

# APPROVAL SHEET

## MULTILAYER CERAMIC CAPACITORS

General Purpose Series (4V to 100V)

0201 to 1812 Sizes

NP0, X7R, Y5V, X6S & X5R Dielectrics

RoHS Compliance

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

## 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).

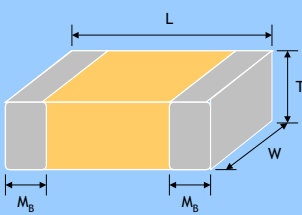
## 3. APPLICATIONS

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

## 5. EXTERNAL DIMENSIONS

Outline	Size Inch (mm)	L (mm)	W (mm)	T (mm)/Symbol	Soldering Method *	M <sub>B</sub> (mm)
 <p>Fig. 1 The outline of MLCC</p>	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 <sup>#2</sup>	0.3±0.05 <sup>#2</sup>	0.3±0.05 <sup>#2</sup>		
		0.6±0.09 <sup>#3</sup>	0.3±0.09 <sup>#3</sup>	0.3±0.09 <sup>#3</sup>		
	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	
	0603 (1608)	1.60±0.15/-0.10	0.80±0.15/-0.10	0.50±0.05	E R	0.40±0.15
				0.80±0.07	S R / W	
				0.80±0.15/-0.10	H R / W	
	0805 (2012)	2.00±0.15	1.25±0.10	0.50±0.10	X R / W	0.50±0.20
				0.60±0.10	A R / W	
				0.80±0.10	B R / W	
		2.00±0.20	1.25±0.20	1.25±0.10	D R	
				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	H R / W	0.60±0.20 (0.5±0.25) <sup>***</sup>
				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	
3.20±0.30/-0.10	1.60±0.30/-0.10	1.60±0.30/-0.10	0.85±0.10	T R / W		
1210 (3225)	3.20±0.30	2.50±0.20	0.95±0.10	P R	0.75±0.25	
			0.85±0.10	C R		
			1.25±0.10	T R		
	3.20±0.40	2.50±0.30	1.60±0.20	D R		
			2.00±0.20	G R		
2.50±0.30	M R					
1808 (4520)	4.50±0.40 (4.5+0.5/-0.3) <sup>**</sup>	2.03±0.25	1.25±0.10	K R	0.75±0.25 (0.5±0.25) <sup>***</sup>	
			1.40±0.15	D R		
			1.60±0.20	F R		
			2.00±0.20	G R		
1812 (4532)	4.50±0.40 (4.5+0.5/-0.3) <sup>**</sup>	3.20±0.30	1.25±0.10	K R	0.75±0.25 (0.5±0.25) <sup>***</sup>	
			1.60±0.20	D R		
			2.00±0.20	G R		
		3.20±0.40	2.50±0.30	M R		
			2.80±0.30	K 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(>10V)/Cap>1μF products.

#2: For 0201/Cap ≥ 0.68μF products.

#3: For 0201/Cap >1μF products.

## 6. GENERAL ELECTRICAL DATA

Dielectric	NP0	X7R	Y5V	X5R	X6S
Size	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
Capacitance tolerance**	Cap≤5pF <sup>#1</sup> : 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%)
Rated voltage (WVDC)	10V, 16V, 25V, 50V, 100V	6.3V, 10V, 16V, 25V, 50V, 100V		4V, 6.3V, 10V, 16V, 25V, 50V	
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
Capacitance characteristic	±30ppm	±15%	+30/-80%	±15%	±22%
Termination	Ni/Sn (lead-free termination)				

#1: NP0, 0.1pF product only provide B 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: Apply 1.0±0.2Vrms, 1.0kHz±10%, at 25°C ambient temperature.

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

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

Note 1:

X7R/X5R/X6S

Rated vol.	D.F. ≤	Exception of D.F. ≤	
≥ 100V	≤ 2.5%	≤ 3%	1206 ≥ 0.47μF
		≤ 5%	0805 > 0.1μF, 0603 ≥ 0.068μF, 1206 > 1μF; TT series
50V	≤ 2.5%	≤ 3%	0201 (50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF
		≤ 5%	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; 1210 ≥ 10μF
25V	≤ 3.5%	≤ 5%	0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF
		≤ 7%	0603 ≥ 0.33μF; 1206 ≥ 4.7μF
		≤ 10%	0402 ≥ 0.10μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF; TT series
		≤ 12.5%	0402 ≥ 1μF
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 ≥ 0.22μF; 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
		≤ 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
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
16V (C < 1.0μF)	7%	9%	0402 ≥ 0.068μF; 0603 ≥ 0.68μF
16V (C ≥ 1.0μF)	9%	12.5%	0402 ≥ 0.22μF
		12.5%	0603 ≥ 2.2μF; 0805 ≥ 3.3μF; 1206 ≥ 10μF; 1210 ≥ 22μF; 1812 ≥ 47μF
10V	12.5%	20%	0402 ≥ 0.47μF
6.3V	20%	---	---

