

# DATA SHEET

## SURFACE-MOUNT CERAMIC MULTILAYER CAPACITORS

C-Array

NP0/X7R/Y5V

16 V TO 50 V

sizes 0508 (4 x 0402) / 0612 (4 x 0603)

RoHS compliant



SCOPE

This specification describes NP0/X7R/Y5V 4-capacitor Array with lead-free terminations.

APPLICATIONS

- Professional electronics
- High density consumer electronics

FEATURES

- Supplied in tape on reel
- Nickel-barrier end termination
- 0508 (4x0402) / 0612 (4x0603) capacitors (of the same capacitance value) per array
- Less than 50% board space of an equivalent discrete component
- High volumetric efficiency
- Increased throughput, by time saved in mounting
- 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. Please note that 12 digits ordering code will expire at the end of 2010.

**YAGEO BRAND ordering code**

**GLOBAL PART NUMBER (PREFERRED)**

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

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**(1) SIZE – INCH BASED (METRIC)**

0508 (1220)  
 0612 (1632)

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**(2) TOLERANCE**

J = ±5%  
 K = ±10%  
 M = ±20%  
 Z = -20% to +80%

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**(3) PACKING STYLE**

R = Paper taping reel; Reel 7 inch

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**(4) TC MATERIAL**

NPO  
 X7R  
 Y5V

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**(5) RATED VOLTAGE**

7 = 16 V  
 8 = 25 V  
 9 = 50 V

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**(6) PROCESS**

N = NPO  
 B = X7R / Y5V

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**(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 × 10<sup>1</sup> = 120 pF

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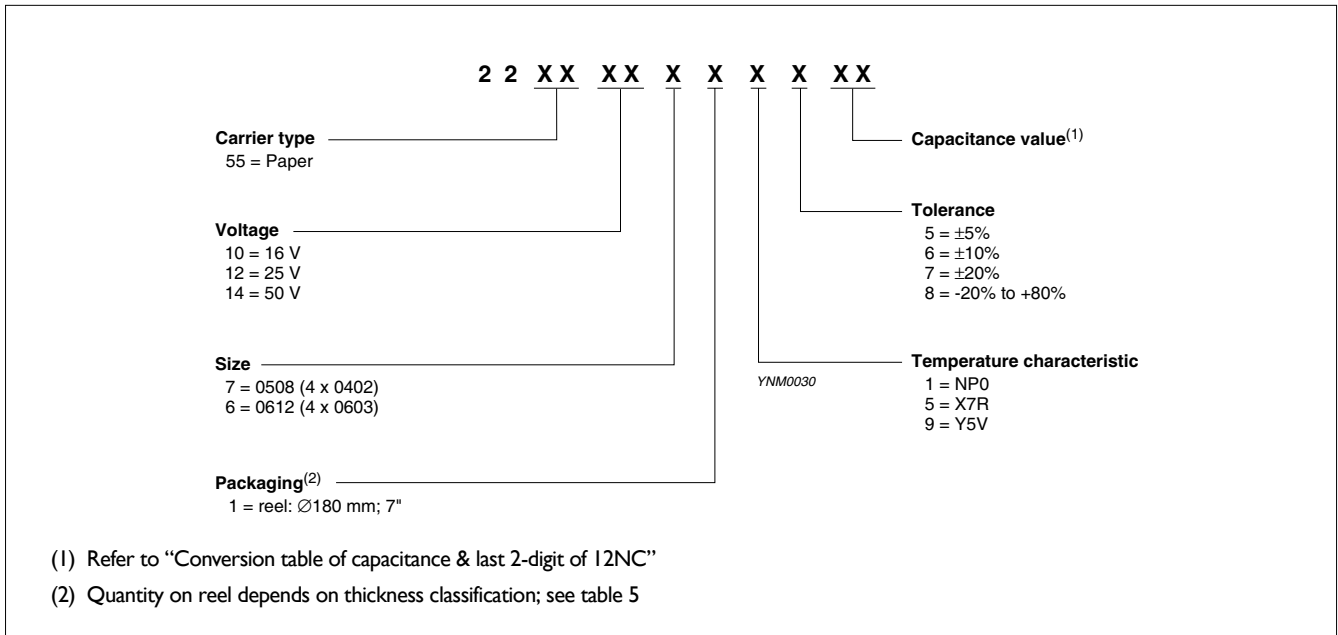
**PHYCOMP BRAND ordering codes**

GLOBAL PART NUMBER (preferred), PHYCOMP CTC (for North America) and I2NC (traditional) codes are acceptable to order Phycomp brand products.

**GLOBAL PART NUMBER (PREFERRED)**

For detailed information of GLOBAL PART NUMBER and ordering example, please refer to page 2.

