

DELIVERY SPECIFICATION

SPEC. No. C-MEGA-e

D A T E : Jun, 2019

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 _____

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	H
(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	2.90 mm
335	3.35 mm
500	5.00 mm

(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◇◇◇○○○△△□□□x.

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

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12. TABLE A (TDK products line up)

<EXPLANATORY NOTE>

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

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

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

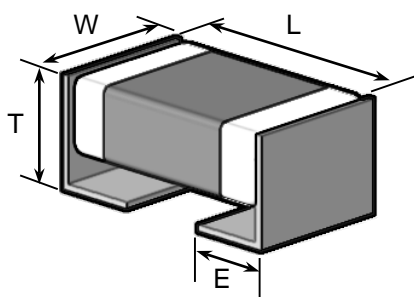
Division	Date	SPEC. No.
Ceramic Capacitors Business Group	Jun, 2019	C-MEGA-e

1. CODE CONSTRUCTION

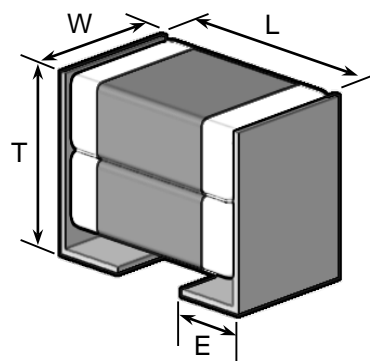
(Example)	CKG32K	X7S	1H	106	K	T	0000
	<u>CKG57N</u>	<u>X7R</u>	<u>1E</u>	<u>226</u>	<u>M</u>	<u>T</u>	<u>0000</u>
	(1)	(2)	(3)	(4)	(5)	(6)	(7)

(1) Case size

Single type
CKG**K : 1 chip capacitor.



Stacked type
CKG**N : 2 chip capacitors.



Case size		Dimensions (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	2 A	DC 100 V
2 J	DC 630 V	1 H	DC 50 V
2 W	DC 450 V	1 E	DC 25 V
2 E	DC 250 V	1 C	DC 16 V

(4) Rated Capacitance

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

(Example)

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

- (5) Capacitance tolerance
 * K ($\pm 10\%$) tolerance is available only for
 CKG**K single type ($10\mu\text{F}$ 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/X7R/X7S/X7T	-55°C	125°C	25°C

3. STORING CONDITION AND TERM

Storing temperature	Storing humidity	Storing term
$5\sim 40^{\circ}\text{C}$	$20\sim 70\%RH$	Within 6 months upon receipt.

4. INDUSTRIAL WASTE DISPOSAL

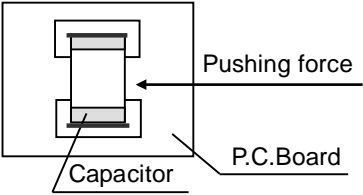
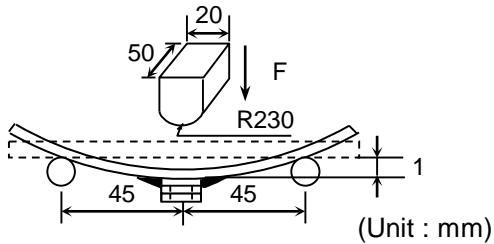
Dispose this product as industrial waste in accordance with the Industrial Waste Law.

5. PERFORMANCE

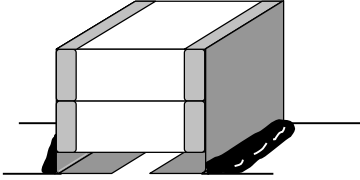
table 1

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. whichever smaller. (As for the capacitor of rated voltage 16V DC, 100MΩ·μF min.)	Measuring voltage : Rated voltage (As for the capacitor of rated voltage 1kV and 630V DC, 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>$500V < RV$</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	$500V < RV$	1.3 × rated voltage
Class	Rated voltage(RV)	Apply voltage																				
1	$RV \leq 100V$	3 × rated 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																				
	$500V < RV$	1.3 × rated voltage																				
4	Capacitance	Within the specified tolerance.	<p>《Class1》</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">0.5~5Vms.</td> </tr> <tr> <td>Over 1000pF</td> <td>1kHz±10%</td> </tr> </tbody> </table> <p>《Class2》</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±0.2Vms.</td> </tr> <tr> <td>Over 10uF</td> <td>120Hz±20%</td> <td>0.5±0.2Vms.</td> </tr> </tbody> </table>	Capacitance	Measuring frequency	Measuring voltage	1000pF	1MHz±10%	0.5~5Vms.	Over 1000pF	1kHz±10%	Capacitance	Measuring frequency	Measuring voltage	10uF and under	1kHz±10%	1.0±0.2Vms.	Over 10uF	120Hz±20%	0.5±0.2Vms.		
Capacitance	Measuring frequency	Measuring voltage																				
1000pF	1MHz±10%	0.5~5Vms.																				
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10uF and under	1kHz±10%	1.0±0.2Vms.																				
Over 10uF	120Hz±20%	0.5±0.2Vms.																				
5	Q (Class1) Dissipation Factor (Class2)	Please refer to detail page on TDK Web.	See No.4 in this table for measuring condition.																			

(continued)

No.	Item	Performance	Test or inspection method																						
6	Temperature Characteristics of Capacitance (Class1)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 20%; text-align: center;">T.C.</td> <td style="text-align: center;">Temperature Coefficient (ppm/°C)</td> </tr> <tr> <td style="text-align: center;">C0G</td> <td style="text-align: center;">0 ± 30</td> </tr> <tr> <td colspan="2" style="border-top: 1px solid black;"> </td> </tr> <tr> <td style="text-align: center;">Capacitance drift</td> <td style="text-align: center;">Within ± 0.2%</td> </tr> </table>	T.C.	Temperature Coefficient (ppm/°C)	C0G	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)																								
C0G	0 ± 30																								
Capacitance drift	Within ± 0.2%																								
7	Temperature Characteristics of Capacitance (Class2)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="2" style="text-align: center;">Capacitance Change (%)</th> </tr> <tr> <th colspan="2" style="text-align: center;">No voltage applied</th> </tr> <tr> <td style="text-align: center;">X5R :</td> <td style="text-align: center;">±15</td> </tr> <tr> <td style="text-align: center;">X7R :</td> <td style="text-align: center;">±15</td> </tr> <tr> <td style="text-align: center;">X7S :</td> <td style="text-align: center;">±22</td> </tr> <tr> <td style="text-align: center;">X7T :</td> <td style="text-align: center;">+22 - 33</td> </tr> </table>	Capacitance Change (%)		No voltage applied		X5R :	±15	X7R :	±15	X7S :	±22	X7T :	+22 - 33	<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" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">Step</th> <th style="width: 90%;">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> <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
Capacitance Change (%)																									
No voltage applied																									
X5R :	±15																								
X7R :	±15																								
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X7T :	+22 - 33																								
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 Appendix2. Apply a pushing force gradually at the center of a specimen in a horizontal direction of P.C.board. Pushing force : 5N Holding time : 10±1s</p> 																						
9	Bending	No mechanical damage.	<p>Reflow solder the capacitors on a P.C.Board shown in Appendix1 and bend it for 1mm.</p>  <p style="text-align: right;">(Unit : mm)</p>																						

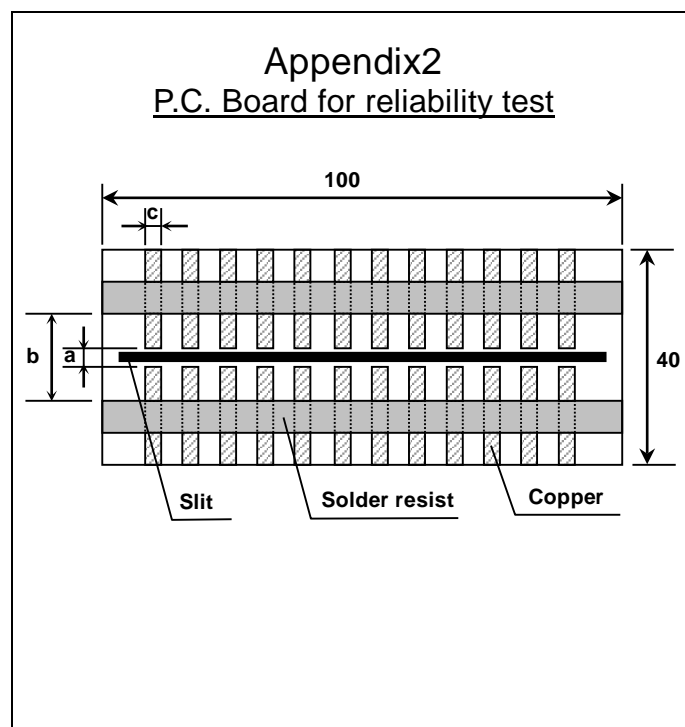
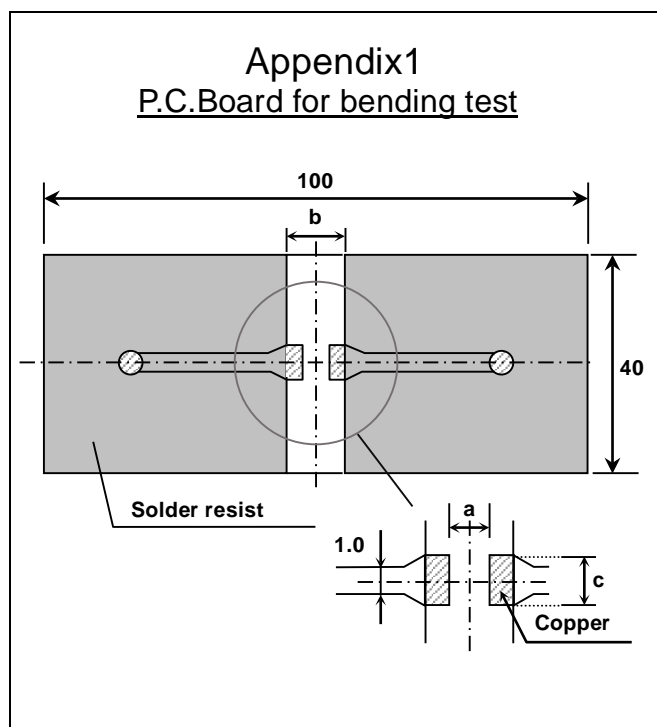
(continued)

