

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, X7S and X5R dielectric material and which provides product with high electrical precision, stability and reliability.

2. FEATURES

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

3. APPLICATIONS

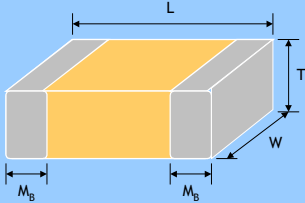
- a. For general digital circuit.
- b. For power supply bypass capacitors.
- c. For consumer electronics.
- d. For telecommunication.

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 (COG) B =X7R F =Y5V 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 350 =35 VDC 500 =50 VDC 101 =100 VDC	C =Cu/Ni/Sn	T =7" reeled G =13" reeled

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5. EXTERNAL DIMENSIONS

Outline	Size Inch (mm)	L (mm)	W (mm)	T (mm)/Symbol	Soldering Method *	M _B (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 ^{#2}	0.3±0.05 ^{#2}	0.3±0.05 ^{#2}			0.15+0.1/-0.05
		0.6±0.09 ^{#3}	0.3±0.09 ^{#3}	0.3±0.09 ^{#3}			
	0402 (1005)	1.00±0.05	0.50±0.05	0.50±0.05	N	R	0.25 +0.05/-0.10
		1.00±0.20	0.50±0.20	0.5±0.20	Q	R	
		1.00±0.15 ^{#6}	0.50±0.15 ^{#6}	0.5±0.15 ^{#6}	E	R	
	0603 (1608)	1.60±0.10	0.80±0.10	0.80±0.07	S	R / W	0.40±0.15
		1.60+0.15/-0.10	0.80+0.15/-0.10	0.50±0.10	H	R / W	
		1.60±0.20 ^{#1}	0.80±0.20 ^{#1}	0.8±0.20 ^{#1}	X	R / W	
	0805 (2012)	2.00±0.15	1.25±0.10	0.50±0.10	H	R / W	0.50±0.20
				0.60±0.10	A	R / W	
				0.80±0.10	B	R / W	
				1.25±0.10	D	R	
		2.00±0.20	1.25±0.20	0.85±0.10	T	R / W	
	1.25±0.20	I	R				
	1206 (3216)	3.20±0.15	1.60±0.15	0.80±0.10	B	R / W	0.60±0.20 (0.5±0.25) ^{***}
				0.95±0.10	C	R	
				1.25±0.10	D	R	
		3.20±0.20	1.60±0.20	1.60±0.20	G	R	
3.20+0.30/-0.1		1.60+0.30/-0.1 ^{#5}	1.60+0.30/-0.10	P	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	2.00±0.20	K	R		
	3.20±0.60 ^{#4}	2.50±0.50 ^{#4}	2.50±0.50 ^{#4}	M	R		
1808 (4520)	4.50±0.40 (4.5+0.5/-0.3) ^{**}	2.03±0.25	1.25±0.10	D	R	0.75±0.25 (0.5±0.25) ^{***}	
			1.40±0.15	F	R		
			1.60±0.20	G	R		
			2.00±0.20	K	R		
1812 (4532)	4.50±0.40 (4.5+0.5/-0.3) ^{**}	3.20±0.30	1.25±0.10	D	R	0.75±0.25 (0.5±0.25) ^{***}	
			1.60±0.20	G	R		
		3.20±0.40	2.00±0.20	K	R		
			2.50±0.30	M	R		
2.80±0.30	U	R					

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

** For 1808/1812/1825_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 0201X334(16V&25V), 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: For 0402X475M6R3CT 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, 35V, 50V, 100V			
Operating temperature	-55 to +125°C		-55 to +85°C	-55 to +105°C	-55 to +125°C
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°C 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°C for 1 hour and then leave in ambient condition for 24±2 hours before measurement.



