MULTILAYER CERAMIC CHIP CAPACITOR - GMX SERIES - SOFT TERMINATION

INTRODUCTION

- Multilayer Ceramic Chip Capacitors supplied in bulk or tape & reel package are ideally suitable for thick-film hybrid circuits and automatic surface mounting on any printed circuit boards.
- GMX series use a special material between nickel-barrier and ceramic body. It provides excellent performance to guard against bending stress occurred during process and provide more security for PCB process.
- The nickel-barrier terminations are consisted of a nickel barrier layer over the silver metalization and then finished by electroplated solder layer to ensure the terminations have good solderability. The nickel barrier layer in terminations prevents the dissolution of termination when extended immersion in molten solder at elevated solder temperature.

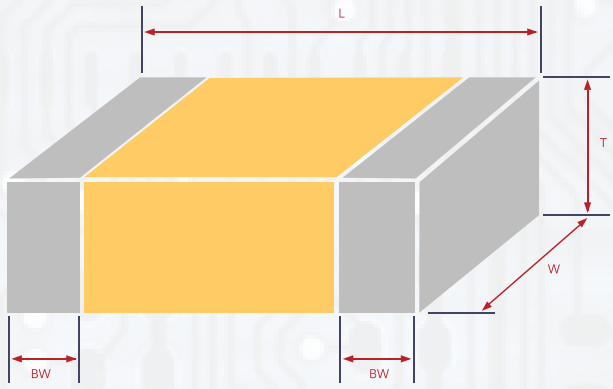
APPLICATIONS

- For general digital circuit.
- For power supply bypass capacitors.
- For consumer electronics.
- For telecommunication.
- DC to DC converter.

FEATURES

- High performance to withstanding 3~5mm of substrate bending test guarantee.
- A wide selection of sizes is available.
- High capacitance in given case size.
- Capacitor with lead-free termination (pure Tin).
- Reduction in PCB bend failure.
- High reliability and stability.
- RoHS & HALOGEN FREE.

EXTERNAL DIMENSION



UNIT: MM

SIZE	INCH	L	W	t	BW
0402	1005	1.00±0.20	0.50±0.20	SEE TABLE BELOW	0.25 +0.05/-0.10
0603	1608	1.60±0.20	0.80±0.20		0.40±0.15
0805	2012	2.10±0.20	1.25±0.20		0.50±0.20
1206	3216	3.30±0.30	1.60±0.20 1.60 +0.30/-0.10		0.60±0.20
1210	3225	3.30±0.40	2.50±0.30		0.75±0.35
1808	4520	4.60±0.50	2.00±0.25		0.75±0.35
1812	4532	4.60±0.50	3.20±0.30		0.75±0.35
1825	4563	4.60±0.50	6.30±0.40		0.75±0.35
2220	5750	5.70±0.50	5.00±0.40		0.85±0.35
2225	5763	5.70±0.50	6.30±0.40		0.85±0.35

ORDERING INFORMATION

GMX	31	X7R	104	K	100	CT
SERIES	SIZE	DIELECTRIC	CAPACITANCE	TOLERANCE	RATED VOLTAGE	PACKAGING
Anti-Bend General Purpose Product	04 - 0402 (1005) 10 - 0603 (1608) 21 - 0805 (2012) 31 - 1206 (3216) 32 - 1210 (3225) 40 - 1808 (4520) 43 - 1812 (4532) 45 - 1825 (4563) 55 - 2220 (5750) 57 - 2225 (5763)	CG - C0G X7R - X7R X7S - X7S X5R - X5R	R47 - 0.47pF 0R5 - 0.5pF 100 - $10x10^0$-10pF 102 - $10x10^2$-1000pF 104 - $10x10^4$-100nF 106 - $10x10^6$-10μF	A : ±0.05pF B : ±0.10pF C : ±0.25 pF D : ±0.50 pF F : ±1 % G: ±2% H : ±3% I : -10% ~ 0% J : ±5% K : ±10% L : 0% ~ +10% M: ±20% N: -5% ~ +10% P : ±0.02 pF Q: ±0.03 pF Z : -20% ~ +80% X : +10% ~ +20%	6R3 - 6.3Vdc 10 - 10Vdc 16 - 16Vdc 25 - 25Vdc 35 - 35Vdc 50 - 50Vdc 100 - 100Vdc 200 - 200Vdc 250 - 250Vdc 400 - 400Vdc 500 - 500Vdc 630 - 630Vdc 1K0 - 1000Vdc 1K5 - 1500Vdc 2K0 - 2000Vdc 3K0 - 3000Vdc 4K0 - 4000Vdc 5K0 - 5000Vdc	CT -Tape and 7" Reel CTD - Tape and 10" Reel CTG - Tape and 13" Reel

GENERAL ELECTRICAL DATA

DIELECTRIC	C0G	X7R	X7S	X5R
SIZE	0402, 0603, 0805, 1206, 1210, 1808, 1812, 1825, 2220, 2225	0402, 0603, 0805, 1206, 1210, 1808, 1812, 1825, 2220, 2225	0402, 0603, 0805, 1206, 1210, 2220	0402, 0603, 0805, 1206, 1210
RATED VOLTAGE (WVDC)	10V, 16V, 25V, 50V, 100V, 200V, 250V, 500V, 630V, 1KV, 1.5KV, 2KV, 3KV, 4KV	6.3V, 10V, 16V, 25V, 50V, 100V, 200V, 250V, 500V, 630V, 1KV, 1.5KV, 2KV, 3KV, 4KV, 5KV	6.3V, 10V, 16V, 25V, 50V, 100V, 2KV	6.3V, 10V, 16V, 25V, 50V, 100V, 200V, 250V, 500V, 630V, 1KV, 1.5KV, 2KV, 3KV, 4KV, 5KV
CAPACITANCE RANGE	0.1pF ~ 100nF	100pF ~ 47µF	470PF-47UF	0.033uF ~ 100uF
CAPACITANCE TOLERANCE	SEE ORDERING INFORMATION			
TAN δ	CAP. RANGE / Q SPEC CAP. <30pF: Q≥400+20°C CAP. ≥30pF: Q≥1000	SEE RELIABILITY TEST CONDITIONS AND REQUIREMENTS BELOW		
CAPACITANCE & TAN δ TEST CONDITION	For 25°C at ambient temperature	Preconditioning for Class II MLCC: Perform a heat treatment at 150±10°C for 1 hour, then leave in ambient condition for 24±2 hours before measurement		
	CAP. RANGE / TEST CONDITION	CAP. RANGE / TEST CONDITION	CAP. RANGE / TEST CONDITION	CAP. RANGE / TEST CONDITION
	Cap.≤1000pF: 1.0±0.2Vrms, 1.0MHz±10%	Cap.≤10µF: 1.0±0.2Vrms, 1.0KHz±10%	Cap.≤10µF: 1.0±0.2Vrms, 1.0KHz±10%	Cap.≤10µF: 1.0±0.2Vrms, 1.0KHz±10%
	Cap.>1000pF: 1.0±0.2Vrms, 1.0KHz±10%	Cap.>10µF: 0.5±0.2Vrms, 120Hz±20%	Cap.>10µF: 0.5±0.2Vrms, 120Hz±20%	Cap.>10µF: 0.5±0.2Vrms, 120Hz±20%
INSULATION RESISTANCE	≥10GΩ or RxC≥500Ω-F, whichever is smaller			
OPERATING TEMPERATURE	-55°C to + 125°C	-55°C to + 125°C	-55°C to + 125°C	-55°C to + 85°C
TEMPERATURE COEFFICIENT	±30ppm/°C	±15%	±22%	±15%
TERMINATION	Cu/Ag polymer/Ni/Sn (lead-free termination)			

MS LEVEL 1

59 Steamwhistle Drive, Ivyland, PA 18974 | p. 215.942.8900 | www.calchip.com | quotes@calchip.com

CAPACITANCE RANGE

DIELECTRIC		COG																						
SIZE		0402					0603							0805										
RATED VOLTAGE		10	16	25	50	100	10	16	25	50	100	200	250	10	16	25	50	100	200	250	500	630	1000	
0.1pF	0R1	G	G	G	G																			
0.2pF	0R2	G	G	G	G																			
0.3pF	0R3	G	G	G	G		I	I	I	I	I													
0.4pF	0R4	G	G	G	G		I	I	I	I	I													
0.5pF	0R5	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	H	H	H	N	
0.6pF	0R6	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	H	H	H	N	
0.7pF	0R7	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	H	H	H	N	
0.8pF	0R8	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	H	H	H	N	
0.9pF	0R9	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	H	H	H	N	
1.0pF	1R0	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	H	H	H	N	
1.2pF	1R2	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	H	H	H	N	
1.5pF	1R5	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	H	H	H	N	
1.8pF	1R8	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	H	H	H	N	
2.2pF	2R2	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	H	H	H	N	
2.7pF	2R7	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	H	H	H	N	
3.3pF	3R3	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	H	H	H	N	
3.9pF	3R9	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	H	H	H	N	
4.7pF	4R7	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	H	H	H	N	
5.6pF	5R6	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	H	H	H	N	
6.2pF	6R2	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	H	H	H	N	
6.8pF	6R8	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	H	H	H	N	
8.2pF	8R2	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	H	H	H	N	
10pF	100	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	H	H	H	N	
12pF	120	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	H	H	H	N	
15pF	150	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	H	H	H	N	
18pF	180	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	H	H	H	N	
22pf	220	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	H	H	H	N	
27pf	270	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	H	H	H	N	
33pf	330	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	H	H	H	N	
39pf	390	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	H	H	H	N	
47pf	470	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	H	H	H	N	
56pf	560	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	H	H	H	N	
68pf	680	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	H	H	H	N	
82pf	820	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	H	X	X	N	
100pf	101	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	X	X	X	N	
120pf	121	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	H	X	N	N	N	
150pf	151	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	X	X	N	N	N	
180pf	181	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	X	N	N	N	N	
220pf	221	G	G	G	G	G	I	I	I	I	I	I	I	H	H	H	H	H	N	N	N	N	N	
270pf	271	G	G	G	G		I	I	I	I	I	G	G	H	H	H	H	H	N	N	N	N	N	
330pf	331	G	G	G	G		I	I	I	I	I	G	G	H	H	H	H	H	N	N	N	N	N	
390pF	391	G	G	G	G		I	I	I	I	I	G	G	X	X	X	X	X	N	N	N	N	N	
470pf	471	G	G	G	G		I	I	I	I	I	G	G	X	X	X	X	X	N	N	R	R		
560pf	561	G	G	G	G		I	I	I	I	I			X	X	X	X	X	N	N	R	R		
680pf	681	G	G	G	G		I	I	I	I	I			X	X	X	X	X	N	N	R	R		
820pf	821	G	G	G	G		I	I	I	I	I			X	X	X	X	X	N	N	R	R		
1,000pf	102	G	G	G	G		I	I	I	I	I			X	X	X	X	X	N	N	R	R		
1,200pf	122						G	G	G	G				X	X	X	X	X	N	N				
1,500pf	152						G	G	G	G				X	X	X	X	X	N	N				
1,800pf	182						G	G	G	G				X	X	X	X	X	N	N				
2,200pf	222						G	G	G	G				X	X	X	X	X	N	N				
2,700pf	272						G	G	G	G				N	N	N	N	N	N	N				
3,300pf	332						G	G	G	G				N	N	N	N	N						
3,900pf	392													N	N	N	N	N						
4,700pf	472													N	N	N	N	N						
5,600pf	562													N	N	N	N	N						
6,800pf	682													N	N	N	N	N						
8,200pf	822													N	N	N	N							
0.01µF	103													N	N	N	N							
0.012µF	123																							

CAPACITANCE RANGE

* ARC PROTECTION COATING

CODE	H	K	Q	R	G	I	N
THICKNESS	0.60 ± 0.10 mm	0.8 + 0.15/-0.10 mm	1.25 ± 0.10 mm	1.25 ± 0.20 mm	0.50 ± 0.20 mm	0.80 ± 0.07 mm	0.80 ± 0.10 mm

