DATA SHEET
SURFACE-MOUNT CERAMIC MULTILAYER CAPACITORS
General Purpose & High Capacitance
Class 2, X7R
6.3 V TO 50 V
100 pF to 22 µF
RoHS compliant & Halogen Free
**SCOPE**
This specification describes X7R series chip capacitors with lead-free terminations.

**APPLICATIONS**
- PCs, Hard disk, Game PCs
- DVDs, Video cameras
- Mobile phones
- Data processing

**FEATURES**
- Supplied in tape on reel
- Nickel-barrier end termination
- RoHS compliant
- Halogen Free compliant

**ORDERING INFORMATION - GLOBAL PART NUMBER, PHYCOMP CTC & 12NC**
All part numbers are identified by the series, size, tolerance, TC material, packing style, voltage, process code, termination and capacitance value.

**YAGEO BRAND ordering code**

**GLOBAL PART NUMBER (PREFERRED)**

<table>
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<tr>
<th>CC</th>
<th>xxxx</th>
<th>x</th>
<th>X7R</th>
<th>BB</th>
<th>xxx</th>
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<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
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(1) SIZE – INCH BASED (METRIC)

<table>
<thead>
<tr>
<th>Size – Inch Based (Metric)</th>
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<tbody>
<tr>
<td>0201 (0603)</td>
</tr>
<tr>
<td>0402 (1005)</td>
</tr>
<tr>
<td>0603 (1608)</td>
</tr>
<tr>
<td>0805 (2012)</td>
</tr>
<tr>
<td>1206 (3216)</td>
</tr>
<tr>
<td>1210 (3225)</td>
</tr>
<tr>
<td>1812 (4532)</td>
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(2) TOLERANCE

<table>
<thead>
<tr>
<th>Tolerance Code</th>
<th>Tolerance</th>
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<tr>
<td>J</td>
<td>±5% (1)</td>
</tr>
<tr>
<td>K</td>
<td>±10%</td>
</tr>
<tr>
<td>M</td>
<td>±20%</td>
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(3) PACKING STYLE

<table>
<thead>
<tr>
<th>Packing Style</th>
<th>Description</th>
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<tr>
<td>R</td>
<td>Paper/PE taping reel; Reel 7 inch</td>
</tr>
<tr>
<td>K</td>
<td>Blister taping reel; Reel 7 inch</td>
</tr>
<tr>
<td>P</td>
<td>Paper/PE taping reel; Reel 13 inch</td>
</tr>
<tr>
<td>F</td>
<td>Blister taping reel; Reel 13 inch</td>
</tr>
</tbody>
</table>

(4) RATED VOLTAGE

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<th>Voltage</th>
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<td>6</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>8</td>
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<tr>
<td>9</td>
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</table>

(5) CAPACITANCE VALUE

<table>
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<th>Capacitance Value</th>
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<tr>
<td>2 significant digits + number of zeros</td>
</tr>
<tr>
<td>The 3rd digit signifies the multiplying factor; and letter R is decimal point</td>
</tr>
<tr>
<td>Example: 103 = 10 × 10^3 = 10,000 pF = 10 nF</td>
</tr>
</tbody>
</table>

**NOTE**

1. Tolerance ±5% is not available for full product range, please contact local sales force before ordering
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.

