Control Chip Temperature During VLSI Device Burn-in

Harold Hamilton - April 01, 1999
Micro Control Co., has a B.S.E.E. degree from the Georgia Institute of Technology. Harold E. Hamilton is founder and president of Micro Control Co. He has a B.S.E.E. degree from the University of Nebraska and an M.S.E.E. degree from the University of Minnesota. Charles H. Morris, technical writer at Micro Control Co., has a B.S.E.E. degree from the University of Nebraska and an M.S.E.E. degree from the Georgia Institute of Technology.

The display also shows global temperature settings for the burn-in board as well as actual minimum, maximum, and average temperatures and heater duty cycles. T&MW

A high-power burn-in system’s software can provide individual device temperature control and monitoring. In the power to the heater for the corresponding device.

The temperature-control mechanism compensates for variations in the air temperature and velocity at a particular device in the test chamber. For example, slightly warmer air at one device location would result in slightly less heat flow from a heat-sink assembly.

The amount of heat transferred to the air stream is proportional to (T - T)

The air temperature and velocity must ensure that the heater can control the device temperature over the full potential range of heat dissipation. If the air stream carries away too much heat from the heat-sink assembly, the heater will not be able to maintain the package at the desired temperature. In the other hand, if the air stream carries away too little heat, the device will become too hot even with the heater turned off.

A burn-in test strategy ensures good thermal contact between DUT and heat-sink assembly. He can control the device temperature over the full potential range of heat dissipation. The thermal impedance varies by device type, it’s usually uniform for a given part number.

The die inside the DUT is the active component whose temperature is most important. The high-power burn-in system monitors and controls the package temperature, which in turn controls the die temperature in accordance with the thermal impedance of the part. The test chamber accommodates multiple burn-in-board/heat-sink-assembly combinations and provides uniform airflow. The optimum air temperature and velocity are functions of device power, the thermal characteristics of the heat-sink assembly, and the required package temperature.

A burn-in test strategy ensures good thermal contact between DUT and heat-sink assembly. The heat-sink assembly contains a spring, temperature sensor, and heater. The control circuitry monitors the device temperature and supplies the proper heater power to maintain the device at the required temperature.

The quantity of heat transferred to the air stream is proportional to (T - T)

For example, the package temperature required to provide a die temperature of 150°C for a device with the thermal impedance equal to 0.25°C/W and a heat dissipation of 10 W is as follows:

T = 150°C – (0.25°C/W x 10 W) = 147.5°C

Thus, controlling the package temperature to 147.5°C will maintain the die temperature at 150°C at 10 W dissipation.

Air Temperature and Velocity

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Control Software

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In one approach to high-power burn-in, an operator plugs devices into sockets on one side of a burn-in board (Fig. 2). A clamshell or other press fixture then brings a heat-sink assembly (Fig. 3) into contact with each device.

Figure 5. Burn-in control software provides information about each DUT on a burn-in board. Here, green indicates satisfactory temperature performance; red indicates a temperature anomaly; and blue indicates a disabled heater. The 286°C temperature radiating unit (TRU) is an open-circuit power heating device.

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