



Innovation in Thermal Management™

thermVIEW™

Liquid Crystal Thermographic Analysis Tool

thermVIEW™ Features

- One micron spatial, 0.1°C thermal resolutions.
- User-calibrated temperature accuracy to +/- 0.1°C.
- Color/Temperature key with cursor link indicates temperature at cursor location.
- Temperature profile can be observed without microscope for cursory observations or with microscope for more precise analysis.
- Thermography can be performed even by viewing through glass or transparent plastic.
- View physical and thermographic images simultaneously.
- Thermal image analysis with capability to select thermal and spatial regions of interest.
- On-screen temperature probe.
- Automatic calibration system for liquid crystal temperature response.
- thermSOFT™, a thermal image analysis software with temperature and position indicators.



thermVIEW™ is a high resolution liquid crystal thermography system for cost effective temperature measurement of electronic circuit boards, micro circuits, hybrid components and integrated circuits.

System Components

- High performance, solid-state, color camera with micro or macro-scopic optics
- Stable, flicker-free white light source
- High speed digital, color frame-grabber
- State-of-the-art color temperature calibration device
- PC computer platform
- Thermochromic Liquid Crystal (TLC) materials supplied in an easy to use kit
- thermVIEW™ image processing software system, thermSOFT™

Applications

- **One micron level* thermal mapping of electronic devices (not possible with IR systems)**
- **Locate hot spots and defects**
- **IC thermal design and verification**
- **Accurate temperature measurement on micron size hot spots on microcircuits, components, modules, and PCBs**
- **State-of-the-art thermal analysis of devices**
- **Comparative failure analysis**
- **Live (transient) thermal analysis (30 images per second)**

*0°C to 90°C less than 1 micron spatial resolution with unencapsulated liquid crystal
0°C to 160°C minimum 5 micron spatial resolution with encapsulated liquid crystal



The turnkey **thermVIEW™** Thermo-chromic Liquid Crystal based temperature measurement system performs high-resolution thermography with precise temperature accuracy and micron level spatial resolution. The system provides greater range and flexibility while it is more cost-effective than alternative technologies. Applications for thermVIEW™ exist in a wide range of industries, including electronics thermal management and failure analysis, gas turbine heat transfer industries and academic laboratories.

The **thermVIEW™** system uses the color response of thermochromic liquid crystals (TLC) for the purpose of temperature measurement. Liquid crystals reflect incident light at the visible wavelength based on the temperature of the surface to which they are applied. The temperature response of liquid crystal is called the event temperature. When the surface is illuminated by white light and viewed under fixed optical conditions, the TLC material will reflect a unique wavelength distribution of visible light (i.e., color). As the temperature rises through the TLC's bandwidth, the reflected color of the TLC will change. Finally, when the temperature exceeds the TLC's clearing point temperature, the material will enter the pure liquid state and will revert back to being transparent. This phenomenon is selective reflection and occurs in most TLCs both on heating and cooling, and occurs with minimal hysteresis.

The reflected color distribution for most TLC materials will vary continuously from the longer wavelengths (i.e. red) corresponding to the event temperature to shorter wavelengths (i.e. blue) corresponding to the clearing point temperature. Additionally, a TLC material will also transmit a significant amount of the incident light with virtually no modification. This color-temperature response can then be captured by a color camera, formulated into a calibration curve of color versus temperature and used to transform a color measurement system into a very accurate TLC based thermography system.

In building efficient TLC-based thermography systems, thermVIEW™ technology and performance surpasses all other available methods,

including Infra Red thermography.

TLC Color Temperature Calibration
thermVIEW™ built-in features allow fully automatic color-temperature calibration of virtually any TLC formulation available via the patented RS-232-enabled calibration device. This device permits the color-calibration data to be acquired by simultaneously using the camera to record the color response while it is being subjected to successively higher levels of temperature on a solid-state, PID-controlled test surface. The software then analyzes the color/temperature response and builds the calibration data.

Thermograph Analysis Tools

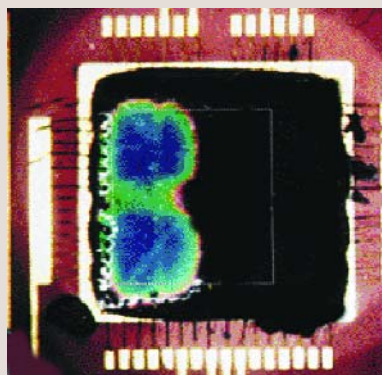
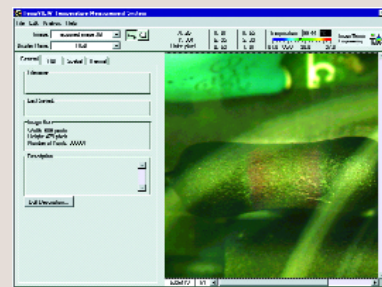
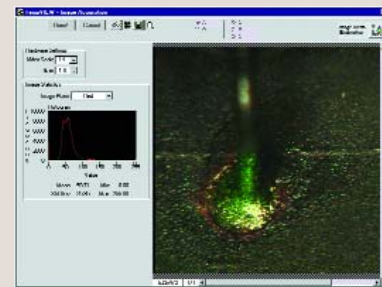
thermVIEW™ analysis tools provide users with dynamic data-probing capabilities with point value and linked X-Y data profile display. Users can interactively calibrate the physical-to-screen coordinate system for any image being analyzed. This feature gives thermVIEW™ operators a very simple and direct mechanism to make spatial measurements of the thermal phenomena present in their thermographs.