CAPACITANCE RANGE

DIELECTRIC		COG																								
SIZE		1206												1210												
RATED VOLTAGE		10	16	25	50	100	200	250	500	630	1000	1500	2000	10	16	25	50	100	200	250	500	630	1000	1500	2000	3000
CAPACITANCE RANGE	1.0pf	1R0				J																				
	1.2pf	1R2	J	J	J	J	J			J																	
	1.5pf	1R5	J	J	J	J	J	J	J	J	J	J	J	J													
	1.8pf	1R8	J	J	J	J	J	J	J	J	J	J	J	J													
	2.2pf	2R2	J	J	J	J	J	J	J	J	J	J	J	J													
	2.7pf	2R7	J	J	J	J	J	J	J	J	J	J	J	J													
	3.3pF	3R3	J	J	J	J	J	J	J	J	J	J	J	J													
	3.9pf	3R9	J	J	J	J	J	J	J	J	J	J	J	J													
	4.7pf	4R7	J	J	J	J	J	J	J	J	J	J	J	J													
	5.0 pF	5R0	J	J	J	J	J	J	J	J	J	J	J	J													
	5.6pF	5R6	J	J	J	J	J	J	J	J	J	J	J	J													
	6.8pf	6R8	J	J	J	J	J	J	J	J	J	J	J	J													
	8.2pf	8R2	J	J	J	J	J	J	J	J	J	J	J	J													
	10pf	100	J	J	J	J	J	J	J	J	J	J	J	J	O	O	O	O	O	O	O	O	O	O	O	O	Z
	12pF	120	J	J	J	J	J	J	J	J	J	J	J	J	O	O	O	O	O	O	O	O	O	O	O	O	Z
	15pF	150	J	J	J	J	J	J	J	J	J	J	J	J	O	O	O	O	O	O	O	O	O	O	O	O	Z
	18pF	180	J	J	J	J	J	J	J	J	J	J	J	J	O	O	O	O	O	O	O	O	O	O	O	O	Z
	22pF	220	J	J	J	J	J	J	J	J	J	J	J	J	O	O	O	O	O	O	O	O	O	O	O	O	Z
	27pF	270	J	J	J	J	J	J	J	J	J	J	J	J	O	O	O	O	O	O	O	O	O	O	O	O	Z
	33pF	330	J	J	J	J	J	J	J	J	J	J	O	O	O	O	O	O	O	O	O	O	O	O	O	O	Z
	39pF	390	J	J	J	J	J	J	J	J	J	J	O	O	O	O	O	O	O	O	O	O	O	O	O	O	Z
	47pF	470	J	J	J	J	J	J	J	J	J	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	Z
	56pF	560	J	J	J	J	J	J	J	J	J	O	Q	Q	O	O	O	O	O	O	O	O	O	O	Q	Q	Z
	68pF	680	J	J	J	J	J	J	J	J	J	O	Q	Q	O	O	O	O	O	O	O	O	O	O	Q	Q	Z
	82pF	820	J	J	J	J	J	J	J	J	J	Q	Q	Q	O	O	O	O	O	O	O	O	O	O	Q	Q	Z
	100pF	101	J	J	J	J	J	J	J	J	J	Q	Q	Q	O	O	O	O	O	O	O	O	O	Q	Q	Q	Z
	120pF	121	J	J	J	J	J	J	J	J	J	Q	U	U	O	O	O	O	O	O	O	O	O	Q	Q	Q	Z
	150pF	151	J	J	J	J	J	J	J	J	J	Q	U	U	O	O	O	O	O	O	O	O	O	Q	U	U	Z
	180pF	181	J	J	J	J	J	J	J	J	J	U	U	U	O	O	O	O	O	O	O	O	O	Q	U	U	Z
	220pF	221	J	J	J	J	J	J	J	J	J	U	U	U	O	O	O	O	O	O	O	O	O	U	U	U	Z
	270pF	271	J	J	J	J	J	J	O	O	O	U	V	V	O	O	O	O	O	O	O	O	O	U	Z	Z	AA
	330pF	331	J	J	J	J	J	J	O	O	O	U	V	V	O	O	O	O	O	O	O	O	O	U	AA	AA	
	390pF	391	J	J	J	J	J	J	O	O	O	U	V	V	O	O	O	O	O	O	O	O	O	U	AA	AA	
	470pF	471	J	J	J	J	J	O	O	O	O	U	U	U	O	O	O	O	O	O	O	O	O	U	AA	AA	
	560pF	561	J	J	J	J	J	O	Q	Q	Q	U			O	O	O	O	O	O	O	O	O	U	AA	AA	
	680pF	681	J	J	J	J	J	O	Q	Q	Q	U			O	O	O	O	O	O	O	O	O	U	AA	AA	
	820pF	821	J	J	J	J	J	O	U	U	U	U			O	O	O	O	O	O	O	O	O	U	AA	AA	
	1000pF	102	J	J	J	J	J	O	U	U	U	U			O	O	O	O	O	Q	Q	Q	Q	U	AA	AA	
	1200pF	122	J	J	J	J	J	O	U	U	U				O	O	O	O	O	Q	Q	Q	Q	U	Z	Z	
	1500pF	152	J	J	J	J	J	Q	U	U	U				O	O	O	O	O	Q	Q	Q	Q	Z	AA	AA	
	1800pF	182	J	J	J	J	J	Q	U	U	U				O	O	O	O	O	Q	Q	Q	Q	AA	AA	AA	
	2200pF	222	J	J	J	J	J	Q	U	U	U				O	O	O	O	O	Q	Q	Q	Q	AA			
	2700pF	272	J	J	J	J	J	Q	U	U	U				O	O	O	O	O	Q	Q	Q	Q	AA			
	3300pF	332	J	J	J	J	J	Q	U	U	U				O	O	O	O	O	Q	Q	Q	Q	AA			
	3900pF	392	J	J	J	J	J	U	U	U	U				O	O	O	O	O	Q	Q	Q	Q	AA			
	4700pF	472	J	J	J	J	J	U	U	U	U				O	O	O	O	O	U	U	U	U	AA			
	5600pF	562	J	J	J	J	J	U	U	U	U				O	O	O	O	Q	U	U	U	U	AA			
	6800pF	682	O	O	O	O	O	U	U	U	Q./U				O	O	O	O	Q	U	U	U	U	AA			
	8200pF	822	Q	Q	Q	Q	Q	U	U	U	U				O	O	O	O	Q	U	U	U	U	AA			
	0.010µF	103	Q	Q	Q	Q	Q	U	U	U	U				O	O	O	O	U	Z	Z	Z	Z	AA			
	0.012µF	123	V	V	V	V	V								Q	Q	Q	Q	U	Z	Z	Z	Z	AA			
	0.015µF	153	V	V	V	V	V								Q	Q	Q	Q	Z	Z	Z	Z	Z	AA			
	0.018µF	183	V	V	V	V	V								Z	Z	Z	Z	Z	Z	Z	Z	Z	AA			
	0.022µF	223	V	V	V	V	V								Z	Z	Z	Z	Z	Z	Z	Z	Z	AA			
	0.027µF	273	V	V	V	V									Z/AA	Z/AA	Z/AA	Z/AA	Z	Z	Z	AA	AA				
	0.033µF	333	V	V	V	V									Z/AA	Z/AA	Z/AA	Z/AA	Z		Z	AA	AA				
	0.039µF	393	V	V	V	V									Z/AA	Z/AA	Z/AA	Z/AA	Z		Z						
	0.047µF	473				K									Z	Z	Z	Z	Z	Z	Z						
	0.056µF	563				K																					
	0.068µF	683																									

* ARC PROTECTION COATING

CODE	J	K	O	Q	U	V	Z	AA
THICKNESS	0.80 ± 0.10	0.80 + 0.15/-0.10	0.95 ± 0.10	1.25 ± 0.10	1.60 ± 0.20	1.60 +0.30/-0.10	2.00 ± 0.20	2.50 ± 0.30

MS LEVEL 1

Cal-Chip Electronics Inc.
59 Steamwhistle Drive, Ivyland, PA 18974 | p. 215.942.8900 | www.calchip.com | quotes@calchip.com

CAPACITANCE RANGE

DIELECTRIC		COG																								
SIZE		1808												1812												
RATED VOLTAGE		25	50	100	200	250	500	630	1000	1500	2000	3000	4000	10	16	25	50	100	200	250	630	1000	1500	2000	3000	4000
CAPACITANCE RANGE	1.8pf	1R8																								
	2.2pf	2R2	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q												
	2.7pf	2R7	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q												
	3.3pF	3R3	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q												
	3.9pf	3R9	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q												
	4.7pf	4R7	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q												
	5.0 pF	5R0	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q												
	5.6pF	5R6	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q												
	6.8pf	6R8	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q												
	8.2pf	8R2	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q												
	10pf	100	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
	12pF	120	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
	15pF	150	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
	18pF	180	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
	22pF	220	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	U	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
	27pF	270	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	U	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
	33pF	330	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Z	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q*
	39pF	390	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Z	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q*
	47pF	470	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	U*
	56pF	560	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	U*
	68pF	680	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Z*
	82pF	820	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Z*
	100pF	101	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Z		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Z*
	120pF	121	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Z		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	AA
	150pF	151	Q	Q	Q	Q	Q	Q	Q	Q	Z	Z	Z		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	
	180pF	181	Q	Q	Q	Q	Q	Q	Q	Q	Z	Z	Z		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Z	
	220pF	221	Q	Q	Q	Q	Q	Q	Q	Q	Z	Z	Z		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Z	
	270pF	271	Q	Q	Q	Q	Q	Q	Q	Z	Z	Z	Z		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Z	
	330pF	331	Q	Q	Q	Q	Q	Q	Q	Z	Z	Z	Z		Q	Q	Q	Q	Q	Q	Q	Q	Q	Z	Z	Z	
	390pF	391	Q	Q	Q	Q	Q	Q	Q	Z	Z	Z	Z		Q	Q	Q	Q	Q	Q	Q	Q	Q	Z	Z	Z	
	470pF	471	Q	Q	Q	Q	Q	Q	Q	Z	Z	Z	Z		Q	Q	Q	Q	Q	Q	Q	Q	Q	Z	Z	Z	
	560pF	561	Q	Q	Q	Q	Q	Q	Q	Z	Z	Z			Q	Q	Q	Q	Q	Q	Q	Q	Q	Z	Z	Z	
	680pF	681	Q	Q	Q	Q	Q	Q	Q	Z	Z	Z			Q	Q	Q	Q	Q	Q	Q	Q	Q	Z	Z	Z	
	820pF	821	Q	Q	Q	Q	Q	Q	Q	Z	Z	Z			Q	Q	Q	Q	Q	Q	Q	Q	Q	Z	Z	AA	
	1000pF	102	Q	Q	Q	Q	Q	Q	Q	Z	Z	Z			Q	Q	Q	Q	Q	Q	Q	Q	Q	Z	Z	AA	
	1200pF	122	Q	Q	Q	Q	Q	Q	Q	Z	Z	Z			Q	Q	Q	Q	Q	Q	Q	Q	Q	Z	Z	CC	
	1500pF	152	Q	Q	Q	Q	Q	Q	Q	Z	Z	Z			Q	Q	Q	Q	Q	Q	Q	Q	Q	Z	Z		
	1800pF	182	Q	Q	Q	Q	Q	Q	Q	Z	Z	Z			Q	Q	Q	Q	Q	Q	Q	Q	Z	Z	Z		
	2200pF	222	Q	Q	Q	Q	Q	Q	Q	Z					Q	Q	Q	Q	Q	Q	Q	Q	U	Z	Z		
	2700pF	272	Q	Q	Q	Q	Q	Q	Q						Q	Q	Q	Q	Q	Q	Q	Q	Z	AA	AA		
	3300pF	332	Q	Q	Q	Q	Q	Q	Q						Q	Q	Q	Q	Q	Q	Q	Q	Z	AA	AA		
	3900pF	392	Q	Q	Q	Q	Q								Q	Q	Q	Q	Q	Q	Q	Q	AA				
	4700pF	472	Q	Q	Q	Q	Q								Q	Q	Q	Q	Q	Q	Q	Q	Z/AA				
	5600pF	562	Q	Q	Q	U	U								Q	Q	Q	Q	Q	Q	Q	Q	AA				
	6800pF	682	Q	Q	Q	U	U								Q	Q	Q	Q	Q	Q	Q	Q					
	8200pF	822	Q	Q	U	Z	Z								Q	Q	Q	Q	Q	Q	Q	Q					
	0.010µF	103	Q	Q	U	Z	Z								Q	Q	Q	Q	Q	Q	Q	Q					
	0.012µF	123	U	U											Q	Q	Q	Q	Q	U	U	U					
	0.015µF	153	U	U											Q	Q	Q	Q	Q	U	U	U					
	0.018µF	183	Z	Z											Q	Q	Q	Q	U	Z	Z	Z					
	0.022µF	223	Z	Z											Q	Q	Q	Q	U	Z	Z	Z					
	0.027µF	273													Q	Q	U	U	Z	AA	AA						
	0.033µF	333													Q	Q	U	U	Z								
	0.039µF	393															Z	Z	AA								
	0.047µF	473															Z	Z	AA								
	0.056µF	563															AA	AA									
	0.068µF	683															AA	AA									
	0.083µF	823															AA	AA									
	0.10µF	104															AA	AA									

