 pF	393	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	LD	LD		GB	GB	GB	GB	GB	HB	HB	HB	HB	JB	JB	JB						
47,000 pF	4/3	J	K	M	FB	FB	FB	FB	FB	FB	FC	FC				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		LU		GB	GB	GB	GB	GB	HB	HB	HB	HB	JB	JB	JB						
82,000 pF	823	Ĵ	K	M	FB	FB	FB	FB	FB	FC	FF	FF	LD			GB	GB	GB	GB	GB	HB	HB	HB	HB	JC	JC	JC	JC	JC				
0.10 µF	104	J	K	M	FB	FB	FB	FB	FB	FD	FG	FG	LD			GB	GB	GB	GB	GB	НВ	HB	HB	HB	JC	JC	JC	JC	JC	кс	KC	KC	KC
0.12 µF	124	J	K	M	FB	FB	FB	FB	FB	FD			LD			GB	GB	GB	GB	GB	HB	HB	HB	HB	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.15 µF	154	J	K	M	FC	FC	FC	FC	FC	FD			LD			GB	GB	GB	GE	GE	HB	HB	HB	HB	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.18 µF	184	J	ĸ	M	FC	FC	FC	FC	FC	FD						GB	GB	GB	GG	GG	HB	HB	HB	HB	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.22 µr	274	J	K	M	FC	FC	FC	FC	FC	FD						GB	GB	GG	GG	GG	НВ	HB	HB	HB	JC	JC	JC	JC	JC	KB	KC	KC	KC
0.33 µF	334	Ĵ	K	M	FD	FD	FD	FD	FD	FD						GB	GB	GG	GG	GG	HB	HB	HB	HB	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	GG	HB	HB	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	HB	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			HB	HD	HD	HD	JC	JC	JC	JD	JD	KB	KC	KD	KD
0.68 µF	684 824	J	K	M			FD			FG						GC	GC	GG			HR HR	HD	HD	HD	JC JC	JC	JD	JD		KB KD	KC	KD KE	KD K⊑
0.02 μr 10 μF	024 105		K	M	FH	FH	FH	FH	FH	FM						GF	GF	GG			HR	HF	HF	HF			JF	JF	JF	KR	KD	KF	KE
1.2 µF	125	J	K	M	FH	FH	FH	FH	FG								52				HB				JC	JC				KB	KE	KE	KE
1.5 µF	155	J	K	M	FH	FH	FH	FH	FG												НС				JC	JC				KC			
1.8 µF	185	J	K	М	FH	FH	FH	FH	FG												HD				JD	JD				KD			
2.2 µF	225	J	K	M	FJ	FJ	FJ	FJ	FG							GO	GO				HF				JF	JF				KD			
2./µ⊦ 3.3.u⊑	275	J	K	M	FE	FE	FE	FG	FH																								
3.9 uF	395	J	K	M	FG	FG	FG	FG	FK																								
		Rate	ed Vo	Itage	3.3	9	16	25	20	8	00	50	20	0	00	25	20	8	00	50	2	0	00	50	25	20	8	00	50	20	8	00	50
		Volt	(VDC) Code	a	8	4	3	5	1	2		5	1	2	3	5	1	2	Δ	5	1	2		3	5	1	2	Δ	5	1	2	Δ
Сар	Cap Code		se 9	i7e/	5		-				-													^					1			-	~
			Serie	S				C12	10C				C	1808	C		с 	1812	C			C18	25C			с 	2220	00			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

	0	C S S	Cas lize erie	e / es			(C12	100	;			Cŕ	180	BC		C	1812	2C		(C18	250)		C2	2220	C		(222	25C	•
Capacitance	Cap	Volt	age (Code	9	8	4	3	5	1	2	Α	5	1	2	3	5	1	2	A	5	1	2	Α	3	5	1	2	Α	5	1	2	Α
	Code	Rate	d Vo VDC	ltage)	6.3	9	16	25	50	100	200	250	50	100	200	25	50	100	200	250	50	100	200	250	25	50	100	200	250	50	100	200	250
		Cap To	acita Ieran	ance ice					Prod	uct	Avail	abili	ty ar	nd Cl	nip T	hick	ness	s Coc	des -	- See	a Tab	le 2 i	for C	hip '	Thic	nes	s Dir	nens	sions	;			
4.7 µF	475	J	Κ	М	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							
10 µF	100	J	ĸ	IVI	FH	FH	FH	F5								GK									JF	10							
15 µF 22 µF	226	J	ĸ	M	FIVI	FIN																			10	JU							
p	220	<u>,</u>			10	10						_								_			_	_				_				_	
		Rate	a vo VDC	itage)	6.3	9	16	25	50	100	200	250	50	10	200	25	50	100	200	250	50	10	200	250	25	50	100	200	250	50	100	200	250
Cap	Cap Code	Volt	age C	Code	9	8	4	3	5	1	2	Α	5	1	2	3	5	1	2	A	5	1	2	A	3	5	1	2	Α	5	1	2	А
		Cas	se Si Serie	ize/ s				C12	10C				с	1808	C		с	1812	C			C18	25C			с	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) **Capacitance range Includes E12 decade values only. (i.e., 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68 and 82)

Table 2 – Chip Thickness/Packaging Quantities

Thickness	Case	Thickness ±	Paper C	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
CB	0603	0.80 ± 0.07	4,000	10,000	0	0
CF	0603	0.80 ± 0.07	4,000	15,000	0	0
DE	0805	0.70 ± 0.20	4,000	10,000	0	0
DC	0805	0.78 ± 0.10	4,000	10,000	0	0
DD	0805	0.90 ± 0.10	4,000	10,000	0	0
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
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	Range (mm)	Paper G	Quantity	Plastic	Quantity

Package quantity based on finished chip thickness specifications.



Table 2 – Chip Thickness/Packaging Quantities cont'd

Thickness	Case	Thickness ±	Paper G	Quantity	Plastic	Quantity
Code	Size	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
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	Range (mm)	Paper G	Quantity	Plastic	Quantity

Package quantity based on finished chip thickness specifications.



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

EIA Size Code	Metric Size Code		Dens Maxi Land P	sity Lev imum (f rotrusio	rel A: Most) on (mm)		Dens Medi Land P	sity Lev an (Nor rotrusio	vel B: ninal) on (mm)		Dens Minir Land Pr	sity Lev mum (L rotrusio	rel C: .east) on (mm)
oouc	oouc	С	Y	X	V1	V2	C	Y	X	V1	V2	С	Y	X	V1	V2
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	0.40	0.52	0.52	1.60	0.80
0603	1608	0.90	1.15	1.10	4.00	2.10	0.80	0.95	1.00	3.10	1.50	0.60	0.75	0.90	2.40	1.20
0805	2012	1.00	1.35	1.55	4.40	2.60	0.90	1.15	1.45	3.50	2.00	0.75	0.95	1.35	2.80	1.70
1206	3216	1.60	1.35	1.90	5.60	2.90	1.50	1.15	1.80	4.70	2.30	1.40	0.95	1.70	4.00	2.00
1210	3225	1.60	1.35	2.80	5.65	3.80	1.50	1.15	2.70	4.70	3.20	1.40	0.95	2.60	4.00	2.90
1210 ¹	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 \geq 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).



Soldering Process

Recommended Soldering Technique:

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

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020



Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 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:
Saldarability		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 +/- 2 hours after test conclusion.
Riased Humidity	MIL_STD_202 Method 103	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Diased Humaity		Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
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

Reference	lt	em	Material
А		Finish	SnPb (5% minimum)
В	Termination Svstem	Barrier Layer	Ni
С	,	Base Metal	Cu
D	Inner E	Electrode	Ni
E	Dielectri	ic Material	BaTiO ₃



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



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

Ordering Information

temperature. Capacitance change is limited to $\pm 30 \text{ ppm/}^{\circ}\text{C}$ 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:





С С 1206 104 Κ 5 G TU Т Α Case Size Specification/ Packaging/Grade Capacitance Capacitance Termination Ceramic Voltage Dielectric Failure Rate/Design (L" x W") Code (pF) Tolerance¹ (C-Spec)³ Series Finish² 0402 T = COTS 2 Significant $B = \pm 0.10 \, pF$ 8 = 10 V G = COGC = 100% Blank = Bulk A = Testing per MIL-PRF-0603 Digits + Number $C = \pm 0.25 \, pF$ 4 = 16 V 55681 PDA 8% Matte Sn TU = 7" Reel 0805 of Zeros $D = \pm 0.5 \, pF$ 3 = 25 V B= Testing per MIL-PRF-L = SnPb (5% Unmarked F = ± 1% 6 = 35 V 55681 PDA 8%, DPA per TM = 7" Reel 1206 Use 9 for minimum) 1210 1.0 – 9.9 pF $G = \pm 2\%$ 5 = 50 V EIA-469 Marked 1812 Use 8 for J = ±5% 1 = 100 V C = Testing per MIL-2220 0.5 - .99 pF K = ±10% 2 = 200 V PRF-55681 PDA 8%, DPA ex. 2.2 pF = 229 M = ±20% per EIA-469, Humidity per ex. 0.5 pF = 508 MIL-STD-202, Method 103, Condition A

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

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

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



Dimensions – Millimeters (Inches)





Electrodes / Conductive Metalization

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)		

Benefits

- -55°C to +125°C operating temperature range
- 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
- · Certificate of compliance
- · 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, and 200 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
- 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
- SnPb end metallization option available upon request (5% minimum)

Applications

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



Qualification/Certification

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

Environmental Compliance

Pb-Free and RoHS Compliant.



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)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit @ 25°C	0.1%
Insulation Resistance (IR) Limit @ 25°C	1,000 megohm microfarads or 100 GΩ (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 Ω 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 Vrms ±0.2 V if capacitance \leq 1,000 pF

1 kHz \pm 50 Hz and 1.0 Vrms \pm 0.2 V 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 Temperatu	ıre Life, Biased	Humidity, Mois	ture Resistance	•
Dielectric	Rated DC Voltage	Capacitance Value	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance
COG	All	All	0.5	0.3% or ±0.25 pF	10% of Initial Limit



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

		C	as	se S	Siz	e /	Se	rie	s			C04	02C					C06	03C					C08	05C		
0	Сар			Vol	Itag	e Co	ode			8	4	3	5	1	2	8	4	3	5	1	2	8	4	3	5	1	2
Capacitance	Code		Rat	ted	Volt	tage	e (VI	DC)		9	16	25	50	100	200	9	16	25	50	100	200	10	16	25	50	100	200
				Са		itar	ice								Prod	uct Ava	ailabili	ty and	Chip	Thick	1ess C	odes					
0.50 & 0.75 pF	508 & 758	В	С	D						BB	BB	BB	BB		000	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC
1.0 - 9.1 pF*	109 - 919*	В	С	D						BB	BB	BB	BB			СВ	CB	CB	СВ	CB	CB	DC	DC	DC	DC	DC	DC
10 - 91 pF*	100 - 910*				F	G	J	K	М	BB	BB	BB	BB			CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC
100 pF	101				F	G	J	K	M	BB	BB	BB	BB	BB	BB	CB	CB	CB	CF	CB	CB	DC	DC	DC	DC	DC	DC
110 - 270 pF*	111 -271*				F	G	J	K	M	BB	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC
300 pF	301					G	J	ĸ	M	BB	BB	BB	BB	BB	BD	CB	CB	CB	CE	CB	CB						
360 pF	361				F	G	J	ĸ	M	BB	BB	BB	BB	BB	Ъ	CB	CB	CB	CR	CB	CB						
390 pF	301				F	G		ĸ	M	BB	BB	BB	BB	BB		CB	CB	CB	CB	CB	CB			DC	DC		
430 pF	431				F	G	Ĵ	ĸ	м	BB	BB	BB	BB	BB		CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC
470 pF	471				F	G	J	Κ	М	BB	BB	BB	BB	BB		CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DD
510 - 820 pF*	511 - 821*				F	G	J	К	М	BB	BB	BB	BB	BB		СВ	CB	СВ	СВ	СВ	СВ	DC	DC	DC	DC	DC	DC
910 pF	911				F	G	J	K	М	BB	BB	BB	BB	BB		СВ	СВ	CB	СВ	CB	СВ	DC	DC	DC	DC	DD	DD
1,000 pF	102				F	G	J	K	М	BB	BB	BB	BB	BB		CB	CB	CB	CB	СВ	CB	DC	DC	DC	DC	DD	DD
1,100 pF	112				F	G	J	Κ	М	BB	BB	BB	BB			CB	CB	CB	CB	CB	CH	DC	DC	DC	DC	DC	DC
1,200 pF	122				F	G	J	K	М	BB	BB	BB	BB			CB	CB	CB	CB	CB	CH	DC	DC	DC	DC	DC	DC
1,300 pF	132				F	G	J	K	M	BB	BB	BB	BB			CB	CB	CB	CB	CB	CH			DD	DD		DC
1,500 pF	152					G	J	K	M	BB	BB	BB	BB			CB	CB	CB	CB	CB	CH	00		DD	עט	עט	DC
1,600 pF	102					G	J	ĸ	IVI M	BB	BB	BB				CB	CB	CB	CB	CB		עע	עט	עט	עט	עט	
2,000 pF	202				F	G	J	ĸ	M	BB	BB	BB				CB	CB	CB	CB	CB	СН						DC
2,000 pF	202				F	G	J	K	M	BB	BB	BB				CB	CB	CB	CB	CB	СН		DC	DC	DC	DC	DC
2,400 pF	242				F	G	J	ĸ	м		00					CB	CB	CB	CB	CB	011	DC	DC	DC	DC	DC	DC
2,700 pF	272				F	G	J	K	Μ							CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC
3,000 pF	302				F	G	J	К	М							СВ	СВ	СВ	СВ	СВ		DD	DD	DD	DD	DC	DC
3,300 pF	332				F	G	J	Κ	М							CB	CB	CB	CB	CB		DD	DD	DD	DD	DC	DC
3,600 pF	362				F	G	J	K	М							СВ	СВ	CB	СВ	СВ		DD	DD	DD	DD	DC	DD
3,900 pF	392				F	G	J	K	М							CB	CB	CB	CB	CB		DE	DE	DE	DE	DC	DD
4,300 pF	432				F	G	J	K	M							CB	CB	CB	CB	CB		DE	DE	DE	DE	DC	DD
4,700 pF	4/2				F	G	J	K	M							CB	CB	CB	CB	CB		DE	DE	DE	DE	DC	DD
5,100 pF	562					G	J	r k	M								CB							DE			ם חח
6 200 pF	622				F	G	J	K	M							CB	CB	CB	CB					DC			DG
6.800 pF	682				F	G	J	ĸ	м							CB	CB	CB	CB			DC	DC	DC	DC	DC	DG
7,500 pF	752				F	G	J	K	Μ							CB	CB	CB				DC	DC	DC	DC	DC	DG
8,200 pF	822				F	G	J	Κ	М							СВ	CB	СВ				DC	DC	DC	DC	DC	DG
9,100 pF	912				F	G	J	K	М							СВ	СВ	СВ				DC	DC	DC	DC	DC	
10,000 pF	103				F	G	J	K	М							СВ	СВ	CB				DC	DC	DC	DC	DD	
12,000 pF	123				F	G	J	K	М							CB	СВ	CB				DC	DC	DC	DC	DE	
15,000 pF	153				F	G	J	K	M	_	_					СВ	CB	СВ		_		DC	DC	DC	DD	DG	
18,000 pF	183				F	G	J	K	M													DC	DC	DC	DD		
22,000 pF	223				F	G	J	ĸ	M																DF		
27,000 pF 33,000 pF	213				F	G	J	K	M													DG	DG	DG			
39.000 pF	393				F	G	J	K	M													DG	DG	DG			
47.000 pF	473				F	G	J	K	M	_	_											DG	DG	DG			
		Ľ	Ra	ted	Volt	age	e (VI	DC)		6	16	25	20	100	200	10	16	25	50	100	200	9	16	25	20	100	200
Capacitance	Cap Code			Vo	Itag	e Co	ode			8	4	3	5	1	2	8	4	3	5	1	2	8	4	3	5	1	2
			С	ase	Siz	e / S	Seri	es				C04	02C					C06	03C					C08	05C		

*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 (1206 – 2220 Case Sizes)

		C	Cas	e S	ize	e/ 8	Sei	rie	s			C12	06C					C12	10C			C	1812	С	C	2220	С
0	Сар			Volt	age	e Co	de			8	4	3	5	1	2	8	4	3	5	1	2	5	1	2	3	1	2
Capacitance	Code		Rat	ed V	/olta	age	(VE)C)		ę	9 9	25	50	100	200	9	16	25	50	100	200	50	100	200	50	100	200
				Cap	baci	itan	ce								Produ	ct Ava	ailabili	ity and	d Chip	Thick	ness	Codes	5				
	400 040*		0	To	olera	ance	;					50	50	50	See	Table	2 for	Chip T	hickn	ess D	imens	ions					
1.0 - 9.1 pF*	109 - 919*	B	C	D	-	G		ĸ	м	EB	EB	EB	EB	EB	ED	FB	FB	FB	FB	FB	FB						
100 - 430 nF*	100 - 310				F	G	J	K	M	FR	FB	FB	FR	FR	FR	FB	FB	FB	FB	FB	FB						
470 - 910 pF*	471 - 911*				F	G	J	K	M	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	GB	GB	GB			
1,000 pF	102				F	G	J	κ	Μ	EB	EB	EB	EB	EB	EE	FB	FB	FB	FB	FB	FB	GB	GB	GB			
1,100 pF	112				F	G	J	Κ	М	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	GB	GB	GB			
1,200 pF	122				F	G	J	K	M	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	GB	GB	GB			
1,300 pF	132				F	G	J	K	M	EB	EB	EB	EB	EC	EC	FB	FB	FB	FB	FB	FC	GB	GB	GB			
1,500 pF 1,600 pF	152				F	G	J	ĸ	M	EB	EB	EB	EB		EC	FB	FB	FB	FB	FB	FE	GB	GB	GB			
1,000 pF	182				F	G	J	K	M	FB	FB	FB	FB	FD	FD	FB	FB	FB	FB	FB	FE	GB	GB	GB			
2,000 pF	202				F	G	J	K	M	EB	EB	EB	EB	ED	ED	FB	FB	FB	FB	FC	FE	GB	GB	GB			
2,200 pF	222				F	G	J	κ	M	EB	EB	EB	EB	EE	ED	FB	FB	FB	FB	FC	FG	GB	GB	GB			
2,400 pF	242				F	G	J	Κ	М	EB	EB	EB	EB	EC	EC	FB	FB	FB	FB	FC	FC						
2,700 pF	272				F	G	J	K	M	EB	EB	EB	EB	EC	EC	FB	FB	FB	FB	FC	FC	GB	GB	GB			
3,000 pF	302					G	J	ĸ	M	EC	EC	EC	EC	EC	EB	FB	FB	FB	FB	FC		CD	CP	CP			
3,500 pF 3,600 pF	362				F	G	J	ĸ	M	EC	FC	EC EC	EC	FF	FR	FR	FB	FR	FB	FF	FF	GB	GD	GD			
3.900 pF	392				F	G	J	ĸ	M	EC	EC	EC	EC	EF	EB	FB	FB	FB	FB	FF	FF	GB	GB	GB			
4,300 pF	432				F	G	J	к	М	EC	EC	EC	EC	EC	EB	FB	FB	FB	FB	FF	FF			-			
4,700 pF	472				F	G	J	Κ	Μ	EC	EC	EC	EC	EC	EB	FF	FF	FF	FF	FG	FG	GB	GB	GD			
5,100 pF	512				F	G	J	Κ	M	ED	ED	ED	ED	ED	EB	FB	FB	FB	FB	FG	FG						
5,600 pF	562		F G J K M E F G J K M E F G J K M E			ED	ED	ED	ED	ED	EB	FB	FB	FB	FB	FG	FG	GB	GB	GH							
6,200 pF	622		FGJKM FGJKME FGJKME FGJKME			EB	EB	EB	EB	EB	ED	FB	FB	FB	FB	FG	FB	GP	GP	GL	16	IE	ю				
7 500 pF	752				F	G	J	K	M	FB	FB	FB	FB	FB	FB	FC	FC	FC	FC	FC	FB	GD	GD	65	JL	JL	JD
8,200 pF	822				F	G	Ĵ	ĸ	M	EC	EC	EC	EC	EB	EC	FC	FC	FC	FC	FC	FB	GB	GH	GB	JE	JE	JB
9,100 pF	912				F	G	J	К	М	EC	EC	EC	EC	EB	EC	FE	FE	FE	FE	FE	FB						
10,000 pF	103				F	G	J	Κ	M	ED	ED	ED	ED	EB	EC	FF	FF	FF	FF	FF	FB	GB	GH	GB	JE	JE	JB
12,000 pF	123		_	_	F	G	J	K	M	EB	EB	EB	EB	EB	ED	FG	FG	FG	FG	FB	FB	GB	GG	GB	JE	JE	JB
15,000 pF	153					G	J	K	M	EB	EB	EB	EB	EB		FG	FG	FG	FG	FB	FC	GB	GB	GB	JE	JE	JB
22 000 pF	223				F	G	J	ĸ	M	FR	FR	FR	FR	ED	EH	FR	FB	FB	FB	FB	FE	GB	GB	GB	JE	JE	JB JB
27.000 pF	273				F	G	J	ĸ	M	EB	EB	EB	EB	EE		FB	FB	FB	FB	FB	FG	GB	GB	GB	JE	JB	JB
33,000 pF	333				F	G	J	к	М	EB	EB	EB	EB	EE		FB	FB	FB	FB	FB	FH	GB	GB	GB	JB	JB	JB
39,000 pF	393				F	G	J	Κ	М	EC	EC	EC	EE	EH		FB	FB	FB	FB	FE	FH	GB	GB	GB	JB	JB	JB
47,000 pF	473				F	G	J	Κ	М	EC	EC	EC	EE	EH		FB	FB	FB	FB	FE	FJ	GB	GB	GD	JB	JB	JB
56,000 pF	563				F	G	J	K	M	ED	ED	ED	EF			FB	FB	FB	FB	FF		GB	GB	GD	JB	JB	JB
68,000 pF	683 823					G	J	ĸ	M				EH			FB	FB	FB	FC	FG		GB	GB	GK	JB	JB	JB
0 10 µF	104				F	G	J	K	M	FH	EH	EH				FF	FF	FF	FG	FM		GB	GD	GM	JB	JB	JD
0.12 µF	124				F	G	J	K	M							FG	FG	FG	FH			GB	GH	C.M	JB	JB	JD
0.15 µF	154				F	G	J	К	M							FH	FH	FH	FM			GD	GN		JB	JB	JG
0.18 µF	184				F	G	J	Κ	Μ							FJ	FJ	FJ				GH			JB	JD	JG
0.22 µF	224		F G J K M F G J K M F G J K M										FK	FK	FK				GK			JB	JD	JL			
0.27 µF	274		F G J K M F G J K M F G J K M																				JB	JF			
0.35 µF 0.39 µF	304 394				F	G	J	ĸ	M																JG	10	
0.47 µF	474		F G J K M F G J K M																			JG					
			Rat	ed V	/olta	age	(VE)C)		6	16	25	50	100	200	ę	16	25	50	100	200	50	100	200	50	100	200
Capacitance	Cap Code			Volt	age	e Co	de			8	4	3	5	1	2	8	4	3	5	1	2	5	1	2	3	1	2
	0040		Ca	Rated Voltage (VDC) ♀ Voltage Code 8 Case Size / Series							C12	206C					C12	10C			0	C18120	2	C	22200)	

*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 2 – Chip Thickness/Packaging Quantities

Thickness	Case	Thickness ±	Paper C	Paper Quantity		Quantity
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
BB BD CB CF	402 402 603 603	$\begin{array}{c} 0.50 \pm 0.05 \\ 0.55 \pm 0.05 \\ 0.80 \pm 0.07 \\ 0.80 \pm 0.07 \end{array}$	10000 10000 4000 4000	50000 50000 10000 15000	0 0 0 0	0 0 0 0
CH	603 0805	0.85 ± 0.07 0.70 ± 0.20	4000	10000	0	0
DC DD DF	0805 0805 0805 0805	0.78 ± 0.10 0.78 ± 0.10 0.90 ± 0.10 1.10 ± 0.10 1.25 ± 0.15	4,000 4,000 0	10,000 10,000 0	0 0 2,500 2,500	0 0 10,000
EB EC ED EE EF	1206 1206 1206 1206 1206 1206	1.23 ± 0.13 0.78 ± 0.10 0.90 ± 0.10 1.00 ± 0.10 1.10 ± 0.10 1.20 ± 0.15	4,000 0 0 0 0	10,000 0 0 0 0	4,000 4,000 2,500 2,500 2,500	10,000 10,000 10,000 10,000 10,000 10,000
EH FB FC FE FF	1206 1210 1210 1210 1210 1210	1.60 ± 0.20 0.78 ± 0.10 0.90 ± 0.10 1.00 ± 0.10 1.10 ± 0.10	0 0 0 0 0	0 0 0 0 0	2,000 4,000 4,000 2,500 2,500	8,000 10,000 10,000 10,000 10,000
FG FH FM FJ FK	1210 1210 1210 1210 1210 1210	$\begin{array}{c} 1.25 \pm 0.15 \\ 1.55 \pm 0.15 \\ 1.70 \pm 0.20 \\ 1.85 \pm 0.20 \\ 2.10 \pm 0.20 \end{array}$	0 0 0 0 0	0 0 0 0 0	2,500 2,000 2,000 2,000 2,000 2,000	10,000 8,000 8,000 8,000 8,000 8,000
GB GD GH GG GK	1812 1812 1812 1812 1812 1812	$\begin{array}{c} 1.00 \pm 0.10 \\ 1.25 \pm 0.15 \\ 1.40 \pm 0.15 \\ 1.55 \pm 0.10 \\ 1.60 \pm 0.20 \end{array}$	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
GJ GN GM JB JD	1812 1812 1812 2220 2220	$\begin{array}{c} 1.70 \pm 0.15 \\ 1.70 \pm 0.20 \\ 2.00 \pm 0.20 \\ 1.00 \pm 0.15 \\ 1.30 \pm 0.15 \end{array}$	0 0 0 0	0 0 0 0	1,000 1,000 500 1,000 1,000	4,000 4,000 2,000 4,000 4,000
JE JF JG JL	2220 2220 2220 2220 2220	$\begin{array}{c} 1.40 \pm 0.15 \\ 1.50 \pm 0.15 \\ 1.70 \pm 0.15 \\ 2.00 \pm 0.20 \end{array}$	0 0 0 0	0 0 0 0	1,000 1,000 1,000 500	4,000 4,000 4,000 2,000
Thickness	Case	Thickness ± Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
Code	Size	Size Range (mm)	Paper G	Quantity	Plastic	Quantity

Package quantity based on finished chip thickness specifications.



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

EIA Size Code	EIAMetricDensity Level A:SizeSizeMaximum (Most)CodeCodeLand Protrusion (mm)			Density Level B: Median (Nominal) Land Protrusion (mm)				Density Level C: Minimum (Least) Land Protrusion (mm)								
Code Code		C	Y	X	V1	V2	C	Y	X	V1	V2	C	Y	X	V1	V2
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	0.40	0.52	0.52	1.60	0.80
0603	1608	0.90	1.15	1.10	4.00	2.10	0.80	0.95	1.00	3.10	1.50	0.60	0.75	0.90	2.40	1.20
0805	2012	1.00	1.35	1.55	4.40	2.60	0.90	1.15	1.45	3.50	2.00	0.75	0.95	1.35	2.80	1.70
1206	3216	1.60	1.35	1.90	5.60	2.90	1.50	1.15	1.80	4.70	2.30	1.40	0.95	1.70	4.00	2.00
1210	3225	1.60	1.35	2.80	5.65	3.80	1.50	1.15	2.70	4.70	3.20	1.40	0.95	2.60	4.00	2.90
1210 ¹	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 \geq 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).



Soldering Process

Recommended Soldering Technique:

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

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020



Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method			
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.			
Board Flex	JIS-C-6429	Appendix 2, Note: 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		a) Method B, 4 hours @ 155°C, dry heat @ 235°C			
Solderability	3-310-002	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 +/- 2 hours after test conclusion.			
Biased Humidity	MIL_STD_202 Method 103	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.			
Diased Humany		Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.			
Moisture Resistance MIL-STD-202 Method 106		t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.			
Thermal Shock MIL–STD–202 Method 107		-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.			
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.			
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.			
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

Reference	Item		Material
А		Finish	100% Matte Sn
В	Termination System	Barrier Layer	Ni
С	,	Base Metal	Cu
D	Inner E	Ni	
E	Dielectri	CaZrO ₃	



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



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 $\pm 15\%$ from -55°C to +125°C.

Ordering Information

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:



С	1210	Т	104	K	5	R	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Dielectric	Failure Rate/Design	Termination Finish ¹	Packaging/Grade (C-Spec) ²
	0402 0603 0805 1206 1210 1812 2220	T = COTS	2 Significant Digits + Number of Zeros	J = ±5% K = ±10% M = ±20%	9 = 6.3 V 8 = 10 V 4 = 16 V 3 = 25 V 5 = 50 V 1 = 100 V 2 = 200 V A = 250 V	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% minimum)	Blank = Bulk TU = 7" Reel Unmarked TM = 7" Reel Marked

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

² Additional reeling or packaging options may be available. Contact KEMET for details.



Dimensions – Millimeters (Inches)





Electrodes / Conductive Metalization

EIA Size Code	Metric Size Code	L W Length 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 ¹	3225	3.20 (.126) ± 0.20 (.008)	2.50 (.098) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)	N/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 \geq 12 μ F add 0.02 (0.001) to the width tolerance dimension

Benefits

- -55°C to +125°C operating temperature range
- Pb-Free and RoHS 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 $\pm 5\%$, $\pm 10\%$, and $\pm 20\%$
- · Non-polar device, minimizing installation concerns
- 100% pure matte tin-plated termination finish allowing for excellent solderability
- SnPb termination finish option available upon request (5% minimum)

Applications

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



Qualification/Certification

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

Environmental Compliance

Pb-Free and RoHS Compliant (excluding SnPb termination finish option).



Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +125°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit @ 25°C	5% (6.3 and 10 V), 3.5% (16 and 25 V) and 2.5% (50 V to 250 V)
Insulation Resistance (IR) Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ±5 seconds @ 25°C)

Regarding aging rate: Capacitance measurements (including tolerance) are indexed to a referee time of 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 \pm 50 Hz and 1.0 \pm 0.2 Vrms if capacitance \leq 10 μ F

120 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."

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	< 0.047 µF	≥ 0.047 µF
1206	< 0.22 µF	≥ 0.22 µF
1210	< 0.39 µF	≥ 0.39 µF
1808	ALL	N/A
1812	< 2.2 µF	≥ 2.2 µF
1825	ALL	N/A
2220	< 10 µF	≥ 10 µF
2225	ALL	N/A



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

		Cas S	se Si Serie	ize / es		CO	402	2C				C0	603	3C					C	208	05C	;					C	212	06C	;		
Canacitance	Сар	Vol	tage C	ode	9	8	4	3	5	9	8	4	3	5	1	2	9	8	4	3	5	1	2	A	9	8	4	3	5	1	2	A
Oupuonuneo	Code	Rate	ed Vol (VDC)	tage)	6.3	9	16	25	50	6.3	9	9	25	50	1 0	200	6.3	9	16	25	50	1 0	200	250	6.3	9	16	25	50	0	200	250
		Cap	pacita	ince									Pr	oduc	ct Av	vaila	l bility	and	Chi	p Th	ickn	ess	Code	es		<u> </u>				I		
10 91 pE*	100 . 910*		bleran	ICE M	BB	BB	BB	DB	DB	CB	CB	CB	CB	See I	CB	e 2 te	or Cr		hicki	ness	Dim	nens	ions		ER	ER	EB	EB	EB	EB	EB	
100 - 150 pF**	101 - 151**	J	K	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC		EB	EB	EB	EB	EB	EB	EB	
180 - 820 pF**	181 - 820**	J	ĸ	M	BB	BB	BB	BB	BB	СВ	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	
1,000 pF	102	J	К	М	BB	BB	BB	BB	BB	СВ	СВ	СВ	СВ	CF	СВ	CF	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB
1,200 pF	122	J	K	М	BB	BB	BB	BB	BB	СВ	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB
1,500 pF	152	J	K	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB
1,800 pF	182	J	K	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CR	CR	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB
2,200 pr 2,700 pF	222	J	ĸ	M	BB	BB	BB	BD	BB	CB	CB	CB	CB		CE	CB									ED	FR	FR	FR	ED	FR	FR	FR
3,300 pF	332		K	M	BB	BB	BB	RB	RB	CB	CB	CB	CB	CB	CB	CB		DC			DC				FB	FB	FB	FB	FB	FB	FB	FB
3.900 pF	392	J	K	М	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB
4,700 pF	472	J	K	М	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB
5,600 pF	562	J	К	М	BB	BB	BB	BB	BB	СВ	СВ	СВ	СВ	CB	СВ	СВ	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB
6,800 pF	682	J	К	М	BB	BB	BB	BB	BB	СВ	CB	CB	CB	CB	СВ	СВ	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB
8,200 pF	822	J	K	М	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB
10,000 pF	103	J	K	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CF	CF	СВ	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB
12,000 pF	123	J	K	M	BB	BB	BB	BB	BR	CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DC	DC	EB ED	EB	EB	EB	ER	FR	EB	EB EB
15,000 pF 18,000 pF	183	J	K	M	BD	BB	BD	BD	DD RR	CB	CB	CB	CB	CB	CB			DC			DC	ם חח	DC			ED	FR		FR		EB	
22 000 pF	223	Ĵ	K	M	BB	BB	BB	RB	RB	CB	CB	CB	CB	CF	CF		DC	DC		DC	DC	סט	DC		FB	EB	EB	EB	FB	FB	EB	EB
27.000 pF	273	J	K	М	BB	BB	BB	BB	00	CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DD	DE	00	EB	EB	EB	EB	EB	EB	EB	EB
33,000 pF	333	J	K	М	BB	BB	BB	BB		СВ	СВ	СВ	CF	СВ	СВ		DC	DC	DC	DC	DC	DD	DE		EB	EB	EB	EB	EB	EB	EB	EB
39,000 pF	393	J	К	М	BB	BB	BB	BB		СВ	СВ	СВ	СВ	СВ	СВ		DC	DC	DC	DC	DC	DD	DE		EB	EB	EB	EB	EB	EC	EB	EB
47,000 pF	473	J	K	М	BB	BB	BB	BB		СВ	CB	CB	CB	CF	CB		DC	DC	DC	DC	DC	DE	DG		EB	EB	EB	EB	EB	EC	ED	ED
56,000 pF	563	J	K	M	BB	BB	BB			CB	CB	CB	CB	CB			DD	DD	DD	DD	DD	DE	DG		EB	EB	EB	EB	EB	EB	ED	ED
68,000 pF	683	J	K	M	BB	BB	BB			CB	CB	CB	CB				DD	DD	00	טט	DD	DE			EB	EB	EB	EB	EB	EB	ED	ED
02,000 pr 0.10 µF	023	J	K	M	BD	BB	BD			CB	CB	CE	CE	CE				DC							FR	FR	FR		FR	FR	ED	ED
0.12 µF	124	Ĵ	K	M						CB	CB	CB	CB	CB			DC	DC	DC	DC	DD	DG			EC	EC	EC	EC	EC	EC	EG	Livi
0.15 µF	154	J	K	М						CB	CB	CB	CB	CB			DC	DC	DC	DC	DD	DG			EC	EC	EC	EC	EC	EC	EG	
0.18 µF	184	J	K	М						СВ	CB	CB	CB				DC	DC	DC	DC	DD	DG			EC	EC	EC	EC	EC	EC		
0.22 µF	224	J	К	М						СВ	CB	CB	CB				DC	DC	DC	DC	DD	DG			EC	EC	EC	EC	EC	EC		
0.27 µF	274	J	K	М						СВ	CB	CB					DD	DD	DD	DD	DD				EB	EB	EB	EB	EC	EM		
0.33 µF	334	J	K	М						CB	CB	CB					DD	DD	DD	DD	DD				EB	EB	EB	EB	EC	EG		
0.39 µF	394	J	K	M						CB	CB	CB					DG	DG	DG	DG	DE				EB	EB	EB	EB	EC	EG		
0.47 µr	4/4	J	ĸ	M						СВ	CB	CB					ם ח	ם	ם		DE					EU			EU FC	EG	1 /	
0.50 µi	684		K	M													חח		ם ח	DG	DH				FF	FF	FF	FF	FD		1 /	
0.82 µF	824	Ĵ	K	M													DD	DD	DD	DG	0				EF	EF	EF	EF	ED		1 /	
1.0 µF	105	J	ĸ	М													DD	DD	DD	DG					EF	EF	EF	EG	ED		1 /	
1.2 µF	125	J	K	М													DE	DE	DE						ED	ED	ED	EG	EH			
1.5 µF	155	J	K	М													DG	DG	DG						EF	EF	EF	EG	EH			
1.8 µF	185	J	K	М													DG	DG	DG						ED	ED	ED	EF	EH			
2.2 µF	225	J	K	M													DG	DG	DG						ED	ED	ED	EF	EH			
2./µ⊦ 2.3.µE	2/5	J	K	M																					EN	EN	EN 5D	EH			_	
3.3 µr 3.9 µF	300	J	K	M																					FF		FF	FH			1 /	
4.7 µF	475	J	K	M																					EF	EF	EF	EH			1 /	
P.		Rate	ed Vol	tage	6.3	÷	16	25	50	6.3	10	16	25	50	8	00	6.3	6	16	25	50	8	00	250	6.3	9	16	25	50	8	00	50
Capacitance	Cap Code	Volt	(VDC)	ode	-	8	4	3	5	_ ٩	8	4	3	5	1	2	- ۹	8	4	3	5	1	2	Δ	_ ٩	8	4	3	5	1	2	
	00000	101	uge o	Jouc	Ľ		-		•	<u> </u>	•	-	<u> </u>	_		-	L,	U	-		<u> </u>	•	-	^	Ļ		-		<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

		Cas	se S Serie	ize / es		C)402	2C				CO	603	3C					(208	050	2					C	C12	06C	,		
Canacitanco	Сар	Vo	ltage (ode	9	8	4	3	5	9	8	4	3	5	1	2	9	8	4	3	5	1	2	A	9	8	4	3	5	1	2	Α
Capacitance	Code	Rat	ed Vo (VDC	tage)	6.3	9	16	25	50	6.3	9	16	25	50	100	200	6.3	9	16	25	50	100	200	250	6.3	10	16	25	50	100	200	250
		Ca To	pacita olerar	ance ice									Pr	odu See	ct Av Tabl	vaila e 2 fe	bility or Ch	and and	Chi hick	p Th ness	ickn Din	ess nens	Cod ions	es								
5.6 µF	565	J	K	М																					EH	EH	EH					
6.8 µF	685	J	K	M																					EH	EH	EH					
8.2 µF	825	J	K	M																					EH	EH	EH					
10 µF	106	J	K	M																					EH	EH	EH					
	Can	Rat	ed Vo (VDC	ltage)	6.3	10	16	25	50	6.3	10	16	25	50	100	200	6.3	10	16	25	50	100	200	250	6.3	10	16	25	50	100	200	250
Capacitance	Code	Vo	ltage (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
			Serie	s		C	0402	C				C	0603	C	,					C08	05C							C12)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 – 2220 Case Sizes)

		Cas	se Si Serie	ze / s				C12	10C					С	1812	2C			C18	25C			C	2220	C	
Conscitones	Сар	Vol	tage C	ode	9	8	4	3	5	1	2	A	3	5	1	2	A	5	1	2	A	3	5	1	2	Α
Capacitance	Code	Rat	ed Volt (VDC)	tage	6.3	10	16	25	20	100	200	250	25	20	100	200	250	50	100	200	250	25	50	100	200	250
		Caj To	oacita oleran	nce ce							Р	roduc See 1	t Ava able 2	ilabili 2 for (ty and Chip T	l Chip hickr	o Thic ness C	kness)imen	Code sions	es						
10 - 91 pF*	100 - 910*	J	K	М	FB	FB	FB	FB	FB	FB	FB															
100 - 390 pF**	101 - 391**	J	K	M	FB	FB	FB	FB	FB	FB	FB															
470 - 820 pF**	471 - 821**	J	K	M	FB	FB	FB	FB	FB	FB	FB		GB	GB	GB	GB										
560 pF	561	J	K	M	FB	FB	FB	FB	FB	FB	FB		GB	GB	GB	GB										
680 pF	681	J	K	M	FB	FB	FB	FB	FB	FB	FB		GB	GB	GB	GB										
820 pF	821	J	K	M	FB	FB	FB	FB	FB	FB	FB		GB	GB	GB	GB										
1,000 pF	102	J	K	M	FB	FB	FB	FB	FB	FB	FB		GB	GB	GB	GB										
1,200 pF	122	J	K	M	FB	FB	FB	FB	FB	FB	FB		GB	GB	GB	GB										
1,500 pF	152	J	K	M	FB	FB	FB	FB	FB	FB	FE		GB	GB	GB	GB										
1,800 pF	182	J	K	M	FB	FB	FB	FB	FB	FB	FE		GB	GB	GB	GB										
2,200 pF	222	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB										
2,700 pF	272	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB										
3,300 pF	332	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB										
3,900 pF	392	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB										
4,700 pF	472	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GD										
5,600 pF	562	J	Κ	Μ	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GH										
6,800 pF	682	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB					JE	JE	JE		
8,200 pF	822	J	K	м	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB					JE	JE	JE		
10,000 pF	103	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB					JE	JE	JE		
	Can	Rat	ed Volt (VDC)	tage	6.3	10	16	25	50	100	200	250	25	50	100	200	250	50	100	200	250	25	50	100	200	250
Capacitance	Code	Vol	tage C	ode	9	8	4	3	5	1	2	A	3	5	1	2	A	5	1	2	A	3	5	1	2	Α
			Series	3				C12	10C					C	C1812	С			C18	25C			C	2220	C	

