

DELIVERY SPECIFICATION

SPEC. No. C-ULI-b

D A T E : Jun, 2019

To

Non-Controlled Copy

CUSTOMER'S PRODUCT NAME

TDK PRODUCT NAME

Multilayer Ceramic Chip Capacitors
 Ultra Low Inductance
 Bulk and Tape packaging **【RoHS compliant】**
 CLLC1A Type
 X6S,X7R,X7S Characteristics

Please return this specification to TDK representatives with your signature.
 If orders are placed without returned specification, please allow us to judge that specification is accepted by your side.

RECEIPT CONFIRMATION

DATE: _____ YEAR _____ MONTH _____ DAY _____

TDK Corporation
 Sales
 Electronic Components
 Sales & Marketing Group

Engineering
 Electronic Components Business Company
 Ceramic Capacitors Business Group

APPROVED	Person in charge

APPROVED	CHECKED	Person in charge

■ CATALOG NUMBER CONSTRUCTION

CLL	C1A	X6S	0G	475	M	050	A	C
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

(1) Series

(2) Dimensions L x W (mm)

Dimensions code	EIA	Length	Width	Terminal width
C1A	CC0603	1.60	0.80	0.25
E1A	CC0805	2.00	1.25	0.25
G1A	CC1206	3.20	1.60	0.40

(3) Temperature characteristics

Temperature characteristics	Capacitance change	Temperature range
X6S	±22%	-55 to +105°C
X7R	±15%	-55 to +125°C
X7S	±22%	-55 to +125°C

(4) Rated voltage (DC)

Code	Voltage (DC)
0G	4V
0J	6.3V
1A	10V

(5) 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

(6) Capacitance tolerance

Code	Tolerance
M	±20%

(7) Thickness

Code	Thickness
050	0.50mm
085	0.85mm

(8) Packaging style

Code	Style
A	178mm reel, 4mm pitch

(9) Special reserved code

Code	Description
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 CLLC1A0000△△□□□×.

REFERENCE STANDARD

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

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6. PERFORMANCE
7. INSIDE STRUCTURE AND MATERIAL
8. PACKAGING
9. EQUIVALENT CIRCUIT
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11. CAUTION
12. TAPE PACKAGING SPECIFICATION
13. TABLE A (TDK products line up)

<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.

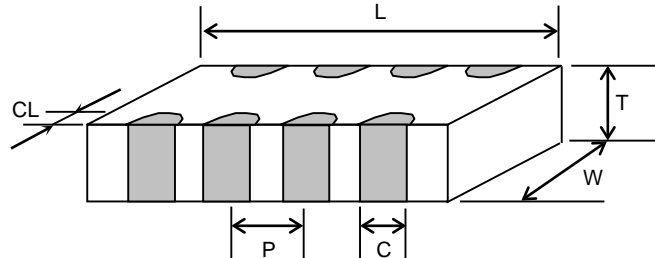
If the use of the capacitors goes beyond the bounds of this specification, we can not afford to guarantee.

Division	Date	SPEC. No.
Ceramic Capacitors Business Group	Jun, 2019	C-ULI-b

1. CODE CONSTRUCTION

(Example) CLLC1A X7S 0G 105 M T 0000
 (1) (2) (3) (4) (5) (6) (7)

(1) Type



Case size [EIA style]	Dimensions (Unit : mm)					
	L	W	T	P	C	CL
CLLC1A [CC0603]	1.60 ± 0.10	0.80 ± 0.10	0.50 ^{+0.05} _{-0.10}	0.40 ± 0.10	0.25 ± 0.10	0.15 ± 0.10

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

(2) Temperature Characteristics

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

(3) Rated Voltage

Symbol	Rated Voltage
0G	DC 4 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
105	1,000,000 pF

(5) Capacitance tolerance

Symbol	Tolerance
M	± 20 %

(6) Packaging

Symbol	Packaging
B	Bulk
T	Taping

(7) TDK internal code

2. COMBINATION OF RATED CAPACITANCE AND TOLERANCE

Temperature Characteristics	Capacitance tolerance	Rated capacitance
X6S X7R X7S	M ($\pm 20\%$)	E – 6 series

Capacitance Step in E series

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

3. OPERATING TEMPERATURE RANGE

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

4. STORING CONDITION AND TERM

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

5. INDUSTRIAL WASTE DISPOSAL

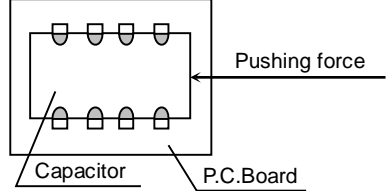
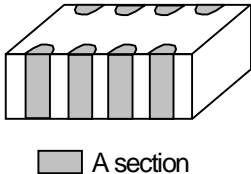
Dispose this product as industrial waste in accordance with the Industrial Waste Law.

6. PERFORMANCE

table 1

No.	Item	Performance	Test or inspection method										
1	External Appearance	No defects which may affect performance.	Inspect with magnifying glass(3×)										
2	Insulation Resistance	100MΩ·μF min.	Measuring voltage : Rated voltage Voltage application time : 60s. Measure 8 terminal electrodes at the same time.										
3	Voltage Proof	Withstand test voltage without insulation breakdown or other damage.	Applied voltage : 2.5 times of rated voltage Above DC voltage shall be applied between each terminal in equivalent circuit for 1s. Charge / discharge current : 50mA or lower										
4	Capacitance	Within the specified tolerance.	<table border="1"> <thead> <tr> <th>Measuring frequency</th> <th>Measuring voltage</th> </tr> </thead> <tbody> <tr> <td>1kHz±10%</td> <td>0.5±0.2Vrms.</td> </tr> </tbody> </table> <p>Measure 8 terminal electrodes at the same time.</p>	Measuring frequency	Measuring voltage	1kHz±10%	0.5±0.2Vrms.						
Measuring frequency	Measuring voltage												
1kHz±10%	0.5±0.2Vrms.												
5	Dissipation Factor	Please refer to detail page on TDK Web.	See No.4 in this table for measuring condition.										
6	Temperature Characteristics of Capacitance	<p>Capacitance Change (%)</p> <hr/> <p>No voltage applied</p> <hr/> <p>X6S : ±22 X7R : ±15 X7S : ±22</p> <hr/>	<p>Capacitance shall be measured by the steps shown in the following table after thermal equilibrium is obtained for each step. Capacitance change shall be calculated by the value of the reference temperature in Step 3.</p> <table border="1"> <thead> <tr> <th>Step</th> <th>Temperature(°C)</th> </tr> </thead> <tbody> <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> </tbody> </table> <p>As for Min./Max. operating temp and Reference temp., please refer to “3.OPERATING TEMPERATURE RANGE” As for measuring voltage, please contact with our sales representative.</p>	Step	Temperature(°C)	1	Reference temp. ± 2	2	Min. operating temp. ± 2	3	Reference temp. ± 2	4	Max. operating temp. ± 2
Step	Temperature(°C)												
1	Reference temp. ± 2												
2	Min. operating temp. ± 2												
3	Reference temp. ± 2												
4	Max. operating temp. ± 2												

(continued)

No.	Item	Performance	Test or inspection method				
7	Robustness of Terminations	No sign of termination coming off, breakage of ceramic, or other abnormal signs.	<p>Reflow solder the capacitors on a P.C.Board shown in Appendix1.</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 : 5N Holding time : 10±1s</p> 				
8	Solderability	<p>All terminations shall exhibit a continuous solder coating free from defects for a minimum of 75% of the surface area of any individual termination. Anomalies other than dewetting, non-wetting, and pin holes are not cause for rejection.</p> 	<p>Solder : Sn-3.0Ag-0.5Cu or Sn-37Pb</p> <p>Flux : Isopropyl alcohol (JIS K 8839) Rosin (JIS K 5902) 25% solid solution.</p> <p>Solder temp. : 245±5°C (Sn-3.0Ag-0.5Cu) 235±5°C (Sn-37Pb)</p> <p>Dwell time : 3±0.3s.(Sn-3.0Ag-0.5Cu) 2±0.2s.(Sn-37Pb)</p> <p>Solder position : Until both terminations are completely soaked.</p>				
9	Resistance to solder heat	<p>No cracks are allowed and terminations shall be covered at least 60% with new solder.</p> <table border="1" data-bbox="564 1406 948 1576"> <thead> <tr> <th>Characteristics</th> <th>Change from the value before test</th> </tr> </thead> <tbody> <tr> <td>X6S X7R X7S</td> <td>± 7.5 %</td> </tr> </tbody> </table> <p>D.F. Meet the initial spec.</p> <p>Insulation Resistance Meet the initial spec.</p>	Characteristics	Change from the value before test	X6S X7R X7S	± 7.5 %	<p>Solder : Sn-3.0Ag-0.5Cu or Sn-37Pb</p> <p>Flux : Isopropyl alcohol (JIS K 8839) Rosin (JIS K 5902) 25% solid solution.</p> <p>Solder temp. : 260±5°C</p> <p>Dwell time : 10±1s.</p> <p>Solder position : Until both terminations are completely soaked.</p> <p>Pre-heating : Temp. — 110~140°C Time — 30~60s.</p> <p>Leave the capacitors in ambient condition for 24±2h before measurement.</p>
Characteristics	Change from the value before test						
X6S X7R X7S	± 7.5 %						

