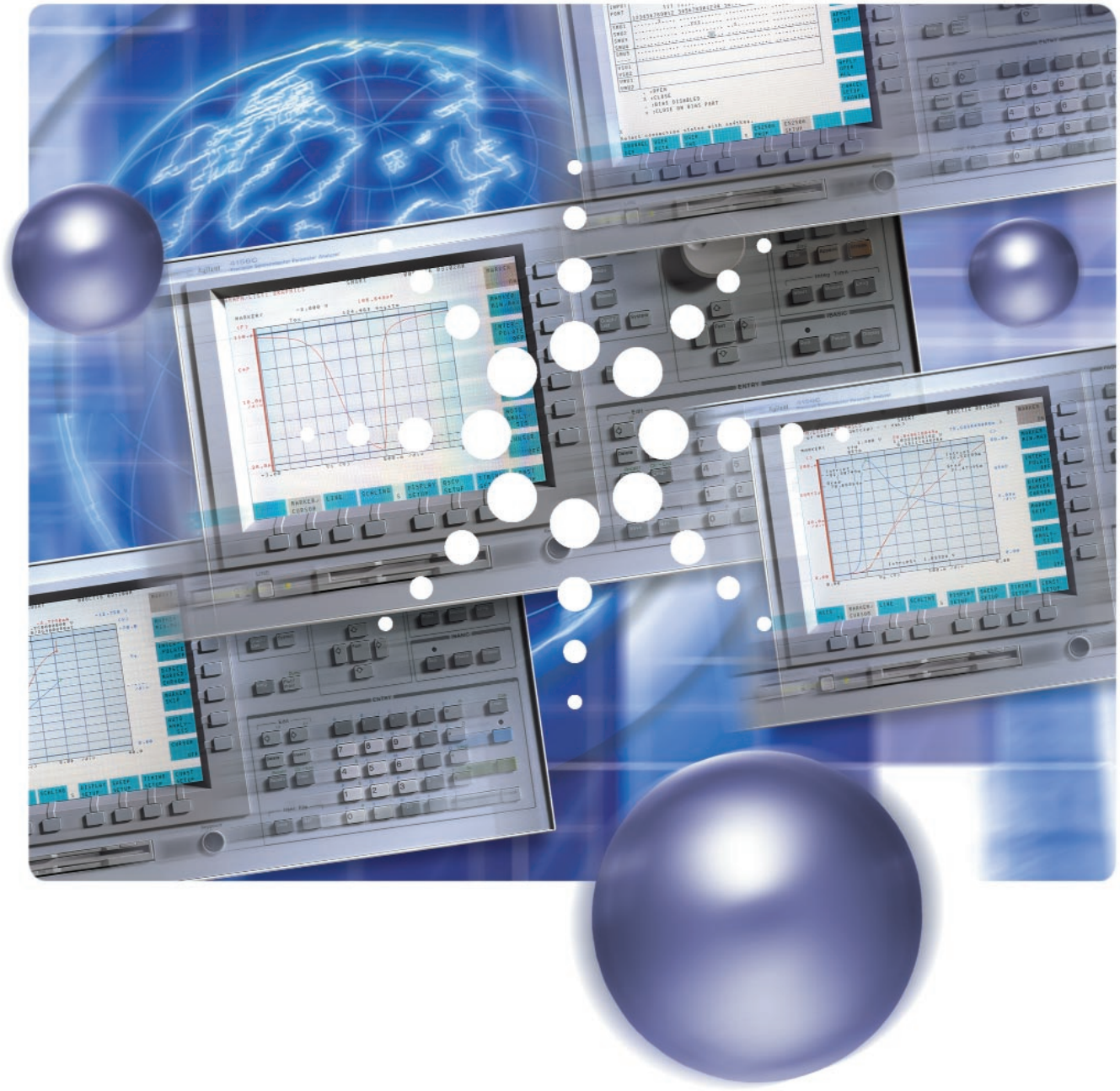


New Dimensions in Parametric Analysis

Agilent 4155C Semiconductor Parameter Analyzer

Agilent 4156C Precision Semiconductor Parameter Analyzer

Agilent E5250A Low Leakage Switch Mainframe

Agilent Technologies
Innovating the HP Way

Thinking Beyond the Box...

Parametric Test Leader

Agilent Technologies has become the world leader in parametric test (judged by market share) by always striving to lower your cost-of-test and provide you with the right test at the right cost. In the year 2000 Agilent reached the milestone of installing its 2000th parametric test system. It has also sold over 10,000 benchtop parameter analyzers since creating the first version of this product, the 4145A, back in 1982.

Continuous Innovation

The Agilent 4155C and 4156C maintain this tradition of continuous innovation in parametric measurement and analysis. The new capabilities of the 4155C and 4156C make them more than just new “boxes”; they are complete parametric measurement solutions. The integrated matrix control and quasi-static CV measurement capabilities of the 4155C and 4156C truly add new dimensions to your parametric test capability. Most importantly, the ability to start small and then build your way up to a fast and efficient automated parametric measurement station provides you with a solution without limits.

The Power of Information

Agilent’s Parametric Test Assistant CD contains the answers to all of your parametric measurement challenges. This unique HTML-based tool contains over 100 FAQs, as well as PDF versions of all instrument manuals, data sheets, and application notes (organized in a searchable database). It also contains a JavaScript-based Application Navigator utility that can help you to configure solutions based upon your measurement needs. Moreover, the entire CD works in both PC and UNIX environments. Please specify publication number 5980-0393E to get your free copy.

to a Solution Without Limits

Start with the Agilent 4155C and 4156C

The superior low-current and low-voltage resolution and built-in quasi-static CV measurement capability of the 4155C and 4156C provide a firm foundation for future expansion.

Perform Benchtop Analysis

The Agilent 4155C and 4156C combine with the Agilent E5250A and Agilent 4284A to form an efficient and cost-effective benchtop analysis system. Integrated matrix control ensures that you can perform CV-IV analysis quickly and effortlessly without the need for a PC. Alternatively, if you want instrument control in an MS Windows 98 or NT environment, you can use Agilent Interactive Characterization Software (ICS).

High-speed Automated Test

The Agilent FLEX command language gives you a powerful tool for automating your testing in conjunction with a semi-automatic wafer prober. Automate with commercial packages such as Metrics I/CV, or with your own custom software written in BASIC, C/C++, National Instruments LabView, or Agilent VEE.

A Powerful and Expandable Solution

Sweep a family of curves with a simple turn of the knob.

Organize test flow and minimize time required to obtain semiconductor parameters with the logical setup pages.

Easily analyze measured results on the large LCD.

Automatically obtain derived results like GMMAX with a single button.

Quickly set up measurements and extract parameters using context-dependent menu and sub-menu softkeys.

Preserve device power between measurements with the standby mode.

Execute separate stress conditions with a single keystroke.

