

# OptoTherm EL

Thermal Imaging System for Electronics Defect Analysis



Many printed circuit board assembly defects cannot be identified easily using conventional methods such as ICT, FT, AOI, and AXI. Such defects include power-to-ground, low resistance and cable shorts, stressed components, faulty heat sink attachment, programming errors, and defective BGAs, VCOs, and decoupling capacitors.

Technicians and engineers spend many hours debugging boards with such defects. Often, these boards end up in the scrap pile. OptoTherm EL provides an alternative method of fault detection that can isolate these defects, thus filling the gaps between conventional test equipment. EL is an effective and economical tool that can reduce debugging costs and minimize scrap.

## Applications

- Quickly locate shorts, stressed components, and other defects
- Analyze thermal behavior of individual components
- Evaluate thermal management systems

## Key Software Features

- Model Board Comparison™
- Sophisticated short detection algorithms
- Transparent picture overlay

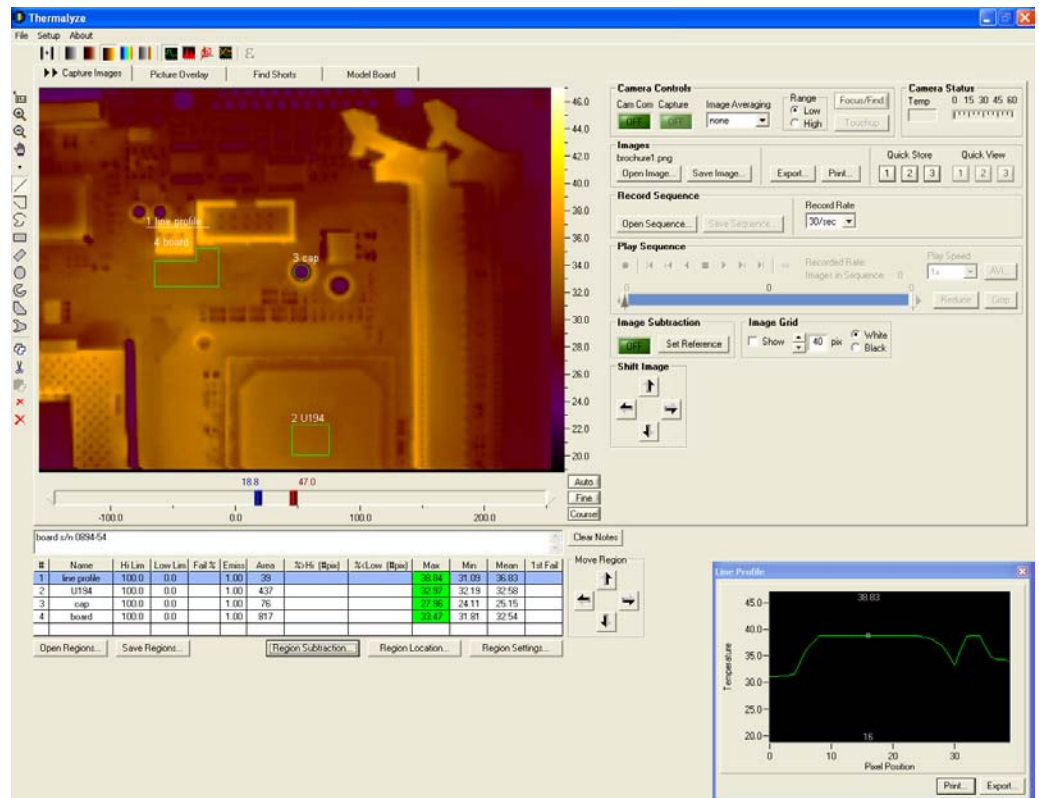
## Key Hardware Features

- <math><0.05^{\circ}\text{C}</math> temperature sensitivity
- 320 x 240 uncooled detector
- 100  $\mu\text{m}$  pixel resolution
- 30 frames/second image capture

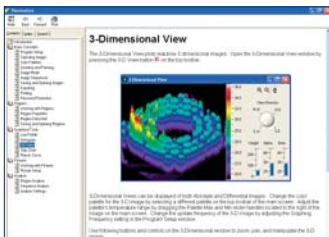


# Thermalyze Software

Thermalyze™ provides an extensive set of analysis tools to help you perform sophisticated temperature analysis. Tools such as Model Board Comparison™, Find Shorts, and Picture Overlay allow you to detect and locate defects quickly and easily. The ability to create real-time strip charts, record and play back image sequences, and create regions of any size and shape enable you to analyze data in many different and insightful ways.



