# High Voltage COG Dielectric, 500 - 3,000 VDC (Automotive Grade)



### **Overview**

KEMET's Automotive Grade High Voltage surface mount MLCCs in COG dielectric 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 ±30ppm/°C from -55°C to +125°C.

Their exceptional performance at high frequencies has made C0G high voltage the preferred dielectric choice of design engineers worldwide. Whether under-hood or in-cabin, these capacitors are designed to provide reliable performance in 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.

## **Benefits**

- · AEC-Q200 automotive qualified
- Operating temperature range of -55°C to +125°C
- Capacitance offerings ranging from 1 pF to 0.15 μF
- DC voltage ratings of 500 V, 630 V, 1 KV, 1.5 KV, 2 KV, 2.5 KV and 3 KV
- EIA 0603, 0805, 1206, 1210, 1808, 1812, 1825, 2220, 2225, 2824, 3040, 3640 and 4540 case sizes
- Extremely low ESR and ESL
- High ripple current capability
- · No capacitance shift with voltage
- · Negligible capacitance shift with respect to temperature
- · No piezoelectric noise
- · Lead (Pb)-Free, RoHS and REACH compliant



# **Applications**

- High frequency power converters
- · Wide bandgap (WBG), silicon carbide (SiC) and gallium nitride (GaN) systems
- Snubber (high dV/dT)
- Resonant circuits (LLC, Wireless Charging, etc)
- Timing
- Filtering



## **Ordering Information**

C	1210	С	332	J	С	G	Α	С	AUTO
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance <sup>1</sup>	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish <sup>2</sup>	Packaging/Grade (C-Spec)
	0603 0805 1206 1210 1808 1812 1825 2220 2225 2824 3040 3640 4540	C = Standard	Two significant digits and number of zeros.	B = ±0.10 pF C = ±0.25 pF D = ±0.5 pF F = ±1% G = ±2% J = ±5% K = ±10% M = ±20%	C = 500 B = 630 D = 1,000 F = 1,500 G = 2,000 Z = 2,500 H = 3,000	G = COG	A = N/A	C = 100% Matte Sn	See "Packaging C-Spec Ordering Options Table"

<sup>&</sup>lt;sup>1</sup> Additional capacitance tolerance offerings may be available. Contact KEMET for details.

# **Packaging C-Spec Ordering Options Table**

Packaging Type <sup>1</sup>	Packaging/Grade Ordering Code (C-Spec) <sup>3</sup>
7" Reel	AUTO
13" Reel/Unmarked	AUT07411 (EIA 0603 and smaller case sizes) AUT07210 (EIA 0805 and larger case sizes)
7" Reel/Unmarked/2 mm pitch <sup>2</sup>	3190
13" Reel/Unmarked/2 mm pitch <sup>2</sup>	3191

<sup>&</sup>lt;sup>1</sup> Reeling tape options (Paper or Plastic) are dependent on capacitor case size (L" x W") and thickness dimension. See "Chip Thickness/Tape & Reel Packaging Quantities" and "Tape & Reel Packaging Information".

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

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

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

<sup>&</sup>lt;sup>3</sup> For additional Information regarding "AUTO" C-Spec options, see "Automotive C-Spec Information."



# **Automotive C-Spec Information**

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

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

#### **Product Change Notification (PCN)**

The KEMET product change notification system is used to communicate primarily the following types of changes:

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

KEMET Automotive	Customer Notifica	tion Due To:	Days Prior To
C-Spec	Process/Product change	Obsolescence*	Implementation
KEMET assigned <sup>1</sup>	Yes (with approval and sign off)	Yes	180 days minimum
AUT0	Yes (without approval)	Yes	90 days minimum

<sup>&</sup>lt;sup>1</sup> KEMET assigned C-Specs require the submittal of a customer SCD or customer specification for review. For additional information contact KEMET.

#### **Production Part Approval Process (PPAP)**

The purpose of the Production Part Approval Process is:

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

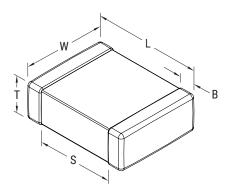
KEMET Automotive		PPAP (Product	Part Approval	Process) Leve	I
C-Spec	1	2	3	4	5
KEMET assigned <sup>1</sup>	•	•	•	•	•
AUT0			0		

<sup>&</sup>lt;sup>1</sup> KEMET assigned C-Specs require the submittal of a customer SCD or customer specification for review. For additional information contact KEMET.

- Part number specific PPAP available
- Product family PPAP only



# **Dimensions - Millimeters (Inches)**



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0603	1608	1.60 (0.063) ±0.15 (0.006)	0.80 (0.032) ±0.15 (0.006)		0.35 (0.014) ±0.15 (0.006)	0.70 (0.028)	
0805	2012	2.00 (0.079) ±0.20 (0.008)	1.25 (0.049) ±0.20 (0.008)		0.50 (0.02) ±0.25 (0.010)	0.75 (0.030)	Solder Wave or Solder Reflow
1206	3216	3.20 (0.126) ±0.20 (0.008)	1.60 (0.063) ±0.20 (0.008)		0.50 (0.02) ±0.25 (0.010)		
1210	3225	3.20 (0.126) ±0.20 (0.008)	2.50 (0.098) ±0.20 (0.008)		0.50 (0.02) ±0.25 (0.010)		
1808	4520	4.70 (0.185) ±0.50 (0.020)	2.00 (0.079) ±0.20 (0.008)		0.60 (0.024) ±0.35 (0.014)		
1812	4532	4.50 (0.177) ±0.30 (0.012)	3.20 (0.126) ±0.30 (0.012)		0.60 (0.024) ±0.35 (0.014)		
1825	4564	4.50 (0.177) ±0.30 (.012)	6.40 (0.252) ±0.40 (0.016)	See Table 2 for Thickness	0.60 (0.024) ±0.35 (0.014)		
2220	5650	5.70 (0.224) ±0.40 (0.016)	5.00 (0.197) ±0.40 (0.016)	-	0.60 (0.024) ±0.35 (0.014)	N/A	Solder Reflow
2225	5664	5.60 (0.220) ±0.40 (0.016)	6.40 (0.248) ±0.40 (0.016)	-	0.60 (0.024) ±0.35 (0.014)		Only
2824	7260	7.10 (0.280) ±0.40 (0.016)	6.10 (0.240) ±0.40 (0.016)	-	1.27 (0.050) ±0.40 (0.016)		
3040	7610	7.60 (0.300) ±0.40 (0.016)	10.20 (0.402) ±0.40 (0.016)	-	1.27 (0.050) ±0.40 (0.016)		
3640	9210	9.10 (0.358) ±0.40 (0.016)	10.20 (0.402) ±0.40 (0.016)	-	1.27 (0.050) ±0.40 (0.016)		
4540	-	11.40 (0.449) ±0.40 (0.016)	10.20 (0.402) ±0.40 (0.016)		1.27 (0.050) ±0.40 (0.016)		



## **Qualification/Certification**

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

## **Environmental Compliance**

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

## **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%
<sup>1</sup> Dielectric Withstanding Voltage (DWV)	See Dielectric Withstanding Voltage (DWV) Table (5 ±1 seconds and charge/discharge not exceeding 50 mA)
<sup>2</sup> Dissipation Factor (DF) Maximum Limit at 25°C	0.1%
<sup>3</sup> Insulation Resistance (IR) Limit at 25°C	1,000 megohm microfarads or 100 GΩ (500 VDC applied for 120 ±5 seconds at 25°C)

<sup>&</sup>lt;sup>1</sup>DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

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

<sup>&</sup>lt;sup>2</sup> Capacitance and dissipation factor (DF) measured under the following conditions:

<sup>1</sup> MHz ±100 kHz and 1.0  $V_{rms}$  ±0.2 V if capacitance  $\leq$  1,000 pF

<sup>1</sup> kHz  $\pm$ 50 Hz and 1.0  $V_{rms}$   $\pm$ 0.2 V if capacitance > 1,000 pF

<sup>&</sup>lt;sup>3</sup> 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.



