GRACE

SPECIFICATION

ROHS Compliant Parts

Customer :

Part Name : Chip PTC Thermistor

Part Number : KPTC-S Series

Dongguan GRACE electronic Technology Co., LTD

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Chip PTC Thermistor — KPTC - S series

For **Overheat Sensing**

Features

- Suitable for miniaturizing circuits due to small size SMD type
- Fast response for overheating sensing with an accuracy of ±5℃
- 100% Pb free, RoHS

Applications

- For overheating detection in FET, power IC, and other heating areas.

Part Numbering

KPTC	0603	S	471	L	135	S	X	XXXX	T
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩

①	Series
GRACE Chip CPTC Thermistor	

②	Chip size (EIA)
0402	
0603	
0805	

③	Series code
P	Over Current Protection
S	Overheat Sensing

④	Nominal resistance R_{25}(Ω)
471	470
102	1,000
103	10,000

⑤	Resistance tolerance
M	±20%
N	±30%
L	±50%

⑥	Sensing Temperature (℃)
075	75
135	135

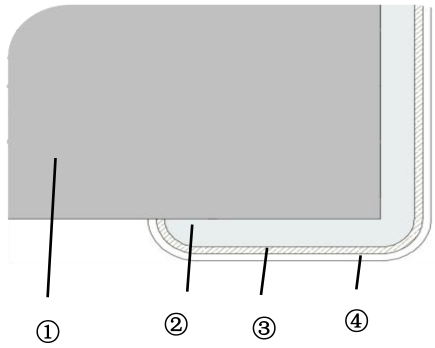
⑦	Sensing Temperature (℃)
S	Single sensing product
D	Dual sensing product

⑧	internal code
X	

⑨	Customer identification code
XXXX	

⑩	Packaging style
T	Tape
B	Bulk

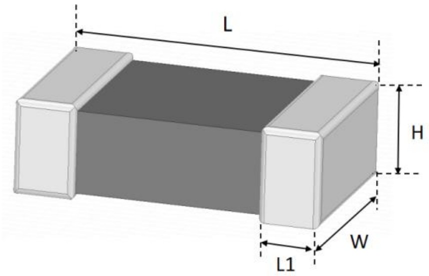
Construction



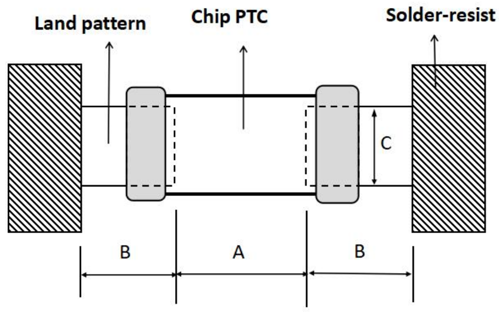
No.	Name	
①	PTC Semiconductive Ceramics	
②	Terminal electrode	Ag
③		Ni
④		Sn

Shape and Dimensions

1）Dimensions：



2）Recommended PCB pattern for reflow soldering:



Unit: mm

Size （EIA/JIS)	L	W	H	L1	A	B	C
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	0.45±0.25	0.80~1.20	0.80~1.20	0.90~1.60

Electrical Characteristics

Single sensing temperature 0402 Type

Part Number	Resistance @25℃	Sensing Temp.		Max. Voltage	Operating Temp.
	R_{25}(Ω)	Ts （℃）		V_{max}(V）	T_L~T_U （℃）
KPTC0402S471□095S□□T	470	95 ± 5	@4.7kΩ	32	-25 ~ 110
KPTC0402S471□105S□□T		105 ± 5			-25 ~ 120
KPTC0402S471□115S□□T		115 ± 5			-25 ~ 130
KPTC0402S471□125S□□T		125 ± 5			-25 ~ 140
KPTC0402S102□085S□□T	1,000	85 ± 5	@10kΩ		-25 ~ 100
KPTC0402S102□125S□□T		125 ± 5			-25 ~ 140
KPTC0402S103□080S□□T	10,000	80 ± 5	@4.7MΩ		-25 ~ 95
KPTC0402S103□095S□□T		95 ± 5			-25 ~ 110
KPTC0402S103□100S□□T		100 ± 5			-25 ~ 115
KPTC0402S103□110S□□T		110 ± 5			-25 ~ 125

KPTC0402S103□120S□□T		120 ± 5			-25 ~ 135
KPTC0402S103□130S□□T		130 ± 5			-25 ~ 145
KPTC0402S473□130S□□T	47,000	130 ± 5	@4.7MΩ		-25 ~ 145

Single sensing temperature 0603 Type

Part Number	Resistance @25℃	Sensing Temp.		Max. Voltage	Operating Temp.
	R_{25}(Ω)	Ts （℃）		V_{max}(V)	T_L~T_U （℃）
KPTC0603S101□115S□□T	100	115 ± 7	@1KΩ	24	-25 ~ 130
KPTC0603S101□130S□□T		130 ± 7			-25 ~ 145
KPTC0603S221□090S□□T	220	90 ± 7	@2.2KΩ		-25 ~ 105
KPTC0603S221□105S□□T		105 ± 7			-25 ~ 120
KPTC0603S471□065S□□T	470	65 ± 5	@4.7KΩ	32	-25 ~ 80
KPTC0603S471□075S□□T		75 ± 5			-25 ~ 90
KPTC0603S471□080S□□T		80 ± 5			-25 ~ 95
KPTC0603S471□085S□□T		85 ± 5			-25 ~ 100
KPTC0603S471□095S□□T		95 ± 5			-25 ~ 110
KPTC0603S471□100S□□T		100 ± 5			-25 ~ 115
KPTC0603S471□105S□□T		105 ± 5			-25 ~ 120
KPTC0603S471□110S□□T		110 ± 5			-25 ~ 125
KPTC0603S471□115S□□T		115 ± 5			-25 ~ 130
KPTC0603S471□125S□□T		125 ± 5			-25 ~ 140
KPTC0603S471□135S□□T		135 ± 5			-25 ~ 150
KPTC0603S102□095S□□T	1,000	95±5	@4.7MΩ	32	-25 ~ 110
KPTC0603S102□105S□□T		105±5			-25 ~ 120
KPTC0603S102□115S□□T		115±5			-25 ~ 130
KPTC0603S103□075S□□T	10,000	75±5	@4.7MΩ	32	-25 ~ 90
KPTC0603S103□080S□□T		80±5			-25 ~ 95
KPTC0603S103□110S□□T		110±5			-25 ~ 125
KPTC0603S103□120S□□T		120±5			-25 ~ 135
KPTC0603S103□130S□□T		130±5			-25 ~ 145
KPTC0603S473□130S□□T	47,000	130±5	@4.7MΩ	32	-25 ~ 145

Single sensing temperature 0805 Type

Part Number	Resistance @25℃	Sensing Temp.		Max. Voltage	Operating Temp.
	R_{25}(Ω)	Ts （℃）		V_{max}(V)	T_L~T_U （℃）
KPTC0805S150□130S□□T	15	130±7	@1KΩ	32	-25 ~ 145
KPTC0805S101□110S□□T	100	110±7	@1KΩ	24	-25 ~ 125
KPTC0805S101□115S□□T		115±7			-25 ~ 130
KPTC0805S101□130S□□T		130±7			-25 ~ 145
KPTC0805S471□065S□□T	470	65±5	@4.7KΩ	32	-25 ~ 80
KPTC0805S471□075S□□T		75±5			-25 ~ 90
KPTC0805S471□085S□□T		85±5			-25 ~ 100
KPTC0805S471□090S□□T		90±5			-25 ~ 105
KPTC0805S471□095S□□T		95±5			-25 ~ 110
KPTC0805S471□100S□□T		100±5			-25 ~ 115
KPTC0805S471□105S□□T		105±5			-25 ~ 120
KPTC0805S471□115S□□T		115±5			-25 ~ 130
KPTC0805S471□120S□□T		120±5			-25 ~ 135
KPTC0805S471□125S□□T		125±5			-25 ~ 140
KPTC0805S471□135S□□T		135±5			-25 ~ 150
KPTC0805S103□110S□□T	10,000	110±5	@4.7MΩ	32	-25 ~ 125
KPTC0805S103□130S□□T		130±5			-25 ~ 145

