

High-Q, High-Power Multilayer Ceramic Chip Capacitors

P0402C0G2R2B201NTB (0402,C0G,2.2 pF,DC 200 V)

1. Scope

This specification applies to High-Q, High-Power Multilayer Ceramic Chip Capacitors (MLCCs).

Application Scope: High-power RF signal transmission/reception in: Telecommunications base station power amplifiers,Low Earth Orbit (LEO) satellite transceiver systems

2. Part Number System

|             |           |                             |                     |                       |               |                  |                |                |
|-------------|-----------|-----------------------------|---------------------|-----------------------|---------------|------------------|----------------|----------------|
| P           | 0402      | C0G                         | 2R2                 | B                     | 201           | N                | T              | B              |
| ①           | ②         | ③                           | ④                   | ⑤                     | ⑥             | ⑦                | ⑧              | ⑨              |
| Series Code | Size Code | Temperature Characteristics | Nominal Capacitance | Capacitance Tolerance | Rated Voltage | Termination Type | Packaging Code | Thickness Code |

- ① Series Code P - High-Q, High-Power MLCC ( Internal Electrodes : Cu)
- ② Size Code (Unit: mm)

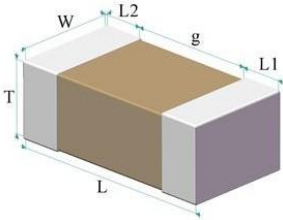


Fig.1 Structure & Dimension

| Size Code | L           | W           | L1,L2     | g        | T           | ⑨ Thickness Code |
|-----------|-------------|-------------|-----------|----------|-------------|------------------|
| 0402      | 1.00 ± 0.05 | 0.50 ± 0.05 | 0.15-0.35 | 0.30 min | 0.50 ± 0.05 | B                |

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±30 ppm/°C                 | 25 °C-125 °C | 25 °C      |

④ Nominal Capacitance

| Code | Nominal Capacitance |
|------|---------------------|
| 2R2  | 2.2 pF              |

⑤ Capacitance Tolerance

| Code | Capacitance Tolerance |
|------|-----------------------|
| B    | ±0.1 pF               |

⑥ Rated Voltage

| Code | Voltage Values |
|------|----------------|
| 201  | DC 200 V       |

⑦ Termination Type

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

⑧ Packaging Code

| Code | Square Hole Spacing | Disc Size | Carrier Tape | QTY (Kpcs) |
|------|---------------------|-----------|--------------|------------|
| T    | 2 mm                | 7 //      | Paper        | 10         |

### 3. Technical Specifications and Test Methods

#### 1. Operating Environment

| Temp. Characteristics | Temp. Range   | Relative Humidity | Atmospheric Pressure |
|-----------------------|---------------|-------------------|----------------------|
| COG                   | -55 °C-125 °C | ≤95% (25 °C)      | 86 kPa-106 kPa       |

#### 3.2 Reliability Test Specifications and Methods

Unless otherwise specified, the test methods in Table 1 are based on: GB/T 21041 and GB/T 21042 (IDT IEC 6038)

