

# DATA SHEET

## SURFACE-MOUNT CERAMIC MULTILAYER CAPACITORS

High-Voltage

NP0/X7R

1 KV TO 3 KV

10 pF to 33 nF

RoHS compliant & Halogen Free



**SCOPE**

This specification describes High-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  
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.

**YAGEO BRAND ordering code****GLOBAL PART NUMBER (PREFERRED)**

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

**(1) SIZE – INCH BASED (METRIC)**

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

**(2) TOLERANCE**

C =  $\pm 0.25$  pF  
D =  $\pm 0.5$  pF  
G =  $\pm 2\%$   
J =  $\pm 5\%$   
K =  $\pm 10\%$   
M =  $\pm 20\%$

**(3) PACKING STYLE**

R = Paper/PE taping reel; Reel 7 inch  
K = Blister taping reel; Reel 7 inch  
P = Paper/PE taping reel; Reel 13 inch  
F = Blister taping reel; Reel 13 inch  
C = Bulk case

**(4) TC MATERIAL**

NPO  
X7R

**(5) RATED VOLTAGE**

C = 1 KV  
D = 2 KV  
S = 2.5KV  
E = 3 KV

**(6) PROCESS**

N = NP0  
B = Class 2 MLCC

**(7) CAPACITANCE VALUE**

2 significant digits+number of zeros  
The 3rd digit signifies the multiplying factor, and letter R is decimal point  
Example: 121 =  $12 \times 10^1 = 120$  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. A cross section of the structure is shown in Fig.1.

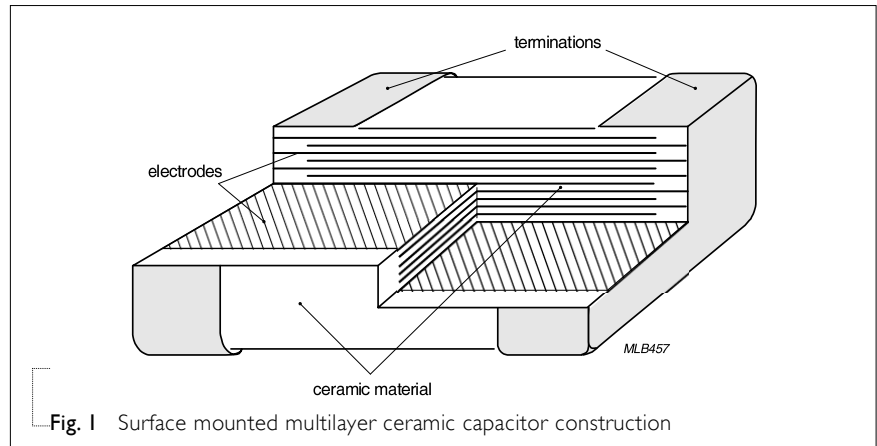


Fig. 1 Surface mounted multilayer ceramic capacitor construction

## DIMENSION

Table I For outlines see fig. 2

| TYPE | L <sub>1</sub> (mm) | W (mm)     | T (MM)                   | L <sub>2</sub> / L <sub>3</sub> (mm) |      | L <sub>4</sub> (mm) |
|------|---------------------|------------|--------------------------|--------------------------------------|------|---------------------|
|      |                     |            |                          | min.                                 | max. | min.                |
| 0805 | 2.0 ±0.20           | 1.25 ±0.20 | Refer to<br>table 2 to 4 | 0.25                                 | 0.75 | 0.70                |
| 1206 | 3.2 ±0.30           | 1.6 ±0.20  |                          | 0.25                                 | 0.75 | 1.40                |
| 1210 | 3.2 ±0.30           | 2.5 ±0.20  |                          | 0.25                                 | 0.75 | 1.40                |
| 1808 | 4.5 ±0.40           | 2.0 ±0.30  |                          | 0.25                                 | 0.75 | 2.20                |
| 1812 | 4.5 ±0.40           | 3.2 ±0.20  |                          | 0.25                                 | 0.75 | 2.20                |

