

APPROVAL SHEET

MULTILAYER CERAMIC CAPACITORS

General Purpose Series (4V to 100V)

0201 to 1812 Sizes

NP0, X7R, Y5V, X6S, X7S & X5R Dielectrics

Halogen Free & RoHS Compliance



*Contents in this sheet are subject to change without prior notice.

Multilayer Ceramic Capacitors

Approval Sheet

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.

WTC's MLCC is made by NP0, X7R, X6S, X5R and Y5V dielectric material and which provides product with high electrical precision, stability and reliability.

2. FEATURES

- A wide selection of sizes is available (0201 to 1812).
- High capacitance in given case size.
- Capacitor with lead-free termination (pure Tin).

3. APPLICATIONS

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

4. HOW TO ORDER

<u>1206</u>	<u>B</u>	<u>104</u>	<u>K</u>	<u>500</u>	<u>C</u>	<u>I</u>
<u>Size</u>	<u>Dielectric</u>	<u>Capacitance</u>	<u>Tolerance</u>	<u>Rated voltage</u>	<u>Termination</u>	<u>Packaging style</u>
Inch (mm)	N=NP0 (C0G)	Two significant digits followed by no. of zeros. And R is in place of decimal point.	A=±0.05pF B=±0.1pF C=±0.25pF D=±0.5pF F=±1% G=±2% J=±5% K=±10% M=±20% Z=-20/+80%	Two significant digits followed by no. of zeros. And R is in place of decimal point.	C=Cu/Ni/Sn	T=7" reeled G=13" reeled
0201 (0603)						
0402 (1005)	B=X7R					
0603 (1608)	F=Y5V					
0805 (2012)	X=X5R					
1206 (3216)	S=X6S					
1210 (3225)	A=X7S	eg.: 0R5=0.5pF 1R0=1.0pF 104=10x10 ⁴ =100nF		4R0=4 VDC 6R3=6.3 VDC 100=10 VDC 160=16 VDC 250=25 VDC 500=50 VDC 101=100 VDC		
1812 (4532)						

5. EXTERNAL DIMENSIONS

Outline	Size Inch (mm)	L (mm)	W (mm)	T (mm)/Symbol		Soldering Method *	M _B (mm)
 Fig. 1 The outline of MLCC	01R5 (0402)	0.4±0.02	0.2±0.02	0.2±0.02	V	R	0.10±0.03
	0201 (0603)	0.6±0.03	0.3±0.03	0.3±0.03	L	R	0.15±0.05
		0.6±0.05 ^{#2}	0.3±0.05 ^{#2}	0.3±0.05 ^{#2}			0.15±0.1/-0.05
		0.6±0.09 ^{#3}	0.3±0.09 ^{#3}	0.3±0.09 ^{#3}			
	0402 (1005)	1.00±0.05	0.50±0.05	0.50±0.05	N	R	0.25 +0.05/-0.10
				0.50+0.02/-0.05	Q	R	
		1.00±0.20	0.50±0.20	0.5±0.20	E	R	
	0603 (1608)	1.60±0.10	0.80±0.10	0.80±0.07	S	R / W	0.40±0.15
		1.60+0.15/-0.10	0.80+0.15/-0.10	0.50±0.10	H	R / W	
		1.60±0.20 ^{#1}	0.80±0.20 ^{#1}	0.80+0.15/-0.10	X	R / W	
	0805 (2012)	2.00±0.15	1.25±0.10	0.50±0.10	H	R / W	0.50±0.20
				0.60±0.10	A	R / W	
				0.80±0.10	B	R / W	
		1.25±0.10	D	R			
		2.00±0.20	1.25±0.20	0.85±0.10	T	R / W	
				1.25±0.20	I	R	
	1206 (3216)	3.20±0.15	1.60±0.15	0.80±0.10	B	R / W	0.60±0.20 (0.5±0.25) ^{***}
				0.95±0.10	C	R	
				1.25±0.10	D	R	
		3.20±0.20	1.60±0.20	1.15±0.15	J	R	
				1.60±0.20	G	R	
				0.85±0.10	T	R / W	
	3.20+0.30/-0.10	1.60+0.30/-0.10	1.60+0.30/-0.10	P	R		
	1210 (3225)	3.20±0.30	2.50±0.20	0.95±0.10	C	R	0.75±0.25
				0.85±0.10	T	R	
				1.25±0.10	D	R	
		3.20±0.40	2.50±0.30	1.60±0.20	G	R	
				2.00±0.20	K	R	
		3.20±0.60 ^{#4}	2.50±0.50 ^{#4}	2.50±0.30	M	R	
	1808 (4520)	4.50±0.40 (4.5+0.5/-0.3) ^{**}	2.03±0.25	1.25±0.10	D	R	0.75±0.25 (0.5±0.25) ^{***}
				1.40±0.15	F	R	
				1.60±0.20	G	R	
				2.00±0.20	K	R	
	1812 (4532)	4.50±0.40 (4.5+0.5/-0.3) ^{**}	3.20±0.30	1.25±0.10	D	R	0.75±0.25 (0.5±0.25) ^{***}
				1.60±0.20	G	R	
			3.20±0.40	2.00±0.20	K	R	
				2.50±0.30	M	R	
				2.80±0.30	U	R	

* R = Reflow soldering process ; W = Wave soldering process.

** For 1808_200V ~3kV, 1812_200V~3kV and safety certificated products.

*** For 1206_1000V ~3kV,1808_200V ~3kV, 1812_200V~3kV and safety certificated products.

#1 : For 0603/Cap ≥ 10μF or 0603/Cap ≥ 4.7μF (≤ 6.3V) or 0603/Cap > 1μF (> 10V) products.

#2 : For 0201/ 0.1μF < Cap < 0.68μF products.

#3 : For 0201/Cap ≥ 0.68μF products.

#4 : For 1210_100V: Cap > 1μF, 250V: Cap > 0.47μF, 400V~630V: Cap > 0.22μF.

6. GENERAL ELECTRICAL DATA

Dielectric	NP0	X7R	Y5V	X5R	X6S	X7S
Size	0201, 0402, 0603, 0805, 1206, 1210, 1812					
Capacitance range*	0.1pF to 0.1μF	100pF to 47μF	0.01μF to 100μF	100pF to 220μF	0.1μF to 100μF	1μF to 100μF
Capacitance tolerance**	Cap≤5pF ^{#1} : A (±0.05pF), B (±0.1pF), C (±0.25pF) 5pF<Cap<10pF: C (±0.25pF), D (±0.5pF) Cap≥10pF: F (±1%), G (±2%), J (±5%), K (±10%)	J (±5%), K (±10%), M (±20%)	M (±20%), Z (-20/+80%)	K (±10%), M (±20%)	K (±10%), M (±20%)	K (±10%), M (±20%)
Rated voltage (WVDC)	10V, 16V, 25V, 50V, 100V	6.3V, 10V, 16V, 25V, 50V, 100V				
DF(Tan δ)*	Cap<30pF: Q≥400+20C Cap≥30pF: Q≥1000	Note 1				
Operating temperature	-55 to +125°C	-25 to +85°C	-55 to +85°C	-55 to +105°C	-55 to +125°C	-55 to +125°C
Capacitance characteristic	±30ppm	±15%	+30/-80%	±15%	±22%	±22%
Termination	Ni/Sn (lead-free termination)					

#1: NP0, 0.1pF product only provide B tolerance; 0603N0R4 provide B&C tolerance; 0603N0R3 only provide C tolerance.

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

NP0: Apply 1.0±0.2Vrms, 1.0MHz±10% for Cap≤1000pF and 1.0±0.2Vrms, 1.0kHz±10% for Cap>1000pF, 25°C at ambient temperature

X7R/X6S/X5R/X7S: Please refer to page 13 "Reliability test conditions and requirements" for detail.

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

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

Note 1:

X7R/X5R/X6S/X7S

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 ≥ 0.012μF; 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 & (0402/X7R ≥ 0.056μF); TT series
		≤ 12.5% 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF
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 (0201/X7R ≥ 0.022μF); 0402 ≥ 0.22μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series
		≤ 15% 0201 ≥ 0.012μF; 0402 ≥ 0.33μF (0402/X7R ≥ 0.22μF); TT series
10V	≤ 5%	≤ 10% 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%	---

Y5V

Rated vol.	D.F. ≤	Exception of D.F. ≤
≥ 50V	≤ 5%	≤ 7% 0603 ≥ 0.1μF; 0805 ≥ 0.47μF; 1206 ≥ 4.7μF; TT series
35V	≤ 7%	≤ 12.5% 1210 ≥ 6.8μF

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	≤ 7%	≤ 9% 0402 ≥ 0.068μF; 0603 ≥ 0.68μF
16V (C<1.0μF)	≤ 7%	≤ 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%	---