Dual sensing temperature 0402 Type

Part Number	Resistance @25℃	Sensing Temp.1		Sensing Temp.2		Max. Voltage	Operating Temp.
	R_{25}(Ω)	Ts1（℃）		Ts2（℃）		V_{max}(V)	T_L~T_U （℃）
KPTC0402S471□115D□□T	470	115 ± 5	@4.7KΩ	130 ± 7	@47KΩ	32	-25 ~ 140
KPTC0402S541□115D□□T	540	115 ± 5		135 ± 7			-25 ~ 150
KPTC0402S102□065D□□T	1,000	65±5	@10KΩ	80±5	@100KΩ	32	-40 ~ 90
KPTC0402S102□075D□□T		75±5		90±5			-40 ~ 100
KPTC0402S102□085D□□T		85±5		100±5			-40 ~ 110
KPTC0402S102□095D□□T		95±5		110±5			-40 ~ 120
KPTC0402S102□105D□□T		105±5		120±3			-40 ~ 130
KPTC0402S102□115D□□T		115±5		130±5			-40 ~ 140
KPTC0402S102□125D□□T		125±5		140±5			-40 ~ 150

Dual sensing temperature 0603 Type

Part Number	Resistance @25℃	Sensing Temp.1		Sensing Temp.2		Max. Voltage	Operating Temp.
	R_{25}(Ω)	Ts1（℃）		Ts2（℃）		V_{max}(V)	T_L~T_U（℃）
KPTC0603S471□065D□□T		65±5		80±7			-25 ~ 90
KPTC0603S471□075D□□T		75±5		90±7			-25 ~ 100
KPTC0603S471□085D□□T		85±5		100±7			-25 ~ 110
KPTC0603S471□095D□□T		95±5		110±7			-25 ~ 120
KPTC0603S471□105D□□T	470	105±5	@4.7KΩ	120±7	@47KΩ	32	-25 ~ 130
KPTC0603S471□115D□□T		115±5		130±7			-25 ~ 140
KPTC0603S471□125D□□T		125±5		140±7			-25 ~ 150
KPTC0603S471□130D□□T		130±5		145±5			-25 ~ 155
KPTC0603S471□135D□□T		135±5		150±7			-25 ~ 160

※ The above data were tested in stationary air at 25℃ with unmounted independent units.

Description and definition of terms

No.	Items	Test Methods and Remarks
1	Nominal Zero-Power Resistance (R25)	Ambient temperature: 25±0.2℃. Measuring electric power: 0.1mW Max.
2	Sensing Temperature	In the current voltage characteristics of PTC, the temperature when the resistance rises sharply
3	Max. Voltage	Refers to the maximum voltage that can be applied to PCT within the working temperature range

Reliability Test

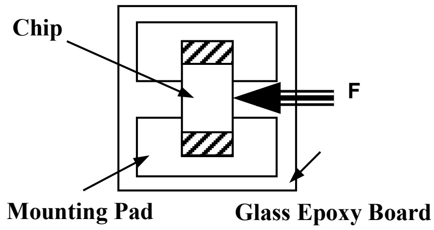
<table>
<tr><th>Items</th><th>Requirements</th><th>Test Methods and Remarks</th></tr>
<tr><td>Terminal Strength</td><td>No removal or split of the termination or other defects shall occur.


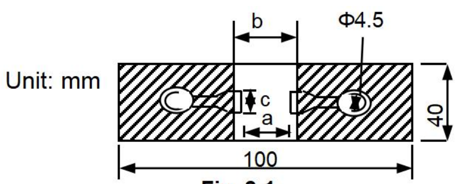
Fig.1-1</td><td>Solder the chip to the testing jig (glass epoxy board shown in the following Fig. 1-1) using eutectic solder. Then apply a force in the direction of the arrow.
<table>
<tr><th>Size（EIA）</th><th>Force</th><th>Duration</th></tr>
<tr><td>0402、0603</td><td>5N</td><td rowspan="2">10±1s</td></tr>
<tr><td>0805</td><td>10N</td></tr>
</table></td></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>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>
</table>


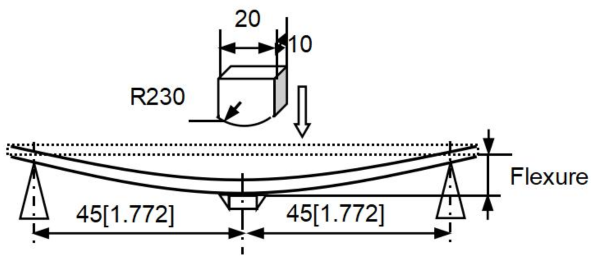
Fig. 2-1</td><td>Solder the chip to the test jig (glass epoxy board shown in Fig.2-1) using a eutectic solder. Then apply a force in the direction shown in Fig. 2-2.
<table>
<tr><th>Size（EIA）</th><th>Flexure</th><th>Pressurizing Speed</th><th>Duration</th></tr>
<tr><td>0402、0603、0805</td><td>2mm</td>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


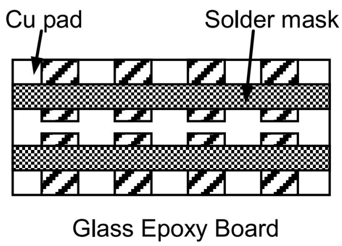
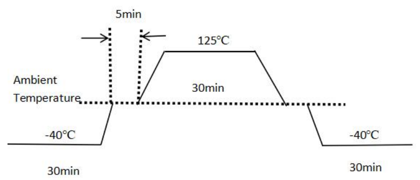
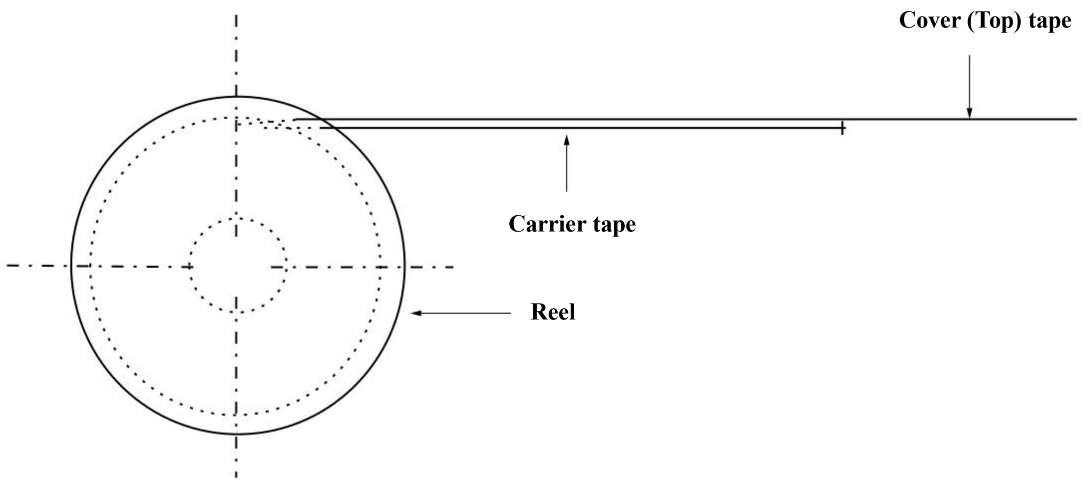
Fig.2-2</td></tr>
<tr><td>Vibration</td><td>No visible mechanical damage.


