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## APPROVAL SHEET

Product Name : High Voltage Multilayer Ceramic Chip Capacitors

Part No. : MA Series

Description : Size 0805~2225, C0G/X7R,  $\geq 1KVdc$ , RoHS Compliant

PREPARED BY	APPROVED BY

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SPECIFICATION FOR

HIGH VOLTAGE MULTILAYER CERAMIC CHIP CAPACITORS

Part No. : MA Series

Description : Size 0805~2225, C0G/X7R,  $\geq 1KVdc$ , RoHS Compliant

<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

- a. Special interior design offers high voltage rating in a given case size.
- b. High reliability and stability.
- c. RoHS compliant
- d. HALOGEN compliant

## 3. APPLICATIONS

- a. DC to DC converter.
- b. High voltage coupling/DC blocking.
- c. Back-lighting inverters.
- d. LAN/WLAN interface.
- e. Modem.
- f. Power supplies.

## 4. HOW TO ORDER

<u>MA</u>	<u>1206</u>	<u>CG</u>	—	<u>120</u>	<u>J</u>	—	<u>202</u>	<u>PR</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) <b>0805</b> (2012) <b>1206</b> (3216) <b>1210</b> (3225) <b>1808</b> (4520) <b>1812</b> (4532) <b>1825</b> (4563) <b>2220</b> (5750) <b>2225</b> (5763)	CG: C0G(NPO)  XR: X7R		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 <sup>0</sup> =10pF	<b>B</b> =±0.1pF <b>C</b> =±0.25pF <b>D</b> =±0.5pF <b>F</b> =±1% <b>G</b> =±2% <b>J</b> =±5% <b>K</b> =±10% <b>M</b> =±20%		Two significant digits followed by no. of zeros. And R is in place of decimal point.  <b>102</b> = 1000 VDC <b>152</b> = 1500 VDC <b>202</b> = 2000 VDC <b>302</b> = 3000 VDC <b>402</b> = 4000 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 <sub>B</sub> min (mm)
			mm	Symbol	
0805 (2012)	2.10±0.20	1.25±0.20	0.80±0.10	B	0.50±0.20
			1.25±0.10	D	
1206 (3216)	3.30±0.30	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	
	3.20+0.30/-0.10	1.60+0.30/-0.10	1.60+0.30/-0.10	P, #	
1210 (3225)	3.30±0.40	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±0.20	1.25±0.10	D	0.75±0.35
			1.60±0.20	G	
			2.00±0.20	K	
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)	4.60±0.30	6.30±0.40	2.80±0.30	U	0.75±0.35
			2.00±0.20	K	
			2.50±0.30	M	
2220 (5750)	5.70±0.40	5.00±0.40	2.80±0.30	U	0.85±0.35
			2.00±0.20	K	
			2.50±0.30	M	
2225 (5763)	5.70±0.40	6.30±0.40	2.80±0.30	U	0.85±0.35
			2.00±0.20	K	
			2.50±0.30	M	

