

SPECIFICATION

SPEC. No. C-gen-0402-a

D A T E : Aug., 2024

To

Non-Controlled Copy

CUSTOMER'S PRODUCT NAME

TDK PRODUCT NAME

Multilayer Ceramic Chip Capacitors
Tape packaging 【RoHS2 compliant】
C0402 type / C0G,X5R,X7R Characteristics

Please return this specification to TDK representatives.
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

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 C0402○○○△△□□□×.

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-Part 21 : Sectional specification
 : Fixed surface mount multilayer capacitors of ceramic dielectric,Class1
 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

CONTENTS

1. CODE CONSTRUCTION
2. COMBINATION OF RATED CAPACITANCE AND TOLERANCE
3. OPERATING TEMPERATURE RANGE
4. STORING CONDITION AND TERM
5. INDUSTRIAL WASTE DISPOSAL
6. PERFORMANCE
7. INSIDE STRUCTURE AND MATERIAL
8. PACKAGING
9. SOLDERING CONDITION
10. CAUTION
11. 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.

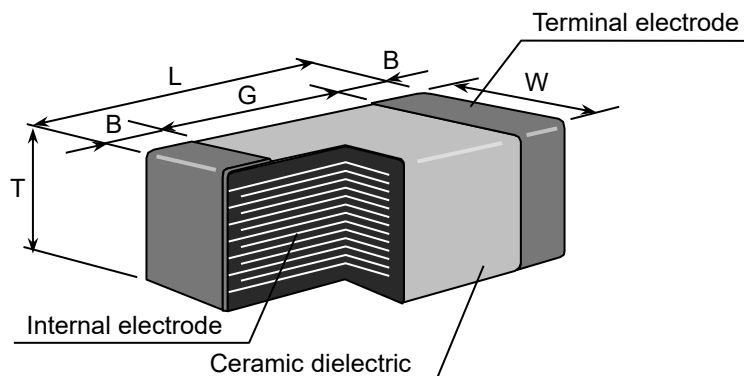
If the use of the capacitors goes beyond the bounds of this specification, we can not afford to guarantee.

Division	Date	SPEC. No.
Ceramic Capacitors Business Group	Aug, 2024	C-gen-0402-a

1. CODE CONSTRUCTION

(Example) C0402 X5R 1A 102 K T 0000
 (1) (2) (3) (4) (5) (6) (7)

(1) Case size



Type	Dimensions (Unit : mm)				
TDK (EIA style)	L	W	T	B	G
C0402 (CC01005)	0.40±0.02	0.20±0.02	0.20±0.02	0.70 min.	0.14 min.

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

(2) Temperature Characteristics

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

(3) Rated Voltage

Symbol	Rated Voltage
1 C	DC 16 V
1 A	DC 10 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
100	10 pF
102	1,000 pF

(5) Capacitance tolerance

Symbol	Tolerance	Capacitance
D	±0.5 pF	10pF and under
J	± 5 %	Over 10pF
K	±10 %	

(6) Packaging

Symbol	Packaging
T	Taping

(7) TDK internal code

2. COMBINATION OF RATED CAPACITANCE AND TOLERANCE

Class	Temperature Characteristics	Capacitance tolerance		Rated capacitance
1	C0G	10pF and under	D ($\pm 0.5\text{pF}$)	10
		Over 10pF	J ($\pm 5\%$)	E – 3 series
2	X5R X7R	K ($\pm 10\%$)		E – 3 series

Capacitance Step in E series

E series	Capacitance Step		
E-3	1.0	2.2	4.7

3. OPERATING TEMPERATURE RANGE

T.C.	Min. operating Temperature	Max. operating Temperature	Reference Temperature
X5R	-55°C	85°C	25°C
C0G/X7R	-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

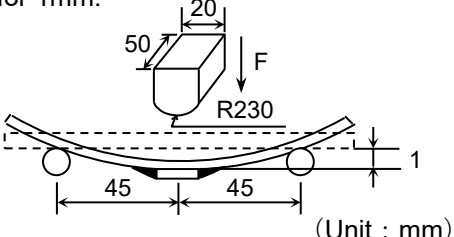
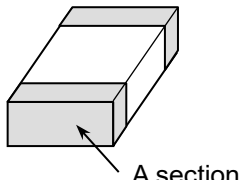
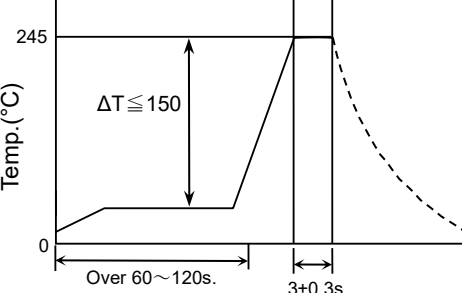
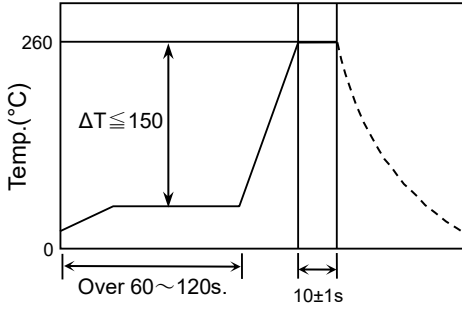
Dispose this product as industrial waste in accordance with the Industrial Waste Law.

