

DELIVERY SPECIFICATION

SPEC. No. C-MEGA-h

D A T E : Oct., 2023

To

Non-Controlled Copy

CUSTOMER'S PRODUCT NAME

TDK'S PRODUCT NAME

Multilayer Ceramic Chip Capacitors
 Mega Cap Series
 Tape packaging 【RoHS2 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

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-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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<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.

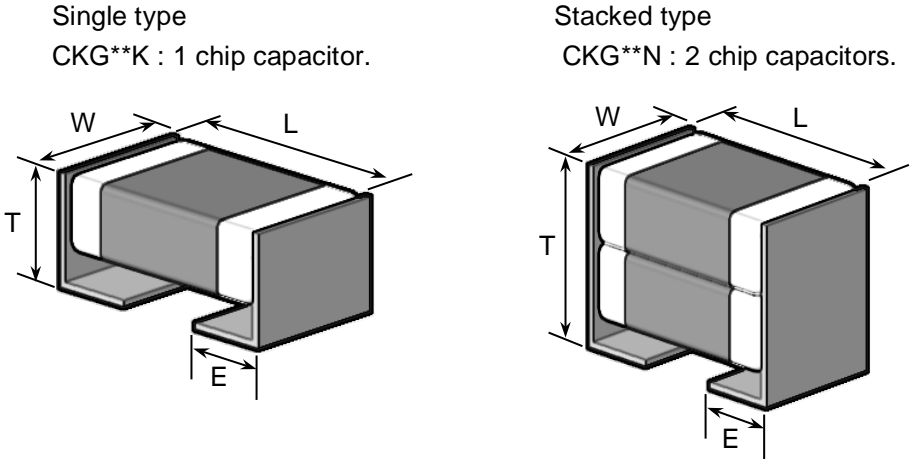
If the use of the capacitors goes beyond the bounds of this specification, we can not afford to guarantee.

Division	Date	SPEC. No.
Ceramic Capacitors Business Group	October, 2023	C-MEGA-h

1. CODE CONSTRUCTION

(Example)	CKG32K	C0G	2A	683	J	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



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	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
683	68,000 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

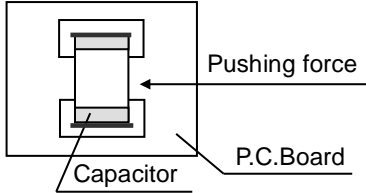
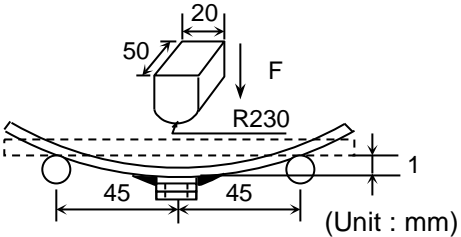
Dispose this product as industrial waste in accordance with the Industrial Waste Law.

5. PERFORMANCE

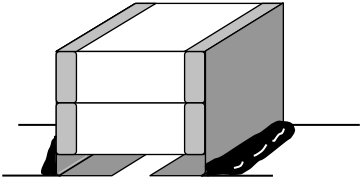
table 1

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="3">1</td> <td>$RV \leq 100V$</td> <td>3 × rated voltage</td> </tr> <tr> <td>$100V < RV < 1kV$</td> <td>1.5 × 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	$100V < RV < 1kV$	1.5 × 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																		
	$100V < RV < 1kV$	1.5 × 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">0.5~5Vrms.</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±0.2Vrms.</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%	0.5~5Vrms.	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																		
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10uF and under	1kHz±10%	1.0±0.2Vrms.																		
Over 10uF	120Hz±20%	0.5±0.2Vrms.																		
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;">COG</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)	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%																								
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.</p> <p>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".</p> <p>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																								
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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.</p> <p>Apply a pushing force gradually at the center of a specimen in a horizontal direction of P.C.board.</p> <p>Pushing force : 5N Holding time : 10±1s</p> 																						
9	Bending External appearance	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>																						

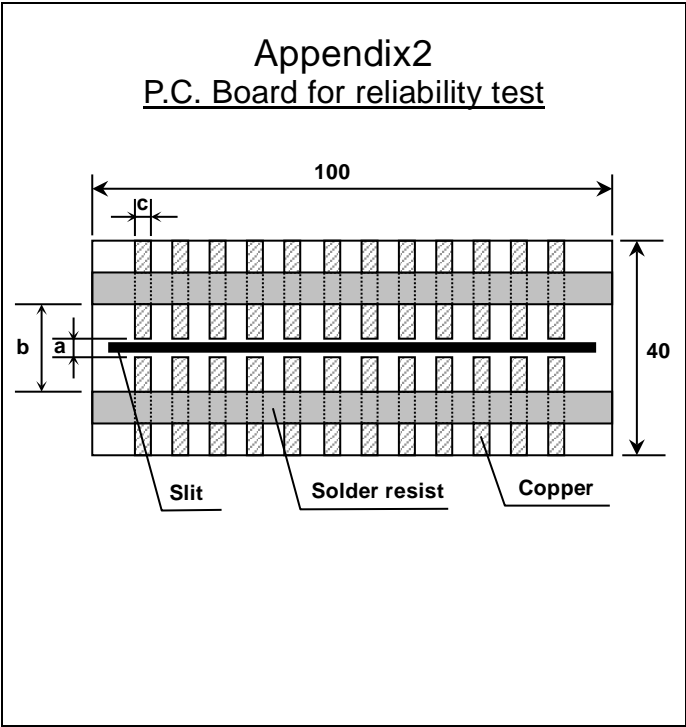
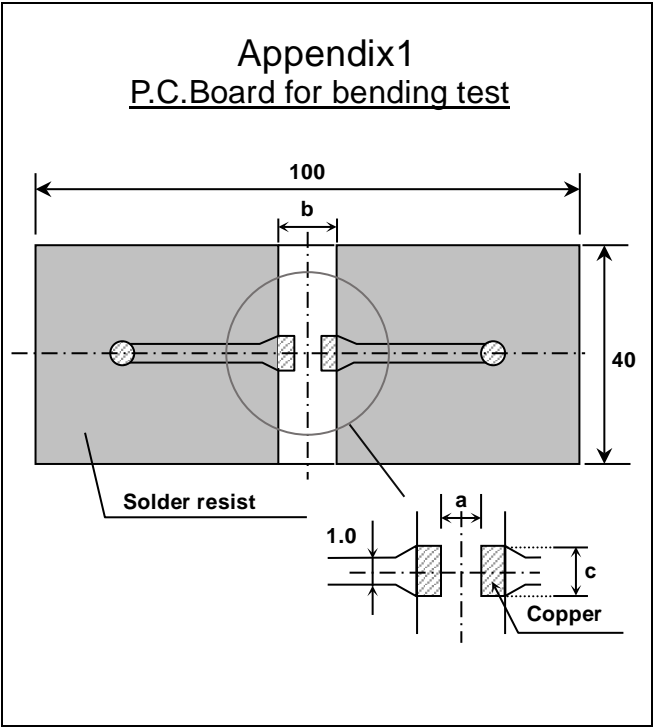
(continued)

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</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>Class2</td> <td>X5R X7R X7S X7T</td> <td>± 7.5 %</td> </tr> </tbody> </table>	Characteristics		Change from the value before test	Class1	C0G	± 2.5 %	Class2	X5R X7R X7S X7T	± 7.5 %						
		Characteristics		Change from the value before test														
		Class1	C0G	± 2.5 %														
Class2	X5R X7R X7S X7T	± 7.5 %																
Q (Class1)	Meet the initial spec.																	
D.F. (Class2)	Meet the initial spec.																	
			<p>Frequency : 10~55~10Hz Reciprocating sweep time : 1 min. Amplitude : 1.5mm Repeat this for 2h each in 3 perpendicular directions(Total 6h).</p> <p>Reflow solder the capacitors on a P.C.Board shown in Appendix2 before testing.</p>															
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.											
		Capacitance	<table border="1"> <thead> <tr> <th colspan="2">Characteristics</th> <th rowspan="2">Change from the value before test</th> </tr> </thead> <tbody> <tr> <td>Class1</td> <td>C0G</td> </tr> <tr> <td rowspan="3">Class2</td> <td>X5R</td> <td rowspan="4">Please contact with our sales representative.</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	Class2	X5R	Please contact with our sales representative.	X7R	X7S	X7T
			Characteristics		Change from the value before test									
			Class1	C0G										
		Class2	X5R	Please contact with our sales representative.										
X7R														
X7S														
X7T														
Q (Class1)	200 min.													
D.F. (Class2)	200% of initial spec. max.													
Insulation Resistance	Please contact with our sales representative.													
14	Life	External appearance	No mechanical damage.											
		Capacitance	<table border="1"> <thead> <tr> <th colspan="2">Characteristics</th> <th rowspan="2">Change from the value before test</th> </tr> </thead> <tbody> <tr> <td>Class1</td> <td>C0G</td> </tr> <tr> <td rowspan="3">Class2</td> <td>X5R</td> <td rowspan="4">Please contact with our sales representative.</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	Class2	X5R	Please contact with our sales representative.	X7R	X7S	X7T
			Characteristics		Change from the value before test									
			Class1	C0G										
		Class2	X5R	Please contact with our sales representative.										
X7R														
X7S														
X7T														
Q (Class1)	350 min.													
D.F. (Class2)	200% of initial spec. max.													
Insulation Resistance	Please contact with our sales representative.													