## OUTLINES

For dimension see Table I

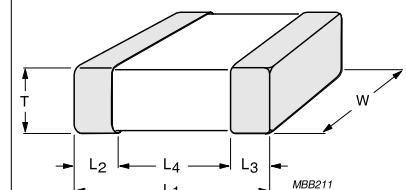


Fig. 2 Surface mounted multilayer ceramic capacitor dimension

**CAPACITANCE RANGE & THICKNESS FOR NP0****Table 2** Sizes from 0805 to 1812

| CAP.   | 0805     |          | 1206     |          | 1210     |          | 1808     |          | 1812    |          |          |          |
|--------|----------|----------|----------|----------|----------|----------|----------|----------|---------|----------|----------|----------|
|        | 1 KV     | 1 KV     | 2 KV     | 3 KV     | 1 KV     | 2 KV     | 1 KV     | 2 KV     | 3 KV    | 1 KV     | 2 KV     | 3 KV     |
| 10 pF  | 0.85±0.1 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |          |          |          |          | 1.6±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |
| 12 pF  | 0.85±0.1 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |          |          |          |          | 1.6±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |
| 15 pF  | 0.85±0.1 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |          |          |          |          | 1.6±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |
| 18 pF  | 0.85±0.1 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |          |          |          |          | 1.6±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |
| 22 pF  | 0.85±0.1 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |          |          |          |          | 1.6±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |
| 27 pF  | 0.85±0.1 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |          |          |          |          | 1.6±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |
| 33 pF  | 0.85±0.1 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.6±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |
| 39 pF  | 0.85±0.1 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.6±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |
| 47 pF  | 0.85±0.1 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.6±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |
| 56 pF  |          | 1.25±0.2 | 1.25±0.2 |          | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.6±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |
| 68 pF  |          | 1.25±0.2 | 1.25±0.2 |          | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.6±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |
| 82 pF  |          | 1.25±0.2 | 1.25±0.2 |          | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.6±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |
| 100 pF |          | 1.25±0.2 | 1.25±0.2 |          | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.6±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |
| 120 pF |          | 1.25±0.2 | 1.25±0.2 |          | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |         | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |
| 150 pF |          | 1.25±0.2 | 1.25±0.2 |          | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |         | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |
| 180 pF |          | 1.25±0.2 | 1.25±0.2 |          | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |         | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |
| 220 pF |          | 1.25±0.2 | 1.25±0.2 |          | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |         | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |
| 270 pF |          | 1.25±0.2 |          |          | 1.25±0.2 |          | 1.25±0.2 | 1.25±0.2 |         | 1.25±0.2 | 1.25±0.2 |          |
| 330 pF |          | 1.25±0.2 |          |          | 1.25±0.2 |          | 1.25±0.2 | 1.25±0.2 |         | 1.25±0.2 | 1.25±0.2 |          |
| 390 pF |          | 1.25±0.2 |          |          | 1.25±0.2 |          | 1.25±0.2 | 1.25±0.2 |         | 1.25±0.2 | 1.25±0.2 |          |
| 470 pF |          | 1.25±0.2 |          |          | 1.25±0.2 |          | 1.25±0.2 | 1.25±0.2 |         | 1.25±0.2 | 1.25±0.2 |          |
| 560 pF |          | 1.25±0.2 |          |          | 1.25±0.2 |          | 1.25±0.2 | 1.25±0.2 |         | 1.25±0.2 | 1.25±0.2 |          |
| 680 pF |          | 1.25±0.2 |          |          | 1.25±0.2 |          | 1.25±0.2 |          |         | 1.25±0.2 | 1.25±0.2 |          |
| 820 pF |          | 1.25±0.2 |          |          | 1.25±0.2 |          |          |          |         | 1.25±0.2 | 1.25±0.2 |          |
| 1.0 nF |          | 1.25±0.2 |          |          | 1.25±0.2 |          |          |          |         | 1.25±0.2 | 1.25±0.2 |          |
| 1.2 nF |          |          |          |          |          |          |          |          |         | 1.25±0.2 |          |          |
| 1.5 nF |          |          |          |          |          |          |          |          |         | 1.25±0.2 |          |          |
| 1.8 nF |          |          |          |          |          |          |          |          |         |          |          |          |
| 2.2 nF |          |          |          |          |          |          |          |          |         |          |          |          |
| 2.7 nF |          |          |          |          |          |          |          |          |         |          |          |          |
| 3.3 nF |          |          |          |          |          |          |          |          |         |          |          |          |

