

# 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)

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**(1) SIZE – INCH BASED (METRIC)**

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

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**(2) TOLERANCE**

C = ±0.25 pF  
D = ±0.5 pF  
G = ±2%  
J = ±5%  
K = ±10%  
M = ±20%

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**(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

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**(4) TC MATERIAL**

NPO  
X7R

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**(5) RATED VOLTAGE**

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

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**(6) PROCESS**

N = NPO  
B = Class 2 MLCC

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**(7) CAPACITANCE VALUE**

2 significant digits+number of zeros  
The 3rd digit signifies the multiplying factor, and letter R is decimal point  
Example: 121 = 12 × 10<sup>1</sup> = 120 pF

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**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.

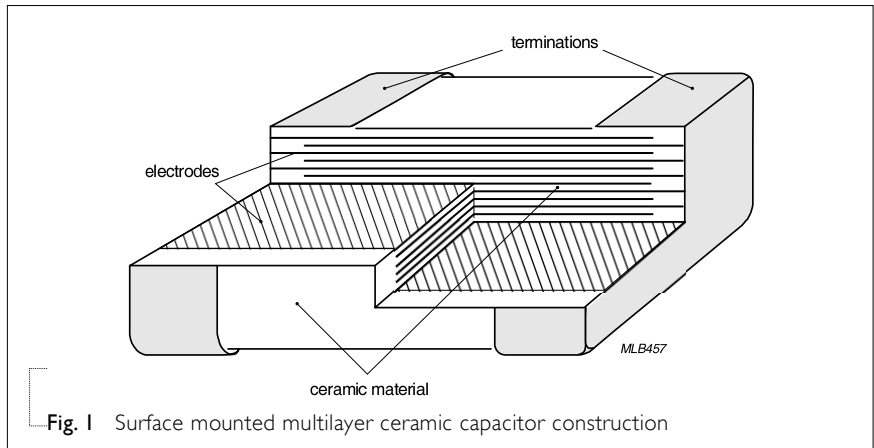


Fig. 1 Surface mounted multilayer ceramic capacitor construction

**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 | 1.25±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 | 1.25±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 | 1.25±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 | 1.25±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 | 1.25±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 | 1.25±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 | 1.25±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 | 1.6±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 |
| 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 | 1.25±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 | 1.6±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 |
| 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 | 1.25±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 | 1.6±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 |
| 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 | 1.25±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 | 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 | 1.25±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 | 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 | 1.25±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 | 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 | 1.25±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 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 1.25±0.2 |          |          |          |          |
| 820 pF |          | 1.25±0.2 |          |          |          | 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 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 | ---               | ---     | ---                    |
| 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±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 | ±0.25 pF, ±0.5 pF                                                                |
|                                                                                                   | C ≥ 10 pF | ±2%, ±5%                                                                         |
| X7R                                                                                               |           | ±5% <sup>(1)</sup> , ±10%                                                        |
| Dissipation factor (D.F.)                                                                         |           |                                                                                  |
| NP0                                                                                               | C < 30 pF | ≤ 1 / ( 400 + 20C )                                                              |
|                                                                                                   | C ≥ 30 pF | ≤ 0.1 %                                                                          |
| X7R                                                                                               |           | ≤ 2.5 %                                                                          |
| Insulation resistance after 1 minute at U <sub>r</sub> (DC)                                       |           | R <sub>ins</sub> ≥ 10 GΩ or R <sub>ins</sub> × C ≥ 500 seconds whichever is less |
| Maximum capacitance change as a function of temperature (temperature characteristic/coefficient): |           |                                                                                  |
| NP0                                                                                               |           | ±30 ppm/°C                                                                       |
| X7R                                                                                               |           | ±15%                                                                             |
| Operating temperature range:                                                                      |           |                                                                                  |
| NP0/X7R                                                                                           |           | -55 °C to +125 °C                                                                |