*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.



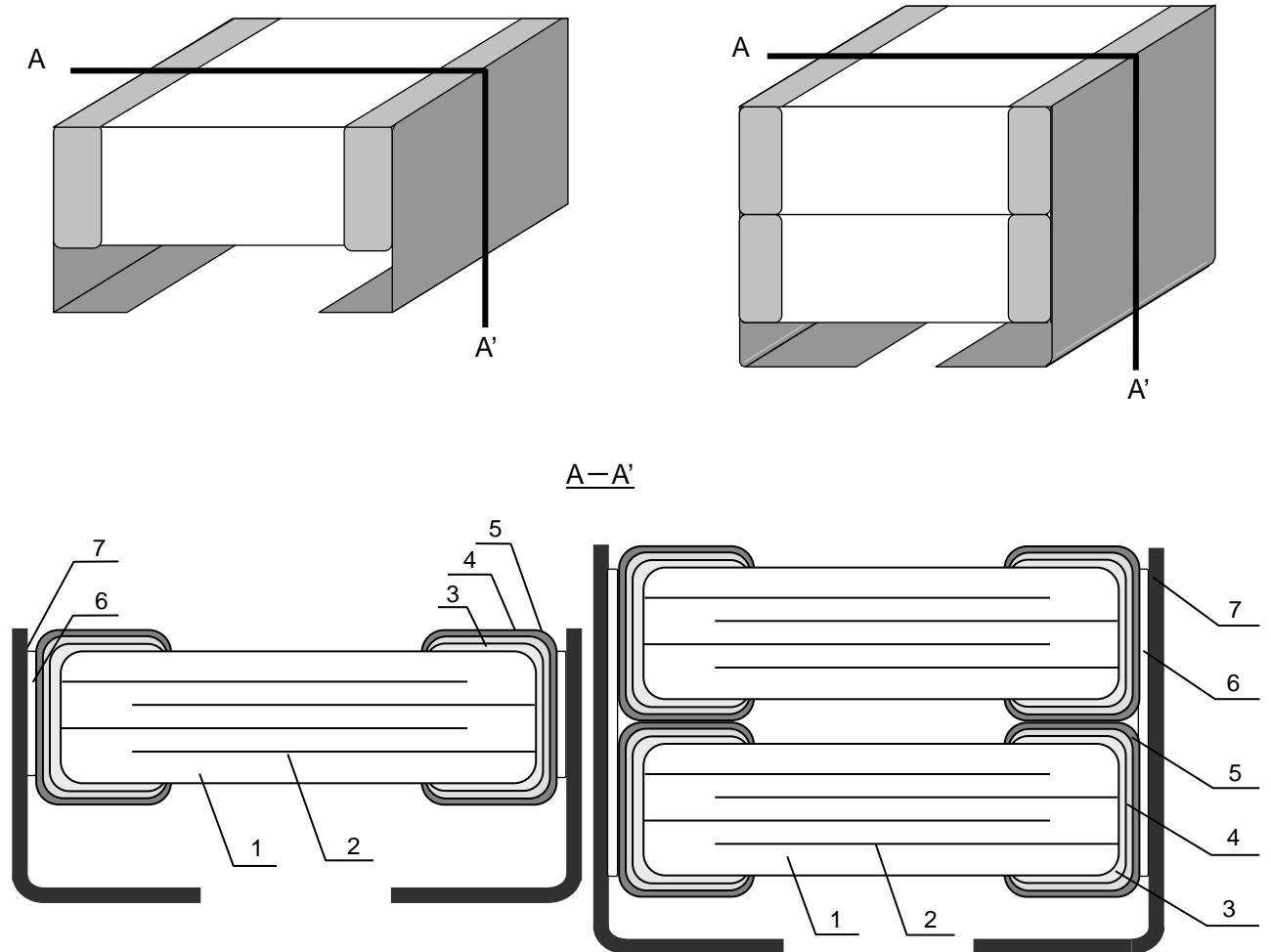
(Unit : mm)

Symbol Case size	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 A 3 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	3	E	2	3	A	0	0	1
(a)	(b)	(c)	(d)	(e)	(f)	(g)			

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

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

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


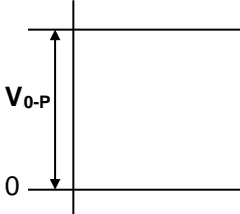
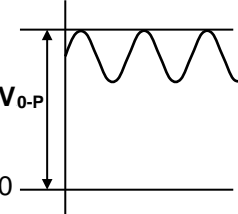
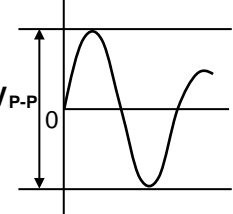
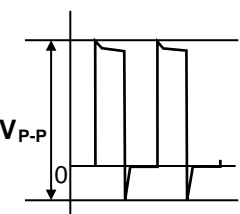
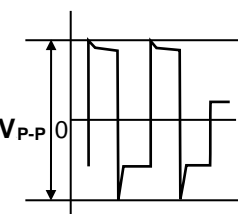
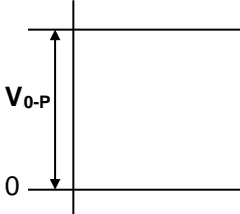
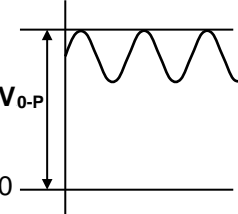
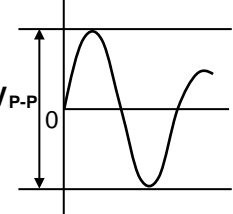
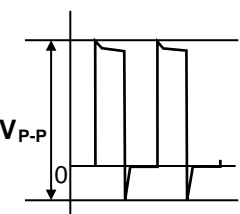
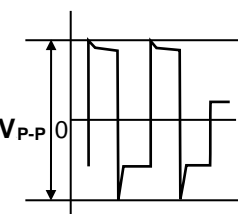
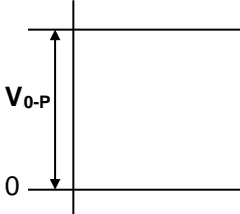
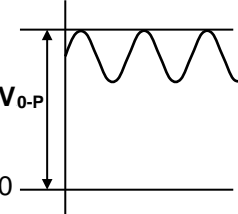
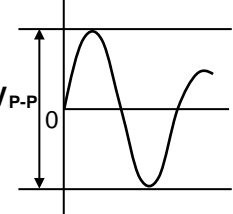
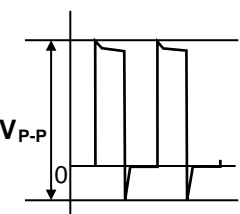
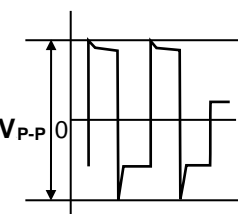
Reflow soldering only.