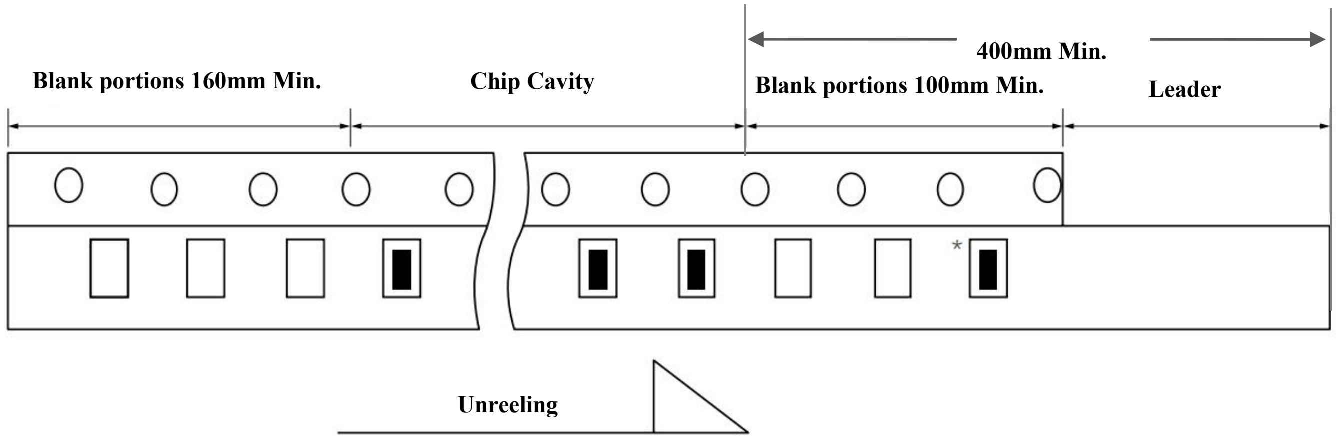
Fig. 3-1</td><td>❖ Solder the chip to the testing jig (glass epoxy board shown in Fig.3-1) using eutectic solder.
❖ The chip shall be subjected to a simple harmonic motion having total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55 Hz.
❖ The frequency 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>Dropping</td><td>No visible mechanical damage.</td><td>Drop chip inductor 10 times on a concrete floor from a height of 100 cm.</td></tr>
<tr><td>Solderability</td><td>❖ No visible mechanical damage.
❖ Wetting shall exceed 80% coverage.</td><td>❖ Solder temperature: 245±2℃ .
❖ Duration: 3 sec.
❖ Solder: Sn/3.0Ag/0.5Cu.
❖ Flux: 25% Resin and 75% ethanol in weight.</td></tr>
</table>

Resistance to Soldering Heat	❖ No visible mechanical damage. ❖ R25 change: within ±20%. ❖ R25 change: within ±30%.(103/473)	❖ Solder temperature: 250±5℃ ❖ 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.
Thermal Shock	❖ No visible mechanical damage. ❖ R25 change: within ±20%. ❖ R25 change: within ±30%.(103/473) 	❖ Temperature, Time: -40℃ for 30±3 min→ 125℃ for 30±3min. ❖ Transforming interval: 5sec. Max. ❖ Tested cycle: 5 cycles. ❖ The chip shall be stabilized at normal condition for 1~2 hours before measuring.
Resistance to Low Temperature	❖ No visible mechanical damage. ❖ R25 change: within ±20%. ❖ R25 change: within ±30%.(103/473)	❖ Temperature: -40±3℃ ❖ Duration: 1000+24 hours. ❖ The chip shall be stabilized at normal condition for 1~2 hours before measuring.
Resistance to High Temperature	❖ No visible mechanical damage. ❖ R25 change: within ±20%. ❖ R25 change: within ±30%.(103/473)	❖ Temperature: 125±3℃ ❖ Duration: 1000+24 hours. ❖ The chip shall be stabilized at normal condition for 1~2 hours before measuring.
Damp Heat (Steady States)	❖ No visible mechanical damage. ❖ R25 change: within ±10%. ❖ R25 change: within ±30%.(103/473)	❖ Temperature: 60±2℃ ❖ Humidity: 90% to 95% RH. ❖ Duration: 1000+24 hours. ❖ The chip shall be stabilized at normal condition for 1~2 hours before measuring.
Loading at High Temperature (Life Test)	❖ No visible mechanical damage. ❖ R25 change: Within ±20%. ❖ R25 change: within ±30%.(103/473)	❖ 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.
Climatic sequence test	❖ No visible mechanical damage. ❖ R25 change: within ±20%. ❖ R25 change: within ±30%.(103/473)	❖ Temperature, Time: 125℃ for 16 hours ❖ First cycle: 40 ℃ 95%RH x 24 hours ❖ -40℃,2 hours ❖ Five cycles 40℃ 95% RH x 24 hours/time

Packaging

(1) Figure



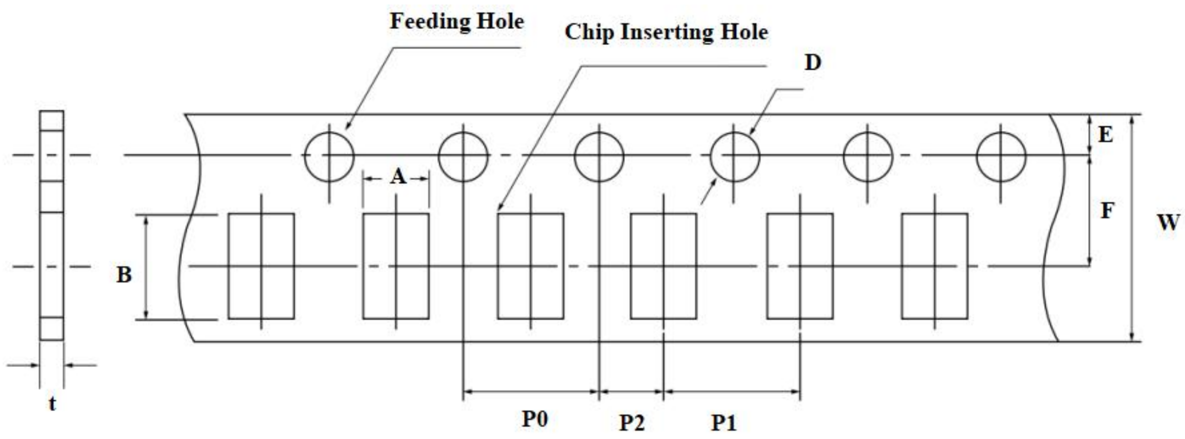


(2) Quantity

Size(EIA)		0402	0603	0805
Taping Type		PAPER	PAPER	PAPER
Quantity	Reel	10K	4K	4K
	Inner Box	10K×10=100K	4K×10=40K	4K×10=40K
	Outer Box	10K×10×6=600K	4K×10×6=240K	4K×10×6=240K

(3) Tape Size

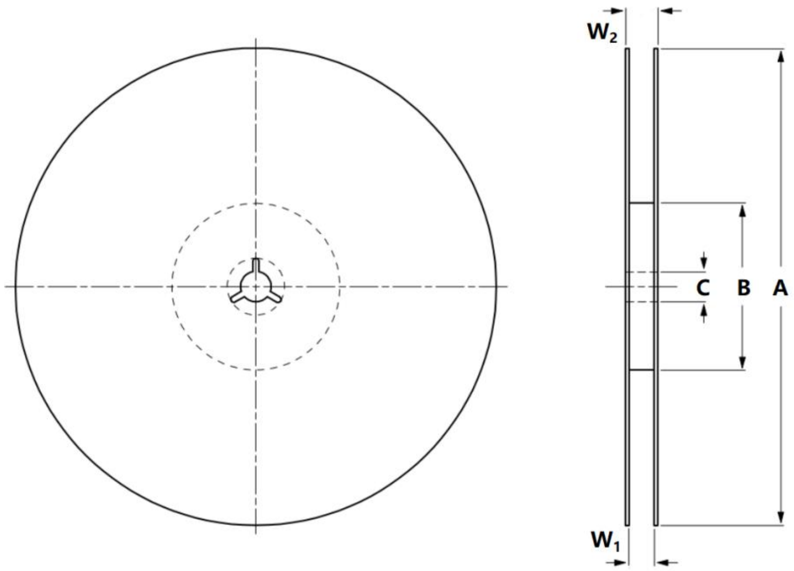
❖ Cardboard(Paper) tape



Unit: mm

Size (EIA)	A	B	W	F	E	P1	P2	P0	D	t
0402	0.65±0.1	1.15±0.1				2.00 ±0.05				≤0.8
0603	1.0±0.2	1.8±0.2	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	≤1.1
0805	1.5±0.2	2.3±0.2				4.00 ±0.10				≤1.1

