Encapsulated Type Varistors — KREV - H series Rev. :A2

For Surge protection - High surge current capability

Features

- High voltage varistor, suitable for AC circuit
- 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
- Able to replace part of leaded Varistor in situations with limited height
- Replacement of larger surface mount TVS Zeners in many applications

Explanation of Part Numbers

KREV	3225	H	B	271	A102	A	NNNN	T
①	②	③	④	⑤	⑥	⑦	⑧	⑨

①	Series
GRACE Encapsulated Type Varistor	

②	Chip size (EIA)
2220、3225、4032	

③	Series code
H	High surge current capability

④	Type of voltage
B	Breakdown voltage / Varistor Voltage

⑤	Voltage values
271	270V

⑥	Peak surge current @8/20 μs
A102	1000A

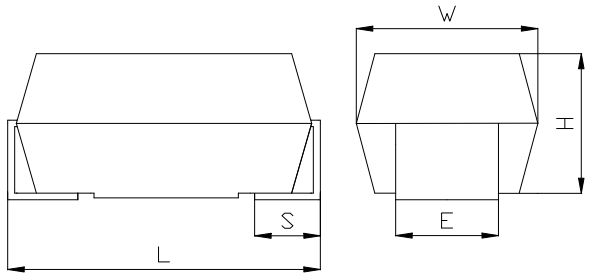
⑦	internal code
A	

⑧	Customer identification code
NNNN	

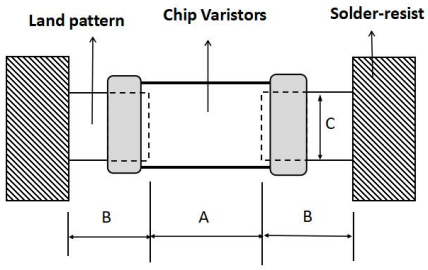
⑨	Packaging style
T	Tape

Shape and Dimensions

1）Dimensions：



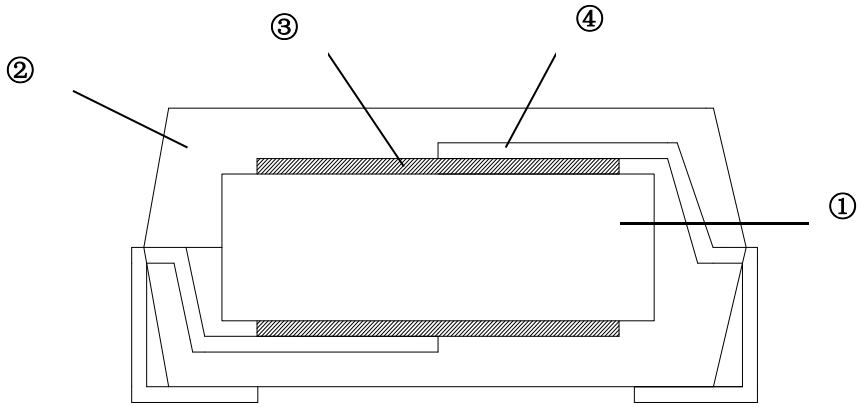
2）Recommended PCB pattern for reflow soldering:



Unit: mm

Size (EIA/JIS)	L	W	H	E	S	A	B	C
2220/5750	6.75±0.20	5.15±0.20	3.75±0.20	1.80±0.20	1.55±0.20	3.55~3.95	1.35~1.75	1.6~2.0
3225/8060	8.00±0.30	6.30±0.30	3.65±0.35	3.0±0.30	1.5±0.30	4.4~4.6	2.7~2.9	3.4~3.6
4032/10080	10.60±0.40	8.20±0.30	4.10±0.35	3.0±0.30	1.5±0.30	6.4~6.6	2.7~2.9	3.4~3.6

Structure and Materials



Code	Part Name	Material Name
①	Varistor element	Zinc oxide
②	Plastic Encapsulated	Epoxy resin
③	Electrode	Silver or Copper
④	Lead terminals	Fe-Ni Alloy or Copper, Sn Plating

