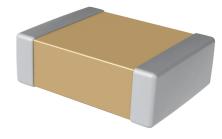


#### **Overview**

KEMET's COG dielectric features a 125°C maximum operating temperature and is considered "stable." The Electronics Components, Assemblies & Materials Association (EIA) characterizes COG dielectric as a Class I material. Components of this classification are temperature compensating and are suited for resonant circuit applications or those where Q and stability of capacitance characteristics are required. C0G exhibits no change in capacitance with respect to time and voltage and boasts a negligible change in capacitance with reference to ambient temperature. Capacitance change is limited to ±30 ppm/°C from -55°C to +125°C.

#### **Benefits**

- -55°C to +125°C operating temperature range
- · Lead (Pb)-Free, RoHS, and REACH compliant
- EIA 0201, 0402, 0603, 0805, 1206, 1210, 1808, 1812, 1825, 2220, and 2225 case sizes
- DC voltage ratings of 10 V, 16 V, 25 V, 50 V, 100 V, 200 V and 250 V
- Capacitance offerings ranging from 0.5 pF up to 0.47 μF
- Available capacitance tolerances of  $\pm 0.10$  pF,  $\pm 0.25$  pF,  $\pm 0.5$  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



С	1206	С	104	J	3	G	Α	С	TU
Ceramic	Case Size (L" x W")	Specification/ Series <sup>1</sup>	Capacitance Code (pF)	Capacitance Tolerance <sup>2</sup>	Voltage	Dielectric	Failure Rate/ Design	Termination Finish <sup>3</sup>	Packaging/Grade (C-Spec) <sup>4</sup>
	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 = ±0.25 pF D = ±0.5 pF F = ±1% G = ±2% J = ±5% K = ±10% M = ±20%	8 = 10 V 4 = 16 V 3 = 25 V 5 = 50 V 1 = 100 V 2 = 200 V A = 250 V	G = C0G	A = N/A	C = 100% Matte Sn	Blank = Bulk TU = 7" Reel Unmarked

## **Ordering Information**

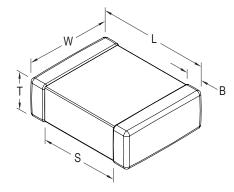
<sup>1</sup> Flexible termination option is available. Please see FT-CAP product bulletin C1062\_C0G\_FT-CAP\_SMD

<sup>2</sup> Additional capacitance tolerance offerings may be available. Contact KEMET for details.

<sup>3</sup> Additional termination finish options may be available. Contact KEMET for details.

<sup>4</sup> 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	Solder Beflow Only
0402	1005	1.00 (.040) ± 0.05 (.002)	0.50 (.020) ± 0.05 (.002)		0.30 (.012) ± 0.10 (.004)	0.30 (.012)	Solder Reflow Only
0603	1608	1.60 (.063) ± 0.15 (.006)	0.80 (.032) ± 0.15 (.006)		0.35 (.014) ± 0.15 (.006)	0.70 (.028)	
0805	2012	2.00 (.079) ± 0.20 (.008)	1.25 (.049) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	Solder Wave or Solder Reflow
1206	3216	3.20 (.126) ± 0.20 (.008)	1.60 (.063) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)		
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	Ostidas Deflava Osta
1825	4564	4.50 (.177) ± 0.30 (.012)	6.40 (.252) ± 0.40 (.016)	1	0.60 (.024) ± 0.35 (.014)		Solder Reflow Only
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**

- · 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)

### **Applications**

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



## **Qualification/Certification**

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

#### **Environmental Compliance**

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

## **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 $\Omega$ (Rated voltage applied for 120 ±5 seconds @ 25°C)

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 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 (0201 – 1206 Case Sizes)

