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APPROVAL SHEET

Product Name : General Purpose Multilayer Ceramic Chip Capacitors

Part No. : MA Series

Description : Size 0402~2225, C0G(NPO)/X7R/X5R/Y5V, $U_R \leq 50V$,

PREPARED BY	APPROVED BY

信昌電子陶瓷股份有限公司

PROSPERITY DIELECTRICS CO., LTD.

桃園縣蘆竹鄉南山路二段 220-1 號 <http://www.pdc.com.tw>

Tel: 03-322-4471 ext: Fax: 03-322-5231 / 03-321-2215

Contact: _____ Mobile: _____

SPECIFICATION FOR

GENERAL PURPOSE MULTILAYER CERAMIC CHIP CAPACITORS

Part No. : MA Series

Description : Size 0402~2225, C0G(NPO)/X7R/X5R/Y5V, $U_R \leq 50V$,

<u>DRAWN BY</u>	<u>CHECKED BY</u>	<u>APPROVED BY</u>
蕭敏珍	蔡永承	巫宏俊

1. INTRODUCTION

PROSPERITY Multilayer Ceramic Chip Capacitors supplied in bulk or tape & reel package are ideally suitable for thick-film hybrid circuits and automatic surface mounting on any printed circuit boards.

The nickel-barrier terminations are consisted of a nickel barrier layer over the silver metallization and then finished by electroplated solder layer to ensure the terminations have good solderability. The nickel barrier layer in terminations prevents the dissolution of termination when extended immersion in molten solder at elevated solder temperature.

2. FEATURES

- A wide selection of sizes is available (0402 to 2225).
- High capacitance in given case size.
- Capacitor with lead-free termination (pure Tin).
- RoHS compliant
- HALOGEN compliant

3. APPLICATIONS

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

4. HOW TO ORDER

<u>MA</u>	<u>1206</u>	<u>XR</u>	—	<u>104</u>	<u>K</u>	—	<u>500</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) 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 or X5R 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. 6R3 = 6.3 VDC 100 =10 VDC 160 =16 VDC 250 =25 VDC 500 =50 VDC	ER: Tape and Reel, Embossed Tape PR: Tape and Reel, Paper Tape No Code: Bulk	G: RoHS compliant

5. EXTERNAL DIMENSIONS

Size	L (mm)	W (mm)	Tmax (mm)	M _B min (mm)
0402 (1005)	1.00±0.05	0.50±0.05	0.55	0.15
0603 (1608)	1.60±0.15	0.80±0.15	0.95	0.20
0805 (2012)	2.00±0.20	1.25±0.20	1.45	0.30
1206 (3216)	3.20±0.20	1.60±0.20	1.80	0.30
	3.20+0.3/-0.1	1.60+0.3/0.1	1.90	
1210 (3225)	3.20±0.40	2.50±0.30	2.80	0.30
1812 (4532)	4.50±0.40	3.20±0.30	2.80	0.26
1825 (4563)	4.50±0.40	6.30±0.40	3.00	0.30
2220 (5750)	5.70±0.40	5.00±0.40	3.00	0.30
2225 (5763)	5.70±0.40	6.30±0.40	3.00	0.30

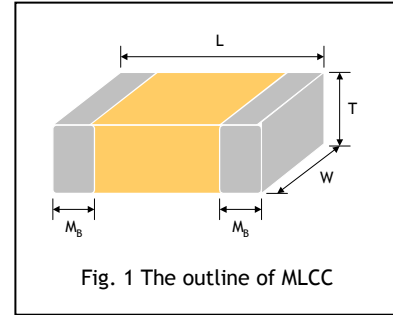


Fig. 1 The outline of MLCC

6. GENERAL ELECTRICAL DATA

Dielectric	C0G(NP0)	X7R	Y5V	X5R
Size	0402, 0603, 0805, 1206, 1210, 1812	0402, 0603, 0805, 1206, 1210, 1812, 1825, 2220, 2225	0402, 0603, 0805, 1206, 1210, 1812	0402, 0603
Capacitance range*	0.5pF to 39nF	100pF to 2.2μF	10nF to 1.0μF	10nF to 1.0μF
Capacitance tolerance	Cap≤5pF: B (±0.1pF), C (±0.25pF) 5pF<Cap<10pF: C (±0.25pF), D (±0.5pF) Cap≥10pF: F (±1%), G (±2%), J (±5%), K (±10%)	J (±5%), K (±10%), M (±20%)	M (±20%), Z (-20/+80%)	J (±5%), K (±10%), M (±20%)
Rated voltage (WVDC)	16V, 25V, 50V	10V, 16V, 25V, 50V		6.3V, 10V, 16V, 25V,
Tan δ*	Cap<30pF: Q≥400+20C Cap≥30pF: Q≥1000	Note 1		
Insulation resistance at Ur	≥10GΩ	≥10GΩ or RxC≥100ΩxF whichever is less		
Operating temperature	-55 to +125°C		-25 to +85°C	-55 to +85°C
Capacitance characteristic	±30ppm	±15%	+30/-80%	±15%
Termination	Cu (or Ag)/Ni/Sn (lead-free termination)			

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

C0G(NP0): 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.

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

Note 1:

X7R/X5R

Rated vol.	D.F.	Exception of D.F.	
≥50V	≤2.5%	≤3%	0603≥0.047μF; 0805≥0.18μF, 1206≥0.47μF
25V	≤3.5%	≤5%	0805≥1μF; 1210≥10μF
		≤7%	0603≥0.33μF
16V	≤3.5%	≤5%	0402≥0.033μF; 0603≥0.15μF; 0805≥0.68μF; 1206≥2.2μF
		≤10%	1210≥22μF; 0603≥0.68μF
10V	≤5.0%	≤10%	0603≥1μF; 0805≥2.2μF

Y5V

Rated vol.	D.F.	Exception of D.F.	
≥50V	≤5.0%	7.0%	0603≥0.1μF; 0805≥0.47μF
25V	≤5.0%	≤7%	0402≥0.047μF; 0603≥0.1μF; 0805≥0.33μF; 1206≥1μF
		≤9%	0402≥0.068μF; 0603≥0.47μF
16V (C<1.0μF)	≤7.0%	≤9%	0402≥0.068μF; 0603≥0.68μF
16V (C≥1.0μF)	≤9.0%	≤12.5%	0805≥4.7μF; 1206≥10μF; 1210≥22μF; 1812≥47μF
10V	≤12.5%	---	---

7. CAPACITANCE RANGE (C0G/NPO Dielectric)

7-1. 0402, 0603, 0805 Sizes.

