

DELIVERY SPECIFICATION

SPEC. No. A-RGC-b

D A T E : Aug, 2018

To

Non-Controlled Copy

CUSTOMER'S PRODUCT NAME

TDK PRODUCT NAME

Multilayer Ceramic Chip Capacitors
Low ESL Reverse Geometry
Tape packaging **[RoHS compliant]**
CGAE Type
X7R 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 _____

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

■ CATALOG NUMBER CONSTRUCTION

CGA	E	A	1	X7R	1H	473	M	030	B	C
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)

(1) Series

(2) Dimensions L x W (mm)

Dimensions code	EIA	Length	Width	Terminal width
E	CC0204	0.52	1.00	0.10

(3) Thickness code

Code	Thickness
A	0.30mm

(4) Voltage condition for life test

Code	Condition
1	1 x R.V.
2	2 x R.V.

(5) Temperature characteristics

Temperature characteristics	Capacitance change	Temperature range
X7R	±15%	-55 to 125°C

(6) Rated voltage (DC)

Code	Voltage (DC)
1H	50V
1E	25V

(7) Nominal capacitance (pF)

The capacitance is expressed in three digit codes 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. R designates a decimal point.

(Example)0R5 = 0.5pF

101 = 100pF

225 = 2,200,000pF = 2.2μF

(8) Capacitance tolerance

Code	Tolerance
M	±20%

(9) Thickness

Code	Thickness
030	0.30mm

(10) Packaging style

Code	Style
B	178mm reel, 2mm pitch

(11) Special reserved code

Code	Description
A, C	TDK internal code

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 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.

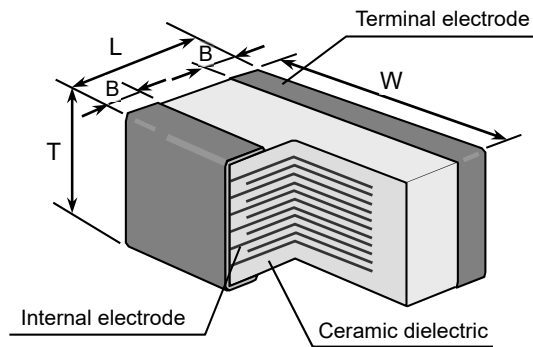
2. CODE CONSTRUCTION

(Example) CGA E A 1 X7R 1H 473 M I 0000
 (1) (2) (3) (4) (5) (6) (7) (8) (9) (10)

(1) Series

Symbol	Series
CGA	For automotive application

(2) Case size



Case size Symbol	Type [EIA style]	Dimensions (Unit : mm)			
		L	W	T	B
E	CGAE [CC0204]	0.52 ± 0.05	1.00 ± 0.05	0.30 ± 0.05	0.10 min.

* As for each item, please refer to the table A in the end of the specification

(3) Thickness

Symbol	Dimension(mm)
A	0.30

(4) Voltage condition in the life test

* Details are shown in table1 No.15 at 8.PERFORMANCE.

Symbol	Dimension(mm)
1	Rated voltage
2	Rated voltage x 2

(5) Temperature Characteristics

* Details are shown in table 1 No.6 at 7.PERFORMANCE

(6) Rated Voltage

Symbol	Rated Voltage
1 H	DC 50 V
1 E	DC 25 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.

(Example)

Symbol	Rated Capacitance
473	47,000 pF

(8) Capacitance tolerance

Symbol	Tolerance
M	± 20 %

(9) Packaging

Symbol	Packaging
T	Taping

(10) TDK internal code

3. RATED CAPACITANCE AND CAPACITANCE TOLERANCE

3.1 Standard combination of rated capacitance and tolerances

Temperature Characteristics	Capacitance tolerance	Rated capacitance
X7R	M (± 20 %)	47,000 pF

4. OPERATING TEMPERATURE RANGE

T.C.	Min. operating Temperature	Max. operating Temperature	Reference Temperature
X7R	-55°C	125°C	25°C

5. STORING CONDITION AND TERM

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

6. INDUSTRIAL WASTE DISPOSAL

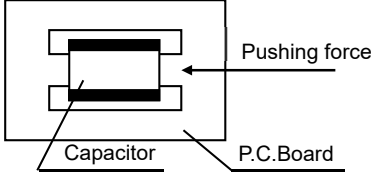
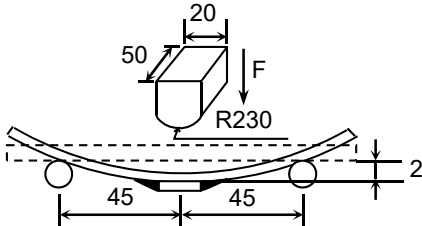
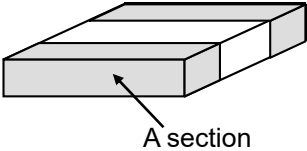
Dispose this product as industrial waste in accordance with the Industrial Waste Law.

7. 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 min.	Apply rated voltage for 60s.										
3	Voltage Proof	Withstand test voltage without insulation breakdown or other damage.	2.5 times of rated voltage. Above DC voltage shall be applied for 1s. Charge / discharge current shall not exceed 50mA.										
4	Capacitance	Within the specified tolerance.	As for measuring condition, please refer to the table A.										
5	Dissipation Factor	Please refer to the table A in the end of the specification	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;">X7R : ±15</p> <hr/>	<p>Capacitance shall be measured by the steps shown in the following table after thermal equilibrium is obtained for each step. 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 "4. OPERATING TEMPERATURE RANGE" As for measuring voltage, please refer to the table A.</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												

(continued)

No.	Item	Performance	Test or inspection method
7	Robustness of Terminations	No sign of termination coming off, breakage of ceramic, or other abnormal signs.	Reflow solder the capacitors on a P.C.Board shown in Appendix 2 and apply a pushing force of 2N with 10±1s. 
8	Bending	_____ Change from the value before test _____ $\pm 12.5 \%$ _____	Reflow solder the capacitors on a P.C.Board shown in Appendix 1 and bend it for 2mm.  <p style="text-align: right;">(Unit : mm)</p>
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. 	Completely soak both terminations in solder at the following conditions. <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>
10	Resistance to solder heat	External appearance	No cracks are allowed and terminations shall be covered at least 60% with new solder.
		Capacitance	_____ Change from the value before test _____ $\pm 7.5 \%$ _____
		D.F.	Meet the initial spec.
		Insulation Resistance	Meet the initial spec.
		Voltage proof	No insulation breakdown or other damage.
Completely soak both terminations in solder at the following conditions. 260±5°C for 10±1s. <p>Preheating condition Temp.: 110 to 140°C Time : 30 to 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 24±2h before measurement.</p>			

(continued)