			(				Siz		1		:02	201				C	)40	20						CO	00	3C					C	)80	50					C1	20	60		
	Сар	L		_			es										J-10		-								-	-				,00	50	1	-							
Сар	Code	L		Vo	lta	ge	Cod	de		-	_	4	3	8	4	3	5	1	_		A	8	4	3	5	1	2	_	8	4	3	5	1	2	A	8	4	3	5	1	2	Α
	Coue	L	Ra	ted	Vo	olta	ge	(VD	C)	=	2   9	<u>9</u>	25	9	16	25	20	100	3	30	250	9	16	25	50	9	200	250	9	16	25	50	100	200	250	9	16	25	50	<b>1</b> 0	200	250
		Γ	C				tar		Э										Ρ									Chi nick							3							
0.50 & 0.75 pF	508 & 758			D						T				BB	BB						Τ	CF	CF	CF	CF	CF	CF	-	DN	DN	DN	DN	DN	DN								
0.75 pF	758													BB	BB								CF	CF	CF				DN			DN										
1.0 – 9.1 pF* 1.1 pF	109 – 919* 119	B												BB BB	BB BB								CF CF	CF CF	CF CF		CF		DN DN			DN DN		DN		EB EB	EB EB		EB EB	EB EB	EB EB	
1.1 pF 1.2 pF	129													BB	BB								CF	CF	CF	1.1						DN				EB			EB			
1.3 pF	139	В	_		_		Т	Т	Т	Г				BB	BB			_			_	_	CF	CF	CF	-	CF		DN			DN			-	EB	EB				EB	
1.5 pF	159	В												BB	BB							CF	CF	CF	CF		CF		DN			DN		DN		EB	EB		EB		EB	
1.6 pF	169	В		) C	)									BB	BB	BB	BB					CF	CF	CF	CF	CF	CF	=	DN	DN	DN	DN	DN	DN	1	EB	EB		EB	EB	EB	
1.8 pF	189	В	3 0	)   C	)									BB	BB	BB	BB					CF	CF	CF	CF	CF	CF	=	DN	DN	DN	DN	DN	DN	1	EB	EB		EB	EB	EB	
2.0 pF	209	В	-	_	_									BB	BB			_			_		CF	CF	CF	_	_	_	DN	_	_	DN	_	DN	_	EB	EB		EB	EB	EB	
2.2 pF	229	B												BB		BB						CF	CF	CF	CF		CF		DN			DN				EB		EB		EB		
2.4 pF	249	B												BB	BB								CF	CF	CF				DN			DN				EB	EB			EB	EB	
2.7 pF 3.0 pF	279 309	B												BB BB	BB BB							CF CF	CF CF	CF CF	CF CF		CF CF		DN DN			DN DN				EB EB	EB	EB EB		EB EB		
3.3 pF	309	B												BВ		BB						CF	CF	CF	CF							DN				EB			EB	EB		
3.6 pF	369	В	_	_	_		T		T	L				BB	BB	_		_			_	_	CF	CF	CF		CF		DN			DN			-	EB	EB		EB		EB	
3.9 pF	399	В												BB		BB							CF	CF	CF				DN			DN		DN		EB	EB		EB		EB	
4.3 pF	439	В		) D	)									BB	BB	BB	BB					CF	CF	CF	CF	CF	CF	=	DN	DN	DN	DN	DN	DN	1	EΒ	EB	EB	EB	EB	EB	
4.7 pF	479	В	C											BB	BB	BB	BB					CF	CF	CF	CF	CF	CF	=	DN	DN	DN	DN	DN	DN	1	EB	EB	EB	EB	EB	EB	
5.1 pF	519	В	-	_	_									BB	BB			_				CF	CF	CF	CF	CF	-	_	DN		_	DN	_	_	_	EB	EB	EB	EB	EB	EB	
5.6 pF	569	В												BB		BB						CF	CF	CF	CF	-	-			DN						EB	EB		EB	EB	EB	
6.2 pF	629	B												BB	BB							CF	CF	CF	CF	1.1	1.1		DN		1	DN			-	EB	EB		EB	EB	EB	
6.8 pF	689	B												BB BB	BB BB		BB					CF CF	CF CF	CF CF	CF CF	-	-			DN		DN				EB EB	EB	EB EB	EB EB	EB EB		
7.5 pF 8.2 pF	759 829	B												BВ		BB						CF	CF	CF	CF											EB			EB	EB		
9.1 pF	919						Т	Т	Т	Г				BB	BB	_					_	CF	CF	CF	CF	-			DN			DN				EB	EB				EB	
10 pF	100	ľ				=   (	G	J	< M		31 A	B1	AB1	BB		BB						CF	CF.	CF	CF					DN				DN		EB	EB			EB	EB	
11 pF	110				F	=   (	G							BB	BB	BB	BB					CF	CF	CF	CF	CF	CF	=	DN	DN	DN	DN	DN	DN	1	EB	EB		EB	EB	EB	
12 pF	120						G				3² A	B²	AB²			BB						CF	CF	CF	CF			=	DN	DN	DN	DN	DN	DN	1	EB	EB		EB			
13 pF	130	L			_	_	G	_	< M					BB	BB	_	_	_				CF	CF	CF	CF	_	_	_	DN	_	_	DN	_	DN	_	EB	EB	EB	EB	EB	EB	
15 pF	150				F		GJ				3² A	.B²	AB²		BB							CF	CF	CF	CF	-	-			DN						EB	EB		EB	EB	EB	
16 pF	160				F		GJ				D2 A	D2	AB²	BB	BB							CF CF	CF CF	CF CF	CF CF	CF			DN			DN DN				EB EB	EB EB		EB EB	EB	EB EB	
18 pF 20 pF	180 200				F		G J G J				A	D-	AD*	BB	BB BB							CF	CF	CF	CF	-	-		DN DN			DN				EB	EB		EB	EB EB	EB	
20 př 22 pF	200						G				32 A	B²	AB²		BB							CF	CF	CF	CF	1.1	-									EB		EB		EB	EB	
24 pF	240	Γ	T	T	F	_	G		K M					BB	BB	_		_			_	CF	CF	CF	CF	-			DN			DN	-	_	-	EB			EB		EB	
27 pF	270				F		G				3² A	B²	AB²		BB							CF	CF	CF	CF			:	DN	DN	DN	DN	DN	DN	1	EB	EB		EB	EB	EB	
30 pF	300				F		G		( M					BB	BB							CF	CF	CF	CF	CF			DN			DN		DN		EB	EB	EB	EB	EB	EB	
33 pF	330						G				3² A	B²	AB²		BB							CF	CF	CF	CF	CF			DN			DN		DN		EB	EB		EB		EB	
36 pF	360								K M		2 .	<b>D</b> 2	A D 2				BB						CF	CF	CF					DN						EB			EB			
39 pF	390						j .		K   M K   M	A	5 <sup>2</sup> A	B <sup>2</sup>	AB²				BB							CF			CF			DN						EB		EB		EB		
43 pF 47 pF	430 470						G	J P J L			22 A	R <sup>2</sup>	ΔR <sup>2</sup>				BB							CF CF						DN DN						EB			EB EB			
47 pF 51 pF	470 510					- (			K M								BB													DN									EB			
56 pF	560				F	= 0	3.		M	A	32 A	B <sup>2</sup>	AB²	BB	BB	BB	BB							CF						DN									EB			
62 pF	620	Г	Τ	T	F	= (	GJ	J۴	( M					BB	BB	BB	BB										CF			DN						EB	EB	EB	EB	EB	EB	
68 pF	680						G	J۴	( M	A	3² A	B²		BB	BB	BB	BB					CF	CF	CF	CF	CF	CF	=	DN	DN	DN	DN	DN	DN	1	EB	EB	EB	EB	EB	EB	
75 pF	750						G							BB	BB	BB	BB							CF						DN									EB			
82 pF	820										3² A	B²	AB²	BB	BB	BB	BB							CF						DN									EB			
91 pF	910						GJ				72 4	D2	102	BB	BB	BB	BB	D												DN						EB	EB	EB	EB	EB	EB	
100 pF	101	┢	D	<u>بر ما</u>	_	_				_	3² A ⊇ :	_	25 <sup>3</sup> 8	<b>5</b> RR	<b>6</b> 88	_		_			250 RF	운	10 10	55 J.	-10 20				P P	DN 92	25 25	DN 20				5 FR	6 EB	25 FR	EB 09	60 FR	200 FE	250
Сар	Сар	┢	кă				ge ( Cod	·	(0)	+	-	-	3	8	4	3	دى 5	1			ېز A	-	4	~ 3		₽ 1	2		8	4	~ 3	აი 5	₽ 1	2		8	4	~ 3	აი 5	₽ 1	2 2	نة A
Cap	Code	╞				-				+	_			5	"			_		- / '	-	•	-				14	<u> </u>	ŀ					-	1	ŀ	-				4	
		ľ	a	se	5	ze	e/S	er	ies	10	02	:01	C			C	040	20	•					00	160	3C					C	080	50					<u> </u>	120	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).

 $xx^1$  Available only in D, J, K,M tolerance

 $xx^2$  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 1A – Capacitance Range/Selection Waterfall (0201 – 1206 Case Sizes) cont'd

