TO. :

NO. :

# APPROVAL SHEET

MULTILAYER CERAMIC CAPACITOR

Commercial Grade

(IEC-60384 Qualified)

| Approved by customer : (signing or stamping here) |
|---|
| |

| SAMWHA CAPACITOR CO., LTD. | | |
|---|---|---|
| Writtern by | Checked by | Approved by |
|  |  |  |

2023. 02. 10.

**SAMWHA CAPACITOR CO., LTD.**

**Address : 227,GYEONGGIDONG-RO, NAMSA-EUP, CHEOIN-GU, YONGIN-SI, GYEONGGI-DO, KOREA**

**Contact : TEL 82-31-332-6441 , FAX 82-31-332-7661**

**Home page : www.samwha.com**

# Contents

## 1. General Article

Application Range

These specifications refer to the "Multilayer Ceramic Capacitors"mainly used to the computer equipment, communication equipment.

*Caution : Industrial equipment / For the high reliability equipment / LED equipment / Etc.
Please contact sales representatives or product engineers before using the products.
(For details, please refer Page 16)

## 2. General Code

(1) Type Designation

| CS | 1608 | X7R | 104 | K | 500 | N | R | B |
|---|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |

1) Multilayer Ceramic Capacitor (Commercial Grade)

2) Size Code :
This is expressed in tens of a millimeter.
The first two digits are the length, The last two digits are width.

3) Temperature Coefficient Code

| Classification | Code | Temperature Range | Capacitance Tolerance |
|---|---|---|---|
| Class I | C0G | -55 to +125℃ | ±30 ppm/℃ |
| Class II | X5R | -55 to +85℃ | ±15% |
| | X7R | -55 to +125℃ | ±15% |
| | Y5V | -30 to +85℃ | +22% ~ -82% |

4) Capacitance Code(Pico farads) :
The nominal Capacitance Value in pF is expressed by three digit numbers.
The first two digits represents significant figures and the last digit denotes the number of zero
ex) 104 = 100000 pF
R denotes decimal
8R2 = 8.2 pF

5) Capacitance Tolerance Code

| Code | Tolerance |
|---|---|
| B | ± 0.1 pF |
| C | ± 0.25 pF |
| D | ± 0.5 pF |
| F | ± 1.0 % |
| G | ± 2.0 % |
| J | ± 5 % |
| K | ± 10 % |

| Code | Tolerance |
|---|---|
| M | ± 20 % |
| P | + 100, -0% |
| Z | + 80, -20% |
| H | + 0.25/-0 pF |
| I | + 0/-0.25 pF |
| U | + 5/-0 % |
| V | + 0/-5 % |

6) Voltage Code

| code | 6R3 | 100 | 160 | 250 | 350 | 500 | 101 | 201 | 251 | 501 | 631 | 102 | 202 | 302 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vol. | DC 6.3V | DC 10V | DC 16V | DC 25V | DC 35V | DC 50V | DC 100V | DC 200V | DC 250V | DC 500V | DC 630V | DC 1KV | DC 2KV | DC 3KV |

7) Termination Code

ex) N : Ni-Sn (Nickel-Tin Plate)

A : Ag/Ni-Sn (Ag Epoxy/Nickel-Tin Plate) -> **Soft Termination** Type

8) Packing Code

ex) R : 7" Reel Type

L : 13" Reel Type

B : Bulk Type

9) Thickness option

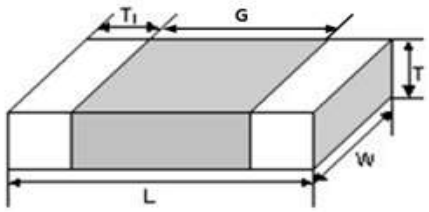
| Thickness(mm) | | Code | Thickness(mm) | | Code |
|---|---|---|---|---|---|
| t | Tol(±) | | t | Tol(±) | |
| 0.30 | 0.03 | Blank | 1.30 | 0.20 | E |
| 0.50 | 0.05 | Blank | 1.35 | 0.20 | H |
| 0.60 | 0.10 | A | 1.60 | 0.20 | I |
| 0.80 | 0.10 | B | 1.80 | 0.20 | J |
| 0.85 | 0.15 | B | 2.00 | 0.25 | K |
| 1.00 | 0.15 | E | 2.50 | 0.25 | L |
| 1.10 | 0.15 | E | 2.80 | 0.30 | M |
| 1.15 | 0.15 | E | 3.20 | 0.30 | N |
| 1.25 | 0.15 | E | 5.00 | 0.40 | O |

## 3. Temperature Characteristics

See Page 6/16 (No.14)

## 4. Constructions and Dimensions

(I) Dimensions




(Unit : mm)

| Code | Dimension | | | | | |
|---|---|---|---|---|---|---|
| | Length | | Width | | T1(min) | G(min) |
| | L | Tol(±) | W | Tol(±) | | |
| 0603 | 0.60 | 0.03 | 0.30 | 0.03 | 0.05 | 0.15 |
| 1005 | 1.00 | 0.05 | 0.50 | 0.05 | 0.15 | 0.30 |
| 1608 | 1.60 | 0.15 | 0.80 | 0.10 | 0.20 | 0.50 |
| 2012 | 2.00 | 0.20 | 1.25 | 0.15 | 0.20 | 0.70 |
| 3216 | 3.20 | 0.30 | 1.60 | 0.20 | 0.30 | 1.20 |
| 3225 | 3.20 | 0.40 | 2.50 | 0.25 | 0.30 | 1.00 |
| 4520 | 4.50 | 0.40 | 2.00 | 0.25 | 0.30 | 1.00 |
| 4532 | 4.50 | 0.40 | 3.20 | 0.30 | 0.30 | 2.20 |
| 5750 | 5.70 | 0.50 | 5.00 | 0.40 | 0.30 | 3.20 |

*1005 Size ≥4.7㎌ ⇒ L, W, T : Tol±0.15 *1608 Size ≥10㎌ ⇒ W : 0.80±0.15, T : 0.80±0.15

*2012 Size ≥10㎌ ⇒ W : 1.25±0.20, T : 0.85±0.15 *3216 Size ≥47㎌ ⇒ W : 1.60±0.30, T : 1.60±0.30