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7. CAPACITANCE RANGE

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

DIELECTRIC	NPO																				
	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
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	P	K	K	K	K	K	D	D	D	D		
0.033μF (333)	P	P	P	P	P	K	K	K	K	K	D	D	D	D		
0.039μF (393)	P	P	P	P	P	K	K	K	K	K	M	M	M	M		
0.047μF (473)	P	P	P	P	P	K	K	K	K	K	M	M	M	M		
0.056μF (563)	P	P	P	P	P						M	M	M	M		
0.068μF (683)	P	P	P	P	P						M	M	M	M		
0.082μF (823)	P	P	P	P	P						M	M	M	M		
0.1μF (104)	P	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.

Multilayer Ceramic Capacitors

Approval Sheet

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

DIELECTRIC		X7R																								
SIZE		0201					0402						0603						0805							
RATED VOLTAGE (VDC)		6.3	10	16	25	50	6.3	10	16	25	50	100	6.3	10	16	25	50	100	6.3	10	16	25	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		S	S	S	S	S		B	B	B		B	B	
	1,200pF (122)	L	L	L	L			N	N	N	N	N		S	S	S	S	S		B	B	B		B	B	
	1,500pF (152)	L	L	L	L			N	N	N	N	N		S	S	S	S	S		B	B	B		B	B	
	1,800pF (182)	L	L	L	L			N	N	N	N	N		S	S	S	S	S		B	B	B		B	B	
	2,200pF (222)	L	L	L	L			N	N	N	N	N		S	S	S	S	S		B	B	B		B	B	
	2,700pF (272)	L	L	L	L			N	N	N	N	N		S	S	S	S	S		B	B	B		B	B	
	3,300pF (332)	L	L	L	L			N	N	N	N	N		S	S	S	S	S		B	B	B		B	B	
	3,900pF (392)	L	L	L	L			N	N	N	N	N		S	S	S	S	S		B	B	B		B	B	
	4,700pF (472)	L	L	L	L		N	N	N	N	N	N		S	S	S	S	S		B	B	B		B	B	
	5,600pF (562)	L	L	L	L			N	N	N	N	N		S	S	S	S	S		B	B	B		B	B	
	6,800pF (682)	L	L	L				N	N	N	N	N		S	S	S	S	S		B	B	B		B	B	
	8,200pF (822)	L	L	L				N	N	N	N	N		S	S	S	S	S		B	B	B		B	B	
	0.010μF (103)	L	L	L	L			N	N	N	N	N		S	S	S	S	S		B	B	B		B	B	
	0.012μF (123)							N	N	N	N	N		S	S	S	S	X		B	B	B		B	B	
	0.015μF (153)							N	N	N	N	N		S	S	S	S	X		B	B	B		B	B	
	0.018μF (183)							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		S	S	S	S	X		B	B	B		B	B	
	0.027μF (273)							N	N	N	N	N		S	S	S	S	X		B	B	B		B	D	
	0.033μF (333)							N	N	N	N	N		S	S	S	S	X	X		B	B	B		B	D
	0.039μF (393)							N	N	N	N	N		S	S	S	S	X	X		B	B	B		B	D
0.047μF (473)							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)							N	N					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	I				
2.2μF (225)													X	X	X				I	I	I	I	I			
3.3μF (335)																										
4.7μF (475)													X	X					I	I	I	I				
6.8μF (685)																			I	I	I*					
10μF (106)																			I	I	I*					
22μF (226)																										

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

Multilayer Ceramic Capacitors

Approval Sheet

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

DIELECTRIC		X7R																		
SIZE		1206						1210						1812						
RATED VOLTAGE (VDC)		6.3	10	16	25	35	50	100	6.3	10	16	25	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	C	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	D	D	K	K	
2.2µF (225)		J	J	J	P		P			G	G		M	M	G	G	G	M	M	
3.3µF (335)			P	P	P		P			G	G		M		K	K	K	K		
4.7µF (475)		P	P	P	P		P			K	K	K		M	M	M	M	M		
6.8µF (685)															M	M	M	M		
10µF (106)		P	P	P	P	P			K	K	K	M	M		M	M	M	M		
22µF (226)		P	P	P*						M	M	M			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

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	63	4	6.3	10	16	25	35	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	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	L				N	N	N	N	N	N		X	X	X	X		
	0.33μF (334)	L	L	L	L				N	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	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				J	J	P	P			K	K				
	3.3μF (335)		I	I	I	I				P	P	P	P								
	4.7μF (475)		I	I	I	I				P	P	P	P			K	K	K			
	6.8μF (685)									P	P										
	10μF (106)		I	I	I	I	I			P	P	P	P	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*			
220μF (227)								P*	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.

