Innovative Service Around the Globe YAGEO

DATA SHEET

SURFACE-MOUNT CERAMIC MULTILAYER CAPACITORS

High-voltage SC type: NP0/X7R

X1/Y2 & X2

10pF to 56nF

YAGEO

Product Specification – May 21, 2024 V.0

SCOPE

This specification describes safety certification NP0/X7R series chip capacitors with lead-free terminations.

APPLICATIONS

- PCs, Notebook
- Networking
- Power supplies

FEATURES

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

MARKING

- YSC: Safety Cap
- YST: Satefy Cap with Soft-Termination

ORDERING INFORMATION - GLOBAL PART NUMBER, PHYCOMP CTC & 12NC

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

YAGEO BRAND ordering codes

GLOBAL PART NUMBER (PREFERRED)

XX	xxxx	x	x	xxx	x	B	x	xxx
(1)	(2)	(3)	(4)	(5)	(6)		(7)	(8)

(1) SERIES

SC : Safety Capacitor

ST : Safety Capacitor with Soft-Termination

(2) SIZE – INCH BASED (METRIC)

1808 (4520)

2211 (5728)

2220 (5750)

(3) TOLERANCE

J = ± 5%

K = ± 10%

M = ± 20%

(4) PACKING STYLE

K = Blister taping reel; Reel 7 inch

(5) TC MATERIAL

NPO

X7R

(6) IMPULSE VOLTAGE

W = X1/Y2 Series for TUV/UL

T = X2 Series for TUV/UL

(7) PROCESS

N = NP0

B = Class 2 product

(8) 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.

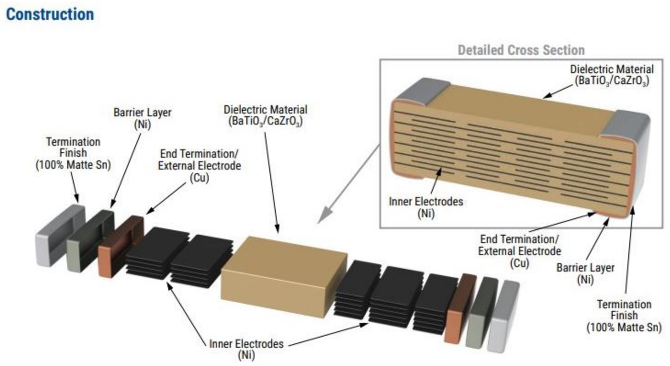

Fig. 1 Surface mounted multilayer ceramic capacitor construction

DIMENSION

Table 1 For outlines see fig. 2

				L2 / L3(MM)		L4(MM)	DIMENSION
TYPE	L1 (MM)	W (MM)	T (MM)	MIN.	MAX.	MIN.	CODE
1808	4.5+0.6/-0.3	2.0 ±0.30	1.25 ±0.20	0.25	0.40	4.0	HA
	4.5+0.6/-0.3	2.0 ±0.30	1.6 ±0.20	0.25	0.40	4.0	HC
	4.5+0.6/-0.3	2.0 ±0.30	2.0 ±0.20	0.25	0.40	4.0	HD
	4.5+0.9/-0.3	2.0 ±0.40	1.25 ±0.20	0.25	0.40	4.0	HE
	4.5+0.9/-0.3	2.0 ±0.40	1.6 ±0.20	0.25	0.40	4.0	HG
	4.5+0.9/-0.3	2.0 ±0.40	2.0 ±0.20	0.25	0.40	4.0	HI
2211	5.7 ±0.40	2.8 ±0.30	1.6 ±0.20	0.3	0.75	4.0	GA
	5.7 ±0.40	2.8 ±0.30	2.0 ±0.20	0.3	0.75	4.0	GB
	5.7 ±0.40	2.8 ±0.30	2.5 ±0.30	0.3	0.75	4.0	GC
	5.7 ±0.40	2.8 ±0.30	2.8 ±0.30	0.3	0.75	4.0	GD
	5.7 ±0.50	2.8 ±0.40	1.6 ±0.20	0.3	0.75	4.0	GE
	5.7 ±0.50	2.8 ±0.40	2.0 ±0.20	0.3	0.75	4.0	GF
	5.7 ±0.50	2.8 ±0.40	2.5 ±0.30	0.3	0.75	4.0	GG
	5.7 ±0.50	2.8 ±0.40	2.8 ±0.30	0.3	0.75	4.0	GH
2220	5.7 ±0.40	5.0 ±0.40	2.0 ±0.20	0.3	0.75	4.0	KB
	5.7 ±0.40	5.0 ±0.40	2.5 ±0.30	0.3	0.75	4.0	KC
	5.7 ±0.40	5.0 ±0.40	2.8 ±0.30	0.3	0.75	4.0	KD
	5.7 ±0.50	5.0 ±0.40	2.0 ±0.20	0.3	0.75	4.0	KF
	5.7 ±0.50	5.0 ±0.40	2.5 ±0.30	0.3	0.75	4.0	KG
	5.7 ±0.50	5.0 ±0.40	2.8 ±0.30	0.3	0.75	4.0	KH

