

宽电极厚膜电阻在车载上的应用分析

Analysis of the Application of Wide Electrode Thick Film Chip Resistors in Automobiles

§0 . 摘要 Abstract

贴片电阻现在已经成为了电子电路最常用的元件之一，但由于贴片电阻本体的结构、分层、端电极脱落等问题，器件在组装及使用过程中，任何可能产生弯曲变形的操作都可能导致器件开裂，针对这些不良现象我司研发了一款宽电极产品。此产品电极尺寸比普通的要宽，具有良好的可焊性、抗弯曲强度大及良好的可靠性等特征。

Chip resistors have now become one of the most commonly used components in electronic circuits. However, due to the structure, layering, and terminal electrode detachment of the chip resistor body, any operation that may cause bending deformation during the assembly and use of the device may lead to resistor cracking. In response to these adverse phenomena, our company has developed a wide electrode product. The electrode size of this product is wider than that of ordinary ones, and it has characteristics such as good solderability, high bending strength, and good reliability.

§1 . 宽电极厚膜贴片电阻器介绍

Introduction of Wide Electrode Thick Film Chip Resistors

普通电阻小尺寸，节省空间。宽电极电阻的研究对象是把普通产品的电极长度（ L ）和电极宽（ W ）分别变为电极的宽 W' 和电极长 L' 。同样的电阻尺寸，印刷长尺寸的电极，目的是减少温度变化后的机械应力的影响即电阻长度热耗散能力增强。

WR series products have the same small size of ordinary products which can save space. The research object of wide electrode resistor is to change the electrode length (L) and electrode width (W) of ordinary products into the electrode width W' and electrode length L' , respectively. The purpose of printing long size of electrode on the same size of resistor is to reduce the effect of mechanical stress after temperature changes, i.e. the thermal dissipation capacity of the resistor length is enhanced.

宽电极厚膜贴片电阻器与普通厚膜贴片电阻器在功率性能的对比，具体如下：

The comparison of power performance between wide electrode thick film chip resistors and ordinary thick film chip resistors is as follows:

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规格 Spec.		功率 Power		阻值範圍 Resistance value range
特殊特性 Special characteristics	尺寸 Size	WR 系列 WR Series	普通厚膜 Ordinary thick film	10R~1M
	0508	1/3W	1/8W	
	0612	1/2W	1/4W	
	1020	1W	3/4W	
	1218	1W	/	
	1225	2W	1W	
	WR 系列宽电极特性比普通的优越 WR series wide electrode resistors have superior characteristics compared to ordinary ones			

§2 . 宽电极贴片电阻器结构介绍

Introduction of the Structure of Wide Electrode Chip Resistors

2.1 设计原理:

Design Principle

普通电阻小尺寸，节省空间。宽电极电阻的研究对象是把普通产品的电极长度和电极宽分别变为电极的宽和电极长。同样的电阻尺寸，印刷长尺寸的电极，目的是减少温度变化后的机械应力的影响即电阻长度热耗散能力增强。

WR series products have the same small size of ordinary products which can save space. The research object of wide electrode resistors is to change the electrode length and electrode width of ordinary products into the electrode width and electrode length, respectively. The purpose of printing long size of electrode on the same size of resistor is to reduce the effect of mechanical stress after temperature changes, i.e. the thermal dissipation capacity of the resistor length is enhanced.

我司通过增加正电极的长度来达到提高产品焊接性、耐脉冲能力。因此，宽电极贴片电阻产品的电极设计尺寸有所不同：

Our company improves the product's solderability and pulse resistance by increasing the length of electrode. Therefore, the electrode design dimension of wide electrode chip resistors is different:

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WR 系列产品 WR series resistors

L : 2.00 ± 0.15 mm W : 0.40 ± 0.20 mm

普通厚膜产品 Ordinary thick film chip resistors



L : 0.40 ± 0.20 mm W : 2.00 ± 0.15 mm

2.2 工艺印刷

Printing process

2.2.1 以字码 104 为例：

Take marking 104 as an example:

图形变更 Pattern change	WR (加强) 系列 WR (reinforced) series	普通厚膜产品 Ordinary thick film chip resistors
正电极厚度 Thickness of top electrode	 <p>宽电极產品字码 104 印刷正电极的尺寸更大。</p> <p>The size of the top electrode printed on the wide electrode product with marking 104 is bigger.</p>	 <p>普通厚膜产品电极形状为山字型，正电极的尺寸偏小</p> <p>The electrode pattern of ordinary thick film product is like a mountain, and the size of the top electrode is relatively small</p>
小結 Summary	<p>WR (加强) 系列比普通厚膜产品的正电极尺寸的要大并具有良好的焊接性。</p> <p>With bigger top electrode pattern, WR (reinforced) series resistors have better solderability than ordinary thick film chip resistors.</p>	