Electrical Characteristics

2220 Type

Part Number	Max.Working voltage		Breakdown voltage		Clamping voltage	Transient energy	Peak current	Rated Power
Test Condition	AC	DC	@1mA DC		8/20μs @1A	10/1000μs	8/20μs	/
Symbol	V_{RMS}	V_{DC}	V_B		V_c	E_T	I_p	P
Units	Volts	Volts	Volts		Volts	Joules	Amps	mW
KREV2220HB180A251□□T	11	14	18	±15%	40	0.4	250	10
KREV2220HB220A251□□T	14	18	22	±15%	48	0.5	250	10
KREV2220HB270A251□□T	17	22	27	±10%	60	0.6	250	10
KREV2220HB330A251□□T	20	26	33	±10%	73	0.8	250	10
KREV2220HB390A251□□T	25	31	39	±10%	80	0.9	250	10
KREV2220HB470A251□□T	30	38	47	±10%	104	1.1	250	10
KREV2220HB560A251□□T	35	45	56	±10%	123	1.3	250	10
KREV2220HB680A251□□T	40	56	68	±10%	145	1.6	250	10
KREV2220HB820A501□□T	50	65	82	±10%	150	2.5	500	100
KREV2220HB101A501□□T	60	85	100	±10%	177	3.0	500	100
KREV2220HB121A501□□T	75	100	120	±10%	210	4.0	500	100
KREV2220HB151A501□□T	95	125	150	±10%	260	4.1	500	100
KREV2220HB181A501□□T	115	150	180	±10%	320	4.9	500	100
KREV2220HB201A501□□T	130	170	200	±10%	355	6.5	500	100
KREV2220HB221A501□□T	140	180	220	±10%	380	7.5	500	100
KREV2220HB241A501□□T	150	200	240	±10%	415	8.0	500	100
KREV2220HB271A501□□T	175	225	270	±10%	475	8.5	500	100
KREV2220HB301A501□□T	195	250	300	±10%	520	9.0	500	100
KREV2220HB331A501□□T	200	260	330	±10%	570	9.5	500	100
KREV2220HB361A501□□T	230	280	360	±10%	620	10.0	500	100
KREV2220HB391A501□□T	250	300	390	±10%	675	12.0	500	100
KREV2220HB431A501□□T	275	350	430	±10%	745	13.0	500	100
KREV2220HB471A501□□T	300	380	470	±10%	810	15.0	500	100
KREV2220HB511A501□□T	320	420	510	±10%	845	16.0	500	100
KREV2220HB561A501□□T	350	460	560	±10%	920	16.5	500	100
KREV2220HB621A501□□T	385	505	620	±10%	1025	21.0	500	100
KREV2220HB681A501□□T	420	560	680	±10%	1120	22.0	500	100

3225 Type

Part Number	Max.Working voltage		Breakdown voltage		Clamping voltage	Transient energy	Peak current/ Surge voltage	Rated Power
Test Condition	AC	DC	@1mA DC		8/20μs @1A	10/1000μs	8/20μs	/
Symbol	V_{RMS}	V_{DC}	V_B		V_c	E_T	I_p	P
Units	Volts	Volts	Volts		Volts	Joules	Amps	mW
KREV3225HB180A251□□T	11	14	18	±15%	36	0.9	250	20
KREV3225HB220A251□□T	14	18	22	±15%	43	1.1	250	20
KREV3225HB270A251□□T	17	22	27	±10%	53	1.4	250	20
KREV3225HB330A251□□T	20	26	33	±10%	65	1.7	250	20
KREV3225HB390A251□□T	25	31	39	±10%	77	2.1	250	20
KREV3225HB470A251□□T	30	38	47	±10%	93	2.5	250	20
KREV3225HB560A251□□T	35	45	56	±10%	110	3.1	250	20
KREV3225HB680A251□□T	40	56	68	±10%	135	3.6	250	20
KREV3225HB820A102□□T	50	65	82	±10%	135	5.5	1000	250
KREV3225HB101A102□□T	60	85	100	±10%	165	6.5	1000	250
KREV3225HB121A102□□T	75	100	120	±10%	200	7.8	1000	250
KREV3225HB151A102□□T	95	125	150	±10%	250	9.7	1000	250
KREV3225HB181A102□□T	115	150	180	±10%	300	11.7	1000	250
KREV3225HB201A102□□T	130	170	200	±10%	330	13	1000	250
KREV3225HB221A102□□T	140	180	220	±10%	360	14	1000	250
KREV3225HB241A102□□T	150	200	240	±10%	390	15	1000	250
KREV3225HB271A102□□T	175	225	270	±10%	450	18	1000	250
KREV3225HB301A102□□T	190	250	300	±10%	505	20	1000	250
KREV3225HB331A102□□T	200	260	330	±10%	545	23	1000	250
KREV3225HB361A102□□T	230	280	360	±10%	595	25	1000	250
KREV3225HB391A102□□T	250	300	390	±10%	650	25	1000	250
KREV3225HB431A102□□T	275	350	430	±10%	705	28	1000	250
KREV3225HB471A102□□T	300	380	470	±10%	775	30	1000	250
KREV3225HB511A102□□T	320	420	510	±10%	850	30	1000	250
KREV3225HB561A102□□T	350	460	560	±10%	925	30	1000	250
KREV3225HB621A102□□T	385	505	620	±10%	1025	33	1000	250
KREV3225HB681A102□□T	420	560	680	±10%	1120	33	1000	250
KREV3225HB751A102□□T	460	615	750	±10%	1240	65	1000	250
KREV3225HB781A102□□T	485	640	780	±10%	1290	65	1000	250
KREV3225HB821A102□□T	510	670	820	±10%	1355	65	1000	250