7. CAPACITANCE RANGE

7-1. NP0 Dielectric 0201, 0402, 0603, 0805 Sizes

DIELECTRIC		NP0																		
SIZE		0201			0402					0603					0805					
RATED VOLTAGE (VDC)		16	25	50	10	16	25	50	100	10	16	25	50	100	10	16	25	50	100	
Capacitance	0.1pF (0R1)	L	L	L	N	N	N	N												
	0.2pF (0R2)	L	L	L	N	N	N	N												
	0.3pF (0R3)	L	L	L	N	N	N	N	N	S	S	S	S							
	0.4pF (0R4)	L	L	L	N	N	N	N	N	S	S	S	S							
	0.5pF (0R5)	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A	
	0.6pF (0R6)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	0.7pF (0R7)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	0.8pF (0R8)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	0.9pF (0R9)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	1.0pF (1R0)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	1.2pF (1R2)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	1.5pF (1R5)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	1.8pF (1R8)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	2.0pF (2R0)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	2.2pF (2R2)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	2.7pF (2R7)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	3.0pF (3R0)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	3.3pF (3R3)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	3.9pF (3R9)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	4.0pF (4R0)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	4.7pF (4R7)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	5.0pF (5R0)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	5.6pF (5R6)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	6.0pF (6R0)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	6.8pF (6R8)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	7.0pF (7R0)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	8.0pF (8R0)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	8.2pF (8R2)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	9.0pF (9R0)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	10pF (100)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	12pF (120)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	15pF (150)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	18pF (180)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	22pF (220)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	27pF (270)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	33pF (330)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	39pF (390)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	47pF (470)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	56pF (560)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	68pF (680)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	82pF (820)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	100pF (101)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	120pF (121)	L	L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	150pF (151)		L	L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	180pF (181)				N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	220pF (221)				N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	270pF (271)			L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	330pF (331)			L	N	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	390pF (391)			L	N	N	N	N	N	N	S	S	S	S	S	B	B	B	B	B
	470pF (471)			L	N	N	N	N	N	N	S	S	S	S	S	B	B	B	B	B
560pF (561)			L	N	N	N	N	N	N	S	S	S	S	S	B	B	B	B	B	
680pF (681)				N	N	N	N	N	N	S	S	S	S	S	B	B	B	B	B	
820pF (821)				N	N	N	N	N	N	S	S	S	S	S	B	B	B	B	B	
1,000pF (102)				N	N	N	N	N	N	S	S	S	S	S	B	B	B	B	B	
1,200pF (122)										X	X	X	X	X*	B	B	B	B	B	
1,500pF (152)										X	X	X	X	X*	B	B	B	B	B	
1,800pF (182)										X	X	X	X		B	B	B	B	B	
2,200pF (222)										X	X	X	X		B	B	B	B	B	
2,700pF (272)										X	X	X	X		D	D	D	D	D	
3,300pF (332)										X	X	X	X		D	D	D	D	D	
3,900pF (392)										X*	X*	X*	X*		D	D	D	D	D	
4,700pF (472)										X*	X*	X*	X*		D	D	D	D	D	
5,600pF (562)										X*	X*	X*	X*		D	D	D	D	D	
6,800pF (682)										X*	X*	X*	X*		D	D	D	D	D	
8,200pF (822)										X*	X*	X*	X*		D	D	D	D	D	
0.010uF (103)										X*	X*	X*	X*		D	D	D	D	D	
0.012uF (123)															T*	T*	T*	T*		
0.015uF (153)															T*	T*	T*	T*		
0.018uF (183)															D*	D*	D*	D*		
0.022uF (223)															D*	D*	D*	D*		

1. The letter in cell is expressed the symbol of product thickness.

2. The letter in cell with " * " mark is expressed capacitance tolerance "J" (±5%) only.

3. For more information about products with special capacitance or other data, please contact WTC local representative.

Multilayer Ceramic Capacitors

Approval Sheet

7-1. NP0 Dielectric 1206, 1210, 1812 Sizes

DIELECTRIC		NP0													
SIZE		1206					1210					1812			
RATED VOLTAGE (VDC)		10	16	25	50	100	10	16	25	50	100	16	25	50	100
Capacitance	1.0pF (1R0)														
	1.2pF (1R2)	B	B	B	B	B									
	1.5pF (1R5)	B	B	B	B	B									
	1.8pF (1R8)	B	B	B	B	B									
	2.2pF (2R2)	B	B	B	B	B									
	2.7pF (2R7)	B	B	B	B	B									
	3.3pF (3R3)	B	B	B	B	B									
	3.9pF (3R9)	B	B	B	B	B									
	4.7pF (4R7)	B	B	B	B	B									
	5.6pF (5R6)	B	B	B	B	B									
	6.8pF (6R8)	B	B	B	B	B									
	8.2pF (8R2)	B	B	B	B	B									
	10pF (100)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	12pF (120)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	15pF (150)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	18pF (180)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	22pF (220)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	27pF (270)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	33pF (330)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	39pF (390)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	47pF (470)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	56pF (560)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	68pF (680)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	82pF (820)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	100pF (101)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	120pF (121)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	150pF (151)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	180pF (181)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	220pF (221)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	270pF (271)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	330pF (331)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	390pF (391)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	470pF (471)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	560pF (561)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	680pF (681)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	820pF (821)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	1,000pF (102)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	1,200pF (122)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	1,500pF (152)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	1,800pF (182)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	2,200pF (222)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	2,700pF (272)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	3,300pF (332)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	3,900pF (392)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	4,700pF (472)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	5,600pF (562)	B	B	B	B	B	C	C	C	C	C	D	D	D	D
	6,800pF (682)	C	C	C	C	C	C	C	C	C	C	D	D	D	D
	8,200pF (822)	D	D	D	D	D	C	C	C	C	C	D	D	D	D
	0.010μF (103)	D	D	D	D	D	C	C	C	C	C	D	D	D	D
	0.012μF (123)	P	P	P	P	P	D	D	D	D	D	D	D	D	D
0.015μF (153)	P	P	P	P	P	D	D	D	D	D	D	D	D	D	
0.018μF (183)	P	P	P	P	P	K	K	K	K	K	D	D	D	D	
0.022μF (223)	P	P	P	P	P	K	K	K	K	K	D	D	D	D	
0.027μF (273)	P	P	P	P		K	K	K	K	K	D	D	D	D	
0.033μF (333)	P	P	P	P		K	K	K	K	K	D	D	D	D	
0.039μF (393)	P	P	P	P		K	K	K	K	K	M	M	M	M	
0.047μF (473)	J*	J*	J*	J*		K	K	K	K	K	M	M	M	M	
0.056μF (563)	J*	J*	J*	J*							M	M	M	M	
0.068μF (683)	G*	G*	G*	G*							M	M	M	M	
0.082μF (823)	G*	G*	G*	G*							M	M	M	M	
0.1μF (104)	G*	G*	G*	G*							M	M	M	M	

1. The letter in cell is expressed the symbol of product thickness.
2. The letter in cell with " * " mark is expressed capacitance tolerance "J" (±5%) only.
3. For more information about products with special capacitance or other data, please contact WTC local representative.

Multilayer Ceramic Capacitors

Approval Sheet

7-2. X7R Dielectric 0201, 0402, 0603, 0805 Sizes

DIELECTRIC		X7R																							
SIZE		0201					0402						0603						0805						
RATED VOLTAGE (VDC)		6.3	10	16	25	50	6.3	10	16	25	50	100	6.3	10	16	25	50	100	6.3	10	16	25	50	100	
Capacitance	100pF (101)			L	L	L		N	N	N	N	N		S	S	S	S	S		B	B	B	B	B	
	120pF (121)			L	L	L		N	N	N	N	N		S	S	S	S	S		B	B	B	B	B	
	150pF (151)			L	L	L		N	N	N	N	N		S	S	S	S	S		B	B	B	B	B	
	180pF (181)			L	L	L		N	N	N	N	N		S	S	S	S	S		B	B	B	B	B	
	220pF (221)			L	L	L		N	N	N	N	N		S	S	S	S	S		B	B	B	B	B	
	270pF (271)			L	L	L		N	N	N	N	N		S	S	S	S	S		B	B	B	B	B	
	330pF (331)			L	L	L		N	N	N	N	N		S	S	S	S	S		B	B	B	B	B	
	390pF (391)			L	L	L		N	N	N	N	N		S	S	S	S	S		B	B	B	B	B	
	470pF (471)			L	L	L		N	N	N	N	N		S	S	S	S	S		B	B	B	B	B	
	560pF (561)			L	L	L		N	N	N	N	N		S	S	S	S	S		B	B	B	B	B	
	680pF (681)			L	L	L		N	N	N	N	N		S	S	S	S	S		B	B	B	B	B	
	820pF (821)			L	L	L		N	N	N	N	N		S	S	S	S	S		B	B	B	B	B	
	1,000pF (102)	L	L	L	L	L		N	N	N	N	N		S	S	S	S	S		B	B	B	B	B	
	1,200pF (122)	L	L	L	L			N	N	N	N	N		S	S	S	S	S		B	B	B	B	B	
	1,500pF (152)	L	L	L	L			N	N	N	N	N		S	S	S	S	S		B	B	B	B	B	
	1,800pF (182)	L	L	L	L			N	N	N	N	N		S	S	S	S	S		B	B	B	B	B	
	2,200pF (222)	L	L	L	L			N	N	N	N	N		S	S	S	S	S		B	B	B	B	B	
	2,700pF (272)	L	L	L	L			N	N	N	N	N		S	S	S	S	S		B	B	B	B	B	
	3,300pF (332)	L	L	L	L			N	N	N	N	N		S	S	S	S	S		B	B	B	B	B	
	3,900pF (392)	L	L	L	L			N	N	N	N	N		S	S	S	S	S		B	B	B	B	B	
	4,700pF (472)	L	L	L	L			N	N	N	N	N		S	S	S	S	S		B	B	B	B	B	
	5,600pF (562)	L	L	L	L			N	N	N	N	N		S	S	S	S	S		B	B	B	B	B	
	6,800pF (682)	L	L	L				N	N	N	N	N		S	S	S	S	S		B	B	B	B	B	
	8,200pF (822)	L	L	L				N	N	N	N	N		S	S	S	S	S		B	B	B	B	B	
	0.010μF (103)	L	L	L	L			N	N	N	N	N		S	S	S	S	S		B	B	B	B	B	
	0.012μF (123)							N	N	N	N	E		S	S	S	S	X		B	B	B	B	B	
	0.015μF (153)							N	N	N	N	E		S	S	S	S	X		B	B	B	B	B	
	0.018μF (183)							N	N	N	N	E		S	S	S	S	X		B	B	B	B	B	
	0.022μF (223)		L	L				N	N	N	N	E		S	S	S	S	X		B	B	B	B	B	
	0.027μF (273)							N	N	N	N	E		S	S	S	S	X		B	B	B	B	D	
	0.033μF (333)							N	N	N	N	E		S	S	S	S	X	X		B	B	B	B	D
	0.039μF (393)							N	N	N	N	E		S	S	S	S	X	X		B	B	B	B	D
	0.047μF (473)							N	N	N	N	E		S	S	S	S	X	X		B	B	B	B	D
	0.056μF (563)							N	N	N	N	E		S	S	S	S	X	X		B	B	B	B	D
	0.068μF (683)							N	N	N	N	E		S	S	S	S	X	X		B	B	B	B	D
	0.082μF (823)							N	N	N	N	E		S	S	S	S	X	X		B	B	B	B	D
	0.10μF (104)							N	N	N	N	E		S	S	S	S	X	X		B	B	B	B	D
	0.12μF (124)													S	S	S	X				B	B	B	D	I
	0.15μF (154)													S	S	S	X				D	D	D	D	I
	0.18μF (184)													S	S	S	X				D	D	D	D	I
0.22μF (224)							N	N	N	N			S	S	S	X	X			D	D	D	D	I	
0.27μF (274)													X	X	X	X				D	D	D	I		
0.33μF (334)													X	X	X	X	X			D	D	D	I		
0.39μF (394)													X	X	X	X				D	D	D	I		
0.47μF (474)							N	N					X	X	X	X	X			D	D	D	I	I	
0.56μF (564)													X	X	X					D	D	D			
0.68μF (684)													X	X	X					D	D	D			
0.82μF (824)													X	X	X					D	D	D			
1.0μF (105)							N						X	X	X	X	X			D	D	D	I		
1.5μF (155)																				I	I	I			
2.2μF (225)													X	X	X					I	I	I	I		
3.3μF (335)																									
4.7μF (475)													X							I	I	I	I		
6.8μF (685)																									
10μF (106)																				I	I	I*			
22μF (226)																									