6. PERFORMANCE

table 1

No.	Item		Performance	Test or inspection method													
1	External Appearance		No defects which may affect performance.	Inspect with magnifying glass(10×)													
2	Insulation Resistance		10,000MΩ or 100MΩ·μF min. whichever smaller.	Measuring voltage : Rated voltage Voltage application time : 60s.													
3	Voltage Proof		Withstand test voltage without insulation breakdown or other damage.	Class 1 : 3 times of rated voltage Class 2 : 2.5 times of rated voltage Voltage application time : 1s. Charge / discharge current : 50mA or lower													
4	Capacitance		Within the specified tolerance.	As for measuring condition, please contact with our sales representative.													
5	Q	Class1	Please refer to detail page on TDK web.	See No.4 in this table for measuring condition.													
	Dissipation Factor	Class2															
6	Temperature Characteristics of Capacitance (Class1)		<table border="1"> <tr> <td style="text-align: center;">Temperature Coefficient (ppm/°C)</td> </tr> <tr> <td style="text-align: center;">C0G : 0 ± 30</td> </tr> </table> Capacitance drift Within ±0.2% or ±0.05pF, whichever larger.	Temperature Coefficient (ppm/°C)	C0G : 0 ± 30	Temperature Coefficient shall be calculated based on values at 25°C and 85°C temperature. Measuring temperature below 20°C shall be -10°C and -25°C											
Temperature Coefficient (ppm/°C)																	
C0G : 0 ± 30																	
7	Temperature Characteristics of Capacitance (Class2)		<table border="1"> <tr> <td style="text-align: center;">Capacitance Change (%)</td> </tr> <tr> <td style="text-align: center;">No voltage applied</td> </tr> <tr> <td style="text-align: center;">X5R : ±15 X7R : ±15</td> </tr> </table>	Capacitance Change (%)	No voltage applied	X5R : ±15 X7R : ±15	Capacitance shall be measured by the steps shown in the following table, after thermal equilibrium is obtained for each step. ΔC be calculated ref. STEP3 reading. <table border="1"> <thead> <tr> <th>Step</th> <th>Temperature(°C)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">Reference temp. ± 2</td> </tr> <tr> <td style="text-align: center;">2</td> <td style="text-align: center;">Min. operating temp. ± 2</td> </tr> <tr> <td style="text-align: center;">3</td> <td style="text-align: center;">Reference temp. ± 2</td> </tr> <tr> <td style="text-align: center;">4</td> <td style="text-align: center;">Max. operating temp. ± 2</td> </tr> </tbody> </table> 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.	Step	Temperature(°C)	1	Reference temp. ± 2	2	Min. operating temp. ± 2	3	Reference temp. ± 2	4	Max. operating temp. ± 2
Capacitance Change (%)																	
No voltage applied																	
X5R : ±15 X7R : ±15																	
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																								
8	Bending	No mechanical damage.	Reflow solder the capacitor on a P.C. Board shown in Appendix1 and bend it for 1mm. 																								
9	Solderability	Both end faces and the contact areas shall be covered with a smooth and bright solder coating with no more than a small amount of scattered imperfections such as pinholes or un-wetted or de-wetted areas. These imperfections shall not be concentrated in one area. 	Solder : Sn-3.0Ag-0.5Cu Flux : Isopropyl alcohol(JIS K 8839) Rosin(JIS K 5902) 25% solid solution. Preheating condition Temp. : 110 ~ 140°C Time : 30 ~ 60s. Reflow profile 																								
10	Resistance to solder heat	<table border="1" data-bbox="359 1227 1002 2018"> <tr> <td data-bbox="359 1227 536 1332">External appearance</td> <td colspan="2" data-bbox="536 1227 1002 1332">No cracks are allowed and terminations shall be covered at least 60% with new solder.</td> </tr> <tr> <td data-bbox="359 1332 536 1630">Capacitance</td> <td data-bbox="536 1332 742 1630"> <table border="1"> <thead> <tr> <th data-bbox="536 1332 662 1429">Characteristics</th> <th data-bbox="662 1332 742 1429">Change from the value before test</th> </tr> </thead> <tbody> <tr> <td data-bbox="536 1429 662 1534">Class1 C0G</td> <td data-bbox="662 1429 742 1534">2.5% or ±0.25pF max.whichever larger</td> </tr> <tr> <td data-bbox="536 1534 662 1630">Class2 X5R X7R</td> <td data-bbox="662 1534 742 1630">±7.5 %</td> </tr> </tbody> </table> </td> <td data-bbox="742 1332 1002 1630"></td> </tr> <tr> <td data-bbox="359 1630 536 1736">Q (Class1)</td> <td colspan="2" data-bbox="536 1630 1002 1736">Meet the initial spec.</td> </tr> <tr> <td data-bbox="359 1736 536 1825">D.F. (Class2)</td> <td colspan="2" data-bbox="536 1736 1002 1825">Meet the initial spec.</td> </tr> <tr> <td data-bbox="359 1825 536 1915">Insulation Resistance</td> <td colspan="2" data-bbox="536 1825 1002 1915">Meet the initial spec.</td> </tr> <tr> <td data-bbox="359 1915 536 2018">Voltage proof</td> <td colspan="2" data-bbox="536 1915 1002 2018">No insulation breakdown or other damage.</td> </tr> </table>	External appearance	No cracks are allowed and terminations shall be covered at least 60% with new solder.		Capacitance	<table border="1"> <thead> <tr> <th data-bbox="536 1332 662 1429">Characteristics</th> <th data-bbox="662 1332 742 1429">Change from the value before test</th> </tr> </thead> <tbody> <tr> <td data-bbox="536 1429 662 1534">Class1 C0G</td> <td data-bbox="662 1429 742 1534">2.5% or ±0.25pF max.whichever larger</td> </tr> <tr> <td data-bbox="536 1534 662 1630">Class2 X5R X7R</td> <td data-bbox="662 1534 742 1630">±7.5 %</td> </tr> </tbody> </table>	Characteristics	Change from the value before test	Class1 C0G	2.5% or ±0.25pF max.whichever larger	Class2 X5R X7R	±7.5 %		Q (Class1)	Meet the initial spec.		D.F. (Class2)	Meet the initial spec.		Insulation Resistance	Meet the initial spec.		Voltage proof	No insulation breakdown or other damage.		Solder : Sn-3.0Ag-0.5Cu Flux : Isopropyl alcohol(JIS K 8839) Rosin(JIS K 5902) 25% solid solution. Preheating condition Temp. : 110 ~ 140°C Time : 30 ~ 60s. Leave the capacitors in ambient condition for 6 to 24h (Class1) or 24±2h (Class2) before measurement. Reflow profile 
External appearance	No cracks are allowed and terminations shall be covered at least 60% with new solder.																										
Capacitance	<table border="1"> <thead> <tr> <th data-bbox="536 1332 662 1429">Characteristics</th> <th data-bbox="662 1332 742 1429">Change from the value before test</th> </tr> </thead> <tbody> <tr> <td data-bbox="536 1429 662 1534">Class1 C0G</td> <td data-bbox="662 1429 742 1534">2.5% or ±0.25pF max.whichever larger</td> </tr> <tr> <td data-bbox="536 1534 662 1630">Class2 X5R X7R</td> <td data-bbox="662 1534 742 1630">±7.5 %</td> </tr> </tbody> </table>	Characteristics	Change from the value before test	Class1 C0G	2.5% or ±0.25pF max.whichever larger	Class2 X5R X7R	±7.5 %																				
Characteristics	Change from the value before test																										
Class1 C0G	2.5% or ±0.25pF max.whichever larger																										
Class2 X5R X7R	±7.5 %																										
Q (Class1)	Meet the initial spec.																										
D.F. (Class2)	Meet the initial spec.																										
Insulation Resistance	Meet the initial spec.																										
Voltage proof	No insulation breakdown or other damage.																										

(continued)

No.	Item		Performance	Test or inspection method															
11	Vibration	External appearance	No mechanical damage.	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 Appendix 2 before testing.															
		Capacitance	<table border="1"> <thead> <tr> <th colspan="2">Characteristics</th> <th>Change from the value before test</th> </tr> </thead> <tbody> <tr> <td>Class1</td> <td>C0G</td> <td>2.5% or $\pm 0.25\mu\text{F}$ max.whichever larger</td> </tr> <tr> <td>Class2</td> <td>X5R X7R</td> <td>$\pm 7.5\%$</td> </tr> </tbody> </table>		Characteristics		Change from the value before test	Class1	C0G	2.5% or $\pm 0.25\mu\text{F}$ max.whichever larger	Class2	X5R X7R	$\pm 7.5\%$						
			Characteristics		Change from the value before test														
			Class1		C0G	2.5% or $\pm 0.25\mu\text{F}$ max.whichever larger													
		Class2	X5R X7R		$\pm 7.5\%$														
Q (Class1)	Meet the initial spec.																		
D.F. (Class2)	Meet the initial spec.																		
12	Temperature cycle	External appearance	No mechanical damage.	Expose the capacitors in the condition step1 through step 4 listed in the following table. Temp. cycle : 5 cycles <table border="1"> <thead> <tr> <th>Step</th> <th>Temperature($^{\circ}\text{C}$)</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> As for Min./Max. operating temp., please refer to "3. OPERATING TEMPERATURE RANGE" Leave the capacitors in ambient condition for Class 1 : 6~24h Class 2 : 24 \pm 2h before measurement. Reflow solder the capacitors on a P.C.Board shown in Appendix2 before testing.	Step	Temperature($^{\circ}\text{C}$)	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($^{\circ}\text{C}$)		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	<table border="1"> <thead> <tr> <th colspan="2">Characteristics</th> <th>Change from the value before test</th> </tr> </thead> <tbody> <tr> <td>Class1</td> <td>C0G</td> <td>Please contact with our sales representative.</td> </tr> <tr> <td>Class2</td> <td>X5R X7R</td> <td></td> </tr> </tbody> </table>		Characteristics		Change from the value before test	Class1	C0G	Please contact with our sales representative.	Class2	X5R X7R							
Characteristics			Change from the value before test																
Class1	C0G		Please contact with our sales representative.																
Class2	X5R X7R																		
Q (Class1)	Meet the initial spec.																		
D.F. (Class2)	Meet the initial spec.																		
Insulation Resistance	Meet the initial spec.																		
Voltage proof	No insulation breakdown or other damage.																		

(continued)

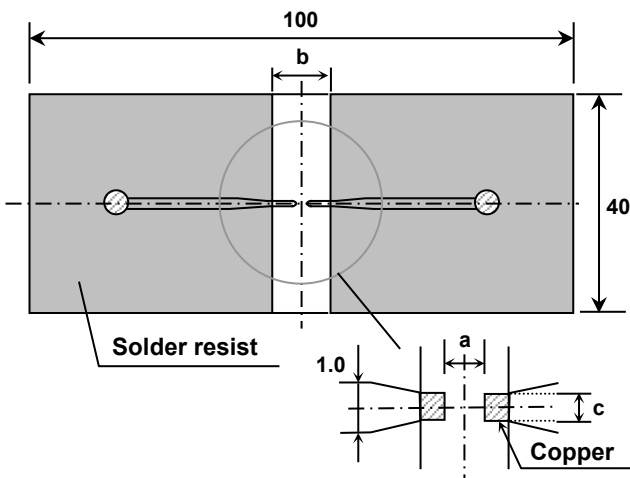
No.	Item		Performance	Test or inspection method								
13	Moisture Resistance (Steady state)	External appearance	No mechanical damage.	Test temp. : 40±2°C Test humidity : 90~95%RH Test time : 500 +24,0h Leave the capacitors in ambient condition for Class 1 : 6~24h Class 2 : 24±2h before measurement. Reflow solder the capacitors on a P.C.Board shown in Appendix2 before testing.								
		Capacitance	<table border="1"> <thead> <tr> <th colspan="2">Characteristics</th> <th>Change from the value before test</th> </tr> </thead> <tbody> <tr> <td>Class1</td> <td>C0G</td> <td rowspan="2">Please contact with our sales representative.</td> </tr> <tr> <td>Class2</td> <td>X5R X7R</td> </tr> </tbody> </table>		Characteristics		Change from the value before test	Class1	C0G	Please contact with our sales representative.	Class2	X5R X7R
			Characteristics		Change from the value before test							
			Class1		C0G	Please contact with our sales representative.						
		Class2	X5R X7R									
Q (Class1)	<table border="1"> <thead> <tr> <th>Capacitance</th> <th>Q</th> </tr> </thead> <tbody> <tr> <td>30pF and over</td> <td>350 min.</td> </tr> <tr> <td>10pF and over under 30pF</td> <td>275+5/2×C min.</td> </tr> <tr> <td>Under 10pF</td> <td>200+10×C min.</td> </tr> </tbody> </table> C : Rated capacitance (pF)	Capacitance	Q	30pF and over	350 min.	10pF and over under 30pF	275+5/2×C min.	Under 10pF	200+10×C min.			
	Capacitance	Q										
	30pF and over	350 min.										
10pF and over under 30pF	275+5/2×C min.											
Under 10pF	200+10×C min.											
D.F. (Class2)	200% of initial spec max.											
Insulation Resistance	1,000MΩ or 10MΩ·μF min. whichever smaller.											
14	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 Class 1 : 6~24h Class 2 : 24±2h before measurement. Reflow solder the capacitors on a P.C.Board shown in Appendix2 before testing. Initial value setting (only for class 2) 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	<table border="1"> <thead> <tr> <th colspan="2">Characteristics</th> <th>Change from the value before test</th> </tr> </thead> <tbody> <tr> <td>Class1</td> <td>C0G</td> <td rowspan="2">Please contact with our sales representative.</td> </tr> <tr> <td>Class2</td> <td>X5R X7R</td> </tr> </tbody> </table>		Characteristics		Change from the value before test	Class1	C0G	Please contact with our sales representative.	Class2	X5R X7R
			Characteristics		Change from the value before test							
			Class1		C0G	Please contact with our sales representative.						
		Class2	X5R X7R									
Q (Class1)	<table border="1"> <thead> <tr> <th>Capacitance</th> <th>Q</th> </tr> </thead> <tbody> <tr> <td>30pF and over</td> <td>200 min.</td> </tr> <tr> <td>Under 30pF</td> <td>100+10/3×C min.</td> </tr> </tbody> </table> C : Rated capacitance (pF)	Capacitance	Q	30pF and over	200 min.	Under 30pF	100+10/3×C min.					
	Capacitance	Q										
30pF and over	200 min.											
Under 30pF	100+10/3×C min.											
D.F. (Class2)	200% of initial spec max.											
Insulation Resistance	500MΩ or 5MΩ·μF min. whichever smaller.											