(continued)

No.	Item	Performance	Test or inspection method															
10	Vibration	External appearance	Frequency : 10~55~10Hz Reciprocating sweep time : 1 min. Amplitude : 1.5mm Repeat this for 2h each in 3 perpendicular directions(Total 6h). Reflow solder the capacitors on a P.C.Board shown in Appendix1 before testing.															
		Capacitance		Characteristics	Change from the value before test													
	X6S X7R X7S			± 7.5 %														
	D.F.	Meet the initial spec.																
11	Temperature cycle	External appearance	Expose the capacitors in the condition step1 through step 4 listed in the following table. Temp. cycle : 5 cycles <table border="1" data-bbox="989 784 1452 1120"> <thead> <tr> <th>Step</th> <th>Temperature(°C)</th> <th>Time (min.)</th> </tr> </thead> <tbody> <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> </tbody> </table>	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
		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													
Capacitance	Characteristics	Change from the value before test																
	X6S X7R X7S	Please contact with our sales representative.																
D.F.	Meet the initial spec.																	
Insulation Resistance	Meet the initial spec.																	
Voltage proof	No insulation breakdown or other damage.	As for Min./Max. operating temp., please refer to "3. OPERATING TEMPERATURE RANGE" Leave the capacitors in ambient condition for 24±2h before measurement. Reflow solder the capacitors on a P.C.Board shown in Appendix1 before testing.																
12	Moisture Resistance (Steady State)	External appearance	Test temp. : 40±2°C Test humidity : 90~95%RH Test time : 500 +24,0h Leave the capacitors in ambient condition for 24±2h before measurement. Reflow solder the capacitors on a P.C.Board shown in Appendix1 before testing.															
		Capacitance		Characteristics	Change from the value before test													
				X6S X7R X7S	Please contact with our sales representative.													
		D.F.		200% of initial spec. max.														
Insulation Resistance	10MΩ·μF min.																	

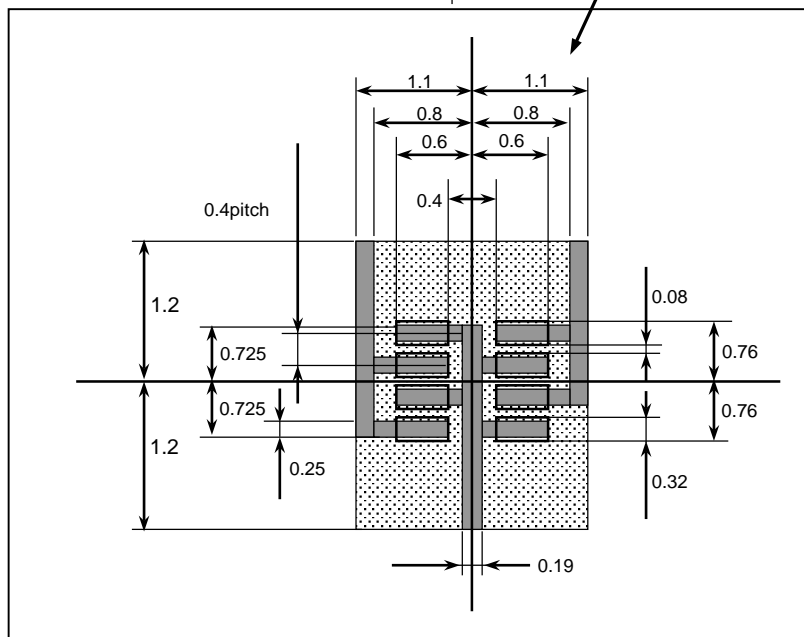
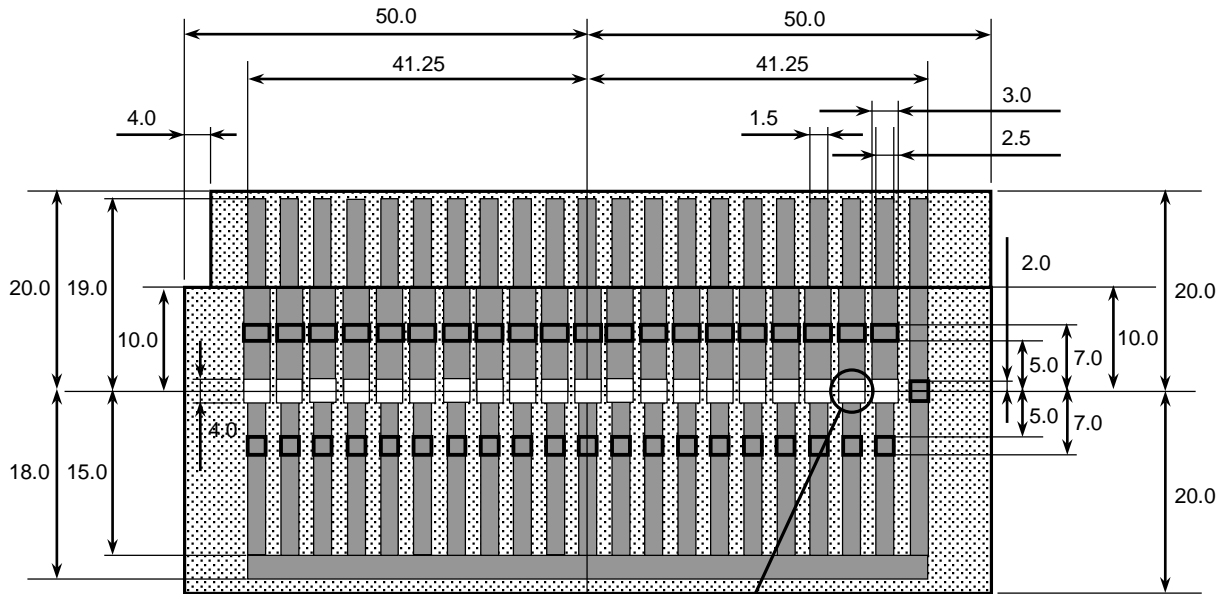
(continued)

No.	Item		Performance	Test or inspection method	
13	Moisture Resistance	External appearance	No mechanical damage.	Test temp. : 40±2°C Test humidity : 90~95%RH Applied voltage : Rated voltage Test time : 500 +24,0h Charge/discharge current : 50mA or lower Leave the capacitors in ambient condition for 24±2h before measurement. Reflow solder the capacitors on a P.C.Board shown in Appendix1 before testing. Initial value setting Voltage conditioning 《After voltage treat the capacitors under testing temperature and voltage for 1 hour,》 leave the capacitors in ambient condition for 24±2h before measurement. Use this measurement for initial value.	
		Capacitance	Characteristics		Change from the value before test
			X6S X7R X7S		Please contact with our sales representative.
		D.F.	200% of initial spec. max.		
14	Life	External appearance	No mechanical damage.	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 24±2h before measurement. Reflow solder the capacitors on a P.C.Board shown in Appendix1 before testing. Initial value setting Voltage conditioning 《After voltage treat the capacitors under testing temperature and voltage for 1 hour,》 leave the capacitors in ambient condition for 24±2h before measurement. Use this measurement for initial value.	
		Capacitance	Characteristics		Change from the value before test
			X6S X7R X7S		Please contact with our sales representative.
		D.F.	200% of initial spec. max.		
Insulation Resistance	10MΩ·μF min.				

*As for the initial measurement of capacitors on number 6,9,10,11 and 12, leave capacitors at 150 0,-10°C for 1h and measure the value after leaving capacitors for 24±2h in ambient condition.

Appendix 1 CLLC1A

P.C. Board for reliability test



(Unit: mm)

