GRACE

SPECIFICATION

ROHS Compliant Parts

Customer : _____

Part Name : Chip Varistors

Part Number : KRMV-G Series

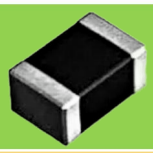
Dongguan GRACE electronic Technology Co., LTD

Address: Songhu Information Industrial Park.GuanminTou,Chashan Town, Dongguan ,Guangdong ,China

Tel: 0769-22008861 Web: www.gracevn.com Email: grace@gracevn.com

Multilayer chip varistors — KRMV - G series

For ESD / Surge protection - General



Features

- Suitable for miniaturizing circuits due to small size SMD type
- Operating temperature from -55 °C to 125°C
- Excellent clamping ratio and quick response time(<1ns)
- 100% Pb free, RoHS

Applications

- Suppression of inductive switching or other transient events such as surge voltage
- ESD protection for components sensitive
- Replacement of larger surface mount TVS Zeners in many applications

Explanation of Part Numbers

KRMV	1206	G	D	380	C681	A201	A	A001	T
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩

①	Series
GRACE Multilayer Chip Varistors	

②	Chip size (EIA)
1206	

③	Series code
G	General

④	Type of voltage
D	DC working voltage

⑤	Voltage values
380	38V

⑥	Typical Capacitance @1KHZ
C681	680pF

⑦	Peak surge current
A201	200A

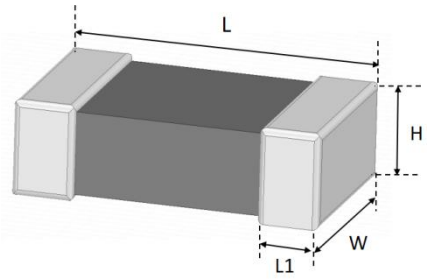
⑧	internal code
A	

⑨	Customer identification code
A001	

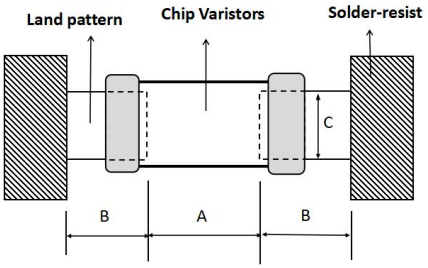
⑩	Packaging style
T	Tape

Shape and Dimensions

1）Dimensions：



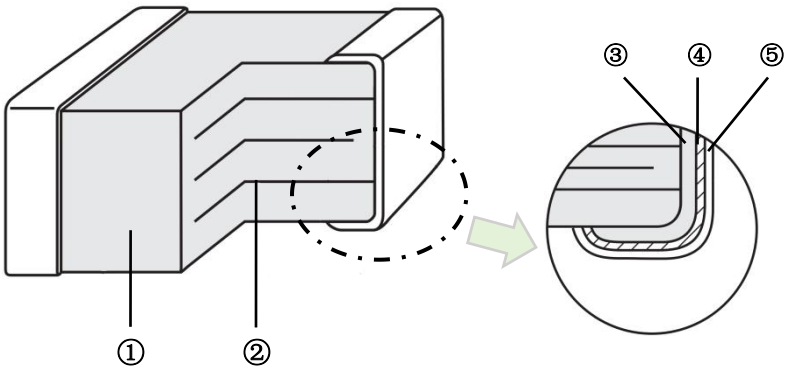
2）Recommended PCB pattern for reflow soldering:



Unit: mm

Size （EIA/JIS)	L	W	H	L1	A	B	C
0201/0603	0.60±0.15	0.30±0.15	0.30±0.15	0.2±0.10	0.45~0.55	0.40~0.50	0.45~0.55
0402/1005	1.00±0.20	0.50±0.20	0.50±0.20	0.30±0.20	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
0805/2012	2.00±0.20	1.20±0.20	0.85±0.20	0.40±0.20	0.80~1.20	0.80~1.20	0.90~1.60
1206/3216	3.20±0.20	1.60±0.20	1.60 Max.	0.40±0.30	1.8~2.5	1.0~1.5	1.6~2.2
1210/3225	3.20±0.20	2.50±0.20	3.20 Max.	0.40±0.30	1.90~2.10	1.20~1.50	2.60~2.80
1812/4532	4.50±0.20	3.20±0.20	3.20 Max.	0.50±0.30	2.80~3.00	1.50~1.80	3.30~3.60
2220/5650	5.60±0.20	5.00±0.20	3.50 Max.	0.80±0.30	4.00~4.20	1.80~2.00	5.20~5.50
3220/8050	8.00±0.30	5.00±0.20	3.60 Max.	0.80±0.30	7.20~7.90	2.00~2.60	6.00~6.80