4032 Type

Part Number	Max.Working voltage		Breakdown voltage		Clamping voltage	Transient energy	Peak current/ Surge voltage	Rated Power
Test Condition	AC	DC	@1mA DC		8/20μs @1A	10/1000μs	8/20μs	/
Symbol	V_{RMS}	V_{DC}	V_B		V_c	E_T	I_p	P
Units	Volts	Volts	Volts		Volts	Joules	Amps	mW
KREV4032HB180A501□□T	11	14	18	±15%	36	2.1	500	50
KREV4032HB220A501□□T	14	18	22	±15%	43	2.5	500	50
KREV4032HB270A501□□T	17	22	27	±10%	53	3.0	500	50
KREV4032HB330A501□□T	20	26	33	±10%	65	4.0	500	50
KREV4032HB390A501□□T	25	31	39	±10%	77	4.6	500	50
KREV4032HB470A501□□T	30	38	47	±10%	93	5.5	500	50
KREV4032HB560A501□□T	35	45	56	±10%	110	7.0	500	50
KREV4032HB680A501□□T	40	56	68	±10%	135	8.2	500	50
KREV4032HB820A182□□T	50	65	82	±10%	135	12	1800	400
KREV4032HB101A182□□T	60	85	100	±10%	165	15	1800	400
KREV4032HB121A252□□T	75	100	120	±10%	200	18	2500	400
KREV4032HB151A252□□T	95	125	150	±10%	250	22	2500	400
KREV4032HB181A252□□T	115	150	180	±10%	300	27	2500	400
KREV4032HB201A252□□T	130	170	200	±10%	330	30	2500	400
KREV4032HB221A252□□T	140	180	220	±10%	360	32	2500	400
KREV4032HB241A252□□T	150	200	240	±10%	390	35	2500	400
KREV4032HB271A252□□T	175	225	270	±10%	450	37	2500	400
KREV4032HB301A252□□T	190	250	300	±10%	505	40	2500	400
KREV4032HB331A252□□T	200	260	330	±10%	545	43	2500	400
KREV4032HB361A252□□T	230	280	360	±10%	595	47	2500	400
KREV4032HB391A252□□T	250	300	390	±10%	650	60	2500	400
KREV4032HB431A252□□T	275	350	430	±10%	705	65	2500	400
KREV4032HB471A252□□T	300	380	470	±10%	775	67	2500	400
KREV4032HB511A252□□T	320	420	510	±10%	850	69	2500	400
KREV4032HB561A252□□T	350	460	560	±10%	925	70	2500	400
KREV4032HB621A252□□T	385	505	620	±10%	2525	72	2500	400
KREV4032HB681A252□□T	420	560	680	±10%	1120	75	2500	400

※ 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 8/20μs waveform.