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
1.60+0.30/-0.10	P	-	-	2,000	9,000	
1210 (3225)	0.85±0.10	T	-	-	3,000	10,000
	0.95±0.10	C	-	-	3,000	10,000
	1.25±0.10	D	-	-	3,000	10,000
	1.60±0.20	G	-	-	2,000	-
	2.00±0.20	K	-	-	1,000	6,000
2.50±0.30	M	-	-	1,000	6,000	
1808 (4520)	1.25±0.10	D	-	-	2,000	10,000
	1.40±0.15	F	-	-	2,000	10,000
	1.60±0.20	G	-	-	2,000	8,000
	2.00±0.20	K	-	-	1,000	6,000
1812 (4532)	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

Multilayer Ceramic Capacitors

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 #1: 0201 ≥ 224 (6.3V,10V,16V), 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);224(16V), 0402X475M6R3, 0402X106M100 (1.0±0.2Vrms · 1KHz±10%) *Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.	NP0: Cap≥30pF, Q≥1000; Cap<30pF,Q≥400+20C X7R:																																																																																
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10V	≤ 5%	≤ 10%	0201 ≥ 0.012μF; 0402 ≥ 0.22μF; 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF; 01R5/X5R																																																																																
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* "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																																																																														
4.	Dielectric Strength	* To apply voltage ($\leq 100V$) 250%. * Duration: 1 to 5 sec. * Charge and discharge current less than 50mA.	<table border="1"> <thead> <tr> <th colspan="4">X6S:</th> </tr> <tr> <th>Rated vol.</th> <th>D.F. \leq</th> <th colspan="2">Exception of D.F. \leq</th> </tr> </thead> <tbody> <tr> <td rowspan="3">$\geq 100V$</td> <td rowspan="3">$\leq 2.5\%$</td> <td>$\leq 3\%$</td> <td colspan="2">1206 $\geq 0.47\mu F$</td> </tr> <tr> <td>$\leq 5\%$</td> <td colspan="2">0603 $\geq 0.068\mu F$; 0805 $> 0.1\mu F$; 1206 $\geq 1\mu F$; 1210 $\geq 2.2\mu F$</td> </tr> <tr> <td>$\leq 10\%$</td> <td colspan="2">0805 $> 0.22\mu F$; 1210 $\geq 3.3\mu F$</td> </tr> <tr> <td rowspan="3">50V</td> <td rowspan="3">$\leq 2.5\%$</td> <td>$\leq 3\%$</td> <td colspan="2">0201(50V); 0603 $\geq 0.047\mu F$; 0805 $\geq 0.18\mu F$; 1206 $\geq 0.47\mu F$</td> </tr> <tr> <td>$\leq 5\%$</td> <td colspan="2">0201 $\geq 0.01\mu F$; 1210 $\geq 3.3\mu F$</td> </tr> <tr> <td>$\leq 10\%$</td> <td colspan="2">0402 $\geq 0.012\mu F$; 0603 $> 0.1\mu F$; 0805 $\geq 1\mu F$; 1206 $\geq 2.2\mu F$; 1210 $\geq 10\mu F$</td> </tr> <tr> <td>35V</td> <td>$\leq 3.5\%$</td> <td>$\leq 10\%$</td> <td colspan="2">0603 $\geq 1\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 2.2\mu F$; 1210 $\geq 10\mu F$</td> </tr> <tr> <td rowspan="3">25V</td> <td rowspan="3">$\leq 3.5\%$</td> <td>$\leq 5\%$</td> <td colspan="2">0201 $\geq 0.01\mu F$; 0402 $\geq 0.10\mu F$; 0603 $\geq 0.47\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 4.7\mu F$; 1210 $\geq 22\mu F$</td> </tr> <tr> <td>$\leq 7\%$</td> <td colspan="2">0603 $\geq 0.33\mu F$</td> </tr> <tr> <td>$\leq 10\%$</td> <td colspan="2">0201 $\geq 0.1\mu F$; 0402 $\geq 0.10\mu F$; 0603 $\geq 0.47\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 4.7\mu F$; 1210 $\geq 22\mu F$</td> </tr> <tr> <td rowspan="3">16V</td> <td rowspan="3">$\leq 3.5\%$</td> <td>$\leq 12.5\%$</td> <td