## 7. CAPACITANCE RANGE

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

DIELECTRIC		NP0																	
		0201			0402				0603					0805					
SIZE	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											
	0.4pF (0R4)	L	L	L	N	N	N	N											
	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	S	S	S	S	S	A	A	A	A	A
	0.7pF (0R7)	L	L	L	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	S	S	S	S	S	A	A	A	A	A
	0.9pF (0R9)	L	L	L	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	S	S	S	S	S	A	A	A	A	A
	1.2pF (1R2)	L	L	L	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	S	S	S	S	S	A	A	A	A	A
	1.8pF (1R8)	L	L	L	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	S	S	S	S	S	A	A	A	A	A
	2.2pF (2R2)	L	L	L	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	S	S	S	S	S	A	A	A	A	A
	3.0pF (3R0)	L	L	L	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	S	S	S	S	S	A	A	A	A	A
	3.9pF (3R9)	L	L	L	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	S	S	S	S	S	A	A	A	A	A
	4.7pF (4R7)	L	L	L	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	S	S	S	S	S	A	A	A	A	A
	5.6pF (5R6)	L	L	L	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	S	S	S	S	S	A	A	A	A	A
	6.8pF (6R8)	L	L	L	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	S	S	S	S	S	A	A	A	A	A
	8.0pF (8R0)	L	L	L	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	S	S	S	S	S	A	A	A	A	A
	9.0pF (9R0)	L	L	L	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	S	S	S	S	S	A	A	A	A	A
	12pF (120)	L	L	L	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	S	S	S	S	S	A	A	A	A	A
	18pF (180)	L	L	L	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	S	S	S	S	S	A	A	A	A	A
	27pF (270)	L	L	L	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	S	S	S	S	S	A	A	A	A	A
	39pF (390)	L	L	L	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	S	S	S	S	S	A	A	A	A	A
	56pF (560)	L	L	L	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	S	S	S	S	S	A	A	A	A	A
	82pF (820)	L	L	L	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	S	S	S	S	S	A	A	A	A	A
120pF (121)	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A	
150pF (151)				N	N	N	N	N	S	S	S	S	S	A	A	A	A	A	
180pF (181)				N	N	N	N	N	S	S	S	S	S	A	A	A	A	A	
220pF (221)				N	N	N	N	N	S	S	S	S	S	A	A	A	A	A	
270pF (271)				N	N	N	N	N	S	S	S	S	S	A	A	A	A	A	
330pF (331)				N	N	N	N	N	S	S	S	S	S	A	A	A	A	A	
390pF (391)				N	N	N	N	N	S	S	S	S	S	B	B	B	B	B	
470pF (471)				N	N	N	N	N	S	S	S	S	S	B	B	B	B	B	
560pF (561)				N	N	N	N	N	S	S	S	S	S	B	B	B	B	B	
680pF (681)				N	N	N	N	N	S	S	S	S	S	B	B	B	B	B	
820pF (821)				N	N	N	N	N	S	S	S	S	S	B	B	B	B	B	
1,000pF (102)				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	X	B	B	B	B	B	
2,200pF (222)									X	X	X	X	X	B	B	B	B	B	
2,700pF (272)									X	X	X	X	X	D	D	D	D	D	
3,300pF (332)									X	X	X	X	X	D	D	D	D	D	
3,900pF (392)									X	X	X	X	X	D	D	D	D	D	
4,700pF (472)									X	X	X	X	X	D	D	D	D	D	
5,600pF (562)									X	X	X	X	X	D	D	D	D	D	
6,800pF (682)									X	X	X	X	X	D	D	D	D	D	
8,200pF (822)									X	X	X	X	X	D	D	D	D	D	
0.010uF (103)									X	X	X	X	X	D	D	D	D	D	
0.012uF (123)														T	T	T	T	T	
0.018uF (183)														D	D	D	D	D	
0.022uF (223)														D	D	D	D	D	

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.

7-1. 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	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	
	12pF (120)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	15pF (150)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	18pF (180)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	22pF (220)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	27pF (270)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	33pF (330)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	39pF (390)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	47pF (470)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	56pF (560)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	68pF (680)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	82pF (820)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	100pF (101)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	120pF (121)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	150pF (151)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	180pF (181)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	220pF (221)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	270pF (271)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	330pF (331)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	390pF (391)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	470pF (471)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	560pF (561)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	680pF (681)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	820pF (821)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	1,000pF (102)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	1,200pF (122)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	1,500pF (152)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	1,800pF (182)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	2,200pF (222)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	2,700pF (272)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	3,300pF (332)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	3,900pF (392)	B	B	B	B	B	C	C	C	C	C	D	D	D	
	4,700pF (472)	B	B	B	B	B	C	C	C	C	C	D	D	D	
5,600pF (562)	B	B	B	B	B	C	C	C	C	C	D	D	D		
6,800pF (682)	C	C	C	C	C	C	C	C	C	C	D	D	D		
8,200pF (822)	D	D	D	D	D	C	C	C	C	C	D	D	D		
0.010μF (103)	D	D	D	D	D	C	C	C	C	C	D	D	D		
0.012μF (123)	T	T	T	T	T	D	D	D	D	D	D	D	D		
0.015μF (153)	T	T	T	T	T	D	D	D	D	D	D	D	D		
0.018μF (183)	T	T	T	T	T						D	D	D		
0.022μF (223)	T	T	T	T	T						D	D	D		
0.027μF (273)	T	T	T	T	T						D	D	D		
0.033μF (333)	T	T	T	T	T						D	D	D		
0.039μF (393)	J	J	J	J	J										
0.047μF (473)	J	J	J	J	J										
0.056μF (563)	J	J	J	J	J										
0.068μF (683)	G	G	G	G	G										
0.082μF (823)	G	G	G	G	G										
0.1μF (104)	G	G	G	G	G										

