General Purpose Multilayer Ceramic Capacitors
4 to 100V (NP0, X7R, Y5V, X6S, X7S & X5R Dielectrics)

multicomp PRO

RoHS Compliant

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

Features

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

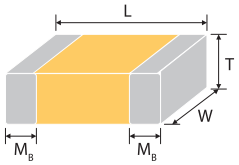
Application

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

How To Order

1206 Size	B Dielectric	104 Capacitance	K Tolerance	500 Rated Voltage	C Termination	T Packaging style
Inch (mm) 0201 (0603) 0402 (1005) 0603 (1608) 0805 (2012) 1206 (3216) 1210 (3225) 1812 (4532)	N=NP0 (C0G) 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 = 10×10^4 = 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=4V DC 6R3=6.3V DC 100=10V DC 160=16V DC 250=25V DC 350=35V DC 500=50V DC 101=100V DC	C=Cu/Ni/Sn	T=7″ reeled G=13″ reeled

External Dimensions



The outline of MLCC

Size Inch (mm)	L (mm)	W (mm)	T (mm)/Symbol		Soldering Method *	M_B (mm)
01R5 (0402)	0.4 ±0.02	0.2 ±0.02	0.2 ±0.02	V	R	0.1 ±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			
	0.6±0.09#3	0.3 ±0.09#3	0.3 ±0.09#3			0.15 +0.1/-0.05
0402 (1005)	1 ±0.05	0.5 ±0.05	0.5 ±0.05	N	R	0.25 +0.05/-0.1
			0.5 +0.02/-0.05	Q		
	1 ±0.2	0.5 ±0.2	0.5 ±0.2	E		
	1 ±0.15#6	0.5 ±0.15#6	0.5 ±0.15#6			

Newark.com/multicomp-pro
Farnell.com/multicomp-pro
sg.element14.com/b/multicomp-pro

multicomp PRO

Size Inch (mm)	L (mm)	W (mm)	T (mm)/Symbol		Soldering Method *	M_B (mm)
0603 (1608)	1.6 ±0.1	0.8 ±0.1	0.8 ±0.07	S	R / W	0.4 ±0.15
	1.6 +0.15/-0.1	0.8 +0.15/-0.1	0.5 ±0.1	H	R / W	
			0.8 +0.15/-0.1	X	R / W	
	1.6 ±0.2[#1]	0.8 ±0.2[#1]	0.8 ±0.2[#1]			
0805 (2012)	2 ±0.15	1.25 ±0.1	0.5 ±0.1	H	R / W	0.5 ±0.2
			0.6 ±0.1	A	R / W	
			0.8 ±0.1	B	R / W	
			1.25 ±0.1	D	R	
	2 ±0.2	1.25 ±0.2	0.85 ±0.1	T	R / W	
			1.25 ±0.2	I	R	
1206 (3216)	3.2 ±0.15	1.6 ±0.15	0.8 ±0.1	B	R / W	0.6 ±0.2 (0.5±0.25)***
			0.95 ±0.1	C	R	
			1.25 ±0.1	D	R	
	3.2 ±0.2		1.15 ±0.15	J	R	
		1.6 ±0.2	1.6 ±0.2	G	R	
			0.85 ±0.1	T	R / W	
	3.2 +0.3/-0.1 3.3 +0.3/-0.1[#5]	1.6 +0.3/-0.1	1.6 +0.3/-0.1	P	R	
1210 (3225)	3.2 ±0.3	2.5±0.2	0.95 ±0.1	C	R	0.75 ±0.25
			0.85 ±0.1	T	R	
			1.25 ±0.1	D	R	
	3.2±0.4	2.5±0.3	1.6 ±0.2	G	R	
			2 ±0.2	K	R	
			2.5 ±0.3	M	R	
	3.20 ±0.6[#4]	2.5 ±0.5[#4]	2.5 ±0.5[#4]			
1808 (4520)	4.5 ±0.4 (4.5+0.5/-0.3)**	2.03 ±0.25	1.25 ±0.1	D	R	0.75 ±0.25 (0.5±0.25)***
			1.4 ±0.15	F	R	
			1.6 ±0.2	G	R	
			2 ±0.2	K	R	
1812 (4532)	4.5 ±0.4 4.5+0.5/-0.3)**	3.2 ±0.3	1.25 ±0.1	D	R	0.75 ±0.25 0.5±0.25)***
			1.6 ±0.2	G	R	
			2 ±0.2	K	R	
		3.2 ±0.4	2.5 ±0.3	M	R	
			2.8 ±0.3	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/Cap≧4.7μF(≦6.3V) or 0603/Cap>1μF(>10V) products.
#2 : For 0201/Cap≧0.68μF products.
#3 : For 0201/Cap≧1μF products.
#4 : For 1210_100V: Cap > 1μF, 250V: Cap >0. 47μF, 400V~630V: Cap >0.22μF.

General Electrical Data

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

#1: NP0, 0.1pF product only provide B tolerance; 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: Refer “Reliability test conditions and requirements” details.
Y5V: Apply 1.0±0.2Vrms, 1kHz±10%, at 20°C ambient temperature.
** Preconditioning for Class II MLCC: Perform a heat treatment at 150±10°C for 1 hour, then leave in ambient condition for 24±2 hours before measurement.

Capacitance Range

NP0 Dielectric 0201, 0402, 0603, 0805 Sizes

Dielectric		NP0																			
Size		0201					0402					0603					0805				
Rated Voltage (V DC)		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

Dielectric		NP0																			
Size		0201					0402					0603					0805				
Rated Voltage (V DC)		10	16	25	50	100	10	16	25	50	100	10	16	25	50	100	10	16	25	50	100
Capacitance	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
	0.010µF (103)											X	X	X	X	X	D	D	D	D	D
	0.012µF (123)																D	D	D	D	D
	0.015µF (153)																D	D	D	D	D
	0.018µF (183)																D	D	D	D	D
	0.022µF (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.

NP0 Dielectric 1206, 1210, 1812 Sizes

Dielectric		NP0													
Size		1206					1210					1812			
Rated Voltage (V DC)		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									

Dielectric		NP0													
Size		1206					1210					1812			
Rated Voltage (V DC)		10	16	25	50	100	10	16	25	50	100	16	25	50	100
Capacitance	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

Dielectric		NP0													
Size		1206					1210					1812			
Rated Voltage (V DC)		10	16	25	50	100	10	16	25	50	100	16	25	50	100
Capacitance	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.

X7R Dielectric 0201, 0402, 0603, 0805 Sizes

Dielectric		X7R																						
Size		0201					0402						0603						0805					
Rated Voltage (V DC)		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		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				N	N	N	N	N		S	S	S	S	S		B	B	B		B	B
	2,200pF (222)	L	L	L				N	N	N	N	N		S	S	S	S	S		B	B	B		B	B