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§3 . 宽电极贴片电阻电极强度

Electrode strength of Wide Electrode Chip Resistors

3.1 端子抗折弯力


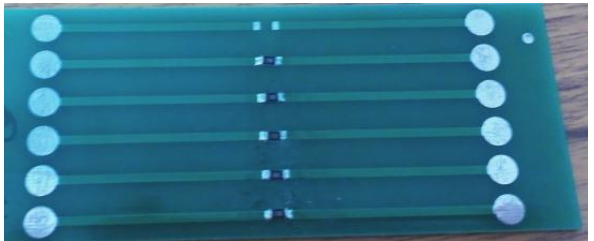
Terminal bending resistance

a.测试标准依据 Test standard basis JIS-C-5201 4.33

b.测试数量 Test quantity 5mm 60S 20 pcs

以 WR06 (加强品) 为例, 普通厚膜产品以 1206 为例

Take WR06 (reinforced product) as an example of wide electrode chip resistor and 1206 as an example of ordinary thick film chip resistors:

试验项目 Test item	弯折测试机 Bending test machine	弯折测试板 Bending test board
端子弯曲 Terminal bending		

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测试结果 Test result	<div>变形量 (mm)</div> <div>抗弯折变形力对比</div> <table><caption>抗弯折变形力对比数据 (估算值)</caption><thead><tr><th>序号</th><th>加强品 (mm)</th><th>普通品 (mm)</th></tr></thead><tbody><tr><td>1</td><td>9.0</td><td>7.0</td></tr><tr><td>2</td><td>8.0</td><td>6.0</td></tr><tr><td>3</td><td>9.0</td><td>7.0</td></tr><tr><td>4</td><td>9.0</td><td>7.0</td></tr><tr><td>5</td><td>11.0</td><td>8.0</td></tr><tr><td>6</td><td>10.0</td><td>6.0</td></tr><tr><td>7</td><td>11.0</td><td>8.0</td></tr><tr><td>8</td><td>10.0</td><td>6.0</td></tr><tr><td>9</td><td>10.0</td><td>6.0</td></tr><tr><td>10</td><td>11.0</td><td>6.0</td></tr><tr><td>11</td><td>11.0</td><td>8.0</td></tr><tr><td>12</td><td>9.0</td><td>7.0</td></tr><tr><td>13</td><td>9.0</td><td>6.0</td></tr><tr><td>14</td><td>10.0</td><td>6.0</td></tr><tr><td>15</td><td>9.0</td><td>8.0</td></tr><tr><td>16</td><td>8.0</td><td>7.0</td></tr><tr><td>17</td><td>9.0</td><td>6.0</td></tr><tr><td>18</td><td>9.0</td><td>7.0</td></tr><tr><td>19</td><td>9.0</td><td>6.0</td></tr><tr><td>20</td><td>9.0</td><td>8.0</td></tr></tbody></table>	序号	加强品 (mm)	普通品 (mm)	1	9.0	7.0	2	8.0	6.0	3	9.0	7.0	4	9.0	7.0	5	11.0	8.0	6	10.0	6.0	7	11.0	8.0	8	10.0	6.0	9	10.0	6.0	10	11.0	6.0	11	11.0	8.0	12	9.0	7.0	13	9.0	6.0	14	10.0	6.0	15	9.0	8.0	16	8.0	7.0	17	9.0	6.0	18	9.0	7.0	19	9.0	6.0	20	9.0	8.0
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3.1.2 端子推力实验