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

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			S	S	S	S	S		B	B	B	B	B
	1,500pF (152)	L	L	L	L			N	N	N	N			S	S	S	S	S		B	B	B	B	B
	1,800pF (182)	L	L	L				N	N	N	N			S	S	S	S	S		B	B	B	B	B
	2,200pF (222)	L	L	L				N	N	N	N			S	S	S	S	S		B	B	B	B	B
	2,700pF (272)	L	L	L				N	N	N	N			S	S	S	S	S		B	B	B	B	B
	3,300pF (332)	L	L	L				N	N	N	N			S	S	S	S	S		B	B	B	B	B
	3,900pF (392)	L	L	L				N	N	N	N			S	S	S	S	S		B	B	B	B	B
	4,700pF (472)	L	L	L				N	N	N	N			S	S	S	S	S		B	B	B	B	B
	5,600pF (562)	L	L					N	N	N	N			S	S	S	S	S		B	B	B	B	B
	6,800pF (682)	L	L					N	N	N	N			S	S	S	S	S		B	B	B	B	B
	8,200pF (822)	L	L					N	N	N	N			S	S	S	S	S		B	B	B	B	B
	0.010μF (103)	L	L	L				N	N	N	N			S	S	S	S	S		B	B	B	B	B
	0.012μF (123)							N	N	N				S	S	S	S	X		B	B	B	B	B
	0.015μF (153)							N	N	N				S	S	S	S	X		B	B	B	B	B
	0.018μF (183)							N	N	N				S	S	S	S	X		B	B	B	B	B
	0.022μF (223)							N	N	N	N			S	S	S	S	X		B	B	B	B	B
	0.027μF (273)							N	N	N				S	S	S	S	X		B	B	B	B	D
	0.033μF (333)							N	N	N	N			S	S	S	X	X		B	B	B	B	D
	0.039μF (393)							N	N	N				S	S	S	X	X		B	B	B	B	D
0.047μF (473)							N	N	N	N			S	S	S	X	X		B	B	B	B	D	
0.056μF (563)							N	N					S	S	S	X	X		B	B	B	B	D	
0.068μF (683)							N	N		N			S	S	S	X	X		B	B	B	B	D	
0.082μF (823)							N	N					S	S	S	X	X		B	B	B	B	D	
0.10μF (104)						N	N	N	N	N			S	S	S	X	X		B	B	B	B	D	
0.12μF (124)													S	S	X				B	B	B	D		
0.15μF (154)													S	S	X				D	D	D	D		
0.18μF (184)													S	S	X				D	D	D	D		
0.22μF (224)						N	N	N	N				S	S	X	X			D	D	D	D	T	
0.27μF (274)												X	X	X	X				D	D	D	I		
0.33μF (334)												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						I	I	I	I		
3.3μF (335)																			I	I	I	I		
4.7μF (475)																			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.

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

DIELECTRIC		X7R																
SIZE		1206					1210					1812						
RATED VOLTAGE (VDC)		6.3	10	16	25	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	D	D	D	D	D	D
	0.18μF (184)		C	C	C	C	G		C	C	C	C	D	D	D	D	D	D
0.22μF (224)		C	C	C	C	G		C	C	C	C	D	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	P				K	G								
4.7μF (475)	P	P	P	P	P				K	K	K	M						
6.8μF (685)																		
10μF (106)	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.



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

DIELECTRIC		Y5V															
SIZE		0402					0603					0805					
RATED VOLTAGE (VDC)		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	N					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	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			D	D	D	D	
10μF (106)		J	J	P				D	D	G			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	6.3	10	16	25	50	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												
	2,200pF (222)		L	L												
	2,700pF (272)		L	L												
	3,300pF (332)		L	L												
	4,700pF (472)		L	L												
	6,800pF (682)		L													
	0.010μF (103)	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							
	0.056μF (563)	L	L						N	N						
	0.068μF (683)	L	L						N	N						
	0.082μF (823)	L	L				N	N	N							
	0.10μF (104)	L	L	L	L		N	N	N	N	N					
	0.15μF (154)						N	N	N	N						
	0.22μF (224)	L	L				N	N	N	N	N			X	X	
	0.27μF (274)												X	X	X	X
0.33μF (334)						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	X	
0.68μF (684)						N	N				X	X	X	X		
0.82μF (824)											X	X	X			
1.0μF (105)	L	L*				N	N	N	N		X	X	X	X	X	
1.5μF (155)											X					
2.2μF (225)	L*					N	N	E*	E		X	X	X	X	X	
3.3μF (335)											X	X				
4.7μF (475)						E*	E*				X	X	X	X		
6.8μF (685)																
10μF (106)						E*	E*				X	X	X	X*		
22μF (226)											X*	X*				

