

DELIVERY SPECIFICATION

SPEC. No. A-MEGA-g

D A T E : March, 2021

To

Non-Controlled Copy

CUSTOMER'S PRODUCT NAME

TDK'S PRODUCT NAME

Multilayer Ceramic Chip Capacitors

Mega Cap Series

Tape packaging 【RoHS compliant】

CKG32K,CKG45K,CKG57K,CKG45N,CKG57N Type

C0G,X5R,X7R,X7S,X7T Characteristics

Please return this specification to TDK representatives with your signature.

If orders are placed without returned specification, please allow us to judge that specification is accepted by your side.

RECEIPT CONFIRMATION

DATE: YEAR MONTH DAY

Test conditions in this specification based on AEC-Q200 for automotive application.

TDK Corporation

Sales

Electronic Components

Sales & Marketing Group

Engineering

Electronic Components Business Company

Ceramic Capacitors Business Group

APPROVED	Person in charge

APPROVED	CHECKED	Person in charge

■ CATALOG NUMBER CONSTRUCTION

CKG	57	N	X7R	1E	107	M	500	J	J
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)

(1) Series

(2) Dimensions L x W (mm)

Code	EIA	Length	Width	Metal frame width
32	CC1210	3.60	2.60	0.80
45	CC1812	5.00	3.50	1.10
57	CC2220	6.00	5.00	1.60

(3) Structure

Code	Description
K	Single type
N	Stacked type

(4) Temperature characteristics

Temperature characteristics	Temperature coefficient or capacitance change	Temperature range
C0G	0±30ppm/°C	-55 to +125°C
X5R	±15%	-55 to +85°C
X7R	±15%	-55 to +125°C
X7S	±22%	-55 to +125°C
X7T	+22,-33%	-55 to +125°C

(5) Rated voltage (DC)

Code	Voltage (DC)
1C	16V
1E	25V
1H	50V
2A	100V
2E	250V
2W	450V
2J	630V
3A	1000V

(6) 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

(7) Capacitance tolerance

Code	Tolerance
J	±5%
K	±10%
M	±20%

(8) Thickness

Code	Thickness
290	2.90mm
335	3.35mm
500	5.00mm

(9) Packaging style

Code	Style
A	178mm reel, 4mm pitch
J	330mm reel, 8mm pitch

(10) Special reserved code

Code	Description
H	MEGACAP type

SCOPE

This delivery specification shall be applied to Multilayer ceramic chip capacitors (Mega cap series) to be delivered to _____.

PRODUCTION PLACES

Production places defined in this specification shall be TDK Corporation, TDK Xiamen Co.,Ltd, 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 CKG◇◇◇○○○△△□□□×.

REFERENCE STANDARD

JIS C 5101-1 : 2010	Fixed capacitors for use in electronic equipment-Part 1: Generic specification
C 5101-21 : 2014	Fixed capacitors for use in electronic equipment-Part21 : Sectional specification : Fixed surface mount multilayer capacitors of ceramic dielectric,Class1
C 5101-22 : 2014	Fixed capacitors for use in electronic equipment-Part22 : Sectional specification : Fixed surface mount multilayer capacitors of ceramic dielectric,Class 2
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

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<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.

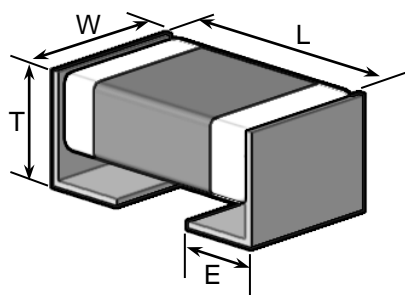
Division	Date	SPEC. No.
Ceramic Capacitors Business Group	March, 2021	A-MEGA-g

1. CODE CONSTRUCTION

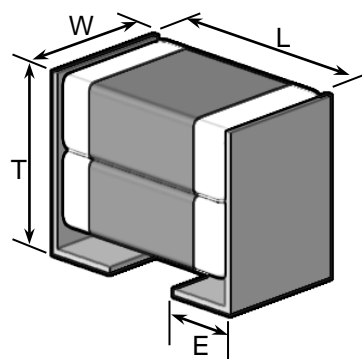
(Example)	<u>CKG32K</u>	<u>X7S</u>	<u>1H</u>	<u>106</u>	<u>K</u>	<u>T</u>	○○○○
	<u>CKG57N</u>	<u>X7R</u>	<u>1E</u>	<u>226</u>	<u>M</u>	<u>T</u>	○○○○
	(1)	(2)	(3)	(4)	(5)	(6)	(7)

(1) Type

Single type
CKG**K: 1 chip capacitor.



Stacked type
CKG**N: 2 chip capacitors.



Case size		Dimensions (Unit : mm)			
		L	W	T	E
Single type	CKG32K	3.60±0.30	2.60±0.30	3.35±0.10	0.80±0.15
	CKG45K	5.00±0.50	3.50±0.50	2.90±0.10	1.10±0.30
	CKG57K	6.00±0.50	5.00±0.50	3.35±0.15	1.60±0.30
Stacked type	CKG45N	5.00±0.50	3.50±0.50	5.00±0.50	1.10±0.30
	CKG57N	6.00±0.50	5.00±0.50	5.00±0.50	1.60±0.30

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

(2) Temperature Characteristics

* Details are shown in table 1 No.6 and No.7 at 5.PERFORMANCE.

(3) Rated Voltage

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

(4) Rated Capacitance

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

(Example)

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

- (5) Capacitance tolerance
 * K ($\pm 10\%$) tolerance is available only for CKG**K single type (10 μ F and under).

Symbol	Tolerance
J	$\pm 5 \%$
K*	$\pm 10 \%$
M	$\pm 20 \%$

- (6) Packaging

Symbol	Packaging
T	Taping

- (7) TDK internal code

2 OPERATING TEMPERATURE RANGE

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

3 STORING CONDITION AND TERM

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

4 INDUSTRIAL WASTE DISPOSAL

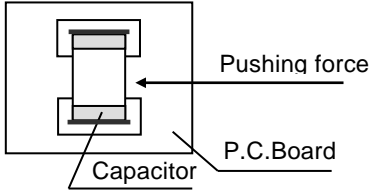
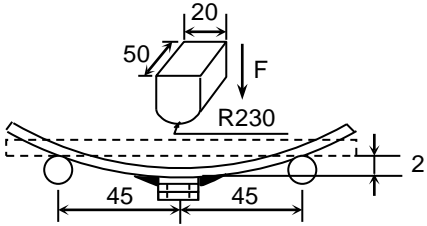
Dispose this product as industrial waste in accordance with the Industrial Waste Law.

5 PERFORMANCE

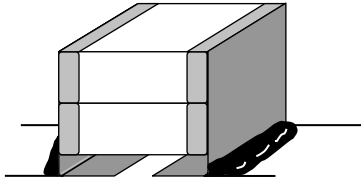
Table 1

No.	Item	Performance	Test or inspection method																			
1	External Appearance	No defects which may affect performance.	Inspect with magnifying glass (3×)																			
2	Insulation Resistance	10,000MΩ or 500MΩ·μF min. (As for the capacitors of rated voltage 16V DC, 100MΩ·μF min.)	Measuring voltage : Rated voltage (As for the capacitor of rated voltage 630V DC or over, apply 500V DC.) Voltage application time : 60s.																			
3	Voltage Proof	Withstand test voltage without insulation breakdown or other damage.	<table border="1"> <thead> <tr> <th>Class</th> <th>Rated voltage(RV)</th> <th>Apply voltage</th> </tr> </thead> <tbody> <tr> <td rowspan="4">1</td> <td>$RV \leq 100V$</td> <td>3 × rated voltage</td> </tr> <tr> <td>$100V < RV \leq 500V$</td> <td>1.5 × rated voltage</td> </tr> <tr> <td>$500V < RV < 1kV$</td> <td>1.3 × rated voltage</td> </tr> <tr> <td>1kV</td> <td>1.2 × rated voltage</td> </tr> <tr> <td rowspan="3">2</td> <td>$RV \leq 100V$</td> <td>2.5 × rated voltage</td> </tr> <tr> <td>$100V < RV \leq 500V$</td> <td>1.5 × rated voltage</td> </tr> <tr> <td>$500V < RV < 1kV$</td> <td>1.3 × rated voltage</td> </tr> </tbody> </table> <p>Voltage application time : 1s. Charge / discharge current : 50mA or lower</p>	Class	Rated voltage(RV)	Apply voltage	1	$RV \leq 100V$	3 × rated voltage	$100V < RV \leq 500V$	1.5 × rated voltage	$500V < RV < 1kV$	1.3 × rated voltage	1kV	1.2 × rated voltage	2	$RV \leq 100V$	2.5 × rated voltage	$100V < RV \leq 500V$	1.5 × rated voltage	$500V < RV < 1kV$	1.3 × rated voltage
Class	Rated voltage(RV)	Apply voltage																				
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	$500V < RV < 1kV$	1.3 × rated voltage																				
	1kV	1.2 × rated voltage																				
2	$RV \leq 100V$	2.5 × rated voltage																				
	$100V < RV \leq 500V$	1.5 × rated voltage																				
	$500V < RV < 1kV$	1.3 × rated voltage																				
4	Capacitance	Within the specified tolerance.	<p>《Class 1》</p> <table border="1"> <thead> <tr> <th>Capacitance</th> <th>Measuring frequency</th> <th>Measuring voltage</th> </tr> </thead> <tbody> <tr> <td>1000pF</td> <td>1MHz±10%</td> <td rowspan="2">0.5 ~ 5 Vrms.</td> </tr> <tr> <td>Over 1000pF</td> <td>1kHz±10%</td> </tr> </tbody> </table> <p>《Class 2》</p> <table border="1"> <thead> <tr> <th>Capacitance</th> <th>Measuring frequency</th> <th>Measuring voltage</th> </tr> </thead> <tbody> <tr> <td>10uF and under</td> <td>1kHz±10%</td> <td>1.0±0.2Vrms</td> </tr> <tr> <td>Over 10uF</td> <td>120Hz±20%</td> <td>0.5±0.2Vrms.</td> </tr> </tbody> </table>	Capacitance	Measuring frequency	Measuring voltage	1000pF	1MHz±10%	0.5 ~ 5 Vrms.	Over 1000pF	1kHz±10%	Capacitance	Measuring frequency	Measuring voltage	10uF and under	1kHz±10%	1.0±0.2Vrms	Over 10uF	120Hz±20%	0.5±0.2Vrms.		
Capacitance	Measuring frequency	Measuring voltage																				
1000pF	1MHz±10%	0.5 ~ 5 Vrms.																				
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Capacitance	Measuring frequency	Measuring voltage																				
10uF and under	1kHz±10%	1.0±0.2Vrms																				
Over 10uF	120Hz±20%	0.5±0.2Vrms.																				
5	Q	Class1	Please refer to detail page on TDK web.																			
	Dissipation Factor	Class2																				
6	Temperature Characteristics of Capacitance (Class1)	<table border="1"> <thead> <tr> <th>T.C.</th> <th>Temperature Coefficient (ppm/°C)</th> </tr> </thead> <tbody> <tr> <td>COG</td> <td>0 ± 30</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th>Capacitance drift</th> <th>Within ± 0.2%</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> </tr> </tbody> </table>	T.C.	Temperature Coefficient (ppm/°C)	COG	0 ± 30	Capacitance drift	Within ± 0.2%			<p>Temperature coefficient shall be calculated based on values at 25°C and 85°C temperature.</p> <p>Measuring temperature below 25°C shall be -10°C and -25°C.</p>											
T.C.	Temperature Coefficient (ppm/°C)																					
COG	0 ± 30																					
Capacitance drift	Within ± 0.2%																					

