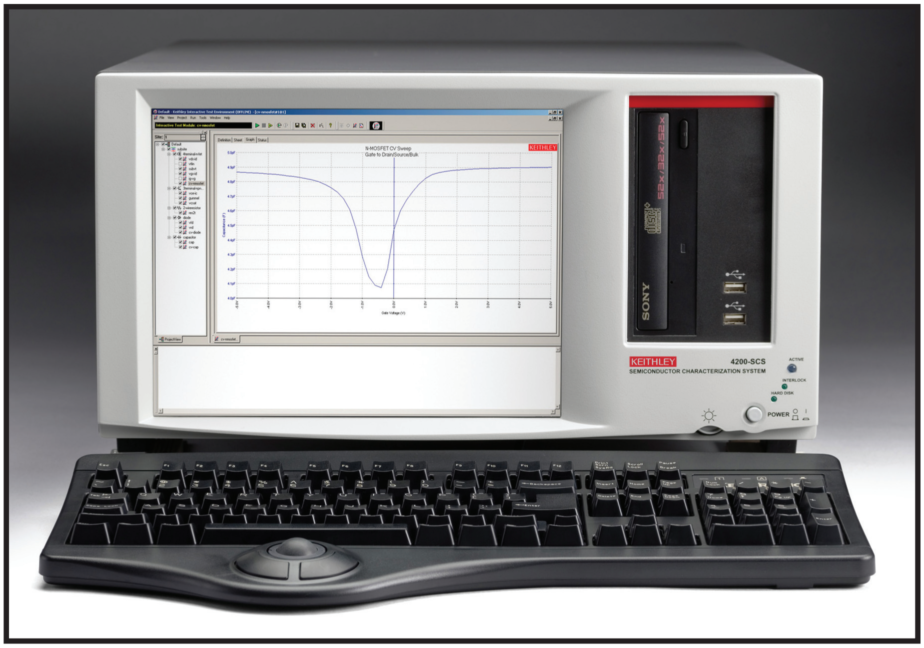
4200-CVU

- **Integrated C-V meter for the 4200-SCS chassis for capacitance (C) and conductance (G) measurements**
- **C-V measurement and parameter extraction capabilities are fully integrated into the latest system software release**
- **Extensive C-V test library and parameter extractions included**
- **Eliminates the need for external GPIB-based C-V instrumentation**
- **Integrated design simplifies device and materials characterization**
- **Configure linear or custom sweeps with up to 4096 data points**
- **Multi-frequency test signal flexibility from 10kHz to 10MHz**
- **Available with new 4200-SCS systems or as upgrades to existing ones**
- **Optional accessory kit for connection to popular analytical probers**

Integrated C-V Option for the Model 4200-SCS



The Model 4200-CVU Integrated C-V Option is the latest addition to Keithley's growing line of optional integrated test solutions for the Model 4200 Semiconductor Characterization System. This new instrument integrates directly into one of the Model 4200's instrument slots, allowing users to integrate capacitance and conductance measurement capabilities into their already powerful parametric analyzers. With the introduction of the 4200-CVU, the Model 4200-SCS now offers semiconductor test users the flexibility to create a solution that integrates DC, pulse, and C-V testing capabilities, all in the same space-saving chassis and in one integrated test environment. The newest version of the system's software, Keithley Test Environment Interactive (KTEI, version 7.0), supports the new C-V instrument fully, allowing Model 4200-SCS users to make C-V measurements as easily as they make DC measurements. The Model 4200-CVU is supplied with the broadest C-V test and analysis library available in any commercial C-V measurement solution.

A variety of standard C-V tests designed to be ready to run right out of the box are included with the instrument. Sample data from actual devices and user-customizable source code are also provided to help users tailor their tests to their specific test requirements. The extensive suite of C-V sample tests and parameter extraction formulas bundled with the 4200-CVU give users working in semiconductor technology development, process development, and reliability labs the tools they need to work more productively. Bundled sample tests include:

- Standard C-V sweeps for generic MOSFETs, diodes, and capacitors.
- MOScap: Measures C-V on a MOS capacitor. Extracted parameters include oxide capacitance, oxide thickness, doping density, depletion depth, Debye length, flatband capacitance, flatband voltage, bulk potential, threshold voltage, metal-semiconductor work function difference, and effective oxide charge.
- MOSFET: Makes a C-V sweep on a MOSFET device. Extracted/calculated parameters include oxide thickness, oxide capacitance, flatband capacitance, flatband voltage, threshold voltage, and doping concentration as a function of depletion depth.
- Lifetime: Determines generation velocity and lifetime testing (Zerbst plot) of MOS capacitors.
- Mobile Ion: Determines mobile charge using bias-temperature stress method. Extracts flatband voltage. Includes built-in control of a hot chuck to test a sample at room temperature, then when heated, then at room temperature to determine flatband shift.

