

# APPROVAL SHEET

## MULTILAYER CERAMIC CAPACITORS

Mega Cap type (M Series)

1210 to 2225 Sizes (50V to 630V)

NP0, X7R Dielectrics

Halogen Free & RoHS Compliance

Preliminary Specification

\*Contents in this sheet are subject to change without prior notice.

## 1. DESCRIPTION

M Series green type capacitors are manufactured by using green materials without lead and cadmium. These capacitors to achieve a unique structure of high reliability. The use of metal lead frame, can absorb the heat and mechanical stress. ESR (equivalent series resistance), ESL (equivalent series inductance) is small, the most suitable for high frequency operation of the rectifier power supply.

## 2. FEATURES

- High reliability and stability.
- Higher mechanical endurance.
- Anti thermal stress and mechanical stress.
- Improved vibration performance.
- More capacitance without changing footprint.
- RoHS & HALOGEN Compliant.

## 3. APPLICATIONS

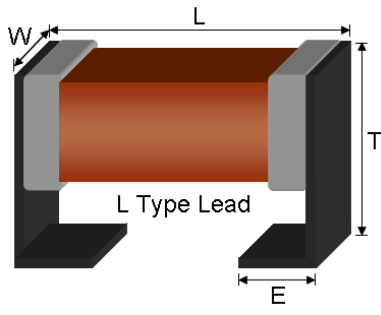
- DC to DC converter.
- High voltage coupling/DC blocking.
- Back-lighting inverters.
- Snubbers in high frequency power converters.
- Power supplies.
- Surge protection.
- Filtering, smoothing, and decoupling application.

## 4. HOW TO ORDER

<u>M</u>	<u>2</u>	<u>55</u>	<u>B</u>	<u>106</u>	<u>K</u>	<u>500</u>	<u>G</u>	<u>L</u>
Series	Number	Chip Size	Dielectric	Capacitance	Tolerance	Rated voltage	Thickness	Control code
M= Mega Cap series (Stacked Capacitors)	Number of chips in stack 2= 2 chips 1= 1 chip	32=1210 (3225) 43=1812 (4532) 46=1825 (4563) 55=2220 (5750) 56=2225 (5763)	N=NPO (COG) B=X7R	Two significant digits followed by no. of zeros. And R is in place of decimal point. eg.: 0R5=0.5pF 1R0=1.0pF 104=10x10 <sup>4</sup> =100nF 106=10μF	B=±0.1pF C=±0.25pF D=±0.5pF F=±1% G=±2% J=±5% K=±10% M=±20%	Two significant digits followed by no. of zeros. And R is in place of decimal point.  500=50 VDC 101=100 VDC 201=200 VDC 251=250 VDC 501=500 VDC 631=630 VDC 102=1000 VDC	B=3.60±0.35mm C=4.20±0.35mm F=6.00±0.35mm G=6.60±0.35mm  Please refer to Table 1	L= L type lead <b>Others:</b> Customizable, Please contact the liaison

Table 1		Thickness Description			
Code	Description	Code	Description	Code	Description
A	3.00±0.35 mm	J	7.80±0.35 mm	S	12.60±0.35 mm
B	3.60±0.35 mm	K	8.40±0.35 mm	T	13.20±0.35 mm
C	4.20±0.35 mm	L	9.00±0.35 mm	U	1.70±0.25 mm
D	4.80±0.35 mm	M	9.60±0.35 mm	V	2.10±0.25 mm
E	5.40±0.35 mm	N	10.20±0.35 mm	W	2.50±0.25 mm
F	6.00±0.35 mm	P	10.80±0.35 mm		
G	6.60±0.35 mm	Q	11.40±0.35 mm		
H	7.20±0.35 mm	R	12.00±0.35 mm		

## 5. EXTERNAL DIMENSIONS

Size Inch (mm)	L (mm)	W (mm)	Code / T (mm)	E (mm)	
1210 (3225)	3.50±0.40	2.50±0.40	Reference Table 1	1.10±0.15	
1812 (4532)	4.80±0.40	3.20±0.40		1.40±0.15	
1825 (4563)	4.80±0.40	6.30±0.50		1.70±0.15	
2220 (5750)	6.00±0.50	5.00±0.50		1.70±0.15	
2225 (5763)	6.00±0.50	6.30±0.50		1.70±0.15	
					Fig. 5.1 The outline of Stacked Capacitors

