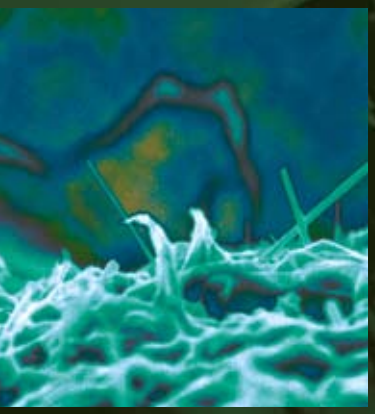
Model 4200-SCS

Semiconductor Characterization System

The simple choice for complex characterization tasks

KEITHLEY

A GREATER MEASURE OF CONFIDENCE



The Model 4200-SCS

IS THE BEST, MOST COST-EFFECTIVE SOLUTION

FOR A GROWING LIST OF APPLICATIONS

- Semiconductor technology development
- Semiconductor process integration
- Incoming inspection
- Failure analysis
- Device reliability and lifetime testing
- Nanotechnology research
- High and low κ dielectrics
- Organic LEDs
- Hall Effect and Van der Pauw testing
- Semiconductor device modeling
- RFIC, high power MOSFET/BJT

Familiar Windows® Interface

No training, no floppies

Single click test sequencing

No programming

Configurable, scalable, upgradable

Works now, grows later, protects your investment

Sub-femtoamp noise

See more, faster

DC and pulse testing in a single system...

one environment, expanded capabilities

Visit **www.keithley.com** to request a free copy of Keithley's newest reference book, ***Overcoming the Measurement Challenges of Advanced Semiconductor Technologies: DC, Pulse, and RF–From Modeling to Manufacturing.***

A COMPLETE, INTEGRATED SOLUTION

ALL FROM ONE VENDOR

Integrated industrial controller and additional RAM ensure high test throughput, plus system robustness, stability, and security.

Industry-standard Windows-based GUI minimizes set-up and integration time.

High speed, high precision ADC per channel eliminates performance tradeoffs.

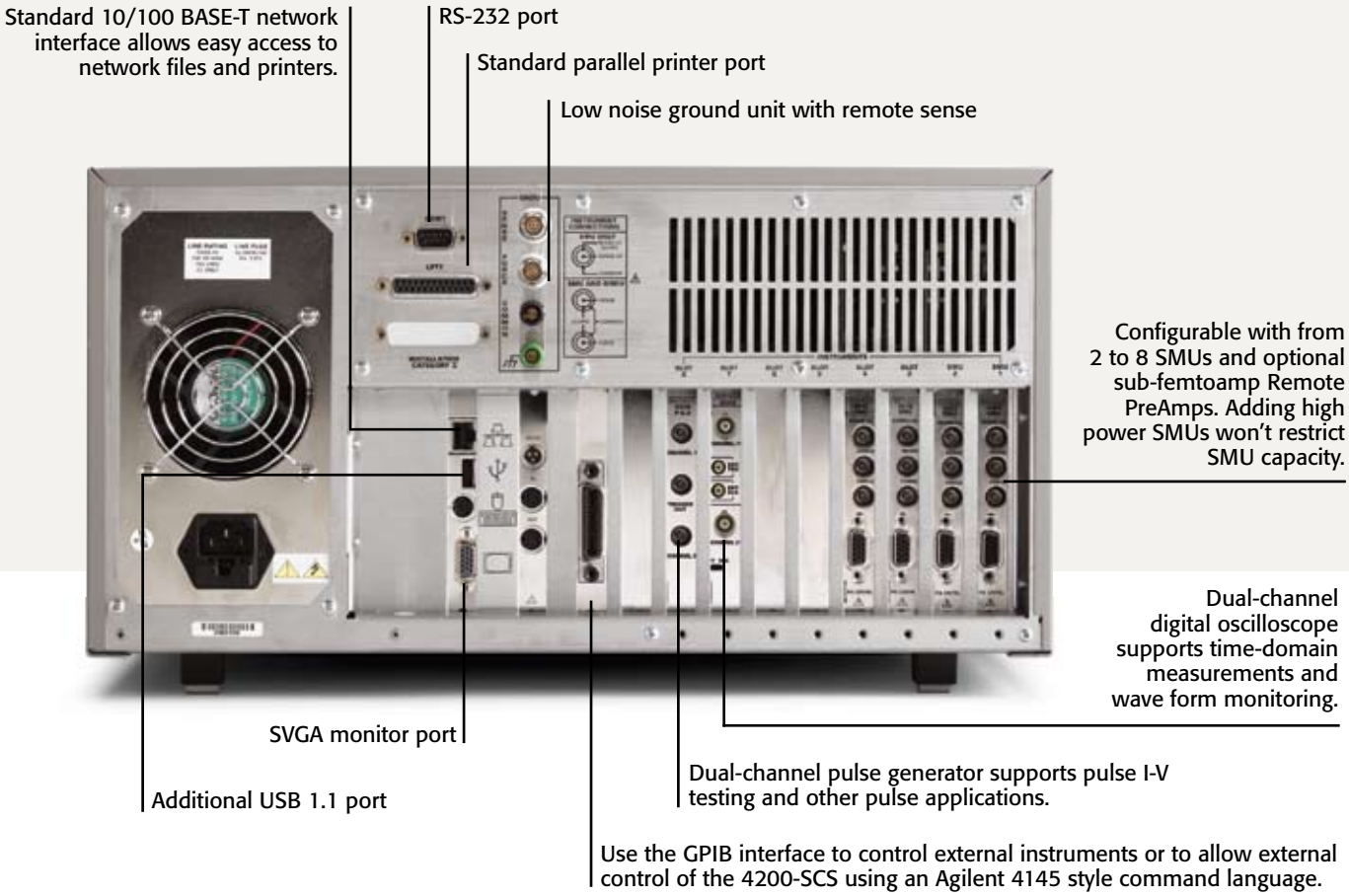
Store test setups and results right on the system with the high capacity fixed disk drive. No sorting through floppy disks to find the desired test.

The integrated CD-RW drive allows high capacity backup and data transfer.

Communicate quickly with a wide range of PC accessories with the built-in USB interface.

KEITHLEY INTERACTIVE TEST ENVIRONMENT (KITE)

- Even infrequent users can begin testing productively right away, without programming assistance, for a lower cost of test and faster ROI.
- The flexible user interface makes it easy to change parameters on the fly and test devices interactively with just a mouse click.
- The optional Pulse I-V bundle, complete with dual-channel pulse generation and dual-channel digital oscilloscope for time-domain measurements, expands the Model 4200-SCS's applications for leading-edge device and materials development, reliability, modeling, and failure analysis labs.
- Easy transition from the Agilent 4145/56. Work more productively by acquiring data, analyzing plots, and printing reports simultaneously.
- Export test settings, data, and plots to .xls, delimited text, .bmp, .jpg, or .tif file formats.
- Sample tests and projects for a variety of applications are included to simplify startup.
- Powerful stress-measure capabilities make reliability testing easier.
- Factory-supplied drivers for capacitance meters, switch matrices, pulse generators, and a variety of probers simplify building configurations for specialized applications.
- Optional drivers for leading modeling software packages let the Model 4200-SCS fit into any lab's test environment.



