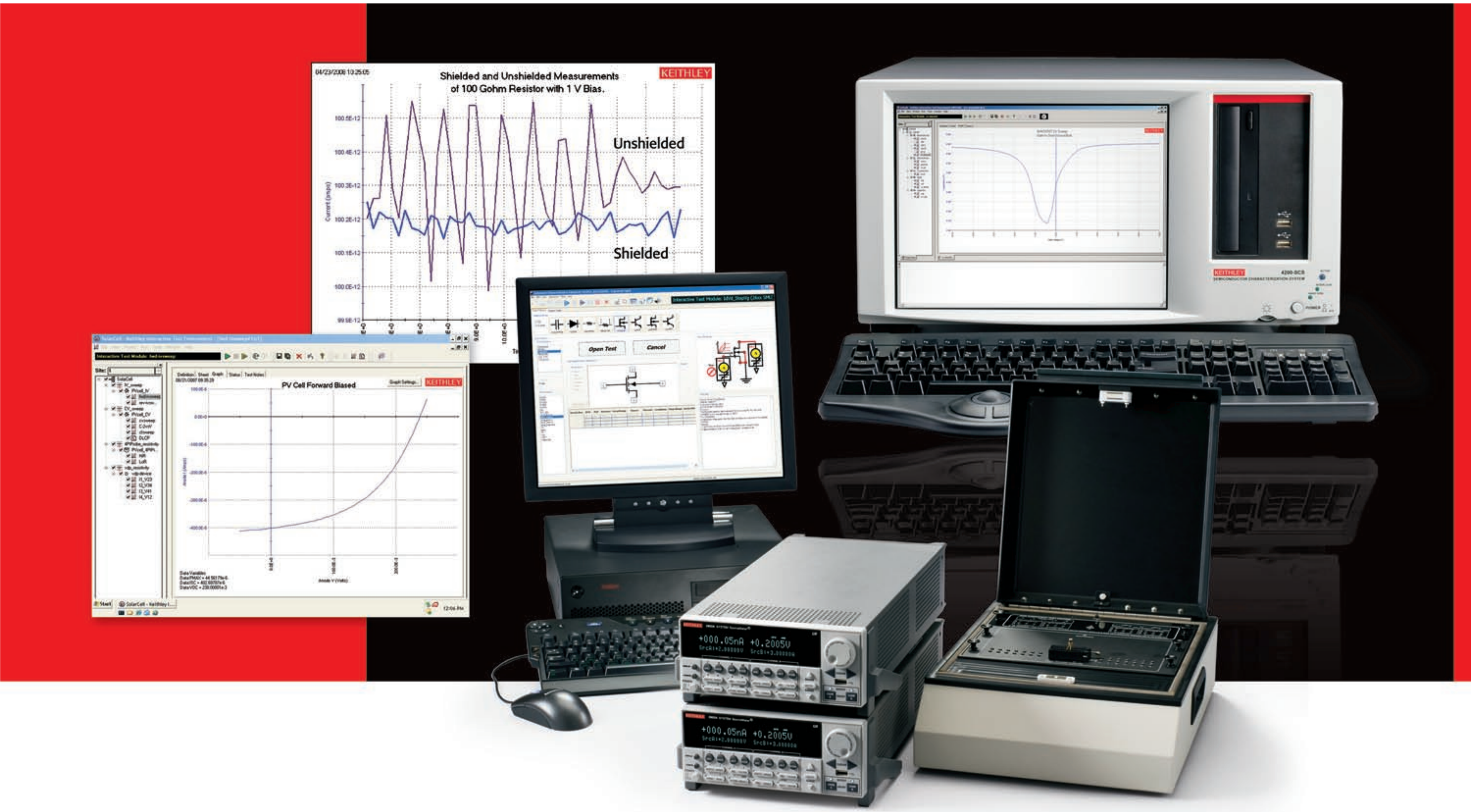
New Test Methods for the R&D Lab

Learn how to solve 2009's toughest electrical measurement problems



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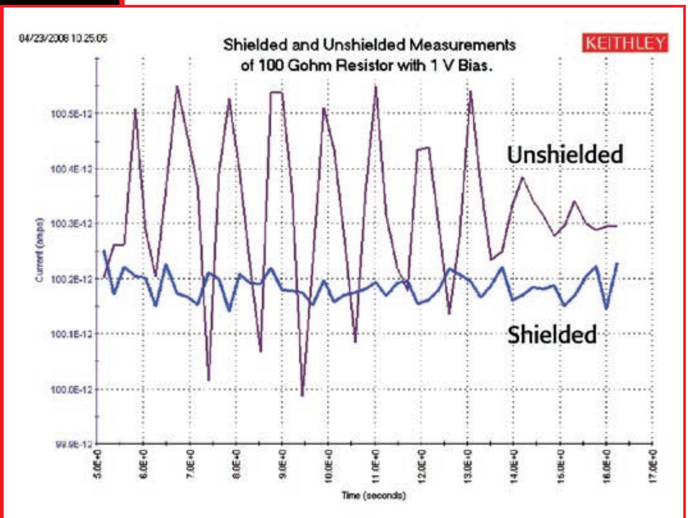
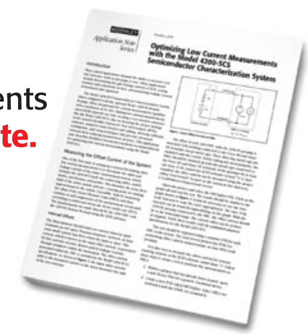
FEATURED APPLICATION

Optimize your low current measurements



Shielded vs. unshielded measurements on a 100GΩ resistor

For applications like determining the gate leakage current of FETs or testing sensitive nanoelectronic devices, you need to measure picoamps of current or less with high accuracy. To make these measurements successfully, you'll not only need a very sensitive ammeter but the knowledge to choose the proper measurement settings, select low noise fixtures and cabling, allow sufficient settling time, and use techniques that prevent unwanted currents from reducing accuracy. ***Learn more.***



Learn how to make better low current measurements faster. **Read our online application note.**

Need advice on your application?

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VIEW THE WEBINAR:
How to Get the Most from Your Low Current Measurement Instruments

