SPECIFICATION

SPEC. No. A-MEGA-c

D A T E : 2017 Aug.

To

_____

CUSTOMER'S PRODUCT NAME	TDK PRODUCT NAME Multilayer Ceramic Chip Capacitors CKG Series/ Automotive grade MEGACAP type

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 condition 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, TDK Xiamen Co.,Ltd, and TDK Components U.S.A.Inc.

EXPLANATORY NOTE:

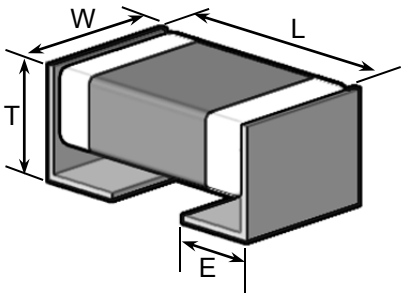
This specification warrants the quality of the ceramic chip capacitors. Capacitors should be evaluated or confirmed a state of mounted on your product.
If the use of capacitors goes beyond the bounds of the specification, we can not afford to guarantee.

2. CODE CONSTRUCTION

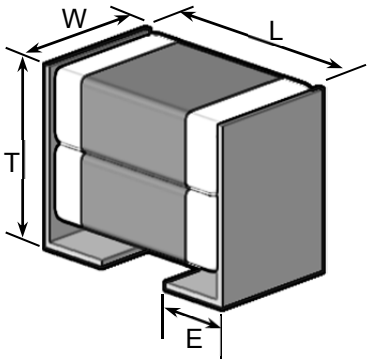
Catalog Number (Web)	CKG32K	X7S	1H	106	K	335	A	J
	CKG57N	X7R	1E	226	M	500	J	J
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Item Decription	CKG32K	X7S	1H	106	K	T	xxxx	
	CKG57N	X7R	1E	226	M	T	xxxx	
	(1)	(2)	(3)	(4)	(5)	(9)	(10)	

(1) Type

Single type
CKG**K: 1 chip capacitor.



Stacked type
CKG**N: 2 chip capacitors.



* As for dimensions, please refer to detail page of each products on TDK Web.

(2) Temperature Characteristics

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

(3) Rated Voltage

Symbol	Rated Voltage
3 A	DC 1k V
2 J	DC 630 V
2 W	DC 450 V
2 E	DC 250 V
2 A	DC 100 V
1 H	DC 50 V
1 V	DC 35 V
1 E	DC 25 V
1 C	DC 16 V

(4) Rated Capacitance

Stated in three digits and in units of pico farads (pF).
The first and Second digits identify the first and second significant figures of the capacitance, the third digit identifies the multiplier.

(Example)

Symbol	Rated Capacitance
106	10,000,000 pF
226	22,000,000 pF

(5) Capacitance tolerance

* K (±10%) tolerance is available only for CKG**K single type (10μF and under).

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

(6) Thickness Code (Only for Catalog Number)

(7) Package Code (Only for Catalog Number)

(8) Special Code (Only for Catalog Number)

(9) Packaging Code (Only for Item Description)

Symbol	Packaging
T	Taping

(10) Internal Code (Only for Item Description)

3. OPERATING TEMPERATURE RANGE

T.C.	Min. operating Temperature	Max. operating Temperature	Reference Temperature
X5R	-55°C	85°C	25°C
C0G, X7R, X7S, X7T	-55°C	125°C	25°C

4. STORING CONDITION AND TERM

5 to 40°C at 20 to 70%RH

6 months Max.

5. INDUSTRIAL WASTE DISPOSAL

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

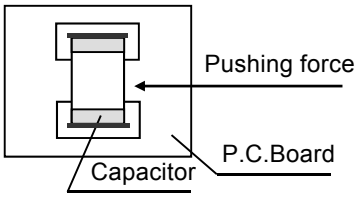
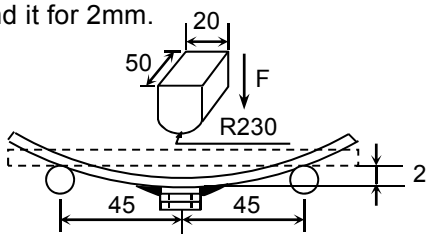
6. PERFORMANCE

table 1

<table>
<tr><th>No.</th><th>Item</th><th>Performance</th><th>Test or inspection method</th></tr>
<tr><td>1</td><td>External Appearance</td><td>No defects which may affect performance.</td><td>Inspect with magnifying glass (3×)</td></tr>
<tr><td>2</td><td>Insulation Resistance</td><td>10,000MΩ or 500MΩ·μF min.
(As for the capacitors of rated voltage 16V DC, 100MΩ·μF min.)</td><td>Apply rated voltage for 60s.
As for the rated voltage 630V DC and higher, apply 500V DC.</td></tr>
<tr><td>3</td><td>Voltage Proof</td><td>Withstand test voltage without insulation breakdown or other damage.</td><td>
<table>
<tr><th>Class</th><th>Rated voltage(RV)</th><th>Apply voltage</th></tr>
<tr><td rowspan="4">1</td><td>RV≦100V</td><td>3 × rated voltage</td></tr>
<tr><td>100V＜RV≦500V</td><td>1.5 × rated voltage</td></tr>
<tr><td>500V＜RV＜1kV</td><td>1.3 × rated voltage</td></tr>
<tr><td>1kV</td><td>1.2 × rated voltage</td></tr>
<tr><td rowspan="4">2</td><td>RV≦100V</td><td>2.5 × rated voltage</td></tr>
<tr><td>100V＜RV≦500V</td><td>1.5 × rated voltage</td></tr>
<tr><td>500V＜RV＜1kV</td><td>1.3 × rated voltage</td></tr>
<tr><td>1kV</td><td>1.2 × rated voltage</td></tr>
</table>
Above DC voltage shall be applied for 1s. Charge / discharge current shall not exceed 50mA.</td></tr>
<tr><td>4</td><td>Capacitance</td><td>Within the specified tolerance.</td><td>
<table>
<tr><th>Class</th><th>Capacitance</th><th>Measuring frequency</th><th>Measuring voltage</th></tr>
<tr><td rowspan="2">1</td><td>1000pF</td><td>1MHz±10%</td><td rowspan="2">0.5-5Vrms.</td></tr>
<tr><td>Over 1000pF</td><td>1kHz±10%</td></tr>
<tr><td rowspan="2">2</td><td>10uF and under</td><td>1kHz±10%</td><td>1.0±0.2Vrms</td></tr>
<tr><td>Over 10uF</td><td>120Hz±20%</td><td>0.5±0.2Vrms.</td></tr>
</table></td></tr>
<tr><td>5</td><td>Q
(Class1)</td><td>1,000 Min.</td><td rowspan="2">See No.4 in this table for measuring condition.</td></tr>
<tr><td></td><td>Dissipation Factor
(Class2)</td><td>Please refer to detail page of each products on TDK Web.</td></tr>
<tr><td>6</td><td>Temperature Characteristics of Capacitance
(Class1)</td><td>
<table>
<tr><th>T.C.</th><th>Temperature Coefficient (ppm/°C)</th></tr>
<tr><td>C0G</td><td>0 ± 30</td></tr>
</table>
Capacitance drift within ± 0.2% or ± 0.05pF, whichever larger.</td><td>Temperature coefficient shall be calculated based on values at 25°C and 85°C temperature.

