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APPROVAL SHEET

Product Name : Medium Voltage Multilayer Ceramic Chip Capacitors

Part No. : MA Series

Description : Size 0402~2225, C0G(NPO)/X7R/Y5V, 100Vdc to 630Vdc

PREPARED BY	APPROVED BY

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SPECIFICATION FOR

MEDIUM VOLTAGE MULTILAYER CERAMIC CHIP CAPACITORS

Part No. : MA Series

Description : Size 0402~2225, C0G(NPO)/X7R/Y5V, 100Vdc to 630Vdc

<u>DRAWN BY</u>	<u>CHECKED BY</u>	<u>APPROVED BY</u>
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1. INTRODUCTION

MA Series green type capacitors are manufactured by using green materials without lead and cadmium. These capacitors feature series connection of multi-layer capacitor units in a MLCC to realize high voltage performance. Reliable performances are built-in through exact formulation of dielectric powders, preparation of conductive paste, advanced automatic manufacturing, and strict quality control to assure excellent control in dielectric thickness, electrode integrity, and electrode-to-termination continuity.

2. FEATURES

- High Voltage in a given case size.
- High reliability and stability.
- RoHS Compliant
- HALOGEN compliant

3. APPLICATIONS

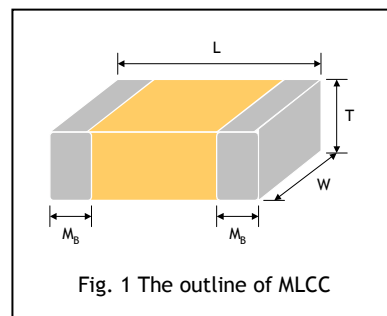
- DC to DC converter.
- High voltage coupling/DC blocking.
- Back-lighting inverters.
- Snubbers in high frequency power convertors.

4.HOW TO ORDER

<u>MA</u>	<u>1210</u>	<u>XR</u>	—	<u>224</u>	<u>K</u>	—	<u>251</u>	<u>ER</u>	<u>G</u>
<u>PDC Family</u>	<u>Size</u>	<u>Dielectric</u>		<u>Capacitance</u>	<u>Tolerance</u>		<u>Rated voltage</u>	<u>Packaging</u>	<u>Control Code</u>
	Inch (mm) 0402 (1005) 0603 (1608) 0805 (2012) 1206 (3216) 1210 (3225) 1808 (4520) 1812 (4532) 1825 (4563) 2220 (5750) 2225 (5763)	CG: C0G(NPO) XR: X7R YV: Y5V		Two significant digits followed by no. of zeros. And R is in place of decimal point. eg.: R47=0.47pF 0R5=0.5pF 1R0=1.0pF 100=10x10 ⁰ =10pF	B =±0.1pF C =±0.25pF D =±0.5pF F =±1% G =±2% J =±5% K =±10% M =±20% Z =-20/+80%		Two significant digits followed by no. of zeros. And R is in place of decimal point. 101 =100 VDC 201 = 200 VDC 251 =250 VDC 501 =500 VDC 631 =630 VDC	ER: Tape and Reel, Embossed Tape PR: Tape and Reel, Paper Tape No Code: Bulk	G: RoHS compliant

5. EXTERNAL DIMENSIONS

Size Inch (mm)	L (mm)	W (mm)	Thickness		M _b (mm)
			mm	Symbol	
0402 (1005)	1.00±0.10	0.50±0.10	0.50±0.05	N	0.25 +0.05/-0.10
0603 (1608)	1.60±0.15	0.80±0.15	0.80±0.07	S	0.40±0.15
			0.80 +0.15/-0.10	X	
0805 (2012)	2.00±0.20	1.25±0.20	0.60±0.10	A	0.50±0.20
			0.80±0.10	B	
			1.25±0.10	D	
1206 (3216)	3.20±0.20	1.60±0.20	0.80±0.10	B	0.60±0.20
			0.85±0.10	T	
			0.95±0.10	C	
			1.25±0.10	D	
			1.60±0.20	G	
			1.60+0.30/-0.10	P, #	
1210 (3225)	3.20±0.30	2.50±0.30	0.95±0.10	C	0.75±0.35
			1.25±0.10	D	
			1.60±0.20	G	
			2.00±0.20	K	
			2.50±0.30	M	
1808 (4520)	4.50±0.40	2.00±0.25	1.60±0.20	G	0.75±0.35
1812 (4532)	4.50±0.40	3.20±0.30	1.25±0.10	D	0.75±0.35
			1.60±0.20	G	
			2.00±0.20	K	
			2.50±0.30	M	
1825 (4563)	4.50±0.40	6.30±0.40	2.00±0.20	K	0.75±0.35
2220 (5750)	5.70±0.40	5.00±0.40	2.00±0.20	K	0.85±0.35
			2.50±0.30	M	
2225 (5763)	5.70±0.40	6.30±0.40	2.00±0.20	K	0.85±0.35
			2.50±0.30	M	



