

SPECIFICATION

SPEC. No. A-SoftC-d

D A T E : 2016 Nov.

To

Non-Controlled Copy

CUSTOMER'S PRODUCT NAME

TDK'S PRODUCT NAME

Multilayer Ceramic Chip Capacitors
CGA series/ Automotive grade
Soft Termination

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 _____

Test conditions in this specification based on AEC-Q200 for automotive application.

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 |
|----------|---------|------------------|
| | | |

1. SCOPE

This specification is applicable to chip type multilayer ceramic capacitors with a priority over the other relevant specifications.

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

EXPLANATORY NOTE:

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

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

2. CODE CONSTRUCTION

(Example)

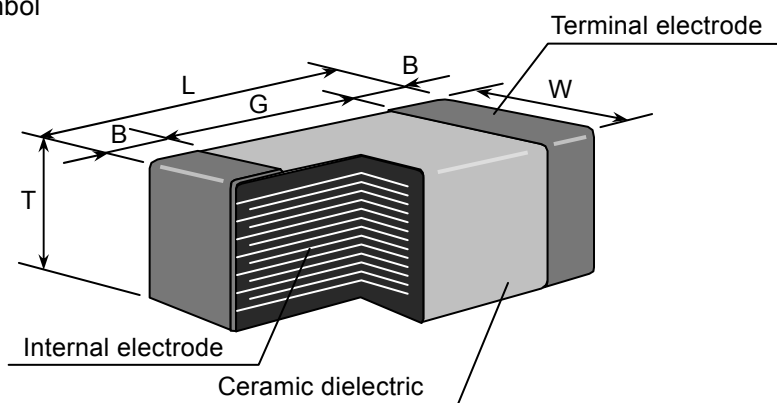
Catalog Number: CGA 6 P 3 X7S 1H 106 K 250 A E
 (Web) (1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11)

Item Description: CGA 6 P 3 X7S 1H 106 K T xxxS
 (1) (2) (3) (4) (5) (6) (7) (8) (12) (13)

(1) Series

| Symbol | Series |
|--------|----------------------------|
| CGA | For Automotive application |

(2) Case size symbol



| Symbol | Type (EIA style) |
|--------|------------------|
| 2 | CC0402 |
| 3 | CC0603 |
| 4 | CC0805 |
| 5 | CC1206 |
| 6 | CC1210 |

| Symbol | Type (EIA style) |
|--------|------------------|
| 7 | CC1808 |
| 8 | CC1812 |
| 9 | CC2220 |
| D | CC3025 |

*As for dimensions of each product, please refer to detailed information on TDK web.

(3) Thickness

| Symbol | Dimension (mm) | Symbol | Dimension (mm) |
|--------|----------------|--------|----------------|
| B | 0.50 | K | 1.30 |
| E | 0.80 | L | 1.60 |
| F | 0.85 | M | 2.00 |
| H | 1.15 | N | 2.30 |
| J | 1.25 | P | 2.50 |

(4) Voltage condition in the life test
(Details are shown in table 1 No.16 at 8.PERFORMANCE.)

| Symbol | Condition |
|--------|---------------------|
| 1 | Rated Voltage |
| 2 | Rated Voltage x 2 |
| 3 | Rated Voltage x 1.5 |
| 4 | Rated Voltage x 1.2 |

(5) Temperature Characteristics
(Details are shown in table 1 No.6 and No.7 at 8.PERFORMANCE.)

(6) Rated Voltage

| Symbol | Rated Voltage | Symbol | Rated Voltage |
|--------|---------------|--------|---------------|
| 0 J | DC 6.3 V | 2 E | DC 250 V |
| 1 A | DC 10 V | 2 W | DC 450 V |
| 1 C | DC 16 V | 2 J | DC 630 V |
| 1 E | DC 25 V | 3 A | DC 1000 V |
| 1 V | DC 35 V | 3 D | DC 2000 V |
| 1 H | DC 50 V | 3 F | DC 3000 V |
| 2 A | DC 100 V | | |

(7) 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.

| Symbol | Rated Capacitance |
|--------|-------------------------|
| 101 | 100pF |
| 225 | 2,200,000pF (=2.2μF) |

(8) Capacitance tolerance

*M tolerance shall be TDK standard for
Over 10μF parts.

| Symbol | Tolerance |
|--------|-----------|
| J | ± 5 % |
| K | ± 10 % |
| M* | ± 20 % |

(9) Thickness code (Only catalog number)

(10) Package code (Only catalog number)

(11) Special code (Only catalog number)

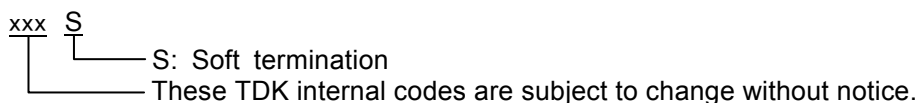
| Symbol | Description |
|--------|------------------|
| E | Soft termination |

(12) Packaging (Only item description)

(Bulk is not applicable for CGA2 [CC0402] type.)

| Symbol | Packaging |
|--------|-----------|
| B | Bulk |
| T | Taping |

(13) TDK internal code (Only item description)

xxx S

 S: Soft termination
 These TDK internal codes are subject to change without notice.

3. RATED CAPACITANCE AND TOLERANCE

3.1 Standard combination of rated capacitance and tolerances

| Class | Temperature Characteristics | Capacitance tolerance | | Rated capacitance |
|-------|-----------------------------|-------------------------------------|--------------------------------------|-------------------|
| 1 | C0G | J ($\pm 5\%$) K ($\pm 10\%$) | | E – 6 series |
| 2 | X7R X7S X7T X8R | Cap \leq 10 μ F | K ($\pm 10\%$) M ($\pm 20\%$) | E – 6 series |
| | | Cap $>$ 10 μ F | M ($\pm 20\%$) | E – 3 series |

3.2 Capacitance Step in E series

| E series | Capacitance Step | | | | | |
|----------|------------------|-----|-----|-----|-----|-----|
| E- 3 | 1.0 | | 2.2 | | 4.7 | |
| E- 6 | 1.0 | 1.5 | 2.2 | 3.3 | 4.7 | 6.8 |

4. OPERATING TEMPERATURE RANGE

| T.C. | Min. operating Temperature | Max. operating Temperature | Reference Temperature |
|---------------------|----------------------------|----------------------------|-----------------------|
| C0G, X7R,X7S,X7T | -55°C | 125°C | 25°C |
| X8R | -55°C | 150°C | 25°C |

5. STORING CONDITION AND TERM

5 to 40°C at 20 to 70%RH
6 months Max.

6. P.C. BOARD

When mounting on an aluminum substrate, large case size such as CGA6 [CC1210]~CGAD [CC3025] types are more likely to be affected by heat stress from the substrate. Please inquire separate specification for the large case sizes when mounted on the substrate.

7. INDUSTRIAL WASTE DISPOSAL

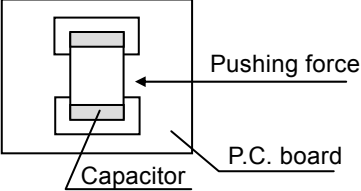
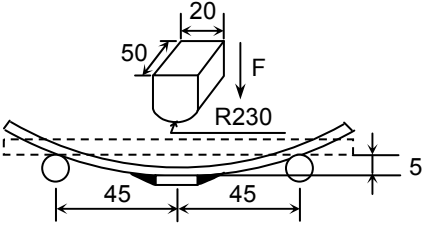
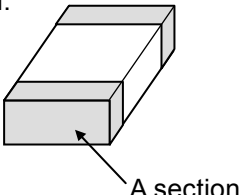
Dispose this product as industrial waste in accordance with the Industrial Waste Law.

8. 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, 10,000 MΩ or 100MΩ·μF min.,) whichever smaller. | Apply rated voltage for 60s. As for the capacitor of rated voltage 630V DC and above, apply 500V DC. | | | | | | | | | | | | | | | | | | | | | |
| 3 | Voltage Proof | Withstand test voltage without insulation breakdown or other damage. | <table border="1"> <thead> <tr> <th>Class</th> <th>Rated voltage (RV)</th> <th>Apply voltage</th> </tr> </thead> <tbody> <tr> <td rowspan="4">1</td> <td>$RV \leq 100V$</td> <td>3 × rated voltage</td> </tr> <tr> <td>$100V < RV \leq 500V$</td> <td>1.5 × rated voltage</td> </tr> <tr> <td>630V</td> <td>1.3 × rated voltage</td> </tr> <tr> <td>$630V < RV$</td> <td>1.2 × rated voltage</td> </tr> <tr> <td rowspan="4">2</td> <td>$RV \leq 100V$</td> <td>2.5 × rated voltage</td> </tr> <tr> <td>$100V < RV \leq 500V$</td> <td>1.5 × rated voltage</td> </tr> <tr> <td>630V</td> <td>1.3 × rated voltage</td> </tr> <tr> <td>$630V < RV$</td> <td>1.2 × rated voltage</td> </tr> </tbody> </table> <p>Above DC voltage shall be applied for 1s. Charge/ discharge current shall not exceed 50mA.</p> | Class | Rated voltage (RV) | Apply voltage | 1 | $RV \leq 100V$ | 3 × rated voltage | $100V < RV \leq 500V$ | 1.5 × rated voltage | 630V | 1.3 × rated voltage | $630V < RV$ | 1.2 × rated voltage | 2 | $RV \leq 100V$ | 2.5 × rated voltage | $100V < RV \leq 500V$ | 1.5 × rated voltage | 630V | 1.3 × rated voltage | $630V < RV$ | 1.2 × rated voltage |
| Class | Rated voltage (RV) | Apply voltage | | | | | | | | | | | | | | | | | | | | | | |
| 1 | $RV \leq 100V$ | 3 × rated voltage | | | | | | | | | | | | | | | | | | | | | | |
| | $100V < RV \leq 500V$ | 1.5 × rated voltage | | | | | | | | | | | | | | | | | | | | | | |
| | 630V | 1.3 × rated voltage | | | | | | | | | | | | | | | | | | | | | | |
| | $630V < RV$ | 1.2 × rated voltage | | | | | | | | | | | | | | | | | | | | | | |
| 2 | $RV \leq 100V$ | 2.5 × rated voltage | | | | | | | | | | | | | | | | | | | | | | |
| | $100V < RV \leq 500V$ | 1.5 × rated voltage | | | | | | | | | | | | | | | | | | | | | | |
| | 630V | 1.3 × rated voltage | | | | | | | | | | | | | | | | | | | | | | |
| | $630V < RV$ | 1.2 × rated voltage | | | | | | | | | | | | | | | | | | | | | | |
| 4 | Capacitance | Within the specified tolerance. | <table border="1"> <thead> <tr> <th>Class</th> <th>Capacitance</th> <th>Measuring frequency</th> <th>Measuring voltage</th> </tr> </thead> <tbody> <tr> <td rowspan="2">1</td> <td>$Cap \leq 1000pF$</td> <td>1MHz±10%</td> <td rowspan="2">0.5-5Vrms.</td> </tr> <tr> <td>$Cap > 1000pF$</td> <td>1kHz±10%</td> </tr> <tr> <td rowspan="2">2</td> <td>$Cap \leq 10\mu F$</td> <td>1kHz±10%</td> <td>1.0±0.2Vrms</td> </tr> <tr> <td>$Cap > 10\mu F$</td> <td>120Hz±20%</td> <td>0.5±0.2Vrms</td> </tr> </tbody> </table> <p>For information which product has which measuring voltage, please contact with our sales representative.</p> | Class | Capacitance | Measuring frequency | Measuring voltage | 1 | $Cap \leq 1000pF$ | 1MHz±10% | 0.5-5Vrms. | $Cap > 1000pF$ | 1kHz±10% | 2 | $Cap \leq 10\mu F$ | 1kHz±10% | 1.0±0.2Vrms | $Cap > 10\mu F$ | 120Hz±20% | 0.5±0.2Vrms | | | | |
| Class | Capacitance | Measuring frequency | Measuring voltage | | | | | | | | | | | | | | | | | | | | | |
| 1 | $Cap \leq 1000pF$ | 1MHz±10% | 0.5-5Vrms. | | | | | | | | | | | | | | | | | | | | | |
| | $Cap > 1000pF$ | 1kHz±10% | | | | | | | | | | | | | | | | | | | | | | |
| 2 | $Cap \leq 10\mu F$ | 1kHz±10% | 1.0±0.2Vrms | | | | | | | | | | | | | | | | | | | | | |
| | $Cap > 10\mu F$ | 120Hz±20% | 0.5±0.2Vrms | | | | | | | | | | | | | | | | | | | | | |
| 5 | Q (Class1) Dissipation Factor (Class2) | As for spec of each product, please refer to detailed information on TDK web. | See No.4 in this table for measuring condition. | | | | | | | | | | | | | | | | | | | | | |
| 6 | Temperature Characteristics of Capacitance (Class1) | <table border="1"> <thead> <tr> <th>T. C.</th> <th>Temperature Coefficient</th> </tr> </thead> <tbody> <tr> <td>C0G</td> <td>0 ± 30 (ppm/°C)</td> </tr> </tbody> </table> <p>Capacitance drift within ± 0.2% or ± 0.05pF, whichever larger.</p> | T. C. | Temperature Coefficient | C0G | 0 ± 30 (ppm/°C) | <p>Temperature coefficient shall be calculated based on values at 25°C and 85°C temperature.</p> <p>Measuring temperature below 20°C shall be -10°C and -25°C.</p> | | | | | | | | | | | | | | | | | |
| T. C. | Temperature Coefficient | | | | | | | | | | | | | | | | | | | | | | | |
| C0G | 0 ± 30 (ppm/°C) | | | | | | | | | | | | | | | | | | | | | | | |

