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 & IRC
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>
<thead>
<tr>
<th>CC</th>
<th>xxxx</th>
<th>x</th>
<th>x7R</th>
<th>x</th>
<th>BB</th>
<th>xxx</th>
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</thead>
<tbody>
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<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
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<td></td>
</tr>
</tbody>
</table>

(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>
</tr>
</tbody>
</table>

(2) TOLERANCE

<table>
<thead>
<tr>
<th>TOLERANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>J = ±5% (1)</td>
</tr>
<tr>
<td>K = ±10%</td>
</tr>
<tr>
<td>M = ±20%</td>
</tr>
</tbody>
</table>

(3) PACKING STYLE

<table>
<thead>
<tr>
<th>PACKING STYLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>R = Paper/PE taping reel; Reel 7 inch</td>
</tr>
<tr>
<td>K = Blister taping reel; Reel 7 inch</td>
</tr>
<tr>
<td>P = Paper/PE taping reel; Reel 13 inch</td>
</tr>
<tr>
<td>F = Blister taping reel; Reel 13 inch</td>
</tr>
</tbody>
</table>

(4) RATED VOLTAGE

<table>
<thead>
<tr>
<th>RATED VOLTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 = 6.3 V</td>
</tr>
<tr>
<td>6 = 10 V</td>
</tr>
<tr>
<td>7 = 16 V</td>
</tr>
<tr>
<td>8 = 25 V</td>
</tr>
<tr>
<td>9 = 50 V</td>
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</tbody>
</table>

(5) CAPACITANCE VALUE

<table>
<thead>
<tr>
<th>2 significant digits + number of zeros</th>
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<tbody>
<tr>
<td>The 3rd digit signifies the multiplying factor, and letter R is decimal point</td>
</tr>
<tr>
<td>Example: 103 = 10 x 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**

For outlines see fig. 2

<table>
<thead>
<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>
</tr>
</thead>
<tbody>
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<td>0201</td>
<td>0.6 ±0.03</td>
<td>0.3 ±0.03</td>
<td>0.3 ±0.03</td>
<td>0.1</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>0402</td>
<td>1.0 ±0.05</td>
<td>0.5 ±0.05</td>
<td>0.5 ±0.05</td>
<td>0.15</td>
<td>0.35</td>
<td>0.4</td>
</tr>
<tr>
<td>0603</td>
<td>1.6 ±0.1</td>
<td>0.8 ±0.1</td>
<td>0.8 ±0.1</td>
<td>0.2</td>
<td>0.6</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<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</td>
</tr>
<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</td>
</tr>
<tr>
<td>0805</td>
<td>2.0 ±0.1</td>
<td>1.25 ±0.1</td>
<td>0.6 ±0.1</td>
<td>0.25</td>
<td>0.75</td>
<td>0.55</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>0.55</td>
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<tr>
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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>0.55</td>
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<tr>
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<td>1.6 ±0.15</td>
<td>0.85 ±0.1</td>
<td>0.25</td>
<td>0.75</td>
<td>1.4</td>
</tr>
<tr>
<td></td>
<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</td>
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<td>1.15 ±0.1</td>
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<td>0.75</td>
<td>1.4</td>
</tr>
<tr>
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<td>1.6 ±0.2</td>
<td>1.6 ±0.2</td>
<td>0.25</td>
<td>0.8</td>
<td>1.4</td>
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<tr>
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<td>0.75</td>
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<td>0.75</td>
<td>1.4</td>
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<td>0.75</td>
<td>1.4</td>
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<td>1.4</td>
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<tr>
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<td>1.9 ±0.2</td>
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<td>0.75</td>
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<td>0.75</td>
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<td>0.75</td>
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<tr>
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<td>1.15 ±0.1</td>
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### CAPACITANCE RANGE & THICKNESS FOR X7R

**Table 2** Sizes from 0201 to 0402

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<tr>
<td>150 pF</td>
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<tr>
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<tr>
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</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
### CAPACITANCE RANGE & THICKNESS FOR X7R

Table 3  Sizes from 0603 to 0805

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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