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

2. Thickness : 0.8mm

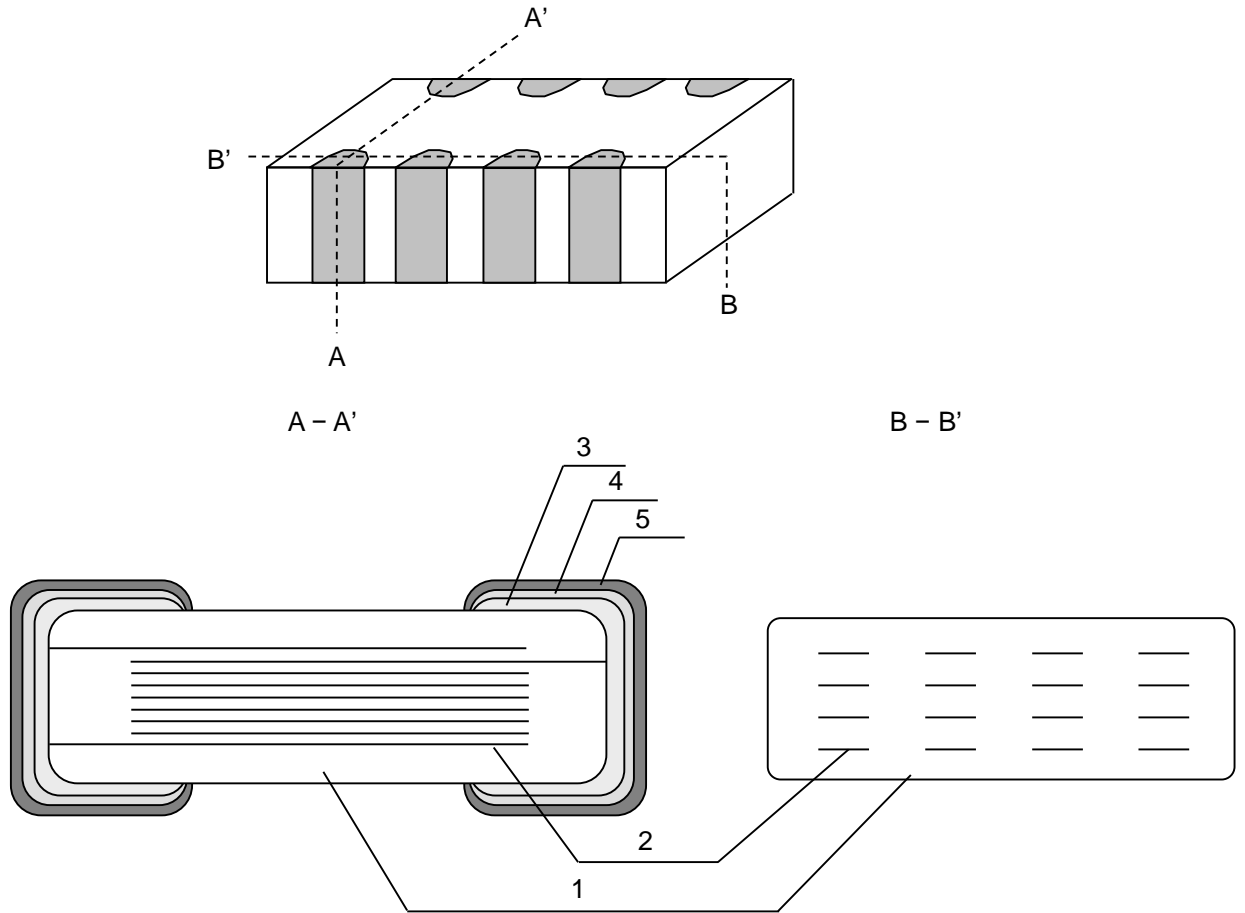


Copper (Thickness: 0.035mm)



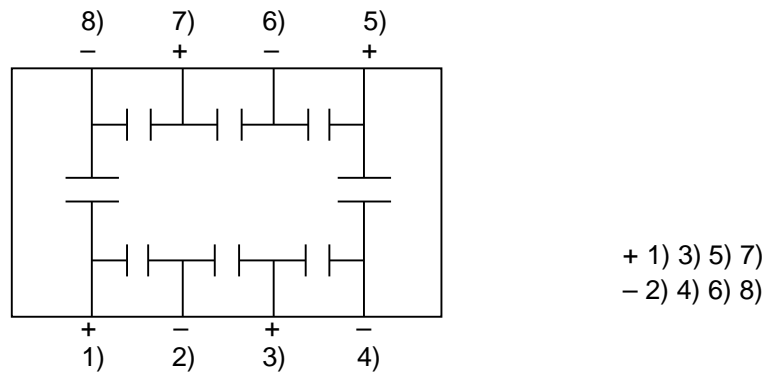
Solder resist

7. INSIDE STRUCTURE AND MATERIAL



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

8. EQUIVALENT CIRCUIT



8 terminals are connected and measured at the same time.

9. PACKAGING

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

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

9.2 Tape packaging is as per 12. 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)


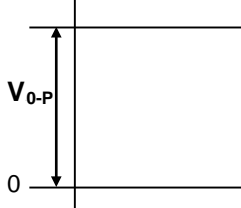
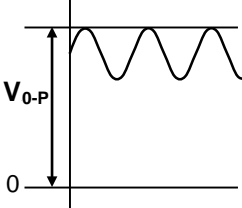
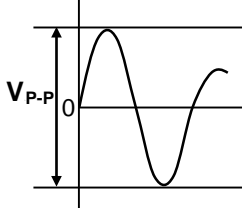
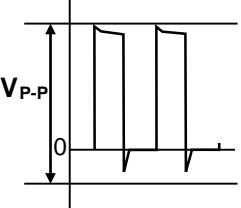
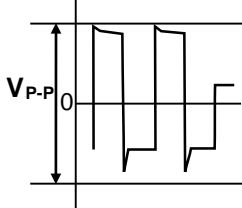
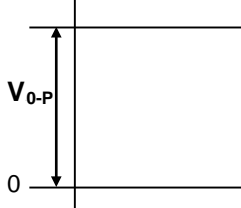
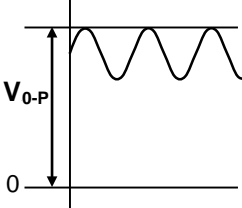
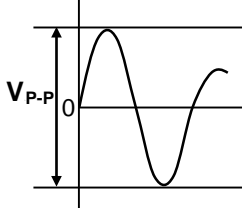
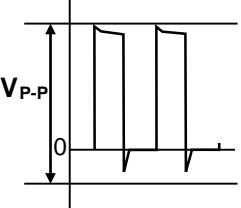
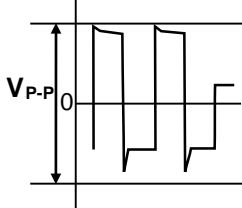
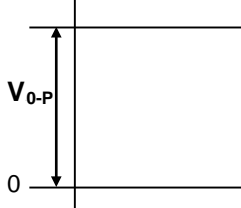
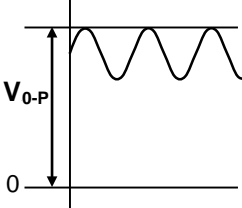
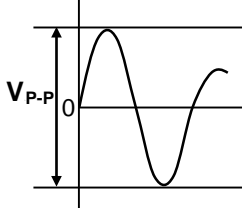
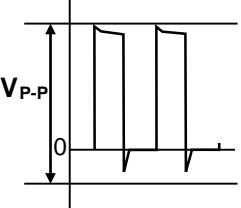
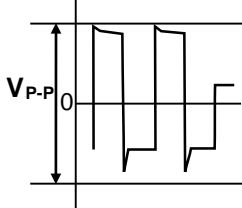
- (a) Prefix
- (b) Line code
- (c) Last digit of the year
- (d) Month and A for January and B for February and so on. (Skip I)
- (e) Inspection Date of the month.
- (f) Serial No. of the day(00 ~ ZZ)
- (g) Suffix(00 ~ ZZ)

*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.

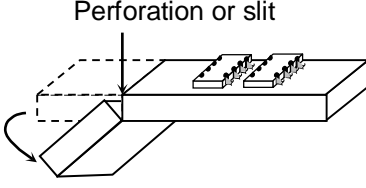
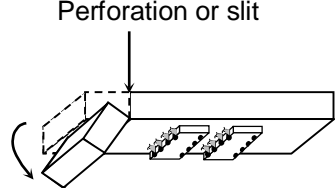
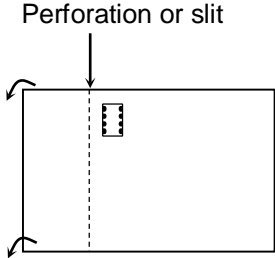
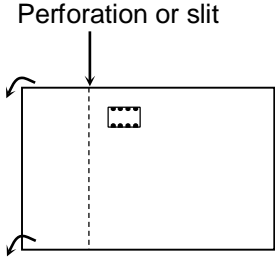
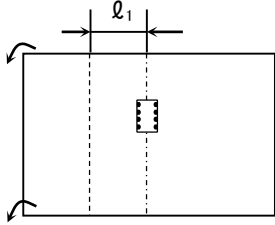
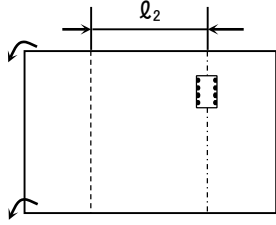
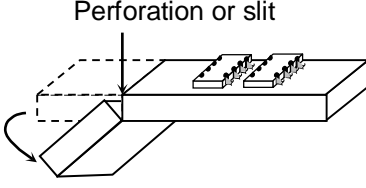
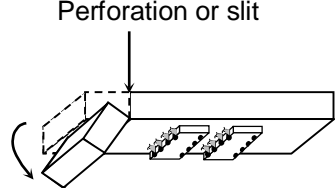
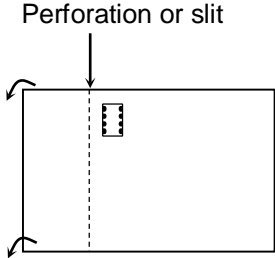
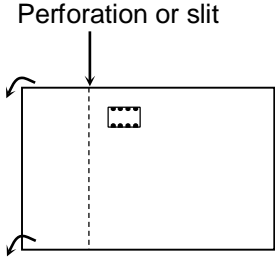
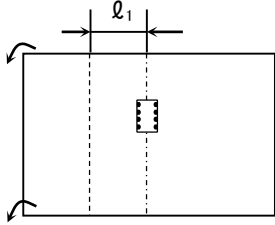
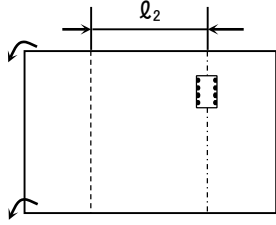
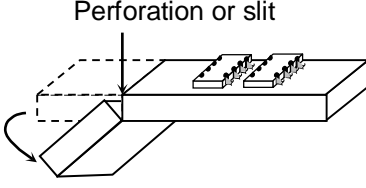
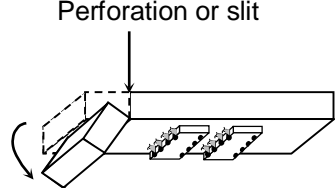
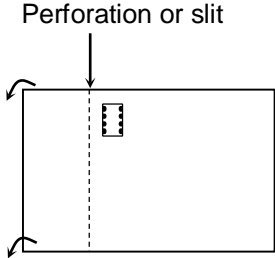
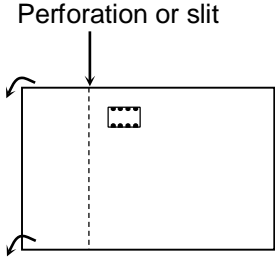
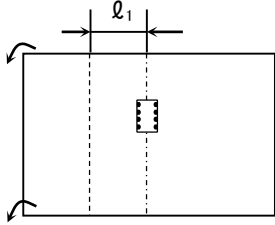
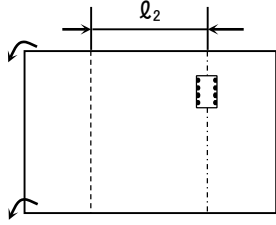
10. SOLDERING CONDITION

