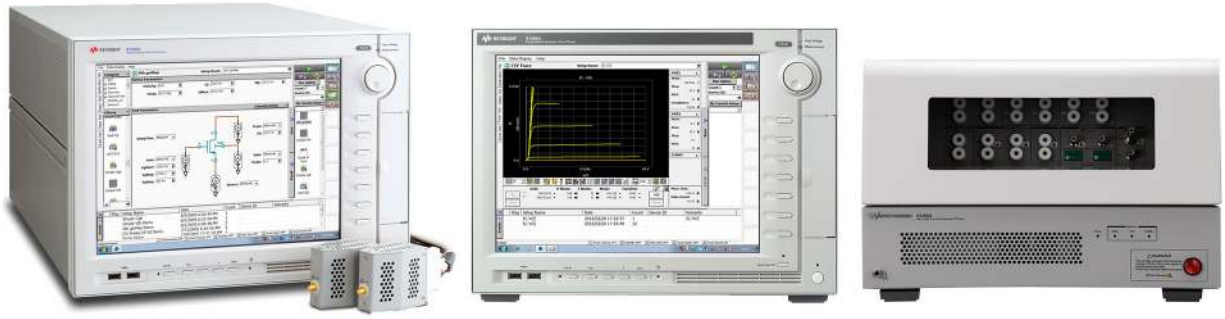
Keysight Technologies
EasyEXPERT & Desktop EasyEXPERT

Technical Overview



KEYSIGHT TECHNOLOGIES

Introduction

Accelerate your device characterization from exploration to automation

Wideband commercial, satellite or radar signals can now be analyzed Electrical characterization, such as current versus voltage (I-V) measurement, is a basic research and development (R&D) need when characterizing next-generation materials and devices. Since device characterization involves various types of tests, being able to execute them quickly and efficiently is very important to reduce time to market and maximize your return on investment. The biggest time sinks that typically work against this goal are listed below.

- Learning how to use the test instrument
- Developing tests and programming the instrument
- Optimizing test conditions through trial-and-error
- Generating reports from graphical test results
- Managing many different files (such as test setup, test result and test report files)
- Waiting for the instrument to be available when shared among multiple users
- Moving between interactive and automated testing

To solve these device characterization issues, Keysight Technologies, Inc. has developed EasyEXPERT and Desktop EasyEXPERT software. EasyEXPERT is resident software on the B1500A/B1505A device analyzers; Desktop EasyEXPERT is free PC-based software that works with the Keysight B1500A, B1505A, 4155/56B or 4155/56C. Both versions of GUI-based EasyEXPERT software provide the same user experience, enabling you to accelerate device characterization from test development, analysis and reporting up through and including complete test automation.

Accelerate Test Development, Execution and Debug

EasyEXPERT dramatically reduces test times

The early R&D phase of process development typically requires a lot of interactive trial-and-error measurement because test conditions are in a state of flux. Conversely, as a process reaches maturity it is usually more convenient to use pre-defined tests. To meet these diverse needs, Keysight EasyEXPERT supports three unique test modes: application test mode, classic test mode and tracer test mode. This flexibility allows EasyEXPERT to meet device characterization needs across all phases of the process development lifecycle.

Table1. EasyEXPERT Application Test examples

Library Category	Application Tests
B1500A	
CMOS Transistor	Id-Vg, Id-Vd, Vth, breakdown, capacitance, QSCV, etc.
Bipolar Junction Transistor	Ic-Vc, diode, Gummel plot, breakdown, hfe, capacitance, etc.
Discrete device	Id-Vg, Id-Vd, Ic-Vc, diode, etc.
Memory	Vth, capacitance, endurance test, etc.
Nano device	Resistance, Id-Vg, Id-Vd, Ic-Vc, etc.
Reliability test	NBTI/PBTI, charge pumping, electro migration, hot carrier injection, Vramp, J-Ramp, TDDB, etc.
B1505A	
IGBT	Ic-Vce, Ic-Vge, Vce(sat), Vth Vge(off), breakdown, capacitance, etc.
GaN device	FET Current Collapse, Id-Vds Current Collapse, Diode Current Collapse, etc.
SiC transistor	Id-Vds, Rds-Id, Id-Vgs, Vds-Vgs, etc.
Power MOSFET	Id-Vds, Rds-Id, Id-Vgs, Capacitance, etc.
Power BJT	Ic-Vce, Vce(sat)-Ic, Ic-Vces, Ic-Vceo, etc.
Power diode	If-Vf, Ir-Vr, Capacitance, etc.

Application Test Mode: Measurement in Three Easy Steps

Application test mode provides over 300 test setups (application tests) for the B1500A and the B1505A. These ready-to-use test setups are pre-installed, enabling you to start making measurements and collecting data quickly without the need to do any test development or programming.

As shown in Figure 1, measurements can be executed in three simple steps. Step one is to select an application test from the furnished libraries (by device type and/or desired measurement). Step two is to modify the default parameters as needed. Step three is to execute the measurement by clicking on the "start measurement" button.

In addition to measurement data, since many of the application tests include automatic analysis you also get calculated and extracted parameters in real time. Once you have set up an application test's parameters a specific way, you can store it into a "My Favorite Setup" list for quick future execution. Moreover, although the application tests are pre-defined, they can easily be modified and customized using EasyEXPERT's built-in graphical programming environment. For more information, please refer to the application note *Customizing Keysight B1500A EasyEXPERT Application Test*.

Step 1
Select a measurement from one of the furnished libraries.

Step 2
Modify the measurement parameters as needed. (Note: Customized tests can be saved into a "My favorite" setup)

Step 3
Press the measure button to start the measurement. Graphical and numerical measurement results, data analyses, and parameter extractions are automatically displayed.