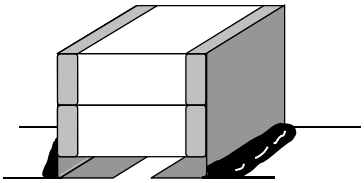
Measuring temperature below 25°C shall be -10°C and -25°C.</td></tr>
</table>

(continued)

<table>
<tr><th>No.</th><th>Item</th><th>Performance</th><th>Test or inspection method</th></tr>
<tr><td>7</td><td>Temperature Characteristics of Capacitance</td><td>Capacitance Change (%)
No voltage applied
X5R : ± 15
X7R : ±15
X7S : ±22
X7T : +22 -33</td><td>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
<table><tr><th>Step</th><th>Temperature(°C)</th></tr><tr><td>1</td><td>Reference temp. ± 2</td></tr><tr><td>2</td><td>Min. operating temp. ± 2</td></tr><tr><td>3</td><td>Reference temp. ± 2</td></tr><tr><td>4</td><td>Max. operating temp. ± 2</td></tr></table>Measuring voltage: 0.1, 0.2, 0.5, 1.0Vrms. For information which product has which applied voltage, please contact with our sales representative.</td></tr>
<tr><td>8</td><td>Robustness of Terminations</td><td>No sign of termination coming off, breakage of ceramic, or other abnormal signs.</td><td>Reflow solder the capacitors on a P.C.Board shown in Appendix 2 and apply a pushing force of 17.7N with 10±1s.
 
</td></tr>
<tr><td>9</td><td>Bending</td><td>No mechanical damage.</td><td>Reflow solder the capacitors on a P.C.Board shown in Appendix 1 and bend it for 2mm.
 

(Unit : mm)</td></tr>
</table>

(continued)

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Performance</th><th>Test or inspection method</th></tr>
<tr><td>10</td><td colspan="2">Solderability</td><td>Both end faces and the contact areas shall be covered with a smooth and bright solder coating with no more than a small amount of scattered imperfections such as pinholes or un-wetted or de-wetted areas.
These imperfections shall not be concentrated in one area.
  </td><td>Reflow solder the capacitor on a P.C.Board shown in Appendix2.

Solder : Sn-3.0Ag-0.5Cu or Sn-37Pb

Please refer to the condition at page15,16 for soldering.</td></tr>
<tr><td rowspan="4">11</td><td rowspan="4">Vibration</td><td>External appearance</td><td>No mechanical damage.</td><td rowspan="4">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.</td></tr>
<tr><td>Capacitance</td><td><table><tr><th colspan="2">Characteristics</th><th>Change from the value before test</th></tr><tr><td>Class1</td><td>C0G</td><td>± 2.5 %</td></tr><tr><td>Class2</td><td>X5R
X7R
X7S
X7T</td><td>± 7.5 %</td></tr></table></td></tr>
<tr><td>Q (Class1)</td><td>Meet the initial spec.</td></tr>
<tr><td>D.F. (Class2)</td><td>Meet the initial spec.</td></tr>
<tr><td rowspan="6">12</td><td rowspan="6">Temperature cycle</td><td>External appearance</td><td>No mechanical damage.</td><td rowspan="6">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.

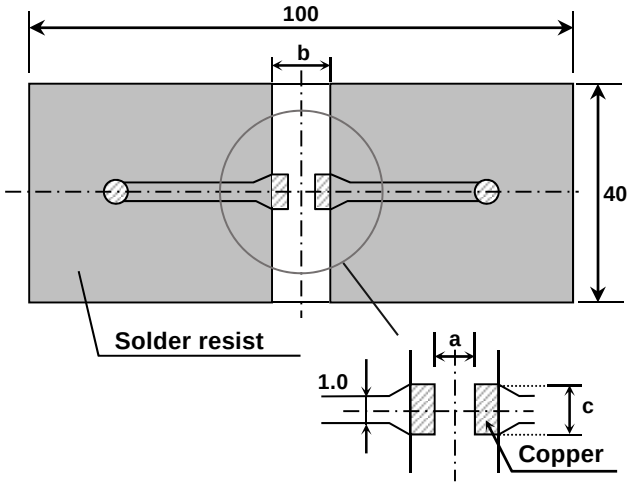
Leave the capacitors in ambient condition for 6 to 24h (Class 1) or 24±2h (Class 2) before measurement.<table><tr><th>Step</th><th>Temperature(°C)</th><th>Time (min.)</th></tr><tr><td>1</td><td>Min. operating temp. ±3</td><td>30 ± 3</td></tr><tr><td>2</td><td>Ambient Temp.</td><td>2 - 5</td></tr><tr><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></table>As for Min./ Max. operating temp., please refer to "3.OPERATING TEMPERATURE RANGE".</td></tr>
<tr><td>Capacitance</td><td><table><tr><th colspan="2">Characteristics</th><th>Change from the value before test</th></tr><tr><td>Class1</td><td>C0G</td><td>± 2.5 %</td></tr><tr><td>Class2</td><td>X5R
X7R
X7S
X7T</td><td>± 7.5 %</td></tr></table></td></tr>
<tr><td>Q (Class1)</td><td>Meet the initial spec.</td></tr>
<tr><td>D.F. (Class2)</td><td>Meet the initial spec.</td></tr>
<tr><td>Insulation Resistance</td><td>Meet the initial spec.</td></tr>
<tr><td>Voltage proof</td><td>No insulation breakdown or other damage.</td></tr>
</table>

(continued)

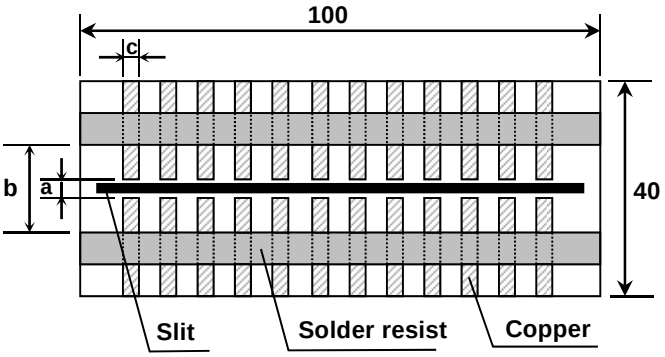
<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Performance</th><th>Test or inspection method</th></tr>
<tr><td>13</td><td>Moisture Resistance</td><td>External appearance</td><td>No mechanical damage.</td><td rowspan="5">Reflow solder the capacitors on a P.C.Board shown in Appendix2 before testing.
Apply the rated voltage at temperature 85±2°C and 85%RH for 1,000 +48,0h. (For X5R, the rated voltage at 40±2°C, 90 to 95%RH for 500 +24,0h is applied.)
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 class 2) 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.</td></tr>
<tr><td></td><td></td><td>Capacitance</td><td><table><tr><th colspan="2">Characteristics</th><th>Change from the value before test</th></tr><tr><td>Class 1</td><td>C0G</td><td>± 7.5 %</td></tr><tr><td>Class 2</td><td>X5R
X7R
X7S
X7T</td><td>± 12.5 %</td></tr></table></td></tr>
<tr><td></td><td></td><td>Q (Class1)</td><td>200 min.</td></tr>
<tr><td></td><td></td><td>D.F. (Class2)</td><td>200% of initial spec. max.</td></tr>
<tr><td></td><td></td><td>Insulation Resistance</td><td>500MΩ or 25MΩ·μF min.
(As for the capacitors of rated voltage 16V DC, 5MΩ·μF min.,).</td></tr>
<tr><td>14</td><td>Life</td><td>External appearance</td><td>No mechanical damage.</td><td rowspan="5">Reflow solder the capacitors on a P.C.Board shown in Appendix2 before testing.
Test condition : maximum operating temperature ±2°C for 1,000 +48,0h
<table><tr><th>Applied Voltage</th></tr><tr><td>Rated Voltage x 2</td></tr><tr><td>Rated Voltage x 1.5</td></tr><tr><td>Rated Voltage x 1.2</td></tr><tr><td>Rated Voltage x 1</td></tr></table>As for applied voltage, please contact with our sales representative.
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 class 2) 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.</td></tr>
<tr><td></td><td></td><td>Capacitance</td><td><table><tr><th colspan="2">Characteristics</th><th>Change from the value before test</th></tr><tr><td>Class1</td><td>C0G</td><td>± 3 %</td></tr><tr><td>Class2</td><td>X5R
X7R
X7S
X7T</td><td>± 15 %</td></tr></table></td></tr>
<tr><td></td><td></td><td>Q (Class1)</td><td>350 min.</td></tr>
<tr><td></td><td></td><td>D.F. (Class2)</td><td>200% of initial spec. max.</td></tr>
<tr><td></td><td></td><td>Insulation Resistance</td><td>1,000MΩ or 50MΩ·μF min.
(As for the capacitors of rated voltage 16V DC, 10MΩ·μF min.,)</td></tr>
</table>