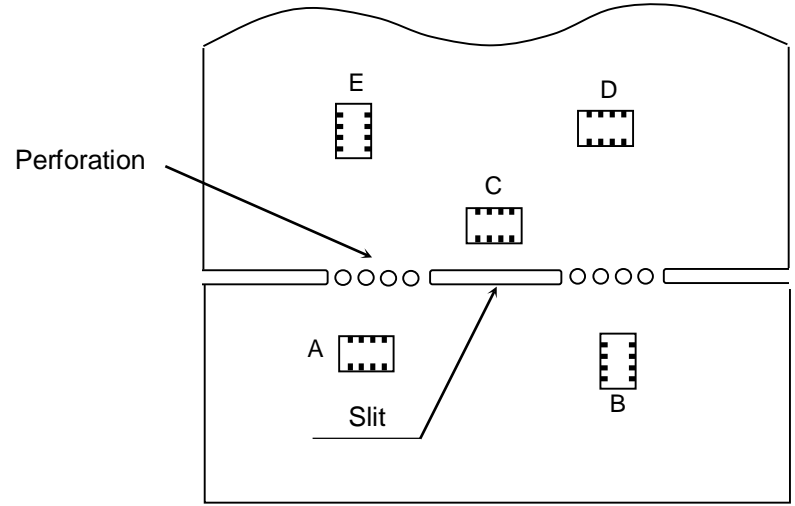
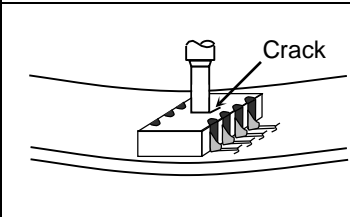
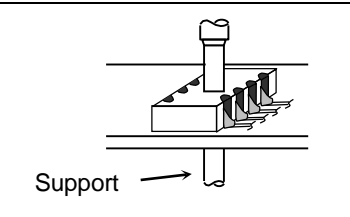
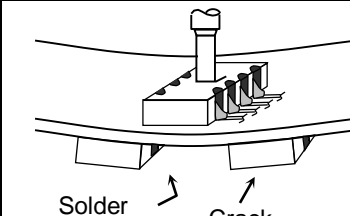
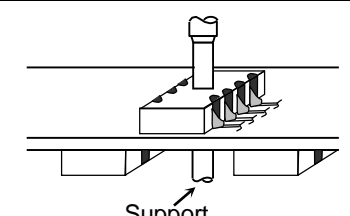
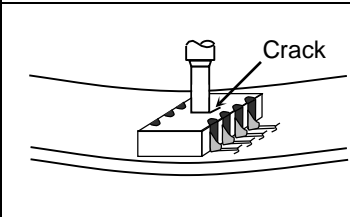
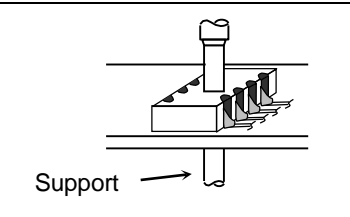
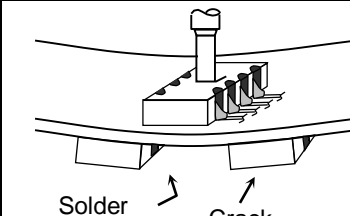
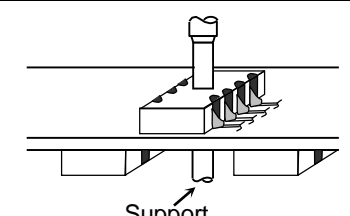
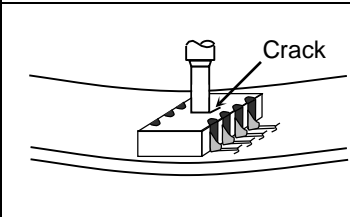
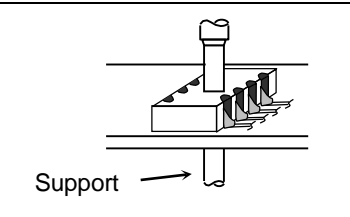
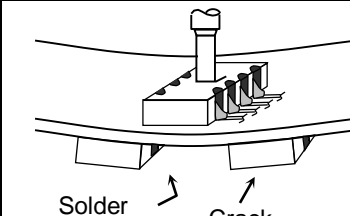
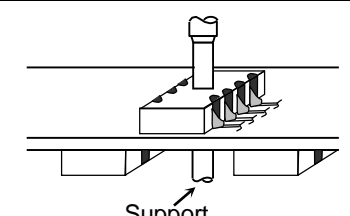
Reflow soldering only.

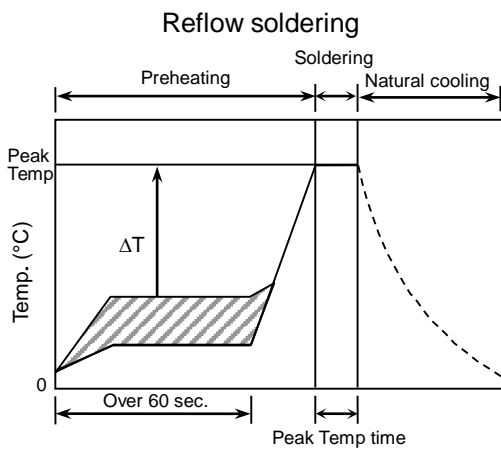
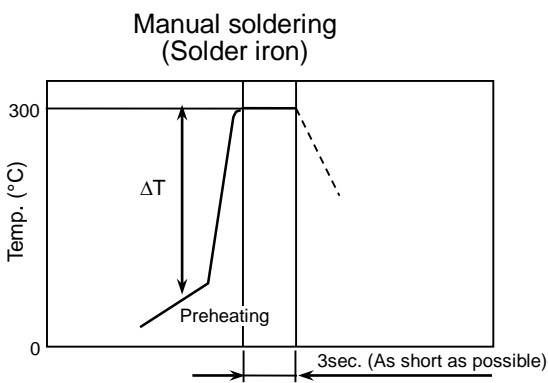
11. CAUTION

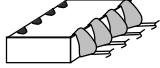

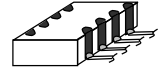
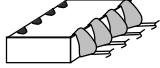

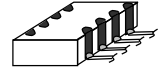
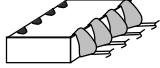

