

DELIVERY SPECIFICATION

SPEC. No. C-FLIP-e

D A T E : Dec., 2021

To

Non-Controlled Copy

CUSTOMER'S PRODUCT NAME

TDK'S PRODUCT NAME

Multilayer Ceramic Chip Capacitors
 Low ESL Reverse Geometry
 Tape packaging **【RoHS compliant】**
 C0510 Type
 X5R,X6S,X7R,X7S Characteristics

Please return this specification to TDK representatives with your signature.

If orders are placed without returned specification, please allow us to judge that specification is accepted by your side.

RECEIPT CONFIRMATION

DATE: YEAR MONTH DAY

TDK Corporation
 Sales
 Electronic Components
 Sales & Marketing Group

Engineering
 Electronic Components Business Company
 Ceramic Capacitors Business Group

| APPROVED | Person in charge |
|----------|------------------|
| | |

| APPROVED | CHECKED | Person in charge |
|----------|---------|------------------|
| | | |

SCOPE

This delivery specification shall be applied to Multilayer ceramic chip capacitors to be delivered to _____.

PRODUCTION PLACES

Production places defined in this specification shall be TDK Corporation, TDK(Suzhou)Co.,Ltd and TDK Components U.S.A.,Inc.

PRODUCT NAME

The name of the product to be defined in this specifications shall be C◇◇◇◇○○○△△□□□×.

REFERENCE STANDARD

| | |
|-------------------------|---|
| JIS C 5101 – 1 : 2010 | Fixed capacitors for use in electronic equipment-Part 1: Generic specification |
| C 5101 – 22 : 2014 | Fixed capacitors for use in electronic equipment-Part 22 : Sectional specification : Fixed surface mount multilayer capacitors of ceramic dielectric,Class2 |
| C 0806 – 3 : 2014 | Packaging of components for automatic handling - Part 3: Packaging of surface mount components on continuous tapes |
| JEITA RCR – 2335 C 2014 | Safety application guide for fixed ceramic capacitors for use in electronic equipment |

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<EXPLANATORY NOTE>

When the mistrust in the spec arises, this specification is given priority. And it will be confirmed by written spec change after conference of both posts involved.

This specification warrants the quality of the ceramic chip capacitor. Capacitors should be evaluated or confirmed a state of mounted on your product.

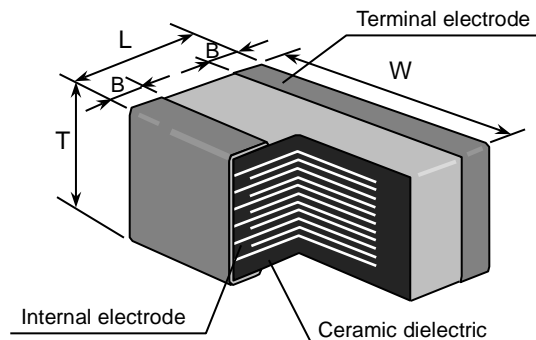
If the use of the capacitors goes beyond the bounds of this specification, we can not afford to guarantee.

| Division | Date | SPEC. No. |
|-----------------------------------|----------------|-----------|
| Ceramic Capacitors Business Group | December, 2021 | C-FLIP-e |

1. CODE CONSTRUCTION

(Example) C0510 X5R 1C 104 M T 0000
 (1) (2) (3) (4) (5) (6) (7)

(1) Case size



| Case size [EIA style] | Dimensions (Unit : mm) | | | |
|--------------------------|------------------------|-------------|-------------|-----------|
| | L | W | T | B |
| C0510 [CC0204] | 0.52 ± 0.05 | 1.00 ± 0.05 | 0.30 ± 0.05 | 0.10 min. |

* As for each item, please refer to detail page on TDK web.

(2) Temperature Characteristics

* Details are shown in table 1 No.6 at 6.PERFORMANCE

(3) Rated Voltage

| Symbol | Rated Voltage |
|--------|---------------|
| 1 H | DC 50 V |
| 1 E | DC 25 V |
| 1 C | DC 16 V |
| 1 A | DC 10 V |
| 0 J | DC 6.3 V |
| 0 G | DC 4 V |
| 0 E | DC 2.5 V |

(4) Rated Capacitance

Stated in three digits and in units of pico farads (pF).

The first and Second digits identify the first and second significant figures of the capacitance, the third digit identifies the multiplier.

(Example)

| Symbol | Rated Capacitance |
|--------|-------------------|
| 104 | 100,000 pF |

(5) Capacitance tolerance

| Symbol | Tolerance |
|--------|-----------|
| M | ± 20 % |

(6) Packaging

| Symbol | Packaging |
|--------|-----------|
| T | Taping |

(7) TDK internal code

2. COMBINATION OF RATED CAPACITANCE AND TOLERANCE

| Temperature Characteristics | Capacitance tolerance | Rated capacitance |
|-----------------------------|-----------------------|-------------------|
| X5R X6S X7R X7S | M ($\pm 20\%$) | E - 3 series |

Capacitance Step in E series

| E series | Capacitance Step | | |
|----------|------------------|-----|-----|
| E- 3 | 1.0 | 2.2 | 4.7 |

3. OPERATING TEMPERATURE RANGE

| T.C. | Min. operating Temperature | Max. operating Temperature | Reference Temperature |
|---------|----------------------------|----------------------------|-----------------------|
| X5R | -55°C | 85°C | 25°C |
| X6S | -55°C | 105°C | 25°C |
| X7R/X7S | -55°C | 125°C | 25°C |

4. STORING CONDITION AND TERM

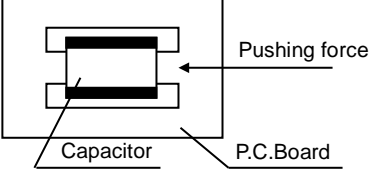
| Storing temperature | Storing humidity | Storing term |
|---------------------|------------------|-------------------------------|
| 5~40°C | 20~70%RH | Within 6 months upon receipt. |

5. INDUSTRIAL WASTE DISPOSAL

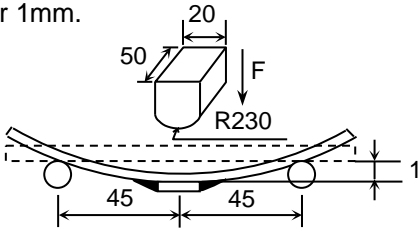
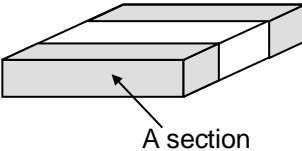
Dispose this product as industrial waste in accordance with the Industrial Waste Law.

6. PERFORMANCE

table 1

| No. | Item | Performance | Test or inspection method | | | | | | | | | | |
|------|--|--|--|------|-----------------|---|--------|---|---------|---|--------|---|--------------------------|
| 1 | External Appearance | No defects which may affect performance. | Inspect with magnifying glass (3×) | | | | | | | | | | |
| 2 | Insulation Resistance | 10,000MΩ or 500MΩ·μF min. (As for the capacitors of rated voltage 16V DC and lower, 10,000MΩ or 100MΩ·μF min.), whichever smaller. | Measuring voltage : Rated voltage Voltage application time : 60s. | | | | | | | | | | |
| 3 | Voltage Proof | Withstand test voltage without insulation breakdown or other damage. | Applied voltage : 2.5 times of rated voltage Voltage application time : 1s. Charge / discharge current : 50mA or lower | | | | | | | | | | |
| 4 | Capacitance | Within the specified tolerance. | As for measuring condition, please contact with our sales representative. | | | | | | | | | | |
| 5 | Dissipation Factor | Please refer to detail page on TDK web. | See No.4 in this table for measuring condition. | | | | | | | | | | |
| 6 | Temperature Characteristics of Capacitance | <p style="text-align: center;">Capacitance Change (%)</p> <hr/> <p style="text-align: center;">No voltage applied</p> <hr/> <p style="text-align: center;">X5R : ±15 X6S : ±22 X7R : ±15 X7S : ±22</p> <hr/> | <p>Capacitance shall be measured by the steps shown in the following table after thermal equilibrium is obtained for each step.</p> <p>ΔC be calculated ref. STEP3 reading</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Step</th> <th>Temperature(°C)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">25 ± 2</td> </tr> <tr> <td style="text-align: center;">2</td> <td style="text-align: center;">-55 ± 2</td> </tr> <tr> <td style="text-align: center;">3</td> <td style="text-align: center;">25 ± 2</td> </tr> <tr> <td style="text-align: center;">4</td> <td style="text-align: center;">Max. operating temp. ± 2</td> </tr> </tbody> </table> <p>As for Max. operating temp, please refer to "3. OPERATING TEMPERATURE RANGE" As for measuring voltage, please contact with our sales representative.</p> | Step | Temperature(°C) | 1 | 25 ± 2 | 2 | -55 ± 2 | 3 | 25 ± 2 | 4 | Max. operating temp. ± 2 |
| Step | Temperature(°C) | | | | | | | | | | | | |
| 1 | 25 ± 2 | | | | | | | | | | | | |
| 2 | -55 ± 2 | | | | | | | | | | | | |
| 3 | 25 ± 2 | | | | | | | | | | | | |
| 4 | Max. operating temp. ± 2 | | | | | | | | | | | | |
| 7 | Robustness of Terminations | No sign of termination coming off, breakage of ceramic, or other abnormal signs. | <p>Reflow solder the capacitors on a P.C.Board shown in Appendix2.</p> <p>Apply a pushing force gradually at the center of a specimen in a horizontal direction of P.C.board.</p> <p>Pushing force : 2N Holding time : 10±1s</p> <div style="text-align: center;">  </div> | | | | | | | | | | |

(continued)

| No. | Item | | Performance | Test or inspection method |
|-----------------------|---------------------------|---|---|--|
| 8 | Bending | External appearance | No mechanical damage. | Reflow solder the capacitors on a P.C.Board shown in Appendix 1 and bend it for 1mm.  (Unit : mm) |
| 9 | Solderability | | New solder to cover over 75% of termination. 25% may have pin holes or rough spots but not concentrated in one spot. Ceramic surface of A sections shall not be exposed due to melting or shifting of termination material.  A section | Solder : Sn-3.0Ag-0.5Cu Flux : Isopropyl alcohol (JIS K 8839) Rosin (JIS K 5902) 25% solid solution. Solder temp. : 245±5°C Dwell time : 3±0.3s. Solder position : Until both terminations are completely soaked. |
| 10 | Resistance to solder heat | External appearance | No cracks are allowed and terminations shall be covered at least 60% with new solder. | Solder : Sn-3.0Ag-0.5Cu Flux : Isopropyl alcohol (JIS K 8839) Rosin (JIS K 5902) 25% solid solution. Solder temp. : 260±5°C Dwell time : 10±1s. Solder position : Until both terminations are completely soaked. Pre-heating : Temp. — 110~140°C Time — 30~60s. Leave the capacitors in ambient condition for 24±2h before measurement. |
| Capacitance | | _____ Change from the value before test _____ ± 7.5 % _____ | | |
| D.F. | | Meet the initial spec. | | |
| Insulation Resistance | | Meet the initial spec. | | |
| Voltage proof | | No insulation breakdown or other damage. | | |
| 11 | Vibration | External appearance | No mechanical damage. | Frequency : 10~55~10Hz Reciprocating sweep time : 1 min. Amplitude : 1.5mm Repeat this for 2h each in 3 perpendicular directions(Total 6h). Reflow solder the capacitors on a P.C.Board shown in Appendix2 before testing. |
| Capacitance | | _____ Change from the value before test _____ ± 7.5 % _____ | | |
| D.F. | | Meet the initial spec. | | |