OUTLINES

For dimension see Table 1

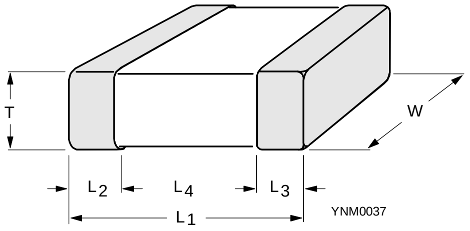

Fig. 2 Surface mounted multilayer ceramic capacitor dimension

CAPACITANCE RANGE & THICKNESS FOR NP0 X1/Y2

Table 2 Sizes from 1808

CAP.	SC 1808, NPO X1/Y2	ST 1808, NPO X1/Y2
10 PF	HA	HE
12 PF	HA	HE
15 PF	HA	HE
18 PF	HA	HE
22 PF	HA	HE
27 PF	HC	HG
33 PF	HC	HG
39 PF	HC	HG
47 PF	HC	HG
56 PF	HC	HG
68 PF	HC	HG
82 PF	HC	HG
100 PF	HD	HI
120 PF	HD	HI
150 PF	HD	HI
180 PF	HD	HI
220 PF	HD	HI
270 PF	HD	HI
330 PF	HD	HI
390 PF		
470 PF		

Table 3

CASE SIZE	L (MM)	W (MM)	T (MM)	DIMENSION CODE
1808	4.5+0.6/-0.3	2.0 ±0.30	1.25 ±0.20	HA
	4.5+0.6/-0.3	2.0 ±0.30	1.6 ±0.20	HC
	4.5+0.6/-0.3	2.0 ±0.30	2.0 ±0.20	HD
	4.5+0.9/-0.3	2.0 ±0.40	1.25 ±0.20	HE
	4.5+0.9/-0.3	2.0 ±0.40	1.6 ±0.20	HG
	4.5+0.9/-0.3	2.0 ±0.40	2.0 ±0.20	HI

CAPACITANCE RANGE & THICKNESS FOR X7R X1/Y2 AND X2

Table 4 Sizes from 1808 to 2220

CAP.	SC 1808, X7R	ST 1808, X7R	SC 2211, X7R	ST 2211, X7R	SC 2220, X7R		ST 2220, X7R	
	X1/Y2	X1/Y2	X1/Y2	X1/Y2	X1/Y2	X2	X1/Y2	X2
100 PF	HC	HG	GA	GE	KB		KF	
120 PF	HC	HG	GA	GE	KB		KF	
150 PF	HC	HG	GA	GE	KB		KF	
180 PF	HC	HG	GA	GE	KB		KF	
220 PF	HC	HG	GA	GE	KB		KF	
270 PF	HD	HI	GA	GE	KB		KF	
330 PF	HD	HI	GA	GE	KB		KF	
390 PF	HD	HI	GA	GE	KB		KF	
470 PF	HD	HI	GB	GF	KB		KF	
560 PF	HD	HI	GB	GF	KB		KF	
680 PF	HD	HI	GB	GF	KB		KF	
820 PF	HD	HI	GB	GF	KB		KF	
1.0 NF	HD	HI	GC	GG	KB		KF	
1.2 NF			GC	GG	KC		KG	
1.5 NF			GC	GG	KC		KG	
1.8 NF			GC	GG	KC		KG	
2.2 NF			GC	GG	KC		KG	
2.7 NF			GD	GH	KC		KG	
3.3 NF					KC		KG	
3.9 NF					KC		KG	
4.7 NF					KC		KG	
5.6 NF								
6.8 NF								
8.2 NF								
10 NF						KC		KG
12 NF						KC		KG
15 NF						KC		KG
18 NF						KC		KG
22 NF						KD		KH
27 NF						KD		KH
33 NF						KD		KH
39 NF						KD		KH
47 NF						KD		KH
56 NF						KD		KH

