

Product Specification

RoHS compliant & Halogen Free

Surface-mount Ceramic Multilayer Capacitors

Part Description : X5R/0402/4.7uF/10V/±20%

Yageo Part number : CC0402MRX5R6BB475

SCOPE

This product specification is applied to Multi-layer Ceramic Capacitor used for General Electronic equipment.

Description

The capacitor consists of a rectangular block of ceramic dielectric in which a number of interleaved nickel electrodes are contained. This structure gives rise to a high capacitance per unit volume.

The inner electrodes are connected to the two end terminations and finally covered with a layer of plated tin (NiSn).The terminations are lead-free. A cross section of the structure is shown in Fig.1.

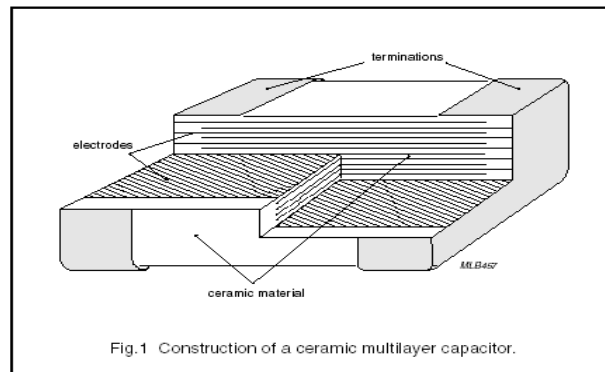


Fig.1 Construction of a ceramic multilayer capacitor.

MECHANICAL DATA

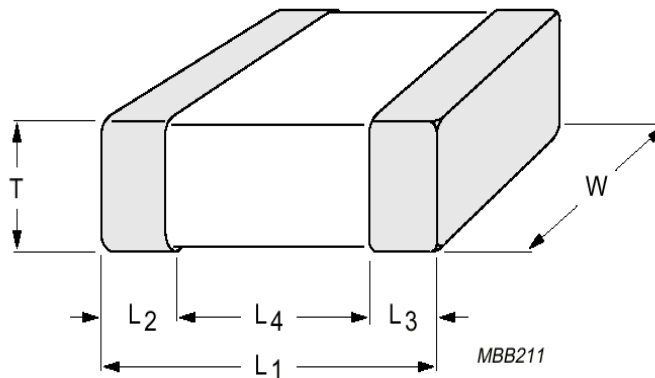


Fig. 2 Component outline

Physical dimensions (all in mm)

Size	L1	W	T	L2/L3		L4
				Min	Max	Min
0402	1.0 ±0.15	0.5 ±0.15	0.5±0.15	0.20	0.30	0.40

Thickness classification and packaging quantities:

Thickness Classification	Tape Width	Amount
0.5±0.15 mm	Paper/PE tape reel 7"	10,000

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, all test and measurements shall be made under standard atmospheric conditions for testing as given in 5.3 of IEC 60068-1:

--temperature: 15°C to 35°C

--relative humidity: 25% to 75%

--air pressure: 86 kPa to 106 kPa

Before the measurements are made, the capacitor shall be stored at the measuring temperature for a time sufficient to allow the entire capacitor to reach this temperature. The period as prescribed for recovery at the end of a test is normally sufficient for this purpose.