**NOTE**

1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-12 series is on request

**CAPACITANCE RANGE & THICKNESS FOR X7R****Table 3** Sizes from 0805 to 1812

| CAP.   | 0805     |          | 1206     |         | 1210     |          | 1808      |           | 1812    |           |           |         |
|--------|----------|----------|----------|---------|----------|----------|-----------|-----------|---------|-----------|-----------|---------|
|        | 1 KV     | 1 KV     | 2 KV     | 2.5KV   | 1 KV     | 2 KV     | 1 KV      | 2 KV      | 3 KV    | 1 KV      | 2 KV      | 3 KV    |
| 100 pF |          |          |          |         |          |          |           |           |         |           |           |         |
| 150 pF | 0.85±0.1 |          |          |         |          |          |           |           | 1.6±0.2 |           |           |         |
| 220 pF | 0.85±0.1 | 1.25±0.2 | 1.25±0.2 |         | 1.25±0.2 | 1.25±0.2 |           |           | 1.6±0.2 |           |           |         |
| 330 pF | 0.85±0.1 | 1.25±0.2 | 1.25±0.2 |         | 1.25±0.2 | 1.25±0.2 |           | 1.35±0.15 | 1.6±0.2 |           |           |         |
| 470 pF | 0.85±0.1 | 1.25±0.2 | 1.25±0.2 |         | 1.25±0.2 | 1.25±0.2 | 1.35±0.15 | 1.35±0.15 | 1.6±0.2 |           |           |         |
| 680 pF | 0.85±0.1 | 1.25±0.2 | 1.25±0.2 |         | 1.25±0.2 | 1.25±0.2 | 1.35±0.15 | 1.35±0.15 | 1.6±0.2 |           |           |         |
| 1.0 nF | 0.85±0.1 | 1.25±0.2 | 1.25±0.2 | 1.6±0.2 | 1.25±0.2 | 1.25±0.2 | 1.35±0.15 | 1.35±0.15 | 2.0±0.2 | 1.35±0.15 | 1.35±0.15 | 1.6±0.2 |
| 1.5 nF |          | 1.25±0.2 | 1.25±0.2 |         | 1.25±0.2 | 1.25±0.2 | 1.35±0.15 | 1.35±0.15 | 2.0±0.2 | 1.35±0.15 | 1.35±0.15 |         |
| 2.2 nF |          | 1.25±0.2 |          |         | 1.25±0.2 | 1.60±0.2 | 1.35±0.15 | 1.6±0.2   |         | 1.35±0.15 | 1.35±0.15 |         |
| 3.3 nF |          | 1.25±0.2 |          |         | 1.25±0.2 |          | 1.35±0.15 |           |         | 1.35±0.15 | 1.35±0.15 |         |
| 4.7 nF |          | 1.25±0.2 |          |         | 1.25±0.2 |          | 1.35±0.15 |           |         | 1.35±0.15 | 1.35±0.15 |         |
| 6.8 nF |          | 1.25±0.2 |          |         | 1.25±0.2 |          | 1.6±0.2   |           |         | 1.35±0.15 |           |         |
| 10 nF  |          | 1.25±0.2 |          |         | 1.25±0.2 |          | 1.6±0.2   |           |         | 1.35±0.15 |           |         |
| 15 nF  |          |          |          |         | 1.25±0.2 |          |           |           |         | 1.35±0.15 |           |         |
| 22 nF  |          |          |          |         |          | 1.6±0.2  |           |           |         | 1.35±0.15 |           |         |
| 33 nF  |          |          |          |         |          |          |           |           |         | 1.6±0.2   |           |         |
| 47 nF  |          |          |          |         |          |          |           |           |         |           |           |         |
| 68 nF  |          |          |          |         |          |          |           |           |         |           |           |         |
| 100 nF |          |          |          |         |          |          |           |           |         |           |           |         |

**NOTE**

1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-6 series is on request
3. For products with 5% tolerance, please contact local sales force before ordering

