

Self-paced Training Manual

Agilent B1500A Semiconductor Device Analyzer Agilent EasyEXPERT Software



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Agilent B1500A Semiconductor Device Analyzer Agilent EasyEXPERT Software



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8. Miscellaneous Operations



Notices

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Module 1. Introduction



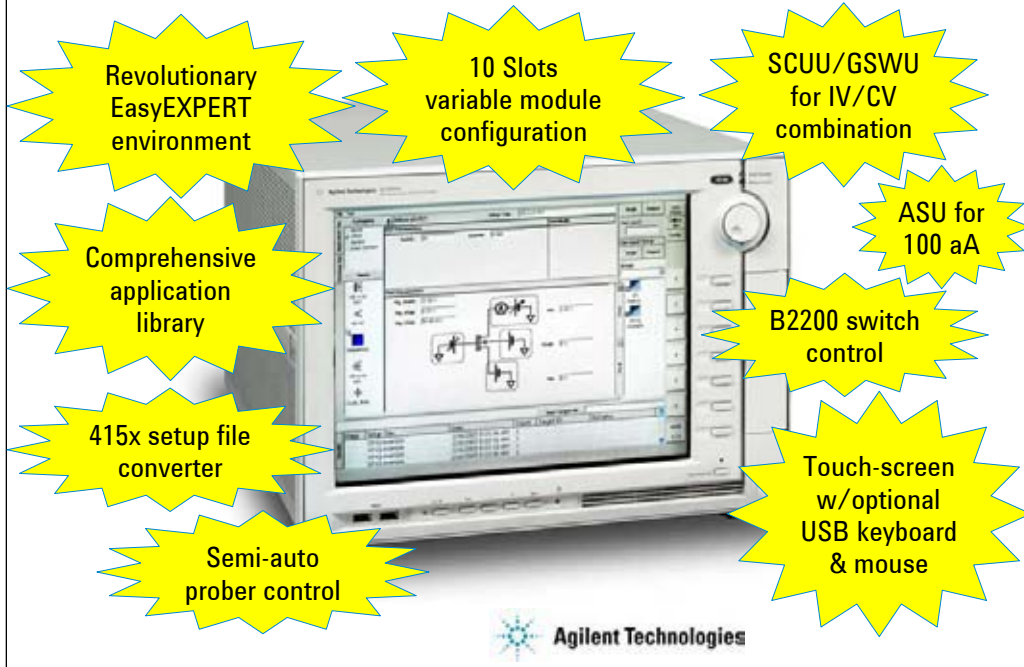
In This Module

- **New Features**
- **EasyEXPERT**
- **To Perform Easy Application Test**
- **User Interface**
- **Modular Mainframe**
- **SCUU/GSWU**
- **ASU**
- **B2200 Switch Control**
- **Desktop EasyEXPERT**
- **415x Setup File Converter**



Note:

Agilent B1500A Semiconductor Device Analyzer



The image shows the Agilent B1500A Semiconductor Device Analyzer, a rack-mounted instrument with a large color touch-screen display. The screen displays a software interface with various graphs and data points. Surrounding the device are several yellow starburst callouts highlighting key features. At the bottom center of the device, the Agilent Technologies logo is visible.

- Revolutionary EasyEXPERT environment
- 10 Slots variable module configuration
- SCUU/GSWU for IV/CV combination
- ASU for 100 aA
- Comprehensive application library
- B2200 switch control
- 415x setup file converter
- Touch-screen w/optional USB keyboard & mouse
- Semi-auto prober control

The B1500A has many exciting new features and capabilities.