**I2NC CODE**



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

🔗 Example: 0508CG220K9B20

0508	CG	220	K	9	B	2	0	0
Size code	Temp. Char.	Capacitance in pF	Tolerance	Voltage	Termination	Packing	Marking	Range identifier
0508 (4 x 0402)	CG = NP0 2R = X7R	101 = 100 pF; the third digit signifies the multiplying factor: 0 = × 1 1 = × 10 2 = × 100 3 = × 1,000	J = ±5% K = ±10% M = ±20% Z = -20% to +80%	7 = 16 V 8 = 25 V 9 = 50 V	B = NiSn	2 = 180 mm / 7" paper	0 = no marking	0 = conv. Ceramic D = Class 2 MLCC

**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. An outline of the structure is shown in Fig.1.

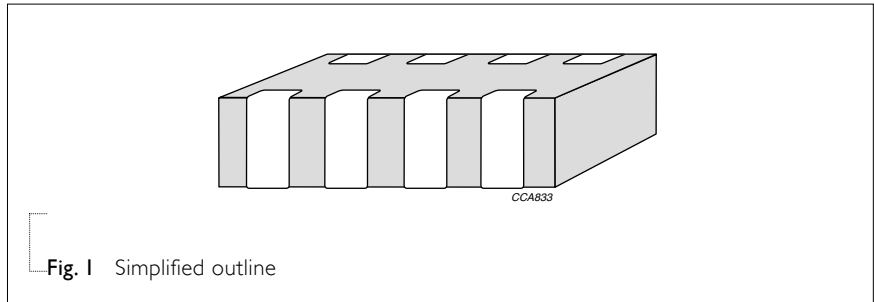


Fig. 1 Simplified outline

**DIMENSIONS**

Table I

TYPE	0508 (4 X 0402)	0612 (4 X 0603)
L (mm)	2.0 ±0.15	3.2 ±0.15
W (mm)	1.25 ±0.15	1.60 ±0.15
T <sub>min.</sub> (mm)	0.50	0.70
T <sub>max.</sub> (mm)	0.70	0.90
A (mm)	0.28 ±0.10	0.4 ±0.10
B (mm)	0.2 ±0.10	0.3 ±0.20
P (mm)	0.5 ±0.10	0.8 ±0.10

**OUTLINES**

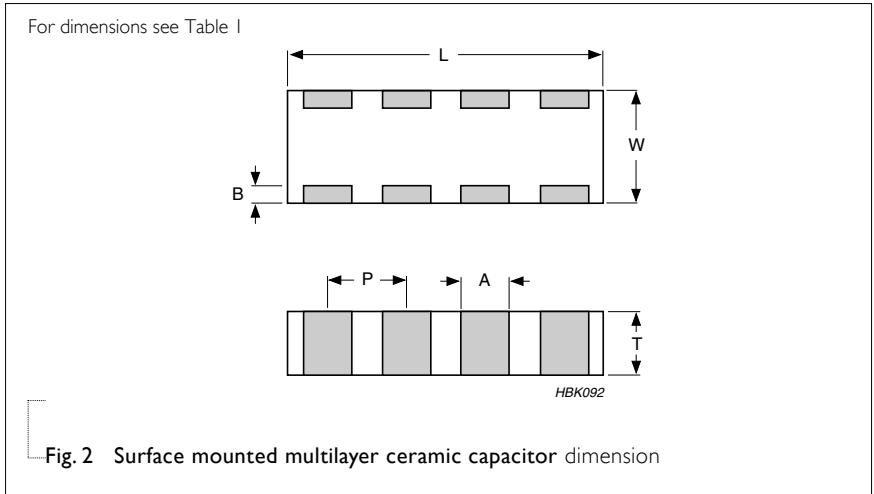


Fig. 2 Surface mounted multilayer ceramic capacitor dimension

CAPACITANCE RANGE & THICKNESS FOR 4C-ARRAY

Table 2 Temperature characteristic material from NP0

CAPACITANCE	Last 2-digit of	0508 (4 x 0402)		0612 (4 x 0603)	
		I2NC	50 V		50 V
10 pF	23				
15 pF	25				
18 pF	26				
22 pF	27				
33 pF	29				
39 pF	31				
47 pF	32				
56 pF	33		0.6±0.1		
68 pF	34				
82 pF	35				
100 pF	36				
120 pF	37				0.8±0.1
150 pF	38				
180 pF	39				
220 pF	41				
270 pF	42				
330 pF	43				
390 pF	44				
470 pF	45				
560 pF	46				
680 pF	47				
820 pF	48				
1.0 nF	49				

**NOTE**

Values in shaded cells indicate thickness class in mm

**CAPACITANCE RANGE & THICKNESS FOR 4C-ARRAY**

**Table 3** Temperature characteristic material from X7R

CAPACITANCE	Last 2-digit of	0508 (4 x 0402)		0612 (4 x 0603)	
		12NC	16 V	16 V	25 V
180 pF	13				
220 pF	14				
270 pF	15				
330 pF	16				
390 pF	17				
470 pF	18				
560 pF	19				
680 pF	21				
820 pF	22				
1.0 nF	23				
1.2 nF	24				
1.5 nF	25				
1.8 nF	26				
2.2 nF	27				
2.7 nF	28				
3.3 nF	29		0.6±0.1		
3.9 nF	31				
4.7 nF	32				
5.6 nF	33				
6.8 nF	34				
8.2 nF	35				
10 nF	36				
12 nF	37				
15 nF	38				
18 nF	39				
22 nF	41				
27 nF	42				
33 nF	43		0.8±0.1		
47 nF	45				
56 nF	46				
68 nF	47				
82 nF	48				
100 nF	49				