DIMENSION

Table 1 For outlines see fig. 2

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<tr>
<th>TYPE</th>
<th>L₁ (mm)</th>
<th>W (mm)</th>
<th>T (mm)</th>
<th>L₂ / L₃ (mm) min.</th>
<th>L₄ (mm) min.</th>
<th>DIMENSION CODE</th>
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</thead>
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<td>0.3 ±0.03</td>
<td>0.3 ±0.03</td>
<td>0.1</td>
<td>0.2</td>
<td>0.2 BA</td>
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<tr>
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<td>1.0 ±0.05</td>
<td>0.5 ±0.05</td>
<td>0.5 ±0.05</td>
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<td>0.35</td>
<td>0.4 CA</td>
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<td>1.6 ±0.1</td>
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<td>0.8 ±0.1</td>
<td>0.2</td>
<td>0.6</td>
<td>0.4 DA</td>
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<td>1.6 ±0.15</td>
<td>0.8 ±0.15</td>
<td>0.8 ±0.15</td>
<td>0.2</td>
<td>0.6</td>
<td>0.4 DB</td>
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<tr>
<td></td>
<td>1.6 ±0.2</td>
<td>0.8 ±0.2</td>
<td>0.8 ±0.2</td>
<td>0.2</td>
<td>0.6</td>
<td>0.4 DC</td>
</tr>
<tr>
<td>0805</td>
<td>2.0 ±0.1</td>
<td>1.25 ±0.1</td>
<td>0.6 ±0.1</td>
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<td>0.75</td>
<td>0.7 E0</td>
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<tr>
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<td>2.0 ±0.1</td>
<td>1.25 ±0.1</td>
<td>0.85 ±0.1</td>
<td>0.25</td>
<td>0.75</td>
<td>0.7 EA</td>
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<td>2.0 ±0.2</td>
<td>1.25 ±0.2</td>
<td>1.25 ±0.2</td>
<td>0.25</td>
<td>0.75</td>
<td>0.7 EB</td>
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<td>0.85 ±0.1</td>
<td>0.25</td>
<td>0.75</td>
<td>1.4 F0</td>
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<tr>
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<td>3.2 ±0.2</td>
<td>1.6 ±0.2</td>
<td>1.0 ±0.1</td>
<td>0.25</td>
<td>0.75</td>
<td>1.4 FI</td>
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<td>1.6 ±0.2</td>
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<td>0.75</td>
<td>1.4 FA</td>
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## CAPACITANCE RANGE & THICKNESS FOR X7R

### Table 2  Sizes from 0201 to 0402

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</table>

### NOTE
1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-6 series is on request
3. For product with 5% tolerance, please contact local sales force before ordering
## Capacitance Range & Thickness for X7R

<table>
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<tr>
<th>CAP.</th>
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**Note**

1. Values in shaded cells indicate thickness class in mm.
2. Capacitance value of non E-6 series is on request.
3. For product with 5% tolerance, please contact local sales force before ordering.
### Table 4  Size 1206

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<th>16 V</th>
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<td></td>
<td>F0</td>
<td>F0</td>
<td>F0</td>
<td>F0</td>
</tr>
<tr>
<td>680 nF</td>
<td></td>
<td>FA</td>
<td>FA</td>
<td>FA</td>
<td>FA</td>
</tr>
<tr>
<td>1.0 µF</td>
<td></td>
<td>FA</td>
<td>FA</td>
<td>FA</td>
<td>FA</td>
</tr>
<tr>
<td>2.2 µF</td>
<td></td>
<td>FA</td>
<td>FA</td>
<td>FA</td>
<td>FA</td>
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<tr>
<td>4.7 µF</td>
<td></td>
<td>FC</td>
<td>FC</td>
<td>FC</td>
<td>FC</td>
</tr>
<tr>
<td>10 µF</td>
<td></td>
<td>FC</td>
<td>FC</td>
<td>FC</td>
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</tr>
<tr>
<td>22 µF</td>
<td></td>
<td>FC</td>
<td>FC</td>
<td>FC</td>
<td>FC</td>
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<tr>
<td>47 µF</td>
<td></td>
<td>FC</td>
<td>FC</td>
<td>FC</td>
<td>FC</td>
</tr>
</tbody>
</table>

**NOTE**

1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-6 series is on request
3. For product with 5% tolerance, please contact local sales force before ordering
4. Please contact local sales force for special ordering code before ordering
### Capacitance Range & Thickness for X7R

