

# DELIVERY SPECIFICATION

SPEC. No. A-ESD-d

D A T E : Feb, 2020

To

**Non-Controlled Copy**

CUSTOMER'S PRODUCT NAME	TDK PRODUCT NAME MULTILAYER CERAMIC CHIP CAPACITORS Bulk and Tape packaging 【RoHS compliant】 CGA3EA ESD Protection Series
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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

<b>CGA</b>	<b>3</b>	<b>E</b>	<b>A</b>	<b>NP0</b>	<b>2A</b>	<b>103</b>	<b>J</b>	<b>080</b>	<b>A</b>	<b>C</b>
(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
3	CC0603	1.60	0.80	0.20

(3) Thickness code

Code	Thickness
E	0.80mm

(4) Function identification code

Symbol	Condition
A	ESD protection

(5) Temperature characteristics

Temperature characteristics	Capacitance change	Temperature range
C0G	0±30 ppm/°C	-55 to +125°C
NP0	0±30 ppm/°C	-55 to +150°C

(6) Rated voltage (DC)

Code	Voltage (DC)
2A	100V

(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
J	±5%

(9) Thickness

Code	Thickness
080	0.80mm

(10) Packaging style

Code	Style
A	178mm reel, 4mm pitch

(11) Special reserved code

Code	Tolerance
A,C	TDK internal code

**SCOPE**

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

**PRODUCTION PLACES**

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

**PRODUCT NAME**

The name of the product to be defined in this specifications shall be CGA3EA0002A□□□ ×.

**REFERENCE STANDARD**

JIS C 5101-1 : 2010	Fixed capacitors for use in electronic equipment-Part 1: Generic specification
C 5101-21 : 2014	Fixed capacitors for use in electronic equipment-Part21 : Sectional specification : Fixed surface mount multilayer capacitors of ceramic dielectric,Class1
C 0806-3 : 2014	Packaging of components for automatic handling - Part 3: Packaging of surface mount components on continuous tapes
JEITA RCR-2335 C 2014	Safety application guide for fixed ceramic capacitors for use in electronic equipment

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4. INDUSTRIAL WASTE DISPOSAL
5. PERFORMANCE
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7. PACKAGING
8. SETTING UP FOR ESD TEST
9. CAUTION
10. TAPE PACKAGING SPECIFICATION

**<EXPLANATORY NOTE>**

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

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

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

Division	Date	SPEC. No.
Ceramic Capacitors Business Group	Feb, 2020	A-ESD-d

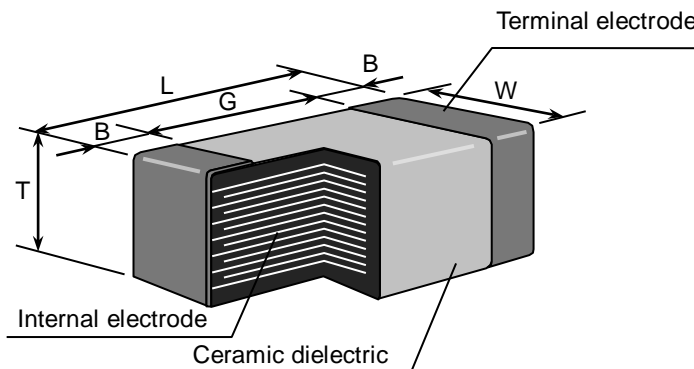
# 1. CODE CONSTRUCTION

(Example)  $\frac{CGA}{(1)} \quad \frac{3}{(2)} \quad \frac{E}{(3)} \quad \frac{A}{(4)} \quad \frac{COG}{(5)} \quad \frac{2 A}{(6)} \quad \frac{103}{(7)} \quad \frac{J}{(8)} \quad \frac{T}{(9)} \quad \frac{OOOO}{(10)}$

(1) Series

Symbol	Series
CGA	Ceramic chip capacitor for automotive application

(2) Case size



Symbol	Case size	Dimensions (Unit : mm)				
	TDK(EIA style)	L	W	T	B	G
3	CGA3(CC0603)	1.60±0.10	0.80±0.10	0.80±0.10	0.20 min.	0.30 min.

(3) Thickness

Symbol	Dimension(mm)
E	0.80

(4) Identification for ESD capacitor

\* Details are shown in Table 1 No.16 at 5.PERFORMANCE.

※ As for applied ESD level, please refer to detail page on TDK Web.

Symbol	Identification
A	ESD capacitor

(5) Temperature Characteristics

\* Details are shown in Table 1 No.6 at 5.PERFORMANCE.

(6) Rated Voltage

Symbol	Rated Voltage
2 A	DC 100 V

(7) Rated Capacitance

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

(Example)

Symbol	Rated Capacitance
103	10,000 pF

(8) Capacitance tolerance

Symbol	Tolerance
J	± 5 %

(9) Packaging

Symbol	Packaging
B	Bulk
T	Taping

(10) TDK internal code

**2. OPERATING TEMPERATURE RANGE**

T.C.	Min. operating Temperature	Max. operating Temperature	Reference Temperature
C0G	-55°C	125°C	25°C
NP0	-55°C	150°C	25°C

**3. STORING CONDITION AND TERM**

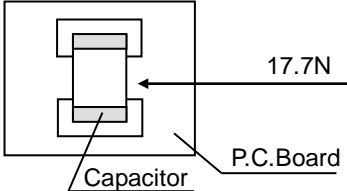
Storing temperature	Storing humidity	Storing term
5~40°C	20~70%RH	Within 6 months upon receipt.

**4. INDUSTRIAL WASTE DISPOSAL**

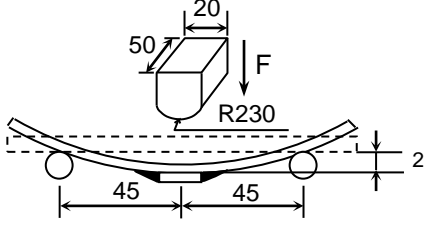
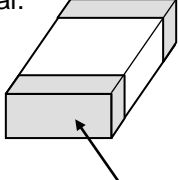
Dispose this product as industrial waste in accordance with the Industrial Waste Law.

5. PERFORMANCE

Table 1

No.	Item	Performance	Test or inspection method								
1	External Appearance	No defects which may affect performance.	Inspect with magnifying glass(3x)								
2	Insulation Resistance	10,000MΩ min.	Measuring voltage : Rated voltage Voltage application time : 60s.								
3	Voltage Proof	Withstand test voltage without insulation breakdown or other damage.	Apply voltage : 3 x rated voltage Voltage application time : 1s. Charge/discharge current : 50mA or lower								
4	Capacitance	Within the specified tolerance.	<table border="1"> <thead> <tr> <th>Rated Capacitance</th> <th>Measuring frequency</th> <th>Measuring voltage</th> </tr> </thead> <tbody> <tr> <td>1000pF</td> <td>1MHz±10%</td> <td rowspan="2">0.5 ~ 5V rms.</td> </tr> <tr> <td>Over 1000pF</td> <td>1kHz±10%</td> </tr> </tbody> </table>	Rated Capacitance	Measuring frequency	Measuring voltage	1000pF	1MHz±10%	0.5 ~ 5V rms.	Over 1000pF	1kHz±10%
Rated Capacitance	Measuring frequency	Measuring voltage									
1000pF	1MHz±10%	0.5 ~ 5V rms.									
Over 1000pF	1kHz±10%										
5	Q	Please refer to detail page on TDK Web.	See No.4 in this table for measuring condition.								
6	Temperature Characteristics of Capacitance	<table border="1"> <thead> <tr> <th>T.C.</th> <th>Temperature Coefficient (ppm/°C)</th> </tr> </thead> <tbody> <tr> <td>COG</td> <td>0 ± 30</td> </tr> <tr> <td>NPO</td> <td>0 ± 30</td> </tr> </tbody> </table> <table border="1"> <tbody> <tr> <td>Capacitance drift</td> <td>Within ± 0.2% or ± 0.05pF, whichever larger.</td> </tr> </tbody> </table>	T.C.	Temperature Coefficient (ppm/°C)	COG	0 ± 30	NPO	0 ± 30	Capacitance drift	Within ± 0.2% or ± 0.05pF, whichever larger.	<p>Temperature coefficient shall be calculated based on values at 25°C and 85°C temperature.</p> <p>Measuring temperature below 25°C shall be -10°C and -25°C.</p>
T.C.	Temperature Coefficient (ppm/°C)										
COG	0 ± 30										
NPO	0 ± 30										
Capacitance drift	Within ± 0.2% or ± 0.05pF, whichever larger.										
7	Robustness of Terminations	No sign of termination coming off, breakage of ceramic, or other abnormal signs.	<p>Reflow solder the capacitors on a P.C.Board shown in Appendix 2.</p> <p>Apply a pushing force gradually at the center of a specimen in a horizontal direction of P.C.board.</p> <p>Pushing force : 17.7N Holding time : 10±1s.</p> 								

(continued)

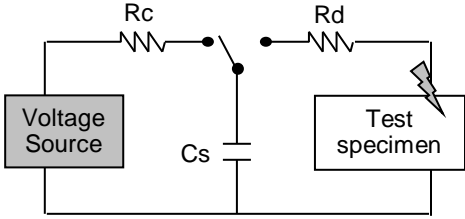
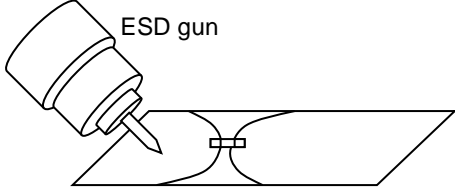
No.	Item	Performance	Test or inspection method				
8	Bending	No mechanical damage.	Reflow solder the capacitor on a P.C.Board shown in Appendix1.  <p style="text-align: right;">(Unit : mm)</p>				
9	Solderability	New solder to cover over 75% of termination. 25% may have pin holes or rough spots but not concentrated in one spot. Ceramic surface of A sections shall not be exposed due to melting or shifting of termination material.  <p style="text-align: center;">A section</p>	Solder : Sn-3.0Ag-0.5Cu or Sn-37Pb Flux : Isopropyl alcohol (JIS K 8839) Rosin (JIS K 5902) 25% solid solution. Solder temp. : 245±5°C (Sn-3.0Ag-0.5Cu) 235±5°C (Sn-37Pb) Dwell time : 3±0.3s.(Sn-3.0Ag-0.5Cu) 2±0.2s.(Sn-37Pb) Solder position : Until both terminations are completely soaked.				
10	Resistance to solder heat	External appearance	No cracks are allowed and terminations shall be covered at least 60% with new solder.				
	Capacitance	<table border="1" data-bbox="550 1220 917 1377"> <thead> <tr> <th>Characteristics</th> <th>Change from the value before test</th> </tr> </thead> <tbody> <tr> <td>C0G NP0</td> <td>±2.5%</td> </tr> </tbody> </table>	Characteristics	Change from the value before test	C0G NP0	±2.5%	Solder : Sn-3.0Ag-0.5Cu or Sn-37Pb Flux : Isopropyl alcohol (JIS K 8839) Rosin (JIS K 5902) 25% solid solution. Solder temp. : 260±5°C
	Characteristics	Change from the value before test					
	C0G NP0	±2.5%					
	Q	Meet the initial spec.	Dwell time : 10±1s.				
Insulation Resistance	Meet the initial spec.	Solder position : Until both terminations are completely soaked.					
Voltage proof	No insulation breakdown or other damage.	Pre-heating : Temp. — 110~140°C Time — 30~60s. Leave the capacitors in ambient condition for 6~24h before measurement.					

