Innovative Service Around the Globe YAGEO

DATA SHEET

SURFACE-MOUNT CERAMIC MULTILAYER CAPACITORS

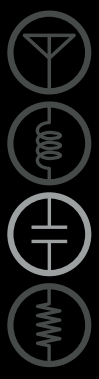
C-Array

NP0/X7R/Y5V

16 V TO 50 V

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

RoHS compliant



YAGEO Phicomp

Product Specification – Jun 22, 2009 V.0

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 taping reel; Reel 7 inch

(4) TC MATERIAL

NPO

X7R

Y5V

(5) RATED VOLTAGE

7 = 16 V

8 = 25 V

9 = 50 V

(6) PROCESS

N = NP0

B = X7R / Y5V

(7) CAPACITANCE VALUE

2 significant digits+number of zeros

The 3rd digit signifies the multiplying factor, and letter R is decimal point

Example: 121 = 12×10^1 = 120 pF

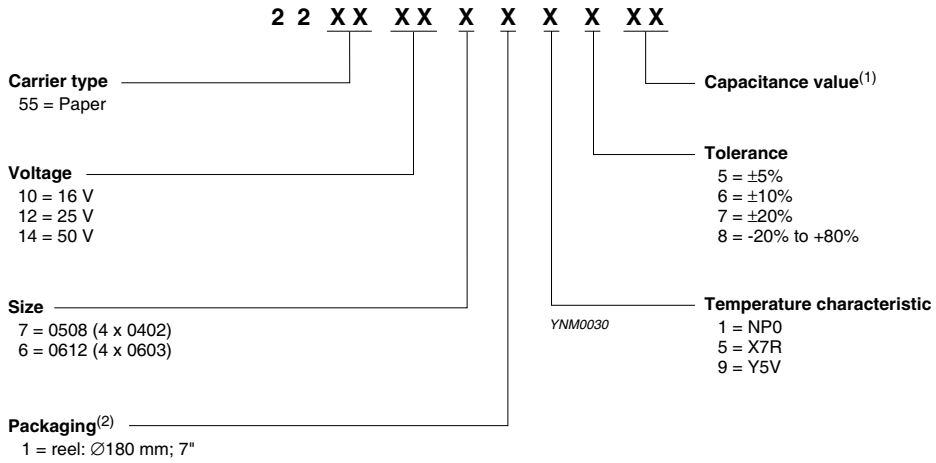
PHYCOMP BRAND ordering codes

GLOBAL PART NUMBER (preferred), PHYCOMP CTC (for North America) and 12NC (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.

12NC CODE



(1) Refer to "Conversion table of capacitance & last 2-digit of 12NC"

(2) Quantity on reel depends on thickness classification; see table 5

PHYCOMP CTC CODE (FOR NORTH AMERICA)

Example: 0508CG220K9B200

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) 0612 (4 x 0603)	CG = NP0 2R = X7R 2F = Y5V	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.

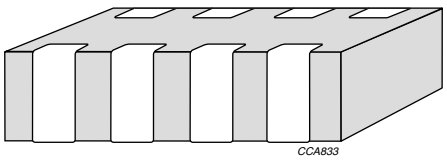


Fig. 1 Simplified outline

DIMENSIONS

Table 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)	0.50	0.70
$T_{max.}$ (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

For dimensions see Table 1

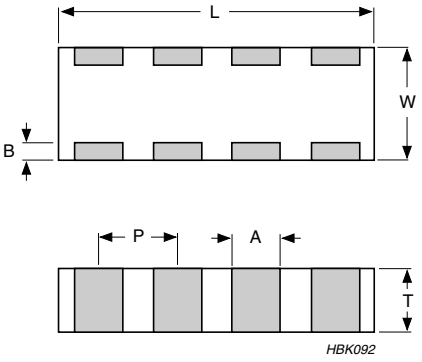


Fig. 2 Surface mounted multilayer ceramic capacitor dimension

CAPACITANCE RANGE & THICKNESS FOR 4C-ARRAY

Table 2 Temperature characteristic material from NP0

CAPACITANCE	Last 2-digit of 12NC	0508 (4 x 0402) 50 V	0612 (4 x 0603) 50 V
10 pF	23	0.6±0.1	0.8±0.1
15 pF	25		
18 pF	26		
22 pF	27		
33 pF	29		
39 pF	31		
47 pF	32		
56 pF	33		
68 pF	34		
82 pF	35		
100 pF	36		
120 pF	37		
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 12NC	0508 (4 x 0402) 16 V	0612 (4 x 0603) 16 V	25 V	50 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				0.8±0.1
1.5 nF	25				
1.8 nF	26				
2.2 nF	27				
2.7 nF	28			0.8±0.1	
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		0.8±0.1		
12 nF	37				
15 nF	38				
18 nF	39				
22 nF	41				
27 nF	42				
33 nF	43				
47 nF	45				
56 nF	46				
68 nF	47				
82 nF	48				
100 nF	49				

