

EZ530 Therm System

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Overview

Overview

The EZ530 Therm system (referred to throughout the source manual as the **EZ-THERM Series / Eazy-THERM**) is a benchtop, non-contact thermal imaging and analysis platform built around **Thermoreflectance (TR)** microscopy, with optional Infrared (IR) and Near-Infrared (NIR) imaging channels. It is a precision analysis tool for static (steady-state) and transient thermal imaging of active semiconductor devices, at scales ranging from millimeter down to micron/sub-micron.

What it measures: The system measures device surface temperature indirectly by detecting the relative change in optical reflectivity of a sample as its temperature changes (thermoreflectance), and/or by measuring infrared thermal emission (IR mode). It can simultaneously support up to **three different sensors** (Visible/TR, IR, and NIR/InGaAs).

Hardware family / platform notes (internal):

- The underlying electronics/optics platform is referred to in the specification table (Section 5 of the source) as the **NT220 Platform**, offered in three power/configuration tiers: **Base**, **PKG-1**, and **PKG-2**.
- The Facilities Requirements section of the source manual is internally inconsistent about naming: the Table of Contents heading reads "NT220 Footprint with Dark box and Vibration Isolation Table," while the body text for the same section is headed "**EZ530** Footprint with Dark box and Vibration Isolation Table." Based on the matching Power Requirement (~2500W, 120V/240V, 20A) and matching electronics rack weight (~260 lbs / ~120 kg), **the EZ530 designation corresponds to the PKG-2 configuration tier of the NT220 platform**. This cross-reference is inferred from matching numbers in the source, not stated explicitly as such — flag for confirmation if this mapping needs to be authoritative.
- The source manual's software/UI descriptions (Section 7 and Figure captions) repeatedly reference the **EZ500A** and the **EZ500A SanjCONTROLLER** module (e.g., "The EZ500A SanjVIEW software controls two outputs from the EZ500A SanjCONTROLLER module," Figure 2 caption: "EZ500A with Microsanj test sample in DC mode"). This indicates the EZ-THERM Series / SanjVIEW 7 software and control architecture is shared across at least the EZ500A and EZ530 (NT220/PKG-2) hardware variants — the manual was evidently written as a general EZ-THERM Series document covering multiple rack/model configurations, of which the EZ530 is one.

Major system components (per source Section 3, "System Description" — any system shipped to a customer includes):

1. Optical Microscope
2. Camera (Visible / IR / NIR / sCMOS / InGaAs, per configuration)
3. Standard Rack Models
4. Probe Station (Option)

Core software: The system is operated through **SanjVIEW™ v7.0**, embedded software running on the **SanjCONTROLLER+** integrated desktop computer, which connects and manages all hardware modules. SanjVIEW 7 provides: Project Manager, Transient Thermoreflectance, Movie Mode, FA (Failure Analysis) Mode, Calibration, and SanjANALYZER™.

Safety Precautions

Safety Precautions

(Source Section 1.1-1.2)

- **High temperature:** Do not touch the thermal plate while it is in operation — contact may cause severe burns.
- **No user-serviceable parts** inside the EZ-THERM controller. Do not remove covers. Exposed AC power can be present even with the power switch off. To avoid accidental shock, turn off the power and unplug the line cord before checking or replacing the fuse. Only use the specified fuse value; do not attempt to bypass or repair the fuse.
- **Shock hazard:** Use extreme care when handling output connections.
- **UV radiation exposure:** There are no regulatory UV exposure limits, but the ACGIH publishes recommended Threshold Limit Values (TLVs), which are wavelength-dependent (3 mJ/cm² to 100,000 mJ/cm²):
 - UV-A (315–400 nm): 1.0 J/cm² for exposures under 1000 s; 1.0 mW/cm² for exposures over 1000 s.
 - UV-B: 3.4 mJ/cm² at 280 nm; 500 mJ/cm² at 313 nm.
 - UV-C: 250 mJ/cm² at 180 nm; 3.1 mJ/cm² at 275 nm.
- **Personal Protective Equipment (PPE):** If engineering/administrative controls cannot protect personnel from UV exposure, use PPE — UV safety goggles, UV face shields, long-sleeved tightly-woven clothing, and gloves. High-SPF (>15) sunscreen may offer some UV-A/UV-B protection but is considered inadequate against high-irradiance man-made UV sources on its own.
 - Eye protection: polycarbonate safety glasses or a polycarbonate face shield, worn whenever there is potential for ongoing UV exposure. Contact EH&S for guidance on appropriate UV protective eyewear.
 - Skin protection: best achieved with clothing, gloves, and face shields (most clothing absorbs UV).
 - Any equipment emitting UV radiation, and its immediate area, must have UV warning labels posted (no standard label format specified).

Specifications

Specifications

NT220 Platform Specification Table

(Source Section 5, "Nano THERM Specification." The EZ530 corresponds to the PKG-2 column — see Overview note above.)