New Features

- EasyEXPERT software
 - Application test environment (> 150 algorithms)
 - Classic test environment – 415x like setup
 - Quick test environment – multiple test execution
 - Semi-auto prober control and B2200 switch control
- Modular mainframe
 - MFCMU for C-V sweep
 - HPSMU, HRSMU, MPSMU for I/V sweep/sampling
- SMU CMU Unify Unit (SCUU)/Guard Switch Unit (GSWU)
 - switching effortlessly between IV and CV measurement
- Atto Sense/Switch Unit (ASU)
 - 100 aA level low current measurement
- Touch-screen, knob, and softkeys
 - optional USB keyboard, mouse, and stylus pen



The EasyEXPERT software

- Task-oriented, “top-down” approach to device characterization
- Multiple test execution
- Automatic measurement, auto-analysis functions
- Test sequencing without programming

Application Library (>150 algorithms)

- Categorized and organized
- Easy-to-use

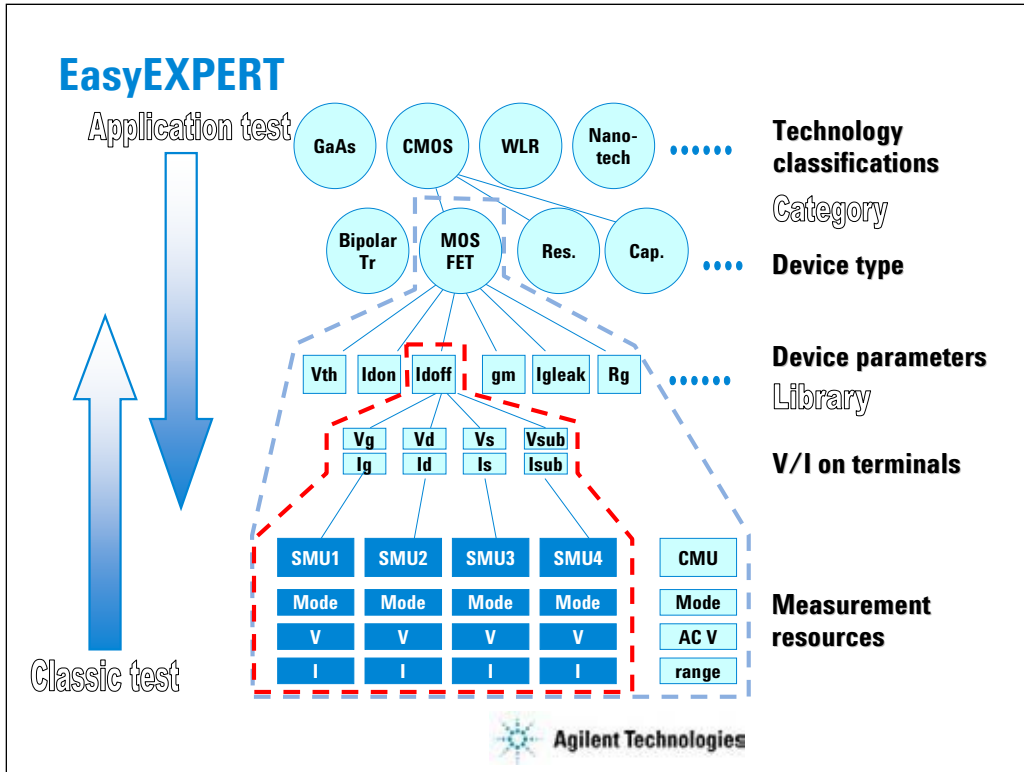
415x setup file converter program

Versatile Modular Mainframe

- Flexible & Expandable (10 slots)
- Multiple SMU types
- Atto-sense and Switch Unit (ASU)
- Multi-Frequency CMU
- SMU CMU Unify Unit for IV/CV Probing
- 4.2 Amp Ground Unit