HTML Help Screen



## Short Detection

Short circuits on a PCBA can be very difficult to troubleshoot. While ICT may indicate that a short circuit exists, often it cannot locate the defect. Technicians and engineers can spend many hours locating a single short, particularly interlayer shorts and low resistance shorts.

The EL camera's high sensitivity, combined with sophisticated noise reduction and image enhancement software algorithms, provide the ability to detect and locate troublesome short circuits. Within a few seconds, EL can identify shorts that dissipate less than 1 milliwatt of power and that exhibit temperature rises of only 0.03°C.

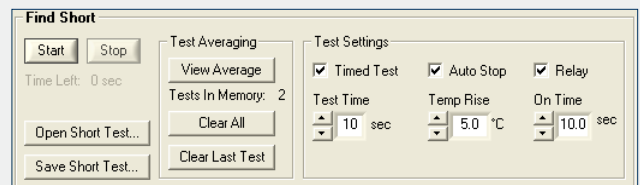
During a short detection test, boards are typically powered for 5 to 10 seconds. The I/O module provides a relay output to apply power to the board.



Low resistance and power-to-ground shorts are often the only areas that heat up on a board during a short detection test. This low resistance short was located by applying 500 milliamps of current for 5 seconds.



The short is located by overlaying a transparent visual picture of the board that has been imported into the program.



Test Averaging enables you to detect shorts with a resistance under 1 ohm. Because low resistance shorts do not dissipate much power and heat, a series of tests are averaged together to increase test sensitivity.

The AutoStop feature opens the I/O module relay, cutting off power to the board, as soon as the temperature of the short increases above a user-defined threshold. This safety feature can prevent damage to the board, while still locating the short.

## Model Board Comparison

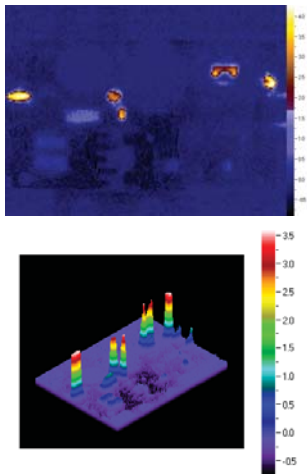
Model Board Comparison™ (MBC) can identify defects on PCBAs (or individual electronic components) by comparing their thermal behavior to a model. Models are created by testing one or more known good boards (golden boards).

MBC can detect and locate very small temperature differences between good and bad boards that are nearly impossible to detect using any other method. During an MBC test, a sequence of thermal images is captured while the board is energized. Boards are energized by powering them or by running a functional or diagnostic test. The I/O module provides relay outputs and digital inputs that are used to control power to the board.

MBC can inspect an entire board at once, regardless of component density, and without contact with the board. Thousands of detector elements in the EL camera act as virtual test probes.

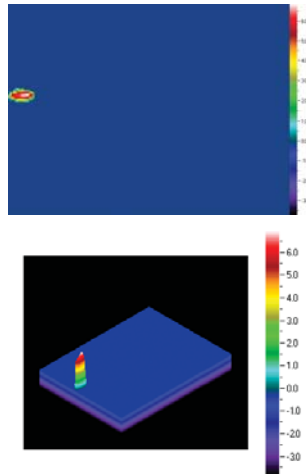
### Step 1 Create Model

Create a golden board model by testing known good boards. These images show the temperature changes that occurred on the board during the test.



### Step 2 Analyze

Test a defective PCBA and make comparisons to the model. Areas on the board that are different from the model are highlighted and may indicate defects.



### Step 3 Locate Defect

Locate the defect by overlaying a transparent visual picture of the board that has been imported into the program.



**Model Board Comparison**

Start Stop

Time Left: 00:00:00

Retest Shift...

Comparison Status

Test Frame: 7874.seq

Failed Pixels:

Open Test Board... Save Test Board... Test Settings...

View Test Board  
 View Comparison  
 View Group Board

Model Board Group

Group Name: 9694

Open Group... Save Group...

