Innovative Service Around the Globe **YAGEO**

DATA SHEET

SURFACE-MOUNT CERAMIC MULTILAYER CAPACITORS

C-Array

NP0/X7R/Y5V

16 V TO 100 V

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

RoHS compliant & Halogen Free

YAGEO

Product Specification – June 16, 2017 V. 5

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 throughout, by time saved in mounting
- RoHS compliant
- Halogen Free compliant

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.

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)

(1) SIZE – INCH BASED (METRIC)

0508 (1220)
0612 (1632)

(2) TOLERANCE

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

(3) PACKING STYLE

R = Paper/PE taping reel; Reel 7 inch
P = Paper/PE taping reel; Reel 13 inch

(4) TC MATERIAL

NPO
X5R
X7R
Y5V

(5) RATED VOLTAGE

7 = 16 V
8 = 25 V
9 = 50 V
0 =100V

(6) PROCESS

N = NP0
B = class 2 material

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

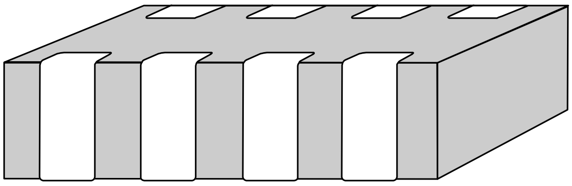

Fig. 1 Simplified outline

DIMENSIONS

Table 1

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
$T_{min.}$ (mm)	Refer to Table 2 ~ Table 4	
$T_{max.}$ (mm)	Refer to Table 2 ~ Table 4	
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

For dimensions see Table 1

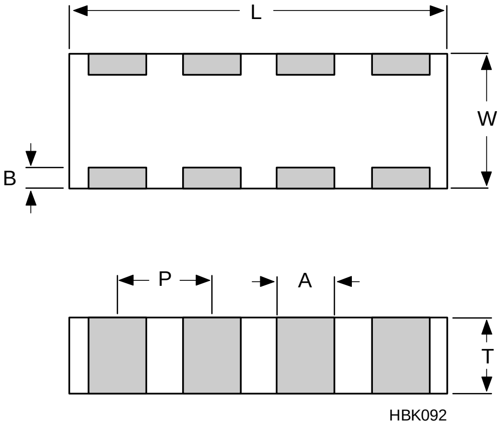

Fig. 2 **Surface mounted multilayer ceramic capacitor** dimension

CAPACITANCE RANGE & THICKNESS FOR 4C-ARRAY

Table 2 Temperature characteristic material from NP0

CAPACITANCE	0508 (4 x 0402)		0612 (4 x 0603)	
	50 V	100V	50 V	100V
10 pF	0.6±0.1	0.6±0.1	0.8±0.1	0.8±0.1
15 pF	0.6±0.1	0.6±0.1	0.8±0.1	0.8±0.1
18 pF	0.6±0.1	0.6±0.1	0.8±0.1	0.8±0.1
22 pF	0.6±0.1	0.6±0.1	0.8±0.1	0.8±0.1
33 pF	0.6±0.1	0.6±0.1	0.8±0.1	0.8±0.1
39 pF	0.6±0.1	0.6±0.1	0.8±0.1	0.8±0.1
47 pF	0.6±0.1	0.6±0.1	0.8±0.1	0.8±0.1
56 pF	0.6±0.1	0.6±0.1	0.8±0.1	0.8±0.1
68 pF	0.6±0.1	0.6±0.1	0.8±0.1	0.8±0.1
82 pF	0.6±0.1	0.6±0.1	0.8±0.1	0.8±0.1
100 pF	0.6±0.1	0.6±0.1	0.8±0.1	0.8±0.1
120 pF	0.6±0.1		0.8±0.1	0.8±0.1
150 pF	0.6±0.1		0.8±0.1	0.8±0.1
180 pF	0.6±0.1		0.8±0.1	0.8±0.1
220 pF	0.6±0.1		0.8±0.1	0.8±0.1
270 pF			0.8±0.1	0.8±0.1
330 pF			0.8±0.1	0.8±0.1
390 pF			0.8±0.1	0.8±0.1
470 pF			0.8±0.1	0.8±0.1
560 pF				
680 pF				
820 pF				
1.0 nF				