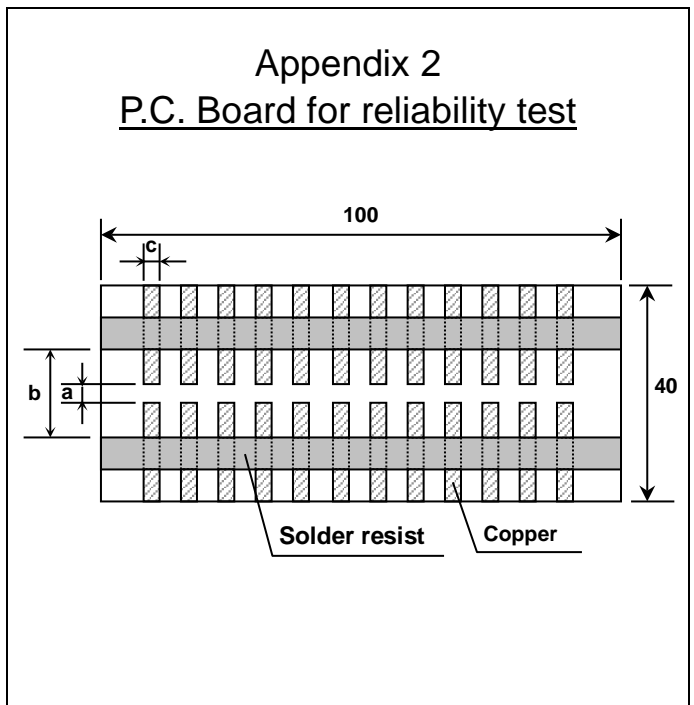
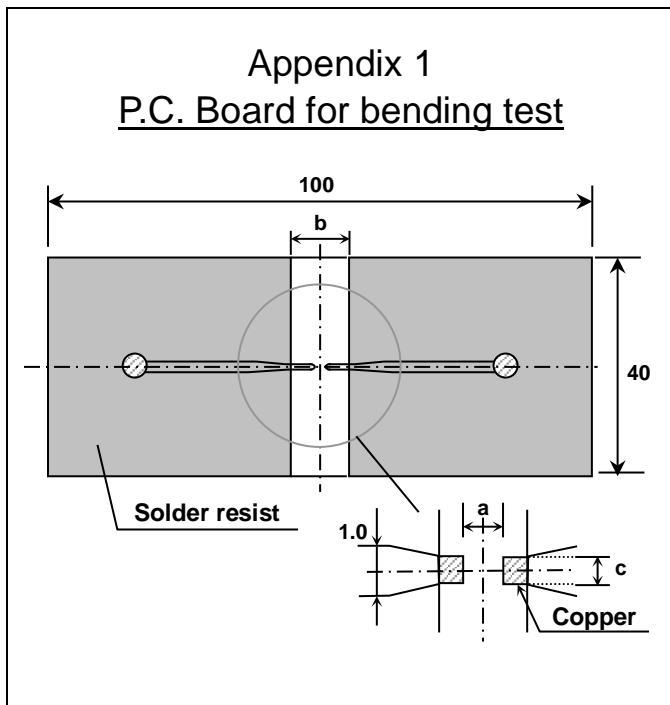
(continued)

| No. | Item | | Performance | Test or inspection method | | | | | | | | | | | | | | | |
|-----------------------|---|-----------------------|---|--|-------------|-----------------|-------------|---|---------|--------|---|---------------|-------|---|-------------------------|--------|---|---------------|-------|
| 12 | Temperature cycle | External appearance | No mechanical damage. | <p>Expose the capacitors in the condition step1 through step 4 listed in the following table.</p> <p>Temp. cycle : 5 cycles</p> <table border="1"> <thead> <tr> <th>Step</th> <th>Temperature(°C)</th> <th>Time (min.)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>-55 ± 3</td> <td>30 ± 3</td> </tr> <tr> <td>2</td> <td>Ambient Temp.</td> <td>2 ~ 5</td> </tr> <tr> <td>3</td> <td>Max. operating temp.± 2</td> <td>30 ± 2</td> </tr> <tr> <td>4</td> <td>Ambient Temp.</td> <td>2 ~ 5</td> </tr> </tbody> </table> <p>As for Max. operating temp., please refer to "3. OPERATING TEMPERATURE RANGE"</p> <p>Leave the capacitors in ambient condition for 24±2h before measurement.</p> <p>Reflow solder the capacitors on a P.C.Board shown in Appendix2 before testing.</p> | Step | Temperature(°C) | Time (min.) | 1 | -55 ± 3 | 30 ± 3 | 2 | Ambient Temp. | 2 ~ 5 | 3 | Max. operating temp.± 2 | 30 ± 2 | 4 | Ambient Temp. | 2 ~ 5 |
| | | Step | Temperature(°C) | | Time (min.) | | | | | | | | | | | | | | |
| | | 1 | -55 ± 3 | | 30 ± 3 | | | | | | | | | | | | | | |
| | | 2 | Ambient Temp. | | 2 ~ 5 | | | | | | | | | | | | | | |
| | | 3 | Max. operating temp.± 2 | | 30 ± 2 | | | | | | | | | | | | | | |
| 4 | Ambient Temp. | 2 ~ 5 | | | | | | | | | | | | | | | | | |
| Capacitance | <p>Change from the value before test</p> <p>Please contact with our sales representative.</p> | | | | | | | | | | | | | | | | | | |
| D.F. | Meet the initial spec. | | | | | | | | | | | | | | | | | | |
| Insulation Resistance | Meet the initial spec. | | | | | | | | | | | | | | | | | | |
| Voltage proof | No insulation breakdown or other damage. | | | | | | | | | | | | | | | | | | |
| 13 | Moisture Resistance (Steady State) | External appearance | No mechanical damage. | <p>Test temp. : 40±2°C</p> <p>Test humidity : 90~95%RH</p> <p>Test time : 500 +24,0h</p> <p>Leave the capacitors in ambient condition for 24±2h before measurement.</p> <p>Reflow solder the capacitors on a P.C.Board shown in Appendix2 before testing.</p> | | | | | | | | | | | | | | | |
| | | Capacitance | <p>Change from the value before test</p> <p>Please contact with our sales representative.</p> | | | | | | | | | | | | | | | | |
| | | D.F. | 200% of initial spec. max. | | | | | | | | | | | | | | | | |
| | | Insulation Resistance | 1,000MΩ or 50MΩ·μF min. (As for the capacitors of rated voltage 16V DC and lower, 1,000MΩ or 10MΩ·μF min.), whichever smaller. | | | | | | | | | | | | | | | | |

(continued)

| No. | Item | | Performance | Test or inspection method |
|-----|---------------------|-----------------------|---|--|
| 14 | Moisture Resistance | External appearance | No mechanical damage. | Test temp. : $40\pm 2^{\circ}\text{C}$ Test humidity : 90~95%RH Applied voltage : Rated voltage Test time : 500 +24,0h Charge/discharge current : 50mA or lower Leave the capacitors in ambient condition for $24\pm 2\text{h}$ before measurement. Reflow solder the capacitors on a P.C.Board shown in Appendix2 before testing. |
| | | Capacitance | _____ Change from the value before test _____ Please contact with our sales representative. | |
| | | D.F. | 200% of initial spec. max. | |
| | | Insulation Resistance | 500M Ω or 25M Ω · μF min. (As for the capacitors of rated voltage 16V DC and lower, 500M Ω or 5M Ω · μF min.), whichever smaller. | |
| 15 | Life | External appearance | No mechanical damage. | Test temp. : Maximum operating temperature $\pm 2^{\circ}\text{C}$ Applied voltage : Please contact with our sales representative. Test time : 1,000 +48,0h Charge/discharge current : 50mA or lower Leave the capacitors in ambient condition for $24\pm 2\text{h}$ before measurement. Reflow solder the capacitors on a P.C.Board shown in Appendix2 before testing. |
| | | Capacitance | _____ Change from the value before test _____ Please contact with our sales representative. | |
| | | D.F. | 200% of initial spec. max. | |
| | | Insulation Resistance | 1,000M Ω or 50M Ω · μF min. (As for the capacitors of rated voltage 16V DC and lower, 1,000M Ω or 10M Ω · μF min.), whichever smaller. | |
| | | | | Initial value setting Voltage conditioning «After voltage treat the capacitors under testing temperature and voltage for 1 hour,» leave the capacitors in ambient condition for $24\pm 2\text{h}$ before measurement. Use this measurement for initial value. |

*As for the initial measurement of capacitors on number 6,10,11,12 and 13, leave capacitors at $150-10,0^{\circ}\text{C}$ for 1 hour and measure the value after leaving capacitors for $24\pm 2\text{h}$ in ambient condition.



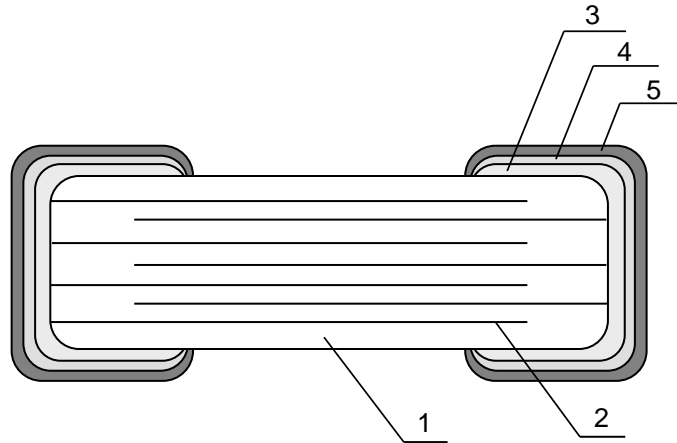
(Unit: mm)

| Symbol | a | b | c |
|---------------|-----|-----|-----|
| Case size | | | |
| C0510[CC0204] | 0.2 | 0.6 | 1.0 |

1. Material : Glass Epoxy(As per JIS C6484 GE4)
2. Thickness : 1.6mm

- Copper (Thickness: 0.035mm)
- Solder resist

8. INSIDE STRUCTURE AND MATERIAL



| No. | NAME | MATERIAL |
|-----|-------------|--------------------|
| 1 | Dielectric | BaTiO ₃ |
| 2 | Electrode | Nickel (Ni) |
| 3 | Termination | Copper (Cu) |
| 4 | | Nickel (Ni) |
| 5 | | Tin (Sn) |

8. PACKAGING

Packaging shall be done to protect the components from the damage during transportation and storing, and a label which has the following information shall be attached.

Tape packaging is as per 11. TAPE PACKAGING SPECIFICATION.

Information on label

- 1) Inspection No.*
- 2) TDK P/N
- 3) Customer's P/N
- 4) Quantity

*Composition of Inspection No.

Example E 1 A - 23 - 001
 (a) (b) (c) (d) (e)

- (a) Line code
- (b) Last digit of the year
- (c) Month and A for January and B for February and so on. (Skip I)
- (d) Inspection Date of the month.
- (e) Serial No. of the day

*Composition of new Inspection No.