Automate or create your own measurements with Instrument BASIC.

Output hardcopies through GPIB or parallel printer port. Also, send print/plots via LAN port to networked printers.

Save setups and measured results to the MS-DOS compatible floppy drive, or to an NFS server via a 10 base-T LAN port.

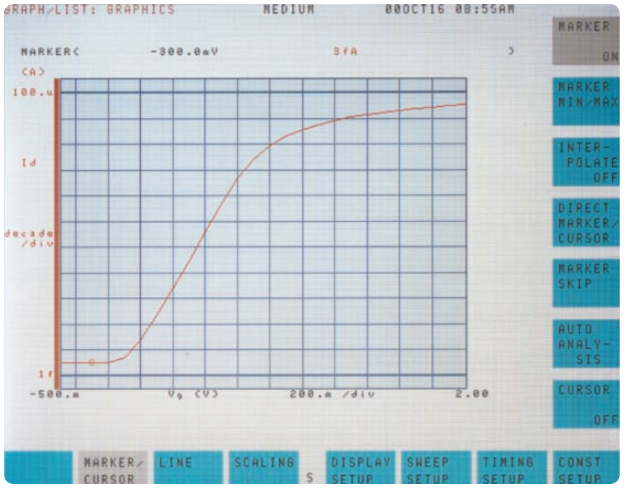
Ease measurement setups and programming with the full size detachable keyboard.

Extend your capabilities to 1 A/200 V, and add a low noise ground unit and dual pulse generators with the Agilent 41501B SMU and Pulse Generator Expander.

Unsurpassed Resolution and Accuracy

Ultra-Low Current Capability

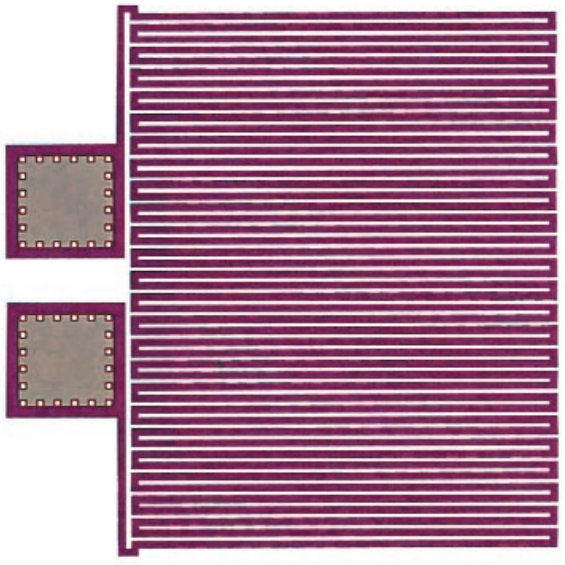
The 1 fA resolution (0.01 fA readable resolution) and 20 fA accuracy of the Agilent 4156C enable you to meet the low-current measurement challenges posed by current and future devices. Agilent continues to set the standard in SMU technology and precision, without sacrificing throughput, flexibility, or resolution. Moreover, Agilent achieves this measurement performance without any cumbersome preamplification schemes. This means you can use the 4156C to develop your most advanced processes, including difficult measurements such as subthreshold leakage and reverse-biased diode currents.



Repeatable Ultra-Low Subthreshold Characteristic

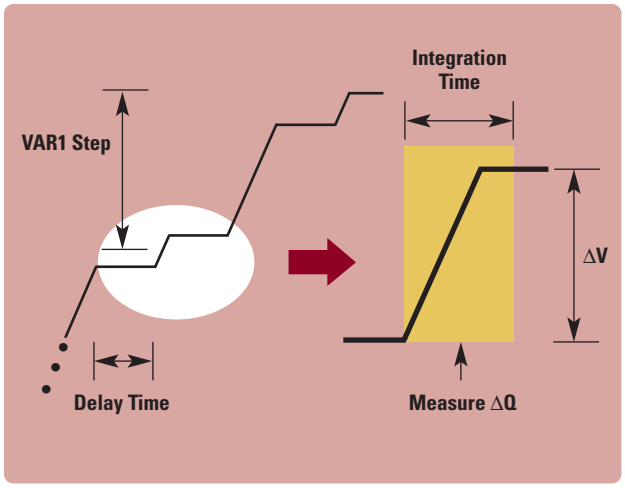
Measure Low Resistance Accurately

The advent of Cu metal processes has made contact and sheet resistance measurements increasingly difficult to perform. With 0.2 μV resolution and special voltage offset cancellation capability, the 4155C and 4156C have the measurement power to enable you to characterize precisely your low resistance Cu metal test structures.

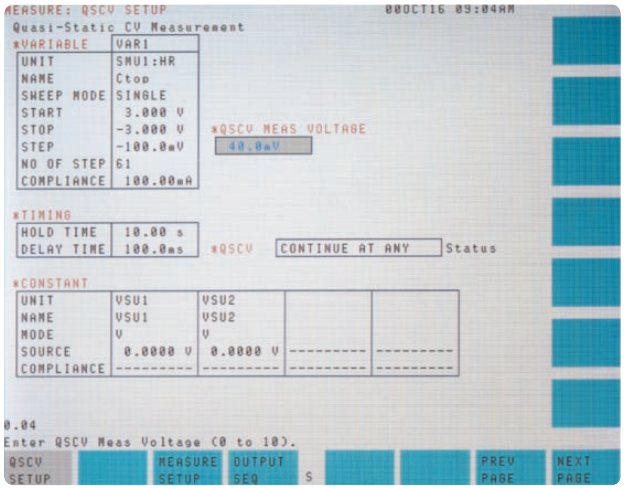


Cu Metal Resistance Structure

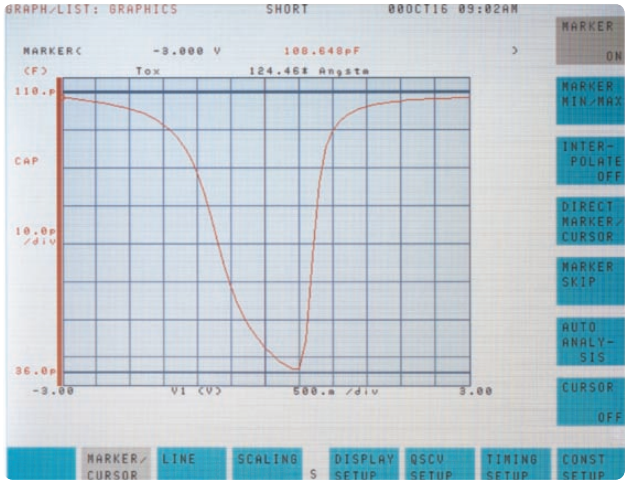
Built-in Quasi-static CV Analysis



Quasi-static CV Measurement Procedure



Quasi-static CV Measurement Setup



Quasi-static CV Measurement Results

Single Sweep Measurement

Capacitance versus voltage (CV) measurements provide essential information about many critical process parameters, such as oxide thickness (tox), surface state charge (Qss), and flat band voltage (Vfb). However, high frequency CV measurements only measure oxide capacitance in the accumulation mode. Low frequency or quasi-static CV (QSCV) techniques often yield better results because the entire range of operation of the oxide capacitor can be monitored in one continuous sweep.

