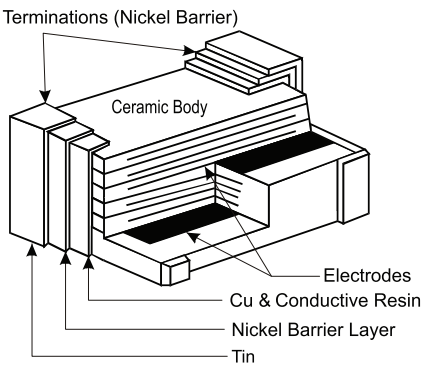
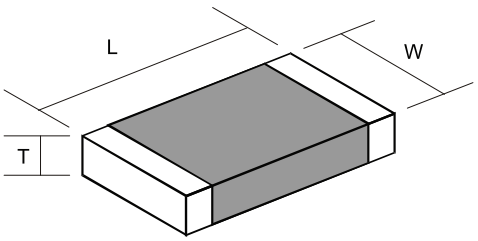
Multilayer Ceramic Capacitors
MA_ _ _ _S: Soft/Flex Terminations





FEATURES

- A wide range of sizes (0402 to 1210)
- Soft / Flex termination reduces cracks caused by board bending

DIMENSIONS

Size Inches (mm)	Length (mm)	Width (mm)	Thickness Max (mm)
0402 (1005)	1.00	0.50	0.55
0603 (1608)	1.60	0.80	0.95
0805 (2012)	2.00	1.25	1.35
1206 (3216)	3.20	1.60	1.85
1210 (3225)	3.20	2.50	2.70

* Thicknesses noted are maximum.
Thicknesses are less on low capacitance values.

HOW TO MAKE A PART NUMBER

MA 0805 S XR 104 K 500 R

- MA — Series
- 0805 — Size Code (inch)
- S — Soft Termination
- XR — Temperature Coefficient Code
- 104 — Capacitance Code
- K — Tolerance Code
- 500 — Voltage Code
- R — Reel

ELECTRICAL CHARACTERISTICS (Ta=25℃ Unless otherwise specified)

Dielectric	C0G / NPO	X7R	X7S
Temperature Coefficient Code	CG	XR	XS
Size	See chart on page 2.		
Rated Voltage (WVDC)			
Capacitance Range *			
Capacitance Tolerance **	J (±5%), K (±10%)	J (±5%), K (±10%), M (±20%)	
Tan δ*	Cap.< 30pF: Q≥400 + 20°C Cap.≥30pF : Q≥1000	≤10% (depending on value/voltage combination)	
Operating Termperature	-55 to +125°C		
Capacitance Characteristic	± 30ppm / °C	± 15%	± 22%

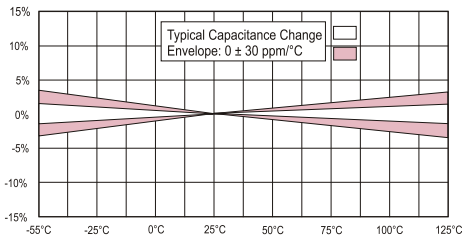
* Measured at the condition of 30~70% related humidity, apply 1.0±0.2Vrms, 1.0MHz±10%, at 25°C ambient temperature

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

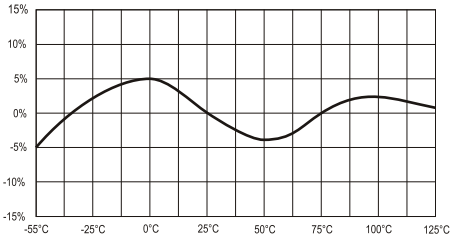
■ STANDARD VOLTAGES AND CAPACITANCE RANGES (pF)