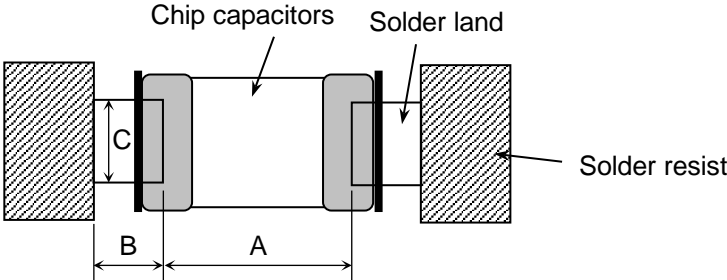
Metal cap is jointed by high temp solder, however the solder temperature must be less than 250°C to avoid melting the solder.

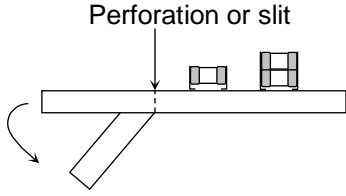
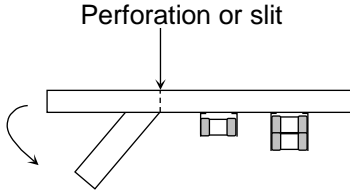
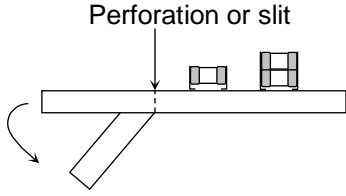
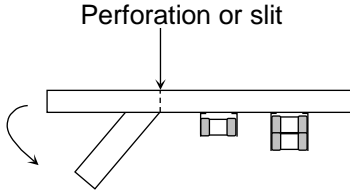
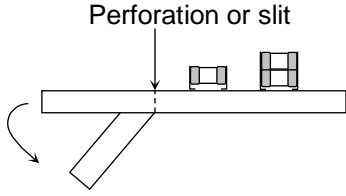
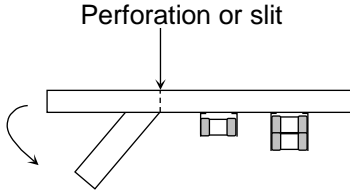
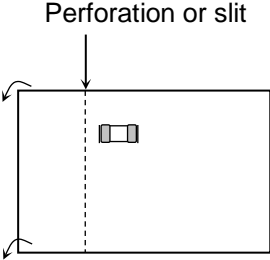
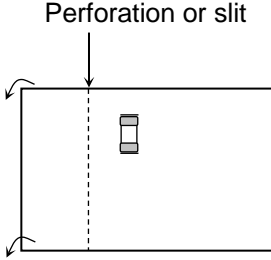
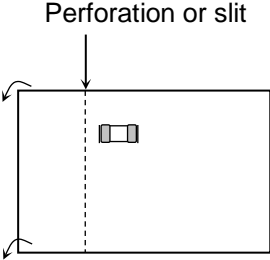
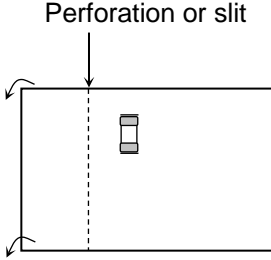
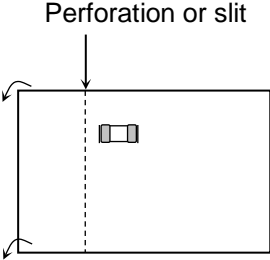
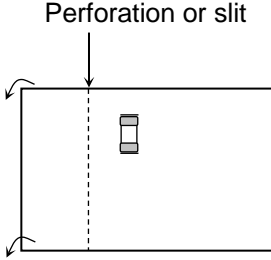
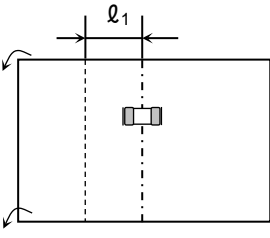
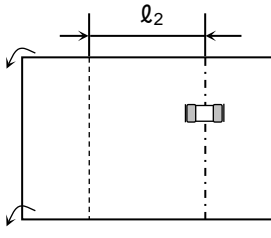
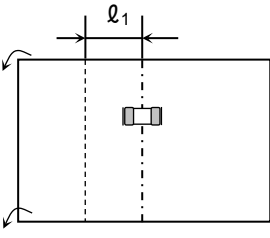
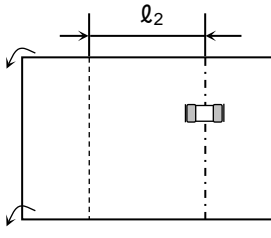
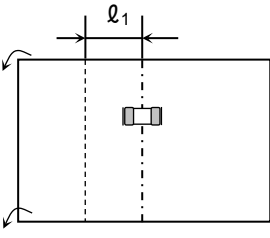
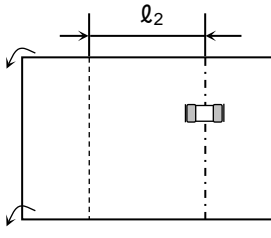
Please refer to No.5 Soldering in 10.CAUTION for recommended soldering condition.