Easy Quasi-static CV Setup

The 4155C and 4156C quasi-static CV measurement function is integrated into the front-panel control. No programming or additional equipment is required. Simply pick your voltage sweep range and the step voltage interval at which you want to measure capacitance. The internal firmware routines take care of the rest.

Reliable Measurement Results

The superior accuracy and resolution of the 4155C and 4156C guarantee that your quasi-static CV measurement results will be consistent and reliable. You can use the auto-analysis function of the 4155C and 4156C to calculate immediately important process parameters.

MS Windows 98 and NT Environment

ICS Gives Convenient Analysis Capability

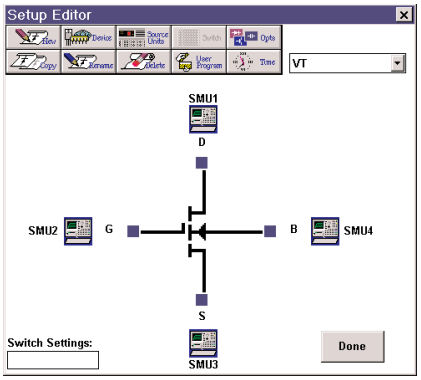
Interactive Characterization Software (ICS) provides a graphical user interface (GUI) in an MS Windows 98 or NT environment. ICS displays the device under test (DUT) as a graphical schematic, which makes parametric testing intuitive and easy by eliminating the need to write complex programs.

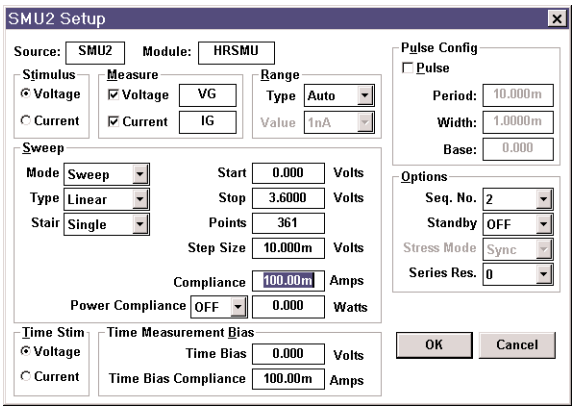
To connect the instrument sources to device terminals, simply select the appropriate instrument, such as an SMU or meter, from the pop-up display and click on the terminal lead on the schematic. The Setup Editor configures the resource for your application.

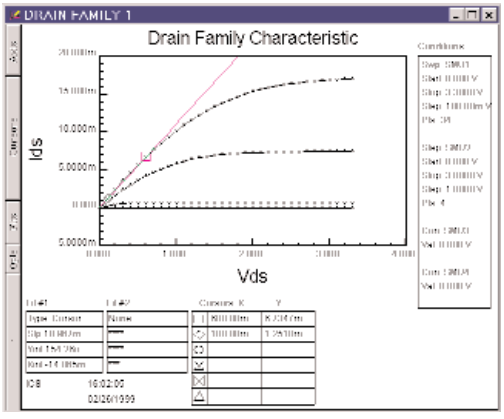
The Data/Plot View tool can immediately and automatically display all of your measured and derived data either as a graph or in a spreadsheet format.

ICS offers all the functionality of the instrument conveniently accessible from your PC for true desktop testing.

Note: ICS will support MS Windows 2000 as soon as business conditions warrant it.







Exceptional Switching Performance

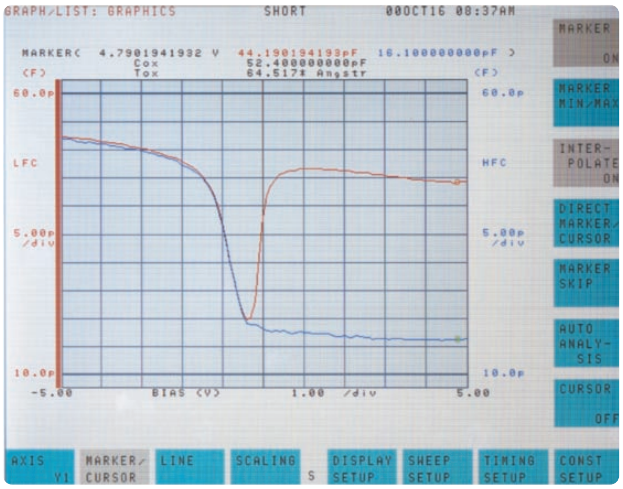
Ultra-accurate Low Current Measurement

The Agilent E5250A Low Leakage Switch Mainframe and E5252A Crosspoint Matrix module combine to form a complete low current matrix solution. Each E5252A card has 10 inputs and 12 outputs. The E5250A can hold up to four E5252A cards, for a maximum of 48 outputs. The inputs to rows 5 and 6 consist of a 3-to-1 multiplexer, which maintains cost-effectiveness without sacrificing performance. With this solution you can easily measure currents of 10fA and less through your switching matrix.