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.

Multilayer Ceramic Capacitors

Approval Sheet

7-2. X7R Dielectric 1206, 1210, 1812 Sizes

DIELECTRIC		X7R																	
SIZE		1206						1210						1812					
RATED VOLTAGE (VDC)		6.3	10	16	25	35	50	100	6.3	10	16	25	50	100	10	16	25	50	100
Capacitance	100pF (101)																		
	120pF (121)																		
	150pF (151)		B	B	B		B	B											
	180pF (181)		B	B	B		B	B											
	220pF (221)		B	B	B		B	B											
	270pF (271)		B	B	B		B	B											
	330pF (331)		B	B	B		B	B											
	390pF (391)		B	B	B		B	B											
	470pF (471)		B	B	B		B	B											
	560pF (561)		B	B	B		B	B											
	680pF (681)		B	B	B		B	B											
	820pF (821)		B	B	B		B	B											
	1,000pF (102)		B	B	B		B	B		C	C	C	C	C	D	D	D	D	D
	1,200pF (122)		B	B	B		B	B		C	C	C	C	C	D	D	D	D	D
	1,500pF (152)		B	B	B		B	B		C	C	C	C	C	D	D	D	D	D
	1,800pF (182)		B	B	B		B	B		C	C	C	C	C	D	D	D	D	D
	2,200pF (222)		B	B	B		B	B		C	C	C	C	C	D	D	D	D	D
	2,700pF (272)		B	B	B		B	B		C	C	C	C	C	D	D	D	D	D
	3,300pF (332)		B	B	B		B	B		C	C	C	C	C	D	D	D	D	D
	3,900pF (392)		B	B	B		B	B		C	C	C	C	C	D	D	D	D	D
	4,700pF (472)		B	B	B		B	B		C	C	C	C	C	D	D	D	D	D
	5,600pF (562)		B	B	B		B	B		C	C	C	C	C	D	D	D	D	D
	6,800pF (682)		B	B	B		B	B		C	C	C	C	C	D	D	D	D	D
	8,200pF (822)		B	B	B		B	B		C	C	C	C	C	D	D	D	D	D
	0.010μF (103)		B	B	B		B	B		C	C	C	C	C	D	D	D	D	D
	0.012μF (123)		B	B	B		B	B		C	C	C	C	C	D	D	D	D	D
	0.015μF (153)		B	B	B		B	B		C	C	C	C	C	D	D	D	D	D
	0.018μF (183)		B	B	B		B	B		C	C	C	C	C	D	D	D	D	D
	0.022μF (223)		B	B	B		B	B		C	C	C	C	C	D	D	D	D	D
	0.027μF (273)		B	B	B		B	B		C	C	C	C	C	D	D	D	D	D
	0.033μF (333)		B	B	B		B	B		C	C	C	C	C	D	D	D	D	D
	0.039μF (393)		B	B	B		B	B		C	C	C	C	C	D	D	D	D	D
	0.047μF (473)		B	B	B		B	B		C	C	C	C	C	D	D	D	D	D
	0.056μF (563)		B	B	B		B	B		C	C	C	C	C	D	D	D	D	D
	0.068μF (683)		B	B	B		B	B		C	C	C	C	C	D	D	D	D	D
	0.082μF (823)		B	B	B		B	D		C	C	C	C	C	D	D	D	D	D
	0.10μF (104)		B	B	B		B	D		C	C	C	C	C	D	D	D	D	D
	0.12μF (124)		B	B	B		B	D		C	C	C	C	C	D	D	D	D	D
	0.15μF (154)		C	C	C		C	G		C	C	C	C	C	D	D	D	D	D
	0.18μF (184)		C	C	C		C	G		C	C	C	C	C	D	D	D	D	D
0.22μF (224)		C	C	C		C	G		C	C	C	C	C	D	D	D	D	D	
0.27μF (274)		C	C	C		D	G		C	C	C	C	G	D	D	D	D	D	
0.33μF (334)		C	C	C		D	G		C	C	C	D	G	D	D	D	D	D	
0.39μF (394)		C	C	J		P	G		C	C	C	D	M	D	D	D	D	D	
0.47μF (474)		J	J	J		P	G		C	C	C	D	M	D	D	D	D	K	
0.56μF (564)		J	J	J		P	P		D	D	D	D	M	D	D	D	D	K	
0.68μF (684)		J	J	J		P	P		D	D	D	D	K	D	D	D	K	K	
0.82μF (824)		J	J	J		P	P		D	D	D	D	K	D	D	D	K	K	
1.0μF (105)		J	J	J		P	P		D	D	D	D	K	D	D	D	K	K	
1.5μF (155)	J	J	J	P						K	G	M	M					K	
2.2μF (225)	J	J	J	P		P	P			K	G	M	M				M	M	
3.3μF (335)		P	P	P						K	G	M							
4.7μF (475)	P	P	P	P		P			K	K	K	M	M						
6.8μF (685)																			
10μF (106)	P	P	P	P	P				K	K	K	M							
22μF (226)	P	P	P*						M	M	M								
47μF (476)								M	M										
100μF (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.

Multilayer Ceramic Capacitors

Approval Sheet

7-3. Y5V Dielectric 0402, 0603, 0805 Sizes

DIELECTRIC SIZE		Y5V															
RATED VOLTAGE (VDC)		0402					0603					0805					
		6.3	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50	100
Capacitance	0.010μF (103)		N	N	N	N		S	S	S	S		A	A	A	A	B
	0.015μF (153)		N	N	N	N		S	S	S	S		A	A	A	A	B
	0.022μF (223)		N	N	N	N		S	S	S	S		A	A	A	A	B
	0.033μF (333)		N	N	N	N		S	S	S	S		A	A	A	A	B
	0.047μF (473)		N	N	N			S	S	S	S		A	A	A	A	B
	0.068μF (683)		N	N	N			S	S	S	S		A	A	A	A	B
	0.10μF (104)		N	N	N			S	S	S	S		A	A	A	A	B
	0.15μF (154)		N	N				S	S	S	S		A	A	A	A	
	0.22μF (224)	N	N	N				S	S	S	S		A	A	A	A	
	0.33μF (334)	N	N	N				S	S	S	X		B	B	B	B	
	0.47μF (474)	N	N	N				S	S	X	X		B	B	B	B	
	0.68μF (684)	N						S	X	X			B	B	D	D	
	1.0μF (105)	N/E	N/E					S	X	X			B	B	D	D	
	1.5μF (155)							S					D	D			
	2.2μF (225)						S	S	X				D	D	I		
	3.3μF (335)												D	D			
	4.7μF (475)						X	X					D	D	I		
	6.8μF (685)												I				
	10μF (106)											I	I	I			
	22μF (226)											I	I				

1. The letter in cell is expressed the symbol of product thickness.
2. For more information about products with special capacitance or other data, please contact WTC local representative.

7-3. Y5V Dielectric 1206, 1210, 1812 Sizes

DIELECTRIC		Y5V																		
SIZE		1206						1210						1812						
RATED VOLTAGE (VDC)		6.3	10	16	25	50	100	6.3	10	16	25	35	50	100	10	16	25	50	100	
Capacitance	0.010μF (103)		B	B	B	B	B							C					D	
	0.015μF (153)		B	B	B	B	B							C					D	
	0.022μF (223)		B	B	B	B	B							C					D	
	0.033μF (333)		B	B	B	B	B							C					D	
	0.047μF (473)		B	B	B	B	B							C					D	
	0.068μF (683)		B	B	B	B	B							C					D	
	0.10μF (104)		B	B	B	B	B							C					D	
	0.15μF (154)		B	B	B	B	C		C	C	C			C	C	D	D	D	D	D
	0.22μF (224)		B	B	B	B	C		C	C	C			C	C	D	D	D	D	D
	0.33μF (334)		B	B	B	B			C	C	C			C	C	D	D	D	D	D
	0.47μF (474)		B	B	B	B			C	C	C			C		D	D	D	D	D
	0.68μF (684)		B	B	B	B			C	C	C			C		D	D	D	D	D
	1.0μF (105)		C	C	C	C			C	C	C			C		D	D	D	D	D
	1.5μF (155)		C	C	C				C	C	C					D	D	D	D	
	2.2μF (225)		C	C	C	J			C	C	C			G		D	D	D	D	
	3.3μF (335)		J	J	J				C	C	C					D	D	D	D	
	4.7μF (475)		J	J	J	P			C	C	D			G		D	D	D	D	
	6.8μF (685)		J	J					C	C	D			K		D	D	D	D	
	10μF (106)		J	J	P				D	D	G	K	K			D	D	D	K	
	22μF (226)		P	P						K	K									
47μF (476)	P							K	K							M				
100μF (107)								M												

1. The letter in cell is expressed the symbol of product thickness.
2. For more information about products with special capacitance or other data, please contact WTC local representative.