Dielectric		X5R																
Size		0805					1206					1210						
Rated Voltage (VDC)		4	6.3	10	16	25	50	6.3	10	16	25	50	4	6.3	10	16	25	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	P			K	K	K	
	6.8μF (685)							P	P									
	10μF (106)		I	I	I	I	I	P	P	P	P	P		K	K	K	K	M
	22μF (226)		I*	I*	I*			P	P	P	P			M	M	M	M	
	47μF (476)		I*	I*				P	P					M	M	M		
	100μF (107)	I*						P*						M*	M*			
220μF (227)												M*						

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

**7-5. X6S Dielectric 0201, 0402, 0603, 0805, 1206, 1210 Sizes**

Dielectric		X6S																											
Size		0201				0402				0603					0805					1206					1210				
Rated Voltage (VDC)		4	6.3	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																										
	0.15μF (154)																												
	0.22μF (224)		L																										
	0.33μF (334)																												
	0.47μF (474)			N																									
	0.68μF (684)																												
	1.0μF (105)	L*		N	E	E	E																						
	1.5μF (155)																												
	2.2μF (225)			N	E	E					X																		
	3.3μF (335)																												
	4.7μF (475)								X		X	X							I	I									
	6.8μF (685)																												
	10μF (106)								X*	X*	X*			I	I	I	I	I				G							
	22μF (226)							X*	X*					I*	I*	I*				P	P	P*					M		
47μF (476)													I*						P						M	M	M		
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
1210 (3225)	1.60+0.30/-0.10	P	-	-	2,000	9,000
	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
1808 (4520)	2.50±0.30	M	-	-	1,000	6,000
	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)	* Shall not exceed the limits given in the detailed spec.	
3.	Q/ D.F. (Dissipation Factor)	$\leq 1000\text{pF}, 1.0\pm 0.2\text{Vrms} \cdot 1\text{MHz}\pm 10\%$ $> 1000\text{pF}, 1.0\pm 0.2\text{Vrms} \cdot 1\text{KHz}\pm 10\%$ Class II: (X7R, X7E, X6S, X5R, Y5V) $C \leq 10\mu\text{F}, 1.0\pm 0.2\text{Vrms} \cdot 1\text{KHz}\pm 10\%$ ** $C > 10\mu\text{F}, 0.5\pm 0.2\text{Vrms} \cdot 120\text{Hz}\pm 20\%$	NP0: Cap $\geq 30\text{pF}$ , Q $\geq 1000$ ; Cap $< 30\text{pF}$ , Q $\geq 400+20\text{C}$ X7R, X5R, X6S:	
		** Test condition: $0.5\pm 0.2\text{Vrms} \cdot 1\text{KHz}\pm 10\%$ X7R: 0805=106(6.3V&10V) X5R: 01R5 $\geq 103$ , 0201 $\geq 224$ (6.3V, 10V), 0402 $\geq 475$ (6.3V), 0402 $\geq 225$ (10V), 0603=106 (6.3V, 10V), TT18X $\geq 475$ (10V) , TT15X series X6S: 0201 $\geq 104$ (6.3V), 0402 $\geq 225$ (6.3V), 0603 $\geq 106$ (6.3V),	X7R, X5R, X6S:	
		Rated vol.	D.F. $\leq$	Exception of D.F. $\leq$
		$\geq 100\text{V}$	$\leq 2.5\%$	$\leq 3\%$ 1206 $\geq 0.47\mu\text{F}$ $\leq 5\%$ 0805 $> 0.1\mu\text{F}$ , 0603 $\geq 0.068\mu\text{F}$ , 1206 $> 1\mu\text{F}$ ; TT series
		50V	$\leq 2.5\%$	$\leq 3\%$ 0201(50V); 0603 $\geq 0.047\mu\text{F}$ ; 0805 $\geq 0.18\mu\text{F}$ ; 1206 $\geq 0.47\mu\text{F}$ $\leq 5\%$ 1210 $\geq 4.7\mu\text{F}$
				$\leq 10\%$ 0402 $\geq 0.1\mu\text{F}$ ; 0603 $> 0.1\mu\text{F}$ ; 0805 $\geq 1\mu\text{F}$ ; 1206 $\geq 2.2\mu\text{F}$ ; 1210 $\geq 10\mu\text{F}$ ; TT series
		35V	$\leq 3.5\%$	$\leq 10\%$ 0603 $\geq 1\mu\text{F}$ ; 0805 $\geq 2.2\mu\text{F}$ ; 1210 $\geq 10\mu\text{F}$ $\leq 5\%$ 0201 $\geq 0.01\mu\text{F}$ ; 0805 $\geq 1\mu\text{F}$ ; 1210 $\geq 10\mu\text{F}$
		25V	$\leq 3.5\%$	$\leq 7\%$ 0603 $\geq 0.33\mu\text{F}$ ; 1206 $\geq 4.7\mu\text{F}$
				$\leq 10\%$ 0402 $\geq 0.10\mu\text{F}$ ; 0603 $\geq 0.47\mu\text{F}$ ; 0805 $\geq 2.2\mu\text{F}$ ; 1206 $\geq 6.8\mu\text{F}$ ; 1210 $\geq 22\mu\text{F}$ ; TT series
