

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 & Halogen Free



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)

(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 = NPO
 B = class 2 material

(7) CAPACITANCE VALUE

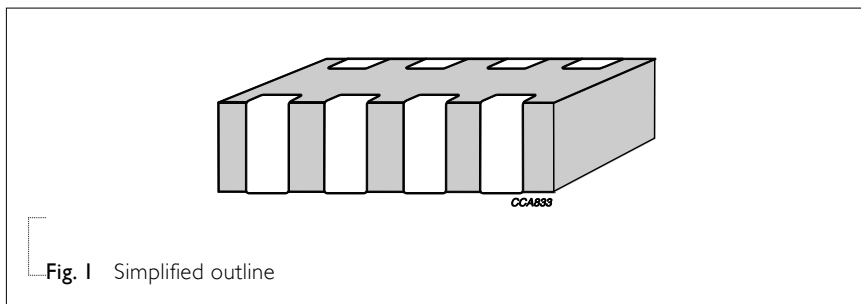
2 significant digits+number of zeros
 The 3rd digit signifies the multiplying factor, and letter R is decimal point
 Example: 121 = 12 × 10¹ = 120 pF

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.

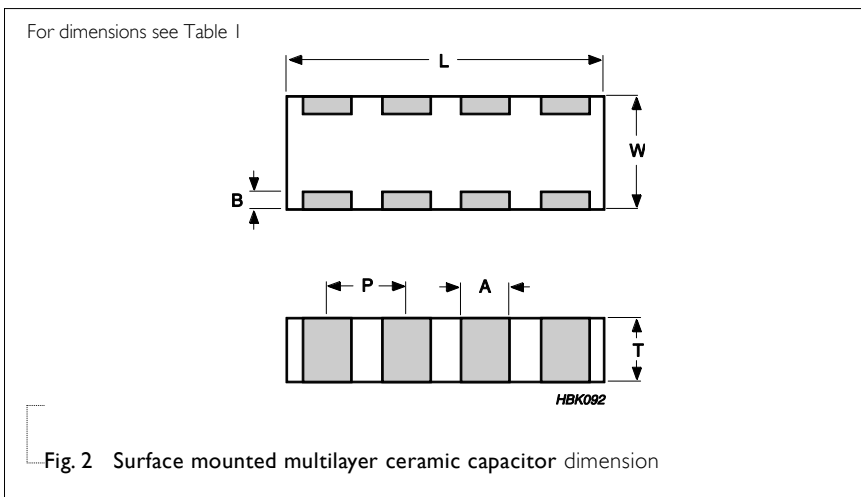


DIMENSIONS

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 _{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



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 |
| 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 | 8 mm | 4,000 | 20,000 |
| 0612 | 0.8 ±0.1 mm | 8 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 |
| | X7R 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 $16\text{ V} \leq 3.5\%$, $25\text{ V} \leq 2.5\%$, $50\text{ V} \leq 2.5\%$ 0508/12nF~100nF/16V, Df $\leq 5\%$ |
| | 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)

