

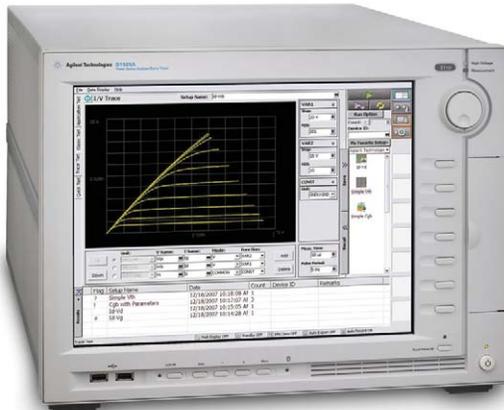
Agilent B1505A Power Device Analyzer/Curve Tracer

A one-box solution for accurate and easy power device analysis

Introduction

In order to meet emerging standards for low-carbon emissions and improved energy efficiencies, power devices are increasingly important for next-generation electronic products. New devices using wide band gap (WBG) materials such as silicon carbide (SiC) or gallium nitride (GaN) are being widely studied in order to achieve improved energy efficiencies. Measuring these devices requires high-voltage measurement capabilities greater than 1000 volts. In addition, power management ICs (PMICs) exemplify a growing device category that requires both high power and high accuracy testing. In addition to these exacting power device test requirements, it is also important to be able to test devices on-wafer to avoid the delays caused by packaging the devices and thereby reducing the development turnaround time.

Traditionally, curve tracers have been widely used for trouble-shooting and high-power measurements in both reliability and failure analysis departments, as well as by the circuit design groups of electronic equipment manufacturers. The abilities to quickly perform power device measurements, analyze data and generate reports are essential for these activities.



However, curve tracers cannot meet all of these requirements due to their limited data analysis and data management capabilities. In addition, the obsolescence of the curve tracer several years ago by major manufacturers has also created concern, since there was no obvious replacement product.

The B1505A is the only single-box solution that can function as a curve tracer replacement due to its ability to accurately evaluate and characterize power devices at up to 3000 volts and 20 amps. It also has the ability to perform capacitance measurements at high voltage biases. For the benefit of traditional curve tracer users, the B1505A includes a curve tracer mode that combines familiar curve tracer functionality with the convenience of a PC-based instrument. The net result is improved ease of use, better data analysis and simplified data management for the measurement of power devices and power circuitry.

B1505A Features and Benefits

A single-box solution with 3000 V/20 A capability

The B1505A is the only single box solution available today with the capability to characterize high power devices from the sub-picoamp level up to 3000 volts and 20 amps. The B1505A has separate modules that support high-current (HCSMU) and high-voltage (HVSMU). The B1505A also supports a high-power SMU (up to 1 A/200 V) and a multi-frequency capacitance measurement unit (up to 5 MHz). Its ten-slot modular construction lets you configure the B1505A exactly the way you want.



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Accurate force/measure capability up to 3000 volts

Power devices using new materials such as SiC or GaN require higher breakdown voltage measurement capabilities than do conventional power device. In addition, there are no solutions available that can measure leakage currents at high voltage biases with sufficient resolution and accuracy. The B1505A's HVSMU supports breakdown measurements up to 3000 V, and its ability to also measure leakage currents in the sub picoamp range at 3000 V bias is far superior to existing solutions that can only measure down to the microamp level.

50 microsecond current pulse width at high current

Device self-heating due to large applied currents distorts measurement results and it is a big concern for power devices such as PMICs. Proper characterization of device on-resistance (R_{on}) requires high measurement accuracy and resolution, but device self-heating can completely distort this sensitive measurement. The B1505A's HCSMU can force a 20 A current pulse as narrow as 50 microseconds, which is sufficient to avoid the deleterious effects of device self-heating thereby enabling the user to perform these sensitive measurements.

Capacitance measurement at up to 3000 V bias

In order to properly evaluate the switching characteristics of power devices, it is important to measure drain-source capacitance and junction capacitance, and to extract the basic physical parameters of the device. Using a high-voltage bias-T (available from Agilent), the HVSMU and MFCMU can be used together to perform capacitance measurements at biases of up to 3000 V. This makes the B1505A the first solution in the industry capable of performing capacitance measurements at this level of voltage bias.