**THICKNESS CLASSES AND PACKING QUANTITY**

Table 5

| SIZE CODE | THICKNESS CLASSIFICATION | TAPE WIDTH<br>QUANTITY PER REEL | Ø180 MM / 7 INCH |                | Ø330 MM / 13 INCH |         | QUANTITY<br>PER BULK CASE |
|-----------|--------------------------|---------------------------------|------------------|----------------|-------------------|---------|---------------------------|
|           |                          |                                 | Paper            | Blister        | Paper             | Blister |                           |
| 0201      | 0.3 ±0.03 mm             | 8 mm                            | 15,000           | ---            | 50,000            | ---     | ---                       |
| 0402      | 0.5 ±0.05 mm             | 8 mm                            | 10,000           | ---            | 50,000            | ---     | 50,000                    |
| 0603      | 0.8 ±0.1 mm              | 8 mm                            | 4,000            | ---            | 15,000            | ---     | 15,000                    |
| 0805      | 0.6 ±0.1 mm              | 8 mm                            | 4,000            | ---            | 20,000            | ---     | 10,000                    |
|           | 0.8 / 0.85 ±0.1 mm       | 8 mm                            | 4,000            | ---            | 15,000            | ---     | 8,000                     |
|           | 1.00 ±0.1 mm             | 8 mm                            | ---              | 3,000          | ---               | 10,000  | ---                       |
|           | 1.25 ±0.2 mm             | 8 mm                            | ---              | 3,000          | ---               | 10,000  | 5,000                     |
| 1206      | 0.6 ±0.1 mm              | 8 mm                            | 4,000            | ---            | 20,000            | ---     | ---                       |
|           | 0.8 / 0.85 ±0.1 mm       | 8 mm                            | 4,000            | ---            | 15,000            | ---     | ---                       |
|           | 1.00 / 1.15 ±0.1 mm      | 8 mm                            | ---              | 3,000          | ---               | 10,000  | ---                       |
|           | 1.25 ±0.2 mm             | 8 mm                            | ---              | 3,000          | ---               | 10,000  | ---                       |
|           | 1.6 ±0.15 mm             | 8 mm                            | ---              | 2,500          | ---               | 10,000  | ---                       |
|           | 1.6 ±0.2 mm              | 8 mm                            | ---              | 2,000          | ---               | 8,000   | ---                       |
| 1210      | 0.6 / 0.7 ±0.1 mm        | 8 mm                            | ---              | 4,000          | ---               | 15,000  | ---                       |
|           | 0.85 ±0.1 mm             | 8 mm                            | ---              | 4,000          | ---               | 10,000  | ---                       |
|           | 1.15 ±0.1 mm             | 8 mm                            | ---              | 3,000          | ---               | 10,000  | ---                       |
|           | 1.15 ±0.15 mm            | 8 mm                            | ---              | 3,000          | ---               | 10,000  | ---                       |
|           | 1.25 ±0.2 mm             | 8 mm                            | ---              | 3,000          | ---               | ---     | ---                       |
|           | 1.5 ±0.1 mm              | 8 mm                            | ---              | 2,000          | ---               | ---     | ---                       |
|           | 1.6 / 1.9 ±0.2 mm        | 8 mm                            | ---              | 2,000          | ---               | ---     | ---                       |
|           | 2.0 ±0.2 mm              | 8 mm                            | ---              | 2,000<br>1,000 | ---               | ---     | ---                       |
|           | 2.5 ±0.2 mm              | 8 mm                            | ---              | 1,000<br>500   | ---               | ---     | ---                       |
| 1808      | 1.15 ±0.15 mm            | 12 mm                           | ---              | 3,000          | ---               | ---     | ---                       |
|           | 1.25 ±0.2 mm             | 12 mm                           | ---              | 3,000          | ---               | ---     | ---                       |
|           | 1.35 ±0.15 mm            | 12 mm                           | ---              | 2,000          | ---               | ---     | ---                       |
|           | 1.5 ±0.1 mm              | 12 mm                           | ---              | 2,000          | ---               | ---     | ---                       |
|           | 1.6 ±0.2 mm              | 12 mm                           | ---              | 2,000          | ---               | ---     | ---                       |
|           | 2.0 ±0.2 mm              | 12 mm                           | ---              | 2,000          | ---               | ---     | ---                       |
| 1812      | 0.6 / 0.85 ±0.1 mm       | 12 mm                           | ---              | 2,000          | ---               | ---     | ---                       |
|           | 1.15 ±0.1 mm             | 12 mm                           | ---              | 1,000          | ---               | ---     | ---                       |
|           | 1.15 ±0.15 mm            | 12 mm                           | ---              | 1,000          | ---               | ---     | ---                       |
|           | 1.25 ±0.2 mm             | 12 mm                           | ---              | 1,000          | ---               | ---     | ---                       |
|           | 1.35 ±0.15 mm            | 12 mm                           | ---              | 1,000          | ---               | ---     | ---                       |
|           | 1.5 ±0.1 mm              | 12 mm                           | ---              | 1,000          | ---               | ---     | ---                       |
|           | 1.6 ±0.2 mm              | 12 mm                           | ---              | 1,000          | ---               | ---     | ---                       |
|           | 2.0 ±0.2 mm              | 12 mm                           | ---              | 1,000          | ---               | ---     | ---                       |
|           | 2.5 ±0.2 mm              | 12 mm                           | ---              | 500            | ---               | ---     | ---                       |

ELECTRICAL CHARACTERISTICS**NP0/X7R 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

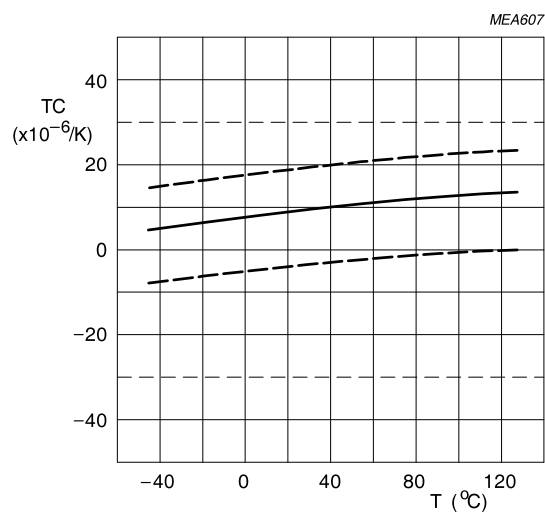
| DESCRIPTION                                                                                       |                | VALUE                                                                                      |
|---------------------------------------------------------------------------------------------------|----------------|--------------------------------------------------------------------------------------------|
| Capacitance range                                                                                 |                | 10 pF to 33 nF                                                                             |
| Capacitance tolerance                                                                             |                |                                                                                            |
| NP0                                                                                               | $C < 10$ pF    | $\pm 0.25$ pF, $\pm 0.5$ pF                                                                |
|                                                                                                   | $C \geq 10$ pF | $\pm 2\%$ , $\pm 5\%$                                                                      |
| X7R                                                                                               |                | $\pm 5\%$ <sup>(1)</sup> , $\pm 10\%$                                                      |
| Dissipation factor (D.F.)                                                                         |                |                                                                                            |
| NP0                                                                                               | $C < 30$ pF    | $\leq 1 / (400 + 20C)$                                                                     |
|                                                                                                   | $C \geq 30$ pF | $\leq 0.1 \%$                                                                              |
| X7R                                                                                               |                | $\leq 2.5 \%$                                                                              |
| Insulation resistance after 1 minute at $U_r$ (DC)                                                |                | $R_{ins} \geq 10 \text{ G}\Omega$ or $R_{ins} \times C \geq 500$ seconds whichever is less |
| Maximum capacitance change as a function of temperature (temperature characteristic/coefficient): |                |                                                                                            |
| NP0                                                                                               |                | $\pm 30$ ppm/°C                                                                            |
| X7R                                                                                               |                | $\pm 15\%$                                                                                 |
| Operating temperature range:                                                                      |                |                                                                                            |
| NP0/X7R                                                                                           |                | $-55$ °C to $+125$ °C                                                                      |