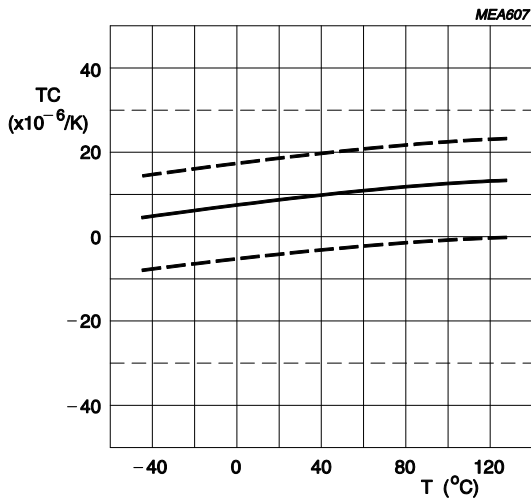


Fig. 3 Typical temperature coefficient as a function of temperature

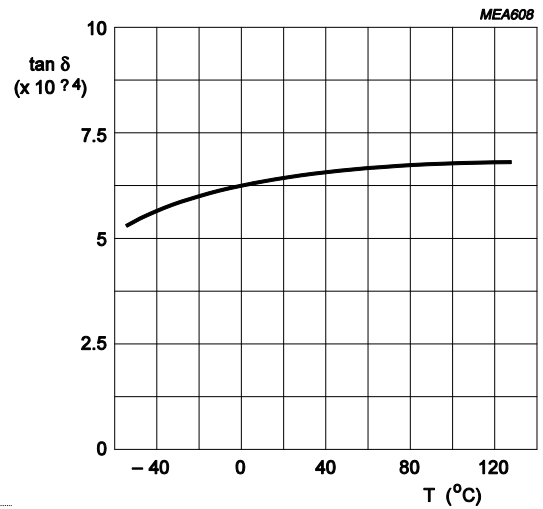


