

# DATA SHEET

## **SURFACE-MOUNT CERAMIC MULTILAYER CAPACITORS**

Safety Certification: NP0/X7R  
(Pb Free & RoHS compliant)

X1/Y2 AND X2/Y3  
2.2 pF to 4.7 nF



SCOPE

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

APPLICATIONS

- PCs, Notebook
- Networking
- Power supplies
- Automotive
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FEATURES

- Supplied in tape on reel
- Nickel-barrier end termination

ORDERING INFORMATION – I2NC & CLEAR TEXT CODE

Part numbers below are identified by the series, size, tolerance, packing style, TC material, rated voltage and capacitance value. Both I2NC or CTC code are acceptable to be used as Phycomp brand.

**YAGEO BRAND ordering codes**

**CTC CODE**

**SC** XXXX X X XXX X **B** X XXX  
 (1) (2) (3) (4) (5) (6) (7)

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**(1) SIZE – INCH BASED (METRIC)**

1808 (4520)  
 1812 (4532)

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**(2) TOLERANCE**

B = ±0.1pF  
 C = ±0.25pF  
 D = ±0.5pF  
 F = ±1%  
 G = ±2%  
 J = ±5%  
 K = ±10%  
 M = ±20%

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**(3) PACKING STYLE**

K = Embossed Plastic Tape; Reel 7 inch

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**(4) TC MATERIAL**

NP0  
 X7R

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**(5) SAFETY RATED VOLTAGE**

T = X2/Y3 for TUV  
 W = X1/Y2 for TUV  
 U = X2/Y3 for UL  
 V = X1/Y2 for UL

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**(6) PROCESS**

B = BME  
 N = Non BME

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**(7) CAPACITANCE VALUE**

First two for significant figures and 3rd for number of zero. Letter "R" for decimal point

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**PHYCOMP BRAND ordering codes**

**I2NC CODE**

<p><b>Carrier type</b></p> <p>50 blister 54 bulk</p>	<p><b>Rated voltage - Termination</b></p> <p>52 = X2/Y3 for TUV 53 = X1/Y2 for TUV 54 = X2/Y3 for UL 55 = X1/Y2 for UL</p>	<p><b>Size</b></p> <p>3 1808 4 1812</p>	<p><b>Capacitance value<sup>(1)</sup></b></p>	<p><b>Tolerance</b></p> <p>5 ±5% 6 ±10%</p>	<p><b>Temperature characteristic</b></p> <p>1 NP0 5 X7R</p>	<p><b>Packaging<sup>(2)</sup></b></p> <p>1 reel: Ø180 mm; 7" 5 reel: Ø330 mm; 13" 4 bulk case</p>
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SCM052

(1) Refer to "Conversion table of capacitance & last 2 digits of I2NC"  
 (2) Quantity on reel depends on thickness classification; see section "Thickness classification and packing quantities for safety certification MLCC"

Conversion table of capacitance & last 2 digits of I2NC

CAP. (pF)	Last 2 digits of I2NC	CAP. (pF)	Last 2 digits of I2NC	CAP. (pF)	Last 2 digits of I2NC	CAP. (pF)	Last 2 digits of I2NC	CAP. (pF)	Last 2 digits of I2NC	CAP. (pF)	Last 2 digits of I2NC	CAP. (pF)	Last 2 digits of I2NC
2.2	18	12	24	33	29	82	35	220	41	560	46	1500	52
3.3	19	15	25	39	31	100	36	270	42	680	47	1800	53
4.7	21	18	26	47	32	120	37	330	43	820	48	2200	54
5	22	22	27	56	33	150	38	390	44	1000	49	3300	56
10	23	27	28	68	34	180	39	470	45	1200	51	4700	58

**CTC CODE (FOR NORTH AMERICA ONLY)**

Example: 1808CG101JTBBIS

Size code	Temp. Char.	Capacitance in pF	Tolerance	Safety rated voltage	Termination	Packing	Marking	Range identifier
1808	CG = NP0	101 = 100 pF; the third digit signifies the multiplying factor:	B = ±0.1 pF C = ±0.25 pF D = ±0.5 pF F = ±1% G = ±2% J = ±5% K = ±10% M = ±20%	T = X2/Y3 for TUV W = X1/Y2 for TUV U = X2/Y3 for UL V = X1/Y2 for UL	B = NiSn	B = 180 mm; 7" blister	I = marking 0 = no marking	S = Safety certification
1812	2R = X7R							