Convenient User Interface

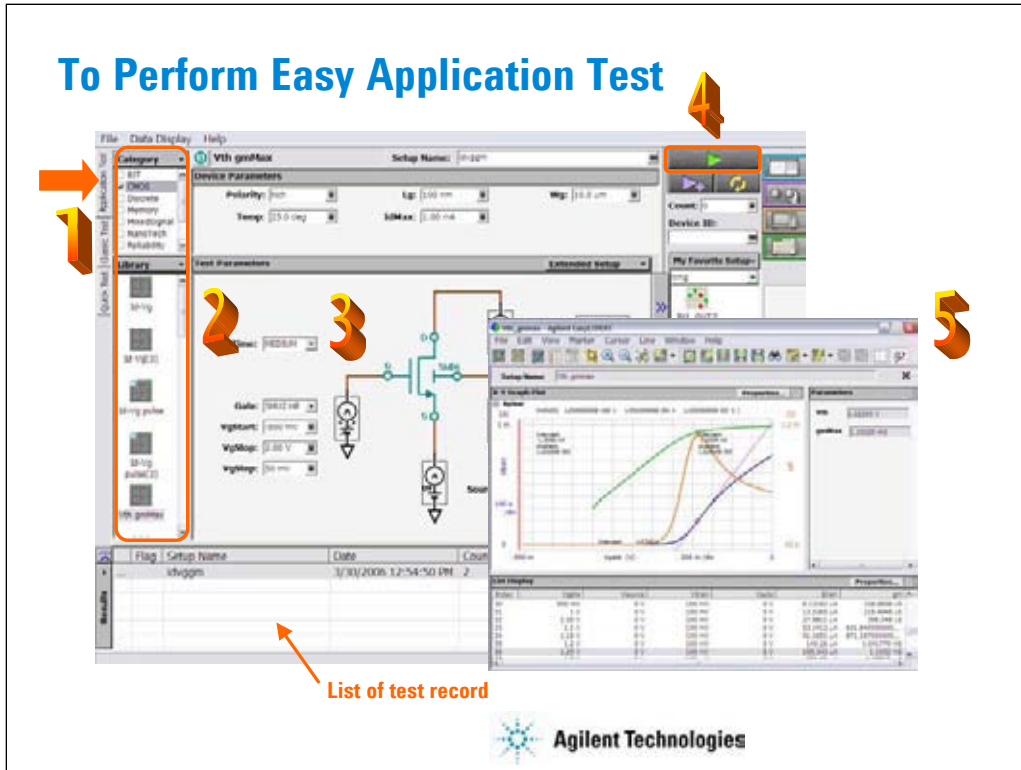
- Touch screen operation (with optional stylus pen)
- Contextual softkeys & knob control
- Optional USB keyboard & mouse



Instead of setting up the instrument hardware, the EasyEXPERT software focuses on the real task at hand for the engineer ---device characterization. All that you need to do is to connect the instrument to the device terminals as shown in the EasyEXPERT test parameters area.

The EasyEXPERT software also provides the classic test mode that allows the 4155/4156 like measurement setup operation.

To Perform Easy Application Test



Step 1: Click Application Test tab.

Step 2: Select one or more technology categories, and select a desired test from the list of tests associated with the selected technology categories.

Step 3: Change the setup parameters (Device parameters and Test parameters) if you want.

Step 4: Connect DUT, and click the Start button. The B1500A starts the selected test.

Step 5: Analyze the measurement result data displayed on the Data Display window automatically opened after the test.

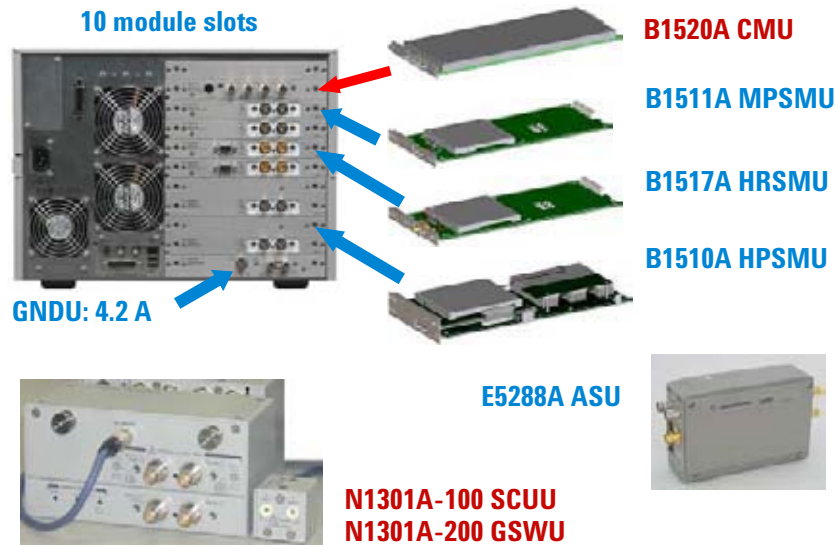
The measurement result record is automatically stored in the internal hard disk drive when the Auto Record mode is ON.