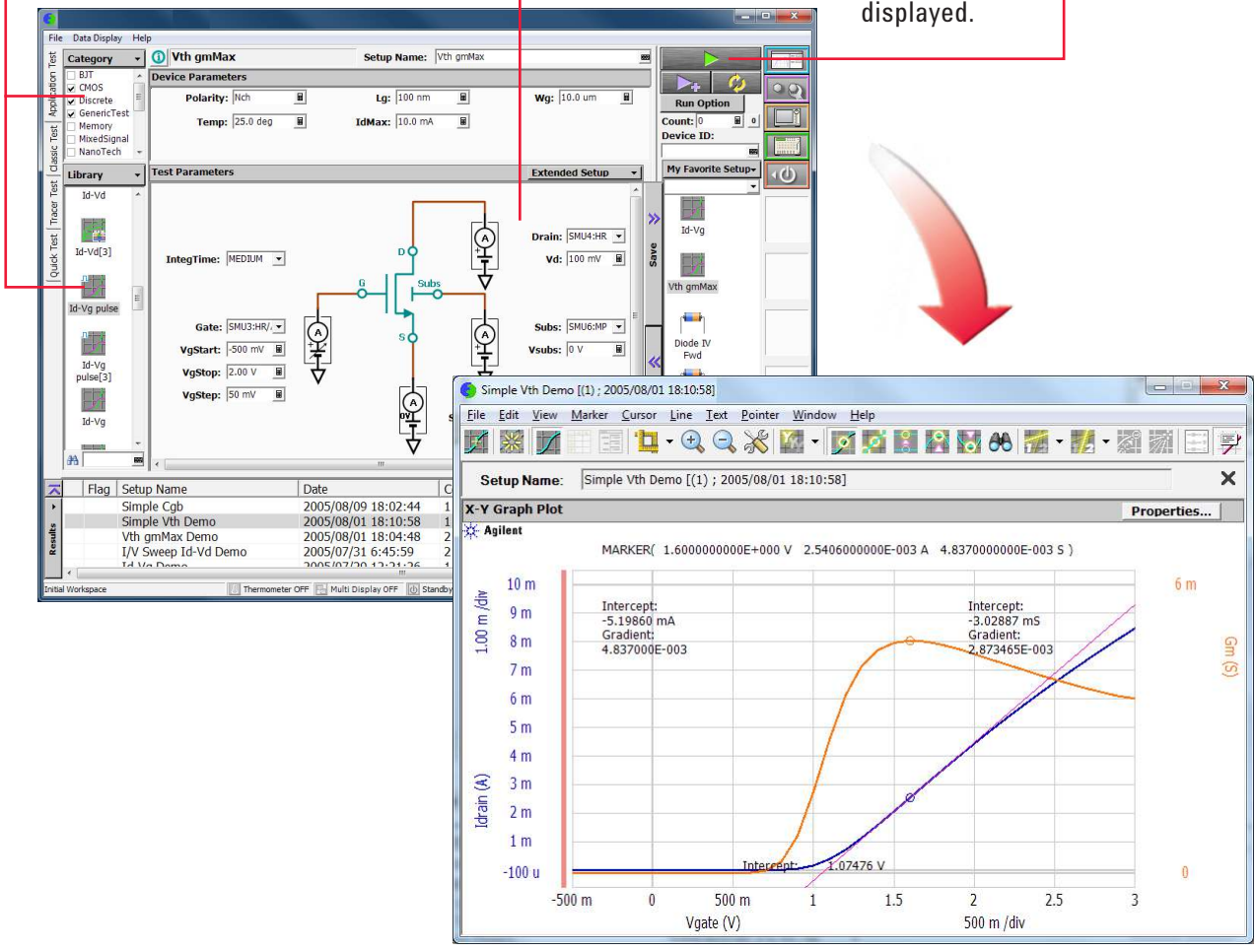


Figure 1. Three simple steps to make measurements using application test mode

Classic Test Mode: Create Customized Tests and Reuse 4155/56 Setups

Classic test mode provides access to intrinsic instrument functions such as current versus voltage (I-V) sweeps, current or voltage versus time (I/V-t) sampling, capacitance versus voltage (C-V) sweeps, etc.

Classic test mode provides full access to all instrument capabilities, making it useful when you want to perform a measurement not available in the furnished application tests. Classic test mode's user interface employs the familiar look-and-feel of the 4155/56 Semiconductor Parameter Analyzer as shown in Figure 2. This makes it easy to create and modify tests, get test results and display data just like when using application test mode.

In addition, EasyEXPERT's classic test mode supports test migration from the 4155/56 (B and C models). Using the furnished setup file converter, you can convert 4155/56 setup files (MES or DAT extensions) into EasyEXPERT classic mode test setups. This permits EasyEXPERT-based instrument users to take advantage of existing 4155/56 test setups without having to create new ones from scratch. It also eliminates the 4155/56's tedious floppy disk based file storage.

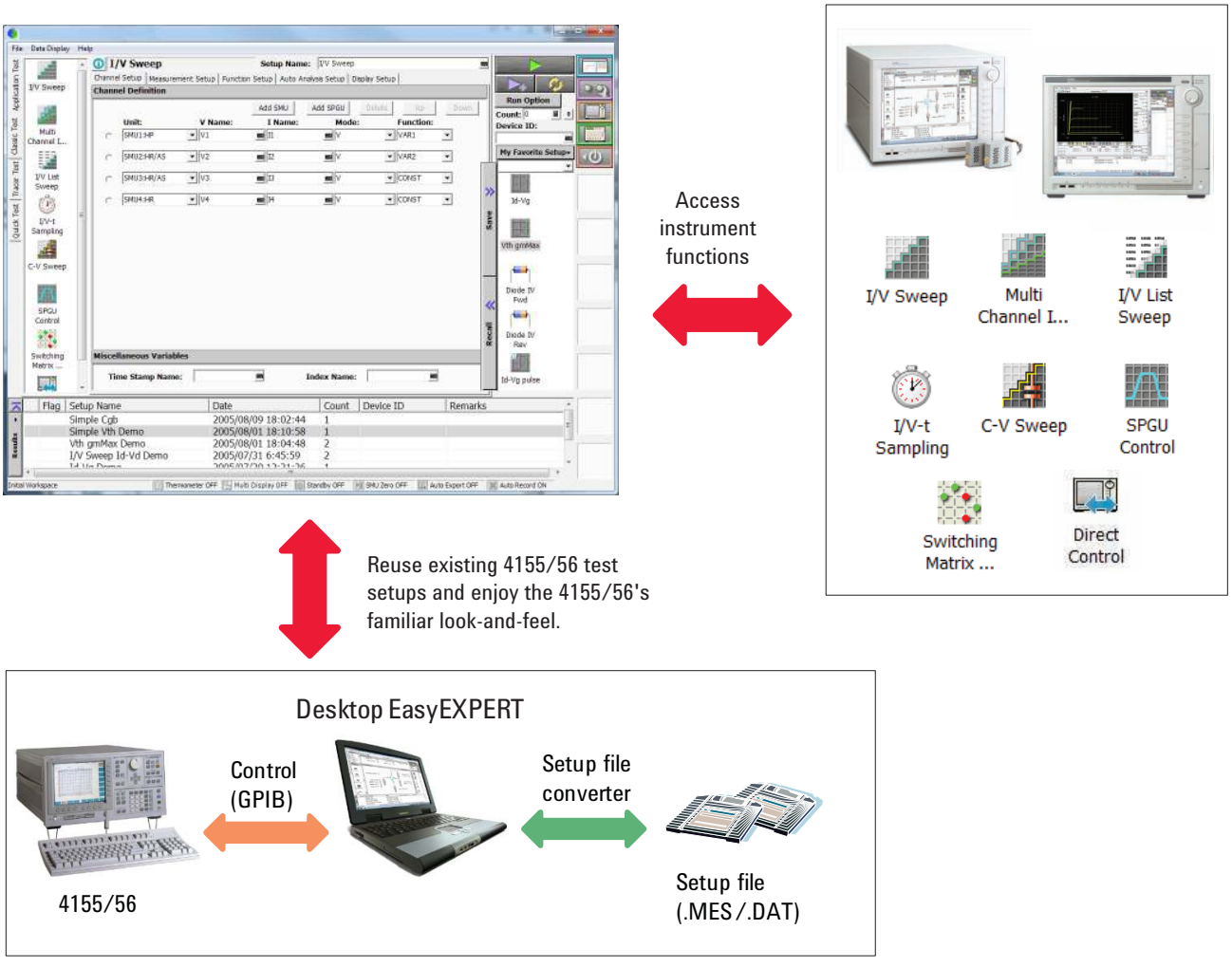


Figure 2. Using Desktop EasyEXPERT and a PC with floppy disk drive access you can import 4155/56 test setup files into classic test mode.