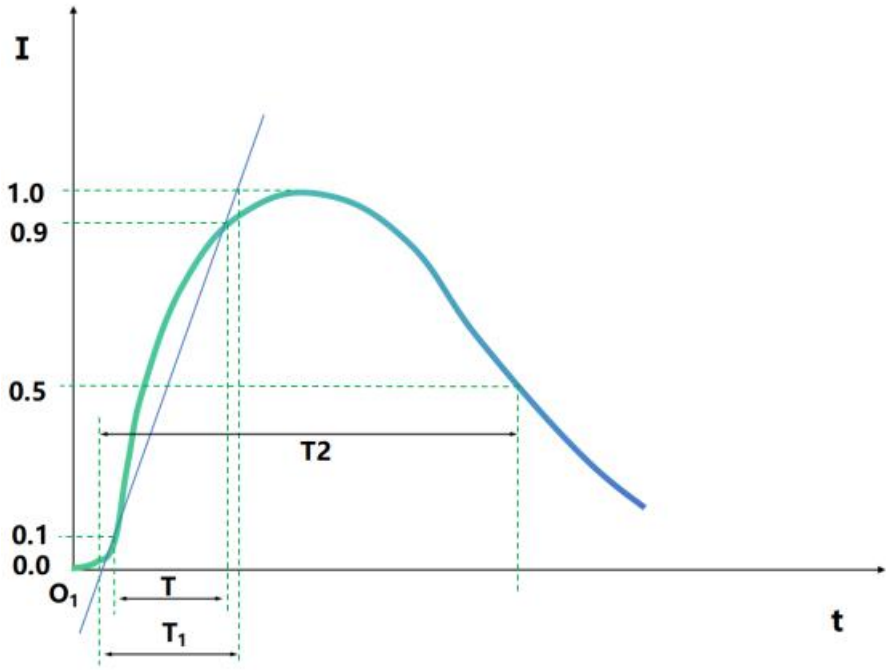
d. The Surge Energy was Test at 10/1000μs waveform.

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

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

Wave Form

❖Surge Wave Form



IEC61000-4-5 Standards

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

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.

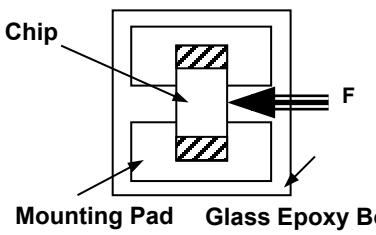


Fig.1-1

Size（EIA）	Force	Duration
2220、3225、4032	10N	10±1s

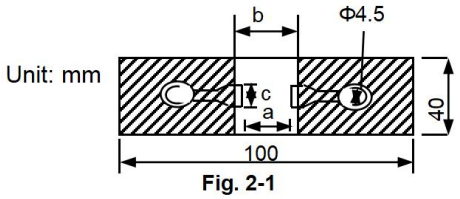
<table>
<tr><th>Items</th><th>Requirements</th><th>Test Methods and Remarks</th></tr>
<tr><td>Resistance to Flexure</td><td>No visible mechanical damage.
Unit: mm
<table>
<tr><th>Size（EIA）</th><th>a</th><th>b</th><th>c</th></tr>
<tr><td>2220</td><td>3.2</td><td>5.2</td><td>2.0</td></tr>
<tr><td>3225</td><td>4.5</td><td>6.5</td><td>3.5</td></tr>
<tr><td>4032</td><td>6.5</td><td>8.5</td><td>3.5</td></tr>
</table>


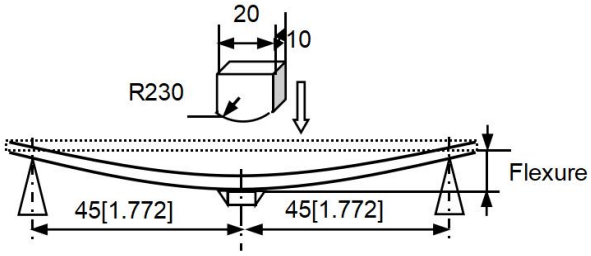
Fig. 2-1</td><td>Solder the chip to the test jig (glass epoxy board shown in Fig.2-1) using a eutectic solder. Then apply a force in the direction shown in Fig. 2-2.
<table>
<tr><th>Size（EIA）</th><th>Flexure</th><th>Pressurizing Speed</th><th>Duration</th></tr>
<tr><td>2220、3225、4032</td><td>2mm</td><td>＜0.5mm/s</td><td>10±1s</td></tr>
</table>


