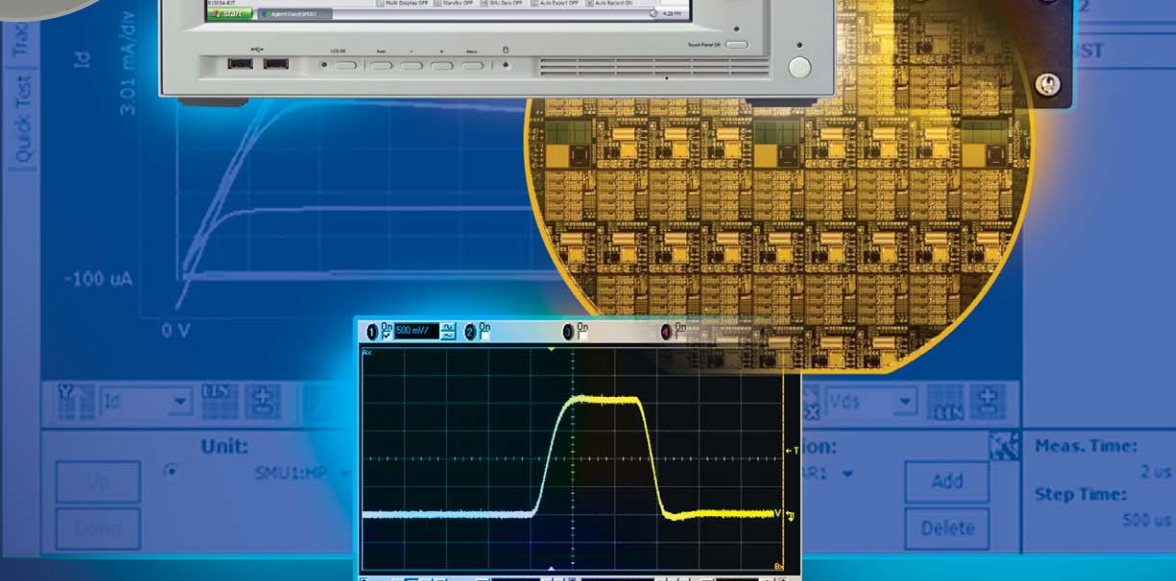
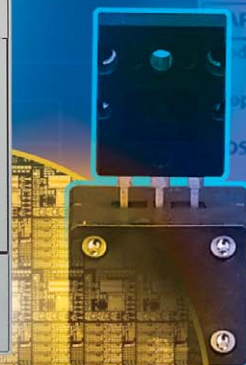
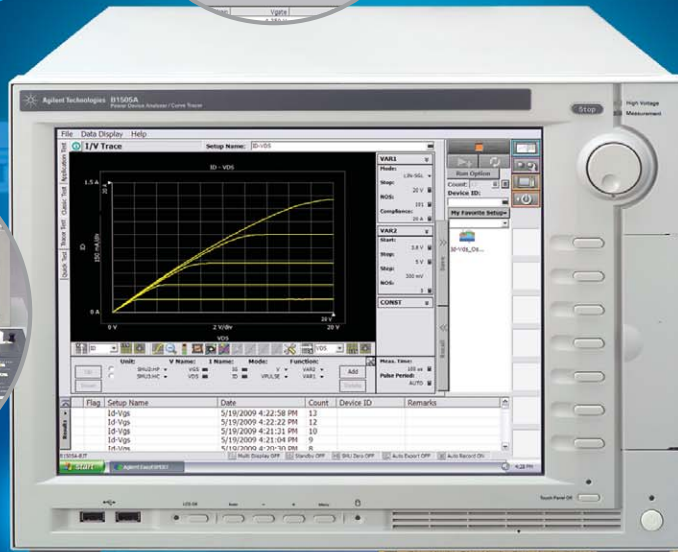
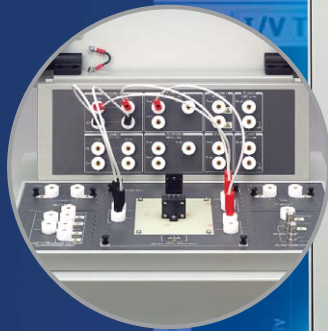
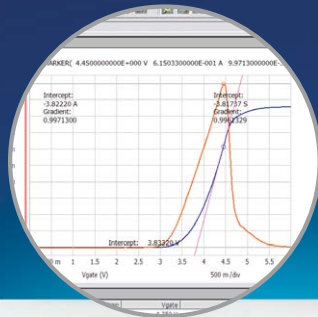


# Agilent B1505A Power Device Analyzer / Curve Tracer

The all-in-one solution  
for power device evaluation  
up to 3000 V / 40 A



# Can your present equipment solve these key power device evaluation challenges?



## **Insufficient measurement capability**

Power devices require characterization across their entire operating region, which can range from nanoamps or microvolts up to many amps and thousands of volts. In addition, the ability to perform narrow (microsecond range) pulsed IV measurements is also important to prevent device self-heating that can distort measurement results. Cable and contact resistance can also distort measurement results and prevent measurement equipment from applying the specified voltage to the DUT, and traditional analog curve tracers as well as other types of measurement equipment often do not have any means of correcting for this. To understand device switching speeds it is also crucial to characterize device capacitance under the actual bias voltages they will experience during use (which can also be in the thousands of volts). However, until now no measurement equipment existed that could meet all of these requirements.



## **Issues with novel new device (SiC, GaN) characterization**

New wide bandgap materials such as SiC and GaN show great promise for emerging high-power applications because of their ability to withstand large voltages and their fast switching speeds. Characterization of large breakdown voltages (up to 3000 V), high currents (more than 10 A), and junction capacitances under high voltage DC biases (also up to 3000 V) are measurement capabilities that are crucial to bringing these new devices to market as quickly as possible.