(continued)

| No. | Item | Performance | Test or inspection method | | | | | | | | | | |
|------|---|--|--|------|-----------------|---|--------|---|---------|---|--------|----|--------------------------|
| 7 | Temperature Characteristics of Capacitance (Class2) | <p style="text-align: center;">Capacitance Change (%)</p> <hr/> <p style="text-align: center;">No voltage applied</p> <hr/> <p style="text-align: center;">X7R: ±15 X7S: ±22 X7T: +22,-33 X8R: ±15</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 ± 3</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>*X7R, X7S, X7T: 125°C X8R: 150°C</p> | Step | Temperature(°C) | 1 | 25 ± 2 | 2 | -55 ± 3 | 3 | 25 ± 2 | 4* | Max. operating Temp. ± 2 |
| Step | Temperature(°C) | | | | | | | | | | | | |
| 1 | 25 ± 2 | | | | | | | | | | | | |
| 2 | -55 ± 3 | | | | | | | | | | | | |
| 3 | 25 ± 2 | | | | | | | | | | | | |
| 4* | Max. operating Temp. ± 2 | | | | | | | | | | | | |
| 8 | 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 and apply a pushing force of 17.7N with 10±1s (2N is applied for CGA2 [CC0402] type).</p>  | | | | | | | | | | |
| 9 | Bending | No mechanical damage. | <p>Reflow solder the capacitors on a P.C. board shown in Appendix1 and bend it for 5mm (2mm is applied for CGA7 [CC1808] ~ CGA9 [CC2220] parts, 1mm is applied for C7563 [CC3025] parts).</p>  <p style="text-align: right;">(Unit : mm)</p> | | | | | | | | | | |
| 10 | Solderability | <p>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.</p>  | <p>Completely soak both terminations in solder at the following conditions.</p> <p>Solder : Sn-3.0Ag-0.5Cu or Sn-37Pb Temperature: 245±5°C (Sn-3.0Ag-0.5Cu) 235±5°C (Sn-37Pb) Soaking time: 3±0.3s (Sn-3.0Ag-0.5Cu) 2±0.2s (Sn-37Pb)</p> <p>Flux: Isopropyl alcohol (JIS K 8839) Rosin (JIS K 5902) 25% solid solution.</p> | | | | | | | | | | |

(continued)

| No. | Item | | Performance | Test or inspection method | | | | | | | |
|----------------------------------|--|----------------------------------|--|---|------------------------------------|------------------------------------|----------------|---------|----------------------------------|---------|--|
| 11 | Resistance to solder heat | External appearance | No cracks are allowed and terminations shall be covered at least 60% with new solder. | <p>Completely soak both terminations in solder at the following conditions. 260±5°C for 10±1s.</p> <p>Preheating condition Temp.: 110 - 140°C Time : 30 - 60s.</p> <p>Solder : Sn-3.0Ag-0.5Cu or Sn-37Pb</p> <p>Flux : Isopropyl alcohol (JIS K 8839) Rosin (JIS K 5902) 25% solid solution.</p> <p>Leave the capacitors in ambient condition for 6 to 24h (Class1) or 24±2h (Class2) before measurement.</p> | | | | | | | |
| | | Capacitance | <table border="1"> <thead> <tr> <th>Characteristics</th> <th>Change from the value before test*</th> </tr> </thead> <tbody> <tr> <td>Class1/ C0G</td> <td>± 2.5 %</td> </tr> <tr> <td>Class2/ X7R, X7S, X7T, X8R</td> <td>± 7.5 %</td> </tr> </tbody> </table> | | Characteristics | Change from the value before test* | Class1/ C0G | ± 2.5 % | Class2/ X7R, X7S, X7T, X8R | ± 7.5 % | |
| | | | Characteristics | | Change from the value before test* | | | | | | |
| | | | Class1/ C0G | | ± 2.5 % | | | | | | |
| | | Class2/ X7R, X7S, X7T, X8R | ± 7.5 % | | | | | | | | |
| Q (Class1) | Meet the initial spec. | | | | | | | | | | |
| D.F. (Class2) | Meet the initial spec. | | | | | | | | | | |
| Insulation Resistance | Meet the initial spec. | | | | | | | | | | |
| Voltage proof | No insulation breakdown or other damage. | | | | | | | | | | |
| 12 | Vibration | External appearance | No mechanical damage. | <p>Reflow solder the capacitors on a P.C. board shown in Appendix2 before testing.</p> <p>Vibrate the capacitors with following conditions. Applied force : 5G max. Frequency : 10 - 2,000Hz Duration : 20 min. Cycle : 12 cycles in each 3 mutually perpendicular directions.</p> | | | | | | | |
| | | Capacitance | <table border="1"> <thead> <tr> <th>Characteristics</th> <th>Change from the value before test*</th> </tr> </thead> <tbody> <tr> <td>Class1/ C0G</td> <td>± 2.5 %</td> </tr> <tr> <td>Class2/ X7R, X7S, X7T, X8R</td> <td>± 7.5 %</td> </tr> </tbody> </table> | | Characteristics | Change from the value before test* | Class1/ C0G | ± 2.5 % | Class2/ X7R, X7S, X7T, X8R | ± 7.5 % | |
| | | | Characteristics | | Change from the value before test* | | | | | | |
| | | | Class1/ C0G | | ± 2.5 % | | | | | | |
| Class2/ X7R, X7S, X7T, X8R | ± 7.5 % | | | | | | | | | | |
| Q (Class1) | Meet the initial spec. | | | | | | | | | | |
| D.F. (Class2) | Meet the initial spec. | | | | | | | | | | |

*Typical SPEC.

(continued)

| No. | Item | | Performance | Test or inspection method | | | | | | | | | | | | | | | |
|----------------------------|---|---------------------|----------------------------|--|------------------------------------|-----------------|-------------|---|--------|--------|---|----|-------|----|-------------------------|--------|---|----|-------|
| 13 | Temperature cycle | External appearance | No mechanical damage. | <p>Reflow solder the capacitors on a P.C. board shown in Appendix2 before testing.</p> <p>Expose the capacitors in the condition step1 through step 4 and repeat 1,000 times consecutively.</p> <p>Leave the capacitors in ambient condition for 6 to 24h (Class1) or 24±2h (Class2) before measurement.</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>25</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>25</td> <td>2 - 5</td> </tr> </tbody> </table> <p>*C0G, X7R, X7S, X7T: 125°C X8R: 150°C</p> | Step | Temperature(°C) | Time (min.) | 1 | -55 ±3 | 30 ± 3 | 2 | 25 | 2 - 5 | 3* | Max. operating Temp. ±2 | 30 ± 2 | 4 | 25 | 2 - 5 |
| | | Step | Temperature(°C) | | Time (min.) | | | | | | | | | | | | | | |
| | | 1 | -55 ±3 | | 30 ± 3 | | | | | | | | | | | | | | |
| | | 2 | 25 | | 2 - 5 | | | | | | | | | | | | | | |
| | | 3* | Max. operating Temp. ±2 | | 30 ± 2 | | | | | | | | | | | | | | |
| | | 4 | 25 | | 2 - 5 | | | | | | | | | | | | | | |
| | | Capacitance | Characteristics | | Change from the value before test* | | | | | | | | | | | | | | |
| Class1/ C0G | ± 2.5 % | | | | | | | | | | | | | | | | | | |
| Class2/ X7R, X7S, X7T, X8R | ± 7.5 % | | | | | | | | | | | | | | | | | | |
| Q (Class1) | Meet the initial spec. | | | | | | | | | | | | | | | | | | |
| D.F. (Class2) | Meet the initial spec. | | | | | | | | | | | | | | | | | | |
| Insulation Resistance | Meet the initial spec. | | | | | | | | | | | | | | | | | | |
| Voltage proof | No insulation breakdown or other damage. | | | | | | | | | | | | | | | | | | |
| 14 | Moisture Resistance (Steady State) | External appearance | No mechanical damage. | <p>Reflow solder the capacitors on a P.C. board shown in Appendix2 before testing.</p> <p>Leave at temperature 40±2°C, 90 to 95%RH for 500 +24,0h.</p> <p>Leave the capacitors in ambient condition for 6 to 24h (Class1) or 24±2h (Class2) before measurement.</p> | | | | | | | | | | | | | | | |
| | | Capacitance | Characteristics | | Change from the value before test* | | | | | | | | | | | | | | |
| | | | Class1/ C0G | | ± 5 % | | | | | | | | | | | | | | |
| | | | Class2/ X7R, X7S, X7T, X8R | | ± 12.5 % | | | | | | | | | | | | | | |
| | | Q (Class1) | 350 min. | | | | | | | | | | | | | | | | |
| | | D.F. (Class2) | 200% of initial spec. max. | | | | | | | | | | | | | | | | |
| Insulation Resistance | 1,000MΩ or 50MΩ·μF min. (As for the capacitors of rated voltage 16V DC, 1,000 MΩ or 10MΩ·μF min.,) whichever smaller. | | | | | | | | | | | | | | | | | | |

*Typical SPEC.

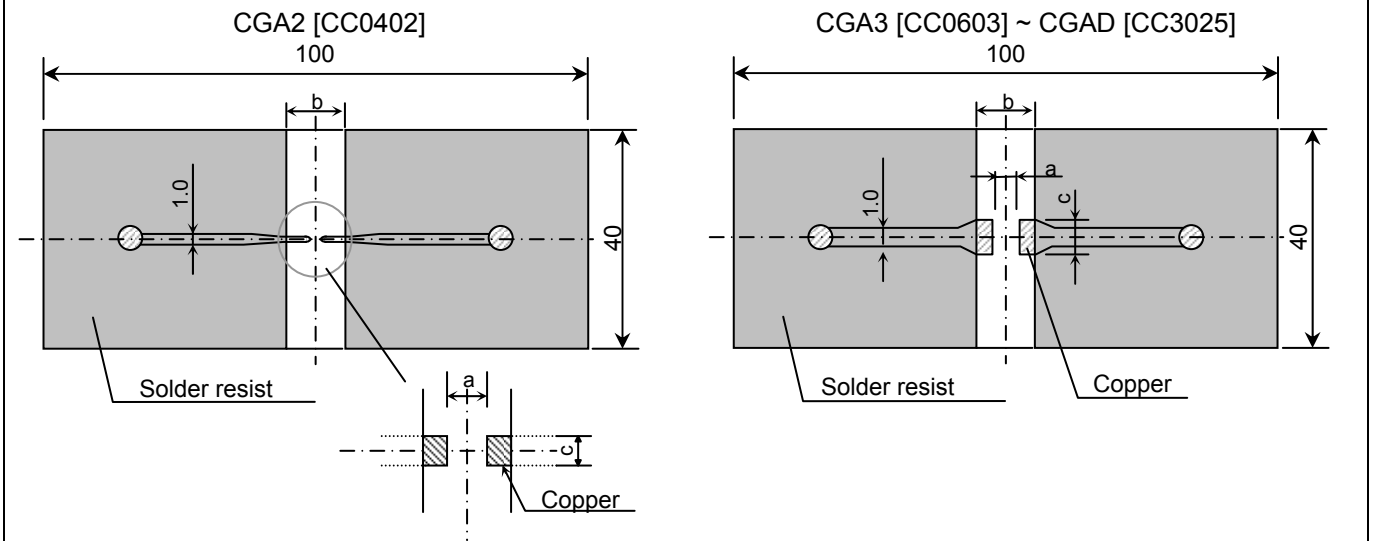
(continued)

| No. | Item | | Performance | | Test or inspection method | | | | | | |
|----------------------------|---|---------------------|---|------------------------------------|--|---|-----------------|------------------|--------------------|--------------------|------------------|
| 15 | Moisture Resistance | External appearance | No mechanical damage. | | Reflow solder the capacitors on a P.C. board shown in Appendix2 before testing. | | | | | | |
| | | Capacitance | Characteristics | Change from the value before test* | | Apply the rated voltage at temperature 85°C and 85%RH for 1,000 +48,0h. Charge/ discharge current shall not exceed 50mA. | | | | | |
| | | | Class1/ C0G | ± 7.5 % | | | | | | | |
| | | | Class2/ X7R, X7S, X7T, X8R | ± 12.5 % | | | | | | | |
| | | Q (Class1) | 200 min. | | Leave the capacitors in ambient condition for 6 to 24h (Class1) or 24±2h (Class2) before measurement. | | | | | | |
| | | D.F. (Class2) | 200% of initial spec. max. | | Voltage conditioning (only for Class2) Voltage treat the capacitors under testing temperature and voltage for 1 hour. | | | | | | |
| Insulation Resistance | 500MΩ or 25MΩ·μF min. (As for the capacitors of rated voltage 16V DC, 500 MΩ or 5MΩ·μF min.,) whichever smaller. | | Leave the capacitors in ambient condition for 24±2h before measurement. Use this measurement for initial value. | | | | | | | | |
| 16 | Life | External appearance | No mechanical damage. | | Reflow solder the capacitors on a P.C. board shown in Appendix2 before testing. | | | | | | |
| | | Capacitance | Characteristics | Change from the value before test* | | Below the voltage shall be applied at Max. operating Temp. ±2°C for 1,000 +48,0h. <table border="1" data-bbox="991 1149 1377 1350"> <tr><td>Applied Voltage</td></tr> <tr><td>Rated voltage x2</td></tr> <tr><td>Rated voltage x1.5</td></tr> <tr><td>Rated voltage x1.2</td></tr> <tr><td>Rated voltage x1</td></tr> </table> | Applied Voltage | Rated voltage x2 | Rated voltage x1.5 | Rated voltage x1.2 | Rated voltage x1 |
| | | | Applied Voltage | | | | | | | | |
| | | | Rated voltage x2 | | | | | | | | |
| | | Rated voltage x1.5 | | | | | | | | | |
| | | Rated voltage x1.2 | | | | | | | | | |
| Rated voltage x1 | | | | | | | | | | | |
| Class1/ C0G | ± 3 % | | | | | | | | | | |
| Class2/ X7R, X7S, X7T, X8R | ± 15 % | | | | | | | | | | |
| Q (Class1) | 350 min. | | As for applied voltage, please refer "Voltage condition in the life test" on p-2. | | | | | | | | |
| D.F. (Class2) | 200% of initial spec. max. | | | | | | | | | | |
| Insulation Resistance | 1,000MΩ or 50MΩ·μF min. (As for the capacitors of rated voltage 16V DC, 1,000 MΩ or 10MΩ·μF min.,) whichever smaller. | | Charge/ discharge current shall not exceed 50mA. Leave the capacitors in ambient condition for 6 to 24h (Class1) or 24±2h (Class2) before measurement. Voltage conditioning (only for Class2) Voltage treat the capacitors under testing temperature and voltage for 1 hour. Leave the capacitors in ambient condition for 24±2h before measurement. Use this measurement for initial value. | | | | | | | | |

