**TO. : Reference Sheet**

**NO. : A250201**

# APPROVAL SHEET

## MULTILAYER CERAMIC CAPACITOR

**Automotive Grade, Soft Termination Type**

**(AEC-Q200 Qualified)**

**SAMWHA CAPACITOR .CO., LTD.**

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*** Notice**
**This sheet is for reference only and is subject to change or discontinuation without notice.**
**Please contact our sales representatives for detailed information**

| < SPECIFICATION SUMMARY > | | | |
|---|---|---|---|
| **SAMWHA Part no.** | **CQ3225X7R475K500ARK** | | |
| **Type** | **MLCC for Automotive Application** | | |
| **Items** | **Specification** | **Unit** | **Test Conditions** |
| **Capacitance** | 4.7 | μF | Testing Frequency : 1.0 ± 0.1KHz<br>Testing Voltage : 1.0 ± 0.2Vrms<br>Should be measured at 25°C. |
| **Capacitance Tolerance** | ± 10 | % | |
| **Dissipation Factor** | Max. 12.5 | % | |
| **Insulation Resistance** | More than 10.64 | MΩ | Should be measured with a DC voltage not exceeding rated voltage at 25℃ for 2 minutes of charging. |
| **Chip Size** | 3.20 ± 0.50 | L (㎜) | Capacitance Tolerance Code ---------- page 4/15<br>Chip size ---------- page 5/15<br>Characteristics & Test Method ---------- page 6/15~9/15 |
| | 2.50 ± 0.30 | W (㎜) | |
| | 2.00 ± 0.30 | T (㎜) | |

※ Thin Layer Large-Capacitance Type

**Record of Revision**

| PART NO. | | SAMWHA SPEC. | CQ3225X7R475K500ARK |
|---|---|---|---|

| NO | REASON | CONTENTS | DATE OF APPROVAL | CHECKED | REMARKS |
|---|---|---|---|---|---|
| 1 | Initial written | full document | 96. 03. 27 | | |
| 2 | Re-revision of approval document | full document | 25. 02. 01 | | |

## General Description

### 1. General Code

※*Caution : ECU/ Power Train/ Safety module/ Etc.*
*Please contact sales representatives or product engineers before using these Automotive products*

(1) Type Designation

| CQ | 3225 | X7R | 475 | K | 500 | A | R | K |
|---|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |

1) Multilayer Ceramic Capacitor (Automovie 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) Temperautre Coefficient Code

| Classification | Code | Temperature Range | Capacitance Tolerance |
|---|---|---|---|
| Class Ⅱ | X7R | -55 to +125℃ | ± 15 % |

4) Capacitance Tolerance Code

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 % |

| Code | Code |
|---|---|
| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rate 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

## General Description

9) Thickness option

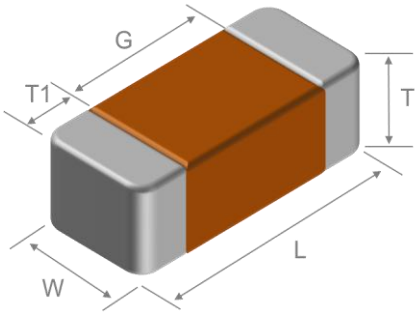
| Thickness (mm) | | Code | Thickness (mm) | | Code |
|---|---|---|---|---|---|
| t | Tolerance (±) | | t | Tolerance (±) | |
| 0.50 | 0.10 | Blank | 1.35 | 0.20 | H |
| 0.60 | 0.10 | A | 1.60 | 0.30 | I |
| 0.80 | 0.15 | B | 1.80 | 0.30 | J |
| 0.85 | 0.15 | B | 2.00 | 0.30 | K |
| 1.00 | 0.15 | E |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

**2. Temperature Characteristics**

See Page 9 (Specifications and Test Methods : No.21)

**3. Constructions and Dimensions**

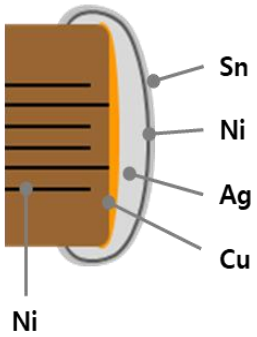
1) Dimensions




(Unit : ㎜)

| Size Code | EIA Code | Dimension | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Length | | | Width | | T1(min.) | G(min.) |
| | | L | Tol(-) | Tol(+) | W | Tol(±) | | |
| 3225 | 1210 | 3.20 | 0.50 | 0.50 | 2.50 | 0.30 | 0.30 | 1.00 |