<table>
<thead>
<tr>
<th>CAP</th>
<th>1210</th>
<th>1812</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6.3 V</td>
<td>10 V</td>
</tr>
<tr>
<td>100 pF</td>
<td></td>
<td></td>
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<tr>
<td>150 pF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>220 pF</td>
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<td></td>
</tr>
<tr>
<td>330 pF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>470 pF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>680 pF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.0 nF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5 nF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2 nF</td>
<td>G0</td>
<td></td>
</tr>
<tr>
<td>3.3 nF</td>
<td>G0</td>
<td></td>
</tr>
<tr>
<td>4.7 nF</td>
<td>G0</td>
<td>G0</td>
</tr>
<tr>
<td>6.8 nF</td>
<td>G0</td>
<td>G0</td>
</tr>
<tr>
<td>10 nF</td>
<td>G0</td>
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<tr>
<td>15 nF</td>
<td>G0</td>
<td>G0</td>
</tr>
<tr>
<td>22 nF</td>
<td>G0</td>
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<tr>
<td>33 nF</td>
<td>G0</td>
<td>G0</td>
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<td>47 nF</td>
<td>G0</td>
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<tr>
<td>68 nF</td>
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<td>150 nF</td>
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<td>G0</td>
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<tr>
<td>220 nF</td>
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<tr>
<td>330 nF</td>
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<tr>
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</tr>
<tr>
<td>680 nF</td>
<td>G1</td>
<td>G1</td>
</tr>
<tr>
<td>1.0 µF</td>
<td>GA</td>
<td>GA</td>
</tr>
<tr>
<td>2.2 µF</td>
<td>G3</td>
<td>G3</td>
</tr>
<tr>
<td>4.7 µF</td>
<td>GB</td>
<td>GB</td>
</tr>
<tr>
<td>10 µF</td>
<td>GB</td>
<td>GB</td>
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<tr>
<td>22 µF</td>
<td>GC</td>
<td>GC</td>
</tr>
<tr>
<td>47 µF</td>
<td>GC</td>
<td>GC</td>
</tr>
</tbody>
</table>

**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.
4. Please contact local sales force for special ordering code before ordering.
## Thickness Classes and Packing Quantity

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

X7R DIELECTRIC CAPACITORS; NISN TERMINATIONS

Unless otherwise specified, all test and measurements shall be made under standard atmospheric conditions for testing as given in 5.3 of IEC 60068-1:

- Temperature: 15 °C to 35 °C
- Relative humidity: 25% to 75%
- Air pressure: 86 kPa to 106 kPa

Before the measurements are made, the capacitor shall be stored at the measuring temperature for a time sufficient to allow the entire capacitor to reach this temperature.

The period as prescribed for recovery at the end of a test is normally sufficient for this purpose.

Table 7

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>VALUE</th>
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</thead>
<tbody>
<tr>
<td>Capacitance range</td>
<td>100 pF to 47 µF</td>
</tr>
<tr>
<td>Capacitance tolerance</td>
<td>±5%, ±10%, ±20%</td>
</tr>
<tr>
<td>Dissipation factor (D.F.)</td>
<td>X7R</td>
</tr>
<tr>
<td></td>
<td>0201</td>
</tr>
<tr>
<td>≤10V</td>
<td>100pF to 10nF</td>
</tr>
<tr>
<td></td>
<td>100nF</td>
</tr>
<tr>
<td></td>
<td>1µF</td>
</tr>
<tr>
<td>16V</td>
<td>100pF to 1.2nF</td>
</tr>
<tr>
<td></td>
<td>560pF to 1µF</td>
</tr>
<tr>
<td></td>
<td>220nF</td>
</tr>
<tr>
<td>25V</td>
<td>100pF to 470pF</td>
</tr>
<tr>
<td></td>
<td>560pF to 470pF</td>
</tr>
<tr>
<td></td>
<td>560pF to 10nF</td>
</tr>
<tr>
<td></td>
<td>220nF</td>
</tr>
<tr>
<td>50V</td>
<td>100pF to 470pF</td>
</tr>
<tr>
<td></td>
<td>560pF to 1nF</td>
</tr>
<tr>
<td></td>
<td>680nF</td>
</tr>
<tr>
<td></td>
<td>100nF</td>
</tr>
<tr>
<td>Insulation resistance after 1 minute at Uı (DC)</td>
<td>Rs ≥ 10 GΩ or Rs × Ci ≥ 500/100/50* seconds whichever is less</td>
</tr>
<tr>
<td>Maximum capacitance change as a function of temperature (temperature characteristic/coefficient):</td>
<td>±15%</td>
</tr>
<tr>
<td>Operating temperature range:</td>
<td>–55 °C to +125 °C</td>
</tr>
</tbody>
</table>

NOTE

* Rins ≥ 10 GΩ or Rins × Cr ≥ 500 GΩ:
  0201 : 100pF to 10nF
  0402 : 100pF to 220nF/6.3V
  0603 : 100pF to 470nF
  0805 : 220pF to 1µF, 2.2µF/6.3V to 16V
  1206/1210 : 220pF to 1µF, 220nF/6.3V to 25V, 47nF/6.3V to 16V
  1812 : 4.7nF to 1µF