(continued)

No.	Item	Performance	Test or inspection method																																
11	Vibration	<table border="1"> <tr> <td data-bbox="360 241 504 327">External appearance</td> <td colspan="2" data-bbox="504 241 959 327">No mechanical damage.</td> </tr> <tr> <td data-bbox="360 327 504 539" rowspan="2">Capacitance</td> <td data-bbox="504 327 695 427">Characteristics</td> <td data-bbox="695 327 959 427">Change from the value before test</td> </tr> <tr> <td data-bbox="504 427 695 539">C0G NP0</td> <td data-bbox="695 427 959 539">±2.5%</td> </tr> <tr> <td data-bbox="360 539 504 730">Q</td> <td colspan="2" data-bbox="504 539 959 730">Meet the initial spec.</td> </tr> </table>	External appearance	No mechanical damage.		Capacitance	Characteristics	Change from the value before test	C0G NP0	±2.5%	Q	Meet the initial spec.		<p>Applied force : 5G max.                      Frequency : 10~2,000Hz                      Reciprocating sweep time : 20 min.                      Cycle : 12 cycles in each 3 mutually perpendicular directions.</p> <p>Reflow solder the capacitors on a P.C.Board shown in Appendix 2 before testing.</p>																					
External appearance	No mechanical damage.																																		
Capacitance	Characteristics	Change from the value before test																																	
	C0G NP0	±2.5%																																	
Q	Meet the initial spec.																																		
12	Temperature cycle	<table border="1"> <tr> <td data-bbox="360 730 504 824">External appearance</td> <td colspan="2" data-bbox="504 730 959 824">No mechanical damage.</td> </tr> <tr> <td data-bbox="360 824 504 1055" rowspan="2">Capacitance</td> <td data-bbox="504 824 695 925">Characteristics</td> <td data-bbox="695 824 959 925">Change from the value before test</td> </tr> <tr> <td data-bbox="504 925 695 1055">C0G NP0</td> <td data-bbox="695 925 959 1055">Please contact with our sales representative.</td> </tr> <tr> <td data-bbox="360 1055 504 1189">Q</td> <td colspan="2" data-bbox="504 1055 959 1189">Meet the initial spec.</td> </tr> <tr> <td data-bbox="360 1189 504 1323">Insulation Resistance</td> <td colspan="2" data-bbox="504 1189 959 1323">Meet the initial spec.</td> </tr> <tr> <td data-bbox="360 1323 504 1532">Voltage proof</td> <td colspan="2" data-bbox="504 1323 959 1532">No insulation breakdown or other damage.</td> </tr> </table>	External appearance	No mechanical damage.		Capacitance	Characteristics	Change from the value before test	C0G NP0	Please contact with our sales representative.	Q	Meet the initial spec.		Insulation Resistance	Meet the initial spec.		Voltage proof	No insulation breakdown or other damage.		<p>Expose the capacitors in the condition step1 through step 4 listed in the following table.</p> <p>Temp. cycle : 1,000 cycles</p> <table border="1"> <thead> <tr> <th data-bbox="983 902 1054 947">Step</th> <th data-bbox="1054 902 1302 947">Temperature(°C)</th> <th data-bbox="1302 902 1453 947">Time (min.)</th> </tr> </thead> <tbody> <tr> <td data-bbox="983 947 1054 1025">1</td> <td data-bbox="1054 947 1302 1025">Min. operating temp. ±3</td> <td data-bbox="1302 947 1453 1025">30 ± 3</td> </tr> <tr> <td data-bbox="983 1025 1054 1070">2</td> <td data-bbox="1054 1025 1302 1070">Ambient Temp.</td> <td data-bbox="1302 1025 1453 1070">2 ~ 5</td> </tr> <tr> <td data-bbox="983 1070 1054 1137">3</td> <td data-bbox="1054 1070 1302 1137">Max. operating temp. ±2</td> <td data-bbox="1302 1070 1453 1137">30 ± 2</td> </tr> <tr> <td data-bbox="983 1137 1054 1193">4</td> <td data-bbox="1054 1137 1302 1193">Ambient Temp.</td> <td data-bbox="1302 1137 1453 1193">2 ~ 5</td> </tr> </tbody> </table> <p>As for Min./ Max. operating temp., please refer to "3.OPERATING TEMPERATURE RANGE".</p> <p>Leave the capacitors in ambient condition for 6~24h before measurement.</p> <p>Reflow solder the capacitors on a P.C.Board shown in Appendix 2 before testing.</p>	Step	Temperature(°C)	Time (min.)	1	Min. operating temp. ±3	30 ± 3	2	Ambient Temp.	2 ~ 5	3	Max. operating temp. ±2	30 ± 2	4	Ambient Temp.	2 ~ 5
External appearance	No mechanical damage.																																		
Capacitance	Characteristics	Change from the value before test																																	
	C0G NP0	Please contact with our sales representative.																																	
Q	Meet the initial spec.																																		
Insulation Resistance	Meet the initial spec.																																		
Voltage proof	No insulation breakdown or other damage.																																		
Step	Temperature(°C)	Time (min.)																																	
1	Min. operating temp. ±3	30 ± 3																																	
2	Ambient Temp.	2 ~ 5																																	
3	Max. operating temp. ±2	30 ± 2																																	
4	Ambient Temp.	2 ~ 5																																	
13	Moisture Resistance (Steady State)	<table border="1"> <tr> <td data-bbox="360 1532 504 1610">External appearance</td> <td colspan="2" data-bbox="504 1532 959 1610">No mechanical damage.</td> </tr> <tr> <td data-bbox="360 1610 504 1834" rowspan="2">Capacitance</td> <td data-bbox="504 1610 695 1711">Characteristics</td> <td data-bbox="695 1610 959 1711">Change from the value before test</td> </tr> <tr> <td data-bbox="504 1711 695 1834">C0G NP0</td> <td data-bbox="695 1711 959 1834">Please contact with our sales representative.</td> </tr> <tr> <td data-bbox="360 1834 504 1924">Q</td> <td colspan="2" data-bbox="504 1834 959 1924">350 min.</td> </tr> <tr> <td data-bbox="360 1924 504 2011">Insulation Resistance</td> <td colspan="2" data-bbox="504 1924 959 2011">1,000MΩ min.</td> </tr> </table>	External appearance	No mechanical damage.		Capacitance	Characteristics	Change from the value before test	C0G NP0	Please contact with our sales representative.	Q	350 min.		Insulation Resistance	1,000MΩ min.		<p>Test temp. : 40±2°C                      Test humidity : 90~95%RH                      Test time : 500 +24,0h</p> <p>Leave the capacitors in ambient condition for 6~24h before measurement.</p> <p>Reflow solder the capacitors on a P.C.Board shown in Appendix2 before testing.</p>																		
External appearance	No mechanical damage.																																		
Capacitance	Characteristics	Change from the value before test																																	
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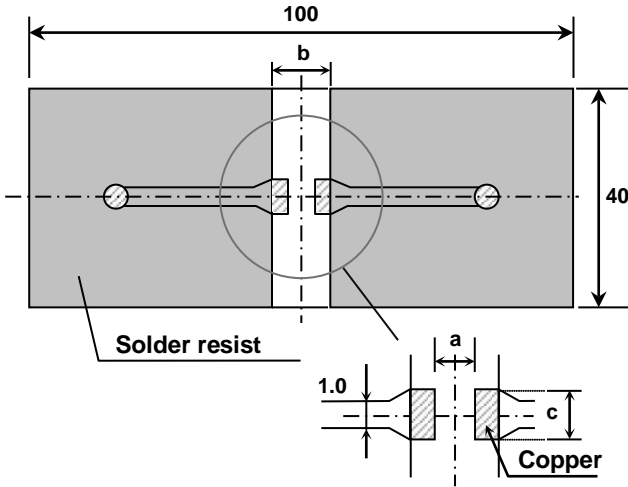


(continued)

No.	Item	Performance	Test or inspection method				
14	Moisture Resistance External appearance Capacitance Q Insulation Resistance	No mechanical damage. <table border="1" data-bbox="515 344 956 524"> <tr> <td data-bbox="515 344 691 416">Characteristics</td> <td data-bbox="695 344 956 416">Change from the value before test</td> </tr> <tr> <td data-bbox="515 423 691 524">COG NPO</td> <td data-bbox="695 423 956 524">Please contact with our sales representative.</td> </tr> </table> 200 min. 500MΩ min.	Characteristics	Change from the value before test	COG NPO	Please contact with our sales representative.	Test temp. : 85±2°C Test humidity : 85%RH Applied voltage : Rated voltage Test time : 1,000 +48,0h Charge/discharge current : 50mA or lower Leave the capacitors in ambient condition for 6~24h before measurement. Reflow solder the capacitors on a P.C.Board shown in Appendix2 before testing.
Characteristics	Change from the value before test						
COG NPO	Please contact with our sales representative.						
15	Life External appearance Capacitance Q Insulation Resistance	No mechanical damage. <table border="1" data-bbox="515 837 956 1016"> <tr> <td data-bbox="515 837 691 909">Characteristics</td> <td data-bbox="695 837 956 909">Change from the value before test</td> </tr> <tr> <td data-bbox="515 916 691 1016">COG NPO</td> <td data-bbox="695 916 956 1016">Please contact with our sales representative.</td> </tr> </table> 350 min. 1,000MΩ min.	Characteristics	Change from the value before test	COG NPO	Please contact with our sales representative.	Test temp. : Maximum operating temperature±2°C Applied voltage : Please contact with our sales representative. Test time : 1,000 +48,0h Charge/discharge current : 50mA or lower Leave the capacitors in ambient condition for 6~24h before measurement. Reflow solder the capacitors on a P.C.Board shown in Appendix2 before testing.
Characteristics	Change from the value before test						
COG NPO	Please contact with our sales representative.						
16	ESD	Withstand ESD voltage without insulation breakdown.  <p data-bbox="496 1630 895 1731">                         Rc : Charge current limit resistor                          Rd : Discharge resistor                          Cs : Energy storage capacitor                     </p> 	Reflow Solder the capacitors on a P.C.Board shown in Appendix3 before testing. Circuit condition : IEC 61000-4-2 (Cs : 150pF / Rd : 330Ω) Test method : Direct contact Number of ESD pulse : ±10 times As for applied ESD level, please refer to detail page on TDK Web. After each ESD pulse, dissipation of residual charge shall be done with applying 1MΩ resistance for 1 sec min.				