(continued)

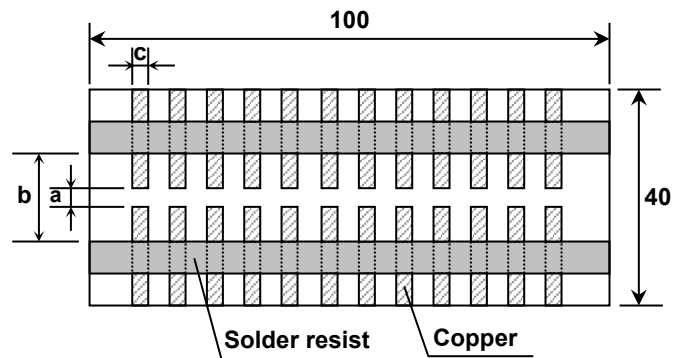
No.	Item		Performance	Test or inspection method									
15	Life	External appearance	No mechanical damage.	Test temp. : Maximum operating temperature $\pm 2^{\circ}\text{C}$ Applied voltage : Please contact with our sales representative. Test time : 1,000 +48,0h Charge/discharge current : 50mA or lower Leave the capacitors in ambient condition for Class 1 : 6~24h Class 2 : 24 \pm 2h before measurement. Reflow solder the capacitors on a P.C.Board shown in Appendix2 before testing. Initial value setting (only for class 2) Voltage conditioning «After voltage treat the capacitors under testing temperature and voltage for 1 hour,» leave the capacitors in ambient condition for 24 \pm 2h before measurement. Use this measurement for initial value.									
		Capacitance	<table border="1"> <thead> <tr> <th colspan="2">Characteristics</th> <th>Change from the value before test</th> </tr> </thead> <tbody> <tr> <td>Class1</td> <td>C0G</td> <td rowspan="2">Please contact with our sales representative.</td> </tr> <tr> <td>Class2</td> <td>X5R X7R</td> </tr> </tbody> </table>		Characteristics		Change from the value before test	Class1	C0G	Please contact with our sales representative.	Class2	X5R X7R	
			Characteristics		Change from the value before test								
			Class1		C0G	Please contact with our sales representative.							
		Class2	X5R X7R										
Q (Class1)	<table border="1"> <thead> <tr> <th>Capacitance</th> <th>Q</th> </tr> </thead> <tbody> <tr> <td>30pF and over</td> <td>350 min.</td> </tr> <tr> <td>10pF and over under 30pF</td> <td>275+5/2\timesC min.</td> </tr> <tr> <td>Under 10pF</td> <td>200+10\timesC min.</td> </tr> </tbody> </table>		Capacitance	Q	30pF and over	350 min.	10pF and over under 30pF	275+5/2 \times C min.	Under 10pF	200+10 \times C min.			
	Capacitance	Q											
	30pF and over	350 min.											
10pF and over under 30pF	275+5/2 \times C min.												
Under 10pF	200+10 \times C min.												
C : Rated capacitance (pF)													
D.F. (Class2)	200% of initial spec max.												
Insulation Resistance	1,000M Ω or 10M Ω · μF min. whichever smaller.												

*As for the initial measurement of capacitors (Class2) on number 7,10,11,12 and 13 leave capacitors at 150 -10,0 $^{\circ}\text{C}$ for 1h and measure the value after leaving capacitors for 24 \pm 2h in ambient condition.

Appendix 1

P.C.Board for bending test

Appendix 2

P.C. Board for reliability test

(Unit : mm)

Symbol Case size	a	b	c
C0402 (CC01005)	0.2	0.8	0.2

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

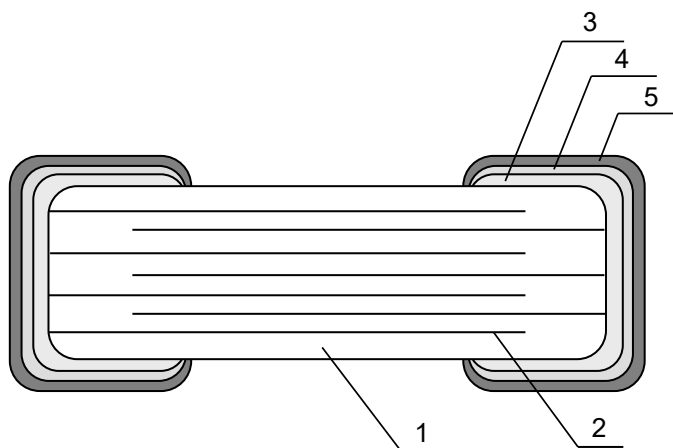
2. Thickness : Appendix 1 — 0.8mm

Appendix 2 — 1.6mm

 Copper(Thickness:0.035mm)

 Solder resist

7. INSIDE STRUCTURE AND MATERIAL



No.	NAME	MATERIAL	
		Class1	Class2
1	Dielectric	CaZrO ₃	BaTiO ₃
2	Electrode	Nickel (Ni)	
3	Termination	Copper (Cu)	
4		Nickel (Ni)	
5		Tin (Sn)	

8. PACKAGING

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

Tape packaging is as per 11. TAPE PACKAGING SPECIFICATION.

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

*Composition of Inspection No.

Example E 4 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.

(Implemented on and after May 1, 2019 in sequence)

Example

I	F	4	E	2	3	A	0	0	1
---	---	---	---	---	---	---	---	---	---

 (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)


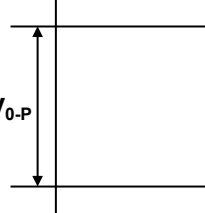
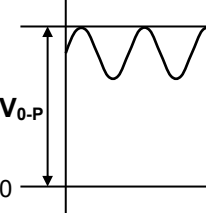
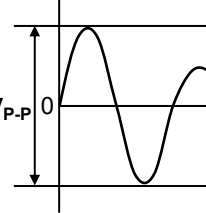
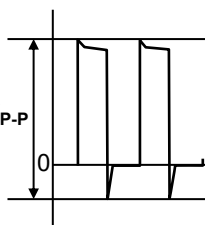
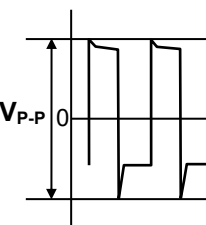
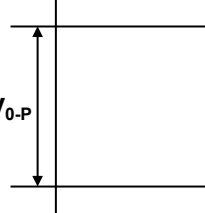
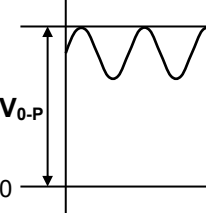
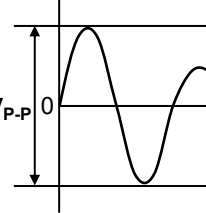
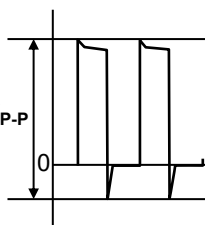
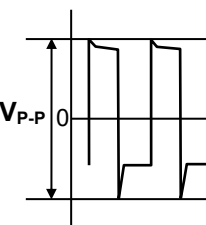
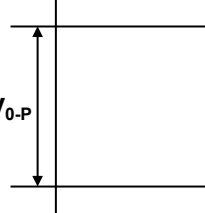
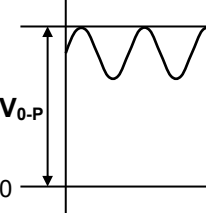
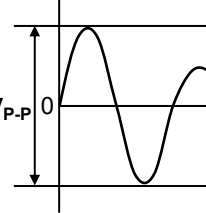
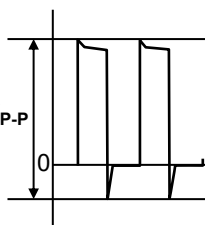
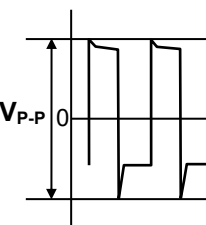
* It was shifted to the new inspection No. on and after May 2019, but the implementation timing may be different depending on shipment bases. Until the shift is completed, either current or new composition of inspection No. will be applied.