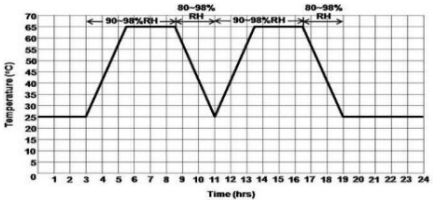
(2) Construction of Termination



## Specifications and Test Methods (For Automotive Applications)

| No. | AEC-Q200 Test Item | | Specification Class I | Specification Class II | Test Methods and Conditions |
|---|---|---|---|---|---|
| 1 | Pre-and Post-Stress Electrical Test | | - | | |
| 2 | High Temperature Exposure (Storage) | Appearance | No defects which may affect performance | | Temperature: Max. operating temperature ±3°C<br>Applied Time: 1000+48/-0 hrs<br>Measurement after test: Let sit for 24±2 hours at room temperature, then measure |
| | | Capacitance Change | Within ±2.5% or ±0.25pF (Whichever is larger) | Within ±10.0% (*Within ±12.5%) | |
| | | Q/D.F. | 30pF min.: Q≧1000<br>30pF max.: Q≧400+20×C<br>C: Nominal Capacitance (pF) | Rated Voltage<br>16V min.: 0.05 max.<br>10V: 0.075 max.<br>*0.2 max. | |
| | | I.R. | More than 10,000MΩ or 500Ω.F (*50Ω.F) (Whichever is smaller) | | |
| 3 | Temperature Cycle | Appearance | No defects which may affect performance | | Perform the 1000 cycles according to the four heat treatments listed in the following table |
| | | Capacitance Change | Within ±2.5% or ±0.25pF (Whichever is larger) | Within ±10.0% | |
| | | Q/D.F. | 30pF min.:Q≧1000<br>30pF max.:Q≧400+20×C<br>C: Nominal Capacitance (pF) | Rated Voltage<br>16V min.: 0.05 max.<br>10V: 0.075 max.<br>*0.2 max. | |
| | | I.R. | More than 10,000MΩ or 500Ω.F (*50Ω.F) (Whichever is smaller) | | Initial measurement: Perform the initial measurement according to Note 1 for Class II<br>Measurement after test: Let sit for 24±2 hours at room temperature, then measure |
| 4 | Destructive Physical Analysis | | No defects or abnormalities | | Per EIA-469 |
| 5 | Moisture Resistance | Appearance | No defects which may affect performance | | Temperature: 25~65°C<br>Humidity: 80~98%<br>Cycle Time: 24 hrs/cycle, 10 cycles<br>Measurement after test: Let sit for 24±2 hours at room temperature, then measure |
| | | Capacitance Change | Within ±3.0% or±0.30pF (Whichever is larger) | Within ±12.5% | |
| | | Q/D.F. | 30pF min.: Q≧350<br>10pF min. and 30pF max.: Q≧275+5/2×C<br>10pF max.: Q≧200+10×C<br>C: Nominal Capacitance (pF) | Rated Voltage<br>16V min.: 0.05 max.<br>10V: 0.075 max.<br>*0.2 max. | |
| | | I.R | More than 10,000MΩ or 500Ω.F (*50Ω.F) (Whichever is smaller) | | |
| 6 | Humidity Bias | Appearance | No defects which may affect performance | | Temperature: 85±3°C<br>Humidity: 80~85%<br>Applied Voltage: Rated Voltage and 1.3+0.2/-0V<br>Applied Time: 1000+48/-0 hrs<br>Charge/Discharge Current: 50mA max.<br>Measurement after test: Let sit for 24±2 hours at room temperature, then measure |
| | | Capacitance Change | Within ±3.0% or ±0.30pF (Whichever is larger) | Within ±12.5% | |
| | | Q/D.F. | 30pF min.: Q≧200<br>30pF max.: Q≧100+10/3×C<br>C: Nominal Capacitance (pF) | Rated Voltage<br>16V min.: 0.05 max.<br>10V: 0.075 max.<br>*0.2 max. | |
| | | I.R. | More than 1,000MΩ or 50Ω.F (*5Ω.F) (Whichever is smaller) | | |
| 7 | High Temperature Operating Life | Appearance | No defects which may affect performance | | Temperature: Max. operating temp. ±3°C<br>Applied Voltage: Rated Voltage x200% (*150%)<br>Applied Time: 1000+48/-0 hrs<br>Charge/Discharge Current: 50mA max.<br>Measurement after test: Let sit for 24±2 hours at room temperature, then measure<br>Initial Measurement for Class II: Applied 200% of the rated voltage for one hour at 125±3°C Remove and let sit for 24±2 hours at room temperature, then measure |
| | | Capacitance Change | Within ±3.0% or ±0.30pF (Whichever is larger) | Within ±12.5% | |
| | | Q/D.F. | 30pF min.:Q≧350<br>10pF min. and 30pF max.: Q≧275+5/2×C<br>10pF max.: Q≧200+10×C<br>C: Nominal Capacitance (pF) | Rated Voltage<br>16V min.: 0.05 max.<br>10V: 0.075 max.<br>*0.2 max. | |
| | | I.R. | More than 1,000MΩ or 50Ω.F (*5Ω.F) (Whichever is smaller) | | |

