

## 1. DESCRIPTION

MLCC consists of a conducting material and electrodes. To manufacture a chip-type SMT and achieve miniaturization, high density and high efficiency, ceramic condensers are used.

PDC high capacitance MLCC offers low ESR and excellent frequency characteristics to be suited for coupling and decoupling applications in circuit. The high dielectric constant material X7R, X5R and Y5V are used for this series product.

## 2. FEATURES

- Realize high capacitance in given sizes.
- Capacitor with lead-free termination (pure Tin).
- RoHS compliant.
- HALOGEM compliant.

## 3. APPLICATIONS

- Digital circuit coupling or decoupling applications.
- For high frequency and high-density type power suppliers.
- For bypassing.

## 4. HOW TO ORDER

<u>MA</u>	<u>2220</u>	<u>XR</u>	—	<u>475</u>	<u>M</u>	—	<u>101</u>	<u>ER</u>	<u>G</u>
<b>PDC Family</b>	<b>Size</b> Inch (mm) <b>0201</b> (0603) <b>0402</b> (1005) <b>0603</b> (1608) <b>0805</b> (2012) <b>1206</b> (3216) <b>1210</b> (3225) <b>1808</b> (4520) <b>1812</b> (4532) <b>1825</b> (4563) <b>2220</b> (5750) <b>2225</b> (5763)	<b>Dielectric</b> <b>CG</b> =NP0 <b>XR</b> =X7R or X5R <b>YV</b> =Y5V <b>XS</b> =X6S		<b>Capacitance</b> Two significant digits followed by no. of zeros. And R is in place of decimal point.  eg.: 106=10x10 <sup>6</sup> =10μF	<b>Tolerance</b> <b>K</b> =±10% <b>M</b> =±20% <b>Z</b> =-20/+80%		<b>Rated voltage</b> Two significant digits followed by no. of zeros. And R is in place of decimal point.  <b>6R3</b> =6.3 VDC <b>100</b> =10 VDC <b>160</b> =16 VDC <b>250</b> =25 VDC <b>350</b> =25 VDC <b>500</b> =50 VDC <b>101</b> =100 VDC <b>251</b> =250 VDC <b>501</b> =500 VDC <b>631</b> =630 VDC	<b>Packaging</b> ER:Tape and Reel, Embossed Tape  PR: Tape and Reel, Paper Tape  No Code: Bulk	<b>Control Code</b> G: RoHS compliant

## 5. EXTERNAL DIMENSIONS

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

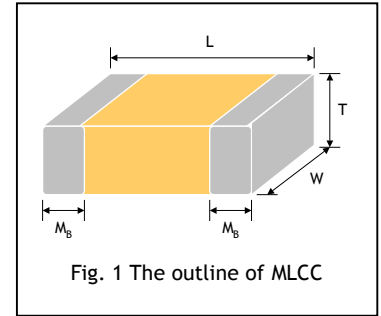


Fig. 1 The outline of MLCC

## 6. GENERAL ELECTRICAL DATA

<b>Dielectric</b>	X7R	X6S/X7S	X5R	Y5V
<b>Size</b>	0402, 0603, 0805, 1206, 1210, 1812, 1825, 2220, 2225	0201, 0402, 0603, 0805, 1206, 1210	0201, 0402, 0603, 0805, 1206, 1210	0402, 0603, 0805, 1206, 1210, 1812
<b>Rated voltage (WVDC)</b>	6.3V, 10V, 16V, 25V, 50V, 100V, 250V, 500V, 630V	6.3V, 10V, 16V, 25V, 35V, 50V	4V, 6.3V, 10V, 16V, 25V, 35V, 50V	6.3V, 10V, 16V, 25V, 35V, 50V, 100V
<b>Capacitance range*</b>	1 $\mu$ F to 47 $\mu$ F	1 $\mu$ F to 100 $\mu$ F	1 $\mu$ F to 220 $\mu$ F	1 $\mu$ F to 100 $\mu$ F
<b>Capacitance tolerance</b>	K ( $\pm$ 10%), M ( $\pm$ 20%)			Z (-20/+80%)
<b>Tan <math>\delta</math></b>	Note 1			
<b>Operating temperature</b>	-55 to +125°C	-55 to +105°C	-55 to +85°C	-25 to +85°C
<b>Capacitance characteristic</b>	$\pm$ 15%	$\pm$ 22%	$\pm$ 15%	+30/-80%
<b>Termination</b>	Cu or Ag/Ni/Sn or Au (lead-free termination)			

\* Measured at 1.0 $\pm$ 0.2Vrms, 1.0kHz $\pm$ 10% for C $\leq$ 10 $\mu$ F; 0.5 $\pm$ 0.2Vrms, 120Hz $\pm$ 20% for C>10 $\mu$ F, 30~70% related humidity, 25°C ambient temperature for X7R/X6S/X5R/X7S: Please refer to page 13 "Reliability test conditions and requirements" for detail.

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

\*\* Preconditioning for Class II MLCC: Perform a heat treatment at 150 $\pm$ 10°C for 1 hour and then leave in ambient condition for 24 $\pm$ 2 hours before measurement.

Note 1

X7R/X5R/X6S/X7S

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

Y5V

Rated vol.	D.F. $\leq$	Exception of D.F. $\leq$
$\geq$ 50V	$\leq$ 5%	$\leq$ 7% 0603 $\geq$ 0.1 $\mu$ F; 0805 $\geq$ 0.47 $\mu$ F; 1206 $\geq$ 4.7 $\mu$ F; TT series
35V	$\leq$ 7%	$\leq$ 12.5% 1210 $\geq$ 6.8 $\mu$ F
		---
25V	$\leq$ 5%	$\leq$ 7% 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
		$\leq$ 9% 0402 $\geq$ 0.068 $\mu$ F; 0603 $\geq$ 0.47 $\mu$ F; 1206 $\geq$ 4.7 $\mu$ F; 1210 $\geq$ 22 $\mu$ F; TT series
16V (C < 1.0 $\mu$ F)	$\leq$ 7%	$\leq$ 9% 0402 $\geq$ 0.068 $\mu$ F; 0603 $\geq$ 0.68 $\mu$ F
16V (C $\geq$ 1.0 $\mu$ F)	$\leq$ 9%	$\leq$ 12.5% 0402 $\geq$ 0.22 $\mu$ F
		$\leq$ 12.5% 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; TT series
10V	$\leq$ 12.5%	$\leq$ 20% 0402 $\geq$ 0.47 $\mu$ F
6.3V	$\leq$ 20%	---

## 7. CAPACITANCE RANGE

### 7-1 X7R Dielectric

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

Dimension		1210							1812					1825						
Cap(pF)	code	6.3V	10V	16V	25V	50V	100V	10V	16V	25V	50V	100V	200V	250V	25V	50V	100V	200V	250V	
1000000	105																			
1200000	125																			
1500000	155																			
1800000	185																			
2200000	225																			
2700000	275																			
3300000	335																			
3900000	395																			
4700000	475																			
5600000	565																			
6800000	685																			
8200000	825																			
10000000	106																			
12000000	126																			
15000000	156																			
18000000	186																			
22000000	226																			
47000000	476																			

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

**7-2 X5R Dielectric**

Dimension		0201		0402				0603					0805					1206					1210							
Cap(μF)	code	6.3V	10V	6.3V	10V	16V	25V	6.3V	10V	16V	25V	50V	4V	6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V	50V	4V	6.3V	10V	16V	25V	35V	50V
1.0	105																													
1.2	125																													
1.5	155																													
1.8	185																													
2.2	225																													
2.7	275																													
3.3	335																													
3.9	395																													
4.7	475																													
5.6	565																													
6.8	685																													
8.2	825																													
10.0	106																													
22.0	226																													
47.0	476																													
100.0	107																													
220.0	227																													