Processing Tools

thermVIEW™ processing tools allow users to “extract” a color or temperature image plane with Region Of Interest (ROI) control, create and apply “masks” (aids in determining valid regions of the image), perform thresholding and apply spatial filters on a loaded image interactively. Automatic conversion to temperature in user specified units (°C, °F, K, R) is supported using the TLC color-temperature calibration data.

Image Acquisition/Storage Software Features

thermVIEW™ has integral support for live, “on-the-fly” image acquisition, averaging and storage (TIFF file format) features. These include ROI specification using the built-in IMAQ Vision ROI tools along with full control of the frame grabber settings such as scaling and calibration. The system also supports image retrieval from disk for post-processing of archived images.



thermVIEW™

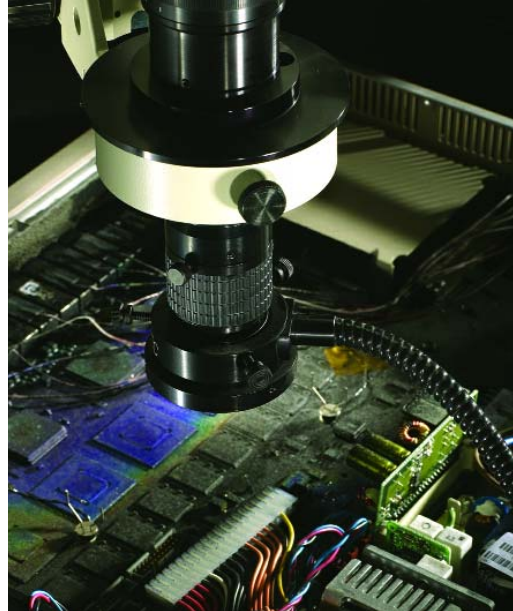
Liquid Crystal Thermographic Analysis Tool

thermVIEW™ is a high resolution liquid crystal thermography system for cost effective temperature measurement of electronic circuit boards, micro circuits, hybrids, components and integrated circuits.

What is liquid crystal thermography? (LCT)

thermVIEW™ system uses the color response of thermochromic liquid crystals (TLC) for the purpose of temperature measurement. Liquid crystals reflect incident light at the visible wavelength based on the temperature of the surface to which they are applied.

- **Does the chip or the board get destroyed as the result of ink/LC application?**
No, ink and LC can be washed off with de-ionized water.
- **Can one reuse the LC treated surface?**
Yes, as long as the surface is kept in a clean environment.
- **How often do I need to calibrate?**
Typically every time the LC is applied to a new surface - a good measurement practice.
- **Are liquid crystals harmful?**
No, but we do not recommend consuming them.
- **Can you use it for board level measurement?**
Yes, LC can be used for any surface that can be treated with LC and trackable lighting.
- **Can you mix different liquid crystal compounds?**
Yes, however, it will be difficult to determine the temperature because the same colors, reflecting a temperature, will appear repeatedly as the surface is heated.



	IR Thermography	LC Thermography	Remarks
Test specimen surface treatment	Yes	Yes	Required for both systems for good measurement
Steady state measurement	Yes	Yes	
Transient measurement	Yes	Yes	
Non-evasive measurement	Yes (emissivity* dependent)	No	*Must know the emissivity for the IR system
PC based	Yes	Yes	
Software for image analysis and acquisition	Yes	Yes	
Effect of ambient temperature	Yes*	No	*To the level that may impact specimen temperature
Ease of use	Yes	Yes	
Video imagery	No	Yes	
Compactness and transportability	Yes	Yes	
Resolution			
Temperature	+/- 2°C	+/- 0.1°C	
Spatial	5 micron	less than 1 micron	
Price			
Base system	\$45 - 70,000	\$34,000*	*(estimate)
Microscopic (part level)	\$180,000	\$45,000*	* starting at (estimate)

* Price subject to change





Innovation in Thermal Management™

thermKIT™

Liquid Crystal Thermography Kit



As used in
ThermVIEW™
Liquid Crystal
Thermography
System



- Compressed air canister
- DI-water
- Heat gun
- Heat gun adapter
- Liquid crystal and black paint spray
- Liquid crystal solutions and paste
- Air tubes for the sprayer
- Black ink
- Cleaning jar
- Beaker
- Magnifying lens
- Filter boxes
- Application brushes
- Swabs
- Safety glass
- Syringes
- Black ink
- Mask
- Wipes
- Gloves

Broad Bandwidth, 5°C Range:

Item	Part #	Red Start	Range	Qty
A	R20C20W	20°C	20°C to 40°C	250 grams
B	R40C20W	40°C	40°C to 60°C	250 grams
C	R60C20W	60°C	60°C to 80°C	250 grams
D	R80C20W	80°C	80°C to 100°C	250 grams
E	R100C20W	100°C	100°C to 120°C	250 grams
F	R120C20W	120°C	120°C to 140°C	250 grams

Narrow Bandwidth, 5°C Range:

Item	Part #	Red Start	Range	Qty
G	R30C5W	30°C	30°C to 35°C	250 grams
H	R40C5W	40°C	40°C to 45°C	250 grams
I	R50C5W	50°C	50°C to 55°C	250 grams
J	R60C5W	60°C	60°C to 65°C	250 grams
K	R70C5W	70°C	70°C to 75°C	250 grams
L	R80C5W	80°C	80°C to 85°C	250 grams
M	R90C5W	90°C	90°C to 95°C	250 grams
N	R100C5W	100°C	100°C to 105°C	250 grams
O	R110C5W	110°C	110°C to 115°C	250 grams
P	R120C5W	120°C	120°C to 125°C	250 grams