(continued)

No.	Item	Performance	Test or inspection method										
7	Temperature Characteristics of Capacitance (Class2)	<p style="text-align: center;">Capacitance Change (%)</p> <hr/> <p style="text-align: center;">No voltage applied</p> <hr/> <p style="text-align: center;">X5R : ± 15</p> <p style="text-align: center;">X7R : ± 15</p> <p style="text-align: center;">X7S : ± 22</p> <p style="text-align: center;">X7T : $\begin{matrix} +22 \\ -33 \end{matrix}$</p> <hr/>	<p>Capacitance shall be measured by the steps shown in the following table after thermal equilibrium is obtained for each step. ΔC be calculated ref. STEP3 reading</p> <table border="1" data-bbox="986 383 1430 651"> <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 "2.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												
8	Robustness of Terminations	No sign of termination coming off, breakage of ceramic, or other abnormal signs.	<p>Reflow solder the capacitors on a P.C.Board shown in Appendix 2. Apply a pushing force gradually at the center of a specimen in a horizontal direction of P.C.board. Pushing force : 17.7N Holding time : 10\pm1s</p> 										
9	Bending	No mechanical damage.	<p>Reflow solder the capacitors on a P.C.Board shown in Appendix 1.</p>  <p style="text-align: right;">(Unit : mm)</p>										

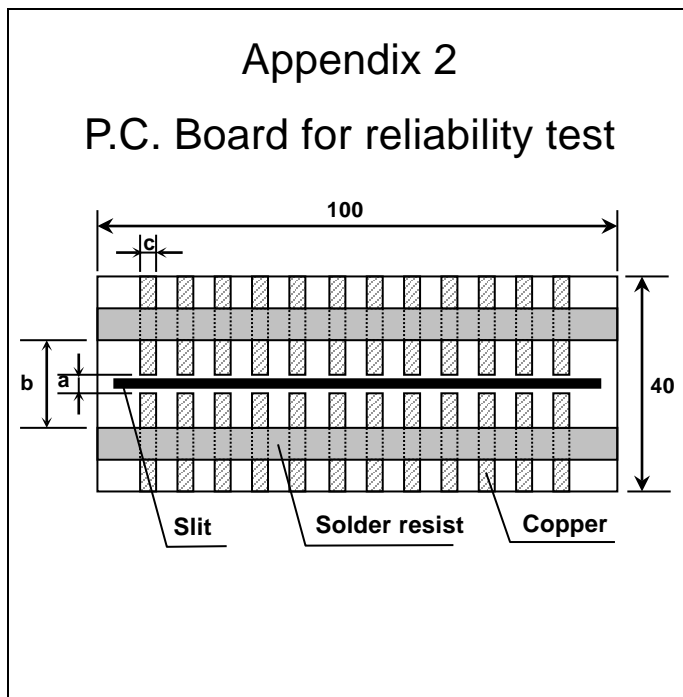
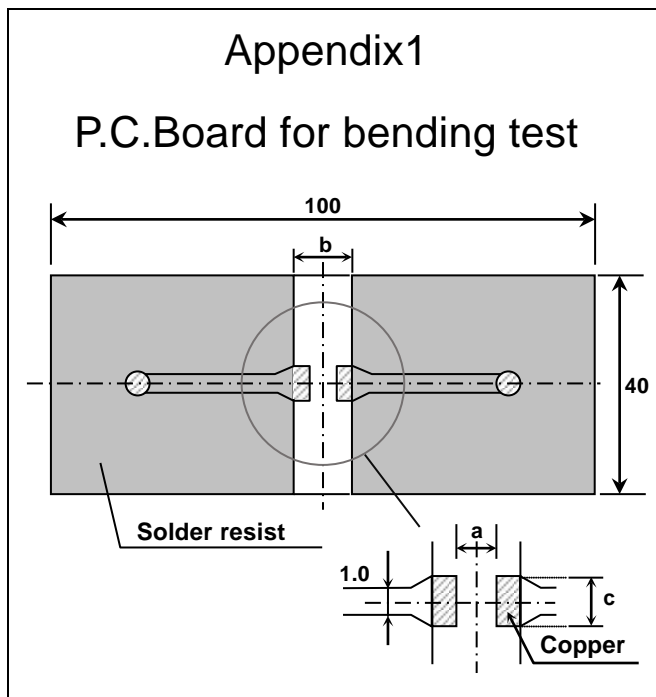
(continued)

No.	Item	Performance	Test or inspection method																							
10	Solderability	<p>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.</p> 	<p>Solder : Sn-3.0Ag-0.5Cu</p> <p>Reflow solder the capacitor on a P.C.Board shown in Appendix2.</p> <p>Please refer to No.5 Soldering in 10.CAUTION for soldering condition.</p>																							
11	Vibration	<p>No mechanical damage.</p> <table border="1" data-bbox="544 853 932 1133"> <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 %</td> </tr> <tr> <td>Class2</td> <td>X5R X7R X7S X7T</td> <td>± 7.5 %</td> </tr> </tbody> </table> <p>Q (Class1) Meet the initial spec.</p> <p>D.F. (Class2) Meet the initial spec.</p>	Characteristics		Change from the value before test	Class1	C0G	± 2.5 %	Class2	X5R X7R X7S X7T	± 7.5 %	<p>Applied force : 5G max. Frequency : 10~2,000Hz Reciprocating sweep time : 20 min. Cycle : 12 cycles in each 3 mutually perpendicular directions.</p> <p>Reflow solder the capacitors on a P.C.Board shown in Appendix 2 before testing.</p>														
Characteristics		Change from the value before test																								
Class1	C0G	± 2.5 %																								
Class2	X5R X7R X7S X7T	± 7.5 %																								
12	Temperature cycle	<p>No mechanical damage.</p> <table border="1" data-bbox="544 1406 932 1686"> <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 X7S X7T</td> </tr> </tbody> </table> <p>Q (Class1) Meet the initial spec.</p> <p>D.F. (Class2) Meet the initial spec.</p> <p>Insulation Resistance Meet the initial spec.</p> <p>Voltage proof No insulation breakdown or other damage.</p>	Characteristics		Change from the value before test	Class1	C0G	Please contact with our sales representative.	Class2	X5R X7R X7S X7T	<p>Expose the capacitors in the condition step1 through step 4 listed in the following table.</p> <p>Temp. cycle : 1,000 cycles</p> <table border="1" data-bbox="975 1462 1457 1753"> <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> <p>As for Min./ Max. operating temp., please refer to "2.OPERATING TEMPERATURE RANGE".</p> <p>Leave the capacitors in ambient condition for Class 1 : 6~24h Class 2 : 24±2h before measurement.</p> <p>Reflow solder the capacitors on a P.C.Board shown in Appendix 2 before testing.</p>	Step	Temperature(°C)	Time (min.)	1	Min. operating temp. ±3	30 ± 3	2	Ambient Temp.	2 ~ 5	3	Max. operating temp. ±2	30 ± 2	4	Ambient Temp.	2 ~ 5
Characteristics		Change from the value before test																								
Class1	C0G	Please contact with our sales representative.																								
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Step	Temperature(°C)	Time (min.)																								
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4	Ambient Temp.	2 ~ 5																								

(continued)

No.	Item		Performance	Test or inspection method								
13	Moisture Resistance	External appearance	No mechanical damage.	Test temp. : 85±2°C Test humidity : 85%RH Applied voltage : Rated voltage Test time : 1,000 +48,0h (For X5R characteristics, the condition below is applied.) 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"> <tr> <td colspan="2">Characteristics</td> <td>Change from the value before test</td> </tr> <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 X7S X7T</td> </tr> </table>		Characteristics		Change from the value before test	Class1	C0G	Please contact with our sales representative.	Class2	X5R X7R X7S X7T
			Characteristics		Change from the value before test							
			Class1		C0G	Please contact with our sales representative.						
		Class2	X5R X7R X7S X7T									
Q (Class1)	200 min.											
D.F. (Class2)	200% of initial spec. max.											
Insulation Resistance	500MΩ or 25MΩ·μF min. (As for the capacitors of rated voltage 16V DC, 5MΩ·μF min.,).											
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 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.								
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			Characteristics		Change from the value before test							
			Class1		C0G	Please contact with our sales representative.						
		Class2	X5R X7R X7S X7T									
Q (Class1)	350 min.											
D.F. (Class2)	200% of initial spec. max.											
Insulation Resistance	1,000MΩ or 50MΩ·μF min. (As for the capacitors of rated voltage 16V DC, 10MΩ·μF min.,)											

*As for the initial measurement of capacitors (Class2) on number 7,11 and 12 leave capacitors at 150 0,-10°C for 1 hour and measure the value after leaving capacitors for 24±2h in ambient condition.



