Multilayer Ceramic Capacitors
High Capacitance Series

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. WTC high capacitance MLCC offers low ESR and excellent frequency characteristics to be suited for coupling and decoupling applications in circuit. The high dielectric constant material X7R, X5R and Y5V are used for this series product.

Features:

- Small size with high capacitance
- Capacitor with lead-free termination (pure Tin)

Applications:

- Digital circuit coupling or decoupling applications
- For high frequency and high-density type power suppliers
- For bypassing

External Dimensions:

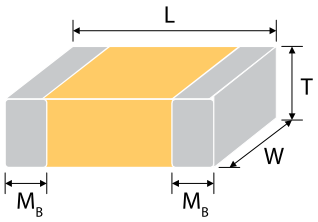


Fig. 1 The outline of MLCC

Size Inch (mm)	L (mm)	W (mm)	T (mm)/Symbol		MB (mm)
0402 (1005)	1 ±0.05	0.5 ±0.05	0.5 ±0.05	N	0.25 +0.05/-0.1
0603 (1608)	1.6 ±0.1	0.8 ±0.1	0.8 ±0.07	S	0.4 ±0.15
	1.6 +0.15/-0.1	0.8 +0.15/-0.1	0.8 +0.15/-0.1	X	
0805 (2012)	2 ±0.15	1.25 ±0.1	0.8 ±0.1	B	0.5 ±0.2
			1.25±0.1	D	
	2 ±0.2	1.25 ±0.2	1.25 ±0.2	I	
1206 (3216)	3.2 ±0.15	1.6 ±0.15	0.95±0.1	C	0.6 ±0.2
			1.25 ±0.1	D	
	3.2 ±0.2	1.6 ±0.2	1.6 ±0.2	G	
			1.15±0.15	J	
	3.2 +0.3/-0.1	1.6 +0.3/-0.1	1.6 +0.3/-0.1	P	
1210 (3225)	3.2 ±0.3	2.5 ±0.2	0.95 ±0.1	C	0.75±0.25
			1.25 ±0.1	D	
	3.2 ±0.4	2.5 ±0.3	1.6 ±0.2	G	
			2 ±0.2	K	
			2.5 ±0.3	M	

Remark: Reflow soldering only is recommended

General Electrical Data:

Dielectric	X7R	X5R
Size	0402, 0603, 0805, 1206, 1210	
Capacitance range*	0.56μF to 10μF	0.027μF to 22μF
Capacitance tolerance**	K (±10%), M (±20%)	
Rated voltage (WVDC)	6.3V, 10V, 16V, 25V, 50V, 100V	
Tan δ*	Note 1	
Insulation resistance at Ur	R × C ≥500Ω × F	
Operating temperature	-55°C to +125°C	-55°C to +85°C
Capacitance characteristic	±15%	
Termination	Ni/Sn (lead-free termination)	

* Measured at 1 ±0.2Vrms, 1kHz ±10% for C≤10μF; 0.5 ±0.2Vrms, 120Hz ±20% for C>10μF, 30~70% related humidity, 25°C ambient temperature for X7R, X5R.

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

Note 1:
X7R/X5R

Rated vol.	D.F.≦	Exception of D.F. ≦	
≧50V	≦2.5%	≦3%	0201(50V); 0603≧0.047μF; 0805≧0.18μF;1206≧0.47μF
		≦5%	1210≧4.7μF
		≦10%	0603≧1μF; 0805≧1μF;1206≧4.7μF; 1210≧10μF
35V	≦3.5%	≦10%	0805≥2.2μF; 1210≧10μF
25V	≦3.5%	≦5%	0201≧0.01μF;0805≧1μF; 1210≧10μF
		≦7%	0603≧0.33μF; 1206≧4.7μF
		≦10%	0402≧0.10μF;0603≧0.47μF; 0805≧2.2μF; 1206≧6.8μF ; 1210≧22μF
16V	≦3.5%	≦5%	0201≧0.01μF;0402≧0.033μF; 0805≧0.68μF;1206≧2.2μF;1210≧4.7μF
		≦10%	0402≧0.22uF; 0603≧0.68μF;0805≧2.2μF; 1206≧4.7μF; 1210≧22μF; TT series
10V	≦5%	≦10%	0201≧0.012μF;0402≧0.33μF;0603≧0.33 μF; 0805≧2.2μF 1206≧2.2μF;1210≧22μF; TT series
		≦15%	0201≧0.1μF; 0402≧1μF
6.3V	≦10%	≦15%	0201≧0.1μF;0402≧1μF;0603≧10μF; 0805≧4.7μF; 1206≧47μF :1210≧100μF
		≦20%	0402≧2.2μF
4V	≦15%	---	---

Capacitance Range:

X7R Dielectric

Dielectric		X7R																	
Size		0603			0805				1206						1210				
Rated Voltage V DC		6.3	10	16	6.3	10	16	25	6.3	10	16	25	50	100	10	16	25	50	100
Capacitance	0.56µF (564)		X	X															
	0.68µF (684)		X	X															
	0.82µF (824)		X	X															
	1.0µF (105)	X	X	X		D	D	D		J	J	J	P	P	D	D	D	D	K
	1.5µF (155)					I	I	I	J	J	J	P							M
	2.2µF (225)				I	I	I	I	J	J	J	P				K	G		M
	3.3µF (335)									P	P	P							
	4.7µF (475)								P	P	P	P			K	K			
	6.8µF (685)																		
	10µF (106)								P	P					K	K	K		

X5R Dielectric

Dielectric		X5R																	
Size		0402				0603				0805				1206				1210	
Rated Voltage (V DC)		6.3	10	16	25	6.3	10	16	25	6.3	10	16	25	6.3	10	16	25	10	16
Capacitance	0.027µF (273)			N															
	0.033µF (333)			N															
	0.039µF (393)			N															
	0.047µF (473)			N															
	0.056µF (563)		N	N															
	0.068µF (683)		N	N															
	0.082µF (823)	N	N	N															
	0.10µF (104)	N	N	N	N														
	0.15µF (154)		N																
	0.22µF (224)	N	N	N				X	X										
	0.27uF (274)						X	X											
	0.33µF (334)	N	N			X	X	X	X										
	0.39µF (394)						X	X											
	0.47µF (474)	N	N				X	X	X										
	0.68µF (684)	N	N				X	X	X										
	0.82uF (824)					X	X	X											
	1.0µF (105)	N	N			X	X	X	X		D		D						

X5R Dielectric

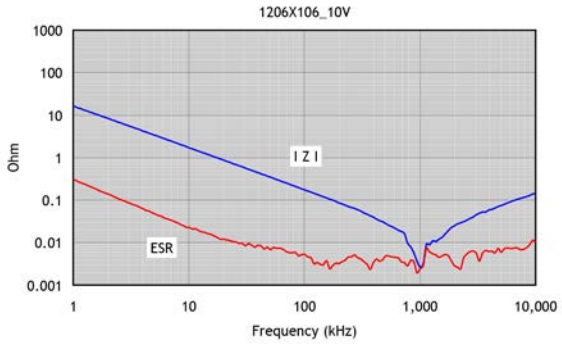
Dielectric		X5R																	
Size		0402				0603				0805				1206				1210	
Rated Voltage (V DC)		6.3	10	16	25	6.3	10	16	25	6.3	10	16	25	6.3	10	16	25	10	16
Capacitance	1.5µF (155)					X				I	I				J	J		K	K
	2.2µF (225)					X	X	X		I	I	I	I		J	J	P	K	K
	3.3µF (335)					X				I	I	I	I		P	P	P		
	4.7µF (475)					X				I	I	I	I	P	P	P	P	K	K
	6.8uF (685)													P	P				
	10µF (106)									I	I	I		P	P	P	P	K	K
	22µF (226)													P	P			M	

Packaging Style and Quantity:

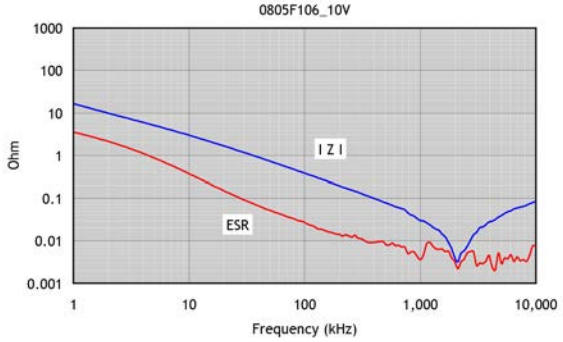
Size	Thickness (mm) / Symbol		Paper tape		Plastic tape	
			7" reel	13" reel	7" reel	13" reel
0402 (1005)	0.5 ±0.05	N	10k	50k	-	-
0603 (1608)	0.8 ±0.07	S	4k	15k	-	-
	0.8 +0.15/-0.1	X	4k	15k	-	-
0805 (2012)	0.8 ±0.1	B	4k	15k	-	-
	1.25 ±0.1	D	-	-	3k	10k
	1.25 ±0.2	I	-	-	3k	10k
1206 (3216)	0.95 ±0.1	C	-	-	3k	10k
	1.15 ±0.15	J	-	-	3K	10K
	1.25 ±0.1	D	-	-	3k	10k
	1.6 ±0.2	G	-	-	2k	10k
	1.6 +0.3/-0.1	P	-	-	2k	9k
1210 (3225)	0.95 ±0.1	C	-	-	3k	10k
	1.25 ±0.1	D	-	-	3k	10k
	1.6 ±0.2	G	-	-	2k	-
	2 ±0.2	K	-	-	1k	6k
	2.5 ±0.3	M	-	-	1k	6k