* Rins × Cr ≥ 100 GΩ:
  0201 : 100nF/6.3V
  0603 : 560nF to 1µF, 2.2µF/6.3V to 16V
  0805 : 2.2µF to 25V, 4.7µF/6.3V to 25V, 1µF/6.3V to 16V
  1206 : 2.2µF/50V, 4.7µF/25V to 50V, 10µF/6.3V to 16V
  1210 : 2.2µF/50V, 4.7µF/25V to 50V, 10µF/6.3V to 50V, 22µF/6.3V to 16V, 47µF/6.3V to 10V

* Rins × Cr ≥ 50 GΩ:
  0402 : 220nF/ 10V to 25V, 470nF/ 6.3V to 10V, 1µF/6.3V
  0603 : 4.7µF/6.3V
Fig. 3  Typical capacitance change as a function of temperature

Fig. 4  Impedance ESR vs. frequency characteristics for multilayer chip capacitors
Fig. 5 Impedance ESR vs. frequency characteristics for multilayer chip capacitors

Fig. 6 Impedance ESR vs. frequency characteristics for multilayer chip capacitors
Size 0805 1 µF / 16 V
Solid lines: Impedance / Dotted lines: ESR

Fig. 7  Impedance ESR vs. frequency characteristics for multilayer chip capacitors

Size 1206 1 µF / 25 V
Solid lines: Impedance / Dotted lines: ESR

Fig. 8  Impedance ESR vs. frequency characteristics for multilayer chip capacitors
**SOLDERING RECOMMENDATION**

**Table 8**

<table>
<thead>
<tr>
<th>SOLDERING METHOD</th>
<th>SIZE</th>
<th>0201</th>
<th>0402</th>
<th>0603</th>
<th>0805</th>
<th>1206</th>
<th>≥ 1210</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reflow</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Reflow only</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; 100 nF</td>
<td>&gt; 1 μF</td>
<td>&gt; 2.2 μF</td>
<td>&gt; 4.7 μF</td>
<td></td>
<td>Reflow only</td>
</tr>
<tr>
<td>Reflow/Wave</td>
<td></td>
<td>≤ 100 nF</td>
<td>≤ 1 μF</td>
<td>≤ 2.2 μF</td>
<td>≤ 4.7 μF</td>
<td></td>
<td>---</td>
</tr>
</tbody>
</table>

Size 1206 10 μF / 10 V
Solid lines: Impedance / Dotted lines: ESR

![Impedance ESR vs. Frequency Characteristics for Multilayer Chip Capacitors](image)

**Fig. 9** Impedance ESR vs. frequency characteristics for multilayer chip capacitors
## TESTS AND REQUIREMENTS

<table>
<thead>
<tr>
<th>TEST</th>
<th>TEST METHOD</th>
<th>PROCEDURE</th>
<th>REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mounting</td>
<td>IEC 60384-21/22</td>
<td>The capacitors may be mounted on printed-circuit boards or ceramic substrates</td>
<td>No visible damage</td>
</tr>
<tr>
<td>Visual Inspection and Dimension Check</td>
<td>4.4</td>
<td>Any applicable method using × 10 magnification</td>
<td>In accordance with specification</td>
</tr>
<tr>
<td>Capacitance (1)</td>
<td>4.5.1</td>
<td>Class 2:</td>
<td>Within specified tolerance</td>
</tr>
<tr>
<td>Dissipation Factor (D.F.) (1)</td>
<td>4.5.2</td>
<td>At 20 °C, 24 hrs after annealing</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cap ≤ 1 µF, f = 1 kHz, measuring at voltage 1 Vrms at 20 °C</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cap &gt; 1 µF, f = 1 kHz for C ≤ 10 µF, rated voltage &gt; 6.3 V, measuring at voltage 1 Vrms at 20 °C</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>f = 1 kHz for C ≤ 10 µF, rated voltage ≤ 6.3 V, measuring at voltage 0.5 Vrms at 20 °C</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>f = 120 Hz for C &gt; 10 µF, measuring at voltage 0.5 Vrms at 20 °C</td>
<td></td>
</tr>
<tr>
<td>Insulation Resistance</td>
<td>4.5.3</td>
<td>At U, (DC) for 1 minute</td>
<td>In accordance with specification</td>
</tr>
</tbody>
</table>

