

Precision Resistors

Advancements in thin film materials and deposition technology have provided the market with reasonably priced precision resistors and allowed their use in a wide range of applications and end products as a result. There are clear advantages and disadvantages to using precision thin film resistors. It is important to understand these advantages and disadvantages in order to select the right precision resistor for a given application or requirement. This product feature will discuss them in detail and how the RNCF, RNCS, and RTAN fit the needs and requirements of the current market.



Advantages

Precision thin film resistors have progressed significantly in the past 10 years. The 0.1% tolerance and 25 ppm/°C TCR resistors that in the past were considered high precision, expensive, and were difficult to find on the shelf anywhere are now commonly found in stock. It should be noted that E96 resistance values are the most popular and common from all manufacturers. When possible, engineers should focus their precision designs on the E96 series of values. In doing so they will have a better chance of finding parts for a prototype, or production build. While most thin film resistor series are available in E192 values, these values will rarely be in stock, may not be marked, and may require a higher minimum order quantity.

The overall electrical performance improvement for precision thin film resistors compared to standard thick film chips is dramatic. Beyond the obvious improvements possible in terms of tolerance and TCR, the measured performance characteristics to the industry standard tests show the impressive capability of precision thin film chips.

Test	Precision Thin Film Performance	Typical Thick Film Performance
Short Time Overload	± 0.05%	± 2%
Load Life	± 0.05%	± 3%
Biased Humidity	± 0.05%	± 3%
Resistance to Solder Heat	± 0.05%	± 1%

Recent advancements in thin film technology now allow production surface mount chip resistors with tolerances down to 0.01% and TCR down to 1 ppm/°C . While this performance still lags behind that of bulk metal foil technology, the gap is narrowing. Further, the cost differential between the highest precision thin film chip resistor and a comparable bulk metal foil resistor is more than an order of magnitude less. Now design engineers with extreme precision requirements have reasonably priced choices that didn't exist in the past. Stackpole's RNCF series provides a wide range of sizes, and resistance values in tolerances as tight as 0.01% and TCR's as low as 1 ppm/°C.

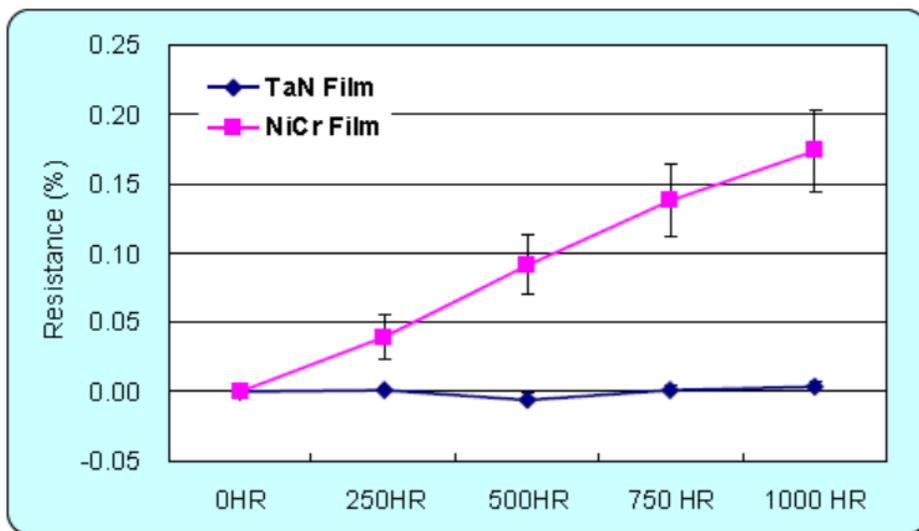
Disadvantages

There are two main disadvantages to thin film technology. Pulse handling for thin film resistive elements is limited due to the small amount of resistive material present for this technology. For Nichrome thin film resistive elements, which are the most abundant thin film resistors in the market today, there is a possibility of moisture corrosion leading to resistance shifts and eventually open failures.

Pulse handling for thin film resistors is comparable to thick film chip resistors for pulse durations of 1 second or longer. This is due to the higher relative density of thin film elements compared to thick film. However for shorter pulse durations, the amount of energy handling dramatically decreases. For pulse durations of 0.1 milliseconds for example, the difference between thick film chip pulse handling compared to thin film is roughly an order of magnitude. However, precision thin film resistors are most often used in precision applications, measurement or monitoring, and highly accurate controls. These applications will typically have little or no pulse handling required. If there are pulse conditions, then other pulse limiting resistors can be used in conjunction with the thin film resistors to limit their exposure to the pulse energy.

Moisture corrosion is a potential cause of failure for standard Nichrome thin film chips. Moisture causes the metals in the thin film element to oxidize making them non-conductive and eventually leading to positive resistance shifts and open circuit failures. Fortunately there are several options to remedy this problem. Stackpole's RNCS series is a proprietary passivated Nichrome thin film technology which provides a moisture proof barrier protecting the resistive element. In 3000 hour biased humidity testing, the RNCS series shows very little resistance shift. For applications which require the highest resistance to moisture corrosion, Stackpole's RTAN series utilizes Tantalum Nitride technology which is impervious to moisture corrosion. The RTAN can withstand thousands of hours under biased humidity with almost no significant resistance shift at all.

Condition: 1000 +48/-0 hours, loaded with 10% rated power in humidity chamber controller at +85°C/ 85% R.H., 1.5 hours ON and 0.5 hours OFF.





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Summary

Design engineers now have a thin film SMD alternative that can provide a wide resistance range, wide range of sizes, tolerances as tight as $\pm 0.01\%$ and TCR down to 1 ppm/ $^{\circ}\text{C}$. The RNCF series provides the broadest range of sizes, resistance values, tolerances, and TCR's. The RNCF has a significant number of part numbers in stock especially in the 0.1% tolerance and 25 ppm/ $^{\circ}\text{C}$ options. For moisture resistant requirements, the RNCS is the anti-moisture version of the RNCF. The RNCS is more limited in value range, tolerances, and TCR's offered and is slightly more expensive than the RNCF. For applications requiring a precision resistor that is impervious to moisture and humidity, Stackpole's RTAN is the best choice. The RTAN is more limited in sizes, values, tolerances, and TCR's offered and is more expensive than the RNCS.

More information and datasheets available at www.seielect.com

For questions on these and any other Stackpole product please contact Stackpole at: marketing@seielect.com