(2) Construction of Termination

# Ⅰ. General Type

# Specifications and Test Methods (General)

<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">Item</th><th colspan="2">Specification</th><th rowspan="2">Test Methods and Conditions</th></tr>
<tr><th>Class I</th><th>Class II</th></tr>
<tr><td>1</td><td colspan="2">Operating Temperature Range</td><td>C0G :-55 to+125℃</td><td>X7R : -55 to +125℃<br>X5R : -55 to +85℃<br>Y5V : -30 to +85℃</td><td></td></tr>
<tr><td>2</td><td colspan="2">Insulation Resistance</td><td colspan="2">More than 10,000 MΩ or 500Ω.F<br>(Whichever is smaller)</td><td>·Applied the rated voltage for 2 minutes of charging,<br>The charge/discharge current is less than 50mA.</td></tr>
<tr><td>3</td><td colspan="2">Voltage proof</td><td colspan="2">No defects or abnormalities</td><td>C0G : The rated voltage ×300%<br>X7R, X5R, Y5V : 〃 ×250%<br><br>- Applied between the terminations for 1 to 5 seconds.<br>- The charge/discharge current is less than 50mA.</td></tr>
<tr><td>4</td><td colspan="2">Capacitance</td><td colspan="2">within the specified tolerance</td><td rowspan="2">The capacitance/Q/D.F. should be measured at 25℃ at the requency and voltage shown in the table.<br><table><tr><th>Cap</th><th>Testing frequency</th><th>Testing Voltage</th></tr><tr><td>C0G (C<1000pF)</td><td>1±0.1MHz</td><td>0.5to5 Vrms</td></tr><tr><td>C0G (C≥1000pF)</td><td>1±0.1kHz</td><td>1±0.2 Vrms</td></tr><tr><td>X7R, X5R,Y5V (C≤10μF)</td><td>1±0.1kHz</td><td>1±0.2 Vrms</td></tr><tr><td>X7R, X5R, Y5V (C>10μF)</td><td>120±24Hz</td><td>0.5±0.1 Vrms</td></tr></table>· Initial measurement<br>Perform the initial measurement according to Note1 for Class II<br>· Measurement after test<br>Take it out and set it for 24±2 hours (Class I) or 24±2 hours (Class II) then measure</td></tr>
<tr><td>5</td><td colspan="2">Dissipation Factor</td><td>30pFmin<br>: Q≧1,000(DF≦0.1%)<br><br>30pFmax<br>: Q≧400+20C<br>(DF≦1/ (400+20C))</td><td><table><tr><th>Char.</th><th>50V min</th><th>25V</th><th>16V</th><th>10V</th><th>6.3V</th></tr><tr><td>X7R<br>X5R</td><td>≦2.5%/<br>*≦5%</td><td>≦3%/<br>*≦7%</td><td>≦3.5%/<br>*≦7%</td><td>≦5%/<br>*≦10%</td><td>≦5%/<br>*≦10%</td></tr><tr><td>Y5V</td><td>≦5%/<br>*≦9%</td><td>≦7%/<br>*≦9%</td><td>≦9%/<br>*≦12.5%</td><td>≦12.5%/<br>*≦15%</td><td>≦15%</td></tr></table></td></tr>
<tr><td>6</td><td colspan="2">Solderability</td><td colspan="2">95% of the terminations is to be soldered evenly and continuously.</td><td>*Pb-Free type<br>Solder : 96.5Sn-3Ag-0.5Cu<br>Solder temperature : 245±5℃<br>Immersion time : 3±0.1sec<br>*Pre-Heating : at 80~120℃ for 10~30sec</td></tr>
<tr><td rowspan="4">7</td><td rowspan="4">Resistance to Soldering Heat</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="4">·Preheat the capacitor at 120 to 150℃ for 1 minute.<br>(Preheating for 3225,4520,4532<br>Step1:100℃ to 120℃, 1min<br>Step2:170℃ to 200℃, 1min )<br>Immerse the capacitor in a eutectic solder solution<br>·Soldering Temp:260 ±5℃<br>·Immersion Time:10 ±0.5 sec<br>·Initial measurement<br>Perform the initial measurement according to Note1 for Class II<br>·Measurement after test<br>Take it out and set it for 24±2 hours (Class I) or 24±2 hours (Class II) then measure</td></tr>
<tr><td>Capacitance change</td><td>within ±2.5%<br>or ±0.25pF<br>(whichever is larger)</td><td>X7R, X5R: ≦ ±7.5%<br>Y5V : ≦ ±20%</td></tr>
<tr><td>Dissipation Factor (or Q)</td><td>30pFmin<br>: Q≧1,000 (DF≦0.1%)<br><br>30pFmax<br>: Q≧400+20C<br>(DF≦1/(400+20C))</td><td><table><tr><th>Char.</th><th>50V min</th><th>25V</th><th>16V</th><th>10V</th><th>6.3V</th></tr><tr><td>X7R<br>X5R</td><td>≦2.5%/<br>*≦5%</td><td>≦3%/<br>*≦7%</td><td>≦3.5%/<br>*≦7%</td><td>≦5%/<br>*≦10%</td><td>≦5%/<br>*≦10%</td></tr><tr><td>Y5V</td><td>≦5%/<br>*≦9%</td><td>≦7%/<br>*≦9%</td><td>≦9%/<br>*≦12.5%</td><td>≦12.5%/<br>*≦15%</td><td>≦15%</td></tr></table></td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω.F<br>(whichever is smaller)</td></tr>
</table>

