TO. : ______________________ NO. : ________________

# APPROVAL SHEET

## MULTILAYER CERAMIC CAPACITOR

**Automotive Grade**

**(AEC-Q200 Qualified)**

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

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

2020. 04. 09.


**SAMWHA CAPACITOR CO., LTD.**

**Address : 124, BUK-RI, NAMSA-MYUN YOUNGIN-SI, KYUNGKI-DO, KOREA**

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

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

# < SPECIFICATION SUMMARY >

| SAMWHA Part no. | CQ3216X7R106K250NRI | | |
|---|---|---|---|
| Type | *MLCC for Automotive Application | | |
| **Items** | **Specification** | **Unit** | **Test Conditions** |
| Capacitance | 10 | ㎌ | Testing Frequency : 1 ±0.1 kHz<br>Testing Voltage : 1 ±0.2 Vrms<br>Should be measured at 25℃. |
| Capacitance Tolerance | ± 10 | % | |
| Dissipation Factor | Max. 12.5 | % | |
| Insulation Resistance | Min. 5 | ㏁ | Should be measured with a DC voltage not exceeding rated voltage at 25℃ for 2 minutes of charging. |
| Chip Size | 3.20 ±0.30 | L (㎜) | Capacitance Tolerance Code ------- page 1/9<br>Chip size ---------------------------------- page 2/9<br>Characteristics & Test Method ----- page 3/9~6/9 |
| | 1.60 ±0.20 | W (㎜) | |
| | 1.60 ±0.20 | T (㎜) | |
| *Thin Layer Large-Capacitance Type | | | |

# Contents

## 1. General Code

(1) Type Designation

| CQ | 3216 | X7R | 106 | K | 250 | N | R | I |
|---|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |

1) Multilayer Ceramic Capacitor (Automotive 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 | X7R | -55 to +125℃ | ±15% |
| | X7S | -55 to +125℃ | ±22% |
| | X7T | -55 to +125℃ | +22% ~ -33% |
| | X6S | -55 to +105℃ | ±22% |

4) Capacitance Code(Pico farads) :
The nominal Capacitance Value in ㎊ 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 ㎊
R denotes decimal
8R2 = 8.2 ㎊

5) Capacitance Tolerance Code

| Code | Tolerance |
|---|---|
| B | ± 0.1 ㎊ |
| C | ± 0.25 ㎊ |
| D | ± 0.5 ㎊ |
| F | ± 1.0 % |

| Code | Tolerance |
|---|---|
| G | ± 2.0 % |
| J | ± 5 % |
| K | ± 10 % |
| M | ± 20 % |

6) Voltage Code

| Code | 6R3 | 100 | 160 | 250 | 350 | 500 | 101 | 201 | 251 | 501 | 631 | 102 | 202 | 302 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rated Voltage | 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
N : Nickel-Tin Plate
A : Nickel-Tin Plate -> Soft Termination Type

8) Packing Code
R : 7“ Reel Type, L : 13“ Reel Type, B : Bulk Type

9) Thickness option

| Thickness (mm) | | Code | Thickness (mm) | | Code |
|---|---|---|---|---|---|
| t | Tolerance(±) | | t | Tolerance(±) | |
| 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 |
| 1.30 | 0.20 | E | | | |

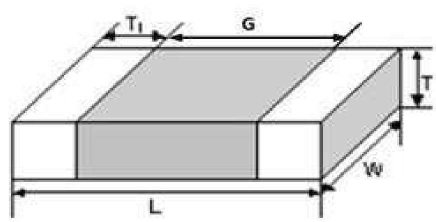
*3216 Size ≥2.2㎌ 100V ⇒ T ： Tol±0.30

## 2. Temperature Characteristics

See Page 6/9 (No.21)