colspan="2">0402 $\geq 0.33\mu F$; 0805 = 10μF</td> </tr> <tr> <td>$\leq 5\%$</td> <td colspan="2">0201 $\geq 0.01\mu F$; 0402 $\geq 0.033\mu F$; 0603 $\geq 0.15\mu F$; 0805 $\geq 0.68\mu F$; 1206 $\geq 2.2\mu F$; 1210 $\geq 4.7\mu F$</td> </tr> <tr> <td>$\leq 10\%$</td> <td colspan="2">0201 $\geq 0.1\mu F$; 0402 $\geq 0.22\mu F$; 0603 $> 0.47\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 4.7\mu F$; 1210 $\geq 22\mu F$</td> </tr> <tr> <td rowspan="3">10V</td> <td rowspan="3">$\leq 5\%$</td> <td>$\leq 12.5\%$</td> <td colspan="2">0402 = 1μF; 0805 = 10μF</td> </tr> <tr> <td>$\leq 10\%$</td> <td colspan="2">0201 $\geq 0.012\mu F$; 0402 $\geq 0.22\mu F$; 0603 $\geq 0.33\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 2.2\mu F$; 1210 $\geq 22\mu F$</td> </tr> <tr> <td>$\leq 15\%$</td> <td colspan="2">0201 $\geq 0.1\mu F$; 0402 $\geq 1\mu F$</td> </tr> <tr> <td>6.3V</td> <td>$\leq 10\%$</td> <td>$\leq 15\%$</td> <td colspan="2">0201 $\geq 0.1\mu F$; 0402 $\geq 0.47\mu F$; 0603 $\geq 10\mu F$; 0805 $\geq 4.7\mu F$; 1206 $\geq 47\mu F$; 1210 $\geq 100\mu F$</td> </tr> <tr> <td>4V</td> <td>$\leq 15\%$</td> <td>---</td> <td colspan="2">---</td> </tr> </tbody> </table>	X6S:				Rated vol.	D.F. \leq	Exception of D.F. \leq		$\geq 100V$	$\leq 2.5\%$	$\leq 3\%$	1206 $\geq 0.47\mu F$		$\leq 5\%$	0603 $\geq 0.068\mu F$; 0805 $> 0.1\mu F$; 1206 $\geq 1\mu F$; 1210 $\geq 2.2\mu F$		$\leq 10\%$	0805 $> 0.22\mu F$; 1210 $\geq 3.3\mu F$		50V	$\leq 2.5\%$	$\leq 3\%$	0201(50V); 0603 $\geq 0.047\mu F$; 0805 $\geq 0.18\mu F$; 1206 $\geq 0.47\mu F$		$\leq 5\%$	0201 $\geq 0.01\mu F$; 1210 $\geq 3.3\mu F$		$\leq 10\%$	0402 $\geq 0.012\mu F$; 0603 $> 0.1\mu F$; 0805 $\geq 1\mu F$; 1206 $\geq 2.2\mu F$; 1210 $\geq 10\mu F$		35V	$\leq 3.5\%$	$\leq 10\%$	0603 $\geq 1\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 2.2\mu F$; 1210 $\geq 10\mu F$		25V	$\leq 3.5\%$	$\leq 5\%$	0201 $\geq 0.01\mu F$; 0402 $\geq 0.10\mu F$; 0603 $\geq 0.47\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 4.7\mu F$; 1210 $\geq 22\mu F$		$\leq 7\%$	0603 $\geq 0.33\mu F$		$\leq 10\%$	0201 $\geq 0.1\mu F$; 0402 $\geq 0.10\mu F$; 0603 $\geq 0.47\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 4.7\mu F$; 1210 $\geq 22\mu F$		16V	$\leq 3.5\%$	$\leq 12.5\%$	0402 $\geq 0.33\mu F$; 0805 = 10 μF		$\leq 5\%$	0201 $\geq 0.01\mu F$; 0402 $\geq 0.033\mu F$; 0603 $\geq 0.15\mu F$; 0805 $\geq 0.68\mu F$; 1206 $\geq 2.2\mu F$; 1210 $\geq 4.7\mu F$		$\leq 10\%$	0201 $\geq 0.1\mu F$; 0402 $\geq 0.22\mu F$; 0603 $> 0.47\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 4.7\mu F$; 1210 $\geq 22\mu F$		10V	$\leq 5\%$	$\leq 12.5\%$	0402 = 1 μF ; 0805 = 10 μF		$\leq 10\%$	0201 $\geq 0.012\mu F$; 0402 $\geq 0.22\mu F$; 0603 $\geq 0.33\mu F$; 0805 $\geq 2.2\mu F$; 1206 $\geq 2.2\mu F$; 1210 $\geq 22\mu F$		$\leq 15\%$	0201 $\geq 0.1\mu F$; 0402 $\geq 1\mu F$		6.3V	$\leq 10\%$	$\leq 15\%$	0201 $\geq 0.1\mu F$; 0402 $\geq 0.47\mu F$; 0603 $\geq 10\mu F$; 0805 $\geq 4.7\mu F$; 1206 $\geq 47\mu F$; 1210 $\geq 100\mu F$		4V	$\leq 15\%$	---	---	
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			* No evidence of damage or flash over during test.																																																																														

