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## **EYANG TECHNOLOGY DEVELOPMENT CO.,LTD**

# **High Q Chip Multilayer Ceramic Chip Capacitors for Automotive Model selection reference book**

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Mark: The Model selection reference book is for design reference only.

**High Q Chip Multilayer Ceramic Capacitors for Automotive****1.Scope**

This specification is applicable to the High Q Chip Multilayer Ceramic Capacitors (MLCC) for Automotive.

**1.1 Temperature Characteristics:** Class1 (Temperature Compensating Type): C0G/X8G

**1.2 Size Code:** 0201\0402\0603\0805

**1.3 Capacitance :** 0.1pF~220pF

**2.Part Number System**

| Q             | 0402        | C0G                          | 100                  | G                      | 500            | N                 | I               | B               |
|---------------|-------------|------------------------------|----------------------|------------------------|----------------|-------------------|-----------------|-----------------|
| ① Series Code | ② Size Code | ③Temperature Characteristics | ④Nominal Capacitance | ⑤Capacitance Tolerance | ⑥Rated Voltage | ⑦Termination Type | ⑧Packaging Code | ⑨Thickness Code |

① **Series Code:** Q -High Q Chip Multilayer Ceramic Capacitors for Automotive (Internal Electrodes: Cu)

② **Size Code** (Unit:mm)

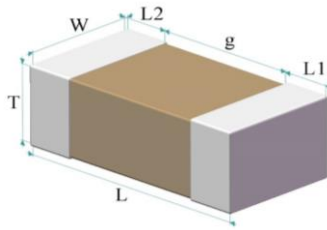


Fig.1 Structure & Dimension

| Size Code | L         | W         | L1,L2       | g        | T         | Thickness Code |
|-----------|-----------|-----------|-------------|----------|-----------|----------------|
| 0201      | 0.60±0.03 | 0.30±0.03 | 0.10 ~ 0.20 | 0.20min. | 0.30±0.03 | A              |
| 0402      | 1.00±0.05 | 0.50±0.05 | 0.15 ~ 0.35 | 0.30min. | 0.50±0.05 | B              |
| 0603      | 1.60±0.10 | 0.80±0.10 | 0.20 ~ 0.50 | 0.50min. | 0.70±0.10 | U              |
| 0805      | 2.00±0.10 | 1.25±0.10 | 0.20 ~ 0.70 | 0.70min. | 0.85±0.10 | E              |

**③ Temperature Characteristics**

| Temperature Characteristics | Operating Temp. Range | Temperature Characteristics |             |            |
|-----------------------------|-----------------------|-----------------------------|-------------|------------|
|                             |                       | Temp. coeff. or Cap. Change | Temp. Range | Ref. Temp. |
| C0G                         | -55°C~125°C           | 0±30ppm/°C                  | 25°C~125°C  | 25°C       |
| X8G                         | -55°C~150°C           | 0±30ppm/°C                  | 25°C~125°C  | 25°C       |

④ **Nominal Capacitance** (Unit: pF)  $1\text{pF}=10^{-3}\text{nF}=10^{-6}\mu\text{F}$

Example: R47=0.47 pF, 2R2=2.2 pF, 120=12×10<sup>0</sup>=12pF, 104=10×10<sup>4</sup>=100000 pF=100 nF,

Class1(C0G\X8G) Capacitance Step in E24 series. Capacitance: See Table3

**⑤ Capacitance Tolerance**

| Code | Capacitance Tolerance | Code | Capacitance Tolerance |
|------|-----------------------|------|-----------------------|
| A    | ±0.05pF               | F    | ±1%                   |
| B    | ±0.1pF                | G    | ±2%                   |
| C    | ±0.25pF               | J    | ±5%                   |
| D    | ±0.5pF                | K    | ±10%                  |

## ⑥ Rated Voltage

| Code | Voltage Values | Code | Voltage Values |
|------|----------------|------|----------------|
| 2R5  | 2.5V           | 101  | 100V           |
| 4R0  | 4.0V           | 201  | 200V           |
| 6R3  | 6.3V           | 251  | 250V           |
| 100  | 10V            | 501  | 500V           |
| 160  | 16V            | 631  | 630V           |
| 250  | 25V            | 102  | 1000V          |
| 350  | 35V            | 202  | 2000V          |
| 500  | 50V            |      |                |

## ⑦ Termination Type

| Code | Terminal Electrodes | Plating Material |
|------|---------------------|------------------|
| N    | Cu                  | Ni/Sn            |

⑧ Packaging Code See Table 4.

⑨ Thickness Code See ② Size Code

Table 3-1 Capacitance Table ( Class1-C0G\X8G)

| NO. | Series Code | Temperature Characteristics | Size Code | Rated Voltage | Thickness code | Capacitance  |
|-----|-------------|-----------------------------|-----------|---------------|----------------|--------------|
| 1   | Q           | C0G                         | 0201      | 200V          | A              | 0.1pF~22pF   |
| 2   | Q           | C0G                         | 0201      | 100V          | A              | 0.1pF ~ 33pF |
| 3   | Q           | C0G                         | 0201      | 50V           | A              | 0.1pF ~ 33pF |
| 4   | Q           | C0G                         | 0201      | 25V           | A              | 0.1pF ~ 33pF |
| 5   | Q           | C0G                         | 0402      | 250V          | B              | 0.1pF~56pF   |
| 6   | Q           | C0G                         | 0402      | 200V          | B              | 0.1pF~100pF  |
| 7   | Q           | C0G                         | 0402      | 100V          | B              | 0.1pF~100pF  |
| 8   | Q           | C0G                         | 0402      | 50V           | B              | 0.1pF~100pF  |
| 9   | Q           | C0G                         | 0402      | 25V           | B              | 0.1pF~100pF  |
| 10  | Q           | C0G                         | 0603      | 250V          | U              | 0.1pF~100pF  |
| 11  | Q           | C0G                         | 0805      | 250V          | E              | 0.2pF~220pF  |
| 12  | Q           | X8G                         | 0201      | 200V          | A              | 0.1pF~22pF   |
| 13  | Q           | X8G                         | 0201      | 100V          | A              | 0.3pF~22pF   |
| 14  | Q           | X8G                         | 0402      | 200V          | B              | 0.1pF~56pF   |
| 15  | Q           | X8G                         | 0402      | 100V          | B              | 0.1pF~56pF   |
| 16  | Q           | X8G                         | 0603      | 250V          | U              | 0.1pF~100pF  |
| 17  | Q           | X8G                         | 0805      | 500V          | E              | 0.2pF~22pF   |
| 18  | Q           | X8G                         | 0805      | 250V          | E              | 0.2pF~220pF  |