KEY DC SPECIFICATIONS

SMU measurement range	Voltage Current	1µV/200V 0.1fA/1A
SMU measurement resolution	Voltage Current	1µV 0.1fA
SMU measurement accuracy	Voltage Current	100µV 10fA
VMU mode	Resolution Accuracy	1µV 80µV
Ground unit max. current	Triax Binding post	2.6A 4.4A

KEY AC SPECIFICATIONS

Minimum pulse width of dual-channel pulse generator:	10ns (20ns period)
Maximum voltage of dual-channel pulse generator:	±20V into 50Ω
Dual-channel digital oscilloscope sample rate:	1.25 gigasamples/sec/channel
Bandwidth (50Ω):	DC to 1GHz
Measurement resolution:	8-bit A/D

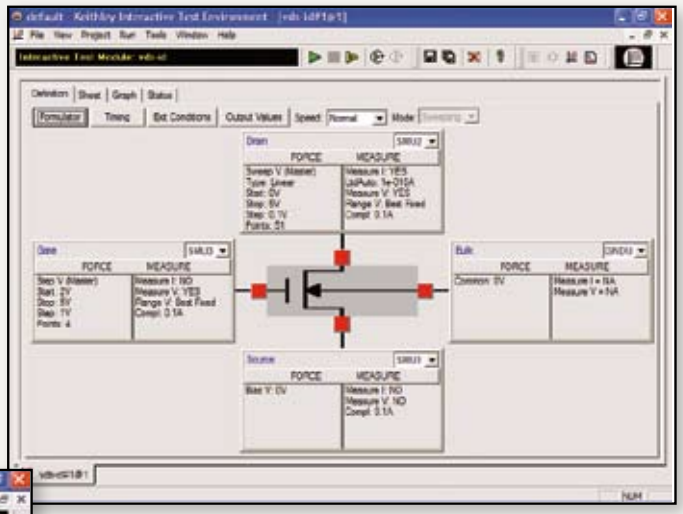
For more details on the Model 4200-SCS and Version 6.0 of the Keithley Test Environment Interactive (KTEI), download the Model 4200-SCS Technical Data Booklet at www.keithley.com.

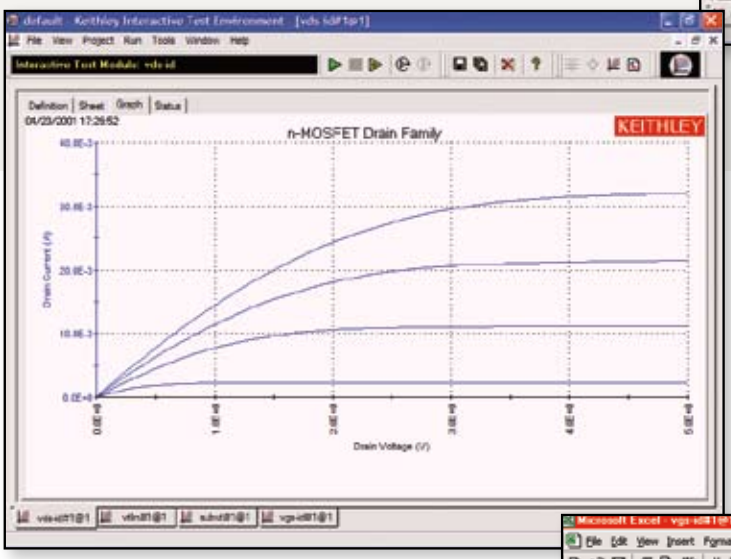
INTUITIVE INTERFACE

SIMPLIFIES DEVICE AND MATERIAL CHARACTERIZATION AND ANALYSIS

1

Define a test starting from the library of supplied setups.



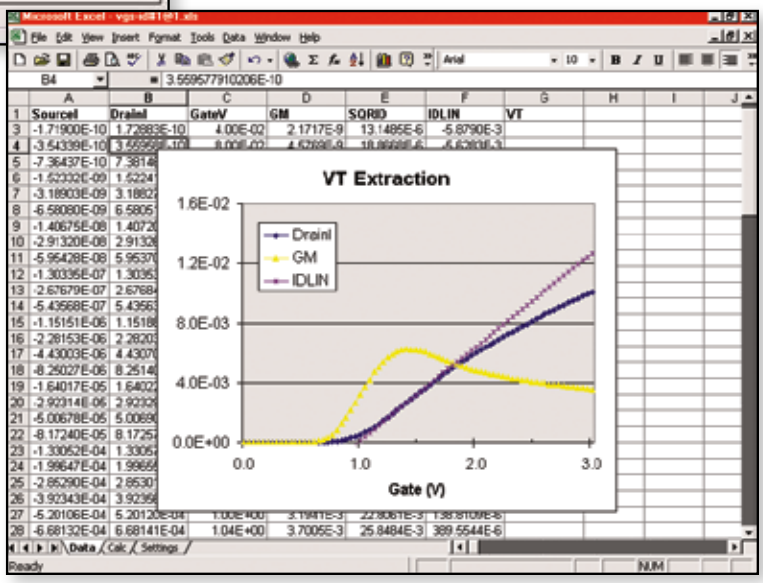


2

Click the on-screen Run button to start the test and view a real-time plot.

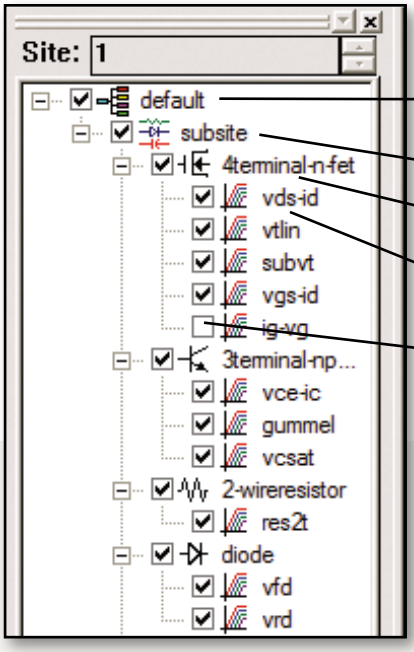
3

Export data in Excel workbook or ASCII formats and plots in bitmap, .jpg, or .tif formats for either online or offline analysis. Built-in Formulator, graphing, and calc sheet functions simplify complex analyses.



AUTOMATED TEST SEQUENCES WITHOUT WRITING CODE

The Project Navigator organizes tests and controls test sequencing. Switching between different test setups and accessing test results is fast and simple. Sequence tests on a single device by clicking on the device in the Navigator, then clicking the Run button.



KITE operates on projects using an interface called the Project Navigator. The Project Navigator organizes tests into a logical hierarchy that parallels the physical layout of the devices on a wafer.

The project level organizes subsites and controls test sequencing for a single wafer.

The subsite level organizes devices and controls subsite test sequencing.