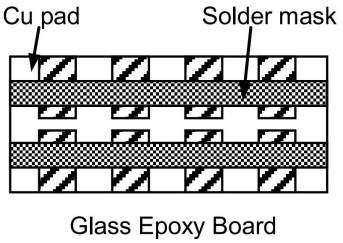
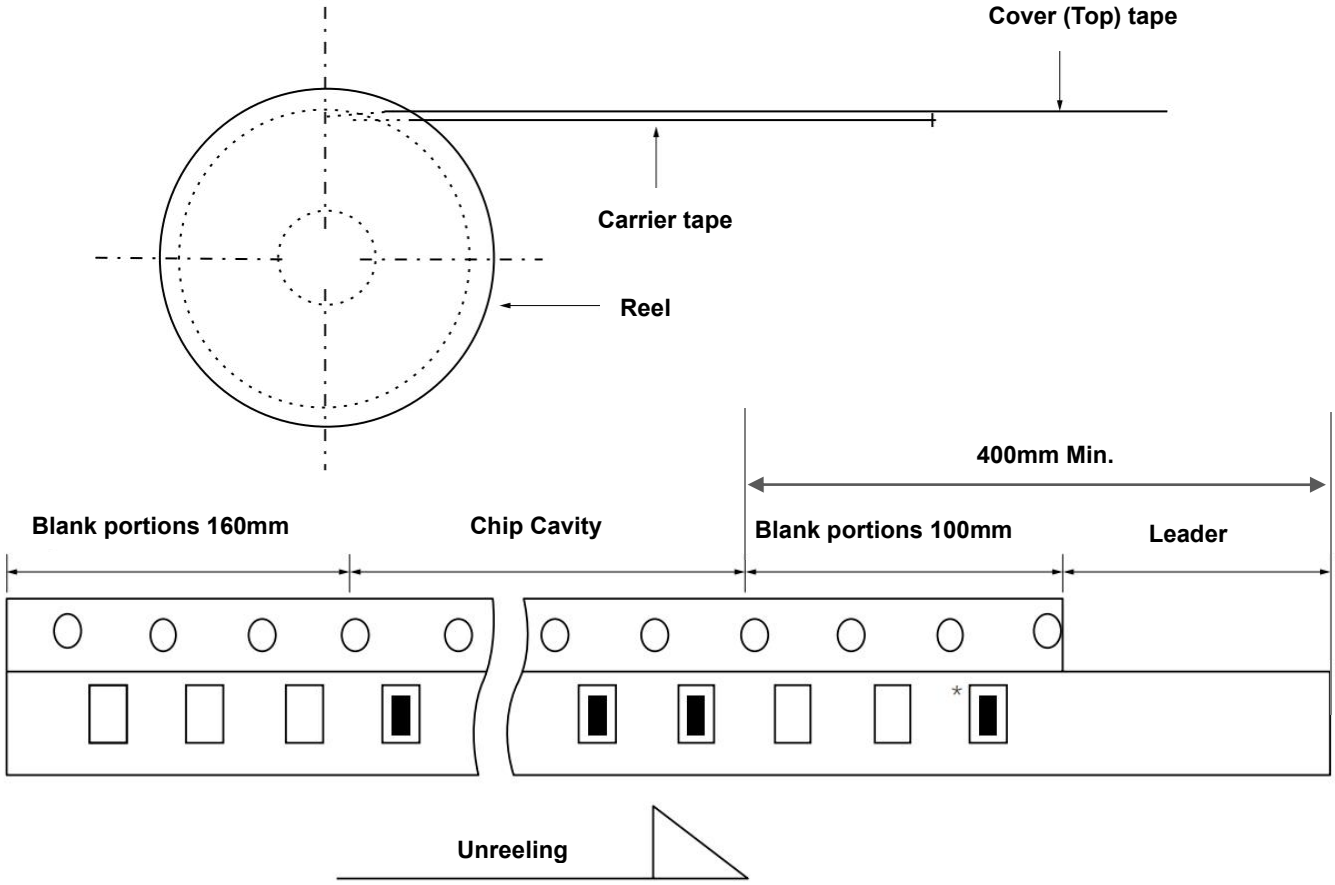
Fig.2-2</td></tr>
<tr><td>Vibration</td><td>No visible mechanical damage.
 

