SanjVIEW 7 Software — Overview

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(Source Section 7)

The EZ-THERM General Purpose Thermal Analyzer is a Thermoreflectance (TR) system: a benchtop precision analysis tool for static and transient thermal imaging of active semiconductors from millimeter to micron scale. The EZ-THERM Controller supports Thermoreflectance-based (TR) thermal imaging and can simultaneously support up to three different sensors. The embedded SanjVIEW™ v7.0 software lets the user acquire, analyze, and output high-resolution thermal images. SanjVIEW v7.0 elements (all reached from Project Manager):

- Transient Thermoreflectance
- Failure Analysis (FA) Mode
- SanjANALYZER
- Calibration
- Steady State (Movie Mode)

Project Manager

SanjVIEW is launched from the Windows 10 start screen shortcut. Once the license is verified, the Project Manager window opens, offering:

- **Transient Thermoreflectance (TR only):** Acquire transient thermal images for pulses between 50 µs and 5 ms. Output images or save data files for advanced analysis. Only available with the Visible Camera (TR imaging).
- **Movie Mode:** Acquire quasi-steady-state thermal images for pulses longer than 5 ms. Output images or save data files.
- **FA Mode:** Simplified mode for quick thermal-event analysis and rapid fault localization.

- **SanjANALYZER:** Advanced analysis of previously acquired data.

Key features of the Project Manager window:

- **Operation Select Buttons**: Transient Thermoreflectance, Movie Mode, FA Mode, SanjANALYZER — single-click to open the corresponding window.
- **System Status**: Shows communication status of instruments controlled by SanjVIEW. Green = powered on and communicating; white/off = not communicating.
- **LED Brightness (TR only)**: Check "Auto" to let the computer self-adjust image brightness. Only available with the Visible Camera.
- **Camera Selection**: Choose between the turret-mounted Infrared (IR) camera and the Visible or Near-IR camera (TR imaging). Use the **F1** hotkey to switch cameras.
- **Workspace Path Selection**: File → Options → Software, to set the file path used to organize session files across SanjVIEW modules.
- **Image Intensity Graphs**: Average image intensity plus a histogram option, to help keep pixel values below saturation.
- **Image Display Window**: Live camera image stream; light source and brightness are controlled via Illumination Controls.

[diagram/image in source — not reproduced here: Figure 1, Project Manager Window]

Starting a new thermal imaging session:

1. Place the Device Under Test (DUT) on the probe station.
2. In Project Manager, confirm all components show a green status light (unless the NIR camera is unavailable).
3. Select the desired illumination option and Channel Number, and focus the microscope. A live image of the DUT appears on the right.
4. Check "Auto" under LED Brightness to auto-adjust brightness (Visible Camera).

> Note: Transient Thermoreflectance options are not available when imaging with infrared (IR) light — LED illumination is disabled during an IR session.

Viewing temperature response in DC mode: While Project Manager is running, approximate temperature values are shown on the camera measurement window as a scrolling average of the drawn Region of Interest (ROI); if no ROI is drawn, the entire image is averaged. Use the rectangle tool to draw an ROI. In DC mode, the user can select different outputs and the output voltage to the device, the TC-100 stage, or the Relay output.

- **DUT Bias Controls**: While acquiring images, use output select and voltage controls to set device bias conditions. The TC-100 stage can also be used (approx. 100 mA/V). The Relay output can be selected from the pulldown.
- **Read TC**: Select the TC-100 tab and press TC-100 State on to read the thermocouple value — useful for setting IR camera gain.

[diagram/image in source — not reproduced here: Figure 2, EZ500A with Microsanj test sample in DC mode; Figure 3, DC mode with heater under bias]

Right-click the image window to directly save the acquired image and its color palette.

Transient Thermoreflectance (TR)

Acquires new thermal imaging data for pulses between 50 µs and 5 ms (transient).

