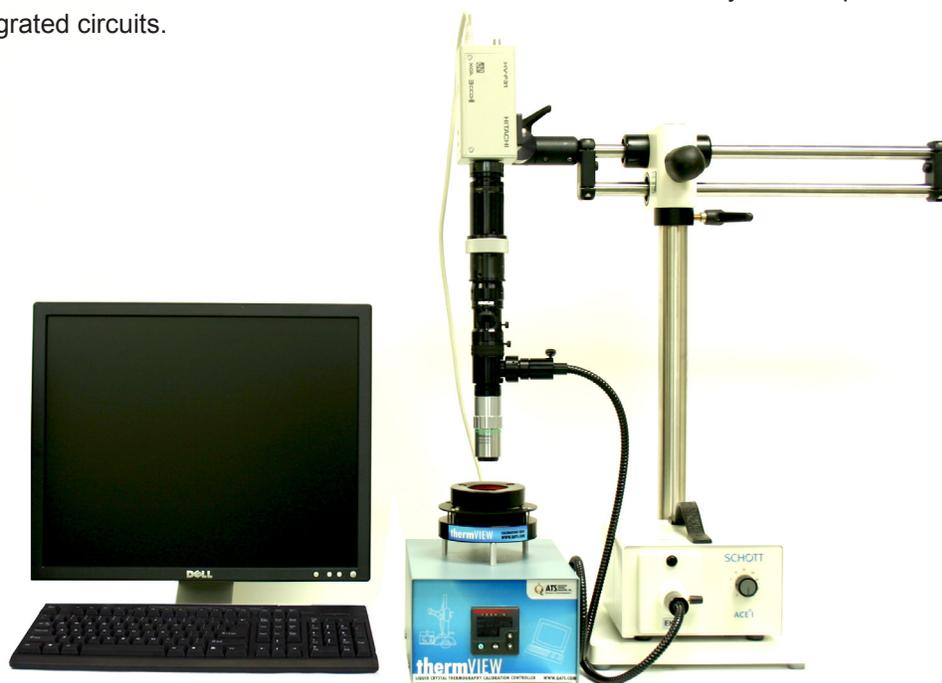




# thermVIEW™

## 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, hybrid components and integrated circuits.



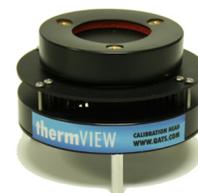
### SYSTEM COMPONENTS

- » High performance, solid-state, color camera with micro or macroscopic 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™
- » Three lens options available: macro lens, micro lens, and ultra lens
- » Transformer supplied for International units
- » Free lifetime tech support

### 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

\*Up to 0°C to 90°C less than 1 micron spatial resolution with unencapsulated liquid crystal and ultra zoom lens



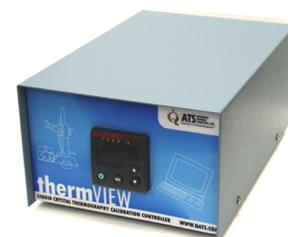
Calibration head



Macro lens



Transformer



Controller



thermKIT™



The turnkey thermVIEW™ Thermochromic 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 wave length 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

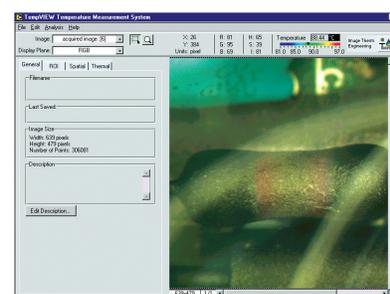
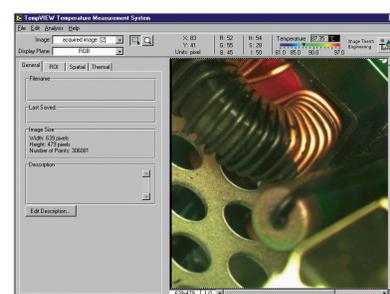
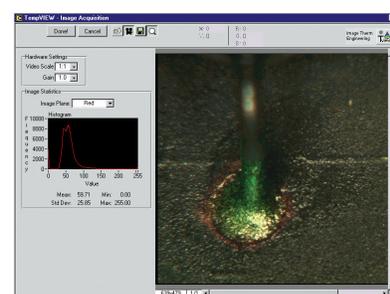
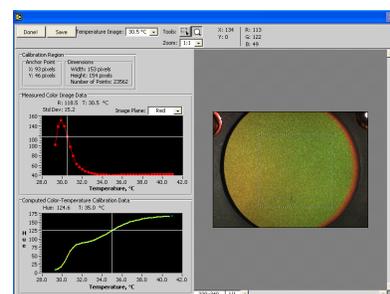
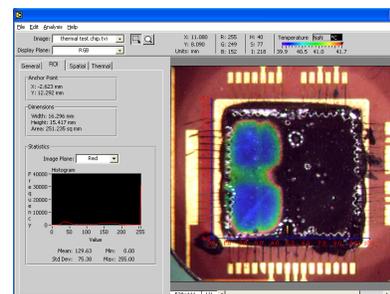
thermVIEW™ analysis tools provide users with dynamic data-probing capabilities with point value and linked X-Y data profile display. Users can interactively calibrate the physical-to screen coordinate system for any image being analyzed. This feature gives thermVIEW™ operators a very simple and direct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

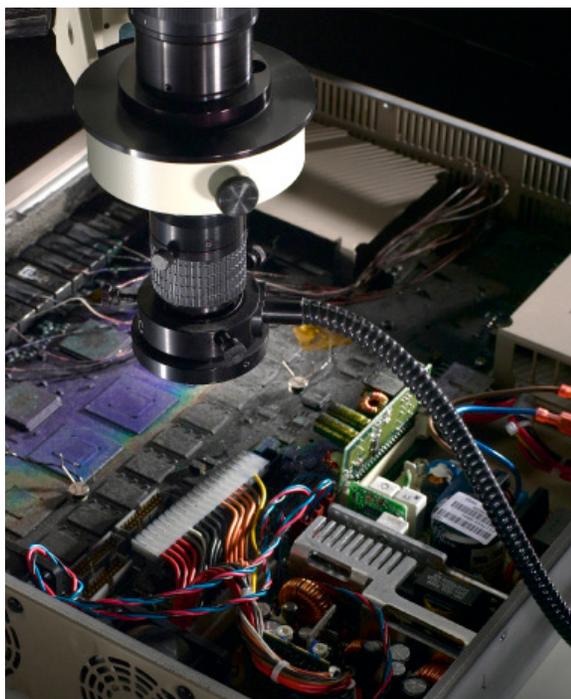




## What is Liquid Crystal Thermography? (LCT)

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.

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|   | IR Thermography             | LC Thermography    | Remarks  |
|---|-----------------------------|--------------------|--|
| Test specimen surface treatment             | Yes                         | Yes                |  |
| 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                |  |
| <b>Resolution</b>                           |                             |                    |  |
| Temperature                                 | +/- 2°C                     | +/- 0.1°C          |  |
| Spatial                                     | 5 micron                    | less than 1 micron |  |
| <b>Price</b>                                |                             |                    |  |
| Base System                                 | \$45 - 70,000               | \$34,000*          | *estimate  |
| Microscopic (part level)                    | \$180,000                   | \$45,000*          | *starting at (estimate)                            |

\*price subject to change

### 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.

