

DATA SHEET

SURFACE-MOUNT CERAMIC MULTILAYER CAPACITORS

01005

NP0/X5R/X7R

4 V TO 25 V

0.5 pF to 470 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

B = $\pm 0.1\text{pF}$
 C = $\pm 0.25\text{pF}$
 D = $\pm 0.5\text{pF}$
 J = $\pm 5\%$
 K = $\pm 10\%$
 M = $\pm 20\%$

(3) PACKING STYLE

R = Paper/PE taping reel; Reel 7 inch

(4) TC MATERIAL

NPO
 X5R
 X7R

(5) RATED VOLTAGE

4 = 4 V
 5 = 6.3 V
 6 = 10 V
 7 = 16 V
 8 = 25 V

(6) PROCESS

N = NPO
 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 = $12 \times 10^1 = 120\text{ pF}$

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.

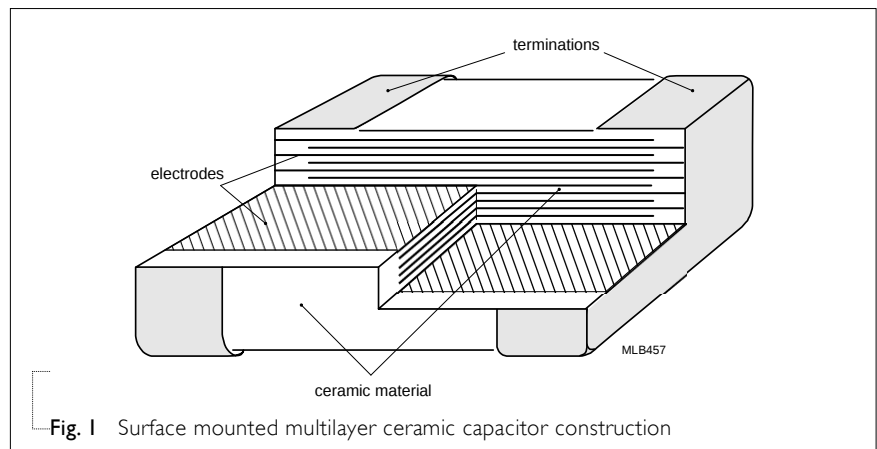


Fig. 1 Surface mounted multilayer ceramic capacitor construction

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

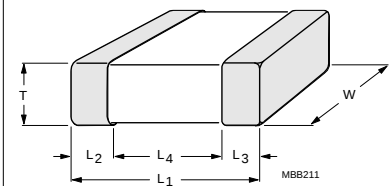


Fig. 2 Surface mounted multilayer ceramic capacitor dimension

CAPACITANCE RANGE & THICKNESS

CAP. NP0			CAP. X5R					CAP. X7R		
16 V / 25 V 50 V			4V 6.3V 10V 16V					6.3V / 10V 16V		
0.1 pF	0.2±0.02	0.2±0.02	100 pF	0.2±0.02	0.2±0.02	0.2±0.02	0.2±0.02	100 pF	0.2±0.02	0.2±0.02
0.2 pF	0.2±0.02	0.2±0.02	150 pF	0.2±0.02	0.2±0.02	0.2±0.02	0.2±0.02	150 pF	0.2±0.02	0.2±0.02
0.3 pF	0.2±0.02	0.2±0.02	220 pF	0.2±0.02	0.2±0.02	0.2±0.02	0.2±0.02	220 pF	0.2±0.02	0.2±0.02
0.4 pF	0.2±0.02	0.2±0.02	330 pF	0.2±0.02	0.2±0.02	0.2±0.02	0.2±0.02	330 pF	0.2±0.02	0.2±0.02
0.5 pF	0.2±0.02	0.2±0.02	470 pF	0.2±0.02	0.2±0.02	0.2±0.02	0.2±0.02	470 pF	0.2±0.02	0.2±0.02
0.6 pF	0.2±0.02	0.2±0.02	680 pF	0.2±0.02	0.2±0.02	0.2±0.02	0.2±0.02	680 pF	0.2±0.02	0.2±0.02
0.7 pF	0.2±0.02	0.2±0.02	1 000 pF	0.2±0.02	0.2±0.02	0.2±0.02	0.2±0.02	1 000 pF	0.2±0.02	0.2±0.02
0.75 pF	0.2±0.02	0.2±0.02	2.2 nF	0.2±0.02	0.2±0.02	0.2±0.02		2.2 nF		
0.8 pF	0.2±0.02	0.2±0.02	4.7 nF	0.2±0.02	0.2±0.02	0.2±0.02		4.7 nF		
0.9 pF	0.2±0.02	0.2±0.02	10 nF	0.2±0.02	0.2±0.02	0.2±0.02		10 nF		
1.0 pF	0.2±0.02	0.2±0.02	22nF	0.2±0.02	0.2±0.02			22nF		
1.2 pF	0.2±0.02	0.2±0.02	47 nF	0.2±0.02	0.2±0.02			47 nF		
1.5 pF	0.2±0.02	0.2±0.02	100 nF	0.2±0.02	0.2±0.02	0.2±0.02		100 nF		
1.8 pF	0.2±0.02	0.2±0.02	220 nF	0.2±0.02	0.2±0.02			220 nF		
2.2 pF	0.2±0.02	0.2±0.02	Tape width 8 mm					Tape width 8 mm		
2.7 pF	0.2±0.02	0.2±0.02								
3.3 pF	0.2±0.02	0.2±0.02								
3.9 pF	0.2±0.02	0.2±0.02								
4.7 pF	0.2±0.02	0.2±0.02								
5.6 pF	0.2±0.02	0.2±0.02								
6.8 pF	0.2±0.02	0.2±0.02								
8.2 pF	0.2±0.02	0.2±0.02								
10 pF	0.2±0.02	0.2±0.02								
12 pF	0.2±0.02	0.2±0.02								
15 pF	0.2±0.02	0.2±0.02								
18 pF	0.2±0.02	0.2±0.02								
22 pF	0.2±0.02	0.2±0.02								
27 pF	0.2±0.02	0.2±0.02								
33 pF	0.2±0.02	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										