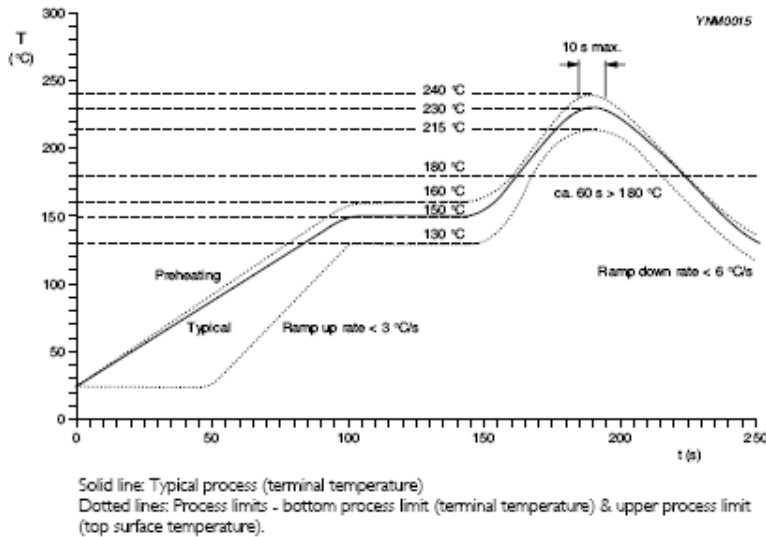
Capacitance range	4.7uF
Temperature range	-55 °C to +85 °C
Tolerance on capacitance after 1000 hours	±20%
Rated voltage UR(DC)	10V
Tan δ	≤ 10%
Insulation resistance after 1 minute at U _R (DC)	Rins. x C ≥ 100 Ω · F
Maximum capacitance change as a function of temperature	±15%
Terminations	Ni/Sn Barrier
Resistance to soldering heat	260°C, 10 sec

STORAGE CONDITIONS

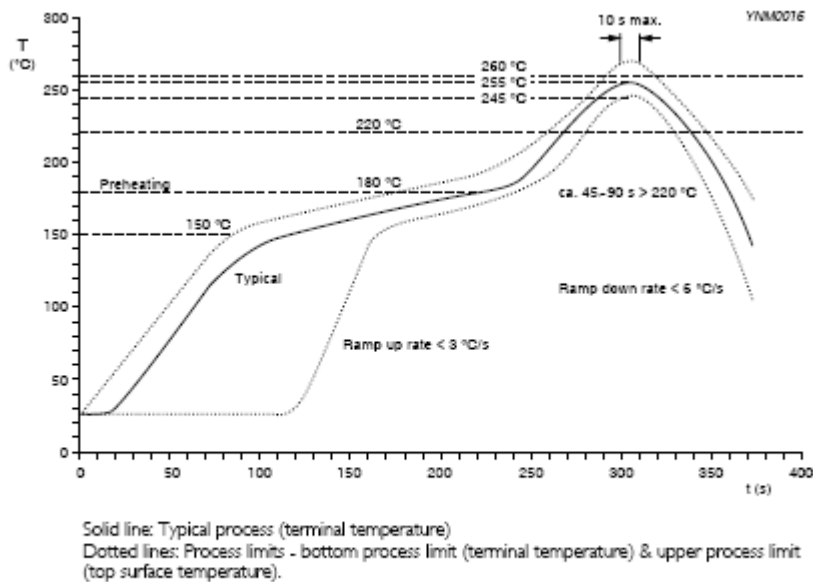
The products must be stored and shipping in an ambient temperature of less than 40°C with a relative humidity of less than 70%.

METHOD OF MOUNTING

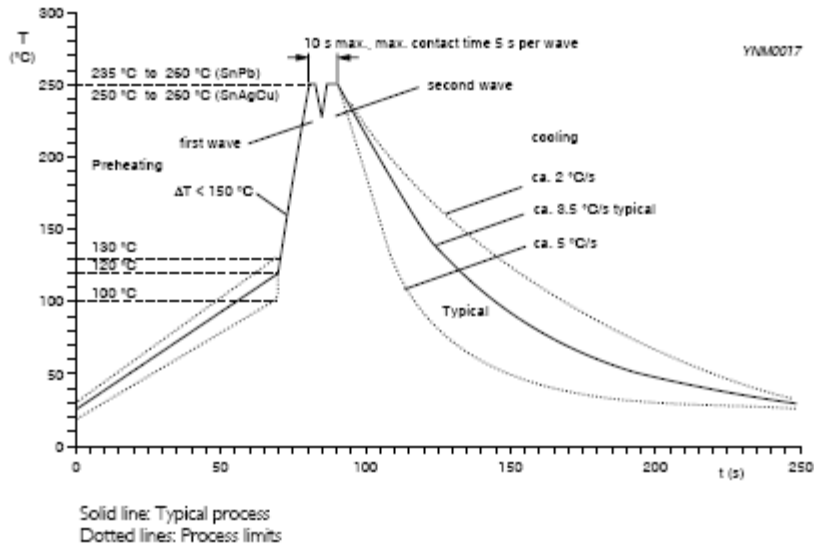
For normal use the capacitors may be mounted on printed-circuit boards or ceramic substrates by applying wave soldering, reflow soldering or conductive adhesive in accordance with "IEC 61760-1" (Standard method for the specification of surface mounting components).