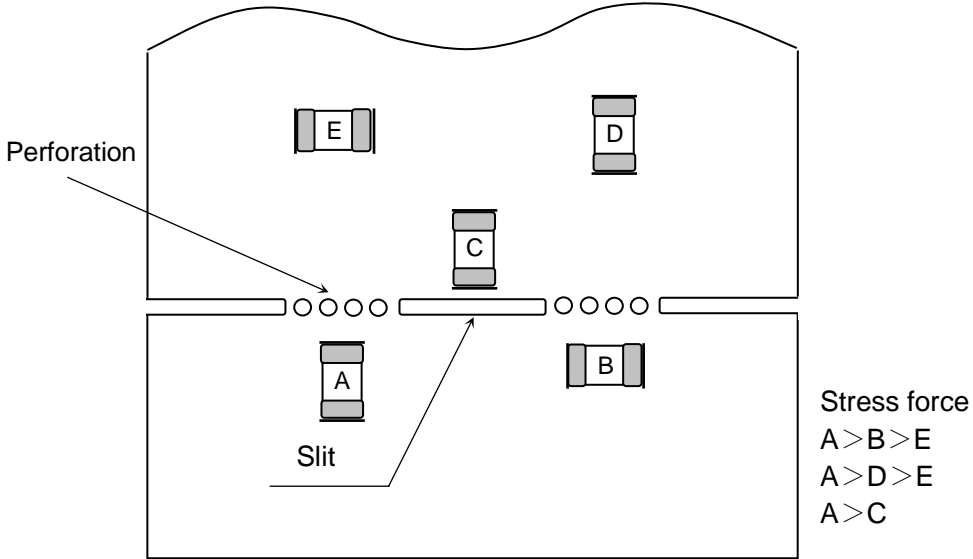
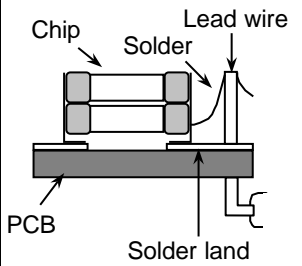
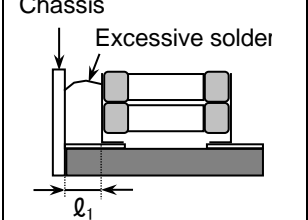
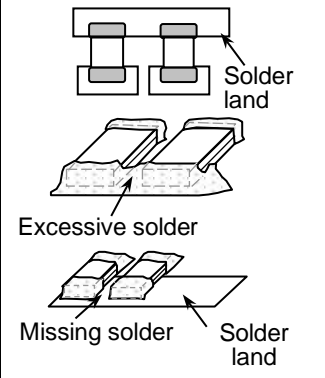
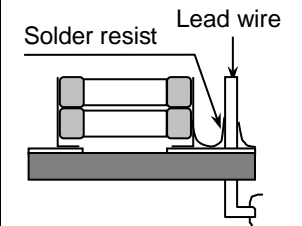
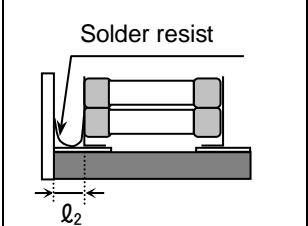
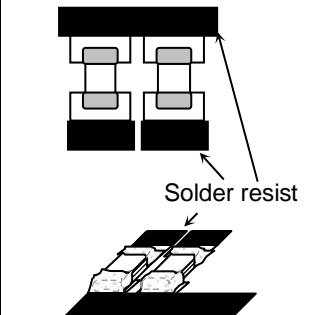
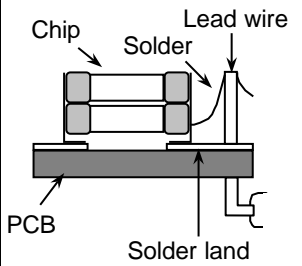
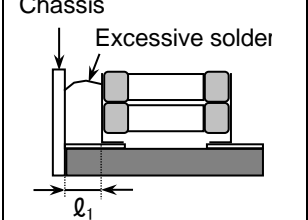
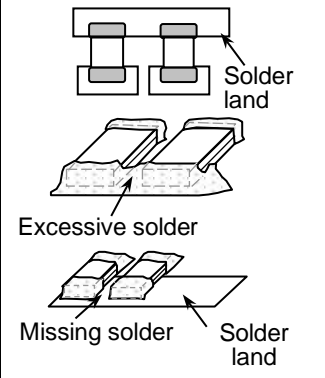
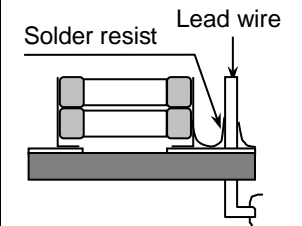
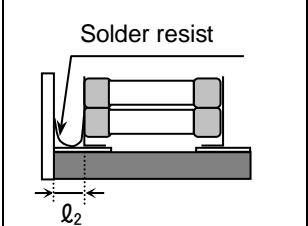
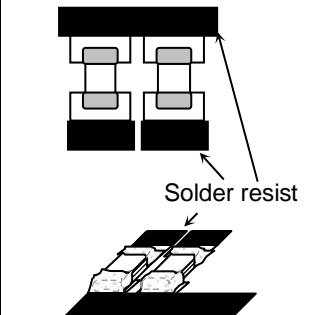
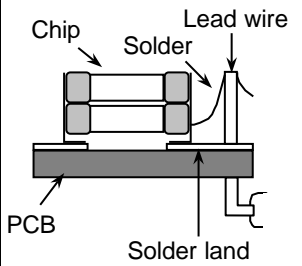
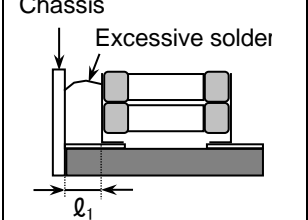
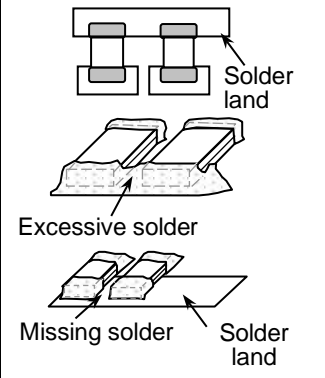
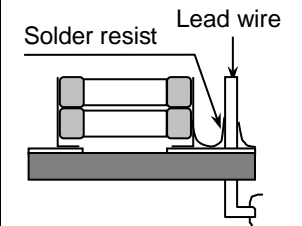
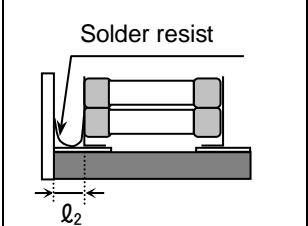
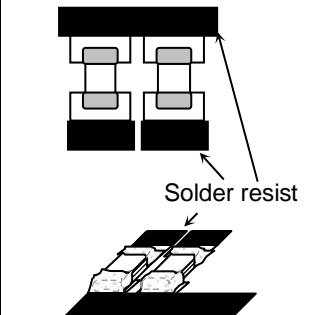
10. CAUTION

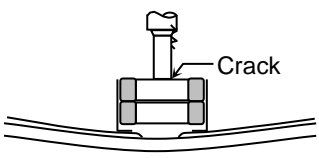
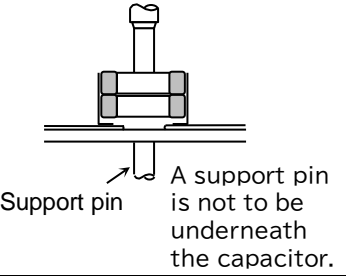
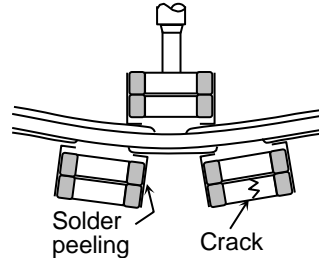
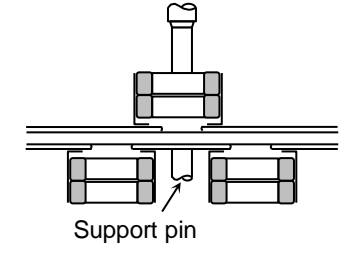
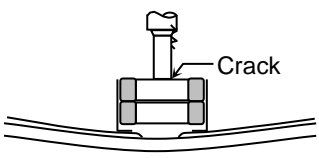
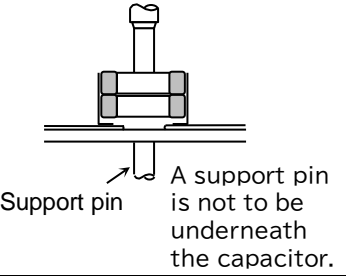
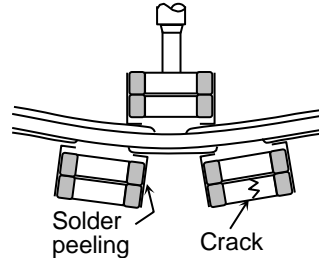
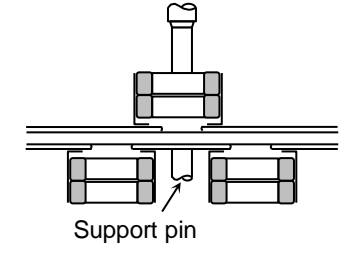
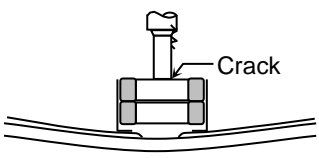
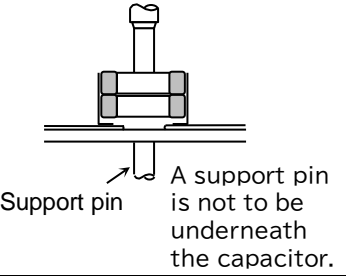
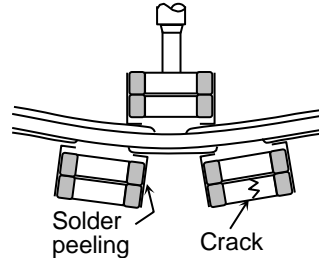
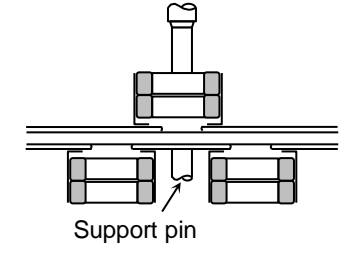
No.	Process	Condition
1	Operating Condition (Storage, Use Transportation)	<p>1-1. Storage, Use The capacitors must be stored in an ambient temperature of 5 to 40°C with a relative humidity of 20 to 70%RH. JIS C 60721-3-1 Class 1K2 should be followed for the other climatic conditions.</p> <p>1) High temperature 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.</p> <p>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.</p> <p>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.)</p> <p>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.</p> <p>5) Refer to JIS C 60721-3-1, class 1K2 for other climate conditions.</p> <p>1-2. Handling in transportation</p> <p>1) In case of the transportation of the capacitors, the performance of the capacitors may be deteriorated depending on the transportation condition. (Refer to JEITA RCR-2335C 9.2 Handling in transportation)</p>
2	Circuit design  Caution	<p>2-1. Operating temperature Operating temperature should be followed strictly within this specification, especially be careful with maximum temperature.</p> <p>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.</p> <p>2) Surface temperature including self heating should be below maximum operating temperature. Due to dielectric loss, capacitors will heat itself when AC is applied due to ESR. Especially at high frequencies, please be careful that the heat might be so extreme. Also, even if the surface temperature of the capacitor includes self-heating and is the maximum operating temperature or lower, excessive heating of the capacitor due to self-heating may cause deterioration of the characteristics and reliability of the capacitor. The self-heating temperature rise of the capacitor changes depending on the difference in heat radiation due to the mounting method to the device, the ambient temperature, the cooling method of the device, etc. The self-heating temperature rise of the capacitor in a natural convection environment at an ambient temperature of 25°C shall be below 20°C. When using in a high-frequency circuit or a circuit in which a capacitor generates heat, such as when a high-frequency ripple current flows, pay attention to the above precautions. (Note that accurate measurement may not be possible with self-heating measurement when the equipment applies cooling other than natural convection such as a cooling fan.)</p> <p>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>

