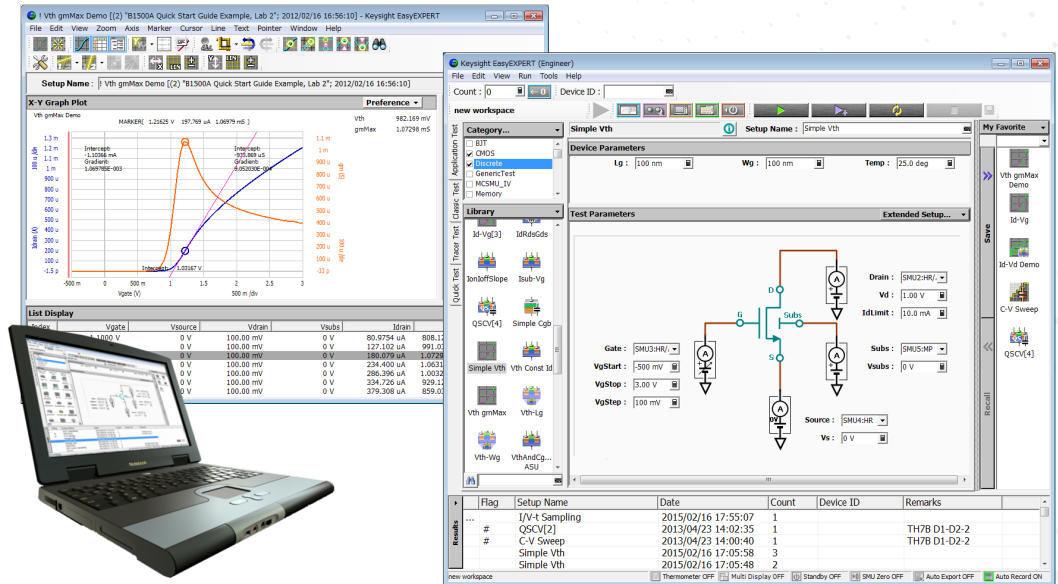


EasyEXPERT Group+ Characterization Software for Precision Current-Voltage Analyzer Series



Introduction

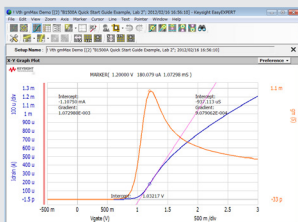
EasyEXPERT group+ Software Accelerates the Characterization Tasks at any Stage in the Process

The EasyEXPERT group+ GUI based characterization software is furnished with the Precision Current-Voltage Analyzer Series to accelerate the current-voltage characterization (IV characterization). It is available on your PC to support efficient and repeatable characterization across the entire process from measurement setup and execution to analysis and data management and so on, using the graphical intuitive user interface and mouse/keyboard operation. Various powerful features of EasyEXPERT group+ allow you to perform the measurement quickly and acquire the result graphically, dramatically improving the productivity of characterization.

It has become increasingly important to accelerate the IV characterization, because it is necessary to fully understand the electrical behavior of devices and materials. This is true not only for semiconductor devices, but also for other devices such as nano-components, photovoltaic cells, optical devices, organic devices, sensors, passive/active discrete components and automotive devices. There is much on-going research into improving these devices to decrease power consumption and lower costs so as to improve the overall performance of the consumer devices in which the devices ultimately reside.

Flag	Setup Name	Date	Count	Device ID	Remarks
I	I/V Sweep	2015/05/07 14:21:33	1		
I	I/V Sweep	2015/04/13 18:47:13	1		
I	I/V Sweep	2015/04/10 16:31:53	1		
	Simple Vth	2015/04/02 14:21:11	1		
	I/V Sweep	2015/03/23 15:23:31	1		
	I/V Trace	2015/03/19 14:21:50	1		
	I/V-I Sampling	2015/02/16 17:55:07	1		
	QSCV(Z)	2013/04/23 14:02:35	1		
	C-V Sweep	2013/04/23 14:00:40	1		
	Simple Vth	2015/02/16 17:04:29	1		
	QSCV(I)	2015/01/29 14:30:31	1		
	I/V Sweep	2015/05/07 14:22:01	2		
	I/V Sweep	2015/04/13 18:47:32	2		
	I/V Sweep	2015/04/10 9:32:32	2		

Built-in data base for measurement setup and data with various data protections



Easy and powerful graphical analysis

Setup Name	Date	Count	Device ID	Remarks
I/V Sweep	2015/05/07 14:21:33	1		
I/V Sweep	2015/04/13 18:47:13	1		
I/V Sweep	2015/04/10 16:31:53	1		
Simple Vth	2015/04/02 14:21:11	1		
I/V Sweep	2015/03/23 15:23:31	1		
I/V Trace	2015/03/19 14:21:50	1		
I/V-I Sampling	2015/02/16 17:55:07	1		
QSCV(Z)	2013/04/23 14:02:35	1		
C-V Sweep	2013/04/23 14:00:40	1		
Simple Vth	2015/02/16 17:04:29	1		
QSCV(I)	2015/01/29 14:30:31	1		
I/V Sweep	2015/05/07 14:22:01	2		
I/V Sweep	2015/04/13 18:47:32	2		
I/V Sweep	2015/04/10 9:32:32	2		