<table>
<tr><th rowspan="2">No.</th><th colspan="2" rowspan="2">Item</th><th colspan="2">Specification</th><th rowspan="2">Test Methods and Conditions</th></tr>
<tr><th>Class I</th><th>Class II</th></tr>
<tr><td rowspan="4">8</td><td rowspan="4">Rapid change of temperature</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="4">Perform the five cycles according to the four heat treatments listed in the following table.<br><table><tr><td>Step</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>Temp (℃)</td><td>Min. operating temp. +0, -3</td><td>Room Temp</td><td>Max. operating temp. +3, -0</td><td>Room Temp</td></tr><tr><td>Time (min)</td><td>30±3</td><td>2 to3</td><td>30±3</td><td>2 to3</td></tr></table><br>·Initial measurement<br>Perform the initial measurement according to Note1 for Class II<br><br>·Measurement after test<br>Perform the final measurement according to Note2</td></tr>
<tr><td>Capacitance Change</td><td>Within ±2.5% or ±0.25pF (whichever is larger)</td><td>X7R, X5R : Within ±7.5%<br>Y5V : Within ±20%</td></tr>
<tr><td>Dissipation Factor (or Q)</td><td>30pF min<br>: Q≧1,000 (DF≦0.1%)<br><br>30pF max<br>: Q≧400+20C<br>(DF≦1/(400+20C))</td><td><table><tr><td>Char</td><td>50V min</td><td>25V</td><td>16V</td><td>10V</td><td>6.3V</td></tr><tr><td>X7R<br>X5R</td><td>≦5%/<br>*≦7.5%</td><td>≦5%/<br>*≦10%</td><td>≦5%/<br>*≦10%</td><td>≦7.5%/<br>*≦12.5</td><td>≦7.5%/<br>*≦12.5%</td></tr><tr><td>Y5V</td><td>≦7.5%/<br>*≦12.5%</td><td>≦10%/<br>*≦12.5%</td><td>≦12.5%/<br>*≦15%</td><td>≦15%/<br>*≦20%</td><td>≦20%</td></tr></table></td></tr>
<tr><td>I.R</td><td colspan="2">More than 10,000MΩ or 500Ω.F<br>(Whichever is smaller)</td></tr>
<tr><td rowspan="4">9</td><td rowspan="4">Accelerated damp heat, steady state</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="4">·Temperature : 40±2℃<br>·Humidity : 90~95%RH<br>·Hour : 500+24/-0 hrs<br>·Applied Voltage : Rated Voltage<br>The charge/discharge current is less than 50mA.<br><br>·Initial measurement<br>Perform the initial measurement according to Note1 for Class II<br><br>·Measurement after test<br>Perform the final measurement according to Note2</td></tr>
<tr><td>Capacitance Change</td><td>Within ±7.5% or ±0.75pF (whichever is larger)</td><td>X7R, X5R : Within ±12.5%<br>Y5V : Within +30%, -40%<br>(Y5V/1.0μF,2.2μF,4.7μF/10V)<br>Within ±30% (others)</td></tr>
<tr><td>Dissipation Factor(or Q)</td><td>30pF min<br>: Q≧200 (DF≦0.5%)<br><br>30pF max<br>: Q≧100+10/3C<br>DF≦1/(100+10/3C)</td><td><table><tr><td>Char</td><td>50V min</td><td>25V</td><td>16V</td><td>10V</td><td>6.3V</td></tr><tr><td>X7R<br>X5R</td><td>≦5%/<br>*≦7.5%</td><td>≦5%/<br>*≦10%</td><td>≦5%/<br>*≦10%</td><td>≦7.5%/<br>*≦12.5</td><td>≦7.5%/<br>*≦12.5%</td></tr><tr><td>Y5V</td><td>≦7.5%/<br>*≦12.5%</td><td>≦10%/<br>*≦12.5%</td><td>≦12.5%/<br>*≦15%</td><td>≦15%/<br>*≦20%</td><td>≦20%</td></tr></table></td></tr>
<tr><td>I.R</td><td colspan="2">More than 500MΩ or 25Ω.F<br>(Whichever is smaller)</td></tr>
<tr><td rowspan="4">10</td><td rowspan="4">Endurance</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="4">·Testing time : 1000+48/-0 hrs<br><br>·Applied voltage :<br>Rated voltage 〈 DC250V : ×200%<br><br>·Temperature :<br>C0G, X7R → 125±3℃<br>X5R, Y5V → 85±3℃<br>The charge/discharge current is less than 50mA.<br><br>·Initial measurement<br>Perform the initial measurement according to Note1 for Class II<br><br>·Measurement after test<br>Perform the final measurement according to Note2</td></tr>
<tr><td>Capacitance Change</td><td>Within ±3% or ±0.3pF (whichever is larger)</td><td>X7R, X5R : Within ±12.5%<br>Y5V : Within ±30% (cap<1.0μF)<br>Within +30%, -40%<br>(cap≧1.0μF)</td></tr>
<tr><td>Dissipation Factor (or Q)</td><td>30pF min<br>: Q≧350 (DF≦0.3%)<br><br>10pF≦Cp≦30pF<br>: Q≧275+5/2C<br>(DF≦1/(275+5/2C))<br><br>10pF max<br>: Q≧200+10C<br>(DF≦1/(200+10C))</td><td><table><tr><td>Char</td><td>50V min</td><td>25V</td><td>16V</td><td>10V</td><td>6.3V</td></tr><tr><td>X7R<br>X5R</td><td>≦5%/<br>*≦7.5%</td><td>≦5%/<br>*≦10%</td><td>≦5%/<br>*≦10%</td><td>≦7.5%/<br>*≦12.5</td><td>≦7.5%/<br>*≦12.5%</td></tr><tr><td>Y5V</td><td>≦7.5%/<br>*≦12.5%</td><td>≦10%/<br>*≦12.5%</td><td>≦12.5%/<br>*≦15%</td><td>≦15%/<br>*≦20%</td><td>≦20%</td></tr></table></td></tr>
<tr><td>I.R</td><td colspan="2">More than 1,000MΩ or 50Ω.F<br>(whichever & smaller)</td></tr>
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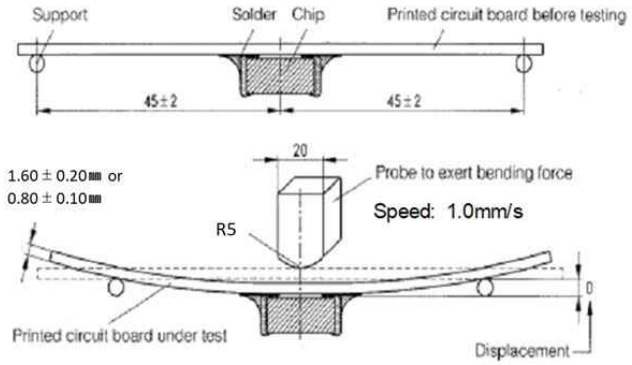
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">Item</th><th colspan="2">Specification</th><th rowspan="2">Test Methods and Conditions</th></tr>
<tr><th>Class I</th><th>Class II</th></tr>
<tr><td>11</td><td>Substrate bending test</td><td></td><td colspan="2"> 

No cracking or marking defects shall occur</td><td rowspan="2">·Substrate material<br>: Glass EPOXY Board.<br><br>·Thickness<br>: 1.6㎜<br>0.8㎜(0603/1005size)<br><br>*. Test condition<br>- Bending limit : 1mm<br>- Pressurizing speed<br>: 1mm/sec<br>- Holding time : 5±1sec</td></tr>
<tr><td></td><td>Capacitance Change</td><td>Within ±5% or ±0.5pF (whichever is larger)</td><td>X7R, X5R: Within ±10%<br>Y5V: Within ±30%</td></tr>
<tr><td rowspan="3">12</td><td rowspan="3">Vibration</td><td>Appearance</td><td colspan="2">No defects or abnormalities</td><td rowspan="3">*After soldering and then let sit for 24±2hr(temperature compensating type), 24±2hr(high dielectric constant type) at room temperature.<br>The capacitor should be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz, shall be traversed(from 10Hz to 55Hz then 10Hz again) in approximately 1 minute.<br>This motion shall be applied for a period of 2 hours in each 3mutually perpendicular directions(total is 6hours).</td></tr>
<tr><td>Capacitance</td><td colspan="2">Whin the specified tolerance</td></tr>
<tr><td>Q/DF</td><td>30pFmin<br>: Q≧1,000<br>(DF≦0.1%)<br>30pFmax<br>: Q≧400+20C<br>(DF≦1/ (400+20C))</td><td><table>
<tr><th>Char.</th><th>50V min</th><th>25V</th><th>16V</th><th>10V</th><th>6.3V</th></tr>
<tr><td>X7R<br>X5R</td><td>≦2.5%/<br>*≦5%</td><td>≦3%/<br>*≦7%</td><td>≦3.5%/<br>*≦7%</td><td>≦5%/<br>*≦10%</td><td>≦5%/<br>*≦10%</td></tr>
<tr><td>Y5V</td><td>≦5%/<br>*≦9%</td><td>≦7%/<br>*≦9%</td><td>≦9%/<br>*≦12.5%</td><td>≦12.5%/<br>*≦15%</td><td>≦15%</td></tr>
</table></td></tr>
<tr><td rowspan="4">13</td><td rowspan="4">Damp heat, steady state</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="4">·Temperature : 40±2℃<br><br>·Humidity : 90~95%RH<br><br>·Hour : 500+24/-0 hrs<br><br>·Initial measurement<br>Perform the initial measurement according to Note1 for Class II<br><br>·Measurement after test<br>Perform the final measurement according to Note2</td></tr>
<tr><td>Capacitance Change</td><td>within ±5% or ±0.5pF (Whichever is larger)</td><td>X7R, X5R: Within ±12.5%<br>Y5V: Within ±30%</td></tr>
<tr><td>Dissipation (or Q)</td><td>30pF min<br>: Q≧350 (DF≦0.3%)<br><br>10pF≦Cp≦30pF<br>: Q≧275+5/2C<br>(DF≦1/(275+5/2C))<br><br>10pFmax<br>: Q≧200+10C<br>(DF≦1/(200+10C))</td><td><table>
<tr><th>Char</th><th>50V min</th><th>25V</th><th>16V</th><th>10V</th><th>6.3V</th></tr>
<tr><td>X7R<br>X5R</td><td>≦5%/<br>*≦7.5%</td><td>≦5%/<br>*≦10%</td><td>≦5%/<br>*≦10%</td><td>≦7.5%/<br>*≦12.5</td><td>≦7.5%/<br>*≦12.5%</td></tr>
<tr><td>Y5V</td><td>≦7.5%/<br>*≦12.5%</td><td>≦10%/<br>*≦12.5%</td><td>≦12.5%/<br>*≦15%</td><td>≦15%/<br>*≦20%</td><td>≦20%</td></tr>
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<tr><td>I.R.</td><td colspan="2">More than 1,000MΩ or 50Ω.F<br>(Whichever is smaller)</td></tr>
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<tr><th>Class I</th><th>Class II</th></tr>
<tr><td rowspan="2">14</td><td rowspan="2">Temperature characteristic of capacitance</td><td>Capacitance Change</td><td></td><td>
<table>
<tr><th>Char.</th><th>Temp Range</th><th>Reference Temp.</th><th>Cap Change</th></tr>
<tr><td>X7R</td><td>-55 to +125℃</td><td rowspan="3">25℃</td><td>Within ±15%</td></tr>
<tr><td>X5R</td><td>-55 to +85℃</td><td>Within ±15%</td></tr>
<tr><td>Y5V</td><td>-30 to +85℃</td><td>Within +22% -82%</td></tr>
</table>
</td><td rowspan="2">(1) Temperature Compensating Type<br>The temperature coefficient is determined using the capacitance measured in step 3 as a reference, When cycling the temperature sequentially from step 1 through 5,(C0G: +25 to 125℃) the capacitance shall be with in the specified tolerance for the temperature coefficient.<br>The capacitance drift is calculated by dividing the difference between the maximum measured values in the step 1, 3 and 5 by the cap. value in step 3
<table>
<tr><th>Step</th><th>Temperature(℃)</th></tr>
<tr><td>1</td><td>25±2</td></tr>
<tr><td>2</td><td>-55±3</td></tr>
<tr><td>3</td><td>25±2</td></tr>
<tr><td>4</td><td>125±3(for C0G)</td></tr>
<tr><td>5</td><td>25±2</td></tr>
</table>
(2) High Dielectric Constant Type<br>The ranges of capacitance change compared with the 25℃ value over the temperature range shown in the table shall be in the specified range.</td></tr>
<tr><td>Temperature Coefficient</td><td>
<table>
<tr><th>Char.</th><th>Temp Range</th><th>Temperature Coefficient</th></tr>
<tr><td>C0G</td><td>-55 to +125℃</td><td>±30 ppm/℃</td></tr>
</table>
</td><td></td></tr>
</table>

