

APPROVAL SHEET

MULTILAYER CERAMIC CAPACITORS

General Purpose Series (4V to 100V)

0201 to 1812 Sizes

NP0, X7R, X6S, X7S & X5R Dielectrics

Halogen Free & RoHS Compliance

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

Multilayer Ceramic Capacitors

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 and X5R 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

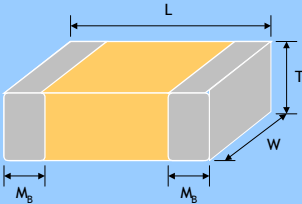
- For general digital circuit.
- For power supply bypass capacitors.
- For consumer electronics.
- For telecommunication.

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

Multilayer Ceramic Capacitors

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	
				0.50±0.02/-0.05	Q	R	+0.05/-0.10	
		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		
				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		
		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	B	R / W	0.60±0.20 (0.5±0.25) ^{***}	
		3.20±0.20		0.95±0.10	C	R		
				1.25±0.10	D	R		
		3.20+0.30/-0.1 3.30+0.30/-0.1 ^{#5}	1.60±0.20	1.15±0.15	J	R		
				1.60±0.20	G	R		
				0.85±0.10	T	R / W		
	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		
				2.50±0.30	M	R		
	1808 (4520)	4.50±0.40 (4.5+0.5/-0.3) ^{**}	2.03±0.25	2.50±0.50 ^{#4}	M	R	0.75±0.25 (0.5±0.25) ^{***}	
				1.25±0.10				
				1.40±0.15				
				1.60±0.20				
	1812 (4532)	4.50±0.40 (4.5+0.5/-0.3) ^{**}	3.20±0.30	2.00±0.20	K	R	0.75±0.25 (0.5±0.25) ^{***}	
				2.50±0.30				
			3.20±0.40	1.25±0.10	D	R		
				1.60±0.20				

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

** For 1808/1812/1825_200V~4000V and safety certificated products.

*** For 1206_≥1000V, 1808/1812_200V~4000V and safety certificated products.

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

Excluding 0603X225(16V&25V), 0603S225(6.3V&16V), 0603X475(6.3V&16V), 0603S475(4V&6.3V).

#2: For 0201/ 0.1uF < Cap < 0.68uF products, Excluding 0201X334~474(≤ 6.3V) & 0201X224(≤ 10V).

#3: For 0201/Cap ≥ 0.68μF products, Excluding 0201X105*6R3=>(L:0.6±0.05,W:0.3±0.05,T:0.3±0.05).

#4: For 1210(200V&250V)/Cap > 0.47μF products.

#5: For 1206(100V)/Cap ≥ 1.2μF products.

6. GENERAL ELECTRICAL DATA

Dielectric	NP0	X7R	X5R	X6S	X7S
Size	0201, 0402, 0603, 0805, 1206, 1210, 1812				
Capacitance range*	0.1pF to 0.1μF	100pF to 47μF	100pF to 220μF	0.1μF to 100μF	0.1μF 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%)	K(±10%), M(±20%)	K(±10%), M(±20%)	K(±10%), M(±20%)
Rated voltage (WVDC)	10V, 16V, 25V, 50V, 100V	4V, 6.3V, 10V, 16V, 25V, 50V, 100V			
Operating temperature	-55 to +125℃		-55 to +85℃	-55 to +105℃	-55 to +125℃
Capacitance characteristic	±30ppm	±15%	±15%	±22%	±22%
Termination	Ni/Sn (lead-free termination)				

#1: NP0, 0.1pF product only provide B tolerance; 0603N0R3/0R4 provide B&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℃ at ambient temperature

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

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



7. CAPACITANCE RANGE

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

DIELECTRIC		NP0																			
SIZE		0201					0402					0603					0805				
RATED VOLTAGE (VDC)		10	16	25	50	100	10	16	25	50	100	10	16	25	50	100	10	16	25	50	100
Capacitance	0.1pF (0R1)	L	L	L	L	L	N	N	N	N											
	0.2pF (0R2)	L	L	L	L	L	N	N	N	N											
	0.3pF (0R3)	L	L	L	L	L	N	N	N	N		S	S	S	S						
	0.4pF (0R4)	L	L	L	L	L	N	N	N	N		S	S	S	S						
	0.5pF (0R5)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	0.6pF (0R6)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	0.7pF (0R7)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	0.8pF (0R8)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	0.9pF (0R9)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	1.0pF (1R0)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	1.2pF (1R2)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	1.5pF (1R5)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	1.8pF (1R8)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	2.0pF (2R0)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	2.2pF (2R2)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	2.7pF (2R7)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	3.0pF (3R0)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	3.3pF (3R3)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	3.9pF (3R9)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	4.0pF (4R0)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	4.7pF (4R7)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	5.0pF (5R0)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	5.6pF (5R6)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	6.0pF (6R0)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	6.8pF (6R8)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	7.0pF (7R0)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	8.0pF (8R0)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	8.2pF (8R2)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	9.0pF (9R0)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	10pF (100)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	12pF (120)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	15pF (150)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	18pF (180)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	22pF (220)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	27pF (270)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	33pF (330)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	39pF (390)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	47pF (470)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	56pF (560)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	68pF (680)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	82pF (820)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	100pF (101)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	120pF (121)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	150pF (151)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	180pF (181)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	220pF (221)	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	A	A	A	A	A
	270pF (271)	L	L	L			N	N	N	N		S	S	S	S	S	A	A	A	A	A
	330pF (331)	L	L	L			N	N	N	N		S	S	S	S	S	A	A	A	A	A
	390pF (391)	L	L	L			N	N	N	N		S	S	S	S	S	B	B	B	B	B
	470pF (471)	L	L	L			N	N	N	N		S	S	S	S	S	B	B	B	B	B
	560pF (561)	L	L	L			N	N	N	N		S	S	S	S	S	B	B	B	B	B
	680pF (681)	L	L	L			N	N	N	N		S	S	S	S	S	B	B	B	B	B
	820pF (821)						N	N	N	N		S	S	S	S	S	B	B	B	B	B
	1,000pF (102)						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)																D	D	D	D	D
	0.015uF (153)																D	D	D	D	D
	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. 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)	P	P	P	P		K	K	K	K	K	M	M	M	M
	0.056μF (563)	P	P	P	P							M	M	M	M
	0.068μF (683)	P	P	P	P							M	M	M	M
	0.082μF (823)	P	P	P	P							M	M	M	M
	0.1μF (104)	P	P	P	P							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.