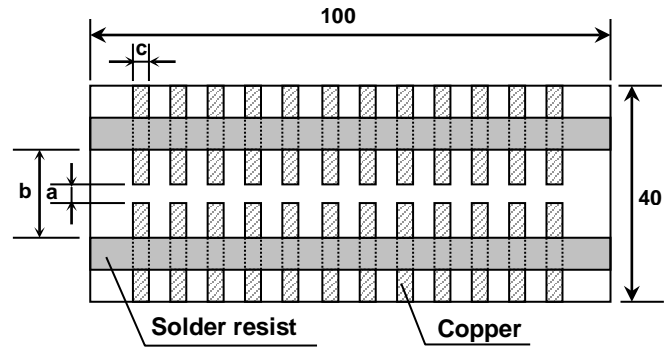
Appendix1

P.C.Board for bending test



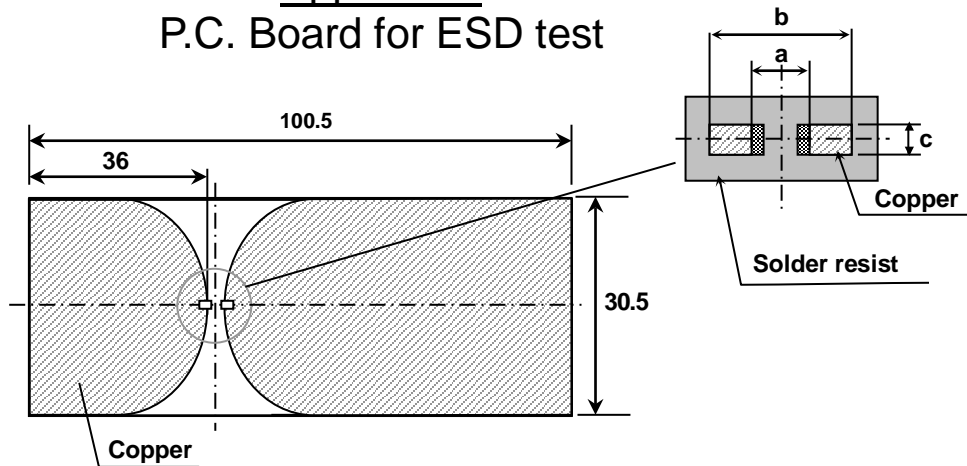
Appendix2

P.C. Board for reliability test



Appendix3

P.C. Board for ESD test



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

2. Thickness : 1.6mm

- Copper(Thickness:0.035mm)
- Solder resist

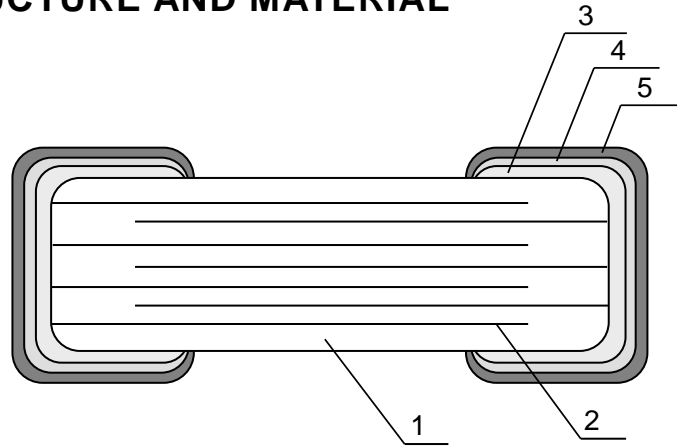
Appendix 1, 2 (Unit : mm)

Case size	a	b	c
TDK(EIA style)			
CGA3(CC0603)	1.0	3.0	1.2

Appendix 3 (ESD TEST) (Unit : mm)

Case size	a	b	c
TDK(EIA style)			
CGA3(CC0603)	1.0	3.0	0.75

## 6. INSIDE STRUCTURE AND MATERIAL



No.	NAME	MATERIAL
1	Dielectric	CaZrO <sub>3</sub>
2	Electrode	Nickel (Ni)
3	Termination	Copper (Cu)
4		Nickel (Ni)
5		Tin (Sn)

## 7. 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.

7.1 Each plastic bag for bulk packaging contains 1000pcs. And the minimum quantity for Bulk packaging is 1000pcs.

7.2 Tape packaging is as per 11. TAPE PACKAGING SPECIFICATION.

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

\*Composition of Inspection No.

Example F 9 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 May 1, 2019)

Example 

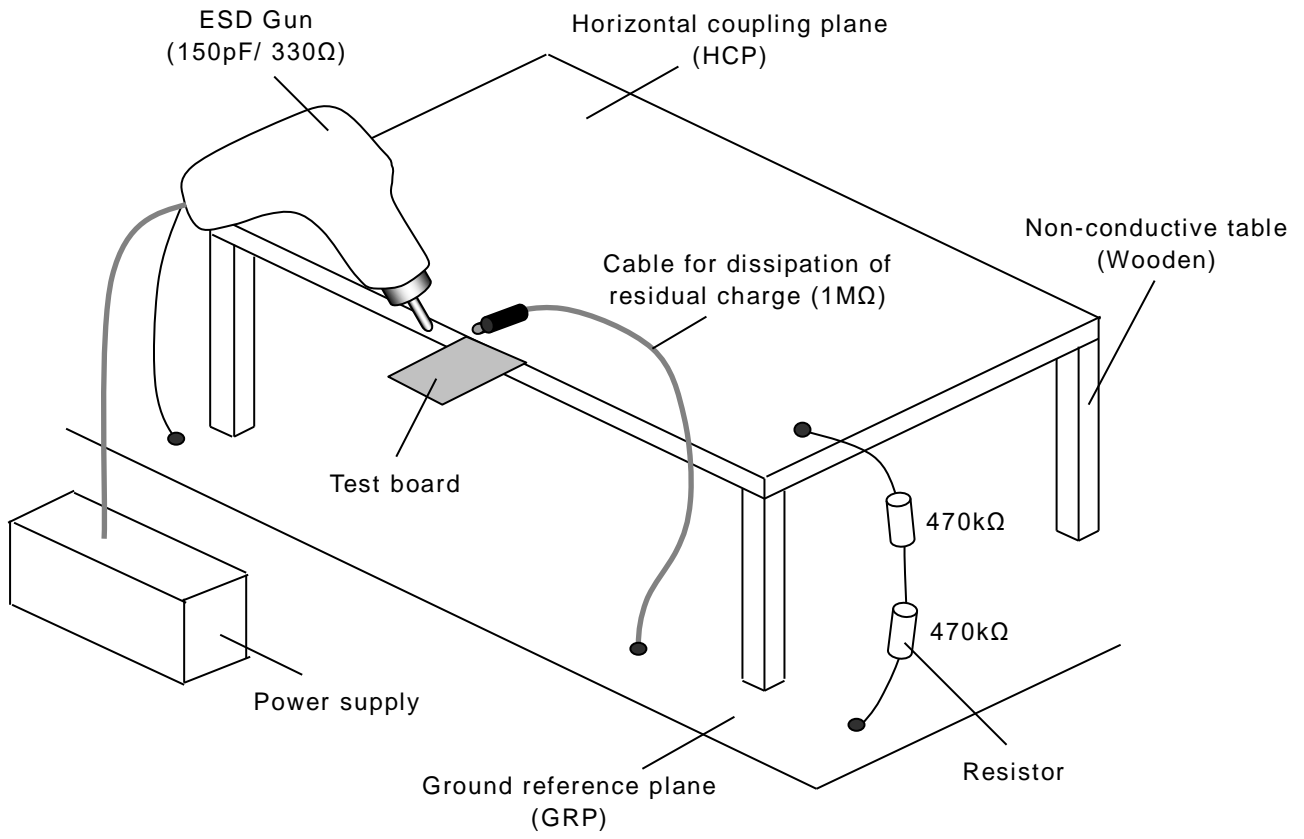
I	F	9	E	2	3	A	0	0	1
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 (a) (b) (c) (d) (e) (f) (g)

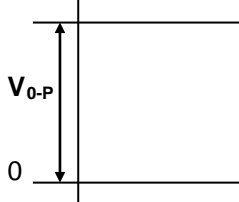
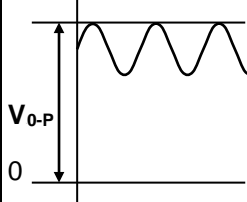
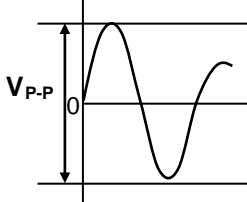
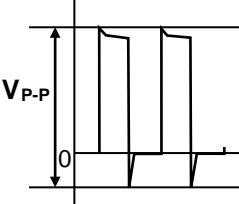
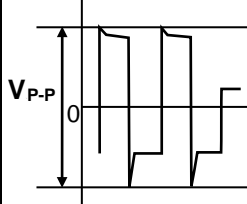
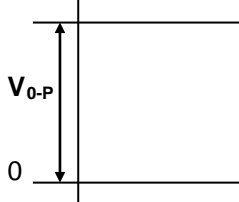
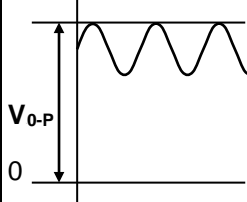
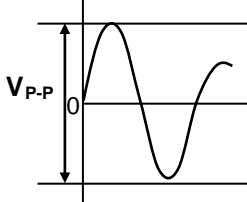
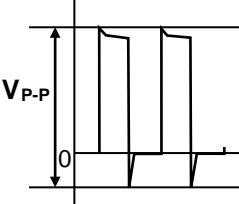
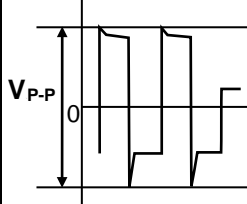
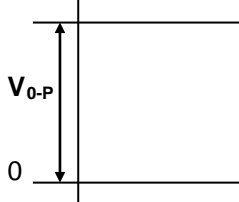
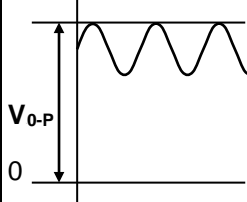
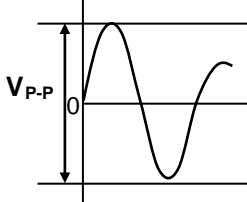
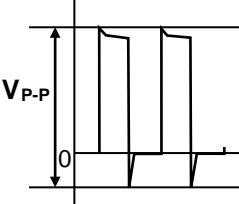
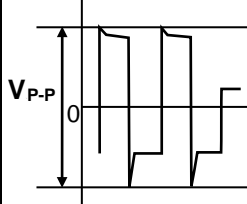
- (a) Prefix
- (b) Line code
- (c) Last digit of the year
- (d) Month and A for January and B for February and so on. (Skip I)
- (e) Inspection Date of the month.
- (f) Serial No. of the day(00 ~ ZZ)
- (g) Suffix(00 ~ ZZ)