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 or Sn-37Pb</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	External appearance	No mechanical damage.															
		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 %</td> </tr> <tr> <td rowspan="4">Class2</td> <td>X5R</td> <td rowspan="4">± 7.5 %</td> </tr> <tr> <td>X7R</td> </tr> <tr> <td>X7S</td> </tr> <tr> <td>X7T</td> </tr> </tbody> </table>	Characteristics		Change from the value before test	Class1	C0G	± 2.5 %	Class2	X5R	± 7.5 %	X7R	X7S	X7T			
		Characteristics		Change from the value before test														
		Class1	C0G	± 2.5 %														
Class2	X5R	± 7.5 %																
	X7R																	
	X7S																	
	X7T																	
Q (Class1)	Meet the initial spec.																	
D.F. (Class2)	Meet the initial spec.																	
12	Temperature cycle	External appearance	No mechanical damage.															
		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="4">Please contact with our sales representative.</td> </tr> <tr> <td rowspan="3">Class2</td> <td>X5R</td> </tr> <tr> <td>X7R</td> </tr> <tr> <td>X7S X7T</td> </tr> </tbody> </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)	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.																	
			<p>Expose the capacitors in the condition step1 through step 4 listed in the following table.</p> <p>Temp. cycle : 100 cycles</p> <table border="1"> <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 Appendix2 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
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																

(continued)

No.	Item		Performance	Test or inspection method									
13	Moisture Resistance	External appearance	No mechanical damage.	Test temp. : 40±2°C Test humidity : 90~95%RH Applied voltage : Rated voltage Test time : 500 +24,0h Charge/discharge current : 50mA or lower Leave the capacitors in ambient condition for 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="3">Please contact with our sales representative.</td> </tr> <tr> <td rowspan="2">Class2</td> <td>X5R</td> </tr> <tr> <td>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. whichever smaller. (As for the capacitor 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. whichever smaller. (As for the capacitor 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.



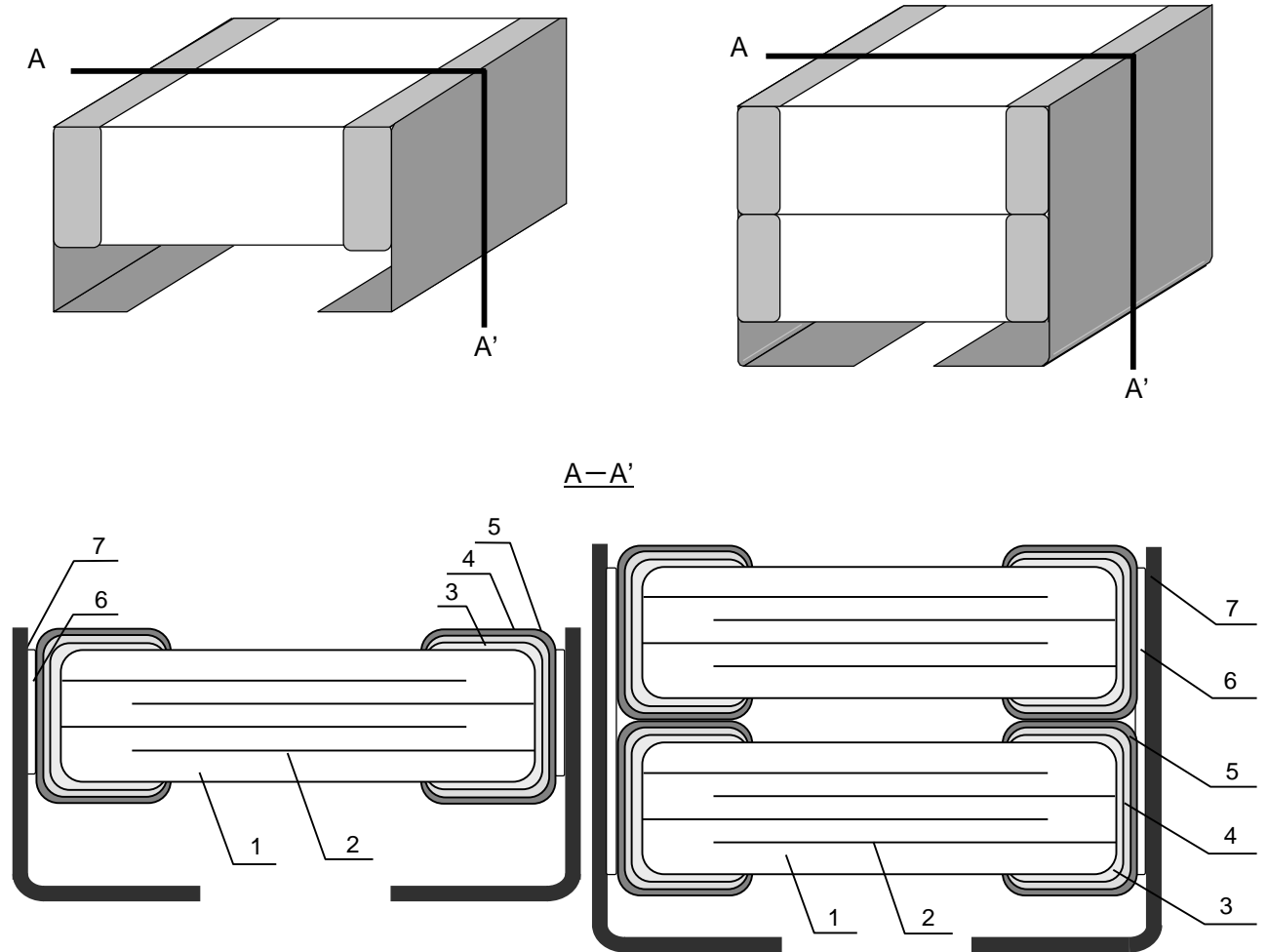
(Unit : mm)

Symbol	a	b	c
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 $\frac{A}{(a)} \frac{9}{(b)} \frac{A}{(c)} - \frac{23}{(d)} - \frac{001}{(e)}$

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

*Composition of new Inspection No.

(Will be implemented on and after May 1, 2019)

Example

I	A	9	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 is planned to shift to the new inspection No. on and after May 2019, but the implementation timing may be different depending on shipment bases. Until the shift is completed, either current or new composition of inspection No. will be applied.

8. 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.

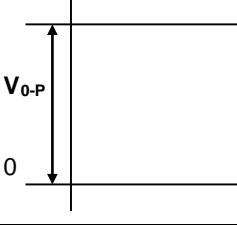
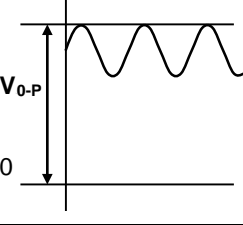
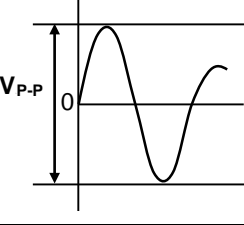
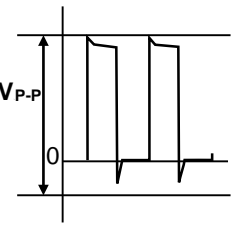
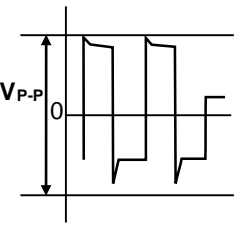
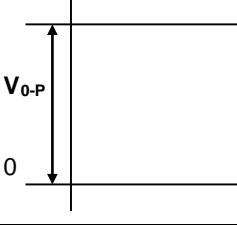
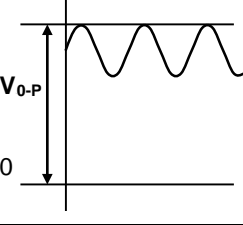
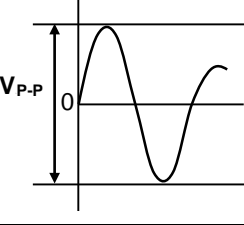
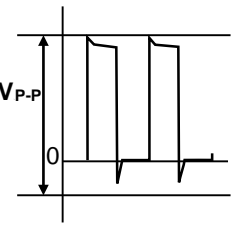
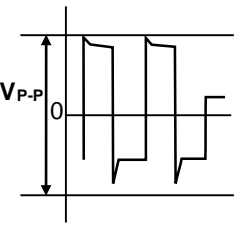
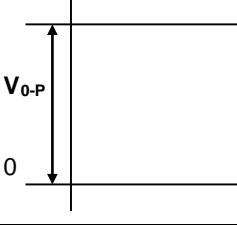
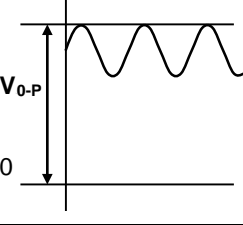
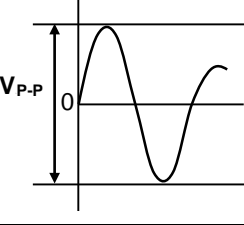
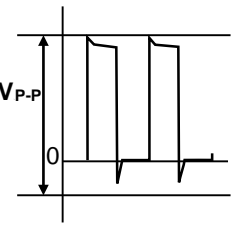
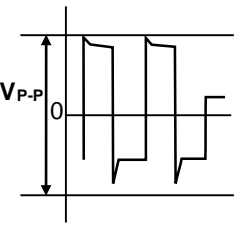
9. SOLDERING CONDITION

Reflow soldering only.