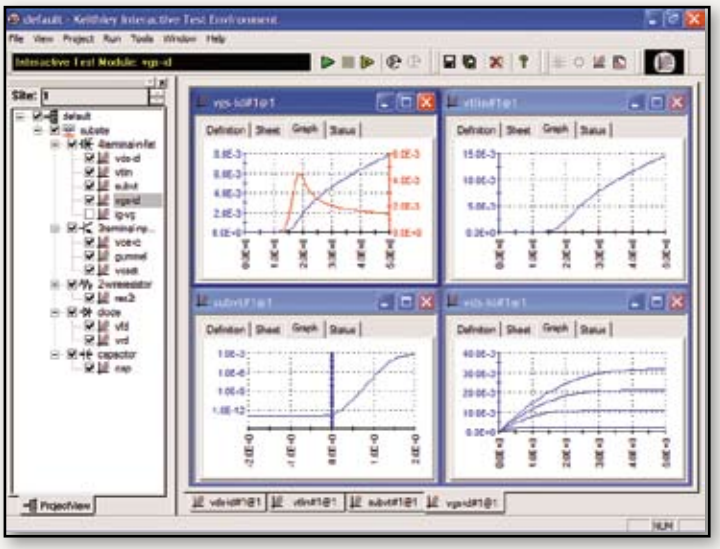
The device level organizes test modules, manages test module libraries, and controls device test sequencing.

The test module level performs tests, analyzes data, and plots results.

Test select/deselect checkboxes allow modifying existing test sequences quickly and easily.

New capabilities added in KTEI 6.0 include:

- Optional PC version: Supports off-line test development and data analysis.
- Pulse SMU mode: Set SMU pulse on-times as short as 5ms for slow pulse I-V tests, clocking, etc.
- Dual sweep function: Force a SMU to sweep forward and back with the click of a checkbox. Useful for hysteresis testing.
- Programmable SMU power-up order and delay: Controls logic chip startups to prevent (or test) latch-up and other power supply considerations.
- Standby mode: Useful for preventing relaxation between tests or for serving as a DC power supply.

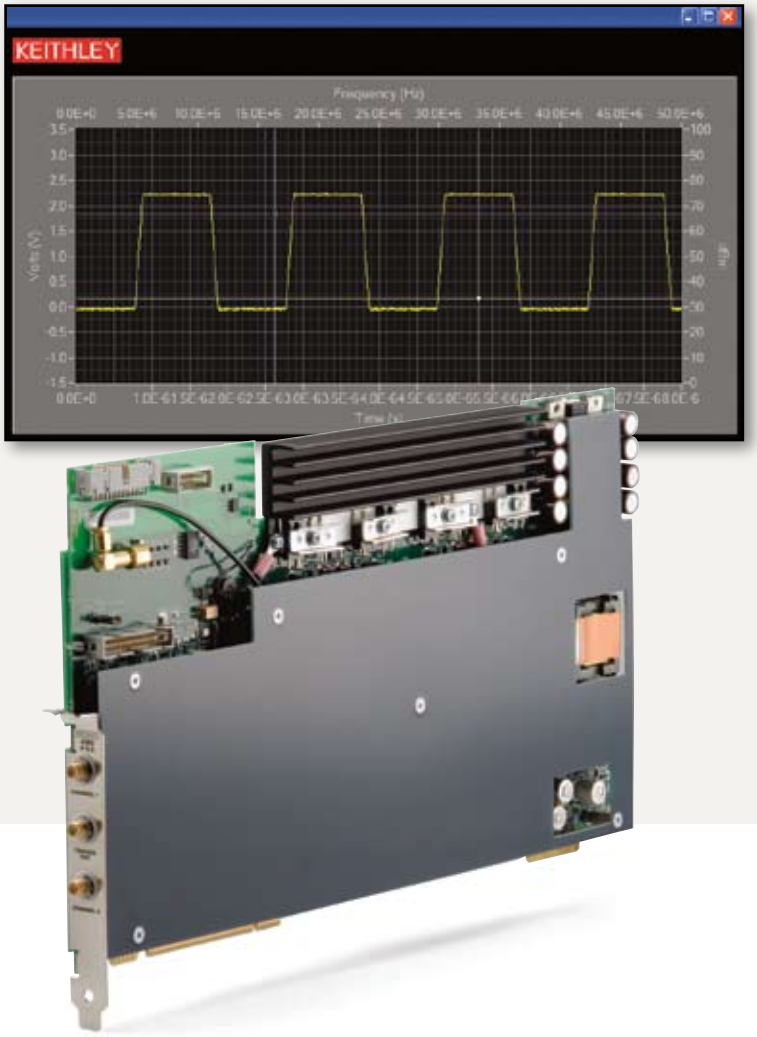


The Keithley Interactive Test Environment is designed to let users understand device behavior quickly. When running a test sequence, users can view results and plots for completed tests while the sequence is still running. As shown here, multiple plots can be viewed at the same time to get a complete picture of device performance.

For additional information, the latest enhancements to this system, visit www.keithley.com to download a copy of the data sheet on the pulse and pulse I-V options for the Model 4200-SCS.

New semiconductor materials, shrinking device dimensions, and higher operating speeds are making characterization more challenging than ever—new measurement techniques will be needed in addition to DC characterization to deliver the data these new technologies demand. Pulse I-V testing offers a new approach to these testing challenges. High speed voltage pulses allow characterizing these materials and devices without the problems of self-heating, which can affect device response and skew test results.

The latest version of KTE Interactive (Ver. 6.0) provides software support for two new instruments—a dual-channel pulse generator card that plugs into one of the Model 4200-SCS's back panel slots, just like an SMU, and a dual-channel digital oscilloscope for time-domain measurements. Together, these new instruments make it simple and cost-effective to integrate pulsing and signal observation capabilities into the Model 4200-SCS's test environment. Now, the same parametric analysis workstation that lab users have come to depend on for DC characterization can also handle pulsed testing applications like charge pumping, AC stress testing, clock generation, and mixed signal device testing.

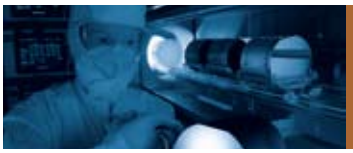


Dual-channel pulse generator

The Model 4200-SCS's intuitive interface makes it easy to control pulse sourcing and measurement. Although the dual-channel pulse generator has a wide range of uses, typical applications include charge pumping to characterize interface state densities in MOSFET devices and using stress pulses of varying frequencies to simulate real-world AC signals applied to clocked devices. Two pulse generators on one card gives users the flexibility to apply pulses to two points on a DUT, such as the gate and the drain, simultaneously.

