Anti-sulfurized resistors are recommended for special circuits

§0．Abstract

In our interactions with many customers, we often encounter some problems in the use of voltage sharing feedback circuits for various power supply devices. Based on analysis, most of them are caused by the failure of resistors (resistance values become open or lower). UR has conducted a detailed study of the characteristics of this special circuit and SMD resistor products, and found that ordinary products used in voltage sharing feedback circuits will have these phenomena: a. Resistors are sulfurized, resulting in open resistance value; b. Resistors silver migration leads to lower resistance values; c. Resistors silver migration leads to open resistance values.

To address above issues, anti-sulfurized products NQ and NS series have been developed. Thus, customers are recommended to use anti-sulfurized products for special circuits.

§1．Resistors are sulfurized and resistance values become OPEN

When there are corrosive substances such as S, Cl or Br in external atmosphere, they may enter the gap and react with the silver layer, resulting in partial non-conductivity or poor conductivity of the silver layer. In serious cases, the silver layer will be disconnected, resulting in OPEN resistance value. Figure 1 shows the phenomenon of an electrode being sulfurized (corroded), the silver layer below the plating layer at the junction of the top electrode being corroded, and Figure 2 shows the normal condition of an electrode.

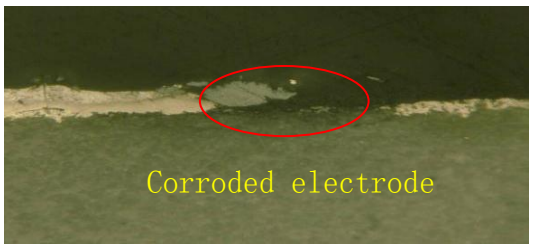

Figure 1 Left top terminal is corroded

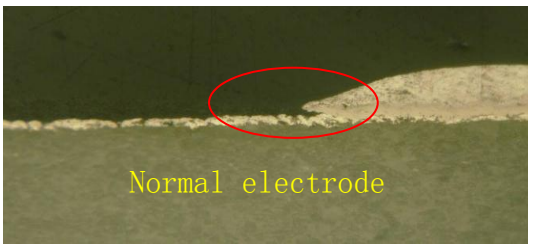

Figure 2 Right top terminal is normal

Measure top electrode ju

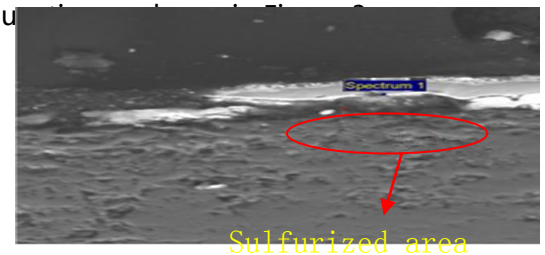

Figure 3 Top electrode junction

The corroded substance in the silver layer below the plating layer at the disconnection of the top electrode has been measured with SEM, and the sulfur content in the corroded area is measured. The specific components are shown in Figure 4.

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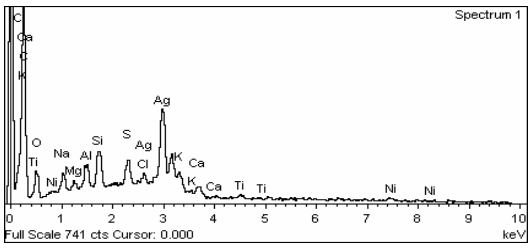

Element	App Conc.	Intensity Corrn.	Weight%	Weight% Sigma	Atomic%
C K	49.25	0.7679	46.74	2.48	69.41
O K	8.41	0.3804	16.11	1.52	17.96
Na K	2.70	0.8554	2.30	0.25	1.78
Mg K	0.54	0.7549	0.52	0.15	0.38
Al K	2.16	0.8489	1.86	0.17	1.23
Si K	3.99	0.9116	3.19	0.22	2.03
S K	3.26	0.9722	2.44	0.21	1.36
Cl K	1.08	0.8440	0.93	0.18	0.47
K K	2.04	1.0839	1.37	0.20	0.62
Ca K	1.82	0.9208	1.44	0.17	0.64
Ti K	0.61	0.7960	0.56	0.17	0.21
Ni K	1.48	0.8429	1.28	0.31	0.39
Ag L	23.97	0.8221	21.25	1.12	3.51
Totals			100.00		

Figure 4 Specific composition list

§2．Resistors silver migration leads to lower resistance values

After ordinary resistors are used in the voltage sharing feedback circuits for a period of time, tiny cracks may form between the G2 protective layers and the nickel layers(for ordinary products, cracks cannot be avoided after use). As the nickel layer and the G2 protective layer (epoxy resin) are the junction surface of metal and non-metal, due to the thermal expansion is different, cracks will form after a long time of application. When corrosive substance such as CL or Br enter from the gap, silver migration occurs under DC voltage, and the migrated silver is connected in parallel with the resistance layer, resulting in defect of low resistance. The structural diagram of a regular product is shown in Figure 5.