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	35	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	N		S	S	S	S	S		B	B	B		B	B	
	1,200pF (122)	L	L	L	L		N	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	N		S	S	S	S	S		B	B	B		B	B	
	1,800pF (182)	L	L	L	L		N	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	N		S	S	S	S	S		B	B	B		B	B	
	2,700pF (272)	L	L	L	L		N	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	N		S	S	S	S	S		B	B	B		B	B	
	3,900pF (392)	L	L	L	L		N	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	N		S	S	S	S	S		B	B	B		B	B	
	5,600pF (562)	L	L	L	L		N	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	N		S	S	S	S	S		B	B	B		B	B	
	8,200pF (822)	L	L	L			N	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	N		S	S	S	S	S		B	B	B		B	B	
	0.012μF (123)						N	N	N	N	N	N		S	S	S	S	X		B	B	B		B	B	
	0.015μF (153)						N	N	N	N	N	N		S	S	S	S	X		B	B	B		B	B	
	0.018μF (183)						N	N	N	N	N	N		S	S	S	S	X		B	B	B		B	B	
	0.022μF (223)		L	L			N	N	N	N	N	N		S	S	S	S	X		B	B	B		B	B	
	0.027μF (273)						N	N	N	N	N	N		S	S	S	S	X		B	B	B		B	D	
	0.033μF (333)						N	N	N	N	N	N		S	S	S	S	X	X		B	B	B		B	D
	0.039μF (393)						N	N	N	N	N	N		S	S	S	S	X	X		B	B	B		B	D
	0.047μF (473)						N	N	N	N	N	N		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		B	I	
	0.15μF (154)							N						S	S	S	X	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	I		
0.33μF (334)													X	X	X	X	X		D	D	D		I	I		
0.39μF (394)													X	X	X	X			D	D	D		I	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		I			
0.82μF (824)													X	X	X				D	D	D					
1.0μF (105)						N							X	X	X	X	X		D	D	D	I	I			
1.5μF (155)																			I	I	I					
2.2μF (225)													X	X	X				I	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

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	35	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	B		C	C	C		C	C	D	D	D	D	D
	0.10μF (104)		B	B	B		B	C		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		P				G	G		M	M			D	K	K	
2.2μF (225)	J	J	J	P		P	P			G	G		M	M			G	M	M	
3.3μF (335)		P	P	P		P				G	G		M				K	K		
4.7μF (475)	P	P	P	P		P				K	K	K		M	M			M	M	
6.8μF (685)																		M	M	
10μF (106)	P	P	P	P	P				K	K	K	K	M	M				M	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. 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												
	150pF (151)			L	L	L												
	220pF (221)			L	L	L												
	330pF (331)			L	L	L												
	470pF (471)			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									N						
	0.022μF (223)	L	L	L	L							N						
	0.033μF (333)	L	L							N		N						
	0.047μF (473)	L	L	L	L			N	N	N		N						
	0.068μF (683)	L	L					N	N	N		E						
	0.082μF (823)	L	L					N	N	N		E						
	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	
	0.33μF (334)	L						N	N	N	N			X	X	X	X	
	0.47μF (474)	L	L					N	N	N	N	E		X	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	N	N	N	E		X	X	X	X	X
	1.5μF (155)													X	X			
2.2μF (225)	L*	L*					N	N	E	E			X	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)						E*	E*					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						P							
	1.5μF (155)		I	I	I	I				J	J	P	P			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	M
	22μF (226)		I	I*	I*	I*			P	P	P	P			M	M	M	M	M	
	47μF (476)	I*	I*	I*					P*	P*	P*				M	M	M	M*		
	100μF (107)	I*	I*						P						M*	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.

Approval Sheet

Dielectric		X6S																														
		0201					0402				0603					0805						1206					1210					
Size		4	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	
Rated Voltage (VDC)		4	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	L	N																									
	0.15μF (154)																															
	0.22μF (224)		L	L*			N																									
	0.33μF (334)																															
	0.47μF (474)	L					N																									
	0.68μF (684)																															
	1.0μF (105)	L*	L*				N	N	N	E																						
	1.5μF (155)																															
	2.2μF (225)						E	E	E			X	X	X	X					I												
	3.3μF (335)																															
	4.7μF (475)						E	E			X	X	X	X	X						I	I										
	6.8uF (685)																															
	10μF (106)						E*				X*	X*	X*	X*		I	I	I	I	I					P							
	22μF (226)										X*	X*				I*	I*	I*	I*			P	P*	P					M			
47μF (476)															I*	I*					P				M	M	M					
100μF (107)																									M*	M*						