**NOTE**

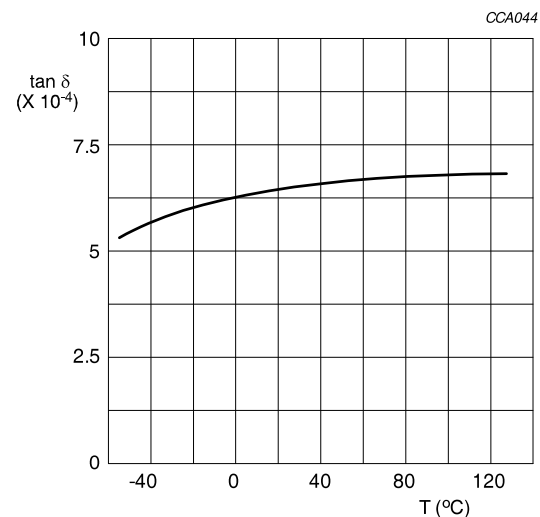
1.  $\pm 5\%$  tolerance of capacitance value isn't available for X7R full product range, please contact local sales force before ordering

## HIGH-VOLTAGE NP0

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

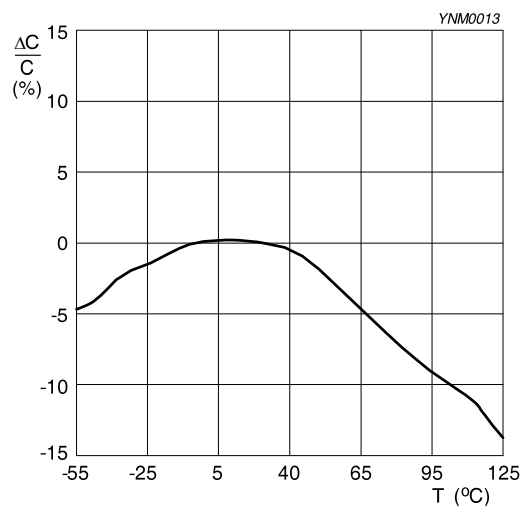


**Fig. 3** Typical temperature coefficient as a function of temperature

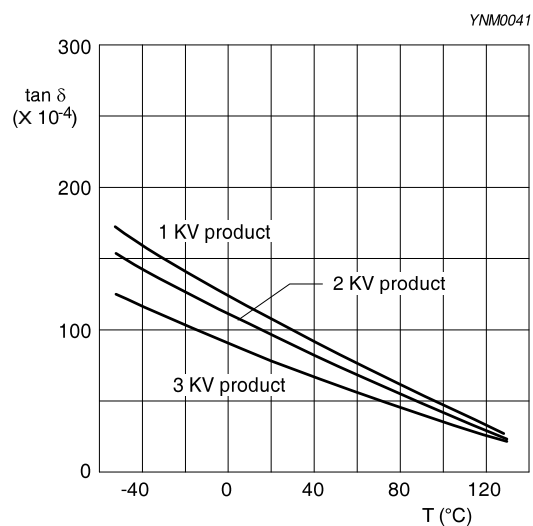


**Fig. 4** Typical  $\tan \delta$  as a function of temperature

## HIGH-VOLTAGE X7R



**Fig. 5** Typical capacitance change as a function of temperature



**Fig. 6** Typical  $\tan \delta$  as a function of temperature



**SOLDERING RECOMMENDATION**

Table 7

| SOLDERING METHOD | SIZE<br>0402 | 0603     | 0805     | 1206     | ≥ 1210      |
|------------------|--------------|----------|----------|----------|-------------|
| Reflow           | Reflow only  | ≥ 1.0 μF | ≥ 2.2 μF | ≥ 4.7 μF | Reflow only |
| Reflow/Wave      | ---          | < 1.0 μF | < 2.2 μF | < 4.7 μF | ---         |