DIELECTRIC SIZE		C0G(NPO)											
		0402				0603				0805			
RATED VOLTAGE (VDC)		10	16	25	50	10	16	25	50	10	16	25	50
Capacitance	0.1pF (0R1)												
	0.2pF (0R2)												
	0.3pF (0R3)												
	0.4pF (0R4)												
	0.5pF (0R5)												
	0.6pF (0R6)												
	0.7pF (0R7)												
	0.8pF (0R8)												
	0.9pF (0R9)												
	1.0pF (1R0)												
	1.2pF (1R2)												
	1.5pF (1R5)												
	1.8pF (1R8)												
	2.2pF (2R2)												
	2.7pF (2R7)												
	3.3pF (3R3)												
	3.9pF (3R9)												
	4.7pF (4R7)												
	5.6pF (5R6)												
	6.8pF (6R8)												
	8.2pF (8R2)												
	10pF (100)												
	12pF (120)												
	15pF (150)												
	18pF (180)												
	22pF (220)												
	27pF (270)												
	33pF (330)												
	39pF (390)												
	47pF (470)												
	56pF (560)												
	68pF (680)												
	82pF (820)												
	100pF (101)												
	150pF (151)												
	180pF (181)												
	220pF (221)												
	270pF (271)												
	330pF (331)												
	390pF (391)												
470pF (471)													
560pF (561)													
680pF (681)													
820pF (821)													
1,000pF (102)													
1,200pF (122)													
1,500pF (152)													
1,800pF (182)													
2,200pF (222)													
2,700pF (272)													
3,300pF (332)													
3,900pF (392)													
4,700pF (472)													
5,600pF (562)													
6,800pF (682)													
8,200pF (822)													
0.010μF (103)													
0.012μF (123)													
0.018μF (183)													
0.022μF (223)													

7-1. 1206, 1210, 1812 Sizes

DIELECTRIC	C0G(NPO)											
	1206				1210				1812			
SIZE	10	16	25	50	10	16	25	50	10	16	25	50
RATED VOLTAGE (VDC)	10	16	25	50	10	16	25	50	10	16	25	50
1.0pF (1R0)												
1.2pF (1R2)												
1.5pF (1R5)												
1.8pF (1R8)												
2.2pF (2R2)												
2.7pF (2R7)												
3.3pF (3R3)												
3.9pF (3R9)												
4.7pF (4R7)												
5.6pF (5R6)												
6.8pF (6R8)												
8.2pF (8R2)												
10pF (100)												
12pF (120)												
15pF (150)												
18pF (180)												
22pF (220)												
27pF (270)												
33pF (330)												
39pF (390)												
47pF (470)												
56pF (560)												
68pF (680)												
82pF (820)												
100pF (101)												
120pF (121)												
150pF (151)												
180pF (181)												
220pF (221)												
270pF (271)												
330pF (331)												
390pF (391)												
470pF (471)												
560pF (561)												
680pF (681)												
820pF (821)												
1,000pF (102)												
1,200pF (122)												
1,500pF (152)												
1,800pF (182)												
2,200pF (222)												
2,700pF (272)												
3,300pF (332)												
3,900pF (392)												
4,700pF (472)												
5,600pF (562)												
6,800pF (682)												
8,200pF (822)												
0.010μF (103)												
0.012μF (123)												
0.015μF (153)												
0.018μF (183)												
0.022μF (223)												
0.027μF (273)												
0.033μF (333)												
0.039μF (393)												
0.039μF (473)												
0.039μF (563)												
0.039μF (683)												
0.039μF (823)												
0.10μF (104)												

Capacitance



7-2. 1825, 2220, 2225 Sizes

	DIELECTRIC	C0G(NPO)		
	SIZE	1825	2220	2225
	RATED VOLTAGE	50	50	50
Capacitance	10pF (100)			
	12pF (120)			
	15pF (150)			
	18pF (180)			
	22pF (220)			
	27pF (270)			
	33pF (330)			
	39pF (390)			
	47pF (470)			
	56pF (560)			
	68pF (680)			
	82pF (820)			
	100pF (101)			
	120pF (121)			
	150pF (151)			
	180pF (181)			
	220pF (221)			
	270pF (271)			
	330pF (331)			
	390pF (391)			
	470pF (471)			
	560pF (561)			
	680pF (681)			
	820pF (821)			
	1,000pF (102)			
	1,200pF (122)			
	1,500pF (152)			
	1,800pF (182)			
	2,200pF (222)			
	2,700pF (272)			
	3,300pF (332)			
	3,900pF (392)			
	4,700pF (472)			
	5,600pF (562)			
	6,800pF (682)			
	8,200pF (822)			
	0.010μF (103)			
	0.012μF (123)			
	0.015μF (153)			
	0.018μF (183)			
	0.022μF (223)			
	0.027μF (273)			
0.033μF (333)				
0.039μF (393)				
0.047μF (473)				
0.056μF (563)				
0.068μF (683)				
0.082μF (823)				
0.10μF (104)				
0.12μF (124)				

8. CAPACITANCE RANGE (X7R Dielectric)

8.1 0402, 0603, 0805, 1206 Sizes

DIELECTRIC	X7R																
	0402				0603				0805				1206				
SIZE	10	16	25	50	6.3	10	16	25	50	10	16	25	50	10	16	25	50
RATED VOLTAGE (VDC)	10	16	25	50	6.3	10	16	25	50	10	16	25	50	10	16	25	50
Capacitance	100pF (101)																
	120pF (121)																
	150pF (151)																
	180pF (181)																
	220pF (221)																
	270pF (271)																
	330pF (331)																
	390pF (391)																
	470pF (471)																
	560pF (561)																
	680pF (681)																
	820pF (821)																
	1,000pF (102)																
	1,200pF (122)																
	1,500pF (152)																
	1,800pF (182)																
	2,200pF (222)																
	2,700pF (272)																
	3,300pF (332)																
	3,900pF (392)																
	4,700pF (472)																
	5,600pF (562)																
	6,800pF (682)																
	8,200pF (822)																
	0.010μF (103)																
	0.012μF (123)																
	0.015μF (153)																
	0.018μF (183)																
	0.022μF (223)																
	0.027μF (273)																
	0.033μF (333)																
	0.039μF (393)																
	0.047μF (473)																
0.056μF (563)																	
0.068μF (683)																	
0.082μF (823)																	
0.10μF (104)																	
0.12μF (124)																	
0.15μF (154)																	
0.18μF (184)																	
0.22μF (224)																	
0.27μF (274)																	
0.33μF (334)																	
0.39μF (394)																	
0.47μF (474)																	
0.56μF (564)																	
0.68μF (684)																	
0.82μF (824)																	
1.0μF (105)																	

8-2. 1210, 1812, 1825 , 2220, 2225 Sizes

DIELECTRIC	X7R										
	SIZE	1210				1812				1825	2220
RATED VOLTAGE (VDC)	10	16	25	50	10	16	25	50	50	50	50
100pF (101)											
120pF (121)											
150pF (151)											
180pF (181)											
220pF (221)											
270pF (271)											
330pF (331)											
390pF (391)											
470pF (471)											
560pF (561)											
680pF (681)											
820pF (821)											
1,000pF (102)											
1,200pF (122)											
1,500pF (152)											
1,800pF (182)											
2,200pF (222)											
2,700pF (272)											
3,300pF (332)											
3,900pF (392)											
4,700pF (472)											
5,600pF (562)											
6,800pF (682)											
8,200pF (822)											
0.010μF (103)											
0.012μF (123)											
0.015μF (153)											
0.018μF (183)											
0.022μF (223)											
0.027μF (273)											
0.033μF (333)											
0.039μF (393)											
0.047μF (473)											
0.056μF (563)											
0.068μF (683)											
0.082μF (823)											
0.10μF (104)											
0.12μF (124)											
0.15μF (154)											
0.18μF (184)											
0.22μF (224)											
0.27μF (274)											
0.33μF (334)											
0.39μF (394)											
0.47μF (474)											
0.56μF (564)											
0.68μF (684)											
0.82μF (824)											
1.0μF (105)											