Temperature Coefficient			COG/Info	X7R	X7S
Size Code	Voltage	Code	(CG)	(XR)	(XS)
0402	10V	100		100 ~ 100,000	470,000
	16V	160		100 ~ 100,000	470,000
	25V	250		100 ~ 100,000	
	50V	500	100 ~ 1,000	100 ~ 100,000	
0603	10V	100		100 ~ 1,000,000	2,200,000
	16V	160		100 ~ 1,000,000	2,200,000
	25V	250		100 ~ 1,000,000	
	35V	350		100 ~ 330,000	
	50V	500	100 ~ 10,000	100 ~ 330,000	
	100V	101	330 ~ 10,000	100 ~ 100,000	
	250V	251	1,000 ~ 1,800	100 ~ 10,000	
0805	10V	100		100 ~ 10,000,000	10,000,000
	16V	160		100 ~ 4,700,000	10,000,000
	25V	250		100 ~ 4,700,000	
	35V	350		100 ~ 470,000	
	50V	500	15,000 ~ 33,000	100 ~ 470,000	
	100V	101	15,000 ~ 33,000	100 ~ 470,000	220,000 ~ 1,000,000
	250V	251	3,300 ~ 6,800	100 ~ 68,000	
	500V	501	100 ~ 3,900	100 ~ 33,000	
1206	10V	100		150 ~ 22,000,000	
	16V	160		150 ~ 10,000,000	
	25V	250		150 ~ 10,000,000	
	35V	350		10,000,000	
	50V	500	47,000 ~ 100,000	150 ~ 4,700,000	
	100V	101	47,000 ~ 100,000	150 ~ 2,200,000	2,200,000
	250V	251	10,000 ~ 15,000	100 ~ 240,000	
	500V	501	6,800 ~ 10,000	100 ~ 56,000	
	630V	631	3,900 ~ 10,000	100 ~ 56,000	
1210	50V	500		2,200,000	4,700,000 ~ 10,000,000
	100V	101	68,000	470,000 ~ 2,200,000	3,300,000 ~ 4,700,000
	250V	251	22,000	100 ~ 220,000	
	450V	451	33,000		
	630V	631	15,000 ~ 33,000	47,000 ~ 68,000	
	1000V	102	1,000 ~ 8,200		

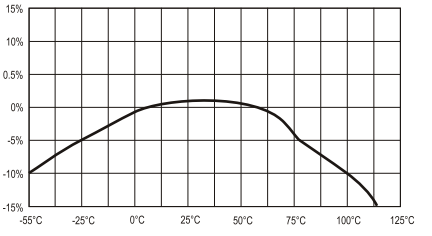
COG/NPO: Typical Capacitance Change vs. Temperature



X7R: Typical Capacitance Change vs. Temperature



X7S: Typical Capacitance Change vs. Temperature



■ CAPACITANCE CODE EXAMPLES

Code	221	222	473	104	105	106
in uF	0.00022	0.0022	0.047	0.1	1.0	10
in pF	220	2,200	47,000	100,000	1,000,000	10,000,000

■ 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 Dimensions</td><td>---</td><td>* No remarkable defect.
* Dimensions to confirm to individual specification sheet.</td></tr>
<tr><td>2.</td><td>Capacitance</td><td>* Class I :
Cap.≤1000pF, 1.0±0.2Vrms, 1MHz±10%.
Cap.>1000pF, 1.0±0.2Vrms, 1KHz±10%.
* Class II :
Cap.≤10μF, 1.0±0.2Vrms, 1KHz±10%**.
Cap.>10μF, 0.5±0.2Vrms, 120Hz±20%.

** Test condition: 0.5±0.2Vrms, 1KHz±10%</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>X7R:
0805=106(6.3V), 0603/475(6.3V)
X5R:
0201≥ 224 (6.3V,10V,16V)#1,
0402≥ 475 (6.3V,16V), 0402≥ 225(10V),
0603=106 (6.3V)

