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Messrs. : _____

Date : _____

APPROVAL SHEET

Product Name : High Capacitance Multilayer Ceramic Chip Capacitors

Part No. : _____ **FS Series**

Description : _____ **Size \leq 2225, CAP \geq 1 μ F, U_R < 1000V**

PREPARED BY	APPROVED BY

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SPECIFICATION

FOR

Product Name : High Capacitance Multilayer Ceramic Chip Capacitors

Part No. : FS Series

Description : Size ≤ 2225 , CAP $\geq 1\mu F$, $U_R < 1000V$

SPEC. No.	: <u>FS-000-001-02</u>
DATE	:

DRAWN BY	CHECEKED BY	APPROVED BY
Angel Liu	Yvens Chou	Ryan Chen



1. INTRODUCTION

PDC FS Series green type capacitors are manufactured by using environmental friendly material without lead or cadmium. These capacitors feature series connection of multi-layer capacitor units in a MLCC to realize high voltage performance. This special design can distribute voltage gradients throughout the entire capacitor, so as to prevent short circuit failure. It is a safety design for LCD back-lighting inverter application.

2. FEATURES

- a. Realize high capacitance in small sizes.
- b. Capacitor with lead-free termination (pure Tin).
- c. RoHS compliant.
- d. HALOGEM compliant.
- e. Surface mount suited for wave and reflow soldering.
- f. High reliability and no polarity.

3. APPLICATIONS

- a. Digital circuit coupling or decoupling applications.
- b. For bypassing.
- c. Ideal for smoothing circuits.
- d. DC to DC converter.

4. HOW TO ORDER

<u>FS</u>	<u>21</u>	<u>X</u>	<u>471</u>	<u>K</u>	<u>500</u>	<u>P</u>	<u>X</u>	<u>G</u>
PDC Family	Size	Dielectric	Capacitance	Tolerance	Rated voltage	Packaging	Thickness	Control Code
Table1.	Table2	Table3	Table4	Table5	Table6	Table7	Table8	Table9

Table 1		PDC family			
Code	Description				
FS	High Capacitance Capacitor $\geq 105(1\mu F)$				

Table 2		General Purpose			
Code	Description	Code	Description	Code	Description
15	0402 (1005)	32	1210 (3225)	52	2211 (5728)
18	0603 (1608)	42	1808 (4520)	55	2220 (5750)
21	0805 (2012)	43	1812 (4532)	56	2225 (5763)
31	1206 (3216)	46	1825 (4563)		

Table 3		Dielectric Material Characteristics	
Code	Description	Code	Description
N	C0G	X	X7R
B	X5R	F	Y5V

Table 4		Table 4 Capacitance Rule Code	
Code	Description	Code	Description
R47	0.47pF	102	$102=10 \times 10^2=1000\text{pF}$
0R5	0.5pF	104	$104=10 \times 10^4=100\text{nF}$
100	$100=10 \times 10^0=10\text{pF}$	106	$106=10 \times 10^6=10\mu F$

Table 5		Tolerance			
Code	Description	Code	Description	Code	Description
A	$\pm 0.05 \text{ pF}$	H	$\pm 3 \%$	N	$-5\% \sim +10\%$
B	$\pm 0.10 \text{ pF}$	I	$-10\% \sim 0\%$	P	$\pm 0.02 \text{ pF}$
C	$\pm 0.25 \text{ pF}$	J	$\pm 5 \%$	Q	$\pm 0.03 \text{ pF}$
D	$\pm 0.50 \text{ pF}$	K	$\pm 10 \%$	Z	$-20\% \sim +80\%$
F	$\pm 1 \%$	L	$0\% \sim +10\%$		
G	$\pm 2 \%$	M	$\pm 20 \%$		

Table 6		Rated voltage			
Code	Description	Code	Description	Code	Description
6R3	6.3VDC	201	200VDC	152	1500VDC
100	10VDC	251	250VDC	202	2000VDC
160	16VDC	401	400VDC	302	3000VDC
250	25VDC	501	500VDC	402	4000VDC
500	50VDC	631	630VDC	502	5000VDC
101	100VDC	102	1000VDC	602	6000VDC

Table 7		Packaging Type	
Code	Description	Code	Description
B	Bulk	T	Tray package
E	Tape and 7" Reel, Embossed Tape	P	Tape and 7" Reel, Paper Tape
K	Tape and 10" Reel, Embossed Tape	D	Tape and 10" Reel, Paper Tape
L	Tape and 13" Reel, Embossed Tape	G	Tape and 13" Reel, Paper Tape

Table 8		Thickness Description			
Code	Description	Code	Description	Code	Description
A	$0.60 \pm 0.10 \text{ mm}$	I	$1.25 \pm 0.20 \text{ mm}$	Q	$0.50 + 0.02/-0.05 \text{ mm}$
B	$0.8 + 0.15/-0.10 \text{ mm}$	J	$1.15 \pm 0.15 \text{ mm}$	R	$3.10 \pm 0.30 \text{ mm}$
C	$1.25 \pm 0.10 \text{ mm}$	K	$0.50 \pm 0.20 \text{ mm}$	S	$0.80 \pm 0.07 \text{ mm}$
D	$1.40 \pm 0.15 \text{ mm}$	L	$0.30 \pm 0.03 \text{ mm}$	T	$0.85 \pm 0.10 \text{ mm}$
E	$1.60 \pm 0.20 \text{ mm}$	M	$0.95 \pm 0.10 \text{ mm}$	U	$0.50 \pm 0.10 \text{ mm}$
F	$2.00 \pm 0.20 \text{ mm}$	N	$0.50 \pm 0.05 \text{ mm}$	V	$0.20 \pm 0.02 \text{ mm}$
G	$2.50 \pm 0.30 \text{ mm}$	O	$3.50 \pm 0.20 \text{ mm}$	X	$0.80 \pm 0.10 \text{ mm}$
H	$2.80 \pm 0.30 \text{ mm}$	P	$1.60 + 0.3/-0.10 \text{ mm}$	Z	$0.25 \pm 0.03 \text{ mm}$

Table 9		Special Control Code	
Code	Description		
G	RoHS Compliant		

5. EXTERNAL DIMENSIONS

Size Inch (mm)	L (mm)	W (mm)	Code / T (mm)	M _B (mm)
0201 (0603)	0.60±0.03	0.30±0.03	See No.4 Reference Table 8	0.15±0.05
0402 (1005)	1.00±0.10	0.50±0.10		0.25 +0.05/-0.10
0603 (1608)	1.60±0.15	0.80±0.15		0.40±0.15
0805 (2012)	2.00±0.20	1.25±0.20		0.50±0.20
1206 (3216)	3.20±0.20	1.60±0.20		0.60±0.20
1210 (3225)	3.20±0.30	2.50±0.30		0.75±0.35
1808 (4520)	4.50±0.40	2.00±0.25		0.75±0.35
1812 (4532)	4.50±0.40	3.20±0.30		0.75±0.35
1825 (4563)	4.50±0.40	6.30±0.40		0.75±0.35
2220 (5750)	5.70±0.40	5.00±0.40		0.85±0.35
2225 (5763)	5.70±0.40	6.30±0.40		0.85±0.35

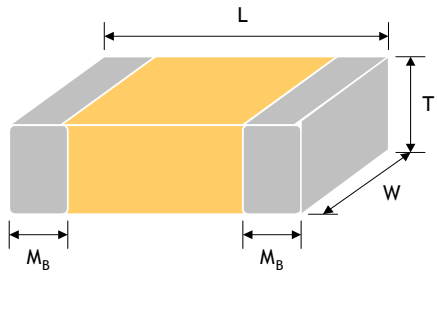


Fig.5-1 The outline of MLCC

6. GENERAL ELECTRICAL DATA

Dielectric	X7R	X5R	Y5V
Size	0402, 0603, 0805, 1206, 1210, 1812, 1825, 2220, 2225	0201, 0402, 0603, 0805, 1206, 1210,	0402, 0603, 0805, 1206, 1210, 1812,
Rated voltage (WVDC)	6.3V, 10V, 16V, 25V, 50V, 100V, 250V, 500V, 630V	4V, 6.3V, 10V, 16V, 25V, 35V, 50V	6.3V, 10V, 16V, 25V, 35V, 50V, 100V,
Capacitance range*	1μF to 47μF	1μF to 220μF	1μF to 100μF
Capacitance tolerance	K (±10%), M (±20%)		Z (-20/+80%)
Tan δ	Note 1		
Operating temperature	-55 to +125°C	-55 to +85°C	-25 to +85°C
Capacitance characteristic	±15%		+30/-80%
Termination	Cu (or Ag) / Ni / Sn (lead-free termination)		

*Measured at 1.0±0.2Vrms, 1.0kHz±10% for C≤10μF; 0.5±0.2Vrms, 120Hz±20% for C>10μF, 30~70% related humidity, 25°C ambient temperature for X7R, X5R and at 20°C for Y5V

** Preconditioning for Class II MLCC: Perform a heat treatment at 150±10°C for 1 hour, then leave in a mbient condition for 24±2 hours before measurement

Note 1

X7R/X5R/X6S/X7S

Y5V

Rated vol.	D.F. ≤	Exception of D.F. ≤
≥ 100V	≤ 2.5%	≤ 3% 1206 ≥ 0.47μF
		≤ 5% 0805 > 0.1μF; 0603 ≥ 0.068μF; 1206 > 1μF; 1210 ≥ 2.2μF; TT series
		≤ 10% 0805 > 0.22μF; 1210 ≥ 3.3μF
50V	≤ 2.5%	≤ 3% 0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF
		≤ 5% 0201 ≥ 0.01μF; 1210 ≥ 4.7μF
		≤ 10% 0402 ≥ 0.1μF; 0603 > 0.1μF; 0805 ≥ 1μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF; TT series
35V	≤ 3.5%	≤ 10% 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF
25V	≤ 3.5%	≤ 5% 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF
		≤ 7% 0603 ≥ 0.33μF; 1206 ≥ 4.7μF
		≤ 10% 0201 ≥ 0.1μF; 0402 ≥ 0.10μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF; TT series
		≤ 12.5% 0402 ≥ 0.47μF
16V	≤ 3.5%	≤ 5% 0201 ≥ 0.01μF; 0402 ≥ 0.033μF; 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 4.7μF
		≤ 10% 0201 ≥ 0.1μF; 0201/X7R ≥ 0.022μF; 0402 ≥ 0.22μF; 0603 ≥ 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series
10V	≤ 5%	≤ 10% 0201 ≥ 0.012μF; 0402 ≥ 0.33μF; 0402/X7R ≥ 0.22μF; TT series
		≤ 15% 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF; 01R5
6.3V	≤ 10%	≤ 15% 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF; TT series
		≤ 20% 0402 ≥ 2.2μF
4V	≤ 15%	---