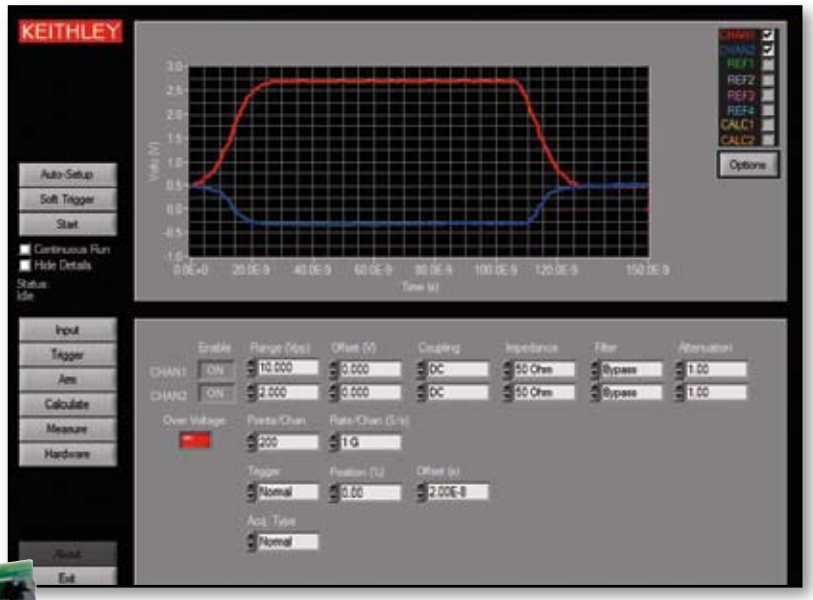
KEY PULSE GENERATOR SPECIFICATIONS

Frequency range:	1Hz–50MHz
Pulse width:	Programmable from 10ns to near DC
Channels:	Dual independent channels
Pulse amplitude range:	Up to 40V p-p into 50Ω, Up to 80V p-p into 1MΩ
Programmable parameters:	Pulse width, duty cycle, rise time, fall time, amplitude, offset



Dual-channel digital oscilloscope

The Model 4200-SCP2 oscilloscope offers both general-purpose scope capabilities and time-domain measurements to complement the pulser's time-domain sourcing. The scope can be programmed for automated measurement and data acquisition or can be used with the stand-alone GUI application provided to perform traditional oscilloscope tasks. The scope provides measurements both in time (frequency, rise/fall time) and voltage domains (amplitude, peak-peak, etc.) These parameters can be applied to the entire captured waveform or to a selected portion of the waveform by setting cursors. Analog scope probes are available as optional accessories.

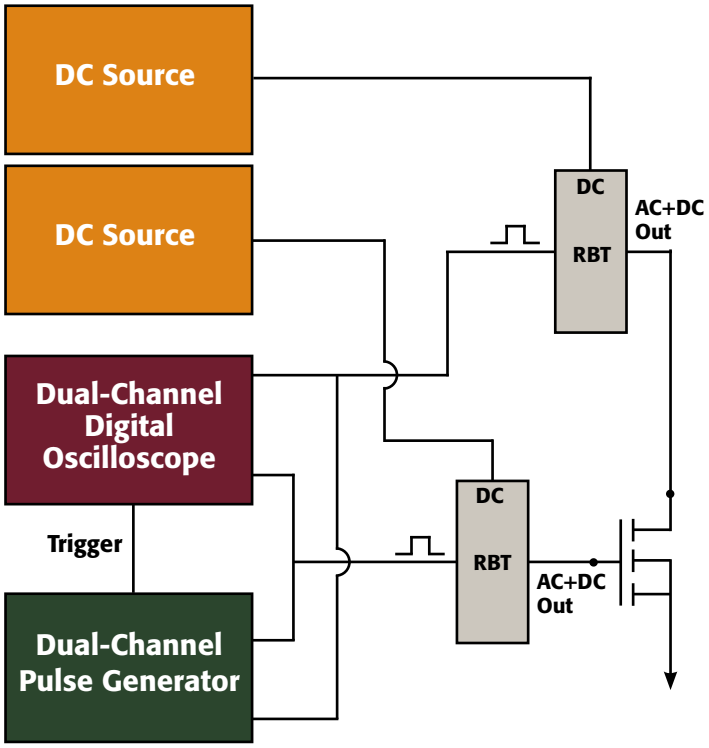


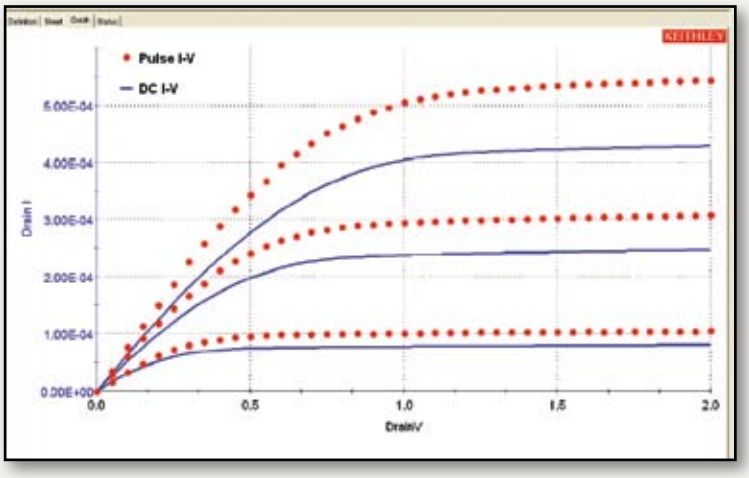
KEY DIGITAL OSCILLOSCOPE SPECIFICATIONS	
Bandwidth (50Ω):	DC to 1GHz
Channels:	2
Maximum sample rate:	1.25 giga-samples per second per channel 2.5 giga-samples per second one channel interleaved
On-board memory buffers:	Up to 1 mega-sample per channel

To learn more about pulse testing, download or request a free copy of this Keithley white paper:
Introducing Pulsing into Reliability Tests for Advanced CMOS Technologies at **www.keithley.com**.

The 4200-PIV option bundle for the Model 4200-SCS includes everything needed to implement a turnkey system for pulsed I-V testing of leading-edge devices and materials:

- Integrated dual-channel pulse generator and GUI for stand-alone control as desired
- Dual-channel digital oscilloscope for time-domain measurements and GUI for stand-alone operation
- PIV control software (patent pending)
- Interconnect fixture designed to minimize the signal reflections common to pulse I-V testing (patent pending)
- All required connectors and cables
- Pulse I-V sample project created for isothermal testing of FinFETs, SOI devices, and power devices
- Charge-trapping sample project created for high κ gate stack characterization

