DIGITAL INDUSTRIES SOFTWARE

Simcenter Micred T3STER SI

Product Information Sheet

Summary

Simcenter Micred T3STER SI is an advanced thermal transient testing hardware designed for the thermal characterization of packaged semiconductor devices such as diodes, BJTs, power MOSFETs, IGBTs, and power LEDs. It measures the thermal transient response with up to 1-microsecond time resolution and an accuracy of ±0.01°C.[1] The tool uses a deconvolution-based evaluation method to determine model parameters that are visualized through thermal impedance curves and structure functions —representing the accumulated thermal resistances and capacitances along the heat flow path. Simcenter Micred T3STER SI is ideal for pre- and post-stress defect detection, with results that can be exported to calibrate detailed 3D thermal models, enhancing thermal design accuracy.

With Simcenter Micred T3STER SI, testing is fast and efficient. After the initial setup of electrical connections for powering and sensing, multiple measurements can be performed quickly using its browser-based, user-friendly control software. The measurement system is optimized to minimize measurement noise. Simcenter Micred T3STER SI enables the user to configure their own measurement setups by offering a wide flexibility of parameters selection and settings. The tool is compatible with nearly all packaged semiconductors, making it an essential tool for thermal characterization.

[1] *Using a diode type sensor with -2mV/°C sensitivity and assuming 50mV temperature induced change of forward voltage*

Introduction

The T3STER SI is a high-precision thermal transient testing tool designed for measuring semiconductor junction temperatures with accuracy and resolution over both temperature and time scales. Its modular design offers flexibility and scalability, allowing users to tailor the system configuration to their specific testing needs. Making it a valuable tool for semiconductor thermal analysis.

Simple and Flexible Testing

Measuring with T3STER SI is simple. The sample is fixed in the desired thermal environment and connected via electrical wires, replicating actual operating temperatures. Four electrical wiring, the four-wire method is used to minimize the wiring impedance. Discrete devices like diodes, LEDs, and transistors can be tested directly, while complex digital ICs can be evaluated through their substrate diodes. The guided software interface simplifies setup, making the system easy to learn and use.

Reliable and Reproducible Measurements

T3STER SI delivers highly repeatable results, eliminating the need for multiple test runs. Because all calibrated T3STER systems produce consistent results, they provide a common reference for comparing semiconductor thermal performance across different testing facilities, ensuring reliable data exchange.

Fast and Non-Destructive Testing

Using the JEDEC JESD 51-1 static test method, T3STER SI:

- Captures the cooling curve in real time after a single heating phase.
- Requires only one measurement thanks to its excellent signal-to-noise ratio.
- Leaves components fully operational, making it ideal for quality control and production monitoring.

Comprehensive Thermal Analysis with T3STER-Master Software

- Converts thermal response data into a one-dimensional thermal RC network model (structure function), mapping the heat flow path from the semiconductor junction to ambient.
- Supports industry-standard thermal metrics such as Rth-JC and Rth-JA.
- Aids failure analysis by identifying structural defects in thermal interface layers.

In-Situ Testing for True Thermal Performance

T3STER SI measures components in their actual operating environment, such as:

- Air cooling or cold plate mounting
- Water jackets
- PCB-mounted setups

Unlike thermocouple-based or infrared methods, T3STER SI does not alter thermal boundary conditions.

Seamless Integration with Thermal Simulation Tools

T3STER SI-generated structure functions can be used for compact thermal R-C network generation, which can be directly exported to FloTHERM and FloEFD to calibrate the detailed 3D simulation models of semiconductor packages (e.g., TO-220, TO-247, LED packages), and provide a more accurate simulation results, thus enhancing thermal design accuracy.

Both the accurate thermal data from T3STER and automated calibration procedures provided by simulation tools like Simcenter FLOEFD and Simcenter Flotherm help ensure that digital twins are accurately calibrated, leading to better performance predictions and more reliable digital twins.

Flexible & Modular Thermal Testing Solution

T3STER SI provides flexibility and a high level of configurability for users. Designed as a modular system, it allows users to tailor the system configuration to their specific testing needs. Various configurations can be made by choosing different plug-in units within the same frame. The system can be configured with:

- Heating and sensing current sources
- Gate voltage supply
- Measurement channels

Additionally, the T3STER SI supports a range of accessories, including current and voltage boosters, to expand testing capabilities. This adaptable design makes it an ideal solution for scalable thermal measurements.

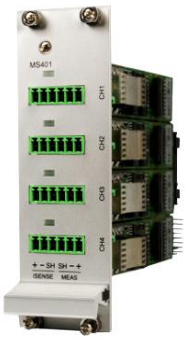
T3STER SI Frame:

The Simcenter Micred T3STER SI Frame is a high-performance chassis designed to accommodate up to 10 plug-in units. It features an embedded System-on-Chip for high-level control and system management. The frame supports multiple interface connections for peripherals, operates within a broad temperature range, and is designed for efficient air cooling. It is rack-mountable, making it ideal for laboratory and industrial environments.

