

# DATA SHEET

## **SURFACE-MOUNT CERAMIC MULTILAYER CAPACITORS**

Mid-voltage: NP0/X7R  
(Pb Free & RoHS compliant)

100 V TO 500 V

10 pF to 470 nF



SCOPE

This specification describes Mid-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

ORDERING INFORMATION

Part number is identified by the series, size, tolerance, packing style, TC material, rated voltage and capacitance value.

**YAGEO ORDERING CODE**

**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)**

0603 (1608)  
 0805 (2012)  
 1206 (3216)  
 1210 (3225)  
 1808 (4520)  
 1812 (4532)

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**(2) TOLERANCE**

J = ±5%  
 K = ±10%

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**(3) PACKING STYLE**

R = 7" paper tape  
 K = 7" blister tape  
 P = 13" paper tape  
 F = 13" blister tape  
 C = Bulk case

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**(4) TC MATERIAL**

NP0  
 X7R

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**(5) RATED VOLTAGE**

0 = 100 V  
 A = 200 V  
 Y = 250 V  
 B = 500 V

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**(6) PROCESS**

B = BME  
 N = NME

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**(7) CAPACITANCE VALUE:**

First two for significant figures and 3rd for number of zero  
 Letter "R" for decimal point

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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. I.

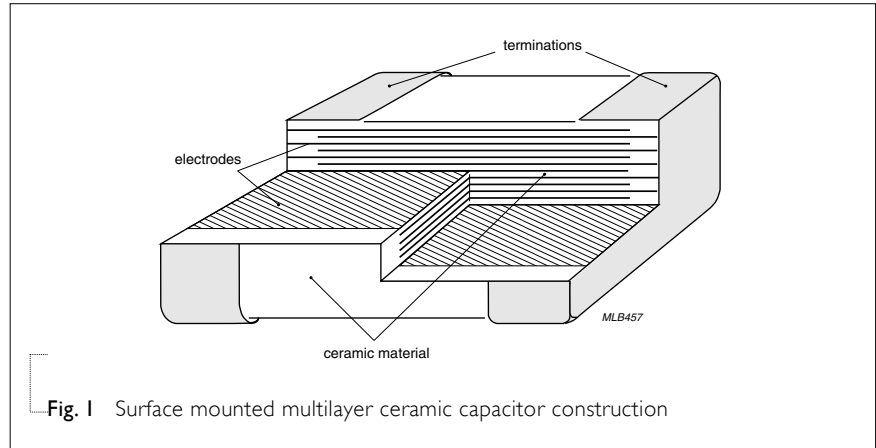


Fig. I Surface mounted multilayer ceramic capacitor construction

**DIMENSION**

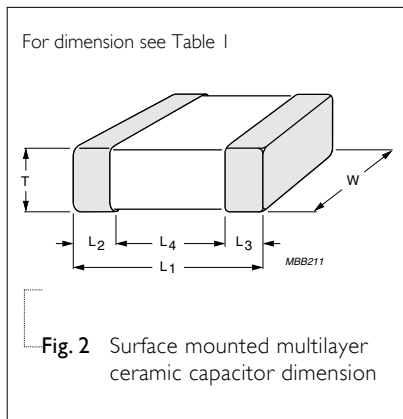


Fig. 2 Surface mounted multilayer ceramic capacitor dimension

Table I

| TYPE                                    | CC0603                | CC0805     | CC1206   | CC1210    | CC1808    | CC1812    |
|---|-----------------------|------------|----------|-----------|-----------|-----------|
| <b>L<sub>1</sub> (mm)</b>               | 1.6 ±0.10             | 2.0 ±0.20  | 3.2±0.20 | 3.2 ±0.20 | 4.5 ±0.30 | 4.5 ±0.30 |
| <b>W (mm)</b>                           | 0.8 ±0.07             | 1.25 ±0.20 | 1.6±0.20 | 2.5 ±0.20 | 2.0 ±0.30 | 3.2 ±0.30 |
| <b>T (mm)</b>                           | Refer to table 2 to 7 |            |          |           |           |           |
| <b>L<sub>2</sub>/L<sub>3</sub> (mm)</b> | <b>min.</b>           | 0.20       | 0.25     | 0.25      | 0.25      | 0.25      |
|   | <b>max.</b>           | 0.50       | 0.75     | 0.75      | 0.75      | 0.75      |
| <b>L<sub>4</sub> (mm)</b>               | <b>min.</b>           | 0.60       | 0.55     | 1.40      | 1.40      | 2.20      |