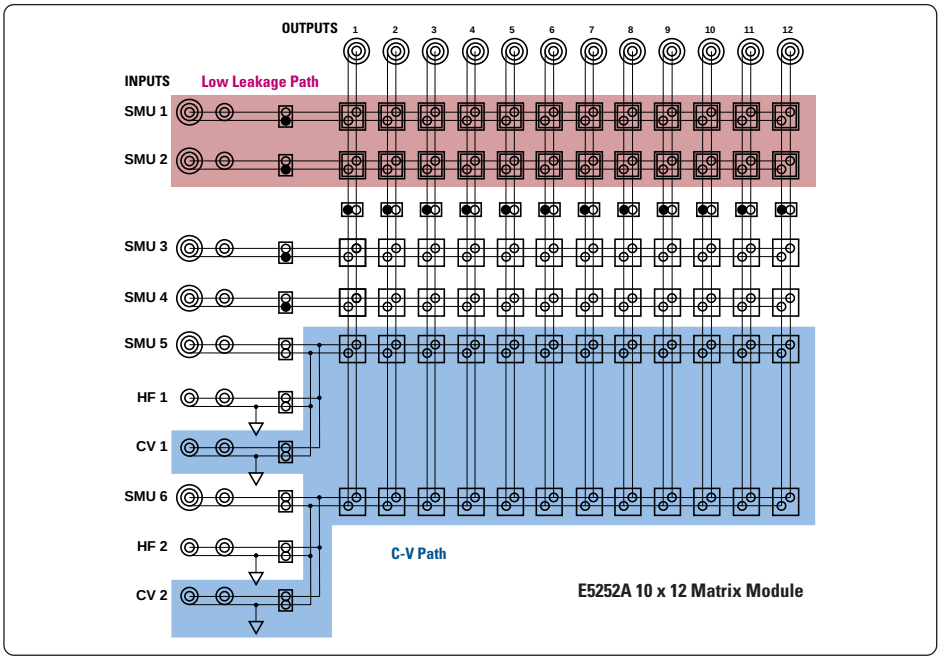
E5250A with E5252A Cards

Superior CV Measurement

The E5250A has special built-in compensation routines to ensure that your CV measurements achieve accuracy and repeatability. Whether you are using the quasi-static CV measurement capability of the 4155C and 4156C, or the high-frequency measurement features of the Agilent 4284A, you can be confident that your capacitance versus voltage data is both consistent and reliable. The plot to the right shows the results of superimposing quasi-static and high frequency CV data.



Consistent and Reliable CV Data



E5252A 10 x 12 Matrix Module

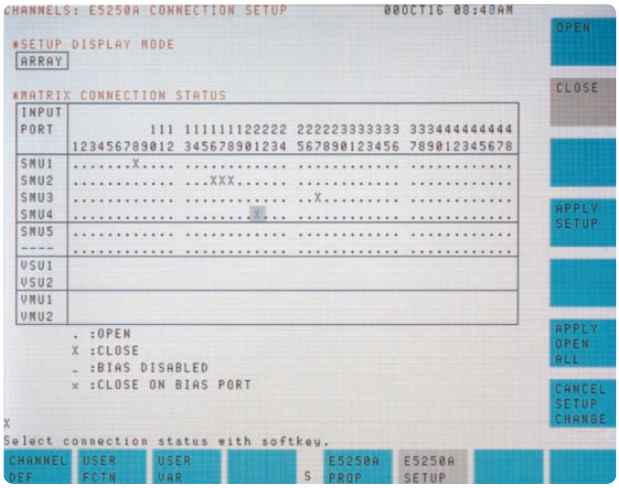
Integrated Matrix Control

Easy Front-Panel Control

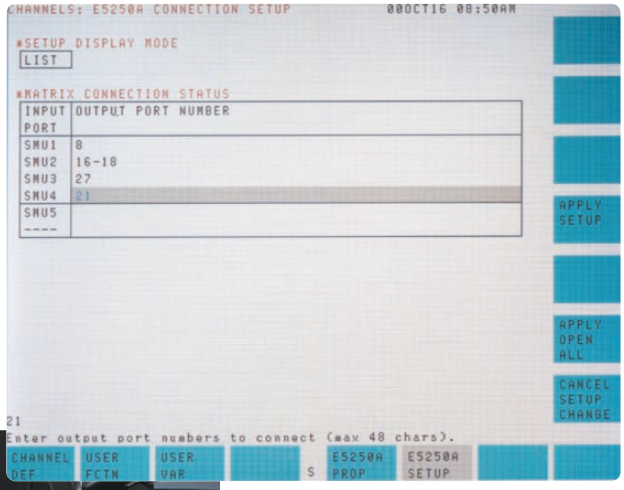
You can control your E5252A matrix cards directly from the front panel of the 4155C and 4156C. All features of the E5252A cards are supported and no programming or external PC control is necessary. In addition, you can save your matrix setups as .MAT files and use these files in both manual and automated applications.

Dual Control Modes

The 4155C and 4156C allow you to control the matrix in two different modes. The Array control mode provides a useful overview of the matrix status. The List control mode makes it easy to view and change output pin number assignments. You can choose either of the two modes to control the matrix and you can switch between them.



Array Control Mode



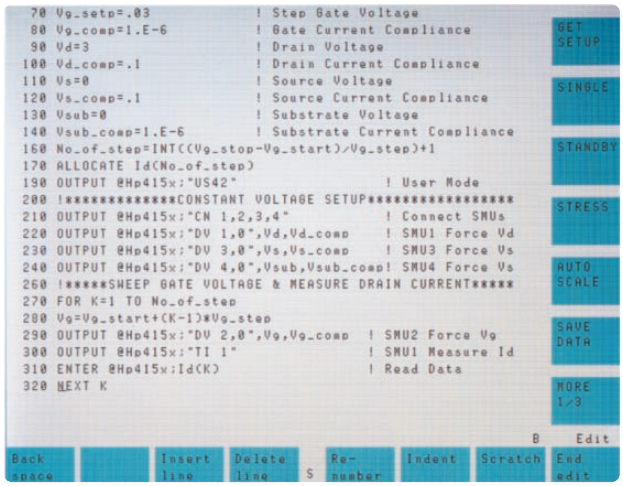
List Control Mode

A Complete Wafer-probing Solution

High Speed Automated Test

Agilent FLEX Speeds Execution Time

Agilent's Fast Language for Execution (FLEX) gives you direct control of instrument hardware, yielding both shorter programming code and faster measurement times. Agilent FLEX can also be used in conjunction with the program memory feature of the 4155C and 4156C to gain even further measurement speed improvements. In addition, since the 4155C and 4156C VXI*plug&play* driver uses Agilent FLEX, it provides a convenient means of enjoying this fast execution speed in BASIC, C/C++, National Instruments LabView, or Agilent VEE with minimal programming work.

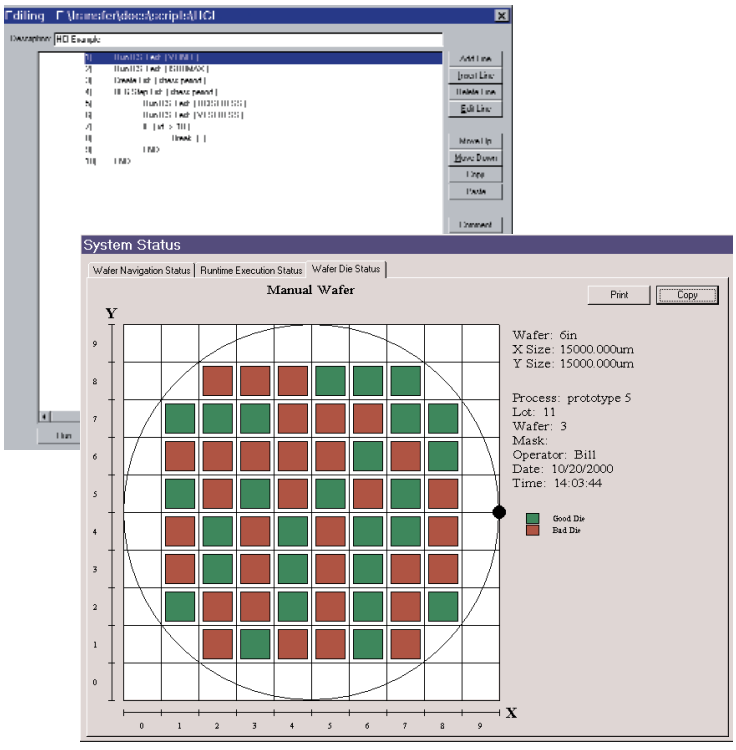


IBASIC Programming Example Using Agilent FLEX

Metrics I/CV

Metrics Technology (www.metricstech.com) is an Agilent partner company that provides standardized software packages for parametric measurement and analysis. Metrics I/CV software runs on both Windows 98 and NT, and supports a wide variety of semi-automatic wafer probers. Since Metrics IC/V uses ICS as its core measurement "engine," you can easily transport algorithms developed in ICS into the automated Metrics IC/V environment. Moreover, Metrics I/CV has a built-in test sequencer that enables you to automate die and sub-die moves, sequence ICS measurement algorithms, and make conditional branching decisions.