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<thead>
<tr>
<th>CAP.</th>
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<tbody>
<tr>
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<td>47 µF</td>
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</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>
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<td>470 pF</td>
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<tr>
<td>680 pF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.0 nF</td>
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<td>G0</td>
<td>G0</td>
</tr>
<tr>
<td>33 nF</td>
<td>G0</td>
<td>G0</td>
</tr>
<tr>
<td>47 nF</td>
<td>G0</td>
<td>G0</td>
</tr>
<tr>
<td>68 nF</td>
<td>G0</td>
<td>G0</td>
</tr>
<tr>
<td>100 nF</td>
<td>G0</td>
<td>G0</td>
</tr>
<tr>
<td>150 nF</td>
<td>G0</td>
<td>G0</td>
</tr>
<tr>
<td>220 nF</td>
<td>G0</td>
<td>G0</td>
</tr>
<tr>
<td>330 nF</td>
<td>G0</td>
<td>G0</td>
</tr>
<tr>
<td>470 nF</td>
<td>G1</td>
<td>G1</td>
</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>GB</td>
<td>GB</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>
</tr>
<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 product with 5% tolerance, please contact local sales force before ordering
4. Please contact local sales force for special ordering code before ordering
## Table 6

### Thickness Classes and Packing Quantity

<table>
<thead>
<tr>
<th>SIZE CODE</th>
<th>THICKNESS CLASSIFICATION</th>
<th>TAPE WIDTH</th>
<th>QUANTITY PER REEL</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></td>
<td>Paper</td>
<td>Blister</td>
<td>Paper</td>
<td>Blister</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>
<td>---</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>
<td>---</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>
<td>---</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>
<td>---</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>
<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>
<td>10,000</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>
<td>---</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>
<td>---</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>
<td>10,000</td>
</tr>
<tr>
<td></td>
<td>1.25 ±0.2 mm</td>
<td>8 mm</td>
<td>---</td>
<td>3,000</td>
<td>---</td>
<td>10,000</td>
</tr>
<tr>
<td></td>
<td>1.6 ±0.15 mm</td>
<td>8 mm</td>
<td>---</td>
<td>2,500</td>
<td>---</td>
<td>10,000</td>
</tr>
<tr>
<td></td>
<td>1.6 ±0.2 mm</td>
<td>8 mm</td>
<td>---</td>
<td>2,000</td>
<td>---</td>
<td>8,000</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>
<td>15,000</td>
</tr>
<tr>
<td></td>
<td>0.85 ±0.1 mm</td>
<td>8 mm</td>
<td>---</td>
<td>4,000</td>
<td>---</td>
<td>10,000</td>
</tr>
<tr>
<td></td>
<td>1.15 ±0.1 mm</td>
<td>8 mm</td>
<td>---</td>
<td>3,000</td>
<td>---</td>
<td>10,000</td>
</tr>
<tr>
<td></td>
<td>1.15 ±0.15 mm</td>
<td>8 mm</td>
<td>---</td>
<td>3,000</td>
<td>---</td>
<td>10,000</td>
</tr>
<tr>
<td></td>
<td>1.25 ±0.2 mm</td>
<td>8 mm</td>
<td>---</td>
<td>3,000</td>
<td>---</td>
<td>10,000</td>
</tr>
<tr>
<td></td>
<td>1.5 ±0.1 mm</td>
<td>8 mm</td>
<td>---</td>
<td>2,000</td>
<td>---</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>
<td>---</td>
</tr>
<tr>
<td></td>
<td>2.0 ±0.2 mm</td>
<td>8 mm</td>
<td>---</td>
<td>2,000</td>
<td>1,000</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>500</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>
<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>
<td>---</td>
</tr>
<tr>
<td></td>
<td>1.35 ±0.15 mm</td>
<td>12 mm</td>
<td>---</td>
<td>2,000</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>1.5 ±0.1 mm</td>
<td>12 mm</td>
<td>---</td>
<td>2,000</td>
<td>---</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>
<td>8,000</td>
</tr>
<tr>
<td></td>
<td>2.0 ±0.2 mm</td>
<td>12 mm</td>
<td>---</td>
<td>2,000</td>
<td>---</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>
<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>
<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>
<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>
<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>
<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>
<td>---</td>
</tr>
<tr>
<td></td>
<td>2.5 ±0.2 mm</td>
<td>12 mm</td>
<td>---</td>
<td>500</td>
<td>---</td>
<td>---</td>
</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>
</tr>
</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>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dissipation factor (D.F.)</th>
<th>X7R</th>
<th>0201</th>
<th>0402</th>
<th>0603</th>
<th>0805</th>
<th>1206</th>
<th>1210</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤10V</td>
<td>100pF to 10nF</td>
<td>100pF to 10nF</td>
<td>100pF to 1mF</td>
<td>100pF to 1mF</td>
<td>220pF to 2.2µF</td>
<td>220pF to 2.2µF</td>
<td>≤5%</td>
</tr>
<tr>
<td></td>
<td>100nF</td>
<td>220nF to 470nF</td>
<td>2.2µF to 4.7µF</td>
<td>4.7µF to 10µF</td>
<td>4.7µF to 22µF</td>
<td>4.7µF to 47µF</td>
<td>≤10%</td>
</tr>
<tr>
<td></td>
<td>1µF</td>
<td>≤12.5%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16V</td>
<td>100pF to 1.2nF</td>
<td>100pF to 22nF</td>
<td>100pF to 220nF</td>
<td>150pF to 470nF</td>
<td>220pF to 1µF</td>
<td>2.2nF to 1µF</td>
<td>≤3.5%</td>
</tr>
<tr>
<td></td>
<td>1.5nF to 10nF</td>
<td>27nF to 100nF</td>
<td>47nF to 10µF</td>
<td>680 nF to 2.2µF</td>
<td>2.2µF</td>
<td>2.2µF to 10µF</td>
<td>≤5%</td>
</tr>
<tr>
<td></td>
<td>220nF</td>
<td>2.2µF</td>
<td>4.7µF to 10µF</td>
<td>4.7µF to 22µF</td>
<td>22µF</td>
<td>≤10%</td>
<td></td>
</tr>
<tr>
<td>25V</td>
<td>100pF to 470pF</td>
<td>100pF to 10nF</td>
<td>100pF to 39nF</td>
<td>150pF to 180nF</td>
<td>220pF to 680nF</td>
<td>2.2nF to 1µF</td>
<td>≤2.5%</td>
</tr>
<tr>
<td></td>
<td>12 nF to 47nF</td>
<td>47nF to 220nF</td>
<td>220nF to 470nF</td>
<td>1µF</td>
<td>≤3.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>560pF to 10nF</td>
<td>56nF to 100nF</td>
<td>680 nF to 1µF</td>
<td>2.2µF</td>
<td>≤5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>270nF to 1µF</td>
<td>2.2µF to 4.7µF</td>
<td>4.7µF to 22µF</td>
<td>4.7µF to 22µF</td>
<td>≤10%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50V</td>
<td>100pF to 1nF</td>
<td>100pF to 10nF</td>
<td>100pF to 39nF</td>
<td>150pF to 180nF</td>
<td>220pF to 470nF</td>
<td>2.2nF to 1µF</td>
<td>≤2.5%</td>
</tr>
<tr>
<td></td>
<td>12 nF to 47nF</td>
<td>47nF to 220nF</td>
<td>220nF to 470nF</td>
<td>680nF to 1µF</td>
<td>≤3.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>680nF</td>
<td>680nF</td>
<td>680nF</td>
<td>680nF</td>
<td>≤5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>100nF</td>
<td>470nF to 1µF</td>
<td>1µF to 2.2µF</td>
<td>2.2µF to 4.7µF</td>
<td>2.2µF to 10µF</td>
<td>≤10%</td>
<td></td>
</tr>
</tbody>
</table>