Rated vol.	D.F. ≤	Exception of D.F. ≤
≥ 50V	≤ 5%	≤ 7% 0603 ≥ 0.1μF; 0805 ≥ 0.47μF; 1206 ≥ 4.7μF; TT series
		≤ 12.5% 1210 ≥ 6.8μF
35V	≤ 7%	---
25V	≤ 5%	≤ 7% 0402 ≥ 0.047μF; 0603 ≥ 0.1μF; 0805 ≥ 0.33μF; 1206 ≥ 1μF; 1210 ≥ 4.7μF
		≤ 9% 0402 ≥ 0.068μF; 0603 ≥ 0.47μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series
16V (C<1.0μF)	≤ 7%	≤ 9% 0402 ≥ 0.068μF; 0603 ≥ 0.68μF
16V (C ≥ 1.0μF)	≤ 9%	≤ 12.5% 0402 ≥ 0.22μF
		≤ 12.5% 0603 ≥ 2.2μF; 0805 ≥ 3.3μF; 1206 ≥ 10μF; 1210 ≥ 22μF; 1812 ≥ 47μF; TT series
10V	≤ 12.5%	≤ 20% 0402 ≥ 0.47μF
6.3V	≤ 20%	---

7.CAPACITANCE RANGE(Con.)

7-1. X7R

Dimension		0402		0603				0805				1206					1210								
Cap(pF)	code	6.3V	6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V	50V	100V	6.3V	10V	16V	25V	50V	100V	
1000000	105	N	B	B	B	B	B		C	C	C	I		J	J	J	P	P		C	C	C	C	F	
1200000	125																P	P	P					G	G
1500000	155								I	I	I	I		J	J	J	P	P			E	E	G	G	G
1800000	185																P	P					G	G	G
2200000	225		B	B	B			I	I	I	I	I		J	J	J	P	P	P		E	E	G	G	G
2700000	275																							G	G
3300000	335													P	P	P	P				E	E	G	G	G
3900000	395																								
4700000	475		B					I	I	I	I		P	P	P	P	P			F	F	F	G	G	
5600000	565																								
6800000	685																								
8200000	825																								
10000000	106							I	I	I			P	P	P	P				F	F	F	G		
12000000	126												P	P	P										
15000000	156																								
18000000	186																								
22000000	226																				G	G	G		
47000000	476																			G	G				

Dimension		1812						1825						2220						2225							
Cap(pF)	code	10V	16V	25V	50V	100V	200V	250V	25V	50V	100V	200V	250V	25V	50V	100V	200V	250V	500V	630V	25V	50V	100V	200V	250V	500V	630V
1000000	105	C	C	C	F	F	G	G	G	F	F	F	F	F	F	F	F	F	H	H	F	F	F	F	F	G	G
1200000	125			C	F	F				F	F	G	G	F	F	F	G	G			F	F	F	G	G	H	H
1500000	155			C	F	F				F	F	G	G	F	F	F	G	G			F	F	F	G	G	H	H
1800000	185			E	F	F				F	F	G	G	F	F	F	G	G			F	F	F	G	G		
2200000	225			E	F	G				F	F	G	G	F	F	F	G	G			F	F	F	G	G		
2700000	275			F	F	G				F	F	H	H	F	F	F	H	H			F	F	F	G	G		
3300000	335			F	F	G				F	F			F	F	F					F	F	F	H	H		
3900000	395			F	F	G				F	F			F	F	F					F	F	F	H	H		
4700000	475			G	G	G				F	G			F	F	F					F	F	G				
5600000	565			G	G	G				G	G			F	F	F					F	F	G				
6800000	685			G	G					G	G			F	F	F					F	F	G				
8200000	825			G	G					G	G			G	G	G					G	G	G				
10000000	106			G	G					G	G			G	G	G					G	G	G				
12000000	126													H							H						
15000000	156													H							H						
18000000	186													H							H						
22000000	226													H	H						H	H					
47000000	476																										

7. CAPACITANCE RANGE (Con.)

7-2. X5R

DIELECTRIC & Series		X5R													
Cap (pF)	EIA Size Rated Voltage	0201			0402					0603					
		6.3V	10V	16V	4V	6.3V	10V	16V	25V	4V	6.3V	10V	16V	25V	50V
1000000	105	L	L	L		N	N	N	N		B	B	B	B	B
1500000	155										B				
2200000	225	L	L			N	N	K	K		B	B	B	B	B
3300000	335										B	B			
4700000	475					K	K	K			B	B	B	B	
6800000	685														
10000000	106					K	K	K			B	B	B	B	B
22000000	226										B	B	B		
47000000	476										B	B			
100000000	107														
220000000	227														

DIELECTRIC & Series		X5R																			
Cap (pF)	EIA Size Rated Voltage	0805						1206						1210							
		4V	6.3V	10V	16V	25V	50V	4V	6.3V	10V	16V	25V	50V	4V	6.3V	10V	16V	25V	35V	50V	
1000000	105			C	C	C	I							P							
1500000	155		I	I	I	I			J	J						F	F				
2200000	225		I	I	I	I	I		J	J	P	P				F	F				
3300000	335		I	I	I	I			P	P	P										
4700000	475		I	I	I	I	I		P	P	P	P	P			F	F	F			
6800000	685								P	P											
10000000	106		I	I	I	I	I		P	P	P	P	P			F	F	F	F	G	G
22000000	226		I	I	I	I			P	P	P	P				G	G	G	G	G	
47000000	476		I	I					P	P	P					G	G	G	G		
100000000	107	I	I						P							G	G	G			
220000000	227							P							G	G					

7.CAPACITANCE RANGE(Con.)

7-3. Y5V

DIELECTRIC & Series		Y5V																
Cap (pF)	EIA Size	0402		0603				0805					1206					
	Rated Voltage	6.3V	10V	6.3V	10V	16V	25V	6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V	35V	50V
1000000	105	N	N		S	B	B		X	X	C	C		M	M	M		M
1500000	155				S				C	C				M	M	M		
2200000	225			S	S	B			C	C	I	I		M	M	M		J
3300000	335								C	C				J	J	J		
4700000	475			B	B				C	C	I			J	J	J	J	P
6800000	685								I					J	J			
10000000	106							I	I	I				J	J	P		
22000000	226							I	I					P	P			
47000000	476												P					
100000000	107																	

DIELECTRIC & Series		Y5V										
Cap (pF)	EIA Size	1210					1812					
	Rated Voltage	6.3V	10V	16V	25V	35V	50V	10V	16V	25V	50V	100V
1000000	105		M	M	M		M	C	C	C	C	C
1500000	155		M	M	M			C	C	C	C	
2200000	225		M	M	M		E	C	C	C	C	
3300000	335		M	M	M			C	C	C	C	
4700000	475		M	M	C		E	C	C	C	C	
6800000	685		M	M	C		F	C	C	C	C	
10000000	106		C	C	E	F	F	C	C	C	F	
22000000	226		F	F								
47000000	476	F	F						G			
100000000	107	G										