## 3. Constructions and Dimensions

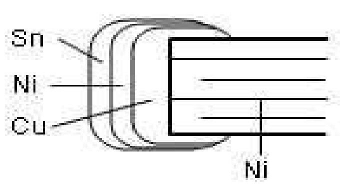
(1) Dimensions



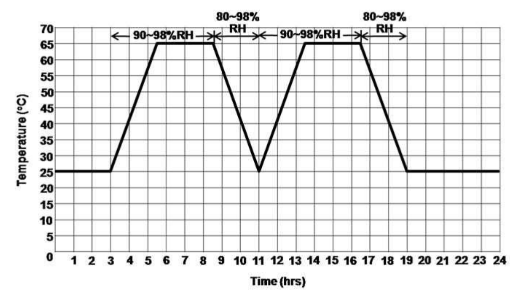

| Size Code | EIA Code | Dimension | | | | | |
|---|---|---|---|---|---|---|---|
| | | Length | | Width | | T1(min.) | G(min.) |
| | | L | Tol(±) | W | Tol(±) | | |
| 1005 | 0402 | 1.00 | 0.05 | 0.50 | 0.05 | 0.05 | 0.30 |
| 1608 | 0603 | 1.60 | 0.15 | 0.80 | 0.10 | 0.10 | 0.50 |
| 2012 | 0805 | 2.00 | 0.20 | 1.25 | 0.15 | 0.10 | 0.65 |
| 3216 | 1206 | 3.20 | 0.30 | 1.60 | 0.20 | 0.15 | 1.00 |
| 3225 | 1210 | 3.20 | 0.40 | 2.50 | 0.25 | 0.15 | 1.05 |
| 4520 | 1808 | 4.50 | 0.40 | 2.00 | 0.25 | 0.20 | 1.50 |
| 4532 | 1812 | 4.50 | 0.40 | 3.20 | 0.30 | 0.20 | 1.50 |
| 5750 | 2220 | 5.70 | 0.50 | 5.00 | 0.40 | 0.30 | 1.85 |

*3216 Size ≥2.2㎌ 100V ⇒ L, W : Tol±0.30 (Unit : ㎜)

(2) Construction of Termination



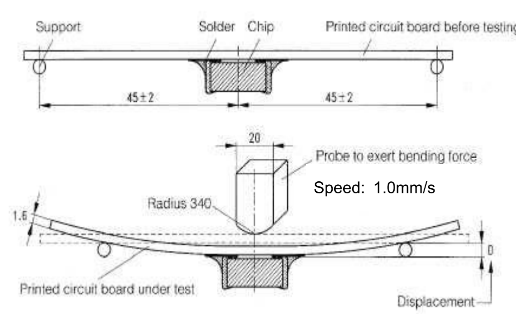
## Specifications and Test Methods (For Automotive Applications)