Electrical Characteristics:

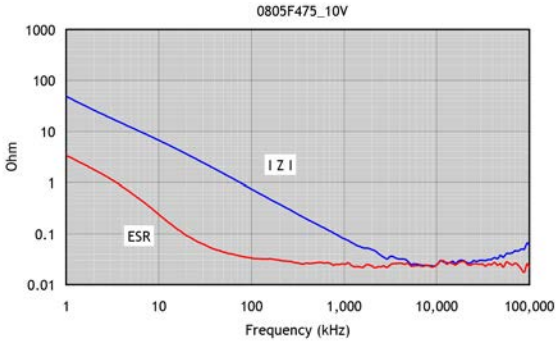
Typical Impedance/ESR vs. Frequency



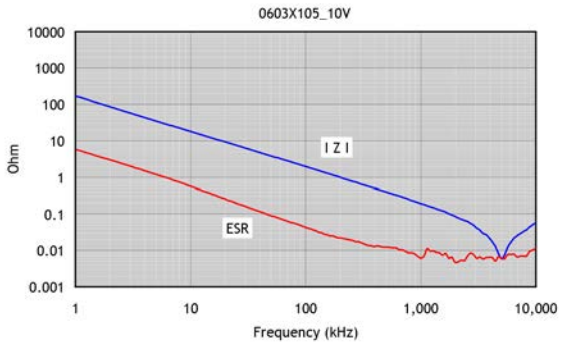
ESR and IZI vs. frequency (1206 × 106_10V)



ESR and IZI vs. frequency (0805F106_10V)



ESR and IZI vs. frequency (0805F475_10V)



ESR and IZI vs. frequency (0603 ×105_10V

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">Class I: NP0
Cap≤1,000pF 1 ±0.2Vrms, 1MHz±10%
Cap>1,000pF 1 ±0.2Vrms, 1KHz±10%
Class II: X7R,X7E, X5R,Y5V
Cap≤10μF, 1 ±0.2Vrms, 1kHz±10%
Cap>10μF, 0.5±0.2Vrms, 120Hz±20%
Test condition: 0.5±0.2Vrms, 1kHz±10%
X7R: 0603≧225(10V), 0805=106(6.3V&10V)
X5R: 01R5≧103, 0201≧224 (6.3V), 0402≧475 (6.3V), 0402≧225(10V), 0603=106 (6.3V)</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, X5R:
<table>
<tr><th>Related Vol.</th><th>D.F.≦</th><th colspan="2">Exception of D.F.≦</th></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>1210≧4.7μF</td></tr>
<tr><td>≦10%</td><td>0603≧1μF;
0805≧1μF;1206≧4.7μF;
1210≧10μF</td></tr>
<tr><td>35V</td><td>≦3.5%</td><td>≦10%</td><td>0805≥2.2μF; 1210≧10μF</td></tr>
<tr><td rowspan="3">25V</td><td rowspan="3">≦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≧0.1μF;0603≧0.47μF;
0805≧2.2μF; 1206≧6.8μF ;
1210≧22μF ; TT series</td></tr>
<tr><td rowspan="2">16V</td><td rowspan="2">≦3.5%</td><td>≦5%</td><td>0201≧0.01μF;0402≧0.033μF;
0805≧0.68μF;1206≧2.2μF;1210≧4.7μF</td></tr>
<tr><td>≦10%</td><td>0402≧ 0.22uF;
0603≧0.68μF;0805≧2.2μF;
1206≧4.7μF; 1210≧22μF; TT series</td></tr>
<tr><td rowspan="2">10V</td><td rowspan="2">≦5%</td><td>≦10%</td><td>0201≧0.012μF;0402≧0.33μF
;0603≧0.33μF; 0805≧2.2μF
1206≧2.2μF;1210≧22μF; TT series</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>

Reliability Test Conditions and Requirements:

<table>
<tr><th>No</th><th>Item</th><th>Test Condition</th><th>Requirements</th></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>To apply rated voltage for max. 120 sec.</td><td>10GΩ or RxC≧500Ω-F whichever is smaller.
Class II (X7R, X5R)
<table>
<tr><th>Rated voltage</th><th>Insulation Resistance</th></tr>
<tr><td>100V: X7R</td><td rowspan="7">10G or RxC≧100Ω-F whichever is smaller.</td></tr>
<tr><td>50V:0603≥1μF;0805≥1μF;1206≥4.7μF;
1210≥4.7μF</td></tr>
<tr><td>35V:0805≥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: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</td></tr>
</table></td></tr>
<tr><td>6</td><td>Temperature Coefficient</td><td>With no electrical load.
<table>
<tr><th>T.C.</th><th>Operating Temp.</th></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>X5R</td><td>-55~ 85°C at 25°C</td></tr>
</table></td><td>
<table>
<tr><th>T.C.</th><th>Capacitance Change</th></tr>
<tr><td>NPO</td><td>Within ±30ppm/°C</td></tr>
<tr><td>X7R</td><td>Within ±15%</td></tr>
<tr><td>X5R</td><td>Within ±15%</td></tr>
</table></td></tr>
<tr><td>7</td><td>Adhesive Strength of Termination</td><td>Pressurizing force:
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.)
Measurement to be made after keeping at room temp. for 24±2 hrs.</td><td>No remarkable damage.
Cap change and Q/D.F.: To meet initial spec.</td></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>
</table>

