

Multilayer Ceramic Capacitor 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 X5R is use for this product.

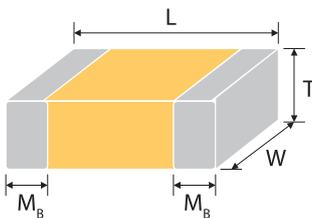
Features:

- 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:



Size Inch (mm)	L (mm)	W (mm)	T (mm)/Symbol	MB (mm)
0603 (1608)	1.6 ±0.1	0.8 ±0.1	0.8 ±0.07	S
	1.6 +0.15/-0.1	0.8 +0.15/-0.1	0.8 +0.15/-0.1	X
	1.6 ±0.2×1	0.8 ±0.2×1	0.8 ±0.2×1	

Fig. 1 The outline of MLCC

Remark: Reflow soldering only is recommended
For 0603/X5R/6.3V/Cap≥10μF products

General Electrical Data:

Dielectric	X5R
Size	0603
Capacitance range*	4.7uF
Capacitance tolerance**	K (±10%)
Rated voltage (WVDC)	6.3V
Tan δ*	Note 1
Operating temperature	-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 X5R.

** 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.

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Note 1: X5R

Rated vol.	D.F. \leq	Exception of D.F. \leq	
6.3V	$\leq 10\%$	$\leq 15\%$	0603 $\geq 10\mu\text{F}$

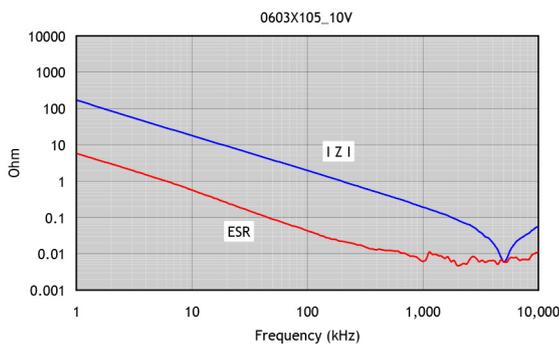
Packaging Style and Quantity:

Size	Thickness (mm) / Symbol		Paper tape	
			7" reel	13" reel
0603 (1608)	0.8 ± 0.07	S	4k	15k
	0.8 ± 0.2	X	4k	15k

Unit: pieces

Electrical Characteristics:

Typical Impedance/ESR vs. Frequency



ESR and |Z| vs. frequency (0603 \times 105_10V)

Reliability Test Conditions and Requirements:

No	Item	Test Condition	Requirements								
1	Visual and Mechanical	-	No remarkable defect. Dimensions to conform to individual specification sheet.								
2	Capacitance	Class II: X5R	Shall not exceed the limits given in the detailed spec.								
3	Q/ D.F. (Dissipation Factor)	Cap $\leq 10\mu\text{F}$, $1 \pm 0.2\text{Vrms}$, $1\text{kHz} \pm 10\%^{**}$ Test condition: $0.5 \pm 0.2\text{Vrms}$, $1\text{kHz} \pm 10\%$ X5R: 0603 = 106 (6.3V)	X5R: <table border="1" style="width: 100%;"> <thead> <tr> <th>Related Vol.</th> <th>D.F. \leq</th> <th colspan="2">Exception of D.F. \leq</th> </tr> </thead> <tbody> <tr> <td>6.3V</td> <td>$\leq 10\%$</td> <td>$\leq 15\%$</td> <td>0603 $\geq 10\mu\text{F}$</td> </tr> </tbody> </table>	Related Vol.	D.F. \leq	Exception of D.F. \leq		6.3V	$\leq 10\%$	$\leq 15\%$	0603 $\geq 10\mu\text{F}$
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4	Dielectric Strength	To apply voltage ($\leq 100\text{V}$) 250%. Duration: 1 to 5 sec. Charge and discharge current less than 50mA.	No evidence of damage or flash over during test.								