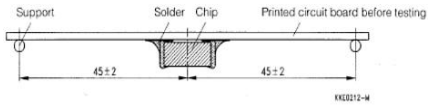
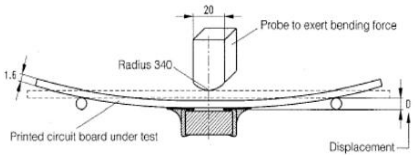
| Step | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Temp.(℃) | -55+0/-3 | 25±2 | 125+3/-0 | 25±2 |
| Time(min) | 15±3 | 1 | 15±3 | 1 |



## 2. Specifications and Test Methods (For Automotive Applications)

| No. | AEC-Q200 Test Item | | Specification | | Test Methods and Conditions |
|---|---|---|---|---|---|
| | | | Class I | Class II | |
| 8 | External Visua | | No defects or abnormalities | | Visual inspection |
| 9 | Physical Dimension | | Within the specified dimensions | | Using calipers |
| 10 | Resistance to Solvent | Appearance | No defects which may affect performance | | Per MIL-STD-202 Method 215 |
| | | Capacitance Change | Within the specified tolerance | | |
| | | Q/D.F. | 30pF min.: Q≧1000<br>30pF max.: Q≧400+20×C<br>C: Nominal Capacitance (pF) | 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. | |
| | | I.R. | More than 10,000MΩ or 500Ω.F (*50Ω.F) (Whichever is smaller) | | |
| 11 | Mechanical Shock | Appearance | No defects which may affect performance | | Three shocks in each direction should be applied along 3 mutually perpendicular axes of the test specimen (18 shocks)<br>Wave form: Half-sine<br>Duration: 0.5ms<br>Peak value: 1,500G<br>Velocity change: 4.7m/s |
| | | Capacitance Change | Within the specified tolerance | | |
| | | Q/D.F. | 30pF min.: Q≧1000<br>30pF max.: Q≧400+20×C<br>C: Nominal Capacitance (pF) | 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. | |
| | | I.R. | More than 10,000MΩ or 500Ω.F (*50Ω.F) (Whichever is smaller) | | |
| 12 | Vibration | Appearance | No defects which may affect performance | | Type of Vibration: 10Hz to 2000Hz then 10Hz<br>Vibration Time: 20min.<br>Total Amplitude: 1.5mm<br>Vibration directions and time: This cycle should be performed 12 times in each of three mutually perpendicular directions (total of 36 times) |
| | | Capacitance Change | Within the specified tolerance | | |
| | | Q/D.F. | 30pF min.: Q≧1000<br>30pF max.: Q≧400+20×C<br>C: Nominal Capacitance (pF) | 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. | |
| | | I.R. | More than 10,000MΩ or 500Ω.F (*50Ω.F) (Whichever is smaller) | | |
| 13 | Resistance to Solder Heat | Appearance | No defects which may affect performance | | Temperature: 260±5°C<br>Dipping Time: 10±1sec.<br>Measurement after test: Let sit for 24±2 hours at room temperature, then measure<br>Initial measurement: Perform the initial measurement according to Note 1 for Class II |
| | | Capacitance Change | Within the specified tolerance | Within the specified tolerance | |
| | | Q/D.F. | 30pF min.: Q≧1000<br>30pF max.: Q≧400+20×C<br>C: Nominal Capacitance (pF) | 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. | |
| | | I.R. | More than 10,000MΩ or 500Ω.F (*50Ω.F) (Whichever is smaller) | | |
| 14 | Thermal Shock | Appearance | No defects which may affect performance | | Perform the 300 cycles according to the two heat treatments listed in the following table.<br>Step: 1: Temp.(℃) -55+0/-3, Time(min.) 15±3; 2: Temp.(℃) 125+3/-0, Time(min.) 15±3<br>Transfer Time: 20sec. max.<br>Measurement after test: Let sit for 24±2 hours at room temperature, then measure.<br>Initial measurement: Perform the initial measurement according to Note 1 for Class II |
| | | Capacitance Change | Within ±2.5% or ±0.25pF (Whichever is larger) | Within ±15% | |
| | | Q/D.F. | 30pF min.: Q≧1000<br>30pF max.: Q≧400+20×C<br>C: Nominal Capacitance (pF) | 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. | |
| | | I.R. | More than 10,000MΩ or 500Ω.F (*50Ω.F) (Whichever is smaller) | | |

