Application Note
应用指南

Product Name: Chip Resistor

产品名称： 晶片电阻器

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1 Safety consideration安全注意事项

1.1 The products are designed and produced for application in ordinary electronic equipment (AV equipment, telecommunication equipment, home appliances amusement, etc.).If the products are to be used in devices requiring extremely high reliability (medical equipment, transport equipment, aircraft/spacecraft, nuclear power controllers, car equipment including car accessories, safety devices, etc.) and whose failure or operational error may endanger human life, please consult with the company，s Sale's Dept. to advance.

产品被设计和生产用于普通电子设备（AV 设备、电信设备、家电娱乐等）。如果产品用于要求极高可靠性的设备（医疗设备、运输设备、飞机/ 航天器、核电控制器、汽车设备（包括汽车配件、安全装置等），其故障或操作错误可能危及人的生命，请提前咨询本公司销售部。

1.2 If product failures may result in serious damage, including that to human life, sufficient fail measures must be taken, including the following:

如果产品故障,可能导致严重的损害，包括对人的生命的损害。必须采取足够的故障措施，包括：

1.2.1 Installation of protection circuits or other protective to improve system safety.

加装保护电路或其他保护措施以提高系统安全性。

1.2.2 Installation of redundant circuits in the case of single-circuit failure.

在单回路故障的情况下安装冗余回路。

1.3 The products are designed only for use in a standard environment. If you use it in special environment, it will worsen product characteristic .Therefore, it is recommended the customer to verifying the product characteristic before using, it can't be used under the following condition:

产品仅设计用于标准环境。 如果在特殊环境下使用，会使产品特性变差。因此，建议客户在使用前先对产品特性进行验证，以下情况不能使用：

1.3.1 Use outdoors where the products are exposed to direct sunlight, or in dusty places.

在产品暴露在阳光直射的室外或多尘的地方使用。

1.3.2 Use in places where the products are exposed to sea winds or corrosive gases, including Cl2, H2S, NH3, SO2, and NO2.

在产品暴露于海风或腐蚀性气体（包括 Cl2、H2S、NH3,、SO2 和 NO2）的地方使用。

1.3.3 Use of the products in places subject to dew condensation.

在易结露的场所使用。

1.3.4 Use in places where the products are exposed to static electricity or electromagnetic waves.

在产品暴露于静电或电磁波的地方使用。

1.3.5 Use in proximity to heat-producing components, plastic cords, or other flammable items.

在发热部件、塑料线或其他易燃物品附近使用。

1.3.6 Use involving sealing or coating the products with resin or other coating materials.

在密封或涂装产品是使用涉及树脂或其他的涂层材料。

1.3.7 Use involving unclean solder or use of water or water-soluble cleaning agents for cleaning agents for cleaning after soldering.
在焊接后，使用不干净的焊料或使用水或水溶性清洁剂作为焊接后清洁剂。
1.3.8 Use in various types of liquid, including water, oils, chemicals, and organic solvents.
用于各种类型的液体，包括水、油、化学品和有机溶剂。

1.4 The products are radiation resistant.
产品具有抗辐射性。

1.5 The company is not responsible for any problems resulting from use of the products under conditions not recommended herein.
本公司对在非本说明书推荐条件下使用产品造成的任何问题概不负责。

1.6 The company should be notified of any product safety issues. Moreover, product safety issues should be periodically monitored by the customer.
任何产品安全问题都应通知本公司。 此外，客户应定期监控产品安全问题。

2 Usage considerations使用注意事项

2.1 It is recommended the customer to verify the characteristics of products after on-board mounting.
建议客户在上板后验证产品特性。

2.2 It is strongly recommended the customer to verifying the characteristics after on board mounting if applying of a instant load (a large amount of load applied in a short period of time, such as pulse).If it exceeds the power rating under steady-state loading condition may negatively affect product characteristics and reliability.
如果施加瞬时负载（短时间施加大量负载，例如脉冲），强烈建议客户在上板安装后验证特性。如果超过稳态负载条件下的额定功率，可能会对产品特性和可靠性产生负面影响。

2.3 It is recommended to be careful when pick up the products with tweezers, avoiding the overcoating and/ or the body breaking.
建议用镊子拿起产品时要小心，避免保护涂层和/或主体破裂。

2.4 It is recommended to prevent the product from fall off to make product damaged.
建议防止产品脱落，使产品损坏。

2.5 It is recommended customer don't choose TC resistors with high resistance value in the high- humidity ambient. Although we have taken some action to improve the waterproofing of protective coating continually, it is still not perfectly, especially for the high resistance value, which is above 100KΩ. For the resistance element's thickness of high value resistors is thinner, the resistance element can be corroded by entering water molecule easier.
由于高值电阻的电阻元件厚度较薄，电阻元件更容易进入水分子而被腐蚀。建议客户在高湿环境下不要选择阻值高的 TC 电阻。虽然我们不断采取一些措施来改善保护涂层的防水性，但仍然不完美，特别是对于 100KΩ 以上的高阻值。

