

DATA SHEET

SURFACE-MOUNT CERAMIC MULTILAYER CAPACITORS

01005

NP0/X5R/X7R

4 V TO 16 V

10 pF to 100 nF

RoHS compliant & Halogen Free



SCOPE

This specification describes 01005 NP0/X5R series chip capacitors with lead-free terminations.

APPLICATIONS

- Mobile
- Module

FEATURES

- Supplied in tape on reel
- Nickel-barrier end termination
- RoHS compliant
- Halogen Free compliant

ORDERING INFORMATION - GLOBAL PART NUMBER, PHYCOMP

CTC & I2NC

All part numbers are identified by the series, size, tolerance, TC material, packing style, voltage, process code, termination and capacitance value.

YAGEO BRAND ordering code

GLOBAL PART NUMBER (PREFERRED)

CC xxxx x x xxx x **B** x xxx
 (1) (2) (3) (4) (5) (6) (7)

(1) SIZE – INCH BASED (METRIC)

0100(0402)

(2) TOLERANCE

J = ±5%
 K = ±10%
 M = ±20%

(3) PACKING STYLE

R = Paper/PE taping reel; Reel 7 inch

(4) TC MATERIAL

NP0
 X5R
 X7R

(5) RATED VOLTAGE

2 = 4 V
 5 = 6.3 V
 6 = 10 V
 7 = 16 V

(6) PROCESS

N = NP0
 B = Class 2 MLCC

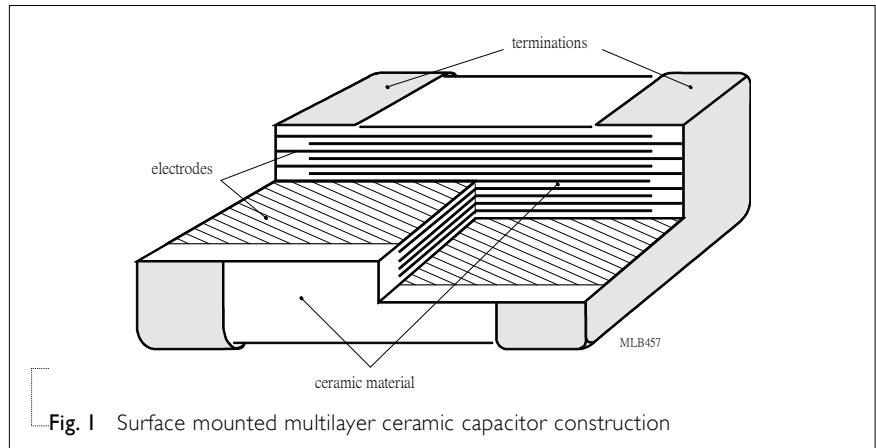
(7) CAPACITANCE VALUE

2 significant digits+number of zeros
 The 3rd digit signifies the multiplying factor, and letter R is decimal point
 Example: 121 = 12 x 10¹ = 120 pF

CONSTRUCTION

The capacitor consists of a rectangular block of ceramic dielectric in which a number of interleaved metal 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.



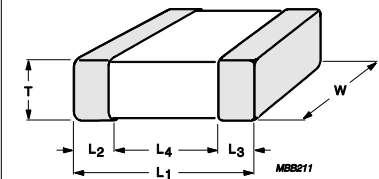
DIMENSION

Table I For outlines see fig. 2

| TYPE | L ₁ (mm) | W (mm) | T (mm) | L ₂ / L ₃ (mm) | | L ₄ (mm) |
|-------|---------------------|-----------|-----------|--------------------------------------|------|---------------------|
| | | | | min. | max. | min. |
| 01005 | 0.4 ±0.02 | 0.2 ±0.02 | 0.2 ±0.02 | 0.07 | 0.14 | 0.13 |