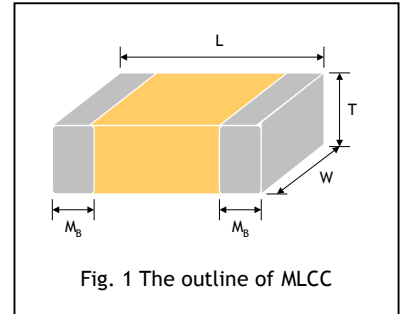


Fig. 1 The outline of MLCC

## 6. GENERAL ELECTRICAL DATA

<b>Dielectric</b>	C0G(NPO)		X7R
<b>Size</b>	0805,1206, 1210, 1808, 1812, 1825, 2211, 2220, 2225		0805,1206, 1210, 1808, 1812, 1825, 2211, 2220, 2225
<b>Rated voltage (WVDC)</b>	1KV, 1.5KV, 2KV, 3KV,4KV		1KV, 1.5KV, 2KV, 3KV,4KV
<b>Capacitance range*</b>	0.5pF ~ 12nF		100pF ~ 330nF
<b>Capacitance tolerance</b>	<b>Cap. Rang</b>	<b>Tolerance Spec.</b>	J (±5%), K (±10%), M (±20%)
	Cap≤5pF:	B (±0.1pF), C (±0.25pF)	
	5pF<Cap<10pF:	C (±0.25pF), D (±0.5pF)	
	10pF≤Cap:	F (±1%), G (±2%), J (±5%),K (±10%)	
<b>Tan δ*</b>	<b>Cap. Rang</b>	<b>Q Spec.</b>	≤2.5%
	Cap<30pF:	Q≥400+20C	
	Cap≥30pF:	Q≥1000	
<b>Capacitance &amp; Tan δ Test Condition</b>	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 for 24±2 hours before measurement.
	for 25°C at ambient temperature		
	<b>Cap. Rang</b>	<b>Test Condition</b>	Apply 1.0±0.2Vrms, 1.0kHz±10%, at 25°C ambient temperature.
	Cap≤1000pF	1.0±0.2Vrms, 1.0MHz±10%	
Cap>1000pF,	1.0±0.2Vrms, 1.0kHz±10%		
<b>Insulation resistance</b>	≥100GΩ or R•C≥ 500Ω-F whichever is smaller		≥10GΩ or R•C≥100Ω-F whichever is smaller
<b>Operating temperature</b>	-55 to +125°C		
<b>Temperature coefficient</b>	±30ppm / °C		±15%
<b>Termination</b>	Ag (or Cu)/Ni/Sn (lead-free termination)		

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

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

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

## 7. CAPACITANCE RANGE

### 7.1 C0G(NPO)

Dimension		0805		1206			1210			
Cap.(pF)	Code	1000V	1000V	1500V	2000V	3000V	1000V	1500V	2000V	3000V
1.5	1R5									
1.8	1R8									
2.2	2R2									
2.7	2R7									
3.3	3R3									
3.9	3R9									
4.7	4R7									
5.0	5R0									
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									

## 7. CAPACITANCE RANGE

Prosperity Dielectrics Co., Ltd.

No.220-1, Sec. 2, Nanshan Rd., Lujhu, Taoyuan 33860, Taiwan



### 7.1 C0G(NPO)

Dimension		1808				1812				1825			
Cap.(pF)	Code	1000V	1500V	2000V	3000V	1000V	1500V	2000V	3000V	1000V	1500V	2000V	3000V
1.5	1R5												
1.8	1R8												
2.2	2R2												
2.7	2R7												
3.3	3R3												
3.9	3R9												
4.7	4R7												
5.0	5R0												
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												



### 7.1 C0G(NPO)

Dimension		2220					2225				
Cap.(pF)	Code	1000V	1500V	2000V	3000V	4000V	1000V	1500V	2000V	3000V	4000V
1.5	1R5										
1.8	1R8										
2.2	2R2										
2.7	2R7										
3.3	3R3										
3.9	3R9										
4.7	4R7										
5.0	5R0										
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										





## 7. CAPACITANCE RANGE(Con.)

### 7.2 X7R

Dimension		0805			1206			1210			1808			
Cap.(pF)	Code	1000V	1000V	1500V	2000V	1000V	1500V	2000V	1000V	1500V	2000V	3000V	4000V	
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													

## 7. CAPACITANCE RANGE(Con.)

### 7.2 X7R

Dimension		1812					1825				
Cap.(pF)	Code	1000V	1500V	2000V	3000V	4000V	1000V	1500V	2000V	3000V	4000V
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										