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	Typical capacitance
Test Condition	AC	DC	@1mA DC		8/20 μs @1A	10/1000 μs	8/20 μs	@ 1kHz
Units	V_{RMS}	V_{DC}	V_B		V_c	E_T	I_p	C
Symbol	Volts	Volts	Volts		Volts	Joules	Amps	pF
KRMV0201GD4R0C101A5R0☐☐T	3	4.0	6.8	±20%	10	0.01	5	100
KRMV0201GD5R0C101A5R0☐☐T	3.3	5.0	8	±20%	10	0.01	5	100
KRMV0201GD5R6C101A8R0☐☐T	4	5.6	12	±20%	20	0.01	8	100
KRMV0402GD3R3C361A100☐☐T	2.5	3.3	5	±20%	10	0.02	10	360
KRMV0402GD5R0C161A100☐☐T	4	5.0	8	±20%	20	0.05	10	160
KRMV0402GD5R0C481A100☐☐T	4	5.0	8	±20%	20	0.05	10	480
KRMV0402GD5R0C651A100☐☐T	4	5.0	8	±20%	20	0.05	10	650
KRMV0402GD5R6C121A100☐☐T	4	5.6	12	±10%	20	0.05	10	120
KRMV0403GD5R6C231A100☐☐T	4	5.6	12	±10%	20	0.03	10	230
KRMV0402GD5R6C361A100☐☐T	4	5.6	12	±10%	20	0.05	10	360
KRMV0403GD5R6C481A100☐☐T	4	5.6	12	±10%	20	0.03	10	480
KRMV0603GD3R3C361A300☐☐T	2.5	3.3	5	±20%	10	0.10	30	360
KRMV0603GD5R5C361A300☐☐T	3.5	5.5	8	±20%	15	0.10	30	360
KRMV0603GD5R5C271A300☐☐T	3.5	5.5	8	±20%	15	0.10	30	270
KRMV0603GD5R5C481A300☐☐T	3.5	5.5	8	±20%	15	0.10	30	480
KRMV0603GD5R5C801A300☐☐T	3.5	5.5	8	±20%	15	0.10	30	800
KRMV0603GD5R5C222A300☐☐T	3.5	5.5	8	±20%	15	0.10	30	2200
KRMV0603GD5R6C271A300☐☐T	4	5.6	9	±20%	15	0.10	30	270
KRMV0603GD5R6C121A300☐☐T	4	5.6	12	±10%	20	0.10	30	120
KRMV0603GD5R6C361A300☐☐T	4	5.6	12	±10%	20	0.10	30	360
KRMV0603GD5R6C481A300☐☐T	4	5.6	12	±10%	20	0.10	30	480
KRMV0603GD9R0C551A300☐☐T	6.4	9	12	±10%	26	0.20	30	550
KRMV0603GD9R0C821A300☐☐T	6.4	9	12	±10%	26	0.20	30	820
KRMV0603GD120C251A300☐☐T	8	12	16	±10%	28	0.20	30	250
KRMV0603GD140C351A300☐☐T	11	14	18	±10%	30	0.20	30	350
KRMV0603GD180C251A300☐☐T	14	18	24	±10%	39	0.20	30	250
KRMV0603GD220C181A300☐☐T	17	22	27	±10%	45	0.20	30	180
KRMV0603GD260C121A300☐☐T	18	26	33	±10%	54	0.10	30	120
KRMV0603GD300C161A300☐☐T	25	30	39	±10%	65	0.20	30	160
KRMV0603GD380C131A300☐☐T	30	38	47	±10%	77	0.20	30	130
KRMV0603GD450C111A300☐☐T	35	45	56	±10%	90	0.20	30	110
KRMV0603GD560C800A300☐☐T	40	56	68	±10%	110	0.20	30	80
KRMV0603GD650C600A300☐☐T	50	65	82	±10%	135	0.20	30	60

0805-1206 Type

Part Number	Max.Working voltage		Breakdown voltage		Clamping voltage	Transient energy	Peak current	Typical capacitance
Test Condition	AC	DC	@1mA DC		8/20 μs @1A	10/1000 μs	8/20 μs	@ 1kHz
Units	V_{RMS}	V_{DC}	V_B		V_c	E_T	I_p	C
Symbol	Volts	Volts	Volts		Volts	Joules	Amps	pF
KRMV0805GD3R3C162A400☐☐T	2.5	3.3	5	±20%	10	0.10	40	1600
KRMV0805GD5R6C122A400☐☐T	4	5.6	8	±20%	15	0.10	40	1200
KRMV0805GD8R0C901A400☐☐T	6	8	12	±10%	20	0.10	40	900
KRMV0805GD140C801A400☐☐T	11	14	18	±10%	30	0.10	40	800
KRMV0805GD180C601A400☐☐T	14	18	22	±10%	33	0.20	40	600
KRMV0805GD220C521A400☐☐T	17	22	27	±10%	44	0.20	40	520
KRMV0805GD260C451A400☐☐T	20	26	33	±10%	54	0.20	40	450
KRMV0805GD300C441A400☐☐T	25	30	39	±10%	65	0.20	40	440
KRMV0805GD380C431A400☐☐T	30	38	47	±10%	77	0.20	40	430
KRMV0805GD450C381A400☐☐T	35	45	56	±10%	90	0.20	40	380
KRMV0805GD560C361A400☐☐T	40	56	68	±10%	110	0.20	40	360
KRMV0805GD650C331A400☐☐T	50	65	82	±10%	135	0.20	40	330
KRMV0805GD850C321A400☐☐T	60	85	100	±10%	165	0.20	40	320
KRMV0805GD101C221A400☐☐T	75	100	120	±10%	250	0.20	40	220
KRMV1206GD3R3C192A151☐☐T	2.5	3.3	5	±20%	10	0.40	150	1900
KRMV1206GD5R6C162A151☐☐T	4	5.6	8	±20%	15	0.40	150	1600
KRMV1206GD8R0C132A151☐☐T	6	8	12	±10%	20	0.40	150	1300
KRMV1206GD120C122A151☐☐T	9	12	15	±10%	26	0.40	150	1200
KRMV1206GD140C122A151☐☐T	11	14	18	±10%	30	0.40	150	1200
KRMV1206GD180C102A151☐☐T	14	18	22	±15%	39	0.40	150	1000
KRMV1206GD220C991A151☐☐T	17	22	27	±10%	45	0.40	150	990
KRMV1206GD260C851A151☐☐T	20	26	33	±10%	54	0.40	150	850
KRMV1206GD300C751A151☐☐T	25	30	39	±10%	65	0.40	150	750
KRMV1206GD330C721A151☐☐T	28	33	45	±10%	72	0.40	150	720
KRMV1206GD380C681A151☐☐T	30	38	47	±10%	77	0.40	150	680
KRMV1206GD450C581A151☐☐T	35	45	56	±10%	90	0.40	150	580
KRMV1206GD560C421A151☐☐T	40	56	68	±10%	110	0.40	150	420
KRMV1206GD650C401A151☐☐T	50	65	82	±10%	135	0.40	150	400
KRMV1206GD850C321A151☐☐T	60	85	100	±10%	165	0.40	150	320
KRMV1206GD101C221A151☐☐T	75	100	120	±10%	250	0.40	150	220
KRMV1206GD3R3C192A201☐☐T	2.5	3.3	5	±20%	10	0.40	200	1900
KRMV1206GD5R6C162A201☐☐T	4	5.6	8	±20%	15	0.40	200	1600
KRMV1206GD8R0C132A201☐☐T	6	8	12	±10%	20	0.40	200	1300
KRMV1206GD120C122A201☐☐T	9	12	15	±10%	26	0.40	200	1200
KRMV1206GD140C122A201☐☐T	11	14	18	±10%	30	0.40	200	1200
KRMV1206GD180C102A201☐☐T	14	18	22	±15%	39	0.40	200	1000