Parameter	Base	PKG-1	PKG-2
Transient Response	50 ns LED Pulse Duration (FWHM), 12.5 ns Delay Resolution (all tiers)		
Operating System	SanjCONTROLLER™ with embedded SanjVIEW, for system management, image data acquisition, and data processing/analysis (all tiers)		
Display	32-inch 4K Monitor, Keyboard & Mouse (all tiers)		
Operating Temperature	10 °C to 35 °C	10 °C to 35 °C	10 °C to 35 °C
Power	120V/240V, ~1500W	120V/240V, ~2000W	120V/240V, ~2500W
Rack Size (D x W x H)	36" x 24" x 29"	36" x 24" x 46"	36" x 24" x 46"
Electronics Rack Weight	190 lbs (~90 kg)	210 lbs (~95 kg)	260 lbs (~120 kg)

Selectable SanjSOURCE™ illumination models (as listed in the source; the exact model-to-tier mapping is not made explicit in the source table):

- **NT220-40 / LS310-40:** 365, 470, 530, 780 nm
- **NT220-80 / LS310-80:** 365, 405, 455, 470, 530, 625, 656, 780 nm
- **NT220-44 / LS310-44:** 365, 470, 530, 780, 985, 1064, 1210, 1370 nm

CTR PIEZO Calibration (available as an after-purchase option, AF-100 or AFP-200):

	AF-100	AFP-200
Temperature Range	20 °C to 120 °C ±1% Typ	20 °C to 150 °C ±1% Typ
Leveling Adjustment	±5 Degrees	±2 Degrees
Heating/Cooling Capacity	50 W	500 W
Stage Working Area	40 mm x 40 mm	125 mm x 125 mm

Probe Station (available as an after-purchase option, SPS-400 or GPS-150):

	SPS-400	GPS-150
Chuck	4" Vacuum Chuck	6" Vacuum Chuck
X-Y Travel	100 mm x 100 mm	150 mm x 150 mm
Probes	3 DC Probes	3 DC Probes

Facilities & Power Requirements

(Source Section 2)

- Typical workspace: 8 ft wide x 6 ft deep.
- Allow >12" clearance from the wall for airflow needed for rack cooling.
- EZ530: ~260 lbs (~120 kg).
- VT200 (Vibration Isolation Table): ~507 lbs (~230 kg).
- Internet connection is recommended (remote data access/tool control) but not required for tool operation.
- Compressed Dry Air (CDA) >50 psi is required for the vibration isolation table. A portable air compressor can be used if no facility line is available.
- Vacuum is required to hold the wafer. A portable vacuum pump can be used if no facility vacuum is available.
- Power: ~**2500W, 120V/240V - 20A.**
- Install away from large mechanical equipment or motors to avoid reduced specifications due to vibration.
- Install in as clean an environment as reasonably possible.

Optical Microscope & Illumination

(Source Section 3.1)

The Optical Microscope allows the user to change objectives and use a manual focus knob. Two main adjustments are used routinely: focusing via the frame knobs, and changing objectives on the

nosepiece. The camera adapter can be rotated by loosening threaded screws with the provided blue Allen wrench.

[diagram/image in source — not reproduced here: Figure 1 Microscope Frame & C-Mount Fiber Illumination for LLGVIS8; Figure 2 C-Mount Fiber Illumination for LLGVIS8; Figure 4 Microscope Dimensions; Figure 5 Microscope Views; Figure 6 Camera]

LLGVIS8 / LLGNIR8 fiber illumination specifications:

	LLGVIS8	LLGNIR8
Wavelength Range	340 nm to 800 nm	420 nm to 2000 nm
Numerical Aperture	0.59	0.59
Half Angle	36°	36°
Minimum Bend Radius	60 mm	60 mm
Core Diameter	5 mm	5 mm
Length	8 ft (2.4 m)	8 ft (2.4 m)
Temperature Range (Continuous)	-5 to 35 °C (23 to 95 °F)	-5 to 35 °C (23 to 95 °F)

Cameras

(Source Sections 3.2–3.5)

- **Visible Camera (Optional):** Collects individual pixel data used by SanjVIEW™ . Mounted on top of the microscope to capture images from the lens. Available in 2 Megapixel or 4 Megapixel.
- **Infrared Camera:** Compact longwave infrared (LWIR) thermal camera using FLIR infrared video processing architecture for advanced image processing and industry communication interfaces at low power. 12 μm pitch Vanadium Oxide (VOx) uncooled detector, 640 x 512 resolution. Available with a 2.5x lens or a 0.1–0.5x adjustable lens.
- **Scientific CMOS (sCMOS) Camera (Optional):** Next-generation CMOS sensor design offering extremely low noise, rapid frame rates, wide dynamic range, high quantum efficiency, high resolution, and large field of view.
- **InGaAs Camera:** InGaAs sensor extends sensitivity further into the infrared (900–1700 nm) than classic CCD/CMOS cameras. Supports high frame rates at full resolution, with further frame-rate increases available by selecting a smaller ROI.

Chiller Specifications

(Source Sections 3.10–3.11)

500W Internal Chiller — RMUP-500 (Optional): 6U rack-mount design; $\pm 0.1^{\circ}\text{C}$ temperature stability via PID control; refrigerating power up to 650W; 220V supply; front-mounted water level indicator; water temperature settable between 5°C and 35°C in constant-temperature or intelligent-control mode.

500W External Chiller:

Model	CWUL-10DH	CWUL-10AH
Voltage/Frequency	AC 110V / 60Hz	AC 220V-240V / 50Hz
Current	0.5–9.9A	0.5–7.2A
Cooling Capacity	750W	750W
Max Pump Pressure	1.2 bar	1.2 bar
Max Pump Flow	13 L/min	13 L/min

- Temperature stability: $\pm 0.3^{\circ}\text{C}$.
- Placement: well-ventilated, dry environment, away from heat sources. Keep ≥ 30 cm from the air outlet (rear) and ≥ 10 cm between the two side air inlets and any obstruction.
- Use distilled water only; drain the chiller before extended non-use or transport.
- Liquid replacement: every 3 months under light usage; monthly under heavy usage.
- At the maximum flow rate (13 L/min), image vibration may be visible on high-magnification lenses (especially 100x) — not noticeable at 50x or below. To minimize this, reduce flow with the valve (clockwise reduces flow, counter-clockwise increases flow). **Do not close the flow by turning the valve handle clockwise 90° while the chiller is operating.** Only reduce flow when vibration is observed on a specific lens, and return to full speed for lower-magnification lenses.