		16V	$\leq 3.5\%$	$\leq 5\%$ 0402 $\geq 1\mu\text{F}$
				$\leq 12.5\%$ 0402 $\geq 1\mu\text{F}$
		10V	$\leq 5\%$	$\leq 5\%$ 0201 $\geq 0.01\mu\text{F}$ ; 0402 $\geq 0.033\mu\text{F}$ ; 0603 $\geq 0.15\mu\text{F}$ ; 0805 $\geq 0.68\mu\text{F}$ ; 1206 $\geq 2.2\mu\text{F}$ ; 1210 $\geq 4.7\mu\text{F}$
				$\leq 10\%$ 0201 $\geq 0.1\mu\text{F}$ ; 0402 $\geq 0.22\mu\text{F}$ ; 0603 $\geq 0.68\mu\text{F}$ ; 0805 $\geq 2.2\mu\text{F}$ ; 1206 $\geq 4.7\mu\text{F}$ ; 1210 $\geq 22\mu\text{F}$ ; TT series
		6.3V	$\leq 10\%$	$\leq 10\%$ 0201 $\geq 0.012\mu\text{F}$ ; 0402 $\geq 0.33\mu\text{F}$ (0402/X7R $\geq 0.22\mu\text{F}$ ); TT series 0603 $\geq 0.33\mu\text{F}$ ; 0805 $\geq 2.2\mu\text{F}$ ; 1206 $\geq 2.2\mu\text{F}$ ; 1210 $\geq 22\mu\text{F}$
				$\leq 15\%$ 0201 $\geq 0.1\mu\text{F}$ ; 0402 $\geq 1\mu\text{F}$ ; 0603 $\geq 10\mu\text{F}$ ; 0805 $\geq 4.7\mu\text{F}$ ; 1206 $\geq 47\mu\text{F}$ ; 1210 $\geq 100\mu\text{F}$ ; TT series
		4V	$\leq 15\%$	$\leq 20\%$ 0402 $\geq 2.2\mu\text{F}$
		Y5V:		
		Rated vol.	D.F. $\leq$	Exception of D.F. $\leq$
		$\geq 50\text{V}$	5%	$7\%$ 0603 $\geq 0.1\mu\text{F}$ ; 0805 $\geq 0.47\mu\text{F}$ ; 1206 $\geq 4.7\mu\text{F}$
		35V	7%	---
		25V	5%	$7\%$ 0402 $\geq 0.047\mu\text{F}$ ; 0603 $\geq 0.1\mu\text{F}$ ; 0805 $\geq 0.33\mu\text{F}$ ; 1206 $\geq 1\mu\text{F}$ ; 1210 $\geq 4.7\mu\text{F}$
				$9\%$ 0402 $\geq 0.068\mu\text{F}$ ; 0603 $\geq 0.47\mu\text{F}$ ; 1206 $\geq 4.7\mu\text{F}$ ; 1210 $\geq 22\mu\text{F}$
		16V (C $< 1.0\mu\text{F}$ )	7%	$9\%$ 0402 $\geq 0.068\mu\text{F}$ ; 0603 $\geq 0.68\mu\text{F}$ $12.5\%$ 0402 $\geq 0.22\mu\text{F}$
16V (C $\geq 1.0\mu\text{F}$ )	9%	$12.5\%$ 0603 $\geq 2.2\mu\text{F}$ ; 0805 $\geq 3.3\mu\text{F}$ ; 1206 $\geq 10\mu\text{F}$ ; 1210 $\geq 22\mu\text{F}$ ; 1812 $\geq 47\mu\text{F}$		
10V	12.5%	$20\%$ 0402 $\geq 0.47\mu\text{F}$		
6.3V	20%	---		
4.	Dielectric Strength	* To apply voltage ( $\leq 100\text{V}$ ) 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. 120 sec.	10G $\Omega$ or Rx C $\geq 500\Omega\cdot\text{F}$ whichever is smaller. Class II (X7R, X5R, X6S, Y5V)	
		Rated voltage	Insulation Resistance	
		100V: X7R	10G $\Omega$ or Rx C $\geq 100\Omega\cdot\text{F}$ whichever is smaller.	
		50V: 0603 $\geq 1\mu\text{F}$ ; 0805 $\geq 1\mu\text{F}$ ; 1206 $\geq 4.7\mu\text{F}$ ; 1210 $\geq 4.7\mu\text{F}$		
		35V: 0805 $\geq 2.2\mu\text{F}$ ; 1210 $\geq 10\mu\text{F}$		
		25V: 0402 $\geq 1\mu\text{F}$ ; 0603 $\geq 2.2\mu\text{F}$ ; 0805 $\geq 2.2\mu\text{F}$ ; 1206 $\geq 10\mu\text{F}$ ; 1210 $\geq 10\mu\text{F}$		
		16V: 0402 $\geq 0.22\mu\text{F}$ ; 0603 $\geq 1\mu\text{F}$ ; 0805 $\geq 2.2\mu\text{F}$ ; 1206 $\geq 10\mu\text{F}$ ; 1210 $\geq 47\mu\text{F}$		
		10V: 0201 $\geq 47\text{nF}$ ; 0402 $\geq 0.47\mu\text{F}$ ; 0603 $\geq 0.47\mu\text{F}$ ; 0805 $\geq 2.2\mu\text{F}$ ; 1206 $\geq 4.7\mu\text{F}$ ; 1210 $\geq 47\mu\text{F}$		
		6.3V ; 4V	Rx C $\geq 50\Omega\cdot\text{F}$ .	
		Rated voltage		Insulation Resistance
		All X6S items		
		50V: 0402 $\geq 0.1\mu\text{F}$ ; 0603 $\geq 2.2\mu\text{F}$ ; 0805 $\geq 10\mu\text{F}$ ; 1206 $\geq 10\mu\text{F}$		
		35V: 0603 $\geq 1\mu\text{F}$ ;		
		25V: 0201 $\geq 0.1\mu\text{F}$ ; 0402 $\geq 0.22\mu\text{F}$ ; 0603 $\geq 10\mu\text{F}$ ; 1206 $\geq 22\mu\text{F}$		
16V: 0603 $\geq 10\mu\text{F}$				
10V: 0201 $> 0.1\mu\text{F}$ ; 0603 $\geq 10\mu\text{F}$ ; 0805 $\geq 47\mu\text{F}$				
6.3V: 0201 $\geq 0.1\mu\text{F}$ ; 1206 $\geq 10\mu\text{F}$				
4V: 0603 $\geq 22\mu\text{F}$ ; 0805 $\geq 47\mu\text{F}$				