<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">AEC-Q200<br>Test 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">Pre-and Post-Stress<br>Electrical Test</td><td colspan="3">-</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">High<br>Temperature<br>Exposure<br>(Storage)</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="4">Temperature : Max. operating temperature±3℃<br>Maintenance Time : 1000+48/-0 hrs<br>Let sit for 24±2 hours at room temperature, then measure.</td></tr>
<tr><td>Capacitance<br>Change</td><td>Within ±2.5% or ±0.25pF<br>(Whichever is larger)</td><td>Within ±10.0%<br>(*Within ±12.5%)</td></tr>
<tr><td>Q/D.F.</td><td>30pF min.: Q≧1000<br>30pF max.: Q≧400+20×C<br>C: Nominal Capacitance (pF)</td><td>Rated Voltage 16V min.: 0.05 max.<br>10V: 0.075 max.<br>*0.2 max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω·F (*50Ω·F)<br>(Whichever is smaller)</td></tr>
<tr><td rowspan="4">3</td><td rowspan="4">Temperature<br>Cycle</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="4">Perform the 1000 cycles according to the four heat treatments listed in the following table.<br>Let sit for 24±2 hours at room temperature, then measure.<br><table><tr><td>Step</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>Temp.(℃)</td><td>-55+0/-3</td><td>25±2</td><td>125+3/-0</td><td>25±2</td></tr><tr><td>Time(min)</td><td>15±3</td><td>1</td><td>15±3</td><td>1</td></tr></table>Initial measurement<br>Perform the initial measurement according to Note 1 for Class II.</td></tr>
<tr><td>Capacitance<br>Change</td><td>Within ±2.5% or ±0.25pF<br>(Whichever is larger)</td><td>Within ±10.0%</td></tr>
<tr><td>Q/D.F.</td><td>30pF min.:Q≧1000<br>30pF max.:Q≧400+20×C<br>C: Nominal Capacitance (pF)</td><td>Rated Voltage 16V min.: 0.05 max.<br>10V: 0.075 max.<br>*0.2 max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω·F (*50Ω·F)<br>(Whichever is smaller)</td></tr>
<tr><td>4</td><td colspan="2">Destructive<br>Physical Analysis</td><td colspan="2">No defects or abnormalities</td><td>Per EIA-469</td></tr>
<tr><td rowspan="4">5</td><td rowspan="4">Moisture<br>Resistance</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="4">Temperature : 25~65℃, Humidity : 80~98%<br>Cycle Time : 24 hrs/cycle, 10 cycles<br>Let sit for 24±2 hours at room temperature, then measure.<br></td></tr>
<tr><td>Capacitance<br>Change</td><td>Within ±3.0% or±0.30pF<br>(Whichever is larger)</td><td>Within ±12.5%</td></tr>
<tr><td>Q/D.F.</td><td>30pF min.: Q≧350<br>10pF min. and 30pF max.:<br>Q≧275+5/2×C<br>10pF max.: Q≧200+10×C<br>C: Nominal Capacitance (pF)</td><td>Rated Voltage 16V min.: 0.05 max.<br>10V: 0.075 max.<br>*0.2 max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω·F (*50Ω·F)<br>(Whichever is smaller)</td></tr>
<tr><td rowspan="4">6</td><td rowspan="4">Biased<br>Humidity</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="4">Temperature : 85±3℃<br>Humidity : 80~85%<br>Applied Voltage : Rated Voltage and 1.3+0.2/-0V<br>Maintenance Time : 1000+48/-0 hrs<br>Let sit for 24±2 hours at room temperature, then measure.<br>The charge/discharge current is less than 50mA.</td></tr>
<tr><td>Capacitance<br>Change</td><td>Within ±3.0% or ±0.30pF<br>(Whichever is larger)</td><td>Within ±12.5%</td></tr>
<tr><td>Q/D.F.</td><td>30pF min.: Q≧200<br>30pF max.: Q≧100+10/3×C<br>C: Nominal Capacitance (pF)</td><td>Rated Voltage 16V min.: 0.05 max.<br>10V: 0.075 max.<br>*0.2 max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 1,000MΩ or 50Ω·F (*5Ω·F)<br>(Whichever is smaller)</td></tr>
<tr><td rowspan="4">7</td><td rowspan="4">Operational<br>Life</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="4">Temperature : Max. operating temperature±3℃<br>Applied Voltage : Rated Voltage × 200% (*100%)<br>Maintenance Time : 1000+48/-0 hrs<br>Let sit for 24±2 hours at room temperature, then measure.<br>The charge/discharge current is less than 50mA.<br><br>Initial Measurement for Class II<br>Applied 200% of the rated voltage for one hour at 125±3℃.<br>Remove and let sit for 24±2 hours at room temperature, then measure.</td></tr>
<tr><td>Capacitance<br>Change</td><td>Within ±3.0% or ±0.30pF<br>(Whichever is larger)</td><td>Within ±12.5%</td></tr>
<tr><td>Q/D.F.</td><td>30pF min.:Q≧350<br>10pF min. and 30pF max.:<br>Q≧275+5/2×C<br>10pF max.: Q≧200+10×C<br>C: Nominal Capacitance (pF)</td><td>Rated Voltage 16V min.: 0.05 max.<br>10V: 0.075 max.<br>*0.2 max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 1,000MΩ or 50Ω·F (*5Ω·F)<br>(Whichever is smaller)</td></tr>
</table>