**Insulation resistance after 1 minute at Uc (DC)**

\[ R_{ins} \geq 10 \, G\Omega \text{ or } R_{ins} \times C \geq 500(100)^* \text{ seconds whichever is less} \]

**Maximum capacitance change as a function of temperature**

(temperature characteristic/coefficient):

\[ \pm 15% \]

**Operating temperature range:**

\[-55 ^\circ C \text{ to } +125 ^\circ C\]

**NOTE**

*For individual I.R specification, please contact local sales.*
Fig. 3  Typical capacitance change as a function of temperature
**Surface-Mount Ceramic Multilayer Capacitors**

**General Purpose & High Cap.**

**Size 0201 10 nF / 16 V**

Solid lines: Impedance / Dotted lines: ESR

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

**Size 0402 100 nF / 16 V**

Solid lines: Impedance / Dotted lines: ESR

**Fig. 5** Impedance ESR vs. frequency characteristics for multilayer chip capacitors
Size 0603 1 µF / 16 V
Solid lines: Impedance / Dotted lines: ESR

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

Fig. 9  Impedance ESR vs. frequency characteristics for multilayer chip capacitors
SOLDERING RECOMMENDATION

<table>
<thead>
<tr>
<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>
<td>Reflow only</td>
<td>&gt; 100 nF</td>
<td>&gt; 1 µF</td>
<td>&gt; 2.2 µF</td>
<td>&gt; 4.7 µF</td>
<td>Reflow only</td>
</tr>
<tr>
<td>Reflow/Wave</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>