0.8±0.1

0.8±0.1

0.8±0.1

**NOTE**

Values in shaded cells indicate thickness class in mm

CAPACITANCE RANGE & THICKNESS FOR 4C-ARRAY

Table 4 Temperature characteristic material from Y5V

CAPACITANCE	Last 2-digit of I2NC	0612 (4 x 0603)	25 V
10 nF	36	0.6±0.1	0.6±0.1
22 nF	41		
47 nF	45		
100 nF	49		

**NOTE**

Values in shaded cells indicate thickness class in mm

THICKNESS CLASSES AND PACKING QUANTITY

Table 5

SIZE CODE	THICKNESS CLASSIFICATION	TAPE WIDTH QUANTITY PER REEL	Ø180 MM / 7 INCH Paper
0508	0.6 ±0.1 mm	8 mm	4,000
0612	0.8 ±0.1 mm	8 mm	4,000

**ELECTRICAL CHARACTERISTICS**
**4C-ARRAY DIELECTRIC CAPACITORS; NISN TERMINATIONS**

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

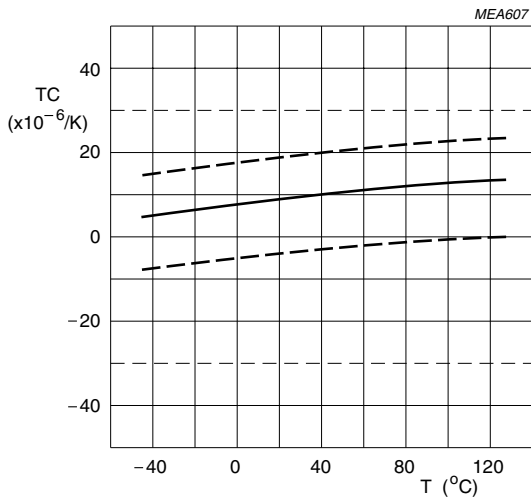
Table 6

DESCRIPTION	VALUE
Capacitance range	10 pF to 100 nF
Rated voltage	NP0 50 V
	X7R 0508: 16 V, 0612: 16 V to 50 V
	Y5V 0612: 25 V
Capacitance tolerance	NP0 $\pm 5\%$ , $\pm 10\%$
	X7R $\pm 10\%$ , $\pm 20\%$
	Y5V $-20\%$ to $+80\%$
Dissipation factor (D.F.)	NP0 $\leq 0.1\%$
	X7R $16\text{ V} \leq 3.5\%$ , $25\text{ V} \leq 2.5\%$ , $50\text{ V} \leq 2.5\%$
	Y5V $0508 \leq 9\%$ , $0612 \leq 7\%$
Insulation resistance after 1 minute at $U_r$ (DC)	$R_{ins} \geq 10\text{ G}\Omega$ or $R_{ins} \times C_r \geq 500$ seconds whichever is less
Maximum capacitance change as a function of temperature (temperature characteristic/coefficient):	NP0 $\pm 30\text{ ppm}/^\circ\text{C}$
	X7R $\pm 15\%$
	Y5V $+22\%$ to $-82\%$
Operating temperature range:	NP0 $-55$ °C to $+125$ °C
	X7R $-55$ °C to $+125$ °C
	Y5V $-30$ °C to $+85$ °C

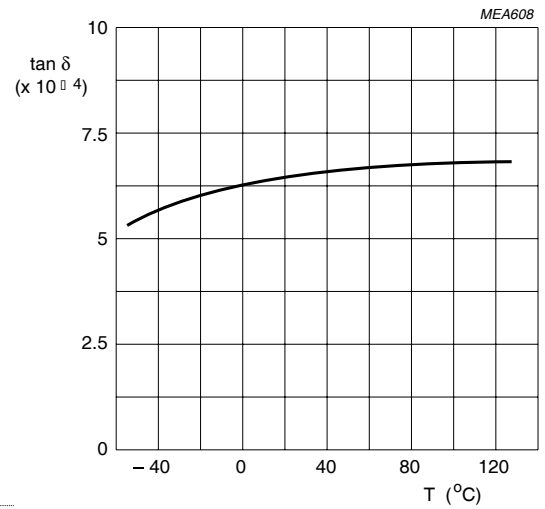


**NP0 0508/0612 50 V**

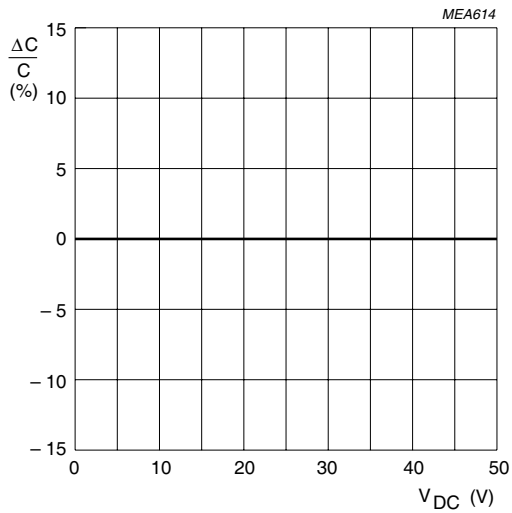
Sample limits (broken lines)  
Requirement levels (dotted lines)