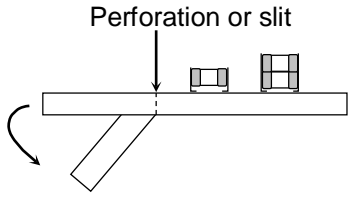
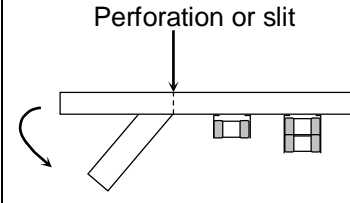
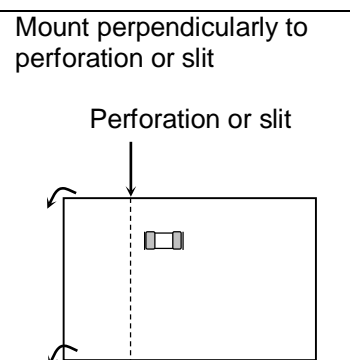
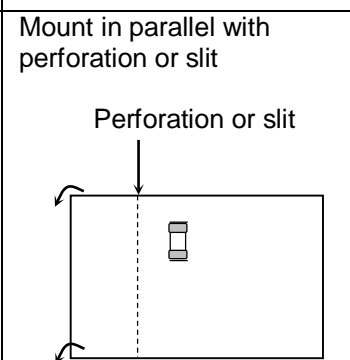
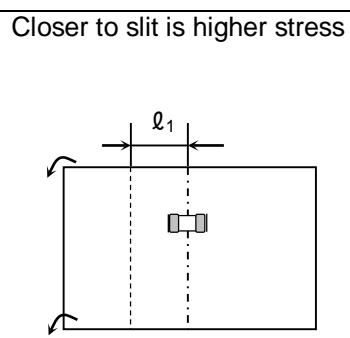
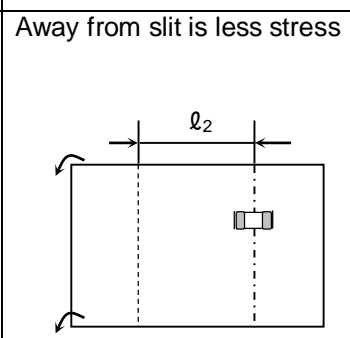
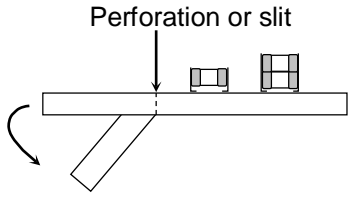
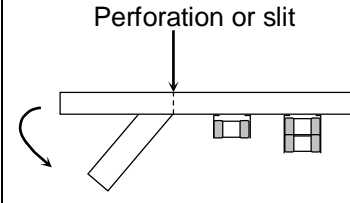
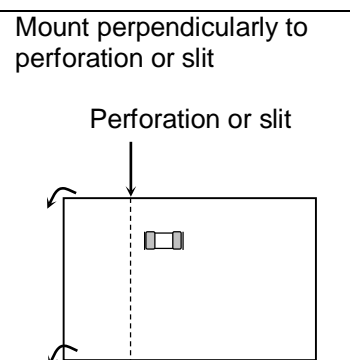
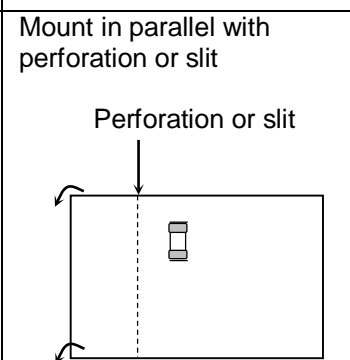
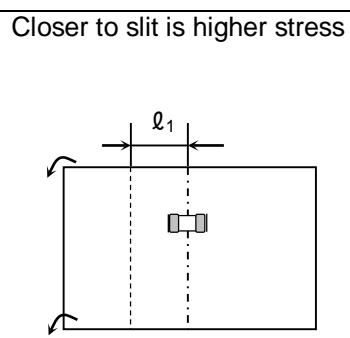
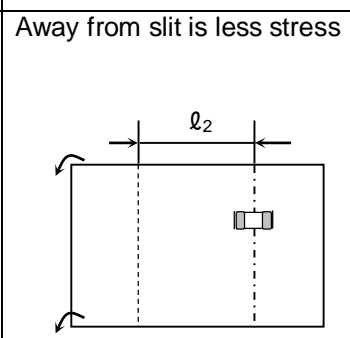
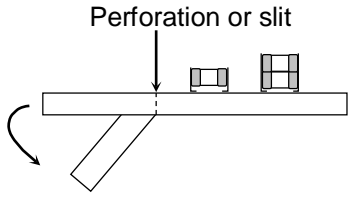
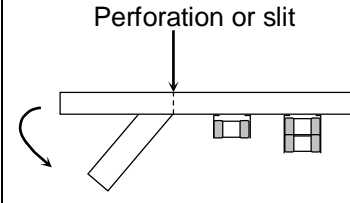
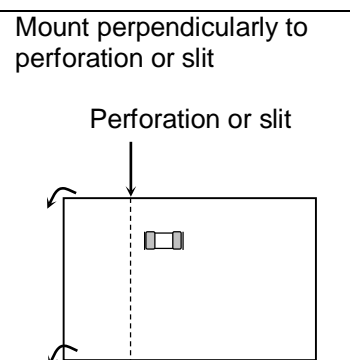
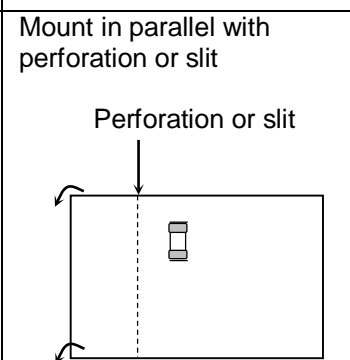
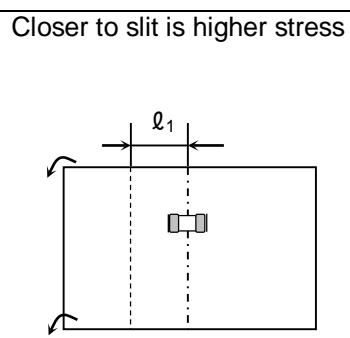
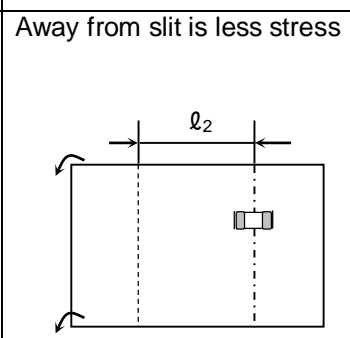
Metal cap is jointed by high temp solder, however the solder temperature must be less than 250°C to avoid melting the solder.

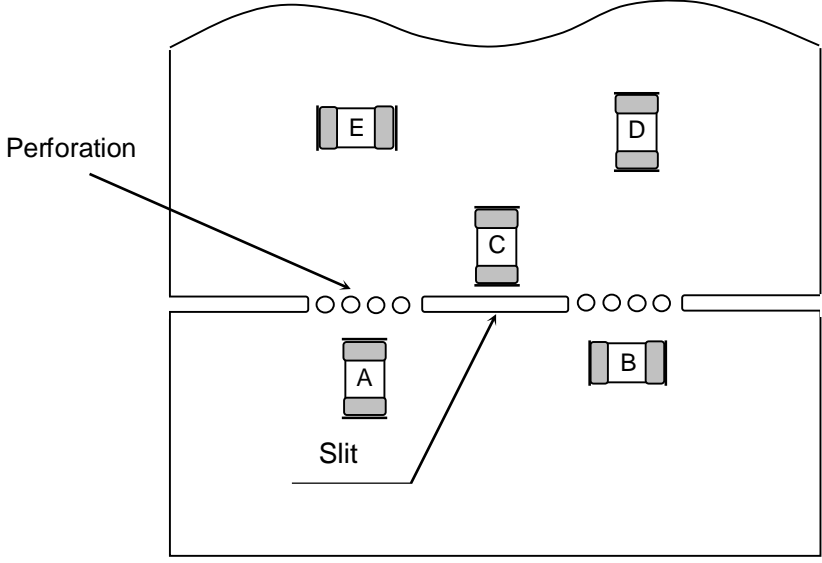
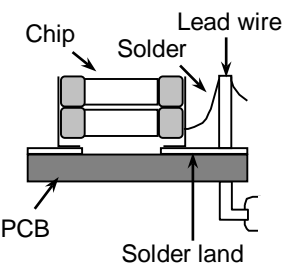
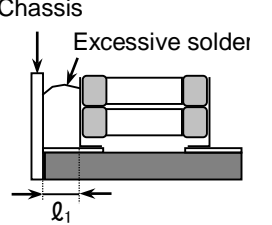
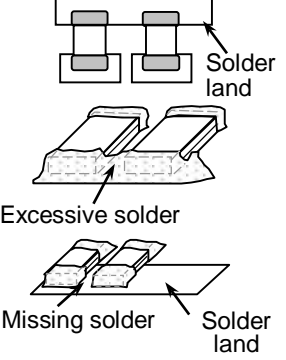
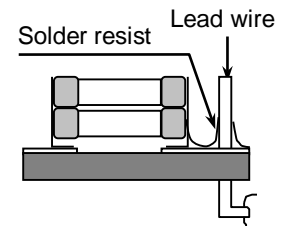
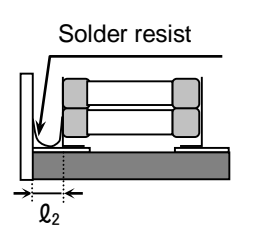
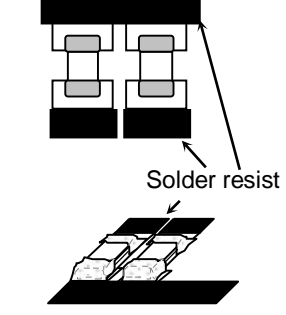
Please refer to No.5 Soldering in 10.CAUTION for recommended soldering condition.