Dielectric		X7R																						
Size		0201					0402						0603						0805					
Rated Voltage (V DC)		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	2,700pF (272)	L	L	L				N	N	N	N	N		S	S	S	S	S		B	B	B		B	B
	3,300pF (332)	L	L	L				N	N	N	N	N		S	S	S	S	S		B	B	B		B	B
	3,900pF (392)	L	L	L				N	N	N	N	N		S	S	S	S	S		B	B	B		B	B
	4,700pF (472)	L	L	L			N	N	N	N	N	N		S	S	S	S	S		B	B	B		B	B
	5,600pF (562)	L	L					N	N	N	N			S	S	S	S	S		B	B	B		B	B
	6,800pF (682)	L	L					N	N	N	N			S	S	S	S	S		B	B	B		B	B
	8,200pF (822)	L	L					N	N	N	N			S	S	S	S	S		B	B	B		B	B
	0.010µF (103)	L	L	L			N	N	N	N	N			S	S	S	S	S		B	B	B		B	B
	0.012µF (123)							N	N	N	N			S	S	S	S	X		B	B	B		B	B
	0.015µF (153)							N	N	N	N			S	S	S	S	X		B	B	B		B	B
	0.018µF (183)							N	N	N	N			S	S	S	S	X		B	B	B		B	B
	0.022µF (223)						N	N	N	N	N			S	S	S	S	X		B	B	B		B	B
	0.027µF (273)							N	N	N	N			S	S	S	S	X		B	B	B		B	D
	0.033µF (333)							N	N	N	N			S	S	S	X	X		B	B	B		B	D
	0.039µF (393)							N	N	N	N			S	S	S	X	X		B	B	B		B	D
	0.047µF (473)							N	N	N	N			S	S	S	X	X		B	B	B		B	D
	0.056µF (563)							N	N		E			S	S	S	X	X		B	B	B		B	D
	0.068µF (683)							N	N		E			S	S	S	X	X		B	B	B		B	D
	0.082µF (823)							N	N		E			S	S	S	X	X		B	B	B		B	D
	0.10µF (104)						N	N	N	N	E			S	S	S	X	X		B	B	B		B	D
	0.12µF (124)													S	S	X				B	B	B		B	I
	0.15µF (154)								N					S	S	X	X			D	D	D		D	I
	0.18µF (184)													S	S	X				D	D	D		D	I
	0.22µF (224)						N	N	N	N				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			
	2.2µF (225)												X	X	X				I	I	I	I	I	I	
	3.3µF (335)																								
	4.7µF (475)												X	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.

X7R Dielectric 1206, 1210, 1812 Sizes

Dielectric		X7R																		
Size		1206							1210							1812				
Rated Voltage (V DC)		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	D		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

Dielectric		X7R																		
Size		1206							1210							1812				
Rated Voltage (V DC)		6.3	10	16	25	35	50	100	6.3	10	16	25	35	50	100	10	16	25	50	100
Capacitance	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	P		P				G	G		M	M	D	D	D	K	K
	2.2µF (225)		J	J	P		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			K	K	K		M	M	M	M	M	M	
	6.8µF (685)															M	M	M	M	
	10µF (106)	P	P	P	P	P			K	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.

Y5V Dielectric 0402, 0603, 0805 Sizes

Dielectric		Y5V															
Size		0402					0603					0805					
Rated Voltage (VDC)		6.3	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50	100
Capacitance	0.01µF (103)		N	N	N	N		S	S	S	S		A	A	A	A	B
	0.015µF (153)		N	N	N	N		S	S	S	S		A	A	A	A	B
	0.022µF (223)		N	N	N	N		S	S	S	S		A	A	A	A	B
	0.033µF (333)		N	N	N	N		S	S	S	S		A	A	A	A	B
	0.047µF (473)		N	N	N			S	S	S	S		A	A	A	A	B
	0.068µF (683)		N	N	N			S	S	S	S		A	A	A	A	B
	0.10µF (104)		N	N	N			S	S	S	S		A	A	A	A	B
	0.15µF (154)		N	N				S	S	S	S		A	A	A	A	
	0.22µF (224)	N	N	N				S	S	S	S		A	A	A	A	
	0.33µF (334)	N	N	N				S	S	S	X		B	B	B	B	
	0.47µF (474)	N	N	N				S	S	X	X		B	B	B	B	
	0.68µF (684)	N						S	X	X			B	B	D	D	
	1.0µF (105)	N	N					S	X	X			B	B	D	D	
	1.5µF (155)							S					D	D			
	2.2µF (225)						S	S	X				D	D	I		

Dielectric		Y5V															
Size		0402					0603					0805					
Rated Voltage (VDC)		6.3	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50	100
Capacitance	3.3µF (335)												D	D			
	4.7µF (475)						X	X					D	D	I		
	6.8µF (685)												I				
	10µF (106)											I	I	I			
	22µF (226)											I	I				

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

Y5V Dielectric 1206, 1210, 1812 Sizes

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

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

X5R Dielectric 0201, 0402, 0603, 0805, 1206, 1210 Sizes

Dielectric		X5R																		
Size		0201					0402							0603						
Rated Voltage (V DC)		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				X	X	X	X		
	0.47µF (474)	L	L					N	N	N	N				X	X	X	X		X
	0.68µF (684)							N	N						X	X	X	X		
	0.82uF (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		
	6.8uF (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 (V DC)		4	6.3	10	16	25	50	4	6.3	10	16	25	50	63	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		
	6.8uF (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.

X6S Dielectric 0201, 0402, 0603, 0805, 1206, 1210 Sizes

Dielectric		X6S												
Size		0201				0402				0603				
Rated Voltage (VDC)		6.3	10	16	25	6.3	10	16	25	4	6.3	10	16	25
Capacitance	0.10μF (104)	L	L	L	L									
	0.15μF (154)													
	0.22μF (224)	L	L*											
	0.33μF (334)													
	0.47μF (474)					E								
	0.68μF (684)													
	1.0μF (105)	L*				E	E	E	E					
	1.5μF (155)													
	2.2μF (225)					E	E	E					X	X
	3.3μF (335)													
	4.7μF (475)										X	X	X	X
	6.8uF (685)													
	10μF (106)					E*					X*	X*	X*	
	22μF (226)									X*	X*			
	47μF (476)													
	100μF (107)													

Dielectric		X6S															
Size		0805						1206					1210				
Rated Voltage (VDC)		4	6.3	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50
Capacitance	0.10µF (104)																
	0.15µF (154)																
	0.22µF (224)																
	0.33µF (334)																
	0.47µF (474)																
	0.68µF (684)																
	1.0µF (105)																
	1.5µF (155)																
	2.2µF (225)																
	3.3µF (335)																
	4.7µF (475)					I	I										
	6.8uF (685)																
	10µF (106)	I	I	I	I	I					P						
	22µF (226)		I*	I*	I*				P	P*	P					M	
	47µF (476)	I*	I*					P					M	M	M		
	100µF (107)												M*	M*			

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

X7S Dielectric 0402, 0603, 0805, 1206, 1210 Sizes

Dielectric		X7S																				
Size		0402			0603				0805					1206					1210				
Rated Voltage (VDC)		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	1.0µF (105)		E										I										
	1.5µF (155)																						
	2.2µF (225)	E	E				X	X															
	3.3µF (335)																						
	4.7µF (475)					X	X					I											
	6.8uF (685)																						
	10µF (106)									I	I												
	22µF (226)															P*							
	47µF (476)													P*									
	100µF (107)																		P*				

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.