Ionization of metallic silver occurs due to the potential difference between silver electrodes and the presence of water adsorbed from the surrounding environment on the surface: Ag→Ag+ , H2O →H+ + OH- ; Ag+ and OH- generate AgOH precipitation at the anode end： Ag+ + OH- → AgOH ; AgOH decomposes and forms Ag2O at the anode, which is dispersed in a colloidal form. The Ag2O generated by 2AgOH⇌Ag2O+H2O reacts with water, causing the silver ions to move towards the cathode and precipitate, forming a dendritic structure (as shown in Figure 11): Ag2O + H2O⇌2AgOH ⇌2Ag+ + 2OH-.

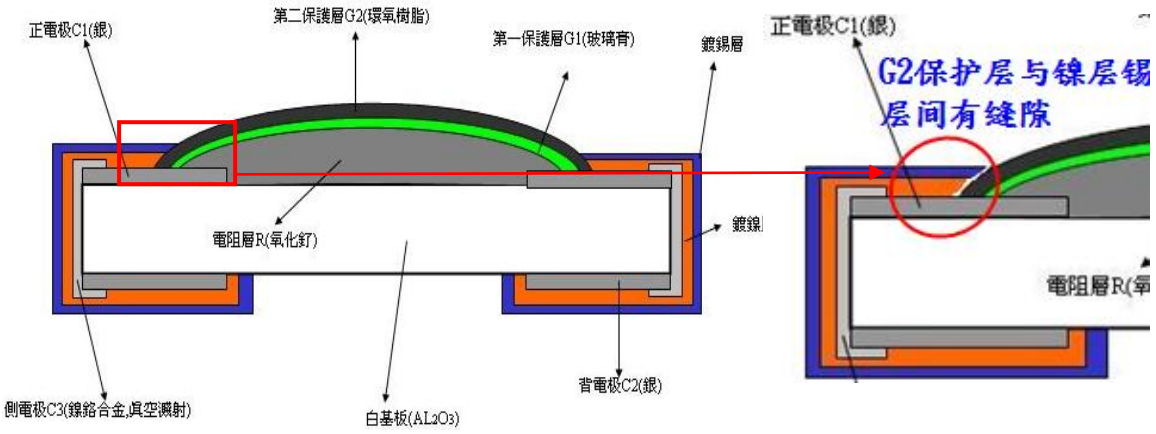

Figure 5: structural diagram of an ordinary product

Figure 6: structural diagram of an ordinary product after use

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Typical cracks on a product that has occurred after a period of application, as shown in Figure 7.

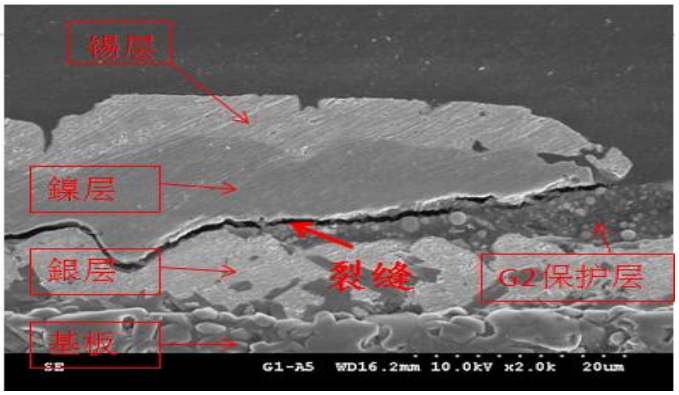

Figure 7 Cracks on an ordinary product after application

§3．Resistors silver migration leads to open resistance values

After Cl and Br elements have entered the gap, and under DC voltage, silver on the electrode is migrated, resulting in a disconnection between the electrode and the resistance layer and consequently an OPEN resistance value. The migration appearance is shown in Figure 8.

Figure 8 migration appearance

Detect the metal that has migrated onto the surface of the resistance layer and find it contains Ag with no other abnormalities, and the rest are all components originally contained in resistance layer. Please refer to Figure 13 for details.