6. GENERAL ELECTRICAL DATA

Dielectric	C0G		X7R	Y5V
Size	0402, 0603, 0805, 1206, 1210, 1808, 1812, 1825, 2220, 2225		0402, 0603, 0805, 1206, 1210, 1808, 1812, 1825, 2220, 2225	0805, 1206, 1210, 1812
Rated voltage (WVDC)	100V, 200V, 250V, 500V, 630V		100V, 200V, 250V, 500V, 630V	100V, 200V, 250V
Capacitance range	0.5pF ~ 220nF		100pF ~ 820nF	10nF to 680nF
Capacitance tolerance	Cap. Rang	Tolerance Spec.	J ($\pm 5\%$), K ($\pm 10\%$), M ($\pm 20\%$)	Z (-20/+80%)
	Cap \leq 5pF:	B ($\pm 0.1\text{pF}$), C ($\pm 0.25\text{pF}$)		
	5pF<Cap<10pF:	C ($\pm 0.25\text{pF}$), D ($\pm 0.5\text{pF}$)		
	10pF \leq Cap:	F ($\pm 1\%$), G ($\pm 2\%$), J ($\pm 5\%$), K ($\pm 10\%$)		
Tan δ	Cap. Rang	Q Spec.	$\leq 2.5\%$	$\leq 5.0\%$
	Cap.<30pF	$Q \geq 400+20C$		
	Cap. \geq 30pF	$Q \geq 1000$		
Capacitance & Tan δ Test condition	Measured at the condition of 30~70% related humidity			
	For 25°C at ambient temperature		Preconditioning for Class II MLCC : Perform a heat treatment at 150 \pm 10°C for 1 hour, then leave in ambient condition for 24 \pm 2 hours before measurement	
	Cap. Rang	Test Condition	1.0 \pm 0.2Vrms, 1.0KHz \pm 10%, at 25°C ambient temperature	1.0 \pm 0.2Vrms, 1.0KHz \pm 10%, at 20°C ambient temperature
	Cap. \leq 1000pF	1.0 \pm 0.2Vrms, 1.0MHz \pm 10%		
Cap.>1000pF	1.0 \pm 0.2Vrms, 1.0KHz \pm 10%			
Insulation resistance at Ur	$\geq 100\text{G}\Omega$ or $R_{xC} \geq 500\Omega\text{-F}$, whichever is smaller		$\geq 10\text{G}\Omega$ or $R_{xC} \geq 100\Omega\text{-F}$, whichever is smaller	
Operating temperature	-55 to +125°C			-25 to +85°C
Capacitance characteristic	$\pm 30\text{ppm}/^\circ\text{C}$		$\pm 15\%$	+30/-80%
Termination	Cu or Ag/Ni/Sn or Au (lead-free termination)			

* Measured at the condition of 30~70% related humidity.

C0G(NPO): Apply 1.0 \pm 0.2Vrms, 1.0MHz \pm 10% for Cap \leq 1000pF and 1.0 \pm 0.2Vrms, 1.0kHz \pm 10% for Cap>1000pF, 25°C at ambient temperature

X7R: Apply 1.0 \pm 0.2Vrms, 1.0kHz \pm 10%, at 25°C ambient temperature.

Y5V: Apply 1.0 \pm 0.2Vrms, 1.0kHz \pm 10%, at 20°C ambient temperature.

**Measured at 500VDC for 60 sec, for $U_R > 500\text{VDC}$

7. CAPACITANCE RANGE

7-1. C0G(NPO) Dielectric

Dimension		0402			0603			0805					1206				
Cap(pF)	code	100V	200V	250V	100V	200V	250V	100V	200V	250V	500V	630V	100V	200V	250V	500V	630V
0.5	0R5																
1.0	1R0																
1.2	1R2																
1.5	1R5																
1.8	1R8																
2.2	2R2																
2.7	2R7																
3.3	3R3																
3.9	3R9																
4.7	4R7																
5.6	5R6																
6.8	6R8																
8.2	8R2																
10	100																
12	120																
15	150																
18	180																
22	220																
27	270																
33	330																
39	390																
47	470																
56	560																
68	680																
82	820																
100	101																
120	121																
150	151																
180	181																
220	221																
270	271																
330	331																
390	391																
470	471																
560	561																
680	681																
820	821																
1000	102																
1200	122																
1500	152																
1800	182																
2200	222																
2700	272																
3300	332																
3900	392																
4700	472																
5600	562																
6800	682																
8200	822																
10000	103																
12000	123																
15000	153																
18000	183																
22000	223																
27000	273																
33000	333																

7-1. COG(NPO) Dielectric

Dimension		1210					1808					1812				
Cap(pF)	code	100V	200V	250V	500V	630V	100V	200V	250V	500V	630V	100V	200V	250V	500V	630V
2.2	2R2															
2.7	2R7															
3.3	3R3															
3.9	3R9															
4.7	4R7															
5.6	5R6															
6.8	6R8															
8.2	8R2															
10	100															
12	120															
15	150															
18	180															
22	220															
27	270															
33	330															
39	390															
47	470															
56	560															
68	680															
82	820															
100	101															
120	121															
150	151															
180	181															
220	221															
270	271															
330	331															
390	391															
470	471															
560	561															
680	681															
820	821															
1000	102															
1200	122															
1500	152															
1800	182															
2200	222															
2700	272															
3300	332															
3900	392															
4700	472															
5600	562															
6800	682															
8200	822															
10000	103															
12000	123															
15000	153															
18000	183															
22000	223															
27000	273															
33000	333															
39000	393															
47000	473															
56000	563															
68000	683															
82000	823															
100000	104															



7-1. COG(NPO) Dielectric

Dimension		1825					2220					2225				
Cap(pF)	code	100V	200V	250V	500V	630V	100V	200V	250V	500V	630V	100V	200V	250V	500V	630V
10	100															
12	120															
15	150															
18	180															
22	220															
27	270															
33	330															
39	390															
47	470															
56	560															
68	680															
82	820															
100	101															
120	121															
150	151															
180	181															
220	221															
270	271															
330	331															
390	391															
470	471															
560	561															
680	681															
820	821															
1000	102															
1200	122															
1500	152															
1800	182															
2200	222															
2700	272															
3300	332															
3900	392															
4700	472															
5600	562															
6800	682															
8200	822															
10000	103															
12000	123															
15000	153															
18000	183															
22000	223															
27000	273															
33000	333															
39000	393															
47000	473															
56000	563															
68000	683															
82000	823															
100000	104															
120000	124															
150000	154															
180000	184															
220000	224															