X6S:
0201/474(4V),0201≥ 104 (6.3V,10V#1),
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),
X6S/0201/104(10V)
(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> Class I :
<table><tr><th>Dielectric</th><th>Rated Vol.(V)</th><th>Q/D.F.</th><th>Remark</th></tr><tr><td rowspan="2">Class I</td><td rowspan="2">All</td><td>Q≥1000</td><td>Cap.≥30pF</td></tr><tr><td>Q≥400+20C</td><td>Cap.<30pF</td></tr></table>* Class II :
<table><tr><th>Rated</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>≤3.5%</td><td>0603≥0.047μF, 0805=0.1μF, 1206≥0.47μF, 1812≥4.7μF, 1825≥4.7μF, 2220≥4.7μF, 2225≥4.7μF</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>≤3.5%</td><td>0201(50V), 0603≥0.047μF, 0805≥0.1μF, 1206≥0.47μF, 1210≥2.2μF, 1812≥4.7μF, 1825≥4.7μF, 2220≥4.7μF, 2225≥4.7μF</td></tr><tr><td>≤5%</td><td>0201≥0.01uF, 1210≥4.7μF</td></tr><tr><td>≤10%</td><td>0402≥0.1μF, 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, 1206≥4.7μF</td></tr><tr><td>≤10%</td><td>0201≥0.1μF, 0402≥0.10μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥6.8μF, 1210≥22μF</td></tr><tr><td>≤12.5%</td><td>0402≥0.47μF</td></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≥0.1uF(0201/X7R≥0.022μF), 0402≥0.22uF, 0603≥0.68μF, 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≥0.33μF(0402/X7R≥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>Temperature Coefficient</td><td>* With no electrical load.
<table><tr><th>T.C.</th><th>Operating Temp.</th></tr><tr><td>C0G</td><td>-55~125°C at 25°C</td></tr><tr><td>X7R</td><td>-55~125°C at 25°C</td></tr></table>* Measurement voltage for Class II :
<table><tr><th>Size</th><th>Cap. Range</th><th>Condition</th></tr><tr><td rowspan="3">0201</td><td>Cap.<0.1μF</td><td>1V</td></tr><tr><td>0.1μF≤Cap.<1μF</td><td>0.2V</td></tr><tr><td>Cap.≥1μF</td><td>0.1V</td></tr><tr><td rowspan="4">0402</td><td>Cap.<0.1μF</td><td>1V</td></tr><tr><td>Cap.=1μF</td><td>0.5V</td></tr><tr><td>1μF<Cap.<10μF</td><td>0.2V</td></tr><tr><td>Cap.≥10μF</td><td>0.1V</td></tr><tr><td rowspan="3">0603</td><td>Cap.≤1μF</td><td>1V</td></tr><tr><td>1μF<Cap.≤4.7μF</td><td>0.5V</td></tr><tr><td>Cap.>4.7μF</td><td>0.2V</td></tr><tr><td rowspan="3">0805</td><td>Cap.<10μF</td><td>1V</td></tr><tr><td>Cap.=10μF</td><td>0.5V</td></tr><tr><td>Cap.>10μF</td><td>0.2V</td></tr><tr><td rowspan="3">1206/1210</td><td>Cap.≤10μF</td><td>1V</td></tr><tr><td>10μF<Cap.≤100μF</td><td>0.5V</td></tr><tr><td>Cap.>100μF</td><td>0.2V</td></tr></table></td><td><table><tr><th>T.C.</th><th>Capacitance Change</th></tr><tr><td>C0G</td><td>Within ±30ppm/°C</td></tr><tr><td>X7R</td><td>Within ±15%</td></tr></table></td></tr>
</table>

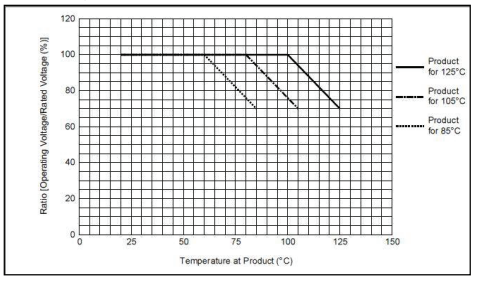
■ RELIABILITY TEST CONDITIONS AND REQUIREMENTS