KRMV1206GD220C991A201☐☐T	17	22	27	±10%	45	0.40	200	990
KRMV1206GD260C851A201☐☐T	20	26	33	±10%	54	0.40	200	850
KRMV1206GD300C751A201☐☐T	25	30	39	±10%	65	0.40	200	750
KRMV1206GD330C721A201☐☐T	28	33	45	±10%	72	0.40	200	720
KRMV1206GD380C681A201☐☐T	30	38	47	±10%	77	0.40	200	680
KRMV1206GD450C581A201☐☐T	35	45	56	±10%	90	0.40	200	580
KRMV1206GD560C421A201☐☐T	40	56	68	±10%	110	0.40	200	420
KRMV1206GD650C401A201☐☐T	50	65	82	±10%	135	0.40	200	400

1210-3220 Type

Part Number	Max.Working voltage		Breakdown voltage		Clamping voltage	Transient energy	Peak current	Typical capacitance
Test Condition	AC	DC	@1mA DC		8/20 μs @1A	10/1000 μs	8/20 μs	@ 1kHz
Units	V_{RMS}	V_{DC}	V_B		V_c	E_T	I_p	C
Symbol	Volts	Volts	Volts		Volts	Joules	Amps	pF
KRMV1210GD5R6C162A301☐☐T	4	5.6	8	±20%	15.5	1.50	300	1600
KRMV1210GD8R0C162A301☐☐T	6	8	12	±10%	25	1.50	300	1600
KRMV1210GD140C152A301☐☐T	11	14	18	±10%	35	1.50	300	1500
KRMV1210GD180C152A301☐☐T	14	18	22	±10%	39	1.50	300	1500
KRMV1210GD220C152A301☐☐T	17	22	27	±10%	45	1.50	300	1500
KRMV1210GD260C142A301☐☐T	20	26	33	±10%	54	1.50	300	1400
KRMV1210GD300C132A301☐☐T	25	30	39	±10%	65	1.50	300	1300
KRMV1210GD330C901A301☐☐T	28	33	45	±10%	72	1.50	300	900
KRMV1210GD380C601A301☐☐T	30	38	47	±10%	77	1.50	300	600
KRMV1210GD450C501A301☐☐T	35	45	56	±10%	90	1.50	300	500
KRMV1210GD560C451A301☐☐T	40	56	68	±10%	110	1.50	300	450
KRMV1210GD650C401A301☐☐T	50	65	82	±10%	135	1.50	300	400
KRMV1210GD850C301A301☐☐T	60	85	100	±10%	165	1.50	300	300
KRMV1210GD101C221A301☐☐T	75	100	120	±10%	250	1.50	300	220
KRMV1210GD121C221A301☐☐T	95	120	150	±10%	290	1.50	300	220
KRMV1812GD5R6C152A501☐☐T	4	5.6	8	±20%	15	2.50	500	1500
KRMV1812GD8R0C132A501☐☐T	6	8	12	±10%	20	2.50	500	1300
KRMV1812GD120C122A501☐☐T	9	12	15	±10%	26	2.50	500	1200
KRMV1812GD140C122A501☐☐T	11	14	18	±10%	30	2.50	500	1200
KRMV1812GD180C162A501☐☐T	14	18	22	±10%	35	2.50	500	1600
KRMV1812GD220C152A501☐☐T	17	22	27	±10%	45	1.50	500	1500
KRMV1812GD260C152A501☐☐T	20	26	33	±10%	45	1.00	500	1500
KRMV1812GD300C142A501☐☐T	25	30	39	±10%	65	1.00	500	1400
KRMV1812GD380C132A501☐☐T	30	38	47	±10%	77	1.00	500	1300
KRMV1812GD450C122A501☐☐T	35	45	56	±10%	90	1.00	500	1200
KRMV1812GD560C112A501☐☐T	40	56	68	±10%	110	2.00	500	1100
KRMV1812GD650C102A501☐☐T	50	65	82	±10%	135	2.00	500	1000

KRMV1812GD850C901A501□□T	60	85	100	±10%	160	2.00	500	900
KRMV1812GD101C801A501□□T	75	100	120	±10%	250	2.50	500	800
KRMV2220GD5R6C183A122□□T	4	5.6	8	±20%	15.5	2.00	1200	18000
KRMV2220GD140C402A122□□T	11	14	18	±10%	30	5.40	1200	4000
KRMV2220GD180C402A122□□T	13	18	24	±10%	39	5.80	1200	4000
KRMV2220GD220C352A122□□T	18	22	27	±10%	45	7.20	1200	3500
KRMV2220GD260C352A122□□T	20	26	33	±10%	54	7.80	1200	3500
KRMV2220GD300C302A122□□T	25	30	39	±10%	65	9.60	1200	3000
KRMV2220GD380C252A122□□T	30	38	47	±10%	77	12.0	1200	2500
KRMV2220GD450C202A122□□T	35	45	56	±10%	85	12.0	1200	2000
KRMV2220GD560C202A102□□T	40	56	68	±10%	110	8.80	1000	2000
KRMV2220GD650C202A801□□T	50	65	82	±10%	135	5.60	800	2000
KRMV2220GD850C102A801□□T	60	85	100	±10%	160	5.00	800	1000
KRMV2220GD101C102A801□□T	75	100	120	±10%	200	4.50	800	1000
KRMV3220GD180C143A152□□T	13	18	24	±10%	58	4.0	1500	14000
KRMV3220GD200C133A152□□T	14	20	27	±10%	65	4.0	1500	13000
KRMV3220GD240C123A152□□T	17	24	33	±10%	79	4.0	1500	12000
KRMV3220GD280C103A152□□T	20	28	39	±10%	94	4.0	1500	10000
KRMV3220GD300C802A152□□T	21	30	40	±10%	97	4.0	1500	8000
KRMV3220GD350C702A152□□T	25	35	47	±10%	113	4.0	1500	7000
KRMV3220GD380C602A152□□T	27	38	52	±10%	125	4.0	1500	6000
KRMV3220GD420C552A152□□T	30	42	56	±10%	135	4.0	1500	5500
KRMV3220GD500C502A152□□T	35	50	68	±10%	165	4.0	1500	5000
KRMV3220GD560C502A152□□T	40	56	75	±10%	181	4.0	1500	5000
KRMV3220GD600C452A152□□T	42	60	82	±10%	198	4.0	1500	4500
KRMV3220GD680C402A152□□T	48	68	90	±10%	218	4.0	1500	4000
KRMV3220GD750C382A152□□T	53	75	100	±10%	242	4.0	1500	3800