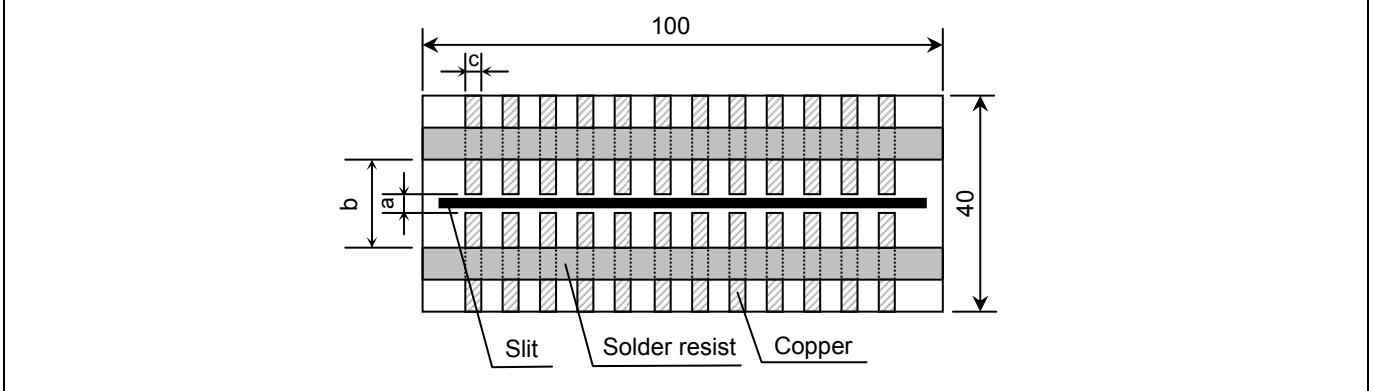
*Typical SPEC.

**As for the initial measurement of capacitors (Class2) on number 7,11,12,13 and 14 leave capacitors at 150 –10,0°C for 1 hour and measure the value after leaving capacitors for 24±2h in ambient condition.

Appendix1 P.C. board for bending test



Appendix2 P.C. Board for reliability test



(It is recommended to provide a slit on P.C. board for CGA6 [CC1210] ~ CGAD [CC3025].)

(Unit : mm)

| Type | Dimensions | | |
|----------------|------------|-----|------|
| | a | b | c |
| TDK(EIA style) | | | |
| CGA2 [CC0402] | 0.4 | 1.5 | 0.5 |
| CGA3 [CC0603] | 1.0 | 3.0 | 1.2 |
| CGA4 [CC0805] | 1.2 | 4.0 | 1.65 |
| CGA5 [CC1206] | 2.2 | 5.0 | 2.0 |
| CGA6 [CC1210] | 2.2 | 5.0 | 2.9 |
| CGA7 [CC1808] | 3.5 | 7.0 | 2.5 |
| CGA8 [CC1812] | 3.5 | 7.0 | 3.7 |
| CGA9 [CC2220] | 4.5 | 8.0 | 5.6 |
| CGAD [CC3025] | 5.5 | 9.1 | 6.9 |

1. Material : Glass Epoxy(As per JIS C6484 GE4)

Copper (Thickness:0.035mm)

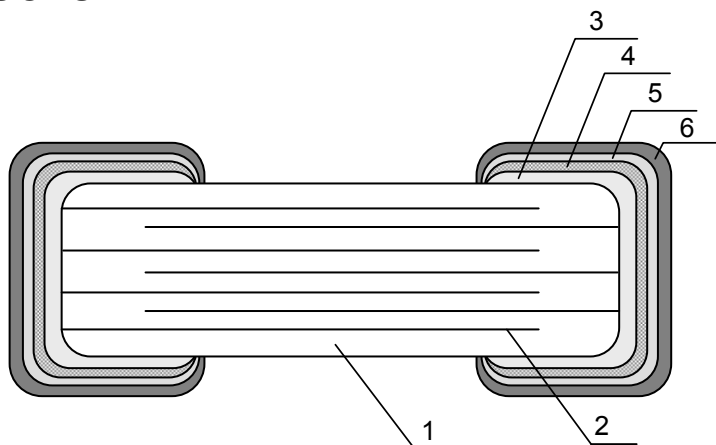
Solder resist

2. Thickness : Appendix 1 — 0.8mm (CGA2 [CC0402])

— 1.6mm (CGA3 [CC0603] ~ CGAD [CC3025])

: Appendix 2 — 1.6mm

9. INSIDE STRUCTURE AND MATERIAL



| No. | NAME | MATERIAL | |
|-----|-------------|-------------------------------|--------------------|
| | | Class1 | Class2 |
| 1 | Dielectric | CaZrO ₃ | BaTiO ₃ |
| 2 | Electrode | Nickel (Ni) | |
| 3 | Termination | Copper (Cu) | |
| 4 | | Conductive resin (Filler: Ag) | |
| 5 | | Nickel (Ni) | |
| 6 | | Tin (Sn) | |

10. 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.

- 1) Total number of components in a plastic bag for bulk packaging : 1000pcs
- 2) Tape packaging is as per 14. TAPE PACKAGING SPECIFICATION.
(CGA2 [CC0402] types are applicable only to tape packaging.)

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

*Composition of Inspection No.

Example F 6 A - 00 - 000
 (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

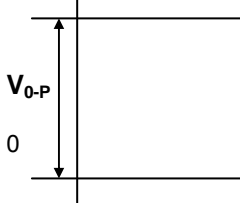
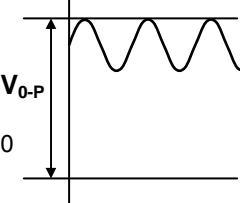
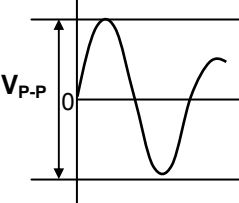
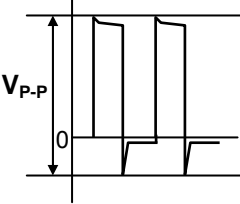
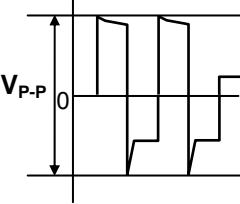
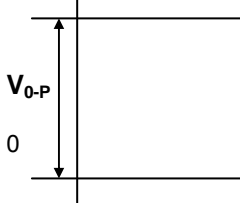
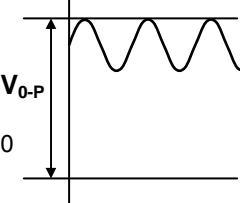
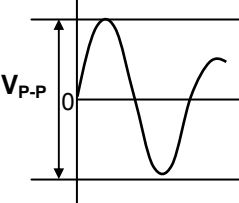
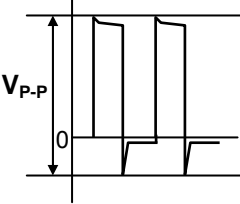
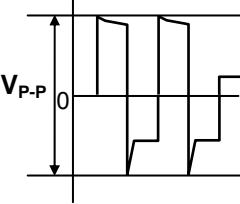
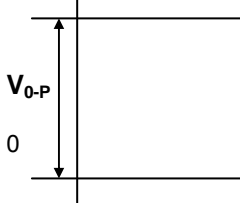
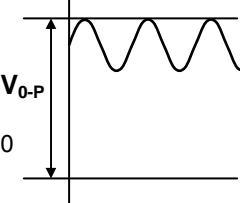
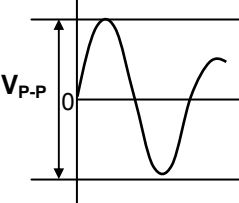
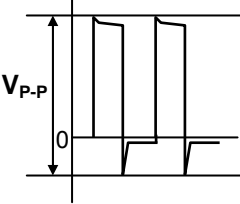
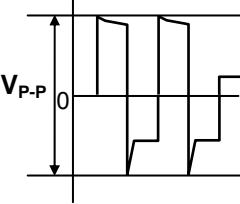
11. RECOMMENDATION

As for CGA6 [CC1210] and larger, it is recommended to provide a slit (about 1mm width) in the board under the components to improve washing Flux. And please make sure to dry detergent up completely before.

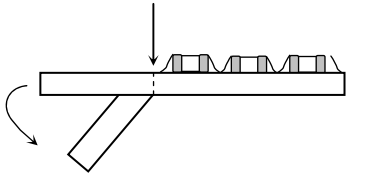
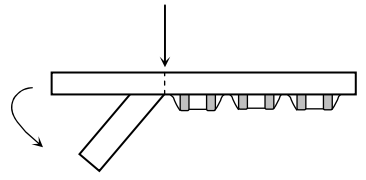
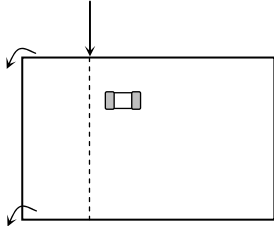
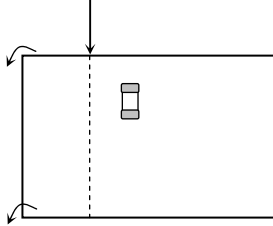
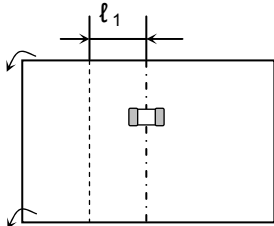
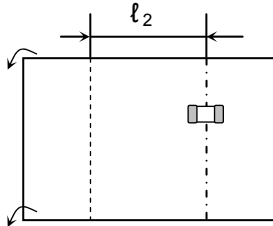
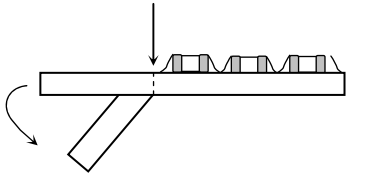
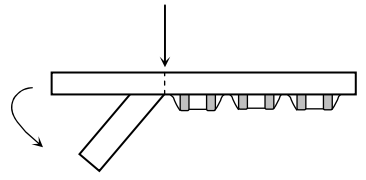
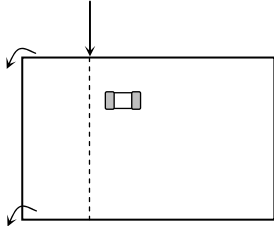
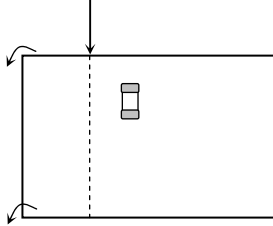
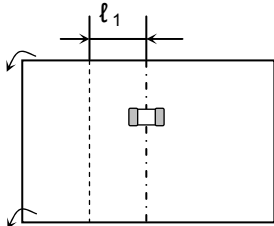
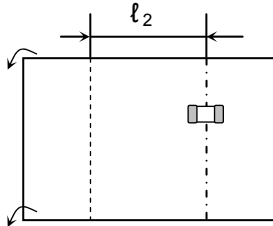
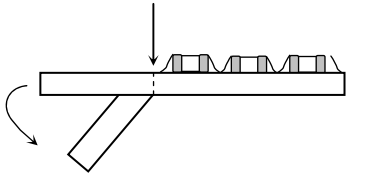
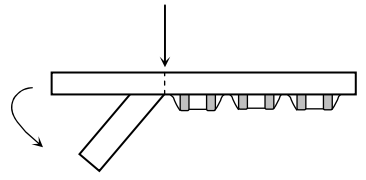
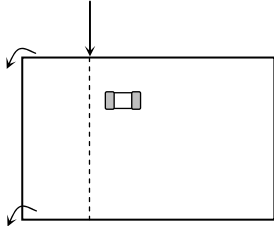
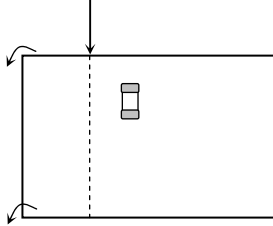
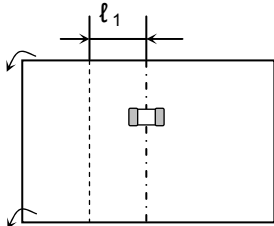
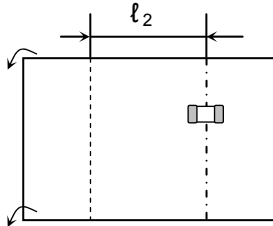
12. SOLDERING CONDITION

As for CGA2 [CC0402], CGA6 [CC1210] and larger, reflow soldering only.