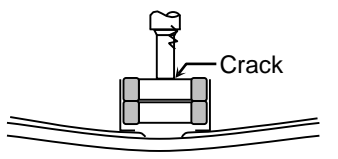
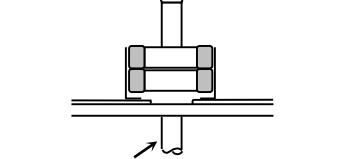
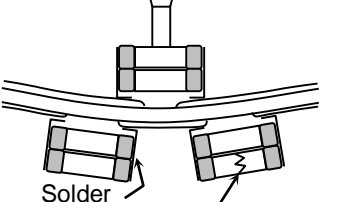
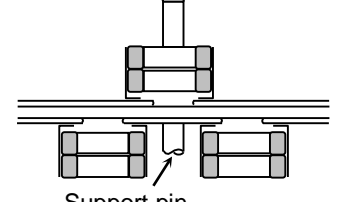
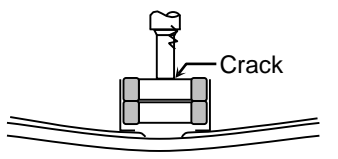
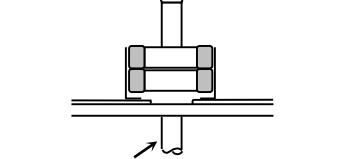
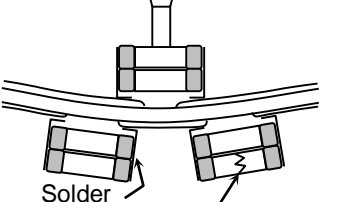
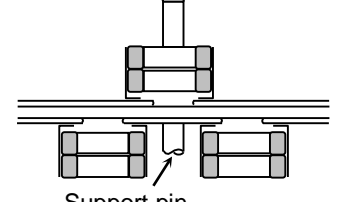
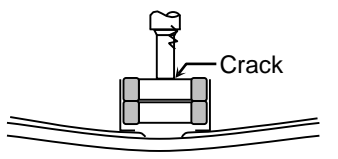
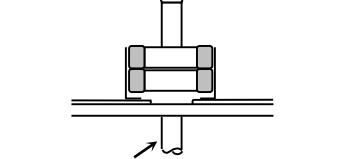
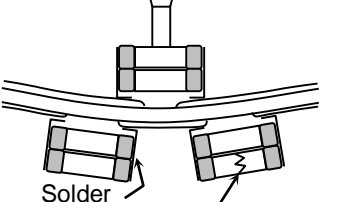
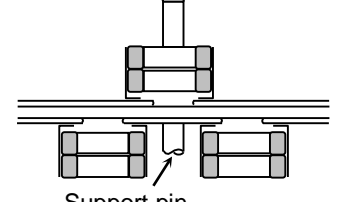
10. CAUTION

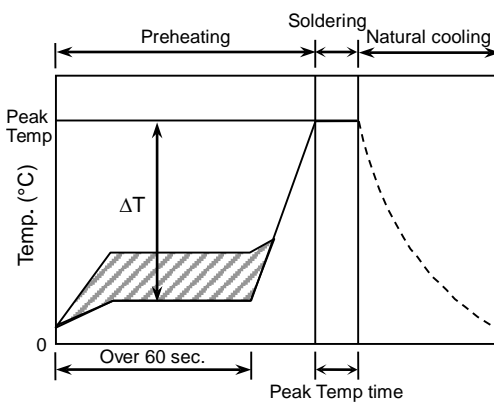
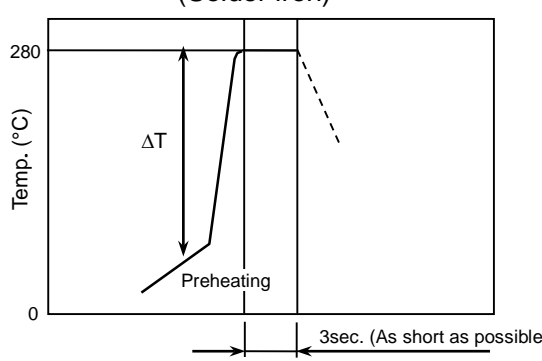
No.	Process	Condition																
1	Operating Condition (Storage, Use Transportation)	<p>1-1. Storage, Use</p> <ol style="list-style-type: none"> 1) The capacitors must be stored in an ambient temperature of 5 to 40°C with a relative humidity of 20 to 70%RH. The products should be used within 6 months upon receipt. 2) The capacitors must be operated and stored in an environment free of dew condensation and these gases such as Hydrogen Sulphide, Hydrogen Sulphate, Chlorine, Ammonia and sulfur. 3) Avoid storing in sun light and falling of dew. 4) Do not use capacitors under high humidity and high and low atmospheric pressure which may affect capacitors reliability. 5) Capacitors should be tested for the solderability when they are stored for long time. <p>1-2. Handling in transportation</p> <p>In case of the transportation of the capacitors, the performance of the capacitors may be deteriorated depending on the transportation condition. (Refer to JEITA RCR-2335C 9.2 Handling in transportation)</p>																
2	Circuit design ⚠ Caution	<p>2-1. Operating temperature</p> <p>Operating temperature should be followed strictly within this specification, especially be careful with maximum temperature.</p> <ol style="list-style-type: none"> 1) Do not use capacitors above the maximum allowable operating temperature. 2) Surface temperature including self heating should be below maximum operating temperature. (Due to dielectric loss, capacitors will heat itself when AC is applied. Especially at high frequencies around its SRF, the heat might be so extreme that it may damage itself or the product mounted on. Please design the circuit so that the maximum temperature of the capacitors including the self heating to be below the maximum allowable operating temperature. Temperature rise at capacitor surface shall be below 20°C) 3) The electrical characteristics of the capacitors will vary depending on the temperature. The capacitors should be selected and designed in taking the temperature into consideration. <p>2-2. Operating voltage</p> <ol style="list-style-type: none"> 1) Operating voltage across the terminals should be below the rated voltage. When AC and DC are super imposed, V_{0-P} must be below the rated voltage. — (1) and (2) AC or pulse with overshooting, V_{P-P} must be below the rated voltage. — (3), (4) and (5) <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="469 1487 1442 2040"> <thead> <tr> <th data-bbox="469 1487 660 1538">Voltage</th> <th data-bbox="660 1487 919 1538">(1) DC voltage</th> <th data-bbox="919 1487 1182 1538">(2) DC+AC voltage</th> <th data-bbox="1182 1487 1442 1538">(3) AC voltage</th> </tr> </thead> <tbody> <tr> <td data-bbox="469 1538 660 1762">Positional Measurement (Rated voltage)</td> <td data-bbox="660 1538 919 1762"></td> <td data-bbox="919 1538 1182 1762"></td> <td data-bbox="1182 1538 1442 1762"></td> </tr> <tr> <th data-bbox="469 1762 660 1814">Voltage</th> <th data-bbox="660 1762 919 1814">(4) Pulse voltage (A)</th> <th data-bbox="919 1762 1182 1814">(5) Pulse voltage (B)</th> <td></td> </tr> <tr> <td data-bbox="469 1814 660 2040">Positional Measurement (Rated voltage)</td> <td data-bbox="660 1814 919 2040"></td> <td data-bbox="919 1814 1182 2040"></td> <td></td> </tr> </tbody> </table>	Voltage	(1) DC voltage	(2) DC+AC voltage	(3) AC voltage	Positional Measurement (Rated voltage)				Voltage	(4) Pulse voltage (A)	(5) Pulse voltage (B)		Positional Measurement (Rated voltage)			
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)																		