# **Dielectric Withstanding Voltage (DWV)**

<b>EIA Case Size</b>	500V	630V	≥ 1000V
0603		130% of rated voltage	
0805		< 620pF 150% of rated voltage ≥ 620pF 130% of rated voltage	
1206		< 5.1nF 150% of rated voltage ≥ 5.1nF 130% of rated voltage	
1210		< 7.5nF 150% of rated voltage ≥ 7.5nF 130% of rated voltage	
1808	150% of rated voltage	< 5.1nF 150% of rated voltage ≥ 5.1nF 130% of rated voltage	120% of rated voltage
1812	ronage	< 12nF 150% of rated voltage ≥ 12nF 130% of rated voltage	ronage
1825		< 22nF 150% of rated voltage ≥ 22nF 130% of rated voltage	
2220		< 27nF 150% of rated voltage ≥ 27nF 130% of rated voltage	
±2225		< 33nF 150% of rated voltage ≥ 33nF 130% of rated voltage ≥ 33nF 130% of rated voltage	

# **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 - 1808 Case Sizes)

		Ca	ase	S	ize	e/\$	Ser	ie	S	CO	603	3C	C	080	5C		C.	120	6C			C	121	0C				С	180	8C		
	Сар		١	/olt	age	Co	de		-	С	В	D	С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	Z	Н
Capacitance	Code		Rate	d V	olta	ige	(VD	C)		500	630	1000	500	630	1000	500	630	1000	1500	2000	500	630	1000	1500	2000	500	630	1000	1500	2000	2500	3000
			C	ap					T				•			. Р	rodu	ct Av	ailab	ility	and C	hip 1	hick	ness	Code	es						
1.0 - 9.1 pF*	109-919*	В	С	D D	lera	inc	e		+				DG	DG	DG		See	labie	e 2 10	r Cni	p i ni	скпе	יע צצ	mens	ions	LB	LB	LB	LB	LB	LB	LB
10 pF - 47pF*	100 - 470*					G			М				DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
51 pF	510					G			М				DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
56 pF	560					G			М				DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
62 pF	620			_	_	G			М				DG	DG	DG	ED	ED	ED	ED	ED	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
68 pF 75 pF	680 750			- 1		G G			M   M				DG DG	DG DG	DG DG	ED ED	ED ED	ED ED	ED ED	ED EF	FM FM	FM FM	FM FM	FM FM	FM FM	LB LB	LB LB	LB LB	LB	LB	LB LB	LB LB
82 pF	820			- 1		G		- 1	МΙ				DG	DG	DG	ED	ED	ED	ED	EF	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
91 pF	910			- 1		G		- 1	мΙ				DG	DG	DG	ED	ED	ED	ED	EF	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LB	LB
100 pF	101			- 1		G			м	CG	CG	CG	DG	DG	DG	ED	ED	ED	ED	EF	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LC	LB
110 pF	111				F	G	J	K	М	CG	CG	CG	DG	DG	DG	ED	ED	ED	ED	EG	FM	FM	FM	FM	FM	LB	LB	LB	LB	LB	LC	LB
120 pF	121				F	G	J	K	М	CG	CG	CG	DG	DG	DG	ED	ED	ED	ED	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LB	LC	LB
130 pF	131					G			М	CG	CG	CG	DG	DG	DG	ED	ED	ED	ED	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LB	LC	LC
150 pF	151					G		K	М	CG	CG	CG	DG	DG	DG	ED	ED	ED	EF	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LB	LC	LC
160 pF	161			_	_	G	_	_	_	CG	CG	CG	DG	DG	DG	ED	ED	ED	EF	EG	FG	FG	FG	FM	FM	LA	LA	LA	LA	LC	LC	LC
180 pF	181			- 1		G			М	CG	CG	CG	DG	DG	DG	ED	ED	ED	EF	EG	FG	FG	FG FG	FM	FM	LA	LA	LA	LA	LC	LC	LC
200 pF 220 pF	201 221			- 1		G G			M M	CG CG	CG CG	CG	DG DG	DG DG	DG DG	ED ED	ED ED	ED ED	EF EG	EG EG	FG FG	FG FG	FG	FM FM	FM FM	LA LA	LA	LA	LA	LC	LC	
240 pF	241					G			МΙ	CG	CG	CG	DG	DG	DG	ED	ED	ED	EG	EG	FG	FG	FG	FM	FM	LA	LA	LA	LB	LC	LC	
270 pF	271			- 1		G			ΜТ	CG	CG		DG	DG	DG	ED	ED	ED	EG	EG	FG	FG	FG	FK	FK	LA	LA	LA	LB	LC	LC	
300 pF	301			_	-	G	_	_	м	CG	CG		DG	DG	DN	ED	ED	EF	EG		FG	FG	FG	FK	FK	LA	LA	LA	LB	LC	LC	
330 pF	331					G			м	CG	CG		DG	DG	DN	ED	ED	EF	EG		FG	FG	FG	FK	FK	LA	LA	LA	LB	LC	LC	
360 pF	361				F	G	J	K	М	CG	CG		DG	DG	DN	ED	ED	EF	EG		FG	FG	FG	FK	FS	LA	LA	LA	LB	LA	LC	
390 pF	391					G	J	K	М	CG	CG		DG	DG	DN	ED	ED	EF	EG		FG	FG	FG	FK	FS	LA	LA	LA	LB	LA	LC	
430 pF	431			_	_	G	_	_	М	CG	CG		DG	DG	DP	ED	ED	EF	EG		FG	FM	FM	FS	FS	LA	LB	LB	LC	LA		
470 pF	471			- 1		G			М	CG	CG		DG	DG	DP	ED	ED	EG	EG		FG	FM	FM	FS	FS	LA	LB	LB	LC	LA		
510 pF	511			- 1		G			- 1	CG	CG		DG	DG	DP	ED	ED	EG	EG		FG	FM	FM	FS	FS	LA	LB	LB	LC	LB		
560 pF 620 pF	561 621			- 1		G G			M   M	CG CG	CG CG		DG DG	DG DG	DG DG	ED ED	ED ED	EG EG	EG		FG FG	FM FM	FM FM	FS FS	FS FS	LA LA	LB LB	LB LB	LC	LB		
680 pF	681			- 1		G			М	CG	CG		DG	DG	DG	ED	ED	EG			FG	FM	FM	FS	FS	LA	LB	LB	LA	LC		
750 pF	751			_	-	G	_	_	м	CO	00		DG	DG	DG	ED	EF	EG			FG	FM	FM	FM	13	LB	LB	LB	LA	LU		
820 pF	821					G			м				DG	DG	DG	ED	EF	EG			FG	FM	FM	FM		LB	LB	LB	LA			
910 pF	911					G			м				DN	DN		ED	EF	EG			FM	FM	FM	FY		LB	LB	LB	LA			
1,000 pF	102				F	G	J	K	М				DN	DN		ED	EF	EG			FM	FM	FM	FY		LB	LB	LB	LB			
1,100 pF	112			_		G		_	М				DN	DN		EF	EG	ED			FM	FK	FK	FS		LC	LC	LC	LB			
1,200 pF	122			- 1		G			М				DN	DN		EF	EG	ED			FM	FK	FK	FS		LC	LC	LC	LC			
1,300 pF	132			- 1		G			М				DN	DN		EF	EG	ED			FM	FS	FS			LC	LC	LC	LC			
1,500 pF	152					G			М				DP	DP		EF	EG	ED			FK	FS	FS			LC	LC	LC	LC			
1,600 pF 1,800 pF	162 182			- 1		G G			M I				DP DG	DP DG		EF EF	EG EG	ED EF			FK FK	FS FS	FS FS			LC	LC	LC LC				
2,000 pF	202			_	-	G	_	_	М				DG	DG		EG	EB	EF			FK	FL	FS			LC	LA	LB				
2,200 pF	222					G			М				DG	DG		EG	EB	EF			FK	FL	FS			LC	LA	LB				
2,400 pF	242					G			М				DG	DG		EG	EB	EG			FS	FL	FS			LC	LA	LB				
2,700 pF	272					G			М				DG	DG		EG	EB	EG			FS	FL	FS			LC	LA	LC				
3,000 pF	302					G		_	М							EB	EB				FS	FL	FF			LA	LA	LA				
3,300 pF	332					G		- 1	М							EB	EB				FS	FM	FG			LA	LA	LA				
3,600 pF	362					G		- 1	М							EC	EC				FL	FM	FG			LA	LB	LA				
3,900 pF	392					G			М							EC	EC				FL	FY	FL			LA	LB	LA				
4,300 pF 4,700 pF	432 472					G G		K K	М							ED ED	ED ED				FM FM	FY FY	FL FM			LA LA	LC	LA LB				
5,100 pF	512			_	-	_		K								EE	EE				FIVI	FS	FM			LA	LB	LB				
5,600 pF	562					G		K								EF	EF				FY	FS	FM			LB	LC	LC				
			Rate	d V	olta	ge	(VD	C)	1	500	630	1000	500	630	1000	500	630	1000	1500	2000	500	630	1000	1500	2000	500	630	1000	1500	2000	2500	3000
Capacitance	Cap Code		١	/olt	age	Co	de		_†	С	В	D	С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	Z	Н
			Cas	se S	Size/Series C						0603	С	C	0805	С		C	1206	C				1210	С				(	1808	ВС		