User Interface

- **Touch panel**
 - **Stylus pen (option)**
- **Rotary knob**
- **Softkeys**
- **USB keyboard (option)**
- **USB mouse (option)**



Modular Mainframe



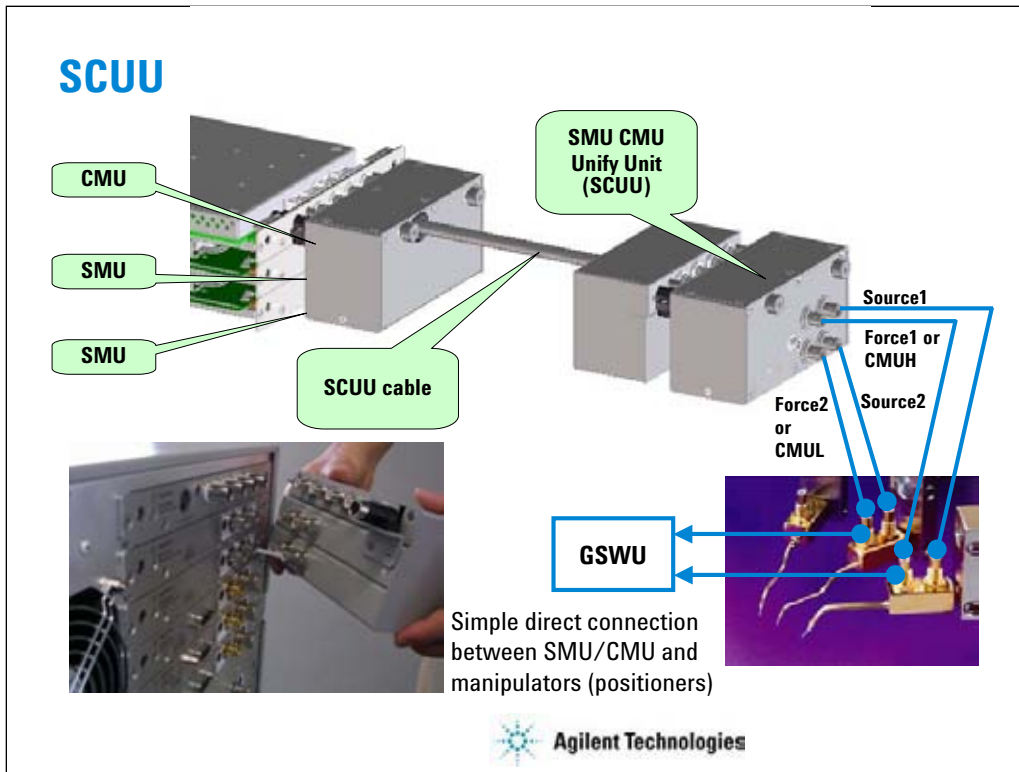
The following modules and accessories are available for the B1500A:

- B1520A CMU: 1 kHz to 5 MHz CV capability (1 slot)
- B1511A MPSMU: 100 mA/100 V force capability, 10 fA/0.5 mV measurement resolution (1 slot)
- B1517A HRSMU: 100 mA/100 V force capability, 1 fA/0.5 mV measurement resolution (1 slot)
- B1510A HPSMU: 1 A/200 V force capability, 10 fA/2 mV measurement resolution (2 slots)
- N1301A-100/102: SMU CMU unify unit (SCUU) & cable assembly
- N1301A-200/201/202: Guard switch unit (GSWU) & cable assembly
- E5288A ASU: 0.1 fA/0.5 mV measurement resolution with support for IV/CV switching

The ASU (Atto sense/switch unit) can be used with the HRSMU calibrated with it.

The SCUU can be used with the CMU (slot N), SMU (slot N-1), and SMU (slot N-2).

The GSWU can be used with the SCUU.