**CAPACITANCE RANGE & THICKNESS FOR NPO 100V**

Table 2 For NPO 100 V sizes from 0603 to 1812

| CAPACITANCE<br>(pF) | 100 V<br>0603 | 0805       | 1206       | 1210       | 1808       | 1812       |
|---------------------|---------------|------------|------------|------------|------------|------------|
| 10                  |               |            |            |            |            |            |
| 12                  |               |            |            |            |            |            |
| 15                  |               |            |            |            |            |            |
| 18                  |               |            |            |            |            |            |
| 22                  |               |            |            |            |            |            |
| 27                  |               |            |            |            |            |            |
| 33                  |               |            |            |            |            |            |
| 39                  |               |            |            |            |            |            |
| 47                  |               |            |            |            |            |            |
| 56                  |               |            |            |            |            |            |
| 68                  |               |            |            |            |            |            |
| 82                  |               |            |            |            |            |            |
| 100                 | 0.8 ±0.10     | 0.6 ±0.10  |            |            |            |            |
| 120                 |               |            |            |            |            |            |
| 150                 |               |            | 0.6 ±0.10  |            |            |            |
| 180                 |               |            |            |            |            |            |
| 220                 |               |            |            |            |            |            |
| 270                 |               |            |            |            |            |            |
| 330                 |               |            |            |            |            |            |
| 390                 |               |            |            |            |            |            |
| 470                 |               |            |            |            |            |            |
| 560                 |               |            |            |            |            |            |
| 680                 |               |            |            |            |            |            |
| 820                 |               |            |            |            |            |            |
| 1,000               |               |            |            |            |            |            |
| 1,200               |               |            |            |            |            |            |
| 1,500               |               | 0.85 ±0.10 |            |            |            |            |
| 1,800               |               |            |            |            |            |            |
| 2,200               |               |            |            | 0.6 ±0.10  | 1.25 ±0.20 | 1.25 ±0.20 |
| 2,700               |               |            |            |            |            |            |
| 3,300               |               | 1.25 ±0.20 |            |            |            |            |
| 3,900               |               |            | 0.85 ±0.10 |            |            |            |
| 4,700               |               |            |            |            |            |            |
| 5,600               |               |            | 1.15±0.15  | 0.85 ±0.10 |            |            |

Table 2 For NP0 100 V sizes from 0603 to 1812 (continued)

| CAPACITANCE<br>(pF) | 100 V |      |            |            |      |            |
|---------------------|-------|------|------------|------------|------|------------|
|                     | 0603  | 0805 | 1206       | 1210       | 1808 | 1812       |
| 6,800               |       |      | 1.15±0.15  |            |      |            |
| 8,200               |       |      |            | 0.85 ±0.10 |      | 1.25 ±0.20 |
| 10,000              |       |      | 1.25 ±0.20 |            |      |            |
| 12,000              |       |      |            |            |      |            |
| 15,000              |       |      |            | 1.25 ±0.20 |      | 0.85 ±0.10 |
| 18,000              |       |      |            |            |      |            |
| 22,000              |       |      |            |            |      | 1.15±0.15  |
| 27,000              |       |      |            |            |      |            |
| 33,000              |       |      |            |            |      |            |
| 39,000              |       |      |            |            |      |            |
| 47,000              |       |      |            |            |      |            |

