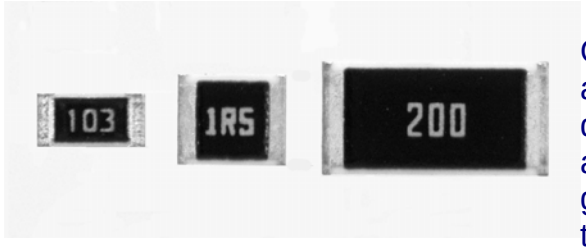
Thick Film and Thin Film Resistors – A Comparison

Even though they look essentially the same to the naked eye and share many of the same process steps, thick film and thin film technologies are very different. The resistive element for thin film resistors is approximately 1000 angstroms thick and is deposited on the ceramic using a sputtering process. Thin film processing may also include a photo etching process when a complex film pattern is required. The sputtering process provides a uniform metallic film most commonly using of an alloy of nickel and chromium, or Nichrome. This film is uniform and dense. It withstands the laser trimming process used to calibrate these resistors without microcracks around the trim line. Thin film resistors are able to achieve much lower tolerances and resistor temperature coefficients, have lower noise, lower parasitic inductance and lower capacitance. As a result, thin film resistors are stable at much higher frequencies and will be significantly more stable over their lifetime compared to thick film resistors. The improved electrical characteristics and performance equates to a higher cost for thin film. In addition, thin film resistors (except for the RNCS and HDM) are susceptible to moisture if operated under extremely humid conditions at low power loading.



General purpose thick film chip resistors (RMCF series) are the most prolific part used in electronic and electrical devices today. As a result, they are the most widely available and lowest cost of any resistor technology. For general purpose applications that don't require low TCR or tight tolerance, thick film resistors are generally the preferred solution. Thick film resistive elements start with a grain-containing ruthenium oxide paste which is screen printed onto a ceramic substrate. The resistive element is thousands of times thicker than a thin film resistive element. Typical TCR's range from 100 ppm to 400 ppm, and standard tolerances are 1% and 5%.. The RGC series of semi-precision thick film chip resistors is capable of 50 ppm and 0.5% tolerance, but is much more expensive than the RMCF. Thick film resistor elements become glasslike after firing, which means they are inherently impervious to moisture.

Thin Film resistors are typically used for applications that require high stability, high accuracy, or low noise. Such applications may include test and measurement equipment, monitoring equipment, medical equipment, audio applications, precision controls and instrumentation. Thick film resistors are used on literally every type of electrical device; if it has a battery or an AC plug, it will probably have a thick film resistor. For example the average PC currently contains over 1200 chip resistors, most of which are thick film chip resistors. Unless there are stability, accuracy, or noise requirements, thick film resistors will always be the preferred resistive solution in any circuit design.