Table 4 Packaging (Minimum Quantity)

| NO. | Size Code | Thickness Code | Square hole spacing | Disc Size | Carrier Tape Type | QTY (Kpcs) | Packaging Code |
|-----|-----------|----------------|---------------------|-----------|-------------------|------------|----------------|
| 1   | 0201      | A              | 2mm                 | 7 #       | Paper             | 15         | T              |
| 2   | 0201      | A              | 2mm                 | 13 #      | Paper             | 50         | J              |
| 3   | 0201      | A              | 1mm                 | 13 #      | Paper             | 100        | D              |
| 4   | 0201      | A              | 2mm                 | 7 #       | Paper             | 10         | H              |
| 5   | 0201      | A              | 1mm                 | 7 #       | Paper             | 30         | L              |
| 6   | 0402      | B              | 2mm                 | 7 #       | Paper             | 10         | T              |
| 7   | 0402      | B              | 2mm                 | 13 #      | Paper             | 50         | J              |
| 8   | 0603      | U              | 4mm                 | 7 #       | Paper             | 4          | T              |
| 9   | 0805      | E              | 4mm                 | 7 #       | Paper             | 4          | T              |

**First packaging:** Each multi-disc material is packed into a box.

**The second packaging:** the first packaged packaging box is loaded into the paper packaging box, and the remaining space in the box is filled with light auxiliary materials.

The above packaging forms can also be packaged according to user needs.

3. Technical Specifications and Test Methods

3.1 Operating Environment

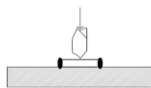
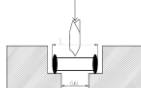
| Temp. Characteristics | Temp. Range | Relative Humidity | Atmospheric Pressure |
|-----------------------|-------------|-------------------|----------------------|
| C0G                   | -55℃~125℃   | ≤95% (25℃)        | 86 KPa~106KPa        |
| X8G                   | -55℃~150℃   | ≤95% (25℃)        | 86 KPa~106KPa        |