2.6 It is recommended to control the humidity of the end use side below 75%RH, for the TC resistors with high precision ±0.1%, it can be affected by ambient.
对于高精度±0.1%的 TC 电阻，会受环境影响，建议最终使用方的湿度控制在 75%RH 以下。

2.7 It is recommended to control the voltage below 100V although the working voltage for some types is above 100V when customer's design circuit.
尽管客户设计电路时某些型号的工作电压在 100V 以上，但建议将电压控制在 100V 以下。

2.8 After the surface of TC series high resistance resistors is coated with flux, the resistance value may be affected (exceeding the resistance value range). After the customer's evaluation, if necessary, corresponding cleaning measures can be taken to restore the resistance. In addition, if the surface of the resistor needs to be coated with other substances, the client needs to evaluate the impact on the product to avoid any impact during use.
TC 系列高阻电阻器表面涂上助焊剂后，可能对阻值产生影响（超过电阻值范围）。客户评估后，必要时可采取相应的清洗措施以恢复阻值。此外，若电阻器表面需要涂覆其他物质，客户端需要评估对产品产生的影响，以避免在使用过程中受到任何影响。

2.9 Excessive humidity will affect the solderability of the resistor. During the rainy season, the humidity is high, and small-sized resistance products will cause tombstones and side-backs due to moisture during the welding process. In application, temperature and humidity need to be controlled.
过高的湿度会影响电阻的可焊性。梅雨季节湿度高，小尺寸电阻产品在焊接过程中因受潮产生立碑、侧背现象。在应用时，需对温湿度采取控制。

3 Mounting consideration安装注意事项

3.1 It is recommended to use reflow soldering for chip resistors, if flow soldering method is preferred, please consult with the company at advance. It is recommended to pay attention to the soldering condition to avoid silver leaching.
对于晶片电阻器，建议采用回流焊。如首选流焊方式，请提前与本公司咨询。建议注意焊接条件，避免银浸出。

3.2 It is recommended the customer can't use highly active halogen (chlorine, bromine, etc.) flux, because the remainder of flux may negatively affect product characteristic and reliability.
建议客户不要使用高活性卤素（氯、溴等）助焊剂，因为助焊剂的剩余部分可能会对产品特性和可靠性产生负面影响。

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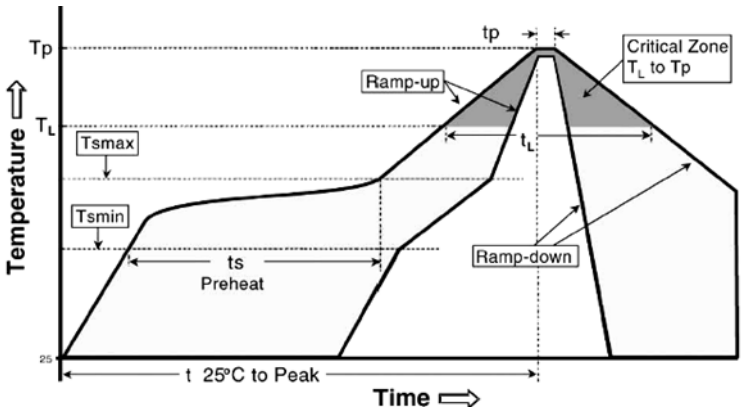
3.4 Reflow Soldering Profile (solder: Sn 96.5 / Ag 3 / Cu 0.5): 回流焊曲线（焊料：Sn 96.5 / Ag 3 / Cu 0.5）：



Profile Feature	Lead (Pb)-Free solder
Preheat： Temperature Min (Tsmin) Temperature Max (Tsmax) Time (Tsmin to Tsmax) (ts)	150℃ 200℃ 60 -120 seconds
Average ramp-up rate： (Ts max to Tp)	3℃ / second max.
Time maintained above :Temperature (TL) Time (tL)	217℃ 60-150 seconds
Peak Temperature (Tp)	260℃
Time within $^{+0}_{-5}$ ℃ of actual peak Temperature (tp)2	10 seconds
Ramp-own Rate	6℃/second max.
Time 25℃ to Peak Temperature	8 minutes max.

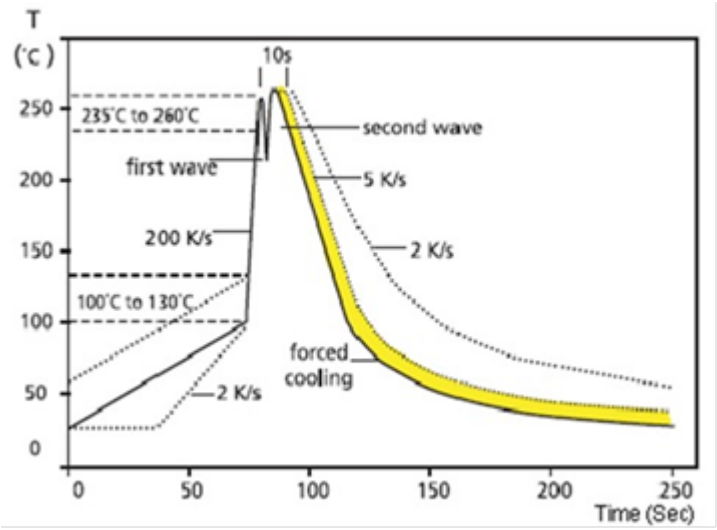
Allowed Re-flow times : 2 times

允许回流次数：2 次

To avoid discoloration phenomena of chip on terminal electrodes, please use N2 Re-flow furnace.