7.2 X7R Dielectric

Dimension		0402		0603		0805					1206				
Cap(pF)	code	100V	100V	200V	250V	100V	200V	250V	500V	630V	100V	200V	250V	500V	630V
100	101														
120	121														
150	151														
180	181														
220	221														
270	271														
330	331														
390	391														
470	471														
560	561														
680	681														
820	821														
1000	102														
1200	122														
1500	152														
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2200	222														
2700	272														
3300	332														
3900	392														
4700	472														
5600	562														
6800	682														
8200	822														
10000	103														
12000	123														
15000	153														
18000	183														
22000	223														
27000	273														
33000	333														
39000	393														
47000	473														
56000	563														
68000	683														
82000	823														
100000	104														
120000	124														
150000	154														
180000	184														
220000	224														
270000	274														
330000	334														
390000	394														
470000	474														
560000	564														
680000	684														
820000	824														



7.2 X7R Dielectric

Dimension		1210					1808		1812				
Cap(pF)	code	100V	200V	250V	500V	630V	500V	630V	100V	200V	250V	500V	630V
100	101												
120	121												
150	151												
180	181												
220	221												
270	271												
330	331												
390	391												
470	471												
560	561												
680	681												
820	821												
1000	102												
1200	122												
1500	152												
1800	182												
2200	222												
2700	272												
3300	332												
3900	392												
4700	472												
5600	562												
6800	682												
8200	822												
10000	103												
12000	123												
15000	153												
18000	183												
22000	223												
27000	273												
33000	333												
39000	393												
47000	473												
56000	563												
68000	683												
82000	823												
100000	104												
120000	124												
150000	154												
180000	184												
220000	224												
270000	274												
330000	334												
390000	394												
470000	474												
560000	564												
680000	684												
820000	824												



7.2 X7R Dielectric

Dimension		1825					2220					2225				
Cap(pF)	code	100V	200V	250V	500V	630V	100V	200V	250V	500V	630V	100V	200V	250V	500V	630V
1000	102															
1200	122															
1500	152															
1800	182															
2200	222															
2700	272															
3300	332															
3900	392															
4700	472															
5600	562															
6800	682															
8200	822															
10000	103															
12000	123															
15000	153															
18000	183															
22000	223															
27000	273															
33000	333															
39000	393															
47000	473															
56000	563															
68000	683															
82000	823															
100000	104															
120000	124															
150000	154															
180000	184															
220000	224															
270000	274															
330000	334															
390000	394															
470000	474															
560000	564															
680000	684															
820000	824															



7-3. Y5V Dielectric

Dimension		0805			1206			1210			1812		
Cap(μF)	code	100V	200V	250V	100V	200V	250V	100V	200V	250V	100V	200V	250V
0.010	103												
0.015	153												
0.022	223												
0.033	333												
0.047	473												
0.068	683												
0.10	104												
0.15	154												
0.22	224												
0.33	334												
0.47	474												
0.68	684												

8. 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	-	-
0603 (1608)	0.80±0.07	4k	15k	-	-
	0.80+0.15/-0.10	4k	15k		
0805 (2012)	0.60±0.10	4k	15k	-	-
	0.80±0.10	4k	15k	-	-
	1.25±0.10	-	-	3k	10k
1206 (3216)	1.25±0.20	-	-	3k	-
	0.80±0.10	4k	15k	-	-
	0.95±0.10	-	-	3k	10k
	1.25±0.10	-	-	3k	10k
1210 (3225)	1.60±0.20	-	-	2k	-
	1.60 +0.30/-0.10	-	-		
	0.95±0.10	-	-	3k	10k
	1.25±0.10	-	-	3k	10k
1808 (4520)	1.60±0.20	-	-	1k	-
	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	3k
	1.60±0.20	-	-	1k	-
1812 (4532)	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	3k
	1.60±0.20	-	-	1k	-
1825 (4563)	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	-
	1.60±0.20	-	-	1k	-
2220 (5750)	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	-
	2.00±0.20	-	-	1k	-
2225 (5763)	2.50±0.30	-	-	0.5k	-

