

# DATA SHEET

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

Mid-voltage: NP0/X7R  
(Pb Free & RoHS compliant)

100 V TO 500 V

10 pF to 470 nF



SCOPE

This specification describes Mid-voltage NP0/X7R series chip capacitors with lead-free terminations.

APPLICATIONS

- PCs, hard disk, game PCs
- Power supplies
- LCD panel
- ADSL, modem

FEATURES

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

ORDERING INFORMATION

Part number is identified by the series, size, tolerance, packing style, TC material, rated voltage and capacitance value.

**YAGEO ORDERING CODE**

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

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**(1) SIZE – INCH BASED (METRIC)**

0603 (1608)  
 0805 (2012)  
 1206 (3216)  
 1210 (3225)  
 1808 (4520)  
 1812 (4532)

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**(2) TOLERANCE**

J = ±5%  
 K = ±10%

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**(3) PACKING STYLE**

R = 7" paper tape  
 K = 7" blister tape  
 P = 13" paper tape  
 F = 13" blister tape  
 C = Bulk case

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**(4) TC MATERIAL**

NP0  
 X7R

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**(5) RATED VOLTAGE**

0 = 100 V  
 A = 200 V  
 Y = 250 V  
 B = 500 V

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**(6) PROCESS**

B = BME  
 N = NME

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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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**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.

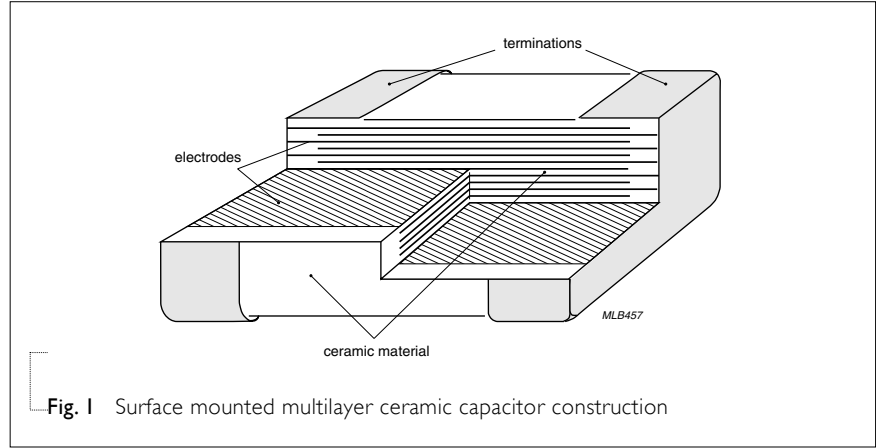


Fig. I Surface mounted multilayer ceramic capacitor construction

**DIMENSION**

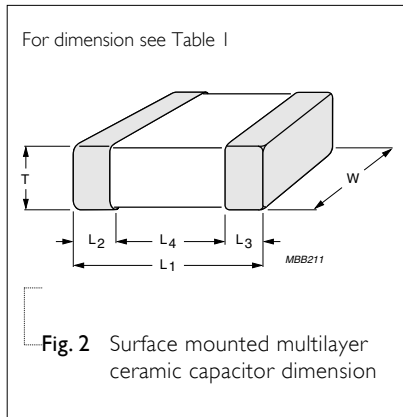


Fig. 2 Surface mounted multilayer ceramic capacitor dimension

Table I

TYPE	CC0603	CC0805	CC1206	CC1210	CC1808	CC1812
<b>L<sub>1</sub> (mm)</b>	1.6 ±0.10	2.0 ±0.20	3.2±0.20	3.2 ±0.20	4.5 ±0.30	4.5 ±0.30
<b>W (mm)</b>	0.8 ±0.07	1.25 ±0.20	1.6±0.20	2.5 ±0.20	2.0 ±0.30	3.2 ±0.30
<b>T (mm)</b>	Refer to table 2 to 7					
<b>L<sub>2</sub>/L<sub>3</sub> (mm)</b>	<b>min.</b>	0.20	0.25	0.25	0.25	0.25
	<b>max.</b>	0.50	0.75	0.75	0.75	0.75
<b>L<sub>4</sub> (mm)</b>	<b>min.</b>	0.60	0.55	1.40	1.40	2.20