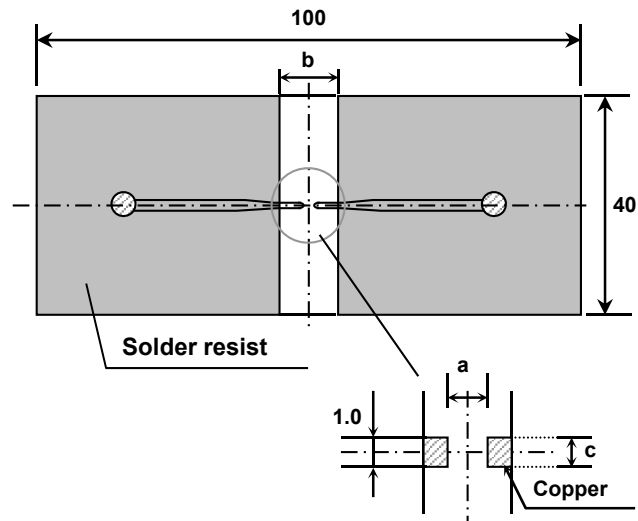
No.	Item		Performance	Test or inspection method														
11	Vibration	External appearance	No mechanical damage.	Reflow solder the capacitors on a P.C.Board shown in Appendix 2 before testing. Vibrate the capacitors with following conditions. Applied force : 5G max. Frequency : 10~2,000Hz Duration : 20 min. Cycle : 12 cycles in each 3 mutually perpendicular directions.														
		Capacitance	_____ Change from the value before test _____ $\pm 7.5 \%$ _____															
		D.F.	Meet the initial spec.															
12	Temperature cycle	External appearance	No mechanical damage.	Reflow solder the capacitors on a P.C.Board shown in Appendix 2 before testing. Expose the capacitors in the condition step1 through step 4 and repeat 1,000 times consecutively. Leave the capacitors in ambient condition for 24±2h before measurement.														
		Capacitance	_____ Change from the value before test _____ Please refer to the table A in the end of the specification. _____															
		D.F.	Meet the initial spec.															
		Insulation Resistance	Meet the initial spec.															
		Voltage proof	No insulation breakdown or other damage.															
					<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>	Step	Temperature(°C)	Time (min.)	1	-55 ± 3	30 ± 3	2	Ambient Temp.	2 - 5	3	Max. operating temp. ± 2	30 ± 2	4
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																
			As for Max operating temp, please refer to "4. OPERATING TEMPERATURE RANGE"															
13	Moisture Resistance (Steady State)	External appearance	No mechanical damage.	Reflow solder the capacitors on a P.C.Board shown in Appendix 2 before testing. Leave at temperature 40±2°C, 90 to 95%RH for 500 +24,0h. Leave the capacitors in ambient condition for 24±2h before measurement.														
		Capacitance	_____ Change from the value before test _____ Please refer to the table A in the end of the specification. _____															
		D.F.	200% of initial spec. max.															
		Insulation Resistance	1,000MΩ·μF min.															

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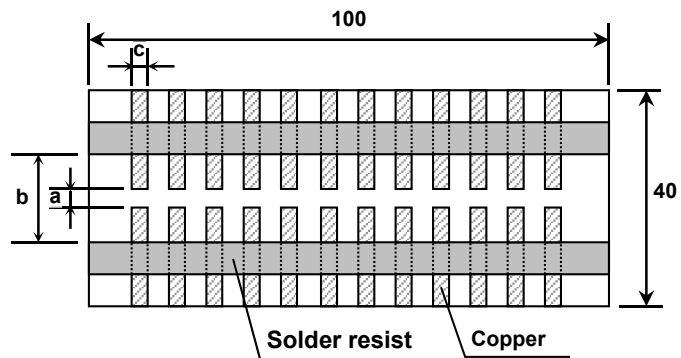
No.	Item		Performance	Test or inspection method
14	Moisture Resistance	External appearance	No mechanical damage.	Reflow solder the capacitors on a P.C.Board shown in Appendix 2 before testing.
		Capacitance	<hr/> Change from the value before test <hr/> Please refer to the table A in the end of the specification. <hr/>	Apply the rated voltage at temperature $85\pm 2^{\circ}\text{C}$ and 85%RH for 1,000 +48,0h. Charge/discharge current shall not exceed 50mA.
		D.F.	200% of initial spec. max.	Leave the capacitors in ambient condition for $24\pm 2\text{h}$ before measurement.
		Insulation Resistance	$500\text{M}\Omega\cdot\mu\text{F}$ min.	Voltage conditioning Voltage treat the capacitors under testing temperature and voltage for 1hour. Leave the capacitors in ambient condition for $24\pm 2\text{h}$ before measurement. Use this measurement for initial value.
15	Life	External appearance	No mechanical damage.	Reflow solder the capacitors on a P.C.Board shown in Appendix 2 before testing.
		Capacitance	<hr/> Change from the value before test <hr/> Please refer to the table A in the end of the specification. <hr/>	Test condition : Maximum operating temperature $\pm 2^{\circ}\text{C}$ for 1,000 +48,0h As for applied voltage, please refer to the table A in the end of the specification.
		D.F.	200% of initial spec. max.	Charge/discharge current shall not exceed 50mA.
		Insulation Resistance	$1,000\text{M}\Omega\cdot\mu\text{F}$ min.	Leave the capacitors in ambient condition for $24\pm 2\text{h}$ before measurement. Voltage conditioning Voltage treat the capacitors under testing temperature and voltage for 1hour. 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.

Appendix 1 P.C. Board for bending test



Appendix 2 P.C. Board for reliability test



(Unit : mm)

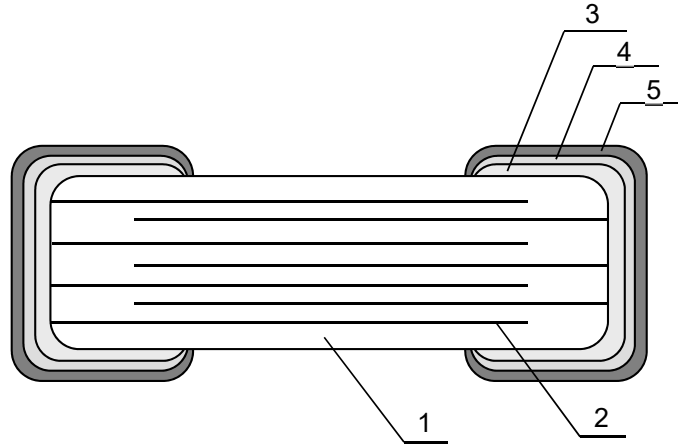
Type	Dimensions		
	a	b	c
TDK [EIA style]			
CGAE [CC0204]	0.2	0.6	1.0

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

Copper(Thickness:0.035mm)
 Solder resist

2. Thickness : Appendix1: 0.8mm
Appendix2: 1.6mm

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)

9. 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 12. TAPE PACKAGING SPECIFICATION.

* CGAE[CC0204] type is applicable to tape packaging only.

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

*Composition of Inspection No.

Example F 8 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.

(Will be implemented on and after Jan. 1, 2019)

Example

I	F	9	A	2	3	A	8	0	1
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 (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)


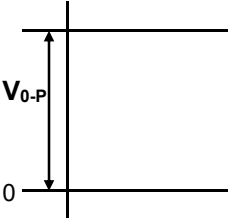
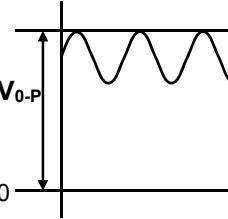
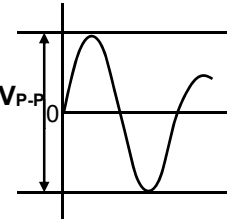
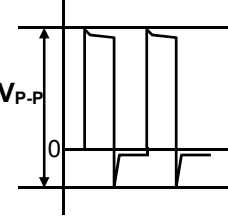
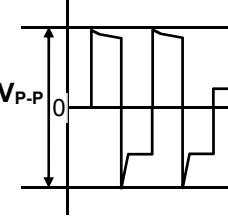
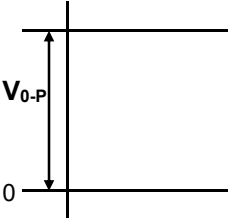
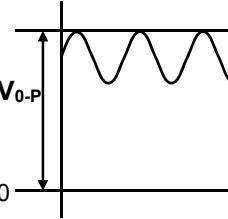
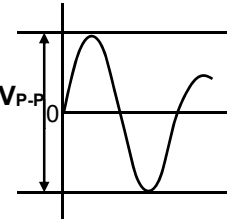
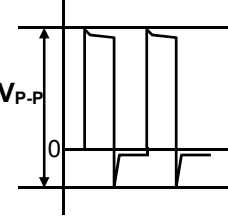
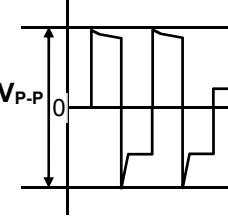
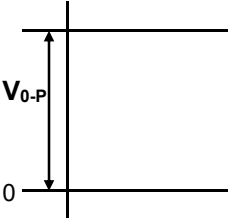
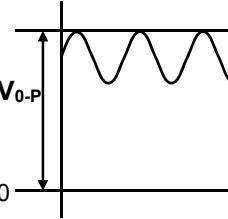
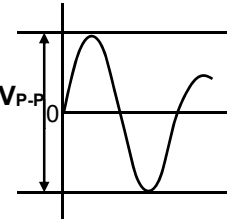
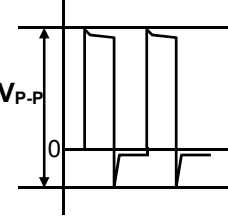
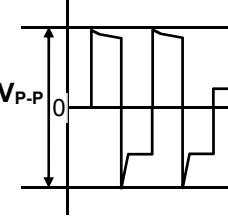
*It is planned to shift to the new inspection No. on and after January 2019, but the implementation timing may be different depending on shipment bases.