*As for the initial measurement of capacitors (Class2) on number 7,11 and 12 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



（Unit：mm）

Type	Dimensions		
TDK(EIA style)	a	b	c
CKG32K	2.2	5.0	2.9
CKG45K	3.5	6.1	2.9
CKG57K	4.1	7.6	4.7
CKG45N	3.5	6.1	2.9
CKG57N	4.1	7.6	4.7

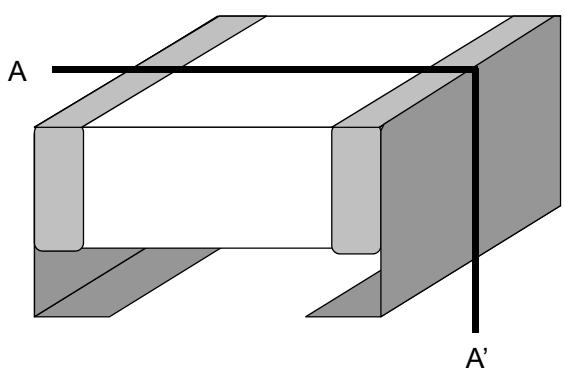
1. Material : Glass Epoxy(As per JIS C6484 GE4)

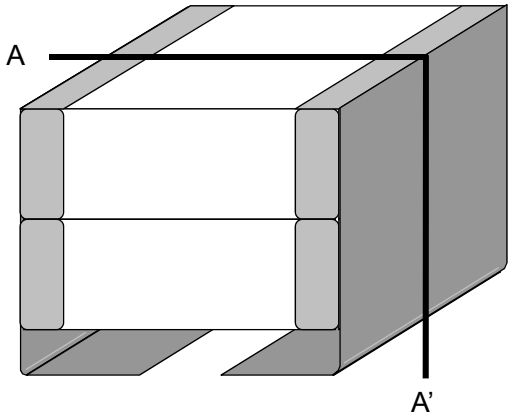
2. Thickness : 1.6mm

Copper (Thickness:0.035mm)

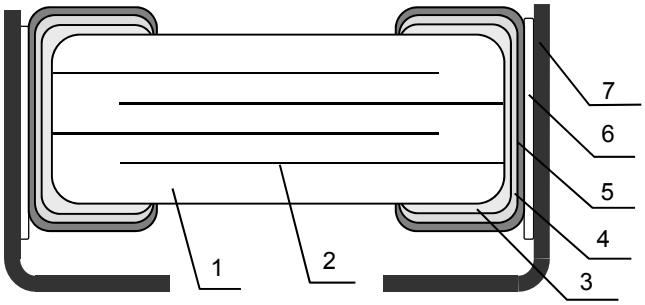
Solder resist

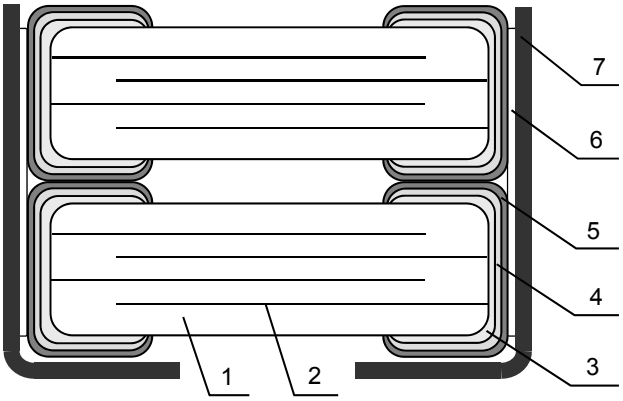
7. INSIDE STRUCTURE AND MATERIAL





A－A'





No.	NAME	MATERIAL	
		Class1	Class2
1	Dielectric	$CaZrO_3$	$BaTiO_3$
2	Electrode	Nickel (Ni)	
3	Termination	Copper (Cu)	
4		Nickel (Ni)	
5		Tin (Sn)	
6	Metal cap joint	High temp solder	
7	Metal frame	42 Alloy	

8. PACKAGING

Packaging shall be done to protect the components from the damage during transportation and storing, and a label which has the following information shall be attached.
Tape packaging is as per 12.TAPE PACKAGING SPECIFICATION.

Information on label

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

*Composition of Inspection No.

Example A 7 A – ○○ – ○○○
(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

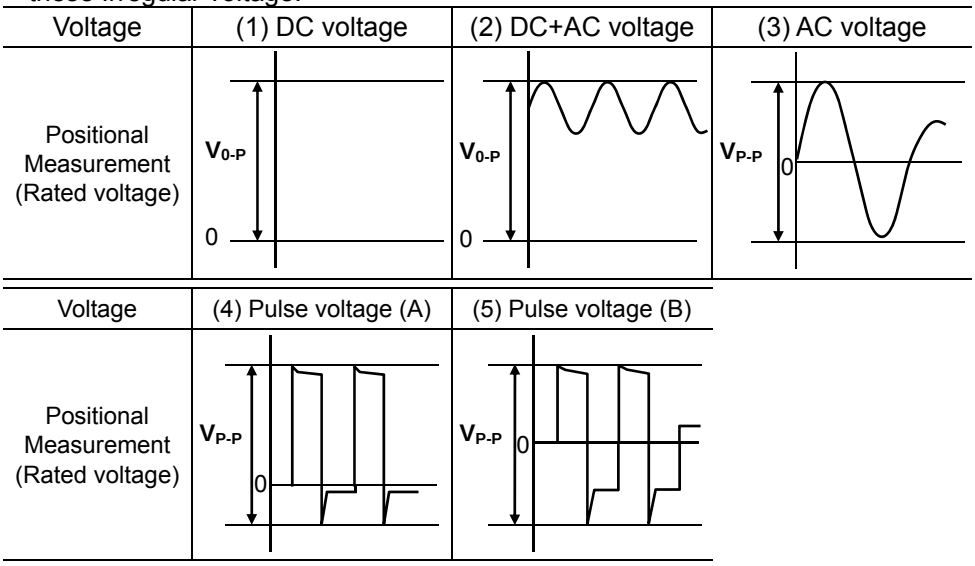
9. RECOMMENDATION

It is recommended to provide a slit (about 1mm wide) in the board under the components to improve washing Flux.
And please make sure to dry detergent up completely before.