Packaging Dimension and Quantity

Size	Thickness (mm)/Symbol		Paper tape		Plastic tape	
			7″ reel	13″ reel	7″ reel	13″ reel
0201 (0603)	0.3 ±0.03	L	15,000	70,000	-	-
	0.3 ±0.05	L	15,000	50,000	-	-
	0.3 ±0.09	L	15,000	50,000	-	-
0603 (1608)	0.5 ±0.05	N	10,000	50,000	-	-
	0.5 +0.02/-0.05	Q	10,000	50,000	-	-
	0.5 ±0.20	E	10,000	-	-	-
0805 (2012)	0.5 ±0.10	H	4,000	-	-	-
	0.8 ±0.07	S	4,000	15,000	-	-
	0.8 +0.15/-0.10	X	4,000	15,000	-	-
0805 (2012)	0.5 ±0.10	H	4,000	15,000	-	-
	0.6 ±0.10	A	4,000	15,000	-	-
	0.8 ±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)	0.8 ±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
	1.6 ±0.20	G	-	-	2,000	10,000
	1.6 +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
	1.6 ±0.20	G	-	-	2,000	-
	2 ±0.20	K	-	-	1,000	6,000
	2.5 ±0.30	M	-	-	1,000	6,000
1808 (4520)	1.25 ±0.10	D	-	-	2,000	10,000
	1.4 ±0.15	F	-	-	2,000	10,000
	1.6 ±0.20	G	-	-	2,000	8,000
	2 ±0.20	K	-	-	1,000	6,000
1812 (4532)	1.25±0.10	D	-	-	1,000	5,000
	1.6 ±0.20	G	-	-	1,000	-
	2 ±0.20	K	-	-	1,000	-
	2.5 ±0.30	M	-	-	500	3,000
	2.8 ±0.30	U	-	-	500	-

Unit : pieces

Reliability Test Conditions And Requirements:

<table>
<tr><th>No</th><th>Item</th><th>Test Condition</th><th>Requirements</th></tr>
<tr><td>1</td><td>Visual and Mechanical</td><td>-</td><td>No remarkable defect.
Dimensions to conForm to individual specification sheet.</td></tr>
<tr><td>2</td><td>Capacitance</td><td rowspan="2">*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%

** 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</td><td>*Shall not exceed the limits given in the detailed spec.</td></tr>
<tr><td>3</td><td>Q/ D.F. (Dissipation Factor)</td><td>NP0: Cap≥30pF, Q≥1000; Cap<30pF,Q≥400+20C
X7R:
<table>
<tr><th>Rated vol.</th><th>D.F.≦</th><th colspan="2">Exception of D.F. ≦</th></tr>
<tr><td rowspan="3">≧100V</td><td rowspan="3">≦2.5%</td><td>≦3%</td><td>1206≧0.47μF</td></tr>
<tr><td>≦3.5%</td><td>1812≧4.7μF;1825≥4.7μF;2220≥4.7μF;2225≥ 4.7μF</td></tr>
<tr><td>≦5%</td><td>0805>0.1μF, 0603≧0.068μF,
1206>1μF;</td></tr>
<tr><td rowspan="4">≧50V</td><td rowspan="4">≦2.5%</td><td>≦3%</td><td>0201(50V); 0603≧0.047μF;
0805≧0.18μF;1206≧0.47μF</td></tr>
<tr><td>≦3.5%</td><td>1812≧4.7μF;1825≥4.7μF;2220≥4.7μF;2225≥ 4.7μF</td></tr>
<tr><td>≦5%</td><td>0201≧0.01uF; 0402≥0.012μF; 1210≧3.3μF</td></tr>
<tr><td>≦10%</td><td>0402≧0.1μF; 0603≧1μF; 0805≧1μF;
1206≧4.7μF; 1210≧10μF</td></tr>
<tr><td>35V</td><td>≦3.5%</td><td>≦10%</td><td>0603≧1μF; 0805≥2.2μF; 1206≧2.2μF;
1210≧10μF</td></tr>
<tr><td rowspan="4">25V</td><td rowspan="4">≦3.5%</td><td>≦5%</td><td>0201≧0.01μF;0805≧1μF; 1210≧10μF</td></tr>
<tr><td>≦7%</td><td>0603≧0.33μF; 1206≧4.7μF</td></tr>
<tr><td>≦10%</td><td>0402≧0.10μF;0603≧0.47μF;0805≧2.2μF;
1206≧6.8μF ; 1210≧22μF;</td></tr>
<tr><td>≦12.5%</td><td>0402≧0.33μF</td></tr>
</table>
<table>
<tr><th>Rated vol.</th><th>D.F.≦</th><th colspan="2">Exception of D.F. ≦</th></tr>
<tr><td rowspan="2">16V</td><td rowspan="2">≦3.5%</td><td>≦5%</td><td>0201≧0.01μF; 0402≧0.033μF; 0603≧0.15μF;
0805≧0.68μF; 1206≧2.2μF; 1210≧4.7μF</td></tr>
<tr><td>≦10%</td><td>0201/X7R≧0.022μF; 0402≧0.15uF;
0603>0.47μF; 0805≧2.2μF; 1206≧4.7μF;
1210≧22μF</td></tr>
<tr><td rowspan="2">10V</td><td rowspan="2">≦5%</td><td>≦10%</td><td>0201≧0.012μF; 0402≧0.15μF;
0603≧0.33μF; 0805≧2.2μF; 1206≧2.2μF;
1210≧22μF</td></tr>
<tr><td>≦15%</td><td>0201≧0.1μF; 0402≧1μF</td></tr>
<tr><td rowspan="2">6.3V</td><td rowspan="2">≦10%</td><td>≦15%</td><td>0201≧0.1μF;0402≧1μF;0603≧10μF;
0805≧4.7μF; 1206≧47μF :1210≧100μF;</td></tr>
<tr><td>≦20%</td><td>0402≧2.2μF</td></tr>
<tr><td>4V</td><td>≦15%</td><td>-</td><td>-</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>No</th><th>Item</th><th>Test Condition</th><th>Requirements</th></tr>
<tr>
<td></td>
<td>Q/ D.F.
(Dissipation Factor)</td>
<td>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.</td>
<td>X5R:
<table>
<tr><th>Rated vol.</th><th>D.F.≦</th><th colspan="2">Exception of D.F. ≦</th></tr>
<tr><td rowspan="3">≧100V</td><td rowspan="3">≦2.5%</td><td>≦3%</td><td>1206≧0.47μF</td></tr>
<tr><td>≦5%</td><td>0603≧0.068μF; 0805≧0.1μF; 1206≧1μF; 1210≧2.2μF</td></tr>
<tr><td>≦10%</td><td>0805>0.22μF; 1210≧3.3μF</td></tr>
<tr><td rowspan="4">≧50V</td><td rowspan="4">≦2.5%</td><td>≦3%</td><td>0201(50V); 0603≧0.047μF;
0805≧0.18μF;1206≧0.47μF</td></tr>
<tr><td>≦5%</td><td>0201≧0.01uF; 0402≧0.012μF;1210≧3.3μF</td></tr>
<tr><td>≦10%</td><td>0402≧0.047μF; 0603>0.1μF;
0805≧1μF;1206≧2.2μF; 1210≧10μF</td></tr>
<tr><td>≦12.5%</td><td>1206=10μF</td></tr>
<tr><td>35V</td><td>≦3.5%</td><td>≦10%</td><td>0603≧1μF; 0805≥2.2μF; 1206≧2.2μF;
1210≧10μF</td></tr>
<tr><td rowspan="4">25V</td><td rowspan="4">≦3.5%</td><td>≦5%</td><td>0201=0.01μF; 0805≧1μF</td></tr>
<tr><td>≦7%</td><td>0603≧0.33μF</td></tr>
<tr><td>≦10%</td><td>0201>0.01μF; 0402≧0.10μF; 0603≧0.47μF;
0805≧2.2μF; 1206≧4.7μF; 1210≧10μF</td></tr>
<tr><td>≦12.5%</td><td>0402≧0.33μF;0805=10μF</td></tr>
<tr><td rowspan="3">16V</td><td rowspan="3">≦3.5%</td><td>≦5%</td><td>0201=0.01μF; 0402≧0.033μF; 0603≧0.15μF;
0805≧0.68μF; 1206≧2.2μF; 1210≧4.7μF</td></tr>
<tr><td>≦10%</td><td>0201>0.01uF; 0402≧ 0.22uF;
0603>0.47μF; 0805≧2.2μF; 1206≧4.7μF;
1210≧22μF</td></tr>
<tr><td>≦12.5%</td><td>0402≧1μF;0805=10μF</td></tr>
<tr><td rowspan="3">10V</td><td rowspan="3">≦5%</td><td>≦10%</td><td>0201≧0.012μF; 0402≧0.22μF;
0603≧0.33μF; 0805≧2.2μF; 1206≧2.2μF;
1210≧22μF; 01R5/X5R</td></tr>
<tr><td>≦12.5%</td><td>0805=10μF</td></tr>
<tr><td>≦15%</td><td>0201>0.1μF; 0402≧1μF; 0603≧10μF</td></tr>
<tr><td rowspan="2">6.3V</td><td rowspan="2">≦10%</td><td>≦15%</td><td>0201>0.1μF; 0402≧1μF; 0603≧10μF;
0805≧4.7μF; 1206≧47μF; 1210≧100μF</td></tr>
<tr><td>≦20%</td><td>0402≧2.2μF</td></tr>
<tr><td>4V</td><td>≦15%</td><td>-</td><td>-</td></tr>
</table>
Y5V:
<table>
<tr><th>Rated vol.</th><th>D.F.≦</th><th colspan="2">Exception of D.F. ≦</th></tr>
<tr><td rowspan="2">≧50V</td><td rowspan="2">≦5%</td><td>≦7%</td><td>0603≧0.1μF;0805≧0.47μF;1206≧4.7μF</td></tr>
<tr><td>≦12.5%</td><td>1210≧6.8μF</td></tr>
<tr><td>35V</td><td>≦7%</td><td>-</td><td>-</td></tr>
<tr><td rowspan="2">25V</td><td rowspan="2">≦5%</td><td>≦7%</td><td>0402≧0.047μF;0603≧0.1μF;0805≧0.33μF;
1206≧1μF;1210≧4.7μF</td></tr>
<tr><td>≦9%</td><td>0402≧0.068μF;0603≧0.47μF;1206≧4.7μF;
1210≧22μF</td></tr>
<tr><td rowspan="2">16V
(C<1μF)</td><td rowspan="2">≦7%</td><td>≦9%</td><td>0402≧0.068μF;0603≧0.68μF</td></tr>
<tr><td>≦12.5%</td><td>0402≧0.22μF</td></tr>
<tr><td>16V
(C≧1.0μF)</td><td>≦9%</td><td>≦12.5%</td><td>0603≧2.2μF;0805≧3.3μF;1206≧10μF;
1210≧22μF;1812≧47μF</td></tr>
<tr><td>10V</td><td>≦12.5%</td><td>≦20%</td><td>0402≧0.47μF</td></tr>
<tr><td>6.3V</td><td>≦20%</td><td>-</td><td>-</td></tr>
</table>
</td>
</tr>
</table>