* ARC PROTECTION COATING

CODE	Q	U	Z	AA	CC
THICKNESS	1.25 ± 0.10	1.60 ± 0.20	2.00 ± 0.20	2.50 ± 0.30	3.10 ± 0.30

CAPACITANCE RANGE

DIELECTRIC		COG																																		
SIZE		1825											2220											2225												
RATED VOLTAGE		25	50	100	200	250	500	630	1k	1500	2k	3k	25	50	100	200	250	500	630	1k	1500	2k	3k	4k	25	50	100	200	250	500	630	1k	1500	2k	3k	4k
CAPACITANCE RANGE	10pF	100	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z		Z	Z		Z	Z	F	F	F	F	F	F	F	F		
	12pF	120	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z		Z	Z		Z	Z	Z	Z	Z	Z	Z	Z	Z	Z		
	15pF	150	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z		Z	Z	Z	Z	Z	Z	Z	Z	Z	Z		
	18pF	180	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z		Z	Z	Z	Z	Z	Z	Z	Z	Z	Z		
	22pF	220	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z		Z	Z	Z	Z	Z	Z	Z	Z	Z	Z		
	27pF	270	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
	33pF	330	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
	39pF	390	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
	47pF	470	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
	56pF	560	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
	68pF	680	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
	82pF	820	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
	100pF	101	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
	120pF	121	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	
	150pF	151	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	
	180pF	181	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	
	220pF	221	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	
	270pF	271	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	AA	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	
	330pF	331	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	AA	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	
	390pF	391	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z		Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	
	470pF	471	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z		Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	
	560pF	561	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z		Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	
	680pF	681	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z		Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	
	820pF	821	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z		Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	
	1000pF	102	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z		Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	
	1200pF	122	Z	Z	Z	Z	Z	Z	Z	Z	Z			Z	Z	Z	Z	Z	Z	Z	Z	Z	Z		Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	
	1500pF	152	Z	Z	Z	Z	Z	Z	Z	Z	Z			Z	Z	Z	Z	Z	Z	Z	Z	Z	Z		Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	
	1800pF	182	Z	Z	Z	Z	Z	Z	Z	Z	Z			Z	Z	Z	Z	Z	Z	Z	Z	Z			Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	
	2200pF	222	Z	Z	Z	Z	Z	Z	Z	Z	Z			Z	Z	Z	Z	Z	Z	Z	Z	Z			Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	
	2700pF	272	Z	Z	Z	Z	Z	Z	Z	Z	Z			Z	Z	Z	Z	Z	Z	Z	Z	Z			Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	AA	
	3300pF	332	Z	Z	Z	Z	Z	Z	Z	Z	Z			Z	Z	Z	Z	Z	Z	Z	Z	Z			Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	AA	
	3900pF	392	Z	Z	Z	Z	Z	Z	Z	Z	Z			Z	Z	Z	Z	Z	Z	Z	Z	Z			Z	Z	Z	Z	Z	Z	Z	Z	Z	Z		
	4700pF	472	Z	Z	Z	Z	Z	Z	Z	Z	Z			Z	Z	Z	Z	Z	Z	Z	Z	Z			Z	Z	Z	Z	Z	Z	Z	Z	Z	Z		
	5600pF	562	Z	Z	Z	Z	Z	Z	Z	Z				Z	Z	Z	Z	Z	Z	Z	Z				Z	Z	Z	Z	Z	Z	Z	Z	Z	Z		
	6800pF	682	Z	Z	Z	Z	Z	Z	Z	Z				Z	Z	Z	Z	Z	Z	Z	Z				Z	Z	Z	Z	Z	Z	Z	Z	Z	Z		
	8200pF	822	Z	Z	Z	Z	Z	Z	Z	AA				Z	Z	Z	Z	Z	Z	Z	AA				Z	Z	Z	Z	Z	Z	Z	Z	AA	AA		
	0.01µF	103	Z	Z	Z	Z	Z	Z	Z	AA				Z	Z	Z	Z	Z	Z	Z	AA				Z	Z	Z	Z	Z	Z	Z	AA	AA	AA		
	0.012µF	123	Z	Z	Z	Z	Z	Z	Z					Z	Z	Z	Z	Z	Z	Z					Z	Z	Z	Z	Z	Z	Z					
	0.015µF	153	Z	Z	Z	Z	Z	Z	Z					Z	Z	Z	Z	Z	Z	Z					Z	Z	Z	Z	Z	Z	Z					
	0.018µF	183	Z	Z	Z	Z	Z	Z	Z					Z	Z	Z	Z	Z	Z	Z					Z	Z	Z	Z	Z	Z	Z					
	0.022µF	223	Z	Z	Z	Z	Z	Z	Z					Z	Z	Z	Z	Z	Z	Z					Z	Z	Z	Z	Z	Z	Z					
	0.027µF	273	Z	Z	Z	Z	Z	Z	Z					Z	Z	Z	Z	Z	Z	Z					Z	Z	Z	Z	Z	Z	Z					
	0.033µF	333	Z	Z	Z	Z	Z	Z	Z					Z	Z	Z	Z	Z	Z	U/Z					Z	Z	Z	Z	Z	Z	Z					
	0.039µF	393	Z	Z	U	Z	Z	AA	AA					Z	Z	Z	Z	Z	Z	U/Z					Z	Z	Z	Z	Z	Z	Z					
	0.047µF	473	Z	Z	Z	Z	Z							Z	Z	Z	AA	AA	AA	U/Z					Z	Z	Z	Z	Z	Z	Z					
	0.056µF	563	Z	Z	Z	AA	AA							Z	Z	Z	AA	AA		Z					Z	Z	Z	AA	AA	AA	AA					
	0.068µF	683	Z	Z	Z	AA	AA							Z	Z	Z	AA	AA		Z					Z	Z	Z	AA	AA	AA	AA					
	0.082µF	823	Z	Z	AA									Z	Z	AA				Z					Z	Z	Z	AA	AA	AA						
	0.1µF	104	AA	AA	AA									AA	AA	AA				AA					Z	Z	AA	AA	AA							
	0.12µF	124																																		
	0.15µF	154																																		
	0.18µF	184																																		
	0.22µF	224																																		
	0.27µF	274																																		
	0.33µF	334																																		

* ARC PROTECTION COATING

CODE	F	U	Z	AA
THICKNESS	0.50 ± 0.10 mm	1.60 ± 0.20	2.00 ± 0.20	2.50 ± 0.30

MS LEVEL 1

Cal-Chip Electronics Inc.
59 Steamwhistle Drive, Ivyland, PA 18974 | p. 215.942.8900 | www.calchip.com | quotes@calchip.com

CAPACITANCE RANGE

DIELECTRIC			X7R																													
SIZE			0402							0603									0805													
RATED VOLTAGE			6.3	10	16	25	35	50	100	6.3	10	16	25	35	50	100	200	250	6.3	10	16	25	50	100	200	250	500	630	1000
CAPACITANCE RANGE	100pf	101		G	G	G		G	G		I	I	I	I	I	I	K	K		Q	Q	Q	Q	Q	Q	Q	N	N	N
	120pf	121		G	G	G		G	G		I	I	I	I	I	I	K	K		Q	Q	Q	Q	Q	Q	Q	N	N	N
	150pf	151		G	G	G		G	G		I	I	I	I	I	I	K	K		Q	Q	Q	Q	Q	Q	Q	N	N	N
	180pf	181		G	G	G		G	G		I	I	I	I	I	I	K	K		Q	Q	Q	Q	Q	Q	Q	N	N	N
	220pf	221		G	G	G		G	G		I	I	I	I	I	I	K	K		Q	Q	Q	Q	Q	Q	Q	N	N	N
	270pf	271		G	G	G		G	G		I	I	I	I	I	I	K	K		Q	Q	Q	Q	Q	Q	Q	N	N	N
	330pf	331		G	G	G		G	G		I	I	I	I	I	I	K	K		Q	Q	Q	Q	Q	Q	Q	N	N	N
	390	391		G	G	G		G	G		I	I	I	I	I	I	K	K		Q	Q	Q	Q	Q	Q	Q	N	N	N
	470pf	471		G	G	G		G	G		I	I	I	I	I	I	K	K		Q	Q	Q	Q	Q	Q	Q	N	N	N
	560pf	561		G	G	G		G	G		I	I	I	I	I	I	K	K		Q	Q	Q	Q	Q	Q	Q	N	N	N
	680pf	681		G	G	G		G	G		I	I	I	I	I	I	K	K		Q	Q	Q	Q	Q	Q	Q	N	N	N
	820pf	821		G	G	G		G	G		I	I	I	I	I	I	K	K		Q	Q	Q	Q	Q	Q	Q	N	N	N
	1,000pf	102		G	G	G		G	G		I	I	I	I	I	I	K	K		Q	Q	Q	Q	Q	Q	Q	N	N	N
	1,200pf	122		G	G	G		G	G		I	I	I	I	I	I	K	K		Q	Q	Q	Q	Q	Q	Q	N	N	N
	1,500pf	152		G	G	G		G	G		I	I	I	I	I	I	K	K		Q	Q	Q	Q	Q	Q	Q	N	N	Q
	1,800pf	182		G	G	G		G	G		I	I	I	I	I	I	K	K		Q	Q	Q	Q	Q	Q	Q	N	N	Q
	2,200pf	222		G	G	G		G	G		I	I	I	I	I	I	K	K		Q	Q	Q	Q	Q	Q	Q	N	N	Q
	2,700pf	272		G	G	G		G	G		I	I	I	I	I	I	K	K		Q	Q	Q	Q	Q	Q	Q	N	N	
	3,300pf	332		G	G	G		G	G		I	I	I	I	I	I	K	K		Q	Q	Q	Q	Q	Q	Q	N	N	
	3,900pf	392		G	G	G		G	G		I	I	I	I	I	I	K	K		Q	Q	Q	Q	Q	Q	Q	N	N	
	4,700pf	472		G	G	G		G	G		I	I	I	I	I	I	K	K		Q	Q	Q	Q	Q	Q	Q	Q	Q	
	5,600pf	562		G	G	G		G			I	I	I	I	I	I	K	K		Q	Q	Q	Q	Q	Q	Q	Q	Q	
	6,800pf	682		G	G	G		G			I	I	I	I	I	I	K	K		Q	Q	Q	Q	Q	Q	Q	Q	Q	
	8,200pf	822		G	G	G		G			I	I	I	I	I	I	K	K		Q	Q	Q	Q	Q	Q	Q	Q	Q	
	0.01µF	103		G	G	G		G			I	I	I	I	I	I	K	K		Q	Q	Q	Q	Q	Q	Q	Q	Q	
	0.012µF	123		G	G	G					I	I	I	I	I	K				Q	Q	Q	Q	Q	Q	Q	Q	Q	
	0.015µF	153		G	G	G					I	I	I	I	I	K				Q	Q	Q	Q	Q	Q	Q	Q	Q	
	0.018µF	183		G	G	G					I	I	I	I	I	K				Q	Q	Q	Q	Q	Q	Q	Q	Q	
	0.022µF	223		G	G	G					I	I	I	I	I	K				Q	Q	Q	Q	Q	Q	Q	Q	Q	
	0.027µF	273		G	G	G					I	I	I	I	I	K				Q	Q	Q	Q	Q	Q	Q	Q	Q	
	0.033µF	333		G	G	G					I	I	I	K	K	K				Q	Q	Q	Q	Q	Q	Q	Q		
	0.039µF	393		G	G	G					I	I	I	K	K	K				Q	Q	Q	Q	Q	Q	Q			
	0.047µF	473		G	G	G					I	I	I	K	K	K				Q	Q	Q	Q	Q	Q	Q			
	0.056µF	563		G	G						I	I	I	K	K	K				Q	Q	Q	Q	Q	Q	Q			
	0.068µF	683		G	G						I	I	I	K	K	K				Q	Q	Q	Q	Q	Q	Q			
	0.082µF	823		G	G						I	I	I	K	K	K				Q	Q	Q	Q	Q	Q	Q			
	0.1µF	104	G	G	G						I	I	I	K	K	K				Q	Q	Q	Q	Q	Q				
	0.12µF	124									I	I	K							Q	Q	Q	Q	R					
	0.15µF	154									I	I	K							Q	Q	Q	Q	R					
	0.18µF	184									I	I	K							Q	Q	Q	Q	R					
	0.22µF	224									I	I	K	K	K					Q	Q	Q	Q	R					
	0.27µF	274								K	K	K	K							R	R	R	R						
	0.33µF	334									K	K	K							R	R	R	R						
	0.39µF	394									K	K	K							R	R	R	R						
	0.47µF	474								K	K	K	K							R	R	R	R	R					
	0.56µF	564									K	K								R	R	R	R						
	0.68µF	684								K	K	K								R	R	R							
	0.82µF	824									K	K								R	R	R							
	1µF	105								K	K	K	K	N						R	R	R	R						
	1.2µF	125									K	K	K	K	K														
	1.5µF	155									K	K	K	K	K					R	R	R							
	2.2µF	225									K	K	K	K	K				R	R	R	R							
	4.7µF	475																	R	R	R	R							
	10µF	106								L#	L#								S	S									

* ARC PROTECTION COATING
# - L: 1.6 ± 0.3 W: 0.8 ± 0.3

CODE	G	I	N	K	L	Q	R	S
THICKNESS	0.50 ± 0.20	0.80 ± 0.07	0.80 ± 0.10	0.8 + 0.15/-0.10	0.8 ± 0.25	1.25 ± 0.10	1.25 ± 0.20	1.25 ± 0.30