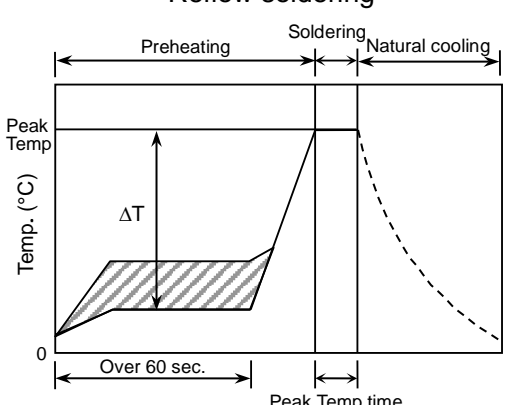
No.	Process	Condition																
2	Circuit design  Caution	<p>2-2. When overvoltage is applied Applying overvoltage to a capacitor may cause dielectric breakdown and result in a short circuit. The duration until dielectric breakdown depends on the applied voltage and the ambient temperature.</p> <p>2-3. Operating voltage</p> <p>1) Operating voltage across the terminals should be below the rated voltage. When AC and DC are super imposed, V_{0-P} must be below the rated voltage. — (1) and (2) AC or pulse with overshooting, V_{P-P} must be below the rated voltage. — (3), (4) and (5) When the voltage is started to apply to the circuit or it is stopped applying, the irregular voltage may be generated for a transit period because of resonance or switching. Be sure to use the capacitors within rated voltage containing these Irregular voltage.</p> <table border="1" data-bbox="496 703 1477 1290"> <thead> <tr> <th data-bbox="496 703 692 741">Voltage</th> <th data-bbox="692 703 954 741">(1) DC voltage</th> <th data-bbox="954 703 1216 741">(2) DC+AC voltage</th> <th data-bbox="1216 703 1477 741">(3) AC voltage</th> </tr> </thead> <tbody> <tr> <td data-bbox="496 741 692 976">Positional Measurement (Rated voltage)</td> <td data-bbox="692 741 954 976">  </td> <td data-bbox="954 741 1216 976">  </td> <td data-bbox="1216 741 1477 976">  </td> </tr> <tr> <th data-bbox="496 1003 692 1041">Voltage</th> <th data-bbox="692 1003 954 1041">(4) Pulse voltage (A)</th> <th data-bbox="954 1003 1216 1041">(5) Pulse voltage (B)</th> <th></th> </tr> <tr> <td data-bbox="496 1041 692 1290">Positional Measurement (Rated voltage)</td> <td data-bbox="692 1041 954 1290">  </td> <td data-bbox="954 1041 1216 1290">  </td> <td></td> </tr> </tbody> </table> <p>2) Even below the rated voltage, if repetitive high frequency AC or pulse is applied, the reliability of the capacitors may be reduced.</p> <p>3) The effective capacitance will vary depending on applied DC and AC voltages. The capacitors should be selected and designed in taking the voltages into consideration.</p> <p>4) Abnormal voltage (surge voltage, static electricity, pulse voltage, etc.) shall not exceed the rated voltage.</p> <p>5) When capacitors are used in a series connection, it is necessary to add a balancing circuit such as voltage dividing resistors in order to avoid an imbalance in the voltage applied to each capacitor.</p> <p>2-4. Frequency When the capacitors (Class 2) are used in AC and/or pulse voltages, the capacitors may vibrate themselves and generate audible sound.</p>	Voltage	(1) DC voltage	(2) DC+AC voltage	(3) AC voltage	Positional Measurement (Rated voltage)				Voltage	(4) Pulse voltage (A)	(5) Pulse voltage (B)		Positional Measurement (Rated voltage)			
Voltage	(1) DC voltage	(2) DC+AC voltage	(3) AC voltage															
Positional Measurement (Rated voltage)																		
Voltage	(4) Pulse voltage (A)	(5) Pulse voltage (B)																
Positional Measurement (Rated voltage)																		