10. SOLDERING CONDITION

Reflow soldering only.
"Metal cap joint" is high temperature solder, but it may be melted under high temperature (more than 250°C).
Please keep a soldering temperature of 250°C or less and refer to 11.CAUTION on page 15-17 in detail.

11. CAUTION

<table>
<tr><th>No.</th><th>Process</th><th>Condition</th></tr>
<tr><td>1</td><td>Operating Condition (Storage, Transportation)</td><td>1-1. Storage
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.
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)</td></tr>
<tr><td>2</td><td>Circuit design
⚠ Caution</td><td>2-1. Operating temperature
Operating temperature should be followed strictly within this specification, especially be careful with maximum temperature.
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.
2-2. Operating voltage
1) Operating voltage across the terminals should be below the rated voltage.
When AC and DC are super imposed, $V_{0\text{-}P}$ must be below the rated voltage.
— (1) and (2)
AC or pulse with overshooting, $V_{P\text{-}P}$ must be below the rated voltage.
— (3), (4) and (5)
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.
 
</td></tr>
</table>

<table>
<tr><th>No.</th><th>Process</th><th>Condition</th></tr>
<tr><td>2</td><td>Circuit design
⚠ Caution</td><td>2) Even below the rated voltage, if repetitive high frequency AC or pulse is applied, the reliability of the capacitors may be reduced.

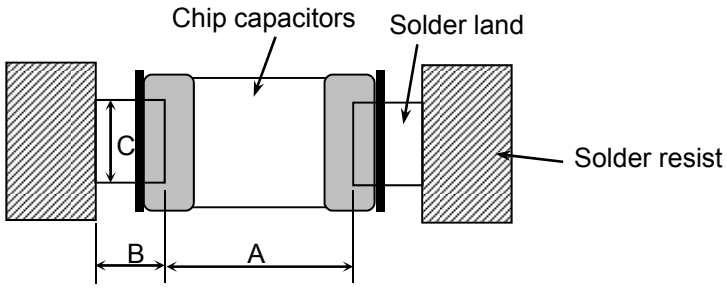
3) The effective capacitance will vary depending on applied DC and AC voltages. The capacitors should be selected and designed in taking the voltages into consideration.

2-3. Frequency
When the capacitors are used in AC and/or pulse voltages, the capacitors may vibrate themselves and generate audible sound.</td></tr>
<tr><td>3</td><td>Designing P.C.board</td><td>The amount of solder at the terminations has a direct effect on the reliability of the capacitor.

1) The greater the amount of solder, the higher the stress on the chip capacitor, and the more likely that it will break. When designing a P.C.board, determine the shape and size of the solder lands to have proper amount of solder on the terminations.

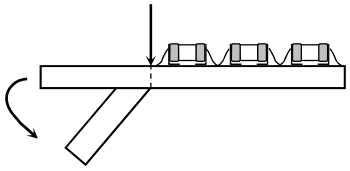
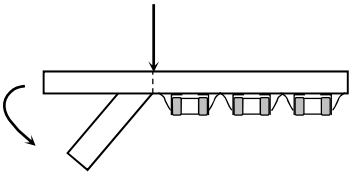
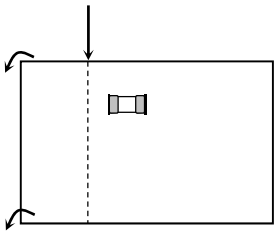
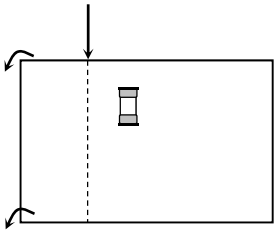
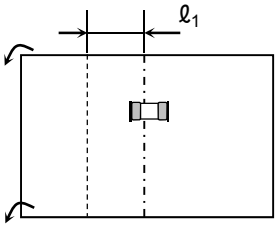
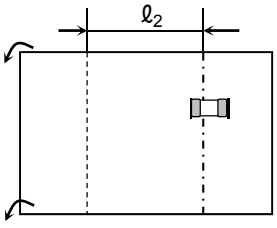
2) Avoid using common solder land for multiple terminations and provide individual solder land for each terminations.

3) Size and recommended land dimensions.

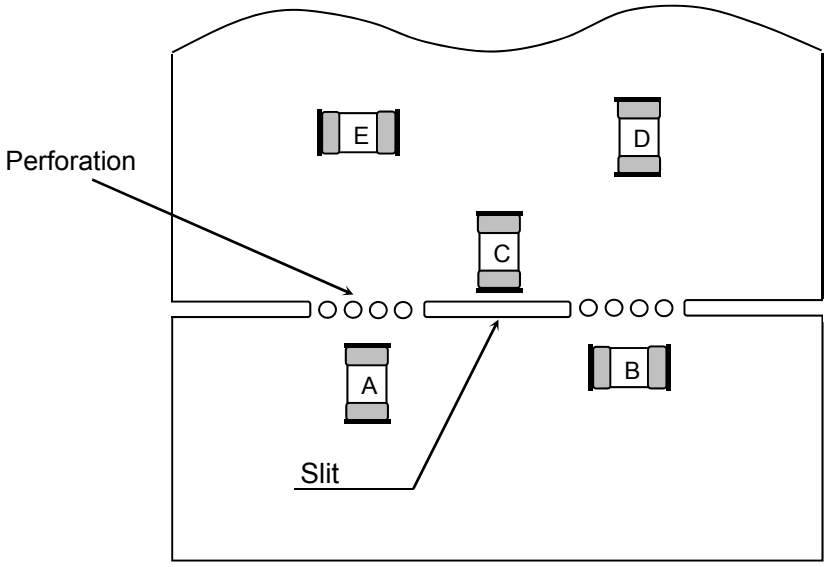
 

Reflow soldering
（mm）
<table>
<tr><th>Type / Symbol</th><th>CKG32K</th><th>CKG45K</th><th>CKG57K</th></tr>
<tr><td>A</td><td>2.0～2.2</td><td>3.3～3.7</td><td>3.9～4.3</td></tr>
<tr><td>B</td><td>1.1～1.3</td><td>1.2～1.5</td><td>1.5～2.0</td></tr>
<tr><td>C</td><td>2.3～2.5</td><td>2.7～3.2</td><td>4.5～5.0</td></tr>
</table>
<table>
<tr><th>Type / Symbol</th><th>CKG45N</th><th>CKG57N</th></tr>
<tr><td>A</td><td>3.3～3.7</td><td>3.9～4.3</td></tr>
<tr><td>B</td><td>1.2～1.5</td><td>1.5～2.0</td></tr>
<tr><td>C</td><td>2.7～3.2</td><td>4.5～5.0</td></tr>
</table></td></tr>
</table>

No.	Process	Condition
3	Designing P.C.board	4) Recommended chip capacitor layout is as following.