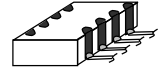
No.	Process	Condition																
1	Operating Condition (Storage, Use, Transportation)	<p>1-1. Storage, Use</p> <ol style="list-style-type: none"> 1) The capacitors must be stored in an ambient temperature of 5 to 40°C with a relative humidity of 20 to 70%RH. The products should be used within 6 months upon receipt. 2) The capacitors must be operated and stored in an environment free of dew condensation and these gases such as Hydrogen Sulphide, Hydrogen Sulphate, Chlorine, Ammonia and sulfur. 3) Avoid storing in sun light and falling of dew. 4) Do not use capacitors under high humidity and high and low atmospheric pressure which may affect capacitors reliability. 5) Capacitors should be tested for the solderability when they are stored for long time. <p>1-2. Handling in transportation</p> <p>In case of the transportation of the capacitors, the performance of the capacitors may be deteriorated depending on the transportation condition. (Refer to JEITA RCR-2335C 9.2 Handling in transportation)</p>																
2	Circuit design  Caution	<p>2-1. Operating temperature</p> <p>Operating temperature should be followed strictly within this specification, especially be careful with maximum temperature.</p> <ol style="list-style-type: none"> 1) Do not use capacitors above the maximum allowable operating temperature. 2) Surface temperature including self heating should be below maximum operating temperature. (Due to dielectric loss, capacitors will heat itself when AC is applied. Especially at high frequencies around its SRF, the heat might be so extreme that it may damage itself or the product mounted on. Please design the circuit so that the maximum temperature of the capacitors including the self heating to be below the maximum allowable operating temperature. Temperature rise at capacitor surface shall be below 20°C) 3) The electrical characteristics of the capacitors will vary depending on the temperature. The capacitors should be selected and designed in taking the temperature into consideration. <p>2-2. Operating voltage</p> <ol style="list-style-type: none"> 1) Operating voltage across the terminals should be below the rated voltage. When AC and DC are super imposed, V_{0-P} must be below the rated voltage. AC or pulse with overshooting, V_{P-P} must be below the rated voltage. <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="448 1469 1423 2045"> <thead> <tr> <th data-bbox="448 1469 635 1514">Voltage</th> <th data-bbox="635 1469 898 1514">(1) DC voltage</th> <th data-bbox="898 1469 1161 1514">(2) DC+AC voltage</th> <th data-bbox="1161 1469 1423 1514">(3) AC voltage</th> </tr> </thead> <tbody> <tr> <td data-bbox="448 1514 635 1742"> Positional Measurement (Rated voltage) </td> <td data-bbox="635 1514 898 1742">  </td> <td data-bbox="898 1514 1161 1742">  </td> <td data-bbox="1161 1514 1423 1742">  </td> </tr> <tr> <th data-bbox="448 1776 635 1821">Voltage</th> <th data-bbox="635 1776 898 1821">(4) Pulse voltage (A)</th> <th data-bbox="898 1776 1161 1821">(5) Pulse voltage (B)</th> <th></th> </tr> <tr> <td data-bbox="448 1821 635 2045"> Positional Measurement (Rated voltage) </td> <td data-bbox="635 1821 898 2045">  </td> <td data-bbox="898 1821 1161 2045">  </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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Positional Measurement (Rated voltage)																		