(Implemented on and after May 1, 2019 in sequence)

Example

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| I | F | 1 | E | 2 | 3 | A | 0 | 0 | 1 |
|---|---|---|---|---|---|---|---|---|---|

 (a) (b) (c) (d) (e) (f) (g)

- (a) Prefix
- (b) Line code
- (c) Last digit of the year
- (d) Month and A for January and B for February and so on. (Skip I)
- (e) Inspection Date of the month.
- (f) Serial No. of the day(00 ~ ZZ)
- (g) Suffix(00 ~ ZZ)


* It was shifted to the new inspection No. on and after May 2019, but the implementation timing may be different depending on shipment bases.

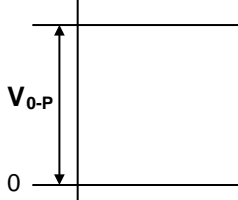
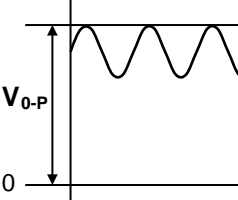
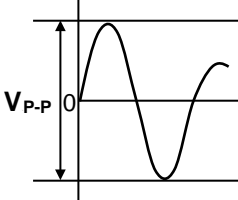
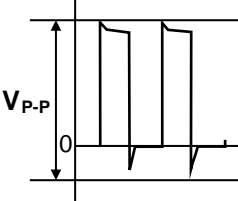
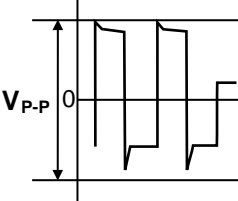
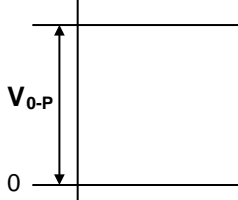
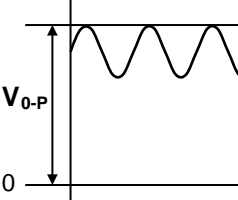
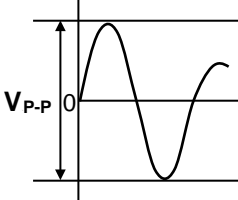
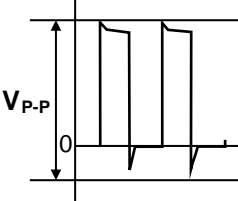
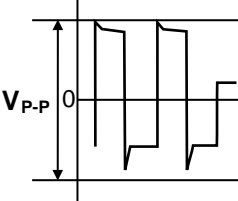
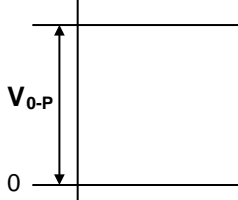
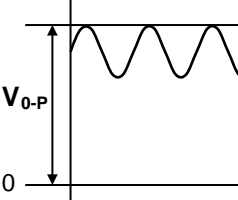
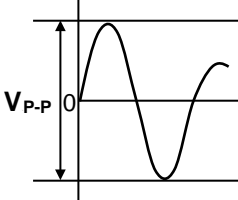
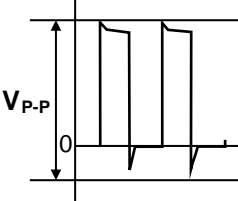
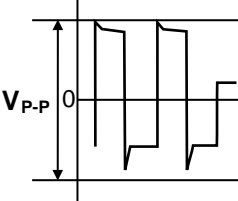
Until the shift is completed, either current or new composition of inspection No. will be applied.

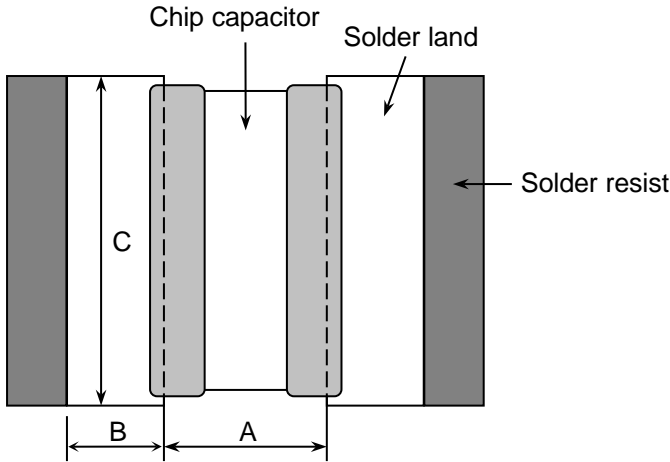
9. SOLDERING CONDITION

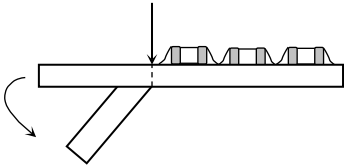
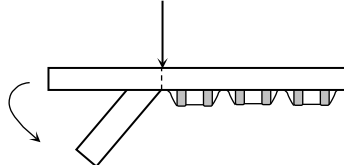
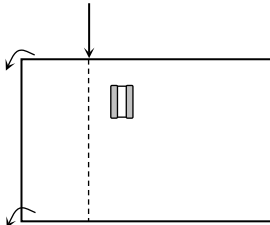
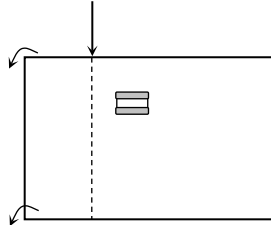
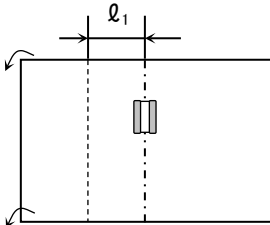
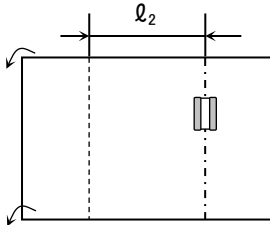
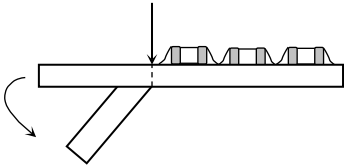
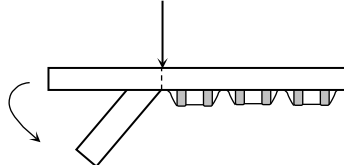
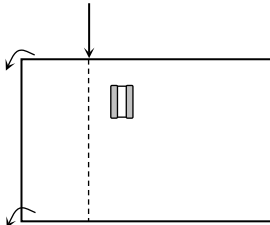
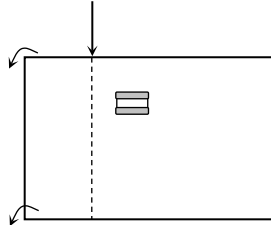
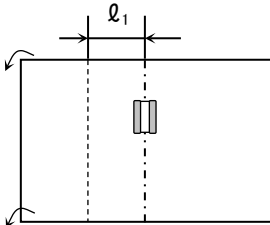
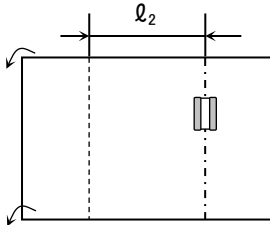
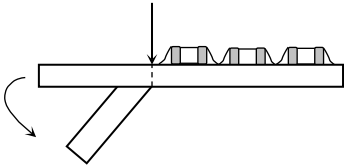
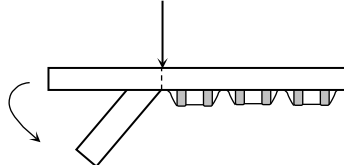
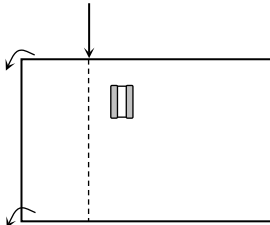
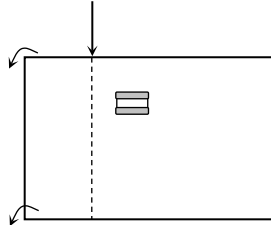
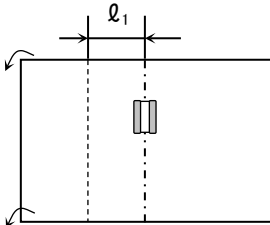
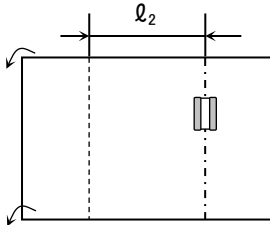
Reflow soldering only.