## **Curve tracer obsolescence and support**

Until recently, curve tracers have been the de facto standard tool for power device evaluation. However, all major suppliers have stopped producing traditional analog curve tracers. As existing curve tracers age, support and repair will continue to become increasingly difficult. Even when they operate correctly, extracting PC-compatible data from curve tracers is inconvenient and time consuming.



## **Safe and efficient packaged device testing**

A test fixture that is both safe and easy to use is very important for packaged power device evaluation. However, the lack of a standard test fixture for high-power devices has forced many people to create their own solutions, which become difficult to manage when multiple package types need to be tested. Moreover, additional factors such as safety and measurement performance are often not properly taken into account. All of these issues tend to make user-created test fixtures inefficient, expensive and potentially dangerous.



## **Power device development costs**

The ability to probe devices on-wafer greatly saves both time and money by eliminating the need to package the devices beforehand. However, on-wafer power device measurements have previously not been easy to make. Not only the time and cost of supporting the on-wafer measurement environment but also the safety of the on-wafer measurement environment are big concerns.

# The Agilent B1505A meets the most challenging power device evaluation requirements

## A one box solution for accurate and easy power device evaluation and analysis

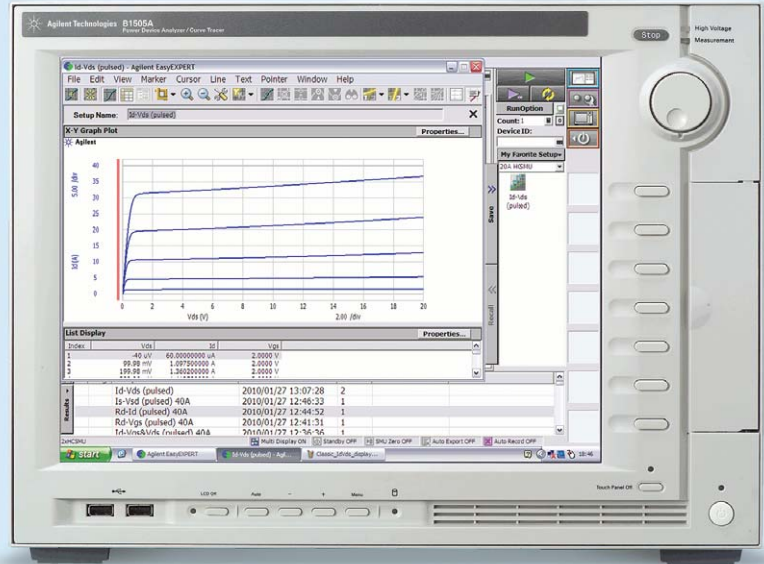
The B1505A meets the measurement challenges posed by state-of-the-art power devices. It is the only single-box solution that can accurately evaluate and characterize power devices from sub-picoamps up to 3000 volts and 40 amps. Moreover, it can also measure capacitance at 3000 V of DC bias.

A built-in curve tracer mode provides traditional and familiar curve tracer functionality, permitting quick device characterization with minimal measurement setup effort. An innovative automatic recording feature prevents data loss even if the device under test (DUT) is inadvertently destroyed.

In addition to these impressive measurement capabilities, the intuitive EasyEXPERT software environment makes data analysis a snap. You can also easily export data into your PC-based work environment and use this data to generate presentations and reports.

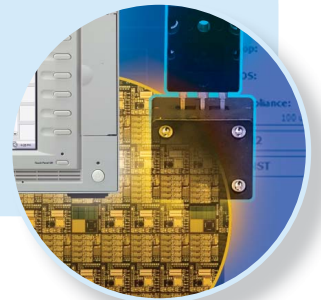
The B1505A supports a standardized test fixture solution, the N1259A, which is compatible with a variety of different socket types. The B1505A also supports on-wafer testing of power devices, thereby eliminating the need to package the devices first. This capability dramatically improves the turn-around-time (TAT) when testing devices in the lab.

Taken together, these capabilities and features result in revolutionary efficiency improvements in power device evaluation.



## Agilent B1505A key feature summary

- Voltage force/measure capability up to 3000 V
- Accurate sub-picoamp level current measurement at high voltage bias
- Current force/measure capability up to 40 A
- 50  $\mu$ s current pulse width at high current
- Switch between high-voltage and high-current measurements without the need to recable
- Capacitance measurement at up to 3000 V of DC bias
- True curve tracer functionality with knob sweep capability
- MS Windows-based EasyEXPERT software facilitates data management and simplifies data analysis
- Standard test fixture with interlock for safe packaged power device testing
- Supported and secure on-wafer high-power testing





# Unprecedented power device measurement capabilities

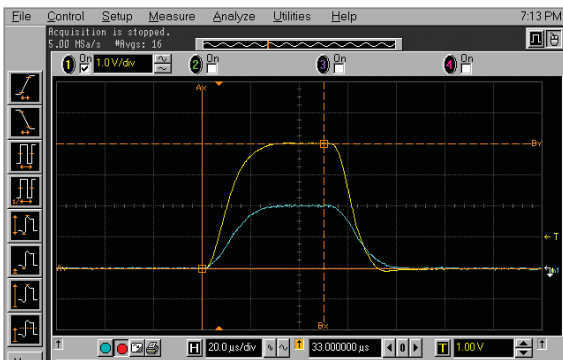
## Accurate power device characterization across the entire device operating range

Accurate current versus voltage (IV) characterization of power devices across their entire operating ranges has not been possible in the past because no equipment existed that had sufficient current and voltage measurement capabilities. In addition, power devices require relatively fast pulsed measurements to prevent device self-heating effects that can distort the measurement results. The B1505A solves the measurement ranging issue by supporting two new types of source/monitor units (SMUs) with wide measurement ranges: a high-voltage SMU (HVSMU) and a high-current SMU

(HCSMU). An available module selector unit supports automatic switching not only between these two units but also with a high-power SMU (HPSMU). This permits low-level voltage or current measurements to be made first with the HPSMU, and then the HVSMU or HCSMU can be switched in to measure larger voltages and currents. Moreover, unlike conventional curve tracers the B1505A's SMUs possess feedback circuitry that continuously corrects the output to ensure accuracy. The B1505A HCSMU also supports pulsed current measurements of 50 microseconds width at 20 amps, which prevents device self-heating. Finally, the HCSMU's 200 mV voltage measurement range makes it the only instrument able to make accurate milliohm on-resistance measurements.