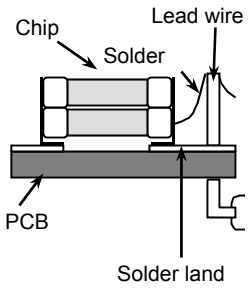
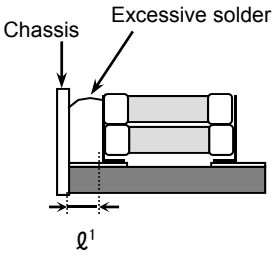
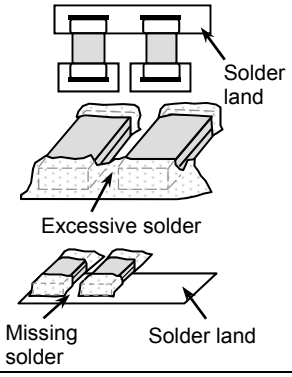
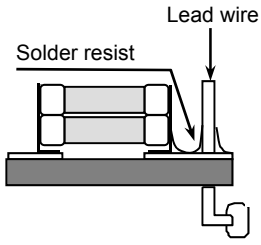
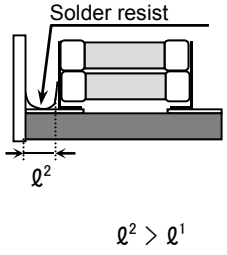
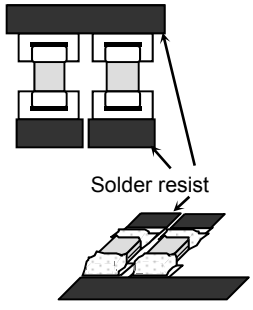
	Disadvantage against bending stress	Advantage against bending stress
Mounting face	Perforation or slit  Break P.C.board with mounted side up.	Perforation or slit  Break P.C.board with mounted side down.
Chip arrangement (Direction)	Mount perpendicularly to perforation or slit Perforation or slit 	Mount in parallel with perforation or slit Perforation or slit 
Distance from slit	Closer to slit is higher stress  ($\ell_1 < \ell_2$)	Away from slit is less stress  ($\ell_1 < \ell_2$)

No.	Process	Condition
3	Designing P.C.board	5) Mechanical stress varies according to location of chip capacitors on the P.C.board.



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

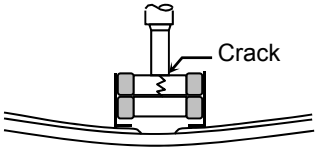
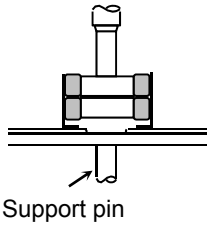
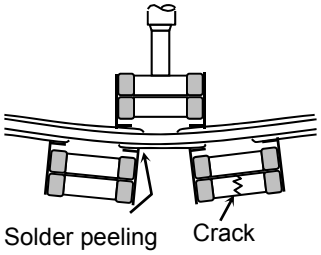
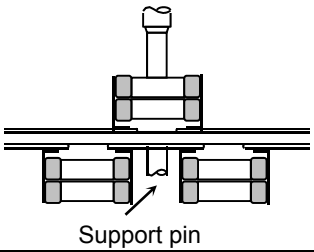
6) Layout recommendation

Example	Use of common solder land	Soldering with chassis	Use of common solder land with other SMD
Need to avoid			
Recommen-dation			

<table>
<tr><th>No.</th><th>Process</th><th>Condition</th></tr>
<tr><td>4</td><td>Mounting</td><td>
4-1. Stress from mounting head
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.

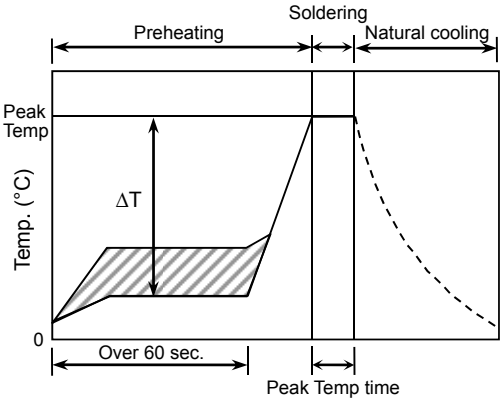
1) Adjust the bottom dead center of the mounting head to reach on the P.C.board surface and not press it.

2) Adjust the mounting head pressure to be 1 to 3N of static weight.

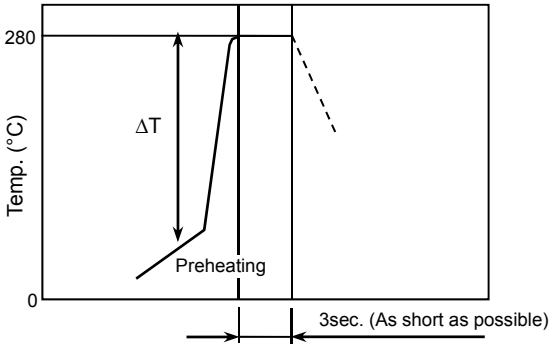
3) To minimize the impact energy from mounting head, it is important to provide support from the bottom side of the P.C.board.
See following examples.
<table>
<tr><th></th><th>Not recommended</th><th>Recommended</th></tr>
<tr><td>Single-sided mounting</td><td> 
</td><td> 
</td></tr>
<tr><td>Double-sides mounting</td><td> 
</td><td> 
</td></tr>
</table>
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.
</td></tr>
</table>

No.	Process	Condition
5	Soldering	5-1. Flux selection Flux can seriously affect the performance of capacitors. Confirm the following to select the appropriate flux. 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. 5-2. Recommended soldering profile by various methods Reflow soldering condition 1) Soldering condition (Preheating temperature, soldering temperature and these times) is limited to reflow soldering method which is stipulated on the specification. 2) Chips should be mounted, shortly after a solder is on a P.C.Board. 3) Temperature of metal cap surface must not exceed 250℃. (Metal frames are jointed by high temp solder, however the solder temperature must be less than 250℃ to avoid melting the solder.)

Reflow soldering



Manual soldering (Solder iron)



5-3. Recommended soldering peak temp and peak temp duration

Temp./Duration / Solder	Reflow soldering	
	Peak temp(°C)	Duration(sec.)
Sn-Pb Solder	230 max.	20 max.
Lead Free Solder	250 max.	10 max.