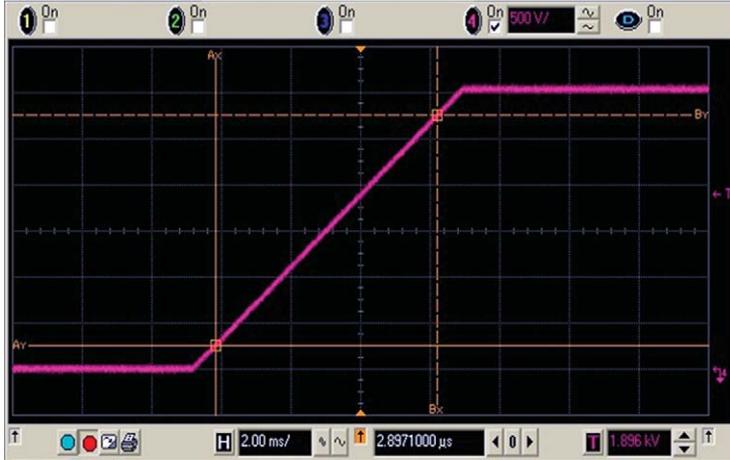


Figure 1. Waveform showing a 3000 V sweep using the HVSMU.

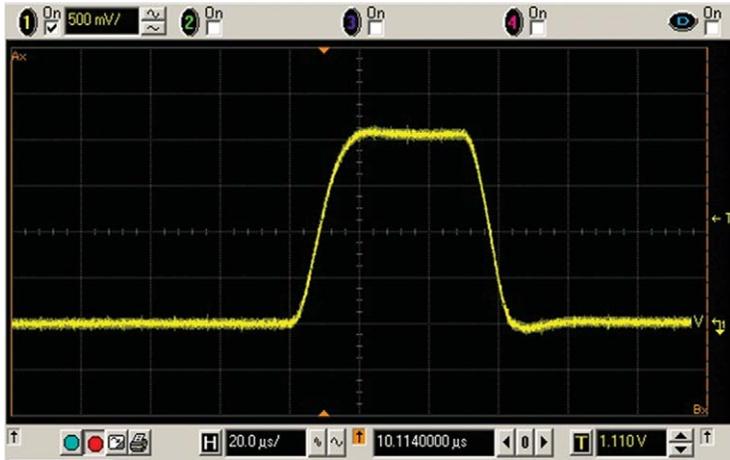


Figure 2. Waveform showing a 20 A current pulse with 50 μ s width.

Quick measurement via the curve tracer mode

The B1505A software environment allows users to check device characteristics and detect device faults with the easy convenience of a curve tracer. Just like on a curve tracer, the B1505A supports rotary knob control of the independent sweep variable for intuitive and real-time evaluation of parameters such as breakdown voltage. The measurement setup information and data can be automatically stored to the B1505A's built-in hard disk drive and transferred to USB memory sticks as well as other portable storage devices. It is also easy to print graphical measurement data and to copy and paste it into reports when the analysis results are summarized.

Easy-to-use Windows PC-based EasyEXPERT software incorporates data management functions

The B1505A, which uses the same PC-based EasyEXPERT software as Agilent's popular B1500A Semiconductor Device Analyzer, allows users to get measurement results quickly and easily. Device parameters can be automatically analyzed using the auto-analysis function and displayed on the screen when the measurement is done. Application tests for power device characterization are also included with the EasyEXPERT software.

On-wafer testing and prober control

On-wafer power device testing faces many obstacles. The need to disable interlock in order to connect cables from equipment to the wafer prober creates many safety concerns. It is also highly desirable that the measurement instrument have a prober driver to permit automated testing in conjunction with the on-wafer measurements. The B1505A provides both a standard cable and interlock mechanism (to permit safe prober connections) and driver support for a variety of semiautomatic wafer probers. These features make it possible to replace time consuming packaged device testing with safe and efficient on-wafer testing, thereby drastically reducing the TAT (turn-around-time) and decreasing overall cost.