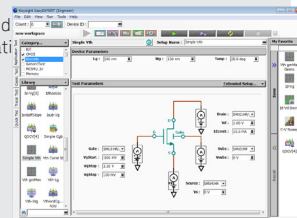


Test sequence with switch and prober control



Measurement execution for analyzer instrument

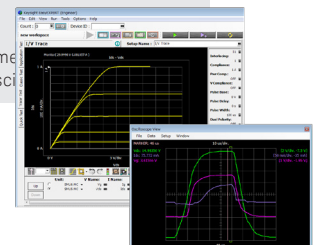
Application based (Applicati



Direct resource

Item	Value	Unit	Min	Max	Mean	Std Dev	Max Error
Area	200.00	μA					
Width	1.00	μm					
Length	1.00	μm					
Perimeter	4.00	μm					
Volume	200.00	μm³					
Mass	200.00	μg					
Weight	200.00	mg					
Force	200.00	μN					
Energy	200.00	μJ					
Power	200.00	μW					
Temperature	200.00	°C					
Pressure	200.00	μPa					
Current	200.00	μA					
Voltage	200.00	μV					
Resistance	200.00	Ω					
Capacitance	200.00	μF					
Inductance	200.00	μH					
Frequency	200.00	kHz					
Wavelength	200.00	μm					
Speed	200.00	μm/s					
Acceleration	200.00	μg					
Angular Velocity	200.00	μrad/s					
Angular Acceleration	200.00	μrad/s²					
Rotational Inertia	200.00	μg·m²					
Moment of Inertia	200.00	μg·m²					
Mass Moment of Inertia	200.00	μg·m²					
Area Moment of Inertia	200.00	μm⁴					
Polar Moment of Inertia	200.00	μm⁴					
Section Modulus	200.00	μm³					
Radius of Gyration	200.00	μm					
Centroidal Moment of Inertia	200.00	μm⁴					
Polar Centroidal Moment of Inertia	200.00	μm⁴					
Centroidal Polar Moment of Inertia	200.00	μm⁴					
Centroidal Area Moment of Inertia	200.00	μm⁴					
Centroidal Polar Area Moment of Inertia	200.00	μm⁴					
Centroidal Section Modulus	200.00	μm³					
Centroidal Polar Section Modulus	200.00	μm³					
Centroidal Radius of Gyration	200.00	μm					
Centroidal Centroidal Moment of Inertia	200.00	μm⁴					
Centroidal Centroidal Polar Moment of Inertia	200.00	μm⁴					
Centroidal Centroidal Area Moment of Inertia	200.00	μm⁴					
Centroidal Centroidal Polar Area Moment of Inertia	200.00	μm⁴					
Centroidal Centroidal Section Modulus	200.00	μm³					
Centroidal Centroidal Polar Section Modulus	200.00	μm³					
Centroidal Centroidal Radius of Gyration	200.00	μm					

Interactive measurement (Tracer test mode/Osc



Easy EXPERT group+ provides a complete, personalized and portable analyzer environment for characterization tasks across the entire process such as measurement setup and execution to analysis and data management and so on.

Application Test Mode Supports the Measurement in Three Easy Steps with Extensive Libraries of Pre-defined Tests

Application test mode provides convenient task oriented point and click test setup and execution with the hundreds of pre-refined test setups (application tests) prepared for the Precision Current-Voltage Analyzer series. These ready-to-use test setups are preinstalled, enabling you to start making measurements and collecting data quickly without the need for any test development or programming. (Available applications can be adapted to configured resources.)

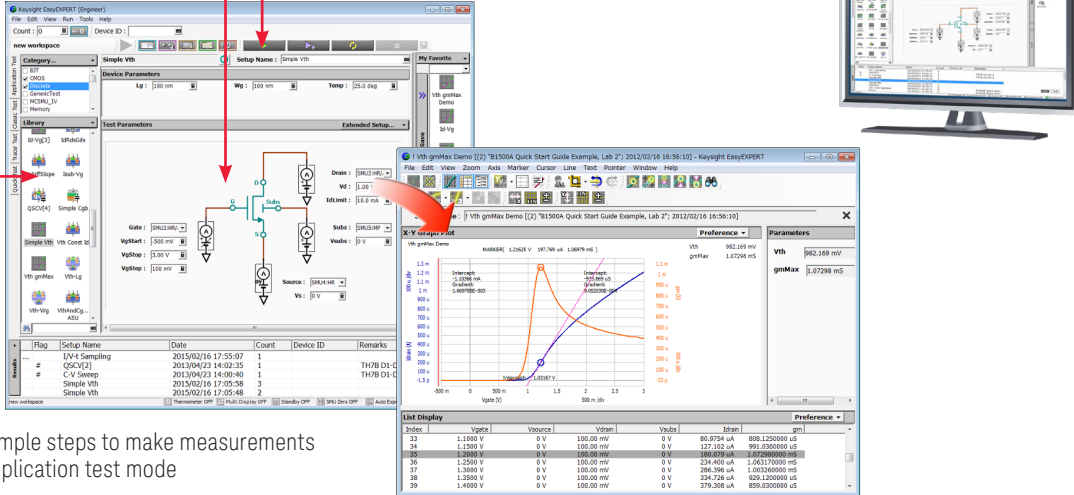
As shown in the following figure, measurements can be executed in three simple steps. Step one is to select an application test from the furnished libraries by device type and/or desired measurement. Step two is to modify the default measurement parameters as needed. Step three is to execute the measurement 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 in 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.

Step 3. Press the measure button to start the measurement.