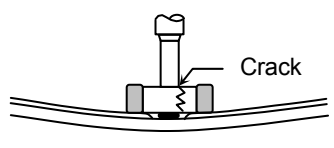
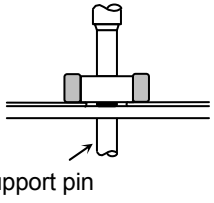
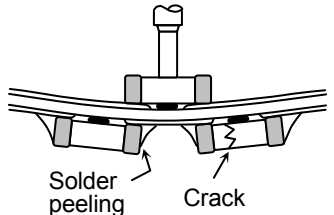
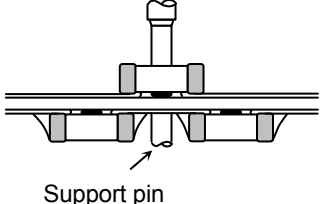
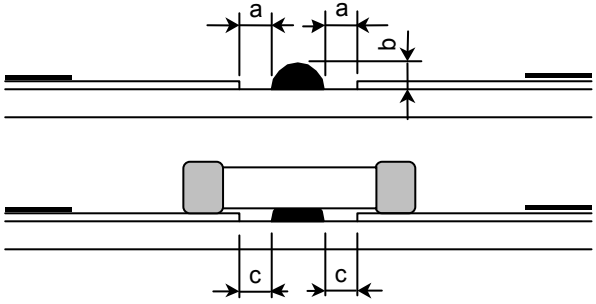
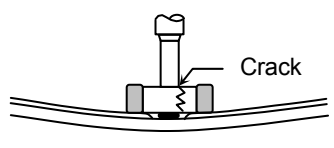
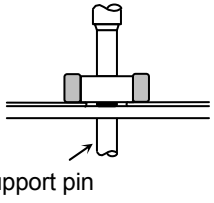
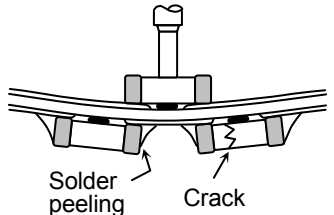
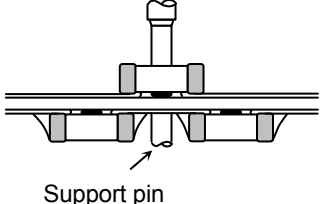
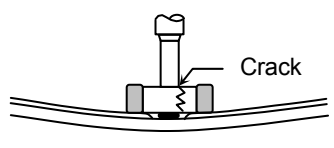
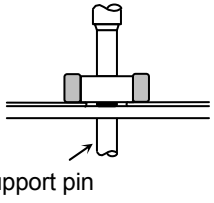
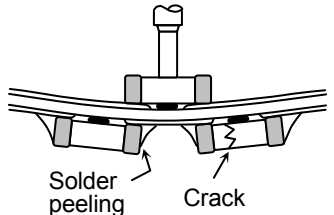
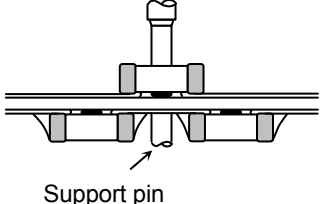
13. Caution

| No. | Process | Condition | | | | | | | | | | | | | | | | |
|--|---|---|---|----------------|-------------------|----------------|--|---|--|---|---------|-----------------------|-----------------------|--|--|---|--|--|
| 1 | Operating Condition (Storage, Transportation) | <p>1-1. Storage</p> <ol style="list-style-type: none"> 1) The capacitors must be stored in an ambient temperature of 5 to 40°C with a relative humidity of 20 to 70%RH. The products should be used within 6 months upon receipt. 2) The capacitors must be operated and stored in an environment free of dew condensation and these gases such as Hydrogen Sulphide, Hydrogen Sulphate, Chlorine, Ammonia and sulfur. 3) Avoid storing in sun light and falling of dew. 4) Do not use capacitors under high humidity and high and low atmospheric pressure which may affect capacitors reliability. 5) Capacitors should be tested for the solderability when they are stored for long time. <p>1-2. Handling in transportation 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 Operating temperature should be followed strictly within this specification, especially be careful with maximum temperature.</p> <ol style="list-style-type: none"> 1) Do not use capacitors above the maximum allowable operating temperature. 2) Surface temperature including self heating should be below maximum operating temperature. (Due to dielectric loss, capacitors will heat itself when AC is applied. Especially at high frequencies around its SRF, the heat might be so extreme that it may damage itself or the product mounted on. Please design the circuit so that the maximum temperature of the capacitors including the self heating to be below the maximum allowable operating temperature. Temperature rise at capacitor surface shall be below 20°C) 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. <p>2-2. Operating voltage</p> <ol style="list-style-type: none"> 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>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="475 1480 1449 2056"> <thead> <tr> <th data-bbox="475 1480 660 1525">Voltage</th> <th data-bbox="660 1480 922 1525">(1) DC voltage</th> <th data-bbox="922 1480 1184 1525">(2) DC+AC voltage</th> <th data-bbox="1184 1480 1449 1525">(3) AC voltage</th> </tr> </thead> <tbody> <tr> <td data-bbox="475 1525 660 1753">Positional Measurement (Rated voltage)</td> <td data-bbox="660 1525 922 1753">  </td> <td data-bbox="922 1525 1184 1753">  </td> <td data-bbox="1184 1525 1449 1753">  </td> </tr> <tr> <th data-bbox="475 1783 660 1827">Voltage</th> <th data-bbox="660 1783 922 1827">(4) Pulse voltage (A)</th> <th data-bbox="922 1783 1184 1827">(5) Pulse voltage (B)</th> <td></td> </tr> <tr> <td data-bbox="475 1827 660 2056">Positional Measurement (Rated voltage)</td> <td data-bbox="660 1827 922 2056">  </td> <td data-bbox="922 1827 1184 2056">  </td> <td></td> </tr> </tbody> </table> | 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) |  |  | | | | | | | | | | | | | | | | |