## 6. GENERAL ELECTRICAL DATA

Dielectric	NP0 (C0G)	X7R														
Size	1210, 1812, 1825, 2220, 2225	1210, 1812, 1825, 2220, 2225														
Rated voltage (WVDC)	50V, 100V, 200V, 250V, 500V, 630V, 1000V	50V, 100V, 200V, 250V, 500V, 630V, 1000V														
Capacitance range	220nF Max.	47µF Max.														
Capacitance tolerance	Reference to Table 5	Reference to Table 5														
Tan δ	<table border="1"> <thead> <tr> <th>Cap. Range</th> <th>Q Spec.</th> </tr> </thead> <tbody> <tr> <td>Cap.&lt;30pF</td> <td>Q≥400+20C</td> </tr> <tr> <td>Cap.≥30pF</td> <td>Q≥1000</td> </tr> </tbody> </table>	Cap. Range	Q Spec.	Cap.<30pF	Q≥400+20C	Cap.≥30pF	Q≥1000	<table border="1"> <thead> <tr> <th>Cap. Range</th> <th>D.F. Spec.</th> </tr> </thead> <tbody> <tr> <td>1210≥2.2µF</td> <td>≤5.0%</td> </tr> <tr> <td>1812~2225≥4.7µF</td> <td>≤5.0%</td> </tr> <tr> <td>Other</td> <td>≤2.5%</td> </tr> </tbody> </table>	Cap. Range	D.F. Spec.	1210≥2.2µF	≤5.0%	1812~2225≥4.7µF	≤5.0%	Other	≤2.5%
Cap. Range	Q Spec.															
Cap.<30pF	Q≥400+20C															
Cap.≥30pF	Q≥1000															
Cap. Range	D.F. Spec.															
1210≥2.2µF	≤5.0%															
1812~2225≥4.7µF	≤5.0%															
Other	≤2.5%															
Capacitance & Tan δ Test condition	Measured at the condition of 30~70% related humidity For 25°C at ambient temperature	Measured at the condition of 30~70% related humidity Preconditioning for Class II MLCC : Perform a heat treatment at 150±10°C for 1 hour, then leave in ambient condition (25°C) for 24±2 hours before measurement														
	<table border="1"> <thead> <tr> <th>Cap. Range</th> <th>Test Condition</th> </tr> </thead> <tbody> <tr> <td>Cap.&lt;1000pF</td> <td>1.0±0.2Vrms, 1.0MHz±10%</td> </tr> <tr> <td>Cap.≥1000pF</td> <td>1.0±0.2Vrms, 1.0KHz±10%</td> </tr> </tbody> </table>	Cap. Range	Test Condition	Cap.<1000pF	1.0±0.2Vrms, 1.0MHz±10%	Cap.≥1000pF	1.0±0.2Vrms, 1.0KHz±10%	<table border="1"> <thead> <tr> <th>Cap. Range</th> <th>Test Condition</th> </tr> </thead> <tbody> <tr> <td>Cap.≤10µF</td> <td>1.0±0.2Vrms, 1.0KHz±10%</td> </tr> <tr> <td>Cap.&gt;10µF</td> <td>0.5±0.2Vrms, 120Hz±20%</td> </tr> </tbody> </table>	Cap. Range	Test Condition	Cap.≤10µF	1.0±0.2Vrms, 1.0KHz±10%	Cap.>10µF	0.5±0.2Vrms, 120Hz±20%		
Cap. Range	Test Condition															
Cap.<1000pF	1.0±0.2Vrms, 1.0MHz±10%															
Cap.≥1000pF	1.0±0.2Vrms, 1.0KHz±10%															
Cap. Range	Test Condition															
Cap.≤10µF	1.0±0.2Vrms, 1.0KHz±10%															
Cap.>10µF	0.5±0.2Vrms, 120Hz±20%															
Insulation resistance at Ur	≥10GΩ or RxC≥500Ω-F, whichever is smaller	≥10GΩ or RxC≥100Ω-F, whichever is smaller														
Operating temperature	-55 to +125°C	-55 to +125°C														
Capacitance characteristic	±30ppm / °C	±15%														
Termination	L type lead (Customizable, Please contact the liaison)	L type lead (Customizable, Please contact the liaison)														

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**7. CAPACITANCE RANGE**

**7-1 NP0 (C0G) Dielectric**

Cap(pF)	EIA Size		1210					
	Voltage		50V	100V	200V	250V	500V	630V
	Stacked		1	1	1	1	1	1
1000	102	B	B	B	B	B	B	B
1200	122	B	B	B	B	B	B	B
1500	152	B	B	B	B	B	B	B
1800	182	B	B	B	B	B	B	B
2200	222	B	B	B	B	B	B	B
2700	272	B	B	B	B	B	B	B
3300	332	B	B	B	B	B	B	B
3900	392	B	B	B	B	B	B	B
4700	472	B	B	B	B	B	B	B
5600	562	B	B	B	B	B	B	B
6800	682	B	B	B	B	B	B	B
8200	822	B	B	B	B	B	B	B
10000	103	B	B	B	B	B	B	B
12000	123	B	B					
15000	153	B	B					
18000	183	B	B					
22000	223	B	B					
27000	273	B						
33000	333	B						
39000	393	B						

The letter in cell is expressed the symbol of product thickness.

Cap(pF)	EIA Size		1812											
	Voltage		50V		100V		200V		250V		500V		630V	
	Stacked		1	2	1	2	1	2	1	2	1	2	1	2
10000	103	B			B		B		B		B		B	
12000	123	B			B		B		B		B		B	
15000	153	B			B		B		B		B		B	
18000	183	B			B		B		B		B		B	
22000	223	B	F*		B	F*	B	F*	B	F*	B	F*	B	F*
27000	273	B	F*		B	F*	B	F*	B	F*		F*		F*
33000	333	B	F*		B	F*		F*		F*		F*		F*
39000	393	B	F*		B	F*		F*		F*		F*		F*
47000	473	B	F*		B	F*		F*		F*		F*		F*
56000	563	B	F*			F*		F*		F*				
68000	683	B	F*			F*								
82000	823	B	F*			F*								
100000	104	B	F*			F*								
120000	124		F*											
150000	154		F*											
180000	184		F*											
220000	224		F*											