**NOTE**

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

**HIGH-VOLTAGE NP0**



**HIGH-VOLTAGE X7R**





**SOLDERING RECOMMENDATION**

Table 7

| SOLDERING METHOD | SIZE        |          |          |          |             |
|------------------|-------------|----------|----------|----------|-------------|
|                  | 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   V <sub>rms</sub> at 20 °C<br>f = 1 KHz for C > 1 nF, measuring at voltage   V <sub>rms</sub> at 20 °C<br>Class 2:<br>f = 1 KHz for C ≤ 10 μF, measuring at voltage   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   V <sub>rms</sub> at 20 °C<br>f = 1 KHz for C > 1 nF, measuring at voltage   V <sub>rms</sub> at 20 °C<br>Class 2:<br>f = 1 KHz for C ≤ 10 μF, measuring at voltage   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                   | Capacitance shall be measured by the steps shown in the following table.<br>The capacitance change should be measured after 5 min at each specified temperature stage.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <General purpose series><br>Class I:<br>$\Delta C/C: \pm 30\text{ppm}$<br><br>Class 2:<br>X7R: $\Delta C/C: \pm 15\%$<br>Y5V: $\Delta C/C: 22\sim-82\%$<br><br><High Capacitance series><br>Class 2:<br>X7R/X5R: $\Delta C/C: \pm 15\%$<br>Y5V: $\Delta C/C: 22\sim-82\%$ |      |                 |   |      |   |                       |   |      |   |
|                         |                       | <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<br/>Temperature Coefficient shall be calculated from the formula as below<br/> <math display="block">\text{Temp. Coefficient} = \frac{C2 - C1}{C1 \times \Delta T} \times 10^6 \text{ [ppm/°C]}</math>                     C1: Capacitance at step c<br/>                     C2: Capacitance at 125°C<br/> <math>\Delta T: 100^\circ\text{C}(=125^\circ\text{C}-25^\circ\text{C})</math></p> <p>(2) Class II<br/>Capacitance Change shall be calculated from the formula as below<br/> <math display="block">\Delta C = \frac{C2 - C1}{C1} \times 100\%</math>                     C1: Capacitance at step c<br/>                     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                | IEC 60384-21/22       | 4.7 A force applied for 10 seconds to the line joining the terminations and in a plane parallel to the substrate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Force size $\geq 0603: 5\text{N}$                                                                                                                                                                                                                                         |      |                 |   |      |   |                       |   |      |   |
| Bending Strength        |                       | 4.8 Mounting in accordance with IEC 60384-22 paragraph 4.3<br><br>Conditions: bending 1 mm at a rate of 1 mm/s, radius jig 5 mm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | No visible damage<br><br>$\Delta C/C$<br>Class 1:<br>NP0: within $\pm 1\%$ or 0.5 pF, whichever is greater<br>Class 2:<br>X7R: $\pm 10\%$                                                                                                                                 |      |                 |   |      |   |                       |   |      |   |

| 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><br/>Class 1:<br/>NP0: within ±0.5% or 0.5 pF, whichever is greater<br/>Class2:<br/>X7R: ±10%</p> <hr/> <p>D.F. within initial specified value<br/><math>R_{ins}</math> 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<br/>2. Temperature: 245±5°C / Dipping time: 3 ±0.5 s<br/>(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 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><br/>Class 1:<br/>NP0: within ±1% or 1 pF, whichever is greater<br/>Class2:<br/>X7R: ±15%</p> <hr/> <p>D.F. meet initial specified value<br/><math>R_{ins}</math> 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><br/>Class 1:<br/>NP0: within ±2% or 1 pF, whichever is greater<br/>Class2:<br/>X7R: ±15%</p> <p>D.F.<br/>Class 1:<br/>NP0: ≤ 2 × specified value<br/>Class2:<br/>X7R: ≥ 25 V: ≤ 5%</p> <p><math>R_{ins}</math><br/>Class 1:<br/>NP0: ≥ 2,500 MΩ or <math>R_{ins} \times C_r \geq 25s</math> whichever is less<br/>Class2:<br/>X7R: ≥ 500 MΩ or <math>R_{ins} \times C_r \geq 25s</math> 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<br><br>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:                                                                                                                                                                                                                                                                                                                                                                                          | No visual damage<br><br><hr/> $\Delta C/C$<br>Class1:<br>NP0: within ±2% or 1 pF, whichever is greater<br>Class2:<br>X7R: ±15%<br>D.F.<br>Class1:<br>NP0: ≤ 2 × specified value<br>Class2:<br>X7R: ≥ 25 V: ≤ 5%<br>$R_{ins}$<br>Class1:<br>NP0: ≥ 4,000 MΩ or<br>$R_{ins} \times C_r \geq 40s$ whichever is less<br>Class2:<br>X7R: ≥ 1,000 MΩ or<br>$R_{ins} \times C_r \geq 50s$ whichever is less |         |     |     |        |          |          |          |          |          |          |          |          |
|               |                      | <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Voltage</th> <th>NP0</th> <th>X7R</th> </tr> </thead> <tbody> <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> </tbody> </table> 3. Recovery time: 24 ± 2 hours<br>4. Final measure: C, D, IR<br><br>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 | 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 |
| 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 Proof |                      | Specified stress voltage applied for 1~5 seconds<br><br>$U_r \leq 100 V$ : series applied 2.5 $U_r$<br>$100 V < U_r \leq 200 V$ series applied<br>(1.5 $U_r + 100$ )<br>$200 V < U_r \leq 500 V$ series applied<br>(1.3 $U_r + 100$ )<br>$U_r > 500 V$ : 1.3 $U_r$<br>$U_r \geq 1KV$ : 1.2 $U_r$<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: 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                                                                                                                                                                                                                                                                                                                                       |