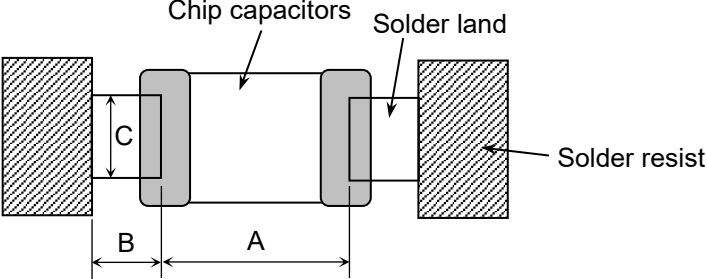
9. SOLDERING CONDITION

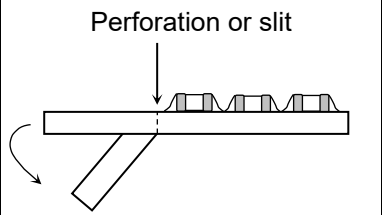
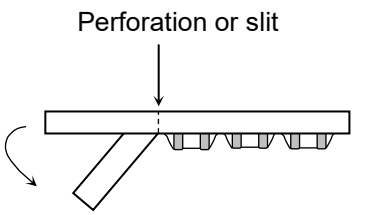
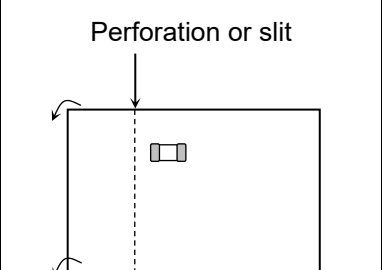
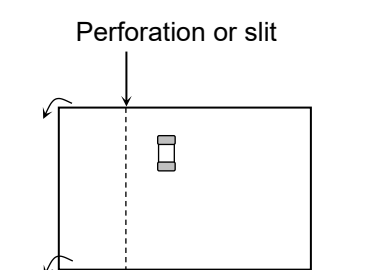
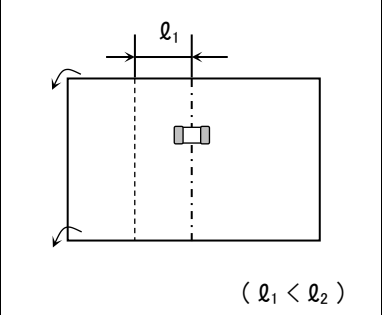
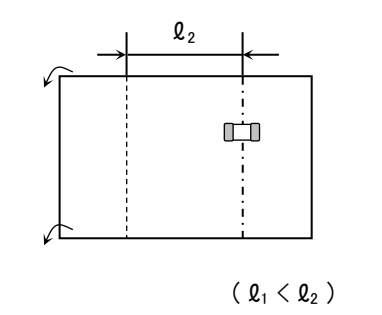
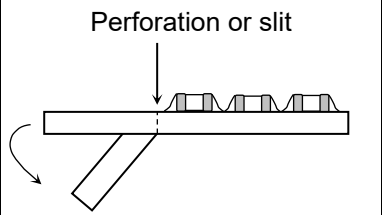
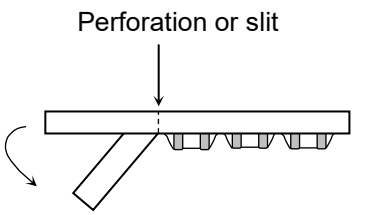
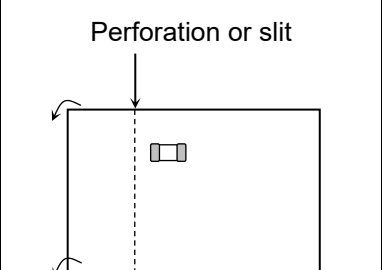
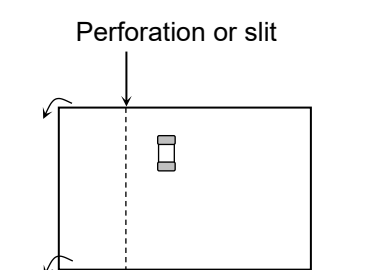
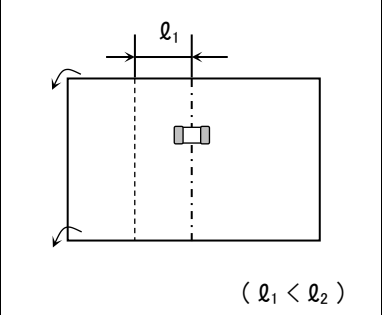
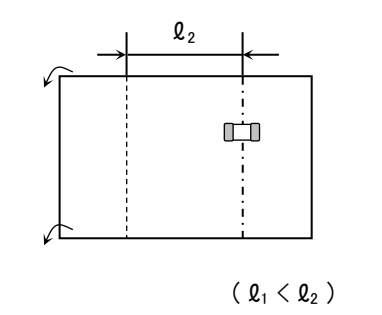
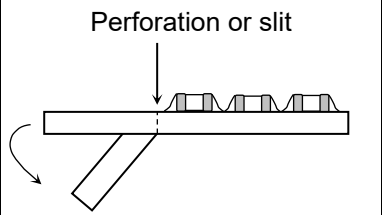
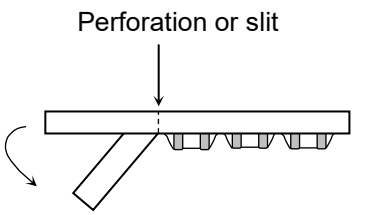
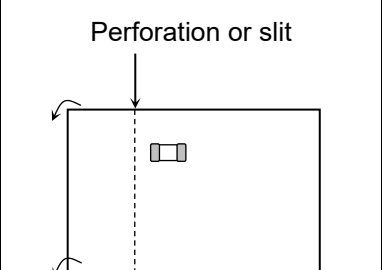
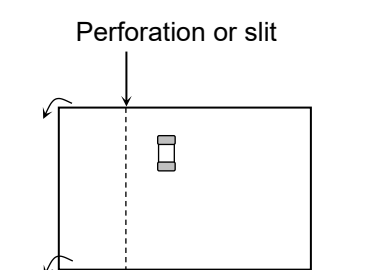
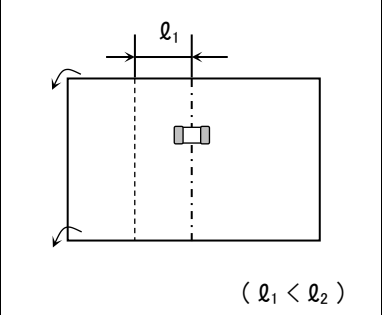
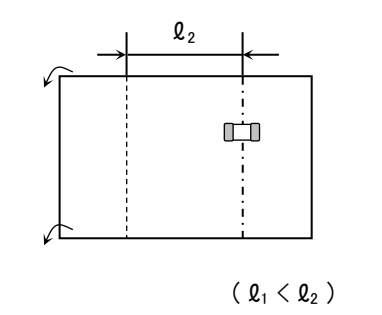
Reflow soldering only.