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Simplify your low current measurements

WITH THE MODEL 4200-SCS

DOWNLOAD TECHNICAL DATA BOOK

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The **Model 4200-SCS Semiconductor Characterization System** delivers best-in-class DC, CV, and pulse device characterization, real-time plotting, and analysis with high precision and sub-femtoamp resolution. Its self-documenting, point-and-click interface speeds and simplifies taking data, so you can start analyzing your results sooner.

- Remote preamps extend current measurement resolution to 0.1fA.
- High speed, high precision A/D converter for each DC channel eliminates measurement tradeoffs.

Need more details about the Model 4200-SCS?
Download the **Model 4200-SCS Semiconductor Characterization System Technical Data Book**

Ready to request a quote or place an order?

Call 1-800-492-1955 and

- **Press 1** to place an order, or email **orders@keithley.com**
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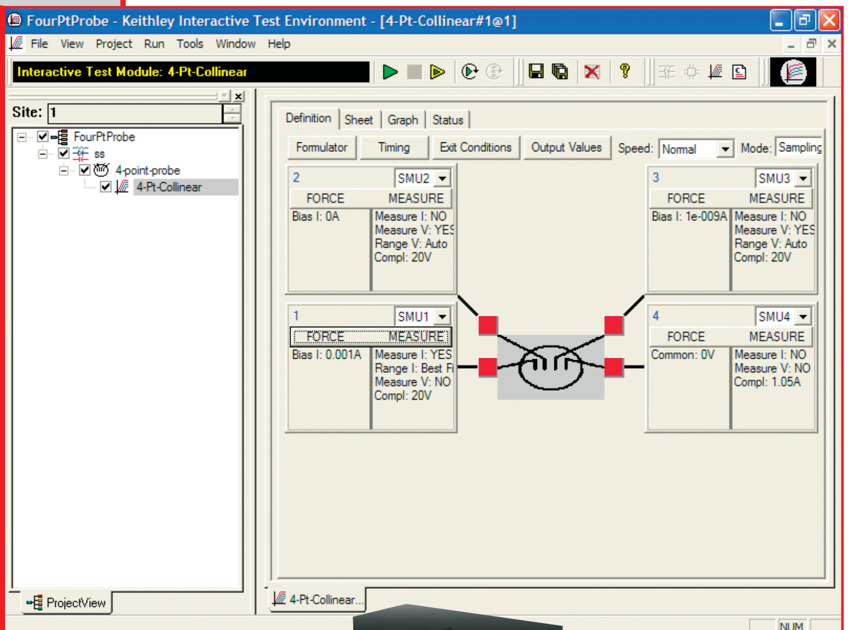
MODEL 4200-SCS CURRENT MEASUREMENT PERFORMANCE WITH OPTIONAL REMOTE PREAMPS