4200-CVU

Integrated C-V Option for the Model 4200-SCS

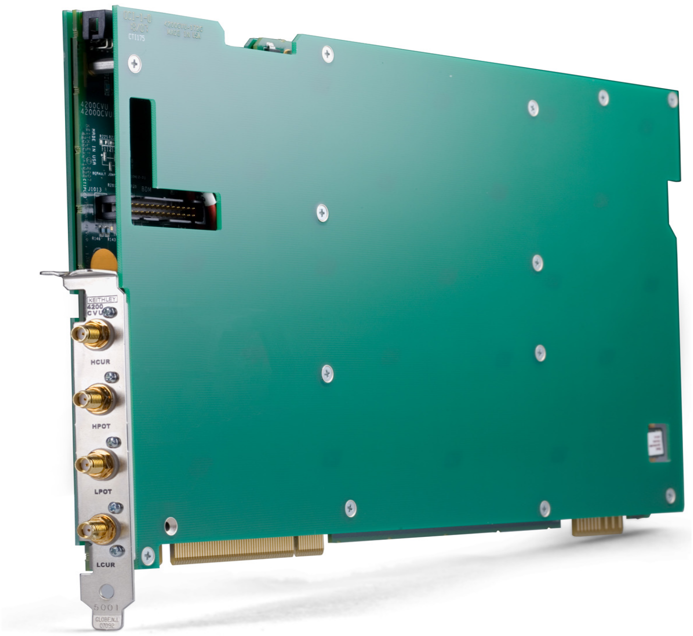
Ordering Information

4200-CVU	**4200 Capacitance Voltage Unit**
4200-CVU-PROBER-KIT	**Prober Accessory Kit for 4200-CVU**
4200-CVU-UPGRADE	**4200-CVU Card and Upgrade for existing 4200-SCS systems**
4200-CVU-1Y-EW	**1 year of return to factory repairs of the 4200-CVU. Before and after data reports compliant with ANSI/NCSL Z540-1. Must be purchased with 4200-1Y-EW and 4200-CAL.**
4200-CVU-3Y-EW	**1-year factory warranty on the 4200-CVU extended to 3 years from date of shipment. Includes calibration and return shipping. Requires purchase of 4200-3Y-EW.**
4200-CVU-5Y-EW	**1-year factory warranty on the 4200-CVU extended to 5 years from date of shipment. Includes calibration and return shipping. Requires purchase of 4200-5Y-EW.**
4200-CVU-3Y-CAL	**3 calibrations / 3 years of calibrated operation of the 4200-CVU. Requires purchase of 4200-3Y-CAL**
4200-CVU-5Y-CAL	**5 calibrations / 5 years of calibrated operation of the 4200-CVU. Requires purchase of 4200-5Y-CAL**

- Capacitor: Performs both a C-V sweep and a C-f sweep on a Metal-Insulator-Metal (MIM) capacitor, and calculates standard deviation.
- PNjunction: Measures the capacitance of a p-n junction or Schottky diode as a function of the DC bias voltage across the device.
- Photo Voltaic cell: Measures both forward and reverse biased DC characteristics of an illuminated solar cell and extracts parameters such as maximum power, max current, max voltage, short-circuit current, open-circuit voltage, and efficiency. Also performs characteristic C-V and C-f sweeps.
- BJT: Measures capacitance (at 0V bias) between terminals, including C_{be}, C_{bc}, and C_{ec}.
- I-V/C-V switch: Demonstrates using DC SMUs, CVU, and 707A/708A (switch matrix) in one project. Switches back and forth between DC and C-V tests and connections to the DUT.
- Interconnect Capacitance: Measures C-V of small interconnect capacitance on wafer.
- Nanowire: Makes C-V sweep on a two-terminal nanowire device.
- Flash: Performs C-V measurements on a typical floating gate Flash memory device.

The Model 4200-CVU can be configured into the system when ordering a new Model 4200-SCS, or added as an upgrade to any existing 4200 system (requires a return to a Keithley Service Facility).

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



The 4200-CVU C-V instrument integrates directly into one of the Model 4200-SCS's instrument slots.

Model 4200-CVU Specifications

MEASUREMENT FUNCTIONS

MEASUREMENT PARAMETERS: Cp-G, Cp-D, Cs-Rs, Cs-D, R-jX, Z-theta.

RANGING: Auto and fixed.

MEASUREMENT TERMINAL CONFIGURATION: Four-terminal pair.

CONNECTOR TYPE: Four SMA (female) connectors.

CABLE LENGTH: 0m, 1.5m, or 3m selectable.

INTEGRATION TIME: FAST, NORMAL, QUIET, and CUSTOM.

TEST SIGNAL

FREQUENCY RANGE: 10kHz to 10MHz.

MINIMUM RESOLUTION: 10kHz, 100kHz, 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).

OUTPUT IMPEDANCE: 100Ω, typical.

DC BIAS FUNCTION

DC VOLTAGE BIAS:
- **Range:** ±30V.
- **Resolution:** 1.0mV.
- **Accuracy:** ±(0.5% + 5.0mV) unloaded.

MAXIMUM DC CURRENT: 10mA.

SWEEP CHARACTERISTICS

AVAILABLE SWEEP PARAMETERS: DC bias voltage, frequency.