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 12NC	0612 (4 x 0603) 25 V
10 nF	36	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±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	±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 ≤ 2.5%
	Y5V	0508 ≤ 9%, 0612 ≤ 7%
Insulation resistance after 1 minute at U_r (DC)		R_{ins} ≥ 10 GΩ or R_{ins} × 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

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

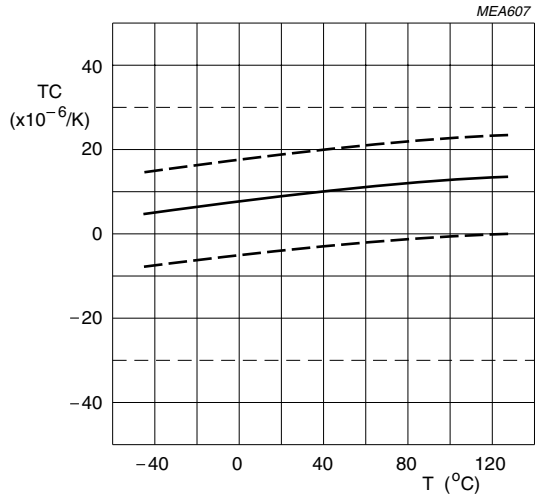


Fig. 3 Typical temperature coefficient as a function of temperature

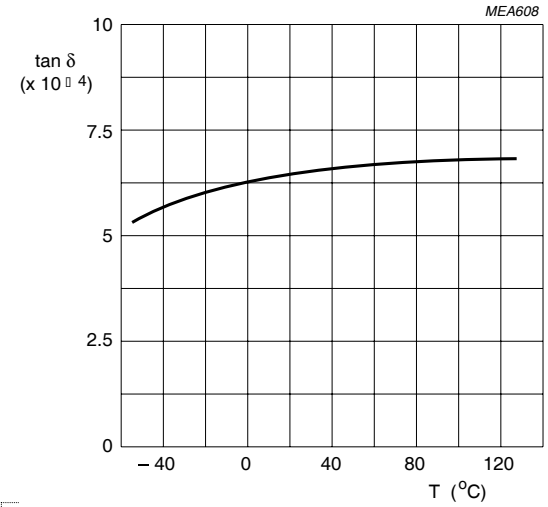


Fig. 4 Typical tan δ as a function of temperature

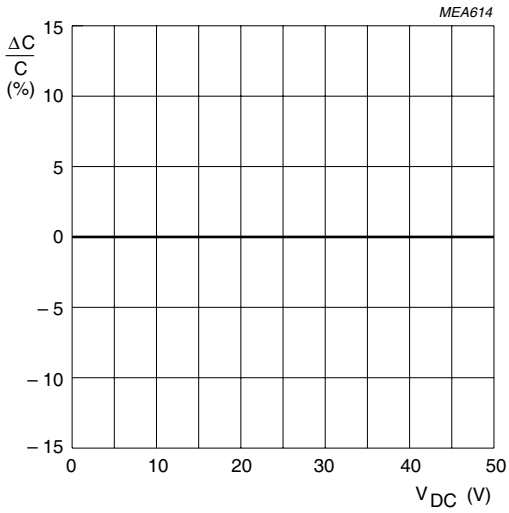


Fig. 5 Typical capacitance change with respect to the capacitance at 1 V as a function of DC voltage

X7R 0508 16 V

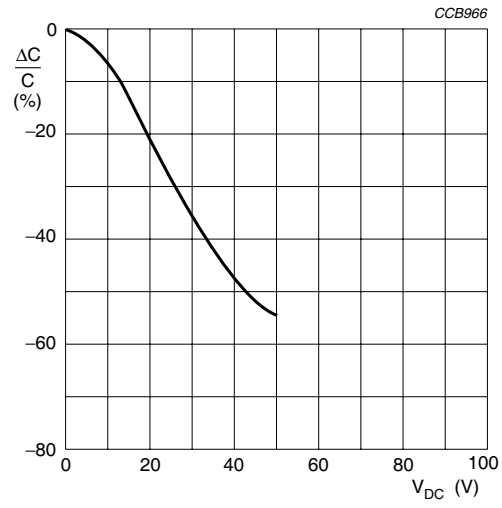


Fig. 6 Typical capacitance change with respect to the capacitance at 1 V as a function of DC voltage at 20 °C