Reliability Test Conditions and Requirements:

<table>
<tr><th>No</th><th>Item</th><th>Test Condition</th><th>Requirements</th></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 1 mm per second until the deflection becomes 1 mm and then the pressure shall be maintained for 5±1 sec.
Measurement to be made after keeping at room temp. for 24±2 hrs.</td><td>No remarkable damage.
Cap change:
NP0: within ±5% or 0.5pF whichever is larger
X7R, X5R: within ±12.5%
Y5V: within ±30%
(This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test.)</td></tr>
<tr><td>11</td><td>Resistance to Soldering Heat</td><td>Solder temperature: 260±5°C
Dipping time: 10±1 sec
Preheating: 120 to 150°C for 1 minute before immerse the capacitor in a eutectic solder.
Before initial measurement (Class II only): Perform 150+0/-10°C for 1 hr and then set for 24±2 hrs at room temp.
Measurement to be made after keeping at room temp. for 24±2 hrs.</td><td>No remarkable damage.
Cap change:
NP0: within ±2.5% or 0.25pF whichever is larger
X7R, X5R: 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): Perform 150+0/-10°C for 1 hr and then set for 24±2 hrs at r oom temp.
Measurement to be made after keeping at room temp. for 24±2 hrs.</td><td>No remarkable damage.
Cap change:
NP0: within ±2.5% or 0.25pF whichever is larger
X7R, X5R: within ±7.5%
Q/D.F., I.R. and dielectric strength: To meet initial requirements.</td></tr>
</table>

Reliability Test Conditions and Requirements:

<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 hour 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, X7E, X5R: ≥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
<table>
<tr><th>Related Vol.</th><th>D.F.≦</th><th colspan="2">Exception of D.F. ≦</th></tr>
<tr><td rowspan="3">≧50V</td><td rowspan="3">≦3%</td><td>≦6%</td><td>0201(50V);0603≧0.047μF;
0805≧0.18μF; 1206≧0.47μF</td></tr>
<tr><td>≦10%</td><td>1210≧4.7μF</td></tr>
<tr><td>≦20%</td><td>0603≧1μF;
0805≧1μF;1206≧4.7μF;
1210≧10μF</td></tr>
<tr><td>35V</td><td>≦5%</td><td>≦20%</td><td>0805≥2.2μF;1210≧10μF</td></tr>
<tr><td rowspan="3">25V</td><td rowspan="3">≦5%</td><td>≦10%</td><td>0201≧0.01μF;0805≧1μF;
1210≧10μF</td></tr>
<tr><td>≦14%</td><td>0603≧0.33μF;1206≧4.7μF</td></tr>
<tr><td>≦15%</td><td>0402≧0.10μF;0603≧0.47μF;
0805≧2.2μF;1206≧6.8μF;
1210≧22μF</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;0402≧0.033μF;
0603≧0.68μF;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≧0.33μF;
0603≧0.33μF; 0805≧2.2μF;
1206≧2.2μF; 1210≧22μF</td></tr>
<tr><td>≦20%</td><td>0201≧0.1μF ;0402≧1μF</td></tr>
<tr><td>6.3V</td><td>≦15%</td><td>≦30%</td><td>0201≧0.1μF;0402≧1μF;
0603≧10μF; 805≧4.7μF;
1206≧47μF;1210≧100μF</td></tr>
<tr><td>4V</td><td>≦20%</td><td>-</td><td>-</td></tr>
</table>
</td></tr>
</table>

Reliability Test Conditions and Requirements:

<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 hour 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>I.R.: ≥10V, 1G or 50 -F whichever is smaller.
Class II (X7R, X5R)
<table>
<tr><th>Rated voltage</th><th>Insulation Resistance</th></tr>
<tr><td>100V: X7R</td><td rowspan="7">1GΩ or RxC ≧10Ω -F which-ever is smaller.</td></tr>
<tr><td>50V:0603≥1μF;0805≥1μF;1206≥4.7μF;1210≥4.7μF</td></tr>
<tr><td>35V:0805≥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: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</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.
Before initial measurement (Class II only): To apply test voltage for 1hr at 40°C 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: ±7.5% or 0.75pF whichever is larger.
X7R, X5R: ≥10V, within ±12.5%;6.3V within ±25%;
10V:0603≧4.7μF;0402≧1μF;0201≧0.1μF, within ±25%;
Q/D.F. value:
NP0: C≥30pF,Q≥200;C<30pF, Q≥100+10/3C</td></tr>
</table>