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>4.3 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>
</tbody>
</table>
| Capacitance (1)                  | 4.5.1 | Class 2: At 20 °C, 24 hrs after annealing  
  f = 1 KHz for C ≤ 10 µF, rated voltage > 6.3 V, measuring at voltage 1 V RMS at 20 °C  
  f = 1 KHz, for C ≤ 10 µF, rated voltage ≤ 6.3 V, measuring at voltage 0.5 V RMS at 20 °C  
  f = 120 Hz for C > 10 µF, measuring at voltage 0.5 V RMS at 20 °C | Within specified tolerance |
| Dissipation Factor (D.F.) (1)    | 4.5.2 | Class 2: At 20 °C, 24 hrs after annealing  
  f = 1 KHz for C ≤ 10 µF, rated voltage > 6.3 V, measuring at voltage 1 V RMS at 20 °C  
  f = 1 KHz, for C ≤ 10 µF, rated voltage ≤ 6.3 V, measuring at voltage 0.5 V RMS at 20 °C  
  f = 120 Hz for C > 10 µF, measuring at voltage 0.5 V RMS at 20 °C | In accordance with specification |
| Insulation Resistance            | 4.5.3 | At Uo (DC) for 1 minute | In accordance with specification |

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

IEC 60384-21/22 4.6

Capacity 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 as below:

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

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

### REQUIREMENTS

<General purpose series>

Class I:
- \(\Delta C/C\): ±30ppm

Class II:
- X7R: \(\Delta C/C\): ±15%
- Y5V: \(\Delta C/C\): 22~82%

<High Capacitance series>

Class II:
- X7R/X5R: \(\Delta C/C\): ±15%
- Y5V: \(\Delta C/C\): 22~82%

### Adhesion

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

<table>
<thead>
<tr>
<th>Force</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≥ 0603: 5N</td>
</tr>
<tr>
<td></td>
<td>0402: 2.5N</td>
</tr>
<tr>
<td></td>
<td>0201: 1N</td>
</tr>
</tbody>
</table>
### TEST

<table>
<thead>
<tr>
<th>TEST</th>
<th>TEST METHOD</th>
<th>PROCEDURE</th>
<th>REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bond Strength</td>
<td>4.8</td>
<td>Mounting in accordance with IEC 60384-22 paragraph 4.3</td>
<td>No visible damage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conditions: bending 1 mm at a rate of 1 mm/s, radius jig 5 mm</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Test Substrate:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><img src="https://example.com/diagram.png" alt="Diagram" /></td>
<td></td>
</tr>
</tbody>
</table>

### Dimension (mm)

<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>

### 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:

<table>
<thead>
<tr>
<th>Dimension (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1206: 1.65</td>
</tr>
<tr>
<td>1210: 2.0</td>
</tr>
<tr>
<td>1808: 3.7</td>
</tr>
</tbody>
</table>

D.F. within initial specified value
R<sub>ins</sub> within initial specified value
<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>
</tbody>
</table>

  - Test conditions for lead containing solder alloy
  - Temperature: 235 ±5 °C
  - Dipping time: 2 ±0,2 seconds
  - Depth of immersion: 10 mm
  - Alloy Composition: 60/40 Sn/Pb
  - Number of immersions: 1

  - Test conditions for lead-free containing solder alloy
  - Temperature: 245 ±5 °C
  - Dipping time: 3 ±0,3 seconds
  - Depth of immersion: 10 mm
  - Alloy Composition: SAC305
  - Number of immersions: 1

| Rapid Change of Temperature  | 4.11 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 | No visual damage |

  - ∆C/C
  - Class2: X7R: ±15%

  - D.F. meet initial specified value
  - R_{inv} meet initial specified value
<table>
<thead>
<tr>
<th>TEST</th>
<th>TEST METHOD</th>
<th>PROCEDURE</th>
<th>REQUIREMENTS</th>
</tr>
</thead>
</table>
| Damp Heat with U_l Load    | IEC 60384-21/22 | 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_l 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. | No visual damage after recovery  
**<General Purpose series>**  
ΔC/C  
Class2: X7R: ±15%  
D.F.  
Class2: X7R: ≤ 16V: ≤ 7%  
≥ 25V: ≤ 5%  
R_{ins}  
Class2: X7R: ≥ 500 MΩ or R_{ins} x C ≥ 25s whichever is less  
**<High Capacitance series(≥ 1uF) and C0402xRX7R9BB104>**  
ΔC/C  
Class2: X7R: ±20%  
D.F.  
Class2: X7R: 2 x initial value max  
R_{ins}  
Class2: X7R: 500 MΩ or R_{ins} x C ≥ 5s whichever is less  |
## Surface-Mount Ceramic Multilayer Capacitors