CURRENT RANGE	MAX VOLTAGE	MEASURE	
		RESOLUTION	ACCURACY
10 nA	210 V	10 fA	0.050 % + 1 pA
1 nA	210 V	3 fA	0.050 % + 100 fA
100 pA	210 V	1 fA	0.100 % + 30 fA
10 pA	210 V	0.3 fA	0.500% + 15 fA
1 pA	210 V	100 aA	1.000% + 10 fA

FEATURED APPLICATION

Characterize your sample's resistivity and Hall voltage



The resistivity of semiconductor devices can affect their capacitance, series resistance, and threshold voltage. For materials testing, you may want to use a four-point probe technique to determine resistivity because it eliminates measurement errors due to the probe resistance, the spreading resistance under each probe, and the contact resistance between each metal probe and the semiconductor material. ***Learn more.***

Four-point probe project for resistivity measurements

Discover how to use Hall voltage measurements to derive a sample's conductivity type, carrier density, and Hall mobility – **view our free online application note** now.

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VIEW THE WEBINAR: Hall Effect Measurements Fundamentals

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Improve the accuracy of your resistivity measurements

WITH THE MODEL 4200-SCS

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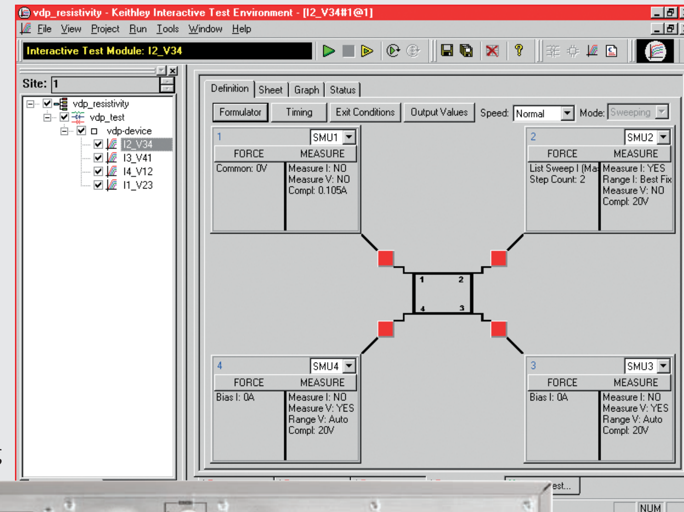
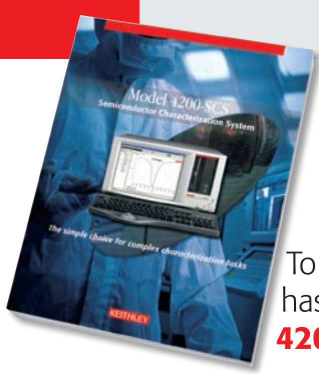
The **Model 4200-SCS** supports both the four-point collinear probe method and the van der Pauw method of determining resistivity. Its high input impedance ($>10^{16}\Omega$), accurate low current sourcing, and optional remote preamps make it ideal for characterizing high resistance samples.

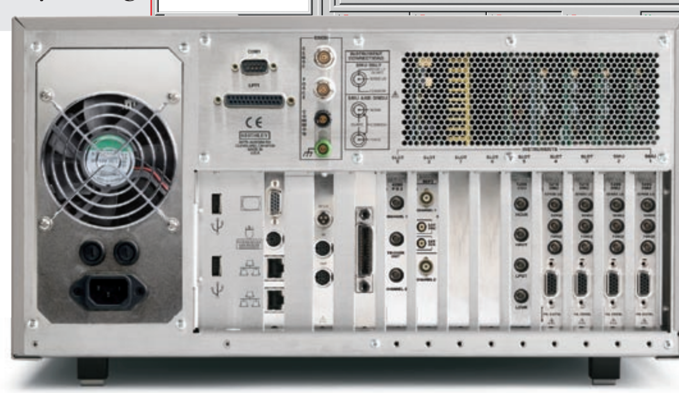
- Supports measuring resistances $>10^{12}\Omega$
- No external switching required, eliminating leakage and offsets errors due to mechanical switches
- No external instruments required



Built-in support for van der Pauw resistivity testing



Model 4200-SCS systems can be configured with up to nine Source-Measure Units (SMUs), in any combination of medium- and high-power versions.