10. CAUTION

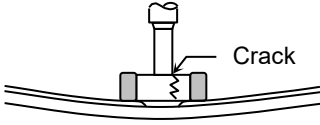
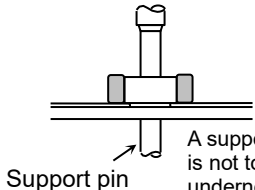
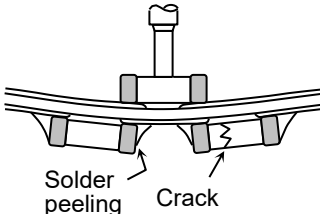
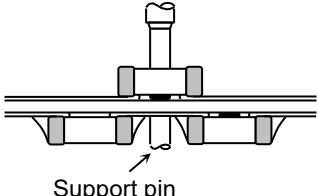
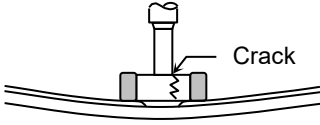
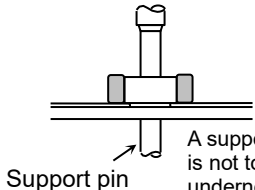
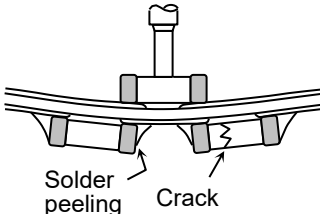
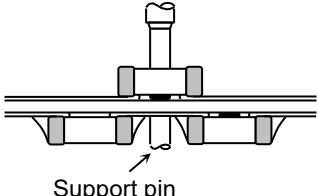
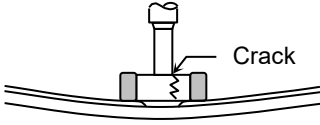
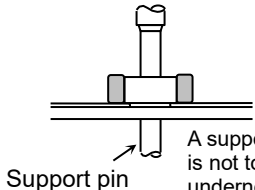
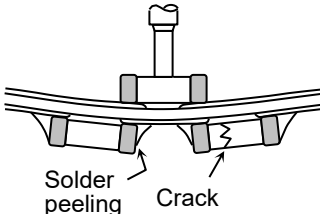
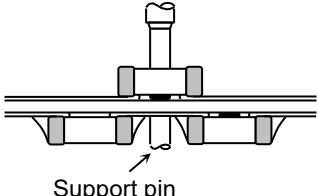
No.	Process	Condition
1	Operating Condition (Storage, Use, Transportation)	<p>1-1. Storage, Use The capacitors must be stored in an ambient temperature of 5 to 40°C with a relative humidity of 20 to 70%RH. JIS C 60721-3-1 Class 1K2 should be followed for the other climatic conditions.</p> <ol style="list-style-type: none"> 1) High temperature and humidity environment may affect a capacitor's solder ability because it accelerates terminal oxidization. They also deteriorate performance of taping and packaging. Therefore, SMD capacitors shall be used within 6 months. For capacitors with terminal electrodes consisting of silver or silver-palladium which tend to become oxidized or sulfurized, use as soon as possible, such as within one month after opening the bag. 2) When capacitors are stored for a longer time period than 6 months, confirm the solderability of the capacitors prior to use. During storage, keep the minimum packaging unit in its original packaging without opening it. Do not deviate from the above temperature and humidity conditions even for a short term. 3) Corrosive gasses in the air or atmosphere may result in deterioration of the reliability, such as poor solderability of the terminal electrodes. Do not store capacitors where they will be exposed to corrosive gas (e.g., hydrogen sulfide, sulfur dioxide, chlorine ammonia etc.) 4) Solderability and electrical performance may deteriorate due to photochemical change in the terminal electrode if stored in direct sunlight, or due to condensation from rapid changes in humidity. The capacitors especially which use resin material must be operated and stored in an environment free of dew condensation, as moisture absorption due to condensation may affect the performance. 5) Refer to JIS C 60721-3-1, class 1K2 for other climate conditions. <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</p> <ol style="list-style-type: none"> 1) Upper category temperature (maximum operating temperature) is specified. It is necessary to select a capacitor whose rated temperature is higher than the operating temperature. Also, it is necessary to consider the temperature distribution in the equipment and seasonal temperature variation. 2) Surface temperature including self heating should be below maximum operating temperature. Due to dielectric loss, capacitors will heat itself when AC is applied due to ESR. Especially at high frequencies, please be careful that the heat might be so extreme. Also, even if the surface temperature of the capacitor includes self-heating and is the maximum operating temperature or lower, excessive heating of the capacitor due to self-heating may cause deterioration of the characteristics and reliability of the capacitor. The self-heating temperature rise of the capacitor changes depending on the difference in heat radiation due to the mounting method to the device, the ambient temperature, the cooling method of the device and circuit board material and the design, etc. The load should be contained so that the self-heating temperature rise of the capacitor body in a natural convection environment at an ambient temperature of 25°C remain below 20°C. When using in a high-frequency circuit or a circuit in which a capacitor generates heat, such as when a high-frequency ripple current flows, pay attention to the above precautions. (Note that accurate measurement may not be possible with self-heating measurement when the equipment applies cooling other than natural convection such as a cooling fan.) 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.

No.	Process	Condition														
2	Circuit design  Caution	<p>2-2. When overvoltage is applied Applying overvoltage to a capacitor may cause dielectric breakdown and result in a short circuit. The duration until dielectric breakdown depends on the applied voltage and the ambient temperature.</p> <p>2-3. Operating voltage</p> <p>1) Operating voltage across the terminals should be below the rated voltage. When AC and DC are super imposed, V_{0-P} must be below the rated voltage. — (1) and (2) AC or pulse with overshooting, V_{P-P} must be below the rated voltage. — (3), (4) and (5) 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="488 689 1473 958"> <thead> <tr> <th data-bbox="488 689 687 734">Voltage</th> <th data-bbox="687 689 948 734">(1) DC voltage</th> <th data-bbox="948 689 1208 734">(2) DC+AC voltage</th> <th data-bbox="1208 689 1473 734">(3) AC voltage</th> </tr> </thead> <tbody> <tr> <td data-bbox="488 734 687 958">Positional Measurement (Rated voltage)</td> <td data-bbox="687 734 948 958">  </td> <td data-bbox="948 734 1208 958">  </td> <td data-bbox="1208 734 1473 958">  </td> </tr> </tbody> </table> <table border="1" data-bbox="488 987 1208 1272"> <thead> <tr> <th data-bbox="488 987 687 1032">Voltage</th> <th data-bbox="687 987 948 1032">(4) Pulse voltage (A)</th> <th data-bbox="948 987 1208 1032">(5) Pulse voltage (B)</th> </tr> </thead> <tbody> <tr> <td data-bbox="488 1032 687 1272">Positional Measurement (Rated voltage)</td> <td data-bbox="687 1032 948 1272">  </td> <td data-bbox="948 1032 1208 1272">  </td> </tr> </tbody> </table> <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>4) Abnormal voltage (surge voltage, static electricity, pulse voltage, etc.) shall not exceed the rated voltage.</p> <p>5) When capacitors are used in a series connection, it is necessary to add a balancing circuit such as voltage dividing resistors in order to avoid an imbalance in the voltage applied to each capacitor.</p> <p>2-4. Frequency When the capacitors (Class 2) are used in AC and/or pulse voltages, the capacitors may vibrate themselves and generate audible sound.</p>	Voltage	(1) DC voltage	(2) DC+AC voltage	(3) AC voltage	Positional Measurement (Rated voltage)				Voltage	(4) Pulse voltage (A)	(5) Pulse voltage (B)	Positional Measurement (Rated voltage)		
Voltage	(1) DC voltage	(2) DC+AC voltage	(3) AC voltage													
Positional Measurement (Rated voltage)																
Voltage	(4) Pulse voltage (A)	(5) Pulse voltage (B)														
Positional Measurement (Rated voltage)																

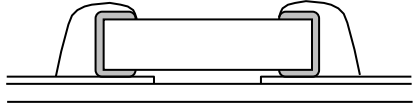
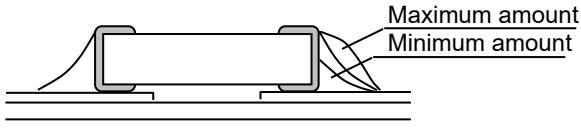
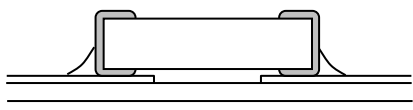
No.	Process	Condition																		
3	Designing P.C.board	<p>The amount of solder at the terminations has a direct effect on the reliability of the capacitors.</p> <ol style="list-style-type: none"> 1) The greater the amount of solder, the higher the stress on the chip capacitors, and the more likely 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. 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> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2" style="text-align: left;">Reflow soldering</th> <th style="text-align: right;">(Unit : mm)</th> </tr> <tr> <th style="text-align: center;">Case size</th> <th colspan="2" style="text-align: center;">C0402 (CC01005)</th> </tr> <tr> <th style="text-align: center;">Symbol</th> <th colspan="2"></th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">A</td> <td colspan="2" style="text-align: center;">0.15 ~ 0.25</td> </tr> <tr> <td style="text-align: center;">B</td> <td colspan="2" style="text-align: center;">0.15 ~ 0.25</td> </tr> <tr> <td style="text-align: center;">C</td> <td colspan="2" style="text-align: center;">0.15 ~ 0.25</td> </tr> </tbody> </table>	Reflow soldering		(Unit : mm)	Case size	C0402 (CC01005)		Symbol			A	0.15 ~ 0.25		B	0.15 ~ 0.25		C	0.15 ~ 0.25	
Reflow soldering		(Unit : mm)																		
Case size	C0402 (CC01005)																			
Symbol																				
A	0.15 ~ 0.25																			
B	0.15 ~ 0.25																			
C	0.15 ~ 0.25																			

No.	Process	Condition												
3	Designing P.C.board	<p>4) Recommended chip capacitors 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>$(l_1 < l_2)$</p> </td> <td style="text-align: center;"> <p>Away from slit is less stress</p>  <p>$(l_1 < l_2)$</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>$(l_1 < l_2)$</p>	<p>Away from slit is less stress</p>  <p>$(l_1 < l_2)$</p>
	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>$(l_1 < l_2)$</p>	<p>Away from slit is less stress</p>  <p>$(l_1 < l_2)$</p>												