Capacitance

9. CAPACITANCE RANGE (X5R Dielectric)

9-1. 0402, 0603 Sizes

DIELECTRIC SIZE		X5R								
RATED VOLTAGE(VDC)		0402				0603				
		6.3	10	16	25	6.3	10	16	25	50
Capacitance	0.027µF (273)									
	0.033µF (333)									
	0.039µF (393)									
	0.047µF (473)									
	0.056µF (563)									
	0.068µF (683)									
	0.082µF (823)									
	0.100µF (104)									
	0.150µF (154)									
	0.220µF (224)									
	0.270µF (274)									
	0.330µF (334)									
	0.390µF (394)									
	0.470µF (474)									
	0.680µF (684)									
0.820µF (824)										
1.000µF (105)										

10. CAPACITANCE RANGE (Y5V Dielectric)

10-1. 0402, 0603, 0805 Sizes

DIELECTRIC SIZE		Y5V													
RATED VOLTAGE(VDC)		0402					0603					0805			
		6.3	10	16	25	50	6.3	10	16	25	50	10	16	25	50
Capacitance	0.010µF (103)														
	0.015µF (153)														
	0.022µF (223)														
	0.033µF (333)														
	0.047µF (473)														
	0.068µF (683)														
	0.10µF (104)														
	0.15µF (154)														
	0.22µF (224)														
	0.33µF (334)														
	0.47µF (474)														
	0.68µF (684)														
	1.0µF (105)														

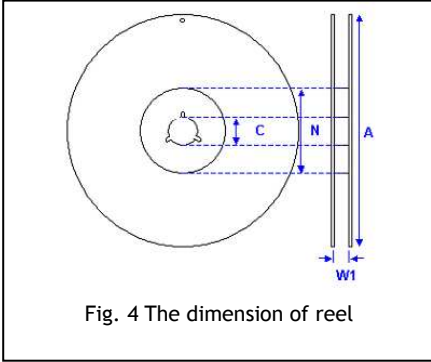
10-2. 1206, 1210, 1812 Sizes

DIELECTRIC SIZE		Y5V											
RATED VOLTAGE (VDC)		1206				1210				1812			
		10	16	25	50	10	16	25	50	10	16	25	50
Capacitance	0.010µF (103)												
	0.015µF (153)												
	0.022µF (223)												
	0.033µF (333)												
	0.047µF (473)												
	0.068µF (683)												
	0.10µF (104)												
	0.15µF (154)												
	0.22µF (224)												
	0.33µF (334)												
	0.47µF (474)												
	0.68µF (684)												
	1.0µF (105)												

10. PACKAGE DIMENSION AND QUANTITY

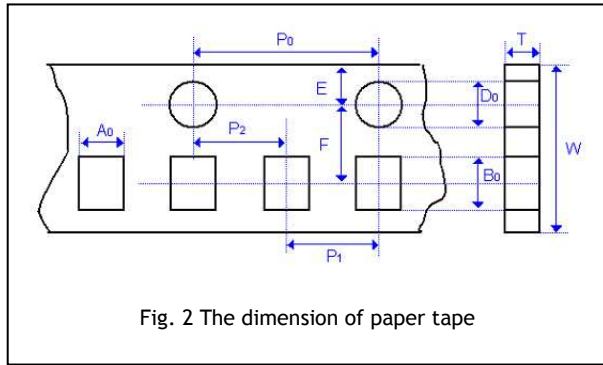
Size	Thickness (mm)	Paper tape		Plastic tape	
		7" reel	13" reel	7" reel	13" reel
0402 (1005)	0.50±0.05	10k	50K	-	-
0603 (1608)	0.80±0.07	4k	15k	-	-
	0.80+0.15/-0.10	4k	15k		
0805 (2012)	0.60±0.10	4k	15k	-	-
	0.80±0.10	4k	15k	-	-
	1.25±0.10	-	-	3k	10k
	1.25±0.20	-	-	3k	-
1206 (3216)	0.80±0.10	4k	15k	-	-
	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	-
	2.50±0.30	-	-	1k	-
1808 (4520)	1.25±0.10	-	-	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	-
1825 (4563)	1.60±0.20	-	-	1k	-
	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	-
2220 (5750)	1.60±0.20	-	-	1k	-
	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	-
2225 (5763)	1.60±0.20	-	-	1k	-
	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	-

Unit: pieces

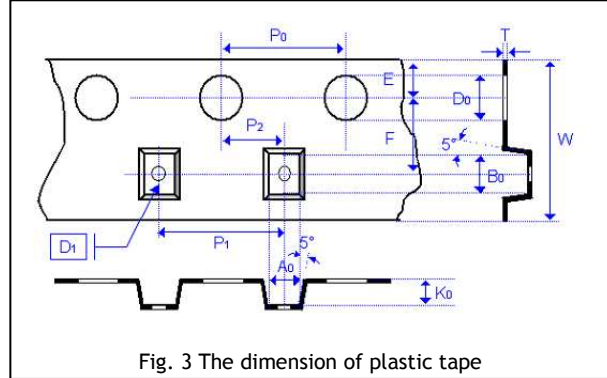


Size	0402, 0603, 0805, 1206, 1210			1812, 1825, 2220, 2225
Reel size	7"	10"	13"	7"
C	13.0+0.5/-0.2	13.0+0.5/-0.2	13.0+0.5/-0.2	13.0+0.5/-0.2
W ₁	8.4+1.5/-0	8.4+1.5/-0	8.4+1.5/-0	12.4+2.0/-0
A	178.0±0.10	250.0±1.0	330.0±1.0	178.0±0.10
N	60.0+1.0/-0	100.0±1.0	100±1.0	80.0±1.0

10-1. CARDBOARD TAPE DIMENSIONS



10-2. EMBOSSED TAPE DIMENSIONS



Size	0402	0603		0805		1206			1210	
Chip Thickness	0.50±0.05	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	0.95±0.10 1.25±0.10 1.60±0.20	2.50±0.30
A ₀	0.62±0.05	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	<3.05	<3.10
B ₀	1.12±0.05	1.80±0.10	1.80±0.10	2.30±0.10	<2.40	3.50±0.10	<3.60	<3.70	<3.80	<4.00
T	0.60±0.05	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	0.23±0.05	0.23±0.05
K ₀	-	-	-	-	<2.50	-	<2.50	<2.50	<2.50	<3.50
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	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	4.00±0.10	4.00±0.100	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	40.00±0.20	40.00±0.20	40.0±0.10
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	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	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	1.55±0.05	1.50±0.10/-0	1.55±0.05	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	1.00±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±0.05	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	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	3.50±0.05

Size	1808		1812		1825		2220		2225	
Chip Thickness	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	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	<2.50	<2.50	<3.90	<3.90	<6.80	<6.80	<5.80	<5.80	<6.80	<6.80
B ₀	<5.30	<5.30	<5.30	<5.30	<5.30	<5.30	<6.50	<6.50	<6.50	<6.50
T	0.25±0.05	0.25±0.05	0.25±0.05	0.25±0.05	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	<2.50	<2.50	<3.00	<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	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	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10
10xP ₀	40.0±0.20	40.0±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	40.00±0.20	40.00±0.20
P ₁	4.00±0.10	4.00±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	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	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	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	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+/-0.1	1.75±0.1	1.75±0.10	1.75±0.1	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	5.50±0.05	5.50±0.05	5.50±0.05	5.50±0.05

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 capacitors should be used within 6 months 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 4°C per second and the final preheat temperature should be within 100°C of the soldering temperature for small chips such as 0402, 0603, 0805 and 1206, within 50°C of the soldering temperature for bigger chips such as 1210, 1808, 1812, 1825, 2220 and 2225, etc.