Cap Code         Series         CU2/IC         CU3/IC         CU3/IC         CU3/IC         CU3/IC         CU2/IC         Image:			Case Size/																									Γ						
Code         Vertige Code         i				C0	20	1C			C0	40	2C					C	)60	3C					C	)80	5C					C	120	6C		
Code         Rated Values (NOC)         P         R         P         R	Сар		Voltage Code	8	4	3	8	4	3	5	1	2	Α	8	4	3	5	1	2	A	8	4	3	5	1	2	Α	8	4	3	5	1	2	A
Capacitance         Product Availability and Chip Thickness Dimensions           110-180 pF         111-181         F         G j k k in         BB BB BB BB BB C C C C C C C C C C C C		Code	Rated Voltage (VDC)	ę	16	25	10	16	25	50	100	200	250	÷	16	25	50	<u>1</u> 0	200	250	ę	16	25	50	<b>1</b> 0	200	250	5	16	25	50	<u>10</u>	200	250
110 - 160 pF       111 - 161       F G J K M       BB 6B 8B 8B 6B 8B 8B 6F 7 CF CF CF CF CF CF CF CF DN ND ND NN ND ND       EB EB 6B 6B 8B 8B 70 0F 7 CF CF CF CF CF CF DN ND ND NN ND ND       EB EB 6B 6B 8B 8B 70 0F 7 CF CF CF CF CF CF DN ND ND NN ND ND       EB EB 6B 6B 8B 8B 70 0F 7 CF CF CF CF CF CF DN ND ND NN ND ND       EB EB 6B 8B 8B 70 0F 7 CF CF CF CF CF CF CF CF CF DN ND ND NN ND ND       EB EB 6B 70 0F 7 CF CF CF CF CF CF CF CF DN ND ND NN ND ND       EB EB 6B 70 0F 7 CF CF CF CF CF CF CF CF DN ND ND NN ND ND       EB EB 70 0F 7 CF CF CF CF CF CF CF CF DN ND ND NN ND ND       EB EB 70 0F 7 CF CF CF CF CF CF CF CF DN ND ND NN ND ND       EB EB 70 0F 7 CF CF CF CF CF CF CF CF CF DN ND ND NN ND ND       EB EB 70 0F 7 CF DN ND ND NN ND ND       EB EB 70 0F 7 CF												Pro	du					уa	nd	Chi	рT				Co	des			1				1	
300 pf         301         F G J K M         BB BB BB BB BD BD GF DN DN NN DN DN NN EB EB EB EB           300 pf         381         F G J K M         BB BB BB BB BB BD BD GF GF GF GF GF GF GF GF GF DN DN NN DN DN NN EB EB EB EB           300 pf         381         F G J K M         BB BB BB BB BB BB BD GF GF GF GF GF GF GF GF GF DN DN NN DN DN NN EB EB EB EB           300 pf         381         F G J K M         BB BB BB BB BB BB BB CF GF GF GF GF GF GF GF DN DN NN DN DN NN EB EB EB EB           400 pF         431         F G J K M         BB BB BB BB BB BB BB BB BB CF GF GF GF GF GF GF DN DN NN DN DN DN DN EB EB EB EB           500 pF         651         F G J K M         BB BB BB BB BB BB BB CF GF GF GF GF GF GF DN DN NN DN DN DN DN EB EB EB EB           800 pF 621         F G J K M         BB BB BB BB BB BB CF GF GF GF GF GF GF GF DN DN NN DN DN DN DN EB EB EB EB           800 pF 621         F G J K M         BB BB BB BB BB CF GF GF GF GF GF GF GF DN DN NN DN DN DN DN DN EB EB EB EB           800 pF 731         F G J K M         BB BB BB BB BB CF GF GF GF GF GF GF DN DN NN DN DN DN DN EB EB EB EB           710 pF 731         F G J K M         BB BB BB BB CF GF GF GF GF GF GF DN DN DN DN DN DN DN EB EB EB EB           710 pF 731         F G J K M         BB BB BB BB CF GF GF GF GF GF GF GF DN DN DN DN DN DN DN DN EB EB EB EB           710 pF 731         F G J K M         BB BB BB BB CF GF GF GF GF GF DN DN DN DN D	110 – 180 pF*	111 – 181*					BB	BB	BB	BB	BB	_	_	_	_			<u> </u>			_							EB	EB	EB	EB	EB	EB	
330 pf         331         F C J K M         BB																																		
360 pF       361       F C J K M       BB BB BB BB BB BB       C F C C F C F C F C F C F C F D N N N N N N N N N N N N N N N N N N																																		
330°F       331       F C J K M       BB B5 B6 B B B3       C F C C F C F C F C F C F C F D N N N N N N N N N N N N N N N N N N												RD	RD		_	_																		
430 pF       431       F G J X M       BB BB BB BB BB BB       CF C C F C F C F C F C F C F C F D N DN DN DN DN DN EB																																		
470 pF       471       F G J K M       BB BS BS BS BS BS BS       CF C C F C F C F C F C F C F C F D N N N N N N N N P       EB ES EE ES ES         560 pF       561       F G J K M       BB BS BS BS BS BS BS       CF C C F C F C F C F C F D N N N N N N N N N N N N N N N N N N																																		
560       F       6.21       F       G       J       K       BB       BB       BB       C																								1		DP								
BB       BB       BB       BB       BB       BB       BB       C<	510 pF	511	F G J K M				BB	BB	BB	BB	BB			CF	CF	CF	CF	CF	CF	CF	DN	I DN	DN	DN	DN	DN	I	EB	EB	EB	EB	EB	EB	
681       F G J K M       BB BB BB BB C       C CF C C C C C C C C C F M NN N	560 pF	561					BB	BB	BB	BB	BB			CF	CF		CF	CF			DN	I DN	DN	DN	DN	DN	1	EB						
P30 pF       P31       F G J K M       B8 B8 B8 B8 B8       CC C C C C C C C C C C C C C C C D N D N																																		
B201       F G J K M       F G J K M       B B B B B B B B B       C C C C C C C C C C D N D N N N N N N N																																		
910 µF       911       1F G J K M       B8 B8 B8 B8 B8 B8       CF 0F 00 ND ND ND ND PD P       EB E8 B8 B8 B8 B8         1.00 pF       112       F G J K M       B8 B8 B8 B8 B8       CF 0F																																		
1000 pF       102       F       G       J       K       M       B8       B8 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>_</td><td></td><td>_</td><td></td><td></td><td></td><td></td><td></td><td>_</td><td></td><td></td><td>_</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>															_		_						_			_								
1100 pF       112       I F G J K M       B8 CF																																		
1200 pF       1320 pF       G J K M       BB BB BB BB BB       CF CF CF CF CF CF CH CH DD N DN DN DN DN DN DN DN BE EE EB EC         1500 pF       152       F G J K M       BB BB BB BB       CF CF CF CF CF CF CH CH DD P DP DP DD PD NN NN EB EE EB EC         1500 pF       152       F G J K M       BB BB BB BB       CF CF CF CF CF CF CH CH DD P DP DP DN NN BE EE EB ED         1800 pF       182       F G J K M       BB BB BB BB       CF CF CF CF CF CF CH CH DD P DP DP DN NN BE EE EB ED         2,000 pF       202       F G J K M       BB BB BB       CF CF CF CF CF CF CF CH CH DN NN NN NN NN NN BN EB EE EB ED         2,000 pF       202       F G J K M       BB BB BB       CF CF CF CF CF CF CF CH CH DN NN NN NN NN NN NN BN EB EE EB ED         2,000 pF       202       F G J K M       BB BB BB       CF CF CF CF CF CF CF CH CH DN NN NN NN NN NN NN NN EB EE EB EB         2,000 pF       202       F G J K M       BB BB BB       CF CF CF CF CF CF CF DN NN																																		
1500 pF       152       F       G       J       K       M       BB       C	1,200 pF	122	F G J K M				BB	BB	BB	BB				CF	CF	CF	CF	CF	CH											EB	EB	EB	EB	
1 800 pF       162       F       G       J       K       M       BB       BB       BB       BB       CF       <	1,300 pF	132												CF		CF		-		_		_	_							EB	EB	EC	EC	
1800 pF       182       F       G       J       K       M       BB       BB <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>BB</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>1.1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>										BB									1.1															
2000 pF       202       F       G       J       K       BB       <																																		