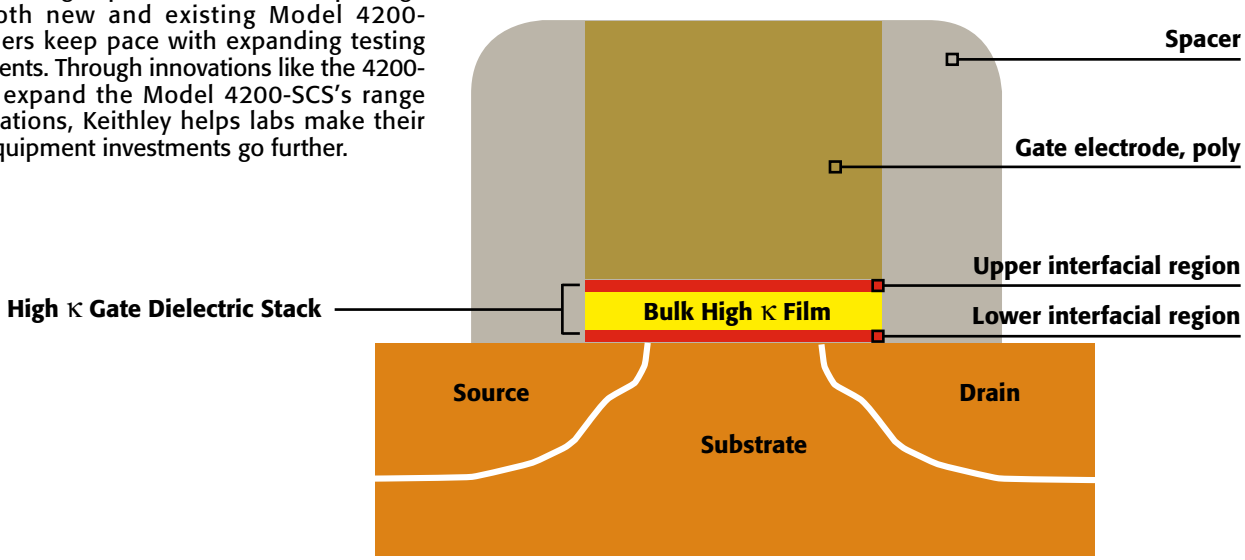




Now, incorporating a pulse I-V characterization system into the lab is no longer a "do-it-yourself" project or a major strain on the capital equipment budget. Keithley's new 4200-PIV bundle is a comprehensive package of hardware and software (including patent-pending cable and load-line compensation utilities), designed to integrate seamlessly with the Model 4200-SCS workstation. It starts with pulse generation and signal monitoring capabilities, then adds all the interconnects and specialized software required to make accurate pulse I-V testing possible. By building on the workstation's high speed architecture and intuitive graphical user interface, the 4200-PIV bundle transforms the Model 4200-SCS into a turnkey solution for an even wider range of pulse testing applications, including charge trapping for high κ dielectric characterization and isothermal testing of devices and materials subject to self-heating effects.

To minimize the signal reflections due to poor impedance matching that often plague custom-built pulse testing systems, Keithley's 4200-PIV bundle includes a system interconnect box (the 4200 Remote Bias-Tee or 'RBT' shown here) that provides AC/DC coupling to connect the pulse generator and the DC instrumentation.

Pulse I-V measurement capabilities are increasingly critical for high κ gate stack characterization and isothermal testing of new devices. Developed in consultation with industry testing experts, the 4200-PIV package helps both new and existing Model 4200-SCS owners keep pace with expanding testing requirements. Through innovations like the 4200-PIV that expand the Model 4200-SCS's range of applications, Keithley helps labs make their capital equipment investments go further.



For more information on how the Model 4200-SCS can simplify high κ reliability testing, request our **FREE** white paper:
Pulsed Characterization of Charge-Trapping Behavior in High κ Gate Stacks at **www.keithley.com**.

CONTROL EXTERNAL INSTRUMENTS QUICKLY AND EASILY

Control external hardware via GPIB with our built-in drivers

Need to incorporate a C-meter, switch matrix, prober, or external pulse generator into your semiconductor characterization system? Just set the GPIB address, install the GPIB cable, and the Model 4200-SCS is ready to start testing. The User Test Modules we supply load external instrument data directly into the system's analysis and graphing tools.

Complete your test configuration with your choice of leading C-V meters

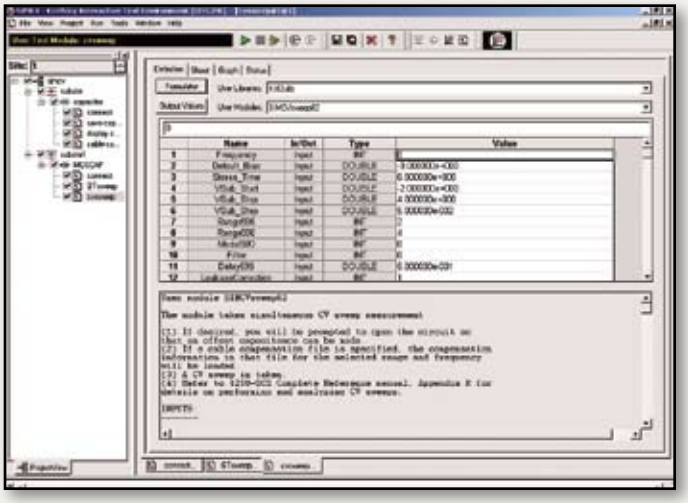
- KITE environment simplifies incorporating popular C-V meters in your setup.
- Drivers for Keithley Models 590 and 595 and Agilent Models 4284 and 4294 are included to make interfacing these instruments easy.

Automate testing and wafer stepping with prober control capabilities

- Control semi-automatic probers from Cascade, Suss, MicroManipulator, and Signatone with the drivers included.
- Use our single-click automation to step easily from die to die and subsite to subsite while running a test sequence and storing all the data.

Extend the 4200-SCS with C language test libraries

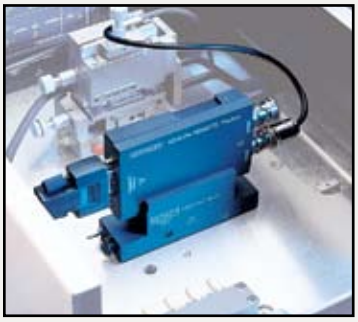
The User Test Module feature in KITE lets the 4200-SCS take on advanced test algorithm requirements with user-written C++ code. These modules give lab users a "fill in the blank" interface to C language subroutines. Everything needed to collect, analyze, and report results is integrated in one application. User Test Modules support viewing and graphing data in real time to monitor test progress. The Keithley User Library Tool (KULT), provided with the 4200-SCS, allows integrating these subroutines easily into a test sequence.

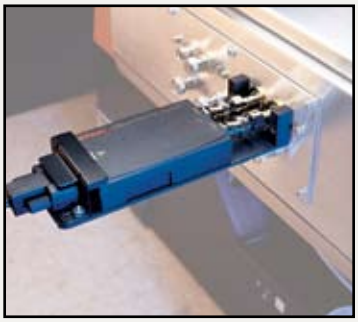


SUPERIOR MEASUREMENTS

PreAmp technology enhances measurement speed and sensitivity

It's easy to connect the Model 4200-SCS to a probe station or a switch matrix with standard triax cables.

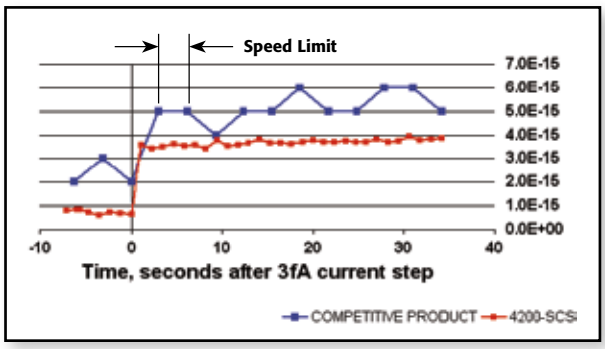




PreAmps can be mounted on the probe station with either a platen base or a triax mounting bracket. By reducing the signal path between the DUT and the PreAmp from several feet to a fraction of an inch, the Model 4200-SCS can eliminate cable effects like parasitic capacitance and leakage currents, for more accurate low-level measurements.