10. CAUTION

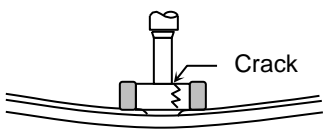
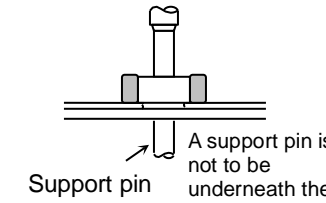
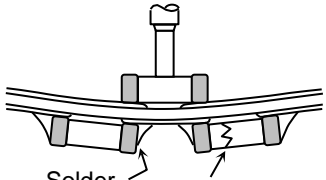
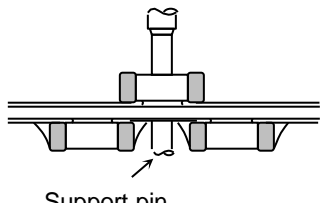
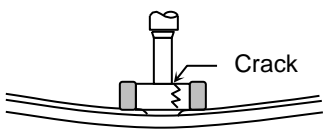
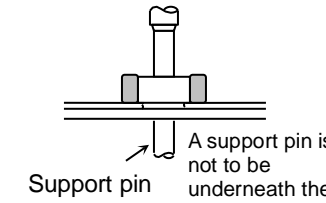
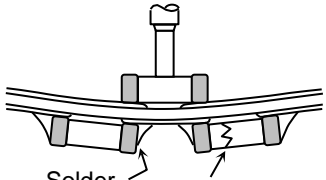
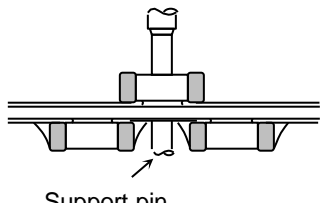
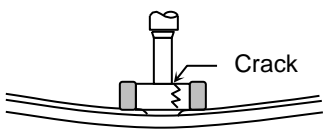
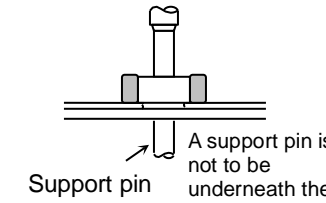
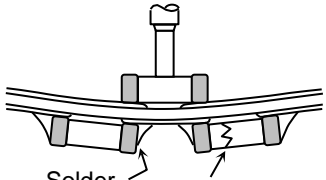
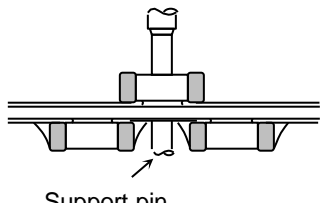
| No. | Process | Condition |
|-----|---|---|
| 1 | Operating Condition (Storage, Use, Transportation) | <p>1-1. Storage, Use</p> <p>The capacitors must be stored in an ambient temperature of 5 to 40°C with a relative humidity of 20 to 70%RH. JIS C 60721-3-1 Class 1K2 should be followed for the other climatic conditions.</p> <ol style="list-style-type: none"> 1) High temperature and humidity environment may affect a capacitor's solder ability because it accelerates terminal oxidization. They also deteriorate performance of taping and packaging. Therefore, SMD capacitors shall be used within 6 months. For capacitors with terminal electrodes consisting of silver or silver-palladium which tend to become oxidized or sulfurized, use as soon as possible, such as within one month after opening the bag. 2) When capacitors are stored for a period longer than specified, confirm the solderability of the capacitors prior to use. During storage, keep the minimum packaging unit in its original packaging without opening it. Do not deviate from the above temperature and humidity conditions even for a short term. 3) Corrosive gasses in the air or atmosphere may result in deterioration of the reliability, such as poor solderability of the terminal electrodes. Do not store capacitors where they will be exposed to corrosive gas (e.g., hydrogen sulfide, sulfur dioxide, chlorine ammonia etc.) 4) Solderability and electrical performance may deteriorate due to photochemical change in the terminal electrode if stored in direct sunlight, or due to condensation from rapid changes in humidity. The capacitors especially which use resin material must be operated and stored in an environment free of dew condensation, as moisture absorption due to condensation may affect the performance. 5) Refer to JIS C 60721-3-1, class 1K2 for other climate conditions. <p>1-2. Handling in transportation</p> <p>In case of the transportation of the capacitors, the performance of the capacitors may be deteriorated depending on the transportation condition. (Refer to JEITA RCR-2335C 9.2 Handling in transportation)</p> |
| 2 | Circuit design  Caution | <p>2-1. Operating temperature</p> <ol style="list-style-type: none"> 1) Upper category temperature (maximum operating temperature) is specified. It is necessary to select a capacitor whose rated temperature is higher than the operating temperature. Also, it is necessary to consider the temperature distribution in the equipment and seasonal temperature variation. 2) Surface temperature including self heating should be below maximum operating temperature. Due to dielectric loss, capacitors will heat itself when AC is applied due to ESR. Especially at high frequencies, please be careful that the heat might be so extreme. Also, even if the surface temperature of the capacitor includes self-heating and is the maximum operating temperature or lower, excessive heating of the capacitor due to self-heating may cause deterioration of the characteristics and reliability of the capacitor. The self-heating temperature rise of the capacitor changes depending on the difference in heat radiation due to the mounting method to the device, the ambient temperature, the cooling method of the device and circuit board material and the design, etc. The load should be contained so that the self-heating temperature rise of the capacitor body in a natural convection environment at an ambient temperature of 25°C remain below 20°C. When using in a high-frequency circuit or a circuit in which a capacitor generates heat, such as when a high-frequency ripple current flows, pay attention to the above precautions. (Note that accurate measurement may not be possible with self-heating measurement when the equipment applies cooling other than natural convection such as a cooling fan.) 3) The electrical characteristics of the capacitors will vary depending on the temperature. The capacitors should be selected and designed in taking the temperature into consideration. |

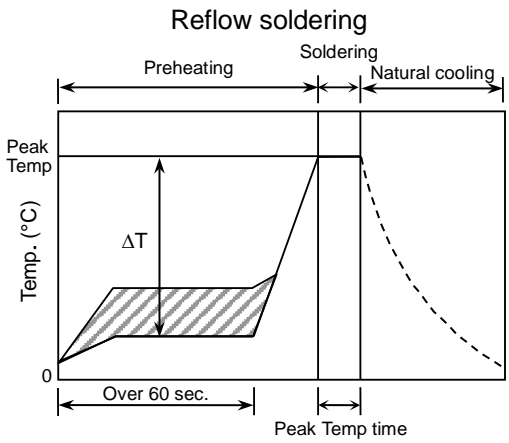
| No. | Process | Condition | | | | | | | | | | | | | | |
|--|---|---|--|----------------|-------------------|----------------|--|--|---|--|---------|-----------------------|-----------------------|--|---|--|
| 2 | Circuit design ⚠ Caution | <p>2-2. When overvoltage is applied</p> <p>Applying overvoltage to a capacitor may cause dielectric breakdown and result in a short circuit. The duration until dielectric breakdown depends on the applied voltage and the ambient temperature.</p> <p>2-3. Operating voltage</p> <p>1) Operating voltage across the terminals should be below the rated voltage. When AC and DC are super imposed, V_{0-P} must be below the rated voltage. — (1) and (2)</p> <p>AC or pulse with overshooting, V_{P-P} must be below the rated voltage. — (3), (4) and (5)</p> <p>When the voltage is started to apply to the circuit or it is stopped applying, the irregular voltage may be generated for a transit period because of resonance or switching. Be sure to use the capacitors within rated voltage containing these Irregular voltage.</p> <table border="1" data-bbox="459 779 1437 1055"> <thead> <tr> <th data-bbox="459 779 651 824">Voltage</th> <th data-bbox="651 779 911 824">(1) DC voltage</th> <th data-bbox="911 779 1171 824">(2) DC+AC voltage</th> <th data-bbox="1171 779 1437 824">(3) AC voltage</th> </tr> </thead> <tbody> <tr> <td data-bbox="459 824 651 1055">Positional Measurement (Rated voltage)</td> <td data-bbox="651 824 911 1055"></td> <td data-bbox="911 824 1171 1055"></td> <td data-bbox="1171 824 1437 1055"></td> </tr> </tbody> </table> <table border="1" data-bbox="459 1084 1171 1359"> <thead> <tr> <th data-bbox="459 1084 651 1128">Voltage</th> <th data-bbox="651 1084 911 1128">(4) Pulse voltage (A)</th> <th data-bbox="911 1084 1171 1128">(5) Pulse voltage (B)</th> </tr> </thead> <tbody> <tr> <td data-bbox="459 1128 651 1359">Positional Measurement (Rated voltage)</td> <td data-bbox="651 1128 911 1359"></td> <td data-bbox="911 1128 1171 1359"></td> </tr> </tbody> </table> <p>2) Even below the rated voltage, if repetitive high frequency AC or pulse is applied, the reliability of the capacitors may be reduced.</p> <p>3) The effective capacitance will vary depending on applied DC and AC voltages. The capacitors should be selected and designed in taking the voltages into consideration.</p> <p>4) Abnormal voltage (surge voltage, static electricity, pulse voltage, etc.) shall not exceed the rated voltage.</p> <p>5) When capacitors are used in a series connection, it is necessary to add a balancing circuit such as voltage dividing resistors in order to avoid an imbalance in the voltage applied to each capacitor.</p> <p>2-3. Frequency</p> <p>When the capacitors are used in AC and/or pulse voltages, the capacitors may vibrate themselves and generate audible sound.</p> | Voltage | (1) DC voltage | (2) DC+AC voltage | (3) AC voltage | Positional Measurement (Rated voltage) |  |  |  | Voltage | (4) Pulse voltage (A) | (5) Pulse voltage (B) | Positional Measurement (Rated voltage) |  |  |
| Voltage | (1) DC voltage | (2) DC+AC voltage | (3) AC voltage | | | | | | | | | | | | | |
| Positional Measurement (Rated voltage) |  |  |  | | | | | | | | | | | | | |
| Voltage | (4) Pulse voltage (A) | (5) Pulse voltage (B) | | | | | | | | | | | | | | |
| Positional Measurement (Rated voltage) |  |  | | | | | | | | | | | | | | |

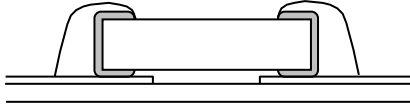
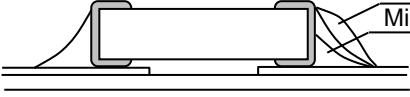
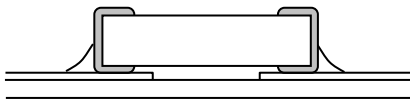
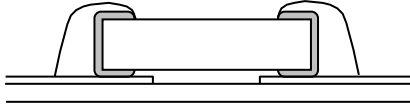
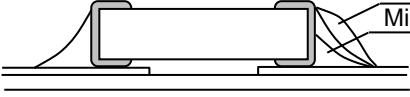
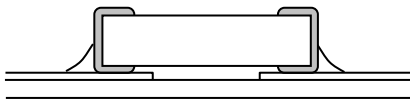
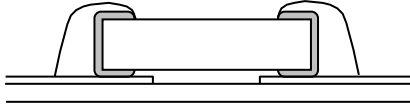
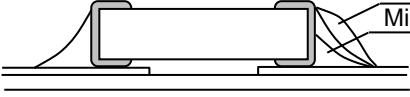
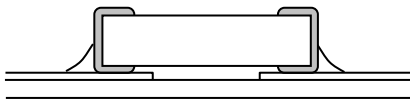
| No. | Process | Condition | | | | | | | | | | | | | | | |
|---------------------|----------------------|--|------------------|--|-------------|---------------------|-------------------|--|---|--|-----|---|--|-----|---|--|-----|
| 3 | Designing P.C. Board | <p>The amount of solder at the terminations has a direct effect on the reliability of the capacitor.</p> <ol style="list-style-type: none"> 1) The greater the amount of solder, the higher the stress on the chip capacitor, and the more likely that it will break. When designing a P.C.Board, determine the shape and size of the solder lands to have proper amount of solder on the terminations. 2) Avoid using common solder land for multiple terminations and provide individual solder land for each terminations. 3) Size and recommended land dimensions. <div style="text-align: center;">  <p>The diagram shows a cross-section of a chip capacitor on a PCB. The capacitor is a small rectangular component with two leads. The solder land is the area of the PCB that is soldered to the leads. Dimension A is the width of the solder land, dimension B is the width of the capacitor body, and dimension C is the height of the capacitor. Labels include 'Chip capacitor', 'Solder land', and 'Solder resist'.</p> </div> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2" data-bbox="563 1227 794 1256">Reflow soldering</th> <th data-bbox="1050 1227 1182 1256">(Unit : mm)</th> </tr> <tr> <th data-bbox="563 1263 794 1368" style="text-align: center;">Case size Symbol</th> <th data-bbox="794 1263 1182 1368" style="text-align: center;">C0510 [CC0204]</th> <th></th> </tr> </thead> <tbody> <tr> <td data-bbox="563 1375 794 1426" style="text-align: center;">A</td> <td data-bbox="794 1375 1182 1426"></td> <td data-bbox="970 1375 1018 1426" style="text-align: center;">0.2</td> </tr> <tr> <td data-bbox="563 1433 794 1485" style="text-align: center;">B</td> <td data-bbox="794 1433 1182 1485"></td> <td data-bbox="970 1433 1018 1485" style="text-align: center;">0.2</td> </tr> <tr> <td data-bbox="563 1491 794 1543" style="text-align: center;">C</td> <td data-bbox="794 1491 1182 1543"></td> <td data-bbox="970 1491 1018 1543" style="text-align: center;">1.0</td> </tr> </tbody> </table> | Reflow soldering | | (Unit : mm) | Case size Symbol | C0510 [CC0204] | | A | | 0.2 | B | | 0.2 | C | | 1.0 |
| Reflow soldering | | (Unit : mm) | | | | | | | | | | | | | | | |
| Case size Symbol | C0510 [CC0204] | | | | | | | | | | | | | | | | |
| A | | 0.2 | | | | | | | | | | | | | | | |
| B | | 0.2 | | | | | | | | | | | | | | | |
| C | | 1.0 | | | | | | | | | | | | | | | |