Reliability Test Conditions and Requirements:

<table>
<tr><th>No</th><th>Item</th><th>Test Condition</th><th>Requirements</th></tr>
<tr><td>14</td><td>Humidity (Damp Heat) Load</td><td></td><td>
X7R, X5R
<table>
<tr><th>Related Vol.</th><th>D.F.≦</th><th colspan="2">Exception of D.F. ≦</th></tr>
<tr><td rowspan="3">≧50V</td><td rowspan="3">≦3%</td><td>≦6%</td><td>0201(50V);0603≧0.047μF; 0805≧0.18μF; 1206≧0.47μF</td></tr>
<tr><td>≦10%</td><td>1210≧4.7μF</td></tr>
<tr><td>≦20%</td><td>0603≧1μF; 0805≧1μF;1206≧4.7μF; 1210≧10μF</td></tr>
<tr><td>35V</td><td>≦5%</td><td>≦20%</td><td>0805≥2.2μF;1210≧10μF</td></tr>
<tr><td rowspan="3">25V</td><td rowspan="3">≦5%</td><td>≦10%</td><td>0201≧0.01μF;0805≧1μF; 1210≧10μF</td></tr>
<tr><td>≦14%</td><td>0603≧0.33μF;1206≧4.7μF</td></tr>
<tr><td>≦15%</td><td>0402≧0.10μF;0603≧0.47μF;0805≧2.2μF;1206≧6.8μF; 1210≧22μF</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;0402≧0.033μF;0603≧0.68μF;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≧0.33μF; 0603≧0.33μF; 0805≧2.2μF; 1206≧2.2μF; 1210≧22μF</td></tr>
<tr><td>≦20%</td><td>0201≧0.1μF ;0402≧1μF</td></tr>
<tr><td>6.3V</td><td>≦15%</td><td>≦30%</td><td>0201≧0.1μF;0402≧1μF; 0603≧10μF; 805≧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 25Ω-F whichever is smaller.
Class II (X7R, X5R)
<table>
<tr><th>Rated voltage</th><th>Insulation Resistance</th></tr>
<tr><td>100V: X7R</td><td rowspan="7">500MΩ or RxC≧5Ω-F whichever is smaller.</td></tr>
<tr><td>50V:0603≥1μF;0805≥1μF;1206≥4.7μF; 1210≥4.7μF</td></tr>
<tr><td>35V:0805≥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: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</td></tr>
</table>
</td></tr>
</table>

Reliability Test Conditions and Requirements:

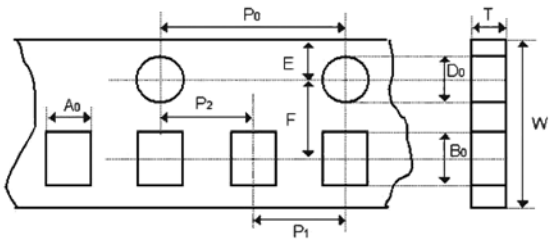
<table>
<tr><th>No</th><th>Item</th><th>Test Condition</th><th>Requirements</th></tr>
<tr><td>15</td><td>High Temperature Load (Endurance)</td><td>
Test temp.:
NP0, X7R: 125±3°C
X5R: 85±3°C
Test time: 1000+24/-0 hrs.
To apply voltage:
(1) 6.3V or C≧10μF or TT series:
150% of rated voltage.
(2) 10V≧Ur<500V:
200% of rated voltage.
(3) 500V: 150% of rated voltage.
(4) Ur≧630V:
120% of rated voltage.
(5) 100% of rated voltage for below range.
<table>
<tr><th>Size</th><th>Dielectric</th><th>Rated voltage</th><th>Capaci-tance range</th></tr>
<tr><td>0201</td><td>X5R/X7R</td><td>6.3V,10V</td><td>C≧0.1μF</td></tr>
<tr><td>0402</td><td>X5R/X7R</td><td>6.3V,10V</td><td>C≧1.0μF</td></tr>
<tr><td>0603</td><td>X5R/X7R</td><td>6.3V,10V</td><td>C≧4.7μF</td></tr>
<tr><td>0805</td><td>X5R/X7R</td><td>6.3V</td><td>C≧22μF</td></tr>
<tr><td rowspan="2">1206</td><td>X5R/X7R</td><td>6.3V</td><td>C≧47μF</td></tr>
<tr><td>NP0</td><td>3000V</td><td>C≧1.5pF</td></tr>
</table>
(6) 150% of rated voltage for below range.
<table>
<tr><th>Size</th><th>Dielectric</th><th>Rated voltage</th><th>Capaci-tance range</th></tr>
<tr><td>0402</td><td>X5R/X7R</td><td>10V,16V, 25V</td><td>C≧0.22μF</td></tr>
<tr><td>0603</td><td>X5R/X7R</td><td>10V,16V</td><td>C≧1.0μF</td></tr>
<tr><td>0805</td><td>X5R/X7R</td><td>10V</td><td>C≧4.7μF</td></tr>
</table>
*Before initial measurement (Class II only): To apply test voltage for 1hr at test temp. 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: ±3.0% or ±0.3pF whichever is larger
X7R, X5R: ≥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:
<table>
<tr><th>Related Vol.</th><th>D.F.≦</th><th colspan="2">Exception of D.F. ≦</th></tr>
<tr><td rowspan="3">≧50V</td><td rowspan="3">≦3%</td><td>≦6%</td><td>0201(50V);0603≧0.047μF; 0805≧0.18μF; 1206≧0.47μF</td></tr>
<tr><td>≦10%</td><td>1210≧4.7μF</td></tr>
<tr><td>≦20%</td><td>0603≧1μF; 0805≧1μF;1206≧4.7μF; 1210≧10μF</td></tr>
<tr><td>35V</td><td>≦5%</td><td>≦20%</td><td>0805≥2.2μF;1210≧10μF</td></tr>
<tr><td rowspan="3">25V</td><td rowspan="3">≦5%</td><td>≦10%</td><td>0201≧0.01μF;0805≧1μF; 1210≧10μF</td></tr>
<tr><td>≦14%</td><td>0603≧0.33μF;1206≧4.7μF</td></tr>
<tr><td>≦15%</td><td>0402≧0.10μF;0603≧0.47μF;0805 ≧2.2μF;1206≧6.8μF; 1210≧22μF</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;0402≧0.033μF; 0603≧0.68μF;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≧0.33μF; 0603≧0.33μF; 0805≧2.2μF; 1206≧2.2μF; 1210≧22μF</td></tr>
<tr><td>≦20%</td><td>0201≧0.1μF ;0402≧1μF</td></tr>
<tr><td>6.3V</td><td>≦15%</td><td>≦30%</td><td>0201≧0.1μF;0402≧1μF; 0603≧10μF; 805≧4.7μF; 1206≧47μF;1210≧100μF</td></tr>
<tr><td>4V</td><td>≦20%</td><td>-</td><td>-</td></tr>
</table>
</td></tr>
</table>

Reliability Test Conditions and Requirements:

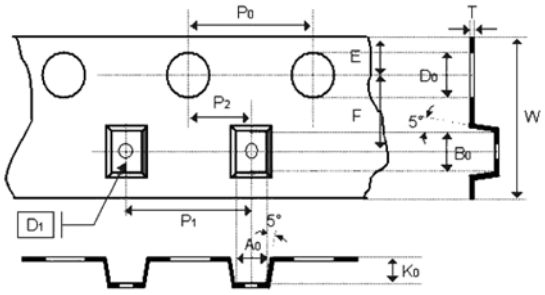
<table>
<tr><th>No</th><th>Item</th><th>Test Condition</th><th>Requirements</th></tr>
<tr><td>15</td><td>High Temperature Load (Endurance)</td><td></td><td>I.R.: ≥10V, 1G or 50 -F whichever is smaller.
Class II (X7R, X5R)
<table>
<tr><th>Rated voltage</th><th>Insulation Resistance</th></tr>
<tr><td>100V: X7R</td><td rowspan="7">500MΩ or RxC≧5Ω-F whichever is smaller.</td></tr>
<tr><td>50V:0603≥1μF;0805≥1μF;1206≥4.7μF;
1210≥4.7μF</td></tr>
<tr><td>35V:0805≥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: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</td></tr>
</table></td></tr>
</table>

Appendixes

Tape & Reel Dimensions



The dimension of paper tape

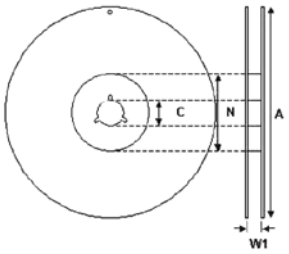


The dimension of plastic tape

Size	0402	0603	0805			1206		
Thickness	N	S, X	A	B	C, D, I	B	C, J, D	G,P
A_0	0.62±0.05	1.02±0.05	1.5±0.1	1.5±0.1	<1.57	2±0.1	<1.85	<1.95
B_0	1.12±0.05	1.8±0.05	2.3±0.1	2.3±0.1	<2.4	3.5±0.1	<3.46	<3.67
T	0.6±0.05	0.95±0.05	0.75±0.05	0.95±0.05	0.23±0.05	0.95±0.05	0.23±0.05	0.23±0.05
K_0	-	-	-	-	<2.5	-	<2.5	<2.5
W	8±0.1	8±0.1	8±0.1	8±0.1	8±0.1	8±0.1	8±0.1	8±0.1
P_0	4±0.1	4±0.1	4±0.1	4±0.1	4±0.1	4±0.1	4±0.1	4±0.1
$10 \times P_0$	40±0.1	4±0.1	40±0.1	40±0.1	40±0.1	40±0.1	40±0.1	40±0.1
P_1	2±0.05	4±0.1	4±0.1	4±0.1	4±0.1	4±0.1	4±0.1	4±0.1