+ - ← → Clear All

Board Name: 9694

Board Number: 2 of 2

Create Model

Acceptance Criteria

Small Group: < 10 Boards

Sensitivity: 10 Noise Level: 0.5 °C

Large Group: > 10 Boards

Standard Dev: +/- 5 Noise Level: 0.0 °C

Bad Pixels To Fail: 10 Misalignment: 0 pix

Save Each Test Board

Models are created by adding tests of known good boards to a group. Acceptance Criteria determines how the board is compared to the model. Board tests can be automatically saved to hard disk after each test.

**Model Board Comparison I/O Settings**

Enable I/O

Relay Outputs

Enable Relay Outputs

Relay	Closed	Open	Status (click to test)
0	<input checked="" type="checkbox"/> 0.0	<input checked="" type="checkbox"/> 5.0	<input checked="" type="checkbox"/>
1	<input checked="" type="checkbox"/> 0.0	<input checked="" type="checkbox"/> 0.0	<input checked="" type="checkbox"/>
2	<input type="checkbox"/> 0.0	<input type="checkbox"/> 0.0	<input type="checkbox"/>
3	<input type="checkbox"/> 0.0	<input type="checkbox"/> 0.0	<input type="checkbox"/>
4	<input type="checkbox"/> 0.0	<input type="checkbox"/> 0.0	<input type="checkbox"/>
5	<input type="checkbox"/> 0.0	<input type="checkbox"/> 0.0	<input type="checkbox"/>
6	Ready	Busy	<input type="checkbox"/>
7	Pass	Fail	<input type="checkbox"/>

Digital Inputs

Enable Digital Inputs

Input	High	Low	Status
0	<input type="checkbox"/> Start Analysis	Reset	<input checked="" type="checkbox"/>
1	<input type="checkbox"/> Stop Analysis	Reset	<input checked="" type="checkbox"/>
2	<input type="checkbox"/> Calibration Shutter	Reset	<input checked="" type="checkbox"/>

OK Cancel

Set the time that each relay will close and open during the test. Only one relay is needed when simply powering a board. Multiple relays can be used to perform more sophisticated tests such as powering different board planes or applying different loads at different times. Relays 6 and 7 and the digital inputs are used to synchronize tests with external test equipment.

**Model Board Comparison Test Settings**

Test Time Length

Hours: 0 Minutes: 0 Seconds: 5

Test Frame Frequency: 5/sec

Stop On Fail

I/O Settings...

OK Cancel

Set the test length and the rate at which images are evaluated.

## EL Components

- InfraSight™ thermal imaging camera with 50° lens
- Thermalyze™ image analysis software
- Adjustable 27.5" camera stand with 16.5" x 15.5" base
- Dell tower PC with LCD multimedia monitor
- I/O module (8 relay outputs, 8 digital inputs)
- Camera Link video board
- Camera Link video cable
- USB camera communication cable
- Camera power supply (100-240 VAC, 50/60 Hz)

I/O module



## EL Accessories

- Adjustable 44" camera stand with 27" x 24" base
- Camera positioning arm with universal mount
- Adjustable PCBA fixture (PCBA up to 6.75" x 11.25")
- Adjustable PCBA fixture (PCBA up to 12.75" x 15.25")
- Thermalyze off-line image analysis software

Camera positioning arm



## Specifications

### Measurement

Temperature Range:	0 to 300°C (32 to 572°F)
Pixel Resolution:	0.1 mm (0.004 in) minimum
Accuracy:	+/-2°C or 2% of reading (whichever is greater)
Sensitivity (NETD):	<0.05°C
Sample Rate:	30 frames per second

### Optics

Field of View:	50° x 37.5°
Focus Distance:	25 mm (1 in) to infinity

### Physical

Ambient Operating:	15 to 35°C (59 to 95°F)
Ambient Storage:	-40 to 80°C (-40 to 176°F)
Camera Dimensions:	89 x 76 x 200 mm (3.5 x 3.0 x 7.9 in)
Camera Weight:	1.4 kg (3.0 lb)
Power Consumption:	1.2 W
Mounting:	1/4"-20 internal threads

### Detector

Thermal Time Const:	21 msec
Start-Up Time:	5 sec
Detector:	Uncooled focal plane array
Array Size:	320 x 240 elements
Spectral Response:	7-14 μm
Moving Parts:	Micro shutter (focal plane array touch up)

PCBA fixture



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