**NOTE**

1. Values in shaded cells indicate thickness class in mm.
2. Capacitance range < 10 pF is on request.

**CAPACITANCE RANGE & THICKNESS FOR NP0 200/250 V**

Table 3 For NP0 200/250 V sizes from 0603 to 1812

| CAPACITANCE<br>(pF) | 200/250 V |           |           |      |      |      |
|---------------------|-----------|-----------|-----------|------|------|------|
|                     | 0603      | 0805      | 1206      | 1210 | 1808 | 1812 |
| 10                  |           |           |           |      |      |      |
| 12                  |           |           |           |      |      |      |
| 15                  |           |           |           |      |      |      |
| 18                  |           |           |           |      |      |      |
| 22                  |           |           |           |      |      |      |
| 27                  |           |           |           |      |      |      |
| 33                  |           |           |           |      |      |      |
| 39                  |           |           |           |      |      |      |
| 47                  | 0.8 ±0.10 | 0.6 ±0.10 | 0.6 ±0.10 |      |      |      |
| 56                  |           |           |           |      |      |      |
| 68                  |           |           |           |      |      |      |
| 82                  |           |           |           |      |      |      |
| 100                 |           |           |           |      |      |      |
| 120                 |           |           |           |      |      |      |
| 150                 |           |           |           |      |      |      |
| 180                 |           |           |           |      |      |      |

Table 3 For NP0 200/250 V sizes from 0603 to 1812 (continued)

| CAPACITANCE<br>(pF) | 200/250 V |            |            |            |            |            |
|---------------------|-----------|------------|------------|------------|------------|------------|
|                     | 0603      | 0805       | 1206       | 1210       | 1808       | 1812       |
| 220                 |           |            |            |            |            |            |
| 270                 |           |            |            |            |            |            |
| 330                 | 0.8 ±0.10 | 0.85 ±0.10 |            |            |            |            |
| 390                 |           |            | 0.6 ±0.10  |            |            |            |
| 470                 |           |            |            |            |            |            |
| 560                 |           | 1.25 ±0.20 |            |            |            |            |
| 680                 |           |            |            |            |            |            |
| 820                 |           | 0.8 ±0.10  |            |            |            |            |
| 1,000               |           |            | 0.85 ±0.10 |            |            |            |
| 1,200               |           |            |            | 1.25 ±0.20 |            |            |
| 1,500               |           | 1.25 ±0.20 | 1.15±0.15  |            |            |            |
| 1,800               |           |            | 0.8 ±0.10  |            |            | 1.25 ±0.20 |
| 2,200               |           |            |            | 0.85 ±0.10 |            |            |
| 2,700               |           |            |            |            | 1.25 ±0.20 |            |
| 3,300               |           |            | 1.25 ±0.20 | 1.15±0.15  |            |            |
| 3,900               |           |            |            |            |            | 0.85 ±0.10 |
| 4,700               |           |            |            | 1.25 ±0.20 |            | 1.15±0.15  |
| 5,600               |           |            |            |            |            |            |
| 6,800               |           |            |            |            |            |            |
| 8,200               |           |            |            |            |            |            |
| 10,000              |           |            |            |            |            |            |

**NOTE**

1. Values in shaded cells indicate thickness class in mm.
2. Capacitance range < 10 pF is on request.

**CAPACITANCE RANGE & THICKNESS FOR NP0 500 V**

Table 4 For NP0 500 V sizes from 0805 to 1812

| CAPACITANCE<br>(pF) | 500 V     |           |      |      |      |
|---------------------|-----------|-----------|------|------|------|
|                     | 0805      | 1206      | 1210 | 1808 | 1812 |
| 10                  |           |           |      |      |      |
| 12                  |           |           |      |      |      |
| 15                  | 0.6 ±0.10 | 0.6 ±0.10 |      |      |      |
| 18                  |           |           |      |      |      |
| 22                  |           |           |      |      |      |
| 27                  |           |           |      |      |      |