OUTLINES

For dimension see Table I



CAPACITANCE RANGE & THICKNESS

Table 2 01005 Sizes

| CAP. | NP0 | CAP. | X5R | | | CAP. | X7R | |
|-----------------|------------|-----------------|----------|----------|-----------------|----------|-----------------|----------|
| | 10V / 16 V | | 4V | 6.3V | 10V | | 6.3V / 10V | 16V |
| 0.5 pF | 0.2±0.02 | 100 pF | 0.2±0.02 | 0.2±0.02 | 0.2±0.02 | 100 pF | 0.2±0.02 | 0.2±0.02 |
| 0.6 pF | 0.2±0.02 | 150 pF | 0.2±0.02 | 0.2±0.02 | 0.2±0.02 | 150 pF | 0.2±0.02 | 0.2±0.02 |
| 0.7 pF | 0.2±0.02 | 220 pF | 0.2±0.02 | 0.2±0.02 | 0.2±0.02 | 220 pF | 0.2±0.02 | 0.2±0.02 |
| 0.8 pF | 0.2±0.02 | 330 pF | 0.2±0.02 | 0.2±0.02 | 0.2±0.02 | 330 pF | 0.2±0.02 | 0.2±0.02 |
| 0.9 pF | 0.2±0.02 | 470 pF | 0.2±0.02 | 0.2±0.02 | 0.2±0.02 | 470 pF | 0.2±0.02 | 0.2±0.02 |
| 1.0 pF | 0.2±0.02 | 680 pF | 0.2±0.02 | 0.2±0.02 | 0.2±0.02 | 680 pF | 0.2±0.02 | 0.2±0.02 |
| 1.2 pF | 0.2±0.02 | 1 000 pF | 0.2±0.02 | 0.2±0.02 | 0.2±0.02 | 1 000 pF | 0.2±0.02 | 0.2±0.02 |
| 1.5 pF | 0.2±0.02 | 2.2 nF | 0.2±0.02 | 0.2±0.02 | 0.2±0.02 | 2.2 nF | | |
| 1.8 pF | 0.2±0.02 | 4.7 nF | 0.2±0.02 | 0.2±0.02 | 0.2±0.02 | 4.7 nF | | |
| 2.2 pF | 0.2±0.02 | 10 nF | 0.2±0.02 | 0.2±0.02 | 0.2±0.02 | 10 nF | | |
| 2.7 pF | 0.2±0.02 | 22nF | 0.2±0.02 | 0.2±0.02 | | 22nF | | |
| 3.3 pF | 0.2±0.02 | 47 nF | 0.2±0.02 | 0.2±0.02 | | 47 nF | | |
| 3.9 pF | 0.2±0.02 | 100 nF | 0.2±0.02 | 0.2±0.02 | | 100 nF | | |
| 4.7 pF | 0.2±0.02 | 220 nF | 0.2±0.02 | | | 220 nF | | |
| 5.6 pF | 0.2±0.02 | | | | | | | |
| 6.8 pF | 0.2±0.02 | | | | | | | |
| 8.2 pF | 0.2±0.02 | | | | | | | |
| 10 pF | 0.2±0.02 | | | | | | | |
| 12 pF | 0.2±0.02 | | | | | | | |
| 15 pF | 0.2±0.02 | | | | | | | |
| 18 pF | 0.2±0.02 | | | | | | | |
| 22 pF | 0.2±0.02 | | | | | | | |
| 27 pF | 0.2±0.02 | | | | | | | |
| 33 pF | 0.2±0.02 | | | | | | | |
| 39 pF | 0.2±0.02 | | | | | | | |
| 47 pF | 0.2±0.02 | | | | | | | |
| 56 pF | 0.2±0.02 | | | | | | | |
| 68 pF | 0.2±0.02 | | | | | | | |
| 82 pF | 0.2±0.02 | | | | | | | |
| 100 pF | 0.2±0.02 | | | | | | | |
| Tape width 8 mm | | Tape width 8 mm | | | Tape width 8 mm | | Tape width 8 mm | |

THICKNESS CLASSES AND PACKING QUANTITY

Table 3

| SIZE CODE | THICKNESS CLASSIFICATION | TAPE WIDTH QUANTITY PER REEL | Ø180 MM / 7 INCH | | Ø330 MM / 13 INCH | | QUANTITY PER BULK CASE |
|-----------|--------------------------|------------------------------|------------------|---------|-------------------|---------|------------------------|
| | | | Paper/PE | Blister | Paper/ | Blister | |
| 01005 | 0.2 ±0.02 mm | 8 mm | 20,000 | --- | --- | --- | --- |

ELECTRICAL CHARACTERISTICS
NP0/X5R DIELECTRIC CAPACITORS; NISN TERMINATIONS

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.