*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 – 2220 Case Sizes) cont'd

		Ca	se Si Serie	ize / es				C12	10C					С	1812	2C			C18	25C			C	2220	IC	
Canacitanca	Сар	Vo	ltage C	ode	9	8	4	3	5	1	2	A	3	5	1	2	A	5	1	2	A	3	5	1	2	Α
Capacitance	Code	Rat	ted Vol (VDC)	tage	6.3	6	16	25	50	100	200	250	25	50	100	200	250	50	100	200	250	25	20	100	200	250
		Ca	pacita oleran	ince					,		Р	roduc See 1	t Ava able	ilabili 2 for (ty and Chip T	l Chip hickn	Thic ess D	kness)imen	Code sions	es			,			
12,000 pF	123	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB					JE	JE	JE		
15,000 pF	153	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB					JE	JE	JE		
18,000 pF	183	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB					JE	JE	JE		
22,000 pF	223	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB	HB	HB	HB	HB	JE	JE	JE		
27,000 pF	273	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB	HB	HB	HB	HB	JE	JE	JE		
33,000 pF	333	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB	HB	HB	HB	HB	JB	JB	JB		
39,000 pF	393	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB	НВ	HB	HB	HB	JB	JB	JB		
47,000 pF	473	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB	HB	HB	HB	HB	JB	JB	JB		
56,000 pF	563	J	K	M	FB	FB	FB	FB	FB	FB	FC	FC	GB	GB	GB	GB	GB	HB	HB	HB	HB	JB	JB	JB		
68,000 pF	683	J	K	M	FB	FB	FB	FB	FB	FB	FC	FC	GB	GB	GB	GB	GB	HB	HB	HB	HB	JB	JB	JB	10	10
82,000 pF	823	J	K	IVI	FB	FB	FB	FB	FB	FC	FF FO	FF FO	GB	GB	GB	GB	GB	HB	HB	HB	HB	JB	JB	JC	JC	JC
0.10 µF	104	J	K	IVI	FB	FB	FB	FB	FB	FD	FG	FG	GB	GB	GB	GB	GB	HB	HB	HB	HB	JB	JB	JC	JC	JC
0.12 µF	124	J	K	M	FB	FB	FB	FB	FB	FD			GB	GB	GB	GB	GB	HB	HB	HB	HB	JB	JB	JC	JC	JC
0.15 µF	154	J	ĸ	IVI	FC	FC	FC	FC	FC				GB	GB	GB	GE	GE	HB	HB	HB	HB	JB	JB	JC	JC	JC
0.10 µF	104	J	r.	IVI	FC	FC	FC	FC	FC				GB	GB	GB	GG	GG					JD	JD	JC	JC	JC
0.22 µF	224	J	ĸ	M	FC	FC	FC	FC	FC				GB	GB	GG	66	GG			HB	HB	1C JD	1C JD	10	10	10
0.27 µi 0.33 µE	33/	J	K	M	FD	FD	FD	FD	FD	FD			GB	GB	00	00	66	НВ	HB	HB	HB	10	10		ic	ic
0.35 µr	30/	J	K	M	FD				FD	FD			GB	GB	60	60	GG			нп	нр	10	10	10	10	10
0.05 µr	17/	1	ĸ	M	FD	FD	FD	FD	FD	FD			GB	GB	60	GI	GI	нп	нп	нп	нр	10	ic	ic		ic
0.56 µF	564	J	K	M	FD	FD	FD	FD	FD	FF			GC	GC	GG	00	00	НП	HD	HD	HD	JC	JD		ID	JD
0.68 µF	684	, i	ĸ	M	FD	FD	FD	FD	FD	FG			GC	GC	GG			HD	HD	HD	HD	JC	JD	JD	JD	JD
0.82 µF	824		ĸ	M	FF	FF	FF	FF	FF	FI			GF	GF	GG			HF	HF	HF	HF	JC	JF	JF	JE	JF
10 µF	105	Ĵ	ĸ	M	FH	FH	FH	FH	FH	FM			GF	GE	GG			HF	HF	HF	HF	JC	JF	JF	JE	JF
1.2 µF	125	Ĵ	ĸ	M	FH	FH	FH	FH	FG				0-	02								JC	JC	0.	0.	0.
1.5 µF	155	J	K	M	FH	FH	FH	FH	FG													JC	JC			
1.8 uF	185	J	к	м	FH	FH	FH	FH	FG									1				JD	JD			
2.2 uF	225	Ĵ	к	м	FJ	FJ	FJ	FJ	FG				GO	GO								JF	JF			
2.7 µF	275	J	к	М	FE	FE	FE	FG	FH																	
3.3 µF	335	J	K	M	FF	FF	FF	FM	FM									i i								
3.9 µF	395	J	K	М	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	М	FH	FH	FH	FS					GK									JF	JO			
15 µF	156	J	K	M																		JO				
22 µF	226	J	K	M	FS	FS																JO				
	Can	Rat	ted Vol (VDC)	tage	6.3	9	16	25	50	100	200	250	25	50	100	200	250	50	100	200	250	25	50	100	200	250
Capacitance	Code	Vo	ltage C	ode	9	8	4	3	5	1	2	A	3	5	1	2	Α	5	1	2	A	3	5	1	2	Α
			Serie	s				C12	10C					(C1812	С			C18	25C			C	2220	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) **Capacitance range Includes E12 decade values only. (i.e., 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68 and 82)



Table 2 – Chip Thickness/Packaging Quantities

Thickness	Case	Thickness ±	Paper C	Quantity	Plastic (Quantity
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
BB CB CF DE DC	0402 0603 0603 0805 0805	$\begin{array}{c} 0.50 \pm 0.05 \\ 0.80 \pm 0.07 \\ 0.80 \pm 0.07^* \\ 0.70 \pm 0.20 \\ 0.78 \pm 0.10 \end{array}$	10,000 4,000 4,000 4,000 4,000 4,000	50,000 10,000 15,000 10,000 10,000	0 0 0 0 0	0 0 0 0 0
DD DG DH EB EC	0805 0805 0805 1206 1206	$\begin{array}{c} 0.90 \pm 0.10 \\ 1.25 \pm 0.15 \\ 1.25 \pm 0.20 \\ 0.78 \pm 0.10 \\ 0.90 \pm 0.10 \end{array}$	4,000 0 0 4,000 0	10,000 0 0 10,000 0	0 2,500 2,500 4,000 4,000	0 10,000 10,000 10,000 10,000
EN ED EE EF EM	1206 1206 1206 1206 1206	$\begin{array}{c} 0.95 \pm 0.10 \\ 1.00 \pm 0.10 \\ 1.10 \pm 0.10 \\ 1.20 \pm 0.15 \\ 1.25 \pm 0.15 \\ 1.25 \pm 0.15 \end{array}$	0 0 0 0	0 0 0 0	4,000 2,500 2,500 2,500 2,500 2,500	10,000 10,000 10,000 10,000 10,000
EG EH FB FC FD	1206 1206 1210 1210 1210 1210	$\begin{array}{c} 1.60 \pm 0.15 \\ 1.60 \pm 0.20 \\ 0.78 \pm 0.10 \\ 0.90 \pm 0.10 \\ 0.95 \pm 0.10 \\ 0.95 \pm 0.10 \end{array}$	0 0 0 0	0 0 0 0	2,000 2,000 4,000 4,000 4,000	8,000 8,000 10,000 10,000 10,000
FE FF FG FL FH	1210 1210 1210 1210 1210 1210	$1.00 \pm 0.10 \\ 1.10 \pm 0.10 \\ 1.25 \pm 0.15 \\ 1.40 \pm 0.15 \\ 1.55 \pm 0.15 \\ $	0 0 0 0	0 0 0 0	2,500 2,500 2,500 2,000 2,000	10,000 10,000 10,000 8,000 8,000
FM FJ FK FS GB	1210 1210 1210 1210 1210 1812	$\begin{array}{c} 1.70 \pm 0.20 \\ 1.85 \pm 0.20 \\ 2.10 \pm 0.20 \\ 2.50 \pm 0.30 \\ 1.00 \pm 0.10 \end{array}$	0 0 0 0	0 0 0 0	2,000 2,000 2,000 1,000 1,000	8,000 8,000 8,000 4,000 4,000
GC GD GE GH GG	1812 1812 1812 1812 1812 1812	$\begin{array}{c} 1.10 \pm 0.10 \\ 1.25 \pm 0.15 \\ 1.30 \pm 0.10 \\ 1.40 \pm 0.15 \\ 1.55 \pm 0.10 \end{array}$	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
GK GJ HB HD	1812 1812 1812 1825 1825	$\begin{array}{c} 1.60 \pm 0.20 \\ 1.70 \pm 0.15 \\ 2.50 \pm 0.20 \\ 1.10 \pm 0.15 \\ 1.30 \pm 0.15 \end{array}$	0 0 0 0	0 0 0 0	1,000 1,000 500 1,000 1,000	4,000 4,000 2,000 4,000 4,000
HF JB JC JD JE JF	1825 2220 2220 2220 2220 2220 2220	$\begin{array}{c} 1.50 \pm 0.15 \\ 1.00 \pm 0.15 \\ 1.10 \pm 0.15 \\ 1.30 \pm 0.15 \\ 1.40 \pm 0.15 \\ 1.50 \pm 0.15 \end{array}$	0 0 0 0 0	0 0 0 0 0	1,000 1,000 1,000 1,000 1,000 1,000	4,000 4,000 4,000 4,000 4,000 4,000
JO	2220	2.40 ± 0.15	0	0	500	2,000
Thickness Code	Case Size	Thickness ± Range (mm)	7" Reel Paper G	13" Reel Quantity	7" Reel Plastic	13" Reel Quantity

Package quantity based on finished chip thickness specifications.



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

EIA Size Code	Metric Size		Dens Maxi Land P	sity Lev imum (I rotrusio	vel A: Most) on (mm)		Dens Medi Land P	sity Lev an (Nor rotrusio	vel B: ninal) on (mm)		Dens Minii Land P	sity Lev mum (L rotrusio	vel C: .east) on (mm)
oout	oouc	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	X	V1	V2
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	0.40	0.52	0.52	1.60	0.80
0603	1608	0.90	1.15	1.10	4.00	2.10	0.80	0.95	1.00	3.10	1.50	0.60	0.75	0.90	2.40	1.20
0805	2012	1.00	1.35	1.55	4.40	2.60	0.90	1.15	1.45	3.50	2.00	0.75	0.95	1.35	2.80	1.70
1206	3216	1.60	1.35	1.90	5.60	2.90	1.50	1.15	1.80	4.70	2.30	1.40	0.95	1.70	4.00	2.00
1210	3225	1.60	1.35	2.80	5.65	3.80	1.50	1.15	2.70	4.70	3.20	1.40	0.95	2.60	4.00	2.90
1210 ¹	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 \geq 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).





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.

Drofilo Fosturo	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:
Soldorability		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 +/- 2 hours after test conclusion.
Piecod Humidity	MIL STD 202 Mothed 103	Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Diased Humany		Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
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.



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 $\pm 15\%$ 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.

Benefits

- -55°C to +150°C operating temperature range
- Pb-Free and RoHS 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 10 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

Ordering Information

- · 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% minimum)



С	1210	С	184	K	3	Н	Α	С	AUTO
Ceramic	Case Size (L" x W")	Specification/ Series ¹	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/Grade (C-Spec) ²
	0402 0603 0805 1206 1210 1812	C = Standard	2 Significant Digits + Number of Zeros	$F = \pm 1\% G = \pm 2\% J = \pm 5\% K = \pm 10\% M = \pm 20\%$	3 = 25 V 5 = 50 V 1 = 100 V	H = Ultra Stable X8R	A = N/A	C = 100% Matte Sn L = SnPb (5% minimum)	Blank = Bulk TU = 7" Reel Unmarked AUTO = Automotive Grade 7"Reel Unmarked

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.

- ^{2,3} SnPb termination finish option is not available on automotive grade product.
- ³ Additional reeling or packaging options may be available. Contact KEMET for details.



Dimensions – Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0402	1005	1.00 (.040) ± 0.05 (.002)	0.50 (.020) ± 0.05 (.002)		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)	See Table 2 for	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)	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)	N/A	Calder Deflaw Only
1812	4532	4.50 (.177) ± 0.30 (.012)	3.20 (.126) ± 0.30 (.012)	1	0.60 (.024) ± 0.35 (.014)		Solder Reflow Unly

Applications

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

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

Pb-Free and RoHS Compliant (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 GΩ (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 Ω 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 \pm 50 Hz and 1.0 \pm 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 Capacitance Dissipation Factor Capacitance Insulation Voltage Value (Maximum %) Shift Resistance												
Ultra-Stable X8R	All	All	2.5	0.3% or ±0.25 pf	10% of Initial Limit							



Table 1 – Capacitance Range/Selection Waterfall (0402 – 1812 Case Sizes)

	Can		Cas S	se S Serie	ize es	1	C	:0402	C	C	0603	C	C	:0805	5C	C	:1206	C	C	:1210	С	C18	12C
Capacitance	Code		Volt	tage (Code		3	5	1	3	5	1	3	5	1	3	5	1	3	5	1	5	1
	oouc	Ra	ated V	/oltag	ge (VI	DC)	25	50	100	25	20	<u> </u>	55	20	ě	25	20	ě	25	50	100	50	- 10
		Cap	oacita	ince 1	Tolera	ance						Produc See 1	ct Avail Fable 2	for Ch	and Cl	hip Thi kness	ckness Dimen	s Code: sions	S				
100 pF	101	F	G	J	K	M	BB	BB	BB														
120 pF	121	F	G	J	K	M	BB	BB	BB														
130 pF	131	F	G	J	K	М	BB	BB	BB														
150 pF	151	F	G	J	K	M	BB	BB	BB														
180 pF	181	F	G	J	K	M	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														
240 pF	241	F	G	J	K	M	BB	BB	BB														
300 pF	301	F	G	J	K	M	BB	BB	BB														
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	M	BB	BB	BB	CP	CP	CP											
430 pF 470 pF	431	F	G	J	K	M	BB	BB	BB	СВ	CB	CB											
510 pF	511	F	G	J	К	М	BB	BB	BB	СВ	СВ	СВ											
560 pF	561	F	G	J	K	M	BB	BB	BB	CB	CB	CB											
620 pF	621	F	G	J	K	M	BB	BB	BB	CB	CB	CB											
750 pF	751	F	G	J	K	M	BB	BB	BB	СВ	CB	CB											
820 pF	821	F	G	J	K	М	BB	BB	BB	СВ	СВ	CB											
910 pF	911	F	G	J	K	M	BB	BB	BB	CB	CB	CB											
1,000 pF	102	F	G	J	K	M	BB	BB	BB	CB	CB	CB											
1,200 pF	122	F	G	J	K	M	BB	BB		CB	CB	CB											
1,300 pF	132	F	G	J	K	М	BB	BB		СВ	CB	CB											
1,500 pF	152	F	G	J	K	M	BB	BB		CB	CB	CB											
1,800 pF	182	F	G	J	K	M				CB	CB	CB											
2,000 pF	202	F	G	J	K	M				СВ	CB	CB	DC	DC	DC								
2,200 pF	222	F	G	J	K	М				CB	CB	CB	DC	DC	DC								
2,400 pF	242	F	G	J	K	M				CB	CB	CB		DC	DC								
3.000 pF	302	F	G	J	K	M				CB	CB	CB	DC	DC	DC								
3,300 pF	332	F	G	J	К	М				СВ	СВ	CB	DC	DC	DC								
3,600 pF	362	F	G	J	K	М				CB	CB	CB	DC	DC	DC								
3,900 pF	392		G	J	K	M				CB	CB	CB			DC								
4,700 pF	472	F	G	J	K	M				CB	CB	CB	DC	DC	DC								
5,100 pF	512	F	G	J	K	М				СВ	СВ		DC	DC	DC								
5,600 pF	562	F	G	J	K	M				CB	CB		DC	DC	DC								
6,200 pF	682	F	G	J	K	M				CB	CB		DC	DC	DC	FB	FB	FB					
7,500 pF	752	F	G	J	K	M				CB	0.5		DC	DC	DC	EB	EB	EB					
8,200 pF	822	F	G	J	K	М				CB			DC	DC	DC	EB	EB	EB					
9,100 pF	912	F	G	J	K	M				CB			DC	DC	DC	EB	EB	EB					
12,000 pF	123	F	G	J	K	M							DC	DC	DE	EB	EB	EB	FB	FB	FB		
15,000 pF	153	F	G	J	K	М							DC	DD	DG	EB	EB	EB	FB	FB	FB	GB	GB
18,000 pF	183	F	G	J	K	М							DC	DD		EB	EB	EB	FB	FB	FB	GB	GB
22,000 pF	223	F	G	J	K	M								DF		EB	EB	EC	FB	FB	FB	GB	GB
33,000 pF	333	F	G	J	K	M							DG			EB	EB	EE	FB	FB	FB	GB	GB
		Ra	ated V	/oltac	ge (VI	DC)	25	50	10	25	50	100	25	50	100	25	50	100	25	50	100	50	10
Capacitance	Cap Code		Volt	tage (Code		3	5	1	3	5	1	3	5	1	3	5	1	3	5	1	5	1
		Ca	ase S	Size /	Seri	ies		C04020	C		C06030	C		C0805	C		C12060	C		C12100	;	C18	12C



Table 1 – Capacitance Range/Selection Waterfall (0402 – 1812 Case Sizes) cont'd

		(Cas S	e S erie	ize es	1	C	:0402	C	C	0603	С	C	:0805	C	C	:1206	С	C	:1210	С	C18	12C
Capacitance	Сар		Volt	age (Code		3	5	1	3	5	1	3	5	1	3	5	1	3	5	1	5	1
	Code	Ra	ted V	/oltag	ge (VI	DC)	25	50	100	25	50	100	25	50	100	25	50	100	25	50	100	50	100
		Сар	acita	G J K M						•		Produc See 1	t Avail Table 2	ability for Ch	and Cl ip Thic	nip Thi kness	ckness Dimen	Codes	5				
47,000 pF	473	F	G	J	K	M										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	Μ													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	ited \	/oltag	ge (VI	DC)	25	50	100	25	50	100	25	50	100	25	50	100	25	50	100	50	100
Capacitance	Cap Code		Volt	age (Code		3	5	1	3	5	1	3	5	1	3	5	1	3	5	1	5	1
		Ca	ase S	Size	Seri	ies		C04020	C		C06030	2		C08050	2		C12060	2		C12100	;	C18	12C

Table 2 – Chip Thickness/Packaging Quantities

Thickness	Case	Thickness ±	+ Paper 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
CB	0603	0.80 ± 0.07	4,000	10,000	0	0
DC	0805	0.78 ± 0.10	4,000	10,000	0	0
DD	0805	0.90 ± 0.10	4,000	10,000	0	0
DE	0805	1.00 ± 0.10	0	0	2,500	10,000
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	Range (mm)	Paper G	Quantity	Plastic (Quantity

Package quantity based on finished chip thickness specifications.



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

EIA Size	Metric Size		Density Level A: Maximum (Most) Land Protrusion (mm)					Dens Media Land P	sity Lev an (Nor rotrusio	vel B: ninal) on (mm)	Density Level C: Minimum (Least) Land Protrusion (mm)					
Code	Code	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	X	V1	V2	
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	0.40	0.52	0.52	1.60	0.80	
0603	1608	0.90	1.15	1.10	4.00	2.10	0.80	0.95	1.00	3.10	1.50	0.60	0.75	0.90	2.40	1.20	
0805	2012	1.00	1.35	1.55	4.40	2.60	0.90	1.15	1.45	3.50	2.00	0.75	0.95	1.35	2.80	1.70	
1206	3216	1.60	1.35	1.90	5.60	2.90	1.50	1.15	1.80	4.70	2.30	1.40	0.95	1.70	4.00	2.00	
1210	3225	1.60	1.35	2.80	5.65	3.80	1.50	1.15	2.70	4.70	3.20	1.40	0.95	2.60	4.00	2.90	
1210 ¹	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 $\geq 22 \ \mu F$

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

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



Soldering Process

Recommended Soldering Technique:

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

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020



Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 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:
Soldorability		a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	3-310-002	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 +/- 2 hours after test conclusion.
Biased Humidity	MIL_STD_202 Method 103	Load Humidity: 1,000 hours 85°C/85%RH and rated voltage. Add 100K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Diased Humany		Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours. +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+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

Reference	lt	em	Material				
A		Finish	100% Matte Sn	SnPb (5% min)			
В	Termination Svstem	Barrier Layer	۱	li			
С	- ,	Base Metal	Cu				
D	Inner E	Electrode	Ni				
E	Dielectri	c Material	CaZrO ₃				



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



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	Voltage	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/Grade (C-Spec) ³
	0402 0603 0805 1206 1210	C = Standard X = Flexible Termination	2 Significant Digits + Number of Zeros	J = ±5% K = ±10% M = ±20%	8 = 10 V 3 = 25 V 5 = 50 V	N = X8L	A = N/A	C = 100% Matte Sn L = SnPb (5% minimum)	Blank = Bulk TU = 7" Reel Unmarked TM = 7" Reel Marked AUTO = Automotive Grade 7" Reel Unmarked

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.

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

^{2.3} SnPb termination finish option is not available on Automotive Grade product.

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



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 (.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)	See Table 2 for Thickness	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)	N1/A	
1210	3225	3.20 (.126) ± 0.20 (.008)	2.50 (.098) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.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 (.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) ± 0.20 (.008)	1.25 (.049) ± 0.20 (.008)	See Table 2 for	0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	or
1206	3216	3.30 (.130) ± 0.40 (.016)	1.60 (.063) ± 0.20 (.008)	Thickness	0.60 (.024) ± 0.25 (.010)	N1/A	Solder Reflow
1210	3225	3.30 (.130) ± 0.40 (.016)	2.50 (.098) ± 0.20 (.008)		0.60 (.024) ± 0.25 (.010)	IN/A	Solder Reflow Only

Benefits

- -55°C to +150°C operating temperature range
- Pb-Free and RoHS Compliant
- EIA 0402, 0603, 0805, 1206, and 1210 case sizes
- DC voltage ratings of 10 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% 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.

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

Pb-Free and RoHS compliant (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 – 125°C) +15, -40% (125°C – 150°C)
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 @ 25°C	3.5% (10 V) and 2.5% (25 V and 50 V)
Insulation Resistance (IR) 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.

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

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

1 kHz \pm 50 Hz and 1.0 \pm 0.2 Vrms.

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		3.0									
X8L	25	All	5.0	±20%	10% of Initial Limit							
	10		7.5									

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	< .047 µF	≥ .047 µF
1206	< 0.22 µF	≥ 0.22 µF
1210	< 0.39 µF	≥ 0.39 µF
1808	ALL	N/A
1812	< 2.2 µF	≥ 2.2 µF
1825	ALL	N/A
2220	< 10 µF	≥ 10 µF
2225	ALL	N/A



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

	Can	Ca	ise Siz Series	ze /	C04	02C	(C0603	С	C	C0805(C	(C1206	C	(C12100	C
Capacitance	Code	V	oltage Co	de	8	3	8	3	5	8	3	5	8	3	5	8	3	5
	ooue	Rated	l Voltage	(VDC)	10	25	10	25	50	10	25	50	10	25	50	10	25	50
		Capac	itance To	lerance	Produ	ct Avai	ı ilability	v and C	hip Th	icknes	s Code	es See	Table 2	2 for Cl	hip Thi	ckness	Dimer	nsions
12.000 pF	123	J	К	М	BB	BB	<u> </u>		1.				1	-	1.	1	_	
15,000 pF	153	J	К	М	BB	BB												
18,000 pF	183	J	к	М	BB	BB												
22.000 pF	223	Ĵ	к	м	BB	BB												
27.000 pF	273	Ĵ	к	м	BB													
33.000 pF	333	J	K	M	BB													
39.000 pF	393	J	ĸ	M	BB													
47 000 pF	473	J	ĸ	M	BB		СВ	CB	CB									
0.12 µF	124	J	ĸ	M			CB	CB	05									
0.15 µF	154	J	ĸ	M			CB	CB		DG	DG	DG						
0.18 µF	184	J	K	M			CB	02		DG	DG	DG						
0.22 µF	224	J	ĸ	M			CB			סס	סס	DG						
0.27 µF	274	J	ĸ	M			05			סס	סס							
0.33 µF	334		ĸ	M						סס	סס							
0.39 µF	394		ĸ	M						DF	DE					FD	FD	FD
0.47 µF	474		ĸ	M						DE	DE		FG	FG	FG	FD	FD	FD
0.56 µF	564		ĸ	M						DG	DH					FF	FF	FF
0.68 µF	684	ŭ	ĸ	M						DG	DH					FG	FG	FG
0.82 µF	824	ŭ	ĸ	M						DG						FI	FI	FI
10 uF	105	ŭ	ĸ	M						DG			FD	FD		FM	FM	FM
1.0 µr	125	U U	K	M						00			FH	EH		FG	FG	1 101
1.2 µi	155	, i	ĸ	M									EH	EH		FG	FG	
1.5 µi	185	J 1	ĸ	M										EH		FG	FG	
2.2 µF	225	J 1	ĸ	M										EH		FG	FG	
2.2 µi 2 7 µF	225	J 1	ĸ	M										L		FG	FH	
2.7 µ1 3 3 µE	335	J	K	M									EH			FM	EM	
3.0 µF	305	J 1	ĸ	M												FG	FK	
3.5 μΓ 4.7 μΕ	475	J 1	ĸ	M												FG	FS	
4.7 μi	475	J		M									LII				13	
6.8 µF	685	1	K	M												FM		
8.2 µF	825	5	K	M												FK		
10 µF	106	.1	K	M												ES		
10 pi	100	Rated	l Voltage	(VDC)	10	25	10	25	50	10	25	50	10	25	50	10	25	50
Capacitance	Cap	V	oltage Co	de	8	3	8	3	5	8	3	5	8	3	5	8	3	5
	Code	Cas	e Size / S	eries	C04	102C		C0603C	1		C0805C	1		C1206C	ļ		C1210C	1



Thickness	Case	Thickness ±	Paper C	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
CB	0603	0.80 ± 0.07	4,000	10,000	0	0
DD	0805	0.90 ± 0.10	4,000	10,000	0	0
DE	0805	1.00 ± 0.10	0	0	2,500	10,000
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
DH	0805	1.25 ± 0.20	0	0	2,500	10,000
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	Range (mm)	Paper C	Quantity	Plastic (Quantity

Table 2 – Chip Thickness/Packaging Quantities

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		Density Level A: Maximum (Most) Land Protrusion (mm)				Density Level B: Median (Nominal) Land Protrusion (mm)					Density Level C: Minimum (Least) Land Protrusion (mm)				
oout	oouc	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
1210 ¹	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 $\geq 22 \, \mu F$

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

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



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)				
0000	0040	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	0.80	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).



Soldering Process

Recommended Soldering Technique:

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

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020



Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 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		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 +/- 2 hours after test conclusion.
Pieced Humidity	MIL STD 202 Method 102	Load Humidity: 1,000 hours 85°C/85%RH and rated voltage. Add 100K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Blased 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.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours. +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+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

Reference	lt	em	Material				
А		Finish	100% Matte Sn	SnPb (5% min)			
В	Termination Svstem	Barrier Layer	Ni				
D	- ,	Base Metal	Cu				
E	Inner E	lectrode	Ni				
F	Dielectri	c Material	BaTiO ₃				



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

Construction – Flexible Termination

Reference	lt	em	Material				
А		Finish 100% Matte Sn		SnPb (5% min)			
В	Termination	Barrier Layer	١	li			
С	System	Epoxy Layer	Ag				
D		Base Metal	Cu				
E	Inner E	lectrode	Ni				
F	Dielectri	c Material	BaTiO ₃				



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



Overview

KEMET's 250 V DC Tip and Ring MLCCs in X7R dielectric are designed and rated for telecommunication ringer circuits where the capacitor is used to block -48 V to -52 V 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 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 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 $\pm 15\%$ 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
- · Pb-Free and RoHS 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

Ordering Information

- SnPb termination finish option available upon request (5% minimum)
- · Flexible termination option available upon request



С	1825	С	105	K	Α	R	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec) ²
	0805 1206 1210 1812 1825 2220 2225	C = Standard X = Flexible Termination	2 Significant Digits + Number of Zeros	J = ±5% K = ±10% M = ±20%	A = 250 V	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% minimum)	Blank = Bulk TU = 7" Reel Unmarked TM = 7" Reel Marked

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

² 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
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)	1	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) ± 0.20 (.008)	1.25 (.049) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	Solder Wave or
1206	3216	3.30 (.130) ± 0.40 (.016)	1.60 (.063) ± 0.20 (.008)		0.60 (.024) ± 0.25 (.010)		Solder Reflow
1210	3225	3.30 (.130) ± 0.40 (.016)	2.50 (.098) ± 0.20 (.008)	-	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)		0.70 (.028) ± 0.35 (.014)	IN/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)		



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

Pb-Free and RoHS Compliant (excluding SnPb termination finish option).



Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +125°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit @ 25°C	5% (6.3 and 10 V), 3.5% (16 and 25 V) and 2.5% (50 to 250 V)
Insulation Resistance (IR) Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ±5 seconds @ 25°C)

Regarding aging rate: Capacitance measurements (including tolerance) are indexed to a referee time of 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 μ 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."



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

	Conscitones	Ca	se Siz Series	ze /	C0805C	C1206C	C1210C	C1812C	C1825C	C2220C	C2225C			
Capacitance	Capacitance	Vo	oltage Co	de	Α	Α	A	Α	A	Α	Α			
	Code	Rated	Voltage	(VDC)	250	250	250	250	250	250	250			
		Capacit	ance To	lerance		P	Product Availability and Chip Thickness Codes							
180 pF	181	J	K	М	DC									
220 pF	221	J	K	М	DC									
270 pF	271	J	K	М	DC									
330 pF	331	J	K	M	DC									
390 pF	391	J	K	M	DC									
470 pF	4/1	J	K	M	DC									
500 pF	501	J	ĸ	IVI M										
820 pF	821	J	ĸ	M										
1000 pF	102		ĸ	M	DC	FB								
1200 pF	122	J	K	M	DC	EB								
1500 pF	152	J	K	M	DC	EB								
1800 pF	182	J	К	М	DC	EB								
2200 pF	222	J	К	М	DC	EB	FB							
2700 pF	272	J	K	М	DC	EB	FB							
3300 pF	332	J	K	М	DC	EB	FB							
3900 pF	392	J	K	М	DC	EB	FB							
4700 pF	472	J	K	М	DC	EB	FB							
5600 pF	562	J	K	M	DC	EB	FB							
6800 pF	682	J	K	M	DC	EB	FB	GB						
8200 pF	822	J	K	M	DC	EB	FB	GB						
12000 pF	103	J	ĸ	IVI M		EB	FB	GB						
12000 pF 15000 pF	123	J	ĸ	M		ED	FB	GB						
18000 pF	183		ĸ	M	DC	FB	FB	GB						
22000 pF	223	J	K	M	DC	EB	FB	GB	HB					
27000 pF	273	J	ĸ	M		EB	FB	GB	HB					
33000 pF	333	J	к	М		EB	FB	GB	НВ					
39000 pF	393	J	ĸ	М		EB	FB	GB	HB					
47000 pF	473	J	K	М		ED	FC	GB	HB					
56000 pF	563	J	K	М		ED	FC	GB	HB					
68000 pF	683	J	K	М		ED	FC	GB	HB					
82000 pF	823	J	K	M		ED	FF	GB	HB	JC	140			
0.1 µF	104	J	K	M		EM	FG	GB	HB	JC	KC			
0.12 µF	124	J	ĸ	M				GB	НВ	JC	KC			
0.13 µF	184	J	K	M				GG	HR	.10	KC			
0.22 µF	224		ĸ	M				GG	HB	JC	KC			
0.27 µF	274	Ĵ	ĸ	M				GG	НВ	JC	KC			
0.33 µF	334	J	к	М				GG	HB	JC	KC			
0.39 µF	394	J	K	М				GG	HD	JC	KC			
0.47 µF	474	J	K	М				GJ	HD	JC	KD			
0.56 µF	564	J	К	М					HD	JD	KD			
0.68 µF	684	J	K	М					HD	JD	KD			
0.82 µF	824	J	K	M					HF	JF	KE			
1 μF 1.2 μF	125	J	K K	M					HF	JF	KE KE			
		Rated	Voltage	(VDC)	250	250	250	250	250	250	250			
Capacitance	Capacitance Code	Vo	ltage Co	de	Α	Α	A	A	A	Α	Α			
		Case	Size / S	eries	C0805C	C1206C	C1210C	C1812C	C1825C	C2220C	C2225C			

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

Thickness	Case	Thickness ±	Paper C	Quantity	Plastic (Quantity
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
DC	0805	0.78 ± 0.10	4,000	10,000	0	0
EB	1206	0.78 ± 0.10	4,000	10,000	4,000	10,000
ED	1206	1.00 ± 0.10	0	0	2,500	10,000
EM	1206	1.25 ± 0.15	0	0	2,500	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
FF	1210	1.10 ± 0.10	0	0	2,500	10,000
FG	1210	1.25 ± 0.15	0	0	2,500	10,000
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

Table 2 – Chip Thickness/Packaging Quantities

Package quantity based on finished chip thickness specifications.

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

EIA Size	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)						
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
1210 ¹	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 \geq 22 μ F





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

EIA Size	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)					
ooue	ooue	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	0.80	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
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).



Soldering Process

Recommended Soldering Technique:

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

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020



Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 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:
Colderability		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 +/- 2 hours after test conclusion.
Discod Llumiditu		Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Blased 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.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
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

Reference	lt	em	Material				
А		Finish	100% Matte Sn	SnPb (5% min)			
В	Termination System	Barrier Layer	Ni				
С	- ,	Base Metal	Cu				
D	Inner E	Electrode	Ni				
E	Dielectri	c Material	BaTiO₃				



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

Construction – Flexible Termination

Reference	lt	em	Material			
А		Finish	100% Matte Sn	SnPb (5% min)		
В	Termination	Barrier Layer	Ni			
С	System	Epoxy Layer	Ag			
D		Base Metal	Cu			
E	Inner Electrode		Ni			
F	Dielectri	c Material	BaTiO₃			



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



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 $\pm 15\%$ from -55° C to $\pm 125^{\circ}$ C.



Ordering Information

С	1210	J	685	К	3	R	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec) ²
	0805 1206 1210 1812	F = Open Mode J = Open Mode with Flexible Termination	2 Significant Digits + Number of Zeros	K = ±10% M = ±20%	4 = 16 V 3 = 25 V 5 = 50 V 1 = 100 V 2 = 200 V	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% minimum)	Blank = Bulk TU = 7" Reel Unmarked TM = 7" Reel Marked AUTO = Automotive Grade

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.



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)	N/A	Saldar Doflaw Only	
1812	4532	4.50 (.177) ± 0.30 (.012)	3.20 (.126) ± 0.30 (.012)		0.60 (.024) ± 0.35 (.014)		Solder Reflow Unly	



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) ± 0.20 (.008)	1.25 (.049) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	Solder Wave or
1206	3216	3.30 (.130) ± 0.40 (.016)	1.60 (.063) ± 0.20 (.008)	See Table 2 for	0.60 (.024) ± 0.25 (.010)		Solder Reflow
1210	3225	3.30 (.130) ± 0.40 (.016)	2.50 (.098) ± 0.20 (.008)	Thickness	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

Benefits

- -55°C to +125°C operating temperature range
- Open Mode/fail open design
- Mid to high capacitance flex mitigation
- Pb-Free and RoHS 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% 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.

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

Pb-Free and RoHS Compliant (excluding SnPb termination finish option).



Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +125°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit @ 25°C	5% (6.3 and 10 V), 3.5% (16 and 25 V) and 2.5% (50 to 250 V)
Insulation Resistance (IR) Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ±5 seconds @ 25°C)

Regarding aging rate: Capacitance measurements (including tolerance) are indexed to a referee time of 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 μF

120 Hz \pm 10Hz 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		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	< 0.047 µF	≥ 0.047 µF				
1206	< 0.22 µF	≥ 0.22 µF				
1210	< 0.39 µF	≥ 0.39 µF				
1808	ALL	N/A				
1812	< 2.2 µF	≥ 2.2 µF				
1825	ALL	N/A				
2220	< 10 µF	≥ 10 µF				
2225	ALL	N/A				



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

	Can	Case Sei	Case Size / Series			0805	βF			С	1206	F			C	:1210	F			C18	12F	
Capacitance	Cado	Voltag	e Code	4	3	5	1	2	4	3	5	1	2	4	3	5	1	2	3	5	1	2
	Code	Rated Vol	tage (VDC)	16	25	50	100	200	16	25	50	100	200	16	25	50	100	200	25	50	100	200
		Capac Tolei	itance rance		~				Pr	oduct See Ta	Availa	bility for Chi	and C ip Thio	hip Thi kness	icknes Dime	s Cod	es		•			
1,000 pF	102	K	М	DD	DD	DD	DD	DD														
1,200 pF	122	K	M	DD	DD	DD	DD															
1,500 pF	152	ĸ	IVI M	עט			עט	עט														
1,000 pF	102	N K	IVI M	םם	םם	םם	םם	עע חח														
2,200 pl	272	K	M	סס	סס	םם	סס	םם														
3.300 pF	332	к	M	DD	DD	DD	DD	DD														
3.900 pF	392	ĸ	M	DD	DD	DD	DD	DD														
4,700 pF	472	К	М	DD	DD	DD	DD	DD														
5,600 pF	562	К	М	DD	DD	DD	DD	DD														
6,800 pF	682	K	М	DD	DD	DD	DD	DD														
8,200 pF	822	K	М	DD	DD	DD	DD	DD														
10,000 pF	103	K	М	DD	DD	DD	DD	DD														
12,000 pF	123	K	М	DD	DD	DD	DD	DG														
15,000 pF	153	K	M	DD	DD	DD	DD	DG														
18,000 pF	183	K	M	DD		DD	DD		EC	EC	EC	EC	EC									
22,000 pF	223	ĸ	M				DG		EC	EC	EC	EC	EC									
27,000 pF	2/3	ĸ	IVI M	עט		עט	DG		EC	EC	EC	EC	EC									
33,000 pF	303	ĸ	IVI M	םם	םם	םם	DG		EC	EC	EC	EC	EC									
47 000 pF	473	K	M	מס	מס	חס	DG		EC	EC	EC	EC	EG						GB	GB	GB	GB
56 000 pF	563	ĸ	M	סס	מס	מס	DL		FC	FC	FC	FC	FG						GB	GB	GB	GB
68 000 pF	683	ĸ	M	סס	סס	DG	DG		FC	FC	FC	FC	FG	FD	FD	FD	FD	FD	GB	GB	GB	GB
82.000 pF	823	ĸ	M	DD	DD	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	М	DG	DG				EC	EC	EC	EG		FD	FD	FD	FD	FH	GB	GB	GB	GB
0.18 µF	184	К	М	DG	DG				EC	EC	EC	EG		FD	FD	FD	FD	FH	GB	GB	GB	GB
0.22 µF	224	К	М	DG	DD	DG			EC	EC	EC	ED		FD	FD	FD	FG	FJ	GB	GB	GB	GC
0.27 µF	274	K	М	DD	DD				EC	EC	EC			FD	FD	FD	FG		GB	GB	GB	GF
0.33 µF	334	K	M	DD	DG				EG	EG	EG	EG		FD	FD	FD	FH		GB	GB	GB	GK
0.39 µF	394	K	M	DD	DG				EG	EG	50			FD	FD	FG	FH		GB	GB	GB	GL
0.47 µF	4/4	ĸ	IVI M	DE	DG				EG	EG	EC				FD	FG	FJ		GB	GB	GC	
0.50 µF	504	ĸ	IVI M	DC					EG						FD	FG			GB	GB	GD	
0.00 µi	824	K	M	00					EG					FD	FG	FH	FR		GD	GD	GK	
10 µF	105	ĸ	M						FG	FC	FH			FD	FH	EI	FS		GN	GN	GM	
12 µF	125	ĸ	M						20	20				FG			10					
1.5 µF	155	K	M											FH								
1.8 µF	185	К	М											FH								
2.2 µF	225	K	М						EC	EH				FJ	FM	FM						
3.3 µF	335	K	М											FM								
4.7 µF	475	К	М						EH					FG	FM				GK	GK		
6.8 µF	685	K	M											FS	FS							
		Rated Vol	tage (VDC)	16	25	50	100	200	16	25	50	100	200	16	25	50	100	200	25	50	100	200
Capacitance	Cap Code	Voltag	e Code	4	3	5	1	2	4	3	5	1	2	4	3	5	1	2	3	5	1	2
	Case Size / Serie		e / Series		(C0805	F			(C1206I	F				C1210F	=			C1812F		



Table 2 – Chip	Thickness/Packaging	Quantities
----------------	---------------------	------------

Thickness	Case	Thickness ±	Paper C	Quantity	Plastic (Quantity
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
DD	0805	0.90 ± 0.10	4,000	10,000	0	0
DE	0805	1.00 ± 0.10	0	0	2,500	10,000
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
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 3A – Land Pattern Design Recommendations per IPC–7351 – Standard Termination

EIA Size	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)					
oouc	oouc	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	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
1210 ¹	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 $\geq 22 \, \mu F$

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

Density Level B: For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes.

Density Level C: For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC Standard 7351 (IPC–7351).



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

EIA Size Code	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)					
oouc	oouc	С	Y	X	V1	V2	C	Y	X	V1	V2	С	Y	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	0.80	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
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).



Soldering Process

Recommended Soldering Technique:

• Solder wave or solder reflow for EIA case sizes 0603, 0805 and 1206

• All other EIA case sizes are limited to solder reflow only

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020



Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method					
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.					
Board Flex	JIS-C-6429	Appendix 2, Note: 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:					
Colderability		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 +/- 2 hours after test conclusion.					
Riased Humidity		Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.					
Blased 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.					
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.					
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.					
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.					
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.					
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

Reference	lt	em	Material				
А		Finish	100% Matte Sn	SnPb (5% min)			
В	Termination System	Barrier Layer	Ni				
С		Base Metal	Cu				
D	Inner E	Electrode	Ni				
E	Dielectri	c Material	BaTiO ₃				



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

Construction – Flexible Termination

Reference	lt	em	Material			
А		Finish	100% Matte Sn	SnPb (5% min)		
В	Termination System	Barrier Layer	Ni			
С		Epoxy Layer	Ag			
D		Base Metal	Cu			
E	Inner E	lectrode	Ni			
F	Dielectri	c Material	BaTiO ₃			



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



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 $\pm 15\%$ 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	К	5	R	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec) ²
	0402 0603 0805 1206 1210 1812	S = Floating Electrode	2 Significant Digits + Number of Zeros	J = ±5% K = ±10% M = ±20%	$\begin{array}{c} 9 = 6.3 \ V \\ 8 = 10 \ V \\ 4 = 16 \ V \\ 3 = 25 \ V \\ 5 = 50 \ V \\ 1 = 100 \ V \\ 2 = 200 \ V \\ A = 250 \ V \end{array}$	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% minimum)	Blank = Bulk TU = 7" Reel Unmarked TM = 7" Reel Marked

¹Additional 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.