Piezo Controller (AF-200)

(Source Section 3.12)

Digital Multi-Channel Piezo Controller with 20 kHz sampling rate and 1 ms cycle time. AF-200 provides 3-axis XYZ positioning with 200 x 200 x 200 μm travel range and $\pm 2^{\circ}$ tip-tilt adjustment.

ATEC302 Temperature Controller

(Source Section 3.13)

Bi-directional temperature controller/indicator for thermoelectric applications.

- 4 temperature zone control modes: P, PI, PD, PID, Auto Tuning, Open-Loop Control
- High-speed ADC; wide-range T/C, RTD, Thermistor input selectable
- DC power supply: 9–36V or 5V DC
- 2 programmable alarm outputs
- RS232, RS485, and USB communication with GUI software
- Supports complex program scripts for sophisticated temperature profile control

Optical Head Models

(Source Section 5, "Single/Dual TR Mount Optical Heads")

Single TR Mount Optical Heads:

Model	Sensor	Spectral Range	Resolution	FOV	NETD
SMC40-VIS2PK	2MP CMOS	400 nm to 800 nm	59 nm/pixel @100x	2.3 x 1.4 mm @5x	100 mK
SMC40-VIS4PK	4MP CMOS	365 nm to 1050 nm	55 nm/pixel @100x	2.3 x 2.3 mm @5x	250 mK
SMC40-NIRIPK	InGaAs, 630 x 508 pixels	900 nm to 1700 nm	150 nm/pixel @100x	3.8 x 3.0 mm @2.5x	—
SMC40-NIREPK	1MP EMCCD	480 nm to 1060 nm	130 nm/pixel @100x	5.3 x 5.3 mm @2.5x	—

Included VIS Band Objectives: 5x (5SVIS35), 20x (20SVIS22), 100x (100SVIS14). Included NIR Band Objectives: 2.5x (2.55NIR12), 20x (20SNIR12).

Dual TR Mount Optical Heads:

- **SMC40-V4NIPK**: SMC40-VIS4PK plus SMC40-NIRIPK, plus VIS and NIR band objectives.
- **SMC40-V4NEPK**: SMC40-VIS4PK plus SMC40-NIREPK, plus VIS and NIR band objectives.

Additional Accessories and Options

(Source Section 5)

Infrared Sensor:

- **EZIR-LW12PK / EZIR-LW12SPK**: Uncooled VOx LWIR sensor, 640 x 512 pixels, 30 fps (8.6 fps for the -SPK variant), 7.5–13.5 μm spectral range, 10 mK NETD.
- **L05LWIR**: 0.5x lens, 24 μm/pixel resolution, FOV 15.4 mm x 12.3 mm.
- **L25LWIR**: 2.5x lens, 4.8 μm/pixel resolution, FOV 3.1 mm x 2.5 mm.

Other accessories:

- **SA-200 SanjANALYZER-PLUS™**: For advanced post-data processing and analysis.
- **Optional Objectives**: NUV, VIS, or NIR bands, 1x to 100x, with varied Numerical Apertures (NA) and Working Distances (WD).
- **Optional Illumination Sources**: Alternatives to the wavelengths included with LS310-40/-80/-44 are available on inquiry.
- **VT100 Vibration Table**: 30" x 36" (750 mm x 900 mm) area vibration isolation table.
- **VT200 Vibration Table**: 30" x 36" (750 mm x 900 mm) area vibration isolation table with dark box enclosure.

Setup and Installation

Setup and Installation

Connecting the EZ-THERM System

(Source Section 4. Ensure all modules are powered off before making any connections. Complete all connections and power on all modules before running the SanjVIEW 7 software.)

4.1 Power up Eazy-THERM. Before powering on, confirm the Main Power Strip is connected to the proper outlet (110V or 220V). Power-up includes the SanjSCOPE, 2 Power Distribution Units (PDUs), and the optional battery backup power supply.

4.2 SanjSCOPE. SanjSCOPE includes the chiller power switch, the master power switch, and the Emergency Off (EMO) button.

4.3 Battery Backup Power Supply (Optional). Protects sensitive equipment during power surge events and allows the user to save data before shutdown.

4.4 Power Distribution Units.

- **Master DPU:** powers the monitor, SanjSOURCE, SanjCONTROLLER, and the 4D Nano.
- **Chiller DPU:** powers the chiller and the 4D Nano.

Power-on sequence (after confirming the Main Power Strip is plugged into a suitable outlet):

1. Ensure the Red Emergency Off (EMO) button is released (turn counterclockwise).
2. Flip the Master and Chiller switches to the ON position.
3. Press the 4D-Nano power button.
4. Press the SanjCONTROLLER+ power button.
5. Press the Chiller power button (may apply to external chiller models).

[diagram/image in source — not reproduced here: Figure 14, annotated power-up steps]

4.5 Chiller Connecting. Chiller (internal or external) cooling fluid hoses connect to the 4-inch or 6-inch thermal stage of the system.

4.6 Components for the Eazy-THERM system:

1. Visible Camera and USB 3.0 camera cable, connected in SanjCONTROLLER+.
2. Power (Master distributor) and Ethernet cable for the InGaAs camera.
3. Microscope with lenses.
4. Thermocouple TC-01, connects to SanjCONTROLLER+.
5. Thermal Electric Cable connecting the thermal stage to the 4D-Nano.
6. IR cable connecting the IR camera to SanjCONTROLLER+.
7. HDMI cable connecting the monitor to SanjCONTROLLER.
8. Piezo cable connecting the Piezo stage to the Piezo Controller located in the 4D-Nano.
9. Liquid Lightguide (visible or near-infrared LED) between the microscope and SanjController+.
10. Test sample.
11. Computers equipped with wireless network connectivity.