- | Dielectric | | X7S | | | | | | | | | | | | | | | | | | | | | | | |
|---------------------|-------------|------|------|----|----|-----|------|----|----|----|------|----|----|-----|-----|------|----|----|----|-----|------|----|----|----|--|
| Size | | 0201 | 0402 | | | | 0603 | | | | 0805 | | | | | 1206 | | | | | 1210 | | | | |
| Rated Voltage (VDC) | | 10V | 6.3 | 10 | 16 | 6.3 | 10 | 16 | 25 | 10 | 16 | 25 | 50 | 100 | 6.3 | 10 | 16 | 25 | 50 | 6.3 | 10 | 16 | 25 | 50 | |
| Capacitance | 0.1μF (104) | L | | | | | | | | | | | | I | | | | | | | | | | | |
| | 1.0μF (105) | | | E | | | | | | | | | | | | | | | | | | | | | |
| | 1.5μF (155) | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2.2μF (225) | | E | E | | | | | X | | | | | | | | | | | | | | | | |
| | 3.3μF (335) | | | | | | | | | | | | | | | | | | | | | | | | |
| | 4.7μF (475) | | | | | | X | X | | | | | | I | | | | | | | | | | | |
| | 6.8uF (685) | | | | | | | | | | | | | | | | | | | | | | | | |
| | 10μF (106) | | | | | | | | | | | | I | I | | | | | | | | | | | |
| | 22μF (226) | | | | | | | | | | | | | | | | | | | | | | | | |
| | 47μF (476) | | | | | | | | | | | | | | | P* | | 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	50,000	-	-
	0.30±0.09	L	15,000	50,000	-	-
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
	1.40±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	*Test temp.: Room Temperature. *Class I: (NP0) ≤ 1000pF, 1.0±0.2Vrms · 1MHz±10% > 1000pF, 1.0±0.2Vrms · 1KHz±10% Class II: (X7R, X7E, X6S, X5R, X7S) 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:							
3.	Q/ D.F. (Dissipation Factor)	** Test condition: 0.5±0.2Vrms · 1KHz±10% X7R: 0603/475(6.3V) X5R: 0201 ≥ 224 (6.3V,10V,16V) ^{#1} , 0402 ≥ 475 (6.3V,16V), 0402 ≥ 225(10V), 0603=106 (6.3V) TT18X ≥ 475(10V) , TT15X series X6S: 0201/474(4V),0201>104 (6.3V,10V), 0402 ≥ 225 (6.3V), 0402/475 (10V), 0603/106 (6.3V), X7S: 0402/225(6.3V) #1 Excluding X5R/0201/105(6.3V);225(10V) , 0402X475M6R3 (1.0±0.2Vrms · 1KHz±10%) *Before initial measurement (Class II only): To apply de-aging at 150℃ for 1hr then set for 24±2 hrs at room temp.	Rated vol.	D.F. ≤	Exception of D.F. ≤					
			≥ 100V	≤ 2.5%	≤ 3%	1206 ≥ 0.47μF				
			50V	≤ 2.5%	≤ 3.5%	1812 ≥ 4.7μF;1825≥4.7μF; 2220≥4.7μF; 2225≥4.7μF				
					≤ 5%	0603 ≥ 0.068μF; 0805 > 0.1μF; 1206 ≥ 1μF; 1210 ≥ 2.2μF;				
					≤ 10%	0805 > 0.22μF; 1210 ≥ 3.3μF				
					≤ 3%	0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF				
			35V	≤ 3.5%	≤ 3.5%	1812 ≥ 4.7μF;1825≥4.7μF; 2220≥4.7μF; 2225≥4.7μF				
					≤ 5%	0201 ≥ 0.01uF; 1210 ≥ 3.3μF				
					≤ 10%	0402 ≥ 0.012μF; 0603>0.1μF; 0805/X7R>0.47μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF				
			25V	≤ 3.5%	≤ 5%	0603 ≥ 1μF; 0805≥2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF				
					≤ 7%	0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF				
					≤ 10%	0603 ≥ 0.33μF				
			16V	≤ 3.5%	≤ 10%	0201 ≥ 0.1μF; 0402 ≥ 0.056μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF				
					≤ 12.5%	0402 ≥ 0.33μF				
					≤ 5%	0201 ≥ 0.01μF; 0402 ≥ 0.033μF; 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF				
			10V	≤ 5%	≤ 10%	0201/X7R ≥ 0.022μF; 0402 ≥ 0.15uF; 0603>0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF				
					≤ 15%	0201 ≥ 0.012μF; 0402 ≥ 0.15μF; 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				
					≤ 20%	0402 ≥ 2.2μF				
					---	---	---			
			4V	≤ 15%	---	---				
			3.	Q/ D.F. (Dissipation Factor)	** Test condition: 0.5±0.2Vrms · 1KHz±10% X7R: 0603/475(6.3V) X5R: 0201 ≥ 224 (6.3V,10V,16V) ^{#1} , 0402 ≥ 475 (6.3V,16V), 0402 ≥ 225(10V), 0603=106 (6.3V) TT18X ≥ 475(10V) , TT15X series X6S: 0201/474(4V),0201>104 (6.3V,10V), 0402 ≥ 225 (6.3V), 0402/475 (10V), 0603/106 (6.3V), X7S: 0402/225(6.3V) #1 Excluding X5R/0201/105(6.3V);225(10V) , 0402X475M6R3 (1.0±0.2Vrms · 1KHz±10%) *Before initial measurement (Class II only): To apply de-aging at 150℃ for 1hr then set for 24±2 hrs at room temp.	Rated vol.	D.F. ≤	Exception of D.F. ≤		
						≥ 100V	≤ 2.5%	≤ 3%	1206 ≥ 0.47μF	
						50V	≤ 2.5%	≤ 5%	0603 ≥ 0.068μF; 0805 > 0.1μF; 1206 ≥ 1μF; 1210 ≥ 2.2μF	
								≤ 10%	0805 > 0.22μF; 1210 ≥ 3.3μF	
								≤ 3%	0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF	
≤ 5%	0201 ≥ 0.01uF; 1210 ≥ 3.3μF									
35V	≤ 3.5%	≤ 10%				0402 ≥ 0.012μF; 0603>0.1μF; 0805 ≥ 1μF;1206 ≥ 2.2μF; 1210 ≥ 10μF				
		≤ 12.5%				1206=10μF				
		≤ 5%				0603 ≥ 1μF; 0805≥2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF				
25V	≤ 3.5%	≤ 5%				0201=0.01μF; 0805 ≥ 1μF				
		≤ 7%				0603 ≥ 0.33μF				
		≤ 10%				0201>0.01μF; 0402 ≥ 0.10μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 10μF				
16V	≤ 3.5%	≤ 12.5%				0402 ≥ 0.33μF;0805=10μF				
		≤ 5%				0201=0.01μF; 0402 ≥ 0.033μF; 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF				
		≤ 10%				0201>0.01uF; 0402 ≥ 0.22uF; 0603>0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF				
10V	≤ 5%	≤ 15%				0402 ≥ 1μF;0805=10μF				
		≤ 10%				0201 ≥ 0.012μF; 0402 ≥ 0.22μF; 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF; 01R5/X5R				
		≤ 12.5%				0805=10μF				
6.3V	≤ 10%	≤ 15%				0201>0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF				
		≤ 20%				0201>0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF				
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4V	≤ 15%	---				---				

* "Room condition" Temperature: 15 to 35°C, Relative humidity: 25 to 75%, Atmospheric pressure: 86 to 106kPa.

Multilayer Ceramic Capacitors

No.	Item	Test Condition	Requirements			
	Q/ D.F. (Dissipation Factor)		X6S:			
			Rated vol.	D.F. ≤	Exception of D.F. ≤	
			≥ 100V	≤ 2.5%	≤ 3%	1206 ≥ 0.47μF
					≤ 5%	0603 ≥ 0.068μF; 0805 > 0.1μF; 1206 ≥ 1μF; 1210 ≥ 2.2μF
					≤ 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 ≥ 3.3μF
					≤ 10%	0402 ≥ 0.012μF; 0603 > 0.1μF; 0805 ≥ 1μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF
			35V	≤ 3.5%	≤ 10%	0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF
					≤ 5%	0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF
					≤ 7%	0603 ≥ 0.33μF
			25V	≤ 3.5%	≤ 10%	0201 ≥ 0.1μF; 0402 ≥ 0.10μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF
					≤ 12.5%	0402 ≥ 0.33μF; 0805 = 10μF
			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 > 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF
					≤ 12.5%	0402 = 1μF; 0805 = 10μF
			10V	≤ 5%	≤ 10%	0201 ≥ 0.012μF; 0402 ≥ 0.22μF; 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF
					≤ 12.5%	0805 = 10μF
					≤ 15%	0201 ≥ 0.1μF; 0402 ≥ 1μF
			6.3V	≤ 10%	≤ 15%	0201 ≥ 0.1μF; 0402 ≥ 0.47μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF
					≤ 20%	0402 ≥ 2.2μF
			4V	≤ 15%	---	---
			X7S:			
			Rated vol.	D.F. ≤	Exception of D.F. ≤	
			≥ 100V	≤ 2.5%	≤ 3%	1206 ≥ 0.47μF
					≤ 5%	0603 ≥ 0.068μF; 0805 > 0.1μF; 1206 ≥ 1μF; 1210 ≥ 2.2μF
					≤ 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 ≥ 3.3μF
					≤ 10%	0402 ≥ 0.012μF; 0603 > 0.1μF; 0805 ≥ 1μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF
			35V	≤ 3.5%	≤ 10%	0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF
					≤ 5%	0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF
					≤ 7%	0603 ≥ 0.33μF
			25V	≤ 3.5%	≤ 10%	0201 ≥ 0.1μF; 0402 ≥ 0.10μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF
					≤ 12.5%	0402 ≥ 0.33μF
			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 > 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF
			10V	≤ 5%	≤ 10%	0201 ≥ 0.012μF; 0402 ≥ 0.22μF; 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
					≤ 20%	0402 ≥ 2.2μF
			4V	≤ 15%	---	---
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.			