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.

Hand soldering with temperature-controlled iron not exceeding 30 watts and diameter of tip less than 1.2 mm is recommended, tip of iron should not contact the ceramic body directly, and the temperature of iron should be set to not more than 260°C.

For bigger chips such as 1210, 1808, 1812, 1825, 2220 and 2225, etc. wave soldering and hand soldering are not recommended.

Refer IPC/JEDEC J-STD-020D Method recommended soldering profiles :

Reflow not sooner than 15 minutes and not longer than 4 hrs after removal from the temperature/humidity chamber, subject the sample to 3 cycle of the appropriate reflow conditions as defined as blow Table description.

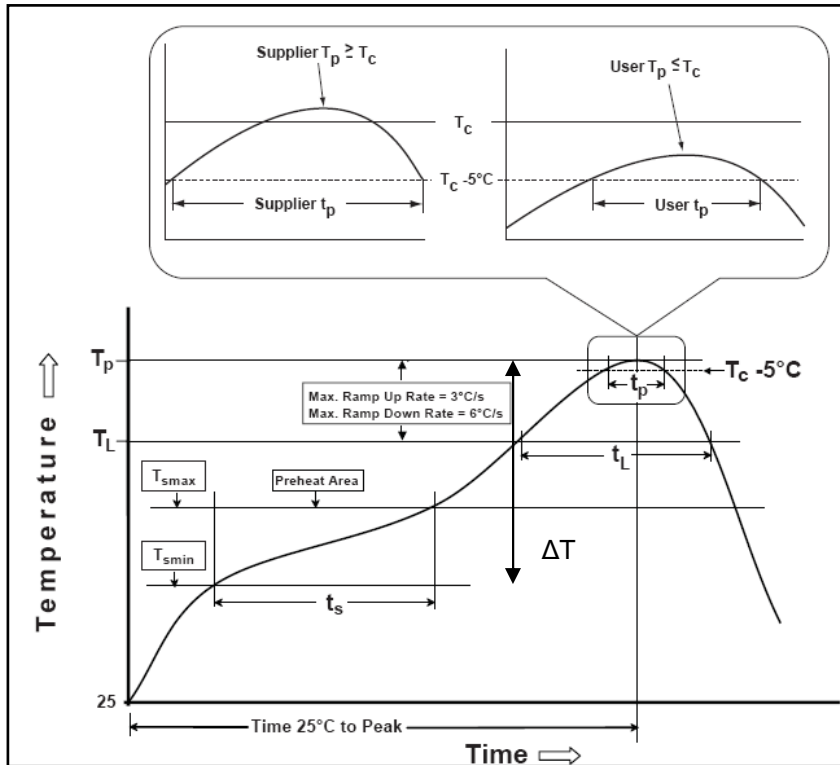
Profile Feature	Pb-Free Assembly
Preheat/Soak	
Temperature Min.(T _{smin})	150°C
Temperature Max.(T _{smax})	200°C
Time(t _s) from (T _{smin} to T _{smax})	60 to 120 seconds
Ramp-up rate(T _L to T _p)	3°C/second max.
Liquidous temperature(T _L)	217°C
Time(t _L) maintained above T _L	60 to 150 seconds
Peak package body temperature(T _p)	For user T _p must not exceed the Classification temp 260°C For suppliers T _p must equal or exceed the Classification temp 260°C
Time(T _p)* within 5°C of the specified classification temperature(T _c)	30* second
Ramp-down rate (T _p to T _L)	6°C/second max.
Time 25°C to peak temperature 260°C	8 minutes max.

Lead-free : Soldering temperature = 235 to 260°C, depending on product.

Maximum temperature = Minimum temperature (235°C)+ ΔT + Tolerance for oven process and measurement(5 ~ 7°C)

Time at peak temperature = 10sec, Dwell above 217°C = 90sec, Ramping rate = 3°C/sec(heating) and 6°C/sec(heating).

Classification Reflow Profiles



Chip Size	ΔT
0402,0603,0805,1206	100 °C
1210, 1808, 1812,1825 2211, 2220, 2225	50 °C

Soldering	Solder Temp.(T _c)	Soldering Time (t _p)
Reflow	235 – 260 °C	< 15 sec.
Wave	230 – 260 °C	< 5 sec.

Note : For example , T_c is 260°C and time t_p is 15sec.
for user : The peak temperature must not exceed 260°C. The time above 255°C must not exceed 15 seconds.

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. A cooling rate not exceeding 4°C per second should be used when forced cooling is necessary.

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.