Tracer Test Mode: Create Customized Tests and Reuse 4155/56 Setups

Tracer test mode provides intuitive and interactive sweep control capability. As shown in Figure 3, the rotary knob on the front panel of the B1500A and B1505A allows sweep measurements to be modified in real-time (just like on an analog curve tracer). Also like a curve tracer, both voltage and current can be swept bidirectionally (expanding in both the positive and negative directions simultaneously). This is useful for failure analysis and when characterizing unknown devices. Moreover, once you have determined the ideal test conditions using tracer test you can easily transfer the settings into a classic test mode setup for further refinement or for automated testing.

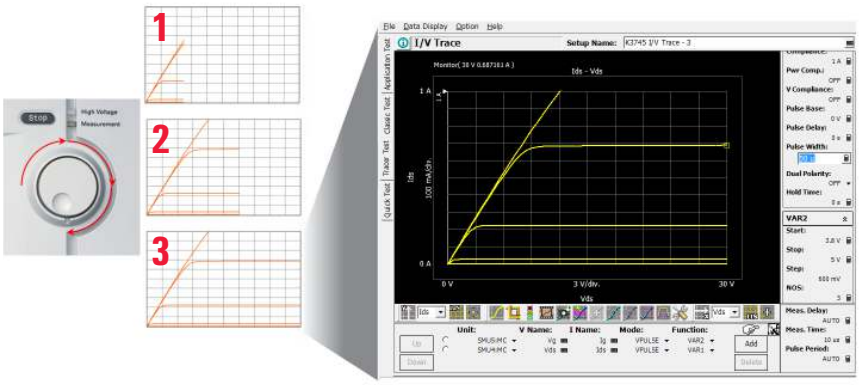


Figure 3. Tracer test mode for interactive testing like a curve tracer

Tracer test mode also possesses many other powerful features not available on curve tracers. A snapshot function allows the user to capture and save traces, permitting easy comparison of different measurements. The snapshot feature is especially useful to document the effects of phenomena such as device self-heating. A stoplight function allows the user to set up visual forbidden regions such that the measurement will immediately halt if any measurement trace enters the prohibited area. Best of all, an auto-record and replay feature constantly saves measurement data into a data buffer, enabling measurement traces to be recalled and displayed even if a device has been inadvertently destroyed.

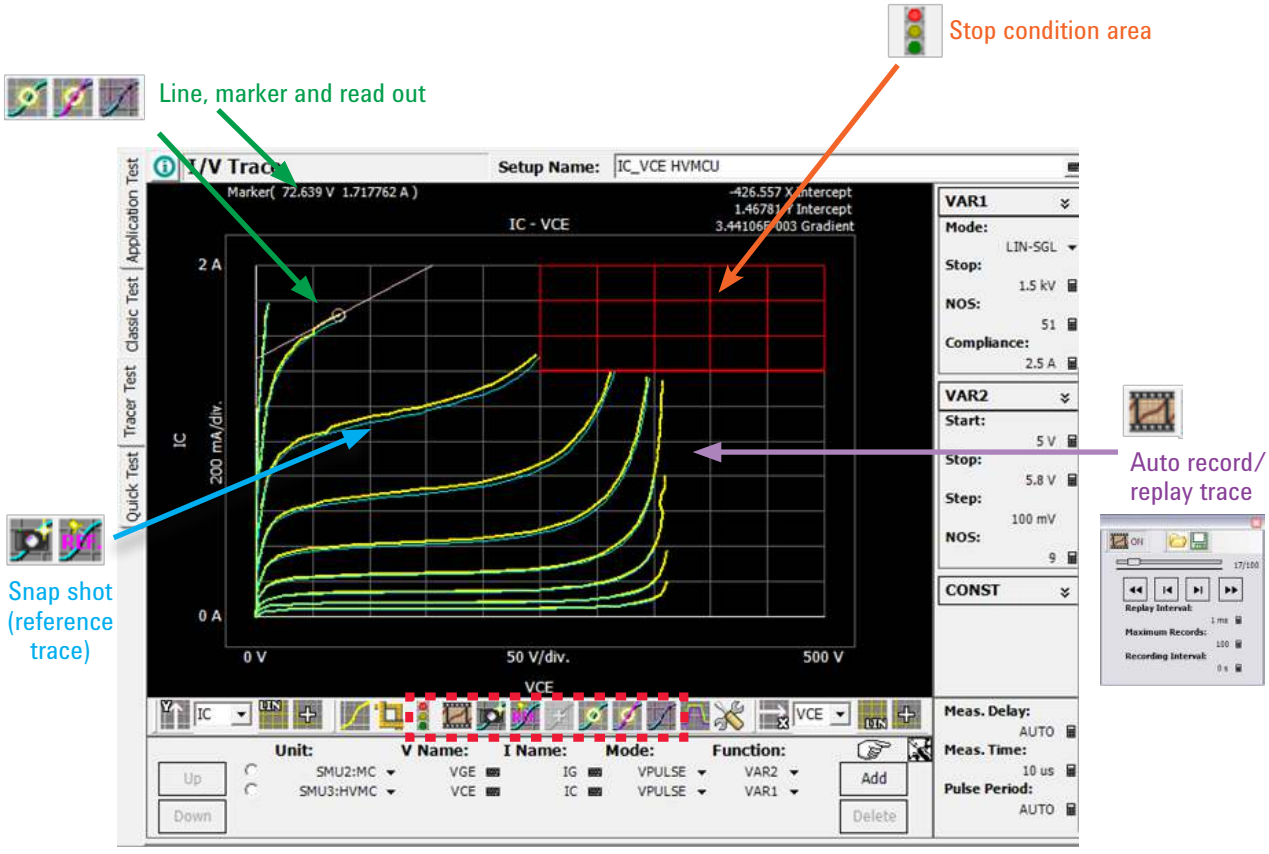


Figure 4. Tracer test mode has many powerful and useful features not found on conventional curve tracers.