Unit: pieces

8. PACKAGE DIMENSION AND QUANTITY

8.1. EMBOSSED TAPE DIMENSIONS

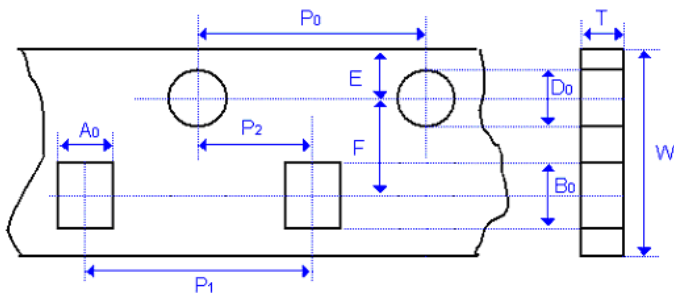


Fig. 8.1 The dimension of paper tape

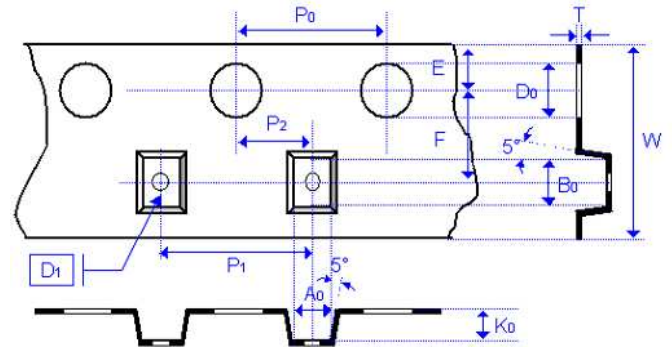


Fig. 8.2 The dimension of plastic tape

Size	0603		0805		1206		
Chip Thickness	0.80±0.07	0.80 +0.15/-0.10	0.80±0.10	1.25±0.10 1.25±0.20	0.80±0.10	0.95±0.10 1.25±0.10	1.60±0.20 1.60 +0.3/-0/1
A ₀	1.00 +0.05/-0.10	1.02 +0.05/-0.10	1.50±0.10	<1.65	2.00±0.10	<2.00	<2.00
B ₀	1.80±0.10	1.80±0.10	2.30±0.10	<2.40	3.50±0.10	<3.60	<3.70
T	0.95±0.05	0.97±0.05	0.95±0.05	0.23±0.05	0.95±0.05	0.23±0.05	0.23±0.05
K ₀	-	-	-	<2.50	-	<2.50	<2.50
W	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10
P ₀	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10
10xP ₀	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20
P ₁	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10
P ₂	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05
D ₀	1.55±0.05	1.55±0.05	1.55±0.05	1.50 +0.10/-0	1.55±0.05	1.50 +0.10/-0	1.50 +0.10/-0
D ₁	-	-	-	1.00±0.10	-	1.00±0.10	1.00±0.10
E	1.75±0.05	1.75±0.05	1.75±0.05	1.75±0.10	1.75±0.10	1.75±0.10	1.75±0.10
F	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05
Unit :	mm	mm	mm	mm	mm	mm	mm

Size	1210		1808		1812	
Chip Thickness	0.95±0.10 1.25±0.10 1.60±0.20	2.50±0.30	1.25±0.10 1.60±0.20	2.00±0.20	1.25±0.10 1.60±0.20 2.00±0.20	2.50±0.30
A ₀	<3.05	<3.10	<2.50	<2.50	<3.90	<3.90
B ₀	<3.80	<4.00	<5.30	<5.30	<5.30	<5.30
T	0.23±0.05	0.23±0.05	0.25±0.05	0.25±0.05	0.25±0.05	0.25±0.05
K ₀	<2.50	<3.50	<2.50	<2.50	<2.50	<3.00
W	8.00±0.10	8.00±0.10	12.0±0.20	12.0±0.20	12.0±0.20	12.0±0.20
P ₀	4.00±0.100	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10
10xP ₀	40.00±0.20	40.0±0.10	40.0±0.20	40.0±0.20	40.00±0.20	40.00±0.20
P ₁	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	8.00±0.10	8.00±0.10
P ₂	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05
D ₀	1.50 +0.10/-0	1.50 +0.10/-0	1.50 +0.10/-0	1.50 +0.10/-0	1.50 +0.10/-0	1.50 +0.10/-0
D ₁	1.00±0.10	1.00±0.10	1.50±0.10	1.50±0.10	1.50±0.10	1.50±0.10
E	1.75±0.10	1.75±0.10	1.75±0.10	1.75±0.10	1.75±0.10	1.75±0.10
F	3.50±0.05	3.50±0.05	5.50±0.05	5.50±0.05	5.50±0.05	5.50±0.05
Unit :	mm	mm	mm	mm	mm	mm

8. PACKAGE DIMENSION AND QUANTITY

Size	1825		2220		2225	
Chip Thickness	1.60±0.20 2.00±0.20	2.50±0.30	1.40±0.15 1.60±0.20 2.00±0.20	2.50±0.30	1.60±0.20 2.00±0.20	2.50±0.30
A ₀	<6.80	<6.80	<5.80	<5.80	<6.80	<6.80
B ₀	<5.30	<5.30	<6.50	<6.50	<6.50	<6.50
T	0.30±0.10	0.30±0.10	0.30±0.10	0.30±0.10	0.30±0.10	0.30±0.10
K ₀	<2.50	<3.10	<2.50	<3.10	<2.50	<3.10
W	12.0±0.20	12.0±0.20	12.0±0.20	12.0±0.20	12.0±0.20	12.0±0.20
P ₀	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10
10xP ₀	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20
P ₁	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10
P ₂	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05
D ₀	1.50 +0.10/-0	1.50 +0.10/-0	1.50 +0.10/-0	1.50 +0.10/-0	1.50 +0.10/-0	1.50 +0.10/-0
D ₁	1.50±0.10	1.50±0.10	1.50±0.10	1.50±0.10	1.50±0.10	1.50±0.10
E	1.75±0.10	1.75±0.10	1.75±0.10	1.75±0.10	1.75±0.10	1.75±0.10
F	5.50±0.05	5.50±0.05	5.50±0.05	5.50±0.05	5.50±0.05	5.50±0.05
Unit :	mm	mm	mm	mm	mm	mm

8.2. REEL DIMENSIONS

Size	0402, 0603, 0805, 1206, 1210			1808, 1812, 1825, 2220, 2225
Reel size	7"	7"	13"	7"
C	13.0 +0.5/-0.2	13.0 +0.5/-0.2	13.0 +0.5/-0.2	13.0 +0.5/-0.2
W ₁	8.4 +1.5/-0	12.4 +2.0/-0	8.4 +1.5/-0	8.4 +1.5/-0
A	178.0 ±0.10	178.0 ±0.10	330.0 ±1.0	178.0 ±0.10
N	60.0 +1.0/-0	80.0 ±1.0	100 ±1.0	60.0 +1.0/-0

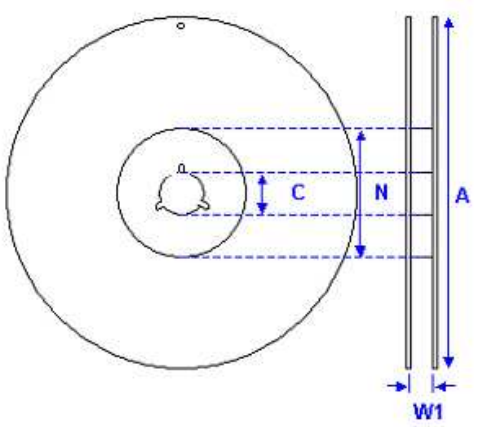


Fig. 9.3 The dimension of reel

9. 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.