No.	Process	Condition												
2	Circuit design ⚠ Caution	<p>2) Even below the rated voltage, if repetitive high frequency AC or pulse is applied, the reliability of the capacitors may be reduced.</p> <p>3) The effective capacitance will vary depending on applied DC and AC voltages. The capacitors should be selected and designed in taking the voltages into consideration.</p> <p>2-3. Frequency When the capacitors are used in AC and/or pulse voltages, the capacitors may vibrate themselves and generate audible sound.</p>												
3	Designing P.C. board	<p>The amount of solder at the terminations has a direct effect on the reliability of the capacitors.</p> <ol style="list-style-type: none"> 1) The greater the amount of solder, the higher the stress on the chip capacitor, and the more likely that it will break. When designing a P.C. board, determine the shape and size of the solder lands to have proper amount of solder on the terminations. 2) Avoid using common solder land for multiple terminations and provide individual solder land for each terminations. 3) Size and recommended land dimensions. <div style="text-align: center;"> </div> <p style="text-align: center;">Recommended Land Dimensions (Unit : mm)</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: center;">Case size Symbol</th> <th style="text-align: center;">CLLC1A [CC0603]</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">A</td> <td style="text-align: center;">0.25</td> </tr> <tr> <td style="text-align: center;">B</td> <td style="text-align: center;">0.40</td> </tr> <tr> <td style="text-align: center;">C</td> <td style="text-align: center;">1.20</td> </tr> <tr> <td style="text-align: center;">D</td> <td style="text-align: center;">0.40</td> </tr> <tr> <td style="text-align: center;">P</td> <td style="text-align: center;">0.40</td> </tr> </tbody> </table>	Case size Symbol	CLLC1A [CC0603]	A	0.25	B	0.40	C	1.20	D	0.40	P	0.40
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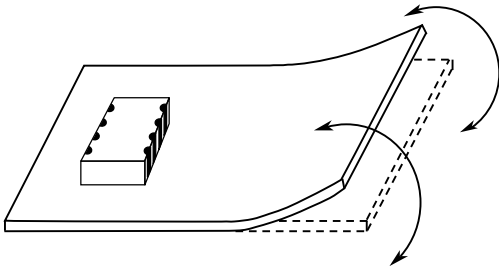
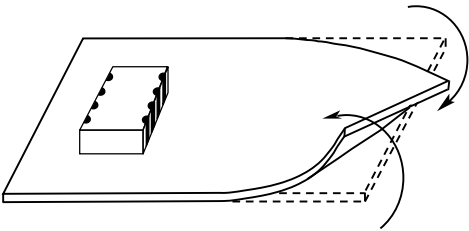
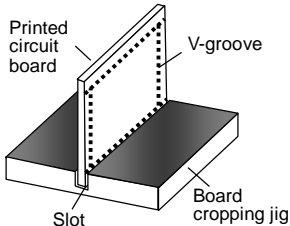
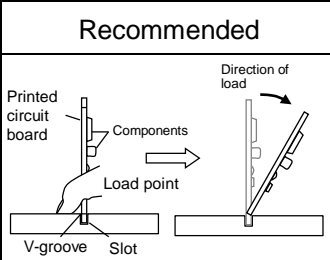
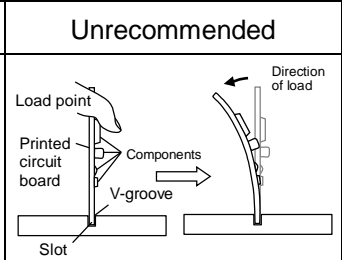
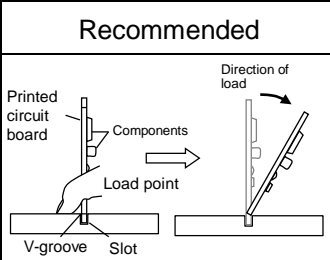
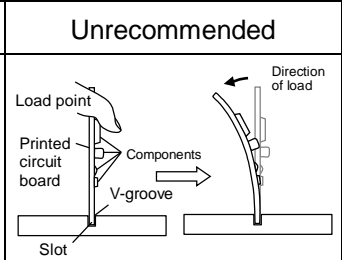
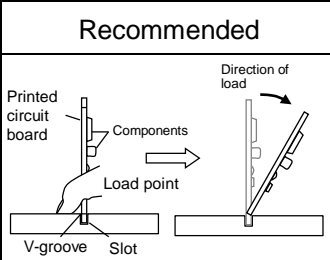
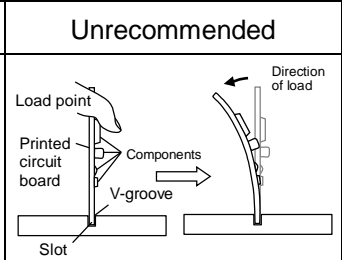
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3	Designing P.C.board	<p>4) Recommended chip capacitor layout is as following.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 20%;"></th> <th style="width: 40%;">Disadvantage against bending stress</th> <th style="width: 40%;">Advantage against bending stress</th> </tr> </thead> <tbody> <tr> <td style="text-align: center; vertical-align: middle;">Mounting face</td> <td style="text-align: center;"> <p>Perforation or slit</p>  <p>Break P.C.board with mounted side up.</p> </td> <td style="text-align: center;"> <p>Perforation or slit</p>  <p>Break P.C.board with mounted side down.</p> </td> </tr> <tr> <td style="text-align: center; vertical-align: middle;">Chip arrangement (Direction)</td> <td style="text-align: center;"> <p>Perforation or slit</p>  </td> <td style="text-align: center;"> <p>Perforation or slit</p>  </td> </tr> <tr> <td style="text-align: center; vertical-align: middle;">Distance from slit</td> <td style="text-align: center;"> <p>Closer to slit is higher stress</p>  <p style="text-align: center;">$(l_1 < l_2)$</p> </td> <td style="text-align: center;"> <p>Away from slit is less stress</p>  <p style="text-align: center;">$(l_1 < l_2)$</p> </td> </tr> </tbody> </table>		Disadvantage against bending stress	Advantage against bending stress	Mounting face	<p>Perforation or slit</p>  <p>Break P.C.board with mounted side up.</p>	<p>Perforation or slit</p>  <p>Break P.C.board with mounted side down.</p>	Chip arrangement (Direction)	<p>Perforation or slit</p> 	<p>Perforation or slit</p> 	Distance from slit	<p>Closer to slit is higher stress</p>  <p style="text-align: center;">$(l_1 < l_2)$</p>	<p>Away from slit is less stress</p>  <p style="text-align: center;">$(l_1 < l_2)$</p>
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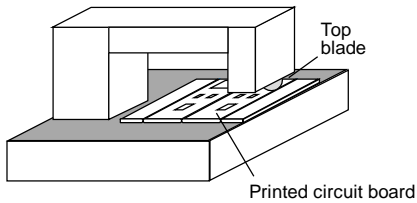
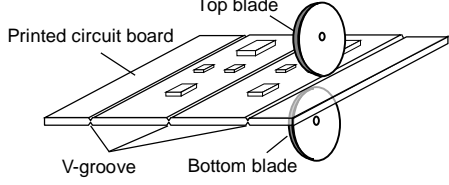
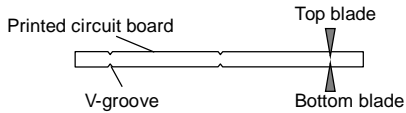
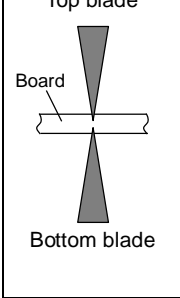
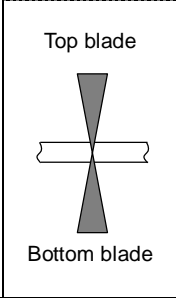
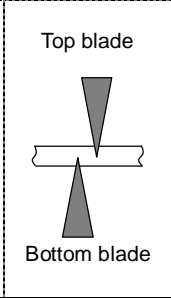
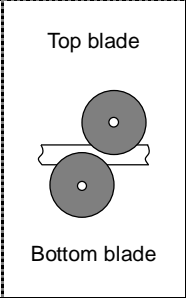
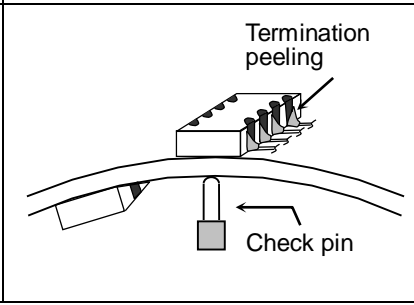
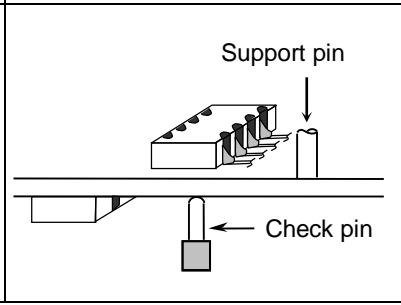
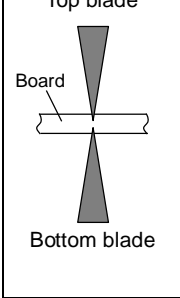
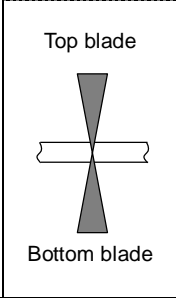
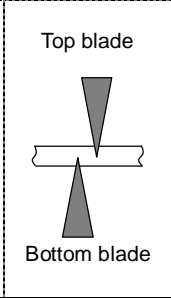
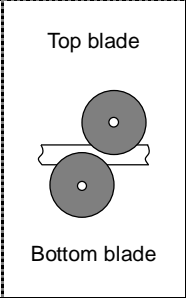
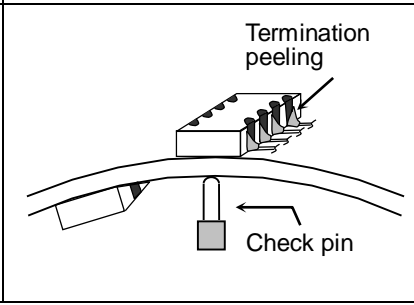
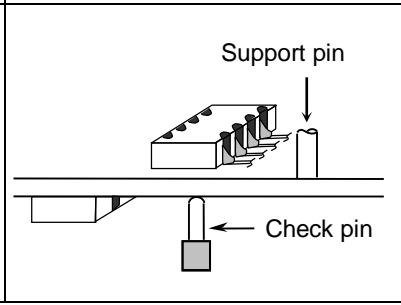
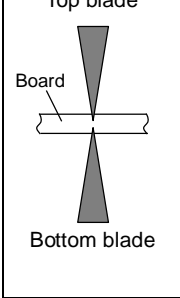
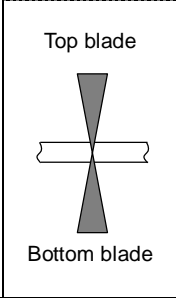
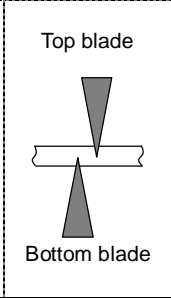
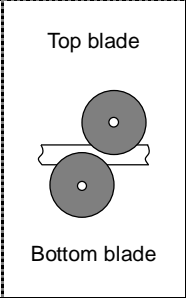
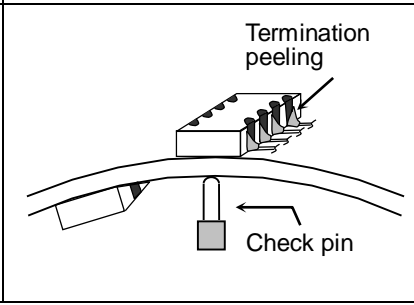
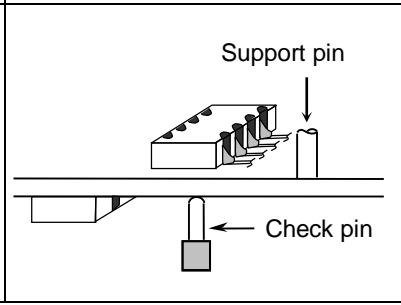
No.	Process	Condition									
3	Designing P.C.board	<p>5) Mechanical stress varies according to location of chip capacitors on the P.C.board.</p>  <p>The stress in capacitors is in the following order. $A > B = C > D > E$</p>									
4	Mounting	<p>4-1. Stress from mounting head</p> <p>If the mounting head is adjusted too low, it may induce excessive stress in the chip capacitor to result in cracking. Please take following precautions.</p> <ol style="list-style-type: none"> 1) Adjust the bottom dead center of the mounting head to reach on the P.C.board surface and not press it. 2) Adjust the mounting head pressure to be 1 to 3N of static weight. 3) To minimize the impact energy from mounting head, it is important to provide support from the bottom side of the P.C.board. See following examples. <table border="1" data-bbox="481 1361 1433 1899"> <thead> <tr> <th></th> <th>Not recommended</th> <th>Recommended</th> </tr> </thead> <tbody> <tr> <td>Single-sided mounting</td> <td></td> <td></td> </tr> <tr> <td>Double-sides mounting</td> <td></td> <td></td> </tr> </tbody> </table> <p>When the centering jaw is worn out, it may give mechanical impact on the capacitor to cause crack. Please control the close up dimension of the centering jaw and provide sufficient preventive maintenance and replacement of it.</p>		Not recommended	Recommended	Single-sided mounting			Double-sides mounting		
	Not recommended	Recommended									
Single-sided mounting											
Double-sides mounting											