Metrics I/CV also now has an Agilent FLEX driver for the 4155C and 4156C. This allows you to run your automated testing in a super-fast "lights out" mode, and to achieve measurement times up to 10 times faster than the equivalent 4145 emulation or SCPI mode commands.

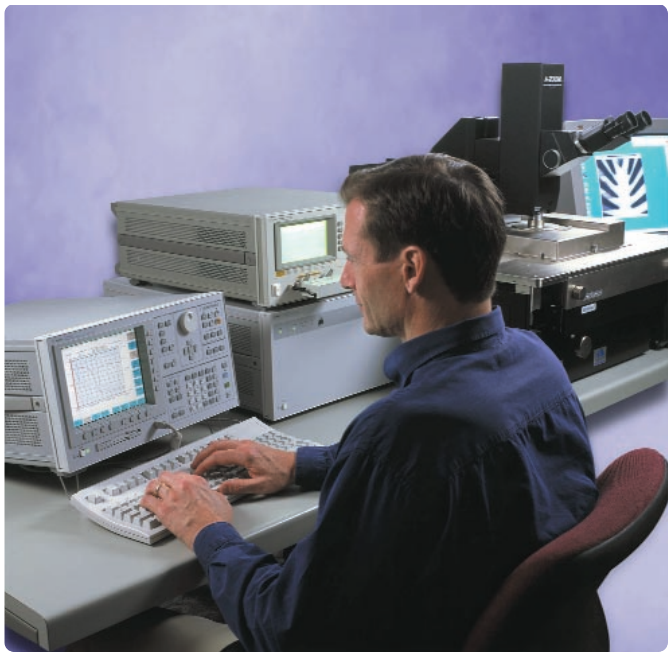


Metrics I/CV Automation Software

Total CV-IV Solutions

Integration without Complication

When making CV-IV measurements, you want to focus on the measurements and not on the equipment. The 4155C and 4156C allow you to do this by creating a seamless benchtop CV-IV measurement solution that has integrated matrix control, quasi-static CV measurement capability, and built-in capacitance compensation routines. Moreover, you can easily network your 4155C or 4156C to any NFS server anywhere on your LAN. You can save data files into Excel spreadsheets, and dump graphs to high-resolution TIFF files.



Benchtop CV-IV

Automation without Frustration

Agilent can also provide you with answers to your automated CV-IV measurement needs. With a single PC you can automate and control both your wafer prober and your measurement instruments. You can do this via a commercial package such as Metrics I/CV, or your own customized solution.

Automated CV-IV

Standard Wafer Level Reliability Functions...

The Best and Only Instrument for Wafer Level Reliability (WLR) Test

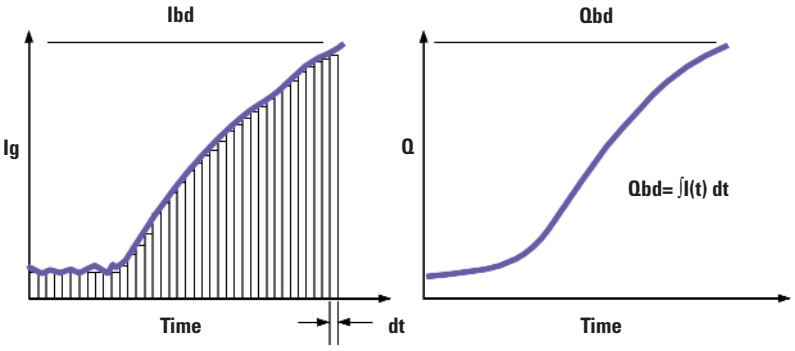
The Agilent 4155C and 4156C have a complete set of functions to support WLR test. For example, many WLR tests require extremely precise clocks in order to determine accurately the area under a curve for such important parameters as charge to breakdown (Qbd). The 4155C and 4156C have a super-accurate clock that can measure time intervals with 20 μs resolution (PC clocks are not adequate for this task). Also, the 4155C and 4156C feature a thinned-out sampling capability that is useful for measuring parameters over long time periods.

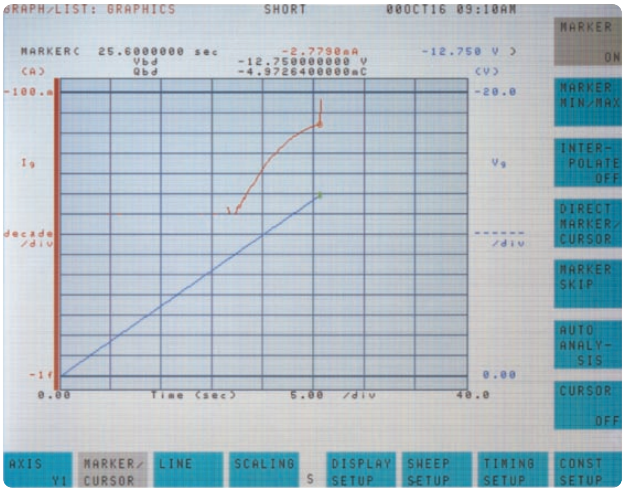
Determine Charge to Breakdown

The 4155C and 4156C can easily perform both Vramp and Jramp tests and automatically determine charge to breakdown (Qbd). Vramp testing can be performed directly from the front panel, and Jramp testing can be performed using a very simple IBASIC program supplied by Agilent.