**Fig. 3** Typical temperature coefficient as a function of temperature

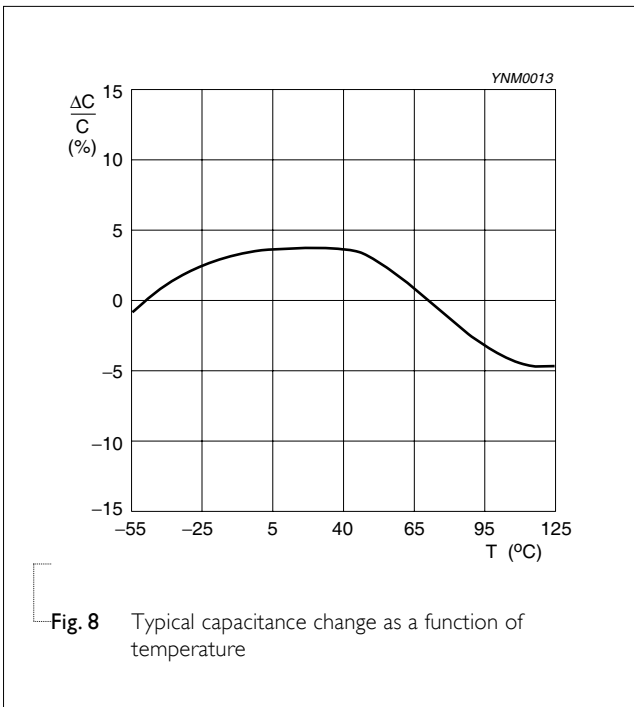
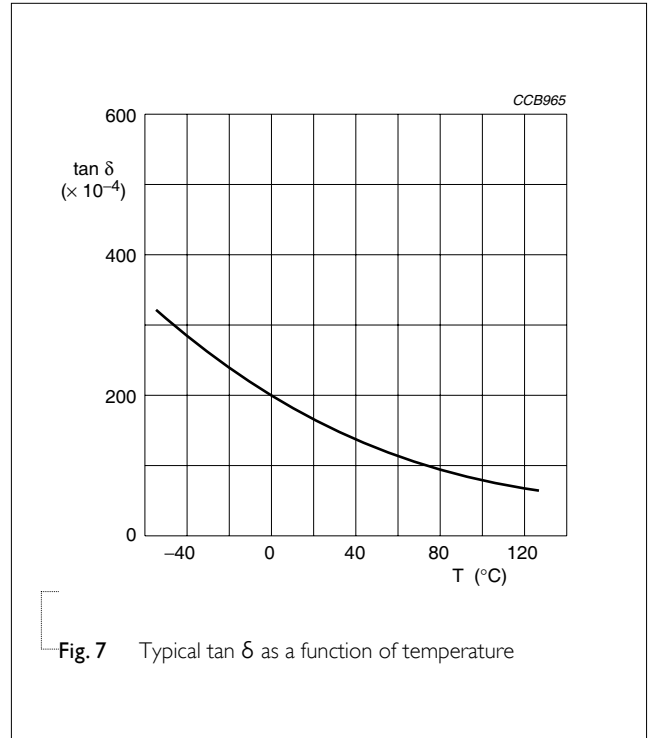
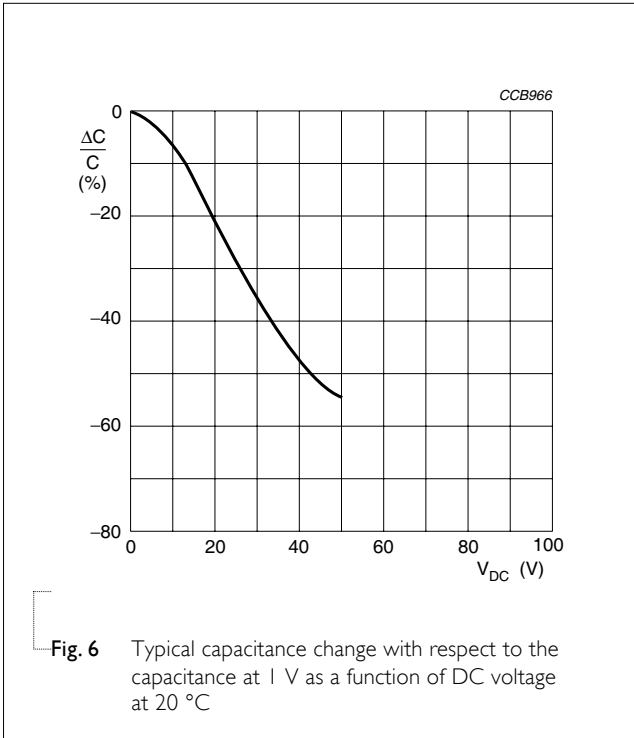