Table 1: Specifications and Methods

| No. | Item                                      | Specification                                                                                                                                                                                                                                                                    | Test Method                                                                                                                                                                                                                                                                                                                         |
|-----|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | Appearance                                | No obvious defects on ceramic body and termination.                                                                                                                                                                                                                              | Visual examination under a microscope                                                                                                                                                                                                                                                                                               |
| 2   | Size Code                                 | See Fig.1 and ② Size Code                                                                                                                                                                                                                                                        | Measuring by gages which precision is not less than 0.01 mm.                                                                                                                                                                                                                                                                        |
| 3   | Capacitance                               | Within the specified tolerance                                                                                                                                                                                                                                                   | Measurement Temperature 18 °C-28 °C<br>Relative Humidity ≤ 80% RH                                                                                                                                                                                                                                                                   |
| 4   | Q                                         | $C \geq 30 \text{ pF}$ : $Q \geq 1400$ , $C < 30 \text{ pF}$ : $Q \geq 800 + 20 \text{ C}$<br>C: Nominal Capacitance (pF)                                                                                                                                                        | Measurement Frequency $C \leq 1 \text{ nF}$ , $f = 1.0 \pm 0.1 \text{ MHz}$<br>$C > 1 \text{ nF}$ , $f = 1.0 \pm 0.1 \text{ KHz}$<br>Measurement Voltage $1.0 \pm 0.2 \text{ Vrms}$                                                                                                                                                 |
| 5   | Insulation Resistance (IR)                | $\geq 10,000 \text{ M}\Omega$                                                                                                                                                                                                                                                    | Measurement Temperature 18 °C-28 °C<br>Relative Humidity ≤ 80% RH<br>Measurement Voltage Rated Voltage<br>Charging Time 1 min<br>Charge/discharge current ≤ 50 mA                                                                                                                                                                   |
| 6   | Voltage proof                             | No defects or abnormalities.                                                                                                                                                                                                                                                     | Test Voltage $\geq 2.5 \times U_R$<br>Applied Time $t = 1 - 5 \text{ s}$<br>Charge/discharge current ≤ 50 mA                                                                                                                                                                                                                        |
| 7   | Temperature characteristic of capacitance | $\text{COG}: \alpha_c \leq \pm 30 \text{ ppm}/^\circ\text{C}(125^\circ\text{C})$ ; $-72 \leq \alpha_c \leq \pm 30 \text{ ppm}/^\circ\text{C}(-55^\circ\text{C})$                                                                                                                 | Pre-drying 16-24 hours<br>Measure the capacitance separately in 25 °C, $\theta_1$ , 25 °C, $\theta_2$ , 25 °C, should satisfied related Temperature Coefficient of Capacitance ( $\alpha_c$ ) .<br>COG $\theta_1 = -55^\circ\text{C}, \theta_2 = 125^\circ\text{C}$<br>T.C. Measurement Voltage $1.0 \pm 0.2 \text{ Vrms}$          |
| 8   | Resistance to soldering heat              | Appearance No visible damage and terminations uncovered shall be less than 25%.<br>Cap. Change $\Delta C/C \leq \pm 2.5\%$ or $\pm 0.25 \text{ pF}$ , (Whichever is larger)<br>IR Initial specification<br>Q Initial specification<br>Voltage proof No defects or abnormalities. | Pre-heating Temp. : 120 °C-150 °C, Time: 60 s<br>Test Method Solder bath<br>Solder alloy Sn-Ag-Cu (Lead Free Solder)<br>Temperature $(270 \pm 5)^\circ\text{C}$<br>Duration of immersion $(10 \pm 1) \text{ s}$<br>Depth of immersion 10 mm<br>Post-treatment Let sit for $(24 \pm 2) \text{ h}$ at room temperature, then measure. |

Table 1: Specifications and Methods

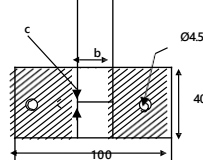
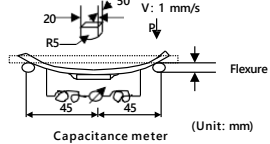
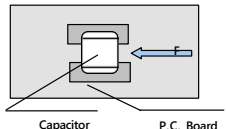
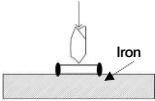
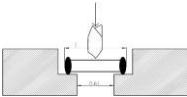
| No. | Item                             | Specification                                                                                                                                  | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-----|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9   | Solderability                    | Appearance<br>95% of the terminations is to be soldered evenly and continuously.                                                               | Pre-heating<br>Temp. : 80 °C-120 °C, Time: 10-30 s<br>Test Method<br>Solder bath<br>Flux<br>Solution of rosin ethanol<br>Solder alloy<br>Sn-Ag-Cu (Lead Free Solder)<br>Temperature<br>(245 ± 5) °C<br>Duration of immersion<br>(2.0 ± 0.5) s<br>Depth of immersion<br>10 mm                                                                                                                                                   |
| 10  | Substrate bending test           | Appearance<br>No defects or abnormalities<br>Cap. Change<br>$\Delta C/C \leq \pm 5\%$ or $\pm 0.5$ pF, (Whichever is larger)                   | Mounting method<br>Solder the capacitor to the test substrate as shown in Fig 2<br>Pressurization Method<br>Shown in Fig 3<br>Flexure<br>1 mm<br>Holding Time<br>(5 ± 1) s<br>then measure the capacitance<br><br><br>Fig. 2<br>Fig. 3                   |
| 11  | Adhesive strength of termination | Appearance<br>No defects or abnormalities                                                                                                      | Subjected to 3 cycles of lead-free reflow at 260 °C (standard profile) for thermal shock testing, with ~30 minutes between cycles.<br>Mounting method<br>Solder the capacitor to the test substrate and apply the normal force F indicated in Fig. 4<br>Holding Time<br>$t = (10 \pm 1)$ s<br>Pushing force<br>0402: F = 5 N<br><br>Fig. 4 |
| 12  | Vibration                        | Appearance<br>No defects or abnormalities<br>Cap. Change<br>Initial specification<br>IR<br>Initial specification<br>Q<br>Initial specification | Mounting method<br>Solder the capacitor to the test substrate<br>Amplitude<br>1.5 mm<br>Kind of Vibration<br>A simple harmonic motion<br>Frequency<br>10 Hz-55 Hz-10 Hz<br>Vibration Time<br>1 min<br>Repeat this for 2 hours each in 3 perpendicular directions X, Y, Z, total 6 hours.                                                                                                                                       |