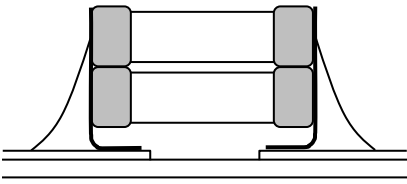
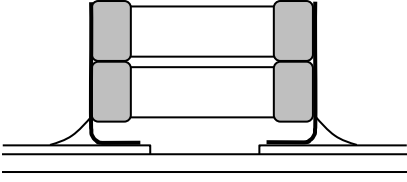
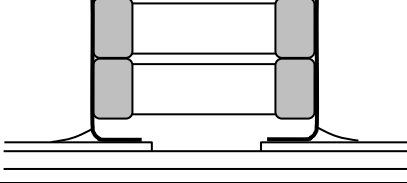
No.	Process	Condition																														
3	Designing P.C.board	<p>The amount of solder at the terminations has a direct effect on the reliability of the capacitor.</p> <ol style="list-style-type: none"> 1) The greater the amount of solder, the higher the stress on the chip capacitor, and the 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 style="text-align: center;">  </div> <p>Reflow soldering</p> <p style="text-align: right;">(Unit : mm)</p> <table border="1" data-bbox="560 1025 1437 1301"> <thead> <tr> <th>Case size</th> <th>CKG32K</th> <th>CKG45K</th> <th>CKG57K</th> <th>CKG45N</th> <th>CKG57N</th> </tr> </thead> <tbody> <tr> <td>Symbol</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>A</td> <td>2.0 ~ 2.2</td> <td>3.3 ~ 3.7</td> <td>3.9 ~ 4.3</td> <td>3.3 ~ 3.7</td> <td>3.9 ~ 4.3</td> </tr> <tr> <td>B</td> <td>1.1 ~ 1.3</td> <td>1.2 ~ 1.5</td> <td>1.5 ~ 2.0</td> <td>1.2 ~ 1.5</td> <td>1.5 ~ 2.0</td> </tr> <tr> <td>C</td> <td>2.3 ~ 2.5</td> <td>2.7 ~ 3.2</td> <td>4.5 ~ 5.0</td> <td>2.7 ~ 3.2</td> <td>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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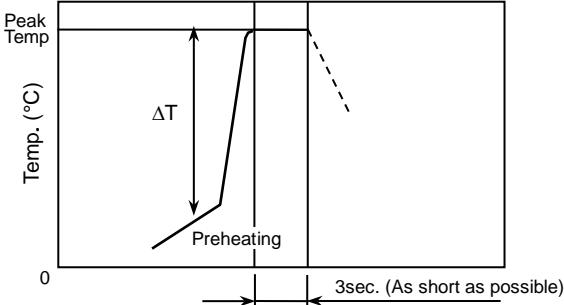
No.	Process	Condition			
3	Designing P.C.board	4) Recommended chip capacitor layout is as following.			
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 30%;"></th> <th style="width: 35%;">Disadvantage against bending stress</th> <th style="width: 35%;">Advantage against bending stress</th> </tr> </thead> </table>				Disadvantage against bending stress	Advantage against bending stress
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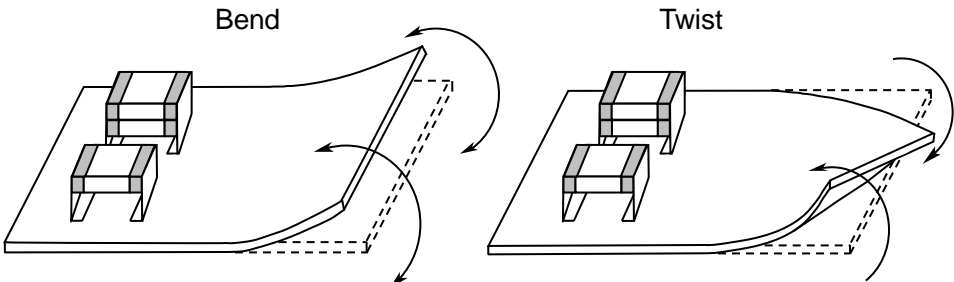
No.	Process	Condition												
3	Designing P.C.board	<p>5) Mechanical stress varies according to location of chip capacitors on the P.C.board.</p>  <p>When dividing printed wiring boards, the intensities of mechanical stress applied to capacitors are different according to each dividing method in 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="405 1099 1481 2047"> <thead> <tr> <th data-bbox="405 1099 544 1211">Example</th> <th data-bbox="544 1099 847 1211">Use of common solder land</th> <th data-bbox="847 1099 1155 1211">Soldering with chassis</th> <th data-bbox="1155 1099 1481 1211">Use of common solder land with other SMD</th> </tr> </thead> <tbody> <tr> <td data-bbox="405 1211 544 1632">Need to avoid</td> <td data-bbox="544 1211 847 1632">  </td> <td data-bbox="847 1211 1155 1632">  </td> <td data-bbox="1155 1211 1481 1632">  </td> </tr> <tr> <td data-bbox="405 1632 544 2047">Recommendation</td> <td data-bbox="544 1632 847 2047">  </td> <td data-bbox="847 1632 1155 2047">  <p>$l_2 > l_1$</p> </td> <td data-bbox="1155 1632 1481 2047">  </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		 <p>$l_2 > l_1$</p>	
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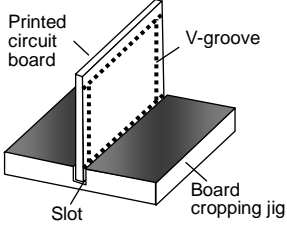
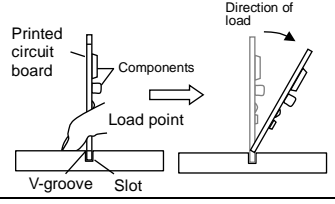
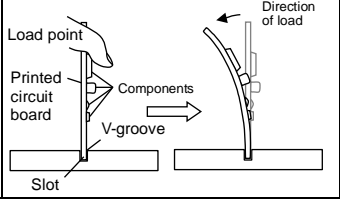
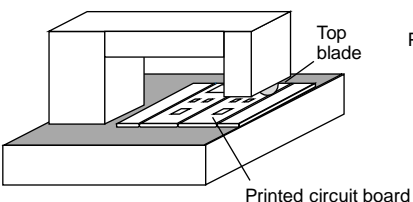
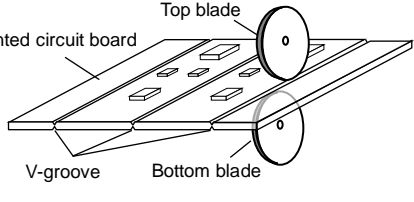
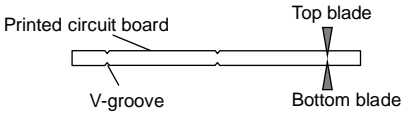
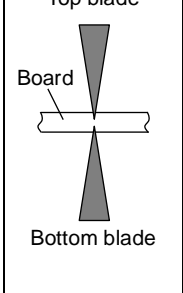
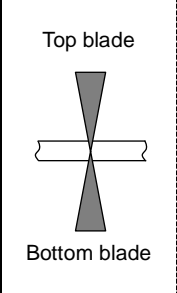
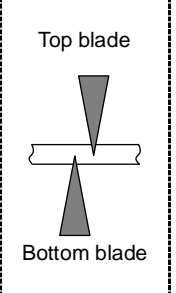
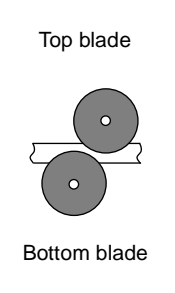
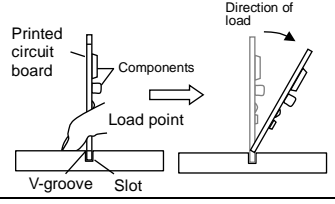
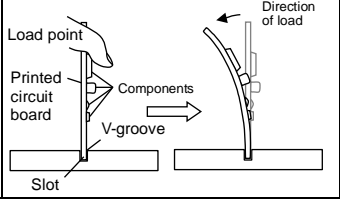
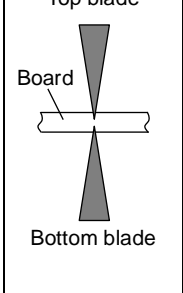
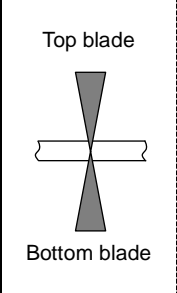
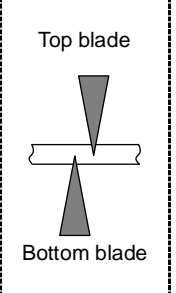
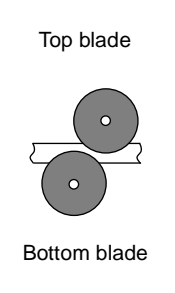
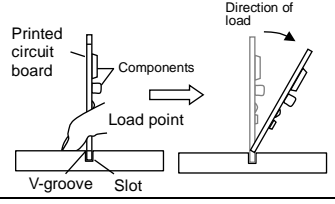
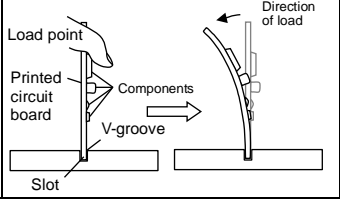
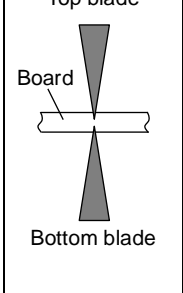
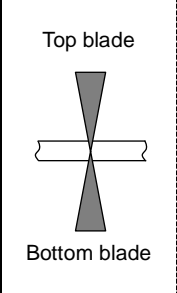
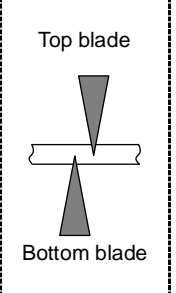
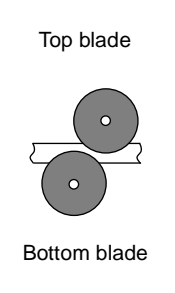
No.	Process	Condition									
4	Mounting	<p>4-1. Stress from mounting head If the mounting head is adjusted too low, it may induce excessive stress in the chip capacitor to result in cracking. Please take following precautions.</p> <ol style="list-style-type: none"> 1) Adjust the bottom dead center 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="485 600 1437 1238"> <thead> <tr> <th data-bbox="485 600 687 651"></th> <th data-bbox="687 600 1059 651">Not recommended</th> <th data-bbox="1059 600 1437 651">Recommended</th> </tr> </thead> <tbody> <tr> <td data-bbox="485 651 687 952">Single-sided mounting</td> <td data-bbox="687 651 1059 952">  </td> <td data-bbox="1059 651 1437 952">  </td> </tr> <tr> <td data-bbox="485 952 687 1238">Double-sides mounting</td> <td data-bbox="687 952 1059 1238">  </td> <td data-bbox="1059 952 1437 1238">  </td> </tr> </tbody> </table> <p>When the centering jaw is worn out, it may give mechanical impact on the capacitor to cause crack. Please control the close up dimension of the centering jaw and provide sufficient preventive maintenance and replacement of it.</p>		Not recommended	Recommended	Single-sided mounting			Double-sides mounting		
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
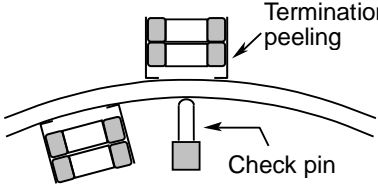
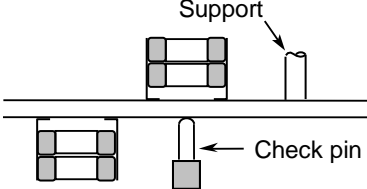
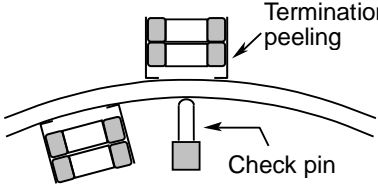
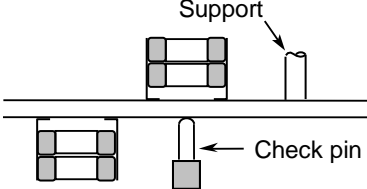
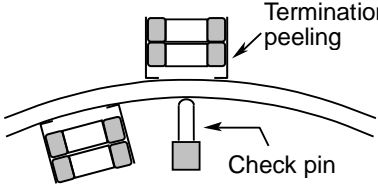
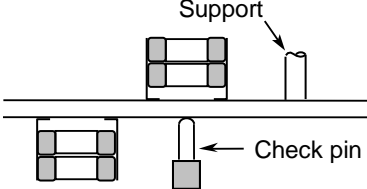
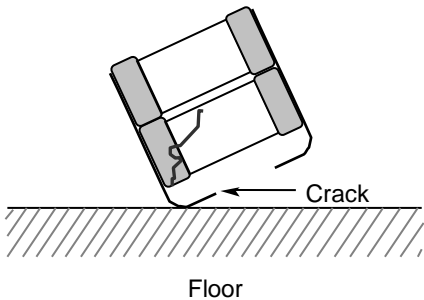
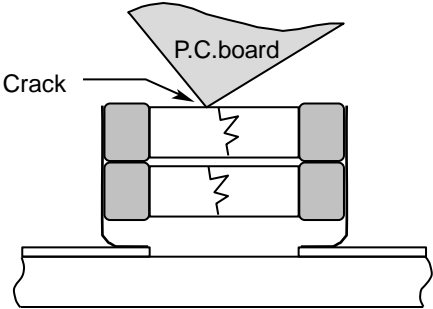
No.	Process	Condition															
5	Soldering	<p>5-1. Flux selection</p> <p>Flux can seriously affect the performance of capacitors. Confirm the following to select the appropriate flux.</p> <ol style="list-style-type: none"> 1) It is recommended to use a mildly activated rosin flux (less than 0.1wt% 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> <p style="text-align: center;">Reflow soldering</p>  <p>5-4. Recommended soldering peak temp and peak temp duration</p> <table border="1" data-bbox="494 1344 1197 1534"> <thead> <tr> <th rowspan="2" style="text-align: center;">Temp./Duration</th> <th colspan="2" style="text-align: center;">Reflow soldering</th> </tr> <tr> <th style="text-align: center;">Peak temp(°C)</th> <th style="text-align: center;">Duration(sec.)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Sn-Pb Solder</td> <td style="text-align: center;">230 max.</td> <td style="text-align: center;">20 max.</td> </tr> <tr> <td style="text-align: center;">Lead Free Solder</td> <td style="text-align: center;">250 max.</td> <td style="text-align: center;">10 max.</td> </tr> </tbody> </table> <p style="margin-left: 40px;">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="526 1747 1053 1836" style="margin-left: 40px;"> <thead> <tr> <th style="text-align: center;">Soldering</th> <th style="text-align: center;">Temp. (°C)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Reflow soldering</td> <td style="text-align: center;">$\Delta T \leq 130$</td> </tr> </tbody> </table> 2) Cooling condition Natural cooling using air is recommended. If the chips are dipped into a solvent for cleaning, the temperature difference (ΔT) must be less than 100°C. 	Temp./Duration	Reflow soldering		Peak temp(°C)	Duration(sec.)	Sn-Pb Solder	230 max.	20 max.	Lead Free Solder	250 max.	10 max.	Soldering	Temp. (°C)	Reflow soldering	$\Delta T \leq 130$
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No.	Process	Condition
5	Soldering	<p data-bbox="438 197 1469 315">5-6. 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> <hr/> <div data-bbox="501 344 1436 526"> <p data-bbox="501 398 624 454">Excessive solder</p>  <p data-bbox="1114 398 1433 454">Higher tensile force in chip capacitor to cause crack</p> </div> <hr/> <div data-bbox="501 555 1091 736"> <p data-bbox="501 622 624 656">Adequate</p>  </div> <hr/> <div data-bbox="501 766 1406 947"> <p data-bbox="501 819 624 875">Insufficient solder</p>  <p data-bbox="1114 792 1406 898">Low robustness may cause contact failure or chip capacitor comes off the P.C.board.</p> </div> <hr/> <p data-bbox="438 999 1161 1093">5-7. Sn-Zn solder Sn-Zn solder affects product reliability. Please contact TDK in advance when utilize Sn-Zn solder.</p> <p data-bbox="438 1128 1437 1346">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>