7-4. X5R Dielectric 0201, 0402, 0603, 0805, 1206, 1210 Sizes

Dielectric		X5R																
Size		0201					0402						0603					
Rated Voltage (VDC)		6.3	10	16	25	50	4	6.3	10	16	25	50	4	6.3	10	16	25	50
Capacitance	100pF (101)			L	L	L												
	120pF (121)			L	L	L												
	150pF (151)			L	L	L												
	180pF (181)			L	L	L												
	220pF (221)			L	L	L												
	270pF (271)			L	L	L												
	330pF (331)			L	L	L												
	390pF (391)			L	L	L												
	470pF (471)			L	L	L												
	560pF (561)			L	L	L												
	680pF (681)			L	L	L												
	820pF (821)			L	L	L												
	1,000pF (102)		L	L	L	L												
	1,500pF (152)		L	L	L													
	2,200pF (222)		L	L	L													
	2,700pF (272)		L	L	L													
	3,300pF (332)		L	L	L													
	4,700pF (472)		L	L	L													
	6,800pF (682)		L	L	L													
	0.010μF (103)	L	L	L	L	L												
	0.015μF (153)	L	L															
	0.022μF (223)	L	L															
	0.027μF (273)	L	L						N									
	0.033μF (333)	L	L						N									
	0.039μF (393)	L	L						N									
	0.047μF (473)	L	L						N	N								
	0.056μF (563)	L	L						N	N	N							
	0.068μF (683)	L	L						N	N	N							
	0.082μF (823)	L	L						N	N	N							
	0.10μF (104)	L	L	L	L				N	N	N	N	E					
	0.15μF (154)								N	N	N	N						
	0.22μF (224)	L	L	L*					N	N	N	N	N		X	X	X	X
	0.27μF (274)															X	X	X
	0.33μF (334)	L*							N	N					X	X	X	X
	0.39μF (394)															X	X	X
	0.47μF (474)	L							N	N	E	E	E		X	X	X	X
0.68μF (684)								N	N					X	X	X	X	
0.82μF (824)														X	X	X	X	
1.0μF (105)	L*	L*	L*					N/E	N/E	N/E	N	E		X	X	X	X	
1.5μF (155)														X				
2.2μF (225)	L*	L*						N	N	E	E			X	X	X	X	
3.3μF (335)														X	X			
4.7μF (475)								E	E	E*				X	X	X	X	
6.8μF (685)																		
10μF (106)						E*	E*	E*					X	X	X	X	X*	
22μF (226)													X*	X*	X*			
47μF (476)													X*	X*				

Dielectric		X5R																		
Size		0805						1206						1210						
Rated Voltage (VDC)		4	6.3	10	16	25	50	4	6.3	10	16	25	50	4	6.3	10	16	25	35	50
Capacitance	1.0μF (105)			D	D	D	I													
	1.5μF (155)		I	I	I	I				J	J					K	K			
	2.2μF (225)		I	I	I	I	I			J	J	P	P			K	K			
	3.3μF (335)		I	I	I	I				P	P	P	P							
	4.7μF (475)		I	I	I	I	I			P	P	P	P			K	K	K		
	6.8μF (685)								P	P										
	10μF (106)		I	I	I	I	I			P	P	P	P			K	K	K	M	M
	22μF (226)		I	I*	I*	I*				P	P	P	P			M	M	M	M	M
	47μF (476)		I*	I*						P	P	P*				M	M	M	M*	
	100μF (107)	I*	I*							P						M*	M*	M*		
	220μF (227)							P*						M*	M*					

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.

Multilayer Ceramic Capacitors

7-5. 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	0.10μF (104)	L	L	L	L																									
	0.15μF (154)																													
	0.22μF (224)	L	L*																											
	0.33μF (334)																													
	0.47μF (474)					E																								
	0.68μF (684)																													
	1.0μF (105)	L*				E	E	E	E																					
	1.5μF (155)																													
	2.2μF (225)					E	E	E					X	X																
	3.3μF (335)																													
	4.7μF (475)										X	X	X	X						I	I									
	6.8uF (685)																													
	10μF (106)					E*					X*	X*	X*		I	I	I	I	I					P						
	22μF (226)									X*	X*					I*	I*	I*				P	P*	P					M	
	47μF (476)															I*	I*					P						M	M	M
100μF (107)																											M*	M*		

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.

7-6. 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	1.0μF (105)		E											I											
	1.5μF (155)								I																
	2.2μF (225)	E	E					X	X																
	3.3μF (335)																								
	4.7μF (475)						X	X					I												
	6.8uF (685)																								
	10μF (106)											I	I												
	22μF (226)																P*								
	47μF (476)															P*									
100μF (107)																				M*					

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)/Symbol		Paper tape		Plastic tape	
			7" reel	13" reel	7" reel	13" reel
0201 (0603)	0.30±0.03	L	15,000	70,000	-	-
	0.30±0.05	L	15,000	-	-	-
	0.30±0.09	L	15,000	-	-	-
0402 (1005)	0.50±0.05	N	10,000	50,000	-	-
	0.50±0.02/-0.05	Q	10,000	50,000	-	-
	0.50±0.20	E	10,000	-	-	-
0603 (1608)	0.50±0.10	H	4,000	-	-	-
	0.80±0.07	S	4,000	15,000	-	-
	0.80±0.15/-0.10	X	4,000	15,000	-	-
0805 (2012)	0.50±0.10	H	4,000	15,000	-	-
	0.60±0.10	A	4,000	15,000	-	-
	0.80±0.10	B	4,000	15,000	-	-
	0.85±0.10	T	4,000	15,000	-	-
	1.25±0.10	D	-	-	3,000	10,000
	1.25±0.20	I	-	-	3,000	10,000
1206 (3216)	0.80±0.10	B	4,000	15,000	-	-
	0.85±0.10	T	4,000	15,000	-	-
	0.95±0.10	C	-	-	3,000	10,000
	1.15±0.15	J	-	-	3,000	10,000
	1.25±0.10	D	-	-	3,000	10,000
	1.60±0.20	G	-	-	2,000	10,000
	1.60±0.30/-0.10	P	-	-	2,000	9,000
1210 (3225)	0.85±0.10	T	-	-	3,000	10,000
	0.95±0.10	C	-	-	3,000	10,000
	1.25±0.10	D	-	-	3,000	10,000
	1.60±0.20	G	-	-	2,000	-
	2.00±0.20	K	-	-	1,000	6,000
	2.50±0.30	M	-	-	1,000	6,000
1808 (4520)	1.25±0.10	D	-	-	2,000	10,000
	1.10±0.15	F	-	-	2,000	10,000
	1.60±0.20	G	-	-	2,000	8,000
1812 (4532)	2.00±0.20	K	-	-	1,000	6,000
	1.25±0.10	D	-	-	1,000	5,000
	1.60±0.20	G	-	-	1,000	-
	2.00±0.20	K	-	-	1,000	-
	2.50±0.30	M	-	-	500	3,000
	2.80±0.30	U	-	-	500	-