Three simple steps to make measurements using application test mode

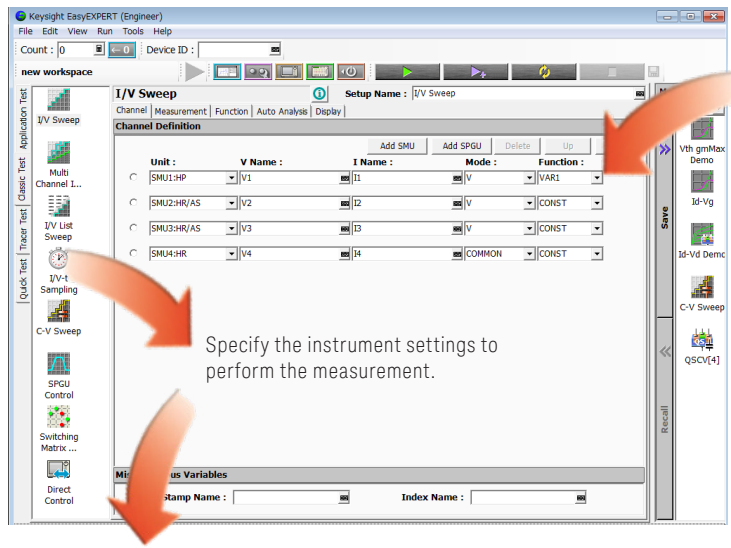
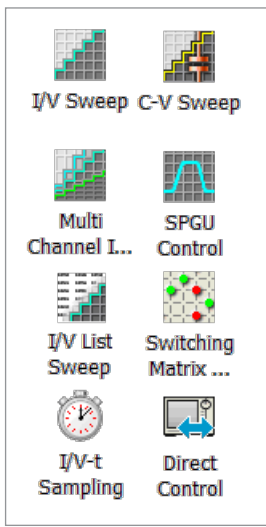
Example of a ready-to-use application test	
Discrete devices	Id-Vg, Id-Vd, Ic-Vc, diode, etc.
Bipolar	Ic-Vc, diode, Gummel plot, breakdown, hfe, capacitance,
CMOS	Id-Vg, Id-Vd, Vth, breakdown, capacitance, QSCV, etc.
Memory	Vth, capacitance, endurance test, etc.
Power MOSFET	Id-Vds, Rds-Id, Id-Vgs, Capacitance, etc.
IGBT	Ic-Vce, Ic-Vge, Vce(sat), Vth Vge(off), breakdown,
Solar Cell	I-V, Cp-V, Nyquist Plot, DLCP, etc.
Nano devices	Resistance, Id-Vg, Id-Vd, Ic-Vc, etc.
GaN	FET Current Collapse, Id-Vds Current Collapse, Diode Current
Discrete devices	Id-Vg, Id-Vd, Ic-Vc, diode, etc.

Classic Test Mode Provides Full Hardware Control by Mouse Point and Click Operation

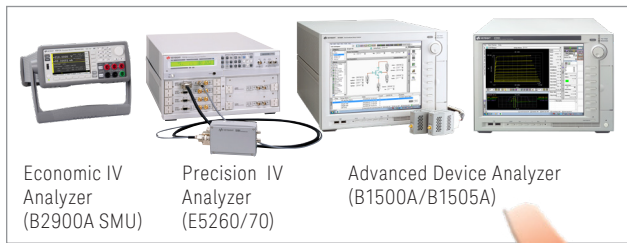
When you perform measurements other than the ready-to-use applications in the library, the classic test mode provides direct access to the analyzers hardware capabilities. By taking full advantage of windows-based features, you can set the various parameters such as output voltage/current, number of sweep steps, range, and so on for the hardware available features. It has a similar look and feel to the front-panel interface of the 4155/56 parameter analyzer that has been the de-facto standard analyzer for a long time.

In addition, the 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 the classic mode test setups. This permits 4155/56 users to take advantage of existing test setups without having to create new ones. It also eliminates the 4155/56's tedious floppy disk based file storage.

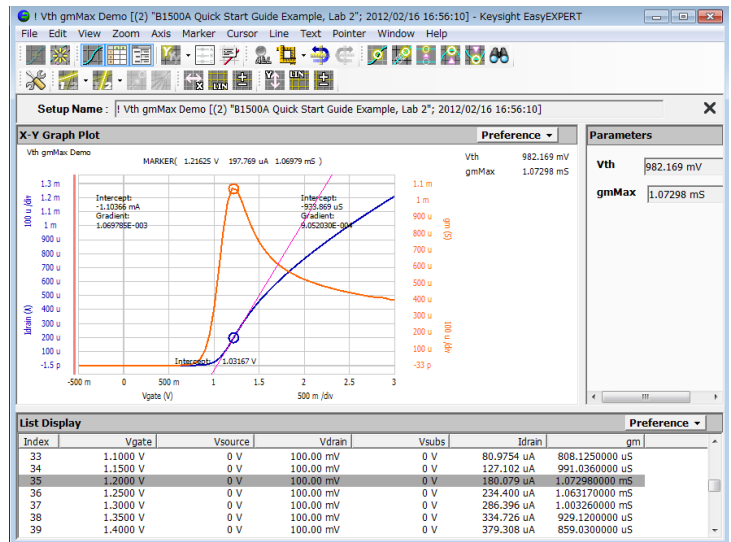
Various options for setting up the available measurement capabilities



Furnished 4155/56 setup file converter allows to migrate existing setup files to set ups for classic test mode.



Graphical and numerical measurement results, data analyses, and parameter extractions are automatically displayed, along with the classic test mode.



Accelerated Graphical Analysis and Data Exporting to Your PC for Further Data Processing

Auto-analysis and graphical display features accelerate your analysis

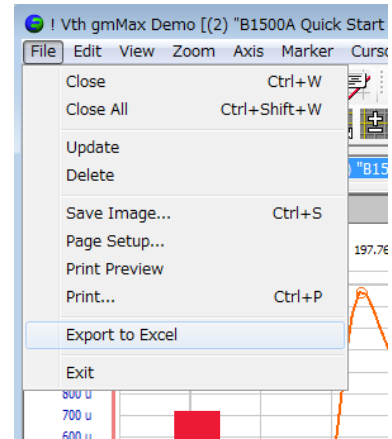
The data display window accelerates the analysis of the measurement results without using the external analysis utilities. It provides the powerful graphical display and analysis features for front-end analysis. This can pop-up automatically when the measurement is complete. It is also available to analyze the measurement results in the data store.