1. The code in the table indicates the thickness.
2. "\*" Capacitance M tolerance only.

Multilayer Ceramic Capacitors

**7-1 NP0 (C0G) Dielectric**

Cap(pF)	EIA Size		1825											
	Voltage		50V		100V		200V		250V		500V		630V	
	Stacked		1	2	1	2	1	2	1	2	1	2	1	2
10000	103	B		B		B		B		B		B		
12000	123	B		B		B		B		B		B		
15000	153	B		B		B		B		B		B		
18000	183	B		B		B		B		B		B		
22000	223	B	F*	B	F*	B	F*	B	F*	B	F*	B	F*	
27000	273	B	F*	B	F*	B	F*	B	F*	B	F*			F*
33000	333	B	F*	B	F*	B	F*	B	F*	B	F*			F*
39000	393	B	F*	B	F*	B	F*	B	F*	B	F*			F*
47000	473	B	F*	B	F*	B	F*	B	F*	B	F*			F*
56000	563	B	F*	B	F*	B	F*	B	F*		F*			
68000	683	B	F*	B	F*	B	F*	B	F*		F*			
82000	823	B	F*	B	F*		F*		F*		F*			
100000	104	B	F*	B	F*		F*		F*		F*			
120000	124		F*		F*		F*		F*					
150000	154		F*		F*									
180000	184		F*		F*									
220000	224		F*		F*									

Cap(pF)	EIA Size		2220											
	Voltage		50V		100V		200V		250V		500V		630V	
	Stacked		1	2	1	2	1	2	1	2	1	2	1	2
10000	103	B		B		B		B		B		B		
12000	123	B		B		B		B		B		B		
15000	153	B		B		B		B		B		B		
18000	183	B		B		B		B		B		B		
22000	223	B	F*	B	F*	B	F*	B	F*	B	F*	B	F*	
27000	273	B	F*	B	F*	B	F*	B	F*	B	F*			F*
33000	333	B	F*	B	F*	B	F*	B	F*	B	F*			F*
39000	393	B	F*	B	F*	B	F*	B	F*	B	F*			F*
47000	473	B	F*	B	F*	B	F*	B	F*	B	F*			F*
56000	563	B	F*	B	F*	B	F*	B	F*		F*			
68000	683	B	F*	B	F*	B	F*	B	F*		F*			
82000	823	B	F*	B	F*		F*		F*		F*			
100000	104	B	F*	B	F*		F*		F*		F*			
120000	124		F*		F*		F*		F*					
150000	154		F*		F*									
180000	184		F*		F*									
220000	224		F*		F*									

Cap(pF)	EIA Size		2225											
	Voltage		50V		100V		200V		250V		500V		630V	
	Stacked		1	2	1	2	1	2	1	2	1	2	1	2
10000	103	B		B		B		B		B		B		
12000	123	B		B		B		B		B		B		
15000	153	B		B		B		B		B		B		
18000	183	B		B		B		B		B		B		
22000	223	B	F*	B	F*	B	F*	B	F*	B	F*	B	F*	
27000	273	B	F*	B	F*	B	F*	B	F*	B	F*	B	F*	
33000	333	B	F*	B	F*	B	F*	B	F*	B	F*	B	F*	
39000	393	B	F*	B	F*	B	F*	B	F*	B	F*	B	F*	
47000	473	B	F*	B	F*	B	F*	B	F*	B	F*	B	F*	
56000	563	B	F*	B	F*	B	F*	B	F*	B	F*	B	F*	
68000	683	B	F*	B	F*	B	F*	B	F*	B	F*	B	F*	
82000	823	B	F*	B	F*	B	F*	B	F*	B	F*			F*
100000	104	B	F*	B	F*	B	F*	B	F*		F*			F*
120000	124		F*		F*		F*		F*		F*			F*
150000	154		F*		F*		F*		F*		F*			F*
180000	184		F*		F*		F*		F*		F*			F*
220000	224		F*		F*		F*		F*		F*			F*

1. The code in the table indicates the thickness.
2. "\*" Capacitance M tolerance only.

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**7-2 X7R Dielectric**

Cap(pF)	EIA Size	1210						
		Voltage	50V	100V	200V	250V	500V	630V
		Stacked	1	1	1	1	1	1
10000	103					B	B	
12000	123					B	B	
15000	153					B	B	
18000	183					B	B	
22000	223					B	B	
27000	273					B	B	
33000	333					B	B	
39000	393					B	B	
47000	473					B	B	
56000	563					B	B	
68000	683					B	B	
82000	823					B	B	
100000	104	B	B	B	B	B	B	
120000	124	B	B	B	B			
150000	154	B	B	B	B			
180000	184	B	B	B	B			
220000	224	B	B	B	B			
270000	274	B	B	B	B			
330000	334	B	B	B	B			
390000	394	B	B	B	B			
470000	474	B	B	B	B			
560000	564	B	B	B	B			
680000	684	B	B	B	B			
820000	824	B	B					
1000000	105	B	B					
1200000	125	B	B					
1500000	155	B	B					
1800000	185	B	B					
2200000	225	B	B					
2700000	275	B	B					
3300000	335	B	B					
3900000	395	B						
4700000	475	B						