<sup>\*</sup>Capacitance range Includes E24 decade values only (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, and 91.) 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 (0603 - 1808 Case Sizes) cont.

		Case Size/Series	C	)603	3C	CO	805	5C		C1	1200	6C			C.	1210	C				C	1808	3C		
	Cap	Voltage Code	С	В	D	С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	Z	Н
Capacitance	Code	Rated Voltage (VDC)	200	630	1000	200	630	1000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	2500	3000
		Capacitance Tolerance							P								ness mens								
6,200pF	622	F G J K M							EF	EF				FY	FE	FY			LC	LC	LC				
6,800pF	682	F G J K M							EG	EG				FY	FE	FY			LC	LC	LC				
7,500pF	752	F G J K M							EG	EG				FS	FF	FS			LA	LA					
8,200 pF	822	F G J K M							EG	EG				FS	FF	FS			LA	LA					
9,100 pF	912	F   G   J   K   M							EG	EG				FF	FF	FS			LA	LA					
10,000 pF	103								EH	EH				FG	FG	FS			LA	LA					
12,000 pF	123								EG					FG	FG	FM			LA	LA					
15,000 pF	153	F G J K M							EG					FM	FM	FS			LB	LB					
18,000 pF	183	F G J K M												FM	FM	FS			LC	LC					
22,000 pF	223	F   G   J   K   M												FY	FY	FS									
27,000 pF	273	F   G   J   K   M												FS	FS										
33,000 pF	333	F G J K M												FS	FS										
	Con	Rated Voltage (VDC)	200	630	1000	200	630	1000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	2500	3000
Capacitance	Cap Code	Voltage Code	tage Code C I		D	С	В	D	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	Z	Н
		Case Size/Series	С	0603	С	С	0805	С		С	1206	С			С	1210	С				C	1808	С		

<sup>\*</sup>Capacitance range Includes E24 decade values only (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, and 91.) 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)

			С	as S		Si ie:		/				C	81	2C					C1	82	5C					C2	222	0C					C2	222	5C		
Capacitance	Cap	l	٧	/olt	age	e Co	ode			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
Capacitance	Code		Rate	d V	olt	age	• (V	DC	)	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
			(	Cap To		itan and																			ip Tl knes												
10 pF - 47pF*	100 - 470*	Ī			F	G	J	K	М	GB	HG	JK	JK	JK	JK	JK	JK	JK	KF																		
51 pF	510	ı			F	G	J	Κ	М	GB	HG	JK	JK	JK	JK	JK	JK	JK	KF																		
56 pF	560	ı			F	G	J	Κ	М	GB	HG	JK	JK	JK	JK	JK	JK	JK	KF																		
62 pF	620	L			F	G	J	K	М	GB	HG	JK	JK	JK	JK	JK	JK	JK	KF																		
68 pF	680	ı			F	G	J	Κ	М	GB	HG	JK	JK	JK	JK	JK	JK	JK	KF																		
75 pF	750	L			F	G	J	Κ	М	GB	HG	JK	JK	JK	JK	JK	JK	JK	KF																		
82 pF	820	l			F	G	J	K	М	GB	HG	JK	JK	JK	JK	JK	JK	JK	KF																		
91 pF	910	ı			F	G	J	K	М	GD	HG	JK	JK	JK	JK	JK	JK	JK	KF																		
100 pF	101	ı			F	G	J	Κ	М	GD	HG	JK	JK	JK	JK	JK	JK	JK	KF																		
110 pF	111	ı			F	G	J	Κ	М	GD	HG	JK	JK	JK	JK	JK	JK	JK	KF																		
120 pF	121	ı			F	G	J	K	М	GD	HG	JK	JK	JK	JK	JK	JK	JK	KF																		
130 pF	131	ı			F	G	J	Κİ	М	GD	HG	JK	JK	JK	JK	JK	JK	JK	KF																		
150 pF	151	ı			F	G	J	K	М	GD	GD	GD	GD	GD	GD	GK	HG	JK	JK	JK	JK	JK	JK	JK	KF												
160 pF	161	ı			F	G	J	K	М	GD	GD	GD	GD	GD	GD	GK	HG	JK	JK	JK	JK	JK	JK	JK	KF												
180 pF	181	ı			F	G	J	K	М	GD	GD	GD	GD	GD	GD	GK	HG	JK	JK	JK	JK	JK	JK	JK	KF												
200 pF	201	l			F	G	J	K	М	GD	GD	GD	GD	GD	GD	GM	HE	HE	HE	HE	HE	HE	HG	JK	JK	JK	JK	JK	JK	JK	KF						
			Rate	d Voltage (VDC)				200	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000	500	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000		
Capacitance	Cap		٧	/olt	age	e Co	ode			С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н
	Code Case Size/Series							С	1812	2C					С	182	5C					C	2220	С					С	222	5C						