<table>
<tr><th>No.</th><th>Item</th><th>Test Condition</th><th>Requirements</th></tr>
<tr><td>5.</td><td>Insulation Resistance</td><td>
<table>
<tr><th>Rated Vol.(V)</th><th>Apply Voltage</th><th>Charge Time</th></tr>
<tr><td>≤100</td><td>1 times of U_R</td><td>Max. 120 sec.</td></tr>
<tr><td>200≤V≤500</td><td>1 times of U_R</td><td>60 sec.</td></tr>
<tr><td>>500</td><td>500Vdc</td><td>60 sec.</td></tr>
</table>
</td><td>
<table>
<tr><th>Dielectric</th><th>Capacitance Change</th></tr>
<tr><td>Class I</td><td>≥10GΩ or RxC≥500Ω-F, whichever is smaller</td></tr>
<tr><td>Class II</td><td>≥10GΩ or RxC≥100Ω-F, whichever is smaller</td></tr>
</table>
* Except (Class II) :
<table>
<tr><th>Rated voltage (X7R)</th><th>I.R.</th></tr>
<tr><td>≥100V : All X7R</td><td rowspan="7">≥10GΩ or RxC≥100Ω-F, whichever is smaller</td></tr>
<tr><td>50V : 0402>0.01μF, 0603≥1μF, 0805≥1μF, 1206≥4.7μF, 1210≥4.7μF, 1812≥10μF, 2220≥22μF</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</td></tr>
<tr><th>Rated voltage (X7R)</th><th>I.R.</th></tr>
<tr><td>100V : 1210≥3.3μF</td><td rowspan="8">RxC≥50Ω-F</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, 0603>4.7μF, 0805≥47μF, 1206≥10μF</td></tr>
<tr><td>4V : 0603≥22μF, 0805≥47μF, 1206≥100μF</td></tr>
</table>
</td></tr>
<tr><td>6.</td><td>Dielectric Strength</td><td>
<table>
<tr><th>Rated Voltage</th><th>Condition</th></tr>
<tr><td>≤100</td><td>2.5 times of U_R</td></tr>
<tr><td>100<V≤250</td><td>2.0 times of U_R</td></tr>
<tr><td>250<V≤500</td><td>1.5 times of U_R</td></tr>
<tr><td>630≤V≤3000V</td><td>1.2 times of U_R</td></tr>
<tr><td>3000<V<5000V</td><td>1.1 times of U_R</td></tr>
<tr><td>≥5000V</td><td>1.0 times of U_R</td></tr>
</table>
* Duration : 1 to 5 sec.
Voltage ramp up rate ≤500Vdc/sec.
* Charge and discharge current less than 50mA.
* Test in insulating fluid for rated voltage ≥1KV products.
</td><td>* No evidence of damage or flash over during test.</td></tr>
<tr><td>7.</td><td>Solderability</td><td>* Solder temperature : 235±5°C for (0402~1210).
* Solder temperature : 245±5°C for (1808~2225).
* Dipping time : 2±0.5 sec.</td><td>* 75% min. coverage of all metalized area.</td></tr>
<tr><td>8.</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) : 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 (Class I) or 48±4 hrs (Class II).</td><td>* No remarkable damage.
* Cap. change :
C0G : Within ±2.5% or ±0.25pF, whichever is larger.
X7R : Within ±7.5%.
* D.F./Q, I.R : To meet initial requirements.
* 25% max. leaching on each edge.</td></tr>
<tr><td>9.</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.
* Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).</td><td>* No remarkable damage.
* Cap. change :
C0G : Within ±2.5% or ±0.25pF, whichever is larger.
X7R : Within ±7.5%.
* D.F./Q :
C0G : Q≥100% of initial requirements.
X7R : D.F.≤150% of initial requirement.
* I.R. : ≥100% of initial requirement.</td></tr>
</table>