**7-3 Y5V Dielectric**

Dimension		0402		0603				0805					1206					1210					1812						
Cap(μF)	code	6.3V	10V	6.3V	10V	16V	25V	6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V	35V	50V	6.3V	10V	16V	25V	35V	50V	10V	16V	25V	50V	100V
1.0	105																												
1.2	125																												
1.5	155																												
1.8	185																												
2.2	225																												
2.7	275																												
3.3	335																												
3.9	395																												
4.7	475																												
5.6	565																												
6.8	685																												
8.2	825																												
10.0	106																												
22.0	226																												
47.0	476																												
100.0	107																												

**7-4. X6S Dielectric 0201, 0402, 0603, 0805, 1206, 1210 Sizes**

Dielectric		X6S																												
Size		0201				0402				0603					0805					1206					1210					
Rated Voltage (VDC)		6.3	10	16	25	6.3	10	16	25	4	6.3	10	16	25	4	6.3	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50
Capacitance	1.0 $\mu$ F (105)																													
	1.5 $\mu$ F (155)																													
	2.2 $\mu$ F (225)																													
	3.3 $\mu$ F (335)																													
	4.7 $\mu$ F (475)																													
	6.8 $\mu$ F (685)																													
	10 $\mu$ F (106)																													
	22 $\mu$ F (226)																													
	47 $\mu$ F (476)																													
100 $\mu$ F (107)																														

1. The letter in cell is expressed the symbol of product thickness.
2. The letter in cell with “\*” mark is expressed product not in 10% (code “K”) tolerance.

**7-5. X7S Dielectric 0402, 0603, 0805, 1206, 1210 Sizes**

Dielectric		X7S																										
Size		0402				0603				0805				1206				1210										
Rated Voltage (VDC)		6.3	10	16	25	6.3	10	16	25	10	16	25	50	100	6.3	10	16	25	50	6.3	10	16	25	50				
Capacitance	1.0 $\mu$ F (105)																											
	1.5 $\mu$ F (155)																											
	2.2 $\mu$ F (225)																											
	3.3 $\mu$ F (335)																											
	4.7 $\mu$ F (475)																											
	6.8 $\mu$ F (685)																											
	10 $\mu$ F (106)																											
	22 $\mu$ F (226)																											
	47 $\mu$ F (476)																											
100 $\mu$ F (107)																												

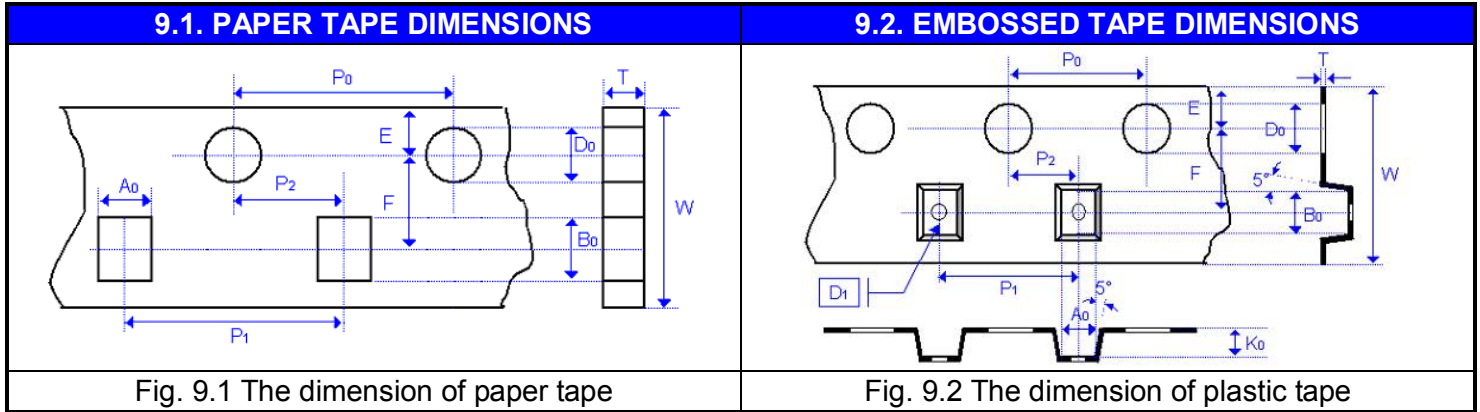
1. The letter in cell is expressed the symbol of product thickness.
2. The letter in cell with “\*” mark is expressed product not in 10% (code “K”) tolerance.

## 8. PACKAGING STYLE AND QUANTITY

Size	Thickness (mm)	Paper tape		Plastic tape	
		7" reel	13" reel	7" reel	13" reel
0201 (1005)	0.30±0.03	15k	70k	-	-
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)	0.80±0.10	4k	15k	-	-
	1.25±0.10	-	-	3k	10k
	1.25±0.20	-	-	3k	10k
1206 (3216)	0.95±0.10	-	-	3k	10k
	1.15±0.15	-	-	3K	10K
	1.25±0.10	-	-	3k	10k
	1.60±0.20	-	-	2k	-
	1.60+0.30/-0.10	-	-	2k	-
1210 (3225)	0.95±0.10	-	-	3k	10k
	1.25±0.10	-	-	3k	10k
	1.60±0.20	-	-	2k	-
	2.00±0.20	-	-	2k	-
	2.50±0.30	-	-	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)	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	-
	2.80±0.30	-	-	0.5k	-
2220 (5750)	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	-
	2.80±0.30	-	-	0.5k	-
2225 (5763)	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	-
	2.80±0.30	-	-	0.5k	-

Unit: pieces

## 8. PACKAGE DIMENSION AND QUANTITY



Size	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 <sub>0</sub>	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 <sub>0</sub>	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 <sub>0</sub>	-	-	-	-	-	<2.50
W	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10
P <sub>0</sub>	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10
10xP <sub>0</sub>	40.00±0.10	40.00±0.10	40.00±0.2	40.00±0.2	40.00±0.2	40.00±0.20
P <sub>1</sub>	2.00±0.05	2.00±0.05	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10
P <sub>2</sub>	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05
D <sub>0</sub>	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 <sub>1</sub>	-	-	-	-	-	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	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05
Unit :	mm	mm	mm	mm	mm	mm

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 <sub>0</sub>	2.00±0.10	<2.00	<2.00	<3.05	<3.10	<3.90	<3.90
B <sub>0</sub>	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 <sub>0</sub>	-	<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 <sub>0</sub>	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 <sub>0</sub>	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 <sub>1</sub>	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 <sub>2</sub>	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05
D <sub>0</sub>	1.55±0.05	1.50 +0.10/-0	1.50 +0.10/-0	1.50 +0.10/-0	1.50 +0.10/-0	1.50 +0.10/-0	1.50 +0.10/-0
D <sub>1</sub>	-	1.00±0.10	1.00±0.10	1.00±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