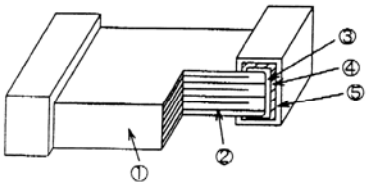
Size	0402	0603	0805			1206		
Thickness	N	S, X	A	B	C, D, I	B	C, J, D	G,P
P_2	2±0.05	2±0.05	2±0.05	2±0.05	2±0.05	2±0.05	2±0.05	2±0.05
D_0	1.55±0.05	1.55±0.05	1.55±0.05	1.55±0.05	1.5±0.05	1.5±0.05	1.5±0.05	1.5±0.05
D_1	-	-	-	-	1±0.1	-	1±0.1	1±0.1
E	1.75±0.05	1.75±0.05	1.75±0.05	1.75±0.05	1.75±0.1	1.75±0.1	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

Size	1210		
Thickness	C, D	G, K	M
A_0	<2.97	<2.97	<2.97
B_0	<3.73	<3.73	<3.73
T	0.23±0.05	0.23±0.05	0.23±0.05
K_0	<2.5	<2.5	<3
W	8±0.1	8±0.1	8±0.1
P_0	4±0.1	4±0.1	4±0.1
$10 \times P_0$	40±0.1	40±0.1	40±0.1
P_1	4±0.1	4±0.1	4±0.1
P_2	2±0.05	2±0.05	2±0.05
D_0	1.5±0.05	1.5±0.05	1.5±0.05
D_1	1±0.1	1±0.1	1±0.1
E	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



Size	0402, 0603, 0805, 1206, 1210		
Reel size	7”	10”	13”
C	13+0.5/-0.2	13+0.5/-0.2	13+0.5/-0.2
W1	8.4+1.5/-0	8.4+1.5/-0	8.4+1.5/-0
A	178±0.1	250±1	330±1
N	60+1/-0	100±1	100±1

Constructions:



No.	Name		X7R, X5R
1	Ceramic material		$BaTiO_3$ based
2	Inner electrode		Ni
3	Termination	Inner layer	Cu
4		Middle layer	Ni
5		Outer layer	Sn (Matt)

Storage and handling conditions:

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

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

Cautions:

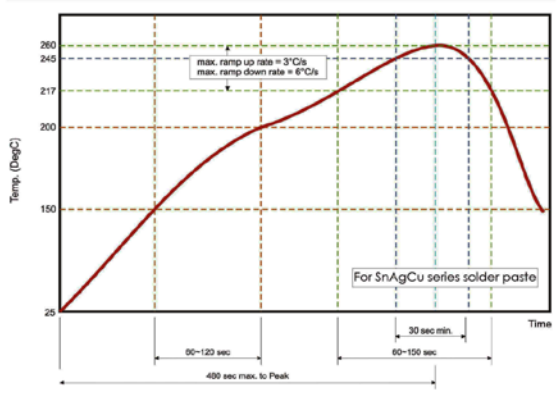
a. The corrosive gas reacts on the terminal electrodes of capacitors, and results in the poor solderability. Do not store the capacitors in the ambience of corrosive gas (e.g., hydrogen sulfide, sulfur dioxide, chlorine, ammonia gas etc.)

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

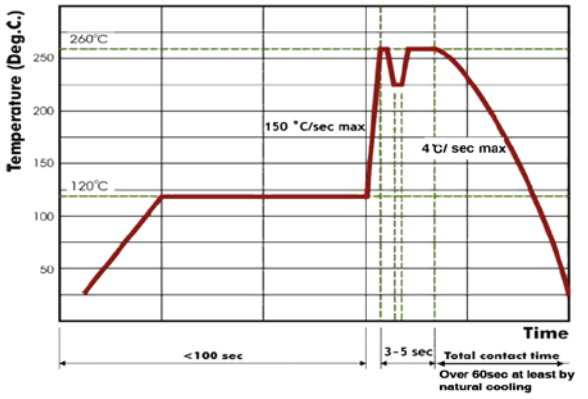
c. Due to the dewing by rapid humidity change, or the photochemical change of the terminal electrode by direct sunlight,the solderability and electrical performance may deteriorate. Do not store capacitors under direct sunlight or dewing condition. To store products on the shelf and avoid exposure to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

Recommended soldering conditions:

The lead-free termination MLCCs are not only to be used on SMT against lead-free solder paste, but also suitable against lead-containing solder paste. If the optimized solder joint is requested, increasing soldering time, temperature and concentration of N2 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.