■ RELIABILITY TEST CONDITIONS AND REQUIREMENTS

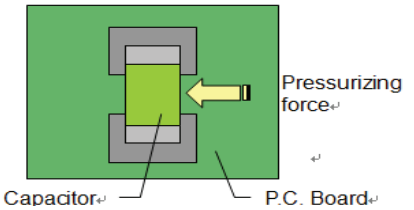
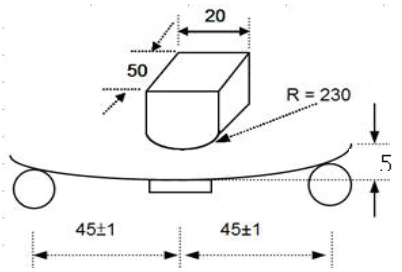
<table>
<tr><th>No.</th><th>Item</th><th>Test Condition</th><th>Requirements</th></tr>
<tr><td>10.</td><td>Humidity (Damp Heat) Steady State</td><td>* Test temp. : 40±2°C.
* Humidity : 90~95%RH.
* Test time : 500 +24/-0hrs.
* Before initial measurement (Class II only) : To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.
* Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).</td><td>* No remarkable damage.
* Cap. change :
C0G : Within ±5.0% or ±0.5pF, whichever is larger.
X7R : Within ±12.5% for ≥10V**, within ±25% for 6.3V.
**10V : Within ±25% for 0603≥4.7μF, 0402≥1μF.
* D.F./Q :
C0G : Q≥350 for Cap.>30pF, Q≥275+2.5C for 10pF≤Cap.≤30pF, Q≥200+10C for Cap.<10pF.
X7R : D.F.≤200% of initial requirement.
* I.R. : ≥10V, ≥1GΩ or R×C≥50Ω-F, whichever is smaller.
Except :
<table>
<tr><th>Rated voltage</th><th>I.R.</th></tr>
<tr><td>100V : All X7R; 1210≥3.3μF</td><td rowspan="7">≥1GΩ or RxC≥10Ω-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; Size≥1812</td></tr>
</table></td></tr>
<tr><td>11.</td><td>Humidity (Damp Heat) Load</td><td>* Reflow solder the capacitors on a P.C. Board before test.
* Test temp. : 40±2°C (85±3°C for control code H).
* Humidity : 90~95% RH (85±5% for control code H).
* Test time : 500 +24/-0hrs.
* To apply voltage : Rated voltage (500Vdc max. for general purpose and 100Vdc max. for control code H)
* Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).</td><td>* No remarkable damage.
* Cap. change :
C0G : Within ±7.5% or ±0.75pF, whichever is larger.
X7R : Within ±12.5% for ≥10V**, within ±25% for 6.3V.
**10V : Within ±25% for 0603≥4.7μF, 0402≥1μF.
* D.F./Q :
C0G : Q≥350 for Cap.>30pF, Q≥275+2.5C for 10pF≤Cap.≤30pF, Q≥200+10C for Cap.<10pF.
X7R : ≤200% of initial requirement.
* I.R. : ≥10V, ≥500MΩ or RxC≥25Ω-F, whichever is smaller.
Except :
<table>
<tr><th>Rated voltage</th><th>I.R.</th></tr>
<tr><td>≥100V : All X7R; 1210≥3.3μF</td><td rowspan="7">≥500MΩ or RxC≥5Ω-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; Size≥1812</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>12.</td><td>High Temperature Load (Endurance)</td><td>
* Test temp. : 125±3°C.
* To apply voltage :
(1) ≤6.3V or Cap.≥10μF : 150% of rated voltage.
(2) 10V≤Ur≤100V : 200% of rated voltage.
(3) 200V≤Ur≤500V : 150% of rated voltage.
(4) 630V : 120% of rated voltage.
(5) Ur≥1000V : 100% of rated voltage.
(6) 100% of rated voltage for below range :
<table>
<tr><th>Size</th><th>Dielectric</th><th>Rated</th><th>Capacitance</th></tr>
<tr><td>0201</td><td>X7R</td><td>≤10V</td><td>C≥0.1μF</td></tr>
<tr><td></td><td></td><td>≥16V</td><td>C>0.1μF</td></tr>
<tr><td>0402</td><td>X7R</td><td>6.3V, 10V, 16V, 25V</td><td>C≥1.0μF</td></tr>
<tr><td rowspan="3">0603</td><td rowspan="3">X7R</td><td>4V</td><td>C≥22μF</td></tr>
<tr><td>6.3V,10V</td><td>C≥4.7μF</td></tr>
<tr><td>25V, 35V</td><td>C≥1.0μF</td></tr>
<tr><td rowspan="3">0805</td><td rowspan="3">X7R</td><td>4V</td><td>C≥47μF</td></tr>
<tr><td>6.3V</td><td>C≥22μF</td></tr>
<tr><td>10V~50V</td><td>C≥10μF</td></tr>
<tr><td rowspan="2">1206</td><td rowspan="2">X7R</td><td>≤6.3V</td><td>C≥47μF</td></tr>
<tr><td>100V</td><td>C≥2.2μF</td></tr>
<tr><td rowspan="2">1210</td><td>X7R</td><td>16V</td><td>C≥47μF</td></tr>
<tr><td>X7R</td><td>≥100V</td><td>C≥3.3μF</td></tr>
<tr><td>2220</td><td>X7R</td><td>100V</td><td>C≥22μF</td></tr>
</table>
(7) 150% of rated voltage for below range :
<table>
<tr><th>Size</th><th>Dielectric</th><th>Rated Voltage</th><th>Capacitance</th></tr>
<tr><td>0201</td><td>X7R</td><td>16V</td><td>C≥0.022μF</td></tr>
<tr><td rowspan="2">0402</td><td rowspan="2">X7R</td><td>50V</td><td>C≥0.1μF</td></tr>
<tr><td>10~25V</td><td>C≥0.22μF</td></tr>
<tr><td rowspan="2">0603</td><td>X7R</td><td>≥50V</td><td>C≥0.082μF</td></tr>
<tr><td>X7R</td><td>10V,16V, 50V</td><td>C≥1.0μF</td></tr>
<tr><td rowspan="3">0805</td><td>X7R</td><td>10~50V</td><td>C≥4.7μF</td></tr>
<tr><td rowspan="2">X7R</td><td>50V</td><td>C≥0.47μF</td></tr>
<tr><td>≥100V</td><td>C≥0.12μF</td></tr>
<tr><td>1206</td><td>X7R</td><td>≥50V</td><td>C≥1.0μF</td></tr>
<tr><td rowspan="2">1210</td><td>X7R</td><td>≤100V</td><td>C≥1.0μF</td></tr>
<tr><td>X7R</td><td>>100V</td><td>C≥0.22μF</td></tr>
<tr><td rowspan="2">1812</td><td rowspan="2">X7R</td><td>≤50V</td><td>C≥4.7μF</td></tr>
<tr><td>100V</td><td>C≥1.0μF</td></tr>
<tr><td>1825
2220
2225</td><td>X7R</td><td>≥100V</td><td>C≥1.0μF</td></tr>
</table>
(8) 120% of rated voltage for below range :
<table>
<tr><th>Size</th><th>Dielectric</th><th>Rated Voltage</th><th>Capacitance</th></tr>
<tr><td>2220</td><td>X7R</td><td>≥100V</td><td>C≥15μF</td></tr>
</table>
* Test time: 1000 +24/-0 hrs.
* 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 48±4 hrs (Class II).
** De-rating conditions :