<table>
<tr><th>No</th><th>Item</th><th>Test Condition</th><th>Requirements</th></tr>
<tr><td></td><td>Q/ D.F.
(Dissipation
Factor)</td><td></td><td>X6S:
<table>
<tr><th>Rated vol.</th><th>D.F.≦</th><th colspan="2">Exception of D.F. ≦</th></tr>
<tr><td rowspan="3">≧100V</td><td rowspan="3">≦2.5%</td><td>≦3%</td><td>1206≧0.47μF</td></tr>
<tr><td>≦5%</td><td>0603≧0.068μF; 0805≧0.1μF; 1206≧1μF;
1210≧2.2μF</td></tr>
<tr><td>≦10%</td><td>0805>0.22μF; 1210≧3.3μF</td></tr>
<tr><td rowspan="3">≧50V</td><td rowspan="3">≦2.5%</td><td>≦3%</td><td>0201(50V); 0603≧0.047μF;
0805≧0.18μF;1206≧0.47μF</td></tr>
<tr><td>≦5%</td><td>0201≧0.01uF; 1210≧3.3μF</td></tr>
<tr><td>≦10%</td><td>0402≧0.012μF;0603>0.1μF; 0805≧1μF;
1206≧2.2μF;1210≧10μF</td></tr>
<tr><td>35V</td><td>≦3.5%</td><td>≦10%</td><td>0603≧1μF; 0805≥2.2μF; 1206≧2.2μF;
1210≧10μF</td></tr>
<tr><td rowspan="4">25V</td><td rowspan="4">≦3.5%</td><td>≦5%</td><td>0201≧0.01μF;0805≧1μF;1210≧10μF</td></tr>
<tr><td>≦7%</td><td>0603≧0.33μF</td></tr>
<tr><td>≦10%</td><td>0201≧0.1μF; 0402≧0.10μF;0603≧0.47μF;
0805≧2.2μF; 1206≧4.7μF;1210≧22μF</td></tr>
<tr><td>≦12.5%</td><td>0402≧0.33μF;0805=10μF</td></tr>
<tr><td rowspan="3">16V</td><td rowspan="3">≦3.5%</td><td>≦5%</td><td>0201=0.01μF; 0402≧0.033μF; 0603≧0.15μF;
0805≧0.68μF; 1206≧2.2μF; 1210≧4.7μF</td></tr>
<tr><td>≦10%</td><td>0201>0.01uF; 0402≧ 0.22uF;
0603>0.47μF; 0805≧2.2μF; 1206≧4.7μF;
1210≧22μF</td></tr>
<tr><td>≦12.5%</td><td>0402≧1μF;0805=10μF</td></tr>
<tr><td rowspan="3">10V</td><td rowspan="3">≦5%</td><td>≦10%</td><td>0201≧0.012μF; 0402≧0.22μF;
0603≧0.33μF; 0805≧2.2μF; 1206≧2.2μF;
1210≧22μF;</td></tr>
<tr><td>≦12.5%</td><td>0805=10μF</td></tr>
<tr><td>≦15%</td><td>0201>0.1μF; 0402≧1μF;</td></tr>
<tr><td rowspan="2">6.3V</td><td rowspan="2">≦10%</td><td>≦15%</td><td>0201>0.1μF; 0402≧1μF; 0603≧10μF;
0805≧4.7μF; 1206≧47μF; 1210≧100μF</td></tr>
<tr><td>≦20%</td><td>0402≧2.2μF</td></tr>
<tr><td>4V</td><td>≦15%</td><td>-</td><td>-</td></tr>
</table>
X7S:
<table>
<tr><th>Rated vol.</th><th>D.F.≦</th><th colspan="2">Exception of D.F. ≦</th></tr>
<tr><td rowspan="3">≧100V</td><td rowspan="3">≦2.5%</td><td>≦3%</td><td>1206≧0.47μF</td></tr>
<tr><td>≦5%</td><td>0603≧0.068μF; 0805≥0.1μF; 1206≧1μF;
1210≧2.2μF</td></tr>
<tr><td>≦10%</td><td>0805>0.22μF; 1210≧3.3μF</td></tr>
<tr><td rowspan="3">≧50V</td><td rowspan="3">≦2.5%</td><td>≦3%</td><td>0201(50V); 0603≧0.047μF;
0805≧0.18μF;1206≧0.47μF</td></tr>
<tr><td>≦5%</td><td>0201≧0.01uF; 1210≧3.3μF</td></tr>
<tr><td>≦10%</td><td>0402≧0.012μF;0603>0.1μF; 0805≧1μF;
1206≧2.2μF;1210≧10μF</td></tr>
<tr><td>35V</td><td>≦3.5%</td><td>≦10%</td><td>0603≧1μF; 0805≥2.2μF; 1206≧2.2μF;
1210≧10μF</td></tr>
<tr><td rowspan="4">25V</td><td rowspan="4">≦3.5%</td><td>≦5%</td><td>0201≧0.01μF;0805≧1μF;1210≧10μF</td></tr>
<tr><td>≦7%</td><td>0603≧0.33μF</td></tr>
<tr><td>≦10%</td><td>0201≧0.1μF; 0402≧0.10μF;0603≧0.47μF;
0805≧2.2μF; 1206≧4.7μF;1210≧22μF</td></tr>
<tr><td>≦12.5%</td><td>0402≧0.33μF</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>No</th><th>Item</th><th>Test Condition</th><th>Requirements</th></tr>
<tr><td></td><td>Q/ D.F.
(Dissipation
Factor)</td><td></td><td>
<table>
<tr><th>Rated vol.</th><th>D.F.≦</th><th colspan="2">Exception of D.F. ≦</th></tr>
<tr><td rowspan="2">16V</td><td rowspan="2">≦3.5%</td><td>≦5%</td><td>0201=0.01μF; 0402≧0.033μF; 0603≧0.15μF;
0805≧0.68μF; 1206≧2.2μF; 1210≧4.7μF</td></tr>
<tr><td>≦10%</td><td>0201>0.01uF; 0402≧ 0.22uF;
0603>0.47μF; 0805≧2.2μF; 1206≧4.7μF;
1210≧22μF</td></tr>
<tr><td rowspan="2">10V</td><td rowspan="2">≦5%</td><td>≦10%</td><td>0201≧0.012μF; 0402≧0.22μF;
0603≧0.33μF; 0805≧2.2μF; 1206≧2.2μF;
1210≧22μF;</td></tr>
<tr><td>≦15%</td><td>0201>0.1μF; 0402≧1μF;</td></tr>
<tr><td rowspan="2">6.3V</td><td rowspan="2">≦10%</td><td>≦15%</td><td>0201>0.1μF; 0402≧1μF; 0603≧10μF;
0805≧4.7μF; 1206≧47μF; 1210≧100μF</td></tr>
<tr><td>≦20%</td><td>0402≧2.2μF</td></tr>
<tr><td>4V</td><td>≦15%</td><td>-</td><td>-</td></tr>