8.RELIABILITY TEST CONDITIONS AND REQUIREMENTS

No.	Item	Test Condition	Requirements																																																																
1.	Visual and Dimensions	---	* No remarkable defect. * Dimensions to confirm to individual specification sheet.																																																																
2.	Capacitance	Class II: (X7R, X5R, Y5V) C ≤ 10μF, 1.0±0.2Vrms · 1KHz±10% ** C > 10μF, 0.5±0.2Vrms · 120Hz±20%	* Shall not exceed the limits given in the detailed spec.																																																																
3.	Q/ D.F. (Dissipation Factor)	** Test condition: 0.5±0.2Vrms · 1KHz±10% X7R: 0805=106(6.3V,10V), 0603/475(6.3V) X5R: 01R5 ≥ 103, 0201 ≥ 224 (6.3V,10V,16V) ^{#1} , 0402 ≥ 475 (6.3V,16V), 0402 ≥ 225(10V), 0603=106 (6.3V,10V)	<p>X7R, X5R</p> <table border="1"> <thead> <tr> <th>Rated vol.</th> <th>D.F. ≤</th> <th>Exception of D.F. ≤</th> </tr> </thead> <tbody> <tr> <td rowspan="3">≥ 100V</td> <td rowspan="3">≤ 2.5%</td> <td>≤ 3% 1206 ≥ 0.47μF</td> </tr> <tr> <td>≤ 5% 0805 > 0.1μF; 0603 ≥ 0.068μF; 1206 > 1μF; 1210 ≥ 2.2μF; TT</td> </tr> <tr> <td>≤ 10% 0805 > 0.22μF; 1210 ≥ 3.3μF</td> </tr> <tr> <td rowspan="3">50V</td> <td rowspan="3">≤ 2.5%</td> <td>≤ 3% 0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF</td> </tr> <tr> <td>≤ 5% 0201 ≥ 0.01μF; 1210 ≥ 4.7μF</td> </tr> <tr> <td>≤ 10% 0402 ≥ 0.1μF; 0603 > 0.1μF; 0805 ≥ 1μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF; TT series</td> </tr> <tr> <td rowspan="3">35V</td> <td rowspan="3">≤ 3.5%</td> <td>≤ 10% 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF</td> </tr> <tr> <td>≤ 5% 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF</td> </tr> <tr> <td>≤ 7% 0603 ≥ 0.33μF; 1206 ≥ 4.7μF</td> </tr> <tr> <td rowspan="3">25V</td> <td rowspan="3">≤ 3.5%</td> <td>≤ 10% 0201 ≥ 0.1μF; 0402 ≥ 0.10μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF; TT series</td> </tr> <tr> <td>≤ 12.5% 0402 ≥ 0.47μF</td> </tr> <tr> <td>≤ 5% 0201 ≥ 0.01μF; 0402 ≥ 0.033μF; 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF</td> </tr> <tr> <td rowspan="2">16V</td> <td rowspan="2">≤ 3.5%</td> <td>≤ 10% 0201 ≥ 0.1μF(0201/X7R ≥ 0.022μF); 0402 ≥ 0.22μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series</td> </tr> <tr> <td>≤ 15% 0201 ≥ 0.1μF; 0402 ≥ 1μF</td> </tr> <tr> <td rowspan="2">10V</td> <td rowspan="2">≤ 5%</td> <td>≤ 10% 0201 ≥ 0.012μF; 0402 ≥ 0.33μF(0402/X7R ≥ 0.22μF); TT series 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF; 01R5</td> </tr> <tr> <td>≤ 15% 0201 ≥ 0.1μF; 0402 ≥ 1μF</td> </tr> <tr> <td rowspan="2">6.3V</td> <td rowspan="2">≤ 10%</td> <td>≤ 15% 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF; TT series</td> </tr> <tr> <td>≤ 20% 0402 ≥ 2.2μF</td> </tr> <tr> <td>4V</td> <td>≤ 15%</td> <td>---</td> </tr> </tbody> </table> <p>Y5V</p> <table border="1"> <thead> <tr> <th>Rated vol.</th> <th>D.F. ≤</th> <th>Exception of D.F. ≤</th> </tr> </thead> <tbody> <tr> <td rowspan="2">≥ 50V</td> <td rowspan="2">≤ 5%</td> <td>≤ 7% 0603 ≥ 0.1μF; 0805 ≥ 0.47μF; 1206 ≥ 4.7μF; TT series</td> </tr> <tr> <td>≤ 12.5% 1210 ≥ 6.8μF</td> </tr> <tr> <td>35V</td> <td>≤ 7%</td> <td>---</td> </tr> <tr> <td rowspan="2">25V</td> <td rowspan="2">≤ 5%</td> <td>≤ 7% 0402 ≥ 0.047μF; 0603 ≥ 0.1μF; 0805 ≥ 0.33μF; 1206 ≥ 1μF; 1210 ≥ 4.7μF</td> </tr> <tr> <td>≤ 9% 0402 ≥ 0.068μF; 0603 ≥ 0.47μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series</td> </tr> <tr> <td>16V (C < 1.0μF)</td> <td>≤ 7%</td> <td>≤ 9% 0402 ≥ 0.068μF; 0603 ≥ 0.68μF</td> </tr> <tr> <td>16V (C ≥ 1.0μF)</td> <td>≤ 9%</td> <td>≤ 12.5% 0603 ≥ 2.2μF; 0805 ≥ 3.3μF; 1206 ≥ 10μF; 1210 ≥ 22μF; 1812 ≥ 47μF; TT series</td> </tr> <tr> <td>10V</td> <td>≤ 12.5%</td> <td>≤ 20% 0402 ≥ 0.47μF</td> </tr> <tr> <td>6.3V</td> <td>≤ 20%</td> <td>---</td> </tr> </tbody> </table>	Rated vol.	D.F. ≤	Exception of D.F. ≤	≥ 100V	≤ 2.5%	≤ 3% 1206 ≥ 0.47μF	≤ 5% 0805 > 0.1μF; 0603 ≥ 0.068μF; 1206 > 1μF; 1210 ≥ 2.2μF; TT	≤ 10% 0805 > 0.22μF; 1210 ≥ 3.3μF	50V	≤ 2.5%	≤ 3% 0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF	≤ 5% 0201 ≥ 0.01μF; 1210 ≥ 4.7μF	≤ 10% 0402 ≥ 0.1μF; 0603 > 0.1μF; 0805 ≥ 1μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF; TT series	35V	≤ 3.5%	≤ 10% 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF	≤ 5% 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF	≤ 7% 0603 ≥ 0.33μF; 1206 ≥ 4.7μF	25V	≤ 3.5%	≤ 10% 0201 ≥ 0.1μF; 0402 ≥ 0.10μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF; TT series	≤ 12.5% 0402 ≥ 0.47μF	≤ 5% 0201 ≥ 0.01μF; 0402 ≥ 0.033μF; 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF	16V	≤ 3.5%	≤ 10% 0201 ≥ 0.1μF(0201/X7R ≥ 0.022μF); 0402 ≥ 0.22μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series	≤ 15% 0201 ≥ 0.1μF; 0402 ≥ 1μF	10V	≤ 5%	≤ 10% 0201 ≥ 0.012μF; 0402 ≥ 0.33μF(0402/X7R ≥ 0.22μF); TT series 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF; 01R5	≤ 15% 0201 ≥ 0.1μF; 0402 ≥ 1μF	6.3V	≤ 10%	≤ 15% 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF; TT series	≤ 20% 0402 ≥ 2.2μF	4V	≤ 15%	---	Rated vol.	D.F. ≤	Exception of D.F. ≤	≥ 50V	≤ 5%	≤ 7% 0603 ≥ 0.1μF; 0805 ≥ 0.47μF; 1206 ≥ 4.7μF; TT series	≤ 12.5% 1210 ≥ 6.8μF	35V	≤ 7%	---	25V	≤ 5%	≤ 7% 0402 ≥ 0.047μF; 0603 ≥ 0.1μF; 0805 ≥ 0.33μF; 1206 ≥ 1μF; 1210 ≥ 4.7μF	≤ 9% 0402 ≥ 0.068μF; 0603 ≥ 0.47μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series	16V (C < 1.0μF)	≤ 7%	≤ 9% 0402 ≥ 0.068μF; 0603 ≥ 0.68μF	16V (C ≥ 1.0μF)	≤ 9%	≤ 12.5% 0603 ≥ 2.2μF; 0805 ≥ 3.3μF; 1206 ≥ 10μF; 1210 ≥ 22μF; 1812 ≥ 47μF; TT series	10V	≤ 12.5%	≤ 20% 0402 ≥ 0.47μF	6.3V	≤ 20%	---
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5.	Insulation Resistance	To apply rated voltage for MAX. 120sec. *Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.	<p>10GΩ or RxC ≥ 500Ω-F whichever is smaller.</p> <p>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: All X7R</td> <td rowspan="6">10GΩ or RxC ≥ 100 Ω-F whichever is smaller.</td> </tr> <tr> <td>50V: 0402 > 0.01μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF</td> </tr> <tr> <td>35V: 0805 ≥ 2.2μF; 1206 ≥ 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: 0201 ≥ 0.1μF; 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 ; TT series; Size ≥ 1812</td> <td></td> </tr> <tr> <td>Rated voltage</td> <td>Insulation Resistance</td> </tr> <tr> <td>100V: 1210 ≥ 3.3μF</td> <td rowspan="7">RxC ≥ 50 Ω-F</td> </tr> <tr> <td>50V: 0402 ≥ 0.1μF; 0603 ≥ 2.2μF; 0805 ≥ 10μF; 1206 ≥ 10μF</td> </tr> <tr> <td>35V: 0603 ≥ 1μF;</td> </tr> <tr> <td>25V: 0201 ≥ 0.1μF; 0402 ≥ 2.2μF; 0603 ≥ 10μF; 0805 ≥ 10μF; 1206 ≥ 22μF</td> </tr> <tr> <td>16V: 0603 ≥ 10μF; 0402 ≥ 1μF; 0201 ≥ 0.22μF</td> </tr> <tr> <td>10V: 0201 > 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 47μF; TT21 > 4.7μF</td> </tr> <tr> <td>6.3V: 0201 ≥ 0.1μF; 0603 > 4.7μF; 0805 ≥ 47μF; 1206 ≥ 10μF;</td> </tr> <tr> <td>4V: 0603 ≥ 22μF; 0805 ≥ 47μF; 1206 ≥ 100μF</td> </tr> </tbody> </table>	Rated voltage	Insulation Resistance	100V: All X7R	10GΩ or RxC ≥ 100 Ω-F whichever is smaller.	50V: 0402 > 0.01μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF	35V: 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF	25V: 0402 ≥ 1μF; 0603 ≥ 2.2μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 10μF	16V: 0201 ≥ 0.1μF; 0402 ≥ 0.22μF; 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 47μF	10V: 0201 > 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 47μF	6.3V ; 4V ; TT series; Size ≥ 1812		Rated voltage	Insulation Resistance	100V: 1210 ≥ 3.3μF	RxC ≥ 50 Ω-F	50V: 0402 ≥ 0.1μF; 0603 ≥ 2.2μF; 0805 ≥ 10μF; 1206 ≥ 10μF	35V: 0603 ≥ 1μF;	25V: 0201 ≥ 0.1μF; 0402 ≥ 2.2μF; 0603 ≥ 10μF; 0805 ≥ 10μF; 1206 ≥ 22μF	16V: 0603 ≥ 10μF; 0402 ≥ 1μF; 0201 ≥ 0.22μF	10V: 0201 > 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 47μF; TT21 > 4.7μF	6.3V: 0201 ≥ 0.1μF; 0603 > 4.7μF; 0805 ≥ 47μF; 1206 ≥ 10μF;	4V: 0603 ≥ 22μF; 0805 ≥ 47μF; 1206 ≥ 100μF																																										
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8.RELIABILITY TEST CONDITIONS AND REQUIREMENTS