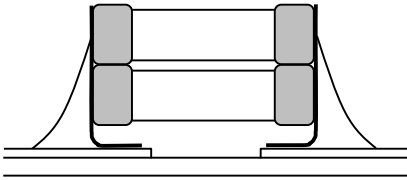
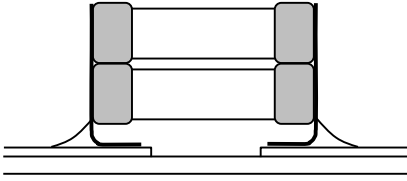
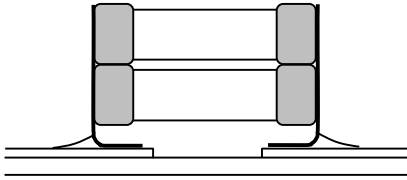
No.	Process	Condition																								
2	Circuit design ⚠ Caution	<p>2) Even below the rated voltage, if repetitive high frequency AC or pulse is applied, the reliability of the capacitors may be reduced.</p> <p>3) The effective capacitance will vary depending on applied DC and AC voltages. The capacitors should be selected and designed in taking the voltages into consideration.</p> <p>2-3. Frequency When the capacitors (Class 2) are used in AC and/or pulse voltages, the capacitors may vibrate themselves and generate audible sound.</p>																								
3	Designing P.C.board	<p>The amount of solder at the terminations has a direct effect on the reliability of the capacitor.</p> <ol style="list-style-type: none"> 1) The greater the amount of solder, the higher the stress on the chip capacitor, and the more likely that it will break. When designing a P.C.board, determine the shape and size of the solder lands to have proper amount of solder on the terminations. 2) Avoid using common solder land for multiple terminations and provide individual solder land for each terminations. 3) Size and recommended land dimensions. <div data-bbox="676 898 1406 1176" style="text-align: center;"> </div> <p>Reflow soldering</p> <p style="text-align: right;">(Unit : mm)</p> <table border="1" data-bbox="560 1249 1441 1518"> <thead> <tr> <th data-bbox="560 1249 762 1361">Case size Symbol</th> <th data-bbox="762 1249 900 1361">CKG32K</th> <th data-bbox="900 1249 1035 1361">CKG45K</th> <th data-bbox="1035 1249 1171 1361">CKG57K</th> <th data-bbox="1171 1249 1307 1361">CKG45N</th> <th data-bbox="1307 1249 1441 1361">CKG57N</th> </tr> </thead> <tbody> <tr> <td data-bbox="560 1361 762 1413">A</td> <td data-bbox="762 1361 900 1413">2.0 ~ 2.2</td> <td data-bbox="900 1361 1035 1413">3.3 ~ 3.7</td> <td data-bbox="1035 1361 1171 1413">3.9 ~ 4.3</td> <td data-bbox="1171 1361 1307 1413">3.3 ~ 3.7</td> <td data-bbox="1307 1361 1441 1413">3.9 ~ 4.3</td> </tr> <tr> <td data-bbox="560 1413 762 1464">B</td> <td data-bbox="762 1413 900 1464">1.1 ~ 1.3</td> <td data-bbox="900 1413 1035 1464">1.2 ~ 1.5</td> <td data-bbox="1035 1413 1171 1464">1.5 ~ 2.0</td> <td data-bbox="1171 1413 1307 1464">1.2 ~ 1.5</td> <td data-bbox="1307 1413 1441 1464">1.5 ~ 2.0</td> </tr> <tr> <td data-bbox="560 1464 762 1518">C</td> <td data-bbox="762 1464 900 1518">2.3 ~ 2.5</td> <td data-bbox="900 1464 1035 1518">2.7 ~ 3.2</td> <td data-bbox="1035 1464 1171 1518">4.5 ~ 5.0</td> <td data-bbox="1171 1464 1307 1518">2.7 ~ 3.2</td> <td data-bbox="1307 1464 1441 1518">4.5 ~ 5.0</td> </tr> </tbody> </table>	Case size Symbol	CKG32K	CKG45K	CKG57K	CKG45N	CKG57N	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
Case size Symbol	CKG32K	CKG45K	CKG57K	CKG45N	CKG57N																					
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																					

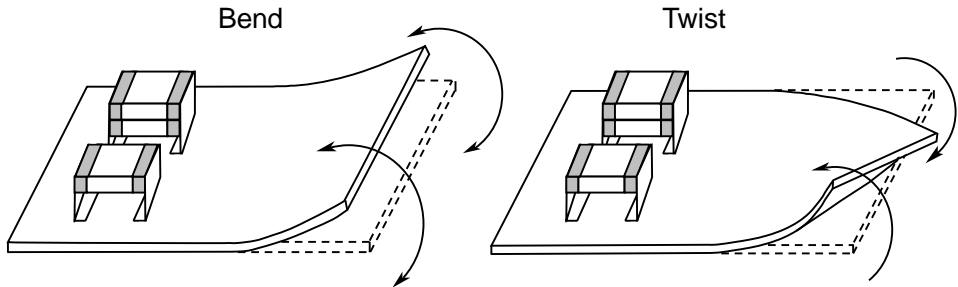
No.	Process	Condition												
3	Designing P.C.board	<p>4) Recommended chip capacitor layout is as following.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 30%;"></th> <th style="width: 35%;">Disadvantage against bending stress</th> <th style="width: 35%;">Advantage against bending stress</th> </tr> </thead> <tbody> <tr> <td style="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="vertical-align: middle;">Chip arrangement (Direction)</td> <td style="text-align: center;"> <p>Perforation or slit</p>  <p>Mount perpendicularly to perforation or slit</p> </td> <td style="text-align: center;"> <p>Perforation or slit</p>  <p>Mount in parallel with perforation or slit</p> </td> </tr> <tr> <td style="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>Mount perpendicularly to perforation or slit</p>	<p>Perforation or slit</p>  <p>Mount in parallel with 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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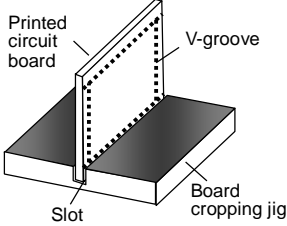
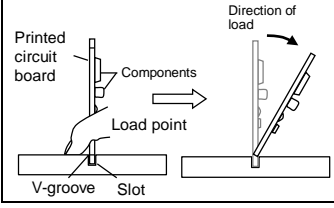
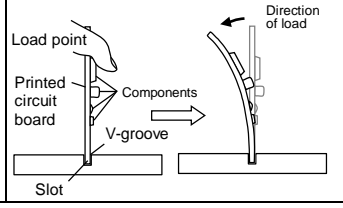
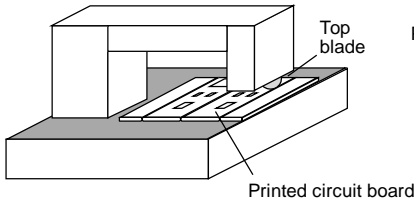
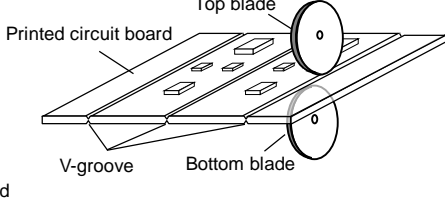
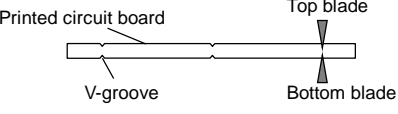
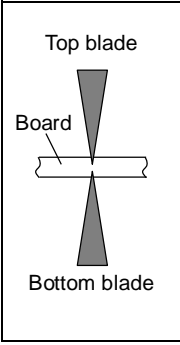
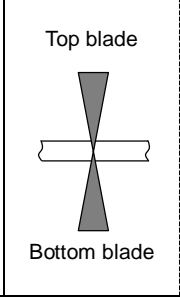
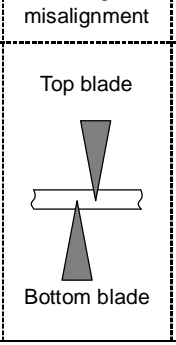
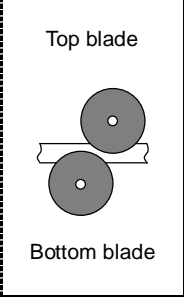
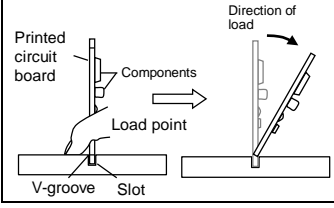
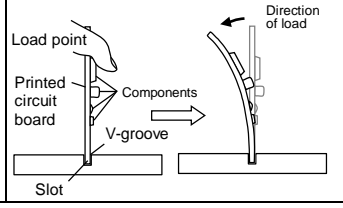
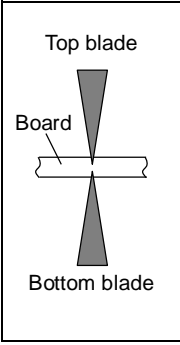
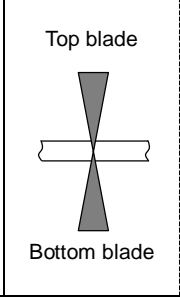
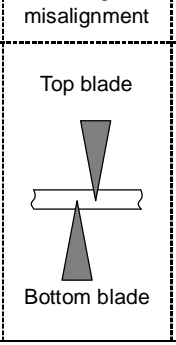
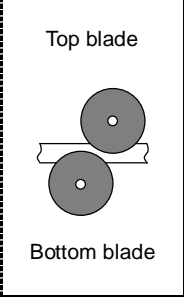
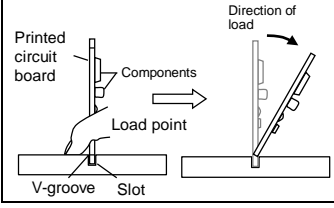
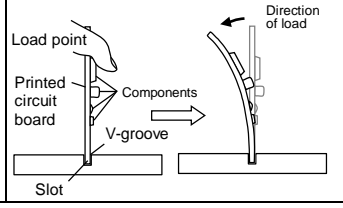
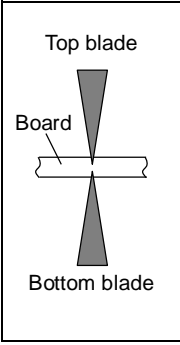
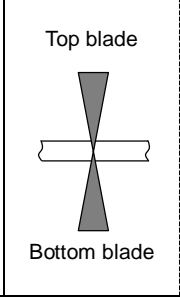
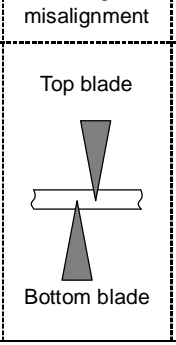
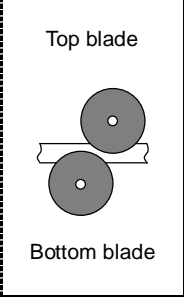
No.	Process	Condition	
3	Designing P.C.board	<p>5) Mechanical stress varies according to location of chip capacitors on the P.C.board.</p>  <p>The stress in capacitors is in the following order. $A > B = C > D > E$</p>	
6) Layout recommendation			
Example	Use of common solder land	Soldering with chassis	Use of common solder land with other SMD
Need to avoid			
Recommendation		 <p>$l_2 > l_1$</p>	