Table 5

CASE SIZE	L (MM)	W (MM)	T (MM)	DIMENSION CODE
1808	4.5+0.6/-0.3	2.0 ±0.30	1.25 ±0.20	HA
	4.5+0.6/-0.3	2.0 ±0.30	1.6 ±0.20	HC
	4.5+0.6/-0.3	2.0 ±0.30	2.0 ±0.20	HD
	4.5+0.9/-0.3	2.0 ±0.40	1.25 ±0.20	HE
	4.5+0.9/-0.3	2.0 ±0.40	1.6 ±0.20	HG
	4.5+0.9/-0.3	2.0 ±0.40	2.0 ±0.20	HI
2211	5.7 ±0.40	2.8 ±0.30	1.6 ±0.20	GA
	5.7 ±0.40	2.8 ±0.30	2.0 ±0.20	GB
	5.7 ±0.40	2.8 ±0.30	2.5 ±0.30	GC
	5.7 ±0.40	2.8 ±0.30	2.8 ±0.30	GD
	5.7 ±0.50	2.8 ±0.40	1.6 ±0.20	GE
	5.7 ±0.50	2.8 ±0.40	2.0 ±0.20	GF
	5.7 ±0.50	2.8 ±0.40	2.5 ±0.30	GG
	5.7 ±0.50	2.8 ±0.40	2.8 ±0.30	GH
2220	5.7 ±0.40	5.0 ±0.40	2.0 ±0.20	KB
	5.7 ±0.40	5.0 ±0.40	2.5 ±0.30	KC
	5.7 ±0.40	5.0 ±0.40	2.8 ±0.30	KD
	5.7 ±0.50	5.0 ±0.40	2.0 ±0.20	KF
	5.7 ±0.50	5.0 ±0.40	2.5 ±0.30	KG
	5.7 ±0.50	5.0 ±0.40	2.8 ±0.30	KH

THICKNESS CLASSES AND PACKING QUANTITY

Table 6

DESCRIPTION	SIZE CODE	THICKNESS CLASSIFICATION (mm)	12 mm TAPE WIDTH /AMOUNT PER REEL Ø180 mm, 7” Blister
Safety Certification Capacitor	1808	1.25 ±0.20	3,000
		1.6 ±0.20	2,000
		2.0 ±0.20	2,000
	2211	1.6 ±0.20	1,000
		2.0 ±0.20	1,000
		2.5 ±0.30	500
		2.8 ±0.30	500
	2220	2.0 ±0.20	1,000
		2.5 ±0.30	500
		2.8 ±0.30	500

ELECTRICAL CHARACTERISTICS

NP0/X7R DIELECTRIC CAPACITORS; NISN TERMINATIONS

Unless otherwise stated all electrical values apply at an ambient temperature of 20±1 °C, an atmospheric pressure of 86 to 106 kPa, and a relative humidity of 63 to 67%.