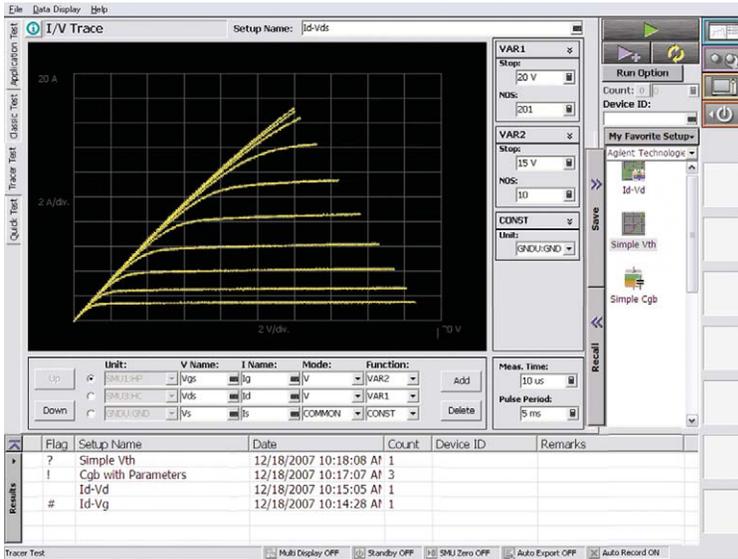
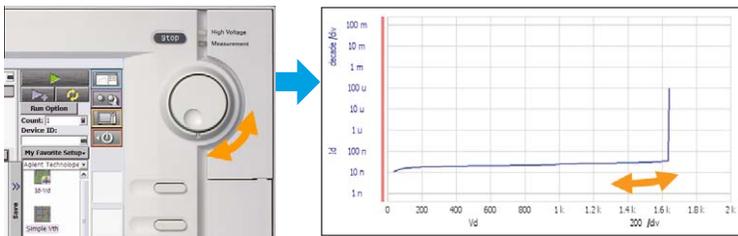


Figure 3. The curve tracer mode supports fast and easy measurement.



Breakdown measurement using the B1505A's rotary knob. (Note: Movement in both directions is supported.)

Figure 4. In the curve tracer mode you can measure breakdown voltage using the rotary knob.

EasyEXPERT makes parametric test as easy as 1-2-3.

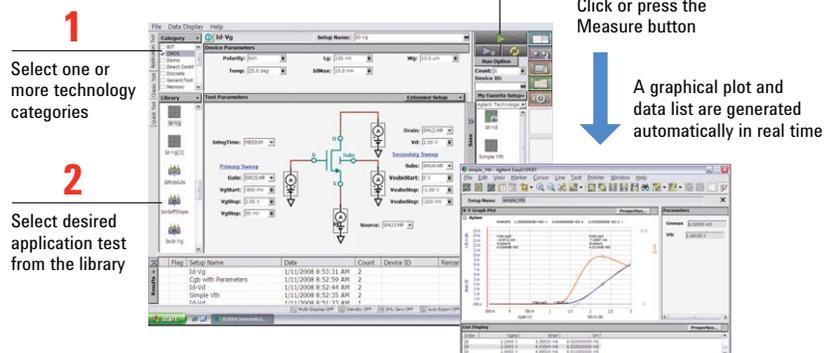


Figure 5. MS Windows-based EasyEXPERT software is a powerful environment for device evaluation and data analysis.

Standard fixture with interlock creates safe measurement environment

A proper test fixture solution is extremely important, both to insure safety (due to the high voltages and currents used) and to support the wide variety of power device package types. A previous limitation of curve tracers was that some power devices could not be evaluated due to their size, or it was necessary to fabricate an adapter in order to test the device (which caused delays and did not guarantee accuracy). However, the B1505A's test fixture can accept a wide variety of devices, such as power MOSFETs, diodes and IGBTs, regardless of their size or shape via a large fixture adapter with customizable fixture modules. In addition, the test fixture's built-in interlock mechanism ensures that high voltages and currents can be applied to test devices safely.

Convert existing B1500A to B1505A

Agilent provides a conversion kit that allows existing B1500A users to convert their B1500A mainframe into a B1505A mainframe. This allows current B1500A users to expand the voltage and current measurement capabilities of their instrument without having to purchase a new instrument.

Date Orderable: May 1, 2009

Preliminary specifications

HVSMU	
Maximum voltage/current:	1500 V/8 mA; 3000 V/4 mA (DC & Pulsed)
Pulse width:	500 μ s to 2 s
Pulse period:	5 ms to 5 s
Leakage measurement:	less than pico amps
Measurement:	10 fA to 8 mA, 1 mV to 3000 V
Maximum of one HVSMU per mainframe	

HCSMU	
Maximum current/voltage:	20 A/20 V (Pulsed), 1 A /40 V (DC)
Pulse width:	50 μ s – 1 ms
Measurement:	10 pA to 20 A, 200 nV to 40 V
Maximum of two HCSMUs per mainframe	



Figure 6. The B1505A's N1258A test fixture can support a variety of different packaged device types.

Feature summary

- Device characterization at 3000 volts and 20 amps in a single instrument
- Sub picoamp level measurement capability at high voltage
- 50 microsecond current pulse width at high current
- Capacitance-Voltage (CV) measurement with up to 3000 V bias
- Quick device check enabled by curve tracer mode
- Easy operation and data management functions with PC-based EasyEXPERT software
- On-wafer testing and built-in wafer prober control
- Standard fixture with interlock creates safe measurement environment

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