It provides many powerful analysis tools such as auto-scaling, marker and line operation, multiple Y axes capabilities and so on. For example, the data display and intuitive GUI operation allow for the extraction of the threshold voltage quickly through the process of finding the max position on the gm curve in Y2, drawing the tangent line on the Id curve in Y1, and reading out the intercept to the X axis, as illustrated in the following figure.

In conjunction with the auto-analysis capability of the measurement setup, you can perform the operation automatically after taking measurements without manual operation.

Direct Excel export for quick further analysis on your PC

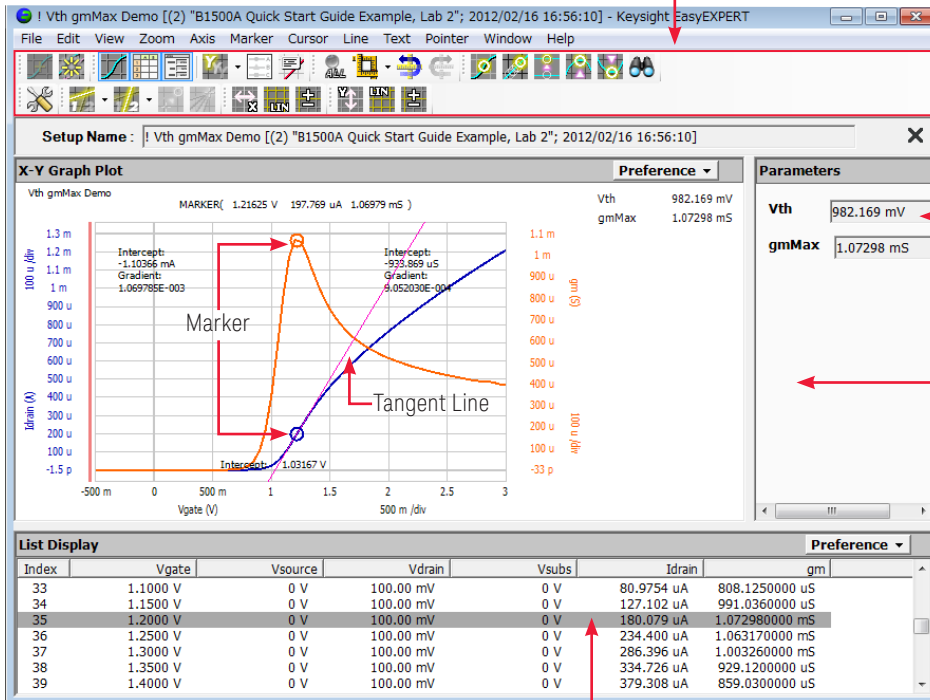
The data display allows you to export data directly to an Excel spreadsheet without saving as a CSV file, thereby accelerating post-analysis on any computer. If necessary, the graph in this window can also be exported as an image file for reporting. The preference menu provides various options for the appearance such as color and information placed in the graph pane.



Direct data link to Excel spreadsheet.



Powerful analysis tool creates IV measurement data that gives an insight into characteristics by providing auto scaling, marker, line operations, and so on.



Parameters pane displays the parameters extracted by user functions. They can be displayed in the graph pane for graph image export

Graph pane is available for powerful graphical analysis.

List data pane. The data at market position is highlighted.