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>Solder ability</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><th>Items</th><th>Requirements</th><th>Test Methods and Remarks</th></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>
<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 : Max. AC Working voltage.
❖ The chip shall be stabilized at normal condition for 1~2 hours before measuring.</td></tr>
<tr><td>Maximum Surge Current</td><td>❖ No visible mechanical damage.
❖ Varistor voltage change: within ±10%.</td><td>❖ Temperature: 25±5℃
❖ ② Humidity: 30% to 65% RH.
❖ ③ Number of hit: each 1 time of +/- polarity.
❖ ④ Pulse waveform: 8/20 us.
❖ ⑤ Applied current: maximum surge current (IP).
❖ ⑥ The chip shall be stabilized at normal condition for 1~2 hours before measuring.</td></tr>
<tr><td>Maximum Surge Energy</td><td>❖ No visible mechanical damage.
❖ Varistor voltage change: within ±10%.</td><td>❖ Temperature :25±5℃
❖ Humidity: 30% to 65% RH.
❖ Number of hit: 1 time.
❖ Pulse waveform: 10/1000 us.
❖ Applied energy: maximum surge energy (E_T).
❖ The chip shall be stabilized at normal condition for 1~2 hours before measuring.</td></tr>
</table>

Packaging

(1)Figure

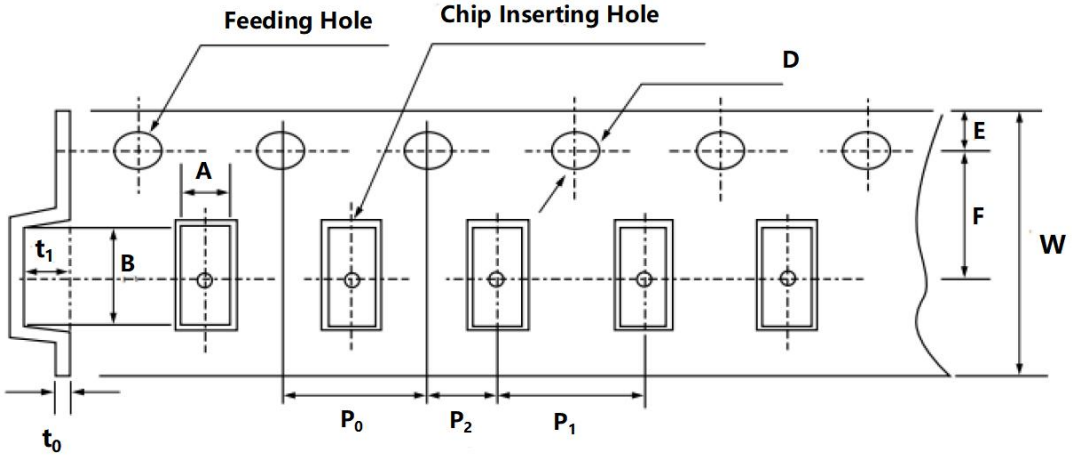


(2)Quantity

Size(EIA)		2220	3225	4032
Taping Type		plastic	plastic	plastic
Quantity	Reel	2K	1.0K	1.0K

(3)Tape Size

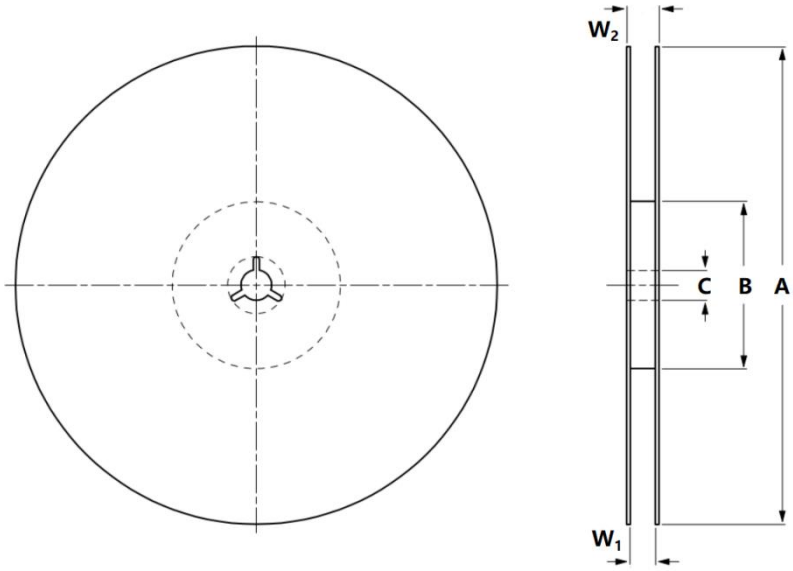
❖ **Embossed (Plastic) tape**



unit: mm

Size (EIA)	A ±0.20	B ±0.20	W ±0.30	F ±0.05	E ±0.10	P1 ±0.10	P2 ±0.05	P0 ±0.1	D +0.05	t_0 max	t_1 ±0.10
2220	6.0	8.15	16.0	7.5	1.75	8.0	2.0	4.0	1.55	0.30	3.85
3225	7.5	8.7	16.0	7.5		12.0					3.85
4032	8.4	10.8	24.0	11.5		12.0					3.85