2.200 pF       222       F       G       J       K       M       BB       BB       BB       BB       BB       BB       BB       CF       <																																		
2400 pF       242       F       G       J       K       M       J       K       M       J       K       M       D																																		
2,700 pF       272       F       G       J       K       M       K       M       J       K       M       J       K       M       J       K       M       J       K       M       J       K       M       J <td< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td>DD</td><td>DD</td><td>DD</td><td></td><td></td><td></td><td></td><td></td><td></td><td>_</td><td></td><td>-</td><td>_</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td<>							DD	DD	DD							_		-	_															
3.000 pF       302       F G J K M       F G F F C F C F																																		
3.300 pF       332       F       G       J       K       M       F       G       J       K       M       F       G       F       G       K       M       F       G       J       K       M       F       G       F       G       K       M       F       G       J       K       M       F       G       F       G       K       M       F       G <td< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>EB</td></td<>																																		EB
3,900 pF       392       F       G       J       K       M       L       L       L       L       CF		332												CF	CF	CF	CF	CF			DF	DP	DP	DP						EC	EC	EE	EB	EB
4,300 pF       432       F G J K M       <																		-				_											_	EB
4,700 pF       472       F G J K M       <																																		EB
5,100 pF       512       F       G       J       K       M       L <thl< th=""> <thl<< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>EB</td></thl<<></thl<>																																		EB
5,600 pF       662       F       G       J       K       M       I																		CF																EB
6,200 pF       622       F       G       J       K       M       J       K       K       G       J       K       M       J       K																																		EB EB
6,800 pF       682       F       G       J       K       M       J       K       M       J       K       M       J       K       M       J       K       M       J       K       M       J       K       M       J       K       M       J       K       M       J       K       M       J       K       M       J       K       M       J       K       M       J       K       M       J       K       M       J       K       M       J       K       M       J       L       J       K       M       J       L       J       K       M       J       L       J       K       M       J       L       J       K       J       K       M       J       L       J       L       J       L       J       L       J       L       J       L       J       L       J       L       J       L       J       L       J       L       L       L       L       L       L       L       L       L       L       L       L       L       L       L       L       L       L       L <thl< th=""> <thl<< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>_</td><td></td><td>_</td><td></td><td></td><td></td><td></td><td>_</td><td>_</td><td></td><td></td><td>_</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>_</td></thl<<></thl<>															_		_					_	_			_								_
7,500 pF       752       5       6       J       K       M       J       K       K       M       J       K <th< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-</td><td>-</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></th<>																										-	-							
9,100 pF       912       9       G       J       K       M       L       L       L       L       C <th< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>EB</td></th<>																																		EB
10.000 pF       103       F       G       J       K       M       L <thl< th=""> <th< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></th<></thl<>																																		
12.000 pF       123       F       G       J       K       M <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-</td><td></td><td></td><td></td><td></td><td></td><td></td><td>_</td><td>_</td><td>_</td><td>-</td><td>_</td><td>_</td><td></td><td>-</td><td>_</td><td>_</td><td>_</td><td></td><td></td><td></td></t<>														-							_	_	_	-	_	_		-	_	_	_			
15.000 pF       153       F       G       J       K       M       J       L <thl< th=""> <th< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></th<></thl<>																																		
18.000 pF       183       F       G       J       K       M       L <thl< th=""> <th< td=""><td></td><td></td><td>FGJKM</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>ED</td></th<></thl<>			FGJKM																															ED
22,000 pF       223       F       G       J       K       M       A       A       A       A       A       B       B       EB			FGJKM											CF	CF	CF													EB	EB	EB	EB	FH	FH
27,000 pF       273       F       G       J       K       M       L <t< td=""><td></td><td></td><td>F G J K M</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>FR</td><td>FR</td><td>FR</td><td>FC</td><td>FH</td><td>EH</td></t<>			F G J K M																										FR	FR	FR	FC	FH	EH
33.000 pF       333       S       F       G       J       K       M       L <t< td=""><td></td><td></td><td>FGJKM</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>EB</td><td>EB</td><td>EB</td><td>EF</td><td></td><td></td></t<>			FGJKM																										EB	EB	EB	EF		
39,000 pF       393 473       4       F       G       J       K       M       L			F G J K M																									EB	EB	EB	EB	EE		
56,000 pF       563       F G J K M       I		393	F G J K M																		DG	DG	DG						EC	EC	EE	EH		
68,000 pF       683       F G J K M			F G J K M																		DG	GDG	DG						EC	EC	EE	EH		
82.000 pF       823       F       G       J       K       M       J       L <thl< th=""> <thl< th=""> <thl< td=""><td>· ·</td><td></td><td>F G J K M</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>1</td><td></td><td></td><td></td><td></td><td></td><td></td><td>ED</td><td>ED</td><td>ED</td><td>EF</td><td></td><td></td><td></td></thl<></thl<></thl<>	· ·		F G J K M																		1							ED	ED	ED	EF			
0.10 µF 104 F G J K M F G																																		
Can         Bated Aoltage (VDC)         10 <td></td> <td></td> <td>FGJKM</td> <td></td> <td>EH</td> <td>EH</td> <td>EH</td> <td>EH</td> <td></td> <td></td> <td></td>			FGJKM																									EH	EH	EH	EH			
	υ.ιυμη	104	i		16	25	9	16	25	50	00	00	50	9	16	25	50	8	8	50	þ	16	25	50	8	0	50					8	8	250
	Сар	Cap	Voltage Code	8	4	3	8	4	3	5		~ 2	∾ A	8	4	3	5		-	⊳ A	8	_	3		1	2		8				1	2	A
Code         Code <th< td=""><td>- <b>F</b></td><td>Code</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-</td><td></td><td></td><td></td><td></td><td></td><td></td><td>ſ</td><td>_</td><td colspan="5"></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></th<>	- <b>F</b>	Code												-							ſ	_												