(4) Reel Size

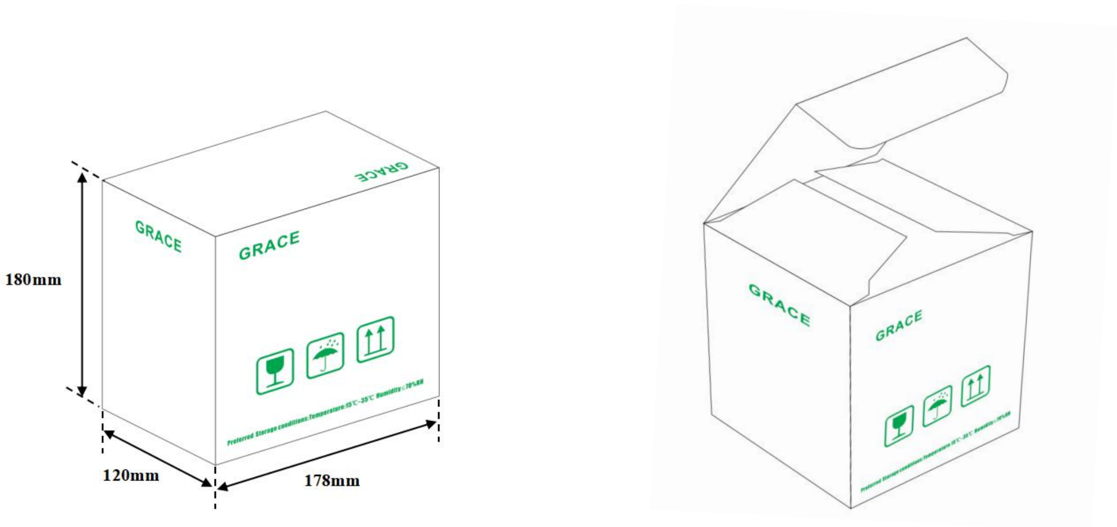


Type	Symbol	Dimensions(mm)
7” Reel	A	178±2
	B	58±2
	C	13.5±0.2
	W1	8.4+1.5/-0.0
	W2	≤14.4

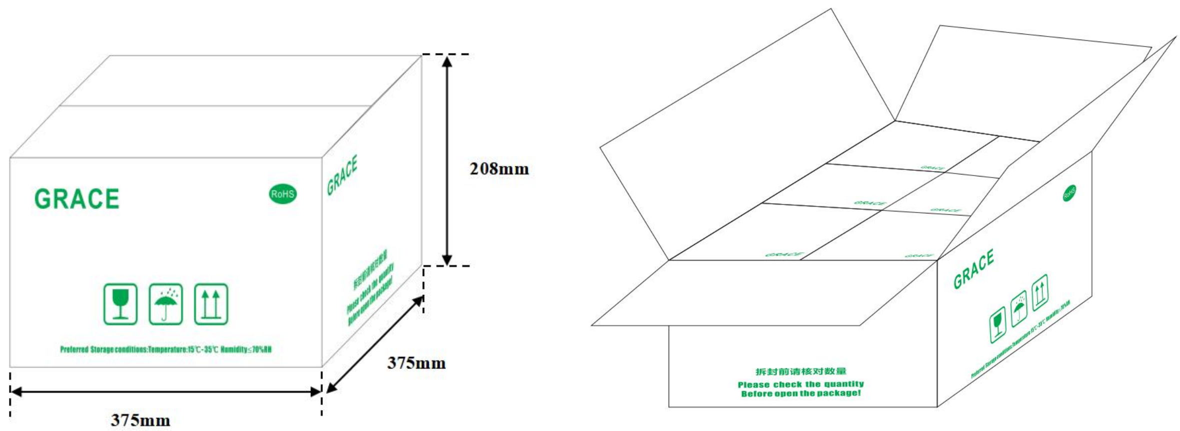
(5) BOX package

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.**

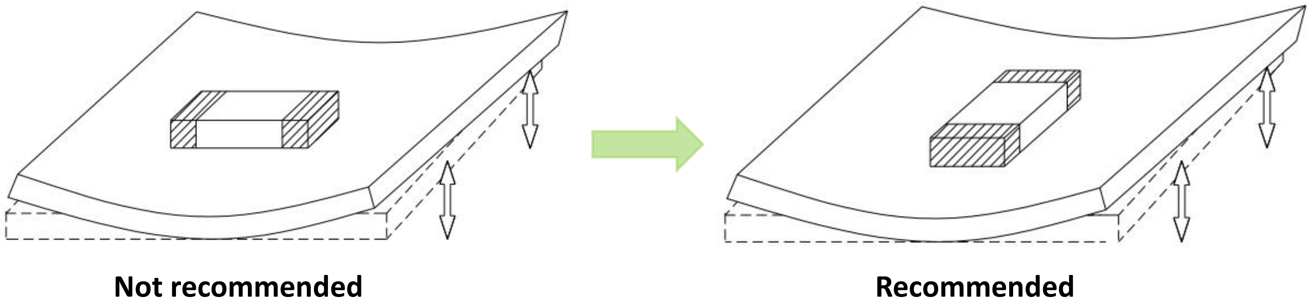
(3) Caution for corrosive environment

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

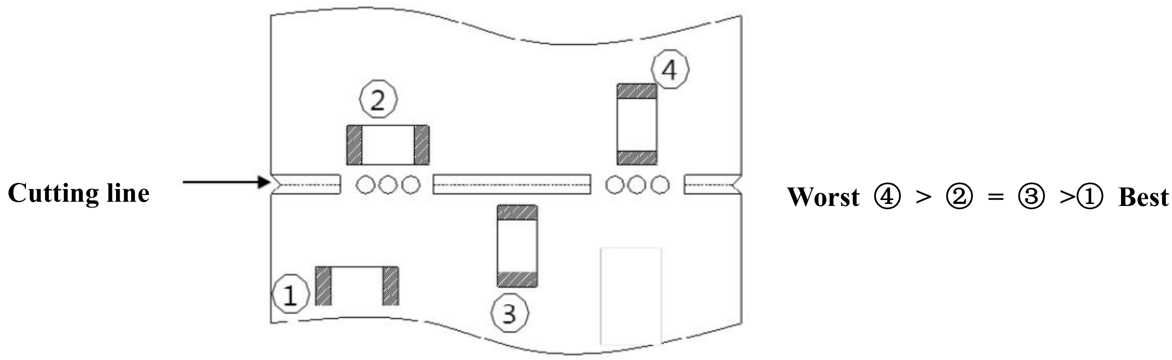
Process of Mounting and Soldering

(1) Mounting

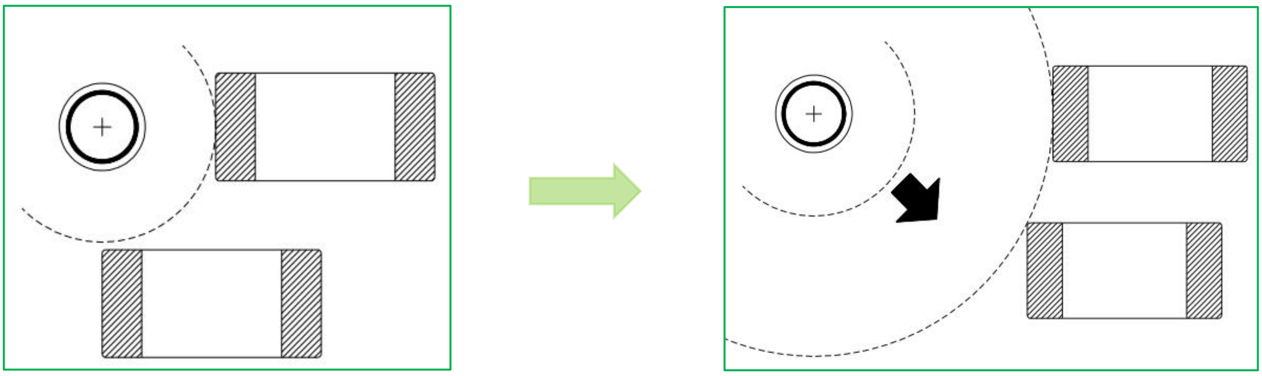
- **It is recommended to locate the major axis of chip in parallel to the direction in which the stress is applied.**



- **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.**

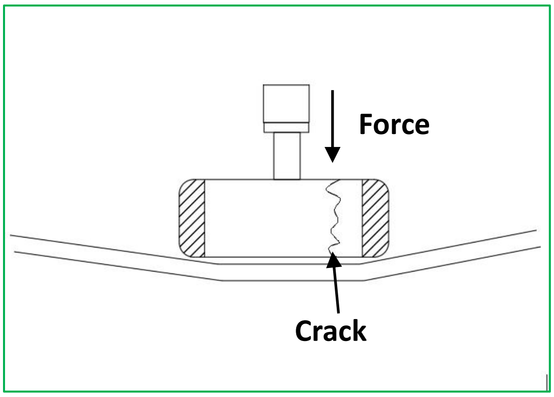


❖ **If the chip is mounted near a screw hole, the board deflection may be occurred by screw torque. Mount the chip as far from the screw holes as possible.**