(Unit : mm)

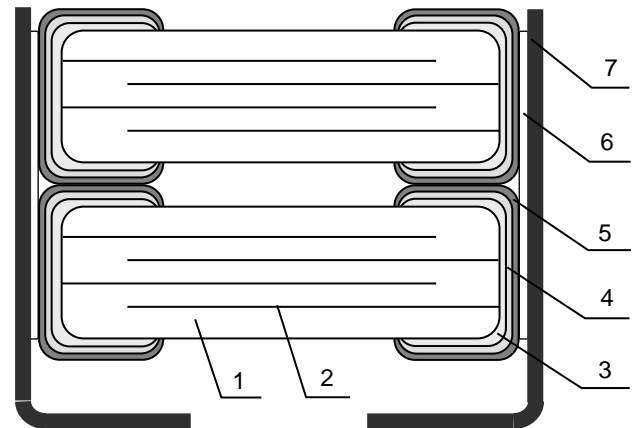
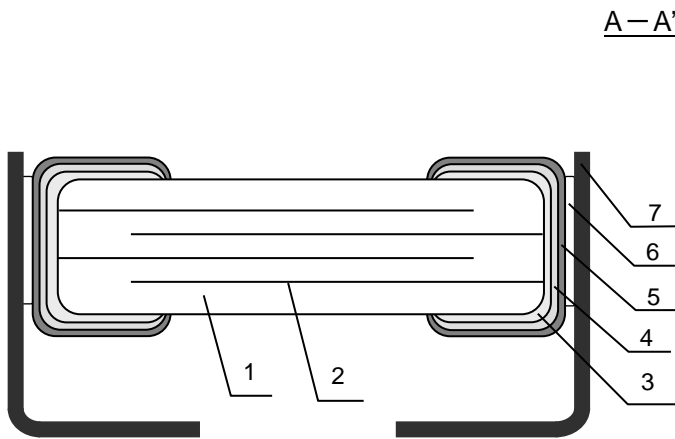
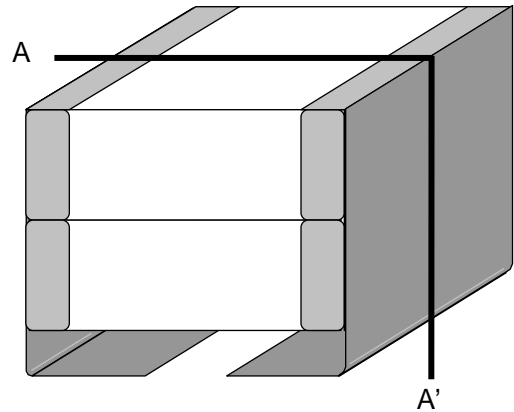
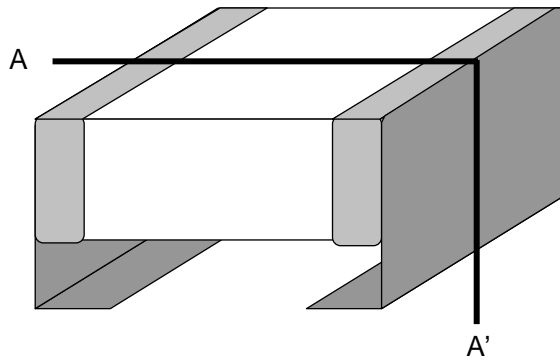
Symbol	a	b	c
Case size			
CKG32K	2.2	5.0	2.9
CKG45K	3.5	6.1	2.9
CKG57K	4.1	7.6	4.7
CKG45N	3.5	6.1	2.9
CKG57N	4.1	7.6	4.7

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

2. Thickness : 1.6mm

- Copper(Thickness:0.035mm)
- Solder resist

6. 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)	
6	Metal cap joint	High temp solder	
7	Metal cap	42 Alloy	

7. PACKAGING

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

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 A 1 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	A	1	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 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.

8. RECOMMENDATION

It is recommended to provide a slit (about 1mm wide) in the board under the components to improve washing Flux.

And please make sure to dry detergent up completely before.


9. SOLDERING CONDITION


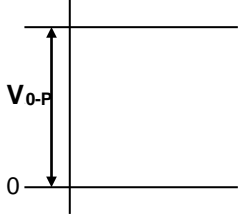
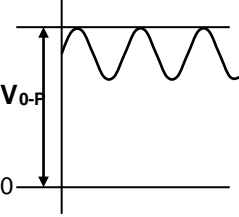
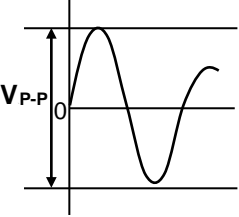
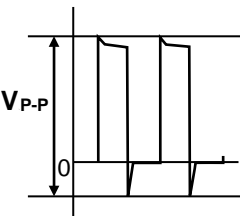
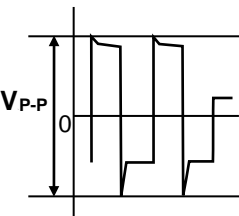
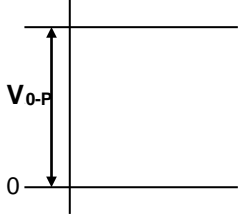
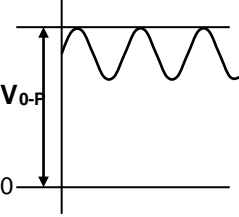
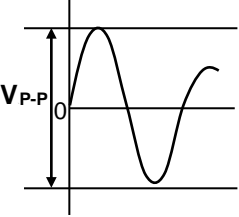
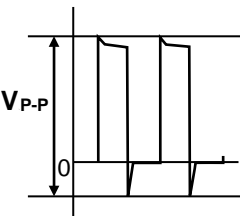
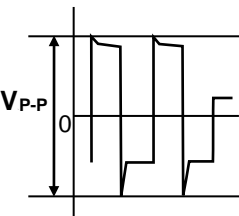
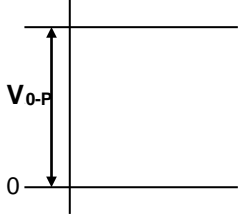
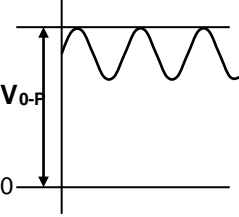
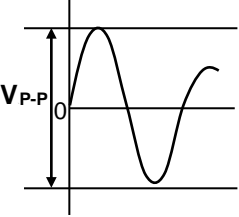
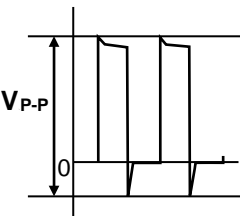
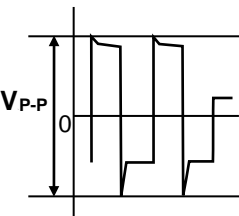
Reflow soldering only.

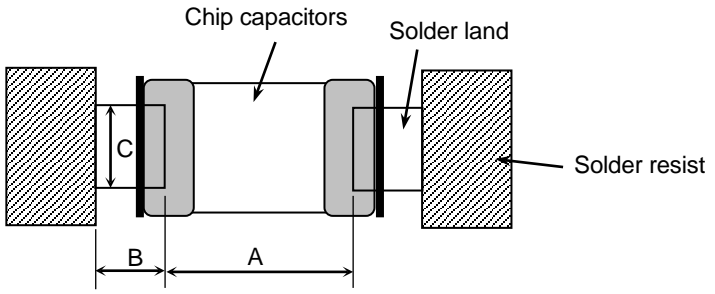
Metal cap is jointed by high temp solder, however the solder temperature must be less than 250°C to avoid melting the solder.

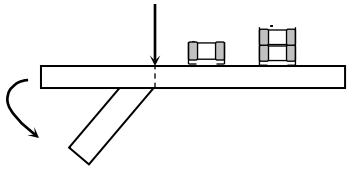
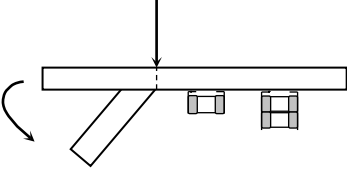
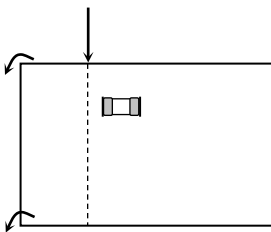
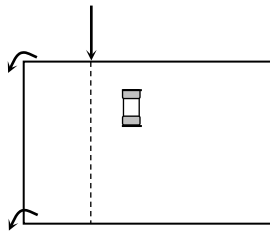
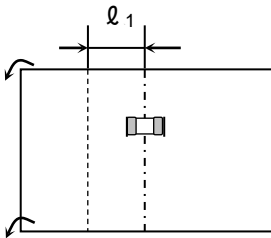
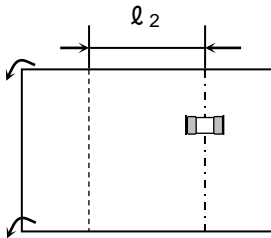
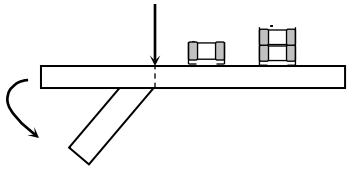
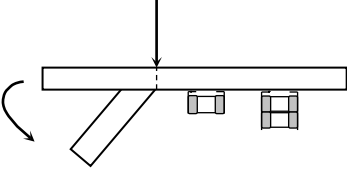
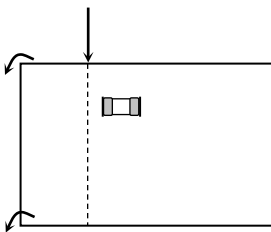
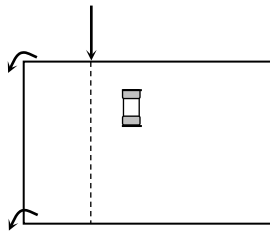
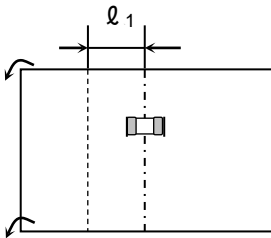
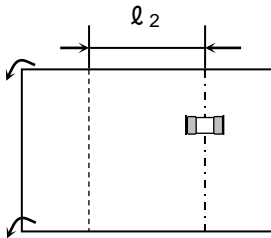
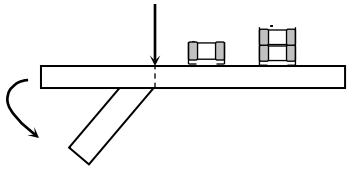
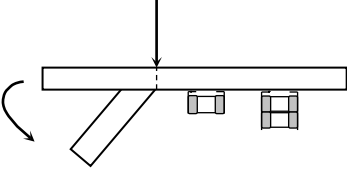
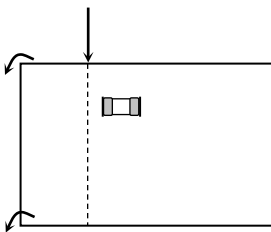
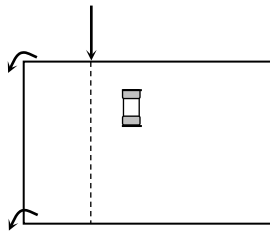
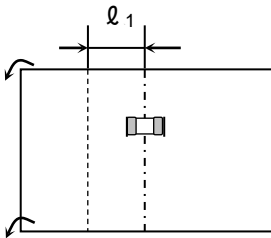
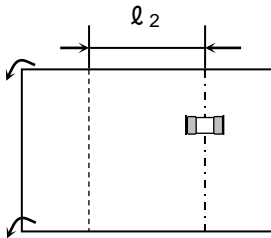
Please refer to No.5 Soldering in 10. CAUTION for recommended soldering condition.