※ **Notes:**

a. **The breakdown voltage was measured at 1mA.**

b. **The clamping voltage was measured at 1A by 8/20μs Pulse.**

c. **The peak current was tested at 8/20 μ s waveform.**

d. **The Surge Energy was Test at 10/1000 μ s waveform.**

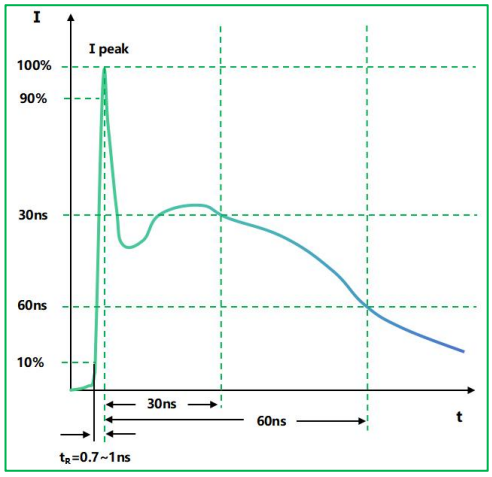
e. **The capacitance value was measured at f=1KHz, VRMS=0.5V.**

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

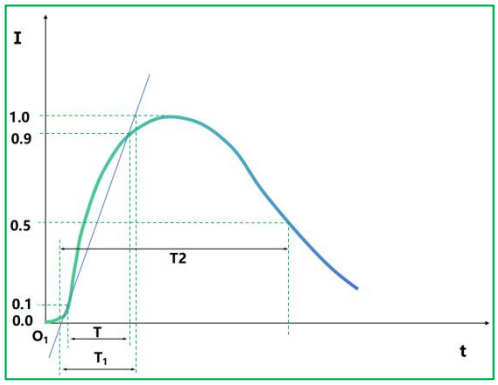
❖ESD Wave Form



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 μ s	1000 μ s
2	8 μ s	20 μ s

Reliability Test

Items	Requirements	Test Methods and Remarks
Terminal Strength	No removal or split of the termination or other defects shall occur.	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.

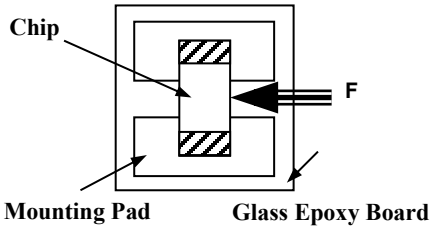


Fig.1-1

Size（EIA）	Force	Duration
0402、0603、0805	5N	10±1s
1206、1210、1812、2220	10N	

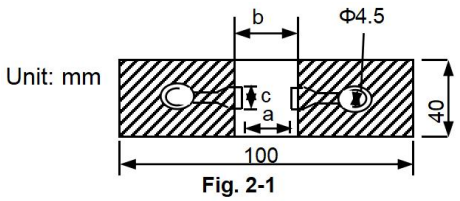
<table>
<tr>
<td>Resistance to Flexure</td>
<td>
No visible mechanical damage.
Unit: mm
<table>
<tr><th>Size（EIA）</th><th>a</th><th>b</th><th>c</th></tr>
<tr><td>0201</td><td>0.25</td><td>0.3</td><td>0.3</td></tr>
<tr><td>0402</td><td>0.4</td><td>1.5</td><td>0.5</td></tr>
<tr><td>0603</td><td>1.0</td><td>3.0</td><td>1.2</td></tr>
<tr><td>0805</td><td>1.2</td><td>4.0</td><td>1.65</td></tr>
<tr><td>1206</td><td>2.2</td><td>5.0</td><td>2.0</td></tr>
<tr><td>1812</td><td>3.0</td><td>6.0</td><td>3.8</td></tr>
<tr><td>2220</td><td>4.2</td><td>7.2</td><td>5.7</td></tr>
</table>


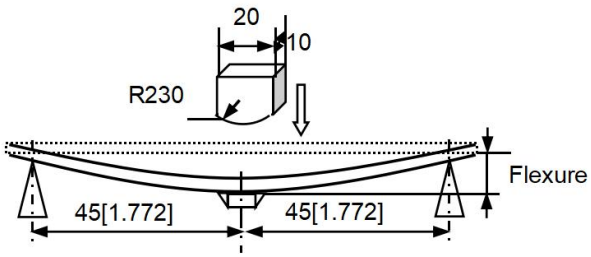
Fig. 2-1
</td>
<td>
Solder the chip to the test jig (glass epoxy board shown in Fig.2-1) using a eutectic solder. Then apply a force in the direction shown in Fig. 2-2.
<table>
<tr><th>Size（EIA）</th><th>Flexure</th><th>Pressurizing Speed</th><th>Duration</th></tr>
<tr><td>0402、0603、0805、1206、1210、1812、2220</td><td>2mm</td><td>＜0.5mm/s</td><td>10±1s</td></tr>
</table>


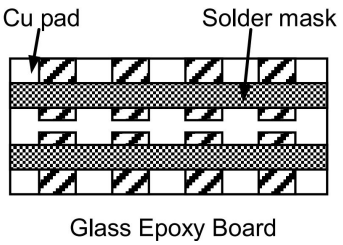
Fig.2-2
</td>
</tr>
<tr>
<td>Vibration</td>
<td>
No visible mechanical damage.