NOTE

Values in shaded cells indicate thickness class in mm

CAPACITANCE RANGE & THICKNESS FOR 4C-ARRAY

Table 3 Temperature characteristic material from X7R

CAPACITANCE	0508 (4 x 0402)			0612 (4 x 0603)			
	16 V	25 V	50 V	16 V	25 V	50 V	100V
220 pF				0.8±0.1	0.8±0.1	0.8±0.1	
330 pF				0.8±0.1	0.8±0.1	0.8±0.1	
470 pF				0.8±0.1	0.8±0.1	0.8±0.1	
680 pF				0.8±0.1	0.8±0.1	0.8±0.1	
1.0 nF	0.6±0.1	0.6±0.1	0.6±0.1	0.8±0.1	0.8±0.1	0.8±0.1	
1.2 nF	0.6±0.1	0.6±0.1		0.8±0.1	0.8±0.1	0.8±0.1	
1.5 nF	0.6±0.1	0.6±0.1		0.8±0.1	0.8±0.1	0.8±0.1	
1.8 nF	0.6±0.1	0.6±0.1		0.8±0.1	0.8±0.1	0.8±0.1	
2.2 nF	0.6±0.1	0.6±0.1		0.8±0.1	0.8±0.1	0.8±0.1	
2.7 nF	0.6±0.1	0.6±0.1		0.8±0.1	0.8±0.1	0.8±0.1	
3.3 nF	0.6±0.1	0.6±0.1		0.8±0.1	0.8±0.1	0.8±0.1	
3.9 nF	0.6±0.1	0.6±0.1		0.8±0.1	0.8±0.1	0.8±0.1	
4.7 nF	0.6±0.1	0.6±0.1		0.8±0.1	0.8±0.1	0.8±0.1	
5.6 nF	0.6±0.1	0.6±0.1		0.8±0.1	0.8±0.1	0.8±0.1	
6.8 nF	0.6±0.1	0.6±0.1		0.8±0.1	0.8±0.1	0.8±0.1	
8.2 nF	0.6±0.1	0.6±0.1		0.8±0.1	0.8±0.1	0.8±0.1	
10 nF	0.6±0.1	0.6±0.1		0.8±0.1	0.8±0.1	0.8±0.1	0.85±0.1
12 nF	0.6±0.1			0.8±0.1	0.8±0.1	0.8±0.1	0.85±0.1
15 nF	0.6±0.1			0.8±0.1	0.8±0.1	0.8±0.1	0.85±0.1
18 nF	0.6±0.1			0.8±0.1	0.8±0.1	0.8±0.1	0.85±0.1
22 nF	0.6±0.1			0.8±0.1	0.8±0.1	0.8±0.1	0.85±0.1
27 nF	0.6±0.1			0.8±0.1	0.8±0.1	0.8±0.1	
33 nF	0.6±0.1			0.8±0.1	0.8±0.1	0.8±0.1	
47 nF	0.6±0.1			0.8±0.1	0.8±0.1	0.8±0.1	
56 nF	0.6±0.1			0.8±0.1	0.8±0.1	0.8±0.1	
68 nF	0.6±0.1			0.8±0.1	0.8±0.1	0.8±0.1	
82 nF	0.6±0.1			0.8±0.1	0.8±0.1	0.8±0.1	
100 nF	0.6±0.1			0.8±0.1	0.8±0.1	0.8±0.1	
220 nF				0.8±0.1			
470 nF				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	**0612 (4 x 0603)** **25 V**
10 nF	0.6±0.1
22 nF	
47 nF	
100 nF	

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	Ø180 MM / 13 INCH Paper
0508	0.6 ±0.1 mm	8 mm	4,000	20,000
0612	0.8 ±0.1 mm	8 mm	4,000	15,000

ELECTRICAL CHARACTERISTICS

4C-ARRAY 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 6

DESCRIPTION		VALUE
Capacitance range		10 pF to 100 nF
Rated voltage		
	NP0	50 V to 100 V
	X7R	16 V to 100 V
	Y5V	0612: 25 V
Capacitance tolerance		
	NP0	±5%, ±10%
	X7R	±10%, ±20%
	Y5V	–20% to +80%
Dissipation factor (D.F.)		
	NP0	≤ 0.1%
	X7R	16 V ≤ 3.5%, 25V ≤ 2.5%, 50V / 100V ≤ 2.5% 0508/12nF~100nF/16V, Df ≤5%
	Y5V	0508 ≤ 9%, 0612 ≤ 7%
Insulation resistance after 1 minute at U_r (DC)		R_{ins} ≥ 10 GΩ or $R_{ins} \times C_r$ ≥ 500 seconds whichever is less
Maximum capacitance change as a function of temperature (temperature characteristic/coefficient):		
	NP0	±30 ppm/°C
	X7R	±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