## 2. 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 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) (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="5">17</td><td rowspan="5">Electrical Characterization</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="3">The capacitance/Q/D.F. should be measured at 25°C at the frequency and voltage shown in the table.<br><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>Measurement after test: Take it out and set it for 24±2 hours (Class II) then measure<br>Initial measurement: Perform the initial measurement according to Note1 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. at 25℃</td><td>More than 100,000MΩ or 1,000Ω.F (Whichever is smaller)</td><td>More than 10,000MΩ or 500Ω.F (*50Ω.F) (Whichever is smaller)</td><td>Applied Voltage: Rated voltage<br>Charging Time: 2min.<br>Charge/Discharge Current: 50mA max.</td></tr>
<tr><td>I.R. at 125℃</td><td>More than 10,000MΩ or 1,000Ω.F (Whichever is smaller)</td><td>More than 1,000MΩ or 10Ω.F (*1Ω.F) (Whichever is smaller)</td></tr>
<tr><td></td><td>Voltage proof</td><td colspan="2">No dielectric breakdown or mechanical breakdown</td><td>Applied Voltage: 250% of the rated voltage<br>Applied Time: 1 to 5sec.<br>Charge/Discharge Current: 50mA max.</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.<br>  <br>  <br>Flexure for Class I: 3mm max. or Class II: 3mm max.</td></tr>
<tr><td>Capacitance Change</td><td>Within ±5.0% or ±0.5pF (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">Applied Force: 18N*<br>Holding Time: 60±1 seconds.<br>*10N for 1608 size (EIA:0603)<br>2N for 1005 size (EIA:0402)</td></tr>
<tr><td>Capacitance Change</td><td>Within ±5.0% or ±0.5pF (Whichever is larger)</td><td>Within the specified tolerance</td></tr>
</table>

## 2. 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>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. Beam Speed : 0.5mm/s<br>(ii) Chip Length : 3.2mm min. Beam Speed : 2.5mm/s<br> 
</td></tr>
<tr><td rowspan="3">21</td><td rowspan="3">Capacitance Temperature Characteris-tics</td><td>Capacitance Change</td><td colspan="2">Within ±15%</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.<br>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><td>Step</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></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><br>(ii) Class II<br>The ranges of capacitance change compared with the 25°C value over the temperature range from -55°C to 125°C.<br>Initial measurement — Perform the initial measurement according to Note 1 for Class II.</td></tr>
<tr><td>Temperature Coefficient</td><td colspan="2">0±30 ppm/℃</td></tr>
<tr><td>Capacitance Drift</td><td colspan="2">Within ±0.2% or ±0.05pF<br>(Whichever is larger)</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/-10oC 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"

## 3. Packing

(1) Bulk Packing

① 1000 pcs per polybag

② 5 polybags per inner box

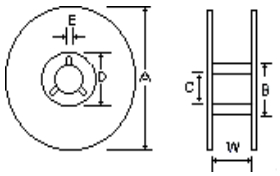
③ 10 inner boxes per out box

(2) Reel Packing

① 8~10 reels per inner box

② 6 inner boxes per out box

(3) Reel Dimensions




(Unit : mm)