</td><td>
* No remarkable damage.
* Cap. change :
C0G : Within ±5.0% or ±0.5pF, whichever is larger.
X7R : Within ±12.5% for ≥10V**, within ±25% for 6.3V.
**10V : Within ±25% for 0603≥4.7μF, 0402≥1μF.
* D.F./Q :
C0G : Q≥350 for Cap.>30pF, Q≥275+2.5C for 10pF≤Cap.≤30pF, Q≥200+10C for Cap.<10pF.
X7R : D.F.≤200% of initial requirement.
* I.R. : ≥10V, ≥1GΩ or R×C≥50Ω-F, whichever is smaller.
Except :
<table>
<tr><th>Rated voltage</th><th>I.R.</th></tr>
<tr><td>100V : All X7R; 1210≥3.3μF</td><td rowspan="6">≥1GΩ or RxC≥10Ω-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; Size≥1812</td></tr>
</table>
</td></tr>
</table>

■ RELIABILITY TEST CONDITIONS AND REQUIREMENTS

No.	Item	Test Condition	Requirements
13.	Adhesive Strength of Termination	* Capacitors mounted on a substrate. A force of 5N(≤0603) or 10N(>0603) applied perpendicular to the place of substrate and parallel the line joining the center of terminations for 10±1 second.  	* No remarkable damage or removal of the terminations.
14.	Bending Test	* 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 5mm for product size < 1808, 3mm for product size ≥ 1808.  Unit : mm	* No remarkable damage. Dielectric / Cap. Change Class I (C0G) / Within ±5.0% or ±0.5pF, whichever is larger Class II (X7R) / Within ±12.5% (This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test)
15.	Vibration Resistance	* Vibration frequency : 10~55 Hz/min. * Total amplitude : 1.5mm. * Test time : 6 hrs. (Two hrs each in three mutually perpendicular directions) * Before initial measurement (Class II only) : To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp. * Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).	* No remarkable damage. * Cap. change and D.F./Q : To meet initial spec.

■ APPLICATION NOTES

■ STORAGE

To prevent the damage of solderability of terminations, the following storage conditions are recommended :

Indoors under 5 ~ 40°C and 20% ~ 70% RH.

No harmful gases containing sulfuric acid, ammonia, hydrogen sulfide or chlorine.

Packaging should not be opened until the capacitors are required for use. If opened, the pack should be re-sealed as soon as is practicable. Taped product should be stored out of direct sunlight, which might promote deterioration in tape or adhesion performance. The product is recommended to be used within 12 months after shipment and checked the solderability before use.

■ HANDLING

Chip capacitors are dense, hard, brittle, and abrasive materials. They are liable to suffer mechanical damage, in the form of cracks or chips. Chip Capacitors should be handled with care to avoid contamination or damage. To use vacuum or plastic tweezers to pick up or plastic tweezers is recommended for manual placement. Tape and reeled packages are suitable for automatic pick and placement machine.

