GRACE

SPECIFICATION

ROHS Compliant Parts

Customer : _____

Part Name : Chip Varistors

Part Number : KRMV-S Series

Dongguan GRACE electronic Technology Co., LTD

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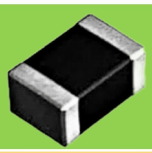
Multilayer chip varistors — KRMV - S series

For ESD protection - Low Capacitance



Features

- Low capacitance, can be used for high-speed transmission lines
- Operating temperature from -55 °C to 125°C
- Excellent clamping ratio and quick response time(<1ns)
- 100% Pb free, RoHS

Applications

- ESD protection for components sensitive
- Normal capacitance product applications for I/O Port such as RS232, USB, PS2, VGA, Audio on Mother Board and Notebook, Set-Top Box, MP3 Players, DVD Players, and Docking System etc.

Explanation of Part Numbers

KRMV	0402	S	D	180	C1R0	N	X	XXXX	T
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩

①	Series
	GRACE Multilayer Chip Varistors

②	Chip size (EIA)
	0402

③	Series code
S	Low Capacitance

④	Type of voltage
D	DC working voltage

⑤	Voltage values
180	18V

⑥	Typical Capacitance @1KHZ
C1R0	1.0pF

⑦	Tolerance of Capacitance
N	±30%

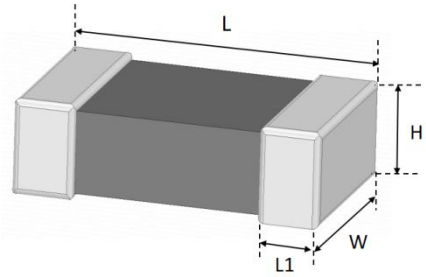
⑧	internal code
	X

⑨	Customer identification code
	XXXX

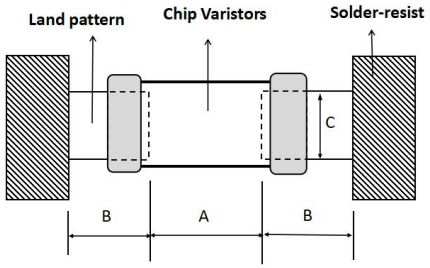
⑩	Packaging style
T	Tape

Shape and Dimensions

1）Dimensions：



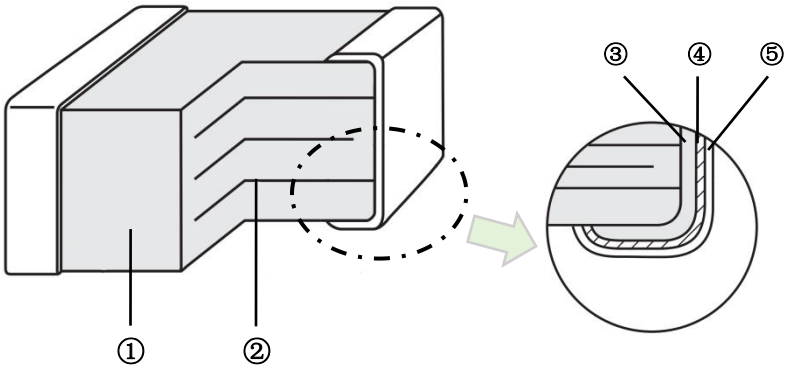
2）Recommended PCB pattern for reflow soldering:



Unit: mm

Size （EIA/JIS)	L	W	H	L1	A	B	C
0201/0603	0.60±0.03	0.30±0.03	0.30±0.05	0.15±0.05	0.20~0.30	0.20~0.30	0.30~0.35
0402/1005	1.00±0.05	0.50±0.05	0.50±0.05	0.30±0.10	0.45~0.55	0.40~0.50	0.45~0.55
0603/1608	1.60±0.20	0.80±0.20	0.80±0.20	0.30±0.20	0.60~0.80	0.60~0.80	0.60~0.80

Structure and Materials



No.	Name	
①	Semiconductive Ceramics	
②	Internal electrode	
③	Terminal electrode	Ag
④		Ni
⑤		Sn

Electrical Characteristics

0201-0603 Type

Part Number	Max.Working voltage		Breakdown voltage		Clamping voltage	Transient energy	Peak current	capacitance
Test Condition	AC	DC	@1mA DC		8/20 μs @1A	10/1000 μs	8/20 μs	@ 1MHz
Units	V_{RMS}	V_{DC}	V_B		V_c	E_T	I_p	C
Symbol	Volts	Volts	Volts		Volts	Joules	Amps	pF
KRMV0201SD5R0C150□□□T	3.3	5.0	8	±20%	15	0.01	5	15
KRMV0201SD5R0C330□□□T	3.3	5.0	8	±20%	15	0.01	5	33
KRMV0201SD5R5C150□□□T	4	5.5	12	±20%	20	0.01	5	15
KRMV0201SD5R5C330□□□T	4	5.5	12	±20%	20	0.01	5	33
KRMV0201SD5R5C500□□□T	4	5.5	12	±20%	20	0.01	5	50
KRMV0201SD5R5C101□□□T	4	5.5	12	±20%	20	0.01	5	100
KRMV0201SD180C150□□□T	12.8	18	27	±10%	50	0.01	5	15
KRMV0201SD180C5R0□□□T	12.8	18	30	±10%	50	0.01	5	5