**TESTS AND REQUIREMENTS**

Table 8 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:<br>f = 1 MHz for C ≤ 1 nF, measuring at voltage 1 V <sub>rms</sub> at 20 °C<br>f = 1 KHz for C > 1 nF, measuring at voltage 1 V <sub>rms</sub> at 20 °C<br>Class 2:<br>f = 1 KHz for C ≤ 10 μF, measuring at voltage 1 V <sub>rms</sub> at 20 °C | Within specified tolerance       |
| Dissipation Factor (D.F.)             | 4.5.2               | Class 1:<br>f = 1 MHz for C ≤ 1 nF, measuring at voltage 1 V <sub>rms</sub> at 20 °C<br>f = 1 KHz for C > 1 nF, measuring at voltage 1 V <sub>rms</sub> at 20 °C<br>Class 2:<br>f = 1 KHz for C ≤ 10 μF, measuring at voltage 1 V <sub>rms</sub> at 20 °C | In accordance with specification |
| Insulation Resistance                 | 4.5.3               | U <sub>r</sub> ≤ 500 V: At U <sub>r</sub> for 1 minute<br>U <sub>r</sub> > 500 V: At 500 V for 1 minute                                                                                                                                                   | In accordance with specification |

| TEST                    | TEST METHOD           | PROCEDURE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | REQUIREMENTS                                                                                                                                                                                                                                          |                 |   |      |   |                       |   |      |   |                       |   |      |                                                                                                                                                                                                                                                           |
|-------------------------|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|---|------|---|-----------------------|---|------|---|-----------------------|---|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Temperature Coefficient | 4.6                   | <p>Capacitance shall be measured by the steps shown in the following table.</p> <p>The capacitance change should be measured after 5 min at each specified temperature stage.</p> <table><tr><th>Step</th><th>Temperature(°C)</th></tr><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></table> <p>(1) Class I</p> <p>Temperature Coefficient shall be calculated from the formula as below</p> <p>Temp, Coefficient = <math>\frac{C2 - C1}{C1 \times \Delta T} \times 10^6</math> [ppm/°C]</p> <p>C1: Capacitance at step c</p> <p>C2: Capacitance at 125°C</p> <p>ΔT: 100°C(=125°C-25°C)</p> <p>(2) Class II</p> <p>Capacitance Change shall be calculated from the formula as below</p> <p>ΔC = <math>\frac{C2 - C1}{C1} \times 100\%</math></p> <p>C1: Capacitance at step c</p> <p>C2: Capacitance at step b or d</p> | Step                                                                                                                                                                                                                                                  | Temperature(°C) | a | 25±2 | b | Lower temperature±3°C | c | 25±2 | d | Upper Temperature±2°C | e | 25±2 | <p>&lt;General purpose series&gt;</p> <p>Class I:</p> <p>Δ C/C: ±30ppm</p> <p>Class2:</p> <p>X7R: Δ C/C: ±15%</p> <p>Y5V: Δ C/C: 22~-82%</p> <p>&lt;High Capacitance series&gt;</p> <p>Class2:</p> <p>X7R/X5R: Δ C/C: ±15%</p> <p>Y5V: Δ C/C: 22~-82%</p> |
| Step                    | Temperature(°C)       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                       |                 |   |      |   |                       |   |      |   |                       |   |      |                                                                                                                                                                                                                                                           |
| a                       | 25±2                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                       |                 |   |      |   |                       |   |      |   |                       |   |      |                                                                                                                                                                                                                                                           |
| b                       | Lower temperature±3°C |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                       |                 |   |      |   |                       |   |      |   |                       |   |      |                                                                                                                                                                                                                                                           |
| c                       | 25±2                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                       |                 |   |      |   |                       |   |      |   |                       |   |      |                                                                                                                                                                                                                                                           |
| d                       | Upper Temperature±2°C |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                       |                 |   |      |   |                       |   |      |   |                       |   |      |                                                                                                                                                                                                                                                           |
| e                       | 25±2                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                       |                 |   |      |   |                       |   |      |   |                       |   |      |                                                                                                                                                                                                                                                           |
| Adhesion                | IEC 60384-21/22       | 4.7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <p>A force applied for 10 seconds to the line joining the terminations and in a plane parallel to the substrate</p> <p>Force size ≥ 0603: 5N</p>                                                                                                      |                 |   |      |   |                       |   |      |   |                       |   |      |                                                                                                                                                                                                                                                           |
| Bending Strength        |                       | 4.8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <p>Mounting in accordance with IEC 60384-22 paragraph 4.3</p> <p>Conditions: bending 1 mm at a rate of 1 mm/s, radius jig 5 mm</p> <p>ΔC/C</p> <p>Class I:</p> <p>NP0: within ±1% or 0.5 pF, whichever is greater</p> <p>Class2:</p> <p>X7R: ±10%</p> |                 |   |      |   |                       |   |      |   |                       |   |      |                                                                                                                                                                                                                                                           |

