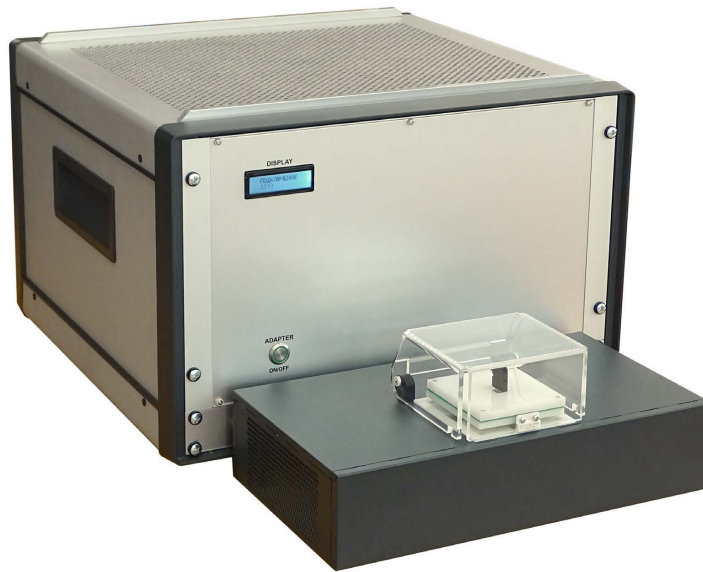


# TSSemi 2000 Automated Test and Measurement System for High-power Semiconductor Devices



## Overview

Automated test and measurement system for high-power semiconductor devices (hereinafter referred to as tester) designed for automated measurement and control of static and dynamic parameters of high-power semiconductor devices at the various stages of semiconductor production such as wafer and final testing.

The tester can be used both for validation and characterization purposes.

The tester consists of the following main blocks:

- Voltage and current source and measurement unit with up to 400 A output current
- Voltage and current source and measurement unit with up to 4000 V output voltage
- Two-channel precision voltage and current source and measurement unit
- Six-channel reference voltage source
- Oscilloscope
- Arbitrary waveform generator
- DMM

Access to the terminals of the measurement-and-control units is carried out through special connectors located on the front panel of the tester. Through these connectors, it is possible to connect loadboards

for different families of semiconductor devices. Through them, connection of switching and interface adapters is provided for different families of semiconductor devices. Daughter boards for a specific DUT are installed on the load board and provides interfacing the device with loadboard.

Using different types of loadboards provides testing DUT's both packaged and on the wafer. The tester is a universal platform for testing a wide range of semiconductor devices such as: high-power diodes (FRD), bipolar transistors (BT), field-controlled transistors (MOSFETs), bipolar transistors with isolated gate (IGBT), thyristors, zener diodes, optocouplers, etc. Testing is performed in accordance with standards.

## Measured Parameters

The list of common parameters for some semiconductor devices measuring by tester is given below.

### **Metal-Oxid Semiconductor Field-Effect Transistor (MOSFET):**

- Gate-Source Leakage Current
- Zero Gate Voltage Drain Current
- Drain-Source Breakdown Voltage
- Threshold Voltage
- Drain-Source On Resistance

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- Forward Transconductance
- Input, Output and Reverse Transfer Capacitance
- Gate charge, Gate-Source Charge, Gate-Drain Charge
- Turn-on Delay, Turn-off Delay, Rise Time, Fall Time
- Drain-Source Avalanche Energy
- Diod Forward Voltage Drop
- Reverse Recovery Time

## **Bipolar transistors with isolated gate (IGBT):**

- Collector-Emitter Breakdown Voltage
- Collector-Emitter Cut-off Current
- Gate - Emitter Leakage Current
- Collector-Emitter Saturation Voltage
- Gate-Emitter Threshold Voltage
- Input, Output and Reverse Transfer Capacitance
- Gate Charge, Gate-Emitter Charge, Gate- Collector Charge
- Turn-on Delay, Turn-off Delay, Rise Time, Fall Time
- Turn-on and Turn-off Loss

## **Bipolar transistors (BT):**

- Threshold Voltage
- Collector-Emitter Saturation Voltage
- Base-Emitter Saturation Voltage
- Static Value of the Forward Current Transfer Ratio
- Collector-Emitter Cut-off Current
- Collector-base Cut-off Current
- Emitter Cut-off Current
- Delay Time
- Rise Time
- Fall Time
- Turn-on Time
- Turn-off Time

## **High-power diodes (FRD):**

- Forward Voltage
- Breakdown Voltage
- Reverse Current
- Reverse Recovery Time

The list of measurements are customizable and new measurements can be also added if technical specifications of the tester meet the requirements for the measurement.