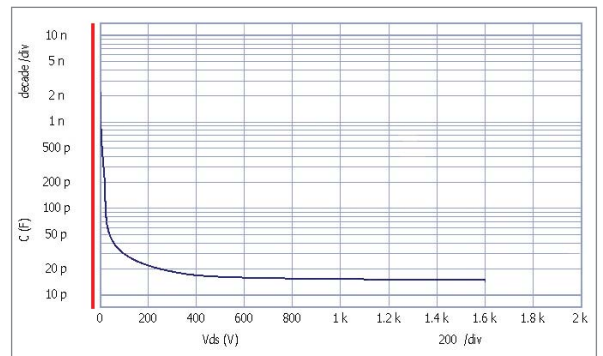
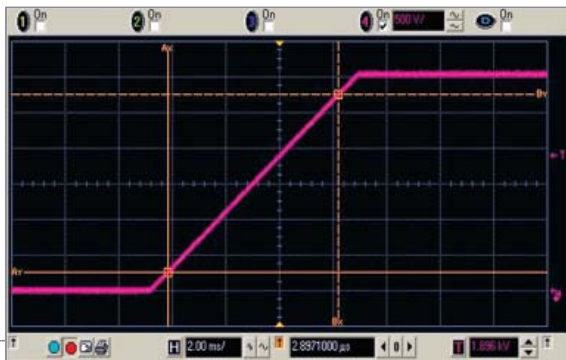
## Unique high-voltage (3000 V) capacitance measurement capability

The B1505A supports a multi-frequency capacitance measurement unit (MFCMU) with a 1 kHz to 5 MHz frequency range. The MFCMU can be used in conjunction with an optional high-voltage bias-T and the HVSMU module to perform capacitance versus voltage (CV) measurements at up to 3000 V of DC bias. This industry-first feature permits the accurate characterization of drain-source and junction capacitances, which are important to correctly predict power device switching characteristics. It also allows material researchers to perform much deeper doping profile characterizations than is possible using conventional equipment. The MFCMU also supports open, short, load, and phase compensation via a user-friendly GUI, making it easy to perform accurate capacitance measurements across the entire voltage bias range.

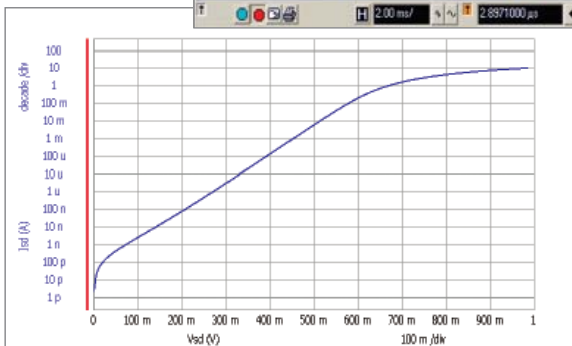


The high-current SMU can provide 50  $\mu$ s wide current pulses to minimize self-heating effects and insure proper device characterization. Blue (20 A) Yellow (40 A)

The high-voltage SMU can sweep from microvolts to 3000 V in a matter of seconds, greatly speeding up device evaluation.



High-voltage CV plots made with the B1505A can be used to perform accurate doping profile characterization.



The B1505A's wide IV measurement range allows characterization of low-level current and voltage signals up through the maximum operating range of the DUT.

## Flexible and expandable architecture protects your investment

The B1505A's modular construction enables you to meet your present needs while also allowing you to expand your capabilities in the future. For example, if your B1505A has an HCMSU installed in it and you need to go beyond 20 A then you can add an additional HCSMU and increase your current capability to 40 A.



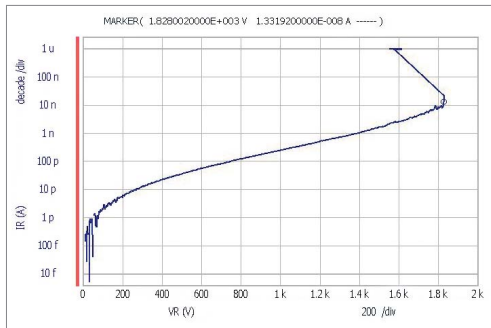


# B1505A solves emerging material development challenges

## Accurately characterize SiC, GaN and diamond devices at up to 3000 V

Devices fabricated using emerging new materials such as SiC or GaN have higher breakdown voltages and smaller leakage currents than conventional power devices. Therefore, the equipment used to characterize these devices needs to have both high breakdown voltage measurement capability as well as the ability to measure leakage currents at high voltage biases. The B1505A's HVSMU meets both of these requirements. It can measure breakdown voltages at up to 3000 V and it can also accurately measure leakage currents at up to 3000 V. These twin capabilities enable researchers to quickly characterize and develop SiC, GaN and other novel new device types.