</table>
</td></tr>
<tr><td>4</td><td>Dielectric
Strength</td><td>* To apply voltage (≤100V) 250%.
* Duration: 1 to 5 sec.
* Charge and discharge current less than 50mA.</td><td>* No evidence of damage or flash over during test.</td></tr>
<tr><td>5</td><td>Insulation
Resistance</td><td>*Test temp.: Room Temperature.
*To apply rated voltage for MAX. 120sec.</td><td>10GΩ or RxC≧500Ω-F whichever is smaller.
Class II (X7R, X7E, X5R,X6S,X7S,Y5V:)
<table>
<tr><th>Rated voltage</th><th>Insulation Resistance</th></tr>
<tr><td>100V: All X7R</td><td rowspan="8">10GΩ or RxC≧100 Ω-F whichever is smaller.</td></tr>
<tr><td>50V:0402>0.01μF;0603≥1μF;0805≥1μF;1206≥4.7μF;
1210≥4.7μF</td></tr>
<tr><td>35V:0805≥2.2μF;1206≧2.2μF;1210≧10μF</td></tr>
<tr><td>25V:0402≥1μF;0603≥2.2μF;0805≥2.2μF;1206≥10μF;
1210≥10μF</td></tr>
<tr><td>16V: 0201≥0.1μF,0402≥0.22μF;0603≥1μF;
0805≥2.2μF;1206≥10μF;1210≥47μF</td></tr>
<tr><td>10V: 0201≥47nF;0402≥0.47μF;0603≥0.47μF;
0805≥2.2μF; 1206≥4.7μF;1210≥47μF</td></tr>
<tr><td>6.3V ; 4V ; Size≥1812</td></tr>
<tr><td>All X6S items, All X7S items</td><td rowspan="9">RxC≧50 Ω-F.</td></tr>
<tr><td>100V: 1210≥3.3μF</td></tr>
<tr><td>50V: 0402≥0.1μF; 0603≥2.2μF; 0805≥10μF;1206≥10μF</td></tr>
<tr><td>35V: 0603≥1μF;</td></tr>
<tr><td>25V: 0201≥0.1μF; 0402≥2.2μF;0603≥10μF;
0805≥10μF;1206≥22μF</td></tr>
<tr><td>16V: 0603≥10μF; 0402≥1μF; 0201≥0.22μF</td></tr>
<tr><td>10V: 0201>0.1μF; 0402≥1μF; 0603≥10μF; 0805≥47μF</td></tr>
<tr><td>6.3V:0201≥0.1μF; 0402≥1μF; 0603>4.7μF; 0805≥47μF;
1206≥10μF</td></tr>
<tr><td>4V: 0603≥22μF; 0805≥47μF; 1206≥100μF</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>No</th><th>Item</th><th>Test Condition</th><th>Requirements</th></tr>
<tr><td>6</td><td>Temperature Coefficient</td><td>With no electrical load.
<table><tr><td>T.C.</td><td>Operating Temp</td></tr><tr><td>NPO</td><td>-55~125°C at 25°C</td></tr><tr><td>X7R</td><td>-55~125°C at 25°C</td></tr><tr><td>X7S</td><td>-55 ~ 125°C at 25°C</td></tr><tr><td>X5R</td><td>-55~ 85°C at 25°C</td></tr><tr><td>X6S</td><td>-55~105°C at 25°C</td></tr></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.
* Measurement voltage for Class II:</td><td><table><tr><td>T.C.</td><td>Capacitance Change</td></tr><tr><td>NPO</td><td>Within ±30ppm/°C</td></tr><tr><td>X7R</td><td>Within ±15%</td></tr><tr><td>X7S</td><td>Within ±22%</td></tr><tr><td>X5R</td><td>Within ±15%</td></tr><tr><td>X6S</td><td>Within ±22%</td></tr></table><table><tr><th>01005</th><th>0201</th></tr><tr><td>Cap≤0.01μF: 0.5V</td><td>Cap<0.1μF:1V</td></tr><tr><td>Cap>0.01μF: 0.2V</td><td>0.1μF≤Cap<1μF: 0.2V*</td></tr><tr><td></td><td>Cap≥1μF: 0.1V*</td></tr><tr><td>*0201X104/6.3V~25V: 0.5V
0201X224/10V~25V: 0.5V</td><td>*0201B104/6.3V~10V: 0.3V
0201S104/6.3V~16V: 0.3V
0201S224/6.3V: 0.3V
0201X334/474/105-6.3V&10V: 0.3V</td></tr><tr><th>0402</th><th>0603</th></tr><tr><td>Cap<1μF: 1V</td><td>Cap<1μF: 1V</td></tr><tr><td>Cap=1μF: 0.5V**
0402B224-16V: 0.5V
0402B334/474-6.3V&10V: 0.5V
0402S334/474-6.3V: 0.5V
0402X225/475-6.3V: 0.5V</td><td>1μF≤Cap≤4.7μF: 0.5V
0603X106-10V: 0.5V</td></tr><tr><td>1μF<Cap<10μF: 0.2V
**0402B105M6R3V: 0.2V</td><td>Cap>4.7μF: 0.2V</td></tr><tr><td>Cap≥10μF: 0.1V</td><td></td></tr><tr><th>0805</th><th>1206/1210</th></tr><tr><td>Cap<10μF: 1V</td><td>Cap≤10μF: 1V</td></tr><tr><td>Cap=10μF: 0.5V
0805B475/6.3V~25V: 0.5V</td><td>10μF<Cap≤100μF: 0.5V</td></tr><tr><td>Cap>10μF: 0.2V</td><td>Cap>100μF: 0.2V
1206X107-6.3V: 0.2V
1206A476-6.3V: 0.1V
1210S107-6.3V: 0.2V</td></tr></table></td></tr>
<tr><td>7</td><td>Adhesive Strength of Termination</td><td>*Pressurizing force:
2N (0201) and 5N (≤0603) and 10N (>0603)
* Test time: 10±1 sec.</td><td>* No remarkable damage or removal of the terminations.</td></tr>
<tr><td>8</td><td>Vibration Resistance</td><td>* 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.</td><td> No remarkable damage.
* Cap change and Q/D.F.: To meet initial spec.</td></tr>
</table>