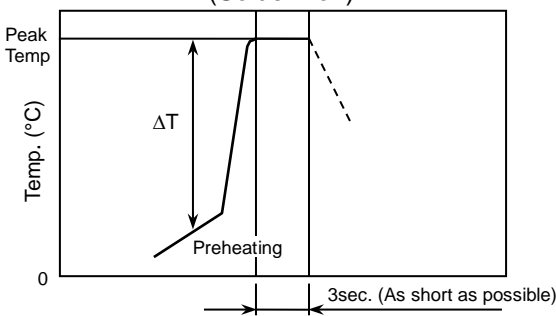
| No. | Process | Condition | | | | | | | | | | | | |
|------------------------------|---|--|--|-------------------------------------|----------------------------------|---------------|--|---|------------------------------|---|---|--------------------|---|---|
| 3 | Designing P.C.Board | <p>4) Recommended chip capacitor layout is as following.</p> <table border="1"> <thead> <tr> <th data-bbox="464 286 651 367"></th> <th data-bbox="651 286 1034 367">Disadvantage against bending stress</th> <th data-bbox="1034 286 1417 367">Advantage against bending stress</th> </tr> </thead> <tbody> <tr> <td data-bbox="464 367 651 786">Mounting face</td> <td data-bbox="651 367 1034 786"> <p>Perforation or slit</p>  <p>Break P.C.Board with mounted side up.</p> </td> <td data-bbox="1034 367 1417 786"> <p>Perforation or slit</p>  <p>Break P.C.Board with mounted side down.</p> </td> </tr> <tr> <td data-bbox="464 786 651 1234">Chip arrangement (Direction)</td> <td data-bbox="651 786 1034 1234"> <p>Mount perpendicularly to perforation or slit</p> <p>Perforation or slit</p>  </td> <td data-bbox="1034 786 1417 1234"> <p>Mount in parallel with perforation or slit</p> <p>Perforation or slit</p>  </td> </tr> <tr> <td data-bbox="464 1234 651 1711">Distance from slit</td> <td data-bbox="651 1234 1034 1711"> <p>Closer to slit is higher stress</p>  <p>($l_1 < l_2$)</p> </td> <td data-bbox="1034 1234 1417 1711"> <p>Away from slit is less stress</p>  <p>($l_1 < l_2$)</p> </td> </tr> </tbody> </table> | | Disadvantage against bending stress | Advantage against bending stress | Mounting face | <p>Perforation or slit</p>  <p>Break P.C.Board with mounted side up.</p> | <p>Perforation or slit</p>  <p>Break P.C.Board with mounted side down.</p> | Chip arrangement (Direction) | <p>Mount perpendicularly to perforation or slit</p> <p>Perforation or slit</p>  | <p>Mount in parallel with perforation or slit</p> <p>Perforation or slit</p>  | Distance from slit | <p>Closer to slit is higher stress</p>  <p>($l_1 < l_2$)</p> | <p>Away from slit is less stress</p>  <p>($l_1 < l_2$)</p> |
| | Disadvantage against bending stress | Advantage against bending stress | | | | | | | | | | | | |
| Mounting face | <p>Perforation or slit</p>  <p>Break P.C.Board with mounted side up.</p> | <p>Perforation or slit</p>  <p>Break P.C.Board with mounted side down.</p> | | | | | | | | | | | | |
| Chip arrangement (Direction) | <p>Mount perpendicularly to perforation or slit</p> <p>Perforation or slit</p>  | <p>Mount in parallel with perforation or slit</p> <p>Perforation or slit</p>  | | | | | | | | | | | | |
| Distance from slit | <p>Closer to slit is higher stress</p>  <p>($l_1 < l_2$)</p> | <p>Away from slit is less stress</p>  <p>($l_1 < l_2$)</p> | | | | | | | | | | | | |

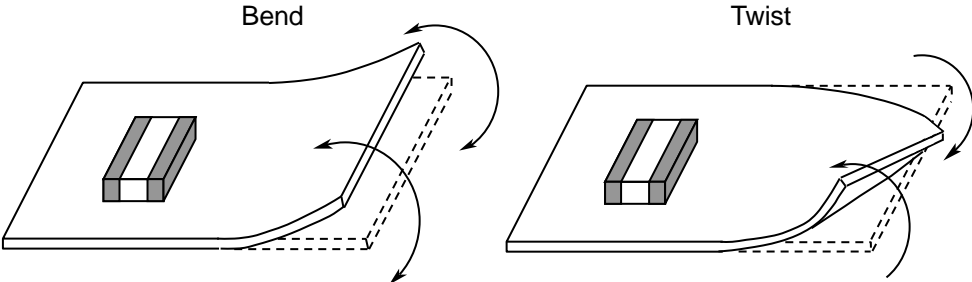
| No. | Process | Condition | | | | | | | | | | | | |
|----------------|---------------------------|---|--|---------------------------|------------------------|--|---------------|--|--|--|----------------|--|--|--|
| 3 | Designing P.C.Board | <p>5) Mechanical stress varies according to location of chip capacitors on the P.C.Board.</p> <div data-bbox="438 257 1404 817" style="text-align: center;"> <p style="text-align: right;">Stress force $A > B > E$ $A > D > E$ $A > C$</p> </div> <p>When dividing printed wiring boards, the intensities of mechanical stress applied to capacitors are different according to each dividing method in the order of : Push-back < Slit < V-groove < Perforation. Therefore consider not only position of capacitors, but also the way of the dividing the printed wiring boards.</p> <p>6) Layout recommendation</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th data-bbox="368 1093 531 1205">Example</th> <th data-bbox="531 1093 837 1205">Use of common solder land</th> <th data-bbox="837 1093 1144 1205">Soldering with chassis</th> <th data-bbox="1144 1093 1469 1205">Use of common solder land with other SMD</th> </tr> </thead> <tbody> <tr> <td data-bbox="368 1205 531 1585" style="text-align: center; vertical-align: middle;">Need to avoid</td> <td data-bbox="531 1205 837 1585"> </td> <td data-bbox="837 1205 1144 1585"> </td> <td data-bbox="1144 1205 1469 1585"> </td> </tr> <tr> <td data-bbox="368 1585 531 2002" style="text-align: center; vertical-align: middle;">Recommendation</td> <td data-bbox="531 1585 837 2002"> </td> <td data-bbox="837 1585 1144 2002"> <p style="text-align: center;">$l_2 > l_1$</p> </td> <td data-bbox="1144 1585 1469 2002"> </td> </tr> </tbody> </table> | Example | Use of common solder land | Soldering with chassis | Use of common solder land with other SMD | Need to avoid | | | | Recommendation | | <p style="text-align: center;">$l_2 > l_1$</p> | |
| Example | Use of common solder land | Soldering with chassis | Use of common solder land with other SMD | | | | | | | | | | | |
| Need to avoid | | | | | | | | | | | | | | |
| Recommendation | | <p style="text-align: center;">$l_2 > l_1$</p> | | | | | | | | | | | | |


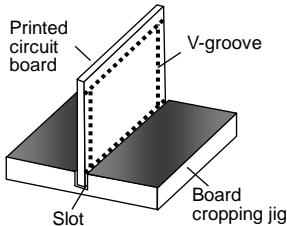
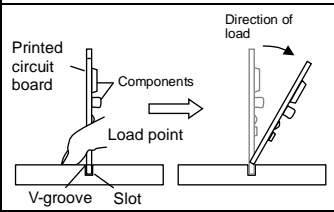
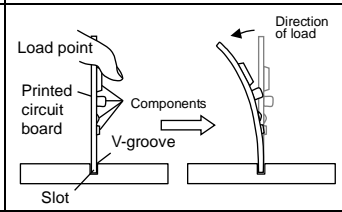
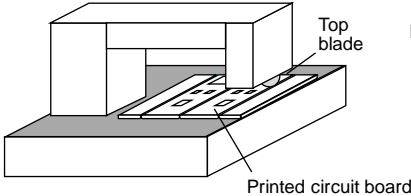
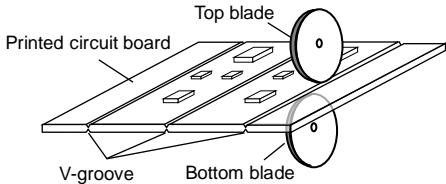
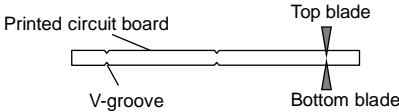
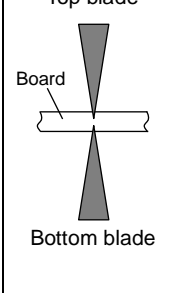
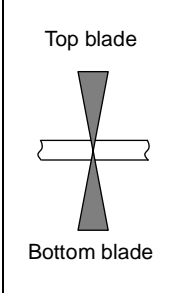
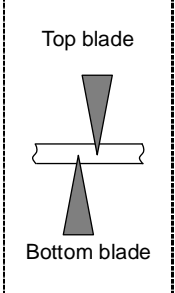
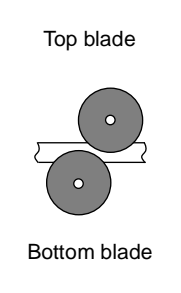
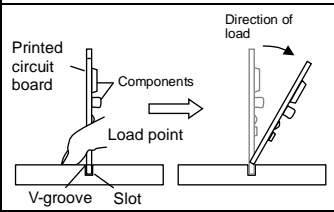
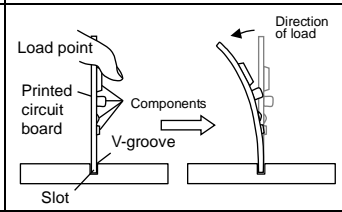
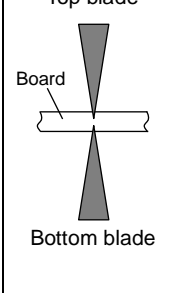
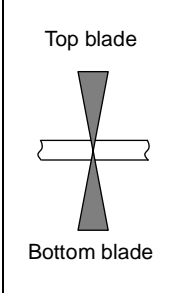
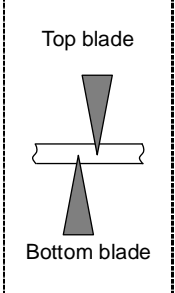
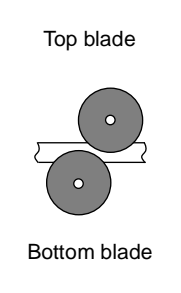
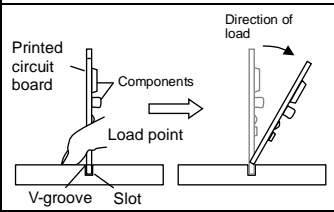
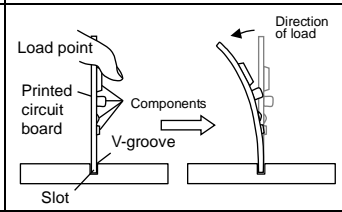
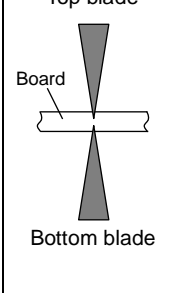
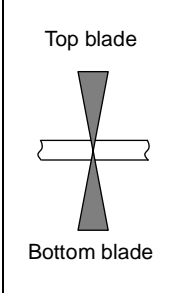
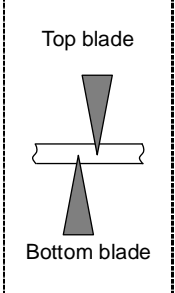
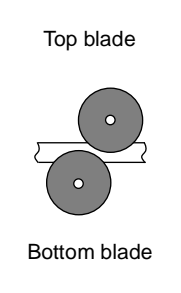
| No. | Process | Condition | | | | | | | | | |
|-----------------------|--|--|--|-----------------|-------------|-----------------------|---|--|-----------------------|--|---|
| 4 | Mounting | <p>4-1. Stress from mounting head</p> <p>If the mounting head is adjusted too low, it may induce excessive stress in the chip capacitor to result in cracking. Please take following precautions.</p> <ol style="list-style-type: none"> 1) Adjust the bottom dead center of the mounting head to reach on the P.C.Board surface and not press it. 2) Adjust the mounting head pressure to be 1 to 3N of static weight. 3) To minimize the impact energy from mounting head, it is important to provide support from the bottom side of the P.C.Board. See following examples. <table border="1" data-bbox="478 660 1433 1220" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th data-bbox="478 660 663 712"></th> <th data-bbox="663 660 1058 712">Not recommended</th> <th data-bbox="1058 660 1433 712">Recommended</th> </tr> </thead> <tbody> <tr> <td data-bbox="478 712 663 958">Single-sided mounting</td> <td data-bbox="663 712 1058 958">  <p style="text-align: center;">Crack</p> </td> <td data-bbox="1058 712 1433 958">  <p style="text-align: center;">Support pin</p> <p style="text-align: center;">A support pin is not to be underneath the capacitor.</p> </td> </tr> <tr> <td data-bbox="478 958 663 1220">Double-sides mounting</td> <td data-bbox="663 958 1058 1220">  <p style="text-align: center;">Solder peeling Crack</p> </td> <td data-bbox="1058 958 1433 1220">  <p style="text-align: center;">Support pin</p> </td> </tr> </tbody> </table> <p>When the centering jaw is worn out, it may give mechanical impact on the capacitor to cause crack. Please control the close up dimension of the centering jaw and provide sufficient preventive maintenance and replacement of it.</p> | | Not recommended | Recommended | Single-sided mounting |  <p style="text-align: center;">Crack</p> |  <p style="text-align: center;">Support pin</p> <p style="text-align: center;">A support pin is not to be underneath the capacitor.</p> | Double-sides mounting |  <p style="text-align: center;">Solder peeling Crack</p> |  <p style="text-align: center;">Support pin</p> |
| | Not recommended | Recommended | | | | | | | | | |
| Single-sided mounting |  <p style="text-align: center;">Crack</p> |  <p style="text-align: center;">Support pin</p> <p style="text-align: center;">A support pin is not to be underneath the capacitor.</p> | | | | | | | | | |
| Double-sides mounting |  <p style="text-align: center;">Solder peeling Crack</p> |  <p style="text-align: center;">Support pin</p> | | | | | | | | | |