4200-SCS SOURCE-MEASURE UNITS

	Max. Voltage	Max. Current	Max. Power
4200-SMU Medium Power	200V	100mA	2W
4210-SMU High Power	200V	1A	20W

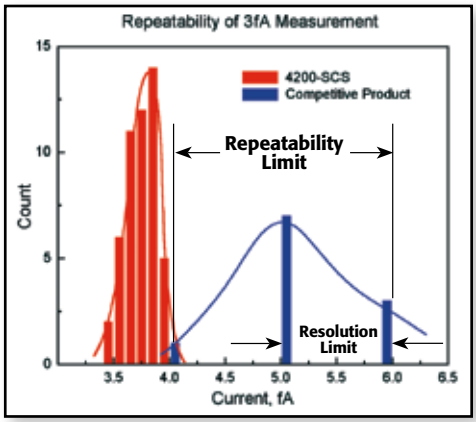


Unlike less flexible competitive solutions, the Model 4200-SCS can be configured with from two to eight Source-Measure Units, available in either medium power or high power designs. While more recent competitors require two slots to hold a single high power module, the Model 4200-SCS can be specified with any combination of eight SMUs, of which up to four can be high power SMUs. Both models provide 100fA resolution for making precise low-level measurements. Optional Remote PreAmps extend the resolution of either SMU to 0.1fA for applications that demand the industry's best low current performance.

LOW CURRENT PERFORMANCE

10×	Better Resolution (0.1fA)
3×	Faster Measurement
4×	Better Repeatability

When configured with an optional Remote PreAmp, the Model 4200-SCS provides faster readings with less noise than competitive characterization technology. The time plot shows the system's superior resolution and speed response to a 3fA current step. The histogram illustrates the greater repeatability of the results from the 4200-SCS after the current step. The 4200-SCS technology lets users see more and see it faster, with better repeatability, than ever before.



For more details on the Model 4200-SCS and Version 6.0 of the Keithley Test Environment Interactive (KTEI), download a **FREE** copy of the **Model 4200-SCS Technical Data Booklet** at **www.keithley.com**.

Characterize new technologies with new pulse source and measure capabilities

The new integrated dual-channel pulse generator, dual-channel digital oscilloscope, and pulse I-V software option expands the system's capabilities for charge pumping and charge trapping for characterizing high κ gate interfaces, AC stress for testing new reliability failure mechanisms, and pulse I-V testing of isothermal materials and devices like SOI devices and FinFETs.

Data acquisition applications in the modeling lab

We've given the Model 4200-SCS the flexibility to interface with Cadence's BSIMProPLUS™ (Virtuoso Device Modeling) package and Agilent's IC-CAP modeling application or Silvaco's UTMOST III SPICE modeling software via the system's built-in GPIB interface. Instrument drivers allow these packages to control the Model 4200-SCS directly, just like any piece of instrumentation linked to the modeling station.

Semiconductor characterization systems applications comparison

By supporting a comprehensive range of characterization applications, the Model 4200-SCS simplifies the buying decision. It combines wide configuration flexibility with industry-leading measurement capabilities, so it makes it unnecessary to sacrifice future expandability to address current testing requirements.

	Model 4200-SCS	Competitor's High Performance System	Competitor's Medium Performance System	Competitor's Modular box + Windows GUI + external PC + GPIB interface
General measurements (failure analysis, device characterization)	■	■	■	■
Nanotechnology research (low current, low voltage)	■	■		
High κ dielectrics (multi-frequency C-V, charge pumping, charge trapping)	■			
Low κ dielectrics	■	■	■	■
Hall Effect and Van der Pauw testing	■			
Copper interconnects (low voltage)	■		■	
RFIC, high power MOSFET/BJT (high power source/measure)	■			■
Device reliability and lifetime testing (AC stress, HCI, NBTI, Q_{BD}, and EM)	■			
Testing devices with isothermal limitations (SOI devices, FinFETs)	■			

INTEGRATED SWITCHING CONTROL

Three different standard switch configurations make it easy to find the best match for the application. Based on Keithley's six-slot Model 707A and single-slot Model 708A switch matrix mainframes, they include all the components, cabling, and instructions needed to assemble the switch matrix and incorporate it into the 4200-SCS test environment. Once the switch is installed, users can connect instrument terminals to output pins in minutes with a simple "fill-in-the-blank" interface in the Keithley Configuration Utility (KCON). No need to remember and program row and column closures—system applications and standard user libraries manage routing test signals from instruments to DUT pins.

STANDARD SWITCH MATRIX CONFIGURATIONS

General Purpose

<100pA
Uses Model 7071 switch card

- Component ATE
- Best match to the 4200-SCS without optional PreAmps
- Excellent for remote sense applications
- Low cost, high density cables
- Expandable from 8×12 to 8×72

Low Current

<1pA
Uses Model 7072 switch card

- Basic device characterization
- Good match to the 4200-SCS with or without optional PreAmps
- Local sense, excellent for C-V meters and pulse generators
- Standard triax cables
- Expandable from 8×12 to 8×72

Ultra Low Current

<100fA
Uses Model 7174A switch card

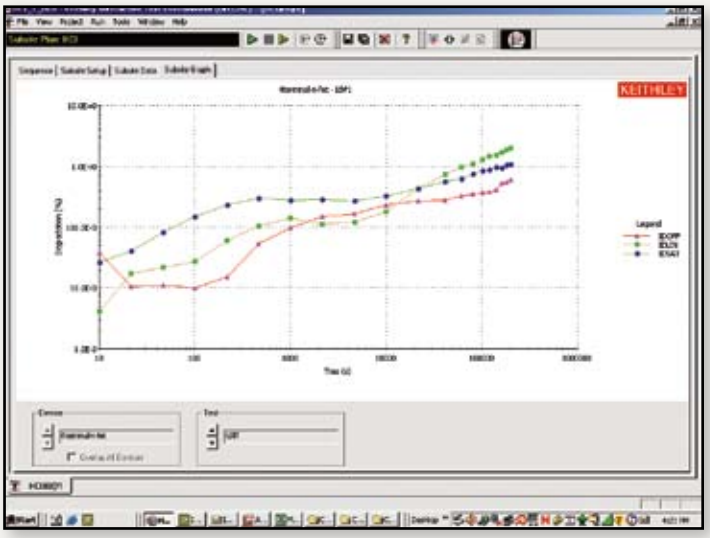
- High performance device characterization
- Best match for the 4200-SCS when equipped with optional PreAmps
- Standard triax cables
- Expandable from 8×12 to 8×72

To learn more about pulse testing, download or request a **FREE** copy of this Keithley white paper:
Introducing Pulsing into Reliability Tests for Advanced CMOS Technologies at **www.keithley.com**.