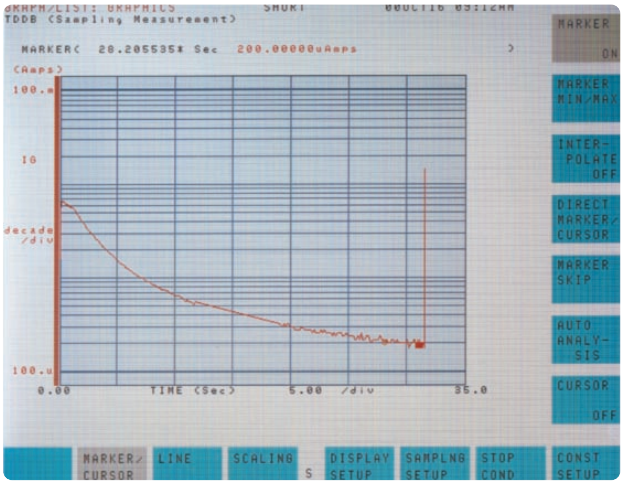
Intelligent TDDB Testing

For time-sampled measurements, the 4155C and 4156C support a unique "thinned-out" sampling function. This feature is particularly useful when performing tests such as time dependent dielectric breakdown (TDDB), where the time to failure is unknown beforehand. The thinned-out sampling function intelligently throws out extraneous data points if the data buffer (up to 10,001 points) fills up without reaching your failure criteria. This capability ensures that you never overflow your data buffer no matter how long your TDDB test is running.



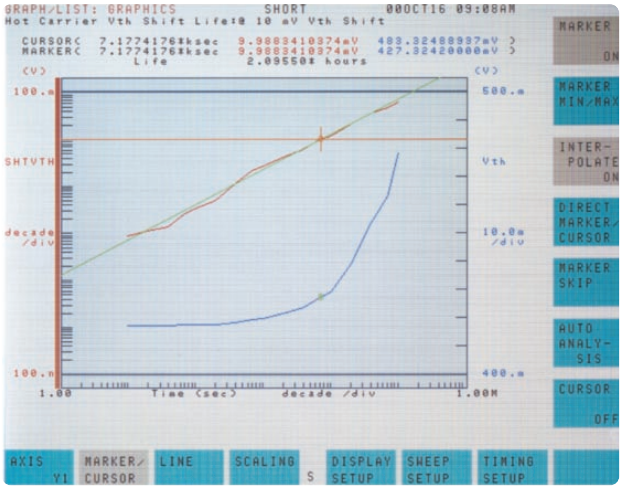


Vramp Test

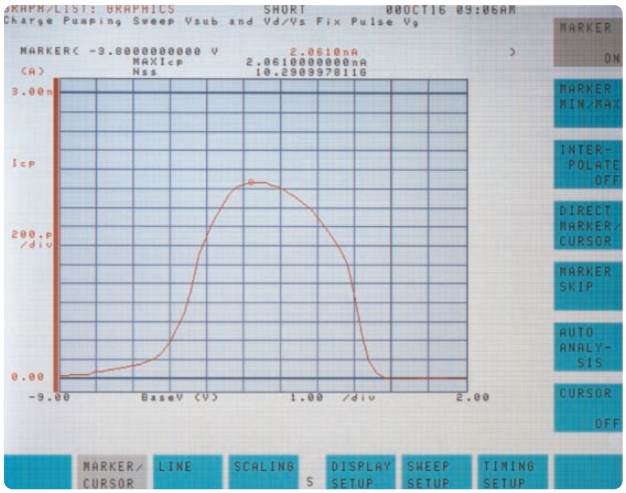


TDDB Test

Expandable to Advanced Applications



Push Button HCI



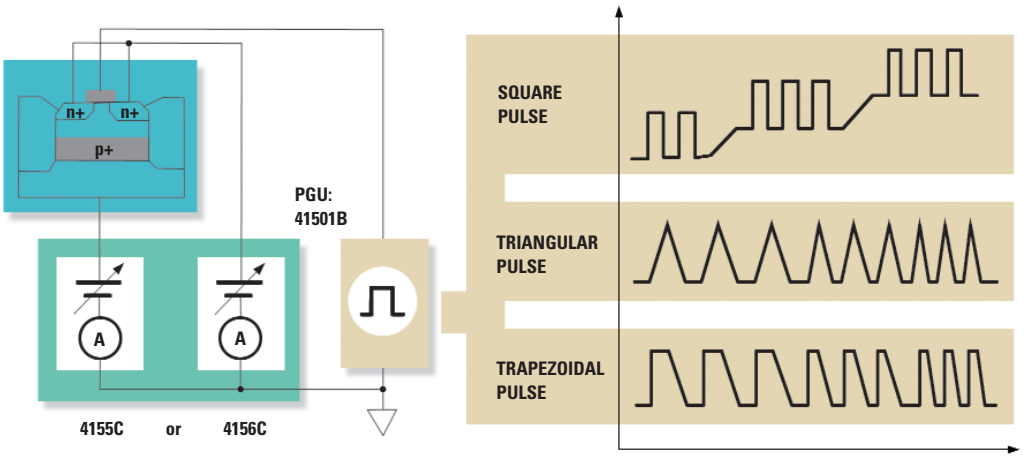
Charge Pumping Using Agilent 41501B PGU

Effortless Push Button Stress Measure

Many tests such as hot carrier injection (HCI) involve repeating a voltage stress until the user degrades a device parameter by some predetermined amount. The 4155C and 4156C simplify this tedious stress/measure procedure to only two keys: stress and measure. The user can also create programs to automate this stress/measure procedure (see next page).

Charge Pumping Station

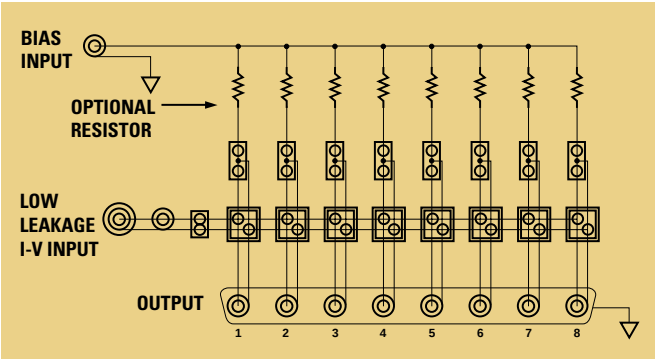
Charge pumping is a direct measure of the interface state density, which in turn provides an indication of the electron and hole trapping occurring in a MOS transistor. The Agilent 41501B expander unit provides a fully integrated solution for charge pumping. The pulse generators provide the range of pulse types, widths, and amplitudes, as well as the rise and fall time control needed for this crucial measurement.



The Agilent 41501B expander unit enables a variety of charge pumping pulses.

Automated Reliability Test

E5250A with E5255A Cards



Eight of 24 channels in the E5255A multiplexer module

HCI Test Solution

Long-Term Stress Testing

The Agilent E5250A Low Leakage Switch Mainframe also supports the E5255A Multiplexer Module for long-term reliability testing. The multiplexer module has 24 outputs, organized in groups of 8. Each module has one multilevel dc bias input for each set of eight channels, permitting the use of inexpensive power supplies for a consistent stress. The E5250A accepts four of these cards, for a total of 96 outputs. Each channel can also have a customer-selected protection resistor to safeguard against erroneous results. The user can gang up to four E5250A switch mainframes to create a system with 384-channel capability.