Specifications

- Interfaces: Control (Ethernet, RS232 and RS422/485). Peripheral (USB-A, USB-B , 28-pin I/O Interface and Fiber Optic RX & TX)
- Operating temperature: 0 to 50°C
- Dimensions: 177.8 mm × 448.9 mm × 375.5 mm
- Empty frame weight: 7 kg
- Rack mountable(19” standard) and air-cooled
- Mains supply: 90-264 VAC, 47-63 Hz
- Plug-in unit slots: 10

Transient Measurement & Sensing Current Source Channels (MS401 module)



The T3STER SI MS401 module is a plug-in unit designed for precise transient thermal measurements. It features four galvanically isolated transient measurement channels and corresponding sensing current sources. Galvanic isolation eliminates any problems caused by grounding issues. The module has a single slot Plug-in-Unit form factor.

The T3STER SI MS401 module offers a nominal current range of ±200mA with a resolution of 6.2µA and an accuracy of 0.01% Iset + 200µA to 0.01% Iset + 500µA. It also provides a minimum output resistance of 1MΩ and supports output current derating based on the output voltage.

Specifications:

- Conversion Time: 1µs (1Msample/s/CH).
- Input Differential Impedance: 100kΩ.
- Input Common Mode Impedance: 1GΩ + 2.5nF.
- Nominal Full-Scale Voltage Range: Various ranges from ±10V to ±80V.
- Nominal Resolution: Ranges from 4µV to 80µV.

Low Power Heating Current/Voltage Source (LP220 module)

The T3STER SI LP220 module is a low power heating current/voltage source module designed to provide up to 20W of heating power distributed between two outputs. It offers two power sources that can be individually configured as current or voltage sources.

The module has a double slot Plug-in Unit form factor. The module is galvanically isolated, although both sources share a common ground.

Specifications:

- Number of Power Sources: 2, individually configurable as current or voltage sources.
- Form Factor: Double slot PIU.
- Galvanic Isolation: Yes, with a common ground for both sources.
- Simultaneous Voltage & Current Measurement: Available on both channels in parallel.

Current Source Mode:

- Current Range: ±20mA to ±2A.
- Nominal Current Resolution: 0.64µA to 64µA.
- Current Accuracy: 0.1% I set + 20µA to 0.1% I set + 2mA.
- Turn-on/Turn-off Time: 1µs.

Voltage Source Mode:*

- Voltage Range: 40V.
- Nominal Voltage Resolution: 1.25mV.
- Voltage Accuracy: 0.1% V set + 40mV.

**The voltage source mode is only available with the 3-POLE extended license.*

Passive Temperature Sensor Measurement Module (TH800)

The T3STER SI TH800 module is a passive temperature sensor measurement module designed for precise thermal measurements. It features eight transient measurement input channels compatible with thermocouples or resistive temperature sensors.

The module has a single-slot Plug-in Unit form factor and supports a wide temperature range from -100°C to +400°C, depending on the sensor type. It offers a sampling rate of 1ksample/sec and an analogue bandwidth of 750Hz. The input differential impedance is 20MΩ, and the input common mode impedance is 1.25GΩ, ensuring high accuracy and reliability.

Specifications:

- Number of Input Channels: 8, compatible with thermocouples and resistive temperature sensors.
- Form Factor: Single-slot PIU.
- Temperature Range: -100°C to +400°C (depends on the sensor type).
- Sampling Rate: 1ksample/sec.
- Analogue Bandwidth: 750Hz.
- Input Impedance: Differential: 20MΩ, Common Mode: 1.25GΩ.
- Galvanic Isolation: Channels are isolated from the backend but not from one another.

Thermocouple Measurement:

- Resolution: 0.6µV (~0.016°C).
- Accuracy: 0.012% + 30µV (±2°C)*.

**Sensor inaccuracies are not included.*

RTD Measurement:

- Supported Sensor Types: 2-, 3-, and 4-wire resistive temperature sensors.
- Accuracy: ±1°C (Platinum temperature sensor, default calibration coefficients).

- Excitation Current: Automatically selected from 10µA to 2mA.

T3Ster Booster (50A/30V) Dual Channel

The Simcenter Micred LV Booster 50A 30V Dual Channel is an add-on to the T3STER SI hardware, designed to extend the heating current output capability to up to 50A at up to 30V. This power booster requires an external power (current) source for the high current range, which is not included in the booster package. The switch-on time is less than 50ms, and the switch-off time is less than 100µs.

Specifications:

- Number of Current Outputs: 2.
- Switch-on Time: < 50ms.
- Switch-off Time: < 100µs.
- Form Factor: 19", 3U.