3.2 Reliability Test Specifications and Methods

Table 1: Specifications and Test Methods

| No.               | Item                                |                                                                                                                                          | Specification                                                                                                                                                                                                                                                                                                                                                                                                                    | Test Method                                                                                                                                                                          |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
|-------------------|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|---|-----------------|------|---|------------|---|---|-----------------|------|---|------------|---|
|                   | AEC-Q200 Test Item                  |                                                                                                                                          | Class1 (Temperature Compensating Type)                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                      |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| 1                 | Pre-and Post-Stress Electrical Test |                                                                                                                                          | —                                                                                                                                                                                                                                                                                                                                                                                                                                | —                                                                                                                                                                                    |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| 2                 | High Temperature Exposure (Storage) | Appearance                                                                                                                               | No defects or abnormalities.                                                                                                                                                                                                                                                                                                                                                                                                     | Perform heat treatment 3 times according to Lead-free reflow soldering profiles, the peak temperature is 260℃, and the time gap between each heat treatment is more than 30 minutes. |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| Cap. Change       |                                     | $\Delta C/C \leq \pm 2.5\%$ or $\pm 0.25pF$ , (Whichever is larger)                                                                      | Test temperature                                                                                                                                                                                                                                                                                                                                                                                                                 | $\theta 2 \pm 3^{\circ}C$                                                                                                                                                            | [X8G: $\theta 2=150^{\circ}C$ ,C0G: $\theta 2=125^{\circ}C$ ]                                                                                                            |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| I.R. (Room Temp.) |                                     | $\geq 10000M\Omega$ or $500\Omega \cdot F$ , (Whichever is smaller)                                                                      | Test time                                                                                                                                                                                                                                                                                                                                                                                                                        | 1000±12h                                                                                                                                                                             |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| Q                 |                                     | $C \leq 10pF$ , $Q \geq 200+10C$<br>$10pF < C < 30pF$ , $Q \geq 275+5C/2$<br>$C \geq 30pF$ , $Q \geq 350$<br>C: Nominal Capacitance (pF) | Post-treatment                                                                                                                                                                                                                                                                                                                                                                                                                   | Set for 24±2 hours at room temperature, then measure.                                                                                                                                |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| 3                 | Temperature Cycling                 | Appearance                                                                                                                               | No defects or abnormalities.                                                                                                                                                                                                                                                                                                                                                                                                     | Perform heat treatment 3 times according to Lead-free reflow soldering profiles, the peak temperature is 260℃, and the time gap between each heat treatment is more than 30 minutes. |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| Cap. Change       |                                     | $\Delta C/C \leq \pm 2.5\%$ or $\pm 0.25pF$ , (Whichever is larger)                                                                      | Cycles                                                                                                                                                                                                                                                                                                                                                                                                                           | 1000cycles                                                                                                                                                                           |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| I.R. (Room Temp.) |                                     | $\geq 10000M\Omega$ or $500\Omega \cdot F$ , (Whichever is smaller)                                                                      | Temperature Step                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                      |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| Q                 |                                     | $C < 30pF$ , $Q \geq 400+20C$<br>$C \geq 30pF$ , $Q \geq 1000$<br>C: Nominal Capacitance (pF)                                            | <table><tr><th>Step</th><th>Temp.(℃)</th><th>Time (min)</th></tr><tr><td>1</td><td><math>\theta 1+0/-3</math></td><td>30±3</td></tr><tr><td>2</td><td>Room Temp.</td><td>1</td></tr><tr><td>3</td><td><math>\theta 2+3/-0</math></td><td>30±3</td></tr><tr><td>4</td><td>Room Temp.</td><td>1</td></tr></table> X8G: $\theta 1=-55^{\circ}C$ , $\theta 2=150^{\circ}C$<br>C0G: $\theta 1=-55^{\circ}C$ , $\theta 2=125^{\circ}C$ | Step                                                                                                                                                                                 | Temp.(℃)                                                                                                                                                                 | Time (min) | 1 | $\theta 1+0/-3$ | 30±3 | 2 | Room Temp. | 1 | 3 | $\theta 2+3/-0$ | 30±3 | 4 | Room Temp. | 1 |
| Step              | Temp.(℃)                            | Time (min)                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                      |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| 1                 | $\theta 1+0/-3$                     | 30±3                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                      |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| 2                 | Room Temp.                          | 1                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                      |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| 3                 | $\theta 2+3/-0$                     | 30±3                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                      |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| 4                 | Room Temp.                          | 1                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                      |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
|                   |                                     | Post-treatment                                                                                                                           | Set for 24±2 hours at room temperature, then measure.                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                      |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| 4                 | Destructive Physical Analysis (DPA) |                                                                                                                                          | No defects or abnormalities.                                                                                                                                                                                                                                                                                                                                                                                                     | EIA-469                                                                                                                                                                              |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| 5                 | Biased Humidity (85B5)              | Appearance                                                                                                                               | No defects or abnormalities.                                                                                                                                                                                                                                                                                                                                                                                                     | Perform heat treatment 3 times according to Lead-free reflow soldering profiles, the peak temperature is 260℃, and the time gap between each heat treatment is more than 30 minutes. |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| Cap. Change       |                                     | $\Delta C/C \leq \pm 3\%$ or $\pm 0.3pF$ (Whichever is larger)                                                                           | Test temperature                                                                                                                                                                                                                                                                                                                                                                                                                 | $85 \pm 3^{\circ}C$                                                                                                                                                                  |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| I.R. (Room Temp.) |                                     | $\geq 1000M\Omega$ or $50\Omega \cdot F$ , (Whichever is smaller)                                                                        | Test humidity                                                                                                                                                                                                                                                                                                                                                                                                                    | $85 \pm 3\%RH$                                                                                                                                                                       |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| Q                 |                                     | $C < 30pF$ , $Q \geq 100+10C/3$<br>$C \geq 30pF$ , $Q \geq 200$<br>C: Nominal Capacitance (pF)                                           | Test time                                                                                                                                                                                                                                                                                                                                                                                                                        | 1000±12h                                                                                                                                                                             |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
|                   |                                     |                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                  | Test voltage                                                                                                                                                                         | Rated voltage( $U_R < 500V$ ) and 1.3Vdc to 1.5Vdc (Add 100k $\Omega$ resistor)<br>500±50V ( $U_R=500V/630V/1KV/2KV$ ) and 1.3Vdc to 1.5Vdc (Add 100k $\Omega$ resistor) |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
|                   |                                     |                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                  | The charge/discharge current                                                                                                                                                         | 50mA or lower                                                                                                                                                            |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
|                   |                                     |                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                  | Post-treatment                                                                                                                                                                       | Set for 24±2 hours at room temperature, then measure.                                                                                                                    |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| 6                 | Operational Life                    | Appearance                                                                                                                               | No defects or abnormalities.                                                                                                                                                                                                                                                                                                                                                                                                     | Perform heat treatment 3 times according to Lead-free reflow soldering profiles, the peak temperature is 260℃, and the time gap between each heat treatment is more than 30 minutes. |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| Cap. Change       |                                     | $\Delta C/C \leq \pm 3\%$ or $\pm 0.3pF$ (Whichever is larger)                                                                           | Test temperature                                                                                                                                                                                                                                                                                                                                                                                                                 | $\theta 2 \pm 3^{\circ}C$ [X8G: $\theta 2=150^{\circ}C$ ,C0G: $\theta 2=125^{\circ}C$ ]                                                                                              |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| I.R. (Room Temp.) |                                     | $\geq 1000M\Omega$ or $50\Omega \cdot F$ , (Whichever is smaller)                                                                        | Test time                                                                                                                                                                                                                                                                                                                                                                                                                        | 1000±12h                                                                                                                                                                             |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| Q                 |                                     | $C \leq 10pF$ , $Q \geq 200+10C$<br>$10pF < C < 30pF$ , $Q \geq 275+5C/2$<br>$C \geq 30pF$ , $Q \geq 350$<br>C: Nominal Capacitance (pF) | Test voltage                                                                                                                                                                                                                                                                                                                                                                                                                     | $2.0 \times U_R$ ( $U_R < 100V$ )<br>$1.5 \times U_R$ ( $100V \leq U_R \leq 250V$ )<br>$1.2 \times U_R$ ( $U_R=500V/630V/1KV$ )                                                      |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