*Note1. Initial Measurement for Class II

Perform a heat treatment at 150+0,-10℃ for one hour and then let sit for 24±2 hours at room temperature,then measure

*Note2. Measurement after test

1.Class I

Let sit for 24±2 hours at room temperature,then measurement

2.Class II

Perform a heat treatment at 150+0,-10℃ for one hour and then let sit for 24±2 hours at room temperature,then measure.

"Following the International standards, the title of each test item is subject to change."

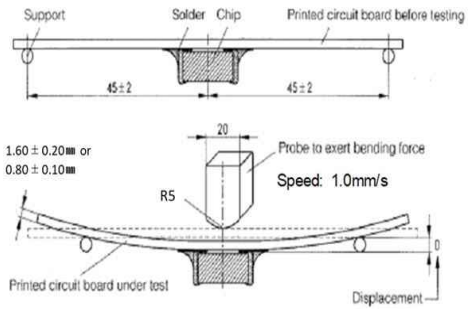
# Ⅱ. Thin Layer Large-Capacitance Type

# Specifications and Test Methods (Thin Layer Large-Capacitance Type)

| No. | Item | | Specification | Test Methods and Conditions |
|---|---|---|---|---|
| 1 | Operating Temperature Range | | X7R : -55 to +125℃<br>X5R : -55 to +85℃<br>Y5V : -30 to +85℃ | |
| 2 | Insulation Resistance | | 50Ω·F min | ·Applied the rated voltage for 2 minutes of charging, The charge/discharge current is less than 50mA. |
| 3 | Voltage proof | | No defects or abnormalities | X7R, X5R, Y5V : The rated voltage × 250%<br>- Applied between the terminations for 1 to 5 seconds.<br>- The charge/discharge current is less than 50mA. |
| 4 | Capacitance | | within the specified tolerance | The capacitance/D.F. should be measured at 25℃ at the frequency and voltage shown in the table. |
| 5 | Dissipation Factor | | X7R, X5R : 12.5%max<br>*3216 Size 100㎌ : 15%max<br>Y5V : 20%max | · Initial measurement<br>Perform the initial measurement according to Note1 for Class II<br>· Measurement after test<br>Take it out and set it for 24±2 hours (Class II) then measure |
| 6 | Solderability | | 95% of the terminations is to be soldered evenly and continuously. | *Pb-Free type<br>Solder : 96.5Sn-3Ag-0.5Cu<br>Solder temperature : 245±5℃<br>Immersion time : 3±0.1sec<br>*Pre-Heating : at 80~120℃ for 10~30sec |
| 7 | Resistance to Soldering Heat | Appearance | No defects which may affect performance | Preheat the capacitor at 120 to 150℃ for 1 minute.<br>(Preheating for 3225,4520,4532<br>Step1:100℃ to 120℃, 1min<br>Step2:170℃ to 200℃, 1min )<br>Immerse the capacitor in a eutectic solder solution at 260±5℃ for 10±0.5 seconds.<br>·Initial measurement<br>Perform the initial measurement according to Note1 for Class II<br>·Measurement after test<br>Let sit at room temperature for 24±2 hours,then measure. |
| | | Capacitance change | X7R, X5R : Within±7.5%<br>Y5V : Within±20% | |
| | | Dissipation Factor | X7R, X5R : 12.5%max<br>*3216 Size 100㎌ : 15%max<br>Y5V : 20%max | |
| | | I.R. | 50Ω·F min | |
| 8 | Rapid change of temperature | Appearance | No defects which may affect performance | Perform the five cycles according to the four heat treatments listed in the following table.<br>·Initial measurement<br>Perform the initial measurement according to Note1 for Class II<br>·Measurement after test<br>Perform the final measurement according to Note2 |
| | | Capacitance Change | X7R, X5R : Within ±7.5%<br>Y5V : Within ±20% | |
| | | Dissipation Factor | X7R, X5R : 12.5%max<br>*3216 Size 100㎌ : 15%max<br>Y5V : 20%max | |
| | | I.R | 50Ω·F min | |

| Capacitance | Frequency | Voltage |
|---|---|---|
| C≦10㎌ | 1 ± 0.1kHz | 0.5~1.0Vrms |
| C>10㎌ | 120 ± 24Hz | 0.5±0.1Vrms |

| Step | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Temp (℃) | Min. operating temp. +0/-3 | Room Temp | Max. operating temp. +3/-0 | Room Temp |
| Time (min) | 30±3 | 2 to3 | 30±3 | 2 to3 |