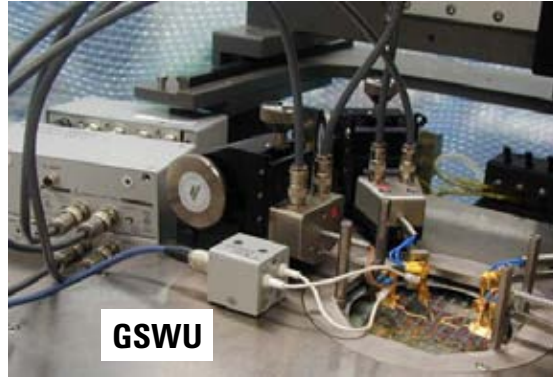
You have a very hard time switching between CV and IV measurements (you may actually devote separate probe stations to CV and IV just to avoid having to change cables). In addition, great care has to be taken when cabling to a capacitance meter to insure that all of the capacitance measurements are properly compensated. The SCUU removes all of these worries and makes connection simple and easy. In addition, the B1500A software automatically takes care of the multiplexing based upon the type of algorithm selected from the front panel.

To install the SCUU near the manipulators/positioners, use the N1301A-102 SCUU cable.

To realize accurate capacitance measurement, use the N1301A-200/201/202 GSWU & cable.

GSWU

SCUU



The GSWU must be connected to the outer conductors of the manipulators/positioners connected to the Force1/CMUH and Force2/CMUL connectors of the SCUU. And the GSWU control cable must be connected between the GSWU and the SCUU.

When the SMU paths are available for the manipulators/positioners, the GSWU opens between the outer conductors. However, when the MFCMU paths are available, the GSWU connects them together to make the return path of measurement current. This will reduce the signal path impedance. And this is effective for the accurate capacitance measurement.

By using the EasyEXPERT software, cable length between the CMU and the SCUU is automatically detected, and the GSWU switch control is automatically performed. Also, capacitance error compensation is also automatically performed if the compensation data are available.

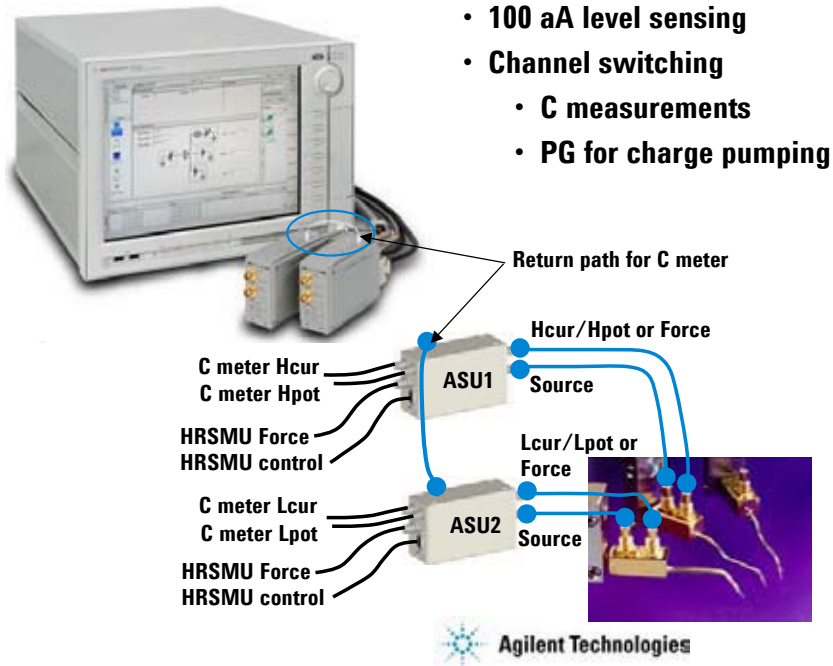
The GSWU is effective for

- reducing the residual inductance of the measurement cable
 - stabilizing the residual inductance when measurement cable distance is changed (moved)
- It's roughly 1/10 to 1/30 when used with two 80 cm cable.

Note:

When the SMU paths are available for the manipulators/positioners, the outer conductors must be open because they must be connected to the SMU guard terminals that must be always open.