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		0.5 pF to 470 nF
Capacitance tolerance		
	C < 10 pF	±0.1 pF, ±0.25 pF, ±0.5 pF
NP0	C ≥ 10 pF	±5%, ±10%
X5R / X7R		±10%, ±20%
Dissipation factor (D.F.)		
NP0	C < 30 pF	≤ 1 / (400 + 20C)
	C ≥ 30 pF	≤ 0.1 %
X5R / X7R		≤ 10 %
Insulation resistance after 1 minute at U _r (DC)		R _{ins} ≥ 10 GΩ or R _{ins} × C ≥ 500Ω · F whichever is less X5R/X7R > 10nF: R _{ins} × C ≥ 50Ω · F
Maximum capacitance change as a function of temperature (temperature characteristic/coefficient):		
NP0		±30 ppm/°C
X5R / X7R		±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 $\times 10$ magnification	In accordance with specification
Capacitance		4.5.1 Class 1: $f = 1 \text{ MHz}$ for $C \leq 1 \text{ nF}$, measuring at voltage $1 V_{\text{rms}}$ at 20°C $f = 1 \text{ KHz}$ for $C > 1 \text{ nF}$, measuring at voltage $1 V_{\text{rms}}$ at 20°C Class 2: $C \leq 1 \text{ nF}$ $f = 1 \text{ KHz}$, measuring at voltage $1 V_{\text{rms}}$ at 20°C $C > 1 \text{ nF}$ $f = 1 \text{ KHz}$, rated voltage $\leq 6.3 \text{ V}$, measuring at voltage $0.5 V_{\text{rms}}$ at 20°C $f = 1 \text{ KHz}$, rated voltage $> 10 \text{ V}$, measuring at voltage $1 V_{\text{rms}}$ at 20°C	Within specified tolerance
Dissipation Factor (D.F.)		4.5.2 Class 1: $f = 1 \text{ MHz}$ for $C \leq 1 \text{ nF}$, measuring at voltage $1 V_{\text{rms}}$ at 20°C $f = 1 \text{ KHz}$ for $C > 1 \text{ nF}$, measuring at voltage $1 V_{\text{rms}}$ at 20°C Class 2: $C \leq 1 \text{ nF}$ $f = 1 \text{ KHz}$, measuring at voltage $1 V_{\text{rms}}$ at 20°C $C > 1 \text{ nF}$ $f = 1 \text{ KHz}$, rated voltage $\leq 6.3 \text{ V}$, measuring at voltage $0.5 V_{\text{rms}}$ at 20°C $f = 1 \text{ KHz}$, rated voltage $> 10 \text{ V}$, measuring at voltage $1 V_{\text{rms}}$ 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	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.	$\Delta C/C$ Class I (NP0): $\pm 30\text{ppm}$ Class 2: (X7R/X5R): $\pm 15\%$										
		<table border="1"><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> (1) Class I Temperature Coefficient shall be calculated from the formula as below $\text{Temp. Coefficient} = \frac{C2 - C1}{C1 \times \Delta T} \times 10^6 \text{ [ppm/°C]}$ C1: Capacitance at step c C2: Capacitance at 125°C $\Delta T: 100^\circ\text{C}(=125^\circ\text{C}-25^\circ\text{C})$ Measuring Voltage: 0.5 to 5 Vrms (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	Step	Temperature(°C)	a	25±2	b	Lower temperature±3°C	c	25±2	d	Upper Temperature±2°C	e
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 A force applied for 10 seconds to the line joining the terminations and in a plane parallel to the substrate	Force size 01005 : 1N										
Bending Strength	4.8	Mounting in accordance with IEC 60384-22 paragraph 4.3 Conditions: bending 1 mm at a rate of 1 mm/s, radius jig 5 mm	No visible damage										
			$\Delta C/C$ Class I (NP0): within ±1% or 0.5 pF, whichever is greater Class2 (X5R/X7R): ±10%										