No.	Item	Test Condition	Requirements																								
6.	Temperature Coefficient	With no electrical load. <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>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>	T.C.	Operating Temp	NPO	-55~125°C at 25°C	X7R	-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	<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>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%	X5R	Within ±15%	X6S	Within ±22%	Y5V	Within +30%/-80%
T.C.	Operating Temp																										
NPO	-55~125°C at 25°C																										
X7R	-55~125°C at 25°C																										
X5R	-55~ 85°C at 25°C																										
X6S	-55~105°C at 25°C																										
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Y5V	Within +30%/-80%																										
7.	Adhesive Strength of Termination	* Pressurizing force : 1N (0201) and 5N (≤0603) and 10N (>0603) * Test time: 10±1 sec.	* No remarkable damage or removal of the terminations.																								
8.	Vibration Resistance	* Vibration frequency: 10~55 Hz/min. * Total amplitude: 1.5mm * Test time: 6 hrs. (Two hrs each in three mutually perpendicular directions.) * Measurement to be made after keeping at room temp. for 24±2 hrs.	* No remarkable damage. * Cap change and Q/D.F.: To meet initial spec.																								
9.	Solderability	* Solder temperature: 235±5°C * Dipping time: 2±0.5 sec.	95% min. coverage of all metalized area.																								
10.	Bending Test	* The middle part of substrate shall be pressurized by means of the pressurizing rod at a rate of about 1 mm per second until the deflection becomes 1 mm and then the pressure shall be maintained for 5±1 sec. * Measurement to be made after keeping at room temp. for 24±2 hrs.	* No remarkable damage. * Cap change : NPO: within ±5% or 0.5pF whichever is larger X7R, X5R, X6S: within ±12.5% Y5V: within ±30% (This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test.)																								
11.	Resistance to Soldering Heat	* Solder temperature: 260±5°C * Dipping time: 10±1 sec * Preheating: 120 to 150°C for 1 minute before immerse the capacitor in a eutectic solder. * Before initial measurement (Class II only): Perform 150+0/-10°C for 1 hr and then set for 24±2 hrs at room temp. * Measurement to be made after keeping at room temp. for 24±2 hrs.	* No remarkable damage. * Cap change: NPO: within ±2.5% or 0.25pF whichever is larger X7R, X5R, X6S: within ±7.5% Y5V: within ±20% * Q/D.F., I.R. and dielectric strength: To meet initial requirements. * 25% max. leaching on each edge.																								
12.	Temperature Cycle	* Conduct the five cycles according to the temperatures and time. <table border="1"> <thead> <tr> <th>Step</th> <th>Temp. (°C)</th> <th>Time (min.)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Min. operating temp. +0/-3</td> <td>30±3</td> </tr> <tr> <td>2</td> <td>Room temp.</td> <td>2~3</td> </tr> <tr> <td>3</td> <td>Max. operating temp. +3/-0</td> <td>30±3</td> </tr> <tr> <td>4</td> <td>Room temp.</td> <td>2~3</td> </tr> </tbody> </table> * Before initial measurement (Class II only): Perform 150+0/-10°C for 1 hr and then set for 24±2 hrs at room temp. * Measurement to be made after keeping at room temp. for 24±2 hrs.	Step	Temp. (°C)	Time (min.)	1	Min. operating temp. +0/-3	30±3	2	Room temp.	2~3	3	Max. operating temp. +3/-0	30±3	4	Room temp.	2~3	* No remarkable damage. * Cap change : NPO: within ±2.5% or 0.25pF whichever is larger X7R, X5R, X6S: within ±7.5% Y5V: within ±20% * Q/D.F., I.R. and dielectric strength: To meet initial requirements.									
Step	Temp. (°C)	Time (min.)																									
1	Min. operating temp. +0/-3	30±3																									
2	Room temp.	2~3																									
3	Max. operating temp. +3/-0	30±3																									
4	Room temp.	2~3																									