Table 4 For NP0 500 V sizes from 0805 to 1812 (continued)

| CAPACITANCE<br>(pF) | 500 V      |            |            |            |            |
|---------------------|------------|------------|------------|------------|------------|
|                     | 0805       | 1206       | 1210       | 1808       | 1812       |
| 33                  |            |            |            |            |            |
| 39                  |            |            |            |            |            |
| 47                  |            |            |            |            |            |
| 56                  |            |            |            |            |            |
| 68                  | 0.6 ±0.10  | 0.6 ±0.10  |            |            |            |
| 82                  |            |            |            |            |            |
| 100                 |            |            |            |            |            |
| 120                 |            |            |            |            |            |
| 150                 |            |            |            |            |            |
| 180                 |            |            | 0.85 ±0.10 |            |            |
| 220                 |            |            |            |            |            |
| 270                 |            |            |            |            |            |
| 330                 | 0.85 ±0.10 |            |            |            |            |
| 390                 |            |            |            |            |            |
| 470                 |            | 0.85 ±0.10 |            |            |            |
| 560                 |            |            |            |            |            |
| 680                 |            |            |            |            |            |
| 820                 | 1.25 ±0.20 | 1.15±0.15  |            |            |            |
| 1,000               |            |            |            |            |            |
| 1,200               |            | 0.8 ±0.10  |            |            |            |
| 1,500               |            |            | 1.15±0.15  |            | 1.25 ±0.20 |
| 1,800               |            | 1.25 ±0.20 |            | 1.25 ±0.20 |            |
| 2,200               |            |            | 1.25 ±0.20 |            |            |
| 2,700               |            |            |            |            | 1.15±0.15  |
| 3,300               |            |            |            |            |            |
| 3,900               |            |            |            |            |            |
| 4,700               |            |            |            |            | 1.25 ±0.20 |
| 5,600               |            |            |            |            |            |
| 6,800               |            |            |            |            |            |
| 8,200               |            |            |            |            |            |
| 10,000              |            |            |            |            |            |

**NOTE**

1. Values in shaded cells indicate thickness class in mm.
2. Capacitance range < 10 pF is on request.

**CAPACITANCE RANGE & THICKNESS FOR X7R 100V**

Table 5 For X7R 100 V sizes from 0805 to 1812

| CAPACITANCE<br>(pF) | 100 V<br>0603 | 0805       | 1206       | 1210       | 1808       | 1812       |
|---------------------|---------------|------------|------------|------------|------------|------------|
| 100                 |               |            |            |            |            |            |
| 150                 |               |            |            |            |            |            |
| 220                 |               |            |            |            |            |            |
| 330                 |               |            |            |            |            |            |
| 470                 |               |            |            |            |            |            |
| 680                 |               |            |            |            |            |            |
| 1,000               | 0.8 ±0.10     |            |            |            |            |            |
| 1,500               |               |            |            |            |            |            |
| 2,200               |               | 0.6 ±0.10  | 0.85 ±0.10 |            |            |            |
| 3,300               |               |            |            |            |            |            |
| 4,700               |               |            |            |            |            |            |
| 6,800               |               |            |            |            |            |            |
| 10,000              |               |            |            |            |            |            |
| 15,000              |               |            |            |            |            |            |
| 22,000              |               | 0.85 ±0.10 |            |            |            |            |
| 33,000              |               |            |            |            |            |            |
| 47,000              |               | 1.25 ±0.20 |            |            |            | 0.85 ±0.10 |
| 68,000              |               |            |            | 0.85 ±0.10 | 1.25 ±0.20 |            |
| 100,000             |               |            | 1.15±0.15  |            |            |            |
| 150,000             |               |            |            | 1.15±0.15  |            | 1.15±0.15  |
| 220,000             |               |            |            | 1.6 ±0.20  |            |            |
| 330,000             |               |            |            |            |            |            |
| 470,000             |               |            |            |            |            | 1.6 ±0.20  |
| 680,000             |               |            |            |            |            |            |
| 1,000,000           |               |            |            |            |            |            |