Table 1: Specifications and Methods

| No.           | Item                                    | Specification  |                                                                     | Test Method                                                                                                                        |                                                                                                                                                                                                                                                            |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
|---------------|-----------------------------------------|----------------|---------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------|------------|---|-----|--------|---|----|-----|---|-----|--------|---|----|-----|
| 13            | Rapid change of temperature             | Appearance     | No defects or abnormalities                                         | Subjected to 3 cycles of lead-free reflow at 260 °C (standard profile) for thermal shock testing, with ~30 minutes between cycles. |                                                                                                                                                                                                                                                            |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
|               |                                         | Cap. Change    | $\Delta C/C \leq \pm 2.5\%$ or $\pm 0.25$ pF, (Whichever is larger) | Mounting method                                                                                                                    | Solder the capacitor to the test substrate                                                                                                                                                                                                                 |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
|               |                                         | IR             | Initial specification                                               | The number of cycles                                                                                                               | 100 cycles                                                                                                                                                                                                                                                 |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
|               |                                         | Q              | Initial specification                                               | Temperature Step                                                                                                                   | <table><tr><th>Step</th><th>Temp.(°C)</th><th>Time (min)</th></tr><tr><td>1</td><td>-55</td><td>30 ± 3</td></tr><tr><td>2</td><td>25</td><td>2-5</td></tr><tr><td>3</td><td>125</td><td>30 ± 3</td></tr><tr><td>4</td><td>25</td><td>2-5</td></tr></table> | Step | Temp.(°C) | Time (min) | 1 | -55 | 30 ± 3 | 2 | 25 | 2-5 | 3 | 125 | 30 ± 3 | 4 | 25 | 2-5 |
|               |                                         | Step           | Temp.(°C)                                                           | Time (min)                                                                                                                         |                                                                                                                                                                                                                                                            |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
|               |                                         | 1              | -55                                                                 | 30 ± 3                                                                                                                             |                                                                                                                                                                                                                                                            |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
| 2             | 25                                      | 2-5            |                                                                     |                                                                                                                                    |                                                                                                                                                                                                                                                            |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
| 3             | 125                                     | 30 ± 3         |                                                                     |                                                                                                                                    |                                                                                                                                                                                                                                                            |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
| 4             | 25                                      | 2-5            |                                                                     |                                                                                                                                    |                                                                                                                                                                                                                                                            |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
| Voltage proof | No defects or abnormalities.            |                |                                                                     |                                                                                                                                    |                                                                                                                                                                                                                                                            |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
|               |                                         | Post-treatment | Let sit for (24 ± 2) h at room temperature, then measure.           |                                                                                                                                    |                                                                                                                                                                                                                                                            |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
| 14            | Damp heat, steady state                 | Appearance     | No defects or abnormalities                                         | Subjected to 3 cycles of lead-free reflow at 260 °C (standard profile) for thermal shock testing, with ~30 minutes between cycles. |                                                                                                                                                                                                                                                            |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
|               |                                         | Cap. Change    | $\Delta C/C \leq \pm 7.5\%$ or 0.75 pF, (Whichever is larger)       | Mounting method                                                                                                                    | Solder the capacitor to the test substrate                                                                                                                                                                                                                 |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
|               |                                         | IR             | $\geq 500$ Mfi                                                      | Test Temperature                                                                                                                   | (60 ± 2) °C                                                                                                                                                                                                                                                |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
|               |                                         | Q              | C $\geq 30$ pF, Q $\geq 200$                                        | Test Humidity                                                                                                                      | 90%–95% RH                                                                                                                                                                                                                                                 |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
|               |                                         |                | C < 30 pF, Q $\geq 100 + 10 C/3$                                    | Test Time                                                                                                                          | (500 ± 12) h                                                                                                                                                                                                                                               |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
|               |                                         |                | C: Nominal Capacitance (pF)                                         | Post-treatment                                                                                                                     | Let sit for (24 ± 2) h at room temperature, then measure.                                                                                                                                                                                                  |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