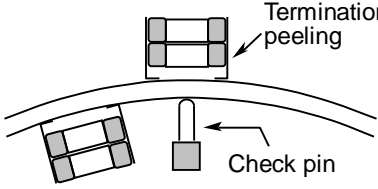
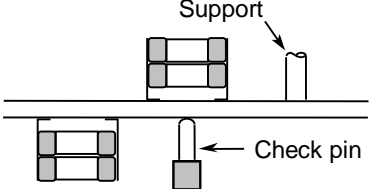
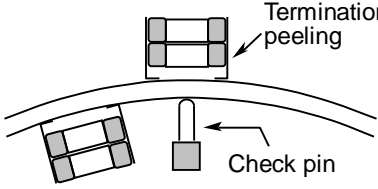
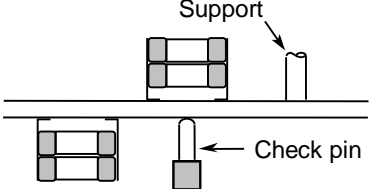
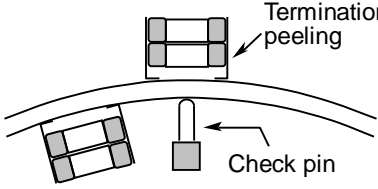
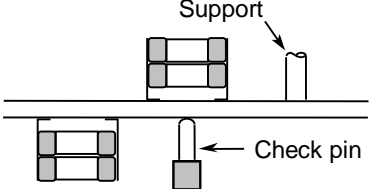
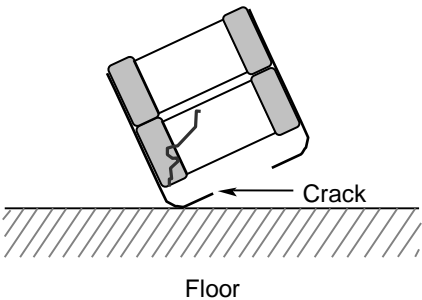
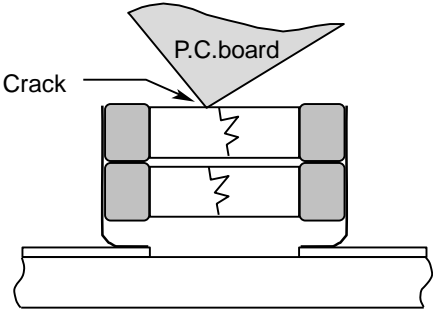
No.	Process	Condition									
4	Mounting	<p>4-1. Stress from mounting head If the mounting head is adjusted too low, it may induce excessive stress in the chip capacitor to result in cracking. Please take following precautions.</p> <ol style="list-style-type: none"> 1) Adjust the bottom dead center of the mounting head to reach on the P.C.board surface and not press it. 2) Adjust the mounting head pressure to be 1 to 3N of static weight. 3) To minimize the impact energy from mounting head, it is important to provide support from the bottom side of the P.C.board. See following examples. <table border="1" data-bbox="483 600 1437 1182"> <thead> <tr> <th></th> <th data-bbox="687 600 1058 651">Not recommended</th> <th data-bbox="1058 600 1437 651">Recommended</th> </tr> </thead> <tbody> <tr> <td data-bbox="483 651 687 898">Single-sided mounting</td> <td data-bbox="687 651 1058 898">  <p>Crack</p> </td> <td data-bbox="1058 651 1437 898">  <p>Support pin</p> </td> </tr> <tr> <td data-bbox="483 898 687 1182">Double-sides mounting</td> <td data-bbox="687 898 1058 1182">  <p>Solder peeling Crack</p> </td> <td data-bbox="1058 898 1437 1182">  <p>Support pin</p> </td> </tr> </tbody> </table> <p>When the centering jaw is worn out, it may give mechanical impact on the capacitor to cause crack. Please control the close up dimension of the centering jaw and provide sufficient preventive maintenance and replacement of it.</p>		Not recommended	Recommended	Single-sided mounting	 <p>Crack</p>	 <p>Support pin</p>	Double-sides mounting	 <p>Solder peeling Crack</p>	 <p>Support pin</p>
	Not recommended	Recommended									
Single-sided mounting	 <p>Crack</p>	 <p>Support pin</p>									
Double-sides mounting	 <p>Solder peeling 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 by various methods Reflow soldering condition</p> <ol style="list-style-type: none"> 1) Soldering condition (Preheating temperature, soldering temperature and these times) is limited to reflow soldering method which is stipulated on the specification. 2) Chips should be mounted, shortly after a solder is on a P.C.Board. 3) Temperature of metal cap surface must not exceed 250°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 style="text-align: center;">Reflow soldering</p>  <p>The graph shows temperature in °C on the y-axis and time on the x-axis. It 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 and a duration of 'Over 60 sec.'. The Soldering phase shows a sharp rise to the 'Peak Temp' followed by a horizontal plateau. The 'Peak Temp time' is indicated for this plateau. The Natural cooling phase shows a dashed line representing the temperature falling back to 0.</p> <p style="text-align: center;">Manual soldering (Solder iron)</p>  <p>The graph shows temperature in °C on the y-axis and time on the x-axis. It shows a 'Preheating' phase with a temperature rise to a level below 280°C. The main phase shows a sharp rise to 280°C, followed by a horizontal plateau. The duration of this plateau is marked as '3sec. (As short as possible)'. A dashed line indicates the temperature falling after the plateau. A temperature difference ΔT is also indicated.</p> <p>5-3. Recommended soldering peak temp and peak temp duration</p> <table border="1" data-bbox="494 1747 1197 1937"> <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>Sn-Pb Solder</td> <td>230 max.</td> <td>20 max.</td> </tr> <tr> <td>Lead Free Solder</td> <td>250 max.</td> <td>10 max.</td> </tr> </tbody> </table> <p>Recommended solder compositions Lead Free Solder : Sn-3.0Ag-0.5Cu Sn-Pb Solder : Sn-37Pb</p>	Temp./Duration	Reflow soldering		Peak temp(°C)	Duration(sec.)	Solder			Sn-Pb Solder	230 max.	20 max.	Lead Free Solder	250 max.	10 max.
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	Peak temp(°C)	Duration(sec.)														
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Sn-Pb Solder	230 max.	20 max.														
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No.	Process	Condition														
5	Soldering	<p>5-4. Avoiding thermal shock</p> <p>1) Preheating condition</p> <table border="1" data-bbox="544 277 979 405"> <thead> <tr> <th>Soldering</th> <th>Temp. (°C)</th> </tr> </thead> <tbody> <tr> <td>Reflow soldering</td> <td>$\Delta T \leq 130$</td> </tr> <tr> <td>Manual soldering</td> <td>$\Delta T \leq 130$</td> </tr> </tbody> </table> <p>2) Cooling condition Natural cooling using air is recommended. If the chips are dipped into a solvent for cleaning, the temperature difference (ΔT) must be less than 100°C.</p> <p>5-5. Amount of solder Excessive solder will induce higher tensile force in chip capacitor when temperature changes and it may result in chip cracking. In sufficient solder may detach the capacitor from the P.C.board.</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div data-bbox="501 768 624 819" style="text-align: center;">Excessive solder</div>  <div data-bbox="1114 768 1433 819" style="text-align: center;">Higher tensile force in chip capacitor to cause crack</div> </div> <hr/> <div style="display: flex; justify-content: center; align-items: center;"> <div data-bbox="501 992 624 1021" style="text-align: center;">Adequate</div>  </div> <hr/> <div style="display: flex; justify-content: space-around; align-items: center;"> <div data-bbox="501 1182 624 1234" style="text-align: center;">Insufficient solder</div>  <div data-bbox="1114 1160 1433 1267" style="text-align: center;">Low robustness may cause contact failure or chip capacitor comes off the P.C.board.</div> </div> <hr/> <p>5-6. Solder repair by solder iron</p> <p>1) Selection of the soldering iron tip Tip temperature of solder iron varies by its type, P.C.board material and solder land size. The higher the tip temperature, the quicker the operation. However, heat shock may cause a crack in the chip capacitors. Please make sure the tip temp. before soldering and keep the peak temp and time in accordance with following recommended condition.</p> <p>Recommended solder iron condition (Sn-Pb Solder and Lead Free Solder)</p> <table border="1" data-bbox="544 1626 1378 1731"> <thead> <tr> <th>Temp. (°C)</th> <th>Duration (sec.)</th> <th>Wattage (W)</th> <th>Shape (mm)</th> </tr> </thead> <tbody> <tr> <td>280 max.</td> <td>3 max.</td> <td>20 max.</td> <td>∅ 3.0 max.</td> </tr> </tbody> </table> <p>* Please preheat the chip capacitors with the condition in 5-4 to avoid the thermal shock.</p> <p>2) Direct contact of the soldering iron with ceramic dielectric of chip capacitors may cause crack. Do not touch the ceramic dielectric and the terminations by solder iron.</p>	Soldering	Temp. (°C)	Reflow soldering	$\Delta T \leq 130$	Manual soldering	$\Delta T \leq 130$	Temp. (°C)	Duration (sec.)	Wattage (W)	Shape (mm)	280 max.	3 max.	20 max.	∅ 3.0 max.
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280 max.	3 max.	20 max.	∅ 3.0 max.													