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)	See Table 2 for	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)	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)	N/A	
1812	4532	4.50 (.177) ± 0.30 (.012)	3.20 (.126) ± 0.30 (.012)		0.60 (.024) ± 0.35 (.014)		Solder Reflow Unly

Benefits

- -55°C to +125°C operating temperature range
- · Floating Electrode/fail open design
- · Low to mid capacitance flex mitigation
- Pb-Free and RoHS 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% 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.



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

Pb-Free and RoHS Compliant (excluding SnPb termination finish option).



Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +125°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit @ 25°C	5% (6.3 and 10 V), 3.5% (16 and 25 V) and 2.5% (50 to 250 V)
Insulation Resistance (IR) Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ±5 seconds @ 25°C)

Regarding aging rate: Capacitance measurements (including tolerance) are indexed to a referee time of 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 μ F

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

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



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	< 0.047 µF	≥ 0.047 µF
1206	< 0.22 µF	≥ 0.22 µF
1210	< 0.39 µF	≥ 0.39 µF
1808	ALL	N/A
1812	< 2.2 µF	≥ 2.2 µF
1825	ALL	N/A
2220	< 10 µF	≥ 10 µF
2225	ALL	N/A



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

		Case Size / Series			С	0402	2S				С	0603	S		1				C08	05S				
Canacitanco	Сар	Vo	ltage C	ode	9	8	4	3	5	9	8	4	3	5	1	2	9	8	4	3	5	1	2	A
Capacitance	Code	Rat	ed Vol (VDC	tage)	6.3	10	16	25	50	6.3	10	16	25	50	100	200	6.3	10	16	25	50	100	200	250
		Ca	pacita	nce						Pro	duct	Avail	abilit	y and	d Chi	p Thie	cknes	ss Co	des					
		Т	oleran	ce						<u> </u>	ee Ta	ble 2	for C	hip T	hick	ness	Dime	nsio	ns					
150 pF	151	J	K	M	BB	BB	BB	BB	BB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50	50	50		50	50		50
180 pF	101	J	ĸ		BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DC
220 pF	221	J	ĸ	IVI	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DC
270 pF	2/1	J	ĸ	IVI	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DC
330 pF	201	J	ĸ	IVI	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DC
390 pF	391	J	ĸ	IVI	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB	CB						DC	DC	DC
470 pF	4/1	J	ĸ	IVI	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB	CB							DC	DC
560 pF	501	J	ĸ		BB	BB	BB	BB	BB	CB	CB	CB	CB	CB	CB	CB								
000 pF	001	J	n k									CB	CB	CB	CB	CB								
020 pF	021	J	n K	IVI	DD	DD	DD	DD	DD	CB	CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DC
1,000 pF	102	J	n K		вв	БВ	BB	BB	BB		CB	CB	CB		CB			DC	DC	DC	DC		DC	
1,200 pF	122	J	n K	IVI							CB			CB	CB	CB		DC	DC	DC	DC	DC	DC	DC
1,500 pF	102	J	n K								CB	CB	CB	CB	CB	CB		DC	DC	DC	DC		DC	
1,000 pF	102	J	n K								CB	CB	CB	CB	CB	CB		DC	DC	DC	DC		DC	
2,200 pF	222	J	n K	IVI							CB	CB	CB	CP	CE	CB		DC	DC	DC	DC	DC	DC	DC
2,700 pF	212	J	n K										CB	CB		CB								
3,300 pF	302	J	r v										CB	CB	CB	CB								
3,900 pF	470	J																						
4,700 pF	472	J		M																				
5,000 pF	682	J	ĸ	M							CB	CB	CB	CB	CB			DC		DC		DC	DC	
0,000 pF	002	J		IVI M																				
10,200 pi	1022			M							CB	CB	CB	CE	UD									
10,000 pF	103	J		IVI M																				
12,000 pl	123		K K	M							CB	CB	CB	CB									DC	DC
18,000 pl	193	J	K	M							CB	CB	CB	CB				DC						
22 000 pF	222		K K	M									CB	CB										
22,000 pf	223	, i	ĸ	M																				
27,000 pi 33,000 pE	273		K K	M																				
39,000 pF	303	, i	ĸ	M																				
47.000 pF	173		K	M															DC	DC				
56 000 pF	563	l i	ĸ	M																				
68 000 pF	683	l i	ĸ	M													חח	םם	חח	חח	חח			
82 000 pF	823		ĸ	M													DG	DG	DG	DG	DG			
0.10 µF	104	J	K	M													DG	DG	DG	DG	DG			
																_							_	_
	Corr	Rat	ea Vol (VDC	tage	6.3	9	16	25	50	6.3	9	16	25	50	100	200	6.3	9	16	25	50	100	200	250
Capacitance	Code	Vo	ltage C	ode	9	8	4	3	5	9	8	4	3	5	1	2	9	8	4	3	5	1	2	Α
	Case Size / Series		ize / s		C0402S C0603S					C0805S														



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

		Cas	Case Size / Series					C12	06S							C12	10S					С	1812	S	
Canacitance	Сар	Vo	ltage C	ode	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	A	3	5	1	2	Α
Gapacitance	Code	Rat	ed Volt	age	6.3	9	16	25	50	100	200	250	6.3	9	16	25	50	100	200	250	25	50	100	200	250
		Ca	pacitar	псе						Pr	oduc	t Ava	ilabi	litv a	nd C	; hip 1	l Fhick	ness	Coc	les					I
		Т	olerand	e							See T	able	2 for	Chi	o Thi	ckne	ss D	imen	sion	s					
1,000 pF	102	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB													
1,200 pF	122	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB													
1,500 pF	152	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB													
1,800 pF	182	J	ĸ	IVI	EB	EB	EB	EB	EB	EB	EB	EB	гр	гр	гр	гр	гр	гр	гр	гр					
2,200 pF	222	J	r.	IVI		ED	ED		ED	ED	ED	ED						FD	FD	FD					
2,700 pF	212	J																							
3,300 pF	302	J	r k	M																					
3,300 pl	172	J I		M																					
4,700 pr 5,600 pF	562	ı ı	K	M	FR	EB	EB	EB	EB	EB	EB	EB	FR	FR	FR	FR	FR	FR	FR	FB					
6.800 pF	682	J	K	M	FR	FR	FR	FR	EB	FR	FR	FR	FR	FR	FR	FR	FR	FB	FR	FR	GB	GB	GB	GB	GB
8 200 pF	822	, i	K	M	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR	GB	GB	GB	GB	GB
10.000 pF	103	, i	ĸ	M	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR	GB	GB	GB	GB	GB
12,000 pF	100	ů	ĸ	M	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR	GB	GB	GB	GB	GB
15,000 pF	153	, i	ĸ	M	FR	FB	FR	FB	FB	FR	FB	FB	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB
18,000 pF	183	J	K	M	FB	FB	FB	FB	FB	FB	FB	FB	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB
22 000 pF	223	Ĵ	ĸ	M	FB	FB	FB	FB	FB	FB	FB	FB	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB
27 000 pF	273	Ĵ	ĸ	M	FB	FB	FB	FB	FB	FB	FB	FB	FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB
33 000 pF	333	Ĵ	ĸ	M	FB	FB	FB	FB	FB	FB			FB	FB	FB	FB	FB	FB	FB	FB	GB	GB	GB	GB	GB
39 000 pF	393	Ĵ	ĸ	M	FB	FB	FB	FB	FB	FC			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	Ĵ	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	Ĵ	K	M	EB	EB	EB	EB	EB				FB	FB	FB	FB	FB	FB			GB	GB	GB	GB	GB
82.000 pF	823	Ĵ	K	M	EB	EB	EB	EB	EB				FB	FB	FB	FB	FB	FC			GB	GB	GB	GB	GB
0.10 µF	104	J	К	М	EB	EB	EB	EB	EB				FB	FB	FB	FB	FB	FD			GB	GB	GB	GB	GB
0.12 µF	124	J	K	М	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
		Rat	ed Volt (VDC)	age	6.3	9	16	25	50	100	200	250	6.3	9	16	25	50	100	200	250	25	50	100	200	250
Capacitance	Cap	Vo	Itage C	ode	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	A	3	5	1	2	A
	Code	Ca	se Si Serie	ze / s	-	C1206S				C1210S					C1812S										



Thickness	Case	Thickness ±	Paper C	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
CB	0603	0.80 ± 0.07	4,000	10,000	0	0
CF	0603	0.80 ± 0.07	4,000	15,000	0	0
DC	0805	0.78 ± 0.10	4,000	10,000	0	0
DD	0805	0.90 ± 0.10	4,000	10,000	0	0
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
FD	1210	0.95 ± 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	Range (mm)	Paper C	Quantity	Plastic (Quantity

Table 2 – Chip Thickness/Packaging Quantities

Package quantity based on finished chip thickness specifications.

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

EIA Size	Metric Size		Density Level A: Maximum (Most) Land Protrusion (mm)					Dens Media Land P	sity Lev an (Nor rotrusio	vel B: ninal) on (mm)	Density Level C: Minimum (Least) Land Protrusion (mm)					
Coue	Code	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	X	V1	V2	
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	0.40	0.52	0.52	1.60	0.80	
0603	1608	0.90	1.15	1.10	4.00	2.10	0.80	0.95	1.00	3.10	1.50	0.60	0.75	0.90	2.40	1.20	
0805	2012	1.00	1.35	1.55	4.40	2.60	0.90	1.15	1.45	3.50	2.00	0.75	0.95	1.35	2.80	1.70	
1206	3216	1.60	1.35	1.90	5.60	2.90	1.50	1.15	1.80	4.70	2.30	1.40	0.95	1.70	4.00	2.00	
1210	3225	1.60	1.35	2.80	5.65	3.80	1.50	1.15	2.70	4.70	3.20	1.40	0.95	2.60	4.00	2.90	
1210 ¹	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 \geq 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).





Soldering Process

Recommended Soldering Technique:

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

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020

Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 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:
Colderability		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
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 2 hours after test conclusion.
Discod Llumidity		Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Blased Humidity	MIL-SID-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.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
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

Reference	lt	em	Material				
A		Finish	100% Matte Sn	SnPb (5% min)			
В	Termination System	Barrier Layer	Ni				
С	- ,	Base Metal	Cu				
D	Inner E	Electrode	Ni				
E	Dielectri	c Material	BaTiO ₃				



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



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 5mm 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 $\pm 15\%$ 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	X	106	K	4	R	Α	С	AUTO
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec) ²
	0603 0805 1206 1210 1808 1812 1825 2220 2225	X = Flexible Termination	2 significant digits + number of zeros	J = ±5% K = ±10% M = ±20%	9 = 6.3 V 8 = 10 V 4 = 16 V 3 = 25 V 5 = 50 V 1 = 100 V 2 = 200 V A = 250 V	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% minimum)	Blank = Bulk TU = 7" Reel Unmarked TM = 7" Reel Marked AUTO = Automotive Grade 7" Reel Unmarked

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.



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) ± 0.20 (.008)	1.25 (.049) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	or
1206	3216	3.30 (.130) ± 0.40 (.016)	1.60 (.063) ± 0.20 (.008)		0.60 (.024) ± 0.25 (.010)		Solder Reflow
1210 ¹	3225	3.30 (.130) ± 0.40 (.016)	2.50 (.098) ± 0.20 (.008)		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)		

¹ For capacitance values \geq 12 μ F add 0.02 (0.001) to the width tolerance dimension

Benefits

- -55°C to +125°C operating temperature range
- Superior flex performance (up to 5 mm)
- High capacitance flex mitigation
- · Pb-Free and RoHS 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 μ F
- 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% min)
- Commercial and Automotive (AEC-Q200) grades available

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.



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

Pb-Free and RoHS Compliant (excluding SnPb termination finish option).



Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +125°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit @ 25°C	5% (6.3 and 10 V), 3.5% (16 and 25 V) and 2.5% (50 to 250 V)
Insulation Resistance (IR) Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ±5 seconds @ 25°C)

Regarding aging rate: Capacitance measurements (including tolerance) are indexed to a referee time of 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 μF

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 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	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	< 0.047 µF	≥ 0.047 µF
1206	< 0.22 µF	≥ 0.22 µF
1210	< 0.39 µF	≥ 0.39 µF
1808	ALL	N/A
1812	< 2.2 µF	≥ 2.2 µF
1825	ALL	N/A
2220	< 10 µF	≥ 10 µF
2225	ALL	N/A



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

		Cas S	e Si erie	ize / s			C	060	3X					(C08	05)	(C12	206)	(C12	210)	(
Can	Сар	Volt	age C	ode	9	8	4	3	5	1	2	9	8	4	3	5	1	2	A	9	8	4	3	5	1	2	A	9	8	4	3	5	1	2	A
oup	Code	Rate	d Vol	tage	6.3	9	16	25	50	<u>10</u>	200	6.3	9	16	25	50	100	200	250	6.3	9	16	25	50	100	200	250	6.3	9	16	25	50	<u>6</u>	200	250
		Cap	Tolera	ance		I			ŀ	Prod	uct A	vail	abili	ty ar	d Cł	nip T	hick	ness	s Coo	des ·	- See	e Tab	le 2	for C	hip	Thic	knes	s Di	men	sion	s				
180 pF	181	J	K	M	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC																
220 pF 270 pF	221	J	ĸ	M	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC																
330 pF	331	J	K	M	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC																
390 pF 470 pF	391 471	J	ĸ	M	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB											
560 pF	561	J	К	М	СВ	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC																
680 pF 820 pF	681 821	J	K K	M	CB	CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DC																
1,000 pF	102	J	K	M	СВ	CB	CB	CB	CF	CB	CF	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB								
1,200 pF	122	J	K	M	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB								
1,800 pF	182	J	K	M	СВ	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB								
2,200 pF	222	J	K	M	CB	CB	CB	CB	CF	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB
2,700 pF 3.300 pF	332	J	ĸ	M	CB	CB	CB	CB	CB	CF	CB	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB
3,900 pF	392	J	Κ	М	СВ	СВ	СВ	СВ	СВ	СВ	СВ	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB
4,700 pF	472 562	J	ĸ	M	CB	CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB
6,800 pF	682	J	K	M	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB
8,200 pF	822	J	K	M	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB
12,000 pF	123	J	K	M	CB	CB	CB	CB	CB	CB	CD	DC	DC	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB
15,000 pF	153	J	K	M	CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DD	DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB
18,000 pF 22,000 pF	183 223	J	K K	M	CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC		DC	DC	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB
27,000 pF	273	J	K	M	СВ	CB	СВ	СВ	CB	CB		DC	DC	DC	DC	DC	DD	DE		EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB
33,000 pF	333 303	J	ĸ	M	CB	CB	CB	CF	CB	CB		DC	DC	DC	DC	DC	DD	DE		EB FR	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB
47,000 pF	473	J	K	M	CB	CB	CB	CB	CF	CB		DC	DC	DC	DC	DC	DE	DG		EB	EB	EB	EB	EB	EC	ED	ED	FB	FB	FB	FB	FB	FB	FC	FC
56,000 pF	563	J	K	M	CB	CB	CB	CB	CB			DD	DD	DD	DD	DD	DE	DG		EB	EB	EB	EB	EB	EB	ED	ED	FB	FB	FB	FB	FB	FB	FC	FC
82,000 pF	823	J	ĸ	M	СВ	CB	CB	CB	CF			DD	DD	DD	DD	DD	DE			EB	EB	EB	EB	EB	EB	ED	ED	FB	FB	FB	FB	FB	FC	FF	FF
0.10 µF	104	J	K	M	CB	CB	CF	CF	CF			DC	DC	DC	DC	DC	DE			EB	EB	EB	EB	EB	EB	EM	EM	FB	FB	FB	FB	FB	FD	FG	FG
0.12 µF 0.15 µF	124 154	J	K K	M	CB	CB	CB	CB	CD			DC	DC	DC	DC		DG			EC	EC	EC	EC	EC	EC	EG		FC	FC	FC	FC	FC	FD		
0.18 µF	184	J	K	М	СВ	CB	СВ	CB				DC	DC	DC	DC	DG	DG			EC	EC	EC	EC	EC	EC			FC	FC	FC	FC	FC	FD		
0.22 µF	224 274	J	ĸ	M	CB	CB	CB	CD					DC	DC	DC	DG	DG			EC FR	EC	EC	EC	EC	EC			FC	FC	FC	FC	FC	FD		
0.33 µF	334	J	K	M	CB	CB	CB					DG	DG	DG	DG	DD				EB	EB	EB	EB	EC	EG			FD	FD	FD	FD	FD	FD		
0.39 µF	394	J	K	M	CB	CB	CB					DG	DG	DG	DG	DE				EB	EB	EB	EB	EC	EG			FD	FD	FD	FD	FD	FD		
0.47 µr 0.56 µF	564	J	K	M		CD						DD	DD	DD	DG	DH				ED	ED	ED	ED	EC	LG			FD	FD	FD	FD	FD	FF		
0.68 µF	684	J	K	M								DD	DD	DD	DG	DH				EE	EE	EE	EE	ED				FD	FD	FD	FD	FD	FG		
0.82 μF 1.0 μF	824 105	J	ĸ	M								DD	DD	DD	DG					EF	EF	EF	EG	ED				FH	FH	FH	FH	FH	FM		
1.2 µF	125	J	К	М								DE	DE	DE						ED	ED	ED	EG	EH				FH	FH	FH	FH	FG			
1.5 µF 1.8 µF	155 185	J	ĸ	M								DG	DG	DG						EF FD	EF	EF	EG	EH FH				FH	FH	FH	FH	FG			
2.2 µF	225	J	ĸ	M								DG	DG	DG						ED	ED	ED	EF	EH				FJ	FJ	FJ	FJ	FG			
2.7 µF	275	J	ĸ	M																EN ED	EN	EN	EH					FE	FE	FE	FG	FH			
3.9 µF	395	J	K	M																EF	EF	EF	EH					FG	FG	FG	FG	FK			
4.7 μF	475	J	K	M																EF	EF	EF	EH					FC	FC	FC	FG	FS			
5.6 µF 6.8 µF	685	J	K	M																EH	EH	EH						FG	FG	FG	FM				
8.2 µF	825	J	К	М																EH	EH	EH						FH	FH	FH	FK				
	Can	Rate	ed Vol (VDC)	tage	6.3	9	16	25	50	100	200	6.3	9	16	25	50	10 10	200	250	6.3	9	16	25	50	<u>1</u> 0	200	250	6.3	9	16	25	50	100	200	250
Сар	Code	Volt	age C	ode	9	8	4	3	5	1	2	9	8	4	3	5	1	2	A	9	8	4	3	5	1	2	A	9	8	4	3	5	1	2	A
		Cas	se Si Serie	ze / s			С	0603	3X						C08	05X							C12	206X							C12	210X			

© KEMET Electronics Corporation • P.O. Box 5928 • Greenville, SC 29606 (864) 963-6300 • www.kemet.com



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

		Case Size / Series			С)60	3X					(C08	05)	((C12	06)	((C12	10X	ζ	I	
Cap	Сар	Voltage Code	9	8	4	3	5	1	2	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	A	9	8	4	3	5	1	2	Α
••••	Code	Rated Voltage (VDC)	6.3	10	16	25	50	100	200	6.3	10	16	25	50	100	200	250	6.3	9	16	25	50	100	200	250	6.3	10	16	25	50	100	200	250
		Cap Tolerance					F	Prod	uct A	Avail	abili	ty an	d Cl	nip T	hick	ness	Cod	des -	- See	Tab	le 2	for C	hip	Thic	knes	s Di	men	sion	s				
10 μF 22 μF	106 226	JKM JKM																EH	EH	EH						FH FS	FH FS	FH	FS				
		Rated Voltage (VDC)	6.3	10	16	25	50	100	200	6.3	10	16	25	50	100	200	250	6.3	10	16	25	50	100	200	250	6.3	10	16	25	50	100	200	250
Сар	Code	Voltage Code	9	8	4	3	5	1	2	9	8	4	3	5	1	2	A	9	8	4	3	5	1	2	A	9	8	4	3	5	1	2	Α
	ooue	Case Size / Series			0 4 3 5 1 2 C0603X						C08	05X							C12	206X							C12	10X					

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

		Cas S	se S Serie	ize / s		C18	08X			С	1812	X			C18	25X			С	2220	X			C22	25X	
Сар	Сар	Volt	age C	ode	5	1	2	A	3	5	1	2	A	5	1	2	Α	3	5	1	2	Α	5	1	2	Α
	Code	Rate	ed Vol (VDC	tage)	50	100	200	250	25	50	100	200	250	50	100	200	250	25	50	100	200	250	50	100	200	250
		Cap	Toler	ance			,	Proc	uct A	vailab	ilitv ar	d Chi	p Thic	kness	Code	s – Se	e Table	e 2 for	Chip	Thickn	ess D	imens	ions			
4,700 pF	472	J	K	M	LD	LD	LD													-						
5,600 pF	562	J	К	Μ	LD	LD	LD																			
6,800 pF	682	J	K	Μ	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	HB	HB	HB	HB									
33,000 pF	333	J	K	M	LD	LD			GB	GB	GB	GB	GB	HB	HB	HB	HB									
39,000 pF	393	J	K	M	LD	LD			GB	GB	GB	GB	GB	HB	HB	HB	HB									
47,000 pF	473	J	K	M	LD	LD			GB	GB	GB	GB	GB	HB	HB	HB	HB						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	HB	HB	HB	10	10	10	10	10	KC	KC	KC	KC
82,000 p⊦	823	J	K	M	LD				GB	GB	GB	GB	GB	HB	HB	НВ	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 µ⊦	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 µ⊦	154	J	K	M	LD				GB	GB	GB	GE	GE	HB	HB	НВ	HB	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.18 µF	184	J	K	M	LD				GB	GB	GB	GF	GG	HB	HB	HB	HB	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.22 µF	224	J	K	M					GB	GB	GB	GG	GG	HB	HB	HB	HB	JC	JC	JC	JC	JC	KC	KC	KC	KC
0.27 µF	2/4	J	ĸ	IVI					GB	GB	GG	GG	GG	HB	HB	НВ	HB	JC	JC	JC	JC	JC	KB	KC	KC	KC
0.33 µF	334 204	J	ĸ	IVI M					GB	GB	GG	GG	GG	НВ	HB	НВ	HB	JC	JC	JC	JC	JC		KC	KC	KC
0.39 µr	394 171	J	ĸ	M					GB	GB	GG	GU	GL					10	10	10	10	10		KC	KC KD	KD KD
0.47 µi	564	J	K	M					GC	GC	66	00	00	HB	HD	нр	HD	10	10	10	JC	10	KB	KC	KD	KD
0.50 µi 0.68 µE	68/	1	ĸ	M					60	60	60			HB		нп		10	10		JD	л Л	KB	KC	KD KD	KD KD
0.00 µi 0.82 µE	824	1	ĸ	M					GE	GE	00			HB	HE	HE	HE		10	IF	IE	IE	KB	KC	KE	KE
0.02 μι 10 μΕ	105	J	ĸ	M					GE	GE	66			HR	HE	HE	HE		IC	JE	JE	JE	KB	KD	KE	KE
1.0 µi	125	J	ĸ	M					0L	0L	00			HR					10	01	01	01	KB	KE	KE	KE
15 µF	155	J	K	M										HC				JC	JC				KC			
18 µF	185	J	K	M										HD				JD	JD				KD			
2.2 µF	225	,	ĸ	M										HF				JF	JF				KD			
4.7 uF	475	J	K	M					GK	GK								0.								
10 µF	106	Ĵ	ĸ	M					GK	0								JF	JO							
15 µF	156	J	K	M														JO	JO							
22 µF	226	J	K	Μ														JO								
		Rate	ed Vol	tage	50	100	200	250	25	50	100	200	250	50	100	200	250	25	50	100	200	250	50	100	200	250
Can	Сар	Volt	age C	ode	5	1	2	2 A		5	1	2	Α	5	1	2	Α	3	5	1	2	Α	5	1	2	Α
Cap	Code	Ca	se Si Serie	ze / s		C18	08X	I		(C1812)	(C18	25X			(2220)	(C22	25X	

© KEMET Electronics Corporation • P.O. Box 5928 • Greenville, SC 29606 (864) 963-6300 • www.kemet.com



Table 2 – Chip Thickness/Packaging Quantities

Thickness	Case	Thickness ±	Paper C	Quantity	Plastic (Quantity
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
СВ	0603	0.80 ± 0.07	4,000	10,000	0	0
CF	0603	0.80 ± 0.07*	4,000	15,000	0	0
CD	0603	0.80 ± 0.15	4,000	10,000	0	0
DC	0805	0.78 ± 0.10	0	0	4,000	10,000
DD	0805	0.90 ± 0.10	0	0	4,000	10,000
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
	1200	1.10 ± 0.10 1.20 ± 0.15	0	0	2,500	10,000
	1200	1.20 ± 0.10 1.25 ± 0.15	0	0	2,500	10,000
EM	1200	1.25 ± 0.15	0	0	2,500	8 000
	1200	1.00 ± 0.10 1.60 ± 0.20	0	0	2,000	8,000
ER	1200	1.00 ± 0.20 0.78 \pm 0.10	0	0	2,000	10,000
FC	1210	0.70 ± 0.10 0.90 + 0.10	0	0	4,000	10,000
FD	1210	0.00 ± 0.10 0.95 + 0.10	0	0 0	4 000	10,000
FF	1210	1.00 ± 0.10	0	0	2,500	10,000
FF	1210	1.10 ± 0.10	0	0	2,500	10.000
FG	1210	1.25 ± 0.15	0	0	2,500	10,000
FL	1210	1.40 ± 0.15	0	0	2,000	8,000
FH	1210	1.55 ± 0.15	0	0	2,000	8,000
FM	1210	1.70 ± 0.20	0	0	2,000	8,000
FJ	1210	1.85 ± 0.20	0	0	2,000	8,000
FK	1210	2.10 ± 0.20	0	0	2,000	8,000
FS	1210	2.50 ± 0.30	0	0	1,000	4,000
	1808	0.90 ± 0.10	0	0	2,500	10,000
GC	1012	1.00 ± 0.10 1.10 ± 0.10	0	0	1,000	4,000
GC	1812	1.10 ± 0.10 1.30 + 0.10	0	0	1,000	4,000
GE	1812	1.50 ± 0.10 1.50 ± 0.10	0	0	1,000	4,000
GG	1812	1.55 + 0.10	Ő	Ő	1,000	4 000
GK	1812	1.60 ± 0.20	0	0	1.000	4.000
GJ	1812	1.70 ± 0.15	0	0	1,000	4,000
HB	1825	1.10 ± 0.15	0	0	1,000	4,000
HC	1825	1.15 ± 0.15	0	0	1,000	4,000
HD	1825	1.30 ± 0.15	0	0	1,000	4,000
HF	1825	1.50 ± 0.15	0	0	1,000	4,000
JC	2220	1.10 ± 0.15	0	0	1,000	4,000
JD	2220	1.30 ± 0.15	0	0	1,000	4,000
JF	2220	1.50 ± 0.15	0	0	1,000	4,000
JU	2220	2.40 ± 0.15	0	0	500	2,000
KC	2225	1.00 ± 0.15 1.10 ± 0.15	0	0	1,000	4,000
KD	2225	1.10 ± 0.15 1.30 ± 0.15	0	0	1,000	4,000
KE	2225	1.40 ± 0.15	Ő	Ő	1,000	4,000
Thickness	Case	Thickness +	7" Reel	13" Reel	7" Reel	13" Reel
Code	Size	Range (mm)	Paper C	Quantity	Plastic	Quantity

Package quantity based on finished chip thickness specifications.



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

EIA Size	Metric Size		Dens Maxi Land P	sity Lev imum (I rotrusio	rel A: Most) on (mm)		Dens Medi Land P	sity Lev an (Nor rotrusio	vel B: ninal) on (mm)		Dens Minii Land P	sity Lev mum (L rotrusio	vel C: .east) on (mm)
Code	Code	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	0.80	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
1808	4520	2.25	1.85	2.30	7.40	3.30	2.15	1.65	2.20	6.50	2.70	2.05	1.45	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).



Soldering Process

Recommended Soldering Technique:

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

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020



Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 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:
Colderability		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 +/- 2 hours after test conclusion.
Disco d Ulumidit.		Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Blased 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.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.
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

Reference	lt	em	Mat	erial
А		Finish	100% Matte Sn	SnPb (5% min)
В	Termination	Barrier Layer	1	Ni
С	System	Epoxy Layer	A	٨g
D		Base Metal	C	Cu
E	Inner E	lectrode	1	Ni
F	Dielectri	c Material	Ba	ГіO ₃



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

F 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 ±15% from -55°C to +125°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	К	5	R	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec) ²
	0603 0805 1206 1210 1812	Y = Floating Electrode with Flexible Termination	2 Significant Digits + Number of Zeros	J = ±5% K = ±10% M = ±20%	9 = 6.3 V 8 = 10 V 4 = 16 V 3 = 25 V 5 = 50 V 1 = 100 V 2 = 200 V A = 250 V	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% minimum)	Blank = Bulk TU = 7" Reel Unmarked TM = 7" Reel Marked

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.



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)	
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	3.30 (.130) ± 0.40 (.016)	1.60 (.063) ± 0.20 (.008)	See Table 2 for Thickness	0.60 (.024) ± 0.25 (.010)		
1210	3225	3.30 (.130) ± 0.40 (.016)	2.50 (.098) ± 0.20 (.008)		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

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
- Pb-Free and RoHS 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 $\pm 5\%$, $\pm 10\%$, and $\pm 20\%$
- · 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% 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.



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

Pb-Free and RoHS Compliant (excluding SnPb termination finish option).



Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +125°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
Dielectric Withstanding Voltage	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit @ 25°C	5% (6.3 and 10 V), 3.5% (16 and 25 V) and 2.5% (50 to 250 V)
Insulation Resistance (IR) Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ±5 seconds @ 25°C)

Regarding aging rate: Capacitance measurements (including tolerance) are indexed to a referee time of 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 μ F

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

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



Post Environmental Limits

High Temperature Life, Biased Humidity, Moisture Resistance												
Dielectric	Dielectric Rated DC Voltage Capacitance Value Dissipation Factor (Maximum %) Capacitance Shift											
	> 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	< 0.047 µF	≥ 0.047 µF
1206	< 0.22 µF	≥ 0.22 µF
1210	< 0.39 µF	≥ 0.39 µF
1808	ALL	N/A
1812	< 2.2 µF	≥ 2.2 µF
1825	ALL	N/A
2220	< 10 µF	≥ 10 µF
2225	ALL	N/A



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

		Ca	se Siz Series	ze / S			C	CO6O 3	Y			C0805Y							
Canacitanco	Сар	Va	ltage Co	de	9	8	4	3	5	1	2	9	8	4	3	5	1	2	Α
Capacitance	Code	Ra	ted Volta (VDC)	age	6.3	9	16	25	50	100	200	6.3	9	16	25	50	100	200	250
		Ca	pacita	nce ce				Pr	oduct See Ta	Availa ble 2 f	bility for Chi	and Cl	hip Th kness	icknes Dime	ss Cod nsion	les s			
180 pF	181	J	K	M	СВ	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC
220 pF	221	J	К	M	СВ	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC
270 pF	271	J	K	M	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC
330 pF	331	J	K	M	СВ	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC
390 pF	391	J	K	M	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC
470 pF	471	J	K	M	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC
560 pF	561	J	K	M	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC
680 pF	681	J	K	M	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC
820 pF	821	J	K	M	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC
1,000 pF	102	J	K	M	СВ	CB	CB	CB	CF	CB	CF	DC	DC	DC	DC	DC	DC	DC	DC
1,200 pF	122	J	K	M	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC
1,500 pF	152	J	K	M	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC
1,800 pF	182	J	K	M	CB	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC
2,200 pF	222	J	K	M	СВ	CB	CB	CB	CF	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC
2,700 pF	272	J	K	M	CB	CB	CB	CB	CB	CF	CB	DC	DC	DC	DC	DC	DC	DC	DC
3,300 pF	332	J	K	M	СВ	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC
3,900 pF	392	J	K	M	СВ	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC
4,700 pF	472	J	K	M	СВ	CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	DC	DC
5,600 pF	562	J	K	M	СВ	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DC	DC
6,800 pF	682	J	K	M	CB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	DC	DC
8,200 pF	822	J	K	M	CB	CB	CB	CB	CB	СВ		DC	DC	DC	DC	DC	DC	DC	DC
10,000 pF	103	J	K	M	CB	CB	CB	CB	CF			DC	DC	DC	DC	DC	DC	DC	DC
12,000 pF	123	J	K	M	CB	CB	CB	CB	CB			DC	DC	DC	DC	DC	DC	DC	DC
15,000 pF	153	J	K	M	CB	CB	CB	CB	CB			DC	DC	DC	DC	DC	DD		
18,000 pF	183	J	K	M	CB	CB	CB	CB	CB			DC	DC	DC	DC	DC	DD		
22,000 pF	223	J	K	M	CB	CB	CB	CB	CB			DC					טט		
27,000 pF	2/3	J	K	M									DC						
33,000 pF	333	J	K	M								DC	DC	DC					
39,000 pF	393	J	ĸ	IVI															
47,000 pF	4/3	J	ĸ	IVI								DC	DC	DC	DC	DC			
50,000 pF	503	J	K	IVI															
00,000 pF	003	J	K	IVI									DD	DD	DD	DD			
02,000 pr	023	J	ĸ	M								DG	DG	DG	DG	DG			
υ.ιυ με	104	J	N	IVI								00	DG	DG	DG	DG			
	Rated Voltage (VDC)			6.3	9	16	25	50	100	200	6.3	9	16	25	50	100	200	250	
Capacitance Cap Code Voltage Code			9	8	4	3	5	1	2	9	8	4	3	5	1	2	A		
		Ca	ise Siz Series	ze /			(20603	Y			C0805Y							



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

		Cas	se S Serie	ize / es				C12	06Y							C12	10Y					С	1812	Y	
Canacitanco	Сар	Vol	tage C	ode	9	8	4	3	5	1	2	Α	9	8	4	3	5	1	2	A	3	5	1	2	Α
Capacitance	Code	Rat	ed Vol (VDC)	tage)	6.3	6	16	25	50	100	200	250	6.3	9	16	25	50	100	200	250	25	50	100	200	250
		Cap To	acita lerar	ance 1ce						Pr	oduc See 1	ct Ava Fable	ailabi 2 for	ility a r Chi	and C p Thi	hip 1 ckne	'hick ss Di	ness men	Cod sions	es S					
1,000 pF	102	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB													
1,200 pF	122	J	K	M	EB	EB	EB	EB	EB	EB	EB	EB													
1,500 pF	152	J	K	IVI	EB	EB	EB	EB	EB	EB	EB	EB													
1,800 pF	182	J	ĸ	IVI M	EB	EB	EB	EB	EB	EB	EB	EB	ED.	гр	гр	FD	гр	гр	гр	FD					
2,200 pF	222	J	ĸ	IVI	EB	EB	EB	EB	EB	EB	EB	EB	FB	FB	FB	FB	FB	FB	FB	FB					
2,700 pF	212	J	n v																						
3,300 pF	33Z 202	J	r v	IVI M																					
3,900 pF	392	J																							
4,700 pF	47Z 562	J	ĸ	M																					
5,000 pF	682	J	ĸ	M		ED	ED	ED	ED	ED	ED	ED	ED	ED	ED	ED	ED	ED	ED	ED	GR	CP	CP	GR	GP
8,000 pl	822	J		M																	GB	CP	CP	CP	GB
0,200 pi 10,000 pE	1022	J		M																	GB	CP	CP	CP	GB
12,000 pl	103	1		M																	GB	CP	GB	CP	GB
12,000 pl 15,000 pE	123	1		M																	GB	GB	GB	CP	CP
18,000 pl	193	J	K K	M																	GB	GB	GB	GB	GD
22,000 pF	222	1	K K	M																	CP	GD	CP	CP	CP CP
22,000 pl 27,000 pE	223	1	K K	M																	CP	CP	CP	CP	CP
27,000 pl 33,000 pE	213	1	k K	M																	CP	CP	CP	CP	CP
30,000 pl	303	1	k K	M																	CP	CP	CP	CP	CP
47,000 pF	/73	J	K K	M		ED	ED	ED	ED	EC			ED	ED	ED	ED	ED	ED	FC	FC	GB	GB	GB	GB	GB
56 000 pF	563	J	ĸ	M	EB	EB	EB	EB	EB	EB			FR	FB	FR	FR	FR	FR	FC	FC	GB	GB	GB	GB	GB
68 000 pF	683		ĸ	M	FR	EB	EB	EB	EB	LD			FR	FR	FR	FR	FR	FR	10	10	GB	GB	GB	GB	GB
82 000 pF	823	J J	ĸ	M	FR	FR	FR	FR	FR				FR	FR	FR	FR	FR	FC			GB	GB	GB	GB	GB
0.10 µF	104	ŭ	ĸ	M	FR	FR	FR	FR	FR				FR	FR	FR	FR	FR	FD			GB	GB	GB	GB	GB
0.12 µF	124	J	ĸ	M	FC	FC	FC	FC	FC				FB	FB	FB	FB	FB	10			GB	GB	GB	GB	GB
0.15 µF	154	Ĵ	ĸ	M	[_]				20				FC	FC	FC	FC	FC				GB	GB	GB	GB	GB
0.18 µF	184	Ĵ	ĸ	M									FC	FC	FC	FC	FC				GB	GB	GB	GB	GB
0.22 µF	224	Ĵ	ĸ	M									FC	FC	FC	FC	FC				GB	GB	GB	GB	GB
p.		Rat	ed Vol	tage	6.3	6	16	25	50	100	200	250	6.3	10	16	25	20	00	500	250	25	50	100	500	250
	Сар	(VDC)																					-		
Capacitance	Code	ode Voltage Code			9 8 4 3 5 1 2 A			A	9 8 4 3 5 1 2 A				A	A 3 5 1 2 A											
	Case Size / Series							C12	06Y							C12	10Y				C1812Y				



Thickness	Case	Thickness ±	Paper G	Quantity	Plastic (Quantity
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
CB	0603	0.80 ± 0.07	4,000	10,000	0	0
CF	0603	0.80 ± 0.07	4,000	15,000	0	0
DC	0805	0.78 ± 0.10	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
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
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	Range (mm)	Paper C	Juantity	Plastic (Quantity

Table 2 – Chip Thickness/Packaging Quantities

Package quantity based on finished chip thickness specifications.

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

EIA Size	Metric Size	Density Level A: Maximum (Most) Land Protrusion (mm)						Dens Media Land P	sity Lev an (Nor rotrusio	vel B: ninal) on (mm)	Density Level C: Minimum (Least) Land Protrusion (mm)				
ooue	ooue	С	Y	X	V1	V2	C	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	1.00	1.35	1.55	4.40	2.60	0.90	1.15	1.45	3.50	2.00	0.80	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
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).





Soldering Process

Recommended Soldering Technique:

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

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020

Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method					
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.					
Board Flex	JIS-C-6429	Appendix 2, Note: 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:					
Soldorability		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					
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 2 hours after test conclusion.					
Riased Humidity		Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.					
Blased Humidity	MIL-SID-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.					
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.					
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.					
High Temperature Life	MIL-STD-202 Method 108 /EIA-198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.					
Storage Life	MIL-STD-202 Method 108	150°C, 0 VDC for 1,000 hours.					
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

Reference	lt	em	Mate	erial			
A	Termination System	Finish	100% Matte Sn SnPb (5% r				
В		Barrier Layer	Ν	li			
С		Epoxy Layer	Ag				
D		Base Metal	Cu				
E	Inner E	lectrode	Ν	li			
F	Dielectri	c Material	Bal	۲iO ₃			



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

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 $\pm 15\%$ 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 μ F up to 47 μ F
- Available capacitance tolerances of $\pm 10\%$ and $\pm 20\%$
- 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
- Pb-Free and RoHS Compliant
- · Capable of Pb-Free reflow profiles
- Non-polar device, minimizing installation concerns
- · Tantalum and electrolytic alternative



Ordering Information

С	2210	С	106	М	5	R	2	С	7186
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance ¹	Voltage	Dielectric	Failure Rate/Design	Leadframe Finish ²	Packaging/Grade (C-Spec) ³
	1210 1812 2220	C = Standard	2 significant digits + number of zeros	K = ±10% M = ±20%	8 = 10 V 4 = 16 V 3 = 25 V 5 = 50 V 1 = 100 V A = 250 V	R = X7R	1 = KPS Single Chip Stack 2 = KPS Double Chip Stack	C = 100% Matte Sn	7186 = 7" Reel Unmarked 7289 = 13" Reel Unmarked

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.

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



Dimensions – Millimeters (Inches)



-LW

-LW

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)	

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

Pb-Free and RoHS Compliant.




Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +125°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit @ 25°C	5%(10 V), 3.5%(16 V and 25 V) and 2.5%(50 V to 250 V)
Insulation Resistance (IR) Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ±5 seconds @ 25°C)

Regarding aging rate: Capacitance measurements (including tolerance) are indexed to a referee time of 48 or 1,000 hours. Please refer to a part number specific datasheet for referee time details.