## 7. CAPACITANCE RANGE(Con.)

### 7.2 X7R

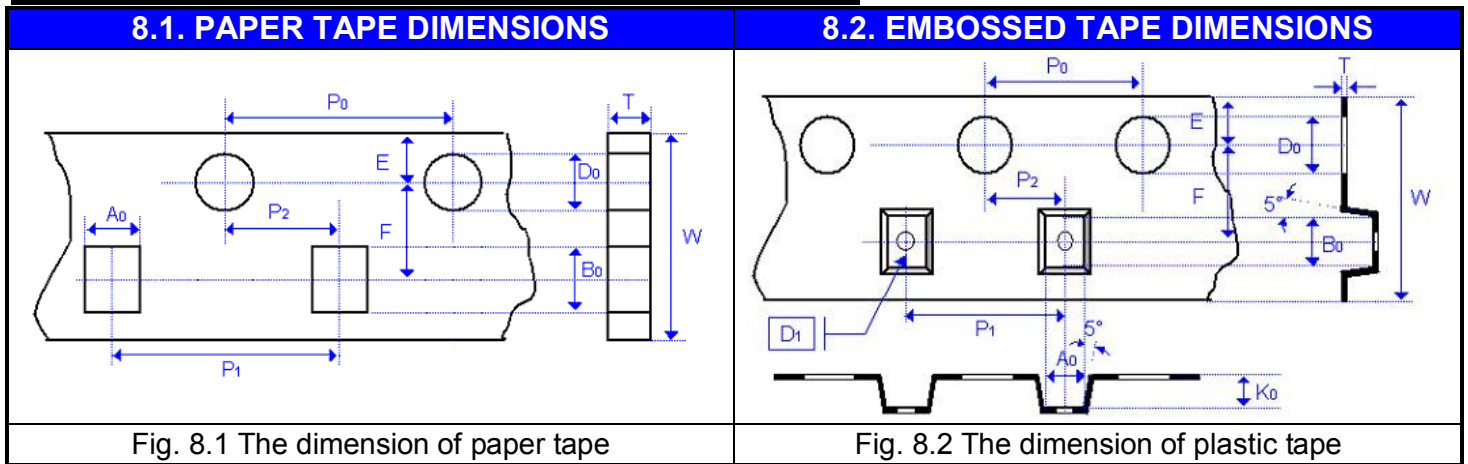
Dimension		2220					2225				
Cap.(pF)	Code	1000V	1500V	2000V	3000V	4000V	1000V	1500V	2000V	3000V	4000V
270	271										
330	331										
390	391										
470	471										
560	561										
680	681										
820	821										
1000	102										
1200	122										
1500	152										
1800	182										
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										

## 8. PACKAGE DIMENSION AND QUANTITY

Size	Thickness (mm)	Paper tape		Plastic tape	
		7" reel	13" reel	7" reel	13" reel
0805 (2012)	0.80±0.10	4K	15k	-	-
	1.25±0.10	-	-	3k	10k
1206 (3216)	0.80±0.10	4k	15k	-	-
	0.95±0.10	-	-	3k	10k
	1.25±0.10	-	-	3k	10k
	1.60±0.20	-	-	2k	-
1210 (3225)	0.95±0.10	-	-	3k	10k
	1.25±0.10	-	-	3k	10k
	1.60±0.20	-	-	2k	-
	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	1k	-
1808 (4520)	1.25±0.10	-	-	2k	-
	1.40±0.15	-	-	2k	-
	1.60±0.20	-	-	2k	-
	2.00±0.20	-	-	1k	-
1812 (4532)	1.25±0.10	-	-	1k	-
	1.60±0.20	-	-	1k	-
	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	3k
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	-
2225 (5763)	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	-
	2.80±0.30	-	-	0.5k	-

Unit: pieces

## 8. PACKAGE DIMENSION AND QUANTITY



Size	0603		0805		1206		
Chip Thickness	<b>0.80±0.07</b>	<b>0.80 +0.15/-0.1</b>	<b>0.80±0.10</b>	<b>1.25±0.10 1.25±0.20</b>	<b>0.80±0.10</b>	<b>0.95±0.10 1.25±0.10</b>	<b>1.60±0.20 1.60+0.3/-0.1</b>
A <sub>0</sub>	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 <sub>0</sub>	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 <sub>0</sub>	-	-	-	<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 <sub>0</sub>	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 <sub>0</sub>	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 <sub>1</sub>	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 <sub>2</sub>	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 <sub>0</sub>	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 <sub>1</sub>	-	-	-	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	<b>0.95±0.10 1.25±0.10 1.60±0.20</b>	<b>2.50±0.30</b>	<b>1.25±0.10 1.60±0.20</b>	<b>2.00±0.20</b>	<b>1.25±0.10 1.60±0.20 2.00±0.20</b>	<b>2.50±0.30</b>
A <sub>0</sub>	<3.05	<3.10	<2.50	<2.50	<3.90	<3.90
B <sub>0</sub>	<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 <sub>0</sub>	<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 <sub>0</sub>	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 <sub>0</sub>	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 <sub>1</sub>	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 <sub>2</sub>	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 <sub>0</sub>	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 <sub>1</sub>	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 <sub>0</sub>	<6.80	<6.80	<5.80	<5.80	<6.80	<6.80
B <sub>0</sub>	<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 <sub>0</sub>	<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 <sub>0</sub>	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 <sub>0</sub>	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 <sub>1</sub>	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 <sub>2</sub>	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 <sub>0</sub>	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 <sub>1</sub>	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±0.1	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