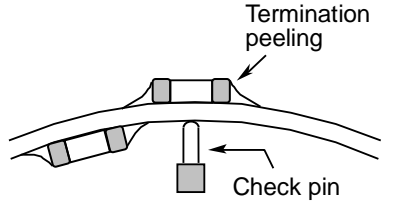
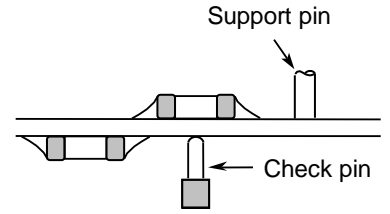
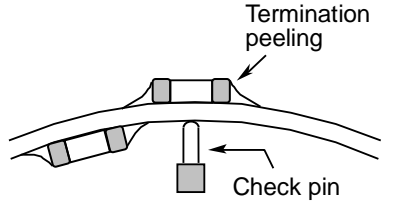
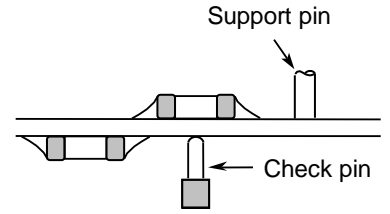
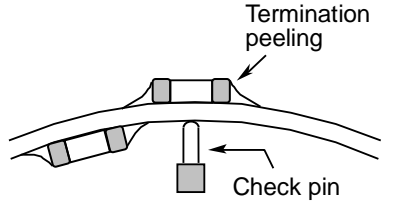
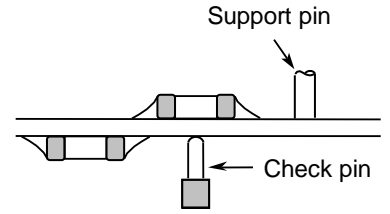
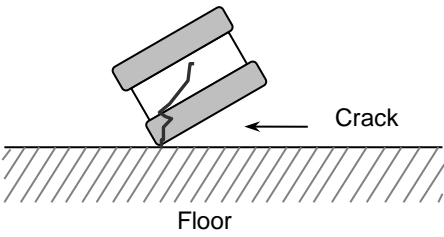
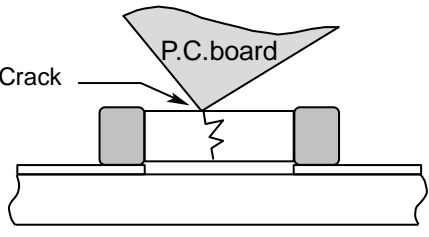
| No. | Process | Condition | | | | | | | | | | | |
|------------------|------------------|---|----------------|------------------|--|---------------|----------------|------------------|----------|---------|--------------|----------|---------|
| 5 | Soldering | <p>5-1. Flux selection</p> <p>Flux can seriously affect the performance of capacitors. Confirm the following to select the appropriate flux.</p> <ol style="list-style-type: none"> 1) It is recommended to use a mildly activated rosin flux (less than 0.1wt% chlorine). Strong flux is not recommended. 2) Excessive flux must be avoided. Please provide proper amount of flux. 3) When water-soluble flux is used, enough washing is necessary. <p>5-2. Recommended soldering profile : Reflow method</p> <p>Refer to the following temperature profile at Reflow soldering.</p> <div style="text-align: center;">  <p>The graph illustrates the reflow soldering temperature profile. The y-axis represents temperature in degrees Celsius, starting from 0 and reaching a 'Peak Temp'. The x-axis represents time. The process is divided into three phases: 'Preheating', 'Soldering', and 'Natural cooling'. The preheating phase is indicated as lasting 'Over 60 sec.' and shows a temperature rise with a shaded area representing the temperature difference ΔT. The soldering phase is a short duration at the peak temperature, labeled 'Peak Temp time'. The natural cooling phase is shown as a dashed line decreasing from the peak temperature.</p> </div> <p>5-3. Recommended soldering peak temp and peak temp duration for Reflow soldering</p> <p>Pb free solder is recommended, but if Sn-37Pb must be used, refer to below.</p> <table border="1" data-bbox="507 1216 1225 1451"> <thead> <tr> <th rowspan="2" style="text-align: center;">Temp./Duration</th> <th colspan="2" style="text-align: center;">Reflow soldering</th> </tr> <tr> <th style="text-align: center;">Peak temp(°C)</th> <th style="text-align: center;">Duration(sec.)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Lead Free Solder</td> <td style="text-align: center;">260 max.</td> <td style="text-align: center;">10 max.</td> </tr> <tr> <td style="text-align: center;">Sn-Pb Solder</td> <td style="text-align: center;">230 max.</td> <td style="text-align: center;">20 max.</td> </tr> </tbody> </table> <p>Recommended solder compositions Lead Free Solder : Sn-3.0Ag-0.5Cu</p> | Temp./Duration | Reflow soldering | | Peak temp(°C) | Duration(sec.) | Lead Free Solder | 260 max. | 10 max. | Sn-Pb Solder | 230 max. | 20 max. |
| Temp./Duration | Reflow soldering | | | | | | | | | | | | |
| | Peak temp(°C) | Duration(sec.) | | | | | | | | | | | |
| Lead Free Solder | 260 max. | 10 max. | | | | | | | | | | | |
| Sn-Pb Solder | 230 max. | 20 max. | | | | | | | | | | | |


| No. | Process | Condition | | | | | | | | | | | | | |
|---------------------|--|--|-----------|------------|------------------|---------------------|------------------|--|--|----------|--|--|---------------------|--|---|
| 5 | Soldering | <p>5-4. Avoiding thermal shock</p> <p>1) Preheating condition</p> <table border="1" data-bbox="544 293 1177 427"> <thead> <tr> <th data-bbox="544 293 821 353">Soldering</th> <th data-bbox="821 293 1177 353">Temp. (°C)</th> </tr> </thead> <tbody> <tr> <td data-bbox="544 353 821 427">Reflow soldering</td> <td data-bbox="821 353 1177 427">$\Delta T \leq 150$</td> </tr> </tbody> </table> <p>2) Cooling condition Natural cooling using air is recommended. If the chips are dipped into a solvent for cleaning, the temperature difference (ΔT) must be less than 100°C.</p> <p>5-5. Amount of solder Excessive solder will induce higher tensile force in chip capacitors when temperature changes and it may result in chip cracking. In sufficient solder may detach the capacitors from the P.C.board.</p> <table border="1" data-bbox="488 808 1437 1272"> <tbody> <tr> <td data-bbox="488 808 683 965">Excessive solder</td> <td data-bbox="683 808 1098 965">  </td> <td data-bbox="1098 808 1437 965">Higher tensile force in chip capacitors to cause crack</td> </tr> <tr> <td data-bbox="488 965 683 1115">Adequate</td> <td data-bbox="683 965 1098 1115">  </td> <td data-bbox="1098 965 1437 1115"></td> </tr> <tr> <td data-bbox="488 1115 683 1272">Insufficient solder</td> <td data-bbox="683 1115 1098 1272">  </td> <td data-bbox="1098 1115 1437 1272">Low robustness may cause contact failure or chip capacitors come off the P.C.board.</td> </tr> </tbody> </table> <p>5-6. Sn-Zn solder Sn-Zn solder affects product reliability. Please contact TDK in advance when utilize Sn-Zn solder.</p> <p>5-7. Countermeasure for tombstone The misalignment between the mounted positions of the capacitors and the land patterns should be minimized. The tombstone phenomenon may occur especially the capacitors are mounted (in longitudinal direction) in the same direction of the reflow soldering. (Refer to JEITA RCR-2335C Annex A (Informative) Recommendations to prevent the tombstone phenomenon)</p> | Soldering | Temp. (°C) | Reflow soldering | $\Delta T \leq 150$ | Excessive solder |  | Higher tensile force in chip capacitors to cause crack | Adequate |  | | Insufficient solder |  | Low robustness may cause contact failure or chip capacitors come off the P.C.board. |
| Soldering | Temp. (°C) | | | | | | | | | | | | | | |
| Reflow soldering | $\Delta T \leq 150$ | | | | | | | | | | | | | | |
| Excessive solder |  | Higher tensile force in chip capacitors to cause crack | | | | | | | | | | | | | |
| Adequate |  | | | | | | | | | | | | | | |
| Insufficient solder |  | Low robustness may cause contact failure or chip capacitors come off the P.C.board. | | | | | | | | | | | | | |