| No. | Item | | Specification | Test Methods and Conditions |
|---|---|---|---|---|
| 9 | Endurance | Appearance | No defects which may affect performance | Apply 150% of the rated voltage for 1000+48/-0 hrs at the maximum operating temperature ±3℃. The charge/discharge current is less than 50mA.<br>-Initial measurement<br>Perform the initial measurement according to Note1 for Class II<br>-Measurement after test<br>Perform the final measurement according to Note2 |
| | | Capacitance Change | X7R, X5R : Within ±12.5%<br>Y5V : Within ±30% | |
| | | Dissipation Factor | X7R, X5R : 20%max<br>*3216 Size 100㎌ : 30%max<br>Y5V : 40%max | |
| | | I.R | 12.5Ω·F min | |
| 10 | Substrate bending test | |  <br>No cracking or marking defects shall occur | ·Substrate material<br>: Glass EPOXY Board.<br>·Thickness<br>: 1.6㎜<br>0.8㎜(0603/1005size)<br>*. Test condition<br>- Bending limit : 1mm<br>- Pressurizing speed : 1mm/sec<br>- Holding time : 5±1sec |
| | | Capacitance Change | X7R, X5R: Within ±10%<br>Y5V : Within ±30%<br>Within +30/-40% (cap≥10㎌) | |
| 11 | Vibration | Appearance | No defects or abnormalities | After soldering and then let sit for 24±2hr at room temperature.<br>The capacitor should be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz, shall be traversed(from 10Hz to 55Hz then 10Hz again) in approximately 1 minute. This motion shall be applied for a period of 2 hours in each 3mutually perpendicular directions(total is 6hours). |
| | | Capacitance | Whin the specified tolerance | |
| | | Dissipation Factor | X7R, X5R : 12.5%max<br>*3216 Size 100㎌ : 15%max<br>Y5V : 20%max | |
| 12 | Accelerated damp heat, steady state | Appearance | No defects which may affect performance | Apply the rated voltage at 40±2℃ and 90 to 95%RH for 500+24/-0 hrs. The charge/discharge current is less than 50mA.<br>·Initial measurement<br>Perform the initial measurement according to Note1 for Class II<br>·Measurement after test<br>Perform the final measurement according to Note2 |
| | | Capacitance Change | X7R, X5R: Within ±12.5%<br>Y5V : Within ±30% | |
| | | Dissipation Factor | X7R, X5R : 20%max<br>*3216 Size 100㎌ : 30%max<br>Y5V : 40%max | |
| | | I.R. | 12.5Ω·F min | |

<table>
<tr><th>No.</th><th>Item</th><th>Specification</th><th>Test Methods and Conditions</th></tr>
<tr><td>13</td><td>Temperature characteristic of capacitance</td><td>
<table>
<tr><th>Char.</th><th>Temp. Range</th><th>Reference Temp.</th><th>Cap. Change</th></tr>
<tr><td>X5R</td><td>-55 to +85℃</td><td>25℃</td><td>Within ±15%</td></tr>
<tr><td>X7R</td><td>-55 to +125℃</td><td>25℃</td><td>Within ±15%</td></tr>
<tr><td>Y5V</td><td>-30 to +85℃</td><td>25℃</td><td>Within +22/-82%</td></tr>
</table>
</td><td>The capacitance change should be measured after 5 min. at each specified temperature stage.<br>The ranges of capacitance change compared with the 25℃ value over the temperature ranges shown in the table should be within the specified ranges.</td></tr>
</table>

*Note1. Initial Measurement for Class II

Perform a heat treatment at 150+0,-10℃ for one hour and then let sit for 24±2 hours at room temperature,then measure

*Note2. Measurement after test

Class II

Perform a heat treatment at 150+0,-10℃ for one hour and then let sit for 24±2 hours at room temperature,then measure.

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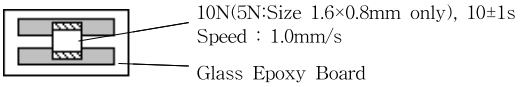
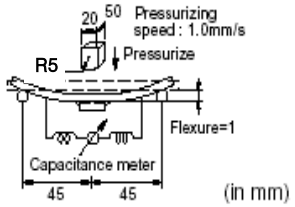
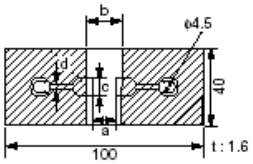
# Ⅲ. High Voltage Type

# Specifications and Test Methods (High voltage type)

| No. | Item | Specification | | Test Methods and Conditions |
|---|---|---|---|---|
| | | Class Ⅰ | Class Ⅱ | |
| 1 | Operating Temperature Range | C0G :-55 to+125℃ | X7R : -55 to +125℃ | |
| 2 | Dimensions | Within the specified dimension | | Using calipers |
| 3 | Voltage proof | No defects or abnormalities | | No failure should be observed when voltage in table is applied between the terminations, provided the charge/discharge current is less than 50mA.<br>Cap. / Rated voltage / Test voltage / Time<br>C0G: DC100V~630V — 150% of the rated voltage<br>C0G: DC1kV, DC2kV DC3kV, DC3.15kV — 120% of the rated voltage<br>X7R: DC100V~630V — 150% of the rated voltage<br>X7R: DC1kV, DC2kV, DC3kV — 120% of the rated voltage<br>Time: 1to5 sec. |
| 4 | Insulation Resistance | More than 10,000 MΩ | -DC100V~1KV :C≥0.01㎌:More than 100MΩ·㎌ :C<0.01㎌:More than 10,000MΩ -DC2~3KV:More than6,000 MΩ | Rated voltage <DC500V : Applied the rated voltage for 2 minutes of charging.<br>Rated voltage ≥DC500V : The insulation resistance should be measured with DC500±50V and within 2 minutes of charging. |
| 5 | Capacitance | within the specified tolerance | | Cap / Testing frequency / Testing Voltage / Measure temperature<br>C0G: 1±0.2㎒(C<1000㎊) 1±0.1㎑(C≥1000㎊) — AC 1±0.2Vrms — 25℃<br>X7R: 1±0.2㎑ |
| 6 | Dissipation Factor | C0G Char. : 30㎊min : Q≧1,000(DF≦0.1%) 30㎊max : Q≧400+20C (DF≦1/ (400+20C)) | 2.5% max | · Initial measurement Perform the initial measurement according to Note1 for Class Ⅱ<br>· Measurement after test Take it out and set it for 24±2 hours (Class Ⅰ) or 24±2 hours (Class Ⅱ) then measure |
| 7 | Temperature characteristic of capacitance | Temp. Coefficient C0G char. : 0±30ppm/℃ (Temp. Range : -55to+125℃) | Cap. Change within ±15% (Temp. Range : -55 to +125℃) | C0G : The temperature coefficient is determined using the capacitance measured in step 3 as a reference. When cycling the temperature sequentially from step 1 through 5 the capacitance should be within the specified tolerance for the temperature coefficient.<br>Step / Temperature(℃)<br>1 / 25±2<br>2 / -55±3<br>3 / 25±2<br>4 / 125±3 (for C0G)<br>5 / 25±2<br>X7R : The range of capacitance change compared with the 25℃value should be within the specified range.<br>-Pretreatment Perform a heat treatment at 150 -10, +0℃ for 60±5min. and then let sit for 24±2hrs.(Class Ⅰ), 24±2hrs.(Class Ⅱ) at room Temperature |