Benchtop HCI

Agilent can supply you with the hardware and the free software to build a low-cost benchtop HCI test solution. You can stress and measure eight or more devices automatically for days or weeks. The only equipment required is a 4156C, an E5250A, and a quad-output power supply. You can perform HCI testing without a PC. Please see our Parametric Test Assistant CD for more information.

Flash Memory Cell Evaluation

Standard solid-state Switch

The Agilent 16440A SMU/Pulse Generator Selector is a special solid-state switching module designed specifically for Flash cell testing. It enables you to perform thousands of Write/Erase cycles on Flash memory cells, which would be impossible using conventional mechanical relays.

Versatile Flash Memory Cell Solution

The 4155C and 4156C, the 41501B Expander Box (with PGU option), and the 16440A combine to form a powerful Flash memory cell evaluation solution. The PGUs are fully integrated resources within the 4155C and 4156C front panel, and they can be used to control other pulse generators such as the Agilent 81110A.

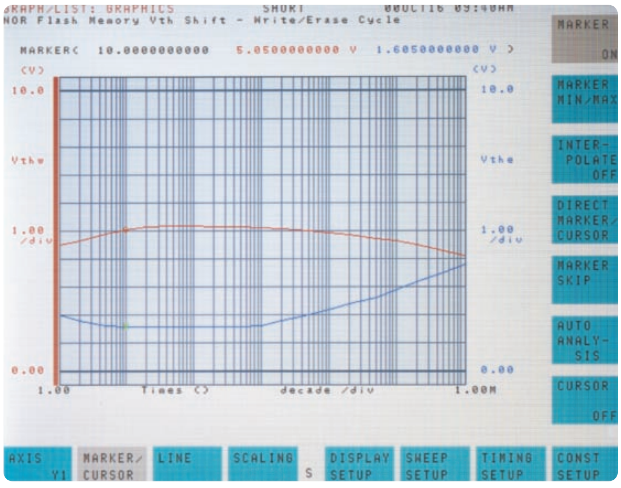
Million Cycle Write/Erase

You can use the 4155C and 4156C to both stress and measure Flash memory cells over thousands of cycles. You can also use them to perform automatic analysis and display of important data such as Vth shift.

Agilent 16440A SMU/Pulse Generator Selector (front)

Agilent 16440A SMU/Pulse Generator Selector (back)

Benchtop Flash Testing

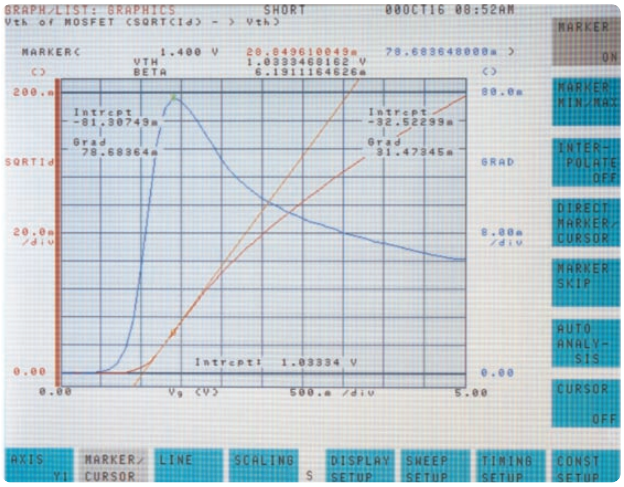


Flash Test Results

Device Characterization

Automated Parameter Extraction

The 4155C and 4156C have extensive built-in analysis capabilities that greatly facilitate parameter extraction and post-measurement calculations. The user can define new variables by specifying mathematical equations that utilize measurement parameters and/or other user-defined variables. The automatic analysis capabilities then enable you to calculate and to plot your desired variables each time you do a measurement without the need to resort to any other post-measurement computations.

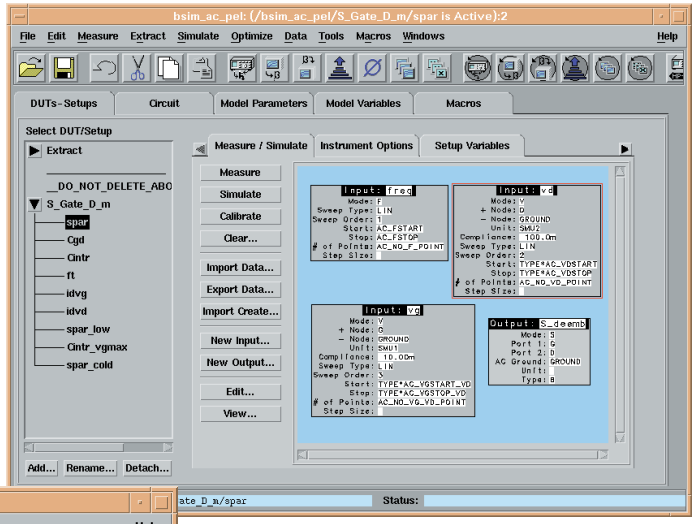


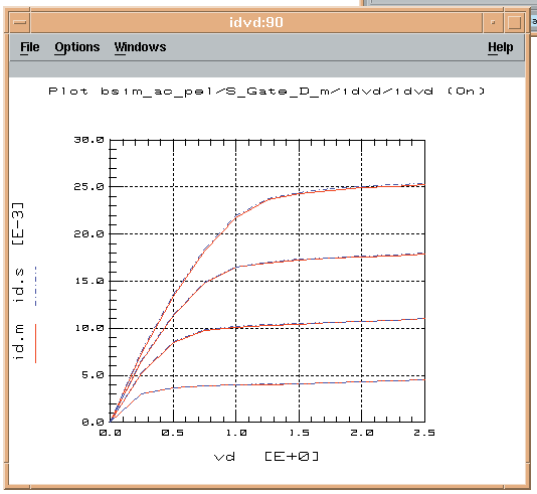
Automatic Extraction Facilitates Gm max and Vth Measurement

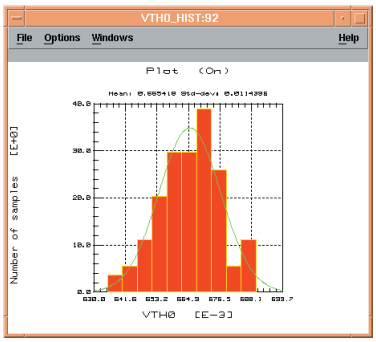
Parameter Extraction for Modeling

The Agilent Integrated Circuit Characterization and Analysis Program (IC-CAP) is an industry-standard device modeling package that provides a complete environment for parameter extraction and circuit simulation.