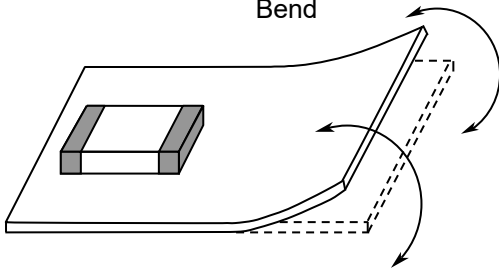
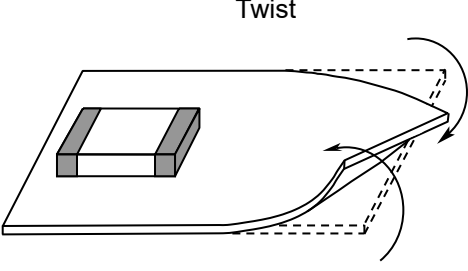
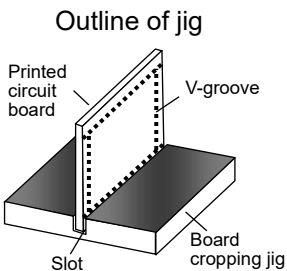
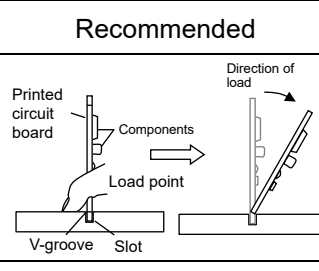
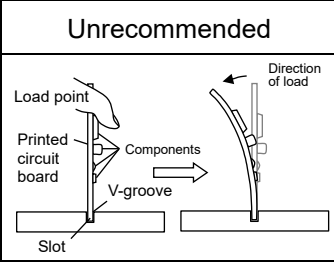
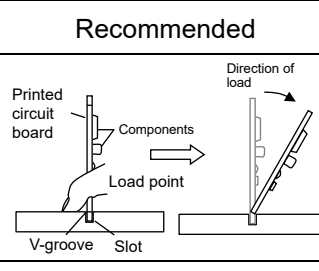
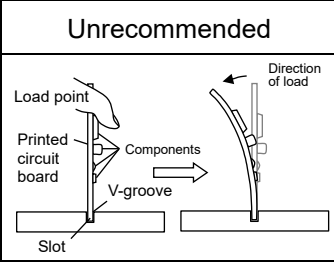
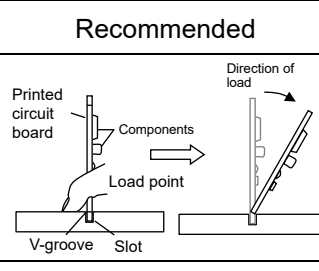
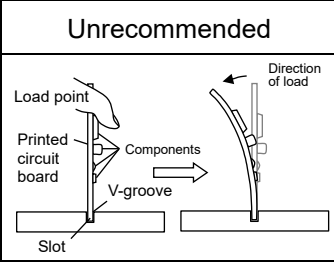
No.	Process	Condition												
3	Designing P.C.board	<p>5) Mechanical stress varies according to location of chip capacitors on the P.C.board.</p> <div data-bbox="399 268 1420 851"> <p>Perforation</p> <p>Slit</p> <p>Stress force $A > B > E$ $A > D > E$ $A > C$</p> </div> <p>When dividing printed wiring boards, the intensities of mechanical stress applied to capacitors are different according to each dividing method in the order of : Push-back < Slit < V-groove < Perforation. Therefore consider not only position of capacitors, but also the way of the dividing the printed wiring boards.</p> <p>6) Layout recommendation</p> <table border="1" data-bbox="391 1097 1492 2016"> <thead> <tr> <th data-bbox="391 1097 555 1209">Example</th> <th data-bbox="555 1097 858 1209">Use of common solder land</th> <th data-bbox="858 1097 1165 1209">Soldering with chassis</th> <th data-bbox="1165 1097 1492 1209">Use of common solder land with other SMD</th> </tr> </thead> <tbody> <tr> <td data-bbox="391 1209 555 1590">Need to avoid</td> <td data-bbox="555 1209 858 1590"> <p>Lead wire</p> <p>Chip</p> <p>Solder</p> <p>PCB</p> <p>Solder land</p> </td> <td data-bbox="858 1209 1165 1590"> <p>Chassis</p> <p>Excessive solder</p> <p>l_1</p> </td> <td data-bbox="1165 1209 1492 1590"> <p>Solder land</p> <p>Excessive solder</p> <p>Missing solder</p> <p>Solder land</p> </td> </tr> <tr> <td data-bbox="391 1590 555 2016">Recommendation</td> <td data-bbox="555 1590 858 2016"> <p>Lead wire</p> <p>Solder resist</p> </td> <td data-bbox="858 1590 1165 2016"> <p>Solder resist</p> <p>$l_2 > l_1$</p> </td> <td data-bbox="1165 1590 1492 2016"> <p>Solder resist</p> </td> </tr> </tbody> </table>	Example	Use of common solder land	Soldering with chassis	Use of common solder land with other SMD	Need to avoid	<p>Lead wire</p> <p>Chip</p> <p>Solder</p> <p>PCB</p> <p>Solder land</p>	<p>Chassis</p> <p>Excessive solder</p> <p>l_1</p>	<p>Solder land</p> <p>Excessive solder</p> <p>Missing solder</p> <p>Solder land</p>	Recommendation	<p>Lead wire</p> <p>Solder resist</p>	<p>Solder resist</p> <p>$l_2 > l_1$</p>	<p>Solder resist</p>
Example	Use of common solder land	Soldering with chassis	Use of common solder land with other SMD											
Need to avoid	<p>Lead wire</p> <p>Chip</p> <p>Solder</p> <p>PCB</p> <p>Solder land</p>	<p>Chassis</p> <p>Excessive solder</p> <p>l_1</p>	<p>Solder land</p> <p>Excessive solder</p> <p>Missing solder</p> <p>Solder land</p>											
Recommendation	<p>Lead wire</p> <p>Solder resist</p>	<p>Solder resist</p> <p>$l_2 > l_1$</p>	<p>Solder resist</p>											


