Investigation of Trim Notch and its Effect on Surface Mount Resistors in RF Circuits

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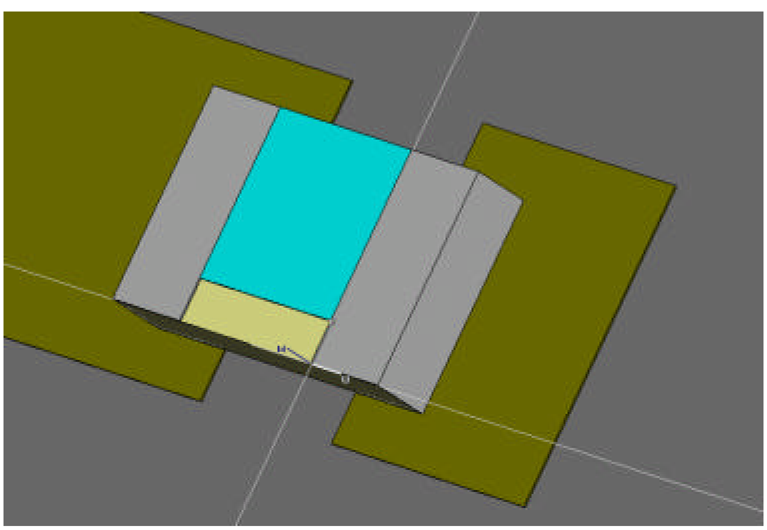
Introduction

Surface mount (SMD) resistors are often employed in microstrip circuitry at RF frequencies. Typical SMD resis tors designed for general purpose circuitry are usually trimmed using plunge trim or “L” trim techniques. This involves removal of material in a narrow groove either perpendicular to the current flow (plunge trim) or in a pattern first perpendicular to current flow and then parallel to the current flow (“L” trim). These configurations can exhibit large variations in RF impedance depending upon the degree of trimming and are therefore not considered here. Instead, SMD resistors intended for use in RF applications are typically trimmed using the scan trim technique. In this process the material is ablated parallel to the flow of current starting at one edge of the film. This effectively narrows the resistive film without changing the uniform area perpendicular to the current flow. The effect of this trim technique on the RF performance of a typical SMD resistor is investigated here.

Description

The configuration examined here consists of a 50 ohm 0805 SMD resistor mounted to a 0.075” wide microstrip circuit trace on a Taconics TLC (er=3.2) substrate 0.031” thick. One end of the trace is connected to the input port and the trace connected to the other terminal of the resistor is connected to the microstrip ground plane with two 0.008” diameter vias. Since the characteristic impedance of the microstrip line is approximately 50 ohms, this represents a typical application of a resistor for an RF termination.



SMD Resistor with Scan Trim Mounted to Microstrip Line

Results

The configuration described above was simulated for trim widths of 10%, 20%, 30%, 40% and 50%. The log magnitude and Smith Chart representations are shown below. It can be seen that the variation increases with increasing frequency and with increasing trim amounts. This intuitively satisfying result still doesn't completely answer the question of what is the acceptable range for a given application. In particular, if the circuit is tuned for maximum return loss over a particular frequency range, the variation (in dB) could be much larger due to the logarithmic relationship. The model does, however, underscore the importance of careful control of the trim process employed in producing SMD resistors for RF applications.