**Fig. 4** Typical tan δ as a function of temperature

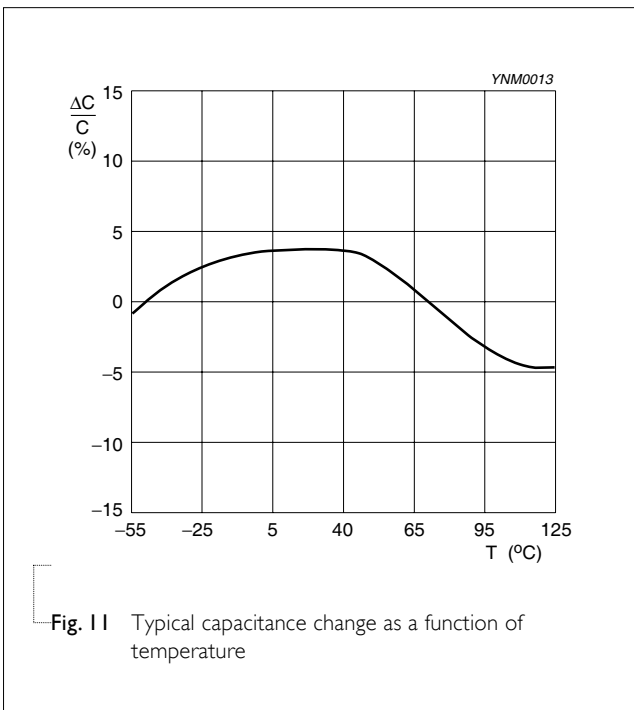
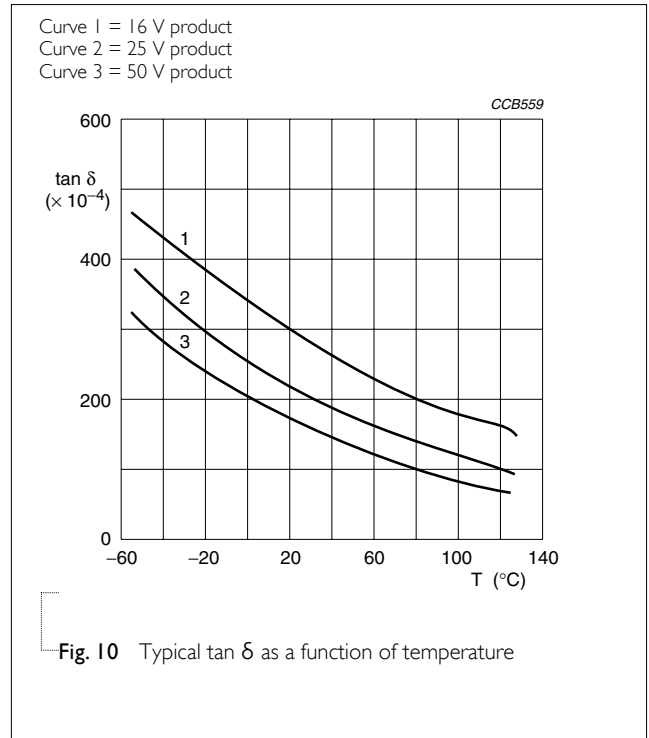
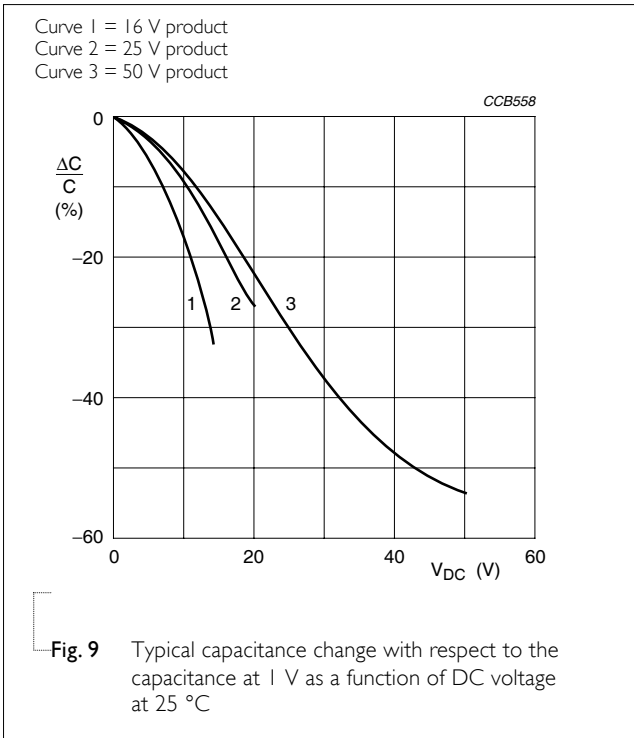