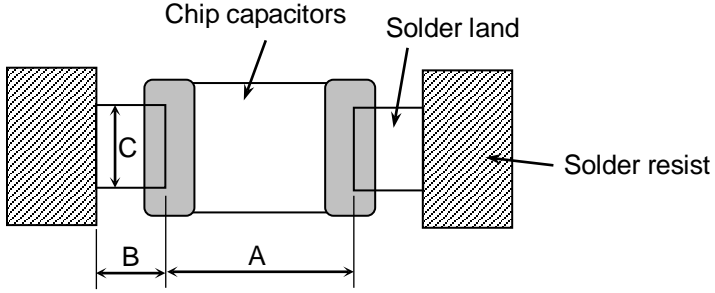
\* It is planned to shift to the new inspection No. on and after May 2019, but the implementation timing may be different depending on shipment bases. Until the shift is completed, either current or new composition of inspection No. will be applied.

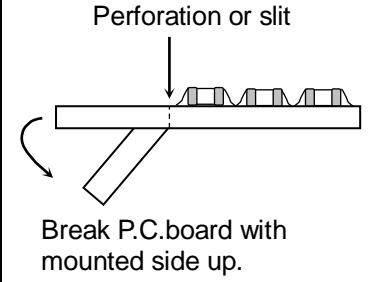
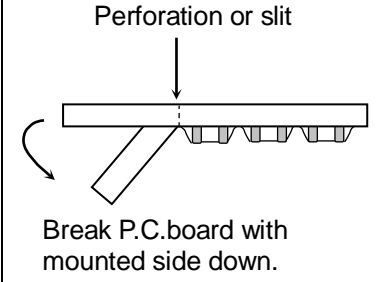
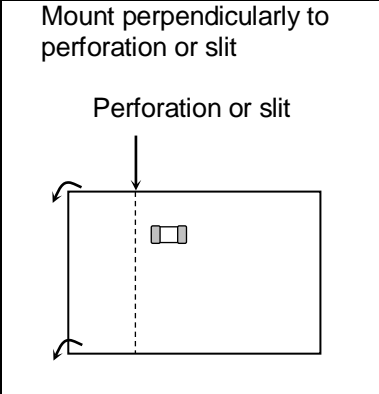
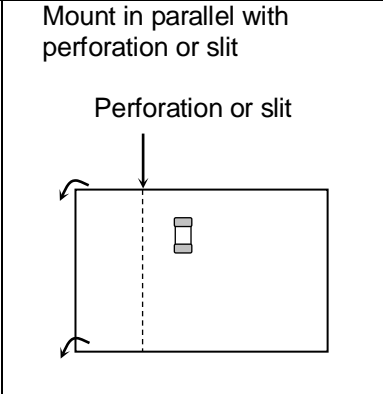
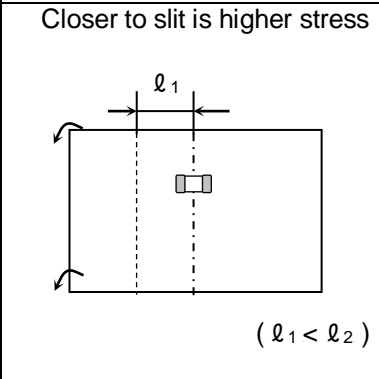
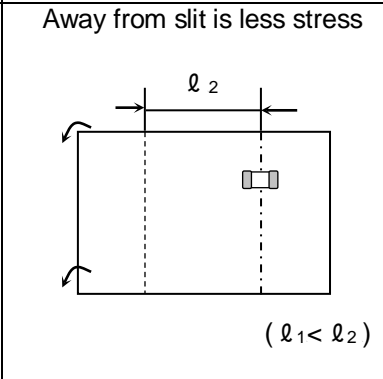
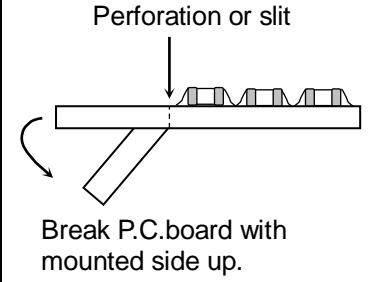
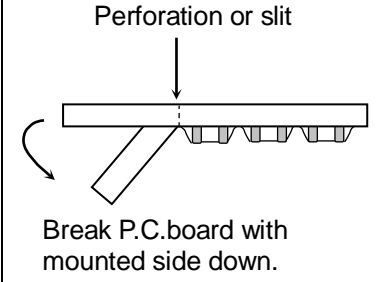
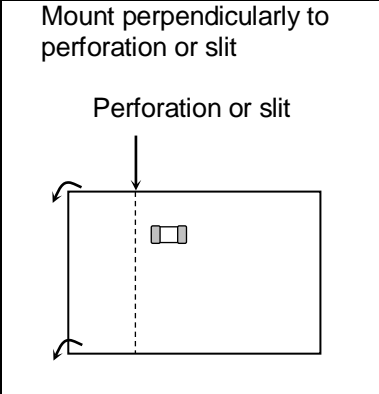
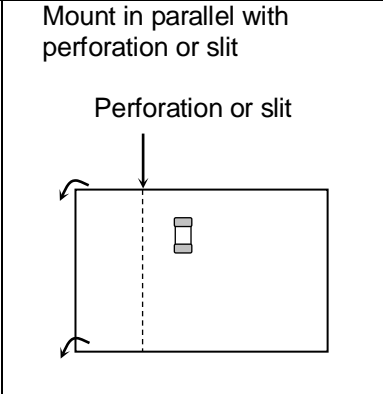
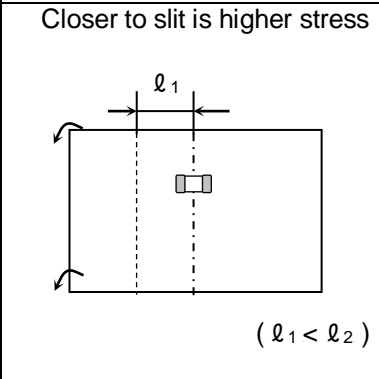
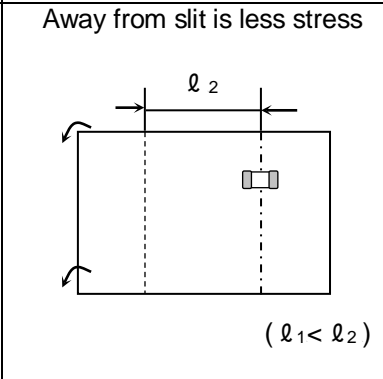
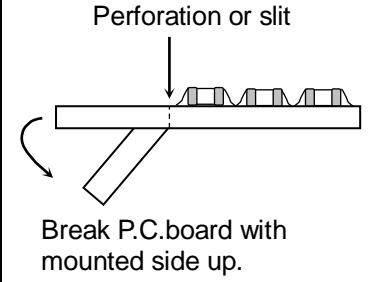
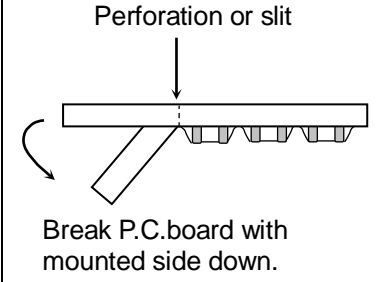
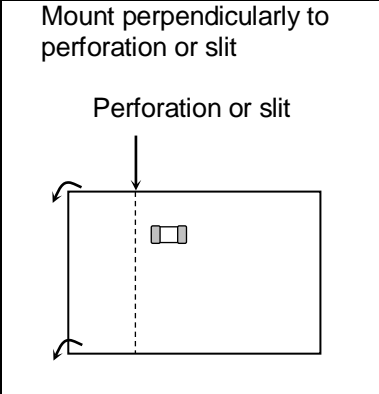
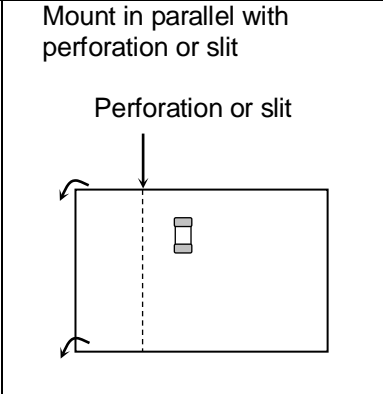
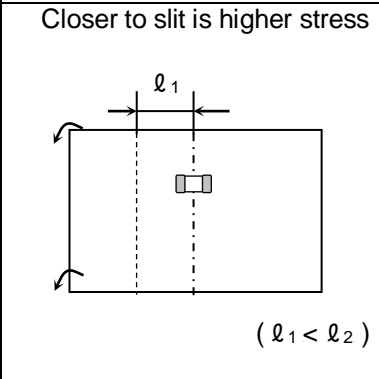
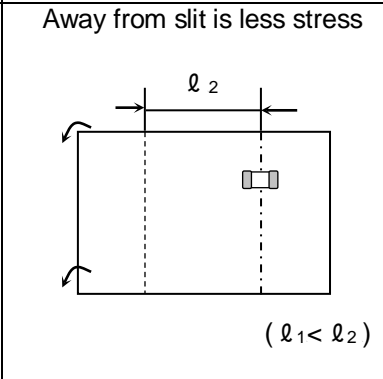
## 8. SETTING UP FOR ESD TEST