4.7 Connecting Eazy-THERM with AF200. [diagram/image in source — not reproduced here]

4.8 SanjSOURCE (rear panel), dedicated connectors. [diagram/image in source — not reproduced here]

4.9 Connecting SanjCONTROLLER+ (rear panel), dedicated port connections.
[diagram/image in source — not reproduced here]

TEA Test Sample Setup

(Source Section 6)

The Microsanj TEA test kit includes: the Microsanj-TEA test sample, three 2 mm screws, a nonconductive thermal paste, and a bias cable connector with a BNC connector. The BNC connector is pre-wired to series resistors (D1) and a diode (D2) in the test sample.

[diagram/image in source — not reproduced here: TEA sample, BNC cable, screws, and thermal paste layout]

Prepare Hardware and Connections:

1. Apply a small amount of thermal paste evenly to the center of the thermal stage (or the back-side metal area of the sample) for good heat transfer.
2. Secure the Microsanj-TEA test sample to the thermal stage using screws or clamps.
3. Plug the BNC cable into the VO INT Output.
4. Plug the connector from the BNC cable into the test sample.
5. Plug the thermal sensor attached to the test sample into the thermal reader.

Maintenance

Maintenance

- **Chiller maintenance** (*Source Section 3.11*): Replace chiller liquid every 3 months under light usage, or monthly under heavy usage. Use distilled water only; drain before extended non-use or transport. Keep the unit ≥ 30 cm from obstructions at the rear air outlet and ≥ 10 cm from obstructions at the side air inlets, in a well-ventilated, dry location away from heat sources. Adjust the flow-control valve (clockwise to reduce flow, counter-clockwise to increase) to reduce vibration at high magnification (particularly 100x); do not fully close the valve (90° clockwise) while the chiller is operating — only reduce flow as needed for a specific lens, then return to full flow for lower magnifications.
- **Controller servicing** (*Source Section 1.1*): There are no user-serviceable parts inside the EZ-THERM controller. Do not remove covers. Exposed AC power can be present even with the power switch off — turn off power and unplug the line cord before checking or replacing the fuse, and use only the specified fuse value. Do not attempt to bypass or repair the fuse.

(The source manual does not include a dedicated, separate "Maintenance" chapter beyond the items above — this section consolidates all explicit maintenance/servicing guidance found elsewhere in the source.)

Appendix — Thermoreflectance Technical Reference

Appendix — Thermoreflectance Technical Reference

(Source Appendix A/B — retained here as background reference material.)

Thermoreflectance Imaging Fundamentals

Thermoreflectance imaging is based on a linear change in a material's reflection coefficient with temperature (Equation 1 in the source: $\Delta R(x,y,\lambda)/R(x,y,\lambda) = C_{th}(x,y,\lambda) \cdot \Delta T$, where C_{th} — the thermoreflectance calibration coefficient, typically 10^{-3} to 10^{-5} per $^{\circ}\text{K}$ — depends on sample material, illumination wavelength, angle of incidence/surface roughness, and sample composition). This is a highly sensitive lock-in technique measuring per-pixel changes in reflected light, sensitive to shifts/thermal expansion at length scales of 580 nm at 20x magnification. Proper experimental setup and surface condition are important for measurement quality. First noted in the 1960s.

Reference publications cited in the source:

- J. Christofferson, K. Maize, Y. Ezzahri, J. Shabani, X. Wang, A. Shakouri, "Microscale and Nanoscale Thermal Characterization Techniques," J. Electronic Packaging, Dec 2008, Vol. 130, Issue 4, 041101.

- Y. Ezzahri, J. Christofferson, G. Zeng, A. Shakouri, "Short time transient thermal behavior of solid-state microrefrigerators," J. Appl. Phys, 106, 114503 (2009).
- B. Vermeersch, J. Christofferson, K. Maize, A. Shakouri, G. De Mey, "Time and Frequency Domain CCD-Based Thermoreflectance Techniques for High-Resolution Transient Thermal Imaging," Proc. IEEE 26th SEMI-THERM, Feb 23–25, Santa Clara CA, pp. 228–234, 2010.
- Mihai G. Burzo, Pavel L. Komarov, Peter E. Raad, "Non-Contact Transient Temperature Mapping Of Active Electronic Devices Using The Thermoreflectance Method," IEEE Trans. Components and Packaging Technologies, Vol. 28(4), pp. 637–643, 2005.
- Pavel L. Komarov, Peter E. Raad, "Performance Analysis of the Transient Thermo-Reflectance Method for Thermal Conductivity of Single Layer Materials," Int. J. Heat and Mass Transfer, Vol. 47, pp. 3233–3244, 2004.
- M. Farzaneh, K. Maize, D. Luers, J.A. Summers, P.M. Mayer, P.E. Raad, K.P. Pipe, A. Shakouri, R.J. Ram, Janice A. Hudgings, "CCD-based thermoreflectance microscopy: principles and applications," J. Physics D: Applied Physics, vol. 42, p.143001, 2009.
- M. Farzaneh, Joe Summers, R.J. Ram, J.A. Hudgings, "Thermal and optical characterization of photonic integrated circuits by thermoreflectance microscopy," J. Quantum Electronics, vol. 46(1), p.3-10, 2010.