Table 4

| DESCRIPTION | VALUE |
|---|--|
| Capacitance range | 10 pF to 100 nF |
| Capacitance tolerance | |
| NP0 | $C \geq 10 \text{ pF}$ ±5%, ±10% |
| X5R | ±10%, ±20% |
| Dissipation factor (D.F.) | |
| NP0 | $C < 30 \text{ pF}$ $\leq 1 / (400 + 20C)$ |
| | $C \geq 30 \text{ pF}$ $\leq 0.1 \%$ |
| X5R / X7R | $\leq 10 \%$ |
| | $R_{ins} \geq 10 \text{ G}\Omega$ or $R_{ins} \times C \geq 500$ seconds whichever is less |
| | X5R / X7R $\geq 1 \text{ nF}$: |
| Insulation resistance after 1 minute at U_r (DC) | $R_{ins} \times C \geq 100 \Omega \cdot \text{F}$ |
| | X5R $\geq 10 \text{ nF}$: |
| | $R_{ins} \times C \geq 50 \Omega \cdot \text{F}$ |
| Maximum capacitance change as a function of temperature (temperature characteristic/coefficient): | |
| NP0 | ±30 ppm/°C |
| X5R | ±15% |
| Operating temperature range: | |
| NP0 | -55 °C to +125 °C |
| X5R | -55 °C to +85 °C |
| X7R | -55 °C to +125 °C |

SOLDERING RECOMMENDATION

Table 5

| SOLDERING METHOD | SIZE |
|------------------|--------------|
| | 01005 |
| Reflow | Reflow only |
| Reflow/Wave | --- |

TESTS AND REQUIREMENTS

Table 6 Test procedures and requirements

| TEST | TEST METHOD | PROCEDURE | REQUIREMENTS |
|---------------------------------------|---------------------|---|----------------------------------|
| Mounting | IEC 60384-21/22 4.3 | The capacitors may be mounted on printed-circuit boards or ceramic substrates | No visible damage |
| Visual Inspection and Dimension Check | 4.4 | Any applicable method using × 10 magnification | In accordance with specification |
| Capacitance | 4.5.1 | Class 1: f = 1 MHz for C ≤ 1 nF, measuring at voltage 1 V _{rms} at 20 °C f = 1 KHz for C > 1 nF, measuring at voltage 1 V _{rms} at 20 °C Class 2: f = 1 KHz, measuring at voltage 0.5 V _{rms} at 20 °C | Within specified tolerance |
| Dissipation Factor (D.F.) | 4.5.2 | Class 1: f = 1 MHz for C ≤ 1 nF, measuring at voltage 1 V _{rms} at 20 °C f = 1 KHz for C > 1 nF, measuring at voltage 1 V _{rms} at 20 °C Class 2: f = 1 KHz, measuring at voltage 0.5 V _{rms} at 20 °C | In accordance with specification |
| Insulation Resistance | 4.5.3 | At U _r (DC) for 1 minute | In accordance with specification |