\*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). xx<sup>1</sup> Available only in D, J, K,M tolerance

xx<sup>2</sup> 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)

18.000 pF       183       F       G       J       K       M       FB       FB       FB       FB       FB       FC       FC       FC       GB       GB       GB       GB       GB       HB       HE       JE		-																										
Capacitance         Total Column         Total Column </td <td></td> <td>0</td> <td></td> <td></td> <td></td> <td>C1</td> <td>210</td> <td>C</td> <td></td> <td></td> <td>(</td> <td>C18</td> <td>080</td> <td>;</td> <td>(</td> <td>C18</td> <td>120</td> <td>;</td> <td>(</td> <td>C18</td> <td>25</td> <td>С</td> <td>C2</td> <td>222</td> <td>0C</td> <td>C2</td> <td>222</td> <td>ōC</td>		0				C1	210	C			(	C18	080	;	(	C18	120	;	(	C18	25	С	C2	222	0C	C2	222	ōC
Normal         Normal<	Capacitance		Voltage Code	8	4	3	5	1	2	Α	5	1	2	Α	5	1	2	Α	5	1	2	A	5	1	2	5	1	2
Ido-41 pf* 10 - 91	• apacitaneo	Code	Rated Voltage (VDC)	2	16	25	20	8	8		ß	8	8	50	ß	8	8	50	ß	8	8	50	ß	8	8	ß	8	8
Un-1 (p)         U0-3 (p)				ŀ				~																I	5		-	2
100-300°       100-300° <th< td=""><td></td><td></td><td>Tolerance</td><td></td><td></td><td></td><td></td><td></td><td></td><td>Š</td><td>ee T</td><td>able</td><td>e 2 1</td><td>or (</td><td>Chip</td><td>Th</td><td>ickr</td><td>iess</td><td>s Di</td><td>mer</td><td>isio</td><td>ons</td><td><u> </u></td><td></td><td></td><td></td><td></td><td></td></th<>			Tolerance							Š	ee T	able	e 2 1	or (	Chip	Th	ickr	iess	s Di	mer	isio	ons	<u> </u>					
100 - 30° F       101 - 30° F       50 F G J K M F B FS FG																												
333-431       471-910 PF       31.431       F G J K M PB																												
471-911       F       G       J K M       F <th< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>IF</td><td>IF</td><td>IF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></th<>											IF	IF	IF															
11200 pF       112       1       F       G       K       K       F															GB	GB	GB											
1200 of -       122       I       F       G       I       B       FB									FB			_				_												
13:00 pF       13:2       I       F       G       I       F <th< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></th<>																												
1520       F       C       J       K       F																												
1500 op F       1162       F       G       J       KM       FB       FF																	-											
1120       F       G       J       KM       FB																												
2000 pF       202       P       G       J       M       P       P       P       C       F       C       F																												
2400 pF       242       242       F       G       J       M       FB					FB						LF	LF			GB		GB											
2700 pF         3700 pF															GB	GB	GB											
3.300 pF       332       332 pF       6 d J K M FB       FF       LF       LF     <												_	_			0.0	0.0											
3320 pF       332       322       1       F       G       K       F <th< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>GB</td><td>GB</td><td>GB</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></th<>															GB	GB	GB											
3800 pF       382       380 pF       380 pF       380 pF       380 pF       380 pF       482       1       F G J K M FB       FB       FB       FF       FF <th< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>GB</td><td>GB</td><td>GB</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></th<>															GB	GB	GB											
4 330 op F       4 32       F G J K M FE																	00											
4700 pF       472       F G J K M FB FF       FF FF FG FG FG       LF       LF<															GB	GB	GB		HB	HB	HB	3						
5100 pF       512       <																												
5.600 pF       662       F G J K M FB       FB       FB       FG											LF	LF			GB	GB	GD		НВ	HB	НВ	5						
6.200 pF       622       F G J K M FB       FB <th< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>GB</td><td>GB</td><td>GH</td><td></td><td>HB</td><td>HB</td><td>НВ</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></th<>															GB	GB	GH		HB	HB	НВ							
6.600 pF       662       F       G       J       K       F										FB																		
8.200 pF       822       912       F G J K M F F F F F F F F F F F F F F F F F F		682		FB	FB										GB	GB	GJ		HB	HB	HB	;	JE	JE	JB			KE
9:100 pF 9:12 9:100 pF 103 9:100 pF 10 100 pF 103 9:100 pF 103 10 10 1																												
10.000 pF 103 1000 pF 103 1000 pF 123 1 F G J K M F G G J K M F G F G F G F G F G F G F G F G F G F															GB	GH	GB	GB	HB	HB	HB	8	JE	JE	JB			
12.000 pF         123         i         F         G         J         K         M         FG															GR	СН	GB	GB	нв	НВ	не	:	IF		IR			
15.000 pF         153         F G J K M FG															_					_	_	_						
22,000 pF         223         F         G         J         K         M         FB         FB         FB         FB         FF         FF         FF         GB         GB        GB         GB																												KE
27,000 pF         273         F         G         J         K         M         FB         FB         FB         FG         FG         J         K         M         FB         FB         FB         FG         FG         J         K         M         FB																												
33.000 pF       333       1       F       G       J       K       M       FB       FB       FB       FB       FH       <																												
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $																			НВ	HG							KE	
47,000 pF       473       473       5       J       K       M       FB       FB       FB       FJ       J       K       M       FB       FB       FB       FJ       L       L       GB       <																												
68,000 pF       683       I       F       G       J       K       M       FB       FB       FC       FG       J       K       M       FC       FC <th< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></th<>																												
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $																												
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $																_												
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $																												
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $								1 IVI									Givi	Givi										
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $			F G J K M	FH																			JB		JG			
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $			F G J K M	FJ	FJ	FJ																		JD				
0.33 μF       334       334       F       G       J       K       M       F       G       J       K       M       J <t< td=""><td></td><td></td><td>F G J K M</td><td>FK</td><td>FK</td><td>FK</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>GK</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>JL</td><td></td><td></td><td></td></t<>			F G J K M	FK	FK	FK									GK										JL			
$\begin{array}{c c c c c c c c c c c c c c c c c c c $																												
0.47 µF       474       F       G       J       M       S			FGJKM																					10				
Capacitance Code       Rated Voltage (VDC)       P			F G J K M																									
Capacitance Code         Voltage Code         8         4         3         5         1         2         A         5<					16	25	50	100	200	250	50	100	200	250	50	100	200	250	50	100	200	250		100	200	50	100	200
Code Case Size/ C1210C C1808C C1812C C1825C C2220C C2225C	Canacitance																									1		
Series 612100 610000 610120 610230 622200 622230	Supartanos	Code	Case Size/							I																		
			Series									010	000			- 10	120				230						.223	

\*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 G	Quantity	Plastic (	Quantity			
Code	Size	Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel			
AB BB BD CF CH	0201 0402 0402 0603 0603	$\begin{array}{c} 0.30 \pm 0.03 \\ 0.50 \pm 0.05 \\ 0.55 \pm 0.05 \\ 0.80 \pm 0.07^* \\ 0.85 \pm 0.07 \end{array}$	15,000 10,000 10,000 4,000 4,000 4,000	0 50,000 50,000 15,000 10,000	0 0 0 0 0	0 0 0 0 0			
DM DN DP DE DF	0805 0805 0805 0805 0805 0805	$\begin{array}{c} 0.00 \pm 0.01 \\ 0.70 \pm 0.20^{*} \\ 0.78 \pm 0.10^{*} \\ 0.90 \pm 0.10^{*} \\ 1.00 \pm 0.10 \\ 1.10 \pm 0.10 \end{array}$	4,000 4,000 4,000 0 0	15,000 15,000 15,000 0 0	0 0 2,500 2,500	0 0 0 10,000 10,000			
DG EB EC ED EE	0805 1206 1206 1206 1206	$\begin{array}{c} 1.10 \pm 0.10 \\ 1.25 \pm 0.15 \\ 0.78 \pm 0.10 \\ 0.90 \pm 0.10 \\ 1.00 \pm 0.10 \\ 1.10 \pm 0.10 \end{array}$	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 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 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	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 0	1,000 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	$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 $	0 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 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 7" Reel	0 13" Reel	1,000 4,00 <b>7" Reel 13" R</b>				
Thickness Code	Case Size	Thickness ± Range (mm)		Quantity	7" Reel 13" Ree 13" Ree Plastic Quantity				

Package quantity based on finished chip thickness specifications.