<table>
<tr><th>No</th><th>Item</th><th>Test Condition</th><th>Requirements</th></tr>
<tr><td>9</td><td>Solderability</td><td>* Solder temperature: 235±5°C
* Dipping time: 2±0.5 sec.</td><td>95% min. coverage of all metalized area.</td></tr>
<tr><td>10</td><td>Bending Test</td><td>* The middle part of substrate shall be pressurized by means of the pressurizing rod at a rate of about 1mm per second until the deflection becomes 1mm 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.</td><td>* 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.)</td></tr>
<tr><td>11</td><td>Resistance to Soldering Heat</td><td>* Solder temperature: 260±5°C
* Dipping time: 10±1sec
* 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.</td><td> 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.</td></tr>
<tr><td>12</td><td>Temperature Cycle</td><td>* Conduct the five cycles according to the temperatures and time.
<table>
<tr><th>Step</th><th>Temp. (°C)</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°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.</td><td>* No remarkable damage.
* Cap change:
NP0: within ±2.5% or 0.25pF whichever is larger
X7R, X5R, X6S, X7S: within ±7.5%
Y5V: within ±20%
* Q/D.F., I.R. and dielectric strength: To meet initial requirements.</td></tr>
</table>

<table>
<tr><th>No</th><th>Item</th><th>Test Condition</th><th>Requirements</th></tr>
<tr><td>13</td><td>Humidity (Damp Heat) Steady State</td><td>Test temp.: 40±2°C
Humidity: 90~95% RH
Test time: 500+24/-0hrs.
Before initial measurement (Class II only): Perform 150+0/-10°C for 1 hr and then set for 24±2 hrs at room temp.
Measurement to be made after keeping at room temp. for 24±2 hrs.</td><td>* 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 colspan="2">Exception of D.F.≦</th></tr>
<tr><td rowspan="4">≧100V</td><td rowspan="4">≦3%</td><td>≦6%</td><td>1206≧0.47μF</td></tr>
<tr><td>≦7%</td><td>1812≧4.7μF;1825≥4.7μF; 2220≥4.7μF; 2225≥4.7μF</td></tr>
<tr><td>≦7.5%</td><td>0603≧0.068μF;0805≧0.1μF;1206≧1μF;
1210≧2.2μF</td></tr>
<tr><td>≦20%</td><td>0805≧0.22μF;1210≧3.3μF</td></tr>
<tr><td rowspan="4">≧50V</td><td rowspan="4">≦3%</td><td>≦6%</td><td>0201(50V);0603≧0.047μF;0805≧0.18μF;
1206≧0.47μF</td></tr>
<tr><td>≦7%</td><td>1812≧4.7μF;1825≥4.7μF; 2220≥4.7μF; 2225≥4.7μF</td></tr>
<tr><td>≦10%</td><td>0201≧0.01uF; 0402≧0.012μF;1210≧3.3μF</td></tr>
<tr><td>≦20%</td><td>0402≧0.047μF;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%</td><td>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%</td><td>0201≧0.01μF(0201/X5R=0.01μF;0805≧1μF;
1210≧10μF*</td></tr>
<tr><td>≦14%</td><td>0603≧0.33μF</td></tr>
<tr><td>≦15%</td><td>0201≧0.1μF(0201/X5R>0.01μF);0603≧0.47μF;
TT series 0402≧0.10μF(0402/X7R≧0.056μF);
0805≧2.2μF; 1206≧4.7μF;1210≧22μF
(1210/X5R≧10μF)*</td></tr>
<tr><td>≦20%</td><td>0402≧0.33μF</td></tr>
<tr><td rowspan="2">16V</td><td rowspan="2">≦5%</td><td>≦10%</td><td>0603≧0.15μF;0805≧0.68μF;1206≧2.2μF;
1210≧4.7μF</td></tr>
<tr><td>≦15%</td><td>0201≧0.01μF(0201/X7R≧0.022μF);0402≧0.033μF;
0603>0.47μF;0805≧2.2μF;1206≧4.7μF;1210≧22μF</td></tr>
<tr><td rowspan="2">10V</td><td rowspan="2">≦7.5%</td><td>≦15%</td><td>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%</td><td>0201≧0.1μF;0402≧1μF;0603/X5R≧10μF;01R5/X5R</td></tr>
<tr><td>6.3V</td><td>≦15%</td><td>≦30%</td><td>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><td>-</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>No</th><th>Item</th><th>Test Condition</th><th>Requirements</th></tr>
<tr><td></td><td>Humidity
(Damp Heat)
Steady State</td><td></td><td>*I.R.: ≥10V, 1GΩ or 50 Ω-F whichever is smaller.
Class II (X7R, X5R, X6S, X7S, Y5V)
<table>
<tr><th>Rated voltage</th><th>Insulation Resistance</th></tr>
<tr><td>100V: All X7R;1210≥3.3μF</td><td rowspan="7">1GΩ or RxC≧10 Ω-F whichever is smaller.</td></tr>
<tr><td>50V: 0402>0.01μF;0603≥1μF;0805≥1μF;1206≥4.7μF;1210≥4.7μF</td></tr>
<tr><td>35V:0603≥1μF;0805≥2.2μF; 1206≧2.2μF;1210≧10μF</td></tr>
<tr><td>25V:0201≧0.1uF; 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></td></tr>
<tr><td>14</td><td>Humidity
(Damp Heat)
Load</td><td>*Test temp.:40±2°C
*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°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.</td><td>* 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%;
Y5V: ≥10V, within ±30%;≦6.3V, within +30/-40%
Q/D.F. value:
NP0: C≥30pF,Q≥200;C<30pF, Q≥100+10/3C
X7R, X5R, X6S, X7S:
<table>
<tr><th>Rated vol.</th><th>D.F.≦</th><th colspan="2">Exception of D.F.≦</th></tr>
<tr><td rowspan="4">≧100V</td><td rowspan="4">≦3%</td><td>≦6%</td><td>1206≧0.47μF</td></tr>
<tr><td>≦7%</td><td>1812≧4.7μF;1825≥4.7μF; 2220≥4.7μF; 2225≥4.7μF</td></tr>
<tr><td>≦7.5%</td><td>0603≧0.068μF;0805≧0.1μF;1206≧1μF; 1210≧2.2μF</td></tr>
<tr><td>≦20%</td><td>0805≧0.22μF;1210≧3.3μF</td></tr>
<tr><td rowspan="4">≧50V</td><td rowspan="4">≦3%</td><td>≦6%</td><td>0201(50V);0603≧0.047μF;0805≧0.18μF; 1206≧0.47μF</td></tr>
<tr><td>≦7%</td><td>1812≧4.7μF;1825≥4.7μF; 2220≥4.7μF; 2225≥4.7μF</td></tr>
<tr><td>≦10%</td><td>0201≧0.01uF; 0402≧0.012μF;1210≧3.3μF</td></tr>
<tr><td>≦20%</td><td>0402≧0.047μF;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%</td><td>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%</td><td>0201≧0.01μF(0201/X5R=0.01μF;0805≧1μF; 1210≧10μF*</td></tr>
<tr><td>≦14%</td><td>0603≧0.33μF</td></tr>
<tr><td>≦15%</td><td>0201≧0.1μF(0201/X5R>0.01μF);0603≧0.47μF; TT series 0402≧0.10μF(0402/X7R≧0.056μF); 0805≧2.2μF; 1206≧4.7μF;1210≧22μF (1210/X5R≧10μF)*</td></tr>
<tr><td>≦20%</td><td>0402≧0.33μF</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>No</th><th>Item</th><th>Test Condition</th><th>Requirements</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th>Rated vol.</th><th>D.F.≦</th><th colspan="2">Exception of D.F.≦</th></tr>
<tr><td rowspan="2">16V</td><td rowspan="2">≦5%</td><td>≦10%</td><td>0603≧0.15μF;0805≧0.68μF;1206≧2.2μF;
1210≧4.7μF</td></tr>
<tr><td>≦15%</td><td>0201≧0.01μF(0201/X7R≧0.022μF);0402≧0.033μF;
0603>0.47μF;0805≧2.2μF;1206≧4.7μF;1210≧22μF</td></tr>
<tr><td rowspan="2">10V</td><td rowspan="2">≦7.5%</td><td>≦15%</td><td>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%</td><td>0201≧0.1μF;0402≧1μF;0603/X5R≧10μF;01R5/X5R</td></tr>
<tr><td>6.3V</td><td>≦15%</td><td>≦30%</td><td>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><td>-</td></tr>
</table>
*I.R.: ≥10V, 500MΩ or 25 Ω-F whichever is smaller.
Class II (X7R, X5R, X6S, X7S, Y5V)
<table>
<tr><th>Rated voltage</th><th>Insulation Resistance</th></tr>
<tr><td>100V: All X7R;1210≥3.3μF</td><td rowspan="7">1GΩ or
RxC≧10 Ω-F
whichever is
smaller.</td></tr>
<tr><td>50V: 0402>0.01μF;0603≥1μF;0805≥1μF;1206≥4.7μF;
1210≥4.7μF</td></tr>
<tr><td>35V:0603≥1μF;0805≥2.2μF; 1206≧2.2μF;1210≧10μF</td></tr>
<tr><td>25V:0201≧0.1uF; 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>
</td></tr>
<tr><td>15</td><td>High Temperature Load (Endurance)</td><td>*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.</td><td>* 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:</td></tr>
</table>