## 8. PACKAGE DIMENSION AND QUANTITY

Size	1825		2220		2225	
Chip Thickness	1.60±0.20 2.00±0.20	2.50±0.30	1.40±0.15 1.60±0.20 2.00±0.20	2.50±0.30	1.60±0.20 2.00±0.20	2.50±0.30
A <sub>0</sub>	<6.80	<6.80	<5.80	<5.80	<6.80	<6.80
B <sub>0</sub>	<5.30	<5.30	<6.50	<6.50	<6.50	<6.50
T	0.30±0.10	0.30±0.10	0.30±0.10	0.30±0.10	0.30±0.10	0.30±0.10
K <sub>0</sub>	<2.50	<3.10	<2.50	<3.10	<2.50	<3.10
W	12.0±0.20	12.0±0.20	12.0±0.20	12.0±0.20	12.0±0.20	12.0±0.20
P <sub>0</sub>	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10
10xP <sub>0</sub>	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20
P <sub>1</sub>	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10
P <sub>2</sub>	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05
D <sub>0</sub>	1.50 +0.10/-0	1.50 +0.10/-0	1.50 +0.10/-0	1.50 +0.10/-0	1.50 +0.10/-0	1.50 +0.10/-0
D <sub>1</sub>	1.50±0.10	1.50±0.10	1.50±0.10	1.50±0.10	1.50±0.10	1.50±0.10
E	1.75±0.1	1.75±0.10	1.75±0.1	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
Reel size	7"	7"	13"	7"
C	13.0 +0.5/-0.2	13.0 +0.5/-0.2	13.0 +0.5/-0.2	13.0 +0.5/-0.2
W <sub>1</sub>	8.4 +1.5/-0	12.4 +2.0/-0	8.4 +1.5/-0	8.4 +1.5/-0
A	178.0 ±0.10	178.0 ±0.10	330.0 ±1.0	178.0 ±0.10
N	60.0 +1.0/-0	80.0 ±1.0	100 ±1.0	60.0 +1.0/-0

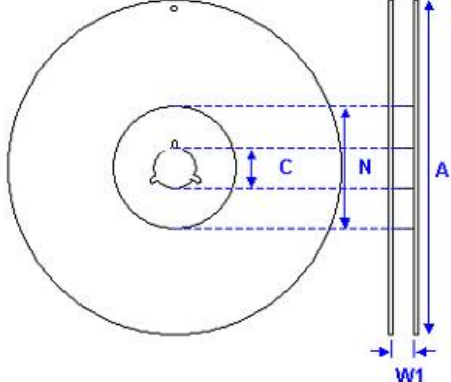


Fig. 9.3 The dimension of reel

## 9. APPLICATION NOTES

### STORAGE

To prevent the damage of solderability of terminations, the following storage conditions are recommended:  
Indoors under 5 ~ 40°C and 20% ~ 70% RH.

No harmful gases containing sulfuric acid, ammonia, hydrogen sulfide or chlorine.

Packaging should not be opened until the capacitors are required for use. If opened, the pack should be re-sealed as soon as is practicable. Taped product should be stored out of direct sunlight, which might promote deterioration in tape or adhesion performance. The product is recommended to be used within 12 months after shipment and checked the solderability before use.

### HANDLING

Chip capacitors are dense, hard, brittle, and abrasive materials. They are liable to suffer mechanical damage, in the form of cracks or chips. Chip Capacitors should be handled with care to avoid contamination or damage. To use vacuum or plastic tweezers to pick up or plastic tweezers is recommended for manual placement. Tape and reeled packages are suitable for automatic pick and placement machine.

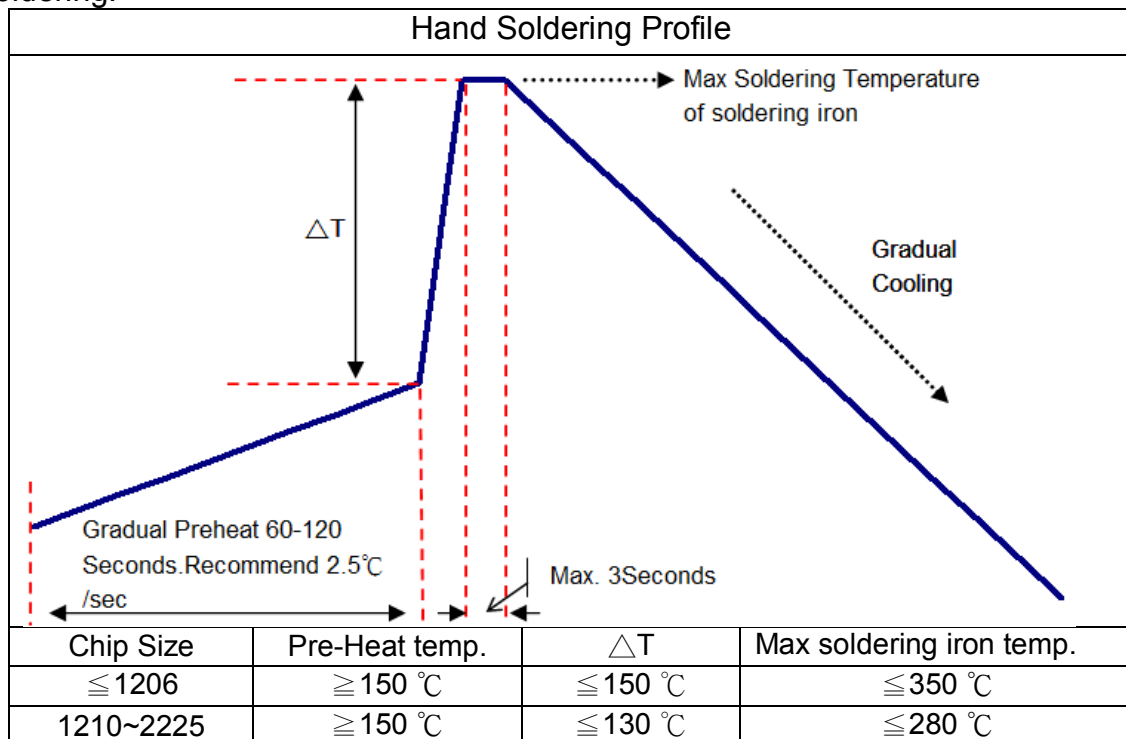
### PREHEAT

In order to minimize the risk of thermal shock during soldering, a carefully controlled preheat is required. The rate of preheat should not exceed 3°C per second.

### SOLDERING

Use middy activated rosin RA and RMA fluxes do not use activated flux. The amount of solder in each solder joint should be controlled to prevent the damage of chip capacitors caused by the stress between solder, chips, and substrate.

a.) Hand soldering:



\*Soldering iron tip diameter  $\leq 1.0\text{ mm}$  and wattage max. 20W.

\*The Capacitors shall be pre-heated and that the temperature gradient between the devices and the tip of the soldering iron.

\*The required amount of solder shall be melted on the soldering tip.