**NOTE:**

1. For individual product specification, please contact local sales.
### Temperature Characteristic

<table>
<thead>
<tr>
<th>TEST METHOD</th>
<th>REQUIREMENTS</th>
</tr>
</thead>
</table>
| IEC 60384-21/22 | Class I: Δ C/C: ±30ppm  
Class II:  
X7R: Δ C/C: ±15%  
Y5V: Δ C/C: 22~82% |

Capacitance shall be measured by the steps shown in the following table. The capacitance change should be measured after 5 min at each specified temperature stage.

<table>
<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>

1. Class I
   Temperature Coefficient shall be calculated from the formula below:

   \[ \text{Temp, Coefficient} = \frac{C_2 - C_1}{C_1 \times \Delta T} \times 10^6 \ [\text{ppm/°C}] \]

   - C1: Capacitance at step c
   - C2: Capacitance at 125°C
   - \( \Delta T = 100°C (=125°C-25°C) \)

2. Class II
   Capacitance Change shall be calculated from the formula below:

   \[ \Delta C = C_2 - C_1 \times \frac{100}{C_1} \]

   - C1: Capacitance at step c
   - C2: Capacitance at step b or d

### Adhesion

A force applied for 10 seconds to the line joining the terminations and in a plane parallel to the substrate.

<table>
<thead>
<tr>
<th>SIZE</th>
<th>REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0603</td>
<td>Force ( \geq 5N )</td>
</tr>
<tr>
<td>0402</td>
<td>Force ( \geq 2.5N )</td>
</tr>
<tr>
<td>0201</td>
<td>Force ( \geq 1N )</td>
</tr>
</tbody>
</table>
**TEST** | **TEST METHOD** | **PROCEDURE** | **REQUIREMENTS**
--- | --- | --- | ---
Bond Strength | 4.8 | Mounting in accordance with IEC 60384-22 paragraph 4.3 | No visible damage

Conditions: bending 1 mm at a rate of 1 mm/s, radius jig 5 mm

Test Substrate:

<table>
<thead>
<tr>
<th>Type</th>
<th>a</th>
<th>b</th>
<th>c</th>
</tr>
</thead>
<tbody>
<tr>
<td>0201</td>
<td>0.3</td>
<td>0.9</td>
<td>0.3</td>
</tr>
<tr>
<td>0402</td>
<td>0.4</td>
<td>1.5</td>
<td>0.5</td>
</tr>
<tr>
<td>0603</td>
<td>1.0</td>
<td>3.0</td>
<td>1.2</td>
</tr>
<tr>
<td>0805</td>
<td>1.2</td>
<td>4.0</td>
<td>1.65</td>
</tr>
<tr>
<td>1206</td>
<td>2.2</td>
<td>5.0</td>
<td>1.65</td>
</tr>
<tr>
<td>1210</td>
<td>2.2</td>
<td>5.0</td>
<td>2.0</td>
</tr>
<tr>
<td>1808</td>
<td>3.5</td>
<td>7.0</td>
<td>3.7</td>
</tr>
</tbody>
</table>

D.R.: within initial specified value
R<sub>V</sub>: within initial specified value

Resistance to Soldering Heat | 4.9 | Precondition: 150 +0/-10 °C for 1 hour, then keep for 24 ±1 hours at room temperature
Preheating: for size ≤ 1206: 120 °C to 150 °C for 1 minute
Preheating: for size >1206: 100 °C to 120 °C for 1 minute and 170 °C to 200 °C for 1 minute
Solder bath temperature: 260 ±5 °C
Dipping time: 10 ±0.5 seconds
Recovery time: 24 ±2 hours | Dissolution of the end face plating shall not exceed 25% of the length of the edge concerned

ΔC/C
Class2:
<General purpose series>
X7R: ±10%
<High Capacitance series>
X7R: ±12.5%
### TESTS