## Specifications and Test Methods (For Automotive Application)

<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">AEC-Q200<br>Test 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">External Visual</td><td colspan="2">No defects or abnormalities</td><td>Visual inspection</td></tr>
<tr><td>9</td><td colspan="2">Physical Dimension</td><td colspan="2">Within the specified dimensions</td><td>Using calipers</td></tr>
<tr><td rowspan="4">10</td><td rowspan="4">Resistance to Solvents</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="4">Per MIL-STD-202 Method 215</td></tr>
<tr><td>Capacitance Change</td><td colspan="2">Within the specified tolerance</td></tr>
<tr><td>Q/D.F.</td><td>30pF min.: Q≧1000<br>30pF max.: Q≧400+20×C<br>C: Nominal Capacitance (pF)</td><td>Rated Voltage 50V: 0.025 max.<br>25V: 0.03 max.<br>16V: 0.035 max.<br>10V: 0.05 max.<br>*0.125 max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω·F (*50Ω·F)<br>(Whichever is smaller)</td></tr>
<tr><td rowspan="4">11</td><td rowspan="4">Mechanical Shock</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="4">Three shocks in each direction should be applied along 3 mutually perpendicular axes of the test specimen (18 shocks)<br>Test Pulse<br>Wave form : Half-sine<br>Duration : 0.5ms<br>Peak value : 1,500G<br>Velocity change : 4.7m/s</td></tr>
<tr><td>Capacitance Change</td><td colspan="2">Within the specified tolerance</td></tr>
<tr><td>Q/D.F.</td><td>30pF min.:Q≧1000<br>30pF max.:Q≧400+20×C<br>C: Nominal Capacitance (pF)</td><td>Rated Voltage 50V: 0.025 max.<br>25V: 0.03 max.<br>16V: 0.035 max.<br>10V: 0.05 max.<br>*0.125 max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω·F (*50Ω·F)<br>(Whichever is smaller)</td></tr>
<tr><td rowspan="4">12</td><td rowspan="4">Vibration</td><td>Appearance</td><td colspan="2">No defects or abnormalities</td><td rowspan="4">The specimens should be subjected to a simple harmonic motion having a total amplitude of 1.5mm. The entire frequency range of 10 to 2,000 Hz and return to 10 Hz should be traversed in 20 minutes. This cycle should be performed 12 times in each of three mutually perpendicular directions (total of 36 times).</td></tr>
<tr><td>Capacitance Change</td><td colspan="2">Within the specified tolerance</td></tr>
<tr><td>Q/D.F.</td><td>30pF min.:Q≧1000<br>30pF max.:Q≧400+20×C<br>C: Nominal Capacitance (pF)</td><td>Rated Voltage 50V: 0.025 max.<br>25V: 0.03 max.<br>16V: 0.035 max.<br>10V: 0.05 max.<br>*0.125 max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω·F (*50Ω·F)<br>(Whichever is smaller)</td></tr>
<tr><td rowspan="4">13</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">Temperature (Eutectic solder solution) : 260±5℃<br>Dipping Time : 10±1s<br>Let sit for 24±2 hours at room temperature, then measure.<br>Initial measurement<br>Perform the initial measurement according to Note 1 for Class II.</td></tr>
<tr><td>Capacitance Change</td><td colspan="2">Within the specified tolerance</td></tr>
<tr><td>Q/D.F.</td><td>30pF min.:Q≧1000<br>30pF max.:Q≧400+20×C<br>C: Nominal Capacitance (pF)</td><td>Rated Voltage 50V: 0.025 max.<br>25V: 0.03 max.<br>16V: 0.035 max.<br>10V: 0.05 max.<br>*0.125 max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω·F (*50Ω·F)<br>(Whichever is smaller)</td></tr>
<tr><td rowspan="4">14</td><td rowspan="4">Thermal Shock</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="4">Perform the 300 cycles according to the two heat treatments listed in the following table.<br>Transfer Time : 20sec. max.<br>Let sit for 24±2 hours at room temperature, then measure.<br><table><tr><td>Step</td><td>1</td><td>2</td></tr><tr><td>Temp.(℃)</td><td>-55+0/-3</td><td>125+3/-0</td></tr><tr><td>Time(min.)</td><td>15±3</td><td>15±3</td></tr></table>Initial measurement<br>Perform the initial measurement according to Note 1 for Class II.</td></tr>
<tr><td>Capacitance Change</td><td>Within ±2.5% or ±0.25pF<br>(Whichever is larger)</td><td>Within ±15.0%</td></tr>
<tr><td>Q/D.F.</td><td>30pF min.:Q≧1000<br>30pF max.:Q≧400+20×C<br>C: Nominal Capacitance (pF)</td><td>Rated Voltage 50V: 0.025 max.<br>25V: 0.03 max.<br>16V: 0.035 max.<br>10V: 0.05 max.<br>*0.125 max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω·F (*50Ω·F)<br>(Whichever is smaller)</td></tr>
</table>