CAPACITANCE RANGE

DIELECTRIC		X7R																									
SIZE		1206													1210												
RATED VOLTAGE		6.3	10	16	25	50	100	200	250	500	630	1000	1500	2000	6.3	10	16	25	50	100	200	250	500	630	1000	1500	2000
100pf	101							Q	Q	Q	Q	Q	Q	Q													
120pf	121							Q	Q	Q	Q	Q	Q	Q													
150pf	151		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q													
180pf	181		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q													
220pf	221		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q				O	O	O	O	O	O	O	O	O	M
270pf	271		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q				O	O	O	O	O	O	O	O	O	M
330pf	331		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q				O	O	O	O	O	O	O	O	O	M
390	391		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q				O	O	O	O	O	O	O	O	O	M
470pf	471		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q				O	O	O	O	O	O	O	O	O	M
560pf	561		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q				O	O	O	O	O	O	O	O	O	M
680pf	681		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q				O	O	O	O	O	O	O	O	O	M
820pf	821		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q				O	O	O	O	O	O	O	O	O	M
1,000pf	102		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	O	O	O	O	O	O	O	O	O	O	O	Q	Q
1,200pf	122		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	U	U	O	O	O	O	O	O	O	O	O	O	O	U	U
1,500pf	152		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	U	U	O	O	O	O	O	O	O	O	O	O	O	U	U
1,800pf	182		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	U	U	O	O	O	O	O	O	O	O	O	O	O	U	U
2,200pf	222		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	U	U	O	O	O	O	O	O	O	O	O	O	O	Z	Z
2,700pf	272		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	U	U	O	O	O	O	O	O	O	O	O	O	O	Z	AA
3,300pf	332		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	U	U	O	O	O	O	O	O	O	O	O	O	O	Z	AA
3,900pf	392		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	U		O	O	O	O	O	O	O	O	O	O	O	AA	AA
4,700pf	472		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	U		O	O	O	O	O	O	O	O	O	O	O	Z/AA	Z/AA
5,600pf	562		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	U		O	O	O	O	O	O	O	O	O	O	O	AA	AA*
6,800pf	682		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	U		O	O	O	O	O	O	O	O	O	O	O	AA	AA*
8,200pf	822		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	U		O	O	O	O	O	O	O	O	O	O	O	AA	AA*
0.01µF	103		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	U		O	O	O	O	O	O	O	O	O	O	Q	AA	AA*
0.012µF	123		Q	Q	Q	Q	Q	Q	Q	Q	Q	U			O	O	O	O	O	O	O	O	O	O	Q	AA	
0.015µF	153		Q	Q	Q	Q	Q	Q	Q	Q	Q	U			O	O	O	O	O	O	O	O	O	O	U	AA	
0.018µF	183		Q	Q	Q	Q	Q	Q	Q	Q	Q				O	O	O	O	O	O	O	O	Q	Q	U	AA	
0.022µF	223		Q	Q	Q	Q	Q	Q	Q	U	U				O	O	O	O	O	O	O	O	Q	Q	U	AA	
0.027µF	273		Q	Q	Q	Q	Q	Q	Q	U	U				O	O	O	O	O	O	O	O	Q	Q	U	AA	
0.033µF	333		Q	Q	Q	Q	Q	U	U	U	U				O	O	O	O	O	O	O	O	U	U	U	AA	
0.039µF	393		Q	Q	Q	Q	Q	U	U	U	U				O	O	O	O	O	O	O	O	U	U	Z		
0.047µF	473		Q	Q	Q	Q	Q	U	U	U	U				O	O	O	O	O	O	Q	Q	U	U	AA		
0.056µF	563		Q	Q	Q	Q	Q	U	U	U	U				O	O	O	O	O	O	Q	Q	U	U			
0.068µF	683		Q	Q	Q	Q	Q	U	U						O	O	O	O	O	O	U	U	Z	Z			
0.082µF	823		Q	Q	Q	Q	Q	U	U						O	O	O	O	O	O	U	U	Z	Z			
0.1µF	104		Q	Q	Q	Q	Q	U	U						O	O	O	O	O	O	Y	Y	Z	Z			
0.12µF	124		Q	Q	Q	Q	Q								O	O	O	O	O	O	U	U	AA	AA			
0.15µF	154		O	O	O	O	U								O	O	O	O	O	Q	U	U	AA	AA			
0.18µF	184		O	O	O	O	U								O	O	O	O	O	Q	U	U					
0.22µF	224		O	O	O	O	U	U	U						O	O	O	O	O	Q	Q/U	Q/U					
0.27µF	274		O	O	O	Q	U								O	O	O	O	O	U	Z	Z					
0.33µF	334		O	O	O	Q	U								O	O	O	O	Q	U	Z	Z					
0.39µF	394		O	O	P	V	U								O	O	O	O	Q	AA	AA	AA					
0.47µF	474		P	P	P	V	U								O	O	O	O	Q	AA	AA	AA					
0.56µF	564		P	P	P	V	V								Q	Q	Q	Q	Q	AA	AA	AA					
0.68µF	684		P	P	P	V	V								Q	Q	Q	Q	Q	Z	AA	AA					
0.82µF	824		P	P	P	V	V								Q	Q	Q	Q	Q	Z							
1.0µF	105		P	P	P	V	V								Q	Q	Q	Q	Q	Z							
1.2µF	125				V	V	V																				
1.5µF	155	P	P	P	V	V	V										Z	U	AA	AA							
1.8µF	185				V	V	V																				
2.2µF	225	P	P	P	V	V	U										Z	U	AA	AA							
2.7µF	275				V	V																					
3.3µF	335		V	V	V	V											Z	U	AA	AA							
3.9µF	395				V	V																					
4.7µF	475	V	V	V	V	V									Z	Z	Z	Z	AA	AA							
10µF	106	V	V	V	V										Z	Z	Z	AA	AA								
22µF	226		V												AA	AA	AA										
47µF	476														AA	AA											

CAPACITANCE RANGE

* ARC PROTECTION COATING

CODE	O	P	Q	U	V	Y	Z	AA
THICKNESS	0.95 ± 0.10	1.15 ± 0.15	1.25 ± 0.10	1.60 ± 0.20	1.60 +0.3/-0.10	1.90 ± 0.20	2.00 ± 0.20	2.50 ± 0.30

MS LEVEL 1

Cal-Chip Electronics Inc.
59 Steamwhistle Drive, Ivyland, PA 18974 | p. 215.942.8900 | www.calchip.com | quotes@calchip.com

CAPACITANCE RANGE

DIELECTRIC		X7R																							
SIZE		1808							1812																
RATED VOLTAGE		500	630	1000	1500	2000	3000	4000	10	16	25	50	100	200	250	400	500	630	1000	1500	2000	3000	4000		
150pf	151	Q	Q	Q	Q	Q	Q	Z*																	
180pf	181	Q	Q	Q	Q	Q	Q	Z*																	
220pf	221	Q	Q	Q	Q	Q	Q	Z*																	
270pf	271	Q	Q	Q	Q	Q	Q	Z*	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Z*		
330pf	331	Q	Q	Q	Q	Q	Q	Z*	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Z*		
390	391	Q	Q	Q	Q	Q	Q	Z*	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Z*		
470pf	471	Q	Q	Q	Q	Q	Q	Z*	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Z*		
560pf	561	Q	Q	Q	Q	Q	U	Z*	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Z*		
680pf	681	Q	Q	Q	Q	Q	U	Z*	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Z*		
820pf	821	Q	Q	Q	Q	Q	U	Z*	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Z*		
1,000pf	102	Q	Q	Q	Q	Q	Z	Z*	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	U	Z*		
1,200pf	122	Q	Q	Q	Q	Q	Z		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Z	G*		
1,500pf	152	Q	Q	Q	Q	Q	Z		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Z	G*		
1,800pf	182	Q	Q	Q	Q	Q	Z		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	AA	G*		
2,200pf	222	Q	Q	Q	U	U	Z		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	G*			
2,700pf	272	Q	Q	Q	Z	Z	Z		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	G*			
3,300pf	332	Q	Q	Q	Z	Z	Z		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	U	U	G*			
3,900pf	392	Q	Q	Q	Z	Z	Z*		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Z	Z	G*			
4,700pf	472	Q	Q	Q	Z	Z	Z*		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Z	Z	G*			
5,600pf	562	Q	Q	Q	Z	Z	Z*		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	AA	AA				
6,800pf	682	Q	Q	Q	Z	Z	Z*		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	AA	AA				
8,200pf	822	Q	Q	Q	Z*	Z*	Z*		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	AA	AA				
0.01µF	103	Q	Q	Q	Z*	Z*	Z*		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	U/Z/AA	U/Z/AA				
0.012µF	123	U	U	U					Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	U/Z/AA					
0.015µF	153	U	U	U					Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	U/Z/AA					
0.018µF	183	Z	Z	Z					Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	U	U/Z/AA					
0.022µF	223	Z	Z	Z					Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	U	Z/AA					
0.027µF	273	Z	Z	Z					Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Z						
0.033µF	333	Z	Z	Z					Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Z						
0.039µF	393	Z	Z	Z					Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	AA						
0.047µF	473	Z	Z	Z					Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Z/AA						
0.056µF	563	Z	Z	Z					Q	Q	Q	Q	Q	Q	Q	Q	U	U	AA						
0.068µF	683	Z	Z						Q	Q	Q	Q	Q	Q	Q	Q	U	U	AA						
0.082µF	823	Z	Z						Q	Q	Q	Q	Q	Q	Q	Q	U	U	AA						
0.1µF	104								Q	Q	Q	Q	Q	Q	Q	Q	U	U	AA						
0.12µF	124								Q	Q	Q	Q	Q	Q	Q	Q	Z	Z							
0.15µF	154								Q	Q	Q	Q	Q	Q	Q	Q	Z	Z							
0.18µF	184								Q	Q	Q	Q	Q	Q	Q	Q	AA	AA							
0.22µF	224								Q	Q	Q	Q	Q	Q	Q	Q	AA	AA							
0.27µF	274								Q	Q	Q	Q	Q	U	U	U	AA								
0.33µF	334								Q	Q	Q	Q	Q	U	U	U	AA								
0.39µF	394								Q	Q	Q	Q	Q	Z	Z	Z	AA								
0.47µF	474								Q	Q	Q	Q	Q	Z	Z	Z	AA								
0.56µF	564								Q	Q	Q	Q	Q	AA	AA										
0.68µF	684								Q	Q	Q	Q	Q	AA	AA										
0.82µF	824								Q	Q	Q	Q	Q	AA	AA										
1.0µF	105								Q	Q	Q	Q	Q	AA	AA										
1.2µF	125								Q	Q	Q	Q	Q												
1.5µF	155								Q	Q	Q	Q	Q												
1.8µF	185								U	U	U	U	U												
2.2µF	225								U	U	U	U	U												
2.7µF	275								Z	Z	Z	Z	Z												
3.3µF	335								Z	Z	Z	Z	Z												
3.9µF	395								Z	Z	Z	Z	Z												
4.7µF	475								AA	AA	AA	AA	AA												
5.6µF	565								AA	AA	AA	AA													
6.8µF	685								AA	AA	AA	AA													
8.2µF	825								AA	AA	AA	AA													
10µF	106								AA	AA	AA	AA													
12µF	126								AA	AA	AA														
15µF	156								AA	AA	AA														
18µF	186								AA	AA	AA														

CAPACITANCE RANGE

* ARC PROTECTION COATING

CODE	Q	U	Z	AA
THICKNESS	1.25 ± 0.10	1.60 ± 0.20	2.00 ± 0.20	2.50 ± 0.30

Cal-Chip Electronics Inc.
59 Steamwhistle Drive, Ivyland, PA 18974 | p. 215.942.8900 | www.calchip.com | quotes@calchip.com

CAPACITANCE RANGE

DIELECTRIC		X7R																																			
SIZE		1825												2220													2225												
RATED VOLTAGE		25	50	100	200	250	500	630	1k	1.5k	2k	3k	4k	25	50	100	200	250	400	500	630	1k	1.5k	2k	3k	4k	25	50	100	200	250	500	630	1k	1.5k	2k	3k	4k	5k
270pf	271												Z*													Z*												Z*	Z*
330pf	331												Z*													Z*												Z*	Z*
390	391												Z*													Z*												Z*	Z*
470pf	471												Z*													Z*												Z*	Z*
560pf	561												Z*													Z*												Z*	Z*
680pf	681												Z*													Z*												Z*	Z*
820pf	821												Z*													Z*												Z*	Z*
1,000pf	102	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z*	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z*	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z*	Z*	Z*
1,200pf	122	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	AA*	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	AA*	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z*	AA*	Z*
1,500pf	152	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	AA*	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	AA*	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z*	AA*	Z*
1,800pf	182	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	AA*	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	AA*	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z*	AA*	Z*
2,200pf	222	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z*		Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z*		Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z*		Z*
2,700pf	272	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z*		Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z*		Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z*		Z*
3,300pf	332	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z*		Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z*		Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z*		Z*
3,900pf	392	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z*		Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z*		Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z*		Z*
4,700pf	472	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z*		Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z*		Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z*		Z/ AA*
5,600pf	562	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	AA*		Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z*		Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	AA*		
6,800pf	682	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	AA*		Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	AA*		Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	AA*		
8,200pf	822	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	AA*		Z	Z	Z	Z	Z	Z	Z	Z	Z	AA	AA	AA*		Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	AA*		
0.01µF	103	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	AA*		Z	Z	Z	Z	Z	Z	Z	Z	Z	Z/AA	Z/AA	AA*		Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	AA*		
0.012µF	123	Z	Z	Z	Z	Z	Z	Z	Z	AA	AA	BB*		Z	Z	Z	Z	Z	Z	Z	Z	Z	AA	AA	BB*		Z	Z	Z	Z	Z	Z	Z	Z	AA	AA	AA*		
0.015µF	153	Z	Z	Z	Z	Z	Z	Z	Z	AA	AA	BB*		Z	Z	Z	Z	Z	Z	Z	Z	Z	AA	AA	BB*		Z	Z	Z	Z	Z	Z	Z	Z	AA	AA	AA*		
0.018µF	183	Z	Z	Z	Z	Z	Z	Z	Z	AA	AA	BB*		Z	Z	Z	Z	Z	Z	Z	Z	Z	BB	BB	BB*		Z	Z	Z	Z	Z	Z	Z	Z	AA	AA	BB*		
0.022µF	223	Z	Z	Z	Z	Z	Z	Z	Z	AA	AA			Z	Z	Z	Z	Z	Z	Z	Z	Z	BB	BB			Z	Z	Z	Z	Z	Z	Z	Z	Z/AA	Z/AA			
0.027µF	273	Z	Z	Z	Z	Z	Z	Z	Z	BB	BB			Z	Z	Z	Z	Z	Z	Z	Z	Z	BB	BB			Z	Z	Z	Z	Z	Z	Z	Z	AA	AA			
0.033µF	333	Z	Z	Z	Z	Z	Z	Z	Z	BB	BB			Z	Z	Z	Z	Z	Z	Z	Z	Z	BB	BB			Z	Z	Z	Z	Z	Z	Z	Z	AA	AA			
0.039µF	393	Z	Z	Z	Z	Z	Z	Z	Z	BB	BB			Z	Z	Z	Z	Z	Z	Z	Z	Z	BB	BB			Z	Z	Z	Z	Z	Z	Z	Z	AA	BB			
0.047µF	473	Z	Z	Z	Z	Z	Z	Z	Z	BB	BB			Z	Z	Z	Z	Z	Z	Z	Z	Z	BB	BB			Z	Z	Z	Z	Z	Z	Z	Z	AA	BB			
0.056µF	563	Z	Z	Z	Z	Z	Z	Z	Z	BB				Z	Z	Z	Z	Z	Z	Z	Z	Z	BB	BB			Z	Z	Z	Z	Z	Z	Z	Z	AA	BB			
0.068µF	683	Z	Z	Z	Z	Z	Z	Z	Z					Z	Z	Z	Z	Z	Z	Z	Z	Z					Z	Z	Z	Z	Z	Z	Z	Z	AA				
0.082µF	823	Z	Z	Z	Z	Z	Z	Z	Z					Z	Z	Z	Z	Z	Z	Z	Z	Z					Z	Z	Z	Z	Z	Z	Z	Z	AA				
0.1µF	104	Z	Z	Z	Z	Z	Z	Z	AA					Z	Z	Z	Z	Z	Z	Z	Z	AA	Z	Z			Z	Z	Z	Z	Z	Z	Z	AA	AA	AA			
0.12µF	124	Z	Z	Z	Z	Z	Z	Z						Z	Z	Z	Z	Z	Z	Z	Z	AA					Z	Z	Z	Z	Z	Z	Z	BB					
0.15µF	154	Z	Z	Z	Z	Z	Z	Z						Z	Z	Z	Z	Z	Z	Z	Z	BB					Z	Z	Z	Z	Z	Z	Z	BB					
0.18µF	184	Z	Z	Z	Z	Z	Z	Z						Z	Z	Z	Z	Z	Z	Z	Z	BB					Z	Z	Z	Z	Z	Z	Z	BB					
0.22µF	224	Z	Z	Z	Z	Z	Z	Z						Z	Z	Z	Z	Z	Z	Z	Z	BB					Z	Z	Z	Z	Z	Z	Z	BB					
0.27µF	274	Z	Z	Z	Z	Z	Z	Z						Z	Z	Z	Z	Z	Z	Z	Z						Z	Z	Z	Z	Z	Z	Z	Z/AA/ BB					
0.33µF	334	Z	Z	Z	Z	Z	Z	Z						Z	Z	Z	Z	Z	Z	Z	Z						Z	Z	Z	Z	Z	Z	Z	Z/AA/ BB					
0.39µF	394	Z	Z	Z	Z	Z	Z	Z						Z	Z	Z	Z	Z	Z	Z	Z						Z	Z	Z	Z	Z	Z	Z						
0.47µF	474	Z	Z	Z	Z	Z	Z	Z						Z	Z	Z	Z	Z	Z	Z	Z						Z	Z	Z	Z	Z	Z	Z						
0.56µF	564	Z	Z	Z	Z	Z	AA	AA						Z	Z	Z	Z	Z	AA	AA	AA						Z	Z	Z	Z	Z	Z	Z						
0.68µF	684	Z	Z	Z	Z	Z								Z	Z	Z	Z	Z	AA	AA	AA						Z	Z	Z	Z	Z								
0.82µF	824	Z	Z	Z	Z	Z								Z	Z	Z	Z	Z	BB	BB	BB						Z	Z	Z	Z	Z								
1µF	105	Z	Z	Z	Z	Z								Z	Z	Z	Z	Z	BB	BB	BB						Z	Z	Z	Z	Z								
1.2µF	125	Z	Z	Z	AA									Z	Z	Z	AA	AA									Z	Z	Z	AA	AA								
1.5µF	155	Z	Z	Z	AA									Z	Z	Z	AA	AA									Z	Z	Z	AA	AA								
1.8µF	185	Z	Z	Z	AA									Z	Z	Z	AA	AA									Z	Z	Z	AA	AA								
2.2µF	225	Z	Z	Z	AA									Z	Z	Z	AA	AA									Z	Z	Z	AA	AA								
2.7µF	275	Z	Z	Z										Z	Z	Z											Z	Z	Z	AA	AA								
3.3µF	335	Z	Z	Z										Z	Z	Z											Z	Z	Z										
3.9µF	395	Z	Z	Z										Z	Z	Z											Z	Z	Z										
4.7µF	475	Z	Z	Z										Z	Z	Z											Z	Z	Z										
5.6µF	565	Z	Z	Z										Z	Z	Z											Z	Z	Z										
6.8µF	685	Z	Z	Z										Z	Z	Z											Z	Z	Z										
8.2µF	825	AA	AA	AA										AA	AA	AA											AA	AA	AA										
10µF	106	AA	AA	AA										AA	AA	AA											AA	AA	AA										
12µF	126													BB	BB												Z/AA												
15µF	156													BB	BB												Z/AA												
18µF	186													BB	BB																								
22µF	226													BB	BB																								
27µF	276													BB	BB																								
33µF	336													BB	BB																								
39µF	396													BB	BB																								
47µF	476													DD	DD																								