KRMV0201SD240C2R5□□□T	17.1	24	120	±20%	200	0.01	3	2.5
KRMV0402SD5R5C330□□□T	4	5.5	12	±10%	20	0.02	10	33
KRMV0402SD5R5C500□□□T	4	5.5	12	±10%	20	0.02	10	50
KRMV0402SD5R5C800□□□T	4	5.5	12	±10%	20	0.02	10	80
KRMV0402SD5R5C101□□□T	4	5.5	12	±10%	20	0.02	10	100
KRMV0402SD120C100□□□T	8.5	12	14	±10%	55	0.05	10	10
KRMV0402SD140C500□□□T	10	14	18	±10%	55	0.05	10	50
KRMV0402SD180C150□□□T	12.8	18	27	±10%	55	0.05	10	15
KRMV0402SD240C2R5□□□T	17.1	24	100	±20%	198	0.05	10	2.5
KRMV0603SD5R0C500□□□T	3.3	5	12	±10%	18	0.20	10	50
KRMV0603SD180C100□□□T	12.8	18	27	±10%	50	0.20	10	10
KRMV0603SD240C2R5□□□T	17.1	24	100	±20%	198	0.20	10	2.5
KRMV0402SD180C1R0□□□T	12.8	18	80	±20%	240	0.01	/	1
KRMV0402SD240C0R5□□□T	17.1	24	130	±30V	300	0.01	/	0.5
KRMV0603SD180C1R0□□□T	12.8	18	80	±20%	240	0.01	/	1
KRMV0603SD240C0R5□□□T	17.1	24	130	±30V	300	0.01	/	0.5

※ Notes:

a. The breakdown voltage was measured at 1mA.

b. The clamping voltage was measured at 1A by 8/20μs Pulse or ESD wave form.

c. The peak current was tested at 8/20 μ s wave form.

d. The Surge Energy was Test at 10/1000 μ s wave form.

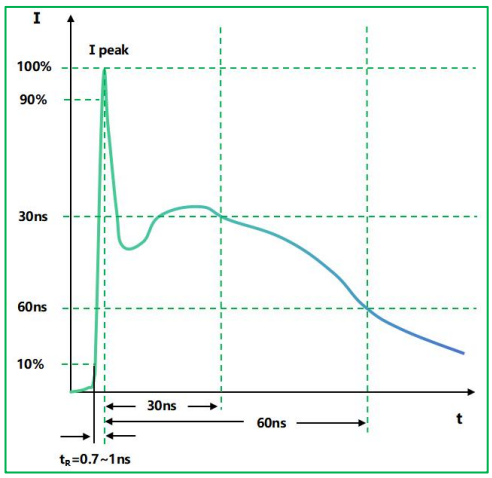
e. The capacitance value was measured at f= 1MHz, VRMS= 0.5V.

f. The maximum peak current within the Breakdown voltage change of ±10% with the standard impulse current (8/20 μ s) applied one time.

g. The maximum Surge Energy within the varistor voltage change of ±10% when one impulse of 10/1000 μ s is applied.

Wave Form

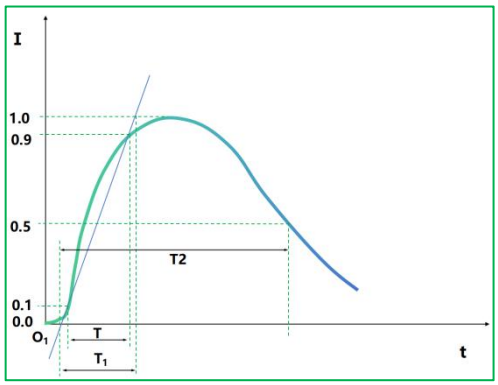
❖ESD Wave Form



IEC61000-4-2 Standards

SEVERITY LEVEL	AIR DIRCHARGE	DIRECT DISCHARGE
1	2KV	2KV
2	4KV	4KV
3	8KV	6KV
4	15KV	8KV

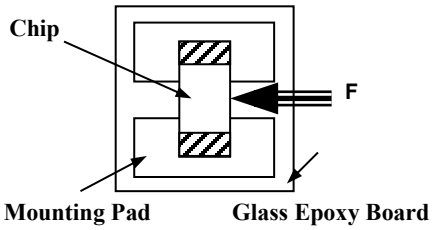
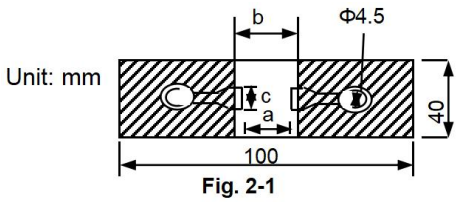
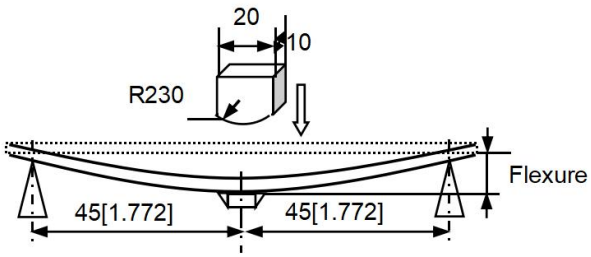
❖ **Surge Wave Form**



