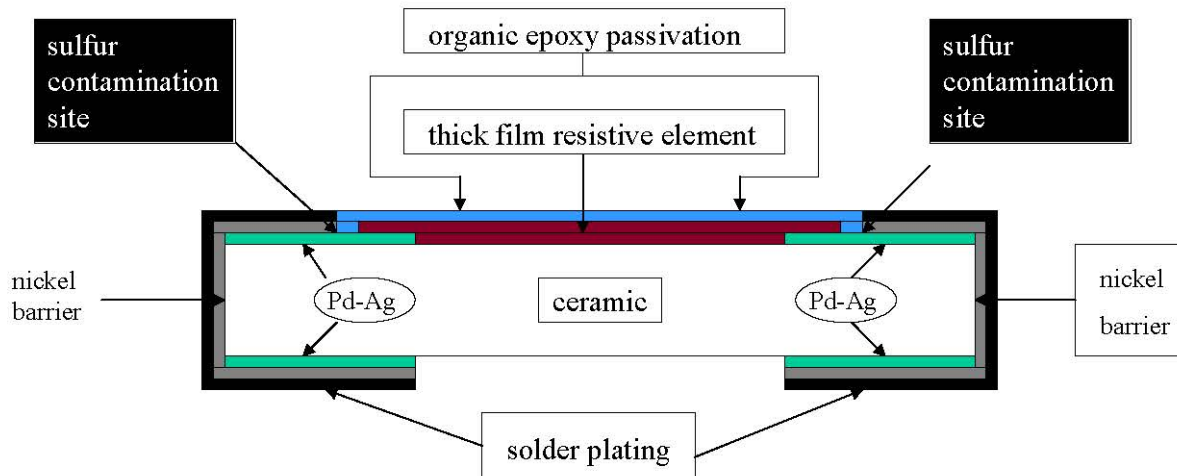


## Anti-Sulfur Resistors

This product highlight will discuss Stackpole's anti sulfur chip resistors. Many market segments ranging from automotive and industrial equipment, to PC's and computer peripherals are now having the reliability of their product effected by sulfur contamination. This product highlight will give a very brief description of what sulfur contamination is, why it happens, what kinds of resistors are effected, and the various solutions that Stackpole has available for customers that require anti-sulfur resistors.



## Sulfur Contamination Basics

The above drawing shows a side view cross section of a typical thick film chip resistor. The inner terminations (shown in green) are a printed palladium silver material. It is the silver in the inner termination that is very susceptible to contamination via sulfur. This contamination is similar to another kind of silver contamination which is far more familiar to most people, which would be tarnish on pure silver items. While this tarnish is actually silver oxide it is a similar chemical reaction which produces silver sulfide in chip resistors. These inner palladium silver terminations are normally protected from any type of contamination since they are covered by a sputtered nickel barrier layer and by a plated 100% matte tin solder layer. However, silver is so susceptible to combination with sulfur that the sulfur diffuses through the outer termination layers to the inner termination forming silver sulfide. Silver sulfide unfortunately makes the termination material non conductive and effectively raises the resistance value until it is essentially open circuit. Sulfur can be found in various types of oils and lubricants, rubber gaskets, hoses, belts, and grommets, connectors, and in some applications in the very air that the electronic device lives in. Silver sulfide contamination is a latent failure mode that is undetectable at the time the resistor is manufactured and when the resistor is mounted into its electrical circuit.

Factors such as incomplete or misaligned passivation, incomplete plating, and using low palladium materials for the inner termination, can accelerate the formation of silver sulfide on the chip and lead to failure much faster than would be expected. There are remedies for each of these issues, but all involve increased manufacturing cost which is never popular when considering thick film commodity chip resistors. Stackpole has several different product options which address applications where sulfur is present. Those applications may include automotive circuitry, industrial, and commercial machinery, construction equipment, welding equipment, and marine electronics. In some highly industrial areas of the world, the air in which standard electronic devices operate contains enough sulfur to cause failures due to sulfur contamination.

## **RMCS Anti-sulfur Chip Resistors**

The RMCS are thick film chip resistors designed to minimize the formation of silver sulfide through increased palladium content (which reduces the amount of silver) and more precise passivation and plating. This series offers good anti-sulfur performance at a modest cost increase over their standard version. However the RMCS is not completely impervious to silver sulfide formation since there is still silver present in the inner termination. The RMCS is available in sizes ranging from 0201 up to 2512, in a wide range of resistance values, in tolerances down to 0.5%, and in TCR's as low as 100 ppm. Pricing ranges from \$0.0038 each to \$0.065 each in full reel quantities. There are many popular sizes and resistance values in stock.

## **RMCG Gold Passivated Sulfur Impervious Chip Resistors**

The RMCG series is also thick film technology, but have a gold barrier layer in the inner terminations which is completely impervious to sulfur contamination. This series is normally specified for very high reliability products such as medical instrumentation, aviation instrumentation, aerospace, and any application with a long expected lifetime in a sulfur rich environment. However, as would be expected for a product that utilizes a precious metal, pricing for the RMCG is significantly higher than standard commodity chip resistors and the usual anti-sulfur chip resistors such as the RMCS. Pricing ranges from \$0.019 to \$0.20 in full reel quantities. The RMCG is offered in sizes ranging from 0402 to 2512, in tolerances as low as 1% and TCR's as low as 100 ppm in a broad range of resistance values. There are a common sizes and resistance values in stock.



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01/16/2013

# Product Highlight



## RNCP High Power Anti Sulfur Thin Film Chips

The RNCP series is a thin film chip resistor that is designed for high power handling, and low cost. Because it has sputtered Nichrome inner terminations with no silver present whatsoever, the RNCP is also completely impervious to sulfur contamination. Unlike typical thin film resistors which are normally used for precision resistor requirements, the RNCP is optimized for high speed manufacturing, and high power handling. The RNCP also doesn't contain any precious metals, so its material costs are less volatile than many other resistor types whose materials can vary with the precious metals market. Finally the RNCP is a truly green alternative resistor technology that doesn't use a lead containing glass layer which is necessary for all thick film chip resistors; this lead containing glass dielectric is exempt from RoHS at this time, but it is uncertain whether it will remain exempt in the future. The RNCP's thin film resistive element is also inherently more stable and less noisy than similar thick film chip resistors. With all of these advantages, the RNCP is a good choice for audio applications, portable electronic devices, remote sensors, data and voice communications equipment, instrumentation, robotics, test equipment, lighting, engine controls, radar instrumentation, electronic scales, solar power systems, and water treatment devices. The RNCP is available in sizes from 0402 and 1206 and in values ranging from 1 ohm to 100K with tolerances down to 1% and TCR's of 100 ppm. Pricing for this series ranges from \$0.002 to \$0.01 each in full reel quantities. There are many popular sizes and resistance values available in stock.

Summary below.

Series	Sizes	Resistance Range	Anti-Moisture?	Pricing	Comment
RMCS	0201 - 2512	1 ohm - 10M ohms	Y	\$0.0038 – \$0.065	thick film, reduced silver
RMCG	0402 - 2512	1 ohm - 10M ohms	Y	\$0.02 - \$0.21	thick film, gold passivated
RNCP	0402 - 1206	1 ohm - 100K ohms	N	\$0.002 - \$0.012	thin film, high power, truly green

More Information and Data Sheets Available At: [www.seielect.com](http://www.seielect.com)

For questions on these and any other Stackpole product please contact Stackpole at: [marketing@seielect.com](mailto:marketing@seielect.com).



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01/16/2013