Table 7

DESCRIPTION		VALUE
Capacitance range		10pF to 56nF
Capacitance tolerance		
NP0	C < 10 pF	±0.25 pF, ±0.5 pF
	C ≥ 10 pF	±5%
X7R		±10%
Dissipation factor (D.F.)		
NP0	C < 30 pF	≤ 1 / (400 + 20C)
	C ≥ 30 pF	≤ 0.1 %
X7R		≤ 2.5 %
Insulation resistance after 1 minute at U_r (DC)		R_{ins} ≥ 10 GΩ or R_{ins} × C ≥ 500 seconds whichever is less
Maximum capacitance change as a function of temperature (temperature characteristic/coefficient):		
NP0		±30 ppm/°C
X7R		±15%
Operating temperature range: NP0/X7R		–55 °C to +125 °C

CAPACITOR REQUIREMENT

Table 8

SAFETY RATING	VOLTAGE RATING	WITHSTANDING VOLTAGE	IMPULSE VOLTAGE
X1	250 VAC	1,500 VAC	4,000 V
X2	250 VAC	1,500 VAC	2,500 V
Y2	250 VAC	1,500 VAC	5,000 V

SOLDERING RECOMMENDATION

Table 9

SOLDERING METHOD	SIZE 0402	0603	0805	1206	≥ 1210
Reflow	≥ 0.1µF	≥ 1.0 µF	≥ 2.2 µF	≥ 4.7 µF	Reflow only
Reflow/Wave	< 0.1µF	< 1.0 µF	< 2.2 µF	< 4.7 µF	---

TESTS AND REQUIREMENTS

Table 10 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	NP0: f = 1 MHz for $C \leq 1$ 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 X7R: f = 1 KHz for $C \leq 10$ μF, measuring at voltage 1 V_{rms} at 20 °C	Within specified tolerance
Dissipation Factor (D.F.)		4.5.2	NP0: f = 1 MHz for $C \leq 1$ 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 X7R: f = 1 KHz for $C \leq 10$ μF, measuring at voltage 1 V_{rms} at 20 °C	In accordance with specification
Insulation Resistance		4.5.3	To apply 500 V max for 60 seconds	In accordance with specification

<table>
<tr><th>TEST</th><th>TEST METHOD</th><th>PROCEDURE</th><th>REQUIREMENTS</th></tr>
<tr><td>Temperature Characteristic</td><td>4.6</td><td>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>
<tr><th>Step</th><th>Temperature(°C)</th></tr>
<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>
</table>
(1) Class I
Temperature Coefficient shall be calculated from the formula as below
$\text{Temp, Coefficient} = \frac{C2 - C1}{C1 \times \Delta T} \times 10^6$ [ppm/°C]
C1: Capacitance at step c
C2: Capacitance at 125°C
ΔT: 100°C (=125°C -25°C)
(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</td><td>Class1:
Δ C/C: ±30ppm

Class2:
X7R: Δ C/C: ±15%</td></tr>
<tr><td>Adhesion</td><td>4.15</td><td>a. A force applied for 10 seconds to the line joining the terminations and in a plane parallel to the substrate
for size ≥ 0603 : a force of 5N applied
b. A force applied until broken
For size ≥ 0603: ≥ 5N</td><td>No visible damage</td></tr>
<tr><td>Bond Strength of Plating on End Face</td><td>IEC 60384-21/22 4.8</td><td>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</td><td>No visible damage
ΔC/C
NP0: ≤ 1% or 0.5 pF whichever is greater
X7R: ≤ 10%</td></tr>
<tr><td>Resistance to Soldering Heat</td><td>4.9</td><td>Precondition: 150 +0/–10 °C for 1 hour, then keep for 24 ±1 hours at room temperature
Preheating: for size ≤ 1206: 120 °C to 150 °C for 1 minute
Preheating: for size >1206: 100 °C to 120 °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</td><td>The termination shall be well tinned
ΔC/C
NP0: ≤ 0.5% or 0.5 pF whichever is greater
X7R: ≤ 10%
D.F. within initial specified value
R_{ins} within initial specified value</td></tr>
</table>