Advanced Capabilities for Interactive Measurement Verification

Tracer test mode provides interactive real-time curve tracing

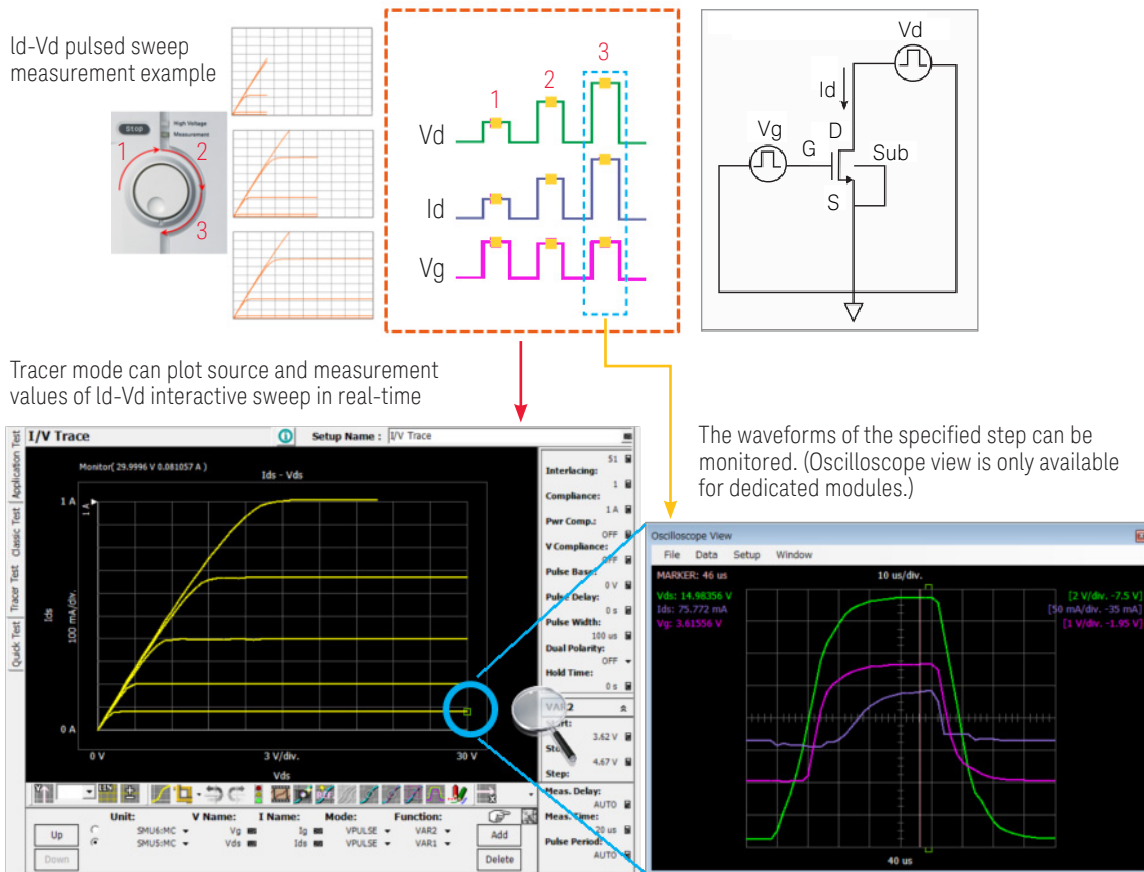
Tracer test mode offers intuitive and interactive sweep control using a rotary knob or mouse operation. It allows sweep measurements to be modified in real-time just like on a curve tracer, and both voltage and current can be swept bidirectionally (expanding in both the positive and negative directions simultaneously). This is useful for failure analysis and when characterizing unknown devices. Moreover, once you have determined the ideal test conditions using the tracer test you can easily transfer the settings into a classic test mode setup for further refinement or for automated testing.

In addition, the tracer test mode supports many other powerful features not available on curve tracers. For example, a snapshot function to capture and compare traces, a stop condition feature to immediately halt if any measurement trace enters the prohibited area, and auto-record/replay feature to constantly save measurement data to be recalled and displayed even if a device has been inadvertently destroyed.

Oscilloscope view increases pulsed IV measurement confidence

EasyEXPERT group+ supports the oscilloscope view, which is available for some dedicated modules of B1500A/B1505A to perform a pulsed measurement. It can display the actual measured voltage and current pulses at any point along a sweep measurement. This permits quick waveform verification, debug and timing parameter optimization without the need for an external oscilloscope.

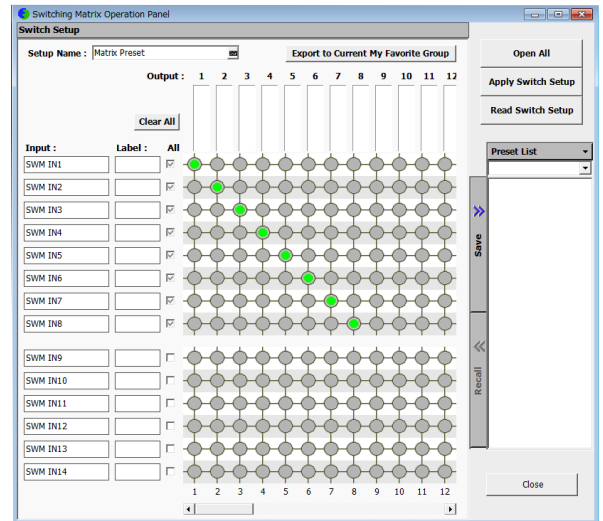
For pulsed measurement, it is important to monitor pulsed IV waveform shapes to maintain measurement accuracy. Stray and device capacitance effects can cause actual waveforms to deviate from their programmed values, which in-turn can result in inaccurate data if measurements are taken before the waveform has stabilized. The oscilloscope view allows you to check graphically the pulse shape to improve pulsed IV measurement accuracy.



Quickly Perform Automated Multiple Measurements with Optional Switching Matrix and Prober Control

Intuitive GUI is used to control an optional switching matrix

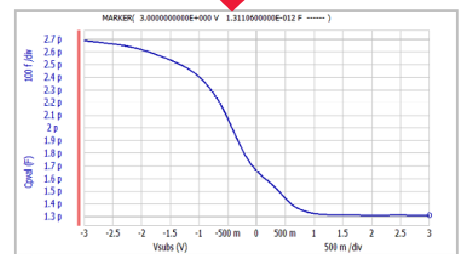
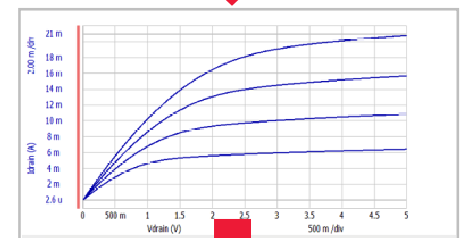
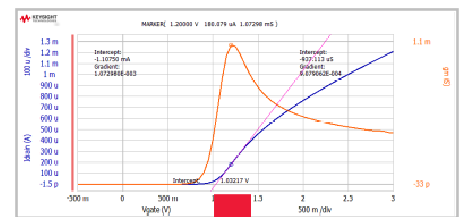
The EasyEXPERT group+ also supports a switching matrix control. This allows you to create a switching matrix setup on GUI using mouse point and click operations. You can also use the EasyEXPERT group+ for the test system by integrating the analyzer and switching matrix to test multiple points with limited resources.



