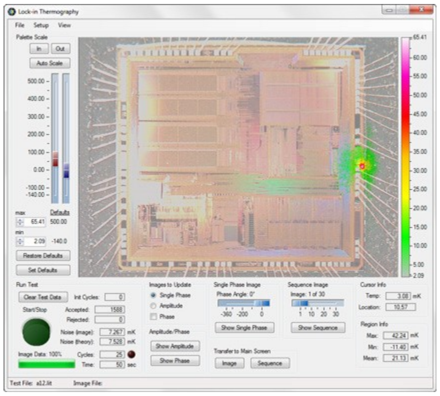
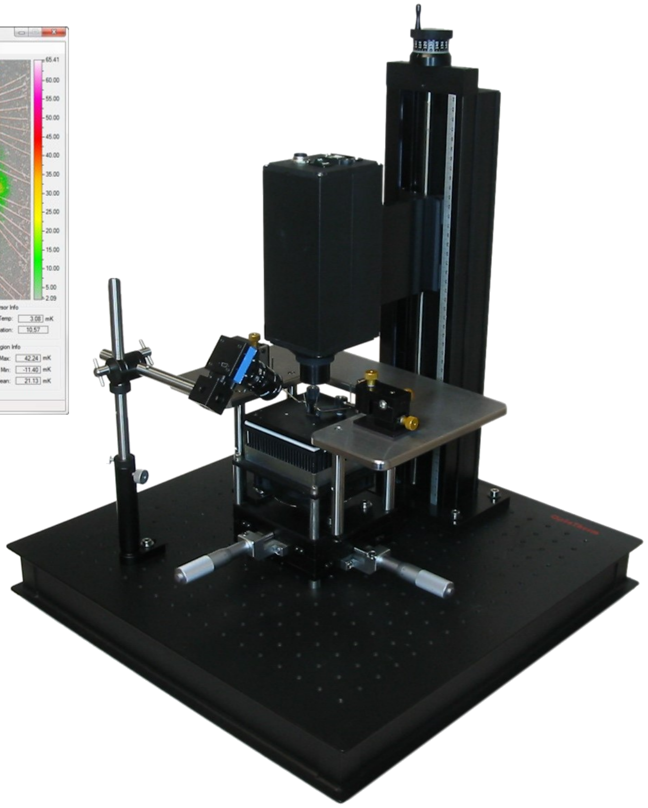
Sentris

Thermal Imaging Microscope

Semiconductor Device Failure Analysis



Due to the continued decrease in integrated circuit feature size and supply voltages, detecting and locating the miniscule amount of heat generated by failure sites has become increasingly difficult. The Sentris thermal imaging microscope pinpoints the low-level infrared thermal emissions by IC faults such as short circuits and leakage current.



Using a non-destructive testing (NDT) process called lock-in thermography, failures can be isolated on both bare (front or backside) and packaged devices and no surface coating is required. Sentris can also locate low-power fail sites on SMD components, such as capacitor leakage. The x, y position of defect sites can be located, as well as defect depth. Depth analysis can be very helpful when isolating faults in stacked die packages.

In addition to fault isolation, Sentris also includes thermal analysis tools for true temperature mapping, junction temperature measurement, die attach evaluation, and thermal resistance

Affordable

The innovative Sentris fault isolation process was developed by Optotherm to simplify and reduce the cost of the lock-in thermography process. Traditional lock-in thermography systems include complex function generators and power supplies in order to synchronize device power with the capture of thermal images. By eliminating the need for these complicated and expensive instruments, Sentris provides a straightforward and affordable technique to semiconductor defect isolation.

Sentris was developed around uncooled, long-wavelength infrared detector technology, that enables us to offer Sentris at a fraction of the cost of competing systems that incorporate mid-wavelength cooled cameras.