| TEST | TEST METHOD | PROCEDURE | REQUIREMENTS | | | | | | | | | | | | |
|--------------------------------------|-----------------------|--|---|-----------------|---|------|---|-----------------------|---|------|---|-----------------------|---|------|---|
| Temperature coefficient | 4.6 | <p>Capacitance shall be measured by the steps shown in the following table.</p> <p>The capacitance change should be measured after 5 min at each specified temperature stage.</p> <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</p> <p>Temperature Coefficient shall be calculated from the formula as below</p> $\text{Temp. Coefficient} = \frac{C2 - C1}{C1 \times \Delta T} \times 10^6 \text{ [ppm/°C]}$ <p>C1: Capacitance at step c C2: Capacitance at 125°C ΔT: 100°C(=125°C-25°C) Measuring Voltage: 0.5 to 5 Vrms</p> <p>(2) Class II</p> <p>Capacitance Change shall be calculated from the formula as below</p> $\Delta C = \frac{C2 - C1}{C1} \times 100\%$ <p>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 | <p><General purpose series> Class I: Δ C/C: ±30ppm</p> <p>Class2: X7R: Δ C/C: ±15% Y5V: Δ C/C: 22~-82%</p> <p><High Capacitance series> Class2: X7R/X5R: Δ C/C: ±15% Y5V: Δ C/C: 22~-82%</p> <p>In case of applying voltage, the capacitance change should be measured after 1 more min. with applying voltage in equilibration of each temp. stage.</p> <p>CC0100MRX5R5BB104: 0.2V±0.1Vrms</p> |
| Step | Temperature(°C) | | | | | | | | | | | | | | |
| a | 25±2 | | | | | | | | | | | | | | |
| b | Lower temperature±3°C | | | | | | | | | | | | | | |
| c | 25±2 | | | | | | | | | | | | | | |
| d | Upper Temperature±2°C | | | | | | | | | | | | | | |
| e | 25±2 | | | | | | | | | | | | | | |
| Adhesion | IEC 60384-21/22 4.7 | <p>A force applied for 10 seconds to the line joining the terminations and in a plane parallel to the substrate</p> | <p>Force size 01005 : 1N</p> | | | | | | | | | | | | |
| Bond Strength of Plating on End Face | 4.8 | <p>Mounting in accordance with IEC 60384-22 paragraph 4.3</p> <p>Conditions: bending 1 mm at a rate of 1 mm/s, radius jig 5 mm</p> | <p>No visible damage</p> <hr/> <p>ΔC/C</p> <p>Class 1: NP0: within ±1% or 0.5 pF, whichever is greater</p> <p>Class2: X5R: ±10%</p> | | | | | | | | | | | | |

| TEST | TEST METHOD | PROCEDURE | REQUIREMENTS |
|------------------------------|----------------------|---|---|
| Resistance to Soldering Heat | 4.9 | <p>Precondition: 150 +0/-10 °C for 1 hour, then keep for 24 ±1 hours at room temperature</p> <p>Preheating: 120 °C to 150 °C for 1 minute and 170 °C to 200 °C for 1 minute.</p> <p>Solder bath temperature: 260 ±5 °C</p> <p>Dipping time: 10 ±0.5 seconds</p> <p>Recovery time: 24 ±2 hours</p> | <p>Dissolution of the end face plating shall not exceed 25% of the length of the edge concerned</p> <hr/> <p>$\Delta C/C$</p> <p>Class 1: NP0: within ±0.5% or 0.5 pF, whichever is greater</p> <p>Class2: X5R: ±10%</p> <hr/> <p>D.F. within initial specified value</p> <p>R_{ins} within initial specified value</p> |
| Solderability | 4.10 | <p>Preheated the temperature of 80 °C to 140 °C and maintained for 30 seconds to 60 seconds.</p> <p>Test conditions for leadfree containing solder alloy</p> <p>Temperature: 245 ±5 °C</p> <p>Dipping time: 3 ±0.3 seconds</p> <p>Depth of immersion: 10 mm</p> | <p>The solder should cover over 95% of the critical area of each termination</p> |
| Rapid Change of Temperature | IEC 60384-21/22 4.11 | <p>Preconditioning; 150 +0/-10 °C for 1 hour, then keep for 24 ±1 hours at room temperature</p> <p>5 cycles with following detail: 30 minutes at lower category temperature 30 minutes at upper category temperature</p> <p>Recovery time 24 ±2 hours</p> | <p>No visual damage</p> <hr/> <p>$\Delta C/C$</p> <p>Class 1: NP0: within ±1% or 1 pF, whichever is greater</p> <p>Class2: X5R: ±15%</p> <hr/> <p>D.F. meet initial specified value</p> <p>R_{ins} meet initial specified value</p> |