| TEST                         | TEST METHOD             | PROCEDURE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | REQUIREMENTS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------------------------------|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Resistance to Soldering Heat | 4.9                     | <p>Precondition: 150 +0/-10 °C for 1 hour, then keep for 24 ± 1 hours at room temperature</p> <p>Preheating: for size ≤ 1206: 120 °C to 150 °C for 1 minute</p> <p>Preheating: for size &gt; 1206: 100 °C to 120 °C for 1 minute and 170 °C to 200 °C for 1 minute</p> <p>Solder bath temperature: 260 ± 5 °C</p> <p>Dipping time: 10 ± 0.5 seconds</p> <p>Recovery time: 24 ± 2 hours</p>                                                                                                                                                                                                                         | <p>Dissolution of the end face plating shall not exceed 25% of the length of the edge concerned</p> <hr/> <p><math>\Delta C/C</math></p> <p>Class 1:</p> <p>NP0: within ±0.5% or 0.5 pF, whichever is greater</p> <p>Class2:</p> <p>X7R: ±10%</p> <hr/> <p>D.F. within initial specified value</p> <p>R<sub>ins</sub> within initial specified value</p>                                                                                                                                                       |
| Solderability                | 4.10                    | <p>Preheated to a temperature of 80 °C to 140 °C and maintained for 30 seconds to 60 seconds.</p> <p>1. Temperature: 235±5°C / Dipping time: 2 ±0.5 s</p> <p>2. Temperature: 245±5°C / Dipping time: 3 ±0.5 s (lead free)Depth of immersion: 10mm</p>                                                                                                                                                                                                                                                                                                                                                              | <p>The solder should cover over 95% of the critical area of each termination</p>                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Rapid Change of Temperature  | IEC 60384-21/22<br>4.11 | <p>Preconditioning:<br/>150 +0/-10 °C for 1 hour, then keep for 24 ± 1 hours at room temperature</p> <p>5 cycles with following detail:<br/>30 minutes at lower category temperature<br/>30 minutes at upper category temperature</p> <p>Recovery time 24 ± 2 hours</p>                                                                                                                                                                                                                                                                                                                                            | <p>No visual damage</p> <hr/> <p><math>\Delta C/C</math></p> <p>Class 1:</p> <p>NP0: within ±1% or 1 pF, whichever is greater</p> <p>Class2:</p> <p>X7R: ±15%</p> <hr/> <p>D.F. meet initial specified value</p> <p>R<sub>ins</sub> meet initial specified value</p>                                                                                                                                                                                                                                           |
| Damp Heat                    | 4.13                    | <p>1. Preconditioning, class 2 only:<br/>150 +0/-10 °C / 1 hour, then keep for 24 ± 1 hour at room temp</p> <p>2. Initial measure:<br/>Spec: refer to initial spec C, D, IR</p> <p>3. Damp heat test:<br/>500 ± 12 hours at 40 ± 2 °C;<br/>90 to 95% R.H.</p> <p>4. Recovery:<br/>Class 1: 6 to 24 hours<br/>Class 2: 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 preconditioned according to "IEC 60384 4.1" and then the requirement shall be met.</p> | <p>No visual damage after recovery</p> <hr/> <p><math>\Delta C/C</math></p> <p>Class 1:</p> <p>NP0: within ±2% or 1 pF, whichever is greater</p> <p>Class2:</p> <p>X7R: ±15%</p> <p>D.F.</p> <p>Class 1:</p> <p>NP0: ≤ 2 × specified value</p> <p>Class2:</p> <p>X7R: ≥ 25 V: ≤ 5%</p> <p>R<sub>ins</sub></p> <p>Class 1:</p> <p>NP0: ≥ 2,500 MΩ or R<sub>ins</sub> × C<sub>r</sub> ≥ 25s whichever is less</p> <p>Class2:</p> <p>X7R: ≥ 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      | 1. Preconditioning, class 2 only:<br>150 +0/-10 °C /1 hour, then keep for<br>24 ±1 hour at room temp                                                                                                                                                                                                                                                                                            | No visual damage                                                                                                                                                                                                                                                                                                                                                                                                            |     |     |        |          |          |          |          |          |          |          |          |       |          |          |  |
|               |                 |           | 2. Initial measure:<br>Spec: refer to initial spec C, D, IR<br><br>Endurance test:<br>Temperature: NP0/X7R: 125 °C<br>Specified stress voltage applied for 1,000 hours.<br>High-Voltage series follows the stress conditions below:                                                                                                                                                             | $\Delta C/C$<br><b>Class I:</b><br>NP0: within ±2% or 1 pF, whichever is greater<br><b>Class2:</b><br>X7R: ±15%<br><br>D.F.<br><b>Class I:</b><br>NP0: ≤ 2 × specified value<br><b>Class2:</b><br>X7R: ≥ 25 V: ≤ 5%<br><br>$R_{ins}$<br><b>Class I:</b><br>NP0: ≥ 4,000 MΩ or<br>$R_{ins} \times C_r \geq 40s$ whichever is less<br><b>Class2:</b><br>X7R: ≥ 1,000 MΩ or<br>$R_{ins} \times C_r \geq 50s$ whichever is less |     |     |        |          |          |          |          |          |          |          |          |       |          |          |  |
|               |                 |           | <table><tr><th>Voltage</th><th>NP0</th><th>X7R</th></tr><tr><td>≤ 100V</td><td>2.0 × Ur</td><td>2.0 × Ur</td></tr><tr><td>200/250V</td><td>1.5 × Ur</td><td>1.5 × Ur</td></tr><tr><td>500/630V</td><td>1.3 × Ur</td><td>1.2 × Ur</td></tr><tr><td>≥ 1KV</td><td>1.2 × Ur</td><td>1.1 × Ur</td></tr></table>                                                                                     | Voltage                                                                                                                                                                                                                                                                                                                                                                                                                     | NP0 | X7R | ≤ 100V | 2.0 × Ur | 2.0 × Ur | 200/250V | 1.5 × Ur | 1.5 × Ur | 500/630V | 1.3 × Ur | 1.2 × Ur | ≥ 1KV | 1.2 × Ur | 1.1 × Ur |  |
| Voltage       | NP0             | X7R       |                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                             |     |     |        |          |          |          |          |          |          |          |          |       |          |          |  |
| ≤ 100V        | 2.0 × Ur        | 2.0 × Ur  |                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                             |     |     |        |          |          |          |          |          |          |          |          |       |          |          |  |
| 200/250V      | 1.5 × Ur        | 1.5 × Ur  |                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                             |     |     |        |          |          |          |          |          |          |          |          |       |          |          |  |
| 500/630V      | 1.3 × Ur        | 1.2 × Ur  |                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                             |     |     |        |          |          |          |          |          |          |          |          |       |          |          |  |
| ≥ 1KV         | 1.2 × Ur        | 1.1 × Ur  |                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                             |     |     |        |          |          |          |          |          |          |          |          |       |          |          |  |
|               |                 |           | 3. Recovery time: 24 ±2 hours                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                             |     |     |        |          |          |          |          |          |          |          |          |       |          |          |  |
|               |                 |           | 4. 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 preconditioned according to "IEC 60384 4.1" and then the requirement shall be met.                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                             |     |     |        |          |          |          |          |          |          |          |          |       |          |          |  |
| Voltage Proof |                 |           | Specified stress voltage applied for 1~5 seconds<br><br>$U_r \leq 100\text{ V}$ : series applied 2.5 Ur<br><br>$100\text{ V} < U_r \leq 200\text{ V}$ series applied<br>(1.5 Ur + 100)<br><br>$200\text{ V} < U_r \leq 500\text{ V}$ series applied<br>(1.3 Ur + 100)<br><br>$U_r > 500\text{ V}$ : 1.3 Ur<br><br>$U_r \geq 1\text{KV}$ : 1.2 Ur<br><br>Charge/Discharge current less than 50mA | No breakdown or flashover                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |        |          |          |          |          |          |          |          |          |       |          |          |  |