**Fig. 5** Typical capacitance change with respect to the capacitance at 1 V as a function of DC voltage

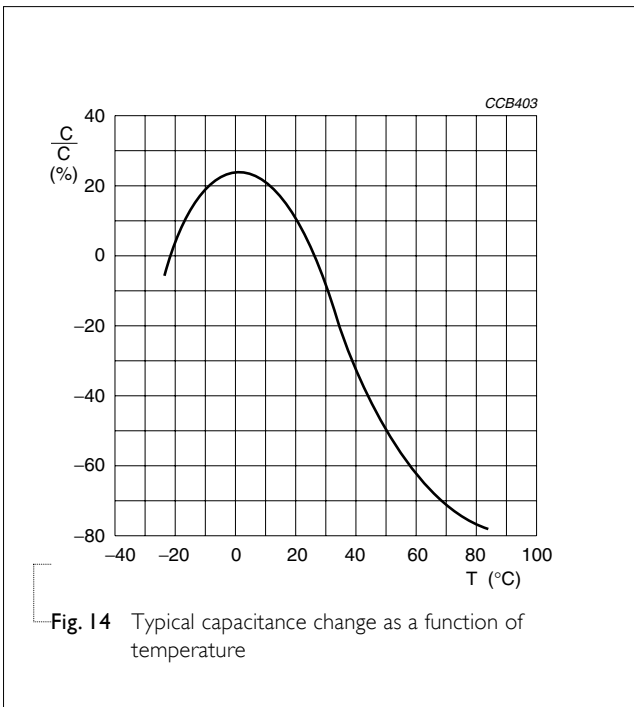
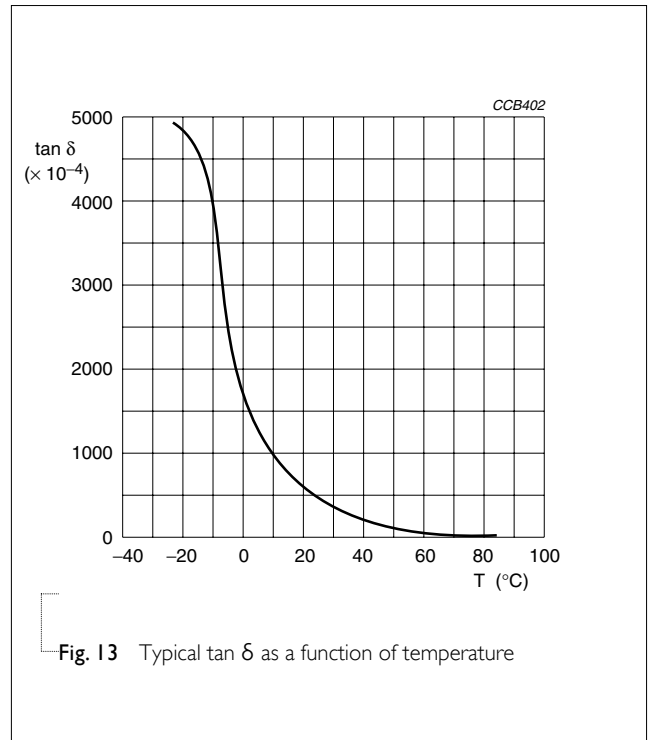
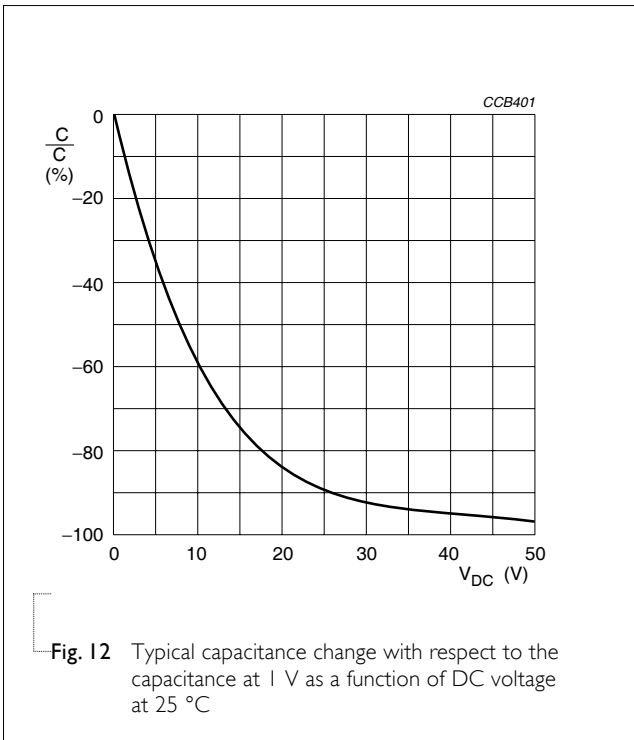
**X7R 0508 16 V**