| 15            | High temperature high humidity (steady) | Appearance     | No defects or abnormalities                                         | Subjected to 3 cycles of lead-free reflow at 260 °C (standard profile) for thermal shock testing, with ~30 minutes between cycles. |                                                                                                                                                                                                                                                            |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
|               |                                         | Cap. Change    | $\Delta C/C \leq \pm 7.5\%$ or 0.75 pF, (Whichever is larger)       | Mounting method                                                                                                                    | Solder the capacitor to the test substrate                                                                                                                                                                                                                 |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
|               |                                         | IR             | $\geq 500$ Mfi                                                      | Test Temperature                                                                                                                   | (60 ± 2) °C                                                                                                                                                                                                                                                |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
|               |                                         | Q              | C $\geq 30$ pF, Q $\geq 200$                                        | Test Humidity                                                                                                                      | 90%–95% RH                                                                                                                                                                                                                                                 |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
|               |                                         |                | C < 30 pF, Q $\geq 100 + 10 C/3$                                    | Test Voltage                                                                                                                       | 1.0 × U <sub>R</sub>                                                                                                                                                                                                                                       |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
|               |                                         |                | C: Nominal Capacitance (pF)                                         | Test Time                                                                                                                          | (500 ± 12) h                                                                                                                                                                                                                                               |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
|               |                                         |                |                                                                     | Charge/discharge curren                                                                                                            | $\leq 50$ mA                                                                                                                                                                                                                                               |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
|               |                                         |                |                                                                     | Post-treatment                                                                                                                     | Let sit for (24 ± 2) h at room temperature, then measure.                                                                                                                                                                                                  |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
| 16            | Endurance                               | Appearance     | No defects or abnormalities                                         | Subjected to 3 cycles of lead-free reflow at 260 °C (standard profile) for thermal shock testing, with ~30 minutes between cycles. |                                                                                                                                                                                                                                                            |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
|               |                                         | Cap. Change    | $\Delta C/C \leq \pm 2\%$ or $\pm 0.2$ pF, (Whichever is larger)    | Mounting method                                                                                                                    | Solder the capacitor to the test substrate                                                                                                                                                                                                                 |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
|               |                                         | IR             | $\geq 1000$ Mfi                                                     | Test Temperature                                                                                                                   | 125 °C ± 3 °C                                                                                                                                                                                                                                              |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
|               |                                         | Q              | C $\geq 30$ pF, Q $\geq 350$                                        | Test Voltage                                                                                                                       | 2.0 × U <sub>R</sub>                                                                                                                                                                                                                                       |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
|               |                                         |                | 10 pF < C < 30 pF, Q $\geq 275 + 5 C/2$                             | Test Time                                                                                                                          | (1000 ± 12) h                                                                                                                                                                                                                                              |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
|               |                                         |                | C $\leq 10$ pF, Q $\geq 200 + 10 C$                                 | Charge/discharge curren                                                                                                            | $\leq 50$ mA                                                                                                                                                                                                                                               |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |
|               |                                         |                | C: Nominal Capacitance (pF)                                         | Post-treatment                                                                                                                     | Let sit for (24 ± 2) h at room temperature, then measure.                                                                                                                                                                                                  |      |           |            |   |     |        |   |    |     |   |     |        |   |    |     |

Table 1: Specifications and Methods

| No. | Item           | Specification                                                                             | Test Method                                                                                                                                                                                 |                                                                                                                                                                                                                                           |
|-----|----------------|-------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 17  | Beam Load Test | Destruction value      Destruction value should be exceed following one<br><br>0402 ≥ 4 N | Mounting method<br><br>Speed supplied the Stress Load<br><br>< Size Code:0805 max ><br><br><br><br>Fig. 5 | Place the capacitor in the beam load fixture as Fig 5/6<br><br>0402min : 0.5 mm/s , 0201: 0.1 mm/s<br><br>< Size Code:1206 min ><br><br><br><br>Fig. 6 |
| 18  | ESR            | See test report                                                                           | Measurement Frequency<br>Measurement Temperature<br>Measurement Instrument                                                                                                                  | 500MHz-3GHz<br>Room Temperature<br>Keysight 4991B                                                                                                                                                                                         |
| 19  | SRF            | See test report                                                                           | Measurement Temperature<br>Measurement Instrument                                                                                                                                           | Room Temperature<br>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 ⑧ Packaging Code

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.