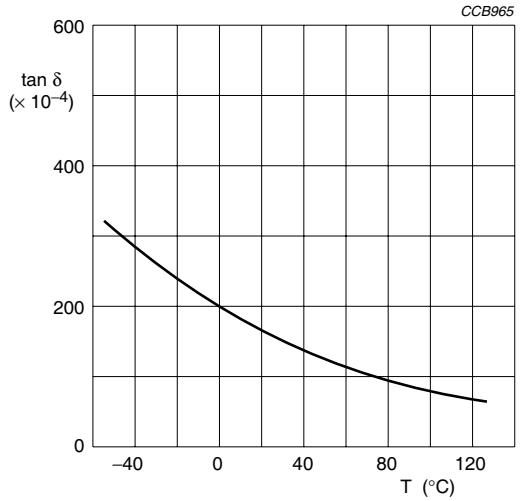


Fig. 7 Typical tan δ as a function of temperature

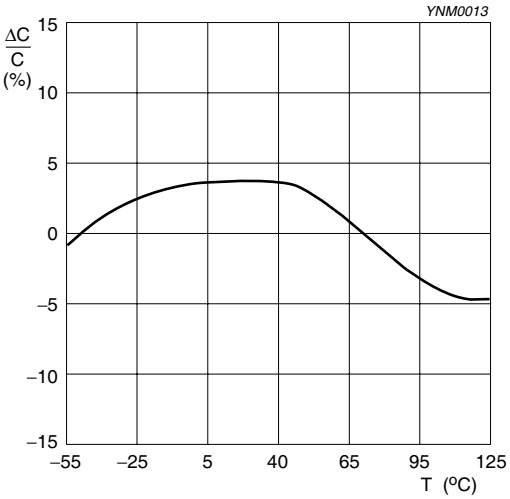


Fig. 8 Typical capacitance change as a function of temperature

X7R 0612 16 V to 50 V

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

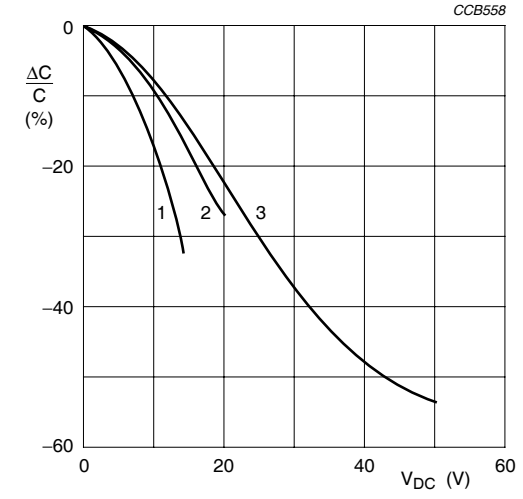


Fig. 9 Typical capacitance change with respect to the capacitance at 1 V as a function of DC voltage at 25 °C

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

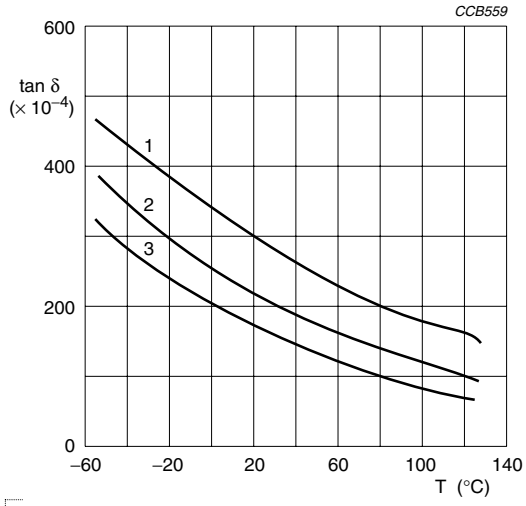


Fig. 10 Typical tan δ as a function of temperature

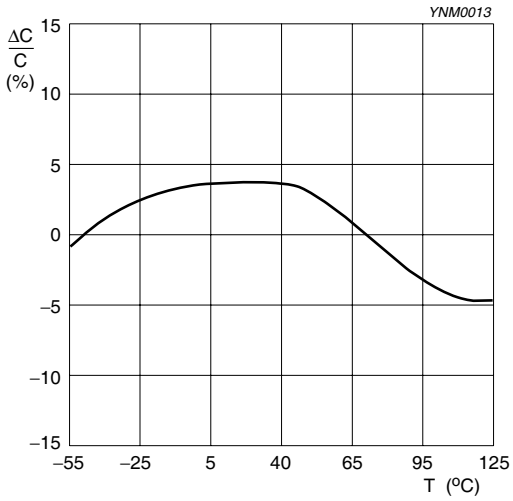


Fig. 11 Typical capacitance change as a function of temperature

Y5V 0612 25 V

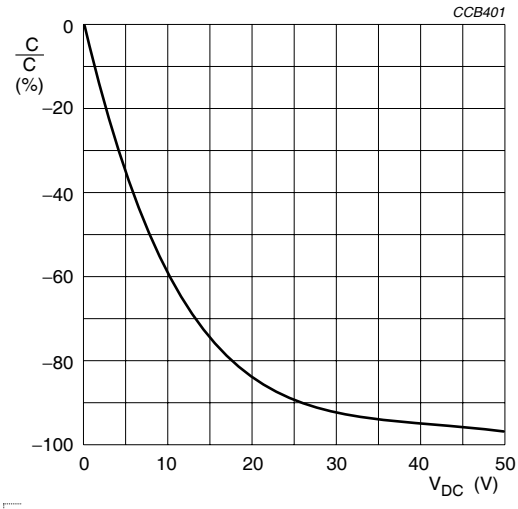


Fig. 12 Typical capacitance change with respect to the capacitance at 1 V as a function of DC voltage at 25 °C