*A breakdown voltage of more than 1800 V accurately characterized on a schottky diode fabricated on a diamond substrate.\**



## Supported modeling software reduces development times

Many popular device modeling software solutions support the B1505A (including Agilent IC-CAP). The B1505A's superb accuracy and resolution combined with IC-CAP's powerful 85194Q HiSIM\_HV\*\* extraction package provide a turnkey solution that enables you to extract extremely accurate modeling parameters for high power devices. This reduces device development times and improves time to market.

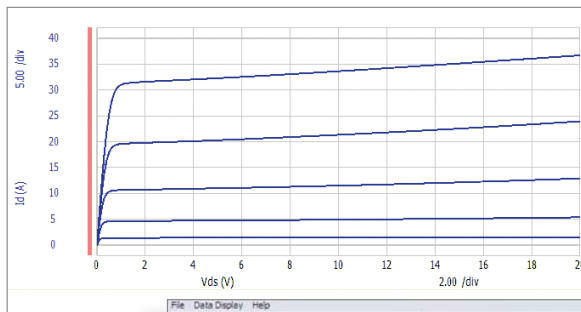
\* This measurement data is courtesy of the national institute of advanced industrial science and technology (AIST) in Japan.

\*\* HiSIM\_HV is the Industry Standard Device Model for High Voltage CMOS/DMOS and LDMOS devices developed by Hiroshima University and STARC

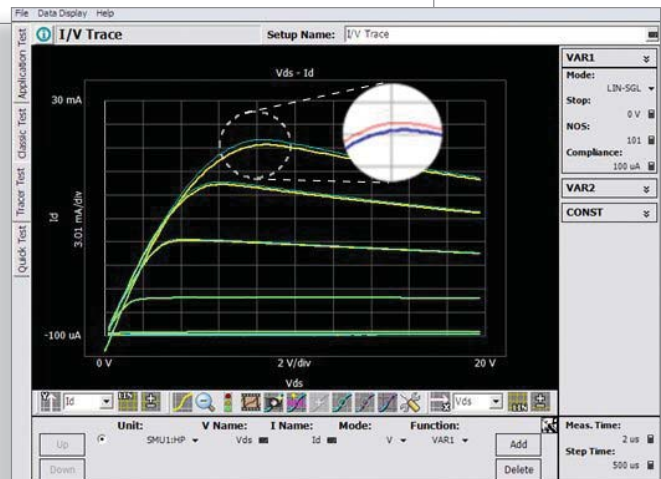
## Up to 40 amp current capabilities facilitate advanced device characterization

Modern power devices frequently require test equipment able to source more than 10 A of current in order to properly characterize their behavior. Since most equipment cannot supply this much current, users frequently attempt to combine multiple current sources (sometimes as many as four single channel SMUs) together to increase the total current output. However, it is very difficult to make individual SMUs work together as a unit due to timing, residual impedance and programming issues. Moreover, the measurement accuracy of parallel SMU solutions is insufficient to accurately characterize power devices constructed from emerging new materials. In contrast, a single B1505A HCSMU can accurately and easily source

and measure currents of up to 20 A, and two HCSMUs can be combined together to double the sourcing and measurement ranges. EasyEXPERT has built-in support for two HCSMUs so that no programming is required for safe and accurate testing at up to 40 A. In addition, the HCSMU's ability to dynamically change settings during measurement further facilitates the fast, in-depth evaluation of new material devices. In Tracer Test mode the HCSMU permits observation of the current collapse effect, which is a common phenomena in emerging material devices. The Tracer Test overlay feature allows multiple measurements to be displayed simultaneously in real time, simplifying analysis of the current collapse effect. These capabilities reduce development times and enable researchers to understand device and material characteristics in greater detail.



*Important transistor  $I_d - V_{ds}$  characteristics can be measured at drain current levels up to 40 A.*



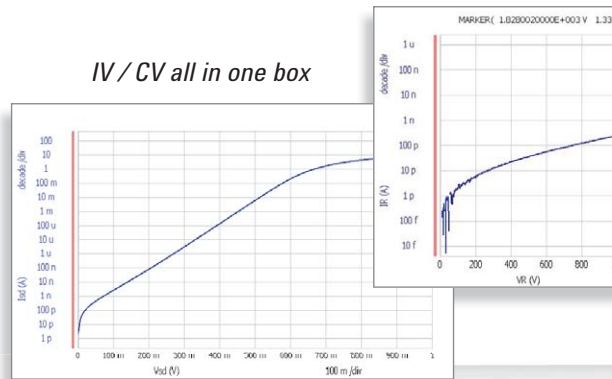
*The Tracer Test mode supports quick and easy observation of the current collapse effect in advanced material devices (such as the GaN device shown above).\**

The simplicity of a curve tracer combined with the power of an analyzer provide unrivaled ease-of-use and efficiency