No.	Item	Test Condition	Requirements																																		
6.	Dielectric Strength	<table border="1"> <thead> <tr> <th>Rated voltage</th> <th>Condition</th> </tr> </thead> <tbody> <tr> <td>≤ 250</td> <td>2 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>	Rated voltage	Condition	≤ 250	2 times of U _R	250 < V ≤ 500	1.5 times of U _R	630	1.2 times of U _R	<p>* No evidence of damage or flash over during test.</p>																										
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<p>* Duration: 1 to 5 sec. * Charge and discharge current less than 50mA</p>																																					
7.	Solderability	<p>* Solder temperature: 235±5°C for (0201~1210) * Solder temperature: 245±5°C for (1808~2225) * Dipping time: 2±0.5 sec.</p>	75% min. coverage of all metalized area.																																		
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): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp. * Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.</p>	<p>* No remarkable damage. * Cap change: X7R, X5R : within ±7.5% Y5V: within ±20% * D.F., I.R. and dielectric strength: To meet initial requirements. * 25% max. leaching on each edge.</p>																																		
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>	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. * Cap change : X7R, X5R : within ±7.5% Y5V: within ±20% * D.F. : ≤ 1.5(Df)×initial requirement * I.R. : 0.25×initial requirement</p>																			
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10.	Humidity (Damp Heat) Steady State	<p>* Test temp.: 40±2°C * Humidity: 90~95% RH * Test time: 500+24/-0hrs. * Measurement to be made after keeping at room temp. for 48±4 hrs (Class II).</p>	<p>* No remarkable damage. * Cap change: X7R, X5R : ≥10V, within ±15%, 6.3V, within ±25%, X7R, X5R</p> <table border="1"> <thead> <tr> <th>Rated v</th> <th>D.F. ≤</th> <th>Exception of D.F. ≤</th> </tr> </thead> <tbody> <tr> <td rowspan="3">≥ 50V</td> <td rowspan="3">≤ 3%</td> <td>≤ 6% 0201(50V);0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF</td> </tr> <tr> <td>≤ 10% 0201 ≥ 0.01μF; 1210 ≥ 4.7μF</td> </tr> <tr> <td>≤ 20% 0402 ≥ 0.1μF; 0603 > 0.1μF; 0805 ≥ 1μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF; TT series</td> </tr> <tr> <td rowspan="2">35V</td> <td rowspan="2">≤ 5%</td> <td>≤ 20% 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF</td> </tr> <tr> <td>≤ 10% 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF</td> </tr> <tr> <td rowspan="4">25V</td> <td rowspan="4">≤ 5%</td> <td>≤ 14% 0603 ≥ 0.33μF; 1206 ≥ 4.7μF</td> </tr> <tr> <td>≤ 15% 0201 ≥ 0.1μF; 0402 ≥ 0.10μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF; TT series</td> </tr> <tr> <td>≤ 20% 0402 ≥ 0.47μF</td> </tr> <tr> <td>≤ 10% 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF</td> </tr> <tr> <td rowspan="3">16V</td> <td rowspan="3">≤ 5%</td> <td>≤ 15% 0201 ≥ 0.01μF(0201/X7R ≥ 0.022μF); 0402 ≥ 0.033μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series</td> </tr> <tr> <td>≤ 15% 0201 ≥ 0.012μF; 0402 ≥ 0.33μF(0402/X7R ≥ 0.22μF); 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF</td> </tr> <tr> <td>≤ 20% 0201 ≥ 0.1μF; 0402 ≥ 1μF; TT series: 01R5</td> </tr> <tr> <td rowspan="2">10V</td> <td rowspan="2">≤ 7.5%</td> <td>≤ 15% 0201 ≥ 0.012μF; 0402 ≥ 0.33μF(0402/X7R ≥ 0.22μF); 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF</td> </tr> <tr> <td>≤ 20% 0201 ≥ 0.1μF; 0402 ≥ 1μF; TT series: 01R5</td> </tr> <tr> <td rowspan="2">6.3V</td> <td rowspan="2">≤ 15%</td> <td>≤ 30% 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF; TT series</td> </tr> <tr> <td>≤ 20% ---</td> </tr> <tr> <td>4V</td> <td>≤ 20%</td> <td>---</td> </tr> </tbody> </table>	Rated v	D.F. ≤	Exception of D.F. ≤	≥ 50V	≤ 3%	≤ 6% 0201(50V);0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF	≤ 10% 0201 ≥ 0.01μF; 1210 ≥ 4.7μF	≤ 20% 0402 ≥ 0.1μF; 0603 > 0.1μF; 0805 ≥ 1μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF; TT series	35V	≤ 5%	≤ 20% 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF	≤ 10% 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF	25V	≤ 5%	≤ 14% 0603 ≥ 0.33μF; 1206 ≥ 4.7μF	≤ 15% 0201 ≥ 0.1μF; 0402 ≥ 0.10μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF; TT series	≤ 20% 0402 ≥ 0.47μF	≤ 10% 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF	16V	≤ 5%	≤ 15% 0201 ≥ 0.01μF(0201/X7R ≥ 0.022μF); 0402 ≥ 0.033μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series	≤ 15% 0201 ≥ 0.012μF; 0402 ≥ 0.33μF(0402/X7R ≥ 0.22μF); 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF	≤ 20% 0201 ≥ 0.1μF; 0402 ≥ 1μF; TT series: 01R5	10V	≤ 7.5%	≤ 15% 0201 ≥ 0.012μF; 0402 ≥ 0.33μF(0402/X7R ≥ 0.22μF); 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF	≤ 20% 0201 ≥ 0.1μF; 0402 ≥ 1μF; TT series: 01R5	6.3V	≤ 15%	≤ 30% 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF; TT series	≤ 20% ---	4V	≤ 20%	---
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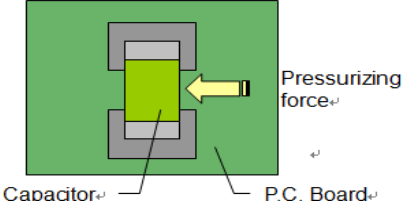
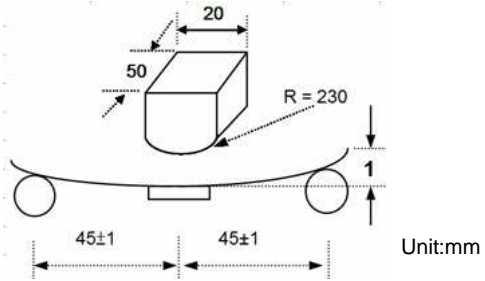
8.RELIABILITY TEST CONDITIONS AND REQUIREMENTS

No.	Item	Test Condition	Requirements																																																																											
11.	Humidity (Damp Heat) Load	<p>*Test temp.: 40±2°C *Humidity: 90~95% RH *Test time: 500+24/-0hrs. *To apply voltage :rated voltage *Measurement to be made after keeping at room temp. for 48±4 hrs (Class II).</p>	<p>* No remarkable damage. * Cap change: X7R, X5R: ≥10V, within ±12.5%; 6.3V within ±25% **10V:0603≥4.7uF;0402≥1 uF;02012≥0.1 uF within ±25% Y5V: ≥10V within ±30%; 6.3V within +30/-40% * Q/D.F. value: X7R, X5R</p> <table border="1"> <thead> <tr> <th>Rated vol.</th> <th>D.F.≤</th> <th>Exception of D.F.≤</th> </tr> </thead> <tbody> <tr> <td rowspan="3">≥ 100V</td> <td rowspan="3">≤ 3%</td> <td>≤ 6% 1206 ≥ 0.47μF</td> </tr> <tr> <td>≤ 7.5% 0805 > 0.1μF; 0603 ≥ 0.068μF; 1206 > 1μF; 1210 ≥ 2.2μF; TT series</td> </tr> <tr> <td>≤ 20% 0805 > 0.22μF; 1210 ≥ 3.3μF</td> </tr> <tr> <td rowspan="3">≥ 50V</td> <td rowspan="3">≤ 3%</td> <td>≤ 6% 0201(50V);0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF</td> </tr> <tr> <td>≤ 10% 0201 ≥ 0.01μF; 1210 ≥ 4.7μF</td> </tr> <tr> <td>≤ 20% 0402 ≥ 0.1μF; 0603 > 0.1μF; 0805 ≥ 1μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF; TT series</td> </tr> <tr> <td>35V</td> <td>≤ 5%</td> <td>≤ 20% 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF</td> </tr> <tr> <td rowspan="4">25V</td> <td rowspan="4">≤ 5%</td> <td>≤ 10% 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF</td> </tr> <tr> <td>≤ 14% 0603 ≥ 0.33μF; 1206 ≥ 4.7μF</td> </tr> <tr> <td>≤ 15% 0201 ≥ 0.1μF; 0402 ≥ 0.10μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF; TT series</td> </tr> <tr> <td>≤ 20% 0402 ≥ 0.47μF</td> </tr> <tr> <td rowspan="2">16V</td> <td rowspan="2">≤ 5%</td> <td>≤ 10% 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF</td> </tr> <tr> <td>≤ 15% 0201 ≥ 0.01μF(0201/X7R ≥ 0.022μF); 0402 ≥ 0.033μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series</td> </tr> <tr> <td rowspan="3">10V</td> <td rowspan="3">≤ 7.5%</td> <td>≤ 15% 0201 ≥ 0.012μF; 0402 ≥ 0.33μF(0402/X7R ≥ 0.22μF); 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF</td> </tr> <tr> <td>≤ 20% 0201 ≥ 0.1μF ; 0402 ≥ 1μF; TT series; 01R5</td> </tr> <tr> <td>≤ 30% 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF; TT series</td> </tr> <tr> <td>6.3V</td> <td>≤ 15%</td> <td>≤ 30%</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>Exception of D.F.≤</th> </tr> </thead> <tbody> <tr> <td rowspan="2">≥ 50V</td> <td rowspan="2">≤ 7.5%</td> <td>≤ 10% 0603 ≥ 0.1μF; 0805 ≥ 0.47μF; 1206 ≥ 4.7μF</td> </tr> <tr> <td>≤ 20% 1210 ≥ 6.8μF</td> </tr> <tr> <td>35V</td> <td>≤ 10%</td> <td>---</td> </tr> <tr> <td rowspan="3">25V</td> <td rowspan="3">≤ 7.5%</td> <td>≤ 10% 0402 ≥ 0.047μF; 0603 ≥ 0.1μF; 0805 ≥ 0.33μF; 1206 ≥ 1μF; 1210 ≥ 4.7μF</td> </tr> <tr> <td>≤ 15% 0402 ≥ 0.068μF; 0603 ≥ 0.47μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF</td> </tr> <tr> <td>≤ 20% 0402 ≥ 0.068μF; 0603 ≥ 0.68μF</td> </tr> <tr> <td>16V (C<1.0μF)</td> <td>≤ 10%</td> <td>≤ 20% 0402 ≥ 0.22μF</td> </tr> <tr> <td>16V (C≥ 1.0μF)</td> <td>≤ 12.5%</td> <td>≤ 20% 0603 ≥ 2.2μF; 0805 ≥ 3.3μF; 1206 ≥ 10μF; 1210 ≥ 22μF; 1812 ≥ 47μF;</td> </tr> <tr> <td>10V</td> <td>≤ 20%</td> <td>≤ 30% 0402 ≥ 0.47μF</td> </tr> <tr> <td>6.3V</td> <td>≤ 30%</td> <td>---</td> </tr> </tbody> </table> <p>*I.R.: ≥10V, 500MΩ or 25 Ω-F whichever is smaller. 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35V	≤ 5%	≤ 20% 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF																																																																												
25V	≤ 5%	≤ 10% 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF																																																																												
		≤ 14% 0603 ≥ 0.33μF; 1206 ≥ 4.7μF																																																																												
		≤ 15% 0201 ≥ 0.1μF; 0402 ≥ 0.10μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF; TT series																																																																												
		≤ 20% 0402 ≥ 0.47μF																																																																												
16V	≤ 5%	≤ 10% 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF																																																																												
		≤ 15% 0201 ≥ 0.01μF(0201/X7R ≥ 0.022μF); 0402 ≥ 0.033μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series																																																																												
10V	≤ 7.5%	≤ 15% 0201 ≥ 0.012μF; 0402 ≥ 0.33μF(0402/X7R ≥ 0.22μF); 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF																																																																												
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6.3V	≤ 15%	≤ 30%																																																																												
4V	≤ 20%	---	---																																																																											
Rated vol.	D.F.≤	Exception of D.F.≤																																																																												
≥ 50V	≤ 7.5%	≤ 10% 0603 ≥ 0.1μF; 0805 ≥ 0.47μF; 1206 ≥ 4.7μF																																																																												
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25V	≤ 7.5%	≤ 10% 0402 ≥ 0.047μF; 0603 ≥ 0.1μF; 0805 ≥ 0.33μF; 1206 ≥ 1μF; 1210 ≥ 4.7μF																																																																												
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16V (C<1.0μF)	≤ 10%	≤ 20% 0402 ≥ 0.22μF																																																																												
16V (C≥ 1.0μF)	≤ 12.5%	≤ 20% 0603 ≥ 2.2μF; 0805 ≥ 3.3μF; 1206 ≥ 10μF; 1210 ≥ 22μF; 1812 ≥ 47μF;																																																																												
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6.3V ; 4V ; TT series ; All X6S/X7S items; Size ≥ 1812																																																																														

