

Resistors

Notes

Precautions for handling resistors are listed.

Precaution on using ROHM Products

1) If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment^{Note1}, aircraft/spacecraft, nuclear power controllers, etc.) and whose malfunction or failure may cause loss of human life, bodily injury or serious damage to property (“Specific Applications”), please consult with the ROHM sales representative in advance. Unless otherwise agreed in writing by ROHM in advance, ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of any ROHM’s Products for Specific Applications.

Note1 Medical Equipment classification of the specific applications

Japan	USA	EU	China
CLASS III	CLASS III	CLASS II	CLASS III
CLASS IV		CLASS III	

2) Our Products are not designed under any special or extraordinary environments or conditions, as exemplified below. Accordingly, ROHM shall not be in any way responsible or liable for any damages, expenses or losses arising from the use of any ROHM’s Products under any special or extraordinary environments or conditions. If you intend to use our Products under any special or extraordinary environments or conditions (as exemplified below), your independent verification and confirmation of product performance, reliability, etc, prior to use, must be necessary:

- [a] Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
- [b] Use of our Products outdoors or in places where the Products are exposed to direct sunlight, or dust
- [c] Use of our Products in places where the Products are exposed to sea winds or corrosive gases, including Cl₂, H₂S, NH₃, SO₂, and NO₂
- [d] Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
- [e] Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
- [f] Sealing or coating our Products with resin or other coating materials
- [g] Use of our Products without cleaning residue of flux (even if you use non-clean type fluxes, cleaning residue of flux is recommended); or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
- [h] Use of the Products in places subject to dew condensation.

3) The Products are not subject to radiation-proof design.

4) Please verify and confirm characteristics of the final or mounted products in using the Products.

5) In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse) is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.

6) De-rate Power Dissipation depending on Derating curve.

When used in sealed area, confirm that the actual ambient temperature and supplying power satisfy the derating curve.

7) In large current circuit, in addition to joule heating occurred in resistor, joule heating occurred in wiring pattern or soldering cannot be ignored, which might cause large heat generation as total circuit. Please use thick and wide wiring pattern with adequate heat releasing design, and be sure to check the temperature increase in prior.

8) Product may be damaged when the impact, such as downfall is given.

9) When product safety related problems arises, please immediately inform to ROHM, and consider technical counter measure.

Precaution for Mounting / Circuit board design.

- 1) When a highly active halogenous (chlorine, bromine, etc.) flux is used, the remainder of flux may negatively affect product performance and reliability.
- 2) In principle, the reflow soldering method must be used; if flow soldering method is preferred, please consult with the Company in advance.
- 3) The component temperature could exceed maximum operation temperature depending on the type of mounting board material, the wiring pattern, heat dissipation from the surrounding components and ambient temperature, not necessarily relevant to the loaded power. Make sure in advance you use it in the condition that it does not damage the mounting board and the surrounding components.
- 4) In the ultra-low resistance value range, the resistance value after soldering may change depending on the size of pad pattern, the wiring pattern or solder amount. Make sure the effect of the change of the resistance value before you use it.
- 5) Pay attention to the soldering condition in order to avoid problems due to silver absorption into solder.
- 6) Be careful when pick up the products with tweezers. There may be a case that the overcoat and /or the body can be chipped.
- 7) Soldering tip shall not touch the product when install product manually.
- 8) After mounting, if there is possibility of contact to the top surface of products (wiping work by waste etc...), please use the product after confirming sufficient influence on the top surface of the product.

Precautions Regarding Application Examples and External Circuits

- 1) If change is made to the constant of an external circuit, allow a sufficient margin due to variations of the characteristics of the products and external components, including transient characteristics, as well as static characteristics.
- 2) You agree that application notes, reference designs, and associated data and information contained in this document are presented only as guidance for Products use. Therefore, in case you use such information, you are solely responsible for it and you must exercise your own independent verification and judgment in the use of such information contained in this document. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of such information.
- 3) In the ultra-low resistance value range, the parasitic inductance of the chip and the wiring pattern may influence current detection under high frequency usage. Make sure the effect before you use it.

Precaution for Electrostatic

This product is Electrostatic sensitive product, which may be damaged due to Electrostatic discharge. Please take proper caution during manufacturing and storing so that voltage exceeding Product maximum rating won't be applied to products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control).