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 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> <div style="text-align: center;"> <p>Manual soldering (Solder iron)</p>  </div> <table border="1" style="margin-left: auto; margin-right: auto;"> <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="text-align: center;">Temp. (°C)</th> <th style="text-align: center;">Duration (sec.)</th> <th style="text-align: center;">Wattage (W)</th> <th style="text-align: center;">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;">ø3.0 max.</td> </tr> </tbody> </table> <p>* Please preheat the chip capacitors with the condition in 6-2 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>3) It is not recommended to reuse dismantled capacitors.</p> <p>6-2. Avoiding thermal shock</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2" style="text-align: center;">Preheating condition</th> </tr> <tr> <th style="text-align: center;">Soldering</th> <th style="text-align: center;">Temp. (°C)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">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.	ø3.0 max.	Preheating condition		Soldering	Temp. (°C)	Manual soldering	$\Delta T \leq 130$
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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="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>
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="text-align: center;">  </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="443 611 730 869"> <p>Outline of jig</p>  </div> <div data-bbox="746 611 1423 869"> <table border="1"> <thead> <tr> <th data-bbox="746 611 1082 667">Recommended</th> <th data-bbox="1082 611 1423 667">Unrecommended</th> </tr> </thead> <tbody> <tr> <td data-bbox="746 667 1082 869">  </td> <td data-bbox="1082 667 1423 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="582 1131 997 1377"> <p>Outline of machine</p>  </div> <div data-bbox="1021 1131 1436 1377"> <p>Principle of operation</p>  </div> </div> <div style="display: flex; justify-content: center; margin-top: 10px;"> <div data-bbox="981 1400 1388 1556"> <p>Cross-section diagram</p>  </div> </div> <table border="1" style="width: 100%; text-align: center; margin-top: 10px;"> <thead> <tr> <th data-bbox="622 1585 805 1675" rowspan="2">Recommended</th> <th colspan="3" data-bbox="805 1585 1332 1641">Unrecommended</th> </tr> <tr> <th data-bbox="805 1641 981 1720">Top-bottom misalignment</th> <th data-bbox="981 1641 1157 1720">Left-right misalignment</th> <th data-bbox="1157 1641 1332 1720">Front-rear misalignment</th> </tr> </thead> <tbody> <tr> <td data-bbox="622 1720 805 2011">  </td> <td data-bbox="805 1720 981 2011">  </td> <td data-bbox="981 1720 1157 2011">  </td> <td data-bbox="1157 1720 1332 2011">  </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						
10	Handling after chip mounted  Caution	<p data-bbox="472 226 1469 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 1461 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 1461 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 1461 734">  </td> </tr> </tbody> </table>	Item	Not recommended	Recommended	Board bending		
Item	Not recommended	Recommended						
Board bending								
11	Handling of loose chip capacitor	<p data-bbox="472 797 1469 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> 						
12	Capacitance aging	<p data-bbox="464 1673 1469 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>						
13	Estimated life and estimated failure rate of capacitors	<p data-bbox="464 1807 1469 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
14	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>
15	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>