CAPACITANCE RANGE

* ARC PROTECTION COATING

CODE	Z	AA	BB	DD
THICKNESS	2.00 ± 0.20	2.50 ± 0.30	2.80 ± 0.30	3.10 ± 0.30

MS LEVEL 1 RoHS Pb HF

Cal-Chip Electronics Inc.

CAPACITANCE RANGE

X7S

DIELECTRIC		X7S																																				
SIZE		0402					0603							0805						1206							1210						2220					
RATED VOLTAGE		6.3	10	16	25	35	6.3	10	16	25	35	50	100	6.3	10	16	25	50	100	6.3	10	16	25	50	100	1K	2K	6.3	10	16	25	50	100	50	100	2K
470pF	471																										II										
1000pF	102																									GG											
2200pF	222																																				
4700pF	472																																				
0.01µF	103																																				AA
0.033µF	333																																				
0.047µF	473											FF	FF																								
0.068µF	683																																				
0.1µF	104											FF	FF																								
0.15µF	154																																				
0.22µF	224																	Q	R																		
0.33µF	334																																				
0.47µF	474	G	G															R	R																		
0.68µF	684																																				
1µF	105							K	K									II	II																		
1.5µF	155																																				
2.2µF	225								K															W	W												
3.3µF	335						K																												KK		
4.7µF	475						K								II	II	II	II						W	W									AA	AA		
6.8µF	685																																				
10µF	106														H	H	H						KK	KK									AA	AA		AA	
22µF	226																				W	KK										JJ					
27µF	276																																				
33µF	336																																				
39µF	396																																				
47µF	476																																				
100µF	107																																				

CODE	G	H	FF	K	GG	Q	R	II	W	KK	AA	JJ
THICKNESS	0.50 ± 0.20	0.60 ± 0.20	0.7 ± 0.20	0.8 + 0.15/-0.10	0.8 ± 0.2	1.25 ± 0.10	1.25 ± 0.20	1.25 ± 0.25	1.6 ± 0.3	1.80 ± 0.20	2.50 ± 0.30	2.55 ± 0.3

X5R

DIELECTRIC		X5R																								
SIZE		0402					0603						0805						1206					1210				
RATED VOLTAGE		6.3	10	16	25	35	6.3	10	16	25	35	50	6.3	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50
1000pF	102											K															
2200pF	222											K															
4700pF	472											K															
0.033µF	333			G																							
0.047µF	473			G																							
0.068µF	683		G	G																							
0.1µF	104	G	G	G	G																						
0.15µF	154	G	G	G	G																						
0.22µF	224	G	G	G	G				M	M																	
0.33µF	334	G	G				M	M	M	M																	
0.47µF	474	G	G		G	G		M	M	M																	
0.68µF	684	G	G				M	M	M	M																	
1µF	105	G	G		G	G	M	M	FF					S	S	S											
1.5µF	155						M						S	S	S	S			P	P				Z	Z		
2.2µF	225				G	G	M	M	M	K		K	S	S	S	S			P	P	X			Z	Z		
3.3µF	335						M						S	S	S	S			X	X	X						
4.7µF	475	G	G				M	K	GG									X	X	X	X			Z	Z	Z	
6.8µF	685																	X	X								
10µF	106	G					GG	GG					II	II	R	R		X	X	X	X		Z	Z	Z		
22µF	226	EE					FF	HH					II	II							U	U					
33µF	336																										
47µF	476																										
100µF	107																	W									

CODE	G	EE	FF	GG	HH	K	M	P	U	W	X	II	S	Z
THICKNESS	0.50 ± 0.20	0.60 ± 0.20	0.7 ± 0.20	0.8 ± 0.2	0.8 ± 0.25	0.8 + 0.15/-0.10	0.80 ± 0.3	1.15 ± 0.15	1.60 ± 0.20	1.6 ± 0.3	1.6 ± 0.5	1.25 ± 0.25	1.25 ± 0.30	2.00 ± 0.20

RELIABILITY TEST CONDITIONS AND REQUIREMENTS

1. Visual and Mechanical

TEST CONDITION: ---

REQUIREMENTS:
- No remarkable damage.
- Dimensions to conform to individual specification sheet.

2. Capacitance

REQUIREMENTS:
- Shall not exceed the limits given in the detailed spec.

3. Q/D.F (Dissipation Factor)

TEST CONDITION:

- Class I :
  Cap.≤1000pF, 1.0±0.2Vrms, 1MHz±10%.
  Cap.>1000pF, 1.0±0.2Vrms, 1KHz±10%.
- Class II :
  Cap.≤10μF, 1.0±0.2Vrms, 1KHz±10%**.
  Cap.>10μF, 0.5±0.2Vrms, 120Hz±20%.

** Test condition: 0.5±0.2Vrms, 1KHz±10%

- X7R:
  0805 - 106 (6.3V), 0603/475 (6.3V)
- X7S:
  0805 - 106 (6.3V), 0603/475 (6.3V)

-X5R-
0402≥475 (6.3V,16V), 0402≥225(10V),
0603=106 (6.3V)
#1 Excluding
GMX04X5R475M6R3NT (1.0±0.2Vrms, 1KHz±10%)

*Before initial measurement (Class II only) : To apply deaging at 150°C for 1hr then set for 24±2 hrs at room temp

REQUIREMENTS:

- Class I :

DIELECTRIC	RATED VOL.	Q/D. F	REMARK
Class 1	All	Q≥1000	Cap.≥30pF
		Q≥400+20C	Cap.<30pF

- Class II:

RATED	D.F.≤	EXCEPTION OF D.F.≤	
≥100V	≤2.5%	≤3.5%	0603≥0.047μF, 0805=0.1μF, 1206≥0.47μF, 1812≥4.7μF, 1825≥4.7μF, 2220≥4.7μF, 2225≥4.7μF
		≤5%	0603≥0.068μF, 0805>0.1μF, 1206>1μF, 1210≥2.2μF
		≤10%	0805>0.22μF, 1210≥3.3μF
50V	≤2.5%	≤3.5%	0603≥0.047μF, 0805≥0.1μF, 1206≥0.47μF, 1210≥2.2μF, 1812≥4.7μF, 1825≥4.7μF, 2220≥4.7μF, 2225≥4.7μF
		≤5%	1210≥4.7μF
		≤10%	0402≥0.1μF, 0603>0.1μF, 0805≥1μF, 1206≥2.2μF, 1210≥10μF
35V	≤3.5%	≤10%	0603≥1μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥10μF
25V	≤3.5%	≤5%	0805≥1μF, 1210≥10μF
		≤7%	0603≥0.33μF, 1206≥4.7μF
		≤10%	0402≥0.10μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥6.8μF, 1210≥22μF
		≤12.5%	0402≥0.47μF
16V	≤3.5%	≤5%	0402≥0.033μF, 0603≥0.15μF, 0805≥0.68μF, 1206≥2.2μF, 1210≥4.7μF
		≤10%	0402≥0.22uF, 0603≥0.68μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥22μF
10V	≤5%	≤10%	0402≥0.33μF(0402/X7R≥0.22μF), 0603≥0.33μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥22μF
		≤15%	0402≥1μF
6.3V	≤10%	≤15%	0402≥1μF, 0603≥10μF, 0805≥4.7μF, 1206≥47μF, 1210≥100μF
		≤20%	0402≥2.2μF
4V	≤15%	---	---

X5R:

RATED	D.F.≤	EXCEPTION OF D.F.≤	
≥100V	≤2.5%	≤3%	1206≥0.47μF
		≤5%	0603≥0.068μF, 0805>0.1μF, 1206>1μF, 1210≥2.2μF
		≤10%	0805>0.22μF, 1210≥3.3μF
50V	≤2.5%	≤3%	0603≥0.047μF, 0805≥0.1μF, 1206≥0.47μF, 1210≥2.2μF, 1812≥4.7μF, 1825≥4.7μF, 2220≥4.7μF, 2225≥4.7μF
		≤5%	1210≥4.7μF
		≤10%	0402≥0.012μF, 0603>0.1μF, 0805≥1μF, 1206≥2.2μF, 1210≥10μF
		≤12.5%	1206≥2.2μF
35V	≤3.5%	≤10%	0603≥1μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥10μF
25V	≤3.5%	≤5%	0201=0.01μF; 0805≥1μF
		≤7%	0603≥0.33μF
		≤10%	0201>0.01μF; 0402≥0.10μF; 0603≥0.47μF; 0805≥2.2μF; 1206≥4.7μF; 1210≥10μF
		≤12.5%	0402≥0.33μF; 0805=10μF
16V	≤3.5%	≤5%	0201=0.01μF; 0402≥0.033μF; 0603≥0.15μF; 0805≥0.68μF; 1206≥2.2μF; 1210≥4.7μF
		≤10%	0402≥0.22uF, 0603≥0.68μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥22μF
		≤12.5%	0402≥1uF, 0805≥2.2μF
10V	≤5%	≤10%	0201≥0.012μF; 0402≥0.22μF; 0603≥0.33μF; 0805≥2.2μF; 1206≥2.2μF; 1210≥22μF; 01R5/X5R
		≤12.5%	0805≥10μF
		≤15%	0201>0.1μF; 0402≥1μF; 0603≥10μF
6.3V	≤10%	≤15%	0201>0.1μF; 0402≥1μF; 0603≥10μF; 0805≥4.7μF; 1206≥47μF; 1210≥100μF
		≤20%	0402≥2.2μF
4V	≤15%	---	---

4. Temperature Coefficient

TEST CONDITION:

- With no electrical load

T.C.	OPERATING TEMPERATURE
C0G	-55~125°C at 25°C
X7R	-55~125°C at 25°C
X7S	-55~125°C at 25°C
X5R	-55~85C at 25°C

- Measurement voltage for Class II:

SIZE	CAP. RANGE	CONDITION
0402	Cap.<0.1μF	1V
	Cap.=1μF	0.5V
	1μF<Cap.<10μF	0.2V
	Cap.≥10μF	0.1V
0603	Cap.≤1μF	1V
	1μF<Cap.≤4.7μF	0.5V
	Cap.>4.7μF	0.2V
0805	Cap.<10μF	1V
	Cap.=10μF	0.5V
	Cap.>10μF	0.2V
1206/1210	Cap.≤10μF	1V
	10μF<Cap.≤100μF	0.5V
	Cap.>100μF	0.2V

REQUIREMENTS:

-No evidence of damage or flash over during test.