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

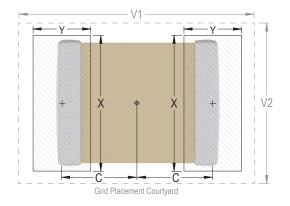
EIA Size Code	Metric Size Code			sity Lev mum (I rotrusio	/lost)	)		Media	sity Lev an (Nor rotrusio		)			sity Lev num (L rotrusio	east)	)
oouc	oode	С	Y	X	V1	V2	С	Y	X	V1	V2	С	Y	X	V1	V2
0201	0603	0.38	0.56	0.52	1.80	1.00	0.33	0.46	0.42	1.50	0.80	0.28	0.36	0.32	1.20	0.60
0402	1005	0.50	0.72	0.72	2.20	1.20	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 <sup>1</sup>	3225	1.50	1.60	2.90	5.60	3.90	1.40	1.40	2.80	4.70	3.30	1.30	1.20	2.70	4.00	3.00
1808	4520	2.30	1.75	2.30	7.40	3.30	2.20	1.55	2.20	6.50	2.70	2.10	1.35	2.10	5.80	2.40
1812	4532	2.15	1.60	3.60	6.90	4.60	2.05	1.40	3.50	6.00	4.00	1.95	1.20	3.40	5.30	3.70
1825	4564	2.15	1.60	6.90	6.90	7.90	2.05	1.40	6.80	6.00	7.30	1.95	1.20	6.70	5.30	7.00
2220	5650	2.75	1.70	5.50	8.20	6.50	2.65	1.50	5.40	7.30	5.90	2.55	1.30	5.30	6.60	5.60
2225	5664	2.70	1.70	6.90	8.10	7.90	2.60	1.50	6.80	7.20	7.30	2.50	1.30	6.70	6.50	7.00

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

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

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

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





#### **Soldering Process**

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

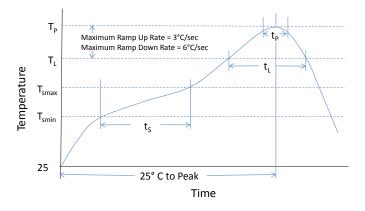
- Solder wave or solder reflow for EIA case sizes 0603, 0805 and 1206
- · All other EIA case sizes are limited to solder reflow only

#### **Recommended Reflow Soldering Profile:**

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

Profile Feature	Terminati	on Finish
FIONETeature	SnPb	100% Matte Sn
Preheat/Soak		
Temperature Minimum (T <sub>Smin</sub> )	100°C	150°C
Temperature Maximum (T <sub>Smax</sub> )	150°C	200°C
Time (t <sub>s</sub> ) from $T_{Smin}$ to $T_{Smax}$	60 – 120 seconds	60 – 120 seconds
Ramp-Up Rate $(T_L \text{ to } T_P)$	3°C/second maximum	3°C/second maximum
Liquidous Temperature $(T_L)$	183°C	217°C
Time Above Liquidous ( $t_L$ )	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T <sub>P</sub> )	235°C	260°C
Time Within 5°C of Maximum Peak Temperature (t <sub>P</sub> )	20 seconds maximum	30 seconds maximum
Ramp-Down Rate $(T_P \text{ to } T_L)$	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum

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





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

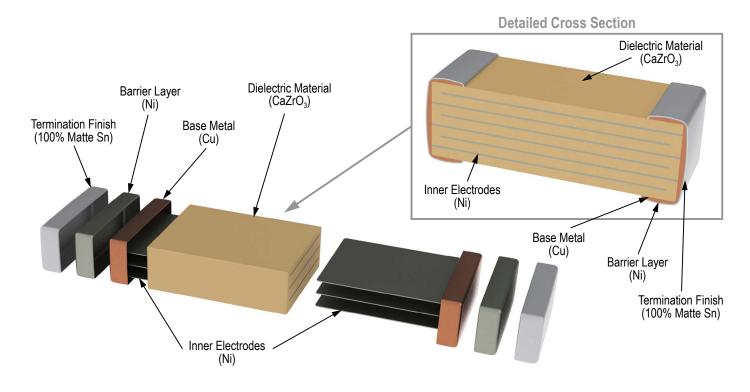
Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8 kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for C0G. Flexible termination system – 3.0 mm (minimum).
		Magnification 50 X. Conditions:
Solderability	J-STD-002	a) Method B, 4 hours @ 155°C, dry heat @ 235°C
Solderability	J-31D-002	b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
Temperature Cycling	JESD22 Method JA-104	1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 2 hours after test conclusion.
Die er del hansi dite a		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	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



# **Capacitor Marking (Optional):**

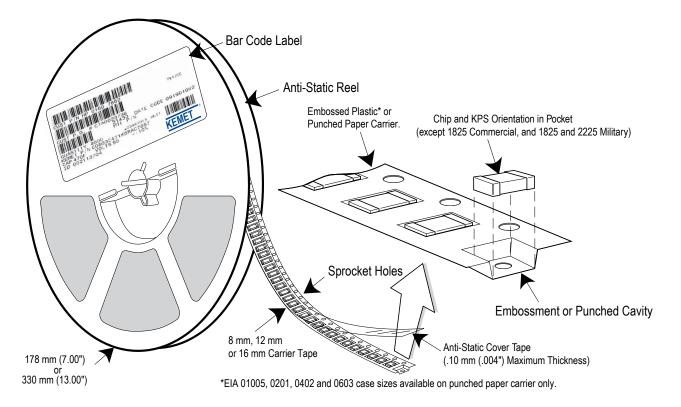
Laser marking option is not available on:

- 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.