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No	Item	Test Condition	Requirements								
5	Insulation Resistance	To apply rated voltage for max. 120 sec.	<p>10GΩ or $RxC \geq 500\Omega\text{-F}$ whichever is smaller. Class II (X5R)</p> <table border="1"> <tr> <td>Rated voltage</td> <td>Insulation Resistance</td> </tr> <tr> <td>6.3V</td> <td>10G or $RxC \geq 100\Omega\text{-F}$ whichever is smaller.</td> </tr> </table>	Rated voltage	Insulation Resistance	6.3V	10G or $RxC \geq 100\Omega\text{-F}$ whichever is smaller.				
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6	Temperature Coefficient	<p>With no electrical load.</p> <table border="1"> <tr> <td>T.C.</td> <td>Operating Temp.</td> </tr> <tr> <td>X5R</td> <td>-55~ 85°C at 25°C</td> </tr> </table>	T.C.	Operating Temp.	X5R	-55~ 85°C at 25°C	<table border="1"> <tr> <td>T.C.</td> <td>Capacitance Change</td> </tr> <tr> <td>X5R</td> <td>Within ±15%</td> </tr> </table>	T.C.	Capacitance Change	X5R	Within ±15%
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7	Adhesive Strength of Termination	<p>Pressurizing force: 5N (≤ 0603) and 10N (>0603) Test time: 10±1 sec.</p>	No remarkable damage or removal of the terminations.								
8	Vibration Resistance	<p>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.</p>	<p>No remarkable damage. Cap change and Q/D.F.: To meet initial spec.</p>								
9	Solderability	<p>Solder temperature: 235±5°C Dipping time: 2±0.5 sec.</p>	95% min. coverage of all metalized area.								
10	Bending Test	<p>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</p>	<p>No remarkable damage. Cap change: X5R: within ±12.5% (This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test.)</p>								
11	Resistance to Soldering Heat	<p>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.</p>	<p>No remarkable damage. Cap change: X5R: within ±7.5% Q/D.F., I.R. & dielectric strength : To meet initial requirements. 25% max. leaching on each edge.</p>								