ASU



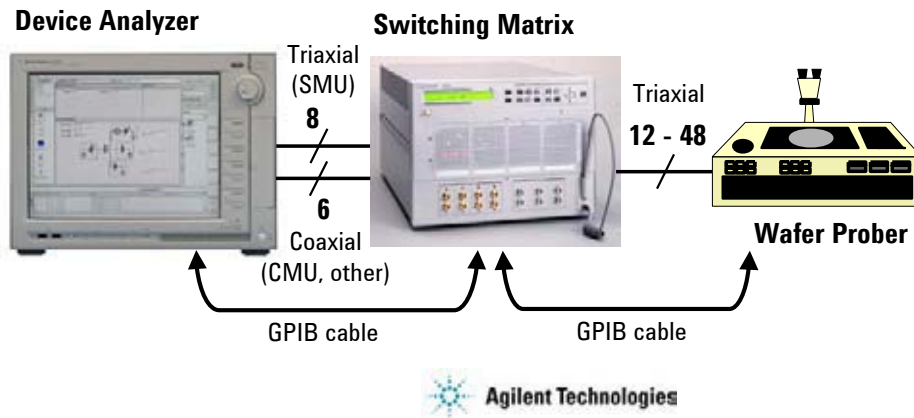
The high-resolution SMU (HRSMU) has an innate 1 fA & 0.5 mV measurement resolution. The optional ASU extends the HRSMU measurement resolution to 0.1 fA.

The ASU has another feature, built-in switching capability. It can switch between the SMU and an auxiliary input (AUX input, two BNC).

If the Agilent 4284A LCR meter is connected to the AUX inputs, the ASU can switch between the low current and CV measurements. Then connect a wire between the CMU return terminals of ASUs to make the return path of measurement current. This is effective for accurate capacitance measurement. However, you need to perform capacitance compensation by yourself.

B2200 Switch Control

- Allows use of a probe card to facilitate probing of standardized device modules (usually 24-pin configuration)
- Enables easy multiplexing between the triaxial outputs of SMUs and the coaxial outputs of other (BNC-based) instruments and modules



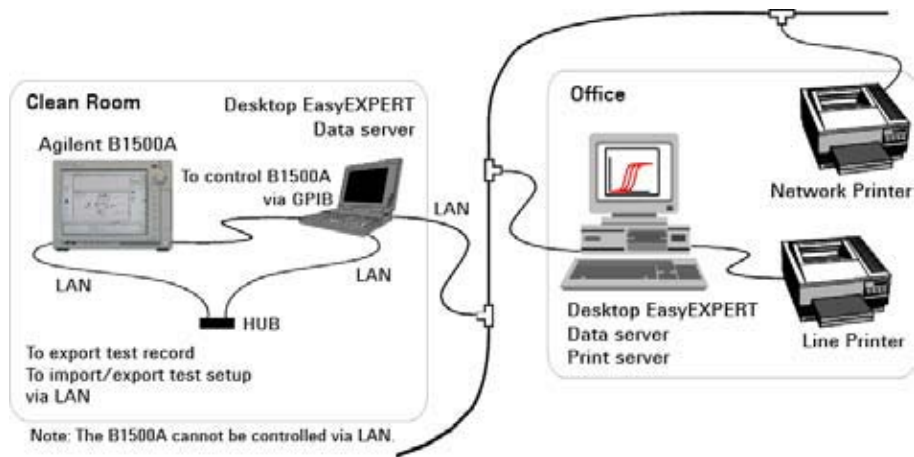
Agilent B2200A/B2201A switching matrix can be controlled by B1500A/EasyEXPERT via GPIB. EasyEXPERT provides the Switching Matrix Operation Panel for interactive control of B2200 independent from the test execution mode of B1500. And switch setup can be saved to a classic test setup data. In the classic test, the switch setup is sent to B2200 when a measurement start button is clicked.

B1500A/EasyEXPERT also provides the semi-auto prober control script. The semi-auto prober can be controlled without programming. The prober control script supports the die move operation by using the following first three procedures in the repeat measurement setup and adds the subsite move operation by using the Subsite procedure in the quick test setup.