(4)Reel Size



Type	Symbol	Dimensions(mm)
7"Reel	A	330.0±1.0
	B	60.0±0.5
	C	13.0±0.2
	W1	17.2±0.7（2220-3225） 24.0±0.3（4032）
	W2	19.5±0.15（2220-3225） 26.3±0.15（4032）

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 solder ability 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 24 months from the outgoing date of delivery in consideration of solder ability.**
- **As for chips in storage over 24 months, please check solder ability before use.**

(3) Caution for corrosive environment

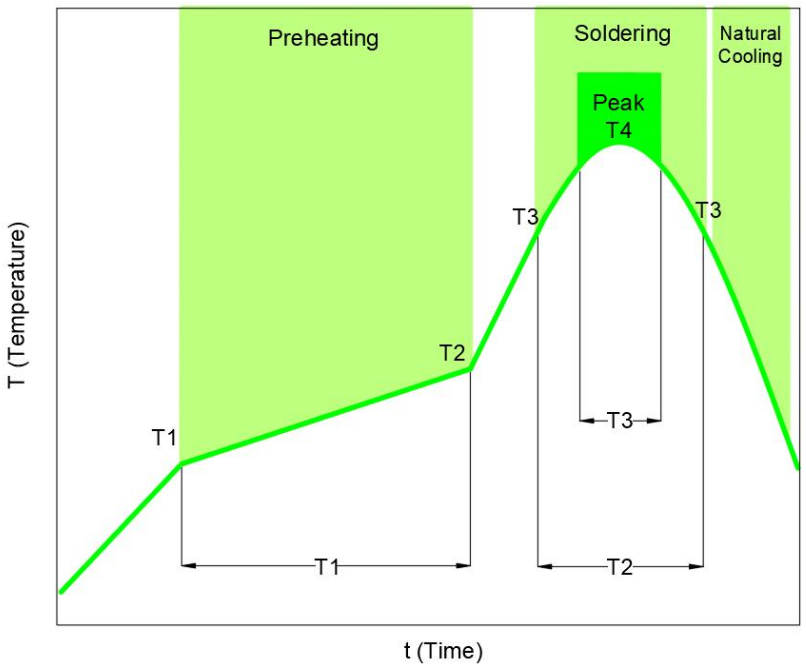
As corrosive gases may deteriorate the solder ability of chip outer termination, it is a must to store chip in an environment without gases. chip that is exposed to corrosive gases may cause its quality issues due to the corrosion of plating layers and the penetration of moisture.

Process of Mounting and Soldering

(1) 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%)

(2) 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 ΔT in the solder iron and preheating temperature;

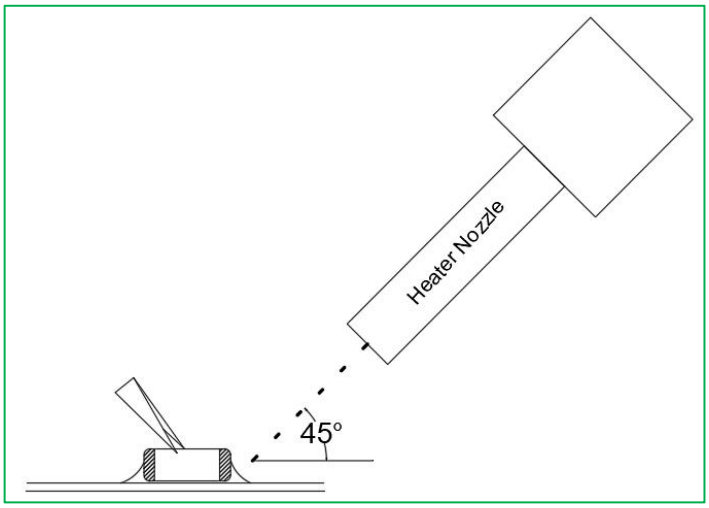
b. Caution - Iron tip should not contact with ceramic body directly;

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

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

(3) 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.

⚠ 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