**NOTE**

1. Values in shaded cells indicate thickness class in mm.



**CAPACITANCE RANGE & THICKNESS FOR X7R 200/250 V**

Table 6 For X7R 200/250 V sizes from 0805 to 1812

| CAPACITANCE<br>(pF) | 200/250 V  |            |            |            |      |           |
|---------------------|------------|------------|------------|------------|------|-----------|
|                     | 0805       | 1206       | 1210       | 1808       | 1812 |           |
| 100                 |            |            |            |            |      |           |
| 150                 |            |            |            |            |      |           |
| 220                 |            |            |            |            |      |           |
| 330                 |            |            |            |            |      |           |
| 470                 |            |            |            |            |      |           |
| 680                 |            |            |            |            |      |           |
| 1,000               | 0.85 ±0.10 |            |            |            |      |           |
| 1,500               |            |            |            |            |      |           |
| 2,200               |            |            |            |            |      |           |
| 3,300               |            | 0.85 ±0.10 |            |            |      |           |
| 4,700               |            |            |            |            |      |           |
| 6,800               |            |            |            |            |      |           |
| 10,000              | 1.25 ±0.20 |            |            |            |      |           |
| 15,000              | 0.8 ±0.10  |            | 0.85 ±0.10 |            |      |           |
| 22,000              | 1.25 ±0.20 |            |            |            |      |           |
| 33,000              |            | 1.15±0.15  | 1.15±0.15  | 1.25 ±0.20 |      |           |
| 47,000              |            |            |            |            |      |           |
| 68,000              |            | 1.25 ±0.20 |            |            |      |           |
| 100,000             |            |            | 1.25 ±0.20 |            |      | 1.15±0.15 |
| 150,000             |            |            |            |            |      |           |
| 220,000             |            |            |            |            |      | 1.6 ±0.20 |
| 330,000             |            |            |            |            |      | 2.0 ±0.20 |
| 470,000             |            |            |            |            |      |           |
| 680,000             |            |            |            |            |      |           |
| 1,000,000           |            |            |            |            |      |           |

**NOTE**

I. Values in shaded cells indicate thickness class in mm.

**CAPACITANCE RANGE & THICKNESS FOR X7R 500 V**

Table 7 For X7R 500 V sizes from 0805 to 1812

| CAPACITANCE<br>(pF) | 500 V      |            |            |            |      |            |
|---------------------|------------|------------|------------|------------|------|------------|
|                     | 0805       | 1206       | 1210       | 1808       | 1812 |            |
| 100                 |            |            |            |            |      |            |
| 150                 |            |            |            |            |      |            |
| 220                 |            |            |            |            |      |            |
| 330                 |            |            |            |            |      |            |
| 470                 |            |            |            |            |      |            |
| 680                 |            |            |            |            |      |            |
| 1,000               | 0.8 ±0.10  |            |            |            |      |            |
| 1,500               |            |            |            |            |      |            |
| 2,200               |            | 1.15±0.15  |            |            |      |            |
| 3,300               |            |            |            |            |      |            |
| 4,700               |            |            | 1.15±0.15  |            |      | 0.85 ±0.10 |
| 6,800               |            |            |            |            |      |            |
| 10,000              | 1.25 ±0.20 | 1.25 ±0.20 |            |            |      | 1.15±0.15  |
| 15,000              |            |            |            | 1.25 ±0.20 |      |            |
| 22,000              |            |            | 1.25 ±0.20 |            |      |            |
| 33,000              |            | 1.6 ±0.20  |            |            |      |            |
| 47,000              |            |            |            |            |      | 1.25 ±0.20 |
| 68,000              |            |            |            |            |      |            |
| 100,000             |            |            |            |            |      | 1.6 ±0.20  |
| 150,000             |            |            |            |            |      |            |
| 220,000             |            |            |            |            |      |            |
| 330,000             |            |            |            |            |      |            |
| 470,000             |            |            |            |            |      |            |
| 680,000             |            |            |            |            |      |            |
| 1,000,000           |            |            |            |            |      |            |