8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

No.	Item	Test Condition	Requirements																																																																																																																									
12.	High Temperature Load (Endurance)	<p>*Test temp. : X7R: 125±3°C X5R, Y5V: 85±3°C</p> <p>*To apply voltage: (1) $\leq 6.3V$ or $C \geq 10\mu F$ or TT series: 150% of rated voltage. (2) $10V \leq U_r < 500V$: 200% of rated voltage. (3) $500V$: 150% of rated voltage. (4) $U_r \geq 630V$: 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/X7R</td> <td>$\leq 10V$ $\geq 16V$</td> <td>$C \geq 0.1\mu F$ $C > 0.1\mu F$</td> </tr> <tr> <td>0402</td> <td>X5R/X7R/ Y5V</td> <td>6.3V, 10V, 16V, 25V</td> <td>$C \geq 1.0\mu F$</td> </tr> <tr> <td>0603</td> <td>X5R/X7R</td> <td>4V 6.3V, 10V, 25V, 35V</td> <td>$C \geq 22\mu F$ $C \geq 4.7\mu F$ $C \geq 1.0\mu F$</td> </tr> <tr> <td>0805</td> <td>X5R/X7R</td> <td>4V 6.3V 10V-50V</td> <td>$C \geq 47\mu F$ $C \geq 22\mu F$ $C \geq 10\mu F$</td> </tr> <tr> <td>1206</td> <td>X5R/X7R</td> <td>$\leq 6.3V$</td> <td>$C \geq 47\mu F$</td> </tr> <tr> <td>1210</td> <td>X5R/X7R X7R</td> <td>16V 100V</td> <td>$C \geq 47\mu F$ $C \geq 3.3\mu F$</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</th> </tr> </thead> <tbody> <tr> <td>0201</td> <td>X5R/X7R X7R</td> <td>16V/25V 16V</td> <td>$C \geq 0.1\mu F$ $C \geq 0.022\mu F$</td> </tr> <tr> <td>0402</td> <td>X5R/X7R Y5V</td> <td>50V 10-25V 16V</td> <td>$C \geq 0.1\mu F$ $C \geq 0.22\mu F$ $C \geq 0.47\mu F$</td> </tr> <tr> <td>0603</td> <td>X5R/X7R Y5V</td> <td>10V, 16V, 50V 16V</td> <td>$C \geq 1.0\mu F$ $C \geq 2.2\mu F$</td> </tr> <tr> <td>0805</td> <td>X5R/X7R X5R/X7R Y5V</td> <td>10-50V 50V 100V 16V</td> <td>$C \geq 4.7\mu F$ $C \geq 2.2\mu F$ $C \geq 0.47\mu F$ $C \geq 4.7\mu F$</td> </tr> <tr> <td>1206</td> <td>X5R/X7R</td> <td>100V</td> <td>$C \geq 1.0\mu F$</td> </tr> <tr> <td>1210</td> <td>X5R/X7R</td> <td>50V-100V</td> <td>$C \geq 2.2\mu F$</td> </tr> <tr> <td>1825 2220 2225</td> <td>X7R</td> <td>100V-250V</td> <td>$C \geq 1.0\mu F$</td> </tr> </tbody> </table> <p>*Test time: 1000+24/-0 hrs. *Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp. * Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150°C for 1hr then set for 24±2 hrs at room temp. ** De-rating conditions:</p>	Size	Dielectric	Rated voltage	Capacitance range	0201	X5R/X7R	$\leq 10V$ $\geq 16V$	$C \geq 0.1\mu F$ $C > 0.1\mu F$	0402	X5R/X7R/ Y5V	6.3V, 10V, 16V, 25V	$C \geq 1.0\mu F$	0603	X5R/X7R	4V 6.3V, 10V, 25V, 35V	$C \geq 22\mu F$ $C \geq 4.7\mu F$ $C \geq 1.0\mu F$	0805	X5R/X7R	4V 6.3V 10V-50V	$C \geq 47\mu F$ $C \geq 22\mu F$ $C \geq 10\mu F$	1206	X5R/X7R	$\leq 6.3V$	$C \geq 47\mu F$	1210	X5R/X7R X7R	16V 100V	$C \geq 47\mu F$ $C \geq 3.3\mu F$	Size	Dielectric	Rated voltage	Capacitance	0201	X5R/X7R X7R	16V/25V 16V	$C \geq 0.1\mu F$ $C \geq 0.022\mu F$	0402	X5R/X7R Y5V	50V 10-25V 16V	$C \geq 0.1\mu F$ $C \geq 0.22\mu F$ $C \geq 0.47\mu F$	0603	X5R/X7R Y5V	10V, 16V, 50V 16V	$C \geq 1.0\mu F$ $C \geq 2.2\mu F$	0805	X5R/X7R X5R/X7R Y5V	10-50V 50V 100V 16V	$C \geq 4.7\mu F$ $C \geq 2.2\mu F$ $C \geq 0.47\mu F$ $C \geq 4.7\mu F$	1206	X5R/X7R	100V	$C \geq 1.0\mu F$	1210	X5R/X7R	50V-100V	$C \geq 2.2\mu F$	1825 2220 2225	X7R	100V-250V	$C \geq 1.0\mu F$	<p>* No remarkable damage. Cap change: X7R, X5R: $\geq 10V^{**}$, within $\pm 12.5\%$; $\leq 6.3V$ within $\pm 25\%$; **10V: 0603 $\geq 4.7\mu F$; 0402 $\geq 1\mu F$; 0201 $\geq 0.1\mu F$, within $\pm 25\%$; Y5V: $\geq 10V$, within $\pm 30\%$; $\leq 6.3V$, within $+30/-40\%$</p> <p>D.F. value: $10pF \leq C < 30pF$, $Q \geq 275+2.5C$ Less than 10pF, $Q \geq 200+10C$</p> <p>X7R, X5R:</p> <table border="1"> <thead> <tr> <th>Rated</th> <th>D.F. \leq</th> <th>Exception of D.F. \leq</th> </tr> </thead> <tbody> <tr> <td>$\geq 100V$</td> <td>$\leq 3\%$</td> <td>$\leq 6\%$ 1206 $\geq 0.47\mu F$ $\leq 7.5\%$ 0805 $> 0.1\mu F$, 0603 $\geq 0.068\mu F$, 1206 $> 1\mu F$; 1210 $\geq 2.2\mu F$; TT series $\leq 20\%$ 0605 $> 0.22\mu F$; 1210 $\geq 3.3\mu F$</td> </tr> <tr> <td>$\geq 50V$</td> <td>$\leq 3\%$</td> <td>$\leq 6\%$ 0201(50V); 0603 $\geq 0.047\mu F$; 0805 $\geq 0.18\mu F$; 1206 $\geq 0.47\mu F$ $\leq 10\%$ 0201 $\geq 0.01\mu F$; 1210 $\geq 4.7\mu F$ $\leq 20\%$ 0402 $\geq 0.1\mu F$; 0603 $> 0.1\mu F$; 0805 $\geq 1\mu F$; 1206 $\geq 2.2\mu F$; 1210 $\geq 10\mu F$; TT series</td> </tr> <tr> <td>35V</td> <td>$\leq 5\%$</td> <td>$\leq 20\%$ 0603 $\geq 1\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 2.2\mu F$; 1210 $\geq 10\mu F$</td> </tr> <tr> <td>25V</td> <td>$\leq 5\%$</td> <td>$\leq 10\%$ 0201 $\geq 0.01\mu F$; 0805 $\geq 1\mu F$; 1210 $\geq 10\mu F$ $\leq 14\%$ 0603 $\geq 0.33\mu F$; 1206 $\geq 4.7\mu F$ $\leq 15\%$ 0201 $\geq 0.1\mu F$; 0402 $\geq 0.10\mu F$; 0603 $\geq 0.47\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 6.8\mu F$; 1210 $\geq 22\mu F$; TT series $\leq 20\%$ 0402 $\geq 0.47\mu F$</td> </tr> <tr> <td>16V</td> <td>$\leq 5\%$</td> <td>$\leq 10\%$ 0603 $\geq 0.15\mu F$; 0805 $\geq 0.68\mu F$; 1206 $\geq 2.2\mu F$; 1210 $\geq 4.7\mu F$ $\leq 15\%$ 0201 $\geq 0.01\mu F$ (0201/X7R $\geq 0.022\mu F$); 0402 $\geq 0.033\mu F$; 0603 $\geq 0.68\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 4.7\mu F$; 1210 $\geq 22\mu F$; TT series</td> </tr> <tr> <td>10V</td> <td>$\leq 7.5\%$</td> <td>$\leq 15\%$ 0201 $\geq 0.012\mu F$; 0402 $\geq 0.33\mu F$ (0402/X7R $\geq 0.22\mu F$); 0603 $\geq 0.33\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 2.2\mu F$; 1210 $\geq 22\mu F$ $\leq 20\%$ 0201 $\geq 0.1\mu F$; 0402 $\geq 1\mu F$; TT series; 01R5</td> </tr> <tr> <td>6.3V</td> <td>$\leq 15\%$</td> <td>$\leq 30\%$ 0201 $\geq 0.1\mu F$; 0402 $\geq 1\mu F$; 0603 $\geq 10\mu F$; 0805 $\geq 4.7\mu F$; 1206 $\geq 47\mu F$; 1210 $\geq 100\mu F$; TT series</td> </tr> <tr> <td>4V</td> <td>$\leq 20\%$</td> <td>---</td> </tr> </tbody> </table> <p>Y5V:</p> <table border="1"> <thead> <tr> <th>Rated vol.</th> <th>D.F. \leq</th> <th>Exception of D.F. \leq</th> </tr> </thead> <tbody> <tr> <td>$\geq 50V$</td> <td>$\leq 7.5\%$</td> <td>$\leq 10\%$ 0603 $\geq 0.1\mu F$; 0805 $\geq 0.47\mu F$; 1206 $\geq 4.7\mu F$ $\leq 20\%$ 1210 $\geq 6.8\mu F$</td> </tr> <tr> <td>35V</td> <td>$\leq 10\%$</td> <td>---</td> </tr> <tr> <td>25V</td> <td>$\leq 7.5\%$</td> <td>$\leq 10\%$ 0402 $\geq 0.047\mu F$; 0603 $\geq 0.1\mu F$; 0805 $\geq 0.33\mu F$; 1206 $\geq 1\mu F$; 1210 $\geq 4.7\mu F$ $\leq 15\%$ 0402 $\geq 0.068\mu F$; 0603 $\geq 0.47\mu F$; 1206 $\geq 4.7\mu F$; 1210 $\geq 22\mu F$</td> </tr> <tr> <td>16V (C < 1.0μF)</td> <td>$\leq 10\%$</td> <td>$\leq 12.5\%$ 0402 $\geq 0.068\mu F$; 0603 $\geq 0.68\mu F$ $\leq 20\%$ 0402 $\geq 0.22\mu F$</td> </tr> <tr> <td>16V (C $\geq 1.0\mu F$)</td> <td>$\leq 12.5\%$</td> <td>$\leq 20\%$ 0603 $\geq 2.2\mu F$; 0805 $\geq 3.3\mu F$; 1206 $\geq 10\mu F$; 1210 $\geq 22\mu F$; 1812 $\geq 47\mu F$;</td> </tr> <tr> <td>10V</td> <td>$\leq 20\%$</td> <td>$\leq 30\%$ 0402 $\geq 0.47\mu F$</td> </tr> <tr> <td>6.3V</td> <td>$\leq 30\%$</td> <td>---</td> </tr> </tbody> </table> <p>*I.R.: $\geq 10V$, 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: All X7R; 1210 $\geq 3.3\mu F$</td> <td rowspan="7">1GΩ or RxC $\geq 10 \Omega \cdot F$ whichever is smaller.</td> </tr> <tr> <td>50V: 0402 $> 0.01\mu F$; 0603 $\geq 1\mu F$; 0805 $\geq 1\mu F$; 1206 $\geq 4.7\mu F$; 1210 $\geq 4.7\mu F$</td> </tr> <tr> <td>35V: 0603 $\geq 1\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 2.2\mu F$; 1210 $\geq 10\mu F$</td> </tr> <tr> <td>25V: 0201 $\geq 0.1\mu F$; 0402 $\geq 0.22\mu F$; 0603 $\geq 2.2\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 10\mu F$; 1210 $\geq 10\mu F$</td> </tr> <tr> <td>16V: 0201 $\geq 0.1\mu F$; 0402 $\geq 0.22\mu F$; 0603 $\geq 1\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 10\mu F$; 1210 $\geq 47\mu F$</td> </tr> <tr> <td>10V: 0201 $\geq 47nF$; 0402 $\geq 0.47\mu F$; 0603 $\geq 0.47\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 4.7\mu F$; 1210 $\geq 47\mu F$</td> </tr> <tr> <td>6.3V ; 4V ; TT series ; All X6S/X7S items; Size ≥ 1812</td> </tr> </tbody> </table>	Rated	D.F. \leq	Exception of D.F. \leq	$\geq 100V$	$\leq 3\%$	$\leq 6\%$ 1206 $\geq 0.47\mu F$ $\leq 7.5\%$ 0805 $> 0.1\mu F$, 0603 $\geq 0.068\mu F$, 1206 $> 1\mu F$; 1210 $\geq 2.2\mu F$; TT series $\leq 20\%$ 0605 $> 0.22\mu F$; 1210 $\geq 3.3\mu F$	$\geq 50V$	$\leq 3\%$	$\leq 6\%$ 0201(50V); 0603 $\geq 0.047\mu F$; 0805 $\geq 0.18\mu F$; 1206 $\geq 0.47\mu F$ $\leq 10\%$ 0201 $\geq 0.01\mu F$; 1210 $\geq 4.7\mu F$ $\leq 20\%$ 0402 $\geq 0.1\mu F$; 0603 $> 0.1\mu F$; 0805 $\geq 1\mu