Cap(pF)	EIA Size	1812												
		Voltage	50V		100V		200V		250V		500V		630V	
		Stacked	1	2	1	2	1	2	1	2	1	2	1	2
100000	104					B		B		B		B		
120000	124					B		B		B		B		
150000	154					B		B		B		B		
180000	184					B		B		B		B		
220000	224					B	F*	B	F*	B	F*	B	F*	
270000	274					B	F*	B	F*	B	F*		F*	
330000	334					B	F*	B	F*	B	F*		F*	
390000	394					B	F*	B	F*	B	F*		F*	
470000	474					B	F*	B	F*	B	F*		F*	
560000	564					B	F*	B	F*		F*			
680000	684					B	F*	B	F*		F*			
820000	824					B	F*	B	F*		F*			
1000000	105	B		B		B	F*	B	F*		F*			
1200000	125	B		B			F*		F*					
1500000	155	B		B			F*		F*					
1800000	185	B		B			F*		F*					
2200000	225	B	F*	B	F*		F*		F*					
2700000	275	B	F*	B	F*									
3300000	335	B	F*	B	F*									
3900000	395	B	F*	B	F*									
4700000	475	B	F*	B	F*									
5600000	565	B	F*		F*									
6800000	685	B	F*		F*									
8200000	825	B	F*		F*									
10000000	106	B	F*		F*									
12000000	126		F*											
15000000	156		F*											
18000000	186		F*											
22000000	226		F*											

1. The code in the table indicates the thickness.
2. "\*" Capacitance M tolerance only.

7-2 X7R Dielectric

Cap(pF)	EIA Size		1825											
	Voltage	Stacked	50V		100V		200V		250V		500V		630V	
			1	2	1	2	1	2	1	2	1	2	1	2
100000	104						B		B		B		B	
120000	124						B		B		B		B	
150000	154						B		B		B		B	
180000	184						B		B		B		B	
220000	224						B	F*	B	F*	B	F*	B	F*
270000	274						B	F*	B	F*	B	F*	B	F*
330000	334						B	F*	B	F*	B	F*	B	F*
390000	394						B	F*	B	F*	B	F*	B	F*
470000	474						B	F*	B	F*	B	F*	B	F*
560000	564						B	F*	B	F*	B	F*	B	F*
680000	684						B	F*	B	F*		F*		F*
820000	824						B	F*	B	F*		F*		F*
1000000	105	B		B			B	F*	B	F*		F*		F*
1200000	125	B		B				F*		F*		F*		F*
1500000	155	B		B				F*		F*				
1800000	185	B		B				F*		F*				
2200000	225	B	F*	B	F*			F*		F*				
2700000	275	B	F*	B	F*									
3300000	335	B	F*	B	F*									
3900000	395	B	F*	B	F*									
4700000	475	B	F*	B	F*									
5600000	565	B	F*	B	F*									
6800000	685	B	F*	B	F*									
8200000	825	B	F*	B	F*									
10000000	106	B	F*	B	F*									
12000000	126		F*		F*									
15000000	156		F*		F*									
18000000	186		F*		F*									
22000000	226		F*		F*									
47000000	476													

Cap(pF)	EIA Size		2220											
	Voltage	Stacked	50V		100V		200V		250V		500V		630V	
			1	2	1	2	1	2	1	2	1	2	1	2
100000	104										B		B	
120000	124										B		B	
150000	154										B		B	
180000	184										B		B	
220000	224										B	F*	B	F*
270000	274										B	F*	B	F*
330000	334										B	F*	B	F*
390000	394										B	F*	B	F*
470000	474										B	F*	B	F*
560000	564											F*		F*
680000	684											F*		F*
820000	824											F*		F*
1000000	105	B		B			B		B			F*		F*
1200000	125	B		B			B		B					
1500000	155	B		B			B		B					
1800000	185	B		B			B		B					
2200000	225	B	F*	B	F*		B	F*	B	F*				
2700000	275	B	F*	B	F*			F*		F*				
3300000	335	B	F*	B	F*			F*		F*				
3900000	395	B	F*	B	F*			F*		F*				
4700000	475	B	F*	B	F*			F*		F*				
5600000	565	B	F*	B	F*									
6800000	685	B	F*	B	F*									
8200000	825	B	F*	B	F*									
10000000	106	B	F*	B	F*									
12000000	126	C	F*		F*									
15000000	156	C	F*		F*									
18000000	186	C	F*		F*									
22000000	226	C	F*		F*									
27000000	276		G*											
33000000	336		G*											
39000000	396		G*											
47000000	476		G*											

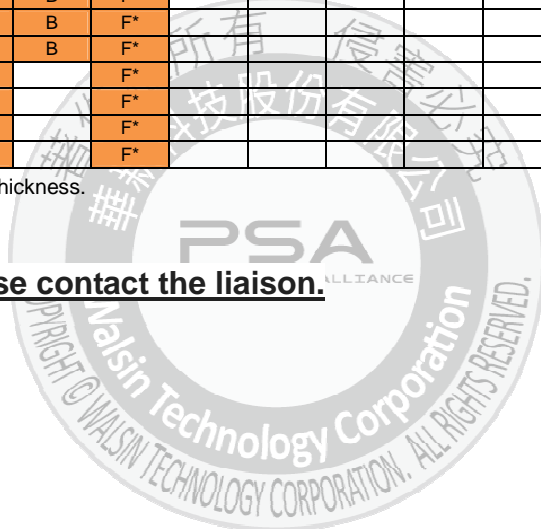
1. The code in the table indicates the thickness. 2. "\*" Capacitance M tolerance only.