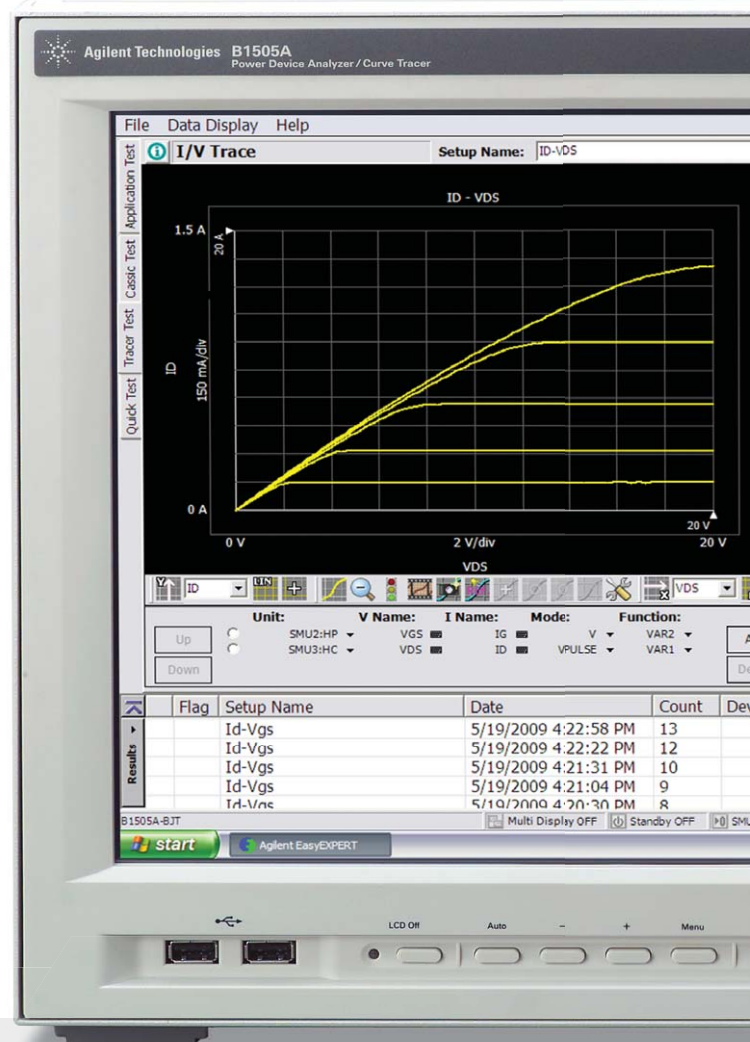
*True knob-sweep curve tracer functionality — intuitive and real time*

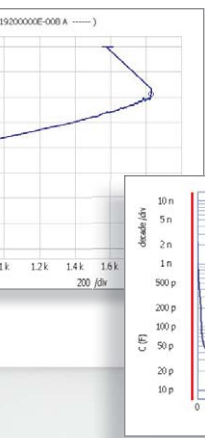


*IV / CV all in one box*

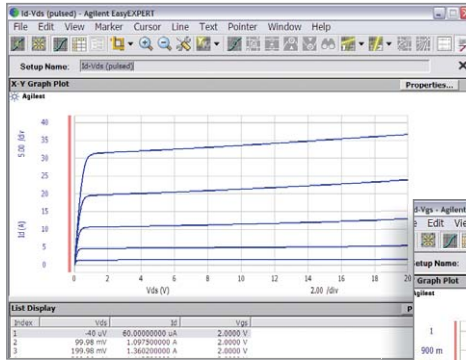
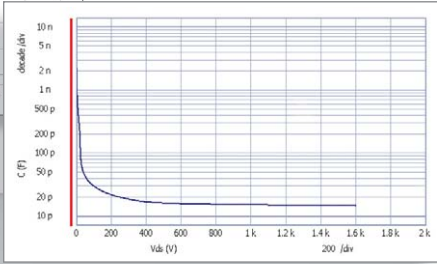


*High-power wafer prober control*

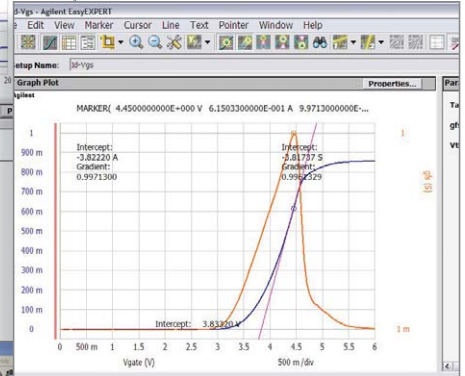




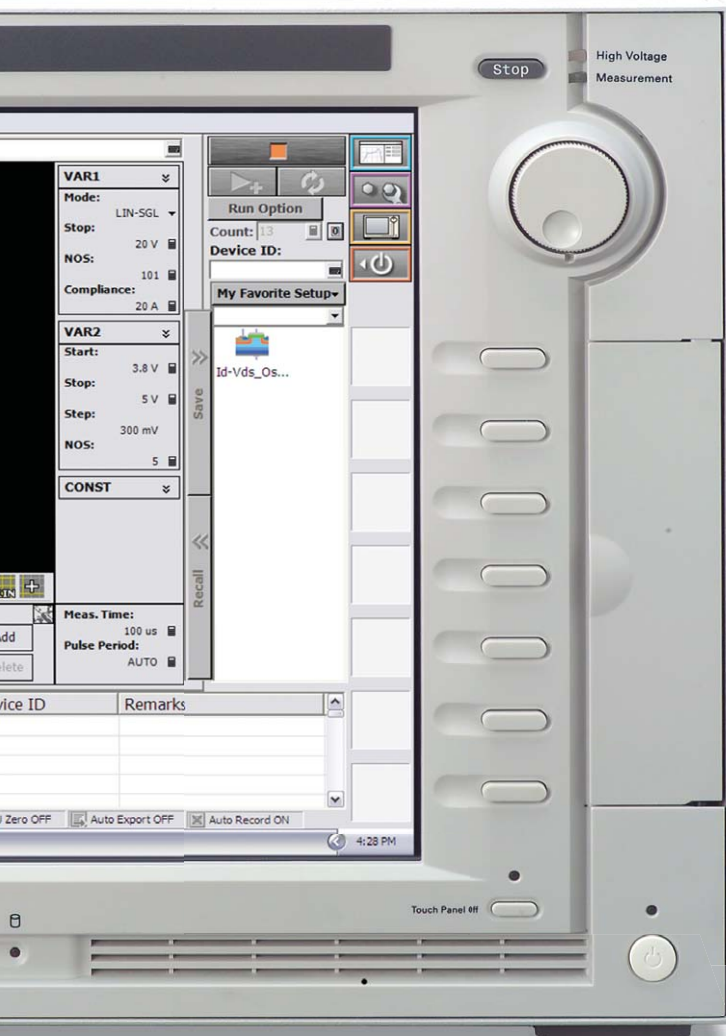
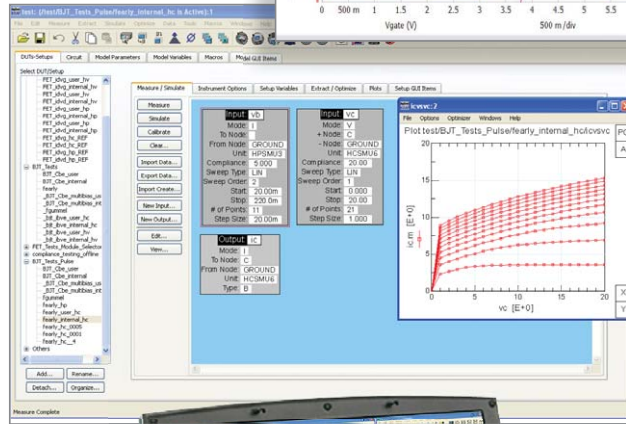
Auto data recording feature prevents data loss even if the DUT is inadvertently damaged or destroyed.