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

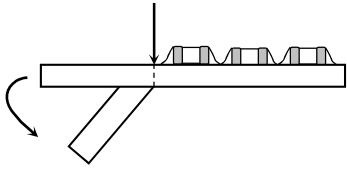
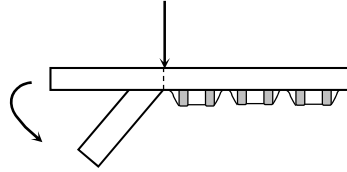
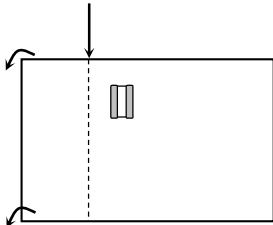
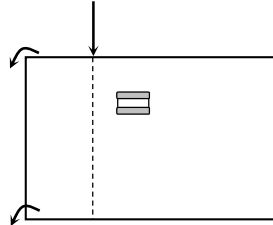
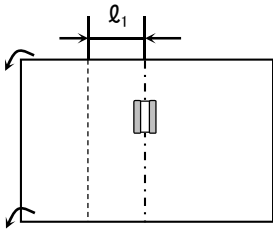
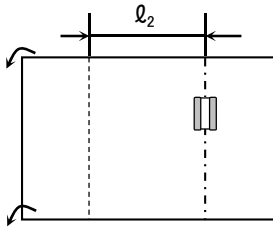
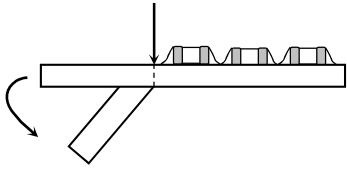
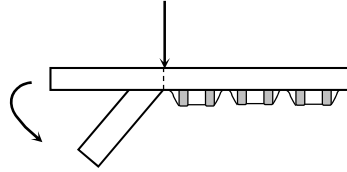
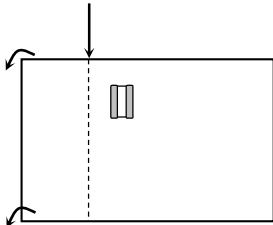
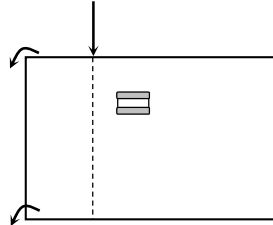
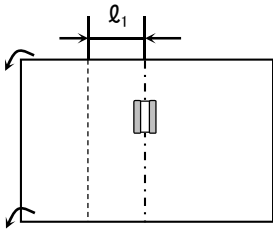
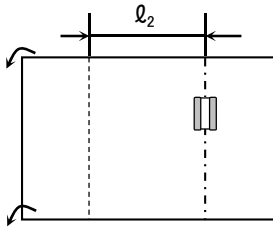
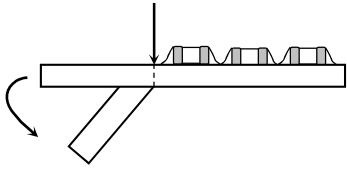
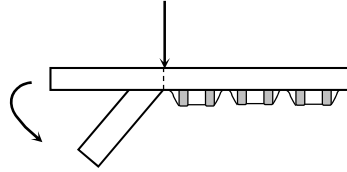
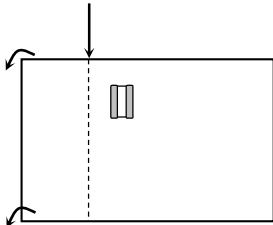
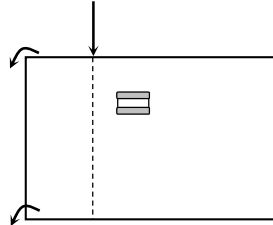
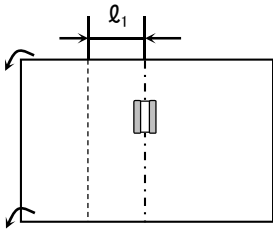
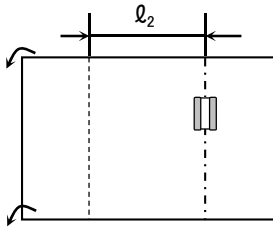
10. SOLDERING CONDITION