<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">Item</th><th colspan="2">Specification</th><th rowspan="2">Test Methods and Conditions</th></tr>
<tr><th>Class I</th><th>Class II</th></tr>
<tr><td>8</td><td colspan="2">Adhesive Strength of Termination</td><td colspan="2">No removal of the terminations or other defect should occur</td><td>Solder the capacitor to the testing jig(glass epoxy board) shown in Fig. 1 using a eutectic solder.<br>Then apply 10N force in the direction of the arrow.<br>The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.<br>  <br></td></tr>
<tr><td rowspan="3">9</td><td rowspan="3">Vibration</td><td>Appearance</td><td colspan="2">No defects or abnormalities</td><td rowspan="3">The capacitor should be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz. The frequency range, from 10 to 55Hz and return to 10Hz, should be traversed in approximately 1 min. This motion should be applied for a period of 2hrs. in each 3mutually perpendicular directions(total of 6hrs.)</td></tr>
<tr><td>Capacitance</td><td colspan="2">Within the specified tolerance</td></tr>
<tr><td>Dissipation Factor(or Q)</td><td>C0G Char. :<br>30pFmin<br>: Q≧1,000(DF≦0.1%)<br>30pFmax<br>: Q≧400+20C<br>(DF≦1/ (400+20C))</td><td>2.5% max</td></tr>
<tr><td rowspan="3">10</td><td rowspan="3">Substrate bending test</td><td rowspan="2"></td><td colspan="2">No cracking defects should occur.</td><td rowspan="3">Solder the capacitor to the testing jig (glass epoxy board) shown in Fig. 2 using a eutectic solder.<br>Then apply a force in the direction shown in Fig. 3.<br>The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.<br>  <br><br>*. Test condition<br>- Bending limit : 1mm<br>- Pressurizing speed : 1mm/sec<br>- Holding time : 5±1sec</td></tr>
<tr><td colspan="2">  <br><br><table><tr><th>L×X (mm)</th><th colspan="3">Dimension(mm)</th></tr><tr><th></th><th>a</th><th>b</th><th>c</th><th>d</th></tr><tr><td>1.6×0.8</td><td>1.0</td><td>3.0</td><td>1.2</td><td rowspan="6">1.0</td></tr><tr><td>2.0×1.25</td><td>1.2</td><td>4.0</td><td>1.65</td></tr><tr><td>3.2×1.6</td><td>2.2</td><td>5.0</td><td>2.0</td></tr><tr><td>3.2×2.5</td><td>2.2</td><td>5.0</td><td>2.9</td></tr><tr><td>4.5×2.0</td><td>3.5</td><td>7.0</td><td>2.4</td></tr><tr><td>4.5×3.2</td><td>3.5</td><td>7.0</td><td>3.7</td></tr></table></td></tr>
<tr><td>Capacitance Change</td><td>Within ±5% or ±0.5pF (whichever is larger)</td><td>Within ±10%</td></tr>
<tr><td>11</td><td colspan="2">Solderability</td><td colspan="2">95% of the terminations is to be soldered evenly and continuously.</td><td>Immerse the capacitor in a solution of ethanol and rosin(25% rosin in weight proportion). Immerse in eutectic solder solution for 2±0.5 sec. at 245±5℃.<br>Immersing speed : 25±2.5mm/s</td></tr>
</table>

<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">Item</th><th colspan="2">Specification</th><th rowspan="2">Test Methods and Conditions</th></tr>
<tr><th>Class I</th><th>Class II</th></tr>
<tr><td rowspan="4">12</td><td rowspan="4">Resistance to Soldering Heat</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="4">Preheat the capacitor at 120 to 150℃* for 1 min.<br>Immerse the capacitor in eutectic solder solution at 260±5℃ for 10±1 sec.<br><br>-Immersing speed : 25±2.5mm/s<br>·Initial measurement<br>Perform the initial measurement according to Note1 for Class II<br>·Measurement after test<br>Let sit at room Temperature for 24±2hrs.(Class I), 24±2hrs.(Class II) then measure.<br>*Preheating for more than 3.2×2.5mm<br><table><tr><th>Step</th><th>Temperature</th><th>Time</th></tr><tr><td>1</td><td>100℃ to 120℃</td><td>1 min</td></tr><tr><td>2</td><td>170℃ to 200℃</td><td>1 min</td></tr></table></td></tr>
<tr><td>Capacitance change</td><td>within ±2.5%or ±0.25pF (whichever is larger)</td><td>within ±10%</td></tr>
<tr><td>Dissipation Factor (or Q)</td><td>C0G Char. :<br>30pFmin<br>: Q≧1,000(DF≦0.1%)<br>30pFmax<br>: Q≧400+20C<br>(DF≦1/ (400+20C))</td><td>2.5% max</td></tr>
<tr><td>I.R.</td><td>More than 10,000MΩ</td><td>-DC100V~1KV<br>:C≥0.01μF:More than 100MΩ·μF<br>:C<0.01μF:More than 10,000MΩ<br>-DC2~3KV:More than1,000 MΩ</td></tr>
<tr><td rowspan="4">13</td><td rowspan="4">Rapid change of temperature</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="4">Perform the 5 cycles according to the 4 heat treatments listed in the following table.<br><table><tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><td>Temp (℃)</td><td>Min. operating temp. ±3</td><td>Room Temp</td><td>Max. operating temp. ±2</td><td>Room Temp</td></tr><tr><td>Time (min)</td><td>30±3</td><td>2 to3</td><td>30±3</td><td>2 to3</td></tr></table>·Initial measurement<br>Perform the initial measurement according to Note1 for Class II<br>·Measurement after test<br>Perform the final measurement according to Note2</td></tr>
<tr><td>Capacitance Change</td><td>Within ±2.5%or ±0.25pF (whichever is larger)</td><td>within ±15%</td></tr>
<tr><td>Dissipation Factor (or Q)</td><td>C0G Char. :<br>30pFmin<br>: Q≧1,000(DF≦0.1%)<br>30pFmax<br>: Q≧400+20C<br>(DF≦1/ (400+20C))</td><td>DC100V~1KV: 2.5% max<br>DC2~3KV : 5%max</td></tr>
<tr><td>I.R</td><td>More than 10,000MΩ</td><td>-DC100V~1KV<br>:C≥0.01μF:More than 100MΩ·μF<br>:C<0.01μF:More than 10,000MΩ<br>-DC2~3KV:More than 3,000MΩ</td></tr>
<tr><td rowspan="4">14</td><td rowspan="4">Damp heat, steady state</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="4">Let the capacitor sit at 40±2℃ and relative humidity of 90 to 95% for 500+24/-0 hrs.<br><br>·Initial measurement<br>Perform the initial measurement according to Note1 for Class II<br>·Measurement after test<br>Perform the final measurement according to Note2</td></tr>
<tr><td>Capacitance Change</td><td>within ±5% or ±0.5pF (Whichever is larger)</td><td>Within ±15%</td></tr>
<tr><td>Dissipation Factor (or Q)</td><td>C0G Char. :<br>C≧30pF : Q≧350<br>C<30pF : Q≧275+$\frac{5}{2}$C</td><td>5% max</td></tr>
<tr><td>I.R</td><td>More than 1,000MΩ</td><td>-DC100V~1KV<br>:C≥0.01μF:More than 10MΩ·μF<br>:C<0.01μF:More than 1,000MΩ<br>-DC2~3KV:More than 1,000MΩ</td></tr>
<tr><td rowspan="5">15</td><td rowspan="5">Endurance</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="5">Apply the voltage in following table for 1,000+48/-0hrs.<br>at maximum operating temperature ±3℃.<br><br>The charge/discharge current is less than 50mA.<br><table><tr><th>Operating temperature range</th><th>Rated voltage</th><th>Test voltage</th></tr><tr><td rowspan="2">C0G</td><td>Rated voltage ≥DC1KV</td><td>Rated voltage</td></tr><tr><td>Rated voltage <DC1KV</td><td>120% of the rated voltage</td></tr><tr><td rowspan="3">X7R</td><td>DC100V~250V</td><td>150% of the rated voltage</td></tr><tr><td>DC500V~630V</td><td>120% of the rated voltage</td></tr><tr><td>DC1KV~DC3KV</td><td>110% of the rated voltage</td></tr></table>·Initial measurement<br>Perform the initial measurement according to Note1 for Class II<br>·Measurement after test<br>Perform the final measurement according to Note2</td></tr>
<tr><td>Capacitance Change</td><td>within ±3% or ±0.3pF (Whichever is larger)</td><td>DC100V,630V:Within ±15%<br>DC1KV:Within ±20%<br>DC2~3KV:Within ±20%</td></tr>
<tr><td>Dissipation (or Q)</td><td>C0G Char. :<br>C≧30pF : Q≧350<br>C<30pF : Q≧275+$\frac{5}{2}$C</td><td>5% max</td></tr>
<tr><td>I.R.</td><td>More than 1,000MΩ</td><td>-DC100V~1KV<br>:C≥0.01μF:More than 10MΩ·μF<br>:C<0.01μF:More than 1,000MΩ<br>-DC2~3KV:More than 2,000MΩ</td></tr>
</table>