### 9. CAUTION

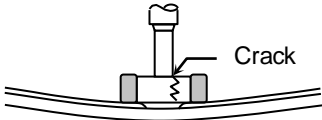
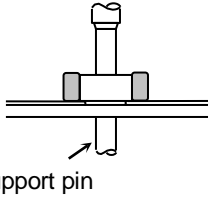
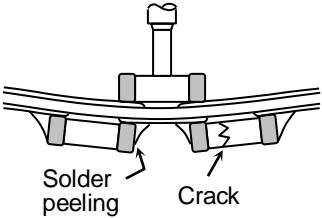
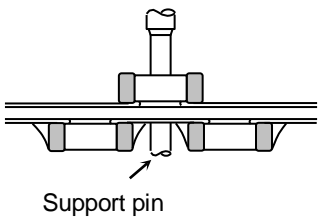
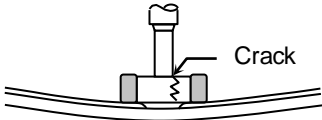
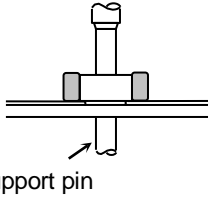
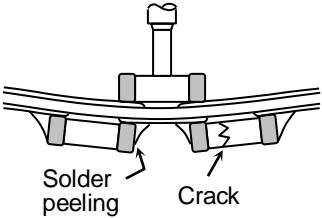
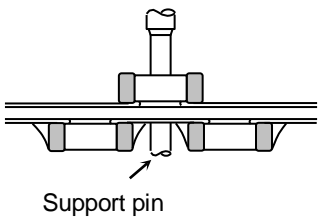
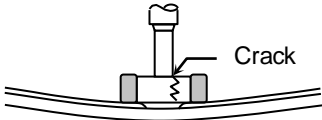
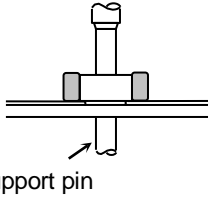
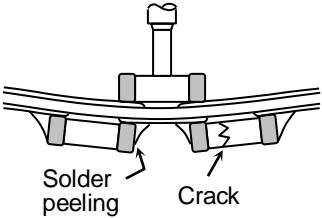
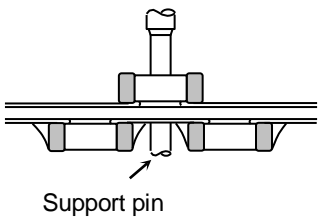
No.	Process	Condition																
1	Operating Condition (Storage, Use, Transportation)	<p>1-1. Storage, Use</p> <ol style="list-style-type: none"> <li>1) The capacitors must be stored in an ambient temperature of 5 to 40°C with a relative humidity of 20 to 70%RH. The products should be used within 6 months upon receipt.</li> <li>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.</li> <li>3) Avoid storing in sun light and falling of dew.</li> <li>4) Do not use capacitors under high humidity and high and low atmospheric pressure which may affect capacitors reliability.</li> <li>5) Capacitors should be tested for the solderability when they are stored for long time.</li> </ol> <p>1-2. Handling in transportation In case of the transportation of the capacitors, the performance of the capacitors may be deteriorated depending on the transportation condition. (Refer to JEITA RCR-2335C 9.2 Handling in transportation)</p>																
2	Circuit design ⚠ Caution	<p>2-1. Operating temperature Operating temperature should be followed strictly within this specification, especially be careful with maximum temperature.</p> <ol style="list-style-type: none"> <li>1) Do not use capacitors above the maximum allowable operating temperature.</li> <li>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)</li> <li>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.</li> </ol> <p>2-2. Operating voltage</p> <ol style="list-style-type: none"> <li>1) Operating voltage across the terminals should be below the rated voltage. When AC and DC are super imposed, <math>V_{0-P}</math> must be below the rated voltage. AC or pulse with overshooting, <math>V_{P-P}</math> must be below the rated voltage.</li> </ol> <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="470 1523 1444 2083"> <thead> <tr> <th data-bbox="470 1523 662 1568">Voltage</th> <th data-bbox="662 1523 917 1568">(1) DC voltage</th> <th data-bbox="917 1523 1181 1568">(2) DC+AC voltage</th> <th data-bbox="1181 1523 1444 1568">(3) AC voltage</th> </tr> </thead> <tbody> <tr> <td data-bbox="470 1568 662 1792">Positional Measurement (Rated voltage)</td> <td data-bbox="662 1568 917 1792">  </td> <td data-bbox="917 1568 1181 1792">  </td> <td data-bbox="1181 1568 1444 1792">  </td> </tr> <tr> <th data-bbox="470 1814 662 1859">Voltage</th> <th data-bbox="662 1814 917 1859">(4) Pulse voltage (A)</th> <th data-bbox="917 1814 1181 1859">(5) Pulse voltage (B)</th> <th></th> </tr> <tr> <td data-bbox="470 1859 662 2083">Positional Measurement (Rated voltage)</td> <td data-bbox="662 1859 917 2083">  </td> <td data-bbox="917 1859 1181 2083">  </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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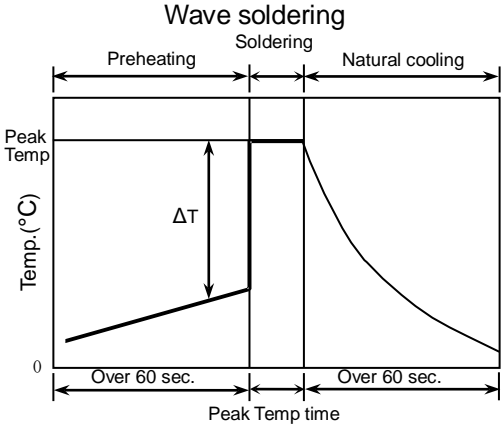
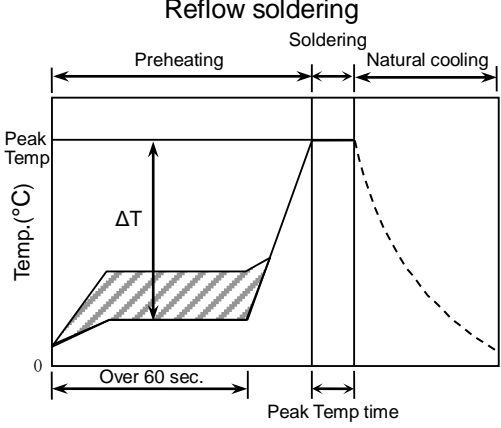
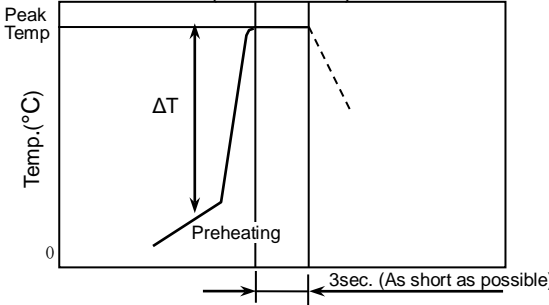
No.	Process	Condition																								
2	Circuit design  Caution	2) Even below the rated voltage, if repetitive high frequency AC or pulse is applied, the reliability of the capacitors may be reduced.  3) The effective capacitance will vary depending on applied DC and AC voltages. The capacitors should be selected and designed in taking the voltages into consideration.  2-3. Frequency When the capacitors (Class 2) are used in AC and/or pulse voltages, the capacitors may vibrate themselves and generate audible sound.																								
3	Designing P.C.board	<p>The amount of solder at the terminations has a direct effect on the reliability of the capacitors.</p> <ol style="list-style-type: none"> <li>1) The greater the amount of solder, the higher the stress on the chip capacitors, and the more likely that it will break. When designing a P.C.board, determine the shape and size of the solder lands to have proper amount of solder on the terminations.</li> <li>2) Avoid using common solder land for multiple terminations and provide individual solder land for each terminations.</li> <li>3) Size and recommended land dimensions.</li> </ol> <div style="text-align: center;">  </div> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2" style="text-align: left;">Flow soldering(mm)</th> </tr> <tr> <th style="text-align: left;">Case size</th> <th style="text-align: left;">CGA3 (CC0603)</th> </tr> </thead> <tbody> <tr> <td style="text-align: left;">Symbol</td> <td></td> </tr> <tr> <td style="text-align: center;">A</td> <td style="text-align: center;">0.7 ~ 1.0</td> </tr> <tr> <td style="text-align: center;">B</td> <td style="text-align: center;">0.8 ~ 1.0</td> </tr> <tr> <td style="text-align: center;">C</td> <td style="text-align: center;">0.6 ~ 0.8</td> </tr> </tbody> </table> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2" style="text-align: left;">Reflow soldering (mm)</th> </tr> <tr> <th style="text-align: left;">Case size</th> <th style="text-align: left;">CGA3 (CC0603)</th> </tr> </thead> <tbody> <tr> <td style="text-align: left;">Symbol</td> <td></td> </tr> <tr> <td style="text-align: center;">A</td> <td style="text-align: center;">0.6 ~ 0.8</td> </tr> <tr> <td style="text-align: center;">B</td> <td style="text-align: center;">0.6 ~ 0.8</td> </tr> <tr> <td style="text-align: center;">C</td> <td style="text-align: center;">0.6 ~ 0.8</td> </tr> </tbody> </table>	Flow soldering(mm)		Case size	CGA3 (CC0603)	Symbol		A	0.7 ~ 1.0	B	0.8 ~ 1.0	C	0.6 ~ 0.8	Reflow soldering (mm)		Case size	CGA3 (CC0603)	Symbol		A	0.6 ~ 0.8	B	0.6 ~ 0.8	C	0.6 ~ 0.8
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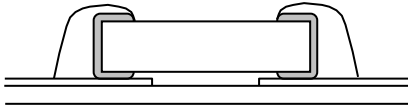
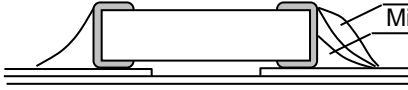
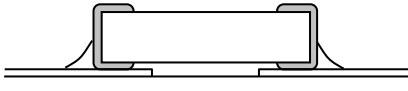
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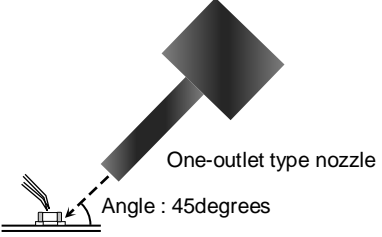
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3	Designing P.C.board	<p>5) Mechanical stress varies according to location of chip capacitors on the P.C.board.</p> <div data-bbox="459 246 1264 806" style="text-align: center;"> </div> <p style="text-align: center;">The stress in capacitors is in the following order.  <math>A &gt; B = C &gt; D &gt; E</math></p> <p>6) Layout recommendation</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th data-bbox="379 985 539 1093">Example</th> <th data-bbox="539 985 845 1093">Use of common solder land</th> <th data-bbox="845 985 1152 1093">Soldering with chassis</th> <th data-bbox="1152 985 1481 1093">Use of common solder land with other SMD</th> </tr> </thead> <tbody> <tr> <td data-bbox="379 1093 539 1478" style="text-align: center; vertical-align: middle;">Need to avoid</td> <td data-bbox="539 1093 845 1478"> </td> <td data-bbox="845 1093 1152 1478"> </td> <td data-bbox="1152 1093 1481 1478"> </td> </tr> <tr> <td data-bbox="379 1478 539 1892" style="text-align: center; vertical-align: middle;">Recommendation</td> <td data-bbox="539 1478 845 1892"> </td> <td data-bbox="845 1478 1152 1892"> </td> <td data-bbox="1152 1478 1481 1892"> </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			
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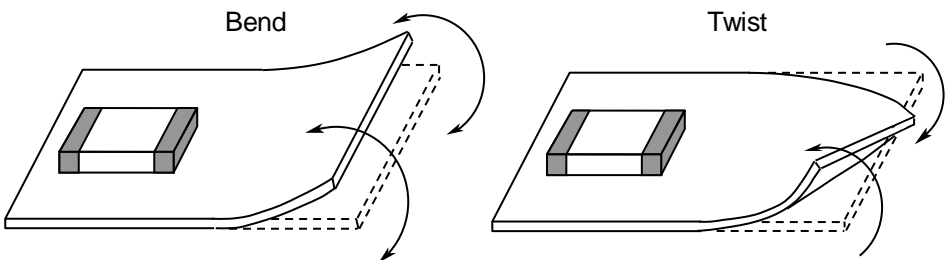