Unit: pieces

9. 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% Class II: (X7R, X7E, X6S, X5R,X7S,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. NP0: Cap≥30pF, Q≥1000; Cap<30pF,Q≥400+20C X7R,X5R,X6S,X7S:																																																																																																
3.	Q/ D.F. (Dissipation Factor)	** Test condition: 0.5±0.2Vrms · 1KHz±10% X7R: 0805=106(6.3V), 0603/475(6.3V) X5R: 0201 ≥ 224 (6.3V,10V,16V) ^{#1} , 0402 ≥ 475 (6.3V,16V), 0402 ≥ 225(10V), 0603=106 (6.3V,10V), TT18X ≥ 475(10V) , TT15X series X6S: 0201 ≥ 104 (6.3V,10V) ^{#1} , 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), X6S/0201/104(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.	<table><tr><th>Rated vol.</th><th>D.F. ≤</th><th colspan="2">Exception of D.F. ≤</th></tr><tr><td rowspan="3">≥ 100V</td><td rowspan="3">≤ 2.5%</td><td>≤ 3%</td><td>1206 ≥ 0.47μF</td></tr><tr><td>≤ 5%</td><td>0805 > 0.1μF;0603 ≥ 0.068μF;1206>1μF;1210 ≥ 2.2μF;TT series</td></tr><tr><td>≤ 10%</td><td>0805 > 0.22μF;1210 ≥ 3.3μF</td></tr><tr><td rowspan="3">50V</td><td rowspan="3">≤ 2.5%</td><td>≤ 3%</td><td>0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF;1206 ≥ 0.47μF</td></tr><tr><td>≤ 5%</td><td>0201 ≥ 0.01uF; 1210 ≥ 4.7μF</td></tr><tr><td>≤ 10%</td><td>0402 ≥ 0.012μF;0603>0.1μF; 0805 ≥ 1μF;1206 ≥ 2.2μF; 1210 ≥ 10μF; TT series</td></tr><tr><td rowspan="2">35V</td><td rowspan="2">≤ 3.5%</td><td>≤ 10%</td><td>0603 ≥ 1μF;0805≥2.2μF; 1206 ≥ 2.2μF;1210 ≥ 10μF</td></tr><tr><td>≤ 5%</td><td>0201 ≥ 0.01μF;0805 ≥ 1μF; 1210 ≥ 10μF</td></tr><tr><td rowspan="4">25V</td><td rowspan="4">≤ 3.5%</td><td>≤ 7%</td><td>0603 ≥ 0.33μF; 1206 ≥ 4.7μF</td></tr><tr><td>≤ 10%</td><td>0201 ≥ 0.1μF;0402 ≥ 0.10μF&(0402/X7R ≥ 0.056μF); TT series</td></tr><tr><td>≤ 12.5%</td><td>0603 ≥ 0.47μF; 0805 ≥ 2.2μF;1206 ≥ 6.8μF; 1210 ≥ 22μF</td></tr><tr><td>0402 ≥ 0.47μF</td><td></td></tr><tr><td rowspan="2">16V</td><td rowspan="2">≤ 3.5%</td><td>≤ 5%</td><td>0201 ≥ 0.01μF;0402 ≥ 0.033μF;0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF;1210 ≥ 4.7μF</td></tr><tr><td>≤ 10%</td><td>0201 ≥ 0.1uF(0201/X7R ≥ 0.022μF); 0402 ≥ 0.22uF; 0603 ≥ 0.68μF;0805 ≥ 2.2μF;1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series</td></tr><tr><td rowspan="2">10V</td><td rowspan="2">≤ 5%</td><td>≤ 10%</td><td>0201 ≥ 0.012μF;0402 ≥ 0.33μF(0402/X7R ≥ 0.22μF); TT series</td></tr><tr><td>≤ 15%</td><td>0603 ≥ 0.33μF; 0805 ≥ 2.2μF;1206 ≥ 2.2μF;1210 ≥ 22μF;01R5</td></tr><tr><td rowspan="2">6.3V</td><td rowspan="2">≤ 10%</td><td>≤ 15%</td><td>0201 ≥ 0.1μF;0402 ≥ 1μF;0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF ;1210 ≥ 100μF; TT series</td></tr><tr><td>≤ 20%</td><td>0402 ≥ 2.2μF</td></tr><tr><td>4V</td><td>≤ 15%</td><td>---</td><td>---</td></tr></table> Y5V: <table><tr><th>Rated vol.</th><th>D.F. ≤</th><th colspan="2">Exception of D.F. ≤</th></tr><tr><td rowspan="2">≥ 50V</td><td rowspan="2">≤ 5%</td><td>≤ 7%</td><td>0603 ≥ 0.1μF; 0805 ≥ 0.47μF; 1206 ≥ 4.7μF; TT series</td></tr><tr><td>≤ 12.5%</td><td>1210 ≥ 6.8μF</td></tr><tr><td>35V</td><td>≤ 7%</td><td>---</td><td>---</td></tr><tr><td rowspan="3">25V</td><td rowspan="3">≤ 5%</td><td>≤ 7%</td><td>0402 ≥ 0.047μF;0603 ≥ 0.1μF; 0805 ≥ 0.33μF; 1206 ≥ 1μF; 1210 ≥ 4.7μF</td></tr><tr><td>≤ 9%</td><td>0402 ≥ 0.068μF;0603 ≥ 0.47μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series</td></tr><tr><td>≤ 9%</td><td>0402 ≥ 0.068μF; 0603 ≥ 0.68μF</td></tr><tr><td>16V (C<1.0μF)</td><td>≤ 7%</td><td>≤ 12.5%</td><td>0402 ≥ 0.22μF</td></tr><tr><td>16V (C ≥ 1.0μF)</td><td>≤ 9%</td><td>≤ 12.5%</td><td>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%</td><td>0402 ≥ 0.47μF</td></tr><tr><td>6.3V</td><td>≤ 20%</td><td>---</td><td>---</td></tr></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 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 ≥ 0.01uF; 1210 ≥ 4.7μF	≤ 10%	0402 ≥ 0.012μF;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	25V	≤ 3.5%	≤ 7%	0603 ≥ 0.33μF; 1206 ≥ 4.7μF	≤ 10%	0201 ≥ 0.1μF;0402 ≥ 0.10μF&(0402/X7R ≥ 0.056μF); TT series	≤ 12.5%	0603 ≥ 0.47μF; 0805 ≥ 2.2μF;1206 ≥ 6.8μF; 1210 ≥ 22μF	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 ≥ 0.1uF(0201/X7R ≥ 0.022μF); 0402 ≥ 0.22uF; 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	≤ 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	≤ 9%	0402 ≥ 0.068μF; 0603 ≥ 0.68μF	16V (C<1.0μF)	≤ 7%	≤ 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%	---	---
			Rated vol.	D.F. ≤	Exception of D.F. ≤																																																																																														
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			50V	≤ 2.5%	≤ 3%	0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF;1206 ≥ 0.47μF																																																																																													
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					≤ 12.5%	0603 ≥ 0.47μF; 0805 ≥ 2.2μF;1206 ≥ 6.8μF; 1210 ≥ 22μF																																																																																													
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			16V	≤ 3.5%	≤ 5%	0201 ≥ 0.01μF;0402 ≥ 0.033μF;0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF;1210 ≥ 4.7μF																																																																																													
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					≤ 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																																																																																													
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			Rated vol.	D.F. ≤	Exception of D.F. ≤																																																																																														
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			25V	≤ 5%	≤ 7%	0402 ≥ 0.047μF;0603 ≥ 0.1μF; 0805 ≥ 0.33μF; 1206 ≥ 1μF; 1210 ≥ 4.7μF																																																																																													
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10V	≤ 12.5%	≤ 20%	0402 ≥ 0.47μF																																																																																																
6.3V	≤ 20%	---	---																																																																																																
4.	Dielectric Strength	* To apply voltage (≤100V) 250%. * Duration: 1 to 5 sec. * Charge and discharge current less than 50mA.	* No evidence of damage or flash over during test.																																																																																																
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.	10GΩ or RxC ≥ 500Ω·F whichever is smaller. Class II (X7R, X7E, X5R,X6S,X7S,Y5V:) <table><tr><th>Rated voltage</th><th>Insulation Resistance</th></tr><tr><td>100V: All X7R</td><td rowspan="8">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></tr><tr><td>Rated voltage</td><th>Insulation Resistance</th></tr><tr><td>All X6S items, All X7S items</td><td rowspan="8">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>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; TT15>1.0μF</td></tr><tr><td>4V:0603≥22μF; 0805≥47μF; 1206≥100μF</td></tr></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	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≥47μF; TT21>4.7μF	6.3V: 0201≥0.1μF; 0603>4.7μF; 0805≥47μF;1206≥10μF; TT15>1.0μF	4V:0603≥22μF; 0805≥47μF; 1206≥100μF																																																																										
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Multilayer Ceramic Capacitors

Approval Sheet

No.	Item	Test Condition	Requirements																												
6.	Temperature Coefficient	With no electrical load.																													
		<table><tr><th>T.C.</th><th>Operating Temp</th></tr><tr><td>NPO</td><td>-55~125℃ at 25℃</td></tr><tr><td>X7R</td><td>-55~125℃ at 25℃</td></tr><tr><td>X7S</td><td>-55 ~ 125℃ at 25℃</td></tr><tr><td>X5R</td><td>-55~ 85℃ at 25℃</td></tr><tr><td>X6S</td><td>-55~105℃ at 25℃</td></tr><tr><td>Y5V</td><td>-25~ 85℃ at 20℃</td></tr></table>	T.C.	Operating Temp	NPO	-55~125℃ at 25℃	X7R	-55~125℃ at 25℃	X7S	-55 ~ 125℃ at 25℃	X5R	-55~ 85℃ at 25℃	X6S	-55~105℃ at 25℃	Y5V	-25~ 85℃ at 20℃	<table><tr><th>T.C.</th><th>Capacitance Change</th></tr><tr><td>NPO</td><td>Within ±30ppm/℃</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></table>	T.C.	Capacitance Change	NPO	Within ±30ppm/℃	X7R	Within ±15%	X7S	Within ±22%	X5R	Within ±15%	X6S	Within ±22%	Y5V	Within +30%/-80%
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<table><tr><th>01005</th><th>0201</th></tr><tr><td>Cap≤0.01μF: 0.5V</td><td>Cap<0.1μF:1V</td></tr><tr><td>Cap>0.01μF: 0.2V</td><td>0.1μF≤Cap<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<1μF: 1V</td><td>Cap≤1μF: 1V</td></tr><tr><td>Cap=1μF: 0.5V</td><td>1μF<Cap≤4.7μF: 0.5V</td></tr><tr><td>1μF<Cap<10μF: 0.2V</td><td>Cap>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<10μF: 1V</td><td>Cap≤10μF: 1V</td></tr><tr><td>Cap=10μF: 0.5V</td><td>10μF<Cap≤100μF: 0.5V</td></tr><tr><td>Cap>10μF: 0.2V</td><td>Cap>100μF: 0.2V</td></tr></table>		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				
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No.	Item	Test Condition	Requirements
13.	Humidity (Damp Heat) Steady State	*Test temp.: 40±2℃	* No remarkable damage.
		*Humidity: 90~95%RH	* Cap change:
		*Test time: 500+24/-0hrs.	NP0: within ±5% or 0.5pF whichever is larger
		*Before initial measurement (Class II only): To apply de-aging at 150℃ for 1hr then set for 24±2 hrs at room temp.	X7R, X5R, X6S, X7S: ≥10V**, within ±12.5%; ≤6.3V within ±25%; TT series & C≥ 1uF, within ±25%
		* Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150℃ for 1hr then set for 24±2 hrs at room temp.	**10V: 0603≥4.7μF; 0402≥1μF; 0201≥0.1μF, within ±25%; Y5V: ≥10V, within ±30%; ≤6.3V, within +30/-40%
			* Q/D.F. value:
			NP0: More than 30pF Q≥350, 10pF≤C≤30pF, Q≥275+2.5C Less than 10pF Q≥200+10C
			X7R, X5R, X6S, X7S:

Multilayer Ceramic Capacitors

No	Item	Test Condition	Requirements																																																																											
14	Humidity (Damp Heat) Load	*Test temp. : 40±2℃ *Humidity : 90~95%RH *Test time : 500+24/-0 hrs. *To apply voltage : Rated voltage (MAX. 500V) *Before initial measurement (Class II only): To apply de-aging at 150℃ 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℃ for 1hr then set for 24±2 hrs at room temp.	* No remarkable damage. 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 & C≥ 1uF, within ±25% **10V: 0603 ≥ 4.7μF; 0402 ≥ 1μF; 0201 ≥ 0.1μF, within ±25%; Y5V: ≥10V, within ±30%; ≤6.3V, within +30/-40% Q/D.F. value: NP0: C≥30pF, Q≥200; C<30pF, Q≥100+10/3C X7R, X5R, X6S, X7S: <table><tr><th>Rated V</th><th>D.F. ≤</th><th>Exception of D.F. ≤</th></tr><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 ≥ 0.012μF; 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 & (0402/X7R ≥ 0.056μF); TT series</td></tr><tr><td>≤ 20% 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF</td></tr><tr><td rowspan="3">16V</td><td rowspan="3">≤ 5%</td><td>≤ 10% 0402 ≥ 0.47μF</td></tr><tr><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="2">10V</td><td rowspan="2">≤ 7.5%</td><td>≤ 15% 0201 ≥ 0.012μF; 0402 ≥ 0.33μF(0402/X7R ≥ 0.22μF);</td></tr><tr><td>≤ 20% 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; TT series; 01R5</td></tr><tr><td>4V</td><td>≤ 20%</td><td>0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF; TT series</td></tr></table> Y5V: <table><tr><th>Rated vol.</th><th>D.F. ≤</th><th>Exception of D.F. ≤</th></tr><tr><td>≥ 50V</td><td>≤ 7.5%</td><td>≤ 10% 0603 ≥ 0.1μF; 0805 ≥ 0.47μF; 1206 ≥ 4.7μF</td></tr><tr><td rowspan="2">35V</td><td rowspan="2">≤ 10%</td><td>≤ 20% 1210 ≥ 6.8μF</td></tr><tr><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 ≥ 0.08μF; 0603 ≥ 0.68μF</td></tr><tr><td>16V (C<1.0μF)</td><td>≤ 10%</td><td>≤ 12.5% 0402 ≥ 0.22μF</td></tr><tr><td>16V (C≥1.0μF)</td><td>≤ 12.5%</td><td>≤ 20% 0402 ≥ 0.22μF</td></tr><tr><td rowspan="2">10V</td><td rowspan="2">≤ 20%</td><td>≤ 30% 0603 ≥ 2.2μF; 0805 ≥ 3.3μF; 1206 ≥ 10μF; 1210 ≥ 22μF; 1812 ≥ 47μF;</td></tr><tr><td>0402 ≥ 0.47μF</td></tr><tr><td>6.3V</td><td>≤ 30%</td><td>---</td></tr></table> *I.R.: ≥10V, 500MΩ or 25 Ω-F whichever is smaller. Class II (X7R, X5R, X6S, X7S, Y5V) <table><tr><th>Rated voltage</th><th>Insulation Resistance</th></tr><tr><td>100V: All X7R; 1210 ≥ 3.3μF</td><td rowspan="7">500MΩ or RxC ≥ 5 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: 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></tr></table>	Rated V	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 ≥ 0.012μF; 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 & (0402/X7R ≥ 0.056μF); TT series	≤ 20% 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF	16V	≤ 5%	≤ 10% 0402 ≥ 0.47μF	≤ 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);	≤ 20% 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF	6.3V	≤ 15%	≤ 30% 0201 ≥ 0.1μF; 0402 ≥ 1μF; TT series; 01R5	4V	≤ 20%	0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF; TT series	Rated vol.	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16V	≤ 5%	≤ 10% 0402 ≥ 0.47μF																																																																												
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10V	≤ 7.5%	≤ 15% 0201 ≥ 0.012μF; 0402 ≥ 0.33μF(0402/X7R ≥ 0.22μF);																																																																												
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6.3V	≤ 15%	≤ 30% 0201 ≥ 0.1μF; 0402 ≥ 1μF; TT series; 01R5																																																																												
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Rated vol.	D.F. ≤	Exception of D.F. ≤																																																																												
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16V (C<1.0μF)	≤ 10%	≤ 12.5% 0402 ≥ 0.22μF																																																																												
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6.3V ; 4V ; TT series ; All X6S/X7S items; Size ≥ 1812																																																																														