**7-2 X7R Dielectric**

Cap(pF)	EIA Size	2225													
		Voltage		50V		100V		200V		250V		500V		630V	
		Stacked	1	2	1	2	1	2	1	2	1	2	1	2	
100000	104											B		B	
120000	124											B		B	
150000	154											B		B	
180000	184											B		B	
220000	224											B	F*	B	F*
270000	274											B	F*	B	F*
330000	334											B	F*	B	F*
390000	394											B	F*	B	F*
470000	474											B	F*	B	F*
560000	564											B	F*	B	F*
680000	684												F*		F*
820000	824												F*		F*
1000000	105	B		B		B		B					F*		F*
1200000	125	B		B		B		B					F*		F*
1500000	155	B		B		B		B							
1800000	185	B		B		B		B							
2200000	225	B	F*	B	F*	B	F*	B	F*						
2700000	275	B	F*	B	F*	B	F*	B	F*						
3300000	335	B	F*	B	F*		F*		F*						
3900000	395	B	F*	B	F*		F*		F*						
4700000	475	B	F*	B	F*		F*		F*						
5600000	565	B	F*	B	F*		F*		F*						
6800000	685	B	F*	B	F*										
8200000	825	B	F*	B	F*										
10000000	106	B	F*	B	F*										
12000000	126		F*		F*										
15000000	156		F*		F*										
18000000	186		F*		F*										
22000000	226		F*		F*										

1. The code in the table indicates the thickness.
2. "\*" Capacitance M tolerance only.

**7-3. Customizable, Please contact the liaison.**



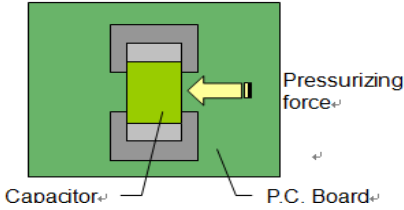
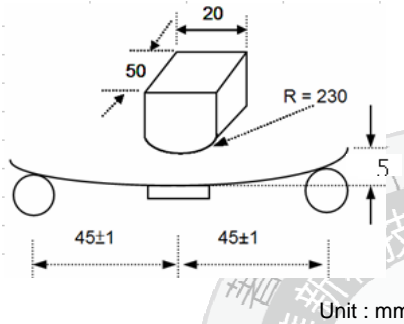


## 8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

No.	Item	Test Condition	Requirements																		
1.	Visual and Dimensions	---	* No remarkable defect. * Dimensions to confirm to individual specification sheet.																		
2.	Capacitance	* Class I : Cap.≤1000pF, 1.0±0.2Vrms, 1MHz±10%. Cap.>1000pF, 1.0±0.2Vrms, 1KHz±10%.	* Shall not exceed the limits given in the detailed spec.																		
3.	Q/D.F. (Dissipation Factor)	* Class II : Cap.≤10μF, 1.0±0.2Vrms, 1KHz±10%. Cap.>10μF, 0.5±0.2Vrms, 120Hz±20%.	<table border="1"> <thead> <tr> <th>Dielectric</th> <th>Cap. Range</th> <th>Q/D.F.</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Class I (C0G)</td> <td>Cap.≥30pF</td> <td>Q≥1000</td> </tr> <tr> <td>Cap.&lt;30pF</td> <td>Q≥400+20C</td> </tr> <tr> <td rowspan="2">Class II (X7R)</td> <td>1210≥2.2μF &amp; 1812~2225≥4.7μF</td> <td>D.F.≤5.0%</td> </tr> <tr> <td>Other</td> <td>D.F.≤2.5%</td> </tr> </tbody> </table>	Dielectric	Cap. Range	Q/D.F.	Class I (C0G)	Cap.≥30pF	Q≥1000	Cap.<30pF	Q≥400+20C	Class II (X7R)	1210≥2.2μF & 1812~2225≥4.7μF	D.F.≤5.0%	Other	D.F.≤2.5%					
Dielectric	Cap. Range	Q/D.F.																			
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	Other	D.F.≤2.5%																			
4.	Temperature Coefficient	* With no electrical load. <table border="1"> <thead> <tr> <th>T.C.</th> <th>Operating Temp.</th> </tr> </thead> <tbody> <tr> <td>C0G</td> <td>-55~125°C at 25°C</td> </tr> <tr> <td>X7R</td> <td>-55~125°C at 25°C</td> </tr> </tbody> </table>	T.C.	Operating Temp.	C0G	-55~125°C at 25°C	X7R	-55~125°C at 25°C	<table border="1"> <thead> <tr> <th>T.C.</th> <th>Capacitance Change</th> </tr> </thead> <tbody> <tr> <td>C0G</td> <td>Within ±30ppm/°C</td> </tr> <tr> <td>X7R</td> <td>Within ±15%</td> </tr> </tbody> </table>	T.C.	Capacitance Change	C0G	Within ±30ppm/°C	X7R	Within ±15%						
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5.	Insulation Resistance	<table border="1"> <thead> <tr> <th>Rated Vol. (V)</th> <th>Apply Voltage</th> <th>Test Time</th> </tr> </thead> <tbody> <tr> <td>≤100</td> <td>1 times of U<sub>R</sub></td> <td>Max. 120 sec.</td> </tr> <tr> <td>100&lt;V≤500</td> <td>1 times of U<sub>R</sub></td> <td>60 sec.</td> </tr> <tr> <td>&gt;500</td> <td>500Vdc</td> <td>60 sec.</td> </tr> </tbody> </table>	Rated Vol. (V)	Apply Voltage	Test Time	≤100	1 times of U <sub>R</sub>	Max. 120 sec.	100<V≤500	1 times of U <sub>R</sub>	60 sec.	>500	500Vdc	60 sec.	<table border="1"> <thead> <tr> <th>Dielectric</th> <th>Requirements</th> </tr> </thead> <tbody> <tr> <td>Class I</td> <td>≥10GΩ or RxC≥500Ω-F, whichever is smaller</td> </tr> <tr> <td>Class II</td> <td>≥10GΩ or RxC≥100Ω-F, whichever is smaller</td> </tr> </tbody> </table>	Dielectric	Requirements	Class I	≥10GΩ or RxC≥500Ω-F, whichever is smaller	Class II	≥10GΩ or RxC≥100Ω-F, whichever is smaller
Rated Vol. (V)	Apply Voltage	Test Time																			
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6.	Dielectric Strength	<table border="1"> <thead> <tr> <th>Rated Voltage</th> <th>Condition</th> </tr> </thead> <tbody> <tr> <td>≤100</td> <td>2.5 times of U<sub>R</sub></td> </tr> <tr> <td>100&lt;V≤250</td> <td>2.0 times of U<sub>R</sub></td> </tr> <tr> <td>250&lt;V≤500</td> <td>1.5 times of U<sub>R</sub></td> </tr> <tr> <td>630</td> <td>1.2 times of U<sub>R</sub></td> </tr> </tbody> </table> * Duration : 1 to 5 sec. * Charge and discharge current less than 50mA.	Rated Voltage	Condition	≤100	2.5 times of U <sub>R</sub>	100<V≤250	2.0 times of U <sub>R</sub>	250<V≤500	1.5 times of U <sub>R</sub>	630	1.2 times of U <sub>R</sub>	* No evidence of damage or flash over during test.								
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7.	Temperature Cycle	* Conduct the 100 cycles according to the temperatures and time. <table border="1"> <thead> <tr> <th>Step</th> <th>Temp.(°C)</th> <th>Time(min.)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Min. operating temp. +0/-3</td> <td>30±3</td> </tr> <tr> <td>2</td> <td>Room temp.</td> <td>2~3</td> </tr> <tr> <td>3</td> <td>Max. operating temp. +3/-0</td> <td>30±3</td> </tr> <tr> <td>4</td> <td>Room temp.</td> <td>2~3</td> </tr> </tbody> </table> * 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).	Step	Temp.(°C)	Time(min.)	1	Min. operating temp. +0/-3	30±3	2	Room temp.	2~3	3	Max. operating temp. +3/-0	30±3	4	Room temp.	2~3	* No remarkable damage. * Cap. change : C0G Within ±2.5% or ±0.25pF, whichever is larger. X7R Within ±7.5%. * Q/D.F. : C0G : Q≥100% of initial requirement. X7R : D.F.≤150% of initial requirement. * I.R. : To meet the initial requirement.			
Step	Temp.(°C)	Time(min.)																			
1	Min. operating temp. +0/-3	30±3																			
2	Room temp.	2~3																			
3	Max. operating temp. +3/-0	30±3																			
4	Room temp.	2~3																			
8.	Humidity (Damp Heat) Steady State	* 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).	* No remarkable damage. * Cap. change : C0G Within ±5.0% or ±0.5pF, whichever is larger. X7R Within ±12.5%. * Q/D.F. : C0G : Q≥350. X7R : D.F.≤200% of initial requirement. * I.R. : ≥1GΩ or RxC≥50Ω-F, whichever is smaller.																		