## Specifications and Test Methods (For Automotive Application)

<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">AEC-Q200<br>Test 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">15</td><td rowspan="4">ESD</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="4">Per AEC-Q200-002</td></tr>
<tr><td>Capacitance Change</td><td colspan="2">Within the specified tolerance</td></tr>
<tr><td>Q/D.F.</td><td>30pF min.:Q≧1000<br>30pF max.:Q≧400+20×C<br>C: Nominal Capacitance (pF)</td><td>Rated Voltage 50V: 0.025 max.<br>25V: 0.03 max.<br>16V: 0.035 max.<br>10V: 0.05 max.<br>*0.125 max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω·F (*50Ω·F)<br>(Whichever is smaller)</td></tr>
<tr><td>16</td><td colspan="2">Solderability</td><td colspan="2">95% of the terminations is to be soldered evenly and continuously.</td><td>(a) Preheat at 155℃ for 4 hours, and then immerse the capacitor in a solution of ethanol and rosin. Immerse in eutectic solder solution for 5+0/-0.5 seconds at 235±5℃.<br>(b) Steam aging for 8 hours, and then immerse the capacitor in a solution of ethanol and rosin. Immerse in eutectic solder solution for 5+0/-0.5 seconds at 235±5℃.<br>(c) Steam aging for 8 hours, and then immerse the capacitor in a solution of ethanol and rosin. Immerse in eutectic solder solution for 120±5 seconds at 260±5℃.</td></tr>
<tr><td rowspan="6">17</td><td rowspan="6">Electrical Characteriza-tion</td><td>Appearance</td><td colspan="2">No defects or abnormalities</td><td rowspan="3">The capacitance/Q/D.F. should be measured at 25℃ at the frequency and voltage shown in the table.
<table>
<tr><th>Class</th><th>Capacitance (C)</th><th>Frequency</th><th>Voltage</th></tr>
<tr><td rowspan="2">Class Ⅰ</td><td>C<1000pF</td><td>1±0.1MHz</td><td>0.5~5Vrms</td></tr>
<tr><td>C≥1000pF</td><td>1±0.1kHz</td><td>1±0.2Vrms</td></tr>
<tr><td rowspan="2">Class Ⅱ</td><td>C≤10μF</td><td>1±0.1kHz</td><td>0.5~1.0Vrms</td></tr>
<tr><td>C>10μF</td><td>120±24Hz</td><td>0.5±0.1Vrms</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 Ⅱ) then measure</td></tr>
<tr><td>Capacitance Change</td><td colspan="2">Within the specified tolerance</td></tr>
<tr><td>Q/D.F.</td><td>30pF min.:Q≧1000<br>30pF max.:Q≧400+20×C<br>C: Nominal Capacitance (pF)</td><td>Rated Voltage 50V: 0.025 max.<br>25V: 0.03 max.<br>16V: 0.035 max.<br>10V: 0.05 max.<br>*0.125 max.</td></tr>
<tr><td>I.R. at 25℃</td><td>More than 100,000MΩ or 1,000Ω·F<br>(Whichever is smaller)</td><td>More than 10,000MΩ 500Ω·F<br>(*50Ω·F) (Whichever is smaller)</td><td rowspan="2">Should be measured with a DC voltage not exceeding rated voltage at 25℃ and 125℃ for 2 minutes of charging.</td></tr>
<tr><td>I.R. at 125℃</td><td>More than 10,000MΩ or 100Ω·F<br>(Whichever is smaller)</td><td>More than 1,000MΩ or 10Ω·F<br>(*1Ω·F) (Whichever is smaller)</td></tr>
<tr><td>Dielectric Strength</td><td colspan="2">No dielectric breakdown or mechanical breakdown</td><td>Applied 250% of the rated voltage for 1~5 seconds<br>The charge/discharge current is less than 50mA.</td></tr>
<tr><td rowspan="2">18</td><td rowspan="2">Board Flex</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="2">Apply a force in the direction shown in the following figure for 60±5 seconds.