###### 4.1.2 Carrier Tape size

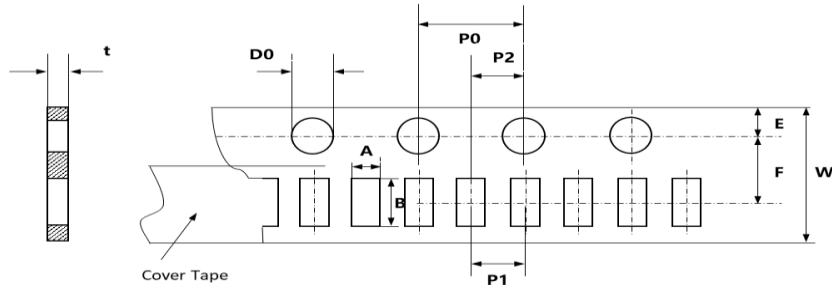


Fig. 7-1 0402 (Paper tape/ 2 mm pitch)

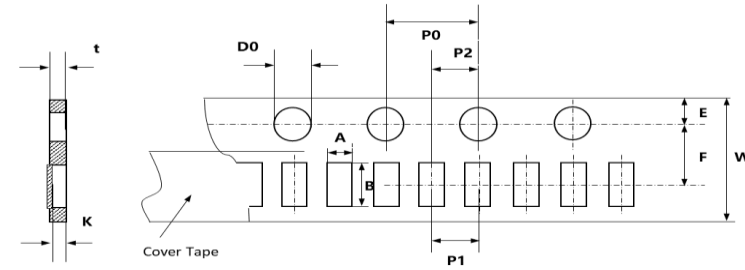


Fig. 7-2 0201 (Paper tape/ 2 mm pitch)

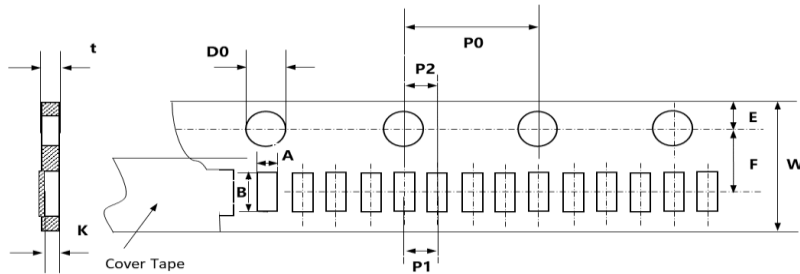


Fig. 7-3 0201 (Paper tape/ 1 mm pitch)

Table 2-1: Carrier size (Size Code: 0402 max)

(Unit:mm)

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

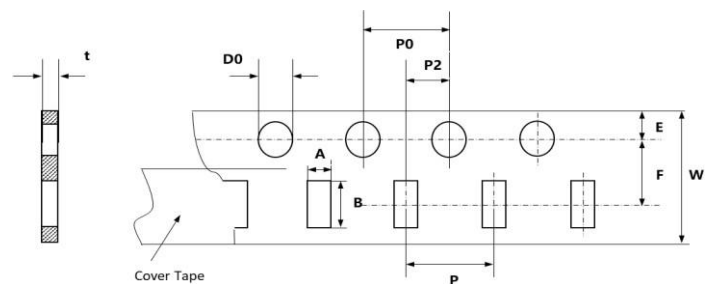


Fig. 7-4 0603 (Paper tape)

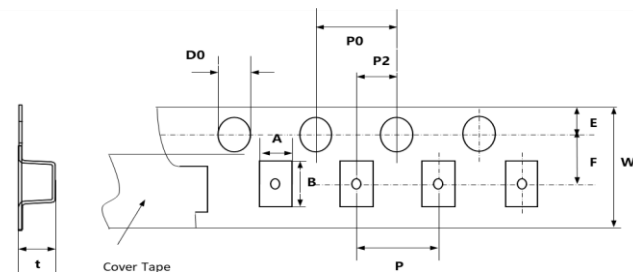


Fig. 7-5 0603 (Plastic tape)