Precaution for Storage / Transportation

- 1) Product performance and soldered connections may deteriorate if the products are stored in the following places:
 - [a] Where the products are exposed to sea winds or corrosive gases, including Cl₂, H₂S, NH₃, SO₂, and NO₂
 - [b] Where the temperature or humidity exceeds those recommended by the Company
Temperature: 5°C - 40°C, Humidity 30% - 80%
 - [c] Storage in direct sunshine or condensation
 - [d] Storage in high Electrostatic
- 2) Even under ROHM recommended storage condition, solderability of products over 1 year old from the date of delivery may be degraded.
It is strongly recommended to confirm solderability before using products of which storage time is exceeding recommended storage time period.
 - Recommended storage condition: Temperature 5°C - 40°C, Humidity 30% - 80%
- 3) Store / transport cartons in the correct direction, which is indicated on a carton as a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.

Precaution for product label

QR code printed on ROHM product label is for internal use only, and please do not use at customer site.

Precaution for disposition

When disposing Products please dispose them properly using an authorized industry waste company.

Precaution for Foreign exchange and Foreign Trade act

Resistor That Rohm Co., Ltd. sells is not an object of controlled goods in Annex 1(Item 1~15) of Export Trade Control Order.

But it is an object of controlled goods in Annex 1(Item 16) of Export Trade Control Order. In case of export, please confirm if it applies to "objective" criteria or an "informed"(by MITT clause) on the basis of "catch-all" controls for Non-Proliferation of Weapons of Mass Destruction.

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Overload failure mechanism

1) The failure mechanism of the component when an overload voltage is applied is explained below.

(Internal structure of chip resistor)

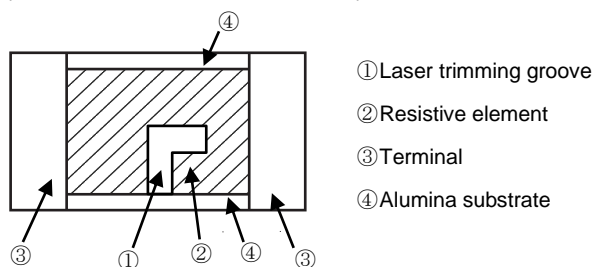


Fig.1

(Current flow concentration region)

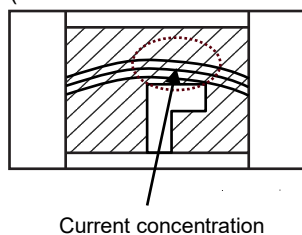


Fig.2

Current flow concentrated in the region left after laser trimming (the region marked with the circle).

(Cutoff due to melting)

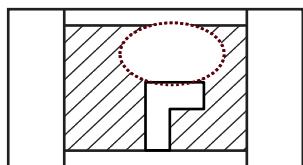


Fig.3

When an overload voltage is applied, Joule heating caused by this current concentration causes the local temperature to rise. The heat generated is dissipated via the ceramic substrate. If the amount of heat generated is greater than the amount that be dissipated, the temperature that the resistor body and glass coating can withstand will be exceeded and partial melting will occur. Higher overload voltages can cause complete melting of the resistive material left after laser trimming.

2) Failure mode analysis

Thermal dissipation: Heat generated is transmitted from the electrodes to the solder to the PCB, and from the alumina substrate to the PCB. Therefore, the failure mode is determined by the amount of heat generated, and the thermal dissipation balance.

Failure mechanism due to over voltage

When an overload voltage is applied, the resistance value drops at first, then increases as the overload voltage is increased, until ultimately the component goes open circuit. This is illustrated in Fig.4.

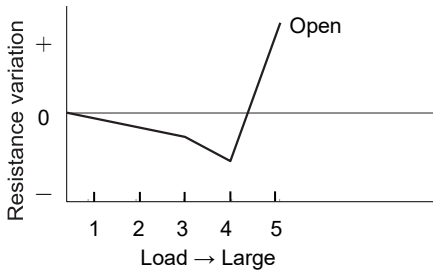
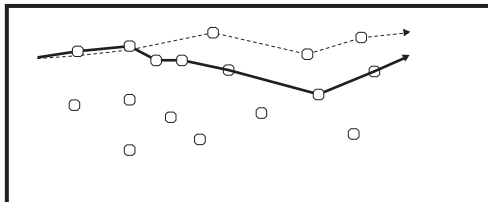


Fig.4

- 1) The dielectric component in the resistor (glass) is destroyed, and the resistance drops (short circuit).
- 2) If a higher load is applied, chemical reduction of the metal oxide in the resistor occurs, a pure metal component with higher conductivity is formed. In other words, the resistance drops further.
- 3) If the load is increased further, thermal decomposition of the dielectric occurs which further increases the shorting.



- : RuO₂ (ruthenium oxide)
- Other : glass
- : Percolation-pass
- : Percolation-pass (after a highly overload)

Fig.5

- 4) If the load is increased further, the metal conductive component heats up, and the resistance starts to increase. Under certain conditions, the resistor body melts or cracks, and due to differences in thermal expansion rates, the resistor body separates.