|                   |                                     |                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                  | The charge/discharge current                                                                                                                                                         | 50mA or lower                                                                                                                                                            |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
|                   |                                     |                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                  | Post-treatment                                                                                                                                                                       | Set for 24±2 hours at room temperature, then measure.                                                                                                                    |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| 7                 | Appearance                          |                                                                                                                                          | No defects or abnormalities.                                                                                                                                                                                                                                                                                                                                                                                                     | Visual inspection under 10 x microscope                                                                                                                                              |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| 8                 | Physical Dimension                  |                                                                                                                                          | See Fig.1                                                                                                                                                                                                                                                                                                                                                                                                                        | Using Measuring instrument of dimension                                                                                                                                              |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| 9                 | Mechanical Shock                    | Appearance                                                                                                                               | No defects or abnormalities.                                                                                                                                                                                                                                                                                                                                                                                                     | Perform heat treatment 3 times according to Lead-free reflow soldering profiles, the peak temperature is 260℃, and the time gap between each heat treatment is more than 30 minutes. |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| Cap. Change       |                                     | Within the specified initial value.                                                                                                      | Solder the capacitor on the test substrate(glass epoxy board). Three shocks in each direction should be applied along 3 mutually perpendicular axes of the test specimen (18 shocks).                                                                                                                                                                                                                                            |                                                                                                                                                                                      |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| I.R. (Room Temp.) |                                     | $\geq 10000M\Omega$ or $500\Omega \cdot F$ , (Whichever is smaller)                                                                      | Waveform                                                                                                                                                                                                                                                                                                                                                                                                                         | Half-sine                                                                                                                                                                            |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| Q                 |                                     | Within the specified initial value.                                                                                                      | Holding Time                                                                                                                                                                                                                                                                                                                                                                                                                     | 0.5ms                                                                                                                                                                                |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
|                   |                                     |                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                  | Peak value                                                                                                                                                                           | 1500g                                                                                                                                                                    |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
|                   |                                     |                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                  | Velocity change                                                                                                                                                                      | 4.7m/s                                                                                                                                                                   |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| 10                | Vibration                           | Appearance                                                                                                                               | No defects or abnormalities.                                                                                                                                                                                                                                                                                                                                                                                                     | Perform heat treatment 3 times according to Lead-free reflow soldering profiles, the peak temperature is 260℃, and the time gap between each heat treatment is more than 30 minutes. |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| Cap. Change       |                                     | Within the specified initial value.                                                                                                      | Mounting method                                                                                                                                                                                                                                                                                                                                                                                                                  | Solder the capacitor on the test substrate(glass epoxy board).                                                                                                                       |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| I.R. (Room Temp.) |                                     | $\geq 10000M\Omega$ or $500\Omega \cdot F$ , (Whichever is smaller)                                                                      | Kind of Vibration                                                                                                                                                                                                                                                                                                                                                                                                                | 10Hz to 2000Hz and return to 10Hz                                                                                                                                                    |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| Q                 |                                     | Within the specified initial value.                                                                                                      | Total amplitude                                                                                                                                                                                                                                                                                                                                                                                                                  | 1.5mm                                                                                                                                                                                |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
|                   |                                     |                                                                                                                                          | Vibration Time                                                                                                                                                                                                                                                                                                                                                                                                                   | 20min                                                                                                                                                                                |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
|                   |                                     |                                                                                                                                          | Vibration directions and time                                                                                                                                                                                                                                                                                                                                                                                                    | This motion should be applied for 12 cycles in each 3 mutually perpendicular directions (total of 36 times).                                                                         |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| 11                | Resistance to Soldering Heat        | Appearance                                                                                                                               | No defects or abnormalities.                                                                                                                                                                                                                                                                                                                                                                                                     | Pre-heating                                                                                                                                                                          | Temp.:120℃~150℃/Time:60s                                                                                                                                                 |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| Cap. Change       |                                     | Within the specified initial value.                                                                                                      | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                      | Solder bath method                                                                                                                                                                   |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| I.R. (Room Temp.) |                                     | $\geq 10000M\Omega$ or $500\Omega \cdot F$ , (Whichever is smaller)                                                                      | Solder alloy                                                                                                                                                                                                                                                                                                                                                                                                                     | Sn-Ag-Cu(Lead Free Solder)                                                                                                                                                           |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
| Q                 |                                     | Within the specified initial value.                                                                                                      | Solder temp.                                                                                                                                                                                                                                                                                                                                                                                                                     | 260℃±5℃                                                                                                                                                                              |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
|                   |                                     |                                                                                                                                          | Duration of immersion                                                                                                                                                                                                                                                                                                                                                                                                            | 10±1s                                                                                                                                                                                |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
|                   |                                     |                                                                                                                                          | Depth of immersion                                                                                                                                                                                                                                                                                                                                                                                                               | 10±1mm                                                                                                                                                                               |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |
|                   |                                     |                                                                                                                                          | Post-treatment                                                                                                                                                                                                                                                                                                                                                                                                                   | Set for 24±2 hours at room temperature, then measure.                                                                                                                                |                                                                                                                                                                          |            |   |                 |      |   |            |   |   |                 |      |   |            |   |