**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. I.

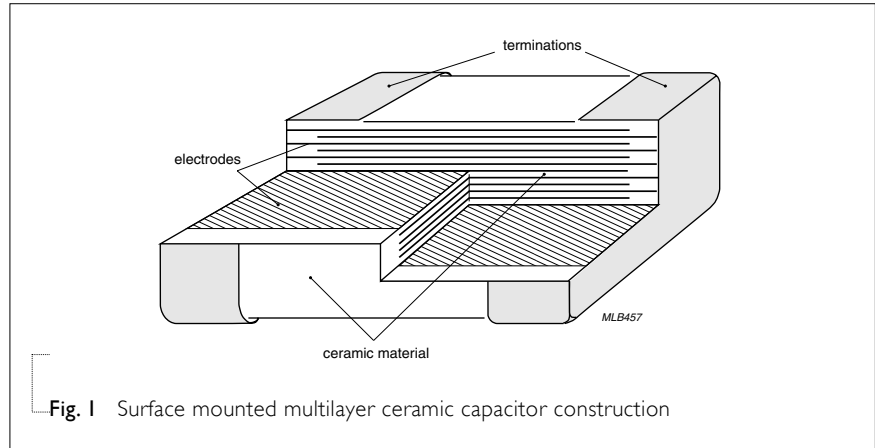


Fig. I Surface mounted multilayer ceramic capacitor construction

**DIMENSION**

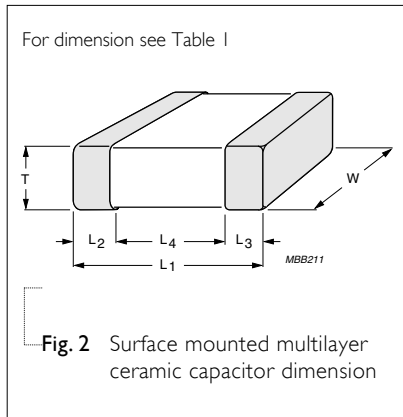


Fig. 2 Surface mounted multilayer ceramic capacitor dimension

Table I

TYPE	SCI808	SCI812
L <sub>1</sub> (mm)	4.5 ±0.30	4.5 ±0.30
W (mm)	2.0 ±0.30	3.2 ±0.30
T (mm)	Refer to table 2 to 4	
L <sub>2</sub> /L <sub>3</sub> (mm) min.	0.25	0.25
L <sub>2</sub> /L <sub>3</sub> (mm) max.	0.75	0.75
L <sub>4</sub> (mm) min.	X1/Y2(TUV) 4.00	4.00
	X2/Y2 (TUV) 2.20	2.20
	UL 2.20	2.20

**CAPACITANCE RANGE & THICKNESS FOR NP0 X1/Y2 AND X2/Y3**

Table 2 For NP0 X1/Y2 and X2/Y3 sizes from 1808 to 1812

CAPACITANCE (pF)	1808, X1/Y2		1812, X1/Y2		1812, X2/Y3
	TUV	UL	TUV	UL	TUV
2.2					
3.3					
4.7					
5					
10					
12					
15					
18					
22		1.6±0.2	1.6±0.2	1.6±0.2	
27	1.6±0.2				
33					
39					
47					1.15±0.15
56					
68					
82					
100					
120					
150				2.0±0.2	
180		2.0±0.2			
220					
270	2.0±0.2		2.0±0.2		
330					
390					
470					

**NOTE**

1. Values in shaded cells indicate thickness class in mm.
2. Capacitance range < 10 pF is on request.
3. Capacitance value of non E-12 series is on request.

**CAPACITANCE RANGE & THICKNESS FOR X7R X1/Y2 AND X2/Y3**

Table 3 For X7R X1/Y2 and X2/Y3 sizes from 1808 to 1812

CAPACITANCE (PF)	1808, X1/Y2		1808, X2/Y3		1812, X1/Y2		1812, X2/Y3
	TUV	UL	TUV	UL	TUV	UL	TUV
150							
180	1.6±0.2	1.6±0.2					
220							
270					1.6±0.2	1.6±0.2	
330							
390							
470							
560	2.0±0.2	2.0±0.2					
680							
820			1.35±0.15		2.0±0.2	2.0±0.2	
1,000							
1,200				2.0±0.2			
1,500							
1,800							1.35±0.15
2,200							
3,300							
4,700							

**NOTE**

1. Values in shaded cells indicate thickness class in mm.
2. Capacitance value of non E-12 series is on request.

**THICKNESS CLASSES AND PACKING QUANTITY**

Table 4

DESCRIPTION	SIZE CODE	THICKNESS CLASSIFICATION	12 mm TAPE WIDTH /AMOUNT PER REEL
		(mm)	Ø180 mm, 7" Blister
Certification Capacitor	1808	1.15 ±0.15	1,500
		1.35 ±0.15	1,000
		1.6 ±0.20	2,000
		2.0 ±0.20	2,000
	1812	1.15 ±0.15	1,500
		1.35 ±0.15	1,000
		1.6 ±0.20	1,000
		2.0 ±0.20	2,000

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 5

DESCRIPTION	VALUE
Capacitance range <sup>(1)</sup>	2.2 pF to 4.7 nF
Capacitance tolerance <sup>(1)</sup>	±5% and ±10%
Dissipation factor (D.F.) <sup>(1)</sup>	
NP0	≤ 0.1%
X7R	≤ 2.5%
Insulation resistance after 1 minute at U <sub>r</sub> (DC)	R <sub>ins</sub> ≥ 10 GΩ or R <sub>ins</sub> × 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
Climatic category (EN 132400)	NP0: 55/125/21 X7R: 55/125/56