* "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																								
5.	Insulation Resistance	*Test temp.: Room Temperature. *To apply rated voltage for MAX. 120sec.	10GΩ or RxC ≥ 500Ω·F whichever is smaller. Class II (X7R, X7E, X5R, X6S, X7S, Y5V:)																								
			Rated voltage	Insulation Resistance																							
			100V: All X7R	10GΩ or RxC ≥ 100 Ω·F whichever is smaller.																							
			50V: 0402 > 0.01μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF																								
			35V: 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF																								
			25V: 0402 ≥ 1μF; 0603 ≥ 2.2μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 10μF																								
			16V: 0201 ≥ 0.1μF; 0402 ≥ 0.22μF; 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 47μF																								
			10V: 0201 ≥ 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 47μF																								
			6.3V; 4V; Size ≥ 1812																								
			Rated voltage		Insulation Resistance																						
			All X6S items, All X7S items		RxC ≥ 50 Ω·F.																						
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6.	Temperature Coefficient	With no electrical load.	<table border="1"> <thead> <tr> <th>T.C.</th> <th>Operating Temp</th> <th>T.C.</th> <th>Capacitance Change</th> </tr> </thead> <tbody> <tr> <td>NPO</td> <td>-55~125°C at 25°C</td> <td>NPO</td> <td>Within ±30ppm/°C</td> </tr> <tr> <td>X7R</td> <td>-55~125°C at 25°C</td> <td>X7R</td> <td>Within ±15%</td> </tr> <tr> <td>X7S</td> <td>-55 ~ 125°C at 25°C</td> <td>X7S</td> <td>Within ±22%</td> </tr> <tr> <td>X5R</td> <td>-55~ 85°C at 25°C</td> <td>X5R</td> <td>Within ±15%</td> </tr> <tr> <td>X6S</td> <td>-55~105°C at 25°C</td> <td>X6S</td> <td>Within ±22%</td> </tr> </tbody> </table>	T.C.	Operating Temp	T.C.	Capacitance Change	NPO	-55~125°C at 25°C	NPO	Within ±30ppm/°C	X7R	-55~125°C at 25°C	X7R	Within ±15%	X7S	-55 ~ 125°C at 25°C	X7S	Within ±22%	X5R	-55~ 85°C at 25°C	X5R	Within ±15%	X6S	-55~105°C at 25°C	X6S	Within ±22%
			T.C.	Operating Temp	T.C.	Capacitance Change																					
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* "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															
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°C for 1hr then set for 24±2 hrs at room temp. * Cap./DF(Q) Measurement to be made after de-aging at 150°C 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°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. * 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 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°C * Dipping time: 10±1 sec * Preheating: 120 to 150°C for 1 minute before immerse the capacitor in a eutectic solder. * Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp. * Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.	* 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 border="1" style="margin-left: 20px;"> <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): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp. * Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.	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 : 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.
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Multilayer Ceramic Capacitors