To obtain IR limit, divide $M\Omega$ - 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 μF

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

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

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
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 C2220C476M3R2C



Z and ESR C2220C225MAR2C





Electrical Characteristics cont'd

ESR – 1812, .10 µF, 50 V X7R



ESR – 1210, .22 μF , 50 V X7R



Impedance - 1812, .10 µF, 50 V X7R



Impedance – 1210, .22 $\mu\text{F},$ 50 V X7R





Electrical Characteristics cont'd

Microphonics – 1210, 4.7 μ F, 50 V, X7R



Microphonics – 2220, 47 μF , 25 V, X7R



Competitive Comparision

Microphonics - 1210, 4.7 µF, 50 V, X7R



Microphonics – 2220, 22 μ F, 50 V, X7R



Microphonics – 1210, 22 μF , 25 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 Flexure to 10 mm



Board Flex vs. Termination Type



Board Flexure to 10 mm





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

		Case Siz	e / Series			C1	210C			C1812C					C	2220	С		
	Can	Voltag	e Code	8	4	3	5	1	A	4	3	5	1	A	4	3	5	1	A
Capacitance	Code	Rated Volt	tage (VDC)	10	16	25	50	100	250	16	25	50	100	250	16	25	50	100	250
		Capacitanc	e Tolerance					Рі	oduct A See Tab	vailabi le 2 for	lity an Chip 1	d Chip Fhickn	Thickn ess Din	ess Cod nensions	les s				
						Sin	gle C	hip St	tack										
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	К	M	FV	FV	FV	FV	FV		GP	GP	GP	GP	GP	JP	JP	JP	JP	JP
0.47 µF	474	К	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	К	M	FV	FV	FV	FV			GP	GP	GP			JP	JP	JP	JP	
4.7 µF	475	К	M	FV	FV	FV	FV			GP	GP	GP			JP	JP	JP		
10 µF	106	К	M	FV	FV	FV				GP	GP				JP	JP	JP		
15 µF	156	К	M	FV											JP	JP			
22 µF	226	K	M	FV											JP	JP			
33 µF	336	K	M																
47 µF	476	K	M																
100 µF	107	K	M																
						Doι	uble (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			
100 µF	107		М																
220 µF	227		м																
		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	A	4	3	5	1	A	4	3	5	1	A
Capacitance	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/Packaging Quantities

Thickness	Case	Thickness ±	Thickness ± Paper 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	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.



EIA SIZE	METRIC SIZE	Median (Nominal) Land Protrusion								
CODE	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				



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_{min} to T_{max})	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:
Colderability		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 @ 250°C
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +125°C). Measurement at 24 hours +/- 2 hours after test conclusion.
Discod Humidity		Load Humidity: 1,000 hours 85°C/85% RH and 200 VDC maximum. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Blased 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.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air-Air.
High Temperature Life	MIL-STD-202 Method 108	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 .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

Reference	ltem	Material
А	Leadframe	Phosphor Bronze – Alloy 510
В	Leadframe Attach	HMP Solder
С		Cu
D	Termination	Ni
E		Sn
F	Inner Electrode	Ni
G	Dielectric Material	BaTiO ₃



Note: Image is exaggerated in order to clearly identify all components of construction. HMP = High Melting Point

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.



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. 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°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.

KEMET's KPS Series devices in X7R dielectric exhibit a

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 $\pm 10\%$ and $\pm 20\%$
- · 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
- Pb-Free and RoHS Compliant
- · Capable of Pb-Free reflow profiles
- Non-polar device, minimizing installation concerns
- Film alternative



Ordering Information

С	2220	С	105	Μ	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) ³
	2220	C = Standard	2 significant digits + number of zeros.	K = ±10% M = ±20%	C = 500 V B = 630 V	R = X7R	1 = KPS Single Chip Stack 2 = KPS Double Chip Stack	C = 100% Matte Sn	7186 = 7" Reel Unmarked 7289 = 13" Reel Unmarked

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.

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



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)	Colder Deflow 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 Reliow 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 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

Pb-Free and RoHS Compliant.



Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +125°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
Dielectric Withstanding Voltage (DWV)	150% of rated voltage for voltage rating of < 1,000 V 120% of rated voltage for voltage rating of \ge 1,000 V (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	See Insulation Resistance Limit Table (500 VDC applied for 120 ±5 seconds @ 25°C)

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

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

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

1 kHz ±50 Hz and 1.0 ±0.2 Vrms if capacitance \leq 10 μ F

120 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."

Post Environmental Limits

High Temperature Life, Biased Humidity, Moisture Resistance								
Dielectric Rated DC Voltage Capacitance Value Dissipation Factor (Maximum %) Capacitance Shift Instance Res								
X7R	> 25		3.0		10% of Initial Limit			
	16/25	All	5.0	±20%				
	< 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 Size / 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	М	JP	JP		
0.10 µF	104	К	М	JP	JP		
0.15 µF	154	K	М	JP	JP		
0.22 µF	224	К	М	JP	JP		
0.33 µF	334	K	М	JP			
0.47 µF	474	K M		JP			
		Double	Chip Stac	k			
0.10 µF	104		М	JR	JR		
0.22 µF	224		М	JR	JR		
0.33 µF	334		M	JR	JR		
0.47 µF	474		М	JR	JR		
0.68 µF	664		M	JR			
1.0 µF	105		M	JR			
		Rated Volt	age (VDC)	500	630	1000	
Capacitance	Capacitance	Voltag	e Code	С	В	D	
	Code	Case Siz	Case Size / Series		C2220C		

Table 2 – Chip Thickness/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 Patterr	n Design Recommendations (r	nm)
----------------------------	-----------------------------	-----

EIA SIZE	METRIC SIZE	Median (Nominal) Land Protrusio				
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



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_{min} to T_{max})	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:
Calderahility		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 @ 250°C
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +125°C). Measurement at 24 hours +/- 2 hours after test conclusion.
-	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 +/- 2 hours after test conclusion.
Blased Humidity		Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air-Air.
High Temperature Life	MIL-STD-202 Method 108	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

Reference	ltem	Material
A	Leadframe	Phosphor Bronze – Alloy 510
В	Leadframe Attach	HMP Solder
С		Cu
D	Termination	Ni
E		Sn
F	Inner Electrode	Ni
G	Dielectric Material	BaTiO ₃



Note: Image is exaggerated in order to clearly identify all components of construction. HMP = High Melting Point

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 VDC – 50 VDC (Commercial & Automotive Grade)

Electronic Components

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 \pm 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 $\pm 10\%$ and $\pm 20\%$
- · 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
- Pb-Free and RoHS Compliant
- · Capable of Pb-Free reflow profiles
- Non-polar device, minimizing installation concerns
- Tantalum and electrolytic alternative
- Commercial & Automotive (AEC-Q200) grades available



Ordering Information

С	2220	С	476	М	4	Ν	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	Packaging/Grade (C-Spec)
	1210 2220	C = Standard	2 significant digits + number of zeros.	K = ±10% M = ±20%	8 = 10 V 4 = 16 V 3 = 25 V 5 = 50 V	N = X8L	1 = KPS Single Chip Stack 2 = KPS Double Chip Stack	C = 100% Matte Sn	7186 = 7" Reel Unmarked 7289 = 13" Reel Unmarked AUTO = Automotive Grade 7" Reel Unmarked AUTO7289 = Automotive Grade 13" Reel Unmarked

¹ Double chip stacks ("2" in the 13th character position of the ordering code) are only available in M (±20%) capacitance tolerance.

CC101_COMM_SMD • 11/25/2013 305



Dimensions – Millimeters (Inches)



Chip Stack	EIA Size Code	Metric Size Code	L Length	W Width	H Height	LW Lead Width	Mounting Technique
Single	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
Double	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)	

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

Pb-Free and RoHS Compliant.



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)
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 @ 25°C	3.5% (10 V and 16 V) and 2.5% (25 V and 50 V)
Insulation Resistance (IR) 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.

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

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

1 kHz \pm 50 Hz and 1.0 \pm 0.2 Vrms.

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		3.0						
X8L	16 / 25	All	5.0	±20%	10% of Initial Limit				
	10		7.5						



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

C			Size / S	Series			C12	10C					C22	20C		
Canacitance	Сар	v.	oltage Co	de	8	4	3	5	1	Α	8	4	3	5	1	Α
Capacitance	Code	Rateo	d Voltage	(VDC)	10	16	25	50	100	250	10	16	25	50	100	250
		Capac	itance Tol	erance		Produ	ct Availab	ility and C	hip Thickn	iess Code	s – See Ta	ble 2 for C	hip Thickr	ness Dime	nsions	
						Single	e Chip	Stack								
0.47 µF	474		K	M	FV	FV	FV	FV								
1.0 µF	105		K	М	FV	FV	FV	FV								
2.2 µF	225		K	М	FV	FV	FV				JP	JP	JP			
3.3 µF	335		K	М	FV	FV	FV				JP	JP	JP			
4.7 µF	475		K	М	FV	FV	FV				JP	JP	JP			
10 µF	106		К	М							JP	JP	JP			
15 µF	156		К	М							JP					
22 µF	226		K	М							JP					
						Doubl	e Chip	Stack								
1.0 µF	105			M	FW	FW	FW	FW								
2.2 µF	225			М	FW	FW	FW	FW								
3.3 µF	335			М	FW	FW	FW									
4.7 µF	475			М	FW	FW	FW				JR	JR	JR			
10 µF	106			М	FW	FW	FW				JR	JR	JR			
22 µF	226			М							JR	JR	JR			
33 µF	336			М							JR					
47 µF	476			М							JR					
	Rated Voltage (VDC)		10	16	25	50	100	250	10	16	25	50	100	250		
Capacitance	Сар	V	oltage Co	de	8	4	3	5	1	Α	8	4	3	5	1	Α
Cupuonanoo	Code	Case	Size / S	Series			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/Packaging Quantities

Thickness	ckness 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	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			
2220	5650	2.69	2.08	4.78	7.70	6.00			



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_{min} to T_{max})	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:
Calderahilitu		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 @ 250°C
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +150°C). Measurement at 24 hours +/- 2 hours after test conclusion.
Discod Utersidite		Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Blased 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.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+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

Reference	ltem	Material
А	Leadframe	Phosphor Bronze – Alloy 510
В	Leadframe Attach	HMP Solder
С		Cu
D	Termination	Ni
E		Sn
F	Inner Electrode	Ni
G	Dielectric Material	BaTiO ₃



Note: Image is exaggerated in order to clearly identify all components of construction. HMP = High Melting Point

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, KEVE DSCC 87106, 50 – 500 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	С	Ν
Performance Specification Indicating MIL–PRF–49470 ¹	Dielectric Classification/ Characteristic ²	Performance Specification Sheet Number (Indicating MIL–PRF–49470/1) ³	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Lead Configuration⁴
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	2 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.

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.

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	Ν	30	С	106	K	S	12	
Product Family ¹	Dielectric Classification/ Characteristic ²	Lead Configuration ³	Case Size / Case Code (CC)	Rated Voltage (VDC)	Capacitance Code (pF)	Capacitance Tolerance	Testing Option ⁴	Maximum Dimensio	Height n (in.)⁵
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"	30 = CC 3 40 = CC 4 50 = CC 5	3 = 25 5 = 50 1 = 100 2 = 200 C = 500 B = 630 D = 1,000	2 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.

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

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.



Construction



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

Reference	ltem	Material			
A	Leadframe	Phosphor Bror	nze – 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	PdAg			
G	Dielectric	Baī	-iO ³		
Н	Lead Solder	Sn60,	Pb40		
J	Enconculation ²	Molding C	Compound		
К		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		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 Min. (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)
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	4	
5	0.250 (6.35)	0.355 (9.02)	0.355 (9.02)	unitension	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 Min. (6.35)
L	(I) Formed	0.070 ± 0.010 (1.78 ±0.25)
М	(L) Formed	0.045 ± 0.010 (1.14 ±0.25)
J	(I) Formod	0.070 ± 0.010 (1.78 ±0.25)
K	(J) Formed	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					
Grou	III qu					
Low temperature storage	4.8.23					
Barometric pressure	4.8.9					
Terminal strength	4.8.10					
Grou	אר 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	ıp VI					
DPA (T level only)	4.8.19					
Grou	ip 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 @ 25°C	2.5%
Insulation Resistance (IR) Limit @ 25°C	1,000 megohm microfarads (minimum) or 100 G Ω
Insulation Resistance (IR) Limit @ 125°C	100 megohm microfarads (minimum) or 10 G Ω

Regarding aging rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours. To obtain IR limit, divide $M\Omega_{-\mu}F$ value by the capacitance and compare to $G\Omega$ limit. Select the lower of the two limits.

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

1 kHz ±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 @ 25°C	2.5%
Insulation Resistance (IR) Limit @ 25°C	1,000 megohm microfarads (minimum) or 100 G Ω
Insulation Resistance (IR) Limit @ 125°C	100 megohm microfarads (minimum) or 10 G Ω

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 @ 25°C	2.5%
Insulation Resistance (IR) Limit @ 25°C	1000 megohm microfarads (minimum) or 100 G Ω
Insulation Resistance (IR) Limit @ 125°C	100 megohm microfarads (minimum) or 10 G Ω

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 @ 25°C	3.5% (25 V) and 2.5% (50 V to 200 V)
Insulation Resistance (IR) Limit @ 25°C	1,000 megohm microfarads or 100 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 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 μ 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						
	Capacitance	Case	Height A	Capacitance	Lead	
MIL-PRF-49470 P/N ¹	(uF)	Code	inch (mm)	Tolerance	Configuration	KEMET P/N ⁻¹
	(Pri /	oouc		Tororanoc	oomigurution	
		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) (1)40470X01275(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) (1)49470X01335(2)A(3)	2.7	5	0.360 (9.14)	K, M	N, L, WI, J, K	L1X(3)505275(2)(4)36
(1)49470X01355(2)A(3) (1)49470X01475(2)A(3)	3.3	5	0.300 (9.14)	K, W		11X(3)505355(2)(4)30
(1)49470X01473(2)A(3)	3.9	5	0.480 (12.13)	K M	NIMIK	11X(3)505395(2)(4)48
(1)49470X01565(2)A(3)	5.6	5	0.650 (16.51)	K M	NIMJK	11X(3)505565(2)(4)65
(1)49470X01685(2)A(3)	6.8	4	0.360 (9.14)	К. М	N. L. M. J. K	L1X(3)405685(2)(4)36
(1)49470X01825(2)A(3)	8.2	4	0.360 (9.14)	K, M	N, L, M, J, K	L1X(3)405825(2)(4)36
(1)49470X01106(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)	К, М	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)	К, М	N, L, M, J, K	L1X(3)305186(2)(4)24
(1)49470X01226(2)A(3)	22	3	0.360 (9.14)	К, М	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)	К, М	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)	К, М	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)	К, М	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)	К, М	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)40470X04495(0)B(3)	1.5	5	0.360 (9.14)	K, M	N, L, M, J, K	L1X(3)501155(2)(4)36
(1)49470X01105(2)B(3) (1)40470X01225(2)B(3)	1.0	5	0.300 (9.14)	K, W	N, L, WI, J, K	L1X(3)501105(2)(4)30
(1)49470X01225(2)B(3)	2.2	5	0.400 (12.19)	K M		112(3)501225(2)(4)40
(1)49470X01275(2)B(3)	3.3	5	0.650 (16.51)	K M	NIMIK	11X(3)501275(2)(4)65
(1)49470X01395(2)B(3)	3.9	4	0.360 (9.14)	K M	NIMJK	11X(3)401395(2)(4)36
(1)49470X01475(2)B(3)	4.7	4	0.360 (9.14)	K, M	N. L. M. J. K	L1X(3)401475(2)(4)36
(1)49470X01565(2)B(3)	5.6	4	0.480 (12.19)	К, М	N, L, M, J, K	L1X(3)401565(2)(4)48
(1)49470X01685(2)B(3)	6.8	4	0.480 (12.19)	K, M	N, L, M, J, K	L1X(3)401685(2)(4)48
(1)49470X01825(2)B(3)	8.2	4	0.650 (16.51)	К, М	N, L, M, J, K	L1X(3)401825(2)(4)65
(1)49470X01106(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)	К, М	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)	К, М	N, L, M, J, K	L1X(3)301276(2)(4)65
		200 V	DC – BR Dielec	tric		
(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)	К, М	N, L, M, J, K	L1R(3)502564(2)(4)24
(1)49470R01684(2)C(3)	0.68	5	0.360 (9.14)	К, М	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)	К, М	N, L, M, J, K	L1R(3)402395(2)(4)65
(1)49470R01475(2)C(3)	4.7	3	0.240 (6.10)	К, М	N, L, M, J, K	L1R(3)302475(2)(4)24
(1)49470R01565(2)C(3)	5.6	3	0.240 (6.10)	К, М	N, L, M, J, K	L1R(3)302565(2)(4)24
(1)49470R01685(2)C(3)	6.8	3	0.360 (9.14)	К, М	N, L, M, J, K	L1R(3)302685(2)(4)36
(1)49470R01825(2)C(3)	8.2	3	0.360 (9.14)	К, М	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 V	DC – BQ Dielec	tric		
(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)	К, М	N, L, M, J, K	L1Q(3)50C224(2)(4)24
(1)49470Q01274(2)E(3)	0.27	5	0.240 (6.10)	К, М	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)	К, М	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)	К, М	N, L, M, J, K	L1Q(3)40C105(2)(4)36
(1)49470Q01125(2)E(3)	1.2	4	0.360 (9.14)	К, М	N, L, M, J, K	L1Q(3)40C125(2)(4)36
(1)49470Q01155(2)E(3)	1.5	4	0.480 (12.19)	К, М	N, L, M, J, K	L1Q(3)40C155(2)(4)48
(1)49470Q01185(2)E(3)	1.8	4	0.650 (16.51)	К, М	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 \	/DC – BX Dieleo	ctric			
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)	К, М	N, L, M, J, K	L2X(2)505155(1)B39	
M49470X02185(1)A(2)	1.8	5	0.390 (9.91)	К, М	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	0.530 (13.46)	K, M	N, L, M, J, K	L2X(2)505275(1)B53	
M49470X02335(1)A(2)	3.3	5	0.530 (13.46)	K, M	N, L, M, J, K	L2X(2)505335(1)B53	
M49470X02475(1)A(2) M49470X02395(1)A(2)	3.9 4.7	5	0.660 (16.76)	K, WI	N, L, W, J, K	L2X(2)5053475(1)B66	
M49470X02565(1)A(2)	5.6	5	0 800 (20 32)	K M	NIMJK	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)	К, М	N, L, M, J, K	L2X(2)405825(1)B53	
M49470X02106(1)A(2)	10	4	0.660 (16.76)	К, М	N, L, M, J, K	L2X(2)405106(1)B66	
M49470X02126(1)A(2)	12	4	0.660 (16.76)	К, М	N, L, M, J, K	L2X(2)405126(1)B66	
M49470X02156(1)A(2)	15	4	0.800 (20.32)	К, М	N, L, M, J, K	L2X(2)405156(1)B80	
M49470X02186(1)A(2)	18	3	0.390 (9.91)	К, М	N, L, M, J, K	L2X(2)305186(1)B39	
M49470X02226(1)A(2)	22	3	0.530 (13.46)	К, М	N, L, M, J, K	L2X(2)305226(1)B53	
M49470X02276(1)A(2)	27	3	0.530 (13.46)	К, М	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)	39	3	0.660 (16.76)	K, M	N, L, M, J, K	L2X(2)305396(1)B66	
M49470X02476(1)A(2)	47	3	0.800 (20.32)	К, М	IN, L, IVI, J, K	L2X(2)305476(1)B80	
		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)	К, М	N, L, M, J, K	L2X(2)501824(1)B39	
M49470X02105(1)B(2)	1	5	0.390 (9.91)	К, М	N, L, M, J, K	L2X(2)501105(1)B39	
M49470X02125(1)B(2)	1.2	5	0.390 (9.91)	К, М	N, L, M, J, K	L2X(2)501125(1)B39	
M49470X02155(1)B(2)	1.5	5	0.530 (13.46)	К, М	N, L, M, J, K	L2X(2)501155(1)B53	
M49470X02185(1)B(2)	1.8	5	0.530 (13.46)	К, М	N, L, M, J, K	L2X(2)501185(1)B53	
M49470X02225(1)B(2)	2.2	5	0.660 (16.76)	К, М	N, L, M, J, K	L2X(2)501225(1)B66	
M49470X02275(1)B(2) M49470X02335(1)B(2)	2.7	5	0.000 (10.70)	K, M	N, L, M, J, K	L2X(2)501275(1)B00	
M49470X02335(1)B(2) M40470X02305(1)B(2)	3.0	5	0.600 (20.32)	K, W	N, L, IVI, J, K		
M49470X02393(1)B(2) M49470X02475(1)B(2)	47	4	0.530 (13.46)	K, M	N, L, W, J, K	L 2X(2)401355(1)B53	
M49470X02565(1)B(2)	5.6	4	0.660 (16.76)	К,М	NIMJK	12X(2)401470(1)866	
M49470X02685(1)B(2)	6.8	4	0.660 (16.76)	К, М	N. L. M. J. K	L2X(2)401685(1)B66	
M49470X02825(1)B(2)	8.2	4	0.800 (20.32)	К, М	N, L, M, J, K	L2X(2)401825(1)B80	
M49470X02106(1)B(2)	10	3	0.390 (9.91)	К, М	N, L, M, J, K	L2X(2)301106(1)B39	
M49470X02126(1)B(2)	12	3	0.390 (9.91)	К, М	N, L, M, J, K	L2X(2)301126(1)B39	
M49470X02156(1)B(2)	15	3	0.530 (13.46)	К, М	N, L, M, J, K	L2X(2)301156(1)B53	
M49470X02186(1)B(2)	18	3	0.530 (13.46)	К, М	N, L, M, J, K	L2X(2)301186(1)B53	
M49470X02226(1)B(2)	22	3	0.660 (16.76)	К, М	N, L, M, J, K	L2X(2)301226(1)B66	
M49470X02276(1)B(2)	27	3	0.800 (20.32)	К, М	N, L, M, J, K	L2X(2)301276(1)B80	
	200 VDC – BR Dielectric						
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)	К, М	N, L, M, J, K	L2R(2)502564(1)B39	
M49470R02684(1)C(2)	0.68	5	0.530 (13.46)	К, М	N, L, M, J, K	L2R(2)502684(1)B53	
M49470R02824(1)C(2)	0.82	5	0.530 (13.46)	К, М	N, L, M, J, K	L2R(2)502824(1)B53	
M49470R02105(1)C(2)	1	5	0.660 (16.76)	К, М	N, L, M, J, K	L2R(2)502105(1)B66	
M49470R02125(1)C(2)	1.2	5	0.660 (16.76)	К, М	N, L, M, J, K	L2R(2)502125(1)B66	
M49470R02155(1)C(2)	1.5	5	0.800 (20.32)	К, М	N, L, M, J, K	L2R(2)502155(1)B80	
M49470R02185(1)C(2)	1.8	4	0.530 (13.46)	K, M	N, L, M, J, K	L2R(2)402185(1)B53	
M49470R02225(1)C(2)	2.2	4	0.530 (13.46)	K, M	N, L, M, J, K	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)	К, М	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)	К, М	N, L, M, J, K	L2R(2)302475(1)B39	
M49470R02565(1)C(2)	5.6	3	0.390 (9.91)	К, М	N, L, M, J, K	L2R(2)302565(1)B39	
M49470R02685(1)C(2)	6.8	3	0.530 (13.46)	К, М	N, L, M, J, K	L2R(2)302685(1)B53	
M49470R02825(1)C(2)	8.2	3	0.530 (13.46)	К, М	N, L, M, J, K	L2R(2)302825(1)B53	
M49470R02106(1)C(2)	10	3	0.660 (16.76)	К, М	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)	К, М	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)	К, М	N, L, M, J, K	L2Q(2)50C274(1)B39	
M49470Q02334(1)E(2)	0.33	5	0.530 (13.46)	К, М	N, L, M, J, K	L2Q(2)50C334(1)B53	
M49470Q02394(1)E(2)	0.39	5	0.530 (13.46)	К, М	N, L, M, J, K	L2Q(2)50C394(1)B53	
M49470Q02474(1)E(2)	0.47	5	0.530 (13.46)	К, М	N, L, M, J, K	L2Q(2)50C474(1)B53	
M49470Q02564(1)E(2)	0.56	5	0.660 (16.76)	К, М	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)	К, М	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)	К, М	N, L, M, J, K	L2Q(2)40C185(1)B80	
M49470Q02225(1)E(2)	2.2	3	0.390 (9.91)	К, М	N, L, M, J, K	L2Q(2)30C225(1)B39	
M49470Q02275(1)E(2)	2.7	3	0.530 (13.46)	К, М	N, L, M, J, K	L2Q(2)30C275(1)B53	
M49470Q02335(1)E(2)	3.3	3	0.530 (13.46)	К, М	N, L, M, J, K	L2Q(2)30C335(1)B53	
M49470Q02395(1)E(2)	3.9	3	0.530 (13.46)	К, М	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

Commercial/Non-Standard – Customer Specific Unencapsulated, Horizontally Stacked					
KEMET P/N ¹	Capacitance (µF)	Case Code	Height A inch (mm)	Capacitance Tolerance	Lead Configuration
25 VDC – BX Dielectric					
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)	К, М	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)	К, М	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
LIX(1)003335(2)(3)30	3.3	5	0.300 (9.14)	K, WI	IN, L, IVI, J, K
L1X(1)405395(2)(3)12 L1X(1)503395(2)(3)36	3.9	4	0.120 (3.03)	K, W	N, L, WI, J, K
11X(1)403475(2)(3)12	17	1	0.300 (9.14)	K, M	
11X(1)503475(2)(3)36	4.7	5	0.360 (9.14)	K M	NIMIK
11X(1)403565(2)(3)24	5.6	4	0 240 (6 10)	КМ	NIMJK
L1X(1)503565(2)(3)48	5.6	5	0.480 (12.19)	К. М	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	0.120 (3.05)	К, М	N, L, M, J, K
L1X(1)403685(2)(3)24	6.8	4	0.240 (6.10)	K, M	N, L, M, J, K
L1X(1)503685(2)(3)65	6.8	5	0.650 (16.51)	K, M	N, L, M, J, K
L1X(1)403755(2)(3)24	7.5	4	0.240 (6.10)	K, M	N, L, M, J, K
L1X(1)503755(2)(3)65	7.5	5	0.650 (16.51)	К, М	N, L, M, J, K
L1X(1)303825(2)(3)12	8.2	3	0.120 (3.05)	K, M	N, L, M, J, K
L1X(1)403825(2)(3)24	8.2	4	0.240 (6.10)	K, M	N, L, M, J, K
L1X(1)303106(2)(3)12	10	3	0.120 (3.05)	К, М	N, L, M, J, K
L1X(1)403106(2)(3)24	10	4	0.240 (6.10)	K, M	N, L, M, J, K
LIX(1)303116(2)(3)12	10	3	0.120 (3.05)	K, M	N, L, M, J, K
L1X(1)303120(2)(3)12	12	3	0.120 (3.05)	K, IVI	IN, L, IVI, J, K
L1X(1)403120(2)(3)30	12	4	0.300 (9.14)	K M	
11X(1)403156(2)(3)36	15	4	0.360 (9.14)	K M	NIMJK
11X(1)303166(2)(3)24	16	3	0 240 (6 10)	K, M	N I M J K
L1X(1)403166(2)(3)48	16	4	0.480 (12.19)	К. М	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)	К, М	N, L, M, J, K
L1X(1)303206(2)(3)24	20	3	0.240 (6.10)	К, М	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)	К, М	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)	К, М	N, L, M, J, K
L1X(1)303306(2)(3)36	30	3	0.360 (9.14)	К, М	N, L, M, J, K
L1X(1)303330(2)(3)30	33	3	0.360 (9.14)	K, M	N, L, M, J, K
LIN(1)303350(2)(3)30	59 15	3 2	0.300 (9.14)	к, M	N, L, IVI, J, K
L1X(1)303+30(2)(3)30	40	3	0.300 (9.14)	K M	N, L, WI, J, K N I M I K
11X(1)303546(2)(3)48	54	3	0.480 (12.13)	K M	NIMIK
L1X(1)303606(2)(3)48	60	3	0.480 (12 19)	K, M	N. L. M. J. K
L1X(1)303666(2)(3)65	66	3	0.650 (16.51)	К, М	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 25 – 50 VDC cont'd

Commercial/Non-S	tandard – Cust	omer Specific	Unencapsulate	d, Horizontally	Stacked				
	Capacitance		Height A inch	Capacitance	Lead				
KEMET P/N ⁻¹	(uF)	Case Code	(mm)	Tolerance	Configuration				
L1X(1)303726(2)(3)65	72	3	0 650 (16 51)	КМ	N I M J K				
L1X(1)303756(2)(3)65	75	3	0.650 (16.51)	К, М	N, L, M, J, K				
50 VDC – BX Dielectric									
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)	К, М	N, L, M, J, K				
L1X(1)505155(2)(3)12	1.5	5	0.120 (3.05)	К, М	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 N L M L K				
L1X(1)505225(2)(3)24	2.2	5	0.240 (0.10)	K, M	N, L, WI, J, K				
11X(1)405275(2)(3)24	2.5	4	0.120 (3.05)	K M	NIMIK				
L1X(1)505275(2)(3)24	2.7	5	0.240 (6.10)	К, М	N, L, M, J, K				
L1X(1)505275(2)(3)36	2.7	5	0.360 (9.14)	К. М	N, L, M, J, K				
L1X(1)405335(2)(3)12	3.3	4	0.120 (3.05)	K, M	N, L, M, J, K				
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)	К, М	N, L, M, J, K				
L1X(1)405475(2)(3)12	4.7	4	0.120 (3.05)	К, М	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	5.0	4	0.240 (6.10)	K, M	N, L, M, J, K				
L1X(1)202202(2)(3)48	5.0	D A	0.480 (12.19)	K, IVI	N, L, M, J, K				
L1X(1)405005(2)(5)24	6	4	0.240 (0.10)	K, IVI	N, L, WI, J, K				
L1X(1)305685(2)(3)40	68	3	0.120 (3.05)	K M	NIMIK				
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)	К, М	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)	К, М	N, L, M, J, K				
L1X(1)305825(2)(3)12	8.2	3	0.120 (3.05)	К, М	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)	К, М	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	12	3	0.120 (3.05)	K, W	N, L, W, J, K				
L1X(1)305126(2)(3)12	12	<u>з</u>	0.120 (3.03)	K, WI	N, L, W, J, K				
11X(1)305156(2)(3)12	15	3	0 120 (3 05)	K M	N, L, M, J, K				
L1X(1)405156(2)(3)36	15	4	0.360 (9.14)	К. М	N, L, M, J, K				
L1X(1)305166(2)(3)24	16	3	0.240 (6.10)	К, М	N, L, M, J, K				
L1X(1)405166(2)(3)48	16	4	0.480 (12.19)	К, М	N, L, M, J, K				
L1X(1)305186(2)(3)24	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				
LIN(I)403220(2)(3)03	22	4 A	0.650 (16.51)	r, M K M	N, L, IVI, J, K				
11X(1)305276(2)(3)24	24	3	0.000 (10.01)	K M	N, ∟, WI, J, K N I M I 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)	К, М	N, L, M, J, K				
L1X(1)305506(2)(3)48	50	3	0.480 (12.19)	К, М	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".



Table 1C – Commercial/Non-Standard – Product Selection 50 – 100 VDC cont'd

Commercial/Non-St	tandard – Cust	omer Specific	Unencapsulate	d, Horizontally	Stacked
	Capacitance		Height A inch	Capacitance	Lead
KEMET P/N ⁺	(uE)	Case Code	(mm)	Tolerance	Configuration
117(1)305546(2)(3)48	(M)	3	0.480 (12.10)	K M	
11X(1)305606(2)(3)48	60 60	3	0.480 (12.19)	K, M	N, L, W, J, K N I M J K
L1X(1)305666(2)(3)65	66	3	0.650 (16.51)	К. М	N, L, M, J, K
L1X(1)305726(2)(3)65	72	3	0.650 (16.51)	К. М	N, L, M, J, K
L1X(1)305756(2)(3)65	75	3	0.650 (16.51)	К, М	N, L, M, J, K
, , , , , , , , , , , , , , , , ,		100 VDC – BR Dieleo	tric		
L1R(1)501564(2)(3)12	0.56	5	0.120 (3.05)	К, М	N, L, M, J, K
L1R(1)501684(2)(3)12	0.68	5	0.120 (3.05)	К, М	N, L, M, J, K
L1R(1)501754(2)(3)12	0.75	5	0.120 (3.05)	К, М	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)	К, М	N, L, M, J, K
L1R(1)501125(2)(3)12	1.2	5	0.120 (3.05)	К, М	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)	К, М	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
LIR(1)401225(2)(3)12	2.2	4	0.120 (3.05)	K, M	N, L, M, J, K
LIR(1)501225(2)(3)24	2.2	5	0.240 (0.10)	K, W	N, L, WI, J, K
LIR(1)301235(2)(3)24	2.5	5	0.240 (0.10)	K, M	N, L, WI, J, K
L1R(1)501275(2)(3)36	2.7	5	0.120 (0.00)	K M	N, L, M, J, K
L 1R(1)401335(2)(3)12	2.7	4	0.300 (3.14)	K M	NIMIK
L1R(1)501335(2)(3)36	3.3	5	0.360 (9.14)	K M	N, L, M, U, 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)	К, М	N, L, M, J, K
L1R(1)401475(2)(3)24	4.7	4	0.240 (6.10)	К. М	N, L, M, J, K
L1R(1)501475(2)(3)48	4.7	5	0.480 (12.19)	К, М	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)	К, М	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)301685(2)(3)12	6.8	3	0.120 (3.05)	K, M	N, L, M, J, K
L1R(1)401685(2)(3)24	6.8	4	0.240 (6.10)	K, M	N, L, M, J, K
L1R(1)401755(2)(3)24	7.5	4	0.240 (6.10)	К, М	N, L, M, J, K
L1R(1)301825(2)(3)12	8.2	3	0.120 (3.05)	К, М	N, L, M, J, K
L1R(1)401825(2)(3)36	8.2	4	0.360 (9.14)	К, М	N, L, M, J, K
L1R(1)301106(2)(3)12	10	3	0.120 (3.05)	K, M	N, L, M, J, K
LIR(1)401100(2)(3)30	10	4	0.300 (9.14)	K, IVI	N, L, WI, J, K
LIR(1)301110(2)(3)12	12	3	0.120 (3.03)	K, IVI	N, L, WI, J, K
LIT(1)301120(2)(3)24	12	1	0.240 (0.10)	K M	N, L, W, J, K
I 1R(1)301156(2)(3)24	15	3	0.240 (6.10)	K M	NIMIK
L1R(1)401156(2)(3)48	15	4	0 480 (12 19)	K M	NIMJK
L1R(1)301166(2)(3)24	16	3	0.240 (6.10)	К. М	N, L, M, J, K
L1R(1)401166(2)(3)65	16	4	0.650 (16.51)	К, М	N, L, M, J, K
L1R(1)301186(2)(3)24	18	3	0.240 (6.10)	К, М	N, L, M, J, K
L1R(1)401186(2)(3)65	18	4	0.650 (16.51)	К, М	N, L, M, J, K
L1R(1)301206(2)(3)24	20	3	0.240 (6.10)	К, М	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)	К, М	N, L, M, J, K
L1R(1)301306(2)(3)36	30	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".



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	(uF)	Case Code	(mm)	Tolerance	Configuration				
L1R(1)301336(2)(3)48	33	3	0.480 (12.19)	К. М	N. L. M. J. K				
L1R(1)301396(2)(3)48	39	3	0.480 (12.19)	К, М	N, L, M, J, K				
L1R(1)301456(2)(3)65	45	3	0.650 (16.51)	К, М	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 Dielectric									
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)	К, М	N, L, M, J, K				
L1Q(1)502474(2)(3)12	0.47	5	0.120 (3.05)	К, М	N, L, M, J, K				
L1Q(1)502564(2)(3)12	0.56	5	0.120 (3.05)	К, М	N, L, M, J, K				
L1Q(1)502684(2)(3)12	0.68	5	0.120 (3.05)	К, М	N, L, M, J, K				
L1Q(1)502754(2)(3)12	0.75	5	0.120 (3.05)	К, М	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	D A	0.240 (0.10)	K, IVI	N, L, M, J, K				
LIQ(1)402105(2)(5)12	1	4	0.120 (3.03)	K, IVI	IN, L, IVI, J, K				
110(1)402125(2)(3)24	12	3	0.240 (0.10)	K, M	N, L, WI, J, K				
110(1)502125(2)(3)12	1.2	5	0.120 (5.05)	K M					
110(1)402155(2)(3)12	1.2	4	0.120 (3.05)	K M	NIMIK				
110(1)502155(2)(3)36	1.5	5	0.360 (9.14)	K, M	NIMIK				
110(1)402185(2)(3)12	1.0	4	0 120 (3 05)	КМ	NIMJK				
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)	К. М	N. L. M. J. K				
L1Q(1)502225(2)(3)48	2.2	5	0.480 (12.19)	К. М	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)	К, М	N, L, M, J, K				
L1Q(1)402275(2)(3)24	2.7	4	0.240 (6.10)	К, М	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)	К, М	N, L, M, J, K				
L1Q(1)402335(2)(3)24	3.3	4	0.240 (6.10)	К, М	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)	К, М	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)	К, М	N, L, M, J, K				
L1Q(1)302475(2)(3)12	4.7	3	0.120 (3.05)	К, М	N, L, M, J, K				
L1Q(1)402475(2)(3)36	4.7	4	0.360 (9.14)	К, М	N, L, M, J, K				
LIQ(1)302505(2)(3)12	5.0	3	0.120 (3.05)	K, M	N, L, M, J, K				
LIQ(1)402505(2)(5)50	5.0	4	0.300 (9.14)	K, W	N, L, WI, J, K				
110(1)402605(2)(3)12	6	3	0.120 (3.03)	K, M	N, L, WI, J, K				
L1Q(1)402003(2)(3)30	68	3	0.240 (6.10)	K M	N, L, M, J, K				
110(1)402685(2)(3)48	6.8	4	0.480 (12.19)	K M	NIMIK				
110(1)402755(2)(3)48	7.5	4	0 480 (12 19)	K M	NIMJK				
L1Q(1)302825(2)(3)24	8.2	3	0.240 (6.10)	К. М	N, L, M, J, K				
L1Q(1)402825(2)(3)65	8.2	4	0.650 (16.51)	К. М	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)	К, М	N, L, M, J, K				
L1Q(1)302116(2)(3)24	11	3	0.240 (6.10)	К, М	N, L, M, J, K				
L1Q(1)302126(2)(3)36	12	3	0.360 (9.14)	К, М	N, L, M, J, K				
L1Q(1)302156(2)(3)36	15	3	0.360 (9.14)	К, М	N, L, M, J, K				
L1Q(1)302166(2)(3)36	16	3	0.360 (9.14)	К, М	N, L, M, J, K				
L1Q(1)302186(2)(3)48	18	3	0.480 (12.19)	К, М	N, L, M, J, K				
L1Q(1)302206(2)(3)48	20	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".



Table 1C – Commercial/Non-Standard – Product Selection 200 – 630 VDC cont'd

Commercial/Non-St	Commercial/Non-Standard – Customer Specific Unencapsulated, Horizontally Stacked							
KEMET P/N ¹	Capacitance (µF)	Case Code	Height A inch (mm)	Capacitance Tolerance	Lead Configuration			
L1Q(1)302226(2)(3)48	22 27	3	0.480 (12.19)	К, М К. М	N, L, M, J, K N I, M, J, K			
500 VDC – X7R Dielectric								
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, W, J, K N I M J K			
L1W(1)50C274(2)(3)12	0.27	5	0.120 (3.05)	К, М	N, L, M, J, K			
L1W(1)50C334(2)(3)24	0.33	5	0.240 (6.10)	К, М	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 K M	N, L, M, J, K			
L1W(1)50C474(2)(3)12	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)	К, М	N, L, M, J, K			
L1W(1)40C684(2)(3)12	0.68	4	0.120 (3.05)	К, М	N, L, M, J, K			
L1W(1)50C684(2)(3)36	0.68	5	0.360 (9.14)	К, М	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)40C624(2)(3)12 L1W(1)50C824(2)(3)36	0.82	4	0.120 (3.05)	K, M	N, L, W, J, K N I M J K			
L1W(1)30C105(2)(3)12	1	3	0.120 (3.05)	K, M	N, L, M, J, K			
L1W(1)40C105(2)(3)24	1	4	0.240 (6.10)	K, M	N, L, M, J, K			
L1W(1)50C105(2)(3)48	1	5	0.480 (12.19)	К, М	N, L, M, J, K			
L1W(1)30C125(2)(3)12	1.2	3	0.120 (3.05)	К, М	N, L, M, J, K			
L1W(1)40C125(2)(3)24	1.2	4	0.240 (6.10)	K, M K M	N, L, M, J, K N L M L K			
L1W(1)30C155(2)(3)12	1.2	3	0.120 (3.05)	K, M	N, L, M, J, K			
L1W(1)40C155(2)(3)24	1.5	4	0.240 (6.10)	К, М	N, L, M, J, K			
L1W(1)50C155(2)(3)65	1.5	5	0.650 (16.51)	К, М	N, L, M, J, K			
L1W(1)40C185(2)(3)36	1.8	4	0.360 (9.14)	К, М	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)30	2.2	3	0.300 (9.14)	K, M	N, L, W, J, K N I 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)	К, М	N, L, M, J, K			
L1W(1)40C335(2)(3)48	3.3	4	0.480 (12.19)	К, М	N, L, M, J, K			
L1W(1)30C305(2)(3)24	3.0 3.9	3	0.240 (6.10)	K, M	N, L, W, J, K N I M I 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)	К, М	N, L, M, J, K			
L1W(1)30C565(2)(3)24	5.6	3	0.240 (6.10)	К, М	N, L, M, J, K			
L1W(1)30C605(2)(3)24	6	3	0.240 (6.10)	К, М	N, L, M, J, K			
L1W(1)30C685(2)(3)36	0.8 8.2	3	0.360 (9.14)	K, M 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)	К, М	N, L, M, J, K			
L1W(1)30C126(2)(3)65	12	3	0.650 (16.51)	К, М	N, L, M, J, K			
		630 VDC – X7R Diele	ctric					
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)50B124(2)(3)12	0.12	5	0.120 (3.05)	K, M	N, L, M, J, K 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".