**NOTE**

1. Values in shaded cells indicate thickness class in mm.

**THICKNESS CLASSES AND PACKING QUANTITY**

Table 8

| DESCRIPTION        | SIZE CODE | THICKNESS CLASSIFICATION (mm) | 8 mm TAPE WIDTH/AMOUNT PER REEL |         |              |         | 12 mm TAPE WIDTH /AMOUNT PER REEL |
|--------------------|-----------|-------------------------------|---------------------------------|---------|--------------|---------|-----------------------------------|
|                    |           |                               | Ø180 mm, 7"                     |         | Ø330 mm, 13" |         | Ø180 mm, 7" Blister               |
|                    |           |                               | Paper                           | Blister | Paper        | Blister |                                   |
| Mid / High voltage | 0603      | 0.8 ±0.10                     | 4,000                           | ---     | ---          | ---     | ---                               |
|                    | 0805      | 0.6 ±0.10                     | 4,000                           | ---     | ---          | ---     | ---                               |
|                    |           | 0.8 ±0.10                     | 4,000                           | ---     | ---          | ---     | ---                               |
|                    |           | 0.85 ±0.1                     | 4,000                           | ---     | ---          | ---     | ---                               |
|                    |           | 1.25 ±0.20                    | ---                             | 3,000   | ---          | ---     | ---                               |
|                    | 1206      | 0.6 ±0.10                     | 4,000                           | ---     | 20,000       | ---     | ---                               |
|                    |           | 0.8 ±0.10                     | 4,000                           | ---     | ---          | ---     | ---                               |
|                    |           | 0.85 ±0.10                    | 4,000                           | ---     | 15,000       | ---     | ---                               |
|                    |           | 1.00 ±0.10                    | ---                             | 3,000   | ---          | 10,000  | ---                               |
|                    |           | 1.15 ±0.15                    | ---                             | 3,000   | ---          | 10,000  | ---                               |
|                    |           | 1.25 ±0.20                    | ---                             | 3,000   | ---          | ---     | ---                               |
|                    | 1210      | 0.6 ±0.10                     | ---                             | 4,000   | ---          | 15,000  | ---                               |
|                    |           | 0.85 ±0.10                    | ---                             | 4,000   | ---          | 10,000  | ---                               |
|                    |           | 1.15 ±0.15                    | ---                             | 3,000   | ---          | 10,000  | ---                               |
|                    |           | 1.25 ±0.20                    | ---                             | 3,000   | ---          | ---     | ---                               |
|                    |           | 1.6 ±0.20                     | ---                             | 2,000   | ---          | ---     | ---                               |
|                    | 1808      | 1.15 ±0.15                    | ---                             | ---     | ---          | ---     | 1,500                             |
|                    |           | 1.25 ±0.20                    | ---                             | ---     | ---          | ---     | 3,000                             |
|                    |           | 1.35 ±0.15                    | ---                             | ---     | ---          | ---     | 1,000                             |
|                    |           | 1.5 ±0.10                     | ---                             | ---     | ---          | ---     | 1,000                             |
|                    |           | 1.6 ±0.20                     | ---                             | ---     | ---          | ---     | 2,000                             |
|                    |           | 2.0 ±0.20                     | ---                             | ---     | ---          | ---     | 2,000                             |
|                    | 1812      | 0.85 ±0.10                    | ---                             | ---     | ---          | ---     | 2,000                             |
|                    |           | 1.15 ±0.15                    | ---                             | ---     | ---          | ---     | 1,500                             |
|                    |           | 1.25 ±0.20                    | ---                             | ---     | ---          | ---     | 1,000                             |
|                    |           | 1.35 ±0.15                    | ---                             | ---     | ---          | ---     | 1,000                             |
|                    |           | 1.5 ±0.1                      | ---                             | ---     | ---          | ---     | 1,000                             |
|                    |           | 1.6 ±0.2                      | ---                             | ---     | ---          | ---     | 1,000                             |
|                    |           | 2.0 ±0.20                     | ---                             | ---     | ---          | ---     | 2,000                             |

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 9

| DESCRIPTION  | VALUE  |
|--|--|
| Capacitance range <sup>(1)</sup>   | 10 pF to 470 nF  |
| Capacitance tolerance <sup>(1)</sup> :   |  |
| NP0  | ±5%  |
| X7R  | ±10%   |
| Dissipation factor (D.F.) <sup>(1)</sup> :   |  |
| NP0  | ≤ 0.1%   |
| X7R  | ≤ 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<br>(temperature characteristic/coefficient): |  |
| NP0  | ±30 ppm/°C   |
| X7R  | ±15%   |
| Operating temperature range:   |  |
| NP0/X7R  | -55 °C to +125 °C  |

**NOTE**

- 1. NP0: frequency = 1 MHz for  $C \leq 1$  nF, measuring at voltage  $1 V_{rms}$ ; frequency = 1 KHz for  $C > 1$  nF, measuring at voltage  $1 V_{rms}$
- X7R: frequency = 1 KHz for  $C \leq 10$  μF, measuring at voltage  $1 V_{rms}$ .