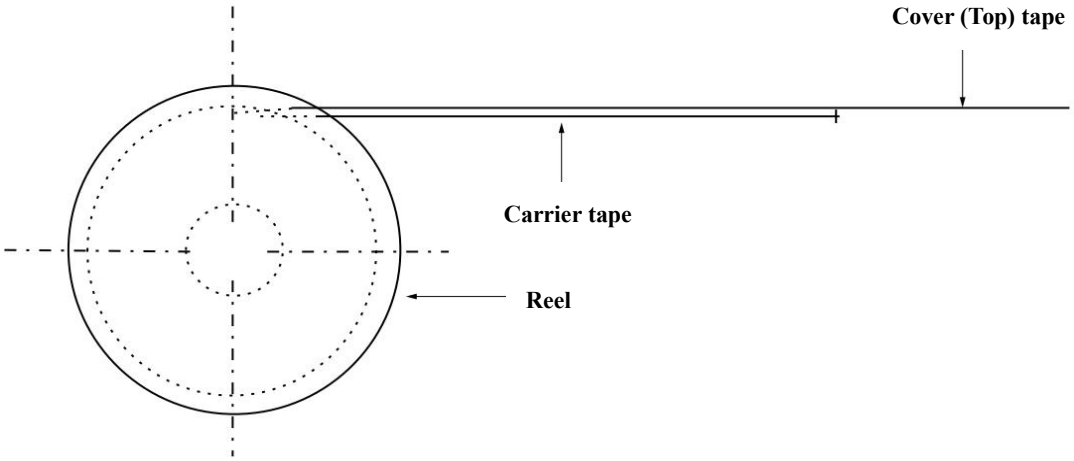
Fig. 3-1
</td>
<td>
❖ Solder the chip to the testing jig (glass epoxy board shown in Fig.3-1) using eutectic solder.
❖ The chip shall be subjected to a simple harmonic motion having total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55 Hz.
❖ The frequency 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>
</table>

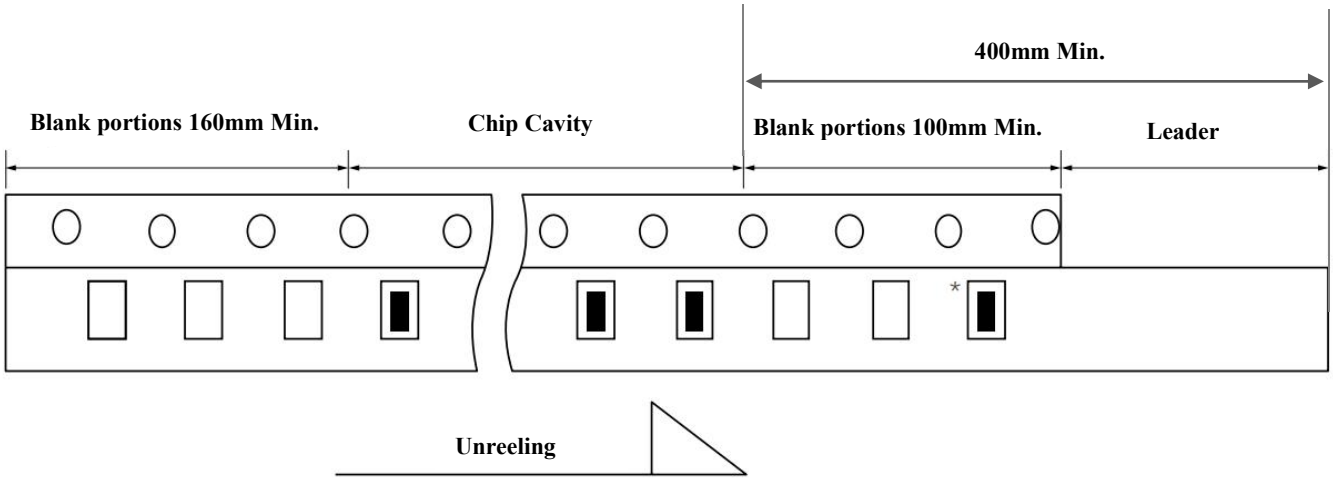
<table>
<tr><td>Thermal Shock</td><td>❖ No visible mechanical damage.
❖ Varistor voltage change: within ±10%.</td><td>After repeating the cycles stated below for specified number of
times, leave the part for 1~2 hours,then evaluate its characteristics.

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>
<tr><td>Loading at High Temperature (Life Test)</td><td>❖ No visible mechanical damage.
❖ Varistor voltage change: within ±10%.</td><td>❖ 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.</td></tr>
</table>

Packaging

(1) Figure



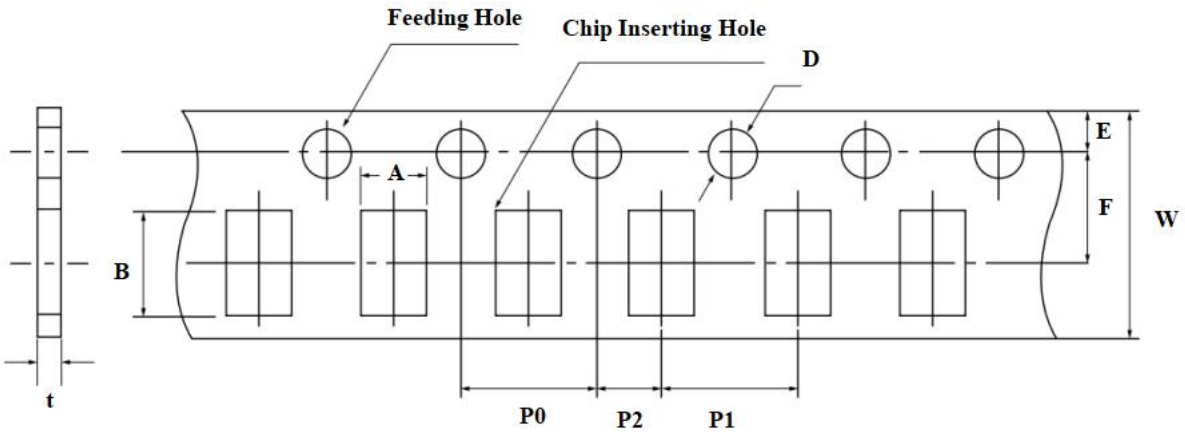


(2) Quantity

Size(EIA)	0402	0603	0805	1206	1210	1812	2220
Taping Type	Paper	Paper	Paper	plastic	plastic	plastic	plastic
Quantity	10K	4K	4K	3K	3K	3K	1K