Table 1C – Commercial/Non-Standard – Product Selection 630 – 1,000 VDC cont'd

Commercial/Non-Standard – Customer Specific Unencapsulated, Horizontally Stacked								
	Capacitance		Height A inch	Capacitance	Lead			
KEMET P/N ¹	(uE)	Case Code	(mm)	Tolerance	Configuration			
11W/(1)50B154/2)/(3)12	0.15	5	0 120 (3 05)	K M	NIMIK			
L1W/(1)50B154(2)(3)12	0.13	5	0.120 (3.03)	K, M	N, L, M, J, K			
1 1W(1)30B224(2)(3)12	0.22	3	0 120 (3 05)	K M	NIMIK			
I 1W(1)40B224(2)(3)12	0.22	4	0 120 (3 05)	K M	NIMIK			
1 1W(1)50B224(2)(3)24	0.22	5	0.240 (6.10)	K M	NIMIK			
1 1W(1)50B274(2)(3)24	0.27	5	0.240 (6.10)	K M	N I M J K			
11W(1)30B334(2)(3)12	0.33	3	0 120 (3 05)	K M	N I M J K			
L1W(1)50B334(2)(3)36	0.33	5	0.360 (9.14)	К. М	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			
L1W(1)50B394(2)(3)36	0.39	5	0.360 (9.14)	К. М	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)	К, М	N, L, M, J, K			
L1W(1)50B754(2)(3)65	0.75	5	0.650 (16.51)	К, М	N, L, M, J, K			
L1W(1)40B824(2)(3)24	0.82	4	0.240 (6.10)	К, М	N, L, M, J, K			
L1W(1)30B105(2)(3)12	1	3	0.120 (3.05)	К, М	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)12	1.5	3	0.120 (3.05)	K, M	N, L, M, J, K			
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)	К, М	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)	К, М	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)	К, М	N, L, M, J, K			
L1W(1)30B475(2)(3)36	4.7	3	0.360 (9.14)	К, М	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	0	3	0.050 (10.51)	K, M	N, L, M, J, K			
L1W(1)30B065(2)(3)05	0.0	<u></u>	0.000 (10.01)	κ, ινι	IN, L, IVI, J, K			
		1,000 VDC – X7R Diele	ectric					
L1W(1)50D473(2)(3)12	0.047	5	0.120 (3.05)	К, М	N, L, M, J, K			
L1W(1)50D683(2)(3)12	0.068	5	0.120 (3.05)	К, М	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	4	0.120 (3.05)	К, М	N, L, M, J, K			
L1W(1)50D104(2)(3)24	0.1	5	0.240 (6.10)	K, M	N, L, M, J, K			
L1W(1)50D124(2)(3)24	0.12	5	0.240 (6.10)	К, М	N, L, M, J, K			
	0.15	5	0.300 (9.14)	K, M	N, L, M, J, K			
L1W(1)20D224(2)(3)30	0.18	5	0.300 (9.14)	K, M	N, L, W, J, K			
LIVV(I)30D224(2)(3)12	0.22	3	0.120 (3.05)	r, M	N, L, ⅣI, J, K			
LIVV(I)40D224(2)(3)12	0.22	4	0.120 (3.05)	r, M	N, L, Ⅳ, J, K			
L1VV(1)50D2Z4(Z)(3)30	0.22	5 F	0.300 (9.14)	K, IVI	N, L, IVI, J, K			
L1W(1)30D374(2)(3)40	0.27	3	0.400 (12.19)	K M	N, L, WI, J, K			
L1W(1)50D334(2)(3)12	0.33	5	0.120 (3.03)	K M	N, L, WI, J, K			
L1W(1)40D394(2)(3)24	0.39	4	0.240 (6.10)	K, M	N. L. M. J. K			
KEMET P/N ¹	Capacitance (µF)	Case Code	Height A	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".



Table 1C – Commercial/Non-Standard – Product Selection 1,000 VDC cont'd

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)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)	К, М	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)	К, М	N, L, M, J, K				
L1W(1)30D105(2)(3)24	1	3	0.240 (6.10)	К, М	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)	К, М	N, L, M, J, K				
L1W(1)30D155(2)(3)36	1.5	3	0.360 (9.14)	К, М	N, L, M, J, K				
L1W(1)30D225(2)(3)36	2.2	3	0.360 (9.14)	К, М	N, L, M, J, K				
L1W(1)30D245(2)(3)48	2.4	3	0.480 (12.19)	К, М	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".

L1	R	Ν	30	С	106	K	S	12	
Product Family	Dielectric Classification/ Characteristic	Lead Configuration	Case Size/ Case Code (CC)	Rated Voltage (VDC)	Capacitance Code (pF)	Capacitance Tolerance	Testing Option	Maximum Height Dimension (in.)	
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"	30 = CC 3 40 = CC 4 50 = CC 5	3 = 25 5 = 50 1 = 100 2 = 200 C = 500 B = 630 D = 1,000	2 Sig. 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"



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 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

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	Test Method	MIL–PRF–49470 B Level (B)	MIL–PRF–49470 T Level (T)	DSSC Drawing 87106 (C) ¹	Commercial (S)	Non-Standard (X) ²
		In-Process I	nspection	-	-	-
Ultrasonic Scanning (C-SAM)	Meet EIA-469 Criteria					Optional per
DPA Analysis	EIA-469	Not required	Yes (per lot)	Not required	Not required	Source Controlled
In-Process Visual Inspection	MIL-PRF-49470 Method 4.8.3					Drawing (SCD)
		Group A Req	uirements			
Thermal Shock	MIL–STD–202 Method 107	Yes (5 cycles)	Yes (20 cycles)	Yes (5 cycles)	-	Ontional son
Voltage Conditioning ≤ 200 V 500 V	MIL–PRF–49470 Method 4.8.5.2 200%V _R @125°C 120%V _R @125°C	Yes (96 hours minimum)	Yes (168 hours minimum)	Yes (96 hours minimum)	Not	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	1	1	
Voltage–Temperature Limits (TCVC)	MIL-PRF-49470 Method 4.8.13.2					
Resistance to Solvents	MIL-STD-202 Method 215			Yes (periodic)		
Terminal Strength	MIL–STD–202 Method 211	Yes (periodic)				
Resistance to Soldering Heat	MIL–STD–202 Method 210	([)		(F)		
Moisture Resistance	MIL-STD-202 Method 106		Yes (per lot)		Not	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		
Life Test ≤ 200 V 500 V	MIL-STD-202 Method 108 200%V _R @125°C 120%V _R @125°C	Yes (periodic)		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.

12345 106K 1103

JT

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 Quantity ¹ (7.5" x 7.5")	Large Box Quantity ¹ (13.0" x 13.0")						
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.



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 $\pm 15\%$ 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.

Benefits

- -55°C to +150°C operating temperature range
- Pb-Free and RoHS 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 10 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

Ordering Information

- · 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% minimum)



С	1210	С	184	K	3	Н	Α	С	AUTO
Ceramic	Case Size (L" x W")	Specification/ Series ¹	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/Grade (C-Spec) ²
	0402 0603 0805 1206 1210 1812	C = Standard	2 Significant Digits + Number of Zeros	$F = \pm 1\% G = \pm 2\% J = \pm 5\% K = \pm 10\% M = \pm 20\%$	3 = 25 V 5 = 50 V 1 = 100 V	H = Ultra Stable X8R	A = N/A	C = 100% Matte Sn L = SnPb (5% minimum)	Blank = Bulk TU = 7" Reel Unmarked AUTO = Automotive Grade 7"Reel Unmarked

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.

- ^{2,3} SnPb termination finish option is not available on automotive grade product.
- ³ Additional reeling or packaging options may be available. Contact KEMET for details.



Dimensions – Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0402	1005	1.00 (.040) ± 0.05 (.002)	0.50 (.020) ± 0.05 (.002)		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)	See Table 2 for	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)	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)	N/A	Calder Deflaw Only
1812	4532	4.50 (.177) ± 0.30 (.012)	3.20 (.126) ± 0.30 (.012)	1	0.60 (.024) ± 0.35 (.014)		Solder Reflow Unly

Applications

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

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

Pb-Free and RoHS Compliant (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 Ω 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 \pm 50 Hz and 1.0 \pm 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	2.5	0.3% or ±0.25 pf	10% of Initial Limit				



Table 1 – Capacitance Range/Selection Waterfall (0402 – 1812 Case Sizes)

	Can		Cas S	se S Serie	ize es	1	C	:0402	C	C	0603	C	C	:0805	5C	C	:1206	C	C	:1210	С	C18	12C
Capacitance	Code		Volt	tage (Code		3	5	1	3	5	1	3	5	1	3	5	1	3	5	1	5	1
	oouc	Ra	ated V	/oltag	ge (VI	DC)	25	50	100	25	20	<u> </u>	55	20	ě	25	20	ě	25	50	100	50	- 10
		Cap	oacita	ince 1	Tolera	ance						Produc See 1	ct Avail Fable 2	for Ch	and Cl	hip Thi kness	ckness Dimen	s Code: sions	S				
100 pF	101	F	G	J	K	M	BB	BB	BB														
120 pF	121	F	G	J	K	M	BB	BB	BB														
130 pF	131	F	G	J	K	М	BB	BB	BB														
150 pF	151	F	G	J	K	M	BB	BB	BB														
180 pF	181	F	G	J	K	M	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														
240 pF	241	F	G	J	K	M	BB	BB	BB														
300 pF	301	F	G	J	K	M	BB	BB	BB														
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	M	BB	BB	BB	CP	CP	CP											
430 pF 470 pF	431	F	G	J	K	M	BB	BB	BB	СВ	CB	CB											
510 pF	511	F	G	J	К	М	BB	BB	BB	СВ	СВ	СВ											
560 pF	561	F	G	J	K	M	BB	BB	BB	CB	CB	CB											
620 pF	621	F	G	J	K	M	BB	BB	BB	CB	CB	CB											
750 pF	751	F	G	J	K	M	BB	BB	BB	СВ	CB	CB											
820 pF	821	F	G	J	K	М	BB	BB	BB	СВ	СВ	CB											
910 pF	911	F	G	J	K	M	BB	BB	BB	CB	CB	CB											
1,000 pF	102	F	G	J	K	M	BB	BB	BB	CB	CB	CB											
1,200 pF	122	F	G	J	K	M	BB	BB		CB	CB	CB											
1,300 pF	132	F	G	J	K	М	BB	BB		СВ	CB	CB											
1,500 pF	152	F	G	J	K	M	BB	BB		CB	CB	CB											
1,800 pF	182	F	G	J	K	M				CB	CB	CB											
2,000 pF	202	F	G	J	K	M				СВ	CB	CB	DC	DC	DC								
2,200 pF	222	F	G	J	K	М				CB	CB	CB	DC	DC	DC								
2,400 pF	242	F	G	J	K	M				CB	CB	CB		DC	DC								
3.000 pF	302	F	G	J	K	M				CB	CB	CB	DC	DC	DC								
3,300 pF	332	F	G	J	К	М				СВ	СВ	CB	DC	DC	DC								
3,600 pF	362	F	G	J	K	M				CB	CB	CB	DC	DC	DC								
3,900 pF	392		G	J	K	M				CB	CB	CB			DC								
4,700 pF	472	F	G	J	K	M				CB	CB	CB	DC	DC	DC								
5,100 pF	512	F	G	J	K	М				СВ	СВ		DC	DC	DC								
5,600 pF	562	F	G	J	K	M				CB	CB		DC	DC	DC								
6,200 pF	682	F	G	J	K	M				CB	CB		DC	DC	DC	FB	FB	FB					
7,500 pF	752	F	G	J	K	M				CB	0.5		DC	DC	DC	EB	EB	EB					
8,200 pF	822	F	G	J	K	М				CB			DC	DC	DC	EB	EB	EB					
9,100 pF	912	F	G	J	K	M				CB			DC	DC	DC	EB	EB	EB					
12,000 pF	123	F	G	J	K	M							DC	DC	DE	EB	EB	EB	FB	FB	FB		
15,000 pF	153	F	G	J	K	М							DC	DD	DG	EB	EB	EB	FB	FB	FB	GB	GB
18,000 pF	183	F	G	J	K	М							DC	DD		EB	EB	EB	FB	FB	FB	GB	GB
22,000 pF	223	F	G	J	K	M								DF		EB	EB	EC	FB	FB	FB	GB	GB
33,000 pF	333	F	G	J	K	M							DG			EB	EB	EE	FB	FB	FB	GB	GB
		Ra	ated V	/oltac	ge (VI	DC)	25	50	10	25	50	100	25	50	100	25	50	100	25	50	100	50	10
Capacitance	Cap Code		Volt	tage (Code		3	5	1	3	5	1	3	5	1	3	5	1	3	5	1	5	1
		Ca	ase S	Size /	Seri	ies		C04020	C		C06030	C		C0805	C		C12060	C		C12100	;	C18	12C



Table 1 – Capacitance Range/Selection Waterfall (0402 – 1812 Case Sizes) cont'd

		(Case Size / Series		Case Size / Series		Case Size / Series		C	C0402C		C	C0603C		C0805C		C1206C		С	C1210C		C1812C	
Capacitance	Сар		Volt	tage	Code		3	5	1	3	5	1	3	5	1	3	5	1	3	5	1	5	1
	Code	Ra	ted \	/olta	ge (VI	DC)	25	50	100	25	50	100	25	50	100	25	50	100	25	50	100	50	100
		Сар	pacitance Tolerance								Produc See 1	t Avail Table 2	ability for Ch	and Cl ip Thic	nip Thi kness	ckness Dimen	Codes	5					
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	М													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	Μ																GK	
		Ra	ted \	/olta	ge (VI	DC)	25	50	100	25	50	100	25	50	100	25	50	100	25	50	100	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
		Ca	ase S	Size	Ser	ies		C04020	0		C06030	2		C08050	2		C12060	2		C12100	2	C18	12C

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
CB	0603	0.80 ± 0.07	4,000	10,000	0	0
DC	0805	0.78 ± 0.10	4,000	10,000	0	0
DD	0805	0.90 ± 0.10	4,000	10,000	0	0
DE	0805	1.00 ± 0.10	0	0	2,500	10,000
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	Range (mm)	Paper G	Quantity	Plastic (Quantity

Package quantity based on finished chip thickness specifications.



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

EIA Size	Metric Size	Density Level A: Maximum (Most) Land Protrusion (mm)						Dens Media Land P	sity Lev an (Nor rotrusio	vel B: ninal) on (mm)	Density Level C: Minimum (Least) Land Protrusion (mm)					
Code	Code	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	X	V1	V2	
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	0.40	0.52	0.52	1.60	0.80	
0603	1608	0.90	1.15	1.10	4.00	2.10	0.80	0.95	1.00	3.10	1.50	0.60	0.75	0.90	2.40	1.20	
0805	2012	1.00	1.35	1.55	4.40	2.60	0.90	1.15	1.45	3.50	2.00	0.75	0.95	1.35	2.80	1.70	
1206	3216	1.60	1.35	1.90	5.60	2.90	1.50	1.15	1.80	4.70	2.30	1.40	0.95	1.70	4.00	2.00	
1210	3225	1.60	1.35	2.80	5.65	3.80	1.50	1.15	2.70	4.70	3.20	1.40	0.95	2.60	4.00	2.90	
1210 ¹	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 $\geq 22 \ \mu F$

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

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



Soldering Process

Recommended Soldering Technique:

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

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020



Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 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:
Soldorability		a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	3-310-002	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 +/- 2 hours after test conclusion.
Biased Humidity	MIL_STD_202 Method 103	Load Humidity: 1,000 hours 85°C/85%RH and rated voltage. Add 100K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Diased Humany		Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours. +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+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

Reference	lt	em	Material				
А		Finish	100% Matte Sn	SnPb (5% min)			
В	Termination Svstem	Barrier Layer	Ni				
С	- ,	Base Metal	Cu				
D	Inner E	Electrode	Ni				
E	Dielectri	c Material	CaZrO ₃				



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



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	Voltage	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/Grade (C-Spec) ³
	0402 0603 0805 1206 1210	C = Standard X = Flexible Termination	2 Significant Digits + Number of Zeros	J = ±5% K = ±10% M = ±20%	8 = 10 V 3 = 25 V 5 = 50 V	N = X8L	A = N/A	C = 100% Matte Sn L = SnPb (5% minimum)	Blank = Bulk TU = 7" Reel Unmarked TM = 7" Reel Marked AUTO = Automotive Grade 7" Reel Unmarked

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.

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

^{2.3} SnPb termination finish option is not available on Automotive Grade product.

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



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 (.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)	See Table 2 for Thickness	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)	N1/A	
1210	3225	3.20 (.126) ± 0.20 (.008)	2.50 (.098) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.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 (.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) ± 0.20 (.008)	1.25 (.049) ± 0.20 (.008)	See Table 2 for	0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	or
1206	3216	3.30 (.130) ± 0.40 (.016)	1.60 (.063) ± 0.20 (.008)	Thickness	0.60 (.024) ± 0.25 (.010)	N1/A	Solder Reflow
1210	3225	3.30 (.130) ± 0.40 (.016)	2.50 (.098) ± 0.20 (.008)		0.60 (.024) ± 0.25 (.010)	N/A	Solder Reflow Only

Benefits

- -55°C to +150°C operating temperature range
- Pb-Free and RoHS Compliant
- EIA 0402, 0603, 0805, 1206, and 1210 case sizes
- DC voltage ratings of 10 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% 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.

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

Pb-Free and RoHS compliant (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 – 125°C) +15, -40% (125°C – 150°C)
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 @ 25°C	3.5% (10 V) and 2.5% (25 V and 50 V)
Insulation Resistance (IR) 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.

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 \pm 50 Hz and 1.0 \pm 0.2 Vrms.

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		3.0						
X8L	25	All	5.0	±20%	10% of Initial Limit				
	10		7.5						

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	< .047 µF	≥ .047 µF
1206	< 0.22 µF	≥ 0.22 µF
1210	< 0.39 µF	≥ 0.39 µF
1808	ALL	N/A
1812	< 2.2 µF	≥ 2.2 µF
1825	ALL	N/A
2220	< 10 µF	≥ 10 µF
2225	ALL	N/A



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

	Can	Ca	ise Siz Series	ze /	C04	02C	(C0603	С	C	C0805(C	(C1206	C	(C12100	C
Capacitance	Code	V	oltage Co	de	8	3	8	3	5	8	3	5	8	3	5	8	3	5
	ooue	Rated	l Voltage	(VDC)	10	25	10	25	50	10	25	50	10	25	50	10	25	50
		Capac	itance To	lerance	Produ	ct Avai	ı ilability	v and C	hip Th	icknes	s Code	es See	Table 2	2 for Cl	hip Thi	ckness	Dimer	nsions
12.000 pF	123	J	К	М	BB	BB	<u> </u>		1.				1	-	1.	1	_	
15,000 pF	153	J	К	М	BB	BB												
18,000 pF	183	J	к	М	BB	BB												
22.000 pF	223	Ĵ	к	м	BB	BB												
27.000 pF	273	Ĵ	к	м	BB													
33.000 pF	333	J	K	M	BB													
39.000 pF	393	J	ĸ	M	BB													
47.000 pF	473	J	ĸ	M	BB		СВ	CB	CB									
0.12 µF	124	J	ĸ	M			CB	CB	05									
0.15 µF	154	J	ĸ	M			CB	CB		DG	DG	DG						
0.18 µF	184	J	K	M			CB	02		DG	DG	DG						
0.22 µF	224	J	ĸ	M			CB			סס	סס	DG						
0.27 µF	274	J	ĸ	M			05			סס	סס							
0.33 µF	334		ĸ	M						סס	סס							
0.39 µF	394		ĸ	M						DF	DE					FD	FD	FD
0.47 µF	474		ĸ	M						DE	DE		FG	FG	FG	FD	FD	FD
0.56 µF	564		ĸ	M						DG	DH					FF	FF	FF
0.68 µF	684	ŭ	ĸ	M						DG	DH					FG	FG	FG
0.82 µF	824	ŭ	ĸ	M						DG						FI	FI	FI
10 uF	105	ŭ	ĸ	M						DG			FD	FD		FM	FM	FM
1.0 µr	125	U U	K	M						00			FH	EH		FG	FG	1 101
1.2 µi	155	, i	ĸ	M									EH	EH		FG	FG	
1.5 µi	185	J 1	ĸ	M										EH		FG	FG	
2.2 µF	225	J 1	ĸ	M										EH		FG	FG	
2.2 µi 2 7 µF	225	J 1	ĸ	M										L		FG	FH	
2.7 µ1 3 3 µE	335	J	K	M									EH			FM	EM	
3.0 µF	305	J 1	ĸ	M												FG	FK	
3.5 μΓ 4.7 μΕ	475	J 1	ĸ	M												FG	FS	
4.7 μi	475	J		M									LII				13	
6.8 µF	685	1	K	M												FM		
8.2 µF	825	5	K	M												FK		
10 µF	106	.1	K	M												ES		
10 pi	100	Rated	l Voltage	(VDC)	10	25	10	25	50	10	25	50	10	25	50	10	25	50
Capacitance	Cap	V	oltage Co	de	8	3	8	3	5	8	3	5	8	3	5	8	3	5
	Code	Cas	e Size / S	eries	C04	102C		C0603C	1		C0805C	1		C1206C	ļ		C1210C	1



Thickness	Case	Thickness ±	Paper C	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
CB	0603	0.80 ± 0.07	4,000	10,000	0	0
DD	0805	0.90 ± 0.10	4,000	10,000	0	0
DE	0805	1.00 ± 0.10	0	0	2,500	10,000
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
DH	0805	1.25 ± 0.20	0	0	2,500	10,000
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	Range (mm)	Paper C	Quantity	Plastic (Quantity

Table 2 – Chip Thickness/Packaging Quantities

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	Density Level A: Maximum (Most) Land Protrusion (mm)			Density Level B: Median (Nominal) Land Protrusion (mm)				Density Level C: Minimum (Least) Land Protrusion (mm)							
oout	oouc	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
1210 ¹	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 $\geq 22 \, \mu F$

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

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



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)						
0000	0040	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	0.80	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).



Soldering Process

Recommended Soldering Technique:

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

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020



Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 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		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 +/- 2 hours after test conclusion.
Pieced Humidity	MIL STD 202 Method 102	Load Humidity: 1,000 hours 85°C/85%RH and rated voltage. Add 100K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Blased 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.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours. +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+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

Reference	lt	em	Mate	erial		
А		Finish	100% Matte Sn	SnPb (5% min)		
В	Termination Svstem	Barrier Layer	Ν	li		
D	- ,	Base Metal	Cu			
E	Inner E	lectrode	Ni			
F	Dielectri	c Material	Bal	ГіO ₃		



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

Construction – Flexible Termination

Reference	lt	em	Material			
А		Finish	100% Matte Sn	SnPb (5% min)		
В	Termination	Barrier Layer	١	li		
С	System	Epoxy Layer	Ag			
D		Base Metal	Cu			
E	Inner E	lectrode	Ν	li		
F	Dielectri	c Material	Bal	۲iO ₃		



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



Overview

KEMET's high temperature surface mount C0G Multilayer Ceramic Capacitors (MLCCs) feature a robust, proprietary base metal dielectric system that offers industry-leading performance relative to capacitance and case size combined with capacitance stability at extreme temperatures up to +200°C. This new platform promotes downsizing opportunities of existing high temperature C0G technology, and offers replacement opportunities of existing X7R, BX and BR dielectric technologies. KEMET's high temperature COG dielectric features a 200°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 +200°C.

Benefits

- -55°C to +200°C operating temperature range
- · Pb-Free and RoHS 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 0.47 μ F
- Available capacitance tolerances of ±0.10 pF, ±0.25 pF, ±0.5 pF, ±1%, ±2%, ±5%, ±10% or ±20%
- · No piezoelectric noise



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) ³
	0402 0603 0805 1206 1210 1812 2220	H= High Temperature (200°C)	2 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% minimum)	Blank = Bulk TU = 7" Reel - Unmarked (full reel quantity) T050 = 50 pcs / 7" Reel - Unmarked T100 = 100 pcs / 7" Reel - Unmarked T250 = 250 pcs / 7" Reel - Unmarked T500 = 500 pcs / 7" Reel - Unmarked T1K0 = 1,000 pcs / Reel - Unmarked

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

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

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. 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)





Electrodes / Conductive Metalization

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)		

Benefits cont'd

- 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

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

RoHS Compliant (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%
Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 second and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit @ 25°C	0.1%
Insulation Resistance (IR) Limit @ 25°C	1,000 megohm microfarads or 100 GΩ
Insulation Resistance (IR) Limit @ 200°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 Vrms ±0.2 V if capacitance \leq 1,000 pF

1 kHz \pm 50 Hz and 1.0 Vrms \pm 0.2 V 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					
COG	All	All	0.5	0.3% or ±0.25 pF	10% of Initial Limit					



Electrical Characteristics

Delta Cap vs. Temperature (Typical)



Capacitance vs. Temperature with 25 V DC Bias (Rated Voltage)



IR vs. Temperature with 25 V DC Bias (Rated Voltage)



C1210H104J1GAC - Life Test IR Distribution (Lognormal)



DF vs. Temperature without DC Bias.



BME vs. PME/IR vs. Temperature with 25 V DC Bias (Rated Voltage)





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

		(Case Size / Series					S		C)40	2H				C06	03H	1				C08	05 ⊦	1			(C12	06H			
Canacitanco	Сар			Vo	oltag	je 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		F	Rated	l Vol	tage	(VD	C)		9	16	25	50	100	9	16	25	50	100	200	9	16	25	50	100	200	9	16	25	50	10	200
			Ca	pacit	and	e To	oler	anc	e							Pr	oduc See T	t Ava able	ailabi 2 foi	lity a Chi	and C p Thi	Chip⊺ ckne	「hick ss D	iness imen	s Coo sion	les s						
0.5 & 0.75 pF	508 & 758	В	C	D						BB	BB	BB	BB		CB	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC						
10 - 91 pF*	109 - 919	в			F	G	J	к	м	BB	BB	BB	BB		CB	CB	CB	CB	CB	CB			DC		DC		FB	FB	FB	FB	FB	FB
100 - 180 pF*	101 - 181*				F	G	Ĵ	K	M	BB	BB	BB	BB	BB	СВ	CB	CB	CB	CB	CB	DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
200 - 430 pF*	201 - 431*				F	G	J	К	М	BB	BB	BB	BB	BB	СВ	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
470 pF	471				F	G	J	K	М	BB	BB	BB	BB	BB	СВ	CB	CB	CB	CB		DC	DC	DC	DC	DC	DD	EB	EB	EB	EB	EB	EB
510 pF	511				F	G	J	K	M	BB	BB	BB	BB	BB	СВ	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
560 pF	561				F	G	J	K	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
620 pF	621				LF.	G	J	K	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
680 pF	681 754				F	G	J	K	IVI N4	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB		DC	DC	DC	DC	DC	DC	EB	EB	EB	EB	EB	EB
820 pF	821				F	G	J	ĸ	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB								ED	ED	ED	ED	ED	ED
910 pF	911				F	G	J	K	M	BB	BB	BB	BB	BB	CB	CB	CB	CB	CB			DC	DC	DC	סס	סס	FB	FB	FB	FB	FB	FB
1.000 pF	102				F	G	Ĵ	K	M	BB	BB	BB	BB	BB	СВ	CB	CB	CB	CB		DC	DC	DC	DC	DD	DD	EB	EB	EB	EB	EB	EE
1,100 pF	112				F	G	J	К	М	BB	BB	BB	BB		СВ	CB	CB	СВ	CB		DC	DC	DC	DC	DC		EB	EB	EB	EB	EB	EB
1,200 pF	122				F	G	J	K	М	BB	BB	BB	BB		СВ	CB	CB	CB	CB		DC	DC	DC	DC	DC		EB	EB	EB	EB	EB	EB
1,300 pF	132				F	G	J	K	M	BB	BB	BB	BB		СВ	CB	CB	CB	CB		DD	DD	DD	DD	DD		EB	EB	EB	EB	EC	EC
1,500 pF	152				F	G	J	K	M	BB	BB	BB	BB		CB	CB	CB	CB	CB		DD	DD	DD	DD	DD		EB	EB	EB	EB	ED	EC
1,600 pF	162				F	G	J	K	M						CB	CB	CB	CB	CB		DD	DD	DD	DD	DD		EB	EB	EB	EB	ED	ED
1,800 pF	182				I F	G	J	K	M						CB	CB	CB	CB	CB		DD	DD	DD	DD	DD		EB	EB	EB	EB	ED	ED
2,000 pF	202					G	J	ĸ							CB	CB	CB	CB	CB				DC	DC	DC		EB	EB	EB	EB	ED	ED
2,200 pF	222				F	G	J	ĸ	M						CB	CB	CB	CB	CB								ED	ED	ED	ED	FC	FC
2,400 pr	272				F	G	J	K	M						CB	CB	CB	CB	CB			DC	DC	DC	DC		FB	FB	FB	FB	FC	FC
3.000 pF	302				F	G	Ĵ	K	M						СВ	CB	CB	CB	CB		DD	DD	DD	DD	DC		EC	EC	EC	EC	EC	
3,300 pF	332				F	G	J	K	M						СВ	CB	CB	CB	CB		DD	DD	DD	DD	DC		EC	EC	EC	EC	EE	
3,600 pF	362				F	G	J	K	М						СВ	СВ	СВ	СВ	СВ		DD	DD	DD	DD	DC		EC	EC	EC	EC	EE	
3,900 pF	392				F	G	J	K	М						СВ	CB	СВ	CB	CB		DE	DE	DE	DE	DC		EC	EC	EC	EC	EF	
4,300 pF	432				F	G	J	K	M						СВ	CB	CB	CB	CB		DE	DE	DE	DE	DC		EC	EC	EC	EC	EC	
4,700 pF	472				F	G	J	K	М						СВ	CB	CB	CB	CB		DE	DE	DE	DE	DC		EC	EC	EC	EC	EC	
5,100 pF	512				F	G	J	K	M						CB	CB	CB	CB			DE	DE	DE	DE	DC		ED	ED	ED	ED	ED	
5,600 pF	562					G	J	K	M						CB	CB	CB	CB			DC	DC	DC	DC	DC		ED	ED	ED	ED	ED	
6,200 pF	622					G	J	ĸ							CB	CB	CB	CB					DC	DC	DC		EB	EB	EB	EB	EB	
7 500 pF	752				F	G	J	K	M						CB	CB	CB	CD					DC				FR	ED FR	FR	FR	FR	
8 200 pF	822				F	G	J	K	M						CB	CB	CB					DC	DC	DC	DC		EC	EC	FC	FC	FB	
9,100 pF	912				F	G	J	K	M						СВ	CB	CB				DC	DC	DC	DC	DC		EC	EC	EC	EC	EB	
10,000 pF	103				F	G	J	K	М						СВ	СВ	CB				DC	DC	DC	DC	DD		ED	ED	ED	ED	EB	
12,000 pF	123				F	G	J	K	M												DC	DC	DC	DC	DE		EB	EB	EB	EB	EB	
15,000 pF	153				F	G	J	K	М												DC	DC	DC	DD	DG		EB	EB	EB	EB	EB	
18,000 pF	183				F	G	J	K	M												DC	DC	DC	DD			EB	EB	EB	EB	EB	
22,000 pF	223				F	G	J	K	M												DD	DD	DD	DF			EB	EB	EB	EB	EC	
27,000 pF	2/3					G	J	K	M																		EB	EB	EB	EB	EE	
47.000 pF	555 173				F	G	J	K	M												DG	DG	DG				EB	EB	EB	EB	EH	
56 000 pF	563				F	G	J	K	M																		FD	FD	FD	FF	LU	
68,000 pF	683				F	G	J	ĸ	M																		EF	EF	EF	EH		
82,000 pF	823				F	G	J	K	M																		EH	EH	EH	EH		
0.10 µF	104	F G J K M					6			0	Ļ		10		0	0		<u>(</u>			0		EH	EH	EH		-	0				
Canacitanaa	Can Cada		F	Rated	I Vol	tage	(VD)C)		, ≓	¥ 4	2 2	20	e	, <u>⊢</u>	4	5°	2C	e	ر 20	¥ ↓	¥ 4	2 2	2(₽ 1	ر 20	4	7	2 2	2C	ę 1	د 20
Capacitance	Cap Code	-			ag		ue 			L°	- ⁴	3	<u> </u>		<u> </u>	4	 			2	<u>⊢</u> °	4	 	J		2	0	4	 	J	'	2
			(Jase	Siz	e / S	eri	es			C	0402	H		1		C06	03H					C08	05H					C12	06H		

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

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



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

			Case Size / Series							C12	10H					C18	12H					C22	20H				
	Сар			v	oltag	e Co	de			8	4	3	5	1	2	8	4	3	5	1	2	8	4	3	5	1	2
Capacitance	Code			Rate	d Volt	tage	(VDC)		ę	2 4	25	50	9	200	9	9	25	50	9	200	9	16	25	50	100	200
			(Capac	itanc	e Tol	erand	ce					,	Pr	oduc See T	t Avai able 2	labilit 2 for C	y and hip T	d Chip hickr) Thic	knes: Dimer	s Cod	es		·		
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	M	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	M	FB	FB	FB	FB	FB	FB												
1,200 pF	122					G	J	K	M	FB	FB	FB	FB	FB	FB												
1,300 pF	132					G	J	K	IVI	FB	FB	FB	FB	FB	FC												
1,500 pF	152					G	J	K	IVI	FB	FB	FB	FB	FB													
1,600 pF	102					G	J	ĸ	IVI	FB	FB	FB		FB													
1,000 pF	102				F	G	J	ĸ	IVI		FD	FD	FD	FD	FE												
2,000 pT	202				F	G	J	K	M	FR	FR	FR	FB	FC	FG												
2,200 pT	242				F	G	J	K	M	FR	FR	FR	FB	FC	FC												
2,400 pr 2,700 pF	242				F	G	J	ĸ	M	FR	FR	FR	FR	FC	FC												
3,000 pF	302				F	G	, i	ĸ	M	FB	FB	FB	FB	FC	FF												
3 300 pF	332				F	G	J	ĸ	M	FB	FB	FB	FB	FF	FF												
3.600 pF	362				F	G	Ĵ	ĸ	M	FB	FB	FB	FB	FF	FF												
3.900 pF	392				F	G	J	ĸ	M	FB	FB	FB	FB	FF	FF												
4,300 pF	432				F	G	J	ĸ	М	FB	FB	FB	FB	FF	FF												
4,700 pF	472				F	G	J	ĸ	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	M	FC	FC	FC	FC	FC													
8,200 pF	822				F	G	J	K	M	FC	FC	FC	FC	FC													
9,100 pF	912				F	G	J	K	M	FE	FE	FE	FE	FE													
10,000 pF	103				F	G	J	K	M	FF	FF	FF	FF	FF													
12,000 pF	123				F	G	J	K	M	FG	FG	FG	FG	FB													
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	M	FB	FB	FB	FB	FB		GB	GB	GB	GB	GB							
22,000 pF	223				F	G	J	K	M	FB	FB	FB	FB	FB		GB	GB	GB	GB	GB							
27,000 pF	273				F	G	J	K	M	FB	FB	FB	FB	FB		GB	GB	GB	GB	GB							
33,000 pF	333				F	G	J	K	M	FB	FB	FB	FB	FB		GB	GB	GB	GB	GB							
47,000 pF	4/3				F	G	J	K	M	FB	FB	FB	FB	FE		GB	GB	GB	GB	GB							
56,000 pF	503					G	J	ĸ	IVI	FB	FB	FB	FB			GB	GB	GB	GB	GB							
82,000 pF	003					G	J	ĸ	IVI		FD					GB	GB	GB	GB	GB							
02,000 pF	023					G	J	r k	IVI M			FC				GB	GB	GB	GB	GB							
0.10 µF	104					G	J		M					FIVI		GD	GB	GB	GB	GD							
0.12 µl	124				F	G	J	K	M	FH	FH	FH	FM			GD	GD	GD	GD	GN							
0.18 µF	184				F	G		K	M		1		1 101			GH	GH	GH	GH	UN							
0.22 µF	224				F	G	, i	ĸ	M							GK	GK	GK	GK								
0.47 µF	474				F	G	Ĵ	K	M								0.11	0.11	- On			JJ	JJ	JJ	JJ		
				Rate	d Volt	tage	(VDC)		÷	e 4	25	20	9	200	9	9	25	20	9	200	9	9	25	50	<u>10</u>	200
Capacitance	Cap Code			v	oltag	e Co	de			8	4	3	5	1	2	8	4	3	5	1	2	8	4	3	5	1	2
				Case	e Siz	e / S	eries	3				C12	10H					C18	12H					C22	20H		

*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 2 –	Chip	Thickness	Packaging	Quantities
-----------	------	-----------	-----------	------------

Thickness	Case	Thickness ±	Paper C	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		
CB	0603	0.80 ± 0.07	4,000	10,000	0	0		
DC	0805	0.78 ± 0.10	4,000	10,000	0	0		
DD	0805	0.90 ± 0.10	4,000	10,000	0	0		
DE	0805	1.00 ± 0.10	0	0	2,500	10,000		
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	Range (mm)	Paper C	Quantity	Plastic Quantity			

Package quantity based on finished chip thickness specifications.



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

EIA Size	Metric Size		Dens Maxi Land P	sity Lev mum (I rotrusio	rel A: Most) on (mm)		Dens Medi Land P	sity Lev an (Nor rotrusio	vel B: ninal) on (mm))	Density Level C: Minimum (Least) Land Protrusion (mm)							
Code	Coue	C Y X V1 V2						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			
1210 ¹	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 \geq 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).





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.

Drofilo Fosturo	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 $T_{\mbox{\scriptsize Smin}}$ to $T_{\mbox{\scriptsize Smax}}$	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.




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 $\pm 15\%$ from -55° C to $+150^{\circ}$ 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	Voltage	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec) ²
	0603 0805 1206 1210 1812	X = Flexible Termination	2 significant digits + number of zeros.	$F = \pm 1\%$ $G = \pm 2\%$ $J = \pm 5\%$ $K = \pm 10\%$ $M = \pm 20\%$	3 = 25 V 5 = 50 V 1 = 100 V	H = Ultra- Stable X8R	A = N/A	C = 100% Matte Sn L = SnPb (5% minimum)	Blank = Bulk TU = 7" Reel Unmarked AUTO = Automotive Grade 7" Reel Unmarked

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.

²Additional 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
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) ±0.20 (.008)	1.25 (.049) ±0.20 (.008)		0.50 (0.02) ±0.25 (.010)	0.75 (.030)	or
1206	3216	3.30 (.130) ±0.40 (.016)	1.60 (.063) ±0.20 (.008)	See Table 2 for Thickness	0.60 (.024) ±0.25 (.010)		Solder Reflow
1210	3225	3.30 (.130) ± 0.40 (.016)	2.50 (.098) ± 0.20 (.008)		0.60 (.024) ± 0.25 (.010)	N/A	Caldes Daflaw Only
1812	4532	4.50 (.178) ±0.40 (.016)	3.20 (.126) ±0.30 (.012)		0.70 (.028) ±0.35 (.014)		Solder Reflow Only

Benefits

- -55°C to +150°C operating temperature range
- Superior flex performance (up to 5 mm)
- · Pb-Free and RoHS 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% 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.



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

Pb-Free and RoHS Compliant (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 \pm 50 Hz and 1.0 \pm 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	2.5	0.3% or ±0.25 pF	10% of Initial Limit				



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

		Ca	se S	ize	/ Ser	ies	C	:0603	С	C	0805	С	C	1206	С	C	C12100	0	C18	12C
0 11	Capacitance		Vol	tage C	ode		3	5	1	3	5	1	3	5	1	3	5	1	5	1
Capacitance	Code	F	Rated N	/oltag	e (VDC	C)	25	20	100	25	50	100	25	50	100	25	50	100	50	100
		Ca	apacita	pacitance Tolerance Product Availability and Chip Thickness Codes																
430 pF	431	F	G	J	K	М	СВ	CB	CB					IIICKIIE	55 Dillio					
470 pF	471	F	G	J	K	М	СВ	CB	CB											
510 pF	511	F	G	J	K	М	СВ	CB	CB											
560 pF	561	F	G	J	K	Μ	СВ	CB	CB											
620 pF	621	F	G	J	K	М	СВ	CB	CB											
680 pF	681	F	G	J	K	M	CB	CB	CB											
750 pF	751	F	G	J	K	M	СВ	CB	CB											
820 pF	821	F	G	J	K	M	CB	CB	CB											
910 pF	911	F	G	J	K	M	CB	CB	CB											
1,000 pF	102	F	G	J	K	M	CB	CB	CB											
1,100 pF	112		G	J	K	M	CB	CB	CB											
1,200 pF	122		G	J	K	M	CB	CB	CB											
1,300 pF	132		G	J	K	M	CB	CB	CB											
1,500 pF	152		G	J	ĸ	IVI	CB	CB	CB											
1,000 pF	102		G	J	r. K	IVI	CB	CB	CB											
2,000 pF	202		G	1	ĸ	M	CB	CB	CB	DC	DC	DC								
2,000 pr 2 200 pF	202	F	G	J	ĸ	M	CB	CB	CB			DC								
2,200 pF	242	F	G		ĸ	M	CB	CB	CB			DC								
2,700 pF	272	F	G	J	ĸ	M	CB	CB	CB	DC	DC	DC								
3.000 pF	302	F	G	J	K	M	CB	CB	CB	DC	DC	DC								
3.300 pF	332	F	G	J	K	M	СВ	CB	CB	DC	DC	DC								
3,600 pF	362	F	G	J	К	М	СВ	СВ	CB	DC	DC	DC								
3,900 pF	392	F	G	J	K	М	СВ	СВ	СВ	DC	DC	DC								
4,300 pF	432	F	G	J	K	М	СВ	CB	CB	DC	DC	DC								
4,700 pF	472	F	G	J	K	М	СВ	CB	CB	DC	DC	DC								
5,100 pF	512	F	G	J	K	M	СВ	CB		DC	DC	DC								
5,600 pF	562	F	G	J	K	M	СВ	CB		DC	DC	DC								
6,200 pF	622	F	G	J	K	M	СВ	CB		DC	DC	DC								
6,800 pF	682	F	G	J	K	М	CB	CB		DC	DC	DC	EB	EB	EB					
7,500 pF	752	F	G	J	K	M	СВ			DC	DC	DC	EB	EB	EB					
8,200 pF	822	F	G	J	K	M	СВ			DC	DC	DC	EB	EB	EB					
9,100 pF	912	F	G	J	K	M	CB			DC	DC	DC	EB	EB	EB					
10,000 pF	103	F	G	J	K	M	СВ			DC	DC	DD	EB	EB	EB					
12,000 pF	123		G	J	K	M				DC	DC	DE	EB	EB	EB	FB	FB	FB	0.0	0.0
15,000 pF	153		G	J	K	IVI NA					עט	DG	EB	EB	EB	FB		FB	GB	GB
10,000 pF	100		C	J	Ň									ED	ED		L R	LD LD		GB
22,000 pF	223		G	J	ĸ	M					DF				EC				GB	GB
33 000 pF	333	F	G		K	M							FR	FR	FF	FR	FR	FR	GR	GR
47.000 pF	473	F	G	.1	K	M				50			EC	EF	EH	FB	FB	FF	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	Ĵ	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	М							EH			FE	FG	FM	GB	GD
120,000 pF	124	F	G	J	K	М										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	
		F	Rated \	/oltag	e (VDC	C)	25	20	100	25	20	Ę	25	50	100	25	20	0	50	0
Capacitance	Capacitance Code		Vol	tage C	ode		3	5	1	3	5	1	3	5	1	3	5	1	5	1
		(Case S	Size /	Serie	s		C0603C	;		C0805C	;		C1206C			C1210C		C18	12C



Table 2 – Chip Thickness/Packaging Quantities

Thickness	Case	Thickness ±	Paper C	Quantity	Plastic (Quantity	
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel	
СВ	0603	0.80 ± 0.07	4,000	10,000	0	0	
DC	0805	0.78 ± 0.10	0	0	4,000	10,000	
DD	0805	0.90 ± 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	
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	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 (mm)

EIA Size	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)				
oouc	oouc	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	0.80	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
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).