T3Ster Booster (240A/11V)

The Simcenter Micred Power Booster LS 240A 11V is designed to enhance the heating current output capability of the T3STER SI hardware, providing up to 240A at up to 11V. This power booster is ideal for high-current applications.

The module has a single heating channel with a maximum total heating current of 240A and a resolution of 15mA. The heating current accuracy is 0.2% set + 240mA, with a switch-on time of 50ms and a switch-off time of 100µs. The module also includes four V_{GE} sources with a voltage range of -10V to +20V, a resolution of 0.01V, and an accuracy of 0.5% set + 0.25% range.

Specifications:

- Number of Heating Channels: 1.
- Heating Current Resolution: 15mA.
- Heating Current Accuracy: 0.2% set + 240mA.
- Switch-on Time: 50ms.
- Switch-off Time: 100ms.
- V_{GE} Voltage Range: -10V to +20V.
- V_{GE} Voltage Resolution: 0.01V.
- Number of V_{GE} Sources: 4.
- Dimensions (L × W × H): 540mm × 485mm × 315mm (including two power supply units).

Micred Power Booster 10A/150V

The Simcenter Micred Power Booster 10A 150V is an add-on to the T3STER SI hardware, designed to extend the heating current output capability to up to 10A at up to 150V. This power booster is primarily intended for the measurement of single or serially connected diode-like two-pole components.

The module consists of four 19" 1U modules, assembled in a 19" 4U desktop frame, and requires two mains inputs for operation.

The heating current source offers an output voltage range of 0 to 150V and an output current range of 20mA to 10A, with an accuracy of 0.1% I set + 10mA.

Specifications:

- Output Voltage Range: 0 to 150V.
- Output Current Range: 20mA to 10A.
- Output Current Accuracy: 0.1% I set + 10mA.
- Output Voltage Range: -15V to +150V.
- Output Current Range: ±100mA to ±25mA.
- Output Current Accuracy: 0.015% I set + 250µA.
- Dimensions (H × W × D): 210mm × 515mm × 610mm.

In addition to its core capabilities, T3STER can be complemented with a range of accessories to enhance testing flexibility and accuracy. These include the Micred Cooling Plate and the T3STER Dual Cold Plate for controlled thermal environments, and the Micred T3STER Still Air Environment for evaluating thermal performance in a natural convection setup (as stipulated in JESD51-2A standard). These accessories further expand T3STER's adaptability.

T3STER SI Control Software

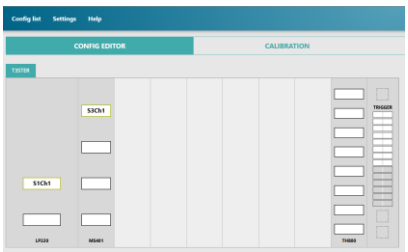
The Simcenter Micred T3STER SI Control Software is a comprehensive tool designed to manage and optimize the functionality of the T3STER SI hardware. This software provides a user-friendly interface for configuring, calibrating, and measuring thermal transient responses, all in an internet browser-based interface.

The opening screen displays a list of available configurations, allowing users to initiate activities such as editing or creating configurations, or starting calibration or measurement operations.

The core capabilities of the tool include:

Configuration Management

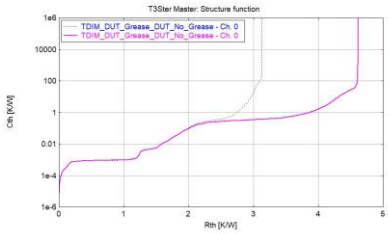
Users can create and manage test configurations with ease. The software provides a visual editor to define hardware connections, measurement channels, and source settings. It also allows flexible assignment of resources to accommodate various device test setups.



Automated Calibration

The software supports precise control of power and thermostat parameters before calibration measurements. Calibration processes can be monitored in real-time, with visual feedback

provided through live plots. Calibration data can be exported in multiple formats for external analysis or documentation.



Measurement Execution

Thermal transient measurements can be executed with detailed control over timing and source parameters. Users can visualize junction temperature responses and power step changes as they occur. Measurement plots and raw data can be saved and exported for further evaluation.

Versatile Power Step Calculation

The software includes multiple built-in methods for power step calculation, tailored to various device types such as diodes, LEDs, BJTs, MOSFETs, and IGBTs. These methods support 2-pole and 3-pole configurations, on-state measurements, voltage or current jump techniques, and $R_{DS(on)}$-based setups.

Advanced Post-Processing with T3STER Master

The measurement data can be downloaded and opened by T3STER Master software. The T3STER Master tool enables comprehensive post-processing, including the generation of structure functions, differential thermal profiles, time-constant spectra, and thermal impedance plots. It also offers options for curve smoothing, detailed data manipulation, and side-by-side comparative evaluations. The export wizard generates compact thermal R-C network models. These models can be directly imported into FloTHERM and FloEFD to calibrate detailed 3D simulation models.