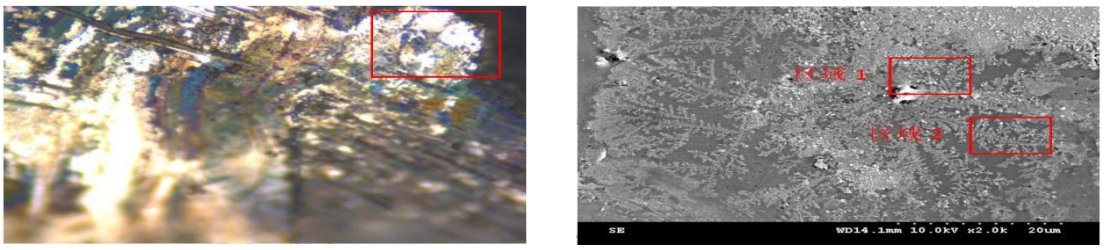

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Figure 9 Magnified area of Figure 8 detection area　　Figure 10 Magnified area of Figure 9 detection area

Figure 11 Magnified detection area 1 of Figure 10

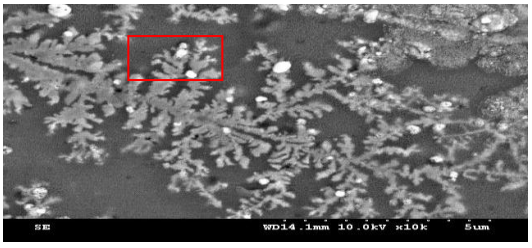
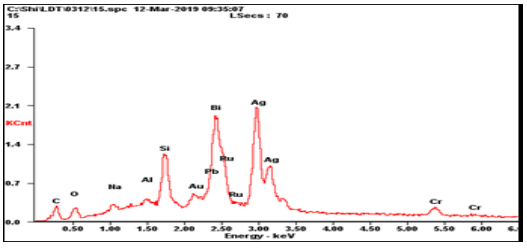


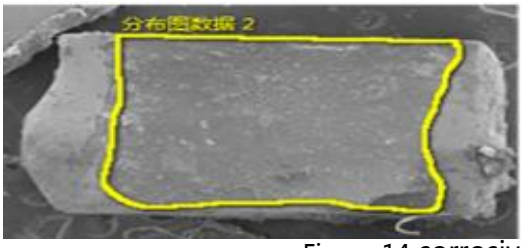
Figure 12 Magnified detection area 2 of Figure 10



Element	Wt %	At %
C	02.77	17.93
O	0200	09.74
Na	00.57	01.93
Al	00.46	01.32
Si	04.32	11.98
Pb	06.12	02.30
Bi	28.95	10.78
Ru	03.54	02.72
Ag	45.75	33.02
Cr	05.52	08.27

Figure 13 Area 1 and 2 are detected to contain Ag

As shown in Figure 14, the entire resistor surface is detected to contain corrosive substances such as Br, S, Cl, etc.



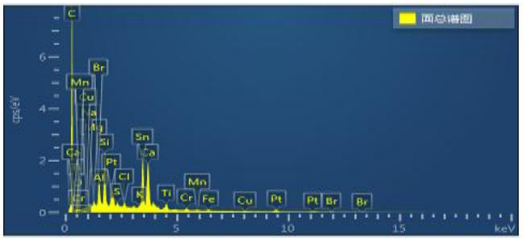


Figure 14 corrosive substances are detected

§4．Series voltage sharing feedback circuit and its characteristics

The complete machine cannot be free from AC power. Generally, to stabilize the output voltage, a voltage sharing feedback circuit is designed at the output end. The purpose is to ensure that the actual voltage can be divided onto resistors according to the resistance values. When the output voltage fluctuates, the voltage sharing on the resistors will also change. This change will be reflected in [illegible] t voltage. However, if the series [illegible] the entire machine to shut dow

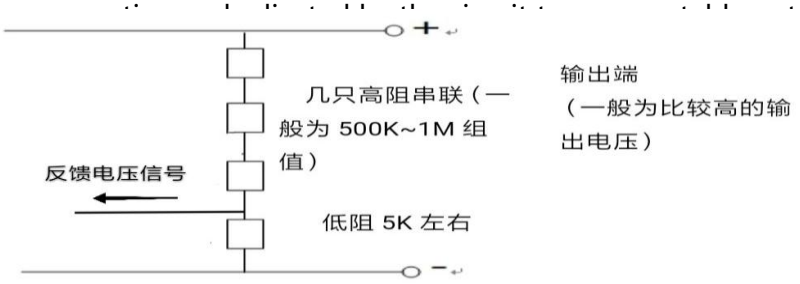


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Figure 15 Series voltage sharing feedback circuit

a. Resistors work under DC voltage. b. The load rate of the resistors is high. c. The products have problems after being used by the customer for a period of time. d. This circuit is sensitive to resistance values, and changes in resistance values can change the values of the voltage sharing.