No.	Item	Test Condition	Requirements																																					
13.	Humidity (Damp Heat) Steady State	*Test temp.: 40±2°C	* No remarkable damage.																																					
		*Humidity: 90~95%RH	* Cap change:																																					
		*Test time: 500+24/-0hrs.	NP0: within ±5% or 0.5pF whichever is larger																																					
		*Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.	X7R, X5R, X6S, X7S: ≥10V**, within ±12.5%; ≤6.3V within ±25%;																																					
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			NP0: More than 30pF Q≥350, 10pF≤C≤30pF, Q≥275+2.5C																																					
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Multilayer Ceramic Capacitors

No	Item	Test Condition	Requirements																																					
14	Humidity (Damp Heat) Load	*Test temp. : 40±2°C	* No remarkable damage.																																					
		*Humidity : 90~95%RH	Cap change:																																					
		*Test time : 500+24/-0 hrs.	NP0: ±7.5% or 0.75pF whichever is larger.																																					
		*To apply voltage :	X7R, X5R, X6S, X7S: ≥10V**, within ±12.5%; ≤6.3V within ±25%;																																					
		Rated voltage (MAX. 500V)	**10V: 0603 ≥4.7μF; 0402 ≥1μF; 0201 ≥0.1μF, within ±25%;																																					
		*Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.	Y5V: ≥10V, within ±30%; ≤6.3V, within +30/-40%																																					
		* Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.	Q/D.F. value:																																					
			NP0: C≥30pF, Q≥200; C<30pF, Q≥100+10/3C																																					
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Multilayer Ceramic Capacitors

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15.	High Temperature Load (Endurance)	Test temp. : NP0, X7R/X7E/X7S: 125±3°C X6S: 105±3°C X5R, 85±3°C 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:																																																																										
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TT21	X5R/X7R/X6S	≤10V	C≥10μF																																																																										
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* Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp. Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.																																																																													
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The general MLCC products are designed for use in devices with a typical lifetime around 10 years. The general MLCC products are designed so that the useful lifetime can be extended longer than 10 years under the following conditions: 「80% of the rated voltage or less, Maximum operating temperature -20 degree C or less」 Extended useful lifetime, under specific operating conditions, can be estimated from the chart. *The useful lifetime is the time when cumulative failure rate becomes 1%. *Please note that the useful lifetime data is for reference only and not guaranteed.																																																																													