Flexure for Class I: 3mm max.<br>for Class II: 2mm max.</td></tr>
<tr><td>Capacitance Change</td><td>Within ±5.0% or ±0.5pF<br>(Whichever is larger)</td><td>Within the specified tolerance</td></tr>
<tr><td rowspan="2">19</td><td rowspan="2">Terminal Strength</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="2">Apply 18N[1] force in parallel with the test jig for 60±1 seconds.<br>[1]10N for 1608(EIA:0603) size<br>2N for 1005(EIA:0402) size</td></tr>
<tr><td>Capacitance Change</td><td>Within ±5.0% or ±0.5pF<br>(Whichever is larger)</td><td>Within the specified tolerance</td></tr>
</table>

## Specifications and Test Methods (For Automotive Application)

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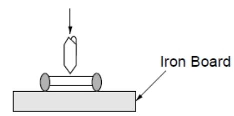
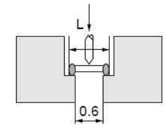
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">AEC-Q200 Test Item</th><th colspan="2">Specification</th><th rowspan="2">Test Methods and Conditions</th></tr>
<tr><th>Class Ⅰ</th><th>Class Ⅱ</th></tr>
<tr><td>20</td><td colspan="2">Beam Load Test</td><td colspan="2">The chip endure following force.<br>
<table>
<tr><th>Chip Length</th><th>Thickness (T)</th><th>Force</th></tr>
<tr><td rowspan="2">2.5mm max.</td><td>T≤0.5mm</td><td>8N</td></tr>
<tr><td>T>0.5mm</td><td>20N</td></tr>
<tr><td rowspan="2">3.2mm min.</td><td>T<1.25mm</td><td>15N</td></tr>
<tr><td>T≥1.25</td><td>54.5N</td></tr>
</table></td><td>Apply a force as shown in the following figure.<br>(i) Chip Length : 2.5mm max.<br>Beam Speed : 0.5mm/s<br>(ii) Chip Length : 3.2mm min.<br>Beam Speed : 2.5mm/s<br><br></td></tr>
<tr><td rowspan="3">21</td><td rowspan="3">Capacitance Temperature Characteris-tics</td><td>Capacitance Change</td><td></td><td>X7R : Within ±15%<br>X7S : Within ±22%<br>X6S : Within ±22%<br>X7T : Within +22% ~ -33%</td><td rowspan="3">(i) Class I<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, the capacitance should be within the specified tolerance for the temperature coefficient. The capacitance drift is calculated by dividing the differences between the maximum and minimum measured values in steps 1, 3 and 5 by the capacitance value in step 3.<br>
<table>
<tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th></tr>
<tr><td>Temp.(℃)</td><td>25±2</td><td>-55±3</td><td>25±2</td><td>125±3</td><td>25±2</td></tr>
</table>
(ii) Class II<br>The ranges of capacitance change compared with the 25℃ value over the temperature range from -55℃ to 125℃.<br>Initial measurement<br>Perform the initial measurement according to Note 1 for Class II.</td></tr>
<tr><td>Temperature Coefficient</td><td>0±30 ppm/℃</td><td></td></tr>
<tr><td>Capacitance Drift</td><td>Within ±0.2% or ±0.05pF<br>(Whichever is larger)</td><td></td></tr>
</table>

In the case of "*" is specifications for "Thin Layer Large Capacitance Type"

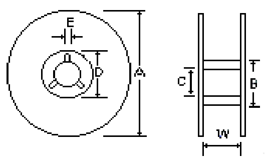
Note 1. Initial Measurement for Class II
Perform a heat treatment at 150+0/-10℃ for one hour, and then let sit for 24±2 hours at room temperature, then measure.