**REVISION HISTORY**

| REVISION   | DATE          | CHANGE NOTIFICATION | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                  |
|------------|---------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Version 11 | Jul. 13, 2018 | -                   | - Add NP0/1206/10pF to 47pF/3KV                                                                                                                                                                                                                                                                                                                              |
| Version 10 | Mar. 7, 2017  | -                   | - 0805 L4 spec updated                                                                                                                                                                                                                                                                                                                                       |
| Version 9  | Jan. 16, 2017 | -                   | - Product range updated                                                                                                                                                                                                                                                                                                                                      |
| Version 8  | Oct. 12, 2015 | -                   | - Product range updated                                                                                                                                                                                                                                                                                                                                      |
| Version 7  | May 21, 2014  | -                   | - Product range updated                                                                                                                                                                                                                                                                                                                                      |
| Version 6  | Jun. 17, 2012 | -                   | - Product range updated                                                                                                                                                                                                                                                                                                                                      |
| Version 5  | Sep 25, 2012  | -                   | - Product range updated                                                                                                                                                                                                                                                                                                                                      |
| Version 4  | Aug 08, 2011  | -                   | - Product range updated                                                                                                                                                                                                                                                                                                                                      |
| Version 3  | Jan 19, 2011  | -                   | - Dimension updated<br>- Add NP0 0805 1KV                                                                                                                                                                                                                                                                                                                    |
| Version 2  | Feb 02, 2010  | -                   | - Change to dual brand datasheet that describe High-Voltage NP0/X7R series with RoHS compliant<br>- Replace the high voltage part of pdf files:<br>UP-NP0X7R_HV_1K-to-4KV_I and UY-NP0X7R_HV_1K-to-4KV_I<br>- Description of "Halogen Free compliant" added<br>- Product range updated<br>- Define global part number<br>- Test method and procedure updated |
| Version 1  | Sep 30, 2005  | -                   | - Thickness revised                                                                                                                                                                                                                                                                                                                                          |