No.	Item	Test Condition	Requirements																																			
13.	Humidity (Damp Heat) Steady State	* Test temp.: 40±2°C * Humidity: 90~95% RH * Test time: 500+24/-0hrs. *Before initial measurement (Class II only): Perform 150+0/-10°C for 1 hr and then set for 24±2 hrs at room temp. * Measurement to be made after keeping at room temp. for 24±2 hrs.	* No remarkable damage. * Cap change: NP0: within ±5% or 0.5pF whichever is larger X7R, X5R, X6S: ≥10V**, within ±12.5%; ≤6.3V within ±25%; TT series & C ≥ 1uF, within ±25% **10V: 0603 ≥ 4.7μF; 0402 ≥ 1μF; 0201 ≥ 0.1μF, within ±25%; Y5V: ≥10V, within ±30%; ≤6.3V, within +30/-40% * Q/D.F. value: NP0: More than 30pF Q ≥ 350, 10pF ≤ C ≤ 30pF, Q ≥ 275 + 2.5C Less than 10pF Q ≥ 200 + 10C X7R, X5R, X6S:																																			
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15.	High Temperature Load (Endurance)	Test temp. : NP0, X7R/X7E: 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.	* No remarkable damage. Cap change: NP0: ±3.0% or ±0.3pF whichever is larger X7R, X5R, X6S: ≥ 10V**, within ±12.5%; ≤ 6.3V within ±25%; TT series & C ≥ 1uF, within ±25% **10V: 0603 ≥ 4.7μF; 0402 ≥ 1μF; 0201 ≥ 0.1μF, within ±25%; Y5V: ≥ 10V, within ±30%; ≤ 6.3V, within +30/-40% Q/D.F. value: NP0: More than 30pF, Q ≥ 350 10pF ≤ C < 30pF, Q ≥ 275+2.5C Less than 10pF, Q ≥ 200+10C X7R, X5R, X6S:																																																																																																										
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## APPENDIXES

