

## System 93

## I-V Systems



- Flexible, modular SMU design fits a variety of I-V test applications
- DC characterization from 10fA to 3A and 10 $\mu$ V to 1100V
- Metrics-ICS software allows point-and-click instrument setup under Windows
- Flexible analysis and spreadsheet functions for parameter extraction
- Optional switching for fully automatic testing
- Optional C-V capability



Model 2400 SourceMeter instrument

ing capability can be used to direct any SMU output to any DUT pin. This further enhances system flexibility, particularly when a Model 237 or 238 is included in the configuration.

### Process Development

Automate parameter extraction, such as Threshold Voltage, using the Numerical Transform Editor. The Transform Editor defines nested equations used to extract parameters from measured data.

### Complete DC Characterization Systems

The System 93 I-V test cluster offers interactive testing of current vs. voltage (I-V) in the research, development, and evaluation of semiconductor devices, processes, and materials. It uses three Keithley Source-Measure Units (SMUs) to measure device characteristics at currents from 10fA to 3A and voltages from 10 $\mu$ V to 1100V. These SMUs offer source-measure times at 1ms, plus sophisticated triggering for I-V curve family tests and DC source-measure tests. This versatile system offers complete characterization of devices and comprehensive analysis of test results, without the need to write code or learn GPIB commands.

### Configuration Flexibility

The standard Model 93 hardware configuration includes three Model 236 SMUs, but it can also be configured with an optional Model 237 High Voltage SMU, a Model 238 High Current SMU, or a Series 2400 SourceMeter instrument. Under Metrics-ICS control, the Model 2361 Trigger Controller Unit (TCU) synchronizes the source and measure activity of each SMU.

This integrated control also makes it possible to apply any configuration of sweep step or constant outputs using any SMUs selected, without the need to program the instruments or operate their front panel controls.

The optional Model 213 Quad Voltage Source (QVS) adds four channels of voltage bias capability. The QVS can be used to apply voltages to device pins at up to  $\pm 10$ V and 10mA. The optional switch-

### OPTIONAL SYSTEM ENHANCEMENTS

#### SOURCE-MEASURE UNITS

237	High Voltage Source-Measure Unit
238	High Current Source-Measure Unit

#### SOURCEMETER INSTRUMENTS

2400	Digital SourceMeter
2410	High Voltage SourceMeter
2420	High Current SourceMeter
2430	Pulse SourceMeter

#### SWITCHING

707A	Switching Matrix – up to 8x72
708A	Switching Matrix – up to 8x12
7174A	8x12 Low Current Matrix Card
7072	8x12 Semiconductor Matrix Card

#### SOFTWARE

Metrics-ICS-SW	Switch Drivers
Metrics-ICS-CV	C-V Analysis Library
TestPoint	Test Development Software

#### RACK KITS

4288-1	Fixed Rack Mount Kit for Model 2400
4288-2	Fixed Rack Mount Kit for Model 2400
1938	Fixed Rack Mount Kit for Model 236

#### CABLES

7007-1	Shielded IEEE-488 Interface
7007-2	Shielded IEEE-488 Interface
8503	Trigger Cable, DIN to BNC

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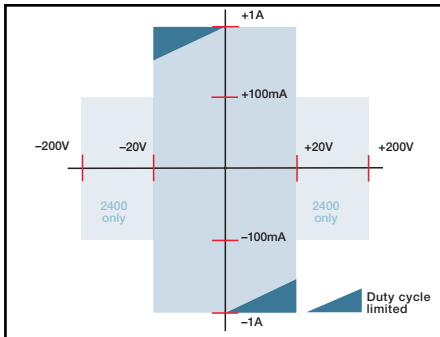
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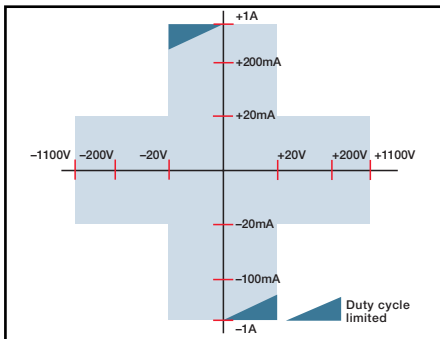
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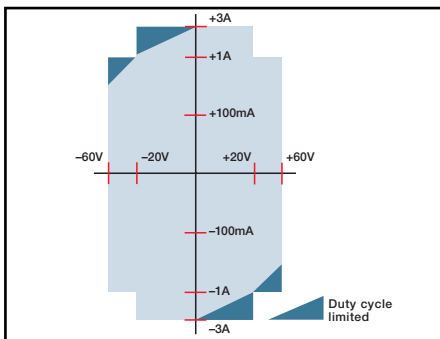
## Optional SourceMeter Choices