Terminal push

a.测试标准依据 Test standard basis JIS-C-5201 4.32

b.测试数量 Test quantity 20pcs

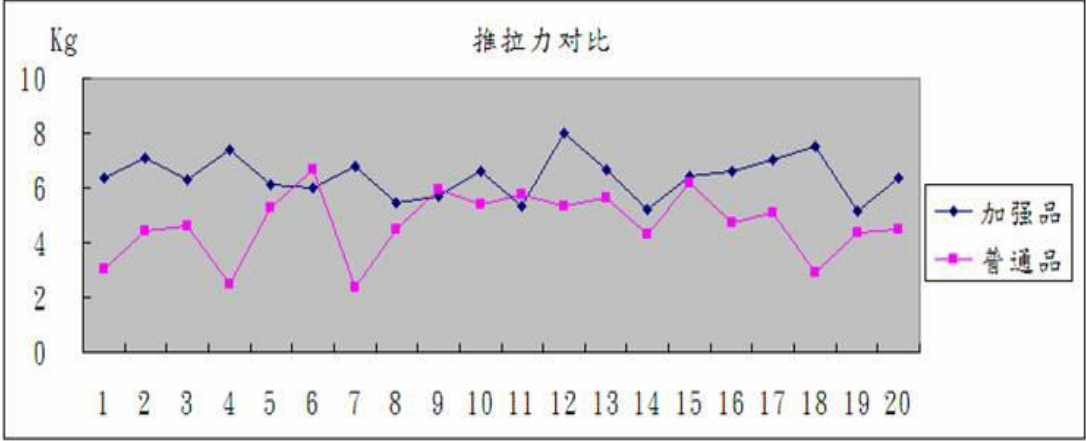
试验项目	焊接后测试样品
Test item	Test product after soldering
<div>端子推力</div> <div>Terminal push</div>	

注意事项：

本文书可能不经预告发生变更。 详情请咨询销售。

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测试结果 Test result	
结论 Conclusion	<p>WR (加强品) 产品抗弯曲强度大, 并有良好的可靠性</p> <p>WR (reinforced) series products have greater bending resistance and better reliability</p>

§4 . 宽电极贴片电阻器车载上的应用

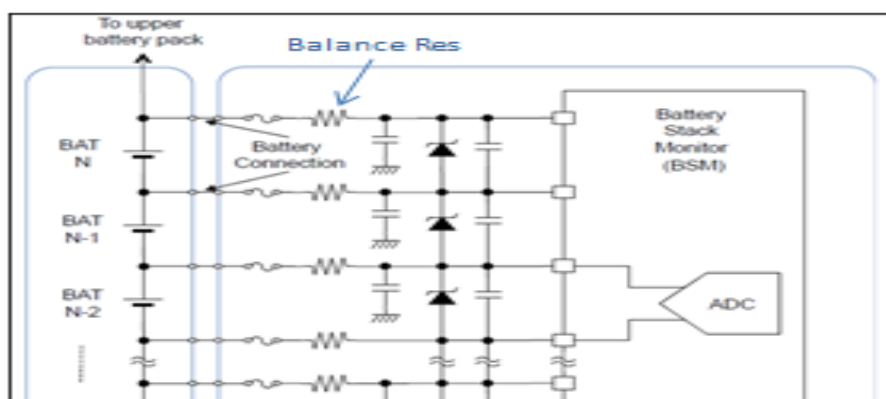
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4.1 以车载电池为例

Take automotive battery as an example

最早的方案中, 均衡电阻通常使用 MELF 电阻。三元锂电池电压 3.65V 及电路通常是串接一个保险丝、一个电阻和一个陶瓷电容。常用的阻值分别为: 33R、36R、39R、47R、51R 以及宽边电极电阻尺寸 (功率) 分别为 0612 (1W or 0.75W)、1020 (1W); 因采购渠道等原因, 现在更多的使用宽边电极厚膜电阻; 电路原理图如下图:

In the earliest schemes, MELF resistors were usually used as equalizer resistors. The voltage of a ternary lithium battery is 3.65V and the circuit is usually connected in series with a fuse, a resistor, and a ceramic capacitor. The commonly used resistance values are 33R, 36R, 39R, 47R, 51R, and the wide electrode resistor sizes (power) are 0612 (1W or 0.75W) and 1020 (1W), respectively; Due to procurement channels and other reasons, more and more wide electrode thick film chip resistors are being used now; The circuit schematic diagram is shown in the following figure:



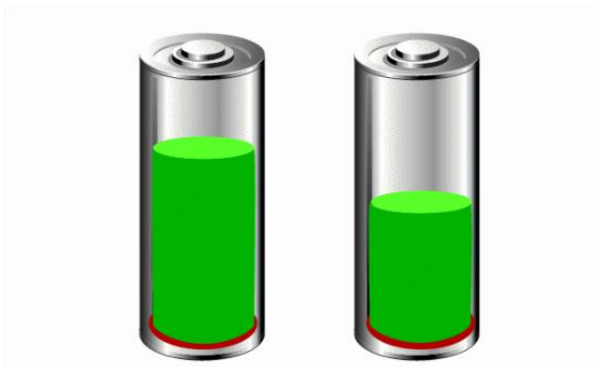
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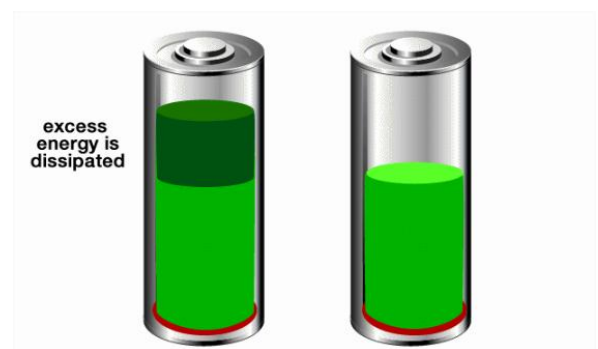
车载电池在使用过程中会出现电池电量不一致，造成电量多的电池无法充分放电；电量少的电池无法充足电量。WR 系列电阻可将多余电量耗散到电阻上来实现电池平衡，从而重新获得将电池充满电并达到完全充电的能力。

During the use of automotive batteries, there may be inconsistent battery levels, resulting in batteries with high battery capacity not being able to fully discharge; batteries with low battery capacity cannot be fully charged. The WR series resistors can dissipate excess power onto other resistor to achieve battery balance, thereby regaining the ability to fully charge the battery and achieve full charging.

车载 电池无法充足电
Automotive batteries cannot be fully charged



车载 电池完全达到充足电
Automotive batteries can be fully charged



4.2 宽电极贴片电阻器车载上的特性

Characteristics of Wide Electrode Thick Film Chip Resistors in Automobiles

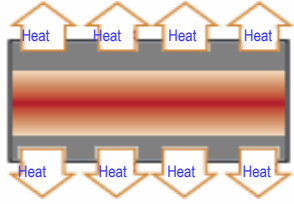
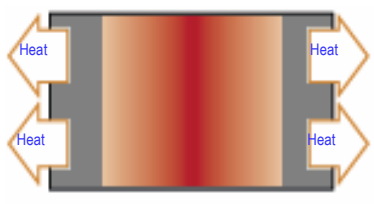
大电机尺寸，节省空间。WR 系列比普通厚膜产品的电极的尺寸更大，并且热耗散高额定功率特性比普通产品的热耗散能力强。

The WR series resistors have a bigger electrode pattern than that of ordinary thick film chip resistors which can save space. Besides, their high rated power characteristic of thermal

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dissipation is stronger than that of ordinary resistors.

特性 Characteristic	WR 系列 WR series	普通厚膜产品 Ordinary thick film chip resistors
电极散热程度 Degree of electrode heat dissipation	 <p>电阻在电极上热耗散能力加强 Enhanced heat dissipation capacity on electrodes</p>	
小结 Summary	<p>WR 系列宽电极热耗散高额定功率特性比普通产品的热耗散能力增强 The WR series resistors have stronger high rated power characteristic of thermal dissipation than that of ordinary resistors.</p>	

除以上的应用之外，宽电极在汽车引擎控制单元、电路板、仪表盘中有广泛的应用。

In addition to the above applications, wide electrodes resistors are widely used in automotive engine control units, circuit boards and dashboards.

应用举例 Application examples:

a. 汽车引擎控制 Automotive Engine Control

引擎控制單元 Engine control unit



b. 电路板 PCB



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C.仪表盘 Dashboard



§5 . 总结

Summary

WR 系列相较普通产品的最大特点就是电阻长度热耗散能力增强。我司通过同样的电阻尺寸把普通产品的电极长度和电极宽分别变为电极的宽 W' 和电极长 L' 。改变电阻体电极尺寸即增大电极尺寸，印刷长尺寸的电极在车载上可减少温度变化后的机械应力的影响即电阻长度热耗散能力增强。

Compared to ordinary products, the biggest feature of the WR series resistors is their enhanced thermal dissipation capacity of the resistor length. Our company changes the electrode length and electrode width of ordinary products with the same size to the electrode width W' and electrode length L' of wide electrode chip resistors. Changing the electrode size of the resistor body i.e. increasing the electrode size, and printing lengthened electrode on the vehicle can reduce the impact of mechanical stress after temperature changes, i.e. enhance the thermal dissipation capacity of the resistor length.