12.RELIABILITY TEST CONDITIONS AND REQUIREMENTS

No.	Item	Test Condition	Requirements																																																																																				
1.	Visual and Dimensions	---	* No remarkable defect. * Dimensions to conform to individual specification sheet.																																																																																				
2.	Capacitance	Class I: NP0 Cap \leq 1000pF 1.0 \pm 0.2Vrms, 1MHz \pm 10%	* Shall not exceed the limits given in the detailed spec. NP0: Cap \geq 30pF, Q \geq 1000; Cap $<$ 30pF, Q \geq 400+20C X7R, X5R: <table border="1"> <thead> <tr> <th>Rated vol.</th> <th>D.F. \leq</th> <th colspan="2">Exception of D.F. \leq</th> </tr> </thead> <tbody> <tr> <td rowspan="3">\geq 50V</td> <td rowspan="3">\leq 2.5%</td> <td>\leq 3%</td> <td>0201(50V); 0603 \geq 0.047μF; 0805 \geq 0.18μF; 1206 \geq 0.47μF</td> </tr> <tr> <td>\leq 5%</td> <td>1210 \geq 4.7μF</td> </tr> <tr> <td>\leq 10%</td> <td>0603 \geq 1μF; 0805 \geq 1μF; 1206 \geq 4.7μF; 1210 \geq 10μF</td> </tr> <tr> <td rowspan="2">35V</td> <td rowspan="2">\leq 3.5%</td> <td>\leq 10%</td> <td>0805 \geq 2.2μF; 1210 \geq 10μF</td> </tr> <tr> <td>\leq 5%</td> <td>0201 \geq 0.01μF; 0805 \geq 1μF; 1210 \geq 10μF</td> </tr> <tr> <td rowspan="3">25V</td> <td rowspan="3">\leq 3.5%</td> <td>\leq 7%</td> <td>0603 \geq 0.33μF; 1206 \geq 4.7μF</td> </tr> <tr> <td>\leq 10%</td> <td>0402 \geq 0.10μF; 0603 \geq 0.47μF; 0805 \geq 2.2μF; 1206 \geq 6.8μF; 1210 \geq 22μF</td> </tr> <tr> <td>\leq 5%</td> <td>0201 \geq 0.01μF; 0402 \geq 0.033μF; 0805 \geq 0.68μF; 1206 \geq 2.2μF; 1210 \geq 4.7μF</td> </tr> <tr> <td rowspan="2">16V</td> <td rowspan="2">\leq 3.5%</td> <td>\leq 10%</td> <td>0402 \geq 0.47μF; 0603 \geq 0.68μF; 0805 \geq 2.2μF; 1206 \geq 4.7μF; 1210 \geq 22μF</td> </tr> <tr> <td>\leq 5%</td> <td>0402 \geq 0.33μF; 0603 \geq 0.33μF; 0805 \geq 2.2μF; 1206 \geq 2.2μF; 1210 \geq 22μF</td> </tr> <tr> <td rowspan="2">10V</td> <td rowspan="2">\leq 5%</td> <td>\leq 10%</td> <td>0402 \geq 0.33μF; 0603 \geq 0.33μF; 0805 \geq 2.2μF; 1206 \geq 2.2μF; 1210 \geq 22μF</td> </tr> <tr> <td>\leq 15%</td> <td>0201 \geq 0.1μF; 0402 \geq 1μF</td> </tr> <tr> <td rowspan="2">6.3V</td> <td rowspan="2">\leq 10%</td> <td>\leq 15%</td> <td>0201 \geq 0.1μF; 0402 \geq 1μF; 0603 \geq 10μF; 0805 \geq 4.7μF; 1206 \geq 47μF; 1210 \geq 100μF</td> </tr> <tr> <td>\leq 20%</td> <td>0402 \geq 2.2μF</td> </tr> <tr> <td>4V</td> <td>\leq 15%</td> <td>---</td> <td>---</td> </tr> </tbody> </table> Y5V: <table border="1"> <thead> <tr> <th>Rated vol.</th> <th>D.F. \leq</th> <th colspan="2">Exception of D.F. \leq</th> </tr> </thead> <tbody> <tr> <td>\geq 50V</td> <td>5%</td> <td>7%</td> <td>0603 \geq 0.1μF; 0805 \geq 0.47μF; 1206 \geq 4.7μF</td> </tr> <tr> <td>35V</td> <td>7%</td> <td>---</td> <td>---</td> </tr> <tr> <td rowspan="2">25V</td> <td rowspan="2">5%</td> <td>7%</td> <td>0402 \geq 0.047μF; 0603 \geq 0.1μF; 0805 \geq 0.33μF; 1206 \geq 1μF; 1210 \geq 4.7μF</td> </tr> <tr> <td>9%</td> <td>0402 \geq 0.068μF; 0603 \geq 0.47μF; 1206 \geq 4.7μF; 1210 \geq 22μF</td> </tr> <tr> <td rowspan="2">16V (C$<$1.0μF)</td> <td rowspan="2">7%</td> <td>9%</td> <td>0402 \geq 0.068μF; 0603 \geq 0.68μF</td> </tr> <tr> <td>12.5%</td> <td>0402 \geq 0.22μF</td> </tr> <tr> <td>16V (C \geq 1.0μF)</td> <td>9%</td> <td>12.5%</td> <td>0603 \geq 2.2μF; 0805 \geq 3.3μF; 1206 \geq 10μF; 1210 \geq 22μF; 1812 \geq 47μF</td> </tr> <tr> <td>10V</td> <td>12.5%</td> <td>20%</td> <td>0402 \geq 0.47μF</td> </tr> <tr> <td>6.3V</td> <td>20%</td> <td>---</td> <td>---</td> </tr> </tbody> </table>	Rated vol.	D.F. \leq	Exception of D.F. \leq		\geq 50V	\leq 2.5%	\leq 3%	0201(50V); 0603 \geq 0.047 μ F; 0805 \geq 0.18 μ F; 1206 \geq 0.47 μ F	\leq 5%	1210 \geq 4.7 μ F	\leq 10%	0603 \geq 1 μ F; 0805 \geq 1 μ F; 1206 \geq 4.7 μ F; 1210 \geq 10 μ F	35V	\leq 3.5%	\leq 10%	0805 \geq 2.2 μ F; 1210 \geq 10 μ F	\leq 5%	0201 \geq 0.01 μ F; 0805 \geq 1 μ F; 1210 \geq 10 μ F	25V	\leq 3.5%	\leq 7%	0603 \geq 0.33 μ F; 1206 \geq 4.7 μ F	\leq 10%	0402 \geq 0.10 μ F; 0603 \geq 0.47 μ F; 0805 \geq 2.2 μ F; 1206 \geq 6.8 μ F; 1210 \geq 22 μ F	\leq 5%	0201 \geq 0.01 μ F; 0402 \geq 0.033 μ F; 0805 \geq 0.68 μ F; 1206 \geq 2.2 μ F; 1210 \geq 4.7 μ F	16V	\leq 3.5%	\leq 10%	0402 \geq 0.47 μ F; 0603 \geq 0.68 μ F; 0805 \geq 2.2 μ F; 1206 \geq 4.7 μ F; 1210 \geq 22 μ F	\leq 5%	0402 \geq 0.33 μ F; 0603 \geq 0.33 μ F; 0805 \geq 2.2 μ F; 1206 \geq 2.2 μ F; 1210 \geq 22 μ F	10V	\leq 5%	\leq 10%	0402 \geq 0.33 μ F; 0603 \geq 0.33 μ F; 0805 \geq 2.2 μ F; 1206 \geq 2.2 μ F; 1210 \geq 22 μ F	\leq 15%	0201 \geq 0.1 μ F; 0402 \geq 1 μ F	6.3V	\leq 10%	\leq 15%	0201 \geq 0.1 μ F; 0402 \geq 1 μ F; 0603 \geq 10 μ F; 0805 \geq 4.7 μ F; 1206 \geq 47 μ F; 1210 \geq 100 μ F	\leq 20%	0402 \geq 2.2 μ F	4V	\leq 15%	---	---	Rated vol.	