No.	Process	Condition
5	Soldering	<p>5-7. Sn-Zn solder Sn-Zn solder affects product reliability. Please contact TDK in advance when utilize Sn-Zn solder.</p> <p>5-8. Countermeasure for tombstone The misalignment between the mounted positions of the capacitors and the land patterns should be minimized. The tombstone phenomenon may occur especially the capacitors are mounted (in longitudinal direction) in the same direction of the reflow soldering. (Refer to JEITA RCR-2335C Annex A (Informative) Recommendations to prevent the tombstone phenomenon)</p>
6	Cleaning	<p>1) If an unsuitable cleaning fluid is used, flux residue or some foreign articles may stick to chip capacitors surface to deteriorate especially the insulation resistance.</p> <p>2) If cleaning condition is not suitable, it may damage the chip capacitors.</p> <p>2)-1. Insufficient washing</p> <p>(1) Terminal electrodes may corrode by Halogen in the flux.</p> <p>(2) Halogen in the flux may adhere on the surface of capacitors, and lower the insulation resistance.</p> <p>(3) Water soluble flux has higher tendency to have above mentioned problems (1) and (2).</p> <p>2)-2. Excessive washing</p> <p>When ultrasonic cleaning is used, excessively high ultrasonic energy output can affect the connection between the ceramic chip capacitor's body and the terminal electrode. To avoid this, following is the recommended condition.</p> <p style="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>
8	Handling after chip mounted ⚠ Caution	<p>1) Please pay attention not to bend or distort the P.C.board after soldering in handling otherwise the chip capacitors may crack.</p> <div style="text-align: center;">  </div>

No.	Process	Condition															
8	Handling after chip mounted  Caution	<p>2) Printed circuit board cropping should not be carried out by hand, but by using the proper tooling. Printed circuit board cropping should be carried out using a board cropping jig as shown in the following figure or a board cropping apparatus to prevent inducing mechanical stress on the board.</p> <p>(1) Example of a board cropping jig Recommended example: The board should be pushed from the back side, close to the cropping jig so that the board is not bent and the stress applied to the capacitor is compressive. Unrecommended example: If the pushing point is far from the cropping jig and the pushing direction is from the front side of the board, large tensile stress is applied to the capacitor, which may cause cracks.</p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="443 607 730 869"> <p>Outline of jig</p>  </div> <div data-bbox="743 607 1422 869"> <table border="1"> <thead> <tr> <th data-bbox="743 607 1078 663">Recommended</th> <th data-bbox="1078 607 1422 663">Unrecommended</th> </tr> </thead> <tbody> <tr> <td data-bbox="743 663 1078 869">  </td> <td data-bbox="1078 663 1422 869">  </td> </tr> </tbody> </table> </div> </div> <p>(2) Example of a board cropping machine An outline of a printed circuit board cropping machine is shown below. The top and bottom blades are aligned with one another along the lines with the V-grooves on printed circuit board when cropping the board. Unrecommended example: Misalignment of blade position between top and bottom, right and left, or front and rear blades may cause a crack in the capacitor.</p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="580 1133 995 1384"> <p>Outline of machine</p>  </div> <div data-bbox="986 1133 1433 1384"> <p>Principle of operation</p>  </div> </div> <p style="text-align: center;">Cross-section diagram</p> <div style="display: flex; justify-content: center;">  </div> <table border="1" style="width: 100%; text-align: center; border-collapse: collapse;"> <thead> <tr> <th data-bbox="624 1585 804 1675" rowspan="2">Recommended</th> <th colspan="3" data-bbox="804 1585 1334 1630">Unrecommended</th> </tr> <tr> <th data-bbox="804 1630 979 1675">Top-bottom misalignment</th> <th data-bbox="979 1630 1155 1675">Left-right misalignment</th> <th data-bbox="1155 1630 1334 1675">Front-rear misalignment</th> </tr> </thead> <tbody> <tr> <td data-bbox="624 1675 804 2018">  </td> <td data-bbox="804 1675 979 2018">  </td> <td data-bbox="979 1675 1155 2018">  </td> <td data-bbox="1155 1675 1334 2018">  </td> </tr> </tbody> </table>	Recommended	Unrecommended			Recommended	Unrecommended			Top-bottom misalignment	Left-right misalignment	Front-rear misalignment				
Recommended	Unrecommended																
																	
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	Top-bottom misalignment	Left-right misalignment	Front-rear misalignment														
																	

No.	Process	Condition						
8	Handling after chip mounted  Caution	<p data-bbox="472 226 1477 367">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 capacitor or peel the terminations off. Please adjust the check pins not to bend the P.C.board.</p> <table border="1" data-bbox="464 389 1469 734"> <thead> <tr> <th data-bbox="464 389 624 454">Item</th> <th data-bbox="624 389 1043 454">Not recommended</th> <th data-bbox="1043 389 1469 454">Recommended</th> </tr> </thead> <tbody> <tr> <td data-bbox="464 454 624 734">Board bending</td> <td data-bbox="624 454 1043 734">  </td> <td data-bbox="1043 454 1469 734">  </td> </tr> </tbody> </table>	Item	Not recommended	Recommended	Board bending		
Item	Not recommended	Recommended						
Board bending								
9	Handling of loose chip capacitor	<p data-bbox="472 799 1417 904">1) If dropped the chip capacitor may crack. Once dropped do not use it. Especially, the large case sized chip capacitors are tendency to have cracks easily, so please handle with care.</p>  <p data-bbox="472 1240 1469 1308">2) Piling the P.C.board after mounting for storage or handling, the corner of the P.C. board may hit the chip capacitor of another board to cause crack.</p> 						
10	Capacitance aging	<p data-bbox="464 1673 1477 1762">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.</p>						
11	Estimated life and estimated failure rate of capacitors	<p data-bbox="464 1807 1477 2009">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.</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> <p>(1) Environment where a capacitor is splattered with water or oil (2) Environment where a capacitor is exposed to direct sunlight (3) Environment where a capacitor is exposed to Ozone, ultraviolet rays or radiation (4) Environment where a capacitor exposed to corrosive gas(e.g. hydrogen sulfide, sulfur dioxide, chlorine, ammonia gas etc.) (5) Environment where a capacitor exposed to vibration or mechanical shock exceeding the specified limits. (6) Atmosphere change with causes condensation</p>
13	Others  Caution	<p>The products listed on this specification sheet are intended for use in general electronic equipment (AV equipment, telecommunications equipment, home appliances, amusement equipment, computer equipment, personal equipment, office equipment, measurement equipment, industrial robots) under a normal operation and use condition.</p> <p>The products are not designed or warranted to meet the requirements of the applications listed below, whose performance and/or quality require a more stringent level of safety or reliability, or whose failure, malfunction or trouble could cause serious damage to society, person or property. Please understand that we are not responsible for any damage or liability caused by use of the products in any of the applications below or for any other use exceeding the range or conditions set forth in this specification sheet. If you intend to use the products in the applications listed below or if you have special requirements exceeding the range or conditions set forth in this specification, please contact us.</p> <p>(1) Aerospace/Aviation equipment (2) Transportation equipment (cars, electric trains, ships, etc.) (3) Medical equipment (Excepting Pharmaceutical Affairs Law classification Class1,2) (4) Power-generation control equipment (5) Atomic energy-related equipment (6) Seabed equipment (7) Transportation control equipment (8) Public information-processing equipment (9) Military equipment (10) Electric heating apparatus, burning equipment (11) Disaster prevention/crime prevention equipment (12) Safety equipment (13) Other applications that are not considered general-purpose applications</p> <p>When designing your equipment even for general-purpose applications, you are kindly requested to take into consideration securing protection circuit/device or providing backup circuits in your equipment.</p>