Multilayer Ceramic Capacitors

Approval Sheet

No	Item	Test Condition	Requirements																																																																																																																																																																																			
15.	High Temperature Load (Endurance)	Test temp. : NP0, X7R/X7E/X7S: 125±3°C X6S: 105±3°C X5R, Y5V: 85±3°C Test time: 1000+24/-0 hrs. To apply voltage: (1) ≤ 6.3V or C ≥ 10μF or TT series: 150% of rated voltage. (2) 10V ≤ Ur<500V: 200% of rated voltage. (3) 500V: 150% of rated voltage. (4) Ur ≥ 630V: 120% of rated voltage. (5) 100% of rated voltage for below range. <table><tr><th>Size</th><th>Dielectric</th><th>Rated voltage</th><th>Capacitance range</th></tr><tr><td>0201</td><td>X5R/X7R/X6S</td><td>≤ 10V ≥ 16V</td><td>C ≥ 0.1μF C > 0.1μF</td></tr><tr><td rowspan="3">0402</td><td rowspan="2">X5R</td><td>≤ 16V</td><td>C > 1.0μF</td></tr><tr><td>25V, 50V</td><td>C ≥ 1.0μF</td></tr><tr><td>X6S</td><td>6.3V 10V~25V</td><td>C > 1.0μF C ≥ 1.0μF</td></tr><tr><td></td><td>X7R/X7S/Y5V</td><td>6.3V, 10V</td><td>C ≥ 1.0μF</td></tr><tr><td rowspan="3">0603</td><td rowspan="2">X5R/X7R/X6S/X7S</td><td>4V 6.3V, 10V</td><td>C ≥ 22μF C ≥ 4.7μF</td></tr><tr><td>25V, 35V</td><td>C ≥ 1.0μF</td></tr><tr><td>X5R/X7R/X6S/X7S</td><td>4V 6.3V 10V~50V</td><td>C ≥ 47μF C ≥ 22μF C ≥ 10μF</td></tr><tr><td>1206</td><td>X5R/X7R/X6S NP0</td><td>≤ 6.3V 3000V</td><td>C ≥ 47μF C ≥ 1.5pF</td></tr><tr><td>1210</td><td>X5R/X7R/X6S X7R</td><td>16V 100V</td><td>C ≥ 47μF C ≥ 3.3μF</td></tr><tr><td>TT15</td><td>X5R</td><td>6.3V</td><td>C > 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></td><td>X5R/X7R/X6S</td><td>≤ 10V</td><td>C ≥ 10μF</td></tr><tr><td>TT31</td><td>Y5V</td><td>6.3V</td><td>C ≥ 22μF</td></tr></table> *1WV items must follow de-rating conditions. (6) 150% of rated voltage for below range. <table><tr><th>Size</th><th>Dielectric</th><th>Rated voltage</th><th>Capacitance range</th></tr><tr><td rowspan="2">0201</td><td>X5R/X6S</td><td>16V, 25V</td><td>C=0.1μF</td></tr><tr><td>X7R</td><td>16V</td><td>C ≥ 0.022μF</td></tr><tr><td rowspan="2">0402</td><td>X7R/X5R/X6S</td><td>50V</td><td>C ≥ 0.1μF</td></tr><tr><td>X6S</td><td>10~25V</td><td>C ≥ 0.22μF</td></tr><tr><td rowspan="5">0603</td><td>Y5V</td><td>16V</td><td>C ≥ 0.47μF</td></tr><tr><td>X7S</td><td>50V~100V</td><td>C > 0.22μF</td></tr><tr><td>X7R</td><td>50V</td><td>C > 0.1μF</td></tr><tr><td>X5R</td><td>50V</td><td>C ≥ 1.0μF</td></tr><tr><td>X5R/X7R/X6S/X7S</td><td>10V, 16V, Y5V</td><td>C ≥ 1.0μF C ≥ 2.2μF</td></tr><tr><td rowspan="4">0805</td><td rowspan="3">X5R/X7R/X6S/X7S</td><td>100V</td><td>C ≥ 0.47μF</td></tr><tr><td>50V</td><td>C ≥ 1.0μF</td></tr><tr><td>35V</td><td>C ≥ 2.2μF</td></tr><tr><td>Y5V</td><td>10~25V</td><td>C ≥ 4.7μF</td></tr><tr><td>1206</td><td>X5R/X7R/X6S/X7S</td><td>100V</td><td>C ≥ 4.7μF</td></tr><tr><td>1210</td><td>X5R/X7R/X6S/X7S</td><td>50V</td><td>C ≥ 4.7μF</td></tr><tr><td>1825 2220 2225</td><td>X7R</td><td>100V~250V</td><td>C ≥ 1.0μF</td></tr></table> * 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: * 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 & C ≥ 1μF, within ±25% **10V: 0603 ≥ 4.7μF; 0402 ≥ 1μF; 0201 ≥ 0.1μF, within ±25%; Y5V: ≥10V, within ±30%; ≤ 6.3V, within +30/-40% Q/D.F. value: NP0: More than 30pF, Q ≥ 350 10pF ≤ C < 30pF, Q ≥ 275+2.5C Less than 10pF, Q ≥ 200+10C X7R, X5R, X6S, X7S: <table><tr><th>Rated V.D.F. ≤</th><th>Exception of D.F. ≤</th></tr><tr><td>≥ 100V ≤ 3%</td><td>≤ 6% 1206 ≥ 0.47μF</td></tr><tr><td rowspan="3">50V ≤ 3%</td><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>≤ 6% 0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF</td></tr><tr><td rowspan="3">35V ≤ 5%</td><td>≤ 10% 0201 ≥ 0.01μF; 1210 ≥ 4.7μF</td></tr><tr><td>≤ 20% 0402 ≥ 0.012μF; 0603 > 0.1μF; 0805 ≥ 1μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF; TT series</td></tr><tr><td>≤ 10% 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF</td></tr><tr><td rowspan="3">25V ≤ 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 & (0402/X7R ≥ 0.056μF); TT series</td></tr><tr><td rowspan="3">16V ≤ 5%</td><td>≤ 20% 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF</td></tr><tr><td>≤ 15% 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">10V ≤ 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>≤ 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>6.3V ≤ 15%</td><td>≤ 30% 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 4.7μF; 1210 ≥ 100μF; TT series</td></tr><tr><td>4V ≤ 20%</td><td>---</td></tr></table> Y5V: <table><tr><th>Rated vol.</th><th>D.F. ≤</th><th>Exception of D.F. ≤</th></tr><tr><td>≥ 50V</td><td>≤ 7.5%</td><td>≤ 10% 0603 ≥ 0.1μF; 0805 ≥ 0.47μF; 1206 ≥ 4.7μF</td></tr><tr><td>35V</td><td>≤ 10%</td><td>≤ 20% 1210 ≥ 6.8μF</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 < 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></table> *I.R.: ≥10V, 1GΩ or 50 Ω·F whichever is smaller. Class II (X7R, X5R, X6S, X7S, Y5V) <table><tr><th>Rated voltage</th><th>Insulation Resistance</th></tr><tr><td>100V: All X7R; 1210 ≥ 3.3μF</td><td rowspan="6">1GΩ or RxC ≥ 10 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: 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 ≥ 4.7μF</td></tr><tr><td>10V: 0201 ≥ 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF</td></tr><tr><td>6.3V; 4V; TT series; All X6S/X7S items; Size ≥ 1812</td><td></td></tr></table>	Size	Dielectric	Rated voltage	Capacitance range	0201	X5R/X7R/X6S	≤ 10V ≥ 16V	C ≥ 0.1μF C > 0.1μF	0402	X5R	≤ 16V	C > 1.0μF	25V, 50V	C ≥ 1.0μF	X6S	6.3V 10V~25V	C > 1.0μF C ≥ 1.0μF		X7R/X7S/Y5V	6.3V, 10V	C ≥ 1.0μF	0603	X5R/X7R/X6S/X7S	4V 6.3V, 10V	C ≥ 22μF C ≥ 4.7μF	25V, 35V	C ≥ 1.0μF	X5R/X7R/X6S/X7S	4V 6.3V 10V~50V	C ≥ 47μF C ≥ 22μF C ≥ 10μF	1206	X5R/X7R/X6S NP0	≤ 6.3V 3000V	C ≥ 47μF C ≥ 1.5pF	1210	X5R/X7R/X6S X7R	16V 100V	C ≥ 47μF C ≥ 3.3μF	TT15	X5R	6.3V	C > 1.0μF	TT18	Y5V	6.3V, 10V	C ≥ 2.2μF	TT21	Y5V	6.3V	C ≥ 10μF		X5R/X7R/X6S	≤ 10V	C ≥ 10μF	TT31	Y5V	6.3V	C ≥ 22μF	Size	Dielectric	Rated voltage	Capacitance range	0201	X5R/X6S	16V, 25V	C=0.1μF	X7R	16V	C ≥ 0.022μF	0402	X7R/X5R/X6S	50V	C ≥ 0.1μF	X6S	10~25V	C ≥ 0.22μF	0603	Y5V	16V	C ≥ 0.47μF	X7S	50V~100V	C > 0.22μF	X7R	50V	C > 0.1μF	X5R	50V	C ≥ 1.0μF	X5R/X7R/X6S/X7S	10V, 16V, Y5V	C ≥ 1.0μF C ≥ 2.2μF	0805	X5R/X7R/X6S/X7S	100V	C ≥ 0.47μF	50V	C ≥ 1.0μF	35V	C ≥ 2.2μF	Y5V	10~25V	C ≥ 4.7μF	1206	X5R/X7R/X6S/X7S	100V	C ≥ 4.7μF	1210	X5R/X7R/X6S/X7S	50V	C ≥ 4.7μF	1825 2220 2225	X7R	100V~250V	C ≥ 1.0μF	Rated V.D.F. ≤	Exception of D.F. ≤	≥ 100V ≤ 3%	≤ 6% 1206 ≥ 0.47μF	50V ≤ 3%	≤ 7.5% 0805 > 0.1μF; 0603 ≥ 0.068μF; 1206 > 1μF; 1210 ≥ 2.2μF; TT series	≤ 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 ≥ 0.012μF; 0603 > 0.1μF; 0805 ≥ 1μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF; TT series	≤ 10% 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 & (0402/X7R ≥ 0.056μF); TT series	16V ≤ 5%	≤ 20% 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF	≤ 15% 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	≤ 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 ≥ 4.7μF; 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	35V	≤ 10%	≤ 20% 1210 ≥ 6.8μF	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%	---	Rated voltage	Insulation Resistance	100V: All X7R; 1210 ≥ 3.3μF	1GΩ or RxC ≥ 10 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 ≥ 4.7μF	10V: 0201 ≥ 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF	6.3V; 4V; TT series; All X6S/X7S items; Size ≥ 1812	
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	X5R/X7R/X6S	≤ 10V	C ≥ 10μF																																																																																																																																																																																			
TT31	Y5V	6.3V	C ≥ 22μF																																																																																																																																																																																			
Size	Dielectric	Rated voltage	Capacitance range																																																																																																																																																																																			
0201	X5R/X6S	16V, 25V	C=0.1μF																																																																																																																																																																																			
	X7R	16V	C ≥ 0.022μF																																																																																																																																																																																			
0402	X7R/X5R/X6S	50V	C ≥ 0.1μF																																																																																																																																																																																			
	X6S	10~25V	C ≥ 0.22μF																																																																																																																																																																																			
0603	Y5V	16V	C ≥ 0.47μF																																																																																																																																																																																			
	X7S	50V~100V	C > 0.22μF																																																																																																																																																																																			
	X7R	50V	C > 0.1μF																																																																																																																																																																																			
	X5R	50V	C ≥ 1.0μF																																																																																																																																																																																			
	X5R/X7R/X6S/X7S	10V, 16V, Y5V	C ≥ 1.0μF C ≥ 2.2μF																																																																																																																																																																																			
0805	X5R/X7R/X6S/X7S	100V	C ≥ 0.47μF																																																																																																																																																																																			
		50V	C ≥ 1.0μF																																																																																																																																																																																			
		35V	C ≥ 2.2μF																																																																																																																																																																																			
	Y5V	10~25V	C ≥ 4.7μF																																																																																																																																																																																			
1206	X5R/X7R/X6S/X7S	100V	C ≥ 4.7μF																																																																																																																																																																																			
1210	X5R/X7R/X6S/X7S	50V	C ≥ 4.7μF																																																																																																																																																																																			
1825 2220 2225	X7R	100V~250V	C ≥ 1.0μF																																																																																																																																																																																			
Rated V.D.F. ≤	Exception of D.F. ≤																																																																																																																																																																																					
≥ 100V ≤ 3%	≤ 6% 1206 ≥ 0.47μF																																																																																																																																																																																					
50V ≤ 3%	≤ 7.5% 0805 > 0.1μF; 0603 ≥ 0.068μF; 1206 > 1μF; 1210 ≥ 2.2μF; TT series																																																																																																																																																																																					
	≤ 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 ≥ 0.012μF; 0603 > 0.1μF; 0805 ≥ 1μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF; TT series																																																																																																																																																																																					
	≤ 10% 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 & (0402/X7R ≥ 0.056μF); TT series																																																																																																																																																																																					
16V ≤ 5%	≤ 20% 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF																																																																																																																																																																																					
	≤ 15% 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																																																																																																																																																																																					
	≤ 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 ≥ 4.7μF; 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																																																																																																																																																																																				
35V	≤ 10%	≤ 20% 1210 ≥ 6.8μF																																																																																																																																																																																				
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%	---																																																																																																																																																																																				
Rated voltage	Insulation Resistance																																																																																																																																																																																					
100V: All X7R; 1210 ≥ 3.3μF	1GΩ or RxC ≥ 10 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 ≥ 4.7μF																																																																																																																																																																																						
10V: 0201 ≥ 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF																																																																																																																																																																																						
6.3V; 4V; TT series; All X6S/X7S items; Size ≥ 1812																																																																																																																																																																																						