Make a quick automated test sequence without the need for programming

The EasyEXPERT group+ 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 the need for any programming. It allows you to select, copy, and rearrange any of these tests with a few simple mouse clicks. If you are using a switching matrix, you can also automatically call switching patterns created interactively using EasyEXPERT group+. You can also combine wafer prober control with quick test mode to perform multiple tests automatically across a wafer. In addition to supporting popular semiautomatic wafer probers, EasyEXPERT also allows you to create your own wafer prober drivers.

Automated testing is important to efficiently gather multiple parameters on the device. In many cases, instruments do not have automated test capability, and manually created test setups cannot be reused for automated testing. Therefore, the ability to reuse interactively created tests in automated testing is a highly useful with obvious productivity benefits.



Simple Management and Access to all Data Without Cumbersome File Handling

Built-in database allows you to store and rapidly recall the data that you need

The IV characterization performs repeatedly for various materials/devices, generating numerous files such as a measurement setup file, results file, and so on. This can make it difficult to manage all the different files and accurately record the information.

EasyEXPERT group+ has a built-in database to resolve this issue. Every time the measurement is performed, the combination of measurement setup and result can be stored automatically into the built-in database known as a “workspace”. This unique “workspace” allows you to manage and access all the relevant data without the need for accessing numerous files. The data stored in the “workspace” can be accessed for analysis or measurement reproduction at any time, and the data can automatically be exported in various file formats such as Excel, images, CSV, and so on.

Built-in database (workspace)

Ready to use application test

Ready to use measurement setup

Setup and result are stored together.

Open the data display for analysis

Data can be exported to various file formats automatically

Flag	Setup Name	Date	Count	Device ID	Remarks
...	I/V-t Sampling	2015/02/16 17:55:07	1		
	QSCV[2]	2013/04/23 14:02:35	1		TH7B D1-D2-2
#	C-V Sweep	2013/04/23 14:00:40	1		TH7B D1-D2-2
	Simple Vth	2015/02/16 17:05:58	3		
	Simple Vth	2015/02/16 17:05:48	2		

Export Options: TXT/CSV, Excel, Image, EasyEXPERT data

Main screen provides easy access to the data in the workspace and measurement capabilities

Options are Available to Protect Important Data Within the Shared Workspace

The workspace can be protected by either an NT account or password




Each workspace can be set as private or public. The public workspace can be accessed by any users who are logged in. If the workspace is set to private, it can be accessed only by the owner NT account, therefore the data can be protected from other users. However, instruments are often shared by different users who use the same NT account. To protect the data in such cases, the workspace can also be password protected. The workspace can export to and import from other PCs while the password protection remains.

Password protection within the shared workspace

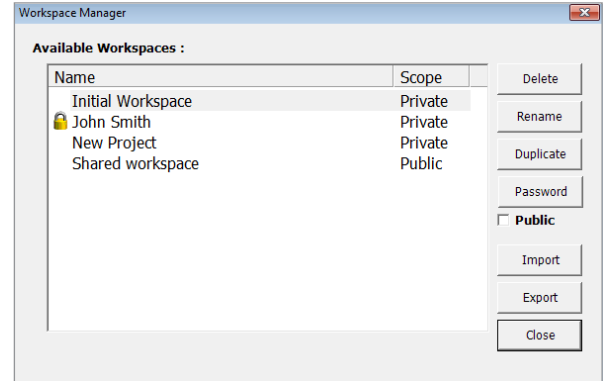
The EasyEXPERT group+ provides a range of options for data protection. Even inside the workspace, it is possible to prohibit access to a test definition or setup, using password protection.

User level access control allows you to limit the user's authority

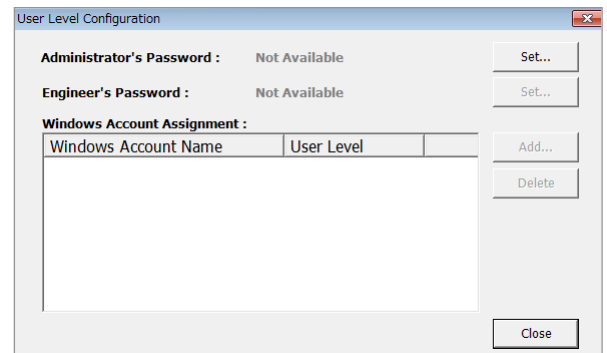
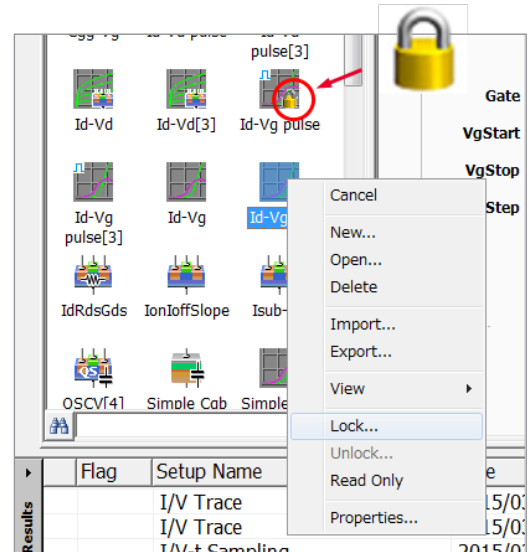
In addition to the password protection to the data, the user's authority can also be limited by the user level access control feature. It allows you to delegate the measurement execution to someone in the group at lower risk of losing the data. Though the engineer mode allows all operation, the operator mode allows only measurement execution and data operation. It is prohibited to change the measurement setups and specified setup conditions. The user's authority can be assigned to NT account by using the administrator menu.