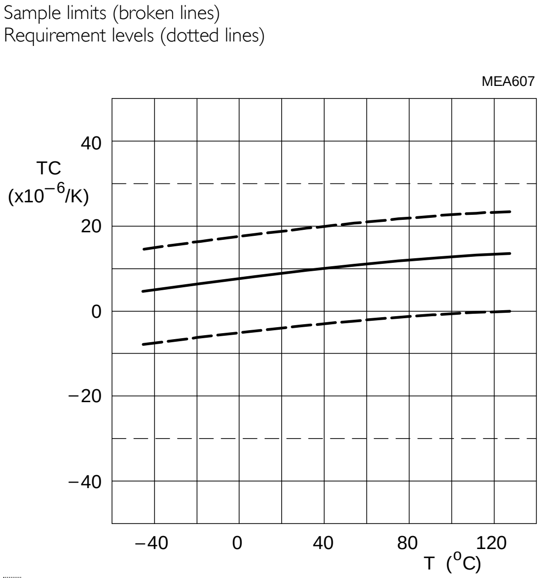

Fig. 3 Typical temperature coefficient as a function of temperature

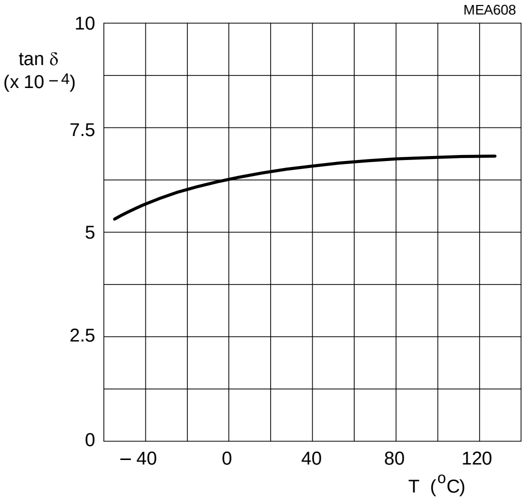

Fig. 4 Typical tan δ as a function of temperature

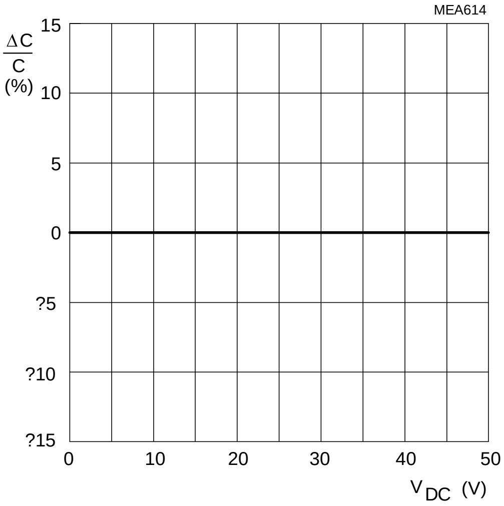

Fig. 5 Typical capacitance change with respect to the capacitance at 1 V as a function of DC voltage

X7R 0508 16 V

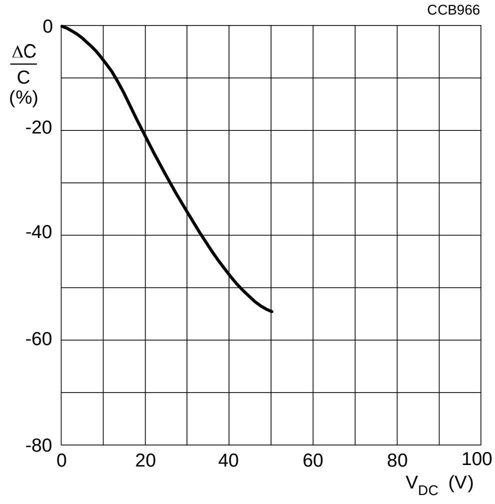

Fig. 6 Typical capacitance change with respect to the capacitance at 1 V as a function of DC voltage at 20 °C