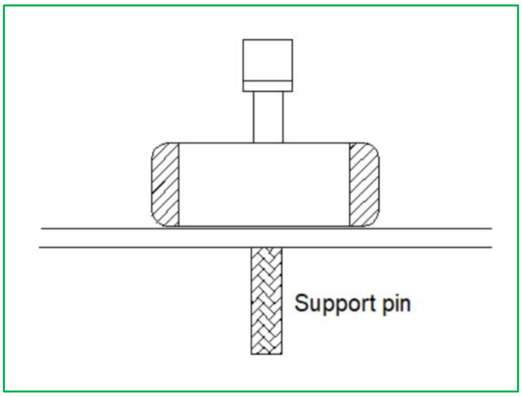


Not recommended **Recommended**

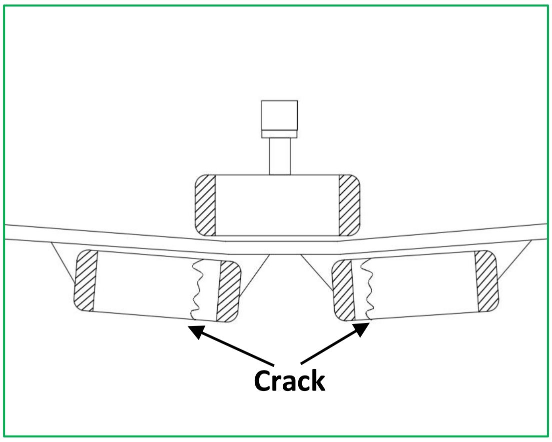
❖ **Substrate fixes up back surface of substrate with support pin in impact of suction nozzle to wely deflection to the utmost, and substrate hold deflection, please. A representative example is shown in the following.**



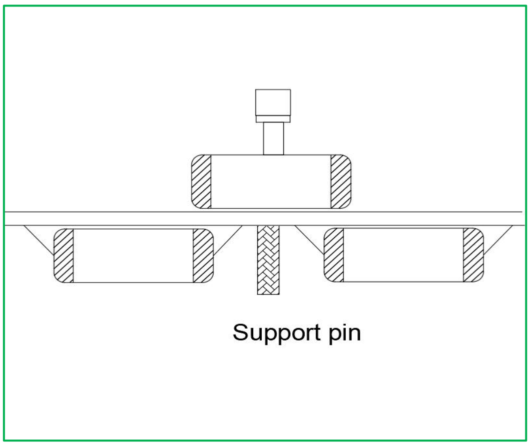
Cases to avoid



Recommended Case



Cases to avoid

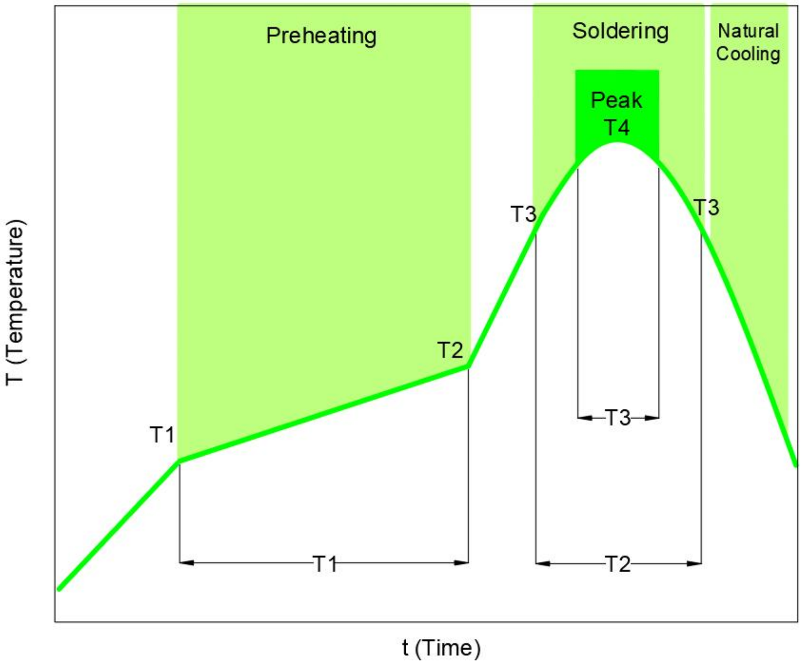


Recommended Case

※ **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 $\Delta T \leqq 150$ °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°C 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;**

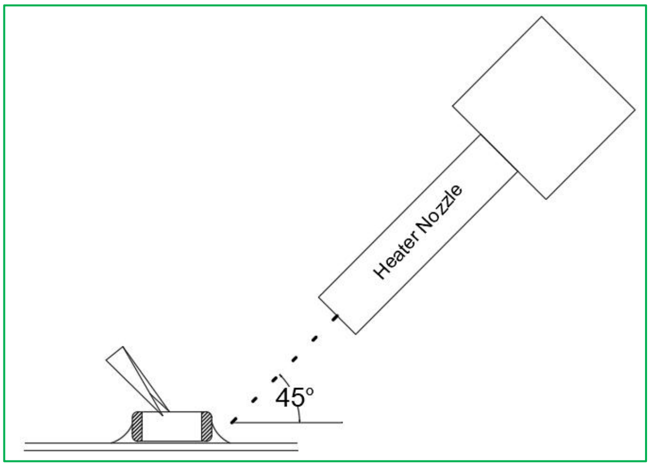
b. **Caution - Iron tip should not contact with ceramic body directly;**

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

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

(4) Spot heater

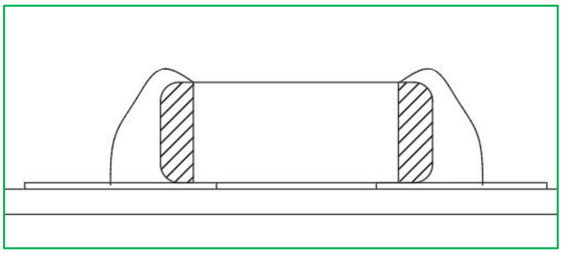
Compared to local heating with a soldering iron, hot air heating by a spot heater heats the overall component and board, therefore, it tends to lessen the thermal shock. In the case of a high density mounted board, a spot heater can also prevent concerns of the soldering iron making direct contact with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



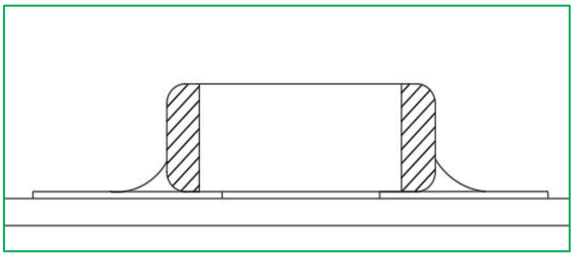
Distance	Hot Air Application angle	Hot Air Temperature Nozzle Outlet	Application Time
≥ 5mm	45°C	≤ 400°C	≤ 10s

※ **If the distance from the air nozzle outlet to the chip is too close, the chip may be cracked due to the thermal stress.**

(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**

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

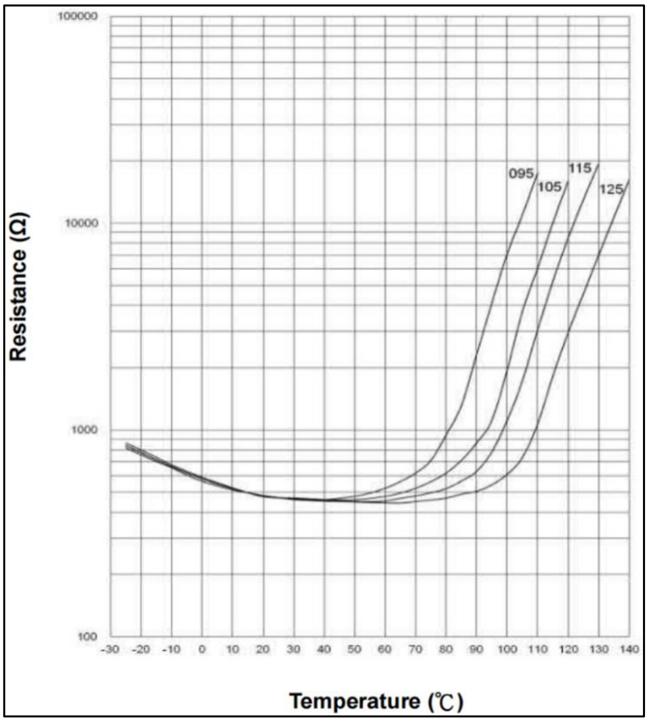
Limitation

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

Resistance-Temperature Characteristics (Typical)