Oscilloscope View: Increase Pulsed IV Measurement Confidence

Monitoring pulsed IV waveform shapes is important to maintain measurement accuracy. Stray and device capacitance effects can cause actual waveforms to deviate from their programmed values, which in-turn can result in inaccurate data if measurements are taken before the waveform has stabilized.

To improve pulsed IV measurement accuracy, tracer test mode supports an oscilloscope view. For supported B1500A and B1505A modules, oscilloscope view can display the actual measured voltage and current pulses at any point along a sweep measurement (refer to Figure 5). This permits quick waveform verification, debug and timing parameter optimization without the need for an external oscilloscope.

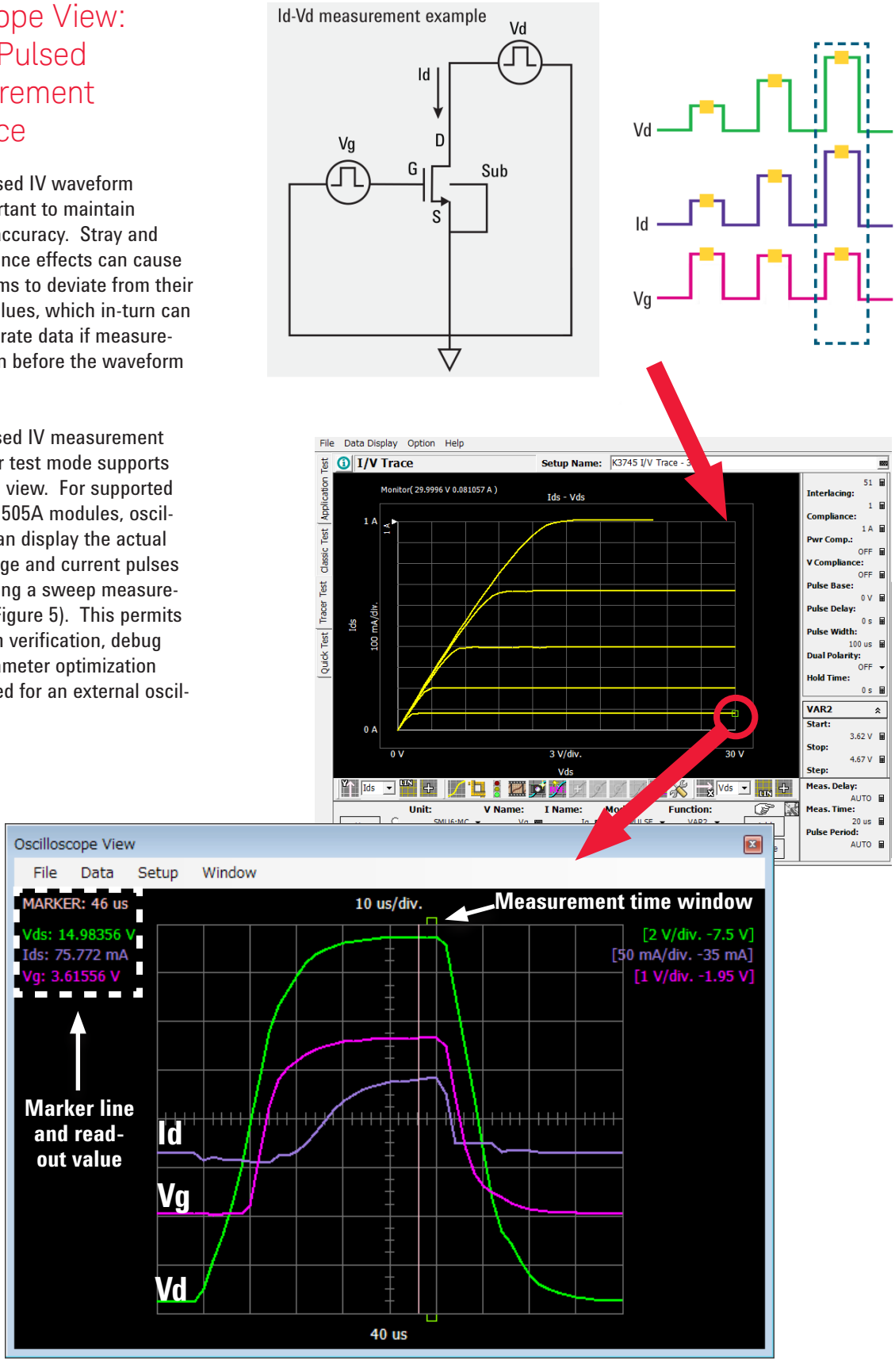


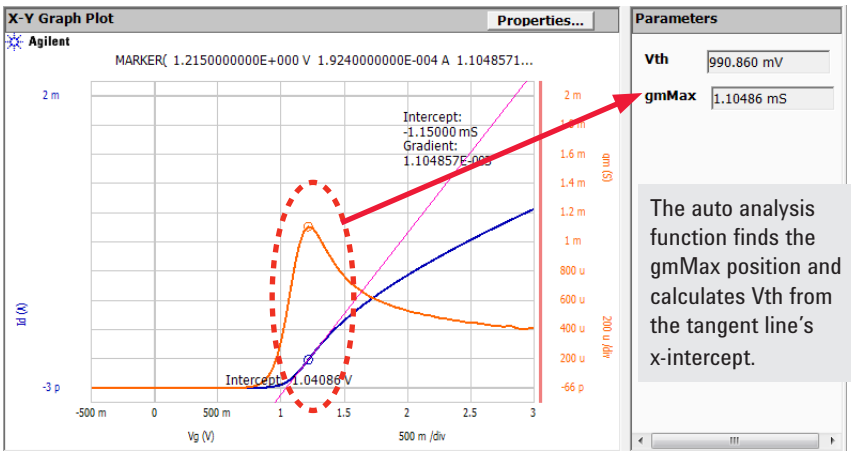
Figure 5. Oscilloscope view allows you to verify pulsed measurements right on the instrument front panel (B1500A or B1505A)

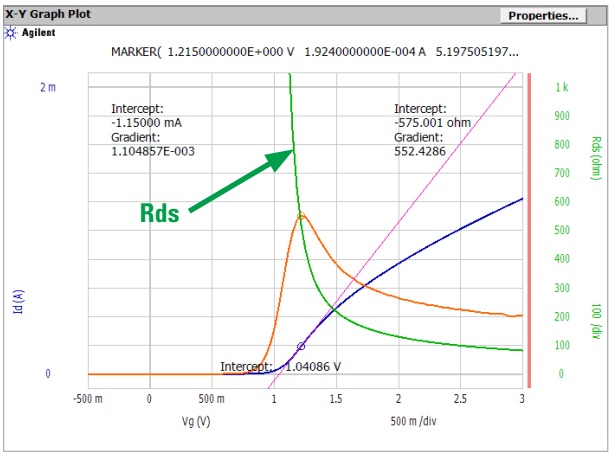
Automated Graphical Analysis Capabilities and Easy Report Creation

As shown in Figure 6, EasyEXPERT supports powerful data display, analysis and arithmetic functions that facilitate automated data analysis and parameter extraction. Since the pre-defined data analyses and parameter extractions are performed in real-time, you can see measurement results (such as Vth, BVdss, etc.) automatically and immediately.