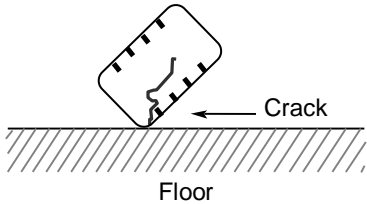
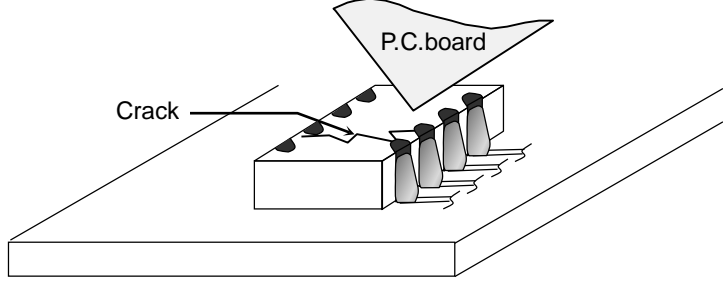
No.	Process	Condition														
5	Soldering	<p>5-1. Flux selection Flux can seriously affect the performance of capacitors. Confirm the following to select the appropriate flux.</p> <ol style="list-style-type: none"> 1) It is recommended to use a mildly activated rosin flux (less than 0.1wt% chlorine). Strong flux is not recommended. 2) Excessive flux must be avoided. Please provide proper amount of flux. 3) When water-soluble flux is used, enough washing is necessary. <p>5-2. Recommended soldering profile by various methods</p> <div style="text-align: center;"> <p>Reflow soldering</p>  </div> <div style="text-align: center; margin-top: 20px;"> <p>Manual soldering (Solder iron)</p>  </div> <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;">Reflow soldering</th> </tr> <tr> <th style="text-align: center;">Peak temp(°C)</th> <th style="text-align: center;">Duration(sec.)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Solder</td> <td></td> <td></td> </tr> <tr> <td style="text-align: center;">Sn-Pb Solder</td> <td style="text-align: center;">230 max.</td> <td style="text-align: center;">20 max.</td> </tr> <tr> <td style="text-align: center;">Lead Free Solder</td> <td style="text-align: center;">260 max.</td> <td style="text-align: center;">10 max.</td> </tr> </tbody> </table> <p>Recommended solder compositions Lead Free Solder : Sn-3.0Ag-0.5Cu Sn-Pb Solder : Sn-37Pb</p>	Temp./Duration	Reflow soldering		Peak temp(°C)	Duration(sec.)	Solder			Sn-Pb Solder	230 max.	20 max.	Lead Free Solder	260 max.	10 max.
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No.	Process	Condition																							
5	Soldering	<p>5-4. Avoiding thermal shock</p> <p>1) Preheating condition</p> <table border="1" data-bbox="539 280 1098 448"> <thead> <tr> <th data-bbox="539 280 837 336">Soldering</th> <th data-bbox="837 280 1098 336">Temp. (°C)</th> </tr> </thead> <tbody> <tr> <td data-bbox="539 336 837 392">Reflow soldering</td> <td data-bbox="837 336 1098 392">$\Delta T \leq 150$</td> </tr> <tr> <td data-bbox="539 392 837 448">Manual soldering</td> <td data-bbox="837 392 1098 448">$\Delta T \leq 150$</td> </tr> </tbody> </table> <p>2) Cooling condition Natural cooling using air is recommended. If the chips are dipped into a solvent for cleaning, the temperature difference (ΔT) must be less than 100°C.</p> <p>5-5. Amount of solder Excessive solder will induce higher tensile force in chip capacitors when temperature changes and it may result in chip cracking. In sufficient solder may detach the capacitors from the P.C.board.</p> <table border="1" data-bbox="486 817 1433 1272"> <tbody> <tr> <td data-bbox="486 817 686 963">Excessive solder</td> <td data-bbox="686 817 1101 963">  </td> <td data-bbox="1101 817 1433 963">Higher tensile force in chip capacitors to cause crack</td> </tr> <tr> <td data-bbox="486 963 686 1108">Adequate</td> <td data-bbox="686 963 1101 1108">  </td> <td data-bbox="1101 963 1433 1108"></td> </tr> <tr> <td data-bbox="486 1108 686 1272">Insufficient solder</td> <td data-bbox="686 1108 1101 1272">  </td> <td data-bbox="1101 1108 1433 1272">Low robustness may cause contact failure or chip capacitors come off the P.C.board.</td> </tr> </tbody> </table> <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> <p>Recommended solder iron condition (Sn-Pb Solder and Lead Free Solder)</p> <table border="1" data-bbox="539 1630 1375 1742"> <thead> <tr> <th data-bbox="539 1630 750 1686">Temp. (°C)</th> <th data-bbox="750 1630 960 1686">Duration (sec.)</th> <th data-bbox="960 1630 1171 1686">Wattage (W)</th> <th data-bbox="1171 1630 1375 1686">Shape (mm)</th> </tr> </thead> <tbody> <tr> <td data-bbox="539 1686 750 1742">300 max.</td> <td data-bbox="750 1686 960 1742">3 max.</td> <td data-bbox="960 1686 1171 1742">20 max.</td> <td data-bbox="1171 1686 1375 1742">∅ 3.0 max.</td> </tr> </tbody> </table> <p>* Please preheat the chip capacitors with the condition in 5-4 to avoid the thermal shock.</p> <p>2) Direct contact of the soldering iron with ceramic dielectric of chip capacitors may cause crack. Do not touch the ceramic dielectric and the terminations by solder iron.</p>	Soldering	Temp. (°C)	Reflow soldering	$\Delta T \leq 150$	Manual soldering	$\Delta T \leq 150$	Excessive solder		Higher tensile force in chip capacitors to cause crack	Adequate			Insufficient solder		Low robustness may cause contact failure or chip capacitors come off the P.C.board.	Temp. (°C)	Duration (sec.)	Wattage (W)	Shape (mm)	300 max.	3 max.	20 max.	∅ 3.0 max.
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No.	Process	Condition
5	Soldering	<p>5-7. Sn-Zn solder Sn-Zn solder affects product reliability. Please contact TDK in advance when utilize Sn-Zn solder.</p> <p>5-8. Countermeasure for tombstone The misalignment between the mounted positions of the capacitors and the land patterns should be minimized. The tombstone phenomenon may occur especially the capacitors are mounted (in longitudinal direction) in the same direction of the reflow soldering. (Refer to JEITA RCR-2335C Annex A (Informative) Recommendations to prevent the tombstone phenomenon)</p>
6	Cleaning	<p>1) If an unsuitable cleaning fluid is used, flux residue or some foreign articles may stick to chip capacitors surface to deteriorate especially the insulation resistance.</p> <p>2) If cleaning condition is not suitable, it may damage the chip capacitors.</p> <p>2)-1. Insufficient washing</p> <p>(1) Terminal electrodes may corrode by Halogen in the flux.</p> <p>(2) Halogen in the flux may adhere on the surface of capacitors, and lower the insulation resistance.</p> <p>(3) Water soluble flux has higher tendency to have above mentioned problems (1) and (2).</p> <p>2)-2. Excessive washing</p> <p>When ultrasonic cleaning is used, excessively high ultrasonic energy output can affect the connection between the ceramic chip capacitor's body and the terminal electrode. To avoid this, following is the recommended condition.</p> <p style="padding-left: 40px;">Power : 20 W/ℓ max. Frequency : 40 kHz max. Washing time : 5 minutes max.</p> <p>2)-3. If the cleaning fluid is contaminated, density of Halogen increases, and it may bring the same result as insufficient cleaning.</p>

No.	Process	Condition				
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="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p>Bend</p>  </div> <div style="text-align: center;"> <p>Twist</p>  </div> </div> <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</p> <p>Recommended example: The board should be pushed from the back side, close to the cropping jig so that the board is not bent and the stress applied to the capacitor is compressive.</p> <p>Unrecommended example: If the pushing point is far from the cropping jig and the pushing direction is from the front side of the board, large tensile stress is applied to the capacitor, which may cause cracks.</p> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;"> <p>Outline of jig</p>  </div> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%; text-align: center;">Recommended</th> <th style="width: 50%; text-align: center;">Unrecommended</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">  </td> <td style="text-align: center;">  </td> </tr> </tbody> </table> </div>	Recommended	Unrecommended		
Recommended	Unrecommended					
						

No.	Process	Condition																	
8	Handling after chip mounted  Caution	<p>(2)Example of a board cropping machine</p> <p>An outline of a printed circuit board cropping machine is shown below. The top and bottom blades are aligned with one another along the lines with the V-grooves on printed circuit board when cropping the board.</p> <p>Unrecommended example: Misalignment of blade position between top and bottom, right and left, or front and rear blades may cause a crack in the capacitor.</p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="539 504 957 757"> <p>Outline of machine</p>  </div> <div data-bbox="986 504 1436 739"> <p>Principle of operation</p>  </div> </div> <div style="text-align: center; margin-top: 10px;"> <p>Cross-section diagram</p>  </div> <table border="1" style="width: 100%; margin-top: 20px; border-collapse: collapse;"> <thead> <tr> <th data-bbox="646 981 826 1070" rowspan="2">Recommended</th> <th colspan="3" data-bbox="826 981 1358 1025">Unrecommended</th> </tr> <tr> <th data-bbox="826 1025 1002 1115">Top-bottom misalignment</th> <th data-bbox="1002 1025 1173 1115">Left-right misalignment</th> <th data-bbox="1173 1025 1358 1115">Front-rear misalignment</th> </tr> </thead> <tbody> <tr> <td data-bbox="646 1115 826 1411">  </td> <td data-bbox="826 1115 1002 1411">  </td> <td data-bbox="1002 1115 1173 1411">  </td> <td data-bbox="1173 1115 1358 1411">  </td> </tr> </tbody> </table> <p>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 capacitors or peel the terminations off. Please adjust the check pins not to bend the P.C.board.</p> <table border="1" style="width: 100%; margin-top: 20px; border-collapse: collapse;"> <thead> <tr> <th data-bbox="478 1653 619 1713">Item</th> <th data-bbox="619 1653 1034 1713">Not recommended</th> <th data-bbox="1034 1653 1436 1713">Recommended</th> </tr> </thead> <tbody> <tr> <td data-bbox="478 1713 619 2016">Board bending</td> <td data-bbox="619 1713 1034 2016">  </td> <td data-bbox="1034 1713 1436 2016">  </td> </tr> </tbody> </table>	Recommended	Unrecommended			Top-bottom misalignment	Left-right misalignment	Front-rear misalignment					Item	Not recommended	Recommended	Board bending		
Recommended	Unrecommended																		
	Top-bottom misalignment	Left-right misalignment	Front-rear misalignment																
																			
Item	Not recommended	Recommended																	
Board bending																			

No.	Process	Condition
9	Handling of loose chip capacitors	<p>1) If dropped the chip capacitors may crack. Once dropped do not use it. Especially, the large case sized chip capacitors are tendency to have cracks easily, so please handle with care.</p>  <p>2) Piling the P.C.board after mounting for storage or handling, the corner of the P.C. board may hit the chip capacitors of another board to cause crack.</p> 
10	Capacitance aging	The capacitors have aging in the capacitance. They may not be used in precision time constant circuit. In case of the time constant circuit, the evaluation should be done well.
11	Estimated life and estimated failure rate of capacitors	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.
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> <ol style="list-style-type: none"> (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