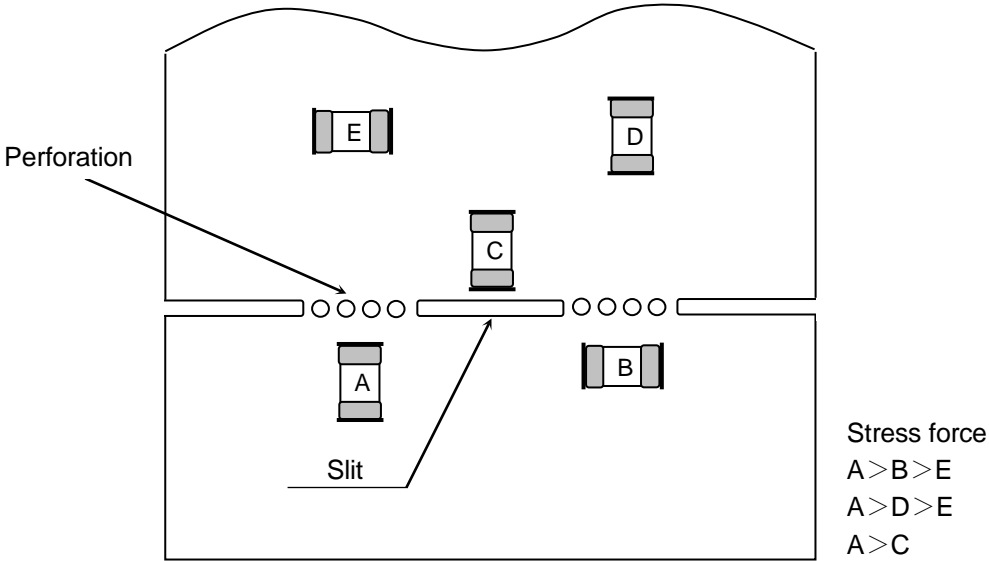
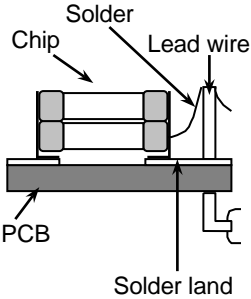
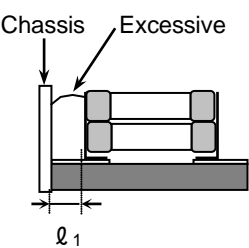
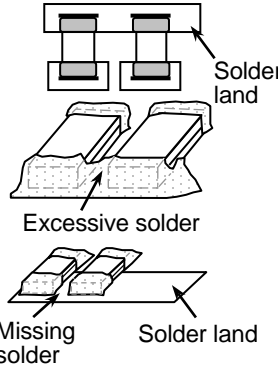
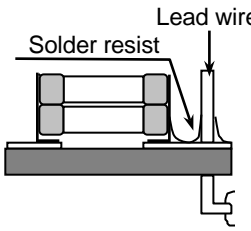
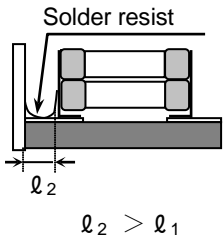
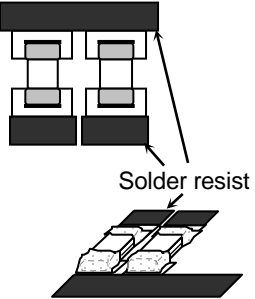
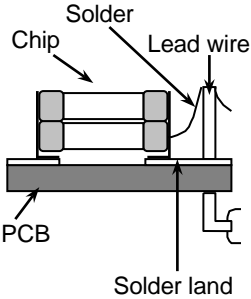
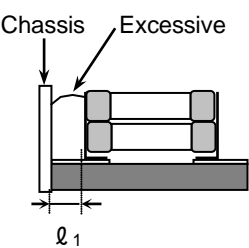
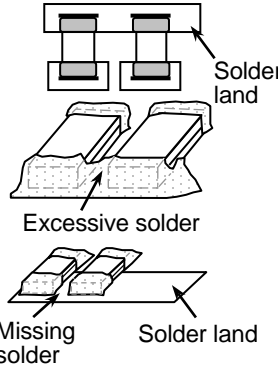
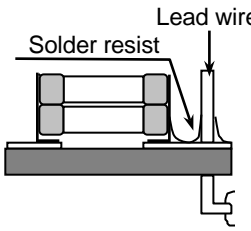
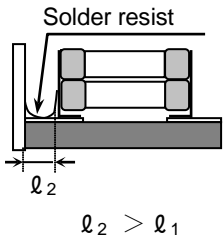
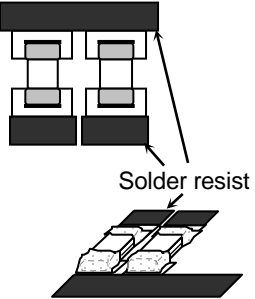
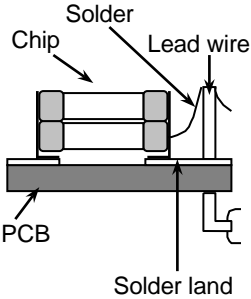
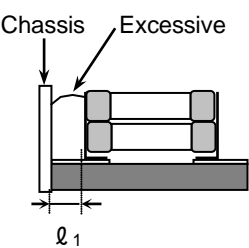
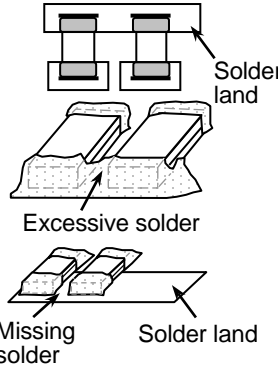
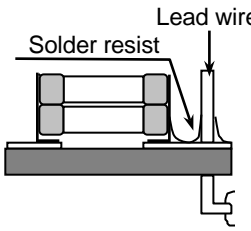
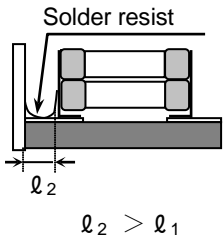
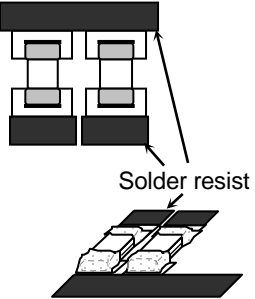
10. CAUTION

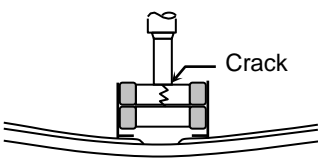
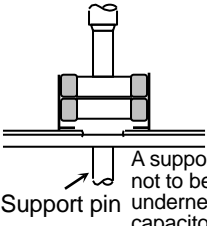
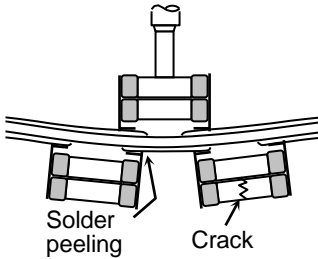
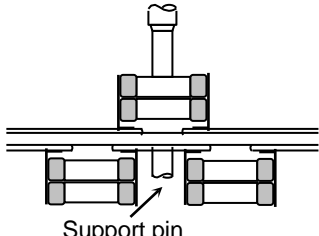
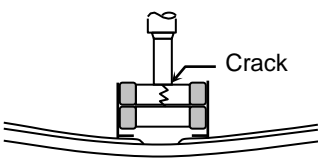
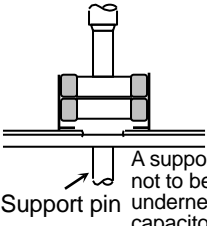
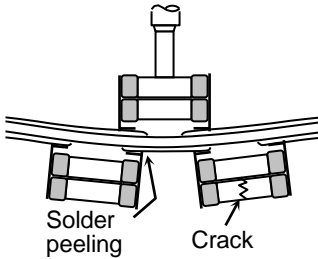
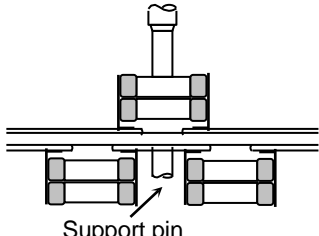
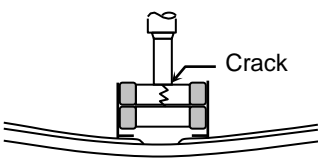
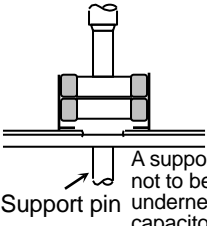
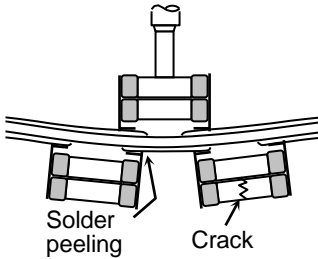
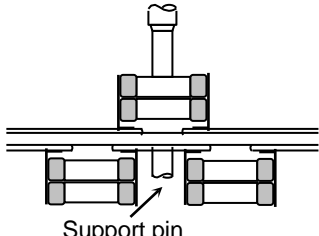
No.	Process	Condition
1	Operating Condition (Storage, Use, Transportation)	<p>1-1. Storage, Use</p> <p>The capacitors must be stored in an ambient temperature of 5 to 40°C with a relative humidity of 20 to 70%RH. JIS C 60721-3-1 Class 1K2 should be followed for the other climatic conditions.</p> <ol 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 period longer than specified, 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</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> <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) Do not use capacitors above the maximum allowable operating temperature. Surface temperature including self heating should be below maximum operating temperature. (Due to dielectric loss, capacitors will heat itself when AC is applied. Especially for high frequency circuit, 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. When overvoltage is applied</p> <p>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>