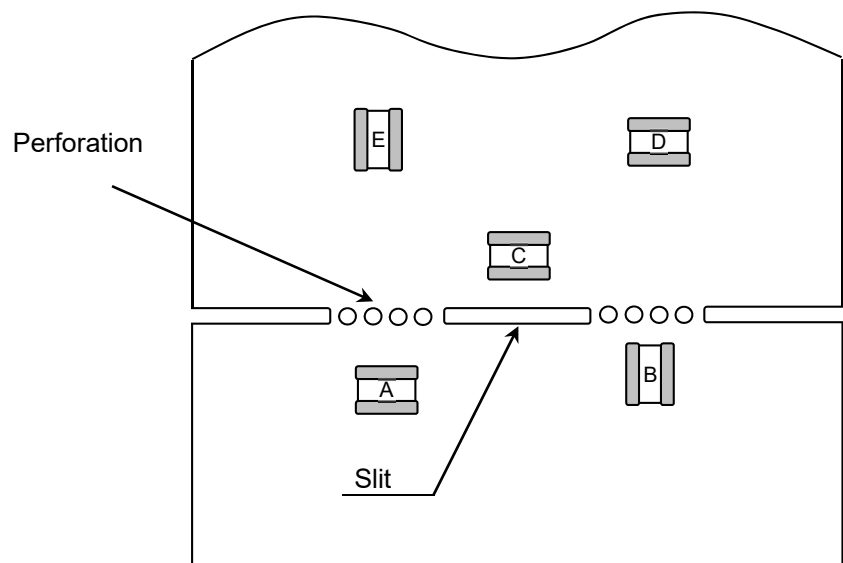
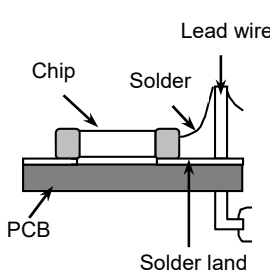
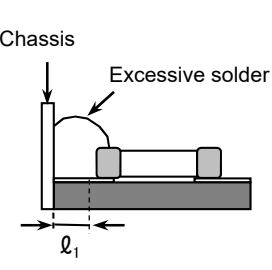
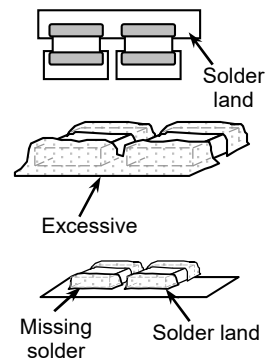
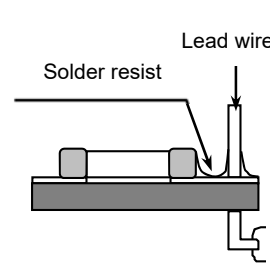
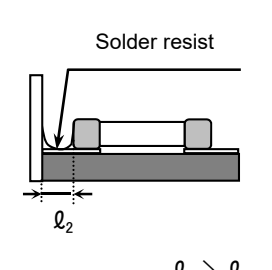
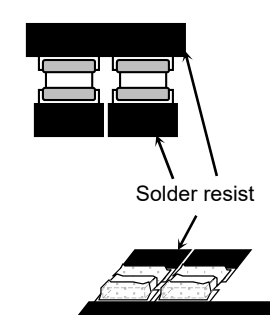
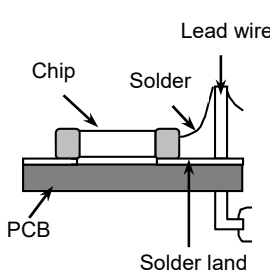
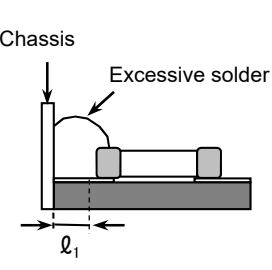
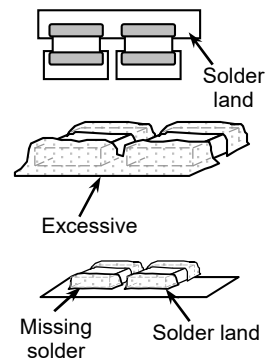
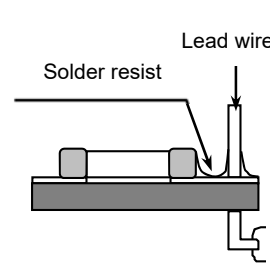
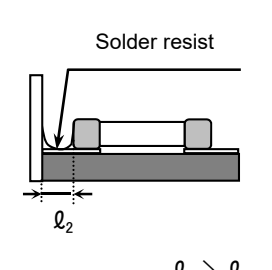
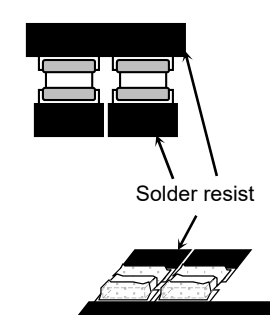
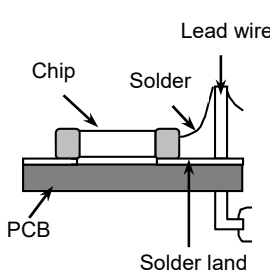
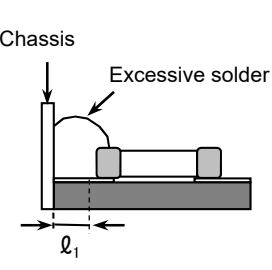
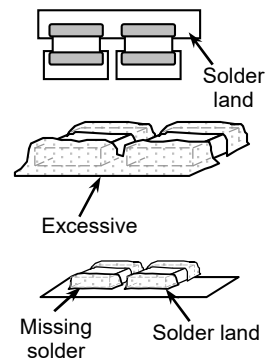
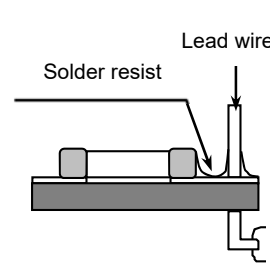
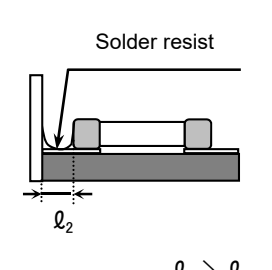
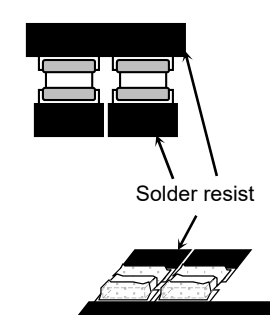
Reflow soldering only.

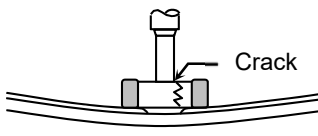
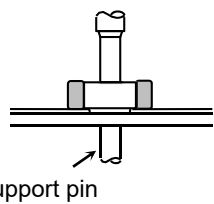
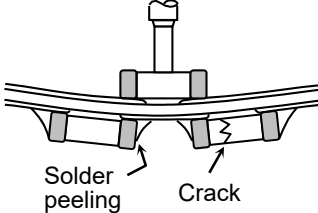
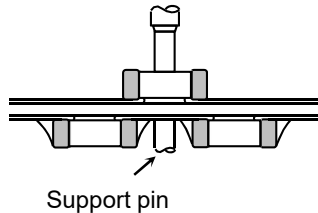
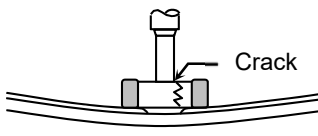
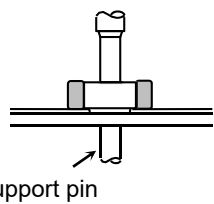
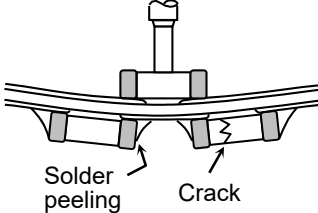
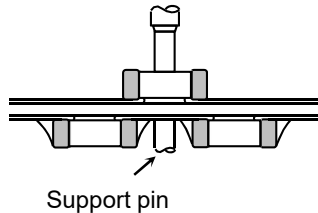
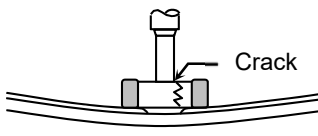
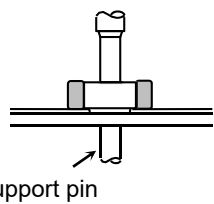
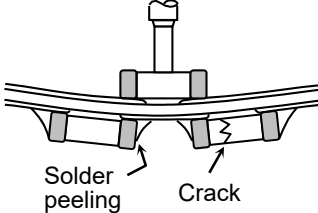
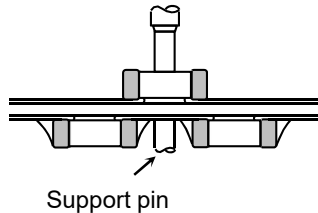
11. CAUTION

