Innovative Service Around the Globe YAGEO

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

YAGEO

Product Specification – November 28, 2022 V.12

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 = ±0.1pF
C = ±0.25pF
D = ±0.5pF
J = ±5%
K = ±10%
M = ±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 = 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 10^1 = 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.

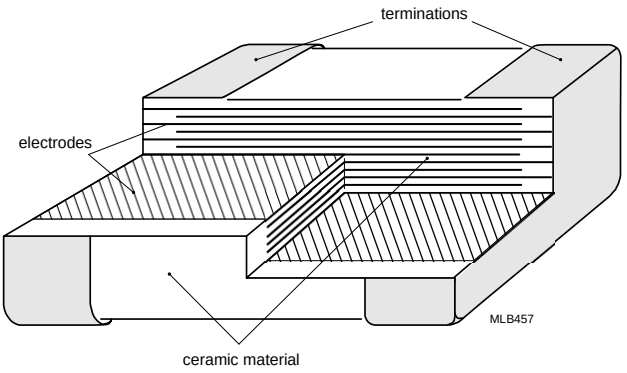

Fig. 1 Surface mounted multilayer ceramic capacitor construction

DIMENSION

Table 1 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 1

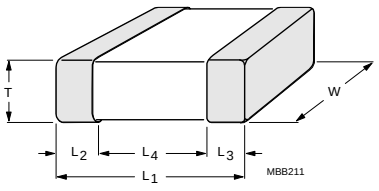

Fig. 2 Surface mounted multilayer ceramic capacitor dimension

CAPACITANCE RANGE & THICKNESS

CAP.	NP0	
	16 V / 25 V	50 V
0.1 pF	0.2±0.02	0.2±0.02
0.2 pF	0.2±0.02	0.2±0.02
0.3 pF	0.2±0.02	0.2±0.02
0.4 pF	0.2±0.02	0.2±0.02
0.5 pF	0.2±0.02	0.2±0.02
0.6 pF	0.2±0.02	0.2±0.02
0.7 pF	0.2±0.02	0.2±0.02
0.75 pF	0.2±0.02	0.2±0.02
0.8 pF	0.2±0.02	0.2±0.02
0.9 pF	0.2±0.02	0.2±0.02
1.0 pF	0.2±0.02	0.2±0.02
1.2 pF	0.2±0.02	0.2±0.02
1.5 pF	0.2±0.02	0.2±0.02
1.8 pF	0.2±0.02	0.2±0.02
2.2 pF	0.2±0.02	0.2±0.02
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	

CAP.	X5R			
	4V	6.3V	10V	16V
100 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	0.2±0.02	0.2±0.02
220 pF	0.2±0.02	0.2±0.02	0.2±0.02	0.2±0.02
330 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	0.2±0.02	0.2±0.02
680 pF	0.2±0.02	0.2±0.02	0.2±0.02	0.2±0.02
1 000 pF	0.2±0.02	0.2±0.02	0.2±0.02	0.2±0.02
2.2 nF	0.2±0.02	0.2±0.02	0.2±0.02	
4.7 nF	0.2±0.02	0.2±0.02	0.2±0.02	
10 nF	0.2±0.02	0.2±0.02	0.2±0.02	
22nF	0.2±0.02	0.2±0.02		
47 nF	0.2±0.02	0.2±0.02		
100 nF	0.2±0.02	0.2±0.02	0.2±0.02	
220 nF	0.2±0.02	0.2±0.02		
Tape width	8 mm			

CAP.	X7R	
	6.3V / 10V	16V
100 pF	0.2±0.02	0.2±0.02
150 pF	0.2±0.02	0.2±0.02
220 pF	0.2±0.02	0.2±0.02
330 pF	0.2±0.02	0.2±0.02
470 pF	0.2±0.02	0.2±0.02
680 pF	0.2±0.02	0.2±0.02
1 000 pF	0.2±0.02	0.2±0.02
2.2 nF		
4.7 nF		
10 nF		
22nF		
47 nF		
100 nF		
220 nF		
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	±0.1pF, ±0.25pF, ±0.5pF
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: Rins x 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 × 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: C ≤ 1 nF f = 1 KHz, measuring at voltage 1 Vrms at 20 °C C > 1 nF f = 1 KHz, rated voltage ≤ 6.3 V, measuring at voltage 0.5 Vrms at 20 °C f = 1 KHz, rated voltage > 10 V, measuring at voltage 1 Vrms 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: C ≤ 1 nF f = 1 KHz, measuring at voltage 1 Vrms at 20 °C C > 1 nF f = 1 KHz, rated voltage ≤ 6.3 V, measuring at voltage 0.5 Vrms at 20 °C f = 1 KHz, rated voltage > 10 V, measuring at voltage 1 Vrms at 20 °C	In accordance with specification
Insulation Resistance		4.5.3	At Ur (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. Step / Temperature(℃) a / 25±2 b / Lower temperature±3℃ c / 25±2 d / Upper Temperature±2℃ e / 25±2 (1) Class I Temperature Coefficient shall be calculated from the formula as below Temp, Coefficient = $\frac{C2 - C1}{C1 \times \Delta T} \times 10^6$ [ppm/℃] C1: Capacitance at step c C2: Capacitance at 125℃ ΔT: 100℃(=125℃-25℃) 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	ΔC/C Class1 (NP0): ±30ppm Class 2: (X7R/X5R): ±15% In case of applying voltage, the capacitance change should be measured after 1 more min. with applying voltage in equilibration of each temp. stage. CC0100MRX5R4(5)BB104(224): 0.2V±0.1Vrms
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 ΔC/C Class 1 (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 ΔC/C Class 1 (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 ΔC/C Class 1 (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): ΔC/C within ±7.5% or 0.75 pF, whichever is greater D.F. ≤ 2 x specified value I.R. ≥ 2,500 MΩ or R_{ins} x Cr ≥ 25Ω · F whichever is less Class2 (X5R/X7R): C ≤ 1nF ΔC/C ±15% D.F. ≤ 10% I.R. ≥ 500 MΩ 10nF ≥ C > 1nF ΔC/C ±20% D.F. ≤ 10% I.R. ≥ 500 MΩ C > 10nF ΔC/C ±25% D.F. ≤ 20% I.R. R_{ins} x Cr ≥ 5Ω · F

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
Endurance	IEC 60384-21/22 4.14	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 x U_r for general product Temperature: X5R: 85°C, X7R: 125°C Specified stress voltage applied for 1,000 hours: Applied 1.5 x Ur for general product 4. Recovery time: 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 Class 1 (NP0): ΔC/C within ±3% or 0.3 pF, whichever is greater D.F. ≤ 2 x specified value I.R. ≥ 4,000 MΩ or R_{ins} x 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} x Cr ≥ 10Ω · F
Voltage Proof	IEC 60384-1 4.5.4	Specified stress voltage applied for 1~5 seconds Ur ≤ 100 V: series applied 2.5 Ur 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

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