Multilayer Ceramic Capacitors

APPENDIXES

■ Tape & reel dimensions

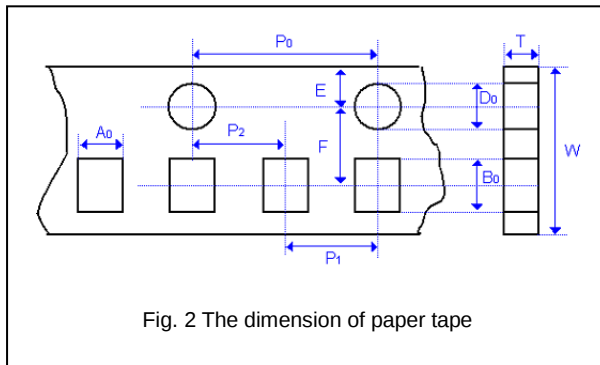


Fig. 2 The dimension of paper tape



Fig. 3 The dimension of plastic tape

Size	0201	0402	0603	0805			1206			1210			1808	1812	
Thickness	L	N,E	S,H,X	A,H	B,T	D,I	B,T	C,J,D	G,P	T	C,D,G,K	M	D,F,G,K	D,F,G,K	M,U
A ₀	0.40 +/-0.10	0.70 +/-0.20	1.05 +/-0.30	1.50 +/-0.20	1.50 +/-0.20	< 1.80	1.90 +/-0.50	< 2.00	< 2.30	< 3.05	< 3.05	< 3.20	< 2.50	< 3.90	< 3.90
B ₀	0.70 +/-0.10	1.20 +/-0.20	1.80 +/-0.30	2.30 +/-0.20	2.30 +/-0.20	< 2.70	3.50 +/-0.50	< 3.70	< 4.00	< 3.80	< 3.80	< 4.00	< 5.30	< 5.30	< 5.30
T	≤ 0.55	≤ 0.80	≤ 1.20	≤ 1.15	≤ 1.20	0.23 +/-0.1	≤ 1.20	0.23 +/-0.1	0.23 +/-0.1	0.23 +/-0.1	0.23 +/-0.1	0.23 +/-0.1	0.25 +/-0.1	0.25 +/-0.1	0.25 +/-0.1
K ₀	-	-	-	-	-	< 2.50	-	< 2.50	< 2.50	< 1.50	< 2.50	< 3.20	< 2.50	< 2.50	< 3.50
W	8.00 +/-0.30	8.00 +/-0.30	8.00 +/-0.30	8.00 +/-0.30	8.00 +/-0.30	8.00 +/-0.30	8.00 +/-0.30	8.00 +/-0.30	8.00 +/-0.30	8.00 +/-0.30	8.00 +/-0.30	8.00 +/-0.30	12.00 +/-0.30	12.00 +/-0.30	12.00 +/-0.30
P ₀	4.00 +/-0.10	4.00 +/-0.10	4.00 +/-0.10	4.00 +/-0.10	4.00 +/-0.10	4.00 +/-0.10	4.00 +/-0.10	4.00 +/-0.10	4.00 +/-0.10	4.00 +/-0.10	4.00 +/-0.10	4.00 +/-0.10	4.00 +/-0.10	4.00 +/-0.10	4.00 +/-0.10
10xP ₀	40.00 +/-0.10	40.00 +/-0.10	40.00 +/-0.20	40.00 +/-0.20	40.00 +/-0.20	40.00 +/-0.20	40.00 +/-0.20	40.00 +/-0.20	40.00 +/-0.20	40.00 +/-0.20	40.00 +/-0.20	40.00 +/-0.20	40.00 +/-0.20	40.00 +/-0.20	40.00 +/-0.20
P ₁	2.00 +/-0.05	2.00 +/-0.05	4.00 +/-0.10	4.00 +/-0.10	4.00 +/-0.10	4.00 +/-0.10	4.00 +/-0.10	4.00 +/-0.10	4.00 +/-0.10	4.00 +/-0.10	4.00 +/-0.10	4.00 +/-0.10	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	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 +/-0.10	2.00 +/-0.10
D ₀	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0
D ₁	-	-	-	-	-	1.00 +/-0.10	-	1.00 +/-0.10	1.00 +/-0.10	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 +/-0.10	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 +/-0.10	1.75 +/-0.10
F	3.50 +/-0.05	3.50 +/-0.05	3.50 +/-0.05	3.50 +/-0.05	3.50 +/-0.05	3.50 +/-0.05	3.50 +/-0.05	3.50 +/-0.05	3.50 +/-0.05	3.50 +/-0.05	3.50 +/-0.05	3.50 +/-0.05	5.50 +/-0.10	5.50 +/-0.10	5.50 +/-0.10

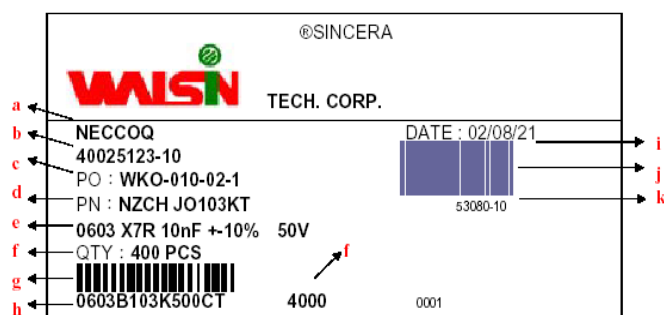


Fig. 4 The dimension of reel

Size	0201, 0402, 0603, 0805, 1206, 1210			1812
Reel size	7"	10"	13"	7"
C	13.0+0.5/-0.2	13.0+0.5/-0.2	13.0+0.5/-0.2	13.0+0.5/-0.2
W ₁	8.4+1.5/-0	8.4+1.5/-0	8.4+1.5/-0	12.4+2.0/-0
A	178.0±1.0	250.0±1.0	330.0±1.0	178.0±1.0
N	60.0+1.0/-0	100.0±1.0	100±1.0	60.0+1.0/-0

Multilayer Ceramic Capacitors

Description of customer label



- a. Customer name
- b. WTC order series and item number
- c. Customer P/O
- d. Customer P/N
- e. Description of product
- f. Quantity
- g. Bar code including quantity & WTC P/N or customer
- h. WTC P/N
- i. Shipping date
- j. Order bar code including series and item numbers
- k. Serial number of label

Constructions

No.	Name	NPO	X7R, X5R, X6S, X7S, Y5V
①	Ceramic material	CaZrO ₃ based	BaTiO ₃ based
②	Inner electrode		Ni
③	Termination	Inner layer	Cu
④		Middle layer	Ni
⑤		Outer layer	Sn

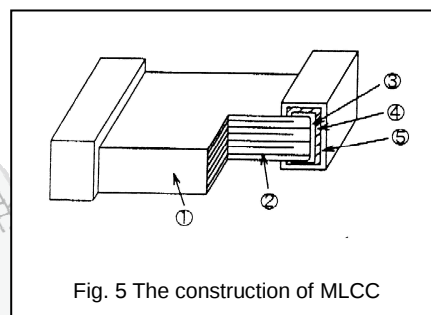


Fig. 5 The construction of MLCC

Storage and handling conditions

- (1) To store products at 5 to 40°C ambient temperature and 20 to 70% related humidity conditions.
- (2) The product is recommended to be used within one year after shipment. Check solderability in case of shelf life extension is needed.

Cautions:

- a. The corrosive gas reacts on the terminal electrodes of capacitors, and results in the poor solderability. Do not store the capacitors in the ambience of corrosive gas (e.g., hydrogen sulfide, sulfur dioxide, chlorine, ammonia gas etc.)
- b. In corrosive atmosphere, solderability might be degraded, and silver migration might occur to cause low reliability.
- c. Due to the dewing by rapid humidity change, or the photochemical change of the terminal electrode by direct sunlight, the solderability and electrical performance may deteriorate. Do not store capacitors under direct sunlight or dewing condition. To store products on the shelf and avoid exposure to moisture.

Recommended soldering conditions

The lead-free termination MLCCs are not only to be used on SMT against lead-free solder paste, but also suitable against lead-containing solder paste. If the optimized solder joint is requested, increasing soldering time, temperature and concentration of N_2 within oven are recommended.

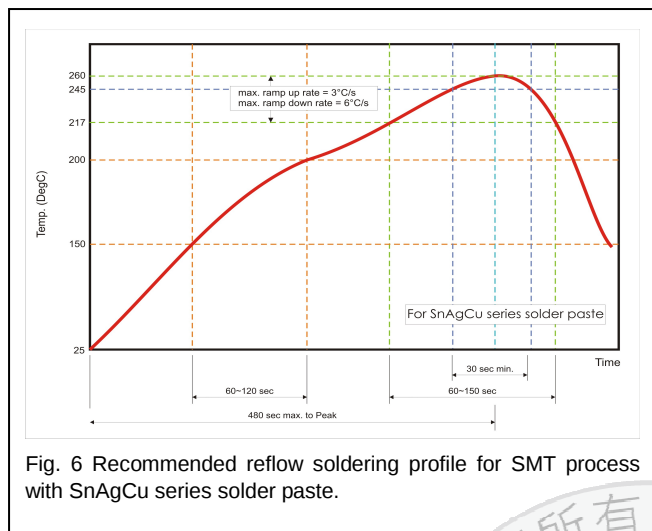


Fig. 6 Recommended reflow soldering profile for SMT process with SnAgCu series solder paste.

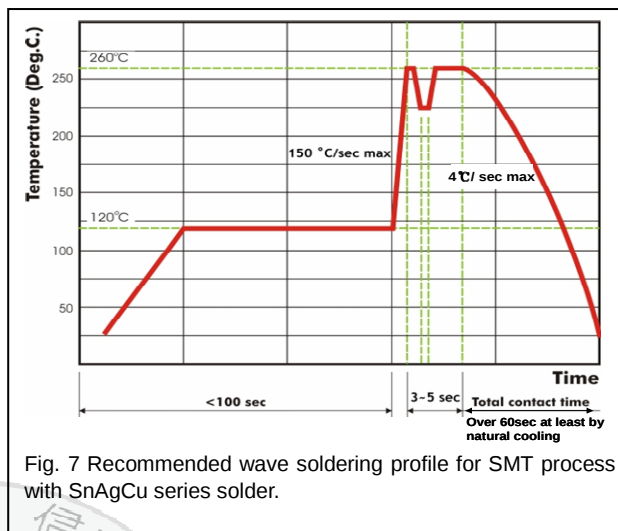


Fig. 7 Recommended wave soldering profile for SMT process with SnAgCu series solder.