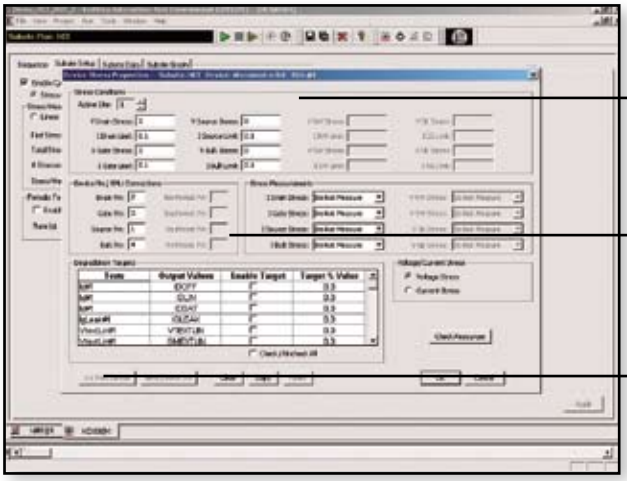
EXPANDED RELIABILITY TESTING CAPABILITIES

Characterize device lifetimes accurately and economically

New stress-measure capabilities make the Model 4200-SCS ideal for both packaged level and wafer level reliability testing applications. The system's sequencer controls the order of stress-measure steps, so any 4200-SCS test can be inserted into the measurement phase. Test sequences are completely user-programmable and can include both standard Interactive Test Modules, like $V_{t\text{-}lin}$, and custom User Test Modules. Multiple tests can be run during each measure step, and switch controls can isolate individual devices that were stressed in parallel. Several JEDEC-compliant sample projects are provided with the system, including projects for standard WLR tests like Hot Carrier Injection or Channel Hot Carrier, Negative Bias Temperature Instability, Charge to Breakdown, and Electromigration. All of these projects are easily customizable to adapt to specific WLR testing requirements.



The pulse testing option (adding a 4200-PG2 pulse generator) supports AC stress testing of new materials, failure mechanisms, and clocked devices, and is controlled through the same point-and-click interface as DC stress is.



KTEI makes it simple to set up the desired stress conditions and patterns graphically.

Define stress voltage or current desired easily.

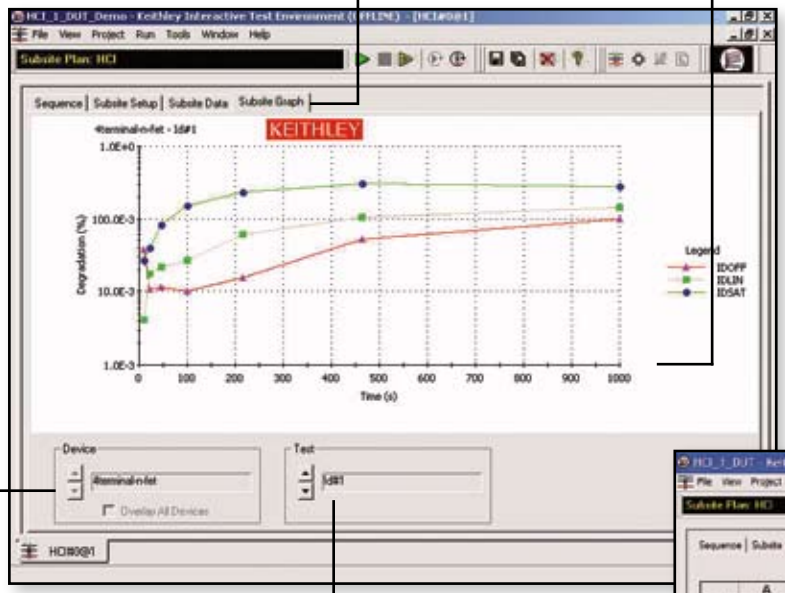
Built-in switch matrix control supports stressing up to 20 devices in parallel.

Set degradation targets and exit tests automatically when the parameter target is reached. Degradation targets can now be set as percentages or actual values (such as 10mV).

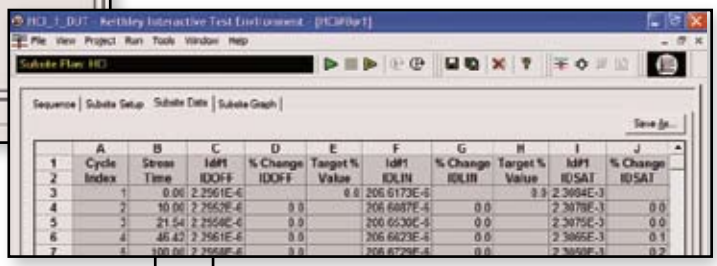
Examine results from multiple devices stressed in parallel.

Get improved graphing capability in the subsite graph for better reporting.

Stress and graph data on a logarithmic or linear time scale.



The subsite data sheet simplifies collecting data from a series of tests, making it easy to track parameters and degradation trends over time. User-programmable parameter degradation targets indicate when devices have failed or degraded sufficiently for the test's needs. Similarly, user-programmable compliance exit conditions can be used to trigger end-of-test. Data from customized reliability test sequences, which may take days or even weeks to complete, is graphed in real time, so it's easy to track the progress of a on-going sequence.



Scroll easily through results from multiple tests.

Tracks cumulative stress time.

Automatically calculates percent degradation.

Additional device characterization solutions

Keithley's free LabTracer 2.0 software can coordinate the measurement and sourcing activities of up to eight **Series 2600 System SourceMeter® instruments** at once, and collect voltage and/or current readings from any of the instruments, as well as a timestamp for each measurement set. This software application offers an alternative method of collecting important device characteristics in a familiar format.

The **Model 4500-MTS Multi-Channel I-V Test System** is a DC source-measure test system optimized for high speed parallel testing. It supports up to 36 source-measure channels while automatically managing complex channel coordination tasks such as inter-channel triggering and communications. It minimizes system complexity by eliminating the need for external trigger control and instrument communications buses.

For more information on how the Model 4200-SCS can simplify high κ reliability testing, request our **FREE** white paper: ***Pulsed Characterization of Charge-Trapping Behavior in High κ Gate Stacks*** at **www.keithley.com**.

PERFORMANCE COMPARISON

			Model 4200-SCS	Competitor's Medium or High Performance System	Competitor's Modular Box + Windows GUI + External PC + 3rd Party GPIB Solution
Measurement Capabilities	Current resolution		0.1fA	10fA or 1fA	10fA
	Maximum current		1A	100mA	1A
	Maximum SMU Configuration	Medium Power SMUs	8 MP	4 MP	8 MP
		High Power SMUs	4 MP + 4 HP	–	0 MP + 4 HP
	Optional Low Noise Remote PreAmp		YES	NO	NO
	Upgradable		YES	NO	YES
	Required self-calibration (ACAL) interval		24 hours	30 minutes	1 hour
	High precision (22-bit) ADC per channel		YES	NO	NO
	Lowest SMU current range/offset		1pA/10fA	1nA/3pA or 10pA/20fA	1nA/3pA
	Lowest SMU voltage range/offset		200mV/80µV	2V/700µV or 2V/200µV	2V/700µV
Data Acquisition and Control	User interface		Windows GUI	Pushbutton	Windows GUI
	View multiple tests simultaneously		YES	NO	YES
	Test sequencing on devices or wafers		Single click	IBASIC programming	Multiple clicks
	Factory-supplied C-V drivers and analysis		YES	NO	YES
	Factory-supplied switch drivers		YES	Sort of. . .	YES
	Factory-supplied prober drivers		YES	NO	YES
	Extendable GUI can support any RS-232 or GPIB device		YES	NO	YES
	Agilent 4145 style command set		YES	YES	NO
	Hardware/GUI architecture		PCI/Windows	Front panel	PC→Windows→USB→GPIB →Proprietary
	Microprocessor/memory per channel		YES	NO	Low resolution only ADCs
Plotting and Reporting	Built-in Excel-style spreadsheet		YES	NO	NO
	Direct .xls file export		YES	NO	NO
	Export graphs to .bmp, .jpg, or .tif		YES	NO	Via PC
Connectivity	Operating system		Windows	Proprietary	Windows on external PC
	CD-RW and high capacity fixed disk for data archiving		YES	NO	Via PC
	Networking		Windows	Limited NFS	Via PC
	Printing		Any Windows driver	Limited HP printer	Via PC
	Portable media		CD-RW & floppy drives	Floppy drive	Via PC
Support	Supplied by a single vendor responsible for all service & support		YES	YES (front panel operation)	NO
	Ongoing software support		KTE Interactive[1]	User-written	IC/V 2.1 Lite[2]
	Supports instrument drivers added by users		YES	NO	NO

1. Backed by a 3-year track record and with an ongoing maintenance and development schedule.
2. Requires hardware key for security, which can be difficult to replace if lost.