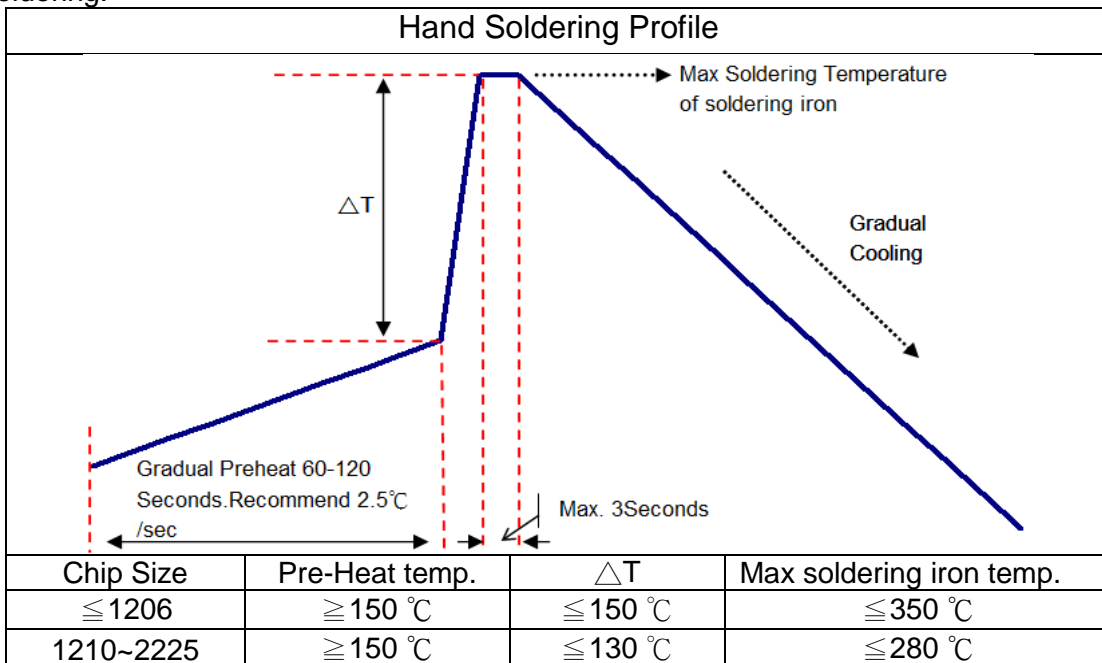
PREHEAT

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 middy 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.) Hand soldering:



*Soldering iron tip diameter $\leq 1.0\text{ mm}$ 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.

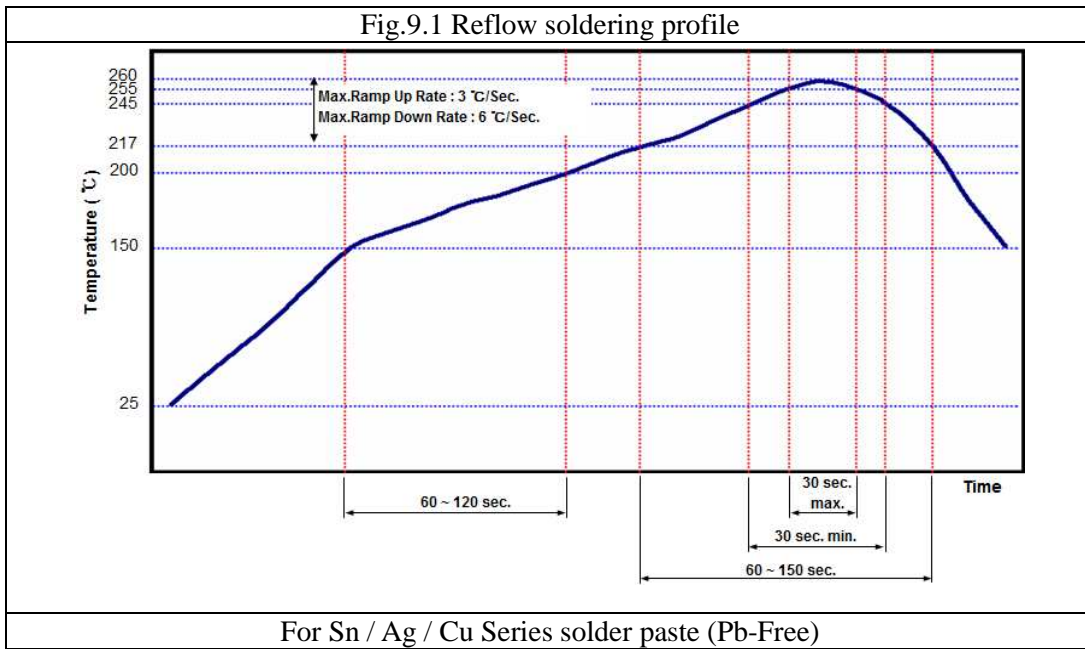
*The tip of iron should not contact the ceramic body directly.