* "Room condition" Temperature: 15 to 35℃, Relative humidity: 25 to 75%, Atmospheric pressure: 86 to 106kPa.

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No	Item	Test Condition	Requirements
5.	Insulation Resistance	*Test temp.: Room Temperature.	10GΩ or $RxC \geq 500\Omega \cdot F$ whichever is smaller.
		*To apply rated voltage for MAX. 120sec.	Class II (X7R, X7E, X5R, X6S, X7S)
			Rated voltage
			100V: All X7R
			50V: 0402 $\geq 0.01\mu F$; 0603 $\geq 1\mu F$; 0805 $\geq 1\mu F$; 1206 $\geq 4.7\mu F$; 1210 $\geq 4.7\mu F$
			35V: 0805 $\geq 2.2\mu F$; 1206 $\geq 2.2\mu F$; 1210 $\geq 10\mu F$
			25V: 0402 $\geq 1\mu F$; 0603 $\geq 2.2\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 10\mu F$; 1210 $\geq 10\mu F$
			16V: 0201 $\geq 0.1\mu F$; 0402 $\geq 0.22\mu F$; 0603 $\geq 1\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 10\mu F$; 1210 $\geq 47\mu F$
			10V: 0201 $\geq 47nF$; 0402 $\geq 0.47\mu F$; 0603 $\geq 0.47\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 4.7\mu F$; 1210 $\geq 47\mu F$
			6.3V ; 4V ; Size ≥ 1812
			Rated voltage
			All X6S items, All X7S items
			100V: 1210 $\geq 3.3\mu F$
			50V: 0402 $\geq 0.1\mu F$; 0603 $\geq 2.2\mu F$; 0805 $\geq 10\mu F$; 1206 $\geq 10\mu F$
6.	Temperature Coefficient	With no electrical load.	
		T.C.	Operating Temp
		NPO	-55~125°C at 25°C
		X7R	-55~125°C at 25°C
		X7S	-55~125°C at 25°C
		X5R	-55~85°C at 25°C
		X6S	-55~105°C at 25°C
			*Before initial measurement (Class II only) To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.
			* Measurement voltage for Class II:
		01005	0201
		Cap $\leq 0.01\mu F$: 0.5V	Cap $\leq 0.1\mu F$: 1V
		Cap $> 0.01\mu F$: 0.2V	0.1μF $\leq$ Cap $< 1\mu F$: 0.2V*
			Cap $\geq 1\mu F$: 0.1V*
		*0201X104/6.3V~25V: 0.5V 0201X224&474/10V: 0.5V	*0201S104/6.3V~16V: 0.3V 0201S224/6.3V: 0.3V 0201X105/6.3V&10V: 0.3V
		0402	0603
		Cap $< 1\mu F$: 1V	Cap $< 1\mu F$: 1V
		Cap = 1μF: 0.5V** 0402B224-16V: 0.5V 0402B474-10V: 0.5V 0402X475M6R3: 0.5V	1μF $\leq$ Cap $\leq 4.7\mu F$: 0.5V 0603X106-10V: 0.5V
		1μF $<$ Cap $< 10\mu F$: 0.2V **0402B105M6R3V: 0.2V	Cap $> 4.7\mu F$: 0.2V
		Cap $\geq 10\mu F$: 0.1V	
		0805	1206/1210
		Cap $< 10\mu F$: 1V	Cap $\leq 10\mu F$: 1V
		Cap = 10μF: 0.5V 0805B475/6.3V~25V: 0.5V	10μF $<$ Cap $\leq 100\mu F$: 0.5V
		Cap $> 10\mu F$: 0.2V	Cap $> 100\mu F$: 0.2V 1206X107-6.3V: 0.2V 1210S107-6.3V: 0.2V

* "Room condition" Temperature: 15 to 35°C, Relative humidity: 25 to 75%, Atmospheric pressure: 86 to 106kPa.

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No.	Item	Test Condition	Requirements															
7.	Adhesive Strength of Termination	* Pressurizing force : 2N (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.) * 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) 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 and Q/D.F.: To meet initial spec.															
9.	Solderability	* Solder temperature: 235±5℃ * 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. * Before initial measurement (Class II only): To apply de-aging at 150℃ for 1hr 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, X7S: within ±12.5% (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℃ * Dipping time: 10±1 sec * Preheating: 120 to 150℃ for 1 minute before immerse the capacitor in a eutectic solder. * 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: within ±2.5% or 0.25pF whichever is larger X7R, X5R, X6S, X7S: within ±7.5% * 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><tr><th>Step</th><th>Temp. (℃)</th><th>Time (min.)</th></tr><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></table> * 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.	Step	Temp. (℃)	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 : NP0: within ±2.5% or 0.25pF whichever is larger X7R, X5R, X6S, X7S: within ±7.5% * Q/D.F., I.R. and dielectric strength: To meet initial requirements.
Step	Temp. (℃)	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																

* "Room condition" Temperature: 15 to 35°C, Relative humidity: 25 to 75%, Atmospheric pressure: 86 to 106kPa.