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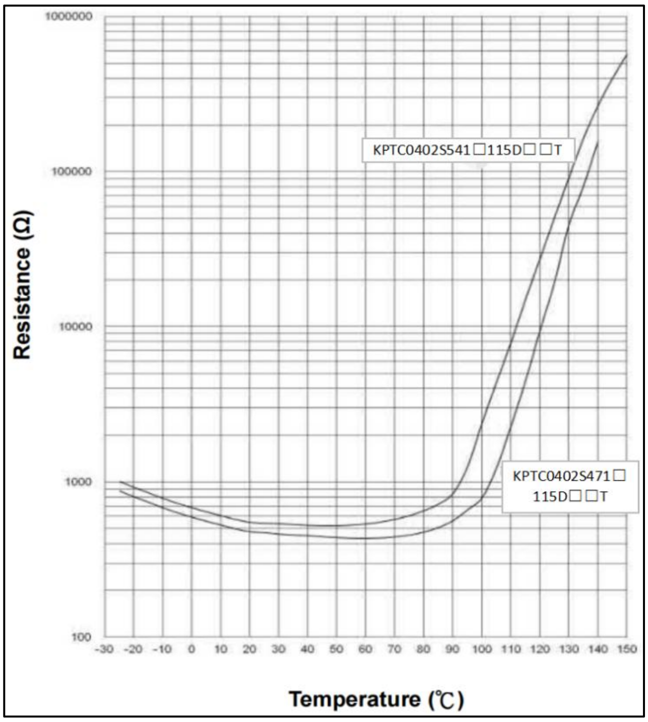

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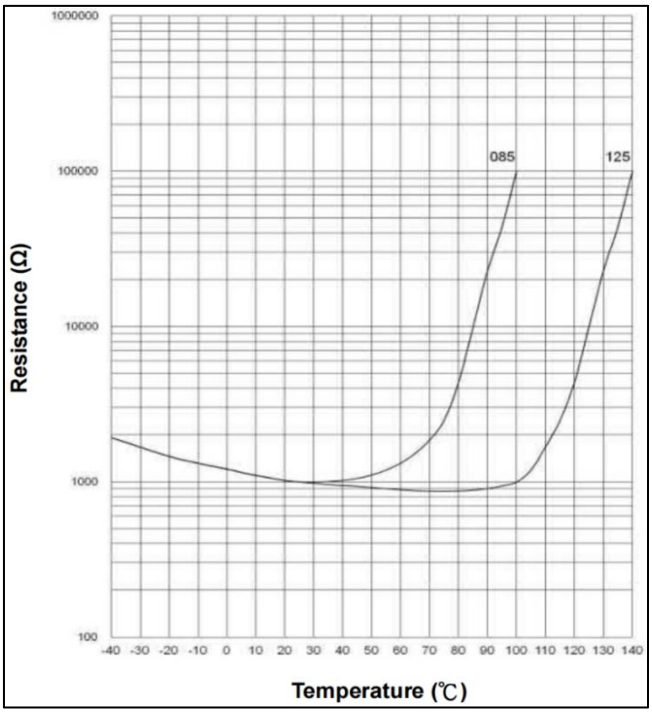

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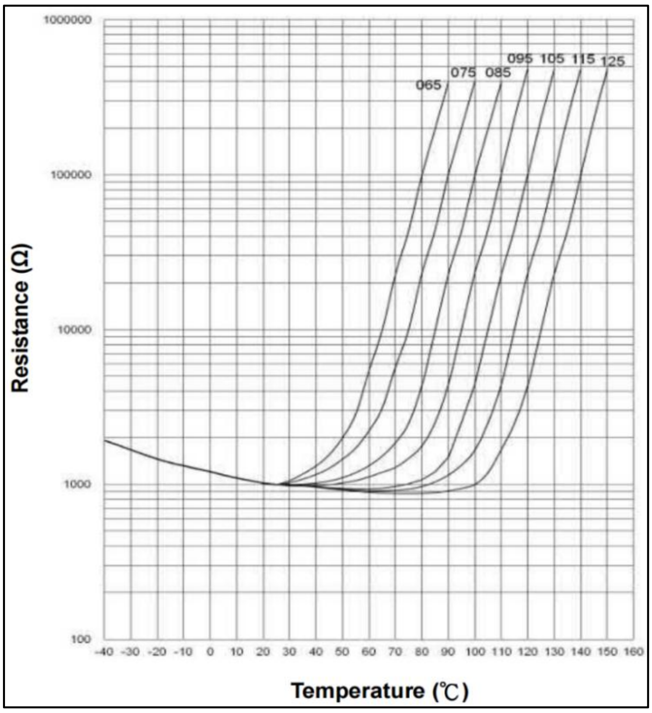

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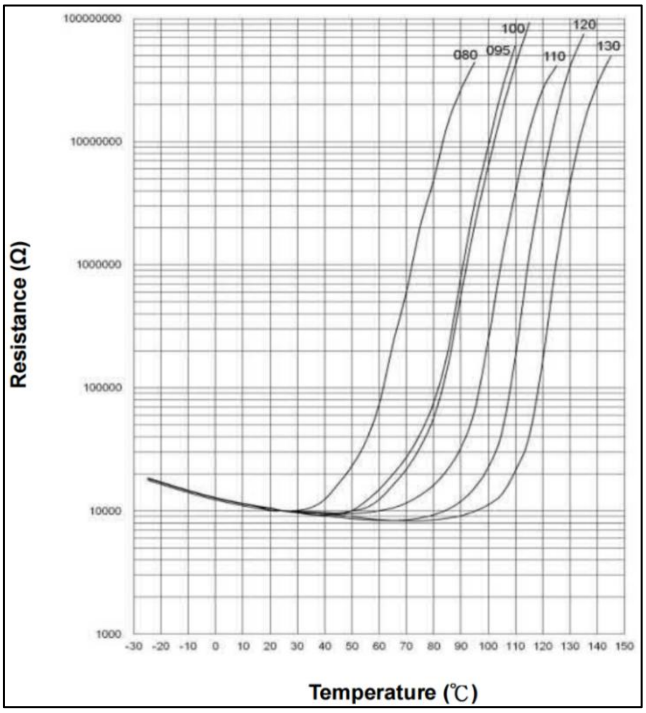

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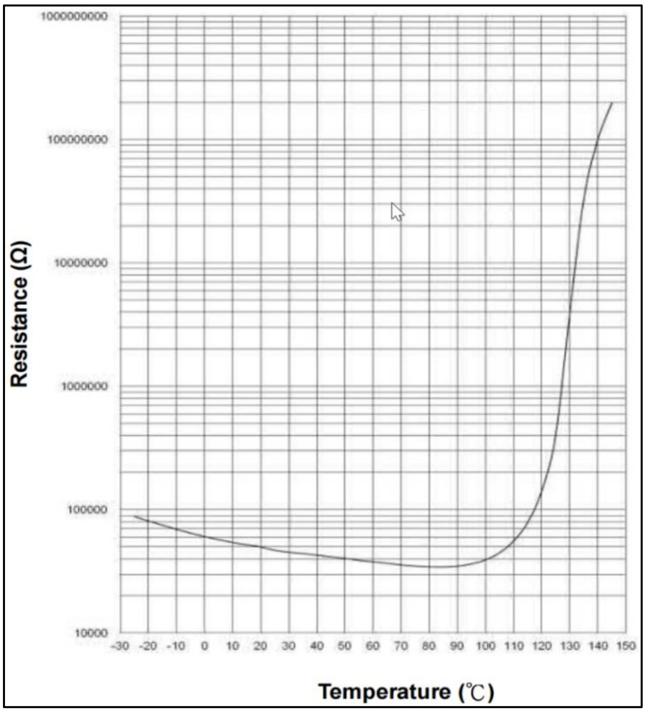