Because reflection changes are imperceptible to the human eye, the system relies on high-resolution, low-noise equipment and sophisticated averaging. The NT220 provides two averaging modes:

- **Low Frequency Imaging:** Uses frequency-domain filtering to resolve minute reflection changes. Can be done without pulsed illumination; enables lower-frequency thermal imaging (down to 0.48 Hz) in "Transient" mode. It's possible to obtain low-frequency thermal images without the BNC 6040/202H LED pulse generator, provided illumination is CW (non-pulsed) — this allows illumination wavelengths beyond the provided pulsed LEDs (e.g., white light plus a bandpass filter for a specific wavelength). Disable the pulse generator (uncheck "use BNC 6040/202H" in Project Manager) when using CW illumination to avoid unnecessary wear on the BNC and pulsed LED.
- **Transient Thermoreflectance Imaging:** Captures thermal image "snapshots" at precise points in the heating/cooling cycle via precise timing of illumination flash vs. device excitation. Has a slightly lower noise floor (0.2°C vs. 0.5°C) than low-frequency imaging and is preferred when possible. A transient image series visualizes the device's change across the active heating cycle; the analyzer can display temperature at a given point across different times.

Thermoreflectance Material Coefficient

The thermoreflectance coefficient is a material property that depends on temperature and illumination wavelength. Unlike IR emissivity, it is not strongly dependent on surface preparation or

deposition method, so per-device calibration is generally not necessary (e.g., Microsanj has found consistent thermorefectance coefficients for gold across various thermal/E-beam evaporation techniques). If the material's visual color changes significantly due to major microstructure/porosity changes, the coefficient may be modified significantly. Microsanj provides thermorefectance coefficients for basic IC materials at the system's included LED colors. For new material systems: the coefficient can be extracted directly if there's an embedded on-chip temperature sensor near the ROI; otherwise, a small chip sample (1x1 mm² up to 1x1 cm²) can be sent to Microsanj for in-house characterization.

For a region of interest covered in Aluminum, use the provided 780 nm LED — the coefficient is too small at 530 nm (green) or 470 nm (blue) for usable thermal images.

Additional reference materials cited:

- G. Tessier et al., "Thermorefectance temperature imaging of integrated circuits: calibration technique and quantitative comparison with integrated sensors and simulations," 2006 J. Phys. D: Appl. Phys. 39, 4159.
- Burzo, M.G., Komarov, P.L., Raad, P.E., "Pixel-by-pixel calibration of a CCD camera based thermorefectance thermography system with nanometer resolution," Thermal Investigations of ICs and Systems, THERMINIC 2009.

Dielectric coatings: Coatings change the reflectance coefficient and therefore the thermorefectance coefficient. Where uncoated regions exist on the sample, use temperature continuity on the surface to calibrate the image; otherwise, Microsanj can determine the coefficient for a coated sample if a small piece is provided. Thin-film interference can cause oscillations in the reflected data on samples with non-uniform film thickness (an inherent optical property) — averaging measurements across different color LEDs can help detect and remove this oscillation envelope/optical artifact.

Microscope objective numerical aperture: The thermorefectance coefficient can depend on objective NA due to the light component polarized perpendicular to the surface (non-negligible above NA ~0.5). Microsanj-provided coefficients specify the objective and illumination LED used. For precise temperature-distribution measurements with high-NA lenses, it's suggested to first measure with a low-NA lens over a larger area, then switch lenses (without altering the device) and scale the temperature data accordingly. Standard objectives are optimized for the visible (VIS) band but can be used beyond that range with reduced sensitivity; Microsanj offers objectives optimized for NUV or NIR performance.

- **12.2.2.1 Optional Objectives for TR Mode** (NA, FOV, Working Distance, resolution): [diagram/image in source — not reproduced here, table not extracted]
- **12.2.2.2 Optional Objectives for IR Mode** (FOV, Working Distance, resolution, for the NTIR220): [diagram/image in source — not reproduced here, table not extracted]. With the 1x or 2x optional IR lens, spatial resolution improves with an offset in Field of View (FOV).

Measurements at different ambient temperatures: Thermoreflectance can operate over a wide temperature range down to cryogenic temperatures — Microsanj has imaged gold contact layers in small devices with sub-micron spatial resolution from 10 K to 800 K. For measurements below 5–10°C, use a cryostat with an optical window to avoid water condensation on the sample.

CCD Camera / 4D Nano Align Temperature Controller Reference

(Source Sections 13.1–13.2 — content in the source consists entirely of figures/tables with no extractable body text.)

[diagram/image in source — not reproduced here: Section 13.1 CCD Camera reference; Section 13.2 4D Nano Align Temperature Controller Reference]

Source Documents

Source Documents

This reference was compiled from:

- **EZ530 Therm User Manual [source-pdf].txt** — text extraction of the Microsanj LLC "Manual User Guide, EZ-THERM Series" (Copyright 2025), located at: `/tmp/claude-1000/-home-davidspitzer-Android-Auto-replacement/f4be41e4-c0ed-4d9c-bf7f-d5fc7ef77d8b/scratchpad/microsanj_docs/internal/txt/EZ530 Therm User Manual [source-pdf].txt`

Figures, diagrams, and screenshots referenced in the source are marked `[diagram/image in source – not reproduced here]` throughout this document rather than reproduced or guessed at.