Table 1: Specifications and Test Methods

| No.                          | Item                                                                  |                                                                      | Specification                                                                                                          | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                 |
|------------------------------|-----------------------------------------------------------------------|----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
|                              | AEC-Q200 Test Item                                                    |                                                                      | Class1 (Temperature Compensating Type)                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                 |
| 12                           | ESD                                                                   | Appearance                                                           | No defects or abnormalities.                                                                                           | Per AEC-Q200-002                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                 |
| Cap. Change                  |                                                                       | Within the specified initial value.                                  |                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                 |
| I.R. (Room Temp.)            |                                                                       | ≥10000MΩ or 500Ω•F, (Whichever is smaller)                           |                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                 |
| Q                            |                                                                       | Within the specified initial value.                                  |                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                 |
| 13                           | Solderability                                                         | Appearance                                                           | 95% of the terminations is to be soldered evenly and continuously                                                      | (a) Preheat at 155°C for 4 hours. After preheating,immerse the capacitor in a solution of rosin ethanol 25(mass)%.<br>Immerse in Sn-3.0Ag-0.5Cu solder solution at 245±5°C or an eutectic solder solution at 235±5°C for 5±0.5 seconds.<br>(b) should be placed into steam aging for 8 hours±15 minutes.<br>After preheating, immerse the capacitor in a solution of rosin ethanol 25(mass)%.<br>Immerse in Sn-3.0Ag-0.5Cu solder solution at 245±5°C or an eutectic solder solution at 235±5°C for 5±0.5 seconds.<br>(c) should be placed into steam aging for 8 hours±15minutes.<br>After preheating, immerse the capacitor in a solution of rosin ethanol 25(mass)%.<br>Immerse in Sn-3.0Ag-0.5Cu solder solution or an eutectic solder solution for 120±5 seconds at 260±5°C. |                                                                                                 |
| 14                           | Electrical Characterization                                           | Capacitance                                                          | Within the specified tolerance                                                                                         | Measurement Temperature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 18 ~ 28°C                                                                                       |
| Q                            |                                                                       | C≥30pF, Q≥1000<br>C < 30pF, Q≥400+20C<br>C: Nominal Capacitance (pF) | C: Nominal Capacitance (pF)                                                                                            | Relative Humidity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | ≤RH 80%                                                                                         |
|                              |                                                                       |                                                                      |                                                                                                                        | Measurement Frequency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | C≤1nF, f=1.0±0.1MHz; C>1nF, f=1.0±0.1KHz                                                        |
|                              |                                                                       |                                                                      |                                                                                                                        | Measurement Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1.0±0.2Vrms                                                                                     |
|                              | 15                                                                    |                                                                      |                                                                                                                        | Measurement Temperature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 18 ~ 28°C                                                                                       |
| 16                           | Electrical Characterization                                           | I.R. (Room Temp.)                                                    | ≥100000MΩ or 1000Ω•F, (Whichever is smaller)                                                                           | Relative Humidity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | ≤RH 80%                                                                                         |
|                              |                                                                       |                                                                      |                                                                                                                        | Measurement Frequency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | C≤1nF, f=1.0±0.1MHz; C>1nF, f=1.0±0.1KHz                                                        |
|                              |                                                                       |                                                                      |                                                                                                                        | Measurement Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1.0±0.2Vrms                                                                                     |
|                              |                                                                       |                                                                      |                                                                                                                        | Measurement Temperature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 25°C                                                                                            |
| 17                           | Electrical Characterization                                           | I.R. (High Temp.)                                                    | ≥10000MΩ or 100Ω•F, (Whichever is smaller)                                                                             | Measurement Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | U <sub>k</sub> <500V: U <sub>k</sub><br>U <sub>k</sub> ≥500V: 500±50V                           |
|                              |                                                                       |                                                                      |                                                                                                                        | Charging Time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1min                                                                                            |
|                              |                                                                       |                                                                      |                                                                                                                        | The charge/discharge current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 50mA or lower                                                                                   |
|                              |                                                                       |                                                                      |                                                                                                                        | 18                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Electrical Characterization                                                                     |
| Measurement Voltage          | U <sub>k</sub> <500V: U <sub>k</sub><br>U <sub>k</sub> ≥500V: 500±50V |                                                                      |                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                 |
| Charging Time                | 1min                                                                  |                                                                      |                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                 |
| The charge/discharge current | 50mA or lower                                                         |                                                                      |                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                 |
| 19                           | Board Flex                                                            | Appearance                                                           | No defects or abnormalities.                                                                                           | Test Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ≥2.5× U <sub>k</sub> (U <sub>k</sub> ≤250V)<br>≥1.5× U <sub>k</sub> (U <sub>k</sub> =500V/630V) |
|                              |                                                                       | Cap. Change                                                          | ΔC/C≤±5% or ±0.5pF,(Whichever is larger)                                                                               | Applied Time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | t=1s~5s                                                                                         |
|                              |                                                                       | I.R. (Room Temp.)                                                    | I.R.≥10000MΩ or 500Ω•F,(Whichever is smaller)                                                                          | The charge/discharge current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 50mA or lower                                                                                   |
|                              |                                                                       | Q                                                                    | Within the specified initial value.                                                                                    | Solder the capacitor on the test substr See Fig.2<br>Pressurization Method See Fig.3<br>Speed 1.0mm/sec<br>Flexure 2mm<br>Holding Time 60s<br>then measure the capacitance.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                 |
| 20                           | Terminal Strength                                                     | Appearance                                                           | No defects or abnormalities.                                                                                           | Perform heat treatment 3 times according to Lead-free reflow soldering profiles, the peak temperature is 260°C, and the time gap between each heat treatment is more than 30 minutes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                 |
|                              |                                                                       | Cap. Change                                                          | Within the specified initial value.                                                                                    | Mounting method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Solder the capacitor on the test substrate(glass epoxy board) shown in Fig4.                    |
|                              |                                                                       | I.R. (Room Temp.)                                                    | ≥10000MΩ or 500Ω•F, (Whichever is smaller)                                                                             | Holding Time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 60s                                                                                             |
|                              |                                                                       | Q                                                                    | Within the specified initial value.                                                                                    | Applied Force                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0201/0402 F=2N<br>0603/0805 F=18N                                                               |
| 21                           | Beam Load Test                                                        | Destruction value                                                    | Destruction value should be exceed following one:                                                                      | Mounting method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Place the capacitor in the beam load fixture as Fig 5/6                                         |
|                              |                                                                       |                                                                      | Size Code Destruction value                                                                                            | Speed supplied the Stress Load                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 0402min: 0.5mm/s, 0201: 0.1mm/s<br><Size Code:0805 max. > <Size Code:1206 min.>                 |
|                              |                                                                       |                                                                      | 0201 ≥ 5N                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                 |
|                              |                                                                       |                                                                      | 0402 ≥ 8N                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Fig.5                                                                                           |
| 0603 ≥20N                    |                                                                       |                                                                      |                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                 |
| 22                           | Temperature Characteristics of Capacitance                            | Destruction value                                                    | 0805 ≥20N                                                                                                              | Pre-drying 16-24 hours<br>Measure the capacitance separately in 25°C, θ1, 25°C, θ2, 25°C, should satisfied related capacitance change characteristics.<br>COG θ1=-55°C, θ2=125°C<br>X8G θ1=-55°C, θ2=150°C<br>T.C. Measurement Voltage 1.0±0.2Vrms                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                 |
|                              |                                                                       |                                                                      |                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                 |
|                              |                                                                       |                                                                      |                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                 |
|                              |                                                                       |                                                                      |                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                 |
| 23                           | ESR                                                                   | See test report                                                      | Measurement Frequency 500MHz~3GHz<br>Measurement Temperature Room Temperature<br>Measurement Instrument Keysight 4991B | Measurement Frequency 500MHz~3GHz<br>Measurement Temperature Room Temperature<br>Measurement Instrument Keysight 4991B/5080B                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                 |
|                              |                                                                       |                                                                      |                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                 |
| 24                           | SRF                                                                   | See test report                                                      | Measurement Temperature Room Temperature<br>Measurement Instrument Keysight 4991B/5080B                                | Measurement Temperature Room Temperature<br>Measurement Instrument Keysight 4991B/5080B                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                 |
|                              |                                                                       |                                                                      |                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                 |

4. Packaging,Shipment and storage

4.1 Packaging

4.1.1 packaging type

Reel Packaging (standard carrier tape disc packaging), single disc smallest package See Table 4

4.1.2 Carrier Tape size

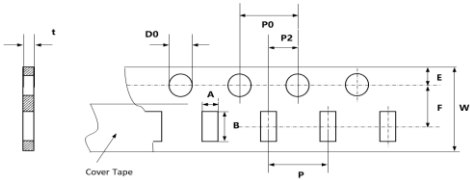


Fig. 7-1: 0603,0805 (Paper tape)

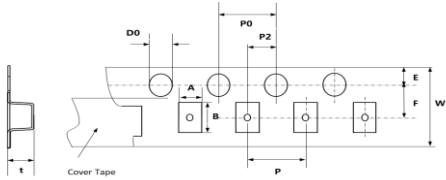


Fig. 7-2: 0603,0805 (Plastic tape)

Table 6-1: Carrier size (Size Code:0603,0805)

| Size Code | Thickness code | Carrier Tape Type | Packaging Code | A         | B         | F         | P         | E         | D0        | P2        | K | W         | P0        | t       |
|-----------|----------------|-------------------|----------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|---|-----------|-----------|---------|
| 0603      | U              | Paper             | T              | 1.00±0.10 | 1.80±0.10 | 3.50±0.05 | 4.00±0.10 | 1.75±0.10 | 1.55±0.05 | 2.00±0.05 | / | 8.00±0.20 | 4.00±0.10 | 0.95max |
| 0805      | E              | Paper             | T              | 1.45±0.10 | 2.20±0.10 | 3.50±0.05 | 4.00±0.10 | 1.75±0.10 | 1.55±0.05 | 2.00±0.05 | / | 8.00±0.20 | 4.00±0.10 | 1.15max |