D.F. \leq	Exception of D.F. \leq		\geq 50V	5%	7%	0603 \geq 0.1 μ F; 0805 \geq 0.47 μ F; 1206 \geq 4.7 μ F	35V	7%	---	---	25V	5%	7%	0402 \geq 0.047 μ F; 0603 \geq 0.1 μ F; 0805 \geq 0.33 μ F; 1206 \geq 1 μ F; 1210 \geq 4.7 μ F	9%	0402 \geq 0.068 μ F; 0603 \geq 0.47 μ F; 1206 \geq 4.7 μ F; 1210 \geq 22 μ F	16V (C $<$ 1.0 μ F)	7%	9%	0402 \geq 0.068 μ F; 0603 \geq 0.68 μ F	12.5%	0402 \geq 0.22 μ F	16V (C \geq 1.0 μ F)	9%	12.5%	0603 \geq 2.2 μ F; 0805 \geq 3.3 μ F; 1206 \geq 10 μ F; 1210 \geq 22 μ F; 1812 \geq 47 μ F	10V	12.5%	20%	0402 \geq 0.47 μ F	6.3V	20%	---	---
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3.	Q/ D.F. (Dissipation Factor)	Class I: NP0 Cap \leq 1000pF 1.0 \pm 0.2Vrms, 1MHz \pm 10% Cap $>$ 1000pF 1.0 \pm 0.2Vrms, 1KHz \pm 10% Class II: X7R, X7E, X5R, Y5V Cap \leq 10 μ F, 1.0 \pm 0.2Vrms, 1kHz \pm 10% ** Cap $>$ 10 μ F, 0.5 \pm 0.2Vrms, 120Hz \pm 20% ** Test condition: 0.5 \pm 0.2Vrms \cdot 1KHz \pm 10% X7R: 0603 \geq 225(10V), 0805=106(6.3V&10V) X5R: 01R5 \geq 103, 0201 \geq 224 (6.3V), 0402 \geq 475 (6.3V), 0402 \geq 225(10V), 0603=106 (6.3V), 0603 \geq 475(10V)																																																																																					
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>NP0</td> <td>-55~125$^{\circ}$C at 25$^{\circ}$C</td> </tr> <tr> <td>X7R</td> <td>-55~125$^{\circ}$C at 25$^{\circ}$C</td> </tr> <tr> <td>X5R</td> <td>-55~ 85$^{\circ}$C at 25$^{\circ}$C</td> </tr> <tr> <td>Y5V</td> <td>-25~ 85$^{\circ}$C at 20$^{\circ}$C</td> </tr> </tbody> </table>	T.C.	Operating Temp	NP0	-55~125 $^{\circ}$ C at 25 $^{\circ}$ C	X7R	-55~125 $^{\circ}$ C at 25 $^{\circ}$ C	X5R	-55~ 85 $^{\circ}$ C at 25 $^{\circ}$ C	Y5V	-25~ 85 $^{\circ}$ C at 20 $^{\circ}$ C	<table border="1"> <thead> <tr> <th>T.C.</th> <th>Capacitance Change</th> </tr> </thead> <tbody> <tr> <td>NP0</td> <td>Within \pm30ppm/$^{\circ}$C</td> </tr> <tr> <td>X7R</td> <td>Within \pm15%</td> </tr> <tr> <td>X5R</td> <td>Within \pm15%</td> </tr> <tr> <td>Y5V</td> <td>Within +30%/-80%</td> </tr> </tbody> </table>	T.C.	Capacitance Change	NP0	Within \pm 30ppm/ $^{\circ}$ C	X7R	Within \pm 15%	X5R	Within \pm 15%	Y5V	Within +30%/-80%																																																																
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5.	Dielectric Strength	* To apply voltage (\leq 50V) 250%. * Duration: 1 to 5 sec. * Charge and discharge current less than 50mA.	* No evidence of damage or flash over during test.																																																																																				
6.	Insulation Resistance	To apply rated voltage for max. 120 sec.	10G Ω or Rx C \geq 500 Ω -F whichever is smaller. Class II (X7R, X5R, Y5V) <table border="1"> <thead> <tr> <th>Rated voltage</th> <th>Insulation Resistance</th> </tr> </thead> <tbody> <tr> <td>100V: X7R</td> <td rowspan="7">10GΩ or Rx C \geq 100 Ω-F whichever is smaller.</td> </tr> <tr> <td>50V: 0603 \geq 1μF; 0805 \geq 1μF; 1206 \geq 4.7μF; 1210 \geq 4.7μF</td> </tr> <tr> <td>35V: 0805 \geq 2.2μF; 1210 \geq 10μF</td> </tr> <tr> <td>25V: 0402 \geq 1μF; 0603 \geq 2.2μF; 0805 \geq 2.2μF; 1206 \geq 10μF; 1210 \geq 10μF</td> </tr> <tr> <td>16V: 0402 \geq 0.22μF; 0603 \geq 1μF; 0805 \geq 2.2μF; 1206 \geq 10μF; 1210 \geq 47μF</td> </tr> <tr> <td>10V: 0201 \geq 47nF; 0402 \geq 0.47μF; 0603 \geq 0.47μF; 0805 \geq 2.2μF; 1206 \geq 4.7μF; 1210 \geq 47μF</td> </tr> <tr> <td>6.3V ; 4V</td> </tr> </tbody> </table>	Rated voltage	Insulation Resistance	100V: X7R	10G Ω or Rx C \geq 100 Ω -F whichever is smaller.	50V: 0603 \geq 1 μ F; 0805 \geq 1 μ F; 1206 \geq 4.7 μ F; 1210 \geq 4.7 μ F	35V: 0805 \geq 2.2 μ F; 1210 \geq 10 μ F	25V: 0402 \geq 1 μ F; 0603 \geq 2.2 μ F; 0805 \geq 2.2 μ F; 1206 \geq 10 μ F; 1210 \geq 10 μ F	16V: 0402 \geq 0.22 μ F; 0603 \geq 1 μ F; 0805 \geq 2.2 μ F; 1206 \geq 10 μ F; 1210 \geq 47 μ F	10V: 0201 \geq 47nF; 0402 \geq 0.47 μ F; 0603 \geq 0.47 μ F; 0805 \geq 2.2 μ F; 1206 \geq 4.7 μ F; 1210 \geq 47 μ F	6.3V ; 4V																																																																										
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12.RELIABILITY TEST CONDITIONS AND REQUIREMENTS(Con.)