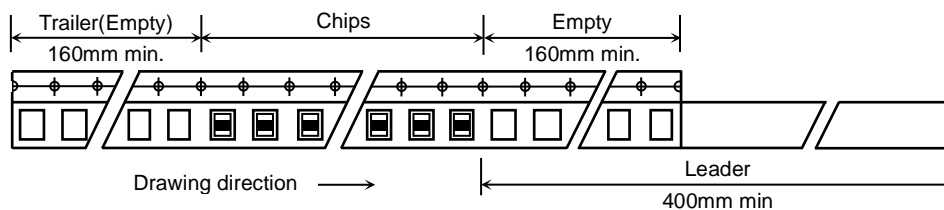
11. TAPE PACKAGING SPECIFICATION

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

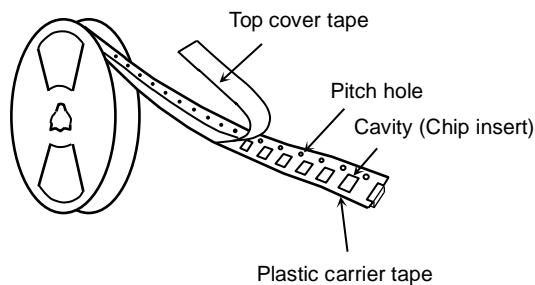


1-3. Dimensions of reel

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



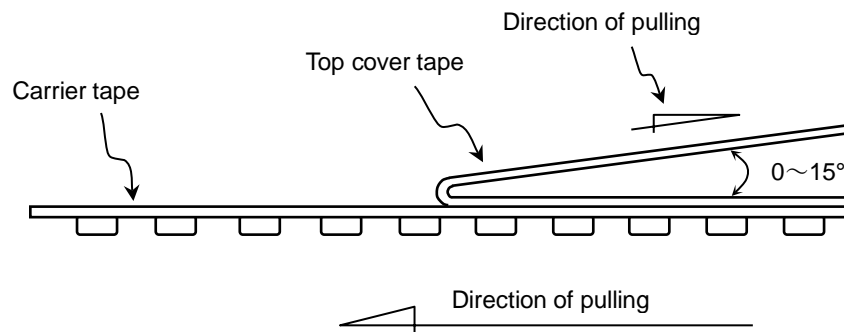
2. CHIP QUANTITY

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.

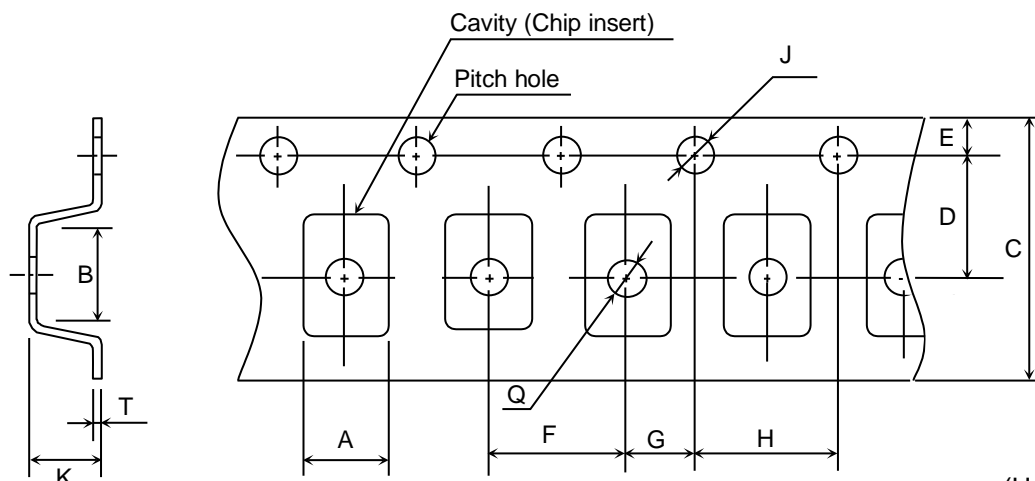
3-3. The missing of components shall be less than 0.1%

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

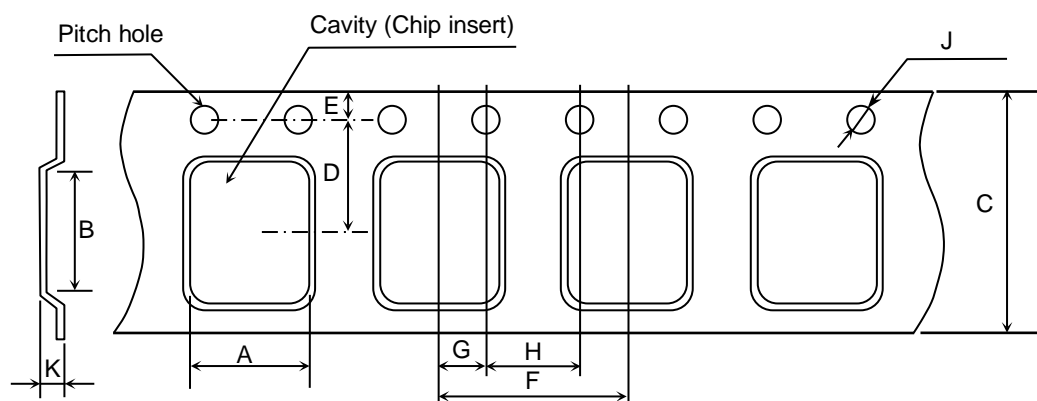
Symbol	G	H	J	K	T	Q
Case size						
CKG32K	2.00 ± 0.10	4.00 ± 0.10	$\varnothing 1.50 \begin{smallmatrix} +0.10 \\ 0 \end{smallmatrix}$	3.75 max.	0.50 ± 0.05	$\varnothing 1.65 \pm 0.10$

() Reference value.

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

Appendix 4

Plastic Tape



(Unit : mm)

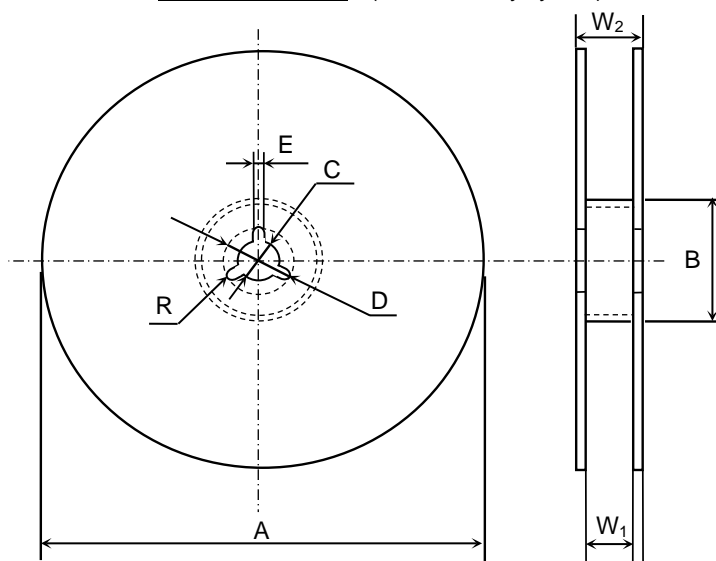
Symbol	A	B	C	D	E	F
Case size						
CKG45K	(3.90)	(5.60)	12.0 ± 0.30	5.50 ± 0.10	1.75 ± 0.10	8.00 ± 0.10
CKG45N						
CKG57K	(5.60)	(6.60)	16.0 ± 0.30	7.50 ± 0.10	1.75 ± 0.10	8.00 ± 0.10
CKG57N						

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)



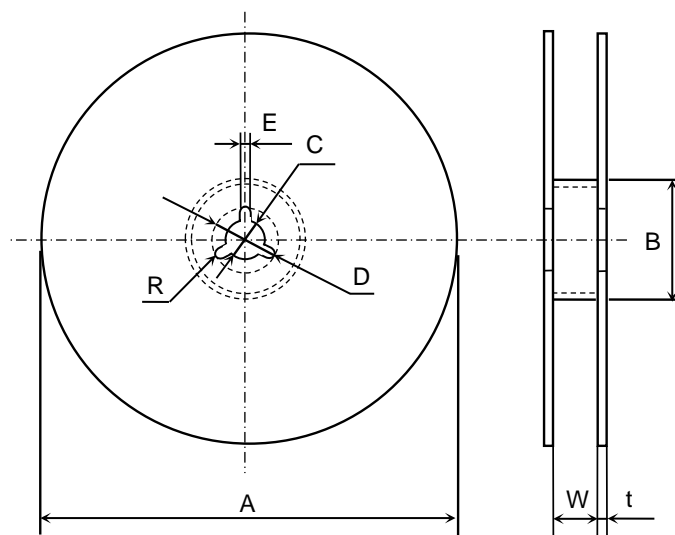
(Unit : mm)

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	$\varnothing 382$ max. (Nominal $\varnothing 330$)	$\varnothing 50$ 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		