TEST	TEST METHOD		PROCEDURE	REQUIREMENTS
Solderability		4.10	Unmounted chips completely immersed in a solder bath at 235 ±5 °C Dipping time: 2 ±0.5 seconds Depth of immersion: 10 mm	The termination shall be well tinned
Damp Heat with U_r Load		4.13	Initial measurements; after 150 +0/-10 °C for 1 hour, then keep for 24 ±1 hours at room temperature Duration and conditions: 500 ±12 hours at 40 ±2 °C; 90 to 95% RH; 1.0 Ur applied Final measurement: perform a heat treatment at 150 +0/–10 °C for 1 hour, final measurements shall be carried out 24 ±1 hours after recovery at room temperature without load	ΔC/C NP0: ≤ 2% or 1 pF whichever is greater X7R: ≤ 15% D.F. NP0: ≤ 2 × specified value X7R: ≥ 100V: ≤ 5% Rins NP0: ≥ 2,500 MΩ or Rins x Cr ≥ 25s whichever is less X7R: ≥ 500 MΩ or Rins x Cr ≥ 25s whichever is less
Endurance	EN132400	4.14 SC	Perform shear test, substrate bending test, impulse voltage and then endurance test progressively	Visual examination
			Same as the above except for 1.25 Ur for X-capacitor and 1.7 Ur for Y-capacitor	DC/C < ± 20%
			Once every hour the voltage shall be increased to 1000 VAC for 0.1 s	Voltage proof
			Total time take to change over to 1000 VAC and back does not exceed 30 s	IR > 3 x10E9 Ω
Impulse Voltage		4.13 SC IEC-60384-14	X1: 4.0 KV, X2: 2.5 KV Y2: 5.0 KV, Y3: None If any three successive impulses are shown by the oscilloscope monitor to have had a waveform indicating that no self-healing breakdowns or flashovers have taken place in the capacitor, then no further impulses shall be applied and the capacitor shall be counted as conforming. 24 impulses have been applied to the capacitor and 3 or more of them are of a waveform indicating that no self-heating breakdowns or flashovers have occurred. Time between impulses shall not be less than 10 s	No breakdown or flashover
Robustness of Termination (Pull Strength)		4.3 SC	a. A force applied for 10 sec to the line joining the terminations and in a plane parallel to the substrate.	a. No visible damage
			b. A force applied until broken	b. Force size ≥ 0603: ≥ 5N
Voltage Proof		4.2.1 SC	X capacitor: Applied voltage 1.075K VDC (4.3 Ur) Y capacitor: Applied voltage 1.5K VAC	No breakdown or flashover

REVISION HISTORY

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version 0	May 21, 2024	-	- New datasheet for high voltage NP0/X7R series with lead-free terminations

LEGAL DISCLAIMER

YAGEO, its distributors and agents (collectively, “YAGEO”), hereby disclaims any and all liabilities for any errors, inaccuracies or incompleteness contained in any product related information, including but not limited to product specifications, datasheets, pictures and/or graphics. YAGEO may make changes, modifications and/or improvements to product related information at any time and without notice.

YAGEO makes no representation, warranty, and/or guarantee about the fitness of its products for any particular purpose or the continuing production of any of its products. To the maximum extent permitted by law, YAGEO disclaims (i) any and all liability arising out of the application or use of any YAGEO product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for a particular purpose, non -infringement and merchantability.

YAGEO products are designed for general purpose applications under normal operation and usage conditions. Please contact YAGEO for the applications listed below which require especially high reliability for the prevention of defects which might directly cause damage to the third party's life, body or property: Aerospace equipment (artificial satellite, rocket, etc.), Atomic energy-related equipment, Aviation equipment, Disaster prevention equipment, crime prevention equipment, Electric heating apparatus, burning equipment, Highly public information network equipment, data-processing equipment , Medical devices, Military equipment, Power generation control equipment, Safety equipment, Traffic signal equipment, Transportation equipment and Undersea equipment, or for any other application or use in which the failure of YAGEO products could result in personal injury or death, or serious property damage. Particularly **YAGEO Corporation and its affiliates do not recommend the use of commercial or automotive grade products for high reliability applications or manned space flight.**

Information provided here is intended to indicate product specifications only. YAGEO reserves all the rights for revising this content without further notification, as long as products are unchanged. Any product change will be announced by PCN.

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

YAGEO:

SC1808JKNPOWBN331 SC1808JKNPOWBN100 SC1808JKNPOWBN220 SC1808JKNPOWBN101