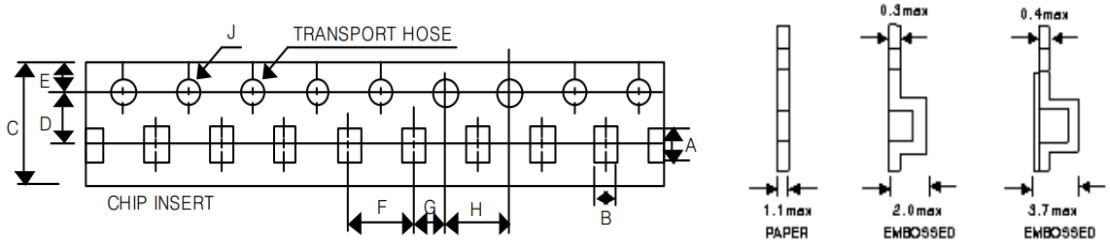
| Mark | Size Code | EIA Code | A | B | C | D | E | W |
|---|---|---|---|---|---|---|---|---|
| 7 ″ Reel | 1005~3225 | 0402~1210 | Φ178±2 | Φ50Min | Φ13±0.5 | Φ21±0.8 | 2±0.5 | 10±1.5 |
| 13 ″ Reel | 1005~3225 | 0402~1210 | Φ330±2 | Φ70Min | Φ13±0.5 | Φ21±0.8 | 2±0.5 | 10±1.5 |

(4) Number of Package

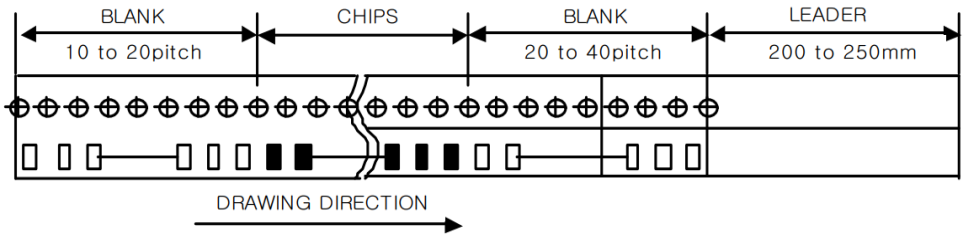
| Size Code | EIA Code | 7" | 13" |
|---|---|---|---|
| | | Quantity(pcs)/Reel | Quantity(pcs)/Reel |
| 1005 | 0402 | 10,000 | 50,000 |
| 1608 | 0603 | 4,000 | 15,000 |
| 2012 | 0805 | 3,000 ~ 4,000 | 8,000 ~ 15,000 |
| 3216 | 1206 | 2,000 ~ 4,000 | 6,000 ~ 10,000 |
| 3225 | 1210 | 1,000 ~ 3,000 | 4,000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