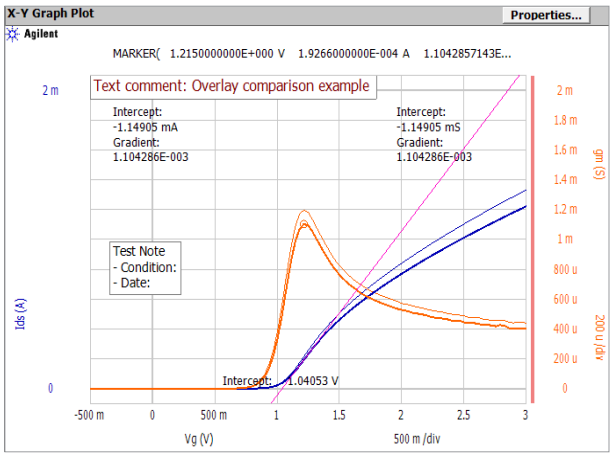
In addition, it is easy to manually analyze measurement data post-test. Various marker, cursor and line functions are available, and you can easily add new parameters to the X-Y display and change back and forth from linear to log scales. You can also overlay graphical data from different measurements for quick comparison and detection of measurement variances between tests.

Moreover, you can have both numerical and graphical data automatically saved so that this information can later be exported into formats (such as txt, csv, jpg, etc.) that allow easy report creation using an external PC.

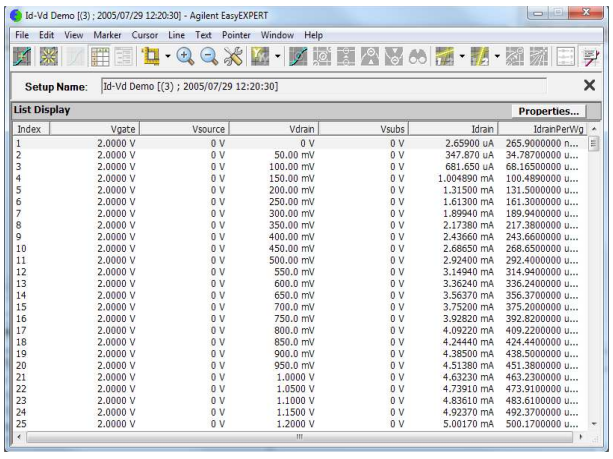




Graph of calculated parameter (Rds example shown)



Graph overlay



List data

Figure 6. Powerful graphing capabilities facilitate analysis and reporting

Built-In Data Management Capabilities Facilitate Test Data Management

The R&D phase of process development typically involves lots of tweaking of measurement parameters and comparing of measurements made under different conditions. Therefore, maintaining the linkages between test conditions and test data is extremely important. However, using standard file formats for this purpose (txt, csv, xls, etc.) can get very complicated and tedious.

To improve this situation, EasyEXPERT has built-in data management features and the ability to automatically record test data. EasyEXPERT saves measurement data, including both test conditions and test results, with a time stamp immediately after measurement completion. This eliminates issues with lost data, overwritten data and uncertain linkages between the test conditions and test results. Users can easily recall both test setups and test results. Multiple test results can be displayed and compared graphically in a variety of ways. EasyEXPERT also permits flags and remarks to be saved with each test record, making it easy to filter through multiple records quickly via flag, remark, setup name and/or data range (please refer to Figure 7). These powerful test data management capabilities dramatically improve test productivity

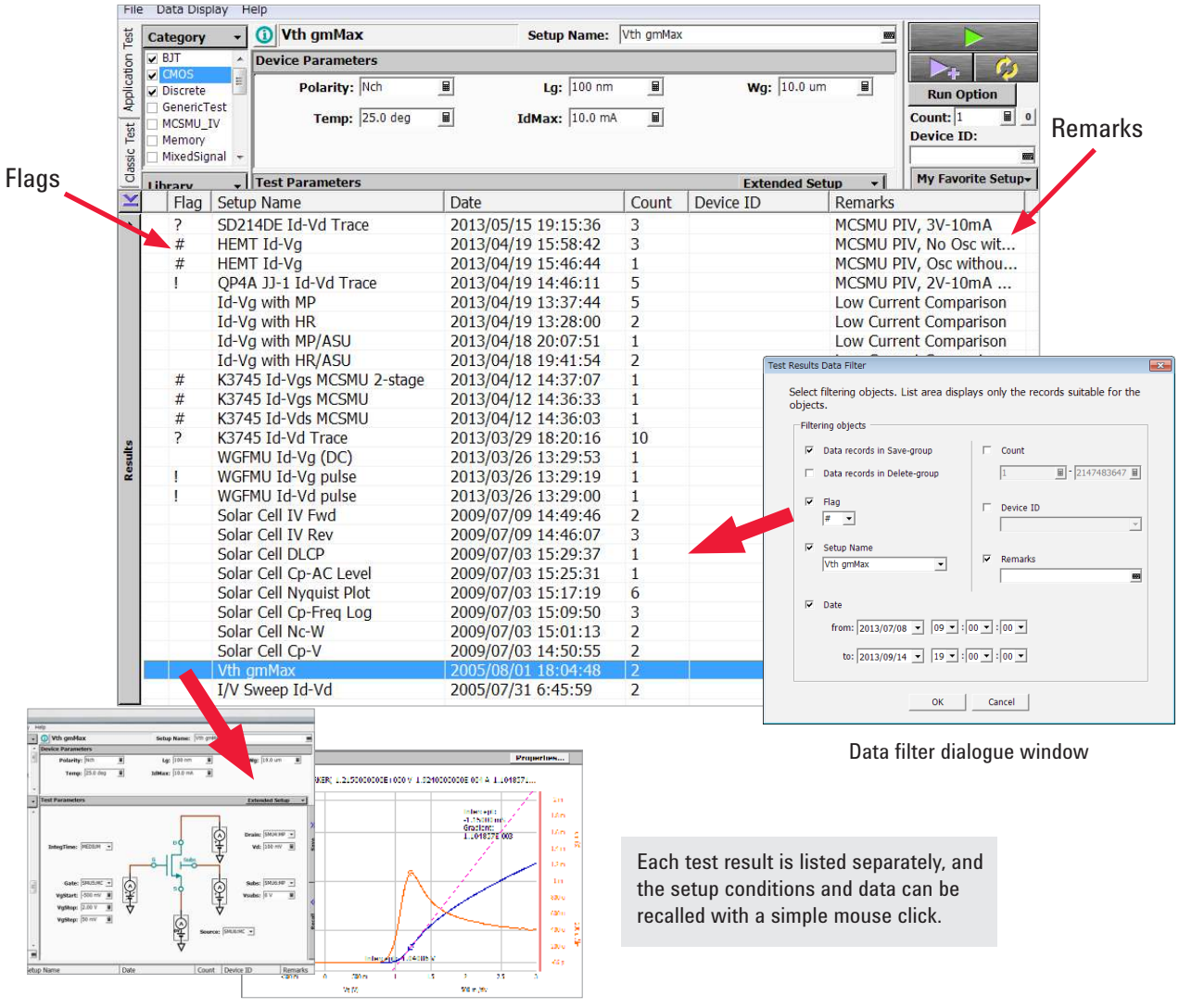


Figure 7. The built-in data management feature enables you to quickly access test setups and test results