Bending of the resistor body, separation of the electrodes and countermeasures

1) Mounting orientation of chip resistors

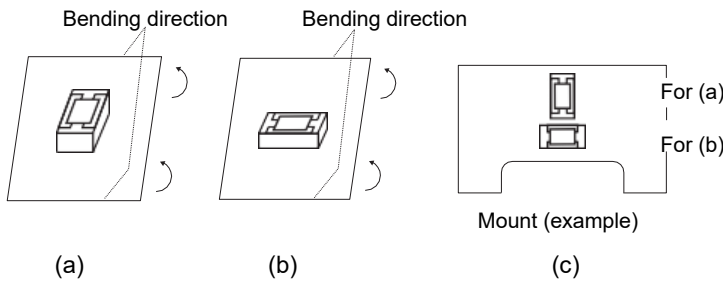


Fig.6

In terms of the strength of the stress applied to components a and b, b receives the greater stress.

2) Points to note regarding separated boards

Component d receives the greatest bending stress, followed by b, a and c in that order. With this pattern layout, separation of the electrodes due to bending stress is most likely to occur with components d, b and a. For this reason, the layout pattern should be revised so that d, b and a are subject to the same bending stress as c.

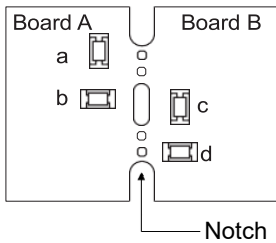


Fig.7

Body bending and countermeasures

When applying adhesive with a dispenser to a board that already has chip resistors soldered onto the rear of the board, if the nozzle of the dispenser is too low, it will warp the board and may damage the solder connections and components on the rear of the board.

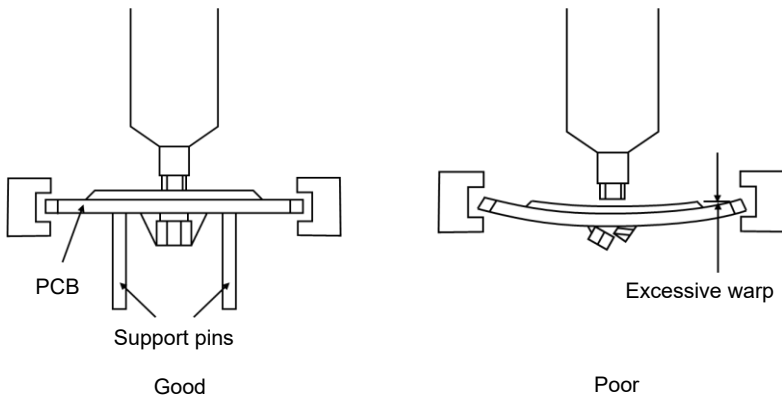


Fig.8

Set the nozzle to between 0 and 0.5mm above the surface of the board, and use support pins below the board to prevent warping. Be certain to check this again after changing the nozzle or adhesive syringe.

Electrode separation and countermeasures

It is necessary to arrange the placement of the components so that they do not take too much of the installation solder. When chip and lead components are mounted together, or when mounting chip components near a chassis, partition the land so that excessive amounts of installation solder are not used (Fig.9). When using flow soldering, soldering problems may arise due to the placement of the components and the flow method of the board, so care is required. This is most like to occur when small components are in the shadow of large components.

	Poor example	Improved example by land separation
Combined with components with leads		
Installation close to chassis		
Subsequent attachment of components with leads		
Side placement		

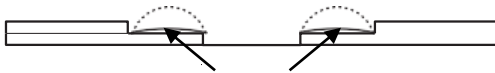
Fig.9

Hand-soldering chip resistors

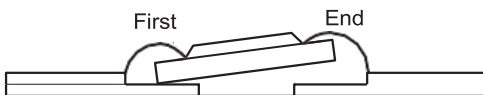
Note the following points with regard to hand-soldering chip resistors.

- 1) Soldering iron tip temperature : 350°C
- 2) Solder correction time : Max. 3s
- 3) Preheating : as far as is possible
- 4) Adhesive : use if at all possible
- 5) Position : should not be inclined, do not apply a moment force to the chip
- 6) Soldering time : solder with the solder on both sides of the chip resistor in the wet state
(if only one side is wet, strain will remain)

In general, there will be no problems when the soldering is performed by an experienced operator, but a combination of poor conditions may result in electrodes becoming separated.



When removing solder, try to keep the left and right side uniform.



Do not attempt to solder again if the chip resistor body is inclined.

Fig.10

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