## Packing

(5) Tape Dimensions




| Size Code | EIA Code | 사이즈 | 두께 | A | B | C | D | E | F | G | H | J |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CS0603 | CC0201 | 0603 | all | 0.7±0.02 | 0.4±0.02 | 8±0.1 | 3.5±0.05 | 1.75±0.05 | 2±0.05 | 2±0.05 | 4±0.1 | 1.55±0.03 |
| CS1005 | CC0402 | 1005 | all | 1.12±0.03 | 0.62±0.03 | 8±0.1 | 3.5±0.05 | 1.75±0.05 | 2±0.05 | 2±0.05 | 4±0.1 | 1.55±0.03 |
| CS1005 | CC0402 | 1005 | all | 1.12±0.03 | 0.58±0.03 | 8±0.1 | 3.5±0.05 | 1.75±0.05 | 2±0.05 | 2±0.05 | 4±0.1 | 1.55±0.03 |
| CS1005 | CC0402 | 1005 | all | 1.16±0.03 | 0.66±0.03 | 8±0.05 | 3.5±0.05 | 1.75±0.05 | 2±0.05 | 2±0.05 | 4±0.1 | 1.55±0.03 |
| CS1608 | CC0603 | 1608 | A, B | 1.8±0.05 | 0.95±0.05 | 8±0.1 | 3.5±0.05 | 1.75±0.05 | 2±0.05 | 2±0.05 | 4±0.1 | 1.55±0.03 |
| CS1608 | CC0603 | 1608 | A, B | 1.78±0.05 | 0.92±0.05 | 8±0.1 | 3.5±0.05 | 1.75±0.05 | 2±0.05 | 2±0.05 | 4±0.1 | 1.55±0.03 |
| CS1608 | CC0603 | 1608 | B | 1.9±0.05 | 1.1±0.05 | 8±0.2 | 3.5±0.05 | 1.75±0.1 | 4±0.1 | 2±0.05 | 4±0.1 | 1.5+0.1 |
| CS1608 | CC0603 | 1608 | B | 1.9±0.05 | 1.1±0.05 | 8±0.1 | 3.5±0.05 | 1.75±0.05 | 4±0.1 | 2±0.05 | 4±0.1 | 1.55±0.03 |
| CS2012 | CC0805 | 2012 | E | 2.25±0.1 | 1.35±0.1 | 8±0.1 | 3.5±0.05 | 1.75±0.1 | 4±0.1 | 2±0.05 | 4±0.05 | 1.5±0.1 |
| CS2012 | CC0805 | 2012 | E | 2.4±0.1 | 1.6±0.1 | 8±0.1 | 3.5±0.05 | 1.75±0.1 | 4±0.1 | 2±0.05 | 4±0.05 | 1.5±0.1 |
| CS2012 | CC0805 | 2012 | E | 2.25±0.1 | 1.35±0.1 | 8±0.1 | 3.5±0.05 | 1.75±0.1 | 4±0.1 | 2±0.05 | 4±0.1 | 1.5+0.1 |
| CS2012 | CC0805 | 2012 | E | 2.25±0.05 | 1.53±0.08 | 8±0.1 | 3.5±0.05 | 1.75±0.1 | 4±0.1 | 2±0.05 | 4±0.1 | 1.5+0.1 |
| CS2012 | CC0805 | 2012 | A | 2.3±0.05 | 1.55±0.05 | 8±0.1 | 3.5±0.05 | 1.75±0.05 | 4±0.1 | 2±0.05 | 4±0.1 | 1.55±0.03 |
| CS2012 | CC0805 | 2012 | B | 2.3±0.05 | 1.55±0.05 | 8±0.1 | 3.5±0.05 | 1.75±0.05 | 4±0.1 | 2±0.05 | 4±0.1 | 1.55±0.03 |
| CS3216 | CC1206 | 3216 | E | 3.5±0.1 | 1.88±0.1 | 8±0.1 | 3.5±0.05 | 1.75±0.1 | 4±0.1 | 2±0.05 | 4±0.05 | 1.5±0.1 |
| CS3216 | CC1206 | 3216 | I | 3.45±0.1 | 1.75±0.1 | 8±0.1 | 3.5±0.05 | 1.75±0.1 | 4±0.1 | 2±0.05 | 4±0.05 | 1.5±0.1 |
| CS3216 | CC1206 | 3216 | I | 3.7±0.1 | 1.85±0.1 | 8±0.1 | 3.5±0.05 | 1.75±0.1 | 4±0.1 | 2±0.05 | 4±0.05 | 1.5±0.1 |
| CS3225 | CC1210 | 3225 | L | 3.58±0.1 | 2.75±0.1 | 8±0.1 | 3.5±0.05 | 1.75±0.1 | 4±0.1 | 2±0.05 | 4±0.05 | 1.5±0.1 |
| CS3225 | CC1210 | 3225 | J | 3.58±0.1 | 2.85±0.1 | 8±0.1 | 3.5±0.05 | 1.75±0.1 | 4±0.1 | 2±0.05 | 4±0.05 | 1.5±0.1 |
| CS3225 | CC1210 | 3225 | L | 3.5±0.1 | 2.7±0.1 | 8±0.1 | 3.5±0.05 | 1.75±0.1 | 4±0.1 | 2±0.05 | 4±0.05 | 1.5±0.1 |
| CS4532 | CC1812 | 4532 | M | 4.9±0.1 | 3.6±0.1 | 12±0.1 | 5.5±0.05 | 1.75±0.1 | 8±0.1 | 2±0.05 | 4±0.05 | 1.5±0.1 |

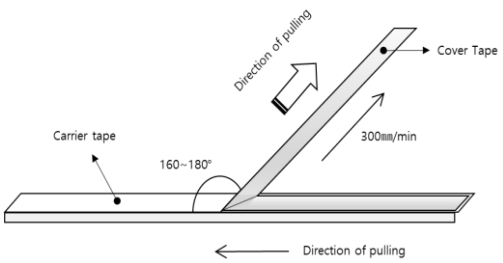



(6) Cover tape peel-off Strength

1. Peeling strength

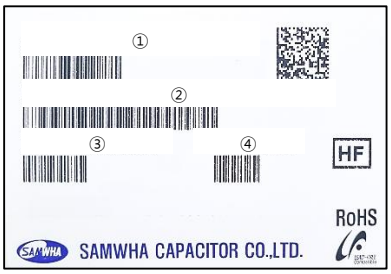
   10 g.f to 70 g.f

2. Measurement Method



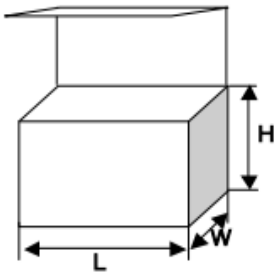
## Packing

(7) Packing Label(* Reference image)