| No. | Item | | Specification | | Test Methods and Conditions |
|---|---|---|---|---|---|
| | | | Class I | Class II | |
| 16 | Humidity Load (Application : DC250V item) | Appearance | | No defects which may affect performance | Apply the rated voltage at 40±2℃ and relative humidity of 90 to 95 for 500+24/-0 hrs.<br>·Initial measurement<br>Perform the initial measurement according to Note1 for Class II<br>·Measurement after test<br>Perform the final measurement according to Note2 |
| | | Capacitance Change | | Within ±15% | |
| | | Dissipation (or Q) | | 5% max. | |
| | | I.R. | | C≥0.01㎌:More than 10MΩ·㎌<br>C<0.01㎌:More than 1,000MΩ | |

*Note1. Initial Measurement for Class II

Perform a heat treatment at 150+0,-10℃ for one hour and then let sit for 24±2 hours at room temperature,then measure

*Note2. Measurement after test

1.Class I

Let sit for 24±2 hours at room temperature,then measurement

2.Class II

Perform a heat treatment at 150+0,-10℃ for one hour and then let sit for 24±2 hours at room temperature,then measure.

"Following the International standards, the title of each test item is subject to change."

## 5. Packing

(1) Bulk packing

① 1000 pcs per Polybag

② 5 Polybags per Inner box

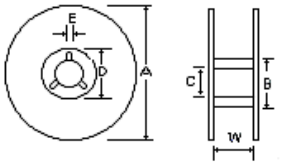
③ 10 Inner boxes per Out box

(2) Reel Packing

① 8~10 Reels per Inner box

② 6 Inner boxes per Out box

(3) Reel Dimensions



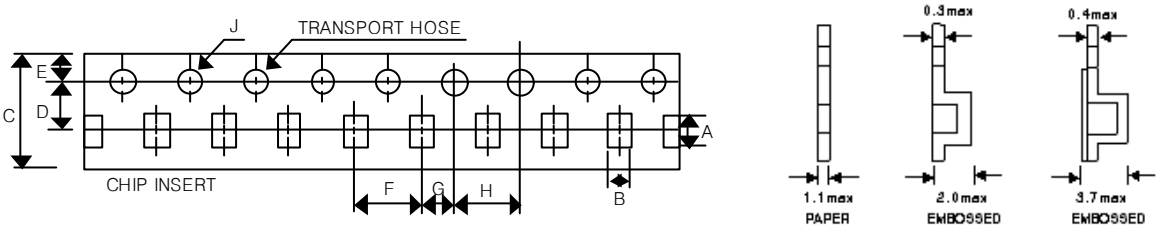

(Unit : mm)

| MARK | SIZE | A | B | C | D | E | W |
|---|---|---|---|---|---|---|---|
| 7 " REEL | 0603~3225 | Φ178±2 | Φ50Min | Φ13±0.5 | Φ21±0.8 | 2±0.5 | 10±1.5 |
| | 4520~4532 | Φ180+0,-3 | Φ60-0,+1 | Φ13±0.2 | Φ57-0+1 | 3±0.2 | 13±0.5 |
| 13 " REEL | 1005~3225 | Φ330±2 | Φ70Min | Φ13±0.5 | Φ21±0.8 | 2±0.5 | 10±1.5 |

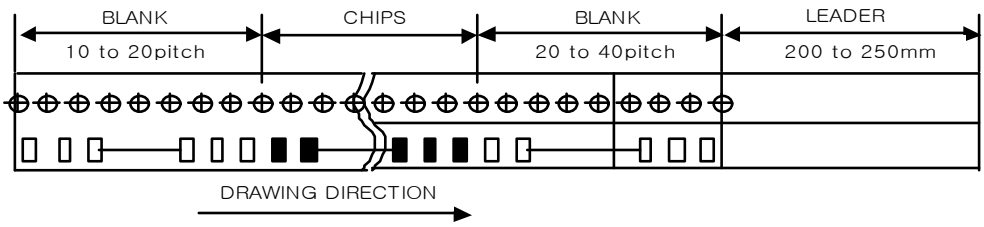
(4)Number of Package

| TYPE | EIA CODE | 7" | 13" |
|---|---|---|---|
| | | Qt/REEL | Qt/REEL |
| CS0603 | CC0201 | 15,000 | |
| CS1005 | CC0402 | 10,000 | 50,000 |
| CS1608 | CC0603 | 4,000 | 15,000 |
| CS2012 | CC0805 | 3,000 ~ 4,000 | 8,000 ~ 15,000 |
| CS3216 | CC1206 | 2,000 ~ 4,000 | 6,000 ~ 10,000 |
| CS3225 | CC1210 | 1,000 ~ 3,000 | 4,000 ~ 10,000 |
| CS4520 | CC1808 | 1,500 ~ 3,000 | - |
| CS4532 | CC1812 | 500 ~ 1,000 | 1,500 ~ 5,000 |

(5) Tape Dimensions




| TYPE | EIA CODE | A | B | C | D | E | F | G | H | J |
|---|---|---|---|---|---|---|---|---|---|---|
| CS0603 | CC0201 | 0.67±0.05 | 0.37±0.05 | 8.0±0.3 | 3.5±0.05 | 1.75±0.1 | 2.0±0.05 | 2.0±0.1 | 4.0±0.1 | 1.5±0.1 |
| CS1005 | CC0402 | 1.15±0.1 | 0.65±0.1 | 8.0±0.3 | 3.5±0.05 | 1.75±0.1 | 2.0±0.05 | 2.0±0.1 | 4.0±0.1 | 1.5±0.1 |
| CS1608 | CC0603 | 1.9±0.2 | 1.10±0.2 | 8.0±0.3 | 3.5±0.05 | 1.75±0.1 | 4.0±0.1 | 2.0±0.1 | 4.0±0.1 | 1.5±0.1 |
| CS2012 | CC0805 | 2.4±0.2 | 1.65±0.2 | 8.0±0.3 | 3.5±0.05 | 1.75±0.1 | 4.0±0.1 | 2.0±0.1 | 4.0±0.1 | 1.5±0.1 |
| CS3216 | CC1206 | 3.6±0.2 | 2.00±0.2 | 8.0±0.3 | 3.5±0.05 | 1.75±0.1 | 4.0±0.1 | 2.0±0.1 | 4.0±0.1 | 1.5±0.1 |
| CS3225 | CC1210 | 3.6±0.2 | 2.80±0.2 | 8.0±0.3 | 3.5±0.05 | 1.75±0.1 | 4.0±0.1 | 2.0±0.1 | 4.0±0.1 | 1.5±0.1 |
| CS4520 | CC1808 | 4.8±0.2 | 2.3±0.2 | 12.0±0.3 | 5.5±0.1 | 1.75±0.1 | 4.0±0.1<br>8.0±0.1 | 2.0±0.1 | 4.0±0.1 | 1.5±0.1 |
| CS4532 | CC1812 | 4.9±0.2 | 3.6±0.2 | 12.0±0.3 | 5.5±0.1 | 1.75±0.1 | 8.0±0.1 | 2.0±0.1 | 4.0±0.1 | 1.5±0.1 |