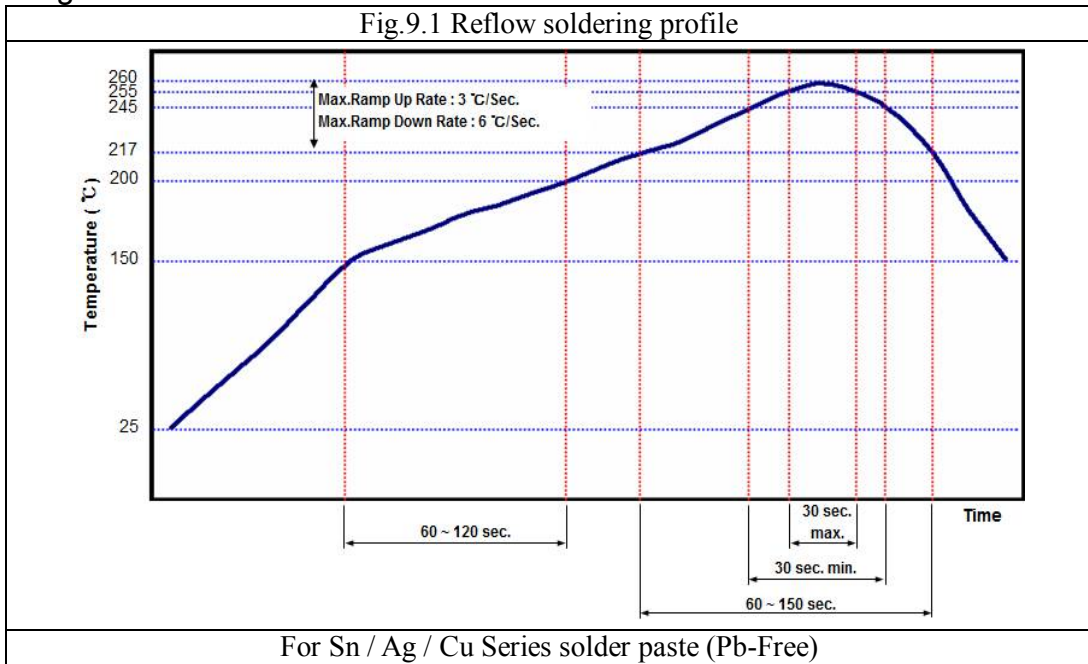
\*The tip of iron should not contact the ceramic body directly.

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

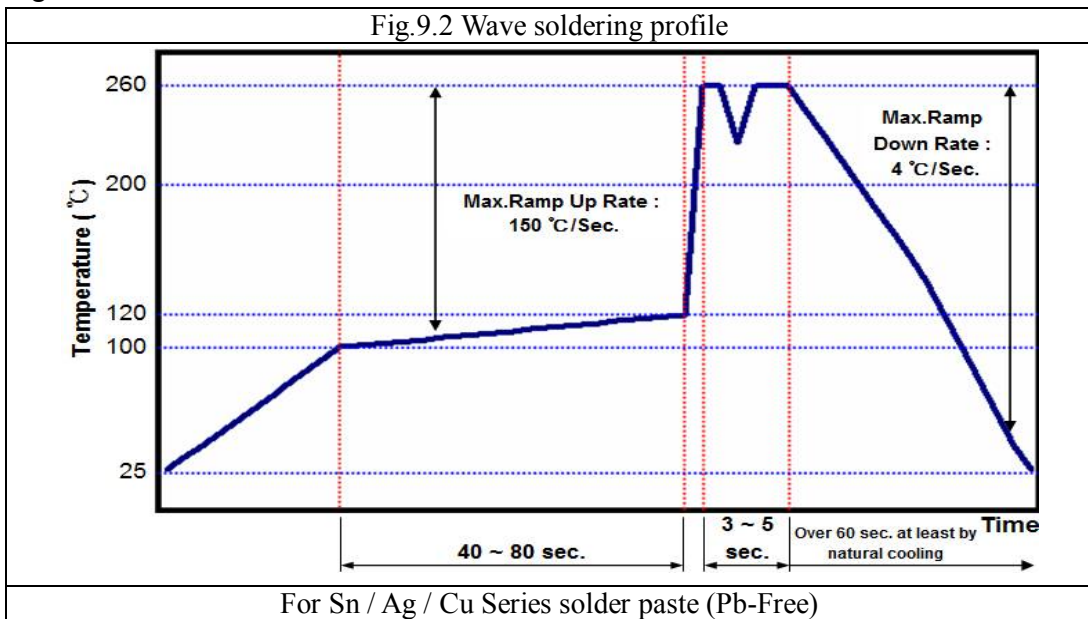
\*Forced air cooling is not allowed.

## 9. APPLICATION NOTES

b.) Reflow soldering:



c.) Wave soldering:



Soldering conditions:

Class:

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

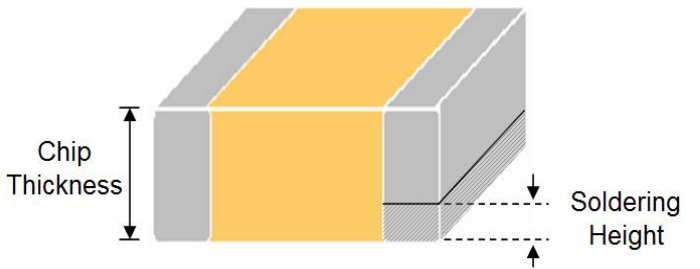
## 9. APPLICATION NOTES

Soldering conditions:

ClassII:

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

Soldering hight:

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

After soldering, cool the chips and the substrate gradually to room temperature. Natural cooling in air is recommended to minimize stress in the solder joint.

## CLEANING

All flux residues must be removed by using suitable electronic-grade vapor-cleaning solvents to eliminate contamination that could cause electrolytic surface corrosion. Good results can be obtained by using ultrasonic cleaning of the solvent. The choice of the proper system is depends upon many factors such as component mix, flux, and solder paste and assembly method. The ability of the cleaning system to remove flux residues and contamination from under the chips is very important.

## 10. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

No.	Item	Test Condition	Requirements
1.	Visual and Mechanical	---	* No remarkable defect. * Dimensions to conform to individual specification sheet.
2.	Capacitance	Class I: (NP0) ≤ 1000pF, 1.0±0.2Vrms · 1MHz±10% > 1000pF, 1.0±0.2Vrms · 1KHz±10%	Shall not exceed the limits given in the detailed spec.
3.	Q/ D.F. (Dissipation Factor)	Class II: (X7R, X7E, X6S, X5R, X7S, Y5V) C ≤ 10μF, 1.0±0.2Vrms · 1KHz±10% ** C > 10μF, 0.5±0.2Vrms · 120Hz±20%	NP0: Cap≥30pF, Q≥1000; Cap<30pF, Q≥400+20C X7R, X5R, X6S, X7S:
		** 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) <sup>#1</sup> , 0402 ≥ 475 (6.3V, 16V), 0402 ≥ 225(10V), 0603=106 (6.3V, 10V), TT 18X ≥ 475(10V), TT 15X series	
		X6S: 0201 ≥ 104 (6.3V, 10V), 0402 ≥ 225 (6.3V), 0402/475 (10V), 0603/106 (6.3V),	
		X7S: 0402/225(6.3V)	
		#1 Excluding X5R/0201/105(6.3V);225(10V), (1.0±0.2Vrms · 1KHz±10%)	
		*Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.	
			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 ≤ 5% 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF	
		≤ 7% 0603 ≥ 0.33μF; 1206 ≥ 4.7μF	
		25V ≤ 3.5% 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; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF	
		≤ 10% 0201 ≥ 0.1μF; 0402 ≥ 0.022μF; 0402 ≥ 0.22μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series	
		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% --- ---	
		Y5V:	
		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 ≤ 12.5% 0402 ≥ 0.22μF	
		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% --- ---	
4.	Dielectric Strength	Rated vol.(V) Condition ≤ 100V 2.5 times of UR > 100V 2.0 times of UR	* No evidence of damage or flash over during test.
		* Duration: 1 to 5 sec.	
		* Charge and discharge current less than 50mA.	