IEC61000-4-5 Standards

SEVERITY LEVEL	T_1 (=1.25*T)	T_2
1	10 μs	1000 μs
2	8 μs	20 μs

Reliability Test

Items	Requirements	Test Methods and Remarks
Terminal Strength	No removal or split of the termination or other defects shall occur.  Fig.1-1	Solder the chip to the testing jig (glass epoxy board shown in the following Fig. 1-1) using eutectic solder. Then apply a force in the direction of the arrow. Size（EIA）: 0201、0402、0603 — Force: 5N — Duration: 10±1s
Resistance to Flexure	No visible mechanical damage. Unit: mm Size（EIA）: 0201 — a: 0.25 — b: 0.3 — c: 0.3 Size（EIA）: 0402 — a: 0.4 — b: 1.5 — c: 0.5 Size（EIA）: 0603 — a: 1.0 — b: 3.0 — c: 1.2  Fig. 2-1	Solder the chip to the test jig (glass epoxy board shown in Fig.2-1) using a eutectic solder. Then apply a force in the direction shown in Fig. 2-2. Size（EIA）: 0201、0402、0603 — Flexure: 2mm — Pressurizing Speed: ＜0.5mm/s — Duration: 10±1s  Fig.2-2

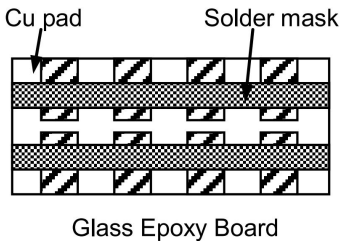
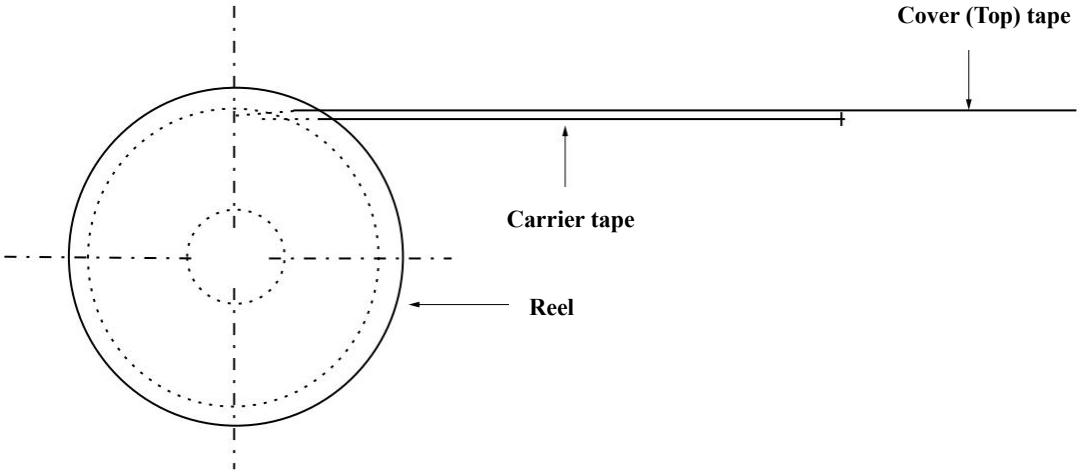
<table>
<tr><td>Vibration</td><td>No visible mechanical damage.
 

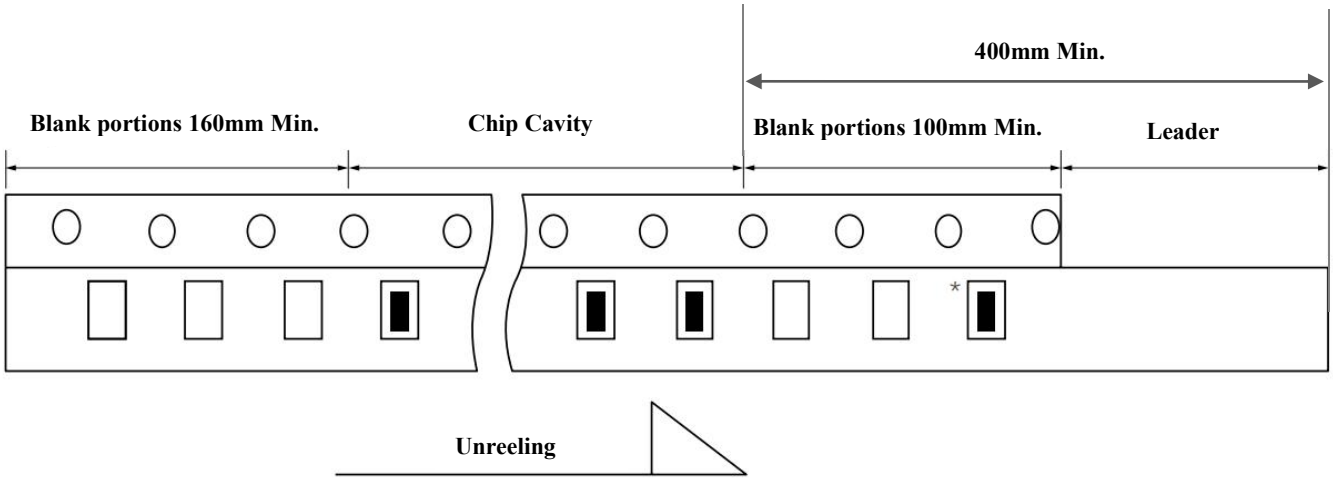
Fig. 3-1</td><td>❖ Solder the chip to the testing jig (glass epoxy board shown in Fig.3-1) using eutectic solder.
❖ The chip shall be subjected to a simple harmonic motion having total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55 Hz.
❖ The frequency ranging from 10 to 55 Hz and returning to 10 Hz shall be traversed in approximately 1 minute. This motion shall be applied for a period of 2 hours in each 3 mutually perpendicular directions (total of 6 hours).</td></tr>
<tr><td>Solderability</td><td>❖ No visible mechanical damage.
❖ Wetting shall exceed 80% coverage.</td><td>❖ Solder temperature: 240±2℃.
❖ Duration: 3 sec.
❖ Solder: Sn/3.0Ag/0.5Cu.
❖ Flux: 25% Resin and 75% ethanol in weight.</td></tr>