## 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



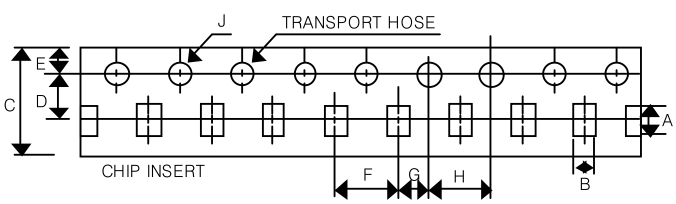

(Unit : mm)

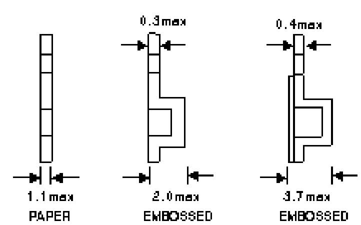
| Mark | Size Code | EIA Code | A | B | C | D | E | W |
|---|---|---|---|---|---|---|---|---|
| 7 " Reel | 1005~3225 | 0402~1210 | Φ178±2 | Φ50Min | Φ13±0.5 | Φ21±0.8 | 2±0.5 | 10±1.5 |
| | 4520~4532 | 1808~1812 | Φ180+0,−3 | Φ60−0,+1 | Φ13±0.2 | Φ57−0+1 | 3±0.2 | 13±0.5 |
| 13 " Reel | 1005~3225 | 0402~1210 | Φ330±2 | Φ70Min | Φ13±0.5 | Φ21±0.8 | 2±0.5 | 10±1.5 |

(4) Number of Package

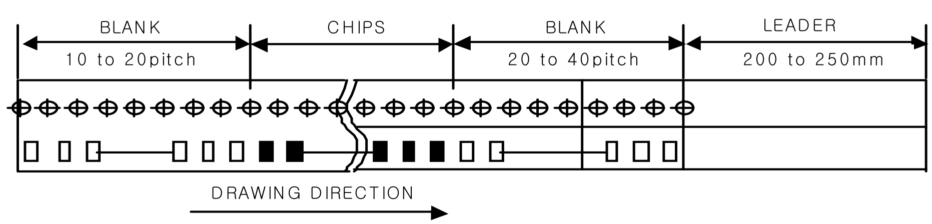
| Size Code | EIA Code | 7" | 13" |
|---|---|---|---|
| | | Quantity(pcs)/Reel | Quantity(pcs)/Reel |
| 1005 | 0402 | 10,000 | 50,000 |
| 1608 | 0603 | 4,000 | 15,000 |
| 2012 | 0805 | 3,000 ~ 4,000 | 8,000 ~ 15,000 |
| 3216 | 1206 | 2,000 ~ 4,000 | 6,000 ~ 10,000 |
| 3225 | 1210 | 1,000 ~ 3,000 | 4,000 ~ 10,000 |
| 4520 | 1808 | 1,500 ~ 3,000 | − |
| 4532 | 1812 | 500 ~ 1,000 | 1,500 ~ 5,000 |

(5) Tape Dimensions




| Size Code | EIA Code | A | B | C | D | E | F | G | H | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 1005 | 0402 | 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 |
| 1608 | 0603 | 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 |
| 2012 | 0805 | 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 |
| 3216 | 1206 | 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 |
| 3225 | 1210 | 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 |
| 4520 | 1808 | 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 |
| 4532 | 1812 | 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 |



## Caution

▶ 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

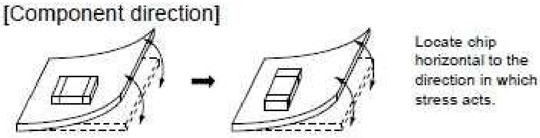
▶ The Regulation of Environmental Pollution Materials

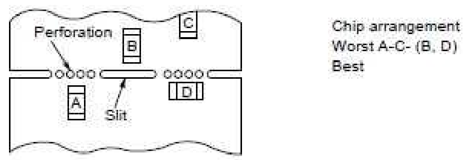
Never use materials mentioned below in MLCC products regulated this document.