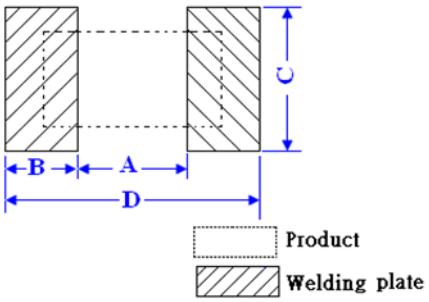
为避免端子电极上的芯片变色现象，请使用 N2 回流炉。

3.5 Wave Soldering Profile (Apply to 0603 and above size)：波峰焊曲线（适用于 0603 及以上尺寸）：



3.6 Soldering pad size recommended推荐的焊盘尺寸

Type	Dimension(mm)			
	A	B	C	D
01005	0.14±0.03	0.2±0.03	0.2±0.03	0.54±0.03
0201	0.25±0.05	0.35±0.05	0.4±0.05	1.0±0.05
0402	0.50±0.05	0.45±0.05	0.5±0.05	1.4±0.05
0603	0.9±0.05	0.65±0.05	0.8±0.05	2.1±0.05
0805	1.0±0.1	1.0±0.1	1.3±0.1	3.0±0.1
1206	2.0±0.1	1.1±0.1	1.6±0.1	4.2±0.1
1210	2.0±0.1	1.1±0.1	2.6±0.1	4.2±0.1
1812	3.2±0.1	1.4±0.1	3.3±0.1	5.8±0.1
2010	3.6±0.1	1.3±0.1	2.6±0.1	6.2±0.1
2512	5.0±0.1	1.6±0.1	3.3±0.1	8.2±0.1



3.7 Hand-soldering chip resistors 手焊贴片电阻

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

关于手工焊接贴片电阻器，请注意以下几点。

(1) Soldering iron tip temperature: 380℃

烙铁头温度：380℃

(2) Solder correction time: 3~4 secs.

焊锡校正时间：3~4 秒

(3) Preheating: as far as is possible

预热：尽可能预热

(4) Adhesive: use if at all possible

粘合剂：尽可能使用

(5) Position: should not be inclined, do not apply a moment force to the chip.

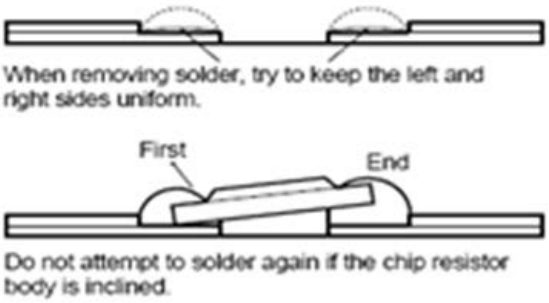
位置：不要倾斜，不要对芯片施加力矩。

(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)

焊接时间：在湿状态下用贴片电阻两侧的焊料焊接（如果只有一侧是湿的，应变会残留）

(7) 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.

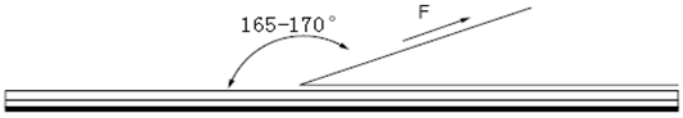
一般情况下，由有经验的操作者进行焊接是不会有问题的，但恶劣条件的结合可能会导致电极分离。



3.8 Peeling angle剥离角度

The peeling angle must be within 165° to 170° which relatives to the bottom taping.

相对于底部胶带，剥离角度必须在 165° 到 170° 之间。



4 Storage consideration存储注意事项

4.1 The recommended storage condition for chip resistors is 20±10℃, below 70％R.H., and 6℃~35℃, 35~88%RH for dipping resistors, if the actual storage condition exceed the recommended condition, the characteristic of product and exposed connections may deteriorate.
贴片电阻推荐储存条件为 20±10℃，70％RH 以下，插件电阻 6℃~35℃，35~88%RH，如果实际储存条件超过推荐条件，产品特性和暴露连接可能会恶化。

4.2 The guaranteed period of solder connections and product performance is within one year from shipment by the company, provided that the above-mentioned storage conditions have been satisfied.
在满足上述储存条件的情况下，本公司自发货之日起一年内保证焊锡连接和产品性能。