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7.	Adhesive Strength of Termination	<ul style="list-style-type: none"> * Pressurizing force : 0201 : 2N 0402 & 0603 : 5N >0603 : 10N * Test time: 10±1 sec. 	<ul style="list-style-type: none"> * No remarkable damage or removal of the terminations. 															
8.	Vibration Resistance	<ul style="list-style-type: none"> * Vibration frequency: 10~55 Hz/min. * Total amplitude: 1.5mm * Test time: 6 hrs. (Two hrs each in three mutually perpendicular directions.) 	<ul style="list-style-type: none"> * No remarkable damage. * Cap change and Q/D.F.: To meet initial spec. 															
9.	Solderability	<ul style="list-style-type: none"> * Solder temperature: 235±5°C * Dipping time: 5±0.5 sec. 	95% min. coverage of all metalized area.															
10.	Bending Test	<ul style="list-style-type: none"> * The middle part of substrate shall be pressurized by means of the pressurizing rod at a rate of about 1 mm per second until the deflection becomes 1 mm and then the pressure shall be maintained for 5±1 sec. * Measurement to be made after keeping at room temp. for 24±2 hrs. (Class I) or 48±4 hrs. (Class II). 	<ul style="list-style-type: none"> * No remarkable damage. * Cap change : NP0: within ±5% or 0.5pF whichever is larger X7R, X5R: within ±12.5% Y5V: within ±30% (This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test.) 															
11.	Resistance to Soldering Heat	<ul style="list-style-type: none"> * 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 (Class II only) at room temp. * Measurement to be made after keeping at room temp. for 24±2hrs (Class I) or 48±4 hrs (Class II). 	<ul style="list-style-type: none"> * No remarkable damage. * Cap change: NP0: within ±2.5% or ±0.25pF whichever is larger. X7R, X5R: within ±7.5% Y5V: within ±20% * 25% max. leaching on each edge. 															
12.	Temperature Cycle	<ul style="list-style-type: none"> * Conduct the five cycles according to the temperatures and time. <table border="1" style="margin-left: 20px;"> <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> <ul style="list-style-type: none"> * 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	<ul style="list-style-type: none"> * No remarkable damage. * Cap change : NP0: within ±2.5% or ±0.25pF whichever is larger. X7R, X5R: within ± 7.5% Y5V: within ±20% * Q/D.F.≤ initial requirement * I.R.≥ 0.25×initial requirements.
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13.	Humidity (Damp Heat) Steady State	* Test temp.: 40±2°C * Humidity: 90~95% RH * Test time: 500+24/-0hrs. * 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: NP0: within ±5% or 0.5pF whichever is larger X7R, X7E, X5R: ≥10V**, within ±12.5%; 6.3V within ±25%; TT series & C ≥ 1uF, within ±25% **10V:0603 ≥ 4.7μF; 0402 ≥ 1μF; 0201 ≥ 0.1μF, within ±25%; Y5V: ≥10V, within ±30%; 6.3V, within +30/-40% * Q/D.F. value: NP0: More than 30pF Q ≥ 350, 10pF ≤ C ≤ 30pF, Q ≥ 275 + 2.5C Less than 10pF Q ≥ 200 + 10C X7R, X5R: <table border="1"> <thead> <tr> <th>Rated vol.</th> <th>D.F. ≤</th> <th colspan="2">Exception of D.F. ≤</th> </tr> </thead> <tbody> <tr> <td rowspan="3">≥ 50V</td> <td rowspan="3">≤ 3%</td> <td>≤ 6%</td> <td>0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF</td> </tr> <tr> <td>≤ 10%</td> <td>1210 ≥ 4.7μF</td> </tr> <tr> <td>≤ 20%</td> <td>0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 10μF</td> </tr> <tr> <td>35V</td> <td>≤ 5%</td> <td>≤ 20%</td> <td>0805 ≥ 2.2μF; 1210 ≥ 10μF</td> </tr> <tr> <td rowspan="3">25V</td> <td rowspan="3">≤ 5%</td> <td>≤ 10%</td> <td>0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF</td> </tr> <tr> <td>≤ 14%</td> <td>0603 ≥ 0.33μF; 1206 ≥ 4.7μF</td> </tr> <tr> <td>≤ 15%</td> <td>0402 ≥ 0.10μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF</td> </tr> <tr> <td rowspan="2">16V</td> <td rowspan="2">≤ 5%</td> <td>≤ 10%</td> <td>0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF</td> </tr> <tr> <td>≤ 15%</td> <td>0201 ≥ 0.01μF; 0402 ≥ 0.033μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF</td> </tr> <tr> <td rowspan="2">10V</td> <td rowspan="2">≤ 7.5%</td> <td>≤ 15%</td> <td>0402 ≥ 0.33μF; 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF</td> </tr> <tr> <td>≤ 20%</td> <td>0201 ≥ 0.1μF; 0402 ≥ 1μF</td> </tr> <tr> <td>6.3V</td> <td>≤ 15%</td> <td>≤ 30%</td> <td>0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF</td> </tr> <tr> <td>4V</td> <td>≤ 20%</td> <td>---</td> <td>---</td> </tr> </tbody> </table> Y5V: <table border="1"> <thead> <tr> <th>Rated vol.</th> <th>D.F. ≤</th> <th colspan="2">Exception of D.F. ≤</th> </tr> </thead> <tbody> <tr> <td>≥ 50V</td> <td>7.5%</td> <td>10%</td> <td>0603 ≥ 0.1μF; 0805 ≥ 0.47μF; 1206 ≥ 4.7μF</td> </tr> <tr> <td>35V</td> <td>10%</td> <td>---</td> <td>---</td> </tr> <tr> <td rowspan="2">25V</td> <td rowspan="2">7.5%</td> <td>10%</td> <td>0402 ≥ 0.047μF; 0603 ≥ 0.1μF; 0805 ≥ 0.33μF; 1206 ≥ 1μF; 1210 ≥ 4.7μF</td> </tr> <tr> <td>15%</td> <td>0402 ≥ 0.068μF; 0603 ≥ 0.47μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF</td> </tr> <tr> <td rowspan="2">16V (C < 1.0μF)</td> <td rowspan="2">10%</td> <td>12.5%</td> <td>0402 ≥ 0.068μF; 0603 ≥ 0.68μF</td> </tr> <tr> <td>20%</td> <td>0402 ≥ 0.22μF</td> </tr> <tr> <td rowspan="2">16V (C ≥ 1.0μF)</td> <td rowspan="2">12.5%</td> <td>20%</td> <td>0603 ≥ 2.2μF; 0805 ≥ 3.3μF; 1206 ≥ 10μF; 1210 ≥ 22μF; 1812 ≥ 47μF</td> </tr> <tr> <td>30%</td> <td>0402 ≥ 0.47μF</td> </tr> <tr> <td>10V</td> <td>20%</td> <td>---</td> <td>---</td> </tr> <tr> <td>6.3V</td> <td>30%</td> <td>---</td> <td>---</td> </tr> </tbody> </table> *I.R.: ≥10V, 1GΩ or 50 Ω-F whichever is smaller. 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12.RELIABILITY TEST CONDITIONS AND REQUIREMENTS(Con.)