*The Capacitors shall be cooled gradually at room temperature after soldering.

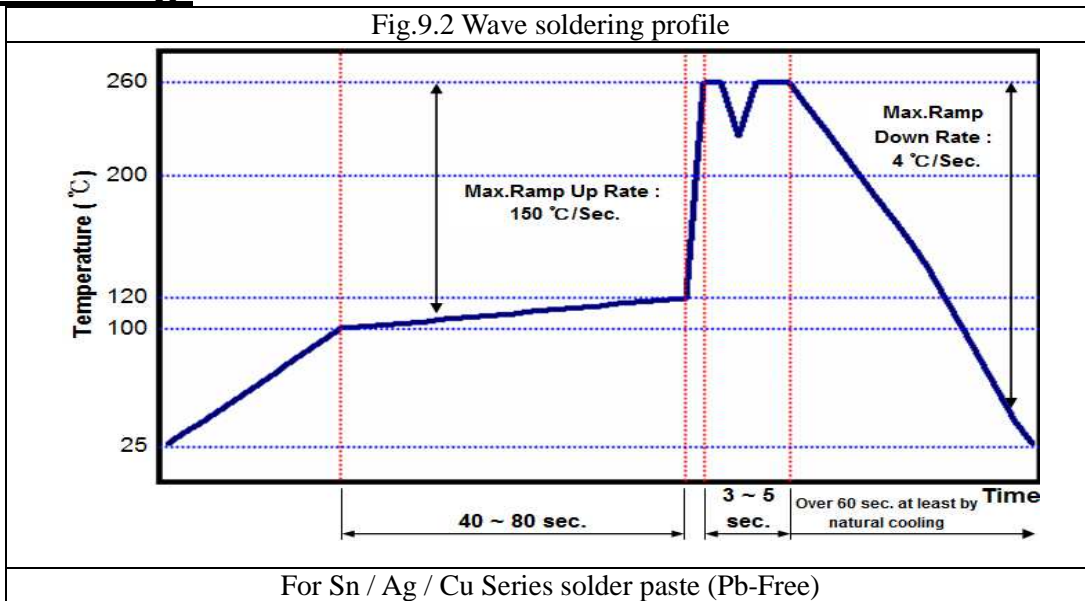
*Forced air cooling is not allowed.

9. APPLICATION NOTES

b.) Reflow soldering:



c.) Wave soldering:



Soldering conditions:

Class:

Size Inch (mm)	Temper. Char.	Capacitance	Condition	
			Wave	Reflow
0402 (1005)	Class I – C0G	All	X	○
0603 (1608)	Class I - C0G	All	○	○
0805 (2012)	Class I - C0G	All	○	○
1206 (3216)	Class I - C0G	All	○	○
≥ 1210 (3225)	Class I - C0G	All	X	○

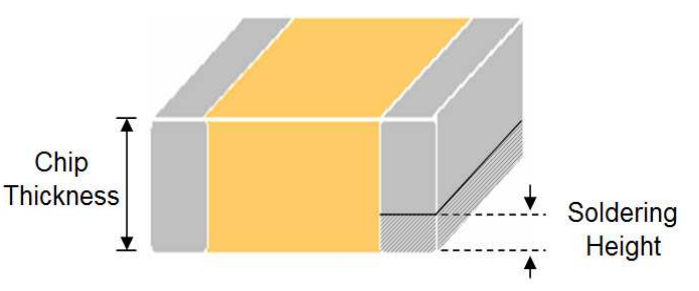
9. APPLICATION NOTES

Soldering conditions:

ClassII:

Size Inch (mm)	Temper. Cher.	Capacitance	Condition	
			Wave	Reflow
0402 (1005)	ClassII - X7R	All	X	○
0603 (1608)	ClassII - X7R	Cap. < 2.2 μ F	○	○
		Cap. \geq 2.2 μ F	X	○
0805 (2012)	ClassII - X7R	Cap. < 4.7 μ F	○	○
		Cap. \geq 4.7 μ F	X	○
1206 (3216)	ClassII - X7R	Cap. < 4.7 μ F	○	○
		Cap. \geq 4.7 μ F	X	○
\geq 1210 (3225)	ClassII - X7R	All	X	○

Soldering height:

<p>The solder climbing minimum height is suggesting to 25% of chip thickness or 500um whichever is less. (Reference from IPC-610E)</p>	 <p>The diagram illustrates a cross-section of a chip (yellow) on a substrate (grey). A vertical double-headed arrow on the left indicates the 'Chip Thickness'. On the right, a vertical double-headed arrow indicates the 'Soldering Height', which is the height of the solder joint connecting the chip to the substrate.</p>
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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.

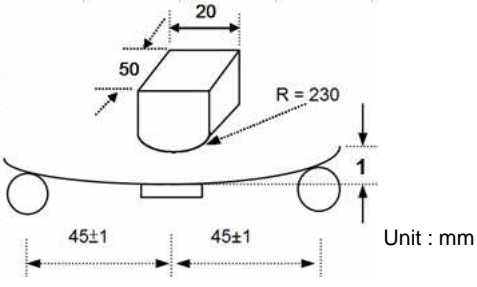
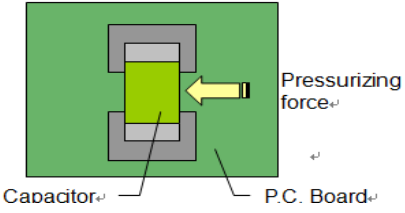
10.RELIABILITY TEST CONDITIONS AND REQUIREMENTS