5 Exportation consideration出口注意事项

5.1 The company has not determined whether or not the products are considered“a controlled product or technology”as specified in the Foreign Exchange and Foreign Trade Control Law. Accordingly, if exportation of the products, either separately or integrated in another company，s products, is intended, or giving the products to persons who are not residents is planned, additional steps are required, based upon the appropriate regulations.
本司尚未确定该产品是否属于《外汇和对外贸易管制法》规定的“受控产品或技术”。 因此，如果打算将产品单独或集成到另一家公司的产品中出口，或计划将产品提供给非居民的人，则需要根据适当的规定采取额外的步骤。

6 Industrial property prohibitions工业产权禁令

6.1 There specifications contain information related to the company’s industrial property. Any use of them other than pertaining to the usage of appropriate products is not permitted. Duplication of these specifications and its disclosure to a third party without the company’s permission is prohibited.
这些规格包含与公司工业产权相关的信息。除了用于适当产品的用途之外，不允许他用。未经公司许可，禁止复制这些规格并将其披露给第三方。

6.2 Information and data on products, including application examples, contained in these specifications are simply for reference; the company does not guarantee any industrial property rights, intellectual property rights, or any other rights of a third party regarding this information or data. Accordingly, the company does not bear any responsibility for.
有关产品的资料及数据，包括应用实例，仅供参考;本公司不保证任何有关此信息或数据的工业产权、知识产权或第三方的任何其他权利。因此，本公司不承担任何责任。

6.3 Infringement of the intellectual property of a third party.
侵犯第三方的知识产权。

6.4 Any problems incurred by the use of the products listed herein.
因使用此处所列产品而引起的任何问题。

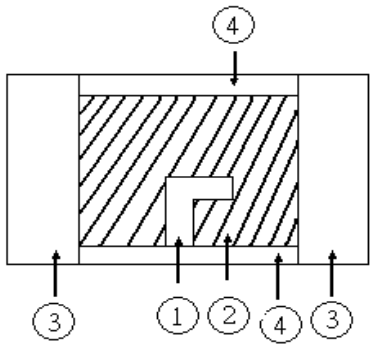
6.5 The company prohibits the purchaser of its products to exercise or use the intellectual property fights, industrial property rights, or any other rights that either belong to or are controlled by the company, other than the right to use, sell, or dispose of the products.
本公司禁止其产品的购买者行使或使用属于本公司或由本公司控制的知识产权、工业产权或任何其他权利，但使用、销售或处置产品的权利除外。

7 Technical Guidance技术指导

The design and specifications are subject to change without prior notice. Before ordering or using, please check the Latest technical specifications.
设计和规格如有更改，恕不另行通知。 在订购或使用之前，请查看最新的技术规格书。

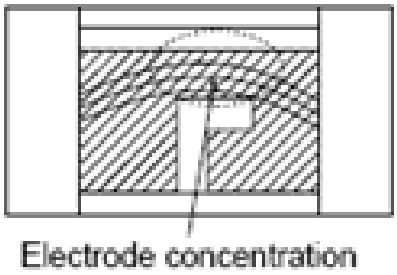
7.1 Overload failure mechanism
过载失效机制

7.1.1 The failure mechanism of the component when an overload voltage is applied is explained below.(internal structure of chip resistor)
施加过载电压时元件的失效机制如下。（贴片电阻的内部结构）



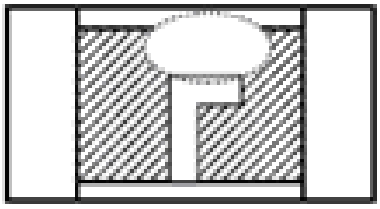
①Laser trimming groove 激光修形槽
②Resistor body 电阻主体

③Electrode　电极
④Alumina substrate　氧化铝基板
(Current concentration region　电流集中区)



7.1.2　Current concentrated in the region left after laser trimming (the region marked with the circle)
电流集中在激光修整后留下的区域（圆圈标出的区域）

(Cut off due to melting)　（因熔化而切断）



7.1.3　When an overload voltage is applied, joule heating caused by this current concentration caused the local temperature to rise. The heat generated is dissipated via the ceramic substrate. If the amount of heat generate 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 resistive material left trimming.
当施加过载电压时，由该电流集中引起的焦耳热导致局部温度升高。 产生的热量通过陶瓷基板散发。 如果产生的热量大于散发的热量，就会超过电阻体和玻璃涂层所能承受的温度而发生部分熔化。较高的过载电压会导致激光后的电阻材料完全熔化。
7.1.4　6.1.4 Failure mode analysis 失效模式分析
Thermal dissipation: Heat generated is transmitted form the electrodes 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.
散热：产生的热量从电极和氧化铝基板传递到 PCB。 因此，失效模式由产生的热量和散热平衡决定。

7.2　Over voltage failure mechanism
过电压失效机制

7.2.1 When a short-time overload voltage is applied, the resistance value will drop. When the short-time overload voltage exceeds a certain value, the resistance value will start to rise. However the short-time overload voltage increase to a certain limited value, the component goes open circuit. This is illustrated in Fig.1.