■ PREHEAT

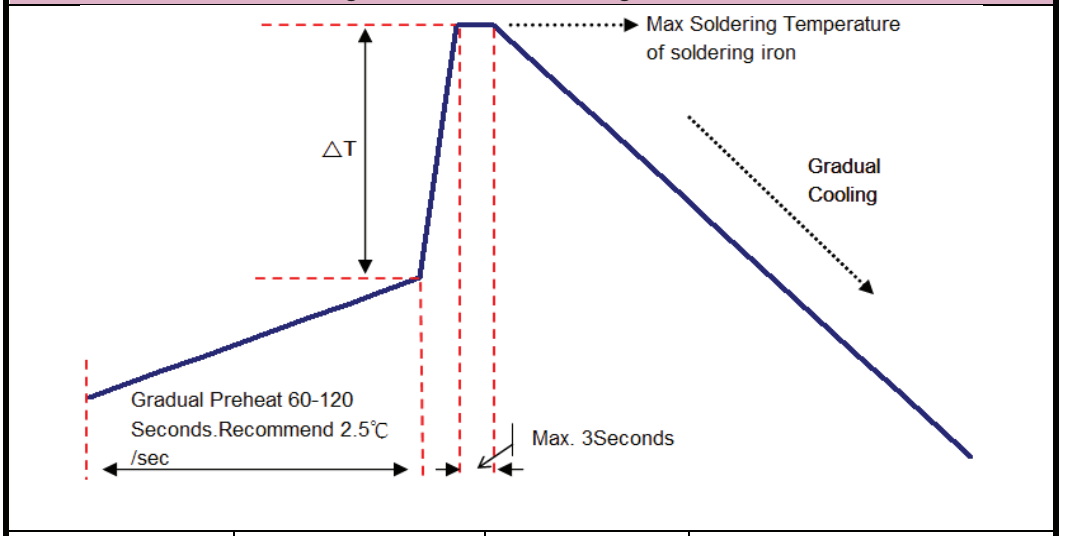
In order to minimize the risk of thermal shock during soldering, a carefully controlled preheat is required. The rate of preheat should not exceed 3°C per second.

■ SOLDERING

Use mildly activated rosin fluxes do not use activated flux. The amount of solder in each solder joint should be controlled to prevent the damage of chip capacitors caused by the stress between solder, chips, and substrate.

a.) Hand soldering :

Fig. 10.1 Hand Soldering Profile



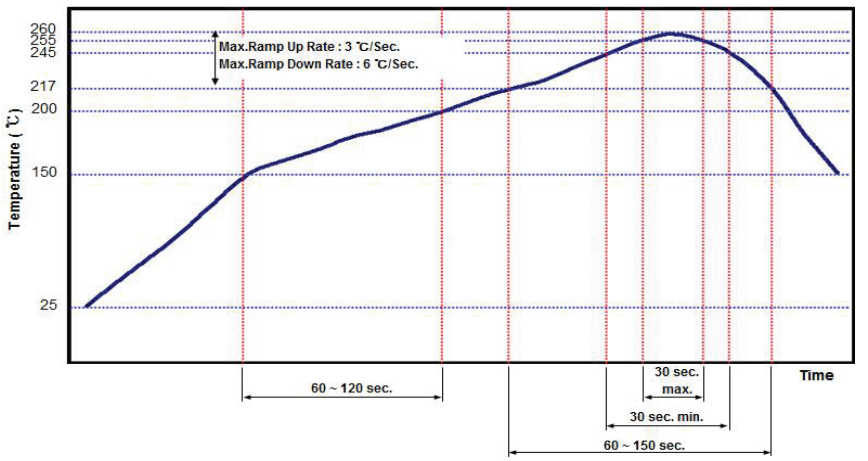
Chip Size	Pre-Heat temp.	ΔT	Max. soldering iron temp.
≤1206	≥150°C	≤150°C	≤350°C
1210~2225	≥150°C	≤130°C	≤280°C

* Soldering iron tip diameter ≤1.0 mm and wattage max. 20W.
* The Capacitors shall be pre-heated and that the temperature gradient between the devices and the tip of the soldering iron.
* The required amount of solder shall be melted on the soldering tip.
* The tip of iron should not contact the ceramic body directly.
* The Capacitors shall be cooled gradually at room temperature after soldering.
* Forced air cooling is not allowed.