Workspace Feature and Desktop Easyexpert Maximize Efficiency of Shared Resources

When multiple people are using the same equipment, it is critical to have some means to maintain the integrity of each user's files and data. EasyEXPERT meets this need through its workspace feature. Each EasyEXPERT workspace is an independent test environment that can be freely customized and modified without impacting the tests or data existing in other workspaces. Each workspace's application test library, "My Favorite" setups and test results are unique and are not influenced by those existing in other workspaces. In addition, EasyEXPERT allows workspaces to be either private or public. Private workspaces cannot be accessed from other workspaces, but public workspaces allow their application tests to be accessed by users in other workspaces. As shown in Figure 8, a workspace management tool supports workspace backup and also enables workspaces to be transported from one test station to another.

Desktop EasyEXPERT is another powerful tool to improve overall instrument use efficiency. Desktop EasyEXPERT, which can run on any supported PC, provides the same functionality as EasyEXPERT running on the B1500A or B1505A. In offline mode Desktop EasyEXPERT permits test development and data analysis. In online mode Desktop EasyEXPERT can control the B1500A or B1505A via GPIB and provide the same user experience as EasyEXPERT running on the instrument front panel. For instruments shared by a group of users, Desktop EasyEXPERT both accelerates development and optimizes equipment utilization (refer to Figure 9).

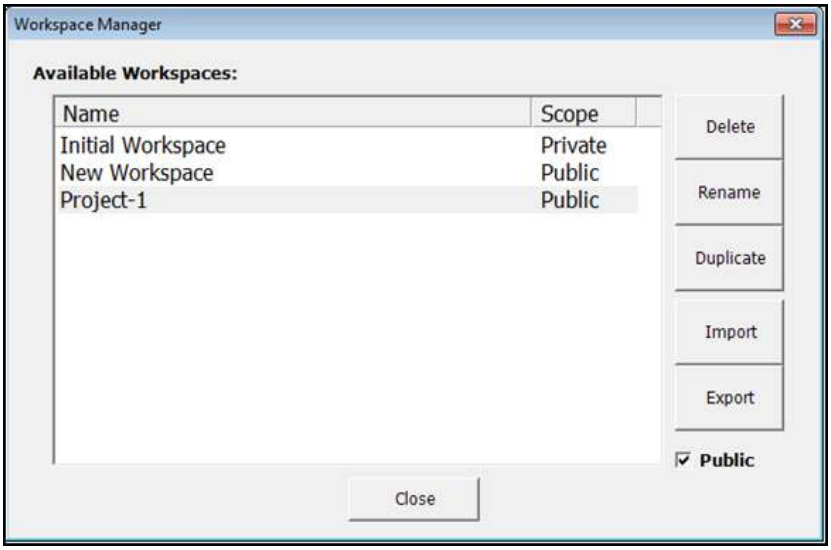


Figure 8. Workspace manager

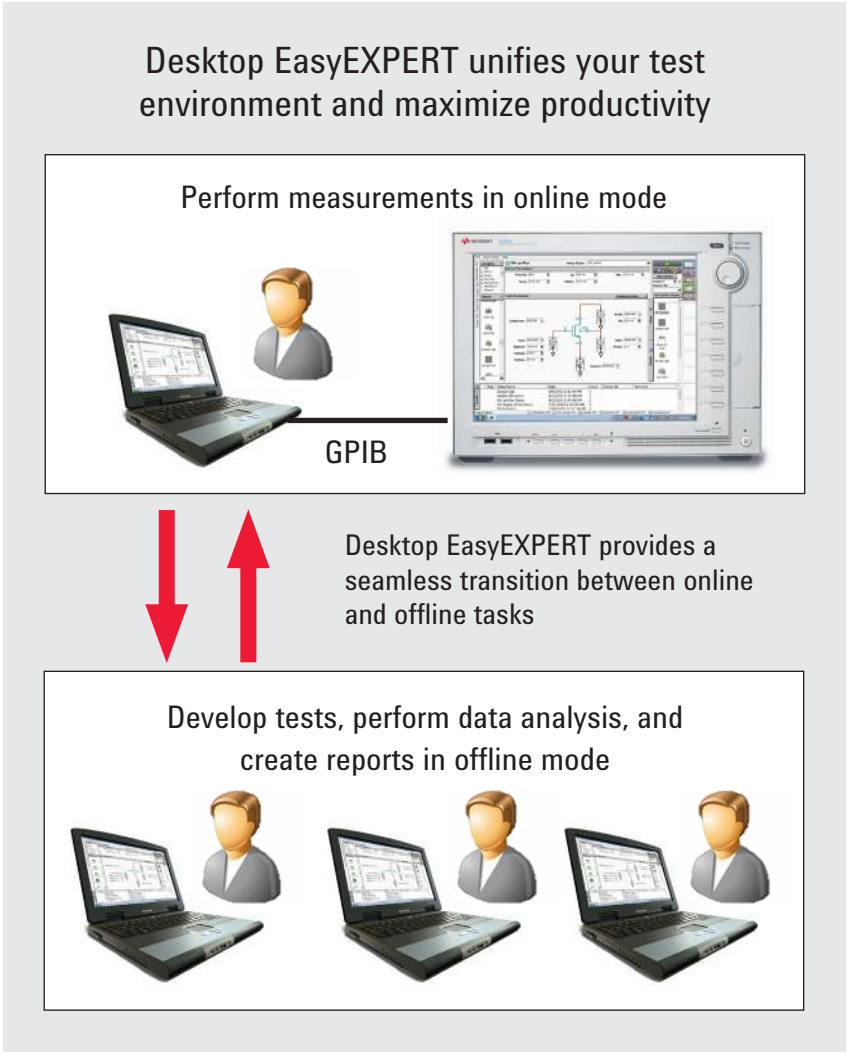


Figure 9. Desktop EasyEXPERT improves productivity in multiple user environments

Quick and Simple Test Set Automation

Set up test sequences easily using EasyEXPERT's quick test mode

Automated testing is important to efficiently gather multiple parameters on multiple devices. However, in many cases instruments used for device characterization do not have automated test capability. This means that manually created test setups cannot be reused for automated testing, so the user has to control the instrument from an external PC over GPIB or LAN. Therefore, the ability to reuse interactively created tests in automated testing is a highly desirable feature with obvious productivity benefits.