<tr><td>Resistance to Soldering Heat</td><td>❖ No visible mechanical damage.
❖ Varistor voltage change: within ±10%.</td><td>❖ Solder temperature: 260±3℃
❖ Duration: 5 sec.
❖ Solder: Sn/3.0Ag/0.5Cu.
❖ Flux: 25% Resin and 75% ethanol in weight.
❖ The chip shall be stabilized at normal condition for 1~2hours before measuring.</td></tr>
<tr><td>Thermal Shock</td><td>❖ No visible mechanical damage.
❖ Varistor voltage change: within ±10%.</td><td>After repeating the cycles stated below for specified number of times, leave the part for 1~2 hours,then evaluate its characteristics.
Cycle : 5 cycles
<table>
<tr><th>Step</th><th>Temperature</th><th>Period</th></tr>
<tr><td>1</td><td>Max. Operating Temp.</td><td>30±3 min</td></tr>
<tr><td>2</td><td>Ordinary temp.</td><td>3 min max.</td></tr>
<tr><td>3</td><td>Min. Operating Temp.</td><td>30±3 min</td></tr>
<tr><td>4</td><td>Ordinary temp.</td><td>3 min max.</td></tr>
</table></td></tr>
<tr><td>Resistance to Low Temperature</td><td>❖ No visible mechanical damage.
❖ Varistor voltage change: within ±10%.</td><td>❖ Temperature: -40±2℃
❖ Duration: 1000+24 hours.
❖ The chip shall be stabilized at normal condition for 1~2 hours before measuring.</td></tr>
<tr><td>Resistance to High Temperature</td><td>❖ No visible mechanical damage.
❖ Varistor voltage change: within ±10%.</td><td>❖ Temperature: 125±2℃
❖ Duration: 1000+24 hours.
❖ The chip shall be stabilized at normal condition for 1~2 hours before measuring.</td></tr>
<tr><td>Damp Heat (Steady States)</td><td>❖ No visible mechanical damage.
❖ Varistor voltage change: within ±10%.</td><td>❖ Temperature: 40±2℃
❖ Humidity: 90% to 95% RH.
❖ Duration: 1000+24 hours.
❖ The chip shall be stabilized at normal condition for 1~2 hours before measuring.</td></tr>
</table>