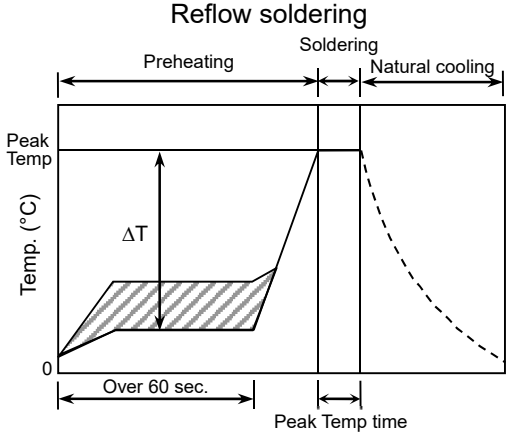
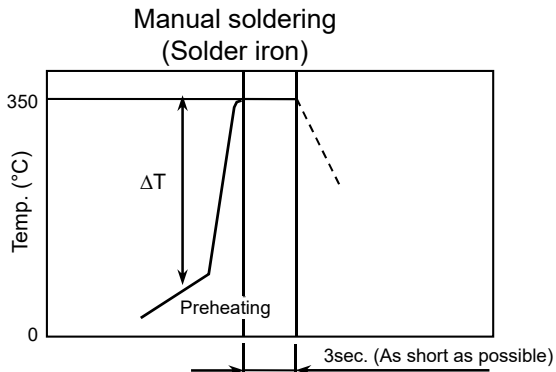
No.	Process	Condition																
1	Operating Condition (Storage, Transportation)	<p>1-1. Storage</p> <ol style="list-style-type: none"> 1) The capacitors must be stored in an ambient temperature of 5 to 40°C with a relative humidity of 20 to 70%RH. The products should be used within 6 months upon 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</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> <p>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) AC or pulse with overshooting, V_{P-P} must be below the rated voltage. — (3), (4) and (5) <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="464 1473 1437 2054"> <thead> <tr> <th data-bbox="464 1473 651 1518">Voltage</th> <th data-bbox="651 1473 911 1518">(1) DC voltage</th> <th data-bbox="911 1473 1171 1518">(2) DC+AC voltage</th> <th data-bbox="1171 1473 1437 1518">(3) AC voltage</th> </tr> </thead> <tbody> <tr> <td data-bbox="464 1518 651 1749">Positional Measurement (Rated voltage)</td> <td data-bbox="651 1518 911 1749">  </td> <td data-bbox="911 1518 1171 1749">  </td> <td data-bbox="1171 1518 1437 1749">  </td> </tr> <tr> <th data-bbox="464 1778 651 1823">Voltage</th> <th data-bbox="651 1778 911 1823">(4) Pulse voltage (A)</th> <th data-bbox="911 1778 1171 1823">(5) Pulse voltage (B)</th> <th></th> </tr> <tr> <td data-bbox="464 1823 651 2054">Positional Measurement (Rated voltage)</td> <td data-bbox="651 1823 911 2054">  </td> <td data-bbox="911 1823 1171 2054">  </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)			
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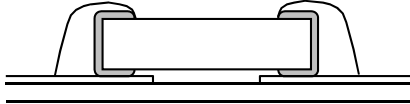
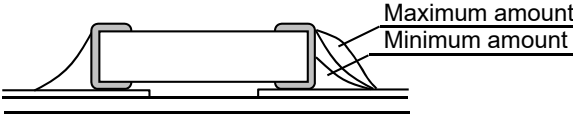
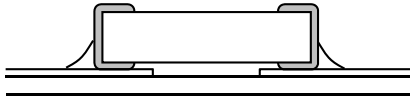
No.	Process	Condition															
2	Circuit design ⚠ Caution	<p>2) Even below the rated voltage, if repetitive high frequency AC or pulse is applied, the reliability of the capacitors may be reduced.</p> <p>3) The effective capacitance will vary depending on applied DC and AC voltages. The capacitors should be selected and designed in taking the voltages into consideration.</p> <p>2-3. Frequency When the capacitors 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 capacitor.</p> <p>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.</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 data-bbox="635 1081 1310 1541" data-label="Diagram"> <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 where the leads are attached. Dimension A is the width of the solder land, B is the width of the capacitor body, and C is the height of the capacitor. Labels include 'Chip capacitor', 'Solder land', and 'Solder resist'.</p> </div> <table border="1" data-bbox="560 1608 1193 1895"> <thead> <tr> <th colspan="2" data-bbox="560 1608 751 1641">Reflow soldering</th> <th data-bbox="1050 1608 1193 1641">(Unit : mm)</th> </tr> <tr> <th data-bbox="560 1648 751 1720">Symbol \ Type</th> <th data-bbox="756 1648 1193 1720">CGAE [CC0204]</th> <th></th> </tr> </thead> <tbody> <tr> <td data-bbox="560 1727 751 1783">A</td> <td data-bbox="756 1727 1193 1783"></td> <td data-bbox="948 1727 995 1760">0.2</td> </tr> <tr> <td data-bbox="560 1789 751 1845">B</td> <td data-bbox="756 1789 1193 1845"></td> <td data-bbox="948 1789 995 1823">0.2</td> </tr> <tr> <td data-bbox="560 1852 751 1895">C</td> <td data-bbox="756 1852 1193 1895"></td> <td data-bbox="948 1852 995 1886">1.0</td> </tr> </tbody> </table>	Reflow soldering		(Unit : mm)	Symbol \ Type	CGAE [CC0204]		A		0.2	B		0.2	C		1.0
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3	Designing P.C.Board	<p data-bbox="427 215 1085 250">4) Recommended chip capacitor layout is as following.</p> <table border="1" data-bbox="466 286 1417 1711"> <thead> <tr> <th data-bbox="466 286 651 367"></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="466 367 651 784">Mounting face</td> <td data-bbox="651 367 1034 784"> <p data-bbox="740 394 944 430">Perforation or slit</p>  <p data-bbox="715 672 970 743">Break P.C.Board with mounted side up.</p> </td> <td data-bbox="1034 367 1417 784"> <p data-bbox="1123 394 1327 430">Perforation or slit</p>  <p data-bbox="1098 672 1353 743">Break P.C.Board with mounted side down.</p> </td> </tr> <tr> <td data-bbox="466 784 651 1232">Chip arrangement (Direction)</td> <td data-bbox="651 784 1034 1232"> <p data-bbox="689 810 989 882">Mount perpendicularly to perforation or slit</p> <p data-bbox="740 904 944 940">Perforation or slit</p>  </td> <td data-bbox="1034 784 1417 1232"> <p data-bbox="1085 810 1347 882">Mount in parallel with perforation or slit</p> <p data-bbox="1123 904 1327 940">Perforation or slit</p>  </td> </tr> <tr> <td data-bbox="466 1232 651 1711">Distance from slit</td> <td data-bbox="651 1232 1034 1711"> <p data-bbox="676 1258 1015 1294">Closer to slit is higher stress</p>  <p data-bbox="868 1612 983 1648">$(l_1 < l_2)$</p> </td> <td data-bbox="1034 1232 1417 1711"> <p data-bbox="1059 1258 1398 1294">Away from slit is less stress</p>  <p data-bbox="1251 1612 1366 1648">$(l_1 < l_2)$</p> </td> </tr> </tbody> </table>		Disadvantage against bending stress	Advantage against bending stress	Mounting face	<p data-bbox="740 394 944 430">Perforation or slit</p>  <p data-bbox="715 672 970 743">Break P.C.Board with mounted side up.</p>	<p data-bbox="1123 394 1327 430">Perforation or slit</p>  <p data-bbox="1098 672 1353 743">Break P.C.Board with mounted side down.</p>	Chip arrangement (Direction)	<p data-bbox="689 810 989 882">Mount perpendicularly to perforation or slit</p> <p data-bbox="740 904 944 940">Perforation or slit</p> 	<p data-bbox="1085 810 1347 882">Mount in parallel with perforation or slit</p> <p data-bbox="1123 904 1327 940">Perforation or slit</p> 	Distance from slit	<p data-bbox="676 1258 1015 1294">Closer to slit is higher stress</p>  <p data-bbox="868 1612 983 1648">$(l_1 < l_2)$</p>	<p data-bbox="1059 1258 1398 1294">Away from slit is less stress</p>  <p data-bbox="1251 1612 1366 1648">$(l_1 < l_2)$</p>
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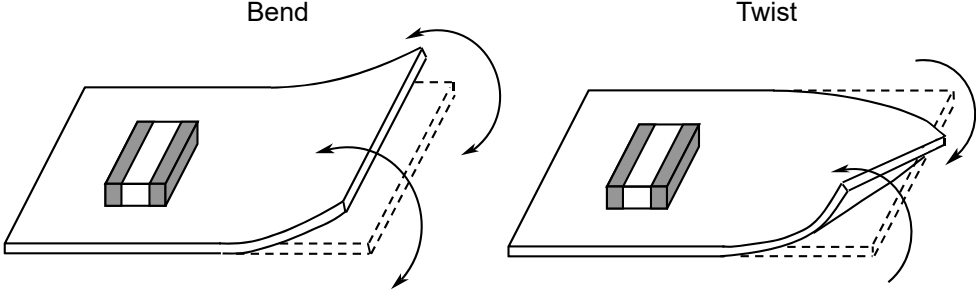
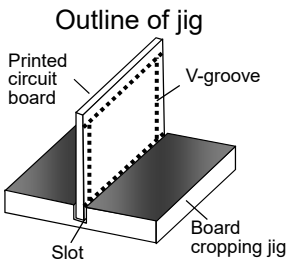
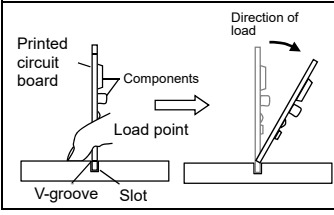
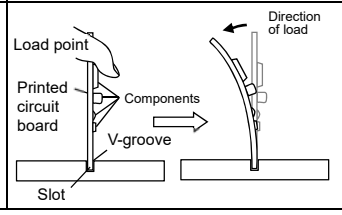
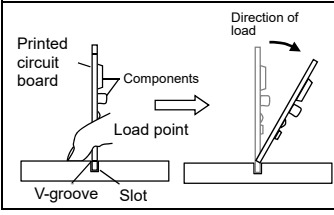
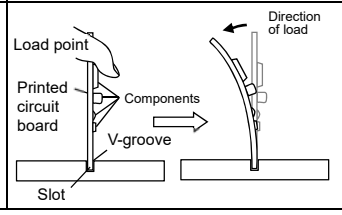
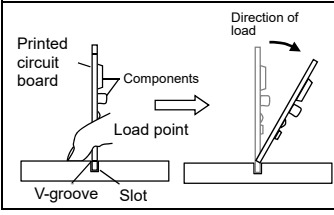
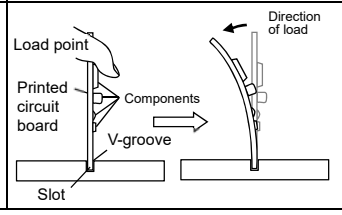
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3	Designing P.C.Board	<p>5) Mechanical stress varies according to location of chip capacitors on the P.C.Board.</p>  <p>The stress in capacitors is in the following order. $A > B = C > D > E$</p> <p>6) Layout recommendation</p> <table border="1" data-bbox="367 1052 1468 1971"> <thead> <tr> <th data-bbox="367 1052 526 1164">Example</th> <th data-bbox="526 1052 829 1164">Use of common solder land</th> <th data-bbox="829 1052 1141 1164">Soldering with chassis</th> <th data-bbox="1141 1052 1468 1164">Use of common solder land with other SMD</th> </tr> </thead> <tbody> <tr> <td data-bbox="367 1164 526 1556">Need to avoid</td> <td data-bbox="526 1164 829 1556">  </td> <td data-bbox="829 1164 1141 1556">  </td> <td data-bbox="1141 1164 1468 1556">  </td> </tr> <tr> <td data-bbox="367 1556 526 1971">Recommendation</td> <td data-bbox="526 1556 829 1971">  </td> <td data-bbox="829 1556 1141 1971">  <p>$l_2 > l_1$</p> </td> <td data-bbox="1141 1556 1468 1971">  </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>	
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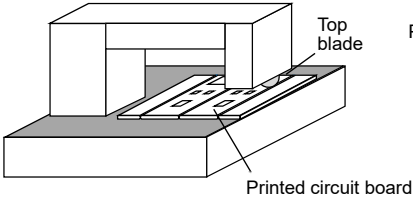
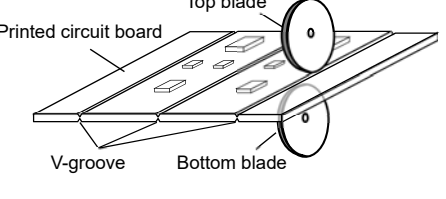
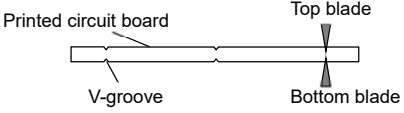
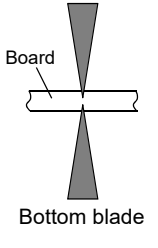
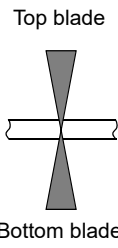
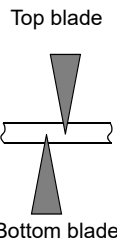
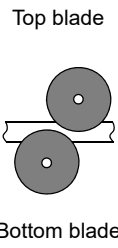
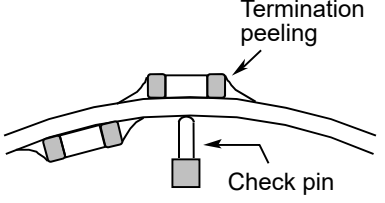
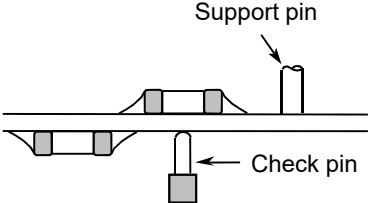
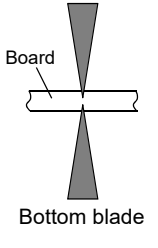
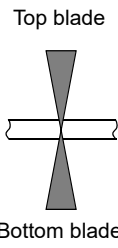
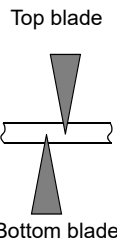
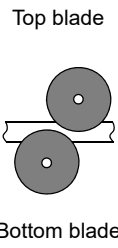
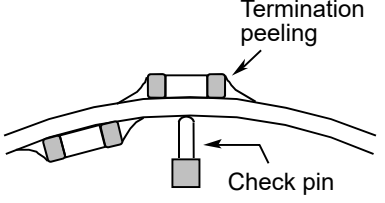
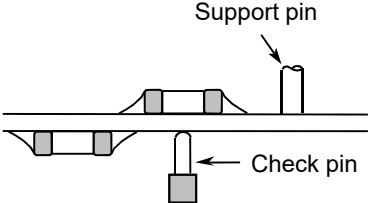
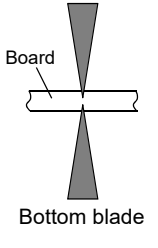
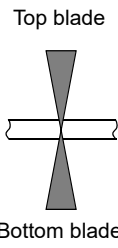
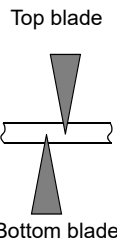
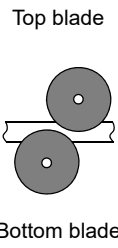
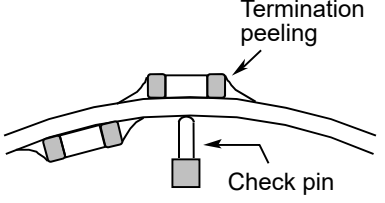
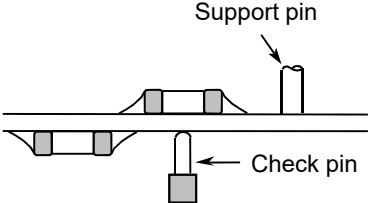
No.	Process	Condition									
4	Mounting	<p>4-1. Stress from mounting head</p> <p>If the mounting head is adjusted too low, it may induce excessive stress in the chip capacitor to result in cracking. Please take following precautions.</p> <ol style="list-style-type: none"> 1) Adjust the bottom dead 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="478 627 1428 1187" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th data-bbox="478 627 662 683"></th> <th data-bbox="662 627 1053 683">Not recommended</th> <th data-bbox="1053 627 1428 683">Recommended</th> </tr> </thead> <tbody> <tr> <td data-bbox="478 683 662 929">Single-sided mounting</td> <td data-bbox="662 683 1053 929">  </td> <td data-bbox="1053 683 1428 929">  </td> </tr> <tr> <td data-bbox="478 929 662 1187">Double-sides mounting</td> <td data-bbox="662 929 1053 1187">  </td> <td data-bbox="1053 929 1428 1187">  </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			Double-sides mounting		
	Not recommended	Recommended									
Single-sided mounting											
Double-sides mounting											