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

Multilayer Ceramic Capacitors

APPENDIXES

■ **Tape & reel dimensions**

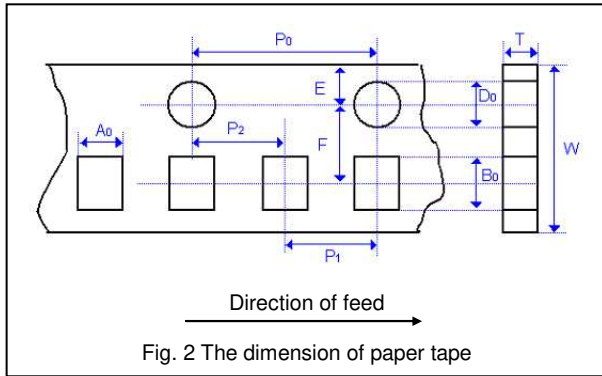


Fig. 2 The dimension of paper tape

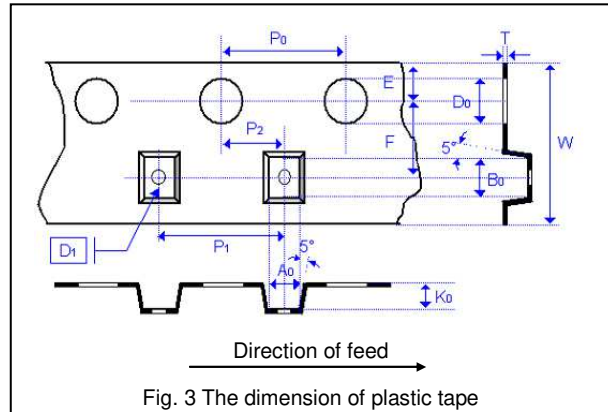


Fig. 3 The dimension of plastic tape

Size	0201	0402	0603	0805			1206			1210				1808		1812		
Thickness	L	N,E	S,H,X	A,H	B,T	D,I	B,T	C,J,D	G,P	T	C,D	G,K	M	D,F	G,K	D,F	G,K	M,U
A ₀	0.40 +/-0.10	0.70 +/-0.20	1.05 +/-0.30	1.50 +/-0.20	1.50 +/-0.20	< 1.80	1.90 +/-0.50	< 2.00	< 2.30	< 3.05	< 3.05	< 3.05	< 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	≤ 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	0.25 +/-0.1	0.25 +/-0.1	0.25 +/-0.1	0.25 +/-0.1	0.25 +/-0.1
K ₀	0.44 +/-0.05	-	-	-	-	< 2.50	-	< 2.50	< 2.50	< 1.50	< 2.00	< 2.50	< 3.20	< 2.50	< 2.50	< 2.50	< 2.50	< 3.50
W	8.00 +/-0.30	8.00 +/-0.30	8.00 +/-0.30	8.00 +/-0.30	8.00 +/-0.30	8.00 +/-0.30	8.00 +/-0.30	8.00 +/-0.30	8.00 +/-0.30	8.00 +/-0.30	8.00 +/-0.30	8.00 +/-0.30	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 +/-0.10	2.00 +/-0.10	2.00 +/-0.10	2.00 +/-0.10	2.00 +/-0.10
D ₀	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0	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	1.50 +/-0.10	1.50 +/-0.10	1.50 +/-0.10
E	1.75 +/-0.10	1.75 +/-0.10	1.75 +/-0.10	1.75 +/-0.10	1.75 +/-0.10	1.75 +/-0.10	1.75 +/-0.10	1.75 +/-0.10	1.75 +/-0.10	1.75 +/-0.10	1.75 +/-0.10	1.75 +/-0.10	1.75 +/-0.10	1.75 +/-0.10	1.75 +/-0.10	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 +/-0.10	3.50 +/-0.10	5.50 +/-0.10	5.50 +/-0.10	5.50 +/-0.10

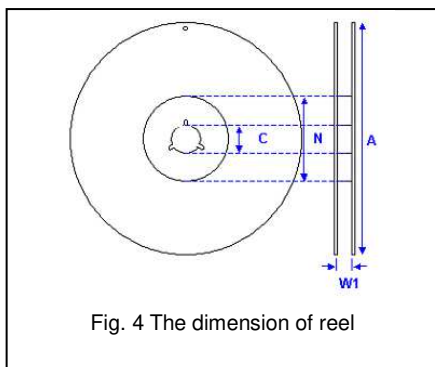
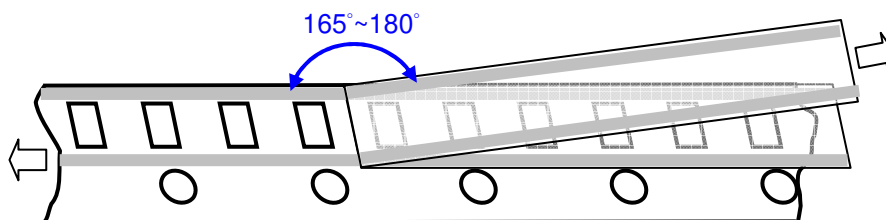