No	Item	Test Condition	Requirements

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
	X7R/X7S	6.3V,10V	C≧1.0μF
0603	X5R/X7R/ X6S/X7S	4V	C≧22μF
		6.3V,10V	C≧4.7μF#1
	X5R/X6S/X7S	25V	C≧1.0μF
	X7R	35V	C≧1.0μF
0805	X5R/X7R/ X6S/X7S	4V	C≧47μF
		6.3V	C≧22μF
		10V,50V	C≧10μF
	X6S	16V	C >10μF
		25V	C≧10μF
	X7R/X7S	16V,25V	C≧10μF
	X5R		C≧22μF
1206	X5R/X7R/X6S	≦6.3V	C≧47μF
1210	X5R/X7R/X6S	16V	C≧47μF
	X7R	100V	C≧3.3μF
TT15	X5R	6.3V	C >1.0μF
TT21	X5R/X7R/X6S	≦10V	C≧10μF

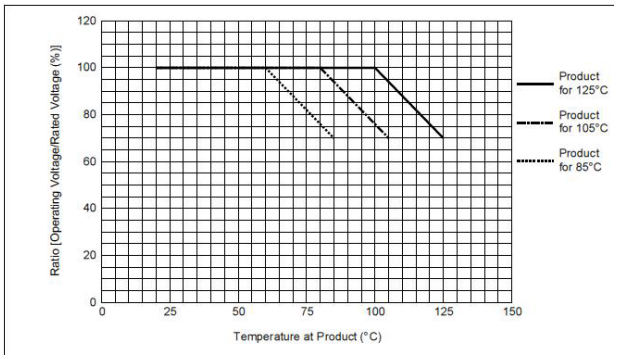
**1WV items must follow de-rating conditions.
#1. 0603X106/475(10V)&0603S106(4V&6.3V):
150% of rated voltage
(2) 150% of rated voltage for below range.

Size	Dielectric	Rated Voltage	Capacitance
0201	X5R/X6S	16V,25V	C=0.1μF
	X7R	16V	C≧0.022μF
0402	X7R/X5R/X6S	50V	C>0.01μF
		10~25V	C≧0.22μF
0603	X7S	50V~100V	C>0.22μF
	X5R	50V	C>0.1μF
		25V	C=1.0μF
	X5R	50V	C≧1.0μF
	X7R/X5R/ X6S/ X7S	10V,16V	C≧1.0μF
0805	X5R/X7R/ X6S/ X7S	100V	C≧0.47μF
		50V	C≧0.68μF
		35V	C≧2.2μF
		10~25V	C≧4.7μF

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; 0402≧0.012μF;1210≧3.3μF
		≦20%	0402≧0.047μF;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; TT series 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
		≦15%	0201≧0.01μF(0201/X7R≧0.022μF);0402≧0.033μF; 0603>0.47μF;0805≧2.2μF;1206≧4.7μF;1210≧22μF
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%	-	-

*I.R.: ≥10V, 1GΩ or 50 Ω-F whichever is smaller.
Class II (X7R, X5R, X6S, X7S, Y5V)

Rated voltage	Insulation Resistance
100V: All X7R;1210≥3.3μF	1GΩ or RxC≧10Ω-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	

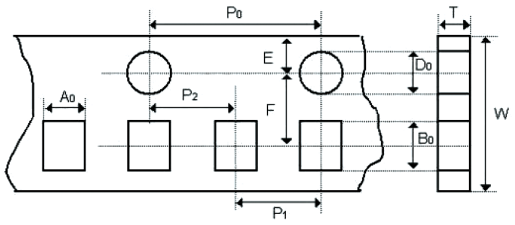
No	Item	Test Condition	Requirements
		(3) ≦6.3V or C≧10μF or TT series:150% of rated voltage. (4) 10V~250V: 200% of rated voltage. Excluding 1812/NP0(250V)/104:100% of rated voltage. (5) 400V~450V: 120% of rated voltage. (6) 500V: 150% of rated voltage. (7) 630V~3000V: 120% of rated voltage. Excluding 1210/X7R(2kV)/103:110% of rated voltage. 1210/NP0(1kV)/333:100% of rated voltage. 1812/NP0(1kV)/472~562:100% of rated voltage. (8) Ur=3.5kV & 4kV: 110% of rated voltage. * Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp. * Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.	** De-rating conditions:  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.