# Tape & Reel Packaging Information

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



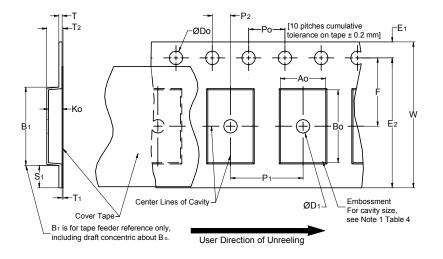
## Table 5 – Carrier Tape Configuration, Embossed Plastic & Punched Paper (mm)

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

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



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



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

Metric will govern

Constant Dimensions — Millimeters (Inches)										
Tape Size	D <sub>0</sub>	D <sub>1</sub> Minimum Note 1	E <sub>1</sub>	P <sub>0</sub>	P <sub>2</sub>	R Reference Note 2	S <sub>1</sub> Minimum Note 3	T Maximum	T <sub>1</sub> Maximum	
8 mm		1.0 (0.039)				25.0 (0.984)				
12 mm	1.5 +0.10/-0.0 (0.059 +0.004/-0.0)		1.5	1.75 ±0.10 (0.069 ±0.004)	4.0 ±0.10 (0.157 ±0.004)	2.0 ±0.05 (0.079 ±0.002)	30	0.600 (0.024)	0.600 (0.024)	0.100 (0.004)
16 mm		(0.059)				(1.181)				
	Variable Dimensions — Millimeters (Inches)									
Tape Size	Pitch	B <sub>1</sub> Maximum Note 4	E <sub>2</sub> Minimum	F	P <sub>1</sub>	T <sub>2</sub> Maximum	W Maximum	A <sub>0</sub> ,B <sub>0</sub>	& K <sub>0</sub>	
8 mm	Single (4 mm)	4.35 (0.171)	6.25 (0.246)	3.5 ±0.05 (0.138 ±0.002)	4.0 ±0.10 (0.157 ±0.004)	2.5 (0.098)	8.3 (0.327)			
12 mm	Single (4 mm) & Double (8 mm)	8.2 (0.323)	10.25 (0.404)	5.5 ±0.05 (0.217 ±0.002)	8.0 ±0.10 (0.315 ±0.004)	4.6 (0.181)	12.3 (0.484)	Note 5		
16 mm	Triple (12 mm)	12.1 (0.476)	14.25 (0.561)	7.5 ±0.05 (0.138 ±0.002)	12.0 ±0.10 (0.157 ±0.004)	4.6 (0.181)	16.3 (0.642)			

1. The embossment hole location shall be measured from the sprocket hole controlling the location of the embossment. Dimensions of embossment location and hole location shall be applied independent of each other.

2. The tape with or without components shall pass around R without damage (see Figure 6).

3. If S<sub>1</sub> < 1.0 mm, there may not be enough area for cover tape to be properly applied (see EIA Standard 481 paragraph 4.3 section b).

4. B, dimension is a reference dimension for tape feeder clearance only.

5. The cavity defined by  $A_{\alpha}$ ,  $B_{\alpha}$  and  $K_{\alpha}$  shall surround the component with sufficient clearance that:

(a) the component does not protrude above the top surface of the carrier tape.

(b) the component can be removed from the cavity in a vertical direction without mechanical restriction, after the top cover tape has been removed.

(c) rotation of the component is limited to 20° maximum for 8 and 12 mm tapes and 10° maximum for 16 mm tapes (see Figure 3).

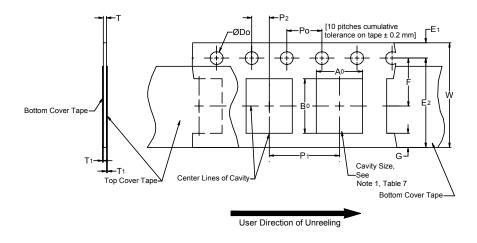
(d) lateral movement of the component is restricted to 0.5 mm maximum for 8 and 12 mm wide tape and to 1.0 mm maximum for 16 mm tape (see Figure 4).

(e) for KPS Series product,  $A_0$  and  $B_0$  are measured on a plane 0.3 mm above the bottom of the pocket.

(f) see Addendum in EIA Standard 481 for standards relating to more precise taping requirements.



#### Figure 2 – Punched (Paper) Carrier Tape Dimensions



## Table 7 – Punched (Paper) Carrier Tape Dimensions

Metric will govern

Constant Dimensions — Millimeters (Inches)								
Tape Size	D <sub>0</sub>	E <sub>1</sub>	P <sub>0</sub>	P <sub>2</sub>	T₁ Maximum	G Minimum	R Reference Note 2	
8 mm	1.5 +0.10 -0.0 (0.059 +0.004 -0.0)	1.75 ±0.10 (0.069 ±0.004)	4.0 ±0.10 (0.157 ±0.004)	2.0 ±0.05 (0.079 ±0.002)	0.10 (0.004) Maximum	0.75 (0.030)	25 (0.984)	
Variable Dimensions — Millimeters (Inches)								
Tape Size	Pitch	E2 Minimum	F	P <sub>1</sub>	T Maximum	W Maximum	A <sub>0</sub> B <sub>0</sub>	
8 mm	Half (2 mm)	6.25	3.5 ±0.05 (0.138 ±0.002)	2.0 ±0.05 (0.079 ±0.002)	1.1	8.3 (0.327)	Note 1	
8 mm	Single (4 mm)	(0.246)		4.0 ±0.10 (0.157 ±0.004)	(0.098)	8.3 (0.327)	NOLE I	

1. The cavity defined by  $A_{\alpha}$ ,  $B_{\alpha}$  and T shall surround the component with sufficient clearance that:

a) the component does not protrude beyond either surface of the carrier tape.

b) the component can be removed from the cavity in a vertical direction without mechanical restriction, after the top cover tape has been removed.

c) rotation of the component is limited to 20° maximum (see Figure 3).

d) lateral movement of the component is restricted to 0.5 mm maximum (see Figure 4).

e) see Addendum in EIA Standard 481 for standards relating to more precise taping requirements.

2. The tape with or without components shall pass around R without damage (see Figure 6).



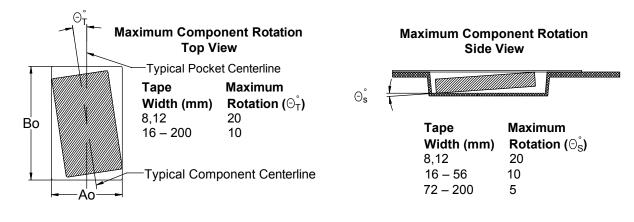
## **Packaging Information Performance Notes**

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

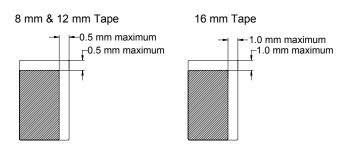
Tape Width	Peel Strength
8 mm	0.1 to 1.0 Newton (10 to 100 gf)
12 and 16 mm	0.1 to 1.3 Newton (10 to 130 gf)

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

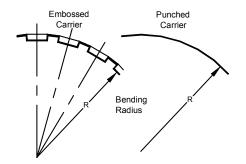
#### **Figure 3 – Maximum Component Rotation**



