

APPLICATION NOTE

ELECTRONICS TESTING

Quality Control in Power Supply Hybrids

The Problem

Fairchild's Power Systems Division produces a 40-watt programmable power supply hybrid circuit. The customer for these custom designed circuits was experiencing an unacceptable (2 to 4 percent) failure rate because of overheating of delivered circuits. Thus they began requiring 100 percent temperature testing of the circuits by the manufacturer.

The failure of the power supply hybrids is related to either poor bonding of the bipolar power transistors to a beryllia (BeO) substrate or poor bonding of the substrate to a base plate heat sink. The poor bonding results in overheating because heat cannot be removed from the power die. The overheating to failure occurs quickly when a poorly bonded circuit is connected to a power source.

The standard quality control testing procedure for temperature on these circuits was based on sampling and the use of an infrared (IR) radiometry system to measure temperature of the circuits.

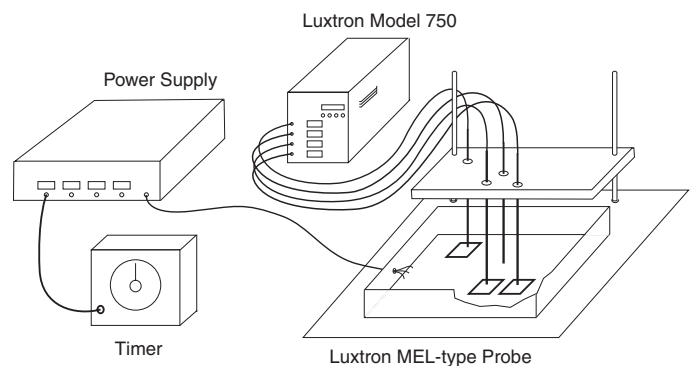
In this application, the difficulty with using IR radiometry is two-fold:

1. The IR system requires a 15-minute, 2-temperature surface emissivity calibration. The calibration is necessary because IR radiometers measure the intensity of received infrared radiation which is converted to temperature based on the emissivity of the surface. The emissivity of silicon and GaAs is a strong function of temperature. Also, their emissivity is a function of their dopant type and concentration. Thus, IR can provide information on the relative temperatures of a circuit but not the absolute temperature of a specific spot quickly.
2. Silicon and GaAs are virtually transparent to long wavelength IR radiation. Thus, an IR radiometer will receive most of its signal from a source behind the die.

(For more information on IR radiometry, see TN 86-6.) By switching to a Luxtron Fluoroptic[®] thermometer, test time was reduced to 30 seconds and 100 percent testing of the hybrid circuit was possible.

The Solution

A test stand was assembled that included a timer, a power source with connects for the circuit, a circuit holder, and Luxtron temperature probe holder/positioner jig and the Luxtron Model 750. The hybrid is fixed in the circuit holder, the power source connected, and four MEL surface temperature probes in the jig were brought in contact with three power transistors (see sketch) and the substrate. The 750 starts measuring temperatures; the timer is started and that switches on the power. The operator records the temperatures at 15 and 30 seconds. At 30 seconds, the timer shuts off the power to the circuit. From tests on known good and bad circuits, it was determined that if a die was at 60 °C or below at the end of 30 seconds, the bonding was good and if a die was above 80 °C, it was known that the substrate or die was poorly bonded. Using such a system, it is possible for one person to test 500 circuits in two days achieving 100% testing.



Schematic of Hybrid Test System



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