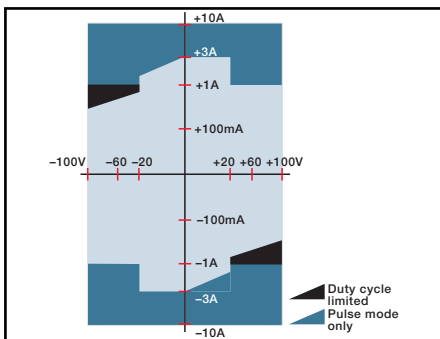
Model 2400 and 2400-LV SourceMeter



Model 2410 High-Voltage SourceMeter



Model 2420 3A SourceMeter



Model 2430 1kW Pulse Mode SourceMeter

### Device Characterization

Automatically characterize new devices using auto-sequence execution of measurements. Data is stored based on user-defined attributes, such as process, lot, wafer, die, and more.

### Process Monitoring/Reliability

Solve in-line production problems by tracking parameters such as line width, resistivity, and mask alignment. Automatically export results to generate early warning reports. Perform on-wafer reliability tests, such as Metal Migration, Time Dependent Dielectric Breakdown, and Hot Carrier Injection.

### Higher Power, Throughput, and Accuracy

Model 93 I-V Characterization Systems can be upgraded with Keithley Series 2400 SourceMeter instruments for faster throughput, higher power, and increased accuracy. The Series 2400 line combines precision voltage and current sources with a high resolution digital multimeter and measurement firmware compatible with Model 93 I-V systems. The latest Metrics-ICS software drivers allow mixing of SourceMeter instruments with previously purchased Model 236, 237, and 238 SMUs, providing seamless integration or replacement in existing systems. Drivers are also available to control Keithley C-V systems, switching systems, and thermal chucks.

The Series 2400 SourceMeter line allows expanded testing in a wide variety of applications, including:

- Device development and characterization
- New material and device development, such as wide band-gap silicon carbide MOSFETs
- High-power testing on rectifiers, diodes, and solar cells
- Testing power semiconductors and industrial electronic devices used in:
  - automotive systems
  - industrial controls
  - aerospace applications

### Basic Specifications

The Series 2400 line not only offers extended voltage and current capabilities, but also greater power levels, as shown in Table 1.

Table 1. Series 2400 Source and Measure Capabilities

Parameter	2400	2410	2420	2430
Meas. Accuracy, I/V ( $\pm$ reading)	$\pm 0.03\%/0.02\%$	$\pm 0.03\%/0.02\%$	$\pm 0.03\%/0.02\%$	$\pm 0.03\%/0.02\%$
Current Output	$\pm 50\text{pA}$ to $\pm 1.05\text{A}$	$\pm 50\text{pA}$ to $\pm 1.05\text{A}$	$\pm 500\text{pA}$ to $\pm 3.15\text{A}$	$\pm 100\text{pA}$ to $\pm 10\text{A}$ (pulse)
Voltage Output	$\pm 5\mu\text{V}$ to $\pm 210\text{V}$	$\pm 5\mu\text{V}$ to $\pm 1100\text{V}$	$\pm 5\mu\text{V}$ to $\pm 63\text{V}$	$\pm 1\mu\text{V}$ to $\pm 100\text{V}$
Power Output	20W	20W	60W	100W pulse
Source Accuracy, I/V ( $\pm$ setting)	$\pm 0.03\%/0.02\%$	$\pm 0.03\%/0.02\%$	$\pm 0.03\%/0.02\%$	$\pm 0.03\%/0.02\%$

These instruments also offer additional features that simplify I-V testing:

- Digital I/O interface provides a fast data link to widely used probes and hot chucks with Start-of-Test, End-of-Test, and three category bits
- Programmable voltage and current output sweeps for fixed, linear stair, log stair, pulse, linear stair pulse, and log stair pulses
- External or hardware (Trigger Link) trigger compatible with the Model 2361 TCU
- Programmable delay time from 0 to 65,000ms
- Built-in over-voltage and over-temperature protection
- Fully guarded four-terminal (Kelvin) and two-terminal measurements

**NOTE:** Any Series 2400 SourceMeter in a system operating under Metrics-ICS software requires a Model 2361 in the system and an 8503 Trigger Link to BNC cable. Also requires firmware revision of C-19 or higher (Model 2430 must have C-22 or higher) and Metrics-ICS revision 3.5.2 or higher.

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