[diagram/image in source — not reproduced here: Figures 4–5, Transient Thermoreflectance Window]

Key features:

- **Mode Selector**: Device Setup (optimize brightness/focus, no thermal image shown) vs. Thermal Imaging (begin acquisition).
- **Camera Image Display**: Live DUT image; zoom tool available (SHIFT-CLICK to zoom out).
- **Output Voltage Control**: Sets device voltage and output source.
- **Illumination Control**: LED pulse width — the integration time for a thermal event. Adjust the acquisition period if there is too little/too much light.
- **Time Delay Control & Timing Parameters**: Controls the "snapshot" delay within the device heating cycle.
- **Thermal Image Display**: Calculated thermal image (using the entered thermoreflectance coefficient); scale bars can compress the scale to reveal detail in shadowed regions.
- **Region Mean Graph**: History of all measured ROIs. Aim for point-to-point variation under 5% before stopping. Right-click → "clear chart" to reset.
- **ROI Statistics**:
  - **Temperature Value**: ROI ΔT for the current image.
  - **CTR**: Coefficient of thermoreflectance — must be entered per substance to get a correct ROI temperature; also referred to as "Cth" in other systems. It changes with the Channel Number/wavelength in use — e.g., Channel 6 (530 nm): CTR = 2.5E-4; Channel 6 (470 nm): CTR = 1.6E-4. *(Channel numbering as given in source; both entries are listed as "Channel 6" — verify against current software labeling.)*
  - **Scale Bars**: Zoom the temperature scale; data outside the limit bars is coerced to the limit value (note: this can skew the ROI mean).
  - **ROI Tools**: Rectangle, annulus (zoom/magnification), freehand, and point.

Example — obtaining a transient measurement:

1. Turn off the "Int Vo 20mA Range" button in Project Manager.
2. Set "DUT Pulse" to the desired pulse width (example: 500 µs).
3. Set "Voltage to Device" (example: 6.0 V) and select "Update Values."
    1. Switch to "Thermal Imaging" mode.

2. Confirm the device is heating as expected for the 500 µs delay.
4. Set "Image Delay(s)" to 0 to initialize delay to 0 µs (a transient measurement can start at any initial delay time).
5. Go to File → Setup Sweep (see Figure 6).
6. Enter "Number Delay Images" (example: 51).
7. Enter "Delay Steps(s)" (example: 10.0 µs) — the software takes 51 images at 10 µs steps starting at 0 s (0–500 µs).
8. Enter "Ave time per frame(s)" (example: 5 s) — the software averages for 5 s at each image.
9. Enter the "Base File Name" to save under.
10. Select an ROI with the "Draw ROI" tool to monitor the region's temperature response.
11. Press "Start."
12. The software steps through the thermal transient automatically and shuts off the voltage when complete. A thermal image is averaged and saved every 5 s (example: 255 s total for 51 data points ≈ 4 min 15 s).
13. Once complete, exit and open the saved data in SanjANALYZER.

> Note: The transient response of an ROI can be monitored live in the "Region Mean Graph" tab (lower left) by selecting a region with "Draw ROI." A small 5 µm gold heater, for example, reaches thermal equilibrium within a few microseconds due to its small thermal mass.

[diagram/image in source — not reproduced here: Figure 6, Setup Sweep dialog]

Movie Mode (TR and IR)

Acquires thermal imaging data for pulses longer than 5 ms (quasi steady state); used to view longer-timescale IR/TR thermal events. In TR mode, SNR may be reduced relative to Transient or FA mode — localize thermal events first, then use Movie Mode for further study.

[diagram/image in source — not reproduced here: Figure 7, Movie Mode Window]

Key features:

- **Camera Image Display**: Zoom, Grab, and ROI selector tools (SHIFT+CLICK to zoom out).
- **Time Domain & Frequency Domain Graphs**: Average pixel value within the ROI, displayed over time or frequency; sweep via the frame number control.
- **Device Controls**: The EZ500A SanjVIEW software controls two outputs from the EZ500A SanjCONTROLLER module. "Voltage Out" (Output 1) is the primary thermal-imaging output, modulated on/off in sync with the camera. "Output 2" is a constant secondary source for powering other circuit parts. Neither output changes until "Update Values" is clicked. Pulse timing duration is also adjustable.

- **Waveforms Graph**: If "Controller Box" is selected as the output source, shows output voltage/current supplied to the device.
- **Thermal Image Display**: In Thermal Imaging mode, data is processed into a thermal image, shown in relative units (1e-4 dR/R) or temperature units (via CTR). Draw an ROI on the device display to view region temperature.
- **Region Temperature**:
  - **DT (C)**: ROI ΔT for the current image (up to 5 ROIs).
  - **CTR or E**: Thermoreflectance coefficient (material-dependent) for TR, or Emissivity (E) for IR sessions.
  - **Scale Bars**: Active when Autoscale is off; max/min adjustable by clicking the numbers or dragging sliders. Palette selector changes visualization. Binning (2X or 4X) can improve SNR.
  - **ROI Tools**: Rectangle, annulus (zoom/magnification), freehand, point.
- **Save Data**: Choose file name/path; a comment field's text appears when the file is reopened in the Thermal Image Analyzer.