**CAPACITANCE RANGE & THICKNESS FOR NPO 100V**

Table 2 For NPO 100 V sizes from 0603 to 1812

CAPACITANCE (pF)	100 V 0603	0805	1206	1210	1808	1812
10						
12						
15						
18						
22						
27						
33						
39						
47						
56						
68						
82						
100	0.8 ±0.10	0.6 ±0.10				
120						
150			0.6 ±0.10			
180						
220						
270						
330						
390						
470						
560						
680						
820						
1,000						
1,200						
1,500		0.85 ±0.10				
1,800						
2,200				0.6 ±0.10	1.25 ±0.20	1.25 ±0.20
2,700						
3,300		1.25 ±0.20				
3,900			0.85 ±0.10			
4,700						
5,600			1.15±0.15	0.85 ±0.10		

Table 2 For NP0 100 V sizes from 0603 to 1812 (continued)

CAPACITANCE (pF)	100 V					
	0603	0805	1206	1210	1808	1812
6,800			1.15±0.15			
8,200				0.85 ±0.10		1.25 ±0.20
10,000			1.25 ±0.20			
12,000						
15,000				1.25 ±0.20		0.85 ±0.10
18,000						
22,000						1.15±0.15
27,000						
33,000						
39,000						
47,000						

**NOTE**

1. Values in shaded cells indicate thickness class in mm.
2. Capacitance range < 10 pF is on request.

**CAPACITANCE RANGE & THICKNESS FOR NP0 200/250 V**

Table 3 For NP0 200/250 V sizes from 0603 to 1812

CAPACITANCE (pF)	200/250 V					
	0603	0805	1206	1210	1808	1812
10						
12						
15						
18						
22						
27						
33						
39						
47	0.8 ±0.10	0.6 ±0.10	0.6 ±0.10			
56						
68						
82						
100						
120						
150						
180						

Table 3 For NP0 200/250 V sizes from 0603 to 1812 (continued)

CAPACITANCE (pF)	200/250 V					
	0603	0805	1206	1210	1808	1812
220						
270						
330	0.8 ±0.10	0.85 ±0.10				
390			0.6 ±0.10			
470						
560		1.25 ±0.20				
680						
820		0.8 ±0.10				
1,000			0.85 ±0.10			
1,200				1.25 ±0.20		
1,500		1.25 ±0.20	1.15±0.15			
1,800			0.8 ±0.10			1.25 ±0.20
2,200				0.85 ±0.10		
2,700					1.25 ±0.20	
3,300			1.25 ±0.20	1.15±0.15		
3,900						0.85 ±0.10
4,700				1.25 ±0.20		1.15±0.15
5,600						
6,800						
8,200						
10,000						

**NOTE**

1. Values in shaded cells indicate thickness class in mm.
2. Capacitance range < 10 pF is on request.

**CAPACITANCE RANGE & THICKNESS FOR NP0 500 V**

Table 4 For NP0 500 V sizes from 0805 to 1812

CAPACITANCE (pF)	500 V				
	0805	1206	1210	1808	1812
10					
12					
15	0.6 ±0.10	0.6 ±0.10			
18					
22					
27					

Table 4 For NP0 500 V sizes from 0805 to 1812 (continued)

CAPACITANCE (pF)	500 V				
	0805	1206	1210	1808	1812
33					
39					
47					
56					
68	0.6 ±0.10	0.6 ±0.10			
82					
100					
120					
150					
180			0.85 ±0.10		
220					
270					
330	0.85 ±0.10				
390					
470		0.85 ±0.10			
560					
680					
820	1.25 ±0.20	1.15±0.15			
1,000					
1,200		0.8 ±0.10			
1,500			1.15±0.15		1.25 ±0.20
1,800		1.25 ±0.20		1.25 ±0.20	
2,200			1.25 ±0.20		
2,700					1.15±0.15
3,300					
3,900					
4,700					1.25 ±0.20
5,600					
6,800					
8,200					
10,000					