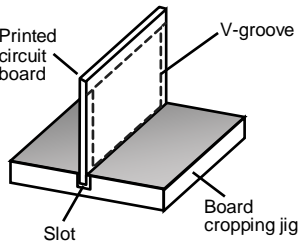
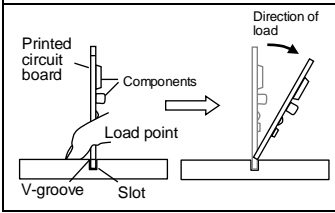
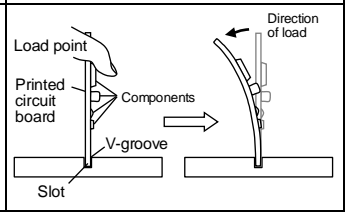
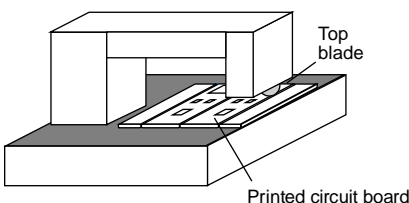
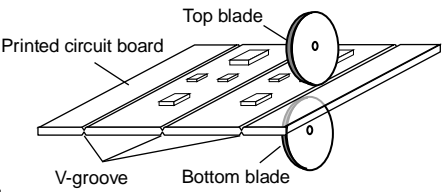
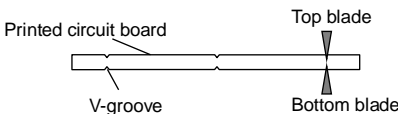
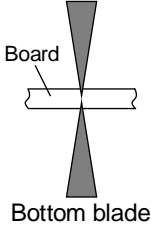
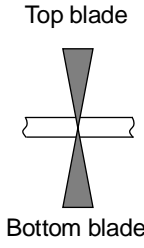
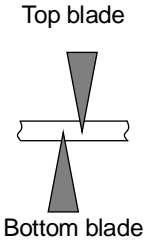
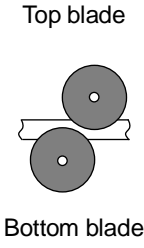
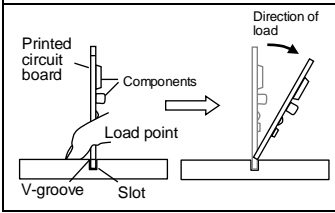
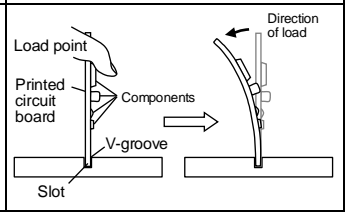
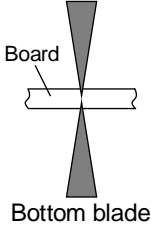
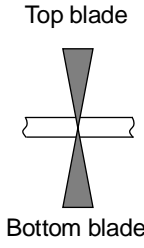
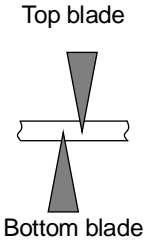
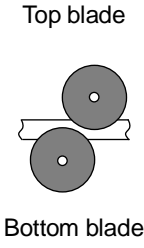
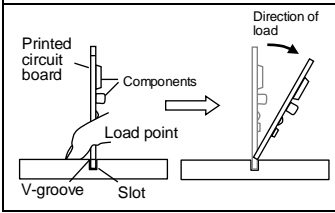
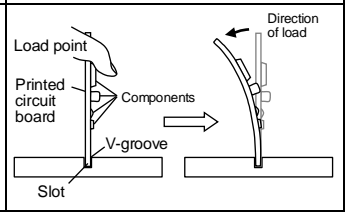
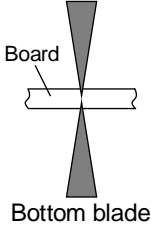
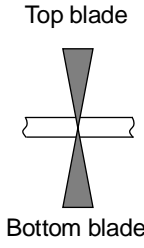
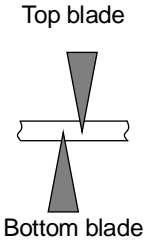
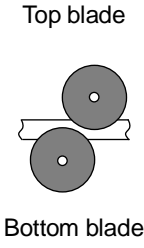
No.	Process	Condition									
4	Mounting	<p>4-1. Stress from mounting head                      If the mounting head is adjusted too low, it may induce excessive stress in the chip capacitors to result in cracking. Please take following precautions.</p> <ol style="list-style-type: none"> <li>1) Adjust the bottom dead center of the mounting head to reach on the P.C.board surface and not press it.</li> <li>2) Adjust the mounting head pressure to be 1 to 3N of static weight.</li> <li>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.</li> </ol> <table border="1" data-bbox="483 566 1433 1137"> <thead> <tr> <th data-bbox="483 566 663 611"></th> <th data-bbox="663 566 1061 611">Not recommended</th> <th data-bbox="1061 566 1433 611">Recommended</th> </tr> </thead> <tbody> <tr> <td data-bbox="483 611 663 875">Single sided mounting</td> <td data-bbox="663 611 1061 875">  </td> <td data-bbox="1061 611 1433 875">  </td> </tr> <tr> <td data-bbox="483 875 663 1137">Double-sides mounting</td> <td data-bbox="663 875 1061 1137">  </td> <td data-bbox="1061 875 1433 1137">  </td> </tr> </tbody> </table> <p>When the centering jaw is worn out, it may give mechanical impact on the capacitors to cause crack. Please control the close up dimension of the centering jaw and provide sufficient preventive maintenance and replacement of it.</p>		Not recommended	Recommended	Single sided mounting			Double-sides mounting		
	Not recommended	Recommended									
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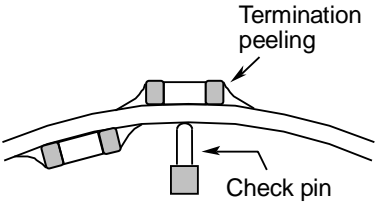
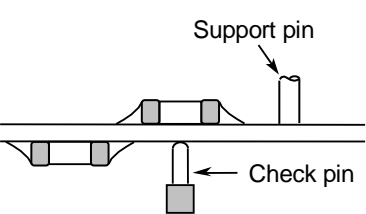
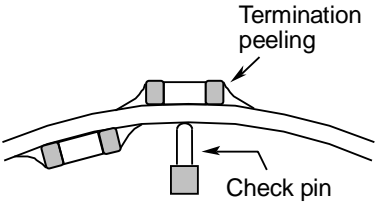
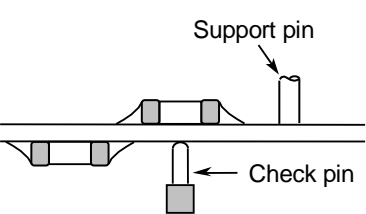
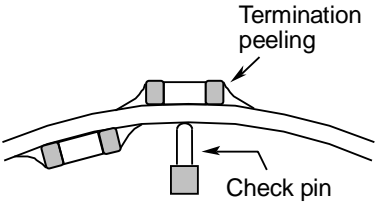
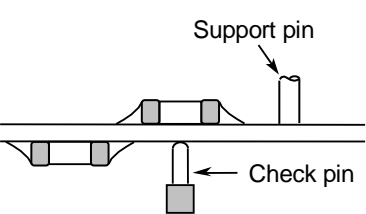
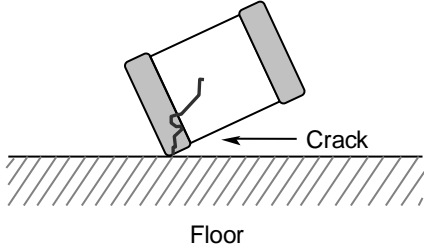
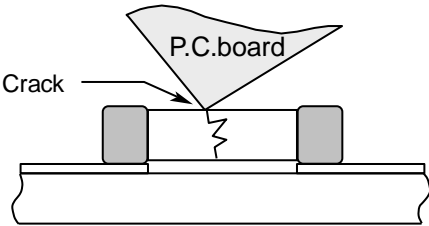
No.	Process	Condition																								
5	Soldering	<p>5-1. Flux selection</p> <p>Flux can seriously affect the performance of capacitors. Confirm the following to select the appropriate flux.</p> <ol style="list-style-type: none"> <li>1) It is recommended to use a mildly activated rosin flux (less than 0.1wt% chlorine). Strong flux is not recommended.</li> <li>2) Excessive flux must be avoided. Please provide proper amount of flux.</li> <li>3) When water-soluble flux is used, enough washing is necessary.</li> </ol> <p>5-2. Recommended soldering profile by various methods</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p><b>Wave soldering</b></p>  </div> <div style="text-align: center;"> <p><b>Reflow soldering</b></p>  </div> </div> <div style="text-align: center; margin-top: 20px;"> <p><b>Manual soldering (Solder iron)</b></p>  </div> <p>※ As for peak temperature of manual soldering, please refer “5-6. Solder repair by solder iron” .</p> <p>5-3. Recommended soldering peak temp and peak temp duration</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2" style="text-align: center;">Temp./Duration</th> <th colspan="2" style="text-align: center;">Wave soldering</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> <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> <td></td> <td></td> </tr> <tr> <td style="text-align: center;">Sn-Pb Solder</td> <td style="text-align: center;">250 max.</td> <td style="text-align: center;">3 max.</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;">5 max.</td> <td style="text-align: center;">260 max.</td> <td style="text-align: center;">10 max.</td> </tr> </tbody> </table> <p style="margin-top: 20px;">Recommended solder compositions                      Lead Free Solder : Sn-3.0Ag-0.5Cu                      Sn-Pb solder : Sn-37Pb</p>	Temp./Duration	Wave soldering		Reflow soldering		Peak temp(°C)	Duration(sec.)	Peak temp(°C)	Duration(sec.)	Solder					Sn-Pb Solder	250 max.	3 max.	230 max.	20 max.	Lead Free Solder	260 max.	5 max.	260 max.	10 max.
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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="539 282 1038 465"> <thead> <tr> <th>Soldering</th> <th>Temp. (°C)</th> </tr> </thead> <tbody> <tr> <td>Wave soldering</td> <td><math>\Delta T \leq 150</math></td> </tr> <tr> <td>Reflow soldering</td> <td><math>\Delta T \leq 150</math></td> </tr> <tr> <td>Manual soldering</td> <td><math>\Delta T \leq 150</math></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 (<math>\Delta T</math>) must be less than 100°C.</p> <p>5-5. Amount of solder Excessive solder will induce higher tensile force in chip capacitors when temperature changes and it may result in chip cracking. In sufficient solder may detach the capacitors from the P.C.board.</p> <div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="text-align: center;"> <p>Excessive solder</p>  </div> <div style="text-align: center;"> <p>Higher tensile force in chip capacitors to cause crack</p> </div> </div> <hr/> <div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;"> <p>Adequate</p>  </div> </div> <hr/> <div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="text-align: center;"> <p>Insufficient solder</p>  </div> <div style="text-align: center;"> <p>Low robustness may cause contact failure or chip capacitors come off the P.C.board.</p> </div> </div> <hr/> <p>5-6. Solder repair by solder iron</p> <p>1) Selection of the soldering iron tip Tip temperature of solder iron varies by its type, P.C.board material and solder land size. The higher the tip temperature, the quicker the operation. However, heat shock may cause a crack in the chip capacitors. Please make sure the tip temp. before soldering and keep the peak temp and time in accordance with following recommended condition.</p> <table border="1" data-bbox="483 1514 1377 1637"> <thead> <tr> <th colspan="4">Recommended solder iron condition (Sn-Pb Solder and Lead Free Solder)</th> </tr> <tr> <th>Temp. (°C)</th> <th>Duration (sec.)</th> <th>Wattage (W)</th> <th>Shape (mm)</th> </tr> </thead> <tbody> <tr> <td>350 max.</td> <td>3 max.</td> <td>20 max.</td> <td>φ3.0 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)	Wave soldering	$\Delta T \leq 150$	Reflow soldering	$\Delta T \leq 150$	Manual soldering	$\Delta T \leq 150$	Recommended solder iron condition (Sn-Pb Solder and Lead Free Solder)				Temp. (°C)	Duration (sec.)	Wattage (W)	Shape (mm)	350 max.	3 max.	20 max.	φ3.0 max.
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No.	Process	Condition												
5	Soldering	<p>5-7.Soldering rework using spot heater Heat stress during rework may possibly be reduced by using a spot heater (also called a “blower”) rather than a soldering iron. It is applied only to adding solder in the case of insufficient solder amount.</p> <p>1) Reworking using a spot heater may suppress the occurrence of cracks in the capacitor compared to using a soldering iron. A spot heater can heat up a capacitor uniformly with a small heat gradient which leads to lower thermal stress caused by quick heating and cooling or localized heating. Moreover, where ultra-small capacitors are mounted close together on a printed circuit board, reworking with a spot heater can eliminate the risk of direct contact between the tip of a soldering iron and a capacitor.</p> <p>2) Rework condition If the blower nozzle of a spot heater is too close to a capacitor, a crack in the capacitor may occur due to heat stress. Below are recommendations for avoiding such an occurrence. Keep more than 5mm between a capacitor and a spot heater nozzle. The blower temperature of the spot heater shall be lower than 400°C. The airflow shall be set as weak as possible. The diameter of the nozzle is recommended to be 2mm(one-outlet type).The size is standard and common. Duration of blowing hot air is recommended to be 10s or less, considering surface area of the capacitor and melting temperature of solder. The angle between the nozzle and the capacitor is recommended to be 45degrees in order to work easily and to avoid partial area heating. As is the case when using a soldering iron, preheating reduces thermal stress on capacitors and improves operating efficiency.</p> <ul style="list-style-type: none"> <li>Recommended rework condition (Consult the component manufactures for details.)</li> </ul> <table border="1" data-bbox="507 1137 1449 1464"> <tbody> <tr> <td>Distance from nozzle</td> <td>5mm and over</td> </tr> <tr> <td>Nozzle angle</td> <td>45degrees</td> </tr> <tr> <td>Nozzle temp.</td> <td>400°C and less</td> </tr> <tr> <td>Airflow</td> <td>Set as weak as possible (The airflow shall be the minimum value necessary for solder to melt in the conditions mentioned above.)</td> </tr> <tr> <td>Nozzle diameter</td> <td>φ2mm (one-outlet type)</td> </tr> <tr> <td>Blowing duration</td> <td>10s and less</td> </tr> </tbody> </table> <ul style="list-style-type: none"> <li>Example of recommended spot heater use</li> </ul>  <p>3) Amount of solder should be suitable to form a proper fillet shape. Excess solder causes mechanical and thermal stress on a capacitor and results in cracks. Insufficient solder causes weak adherence of the capacitor to the substrate and may result in detachment of a capacitor and deteriorate reliability of the printed wiring board. See the example of appropriate solder fillet shape for 5-5.Amount of solder.</p>	Distance from nozzle	5mm and over	Nozzle angle	45degrees	Nozzle temp.	400°C and less	Airflow	Set as weak as possible (The airflow shall be the minimum value necessary for solder to melt in the conditions mentioned above.)	Nozzle diameter	φ2mm (one-outlet type)	Blowing duration	10s and less
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Blowing duration	10s and less													