Loading at High Temperature (Life Test)	❖ No visible mechanical damage. ❖ Varistor voltage change: within ±10%.	❖ Temperature: 85±2℃ ❖ Duration: 1000+24 hours. ❖ Applied current: Max. Permissive Operating Current. ❖ The chip shall be stabilized at normal condition for 1~2 hours before measuring.

Packaging

(1) Figure



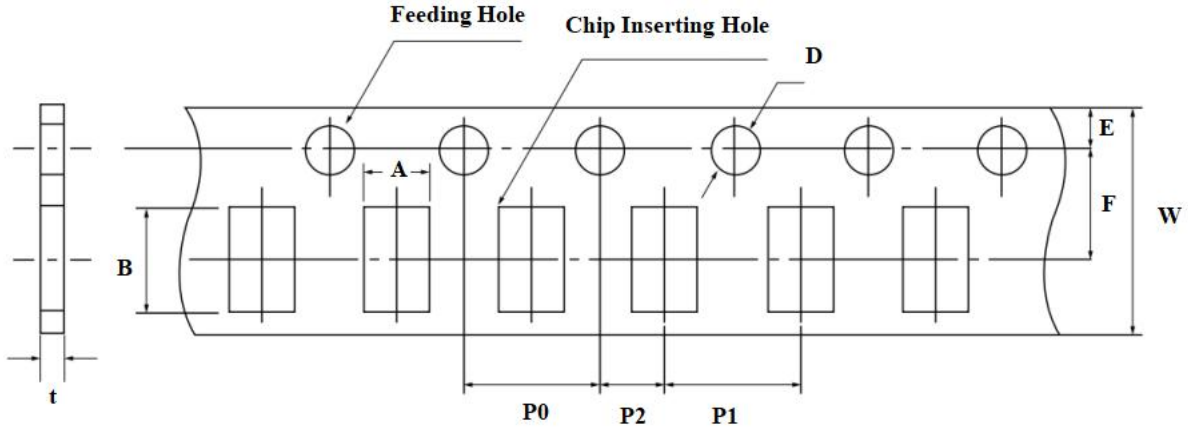


(2) Quantity

Size(EIA)	0201	0402	0603
Taping Type	Paper	Paper	Paper
Quantity	15K	10K	4K

(3) Tape Size

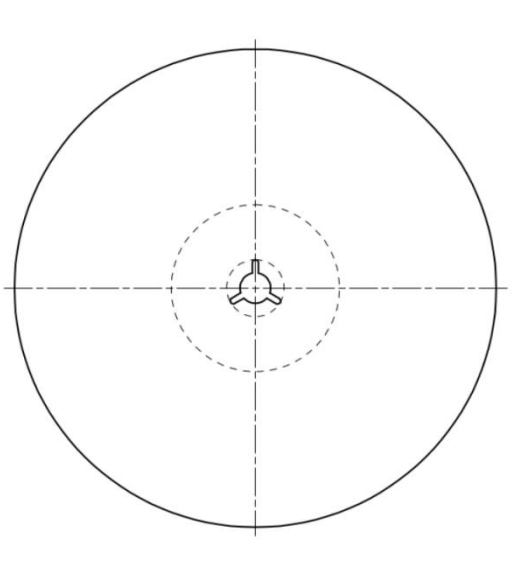
❖ **Cardboard(Paper) tape**

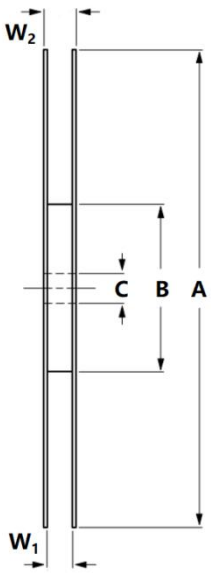


Unit: mm

Size (EIA)	A	B	W	F	E	P1	P2	P0	D	t
0201	0.38±0.1	0.68±0.10	8.00 ±0.30	3.50 ±0.05	1.75 ±0.10	2.00 ±0.05	2.00 ±0.05	4.00 ±0.10	Φ1.50 +0.1/-0.03	≤0.5
0402	0.65±0.1	1.15±0.1				2.00 ±0.05				≤0.8
0603	1.0±0.2	1.8±0.2				4.00 ±0.10				≤1.1

(4) Reel Size



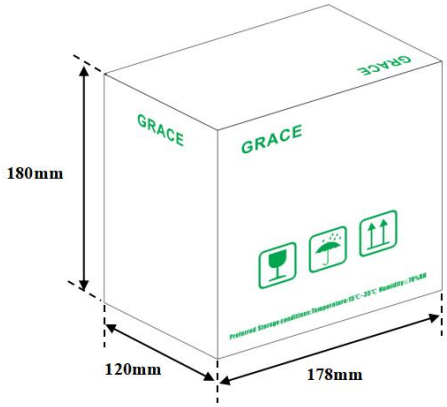


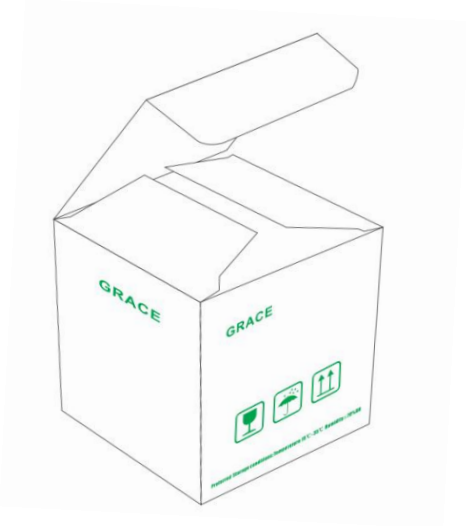
Type	Symbol	Dimensions(mm)
7" Reel	A	178±2
	B	58±2
	C	13.5±0.2
	W1	8.4+1.5/-0.0
	W2	≤14.4

(5) BOX package

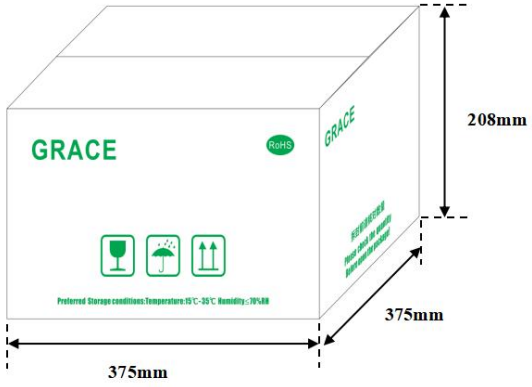
Double packaging with the paper type of inner box and outer box.

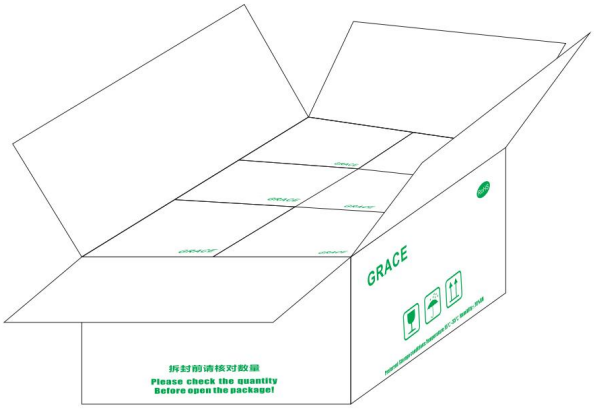
❖ **Inner Box ：**





❖ **Outer Box ：**





※ Box size specifications for reference.

Storage environment

(1) Recommendation for temperature/humidity

❖ **Even taping and packaging materials are designed to endure a long-term storage, they should be stored with a temperature of -10~40℃and an RH of 0~70% otherwise, too high temperatures or humidity may deteriorate the quality of the chip rapidly.**

❖ **Packaging material may be deform-ed if package are stored where they are exposed to heat of direct sunlight.**

❖ **As oxidization is accelerated when relative humidity is above 70%RH, the lower the humidity is, the better the solderability is.**

❖ **As the temperature difference may cause dew condensation during the storage of the chip, it is a must to**

maintain a temperature control environment.

(2) Shelf Life

❖ An allowable storage period should be within 12 months from the outgoing date of delivery in consideration of solderability.

❖ As for chips in storage over 12 months, please check solderability before use.