当施加短时过载电压时，电阻值会下降。 当短时过载电压超过一定值时，电阻值开始上升。 然而，短时过载电压增加到一定的限制值，元件开路。 如图 1 所示。

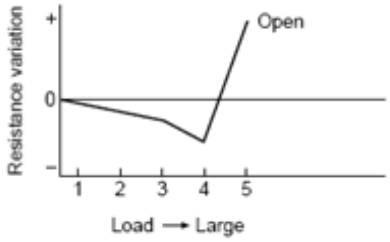
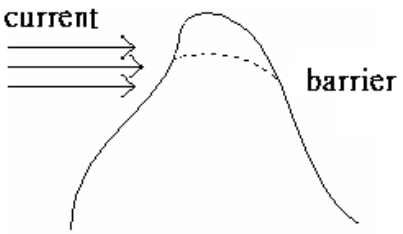


Fig.1

7.2.2 The resistance will be lower after the instant high voltage .the inside electric part is RuO2 and glass, it is the barrier conducting mode, if the barrier is higher, and the resistance will be higher. If the barrier is lower, the resistance will be lower .The barrier will reduce after suffered by the high voltage, at this time the resistance will be lower. The following is resistor element conducting structure and barrier conducting mode:

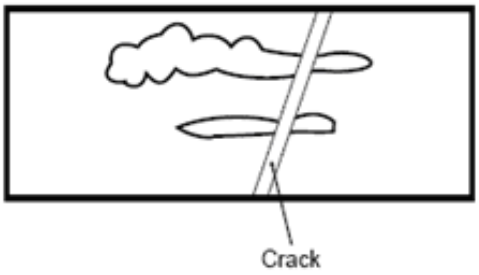
瞬间高电压后，电阻会降低。内电极部分为 RuO2 和玻璃，为阻挡导电模式。如果势垒越高，电阻就越高。如果势垒越低，电阻就越低。在受到高电压的影响后，势垒会减小，此时电阻会降低。下面是电阻元件导电结构和阻挡导电方式



7.2.3 The barrier structure of resistor element is destroyed after suffered by the high voltage, so the barrier is reduced leading to the resistance being lower. (above picture)

在高电压作用下，电阻元件的势垒结构被破坏，势垒减小，电阻降低。(上图)

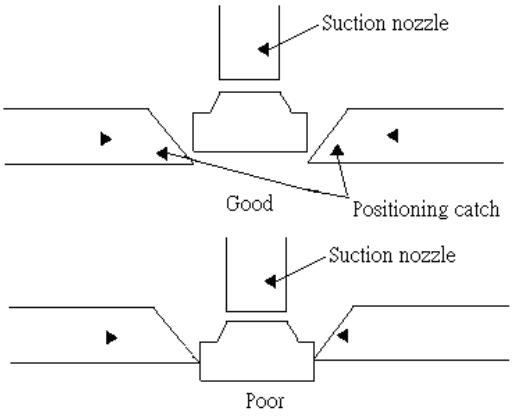
7.2.4 If the load is increased further, the metal conductive component heats up, and the resistance starts to increase. Under certain conditions, the resistors body melts or cracks, and due to differences in thermal expansion rates, the resistor body separates.
如果负荷进一步增加，金属导电元件升温，电阻开始增大。在一定条件下，电阻器本体熔化或开裂，由于热膨胀率的差异，电阻器本体分离。



7.3 Overcoat glass, electrodes, and resistor body splintering failure mechanism
玻璃涂层、电极、电阻体碎裂失效机制

7.3.1 Chip resistors mounting贴片电阻安装

Chip resistors are mounted from four directions simultaneously. When mounting a chip resistor, use a positioning catch below the resistor as shown in Fig. 10 so that the resistor does not drop.
片式电阻器从四个方向同时安装。安装贴片电阻器时，请在电阻器下方使用定位卡扣，如图 10 所示，以免电阻器掉落。

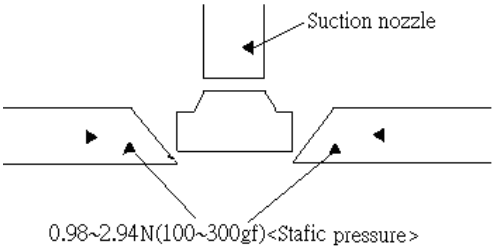


It is important for mounting equipment that has a function for detecting the orientation of the component using the vacuum center. This is because, for the positioning shown in the diagram above, it is easy for a gap to from between the chip resistor and the nozzle. The same consideration is required for the timing of the closure of the positioning catch.
具有使用真空中心检测元件方向的功能的安装设备很重要。这是因为，在上图所示的定位中，片式电阻器和喷嘴之间很容易产生间隙。定位卡扣闭合的时间也需要同样的考虑。