To find out what your old parameter analyzer has been missing, **download the Model 4200-SCS brochure**

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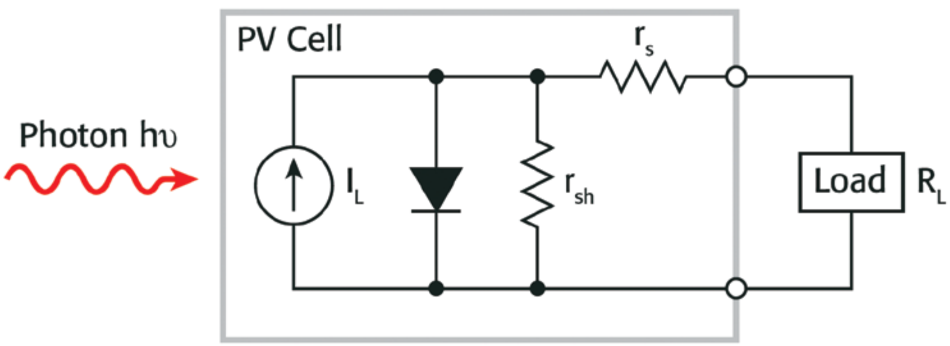
	MAX. VOLTAGE	MAX. CURRENT	MAX. POWER
4200-SMU Medium Power	210 V	100 mA	2 W
4210-SMU High Power	210 V	1 A	20 W

FEATURED APPLICATION

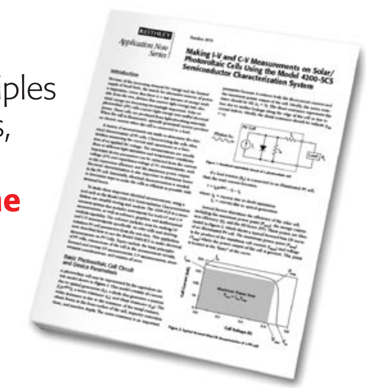
Enhance solar/photovoltaic cell efficiency with I-V and C-V testing



Idealized equivalent circuit of a photovoltaic cell

To characterize solar/PV cells, you may need to measure current and capacitance as a function of an applied DC voltage at various light intensities and temperature conditions. Important device parameters such as conversion efficiency and maximum power output can be extracted from current-voltage (I-V) and capacitance-voltage (C-V) measurements, as well as information on losses in the PV cell. ***Learn more.***

Learn about the basic principles of PV cells, test connections, and sources of error.
Download our free online application note



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VIEW THE WEBINAR:
Photovoltaic Measurements: Testing the Electrical Properties of Today's Solar Cells

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Optimize the efficiency of your solar cells

WITH THE MODEL 4200-SCS

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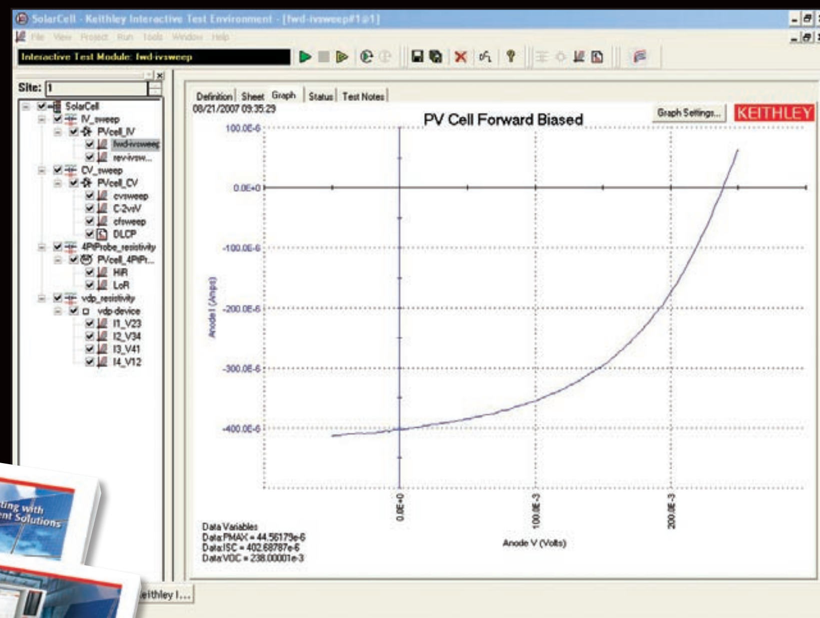
Nine new test libraries expand the Model 4200-SCS's capabilities for solar cell I-V, C-V, and resistivity testing applications. They are applicable to the most popular solar cell technologies, including mono-crystalline, poly-crystalline, amorphous, copper indium gallium selenide (CIGS), cadmium telluride (CdTe), and polymer organic technologies.