Prober control script:

- Start procedure
- Iteration procedure
- Final procedure
- Subsite procedure

Desktop EasyEXPERT Software



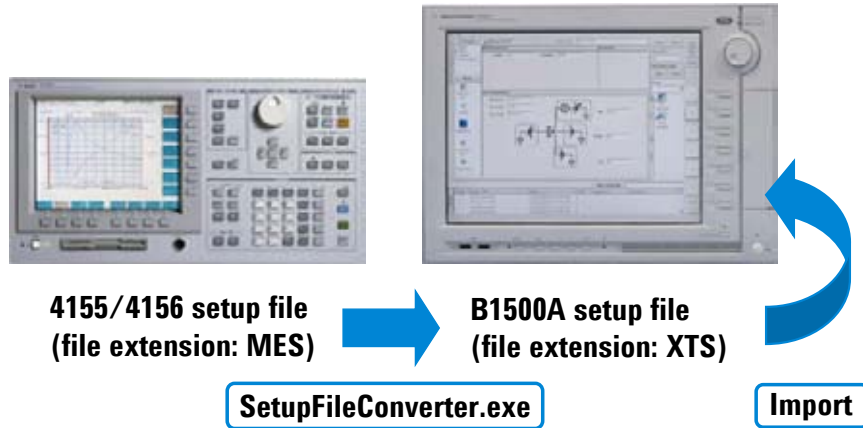
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The Desktop EasyEXPERT software provides the following additional advantages to the B1500A, allowing you to minimize the amount of offline tasks performed on B1500A and increase the working ratio for measurements.

- Allows B1500A to be controlled from an external computer via GPIB while online.
- Allows test setup to be created on an external computer while offline.
- Allows data analysis to be performed on an external computer while offline.

To start Desktop EasyEXPERT, see Module 8.

415x Setup File Converter



Execution example:

```
C:\Mydata>SetupFileConverter.exe setup1.mes  
C:\Mydata>SetupFileConverter.exe *.mes
```



To control the B1500A, you can reuse the 4155/4156 setup file (.MES file) by converting the .MES file to the EasyEXPERT setup file (.XTS file). The file conversion can be done by the SetupFileConverter.exe file. To execute the file conversion, see Module 8.

Module 2. Performing Easy Tests



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In This Module

- **To Turn on/off B1500A**
- **To Launch EasyEXPERT**
- **To Specify/Create Workspace**
- **To Perform Application Test**
- **To Save/Recall Your Test Setup**
- **To Export/Import Your Preset Group**
- **To Export/Import Test Record**
- **To Perform Quick Test**
- **To Control B2200 Switching Matrix**
- **To Manage Data Display Window**



This section explains the above tasks. You will understand how to launch B1500A/EasyEXPERT, how to perform application test and quick test, and how to create your test setups and preset groups.

To Turn on/off B1500A



The Standby button works to turn on the B1500A when it is turned off. When the B1500A is turned on, the Standby button works to terminate the EasyEXPERT software, Windows, and turn off the B1500A.

After the B1500A is turned on, log on Windows.

The default user is Agilent B1500 User with no password.

To Launch EasyEXPERT



After logging on, click Start EasyEXPERT button to launch the EasyEXPERT software.

If you do not see the Start EasyEXPERT button, double click the Start EasyEXPERT icon to open the Start EasyEXPERT window.

To Specify Workspace

Case 1



Case 2



Case 3



After launching the EasyEXPERT, you will see one of the above screens.

Case 1: If this is the first time to launch the EasyEXPERT

The LCD displays the EasyEXPERT main screen.

Case 2: If the B1500A has one workspace only

Select Yes, and click OK if you use the existing workspace.

The EasyEXPERT main screen is displayed.

Select No, and click Next if you want to create a new workspace.

See next slide.

Case 3: If the B1500A has some workspaces (more than one)

Select workspace you want to use, and click Continue.

The EasyEXPERT main screen is displayed.

If you create workspace, check the Create a new Workspace radio button, and click Continue.

To create a public workspace, check the *Allow other users to access this workspace* box. The public workspace can be used by all users.

To create a private workspace, delete the check from the *Allow other users to access this workspace* box.

Workspace is the space created in the Agilent B1500A's internal hard disk drive, and is used to store the test setup, measurement result data, and so on. The workspace can be created and allocated for each user.