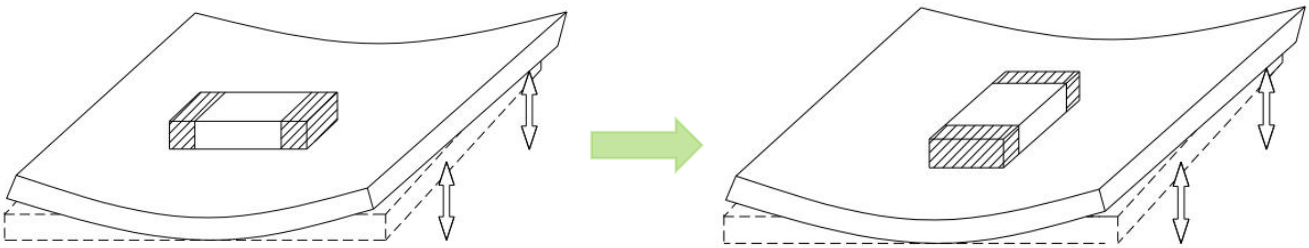
(3) Caution for corrosive environment

As corrosive gases may deteriorate the solderability of chip outer termination, it is a must to store chip in an environment without gases. chip that is exposed to corrosive gases may cause its quality issues due to the corrosion of plating layers and the penetration of moisture.

Process of Mounting and Soldering

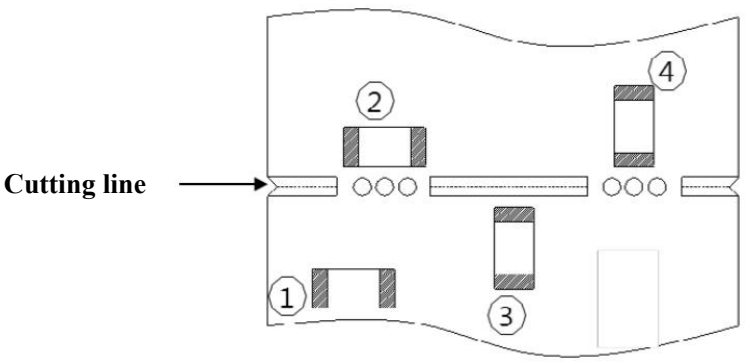
(1) Mounting

❖ It is recommended to locate the major axis of chip in parallel to the direction in which the stress is applied.



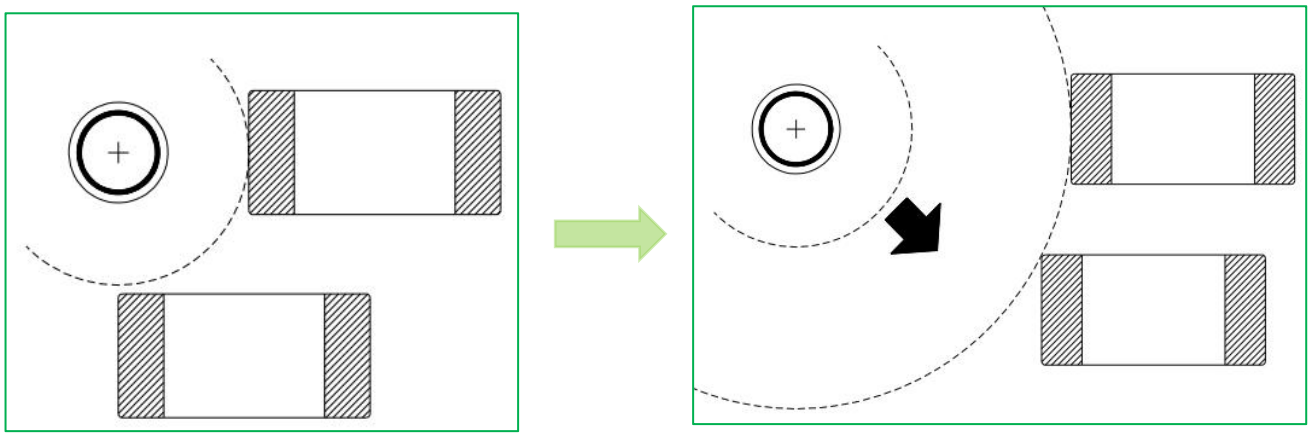
Not recommended Recommended

❖ Please take the following measures to effectively reduce the stress generated from the cutting of PCB. Select the mounting location shown below, since the mechanical stress is affected by a location and a direction of chip mounted near the cutting line.



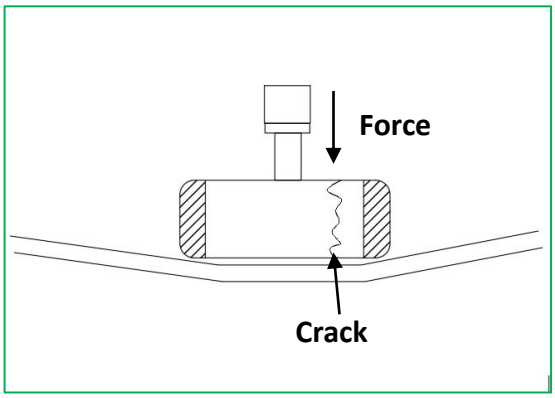
Worst ④ > ② = ③ >① Best

❖ **If the chip is mounted near a screw hole, the board deflection may be occurred by screw torque. Mount the chip as far from the screw holes as possible.**