**X7R 0612 16 V to 50 V**



**Y5V 0612 25 V**



**TESTS AND REQUIREMENTS**

**Table 7** 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 <sub>rms</sub> at 20 °C f = 1 KHz for C > 1 nF, measuring at voltage 1 V <sub>rms</sub> at 20 °C Class 2: f = 1 KHz for C ≤ 10 µF, measuring at voltage 1 V <sub>rms</sub> at 20 °C f = 120 Hz for C > 10 µF, measuring at voltage 0.5 V <sub>rms</sub> 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 <sub>rms</sub> at 20 °C f = 1 KHz for C > 1 nF, measuring at voltage 1 V <sub>rms</sub> at 20 °C Class 2: f = 1 KHz for C ≤ 10 µF, measuring at voltage 1 V <sub>rms</sub> at 20 °C f = 120 Hz for C > 10 µF, measuring at voltage 0.5 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 coefficient		4.6 Class 1: Between minimum and maximum temperature NP0: -55 °C to +125 °C Normal Temperature: 20 °C	<General purpose series> ΔC/C: Class 1: NP0: ±30 ppm/°C
Temperature characteristic		Class 2: Between minimum and maximum temperature X5R: -55 °C to +85 °C X7R: -55 °C to +125 °C Y5V: -30 °C to +85 °C Normal Temperature: 20 °C	<General purpose series> Class 2: X5R/X7R: ±15% Y5V: 22% to -82%  <High Capacitance series> Class 2: X5R/X7R: ±15% Y5V: 22% to -82%
Adhesion		4.7 A force applied for 10 seconds to the line joining the terminations and in a plane parallel to the substrate	Force size ≥ 0603: 5N size = 0402: 2.5N size = 0201: 1N

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	No visible damage
		Conditions: bending 1 mm at a rate of 1 mm/s, radius jig 340 mm	<p>&lt;General purpose series&gt;</p> <p><math>\Delta C/C</math></p> <p>Class 1: NP0: within <math>\pm 1\%</math> or 0.5 pF, whichever is greater</p> <p>Class2: X5R/X7R/Y5V: <math>\pm 10\%</math></p> <p>&lt;High Capacitance series&gt;</p> <p><math>\Delta C/C</math></p> <p>Class2: X5R/X7R/Y5V: <math>\pm 10\%</math></p>
Resistance to soldering heat	4.9	Precondition: 150 $\pm 10$ °C for 1 hour, then keep for 24 $\pm 1$ hours at room temperature	Dissolution of the end face plating shall not exceed 25% of the length of the edge concerned
		Preheating: for size $\leq 1206$ : 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 $\pm 5$ °C Dipping time: 10 $\pm 0.5$ seconds Recovery time: 24 $\pm 2$ hours	
			<p>&lt;General purpose series&gt;</p> <p><math>\Delta C/C</math></p> <p>Class 1: NP0: within <math>\pm 0.5\%</math> or 0.5 pF, whichever is greater</p> <p>Class2: X5R/X7R: <math>\pm 10\%</math> Y5V: <math>\pm 20\%</math></p> <p>&lt;High Capacitance series&gt;</p> <p><math>\Delta C/C</math></p> <p>Class2: X5R/X7R: <math>\pm 10\%</math> Y5V: <math>\pm 20\%</math></p>
Solderability	4.10	Preheated the temperature of 80 °C to 140 °C and maintained for 30 seconds to 60 seconds.	The solder should cover over 95% of the critical area of each termination
		Test conditions for lead containing solder alloy Temperature: 235 $\pm 5$ °C Dipping time: 2 $\pm 0.2$ seconds Depth of immersion: 10 mm Alloy Composition: 60/40 Sn/Pb Number of immersions: 1  Test conditions for leadfree containing solder alloy Temperature: 245 $\pm 5$ °C Dipping time: 3 $\pm 0.3$ seconds Depth of immersion: 10 mm Alloy Composition: SAC305 Number of immersions: 1	