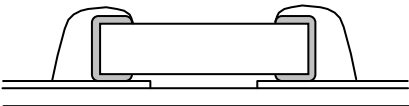
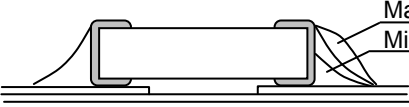
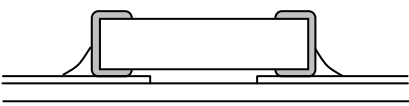
| No. | Process | Condition | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|----------------|-----------------------------|---|------------------|------------------|------------------|------------------|---|-----------|-----------|-----------|---|-----------|-----------|-----------|---|-----------|-----------|-----------|----------------|------------------|------------------|------------------|------------------|---|-----------|-----------|-----------|-----------|---|-------------|-----------|-----------|-----------|---|-----------|-----------|-----------|-----------|----------------|------------------|------------------|------------------|------------------|------------------|---|-----------|-----------|-----------|-----------|-----------|---|-----------|-----------|-----------|-----------|-----------|---|-----------|-----------|-----------|-----------|-----------|
| 2 | Circuit design ⚠ Caution | <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>2-3. Frequency When the capacitors (Class 2) are used in AC and/or pulse voltages, the capacitors may vibrate themselves and generate audible sound.</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | Designing P.C. board | <p>The amount of solder at the terminations has a direct effect on the reliability of the capacitors.</p> <p>1) The greater the amount of solder, the higher the stress on the chip capacitors, 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.</p> <p>2) Avoid using common solder land for multiple terminations and provide individual solder land for each terminations.</p> <p>3) Size and recommended land dimensions.</p> <div style="text-align: center;"> </div> <p style="text-align: center;">Flow soldering (mm)</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>Type Symbol</th> <th>CGA3 [CC0603]</th> <th>CGA4 [CC0805]</th> <th>CGA5 [CC1206]</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>0.7 - 1.0</td> <td>1.0 - 1.3</td> <td>2.1 - 2.5</td> </tr> <tr> <td>B</td> <td>0.8 - 1.0</td> <td>1.0 - 1.2</td> <td>1.1 - 1.3</td> </tr> <tr> <td>C</td> <td>0.6 - 0.8</td> <td>0.8 - 1.1</td> <td>1.0 - 1.3</td> </tr> </tbody> </table> <p style="text-align: right;">(mm)</p> <p style="text-align: center;">Reflow soldering</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>Type Symbol</th> <th>CGA2 [CC0402]</th> <th>CGA3 [CC0603]</th> <th>CGA4 [CC0805]</th> <th>CGA5 [CC1206]</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>0.3 - 0.5</td> <td>0.6 - 0.8</td> <td>0.9 - 1.2</td> <td>2.0 - 2.4</td> </tr> <tr> <td>B</td> <td>0.35 - 0.45</td> <td>0.6 - 0.8</td> <td>0.7 - 0.9</td> <td>1.0 - 1.2</td> </tr> <tr> <td>C</td> <td>0.4 - 0.6</td> <td>0.6 - 0.8</td> <td>0.9 - 1.2</td> <td>1.1 - 1.6</td> </tr> </tbody> </table> <p style="text-align: right;">(mm)</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>Type Symbol</th> <th>CGA6 [CC1210]</th> <th>CGA7 [CC1808]</th> <th>CGA8 [CC1812]</th> <th>CGA9 [CC2220]</th> <th>CGAD [CC3025]</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>2.0 - 2.4</td> <td>3.1 - 3.7</td> <td>3.1 - 3.7</td> <td>4.1 - 4.8</td> <td>5.2 - 5.8</td> </tr> <tr> <td>B</td> <td>1.0 - 1.2</td> <td>1.2 - 1.4</td> <td>1.2 - 1.4</td> <td>1.2 - 1.4</td> <td>1.7 - 1.9</td> </tr> <tr> <td>C</td> <td>1.9 - 2.5</td> <td>1.5 - 2.0</td> <td>2.4 - 3.2</td> <td>4.0 - 5.0</td> <td>6.4 - 7.4</td> </tr> </tbody> </table> | Type Symbol | CGA3 [CC0603] | CGA4 [CC0805] | CGA5 [CC1206] | A | 0.7 - 1.0 | 1.0 - 1.3 | 2.1 - 2.5 | B | 0.8 - 1.0 | 1.0 - 1.2 | 1.1 - 1.3 | C | 0.6 - 0.8 | 0.8 - 1.1 | 1.0 - 1.3 | Type Symbol | CGA2 [CC0402] | CGA3 [CC0603] | CGA4 [CC0805] | CGA5 [CC1206] | A | 0.3 - 0.5 | 0.6 - 0.8 | 0.9 - 1.2 | 2.0 - 2.4 | B | 0.35 - 0.45 | 0.6 - 0.8 | 0.7 - 0.9 | 1.0 - 1.2 | C | 0.4 - 0.6 | 0.6 - 0.8 | 0.9 - 1.2 | 1.1 - 1.6 | Type Symbol | CGA6 [CC1210] | CGA7 [CC1808] | CGA8 [CC1812] | CGA9 [CC2220] | CGAD [CC3025] | A | 2.0 - 2.4 | 3.1 - 3.7 | 3.1 - 3.7 | 4.1 - 4.8 | 5.2 - 5.8 | B | 1.0 - 1.2 | 1.2 - 1.4 | 1.2 - 1.4 | 1.2 - 1.4 | 1.7 - 1.9 | C | 1.9 - 2.5 | 1.5 - 2.0 | 2.4 - 3.2 | 4.0 - 5.0 | 6.4 - 7.4 |
| Type Symbol | CGA3 [CC0603] | CGA4 [CC0805] | CGA5 [CC1206] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A | 0.7 - 1.0 | 1.0 - 1.3 | 2.1 - 2.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B | 0.8 - 1.0 | 1.0 - 1.2 | 1.1 - 1.3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C | 0.6 - 0.8 | 0.8 - 1.1 | 1.0 - 1.3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Type Symbol | CGA2 [CC0402] | CGA3 [CC0603] | CGA4 [CC0805] | CGA5 [CC1206] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A | 0.3 - 0.5 | 0.6 - 0.8 | 0.9 - 1.2 | 2.0 - 2.4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B | 0.35 - 0.45 | 0.6 - 0.8 | 0.7 - 0.9 | 1.0 - 1.2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C | 0.4 - 0.6 | 0.6 - 0.8 | 0.9 - 1.2 | 1.1 - 1.6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Type Symbol | CGA6 [CC1210] | CGA7 [CC1808] | CGA8 [CC1812] | CGA9 [CC2220] | CGAD [CC3025] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A | 2.0 - 2.4 | 3.1 - 3.7 | 3.1 - 3.7 | 4.1 - 4.8 | 5.2 - 5.8 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B | 1.0 - 1.2 | 1.2 - 1.4 | 1.2 - 1.4 | 1.2 - 1.4 | 1.7 - 1.9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C | 1.9 - 2.5 | 1.5 - 2.0 | 2.4 - 3.2 | 4.0 - 5.0 | 6.4 - 7.4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| No. | Process | Condition | | | | | | | | | | | | |
|------------------------------|---|--|--|-------------------------------------|----------------------------------|---------------|---|--|------------------------------|---|---|--------------------|---|---|
| 3 | Designing P.C. board | <p data-bbox="437 226 1098 259">4) Recommended chip capacitors layout is as following.</p> <table border="1" data-bbox="475 293 1430 1715"> <thead> <tr> <th data-bbox="475 293 660 371"></th> <th data-bbox="660 293 1043 371">Disadvantage against bending stress</th> <th data-bbox="1043 293 1430 371">Advantage against bending stress</th> </tr> </thead> <tbody> <tr> <td data-bbox="475 371 660 786">Mounting face</td> <td data-bbox="660 371 1043 786"> <p data-bbox="746 416 954 450">Perforation or slit</p>  <p data-bbox="695 674 954 741">Break P.C. board with mounted side up.</p> </td> <td data-bbox="1043 371 1430 786"> <p data-bbox="1129 416 1337 450">Perforation or slit</p>  <p data-bbox="1085 674 1343 741">Break P.C. board with mounted side down.</p> </td> </tr> <tr> <td data-bbox="475 786 660 1234">Chip arrangement (Direction)</td> <td data-bbox="660 786 1043 1234"> <p data-bbox="746 909 954 943">Perforation or slit</p>  </td> <td data-bbox="1043 786 1430 1234"> <p data-bbox="1129 909 1337 943">Perforation or slit</p>  </td> </tr> <tr> <td data-bbox="475 1234 660 1715">Distance from slit</td> <td data-bbox="660 1234 1043 1715"> <p data-bbox="673 1245 1005 1279">Closer to slit is higher stress</p>  <p data-bbox="900 1615 1005 1648">$(l_1 < l_2)$</p> </td> <td data-bbox="1043 1234 1430 1715"> <p data-bbox="1056 1245 1388 1279">Away from slit is less stress</p>  <p data-bbox="1289 1615 1394 1648">$(l_1 < l_2)$</p> </td> </tr> </tbody> </table> | | Disadvantage against bending stress | Advantage against bending stress | Mounting face | <p data-bbox="746 416 954 450">Perforation or slit</p>  <p data-bbox="695 674 954 741">Break P.C. board with mounted side up.</p> | <p data-bbox="1129 416 1337 450">Perforation or slit</p>  <p data-bbox="1085 674 1343 741">Break P.C. board with mounted side down.</p> | Chip arrangement (Direction) | <p data-bbox="746 909 954 943">Perforation or slit</p>  | <p data-bbox="1129 909 1337 943">Perforation or slit</p>  | Distance from slit | <p data-bbox="673 1245 1005 1279">Closer to slit is higher stress</p>  <p data-bbox="900 1615 1005 1648">$(l_1 < l_2)$</p> | <p data-bbox="1056 1245 1388 1279">Away from slit is less stress</p>  <p data-bbox="1289 1615 1394 1648">$(l_1 < l_2)$</p> |
| | Disadvantage against bending stress | Advantage against bending stress | | | | | | | | | | | | |
| Mounting face | <p data-bbox="746 416 954 450">Perforation or slit</p>  <p data-bbox="695 674 954 741">Break P.C. board with mounted side up.</p> | <p data-bbox="1129 416 1337 450">Perforation or slit</p>  <p data-bbox="1085 674 1343 741">Break P.C. board with mounted side down.</p> | | | | | | | | | | | | |
| Chip arrangement (Direction) | <p data-bbox="746 909 954 943">Perforation or slit</p>  | <p data-bbox="1129 909 1337 943">Perforation or slit</p>  | | | | | | | | | | | | |
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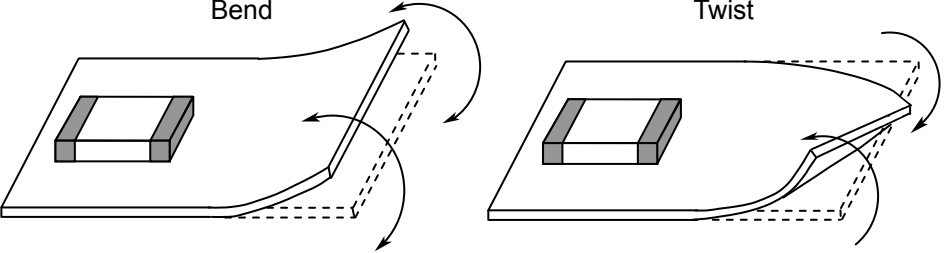
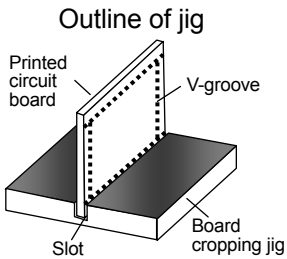
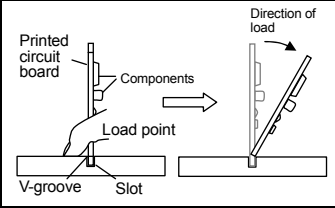
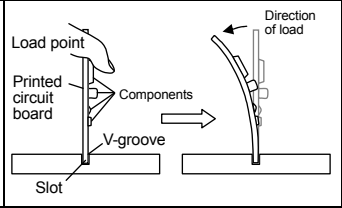
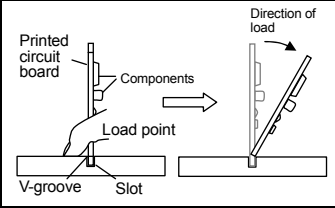
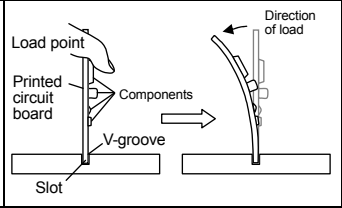
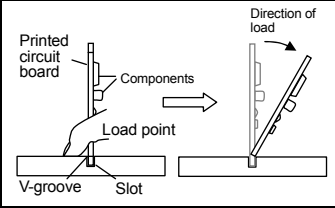
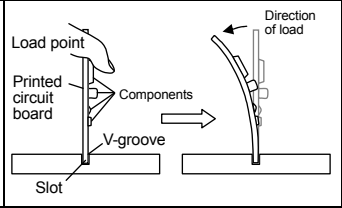
| No. | Process | Condition | | | | | | | | | | | | |
|----------------|---------------------------|--|--|---------------------------|------------------------|--|---------------|--|--|--|----------------|--|----------------------------------|--|
| 3 | Designing P.C. board | <p>5) Mechanical stress varies according to location of chip capacitors on the P.C. board.</p> <div data-bbox="491 271 1299 826" data-label="Diagram"> </div> <p>The stress in capacitors is in the following order. $A > B = C > D > E$</p> <p>6) Layout recommendation</p> <table border="1" data-bbox="379 1010 1481 1921"> <thead> <tr> <th data-bbox="379 1010 539 1122">Example</th> <th data-bbox="539 1010 842 1122">Use of common solder land</th> <th data-bbox="842 1010 1150 1122">Soldering with chassis</th> <th data-bbox="1150 1010 1481 1122">Use of common solder land with other SMD</th> </tr> </thead> <tbody> <tr> <td data-bbox="379 1122 539 1507">Need to avoid</td> <td data-bbox="539 1122 842 1507"> </td> <td data-bbox="842 1122 1150 1507"> </td> <td data-bbox="1150 1122 1481 1507"> </td> </tr> <tr> <td data-bbox="379 1507 539 1921">Recommendation</td> <td data-bbox="539 1507 842 1921"> </td> <td data-bbox="842 1507 1150 1921"> <p>$l_2 > l_1$</p> </td> <td data-bbox="1150 1507 1481 1921"> </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>$l_2 > l_1$</p> | |
| Example | Use of common solder land | Soldering with chassis | Use of common solder land with other SMD | | | | | | | | | | | |
| Need to avoid | | | | | | | | | | | | | | |
| Recommendation | | <p>$l_2 > l_1$</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 capacitors 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. <p>See following examples.</p> <table border="1" data-bbox="478 593 1436 1153"> <thead> <tr> <th></th> <th>Not recommended</th> <th>Recommended</th> </tr> </thead> <tbody> <tr> <td>Single sided mounting</td> <td></td> <td></td> </tr> <tr> <td>Double-sides mounting</td> <td></td> <td></td> </tr> </tbody> </table> <p>When the centering jaw is worn out, it may give mechanical impact on the capacitors to cause crack. Please control the close up dimension of the centering jaw and provide sufficient preventive maintenance and replacement of it.</p> <p>4-2. Amount of adhesive</p> <div style="text-align: center;">  </div> <p>Example : CGA4 [CC0805], CGA5 [CC1206]</p> <table border="1" data-bbox="662 1780 1220 1948"> <tbody> <tr> <td>a</td> <td>0.2mm min.</td> </tr> <tr> <td>b</td> <td>70 - 100μm</td> </tr> <tr> <td>c</td> <td>Do not touch the solder land</td> </tr> </tbody> </table> | | Not recommended | Recommended | Single sided mounting |  |  | Double-sides mounting |  |  | a | 0.2mm min. | b | 70 - 100μm | c | Do not touch the solder land |
| | Not recommended | Recommended | | | | | | | | | | | | | | | |
| Single sided mounting |  |  | | | | | | | | | | | | | | | |
| Double-sides mounting |  |  | | | | | | | | | | | | | | | |
| a | 0.2mm min. | | | | | | | | | | | | | | | | |
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| c | Do not touch the solder land | | | | | | | | | | | | | | | | |

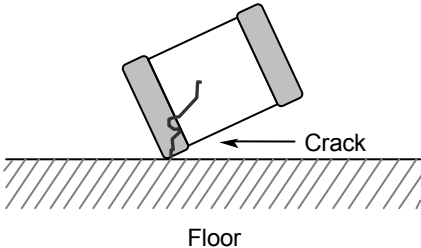
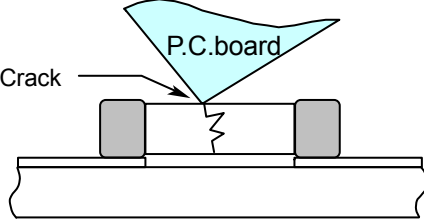
| No. | Process | Condition | | | | | | | | | | | | | | | | | | | | | | | | |
|------------------|----------------|--|----------------|------------------|--|------------------|--|---------------|----------------|---------------|----------------|--------|--|--|--|--|--------------|----------|--------|----------|---------|------------------|----------|--------|----------|---------|
| 5 | Soldering | <p>5-1. Flux selection</p> <p>Although highly-activated flux gives better solderability, substances which increase activity may also degrade the insulation of the chip capacitors. To avoid such degradation, it is recommended following.</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 by various methods</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Wave soldering</p> </div> <div style="text-align: center;"> <p>Reflow soldering</p> </div> </div> <div style="text-align: center; margin-top: 20px;"> <p>Manual soldering (Solder iron)</p> </div> <div style="margin-top: 20px;"> <p><u>APPLICATION</u></p> <p>As for CGA3 [CC0603] ~ CGA5 [CC1206], applied to wave soldering and reflow soldering.</p> <p>As for CGA2 [CC0402] and CGA6 [CC1210] ~ CGAD [CC3025], applied only to reflow soldering.</p> </div> <p>*As for peak temperature of manual soldering, please refer “5-6. Solder repair by solder iron”.</p> <p>5-3. Recommended soldering peak temp and peak temp duration</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th rowspan="2" style="text-align: left;">Temp./Duration</th> <th colspan="2">Wave soldering</th> <th colspan="2">Reflow soldering</th> </tr> <tr> <th>Peak temp(°C)</th> <th>Duration(sec.)</th> <th>Peak temp(°C)</th> <th>Duration(sec.)</th> </tr> </thead> <tbody> <tr> <td style="text-align: left;">Solder</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td style="text-align: left;">Sn-Pb Solder</td> <td>250 max.</td> <td>3 max.</td> <td>230 max.</td> <td>20 max.</td> </tr> <tr> <td style="text-align: left;">Lead Free Solder</td> <td>260 max.</td> <td>5 max.</td> <td>260 max.</td> <td>10 max.</td> </tr> </tbody> </table> <p>Recommended solder compositions</p> <p>Sn-37Pb (Sn-Pb solder)</p> <p>Sn-3.0Ag-0.5Cu (Lead Free Solder)</p> | Temp./Duration | Wave soldering | | Reflow soldering | | Peak temp(°C) | Duration(sec.) | Peak temp(°C) | Duration(sec.) | Solder | | | | | Sn-Pb Solder | 250 max. | 3 max. | 230 max. | 20 max. | Lead Free Solder | 260 max. | 5 max. | 260 max. | 10 max. |
| Temp./Duration | Wave soldering | | | Reflow soldering | | | | | | | | | | | | | | | | | | | | | | |
| | Peak temp(°C) | Duration(sec.) | Peak temp(°C) | Duration(sec.) | | | | | | | | | | | | | | | | | | | | | | |
| Solder | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sn-Pb Solder | 250 max. | 3 max. | 230 max. | 20 max. | | | | | | | | | | | | | | | | | | | | | | |
| Lead Free Solder | 260 max. | 5 max. | 260 max. | 10 max. | | | | | | | | | | | | | | | | | | | | | | |