Operation

SanjVIEW 7 Software — Overview

SanjVIEW 7 Software — Overview

(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 μ s 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 μ s 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 μ s).
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 μ s delay.
4. Set "Image Delay(s)" to 0 to initialize delay to 0 μ s (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 μ s) — the software takes 51 images at 10 μ s steps starting at 0 s (0–500 μ s).
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 $\approx$ 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 μ m 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:** Thermorefectance 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 thermorefectance 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 (thermorefectance); 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 Thermorefectance 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 thermorefectance 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. $\pm 60\text{V}$, 3A maximum.
VO EXT (B) — DC Voltage in	Output	Modulated output of the VI DC input voltage.
AUX INT (C) — Aux out	Output	$\pm 10\text{V}$, 500 mA max (not pulsed).
VO INT (D) — Voltage out	Output	Main output. $\pm 10\text{V}$, 1A maximum. In "Relay" mode: $\pm 60\text{V}$, 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.

Operating SanjVIEW 7 with the Visible Camera (TR)

Operating SanjVIEW 7 with the Visible Camera (TR)

(Source Section 8)

Opening the software and setting up a session:

1. Open SanjVIEW v7.0 from the computer desktop; center the sample in Project Manager and focus on the target device.
2. **System Status** — ensure all indicator lights are green for the connected system.
3. **Select Camera to Use** — available cameras: Infrared (IR), Visible – Thermoreflectance (TR), Near Infrared (NIR). Press **F1** to switch cameras.
4. Click the Auto Focus tab.
5. Set "Mag" to the objective in use (example: 5X).
6. Click "Enable Motion" ON and "Center Stage" ON. (The microscope may need refocusing after centering the stage.)
7. Click the file icon; name the file path and click "current folder."
8. Select the desired imaging operation.

⚡ Note: Transient Thermoreflectance is only available when a Visible camera is selected (not with an Infrared camera).

Steady State

8.1.1 Hardware

1. Enter the desired Base Temp (°C) and click "SET" next to Set Base Temp.
2. Set Stage State ON.
3. Set "Vo ON Voltage" to 7V.

8.1.2 Timing / Illumination

1. Set Device On Time to 10.
2. Set Image Averages (cycle) to 10.

8.1.3 3D Alignment — Focus ROI

1. Select a region on the CCD image using the rectangle tool — choose a unique feature (e.g., edges, scratch marks).
2. Press Focus ROI to set the selected region as the ROI.
3. Wait a few seconds until the Focus ROI light turns green.
 - *Note: To zoom, use the magnifying glass; hold SHIFT to zoom out, SHIFT+click to zoom in.*
4. Ensure "Enable 3D NanoAlign" is checked.

8.1.4 3D Alignment — Capture Reference

1. After the ROI is focused, press Capture Reference to set it as the Reference region.
2. Wait for the Capture Ref light to turn green ("Enable Digital Anti-vibration" turns on automatically).
3. Set initial Focus Tolerance, Alignment %, and Vibration Filter parameters — lights turn green when the image is in range.
 - *Note: Increasing Alignment % and decreasing Vibration Filter improves alignment accuracy. Alternatively, load a prior reference for easier alignment.*

8.1.5 Start Measurement

1. Click "START Measurement" to begin.
2. Progress displays in the System Status bar; "Turn OFF" appears after each cycle; "Loop Iterations" tracks cycle count (9–11 iterations is sufficient for TR).
3. Under Save Path, confirm the directory/name are correct — save in `C:\Data\Qualification\`, appending the filename to the path.
4. Click "Save Every Cycle." Click "Save Data" when ready. (*Save the image before stopping the measurement.*)
5. To stop: click "STOP MEASUREMENT," then "Return to Project Manager," or File → Quit.

Calibration

8.2.1 Hardware

1. Set "Magnification" to match the objective (example: 5x).
2. Set "High Temp" to 120°C and "Base Temp" to 20°C.
3. Turn "Stage State" ON.
4. Click "Set Low Temp" to initialize the chuck to the base temperature.
5. Click "Use Chuck Sensor" to use the embedded chuck thermal sensor, or leave off to use an external thermal probe.

8.2.2 Timing/Illumination

1. Set Stage Heating Time to 40.
2. Set Image Averages to 50.

8.2.3 3D Alignment — Focus ROI: same procedure as 8.1.3.

8.2.4 3D Alignment — Capture Reference: same procedure as 8.1.4. Alternative: click "Load Reference," select a previously saved file, and wait for the "Load Reference" light to turn green.

8.2.5 Start Measurement

1. Click "START Measurement."
2. The calibration cycles through temperatures; progress shown in System Status, "Calibration Done" after each cycle, "Loop Iterations" tracks count.
3. Select a region on Thermal Image View to read the sample's Calibration Factor live, shown in "Mean CTR."
4. Under Save Path, confirm directory/name — example: `C:\Data\Qualification\Training`.
5. Under Save Image, click "Save Every Cycle," then "Save Data" when ready. (*Save before stopping.*)
6. To stop: "STOP MEASUREMENT," then "Return to Project Manager," or File → Quit.

Failure Analysis (FA) Mode

8.3.1 Parameter Setup

1. In Project Manager, set "Cam Selection (F1)" to VISIBLE.
2. Uncheck "INT Vo 20mA Range" (green = checked, grey = unchecked).
3. File → Options.
4. Software tab → set "FA Mode Pulse Width" to Long (15 Frames).
5. Return to Project Manager and click "FA Mode."

8.3.2 Process

FA Mode confirms the device is biased and conducting current before using Movie Mode / Transient Mode.