## **Automated Testing Software Platform SINUS**

The software platform SINUS is specialized software for automated control and measurement developed in NI LabVIEW graphical programming environment, which has an easy-to-use and intuitive user interface.

The “SINUS” software is intended for controlling the measuring process of the tester. The software allows creating, editing and executing measuring programs and test sequences. An important advantage of the software is the ability to configure setups for each test, with the ability to change the list and the order of their execution.

The software allows you to accumulate measurement results in a statistics file for further processing, as well as export measurement results to .CSV (MS Excel compatible) or HTML file, which creates additional convenience for their storage and usage in further operations.

### **SINUS software provides ability to perform the following functions:**

- Self-test
- Calibration
- Metrological verification of the tester
- Program operation in “Validation”, “Characterization” and “Debugging” modes
- Measurement in the “Automatic 1” modes (sequential tests),
- “Automatic 2” (sequential tests until the first fail), “Step” (step by step with a stop on each test), “Cycle” (passing tests on a cycle)
- Parameter monitoring with measuring value and presorting under the principle of pass / fail
- Automatic identification of the loadboard
- Setting measurement conditions and performing a test without restarting the program
- Setting the order of the processing with the ability to reset or save modes after each test
- Classification of the DUT’s according to the measurement results for up to 10 groups
- Trigger the measurement process on the rising edge of the external TTL signal
- Control of the handlers and probers, as well as the



# TSSemi 2000 Automated Test and Measurement System for High-power Semiconductor Devices

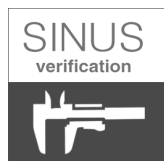
## Advantages of SINUS Software

- Rapid development of new or editing existing measuring programs
- Ability to use templates to speed up the process of creating new measurement programs
- Intuitive user interface
- Using the program for production and research tasks
- Ability to create or edit measurement programs in the NI LabVIEW graphical programming environment using special high-level API's designed to control the measuring and testing modules of the tester

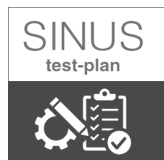
## Components of SINUS Software platform



“SINUS” program is the operator interface and is designed to control the operation of the tester



“SINUS - Verification” program is intended for metrological verification of the tester



“SINUS - Manager of test-plans” program is intended for creation and editing test-plans



“SINUS - Maintenance” program is intended for self-test and monitoring and calibration

# TSSemi 2000 Automated Test and Measurement System for High-power Semiconductor Devices

## Technical Specifications

### Source and meter of voltage and current with a large output current

Voltage range	$\pm 3$ V, $\pm 10$ V, $\pm 30$ V, $\pm 60$ V
Current range	10 A, 100 A, 400 A
Current setting and measuring accuracy	0.5 % of range
Voltage setting and measuring accuracy	0.1 % of range

### High voltage source and meter of voltage and current

Voltage range	+100 V, +200 V, +800 V, +2000 V +4000 V, -100 V, -200 V, -800 V, -2000 V, -4000 V
Current range	100mA, 50mA, 20 mA, 5 mA 500 mA, 50 $\mu$ A, 5 $\mu$ A, 0.5 $\mu$ A
Current setting and measuring accuracy	+/-0.5 % of reading or +/-0.5% of range
Voltage setting and measuring accuracy	+/-0.5 % of reading or +/-0.5% of range

### Precision source and meter of voltage and current

Number of independent channels	2
Voltage range	$\pm 3$ V, $\pm 5$ V, $\pm 10$ V, $\pm 30$ V
Current range	5 $\mu$ A, 50 $\mu$ A, 500 $\mu$ A, 5mA, 50 mA, 500 mA 5 A, 10 A (pulse mode)
Current setting and measuring accuracy	0.1 % of range
Voltage setting and measuring accuracy	0.05 % of range

### Reference voltage source

Number of independent channels	6
Voltage range	$\pm 3$ V, $\pm 10$ V, $\pm 15$ V
Maximum output current	100 mA
Voltage setting accuracy	$\pm 0.05$ % of range

### Oscilloscope

Two analog inputs 8 bit, 1 GS/s, bandwidth 100 MHz,  $\pm 20$  V max.