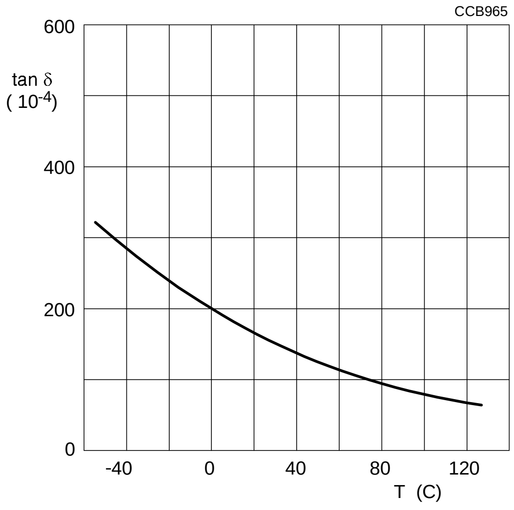

Fig. 7 Typical tan δ as a function of temperature

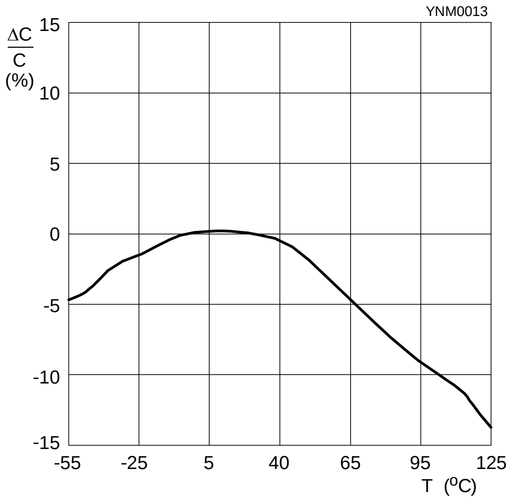

Fig. 8 Typical capacitance change as a function of temperature

X7R 0612 16 V to 50 V

Curve 1 = 16 V product
Curve 2 = 25 V product
Curve 3 = 50 V product

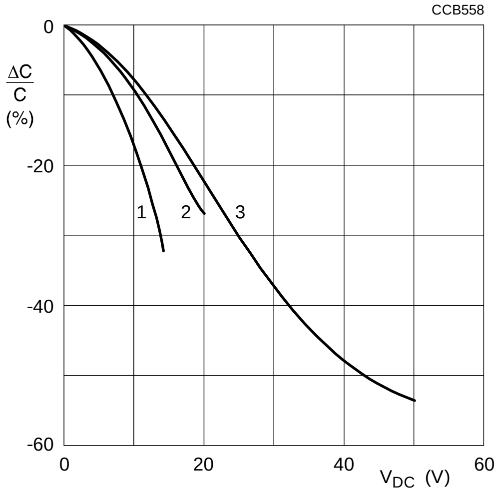

Fig. 9 Typical capacitance change with respect to the capacitance at 1 V as a function of DC voltage at 25 °C

