A Screening Method Using Pulsed-Power Combined with Infrared Imaging to Detect Pattern Defects in Bulk Metal Foil or Thin Film Resistors

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Bulk metal foil and thin film resistors occasionally contain localized defects within the etched resistor pattern. Common defects of this type include in-line constrictions referred to as notches, unremoved resistor material bridges between adjacent pattern lines, and embedded non-conductive particles in the resistor material. Such defects are prone to fracture due to thermomechanical fatigue during powered operation, especially power cycling, resulting in positive resistance change and open circuit failure modes. Common screening methods of optical microscopy, short time overload power tests (e.g., 6.25x rated power for 5 seconds) and burn-in (e.g., 1.5x rated power for 100 hours) are useful, but they are not always effective at removing devices with such defects.

An improved method has been developed to screen for localized resistor pattern defects. The method involves the application of brief, high power electrical pulses at a low duty cycle while inspecting the resistor with a high resolution, high speed infrared camera. The following test conditions were found to be suitable for this purpose: 6.25x rated power, 1 to 5 pulses, 50 ms pulse width and 10% duty cycle. During the power pulsing, localized constrictions in the resistor pattern are identifiable as hot spots via the infrared camera. Reject criteria can be established based on observations of hot spots.

To assess its effectiveness, a total of two hundred eighty (280) surface mount foil resistors (40 each from 7 different lots) were screened using this infrared technique. The screening identified twenty-nine (29) resistors with significant hot spots in the resistor pattern. All 280 resistors were then subjected to an industry standard 10,000 hour life test at 1x rated power at 70°C with power cycled for 90 minutes on and 30 minutes off. During life testing, three resistors exhibited positive resistance change failure mode. All three failures were due to thermomechanical fatigue failure of localized bridge defects at the locations identified via infrared screening. The results of this evaluation illustrate the benefits of the pulsed-power infrared detection screening technique to identify reliability suspect foil or thin film resistors that may escape common screening methods.