No.	Process	Condition
5	Soldering	<p>5-8. Sn-Zn solder Sn-Zn solder affects product reliability. Please contact TDK in advance when utilize Sn-Zn solder.</p> <p>5-9. 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 (1) Terminal electrodes may corrode by Halogen in the flux. (2) Halogen in the flux may adhere on the surface of capacitors, and lower the insulation resistance. (3) Water soluble flux has higher tendency to have above mentioned problems (1) and (2).</p> <p>2)-2. Excessive washing When ultrasonic cleaning is used, excessively high ultrasonic energy output can affect the connection between the ceramic chip capacitor's body and the terminal electrode. To avoid this, following is the recommended condition.</p> <p style="text-align: center;">Power : 20W/ ℓ max. Frequency : 40kHz 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>
7	Coating and molding of the P.C.board	<p>1) When the P.C.board is coated, please verify the quality influence on the product.</p> <p>2) Please verify carefully that there is no harmful decomposing or reaction gas emission during curing which may damage the chip capacitors.</p> <p>3) Please verify the curing temperature.</p>
8	Handling after chip mounted ⚠ Caution	<p>1) Please pay attention not to bend or distort the P.C.board after soldering in handling otherwise the chip capacitors may crack.</p> <div style="text-align: center;">  </div>

No.	Process	Condition																
8	Handling after chip mounted  Caution	<p>2) Printed circuit board cropping should not be carried out by hand, but by using the proper tooling. Printed circuit board cropping should be carried out using a board cropping jig as shown in the following figure or a board cropping apparatus to prevent inducing mechanical stress on the board.</p> <p>(1) Example of a board cropping jig                      Recommended example: The board should be pushed from the back side, close to the cropping jig so that the board is not bent and the stress applied to the capacitor is compressive.                      Unrecommended example: If the pushing point is far from the cropping jig and the pushing direction is from the front side of the board, large tensile stress is applied to the capacitor, which may cause cracks.</p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="459 577 758 862"> <p>Outline of jig</p>  </div> <div data-bbox="762 571 1444 833"> <table border="1"> <thead> <tr> <th data-bbox="762 571 1098 622">Recommended</th> <th data-bbox="1098 571 1444 622">Unrecommended</th> </tr> </thead> <tbody> <tr> <td data-bbox="762 622 1098 833">  </td> <td data-bbox="1098 622 1444 833">  </td> </tr> </tbody> </table> </div> </div> <p>(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.</p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="555 1164 965 1429"> <p>Outline of machine</p>  </div> <div data-bbox="965 1164 1412 1411"> <p>Principle of operation</p>  </div> </div> <div style="text-align: center; margin: 10px 0;"> <p>Cross-section diagram</p>  </div> <table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th data-bbox="641 1646 821 1736">Recommended</th> <th colspan="3" data-bbox="821 1646 1353 1697">Unrecommended</th> </tr> <tr> <th data-bbox="641 1736 821 1780"></th> <th data-bbox="821 1697 997 1780">Top-bottom misalignment</th> <th data-bbox="997 1697 1173 1780">Left-right misalignment</th> <th data-bbox="1173 1697 1353 1780">Front-rear misalignment</th> </tr> </thead> <tbody> <tr> <td data-bbox="641 1780 821 2072">  </td> <td data-bbox="821 1780 997 2072">  </td> <td data-bbox="997 1780 1173 2072">  </td> <td data-bbox="1173 1780 1353 2072">  </td> </tr> </tbody> </table>	Recommended	Unrecommended			Recommended	Unrecommended				Top-bottom misalignment	Left-right misalignment	Front-rear misalignment				
Recommended	Unrecommended																	
																		
Recommended	Unrecommended																	
	Top-bottom misalignment	Left-right misalignment	Front-rear misalignment															
																		

No.	Process	Condition						
8	Handling after chip mounted ⚠ Caution	<p>3) When functional check of the P.C.board is performed, check pin pressure tends to be adjusted higher for fear of loose contact. But if the pressure is excessive and bend the P.C.board, it may crack the chip capacitors or peel the terminations off. Please adjust the check pins not to bend the P.C.board.</p> <table border="1" data-bbox="475 383 1433 680"> <thead> <tr> <th data-bbox="475 383 616 443">Item</th> <th data-bbox="616 383 1034 443">Not recommended</th> <th data-bbox="1034 383 1433 443">Recommended</th> </tr> </thead> <tbody> <tr> <td data-bbox="475 443 616 680">Board bending</td> <td data-bbox="616 443 1034 680">  <p>Termination peeling Check pin</p> </td> <td data-bbox="1034 443 1433 680">  <p>Support pin Check pin</p> </td> </tr> </tbody> </table>	Item	Not recommended	Recommended	Board bending	 <p>Termination peeling Check pin</p>	 <p>Support pin Check pin</p>
Item	Not recommended	Recommended						
Board bending	 <p>Termination peeling Check pin</p>	 <p>Support pin Check pin</p>						
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>Floor</p> <p>Crack</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>  <p>P.C.board</p> <p>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	As per the estimated life and the estimated failure rate depend on the temperature and the voltage. This can be calculated by the equation described in JEITA RCR-2335C Annex F(Informative) Calculation of the estimated lifetime and the estimated failure rate (Voltage acceleration coefficient : 3 multiplication rule, Temperature acceleration coefficient : 10°C rule) The failure rate can be decreased by reducing the temperature and the voltage but they will not be guaranteed.						