Part Number Table

Description	Part Number
Capacitor, MLCC, 2.2UF, 6.3V, X5R, 0402, Reel	MC000404
Capacitor, MLCC, 2.2UF, 6.3V, X7R, 0603, Reel	MC000497
Capacitor, MLCC, 2.2UF, 6.3V, X5R, 0603, Reel	MC000499
Capacitor, MLCC, 4.7UF, 6.3V, X5R, 0603, Reel	MC000500
Capacitor, MLCC, 1UF, 16V, X7R, 0603, Reel	MC000504
Capacitor, MLCC, 2.2UF, 10V, X5R, 0603, Reel	MC000513
Capacitor, MLCC, 4.7UF, 10V, X5R, 0603, Reel	MC000515
Capacitor, MLCC, 1UF, 25V, X7R, 0805, Reel	MC000548
Capacitor, MLCC, 2.2UF, 25V, X7R, 0805, Reel	MC000551
Capacitor, MLCC, 4.7UF, 25V, X5R, 0805, Reel	MC000556
Capacitor, MLCC, 4.7UF, 6.3V, X5R, 0805, Reel	MC000609
Capacitor, MLCC, 1UF, 16V, X7R, 0805, Reel	MC000610
Capacitor, MLCC, 4.7UF, 16V, X7R, 0805, Reel	MC000614
Capacitor, MLCC, 4.7UF, 16V, X5R, 0805, Reel	MC000617
Capacitor, MLCC, 1UF, 10V, X7R, 0805, Reel	MC000618
Capacitor, MLCC, 4.7UF, 10V, X7R, 0805, Reel	MC000619
Capacitor, MLCC, 3.3UF, 10V, X5R, 0805, Reel	MC000622
Capacitor, MLCC, 4.7UF, 10V, X5R, 0805, Reel	MC000623
Capacitor, MLCC, 10PF, 100V, NP0, 1206, Reel	MC000624
Capacitor, MLCC, 1UF, 100V, X7R, 1206, Reel	MC000639
Capacitor, MLCC, 1UF, 25V, X7R, 1206, Reel	MC000656
Capacitor, MLCC, 2.2UF, 25V, X7R, 1206, Reel	MC000658
Capacitor, MLCC, 4.7UF, 25V, X7R, 1206, Reel	MC000661
Capacitor, MLCC, 4.7UF, 25V, X5R, 1206, Reel	MC000664
Capacitor, MLCC, 1UF, 50V, X7R, 1206, Reel	MC000681
Capacitor, MLCC, 1UF, 50V, X7R, 1206, Reel	MC000682
Capacitor, MLCC, 4.7UF, 50V, X7R, 1206, Reel	MC000694
Capacitor, MLCC, 22UF, 6.3V, X5R, 1206, Reel	MC000697
Capacitor, MLCC, 1UF, 16V, X7R, 1206, Reel	MC000708
Capacitor, MLCC, 2.2UF, 16V, X7R, 1206, Reel	MC000710
Capacitor, MLCC, 22UF, 16V, X5R, 1206, Reel	MC000713
Capacitor, MLCC, 2.2UF, 10V, X7R, 1206, Reel	MC000714
Capacitor, MLCC, 1UF, 100V, X7R, 1210, Reel	MC000717
Capacitor, MLCC, 2.2UF, 100V, X7R, 1210, Reel	MC000719
Capacitor, MLCC, 1UF, 25V, X7R, 1210, Reel	MC000722
Capacitor, MLCC, 2.2UF, 25V, X7R, 1210, Reel	MC000724
Capacitor, MLCC, 22UF, 25V, X5R, 1210, Reel	MC000727

Part Number Table

Description	Part Number
Capacitor, MLCC, 4.7UF, 25V, X5R, 1210, Reel	MC000728
Capacitor, MLCC, 1UF, 50V, X7R, 1210, Reel	MC000730
Capacitor, MLCC, 4.7UF, 50V, X7R, 1210, Reel	MC000734
Capacitor, MLCC, 22UF, 6.3V, X5R, 1210, Reel	MC000735
Capacitor, MLCC, 47UF, 6.3V, X5R, 1210, Reel	MC000736
Capacitor, MLCC, 22UF, 16V, X7R, 1210, Reel	MC000739
Capacitor, MLCC, 4.7UF, 16V, X7R, 1210, Reel	MC000740
Capacitor, MLCC, 22UF, 16V, X5R, 1210, Reel	MC000742
Capacitor, MLCC, 22UF, 10V, X7R, 1210, Reel	MC000743
Capacitor, MLCC, 22UF, 10V, X5R, 1210, Reel	MC000745