Table 2-2: Carrier size (Size Code:0603 min)

(Unit:mm)

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

## 4.1.3 Disc size

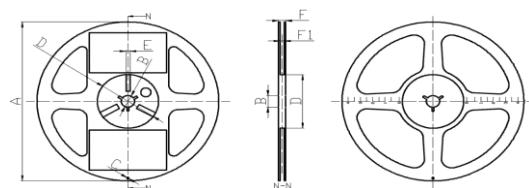


Fig. 8 Disc (Width of carrier-8 mm)

Table 3: Disc size

(Unit:mm)

| Disc size | Width of carrier | A                  | B                 | C                  | D                  | E             | F              | F1             | Size Code |
|-----------|------------------|--------------------|-------------------|--------------------|--------------------|---------------|----------------|----------------|-----------|
| 7"        | $8.00 \pm 0.10$  | $\Phi 178 \pm 2.0$ | $\Phi 13 \pm 1.0$ | $\Phi 4.0 \pm 0.5$ | $\Phi 60 \pm 2.0$  | $4.0 \pm 1.0$ | $11.5 \pm 1.0$ | $10.0 \pm 2.0$ | All       |
| 13"       | $8.00 \pm 0.10$  | $\Phi 330 \pm 2.0$ | $\Phi 13 \pm 1.0$ | $\Phi 4.0 \pm 0.5$ | $\Phi 108 \pm 2.0$ | $4.0 \pm 1.0$ | $13.5 \pm 2.0$ | $10.0 \pm 2.0$ | All       |

## 4.1.4 Carrier Tape specifications

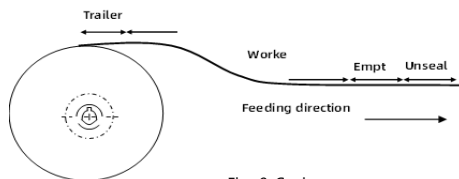


Fig. 9 Carrier

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

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

###### b. Top cover Tape

When a tensile force 1.02 kgf 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 gf to 71.4 gf when the top cover tape is pulled at a speed of 300 mm/min with the angle of  $0^\circ$  to  $15^\circ$  (see Fig.10).

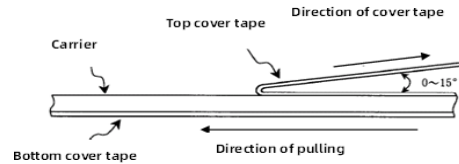


Fig.10 Cover tape peel-off force

## 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.

## 3. Storage

### 1. Storage conditions:

The recommended temperature is less than  $30^\circ\text{C}$ .

A temperature is  $5^\circ\text{C}$  to  $40^\circ\text{C}$  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 one year has elapsed since delivery, also check the solderability before use.

### 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.

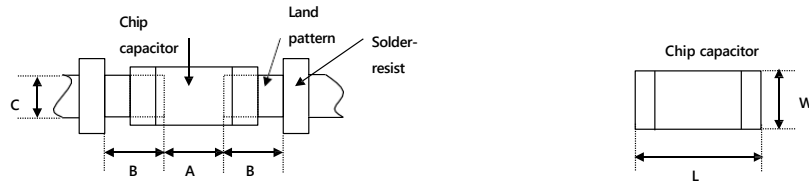
### 5.2 PCB Design

#### 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.



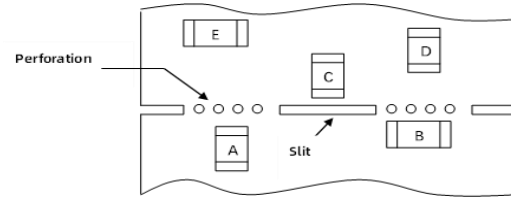
Recommended land dimensions for reflow-soldering