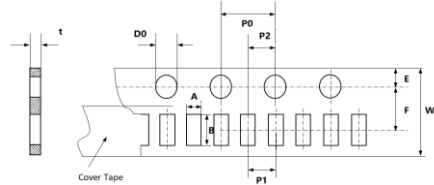


Fig. 7-3: 0402 (Paper tape/ 2mm pitch)

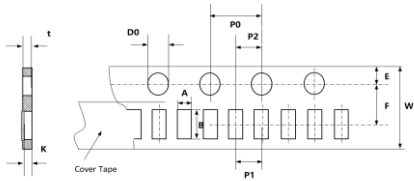


Fig. 7-4: 0201(Paper tape/ 2mm pitch)

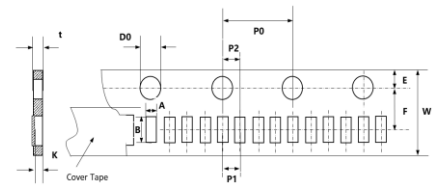


Fig. 7-5: 0201 (Paper tape/ 1mm pitch)

Table 6-2: Carrier size (Size Code: 0201,0402)

| Size Code | Thickness code | Carrier Tape Type | Packaging Code | A         | B         | F         | P1        | E         | D0        | P2        | K         | W         | P0        | t      |
|-----------|----------------|-------------------|----------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|--------|
| 0201      | A              | Paper             | T              | 0.38±0.02 | 0.68±0.03 | 3.50±0.05 | 2.00±0.05 | 1.75±0.10 | 1.55±0.05 | 2.00±0.05 | 0.36±0.02 | 8.00±0.10 | 4.00±0.10 | 0.5max |
| 0201      | A              | Paper             | J              | 0.38±0.02 | 0.68±0.03 | 3.50±0.05 | 2.00±0.05 | 1.75±0.10 | 1.55±0.05 | 2.00±0.05 | 0.36±0.02 | 8.00±0.10 | 4.00±0.10 | 0.5max |
| 0201      | A              | Paper             | D              | 0.38±0.02 | 0.68±0.03 | 3.50±0.05 | 1.00±0.05 | 1.75±0.10 | 1.55±0.05 | 1.00±0.05 | 0.36±0.02 | 8.00±0.10 | 4.00±0.10 | 0.5max |
| 0201      | A              | Paper             | H              | 0.38±0.02 | 0.68±0.03 | 3.50±0.05 | 2.00±0.05 | 1.75±0.10 | 1.55±0.05 | 2.00±0.05 | 0.36±0.02 | 8.00±0.10 | 4.00±0.10 | 0.5max |
| 0201      | A              | Paper             | L              | 0.38±0.02 | 0.68±0.03 | 3.50±0.05 | 1.00±0.05 | 1.75±0.10 | 1.55±0.05 | 1.00±0.05 | 0.36±0.02 | 8.00±0.10 | 4.00±0.10 | 0.5max |
| 0402      | B              | Paper             | T              | 0.63±0.05 | 1.13±0.05 | 3.50±0.05 | 2.00±0.05 | 1.75±0.10 | 1.55±0.05 | 2.00±0.05 | /         | 8.00±0.10 | 4.00±0.10 | 0.8max |
| 0402      | B              | Paper             | J              | 0.63±0.05 | 1.13±0.05 | 3.50±0.05 | 2.00±0.05 | 1.75±0.10 | 1.55±0.05 | 2.00±0.05 | /         | 8.00±0.10 | 4.00±0.10 | 0.8max |

4.1.3 Disc size

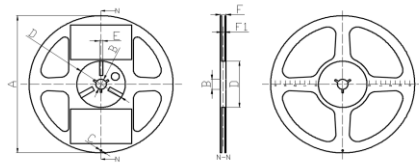


Fig. 8: disc (Width of carrier-8mm)

Table 7: Disc size

| Disc size | Width of carrier | A        | B       | C        | D        | E     | F        | F1   | Size Code |
|-----------|------------------|----------|---------|----------|----------|-------|----------|------|-----------|
| 7"        | 8.00±0.10        | Φ178±2.0 | Φ13±1.0 | Φ4.0±0.5 | Φ60±2.0  | 4±1.0 | 11.5±1.0 | 10±2 | All       |
| 13"       | 8.00±0.10        | Φ330±2.0 | Φ13±1.0 | Φ4.0±0.5 | Φ108±2.0 | 4±1.0 | 13.5±2.0 | 10±2 | All       |

4.1.4 Carrier Tape specifications

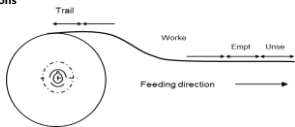


Fig. 9: Carrier

| Packaging | The minimum length of the reserved spaces |       |        |
|-----------|-------------------------------------------|-------|--------|
| Carrier   | Trailer                                   | Empty | Unseal |
|           | 60 mm                                     | 200mm | 160mm  |

#### 4.1.5 Performance of Carrier Taping

##### 4.1.5.1 Strength of Carrier Tape and Top Cover Tape

###### a. Carrier Tape

When a tensile force 1.02kgf is applied in the direction to unreel the tape, the tape shall withstand this force.

###### b. Top cover Tape

When a tensile force 1.02kgf is applied to the tape, the tape shall withstand this force.

##### 4.1.5.2 Peeling Strength of Top Cover Tape

Unless otherwise specified, the peeling strength of top cover tape shall be within 10.2 to 71.4 gf when the top cover tape is pulled at a speed of 300mm/min with the angle of 0 to 15°(see Fig.10).

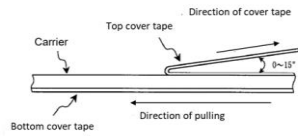


Fig.10: Cover tape peel-off force

#### 4.2 Shipment

Transport packaging products to adapt to the modern means of transport, but the product in the process of transport to prevent rain and acid and alkali corrosion, shall not be whipped extrusion casting and gravity.

#### 4.3 Storage

##### 4.3.1 Storage conditions:

The recommended temperature is less than 30°C.