No.	Item	Test Condition	Requirements																												
1.	Visual and Dimensions	---	* No remarkable defect. * Dimensions to confirm to individual specification sheet.																												
2.	Capacitance		* Shall not exceed the limits given in the detailed spec.																												
3.	Q/ D.F. (Dissipation Factor)	* Class I : C0G Cap.≤1000pF, 1.0±0.2Vrms, 1MHz±10%. Cap.>1000pF, 1.0±0.2Vrms, 1KHz±10%. * Class II : (X7R, Y5V) 1.0±0.2Vrms, 1KHz±10%.	<table border="1"> <thead> <tr> <th>Dielectric</th> <th>Rated V.</th> <th>Q/D.F.</th> <th>Remark</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Class I (C0G)</td> <td rowspan="2">All</td> <td>Q≥1000</td> <td>Cap.≥30pF</td> </tr> <tr> <td>Q≥400+20C</td> <td>Cap.<30pF</td> </tr> <tr> <td rowspan="2">Class II (X7R)</td> <td rowspan="2">≥100</td> <td>D.F.≤2.5%</td> <td></td> </tr> <tr> <td>D.F. ≤3.0%</td> <td>0603≥0.047μF, 0805≥0.18μF, 1206≥0.47μF</td> </tr> <tr> <td>Class II (Y5V)</td> <td>≥100</td> <td>D.F.≤5.0%</td> <td></td> </tr> </tbody> </table>	Dielectric	Rated V.	Q/D.F.	Remark	Class I (C0G)	All	Q≥1000	Cap.≥30pF	Q≥400+20C	Cap.<30pF	Class II (X7R)	≥100	D.F.≤2.5%		D.F. ≤3.0%	0603≥0.047μF, 0805≥0.18μF, 1206≥0.47μF	Class II (Y5V)	≥100	D.F.≤5.0%									
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4.	Temperature Coefficient	<p>* With no electrical load.</p> <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> <tr> <td>Y5V</td> <td>-25~85°C at 20°C</td> </tr> </tbody> </table>	T.C.	Operating Temp.	C0G	-55~125°C at 25°C	X7R	-55~125°C at 25°C	Y5V	-25~85°C at 20°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> <tr> <td>Y5V</td> <td>Within +30%/-80%</td> </tr> </tbody> </table>	T.C.	Capacitance Change	C0G	Within ±30ppm/°C	X7R	Within ±15%	Y5V	Within +30%/-80%												
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5.	Insulation Resistance	<table border="1"> <thead> <tr> <th>Rated Vol.(V)</th> <th>Apply Voltage</th> <th>Test Condition</th> </tr> </thead> <tbody> <tr> <td>=100</td> <td>1 times of U_R</td> <td>Max. 120 sec.</td> </tr> <tr> <td>100<V≤500</td> <td>1 times of U_R</td> <td>60 sec.</td> </tr> <tr> <td>>500</td> <td>500Vdc</td> <td>60 sec.</td> </tr> </tbody> </table>	Rated Vol.(V)	Apply Voltage	Test Condition	=100	1 times of U _R	Max. 120 sec.	100<V≤500	1 times of U _R	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>≥100GΩ 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	≥100GΩ or RxC≥500Ω-F, whichever is smaller	Class II	≥10GΩ or RxC≥100Ω-F, whichever is smaller										
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6.	Solderability	<p>* Solder temperature : 235±5°C for (0603~1210). * Solder temperature : 245±5°C for (1808~2225). * Dipping time : 2±0.5 sec.</p>	* 75% min. coverage of all metalized area.																												
7.	Dielectric Strength	<table border="1"> <thead> <tr> <th>Rated Vol.(V)</th> <th>Condition</th> </tr> </thead> <tbody> <tr> <td>≤100</td> <td>2.5 times of U_R</td> </tr> <tr> <td>100<V≤250</td> <td>2.0 times of U_R</td> </tr> <tr> <td>250<V≤500</td> <td>1.5 times of U_R</td> </tr> <tr> <td>=630</td> <td>1.2 times of U_R</td> </tr> </tbody> </table> <p>* Duration : 1 to 5 sec. * Charge and discharge current less than 50mA.</p>	Rated Vol.(V)	Condition	≤100	2.5 times of U _R	100<V≤250	2.0 times of U _R	250<V≤500	1.5 times of U _R	=630	1.2 times of U _R	* No evidence of damage or flashover during test.																		
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8.	Resistance to Soldering Heat	<p>* 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) : Perform 150 +0/-10°C for 1 hr and then set for 48±4 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.</p> <table border="1"> <thead> <tr> <th>Dielectric</th> <th>Cap. Change</th> <th>Q/D.F. & I.R.</th> </tr> </thead> <tbody> <tr> <td>Class I (C0G)</td> <td>Within ±2.5% or ±0.25pF, whichever is larger</td> <td rowspan="3">To meet initial requirement</td> </tr> <tr> <td>Class II (X7R)</td> <td>Within ±7.5%</td> </tr> <tr> <td>Class II (Y5V)</td> <td>Within ±20%</td> </tr> </tbody> </table> <p>* 25% max. leaching on each edge.</p>	Dielectric	Cap. Change	Q/D.F. & I.R.	Class I (C0G)	Within ±2.5% or ±0.25pF, whichever is larger	To meet initial requirement	Class II (X7R)	Within ±7.5%	Class II (Y5V)	Within ±20%																		
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9.	Temperature Cycle	<p>* Conduct the five cycles according to the temperatures and time.</p> <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> <p>* Before initial measurement (Class II only) : Perform 150 +0/-10°C for 1 hr and then set for 48±4 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>	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	<p>* No remarkable damage.</p> <table border="1"> <thead> <tr> <th>Dielectric</th> <th>I.R.</th> <th>Cap. Change</th> <th>Q/D.F.</th> </tr> </thead> <tbody> <tr> <td>Class I (C0G)</td> <td rowspan="3">To meet initial requirement</td> <td>Within ±2.5% or ±0.25pF, whichever is larger</td> <td>Q≥50% of initial requirement</td> </tr> <tr> <td>Class II (X7R)</td> <td>Within ±7.5%</td> <td rowspan="2">D.F.≤150% of initial requirement</td> </tr> <tr> <td>Class II (Y5V)</td> <td>Within ±20%</td> </tr> </tbody> </table>	Dielectric	I.R.	Cap. Change	Q/D.F.	Class I (C0G)	To meet initial requirement	Within ±2.5% or ±0.25pF, whichever is larger	Q≥50% of initial requirement	Class II (X7R)	Within ±7.5%	D.F.≤150% of initial requirement	Class II (Y5V)	Within ±20%
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10.RELIABILITY TEST CONDITIONS AND REQUIREMENTS (Cont.)