| No. | Process | Condition | | | | | | | | | | | | |
|------------------|---------------------|---|------------|-----------------|-------------|------------|----------|--------|---------|------------|-----------|------------|------------------|---------------------|
| 6 | Solder repairing | <p>Solder repairing is unavoidable, refer to below.</p> <p>6-1. Solder repair by solder iron</p> <p>1) Selection of the soldering iron tip</p> <p>Tip temperature of solder iron varies by its type, P.C.board material and solder land size. The higher the tip temperature, the quicker the operation. However, heat shock may cause a crack in the chip capacitors.</p> <p>Please make sure the tip temp. before soldering and keep the peak temp and time in accordance with following recommended condition.</p> <div style="text-align: center;"> <p>Manual soldering (Solder iron)</p>  </div> <table border="1" style="margin: 10px auto; width: 80%;"> <caption>Recommended solder iron condition (Sn-Pb Solder and Lead Free Solder)</caption> <thead> <tr> <th>Temp. (°C)</th> <th>Duration (sec.)</th> <th>Wattage (W)</th> <th>Shape (mm)</th> </tr> </thead> <tbody> <tr> <td>350 max.</td> <td>3 max.</td> <td>20 max.</td> <td>∅ 3.0 max.</td> </tr> </tbody> </table> <p>* Please preheat the chip capacitors with the condition in 6-2 to avoid the thermal shock.</p> <p>2) Direct contact of the soldering iron with ceramic dielectric of chip capacitors may cause crack. Do not touch the ceramic dielectric and the terminations by solder iron.</p> <p>3) It is not recommended to reuse dismantled capacitors.</p> <p>6-2. Avoiding thermal shock</p> <p>Preheating condition</p> <table border="1" style="margin: 10px auto; width: 60%;"> <thead> <tr> <th>Soldering</th> <th>Temp. (°C)</th> </tr> </thead> <tbody> <tr> <td>Manual soldering</td> <td>$\Delta T \leq 150$</td> </tr> </tbody> </table> | Temp. (°C) | Duration (sec.) | Wattage (W) | Shape (mm) | 350 max. | 3 max. | 20 max. | ∅ 3.0 max. | Soldering | Temp. (°C) | Manual soldering | $\Delta T \leq 150$ |
| Temp. (°C) | Duration (sec.) | Wattage (W) | Shape (mm) | | | | | | | | | | | |
| 350 max. | 3 max. | 20 max. | ∅ 3.0 max. | | | | | | | | | | | |
| Soldering | Temp. (°C) | | | | | | | | | | | | | |
| Manual soldering | $\Delta T \leq 150$ | | | | | | | | | | | | | |

| No. | Process | Condition |
|-----|--|---|
| 7 | Cleaning | <p>1) If an unsuitable cleaning fluid is used, flux residue or some foreign articles may stick to chip capacitors surface to deteriorate especially the insulation resistance.</p> <p>2) If cleaning condition is not suitable, it may damage the chip capacitors.</p> <p>2)-1. Insufficient washing</p> <p>(1) Terminal electrodes may corrode by Halogen in the flux.</p> <p>(2) Halogen in the flux may adhere on the surface of capacitors, and lower the insulation resistance.</p> <p>(3) Water soluble flux has higher tendency to have above mentioned problems (1) and (2).</p> <p>2)-2. Excessive washing</p> <p>When ultrasonic cleaning is used, excessively high ultrasonic energy output can affect the connection between the ceramic chip capacitor's body and the terminal electrode. To avoid this, following is the recommended condition.</p> <p style="padding-left: 40px;">Power : 20 W/l max. Frequency : 40 kHz max. Washing time : 5 minutes max.</p> <p>2)-3. If the cleaning fluid is contaminated, density of Halogen increases, and it may bring the same result as insufficient cleaning.</p> |
| 8 | Coating and molding of the P.C.board | <p>1) When the P.C.board is coated, please verify the quality influence on the product.</p> <p>2) Please verify carefully that there is no harmful decomposing or reaction gas emission during curing which may damage the chip capacitors.</p> <p>3) Please verify the curing temperature.</p> |
| 9 | Handling after chip mounted ⚠ Caution | <p>1) Please pay attention not to bend or distort the P.C.board after soldering in handling otherwise the chip capacitors may crack.</p> <div style="text-align: center;">  </div> |

| No. | Process | Condition | | | | | | | | | | | | | | | |
|---|--|--|---|---------------|--|---|-------------|---------------|--|--|-------------------------|-------------------------|-------------------------|---|--|---|---|
| 9 | Handling after chip mounted  Caution | <p>2) Printed circuit board cropping should not be carried out by hand, but by using the proper tooling. Printed circuit board cropping should be carried out using a board cropping jig as shown in the following figure or a board cropping apparatus to prevent inducing mechanical stress on the board.</p> <p>(1) Example of a board cropping jig Recommended example: The board should be pushed from the back side, close to the cropping jig so that the board is not bent and the stress applied to the capacitor is compressive. Unrecommended example: If the pushing point is far from the cropping jig and the pushing direction is from the front side of the board, large tensile stress is applied to the capacitor, which may cause cracks.</p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="464 600 751 860"> <p>Outline of jig</p>  </div> <div data-bbox="767 595 1445 855"> <table border="1"> <thead> <tr> <th data-bbox="767 595 1102 645">Recommended</th> <th data-bbox="1102 595 1445 645">Unrecommended</th> </tr> </thead> <tbody> <tr> <td data-bbox="767 645 1102 855">  </td> <td data-bbox="1102 645 1445 855">  </td> </tr> </tbody> </table> </div> </div> <p>(2) Example of a board cropping machine</p> <p>An outline of a printed circuit board cropping machine is shown below. The top and bottom blades are aligned with one another along the lines with the V-grooves on printed circuit board when cropping the board.</p> <p>Unrecommended example: Misalignment of blade position between top and bottom, right and left, or front and rear blades may cause a crack in the capacitor.</p> <div style="display: flex; justify-content: space-around; margin-top: 20px;"> <div data-bbox="563 1162 976 1411"> <p>Outline of machine</p>  </div> <div data-bbox="970 1162 1417 1388"> <p>Principle of operation</p>  </div> </div> <div style="text-align: center; margin-top: 20px;"> <p>Cross-section diagram</p>  </div> <table border="1" style="width: 100%; margin-top: 20px; text-align: center;"> <thead> <tr> <th data-bbox="646 1630 826 1720" rowspan="2">Recommended</th> <th colspan="3" data-bbox="826 1630 1358 1675">Unrecommended</th> </tr> <tr> <th data-bbox="826 1675 1002 1765">Top-bottom misalignment</th> <th data-bbox="1002 1675 1177 1765">Left-right misalignment</th> <th data-bbox="1177 1675 1358 1765">Front-rear misalignment</th> </tr> </thead> <tbody> <tr> <td data-bbox="646 1765 826 2056">  </td> <td data-bbox="826 1765 1002 2056">  </td> <td data-bbox="1002 1765 1177 2056">  </td> <td data-bbox="1177 1765 1358 2056">  </td> </tr> </tbody> </table> | Recommended | Unrecommended |  |  | Recommended | Unrecommended | | | Top-bottom misalignment | Left-right misalignment | Front-rear misalignment |  |  |  |  |
| Recommended | Unrecommended | | | | | | | | | | | | | | | | |
|  |  | | | | | | | | | | | | | | | | |
| Recommended | Unrecommended | | | | | | | | | | | | | | | | |
| | Top-bottom misalignment | Left-right misalignment | Front-rear misalignment | | | | | | | | | | | | | | |
|  |  |  |  | | | | | | | | | | | | | | |

| No. | Process | Condition | | | | | | |
|---------------|--|---|------|-----------------|-------------|---------------|--|---|
| 9 | Handling after chip mounted  Caution | <p>3) When functional check of the P.C.board is performed, check pin pressure tends to be adjusted higher for fear of loose contact. But if the pressure is excessive and bend the P.C.board, it may crack the chip capacitors or peel the terminations off. Please adjust the check pins not to bend the P.C.board.</p> <table border="1" data-bbox="478 403 1452 705"> <thead> <tr> <th data-bbox="478 403 619 465">Item</th> <th data-bbox="619 403 1037 465">Not recommended</th> <th data-bbox="1037 403 1452 465">Recommended</th> </tr> </thead> <tbody> <tr> <td data-bbox="478 465 619 705">Board bending</td> <td data-bbox="619 465 1037 705">  </td> <td data-bbox="1037 465 1452 705">  </td> </tr> </tbody> </table> | Item | Not recommended | Recommended | Board bending |  |  |
| Item | Not recommended | Recommended | | | | | | |
| Board bending |  |  | | | | | | |
| 10 | Handling of loose chip capacitors | <p>1) If dropped the chip capacitors may crack. Once dropped do not use it. Especially, the large case sized chip capacitors are tendency to have cracks easily, so please handle with care.</p>  <p>2) Piling the P.C.board after mounting for storage or handling, the corner of the P.C. board may hit the chip capacitors of another board to cause crack.</p>  | | | | | | |
| 11 | Capacitance aging | <p>The capacitors have aging in the capacitance. They may not be used in precision time constant circuit. In case of the time constant circuit, the evaluation should be done well.</p> | | | | | | |
| 12 | Estimated life and estimated failure rate of capacitors | <p>As per the estimated life and the estimated failure rate depend on the temperature and the voltage. This can be calculated by the equation described in JEITA RCR-2335C Annex F (Informative) Calculation of the estimated lifetime and the estimated failure rate (Voltage acceleration coefficient : 3 multiplication rule, Temperature acceleration coefficient : 10°C rule)</p> <p>The failure rate can be decreased by reducing the temperature and the voltage but they will not be guaranteed.</p> | | | | | | |