Infrared soldering, forced gas convection reflow soldering - Temperature/time profile for SnPb solders



Infrared soldering, forced gas convection reflow soldering - Temperature/time profile for lead-free SnAgCu solders



Double wave soldering for SnPb and lead-free SnAgCu solder - Temperature/time profile (terminal temperature)

SOLDERING RECOMMENDATION

Soldering Method	Size					
	0201	0402	0603	0805	1206	≥ 1210
Reflow	Reflow only	≥ 0.1 uF	≥ 1.0 uF	≥ 2.2 uF	≥ 4.7 uF	Reflow only
Reflow / Wave	----	< 0.1 uF	< 1.0 uF	< 2.2 uF	< 4.7 uF	----

Test procedures and requirements.

IEC 60384-21/22	TEST	PROCEDURE	REQUIREMENTS General	REQUIREMENTS High Cap.												
4.3	Mounting	The capacitors may be mounted on printed-circuit boards or ceramic substrates	No visible damage	No visible damage												
4.4	Visual inspection and dimension check	Any applicable method using x10 magnification	In accordance with specification	In accordance with specification												
4.5.1	Capacitance	Class1 : C ≤ 1nF, f = 1 MHz; C > 1nF, f = 1 KHz; NP0: measuring voltage 1 V at 20°C Class 2 : C ≤ 10uF, V>6.3V, f = 1 KHz; measuring voltage 1 V at 20°C C ≤ 10uF, V ≤ 6.3V, f = 1 KHz; measuring voltage 0.5 V at 20°C C > 10uF, f = 120Hz; measuring voltage 0.5V at 20°C	Within specified tolerance	Within specified tolerance CC0402MRX5R6BB475: F=1kHz, measuring voltage V=0.5V at 20°C.												
4.5.2	Dissipation Factor (D.F.)	Class1 : C ≤ 1nF, f = 1 MHz; C > 1nF, f = 1 KHz; NP0: measuring voltage 1 V at 20 °C Class 2 : C ≤ 10uF, f = 1 KHz; measuring voltage 1 V at 20°C C > 10uF, f = 120Hz; measuring voltage 0.5V at 20°C	In accordance with specification	In accordance with specification CC0402MRX5R6BB475: F=1kHz, measuring voltage V=0.5V at 20°C.												
4.5.3	Insulation resistance	At Ur (DC) for 1 minute	In accordance with specification	In accordance with specification												
4.5.4	Voltage proof	Specified stress voltage applied for 1 minute Ur≤100V: series applied 2.5Ur 100<Ur≤200 series applied (1.5Ur +100) 200<Ur≤500 series applied (1.3Ur +100) Ur>500: 1.3Ur I: 7.5mA	No breakdown or flashover	No breakdown or flashover												
4.6	Temperature coefficient	Capacitance shall be measured by the steps shown in the following table. The capacitance change should be measured after 5 min at each specified temperature stage. <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Step</th> <th>Temperature(°C)</th> </tr> </thead> <tbody> <tr> <td>a</td> <td>25±2</td> </tr> <tr> <td>b</td> <td>Lower temperature±3°C</td> </tr> <tr> <td>c</td> <td>25±2</td> </tr> <tr> <td>d</td> <td>Upper Temperature±2°C</td> </tr> <tr> <td>e</td> <td>25±2</td> </tr> </tbody> </table> <p>(1) Class I Temperature Coefficient shall be calculated from the formula as below $\text{Temp. Coefficient} = \frac{C2 - C1}{C1 \times \Delta T} \times 10^5$ C1: Capacitance at step c C2: Capacitance at 125°C ΔT: 100°C(=125°C-25°C)</p> <p>(2) CLASS II Capacitance Change shall be calculated from the formula as below. $\Delta C = \frac{C2 - C1}{C1} \times 100(\%)$ C1: Capacitance at step c C2: Capacitance at step b or d</p>	Step	Temperature(°C)	a	25±2	b	Lower temperature±3°C	c	25±2	d	Upper Temperature±2°C	e	25±2	Class1: Δ C/C: ±30ppm Class2: X7R: Δ C/C: ±15% Y5V: Δ C/C: 22~-82%	Class2: X7R/X5R: Δ C/C: ±15% Y5V: Δ C/C: 22~-82% In case of applying voltage, the capacitance change should be measured after 1 more min. with applying voltage in equilibration of each temp. stage. CC0100MRX5R5BB104: 0.2V±0.1Vrms
Step	Temperature(°C)															
a	25±2															
b	Lower temperature±3°C															
c	25±2															
d	Upper Temperature±2°C															
e	25±2															