(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    | 0.5   | $\pm 0.05$                     | 0.30-0.50 | 0.35-0.45 | 0.40-0.60 |
| 0402      | 1.0    | 0.5   | $\pm 0.15, \pm 0.20$           | 0.40-0.60 | 0.40-0.50 | 0.50-0.70 |
| 0402      | 1.0    | 0.5   | $\pm 0.30$                     | 0.40-0.60 | 0.40-0.50 | 0.50-0.80 |
| 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 |
| 0603      | 1.6    | 0.8   | $\pm 0.25, \pm 0.30$           | 0.70-0.90 | 0.70-0.90 | 0.80-1.10 |
| 0805      | 2.0    | 1.25  | $\pm 0.10, \pm 0.15, \pm 0.20$ | 1.00-1.40 | 0.60-0.80 | 1.20-1.40 |
| 0805      | 2.0    | 1.25  | $\pm 0.25$                     | 1.00-1.40 | 0.70-0.90 | 1.35-1.55 |

### 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

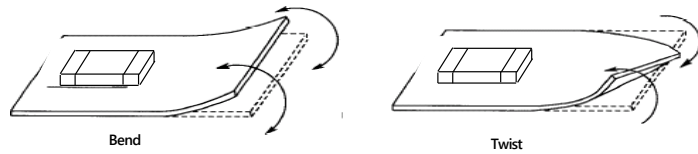


The stress in capacitors is in the following order:  $A > B = C > D > E$

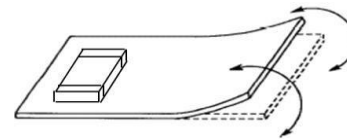
Pay attention not to bend or distort the PC board otherwise the capacitor may crack.

Please refer to the following examples of good and bad capacitors layout.

a. Not recommended

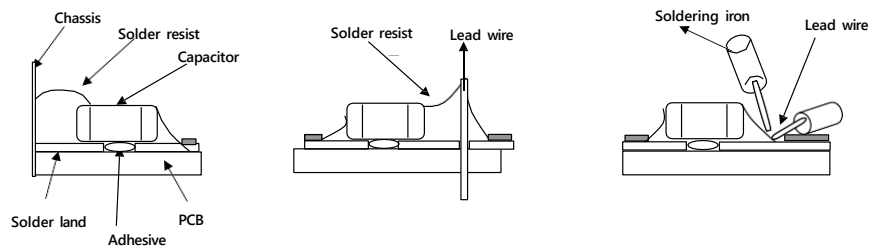


b. Recommended

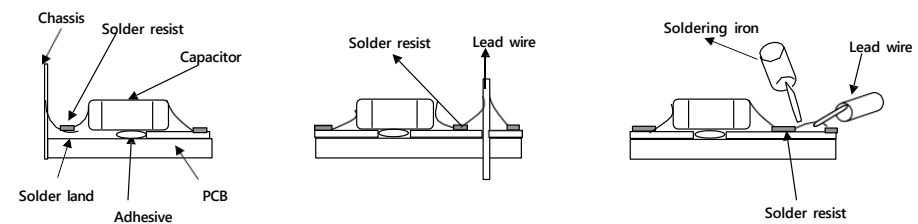


### 5.2.3 Solder Buildup and Soldering

a. Examples of soldering method not recommended



b. Examples of soldering method recommended

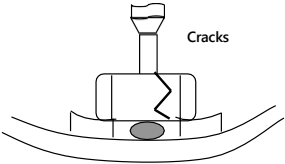
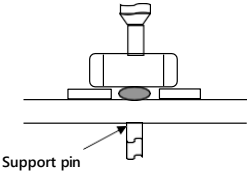
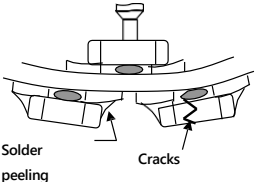
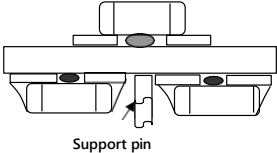


5.3 Consideration for Automatic Placement

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

- a.Adjust the bottom dead center of the mounting head to reach on the PC board surface and not press it ;
- b.Adjust the mounting head pressure to be 1N to 3N of static weight ;
- c.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