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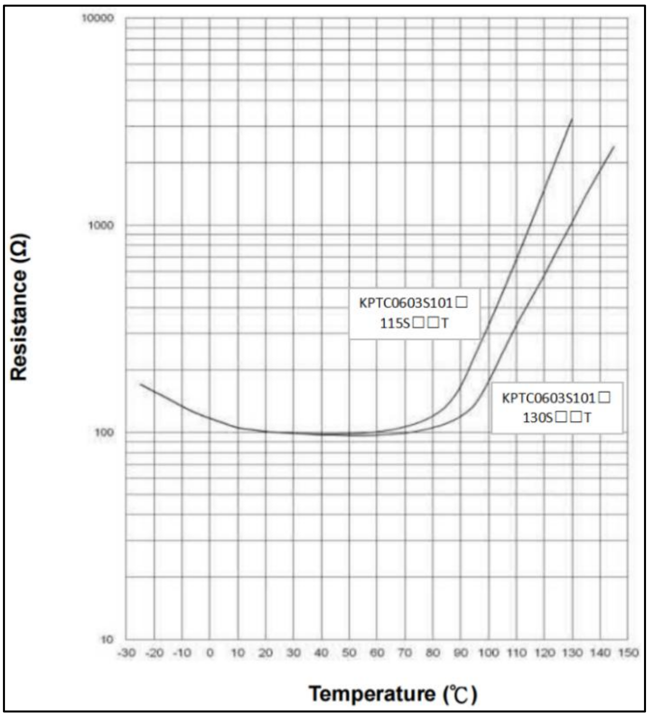

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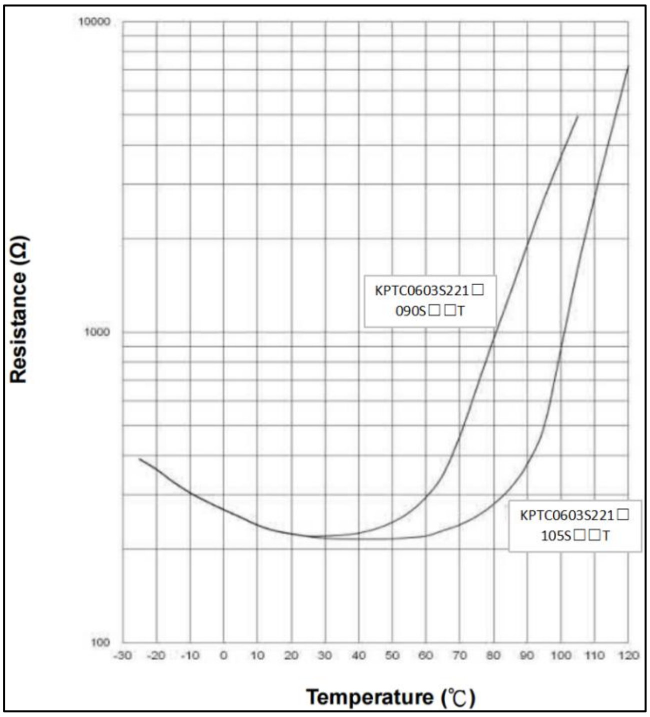

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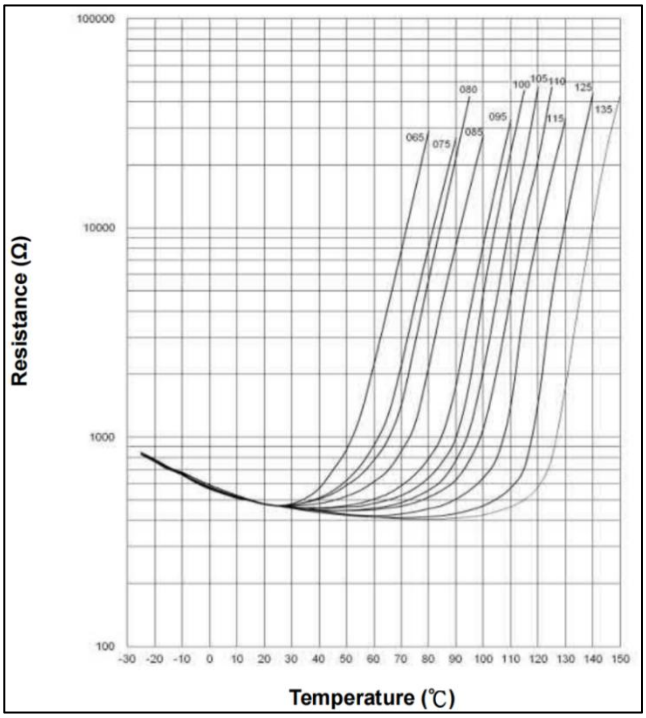

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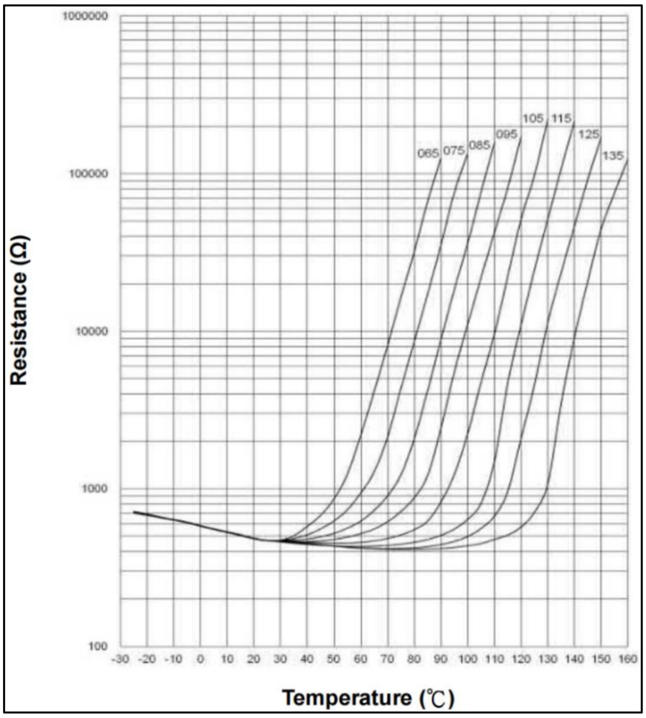

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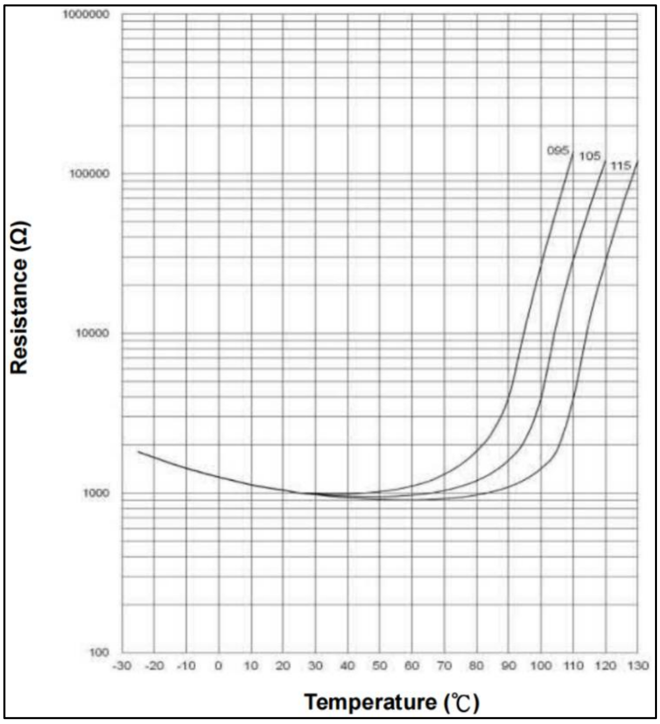

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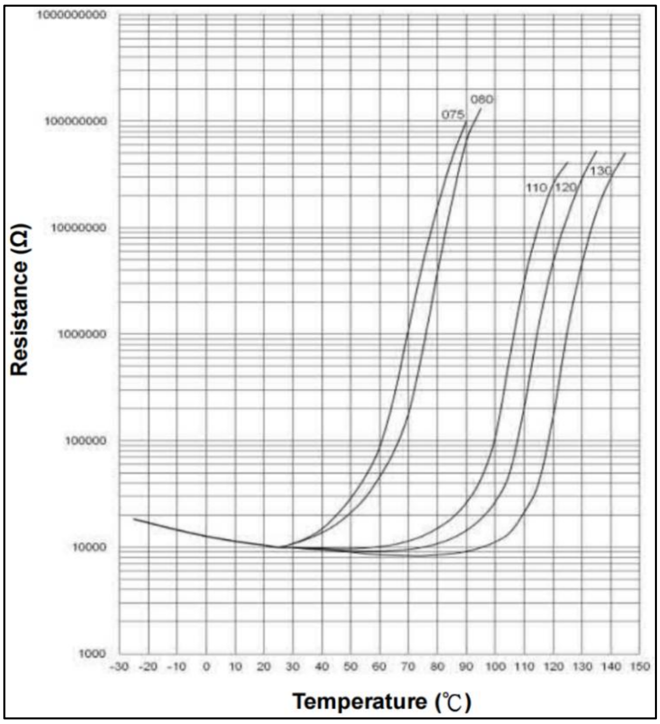