Easy data analysis and parameter extraction



Supported by popular modeling software



Offline test development and data analysis







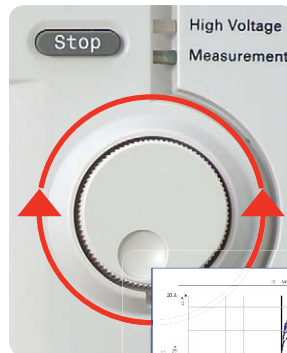
# The logical choice for curve tracer replacement

## True curve tracer knob sweep functionality combined with PC data management

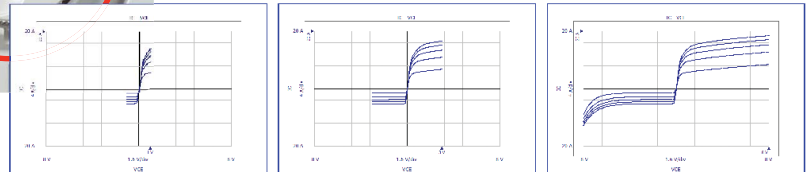
The B1505A's Tracer Test mode offers traditional curve tracer knob sweep control enhanced with the convenience and flexibility of a modern GUI. Just like an analog curve tracer, you can sweep in only one direction (useful for R&D device analysis) or in both directions (useful in failure analysis applications). You can easily export measurement data into PC-compatible formats (both graphical and numerical), making it simple to create presentations and reports. You can also automatically or selectively save setup information and measurement results to the built-in hard disk drive as well as to any other available storage location (USB memory stick, network drive, etc.). These capabilities eliminate the time consuming data management tasks associated with conventional analog curve tracers.

## New features improve curve tracer functionality and boost productivity

Several new features in the B1505A's Tracer Test mode provide dramatic usability improvements over traditional curve tracers. A snapshot feature allows you to save and display multiple data traces so that you can easily compare them with data from the current measurement. A spotlight feature allows you to graphically define forbidden regions (either voltage or current based) such that the measurement immediately ceases if the trace enters the forbidden area. Best of all, an auto-record feature keeps a running record of the most recent trace changes so that you can replay and save measurement trace data even if your device is inadvertently damaged or destroyed. Taken together these improvements represent a truly revolutionary advance in curve tracer design that can significantly reduce device characterization cycle times.



*In curve tracer mode the dual polarity sweep feature allows you to simultaneously sweep in both directions just like on an analog curve tracer.*

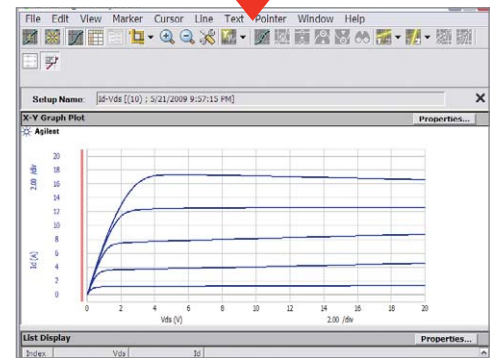
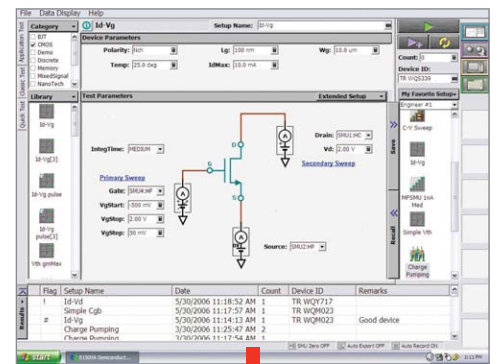


## EasyEXPERT provides a task-oriented approach to power device testing

Agilent EasyEXPERT software, which is resident on the B1505A, represents a paradigm shift from previous generations of test solutions. Besides supporting the new Tracer Test mode, EasyEXPERT on the B1505A also supports an Application Test mode that comes standard with over 40 user-modifiable high power application tests. The Application Test mode provides you with a convenient visual alternative to the conventional curve tracer mode, which can be useful for operators and when performing test automation. In addition, parameters such as threshold voltage or breakdown voltage can easily be extracted automatically using EasyEXPERT's built-in auto analysis capabilities.