**NOTE**

1. Values in shaded cells indicate thickness class in mm.
2. Capacitance range < 10 pF is on request.

**CAPACITANCE RANGE & THICKNESS FOR X7R 100V**

Table 5 For X7R 100 V sizes from 0805 to 1812

CAPACITANCE (pF)	100 V 0603	0805	1206	1210	1808	1812
100						
150						
220						
330						
470						
680						
1,000	0.8 ±0.10					
1,500						
2,200		0.6 ±0.10	0.85 ±0.10			
3,300						
4,700						
6,800						
10,000						
15,000						
22,000		0.85 ±0.10				
33,000						
47,000		1.25 ±0.20				0.85 ±0.10
68,000				0.85 ±0.10	1.25 ±0.20	
100,000			1.15±0.15			
150,000				1.15±0.15		1.15±0.15
220,000				1.6 ±0.20		
330,000						
470,000						1.6 ±0.20
680,000						
1,000,000						

**NOTE**

1. Values in shaded cells indicate thickness class in mm.



CAPACITANCE RANGE & THICKNESS FOR X7R 200/250 V

Table 6 For X7R 200/250 V sizes from 0805 to 1812

CAPACITANCE (pF)	200/250 V					
	0805	1206	1210	1808	1812	
100						
150						
220						
330						
470						
680						
1,000	0.85 ±0.10					
1,500						
2,200						
3,300		0.85 ±0.10				
4,700						
6,800						
10,000	1.25 ±0.20					
15,000	0.8 ±0.10		0.85 ±0.10			
22,000	1.25 ±0.20					
33,000		1.15±0.15	1.15±0.15	1.25 ±0.20		
47,000						
68,000		1.25 ±0.20				
100,000			1.25 ±0.20			1.15±0.15
150,000						
220,000						1.6 ±0.20
330,000						2.0 ±0.20
470,000						
680,000						
1,000,000						

**NOTE**

I. Values in shaded cells indicate thickness class in mm.

**CAPACITANCE RANGE & THICKNESS FOR X7R 500 V**

Table 7 For X7R 500 V sizes from 0805 to 1812

CAPACITANCE (pF)	500 V					
	0805	1206	1210	1808	1812	
100						
150						
220						
330						
470						
680						
1,000	0.8 ±0.10					
1,500						
2,200		1.15±0.15				
3,300						
4,700			1.15±0.15			0.85 ±0.10
6,800						
10,000	1.25 ±0.20	1.25 ±0.20				1.15±0.15
15,000				1.25 ±0.20		
22,000			1.25 ±0.20			
33,000		1.6 ±0.20				
47,000						1.25 ±0.20
68,000						
100,000						1.6 ±0.20
150,000						
220,000						
330,000						
470,000						
680,000						
1,000,000						