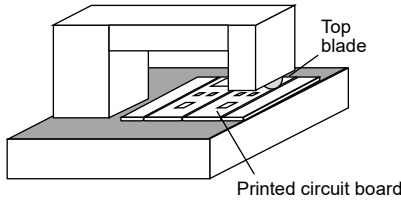
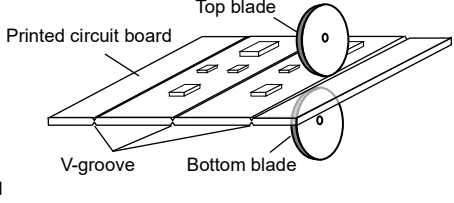
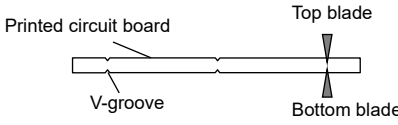
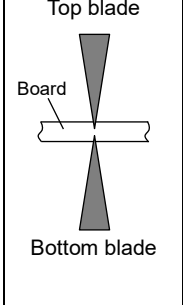
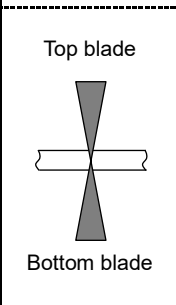
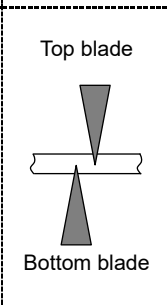
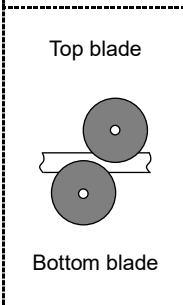
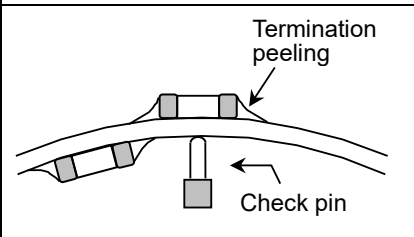
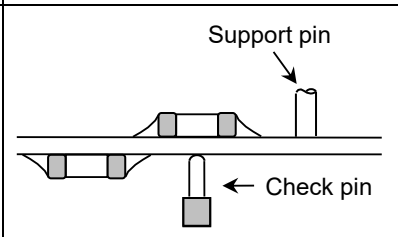
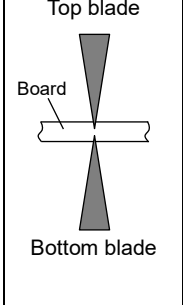
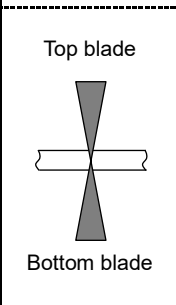
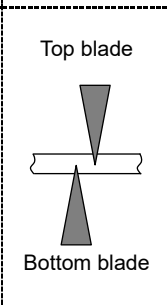
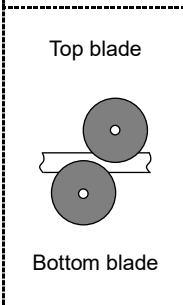
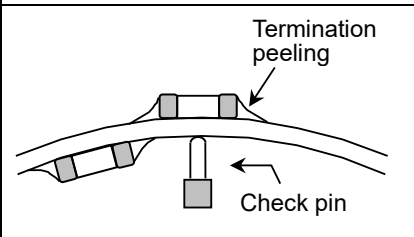
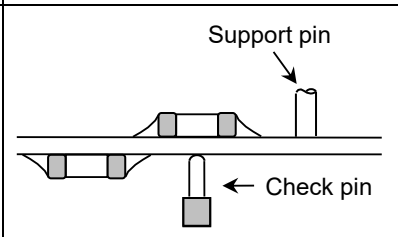
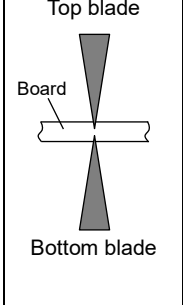
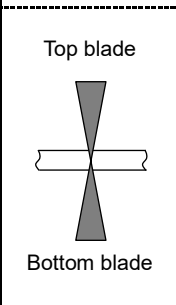
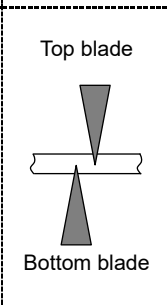
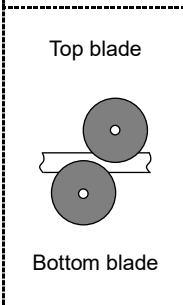
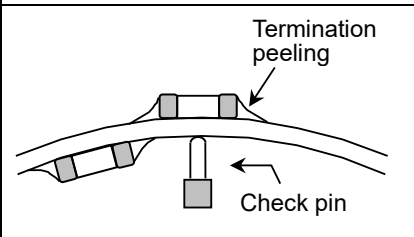
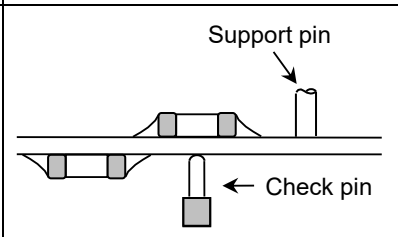
No.	Process	Condition									
4	Mounting	<p>4-1. Stress from mounting head</p> <p>If the mounting head is adjusted too low, it may induce excessive stress in the chip capacitors to result in cracking. Please take following precautions.</p> <ol style="list-style-type: none"> 1) Adjust the bottom dead center of the mounting head to reach on the P.C.board surface and not press it. 2) Adjust the mounting head pressure to be 1 to 3N of static weight. 3) To minimize the impact energy from mounting head, it is important to provide support from the bottom side of the P.C.board. <p>See following examples.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th data-bbox="497 629 692 678"></th> <th data-bbox="692 629 1070 678">Not recommended</th> <th data-bbox="1070 629 1449 678">Recommended</th> </tr> </thead> <tbody> <tr> <td data-bbox="497 678 692 949">Single-sided mounting</td> <td data-bbox="692 678 1070 949">  <p>Crack</p> </td> <td data-bbox="1070 678 1449 949">  <p>Support pin</p> <p>A support pin is not to be underneath the capacitor.</p> </td> </tr> <tr> <td data-bbox="497 949 692 1211">Double-sides mounting</td> <td data-bbox="692 949 1070 1211">  <p>Solder peeling</p> <p>Crack</p> </td> <td data-bbox="1070 949 1449 1211">  <p>Support pin</p> </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	 <p>Crack</p>	 <p>Support pin</p> <p>A support pin is not to be underneath the capacitor.</p>	Double-sides mounting	 <p>Solder peeling</p> <p>Crack</p>	 <p>Support pin</p>
	Not recommended	Recommended									
Single-sided mounting	 <p>Crack</p>	 <p>Support pin</p> <p>A support pin is not to be underneath the capacitor.</p>									
Double-sides mounting	 <p>Solder peeling</p> <p>Crack</p>	 <p>Support pin</p>									

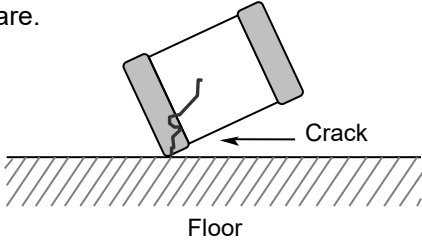
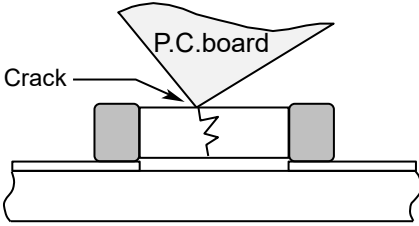
No.	Process	Condition																		
5	Soldering	<p>5-1. Flux selection Flux can seriously affect the performance of capacitors. Confirm the following to select the appropriate flux.</p> <ol style="list-style-type: none"> 1) It is recommended to use a mildly activated rosin flux (less than 0.1wt% 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 : Reflow method Refer to the following temperature profile at Reflow soldering.</p> <div style="text-align: center;"> <p>Reflow soldering</p> </div> <p>5-3. Recommended soldering peak temp and peak temp duration for Reflow soldering Pb free solder is recommended, but if Sn-37Pb must be used, refer to below.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th rowspan="2" style="text-align: center;">Temp./Duration</th> <th colspan="2" style="text-align: center;">Reflow soldering</th> </tr> <tr> <th style="text-align: center;">Peak temp(°C)</th> <th style="text-align: center;">Duration(sec.)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Solder</td> <td></td> <td></td> </tr> <tr> <td style="text-align: center;">Lead Free Solder</td> <td style="text-align: center;">260 max.</td> <td style="text-align: center;">10 max.</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> </tbody> </table> <p>Recommended solder compositions Lead Free Solder : Sn-3.0Ag-0.5Cu</p> <p>5-4. Avoiding thermal shock</p> <ol style="list-style-type: none"> 1) Preheating condition <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: center;">Soldering</th> <th style="text-align: center;">Temp. (°C)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Reflow soldering</td> <td style="text-align: center;">$\Delta T \leq 150$</td> </tr> </tbody> </table> 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. 	Temp./Duration	Reflow soldering		Peak temp(°C)	Duration(sec.)	Solder			Lead Free Solder	260 max.	10 max.	Sn-Pb Solder	230 max.	20 max.	Soldering	Temp. (°C)	Reflow soldering	$\Delta T \leq 150$
Temp./Duration	Reflow soldering																			
	Peak temp(°C)	Duration(sec.)																		
Solder																				
Lead Free Solder	260 max.	10 max.																		
Sn-Pb Solder	230 max.	20 max.																		
Soldering	Temp. (°C)																			
Reflow soldering	$\Delta T \leq 150$																			


No.	Process	Condition
5	Soldering	<p>5-5. Amount of solder</p> <p>Excessive solder will induce higher tensile force in chip capacitors when temperature changes and it may result in chip cracking. In sufficient solder may detach the capacitors from the P.C.board.</p> <hr/> <div style="display: flex; justify-content: space-between;"> <div data-bbox="507 394 632 461">Excessive solder</div> <div data-bbox="684 394 1098 501">  </div> <div data-bbox="1131 380 1425 470">Higher tensile force in chip capacitors to cause crack</div> </div> <hr/> <div style="display: flex; justify-content: space-between;"> <div data-bbox="507 564 625 595">Adequate</div> <div data-bbox="673 517 1256 647">  </div> </div> <hr/> <div style="display: flex; justify-content: space-between;"> <div data-bbox="507 698 639 766">Insufficient solder</div> <div data-bbox="684 698 1098 806">  </div> <div data-bbox="1131 672 1425 792">Low robustness may cause contact failure or chip capacitors come off the P.C.board.</div> </div> <hr/> <p>5-6. Sn-Zn solder Sn-Zn solder affects product reliability. Please contact TDK in advance when utilize Sn-Zn solder.</p> <p>5-7. 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>

No.	Process	Condition
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 equipment is used, excessive ultrasonic power or direct vibration transfer to a printed wiring board may generate a resonant vibration in the board. This may cause a crack in a capacitor or its solder joints to the board and degradation in the terminal strength of the capacitor. In order to avoid this, the following cleaning conditions are recommended.</p> <p style="text-align: center;">Power : 20 W/l max. Frequency : 40 kHz max. Washing time : 5 minutes max.</p> <p>2)-3. If the cleaning fluid is contaminated, density of Halogen increases, and it may bring the same result as insufficient cleaning.</p>
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>