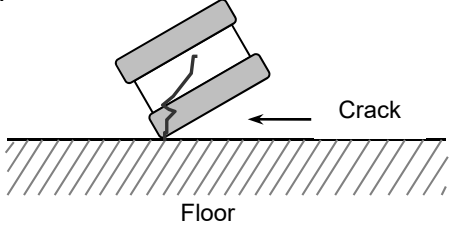
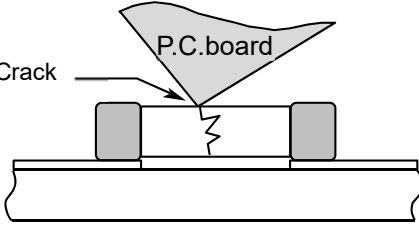
No.	Process	Condition														
5	Soldering	<p>5-1. Flux selection Flux can seriously affect the performance of capacitors. Confirm the following to select the appropriate flux.</p> <ol style="list-style-type: none"> 1) It is recommended to use a mildly activated rosin flux (less than 0.1wt% chlorine). 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 by various methods</p> <div style="text-align: center;">  <p style="text-align: center;">Reflow soldering</p> </div> <div style="text-align: center;">  <p style="text-align: center;">Manual soldering (Solder iron)</p> </div> <p>5-3. Recommended soldering peak temp and peak temp duration</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <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;">Solder</td> <td></td> <td></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> <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> </tbody> </table> <p>Recommended solder compositions Lead Free Solder : Sn-3.0Ag-0.5Cu Sn-Pb Solder : Sn-37Pb</p>	Temp./Duration	Reflow soldering		Peak temp(°C)	Duration(sec.)	Solder			Sn-Pb Solder	230 max.	20 max.	Lead Free Solder	260 max.	10 max.
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Solder																
Sn-Pb Solder	230 max.	20 max.														
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No.	Process	Condition														
5	Soldering	<p>5-4. Avoiding thermal shock</p> <p>1) Preheating condition</p> <table border="1" data-bbox="544 282 1177 472"> <thead> <tr> <th data-bbox="544 282 823 344">Soldering</th> <th data-bbox="823 282 1177 344">Temp. (°C)</th> </tr> </thead> <tbody> <tr> <td data-bbox="544 344 823 407">Reflow soldering</td> <td data-bbox="823 344 1177 407">$\Delta T \leq 150$</td> </tr> <tr> <td data-bbox="544 407 823 472">Manual soldering</td> <td data-bbox="823 407 1177 472">$\Delta T \leq 150$</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</p> <p>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 data-bbox="499 882 624 947" style="width: 30%;">Excessive solder</div> <div data-bbox="687 869 1098 972" style="width: 35%; text-align: center;">  </div> <div data-bbox="1123 864 1417 960" 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 data-bbox="499 1050 617 1081" style="width: 30%;">Adequate</div> <div data-bbox="687 1003 1262 1122" style="width: 35%; text-align: center;">  </div> </div> <hr/> <div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div data-bbox="499 1187 632 1252" style="width: 30%;">Insufficient solder</div> <div data-bbox="687 1178 1098 1281" style="width: 35%; text-align: center;">  </div> <div data-bbox="1123 1160 1417 1279" 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</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. Please make sure the tip temp. before soldering and keep the peak temp and time in accordance with following recommended condition.</p> <p style="text-align: center;">Recommended solder iron condition (Sn-Pb Solder and Lead Free Solder)</p> <table border="1" data-bbox="544 1653 1378 1765"> <thead> <tr> <th data-bbox="544 1653 751 1715">Temp. (°C)</th> <th data-bbox="751 1653 959 1715">Duration (sec.)</th> <th data-bbox="959 1653 1166 1715">Wattage (W)</th> <th data-bbox="1166 1653 1378 1715">Shape (mm)</th> </tr> </thead> <tbody> <tr> <td data-bbox="544 1715 751 1765">350 max.</td> <td data-bbox="751 1715 959 1765">3 max.</td> <td data-bbox="959 1715 1166 1765">20 max.</td> <td data-bbox="1166 1715 1378 1765">Ø 3.0 max.</td> </tr> </tbody> </table> <p>* Please preheat the chip capacitors with the condition in 5-4 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>	Soldering	Temp. (°C)	Reflow soldering	$\Delta T \leq 150$	Manual soldering	$\Delta T \leq 150$	Temp. (°C)	Duration (sec.)	Wattage (W)	Shape (mm)	350 max.	3 max.	20 max.	Ø 3.0 max.
Soldering	Temp. (°C)															
Reflow soldering	$\Delta T \leq 150$															
Manual soldering	$\Delta T \leq 150$															
Temp. (°C)	Duration (sec.)	Wattage (W)	Shape (mm)													
350 max.	3 max.	20 max.	Ø 3.0 max.													