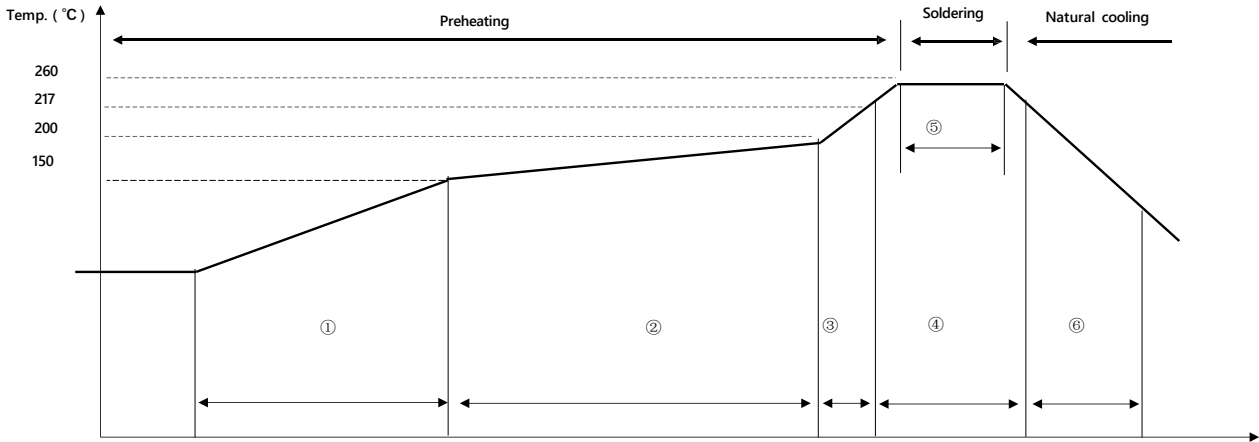
| Mounting              | Not recommended                                                                                               | Recommended                                                                                        |
|-----------------------|---------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| Singel-sided Mounting | <br>Cracks                   | <br>Support pin |
| Double-sided Mounting | <br>Solder peeling<br>Cracks | <br>Support pin |

5.4 Soldering

5.4.1 Flux Selection

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

5.4.2 Recommended Soldering Profile

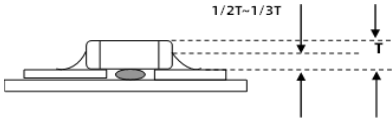


5.4.2.1 Reflow Soldering Condition

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

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 capacitors.



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  $245\text{ }^{\circ}\text{C} \pm 15\text{ }^{\circ}\text{C}$ .

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.

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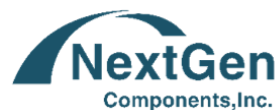
REVISION: A3

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| CODE | NAME                        | KEY SPECIFICATION OPTION                                                                                                                                                                               |
|------|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| P    | Series Code                 | P: High-Q, High-Power Multilayer Ceramic Chip Capacitors                                                                                                                                               |
| 0402 | Case Size                   | 0105 : L0.40*W0.20mm; 0201 : L0.60*W0.30mm; 0402 : L1.00*W0.50mm; 0603 : L1.60*W0.80mm<br>0805 : L2.00*W1.25mm; 1206 : L3.20*W1.60mm; 1210 : L3.20*W2.50mm                                             |
| N    | Temperature Characteristics | N: NP0 (COG); B: X7R; G: X8G; W: X5R; S: X6S; Y: Y5V; T: X7S; R: X7T                                                                                                                                   |
| 2R2  | Capacitance                 | Two significant digits followed by number of Zero, The 3rd digit signifies the multiplying factor, and letter R is decimal point.<br>2R2: 2.2pF; 220: 22pF; 102: 1nF; 150: 15pF; 180: 18pF; 475: 4.7μF |
| B    | Capacitance Tolerance       | A: ±0.05pF; B: ±0.1pF; C: ±0.25pF; D: ±0.5pF; F: ±1%; G: ±2%; J: ±5%; K: ±10%<br>L: ±15%; M: ±20%; N: ±30%; P: ±0.02pF; X: ±40%; S: 50%/-20%; Y: 150%/-20% Z: 80%/-20%                                 |
| 201  | Rated Voltage               | Two significant digits followed by No. of zeros. "R" is in place of decimal point.<br>6R3: 6.3VDC; 160: 16 VDC; 250: 25 VDC; 100: 10 VDC; 500: 50 VDC; 101: 100 VDC; 201: 200 VDC                      |
| B    | Case Thickness              | B: 0.8mm Max, See Page 6 (T's Symbol) for Different part code                                                                                                                                          |
| XX   | Internal Control Code       | Blank: N/A; XX: Letter A~Z, a~z or digits (0~9) for Special/Custom Parameters                                                                                                                          |

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