Soldering Process

Recommended Soldering Technique:

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

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020



Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 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		a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	3-310-002	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 +/- 2 hours after test conclusion.
Pieced Humidity	MIL STD 202 Method 102	Load Humidity: 1,000 hours 85°C/85%RH and rated voltage. Add 100K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Blased 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.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours. +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+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

Reference	lt	Material	
А		Finish	100% Matte Sn
В	Termination System	Barrier Layer	Ni
С		Epoxy Layer	Ag
D		Base Metal	Cu
E	Inner E	Electrode	Ni
F	Dielectri	ic Material	CaZrO ₃



Note: Image is exaggerated in order to clearly identify all components of 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 VDC – 50 VDC (Commercial & Automotive Grade)

Electronic Components

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 \pm 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

Ordering Information

- · 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
- Pb-Free and RoHS Compliant
- · Capable of Pb-Free reflow profiles
- Non-polar device, minimizing installation concerns
- Tantalum and electrolytic alternative
- Commercial & Automotive (AEC-Q200) grades available



С	2220	C	476	М	4	Ν	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	Packaging/Grade (C-Spec)
	1210 2220	C = Standard	2 significant digits + number of zeros.	K = ±10% M = ±20%	8 = 10 V 4 = 16 V 3 = 25 V 5 = 50 V	N = X8L	1 = KPS Single Chip Stack 2 = KPS Double Chip Stack	C = 100% Matte Sn	7186 = 7" Reel Unmarked 7289 = 13" Reel Unmarked AUTO = Automotive Grade 7" Reel Unmarked AUTO7289 = Automotive Grade 13" Reel Unmarked

¹ Double chip stacks ("2" in the 13th character position of the ordering code) are only available in M (±20%) capacitance tolerance.

One world. One KEMET

© KEMET Electronics Corporation • P.O. Box 5928 • Greenville, SC 29606 (864) 963-6300 • www.kemet.com



Dimensions – Millimeters (Inches)



Chip Stack	EIA Size Code	Metric Size Code	L Length	W Width	H Height	LW Lead Width	Mounting Technique
Single	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
Double	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)	

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

Pb-Free and RoHS Compliant.



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)
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 @ 25°C	3.5% (10 V and 16 V) and 2.5% (25 V and 50 V)
Insulation Resistance (IR) 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.

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

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

1 kHz \pm 50 Hz and 1.0 \pm 0.2 Vrms.

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		3.0		10% of Initial Limit		
X8L	16 / 25	All	5.0	±20%			
	10		7.5				



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

		Case Size / Series				C12	10C					C22	20C			
Canacitance	Сар	v v	oltage Co	de	8	4	3	5	1	Α	8	4	3	5	1	Α
oapacitance	Code	Rate	d Voltage	(VDC)	10	16	25	50	100	250	10	16	25	50	100	250
		Capac	itance Tol	erance		Produ	ct Availab	ility and C	hip Thickn	iess Code	s – See Ta	ble 2 for C	hip Thickr	ness Dime	nsions	
						Single	e 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	М							JP					
						Doubl	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			M							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	Сар	v	oltage Co	de	8	4	3	5	1	Α	8	4	3	5	1	Α
	Code Case Size / Series				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/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	METRIC SIZE	Media	n (Nom	inal) La	nd Prot	rusion
OODL	CODE	С	Y	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



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_{min} to T_{max})	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:
Calderahilitu		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 @ 250°C
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +150°C). Measurement at 24 hours +/- 2 hours after test conclusion.
Discod Utersidite		Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Blased 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.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+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

Reference	ltem	Material
А	Leadframe	Phosphor Bronze – Alloy 510
В	Leadframe Attach	HMP Solder
С		Cu
D	Termination	Ni
E		Sn
F	Inner Electrode	Ni
G	Dielectric Material	BaTiO ₃



Note: Image is exaggerated in order to clearly identify all components of construction. HMP = High Melting Point

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 Detonation, High Voltage, High Temperature 200°C, C0G Dielectric, 500 – 2,000 VDC (Industrial Grade)



Overview

KEMET's Industrial Grade Pulse Detonation Series surface mount capacitors in COG dielectric deliver reliable, high voltage and high temperature performance required for operation in harsh environments, specifically detonation 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 Detonation capacitors average greater than 30% higher breakdown voltage than competitive precious metal electrode (PME) devices with similar capacitance and 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 Detonation 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 Detonation surface mount MLCCs are manufactured in state-of-the-art ISO/TS 16949:2002 certified facilities and are proven to function reliably in harsh, high temperature and high humidity down-hole environments.

Benefits

- -55°C to +200°C operating temperature range
- Pb-Free and RoHS Compliant
- · Base metal technology
- High breakdown voltage capability up to +200°C
- · Higher UVBD capability than competitive dielectric technologies
- Capacitance offerings ranging from 0.5 pF up to 0.15 μF
- Available capacitance tolerances of $\pm 5\%$, $\pm 10\%$ or $\pm 20\%$
- Extremely low ESR and ESL
- High thermal stability

Ordering Information



	Contact KEMET for ordering information								
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC) ¹	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/Grade (C-Spec) ³
	2824 3040 3640 4040 4540	H= High Temp (200°C)	2 Significant Digits + Number of Zeros	J = ±5% K = ±10% M = ±20%	C = 500 V B = 630 V D = 1,000 V F = 1,500 V G = 2,000 V	G = C0G	W = Pulse Detonation	C = 100% Matte Sn	Contact KEMET for packaging availability and details

¹ For breakdown voltage (UVBD) values see Table 1, Pulse Detonation Series, Capacitance Range Waterfall.

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

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



Dimensions – Millimeters (Inches)



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)				
3640	9.10 ± 0.40 (0.358 ± 0.016)	10.20 ± 0.40 (0.402 ± 0.016)	2.5 (0.098)	0.76 ± 0.40 (0.030 ± 0.016)	N/A	Solder Reflow Only
4040	10.20 ± 0.40 (0.402 ± 0.016)	10.20 ± 0.40 (0.402 ± 0.016)				
4540	11.40 ± 0.40 (0.449 ± 0.016)	10.20 ± 0.40 (0.402 ± 0.016)				

Benefits

- 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 detonation circuits for down-hole oil exploration and perforation.

Qualification/Certification

Industrial Grade pulse detonation products are designed to meet customer-specific testing requirements.

Environmental Compliance

Pb-Free and RoHS Compliant.





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%
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)
Ultimate Voltage Breakdown (UVBD)	300% of rated voltage for voltage rating of < 1,000 V 250% of rated voltage for voltage rating of 1,000 V 240% of rated voltage for voltage rating of 1,500 V (5 ±1 seconds and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit @ 25°C	0.1%
Insulation Resistance (IR) Limit @ 25°C	1000 megohm microfarads or 100 GΩ (500 VDC 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 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

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			

Ultimate Voltage Breakdown (UVBD) – Typical Mean Breakdown Voltage Ratings

Rated Voltage (VDC)	Breakdown Voltage/UVBD (VDC)
500	3X Rated
630	3X Rated
1,000	2.5X Rated
1,500	2.3X Rated
2,000	2X Rated



Electrical Characteristics







Table 1 – Pulse Detonation Series, Capacitance Range Waterfall

Case S	ize (in.)			282	4				304	0				364	0				404	0				454()	
Length	mm (in.)		7 (0.1	7.10 ± 0 280 ± 0	.40).016)			7. (0.3	60 ± 0 00 ± 0	0.40 0.016)			9 (0.3	.10 ± 0 58 ± 0	.40 .016)			10 (0.4	.20 ± 0	0.40).016)			11. (0.4	.40 ± 0 49 ± 0).40 .016)	
Width	mm (in.)		6 (0.)	6.10 ± 0 240 ± 0	.40).016)			10 (0.4	.20 ± 02 ± 0	0.40).016)			10 (0.4	.20 ± 0 02 ± 0	0.40 0.016)			10 (0.4	.20 ± 0	0.40).016)			10 (0.4	.20 ± 0 02 ± 0).40 .016)	
Thickness Maximum	mm (in.)			2.5 (0.098	3)				2.5 (0.098	3)				2.5 (0.098	3)				2.5 (0.098	8)				2.5 (0.098	5)	
Bandwidth	mm (in.)		0 (0.0).76 ± 0 030 ± 0).40).016)			0. (0.0	76 ± 0 30 ± 0).40).016)			0. (0.0	.76 ± 0 30 ± 0	.40 .016)			0 (0.0	.76 ± 0)30 ± 0).40).016)			0. (0.0)	76 ± 0. 30 ± 0	.40 .016)	
Rated Volt	age (VDC)	500	630	1K	1.5K	2K	500	630	1K	1.5K	2K	500	630	1K	1.5K	2K	500	630	1K	1.5K	2K	500	630	1K	1.5K	2K
Voltag	e Code	С	В	D	F	G	C	В	D	F	G	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
Breakdown V	/oltage (VDC)	1.5K	1.8K	2.5K	3.5K	4K	1.5K	1.8K	2.5K	3.5K	4K	1.5K	1.8K	2.5K	3.5K	4K	1.5K	1.8K	2.5K	3.5K	4K	1.5K	1.8K	2.5K	3.5K	4K
Capacitance	Capacitance Tolerance								Сара	acitan	ce C	ode (Avai	lable	Maxi	mum	n Cap	acita	ance)	1						
6,800pF 8,200pF 0.01µF 0.012µF 0.015µF 0.022µF 0.027µF 0.033µF 0.039µF 0.039µF 0.047µF 0.056µF 0.068µF 0.068µF 0.068µF 0.072µF 0.082µF 0.082µF 0.082µF	J = ±5% K = ±10% M = ±20%	683	333	223	682		104	683	473	153			723	473	153			104	623	223	153		104	683	273	183
0.12µF 0.15µF												124					154					154				
Rated Volt	tage (VDC)	500	630	1K	1.5K	2K	500	630	1K	1.5K	2K	500	630	1K	1.5K	2K	500	630	1K	1.5K	2K	500	630	1K	1.5K	2K
Voltag	e Code	С	В	D	F	G	С	в	D	F	G	С	в	D	F	G	с	В	D	F	G	С	в	D	F	G
Breakdown V	/oltage (VDC)	1.5K	1.8K	2.5K	3.5K	4K	1.5K	1.8K	2.5K	3.5K	4K	1.5K	1.8K	2.5K	3.5K	4K	1.5K	1.8K	2.5K	3.5K	4K	1.5K	1.8K	2.5K	3.5K	4K

¹ Only maximum available CV (capacitance /voltage) values are highlighted. Lower CV values are available upon request. Please contact KEMET to discuss your specific CV requirement.



Table 2 – Chip Capacitor Land Pattern Design Recommendations per IPC–7351

Size Code (in)		Dens Maxi Land P	sity Lev imum (I rotrusio	rel A: Most) on (mm))		Dens Medi Land P	sity Lev an (Nor rotrusio	rel B: ninal) on (mm))		Dens Mini Land P	sity Lev mum (L rotrusio	rel C: east) on (mm))
	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	X	V1	V2
2824	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	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	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
4040	5.00	1.70	10.70	12.70	11.70	4.90	1.50	10.60	11.80	11.10	4.80	1.30	10.50	11.10	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).



Soldering Process

Recommended Soldering Technique:

Solder reflow only

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020



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

Reference	lte	em	Material
А		Finish	100% Matte Sn
В	Termination System	Barrier Layer	Ni
С	, , , , , , , , , , , , , , , , , , ,	Base Metal	Cu
D	Inner E	lectrode	Ni
E	Dielectric	c Material	CaZrO ₃



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



Overview

KEMET's high voltage surface mount MLCCs in COG dielectric feature a 125°C maximum operating temperature and are considered "stable." The Electronics Industries Alliance (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.

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 MLCCs 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.

Automotive Grade is available for applications requiring proven, reliable performance in harsh environments. Whether under-hood or in-cabin, these capacitors are designed for mission and safety critical automotive circuits. Stricter testing protocol and inspection criteria have been established for automotive grade products in recognition of potentially harsh environmental conditions. KEMET automotive grade series capacitors meet the demanding Automotive Electronics Council's AEC–Q200 qualification requirements.



Ordering Information

С	1210	С	332	J	С	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) ³
	0805 1206 1210 1808 1812 1825 2220 2225	C = Standard	2 Significant Digits + Number of Zeros Use 9 for 1.0 - 9.9 pF Use 8 for 0.599 pF ex. 2.2 pF = 229 ex. 0.5 pF = 508	$B = \pm 0.10 \text{ pF} \\ C = \pm 0.25 \text{ pF} \\ D = \pm 0.5 \text{ pF} \\ F = \pm 1\% \\ G = \pm 2\% \\ J = \pm 5\% \\ K = \pm 10\% \\ M = \pm 20\%$	C = 500 V B = 630 V D = 1,000 V F = 1,500 V G = 2,000 V Z = 2,500 V H = 3,000 V	G = COG	A = N/A	C = 100% Matte Sn L = SnPb (5% minimum)	Blank = Bulk TU = 7" Reel Unmarked AUTO = Automotive Grade 7" Reel Unmarked

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

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

^{2,3} Additional termination finish options may be available. Contact KEMET for details.

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



Dimensions – Millimeters (Inches)





Electrodes / Conductive Metalization

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)	See Table 2 for	0.60 (.024) ±0.35 (.014)		
1812	4532	4.50 (.177) ±0.30 (.012)	3.20 (.126) ±0.30 (.012)	Thickness	0.60 (.024) ±0.35 (.014)	N/A	Calder Daflaw Only
1825	4564	4.50 (.177) ±0.30 (.012)	6.40 (.252) ±0.40 (.016)	-	0.60 (.024) ±0.35 (.014)		Solder Reflow Uniy
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)	1	0.60 (.024) ±0.35 (.014)		

Benefits

- -55°C to +125°C operating temperature range
- RoHS 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 0.039 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
- 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% 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.



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

RoHS Compliant (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%
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)
Dissipation Factor (DF) Maximum Limit @ 25°C	0.1%
Insulation Resistance (IR) Limit @ 25°C	1,000 megohm microfarads or 100 G Ω (500 VDC 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 Vrms ±0.2 V if capacitance \leq 1,000 pF

1 kHz \pm 50 Hz and 1.0 Vrms \pm 0.2 V 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 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								



Table 1A – Capacitance Range/Selection Waterfall (0805 – 1808 Case Sizes)

		Case Size / Series	CO	805C		C	1206	5C			С	1210	С				C	1808	C		
Consoitonoo	Сар	Voltage Code	c	B D	с	В	D	F	G	c	В	D	F	G	с	В	D	F	G	Z	Н
Capacitance	Code	Rated Voltage (VDC)	500	630 1000	500	630	1000	1500	2000	500	630	1000	1500	2000	500	630	1000	1500	2000	2500	3000
		Capacitance		·	-		Р	roduc	t Ava	ilabilit	ty and	l Chip	Thick	kness	Code	S					
1.0 - 9.1 pF*	109 - 919*	B C D	DG	DG DG				Jee	able			IIICKI	<u>ess D</u>	men	LB	LB	LB	LB	LB	LB	LB
10 pF - 47pF*	100 - 470*	FGJKM	DG	DG DG	EG	EG	EG	EG	EG	FM	FM FM	FM	FM FM	FM	LB	LB	LB	LB	LB	LB	LB
56 pF	560	F G J K M	DG	DG DG DG	EF	EF	EF	EG	EG	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
62 pF	620	F G J K M	DG	DG DG	EF	EF	EF	EG	EG	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
68 pF	680	F G J K M	DG	DG DG	EF	EF	EF	EG	EG	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
75 pF 82 nF	750 820	F G J K M	DG			FF	FF	EG	EG	FM	FM	FM	FM	FM		LB I R	I B	LB I R	LB I R	LB I B	LB I B
91 pF	910	F G J K M	DG	DG DG	EF	EF	EF	EG	EG	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
100 pF	101	F G J K M	DG	DG DG	EF	EF	EF	EG	EG	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LC	LB
110 pF	111	F G J K M	DG	DG DG	EF	EF	EF	EG	EG	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LC	LB
120 pF 130 pF	121	FGJKM	DG			EF	EF	EG	EG	FG	FG	FG	FM	FM					LB		LB
150 pF	151	F G J K M	DG	DG DG	EF	EF	EF	EG	EG	FG	FG	FG	FM	FM		LA	LA	LA	LB	LC	LC
160 pF	161	F G J K M	DG	DG DG	EF	EF	EF	EG	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LC	LC	LC
180 pF	181	F G J K M	DG	DG DG	EF	EF	EF	EG	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LC	LC	LC
200 pF	201	FGJKM	DG	DG DG		EG	EG	EG	EG	FG	FG	FG	FM	FM EM		LA		LA		LC	
220 pF 240 pF	221	F G J K M	DG		FF	FG	FG	FG	FG	FG	FG	FG	FM	FM				IB			
270 pF	271	F G J K M	DG	DG DG	EF	EG	EG	EG	EG	FG	FG	FG	FK	FK	LA	LA	LA	LB	LC	LC	
300 pF	301	F G J K M	DG	DG	EF	EG	EG	EG		FG	FG	FG	FK	FK	LA	LA	LA	LB	LC	LC	
330 pF	331	FGJKM	DG	DG	EF	EG	EG	EG		FG	FG	FG	FK	FK	LA	LA	LA	LB	LC	LC	
360 pF 390 nF	301	F G J K M	DG	DG	EG FG	EG	EG	EG		FG	FG	FG	FK	FS				LB			
430 pF	431	F G J K M	DG	DG	EG	EG	EG	EG		FG	FM	FM	FS	FS	LA	LB	LB	LC	LA	20	
470 pF	471	F G J K M	DG	DG	EG	EG	EG	EG		FG	FM	FM	FS	FS	LA	LB	LB	LC	LA		
510 pF	511	F G J K M	DG	DG	EG	EG	EG	EG		FG	FM	FM	FS	FS	LA	LB	LB	LC	LB		
560 pF	561	FGJKM	DG	DG	EG	EG	EG	EG		FG	FM	FM	FS	FS							
680 pF	681	F G J K M	DG		EG	EG	EG			FG	FM	FM	FS	FS	LA	LB	LB	LA	LC		
750 pF	751	F G J K M	DG		EG	EF	EG			FG	FM	FM	FM		LB	LB	LB	LA			
820 pF	821	F G J K M	DG		EG	EF	EG			FG	FM	FM	FM		LB	LB	LB	LA			
910 pF	911	F G J K M			EG	EF	EG			FM	FM	FM	FY		LB	LB	LB	LA			
1,000 pF	102	FGJKM			EG FF	EF	EG			FM	FIVI	FM	FY		LB	LB	LB	LB			
1,200 pF	122	F G J K M			EF	EG				FM	FK	FK	FS		LC	LC	LC	LC			
1,300 pF	132	F G J K M			EF	EG				FM	FS	FS			LC	LC	LC	LC			
1,500 pF	152	F G J K M			EF	EG				FK	FS	FS			LC	LC	LC	LC			
1,600 pF 1,800 pF	162	FGJKM				EG				FK	FS	FS									
2,000 pF	202	F G J K M			EG	20				FK	FL	FS			LC	LA	LB				
2,200 pF	222	F G J K M			EG					FK	FL	FS			LC	LA	LB				
2,400 pF	242	F G J K M			EG					FS	FL	FS			LC	LA	LB				
2,700 pF	272	FGJKM			EG					FS	FL	FS				LA	LC				
3,300 pF	332	F G J K M								FS	FM				LA	LA					
3,600 pF	362	F G J K M								FL	FM				LA	LB					
3,900 pF	392	F G J K M								FL	FY				LA	LB					
4,300 pF	432									FM EM	FY										
5,100 pF	512	F G J K M								FY	FS				LA	10					
		Rated Voltage (VDC)	500	630 1000	500	630	1000	1500	20 00	500	630	1000	1500	2000	500	630	1000	1500	2000	2500	3000
Capacitance	Cap Code	Voltage Code	с	B D	с	В	D	F	G	с	В	D	F	G	с	В	D	F	G	Z	н
		Case Size / Series	C	0805C		c	1206	С			C	:1210	2				C	:1808	C		

*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

		Case Size / Series	С	0805	iC		C	1206	SC			С	1210	C				C	1808	C		
	Cap	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)	500	630	1000	500	630	1000	1500	2000	500	630	1000	1500	2000	500	630	1000	1500	2000	2500	3000
		Capacitance						Р	roduc	t Ava	ilabili	ty and	d Chip	Thic	kness	Code	s					
		Tolerance							See 1	able	2 for C	<u>. hip T</u>	hickn	ess D	imen	sions						
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											
8,200pF	822	F G J K M									FS											
		Rated Voltage (VDC)	500	630	1000	500	630	1000	1500	2000	500	630	1000	1500	2000	500	630	1000	1500	2000	2500	3000
Capacitance	Cap 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	0	0805	C		C	1206	c			0	C1210	C				C	18080			

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

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

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

		Case Size / Series			C1	812	2C					C	182	5C					C2	222	OC					C2	222	5C		
Canacitance	Сар	Voltage Code	с	в	D	F	G	z	н	c	в	D	F	G	z	н	с	в	D	F	G	z	н	с	в	D	F	G	z	н
Oapacitance	Code	Rated Voltage (VDC)	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000
		Capacitance Tolerance									Pr	odu See	ct Av Tabl	vaila e 2 f	bility or Cl	y and hip T	d Chi Thick	p Th ness	ickn s Din	iess nens	Cod	es S								
10 - 91 pF*	100 - 910*	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
100 - 180 pF*	101 - 181*	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
200 pF	201	F G J K M	GH	GH	GH	GH	GH	GK	GM	HE	ΗE	HE	HE	HE	HE	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
220 pF	221	F G J K M	GH	GH	GH	GH	GH	GK	GM	HE	ΗE	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	ΗE	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	ΗE	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 M	GH	GH	GH	GH	GH	GK	GM	HE	ΗE	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	GH	GK	GO	HE	ΗE	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	ΗE	HE	HE	HE	HE	HG	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	HE	ΗE	HE	HE	HE	HE	HG	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		HE	ΗE	HE	HE	HE	HE	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	GK	GK	GK	GK		HE	HE	HE	HE	HE	HE	HJ	JE	JE	JE	JE	JE	JK	JK	KF	KF	KF	KF	KE	KE	KF
510 pF	511	F G J K M	GH	GH	GH	GK	GH	GM		HE	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 M	GH	GH	GH	GK	GH	GM		HE	ΗE	HE	HE	HG	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	HE	HE	HG	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	GH	GH	GK	GH	GO		HE	HE	HE	HE	HG	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	GH	GH	GK	GK			HE	HE	HE	HG	HG	HG		JE	JE	JE	JK	JK	JK	JL	KE	KE	KE	KF	KE	KF	KH
820 pF	821	FGJKM	GH	GH	GH	GK	GK			HE	HE	HE	HG	HG	HG		JE	JE	JE	JK	JK	JK	JN	KE	KE	KE	KF	KE	KF	KJ
910 pF	911	FGJKM	GH	GH	GH	GH	GM			HE	HE	HE	HG	HG	HG		JE	JK	JK	JK	JK	JK	JN	KE	KE	KE	KF	KE	KF	KJ
1,000 pF	102	F G J K M	GH	GH	GH	GH	GM			HE	HE	HE	HG	HG	HG		JE	JK	JK	JK	JK	JK	JN	KE	KE	KE	KF	KE	KF	KJ
1,100 pF	112	F G J K M	GH	GK	GK	GH	GO			HE	HE	HE	HG	HG	HJ		JE	JK	JK	JK	JK	JK		KE	KE	KE	KF	KF	KF	
		Rated Voltage (VDC)	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000
Capacitance	Cap	Voltage Code	с	В	D	F	G	z	Н	c	В	D	F	G	z	H	с	В	D	F	G	z	н	с	В	D	F	G	z	н
-	Code	Case Size / Series			С [.]	1812	c					С	1825	5C					C	2220	C					C	2225	C		

*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			C	1812	2 C					C	182	5C					C2	222	0C					C2	222	5C		
Canacitance	Сар	Voltage Code	c	В	D	F	G	z	н	c	в	D	F	G	z	н	с	в	D	F	G	z	н	с	в	D	F	G	z	н
oupuonanoc	Code	Rated Voltage (VDC)	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000
		Capacitance	1							Pr	odu	ict A	∖vai	lab	ility	and	d Cł	nip 1	Thic	kne	ss	Coc	es							
		Tolerance							1		See	Tab	le 2	2 foi	r Ch	ip T	<u>hic</u>	kne	ss [Dim	ens	ion	s				1			
1,200 pF	122	FGJKM	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	FGJKM	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	FGJKM	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	FGJKM	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	FGJKM	GK	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 M	GK	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 M	GK	GK	GK	GO				HE	HG	HG	HE	HJ			JE	JK	JK	JE	JK			KE	KE	KE	KF	KF	KJ	
2,400 pF	242	FGJKM	GK	GH	GK	GO				HE	HG	HG	HE	HJ			JK	JK	JK	JE	JL			KE	KE	KE	KE	KH		
2,700 pF	272	FGJKM	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				JK	JK	JK	JK	JN			KE	KE	KE	KE	KJ		
3,600 pF	362	F G J K M	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					HG	HG	HG	HJ				JK	JK	JK	JK	JN			KE	KF	KF	KF	KJ		
4,300 pF	432	F G J K M	GH	GH	GO					HG	HG	HG	HJ				JK	JK	JK	JK				KE	KF	KF	KF			
4,700 pF	472	F G J K M	GH	GH	GO					HG	HG	HG	HJ				JK	JK	JK	JL				KE	KF	KF	KH			
5,100 pF	512	F G J K M	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			
6,200 pF	622	F G J K M	GH	GK						HG	HE	HG					JK	JE	JE	JN				KE	KF	KF	KJ			
6,800 pF	682	F G J K M	GH	GM						HG	HE	HJ					JK	JE	JK	JN				KE	KF	KF	KJ			
7,500 pF	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	F G J K M	GM	GO						HE	HG	HK					JE	JE	JL					KF	KE	KH				
10,000 pF	103	F G J K M	GM	GO						HE	HG	HK					JE	JE	JL					KF	KE	KH				
12,000 pF	123	F G J K M	GO							HE	HG						JE	JK	JN					KE	KE	KH				
15,000 pF	153	F G J K M	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								ΗK							JN							KH						
39,000 pF	393	F G J K M																			<u> </u>			KJ						
		Rated Voltage (VDC)	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000
Capacitance	Cap	Voltage Code	c	В	D	F	G	z	н	c	в	D	F	G	z	н	С	в	D	F	G	z	н	c	в	D	F	G	z	н
	Code	Case Size / Series			C	1812	2C					C	182	5C			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 2 – Chip Thickness/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
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
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 3 – Chip Capacitor Land Pattern Design Recommendations per IPC–7351

EIA Size	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)							
ooue	ooue	С	Y	X	V1	V2	C	Y	X	V1	V2	С	Y	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
1210 ¹	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 \geq 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).



Soldering Process

Recommended Soldering Technique:

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

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC / JEDEC J-STD-020



Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method			
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.			
Board Flex	JIS-C-6429	Appendix 2, Note: 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:			
Saldarability		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 +/- 2 hours after test conclusion.			
Discod Humidity	MIL STD 202 Method 102	Load Humidity: 1,000 hours 85°C/85% RH and 200 VDC maximum. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.			
Blased 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.			
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.			
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air – Air.			
High Temperature Life	MIL-STD-202 Method 108	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

Reference	lt	em	Material		
А		Finish	100% Matte Sn	SnPb (5% min)	
В	Termination System	Barrier Layer	Ni		
С	,	Base Metal	Cu		
D	Inner E	lectrode	Ni		
E	Dielectri	c Material	CaZrO ₃		



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



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 $\pm 15\%$ 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.

Automotive Grade is available for applications requiring proven, reliable performance in harsh environments. Whether under-hood or in-cabin, these capacitors are designed for mission and safety critical automotive circuits. Stricter testing protocol and inspection criteria have been established for automotive grade products in recognition of potentially harsh environmental conditions. KEMET automotive grade series capacitors 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	Voltage	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec) ²
	0805 1206 1210 1808 1812 1825 2220 2225	C = Standard	2 Significant Digits + Number of Zeros	J = ±5% K = ±10% M = ±20%	C = 500 V B = 630 V D = 1,000 V F = 1,500 V G = 2,000 V Z = 2,500 V H = 3,000 V	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% minimum) C = 100% Matte Sn	Blank = Bulk TU = 7" Reel Unmarked TM = 7" Reel Marked AUTO = Automotive Grade 7" Reel Unmarked

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.



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)	See Table 2 for	0.60 (.024) ± 0.35 (.014)		
1812	4532	4.50 (.177) ± 0.30 (.012)	3.20 (.126) ± 0.30 (.012)	Thickness	0.60 (.024) ± 0.35 (.014)	N/A	Solder Beflow Only
1825	4564	4.50 (.177) ± 0.30 (.012)	6.40 (.252) ± 0.40 (.016)		0.60 (.024) ± 0.35 (.014)		Solder Reliow 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)		

Benefits

- -55°C to +125°C operating temperature range
- Industry-leading CV values
- · Exceptional performance at high frequencies
- Pb-Free and RoHS 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 10 pF to 0.33 μF

- Available capacitance tolerances of ±5%, ±10%, and ±20%
- Low ESR and ESL
- · Non-polar device, minimizing installation concerns
- · Commercial and 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% 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.

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

Pb-Free and RoHS Compliant (excluding SnPb termination finish option).



Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +125°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
Dielectric Withstanding Voltage (DWV)	150% of rated voltage for voltage rating of < 1,000 V 120% of rated voltage for voltage rating of ≥ 1,000 V (5 ±1 second and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit @ 25°C	2.5%
Insulation Resistance (IR) Limit @ 25°C	See Insulation Resistance Limit Table (500 VDC applied for 120 ±5 seconds @ 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 μF

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

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



Post Environmental Limits

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


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

		Cas	se Siz Series	ze / s	C)80	5C		C1	206	6C			Cí	121(C				C1	808	BC					C	1812	2C		
Capacitance	Cap	Vol	tage Co	ode	С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	Z	н	C	В	D	F	G	Z	н
	Code	Rated	Voltage	(VDC)	500	630	1000	500	630	1000	1500	2000	500	630	1000	1500	2000	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000
		Са	pacitan oleranc	ice			I	Prod	uct /	Avail	abili	ty ar	nd Cl	hip T	hick	ness	s Co	des -	See	Tabl	le 2 f	for C	hip	Thic	knes	s Di	mens	sions	;		
10 pF	100	J	K	M	DG	DG	DG	EG	EG	EG	EG	EG	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK	GK	GK	GK	GK	GK	GK
11 pF	110	J	K	M	DG	DG	DG	EG	EG	EG	EG	EG	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK	GK	GK	GK	GK	GK	GK
13 pF	130	J	K	M	DG	DG	DG	EG	EG	EG	EG	EG	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK	GK	GK	GK	GK	GK	GK
15 pF	150	J	K	М	DG	DG	DG	EG	EG	EG	EG	EG	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK	GK	GK	GK	GK	GK	GK
16 pF	160	J	K	M	DG	DG	DG	EG	EG	EG	EG	EG	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK	GK	GK	GK	GK	GK	GK
20 pF	200	J	K	M	DG	DG	DG	EG	EG	EG	EG	EG	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK	GK	GK	GK	GK	GK	GK
22 pF	220	J	к	М	DG	DG	DG	EG	EG	EG	EG	EG	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK	GK	GK	GK	GK	GK	GK
24 pF	240	J	K	М	DG	DG	DG	EG	EG	EG	EG	EG	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK	GK	GK	GK	GK	GK	GK
27 pF	270	J	K	M	DG	DG	DG	EG	EG	EG	EG	EG	FM	FM	FM	FM	FM		LB	LB	LB			LB	GK	GK	GK	GK	GK	GK	GK
33 pF	330	J	K	M	DG	DG	DG	EG	EG	EG	EG	EG	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK	GK	GK	GK	GK	GK	GK
36 pF	360	J	К	М	DG	DG	DG	EG	EG	EG	EG	EG	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	EG	EG	EG	EG	EG	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK	GK	GK	GK	GK	GK	GK
43 pF 47 nF	430	J	ĸ	M	DG	DG	DG	EG	EG	EG	EG	EG	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	IB	IB	GK	GK	GK	GK	GK	GK	GK
51 pF	510	J	ĸ	M	DG	DG	DG	EF	EF	EF	EG	EG	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK	GK	GK	GK	GK	GK	GK
56 pF	560	J	К	М	DG	DG	DG	EF	EF	EF	EG	EG	FΜ	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK	GK	GK	GK	GK	GK	GK
62 pF	620	J	K	M	DG	DG	DG	EF	EF	EF	EG	EG	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK	GK	GK	GK	GK	GK	GK
75 pF	750	J	K	M	DG	DG	DG	EF	EF	EF	EG	EG	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK	GK	GK	GK	GK	GK	GK
82 pF	820	J	K	М	DG	DG	DG	EF	EF	EF	EG	EG	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK	GK	GK	GK	GK	GK	GK
91 pF	910	J	K	М	DG	DG	DG	EF	EF	EF	EG	EG	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB	GK	GK	GK	GK	GK	GK	GK
100 pF	101	J	K	M	DG	DG	DG	타	EF	EF	EG	EG	FM FM	FM	FM	FM	FM FM	LB	LB	LB	LB	LB		LB	GK	GK	GK	GK	GK	GK	GK
120 pF	121	J	ĸ	M	DG	DG	DG	EF	EF	EF	EG	EG	FM	FM	FM	FM	FM	LA	LA	LA	LA	LB	LC	LB	GK	GK	GK	GK	GK	GK	GK
130 pF	131	J	К	М	DG	DG	DG	EF	EF	EF	EG	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LB	LC	LB	GK	GK	GK	GK	GK	GK	GK
150 pF	151	J	K	M	DG	DG	DG	EF	EF	EF	EG	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LB	LC	LB	GK	GK	GK	GK	GK	GK	GK
220 pF	221	J	ĸ	M	DG	DG	DG	FF	FG	FG	FG	FG	FG	FG	FG	FM	FM	LA	LA	LA	LA		LC	LB	GH	GK	GH	GH	GH	GK	GK
270 pF	271	J	K	M	DG	DG	DG	EF	EG	EG	EG	EG	FG	FG	FG	FK	FK	LA	LA	LA	LB	LC	LC	LC	GH	GH	GH	GH	GH	GK	GK
330 pF	331	J	K	М	DG	DG	DG	EF	EG	EG	EG	EG	FG	FG	FG	FK	FK	LA	LA	LA	LB	LC	LC	LC	GH	GH	GH	GH	GH	GK	GK
390 pF	391	J	K	M	DG	DG	DG	EG	EG	EG	EG	EG	FG	FG	FG	FK	FS		LA	LA	LB			LC	GK	GK	GK	GK	GK	GK	GK
560 pF	561	J	K	M	DG	DG	DG	EG	EG	EG	EF	EG	FG	FM	FM	FS	FL	LA	LB	LB	LC	LB	LB	LC	GH	GH	GH	GK	GH	GK	GK
680 pF	681	J	К	М	DG	DG	DG	EG	EG	EG	EF	EG	FG	FM	FM	FS	FL	LB	LB	LB	LA	LB	LC	LC	GH	GH	GH	GK	GH	GK	GK
820 pF	821	J	K	М	DG	DG	DG	EG	EF	EF	EF	EG	FG	FM	FM	FL	FL	LB	LB	LB	LA	LB	LC	LC	GH	GH	GH	GK	GH	GK	GK
1,000 pF 1 200 pF	102	J	ĸ	M	DG	DG	DG	EG	EF FF	EF FF	EF FG	EG	FM	FM	FM	FL FI	FM	LC	LC	LB	LA	LB		LC	GH	GH	GK	GH	GH	GK	GK
1,500 pF	152	J	K	М	DG	DG	DG	EF	EF	EF	EG	EG	FK	FS	FS	FL	FM	LC	LC	LC	LB	LC	LB		GK	GK	GK	GH	GH	GK	
1,800 pF	182	J	K	М	DG	DG	DG	EF	EF	EF	EG	EG	FK	FS	FS	FL	FM	LC	LC	LC	LB	LC	LC		GK	GK	GK	GH	GH	GK	
2,000 pF	202	J	K	M	DG	DG	DG	EF	EF	EF	EG	EG	FK	FL	FL	FL	FM	LC	LA	LA	LB	LC	LC		GK	GK	GK	GH	GH	GK	
2,200 pF 2,700 pF	272	J	K	M	DG	DG	DG	EF	EF	EF	EG	EG	FS	FL	FL	FL	FM	LC	LA	LA	LB	LC			GK	GH	GH	GH	GK	GM	
3,300 pF	332	J	К	М	DG	DG	DG	EF	EF	EF	EG		FS	FL	FL	FL	FM	LA	LA	LA	LB	LA			GK	GH	GH	GH	GK	GM	
3,900 pF	392	J	K	М	DG	DG	DG	EF	EF	EF	EG		FL	FL	FL	FL	FK	LA	LA	LA	LB	LB			GK	GH	GH	GH	GK	GO	
4,700 pF 5,600 pF	472	J	K	M	DG	DG	υG	EF FF	EF FF	EF FF	EG FF		FL	FL	FL FI	FL	FK	LA I A		LA	LB	LC			GH	GH GH	GH GH	GH	GH	GO	
6,800 pF	682	J	K	M	DG	DG		EG	EG	EG	EF		FL	FL	FL	FM	FS	LA	LB	LB	LC				GH	GH	GH	GK	GM		
8,200 pF	822	J	K	М	DG	DG		EG	EG	EG	EF		FL	FL	FL	FK		LA	LB	LB	LC				GH	GH	GH	GK	GM		
		Rated	Voltage	(VDC)	500	630	1000	500	630	1000	1500	2000	500	630	1000	1500	2000	500	630	1000	1500	20 00	2500	3000	500	630	1000	1500	2000	2500	30 00
Capacitance	Cap Code	Vol	tage Co	ode	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
		Case	Size / S	e / Series		0805	с		С	1206	с			С	1210	с				C	1808	C					С	1812	С		



Table 1A – Capacitance Range/Selection Waterfall (0805 – 1812 Case Sizes) cont'd

		Ca	se Si Serie	ze / s	C)80	5C		C	120	6C			C	121(OC				C 1	180	8C					C	1812	2C		
Canacitance	Сар	Vo	ltage C	ode	с	в	D	с	в	D	F	G	c	в	D	F	G	с	в	D	F	G	z	н	с	в	D	F	G	z	н
oupuonanoe	Code	Rated	Voltag	e (VDC)	8	30	8	8	30	00	200	8	8	30	00	200	8	8	30	8	500	8	200	8	8	30	8	500	8	200	000
		- Cr	nacita		5	9	≓	5	9	=	÷	5	5	9	Ŧ	÷	5	5	9	Ŧ	÷	5	ñ	Ř	2	9	Ŧ	÷	5	5	3(
			oleran	ce				Prod	uct	Avai	labili	ity aı	nd C	hip T	hick	nes	s Co	des -	See	Tab	le 2	for C	hip ⁻	Thic	knes	s Dir	nens	sions	;		
10,000 pF	103	J	K	М	DG			EG	EG	EG	EG		FL	FL	FL	FK		LA	LB	LB	LC				GH	GH	GH	GK	GO		
12,000 pF	123	J	K	M	DG			EG	EJ	EJ			FL	FL	FL	FK		LA	LC	LC	LB				GH	GK	GK	GK			
15,000 pF	153	J	K	M				EG	EJ	EJ			FL	FL	FL	FL		LA	LC	LC	LC				GH	GK	GK	GH			
18,000 pF	183	J	K	M				EJ	EJ	EJ			FL	FL	FL	FM		LA	LE	LE					GH	GK	GK	GM			
22,000 pF	223	J	K	M				EJ	EJ	EJ			FL	FM	FM	FM		LA	LE	LE					GH	GK	GK	GM			
27,000 pF	273	J	K	M				EJ	EJ				FΜ	FK	FK	FK		LA	LA	LA					GH	GB	GB	GO			
33,000 pF	333	J	K	M				EJ	EJ				FΜ	FG	FH	FS		LC	LA	LA					GH	GB	GB	GO			
39,000 pF	393	J	K	M				EJ					FK	FG	FH	FS		LC	LA	LA					GH	GB	GB				
47,000 pF	473	J	K	M				EJ					FK	FH	FK			LC	LA	LB					GH	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	1			EJ					FG	FK	FS			LA	LA	LC					GE	GE	GE				
82,000 pF	823	J	K	M	1								FH	FK				LA	LC						GB	GE	GK				
0.10 µF	104	J	K	M									FK	FS				LA	LC						GB	GH	GJ				
0.12 µF	124	J	K	М									FK					LA							GE	GK					
0.15 µF	154	J	K	М									FK					LB							GE	GN					
0.18 µF	184	J	К	м																					GF						
0.22 µF	224	J	К	м																					GJ						
0.27 µF	274	J	К	м																					GL						
0.33 µF	334	J	K	M																					GS						
	ĺ	Rated	Voltag		8	30	00	8	30	8	00	00	8	30	00	00	00	8	30	00	00	00	009	8	8	30	00	00	8	80	00
		luidu	Tonug	(100)	5	9	¥	5	9	12	÷ –	ы М	2	9	¥	÷.	3	5	9	¥	14	2	5	8	5	9	¥	÷.	ž	ъ	30
Capacitance	Cap Code	Vo	Itage C	ode	С	В	D	C	В	D	F	G	C	В	D	F	G	C	В	D	F	G	Z	H	C	B	D	F	G	Z	Н
		Case	Size /	Series	c	0805	5C		С	1206	6C			С	1210	C				С	1808	SC					С	1812	C		