No.	Process	Condition
5	Soldering	<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</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="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. <p>(1) Example of a board cropping jig</p> <p>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.</p> <p>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; align-items: flex-start;"> <div style="margin-right: 20px;">  </div> <table border="1" style="border-collapse: collapse;"> <thead> <tr> <th data-bbox="767 1240 1102 1290">Recommended</th> <th data-bbox="1102 1240 1445 1290">Unrecommended</th> </tr> </thead> <tbody> <tr> <td data-bbox="767 1290 1102 1503">  </td> <td data-bbox="1102 1290 1445 1503">  </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="571 506 986 752"> <p>Outline of machine</p>  </div> <div data-bbox="986 506 1433 752"> <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%; margin-top: 20px; border-collapse: collapse;"> <thead> <tr> <th data-bbox="646 983 826 1070" rowspan="2">Recommended</th> <th colspan="3" data-bbox="826 983 1358 1028">Unrecommended</th> </tr> <tr> <th data-bbox="826 1028 1002 1115">Top-bottom misalignment</th> <th data-bbox="1002 1028 1169 1115">Left-right misalignment</th> <th data-bbox="1169 1028 1358 1115">Front-rear misalignment</th> </tr> </thead> <tbody> <tr> <td data-bbox="646 1115 826 1411"> <p>Top blade</p>  <p>Bottom blade</p> </td> <td data-bbox="826 1115 1002 1411"> <p>Top blade</p>  <p>Bottom blade</p> </td> <td data-bbox="1002 1115 1169 1411"> <p>Top blade</p>  <p>Bottom blade</p> </td> <td data-bbox="1169 1115 1358 1411"> <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%; margin-top: 20px; border-collapse: collapse;"> <thead> <tr> <th data-bbox="478 1653 619 1715">Item</th> <th data-bbox="619 1653 1037 1715">Not recommended</th> <th data-bbox="1037 1653 1455 1715">Recommended</th> </tr> </thead> <tbody> <tr> <td data-bbox="478 1715 619 1951">Board bending</td> <td data-bbox="619 1715 1037 1951">  </td> <td data-bbox="1037 1715 1455 1951">  </td> </tr> </tbody> </table>	Recommended	Unrecommended			Top-bottom misalignment	Left-right misalignment	Front-rear misalignment	<p>Top blade</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		
Recommended	Unrecommended																		
	Top-bottom misalignment	Left-right misalignment	Front-rear misalignment																
<p>Top blade</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																			

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 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	<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
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 splattered 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 product listed in this specification is intended for use in automotive applications under-normal operation and usage conditions.</p> <p>The product is not designed or warranted to meet the requirements of application listed below, whose performance and/or quality requires a more stringent level of safety or reliability, or whose failure, malfunction or defect 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.) (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. In addition, although the product listed in this specification is intended for use in automotive applications as described above, it is not prohibited to use for general electronic equipment, whose performance and/or quality doesn't require a more stringent level of safety or reliability, or whose failure, malfunction or defect could not cause serious damage to society, person or property. Therefore, the description of this caution will be applied, when the product is used in general electronic equipment under a normal operation and usage conditions.</p>