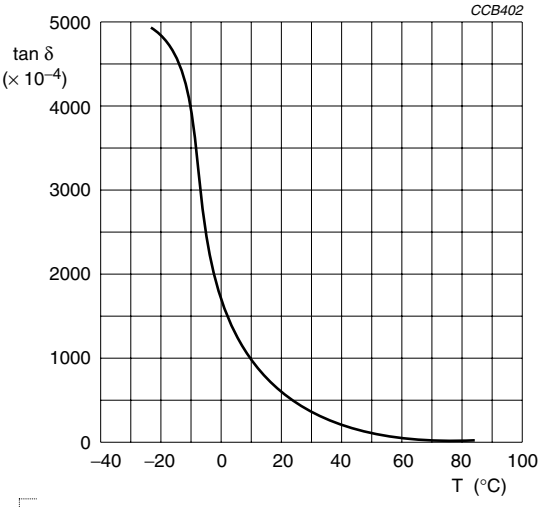


Fig. 13 Typical tan δ as a function of temperature

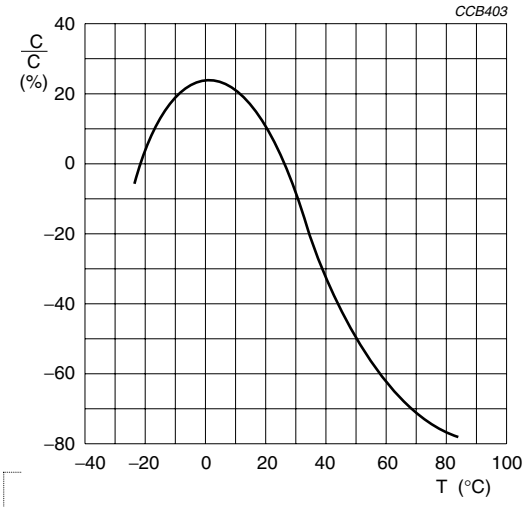


Fig. 14 Typical capacitance change as a function of temperature

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
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 Conditions: bending 1 mm at a rate of 1 mm/s, radius jig 340 mm	No visible damage <General purpose series> ΔC/C Class 1: NP0: within ±1% or 0.5 pF, whichever is greater Class2: X5R/X7R/Y5V: ±10% <High Capacitance series> ΔC/C 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 <General purpose series> ΔC/C Class 1: NP0: within ±0.5% or 0.5 pF, whichever is greater Class2: X5R/X7R: ±10% Y5V: ±20% <High Capacitance series> ΔC/C 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 <General purpose series> ΔC/C Class 1: NP0: within ±1% or 1 pF, whichever is greater Class2: X5R/X7R: ±15% Y5V: ±20% <High Capacitance series> ΔC/C 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 <General purpose series> 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 x 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 <High Capacitance series> ΔC/C Class2: X5R/X7R: ±20%; Y5V: ±30% D.F. Class2: 2 x initial value max R_{ins} Class2: 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 x U_r for general product. Applied 1.5 x U_r for high cap. product. High voltage series follows with below stress condition: Applied 1.3 x U_r for 500V series Applied 1.2 x U_r for 1KV, 2KV, 3KV series 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 x specified value Class2: X5R/X7R: ≤ 16V: ≤ 7% ≥ 25V: ≤ 5% Y5V: ≤ 15% R_{ins} Class1: NP0: ≥ 4,000 MΩ or R_{ins} x C_r ≥ 40s whichever is less Class2: X5R/X7R/Y5V: ≥ 1,000 MΩ or R_{ins} x C_r ≥ 50s whichever is less <High Capacitance series> ΔC/C Class 2: X5R/X7R: ±20%; Y5V: ±30% D.F. Class 2: 2 x initial value max R_{ins} Class 2: 1,000 MΩ or R_{ins} x C_r ≥ 50s, whichever is less
Voltage proof	IEC 60384-1 4.6	Specified stress voltage applied for 1 minute U_r ≤ 100 V: series applied 2.5 U_r 100 V < U_r ≤ 200 V series applied (1.5 U_r + 100) 200 V < U_r ≤ 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 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