| No. | Process | Condition | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|-------------|------------|------------|----------------|---|---------------------|------------------|--|---------------------|---|---------------------|------------------|--|---------------------|---|---------------------|------|------------|-----------------|-------------|------------|--|----------|--------|---------|------------|---|----------|
| 5 | Soldering | <p>5-4. Avoiding thermal shock</p> <p>1) Preheating condition</p> <table border="1"> <thead> <tr> <th>Soldering</th> <th>Type</th> <th>Temp. (°C)</th> </tr> </thead> <tbody> <tr> <td>Wave soldering</td> <td>CGA3 [CC0603], CGA4 [CC0805], CGA5 [CC1206]</td> <td>$\Delta T \leq 150$</td> </tr> <tr> <td rowspan="2">Reflow soldering</td> <td>CGA2 [CC0402], CGA3 [CC0603], CGA4 [CC0805], CGA5 [CC1206]</td> <td>$\Delta T \leq 150$</td> </tr> <tr> <td>CGA6 [CC1210], CGA7 [CC1808], CGA8 [CC1812], CGA9 [CC2220], CGAD [CC3025]</td> <td>$\Delta T \leq 130$</td> </tr> <tr> <td rowspan="2">Manual soldering</td> <td>CGA2 [CC0402], CGA3 [CC0603], CGA4 [CC0805], CGA5 [CC1206]</td> <td>$\Delta T \leq 150$</td> </tr> <tr> <td>CGA6 [CC1210], CGA7 [CC1808], CGA8 [CC1812], CGA9 [CC2220], CGAD [CC3025]</td> <td>$\Delta T \leq 130$</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> <div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="width: 30%;">Excessive solder</div> <div style="width: 30%; text-align: center;">  </div> <div style="width: 30%;">Higher tensile force in chip capacitors to cause crack</div> </div> <hr/> <div style="display: flex; justify-content: space-between; align-items: center;"> <div style="width: 30%;">Adequate</div> <div style="width: 30%; text-align: center;">  </div> </div> <hr/> <div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="width: 30%;">Insufficient solder</div> <div style="width: 30%; text-align: center;">  </div> <div style="width: 30%;">Low robustness may cause contact failure or chip capacitors come off the P.C. board.</div> </div> <hr/> <p>5-6. Solder repair by solder iron</p> <p>1) Selection of the soldering iron tip 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. Please make sure the tip temp. before soldering and keep the peak temp and time in accordance with following recommended condition. (Please preheat the chip capacitors with the condition in 5-4 to avoid the thermal shock.)</p> <p style="text-align: center;">Recommended solder iron condition (Sn-Pb Solder and Lead Free Solder)</p> <table border="1"> <thead> <tr> <th>Type</th> <th>Temp. (°C)</th> <th>Duration (sec.)</th> <th>Wattage (W)</th> <th>Shape (mm)</th> </tr> </thead> <tbody> <tr> <td>CGA2 [CC0402] CGA3 [CC0603] CGA4 [CC0805] CGA5 [CC1206]</td> <td>350 max.</td> <td rowspan="2">3 max.</td> <td rowspan="2">20 max.</td> <td rowspan="2">Ø 3.0 max.</td> </tr> <tr> <td>CGA6 [CC1210] CGA7 [CC1808] CGA8 [CC1812] CGA9 [CC2220] CGAD [CC3025]</td> <td>280 max.</td> </tr> </tbody> </table> | Soldering | Type | Temp. (°C) | Wave soldering | CGA3 [CC0603], CGA4 [CC0805], CGA5 [CC1206] | $\Delta T \leq 150$ | Reflow soldering | CGA2 [CC0402], CGA3 [CC0603], CGA4 [CC0805], CGA5 [CC1206] | $\Delta T \leq 150$ | CGA6 [CC1210], CGA7 [CC1808], CGA8 [CC1812], CGA9 [CC2220], CGAD [CC3025] | $\Delta T \leq 130$ | Manual soldering | CGA2 [CC0402], CGA3 [CC0603], CGA4 [CC0805], CGA5 [CC1206] | $\Delta T \leq 150$ | CGA6 [CC1210], CGA7 [CC1808], CGA8 [CC1812], CGA9 [CC2220], CGAD [CC3025] | $\Delta T \leq 130$ | Type | Temp. (°C) | Duration (sec.) | Wattage (W) | Shape (mm) | CGA2 [CC0402] CGA3 [CC0603] CGA4 [CC0805] CGA5 [CC1206] | 350 max. | 3 max. | 20 max. | Ø 3.0 max. | CGA6 [CC1210] CGA7 [CC1808] CGA8 [CC1812] CGA9 [CC2220] CGAD [CC3025] | 280 max. |
| Soldering | Type | Temp. (°C) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Wave soldering | CGA3 [CC0603], CGA4 [CC0805], CGA5 [CC1206] | $\Delta T \leq 150$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Reflow soldering | CGA2 [CC0402], CGA3 [CC0603], CGA4 [CC0805], CGA5 [CC1206] | $\Delta T \leq 150$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | CGA6 [CC1210], CGA7 [CC1808], CGA8 [CC1812], CGA9 [CC2220], CGAD [CC3025] | $\Delta T \leq 130$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Manual soldering | CGA2 [CC0402], CGA3 [CC0603], CGA4 [CC0805], CGA5 [CC1206] | $\Delta T \leq 150$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | CGA6 [CC1210], CGA7 [CC1808], CGA8 [CC1812], CGA9 [CC2220], CGAD [CC3025] | $\Delta T \leq 130$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Type | Temp. (°C) | Duration (sec.) | Wattage (W) | Shape (mm) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CGA2 [CC0402] CGA3 [CC0603] CGA4 [CC0805] CGA5 [CC1206] | 350 max. | 3 max. | 20 max. | Ø 3.0 max. | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CGA6 [CC1210] CGA7 [CC1808] CGA8 [CC1812] CGA9 [CC2220] CGAD [CC3025] | 280 max. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| No. | Process | Condition |
|-----|-----------|--|
| 5 | Soldering | <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>5-7. Sn-Zn solder Sn-Zn solder affects product reliability. Please contact TDK in advance when utilize Sn-Zn solder.</p> <p>5-8. 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> |
| 6 | 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 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="text-align: center;">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> |

| No. | Process | Condition | | | | |
|--|---|---|-------------|---------------|--|---|
| 7 | Coating and molding of the P.C. board | 1) When the P.C. board is coated, please verify the quality influence on the product. 2) Please verify carefully that there is no harmful decomposing or reaction gas emission during curing which may damage the chip capacitors. 3) Please verify the curing temperature. | | | | |
| 8 | Handling after chip mounted ⚠ Caution | 1) Please pay attention not to bend or distort the P.C. board after soldering in handling otherwise the chip capacitors may crack. <div style="text-align: center;">  </div> 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. (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. <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div data-bbox="475 1232 762 1489" style="text-align: center;"> <p>Outline of jig</p>  </div> <table border="1" data-bbox="778 1227 1457 1489"> <thead> <tr> <th data-bbox="778 1227 1114 1283">Recommended</th> <th data-bbox="1114 1227 1457 1283">Unrecommended</th> </tr> </thead> <tbody> <tr> <td data-bbox="778 1283 1114 1489">  </td> <td data-bbox="1114 1283 1457 1489">  </td> </tr> </tbody> </table> </div> | Recommended | Unrecommended |  |  |
| Recommended | Unrecommended | | | | | |
|  |  | | | | | |

| No. | Process | Condition | | | | | | | | | | | | | | | | | | |
|---|---|---|--------------------------------------|---------------|--|--|--|-------------------------|-------------------------|-------------------------|---|--------------------------------------|--------------------------------------|--------------------------------------|------|-----------------|-------------|---------------|---|-------------------------------------|
| 8 | Handling after chip mounted ⚠ Caution | <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;"> <div data-bbox="571 533 981 790"> <p>Outline of machine</p> </div> <div data-bbox="981 533 1428 772"> <p>Principle of operation</p> </div> </div> <div style="text-align: center; margin-top: 10px;"> <p>Cross-section diagram</p> </div> <table border="1" style="width: 100%; text-align: center; margin-top: 20px;"> <thead> <tr> <th data-bbox="655 1010 836 1099">Recommended</th> <th colspan="3" data-bbox="836 1010 1369 1055">Unrecommended</th> </tr> <tr> <th></th> <th data-bbox="836 1055 1011 1133">Top-bottom misalignment</th> <th data-bbox="1011 1055 1187 1133">Left-right misalignment</th> <th data-bbox="1187 1055 1369 1133">Front-rear misalignment</th> </tr> </thead> <tbody> <tr> <td data-bbox="655 1099 836 1435"> <p>Top blade</p> <p>Board</p> <p>Bottom blade</p> </td> <td data-bbox="836 1099 1011 1435"> <p>Top blade</p> <p>Bottom blade</p> </td> <td data-bbox="1011 1099 1187 1435"> <p>Top blade</p> <p>Bottom blade</p> </td> <td data-bbox="1187 1099 1369 1435"> <p>Top blade</p> <p>Bottom blade</p> </td> </tr> </tbody> </table> <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" style="width: 100%; text-align: center; margin-top: 20px;"> <thead> <tr> <th data-bbox="491 1682 628 1742">Item</th> <th data-bbox="628 1682 1046 1742">Not recommended</th> <th data-bbox="1046 1682 1449 1742">Recommended</th> </tr> </thead> <tbody> <tr> <td data-bbox="491 1742 628 1977">Board bending</td> <td data-bbox="628 1742 1046 1977"> <p>Termination peeling</p> <p>Check pin</p> </td> <td data-bbox="1046 1742 1449 1977"> <p>Support pin</p> <p>Check pin</p> </td> </tr> </tbody> </table> | Recommended | Unrecommended | | | | Top-bottom misalignment | Left-right misalignment | Front-rear misalignment | <p>Top blade</p> <p>Board</p> <p>Bottom blade</p> | <p>Top blade</p> <p>Bottom blade</p> | <p>Top blade</p> <p>Bottom blade</p> | <p>Top blade</p> <p>Bottom blade</p> | Item | Not recommended | Recommended | Board bending | <p>Termination peeling</p> <p>Check pin</p> | <p>Support pin</p> <p>Check pin</p> |
| Recommended | Unrecommended | | | | | | | | | | | | | | | | | | | |
| | Top-bottom misalignment | Left-right misalignment | Front-rear misalignment | | | | | | | | | | | | | | | | | |
| <p>Top blade</p> <p>Board</p> <p>Bottom blade</p> | <p>Top blade</p> <p>Bottom blade</p> | <p>Top blade</p> <p>Bottom blade</p> | <p>Top blade</p> <p>Bottom blade</p> | | | | | | | | | | | | | | | | | |
| Item | Not recommended | Recommended | | | | | | | | | | | | | | | | | | |
| Board bending | <p>Termination peeling</p> <p>Check pin</p> | <p>Support pin</p> <p>Check pin</p> | | | | | | | | | | | | | | | | | | |

| No. | Process | Condition |
|-----|---|--|
| 9 | 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>  |
| 10 | Capacitance aging | The capacitors (Class 2) 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. |
| 11 | Estimated life and estimated failure rate of capacitors | 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) The failure rate can be decreased by reducing the temperature and the voltage but they will not be guaranteed. |

| No. | Process | Condition |
|-----|---|---|
| 12 | 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 spattered with water or oil (2) Environment where a capacitor is exposed to direct sunlight (3) Environment where a capacitor is exposed to Ozone, ultraviolet rays or radiation (4) Environment where a capacitor exposed to corrosive gas(e.g. hydrogen sulfide, sulfur dioxide, chlorine. ammonia gas etc.) (5) Environment where a capacitor exposed to vibration or mechanical shock exceeding the specified limits. (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) and automotive application 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 (2) Transportation equipment (electric trains, ships, etc. except automotive application) (3) Medical equipment (Excepting Pharmaceutical Affairs Law classification Class1, 2) (4) Power-generation control equipment (5) Atomic energy-related equipment (6) Seabed equipment (7) Transportation control equipment (8) Public information-processing equipment (9) Military equipment (10) Electric heating apparatus, burning equipment (11) Disaster prevention/crime prevention equipment (12) Safety equipment (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> |

14. TAPE PACKAGING SPECIFICATION

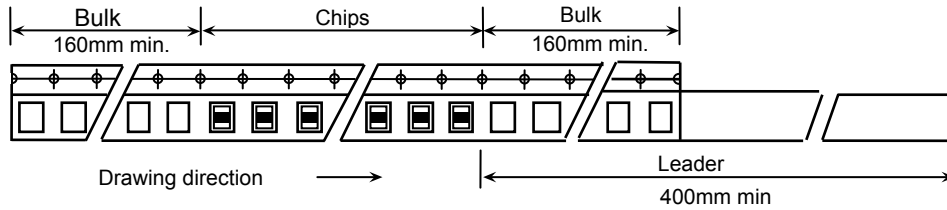
1. CONSTRUCTION AND DIMENSION OF TAPING

1-1. Dimensions of carrier tape

Dimensions of paper tape shall be according to Appendix 3, 4.