## Powerful auto-analysis functions

EasyEXPERT supports many features that allow graphical data analysis to be performed as a measurement is made. This includes displaying parameters calculated from user-defined functions in real time. Measurement data can also be displayed in a variety of formats, including semi-log and log-log graphs. For example, it is easy to extract the ideality factor from a diode IV curve by having EasyEXPERT plot it on a semi-log scale and automatically draw a regression line.



*The furnished EasyEXPERT application tests allow even inexperienced users to become productive quickly without the need for extensive instrument training.*



# Standard solutions improve efficiency and reduce costs

## Safe and supported packaged device testing at 3000 V and 40 A



Connecting to a wide variety of power device package types has always been a challenging

issue when making measurements at high voltages and currents. Many users have had to waste valuable resources creating their own customized test fixtures just to be able to test their devices. Even when completed, concerns often arose about the safety of these home-grown solutions. The B1505A supports a standardized test fixture (the N1259A) that solves these issues. The N1259A has a modular configuration that supports a variety of different package types, including universal and Teflon board socket modules that can be used to create solutions for custom package types. Moreover, a test adapter socket module is available that enables you to use legacy interfaces designed for the Tektronix 370B and 371B curve tracers. The N1259A also has a safety interlock that prevents measurements at dangerous voltage levels unless the lid is closed. In addition, optional protection adapters and resistor boxes are available to work with the test fixture to ensure that lower-power modules (such as the HPSMU) are not inadvertently damaged. These new features and capabilities make packaged power device testing easier than ever before.



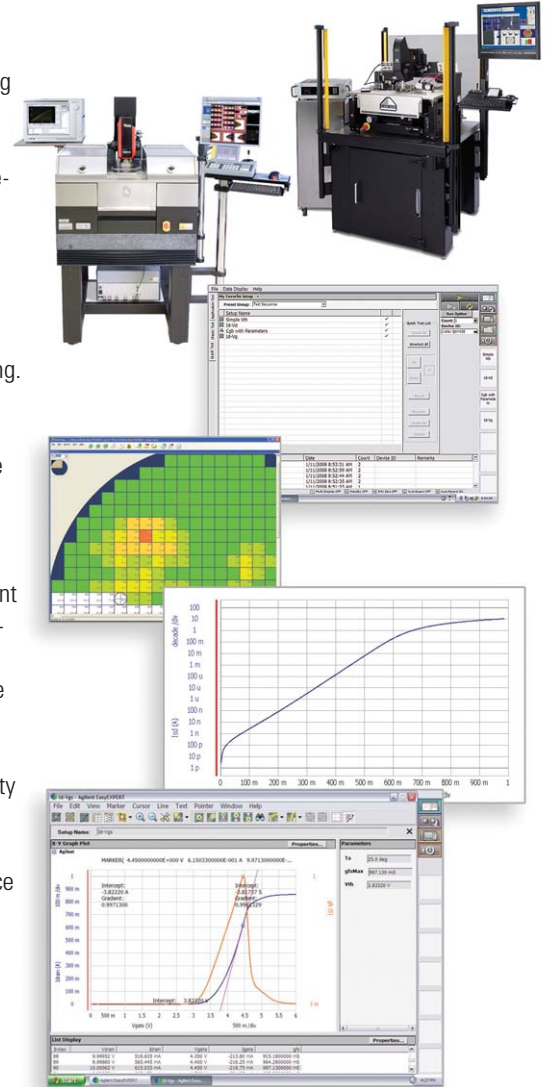
The N1259A test fixture supports a variety of different package types.

## On-wafer measurement and automation capabilities reduce cycle times



It is more efficient to perform high-power device testing on-wafer than on packaged devices.

However, power device on-wafer measurement has always been problematic due to the voltages and currents involved. The B1505A supports the adapters and connectors necessary to interface with all of the major analytical wafer probers for high voltage and high current wafer probing. It can also support a variety of different wafer prober safety interlock schemes. Moreover, it is extremely easy to automate testing across an entire wafer using EasyEXPERT's built-in Quick Test mode. Simply arrange the tests you want to run using Quick Test's GUI and select the Agilent furnished wafer prober drivers corresponding to your wafer prober. A single mouse click will then enable you to test across the entire wafer and automatically save your test data to any available storage location. In addition, the module selector unit's ability to switch as needed between an HVSMU, HCSMU or HPSMU permits such varied parameters as leakage current, on-resistance and breakdown voltage to be measured in a single measurement sequence. These abilities permit the acquisition of valuable process information without the need to first package the devices, thereby greatly saving both time and money.



The Quick Test feature and module selector unit allow you to automate on-wafer testing without having to do any programming or recabling, thereby reducing your overall measurement cycle time.

# Mainframe characteristics and module information

## Mainframe characteristics

<b>Available slots</b>	10
<b>Ground unit sink capability</b>	4.2 A
<b>USB 2.0 ports</b>	2 front and 2 rear
<b>Instrument control</b>	GPIB
<b>Networking</b>	100 BASE-TX / 10 BASE-T LAN Port
<b>External trigger inputs/outputs</b>	1 BNC Trigger In; 1 BNC Trigger Out; 8 Programmable Trigger In / Out

Module	HPSMU (B1510A)	HCSMU (B1512A)	HVSMU (B1513A)
<b>Maximum force voltage</b>	±200 V	±40 V (DC) ±20 V (Pulse)	±3000 V
<b>Maximum force current</b>	±1 A at ±20 V	±1 A (DC) ±20 A (Pulse)*	±8 mA at ±1500 V ±4 mA at ±3000 V
<b>Voltage measurement resolution</b>	2 µV	200 nV	200 µV
<b>Current measurement resolution</b>	10 fA	10 pA	10 fA

\*Note: If two HCSMUs are combined using either the Dual HCSMU combination adapter or the Dual HCSMU Kelvin combination adapter, then the maximum current ranges are ±2 A (DC) and ±40A (Pulsed).

