RF INDUCTION AND ANALOG JUNCTION TECHNIQUES FOR FINDING OPENS

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In response to the need for fast and simple methods for detecting and diagnosing open pins on SMT devices, board test manufactures have introduced power-off, vectorless test techniques that provide reasonable fault coverage with little programming effort. Although the focus of all of these techniques is to find opens on SMT devices without extensive programming, the actual techniques vary. Some make capacitive measurements between device lead frame and fixture-mounted sensors or transmitters. Others examine the characteristics of parasitic transistors or protection diodes typically found on every device pin. A third technique uses radio frequency (RF) fields to induce current in the device circuitry in the same manner that the primary coils of a transformer induce current in the secondary coil. All of these techniques require physical bed-of-nails access to each pin to be tested. This paper describes two techniques: the RF induction and the analog junction technique.

The RF technique applies a 200-500KHz signal to a spiral loop antenna located over the device. This antenna or “inducer” produces an AC signals at the device pin under test which the in-circuit tester measures. The technique requires one inducer for each device to be tested. These inducers are mounted in the in-circuit test fixture, along with a selector board. The selector board routes the RF signal to the inducer over the device being tested. The inducers are passive device, and unlike some capacitive sensors, they require no buffers or amplifiers in the fixture.

The test system software automatically learns the characteristics of the device being tested. The user need only describe the connections between the device and the tester, identify the device’s power and ground pins, and which inducer is mounted over the part. With this information, the software selects the inducer and routes the RF signal to it. It applies a DC bias to each pin to be tested and measures the induced AC signal. This DC bias turns on the protection diodes causing current to flow between the pin and either the power or ground lead of the device, giving the RF signal a path for induction. The test system measures the induced AC voltage on the pins. During the learn operation, the software will try both positive and negative bias, and set the optimal test threshold. The learn process takes a few milliseconds per pin. The test operation is similar to the learn operation, except that it applies the learned bias and compares the measured AC voltage to the learned test threshold to decide if a pin is open.

The analog junction technique also uses the device protection diodes. It requires no fixture hardware, relying only on the bed-of-nails contact with the device pins. The analog junction technique applies voltage to one pin of the device, causing current to flow between the pin and the device ground lead. Voltage is then applied another pin on the device, causing current to flow between this pin and the ground lead. Since the pins share a common substrate resistance to ground, the application voltage on the second pin cause the current flow on the first pin to change.

The analog junction technique determines if pins are soldered by detecting the change in current, or current delta. If the current changes, then both pins are soldered to the board. If the current does not change then either one of the pins, or the ground lead is open. Each device pin is tested with multiple pins on the device to determine which is the open pin. Only pins that fail all of their pin pair tests are identified as open pins. This provides for robust tests, as well as clear diagnosis of the open pin.

Both the analog junction and RF induction techniques are effective means for detecting opens on digital devices.