| No. | Process | Condition |
|-----|---|--|
| 13 | Caution during operation of equipment | <p>1) A capacitor shall not be touched directly with bare hands during operation in order to avoid electric shock. Electric energy held by the capacitor may be discharged through the human body when touched with a bare hand. Even when the equipment is off, a capacitor may stay charged. The capacitor should be handled after being completely discharged using a resistor.</p> <p>2) The terminals of a capacitor shall not be short-circuited by any accidental contact with a conductive object. A capacitor shall not be exposed to a conductive liquid such as an acid or alkali solution. A conductive object or liquid, such as acid and alkali, between the terminals may lead to the breakdown of a capacitor due to short circuit</p> <p>3) Confirm that the environment to which the equipment will be exposed during transportation and operation meets the specified conditions. Do not to use the equipment in the following environments.</p> <p>(1) Environment where a capacitor is splattered with water or oil</p> <p>(2) Environment where a capacitor is exposed to direct sunlight</p> <p>(3) Environment where a capacitor is exposed to Ozone, ultraviolet rays or radiation</p> <p>(4) Environment where a capacitor exposed to corrosive gas (e.g. hydrogen sulfide, sulfur dioxide, chlorine. ammonia gas etc.)</p> <p>(5) Environment where a capacitor exposed to vibration or mechanical shock exceeding the specified limits.</p> <p>(6) Atmosphere change with causes condensation</p> |
| 13 | Others  Caution | <p>The products listed on this specification sheet are intended for use in general electronic equipment (AV equipment, telecommunications equipment, home appliances, amusement equipment, computer equipment, personal equipment, office equipment, measurement equipment, industrial robots) under a normal operation and use condition.</p> <p>The products are not designed or warranted to meet the requirements of the applications listed below, whose performance and/or quality require a more stringent level of safety or reliability, or whose failure, malfunction or trouble could cause serious damage to society, person or property. Please understand that we are not responsible for any damage or liability caused by use of the products in any of the applications below or for any other use exceeding the range or conditions set forth in this specification sheet. If you intend to use the products in the applications listed below or if you have special requirements exceeding the range or conditions set forth in this specification, please contact us.</p> <p>(1) Aerospace/Aviation equipment</p> <p>(2) Transportation equipment (cars, electric trains, ships, etc.)</p> <p>(3) Medical equipment (Excepting Pharmaceutical Affairs Law classification Class1, 2)</p> <p>(4) Power-generation control equipment</p> <p>(5) Atomic energy-related equipment</p> <p>(6) Seabed equipment</p> <p>(7) Transportation control equipment</p> <p>(8) Public information-processing equipment</p> <p>(9) Military equipment</p> <p>(10) Electric heating apparatus, burning equipment</p> <p>(11) Disaster prevention/crime prevention equipment</p> <p>(12) Safety equipment</p> <p>(13) Other applications that are not considered general-purpose applications</p> <p>When designing your equipment even for general-purpose applications, you are kindly requested to take into consideration securing protection circuit/device or providing backup circuits in your equipment.</p> |

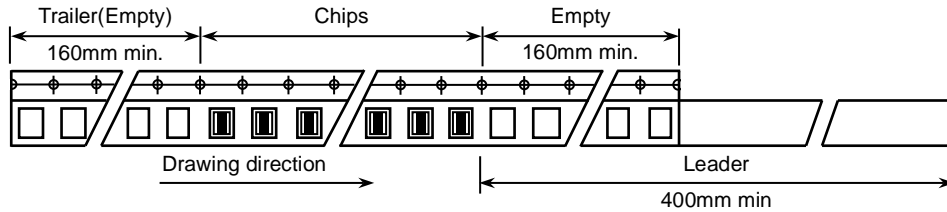
11. TAPE PACKAGING SPECIFICATION

1. CONSTRUCTION AND DIMENSION OF TAPING

1-1. Dimensions of carrier tape

Dimensions of paper tape shall be according to Appendix 3.

1-2. Bulk part and leader of taping

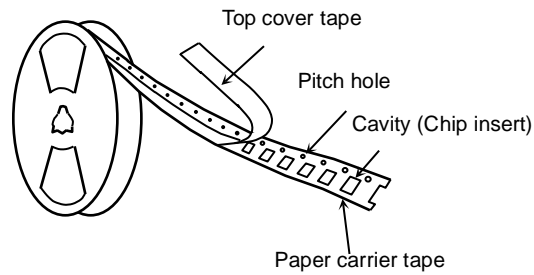


1-3. Dimensions of reel

Dimensions of $\varnothing 178$ reel shall be according to Appendix 4.

Dimensions of $\varnothing 330$ reel shall be according to Appendix 5.

1-4. Structure of taping



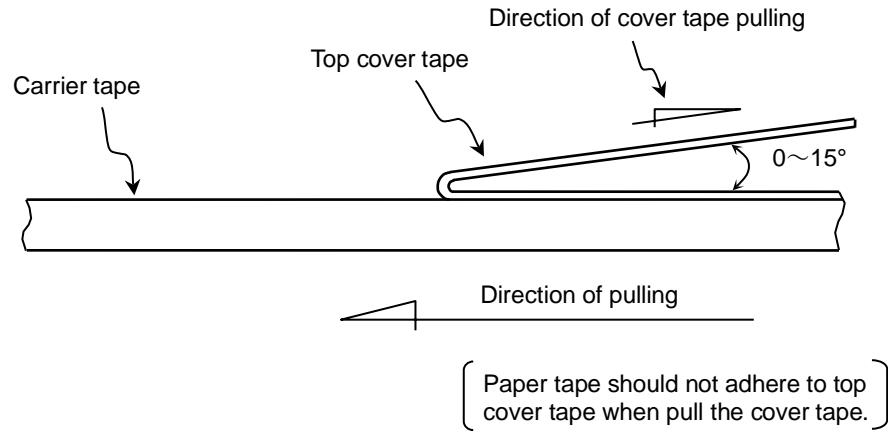
2. CHIP QUANTITY

Please refer to detail page on TDK web.

3. PERFORMANCE SPECIFICATIONS

3-1. Fixing peeling strength (top tape)

$$0.05\text{N} < \text{Peeling strength} < 0.7\text{N}$$



3-2. Carrier tape shall be flexible enough to be wound around a minimum radius of 30mm with components in tape.

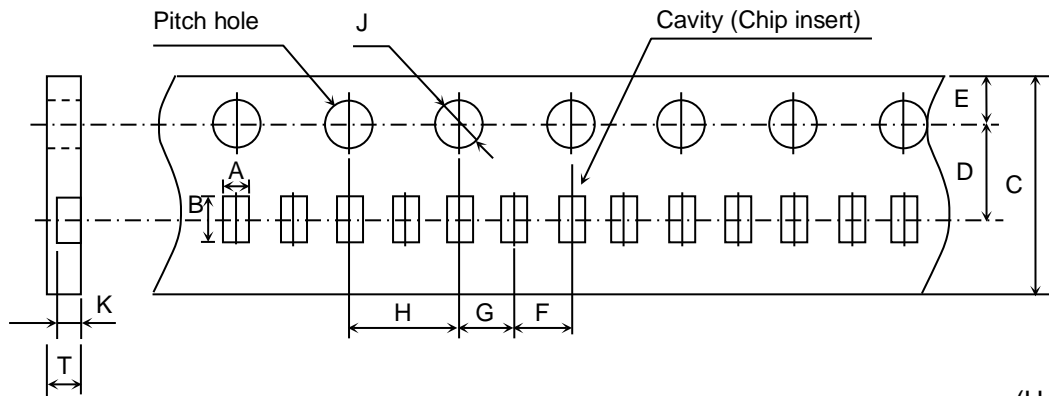
3-3. The missing of components shall be less than 0.1%

3-4. Components shall not stick to fixing tape.

3-5. When removing the cover tape, there shall not be difficulties by unfitting clearance gap, burrs and crushes of cavities. Also the sprocket holes shall not be covered by absorbing dust into the suction nozzle.

Appendix 3

Paper Tape



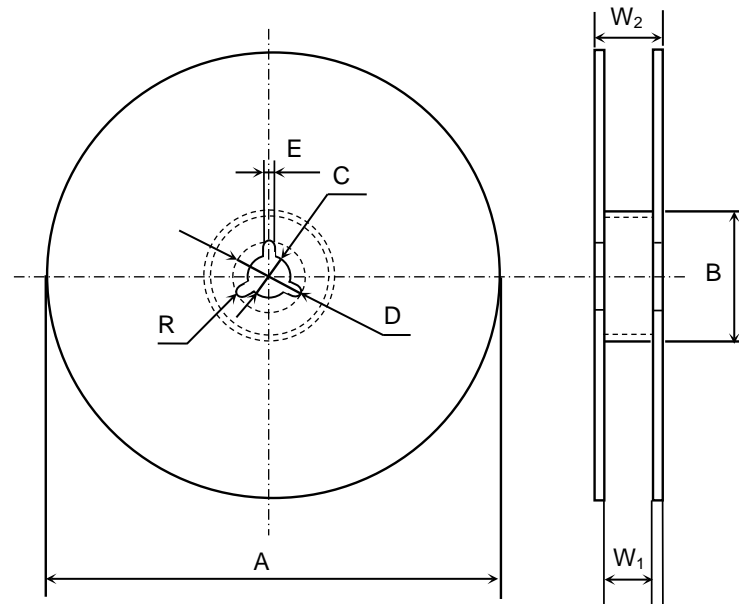
(Unit : mm)

| | | | | | | |
|-----------|-----------------|-----------------|--|-----------------|-----------------|-----------------|
| Symbol | A | B | C | D | E | F |
| Dimension | (0.62) | (1.12) | 8.00 ± 0.30 | 3.50 ± 0.05 | 1.75 ± 0.10 | 2.00 ± 0.05 |
| Symbol | G | H | J | K | T | |
| Dimension | 2.00 ± 0.05 | 4.00 ± 0.10 | $\varnothing 1.50 \begin{matrix} +0.1 \\ 0 \end{matrix}$ | (0.38) | 0.50 max. | |

() Referenced value.

Appendix 4

Dimensions of reel (Material: Polystyrene)

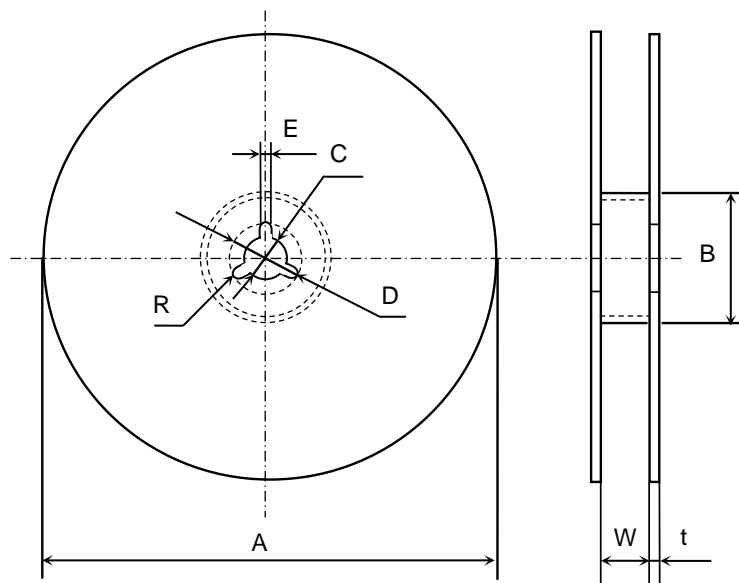


(Unit: mm)

| | | | | | | |
|-----------|----------------|----------|----------|----------|---------|----------------|
| Symbol | A | B | C | D | E | W ₁ |
| Dimension | ∅ 178±2.0 | ∅ 60±2.0 | ∅ 13±0.5 | ∅ 21±0.8 | 2.0±0.5 | 9.0±0.3 |
| Symbol | W ₂ | R | | | | |
| Dimension | 13.0 ± 1.4 | 1.0 | | | | |

Appendix 5

Dimensions of reel (Material: Polystyrene)



(Unit: mm)

| | | | | | | |
|-----------|-------------------------------|-----------|----------|----------|---------|----------|
| Symbol | A | B | C | D | E | W |
| Dimension | ∅ 382 max. (Nominal ∅ 330) | ∅ 50 min. | ∅ 13±0.5 | ∅ 21±0.8 | 2.0±0.5 | 10.0±1.5 |
| Symbol | t | R | | | | |
| Dimension | 2.0±0.5 | 1.0 | | | | |