Fig. 4 Typical tan δ as a function of temperature

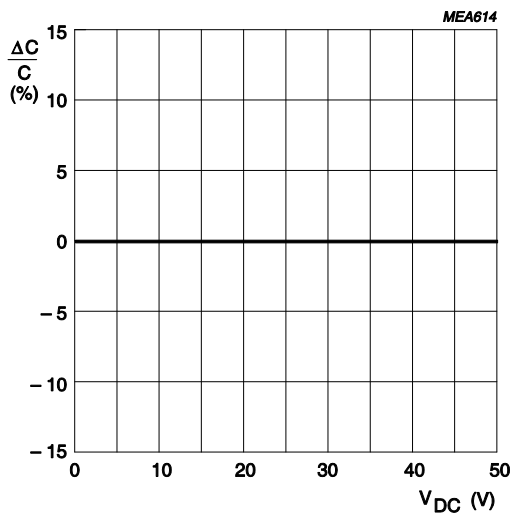
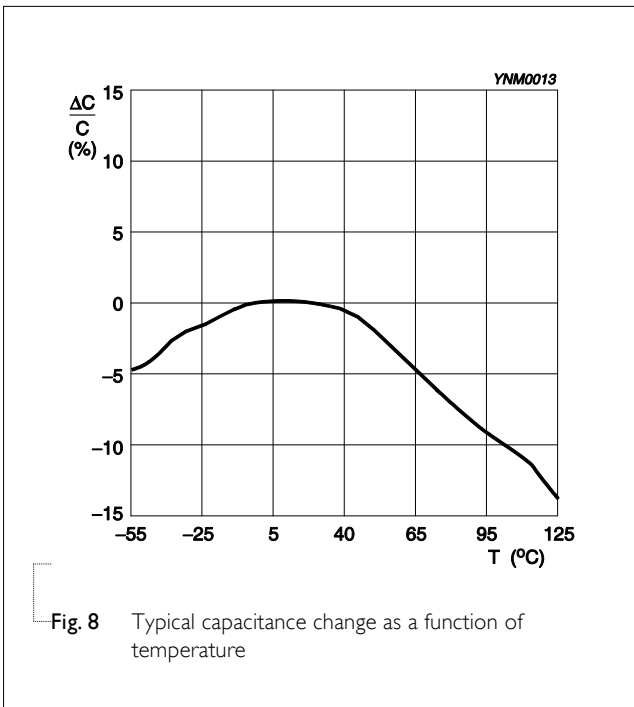
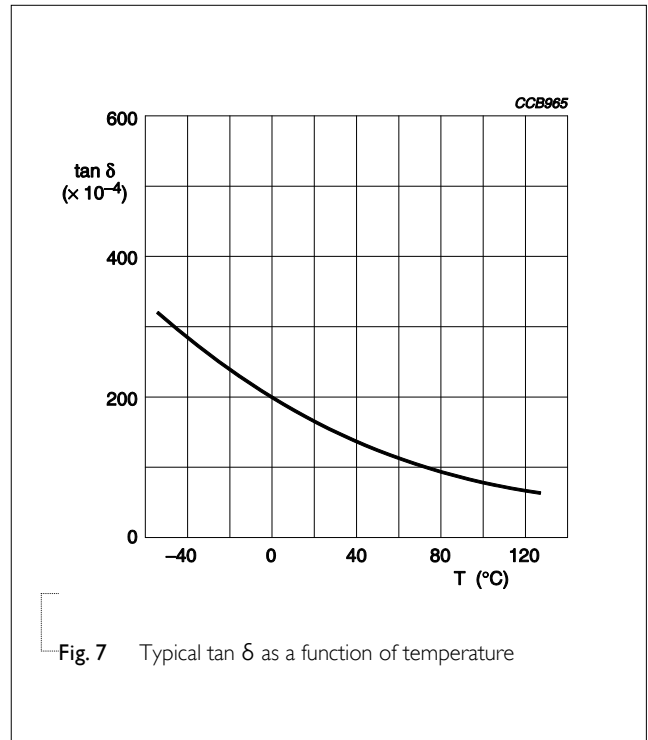