F$; 1206 $\geq 2.2\mu F$; 1210 $\geq 10\mu F$; TT series	35V	$\leq 5\%$	$\leq 20\%$ 0603 $\geq 1\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 2.2\mu F$; 1210 $\geq 10\mu F$	25V	$\leq 5\%$	$\leq 10\%$ 0201 $\geq 0.01\mu F$; 0805 $\geq 1\mu F$; 1210 $\geq 10\mu F$ $\leq 14\%$ 0603 $\geq 0.33\mu F$; 1206 $\geq 4.7\mu F$ $\leq 15\%$ 0201 $\geq 0.1\mu F$; 0402 $\geq 0.10\mu F$; 0603 $\geq 0.47\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 6.8\mu F$; 1210 $\geq 22\mu F$; TT series $\leq 20\%$ 0402 $\geq 0.47\mu F$	16V	$\leq 5\%$	$\leq 10\%$ 0603 $\geq 0.15\mu F$; 0805 $\geq 0.68\mu F$; 1206 $\geq 2.2\mu F$; 1210 $\geq 4.7\mu F$ $\leq 15\%$ 0201 $\geq 0.01\mu F$ (0201/X7R $\geq 0.022\mu F$); 0402 $\geq 0.033\mu F$; 0603 $\geq 0.68\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 4.7\mu F$; 1210 $\geq 22\mu F$; TT series	10V	$\leq 7.5\%$	$\leq 15\%$ 0201 $\geq 0.012\mu F$; 0402 $\geq 0.33\mu F$ (0402/X7R $\geq 0.22\mu F$); 0603 $\geq 0.33\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 2.2\mu F$; 1210 $\geq 22\mu F$ $\leq 20\%$ 0201 $\geq 0.1\mu F$; 0402 $\geq 1\mu F$; TT series; 01R5	6.3V	$\leq 15\%$	$\leq 30\%$ 0201 $\geq 0.1\mu F$; 0402 $\geq 1\mu F$; 0603 $\geq 10\mu F$; 0805 $\geq 4.7\mu F$; 1206 $\geq 47\mu F$; 1210 $\geq 100\mu F$; TT series	4V	$\leq 20\%$	---	Rated vol.	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1206	X5R/X7R	$\leq 6.3V$	$C \geq 47\mu F$																																																																																																																									
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1206	X5R/X7R	100V	$C \geq 1.0\mu F$																																																																																																																									
1210	X5R/X7R	50V-100V	$C \geq 2.2\mu F$																																																																																																																									
1825 2220 2225	X7R	100V-250V	$C \geq 1.0\mu F$																																																																																																																									
Rated	D.F. \leq	Exception of D.F. \leq																																																																																																																										
$\geq 100V$	$\leq 3\%$	$\leq 6\%$ 1206 $\geq 0.47\mu F$ $\leq 7.5\%$ 0805 $> 0.1\mu F$, 0603 $\geq 0.068\mu F$, 1206 $> 1\mu F$; 1210 $\geq 2.2\mu F$; TT series $\leq 20\%$ 0605 $> 0.22\mu F$; 1210 $\geq 3.3\mu F$																																																																																																																										
$\geq 50V$	$\leq 3\%$	$\leq 6\%$ 0201(50V); 0603 $\geq 0.047\mu F$; 0805 $\geq 0.18\mu F$; 1206 $\geq 0.47\mu F$ $\leq 10\%$ 0201 $\geq 0.01\mu F$; 1210 $\geq 4.7\mu F$ $\leq 20\%$ 0402 $\geq 0.1\mu F$; 0603 $> 0.1\mu F$; 0805 $\geq 1\mu F$; 1206 $\geq 2.2\mu F$; 1210 $\geq 10\mu F$; TT series																																																																																																																										
35V	$\leq 5\%$	$\leq 20\%$ 0603 $\geq 1\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 2.2\mu F$; 1210 $\geq 10\mu F$																																																																																																																										
25V	$\leq 5\%$	$\leq 10\%$ 0201 $\geq 0.01\mu F$; 0805 $\geq 1\mu F$; 1210 $\geq 10\mu F$ $\leq 14\%$ 0603 $\geq 0.33\mu F$; 1206 $\geq 4.7\mu F$ $\leq 15\%$ 0201 $\geq 0.1\mu F$; 0402 $\geq 0.10\mu F$; 0603 $\geq 0.47\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 6.8\mu F$; 1210 $\geq 22\mu F$; TT series $\leq 20\%$ 0402 $\geq 0.47\mu F$																																																																																																																										
16V	$\leq 5\%$	$\leq 10\%$ 0603 $\geq 0.15\mu F$; 0805 $\geq 0.68\mu F$; 1206 $\geq 2.2\mu F$; 1210 $\geq 4.7\mu F$ $\leq 15\%$ 0201 $\geq 0.01\mu F$ (0201/X7R $\geq 0.022\mu F$); 0402 $\geq 0.033\mu F$; 0603 $\geq 0.68\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 4.7\mu F$; 1210 $\geq 22\mu F$; TT series																																																																																																																										
10V	$\leq 7.5\%$	$\leq 15\%$ 0201 $\geq 0.012\mu F$; 0402 $\geq 0.33\mu F$ (0402/X7R $\geq 0.22\mu F$); 0603 $\geq 0.33\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 2.2\mu F$; 1210 $\geq 22\mu F$ $\leq 20\%$ 0201 $\geq 0.1\mu F$; 0402 $\geq 1\mu F$; TT series; 01R5																																																																																																																										
6.3V	$\leq 15\%$	$\leq 30\%$ 0201 $\geq 0.1\mu F$; 0402 $\geq 1\mu F$; 0603 $\geq 10\mu F$; 0805 $\geq 4.7\mu F$; 1206 $\geq 47\mu F$; 1210 $\geq 100\mu F$; TT series																																																																																																																										
4V	$\leq 20\%$	---																																																																																																																										
Rated vol.	D.F. \leq	Exception of D.F. \leq																																																																																																																										
$\geq 50V$	$\leq 7.5\%$	$\leq 10\%$ 0603 $\geq 0.1\mu F$; 0805 $\geq 0.47\mu F$; 1206 $\geq 4.7\mu F$ $\leq 20\%$ 1210 $\geq 6.8\mu F$																																																																																																																										
35V	$\leq 10\%$	---																																																																																																																										
25V	$\leq 7.5\%$	$\leq 10\%$ 0402 $\geq 0.047\mu F$; 0603 $\geq 0.1\mu F$; 0805 $\geq 0.33\mu F$; 1206 $\geq 1\mu F$; 1210 $\geq 4.7\mu F$ $\leq 15\%$ 0402 $\geq 0.068\mu F$; 0603 $\geq 0.47\mu F$; 1206 $\geq 4.7\mu F$; 1210 $\geq 22\mu F$																																																																																																																										
16V (C < 1.0μF)	$\leq 10\%$	$\leq 12.5\%$ 0402 $\geq 0.068\mu F$; 0603 $\geq 0.68\mu F$ $\leq 20\%$ 0402 $\geq 0.22\mu F$																																																																																																																										
16V (C $\geq 1.0\mu F$)	$\leq 12.5\%$	$\leq 20\%$ 0603 $\geq 2.2\mu F$; 0805 $\geq 3.3\mu F$; 1206 $\geq 10\mu F$; 1210 $\geq 22\mu F$; 1812 $\geq 47\mu F$;																																																																																																																										
10V	$\leq 20\%$	$\leq 30\%$ 0402 $\geq 0.47\mu F$																																																																																																																										
6.3V	$\leq 30\%$	---																																																																																																																										
Rated voltage	Insulation Resistance																																																																																																																											
100V: All X7R; 1210 $\geq 3.3\mu F$	1GΩ or RxC $\geq 10 \Omega \cdot F$ whichever is smaller.																																																																																																																											
50V: 0402 $> 0.01\mu F$; 0603 $\geq 1\mu F$; 0805 $\geq 1\mu F$; 1206 $\geq 4.7\mu F$; 1210 $\geq 4.7\mu F$																																																																																																																												
35V: 0603 $\geq 1\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 2.2\mu F$; 1210 $\geq 10\mu F$																																																																																																																												
25V: 0201 $\geq 0.1\mu F$; 0402 $\geq 0.22\mu F$; 0603 $\geq 2.2\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 10\mu F$; 1210 $\geq 10\mu F$																																																																																																																												
16V: 0201 $\geq 0.1\mu F$; 0402 $\geq 0.22\mu F$; 0603 $\geq 1\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 10\mu F$; 1210 $\geq 47\mu F$																																																																																																																												
10V: 0201 $\geq 47nF$; 0402 $\geq 0.47\mu F$; 0603 $\geq 0.47\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 4.7\mu F$; 1210 $\geq 47\mu F$																																																																																																																												
6.3V ; 4V ; TT series ; All X6S/X7S items; Size ≥ 1812																																																																																																																												