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Approval Sheet

No.	Item	Test Condition	Requirements																																															
13.	Humidity (Damp Heat) Steady State	*Test temp.: 40±2℃ *Humidity: 90~95%RH *Test time: 500+24/-0hrs. *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: within ±5% or 0.5pF whichever is larger X7R, X5R, X6S, X7S: ≥10V**,within ±12.5%; ≤6.3V within ±25%; **10V: 0603 ≥4.7μF;0402 ≥1μF;0201 ≥0.1μF, within ±25%; * 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 vol.</th><th>D.F. ≤</th><th>Exception of D.F. ≤</th></tr><tr><td rowspan="4">100V</td><td rowspan="4">≤3%</td><td>≤6% 1206 ≥0.47μF</td></tr><tr><td>≤7% 1812 ≥4.7μF;1825≥4.7μF; 2220≥4.7μF; 2225≥4.7μF</td></tr><tr><td>≤7.5% 0603 ≥0.068μF;0805>0.1μF;1206 ≥1μF;1210 ≥2.2μF</td></tr><tr><td>≤20% 0805 >0.22μF;1210 ≥3.3μF</td></tr><tr><td rowspan="4">50V</td><td rowspan="4">≤3%</td><td>≤6% 0201(50V);0603 ≥0.047μF;0805 ≥0.18μF;1206 ≥0.47μF</td></tr><tr><td>≤7% 1812 ≥4.7μF;1825≥4.7μF; 2220≥4.7μF; 2225≥4.7μF</td></tr><tr><td>≤10% 0201 ≥0.01uF;1210 ≥3.3μF</td></tr><tr><td>≤20% 0402 ≥0.012μF;0603>0.1μF; 0805 ≥1μF(0805/X7R>0.47μF); 1206 ≥2.2μF;1210 ≥10μF;</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(0201/X5R=0.01μF);0805 ≥1μF;1210 ≥10μF*</td></tr><tr><td>≤14% 0603 ≥0.33μF</td></tr><tr><td>≤15% 0201 ≥0.1μF(0201/X5R>0.01μF); 0603 ≥0.47μF;TTseries 0402 ≥0.10μF(0402/X7R ≥0.056μF);0805 ≥2.2μF; 1206 ≥4.7μF;1210 ≥22μF(1210/X5R ≥10μF)*;</td></tr><tr><td>≤20% 0402 ≥0.33μF</td></tr><tr><td>16V</td><td>≤5%</td><td>≤10% 0603 ≥0.15μF;0805 ≥0.68μF;1206 ≥2.2μF;1210 ≥4.7μF</td></tr><tr><td rowspan="2">10V</td><td rowspan="2">≤7.5%</td><td>≤15% 0201 ≥0.012μF;0402 ≥0.22μF (0402/X7R ≥0.15μF); 0603 ≥0.33μF;0805 ≥2.2μF;1206 ≥2.2μF;1210 ≥22μF</td></tr><tr><td>≤20% 0201 ≥0.1μF;0402 ≥1μF;0603/X5R ≥10μF;01R5/X5R</td></tr><tr><td>6.3V</td><td>≤15%</td><td>≤30% 0201 ≥0.1μF;0402 ≥1μF(0402/X6S ≥0.47μF); 0603 ≥10μF;0805 ≥4.7μF;1206 ≥47μF;1210 ≥100μF</td></tr><tr><td>4V</td><td>≤20%</td><td>---</td></tr></table> *I.R.: ≥10V, 1GΩ or 50 Ω-F whichever is smaller. Class II (X7R, X5R, X6S, X7S) <table><tr><th>Rated voltage</th><th>Insulation Resistance</th></tr><tr><td>100V: All X7R;1210≥3.3μF</td><td rowspan="7">1GΩ or Rx≥ 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 ≥0.1uF; 0402≥0.22μF; 0603≥2.2μF;0805≥2.2μF; 1206≥10μF;1210≥10μF</td></tr><tr><td>16V: 0201 ≥0.1uF;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 ; All X6S/X7S items; Size≥1812</td></tr></table>	Rated vol.	D.F. ≤	Exception of D.F. ≤	100V	≤3%	≤6% 1206 ≥0.47μF	≤7% 1812 ≥4.7μF;1825≥4.7μF; 2220≥4.7μF; 2225≥4.7μF	≤7.5% 0603 ≥0.068μF;0805>0.1μF;1206 ≥1μF;1210 ≥2.2μF	≤20% 0805 >0.22μF;1210 ≥3.3μF	50V	≤3%	≤6% 0201(50V);0603 ≥0.047μF;0805 ≥0.18μF;1206 ≥0.47μF	≤7% 1812 ≥4.7μF;1825≥4.7μF; 2220≥4.7μF; 2225≥4.7μF	≤10% 0201 ≥0.01uF;1210 ≥3.3μF	≤20% 0402 ≥0.012μF;0603>0.1μF; 0805 ≥1μF(0805/X7R>0.47μF); 1206 ≥2.2μF;1210 ≥10μF;	35V	≤5%	≤20% 0603 ≥1μF;0805≥2.2μF;1206 ≥2.2μF;1210 ≥10μF	25V	≤5%	≤10% 0201 ≥0.01μF(0201/X5R=0.01μF);0805 ≥1μF;1210 ≥10μF*	≤14% 0603 ≥0.33μF	≤15% 0201 ≥0.1μF(0201/X5R>0.01μF); 0603 ≥0.47μF;TTseries 0402 ≥0.10μF(0402/X7R ≥0.056μF);0805 ≥2.2μF; 1206 ≥4.7μF;1210 ≥22μF(1210/X5R ≥10μF)*;	≤20% 0402 ≥0.33μF	16V	≤5%	≤10% 0603 ≥0.15μF;0805 ≥0.68μF;1206 ≥2.2μF;1210 ≥4.7μF	10V	≤7.5%	≤15% 0201 ≥0.012μF;0402 ≥0.22μF (0402/X7R ≥0.15μF); 0603 ≥0.33μF;0805 ≥2.2μF;1206 ≥2.2μF;1210 ≥22μF	≤20% 0201 ≥0.1μF;0402 ≥1μF;0603/X5R ≥10μF;01R5/X5R	6.3V	≤15%	≤30% 0201 ≥0.1μF;0402 ≥1μF(0402/X6S ≥0.47μF); 0603 ≥10μF;0805 ≥4.7μF;1206 ≥47μF;1210 ≥100μF	4V	≤20%	---	Rated voltage	Insulation Resistance	100V: All X7R;1210≥3.3μF	1GΩ or Rx≥ 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 ≥0.1uF; 0402≥0.22μF; 0603≥2.2μF;0805≥2.2μF; 1206≥10μF;1210≥10μF	16V: 0201 ≥0.1uF;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 ; All X6S/X7S items; Size≥1812
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* "Room condition" Temperature: 15 to 35℃, Relative humidity: 25 to 75%, Atmospheric pressure: 86 to 106kPa.