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

▶ Mounting Position

Choose a mounting position that minimizes the stress imposed on the chip during flexing or bending of the board.




▶ 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.

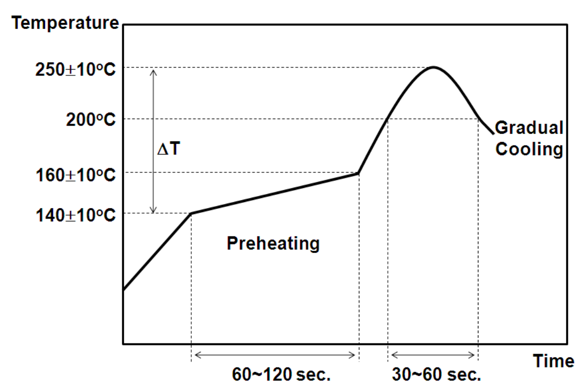
2. Please refer to the recommended soldering profiles as shown in figures, and keep the temperature difference(△T) within the range recommended in Table 1.

Table 1

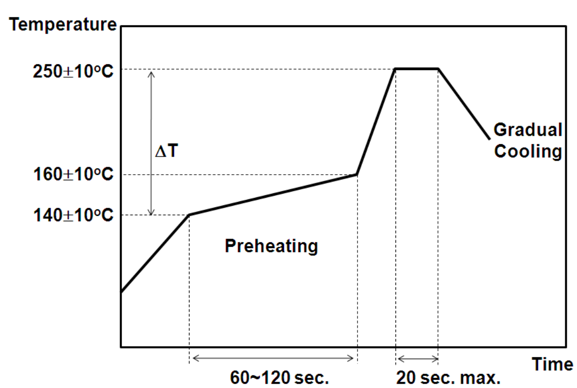
| Size code (EIA Code) | Temperature Difference |
|---|---|
| 1005~3216 (0402~1206) | △T≤190℃ |
| 3225 (1210) | △T≤130℃ |

Recommended Reflow Soldering Profile for Lead Free Solder

Infrared Reflow




Vapor Reflow



## Note

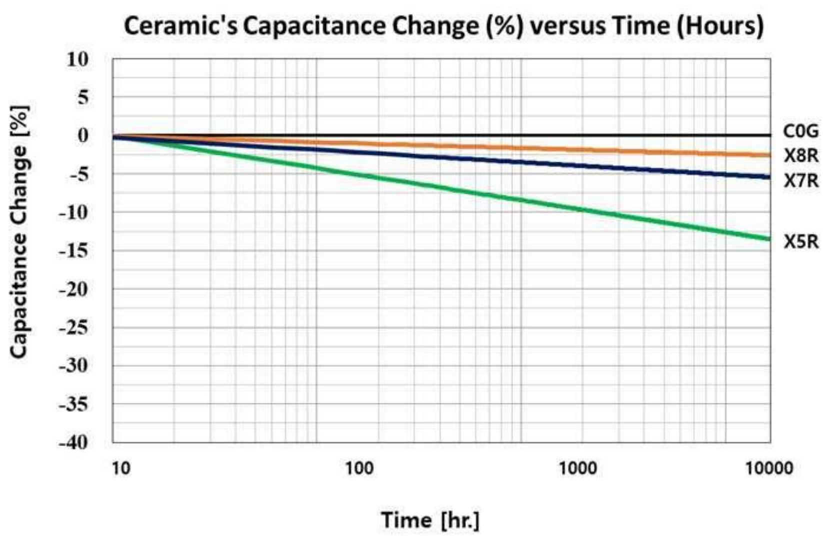
▶ 'Aging'/'De-aging' behavior of high dielectric constant type MLCCs
(Typically represented by X7R temperature characteristic of which main composition is $BaTiO_3$)

'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:

$$C_t = C_{24} (1 - k \log10\ t)$$

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 (also known as 'de-aged') by exposing the component to elevated temperatures approaching its curie temperature (approximately 120℃). This 'de-aging' 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.