1. Go to the "Biasing" tab.

2. Change Vo(V) to 7.000.
3. Click "Update Values."
4. Confirm "Peak Voltage (V)" and "Peak Current (I)" read near 7V and 70 mA for device 2 (Center Diode).
 - *Note: If current is much lower than expected, confirm "INT VO 20mA Range" is unchecked in Project Manager.*

8.3.3 Save Data

1. File → Save Data.
2. Click File Browser, choose the save folder, click "Current Folder" (example: `C:\Data\Qualification\Training`).
3. Enter the file name (example: "FA-File").
4. Click "Save."
5. Click "Return" to close the pop-up.
 - *Note: Change the Microsanj Data Save Path before saving a new data set, to avoid overwriting previous data.*

Transient Thermoreflectance

8.4.1 System Status

1. Change Camera to VISIBLE.
2. Click Transient Thermoreflectance.
3. Click "Measurement Settings" tab.

8.4.2 Measurement Setting

Two alignment approaches:

- *Approach 1 (Focus Region + Capture Reference):*
 1. Select a region on the CCD image with the rectangle tool (a unique feature, e.g., edges/scratch marks).
 2. Press Focus ROI; wait for the light to turn green.
 3. Press Capture Reference; wait for the Capture Ref light to turn green.
- *Approach 2 (Load Reference):*
 1. Click "Load Reference."
 2. Enter/browse the calibration file path and click LOAD.
 3. Wait for the "Load Reference" light to turn green.
 4. Click Enable 3D Motion & Enable DAV.
 5. Set "Alignment %" to 99.00.

8.4.3 Transient Thermoreflectance — Single Image

(Thermal Image should appear before proceeding.)

1. In Measurement Settings, set "Voltage to Device (V)" to 7V.
2. Click "Update Values."
3. Leave "DUT Pulse," "LED width," and "Acq Period" at their automatically-inserted initial values (in this example — they can be changed).
4. Click "Start Measurement."
5. Wait ~30 s or until noise averages out, then File → Save Data.
6. Choose a save location via File Browser, enter the file name, click "Save."
7. Click "Measurement Running" to stop.

8.4.4 Transient Thermoreflectance — Series

1. In Measurement Settings, set "Voltage to Device (V)" to 7V.
2. Click "Update Values."
3. Leave "DUT Pulse," "LED width," and "Acq Period" at automatic values (can be changed).
4. Set "Image Delay" to 0s. Click "Update Delay."
5. File → Setup Sweep.
6. Choose the save location via File Browser (click "current folder") and append the desired file name.
7. Enter "Number Delay Images" (example: 10).
8. Enter "Delay Step" (example: 50 μ s) — the DUT Pulse increment per frame.
9. Enter "Ave time per frame" (example: 30 s).
10. Click "START" to begin acquisition.
11. When the designated number of images is collected, the Start button turns green again — click "Close" to exit the dialog, then click "Measurement Running" to stop.

SanjAnalyzer

8.5.1 System Status

1. Confirm Camera is set to VISIBLE.
2. Click SanjAnalyzer to open the "SanjVIEW Image Analyzer" window.

8.5.2 Process Data

1. Select the Calibration tab.
2. Select "Point to Point" under "Method" — a "Load CTR Map" window appears.
3. Click the Browse icon and select the calibration image.
4. Click "LOAD" to overlay the calibration image onto the selected test image.
5. In the file window (top left), click Browse and select the file to analyze (double-click). *(If the file isn't listed, click "UP Dir" to change directory.)*
6. Drag an ROI box across the specimen with the rectangle tool to measure temperature in that range — up to 5 ROI boxes can be drawn (hold Ctrl while selecting additional boxes)

to compare locations.

7. Adjust the temperature scale and image-averaging factors as desired (optional).
8. Select "Settings" tab, choose a save path via Browse, and click "Save Image Current View" to save the processed image.
9. To process a series: enter the file count in "Number of Images in Series" and click "Process Series" — the ROI Mean graph plots mean temperature of the selected ROIs over time.
 - *Note: Right-click the graph → Export → "Export Data to Clipboard" to export data to a table.*

SanjVIEW 7 for Near Infrared (NIR) Camera

SanjVIEW 7 for Near Infrared (NIR) Camera

(Source Section 10)

- A **visible camera** (mono or color) captures images in the visible light spectrum (400–780 nm), producing images resembling human vision.
- A **NIR camera** captures near-infrared light (780–1400 nm), invisible to the human eye, extending imaging into low-light conditions.
- SanjVIEW 7 offers the same functionality for Visible and NIR cameras, provided the camera selection (VISIBLE/NIR, F1) is matched with a compatible LED selection (F3):

Camera Selection (F1)	Select LED (F3)
VISIBLE	405, 470, 530, 780 nm
NIR	1050, 1100, 1200, 1300 nm

SanjVIEW 7 for Infrared Camera (IR)

SanjVIEW 7 for Infrared Camera (IR)

(Source Section 11)

Opening the software and setting up a session:

1. Open SanjVIEW v7.0 from the desktop; center the sample in Project Manager and focus on the target device.
2. **System Status** — ensure all indicator lights are green.
3. **Select Camera to Use** — Infrared (IR), Visible - Thermoreflectance (TR), Near Infrared (NIR). Press **F1** to switch.
4. Click "Temp Control" tab; toggle ON/OFF and view readings for Stage, Thermal Coupler (TC), and ROI. Set the setpoint (example: 75), then click "Stage State" to turn on the stage.
5. Click the "Auto Focus" tab (Piezo system control); select objective magnification (example: 5X).
6. Click "Enable Motion" ON and "Center Stage" ON to center the Piezo controller. (Microscope may need refocusing after centering.)
7. Click the file browser icon; choose the save folder and click "Current Folder."
8. Select the desired imaging operation.

⚡ Note: Transient Thermoreflectance is not available with the Infrared camera.

Steady State

Select "Steady State" from Project Manager.