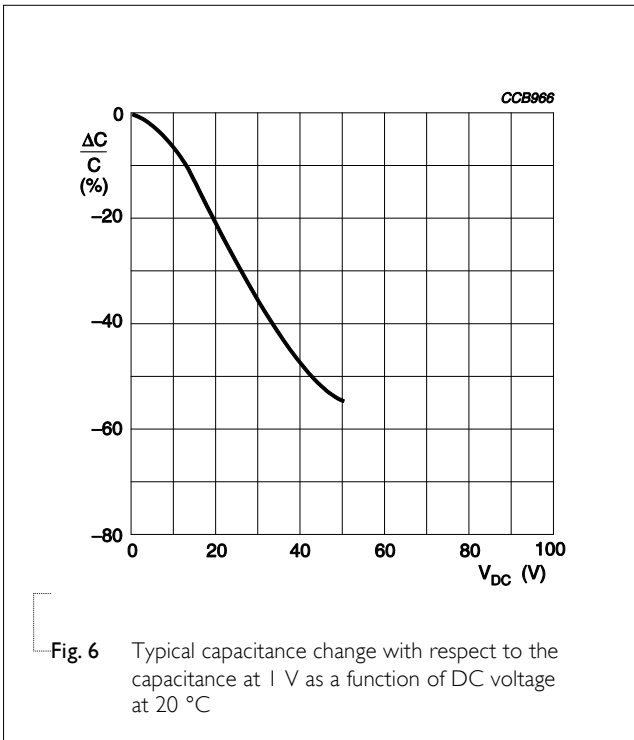
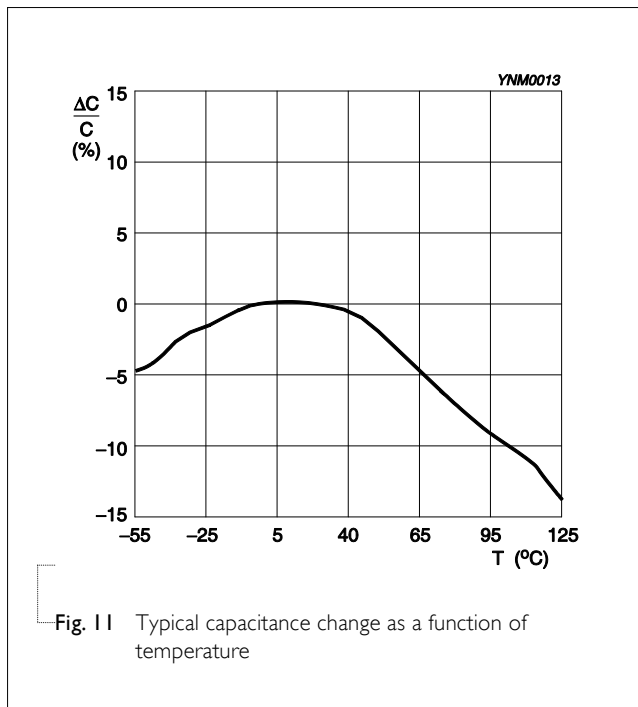
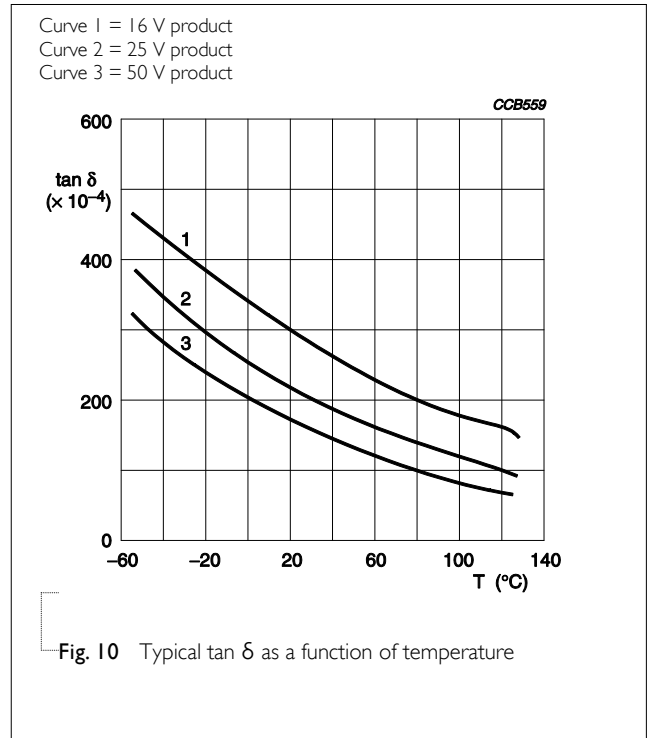
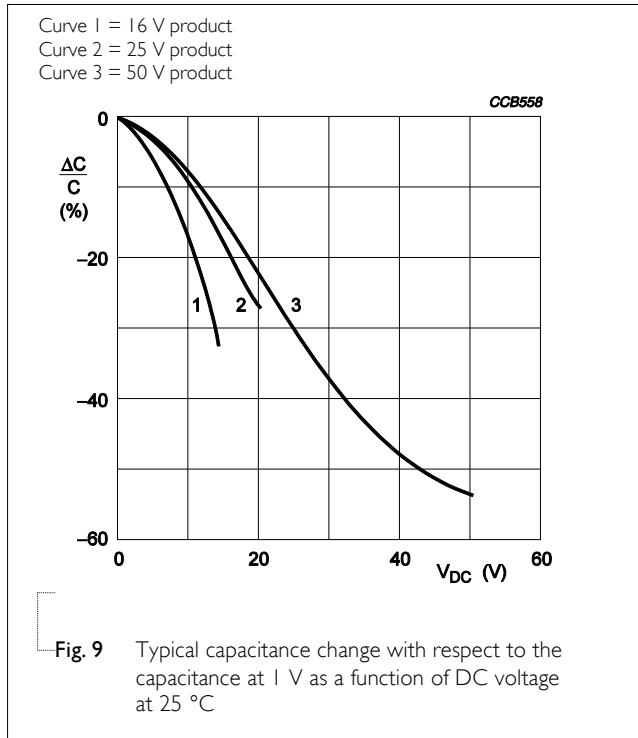