| TEST | TEST METHOD | PROCEDURE | REQUIREMENTS |
|-----------|-----------------|--|--|
| Damp Heat | with Ur load | 4.13 1. Preconditioning, class 2 only: 150 +0/-10 °C /1 hour, then keep for 24 ± 1 hour at room temp 2. Initial measure: Spec: refer initial spec C, D, IR 3. Damp heat test: 500 ± 12 hours at 40 ± 2 °C; 90 to 95% R.H; 1.0 Ur applied. 4. Recovery: Class 1: 6 to 24 hours Class 2: 24 ± 2 hours 5. Final measure: C, D, IR 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. | No visual damage after recovery <hr/> $\Delta C/C$ Class 1: NP0: within ±2% or 1 pF, whichever is greater Class2: X5R: ±20% D.F. Class 1: NP0: ≤ 2 x specified value Class2: X5R: ≤ 2 x specified value R_{ins} Class 1: NP0: ≥ 2,500 MΩ or $R_{ins} \times C_r \geq 25s$ whichever is less Class2: X5R: ≥ 500 MΩ or $R_{ins} \times C_r \geq 25s$ whichever is less X5R ≥ 1nF $\Delta C/C$ Class2: X5R: ±25% D.F. Class2: X5R: ≤ 2 x specified value R_{ins} $R_{ins} \times C_r \geq 5 \Omega \cdot F$ |

| TEST | TEST METHOD | PROCEDURE | REQUIREMENTS |
|----------------------|----------------------|--|--|
| Endurance | IEC 60384-21/22 4.14 | <ol style="list-style-type: none"> 1. Preconditioning, class 2 only: 150 +0/-10 °C /1 hour, then keep for 24 ±1 hour at room temp 2. Initial measure: Spec: refer initial spec C, D, IR 3. Endurance test: Temperature: NP0: 125 °C Specified stress voltage applied for 1,000 hours: Applied 2.0 × U_r for general product Temperature: X5R: 85°C Specified stress voltage applied for 1,000 hours: Applied 1.5 × U_r for general product 4. Recovery time: 24 ±2 hours 5. Final measure: C, D, IR <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> | No visual damage <hr/> $\Delta C/C$ Class1: NP0: within ±2% or 1 pF, whichever is greater Class2: X5R: ±20% D.F. Class1: NP0: ≤ 2 × specified value Class2: X5R: ≤ 2x initial value max R _{ins} Class1: NP0: ≥ 4,000 MΩ or R _{ins} × C _r ≥ 40s whichever is less Class2: X5R: ≥ 1,000 MΩ or R _{ins} × C _r ≥ 50s whichever is less X5R ≥ 1nF $\Delta C/C$ Class2: X5R: ±25% D.F. Class2: X5R: ≤ 2x initial value max R _{ins} Class2: R _{ins} × C _r ≥ 10 Ω · F |
| Voltage Proof | IEC 60384-1 4.5.4 | Specified stress voltage applied for 1 minute U _r ≤ 100 V: series applied 2.5 U _r I: 7.5 mA | No breakdown or flashover |

REVISION HISTORY

| REVISION | DATE | CHANGE NOTIFICATION | DESCRIPTION |
|-----------|---------------|---------------------|--|
| Version 7 | Oct. 31, 2015 | | - Capacitance range & thickness update |
| Version 6 | Jun. 29, 2015 | | -Test procedures and requirements |
| Version 5 | Jun. 06, 2013 | | -Test procedures and requirements |
| Version 4 | Mar. 27, 2013 | | - Change Tolerance |
| Version 3 | Jan. 15, 2013 | | - Change Range |
| Version 2 | Oct. 23, 2012 | | - Change Range |
| Version 1 | July 03, 2012 | | - Change Range |
| Version 0 | Apr 16, 2012 | - | - New |