8.RELIABILITY TEST CONDITIONS AND REQUIREMENTS

No.	Item	Test Condition	Requirements						
13.	Adhesive Strength of Termination	<ul style="list-style-type: none"> 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>Capacitor P.C. Board Pressurizing force</p>	* No remarkable damage or removal of the terminations.						
14.	Bending Test	<p>* The middle part of substrate shall be pressurized by means of the pressurizing rod at a rate of about 1mm per second until the deflection becomes 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 II(X7R, X5R)</td> <td>within $\pm 12.5\%$</td> </tr> <tr> <td>Class II(Y5V)</td> <td>within $\pm 30\%$</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 II(X7R, X5R)	within $\pm 12.5\%$	Class II(Y5V)	within $\pm 30\%$
Dielectric	Cap Change								
Class II(X7R, X5R)	within $\pm 12.5\%$								
Class II(Y5V)	within $\pm 30\%$								
15.	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.PACKAGE DIMENSION AND QUANTITY

Size	Thickness (mm)/Symbol		Paper tape		Plastic tape	
			7" reel	13" reel	7" reel	13" reel
0201 (0603)	0.30±0.03	L	15k	70k	-	-
	0.30±0.05	L	15k	-	-	-
	0.30±0.09	L	15k	-	-	-
0402 (1005)	0.50±0.05	N	10k	50k	-	-
	0.50+0.02/-0.05	Q	10k	50k	-	-
	0.50±0.20	E	10k	-	-	-
0603 (1608)	0.50±0.10	H	4k	-	-	-
	0.80±0.07	S	4k	15k	-	-
	0.80+0.15/-0.10	X	4k	15k	-	-
0805 (2012)	0.50±0.10	H	4k	15k	-	-
	0.60±0.10	A	4k	15k	-	-
	0.80±0.10	B	4k	15k	-	-
	0.85±0.10	T	4k	15k	-	-
	1.25±0.10	D	-	-	3k	10k
	1.25±0.20	I	-	-	3k	10k
1206 (3216)	0.80±0.10	B	4k	15k	-	-
	0.85±0.10	T	4k	15k	-	-
	0.95±0.10	C	-	-	3k	10k
	1.15±0.15	J	-	-	3k	10k
	1.25±0.10	D	-	-	3k	10k
	1.60±0.20	G	-	-	2k	10k
	1.60+0.30/-0.10	P	-	-	2k	9k
1210 (3225)	0.85±0.10	T	-	-	3k	10k
	0.95±0.10	C	-	-	3k	10k
	1.25±0.10	D	-	-	3k	10k
	1.60±0.20	G	-	-	2k	-
	2.00±0.20	K	-	-	1k	6k
	2.50±0.30	M	-	-	1k	6k
1808 (4520)	1.25±0.10	D	-	-	2k	10k
	1.10±0.15	F	-	-	2k	10k
	1.60±0.20	G	-	-	2k	8k
	2.00±0.20	K	-	-	1k	6k
1812 (4532)	1.25±0.10	D	-	-	1k	5k
	1.60±0.20	G	-	-	1k	-
	2.00±0.20	K	-	-	1k	-
	2.50±0.30	M	-	-	0.5k	3k
	2.80±0.30	U	-	-	0.5k	-

Unit: pcs

9. PACKAGE DIMENSION AND QUANTITY

9.1. EMBOSSED TAPE DIMENSIONS

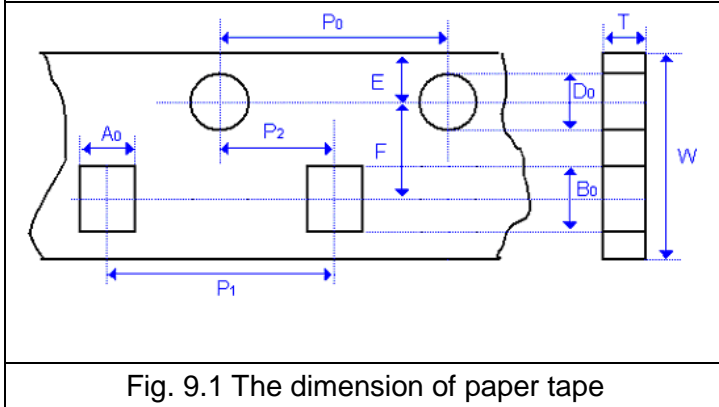


Fig. 9.1 The dimension of paper tape

9.2. EMBOSSED TAPE DIMENSIONS

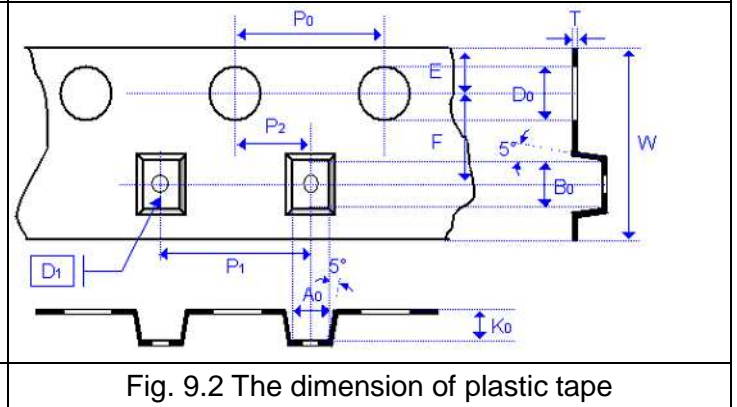


Fig. 9.2 The dimension of plastic tape

Size	0201	0402	0603		0805	
Chip Thickness	0.30±0.03	0.50±0.10	0.80±0.07	0.80+0.15/-0.1	0.80±0.10	1.25±0.10 1.25±0.20
A ₀	0.39 +/-0.07	0.70 +/-0.2	1.00+0.05/-0.1	1.02+0.05/-0.1	1.50±0.10	<1.65
B ₀	0.69 +/-0.07	1.20 +/-0.2	1.80±0.10	1.80±0.10	2.30±0.10	<2.40
T	≤0.50	≤0.80	0.95±0.05	0.97±0.05	0.95±0.05	0.23±0.05
K ₀	-	-	-	-	-	<2.50
W	8+/-0.10	8+/-0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10
P ₀	4+/-0.10	4+/-0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10
10xP ₀	40+/-0.10	40+/-0.10	40.00±0.2	40.00±0.2	40.00±0.2	40.00±0.20
P ₁	2+/-0.05	2+/-0.05	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10
P ₂	2+/-0.05	2+/-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	1.55±0.05	1.50±0.10/-0
D ₁	-	-	-	-	-	1.00±0.10
E	1.75+/-0.05	1.75+/-0.05	1.75±0.05	1.75±0.05	1.75±0.05	1.75±0.10
F	3.5+/-0.05	3.5+/-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