To learn more about the latest enhancements to our solar/PV cell testing capabilities, **download our new brochures:**

- **KTEI V7.2 -** Expand Your SPA Applications and Your Chassis
- **Simplify your Solar Cell Testing** with Keithley's Precision Measurement Solutions

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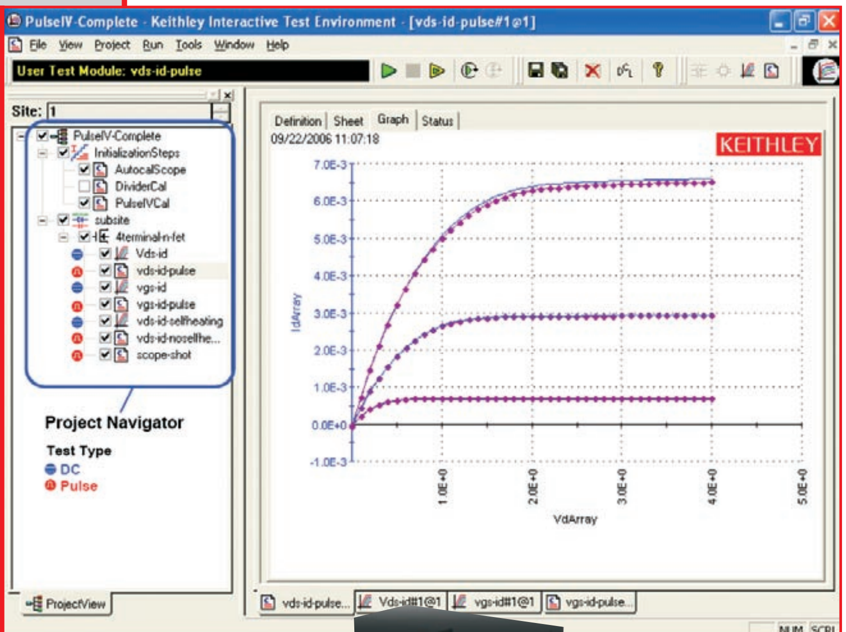
SOLAR/PV CELL PARAMETERS PROVIDED:

- Short-circuit current (I_{SC})
- Open-circuit voltage (V_{oc})
- Maximum power output (P_{max})
- Fill Factor (ff)
- Voltage at maximum power measured at angle of incidence (V_{mp})
- Current at maximum power measured at angle of incidence (I_{mp})
- R_{shunt}
- R_{series}
- Resistivity
- Defect density
- Doping density

FEATURED APPLICATION

Take the pulse of your semi devices



Using pulsed rather than DC signals to characterize devices allows you to eliminate or study the effects of device self-heating (joule heating). Pulse I-V testing also supports time-domain studies, such as transient charge trapping in the device under test (DUT). ***Learn more.***

Support for pulse I-V testing of both nMOS and pMOS devices

Discover how to make common parametric transistor tests like V_{DS}-I_D and V_{GS}-I_D more efficiently. **Read our free online application note.**

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VIEW THE WEBINAR:
Pulsed Characterization of Advanced CMOS Technologies

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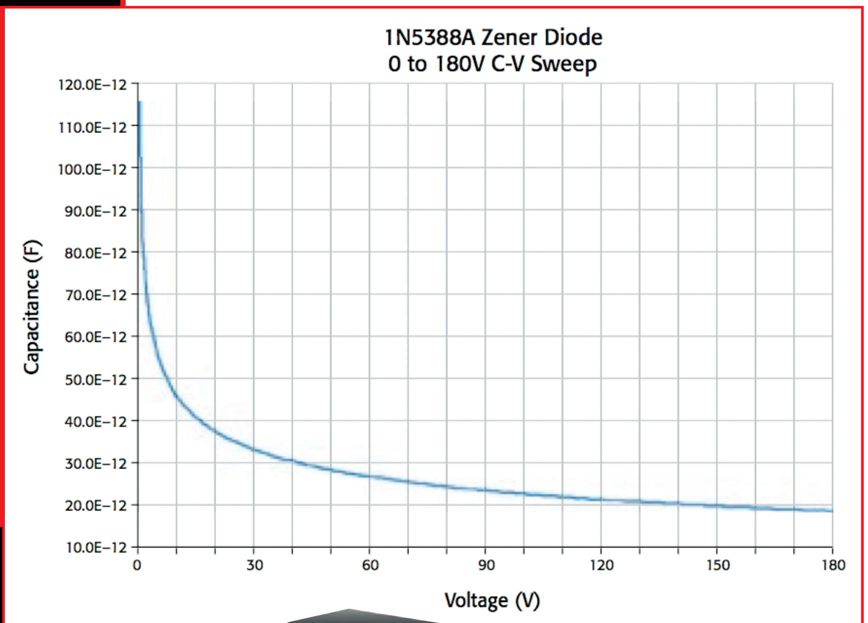
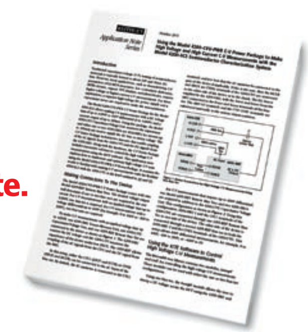
FEATURED APPLICATION