Multilayer Ceramic Capacitor

High Capacitance Series



No	Item	Test Condition	Requirements															
12	Temperature Cycle	<p>Conduct the five cycles according to the temperatures and time.</p> <table border="1"> <thead> <tr> <th>Step</th> <th>Temp. (°C)</th> <th>Time (min.)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Min. operating temp. +0/-3</td> <td>30±3</td> </tr> <tr> <td>2</td> <td>Room temp.</td> <td>2~3</td> </tr> <tr> <td>3</td> <td>Max. operating temp. +3/-0</td> <td>30±3</td> </tr> <tr> <td>4</td> <td>Room temp.</td> <td>2~3</td> </tr> </tbody> </table> <p>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.</p>	Step	Temp. (°C)	Time (min.)	1	Min. operating temp. +0/-3	30±3	2	Room temp.	2~3	3	Max. operating temp. +3/-0	30±3	4	Room temp.	2~3	<p>No remarkable damage. Cap change: X5R: within ±7.5% Q/D.F., I.R. & dielectric strength: To meet initial requirements.</p>
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4	Room temp.	2~3																
13	Humidity (Damp Heat) Steady State	<p>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.</p>	<p>No remarkable damage. Cap change: X5R: ≥10V**, within ±12.5%; 6.3V within ±25%; 10V:0603≥4.7µF; X5R:</p> <table border="1"> <thead> <tr> <th>Related Vol.</th> <th>D.F.≤</th> <th colspan="2">Exception of D.F. ≤</th> </tr> </thead> <tbody> <tr> <td>6.3V</td> <td>≤15%</td> <td>≤30%</td> <td>0603 ≥ 10µF</td> </tr> </tbody> </table> <p>I.R.: ≥10V, 1G or 50 -F whichever is smaller. Class II (X5R)</p>	Related Vol.	D.F.≤	Exception of D.F. ≤		6.3V	≤15%	≤30%	0603 ≥ 10µF							
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14	Humidity (Damp Heat) Load	<p>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.</p>	<p>No remarkable damage. Cap change: X5R: ≥10V, within ±12.5%; 6.3V within ±25%; 10V:0603≥4.7µF X5R</p> <table border="1"> <thead> <tr> <th>Related Vol.</th> <th>D.F.≤</th> <th colspan="2">Exception of D.F. ≤</th> </tr> </thead> <tbody> <tr> <td>6.3V</td> <td>≤15%</td> <td>≤30%</td> <td>0603≥10µF; 805≥4.7µF;</td> </tr> </tbody> </table> <p>I.R.: ≥10V, 500MΩ or 25Ω-F whichever is smaller. Class II (X5R)</p> <table border="1"> <thead> <tr> <th>Rated voltage</th> <th>Insulation Resistance</th> </tr> </thead> <tbody> <tr> <td>6.3V</td> <td>500MΩ or RxC≥5Ω-F whichever is smaller.</td> </tr> </tbody> </table>	Related Vol.	D.F.≤	Exception of D.F. ≤		6.3V	≤15%	≤30%	0603≥10µF; 805≥4.7µF;	Rated voltage	Insulation Resistance	6.3V	500MΩ or RxC≥5Ω-F whichever is smaller.			
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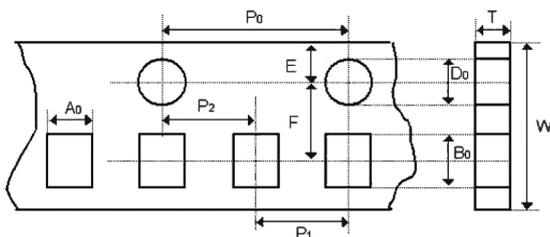
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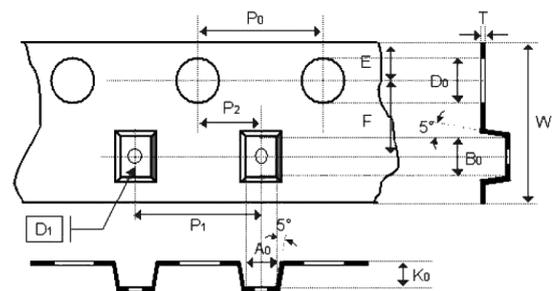
No	Item	Test Condition	Requirements																												
15	High Temperature Load (Endurance)	<p>Test temp.: X5R: 85±3°C Test time: 1,000+24/-0 hrs. To apply voltage: (1) 6.3V or C≥10μF or TT series: 150% of rated voltage. (2) 10V≥Ur<500V: 200% of rated voltage. (3) 500V: 150% of rated voltage. (4) Ur≥630V: 120% of rated voltage. (5) 100% of rated voltage for below range.</p> <table border="1"> <thead> <tr> <th>Size</th> <th>Die-lectric</th> <th>Rated voltage</th> <th>Capacitance range</th> </tr> </thead> <tbody> <tr> <td>0603</td> <td>X5R</td> <td>6.3V</td> <td>C≥4.7μF</td> </tr> </tbody> </table> <p>(6) 150% of rated voltage for below range.</p> <table border="1"> <thead> <tr> <th>Size</th> <th>Die-lectric</th> <th>Rated voltage</th> <th>Capacitance range</th> </tr> </thead> <tbody> <tr> <td>0603</td> <td>X5R</td> <td>10V</td> <td>C≥1.0μF</td> </tr> </tbody> </table> <p>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</p>	Size	Die-lectric	Rated voltage	Capacitance range	0603	X5R	6.3V	C≥4.7μF	Size	Die-lectric	Rated voltage	Capacitance range	0603	X5R	10V	C≥1.0μF	<p>No remarkable damage. Cap change: X5R: ≥10V, within ±12.5%;6.3V within ±25%; 10V :0603 ≥ 4.7μF X5R:</p> <table border="1"> <thead> <tr> <th>Related Vol.</th> <th>D.F.≤</th> <th colspan="2">Exception of D.F. ≤</th> </tr> </thead> <tbody> <tr> <td>6.3V</td> <td>≤15%</td> <td>≤30%</td> <td>0603 ≥ 10μF</td> </tr> </tbody> </table> <p>I.R.: ≥10V, 1G or 50 -F whichever is smaller. Class II (X5R)</p> <table border="1"> <thead> <tr> <th>Rated voltage</th> <th>Insulation Resistance</th> </tr> </thead> <tbody> <tr> <td>6.3V</td> <td>500MΩ or RxC≥5Ω-F whichever is smaller.</td> </tr> </tbody> </table>	Related Vol.	D.F.≤	Exception of D.F. ≤		6.3V	≤15%	≤30%	0603 ≥ 10μF	Rated voltage	Insulation Resistance	6.3V	500MΩ or RxC≥5Ω-F whichever is smaller.
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Appendixes