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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%; **10V: 0603≥4.7μF;0402≥1μF;0201≥0.1μF, within ±25%; Q/D.F. value: NP0: C≥30pF,Q≥200;C<30pF, Q≥100+10/3C X7R, X5R, X6S, X7S: <table><tr><th>Rated vol.</th><th>D.F. ≤</th><th>Exception of D.F. ≤</th></tr><tr><td rowspan="4">100V</td><td rowspan="4">≤ 3%</td><td>≤ 6% 1206 ≥ 0.47μF</td></tr><tr><td>≤ 7% 1812 ≥ 4.7μF;1825≥4.7μF; 2220≥4.7μF; 2225≥4.7μF</td></tr><tr><td>≤ 7.5% 0603 ≥ 0.068μF;0805 > 0.1μF;1206 ≥ 1μF;1210 ≥ 2.2μF</td></tr><tr><td>≤ 20% 0805 > 0.22μF;1210 ≥ 3.3μF</td></tr><tr><td rowspan="4">50V</td><td rowspan="4">≤ 3%</td><td>≤ 6% 0201(50V);0603 ≥ 0.047μF;0805 ≥ 0.18μF;1206 ≥ 0.47μF</td></tr><tr><td>≤ 7% 1812 ≥ 4.7μF;1825≥4.7μF; 2220≥4.7μF; 2225≥4.7μF</td></tr><tr><td>≤ 10% 0201 ≥ 0.01uF;1210 ≥ 3.3μF</td></tr><tr><td>≤ 20% 0402 ≥ 0.012μF;0603>0.1μF;0805 ≥ 1μF(0805/X7R>0.47μF); 1206 ≥ 2.2μF;1210 ≥ 10μF;</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(0201/X5R=0.01μF);0805 ≥ 1μF;1210 ≥ 10μF*</td></tr><tr><td>≤ 14% 0603 ≥ 0.33μF</td></tr><tr><td>0201 ≥ 0.1μF(0201/X5R>0.01μF); 0603 ≥ 0.47μF;TTseries</td></tr><tr><td>≤ 15% 0402 ≥ 0.10μF(0402/X7R ≥ 0.056μF);0805 ≥ 2.2μF; 1206 ≥ 4.7μF;1210 ≥ 22μF(1210/X5R ≥ 10μF)*;</td></tr><tr><td rowspan="2">16V</td><td rowspan="2">≤ 5%</td><td>≤ 20% 0402 ≥ 0.33μF</td></tr><tr><td>≤ 10% 0603 ≥ 0.15μF;0805 ≥ 0.68μF;1206 ≥ 2.2μF;1210 ≥ 4.7μF</td></tr><tr><td rowspan="2">10V</td><td rowspan="2">≤ 7.5%</td><td>≤ 15% 0201 ≥ 0.012μF;0402 ≥ 0.22μF (0402/X7R ≥ 0.15μF); 0603 ≥ 0.33μF;0805 ≥ 2.2μF;1206 ≥ 2.2μF;1210 ≥ 22μF</td></tr><tr><td>≤ 20% 0201 ≥ 0.1μF;0402 ≥ 1μF;0603/X5R ≥ 10μF;01R5/X5R</td></tr><tr><td>6.3V</td><td>≤ 15%</td><td>≤ 30% 0201 ≥ 0.1μF;0402 ≥ 1μF(0402/X6S ≥ 0.47μF); 0603 ≥ 10μF;0805 ≥ 4.7μF;1206 ≥ 47μF;1210 ≥ 100μF</td></tr><tr><td>4V</td><td>≤ 20%</td><td>---</td></tr></table> *I.R.: ≥10V, 500MΩ or 25 Ω-F whichever is smaller. Class II (X7R, X5R, X6S, X7S) <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 ≥ 0.1uF; 0402≥0.22μF; 0603≥2.2μF;0805≥2.2μF; 1206≥10μF;1210≥10μF</td></tr><tr><td>16V: 0201 ≥ 0.1uF;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 ; All X6S/X7S items; Size≥1812</td></tr></table>	Rated vol.	D.F. ≤	Exception of D.F. ≤	100V	≤ 3%	≤ 6% 1206 ≥ 0.47μF	≤ 7% 1812 ≥ 4.7μF;1825≥4.7μF; 2220≥4.7μF; 2225≥4.7μF	≤ 7.5% 0603 ≥ 0.068μF;0805 > 0.1μF;1206 ≥ 1μF;1210 ≥ 2.2μF	≤ 20% 0805 > 0.22μF;1210 ≥ 3.3μF	50V	≤ 3%	≤ 6% 0201(50V);0603 ≥ 0.047μF;0805 ≥ 0.18μF;1206 ≥ 0.47μF	≤ 7% 1812 ≥ 4.7μF;1825≥4.7μF; 2220≥4.7μF; 2225≥4.7μF	≤ 10% 0201 ≥ 0.01uF;1210 ≥ 3.3μF	≤ 20% 0402 ≥ 0.012μF;0603>0.1μF;0805 ≥ 1μF(0805/X7R>0.47μF); 1206 ≥ 2.2μF;1210 ≥ 10μF;	35V	≤ 5%	≤ 20% 0603 ≥ 1μF;0805≥2.2μF;1206 ≥ 2.2μF;1210 ≥ 10μF	25V	≤ 5%	≤ 10% 0201 ≥ 0.01μF(0201/X5R=0.01μF);0805 ≥ 1μF;1210 ≥ 10μF*	≤ 14% 0603 ≥ 0.33μF	0201 ≥ 0.1μF(0201/X5R>0.01μF); 0603 ≥ 0.47μF;TTseries	≤ 15% 0402 ≥ 0.10μF(0402/X7R ≥ 0.056μF);0805 ≥ 2.2μF; 1206 ≥ 4.7μF;1210 ≥ 22μF(1210/X5R ≥ 10μF)*;	16V	≤ 5%	≤ 20% 0402 ≥ 0.33μF	≤ 10% 0603 ≥ 0.15μF;0805 ≥ 0.68μF;1206 ≥ 2.2μF;1210 ≥ 4.7μF	10V	≤ 7.5%	≤ 15% 0201 ≥ 0.012μF;0402 ≥ 0.22μF (0402/X7R ≥ 0.15μF); 0603 ≥ 0.33μF;0805 ≥ 2.2μF;1206 ≥ 2.2μF;1210 ≥ 22μF	≤ 20% 0201 ≥ 0.1μF;0402 ≥ 1μF;0603/X5R ≥ 10μF;01R5/X5R	6.3V	≤ 15%	≤ 30% 0201 ≥ 0.1μF;0402 ≥ 1μF(0402/X6S ≥ 0.47μF); 0603 ≥ 10μF;0805 ≥ 4.7μF;1206 ≥ 47μF;1210 ≥ 100μF	4V	≤ 20%	---	Rated voltage	Insulation Resistance	100V: All X7R;1210≥3.3μF	500MΩ or RxC ≥ 5 Ω-F whichever is smaller.	50V: 0402>0.01μF;0603≥1μF;0805≥1μF;1206≥4.7μF;1210≥4.7μF	35V:0603≥1μF;0805≥2.2μF; 1206 ≥ 2.2μF;1210 ≥ 10μF	25V:0201 ≥ 0.1uF; 0402≥0.22μF; 0603≥2.2μF;0805≥2.2μF; 1206≥10μF;1210≥10μF	16V: 0201 ≥ 0.1uF;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 ; All X6S/X7S items; Size≥1812
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6.3V ; 4V ; All X6S/X7S items; Size≥1812																																																			

* "Room condition" Temperature: 15 to 35℃, Relative humidity: 25 to 75%, Atmospheric pressure: 86 to 106kPa.