No.	Item	Test Condition	Requirements																																								
9.	Humidity (Damp Heat) Load	<p>* Test temp. : 40±2℃. * Humidity : 90~95%RH. * Test time : 500 +24/-0hrs. * To apply voltage : Rated voltage (500V max.). * Before initial measurement (Class II only) : To apply de-aging at 150℃ 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).</p>	<p>* No remarkable damage. * Cap. change : C0G Within ±7.5% or ±0.75pF, whichever is larger. X7R Within ±12.5%. * Q/D.F. : C0G : Q≥200. X7R : D.F.≤200% of initial requirement. * I.R. : ≥500MΩ or RxC≥25Ω-F, whichever is smaller.</p>																																								
10.	High Temperature Load (Endurance)	<p>* Test temp. : 125±3℃. * To apply voltage :</p> <table border="1"> <thead> <tr> <th>Dielectric</th> <th>Rated Vol.(V)</th> <th>Apply Voltage</th> </tr> </thead> <tbody> <tr> <td rowspan="3">C0G/X7R</td> <td>≤100</td> <td>2.0 times of U<sub>R</sub></td> </tr> <tr> <td>200≤V≤500</td> <td>1.5 times of U<sub>R</sub></td> </tr> <tr> <td>=630</td> <td>1.2 times of U<sub>R</sub></td> </tr> </tbody> </table> <p>* Exception items (X7R only) : (1) 150% of rated voltage for below range :</p> <table border="1"> <thead> <tr> <th>Rated Vol.(V)</th> <th>Size</th> <th>Cap. Range</th> </tr> </thead> <tbody> <tr> <td>ALL</td> <td>ALL</td> <td>Cap.≥106</td> </tr> <tr> <td rowspan="4">50V &amp; 100V</td> <td>1210</td> <td rowspan="4">Cap.≥105</td> </tr> <tr> <td>1812</td> </tr> <tr> <td>1825</td> </tr> <tr> <td>2220</td> </tr> <tr> <td>2225</td> <td></td> </tr> </tbody> </table> <p>(2) 120% of rated voltage for below range :</p> <table border="1"> <thead> <tr> <th>Size</th> <th>Dielectric</th> <th>Rated Voltage</th> <th>Capacitance</th> </tr> </thead> <tbody> <tr> <td>2220</td> <td>X7R</td> <td>≥100V</td> <td>Cap.≥15μF</td> </tr> </tbody> </table> <p>(3) 100% of rated voltage for below range :</p> <table border="1"> <thead> <tr> <th>Size</th> <th>Dielectric</th> <th>Rated Voltage</th> <th>Capacitance</th> </tr> </thead> <tbody> <tr> <td>1210</td> <td>X7R</td> <td>≥100V</td> <td>Cap.≥3.3μF</td> </tr> </tbody> </table> <p>* Test time : 1000 +24/-0 hrs. * Before initial measurement (Class II only) : To apply de-aging at 150℃ 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).</p>	Dielectric	Rated Vol.(V)	Apply Voltage	C0G/X7R	≤100	2.0 times of U <sub>R</sub>	200≤V≤500	1.5 times of U <sub>R</sub>	=630	1.2 times of U <sub>R</sub>	Rated Vol.(V)	Size	Cap. Range	ALL	ALL	Cap.≥106	50V & 100V	1210	Cap.≥105	1812	1825	2220	2225		Size	Dielectric	Rated Voltage	Capacitance	2220	X7R	≥100V	Cap.≥15μF	Size	Dielectric	Rated Voltage	Capacitance	1210	X7R	≥100V	Cap.≥3.3μF	<p>* No remarkable damage. * Cap. change : C0G Within ±3.0% or ±0.3pF, whichever is larger. X7R Within ±12.5%. * Q/D.F. : C0G : Q≥350. X7R : D.F.≤200% of initial requirement. * I.R. : ≥1GΩ or RxC≥50Ω-F, whichever is smaller.</p>
Dielectric	Rated Vol.(V)	Apply Voltage																																									
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Multilayer Ceramic Capacitors