**TESTS AND REQUIREMENTS**

**Table 10** Test condition, procedure and requirements

| TEST                                  | TEST METHOD            | PROCEDURE  | REQUIREMENTS   |
|---------------------------------------|------------------------|--|--|
| Mounting                              | IEC 60384-21/22<br>4.3 | The capacitors may be mounted on printed-circuit boards or ceramic substrates  | No visible damage  |
| Visual inspection and dimension check | 4.4                    | Any applicable method using $\times 10$ magnification  | In accordance with specification                         |
| Capacitance                           | 4.5.1                  | NP0:<br>f = 1 MHz for $C \leq 1$ nF, measuring at voltage $1 V_{rms}$ at 20 °C;<br>f = 1 KHz for $C > 1$ nF, measuring at voltage $1 V_{rms}$ at 20 °C<br>X7R:<br>f = 1 KHz for $C \leq 10 \mu F$ , measuring at voltage $1 V_{rms}$ at 20 °C  | Within specified tolerance                               |
| Dissipation factor (D.F.)             | 4.5.2                  | NP0: f = 1 MHz for $C \leq 1$ nF, measuring at voltage $1 V_{rms}$ at 20 °C; f = 1 KHz for $C > 1$ nF, measuring at voltage $1 V_{rms}$ at 20 °C<br>X7R: f = 1 KHz for $C \leq 10 \mu F$ , measuring at voltage $1 V_{rms}$ at 20 °C   | In accordance with specification                         |
| Insulation resistance                 | 4.5.3                  | At $U_r$ (DC) for 1 minute   | In accordance with specification                         |
| Voltage proof                         | 4.5.4.2                | Test voltage (DC) applied for 1 minute<br>$U_r \leq 100$ V: $2.5 \times U_r$ applied to NP0/X7R series<br>$100 \text{ V} < U_r \leq 200$ V: $1.5 \times U_r + 100$ V applied to NP0/X7R series<br>$200 \text{ V} < U_r \leq 500$ V: $1.3 \times U_r + 100$ V applied to NP0/X7R series<br>$U_r > 500$ V: $1.3 \times U_r$ applied to NP0/X7R series<br>I: 7.5 mA | No breakdown or flashover                                |
| Temperature characteristic            | 4.6                    | Between minimum and maximum temperature  | NP0: $\Delta C/C$ : 30 ppm/°C<br>X7R: $\Delta C/C$ : 15% |
| Adhesion                              | 4.15                   | A force applied for 10 seconds to the line joining the terminations and in a plane parallel to the substrate<br>for size $\geq 0603$ : a force of 5 N applied<br>for size 0402: a force of 2.5 N applied   | No visible damage  |

Table 10 Test condition, procedure and requirements (continued)