<sup>\*</sup>Capacitance range Includes E24 decade values only (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, and 91.) KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions.)
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# Table 1B - Capacitance Range/Selection Waterfall (1812 - 2225 Case Sizes) cont.

		Case Size/ Series			C1	812	2C					C1	82	5C					C2	222	0C					C2	222	5C		
Capacitance	Cap	Voltage Code	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н	С	В	D	F	G	z	Н
	Code	Rated Voltage (VDC)	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
		Capacitance Tolerance					~	-	(+)		Pr	oduc	t Av	aila	bilit	y an	d Ch	ip T	hicki s Di	ness	Co	des	(1)					.~	.~	(1)
220 pF	221	F G J K M	GB	GB	GB	GB	GB	GD	GM	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	GB	GB	GB	GB	GB	GD	GM	HE	HE	HE	HE	HE	HE	HG	JK	JK	JK	JK	JK	JK	JK		KE	KE	KE	KE	KE	KF
270 pF	271		GB	GB	GB	GB	GB	GH	GM	HE	HE	HE	HE	HE	HE	HG	JK	JK	JK	JK	JK	JK	JK		KE	KE	KE	KE	KE	KF
300 pF	301	F G J K M	GB	GB	GB	GB	GB	GH	GM	HE	HE	HE	HE	HE	HE	HG	JK	JK	JK	JK	JK	JK	JK	_	KE	KE	KE	KE	KE	KF
330 pF	331	F G J K M	GB	GB	GB	GB	GB	GH	GO	HE	HE	HE	HE	HE	HE	HG	JE	JE	JE	JE	JE	JK	JK	KE	KE	KE	KE	KE	KE	KF
360 pF	361	F G J K M	GB	GB	GB	GB	GD	GK GK	GO	HE	HE	HE	HE	HE	HE	HG	JE	JE	JE	JE	JE	JK	JK	KE	KE	KE	KE	KE	KE	KF
390 pF 430 pF	391 431	F G J K M	GB GB	GB GB	GB GB	GB GB	GD GD	GK	GO	HE	HE	HE	HE	HE	HE	HG HJ	JE JE	JE JE	JE JE	JE JE	JE JE	JK JK	JK JE	KE	KE KE	KE	KE	KE	KE	KF KF
470 pF	471	F G J K M	GB	GB	GB	GB	GD	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	GB	GB	GB	GD	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	GB	GB	GB	GD	GH	GM		HE	HE	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	GB	GB	GB	GD	GH	GM		HE	HE	HE	HE	HG	HE	HK	JK	JK	JK	JK	JK	JK	JL	KF	KF	KF	KF	KE	KF	КН
680 pF	681	F G J K M	GB	GB	GB	GD	GH	GO		HE	HE	HE	HE	HG	HG	HK	JE	JE	JE	JK	JK	JK	JL	KF	KF	KF	KF	KE	KF	КН
750 pF	751	F G J K M	GB	GB	GB	GD	GK			HE	HE	HE	HG	HG	HG		JE	JE	JE	JK	JK	JK	JL	KE	KE	KE	KF	KE	KF	KH
820 pF	821	F G J K M	GB	GB	GB	GD	GK			HE	HE	HE	HG	HG	HG		JE	JE	JE	JK	JK	JK	JN	KE	KE	KE	KF	KE	KF	KJ
910 pF	911	F   G   J   K   M	GB	GB	GB	GH	GM			HE	HE	HE	HG	HG	HG		JE	JK	JK	JK	JK	JK	JN		KE	KE	KF	KE	KF	KJ
1,000 pF	102	F G J K M	GB	GB	GB	GH	GM			HE	HE	HE	HG	HG	HG		JE	JK	JK	JK	JK	JK	JN		KE	KE	KF	KE	KF	KJ
1,100 pF	112	F G J K M	GB	GB	GB	GH	GO			HE	HE	HE	HG	HG	HJ		JE	JK	JK	JK	JK	JK		KE	KE	KE	KF	KF	KF	
1,200 pF	122	F G J K M	GB	GB	GB	GH	GO			HE	HE	HE	HG	HG	HJ		JE	JK	JK	JK	JK	JL		KE	KE	KE	KF	KF	KF	
1,300 pF 1,500 pF	132 152	F G J K M	GB GB	GB GB	GB GB	GH GK	GO GO			HE	HE	HE	HG HG	HE	HJ HK		JE JE	JK JK	JK JK	JK JK	JE JE	JL JL		KE KE	KE KE	KE	KF KF	KF KF	KH	
1,600 pF	162	F G J K M	GB	GD	GD	GK	GU			HE	HG	HG	HG	HG	HK		JE	JK	JK	JK	JE	JL		KE	KE	KE	KF	KE	KH	
1,800 pF	182	F G J K M	GB	GD	GD	GM				HE	HG	HG	HG	HG	IIIX		JE	JK	JK	JK	JE	JN		KE	KE	KE	KF	KE	KH	
2,000 pF	202	F G J K M	GB	GH	GH	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	GB	GH	GH	GO				HE	HG	HG	HE	HJ			JE	JK	JK	JE	JK			KE	KE	KE	KF	KF	KJ	
2,400 pF	242	F G J K M	GB	GH	GK	GO				HE	HG	HG	HE	HJ			JK	JK	JK	JE	JL			KE	KE	KE	KE	KH		
2,700 pF	272	F G J K M	GB	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	GB	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	GB	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	GB		GM					HG	HG	HG	HG				JK	JK	JK	JK	JN			KE	KF	KF	KF	KJ		
3,900 pF 4,300 pF	392 432	F G J K M	GB GH		GM GO					HG HG	HG HG	HG HG	HJ HJ				JK JK	JK JK	JK JK	JK JK	JN			KE KE	KF KF	KF KF	KF KF	KJ		
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			
6,200pF	622	F G J K M	GH	GK	GH					HG	HE	HG					JK	JE	JE	JN				KE	KF	KF	KJ			
6,800pF	682	F G J K M	GH	GM	GH					HG	HE	HJ					JK	JE	JK	JN				KE	KF	KF	KJ			
7,500pF	752	F G J K M	GH	GM	GK					HG	HE	HJ					JK	JE	JK					KF	KE	KF				
8,200 pF	822	F G J K M	GK	G0	GK					HG	HE	HJ					JK	JE	JL					KF	KE	KF				
9,100 pF	912	F G J K M	-		1 -					HE	HG	HK					JE	JE	JL					KF	KE	KH				
10,000 pF	103	F G J K M									HG						JE	JE	JL					KF		KH				
12,000 pF 15,000 pF	123 153	F G J K M									HG HJ						JE JE	JK JL	JN JE					KE KE		KH KJ				
18,000 pF	183	F G J K M			00						HK						JE	JL	JE					KE		KE				
22,000 pF	223	F G J K M								_	HE	_					JK	JN	JK					KF	KJ	_				
27,000 pF	273	F G J K M								HJ		HK					JL	JN	JL					KF		KH				
33,000 pF	333	F G J K M									HE						JN	JE	JN					КН		KH				
39,000 pF	393	F G J K M									HE						JE	JE						KJ		KJ				
47,000 pF	473	F G J K M	GO	GO							HE						JE	JE						KE						
56,000 pF	563	F G J K M	0		2	00		2	0	_	HG	2	2	2	2	00	JK	JK	2	0	2	9	2	KE	_	00	2	00	2	2
	Сар	Rated Voltage (VDC)	200	630	1000	1500	2000	1 2500	3000	200	, 630	1000	1500	2000	1 2500	3000	200	, 630	, 1000	1500	2000			1	, 630	+-	1500	2000	1 2500	
Capacitance	Code	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
		Case Size/Series				1812	.C					C	1825	5C					C	2220	0C					C	222	5C		