### 8.3. REEL DIMENSIONS

Size	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 <sub>1</sub>	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

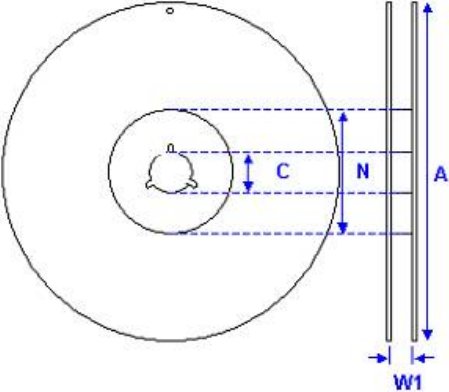


Fig. 8.3 The dimension of reel

## 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.

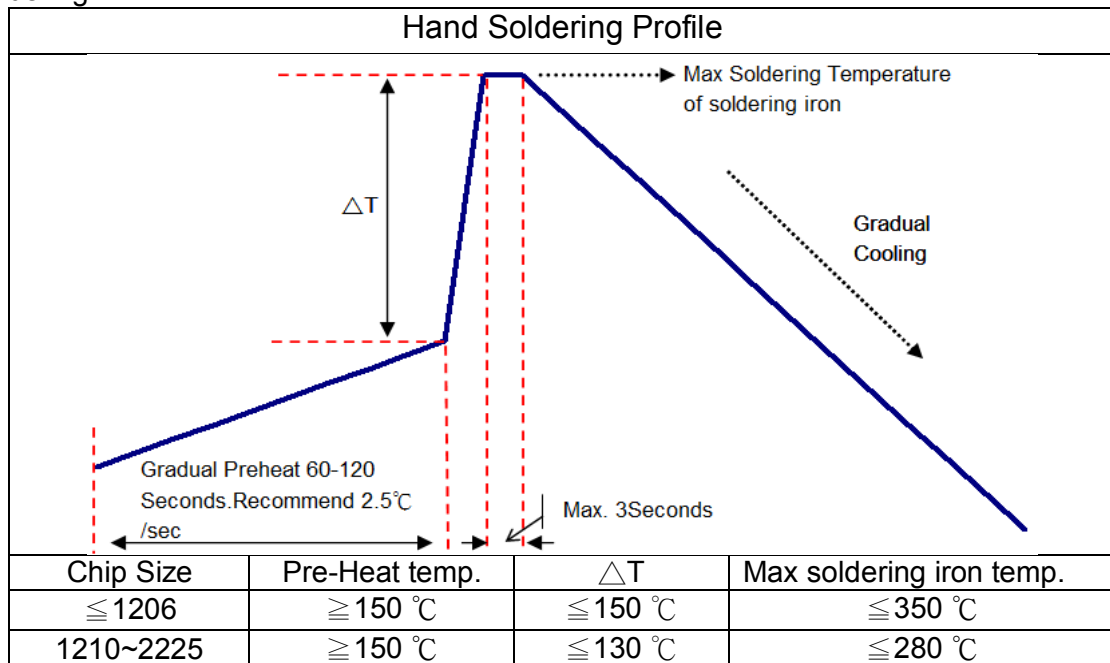
### PREHEAT

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 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.) 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.