No.	Item	Test Condition	Requirements																																				
10.	Humidity (Damp Heat) Steady State	* Test temp. : 40±2°C. * Humidity : 90~95%RH. * Test time : 500 +24/-0 hrs. * Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).	* No remarkable damage. <table border="1"> <thead> <tr> <th>Dielectric</th> <th>I.R.</th> <th>Cap. Change</th> <th colspan="2">Q/D.F.</th> </tr> </thead> <tbody> <tr> <td rowspan="3">Class I (C0G)</td> <td rowspan="3">≥1G or RxC≥50Ω-F</td> <td rowspan="3">Within ±5.0% or ±0.5pF, whichever is larger</td> <td>Cap.≥30pF</td> <td>Q≥350</td> </tr> <tr> <td>10pF≤Cap.<30pF</td> <td>Q≥275+2.5C</td> </tr> <tr> <td>Cap.<10pF</td> <td>Q≥200+10C</td> </tr> <tr> <td>Class II (X7R)</td> <td rowspan="2">, whichever is smaller</td> <td rowspan="2">Within ±12.5%</td> <td colspan="2">D.F.≤200% of initial requirement</td> </tr> <tr> <td>Class II (Y5V)</td> <td>Within ±30%</td> <td colspan="2">D.F.≤200% of initial requirement</td> </tr> </tbody> </table>	Dielectric	I.R.	Cap. Change	Q/D.F.		Class I (C0G)	≥1G or RxC≥50Ω-F	Within ±5.0% or ±0.5pF, whichever is larger	Cap.≥30pF	Q≥350	10pF≤Cap.<30pF	Q≥275+2.5C	Cap.<10pF	Q≥200+10C	Class II (X7R)	, whichever is smaller	Within ±12.5%	D.F.≤200% of initial requirement		Class II (Y5V)	Within ±30%	D.F.≤200% of initial requirement														
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11.	Humidity (Damp Heat) Load	* Test temp. : 40±2°C. * Humidity : 90~95% RH. * Test time : 500 +24/-0hrs. * To apply voltage : Rated voltage (Max. 500Vdc). * Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).	* No remarkable damage. <table border="1"> <thead> <tr> <th>Dielectric</th> <th>I.R.</th> <th>Cap. Change</th> <th colspan="2">Q/D.F.</th> </tr> </thead> <tbody> <tr> <td rowspan="3">Class I (C0G)</td> <td rowspan="3">≥1GΩ or RxC≥50Ω-F</td> <td rowspan="3">Within ±7.5% or ±0.75pF, whichever is larger</td> <td>Cap.≥30pF</td> <td>Q≥350</td> </tr> <tr> <td>10pF≤Cap.< 30pF</td> <td>Q≥275+2.5C</td> </tr> <tr> <td>Cap.<10pF</td> <td>Q≥200+10C</td> </tr> <tr> <td>Class II (X7R)</td> <td rowspan="2">, whichever is smaller</td> <td rowspan="2">Within ±12.5%</td> <td colspan="2">D.F.≤200% of initial requirement</td> </tr> <tr> <td>Class II (Y5V)</td> <td>Within ±30%</td> <td colspan="2">D.F.≤200% of initial requirement</td> </tr> </tbody> </table>	Dielectric	I.R.	Cap. Change	Q/D.F.		Class I (C0G)	≥1GΩ or RxC≥50Ω-F	Within ±7.5% or ±0.75pF, whichever is larger	Cap.≥30pF	Q≥350	10pF≤Cap.< 30pF	Q≥275+2.5C	Cap.<10pF	Q≥200+10C	Class II (X7R)	, whichever is smaller	Within ±12.5%	D.F.≤200% of initial requirement		Class II (Y5V)	Within ±30%	D.F.≤200% of initial requirement														
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10.RELIABILITY TEST CONDITIONS AND REQUIREMENTS (Cont.)

No.	Item	Test Condition	Requirements								
13	Resistance to Flexure of Substrate	<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 1mm.</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>Class I (C0G)</td> <td>Within ±3.0% or ±0.3pF, whichever is larger</td> </tr> <tr> <td>Class II (X7R)</td> <td>Within ±12.5%</td> </tr> <tr> <td>Class II (Y5V)</td> <td>Within ±30%</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	Class I (C0G)	Within ±3.0% or ±0.3pF, whichever is larger	Class II (X7R)	Within ±12.5%	Class II (Y5V)	Within ±30%
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14.	Adhesive Strength of Termination	<p>* 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.</p>  <p>Capacitor P.C. Board Pressurizing force</p>	<p>* No remarkable damage or removal of the terminations.</p>								
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)</p>	<p>* No remarkable damage. * Cap. change and Q/D.F. : To meet initial spec.</p>								