Adjusting the Movie Mode time window: Options → Software tab → "Movie Mode Length" dropdown, sets the time window (3–30 seconds).

[diagram/image in source — not reproduced here: Figure 8, Movie Mode time window option]

Example — obtaining a Movie Mode image:

1. Connect the DUT to Voltage Out (AUX Output is optional).
2. Select biasing conditions via the Device Control panel and click "Update Values."
3. While the image is averaging, use the ROI tool, scale bars, and Thermal Image Display tool to optimize the image.
4. Once the desired thermal image is achieved, save a data file for further analysis/output.

FA Mode (TR and IR)

A simplified differential-imaging mode for quickly acquiring thermal images for fault localization.

[diagram/image in source — not reproduced here: Figures 9–10, FA Mode Window]

Key features:

- **Camera Image Display**: Grab (hand), zoom (magnifying glass, SHIFT-CLICK to zoom out), and area select (square) tools. Area select is used with the merged image to crop the thermal image to the ROI.
- **Output Voltage Control**: Device voltage and output source.
- **Camera Histogram**: Displays brightness set previously in Project Manager.
- **Thermal Image Display**: Calculated thermal image; scale bars compress the scale to reveal shadowed detail.

- **ROI Statistics**: Temperature Value (ΔT); CTR or Emissivity(E) (material-dependent, must be entered by the user); Scale Bars (coerces out-of-range data to limit values); ROI Tools (rectangle, annulus, freehand, point).
- **Region Mean Graph**: History of measured ROIs; aim for <5% point-to-point variance before stopping. Right-click → "clear chart" to reset.

Calibration — Quick Start

Calculates the thermoreflectance coefficient (TR) or emissivity (IR) of specific surfaces on a device. Accurate temperature readings require the coefficient measured from calibration. The calibration module thermally cycles the DUT while reading back the thermocouple to measure calibration coefficients for the different materials in the image; coefficients are continuously averaged during cycling to increase SNR. Coefficient maps can be obtained and used for point-by-point calibration.

[diagram/image in source — not reproduced here: Figure 11, Calibration window (thermoreflectance); Figure 12, Calibration window (infrared)]

Key features:

- **Camera Image Display**: Grab, zoom (SHIFT-CLICK to zoom out), and area select tools; area select crops to the ROI on the merged image.
- **Hardware**: Thermal Chuck Settings (current to the TCAT-100 stage — changed via Options in Project Manager); Microscope Settings (objective magnification, as set in Project Manager).
- **Timing/Illumination**: Thermal Time Constant (hot-cycle duration); "Image Averaging (#/cycle)" (per-cycle averaging duration); Brightness (image should be as bright as possible without saturating — pixels saturate at 4095 units; Auto Brightness auto-adjusts during imaging; "Good Illumination" indicator turns green when illumination is sufficient for a good image).
- **3D Alignment (TR only)**:
  - **Image Auto Alignment**: 3D NanoAlign and digital anti-vibration parameters — detects and corrects image shift during a run, reducing edge effects.
  - **Focus ROI**: Region where the software detects shift — prefer an area with an easily detectable feature (e.g., a corner).
  - **Capture Reference**: Captures the image to shift back to.
  - **Focus Tolerance**: In-focus range once slope is maximized and stable.
  - **Alignment %**: Increasing improves alignment accuracy.
  - **Vibration Filter**: Decreasing improves alignment accuracy.
- **Thermal Image Display**: Shows the calculated Ctr map of all imaged materials.
- **System Status / TCAT Image Parameters**: Chosen measurement parameters, elapsed time in the current cycle, and heating/cooling stage status.
- **Ctr or Emissivity Graphs**:
  - **Camera Data**: Device intensity — should not vary significantly during a measurement; shows intensity change across hot/cold cycle transitions.

    - **Temperature**: Thermocouple reading — used to confirm the device is reaching the target temperature and to see cold/hot cycle state.
    - **ROI History**: Historical Ctr values for a specific ROI (stability check across cycles); ROI histogram shows per-pixel Ctr distribution within the ROI.
- **Area Statistics**: Ctr or Emissivity of the ROI and associated data (including thermocouple temperature); shows the mean Ctr for the selected ROI.
- **Save Image**: Choose file name/path; a comment field's text appears when the file is reopened in the Thermal Image Analyzer.