11.1.1.1 Hardware

1. Enter the desired Base Temp (°C) (example: 75) and click "SET."
2. Turn Stage State ON.
3. Set "Vo ON Voltage" to 7V.

11.1.1.2 Timing / Illumination

1. Set Device On Time to 10.
2. Set Image Averages (#cycle) to 10.

11.1.1.3 3D Alignment — Focus ROI: same procedure as 8.1.3.

11.1.1.4 3D Alignment — Capture Reference: same procedure as 8.1.4.

11.1.1.5 Start Measurement

1. Click "START Measurement."
2. Progress in System Status bar; "Turn OFF" after each cycle; "Loop Iterations" tracked (9-11 sufficient for TR).
3. Under Save Path, confirm directory/name.
4. Click "Save Every Cycle," then "Save Data" when ready. (*Save before stopping.*)
5. Click "STOP MEASUREMENT," then "Return to Project Manager" or File → Quit.

Calibration

Select "Calibration" from Project Manager.

11.2.1 Hardware

1. Set "Magnification" to match the objective (example: 5x).
2. Set "High Temp" to 120°C and "Base Temp" to 75°C.
3. Turn "Stage State" ON.
4. Click "Set Low Temp" to initialize chuck temperature.
5. Click "Use Chuck Sensor" for the embedded sensor, or leave off for an external thermal probe.

11.2.2 Timing/Illumination

1. Set Stage Heating Time to 40.
2. Set Image Averages to 50.

11.2.3 3D Alignment — Focus ROI: same procedure as 8.1.3.

11.2.4 3D Alignment — Capture Reference: same procedure as 8.1.4, with the Load Reference alternative.

11.2.5 Start Measurement

1. Click "START Measurement."
2. Progress shown in System Status; "Calibration Done" after each cycle; "Loop Iterations" tracked.
3. Select a region on Thermal Image View to view the live Calibration Factor ("Mean CTR").
4. Under Save Path, confirm directory/name (example: `C:\Data\Qualification\Training`).
5. Click "Save Every Cycle," then "Save Data." (*Save before stopping.*)
6. Click "STOP MEASUREMENT," then "Return to Project Manager" or File → Quit.

Failure Analysis (FA) Mode

11.3.1 Frame Rate Selection

1. In Project Manager, set "Cam Selection (F1)" to INFRARED.
2. Uncheck "INT Vo 20mA Range."
3. File → Options.
4. Software tab → set "FA Mode Pulse Width" to Long (15 Frames).
5. Return to Project Manager and click "FA Mode."

11.3.2 Process

Confirms the device is biased and conducting current before using Movie Mode.

1. Go to "Biasing" tab.
2. Change Vo(V) to 7.000.
3. Click "Update Values."
4. Confirm "Peak Voltage (V)" and "Peak Current (I)" read near 7V and 70 mA for device 2 (Center Diode).
 - *Note: If current is lower than expected, confirm "INT VO 20mA Range" is unchecked.*

11.3.3 Save Data

1. File → Save Data.
2. Choose the save folder via File Browser and click "Current Folder" (example: `C:\Data\Qualification\Training`).
3. Enter the file name (example: "FA-file").
4. Click "Save."
5. Click "Return" to close the pop-up.
 - *Note: Change the Microsanj Data Save Path before saving new data, to avoid overwriting.*

Movie Mode

Select "Movie Mode" from Project Manager.

11.4.1 Control Settings

1. Set "Voltage to Device (V)" to 7V.
2. Click "Update V."
3. Set "DUT Pulse (s)" (example: 1s). Click "Update Timing."
4. Confirm "Save Whole Series" is on (on by default).
5. Click "File Path" icon (or type the path) and select a name.
6. Click "Start Movie" on Movie Mode Acquisition.
7. Click "Save Image."
 - *Note: Movie Mode saves a series of a 105-file cycle when "Save Image" is clicked.*

SanjANALYZER

11.5.1 System Status

1. Confirm Camera is set to INFRARED.
2. Click SanjANALYZER to open the "SanjVIEW Image Analyzer" window.

11.5.2 Process Data — identical procedure to Section 8.5.2 (Calibration tab → Point to Point → Load CTR map → select analysis file → draw up to 5 ROI boxes → adjust scale/averaging → Settings tab to save the processed image → optional "Process Series" for a file series).

Device Biasing, Trigger Function, and Timing

Device Biasing, Trigger Function, and Timing

(Source Section 9)

9.1 Diagram for TR Imaging — SanjCONTROLLER PLUS™ signals:

- **A. VI EXT:** Input for fixed DC voltage up to +60V.
- **B. VO EXT:** Pulsed output of the DC voltage applied to VI EXT.
- **C. AUX INT:** Up to $\pm 10\text{V}$ DC for secondary DUT bias.
- **D. VO INT:** Up to $\pm 10\text{V}$ pulse for DUT pulsed bias.
- **E. TRIG:** Internal-mode output, 5V TTL pulse, syncs an external DUT bias supply.

9.2 Relation to Timing Sequence for Transient Analysis. [diagram/image in source — not reproduced here]

The following subsections consist of diagrams in the source with no accompanying body text — content not reproduced here:

- **9.3 Internal Biasing** [diagram/image in source — not reproduced here]
- **9.4 External DC Supply** [diagram/image in source — not reproduced here]
- **9.5 Triggering an External Source** [diagram/image in source — not reproduced here]
- **9.6 Slave Mode (TRIG IN) in Movie Mode only** [diagram/image in source — not reproduced here]
- **9.7 Transient Timing Signal** [diagram/image in source — not reproduced here]
- **9.8 Transient Software with Light Emission** [diagram/image in source — not reproduced here]