§5．Introduction of anti-sulfurized resistors

C4 resin silver printing has been added to anti-sulfurized products (NQ, NS series). Although there may be gaps between the nickel layer and the G2 protective layer, C4 cannot be connected to the silver layer due to it having the same component as the protective layer. The product structure diagram is shown in Figure 16.

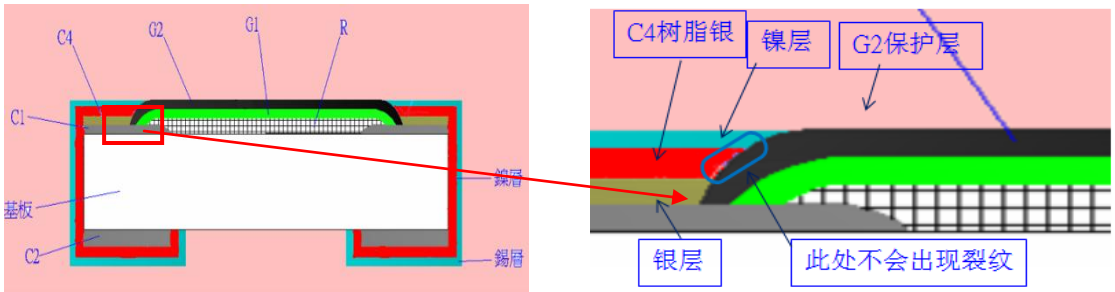

Figure 16 Product structure diagram

As shown in Figure 17, the ground anti-sulfurized product has no cracks on the junction between C4 and G2, which can prevent the invasion of S, Cl, and Br elements.

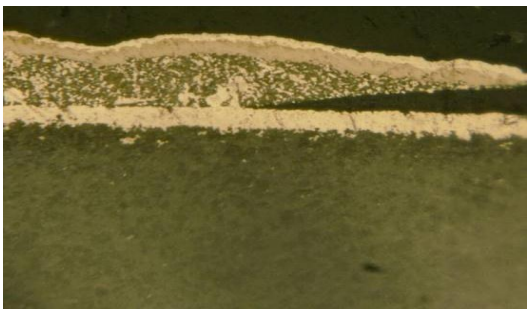

Figure 17 Ground anti-sulfurized product

Anti-sulfurized products are recommended for special circuits

§6．Anti-sulfurized products (NS series) patent certificate


证书号第3141725号

实用新型专利证书

实用新型名称：厚膜抗硫化贴片电阻器

发　明　人：彭荣根;徐玉花;杜杰霞;王晨

专　利　号：ZL 2013 2 0173554.2

专利申请日：2013年04月09日

专 利 权 人：昆山厚声电子工业有限公司

授权公告日：2013年08月28日

本实用新型经过本局依照中华人民共和国专利法进行初步审查，决定授予专利权，颁发本证书并在专利登记簿上予以登记。专利权自授权公告之日起生效。

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专利证书记载专利权登记时的法律状况。专利权的转移、质押、无效、终止、恢复和专利权人的姓名或名称、国籍、地址变更等事项记载在专利登记簿上。

局长

2013年08月28日

第1页（共1页）

24-2S02,4S02,4S03 SERIES.pdf

23-NS SERIES .pdf

§7．Conclusion

When ordinary products are used in voltage sharing feedback circuits, there may be phenomena such as a. Resistors being sulfurized, resulting in open resistance values. b. Resistor silver migration, resulting in open resistance values. c. Resistor silver migration, resulting in low resistance values. Ordinary chip products are not suitable for such circuits. Since there is a metal and nonmetallic junction surface between the nickel layer and the G2 protective layer (epoxy resin layer), and the thermal expansion is different, cracks will form after a long time. As there are S, Cl, Br and other harmful substance elements on the circuit board, but no protective measures have been taken for the products, harmful substance elements will contact the silver layer after entering the gap to activate the silver layer. Under DC voltage, silver migration occurs and the migrated silver is in parallel with the resistance layer, resulting in defective low resistance value.

Based on the above analysis results, it is recommended that customers use anti-sulfurized products in special circuits.