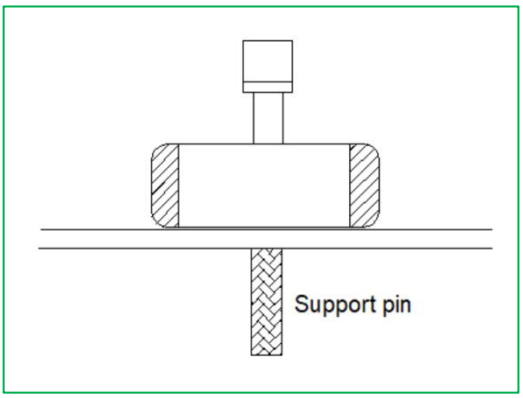


Not recommended **Recommended**

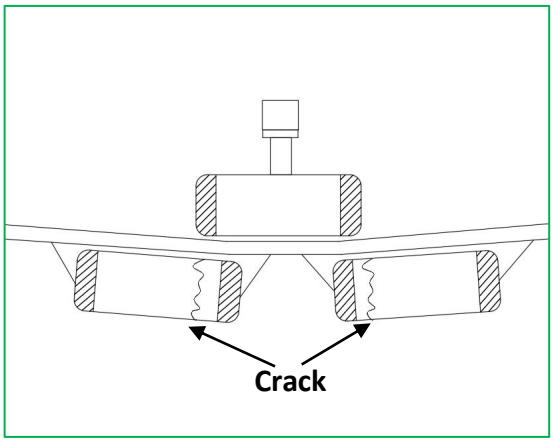
❖ **Substrate fixes up back surface of substrate with support pin in impact of suction nozzle to wely deflection to the utmost, and substrate hold deflection, please. A representative example is shown in the following.**



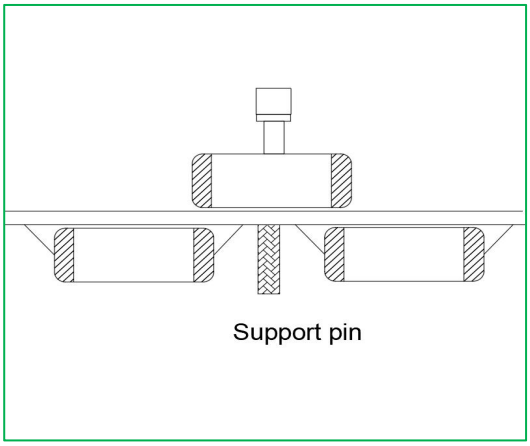
Cases to avoid



Recommended Case



Cases to avoid



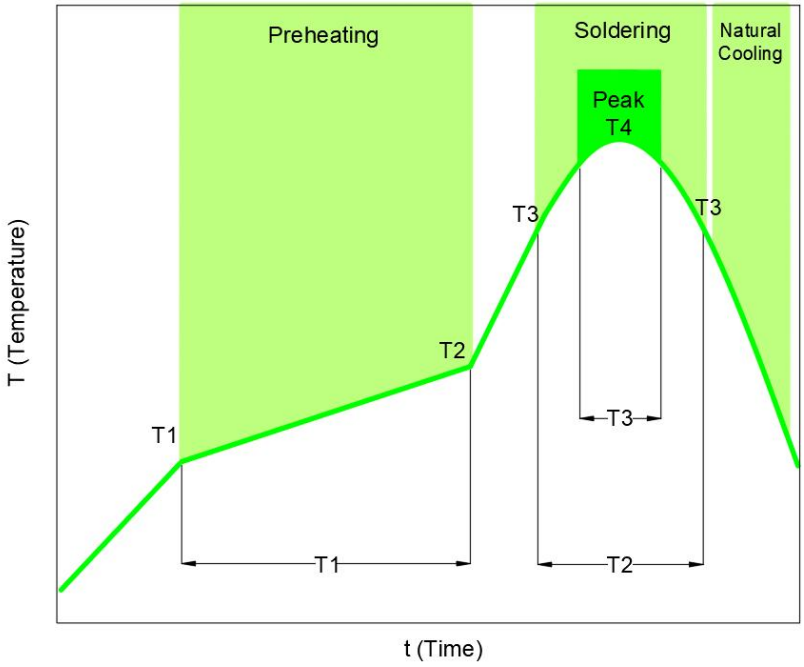
Recommended Case

※ **Dust accumulated in a suction nozzle and suction mechanism can impede a smooth movement of the nozzle. This may cause cracks in the chip due to the excessive force during mounting.If the mounting claw is worn out, it may cause cracks in the chip due to the uneven force during positioning.A regular inspection such as maintenance, monitor and replacement for the suction nozzle and mounting claw should be conducted.**

(2) Reflow soldering

The reflow soldering temperature conditions are composed of temperature curves of Preheating, Temp. rise, Heating, Peak and Gradual cooling. Large temperature difference inside the chip caused by rapid heat application to the chip may lead to excessive thermal stresses, contributing to the thermal cracks. The Preheating temperature requires controlling with great care so that tombstone phenomenon may be prevented.

Follow the recommended soldering conditions to avoid degradation of performance .



Item	Specification	
	For eutectic mixture solder	For lead-free solder
Preheating temperature	160 ～ 180 ℃	150 ～ 180 ℃
Solder melting temperature	200 ℃	230 ℃
Maximum temperature	240° C max.	260 ℃ max.
Preheating time	100s max.	120s max.
Time to reach higher than the solder melting temperature	30s max.	40s max.
number of possible reflow cycles	2 max.	2 max.

※ **Pre-heating is necessary for all constituents including the PCB to prevent the mechanical damages on the chip . The temperature difference between the PCB and the component surface must be kept to the minimum.**

a. **Allowable temperature difference △T≦ 150 °C**

b. **Use non-activated flux. (Max. Cl content less than 0.1%)**

(3) Soldering Iron

Manual soldering can pose a great risk on creating thermal cracks in the chip. The high temperature soldering iron tip may come into a direct contact with the ceramic body of the chip due to the carelessness of an operator. Therefore, the soldering iron must be handled carefully, and close attention must be paid to the selection of the soldering iron tip and to temperature control of the tip.