Characterize C-V parameters as easily as I-V parameters



C-V testing is commonly used to determine semiconductor parameters such as doping profiles, density of interface states, threshold voltages, oxide charge, and carrier lifetime. Traditional capacitance-voltage (C-V) testing of semiconductor materials is typically limited to about 30V and 10mA DC bias. However, many applications, such as characterizing C-V parameters of LD MOS structures, low κ interlayer dielectrics, MEMs devices, organic TFT displays, and photodiodes, require higher voltage or higher current C-V measurements. ***Learn more.***

Results of C-V Sweep of zener diode



Discover how to make higher voltage or higher current C-V measurements — **read our free online application note.**

Need advice on your application?

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VIEW THE WEBINAR: Semiconductor Capacitance-Voltage (C-V) Testing Fundamentals

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Make C-V measurements as easy as I-V

WITH THE MODEL 4200-SCS

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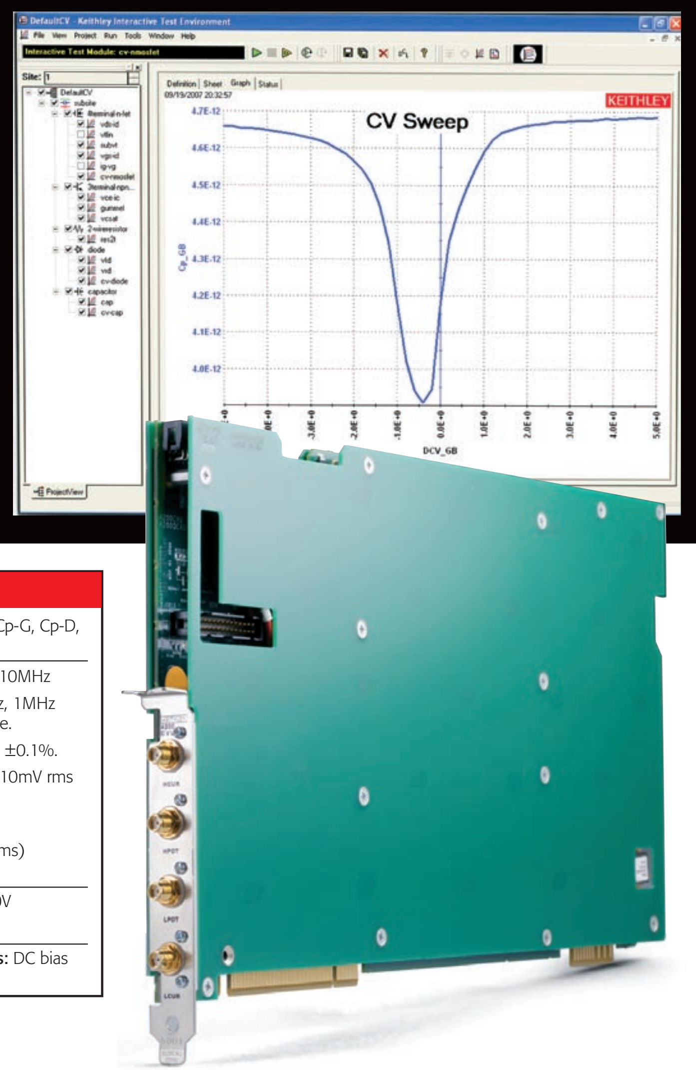
The **Model 4210-CVU** option for the Model 4200-SCS makes C-V tests as easy to set up and run as I-V tests. A variety of sample tests, including tests for MOSCAPs, MOSFETs, and Mobile Ion characterization are bundled in, as well as common parameter extractions like oxide thickness, doping density, depletion depth, and flatband voltage.