No.	Item	Test Condition	Requirements						
11.	Adhesive Strength of Termination	<p>* Capacitors mounted on a substrate. A force of 10N applied perpendicular to the place of substrate and parallel the line joining the center of terminations for 10±1 second.</p>  <p>Capacitor, P.C. Board, Pressurizing force</p>	<p>* No remarkable damage or removal of the terminations.</p>						
14.	Bending Test	<p>* 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.</p>  <p>Unit : mm</p>	<p>* No remarkable damage.</p> <table border="1"> <thead> <tr> <th>Dielectric</th> <th>Cap. Change</th> </tr> </thead> <tbody> <tr> <td>C0G</td> <td>Within ±3.0% or ±2.0pF, whichever is larger</td> </tr> <tr> <td>X7R</td> <td>Within ±12.5%</td> </tr> </tbody> </table> <p>(This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test)</p>	Dielectric	Cap. Change	C0G	Within ±3.0% or ±2.0pF, whichever is larger	X7R	Within ±12.5%
Dielectric	Cap. Change								
C0G	Within ±3.0% or ±2.0pF, whichever is larger								
X7R	Within ±12.5%								
15.	Vibration Resistance	<p>* 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).</p>	<p>* No remarkable damage. * Cap. change and D.F. : To meet initial spec.</p>						

Multilayer Ceramic Capacitors

**9. PACKAGE DIMENSION AND QUANTITY**

**9-1. PACKAGE QUANTITY**

Chip Size	Thickness (mm)	Plastic tape
		13" reel
2220(5750)	3.60±0.35	1.2k
2220(5750)	4.20±0.35	1.2k
2220(5750)	6.00±0.35	1k
2220(5750)	6.60±0.35	1k

For other chip size, please contact the liaison

**9-2. EMBOSSED TAPE DIMENSIONS**

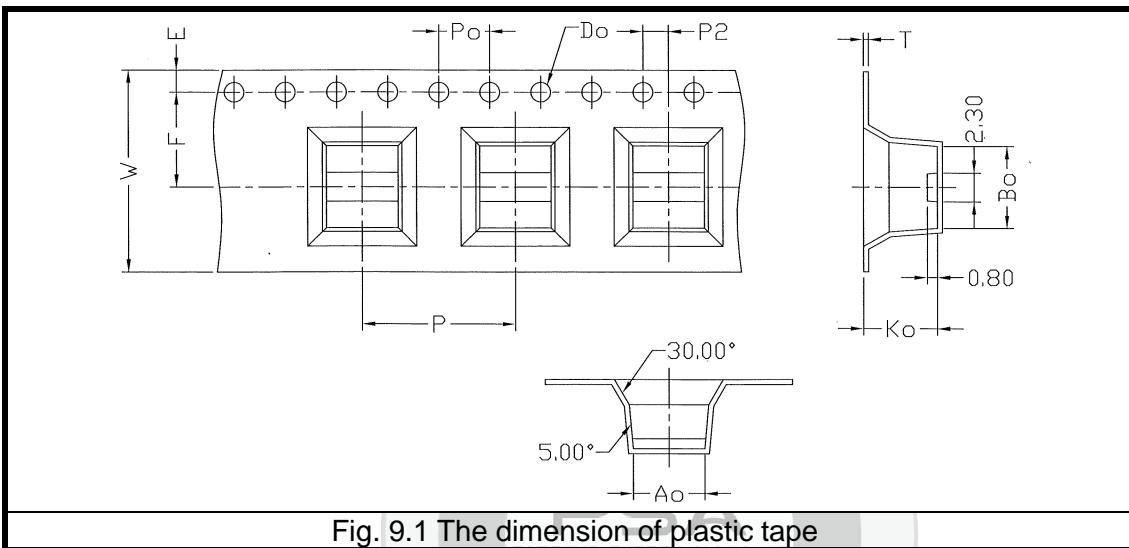
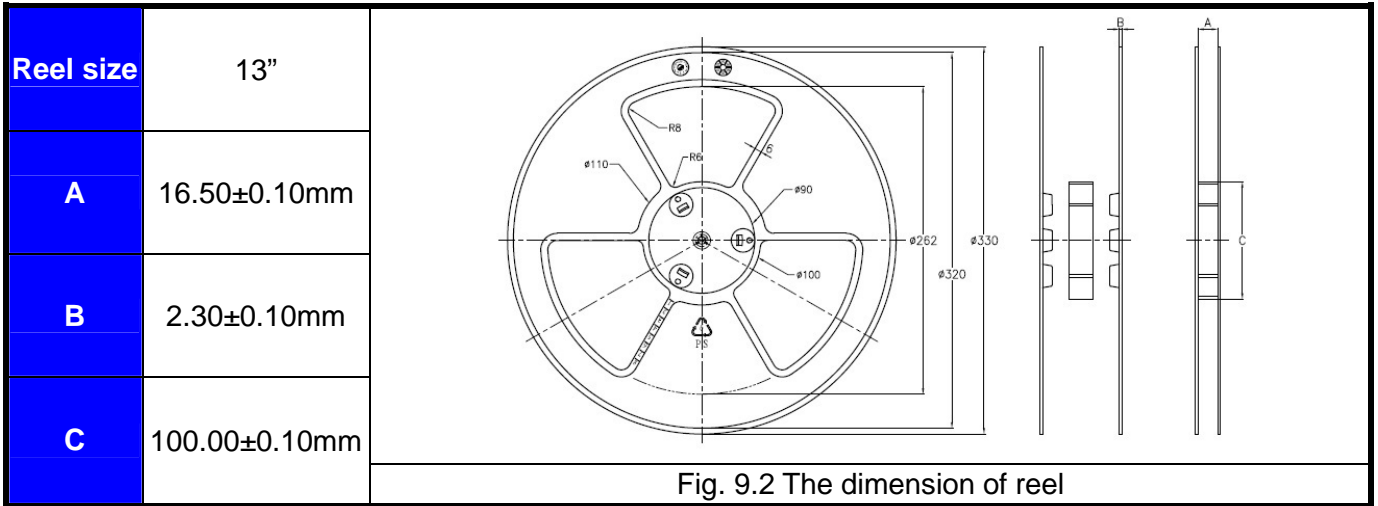