To address this need, EasyEXPERT has a GUI-based quick test mode that supports automated test sequencing. Quick test mode provides a convenient means to execute a sequence of tests created in application test, classic test or tracer test mode without doing any programming. It allows you to select, copy, and rearrange any of these tests with a few simple mouse clicks. Moreover, you can combine wafer prober control with quick test mode to perform multiple tests automatically across a wafer. If you are using a switching matrix, you can also automatically call switching patterns created interactively using EasyEXPERT. In addition to supporting popular semiautomatic wafer probers, EasyEXPERT also allows you to create your own wafer prober drivers.

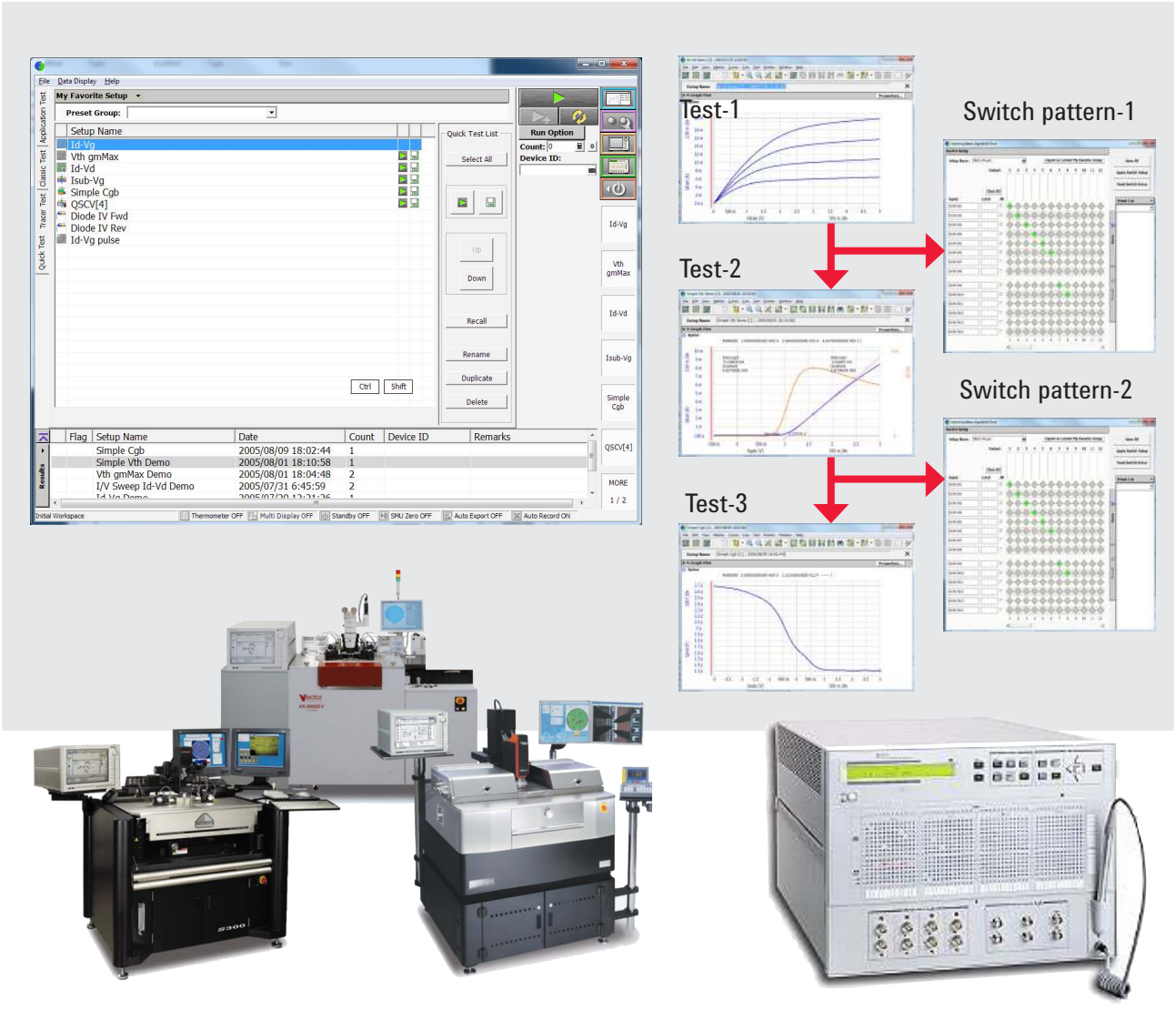


Figure 10. Quick test mode enables you to perform automated testing with a prober and (optional) switching matrix without programming

Flexible Options for Instrument Control

You can control EasyEXPERT over the LAN using its integrated remote control function. This feature provides the benefit of allowing you to use any programming language to control the B1500A or B1505A. Of course, you can also send FLEX commands over GPIB directly to the instruments and bypass EasyEXPERT if desired (see Figure 11).

EasyEXPERT's remote control capability enables you to recall and execute interactively created EasyEXPERT test setups programmatically, eliminating the need to recreate test setups using FLEX commands when controlling instruments over GPIB. This reduces programming effort and provides an easy path to integrate the B1500A or B1505A into an established test platform created in programming languages such as LabVIEW, VEE, Visual Basic, Visual C, etc. (please refer to Figure 12).