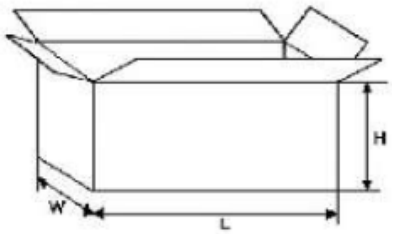



① Customer
② Part No.
③ Lot No
④ Q/ty

(8) Packing Box




Inner box drawing




Out box drawing

Packing Box Dimensions (Unit : mm)

| Division | | Size | | |
|---|---|---|---|---|
| | | L | W | H |
| Inner Box | 7 " Reel Box (in 5 reels) | 183 | 65 | 185 |
| | 7 " Reel Box (in 10 reels) | 185 | 135 | 185 |
| | 13 " Reel Box | 330 | 65 | 337 |
| Out Box | 7 " Reel Box | 430 | 390 | 210 |
| | 13 " Reel Box | 350 | 350 | 360 |

## Caution

▶ Storage Condition

When solderability is considered, capacitor are recommended to be used in 12 months.

MLCC should be stored at 5~40℃ with a relative humidity of 20~70%.

High humidity can reduce solderability due to oxidation.

Use the product within 6 months of the outgoing delivery date, and check the packaging if more than 6 months have passed.

It's recommended to use within 1 year to avoid solderability issues from long-term storage.

If over 1 year, verify solderability before use.

▶ 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

▶ 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

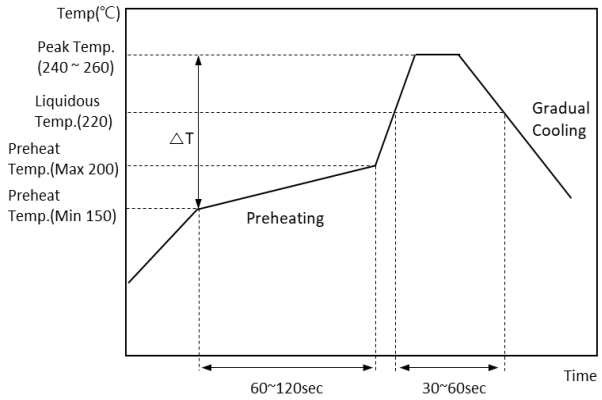
| Size code (EIA Code) | Temperature Difference |
|---|---|
| 0603, 1005, 1608, 2012, 3216 | △T≤150°C |
| 3225 size and over | △T≤130°C |

Recommended Conditions

| Size code (EIA Code) | Lead Free Solder |
|---|---|
| Peak Temperature | 240 - 260°C |
| Atmosphere | Air or $N_2$ |

* Compliant Standard JESD22

▶ Standard condition for reflow soldering




▶ Flow 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 2.

Table 2

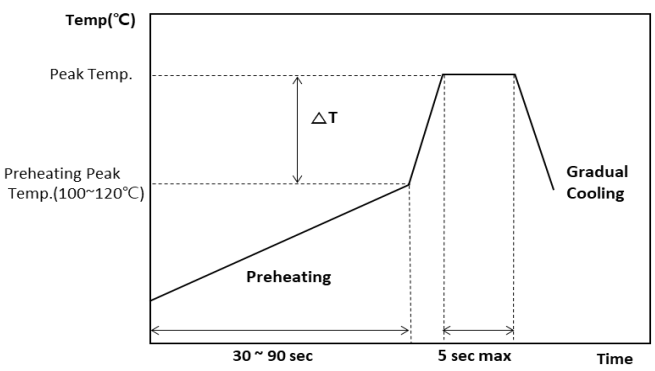
| Size code | Temperature Difference |
|---|---|
| 1608, 2012, 3216 | △T≤150°C |

Recommended Conditions

| Conditions | Lead Free Solder |
|---|---|
| Soldering Peak Temperature | 250 - 260°C |
| Atmosphere | Air or $N_2$ |