A temperature is +5°C to +40°C and a relative humidity is 20% to 70% as a standard condition.(MSL Level 1)

MLCC may be affected by the storage conditions. Please use them promptly after delivery.

High temperature and humidity conditions and/or prolonged storage may cause deterioration of the packaging materials.

If more than six months have elapsed since delivery, check packaging, mounting, etc. before use.

##### 4.3.2 Corrosive gas can react with the termination (external) electrodes or lead wires of capacitors, and result in poor solderability.

Do not store the capacitors in an atmosphere consisting of corrosive gas (e.g.,hydrogen sulfide, sulfur dioxide, chlorine, ammonia gas etc.)

## 5. MLCC Application of Technical Requirements

### 5.1 Circuit Design

#### 5.1.1 Operating Temperature

- Do not use capacitor above the maximum allowable operating temperature.
- Surface temperature including self-heating should be below maximum operating temperature.

#### 5.1.2 Operating Voltage

The operating voltage for capacitors must always be lower than their rated voltage.

### 5.2 PCB Design

#### 5.2.1 Design of Land-patterns

When the capacitors are mounted on a PCB, the amount of solder at the terminations has a direct effect on the performance of the capacitors.

The greater the amount of solder, the higher the stress on the capacitor. Therefore, when designing land-patterns, it is necessary to consider the appropriate size and configuration of the solder pads.

Size and recommended land dimensions are shown in the following figure and table:



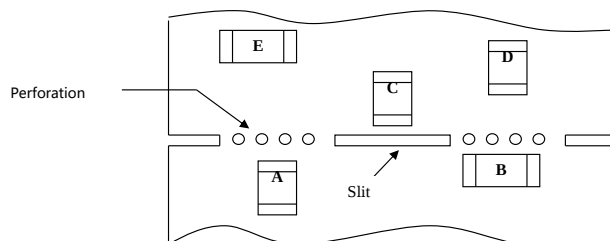
Recommended land dimensions for reflow-soldering

(unit: mm)

| Size Code | Length | Width | Tolerance                | A         | B         | C         |
|-----------|--------|-------|--------------------------|-----------|-----------|-----------|
| 0201      | 0.6    | 0.3   | $\pm 0.03$               | 0.20~0.25 | 0.20~0.30 | 0.20~0.35 |
| 0201      | 0.6    | 0.3   | $\pm 0.05$               | 0.20~0.25 | 0.25~0.35 | 0.30~0.40 |
| 0201      | 0.6    | 0.3   | $\pm 0.09/\pm 0.1$       | 0.23~0.30 | 0.25~0.35 | 0.30~0.40 |
| 0402      | 1      | 0.5   | $\pm 0.05$               | 0.30~0.50 | 0.35~0.45 | 0.40~0.60 |
| 0402      | 1      | 0.5   | $\pm 0.15$ or $\pm 0.20$ | 0.40~0.60 | 0.40~0.50 | 0.50~0.70 |
| 0603      | 1.6    | 0.8   | $\pm 0.10$               | 0.60~0.80 | 0.60~0.70 | 0.60~0.80 |
| 0603      | 1.6    | 0.8   | $\pm 0.20$               | 0.70~0.90 | 0.70~0.80 | 0.80~1.00 |
| 0805      | 2.0    | 1.25  | $\pm 0.10$ or $\pm 0.20$ | 1.00~1.40 | 0.60~0.80 | 1.20~1.40 |

#### 5.2.2 Capacitor Layout on PC Board

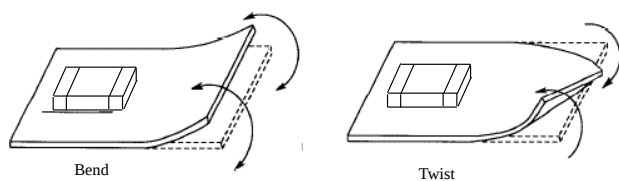
Mechanical stress varies according to the location of capacitors on PC board. The recommendation for better design is as follows:



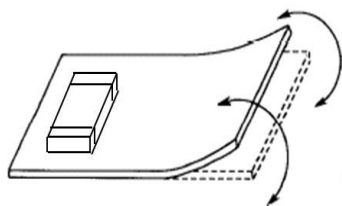
The stress in capacitors is in the following order:  $A > B > C > D > E$

Pay attention not to bend or distort the PC board otherwise the capacitor may crack. Please refer to the following examples of good and bad capacitor layout.