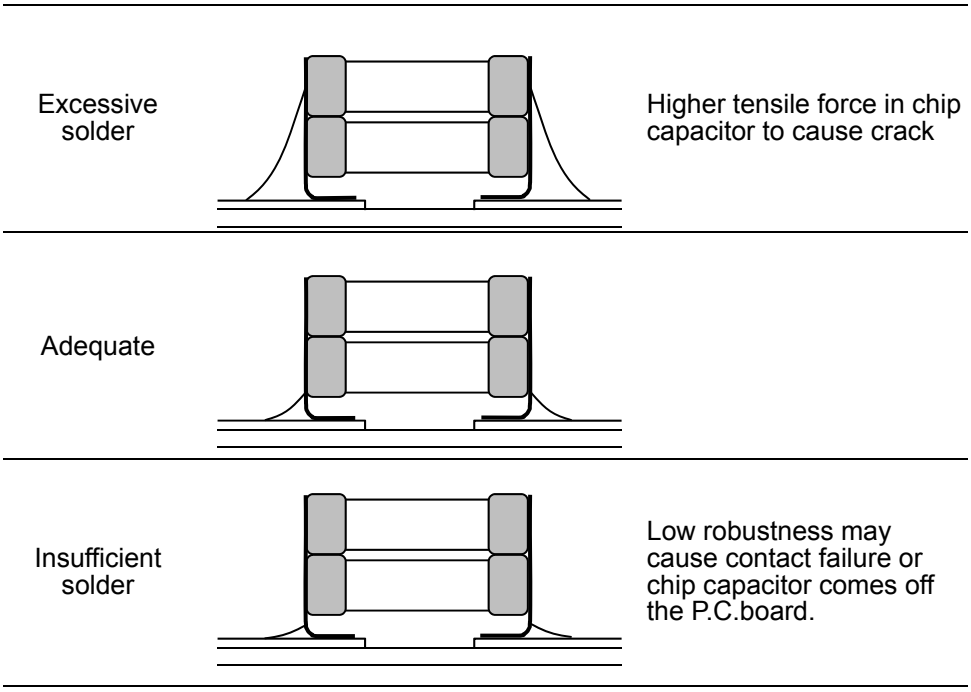
Recommended solder compositions
Sn-37Pb (Sn-Pb solder)
Sn-3.0Ag-0.5Cu (Lead Free Solder)

No.	Process	Condition
5	Soldering	5-4. Avoiding thermal shock 1) Preheating condition

Soldering	Temp. (°C)
Reflow soldering	ΔT ≦ 130
Manual soldering	ΔT ≦ 130

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.

5-5. Amount of solder
Excessive solder will induce higher tensile force in chip capacitor when temperature changes and it may result in chip cracking. In sufficient solder may detach the capacitor from the P.C.board.



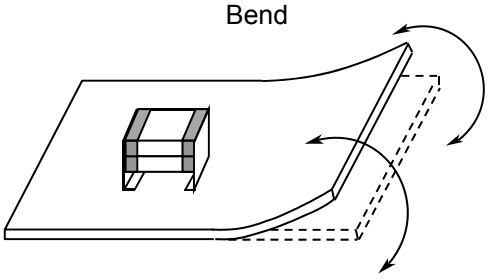
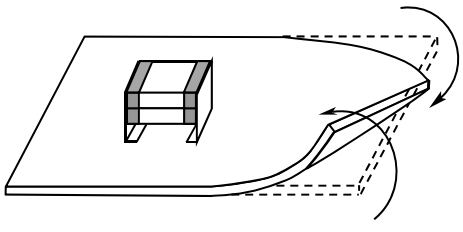
5-6. Solder repair by solder iron
1) Selection of the soldering iron tip
Tip temperature of solder iron varies by its type, P.C.board material and solder land size. The higher the tip temperature, the quicker the operation.
However, heat shock may cause a crack in the chip capacitors.
Please make sure 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.)

Recommended solder iron condition (Sn-Pb Solder and Lead Free Solder)

Temp. (°C)	Duration (sec.)	Wattage (W)	Shape (mm)
280 max.	3 max.	20 max.	Ø 3.0 max.

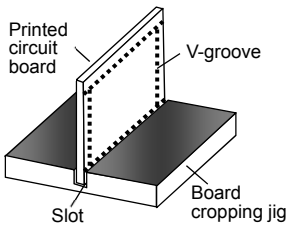
2) Direct contact of the soldering iron with ceramic dielectric of chip capacitors may cause crack. Do not touch the ceramic dielectric and the terminations by solder iron.

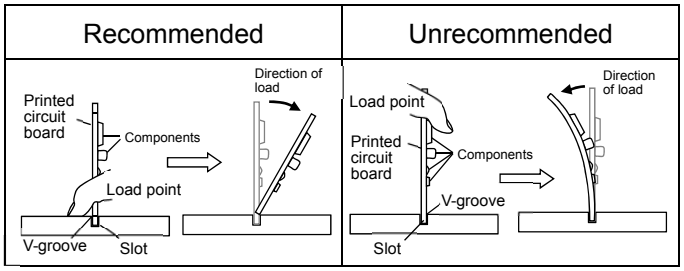
5-7. Sn-Zn solder
Sn-Zn solder affects product reliability.
Please contact TDK in advance when utilize Sn-Zn solder.

No.	Process	Condition
5	Soldering	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)
6	Cleaning	1) If an unsuitable cleaning fluid is used, flux residue or some foreign articles may stick to chip capacitor surface to deteriorate especially the insulation resistance. 2) If cleaning condition is not suitable, it may damage the chip capacitor. 2)-1. Insufficient washing (1) Terminal electrodes may corrode by Halogen in the flux. (2) Halogen in the flux may adhere on the surface of capacitor, and lower the insulation resistance. (3) Water soluble flux has higher tendency to have above mentioned problems (1) and (2). 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. Power : 20W/ℓmax. Frequency : 40kHz max. Washing time : 5 minutes max. 2)-3. If the cleaning fluid is contaminated, density of Halogen increases, and it may bring the same result as insufficient cleaning.
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 capacitor. 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 capacitor may crack. Bend  Twist 

No.	Process	Condition
8	Handling after chip mounted ⚠ Caution	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.

Outline of jig



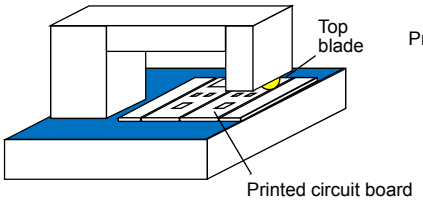


(2)Example of a board cropping machine

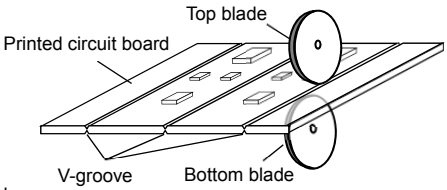
An outline of a printed circuit board cropping machine is shown below.
The top and bottom blades are aligned with one another along the lines with the V-grooves on printed circuit board when cropping the board.

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.