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

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Table 1B - Capacitance Range/Selection Waterfall (1812 - 2225 Case Sizes) cont.

		Case Size/ Series			C1	81:	2C					C1	82	5C					C2	22	0C			C2225C						
Capacitance	Cap	Voltage Code	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	н
	Code	Rated Voltage (VDC)	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
		Capacitance Tolerance														y an hip 1														
68,000 pF	683	F G J K M								HJ	HJ						JL	JL						KF	KF					$\neg$
82,000 pF	823									HK	HK						JL	JL						KH	KH					- 1
0.1 μF	104									HK	HK						JN	JN						KH	KH					
0.12 μF	124	F G J K M																						KJ	KJ					
		Rated Voltage (VDC)	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000	200	630	1000	1500	2000	2500	3000
Capacitance	Capacitance Cap		С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н	С	В	D	F	G	Z	Н
Code		Case Size/Series	C1812C C182					1825	C			C2220C					C2225C													

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

Table 1C - Capacitance Range/Selection Waterfall (2824 - 4540 Case Sizes)

	0	Case Size/ Series			C	2824	IC			C	3040	C			C	3640	C			C	4540	C		
Capacitance	Сар	Vo	ltage Co	de	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G
- Capacitanio	Code		Rated		200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000	200	630	1000	1500	2000
			Itage (V		2	9	2	5	7											2	9	=	===	7
			apacitan Foleranc												d Chip Thickr									
2,200 pF	222	J	K	М	TA	TA	TA	TA	TA		366 1	abic	2 101 (	Jilip i	I	IC33 L	illiell	310113						
2,700 pF	272	Ĵ	K	M	TA	TA	TA	TA	TA	i														
3,300 pF	332	Ĵ	K	M	TA	TA	TA	TA	TA	QB	QB	QB	QB	QB										
3,900 pF	392	Ĵ	K	M	TA	TA	TA	TA	ТВ	OB	QB	QB	QB	QB	МА	MA	MA	MA	МА					
4,700 pF	472	Ĵ	K	M	TA	TA	TA	ТВ	ТВ	QB	QB	QB	QB	QB	MA	MA	MA	MA	MA	SA	SA	SA	SA	SA
5,600 pF	562	J	K	М	TA	TA	TA	TB	TC	OB	OB	QB	QB	OB	MA	MA	MA	MA	MA	SA	SA	SA	SA	SA
6,800 pF	682	Ĵ	K	M	TA	TA	TA	ТВ		QB	QB	QB	QB	QC	MA	MA	MA	MA	MA	SA	SA	SA	SA	SA
8,200 pF	822	Ĵ	K	М	TA	TA	TA	TC		ОB	QB	QB	QC	OC.	МА	MA	MA	MA	МВ	SA	SA	SA	SA	SA
10,000 pF	103	J	К	М	ĪΤΑ	TA	TA			QB	QB	QB	QC	OD	МА	MA	MA	MA	МВ	SA	SA	SA	SA	SB
12,000 pF	123	J	К	М	TA	TA	TA			QB	QB	QB	QD	`	МА	MA	MA	МВ	МВ	SA	SA	SA	SA	SB
15,000 pF	153	J	K	М	TA	TA	ТВ			QB	QB	QB	QD		MA	MA	MA	MB	МС	SA	SA	SA	SB	SB
18,000 pF	183	J	K	М	TA	TA	ТВ			QB	QB	QB			MA	MA	MA	МС		SA	SA	SA	SB	SC
22,000 pF	223	J	K	М	TA	ТВ	TC			QB	QB	QC			MA	MA	MA			SA	SA	SA	SB	
27,000 pF	273	J	K	М	TA	ТВ				QB	QB	QC			MA	MA	MA			SA	SA	SA	SC	
33,000 pF	333	J	K	М	ТВ	ТВ				QB	QC	QC			MA	MA	MB			SA	SA	SA		
39,000 pF	393	J	K	М	ТВ	TC				QB	QC	QD			MA	MA	MB			SA	SA	SB		
47,000 pF	473	J	K	М	ТВ					QB	QC				MA	MB	MC			SA	SA	SB		
56,000 pF	563	J	K	М	TC					QC	QD				MA	MB				SA	SA	SB		
68,000 pF	683	J	K	М						QC	QD				МВ	MC				SA	SB	SC		
82,000 pF	823	J	K	М	İ					QC					МВ					SA	SB			
0.1 μF	104	J	K	М						QD					MC					SB	SC			
0.12 μF	124	J	K	M						l					МС					SB				
0.15 μF	154	J	K	М																SC				
		Rated	Voltage	(VDC)	500	630	1000	1500	2000	200	630	1000	1500	2000	500	630	1000	1500	2000	500	630	1000	1500	2000
Capacitance	Cap Code	Voltage Code		С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	С	В	D	F	G	
*Canacitance range			ase Size/Series				2824	24C C3040C			C3640C				C4540C									

<sup>\*</sup>Capacitance range Includes E24 decade values only (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, and 91.) KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions.)
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Table 2 - Chip Thickness/Tape & Reel Packaging Quantities