Size	Dielectric	Rated Voltage	Capacitance
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
		100V	C≧1.0μF
1825 2220 2225	X7R	100V~250V	C≧1.0μF

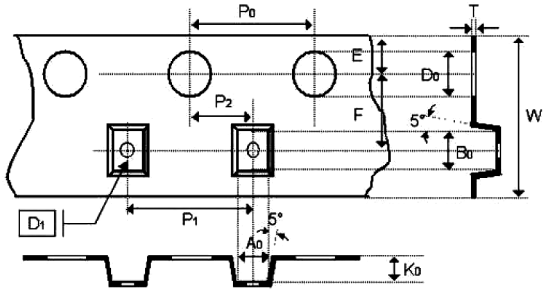
* “Room condition” Temperature: 15 to 35°C, Relative humidity: 25 to 75%, Atmospheric pressure: 86 to 106kPa

Appendixes

Tape & Reel Dimensions



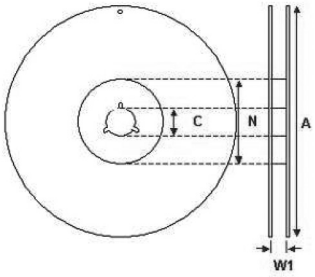
The dimension of paper tape



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	0.4 ±0.1	0.7 ±0.2	1.05 ±0.3	1.5 ±0.20	1.5 ±0.20	< 1.8	1.9 ±0.5	< 2	<2.3	< 3.05	< 3.05	< 3.05	< 3.2	< 2.50	< 2.50	< 3.90	< 3.90	< 3.9
B_0	0.7 ±0.1	1.2 ±0.2	1.8 ±0.3	2.3 ±0.2	2.3 ±0.2	< 2.7	3.5 ±0.5	< 3.7	< 4	< 3.8	< 3.8	< 3.8	<4	< 5.3	< 5.3	< 5.3	< 5.3	< 5.3
T	≦0.55	≦0.8	≦1.2	≦1.15	≦1.2	0.23 ±0.1	≦1.2	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	-	-	-	-	< 2.5	-	< 2.5	< 2.5	< 1.5	< 2	< 2.5q	< 3.2	< 2.5	< 2.5	< 2.5	< 2.5	< 3.5
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 ±0.3
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 ±0.1
10xP_0	40 ±0.1	40 ±0.1	40 ±0.2	40 ±0.2	40 ±0.2	40 ±0.2	40 ±0.2	40 ±0.2	40 ±0.2	40 ±0.2	40 ±0.2	40 ±0.2	40 ±0.2	40 ±0.2	40 ±0.2	40 ±0.2	40 ±0.2	40 ±0.2
P_1	2 ±0.05	2 ±0.05	4 ±0.1	4 ±0.1	4 ±0.1	4 ±0.1	4 ±0.1	4 ±0.1	4 ±0.1	4 ±0.1	4 ±0.1	4 ±0.1	4 ±0.1	4 ±0.1	4 ±0.1	8 ±0.1	8 ±0.1	8 ±0.1
P_2	2 ±0.05	2 ±0.05	2±0.05	2 ±0.05	2 ±0.05	2 ±0.05	2 ±0.05	2 ±0.05	2 ±0.05	2 ±0.05	2 ±0.05	2 ±0.05	2 ±0.05	2. ±0.1	2. ±0.1	2. ±0.1	2. ±0.1	2 ±0.1
D_0	1.5 +0.1/-0	1.5 +0.1/-0	1.5 +0.1/-0	1.5 +0.1/-0	1.5 +0.1/-0	1.5 +0.1/-0	1.5 +0.1/-0	1.5 +0.1/-0	1.5 +0.1/-0	1.5 +0.1/-0	1.5 +0.1/-0	1.5 +0.1/-0	1.5 +0.1/-0	1.5 +0.1/-0	1.5 +0.1/-0	1.5 +0.1/-0	1.5 +0.1/-0	1.5 +0.1/-0
D_1	-	-	-	-	-	1 ±0.1	-	1 ±0.1	1 ±0.1	1 ±0.1	1 ±0.1	1 ±0.1	1 ±0.1	1.5 ±0.1	1.5 ±0.1	1.5 ±0.1	1.5 ±0.1	1.5 ±0.1
E	1.75 ±0.1	1.75 ±0.1	1.75 ±0.1	1.75 ±0.1	1.75 ±0.1	1.75 ±0.1	1.75 ±0.1	1.75 ±0.1	1.75 ±0.1	1.75 ±0.1	1.75 ±0.1	1.75 ±0.1	1.75 ±0.1	1.75 ±0.1	1.75 ±0.1	1.75 ±0.1	1.75 ±0.1	1.75 ±0.1
F	3.5 ±0.05	3.5 ±0.05	3.5 ±0.05	3.5 ±0.05	3.5 ±0.05	3.5 ±0.05	3.5 ±0.05	3.5 ±0.05	3.5 ±0.05	3.5 ±0.05	3.5 ±0.05	3.5 ±0.05	3.5 ±0.05	5.5 ±0.1	5.5 ±0.1	5.5 ±0.1	5.5 ±0.1	5.5 ±0.1

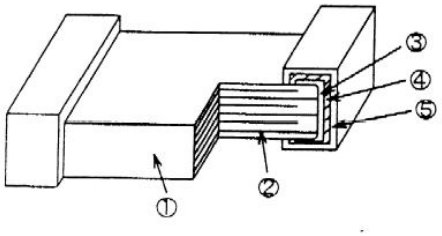
Dimensions : Millimetres



The dimension of reel

Size	0201, 0402, 0603, 0805, 1206, 1210			1812
Reel size	7″	10″	13″	7″
C	13 ±0.5	13 ±0.5	13 ±0.5	13 ±0.5
W_1	10 ±1.5	10 ±1.5	10 ±1.5	12.4 +2.0/-0
A	178 ±2	250 ±2	330 ±2	178 ±2.0
N	60 +1.0/-0	50 min	50 min	60 +1.0/-0

Constructions



No.	Name		NPO, X7R, X5R, X6S, X7S, Y5V	
1	Ceramic material		$CaZrO_3$ based	$BaTiO_3$ based
2	Inner electrode		Ni	
3	Termination	Inner layer	Cu	
4		Middle layer	Ni	
5		Outer layer	Sn	

Storage and handling conditions

(1) To store products at 5°C to 40°C ambient temperature and 20 to 70%. related humidity conditions.

(2) The product is recommended to be used within one year after shipment. Check solderability in case of shelf life extension is needed.

Cautions:

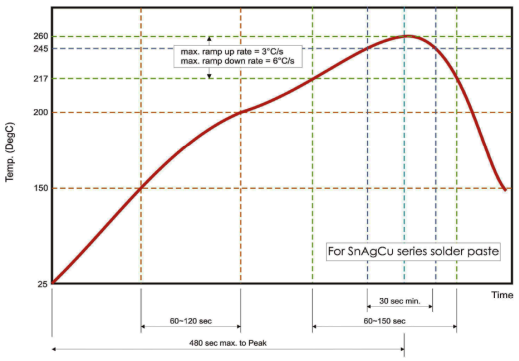
a. The corrosive gas reacts on the terminal electrodes of capacitors, and results in the poor solderability. Do not store the capacitors in the ambience of corrosive gas (e.g., hydrogen sulfide, sulfur dioxide, chlorine, ammonia gas etc.)

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

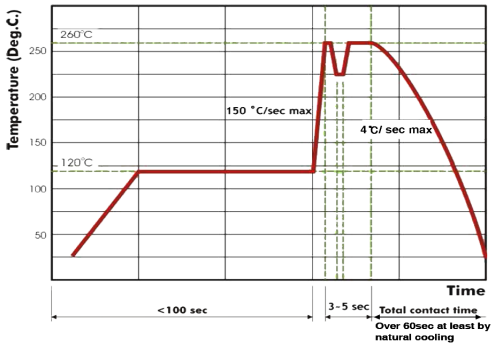
c. Due to the dewing by rapid humidity change, or the photochemical change of the terminal electrode by direct sunlight,the solderability and electrical performance may deteriorate. Do not store capacitors under direct sunlight or dewing condition. To store products on the shelf and avoid exposure to moisture.

Recommended Soldering Conditions:

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



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



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