**NOTE**

- 1. NP0: frequency = 1 MHz for C ≤ 1 nF, measuring at voltage 1 V<sub>rms</sub>; frequency = 1 KHz for C > 1 nF, measuring at voltage 1 V<sub>rms</sub>
- X7R: frequency = 1 KHz for C ≤ 10 μF, measuring at voltage 1 V<sub>rms</sub>

SOLDERING RECOMMENDATION

Table 6

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

**TESTS AND REQUIREMENTS**

**Table 7** Test condition, procedure 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 ≤ 1 nF, measuring at voltage 1 V <sub>rms</sub> at 20 °C; f = 1 KHz for C > 1 nF, measuring at voltage 1 V <sub>rms</sub> at 20 °C X7R: f = 1 KHz for C ≤ 10 μF, measuring at voltage 1 V <sub>rms</sub> at 20 °C	Within specified tolerance
Dissipation factor (D.F.)	4.5.2	NP0: f = 1 MHz for C ≤ 1 nF, measuring at voltage 1 V <sub>rms</sub> at 20 °C; f = 1 KHz for C > 1 nF, measuring at voltage 1 V <sub>rms</sub> at 20 °C X7R: f = 1 KHz for C ≤ 10 μF, measuring at voltage 1 V <sub>rms</sub> at 20 °C	In accordance with specification
Insulation resistance	4.5.3	At U <sub>r</sub> (DC) for 1 minute	In accordance with specification
Temperature characteristic	4.6	Between minimum and maximum temperature	NP0: ΔC/C: 30 ppm/°C X7R: ΔC/C: 15%
Adhesion	4.15	a. A force applied for 10 sec 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	No visible damage



Table 7 Test condition, procedure and requirements (continued)

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
Bond strength of plating on end face	IEC 60384-21/22 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 340 mm	No visible damage  NP0: $\Delta C/C_i \leq 1\%$ or 0.5 pF whichever is greater X7R: $\Delta C/C_i \leq 10\%$
Resistance to soldering heat	4.9	Precondition: 150 +0/-10 °C for 1 hour, then keep for 24 ± 1 hours at room temperature Preheating: for size ≤ 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 ± 5 °C Dipping time: 10 ± 0.5 seconds Recovery time: 24 ± 2 hours.	The termination shall be well tinned NP0: $\Delta C/C_i \leq 0.5\%$ or 0.5 pF whichever is greater X7R: $\Delta C/C_i \leq 10\%$  D.F.: within initial specified value R <sub>ins</sub> : within initial specified value
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.
Rapid change of temperature	4.11	Preconditioning: 150 +0/-10 °C for 1 hour, then keep for 24 ± 1 hours at room temperature <hr/> 5 cycles with following detail: 30 minutes at lower category temperature; 30 minutes at upper category temperature <hr/> Recovery time 24 ± 2 hours.	No visual damage NP0: $\Delta C/C_i \leq 1\%$ or 1 pF whichever is greater X7R: $\Delta C/C_i \leq 15\%$ D.F.: within initial specified value R <sub>ins</sub> : within initial specified value
Damp heat, with U <sub>r</sub> 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; U <sub>r</sub> 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.	NP0: $\Delta C/C_i \leq 2\%$ or 1 pF whichever is greater X7R: $\Delta C/C_i \leq 15\%$  NP0: D.F.: 2 × initial value max. X7R ≥ 100 V: D.F. ≤ 5%  NP0: R <sub>ins</sub> ≥ 2,500 MΩ or R <sub>ins</sub> × C <sub>r</sub> ≥ 25 seconds, whichever is less X7R: R <sub>ins</sub> ≥ 500 MΩ or R <sub>ins</sub> × C <sub>r</sub> ≥ 25 seconds, whichever is less

Table 7 Test condition, procedure and requirements (continued)

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
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 1000VAC for 0.1 s.	Voltage proof
		Total time take to change over to 1000 VAC and back does not exceed 30 s.	IR > 3x10E9 Ω
Impulse Voltage	4.13 SC	X1: 4.0k VDC, X2: 2.5k VDC, X3: 1.2k VDC Y1: 8.0k VDC, Y2: 5.0k VDC, Y3: None, Y4: 2.5k VDC Apply 3 successive impulses. 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.  b. A force applied until broken	a. No visible damage  b. Force size ≥ 0603: ≥ 5N size = 0402: ≥ 2.5N size = 0201: ≥ 1N
Voltage proof	4.2.1 SC	For X1, X2 and X3: 4.3Ur (1.075k VDC) For Y1: 4k VAC For Y2 and Y3: 1.5k VAC For Y4: 900 VAC	No breakdown or flashover

REVISION HISTORY

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version 0	Mar 1, 2007	-	- New