Thickness	Case	Thickness ±	Paper C	Quantity	Plastic (	Quantity	
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel	
CG DN DP DG EB	0603 0805 0805 0805 1206	0.80 ± 0.10* 0.78 ± 0.10* 0.90 ± 0.10* 1.25 ± 0.15 0.78 ± 0.10	4,000 4,000 4,000 0 0	15,000 15,000 15,000 0 0	0 0 0 2,500 4,000	0 0 0 10,000 10,000	
EC ED EE EF EG	1206 1206 1206 1206 1206 1206	0.78 ± 0.10 0.90 ± 0.10 1.00 ± 0.10 1.10 ± 0.10 1.20 ± 0.15 1.60 ± 0.15	0 0 0 0	0 0 0 0	4,000 4,000 2,500 2,500 2,500 2,000	10,000 10,000 10,000 10,000 10,000 8,000	
EH FE FF FG FL	1206 1210 1210 1210 1210	1.60 ± 0.20 1.00 ± 0.10 1.10 ± 0.10 1.25 ± 0.15 1.40 ± 0.15	0 0 0 0 0	0 0 0 0	2,000 2,500 2,500 2,500 2,500 2,000	8,000 10,000 10,000 10,000 8,000	
FM FY FK FS LA	1210 1210 1210 1210 1808	1.70 ± 0.20 2.00 ± 0.20 2.10 ± 0.20 2.50 ± 0.30 1.40 ± 0.15	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	
LB LC GB GD GH	1808 1808 1812 1812 1812	1.60 ± 0.15 2.00 ± 0.15 1.00 ± 0.10 1.25 ± 0.15 1.40 ± 0.15	0 0 0 0	0 0 0 0	1,000 1,000 1,000 1,000 1,000	4,000 4,000 4,000 4,000 4,000	
GK GM GO HE HG	1812 1812 1812 1825 1825	1.60 ± 0.20 2.00 ± 0.20 2.50 ± 0.20 1.40 ± 0.15 1.60 ± 0.20	0 0 0 0	0 0 0 0	1,000 500 500 1,000 1,000	4,000 2,000 2,000 4,000 4,000	
HJ HK JE JK JL	1825 1825 2220 2220 2220	2.00 ± 0.20 2.50 ± 0.20 1.40 ± 0.15 1.60 ± 0.20 2.00 ± 0.20	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	
JN KE KF KH KJ	2220 2220 2225 2225 2225 2225	2.50 ± 0.20 2.50 ± 0.20 1.40 ± 0.15 1.60 ± 0.20 2.00 ± 0.20 2.50 ± 0.20	0 0 0 0 0	0 0 0 0	500 1,000 1,000 500 500	2,000 2,000 4,000 4,000 2,000 2,000	
TA TB TC QB QC	2824 2824 2824 2824 3040 3040	1.40 ± 0.15 2.00 ± 0.20 2.50 ± 0.20 1.40 ± 0.15 2.00 ± 0.20	0 0 0 0 0	0 0 0 0 0	750 300 300 500 500	1,500 1,500 1,500 1,500 1,000	
QD MA MB MC SA	3040 3640 3640 3640 4540	2.50 ± 0.20 1.40 ± 0.15 2.00 ± 0.20 2.50 ± 0.20 1.40 ± 0.15	0 0 0 0 0	0 0 0 0	350 250 250 250 250 200	1,000 1,000 1,000 1,000 1,000	
SB SC	4540 4540	2.00 ± 0.20 2.50 ± 0.20	0 0	0 0	200 200	1,000 1,000	
Thickness	Case	Thickness ±	7" Reel	13" Reel	7" Reel	13" Reel	
Code	Size	Range (mm)	Paper C	Quantity	Plastic Quantity		

Package quantity based on finished chip thickness specifications.

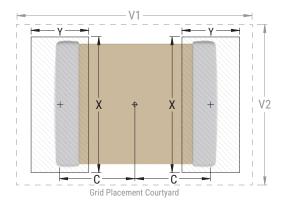


Table 3 - Chip Capacitor Land Pattern Design Recommendations per IPC-7351

EIA Size Code	Metric Size Code	Density Level A:  Maximum (Most)  Land Protrusion (mm)					ı	Media	sity Lev an (Nor otrusio	ninal)	)	Density Level C: Minimum (Least) Land Protrusion (mm)					
oouc	oouc	С	Y	X	V1	V2	С	Y	X	V1	V2	C	Y	X	V1	V2	
0603	1608	0.90	1.15	1.10	4.00	2.10	0.80	0.95	1.00	3.10	1.50	0.60	0.75	0.90	2.40	1.20	
0805	2012	1.00	1.35	1.55	4.40	2.60	0.90	1.15	1.45	3.50	2.00	0.75	0.95	1.35	2.80	1.70	
1206	3216	1.60	1.35	1.90	5.60	2.90	1.50	1.15	1.80	4.70	2.30	1.40	0.95	1.70	4.00	2.00	
1210	3225	1.60	1.35	2.80	5.65	3.80	1.50	1.15	2.70	4.70	3.20	1.40	0.95	2.60	4.00	2.90	
1808	4520	2.30	1.75	2.30	7.40	3.30	2.20	1.55	2.20	6.50	2.70	2.10	1.35	2.10	5.80	2.40	
1812	4532	2.15	1.60	3.60	6.90	4.60	2.05	1.40	3.50	6.00	4.00	1.95	1.20	3.40	5.30	3.70	
1825	4564	2.15	1.60	6.90	6.90	7.90	2.05	1.40	6.80	6.00	7.30	1.95	1.20	6.70	5.30	7.00	
2220	5650	2.75	1.70	5.50	8.20	6.50	2.65	1.50	5.40	7.30	5.90	2.55	1.30	5.30	6.60	5.60	
2225	5664	2.70	1.70	6.90	8.10	7.90	2.60	1.50	6.80	7.20	7.30	2.50	1.30	6.70	6.50	7.00	
2824	7260	3.45	1.70	6.60	9.60	7.60	3.35	1.50	6.50	8.70	7.00	3.25	1.30	6.40	8.00	6.70	
3040	7610	3.70	1.70	10.70	10.10	11.70	3.60	1.50	10.60	9.20	11.10	3.50	1.30	10.50	8.50	10.80	
3640	9210	4.45	1.70	10.70	11.60	11.70	4.35	1.50	10.60	10.70	11.10	4.25	1.30	10.50	10.00	10.80	
4540	-	5.60	1.70	10.70	13.90	11.70	5.50	1.50	10.60	13.00	11.10	5.40	1.30	10.50	12.30	10.80	

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

**Density Level B:** For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes. **Density Level C:** For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC Standard 7351 (IPC-7351). Image below based on Density Level B for an EIA 1210 case size.