a. Not recommended

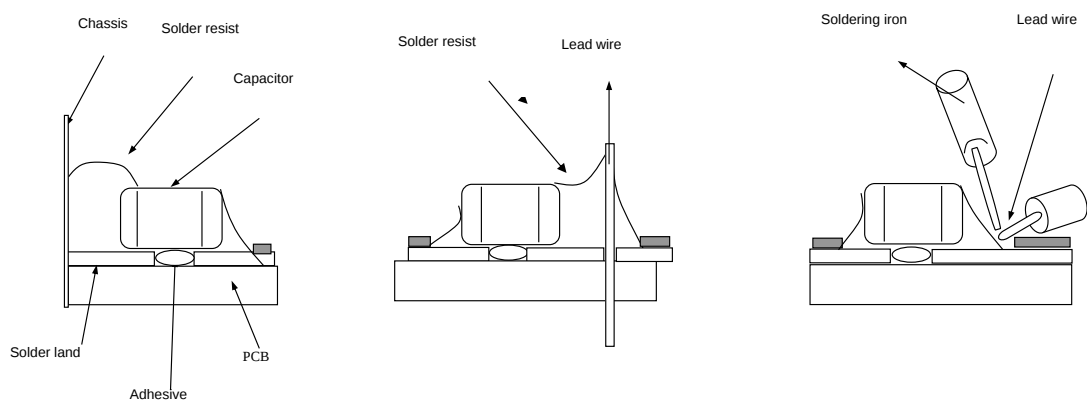


b.Recommended

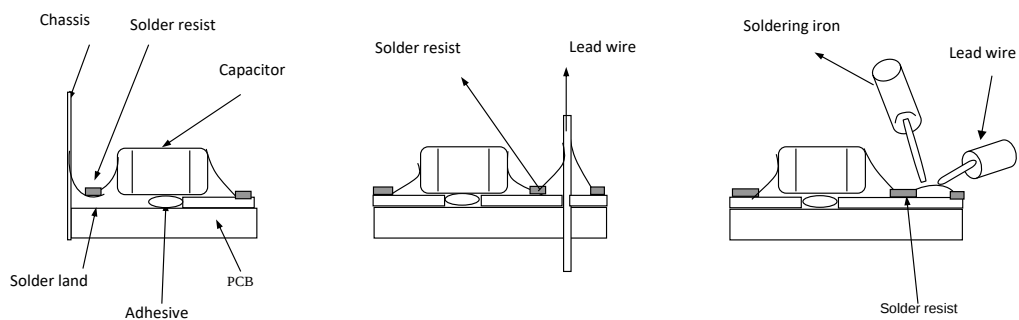


### 5.2.3Solder Buildup and Soldering

a.Examples of soldering method not recommended



b.Examples of soldering method recommended

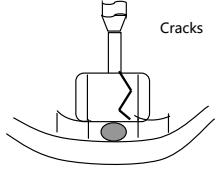
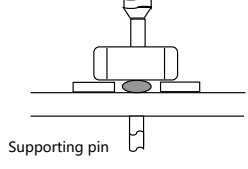
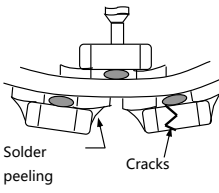
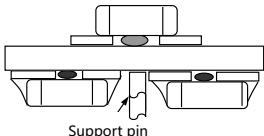


### 5.3 Consideration for Automatic Placement

If the mounting head is adjusted too low, it may induce excessive stress in the chip capacitor to result in cracking. Please take following precautions

- Adjust the bottom dead center of the mounting head to reach on the PC board surface and not press it;
- Adjust the mounting head pressure to be 1N to 3N of static weight;
- To minimize the impact energy from mounting head, it is important to provide support from the bottom side of the PC board.

Please refer to the following samples:

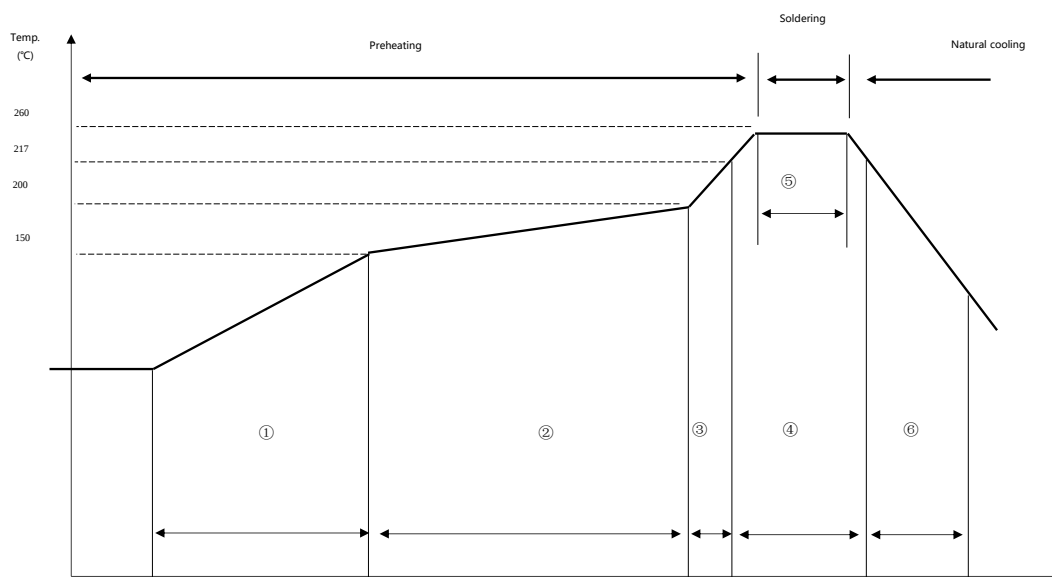
| Mounting              | Not recommended                                                                   | Recommended                                                                        |
|-----------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Singel-sided Mounting |  |  |
| Double-sided Mounting |  |  |

### 5.4 Soldering

#### 5.4.1 Flux Selection

- It is recommended to use a mildly activated rosin flux (less than 0.1wt% chlorine). Strong flux is not recommended.
- Please provide proper amount of flux. Excessive flux must be avoided.
- When water-soluble flux is used, enough washing is necessary.

#### 5.4.2 Recommended Soldering Profile



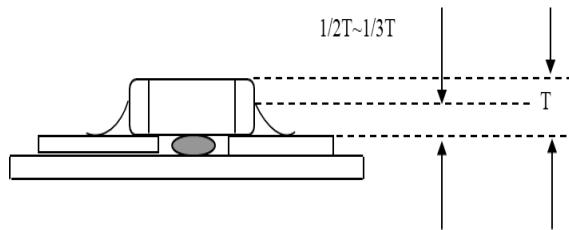
**5.4.2.1 Reflow Soldering Condition**

| NO. | Reflow Soldering zone | Reflow Soldering Condition                                                    |
|-----|-----------------------|-------------------------------------------------------------------------------|
| ①   | Preheating 1          | $\leq 3^{\circ}\text{C/s}; \geq 60\text{s}$                                   |
| ②   | Constant temperature  | $150 \sim 200^{\circ}\text{C}; 60 \sim 120\text{s}; \leq 1^{\circ}\text{C/s}$ |
| ③   | Preheating 1          | $1 \sim 5^{\circ}\text{C/s}$                                                  |
| ④   | Soldering 1           | Above $217^{\circ}\text{C}$ , $60 \sim 150\text{s}$                           |
| ⑤   | Soldering 1           | Above $260^{\circ}\text{C}$ , over $10\text{s}$                               |
| ⑥   | Natural cooling       | $\leq 6^{\circ}\text{C/s}$                                                    |

**Caution:**

a.Excessive solder will induce higher tensile force in chip capacitor when temperature changes and result in cracking. Insufficient solder may detach the capacitor from the PC board.

The ideal condition is to have solder mass controlled to  $1/2$  to  $1/3$  of the thickness of the capacitor



b.Soldering duration should be kept as close to recommended times as possible, because excessive duration can detrimentally affect solderability.

c.The peak temperature of reflow soldering is  $245 \pm 15^{\circ}\text{C}$ .

**6. All products in this specification comply with the EU RoHS directive**

The EU RoHS Directive refers to the "Directive 2011/65/EU on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment" stipulated by the European Union.