Dimensions of plastic tape shall be according to Appendix 5, 6, 7.

1-2. Bulk part and leader of taping



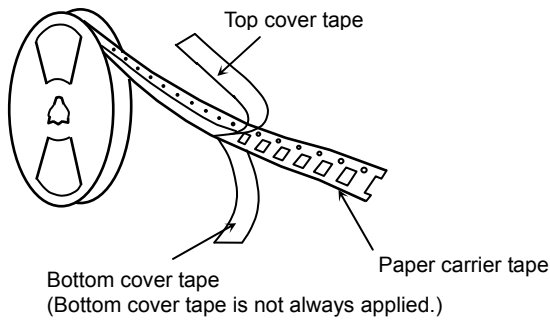
1-3. Dimensions of reel

Dimensions of Ø178 reel shall be according to Appendix 8, 9.

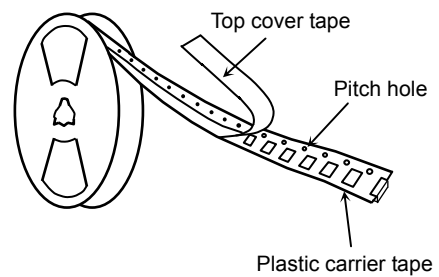
Dimensions of Ø330 reel shall be according to Appendix 10, 11, 12.

1-4. Structure of taping

(a) Paper



(b) Plastic



2. CHIP QUANTITY

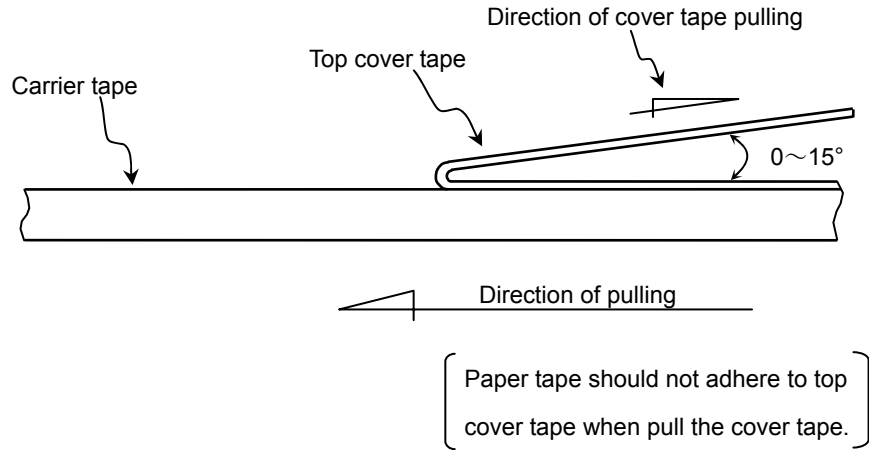
As for chip quantity and taping material of each product, please refer to detailed information on TDK web.

3. PERFORMANCE SPECIFICATIONS

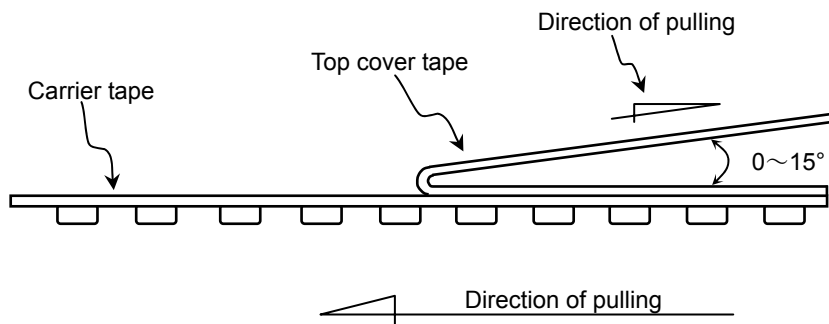
3-1. Fixing peeling strength (top tape)

0.05 - 0.7N. (See the following figure.)

〈Paper〉



〈Plastic〉



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

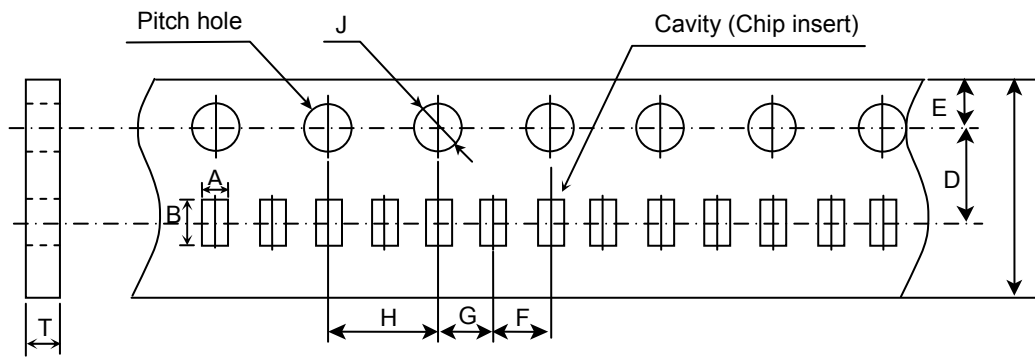
3-3. The missing of components shall be less than 0.1%

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

3-5. The fixing tapes shall not protrude beyond the edges of the carrier tape not shall cover the sprocket holes.

Appendix 3

Paper Tape



(Unit : mm)

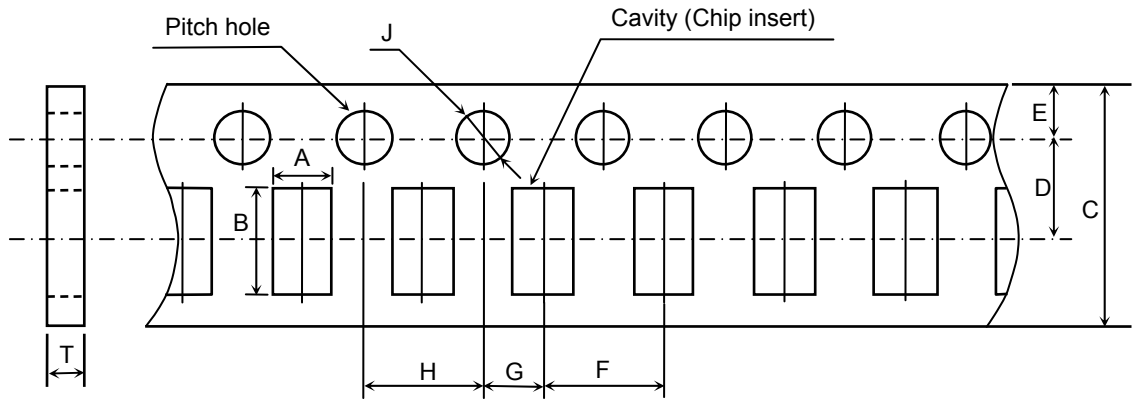
| Symbol Type | A | B | C | D | E | F |
|------------------|----------|----------|-------------|-------------|-------------|-------------|
| CGA2 [CC0402] | (0.65) | (1.15) | 8.00 ± 0.30 | 3.50 ± 0.05 | 1.75 ± 0.10 | 2.00 ± 0.05 |

| Symbol Type | G | H | J | T |
|------------------|-------------|-------------|--------------------------------------|-------------|
| CGA2 [CC0402] | 2.00 ± 0.05 | 4.00 ± 0.10 | ∅ 1.50 ^{+0.10} ₀ | 0.60 ± 0.15 |

() Reference value.

Appendix 4

Paper Tape



(Unit : mm)

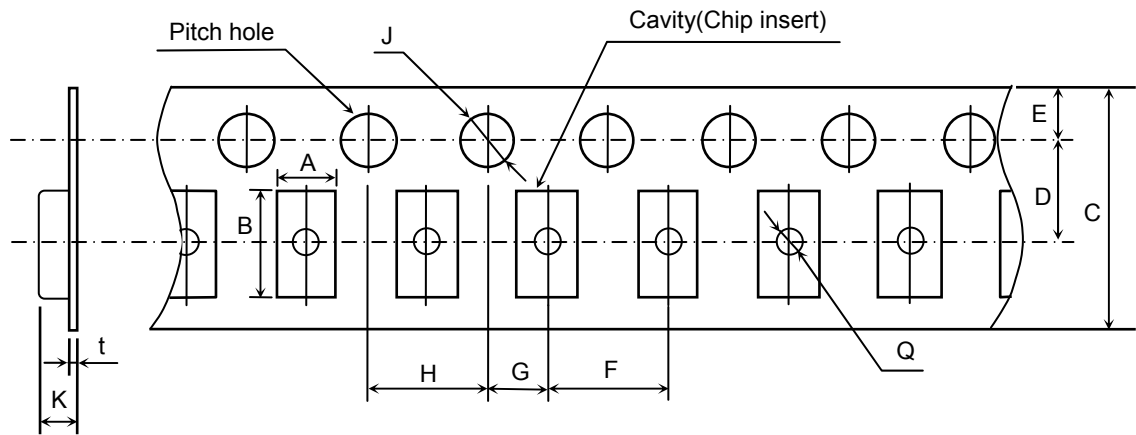
| Symbol Type | A | B | C | D | E | F |
|------------------|----------|----------|-------------|-------------|-------------|-------------|
| CGA3 [CC0603] | (1.10) | (1.90) | 8.00 ± 0.30 | 3.50 ± 0.05 | 1.75 ± 0.10 | 4.00 ± 0.10 |
| CGA4 [CC0805] | (1.50) | (2.30) | | | | |
| CGA5 [CC1206] | (1.90) | (3.50) | | | | |

| Symbol Type | G | H | J | T |
|------------------|-------------|-------------|---|-----------|
| CGA3 [CC0603] | 2.00 ± 0.05 | 4.00 ± 0.10 | ∅ 1.50 $\begin{matrix} +0.10 \\ 0 \end{matrix}$ | 1.20 max. |
| CGA4 [CC0805] | | | | |
| CGA5 [CC1206] | | | | |

() Reference value.

Appendix 5

Plastic Tape



(Unit : mm)

| Symbol Type | A | B | C | D | E | F |
|------------------|-------------|-------------|--------------------------------------|-------------|-------------|-------------|
| CGA4 [CC0805] | (1.50) | (2.30) | 8.00 ± 0.30 | 3.50 ± 0.05 | 1.75 ± 0.10 | 4.00 ± 0.10 |
| CGA5 [CC1206] | (1.90) | (3.50) | | | | |
| CGA6 [CC1210] | (2.90) | (3.60) | | | | |
| Symbol Type | G | H | J | K | t | Q |
| CGA4 [CC0805] | 2.00 ± 0.05 | 4.00 ± 0.10 | ∅ 1.50 ^{+0.10} ₀ | 2.50 max. | 0.60 max. | ∅ 0.50 min. |
| CGA5 [CC1206] | | | | 3.40 max. | | |
| CGA6 [CC1210] | | | | | | |

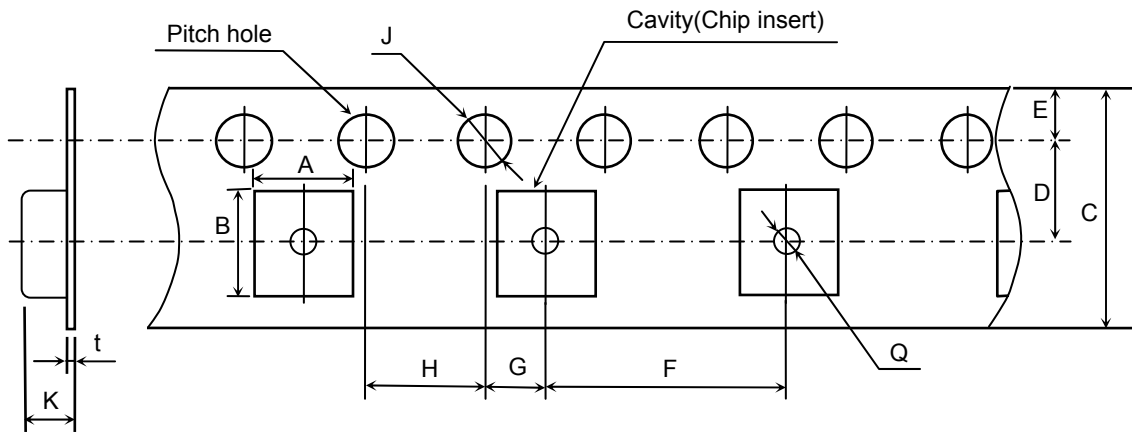
() Reference value.

Exceptionally no hole in the cavity is applied. Please inquire if hole in cavity is mandatory.

* Applied to 2.5mm thickness products.