Size	1206			1210		1812	
Chip Thickness	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	1.25±0.10 1.60±0.20 2.00±0.20	2.50±0.30
A ₀	2.00±0.10	<2.00	<2.00	<3.05	<3.10	<3.90	<3.90
B ₀	3.50±0.10	<3.60	<3.70	<3.80	<4.00	<5.30	<5.30
T	0.95±0.05	0.23±0.05	0.23±0.05	0.23±0.05	0.23±0.05	0.25±0.05	0.25±0.05
K ₀	-	<2.50	<2.50	<2.50	<3.50	<2.50	<3.00
W	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	12.0±0.20	12.0±0.20
P ₀	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.100	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	40.0±0.10	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	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
D 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	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	1.50±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	1.75+/-0.1
F	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05	5.50±0.05	5.50+/-0.05
Unit:	mm	mm	mm	mm	mm	mm	mm

9. 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±0.1	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
Unit:	mm	mm	mm	mm	mm	mm

9.3. REEL DIMENSIONS

Size	0201, 0402, 0603, 0805, 1206, 1210			1808, 1812, 1825, 2220, 2225
	7"	7"	13"	7"
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

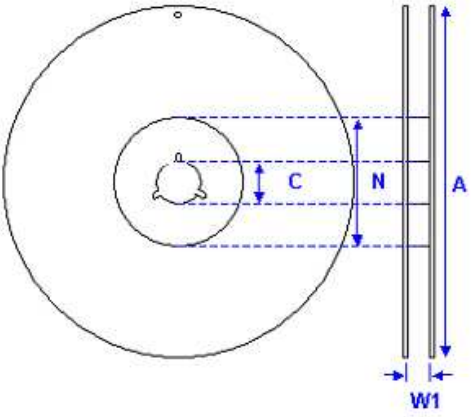


Fig. 4 The dimension of reel

10. 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.

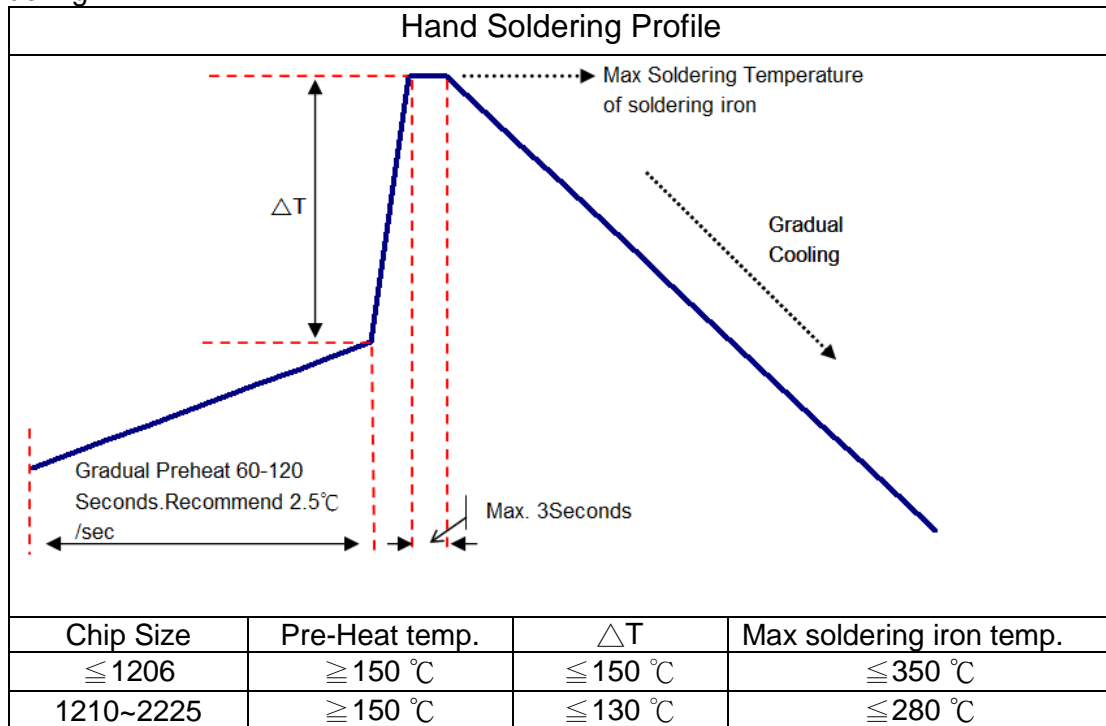
PREHEAT

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.

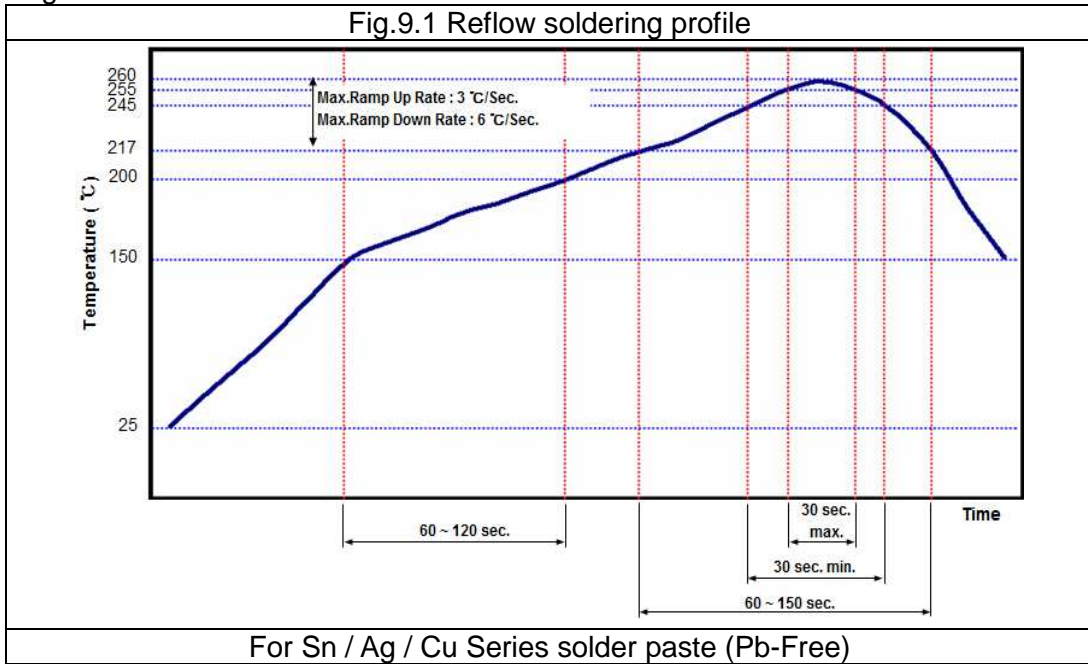
*The tip of iron should not contact the ceramic body directly.

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

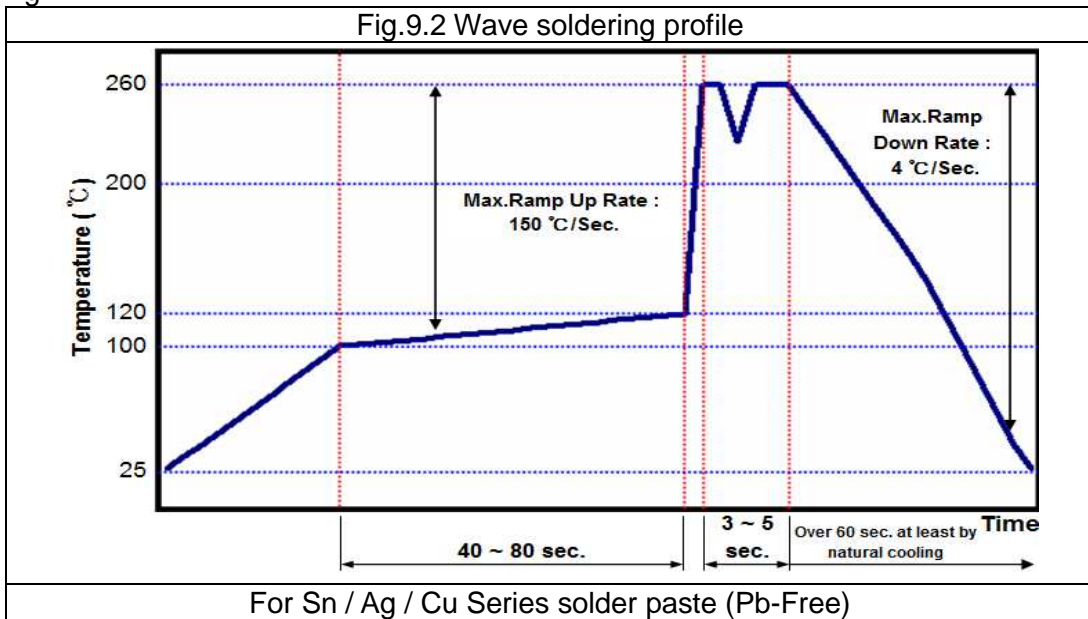
*Forced air cooling is not allowed.

10. APPLICATION NOTES

b.) Reflow soldering:



c.) Wave soldering:



Soldering conditions:

Class I:

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	○

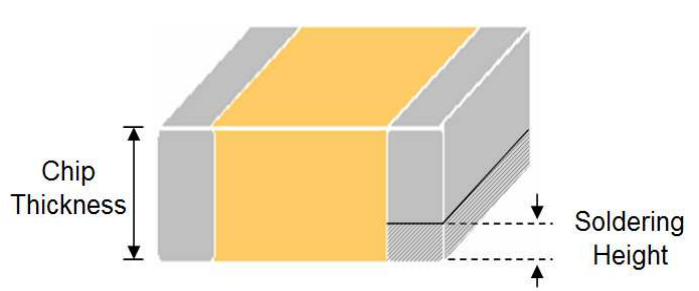
10. APPLICATION NOTES

Soldering conditions:

Class II:

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

Soldering height:

<p>The solder climbing minimum height is suggesting to 25% of chip thickness or 500μm 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 horizontal dashed line with a vertical arrow pointing down on the right indicates the 'Soldering Height', which is the height of the solder joint on the chip's side.</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.