- Plugs directly into one of the Model 4200-SCS option slots, so it can be controlled through the system's point-and-click interface, thereby enabling users of any level of experience to make C-V measurements as if they were experts.
- New C-V Power Package hardware option allows making high power C-V measurements at up to 400V (200V per device terminal).



4210-CVU SPECIFICATIONS

Measurement Functions:	**Measurement Parameters:** Cp-G, Cp-D, Cs-Rs, Cs-D, R-jX, Z-theta.
Test Signal:	**Frequency Range:** 10kHz to 10MHz **Minimum Resolution:** 10kHz, 1MHz depending on frequency range. **Source Frequency Accuracy:** ±0.1%. **Signal Output Level Range:** 10mV rms to 100mV rms. **Resolution:** 1mV rms. **Accuracy:** ±(10.0% + 1mV rms) unloaded (at rear panel).
DC Bias Function:	**DC Voltage Bias Range:** ±30V **Resolution:** 1.0mV.
Sweep Characteristics:	**Available Sweep Parameters:** DC bias voltage, frequency.

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Speed and simplify your component test, verification, and analysis applications with ACS Basic Edition

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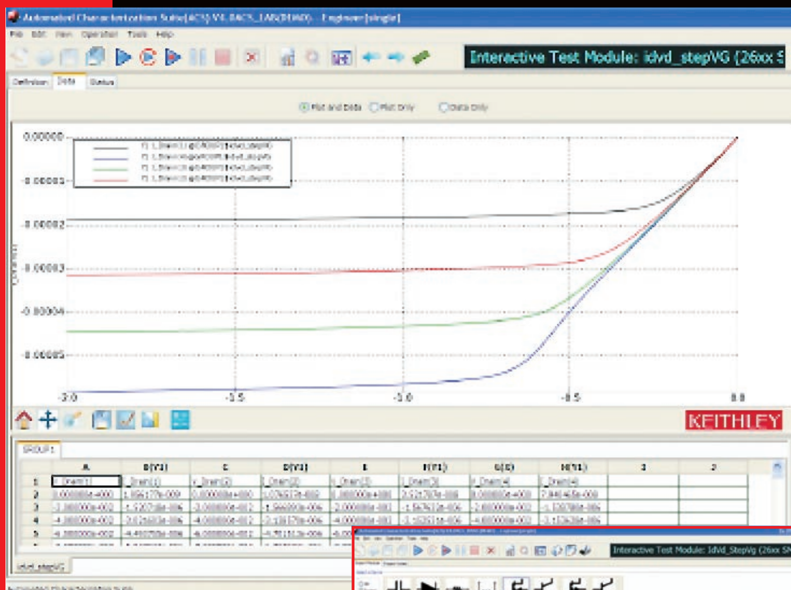
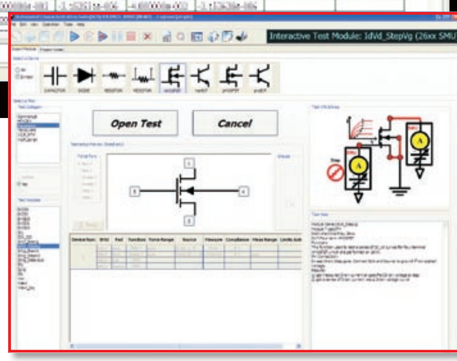


Much like a traditional analog curve tracer, **ACS Basic Edition** can generate a family of curves on a packaged part quickly but also offers the flexibility to save, compare, and correlate results easily.



Conduct I-V testing of solar cells with ACS Basic Edition Software

ACS Basic Edition maximizes the productivity of technicians and engineers responsible for packaged part characterization. When paired with one or more source-measure instruments such as Keithley's Series 2600A System SourceMeter® instruments, ACS Basic Edition software delivers high precision, cost-effective solutions for component test.

- **No coding needed —** ACS's intuitive GUI simplifies getting I-V tests, analysis, and results quickly.
- **Hardware flexibility —** Add or remove instruments dynamically to meet individual test needs.
- **Fast time to first measurements —** Simple installation, intuitive test selection wizard, and built-in tests.
- **Applications flexibility —** All the tools needed to characterize the operational parameters of a broad range of devices, including solar cells.

Learn more.

ACS Basic can fully characterize the operational parameters of a solar cell. **View our our online demonstration.**

Need advice on your application?