Fig. 5 Typical capacitance change with respect to the capacitance at 1 V as a function of DC voltage

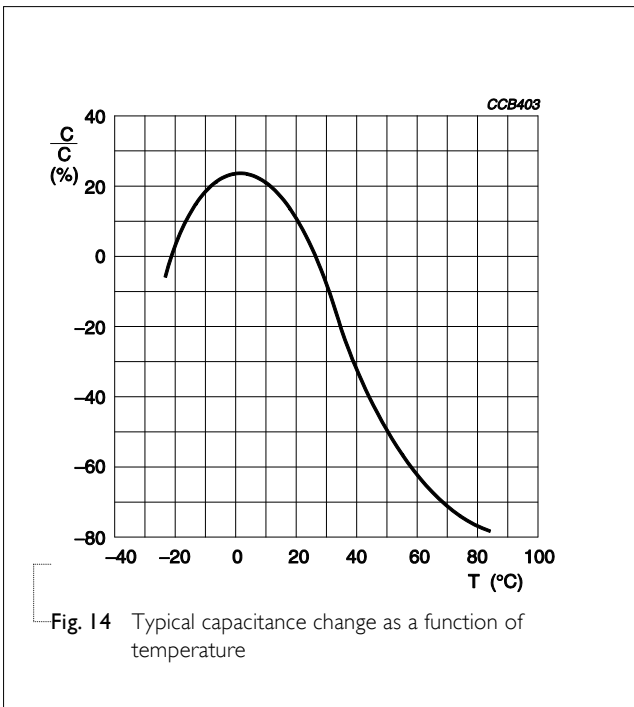
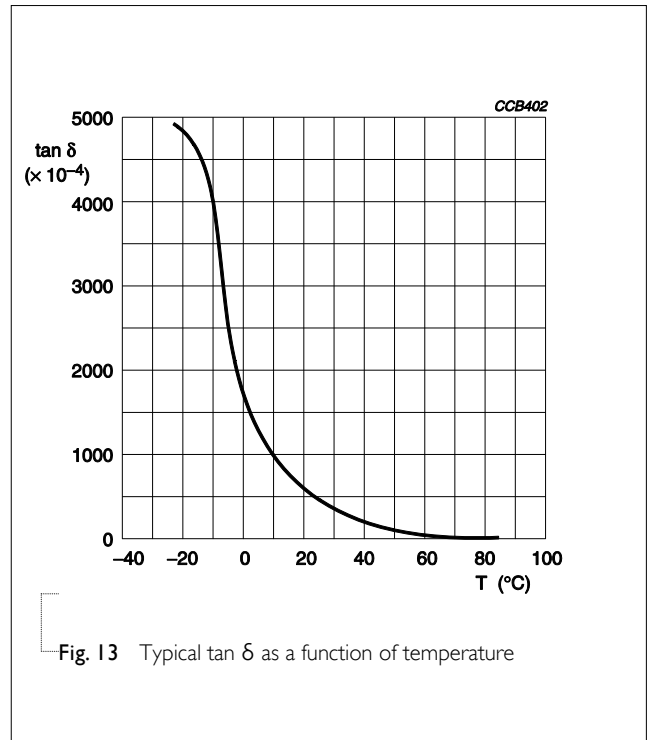
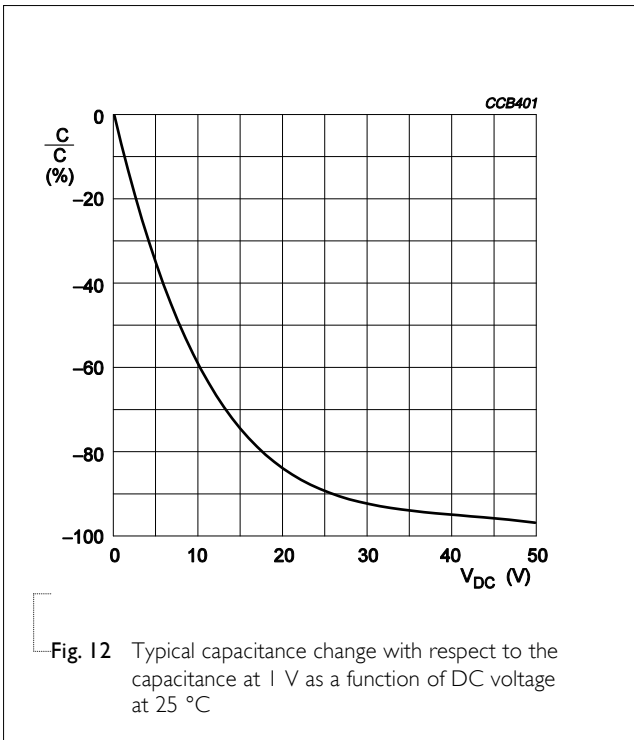
X7R 0508 16 V



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 $\times 10$ magnification | In accordance with specification |
| Capacitance | | 4.5.1 Class 1: $f = 1 \text{ MHz}$ for $C \leq 1 \text{ nF}$, measuring at voltage $1 V_{\text{rms}}$ at $20 \text{ }^\circ\text{C}$ $f = 1 \text{ KHz}$ for $C > 1 \text{ nF}$, measuring at voltage $1 V_{\text{rms}}$ at $20 \text{ }^\circ\text{C}$ Class 2: $f = 1 \text{ KHz}$ for $C \leq 10 \text{ } \mu\text{F}$, measuring at voltage $1 V_{\text{rms}}$ at $20 \text{ }^\circ\text{C}$ $f = 120 \text{ Hz}$ for $C > 10 \text{ } \mu\text{F}$, measuring at voltage $0.5 V_{\text{rms}}$ at $20 \text{ }^\circ\text{C}$ | Within specified tolerance |
| Dissipation Factor (D.F.) | | 4.5.2 Class 1: $f = 1 \text{ MHz}$ for $C \leq 1 \text{ nF}$, measuring at voltage $1 V_{\text{rms}}$ at $20 \text{ }^\circ\text{C}$ $f = 1 \text{ KHz}$ for $C > 1 \text{ nF}$, measuring at voltage $1 V_{\text{rms}}$ at $20 \text{ }^\circ\text{C}$ Class 2: $f = 1 \text{ KHz}$ for $C \leq 10 \text{ } \mu\text{F}$, measuring at voltage $1 V_{\text{rms}}$ at $20 \text{ }^\circ\text{C}$ $f = 120 \text{ Hz}$ for $C > 10 \text{ } \mu\text{F}$, measuring at voltage $0.5 V_{\text{rms}}$ at $20 \text{ }^\circ\text{C}$ | In accordance with specification |
| Insulation Resistance | | 4.5.3 At U_r (DC) for 1 minute | In accordance with specification |