No.	Process	Condition
12	Caution during operation of equipment	<p>1) A capacitor shall not be touched directly with bare hands during operation in order to avoid electric shock. Electric energy held by the capacitor may be discharged through the human body when touched with a bare hand. Even when the equipment is off, a capacitor may stay charged. The capacitor should be handled after being completely discharged using a resistor.</p> <p>2) The terminals of a capacitor shall not be short-circuited by any accidental contact with a conductive object. A capacitor shall not be exposed to a conductive liquid such as an acid or alkali solution. A conductive object or liquid, such as acid and alkali, between the terminals may lead to the breakdown of a capacitor due to short circuit</p> <p>3) Confirm that the environment to which the equipment will be exposed during transportation and operation meets the specified conditions. Do not to use the equipment in the following environments.</p> <p>(1) Environment where a capacitor is 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 products listed in this specification is intended for use in automotive application 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 products are used in general electronic equipment under a normal operation and usage conditions.</p>



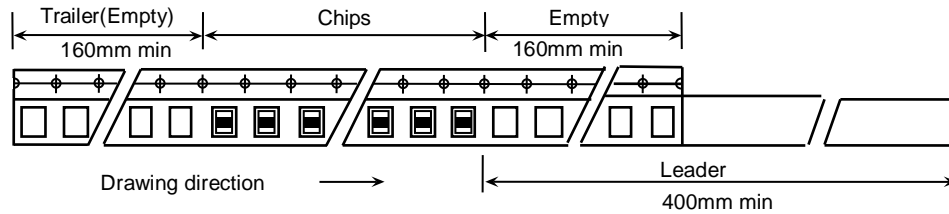
## 10. TAPE PACKAGING SPECIFICATION

### 1. CONSTRUCTION AND DIMENSION OF TAPING

#### 1-1. Dimensions of carrier tape

Dimensions of paper tape shall be according to Appendix 4.

#### 1-2. Bulk part and leader of taping

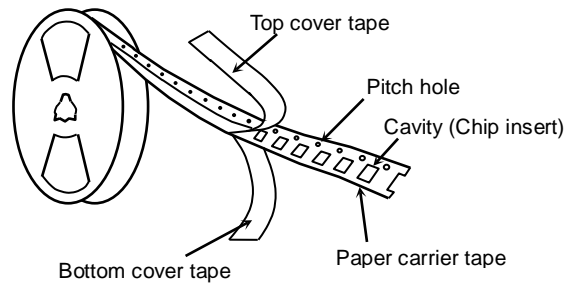


#### 1-3. Dimensions of reel

Dimensions of  $\phi 178$  reel shall be according to Appendix 5.

Dimensions of  $\phi 330$  reel shall be according to Appendix 6.

#### 1-4. Structure of taping



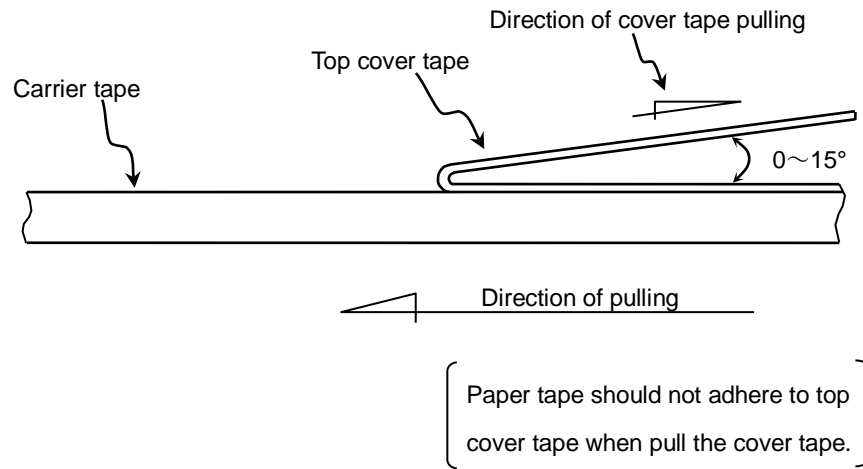
## 2. CHIP QUANTITY

Please refer to detail page on TDK web.

### 3. PERFORMANCE SPECIFICATIONS

#### 3-1. Fixing peeling strength (top tape)

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



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

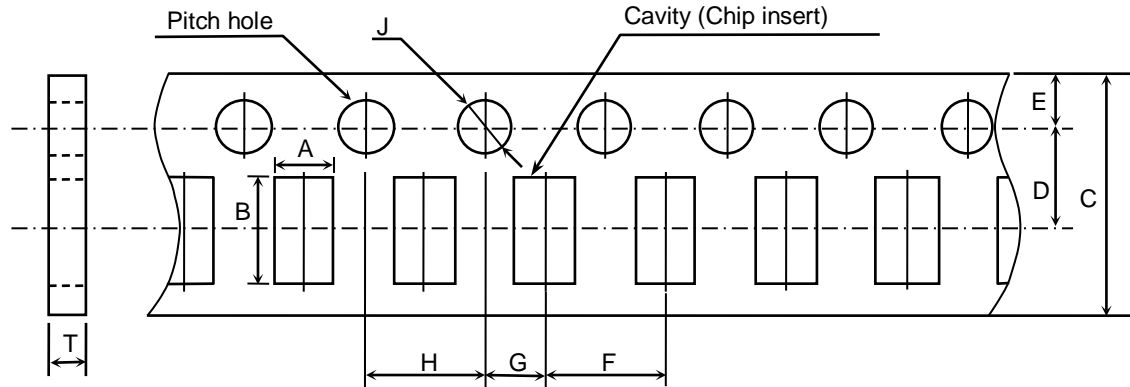
3-3. The missing of components shall be less than 0.1%

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

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

## Appendix 4

### Paper Tape



(Unit : mm)

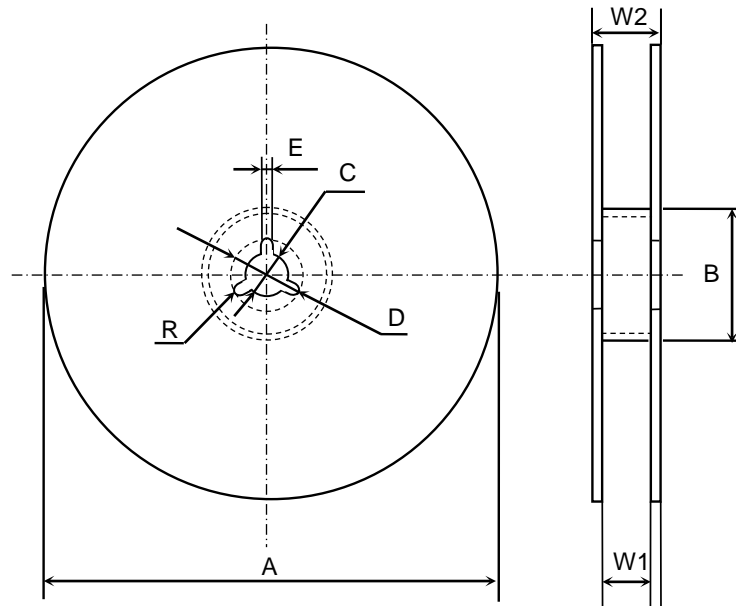
Symbol Case size	A	B	C	D	E	F
CGA3 (CC0603)	( 1.10 )	( 1.90 )	8.00 ± 0.30	3.50 ± 0.05	1.75 ± 0.10	4.00 ± 0.10

Symbol Case size	G	H	J	T
CGA3 (CC0603)	2.00 ± 0.05	4.00 ± 0.10	$\phi 1.50 \begin{smallmatrix} +0.10 \\ 0 \end{smallmatrix}$	1.20 max.

( ) Reference value.

### Appendix 5

Dimensions of reel (Material : Polystyrene)

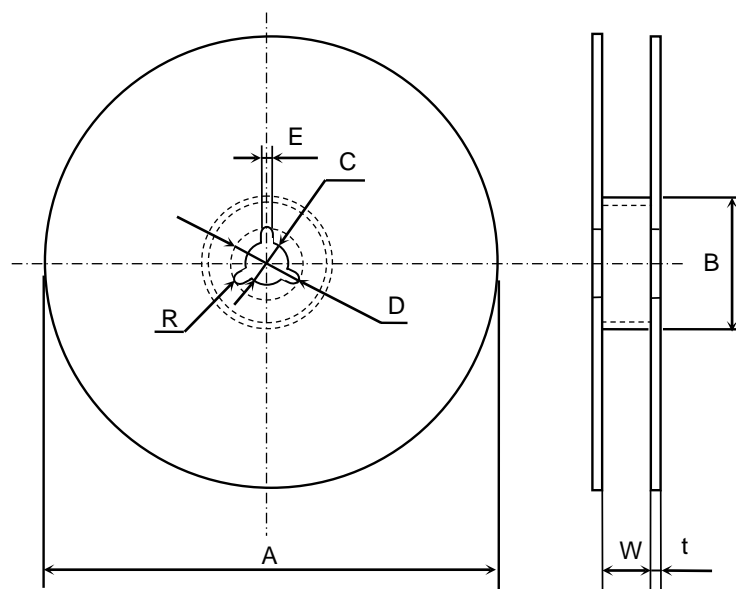


(Unit : mm)

Symbol	A	B	C	D	E	W1
Dimension	$\phi 178 \pm 2.0$	$\phi 60 \pm 2.0$	$\phi 13 \pm 0.5$	$\phi 21 \pm 0.8$	$2.0 \pm 0.5$	$9.0 \pm 0.3$
Symbol	W2	R				
Dimension	$13.0 \pm 1.4$	1.0				

### Appendix 6

Dimensions of reel (Material : Polystyrene)



(Unit : mm)

Symbol	A	B	C	D	E	W
Dimension	$\phi 382$ max. (Nominal $\phi 330$ )	$\phi 50$ min.	$\phi 13 \pm 0.5$	$\phi 21 \pm 0.8$	$2.0 \pm 0.5$	$10.0 \pm 1.5$
Symbol	t	R				
Dimension	$2.0 \pm 0.5$	1.0				