Multilayer Ceramic Capacitors

Approval Sheet

No	Item	Test Condition	Requirements																																																																																																																																									
15.	High Temperature Load (Endurance)	*Test temp. : NP0, X7R/X7E/X7S: 125±3℃ X6S: 105±3℃ X5R: 85±3℃ *Test time: 1000+24/-0 hrs. *To apply voltage: (1) 100% of rated voltage for below range.	* 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%; **10V: 0603≥4.7μF; 0402≥1μF; 0201≥0.1μF, within ±25%																																																																																																																																									
			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>Size</th><th>Dielectric</th><th>Rated voltage</th><th>Capacitance</th></tr><tr><td>01R5</td><td>X5R</td><td>≤10V</td><td>C=0.1μF</td></tr><tr><td rowspan="2">0201</td><td rowspan="2">X5R/X7R/ X6S/X7S</td><td>≤10V</td><td>C≥0.1μF</td></tr><tr><td>≥16V</td><td>C>0.1μF</td></tr><tr><td rowspan="4">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 rowspan="2">X6S</td><td>6.3V, 10V</td><td>C>1.0μF</td></tr><tr><td>16V, 25V</td><td>C≥1.0μF</td></tr><tr><td rowspan="4">0603</td><td rowspan="2">X7R/X7S</td><td>6.3V, 10V</td><td>C≥1.0μF</td></tr><tr><td>4V</td><td>C≥22μF</td></tr><tr><td rowspan="2">X5R/X7R/ X6S/X7S</td><td>6.3V, 10V</td><td>C≥4.7μF¹⁾</td></tr><tr><td>25V</td><td>C≥1.0μF</td></tr><tr><td rowspan="6">0805</td><td rowspan="3">X5R/X7R/ X6S/X7S</td><td>35V</td><td>C≥1.0μF</td></tr><tr><td>4V</td><td>C≥47μF</td></tr><tr><td>6.3V</td><td>C≥22μF</td></tr><tr><td rowspan="3">X6S</td><td>10V, 50V</td><td>C≥10μF</td></tr><tr><td>16V</td><td>C>10μF</td></tr><tr><td>25V</td><td>C≥10μF</td></tr><tr><td>1206</td><td>X5R/X7R/X6S</td><td>≤6.3V</td><td>C≥47μF</td></tr><tr><td>1210</td><td>X5R/X7R/X6S</td><td>16V</td><td>C≥47μF</td></tr><tr><td>TT15</td><td>X5R</td><td>100V</td><td>C≥3.3μF</td></tr><tr><td>TT21</td><td>X5R/X7R/X6S</td><td>6.3V</td><td>C>1.0μF</td></tr><tr><td>TT21</td><td>X5R/X7R/X6S</td><td>≤10V</td><td>C≥10μF</td></tr></table> **1WV items must follow de-rating conditions. #1. 0603X106(10V)&0603S106(4V&6.3V):150% of rated voltage (2) 150% of rated voltage for below range.	Size	Dielectric	Rated voltage	Capacitance	01R5	X5R	≤10V	C=0.1μF	0201	X5R/X7R/ X6S/X7S	≤10V	C≥0.1μF	≥16V	C>0.1μF	0402	X5R	≤16V	C>1.0μF	25V, 50V	C≥1.0μF	X6S	6.3V, 10V	C>1.0μF	16V, 25V	C≥1.0μF	0603	X7R/X7S	6.3V, 10V	C≥1.0μF	4V	C≥22μF	X5R/X7R/ X6S/X7S	6.3V, 10V	C≥4.7μF ¹⁾	25V	C≥1.0μF	0805	X5R/X7R/ X6S/X7S	35V	C≥1.0μF	4V	C≥47μF	6.3V	C≥22μF	X6S	10V, 50V	C≥10μF	16V	C>10μF	25V	C≥10μF	1206	X5R/X7R/X6S	≤6.3V	C≥47μF	1210	X5R/X7R/X6S	16V	C≥47μF	TT15	X5R	100V	C≥3.3μF	TT21	X5R/X7R/X6S	6.3V	C>1.0μF	TT21	X5R/X7R/X6S	≤10V	C≥10μF	<table><tr><th>Size</th><th>Dielectric</th><th>Rated voltage</th><th>Capacitance</th></tr><tr><td rowspan="2">0201</td><td rowspan="2">X5R/X6S</td><td>16V, 25V</td><td>C=0.1μF</td></tr><tr><td>50V</td><td>C≥0.022μF</td></tr><tr><td rowspan="2">0402</td><td rowspan="2">X7R/X5R/ X6S</td><td>10~25V</td><td>C≥0.22μF</td></tr><tr><td>50V~100V</td><td>C>0.22μF</td></tr><tr><td rowspan="4">0603</td><td rowspan="2">X7R</td><td>50V</td><td>C>0.1μF</td></tr><tr><td>25V</td><td>C=1.0μF</td></tr><tr><td rowspan="2">X5R</td><td>50V</td><td>C≥1.0μF</td></tr><tr><td>10V, 16V</td><td>C≥1.0μF</td></tr><tr><td rowspan="4">0805</td><td rowspan="2">X5R/X7R/ X6S/X7S</td><td>100V</td><td>C≥0.47μF</td></tr><tr><td>50V</td><td>C≥0.68μF</td></tr><tr><td rowspan="2">X7R</td><td>35V</td><td>C≥2.2μF</td></tr><tr><td>10~25V</td><td>C≥4.7μF</td></tr><tr><td rowspan="4">1206</td><td rowspan="2">X7R</td><td>100V</td><td>C≥1.0μF</td></tr><tr><td>50V</td><td>C≥2.2μF</td></tr><tr><td rowspan="2">X5R/X6S/ X7S</td><td>100V</td><td>C>1.0μF</td></tr><tr><td>50V</td><td>C=4.7μF</td></tr><tr><td>1210</td><td>X5R/X7R/ X6S/X7S</td><td>50V~100V</td><td>C≥2.2μF</td></tr><tr><td>1812</td><td>X7R</td><td>≤50V</td><td>C≥4.7μF</td></tr><tr><td>1825</td><td rowspan="2">X7R</td><td rowspan="2">100V</td><td rowspan="2">C≥1.0μF</td></tr><tr><td>2220</td></tr><tr><td>2225</td><td></td><td></td><td></td></tr></table>	Size	Dielectric	Rated voltage	Capacitance	0201	X5R/X6S	16V, 25V	C=0.1μF	50V	C≥0.022μF	0402	X7R/X5R/ X6S	10~25V	C≥0.22μF	50V~100V	C>0.22μF	0603	X7R	50V	C>0.1μF	25V	C=1.0μF	X5R	50V	C≥1.0μF	10V, 16V	C≥1.0μF	0805	X5R/X7R/ X6S/X7S	100V	C≥0.47μF	50V	C≥0.68μF	X7R	35V	C≥2.2μF	10~25V	C≥4.7μF	1206	X7R	100V	C≥1.0μF	50V	C≥2.2μF	X5R/X6S/ X7S	100V	C>1.0μF	50V	C=4.7μF	1210	X5R/X7R/ X6S/X7S	50V~100V	C≥2.2μF	1812	X7R	≤50V	C≥4.7μF	1825	X7R	100V	C≥1.0μF	2220	2225			
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* "Room condition" Temperature: 15 to 35°C, Relative humidity: 25 to 75%, Atmospheric pressure: 86 to 106kPa.