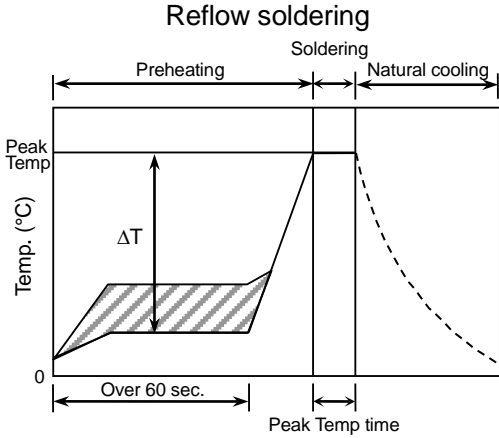
No.	Process	Condition														
2	Circuit design  Caution	<p>2-3. Operating voltage</p> <p>1) Operating voltage across the terminals should be below the rated voltage. When AC and DC are super imposed, V_{0-P} must be below the rated voltage. — (1) and (2)</p> <p>AC or pulse with overshooting, V_{P-P} must be below the rated voltage. — (3), (4) and (5)</p> <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="472 506 1447 779"> <thead> <tr> <th data-bbox="472 506 660 546">Voltage</th> <th data-bbox="660 506 922 546">(1) DC voltage</th> <th data-bbox="922 506 1184 546">(2) DC+AC voltage</th> <th data-bbox="1184 506 1447 546">(3) AC voltage</th> </tr> </thead> <tbody> <tr> <td data-bbox="472 546 660 779">Positional Measurement (Rated voltage)</td> <td data-bbox="660 546 922 779">  </td> <td data-bbox="922 546 1184 779">  </td> <td data-bbox="1184 546 1447 779">  </td> </tr> </tbody> </table> <table border="1" data-bbox="472 801 1184 1077"> <thead> <tr> <th data-bbox="472 801 660 842">Voltage</th> <th data-bbox="660 801 922 842">(4) Pulse voltage (A)</th> <th data-bbox="922 801 1184 842">(5) Pulse voltage (B)</th> </tr> </thead> <tbody> <tr> <td data-bbox="472 842 660 1077">Positional Measurement (Rated voltage)</td> <td data-bbox="660 842 922 1077">  </td> <td data-bbox="922 842 1184 1077">  </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</p> <p>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)																