T.C.	CAPACITANCE CHARGE
C0G	Within ±30ppm/°C
X7R	Within ±15%
X7S	Within ±22%
X5R	Within ±15%

MS LEVEL 1

RELIABILITY TEST CONDITIONS AND REQUIREMENTS

5. Insulation Resistance

TEST CONDITION

RATED VOL. (V)	APPLY VOLTAGE	CHARGE TIME
≤100	1 times of U_R	Max. 120 sec.
200≤V≤500	1 times of U_R	60 sec.
>500	500Vdc	60 sec.

REQUIREMENT

-No evidence of damage or flash over during test.

DIELECTRIC	CAPACITANCE RANGE
Class I	≥10GΩ or RxC≥500Ω-F, whichever is smaller
Class II	≥10GΩ or RxC≥100Ω-F, whichever is smaller

- Except (Class II)

RATED VOLTAGE (X7R)	I.R.
≥10GΩ or RxC≥100Ω-F, whichever is smaller	
50V : 0402>0.01μF, 0603≥1μF, 0805≥1μF, 1206≥4.7μF, 1210≥4.7μF, 1812≥10μF, 2220≥22μF	
35V : 0805≥2.2μF, 1206≥2.2μF, 1210≥10μF	≥10GΩ or RxC≥100Ω-F, whichever is smaller
25V : 0402≥1μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF	
16V : 0402≥0.22μF, 0603≥1μF, 0805≥2.2μF, 1206≥10μF, 1210≥47μF	
10V : 0402≥0.47μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥47μF	
6.3V; 4V	

RATED VOLTAGE (X7R)	I.R.
100V : 1210≥3.3μF	
50V : 0402≥0.1μF, 0603≥2.2μF, 0805≥10μF, 1206≥10μF	
35V : 0603≥1μF	
25V : 0402≥2.2μF, 0603≥10μF, 0805≥10μF, 1206≥22μF	RxC≥50Ω-F
16V : 0603≥10μF, 0402≥1μF, 0201≥0.22μF	
10V : 0402≥1μF, 0603≥10μF, 0805≥47μF	
6.3V : 0603>4.7μF, 0805≥47μF, 1206≥10μF	
4V : 0603≥22μF, 0805≥47μF, 1206≥100μF	

RATED VOLTAGE (X5R)	I.R.
25V: 0402>0.1UF, 0603:>0.22UF, 0805:>1UF:1206>2.2UF, 1210>4.7UF	
16V: 0402>0.033UF, 0603:>0.22UF, 0805:>1UF:1206>1.5UF, 1210>1.5UF	RxC≥50Ω-F
10V: 0402>0.068UF, 0603:>0.33UF, 0805:>1UF:1206>1.5UF, 1210>1.5UF	
6.3V: 0402>0.1UF, 0603:>0.33UF, 0805:>1.5UF:1206>100UF, 1210>10UF	

6. Dielectric Strength

TEST CONDITION

RATED VOLTAGE	CONDITION
≤100	2.5 times of U_R
100≤V≤500	2.0 times of U_R
250<V≤500	1.5 times of U_R
630≤V≤3000V	1.2 times of U_R
3000<V<5000V	1.1 times of U_R
≥5000V	1.0 times of U_R

- Duration : 1 to 5 sec. Voltage ramp up rate ≤500Vdc/sec.
- Charge and discharge current less than 50mA.
- Test in insulating fluid for rated voltage ≥1KV products

REQUIREMENT

- No evidence of damage or flash over during test.

7. Solderability

TEST CONDITION

- Solder temperature : 235±5°C for (0402~1210).
- Solder temperature : 245±5°C for (1808~2225).
- Dipping time : 2±0.5 sec.

REQUIREMENT

- 75% min. coverage of all metalized area

8. Resistance to Soldering Heat

TEST CONDITION

- Solder temperature : 260±5°C.
- Dipping time : 10±1 sec.
- Preheating : 120 to 150°C for 1 minute before immerse the capacitor in a eutectic solder.
- Before initial measurement (Class II only) : To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.
- Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).

REQUIREMENT

- No remarkable damage.
- Cap. change :
  C0G : Within ±2.5% or ±0.25pF, whichever is larger.
  X7R, X7S, X5R : Within ±7.5%.
- D.F./Q, I.R : To meet initial requirements.
- 25% max. leaching on each edge.

9. Temperature Cycle

TEST CONDITION

- Conduct the five cycles according to the temperatures and time

STEP	TEMP (°C)	TIME (MIN)
1	Min. operating temp. +0/-3	30 ± 3
2	Room Temp	2 ~ 3
3	Min. operating temp +0/-3	30 ± 3
4	Room Temp	2 ~ 3

- Before initial measurement (Class II only) : To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.
- Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).

REQUIREMENT

- No remarkable damage.
- Cap. change :
  C0G : Within ±2.5% or ±0.25pF, whichever is larger.
  X7R, X7S, X5R : Within ±7.5%.
- D.F./Q :
  C0G : Q≥100% of initial requirements.
  X7R, X7S, X5R : D.F.≤150% of initial requirement.
- I.R. : ≥100% of initial requirement.

RELIABILITY TEST CONDITIONS AND REQUIREMENTS

<table>
<tr><th>NO.</th><th>ITEM</th><th>TEST CONDITION</th><th>REQUIREMENTS</th></tr>
<tr><td>10.</td><td>Humidity
(Damp Heat)
Steady State</td><td>- Test temp. : 40±2°C.
- Humidity : 90~95%RH.
- Test time : 500 +24/-0hrs.
- Before initial measurement (Class II only) : To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.
- Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).</td><td>- No remarkable damage.
- Cap. change :
C0G : Within ±5.0% or ±0.5pF, whichever is larger.
X7R, X7S, X5R : Within ±12.5% for ≥10V**, within ±25% for 6.3V.
**10V : Within ±25% for 0603≥4.7μF, 0402≥1μF.

- D.F./Q :
C0G : Q≥350 for Cap.>30pF, Q≥275+2.5C for 10pF≤Cap.≤30pF, Q≥200+10C for Cap.<10pF.
X7R, X7S, X5R : D.F.≤200% of initial requirement.

- I.R. : ≥10V, ≥1GΩ or R×C≥50Ω-F, whichever is smaller

Except:
<table><tr><th>RATED VOLTAGE (X7R, X7S, X5R)</th><th>I.R.</th></tr><tr><td>100V : All X7R; 1210≥3.3μF</td><td rowspan="7">≥1GΩ or RxC ≥ 10Ω-F, whichever is smaller</td></tr><tr><td>50V : 0402>0.01μF, 0603≥1μF, 0805≥1μF, 1206≥4.7μF, 1210≥4.7μF</td></tr><tr><td>35V : 0603≥1μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥10μF</td></tr><tr><td>25V : 0402≥0.22μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF</td></tr><tr><td>16V : 0402≥0.22μF, 0603≥1μF, 0805≥2.2μF, 1206≥10μF, 1210≥47μF</td></tr><tr><td>10V : 0402≥0.47μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥47μF</td></tr><tr><td>6.3V; 4V; Size≥1812</td></tr></table></td></tr>
<tr><td>11.</td><td>Humidity
(Damp Heat)
Load</td><td>- Reflow solder the capacitors on a P.C. Board before test.
- Test temp. : 40±2°C (85±3°C for control code H).
- Humidity : 90~95% RH (85±5% for control code H).
- Test time : 500 +24/-0hrs.
- To apply voltage : Rated voltage (500Vdc max. for general purpose and 100Vdc max. for control code H)
- Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).</td><td>- No remarkable damage.
- Cap. change :
C0G : Within ±7.5% or ±0.75pF, whichever is larger.
X7R, X7S, X5R: Within ±12.5% for ≥10V**, within ±25% for 6.3V.
**10V : Within ±25% for 0603≥4.7μF, 0402≥1μF.

- D.F./Q :
C0G : Q≥350 for Cap.>30pF, Q≥275+2.5C for 10pF≤Cap.≤30pF, Q≥200+10C for Cap.<10pF.
X7R, X7S, X5R : ≤200% of initial requirement.

- I.R. : ≥10V, ≥500MΩ or RxC≥25Ω-F, whichever is smaller.
Except:
<table><tr><th>RATED VOLTAGE (X7R, X7S, X5R)</th><th>I.R.</th></tr><tr><td>≥100V : All X7R; 1210≥3.3μF</td><td rowspan="7">≥500MΩ or RxC≥5Ω-F, whichever is smaller</td></tr><tr><td>50V : 0402>0.01μF, 0603≥1μF, 0805≥1μF, 1206≥4.7μF, 1210≥4.7μF</td></tr><tr><td>35V : 0603≥1μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥10μF</td></tr><tr><td>25V : 0402≥0.22μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF</td></tr><tr><td>16V : 0402≥0.22μF, 0603≥1μF, 0805≥2.2μF, 1206≥10μF, 1210≥47μF</td></tr><tr><td>10V : 0402≥0.47μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥47μF</td></tr><tr><td>6.3V; 4V; Size≥1812</td></tr></table></td></tr>
</table>

RELIABILITY TEST CONDITIONS AND REQUIREMENTS

12. High Temperature Load (Endurance)

TEST CONDITION

- Test temp. : 125±3°C.
- To apply voltage :
  - (1) ≤6.3V or Cap.≥10μF : 150% of rated voltage.
  - (2) 10V≤Ur≤100V : 200% of rated voltage.
  - (3) 200V≤Ur≤500V : 150% of rated voltage.
  - (4) 630V : 120% of rated voltage.
  - (5) Ur≥1000V : 100% of rated voltage.
  - (6) 100% of rated voltage for below range:

SIZE	DIELECTRIC	RATED	CAPACITANCE
0402	X7R / X7S	6.3V, 10V, 16V, 25V	C≥1.0μF
0603	X7R / X7S	4V	C≥22μF
		6.3V,10V	C≥4.7μF
		25V, 35V	C≥1.0μF
0805	X7R / X7S	4V	C≥47μF
		6.3V	C≥22μF
		10V~50V	C≥10μF
1206	X7R / X7S	≤6.3V	C≥47μF
		100V	C≥2.2μF
1210	X7R / X7S	16V	C≥47μF
		≥100V	C≥3.3μF
2220	X7R / X7S	100V	C≥22μF

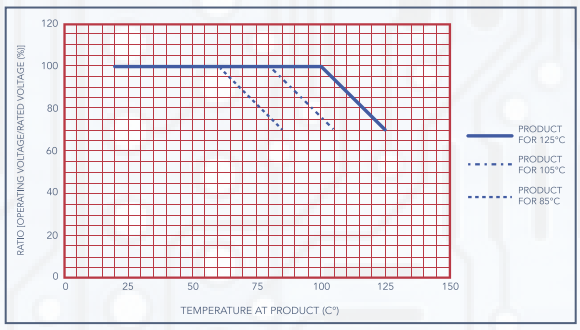
(7) 150% of rated voltage for below range:

SIZE	DIELECTRIC	RATED	CAPACITANCE
0402	X7R / X7S	50V	C≥0.1μF
		10~25V	C≥0.22μF
	X5R	≤16V	C≥1.0μF
		25V, 50V	C≥1.0μF
0603	X7R / X7S	≥50V	C≥0.082μF
		10V, 16V, 50V	C≥1.0μF
	X5R	4V	C≥22μF
0805	X7R / X7S	10~50V	C≥4.7μF
		50V	C≥0.47μF
		≥100V	C≥0.12μF
	X5R	16V, 25V	C≥22μF
1206	X7R / X7S	≥50V	C≥1.0μF
	X5R	≤6.3V	C≥47μF
1210	X7R / X7S	≤100V	C≥1.0μF
		>100V	C≥0.22μF
	X5R	16V	C≥47μF
1812	X7R / X7S	≤50V	C≥4.7μF
		100V	C≥1.0μF
1825 2220 2225	X7R / X7S	≥100V	C≥1.0μF

(8) 120% of rated voltage for below range:

SIZE	DIELECTRIC	RATED	CAPACITANCE
2220	X7R / X7S	≥100V	C≥15μF

- Test time : 1000 +24/-0 hrs.
- Before initial measurement (Class II only) : To apply deaging at 150°C for 1hr then set for 24±2 hrs at room temp.
- Measurement to be made after keeping at room temp. for 48±4 hrs (Class II).
- De-rating conditions :



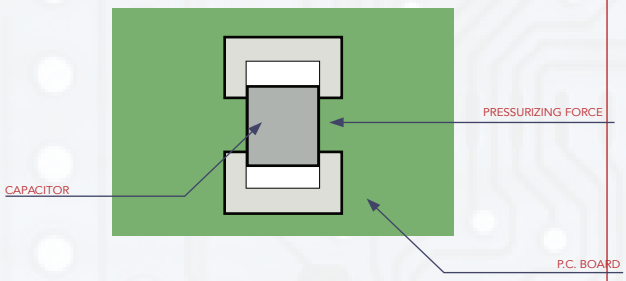
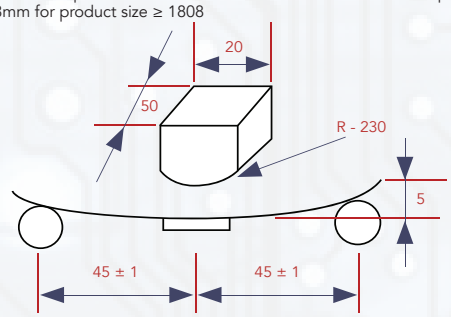
REQUIREMENTS

- No remarkable damage.
- Cap. change :
  - C0G : Within ±5.0% or ±0.5pF, whichever is larger.
  - X7R, X5R : Within ±12.5% for ≥10V**, within ±25% for 6.3V.
  - **10V : Within ±25% for 0603≥4.7μF, 0402≥1μF.
- D.F./Q :
  - C0G : Q≥350 for Cap.>30pF, Q≥275+2.5C for 10pF≤Cap.≤30pF, Q≥200+10C for Cap.<10pF.
  - X7R, X5R : D.F.≤200% of initial requirement.
- I.R. : ≥10V, ≥1GΩ or R×C≥50Ω-F, whichever is smaller.