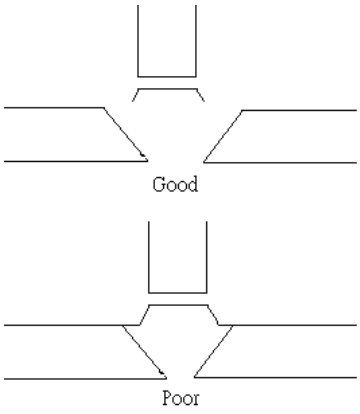
7.3.2 Chucking pressure夹紧压力

The pressure with which the chip resistor is held curing positioning is called the chucking pressure. This is normally set in the range 0.98N to 2.94N (100gt to 300gf) static pressure. In practice, in the same way as with mounting, as the chip only gripped for a short time, a

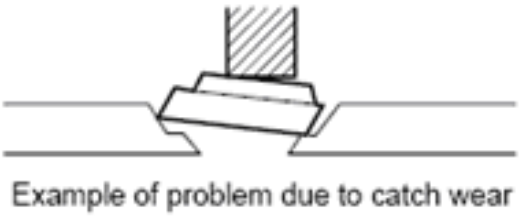
shock load is applied to it.
贴片电阻保持固化定位的压力称为夹紧压力。这通常设置在 0.98N 至 2.94N（100gt 至 300gf）静压范围内。实际上，与安装一样，由于芯片只是短时间夹持，因此会对其施加冲击载荷。



7.3.3 Adjusting the closure dimensions of the positioning catch调整定位卡扣的闭合尺寸
Adjust the closure dimensions so that the chip resistors are not destroyed due to excessive loading.
调整闭合尺寸，使贴片电阻不会因负载过大而损坏。



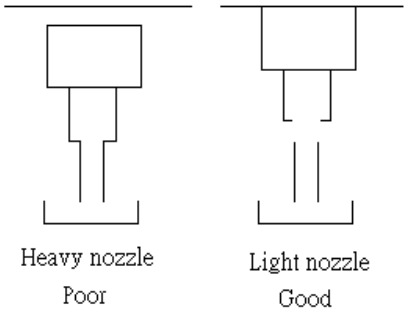
7.3.4 In addition, if the position catch is worn, the load in the chip will be concentrated and may result in cracking or splintering of the chip, or poor positing accuracy. It is necessary to inspect it carefully.
此外，如果定位卡扣磨损，则会导致晶片内的载荷集中，可能导致晶片开裂或断裂，或定位精度差。



7.4 Splintering of the overcoat glass and countermeasures玻璃涂层的碎裂及对策
7.4.1 If excessive shock is applied to the component by the nozzle of the insertion machine, the overcoat glass may crack, causing resistance value to the following points.
如果插入机的喷嘴对元件施加过大的冲击，玻璃涂层可能会破裂，导致阻值达到以下几

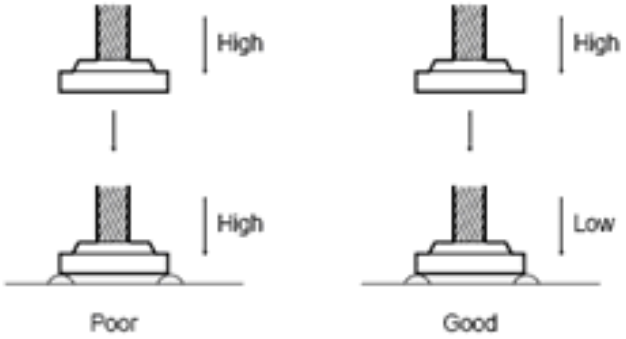
点。

(1) Reducing the nozzle weight 减轻喷嘴重量



(2) Deceleration at the point of mounting 在安装点减速

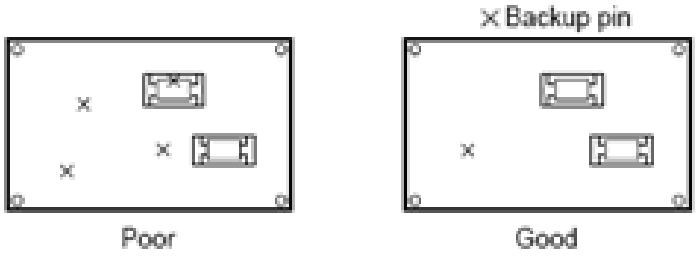
Decelerate the nozzle just before contract to reduce the shock load applied to components.
在收缩之前使喷嘴减速，以减少施加到部件上的冲击负荷。