Password Data Protection		User Level Access Control	
	= Data can be protected by password	Engineer authority	Operator authority
	Workspace	Read/Edit	Read only
	Test Setup	Execute	Execute
	Measurement Execution	Execute	Execute
	Measurement Data	Read/Edit	Read/Limited Edit

Combination of data protections can be adapted to various use cases.



Workspace manager



Administrator menu to set up the user level control

EasyEXPERT group+ Allows Flexible Characterization Tasks to be Performed that Significantly Improve Productivity

Take full advantage of the analyzer's powerful measurement and analysis capabilities from the lab to the office

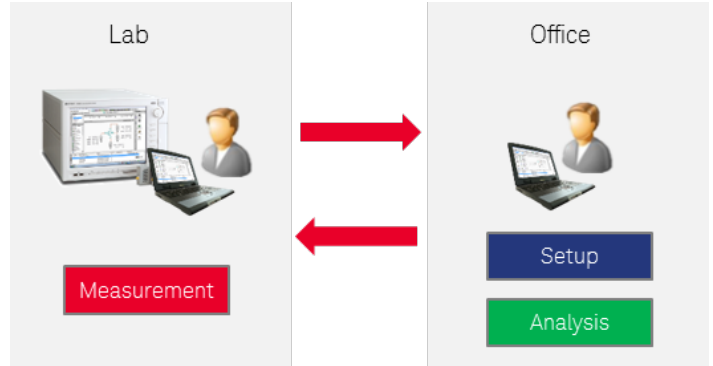
EasyEXPERT group+ can be installed on your PC, and used as your personal analyzer. Because it can be connected to the instrument via USB-GPIB interface, it is portable and can be used seamlessly either for offline tasks in the office or online measurement execution in the lab. It does not need to be within range of the instrument to operate correctly, and most tasks can be operated in the office with the PC peripherals such as wide display, USB, HDD and software such as Excel to improve the productivity.

EasyEXPERT group+ can be installed on multiple PCs at no additional cost

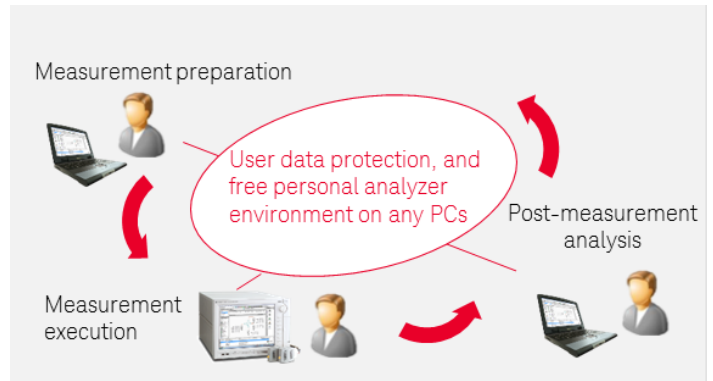
EasyEXPERT group+ can be installed on multiple PCs at no additional cost so that every team member can have their own personal analyzer environment. This ensures speed, accuracy, and efficiency within any group work. EasyEXPERT group+ also provides options to protect important data when sharing it with multiple users.

Offering support across the Keysight analyzer series for more flexibility and scalability according to your needs

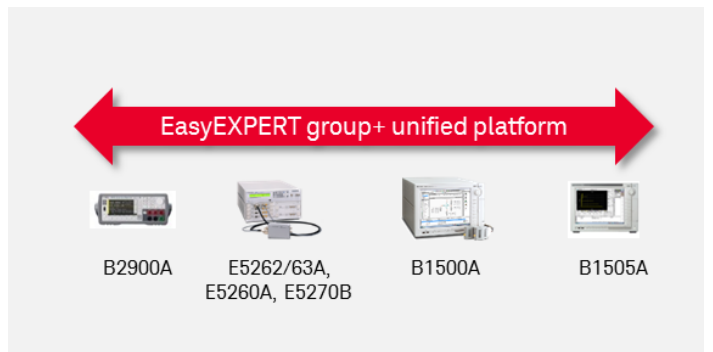
The EasyEXPERT group+ provides a unified characterization platform across the Keysight precision IV analyzer series. Interoperability across the analyzers provides more flexibility in measurement operations and scalability of measurement capacity in the lab. Available applications can be adapted to configured resources.



Your PC becomes your portable personal characterization environment



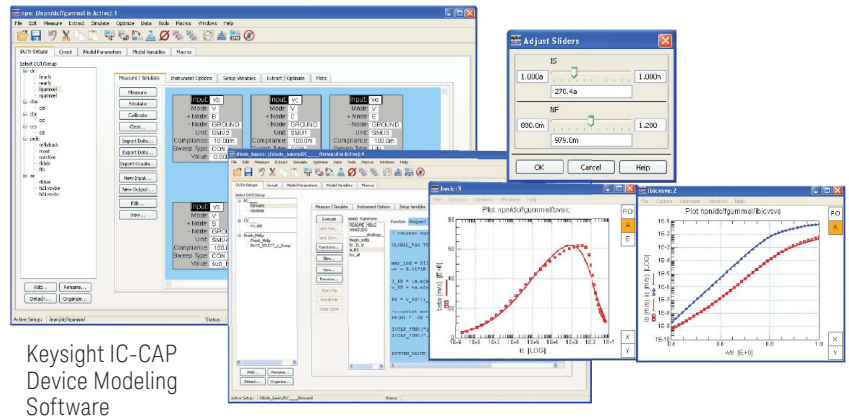
Free personal analyzer accelerates inter-departmental cooperation



Additional functions allow you to fully utilize the capabilities of EasyEXPERT group+