### General Purpose & High Cap

<table>
<thead>
<tr>
<th>TEST</th>
<th>TEST METHOD</th>
<th>PROCEDURE</th>
<th>REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endurance</td>
<td>IEC 60384-21/22</td>
<td>1. Preconditioning, class 2 only:</td>
<td>No visual damage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>150 ±0/-10 °C /1 hour, then keep for 24 ±1 hour at room temp</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Initial measure:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Spec: refer to initial spec C, D, IR</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Endurance test:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Temperature: X7R: 125 °C</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Specified stress voltage applied for 1,000 hours:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Applied 2.0 x Ur, for general products*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Applied 1.5 x Ur, for high cap. Products*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Recovery time: 24 ±2 hours</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Final measure: C, D, IR</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>P.S. If the capacitance value is less than the minimum value permitted,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>then after the other measurements have been made the capacitor shall be</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>preconditioned according to &quot;IEC 60384 4.1&quot; and then the requirement</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>shall be met.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>* General product: 0201 ≤ 10nF, 0402 ≤ 100nF, 0603 ≤ 470nF, 0805, 1206, 1210 ≤ 1µF;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>* High cap product: 0201 &gt; 10nF, 0402 &gt; 100nF, 0603 &gt; 470nF, 0805, 1206, 1210 &gt; 1µF;</td>
<td></td>
</tr>
<tr>
<td>Voltage</td>
<td>IEC 60384-4.6</td>
<td>Specified stress voltage applied for 1~5 seconds</td>
<td>No breakdown or flashover</td>
</tr>
<tr>
<td>Proof</td>
<td></td>
<td>Ur ≤ 100 V: series applied 2.5 Ur</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Charge/Discharge current is less than 50 mA</td>
<td></td>
</tr>
</tbody>
</table>

* Ur: Voltage Proof limit

---

```
No visual damage

<General Purpose series>

ΔC/C
Class2:
X7R: ±15%
D.F.
Class2:
X7R: ≤ 16V: ≤ 7%
≥ 25V: ≤ 5%

R_{ins}
Class2:
X7R: ≥ 1,000 MΩ or R_{ins} x C ≥ 50s
whichever is less

<High Capacitance series>

ΔC/C
Class 2:
X7R: ±20%
D.F.
Class 2:
X7R: 2 x initial value max

R_{ins}
Class 2:
X7R: 1,000 MΩ or R_{ins} x C ≥ 10s
whichever is less
```
## Revision History

<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
<th>Change Notification</th>
<th>Description</th>
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<tbody>
<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>
<td>-</td>
<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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<tr>
<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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<tr>
<td>Version 12</td>
<td>May 26, 2015</td>
<td>-</td>
<td>1210, 25V dissipation factor updated</td>
</tr>
<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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<tr>
<td>Version 10</td>
<td>Jul. 08, 2014</td>
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<td>Dimension updated</td>
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<td>Version 9</td>
<td>Aug. 19, 2013</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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<tr>
<td>Version 6</td>
<td>Oct 13, 2010</td>
<td>-</td>
<td>- Rated voltage of 0201 extend to 50 V</td>
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<td>-</td>
<td>- Capacitance range of 0201 X7R 6.3V to 16V extend to 100 pF</td>
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<td>-</td>
<td>- Capacitance range of 0805 X7R 10V extend to 10 µF</td>
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<td>-</td>
<td>- Capacitance range of 0805 X7R 50V extend to 1 µF</td>
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<td>-</td>
<td>- Capacitance range of 1210 X7R 10V extend to 22 µF</td>
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<td>Figures of impedance ESR updated</td>
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<td>Version 5</td>
<td>Jul 27, 2010</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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<tr>
<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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<tr>
<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>16V Dissipation factor updated</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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<tr>
<td></td>
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<td>-</td>
<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>Combine 0201 from pdf files: UP-NPOX5RX7RY5V_0201_6.3-to-50V_2 and UY-NPOX5RX7RY5V_0201_6.3-to-50V_2</td>
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<tr>
<td></td>
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<td>-</td>
<td>Define global part number</td>
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<tr>
<td></td>
<td></td>
<td>-</td>
<td>Description of &quot;Halogen Free compliant&quot; added</td>
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<tr>
<td></td>
<td></td>
<td>-</td>
<td>Test method and procedure updated</td>
</tr>
</tbody>
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