SWEEP TYPE: Linear, custom.

SWEEP DIRECTION: Up sweep, down sweep.

NUMBER OF MEASUREMENT POINTS: 4096.

MEASUREMENT ACCURACY

Example of C/G Measurement Accuracy

Frequency	Measured Capacitance	C Accuracy [1]	G Accuracy [1, 2]
10 MHz [3]	1 pF	± 0.92%	± 260 ns
	10 pF	± 0.32%	± 990 ns
	100 pF	± 0.29%	± 9 µs
	1 nF	± 0.35%	± 99 µs
1 MHz	1 pF	± 0.38%	± 15 ns
	10 pF	± 0.16%	± 65 ns
	100 pF	± 0.09%	± 590 ns
	1 nF	± 0.09%	± 4 µs
100 kHz	10 pF	± 0.17%	± 15 ns
	100 pF	± 0.18%	± 59 ns
	1 nF	± 0.08%	± 450 ns
	10 nF	± 0.08%	± 3 µs
10 kHz	100 pF	± 0.26%	± 15 ns
	1 nF	± 0.15%	± 66 ns
	10 nF	± 0.08%	± 450 ns
	100 nF	± 0.08%	± 3 µs

[1] The capacitance and conductance measurement accuracy is specified under the following conditions: $D_X < 0.1$.

[2] Conductance accuracy is specified as the maximum conductance measured on the referenced capacitor.

[3] These specs are typical. Typical and supplemental specs are non-warranted, apply at 23°C, and are provided solely as useful information.

Integration time: QUIET.

Test signal level: 30mV rms.

At the rear panel of the 4200-CVU.

SUPPLEMENTAL CABLE SPECIFICATION

4200-CVU Typical C Accuracy with 1.5m Cables (supplemental)

	10 kHz	100 kHz	1 MHz	10 MHz
1 pF	± 8.38%	± 1.95%	± 0.43%	N/A
10 pF	± 0.94%	± 0.21%	± 0.18%	± 1%
100 pF	± 0.29%	± 0.2 %	± 0.15%	± 1%
1 nF	± 0.17%	± 0.12%	± 0.16%	± 2%
10 nF	± 0.12%	± 0.13%	± 0.25%	± 2%
100 nF	± 0.13%	± 0.22%	± 1.14%	N/A

4200-CVU Typical C Accuracy with 3m Cables (supplemental)

	10 kHz	100 kHz	1 MHz	10 MHz
1 pF	± 8.5 %	± 2.05%	± 0.57%	N/A
10 pF	± 0.96%	± 0.23%	± 0.21%	± 1%
100 pF	± 0.29%	± 0.2 %	± 0.17%	± 1%
1 nF	± 0.17%	± 0.12%	± 0.18%	± 2%
10 nF	± 0.12%	± 0.13%	± 0.27%	± 2%
100 nF	± 0.13%	± 0.22%	± 1.16%	N/A

4200-CVU

Integrated C-V Option for the Model 4200-SCS

KEITHLEY

A GREATER MEASURE OF CONFIDENCE

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: 02-363 00 40
Fax: 02-363 00 64
www.keithley.nl

CHINA
Beijing
Ph: 8610-82255010
Fax: 8610-82255018
www.keithley.com.cn

FINLAND
Espoo
Ph: 09-88171661
Fax: 09-88171662
www.keithley.com

FRANCE
Saint-Aubin
Ph: 01-64 53 20 20
Fax: 01-60-11-77-26
www.keithley.fr

GERMANY
Germering
Ph: 089-84 93 07-40
Fax: 089-84 93 07-34
www.keithley.de

INDIA
Bangalore
Ph: 080-26771071-73
Fax: 080-26771076
www.keithley.com

ITALY
Milano
Ph: 02-553842.1
Fax: 02-55384228
www.keithley.it

JAPAN
Tokyo
Ph: 81-3-5733-7555
Fax: 81-3-5733-7556
www.keithley.jp

KOREA
Seoul
Ph: 82-2-574-7778
Fax: 82-2-574-7838
www.keithley.co.kr

MALAYSIA
Penang
Ph: 60-4-656-2592
Fax: 60-4-656-3794
www.keithley.com

NETHERLANDS
Gorinchem
Ph: 0183-63 53 33
Fax: 0183-63 08 21
www.keithley.nl

SINGAPORE
Singapore
Ph: 65-6747-9077
Fax: 65-6747-2991
www.keithley.com.sg

SWEDEN
Solna
Ph: 08-50 90 46 00
Fax: 08-655 26 10
www.keithley.com

SWITZERLAND
Zürich
Ph: 044-821 94 44
Fax: 41-44-820 30 81
www.keithley.ch

TAIWAN
Hsinchu
Ph: 886-3-572-9077
Fax: 886-3-572-9031
www.keithley.com.tw

UNITED KINGDOM
Theale
Ph: 0118-929 75 00
Fax: 0118-929 75 19
www.keithley.co.uk

Printed in the U.S.A. No. 2877 Oct. 07