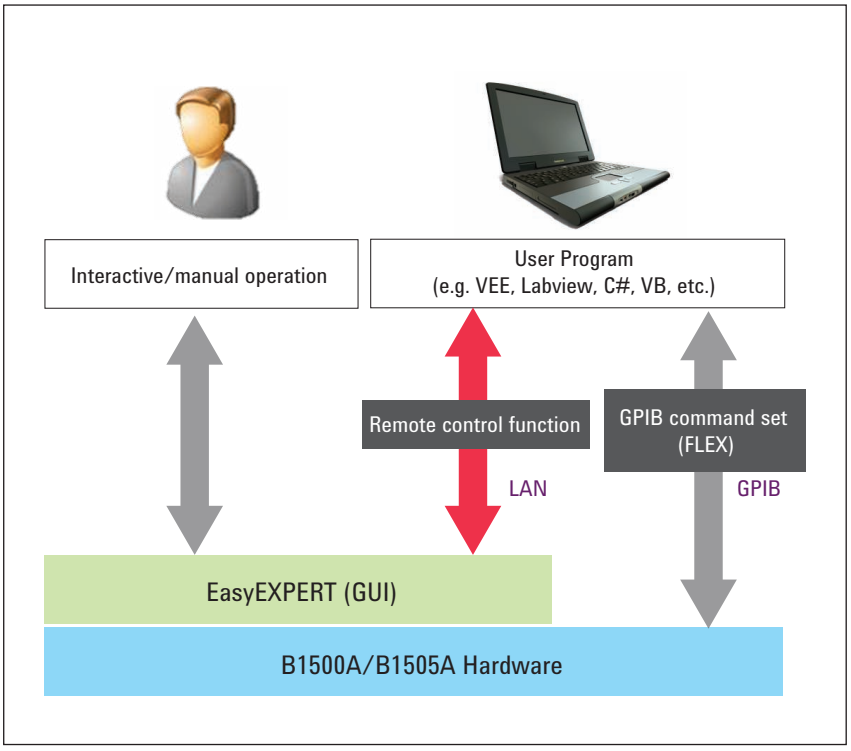


Figure 11. There are multiple ways to use EasyEXPERT and to control the B1500A and B1505A.

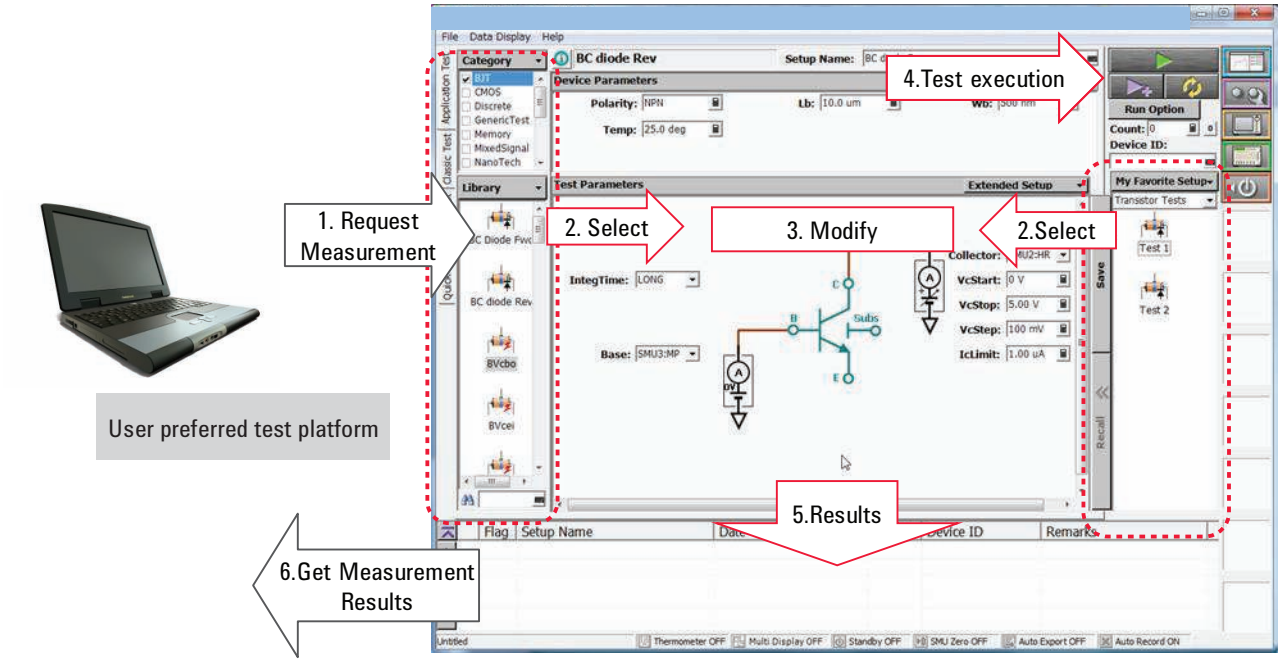


Figure 12. EasyEXPERT's remote control capability makes it is easy to run EasyEXPERT tests remotely using the platform and language of your choice

Conclusion

EasyEXPERT is powerful software that can accelerate device characterization from test development, analysis and reporting up through and including automated test. Three interactive test modes (application test, classic test and tracer test) provide intuitive GUIs that enable easy and quick start-up, customization, execution and data analysis. The workspace feature and built-in data management capabilities help insure the integrity of test setups and measurement results.

EasyEXPERT also supports a seamless transition from manual testing to automated testing via its quick test mode, which provides quick and easy test sequencing without programming.

EasyEXPERT's remote control function provides an efficient means to manage the B1500A or B1505A from an external controller by calling and executing EasyEXPERT test setups created interactively. This minimizes programming effort and ensures that manual test results and automated test results correlate exactly.

In addition, Desktop EasyEXPERT provides the same user experience on your PC as EasyEXPERT running on the B1500A or B1505A. Desktop EasyEXPERT's offline capabilities make it much easier for multiple users to share a single instrument, and its online ability to control a supported instrument over GPIB provides added convenience. For 4155B/C or 4156B/C users, Desktop EasyEXPERT provides easy PC control and a unified test environment with the B1500A and B1505A.

myKeysight

www.keysight.com/find/mykeysight
A personalized view into the information most relevant to you.

Three-Year Warranty

www.keysight.com/find/ThreeYearWarranty
Keysight's commitment to superior product quality and lower total cost of ownership. The only test and measurement company with three-year warranty standard on all instruments, worldwide.

Keysight Assurance Plans

www.keysight.com/find/AssurancePlans
Up to five years of protection and no budgetary surprises to ensure your instruments are operating to specification so you can rely on accurate measurements.

www.keysight.com/go/quality
Keysight Technologies, Inc.
DEKRA Certified ISO 9001:2008
Quality Management System

Keysight Channel Partners

www.keysight.com/find/channelpartners
Get the best of both worlds: Keysight's measurement expertise and product breadth, combined with channel partner convenience.

www.keysight.com/find/easyexpert

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at:
www.keysight.com/find/contactus

Americas

Canada	(877) 894 4414
Brazil	55 11 3351 7010
Mexico	001 800 254 2440
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) 6375 8100

Europe & Middle East

Austria	0800 001122
Belgium	0800 58580
Finland	0800 523252
France	0805 980333
Germany	0800 6270999
Ireland	1800 832700
Israel	1 809 343051
Italy	800 599100
Luxembourg	+32 800 58580
Netherlands	0800 0233200
Russia	8800 5009286
Spain	0800 000154
Sweden	0200 882255
Switzerland	0800 805353 Opt. 1 (DE) Opt. 2 (FR) Opt. 3 (IT)
United Kingdom	0800 0260637

For other unlisted countries:
www.keysight.com/find/contactus
(BP-09-04-14)

KEYSIGHT TECHNOLOGIES

Published in USA, August 4, 2014
5991-4178EN
www.keysight.com