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- **Call 1-800-492-1955 and press 3 to speak to an applications engineer**

Replace your obsolete curve tracer with Series 2600A System SourceMeter instruments and ACS Basic Edition

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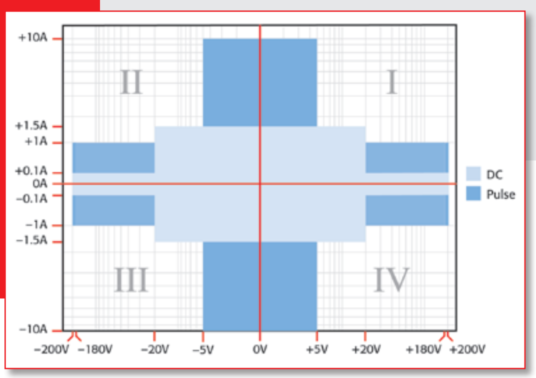
Series 2600A System SourceMeter® instruments are the perfect companions for ACS Basic Edition software. These instruments offer:

- 4-quadrant design that provides both source and sink capability for complete I-V characterization.
- All-in-one solution for I-V characterization with the combined functionality of a precision power supply, high precision DMM, and electronic load.



Source and measure capabilities of the Models 2611A, 2612A, 2635A, and 2636A

Learn more about how our latest instruments can optimize a variety of component characterization applications — **download the Series 2600A datasheet.**

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VIEW THE ONLINE DEMO:
Curve Tracing with ACS Basic Software and Keithley SourceMeter Instruments

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Better cabling means lower semiconductor test cost

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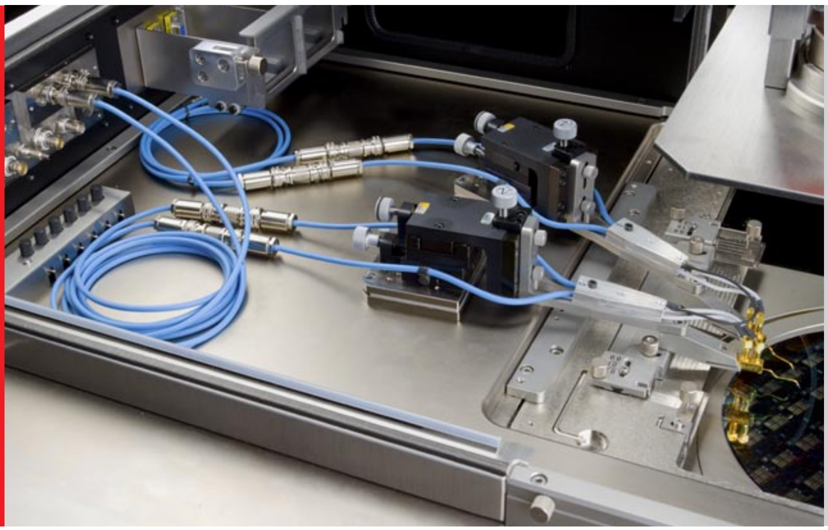
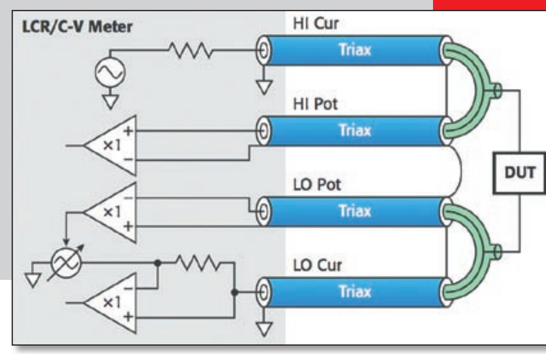


Until recently, the need for differing cable types has complicated integrating DC I-V, C-V, and pulse testing in a single semiconductor characterization system. That's made it impossible for test labs like yours to take full advantage of all the time and cost savings that an integrated system can offer. Now, Keithley can help you realize your system's full potential with a single triaxial cable solution that works for all three test types.



Connections between a DUT and an LCR/C-V meter

Keithley's high performance triaxial cable kits are ideal for anyone whose characterization requirements demand frequent switching between measurement types. The cables are designed for compatibility with Keithley's Model 4200-SCS Semiconductor Characterization System, as well as with other test instruments used for characterization. These new cable kits eliminate the need for recabling when switching between measurement types; they also eliminate the measurement errors that often result from cabling errors. Two versions of the cable kit are available – the **Model 4210-MMPC-C** is optimized for use with Cascade Microtech probers and the **Model 4210-MMPC-S** for SUSS MicroTec probers.

Learn more about the cabling requirements for multiple test types – **download our Cabling Systems Capable of Accommodating Multiple Measurement Types** white paper.

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