## MFCMU (B1520A) Key Specifications

<b>Frequency range</b>	1 kHz to 5 MHz
<b>Maximum DC bias</b>	±25 V ±3000 V*
<b>Supported measurements</b>	Cp-G, Cp-D, Cp-O, Cp-Rp Cs-Rs, Cs-D, Cs-O, Lp-G, Lp-D Lp-O, Lp-Rp, Ls-Rs, Ls-D, Ls-O R-X, G-B, Z-θ, Y-θ

\* Using high voltage bias-tee (N1259A-020 or N1260A) and HVSMU



The B1505A 10-slot mainframe supports a variety of modules for high power test.

# EasyEXPERT Software features and options

## Data acquisition and control

<b>User interface</b>	Windows GUI
<b>User interface options</b>	Clickable knob, 15-inch touch screen, softkeys, USB keyboard and mouse
<b>Operation mode</b>	Tracer Test mode (Curve Tracer mode), Application Test mode, Classic Test mode, Quick Test mode
<b>Data viewing</b>	View multiple graphs in tile, tab or overlay display formats
<b>Data storage</b>	Data and test settings automatically or selectively saved after each measurement
<b>Test sequencing</b>	Test sequencing without programming via Quick Test mode
<b>Wafer prober control</b>	Integrated semiautomatic wafer prober control supports die/sub-die moves
<b>Supported wafer probers</b>	Cascade Microtech, SUSS MicroTec, Vector Semiconductor
<b>CV measurement</b>	Integrated capacitance compensation
<b>Furnished application libraries</b>	High power device, Utility
<b>Application test management</b>	Workspace feature allows creation of public/private application test libraries

## Plotting and reporting

<b>Data analysis</b>	Automated real-time graphical data analysis
<b>Data comparison</b>	Append feature displays multiple measurements on same graph. Tracer Test mode snapshot feature saves and displays multiple data traces.
<b>Data export</b>	Automatic data export to any available drive
<b>Printing</b>	Print to any Windows-supported printer (via LAN or USB)

## Environment and connectivity

<b>Operating system</b>	Windows 7
<b>Hardcopy media</b>	DVD-ROM / CD-ROM / CD-RW Drive
<b>Networking</b>	Windows 7
<b>Supported peripherals</b>	Any PC peripheral using USB

## Order information

<b>B1505A</b>	Power Device Analyzer / Curve Tracer		
	Supported modules:		
	High power SMU (HPSMU)	Slots occupied *	Max number
	High current SMU (HCSMU)	2	2
	High voltage SMU (HVSMU)	2	1
	Multi Frequency CMU (MFCMU)	1	1
<b>N1258A</b>	Module selector		
<b>N1259A</b>	Test fixture		
<b>N1260A</b>	High voltage bias-T		
<b>N1261A</b>	Protection adapter		
<b>N1262A</b>	Resistor box		

\*A total of 10 slots are available.





### Agilent Email Updates

[www.agilent.com/find/emailupdates](http://www.agilent.com/find/emailupdates)

Get the latest information on the products and applications you select.

### Agilent Channel Partners

[www.agilent.com/find/channelpartners](http://www.agilent.com/find/channelpartners)

Get the best of both worlds: Agilent's measurement expertise and product breadth, combined with channel partner convenience.



Agilent Advantage Services is committed to your success throughout your equipment's lifetime. To keep you competitive, we continually invest in tools and processes that speed up calibration and repair and reduce your cost of ownership. You can also use Infoline Web Services to manage equipment and services more effectively. By sharing our measurement and service expertise, we help you create the products that change our world.

[www.agilent.com/find/advantageservices](http://www.agilent.com/find/advantageservices)



[www.agilent.com/quality](http://www.agilent.com/quality)



Agilent B1500A Semiconductor Device Analyzer

[www.agilent.com/find/B1500A](http://www.agilent.com/find/B1500A)



Agilent B2900A Series Precision Source/Measure Unit

[www.agilent.com/find/B2900A](http://www.agilent.com/find/B2900A)

[www.agilent.com](http://www.agilent.com)  
[www.agilent.com/find/b1505a](http://www.agilent.com/find/b1505a)

For more information on Agilent Technologies' products, applications or services, please contact your local Agilent office. The complete list is available at:

### [www.agilent.com/find/contactus](http://www.agilent.com/find/contactus) **Americas**

Canada	(877) 894 4414
Brazil	(11) 4197 3500
Mexico	01800 5064 800
United States	(800) 829 4444

### **Asia Pacific**

Australia	1 800 629 485
China	800 810 0189
Hong Kong	800 938 693
India	1 800 112 929
Japan	0120 (421) 345
Korea	080 769 0800
Malaysia	1 800 888 848
Singapore	1 800 375 8100
Taiwan	0800 047 866
Other AP Countries	(65) 375 8100

### **Europe & Middle East**

Belgium	32 (0) 2 404 93 40
Denmark	45 70 13 15 15
Finland	358 (0) 10 855 2100
France	0825 010 700*
	*0.125 €/minute
Germany	49 (0) 7031 464 6333
Ireland	1890 924 204
Israel	972-3-9288-504/544
Italy	39 02 92 60 8484
Netherlands	31 (0) 20 547 2111
Spain	34 (91) 631 3300
Sweden	0200-88 22 55
United Kingdom	44 (0) 131 452 0200

For other unlisted countries:

[www.agilent.com/find/contactus](http://www.agilent.com/find/contactus)

Revised: June 8, 2011

Product specifications and descriptions in this document subject to change without notice.

© Agilent Technologies, Inc. 2011  
Published in USA, August 16, 2011  
5990-4158EN



**Agilent Technologies**