(3) Tape Size

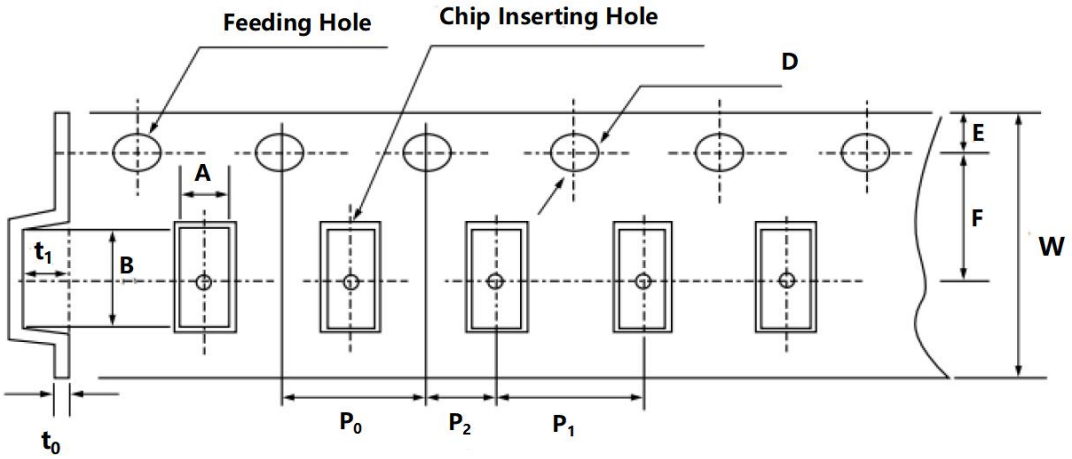
❖ Cardboard(Paper) tape



Unit: mm

Size (EIA)	A	B	W	F	E	P1	P2	P0	D	t
0402	0.65±0.1	1.15±0.1	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	≤0.8
0603	1.0±0.2	1.8±0.2				4.00 ±0.10				≤1.1
0805	1.5±0.2	2.3±0.2				4.00 ±0.10				≤1.1

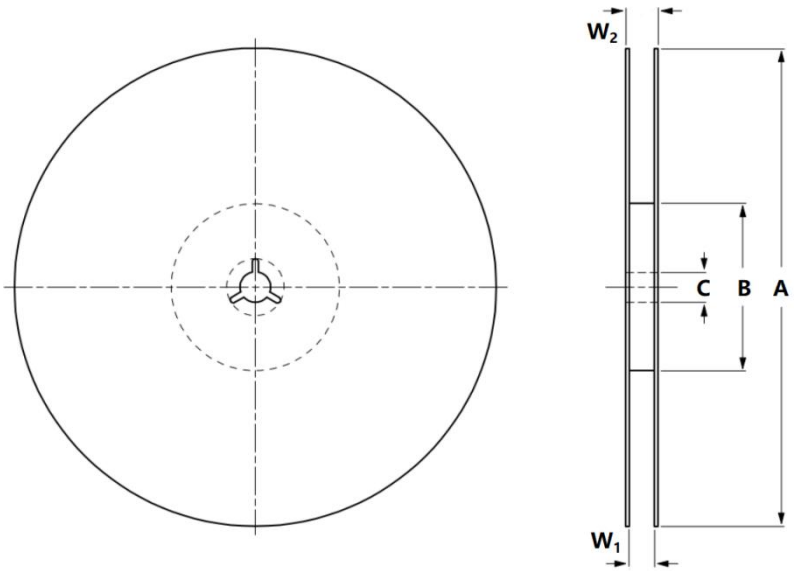
❖ **Embossed (Plastic) tape**



unit: mm

Size (EIA)	A	B	W	F	E	P1	P2	P0	D	t0	t1
1206	1.88 ±0.10	3.50 ±0.10	8.00 ±0.30	3.50 ±0.05	1.75 ±0.10	4.00 ±0.10	2.00 ±0.05	4.00 ±0.10	Φ1.50 +0.1/-0.03	⩽0.5	⩽2.0
1210	2.18 ±0.10	3.46 ±0.10									⩽2.8
1812	3.66 ±0.10	4.95 ±0.10	12.0 ±0.30	5.5 ±0.05		8.00 ±0.10					⩽3.8
2220	5.10 ±0.10	5.97 ±0.10									⩽3.9
3220											

(4) Reel Size

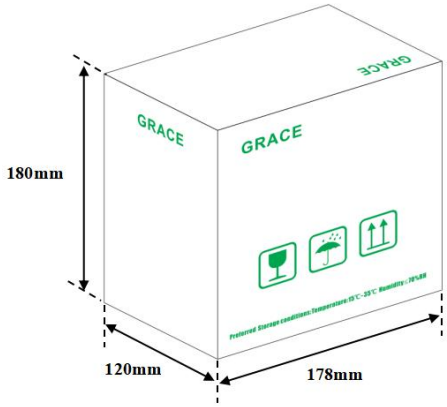


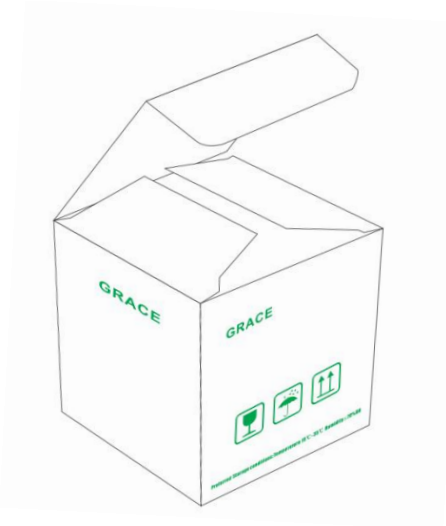
Type	Symbol	Dimensions(mm)
7" Reel	A	178±2
	B	58±2
	C	13.5±0.2
	W1	8.4+1.5/-0.0
	W2	⩽14.4

(5) BOX package

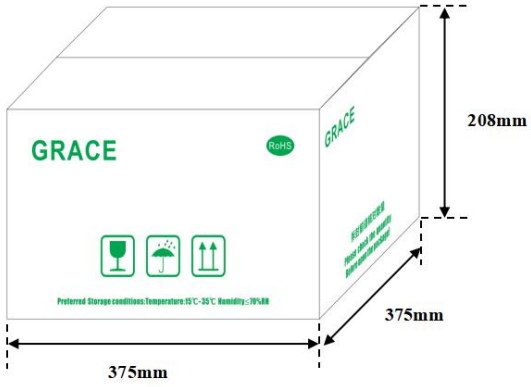
Double packaging with the paper type of inner box and outer box.