| TEST                                 | TEST METHOD         | PROCEDURE  | REQUIREMENTS  |
|--------------------------------------|---------------------|--|---|
| Bond strength of plating on end face | IEC 60384-21/22 4.8 | Mounting in accordance with IEC 60384-22 paragraph 4.3<br><br>Conditions: bending 1 mm at a rate of 1 mm/s, radius jig 340 mm  | No visible damage<br><br>NP0: $\Delta C/C_i \leq 1\%$ or 0.5 pF whichever is greater<br>X7R: $\Delta C/C_i \leq 10\%$   |
| Resistance to soldering heat         | 4.9                 | Precondition: 150 +0/-10 °C for 1 hour, then keep for 24 ± 1 hours at room temperature<br>Preheating: for size ≤ 1206: 120 to 150 °C for 1 minute<br>Preheating: for size > 1206: 100 to 120 °C for 1 minute and 170 to 200 °C for 1 minute<br>Solder bath temperature: 260 ± 5 °C<br>Dipping time: 10 ± 0.5 seconds<br>Recovery time: 24 ± 2 hours.                                 | The termination shall be well tinned<br>NP0: $\Delta C/C_i \leq 0.5\%$ or 0.5 pF whichever is greater<br>X7R: $\Delta C/C_i \leq 10\%$<br><br>D.F.: within initial specified value<br>R <sub>ins</sub> : within initial specified value   |
| Solderability                        | 4.10                | Unmounted chips completely immersed in a solder bath at 235 ± 5 °C<br>Dipping time: 2 ± 0.5 seconds<br>Depth of immersion: 10 mm   | The termination shall be well tinned.   |
| Rapid change of temperature          | 4.11                | Preconditioning;<br>150 +0/-10 °C for 1 hour, then keep for 24 ± 1 hours at room temperature<br><hr/> 5 cycles with following detail:<br>30 minutes at lower category temperature;<br>30 minutes at upper category temperature<br><hr/> Recovery time 24 ± 2 hours.  | No visual damage<br>NP0: $\Delta C/C_i \leq 1\%$ or 1 pF whichever is greater<br>X7R: $\Delta C/C_i \leq 15\%$<br>D.F.: within initial specified value<br>R <sub>ins</sub> : within initial specified value   |
| Damp heat, with U <sub>r</sub> load  | 4.13                | Initial measurements; after 150 +0/-10 °C for 1 hour, then keep for 24 ± 1 hours at room temperature<br>Duration and conditions: 500 ± 12 hours at 40 ± 2 °C; 90 to 95% RH; U <sub>r</sub> applied<br>Final measurement: perform a heat treatment at 150 +0/-10 °C for 1 hour, final measurements shall be carried out 24 ± 1 hours after recovery at room temperature without load. | NP0: $\Delta C/C_i \leq 2\%$ or 1 pF whichever is greater<br>X7R: $\Delta C/C_i \leq 15\%$<br><br>NP0: D.F.: 2 × initial value max.<br>X7R ≥ 100 V: D.F. ≤ 5%<br><br>NP0: R <sub>ins</sub> ≥ 2,500 MΩ or R <sub>ins</sub> × C <sub>r</sub> ≥ 25 seconds, whichever is less<br>X7R: R <sub>ins</sub> ≥ 500 MΩ or R <sub>ins</sub> × C <sub>r</sub> ≥ 25 seconds, whichever is less |

Table 10 Test condition, procedure and requirements (continued)

| TEST      | TEST METHOD          | PROCEDURE  | REQUIREMENTS  |
|-----------|----------------------|--|---|
| Endurance | IEC 60384-21/22 4.14 | <p>Preconditioning;<br/>Initial measurements; after 150 +0/-10 °C for 1 hour, then keep for 24 ± 1 hours at room temperature</p> <p>Duration and conditions: 1,000 ± 12 hours at upper category temperature with 1.5 × U<sub>r</sub> voltage applied</p> <p>Final measurement: perform a heat treatment at 150 +0/-10 °C for 1 hour; final measurements shall be carried out 24 ± 1 hours after recovery at room temperature without load.</p> | <p>NP0: <math>\Delta C/C_i \leq 2\%</math> or 1 pF whichever is greater</p> <p>X7R: <math>\Delta C/C_i \leq 15\%</math></p> <p>NP0: D.F.: 2 × initial value max.</p> <p>X7R: 100 V: D.F. ≤ 5%</p> <p>NP0: <math>R_{ins} \geq 4,000 M\Omega</math> or <math>R_{ins} \times C_r \geq 40</math> seconds, whichever is less</p> <p>X7R: <math>R_{ins} \geq 1,000 M\Omega</math> or <math>R_{ins} \times C_r \geq 50</math> seconds, whichever is less</p> |

REVISION HISTORY

| REVISION | DATE | CHANGE NOTIFICATION | DESCRIPTION |
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|----------|------|---------------------|-------------|

|           |              |   |       |
|-----------|--------------|---|-------|
| Version 0 | Sep 08, 2005 | - | - New |
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