## **Soldering Process**

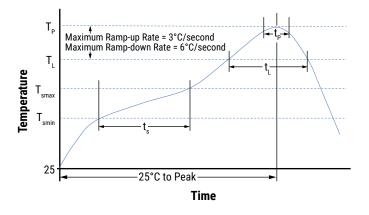
#### **Recommended Soldering Technique:**

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

## **Recommended Reflow Soldering Profile:**

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

Profile Feature	Terminati	ion Finish
Fibilie i catule	SnPb	100% Matte Sn
Preheat/Soak		
Temperature Minimum (T <sub>Smin</sub> )	100°C	150°C
Temperature Maximum (T <sub>Smax</sub> )	150°C	200°C
Time ( $t_s$ ) from $T_{smin}$ to $T_{smax}$	60 - 120 seconds	60 - 120 seconds
Ramp-Up Rate $(T_L \text{ to } T_p)$	3°C/second maximum	3°C/second maximum
Liquidous Temperature (T <sup>L</sup> )	183°C	217°C
Time Above Liquidous (t <sup>L</sup> )	60 - 150 seconds	60 - 150 seconds
Peak Temperature (T <sub>P</sub> )	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t <sub>p</sub> )	20 seconds maximum	30 seconds maximum
Ramp-Down Rate (T <sub>p</sub> to T <sub>L</sub> )	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum



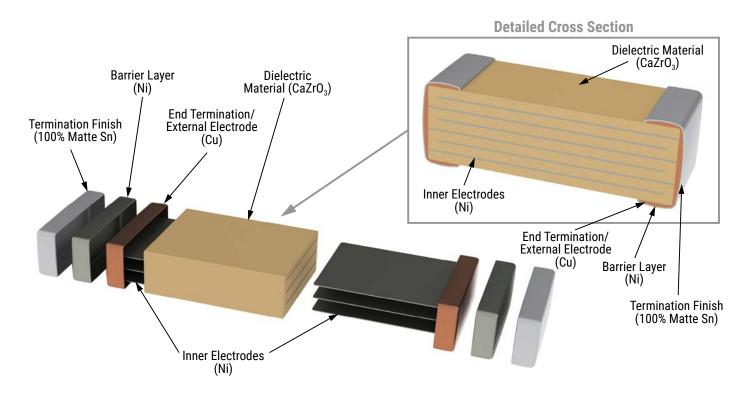
Note 1: All temperatures refer to the center of the package, measured on the capacitor body surface that is facing up during assembly reflow.

# **Storage and Handling**

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 40°C and maximum storage humidity not exceed 70% relative humidity. Temperature fluctuations should be minimized to avoid condensation on the parts and atmospheres should be free of chlorine and sulfur bearing compounds. For optimized solderability chip stock should be used promptly, preferably within 1.5 years of receipt.



## Construction



# **Capacitor Marking (Optional):**

Laser marking option is not available on:

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

These capacitors are supplied unmarked only.



## **Tape & Reel Packaging Information**

KEMET offers multilayer ceramic chip capacitors packaged in 8, 12, 16 and 24 mm tape on 7" and 13" reels in accordance with EIA Standard 481. This packaging system is compatible with all tape-fed automatic pick and place systems. See Table 2 for details on reeling quantities for commercial chips.

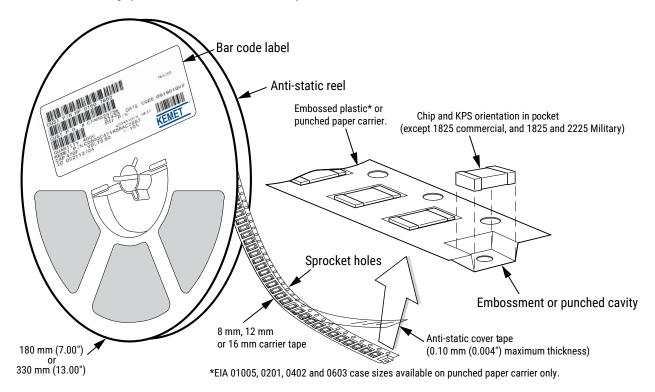


Table 5 - Carrier Tape Configuration, Embossed Plastic & Punched Paper (mm)

	Tape	Embosse	d Plastic	Punche	d Paper	
<b>EIA Case Size</b>	Size	7" Reel	13" Reel	7" Reel	13" Reel	
	(W)*	Pitch	(P <sub>1</sub> )*	Pitch	(P <sub>1</sub> )*	
01005 - 0402	8			2	2	
0603	8			2/4	2/4 _	
0805	8	4	4	4	4	
1206 - 1210	8	4	4	4	4	
1805 - 1808	12	4	4			
≥ 1812	12	8	8			
2824	16	12	12			
3040 - 4540	24	16	16			
KPS 1210	12	8	8			
KPS 1812 & 2220	16	12	12			
Array 0508 & 0612	8	4	4			

<sup>\*</sup>Refer to Figures 1 and 2 for W and  $P_1$  carrier tape reference locations.

#### **New 2 mm Pitch Reel Options\***

-	Packaging Ordering Code (C-Spec)	Packaging Type/Options
	C-3190	Automotive grade 7" reel unmarked
	C-3191	Automotive grade 13" reel unmarked
	C-7081	Commercial grade 7" reel unmarked
	C-7082	Commercial grade 13" reel unmarked

<sup>\* 2</sup> mm pitch reel only available for 0603 EIA case size. 2 mm pitch reel for 0805 EIA case size under development.

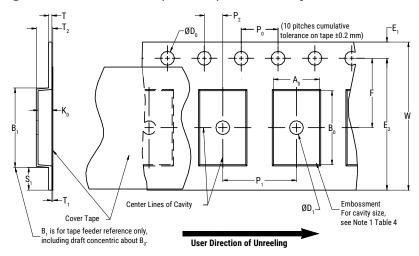
## Benefits of Changing from 4 mm to 2 mm Pitching Spacing

- Lower placement costs
- Double the parts on each reel results in fewer reel changes and increased efficiency
- Fewer reels result in lower packaging, shipping and storage costs, reducing waste

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



# Figure 1 - Embossed (Plastic) Carrier Tape Dimensions



## **Table 6 - Embossed (Plastic) Carrier Tape Dimensions**

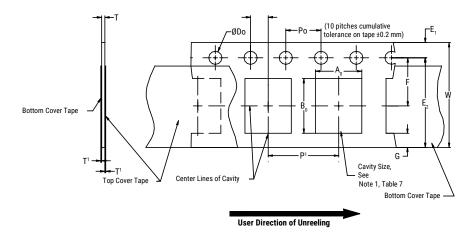
Metric will govern

	Constant Dimensions — Millimeters (Inches)												
Tape Size	D <sub>0</sub>	E <sub>1</sub>	P <sub>0</sub>	P <sub>2</sub>	R Reference Note 2	S <sub>1</sub> Minimum Note 3	T Maximum	T1 Maximum					
8 mm					25.0 (0.984)								
12 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)	30	0.600 (0.024)	0.600 (0.024)	0.100 (0.004)					
16 mm					(1.181)								
24 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±0.10 (0.078±0.003)	30 (1.181)	5 (0.196)	0.250 (0.009)	0.350 (0.013)					
		Varial	ole Dimensions	– Millimeters	(Inches)								
Tape Size	Pitch	$E_{2}$ Minimum	F	P <sub>1</sub>	T <sub>2</sub> Maximum	W Maximum	$A_0, B_0$	& K <sub>0</sub>					
8 mm	Single (4 mm)	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)	10.25 (0.404)	5.5±0.05 (0.217±0.002)	8.0±0.10 (0.315±0.004)	4.6 (0.181)	12.3 (0.484)	Not	o E					
16 mm	Triple (12 mm)	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)	NOU	e J					
24 mm	16 mm	22.25 (0.875)	11.5±0.10 (0.452±0.003)	16.0±0.10 (0.629±0.004)	3 (0.118)	24.3 (0.956)							

- 1. The embossment hole location shall be measured from the sprocket hole controlling the location of the embossment. Dimensions of embossment location and hole location shall be applied independent of each other.
- 2. The tape with or without components shall pass around R without damage (see Figure 6).
- 3. If  $S_1 < 1.0$  mm, there may not be enough area for cover tape to be properly applied (see EIA Standard 481 paragraph 4.3 section b).
- 4. B, dimension is a reference dimension for tape feeder clearance only.
- 5. The cavity defined by  $A_{or} B_{or}$  and  $K_{or}$  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 and B are measured on a plane 0.3 mm above the bottom of the pocket.
  - (f) see Addendum in EIA Standard 481 for standards relating to more precise taping requirements.