■ APPLICATION NOTES

b.) Reflow soldering :

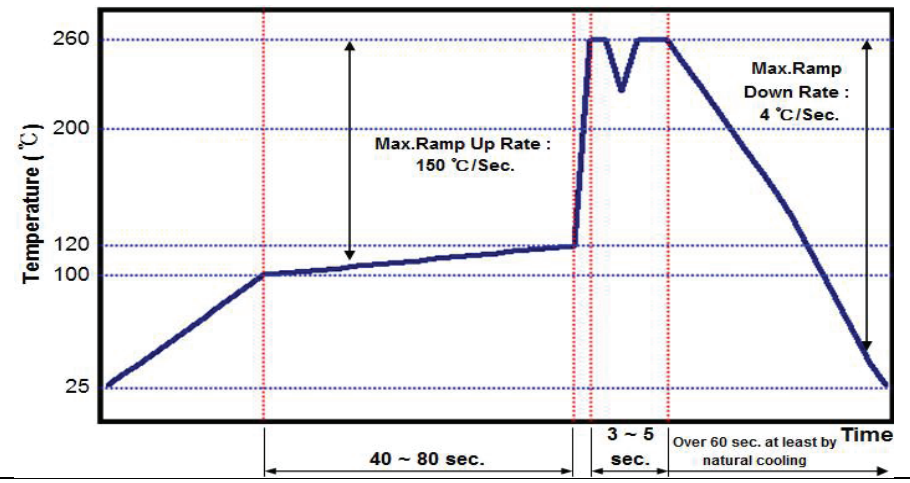
Fig. 10.2 Reflow soldering profile



For Sn/Ag/Cu Series solder paste (Pb-Free)

c.) Wave soldering :

Fig. 10.3 Wave soldering profile



For Sn/Ag/Cu Series solder paste (Pb-Free)

■ SOLDERING CONDITIONS: CLASS I

Size Inch (mm)	Temper. Cher.	Capacitance	Condition	
			Wave	Reflow
≤0402 (1005)	Class I	All	X	O
0603 (1608)	Class I	All	O	O
0805 (2012)	Class I	All	O	O
1206 (3216)	Class I	All	O	O
		Thickness >0.95mm	X	O
≥1210 (3225)	Class I	All	X	O
Coating Products	All	All	X	O

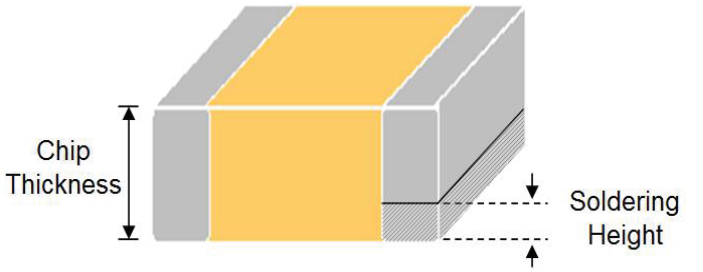
■ APPLICATION NOTES

■ SOLDERING CONDITIONS: CLASS II

Size Inch (mm)	Temper. Cher.	Capacitance	Condition	
			Wave	Reflow
≤0402 (1005)	Class II	All	X	O
0603 (1608)	Class II	Cap. <2.2μF	O	O
		Cap. ≥2.2μF	X	O
0805 (2012)	Class II	Thickness ≤ 0.95mm	O	O
		Thickness > 0.95mm	X	O
1206 (3216)	Class II	Thickness ≤ 0.95mm	O	O
		Thickness > 0.95mm	X	O
≥1210 (3225)	Class II	All	X	O
Coating Products	All	All	X	O

Soldering height :

The solder climbing minimum height is suggesting to 25% of chip thickness or 500um whichever is less.
(Reference from IPC-610E)



■ COOLING

After soldering, cool the chips and the substrate gradually to room temperature. Natural cooling in air is recommended to minimize stress in the solder joint.

■ CLEANING

All flux residues must be removed by using suitable electronic-grade vapor-cleaning solvents to eliminate contamination that could cause electrolytic surface corrosion. Good results can be obtained by using ultrasonic cleaning of the solvent. The choice of the proper system is depends upon many factors such as component mix, flux, and solder paste and assembly method. The ability of the cleaning system to remove flux residues and contamination from under the chips is very important.

Surface coating products are not suitable cleaning/washing by solvent