## 6.Caution

▶Reflow Soldering

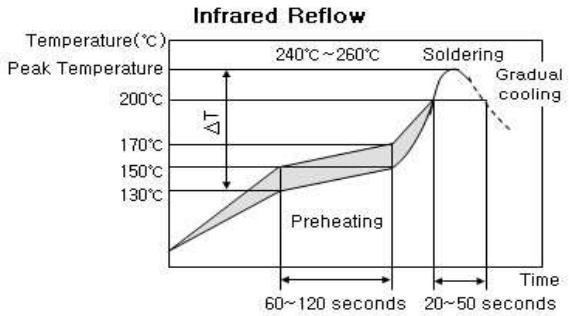
1. The sudden temperature change easily causes mechanical damages to ceramic components. Therefore, the preheating procedures should be required for the soldering of ceramic components.

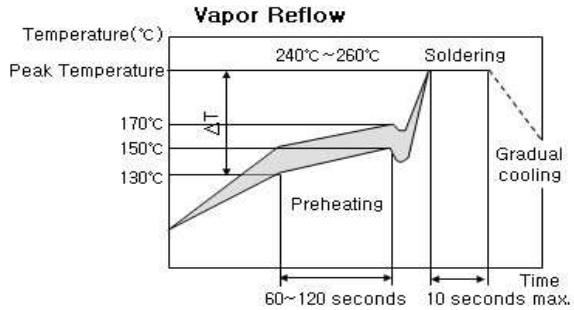
2. Please refer to the recommended soldering profiles as shown in figures, and keep the temperature difference(△T) within the range recommended in Table 1.

Table 1

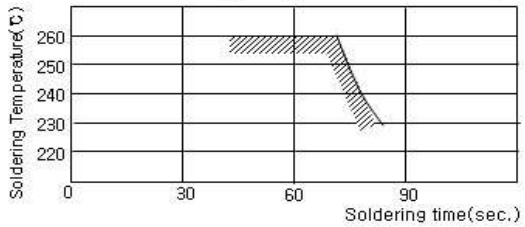
| Size code | Temperature Difference |
|---|---|
| 0603, 1005, 1608, 2012, 3216 | △T≤190℃ |
| 3225size and over | △T≤130℃ |

[Standard Conditions for Reflow Soldering]




[Allowable Soldering Temperature and Time]




In case of repeated soldering, the accumulated soldering time must be within the range shown above.

▶Storage Condition

*When Solderability is considered, Capacitor are recommended to be used in 12 months

(1) Temperature: 25℃ ± 10℃

(2) Relative Humidity: Below 70% RH

▶The Regulation of Environmental Pollution Materials.

*Never use materials mentioned below in MLCC products regulated this document.

Pb, Cd, Hg, $Cr^{+6}$, PBB(Polybromide biphenyl), PBDE(Polybrominated diphenyl ethers), asbestos.

* Note

(1) 'Aging'/'De-aging' Behavior of high dielectric MLCCs

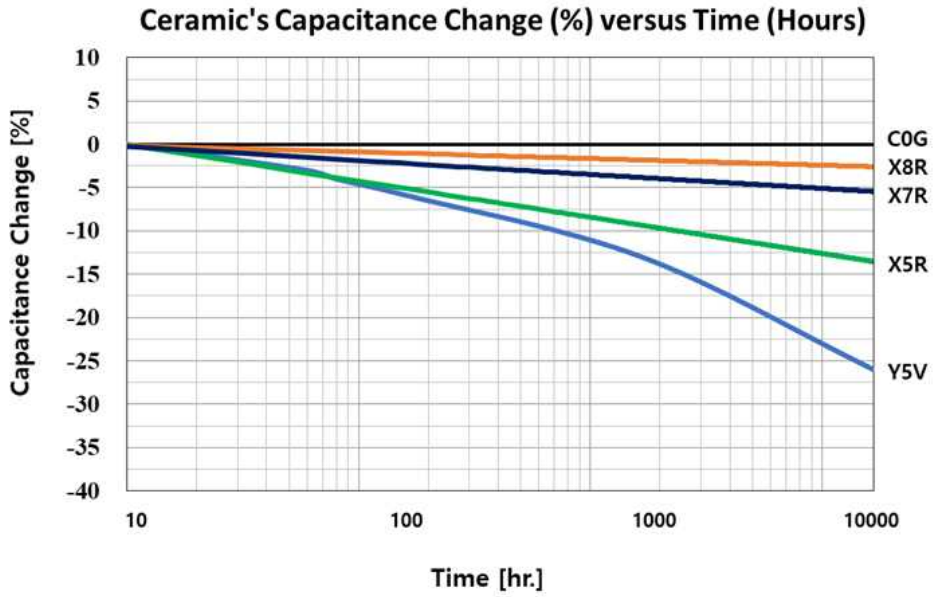
(Typically represented by X7R, Y5V temperature characteristic of which main composition is BaTiO3)

'Aging' / 'De-aging' Behavior of high dielectric MLCCs Please note that high dielectric type dielectric Ceramic Capacitors have a "normal" 'aging' behavior / characteristic, that is; their capacitance value decreases with time from its value when it was first manufactured. From that date, the capacitance value begins to decrease at a logarithmic rate defined by:

$C_t = C_{24} ( 1 - k \log_{10} t )$

where :

$C_t$ = Capacitance Value, t hours after the start of 'aging'
$C_{24}$ = Capacitance Value, 24 hours after its manufacture
k = aging constant ( capacitance decrease per decade-hour )
t = time, in hours, from the start of 'aging'




The capacitance value can be restored ( a.k.a. 'de-aged' ) by exposing the component to elevated temperatures approaching its Curie Temperature ( approximately 120℃ ). This 'deaging' can occur during the component's solder-assembly onto the PCB, during life or temperature cycle testing., or by ' baking ' at 150℃ for about 1 hour.

(2) Please contact our sales representatives or product engineers before using the products in this catalog for the applications listed below, which require especially high reliability for the prevention of defects which might directly damage a third party's life, body or property, or when one of our products is intended for use in applications other than those specified in this catalog.

①Aircraft equipment ②Aerospace equipment ③Undersea equipment ④Power plant equipment
⑤Medical equipment ⑥Transportation equipment (vehicles, trains, ships, etc.)
⑦Traffic signal equipment ⑧Disaster prevention / crime prevention equipment
⑨Industrial equipment (Conveyors, Robot equipment, etc) ⑩Led equipment
⑪Application of similar complexity and/or reliability requirements to the applications listed above