MDM file convertor for the IC-CAP device modeling solution

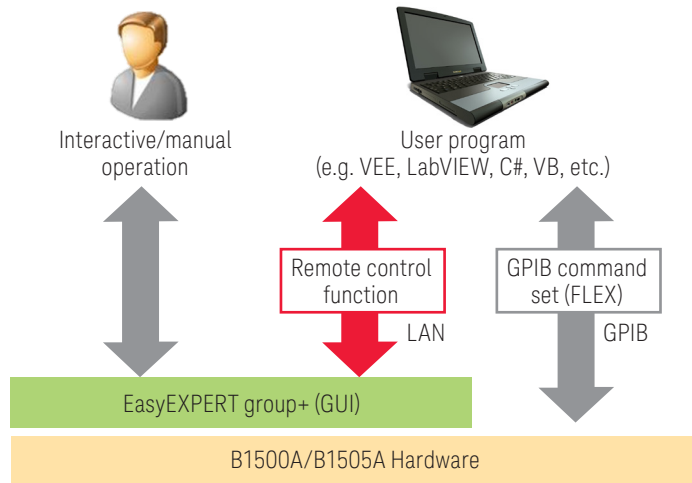
Keysight IC-CAP, a popular device modeling software solution, has long supported device analyzers such as the B1500A. However, now the EasyEXPERT group+ supports an MDM file convertor tool to convert EasyEXPERT data (classic test) into the IC-CAP compatible MDM file format. This allows you to expand the measurement capacity without occupying the IC-CAP system, also allowing IC-CAP users to fully utilize EasyEXPERT's powerful capabilities when performing measurement for device modeling.



Keysight IC-CAP Device Modeling Software

EasyEXPERT Remote Control allows you to reuse the app tests for remote programming (only for B1500A/B1505A)

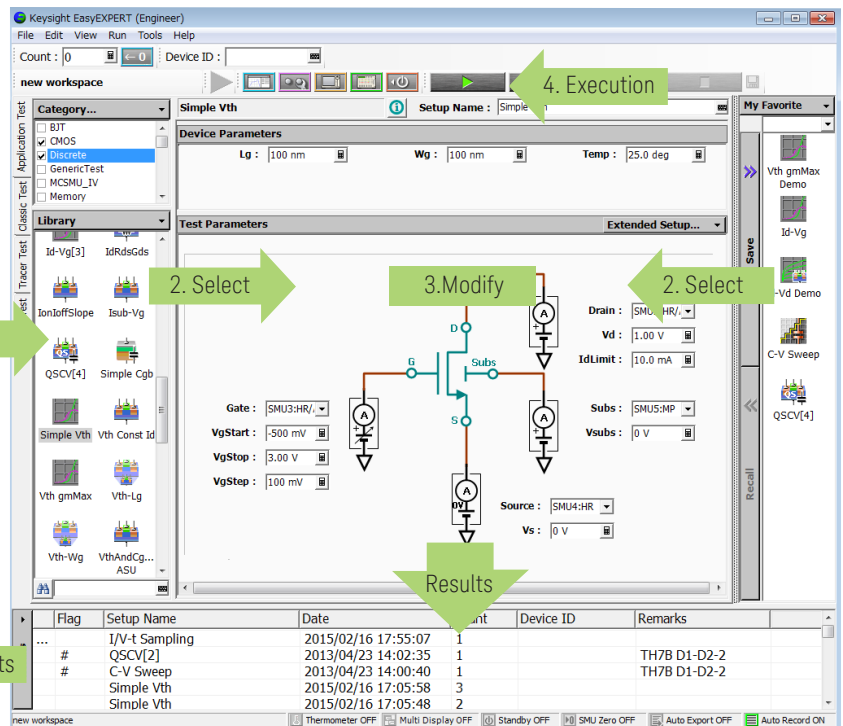
You can control EasyEXPERT over the LAN using its integrated remote control function. This feature provides the benefit of allowing you to use any programming language to control the B1500A or B1505A over the furnished LAN interface. You can also send FLEX commands over GPIB directly to the instruments and bypass EasyEXPERT if desired.



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.



User preferred platform



How to Get the EasyEXPERT group+ Software

The latest version of EasyEXPERT group+ can be downloaded from from:

www.keysight.com/find/easyexpert

EasyEXPERT group+ can be installed on as many PCs as you need for offline purposes. To execute the measurement with the instruments, one of the following licenses is required. The license is granted with the Keysight precision current-voltage analyzer series at initial shipment, and the license is granted according to the module upgrade or software upgrade for existing users who don't have a license.

The available licenses for EasyEXPERT group+ are listed below.

License granted with B1500A/B1505A:

- B1500A-SWS
- B1505A-SWS

License granted with E5260A/E5262A/E5263A/E5270B

- E5260A-SWS
- E5262A-SWS
- E5263A-SWS
- E5270B-SWS

License granted with B2901A/B2902A/B2911A/B2912A

- B2901A-SWS
- B2902A-SWS
- B2911A-SWS
- B2912A-SWS

License granted with upgrade products.

- B1500AU-SWS (for B1500A)
- B1505AU-SWS (for B1505A)
- E5260AU-SWS (for E5260A/62A/63A)
- E5270BU-SWS (for E5270B)
- B2901AU-SWS (for B2901A)
- B2902AU-SWS (for B2902A)
- B2911AU-SWS (for B2911A)
- B2912AU-SWS (for B2912A)

For more details of quotation and ordering for upgrade, contact a Keysight sales representative.

Keysight Precision Current-Voltage Analyzer Series and Power Device Analyzer Series
www.keysight.com/find/analyzer



Learn more at: www.keysight.com

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