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
Rapid change of temperature	IEC 60384-21/22 4.11	<p>Preconditioning; 150 +0/-10 °C for 1 hour, then keep for 24 ± 1 hours at room temperature</p> <p>5 cycles with following detail: 30 minutes at lower category temperature 30 minutes at upper category temperature</p> <p>Recovery time 24 ± 2 hours</p>	<p>No visual damage</p> <hr/> <p>&lt;General purpose series&gt; ΔC/C Class 1: NP0: within ±1% or 1 pF, whichever is greater Class2: X5R/X7R: ±15% Y5V: ±20%</p> <p>&lt;High Capacitance series&gt; ΔC/C Class2: X5R/X7R: ±15% Y5V: ±20%</p> <hr/> <p>D.F. meet initial specified value R<sub>ins</sub> meet initial specified value</p>
Damp heat with U <sub>r</sub> load	4.13	<ol style="list-style-type: none"> <li>Preconditioning, class 2 only: 150 +0/-10 °C /1 hour, then keep for 24 ± 1 hour at room temp</li> <li>Initial measure: Spec: refer initial spec C, D, IR</li> <li>Damp heat test: 500 ± 12 hours at 40 ± 2 °C; 90 to 95% R.H. 1.0 U<sub>r</sub> applied</li> <li>Recovery: Class 1: 6 to 24 hours Class 2: 24 ± 2 hours</li> <li>Final measure: C, D, IR</li> </ol> <p>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.</p>	<p>No visual damage after recovery</p> <hr/> <p>&lt;General purpose series&gt; ΔC/C Class 1: NP0: within ±2% or 1 pF, whichever is greater Class2: X5R/X7R: ±15%; Y5V: ±30%</p> <p>D.F. Class 1: NP0: ≤ 2 × specified value Class2: X5R/X7R: ≤ 16V: ≤ 7%                                   ≥ 25V: ≤ 5% Y5V: ≤ 15%</p> <p>R<sub>ins</sub> Class 1: NP0: ≥ 2,500 MΩ or R<sub>ins</sub> × C<sub>r</sub> ≥ 25s whichever is less Class2: X5R/X7R/Y5V: ≥ 500 MΩ or R<sub>ins</sub> × C<sub>r</sub> ≥ 25s whichever is less</p> <p>&lt;High Capacitance series&gt; ΔC/C Class2: X5R/X7R: ±20%; Y5V: ±30%</p> <p>D.F. Class2: 2 × initial value max</p> <p>R<sub>ins</sub> Class2: 500 MΩ or R<sub>ins</sub> × C<sub>r</sub> ≥ 25s, whichever is less</p>

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
Endurance	IEC 60384-21/22 4.14	<p>1. Preconditioning, class 2 only: 150 +0/-10 °C /1 hour, then keep for 24 ± 1 hour at room temp</p> <p>2. Initial measure: Spec: refer initial spec C, D, IR</p> <p>3. Endurance test: Temperature: NP0/X7R: 125 °C X5R/Y5V: 85 °C Specified stress voltage applied for 1,000 hours: Applied 2.0 × U<sub>r</sub> for general product. Applied 1.5 × U<sub>r</sub> for high cap. product. High voltage series follows with below stress condition: Applied 1.3 × U<sub>r</sub> for 500V series Applied 1.2 × U<sub>r</sub> for 1KV, 2KV, 3KV series</p> <p>4. Recovery time: 24 ± 2 hours</p> <p>5. Final measure: C, D, IR</p> <p>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.</p>	<p>No visual damage</p> <hr/> <p><b>&lt;General purpose series&gt;</b></p> <p>ΔC/C</p> <p>Class 1: NP0: within ±2% or 1 pF, whichever is greater</p> <p>Class 2: X5R/X7R: ±15%; Y5V: ±30%</p> <p>D.F.</p> <p>Class 1: NP0: ≤ 2 × specified value</p> <p>Class 2: X5R/X7R: ≤ 16V: ≤ 7%                                   ≥ 25V: ≤ 5%</p> <p>Y5V: ≤ 15%</p> <p>R<sub>ins</sub></p> <p>Class 1: NP0: ≥ 4,000 MΩ or R<sub>ins</sub> × C<sub>r</sub> ≥ 40s whichever is less</p> <p>Class 2: X5R/X7R/Y5V: ≥ 1,000 MΩ or R<sub>ins</sub> × C<sub>r</sub> ≥ 50s whichever is less</p> <p><b>&lt;High Capacitance series&gt;</b></p> <p>ΔC/C</p> <p>Class 2: X5R/X7R: ±20%; Y5V: ±30%</p> <p>D.F.</p> <p>Class 2: 2 × initial value max</p> <p>R<sub>ins</sub></p> <p>Class 2: 1,000 MΩ or R<sub>ins</sub> × C<sub>r</sub> ≥ 50s, whichever is less</p>
Voltage proof	IEC 60384-1 4.6	<p>Specified stress voltage applied for 1 minute</p> <p>U<sub>r</sub> ≤ 100 V: series applied 2.5 U<sub>r</sub> 100 V &lt; U<sub>r</sub> ≤ 200 V series applied (1.5 U<sub>r</sub> + 100) 200 V &lt; U<sub>r</sub> ≤ 500 V series applied (1.3 U<sub>r</sub> + 100) U<sub>r</sub> &gt; 500 V: 1.3 U<sub>r</sub> I: 7.5 mA</p>	No breakdown or flashover



REVISION HISTORY

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version 0	Jun 22, 2009	-	<ul style="list-style-type: none"> <li>- New datasheet for 4C-Array series with RoHS compliant</li> <li>- Replace from pdf files: 0508_16V to 50V_1, 0612_16V to 50V_0, C-Array_NP0_50V_0508_7, C-Array_NP0_50V_0612_7, C-Array_X7R_16V_25V_50V_0612_6, C-Array_X7R_16V_0508_5, C-Array_Y5V_25V_0508_0, C-Array_Y5V_25V_0612_5</li> <li>- Define global part number</li> <li>- Description of "Halogen Free compliant" added</li> <li>- Test method and procedure updated</li> </ul>