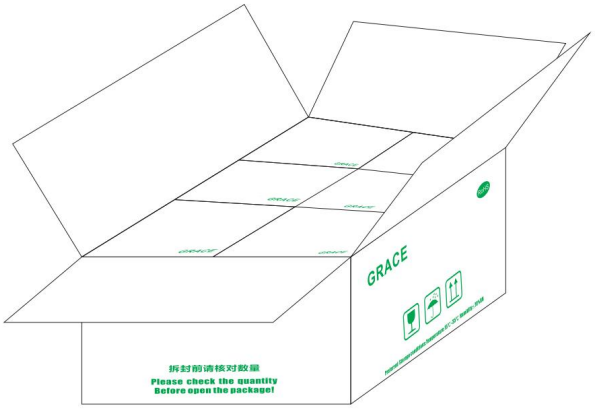
❖ **Inner Box ：**





❖ **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.**

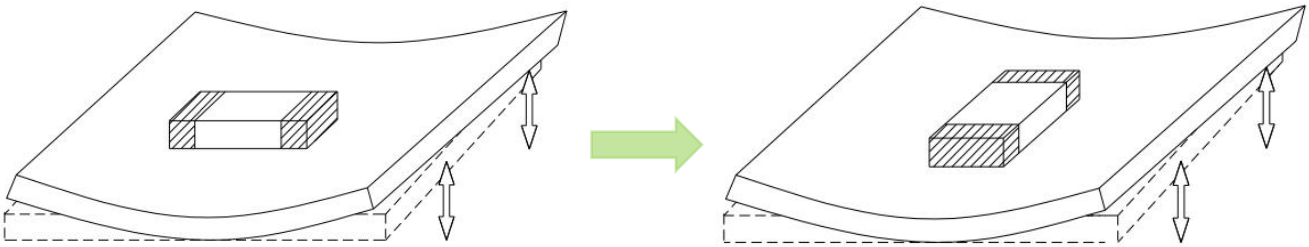
(3) Caution for corrosive environment

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

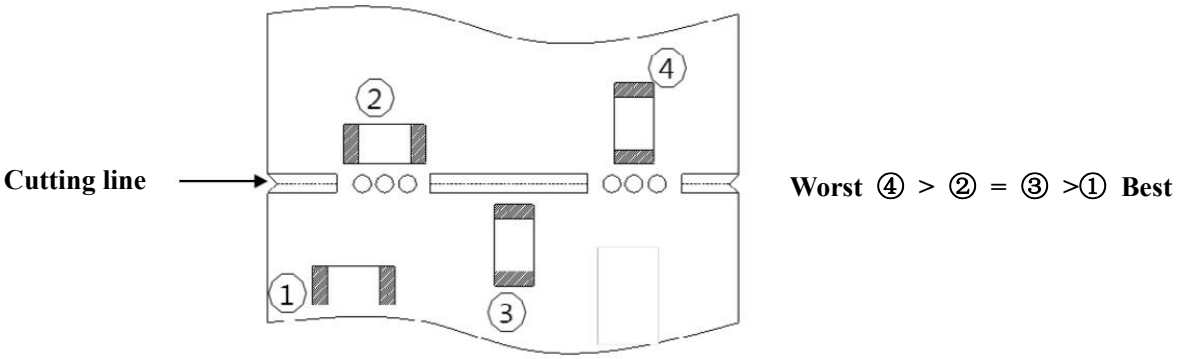
(1) Mounting

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



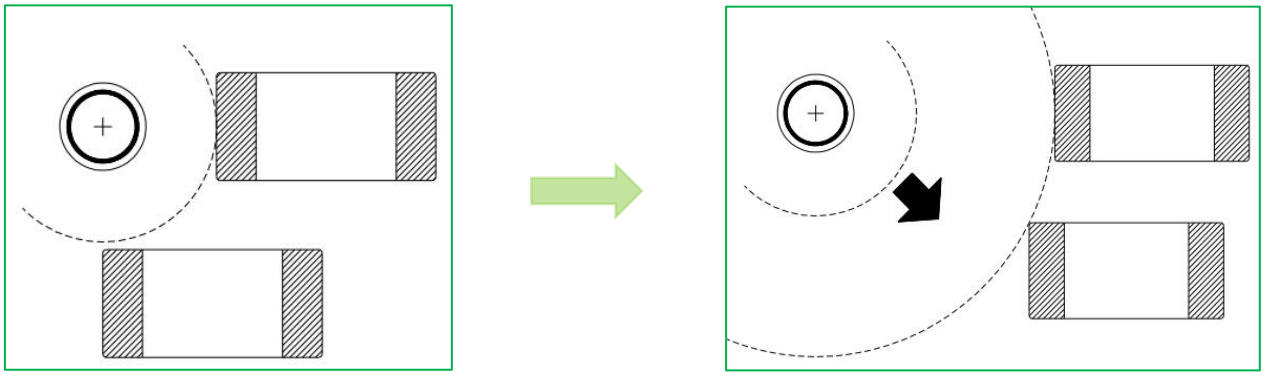
Not recommended **Recommended**

- **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.**



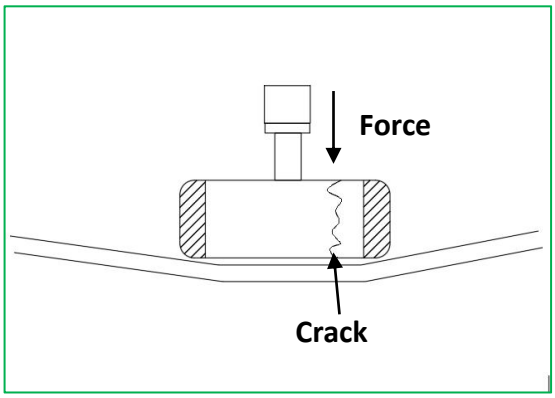
Worst ④ > ② = ③ >① Best

❖ **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.**

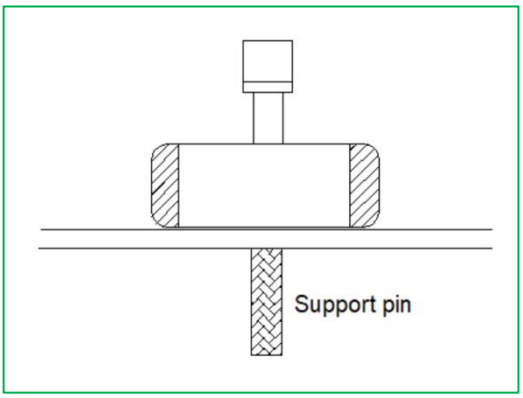


Not recommended **Recommended**

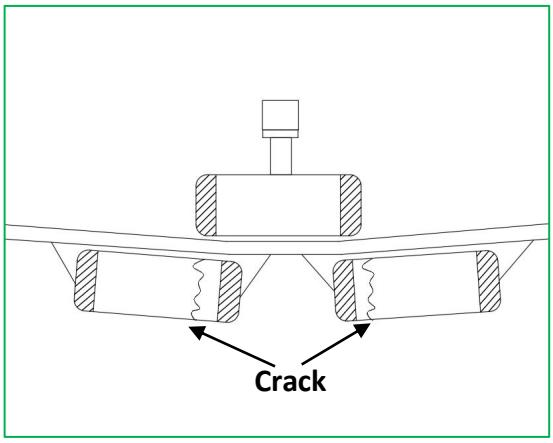
❖ **Substrate fixes up back surface of substrate with support pin in impact of suction nozzle to wely deflection to the utmost, and substrate hold deflection, please. A representative example is shown in the following.**



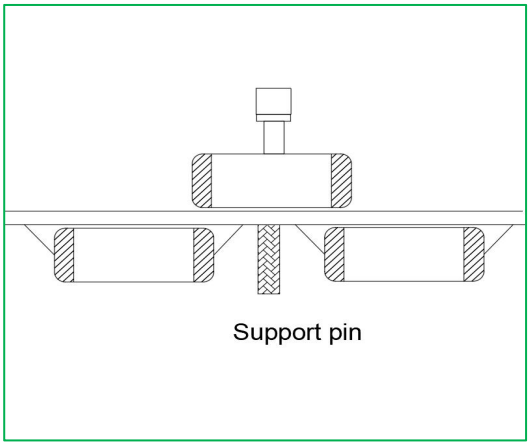
Cases to avoid



Recommended Case



Cases to avoid