The superb accuracy and resolution of the 4155C and 4156C allow the user to extract extremely accurate modeling parameters without any programming or instrument interaction.







Compare Simulated and Measurement Data Using IC-CAP

Specialized Measurement Needs

Low-Noise 300 mm Wafer Probers

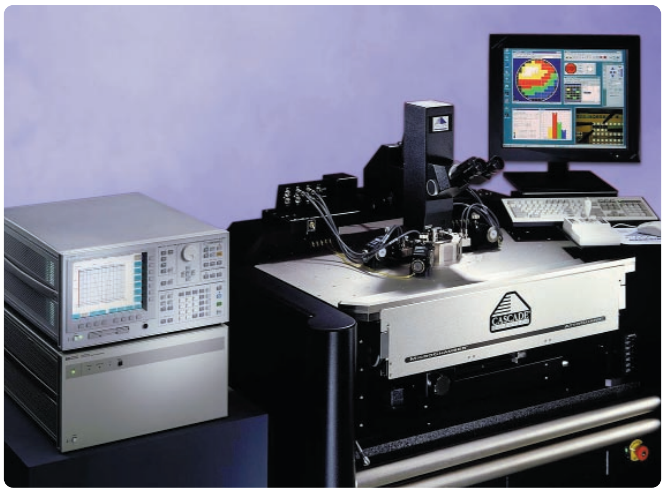
The Agilent 4155C and 4156C work with a wide variety of analytical wafer probers. Various low-noise cables and probe cards are available to help you achieve accurate on-wafer measurements.

Multi-site Probe Cards

For multi-site testing such as HCI and TDDB, Agilent works with Celadon Systems (www.celadonsystems.com) to provide you with cost-effective solutions. Celadon can provide you with multi-site probe cards and cables that plug directly into the E5250A's Multiplexer Module (E5255A) card.

Packaged Part Testing

For packaged part testing Agilent can supply you with the Agilent 16442A Test Fixture. A variety of standard modules are available for testing different packaged part types. Agilent can also supply blank Teflon boards and connection pins so that you can create your own custom low-leakage packaged part testing modules.



Cascade 300 mm Wafer Prober

Celadon Probe Card

Agilent 16442A Test Fixture

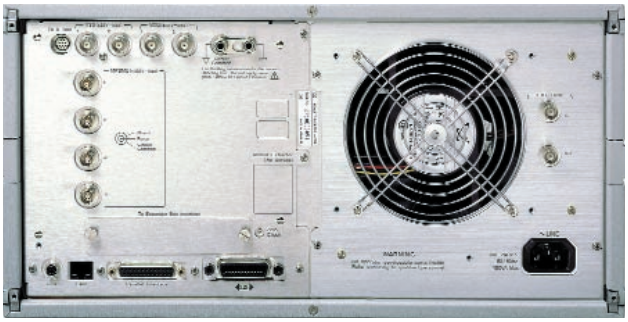
Agilent 4155C/4156C Selection Guide

Standard Resources:	**Agilent 4155C**	**Agilent 4156C**
Source Monitor Unit (SMU)	4 Medium Power SMUs	4 High Resolution SMUs
Voltage Monitor Unit (VMU)	2 VMUs	2 VMUs
Voltage Source Unit (VSU)	2 VSUs	2 VSUs
Optional Resources:		
Medium Power SMU	2 Medium Power SMUs	
High Power SMU	1 High Power SMU	
Pulse Generator Unit (PGU)	2 Integrated Pulse Generator Units (+/-40 V, 200 mA)	
Ground Unit	1 Ground Unit (1.6 A)	
Measurement Capabilities:		
SMU Voltage Measurement Range	2 μV/200 V†	2 μV/200 V†
SMU Current Measurement Range	10 fA/1 A†	1 fA/1 A†
SMU Voltage Resolution	2 μV	2 μV
SMU Current Resolution	10 fA (1 fA readable)††	1 fA (0.01 fA readable)††
SMU Voltage Measurement Accuracy	700 μV	200 μV
SMU Current Measurement Accuracy	3 pA	20 fA
SMU Pulse Width	500 μs to 100 ms	500 μs to 100 ms
VMU Resolution (Differential)	0.2 μV	0.2 μV
VMU Accuracy (Differential)	10 μV	10 μV
Quasi-static CV Resolution	10 fF	5 fF
PGU Minimum Pulse Width/Period	1 μs/2 μs	1 μs/2 μs
Data Acquisition and Control:		
Available User Interfaces	Push button, knob sweep, or keyboard.	
Switching Matrix Control	E5250A matrix control integrated into front panel.	
Programming Options	4142B and 4145 emulation, SCPI commands, Agilent FLEX.	
Interactive Characterization Software (ICS)	PC control of the 4155C, 4156C, E5250A, and 4284A in a Windows 98 or NT environment.	
Metrics I/CV	Agilent FLEX driver available for ultra-fast measurement. Wafer prober control.	
Other PC Control	VXI*plug&play* Driver compatible with BASIC, C/C++, National Instruments LabView, and Agilent VEE.	
Plotting and Reporting:		
Export to Spreadsheet	Spreadsheet key allows data to be exported with space, comma, or tab delimiters.	
Saving Plots to Files	Direct export to TIFF files.	
Connectivity:		
Network File Management	NFS client capability.	
Printing	Prints to networked printer via network print server.	
Other Interfaces	GPIB, parallel port, and 10 base-T LAN port.	

† **The 200 V and 1 A ranges are available when using the Agilent 41501B and HPSMU.**

†† **The accuracy of the readable resolution is not guaranteed.**

Agilent 4155C Back Panel View



4155C Key Features:
- Cost effective measurement solution.
- Non-Kelvin; force and guard terminals for each MPSMU.
- 10 fA resolution, 3 pA accuracy.

Agilent 4156C Back Panel View

4156C Key Features:
- High resolution and accuracy measurement solution.
- Full Kelvin; force, sense, and guard terminals for each HRSMU.
- 1 fA resolution, 20 fA accuracy.

Agilent 4156C Controlling the Agilent E5250A

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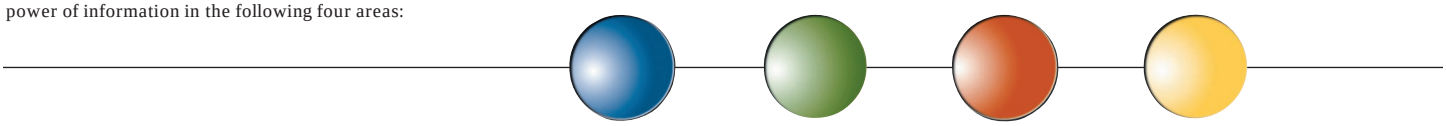

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Leading solutions for memory test, parametric test, wireless RF test, and SOC test applications are reducing cost-of-test and time-to-market in highly competitive markets.

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