<table>
<thead>
<tr>
<th>TEST</th>
<th>TEST METHOD</th>
<th>PROCEDURE</th>
<th>REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solderability</td>
<td>IEC 60384-21/22</td>
<td>4.10 Preheated to a temperature of 80 °C to 140 °C and maintained for 30 seconds to 60 seconds.</td>
<td>The solder should cover over 95% of the critical area of each termination</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1. Temperature: 235±5°C / Dipping time: 2 ±0.5 s</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>2. Temperature: 245±5°C / Dipping time: 3 ±0.5 s (lead free)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Depth of immersion: 10mm</td>
<td></td>
</tr>
<tr>
<td>Rapid Change of Temperature</td>
<td>4.11</td>
<td>Preconditioning; 150 +0/-10 °C for 1 hour, then keep for 24 ±1 hours at room temperature 5 cycles with following detail: 30 minutes at lower category temperature 30 minutes at upper category temperature Recovery time 24 ±2 hours</td>
<td>No visual damage ±C/C Class2: X7R: ±15%</td>
</tr>
<tr>
<td>Damp Heat with U_load</td>
<td>IEC 60384-21/22</td>
<td>4.13 1. Preconditioning, class 2 only: 150 +0/-10 °C /1 hour, then keep for 24 ±1 hour at room temp 2. Initial measure: Spec: refer to initial spec C, D, IR 3. Damp heat test: 500 ± 12 hours at 40 ±2 °C; 90 to 95% R.H. 1.0 U, applied 4. Recovery: Class 2: 24 ±2 hours 5. Final measure: C, D, IR P.S. If the capacitance value is less than the minimum value permitted, then after the other measurements have been made the capacitor shall be preconditioned according to “IEC 60384 4.1” and then the requirement shall be met.</td>
<td>No visual damage after recovery ±C/C Class2: X7R: ±15% D.F. Class2: X7R: ≤ 1.6V/≤ 7% ≥ 25V/≤ 5% R_y5  Class2: X7R: ≥ 500 MΩ or R_y5 × C_t ≥ 25s whichever is less ±C/C Class2: X7R: ±20% D.F. Class2: X7R: 2 × initial value max R_y5  Class2: X7R: 500 MΩ or R_y5 × C_t ≥ 5s whichever is less</td>
</tr>
</tbody>
</table>
### Endurance

**TEST METHOD**
- IEC 60384-21/22

**PROCEDURE**
1. Preconditioning, class 2 only:
   - 150 ±0/-10 °C / 1 hour; then keep for
   - 24 ±1 hour at room temp
2. Initial measure:
   - Spec: refer to initial spec C, D, IR
3. Endurance test:
   - Temperature: X7R: 125 °C
   - Specified stress voltage applied for 1,000 hours:
   - Applied 2.0 x Ur, for general products*
   - Applied 1.5 x Ur, for high cap. Products*
4. Recovery time: 24 ±2 hours
5. Final measure: C, D, IR

P.S. If the capacitance value is less than the minimum value permitted, then after the other measurements have been made the capacitor shall be preconditioned according to “IEC 60384 4.1” and then the requirement shall be met.

* General product (Applied 2.0 x Ur):
  - 0201 ≤ 10nF
  - 0402 ≤ 100nF
  - 0603 ≤ 470nF
  - 0805, 1206, 1210 ≤ 1μF;
* High cap product (Applied 1.5 x Ur):
  - 0201 > 10nF
  - 0402 > 100nF, 100nF/ 50V
  - 0603 > 470nF
  - 0805, 1206, 1210 > 1μF;

#### REQUIREMENTS
- No visual damage

**<General Purpose series>**
- ∆C/C
  - Class2: X7R: ±15%
  - D.F.
    - Class2: X7R: ≤16V: ≤7% ≥25V: ≤5%
  - R<sub>ins</sub>
    - Class2: X7R: ≥1,000 MΩ or R<sub>ins</sub> x C ≥ 50s whichever is less

**<High Capacitance series>**
- ∆C/C
  - Class 2:
    - X7R: 2 x initial value max
  - R<sub>ins</sub>
    - Class 2:
      - X7R: 1,000 MΩ or R<sub>ins</sub> x C ≥ 10s whichever is less

### Voltage Proof

**TEST METHOD**
- IEC 60384-1

**PROCEDURE**
- Specified stress voltage applied for 1~5 seconds
  - Ur ≤ 100 V: series applied 2.5 Ur
  - Charge/Discharge current is less than 50 mA