7.5 Splintering of the electrodes and body and countermeasures电极和本体的碎裂及对策

7.5.1 Nozzle control (optimization of the amount of paste and adhesive) 喷嘴控制(膏体和胶粘剂用量的优化)

7.5.2 Backup pin position备用引脚

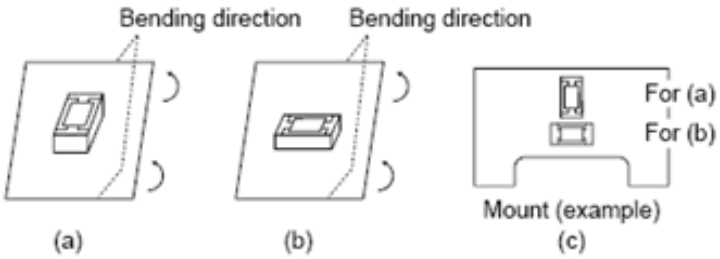


Ensure that there are no backup pins in the vicinity of the mounted chip, either change the

position of the chip resistor, or do away with the backup pins.
确保安装的晶片附近没有备用引脚，要么改变贴片电阻的位置，要么去掉备用引脚。

7.6 Bending of the resistor body, separation of the electrodes countermeasures电阻体弯曲、电极分离对策

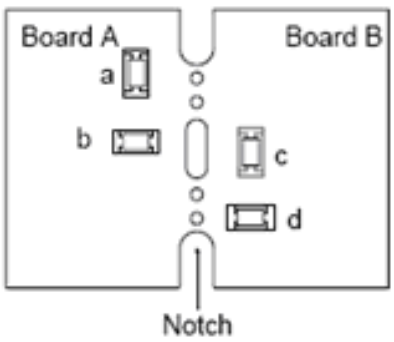
7.6.1 Chip resistors mounting晶片电阻安装



In terms of the strength of the stress applied to components a and b, b receives the greater stress.
就施加到部件 a 和 b 的应力强度而言，b 承受更大的应力。

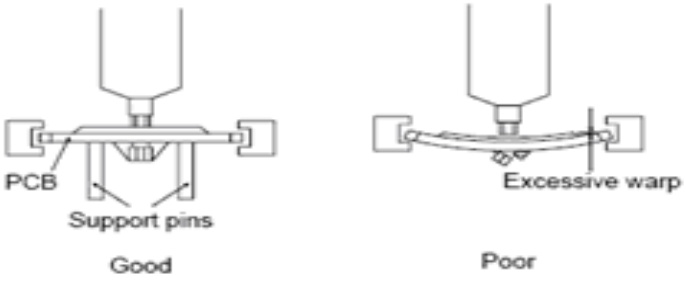
7.6.2 Points to note regarding separated boards分离板的注意事项

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.
构件 d 的弯曲应力最大，依次为 b、a、c。在这种布局方式下，组件 d、b 和 a 很可能由于弯曲应力而导致电极分离。因此，应该修改布局方式，使 d、b 和 a 受到与 c 相同的弯曲应力。



7.7 Body bending and countermeasures本体弯曲及对策

7.7.1 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 near of the board.
当用点胶器将粘合剂涂在已经焊接到板背面的片式电阻器上时，如果点胶器的喷嘴太低，它会使板翘曲，并可能损坏电路板附近的焊锡连接和元件。



7.8 Electrode separation and countermeasures电极分离及对策

7.8.1 It is necessary to arrange 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 (Figs. 2). 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.
有必要安排组件，以便它们不会占用太多安装焊料。 贴片元件和引线元件安装在一起时，或将贴片元件安装在底盘附近时，请对焊盘进行分隔，以免使用过多的安装焊料（图2）。 在使用流焊时，由于元件的放置和电路板的流焊方法可能会出现焊接问题，因此需要小心。 当小组件处于大组件的阴影中时，这种情况最容易发生。