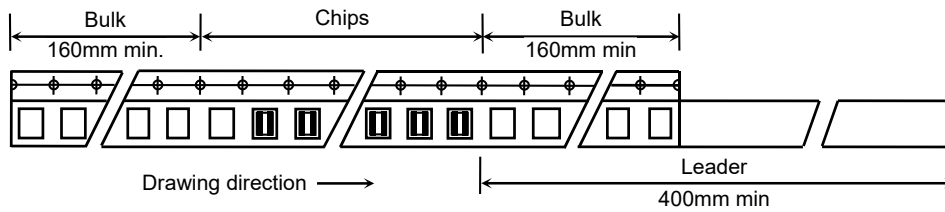
12. TAPE PACKAGING SPECIFICATION

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

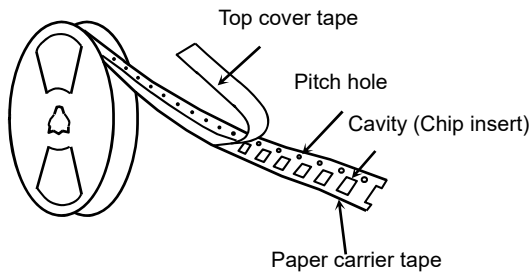


1-3. Dimensions of reel

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

1-4. Structure of taping

<Paper>



2. CHIP QUANTITY

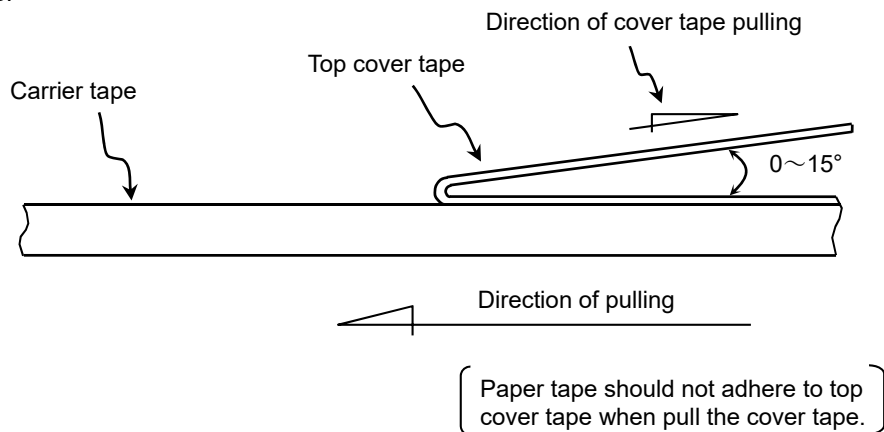
Please refer to the table A in the end of the specification.

3. PERFORMANCE SPECIFICATIONS

3-1. Fixing peeling strength (top tape)

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

<Paper>



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

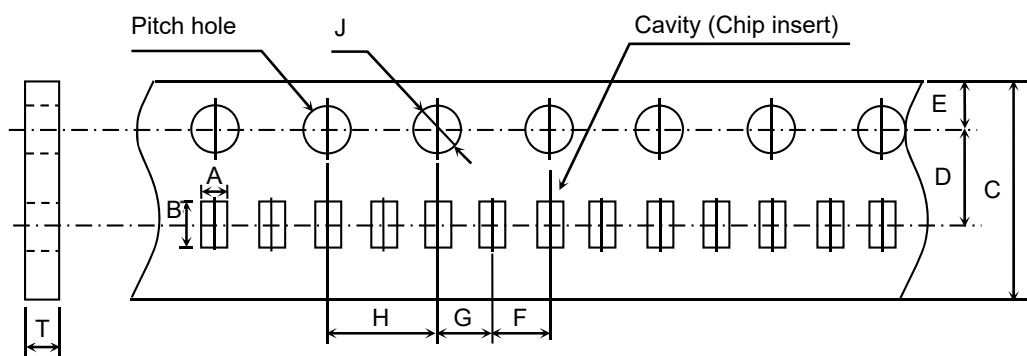
3-3. The missing of components shall be less than 0.1%

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)

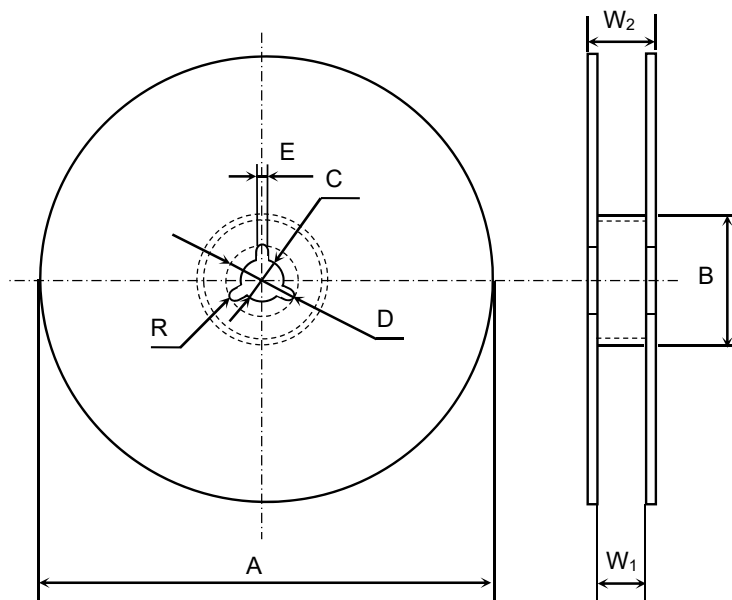
Symbol	A	B	C	D	E	F
Type						
CGAE [CC0204]	(0.62)	(1.12)	8.00 ± 0.30	3.50 ± 0.05	1.75 ± 0.10	2.00 ± 0.05

Symbol	G	H	J	T
Type				
CGAE [CC0204]	2.00 ± 0.05	4.00 ± 0.10	$\phi 1.5 \begin{smallmatrix} +0.1 \\ 0 \end{smallmatrix}$	0.65 max.

() Referenced value.

Appendix 4

Dimensions of reel (Material : Polystyrene)



(Unit: mm)

Symbol	A	B	C	D	E	W ₁
Dimension	$\phi 178 \pm 2.0$	$\phi 60 \pm 2.0$	$\phi 13 \pm 0.5$	$\phi 21 \pm 0.8$	2.0 ± 0.5	9.0 ± 0.3
Symbol	W ₂	R				
Dimension	13.0 ± 1.4	1.0				

13. Table A (TDK products line up [Low ESL Reverse Geometry])

No	Your Part No.	TDK product	Dimensions			Capacitance		tanδ (max.)	Temp. Characteristics of Cap.		Temp cycle	Moisture Resistance (Steady state)	Moisture Resistance	Life		Tape packaging materials	Qty. per 1 reel(pcs.)		
			L (mm)	W (mm)	T (mm)	Measuring frequency	Measuring voltage		Measuring frequency	Measuring voltage				ΔC/C	ΔC/C			ΔC/C	ΔC/C
																	φ 178mm		
1		CGAEA1X7R1H473M	0.52±0.05	1.00±0.05	0.30±0.05	1kHz	1.0Vrms	0.05	1kHz	1.0Vrms	±7.5%	±12.5%	±12.5%	±15%	1.0 x R.V.	Paper	15,000		
2		CGAEA2X7R1E473M	0.52±0.05	1.00±0.05	0.30±0.05	1kHz	1.0Vrms	0.05	1kHz	1.0Vrms	±7.5%	±12.5%	±12.5%	±15%	2.0 x R.V.	Paper	15,000		