## 10. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

No.	Item	Test Condition	Requirements																																																						
5.	Insulation Resistance	<p>To apply rated voltage for MAX. 120sec.</p> <p>*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>	<p>10GΩ or RxC ≥ 500Ω-F whichever is smaller.</p> <p>Class II (X7R, X7E, X5R, X6S, X7S, 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&gt;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≥4.7μF</td> </tr> <tr> <td>10V: 0201≥4.7nF; 0402≥0.47μF; 0603≥0.47μF; 0805≥2.2μF; 1206≥4.7μF; 1210≥4.7μF</td> </tr> <tr> <td>6.3V; 4V; TT series; Size≥1812</td> <td></td> </tr> <tr> <td>Rated voltage</td> <th>Insulation Resistance</th> </tr> <tr> <td>All X6S items, All X7S items</td> <td rowspan="6">RxC ≥ 50 Ω-F.</td> </tr> <tr> <td>100V: 1210≥3.3μF</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&gt;0.1μF; 0402≥1μF; 0603≥10μF; 0805≥4.7μF;</td> <td></td> </tr> <tr> <td>6.3V: 0201≥0.1μF; 0603&gt;4.7μF; 0805≥4.7μF; 1206≥10μF;</td> <td></td> </tr> <tr> <td>4V: 0603≥22μF; 0805≥4.7μF; 1206≥100μF</td> <td></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≥4.7μF	10V: 0201≥4.7nF; 0402≥0.47μF; 0603≥0.47μF; 0805≥2.2μF; 1206≥4.7μF; 1210≥4.7μF	6.3V; 4V; TT series; Size≥1812		Rated voltage	Insulation Resistance	All X6S items, All X7S items	RxC ≥ 50 Ω-F.	100V: 1210≥3.3μF	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≥4.7μF;		6.3V: 0201≥0.1μF; 0603>4.7μF; 0805≥4.7μF; 1206≥10μF;		4V: 0603≥22μF; 0805≥4.7μF; 1206≥100μF																													
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6.	Temperature Coefficient	<p>With no electrical load.</p> <table border="1"> <thead> <tr> <th>T.C.</th> <th>Operating Temp</th> </tr> </thead> <tbody> <tr> <td>NPO</td> <td>-55~125°C at 25°C</td> </tr> <tr> <td>X7R</td> <td>-55~125°C at 25°C</td> </tr> <tr> <td>X7S</td> <td>-55 ~ 125°C at 25°C</td> </tr> <tr> <td>X5R</td> <td>-55~ 85°C at 25°C</td> </tr> <tr> <td>X6S</td> <td>-55~105°C at 25°C</td> </tr> <tr> <td>Y5V</td> <td>-25~ 85°C at 20°C</td> </tr> </tbody> </table> <p>*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> <table border="1"> <thead> <tr> <th>01005</th> <th>0201</th> </tr> </thead> <tbody> <tr> <td>Cap≤0.01μF: 0.5V</td> <td>Cap&lt;0.1μF: 1V</td> </tr> <tr> <td>Cap&gt;0.01μF: 0.2V</td> <td>0.1μF≤Cap&lt;1μF: 0.2V</td> </tr> <tr> <td></td> <td>Cap≥1μF: 0.1V</td> </tr> <tr> <th>0402</th> <th>0603</th> </tr> <tr> <td>Cap&lt;1μF: 1V</td> <td>Cap≤1μF: 1V</td> </tr> <tr> <td>Cap=1μF: 0.5V</td> <td>1μF&lt;Cap≤4.7μF: 0.5V</td> </tr> <tr> <td>1μF&lt;Cap&lt;10μF: 0.2V</td> <td>Cap&gt;4.7μF: 0.2V</td> </tr> <tr> <td>Cap≥10μF: 0.1V</td> <td></td> </tr> <tr> <th>0805</th> <th>1206/1210</th> </tr> <tr> <td>Cap&lt;10μF: 1V</td> <td>Cap≤10μF: 1V</td> </tr> <tr> <td>Cap=10μF: 0.5V</td> <td>10μF&lt;Cap≤100μF: 0.5V</td> </tr> <tr> <td>Cap&gt;10μF: 0.2V</td> <td>Cap&gt;100μF: 0.2V</td> </tr> </tbody> </table> <p>* Measurement voltage for Class II:</p>	T.C.	Operating Temp	NPO	-55~125°C at 25°C	X7R	-55~125°C at 25°C	X7S	-55 ~ 125°C at 25°C	X5R	-55~ 85°C at 25°C	X6S	-55~105°C at 25°C	Y5V	-25~ 85°C at 20°C	01005	0201	Cap≤0.01μF: 0.5V	Cap<0.1μF: 1V	Cap>0.01μF: 0.2V	0.1μF≤Cap<1μF: 0.2V		Cap≥1μF: 0.1V	0402	0603	Cap<1μF: 1V	Cap≤1μF: 1V	Cap=1μF: 0.5V	1μF<Cap≤4.7μF: 0.5V	1μF<Cap<10μF: 0.2V	Cap>4.7μF: 0.2V	Cap≥10μF: 0.1V		0805	1206/1210	Cap<10μF: 1V	Cap≤10μF: 1V	Cap=10μF: 0.5V	10μF<Cap≤100μF: 0.5V	Cap>10μF: 0.2V	Cap>100μF: 0.2V	<table border="1"> <thead> <tr> <th>T.C.</th> <th>Capacitance Change</th> </tr> </thead> <tbody> <tr> <td>NPO</td> <td>Within ±30ppm/°C</td> </tr> <tr> <td>X7R</td> <td>Within ±15%</td> </tr> <tr> <td>X7S</td> <td>Within ±22%</td> </tr> <tr> <td>X5R</td> <td>Within ±15%</td> </tr> <tr> <td>X6S</td> <td>Within ±22%</td> </tr> <tr> <td>Y5V</td> <td>Within +30%/-80%</td> </tr> </tbody> </table>	T.C.	Capacitance Change	NPO	Within ±30ppm/°C	X7R	Within ±15%	X7S	Within ±22%	X5R	Within ±15%	X6S	Within ±22%	Y5V	Within +30%/-80%
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7.	Adhesive Strength of Termination	<p>* Capacitors mounted on a substrate. A force of 5N(≤0603) or 10N(&gt; 0603) applied perpendicular to the place of substrate and parallel the line joining the center of terminations for 10±1 second.</p> <p>The diagram shows a rectangular capacitor mounted on a PC board. A horizontal arrow labeled 'Pressurizing force' points to the center of the capacitor's terminations. The capacitor is labeled 'Capacitor' and the board is labeled 'PC Board'.</p>	<p>* No remarkable damage or removal of the terminations.</p>																																																						
8.	Solderability	<p>* Solder temperature: 235±5°C for (0402~1210)</p> <p>* Solder temperature: 245±5°C for (1808~2225)</p> <p>* Dipping time: 2±0.5 sec.</p>	<p>75% min. coverage of all metalized area.</p>																																																						