Test procedures and requirements.

IEC 60384-21/22	TEST	PROCEDURE	REQUIREMENTS General	REQUIREMENTS High Cap.
4.7	Adhesion	A force applied for 10 sec to the line joining the terminations and in a plane parallel to the substrate.	Force size \geq 0603: \geq 5N size =0402: \geq 2.5N size =0201: \geq 1N	Force size \geq 0603: \geq 5N size =0402: \geq 2.5N size =0201: \geq 1N
4.8	Bond strength of plating on end face	Mounting in accordance with IEC 60384-22 paragraph 4.3 Conditions: bending 1 mm at a rate of 1 mm/s, radius jig 340 mm	No visible damage Δ C/C Class1: NP0 within \pm 1% or 0.5 pF, whichever is greater Class2: X7R/Y5V: \pm 10%	No visible damage Δ C/C Class2: X5R/X7R/Y5V: \pm 10%
4.9	Resistance to soldering heat	Precondition: 150 +0/-10°C/1 hr, then keep for 24 \pm 1 hrs at room temp Preheating: for size \leq 1206:120 to 150°C for 1 minute; Preheating: for size >1206:100 to 120 °C for 1 minute and 170 to 200°C for 1 minute. Solder bath temperature: 260 \pm 5°C; Dipping time 10 \pm 0.5 s Recovery time 24 \pm 2 Hours.	Dissolution of the end face plating shall not exceed 25% of the length of the edge concerned. Δ C/C : Class1: NP0: within \pm 0.5% or 0.5 pF whichever is greater Class2: X7R/X5R: \pm 10% Y5V/Z5U: \pm 20% D.F.: within initial specified value R _{ins} : within initial specified value	Dissolution of the end face plating shall not exceed 25% of the length of the edge concerned. Δ C/C : Class2: X7R/X5R: \pm 10% Y5V: \pm 20% D.F.: within initial specified value R _{ins} : within initial specified value
4.10	Solderability	The specimen shall be preheated to a temperature of (80 to 140) °C and maintained for 30s to 60s. 1. Temperature: 235 \pm 5°C / Dipping time: 2 \pm 0.5 s 2. Temperature: 245 \pm 5°C / Dipping time: 3 \pm 0.5 s (lead free) Depth of immersion: 10mm	The solder should cover over 95% of the critical area of each termination.	The solder should cover over 95% of the critical area of each termination.
4.11	Rapid change of temperature	Preconditioning; 150 +0/-10°C/1 hr, then keep for 24 \pm 1 hrs at room temp 5 cycles with following detail: 30 minutes at Lower Category Temperature; 30 minutes at Upper Category Temperature; Recovery time 24 \pm 2 Hours.	No visual damage Δ C/C : Class1: NP0 : within 1% or 1 pF, whichever is greater Class2: X7R/X5R : \pm 15% Y5V/Z5U : \pm 20% D.F. : meet initial specified value R _{ins} : meet initial specified value	No visual damage; Δ C/C: Class2: X7R/X5R: \pm 15% Y5V: \pm 20% D.F.: meet initial specified value R _{ins} : meet initial specified value

Test procedures and requirements.