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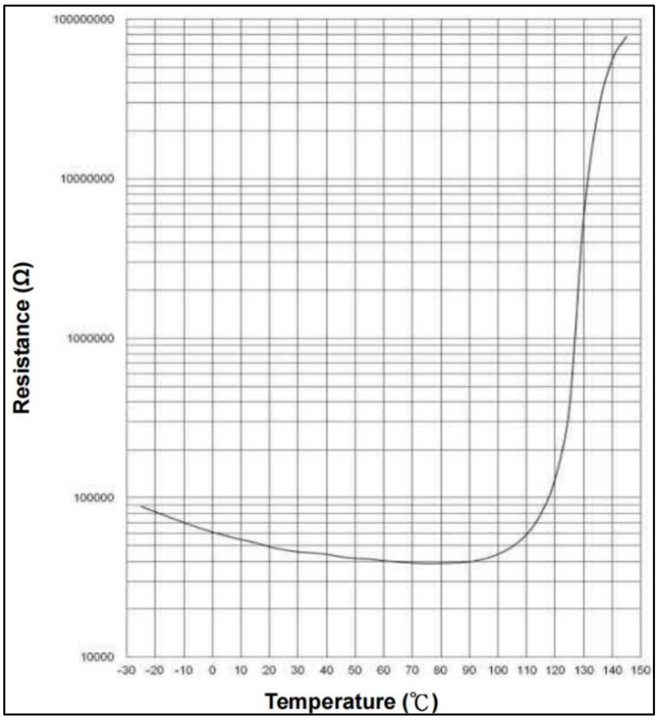

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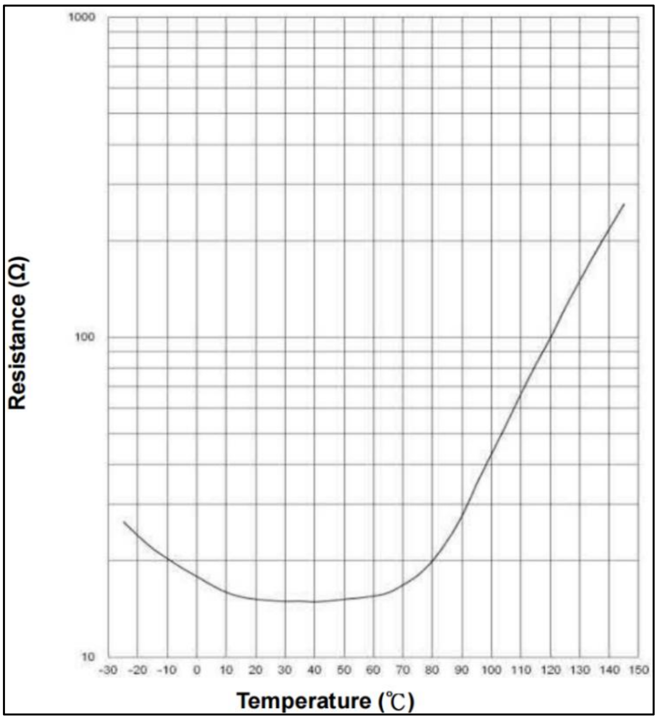

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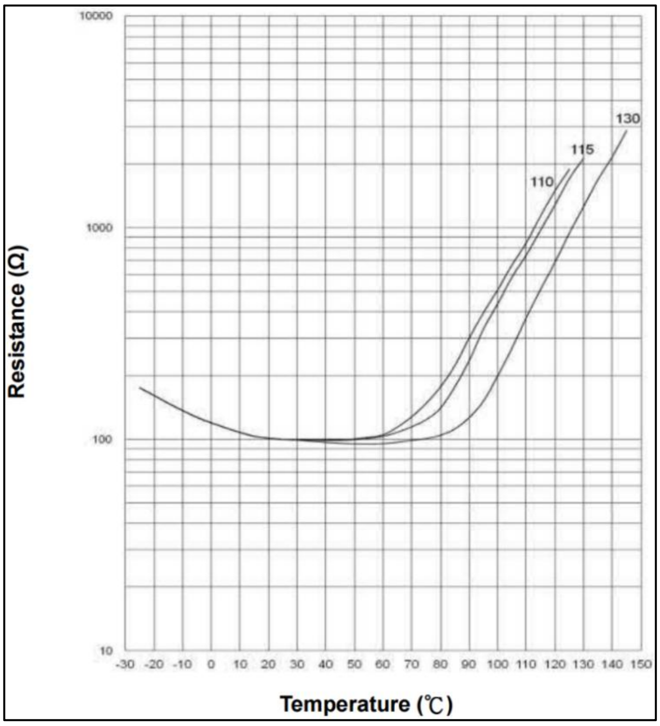

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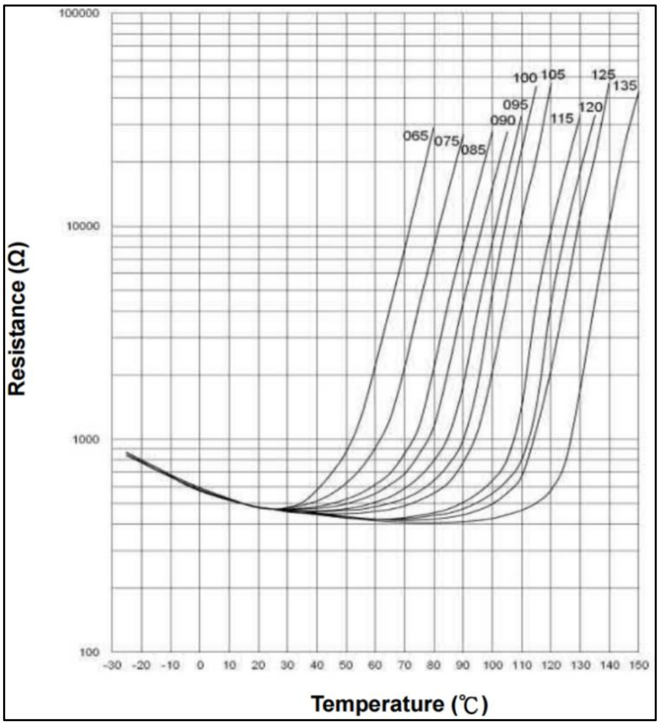

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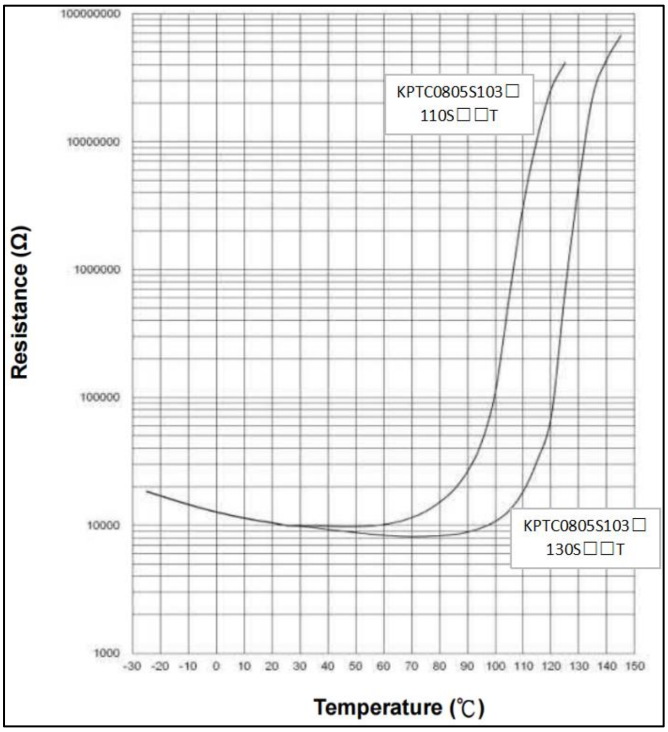

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