**NOTE**

1. Values in shaded cells indicate thickness class in mm.

**THICKNESS CLASSES AND PACKING QUANTITY**

Table 8

DESCRIPTION	SIZE CODE	THICKNESS CLASSIFICATION (mm)	8 mm TAPE WIDTH/AMOUNT PER REEL				12 mm TAPE WIDTH /AMOUNT PER REEL
			Ø180 mm, 7"		Ø330 mm, 13"		Ø180 mm, 7" Blister
			Paper	Blister	Paper	Blister	
Mid / High voltage	0603	0.8 ±0.10	4,000	---	---	---	---
		0805	0.6 ±0.10	4,000	---	---	---
	0805	0.8 ±0.10	4,000	---	---	---	---
		0.85 ±0.1	4,000	---	---	---	---
		1.25 ±0.20	---	3,000	---	---	---
		1206	0.6 ±0.10	4,000	---	20,000	---
	1206	0.8 ±0.10	4,000	---	---	---	---
		0.85 ±0.10	4,000	---	15,000	---	---
		1.00 ±0.10	---	3,000	---	10,000	---
		1.15 ±0.15	---	3,000	---	10,000	---
		1.25 ±0.20	---	3,000	---	---	---
		1210	0.6 ±0.10	---	4,000	---	15,000
	1210	0.85 ±0.10	---	4,000	---	10,000	---
		1.15 ±0.15	---	3,000	---	10,000	---
		1.25 ±0.20	---	3,000	---	---	---
		1.6 ±0.20	---	2,000	---	---	---
	1808	1.15 ±0.15	---	---	---	---	1,500
		1.25 ±0.20	---	---	---	---	3,000
		1.35 ±0.15	---	---	---	---	1,000
		1.5 ±0.10	---	---	---	---	1,000
		1.6 ±0.20	---	---	---	---	2,000
		2.0 ±0.20	---	---	---	---	2,000
	1812	0.85 ±0.10	---	---	---	---	2,000
		1.15 ±0.15	---	---	---	---	1,500
		1.25 ±0.20	---	---	---	---	1,000
		1.35 ±0.15	---	---	---	---	1,000
		1.5 ±0.1	---	---	---	---	1,000
		1.6 ±0.2	---	---	---	---	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 9

DESCRIPTION	VALUE
Capacitance range <sup>(1)</sup>	10 pF to 470 nF
Capacitance tolerance <sup>(1)</sup> :	
NP0	±5%
X7R	±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

**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>.

**TESTS AND REQUIREMENTS**

**Table 10** 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 $\times 10$ 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 $C \leq 10 \mu F$ , 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 $C \leq 10 \mu F$ , measuring at voltage $1 V_{rms}$ at 20 °C	In accordance with specification
Insulation resistance	4.5.3	At $U_r$ (DC) for 1 minute	In accordance with specification
Voltage proof	4.5.4.2	Test voltage (DC) applied for 1 minute $U_r \leq 100$ V: $2.5 \times U_r$ applied to NP0/X7R series $100 \text{ V} < U_r \leq 200$ V: $1.5 \times U_r + 100$ V applied to NP0/X7R series $200 \text{ V} < U_r \leq 500$ V: $1.3 \times U_r + 100$ V applied to NP0/X7R series $U_r > 500$ V: $1.3 \times U_r$ applied to NP0/X7R series I: 7.5 mA	No breakdown or flashover
Temperature characteristic	4.6	Between minimum and maximum temperature	NP0: $\Delta C/C$ : 30 ppm/°C X7R: $\Delta C/C$ : 15%
Adhesion	4.15	A force applied for 10 seconds to the line joining the terminations and in a plane parallel to the substrate for size $\geq 0603$ : a force of 5 N applied for size 0402: a force of 2.5 N applied	No visible damage

Table 10 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 10 Test condition, procedure and requirements (continued)

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
Endurance	IEC 60384-21/22 4.14	<p>Preconditioning; Initial measurements; after 150 +0/-10 °C for 1 hour, then keep for 24 ± 1 hours at room temperature</p> <p>Duration and conditions: 1,000 ± 12 hours at upper category temperature with 1.5 × U<sub>r</sub> voltage applied</p> <p>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.</p>	<p>NP0: <math>\Delta C/C_i \leq 2\%</math> or 1 pF whichever is greater</p> <p>X7R: <math>\Delta C/C_i \leq 15\%</math></p> <p>NP0: D.F.: 2 × initial value max.</p> <p>X7R: 100 V: D.F. ≤ 5%</p> <p>NP0: <math>R_{ins} \geq 4,000 M\Omega</math> or <math>R_{ins} \times C_r \geq 40</math> seconds, whichever is less</p> <p>X7R: <math>R_{ins} \geq 1,000 M\Omega</math> or <math>R_{ins} \times C_r \geq 50</math> seconds, whichever is less</p>

REVISION HISTORY

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
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Version 0	Sep 08, 2005	-	- New
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[CGA2B2C0G1H6R8D](#) [CGA2B2X8R1H221K](#) [CGA2B2X8R1H472K](#) [CGA3E1X7R1C474K](#) [CGA3E2C0G1H561JT0Y0N](#)  
[CGA4J2X7R2A104K](#)