IEC 60384-21/22	TEST	PROCEDURE	REQUIREMENTS General	REQUIREMENTS High Cap.
4.13	Damp heat, with Ur load	<p>1. Preconditioning, class 2 only : 150 +0/-10°C /1 hr , then keep for 24±1hrs at room temp</p> <p>2. Initial measure Spec: refer Initial spec (C, D, IR)</p> <p>3. Damp heat test: 500±12 hours at 40±2°C; 90 to 95% R.H.; 1.0Ur applied.</p> <p>4. Recovery. Class 1 : 6 to 24 hours Class 2 : 24±2 hours</p> <p>5. Final measure: C, D, IR</p> <p>P.S. If the capacitance value is less than the minimum value permitted, then after the other measurements have been made the capacitor shall be precondition according to IEC 60384 4.1 and then the requirement shall be met.</p>	<p>No visual damage after recovery</p> <p>ΔC/C : NP0 : within ±2% or 1 pF, whichever is greater X7R/X5R : ±15% Y5V/Z5U : ±30%</p> <p>D.F. : NP0 : 2 × specified value X7R/X5R : ≤ 16V : ≤ 7% ≥ 25V : ≤ 5% Y5V : ≤ 15% Z5U : ≤ 12.5%</p> <p>R_{ins} : NP0 : ≥ 2,500MΩ or RxC ≥ 25s whichever is less X7R/X5R/Y5V : ≥ 500MΩ or RxC ≥ 25s whichever is less Z5U : ≥ 1,000MΩ or RxC ≥ 100s whichever is less</p>	<p>No visual damage after recovery</p> <p>ΔC/C : X7R/X5R : ±20% Y5V/Z5U : ±30%</p> <p>D.F.: 2 x initial value max</p> <p>R_{ins}: 500 MΩ or Rins x Cr ≥ 10 s, whichever is less</p> <p>CC0100MRX5R5BB104: ΔC/C : X5R : ±25%</p> <p>D.F.: 2 x initial value max</p> <p>R_{ins}: Rins x Cr ≥ 5 s</p>
4.14	Endurance	<p>1. Precondition, class 2 only: 150 +0/-10 °C/1 hr , then keep for 24±1 hrs at room temp</p> <p>2. Initial measure Spec: refer Initial spec C, D, IR</p> <p>3. Endurance test: Temperature: NP0/X7R: 125°C X5R/Y5V/Z5U:85 °C</p> <p>Specified stress voltage applied for 1000 hrs Applied 2.0 x Ur for general product. Applied 1.5 x Ur for high cap. product.</p> <p>High voltage series follows with below stress condition: Applied 1.3 x Ur for 500V series Applied 1.2 x Ur for 1KV, 2KV,3KV series.</p> <p>4. Recovery time: 24±2 hours</p> <p>5. Final measure: C ,D, IR</p> <p>P.S. If the capacitance value is less than the minimum value permitted, then after the other measurements have been made the capacitor shall be precondition according to IEC 60384 4.1 and then the requirement shall be met.</p>	<p>No visual damage</p> <p>ΔC/C : NP0 : within ±2% or 1 pF, whichever is greater X7R/X5R : ± 15% Y5V : ± 30% Z5U : ± 30%</p> <p>D.F. : NP0 : 2 × specified value X7R/X5R : ≤ 16V : ≤ 7% ≥ 25V : ≤ 5% Y5V : ≤ 15% Z5U : ≤ 12.5%</p> <p>R_{ins} : NP0 : ≥ 4,000MΩ or RxC ≥ 40s whichever is less X7R/Y5V/X5R : ≥ 1000MΩ or RxC ≥ 50s whichever is less Z5U : ≥ 1,000MΩ or RxC ≥ 100s whichever is less</p>	<p>No visual damage</p> <p>Δ C/C: Class2: X7R/X5R: ±20% Y5V: ±30%</p> <p>D.F.: 2 x initial value max</p> <p>R_{ins}: 1000 MΩ or Rins x Cr ≥ 10 s, whichever is less</p> <p>CC0100MRX5R5BB104: ΔC/C : X5R : ±25%</p> <p>D.F.: 2 x initial value max</p> <p>R_{ins}: Rins x Cr ≥ 10 s</p>