Curve 1 = 16 V product
Curve 2 = 25 V product
Curve 3 = 50 V product

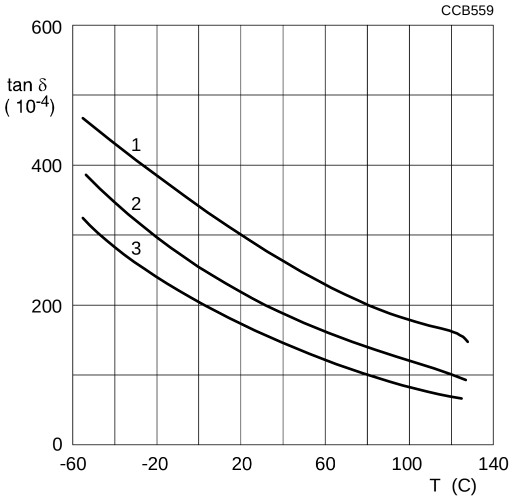

Fig. 10 Typical tan δ as a function of temperature

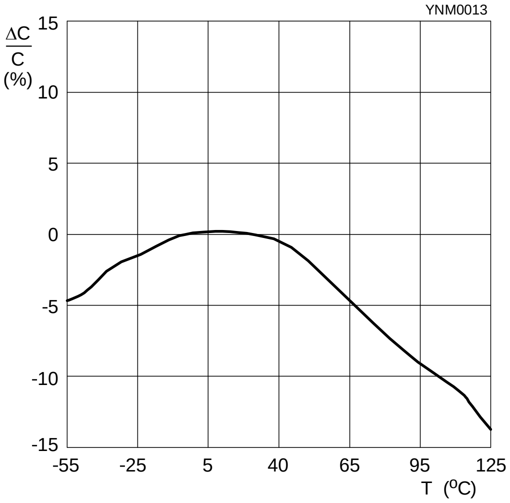

Fig. 11 Typical capacitance change as a function of temperature

Y5V 0612 25 V

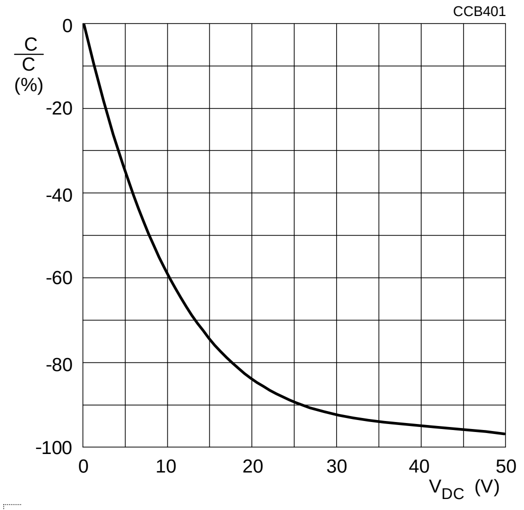

Fig. 12 Typical capacitance change with respect to the capacitance at 1 V as a function of DC voltage at 25 °C

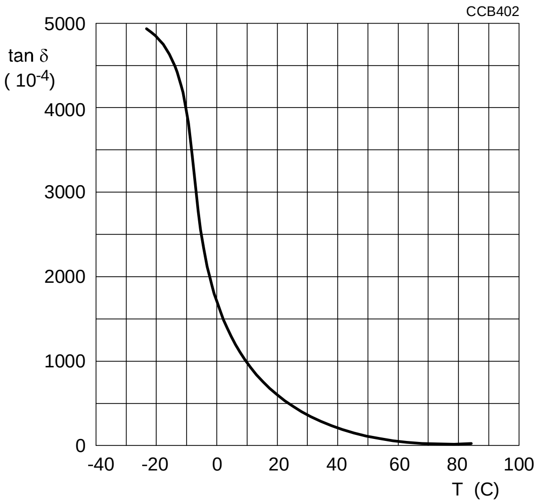

Fig. 13 Typical tan δ as a function of temperature

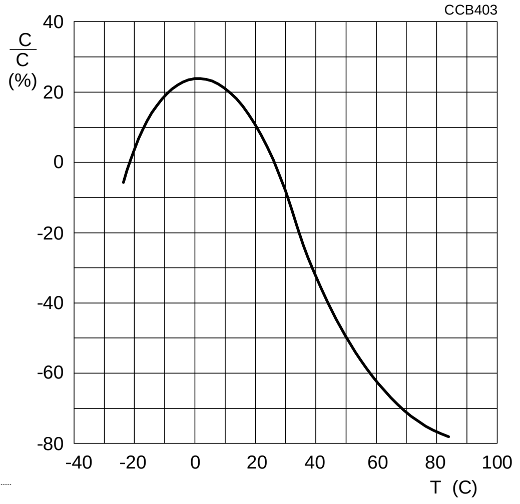

Fig. 14 Typical capacitance change as a function of temperature

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_{rms} at 20 °C f = 1 KHz for C > 1 nF, measuring at voltage 1 V_{rms} at 20 °C Class 2: f = 1 KHz for C ≤ 10 μF, measuring at voltage 1 V_{rms} at 20 °C f = 120 Hz for C >10 μF, measuring at voltage 0.5 V_{rms} 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: f = 1 KHz for C ≤ 10 μF, measuring at voltage 1 V_{rms} at 20 °C f = 120 Hz for C > 10 μF, measuring at voltage 0.5 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