No.	Item	Test Condition	Requirements						
9.	Resistance to flexure of substrate	<ul style="list-style-type: none"> <li>* 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.</li> <li>* Measurement to be made after keeping at room temp. for 24±2 hrs.</li> </ul>	<ul style="list-style-type: none"> <li>* No remarkable damage.</li> </ul> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;">Dielectric</th> <th style="width: 50%;">Cap Change</th> </tr> </thead> <tbody> <tr> <td>Class II(X7R)</td> <td>within ±12.5%</td> </tr> <tr> <td>Class II(Y5V)</td> <td>within ±30%</td> </tr> </tbody> </table> <p>(This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test.)</p>	Dielectric	Cap Change	Class II(X7R)	within ±12.5%	Class II(Y5V)	within ±30%
Dielectric	Cap Change								
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10	Resistance to Soldering Heat	<ul style="list-style-type: none"> <li>* Solder temperature: 260±5°C</li> <li>* Dipping time: 10±1 sec</li> <li>* Preheating: 120 to 150°C for 1 minute before immerse the capacitor in a eutectic solder.</li> <li>* Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.</li> <li>* 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.</li> </ul>	<ul style="list-style-type: none"> <li>* No remarkable damage.</li> <li>* Cap change:               <ul style="list-style-type: none"> <li>NP0: within ±2.5% or 0.25pF whichever is larger</li> <li>X7R, X5R, X6S, X7S: within ±7.5%</li> <li>Y5V: within ±20%</li> </ul> </li> <li>* Q/D.F., I.R. and dielectric strength: To meet initial requirements.</li> <li>* 25% max. leaching on each edge.</li> </ul>						



## 10. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

No.	Item	Test Condition	Requirements																													
11.	Temperature Cycle	* Conduct the five cycles according to the temperatures and time.	** No remarkable damage. * Cap change : NP0: within $\pm 2.5\%$ or $0.25\mu\text{F}$ whichever is larger X7R, X5R, X6S, X7S: within $\pm 7.5\%$ Y5V: within $\pm 20\%$																													
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		* Before initial measurement (Class II only): Perform 150+0/-10 $^{\circ}\text{C}$ for 1 hr and then set for 48 $\pm$ 4 hrs at room temp. * Measurement to be made after keeping at room temp. for 48 $\pm$ 4 hrs.																														
12.	Humidity (Damp Heat) Steady State	*Test temp.: 40 $\pm$ 2 $^{\circ}\text{C}$ *Humidity: 90~95%RH *Test time: 500+24/-0hrs. *Before initial measurement (Class II only): To apply de-aging at 150 $^{\circ}\text{C}$ for 1hr then set for 24 $\pm$ 2 hrs at room temp. * Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150 $^{\circ}\text{C}$ for 1hr then set for 24 $\pm$ 2 hrs at room temp.	* No remarkable damage. Cap change: NP0: $\pm 7.5\%$ or $0.75\mu\text{F}$ whichever is larger. X7R, X5R, X6S, X7S: $\geq 10\text{V}^{**}$ , within $\pm 12.5\%$ ; $\leq 6.3\text{V}$ within $\pm 25\%$ ; TT series & C $\geq 1\mu\text{F}$ , within $\pm 25\%$ <b>**10V: 0603 <math>\geq 4.7\mu\text{F}</math>; 0402 <math>\geq 1\mu\text{F}</math>; 0201 <math>\geq 0.1\mu\text{F}</math>, within <math>\pm 25\%</math>; Y5V: <math>\geq 10\text{V}</math>, within <math>\pm 30\%</math>; <math>\leq 6.3\text{V}</math>, within +30/-40%</b> Q/D.F. value: NP0: C $\geq 30\mu\text{F}$ , Q $\geq 200$ ; C $< 30\mu\text{F}$ , Q $\geq 100+10/3\text{C}$ X7R, X5R, X6S, X7S:																													
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### 10. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

No	Item	Test Condition	Requirements																																																														
13	Humidity (Damp Heat) Load	*Test temp. : 40±2°C	<p>* No remarkable damage.</p> <p>Cap change:            NP0: ±7.5% or 0.75pF whichever is larger.            X7R, X5R, X6S, X7S: ≥10V**, within ±12.5%; ≤ 6.3V within ±25%;            TT series &amp; C≥ 1uF, within ±25%</p> <p>**10V: 0603 ≥ 4.7µF; 0402 ≥ 1µF; 0201 ≥ 0.1µF, within ±25%;            Y5V: ≥10V, within ±30%; ≤ 6.3V, within +30/-40%</p> <p>Q/D.F. value:            NP0: C≥30pF, Q≥200; C&lt;30pF, Q≥100+10/3C            X7R, X5R, X6S, X7S:</p> <table border="1"> <thead> <tr> <th>Rated</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 &gt; 0.1µF, 0603 ≥ 0.068µF, 1206 &gt; 1µF; 1210 ≥ 2.2µF; TT series</td> </tr> <tr> <td>≤ 20% 0805 &gt; 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 &gt; 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="3">25V</td> <td rowspan="3">≤ 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 rowspan="2">16V</td> <td rowspan="2">≤ 5%</td> <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="2">10V</td> <td rowspan="2">≤ 7.5%</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>≤ 20% 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>6.3V</td> <td>≤ 15%</td> <td>≤ 30% 0201 ≥ 0.1µF; 0402 ≥ 1µF; 0603 ≥ 10µF; 0805 ≥ 4.7µF; 1206 ≥ 47µF; 1210 ≥ 100µF; TT series</td> </tr> <tr> <td>4V</td> <td>≤ 20%</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>≤ 12.5% 0402 ≥ 0.068µF; 0603 ≥ 0.68µF</td> </tr> <tr> <td>16V (C&lt;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>	Rated	D.F. ≤	Exception of D.F. ≤	≥ 100V	≤ 3%	≤ 6% 1206 ≥ 0.47µF	≤ 7.5% 0805 > 0.1µF, 0603 ≥ 0.068µF, 1206 > 1µF; 1210 ≥ 2.2µF; TT series	≤ 20% 0805 > 0.22µF; 1210 ≥ 3.3µF	≥ 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	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	16V	≤ 5%	≤ 20% 0402 ≥ 0.47µF	≤ 10% 0603 ≥ 0.15µF; 0805 ≥ 0.68µF; 1206 ≥ 2.2µF; 1210 ≥ 4.7µF	10V	≤ 7.5%	≤ 15% 0201 ≥ 0.01µF(0201/X7R ≥ 0.022µF); 0402 ≥ 0.033µF; 0603 ≥ 0.68µF; 0805 ≥ 2.2µF; 1206 ≥ 4.7µF; 1210 ≥ 22µF; TT series	≤ 20% 0201 ≥ 0.012µF; 0402 ≥ 0.33µF(0402/X7R ≥ 0.22µF); 0603 ≥ 0.33µF; 0805 ≥ 2.2µF; 1206 ≥ 2.2µF; 1210 ≥ 22µF	6.3V	≤ 15%	≤ 30% 0201 ≥ 0.1µF; 0402 ≥ 1µF; 0603 ≥ 10µF; 0805 ≥ 4.7µF; 1206 ≥ 47µF; 1210 ≥ 100µF; TT series	4V	≤ 20%	---	Rated vol.	D.F. ≤	Exception of D.F. ≤	≥ 50V	≤ 7.5%	≤ 10% 0603 ≥ 0.1µF; 0805 ≥ 0.47µF; 1206 ≥ 4.7µF	≤ 20% 1210 ≥ 6.8µF	35V	≤ 10%	---	25V	≤ 7.5%	≤ 10% 0402 ≥ 0.047µF; 0603 ≥ 0.1µF; 0805 ≥ 0.33µF; 1206 ≥ 1µF; 1210 ≥ 4.7µF	≤ 15% 0402 ≥ 0.068µF; 0603 ≥ 0.47µF; 1206 ≥ 4.7µF; 1210 ≥ 22µF	≤ 12.5% 0402 ≥ 0.068µF; 0603 ≥ 0.68µF	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;	10V	≤ 20%	≤ 30% 0402 ≥ 0.47µF	6.3V	≤ 30%	---
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### 10. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