### ■ Tape & reel dimensions

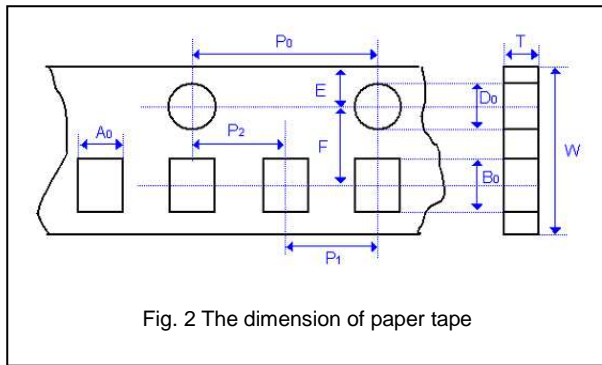


Fig. 2 The dimension of paper tape

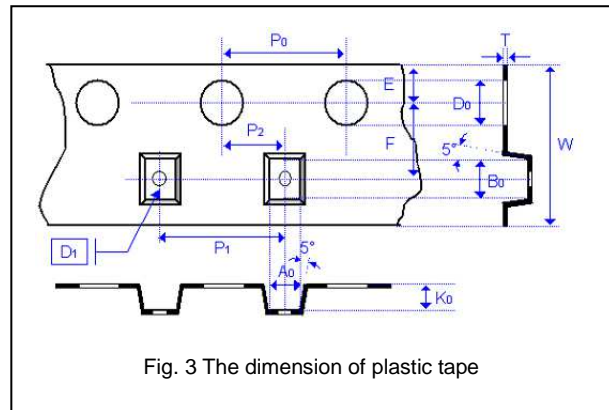


Fig. 3 The dimension of plastic tape

Size	0201			0402			0603			0805			1206			1210			1812		
Thickness	L	N	E	S, X	A, H	B, T	C, D, I	B, T	C, J, D	G, P	C, D	F, G, K	M	D, F, G, K	M	U					
$A_0$	0.38±0.05	0.62±0.05	0.70±0.10	1.02±0.05	1.50±0.10	1.50±0.10	<1.57	2.00±0.10	<1.85	<1.95	<2.97	<2.97	<2.97	<3.81	<3.81	<3.90					
$B_0$	0.68±0.05	1.12±0.05	1.20±0.10	1.80±0.05	2.30±0.10	2.30±0.10	<2.40	3.50±0.10	<3.46	<3.67	<3.73	<3.73	<3.73	<5.30	<5.30	<5.30					
$T$	0.42±0.05	0.60±0.05	0.70±0.10	0.95±0.05	0.75±0.05	0.95±0.05	0.23±0.05	0.95±0.05	0.23±0.05	0.23±0.05	0.23±0.05	0.23±0.05	0.23±0.05	0.25±0.05	0.25±0.05	0.25±0.05					
$K_0$	-	-	-	-	-	-	<2.50	-	<2.50	<2.50	<2.50	<2.50	<3.00	<2.50	<3.00	<3.50					
$W$	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	12.0±0.20	12.0±0.20	12.0±0.20					
$P_0$	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10					
$10 \times P_0$	40.0±0.10	40.0±0.10	40.0±0.10	40.0±0.10	40.0±0.10	40.0±0.10	40.0±0.10	40.0±0.10	40.0±0.10	40.0±0.10	40.0±0.10	40.0±0.10	40.0±0.10	40.0±0.10	40.0±0.10	40.0±0.20					
$P_1$	2.00±0.05	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	8.00±0.10	8.00±0.10	8.00±0.10					
$P_2$	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05					
$D_0$	1.55±0.05	1.55±0.05	1.55±0.05	1.55±0.05	1.55±0.05	1.55±0.05	1.50±0.05	1.50±0.05	1.50±0.05	1.50±0.05	1.50±0.05	1.50±0.05	1.50±0.05	1.50±0.05	1.50±0.05	1.50±0.10					
$D_1$	-	-	-	-	-	-	1.00±0.10	-	1.00±0.10	1.00±0.10	1.00±0.10	1.00±0.10	1.00±0.10	1.50±0.10	1.50±0.10	1.50±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±0.05	1.75±0.10	1.75±0.10	1.75±0.10	1.75±0.10	1.75±0.10	1.75±0.10	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	3.50±0.05	5.50±0.05	5.50±0.05	5.50±0.05					

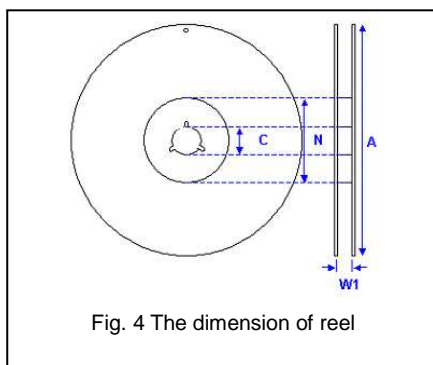


Fig. 4 The dimension of reel

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±0.10	250.0±1.0	330.0±1.0	178.0±0.10
$N$	60.0+1.0/-0	100.0±1.0	100±1.0	60.0+1.0/-0

■ 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<sub>2</sub> within oven are recommended.

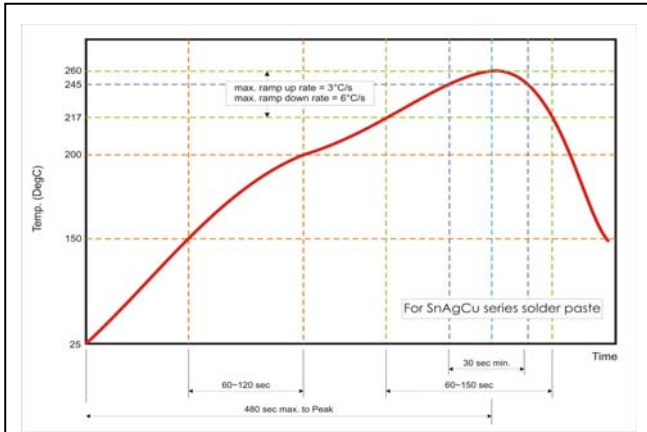


Fig. 6 Recommended reflow soldering profile for SMT process with SnAgCu series solder paste.

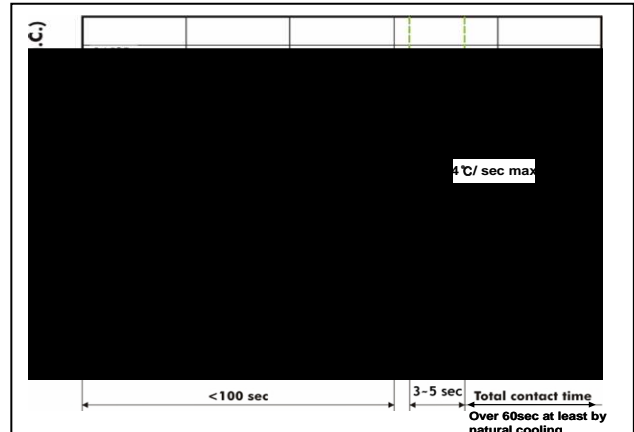


Fig. 7 Recommended wave soldering profile for SMT process with SnAgCu series solder.