| TEST | TEST METHOD | PROCEDURE | REQUIREMENTS | | | | | | | | | |
|-------------------------|-----------------------|---|---|------|-----------------|---|------|---|-----------------------|---|------|---|
| Temperature Coefficient | 4.6 | 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. | Class I: $\Delta C/C$: ± 30 ppm Class 2: X7R: $\Delta C/C$: $\pm 15\%$ Y5V: $\Delta C/C$: 22~82% | | | | | | | | | |
| | | <table border="1"> <thead> <tr> <th>Step</th> <th>Temperature(°C)</th> </tr> </thead> <tbody> <tr> <td>a</td> <td>25±2</td> </tr> <tr> <td>b</td> <td>Lower temperature±3°C</td> </tr> <tr> <td>c</td> <td>25±2</td> </tr> <tr> <td>d</td> <td>Upper Temperature±2°C</td> </tr> <tr> <td>e</td> <td>25±2</td> </tr> </tbody> </table> <p>(1) Class I Temperature Coefficient shall be calculated from the formula as below</p> $\text{Temp, Coefficient} = \frac{C2 - C1}{C1 \times \Delta T} \times 10^6 \text{ [ppm/°C]}$ <p>C1: Capacitance at step c C2: Capacitance at 125°C ΔT: 100°C(=125°C-25°C)</p> <p>(2) Class II Capacitance Change shall be calculated from the formula as below</p> $\Delta C = \frac{C2 - C1}{C1} \times 100\%$ <p>C1: Capacitance at step c C2: Capacitance at step b or d</p> | | Step | Temperature(°C) | a | 25±2 | b | Lower temperature±3°C | c | 25±2 | d |
| Step | Temperature(°C) | | | | | | | | | | | |
| a | 25±2 | | | | | | | | | | | |
| b | Lower temperature±3°C | | | | | | | | | | | |
| c | 25±2 | | | | | | | | | | | |
| d | Upper Temperature±2°C | | | | | | | | | | | |
| e | 25±2 | | | | | | | | | | | |
| 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 5 mm | No visible damage Δ C/C Class 1: NP0: within $\pm 1\%$ or 0.5 pF, whichever is greater Class2: X5R/X7R/Y5V: $\pm 10\%$ |
| Resistance to Soldering Heat | 4.9 | Precondition: 150 $\pm 0/-10$ °C for 1 hour, then keep for 24 ± 1 hours at room temperature 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 ± 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 Δ C/C Class 1: NP0: within $\pm 0.5\%$ or 0.5 pF, whichever is greater Class2: X5R/X7R: $\pm 10\%$ Y5V: $\pm 20\%$ 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 |
|---------------|----------------------|---|---|
| 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 Class I: NP0: within ±2% or 1 pF, whichever is greater Class2: X5R/X7R: ±15%; Y5V: ±30% D.F. Class I: NP0: ≤ 2 × specified value Class2: X5R/X7R: ≤ 16V: ≤ 7% ≥ 25V: ≤ 5% Y5V: ≤ 15% R _{ins} Class I: NP0: ≥ 4,000 MΩ or R _{ins} × C _r ≥ 40s whichever is less Class2: X5R/X7R/Y5V: ≥ 1,000 MΩ or R _{ins} × 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 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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-  Alternative Solution
-  Excess Inventory Management