Appendix 6

Plastic Tape



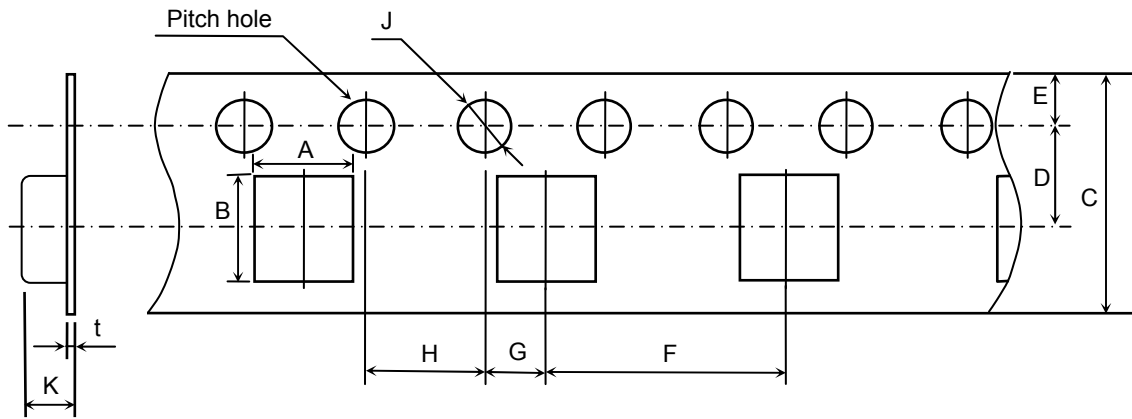
(Unit : mm)

| Symbol Type | A | B | C | D | E | F |
|------------------|-------------|-------------|--------------------------------------|-------------|-------------|-------------|
| CGA7 [CC1808] | (2.50) | (5.10) | 12.00 ± 0.30 | 5.50 ± 0.05 | 1.75 ± 0.10 | 8.00 ± 0.10 |
| CGA8 [CC1812] | (3.60) | (4.90) | | | | |
| CGA9 [CC2220] | (5.40) | (6.10) | | | | |
| Symbol Type | G | H | J | K | t | Q |
| CGA7 [CC1808] | 2.00 ± 0.05 | 4.00 ± 0.10 | ∅ 1.50 ^{+0.10} ₀ | 6.50 max. | 0.60 max. | ∅ 1.50 min. |
| CGA8 [CC1812] | | | | | | |
| CGA9 [CC2220] | | | | | | |

() Reference value.

Appendix 7

Plastic Tape



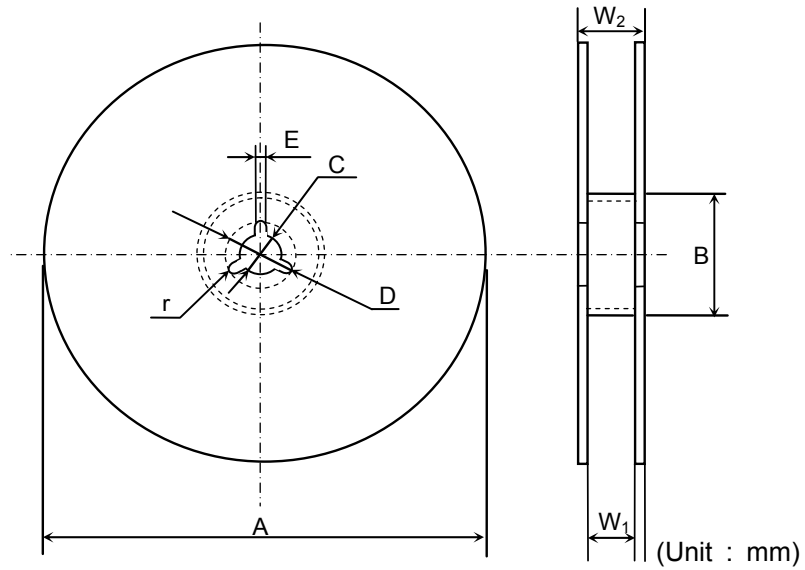
(Unit : mm)

| Symbol Type | A | B | C | D | E | F |
|------------------|-------------|-------------|--|-----------|------------|------------|
| CGAD [CC3025] | (6.9) | (8.0) | 16.0 ± 0.3 | 7.5 ± 0.1 | 1.75 ± 0.1 | 12.0 ± 0.1 |
| Symbol Type | G | H | J | K | t | |
| CGAD [CC3025] | 2.00 ± 0.05 | 4.00 ± 0.10 | ∅ 1.5 $\begin{matrix} +0.10 \\ 0 \end{matrix}$ | 6.50 max. | 0.60 max. | |

() Reference value.

Appendix 8

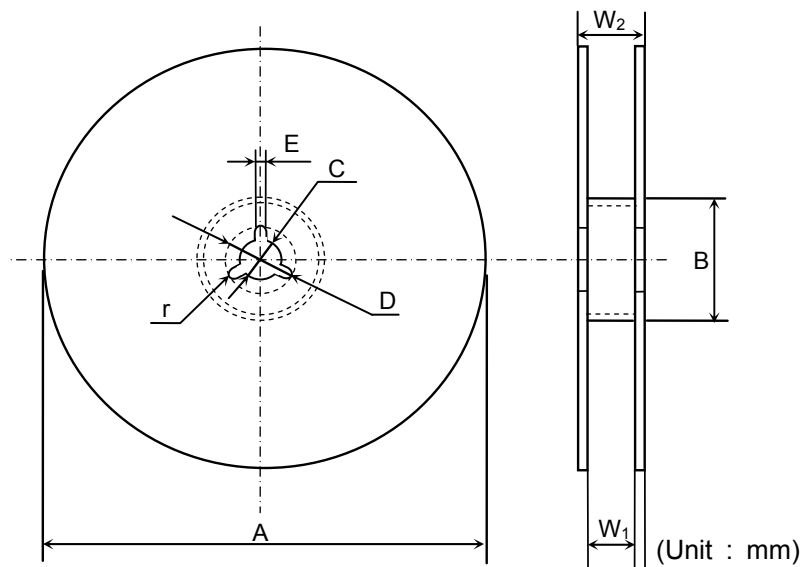
CGA2 [CC0402] ~ CGA6 [CC1210]
 (As for CGA6 type, any thickness of the item except 2.5mm)
 (Material: Polystyrene)



| | | | | | | |
|-----------|----------------|-----------|-----------|-----------|-----------|----------------|
| Symbol | A | B | C | D | E | W ₁ |
| Dimension | Ø178 ± 2.0 | Ø60 ± 2.0 | Ø13 ± 0.5 | Ø21 ± 0.8 | 2.0 ± 0.5 | 9.0 ± 0.3 |
| Symbol | W ₂ | r | | | | |
| Dimension | 13.0 ± 1.4 | 1.0 | | | | |

Appendix 9

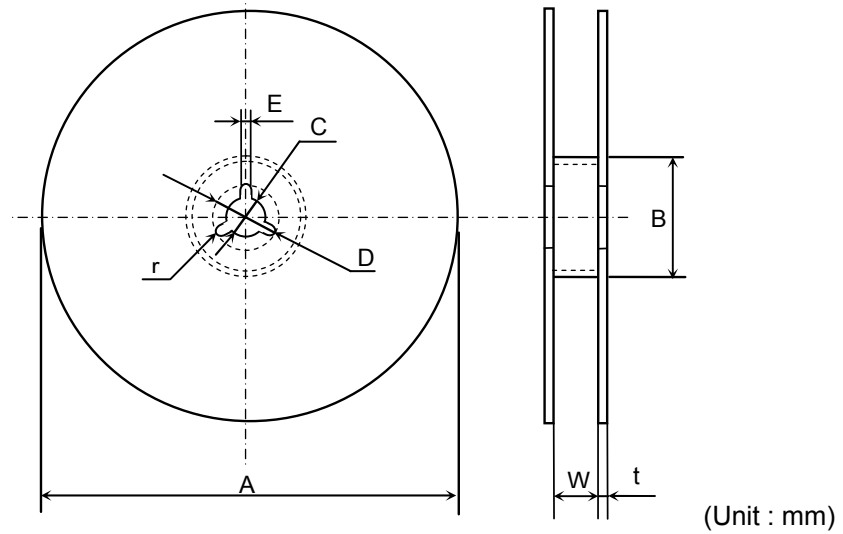
CGA6 [CC1210] ~ CGA9 [CC2220]
 (As for CGA6 type, applied to 2.5mm thickness products)
 (Material: Polystyrene)



| | | | | | | |
|-----------|----------------|-----------|-----------|-----------|-----------|----------------|
| Symbol | A | B | C | D | E | W ₁ |
| Dimension | Ø178 ± 2.0 | Ø60 ± 2.0 | Ø13 ± 0.5 | Ø21 ± 0.8 | 2.0 ± 0.5 | 13.0 ± 0.3 |
| Symbol | W ₂ | r | | | | |
| Dimension | 17.0 ± 1.4 | 1.0 | | | | |

Appendix 10

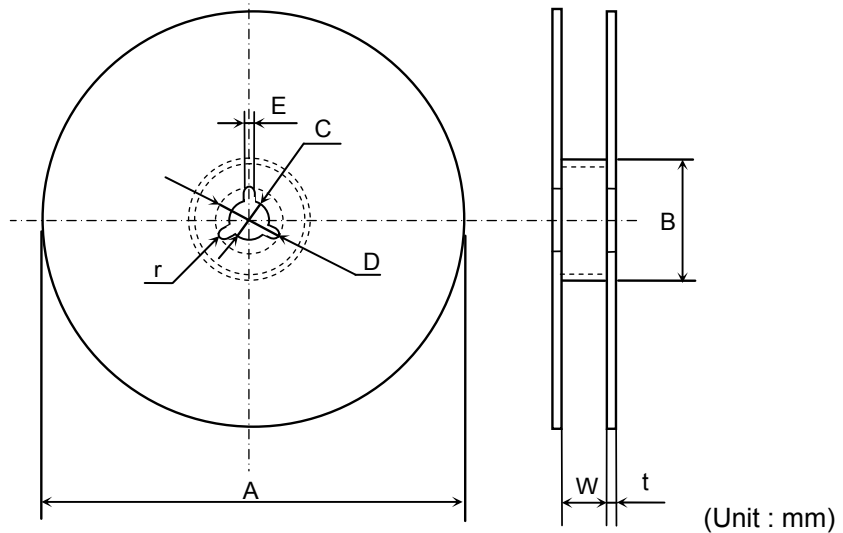
CGA2 [CC0402] ~ CGA6 [CC1210]
 (As for CGA6 type, any thickness of the item except 2.5mm)
 (Material: Polystyrene)



| Symbol | A | B | C | D | E | W |
|-----------|--------------------------------|----------|-----------|-----------|-----------|------------|
| Dimension | Ø382 max. (Nominal Ø330) | Ø50 min. | Ø13 ± 0.5 | Ø21 ± 0.8 | 2.0 ± 0.5 | 10.0 ± 1.5 |
| Symbol | t | r | | | | |
| Dimension | 2.0 ± 0.5 | 1.0 | | | | |

Appendix 11

CGA6 [CC1210] ~ CGA9 [CC2220]
 (As for CGA6 type, applied to 2.5mm thickness products)
 (Material: Polystyrene)

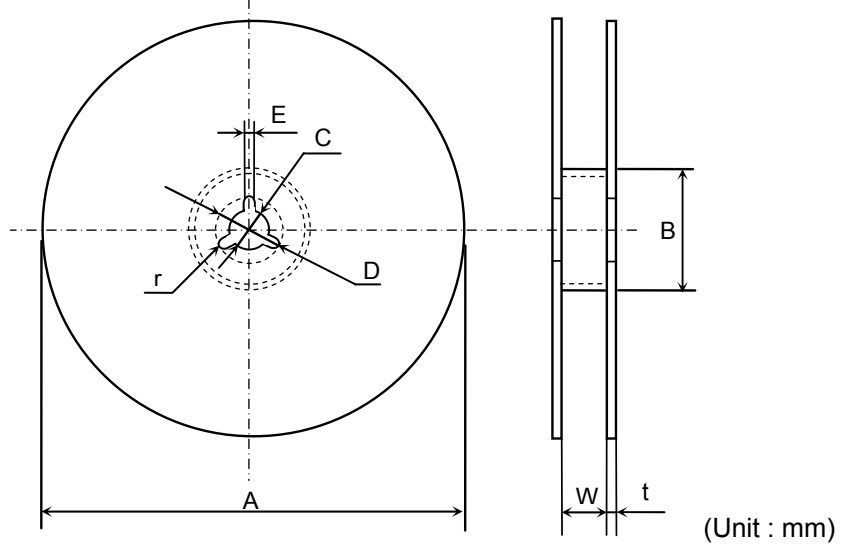


| Symbol | A | B | C | D | E | W |
|-----------|--------------------------------|----------|-----------|-----------|-----------|------------|
| Dimension | Ø382 max. (Nominal Ø330) | Ø50 min. | Ø13 ± 0.5 | Ø21 ± 0.8 | 2.0 ± 0.5 | 14.0 ± 1.5 |
| Symbol | t | r | | | | |
| Dimension | 2.0 ± 0.5 | 1.0 | | | | |

Appendix 12

C7563 [CC3025]

(Material : Polystyrene)



| | | | | | | |
|-----------|--------------------------------|----------|-----------|-----------|-----------|------------|
| Symbol | A | B | C | D | E | W |
| Dimension | Ø382 max. (Nominal Ø330) | Ø50 min. | Ø13 ± 0.5 | Ø21 ± 0.8 | 2.0 ± 0.5 | 17.5 ± 1.5 |
| Symbol | t | r | | | | |
| Dimension | 2.0 ± 0.5 | 1.0 | | | | |