*Lead Free Solder : Sn-3.0Ag-0.5Cu

▶ Flow Profile



**Notice**

▶ Land Dimension

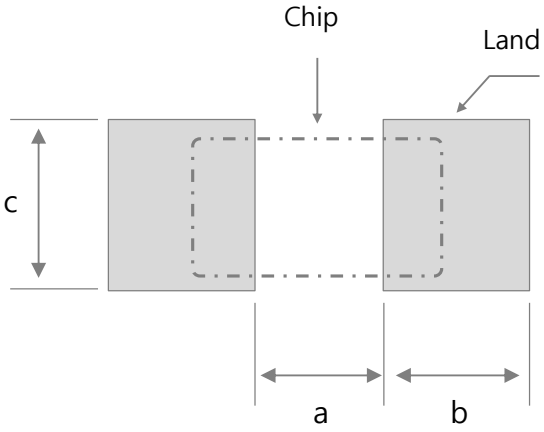



Table . Reflow Soldering Method

| Chip size [mm] | Chip tol. [mm] | a [mm] | b [mm] | c [mm] |
|---|---|---|---|---|
| **0603** | ±0.03 | 0.2~0.25 | 0.2~0.3 | 0.25~0.35 |
| | ±0.05/±0.09 | 0.23~0.3 | 0.25~0.35 | 0.3~0.4 |
| **1005** | ±0.1 | 0.3~0.5 | 0.35~0.45 | 0.4~0.6 |
| | ±0.2 | 0.4~0.6 | 0.4~0.5 | 0.5~0.7 |
| **1608** | ±0.1 | 0.6~0.8 | 0.6~0.7 | 0.6~0.8 |
| | ±0.2 | 0.7~0.9 | 0.7~0.8 | 0.8~1.0 |
| **2012** | ±0.1 | 0.9~1.3 | 0.6~0.8 | 1.2~1.4 |
| | ±0.2 | 1.0~1.4 | 0.6~0.8 | 1.2~1.4 |
| **3216** | ±0.2 | 1.8~2.0 | 0.9~1.2 | 1.5~1.7 |
| | ±0.3 | 1.9~2.1 | 1.0~1.3 | 1.7~1.9 |
| **3225** | | 2.0~2.4 | 1.0~1.2 | 1.8~2.3 |
| **4532** | | 3.0~3.5 | 1.2~1.4 | 2.3~3.0 |
| **5750** | | 4.0~4.6 | 1.4~1.6 | 3.5~4.8 |

*Please confirm the suitable land dimensions, which are determined through the evaluation of the actual SET and PCB

**Note**

(1) '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:

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

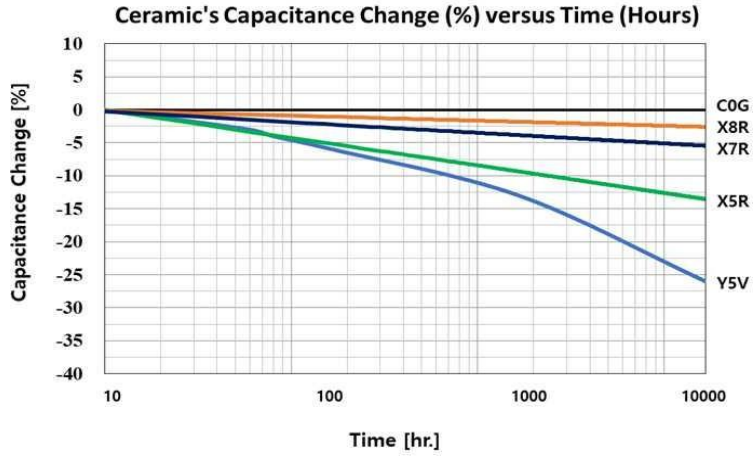
where,

Ct : 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.

(2) Caution of Application

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.

ⓐ Aircraft equipment ⓑ Aerospace equipment ⓒ Undersea equipment ⓓ Power plant equipment
ⓔ Medical equipment ⓕ Transportation equipment (vehicles, trains, ships, etc.)
ⓖ Traffic signal equipment ⓗ Disaster prevention / crime prevention equipment
ⓘ Industrial equipment (Conveyors, Robot equipment, etc) ⓙ Led equipment
ⓚ Application of similar complexity and/or reliability requirements to the applications listed above