Tape & Reel Dimensions



The dimension of paper tape



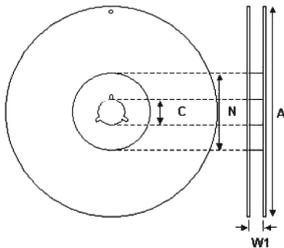
The dimension of plastic tape



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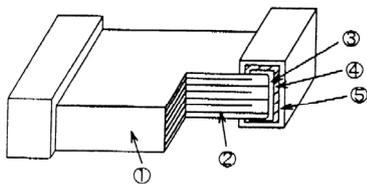


Size	0603
Thickness	S, X
A ₀	1.02±0.05
B ₀	1.8±0.05
T	0.95±0.05
K ₀	-
W	8±0.1
P ₀	4±0.1
10 × P ₀	4±0.1
P ₁	4±0.1
P ₂	2±0.05
D ₀	1.55±0.05
D ₁	-
E	1.75±0.05
F	3.5±0.05



Size	0603		
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	X5R
1	Ceramic material	BaTiO ₃ based
2	Inner electrode	Ni
3	Termination	Inner layer
4		Middle layer
5		Outer layer
		Sn (Matt)



Multilayer Ceramic Capacitor High Capacitance Series



Storage and handling conditions:

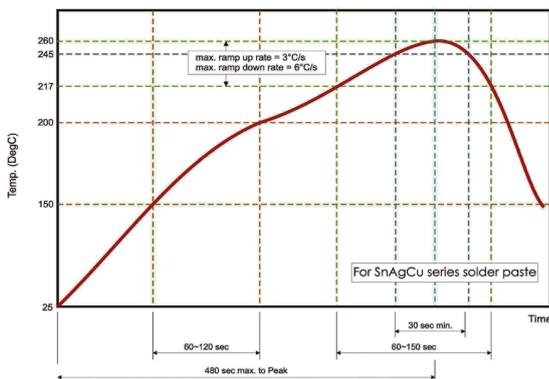
- (1) To store products at 5°C to 40°C ambient temperature and 20 to 70% related humidity conditions.
- (2) The product is recommended to be used within one year after shipment. Check solderability in case of shelf life extension is needed.

Cautions:

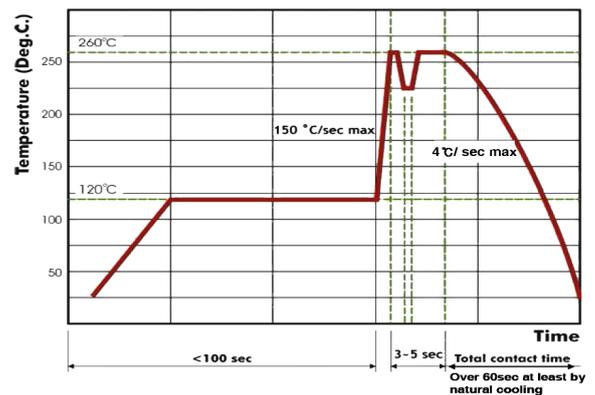
- a. The corrosive gas reacts on the terminal electrodes of capacitors, and results in the poor solderability. Do not store the capacitors in the ambience of corrosive gas (e.g., hydrogen sulfide, sulfur dioxide, chlorine, ammonia gas etc.)
- b. In corrosive atmosphere, solderability might be degraded, 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 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
CAP, MLCC, X5R, 4.7µF, 6.3V, 0603	MC0603X475K6R3CT

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