No.	Item	Test Condition	Requirements																																																																																																																																																																							
14	High Temperature Load (Endurance)	<p>* Test temp. : NP0, X7R/X7E/X7S: 125±3°C X6S: 105±3°C X5R, Y5V: 85±3°C</p> <p>* To apply voltage: (1) ≤ 6.3V or C ≥ 10μF or TT series: 150% of rated voltage. (2) 10V ≤ Ur &lt; 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</th> </tr> </thead> <tbody> <tr> <td rowspan="2">0201</td> <td rowspan="2">X5R/X7R/X6S</td> <td>≤ 10V</td> <td>C ≥ 0.1μF</td> </tr> <tr> <td>≤ 16V</td> <td>C &gt; 0.1μF</td> </tr> <tr> <td rowspan="2">0402</td> <td rowspan="2">X5R/X7R/X6S/X7S/Y5</td> <td>6.3V, 10V, 16V, 2</td> <td>C ≥ 1.0μF</td> </tr> <tr> <td>4V</td> <td>C ≥ 22μF</td> </tr> <tr> <td rowspan="2">0603</td> <td rowspan="2">X5R/X7R/X6S/X7S</td> <td>6.3V, 10V, 25V, 35</td> <td>C ≥ 4.7μF C ≥ 1.0μF</td> </tr> <tr> <td>4V</td> <td>C ≥ 47μF</td> </tr> <tr> <td rowspan="2">0805</td> <td rowspan="2">X5R/X7R/X6S/X7S</td> <td>6.3V, 10V~50</td> <td>C ≥ 22μF C ≥ 10μF</td> </tr> <tr> <td>≤ 6.3V</td> <td>C ≥ 47μF</td> </tr> <tr> <td>1206</td> <td>X5R/X7R/X6S</td> <td>3000V</td> <td>C ≥ 1.5pF</td> </tr> <tr> <td rowspan="2">1210</td> <td rowspan="2">X7R</td> <td>16V</td> <td>C ≥ 47μF</td> </tr> <tr> <td>100V</td> <td>C ≥ 3.3μF</td> </tr> <tr> <td>TT15</td> <td>X5R</td> <td>6.3V</td> <td>C &gt; 1.0μF</td> </tr> <tr> <td>TT18</td> <td>Y5V</td> <td>6.3V, 10V</td> <td>C ≥ 2.2μF</td> </tr> <tr> <td>TT21</td> <td>Y5V</td> <td>6.3V</td> <td>C ≥ 10μF</td> </tr> <tr> <td>TT31</td> <td>X5R/X7R/X6S</td> <td>≤ 10V</td> <td>C ≥ 10μF</td> </tr> <tr> <td></td> <td>Y5V</td> <td>6.3V</td> <td>C ≥ 22μF</td> </tr> </tbody> </table> <p>**1WV items must follow de-rating conditions</p> <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 rowspan="2">0201</td> <td rowspan="2">X7R</td> <td>16V/25V</td> <td>C ≥ 0.1μF</td> </tr> <tr> <td>16V</td> <td>C ≥ 0.022μF</td> </tr> <tr> <td rowspan="2">0402</td> <td rowspan="2">X7R</td> <td>50V</td> <td>C ≥ 0.1μF</td> </tr> <tr> <td>10~25V</td> <td>C ≥ 0.22μF</td> </tr> <tr> <td rowspan="2">0603</td> <td rowspan="2">Y5V</td> <td>16V</td> <td>C ≥ 0.47μF</td> </tr> <tr> <td>X7R</td> <td>50V</td> <td>C &gt; 0.1μF</td> </tr> <tr> <td rowspan="2">0805</td> <td rowspan="2">X5R/X7R/X6S/X7S</td> <td>10V, 16V, 50V</td> <td>C ≥ 1.0μF</td> </tr> <tr> <td>Y5V</td> <td>16V</td> <td>C ≥ 2.2μF</td> </tr> <tr> <td rowspan="2">1206</td> <td rowspan="2">X5R/X7R/X6S/X7S</td> <td>10~50V</td> <td>C ≥ 4.7μF</td> </tr> <tr> <td>Y5V</td> <td>16V</td> <td>C ≥ 2.2μF</td> </tr> <tr> <td rowspan="2">1210</td> <td rowspan="2">X5R/X7R/X6S/X7S</td> <td>50V</td> <td>C ≥ 2.2μF</td> </tr> <tr> <td>100V</td> <td>C ≥ 0.47μF</td> </tr> <tr> <td rowspan="2">1825 2220 2225</td> <td rowspan="2">X7R</td> <td>100V~250V</td> <td>C ≥ 4.7μF</td> </tr> <tr> <td>100V</td> <td>C &gt; 1.0μF</td> </tr> </tbody> </table>	Size	Dielectric	Rated voltage	Capacitance	0201	X5R/X7R/X6S	≤ 10V	C ≥ 0.1μF	≤ 16V	C > 0.1μF	0402	X5R/X7R/X6S/X7S/Y5	6.3V, 10V, 16V, 2	C ≥ 1.0μF	4V	C ≥ 22μF	0603	X5R/X7R/X6S/X7S	6.3V, 10V, 25V, 35	C ≥ 4.7μF C ≥ 1.0μF	4V	C ≥ 47μF	0805	X5R/X7R/X6S/X7S	6.3V, 10V~50	C ≥ 22μF C ≥ 10μF	≤ 6.3V	C ≥ 47μF	1206	X5R/X7R/X6S	3000V	C ≥ 1.5pF	1210	X7R	16V	C ≥ 47μF	100V	C ≥ 3.3μF	TT15	X5R	6.3V	C > 1.0μF	TT18	Y5V	6.3V, 10V	C ≥ 2.2μF	TT21	Y5V	6.3V	C ≥ 10μF	TT31	X5R/X7R/X6S	≤ 10V	C ≥ 10μF		Y5V	6.3V	C ≥ 22μF	Size	Dielectric	Rated voltage	Capacitance	0201	X7R	16V/25V	C ≥ 0.1μF	16V	C ≥ 0.022μF	0402	X7R	50V	C ≥ 0.1μF	10~25V	C ≥ 0.22μF	0603	Y5V	16V	C ≥ 0.47μF	X7R	50V	C > 0.1μF	0805	X5R/X7R/X6S/X7S	10V, 16V, 50V	C ≥ 1.0μF	Y5V	16V	C ≥ 2.2μF	1206	X5R/X7R/X6S/X7S	10~50V	C ≥ 4.7μF	Y5V	16V	C ≥ 2.2μF	1210	X5R/X7R/X6S/X7S	50V	C ≥ 2.2μF	100V	C ≥ 0.47μF	1825 2220 2225	X7R	100V~250V	C ≥ 4.7μF	100V	C > 1.0μF	<p>* No remarkable damage. Cap change: NP0: ±3.0% or ±0.3pF whichever is larger X7R, X5R, X6S, X7S: ≥10V**, within ±12.5%; ≤ 6.3V within ±25%; TT series &amp; C ≥ 1uF, within ±25% **10V: 0603 ≥ 4.7μF; 0402 ≥ 1μF; 0201 ≥ 0.1μF, within ±25%; Y5V: ≥10V, within ±30%; ≤ 6.3V, within +30/-40%</p> <p>Q/D.F. value: NP0: More than 30pF, Q ≥ 350 10pF ≤ C &lt; 30pF, Q ≥ 275+2.5C Less than 10pF, Q ≥ 200+10C X7R, X5R, X6S, X7S:</p> <table border="1"> <thead> <tr> <th>Rated</th> <th>D.F. ≤</th> <th>Exception of D.F. ≤</th> </tr> </thead> <tbody> <tr> <td rowspan="2">≥ 100</td> <td rowspan="2">≤ 3%</td> <td>≤ 6% 1206 ≥ 0.47μF</td> </tr> <tr> <td>≤ 7.5% 0805 &gt; 0.1μF, 0603 ≥ 0.068μF, 1206 &gt; 1μF; 1210 ≥ 2.2μF; TT series</td> </tr> <tr> <td rowspan="2">≥ 50V</td> <td rowspan="2">≤ 3%</td> <td>≤ 20% 0805 &gt; 0.22μF; 1210 ≥ 3.3μF</td> </tr> <tr> <td>≤ 6% 0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF</td> </tr> <tr> <td rowspan="2">35V</td> <td rowspan="2">≤ 5%</td> <td>≤ 10% 0201 ≥ 0.01μF; 1210 ≥ 4.7μF</td> </tr> <tr> <td>≤ 20% 0402 ≥ 0.1μF; 0603 &gt; 0.1μF; 0805 ≥ 1μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF; TT series</td> </tr> <tr> <td rowspan="2">25V</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="2">16V</td> <td rowspan="2">≤ 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 rowspan="2">10V</td> <td rowspan="2">≤ 7.5%</td> <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="2">6.3V</td> <td rowspan="2">≤ 15%</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>≤ 20% 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>4V</td> <td>≤ 20%</td> <td>0201 ≥ 0.1μF; 0402 ≥ 1μF; TT series; 01R5</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="2">25V</td> <td rowspan="2">≤ 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>16V (C &lt; 1.0μF)</td> <td>≤ 10%</td> <td>≤ 12.5% 0402 ≥ 0.068μF; 0603 ≥ 0.68μF</td> </tr> <tr> <td>16V (C ≥ 1.0μF)</td> <td>≤ 12.5%</td> <td>≤ 20% 0402 ≥ 0.22μF</td> </tr> <tr> <td>10V</td> <td>≤ 20%</td> <td>≤ 30% 0603 ≥ 2.2μF; 0805 ≥ 3.3μF; 1206 ≥ 10μF; 1210 ≥ 22μF; 1812 ≥ 47μF;</td> </tr> <tr> <td>6.3V</td> <td>≤ 30%</td> <td>0402 ≥ 0.47μF</td> </tr> </tbody> </table>	Rated	D.F. ≤	Exception of D.F. ≤	≥ 100	≤ 3%	≤ 6% 1206 ≥ 0.47μF	≤ 7.5% 0805 > 0.1μF, 0603 ≥ 0.068μF, 1206 > 1μF; 1210 ≥ 2.2μF; TT series	≥ 50V	≤ 3%	≤ 20% 0805 > 0.22μF; 1210 ≥ 3.3μF	≤ 6% 0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF	35V	≤ 5%	≤ 10% 0201 ≥ 0.01μF; 1210 ≥ 4.7μF	≤ 20% 0402 ≥ 0.1μF; 0603 > 0.1μF; 0805 ≥ 1μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF; TT series	25V	≤ 5%	≤ 20% 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF	≤ 10% 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF	16V	≤ 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	10V	≤ 7.5%	≤ 20% 0402 ≥ 0.47μF	≤ 10% 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF	6.3V	≤ 15%	≤ 15% 0201 ≥ 0.01μF (0201/X7R ≥ 0.022μF); 0402 ≥ 0.033μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series	≤ 20% 0201 ≥ 0.012μF; 0402 ≥ 0.33μF (0402/X7R ≥ 0.22μF); 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF	4V	≤ 20%	0201 ≥ 0.1μF; 0402 ≥ 1μF; TT series; 01R5	Rated vol.	