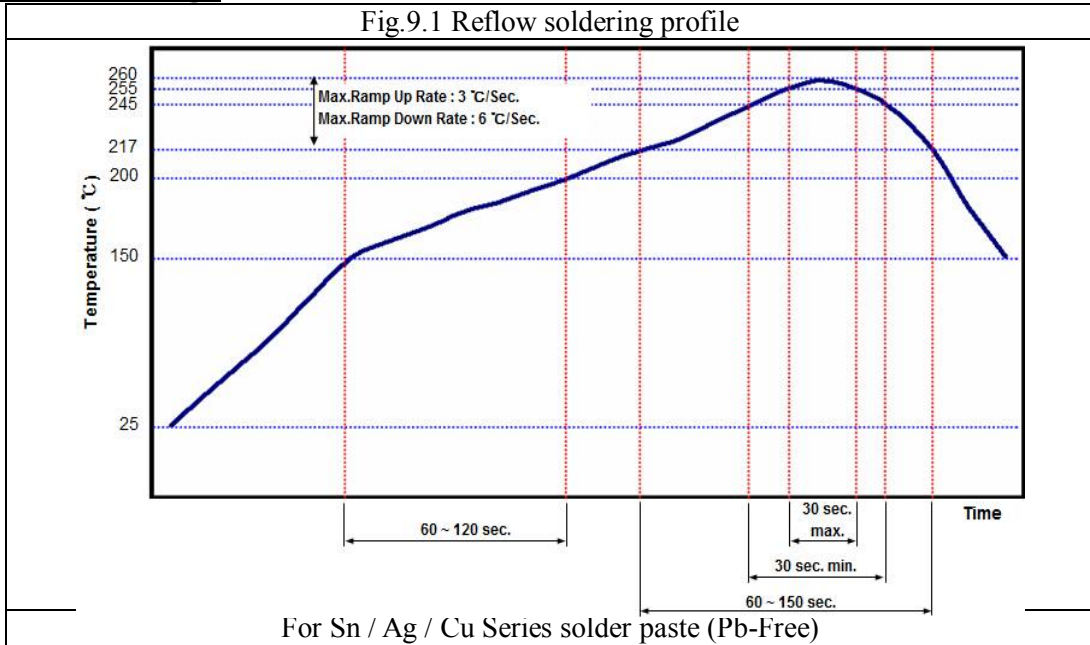
\*The tip of iron should not contact the ceramic body directly.

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

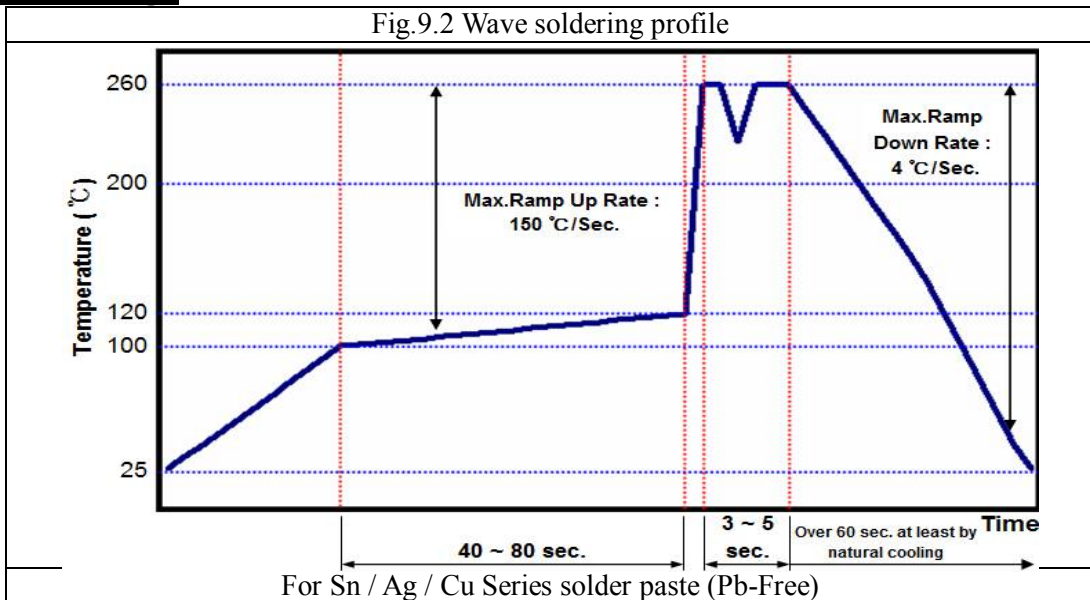
\*Forced air cooling is not allowed.

## 9.APPLICATION NOTES

### b.) Reflow soldering:



### c.)Wave soldering:



### Soldering conditions:

#### ClassI:

Size Inch (mm)	Temper. Cher.	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	○



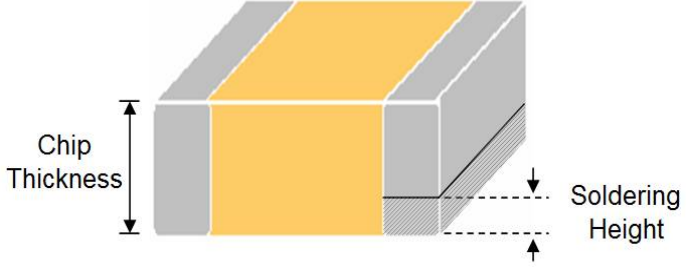
## 9. APPLICATION NOTES

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 $\mu$ F	○	○
		Cap. $\geq$ 2.2 $\mu$ F	X	○
0805 (2012)	ClassII - X7R	Cap. < 4.7 $\mu$ F	○	○
		Cap. $\geq$ 4.7 $\mu$ F	X	○
1206 (3216)	ClassII - X7R	Cap. < 4.7 $\mu$ F	○	○
		Cap. $\geq$ 4.7 $\mu$ 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 500<math>\mu</math>m 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'. A vertical double-headed arrow on the right indicates the 'Soldering Height', which is the height of the solder joint from the substrate surface to the top of the chip.</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.