Except:

RATED VOLTAGE	I.R.
100V : All X7R; 1210≥3.3μF	≥1GΩ or RxC≥10Ω-F, whichever is smaller
50V : 0402>0.01μF, 0603≥1μF, 0805≥1μF, 1206≥4.7μF, 1210≥4.7μF	
35V : 0603≥1μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥10μF	
25V : 0402≥0.22μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF	
16V : 0402≥0.22μF, 0603≥1μF, 0805≥2.2μF, 1206≥10μF, 1210≥47μF	
10V : 0402≥0.47μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥47μF	
6.3V; 4V; Size≥1812	

RELIABILITY TEST CONDITIONS AND REQUIREMENTS

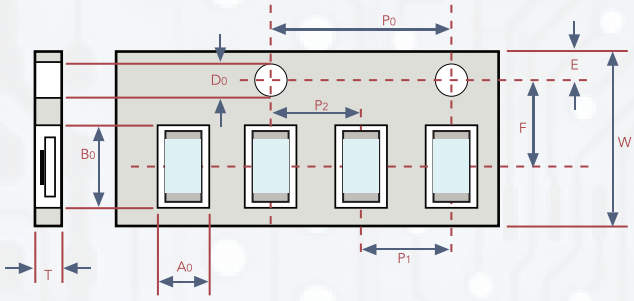
NO.	ITEM	TEST CONDITION	REQUIREMENTS
13.	Adhesive Strength of Termination	- Capacitors mounted on a substrate. A force of 5N(≤0603) or 10N(>0603) applied perpendicular to the place of substrate and parallel the line joining the center of terminations for 10±1 second 	- No remarkable damage or removal of the terminations
14.	Bending Test	- The middle part of substrate shall be pressurized by means of the pressurizing rod at a rate of about 1mm per second until the deflection becomes 5mm for product size < 1808, 3mm for product size ≥ 1808 	- No remarkable damage. DIELECTRIC / CAP. CHANGE Class I (C0G) / Within ±5.0% or ±0.5pF, whichever is larger Class II (X7R, X7S, X5R) / Within ±12.5% - This capacitance change means the change of capacitance under specified flexure of substrate from the before test initial measurement
15.	Vibration Resistance	- Vibration frequency : 10~55 Hz/min. - Total amplitude : 1.5mm. - Test time : 6 hrs. (Two hrs each in three mutually perpendicular directions) - Before initial measurement (Class II only) : To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp. - Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).	- No remarkable damage or removal of the terminations - Cap. change and D.F./Q : To meet initial spec.

PACKAGE DIMENSION AND QUANTITY

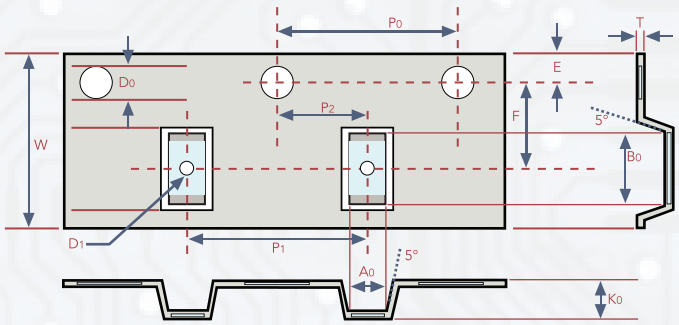
SIZE	THICKNESS (MM)	PAPER TAPE		PLASTIC TAPE	
		7" REEL	13" REEL	7" REEL	13" REEL
0402 (1005)	0.50±0.05	10K	50K	-	-
	0.50 +0.02/-0.05	10K	50K	-	-
	0.50±0.20	10K	-	-	-
0603 (1608)	0.50±0.10	4K	-	-	-
	0.80±0.07	4K	15K	-	-
	0.80 +0.15/-0.10	4K	15K	-	-
0805 (2012)	0.50±0.10	4K	15K	-	-
	0.60±0.10	4K	15K	-	-
	0.80±0.10	4K	15K	-	-
	0.85±0.10	4K	15K	-	-
	1.25±0.10	-	-	3K	10K
	1.25±0.20	-	-	3K	10K
1206 (3216)	0.80±0.10	4K	15K	-	-
	0.85±0.10	4K	15K	-	-
	0.95±0.10	-	-	3K	10K
	1.15±0.15	-	-	3K	10K
	1.25±0.10	-	-	3K	10K
	1.60±0.20	-	-	2K	10K
	1.60 +0.30/-0.10	-	-	2K	9K
1210 (3225)	0.85±0.10	-	-	3K	10K
	0.95±0.10	-	-	3K	10K
	1.25±0.10	-	-	3K	10K
	1.60±0.20	-	-	2K	-
	1.90 ± 0.20	-	-	2K	-
	2.00±0.20	-	-	500 / 1K	6K
	2.50±0.30	-	-	500 / 1K	6K
1808 (4520)	1.25±0.10	-	-	2K	10K
	1.60±0.20	-	-	2K	8K
	2.00±0.20	-	-	1K	6K
1812 (4532)	1.25±0.10	-	-	1K	5K
	1.60±0.20	-	-	1K	-
	2.00±0.20	-	-	1K	-
	2.50±0.30	-	-	0.5K	3K
	2.80±0.30	-	-	0.5K	-
1825 (4563)	1.60±0.20	-	-	1K	-
	2.00±0.20	-	-	1K	-
	2.50±0.30	-	-	0.5K	-
	2.80±0.30	-	-	0.5K	-
2220 (5750)	1.60±0.20	-	-	1K	-
	2.00±0.20	-	-	1K	-
	2.50±0.30	-	-	0.5K	-
	2.80±0.30	-	-	0.5K	-
	3.10±0.30	-	-	-	1K
2225 (5763)	1.60±0.20	-	-	500 / 1K	-
	2.00±0.20	-	-	500 / 1K	-
	2.50±0.30	-	-	0.5K	-
	2.80±0.30	-	-	0.5K	-

PACKAGE DIMENSION AND QUANTITY

- Embossed Tape Dimensions



Dimension of paper tape



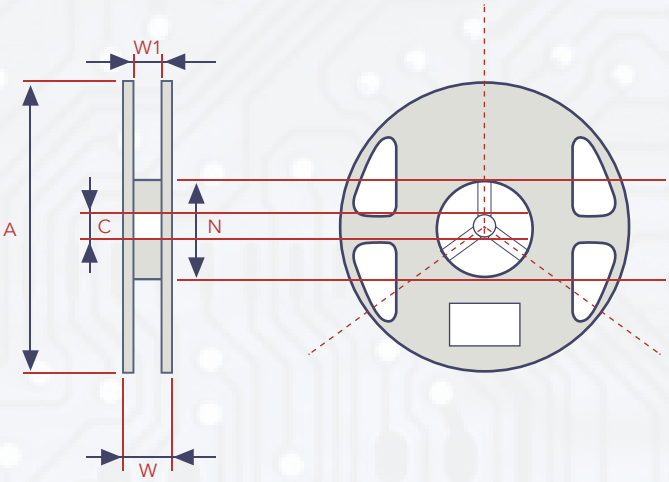
Dimension of plastic tape

SIZE	CHIP THICKNESS	A_0	B_0	T	K_0	W	P_0	10X P_0	P_1	P_2	D_0	D_1	E	F	UNIT
0402	0.50±0.05	0.70±0.20	1.20±0.20	≤0.80	-	8.00±0.10	4.00±0.10	40.00±0.10	2.00±0.05	2.00±0.05	1.55±0.05	-	1.75±0.05	3.50±0.05	MM
	0.50±0.10	0.70±0.20	1.20±0.20	≤0.80	-	8.00±0.10	4.00±0.10	40.00±0.10	2.00±0.05	2.00±0.05	1.55±0.05	-	1.75±0.05	3.50±0.05	MM
0603	0.80±0.07	1.00 +0.05/-0.1	1.80±0.10	0.95±0.05	-	8.00±0.10	4.00±0.10	40.00±0.20	4.00±0.10	2.00±0.05	1.55±0.05	-	1.75±0.05	3.50±0.05	MM
	0.80 +0.15/-0.1	1.02 +0.05/-0.1	1.80±0.10	0.97±0.05	-	8.00±0.10	4.00±0.10	40.00±0.20	4.00±0.10	2.00±0.05	1.55±0.05	-	1.75±0.05	3.50±0.05	MM
0805	0.80±0.10	1.50±0.10	2.30±0.10	0.95±0.05	-	8.00±0.10	4.00±0.10	40.00±0.20	4.00±0.10	2.00±0.05	1.55±0.05	-	1.75±0.05	3.50±0.05	MM
	1.25±0.10 1.25±0.20	<1.65	<2.40	0.23±0.05	<2.50	8.00±0.10	4.00±0.10	40.00±0.20	4.00±0.10	2.00±0.05	1.50 +0.10/-0	1.00±0.10	1.75±0.10	3.50±0.05	MM
1206	0.80±0.10	2.00±0.10	3.50±0.50	0.95±0.05	<2.50	8.00±0.10	4.00±0.10	40.00±0.20	4.00±0.10	2.00±0.05	1.55±0.05	-	1.75±0.10	3.50±0.05	MM
	0.95±0.10 1.25±0.10	<2.00	<3.70	0.23±0.05	<2.50	8.00±0.10	4.00±0.10	40.00±0.20	4.00±0.10	2.00±0.05	1.50 +0.10/-0	1.00±0.10	1.75±0.10	3.50±0.05	MM
	1.60±0.20 1.60+0.3/-0/1	<2.50	<4.00	0.23±0.05	<2.50	12.00±0.20	4.00±0.10	40.00±0.20	4.00±0.10	2.00±0.05	1.50±0.10/-0	1.50±0.10	1.75±0.10	5.50±0.05	MM
1210	1.25±0.10 1.60±0.20	<2.50	<4.00	0.23±0.05	<2.50	12.00±0.20	4.00±0.10	40.00±0.20	4.00±0.10	2.00±0.05	1.50±0.10/-0	1.50±0.10	1.75±0.10	5.50±0.05	MM
	2.50±0.30	<3.10	<4.00	0.23±0.05	<2.50	8.00 ± 0.10 / 12.00±0.20	4.00±0.10	40.00±0.20	4.00±0.10	2.00±0.05	1.50 +0.10/-0	1.00±0.10	1.75±0.10	5.50±0.05	MM
1808	1.25±0.10 1.60±0.20	<2.50	<5.30	0.25±0.05	<2.50	12.00±0.20	4.00±0.10	40.00±0.20	4.00±0.10	2.00±0.05	1.50±0.10/-0	1.50±0.10	1.75±0.10	5.50±0.05	MM
	2.00±0.20	<2.50	<5.30	0.25±0.05	<2.50	12.00±0.20	4.00±0.10	40.00±0.20	4.00±0.10	2.00±0.05	1.50±0.10/-0	1.50±0.10	1.75±0.10	5.50±0.05	MM
1812	1.25±0.10 1.60±0.20 2.00±0.20	<3.90	<5.30	0.25±0.05	<2.50	12.00±0.20	4.00±0.10	40.00±0.20	8.00±0.10	2.00±0.05	1.50 +0.10/-0	1.50±0.10	1.75±0.10	5.50±0.05	MM
	2.50±0.30 2.80±0.30	<3.90	<5.30	0.25±0.05	<3.00	12.00±0.20	4.00±0.10	40.00±0.20	8.00±0.10	2.00±0.05	1.50 +0.10/-0	1.50±0.10	1.75±0.10	5.50±0.05	MM
1825	1.60±0.20 2.00±0.20	<6.80	<5.30	0.30±0.10	<2.50	12.00±0.20	4.00±0.10	40.00±0.20	8.00±0.10	2.00±0.05	1.50 +0.10/-0	1.50±0.10	1.75±0.10	5.50±0.05	MM
	2.50±0.30 2.80±0.30	<6.80	<5.30	0.30±0.10	<3.10	12.00±0.20	4.00±0.10	40.00±0.20	8.00±0.10	2.00±0.05	1.50 +0.10/-0	1.50±0.10	1.75±0.10	5.50±0.05	MM
2220	1.40±0.15 1.60±0.20 2.00±0.20	<5.80	<6.50	0.30±0.10	<2.50	12.00±0.20	4.00±0.10	40.00±0.20	8.00±0.10	2.00±0.05	1.50 +0.10/-0	1.50±0.10	1.75±0.10	5.50±0.05	MM
	2.50±0.30 2.80±0.30	<6.80	<6.50	0.30±0.10	<3.10	12.00±0.20	4.00±0.10	40.00±0.20	8.00±0.10	2.00±0.05	1.50 +0.10/-0	1.50±0.10	1.75±0.10	5.50±0.05	MM
	3.10±0.30	<5.60	<6.50	0.30±0.10	<4.20	12.00±0.20	4.00±0.10	40.00±0.20	8.00±0.10	2.00±0.05	1.50 +0.10/-0	1.50±0.10	1.75±0.10	5.50±0.05	MM
2225	1.60±0.20 2.00±0.20	<6.80	<6.50	0.30±0.10	<2.50	12.00±0.20	4.00±0.10	40.00±0.20	8.00±0.10	2.00±0.05	1.50 +0.10/-0	1.50±0.10	1.75±0.10	5.50±0.05	MM
	2.50±0.30 2.80±0.30	<6.80	<6.50	0.30±0.10	<3.10	12.00±0.20	4.00±0.10	40.00±0.20	8.00±0.10	2.00±0.05	1.50 +0.10/-0	1.50±0.10	1.75±0.10	5.50±0.05	MM

PACKAGE DIMENSION AND QUANTITY

- Reel Dimensions

SIZE	REEL SIZE	C	W_1	W	A	N
0201, 0402, 0603, 0805, 1206, 1210, 0603	7"	13.0 + 0.5/-0.2	8.4 + 1.5	14.4max	178.0 ± 0.10	60.0 + 1.0/-0
	13"	13.0 + 0.7/-0.3	8.4 + 1.5	14.4max	330.0 ± 1.0	100 ± 1.0
1808, 1812, 1825, 2220, 2225	7"	13.0 + 0.5/-0.2	12.4 + 2.0/-0	18.4max	178.0 ± 0.10	60.0 + 1.0/-0
2220, 2225	13"	13.5 ± 0.5	12.4 + 2.0/-0	18.4max	330.0 ± 1.0	100 ± 1.0



APPLICATION NOTES

STORAGE

- To prevent the damage of solderability of terminations, the following storage conditions are recommended:
  - Indoors under 5 ~ 40°C and 20% ~ 70% RH.
  - No harmful gases containing sulfuric acid, ammonia, hydrogen sulfide or chlorine.
  - Packaging should not be opened until the capacitors are required for use. If opened, the pack should be re-sealed as soon as is practicable. Taped product should be stored out of direct sunlight, which might promote deterioration in tape or adhesion performance. The product is recommended to be used within 12 months after shipment and checked the solderability before use.