### Figure 4 – Maximum Lateral Movement

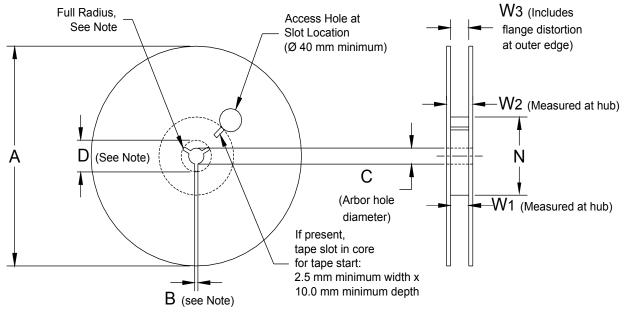


## Figure 5 – Bending Radius





### Figure 6 – Reel Dimensions



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

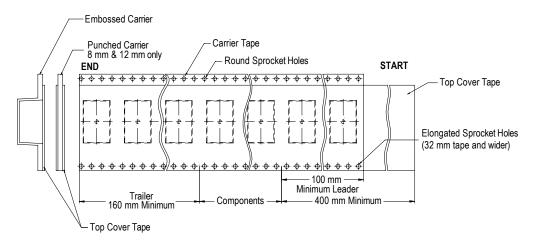
#### Table 8 – Reel Dimensions

Metric will govern

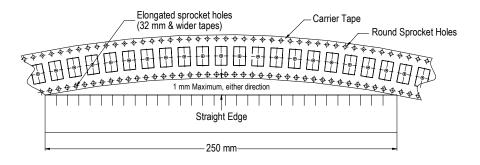
Constant Dimensions — Millimeters (Inches)								
Tape Size	A	B Minimum	С	D Minimum				
8 mm	178 ±0.20			20.2 (0.795)				
12 mm	(7.008 ±0.008) or	1.5 (0.059)	13.0 +0.5/-0.2 (0.521 +0.02/-0.008)					
16 mm	330 ±0.20 (13.000 ±0.008)	, , , , , , , , , , , , , , , , , , ,	,					
	Variable Dimensions — Millimeters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



## Figure 7 – Tape Leader & Trailer Dimensions

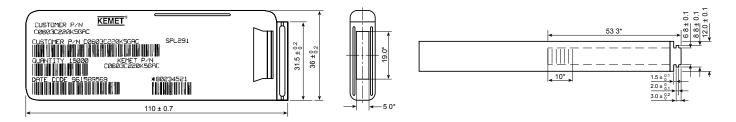


### Figure 8 – Maximum Camber



## Bulk Cassette Packaging (Ceramic Chips Only)

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



## **Capacitor Dimensions for Bulk Cassette**

Cassette Packaging - Millimeters

EIA Size Code	Metric Size Code	L Length	W Width	B Bandwidth	S Separation Minimum	T Thickness	Number of Pieces/Cassette
0402	1005	1.0 ±0.05	0.5 ±0.05	0.2 to 0.4	0.3	0.5 ±0.05	50,000
0603	1608	1.6 ±0.07	0.8 ±0.07	0.2 to 0.5	0.7	0.8 ±0.07	15,000

Surface Mount Multilayer Ceramic Chip Capacitors (SMD MLCCs) – C0G Dielectric, 10 – 250 VDC (Commercial Grade)



### KEMET Corporation World Headquarters

2835 KEMET Way Simpsonville, SC 29681

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

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

Corporate Offices Fort Lauderdale, FL Tel: 954-766-2800

### **North America**

Southeast Lake Mary, FL Tel: 407-855-8886

Northeast Wilmington, MA Tel: 978-658-1663

**Central** Novi, MI Tel: 248-306-9353

West Milpitas, CA Tel: 408-433-9950

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

#### Europe

Southern Europe Sasso Marconi, Italy Tel: 39-051-939111

Skopje, Macedonia Tel: 389-2-55-14-623

**Central Europe** Landsberg, Germany Tel: 49-8191-3350800

Kamen, Germany Tel: 49-2307-438110

Northern Europe Harlow, 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: 86-10-5877-1075

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

Seoul, South Korea Tel: 82-2-6294-0550

Taipei, Taiwan Tel: 886-2-27528585

Southeast Asia Singapore Tel: 65-6701-8033

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.

## 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.



#### О компании

ООО "ТрейдЭлектроникс" - это оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов. Реализуемая нашей компанией продукция насчитывает более полумиллиона наименований.

Благодаря этому наша компания предлагает к поставке практически не ограниченный ассортимент компонентов как оптовыми, мелкооптовыми партиями, так и в розницу.

Наличие собственной эффективной системы логистики обеспечивает надежную поставку продукции по конкурентным ценам в точно указанные сроки.

Срок поставки со стоков в Европе и Америке – от 3 до 14 дней.

Срок поставки из Азии – от 10 дней.

Благодаря развитой сети поставщиков, помогаем в поиске и приобретении экзотичных или снятых с производства компонентов.

Предоставляем спец цены на элементы для создания инженерных сэмплов.

Упорный труд, качественный результат дают нам право быть уверенными в себе и надежными для наших клиентов.

#### Наша компания это:

- Гарантия качества поставляемой продукции
- Широкий ассортимент
- Минимальные сроки поставок
- Техническая поддержка
- Подбор комплектации
- Индивидуальный подход
- Гибкое ценообразование

Наша организация особенно сильна в поставках модулей, микросхем, пассивных компонентов, ксайленсах (XC), EPF, EPM и силовой электроники.

Большой выбор предлагаемой продукции, различные виды оплаты и доставки, позволят Вам сэкономить время и получить максимум выгоды от сотрудничества с нами!

Trade Electronics.ru гарантия бесперебойности производства и качества выпускаемой продукции

## <u>Перечень производителей, продукцию которых мы поставляем</u> на российский рынок

	► ANALOG DEVICES	BOURNS	Coilcraft.
Élantec Semiconductor, Inc.	HARRIS	infineon	JRC
		nichicon	PHILIPS
	ATT SES-THOMSON	Sipex	TAIYD YUDEN
ТОКО	2	Winbond Destroyed Copy	Allegro
AIMEL.	BURR - BROWN	Z EX4R	HITACHI Inspire the Next
(intel)	Lattice	muRata Anostir in Bistonia	OKI
	SAMSUNG	SHARP	SONY
<b>⊗TDK</b>	TOSHIBA	×	
	<b>2</b>	CYPRESS	
	International		Semiconductor
GN Semiconductor	Kontek Kentondecker Corp.	SANYO	
<u>s</u>	TECCOR	TUNDRA.	E XILINX.
Amphenol	Bay Linear	CINILS LOGIC	DALLAS
FUĴĨTSU	<b>DIDT</b>	intersil,	MIXIM
molex	NEC	Panasonic	RENESAS
SII Cale Instrumenta Inc.	SIEMENS		TEXAS INSTRUMENTS
	VISHAY		



С удовольствием будем прорабатывать для Вас поставки всех необходимых компонентов по текущим запросам для скорейшего выявления групп элементов, по которым сотрудничество именно с нашей компанией будет для Вас максимально выгодным!

С уважением,

Менеджер отдела продаж ООО

«Трейд Электроникс»

Шишлаков Евгений

8 (495)668-30-28 доб 169

manager28@tradeelectronics.ru

http://www.tradeelectronics.ru/