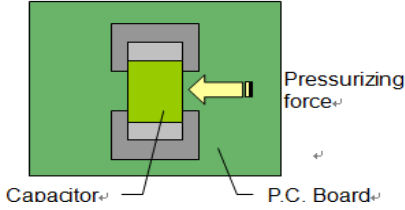
### CLEANING

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 1.0±0.2Vrms, 1KHz±10%.	<table border="1"> <thead> <tr> <th>Dielectric</th> <th>Rated Vol.(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. &lt;30pF</td> </tr> <tr> <td>Class II (X7R)</td> <td>All</td> <td>D.F. ≤2.5%</td> <td></td> </tr> </tbody> </table>	Dielectric	Rated Vol.(V)	Q/D.F.	Remark	Class I (C0G)	All	Q ≥1000	Cap. ≥30pF	Q ≥400+20C	Cap. <30pF	Class II (X7R)	All	D.F. ≤2.5%													
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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 Condition</th> </tr> </thead> <tbody> <tr> <td>&gt;500</td> <td>500Vdc</td> <td>60 sec.</td> </tr> </tbody> </table>	Rated Vol.(V)	Apply Voltage	Test Condition	>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	* Solder temperature : 235±5°C for (0603~1210). * Solder temperature : 245±5°C for (1808~2225). * Dipping time : 2±0.5 sec.	* 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>630 ≤ V ≤ 3000V</td> <td>1.2 times of UR</td> </tr> <tr> <td>3000 &lt; V ≤ 5000V</td> <td>1.1 times of UR</td> </tr> </tbody> </table> * Duration : 1 to 5 sec. * Charge and discharge current less than 50mA.	Rated Vol.(V)	Condition	630 ≤ V ≤ 3000V	1.2 times of UR	3000 < V ≤ 5000V	1.1 times of UR	* No evidence of damage or flashover during test.																				
Rated Vol.(V)	Condition																												
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8.	Resistance to Soldering Heat	* 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).	* No remarkable damage. <table border="1"> <thead> <tr> <th>Dielectric</th> <th>Cap. Change</th> <th>Q/D.F. &amp; 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="2">To meet initial requirement</td> </tr> <tr> <td>Class II (X7R)</td> <td>Within ±7.5%</td> </tr> </tbody> </table> * 25% max. leaching on each edge.	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%																		
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Class II (X7R)	Within ±7.5%																												
9.	Temperature Cycle	* Conduct the five 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) : 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).	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. <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="2">To meet initial requirement</td> <td>Within ±2.5% or ±0.25pF, whichever is larger</td> <td>Q ≥100% of initial requirement</td> </tr> <tr> <td>Class II (X7R)</td> <td>Within ±7.5%</td> <td>D.F. ≤150% of initial requirement</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 ≥100% of initial requirement	Class II (X7R)	Within ±7.5%	D.F. ≤150% of initial requirement
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Class II (X7R)		Within ±7.5%	D.F. ≤150% of initial requirement																										

## 10.RELIABILITY TEST CONDITIONS AND REQUIREMENTS(Cont.)

No.	Item	Test Condition	Requirements
14.	<b>Adhesive Strength of Termination</b>	<p>* Capacitors mounted on a substrate. A force of 5N(<math>\leq 0603</math>) or 10N(<math>&gt;0603</math>) applied perpendicular to the place of substrate and parallel the line joining the center of terminations for <math>10 \pm 1</math> second.</p>  <p>The diagram shows a green rectangular substrate labeled 'P.C. Board' with a yellow capacitor labeled 'Capacitor' mounted on it. A yellow arrow labeled 'Pressurizing force' points to the right, indicating the direction of the applied force. The capacitor is positioned between two grey rectangular pads on the board.</p>	* No remarkable damage or removal of the terminations.
15.	<b>Vibration Resistance</b>	<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>