HANDLING

- Chip capacitors are dense, hard, brittle, and abrasive materials. They are liable to suffer mechanical damage, in the form of cracks or chips. Chip Capacitors should be handled with care to avoid contamination or damage. To use vacuum or plastic tweezers to pick up or plastic tweezers is recommended for manual placement. Tape and reeled packages are suitable for automatic pick and placement machine

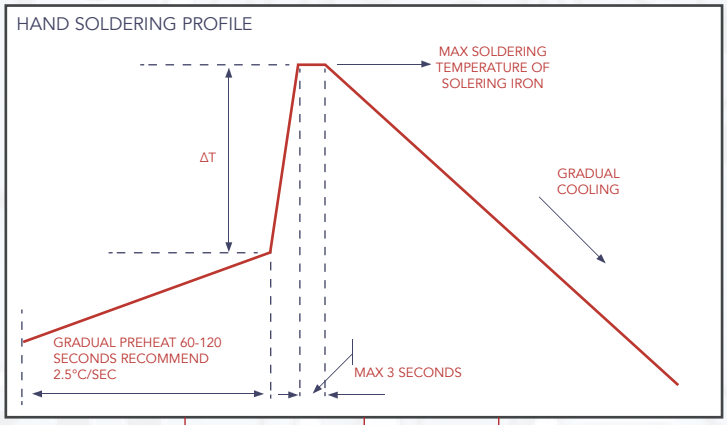
PREHEAT

- In order to minimize the risk of thermal shock during soldering, a carefully controlled preheat is required. The rate of preheat should not exceed 3°C per second.

SOLDERING

- Use mildly activated rosin fluxes do not use activated flux. The amount of solder in each solder joint should be controlled to prevent the damage of chip capacitors caused by the stress between solder, chips, and substrate.

A) Hand Soldering:



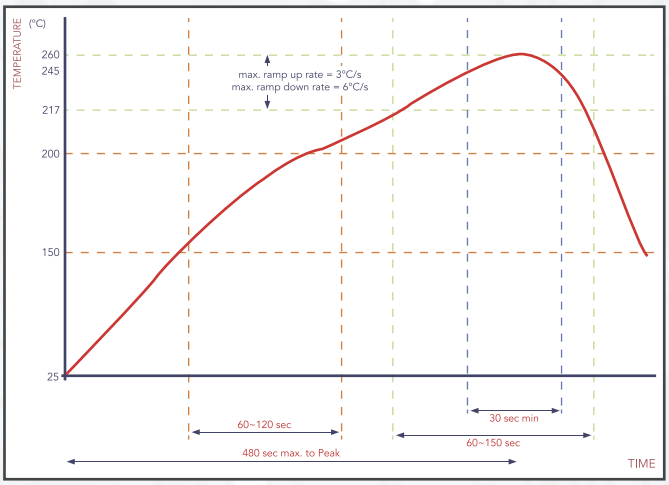
CHIP SIZE	PRE-HEAT TEMP	ΔT	MAX SOLDERING IRON TEMP.
≤1206	≥150°C	≤150°C	≤350°C
1210 ~ 2225	≥150°C	≤130°C	≤280°C

- Soldering iron tip diameter ≤1.0 mm and wattage max. 20W.
- The Capacitors shall be pre-heated and that the temperature gradient between the devices and the tip of the soldering iron.
- The required amount of solder shall be melted on the soldering tip.
- The tip of iron should not contact the ceramic body directly.
- The Capacitors shall be cooled gradually at room temperature after soldering.
- Forced air cooling is not allowed

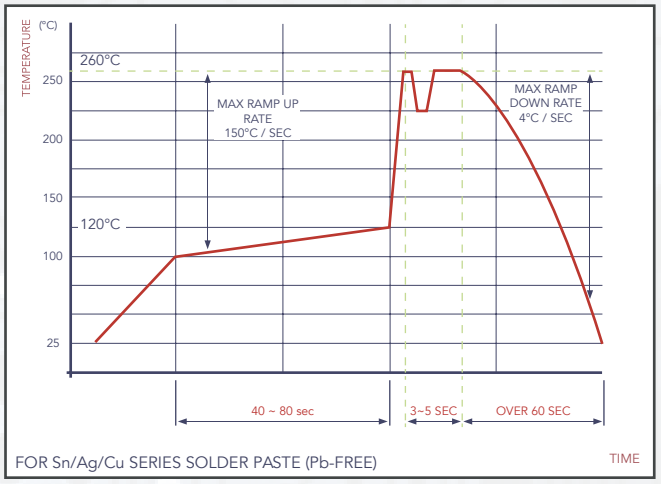
APPLICATION NOTES

SOLDERING (cont.)

B) Reflow Soldering:



C) Wave Soldering:



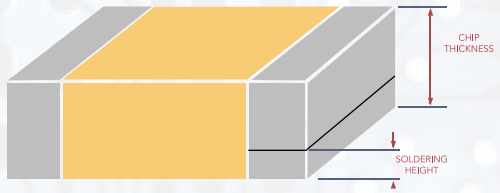
Soldering Conditions:

Class I:

SIZE INCH (MM)	TEMPER CHER.	CAPACITANCE	CONDITION	
			WAVE	REFLOW
≤0402 (1005)	Class I	ALL	X	O
0603 (1608)	Class I	ALL	O	O
0805 (2012)	Class I	ALL	O	O
1206 (3216)	Class I	ALL	O	O
		Thickness >0.95mm	X	O
≥1210 (3225)	Class I	ALL	X	O
Coating Products	ALL	ALL	X	O

SIZE INCH (MM)	TEMPER CHER.	CAPACITANCE	CONDITION	
			WAVE	REFLOW
≤0402 (1005)	Class II	ALL	X	O
0603 (1608)	Class II	Cap. <2.2μF	O	O
		Cap. ≥2.2μF	X	O
0805 (2012)	Class II	Thickness ≤ 0.95mm	O	O
		Thickness > 0.95mm	X	O
1206 (3216)	Class II	Thickness ≤ 0.95mm	O	O
		Thickness >0.95mm	X	O
≥1210 (3225)	Class II	ALL	X	O
Coating Products	ALL	ALL	X	O

Soldering Height:
The solder climbing minimum height is suggesting to 25% of chip thickness or 500um whichever is less.
(Reference from IPC-610E)



COOLING

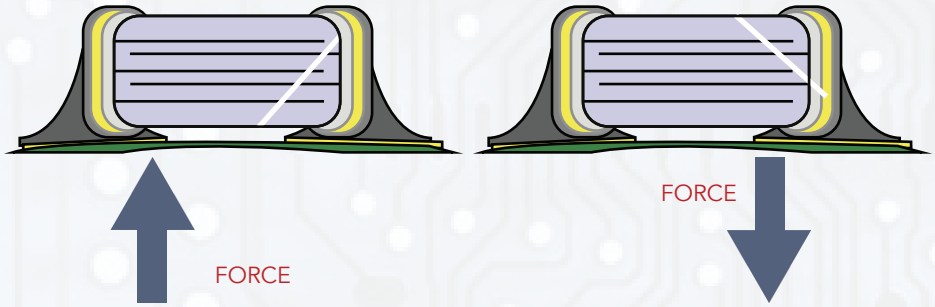
- After soldering, cool the chips and the substrate gradually to room temperature. Natural cooling in air is recommended to minimize stress in the solder joint.

CLEANING

- All flux residues must be removed by using suitable electronic-grade vapor-cleaning solvents to eliminate contamination that could cause electrolytic surface corrosion. Good results can be obtained by using ultrasonic cleaning of the solvent. The choice of the proper system depends upon many factors such as component mix, flux, and solder paste and assembly method. The ability of the cleaning system to remove flux residues and contamination from under the chips is very important.
Surface coating products are not suitable cleaning/washing by solvent

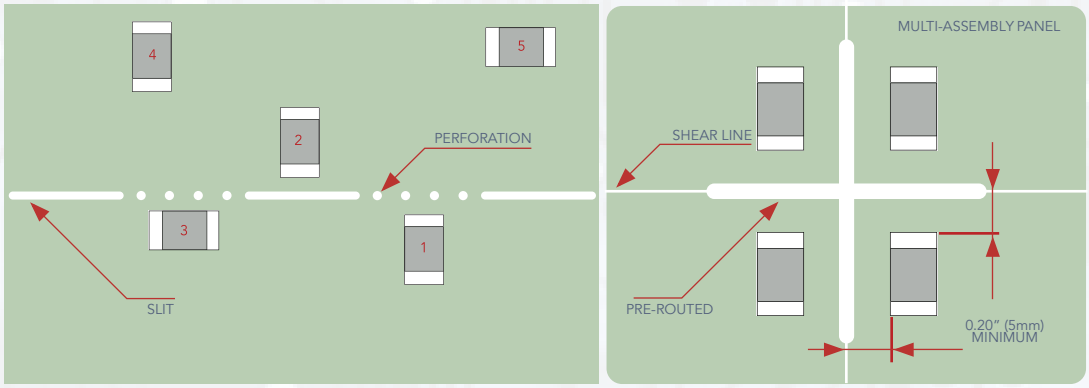
TYPICAL BENDING CRACKS OF MLCC

- MLCC ceramic body consists of rigid material. It will suffer compressive and tensional stress when the carried board is bended. If the suffered stress is over ceramic body strength, the bending crack is occurs. Therefore, the bending crack will occur after soldering process



THE STRESS V.S. POSITION ON PCB DURING BENDING

- Chip mounting close to board separation point



- Magnitude of stress 1>2≈3>4>5

STRUCTURE

- PDC soft termination series added a special termination material (Ultra-Buffer or Anti-Bend) between ceramic body and Ni-barrier that can absorb mechanical stress to prevent bending crack from occurring.

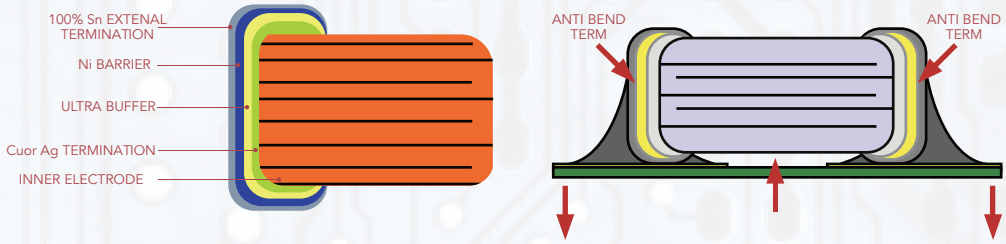
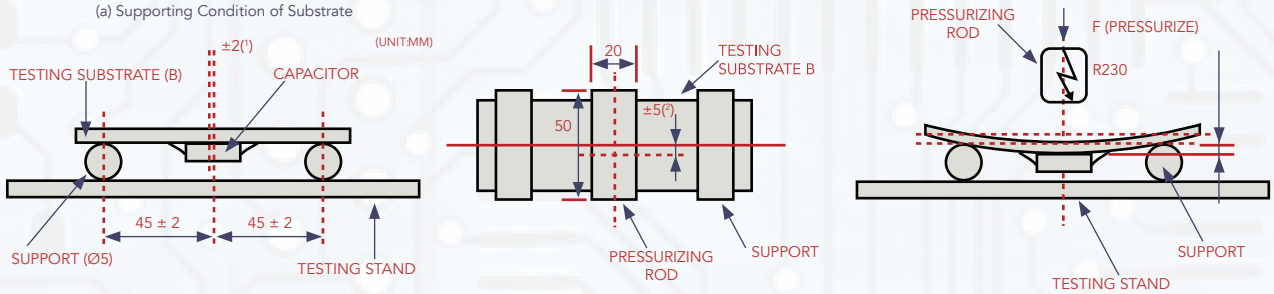


ILLUSTRATION OF BENDING TEST



Discrepancy between center of supports and center of substrate

Discrepancy between center of testing substrate A and center of pressurizing rod