### Generator

125 MSa/s, 14 bit, max. Frequency 20 MHz (sine),  $\pm 12$  V max.

### Digital multimeter

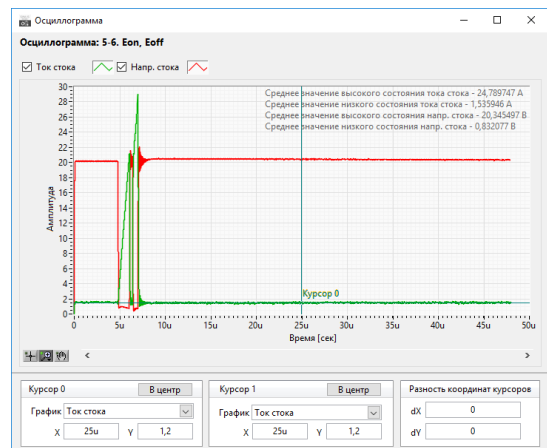
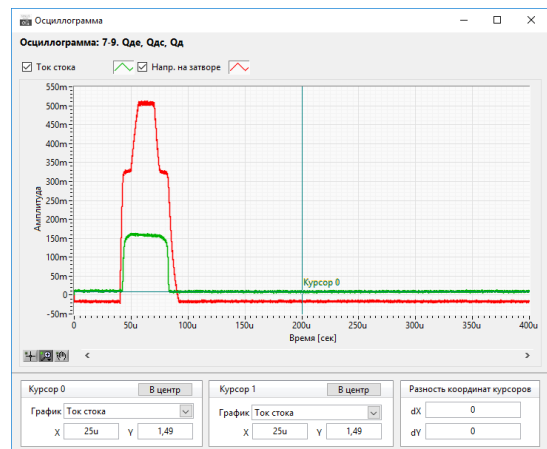
5½ characters, up to 300 V, up to 10 A, up to 100 Mohm.

# TSSemi 2000 Automated Test and Measurement System for High-power Semiconductor Devices

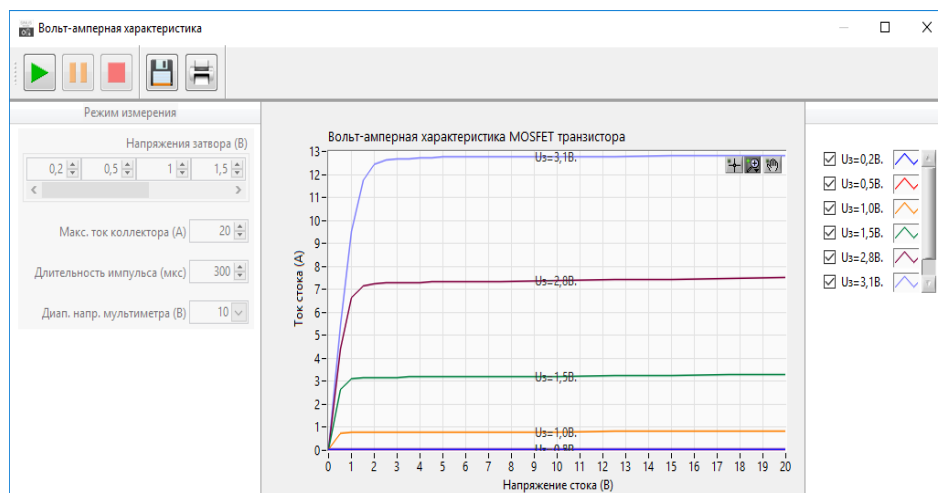
## Hardware and Software

Delivery set includes:

- Tester for High-power Semiconductor Devices
- Loadboards (optional)
- Daughter boards (optional)
- SINUS automated test software platform
- Software tools for developing (editing) measurement programs (optional)
- Technical documentations



Graph visualization windows



V-I curve builder window