Verifying calibration with TCAT-100 in Pulsed Mode: Set up a test sample as for calibration. Launch the Pulsed Mode software and select TCAT-100 as the output device. Enabling thermocouple readback allows simultaneous display of the thermocouple signal alongside the Thermoreflectance or Infrared data. Calibrated IR camera results should closely overlap the thermocouple results. The TCAT thermocouple has a response time of ~0.5 seconds — lengthen the timescale if needed to see an accurate response.

[diagram/image in source — not reproduced here: Figure 13, pulsed mode operation on the Microsanj test sample; Figure 14, final calibrated measurement in Pulsed Imaging mode]

SanjANALYZER™ — Thermal Image Analyzer

A fully integrated analysis package for low-frequency and transient thermal imaging data, used to:

- View previously acquired thermal images
- Correct for two thermoreflectance coefficients
- Use point-by-point calibration maps
- Find area mean temperature values
- Create and save cross-section plots
- Output images in various formats
- Create .avi movies from an image series (SanjAnalyzer Plus only)

[diagram/image in source — not reproduced here: Figure 15, SanjANALYZER™ Analysis Window]

Key features:

- **Load a Thermal Image**: Low-frequency data uses `.fdi` files; Transient data uses `.tti` files. Double-click a file in the selection control to load its CCD and thermal images.
- **CCD Image Display**: Grab, zoom (SHIFT-CLICK to zoom out), and area-select tools; area select crops the thermal image to the ROI on the merged image.
- **Primary Thermal Image Display**: Tab-selected view modes — Thermal Image VIEW, Merge VIEW, and optional 3D VIEW (SanjANALYZER PLUS).

- **Thermal Image VIEW**: Calculates thermoreflectance data using masking info or a single coefficient.
  - **ROI Mean and Statistics**: Predefined-shape or freehand region tools for mean ROI temperature; selecting an ROI/cross-section highlights the area on the CCD image too.
  - **Cross-Section Graph**: Line tool draws a cross-section on the thermal image; invalid points (per masking, under "Calibration") are excluded. Right-click the plot to change the legend. A dropdown converts pixel count to distance — select the correct Objective used during imaging for correct scale. Save cross-sections as tab-delimited ASCII via "Save."
  - **Limit Bars**: Coerce auto-scaled data to selected limits (outlying points can otherwise obscure the image); this scaling also affects merge and 3D views.
  - **Color Palette Selection**: Multiple palettes; also reflected in the merged image and in any saved output.
  - **Software Binning** (x2 or x4): Spatial averaging to improve visibility/SNR of faint images or cross-sections, at the cost of spatial resolution.
- **Merge VIEW**: Display/save-only merged image (temperature values live only in the thermal image). Converts thermal data to an RGB image for compatible output formats. [diagram/image in source — not reproduced here: Figure 16, Merge VIEW window]
  - **CCD / Thermal / Thermal Image Slide Bars**: First slider sets % CCD overlay onto the thermal image (useful for locating hotspots); gain/offset sliders apply to the thermal image (100%/0% = unchanged).
- **Crop from CCD Image checkbox**: Crops the thermal image to a region drawn on the CCD image — useful to reduce .avi file size.
- **Fix Temperature Scale checkbox**: Locks the current scale when loading new files — used when generating an image series or movie (set scale on the hottest image in the series first, then process the series from the first image).
- **Show Voltage / Delay / Color bar checkboxes**: Overlay acquisition conditions and the color-to-temperature mapping on the image.

Example — analyzing a transient thermoreflectance image:

1. Select the first image of the transient series.
2. Enter the "number of images in the series" (example: 51).
3. Select an ROI box over the area of interest (example: 5 µm gold heater).
4. Select "Process Series" — the software steps through the series and plots data in the "ROI Mean Series" (bottom left). Right-click the y-axis to auto-scale the graph.

Output Module

(Source Section 7.7)

Signal	Input/Output	Function

VI EXT (A) — DC Voltage in	Input	Used in "Relay" mode for pulsing the device. ±60V, 3A maximum.
VO EXT (B) — DC Voltage in	Output	Modulated output of the VI DC input voltage.
AUX INT (C) — Aux out	Output	±10V, 500 mA max (not pulsed).
VO INT (D) — Voltage out	Output	Main output. ±10V, 1A maximum. In "Relay" mode: ±60V, 3A max.
VO INT (D) (20 mA Range) — 20 mA out	Output	500 Ω output impedance, approx. 2 mA/V into low impedance.
TRIG (E) — Trigger out (Movie mode only)	Output	Synchronizes external equipment with Movie mode. TTL high-impedance output.

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