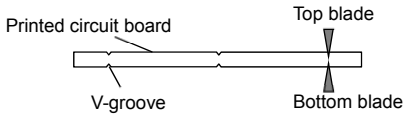
Outline of machine

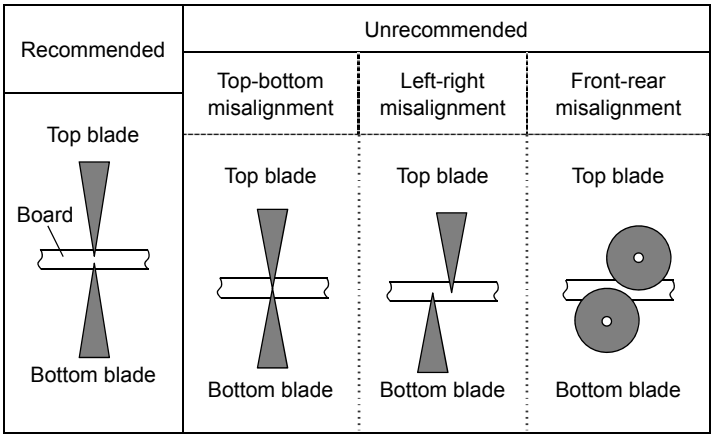


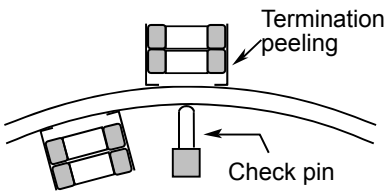
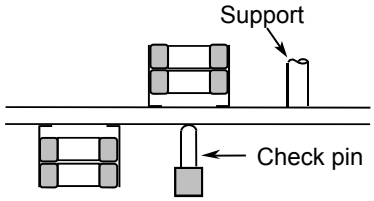
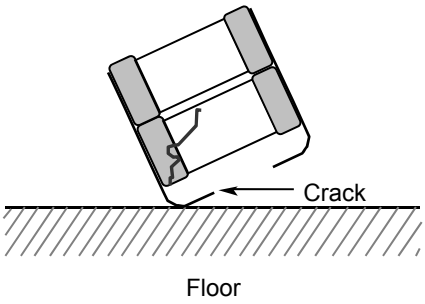
Principle of operation

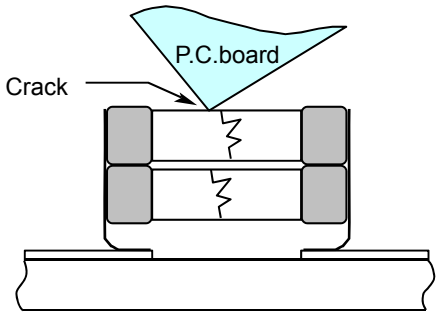


Cross-section diagram





<table>
<tr><th>No.</th><th>Process</th><th>Condition</th></tr>
<tr><td>8</td><td>Handling after chip mounted
⚠ Caution</td><td>2) 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 capacitor or peel the terminations off. Please adjust the check pins not to bend the P.C.board.
<table>
<tr><th>Item</th><th>Not recommended</th><th>Recommended</th></tr>
<tr><td>Board bending</td><td> 
</td><td> 
</td></tr>
</table></td></tr>
<tr><td>9</td><td>Handling of loose chip capacitor</td><td>1) If dropped the chip capacitor 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.
 

2) Piling the P.C.board after mounting for storage or handling, the corner of the P.C. board may hit the chip capacitor of another board to cause crack.
 
</td></tr>
<tr><td>10</td><td>Capacitance aging</td><td>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.</td></tr>
<tr><td>11</td><td>Estimated life and estimated failure rate of capacitors</td><td>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.</td></tr>
</table>

No.	Process	Condition
12	Caution during operation of equipment	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. 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 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. (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
13	Others ⚠ Caution	The products listed on this specification sheet are intended for use in general electronic equipment (AV equipment, telecommunications equipment, home appliances, amusement equipment, computer equipment, personal equipment, office equipment, measurement equipment, industrial robots) under a normal operation and use condition. 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. (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 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.

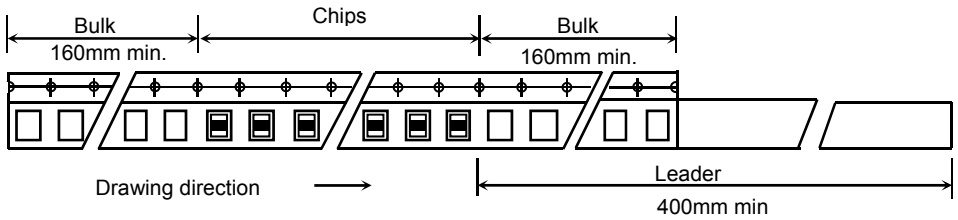
12. TAPE PACKAGING SPECIFICATION

1. CONSTRUCTION AND DIMENSION OF TAPING

1-1. Dimensions of carrier tape

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

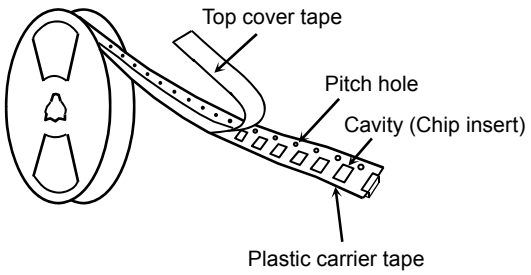
1-2. Bulk part and leader of taping



1-3. Dimensions of reel

Dimensions of Ø178 reel shall be according to Appendix 5.
Dimensions of Ø330 reel shall be according to Appendix 6.

1-4. Structure of taping



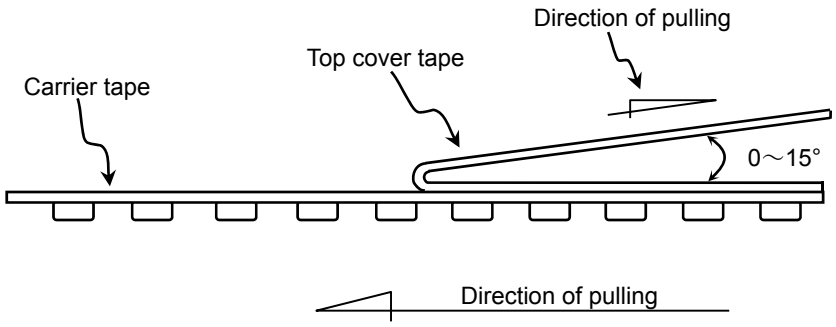
2. CHIP QUANTITY

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

3. PERFORMANCE SPECIFICATIONS

3-1. Fixing peeling strength (top tape)

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



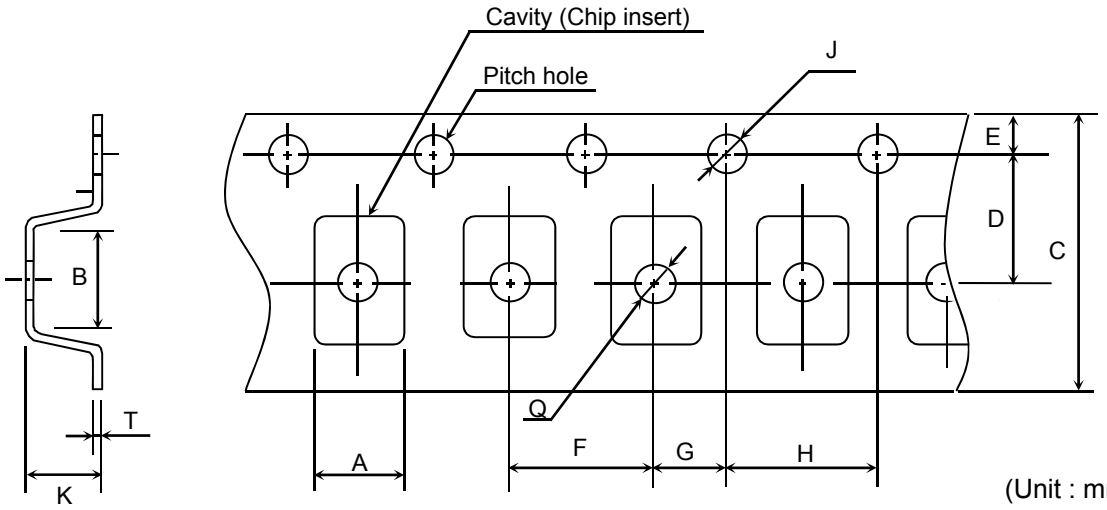
3-2. Carrier tape shall be flexible enough to be wound around a minimum radius of 30mm with components in tape.