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16V	≤ 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																																																																																																																																																																								
10V	≤ 7.5%	≤ 20% 0402 ≥ 0.47μF																																																																																																																																																																								
		≤ 10% 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF																																																																																																																																																																								
6.3V	≤ 15%	≤ 15% 0201 ≥ 0.01μF (0201/X7R ≥ 0.022μF); 0402 ≥ 0.033μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series																																																																																																																																																																								
		≤ 20% 0201 ≥ 0.012μF; 0402 ≥ 0.33μF (0402/X7R ≥ 0.22μF); 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF																																																																																																																																																																								
4V	≤ 20%	0201 ≥ 0.1μF; 0402 ≥ 1μF; TT series; 01R5																																																																																																																																																																								
Rated vol.	D.F. ≤	Exception of D.F. ≤																																																																																																																																																																								
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35V	≤ 10%	---																																																																																																																																																																								
25V	≤ 7.5%	≤ 10% 0402 ≥ 0.047μF; 0603 ≥ 0.1μF; 0805 ≥ 0.33μF; 1206 ≥ 1μF; 1210 ≥ 4.7μF																																																																																																																																																																								
		≤ 15% 0402 ≥ 0.068μF; 0603 ≥ 0.47μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF																																																																																																																																																																								
16V (C < 1.0μF)	≤ 10%	≤ 12.5% 0402 ≥ 0.068μF; 0603 ≥ 0.68μF																																																																																																																																																																								
16V (C ≥ 1.0μF)	≤ 12.5%	≤ 20% 0402 ≥ 0.22μF																																																																																																																																																																								
10V	≤ 20%	≤ 30% 0603 ≥ 2.2μF; 0805 ≥ 3.3μF; 1206 ≥ 10μF; 1210 ≥ 22μF; 1812 ≥ 47μF;																																																																																																																																																																								
6.3V	≤ 30%	0402 ≥ 0.47μF																																																																																																																																																																								
		<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>																																																																																																																																																																								
		<p>The graph shows the de-rating curve for different temperatures. The y-axis is 'Ratio (Operating Voltage/Rated Voltage) (%)' from 0 to 120. The x-axis is 'Temperature at Product (°C)' from 0 to 150. Three lines represent different temperatures: 125°C (solid line), 105°C (dashed line), and 85°C (dotted line). All lines start at 100% at 25°C and decrease linearly. The 125°C line reaches 0% at 125°C. The 105°C line reaches 0% at 105°C. The 85°C line reaches 0% at 85°C.</p>																																																																																																																																																																								
		<p>* I.R.: ≥10V, 1GΩ or 50 Ω-F whichever is smaller. Class II (X7R, X5R, X6S, X7S, Y5V)</p> <table border="1"> <thead> <tr> <th>Rated voltage</th> <th>Insulation Resistance</th> </tr> </thead> <tbody> <tr> <td>100V: All X7R; 1210 ≥ 3.3μF</td> <td rowspan="6">500MΩ or RxC ≥ 5 Ω-F whichever is smaller.</td> </tr> <tr> <td>50V: 0402 &gt; 0.01μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF</td> </tr> <tr> <td>35V: 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF</td> </tr> <tr> <td>25V: 0201 ≥ 0.1μF; 0402 ≥ 0.22μF; 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; All X6S/X7S items; Size ≥ 1812</td> <td></td> </tr> </tbody> </table>	Rated voltage	Insulation Resistance	100V: All X7R; 1210 ≥ 3.3μF	500MΩ or RxC ≥ 5 Ω-F whichever is smaller.	50V: 0402 > 0.01μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF	35V: 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF	25V: 0201 ≥ 0.1μF; 0402 ≥ 0.22μF; 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; All X6S/X7S items; Size ≥ 1812																																																																																																																																																														
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