No.	Process	Condition
13	Others  Caution	<p>The products listed on this specification sheet are intended for use in general electronic equipment (AV equipment, telecommunications equipment, home appliances, amusement equipment, computer equipment, personal equipment, office equipment, measurement equipment, industrial robots) under a normal operation and use condition.</p> <p>The products are not designed or warranted to meet the requirements of the applications listed below, whose performance and/or quality require a more stringent level of safety or reliability, or whose failure, malfunction or trouble could cause serious damage to society, person or property. Please understand that we are not responsible for any damage or liability caused by use of the products in any of the applications below or for any other use exceeding the range or conditions set forth in this specification sheet. If you intend to use the products in the applications listed below or if you have special requirements exceeding the range or conditions set forth in this specification, please contact us.</p> <p>(1) Aerospace/Aviation equipment (2) Transportation equipment (cars, 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.</p>

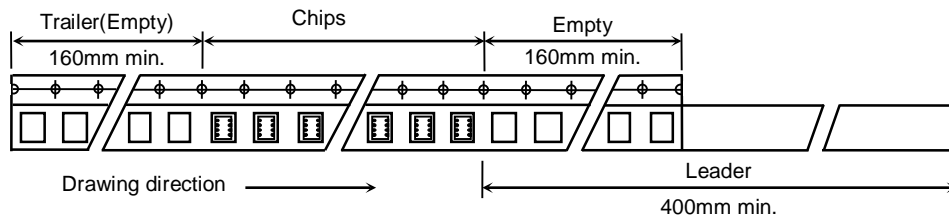
12. TAPE PACKAGING SPECIFICATION

1. CONSTRUCTION AND DIMENSION OF TAPING

1-1. Dimensions of carrier tape

Dimensions of plastic tape shall be according to Appendix 2.

1-2. Trailer and leader of carrier tape

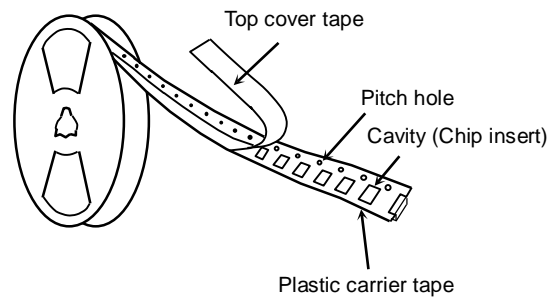


1-3. Dimensions of taping reel

Dimensions of $\varnothing 178\text{mm}$ diameter reel shall be according to Appendix 3.

Dimensions of $\varnothing 330\text{mm}$ diameter reel shall be according to Appendix 4.

1-4. Structure of taping



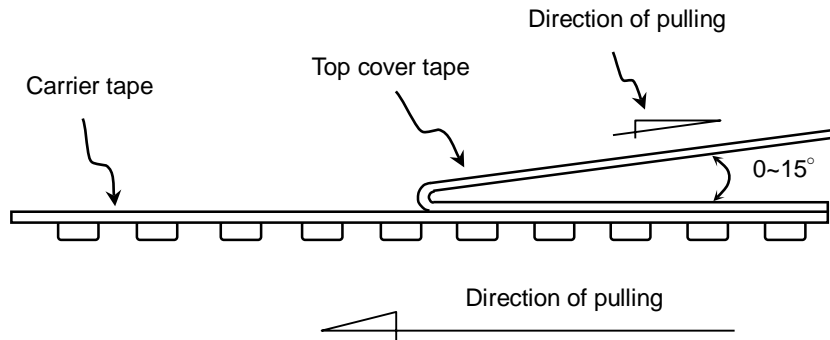
2. CHIP QUANTITY

Please refer to detail page on TDK Web.

3. PERFORMANCE SPECIFICATIONS

3-1. Peel back strength (top cover 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.

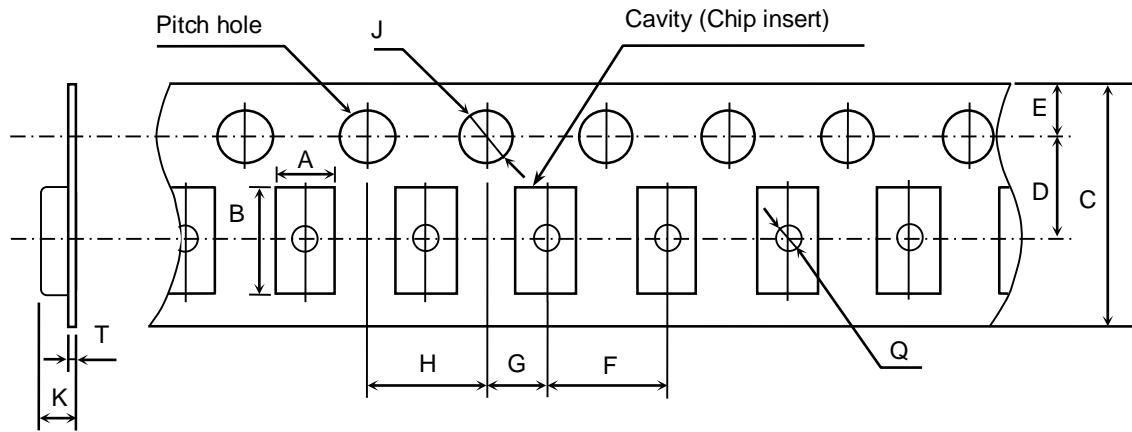
3-3. The missing of components shall be less than 0.1%

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 2

Plastic tape



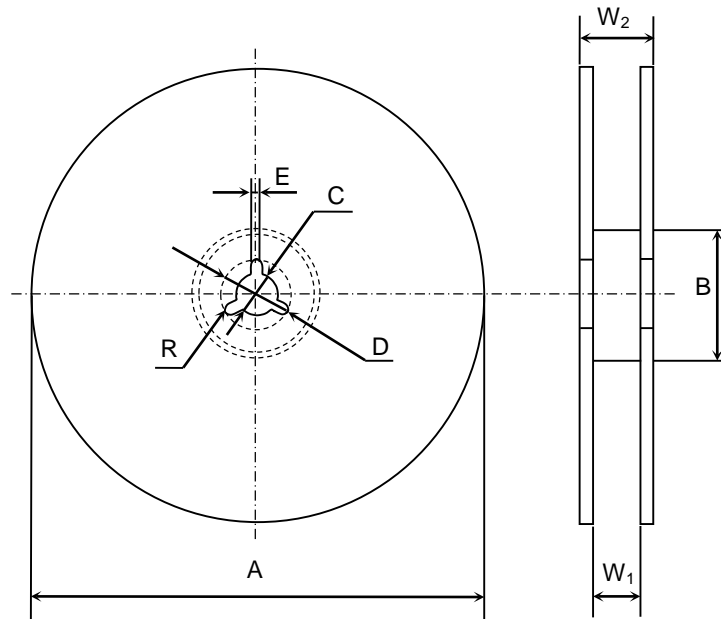
(Unit: mm)

Symbol	A	B	C	D	E	F
Dimension	(1.10)	(1.90)	8.00±0.30	3.50±0.05	1.75±0.10	4.00±0.10
Symbol	G	H	J	K	T	Q
Dimension	2.00±0.05	4.00±0.10	∅ 1.50 $\begin{smallmatrix} +0.10 \\ 0 \end{smallmatrix}$	2.50 max.	0.30 max.	∅ 0.50 min.

() Reference value.

Appendix 3

Dimensions of reel (Material : Polystyrene)

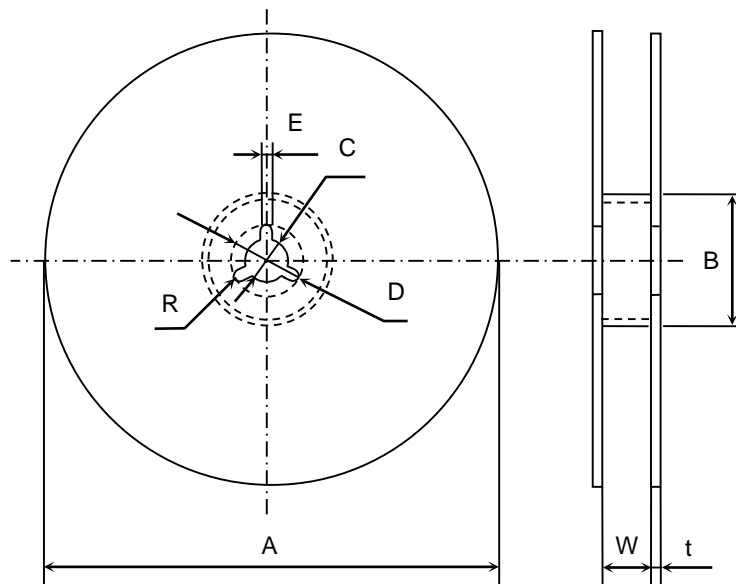


(Unit: mm)

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

Appendix 4

Dimensions of reel (Material : Polystyrene)



(Unit: mm)

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