**REQUIREMENTS**
- No breakdown or flashover
<table>
<thead>
<tr>
<th>REVISION</th>
<th>DATE</th>
<th>CHANGE NOTIFICATION</th>
<th>DESCRIPTION</th>
</tr>
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<tbody>
<tr>
<td>Version 20</td>
<td>Sep. 8, 2020</td>
<td>-</td>
<td>0402, 220nF to 470nF, 10V Insulation resistance after 1 minute at Ur (DC) updated</td>
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<tr>
<td>Version 19</td>
<td>Aug. 17, 2020</td>
<td>-</td>
<td>Add 0402/220nF/25V</td>
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<tr>
<td>Version 18</td>
<td>May. 11th, 2017</td>
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<td>Add 1210/10µF/50V</td>
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<td>Version 17</td>
<td>Mar. 7th, 2017</td>
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<td>0805 L4 spec updated</td>
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<td>Dimension updated</td>
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<tr>
<td>Version 16</td>
<td>Dec. 7th, 2016</td>
<td>-</td>
<td>Dimension updated</td>
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<tr>
<td>Version 15</td>
<td>Oct. 3rd, 2016</td>
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<td>Dimension updated, Soldering recommendation updated</td>
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<tr>
<td>Version 14</td>
<td>May 31st, 2016</td>
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<td>Dimension updated</td>
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<td>Version 13</td>
<td>Dec. 30, 2015</td>
<td>-</td>
<td>Dimension on 0603 and 1206 case size updated</td>
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<td>Version 12</td>
<td>May 26, 2015</td>
<td>-</td>
<td>1210, 25V dissipation factor updated</td>
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<tr>
<td>Version 11</td>
<td>Jan. 06, 2015</td>
<td>-</td>
<td>0402, 100nF, 50V Dissipation factor (D.F.) updated</td>
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<td>Version 10</td>
<td>Jul. 08, 2014</td>
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<td>Version 9</td>
<td>Aug. 19, 2013</td>
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<td>Version 8</td>
<td>Oct. 13, 2011</td>
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<td>50V Dissipation factor(D.F.) updated</td>
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<td>Version 7</td>
<td>Jan. 13, 2011</td>
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<td>Dimension updated</td>
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<td>Version 6</td>
<td>Oct. 13, 2010</td>
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<td>Rated voltage of 0201 extend to 50V</td>
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<td>Capacitance range of 0201 X7R 6.3V to 16V extend to 100pF</td>
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<td>Capacitance range of 0805 X7R 10V extend to 10µF</td>
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<td>Capacitance range of 0805 X7R 50V extend to 1 µF</td>
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<td>Capacitance range of 1210 X7R 10V extend to 22 µF</td>
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<td>Dimension on 0603 and 1206 case size updated</td>
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<td>16V to 25V Dissipation factor(D.F.) updated</td>
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<td>Version 4</td>
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<td>The statement of &quot;Halogen Free&quot; on the cover added</td>
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<td>Version 3</td>
<td>Oct. 26, 2009</td>
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<td>Capacitance range of 0402 X7R 25 V extend to 100 nF</td>
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<td>Version 2</td>
<td>May 11, 2009</td>
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<td>Product range updated</td>
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<tr>
<td>Version 1</td>
<td>Apr 24, 2009</td>
<td>-</td>
<td>Ordering code updated</td>
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<tr>
<td>Version 0</td>
<td>Apr 15, 2009</td>
<td>-</td>
<td>New datasheet for general purpose and high capacitance X7R series with RoHS compliant</td>
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<td></td>
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<td>Replace the &quot;6.3V to 50V&quot; part of pdf files: X7R_10V_9, X7R_16V-to-100V_9, X7R_16-to-500V_9, UP-X5R_X7R_HighCaps_6.3-to-25V_11, UY-X5R_X7R_HighCaps_6.3-to-25V_11</td>
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<td></td>
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<td>Combine 0201 from pdf files: UP-NP0X5RX7RY5V_0201_6.3-to-50V_2 and UY-NPOX5RX7RY5V_0201_6.3-to-50V_2</td>
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<td>Define global part number</td>
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<td></td>
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<td>-</td>
<td>Description of &quot;Halogen Free compliant&quot; added</td>
</tr>
<tr>
<td></td>
<td></td>
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<td>Test method and procedure updated</td>
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