<table>
<tr><th>TEST</th><th>TEST METHOD</th><th>PROCEDURE</th><th>REQUIREMENTS</th></tr>
<tr><td>Temperature Coefficient</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(℃)</th></tr>
<tr><td>a</td><td>25±2</td></tr>
<tr><td>b</td><td>Lower temperature±3℃</td></tr>
<tr><td>c</td><td>25±2</td></tr>
<tr><td>d</td><td>Upper Temperature±2℃</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

$$\text{Temp, Coefficient} = \frac{C2 - C1}{C1 \times \Delta T} \times 10^{6} \ [\text{ppm/℃}]$$

C1: Capacitance at step c

C2: Capacitance at 125℃

ΔT: 100℃(=125℃-25℃)

(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%
Y5V: Δ C/C: 22~-82%</td></tr>
<tr><td>Adhesion</td><td>4.7</td><td>A force applied for 10 seconds to the line joining the terminations and in a plane parallel to the substrate</td><td>Force
size ≥ 0603: 5N
size = 0402: 2.5N
size = 0201: 1N</td></tr>
</table>

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 5 mm	ΔC/C Class 1: NP0: within ±1% or 0.5 pF, whichever is greater Class2: X5R/X7R/Y5V: ±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 °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	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% Y5V: ±20%
				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 lead containing solder alloy Temperature: 235 ±5 °C Dipping time: 2 ±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 ±5 °C Dipping time: 3 ±0.3 seconds Depth of immersion: 10 mm Alloy Composition: SAC305 Number of immersions: 1	The solder should cover over 95% of the critical area of each termination

TEST	TEST METHOD		PROCEDURE	REQUIREMENTS
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 ±1% or 1 pF, whichever is greater Class2: X5R/X7R: ±15% Y5V: ±20% D.F. meet initial specified value R_{ins} meet initial specified value
Damp Heat with U_r 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 U_r 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 ΔC/C Class 1: NP0: within ±2% or 1 pF, whichever is greater Class2: X5R/X7R: ±15%; Y5V: ±30% D.F. Class 1: NP0: ≤ 2 × specified value Class2: X5R/X7R: ≤ 16V: ≤ 7% ≥ 25V: ≤ 5% Y5V: ≤ 15% R_{ins} Class 1: NP0: ≥ 2,500 MΩ or $R_{ins} \times C_r \geq 25s$ whichever is less Class2: X5R/X7R/Y5V: ≥ 500 MΩ or $R_{ins} \times C_r \geq 25s$ whichever is less

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/X7R: 125 °C X5R/Y5V: 85 °C Specified stress voltage applied for 1,000 hours: Applied 2.0 × U_r 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 <General purpose series> ΔC/C Class1: NP0: within ±2% or 1 pF, whichever is greater Class2: X5R/X7R: ±15%; Y5V: ±30% D.F. Class1: NP0: ≤ 2 × specified value Class2: X5R/X7R: ≤ 16V: ≤ 7% ≥ 25V: ≤ 5% Y5V: ≤ 15% R_{ins} Class1: NP0: ≥ 4,000 MΩ or $R_{ins} \times C_r \geq 40s$ whichever is less Class2: X5R/X7R/Y5V: ≥ 1,000 MΩ or $R_{ins} \times C_r \geq 50s$ whichever is less
Voltage Proof	IEC 60384-1	4.6	Specified stress voltage applied for 1 minute $U_r \leq 100$ V: series applied 2.5 U_r 100 V < $U_r \leq 200$ V series applied (1.5 U_r + 100) 200 V < $U_r \leq 500$ V series applied (1.3 U_r + 100) $U_r > 500$ V: 1.3 U_r I: 7.5 mA	No breakdown or flashover

REVISION HISTORY

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version 5	Jun. 16, 2017	-	- X7R/0612 product range updated
Version 4	Nov. 10, 2015	-	- Product range updated
Version 3	May 21, 2014	-	- Product range updated
Version 2	Jun. 17, 2013	-	- Product range updated
Version 1	Feb 05, 2010	-	- The statement of "Halogen Free" on the cover added
Version 0	Jun 22, 2009	-	- New datasheet for 4C-Array series with RoHS compliant - 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 - Define global part number - Description of "Halogen Free compliant" added - Test method and procedure updated

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