# Figure 2 - Punched (Paper) Carrier Tape Dimensions



# **Table 7 - Punched (Paper) Carrier Tape Dimensions**

Metric will govern

	Constant Dimensions — Millimeters (Inches)												
Tape Size	D <sub>0</sub>	E <sub>1</sub>	P <sub>0</sub>	P <sub>2</sub>	T <sub>1</sub> Maximum	G Minimum	R Reference Note 2						
8 mm	1.5+0.10/-0.0 (0.059+0.004/-0.0)	1.75±0.10 (0.069±0.004)	4.0±0.10 (0.157±0.004)	2.0±0.05 (0.079±0.002)	0.10 (0.004) Maximum	0.75 (0.030)	2 (0.984)						
	Variable Dimensions — Millimeters (Inches)												
Tape Size	Pitch	E2 Minimum	F	P <sub>1</sub>	T Maximum	W Maximum	$A_0B_0$						
8 mm	Half (2 mm)	6.25	3.5±0.05	2.0±0.05 (0.079±0.002)	1.1	8.3 (0.327)	Note 1						
8 mm	Single (4 mm)	(0.246)	(0.138±0.002)	4.0±0.10 (0.157±0.004)	(0.098)	8.3 (0.327)	Note 1						

- 1. The cavity defined by  $A_{n}$ ,  $B_{n}$  and T shall surround the component with sufficient clearance that:
  - a) the component does not protrude beyond either surface of the carrier tape.
  - b) the component can be removed from the cavity in a vertical direction without mechanical restriction, after the top cover tape has been removed.
  - c) rotation of the component is limited to 20° maximum (see Figure 3).
  - d) lateral movement of the component is restricted to 0.5 mm maximum (see Figure 4).
  - e) see Addendum in EIA Standard 481 for standards relating to more precise taping requirements.
- 2. The tape with or without components shall pass around R without damage (see Figure 6).



# **Packaging Information Performance Notes**

1. Cover Tape Break Force: 1.0 Kg minimum.

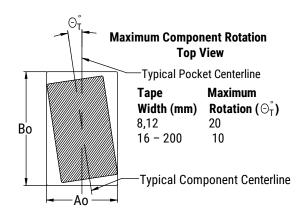
2. Cover Tape Peel Strength: The total peel strength of the cover tape from the carrier tape shall be:

Tape Width	Peel Strength
8 mm	0.1 to 1.0 newton (10 to 100 gf)
12 and 16 mm	0.1 to 1.3 newton (10 to 130 gf)
24 mm	0.1 to 1.6 newton (10 to 160 gf)

The direction of the pull shall be opposite the direction of the carrier tape travel. The pull angle of the carrier tape shall be 165° to 180° from the plane of the carrier tape. During peeling, the carrier and/or cover tape shall be pulled at a velocity of 300 ±10 mm/minute.

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

# Figure 3 - Maximum Component Rotation



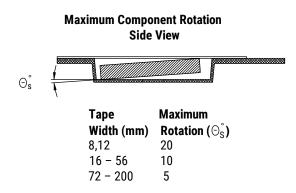


Figure 4 – Maximum Lateral Movement

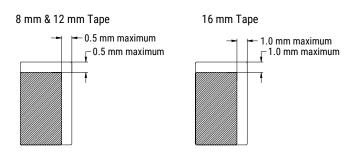


Figure 5 - Bending Radius

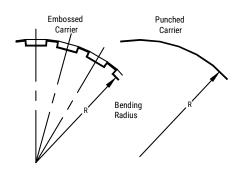
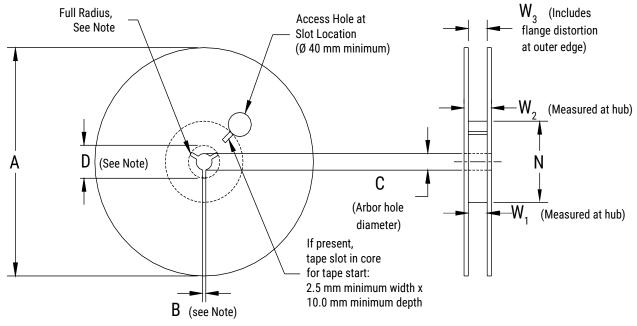




Figure 6 - Reel Dimensions



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

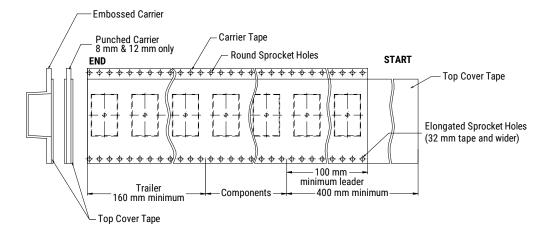
# **Table 8 - Reel Dimensions**

Metric will govern

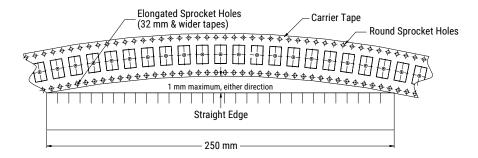
	Constant Dimensions — Millimeters (Inches)												
Tape Size	A	B Minimum	С	D Minimum									
8 mm	170.0.00												
12 mm	178±0.20 (7.008±0.008)	1.5 (0.059)	13.0+0.5/-0.2 (0.521+0.02/-0.008)	20.2 (0.795)									
16 mm	or 330±0.20	,	,	,									
24 mm	(13.000±0.008)	1.2 (0.047)	13.0 + -0.2 (0.521 + -0.008)	21 (0.826)									
	Variable	Dimensions — Millimeter	rs (Inches)										
Tape Size	N Minimum	$W_1$	W <sub>2</sub> Maximum	W <sub>3</sub>									
8 mm		8.4+1.5/-0.0 (0.331+0.059/-0.0)	14.4 (0.567)										
12 mm	50	12.4+2.0/-0.0 (0.488+0.078/-0.0)	18.4 (0.724)	Shall accommodate tape									
16 mm	(1.969)	16.4+2.0/-0.0 (0.646+0.078/-0.0)	22.4 (0.882)	width without interference									
24 mm		25+1.0/-0.0 (0.984+0.039/-0.0)	27.4+1.0/-1.0 (1.078+0.039/-0.039)										



# Figure 7 - Tape Leader & Trailer Dimensions



# Figure 8 - Maximum Camber





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