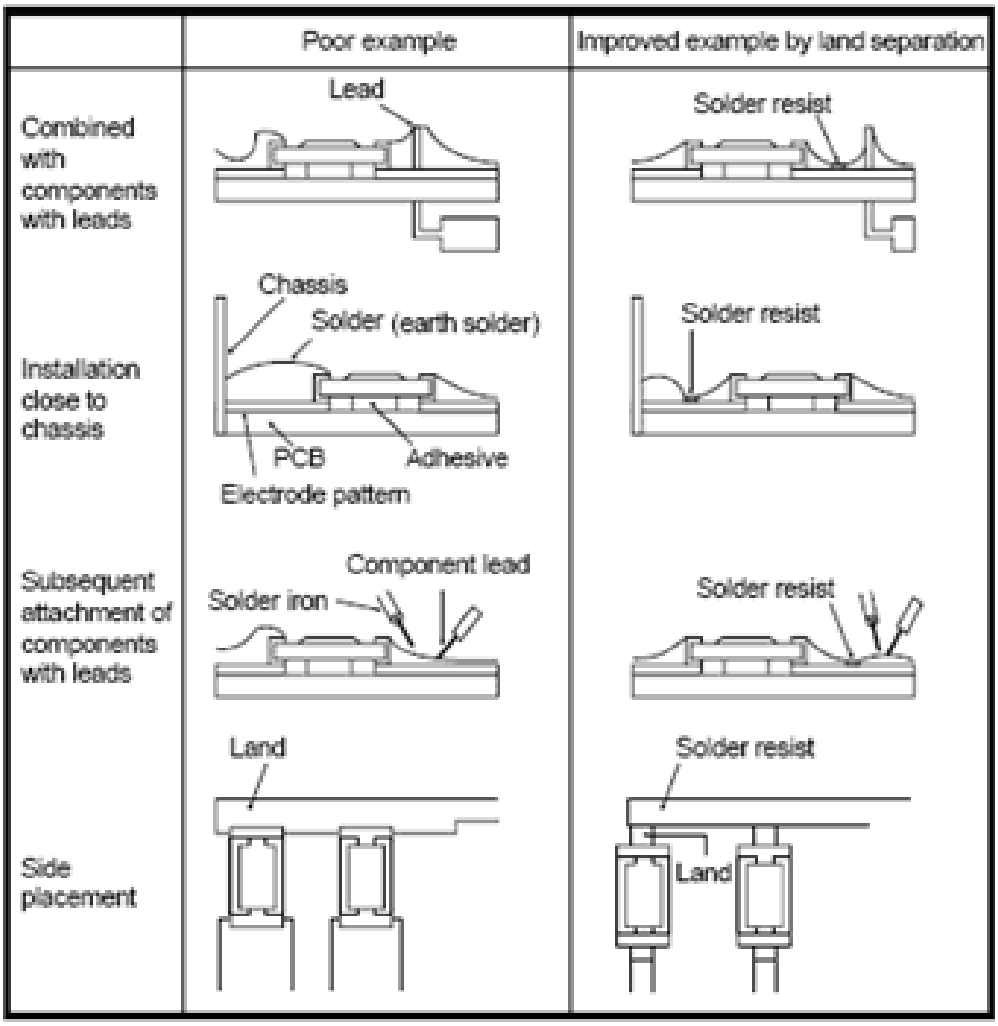


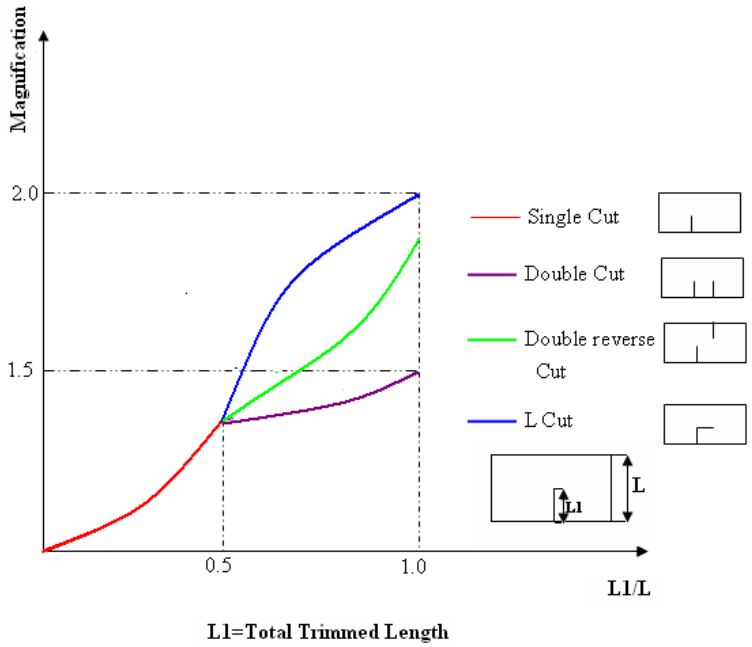
Fig.2

7.8.2 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.

将喷嘴设置在离板面 0 - 0.5mm 之间，并在板面下方使用支撑销防止翘曲。在更换喷嘴或胶粘剂注射器后，一定要再次检查。

8 Other matters其他事项

8.1 Resistance Increase vs. Trimming for Trimmable Resistors阻值增加和可微调电阻器的微调对比



L1=Total Trimmed Length

Trimming by laser increases the initial resistance Amount of resistance increase is dependent on the laser cut configuration as shown. L 1 means the total trimmed length of first and second cut, L means the available trimmed length. The first cut trimming length must not exceed 1/2 L to ensure power rating of the unit. The second cut trimmed length should equal as the first cut's.
激光修整增加初始阻值。电阻增加量取决于如图所示的激光切割配置。L 1 表示第一次和第二次切割的总剪裁长度，L 表示可用剪裁长度。
第一次切割的修剪长度不得超过 1/2 L，以确保设备的额定功率。第二次切割的修剪长度应与第一次切割的长度相等。

8.2 Trimming parameter修整参数

(1) Filed lens focal of laser device is 150mm
激光装置的场透镜焦距为 150mm。

(2) Focal plane is the surface of ceramic substrate, the resistive element should be trimmed completely.
焦平面是陶瓷基板的表面，电阻元件应完全修整。

(3) Trimming speed is 80mm/s , pulse is 130p/mm, and trimming power is 4.5W.
微调速度 80mm/s，脉冲 130p/mm，微调功率 4.5W。

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