No.	Process	Condition				
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; margin-top: 20px;"> <div style="text-align: center;"> <p>Outline of jig</p>  </div> <table border="1" style="border-collapse: collapse; width: 100%;"> <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="587 504 989 772"> <p>Outline of machine</p>  </div> <div data-bbox="989 504 1444 772"> <p>Principle of operation</p>  </div> </div> <div style="text-align: center; margin-top: 10px;"> <p>Cross-section diagram</p>  </div> <table border="1" style="width: 100%; margin-top: 10px; border-collapse: collapse;"> <thead> <tr> <th data-bbox="670 985 853 1064" rowspan="2">Recommended</th> <th colspan="3" data-bbox="853 985 1380 1030">Unrecommended</th> </tr> <tr> <th data-bbox="853 1030 1029 1108">Top-bottom misalignment</th> <th data-bbox="1029 1030 1197 1108">Left-right misalignment</th> <th data-bbox="1197 1030 1380 1108">Front-rear misalignment</th> </tr> </thead> <tbody> <tr> <td data-bbox="670 1108 853 1411" style="text-align: center;">  </td> <td data-bbox="853 1108 1029 1411" style="text-align: center;">  </td> <td data-bbox="1029 1108 1197 1411" style="text-align: center;">  </td> <td data-bbox="1197 1108 1380 1411" style="text-align: center;">  </td> </tr> </tbody> </table> <p>3) When functional check of the P.C. board is performed, check pin pressure tends to be adjusted higher for fear of loose contact. But if the pressure is excessive and bend the P.C. board, it may crack the chip capacitors or peel the terminations off. Please adjust the check pins not to bend the P.C. board.</p> <table border="1" style="width: 100%; margin-top: 10px; border-collapse: collapse;"> <thead> <tr> <th data-bbox="502 1657 646 1713">Item</th> <th data-bbox="646 1657 1061 1713">Not recommended</th> <th data-bbox="1061 1657 1460 1713">Recommended</th> </tr> </thead> <tbody> <tr> <td data-bbox="502 1713 646 1948" style="text-align: center;">Board bending</td> <td data-bbox="646 1713 1061 1948" style="text-align: center;">  </td> <td data-bbox="1061 1713 1460 1948" style="text-align: center;">  </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 (Class 2) have aging in the capacitance. They may not be used in precision time constant circuit. In case of the time constant circuit, the evaluation should be done well.
11	Estimated life and estimated failure rate of capacitors	<p>As per the estimated life and the estimated failure rate depend on the temperature and the voltage. This can be calculated by the equation described in JEITA RCR-2335C Annex F (Informative) Calculation of the estimated lifetime and the estimated failure rate (Voltage acceleration coefficient : 3 multiplication rule, Temperature acceleration coefficient : 10°C rule)</p> <p>The failure rate can be decreased by reducing the temperature and the voltage but they will not be guaranteed.</p>

No.	Process	Condition
12	Caution during operation of equipment	<p>1) A capacitor shall not be touched directly with bare hands during operation in order to avoid electric shock. Electric energy held by the capacitor may be discharged through the human body when touched with a bare hand. Even when the equipment is off, a capacitor may stay charged. The capacitor should be handled after being completely discharged using a resistor.</p> <p>2) The terminals of a capacitor shall not be short-circuited by any accidental contact with a conductive object. A capacitor shall not be exposed to a conductive liquid such as an acid or alkali solution. A conductive object or liquid, such as acid and alkali, between the terminals may lead to the breakdown of a capacitor due to short circuit.</p> <p>3) Confirm that the environment to which the equipment will be exposed during transportation and operation meets the specified conditions. Do not to use the equipment in the following environments.</p> <ul style="list-style-type: none"> (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
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> <ul style="list-style-type: none"> (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>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>

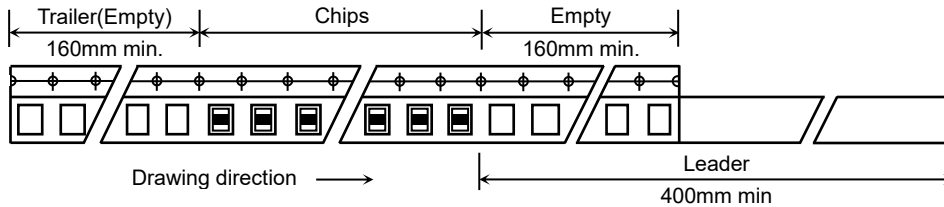
11. TAPE PACKAGING SPECIFICATION

1. CONSTRUCTION AND DIMENSION OF TAPING

1-1. Dimensions of carrier tape

Dimensions of paper tape shall be according to Appendix 3.

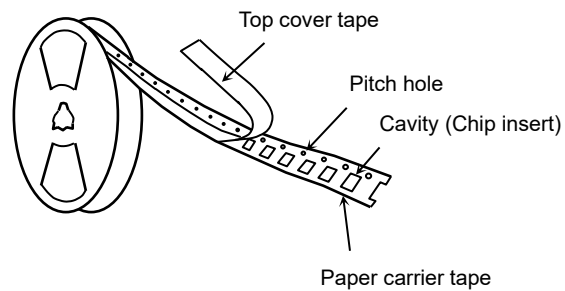
1-2. Bulk part and leader of taping



1-3. Dimensions of reel

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

1-4. Structure of taping

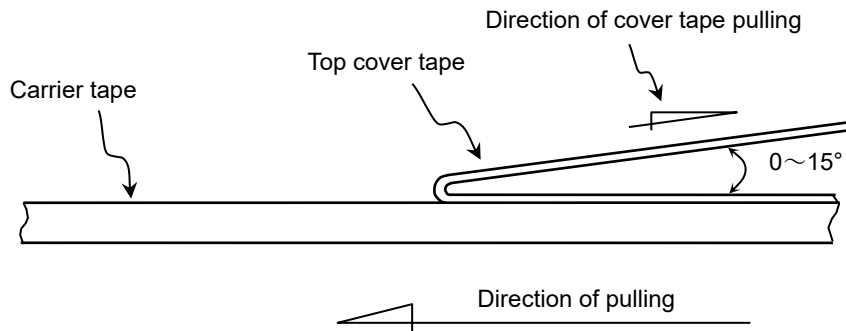


2. CHIP QUANTITY

Please refer to detail page on TDK web.

3. PERFORMANCE SPECIFICATIONS

- 3-1. Fixing peeling strength (top tape)
0.05-0.7N. (See the following figure.)

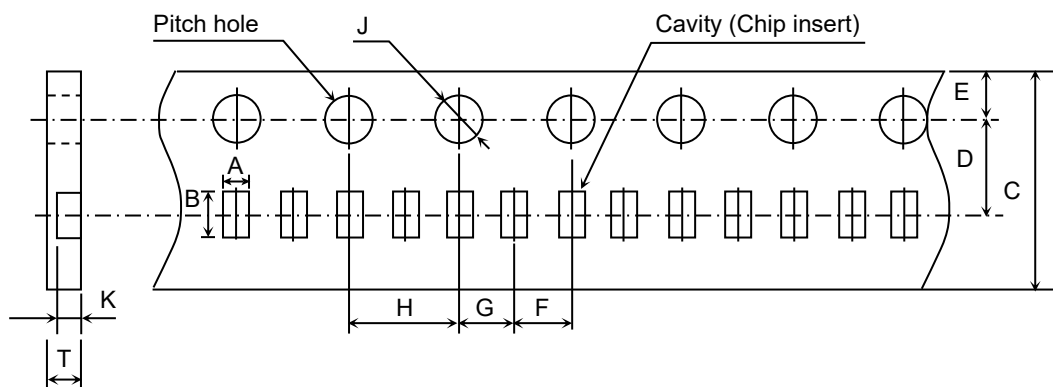


[Paper tape should not adhere to top cover tape
When pull the cover tape.]

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

Appendix 3

Paper Tape



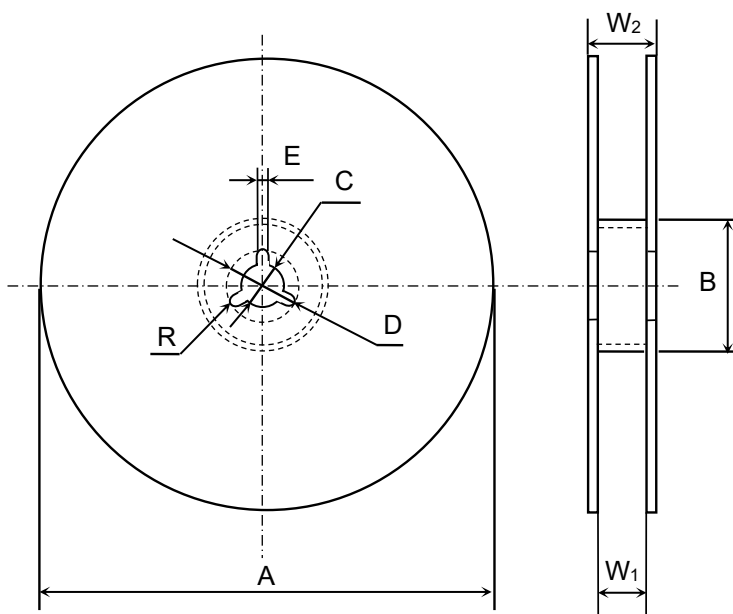
(Unit: mm)

Symbol	A	B	C	D	E	F
Dimension	(0.25)	(0.45)	8.00±0.30	3.50±0.05	1.75±0.10	2.00±0.05
Symbol	G	H	J	K	T	
Dimension	2.00±0.05	4.00±0.05	∅1.50 $\begin{matrix} +0.10 \\ 0 \end{matrix}$	0.23±0.02	0.29 min.	

() Reference value.

Appendix 4

Dimensions of reel (Material : Polystyrene)



(Unit: mm)

Symbol	A	B	C	D	E	W1
Dimension	∅178±2.0	∅60±2.0	∅13±0.5	∅21±0.8	2.0±0.5	9.0±0.3
Symbol	W2	R				
Dimension	13.0±1.4	1.0				