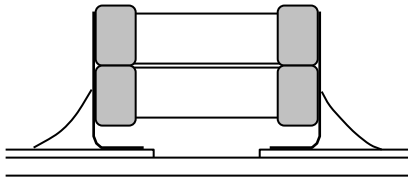
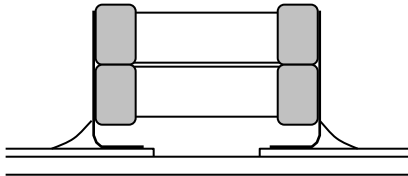
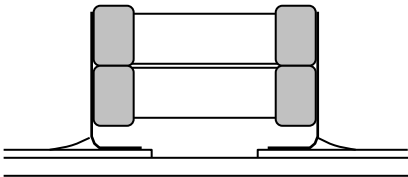
No.	Process	Condition																														
3	Designing P.C.board	<p>The amount of solder at the terminations has a direct effect on the reliability of the capacitors.</p> <ol style="list-style-type: none"> 1) The greater the amount of solder, the higher the stress on the chip capacitors, and 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;"> <caption style="text-align: right;">(mm)</caption> <thead> <tr> <th style="text-align: center;">Case size</th> <th style="text-align: center;">CKG32K</th> <th style="text-align: center;">CKG45K</th> <th style="text-align: center;">CKG57K</th> <th style="text-align: center;">CKG45N</th> <th style="text-align: center;">CKG57N</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Symbol</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td style="text-align: center;">A</td> <td style="text-align: center;">2.0 ~ 2.2</td> <td style="text-align: center;">3.3 ~ 3.7</td> <td style="text-align: center;">3.9 ~ 4.3</td> <td style="text-align: center;">3.3 ~ 3.7</td> <td style="text-align: center;">3.9 ~ 4.3</td> </tr> <tr> <td style="text-align: center;">B</td> <td style="text-align: center;">1.1 ~ 1.3</td> <td style="text-align: center;">1.2 ~ 1.5</td> <td style="text-align: center;">1.5 ~ 2.0</td> <td style="text-align: center;">1.2 ~ 1.5</td> <td style="text-align: center;">1.5 ~ 2.0</td> </tr> <tr> <td style="text-align: center;">C</td> <td style="text-align: center;">2.3 ~ 2.5</td> <td style="text-align: center;">2.7 ~ 3.2</td> <td style="text-align: center;">4.5 ~ 5.0</td> <td style="text-align: center;">2.7 ~ 3.2</td> <td style="text-align: center;">4.5 ~ 5.0</td> </tr> </tbody> </table>	Case size	CKG32K	CKG45K	CKG57K	CKG45N	CKG57N	Symbol						A	2.0 ~ 2.2	3.3 ~ 3.7	3.9 ~ 4.3	3.3 ~ 3.7	3.9 ~ 4.3	B	1.1 ~ 1.3	1.2 ~ 1.5	1.5 ~ 2.0	1.2 ~ 1.5	1.5 ~ 2.0	C	2.3 ~ 2.5	2.7 ~ 3.2	4.5 ~ 5.0	2.7 ~ 3.2	4.5 ~ 5.0
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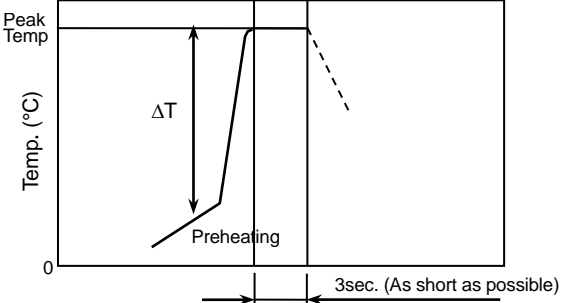
No.	Process	Condition												
3	Designing P.C.board	<p>4) Recommended chip capacitors layout is as following.</p> <table border="1"> <thead> <tr> <th data-bbox="466 253 651 331"></th> <th data-bbox="651 253 1035 331">Disadvantage against bending stress</th> <th data-bbox="1035 253 1420 331">Advantage against bending stress</th> </tr> </thead> <tbody> <tr> <td data-bbox="466 331 651 748">Mounting face</td> <td data-bbox="651 331 1035 748"> <p>Perforation or slit</p>  <p>Break P.C.board with mounted side up.</p> </td> <td data-bbox="1035 331 1420 748"> <p>Perforation or slit</p>  <p>Break P.C.board with mounted side down.</p> </td> </tr> <tr> <td data-bbox="466 748 651 1196">Chip arrangement (Direction)</td> <td data-bbox="651 748 1035 1196"> <p>Mount perpendicularly to perforation or slit</p> <p>Perforation or slit</p>  </td> <td data-bbox="1035 748 1420 1196"> <p>Mount in parallel with perforation or slit</p> <p>Perforation or slit</p>  </td> </tr> <tr> <td data-bbox="466 1196 651 1675">Distance from slit</td> <td data-bbox="651 1196 1035 1675"> <p>Closer to slit is higher stress</p>  <p>($l_1 < l_2$)</p> </td> <td data-bbox="1035 1196 1420 1675"> <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>Mount perpendicularly to perforation or slit</p> <p>Perforation or slit</p> 	<p>Mount in parallel with 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>
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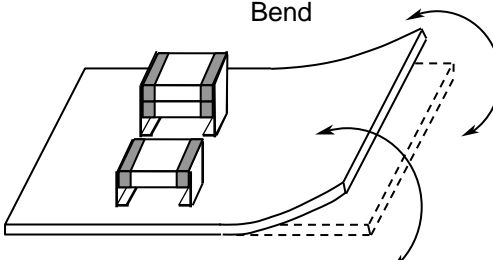
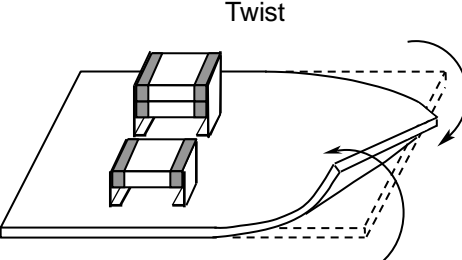
No.	Process	Condition												
3	Designing P.C.board	<p>5) Mechanical stress varies according to location of chip capacitors on the P.C.board.</p>  <p>When dividing printed wiring boards, the intensities of mechanical stress applied to capacitors are different according to each dividing method in 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="379 1041 1481 1971"> <thead> <tr> <th data-bbox="379 1041 539 1160">Example</th> <th data-bbox="539 1041 842 1160">Use of common solder land</th> <th data-bbox="842 1041 1152 1160">Soldering with chassis</th> <th data-bbox="1152 1041 1481 1160">Use of common solder land with other SMD</th> </tr> </thead> <tbody> <tr> <td data-bbox="379 1160 539 1556">Need to avoid</td> <td data-bbox="539 1160 842 1556">  </td> <td data-bbox="842 1160 1152 1556">  </td> <td data-bbox="1152 1160 1481 1556">  </td> </tr> <tr> <td data-bbox="379 1556 539 1971">Recommendation</td> <td data-bbox="539 1556 842 1971">  </td> <td data-bbox="842 1556 1152 1971">  </td> <td data-bbox="1152 1556 1481 1971">  </td> </tr> </tbody> </table>	Example	Use of common solder land	Soldering with chassis	Use of common solder land with other SMD	Need to avoid				Recommendation			
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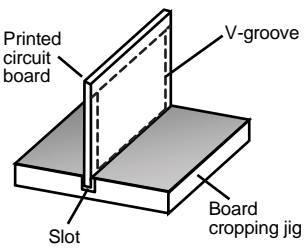
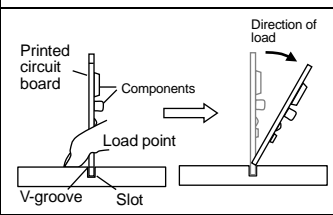
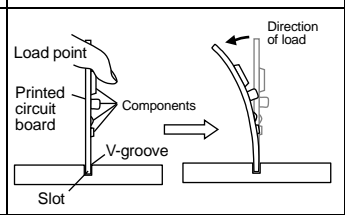
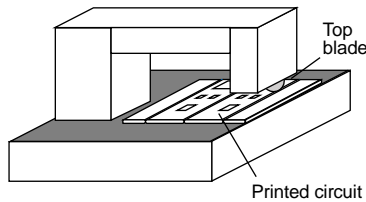
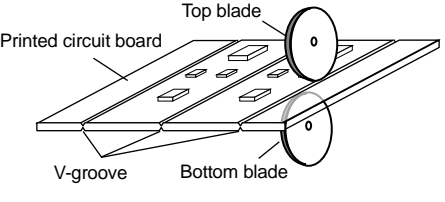
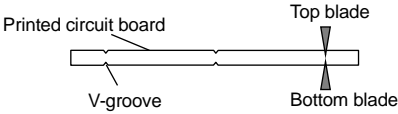
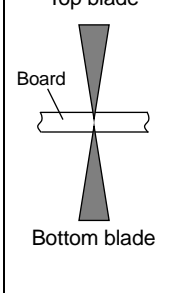
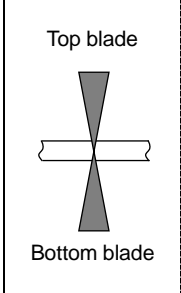
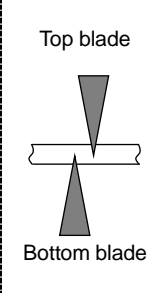
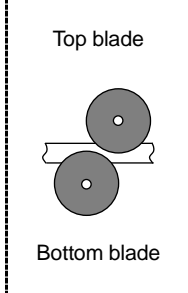
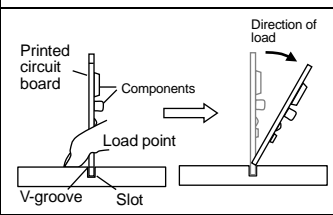
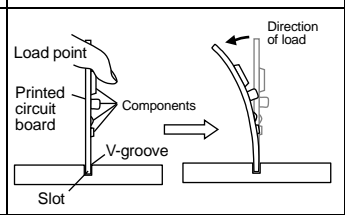
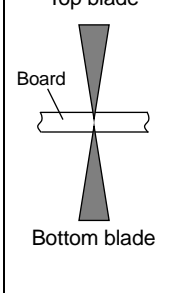
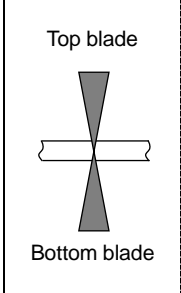
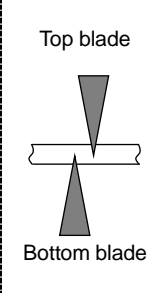
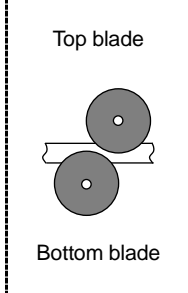
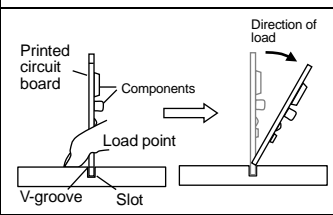
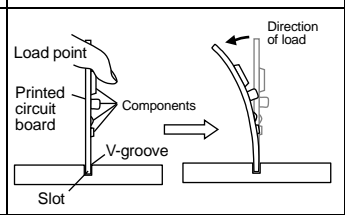
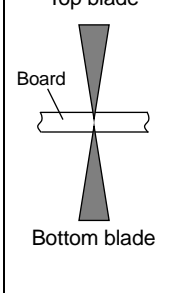
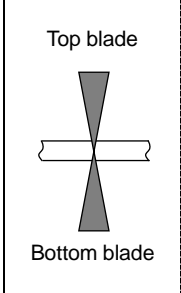
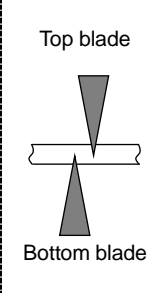
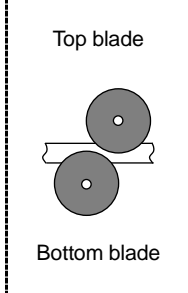
No.	Process	Condition									
4	Mounting	<p>4-1. Stress from mounting head</p> <p>If the mounting head is adjusted too low, it may induce excessive stress in the chip capacitors to result in cracking. Please take following precautions.</p> <ol style="list-style-type: none"> 1) Adjust the bottom dead 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 style="width: 30%;"></th> <th style="width: 35%;">Not recommended</th> <th style="width: 35%;">Recommended</th> </tr> </thead> <tbody> <tr> <td style="text-align: center; vertical-align: middle;">Single sided mounting</td> <td style="text-align: center;">  <p>Crack</p> </td> <td style="text-align: center;">  <p>A support pin is not to be underneath the capacitor. Support pin</p> </td> </tr> <tr> <td style="text-align: center; vertical-align: middle;">Double-sides mounting</td> <td style="text-align: center;">  <p>Solder peeling Crack</p> </td> <td style="text-align: center;">  <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>A support pin is not to be underneath the capacitor. Support pin</p>	Double-sides mounting	 <p>Solder peeling Crack</p>	 <p>Support pin</p>
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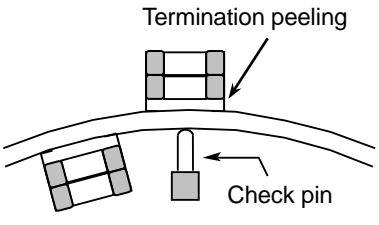
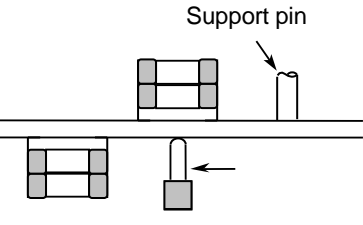
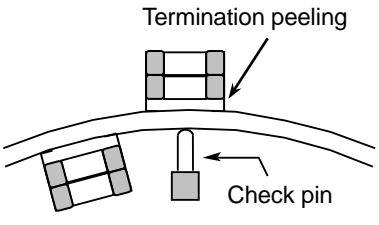
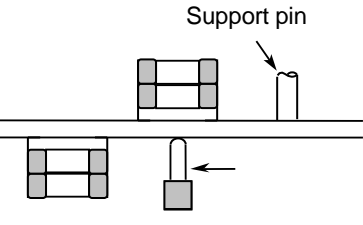
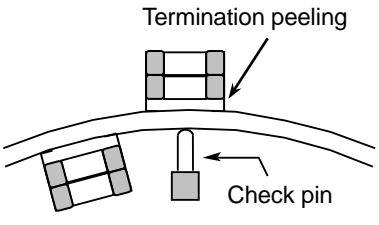
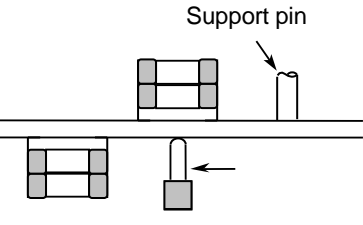
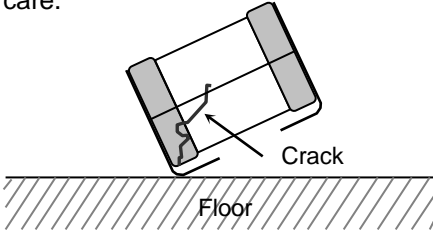
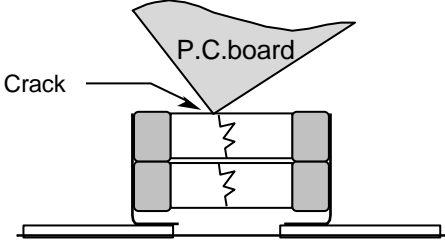
No.	Process	Condition																		
5	Soldering	<p>5-1. Flux selection Flux can seriously affect the performance of capacitors. Confirm the following to select the appropriate flux.</p> <ol style="list-style-type: none"> 1) It is recommended to use a mildly activated rosin flux (less than 0.1wt% 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. Reflow soldering condition</p> <ol style="list-style-type: none"> 1) Soldering condition (Pre heating temperature, soldering temperature and these times) is limited to reflow soldering method which is stipulated on the specification. 2) Chips should be mounted, shortly after a solder is on a P.C.Board. 3) Temperature of metal cap surface must not exceed 250°C. (Metal frames are jointed by high temp solder, however the solder temperature must be less than 250°C to avoid melting the solder.) <p>5-3. Recommended Reflow soldering profile</p> <div style="text-align: center;">  <p>The graph shows a temperature profile for reflow soldering. The y-axis is labeled 'Temp. (°C)' and the x-axis is labeled 'Time'. The profile is divided into three phases: 'Preheating', 'Soldering', and 'Natural cooling'. The 'Preheating' phase shows a temperature rise from 0 to a level below the peak, with a shaded area indicating a temperature difference ΔT. A horizontal line indicates a duration of 'Over 60 sec.' for this phase. The 'Soldering' phase shows a sharp rise to a 'Peak Temp' followed by a short dwell. The 'Natural cooling' phase shows a dashed line representing the temperature falling back to 0. The 'Peak Temp time' is indicated as the duration of the peak temperature.</p> </div> <p>5-4. 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" data-bbox="587 1400 1332 1635"> <thead> <tr> <th rowspan="2">Temp./Duration</th> <th colspan="2">Reflow soldering</th> </tr> <tr> <th>Peak temp(°C)</th> <th>Duration(sec.)</th> </tr> </thead> <tbody> <tr> <td>Solder</td> <td></td> <td></td> </tr> <tr> <td>Lead Free Solder</td> <td>250max.</td> <td>10 max.</td> </tr> <tr> <td>Sn-Pb Solder</td> <td>230 max.</td> <td>20 max.</td> </tr> </tbody> </table> <p>Recommended solder compositions Lead Free Solder : Sn-3.0Ag-0.5Cu</p> <p>5-5. Avoiding thermal shock</p> <ol style="list-style-type: none"> 1) Preheating condition <table border="1" data-bbox="481 1832 1085 1926"> <thead> <tr> <th>Soldering</th> <th>Temp. (°C)</th> </tr> </thead> <tbody> <tr> <td>Reflow soldering</td> <td>$\Delta T \leq 130$</td> </tr> </tbody> </table> <ol style="list-style-type: none"> 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	250max.	10 max.	Sn-Pb Solder	230 max.	20 max.	Soldering	Temp. (°C)	Reflow soldering	$\Delta T \leq 130$
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No.	Process	Condition
5	Soldering	<p data-bbox="437 188 692 215">5-6. Amount of solder</p> <p data-bbox="494 230 1422 338">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="494 427 616 495">Excessive solder</div> <div data-bbox="673 371 1082 546">  </div> <div data-bbox="1118 412 1407 506">Higher tensile force in chip capacitors to cause crack</div> </div> <hr/> <div style="display: flex; justify-content: space-between;"> <div data-bbox="494 667 611 694">Adequate</div> <div data-bbox="673 591 1082 766">  </div> </div> <hr/> <div style="display: flex; justify-content: space-between;"> <div data-bbox="494 869 624 936">Insufficient solder</div> <div data-bbox="673 810 1082 985">  </div> <div data-bbox="1118 842 1407 958">Low robustness may cause contact failure or chip capacitors come off the P.C.board.</div> </div> <hr/> <p data-bbox="437 1066 644 1093">5-7. Sn-Zn solder</p> <p data-bbox="464 1099 1145 1160">Sn-Zn solder affects product reliability. Please contact TDK in advance when utilize Sn-Zn solder.</p> <p data-bbox="437 1196 858 1223">5-8. Countermeasure for tombstone</p> <p data-bbox="464 1229 1453 1350">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.</p> <p data-bbox="464 1357 1417 1417">(Refer to JEITA RCR-2335C Annex A (Informative) Recommendations to prevent the tombstone phenomenon)</p>