Fig. 4 The dimension of reel

Size	0201, 0402, 0603, 0805, 1206, 1210			1812
Reel size	7"	10"	13"	7"
C	13.0±0.5	13.0±0.5	13.0±0.5	13.0±0.5
W ₁	10.0±1.5	10.0±1.5	10.0±1.5	12.4±2.0/-0
A	178.0±2.0	250.0±2.0	330.0±2.0	178.0±2.0
N	60.0±1.0/-0	50 min	50 min	60.0±1.0/-0

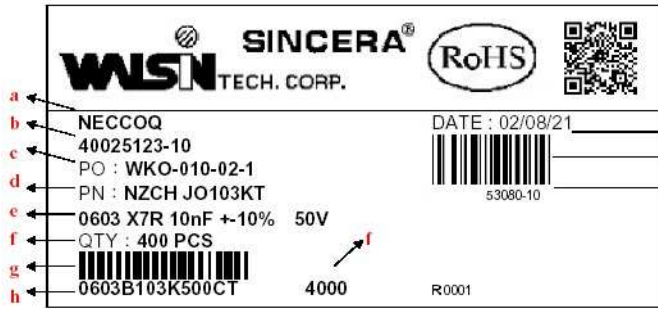
■ **Peeling force (EIA-481)**

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



- 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

*Customized label is available upon request

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

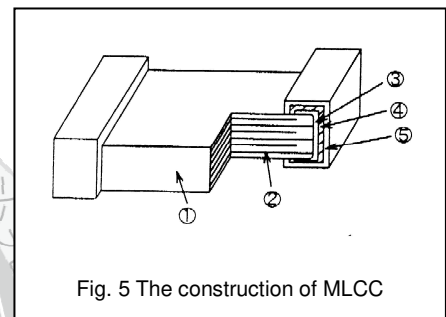


Fig. 5 The construction of MLCC

Storage and handling conditions

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

Cautions:

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

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.

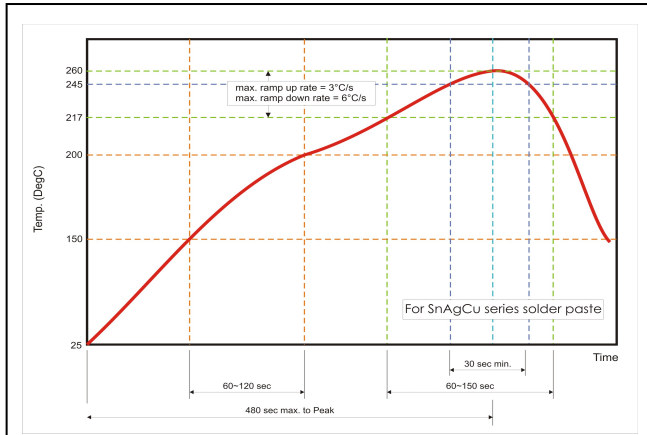


Fig. 6 Recommended reflow soldering profile for SMT process with SnAgCu series solder paste.

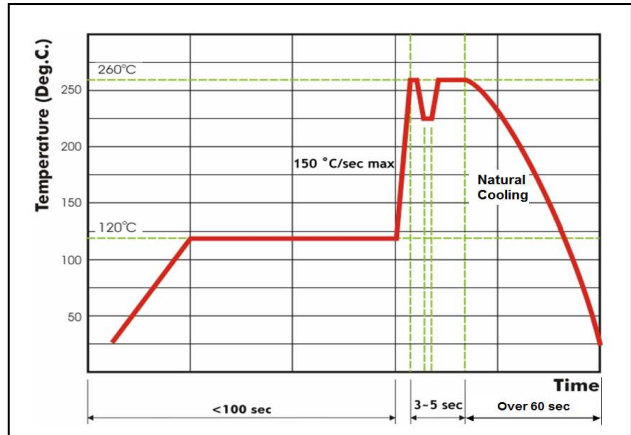


Fig. 7 Recommended wave soldering profile for SMT process with SnAgCu series solder.



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