Fig. 9.1 The dimension of plastic tape

Size	2220	2220
Unit :	mm	mm
Chip Thickness	3.60±0.35 4.20±0.35	6.00±0.35 6.60±0.35
W	16.00±0.30	16.00±0.30
E	1.75±0.10	1.75±0.10
F	7.50±0.10	7.50±0.10
P	12.00±0.10	12.00±0.10
P <sub>0</sub>	4.00±0.10	4.00±0.10
P <sub>2</sub>	2.00±0.10	2.00±0.10
D <sub>0</sub>	∅1.50 +0.10/-0	∅1.50 +0.10/-0
T	0.35±0.05	0.40±0.05
A <sub>0</sub>	5.40±0.10	5.60±0.10
B <sub>0</sub>	6.30±0.10	6.60±0.10
K <sub>0</sub>	4.50±0.10	7.00±0.10
Unit :	mm	mm

\* For other chip size, please contact the liaison.

**9-3. REEL DIMENSIONS**



**10. FOOTPRINT DIMENSIONS**



Multilayer Ceramic Capacitors

**11. 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.

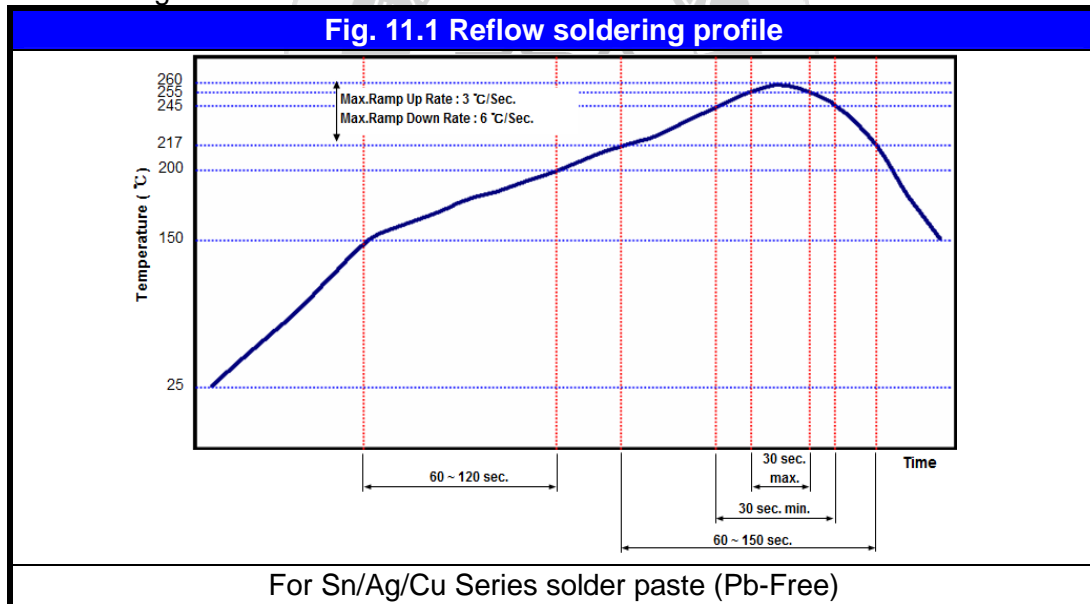
**PREHEAT**

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 RA and RMA 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.) Reflow soldering :



**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 is 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.