Table 1B – Capacitance Range/Selection Waterfall (1825–2225 Case Sizes)

		Ca	se Si Serie	ze / s			С	1825	iC					C	2220	C					C	2225	iC		
Canacitance	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
oupuontanee	Code	Rated	Voltage	e (VDC)	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000
		Ca T	pacitar oleranc	nce ce			Prod	uct A	vailab	ility a	nd Ch	ip Th	ickne	ss Co	des –	See 1	able	2 for (Chip T	hickn	ess D	imens	sions		
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
		Rated	Voltage	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000	
Capacitance	Cap Code	Vo	Itage Co	С	В	D	F	G	z	Н	С	В	D	F	G	z	н	с	В	D	F	G	z	Н	
		Case	Size / S	Series			(C1825	С					c	2220	с					c	2225	C		



Table 1B – Capacitance Range/Selection Waterfall (1825 – 2225 Case Sizes) cont'd

		Ca	se Si Serie	ze / s			С	1825	C					С	2220	C					C	2225	C		
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
	Code	Rated	Voltage	(VDC)	500	630	000	1500	0000	500	3000	500	630	000	1500	000	500	0000	500	630	000	1500	000	500	0000
		Ca	apacitar	ice			Prod		vailah	ilitv a	er, nd Ch	in Th	ickne		des –	See 1	Table (2 for (l Chin T	hickn	ess D	imen	sions	~	
200 -	201	1	olerand	e			1100		anab	iiity a				53 00	uc3 -									KE	KE
470 pF	391 471	J	ĸ	M	HG	HG	нс	НС	нс	HG	HG	JE	JE	JE	JE	JE	JK	JK	KE	KE	KE	KE	KE	KE	KE
560 nF	561		ĸ	M	HG	HG	HG	HG	HG	HG	HG	IK	IK	IK	JK	JK	JK	JK	KE	KE	KE	KE	KE	KE	KE
680 pF	681		ĸ	M	HG	HG	HG	HG	HG	HG	HG	JE	JE	JE	JK	JK	JK	JK	KF	KF	KF	KF	KE	KE	KE
820 pF	821	J	ĸ	M	HG	HG	HG	HG	HG	HG	HG	JE	JE	JE	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	JE	JK	JK	JK	JK	JK	JK	KE	KE	KE	KF	KE	KF	KF
1,200 pF	122	Ĵ	ĸ	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	ĸ	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	ĸ	M	HE	HE	HE	HE	HE	HG	HG	JE	JK	JK	JK	JK	JK	JK	KE	KE	KE	KF	KF	KF	KF
2,000 pF	202	J	к	м	HE	HE	HE	HE	HE	HG	HG	JE	JK	JK	JE	JE	JK	JK	KE	KE	KE	KF	KF	KF	KF
2,200 pF	222	J	K	М	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	М	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	М	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	М	ΗE	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	М	ΗE	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	М	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	М	ΗE	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	ΗE	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	ΗE	HE	HE	HE	HJ	HK		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			JE	JK	JK	JK	JL	JL	JL	KE	KE	KE	KE	KF	KH	KH
15,000 pF	153	J	K	М	HE	HE	HE	HG	HK			JE	JK	JK	JK	JL	JN	JN	KE	KE	KE	KE	KF	KJ	KJ
18,000 pF	183	J	K	М	HE	HE	HE	HG				JE	JK	JK	JK	JN			KE	KE	KE	KE	KH		
22,000 pF	223	J	K	М	HE	HG	HG	HG				JE	JK	JK	JK	JN			KE	KF	KF	KF	KJ		
27,000 pF	273	J	K	М	HE	HG	HG	HG				JE	JK	JK	JK				KE	KF	KF	KF	KJ		
33,000 pF	333	J	K	М	HE	HG	HG	HE				JE	JK	JK	JK				KE	KF	KF	KF			
39,000 pF	393	J	K	М	HE	HG	HG	HG				JE	JK	JK	JE				KE	KF	KF	KF			
47,000 pF	473	J	K	М	HE	HG	HG	HJ				JE	JK	JK	JK				KE	KF	KF	KF			
56,000 pF	563	J	K	М	HE	HG	HG	HJ				JE	JE	JE	JL				KE	KF	KF	KF			
62,000 pF	623	J	K	М	HG	HG	HG	HK				JE	JE	JE	JL				KE	KF	KF	KH			
68,000 pF	683	J	K	М	HG	HJ	HJ	HK				JE	JK	JK	JL				KE	KF	KF	KJ			
82,000 pF	823	J	K	М	HG	HJ	HJ					JE	JL	JL	JN				KE	KF	KF	KJ			
0.10 µF	104	J	K	М	HG	HK	HK					JE	JN	JN					KE	KH	KH	KJ			
0.12 µF	124	J	K	M	HG							JE	JN	JN					KE	KH	KH				
0.15 µF	154	J	K	М	HG							JK							KF	KJ	KJ				
0.18 µF	184	J	K	M	HG							JK							KF						
0.22 µF	224	J	K	M	HG														KF						
		Rated	Voltage	(VDC)	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000
Capacitance	Cap Code	Vo	Itage Co	ode	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н	c	В	D	F	G	Z	Н
		Case	Size / S	Series		C	C1825	C					C	2220	с					C	2225	c			



Table 2 – Chip Thickness/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
	1200	1.20 ± 0.10 1.60 + 0.15	0	0	2,500	
	1200	1.00 ± 0.10 1.70 ± 0.20	0	0	2,000	8,000
EG	1200	1.70 ± 0.20 1.25 ± 0.15	0	0	2,000	10,000
FI	1210	1.20 ± 0.10 1.40 ± 0.15	0	0	2,000	8,000
FH	1210	1.55 + 0.15	Ő	Ő	2,000	8,000
FM	1210	1.70 ± 0.20	Ő	Ő	2,000	8.000
FK	1210	2.10 ± 0.20	Ő	Ő	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	1012	1.50 ± 0.10	0	0	1,000	4,000
GK	1012	1.00 ± 0.20 1.70 ± 0.15	0	0	1,000	4,000
GN	1812	1.70 ± 0.13 1.70 ± 0.20	0	0	1,000	4,000
GI	1812	1.70 ± 0.20 1 90 + 0 20	0	0	500	2 000
GM	1812	2.00 ± 0.20	Ő	Ő	500	2,000
GS	1812	2.10 ± 0.20	Ő	Ő	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
JIN	2220	2.50 ± 0.20	0	0	500	2,000
KE	2225	1.40 ± 0.13 1.60 ± 0.20	0	0	1,000	4,000
КН	2225	2 00 + 0 20	0	0	500	2 000
KJ	2225	2.50 ± 0.20	ŏ	ŏ	500	2,000
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 3 – Chip Capacitor Land Pattern Design Recommendations per IPC–7351

EIA Size	Metric Size		Dens Maxi Land P	sity Lev mum (I rotrusio	vel A: Most) on (mm)		Dens Medi Land P	sity Lev an (Nor rotrusio	vel B: ninal) on (mm)		Dens Minii Land P	sity Lev mum (L rotrusio	vel C: .east) on (mm)
Code	Code	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	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	0.80	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
1210 ¹	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	2.25	1.85	2.30	7.40	3.30	2.15	1.65	2.20	6.50	2.70	2.05	1.45	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

¹ Only for capacitance values \geq 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).



Soldering Process

Recommended Soldering Technique:

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

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020



Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 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		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 +/- 2 hours after test conclusion.
Discod Humidity	MIL STD 202 Method 102	Load Humidity: 1,000 hours 85°C/85% RH and 200 VDC maximum. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Blased Humidity		Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108	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

Reference	lt	em	Mate	erial
А		Finish	100% Matte Sn	SnPb (5% min)
В	Termination System	Barrier Layer	Ν	li
D	,	Base Metal	C	u
E	Inner E	Electrode	Ν	li
F	Dielectri	c Material	Bal	۲iO ₃



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

High Voltage with Flexible Termination System (HV FT-CAP) X7R Dielectric, 500 – 3,000 VDC (Commercial & Automotive 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.

Electronic Components

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 $\pm 15\%$ from -55° C to $+125^{\circ}$ C.

Automotive Grade is available for applications requiring proven, reliable performance in harsh environments. Whether under-hood or in-cabin, these capacitors are designed for mission and safety critical automotive circuits. Stricter testing protocol and inspection criteria have been established for automotive grade products in recognition of potentially harsh environmental conditions. KEMET automotive grade series capacitors 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	Voltage	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec) ²
	0805 1206 1210 1808	X = Flexible Termination	2 Significant Digits + Number of Zeros	J = ±5% K = ±10% M = ±20%	C = 500 V B = 630 V D = 1,000 V F = 1,500 V	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% min)	Blank = Bulk TU = 7" Reel Unmarked TM = 7" Reel Marked
	1812 1825 2220 2225				G = 2,000 V Z = 2,500 V H = 3,000 V			C = 100% Matte Sn	AUTO = Automotive Grade 7" Reel Unmarked

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.



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	3.30 (.130) ± 0.40 (.016)	1.60 (.063) ± 0.20 (.008)		0.60 (.024) ± 0.25 (.010)		Solder Reflow
1210	3225	3.30 (.130) ± 0.40 (.016)	2.50 (.098) ± 0.20 (.008)		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	Solder Beflow Only
1825	4564	4.60 (.181) ± 0.40 (.016)	6.40 (.252) ± 0.40 (.016)		0.70 (.028) ± 0.35 (.014)		Solder Reliow 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)		

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
- · Pb-Free and RoHS 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 130 pF to 0.33 μF
- Available capacitance tolerances of ±5%, ±10% or ±20%
- Low ESR and ESL
- · Non-polar device, minimizing installation concerns
- · Commercial and 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% 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.

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

Pb-Free and RoHS Compliant (excluding SnPb termination finish option).



Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +125°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
Dielectric Withstanding Voltage	150% of rated voltage for voltage rating of < 1,000 V 120% of rated voltage for voltage rating of \ge 1,000 V (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	See Insulation Resistance Limit Table (500 VDC applied for 120 ±5 <i>seconds</i> @ 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 \pm 50 Hz and 1.0 ± 0.2 Vrms if capacitance \leq 10 μF

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 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
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	All



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

		Cas S	se Size / C0805X C1206X C1210X C1808X											C1812X																	
Capacitance	Сар	Vol	tage C	ode	c	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	Η
oupuontanoo	Code	Rat	ed Volt	age	500	630	1000	500	630	1000	1500	2000	500	630	1000	1500	2000	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000
		Ca	pacitar	nce			-						Pro	duct	Avai	labi	lity a	nd C	hip T	hick	nes	s Co	des								
		T	olerand	ce				_					Se	e Ta	ble 2	? for	Chip) Thic	kne	ss Di	imer	sior	ns								
120 pF 130 pF	121	J	K	M	DG	DG	DG											IR	IR	IB	IB	IB	IB	IB	GG	GG	GG	GG	GG	GG	
150 pF	151	J	ĸ	M	DG	DG	DG											LB	LB	LB	LB	LB	LB	LB							
180 pF	181	J	К	М	DG	DG	DG											LB	LB	LB	LB	LB	LB	LB							
220 pF	221	J	K	М	DG	DG	DG	EG	EG	EG	EG	EG						LB	LB	LB	LB	LB	LB	LB	GK	GK	GK	GK	GK	GK	GK
270 pF	271	J	K	М	DG	DG	DG	EG	EG	EG	EG	EG						LC	LC	LC	LC	LC	LC	LC	GK	GK	GK	GK	GK	GK	GK
330 pF	331	J	K	М	DG	DG	DG	EG	EG	EG	EG	EG						LC	LC	LC	LC	LC	LC	LC	GK	GK	GK	GK	GK	GK	GK
390 pF	391	J	K	M	DG	DG	DG	EG	EG	EG	EG	EG						LB	LB	LB	LB	LB	LB	LC	GK	GK	GK	GK	GK	GK	GK
470 pF	4/1	J	K	M	DG	DG	DG					EG	-	-	-	-	-		LB	LB	LB	LB	LB	LC	GK	GK	GK	GK	GK	GK	GK
560 pF	501	J	ĸ	M	DG	DG	DG	EF	EF	EF	EF	EG	FL	FL	FL	FL	FL	LB	LB	LB	LB	LB	LB	LC	GH	GH	GH	GH	GH	GK	GK
820 pF	821	J	ĸ	M			DG		FF	EF	FF	EG	FL	FL	FL	FL	FL								СН	GH	GH	СН	СН	GK	GK
1 000 pF	1021	J	K	M		DG	DG	FF	FF	FF	FF	EG	FI	FI	FI	FL	FI					IR			GH	GH	GH	GH	GH	GK	GK
1,000 pF	122	Ĵ	ĸ	M	DG	DG	DG	FF	FF	FF	EG.	FG	FI	FI	FI	FI	FM	IB	IB	IB	IB	IC	IA	10	GH	GH	GH	GH	GH	GK	GK
1.500 pF	152	Ĵ	K	M	DG	DG	DG	EF	EF	EF	EG	EG	FL	FL	FL	FL	FM	LB	LB	LB	LB	LC	LB		GH	GH	GH	GH	GH	GK	0.11
1,800 pF	182	J	K	М	DG	DG	DG	EF	EF	EF	EG	EG	FL	FL	FL	FL	FM	LB	LB	LB	LB	LC	LC		GH	GH	GH	GH	GH	GK	
2,000 pF	202	J	К	M	DG	DG	DG	EF	EF	EF	EG	EG	FL	FL	FL	FL	FM	LA	LA	LA	LB	LC	LC		GH	GH	GH	GH	GH	GK	
2,200 pF	222	J	K	M	DG	DG	DG	EF	EF	EF	EG	EG	FL	FL	FL	FL	FM	LA	LA	LA	LB	LC	LC		GH	GH	GH	GH	GH	GK	
2,700 pF	272	J	K	M	DG	DG	DG	EF	EF	EF	EG		FL	FL	FL	FL	FM	LA	LA	LA	LB	LC			GH	GH	GH	GH	GK	GM	
3,300 pF	332	J	K	М	DG	DG	DG	EF	EF	EF	EG		FL	FL	FL	FL	FM	LA	LA	LA	LB	LA			GH	GH	GH	GH	GK	GM	
3,900 pF	392	J	K	M	DG	DG	DG	EF	EF	EF	EG		FL	FL	FL	FL	FK	LA	LA	LA	LB	LB			GH	GH	GH	GH	GK	GO	
4,700 pF	472	J	K	M	DG	DG	DG	EF	EF	EF	EG		FL	FL	FL	FL	FK	LA	LA	LA	LB	LC			GH	GH	GH	GH	GH	GO	
5,600 pF	562	J	K	M	DG	DG		EF	EF	EF			FL	FL	FL	FM	FK	LA	LB	LB	LC				GH	GH	GH	GK	GK		
6,800 pF	082	J	ĸ			DG		EG	EG	EG						FIVI	15		LB	LB					GH	GH	GH	GK	GM		
0,200 pF	103	J	ĸ	M		DG		EG	EG	EG	EG		FL	FL	FL	FK				LD					СН	GH	GH	GK	GIVI		
12 000 pF	103		ĸ	M	DG			FG	E.I	E.I			FI	FI	FI	FK			IC	IC	IB				GH	GK	GK	GK	00		
15.000 pF	153	Ĵ	ĸ	M	100			EG	EJ	EJ			FL	FL	FL	FL		LA	LC	LC	LC				GH	GK	GK	GH			
18,000 pF	183	J	K	M				EJ	EJ	EJ			FL	FL	FL	FM		LA	LE	LE					GH	GK	GK	GM			
22,000 pF	223	J	K	M				EJ	EJ	EJ			FL	FM	FM	FM		LA	LE	LE					GH	GK	GK	GM			
27,000 pF	273	J	K	M				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	393	J	K	M				EJ					FK	FG	FH	FS		LC	LA	LA					GH	GB	GB				
47,000 pF	473	J	K	M				EJ					FK	FH	FK			LC	LA	LB					GH	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				EJ					FG	FK	FS					LC					GE	GE	GE				
02,000 pF	023	J	r k	M										EQ												GE	GN				
0.10 µl	104	.1	ĸ	M									FK	10											GF	GK	00				
0.15 µF	154	J	K	M									FK					LB							GE	GN					
0.18 µF	184	J	K	M																					GF						
0.22 µF	224	J	K	М																					GJ						
0.27 µF	274	J	K	М																					GL						
0.33 µF	334	J	K	M																					GS						
		Rat	ed Volt (VDC)	age	500	630	1000	500	630	1000	1500	2000	500	630	1000	1500	2000	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000
Capacitance	Cap Code	Vol	tage C	ode	c	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	Z	H	C	В	D	F	G	z	Н
		Case	Size / S	Series	C C	0805	x		С	1206	х			С	1210	(С	1808	x					С	1812	x		



Table 1B – Capacitance Range/Selection Waterfall (1825 – 2225 Case Sizes)

		Ca	Case Size / Series				C	1825	X					C	2220	X					C	2225	X		
Canacitance	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
oapacitance	Code	Rated	Voltage	(VDC)	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000
		Ca 1	apacitan Foleranc	ice e							Pro Se	duct A ee Tab	vailal le 2 fo	bility a or Chi	and Cl p Thic	hip Th kness	ickne s Dime	ss Co ensio	odes ns						
470 pF	471	J	K	M	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	к	М	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	к	М	HE	HE	HE	HE	HE	HG	HG	JK	JK	JK	JK	JK	JK	JK	KF	KF	KF	KF	KF	KF	KF
2,000 pF	202	J	к	М	HE	HE	HE	HE	HE	HG	HG	JE	JE	JE	JE	JE	JK	JK	KF	KF	KF	KF	KF	KF	KF
2,200 pF	222	J	к	М	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	М	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	к	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	к	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	к	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	к	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	К	М	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	к	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	к	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	к	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	к	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	М	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	к	M	HE	HG	HG	HE				JE	JK	JK	JK				KE	KF	KF	KF			
39,000 pF	393	J	к	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	к	M	HE	HG	HG	HJ				JE	JE	JE	JL				KE	KF	KF	KF			
62,000 pF	623	J	к	M	HG	HG	HG	HK				JE	JE	JE	JL				KF	KF	KF	KH			
68,000 pF	683	J	к	M	HG	HJ	HJ	HK				JE	JK	JK	JL				KE	KF	KF	KJ			
82,000 pF	823	J	к	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							JE	JN	JN					KE	KH	KH				
0.15 µF	154	J	K	M	HG							JK							KF	KJ	KJ				
0.18 µF	184	J	K	M	HG							JK							KF						
0.22 µF	224	J	K	M	HG														KF						
		Rated	Voltage	(VDC)	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000
Capacitance	Cap Code	Vo	ltage Co	ode	С	В	D	F	G	z	Н	С	В	D	F	G	z	н	С	В	D	F	G	z	Н
		Voltage Code Case Size / Series				C	C1825X						(22220	(C	2225X				



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
DG EF EG EJ EG	0805 1206 1206 1206 1206	$\begin{array}{c} 1.25 \pm 0.15 \\ 1.20 \pm 0.15 \\ 1.60 \pm 0.15 \\ 1.70 \pm 0.20 \\ 1.25 \pm 0.15 \end{array}$	0 0 0 0	0 0 0 0	2,500 2,500 2,000 2,000 2,500	10,000 10,000 8,000 8,000 10,000
FL FH FM FK FS	1210 1210 1210 1210 1210 1210	1.20 ± 0.13 1.40 ± 0.15 1.55 ± 0.15 1.70 ± 0.20 2.10 ± 0.20 2.50 ± 0.30	0 0 0 0 0	0 0 0 0 0	2,000 2,000 2,000 2,000 2,000 1,000	8,000 8,000 8,000 8,000 8,000 4,000
LE LA LB LC GB	1808 1808 1808 1808 1808 1812	$\begin{array}{c} 1.00 \pm 0.10 \\ 1.40 \pm 0.15 \\ 1.60 \pm 0.15 \\ 2.00 \pm 0.15 \\ 1.00 \pm 0.10 \end{array}$	0 0 0 0 0	0 0 0 0 0	2,500 1,000 1,000 1,000 1,000	10,000 4,000 4,000 4,000 4,000 4,000
GC GE GG GH GF	1812 1812 1812 1812 1812 1812	$\begin{array}{c} 1.10 \pm 0.10 \\ 1.30 \pm 0.10 \\ 1.55 \pm 0.10 \\ 1.40 \pm 0.15 \\ 1.50 \pm 0.10 \end{array}$	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
GK GJ GN GL GM	1812 1812 1812 1812 1812 1812	$\begin{array}{c} 1.60 \pm 0.20 \\ 1.70 \pm 0.15 \\ 1.70 \pm 0.20 \\ 1.90 \pm 0.20 \\ 2.00 \pm 0.20 \end{array}$	0 0 0 0	0 0 0 0	1,000 1,000 1,000 500 500	4,000 4,000 4,000 2,000 2,000
GS GO HE HG HJ	1812 1812 1825 1825 1825	$\begin{array}{c} 2.10 \pm 0.20 \\ 2.50 \pm 0.20 \\ 1.40 \pm 0.15 \\ 1.60 \pm 0.20 \\ 2.00 \pm 0.20 \end{array}$	0 0 0 0	0 0 0 0	500 500 1,000 1,000 500	2,000 2,000 4,000 4,000 2,000
HK JE JK JL JN	1825 2220 2220 2220 2220 2220	$2.50 \pm 0.20 \\ 1.40 \pm 0.15 \\ 1.60 \pm 0.20 \\ 2.00 \pm 0.20 \\ 2.50 \pm 0.20$	0 0 0 0 0	0 0 0 0 0	500 1,000 500 500 500	2,000 4,000 2,000 2,000 2,000
KE KF KH KJ	2225 2225 2225 2225 2225	$\begin{array}{c} 1.40 \pm 0.15 \\ 1.60 \pm 0.20 \\ 2.00 \pm 0.20 \\ 2.50 \pm 0.20 \end{array}$	0 0 0 0	0 0 0 0	1,000 1,000 500 500	4,000 4,000 2,000 2,000
Thickness Code	Case Size	Thickness ± Range (mm)	7" Reel Paper G	13" Reel Quantity	7" Reel Plastic	13" Reel Quantity

Package quantity based on finished chip thickness specifications.



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

EIA Size Code	Metric Example 2 Code Density Level A: Maximum (Most) Land Protrusion (mm)							Dens Medi Land P	sity Lev an (Nor rotrusio	vel B: ninal) on (mm)	Density Level C: Minimum (Least) Land Protrusion (mm)						
oout	oouc	C	Y	X	V1	V2	C	Y	X	V1	V2	C	Y	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	0.80	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		
1808	4520	2.25	1.85	2.30	7.40	3.30	2.15	1.65	2.20	6.50	2.70	2.05	1.45	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).



Soldering Process

Recommended Soldering Technique:

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

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020



Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 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:
Saldarability		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 +/- 2 hours after test conclusion.
Pieced Humidity	MIL STD 202 Method 102	Load Humidity: 1,000 hours 85°C/85% RH and 200 VDC maximum. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Blased 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.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108	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

Reference	lt	em	Mate	erial				
А		Finish	100% Matte Sn	SnPb (5% min)				
В	Termination	Barrier Layer	Ni					
С	System	Epoxy Layer	Ag					
D		Base Metal	tal Cu					
E	Inner E	lectrode	Ν	li				
F	Dielectri	c Material	BaTiO ₃					



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



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).

"ArcShield" Technology (Patent Pending) 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	1812	V	334	K	С	R	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Dielectric	Failure Rate/ Design	Termination Finish ¹	Packaging/Grade (C-Spec)²
	0805 1206 1210 1808 1812	V = ArcShield W = ArcShield with Flexible Termination	2 Significant Digits + Number of Zeros	J = ±5% K = ±10% M = ±20%	C = 500 V B = 630 V D = 1,000 V	R = X7R	A = N/A	C = 100% Matte Sn L = SnPb (5% minimum)	Blank = Bulk TU = 7" Reel Unmarked TM = 7" Reel Marked AUTO = Automotive Grade 7" Reel Unmarked

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.



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)	See Table 2 for Thickness	0.50 (0.02) ± 0.25 (.010)	NI/A	
1808	4520	4.70 (.185) ± 0.50 (.020)	2.00 (.079) ± 0.20 (.008)		0.60 (.024) ± 0.35 (.014)	N/A	Solder Reflow Only
1812	4532	4.50 (.177) ± 0.30 (.012)	3.20 (.126) ± 0.30 (.012)	-	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) ± 0.20 (.008)	1.25 (.049) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	Solder Wave or
1206	3216	3.30 (.130) ± 0.40 (.016)	1.60 (.063) ± 0.20 (.008)		0.60 (.024) ± 0.25 (.010)		Solder Reflow
1210	3225	3.30 (.130) ± 0.40 (.016)	2.50 (.098) ± 0.20 (.008)	See Table 2 for Thickness	0.60 (.024) ± 0.25 (.010)	NI/A	
1808	4520	4.70 (.185) ± 0.50 (.020)	2.00 (.079) ± 0.20 (.008)		0.70 (.028) ± 0.35 (.014)	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)		



Benefits

- · ArcShield (patent pending) technology
- · Base metal electrode (BME) dielectric system
- Industry leading CV values
- -55°C to +125°C operating temperature range
- Exceptional performance at high frequencies
- Pb-Free and RoHS Compliant
- EIA 0805, 1206, 1210, 1808, and 1812 case sizes
- DC voltage ratings of 500 V, 630 V, and 1 KV
- Capacitance offerings ranging from 2,200 pF to 0.33 μF

- Available capacitance tolerances of ±5%, ±10%, and ±20%
- Low ESR and ESL
- · 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% minimum)
- · Flexible Termination option available upon request

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

Pb-Free and RoHS Compliant (excluding SnPb termination finish option).





Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +125°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
Dielectric Withstanding Voltage (DWV)	150% of rated voltage for voltage rating of < 1,000 V 120% of rated voltage for voltage rating of \ge 1,000 V (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	100 megohm microfarads or 10 G Ω (500 VDC applied for 120 ±5 seconds @ 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 Ω 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 μF

120 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."

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										



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

		Ca	Case Size / Series		CO	805W	//V	C1	206W	//V	C1	210W	// V	C1	808W	//V	C1812W/V		// V
Capacitance	Capacitance	Vo	oltage Co	de	С	В	D	С	В	D	С	В	D	С	В	D	С	В	D
	Code	Rated	Rated Voltage (VDC)		500	630	1000	500	630	1000	500	630	1000	500	630	1000	500	630	1000
		Capac	itance To	lerance		Product Availability and Chip Thickness Codes See Table 2 for Chip Thickness Dimensions													
2,200 pF	222	J	К	M	DG	DG	DG												
2,700 pF	272	J	K	M	DG	DG	DG												
3,300 pF	332	J	K	M	DG	DG	DG												
3,900 pF	392	J	K	M	DG	DG	DG												
4,700 pF	472	J	K	M	DG	DG	DG												
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	103	J	K	M	DG														
12,000 pF	123	J	K	M	DG			EJ	EJ	EJ									
15,000 pF	153	J	K	M				EJ	EJ	EJ									
18,000 pF	183	J	K	M				EJ	EJ	EJ				LE	LE	LE			
22,000 pF	223	J	K	M				EJ	EJ	EJ	FG	FG	FG	LE	LE	LE			
27,000 pF	273	J	K	M				EJ	EJ		FG	FG	FG	LA	LA	LA	GB	GB	GB
33,000 pF	333	J	K	M				EJ	EJ		FG	FG	FH	LA	LA	LA	GB	GB	GB
39,000 pF	393	J	K	M				EJ			FG	FG	FH	LA	LA	LA	GB	GB	GB
47,000 pF	473	J	K	M				EJ			FG	FH	FK	LA	LA	LB	GB	GB	GC
56,000 pF	563	J	K	M				EJ			FG	FH	FK	LA	LA	LB	GB	GB	GE
62,000 pF	623	J	K	M				EJ			FG	FK	FS	LA	LA	LC	GB	GB	GE
68,000 pF	683	J	K	M				EJ			FG	FK	FS	LA	LA	LC	GE	GE	GE
82,000 pF	823	J	K	M							FH	FK		LA	LC		GB	GE	GK
0.10 µF	104	J	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	M													GF		
0.22 µF	224	J	K	M													GJ		
0.27 µF	274	J	K	M													GL		
0.33 µF	334	J	K	M													GS		
	Canacitance	Rateo	l Voltage	(VDC)	500	630	1000	500	630	1000	500	630	1000	500	630	1000	500	630	1000
Capacitance	Capacitance	Vo	Voltage Code		c	В	D	С	В	D	С	В	D	С	В	D	С	В	D
		Case	ase Size / Series		C()805W	// V	Cí	1206W	// V	C,	1210W	/ V	C1	808W	/ V	C,	1812W	/ V

Patent pending technology



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
EJ	1206	1.70 ± 0.20	0	0	2,000	8,000
FG	1210	1.25 ± 0.15	0	0	2,500	10,000
FH	1210	1.55 ± 0.15	0	0	2,000	8,000
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
GS	1812	2.10 ± 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

Table 2 – Chip Thickness/Packaging Quantities

Package quantity based on finished chip thickness specifications.

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

EIA Size	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)				
Code	Code	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	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
1210 ¹	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

¹ Only for capacitance values \geq 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).



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

EIA Size Code	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)					
oouc	oouc	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	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	0.80	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
1808	4520	2.25	1.85	2.30	7.40	3.30	2.15	1.65	2.20	6.50	2.70	2.05	1.45	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

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

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



Soldering Process

Recommended Soldering Technique:

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

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020



Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 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:
Saldarability		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 +/- 2 hours after test conclusion.
Discod Humidity	MIL STD 202 Method 102	Load Humidity: 1,000 hours 85°C/85% RH and 200 VDC maximum. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Blased 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.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL-STD-202 Method 108	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

Reference	lt	em	Material				
A		Finish	100% Matte Sn	SnPb (5% min)			
В	Termination System	Barrier Layer	Ni				
D	,	Base Metal	Cu				
E	Inner E	Inner Electrode		li			
F	Dielectri	c Material	Bal	īiO ₃			



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

Construction – Flexible Termination

Reference	lt	em	Material			
A		Finish	100% Matte Sn	SnPb (5% min)		
В	Termination	Barrier Layer	Ni			
С	System	Epoxy Layer	Ag			
D		Base Metal	C	u		
E	Inner E	lectrode	Ni			
F	Dielectri	c Material	BaTiO ₃			

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





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. 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°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.

KEMET's KPS Series devices in X7R dielectric exhibit a

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 $\pm 10\%$ and $\pm 20\%$
- · 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
- Pb-Free and RoHS Compliant
- · Capable of Pb-Free reflow profiles
- Non-polar device, minimizing installation concerns
- Film alternative



Ordering Information

С	2220	С	105	Μ	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) ³
	2220	C = Standard	2 significant digits + number of zeros.	K = ±10% M = ±20%	C = 500 V B = 630 V	R = X7R	1 = KPS Single Chip Stack 2 = KPS Double Chip Stack	C = 100% Matte Sn	7186 = 7" Reel Unmarked 7289 = 13" Reel Unmarked

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.

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



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)	Colder Deflow 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 Reliow 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 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

Pb-Free and RoHS Compliant.



Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +125°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
Dielectric Withstanding Voltage (DWV)	150% of rated voltage for voltage rating of < 1,000 V 120% of rated voltage for voltage rating of \ge 1,000 V (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	See Insulation Resistance Limit Table (500 VDC applied for 120 ±5 seconds @ 25°C)

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

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

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

1 kHz ±50 Hz and 1.0 ±0.2 Vrms if capacitance \leq 10 μ F

120 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."

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		Capacitance Tolerance		Product Availability and Chip Thickness Codes – See Table 2 for Chip Thickness Dimensions	
Sir			Chip Stack	ζ		
0.047 µF	473	K	М	JP	JP	
0.10 µF	104	К	М	JP	JP	
0.15 µF	154	K	М	JP	JP	
0.22 µF	224	К	М	JP	JP	
0.33 µF	334	K	М	JP		
0.47 µF	474	K M		JP		
		Double	Chip Stac	k		
0.10 µF	104		М	JR	JR	
0.22 µF	224		М	JR	JR	
0.33 µF	334		M	JR	JR	
0.47 µF	474		М	JR	JR	
0.68 µF	664		M	JR		
1.0 µF	105		M	JR		
		Rated Volt	age (VDC)	500	630	1000
Capacitance	Capacitance	Voltage Code Case Size / Series		С	В	D
	Code				C2220C	

Table 2 – Chip Thickness/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 Patterr	ו Design Recommendations (۱	mm)
----------------------------	-----------------------------	-----

EIA SIZE	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



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_{min} to T_{max})	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:
Calderahility		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 @ 250°C
Temperature Cycling	JESD22 Method JA-104	1,000 cycles (-55°C to +125°C). Measurement at 24 hours +/- 2 hours after test conclusion.
Discond Llumiditu	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 +/- 2 hours after test conclusion.
Blased Humidity		Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air-Air.
High Temperature Life	MIL-STD-202 Method 108	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

Reference	ltem	Material
A	Leadframe	Phosphor Bronze – Alloy 510
В	Leadframe Attach	HMP Solder
С		Cu
D	Termination	Ni
E		Sn
F	Inner Electrode	Ni
G	Dielectric Material	BaTiO ₃



Note: Image is exaggerated in order to clearly identify all components of construction. HMP = High Melting Point

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 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



SN	120	N	472	J	501	В	Μ
Style	e/Size	Dielectric	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Lead Configuration ¹	Testing/ Inspection Option ²
SM20 SM21 SM22 SM23 SM24 SM25 SM26	SM30 SM31 SM33 SM34 SM35 SM36	N = COG	2 Significant Digits + Number of Zeros	$J = \pm 5\%$ K = ±10% M = ±20% P = +100%, -0% Z = +80%, -20%	501 = 500 V 102 = 1,000 V 202 = 2,000 V 302 = 3,000 V 402 = 4,000 V 502 = 5,000 V	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 ± 0.015 (3.81 ± 0.38)	0.150 ± 0.015 (3.81 ± 0.38)	0.130 (3.30)			0.040 0.040
SM21	0.200 ± 0.020 (5.08 ± 0.51)	0.200 ± 0.020 (5.08 ± 0.51)	0 180 (4 57)	0.100 (2.54)		0.040 ± 0.010 (1.02 ± 0.25)
SM22	0.250 ± 0.020 (6.35 ± 0.51)	0.200 ± 0.020 (5.08 ± 0.51)	0.100 (4.37)			(1.02 ±0.23)
SM23	0.350 ± 0.030 (8.89 ± 0.76)	0.300 ± 0.030 (7.62 ± 0.76)		0.200 (5.08)		
SM24	0.450 ± 0.030 (11.43 ± 0.76)	0.400 ± 0.030 (10.20 ± 0.76)	0 220 (5 50)	0.300 (7.62)	0.400 0.000	
SM25	0.550 ± 0.030 (14.00 ± 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)	0 100 (2 54)	(2.04 ±0.01)	0.100 ±0.020
SM31	0.400 ± 0.030 (10.20 ± 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 ± 0.030 (7.62 ± 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)		
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)		
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)	±30 ppm/°C
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	0%
Dielectric Withstanding Voltage (DWV)	150% of rated voltage for voltage rating of \leq 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 Ω 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 Vrms ±0.2 V if capacitance \leq 100 pF

1 kHz \pm 50 Hz and 1.0 Vrms \pm 0.2 V if capacitance > 100 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 Capacitance Dissipation Factor Capacitance Insulation Voltage Value (Maximum %) Shift Resistance							
C0G	All	All	0.5	0.3% or ±0.25 pF	10% of Initial Limit		


Table 1A – Capacitance Range/Selection Waterfall SM20 – SM24 Style/Size

Style/Size		SN	120			SN	121			SN	122			;	SM2	3				SN	124			
								Dime	ensior	ns — ir	nches	(mm))											
Length	1	0.150 :	± 0.015	i		0.200 :	± 0.020)		0.250	± 0.020)		0.3	50 ± 0	.030				0.450	± 0.030)		
Width	_	0.150 :	± 0.38) ± 0.015	i		(5.08 : 0.200 :	± 0.51) ± 0.020)		0.200	± 0.51) ± 0.020)		(8.	89 ± 0 00 ± 0	.76) .030				0.400 :	± 0.76 ± 0.030)		
Thicknoon	_	(3.81 :	± 0.38)			(5.08	± 0.51)			(5.08	± 0.51)			(7.	62 ± 0	.76)				(10.20	± 0.76)		
Maximum		0. (3.	30 30)			0. (4.	180 57)			0. (4.	57)				(5.59)					0.4 (5.	220 59)			
Lead Width		0.1	100			0.1	00			0.1	100				0.200					0.3	300			
Lead Length		.2) : 0.100	54) ± 0.020)		.2) : 0.100	54) ± 0.020)	<u> </u>	(2. : 0.100	54) ± 0.020)		0.1	(5.08) 00 ± 0.	.020				./. : 0.100	6∠) ±0.020)		
"L"		(2.54	± 0.51)			(2.54	± 0.51)			(2.54	± 0.51)			(2.	54 ± 0	.51)				(2.54	± 0.51)			
Lead Length		0.040 :	± 0.010 ± 0.25))		0.040 : (1.02 :	± 0.010 ± 0.25))		0.040	± 0.010 ± 0.25))		0.1 (2.	00 ± 0. 54 ± 0	.020 .51)				0.100 :	± 0.020 ± 0.51))		
			,				,		C00	Diel	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	е										
22 pF							220	220														070	070	
27 pF 33 pF							330	330	330	330	330	330										330	330	
39 pF	390	390	390	390	390	390	390	390	390	390	390	390										390	390	
47 pF	470	470	470	470	470	470	470	470	470	470	470	470						560	560	560	560	470	470	
56 pF 68 nF	560 680	680	680	680	560 680	680	680	680	680	680	680	680						560 680	680	680	680	680	560 680	
82 pF	820	820	820	820	820	820	820	820	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	101	101	101	101	101	101	101	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	
180 pF	181	181	181	181	181	181	181	181	181	181	181	181	181	181	181	181	181	181	181	181	181	181	181	
220 pF	221	221	221	221	221	221	221	221	221	221	221	221	221	221	221	221	221	221	221	221	221	221	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 390 pF	331	331	331		331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	
470 pF	471	471	471		471	471	471	471	471	471	471	471	471	471	471	471	471	471	471	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	681	681	681		681	681	681		681	681	681	681	681	681	681	681	681	681	681	681	681	681	681	
820 pF	102	102	821		102	821 102	102		102	102	102	102	102	102	102	102		102	821 102	102	102	102	821 102	
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	152	152			152	152	152		152	152	152		152	152	152	152		152	152	152	152	152	152	
1,800 pF	182	182			182	182	182		182	182	182		182	182	182	182		182	182	182	182			
2,200 pF 2,700 pF	272	272			272	272			272	272	272		272	272	272	222		272	272	272	272			
3,300 pF					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			
4,700 pF 5,600 pF					472	472			472	472			4/2	4/2	4/2			472	472	472	472			
6,800 pF									682	682			682	682	002			682	682	682				
8,200 pF									822				822	822				822	822	822				
0.01 µF									103				103	103				103	103	103				
0.012 µF									123				123	123				123	123					
0.018 µF									183				183					183	183					
0.022 µF	1												223					223	223					1
0.027 µF	1												273					273	273					
0.039 µF	1												333					393	393					
0.047 µF																		473	473					1
0.039 µF 0.047 µF																		393 473						