No.	Process	Condition																		
6	Solder repairing	<p>Solder repairing is unavoidable, refer to below.</p> <p>6-1. Solder repair by solder iron</p> <p>1) Selection of the soldering iron tip</p> <p>Tip temperature of solder iron varies by its type, P.C.board material and solder land size. The higher the tip temperature, the quicker the operation. However, heat shock may cause a crack in the chip capacitors.</p> <p>Please make sure the tip temp. before soldering and keep the peak temp and time in accordance with following recommended condition.</p> <div style="text-align: center;"> <p>Manual soldering (Solder iron)</p>  </div> <table border="1" style="margin: 10px auto; width: 80%;"> <thead> <tr> <th colspan="4" style="text-align: center;">Recommended solder iron condition (Sn-Pb Solder and Lead Free Solder)</th> </tr> <tr> <th style="width: 25%;">Temp. (°C)</th> <th style="width: 25%;">Duration (sec.)</th> <th style="width: 25%;">Wattage (W)</th> <th style="width: 25%;">Shape (mm)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">280 max.</td> <td style="text-align: center;">3 max.</td> <td style="text-align: center;">20 max.</td> <td style="text-align: center;">Ø 3.0 max.</td> </tr> </tbody> </table> <p>* Please preheat the chip capacitors with the condition in 6-3 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> <p>6-2. Avoiding thermal shock</p> <table border="1" style="margin: 10px auto; width: 80%;"> <thead> <tr> <th colspan="2" style="text-align: center;">Preheating condition</th> </tr> <tr> <th style="width: 50%;">Soldering</th> <th style="width: 50%;">Temp. (°C)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Manual soldering</td> <td style="text-align: center;">$\Delta T \leq 130$</td> </tr> </tbody> </table>	Recommended solder iron condition (Sn-Pb Solder and Lead Free Solder)				Temp. (°C)	Duration (sec.)	Wattage (W)	Shape (mm)	280 max.	3 max.	20 max.	Ø 3.0 max.	Preheating condition		Soldering	Temp. (°C)	Manual soldering	$\Delta T \leq 130$
Recommended solder iron condition (Sn-Pb Solder and Lead Free Solder)																				
Temp. (°C)	Duration (sec.)	Wattage (W)	Shape (mm)																	
280 max.	3 max.	20 max.	Ø 3.0 max.																	
Preheating condition																				
Soldering	Temp. (°C)																			
Manual soldering	$\Delta T \leq 130$																			

No.	Process	Condition
7	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>
8	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>
9	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>

No.	Process	Condition																
9	Handling after chip mounted  Caution	<p>2) Printed circuit board cropping should not be carried out by hand, but by using the proper tooling. Printed circuit board cropping should be carried out using a board cropping jig as shown in the following figure or a board cropping apparatus to prevent inducing mechanical stress on the board.</p> <p>(1) Example of a board cropping jig Recommended example: The board should be pushed from the back side, close to the cropping jig so that the board is not bent and the stress applied to the capacitor is compressive. Unrecommended example: If the pushing point is far from the cropping jig and the pushing direction is from the front side of the board, large tensile stress is applied to the capacitor, which may cause cracks.</p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="454 593 758 884"> <p>Outline of jig</p>  </div> <div data-bbox="758 593 1444 851"> <table border="1"> <thead> <tr> <th data-bbox="764 593 1098 638">Recommended</th> <th data-bbox="1098 593 1444 638">Unrecommended</th> </tr> </thead> <tbody> <tr> <td data-bbox="764 638 1098 851">  </td> <td data-bbox="1098 638 1444 851">  </td> </tr> </tbody> </table> </div> </div> <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; margin-top: 20px;"> <div data-bbox="550 1176 965 1444"> <p>Outline of machine</p>  </div> <div data-bbox="965 1176 1412 1444"> <p>Principle of operation</p>  </div> </div> <div style="text-align: center; margin-top: 20px;"> <p>Cross-section diagram</p>  </div> <table border="1" style="width: 100%; margin-top: 20px; text-align: center;"> <thead> <tr> <th data-bbox="641 1657 821 1742">Recommended</th> <th colspan="3" data-bbox="821 1657 1353 1702">Unrecommended</th> </tr> <tr> <th data-bbox="641 1742 821 1792"></th> <th data-bbox="821 1702 1002 1792">Top-bottom misalignment</th> <th data-bbox="1002 1702 1166 1792">Left-right misalignment</th> <th data-bbox="1166 1702 1353 1792">Front-rear misalignment</th> </tr> </thead> <tbody> <tr> <td data-bbox="641 1792 821 2083">  </td> <td data-bbox="821 1792 1002 2083">  </td> <td data-bbox="1002 1792 1166 2083">  </td> <td data-bbox="1166 1792 1353 2083">  </td> </tr> </tbody> </table>	Recommended	Unrecommended			Recommended	Unrecommended				Top-bottom misalignment	Left-right misalignment	Front-rear misalignment				
Recommended	Unrecommended																	
																		
Recommended	Unrecommended																	
	Top-bottom misalignment	Left-right misalignment	Front-rear misalignment															
																		

No.	Process	Condition						
9	Handling after chip mounted  Caution	<p>3) When functional check of the P.C.board is performed, check pin pressure tends to be adjusted higher for fear of loose contact. But if the pressure is excessive and bend the P.C.board, it may crack the chip capacitors or peel the terminations off. Please adjust the check pins not to bend the P.C.board.</p> <table border="1" data-bbox="475 369 1433 701"> <thead> <tr> <th data-bbox="475 369 616 427">Item</th> <th data-bbox="616 369 1034 427">Not recommended</th> <th data-bbox="1034 369 1433 427">Recommended</th> </tr> </thead> <tbody> <tr> <td data-bbox="475 427 616 701">Board bending</td> <td data-bbox="616 427 1034 701">  </td> <td data-bbox="1034 427 1433 701">  </td> </tr> </tbody> </table>	Item	Not recommended	Recommended	Board bending		
Item	Not recommended	Recommended						
Board bending								
10	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> 						
11	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.						
12	Estimated life and estimated failure rate of capacitors	As per the estimated life and the estimated failure rate depend on the temperature and the voltage. This can be calculated by the equation described in JEITA RCR-2335C Annex F (Informative) Calculation of the estimated lifetime and the estimated failure rate (Voltage acceleration coefficient : 3 multiplication rule, Temperature acceleration coefficient : 10°C rule) The failure rate can be decreased by reducing the temperature and the voltage but they will not be guaranteed.						

No.	Process	Condition
13	Caution during operation of equipment	<p>1) A capacitor shall not be touched directly with bare hands during operation in order to avoid electric shock. Electric energy held by the capacitor may be discharged through the human body when touched with a bare hand. Even when the equipment is off, a capacitor may stay charged. The capacitor should be handled after being completely discharged using a resistor.</p> <p>2) The terminals of a capacitor shall not be short-circuited by any accidental contact with a conductive object. A capacitor shall not be exposed to a conductive liquid such as an acid or alkali solution. A conductive object or liquid, such as acid and alkali, between the terminals may lead to the breakdown of a capacitor due to short circuit</p> <p>3) Confirm that the environment to which the equipment will be exposed during transportation and operation meets the specified conditions. Do not to use the equipment in the following environments.</p> <p>(1) Environment where a capacitor is 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</p>
14	Others  Caution	<p>The product listed in this specification is intended for use in automotive applications under-normal operation and usage conditions.</p> <p>The product is not designed or warranted to meet the requirements of application listed below, whose performance and/or quality requires a more stringent level of safety or reliability, or whose failure, malfunction or defect could cause serious damage to society, person or property. Please understand that we are not responsible for any damage or liability caused by use of the products in any of the applications below or for any other use exceeding the range or conditions set forth in this specification sheet. If you intend to use the products in the applications listed below or if you have special requirements exceeding the range or conditions set forth in this specification, please contact us.</p> <p>(1) Aerospace/Aviation equipment (2) Transportation equipment (electric trains, ships etc.) (3) Medical equipment (Excepting Pharmaceutical Affairs Law classification Class1, 2) (4) Power-generation control equipment (5) Atomic energy-related equipment (6) Seabed equipment (7) Transportation control equipment (8) Public information-processing equipment (9) Military equipment (10) Electric heating apparatus, burning equipment (11) Disaster prevention/crime prevention equipment (12) Safety equipment (13) Other applications that are not considered general-purpose applications</p> <p>When designing your equipment even for general-purpose applications, you are kindly requested to take into consideration securing protection circuit/device or providing backup circuits in your equipment. In addition, although the product listed in this specification is intended for use in automotive applications as described above, it is not prohibited to use for general electronic equipment, whose performance and/or quality doesn't require a more stringent level of safety or reliability, or whose failure, malfunction or defect could not cause serious damage to society, person or property. Therefore, the description of this caution will be applied, when the product is used in general electronic equipment under a normal operation and usage conditions.</p>

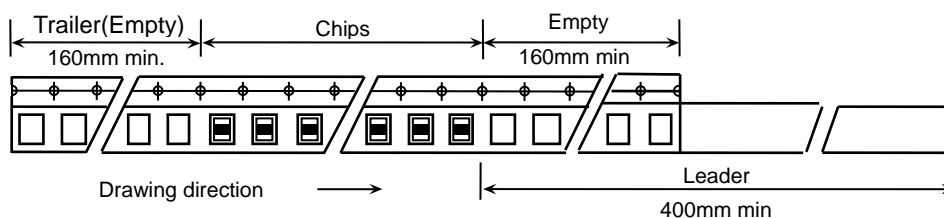
11. TAPE PACKAGING SPECIFICATION

1. CONSTRUCTION AND DIMENSION OF TAPING

1-1. Dimensions of carrier tape

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

1-2. Bulk part and leader of taping

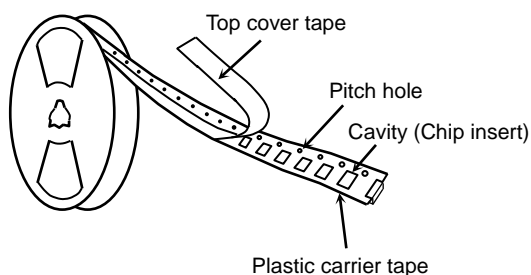


1-3. Dimensions of reel

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

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

1-4. Structure of taping



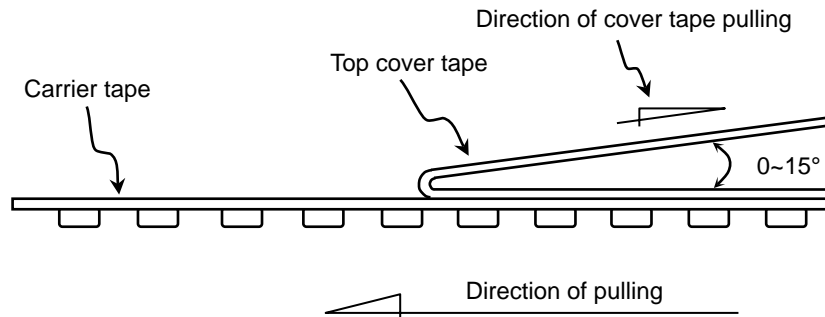
2. CHIP QUANTITY

Please refer to detail page on TDK web.