Faults Detected

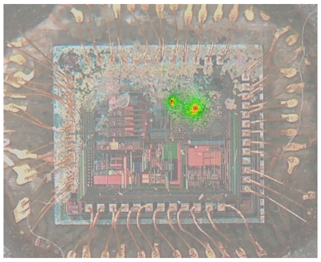
- Semiconductor ESD related faults
- Leakage current and hot spots
- Resistive shorts between gate and drain
- Shorts in mold compound of packaged devices
- Latch-up sites
- Shorts in metallization
- Defective transistors and diodes
- Oxide layer breakdown
- SMD component leakage

Features and Capabilities

- High sensitivity Lock-in Thermography fault isolation
- Defect depth analysis of stacked die
- True temperature mapping using Emissivity Tables
- Visual camera probing
- Junction temperature measurement
- Bare and packaged device analysis
- Front and backside analysis
- Detection of die attach problems
- Thermal resistance evaluation

OPTOTHERM
THERMAL IMAGING

Lock-in Thermography



Lock-in thermography is a process of automatically and repeatedly powering a device at a specific frequency (up to 15 Hz) using a laboratory power supply and solid-state relays while the thermal images of the device are analyzed over time. Using this technique, hot spots that heat up less than 1mK (0.001°C) and dissipate below 10 µW can be detected. Higher frequency tests improve hot spot spatial resolution by reducing thermal diffusion into adjacent areas of the device.

Test sensitivity is directly dependent upon lock-in test time. As a test continues to run, lower and lower power dissipation levels can be detected. There is no limitation on how long a Sentris lock-in test can be performed. Consequently, finding an extremely small heat signature is only a matter of time.

In addition to identifying the x, y location of a defect, fault depth within a stacked-die can also be determined by analyzing the phase angle between device power and subsequent surface heating.

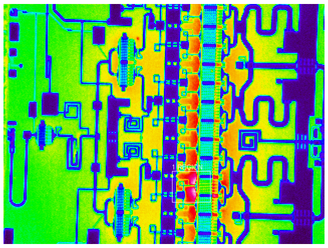
Included Components

- IS640 thermal camera (microscopic 80µm and 20µm lenses)
- Thermalyze software with Lock-in Thermography
- Mounting table, vertical camera stage, and xy stage
- Thermal stage and controller
- Reed relay card, rack, and modules
- Device probing platform and needle probes
- Visual camera, stand, and LED lights

Optional Components

- Macroscopic lens
- Microscopic 5µm lens
- Thermalyze Offline software
- Software Development Kit
- Emissivity coating kit
- Thermal test chip

True Temperature Mapping



When imaging semiconductor devices, much of the contrast on the image is usually due to emissivity variations, not to temperature variations. Measuring true temperature requires compensating for these emissivity variations according to the following procedure.

Unpowered devices are placed on the thermal stage and controlled to a stable temperature. The Emissivity Table software is then used to create an emissivity map of the device, allowing accurate temperatures can be obtained at any point on a device.

Specifications

Infrared Camera	
Detector	Uncooled LWIR* (7-14 µm) microbolometer
Detector Size	640 x 480
Image Capture Rate	60 frames/sec
Output Protocol	Camera Link
Measurement Range	10 to 300°C
Measurement Accuracy	+/-2°C or +/-2% of measurement§
Power	12V Power over Camera Link (PoCL)
Ambient Operating	15 to 35°C
Moving Parts	Calibration shutter
Lenses	
Macroscopic	focusable with min 90 x 68mm FOV, min 100mm WD† , < 0.05°C NETD‡
Microscopic 80 micron	fixed-focus 51.2 x 38.4mm FOV, 63mm WD† , <0.05°C NETD‡
Microscopic 20 micron	fixed-focus 12.8 x 9.6mm FOV, 30mm WD† , <0.05°C NETD‡
Microscopic 5 micron	fixed-focus 3.2 x 2.4mm FOV, 20mm WD† , <0.3°C NETD‡
Physical	
Sentris table unit	450 mm (W) x 450 mm (D) x 650 mm (H), 30 Kg
Thermal Stage Controller	300 mm *W) x 350 mm (D) x 130 mm (H), 4 Kg
Reed Relay Enclosure	220 mm (W) x 180 mm (D) x 120 mm (H), 2 Kg
Benchtop Space (Minimum)	180 cm (W) x 90 cm (D) x 80 cm (H)
Utilities Required	6 outlets: 100 V AC to 240 V AC, 50 Hz to 60 Hz

* Long wavelength infrared
§ Valid for macroscopic, 80 micron and 20 micron lenses
† Working distance
‡ Noise equivalent temperature difference

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