Table 1B – Capacitance Range/Selection Waterfall SM25 – SM31 Style/Size

Style/Size			SN	125					SN	126					SM3	0				SN	131			
-								Dime	ensior	ns – ir	ches	(mm)												
Length			0.550 :	± 0.030)				0.650 :	± 0.030)			0.3	00 ± 0	.030				0.400 :	± 0.030)		
Width			0.500 :	± 0.76)				0.600 :	± 0.76)			0.1	50 ± 0	.76) .015				0.200 :	± 0.76))		
Thickness			(12.70	± 0.76) 20)				(15.20) 0 2	± 0.76)			(3.	81 ± 0 0 140	.38)				(5.08) 0 1	± 0.51) 130			
Maximum			(5.	59)					(5.	59)					(3.55)					(3.	30)			
Lead Width Maximum			0.4 (10	100 .20)					0.5 (12	500 .70)					0.100					0.1 (2.	100 54)			
Lead Length			0.100 =	± 0.020)				0.100 :	± 0.020				0.1	(=10.1)	.020				0.100 :	± 0.020)		
"L"			(2.54 :	± 0.51)	<u> </u>				(2.54)	± 0.51)				(2.	54 ± 0	.51)				(2.54	± 0.51)	<u> </u>		
"J"			(2.54 :	± 0.520	,				(2.54	± 0.520				(2.	54 ± 0	.51)				(2.54	± 0.520	,		
	-	1		1				1	000	Diele	ectric		1	1		1			1				1	
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	Canacitance
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	Tolerance
			-		-	-					Japac			e			400							
10 pF 12 pF																	120							
15 pF													150	150	150	150	150							
18 p⊢ 22 pF													180 220	180	180	180	180					220	220	
27 pF													270	270	270	270	270	270	270	270	270	270	270	
33 pF 39 pF													330 390	330	330	330	330	330	330	330	330	330	330	
47 pF													470	470	470	470	470	470	470	470	470	470	470	
56 pF													560	560	560	560	560	560	560	560	560	560	560	
68 p⊢ 82 nF													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	
180 pF			181	181	181	181	181	181	181	181	181	181	181	181	181	181		181	181	181	181	181	181	
220 pF			221	221	221	221	221	221	221	221	221	221	221	221	221	221		221	221	221	221			
270 pF 330 pE	271	271	271	271	271	271	271	271	271	271	271	271	271	271	271	271		271	271	271	271			
390 pF	391	391	391	391	391	391	391	391	391	391	391	391	391	391	391	391		391	391	391	391			
470 pF	471	471	471	471	471	471	471	471	471	471	471	471	471	471	471	471		471	471	471	471			
560 pF 680 pF	681	681	681	681	681	681	681	681	681	681	681	681	681	681	681	681		681	681	681	681			
820 pF	821	821	821	821	821	821	821	821	821	821	821	821	821	821	821			821	821	821	821			J, K, M, P, Z
1,000 pF	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102			102	102	102	102			
1,200 pF 1,500 pF	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152			152	152	152	122			
1,800 pF	182	182	182	182	182	182	182	182	182	182	182	182	182	182	182			182	182	182				
2,200 pF 2,700 pF	222	222	222	222			222	222	222	222	222	222	222	222				222	222	222				
3,300 pF	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				
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				682	682	682	682								682	682					
8,200 pF	822	822	822				822	822	822	822								822	822					
0.012 µF	123	123	123				123	123	123									123	123					
0.015 µF	153	153					153	153	153									153						
0.018 µF	183	183 223					183	183 223	183 223									183						
0.027 µF	273	273					273	273										273						
0.033 µF	333	333					333	333										333						
0.039 µF 0.047 µF	473	473					473	473																
0.056 µF							563	563																
0.068 µF							683	683																i <u> </u>



Table 1C – Capacitance Range/Selection Waterfall SM33 - SM35 Style/Size

Style/Size SM33 SM34 SM35	5		
Dimensions – inches (mm)			
Length 0.700 ± 0.030 0.900 ± 0.030 1.100 ± 0.0 (17.08 ± 0.76) (22.90 ± 0.76) (27.90 ± 0.0)30 .76)		
Width 0.300 ± 0.030 0.400 ± 0.030 0.500 ± 0.1 Width 0.700 ± 0.070 0.400 ± 0.030 0.500 ± 0.1	030		
Thickness 0.180 0.220 0.220	.70)		
Maximum (4.57) (5.59) (5.59) Lead Width 0.200 0.300 0.400			
Lead Writin 0.200 0.300 0.400 Maximum (5.08) (7.62) (10.2)			
Lead Length 0.100 ± 0.020 0.100 ± 0.020 0.100 ± 0.020 "L" (2.54 ± 0.51) (2.54 ± 0.51) (2.54 ± 0.51))20 51)		
Lead Length 0.100 ± 0.020 0.10)20 51)		
COG Dielectric	51)		
Voltage Code 501 102 202 302 402 502 752 501 102 202 302 402 502 752 501 102 202 302 402 502 752 103 501 102 202 302 40	2 502 752	2 103	
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 500 1 K 2 K 3 K 4 K 5 K 7.5 K 10 K 500 1 K 2 K 3 K 4 I	K 5K 7.51	K 10 K	Capacitance Tolerance
Capacitance Capacitance Code			Tolefulloe
27 pF 270 270 33 pF 330 330			
39 pF 390 390 390 390			
47 pF 470 470 470 470 470 470 560 560 560 560 560 560 560 560 560 56		470	
68 pF 680 500 500 500 500 500 500 500 500 500 5			
100 pF 101 101 101 101 101 101 101 101 101 10			
120 pF 121 121 121 121 121 121 121 121 121 12	1 151 151	1	
180 pF 181 181 181 181 181 181 181 181 181 18	1 181 181	1	
220 pF 221 221 221 221 221 221 221 221 221 22	1 221 221 1 271 271	1	
330 pF 331 331 331 331 331 331 331 331 331 33	1 331 331	1	
390 pF 391 391 391 391 391 391 391 391 391 391	1 391 391 1 471 471	1	
560 pF 561 561 561 561 561 561 561 561 561 561	1 561 561	1	
820 pF 821 821 821 821 821 821 821 821 821 821	1 821 821	1	
1,000 pF 102 102 102 102 102 102 102 102 102 102	2 102 102 2 122 122	2 102	
1,500 pF 152 152 152 152 152 152 152 152 152 152	2 152 152	2	
1,800 pF 182 182 182 182 182 182 182 182 182 182	2 182 182 2 222	2	
2,700 pF 272 272 272 272 272 272 272 272 272 27	2 272		J, K, M, P, Z
3,300 pF 332 332 332 332 332 332 332 332 332 33	2 332 2 392		
4,700 pF 472 4			
3,000 pr 682 68			
8,200 pF 822 82			
0.012 µF 123 123 123 123 123 123 123 123 123 123			
0.015 µF 153 153 153 153 153 153 153 153 153 153			
0.022 µF 223 223 223 223 223 223 223 223 223 22			
0.033 µF 333 333 333 333 333			
0.039 µF 393 393 393 393 393 393 393 473 473 473 473			
0.056 µF 563 563 563 563 563			
0.068 µF 683 683 683 683 823 823 823			
0.1 µF 104 104 104 104			
0.12 µP 124 124 124 124 124 154 154 154 154 154 154 154 154 154 15			
0.18 µF			
0.22 µr 0.27 µF 274 274			

© KEMET Electronics Corporation • P.O. Box 5928 • Greenville, SC 29606 (864) 963-6300 • www.kemet.com



Table 1D – Capacitance Range/Selection Waterfall SM36 Style/Size

Style/Size				SN	136				
Di	imens	ions -	- inch	es (m	im)				
Length									
Width									
Thickness									
Maximum				(5.	59)				
Maximum				0.8 (12	2.7)				
Lead Length				0.100 :	± 0.020				
Lead Length				0.100 :	± 0.01) ± 0.020)			
	C	0G D	ielect	(2.54) ric	± 0.51)				ļ
Voltage Code	501	102	202	302	402	502	752	103	
Voltage DC	500	1K	2K	3K	4K	5K	7.5K	10K	Capacitance Tolerance
Capacitance			Cap	oacita	nce C	ode			
120 pF	151	151	151	151	121	121	121		
180 pF	181	181	181	181	181	181	181		
220 pF	221	221	221	221	221	221	221		
270 pF 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	681	681	681	681	681	681	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	152	
1,500 pF 1.800 pF	182	182	182	182	182	182	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 3 900 pF	332	332	332	332	332	332	332		
4,700 pF	472	472	472	472	472	472			
5,600 pF	562	562	562	562	562	562			
6,800 pF	682	682	682	682	682	682			J, K, M, P, Z
0.01 µF	103	103	103	103	103				
0.012 µF	123	123	123	123					
0.015 µF	153	153	153	153					
0.018 µF	223	223	223	223					
0.027 µF	273	273	273	273					
0.033 µF	333	333	333	333					
0.039 µF 0.047 µF	393	393	393						
0.056 µF	563	563	563						
0.068 µF	683	683							
0.082 µF	823	823							
0.12 µF	124	124							
0.15 µF	154	154							
0.18 µF	184								
0.22 μF 0.27 μF	274								
0.33 µF	334								
0.39 µF	394								



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 $(T_L \text{ to } T_P)$	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 $(T_P \text{ to } T_L)$	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

Reference	Item	Material			
A	Leadframe	Phosphor Bronze - Alloy 510 (Silver plated / Nickle Underplate)			
В	Leadframe Attach Material	Silver Epoxy			
С	MLCC				
D	Termination	Solderable Silver			
E	System				
F	Electrode	PdAg			
G	Dielectric	BaTiO ₃			



Note: Image is exaggerated in order to clearly identify all components of 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 $\pm 15\%$ 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



SN	120	В	153	К	501	В	Μ
Style	/Size	Dielectric	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Lead Configuration ¹	Testing/ Inspection Option ²
SM20 SM21 SM22 SM23 SM24 SM25 SM26	SM30 SM31 SM33 SM34 SM35 SM36	B = X7R	2 Significant Digits + Number of Zeros	K = ±10% M = ±20%	501 = 500 V 102 = 1,000 V 202 = 2,000 V 302 = 3,000 V 402 = 4,000 V 502 = 5,000 V	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 ± 0.015 (3.81 ± 0.38)	0.150 ± 0.015 (3.81 ± 0.38)	0.130 (3.30)			0.040 - 0.040	
SM21	0.200 ± 0.020 (5.08 ± 0.51)	0.200 ± 0.020 (5.08 ± 0.51)	0 180 (4 57)	0.100 (2.54)		0.040 ± 0.010 (1.02 + 0.25)	
SM22	0.250 ± 0.020 (6.35 ± 0.51)	0.200 ± 0.020 (5.08 ± 0.51)	0.160 (4.57)			(1.02 ± 0.23)	
SM23	0.350 ± 0.030 (8.89 ± 0.76)	0.300 ± 0.030 (7.62 ± 0.76)		0.200 (5.08)			
SM24	0.450 ± 0.030 (11.43 ± 0.76)	0.400 ± 0.030 (10.20 ± 0.76)	0.000 (5.50)	0.300 (7.62)	0.100 ± 0.020 (2.54 ± 0.51)		
SM25	0.550 ± 0.030 (14.00 ± 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)			
SM30	0.300 ± 0.030 (7.62 ± 0.76)	0.150 ± 0.015 (3.81 ± 0.38)	0.140 (3.55)	0.100 (2.54)		0.100 ± 0.020	
SM31	0.400 ± 0.030 (10.20 ± 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 ± 0.030 (7.62 ± 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)	-		
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)			
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 \leq 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 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)

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 \pm 50 Hz and 1.0 Vrms \pm 0.2 V if capacitance > 100 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						
X7R	All	All	3.0	±20%						



Table 1A – Capacitance Range/Selection Waterfall SM20 – SM24 Style/Size

Style/Size		SM2	0		SN	121			SN	122				SM2	3				SN	124			
							Di	imens	ions -	- inch	es (m	m)											
Length	0.1	50 ± 0.	015		0.200 :	± 0.020)		0.250	± 0.020)		0.3	50 ± 0.	030				0.450 =	± 0.030)		
Width	0.1	$50 \pm 0.50 \pm 0.$	015		0.200 :	± 0.01) ± 0.020)		0.200	± 0.01) ± 0.020)		0.3	$09 \pm 0.$ 00 ± 0.	030				0.400 :	± 0.76) ± 0.030)		
Thickness	(3.	81 ± 0.	38)		(5.08	± 0.51)			(5.08	± 0.51)			(7.	62 ± 0.0	76)				(10.20	± 0.76)			
Maximum		(3.30)			(4.	180 57)			0. (4.	180 57)				(5.59)					0.2 (5.	220 59)			
Lead Width		0.100			0.1	100			0.1	100				0.200					0.3	300			
Maximum Lead Length	01	(2.54) 00 + 0	020		(2.	54) + 0 020	1		(2.	.54) + 0.020	1		0.1	(5.08) 00 + 0	020				(7.	62) + 0 020	1		
"L"	(2.	54 ± 0.5	.51)		(2.54	± 0.51)			(2.54	± 0.51)			(2.	54 ± 0.5	51)				(2.54 :	± 0.51)			
Lead Length	0.0	$40 \pm 0.02 \pm 0$.010		0.040 :	± 0.010)		0.040	± 0.010)		0.1	00 ± 0. 54 + 0	020 51)				0.100 =	± 0.020 + 0.51)			
	<u>ı (ı.</u>	02 ± 0.	20)		(1.02.	10.20		X	7R Di	electr	ic		(2.	0+ ± 0.	01)				(2.04.	1 0.01			
Voltage Code	501	102	202	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	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	pacita	nce C	ode										
330 pF	331	331	331																				
470 pF	471	471	471																				
560 pF	561	561	561																				
680 pF	681	681	681	0.04	0.04	0.04	0.04	681	681	681	681												
820 pF	821	821	821	821	821	821	821	821	821	821	821	102	102	102	102	102	102	102	102	102	102	102	
1,200 pF	102	102	102	102	102	102	102	122	102	102	102	102	122	102	102	102	102	102	102	102	102	102	
1,500 pF	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	
1,800 pF	182	182	182	182	182	182	182	182	182	182	182	182	182	182	182	182	182	182	182	182	182	182	
2,200 pF	222	222	222	222	222	222	222	222	222	222	222	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	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	
4 700 pF	472	472	392	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	
6,800 pF	682	682		682	682	682		682	682	682		682	682	682	682	682	682	682	682	682	682	682	
8,200 pF	822	822		822	822	822		822	822	822		822	822	822	822		822	822	822	822	822		
0.01 µF	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		
0.018 µF	183	183		183	183			183	183	100		183	183	183	100		183	183	183	183			
0.022 µF	223	223		223	223			223	223			223	223	223			223	223	223	223			К, М
0.027 µF	273			273	273			273	273			273	273	273			273	273	273	273			
0.033 µF	333			333	333			333	333			333	333	333			333	333	333	333			
0.039 µF	393			393	393			393	393			393	393				393	393	393				
0.056 µF	563			563	563			563	563			563	563				563	563	563				
0.068 µF	683			683	683			683	683			683	683				683	683	683				
0.082 µF	823			823				823	823			823	823				823	823	823				
0.1 µF				104				104	104			104	104				104	104	104				
0.12 µF				124				124				124	124				124	124					
0.18 µF				184				184				184	184				184	184					
0.22 µF								224				224	224				224	224					
0.27 µF								274				274	274				274	274					
0.33 µF												334					334	334					
0.39 µF												394 171					394 171	394					
0.56 µF												564					564	+/4					
0.68 µF																	684						
0.82 µF																	824						l
1.0 µF																	105						l
1.2 µF																	125						



Table 1B – Capacitance Range/Selection Waterfall SM25 – SM31 Style/Size

Style/Size			SN	125					SN	126				;	SM3	0				SN	131			
								Dime	ensior	ns – ir	nches	(mm)												
Length			0.550 :	± 0.030)				0.650 :	± 0.030)			0.3	00 ± 0	.030				0.400 :	± 0.030)		
			(14.00	± 0.76) ± 0.030))				(16.50 0.600 :	± 0.76 ± 0.030))			(7.	62 ± 0 50 ± 0	.76) .015				(10.20	± 0.76 ± 0.020))		
Width			(12.70	± 0.76)					(15.20	± 0.76)			(3.	.81 ± 0	.38)				(5.08	± 0.51)			
Thickness Maximum			0.2 (5	220 59)					0.2 (5	220 59)					0.140					0.1 (3	130 30)			
Lead Width			0.4	400					0.5	500					0.100					0.1	100			
Maximum			(10	.20)					(12	.70)	<u> </u>			0.1	(2.54)	000				(2.	54)			
"L"			(2.54 :	± 0.020 ± 0.51)					(2.54	± 0.020 ± 0.51))			(2.	54 ± 0	.020 .51)				(2.54)	± 0.020 ± 0.51))		
Lead Length			0.100 =	± 0.020)				0.100 :	± 0.020)			0.1	00 ± 0	.020				0.100 =	± 0.020)		
J			(2.54 :	± 0.51)					(2.54 X7R	Diele	ectric		<u> </u>	(2.	.54 ± 0	.51)		<u> </u>		(2.54 :	± 0.51)			
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	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
Capacitance									1	(Capac	itanc	e Cod	е										TOTELATICE
150 pF													151	151	151	151	151							
180 pF 220 pF													181	181	181	181	181							
270 pF													271	271	271	271	271							
330 pF													331	331	331	331	331							
390 pF 470 pF													391	391	391	391	391							
560 pF													561	561	561	561	561							
680 pF													681	681	681	681	681	681	681	681	681	681	681	
820 pF													821	821	821	821	821	821	821	821	821	821	821	
1,000 pF													102	102	102	102	102	102	102	102	102	102	102	
1,500 pF													152	152	152	152	152	152	152	152	152	152	152	
1,800 pF	000	000	000	000	000	000		000	000	000			182	182	182	182		182	182	182	182	182		
2,200 pF 2,700 pF	272	272	272	272	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		
3,900 pF	392	392	392	392	392	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	562	472 562	472 562	472 562	472 562	472 562	472 562	562	562	472 562	472 562	472 562	472 562			472 562	472 562	562	562			
6,800 pF	682	682	682	682	682	682	682	682	682	682	682	682	682	682	682			682	682	682	682			
8,200 pF	822	822	822	822	822	822	822	822	822	822	822	822	822	822	822			822	822	822	822			
0.01 µF	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103			103	103	103				К, М
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				
0.022 µF	223	223	223	223			223	223	223	223	223		223	223				223	223	223				
0.033 µF	333	333	333	333			333	333	333	333	333		333	333				333	333					
0.039 µF	393	393	393	393			393	393	393	393			393	393				393	393					
0.047 µF	473	473	473	473			473	473	473	473			473	473				473	473					
0.068 µF	683	683	683				683	683	683	683			683	000				683	683					
0.082 µF	823	823	823				823	823	823	823			823					823	823					
0.1 µF	104	104	104				104	104	104	104			104					104	104					
0.12 µr 0.15 µF	154	154	124				154	154	154				154					154						
0.18 µF	184	184					184	184	184				184					184						
0.22 µF	224	224					224	224										224						
0.27 µF	334	334					334	334										334						
0.39 µF	394	394					394	394										394						
0.47 µF	474	474					474	474																
0.56 µF	564 684						564 684	564 684																
0.82 µF	824						824	824																



Table 1B – Capacitance Range/Selection Waterfall SM25 – SM31 Style/Size cont'd

Style/Size			SN	125			SM26						SM3	0				SN	131					
								Dime	ensior	ns – ir	nches	(mm)												
Length			0.550 =	± 0.030)				0.650 :	± 0.03	<u>)</u>			0.3	$00 \pm 0.$	030				0.400	± 0.03	0		
Width			0.500 : (12.70	± 0.76) ± 0.030 ± 0.76))				0.600 : (15.20	± 0.76 ± 0.030 ± 0.76))			0.1	62 ± 0. 50 ± 0. 81 ± 0.	015 38)				0.200	± 0.70 ± 0.02 ± 0.51) 0)		
Thickness Maximum			0.2	220 59)					0.2	220 59)	/				0.140 (3.55)	,				0.1	130 30)			
Lead Width Maximum			0.4 (10	400 .20)				0.500 (12.70)			0.100 (2.54)				0.100 (2.54)									
Lead Length "L"			0.100 ± (2.54 :	± 0.020 ± 0.51)					0.100 : (2.54 :	± 0.020 ± 0.51))		$\begin{array}{c} 0.100 \pm 0.020 \\ (2.54 \pm 0.51) \end{array}$			$\begin{array}{c} 0.100 \pm 0.020 \\ (2.54 \pm 0.51) \end{array}$				0)				
Lead Length "J"			0.100 ± (2.54 :	± 0.020 ± 0.51))			0.100 ± 0.020 (2.54 ± 0.51))			0.1 (2.	00 ± 0. 54 ± 0.	020 .51)				0.100 : (2.54	± 0.02 ± 0.51	0		
									X7R	Diel	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	
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										
1.0 μF 1.2 μF	105 125						105 125	105 105 125 105																
1.5 μF 1.8 μF	185						100	185														К, М		
2.2 μF 2.7 μF 2.9 μF							225 275 295	25																



Table 1C – Capacitance Range/Selection Waterfall SM33 – SM35 Style/Size

Style/Size				SM3	33			SM34 SM35																
								Dim	ensio	ns – i	nche	s (mn	1)											
l ength	Т		0.7	700 ± (0.030						0.900	± 0.03	0						1.100	± 0.03	0			
Length	_		(1	7.08 ±	0.76)						(22.90	$) \pm 0.76$	5)						(27.90	± 0.76	5) 0			
Width			0.3	300 ± (7.62 ± ().030).76)						(10.20	± 0.03) ± 0.76	6 6)						(12.70	± 0.03 ± 0.76	0 6)			
Thickness				0.18	0						0.	220							0.	220				
Maximum Lead Width	_		_	(4.57	<u>)</u>						(5	.59) 300							(5	.59) 400				
Maximum				(5.08	6 3)						(7	.62)							(1	400 0.2)				
Lead Length			0.1	100 ± (0.020						0.100	± 0.02	0						0.100	± 0.02	0			
Lead Length			0.1	100 ± ().020						0.100	± 0.51) 0						0.100	± 0.51 ± 0.02) 0			
"J" ¯			(2	.54 ±	0.51)						(2.54	± 0.51)						(2.54	± 0.51)			
					1		,		X/ł	K Diel	ectric	;											,	
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	Canacitanco
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	Tolerance
Capacitance											Capa	citanc	ce Co	de										
820 pF	821	821	821	821	821	821	821		400	400	400	400	400	400	400								400	
1,000 pF	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102								102	
1,200 pF	152	122	152	152	152	152	152	152	122	122	122	122	152	152	152								152	
1,800 pF	182	182	182	182	182	182	182	182	182	182	182	182	182	182	182								182	
2,200 pF	222	222	222	222	222	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	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	4/2	4/2	4/2	4/2	4/2	4/2	472	4/2	4/2	4/2	4/2	4/2	4/2	4/2	4/2	4/2	4/2	4/2	4/2	4/2	4/2	4/2	4/2	
5,000 pF	682	682	682	682	682	682		682	682	682	682	682	682	682	502	682	682	682	682	682	682	682	682	
8.200 pF	822	822	822	822	822	002		822	822	822	822	822	822	002		822	822	822	822	822	822	822	002	
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	223	223	223	223				223	223	223	223	223	223			223	223	223	223	223	223			
0.027 µF	333	2/3	2/3	2/3				333	213	213	213	2/3				2/3	2/3	213	213	213	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					КМ
0.068 µF	683	683	683					683	683	683	683					683	683	683	683					IX, W
0.082 µF	823	823	823					823	823	823	823					823	823	823	823					
0.1 µF	104	104						104	104	104						104	104	104	104					
0.12 µr	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	274	274						274	274	274						274	274	274						
0.33 µF	334	334						334	334							334	334							
0.39 µF	394	394						394	394							394	394							
0.56 µF	564	564						564	564							564	564							
0.68 µF	684	684						684	684							684	684							
0.82 µF	824							824	824							824	824							
1.0 µF	105							105	105							105	105							
1.2 µF	125							125								125	125							
1.5 µF	155							100								100								
2.2 µF								225								225								
2.7 µF																275								
2.9 µF																295								
3.3 µF																335								
3.9 µF								I								395								



Table 1D – Capacitance Range/Selection Waterfall SM36 Style/Size

Style/Size									
D	imens	sions	– incl	nes (r	nm)				
Length				1.350	± 0.03 ± 0.76	0 5)			
Width				0.600	± 0.03	0			
Thickness				(15.20	220	o)			
Maximum				(5	.59)				
Maximum				0. (1	.500 2.7)				
Lead Length				0.100	± 0.02	0			
Lead Length				0.100	± 0.01) 0			
"J"	<u> </u>	(7R D	ielec	(2.54 tric	± 0.51)			
Voltage Code	501	102	202	302	402	502	752	103	
Voltage DC	500	1 K	2 K	3 K	4 K	5 K	7.5 K	10 K	Capacitance
Capacitance			Са	pacita	ance (Code			Iolerance
1,500 pF								152	
1,800 pF 2 200 pF								182	
2,700 pF								272	
3,300 pF								332	
4,700 pF	472	472	472	472	472	472	472	472	
5,600 pF	562	562	562	562	562	562	562	562	
6,800 pF 8 200 pE	682 822	682 822	682 822	682 822	682 822	682 822	682 822	682 822	
0.01 µF	103	103	103	103	103	103	103	103	
0.012 µF	123	123	123	123	123	123	123		
0.015 µF 0.018 µF	153 183	153 183	153 183	153	153	153	153 183		
0.022 µF	223	223	223	223	223	223	223		
0.027 µF	273	273	273	273	273	273			
0.039 µF	393	393	393	393	393	555			
0.047 µF	473	473	473	473	473				
0.056 µF 0.068 µF	563 683	563 683	563 683	563 683	563 683				
0.082 µF	823	823	823	823					
0.1 µF	104	104	104	104					K, M, P, Z
0.12 µr 0.15 µF	154	154	154	154					
0.18 µF	184	184	184						
0.22 µF 0.27 µF	224	224	224						
0.33 µF	334	334	334						
0.39 µF	394	394 474							
0.56 µF	564	564							
0.68 µF	684	684							
0.82 µF 1.0 µF	824	824 105							
1.2 µF	125	125							
1.5 µF 1 8 µF	155 185	155 185							
2.2 µF	225	225							
2.7 µF	275								
2.9 µF 3.3 ⊔F	335								
3.9 µF	395								
4.7 μF 5.6 μF	475 565								



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 $(T_L \text{ to } T_p)$	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 $(T_P \text{ to } T_L)$	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

Reference	ltem	Material
А	Leadframe	Phosphor Bronze - Alloy 510 (Silver plated / Nickle Underplate)
В	Leadframe Attach Material	Silver Epoxy
С	MLCC	
D	Termination	Solderable Silver
E	System	
F	Electrode	PdAg
G	Dielectric	BaTiO ₃



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

Pulse Detonation, High Voltage, High Temperature 200°C, C0G Dielectric, 500 – 2,000 VDC (Industrial Grade)



Overview

KEMET's Industrial Grade Pulse Detonation Series surface mount capacitors in COG dielectric deliver reliable, high voltage and high temperature performance required for operation in harsh environments, specifically detonation 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 Detonation capacitors average greater than 30% higher breakdown voltage than competitive precious metal electrode (PME) devices with similar capacitance and 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 Detonation 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 Detonation surface mount MLCCs are manufactured in state-of-the-art ISO/TS 16949:2002 certified facilities and are proven to function reliably in harsh, high temperature and high humidity down-hole environments.

Benefits

- -55°C to +200°C operating temperature range
- Pb-Free and RoHS Compliant
- Base metal technology
- High breakdown voltage capability up to +200°C
- · Higher UVBD capability than competitive dielectric technologies
- Capacitance offerings ranging from 0.5 pF up to 0.15 μF
- Available capacitance tolerances of ±5%, ±10% or ±20%
- Extremely low ESR and ESL
- High thermal stability

Ordering Information



			Со	ntact KEMET	for ordering	informat	on		
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC) ¹	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/Grade (C-Spec) ³
	2824 3040 3640 4040 4540	H= High Temp (200°C)	2 Significant Digits + Number of Zeros	J = ±5% K = ±10% M = ±20%	C = 500 V B = 630 V D = 1,000 V F = 1,500 V G = 2,000 V	G = C0G	W = Pulse Detonation	C = 100% Matte Sn	Contact KEMET for packaging availability and details

¹ For breakdown voltage (UVBD) values see Table 1, Pulse Detonation Series, Capacitance Range Waterfall.

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

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



Dimensions – Millimeters (Inches)



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 \pm 0.016)				
3040	7.60 ± 0.40 (0.300 ± 0.016)	10.20 ± 0.40 (0.402 ± 0.016)				
3640	9.10 ± 0.40 (0.358 ± 0.016)	10.20 ± 0.40 (0.402 ± 0.016)	2.5 (0.098)	0.76 ± 0.40 (0.030 ± 0.016)	N/A	Solder Reflow Only
4040	10.20 ± 0.40 (0.402 ± 0.016)	10.20 ± 0.40 (0.402 ± 0.016)				-
4540	11.40 ± 0.40 (0.449 ± 0.016)	10.20 ± 0.40 (0.402 ± 0.016)				

Benefits

- 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 detonation circuits for down-hole oil exploration and perforation.

Qualification/Certification

Industrial Grade pulse detonation products are designed to meet customer-specific testing requirements.

Environmental Compliance

Pb-Free and RoHS Compliant.





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%
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)
Ultimate Voltage Breakdown (UVBD)	300% of rated voltage for voltage rating of < 1,000 V 250% of rated voltage for voltage rating of 1,000 V 240% of rated voltage for voltage rating of 1,500 V (5 ±1 seconds and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit @ 25°C	0.1%
Insulation Resistance (IR) Limit @ 25°C	1000 megohm microfarads or 100 GΩ (500 VDC 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 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

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 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						

Ultimate Voltage Breakdown (UVBD) – Typical Mean Breakdown Voltage Ratings

Rated Voltage (VDC)	Breakdown Voltage/UVBD (VDC)
500	3X Rated
630	3X Rated
1,000	2.5X Rated
1,500	2.3X Rated
2,000	2X Rated



Electrical Characteristics







Table 1 – Pulse Detonation Series, Capacitance Range Waterfall

Case S	ize (in.)			282	4				304	0				364	0				404	0				454()	
Length	mm (in.)		7 (0.1	7.10 ± 0 280 ± 0	.40).016)			7. (0.3	60 ± 0 00 ± 0	0.40 0.016)			9 (0.3	.10 ± 0 58 ± 0	.40 .016)			10 (0.4	.20 ± 0	0.40).016)			11. (0.4	.40 ± 0 49 ± 0).40 .016)	
Width	mm (in.)		6 (0.)	6.10 ± 0 240 ± 0	.40).016)			10 (0.4	.20 ± 02 ± 0	0.40).016)			10 (0.4	.20 ± 0 02 ± 0	0.40 0.016)			10 (0.4	.20 ± 0	0.40).016)			10 (0.4	.20 ± 0 02 ± 0).40 .016)	
Thickness Maximum	mm (in.)			2.5 (0.098	3)				2.5 (0.098	3)				2.5 (0.098	3)				2.5 (0.098	8)				2.5 (0.098	5)	
Bandwidth	mm (in.)		0 (0.0).76 ± 0 030 ± 0).40).016)			0. (0.0	76 ± 0 30 ± 0).40).016)			0. (0.0	.76 ± 0 30 ± 0	.40 .016)			0 (0.0	.76 ± 0)30 ± 0).40).016)			0. (0.0)	76 ± 0. 30 ± 0	.40 .016)	
Rated Volt	age (VDC)	500	630	1K	1.5K	2K	500	630	1K	1.5K	2K	500	630	1K	1.5K	2K	500	630	1K	1.5K	2K	500	630	1K	1.5K	2K
Voltag	e Code	С	В	D	F	G	C	В	D	F	G	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
Breakdown V	/oltage (VDC)	1.5K	1.8K	2.5K	3.5K	4K	1.5K	1.8K	2.5K	3.5K	4K	1.5K	1.8K	2.5K	3.5K	4K	1.5K	1.8K	2.5K	3.5K	4K	1.5K	1.8K	2.5K	3.5K	4K
Capacitance	Capacitance Tolerance								Сара	acitan	ce C	ode (Avai	lable	Maxi	mum	n Cap	acita	ance)	1						
6,800pF 8,200pF 0.01µF 0.012µF 0.015µF 0.022µF 0.027µF 0.033µF 0.039µF 0.039µF 0.047µF 0.056µF 0.068µF 0.068µF 0.068µF 0.072µF 0.082µF 0.082µF 0.082µF	J = ±5% K = ±10% M = ±20%	683	333	223	682		104	683	473	153			723	473	153			104	623	223	153		104	683	273	183
0.12µF 0.15µF												124					154					154				
Rated Volt	tage (VDC)	500	630	1K	1.5K	2K	500	630	1K	1.5K	2K	500	630	1K	1.5K	2K	500	630	1K	1.5K	2K	500	630	1K	1.5K	2K
Voltag	e Code	С	В	D	F	G	С	в	D	F	G	С	в	D	F	G	с	В	D	F	G	С	в	D	F	G
Breakdown V	/oltage (VDC)	1.5K	1.8K	2.5K	3.5K	4K	1.5K	1.8K	2.5K	3.5K	4K	1.5K	1.8K	2.5K	3.5K	4K	1.5K	1.8K	2.5K	3.5K	4K	1.5K	1.8K	2.5K	3.5K	4K

¹ Only maximum available CV (capacitance /voltage) values are highlighted. Lower CV values are available upon request. Please contact KEMET to discuss your specific CV requirement.

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



Table 2 – Chip Capacitor Land Pattern Design Recommendations per IPC–7351

Size Code (in)	(in) Density Level A: Maximum (Most) Land Protrusion (mm)					Dens Medi Land P	sity Lev an (Nor rotrusio	rel B: ninal) on (mm))	Density Level C: Minimum (Least) Land Protrusion (mm)					
	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	X	V1	V2
2824	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	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	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
4040	5.00	1.70	10.70	12.70	11.70	4.90	1.50	10.60	11.80	11.10	4.80	1.30	10.50	11.10	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).



Soldering Process

Recommended Soldering Technique:

Solder reflow only

Recommended Soldering Profile:

• KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020



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

Reference	lte	em	Material	
А		Finish	100% Matte Sn	
В	Termination System	Barrier Layer	Ni	
С	, , , , , , , , , , , , , , , , , , ,	Base Metal	Cu	
D	Inner E	Inner Electrode		
E	Dielectric	CaZrO ₃		



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



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.

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

© KEMET Electronics Corporation • P.O. Box 5928 • Greenville, SC 29606 (864) 963-6300 • www.kemet.com



Tape & Reel Packaging Information

KEMET offers multilayer ceramic chip capacitors packaged in 8, 12 and 16 mm tape on 7" and 13" reels in accordance with EIA Standard 481. This packaging system is compatible with all tape-fed automatic pick and place systems. See Table 2 for details on reeling quantities for commercial chips.



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

EIA Case Size	Tape Size (W)*	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 Figures 1 & 2 for W and P_1 carrier tape reference locations. *Refer to Tables 6 & 7 for tolerance specifications.



Figure 1 – Embossed (Plastic) Carrier Tape Dimensions



Table 6 – Embossed (Plastic) Carrier Tape Dimensions

Metric will govern

	Constant 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)	No	te 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 S₁ < 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

Metric will govern

	Constant Dimensions — Millimeters (Inches)											
Tape Size	Tape Size D0 E1 P0 P2 T1 Maximum G Minimum R Reference Note 2											
8 mm	1.5 +0.10 -0.0 (0.059 +0.004 -0.0)	1.75 ±0.10 (0.069 ±0.004)	4.0 ±0.10 (0.157 ±0.004)	2.0 ±0.05 (0.079 ±0.002)	0.10 (0.004) Maximum	0.75 (0.030)	25 (0.984)					
		Variable D)imensions — M	lillimeters (Inche	es)							
Tape Size	Pitch	E2 Minimum	F	P ₁	T Maximum	W Maximum	A ₀ B 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)	Noto 1					
8 mm	Single (4 mm)	(0.246)	(0.138 ±0.002)	4.0 ±0.10 (0.157 ±0.004)	(0.098)	8.3 (0.327)	NOLE I					

1. The cavity defined by A_{α} , B_{α} and T shall surround the component with sufficient clearance that:

a) the component does not protrude beyond either surface of the carrier tape.

b) the component can be removed from the cavity in a vertical direction without mechanical restriction, after the top cover tape has been removed.

c) rotation of the component is limited to 20° maximum (see Figure 3).

d) lateral movement of the component is restricted to 0.5 mm maximum (see Figure 4).

e) see Addendum in EIA Standard 481 for standards relating to more precise taping requirements.

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



Packaging Information Performance Notes

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

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

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

Figure 3 – Maximum Component Rotation



Figure 4 – Maximum Lateral Movement



Figure 5 – Bending Radius





Figure 6 – Reel Dimensions



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

Table 8 – Reel Dimensions

Metric will govern

	Constan	t Dimensions — Millimete	rs (Inches)	
Tape Size	А	B Minimum	С	D Minimum
8 mm	178 ±0.20			
12 mm	(7.000 ±0.008) Or 220 +0.20	1.5 (0.059)	13.0 +0.5/-0.2 (0.521 +0.02/-0.008)	20.2 (0.795)
16 mm	(13.000 ±0.008)			
	Variable	Dimensions — Millimeter	rs (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



Bulk Cassette Packaging (Ceramic Chips Only)

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



Capacitor Dimensions for Bulk Cassette

Cassette Packaging - Millimeters

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

© KEMET Electronics Corporation • P.O. Box 5928 • Greenville, SC 29606 (864) 963-6300 • www.kemet.com

CC101_COMM_SMD • 11/25/2013 464



Tape & Reel Packaging Information

KEMET offers multilayer ceramic chip capacitors packaged in 8, 12 and 16 mm tape on 7" and 13" reels in accordance with EIA Standard 481. This packaging system is compatible with all tape-fed automatic pick and place systems. See Table 2 for details on reeling quantities for commercial chips.



Table 5 – Carrier Tape Configuration – Embossed Plastic (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_1 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

Metric will govern

Constant Dimensions — Millimeters (Inches)									
Tape Size	D ₀	D ₁ Minimum Note 1	E ₁	P ₀	P ₂	R Reference Note 2	S ₁ Minimum Note 3	T Maximum	T ₁ Maximum
8 mm		1.0 (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 Dimensions — Millimeters (Inches)									
Tape Size	Pitch	B ₁ Maximum Note 4	E ₂ Minimum	F	P ₁	T ₂ Maximum	W Maximum	A ₀ ,B ₀	& K ₀
8 mm	Single (4 mm)	4.35 (0.171)	6.25 (0.246)	3.5 ±0.05 (0.138 ±0.002)	4.0 ±0.10 (0.157 ±0.004)	2.5 (0.098)	8.3 (0.327)		
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 S₁ < 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 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_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.



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

Metric will govern

Constant Dimensions — Millimeters (Inches)						
Tape Size	А	B Minimum	С	D Minimum		
8 mm	178 ±0.20		13.0 +0.5/-0.2 (0.521 +0.02/-0.008)	20.2 (0.795)		
12 mm	(7.000 ±0.008) Or 220 +0.20	1.5 (0.059)				
16 mm	(13.000 ±0.008)					
Variable Dimensions — Millimeters (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





KEMET Corporation World Headquarters

2835 KEMET Way Simpsonville, SC 29681

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

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

Corporate Offices Fort Lauderdale, FL

Tel: 954-766-2800

North America

Southeast Lake Mary, FL Tel: 407-855-8886

Northeast Wilmington, MA Tel: 978-658-1663

Central Novi, MI Tel: 248-994-1030

West Milpitas, CA Tel: 408-433-9950

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

Europe

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

Sasso Marconi, Italy Tel: 39-051-939111

Central Europe Landsberg, Germany Tel: 49-8191-3350800

Kamen, Germany Tel: 49-2307-438110

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

Espoo, Finland Tel: 358-9-5406-5000

Asia

Northeast Asia Hong Kong Tel: 852-2305-1168

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

Beijing, China Tel: 86-10-5829-1711

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

Taipei, Taiwan Tel: 886-2-27528585

Southeast Asia Singapore Tel: 65-6586-1900

Penang, Malaysia Tel: 60-4-6430200

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

Note: KEMET reserves the right to modify minor details of internal and external construction at any time in the interest of product improvement. KEMET does not assume any responsibility for infringement that might result from the use of KEMET Capacitors in potential circuit designs. KEMET is a registered trademark of KEMET Electronics Corporation.



Other KEMET Resources

Tools		
Resource	Location	
Configure A Part: CapEdge	http://capacitoredge.kemet.com	
SPICE & FIT Software	http://www.kemet.com/spice	
Search Our FAQs: KnowledgeEdge	http://www.kemet.com/keask	
Electrolytic LifeCalculator	http://www.kemet.com:8080/elc	

Product Information		
Resource	Location	
Products	http://www.kemet.com/products	
Technical Resources (Including Soldering Techniques)	http://www.kemet.com/technicalpapers	
RoHS Statement	http://www.kemet.com/rohs	
Quality Documents	http://www.kemet.com/qualitydocuments	

Product Request		
Resource	Location	
Sample Request	http://www.kemet.com/sample	
Engineering Kit Request	http://www.kemet.com/kits	

Contact		
Resource	Location	
Website	www.kemet.com	
Contact Us	http://www.kemet.com/contact	
Investor Relations	http://www.kemet.com/ir	
Call Us	1-877-MyKEMET	
Twitter	http://twitter.com/kemetcapacitors	

Disclaimer

All product specifications, statements, information and data (collectively, the "Information") in this datasheet are subject to change. The customer is responsible for checking and verifying the extent to which the Information contained in this publication is applicable to an order at the time the order is placed.

All Information given herein is believed to be accurate and reliable, but it is presented without guarantee, warranty, or responsibility of any kind, expressed or implied.

Statements of suitability for certain applications are based on KEMET Electronics Corporation's ("KEMET") knowledge of typical operating conditions for such applications, but are not intended to constitute – and KEMET specifically disclaims – any warranty concerning suitability for a specific customer application or use. The Information is intended for use only by customers who have the requisite experience and capability to determine the correct products for their application. Any technical advice inferred from this Information or otherwise provided by KEMET with reference to the use of KEMET's products is given gratis, and KEMET assumes no obligation or liability for the advice given or results obtained.

Although KEMET designs and manufactures its products to the most stringent quality and safety standards, given the current state of the art, isolated component failures may still occur. Accordingly, customer applications which require a high degree of reliability or safety should employ suitable designs or other safeguards (such as installation of protective circuitry or redundancies) in order to ensure that the failure of an electrical component does not result in a risk of personal injury or property damage.

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

Product & Process Design

Sales & Marketing

Supplier

Material Management

Quality

Manufacturing

Logistics & Distribution

People: Leadership & Development

KEMET Production System

One world. One KEMET | KE



Corporate Offices

KEMET Corporation 2835 KEMET Way Simpsonville, SC 29681 USA Tel: 864.963.6300 Fax: 864.963.6521

KEMET Electronics GmbH Rudolf-Diesel-Straße 21 86899 Landsberg Germany Tel: +49 8191 3350 ext. 0 Fax: 49 8191 335063

KEMET Electronics Marketing (S) Pte Ltd. 73 Bukit Timah Road #05-01 Rex House Singapore 229832 Tel: 65.6586.1900 Fax: 65.6586.1901

www.kemet.com

One world. One KEMET.