3. PERFORMANCE SPECIFICATIONS

3-1. Fixing peeling strength (top tape)

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



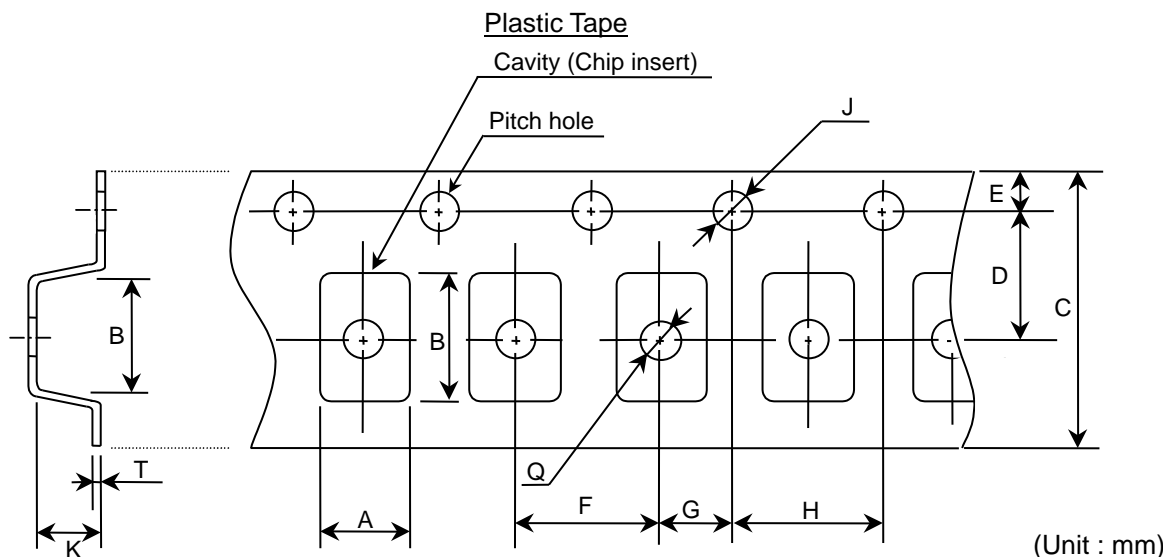
3-2. Carrier tape shall be flexible enough to be wound around a minimum radius of 30mm with components in tape.

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

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

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

Appendix 3

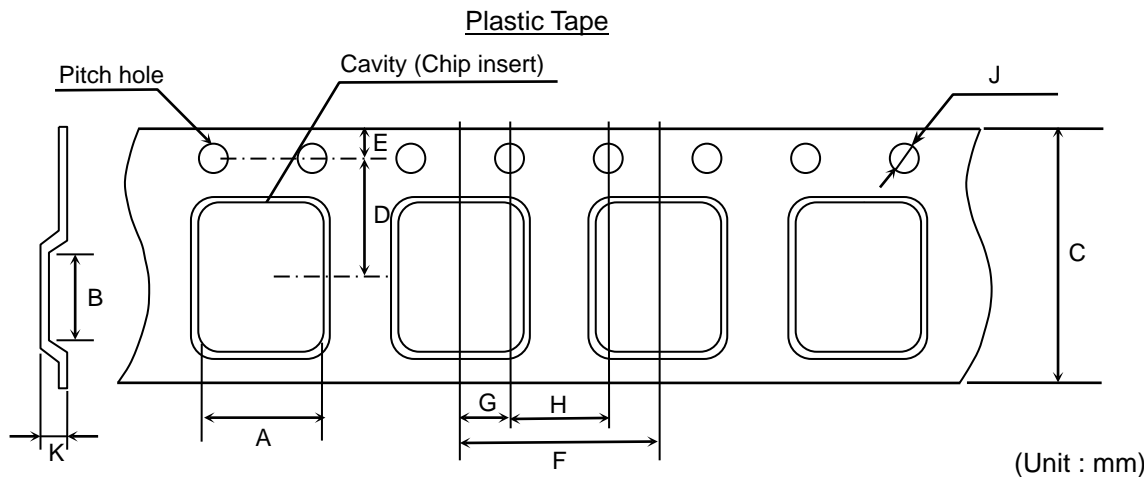


Symbol	A	B	C	D	E	F
Case size						
CKG32K	(3.00)	(3.90)	12.0 ± 0.25	5.50 ± 0.05	1.75 ± 0.10	4.00 ± 0.10

Symbol	G	H	J	K	T	Q
Case size						
CKG32K	2.00 ± 0.10	4.00 ± 0.10	∅ 1.5 ^{+0.10} ₀	3.75 max.	0.50 ± 0.05	∅ 1.65 ± 0.10

() Reference value.
 Exceptionally no hole in the cavity is applied. Please inquire if hole in cavity is mandatory.

Appendix 4



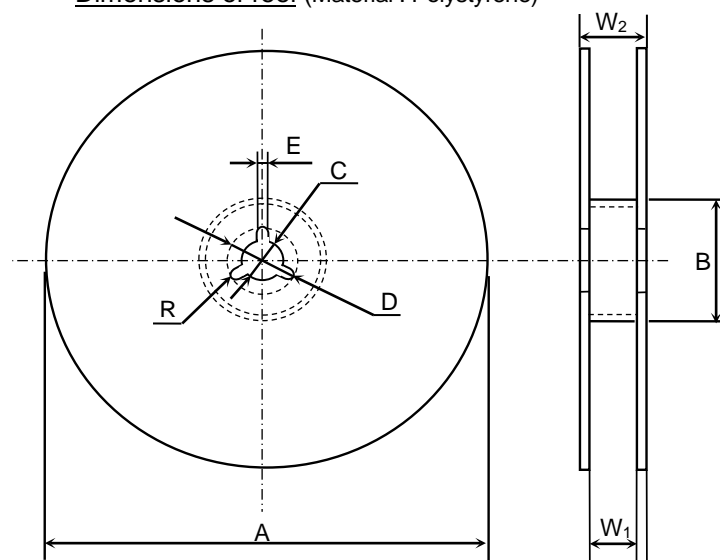
Symbol	A	B	C	D	E	F
Case size						
CKG45K	(3.90)	(5.60)	12.0 ± 0.30	5.50 ± 0.10	1.75 ± 0.10	8.00 ± 0.10
CKG45N						
CKG57K	(5.60)	(6.60)	16.0 ± 0.30	7.50 ± 0.10	1.75 ± 0.10	8.00 ± 0.10
CKG57N						

Symbol	G	H	J	K
Case size				
CKG45K	2.00 ± 0.10	4.00 ± 0.10	∅ 1.5 ^{+0.10} ₀	3.75 max.
CKG45N				6.15 max.
CKG57K	2.00 ± 0.10	4.00 ± 0.10	∅ 1.5 ^{+0.10} ₀	4.15 max.
CKG57N				6.15 max.

() Reference value.

Appendix 5

Dimensions of reel (Material : Polystyrene)



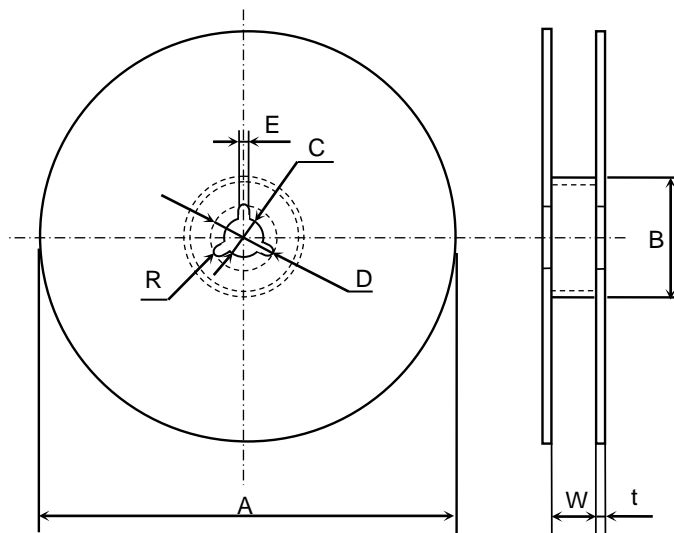
(Unit : mm)

Symbol	A	B	C	D	E	W ₁
Case size						
CKG32	∅178 ± 2.0	∅60 ± 2.0	∅13 ± 0.5	∅21 ± 0.8	2.0 ± 0.5	13.0 ± 0.3

Symbol	W ₂	R
Case size		
CKG32	17.0 ± 1.4	1.0

Appendix 6

Dimensions of reel (Material : Polystyrene)



(Unit : mm)

Symbol	A	B	C	D	E	W
Case size						
CKG32K	∅382 max. (Nominal ∅330)	∅50 min.	∅13 ± 0.5	∅21 ± 0.8	2.0 ± 0.5	14.0 ± 1.5
CKG45K, CKG45N						13.5 ± 1.5
CKG57K, CKG57N						17.5 ± 1.5

Symbol	t	R
Case size		
CKG32	2.0 ± 0.5	1.0
CKG45K, CKG45N		
CKG57K, CKG57N		