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
Resistance to Soldering Heat	4.9	Precondition: 150 +0/-10 °C for 1 hour, then keep for 24 ±1 hours at room temperature Preheating: 120 °C to 150 °C for 1 minute and 170 °C to 200 °C for 1 minute. Solder bath temperature: 260 ±5 °C Dipping time: 10 ±0.5 seconds Recovery time: 24 ±2 hours	Dissolution of the end face plating shall not exceed 25% of the length of the edge concerned $\Delta C/C$ Class I (NP0): within ±0.5% or 0.5 pF, whichever is greater Class2 (X5R/X7R): ±10% D.F. within initial specified value R_{ins} within initial specified value
Solderability	4.10	Preheated the temperature of 80 °C to 140 °C and maintained for 30 seconds to 60 seconds. Test conditions for leadfree containing solder alloy Temperature: 245 ±5 °C Dipping time: 3 ±0.3 seconds Depth of immersion: 10 mm	The solder should cover over 95% of the critical area of each termination
Rapid Change of Temperature	IEC 60384-21/22 4.11	Preconditioning: 150 +0/-10 °C for 1 hour; then keep for 24 ±1 hours at room temperature 5 cycles with following detail: 30 minutes at lower category temperature 30 minutes at upper category temperature Recovery time 24 ±2 hours	No visual damage $\Delta C/C$ Class I (NP0): within ±2.5% or 0.25 pF, whichever is greater Class2 (X5R/X7R): ±15% D.F. meet initial specified value R_{ins} meet initial specified value

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 Class 1 (NP0): $\Delta C/C$ within ±7.5% or 0.75 pF, whichever is greater D.F. ≤ 2 × specified value I.R. ≥ 2,500 MΩ or $R_{ins} \times Cr \geq 25\Omega \cdot F$ whichever is less Class2 (X5R/X7R): $C \leq 1nF$ $\Delta C/C$ ±15% D.F. ≤ 10% I.R. ≥ 500 MΩ 10nF ≥ C > 1nF $\Delta C/C$ ±20% D.F. ≤ 10% I.R. ≥ 500 MΩ C > 10nF $\Delta C/C$ ±25% D.F. ≤ 20% I.R. $R_{ins} \times Cr \geq 5\Omega \cdot F$

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
Endurance	IEC 60384-21/22 4.14	- Preconditioning, class 2 only: 150 +0/-10 °C /1 hour, then keep for 24 ±1 hour at room temp - Initial measure: Spec: refer initial spec C, D, IR - 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, X7R: 125°C Specified stress voltage applied for 1,000 hours: Applied 1.5 × U_r for general product - Recovery time: 24 ±2 hours - 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 Class 1 (NP0): ΔC/C within ±3% or 0.3 pF, whichever is greater D.F. ≤ 2 × specified value I.R. ≥ 4,000 MΩ or R_{ins} × Cr ≥ 40Ω · F whichever is less Class2 (X5R/X7R): C ≤ 1nF ΔC/C ±15% D.F. ≤ 10% I.R. ≥ 1GΩ 10nF ≥ C > 1nF ΔC/C ±15% D.F. ≤ 10% I.R. ≥ 1GΩ C > 10nF ΔC/C ±25% D.F. ≤ 20% I.R. R_{ins} × Cr ≥ 10Ω · F
Voltage Proof	IEC 60384-1 4.5.4	Specified stress voltage applied for 1~5 seconds U_r ≤ 100 V: series applied 2.5 U_r Charge/Discharge current is less than 50 mA	No breakdown or flashover

REVISION HISTORY

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version 12	Nov. 28, 2022	-	- Change Range
Version 11	Apr. 13, 2022	-	- Change Range
Version 10	May 5, 2017	-	- Rated voltage of NPO series extend to 25 V - Add X5R, 470nF, 4V to 6.3V and 100nF, 10V
Version 9	Jan. 17, 2017	-	- Test condition updated
Version 8	Jan. 12, 2016	-	- Capacitance range & thickness update
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