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

3-4. When get cover tape off, there shall not be difficulties by unfitting clearance, burrs and crushes of cavities, also the sprocket holes shall not be covered by absorbing dust into the suction nozzle.

Appendix 3

Plastic Tape



(Unit : mm)

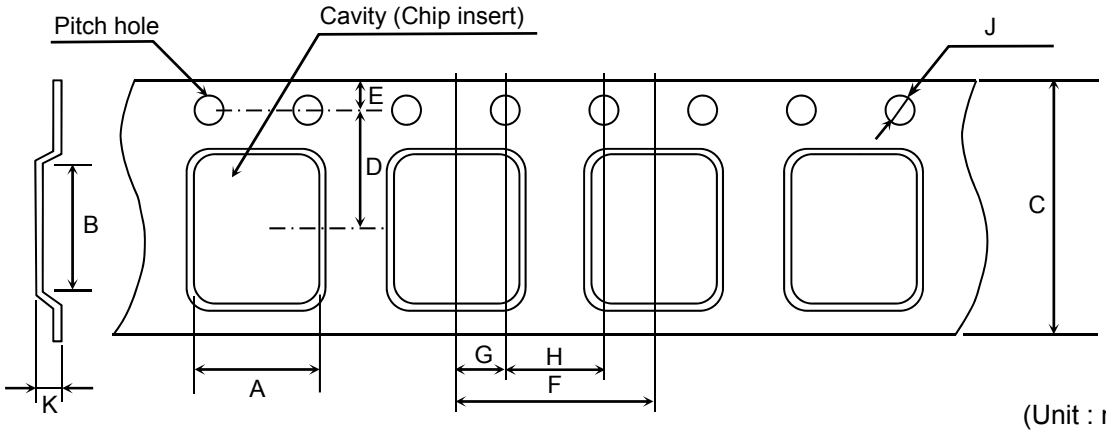
Type \ Symbol	A	B	C	D	E	F
CKG32K	(3.00)	(3.90)	12.0 ± 0.25	5.50 ± 0.05	1.75 ± 0.10	4.00 ± 0.10

Type \ Symbol	G	H	J	K	T	Q
CKG32K	2.00 ± 0.10	4.00 ± 0.10	Ø 1.5 $^{+0.10}_{0}$	3.75 max.	0.50 ± 0.05	Ø 1.65 ± 0.10

( ) Reference value.

Appendix 4

Plastic Tape



(Unit : mm)

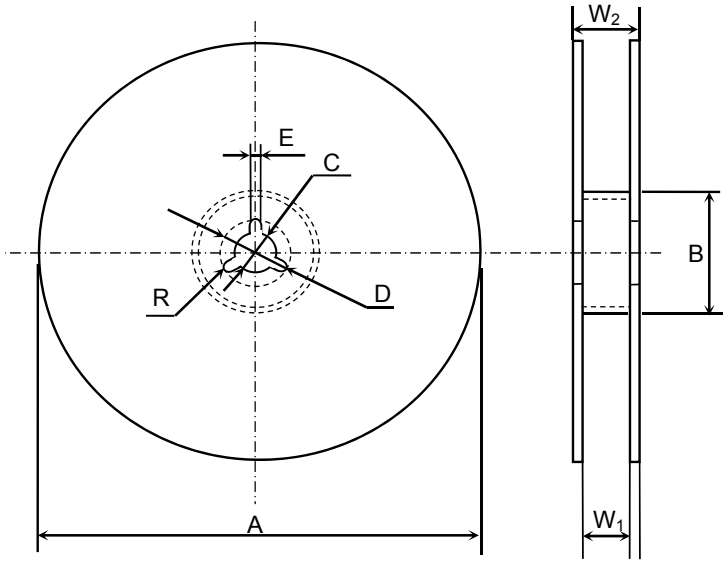
Type \ Symbol	A	B	C	D	E	F
CKG45K	(3.90)	(5.60)	12.0 ± 0.30	5.50 ± 0.10	1.75 ± 0.10	8.00 ± 0.10
CKG45N						
CKG57K	(5.60)	(6.60)	16.0 ± 0.30	7.50 ± 0.10	1.75 ± 0.10	8.00 ± 0.10
CKG57N						

Type \ Symbol	G	H	J	K
CKG45K	2.00 ± 0.10	4.00 ± 0.10	Ø 1.5 $^{+0.10}_{0}$	3.75 max.
CKG45N				6.15 max.
CKG57K	2.00 ± 0.10	4.00 ± 0.10	Ø 1.5 $^{+0.10}_{0}$	4.15 max.
CKG57N				6.15 max.

( ) Reference value.

Appendix 5

(Material : Polystyrene)



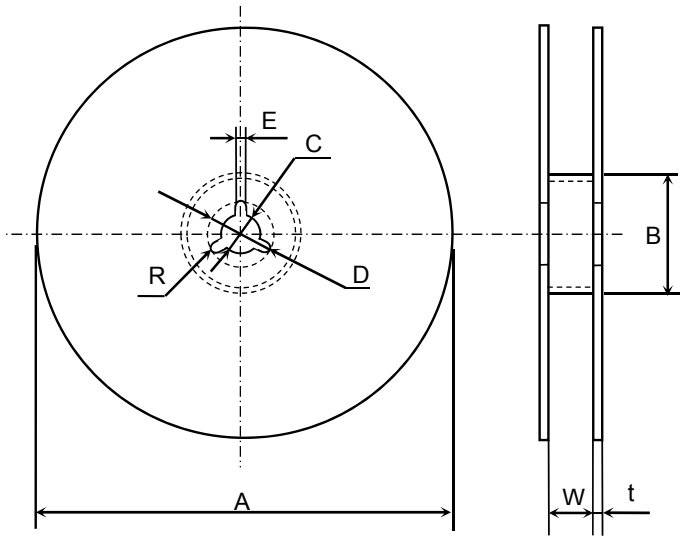
(Unit : mm)

Symbol / Dimension	A	B	C	D	E	W_1
CKG32K	Ø178 ± 2.0	Ø60 ± 2.0	Ø13 ± 0.5	Ø21 ± 0.8	2.0 ± 0.5	13.0 ± 0.3

Symbol / Dimension	W_2	R
CKG32K	17.0 ± 1.4	1.0

Appendix 6

(Material : Polystyrene)



(Unit : mm)

Symbol / Dimension	A	B	C	D	E	W
CKG32K	Ø382 max. (Nominal Ø330)	Ø50 min.	Ø13 ± 0.5	Ø21 ± 0.8	2.0 ± 0.5	14.0 ± 1.5
CKG45K, CKG45N						13.5 ± 1.5
CKG57K, CKG57N						17.5 ± 1.5

Symbol / Dimension	t	R
CKG32	2.0 ± 0.5	1.0
CKG45K, CKG45N		
CKG57K, CKG57N		

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