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14.	Humidity (Damp Heat) Load	* Test temp.: 40±2°C * Humidity: 90~95%RH * Test time: 500+24/-0 hrs. * To apply voltage : rated voltage. * 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: NP0: ±7.5% or 0.75pF whichever is larger. X7R, X7E, X5R: ≥10V**, within ±12.5%; 6.3V within ±25%; TT series & C ≥ 1uF, within ±25% **10V:0603 ≥ 4.7μF; 0402 ≥ 1μF; 0201 ≥ 0.1μF, within ±25%; Y5V: ≥10V, within ±30%; 6.3V, within +30/-40% Q/D.F. value: NP0: C ≥ 30pF, Q ≥ 200; C < 30pF, Q ≥ 100+10/3C X7R, X5R:																																												
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12.RELIABILITY TEST CONDITIONS AND REQUIREMENTS(Con.)

No.	Item	Test Condition	Requirements																																																																																																																																																
15.	High Temperature Load (Endurance)	<p>*Test temp. : NP0, X7R/X7E: 125±3°C X5R, Y5V: 85±3°C *Test time: 1000+24/-0 hrs. *To apply voltage: (1) 6.3V or C≥10μF or TT series: 150% of rated voltage. (2) 10V ≤ Ur<500V: 200% of rated voltage. (3) 500V: 150% of rated voltage. (4) Ur ≥ 630V: 120% of rated voltage. (5) 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 range</th> </tr> </thead> <tbody> <tr> <td>0201</td> <td>X5R</td> <td>6.3V,10V</td> <td>C≥0.1μF</td> </tr> <tr> <td>0402</td> <td>X5R,</td> <td>6.3V,10V</td> <td>C≥1.0μF</td> </tr> <tr> <td>0603</td> <td>X5R</td> <td>6.3V,10V</td> <td>C≥4.7μF</td> </tr> <tr> <td>0805</td> <td>X5R</td> <td>6.3V</td> <td>C≥22μF</td> </tr> <tr> <td rowspan="2">1206</td> <td>X5R</td> <td>6.3V</td> <td>C≥47μF</td> </tr> <tr> <td>NP0</td> <td>3000V</td> <td>C≥1.5pF</td> </tr> </tbody> </table> <p>(6)150% of rated voltage for below range.</p> <table border="1"> <thead> <tr> <th>Size</th> <th>Dielectric</th> <th>Rated voltage</th> <th>Capacitance range</th> </tr> </thead> <tbody> <tr> <td rowspan="2">0402</td> <td>X5R</td> <td>10V,16V,25V</td> <td>C≥0.22μF</td> </tr> <tr> <td>Y5V</td> <td>16V</td> <td>C≥0.47μF</td> </tr> <tr> <td rowspan="2">0603</td> <td>X5R</td> <td>10V,16V</td> <td>C≥1.0μF</td> </tr> <tr> <td>Y5V</td> <td>16V</td> <td>C≥2.2μF</td> </tr> <tr> <td rowspan="2">0805</td> <td>X5R</td> <td>10V</td> <td>C≥4.7μF</td> </tr> <tr> <td>Y5V</td> <td>16V</td> <td>C≥4.7μF</td> </tr> </tbody> </table> <p>* Measurement to be made after keeping at room temp. for 24±2 hrs. 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Cap change: NP0: ±3.0% or ±0.3pF whichever is larger X7R, X7E, X5R: ≥10V**, within ±12.5%; 6.3V within ±25%; TT series & C≥ 1μF, within ±25% **10V:0603 ≥4.7μF;0402 ≥1μF;0201 ≥0.1μF, within ±25%; Y5V: ≥10V, within ±30%; 6.3V, within +30/-40% Q/D.F. value: NP0: More than 30pF, Q≥350 10pF≤C<30pF, Q≥275+2.5C Less than 10pF, Q≥200+10C X7R, X5R:</p> <table border="1"> <thead> <tr> <th>Rated vol.</th> <th>D.F. ≤</th> <th colspan="2">Exception of D.F. ≤</th> </tr> </thead> <tbody> <tr> <td rowspan="3">≥ 50V</td> <td rowspan="3">≤ 3%</td> <td>≤ 6%</td> <td>0201(50V);0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF</td> </tr> <tr> <td>≤ 10%</td> <td>1210 ≥ 4.7μF</td> </tr> <tr> <td>≤ 20%</td> <td>0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 10μF</td> </tr> <tr> <td>35V</td> <td>≤ 5%</td> <td>≤ 20%</td> <td>0805 ≥ 2.2μF; 1210 ≥ 10μF</td> </tr> <tr> <td rowspan="3">25V</td> <td rowspan="3">≤ 5%</td> <td>≤ 10%</td> <td>0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF</td> </tr> <tr> <td>≤ 14%</td> <td>0603 ≥ 0.33μF; 1206 ≥ 4.7μF</td> </tr> <tr> <td>≤ 15%</td> <td>0402 ≥ 0.10μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF</td> </tr> <tr> <td rowspan="2">16V</td> <td rowspan="2">≤ 5%</td> <td>≤ 10%</td> <td>0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF</td> </tr> <tr> <td>≤ 15%</td> <td>0201 ≥ 0.01μF; 0402 ≥ 0.033μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF</td> </tr> <tr> <td rowspan="2">10V</td> <td rowspan="2">≤ 7.5%</td> <td>≤ 15%</td> <td>0402 ≥ 0.33μF; 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF</td> </tr> <tr> <td>≤ 20%</td> <td>0201 ≥ 0.1μF ; 0402 ≥ 1μF</td> </tr> <tr> <td>6.3V</td> <td>≤ 15%</td> <td>≤ 30%</td> <td>0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF</td> </tr> <tr> <td>4V</td> <td>≤ 20%</td> <td>---</td> <td>---</td> </tr> </tbody> </table> <p>Y5V:</p> <table border="1"> <thead> <tr> <th>Rated vol.</th> <th>D.F. ≤</th> <th colspan="2">Exception of D.F. ≤</th> </tr> </thead> <tbody> <tr> <td>≥ 50V</td> <td>7.5%</td> <td>10%</td> <td>0603 ≥ 0.1μF; 0805 ≥ 0.47μF; 1206 ≥ 4.7μF</td> </tr> <tr> <td>35V</td> <td>10%</td> <td>---</td> <td>---</td> </tr> <tr> <td rowspan="2">25V</td> <td rowspan="2">7.5%</td> <td>10%</td> <td>0402 ≥ 0.047μF; 0603 ≥ 0.1μF; 0805 ≥ 0.33μF; 1206 ≥ 1μF; 1210 ≥ 4.7μF</td> </tr> <tr> <td>15%</td> <td>0402 ≥ 0.068μF; 0603 ≥ 0.47μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF</td> </tr> <tr> <td>16V (C<1.0μF)</td> <td>10%</td> <td>12.5%</td> <td>0402 ≥ 0.068μF; 0603 ≥ 0.68μF</td> </tr> <tr> <td></td> <td></td> <td>20%</td> <td>0402 ≥ 0.22μF</td> </tr> <tr> <td>16V (C≥1.0μF)</td> <td>12.5%</td> <td>20%</td> <td>0603 ≥ 2.2μF; 0805 ≥ 3.3μF; 1206 ≥ 10μF; 1210 ≥ 22μF; 1812 ≥ 47μF;</td> </tr> <tr> <td>10V</td> <td>20%</td> <td>30%</td> <td>0402 ≥ 0.47μF</td> </tr> <tr> <td>6.3V</td> <td>30%</td> <td>---</td> <td>---</td> </tr> </tbody> </table> <p>*I.R.: ≥10V, 1GΩ or 50 Ω-F whichever is smaller. Class II (X7R, X5R, Y5V)</p> <table border="1"> <thead> <tr> <th>Rated voltage</th> <th>Insulation Resistance</th> </tr> </thead> <tbody> <tr> <td>100V: X7R</td> <td rowspan="7">1GΩ or RxC ≥ 10 Ω-F whichever is smaller.</td> </tr> <tr> <td>50V:0603≥1μF;0805≥1μF;1206≥4.7μF;1210≥4.7μF</td> </tr> <tr> <td>35V:0805≥2.2μF;1210 ≥ 10μF</td> </tr> <tr> <td>25V:0402≥1μF;0603≥2.2μF;0805≥2.2μF;1206≥10μF;1210≥10μF</td> </tr> <tr> <td>16V:0402≥0.22μF;0603≥1μF;0805≥2.2μF;1206≥10μF;1210≥47μF</td> </tr> <tr> <td>10V:0201≥47nF;0402≥0.47μF;0603≥0.47μF;0805≥2.2μF; 1206≥4.7μF;1210≥47μF</td> </tr> <tr> <td>6.3V ; 4V</td> </tr> </tbody> </table>	Rated vol.	D.F. ≤	Exception of D.F. ≤		≥ 50V	≤ 3%	≤ 6%	0201(50V);0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF	≤ 10%	1210 ≥ 4.7μF	≤ 20%	0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 10μF	35V	≤ 5%	≤ 20%	0805 ≥ 2.2μF; 1210 ≥ 10μF	25V	≤ 5%	≤ 10%	0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF	≤ 14%	0603 ≥ 0.33μF; 1206 ≥ 4.7μF	≤ 15%	0402 ≥ 0.10μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF	16V	≤ 5%	≤ 10%	0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF	≤ 15%	0201 ≥ 0.01μF; 0402 ≥ 0.033μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF	10V	≤ 7.5%	≤ 15%	0402 ≥ 0.33μF; 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF	≤ 20%	0201 ≥ 0.1μF ; 0402 ≥ 1μF	6.3V	≤ 15%	≤ 30%	0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF	4V	≤ 20%	---	---	Rated vol.	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