Iron soldering power	Soldering time	Soldering Temp.	Number of times	Pre-heating
20W max.	3s max.	300±10℃ max.	Within each terminal once(Within total of twice)	① ΔT≤130 ② ⩾60S

※ Keep the contact time between the outer termination of the chip and the soldering iron as short as possible. Long soldering time may cause problems such as adhesion deterioration by the leaching phenomenon of the outer termination.

a. Control Δ T in the solder iron and preheating temperature;

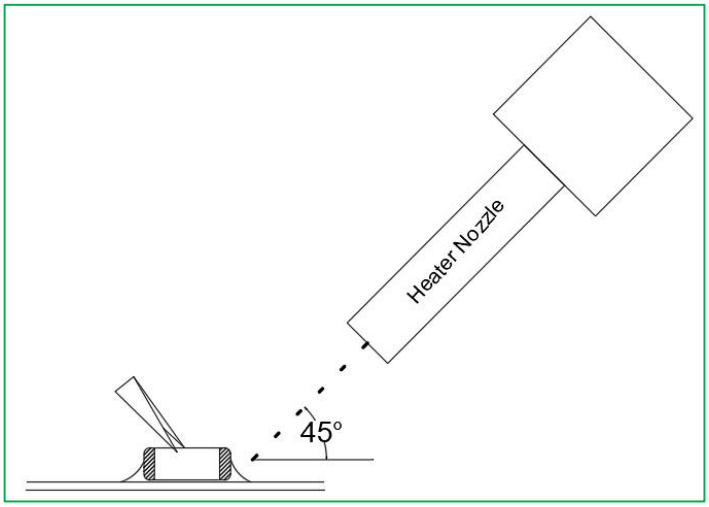
b. Caution - Iron tip should not contact with ceramic body directly;

c. Do not cool down the chip and PCB rapidly after soldering;

d. Lead-free solder: Sn-3.0Ag-0.5CU.

(4) Spot heater

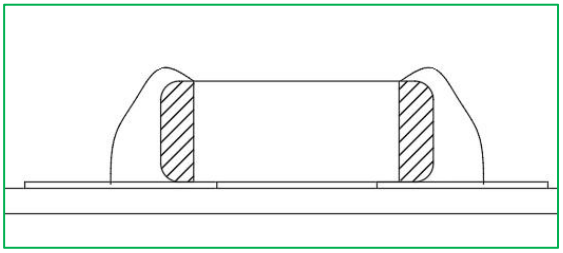
Compared to local heating with a soldering iron, hot air heating by a spot heater heats the overall component and board, therefore, it tends to lessen the thermal shock. In the case of a high density mounted board, a spot heater can also prevent concerns of the soldering iron making direct contact with the component.



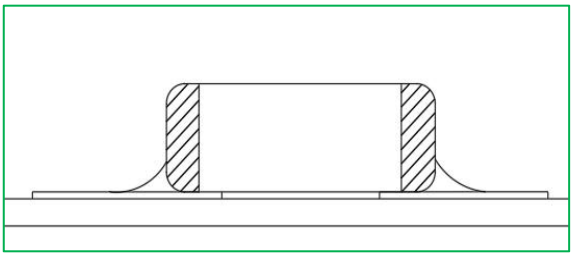
Distance	Hot Air Application angle	Hot Air Temperature Nozzle Outlet	Application Time
≥ 5mm	45℃	≤ 400℃	≤ 10s

※ If the distance from the hot air outlet of the spot heater to the component is too close, cracks may occur due to thermal shock. To prevent this problem,Follow the conditions set in the table above to prevent this problem.

(5) Recommended Amount of Solder



Excessive amount



Insufficient amount

※ **Notes:**

a. Too much solder amount will increase the risk of PCB bending or cause other damages.

b. Too little solder amount will result in the chip breaking loose from the PCB due to the inadequate adhesive strength.

c. Check if the solder has been applied properly and ensure the solder fillet has a proper shape.

(6) Cleaning

❖ **In general, cleaning is unnecessary if rosin flux is used.**

When acidic flux is used strongly, chlorine in the flux may dissolve into some types of cleaning fluids, thereby affecting the performance of the chip.

This means that the cleansing solution must be carefully selected and should always be new.

❖ **Cautions for cleaning**

a. **Soldering flux residue may remain on the PC board if cleaned with an inappropriate solvent.This may deteriorate the performance of Varistors, especially insulation resistance.**

b. **The chip or solder joint may be cracked with the vibration of PCB, if ultrasonic vibration is too strong during cleaning. Therefore，test should be done for the cleaning equipment and its process before the cleaning in order to avoid damages on the chip，you can refer to the following conditions for cleaning**

Ultrasound output	Ultrasound frequency	Cleaning time
20W/liter or less	40kHz or less	5minutes or less

⚠ Limitation

Please contact us with usage environment information such as voltage, current, temperature, or other special conditions before using our products for the applications listed below. The products are not designed or warranted to meet the requirements of the applications listed below, whose performance and/or quality require especially high reliability, or whose failure, malfunction or trouble might directly cause 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.

If you have any questions regarding this 'Limitation'，you should first contact our sales personnel or application engineers.

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- **Automotive of Transportation equipment**
- **Military equipment**
- **Atomic energy-related equipment**
- **Undersea equipment**
- **Medical equipment**
- **Disaster prevention/crime prevention equipment**
- **Power plant control equipment**
- **Traffic signal equipment**
- **Data-processing equipment**
- **Electric heating apparatus，burning equipment**
- **Safety equipment**
- **Any other applications with the same as or similar complexity or reliability to the applications**