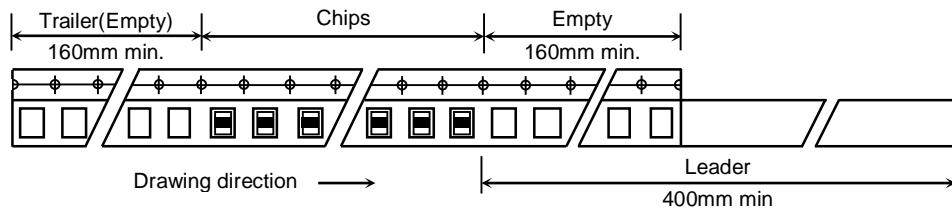
11. TAPE PACKAGING SPECIFICATION

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

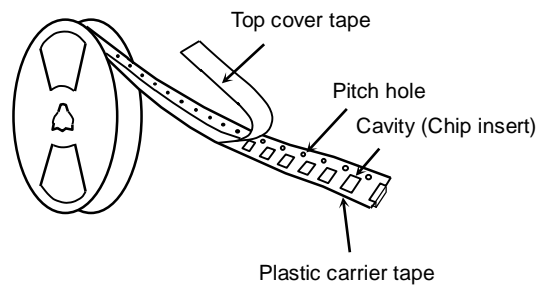


1-3. Dimensions of reel

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



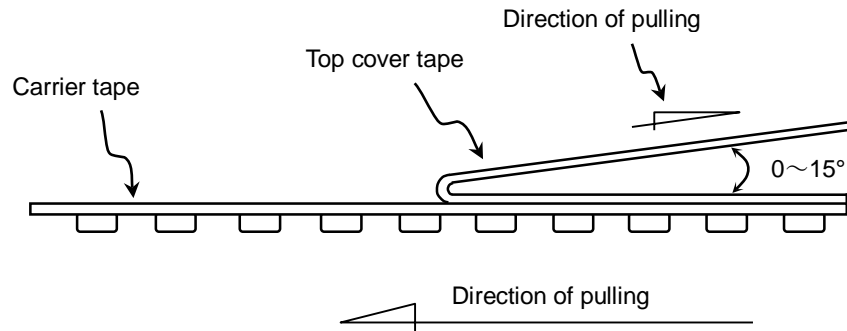
2. CHIP QUANTITY

Please refer to detail page on TDK Web.

3. PERFORMANCE SPECIFICATIONS

3-1. Fixing peeling strength (top tape)

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



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

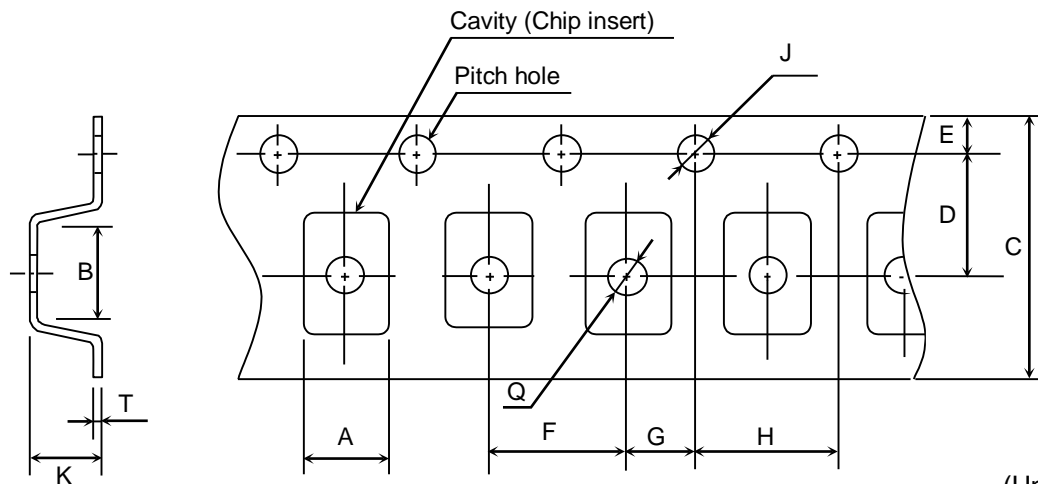
3-3. The missing of components shall be less than 0.1%

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

Plastic Tape



(Unit : mm)

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

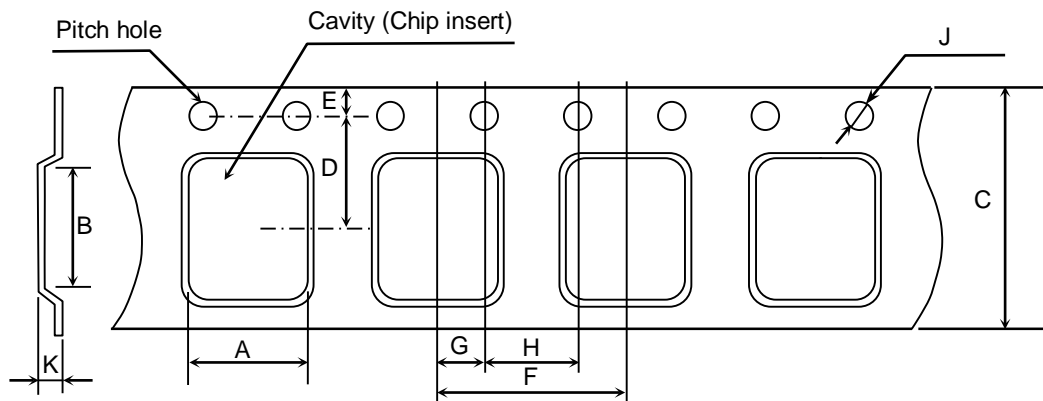
Symbol	G	H	J	K	T	Q
Case size						
CKG32K	2.00 ± 0.10	4.00 ± 0.10	∅ 1.50 ^{+0.10} ₀	3.75 max.	0.50 ± 0.05	∅ 1.65 ± 0.10

() Reference value.

Exceptionally no hole in the cavity is applied. Please inquire if hole in cavity is mandatory.

Appendix 4

Plastic Tape



(Unit : mm)

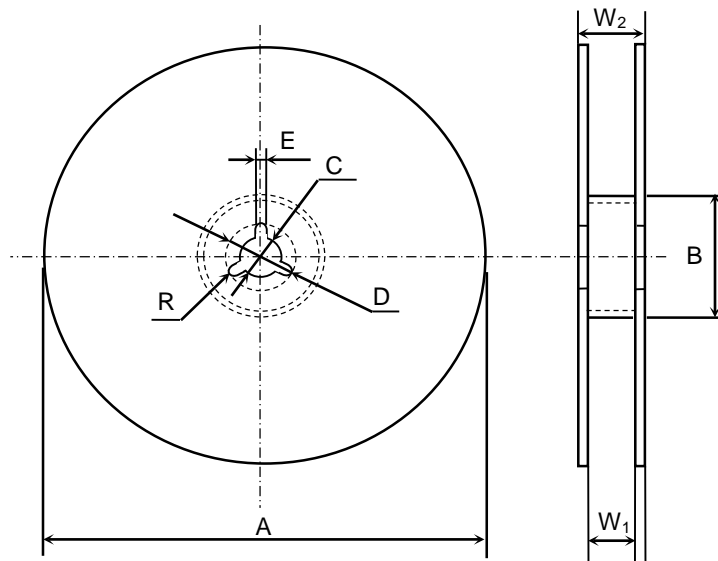
Symbol	A	B	C	D	E	F
Case size						
CKG45K	(3.90)	(5.60)	12.0 ± 0.30	5.50 ± 0.10	1.75 ± 0.10	8.00 ± 0.10
CKG45N						
CKG57K	(5.60)	(6.60)	16.0 ± 0.30	7.50 ± 0.10	1.75 ± 0.10	8.00 ± 0.10
CKG57N						

Symbol	G	H	J	K
Case size				
CKG45K	2.00 ± 0.10	4.00 ± 0.10	∅ 1.50 ^{+0.10} ₀	3.75 max.
CKG45N				6.15 max.
CKG57K	2.00 ± 0.10	4.00 ± 0.10	∅ 1.50 ^{+0.10} ₀	4.15 max.
CKG57N				6.15 max.

() Reference value.

Appendix 5

Dimensions of reel (Material : Polystyrene)



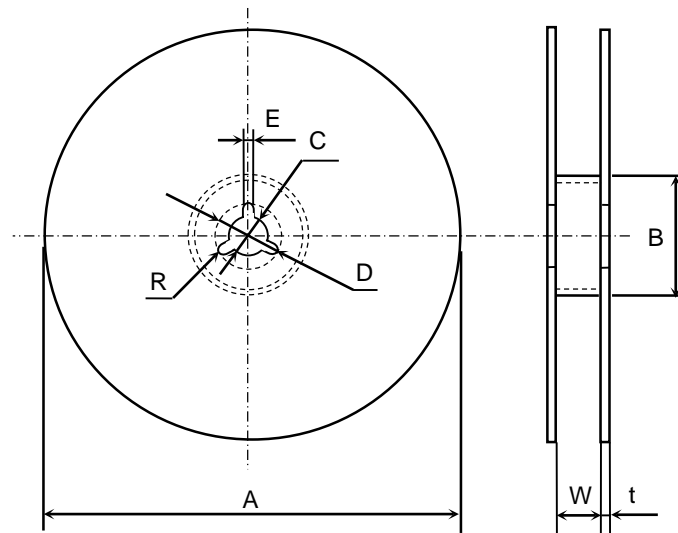
(Unit : mm)

Symbol Case size	A	B	C	D	E	W ₁
CKG32K	$\varnothing 178 \pm 2.0$	$\varnothing 60 \pm 2.0$	$\varnothing 13 \pm 0.5$	$\varnothing 21 \pm 0.8$	2.0 ± 0.5	13.0 ± 0.3

Symbol Case size	W ₂	R
CKG32K	17.0 ± 1.4	1.0

Appendix 6

Dimensions of reel (Material : Polystyrene)



(Unit : mm)

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

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