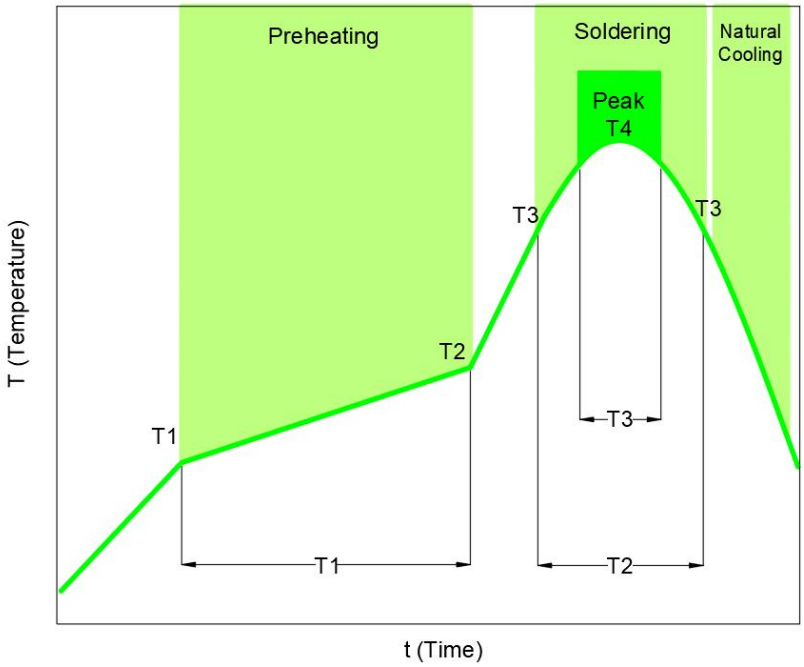
Recommended Case

※ **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;

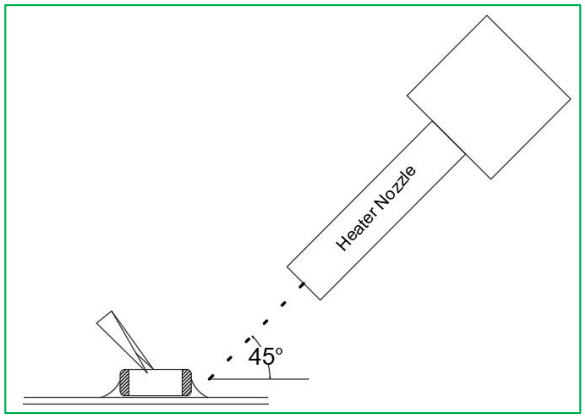
b. Caution - Iron tip should not contact with ceramic body directly;

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

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

(4) Spot heater

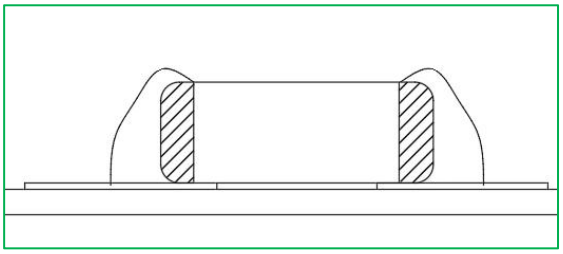
Compared to local heating with a soldering iron, hot air heating by a spot heater heats the overall component and board, therefore, it tends to lessen the thermal shock. In the case of a high density mounted board, a spot heater can also prevent concerns of the soldering iron making direct contact with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



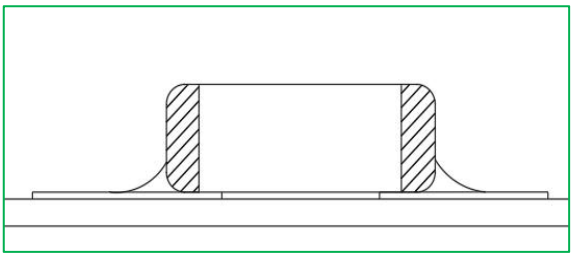
Distance	Hot Air Application angle	Hot Air Temperature Nozzle Outlet	Application Time
≥ 5mm	45℃	≤ 400℃	≤ 10s

※ 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.

- **Aerospace/Aviation equipment1wheeler, 2wheeler and 3wheeler vehicle**
- **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**