CONDENSED SPECIFICATIONS

CURRENT SPECIFICATIONS

	Current Range[1]	Max. Voltage	Measure Resolution[3]	Measure Accuracy ±(% rdg + amps)	Source Resolution[3]	Source Accuracy ±(% rdg + amps)
4210-SMU[2] High Power SMU	1 A	21 V	1 μA	0.100 % + 200 μA	50 μA	0.100 % + 350 μA
	100 mA	210 V	100 nA	0.045 % + 3 μA	5 μA	0.050% + 15 μA
4200-SMU[2] Medium Power SMU	100 mA	21 V	100 nA	0.045 % + 3 μA	5 μA	0.050 % + 15 μA
	10 mA	210 V	10 nA	0.037 % + 300 nA	500 nA	0.042 % + 1.5 μA
	1 mA	210 V	1 nA	0.035 % + 30 nA	50 nA	0.040 % + 150 nA
	100 μA	210 V	100 pA	0.033 % + 3 nA	5 nA	0.038 % + 15 nA
	10 μA	210 V	10 pA	0.050% + 600 pA	500 pA	0.060% + 1.5 nA
	1 μA	210 V	1 pA	0.050% + 100 pA	50 pA	0.060% + 200 pA
	100 nA	210 V	100 fA	0.050% + 30 pA	5 pA	0.060% + 30 pA
4200-SMU and 4210-SMU with optional 4200-PA PreAmp	10 nA	210 V	10 fA	0.050 % + 1 pA	500 fA	0.060 % + 3 pA
	1 nA	210 V	3 fA	0.050 % + 100 fA	50 fA	0.060 % + 300 fA
	100 pA	210 V	1 fA	0.100 % + 30 fA	15 fA	0.100 % + 80 fA
	10 pA	210 V	0.3 fA	0.500% + 15 fA	5 fA	0.500% + 50 fA
	1 pA	210 V	100 aA	1.000% + 10 fA	1.5 fA	1.000% + 40 fA

VOLTAGE COMPLIANCE: Bipolar limits set with a single value between full scale and 10% of selected voltage range.

VOLTAGE SPECIFICATIONS

Voltage Range[1]	Max. Current 4200-SMU	Max. Current 4210-SMU	Measure Resolution[3]	Measure Accuracy ±(% rdg + volts)	Source Resolution[3]	Source Accuracy ±(% rdg + volts)
200 V[4]	10.5 mA	105 mA	200 μV	0.015 % + 3 mV	5 mV	0.02% + 15 mV
20 V	105 mA	1.05 A	20 μV	0.01 % + 1 mV	500 μV	0.02% + 1.5 mV
2 V	105 mA	1.05 A	2 μV	0.012 % + 150 μV	50 μV	0.02% + 300 μV
200 mV	105 mA	1.05 A	1 μV	0.012 % + 100 μV	5 μV	0.02% + 150 μV

CURRENT COMPLIANCE: Bipolar limits set with a single value between full scale and 10% of selected current range.

Additional Specifications

MAX. OUTPUT POWER: 22 watts for 4210-SMU and 2.2 watts for 4200-SMU (both are four-quadrant source/sink operation).

DC FLOATING VOLTAGE: COMMON can be floated ±32 volts from chassis ground.

VOLTAGE MONITOR (SMU in VMU mode):

Voltage Range	Measure Resolution	Measure Accuracy ±(%rdg + volts)
200 V	200 μV	0.015% + 3 mV
20 V	20 μV	0.01% + 1 mV
2 V	2 μV	0.012% + 110 μV
200 mV	1 μV	0.012% + 80 μV

INPUT IMPEDANCE: $>10^{13}\Omega$.

INPUT LEAKAGE CURRENT: <30pA.

MEASUREMENT NOISE: 0.02% of measurement range (rms).

DIFFERENTIAL VOLTAGE MONITOR:

Differential Voltage Monitor is available by measuring with two SMUs in VMU mode, or by using the low sense terminal provided with each SMU.

GROUND UNIT

Voltage error when using the ground unit is included in the 4200-SMU, 4210-SMU, and 4200-PA specifications. No additional errors are introduced when using the ground unit.

OUTPUT TERMINAL CONNECTION: Dual triaxial, 5-way binding post.

MAXIMUM CURRENT: 2.6A using dual triaxial connection; 4.4A using 5-way binding posts.

LOAD CAPACITANCE: No limit.

CABLE RESISTANCE: FORCE ≤1Ω, SENSE ≤10Ω

NOTES

1 All ranges extend to 105% of full scale.

2 Specifications apply on these ranges with or without a 4200-PA.

3 Specified resolution is limited by fundamental noise limits. Measured resolution is 6½ digits on each range. Source resolution is 4½ digits on each range.

4 Interlock must be engaged to use the 200V range.

A greater measure of confidence

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Configuring a system can be confusing. The semiconductor test experts in Keithley's Applications Engineering team are here to help you solve your toughest device characterization challenges, before and after the sale.

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Ongoing system enhancements ensure ongoing ROI

Keithley has continually enhanced the Model 4200-SCS's hardware and software ever since its introduction. This ongoing commitment assures you of a cost-effective system upgrade path to address new testing needs as they arise. That upgrade path ensures you'll never have to buy a new parametric analyzer because your old one is obsolete. The Model 4200-SCS can keep up with the industry's changing test needs—making your capital investment stretch further and improving your ROI.

Download your FREE copies of these white papers at www.keithley.com:

- Introducing Pulsing into Reliability Tests for Advanced CMOS Technologies
- Pulsed Characterization of Charge-Trapping Behavior in High κ Gate Stacks

Call Keithley or visit www.keithley.com to receive your
FREE Model 4200-SCS Technical Data Booklet.

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KEITHLEY INSTRUMENTS, INC. ■ 28775 AURORA ROAD ■ CLEVELAND, OHIO 44139-1891 ■ 440-248-0400 ■ Fax: 440-248-6168 ■ 1-888-KEITHLEY ■ www.keithley.com

BELGIUM
Sint-Pieters-Leeuw
Ph: 32-2363-0040
Fax: 32-2363-0064
www.keithley.nl

CHINA
Beijing
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Fax: 8610-82255018
www.keithley.com.cn

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Hsinchu
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Fax: 886-3-572-9031
www.keithley.com.tw

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