APPENDIXES

■ Tape & reel dimensions

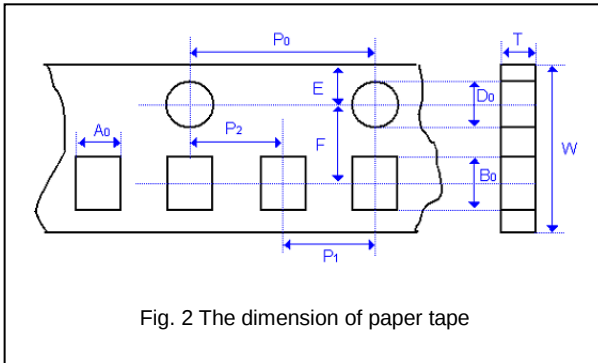


Fig. 2 The dimension of paper tape

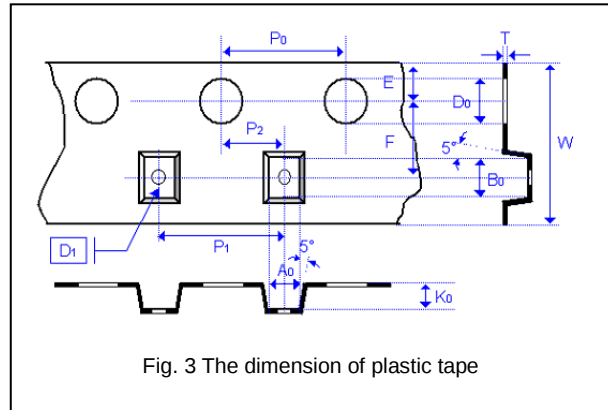


Fig. 3 The dimension of plastic tape

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,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	<3.05	<3.20	<2.50	<2.50	<3.90	<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	<3.80	<4.00	<5.30	<5.30	<5.30	<5.30	<5.30
T	≤0.55	≤0.80	≤1.20	≤1.15	≤1.20	0.23 +/-0.1	0.23 +/-0.1	0.23 +/-0.1	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	0.25 +/-0.1	0.25 +/-0.1
K ₀	-	-	-	-	-	<2.00	-	<2.00	<2.50	<1.50	<2.00	<2.50	<3.20	<2.00	<2.50	<2.00	<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	8.00 +/-0.30	12.00 +/-0.30	12.00 +/-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	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	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	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	2.00 +/-0.05	2.00 +/-0.05
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	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	1.00 +/-0.10	1.00 +/-0.10	1.00 +/-0.10	1.00 +/-0.10	1.00 +/-0.10	1.00 +/-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	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	3.50 +/-0.05	3.50 +/-0.05	3.50 +/-0.05	3.50 +/-0.05	3.50 +/-0.05

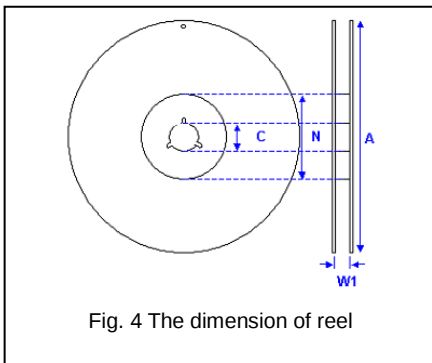
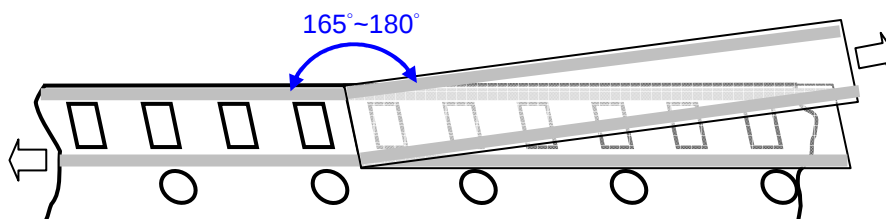


Fig. 4 The dimension of reel

Size	0201, 0402, 0603, 0805, 1206, 1210	1812
Reel size	7"	10"
C	13.0±0.5	13.0±0.5
W ₁	10.0±1.5	10.0±1.5
A	178.0±2.0	250.0±2.0
N	60.0±1.0/-0	50 min

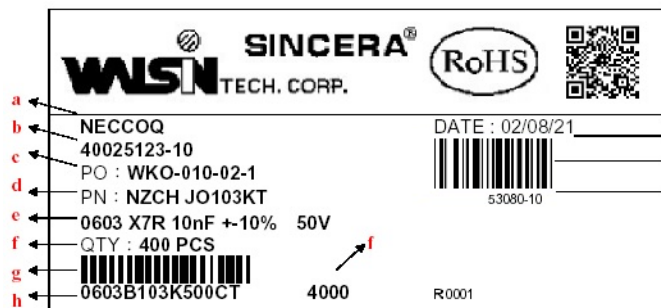
■ Peeling force (EIA-481)

Peel-off force should be in the range of 10 grams to 100 grams at a peel-off speed of 300±10 mm/min.



Multilayer Ceramic Capacitors

Example of customer label



*Customized label is available upon request

- 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
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

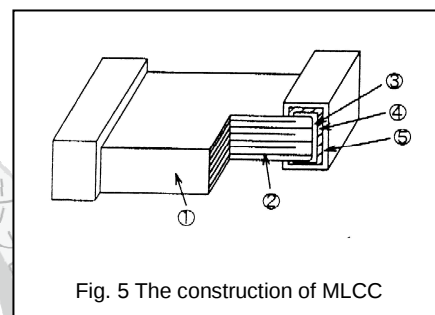


Fig. 5 The construction of MLCC

Storage and handling conditions

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

Cautions:

- 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.)
- In corrosive atmosphere, solderability might be degraded, and silver migration might occur to cause low reliability.
- 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.

Multilayer Ceramic Capacitors

■ 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 N₂ within oven are recommended.

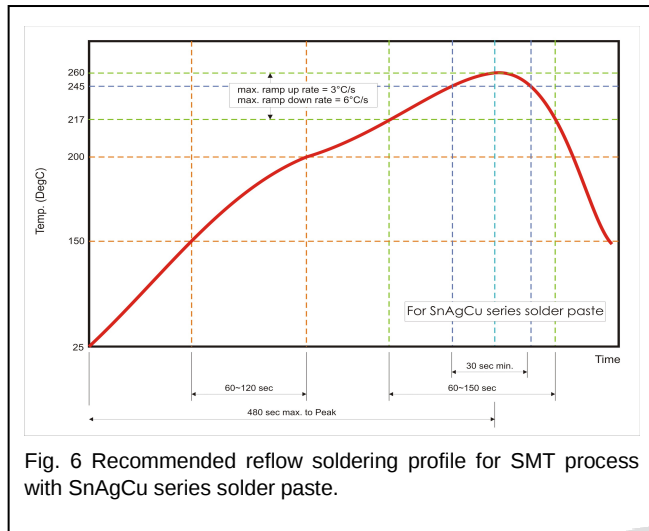


Fig. 6 Recommended reflow soldering profile for SMT process with SnAgCu series solder paste.

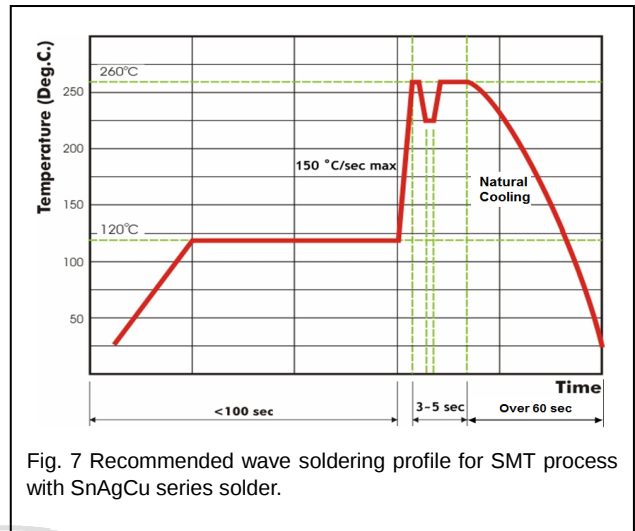


Fig. 7 Recommended wave soldering profile for SMT process with SnAgCu series solder.