To Create Workspace

Agilent EasyEXPERT software manages setups and data in enclosures known as "Workspaces." Since you want to start a new session, you should create a new Workspace with a distinctive name. Please specify a name for the new Workspace:

1 → workspace

Allow other users to access this Workspace.

You can also rename a previously defined workspace:

2 → workspace

Allow other users to access this Workspace.

Cancel OK

Check this box for Public workspace

1: New workspace name to create
2: New workspace name to rename



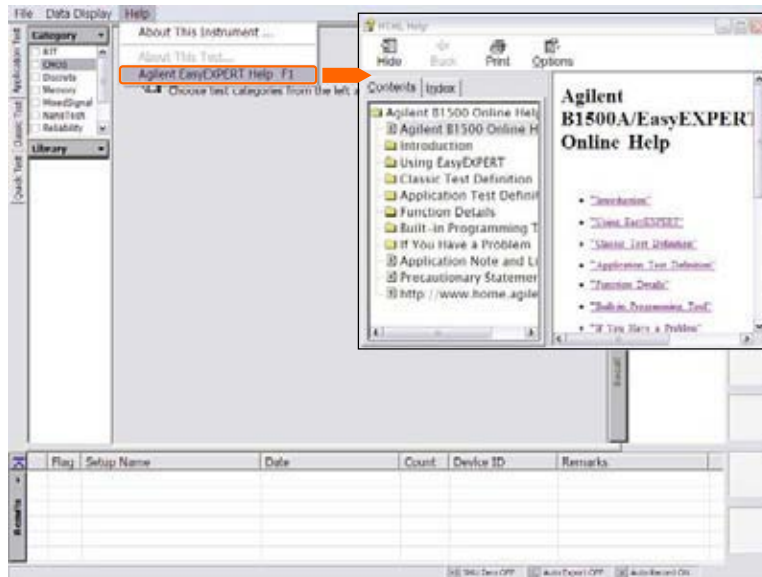
Enter the workspace name and click OK to create/rename the workspace.

If you want to create a public workspace, check the *Allow other users to access this workspace* box.

The public workspace can be used by all users.

If you want to create a private workspace, delete the check from the *Allow other users to access this workspace* box.

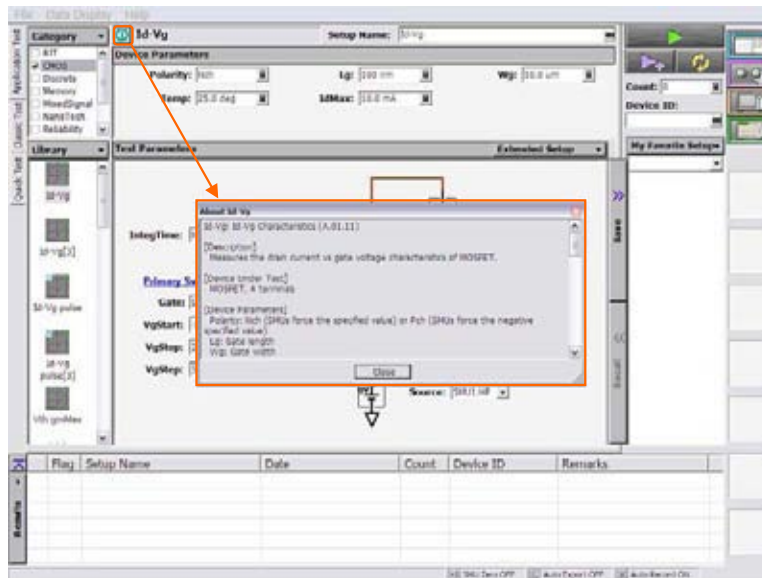
Online Help



Online Help is available for the B1500A and EasyEXPERT. Select Help > Agilent EasyEXPERT Help menu to display the online help window. The online help provides the following information.

- Introduction describes overview, front view, rear view, and measurement units of the Agilent B1500A.
- Using EasyEXPERT provides the reference information of the Agilent EasyEXPERT software.
- Function Details explains the measurement functions of the B1500A with EasyEXPERT.
- Built-in Programming Tool provides the reference information of the built-in function, read out functions, and script programming statements.
- If You Have a Problem describes the problem solving information, the B1500A system maintenance information, and the error messages.

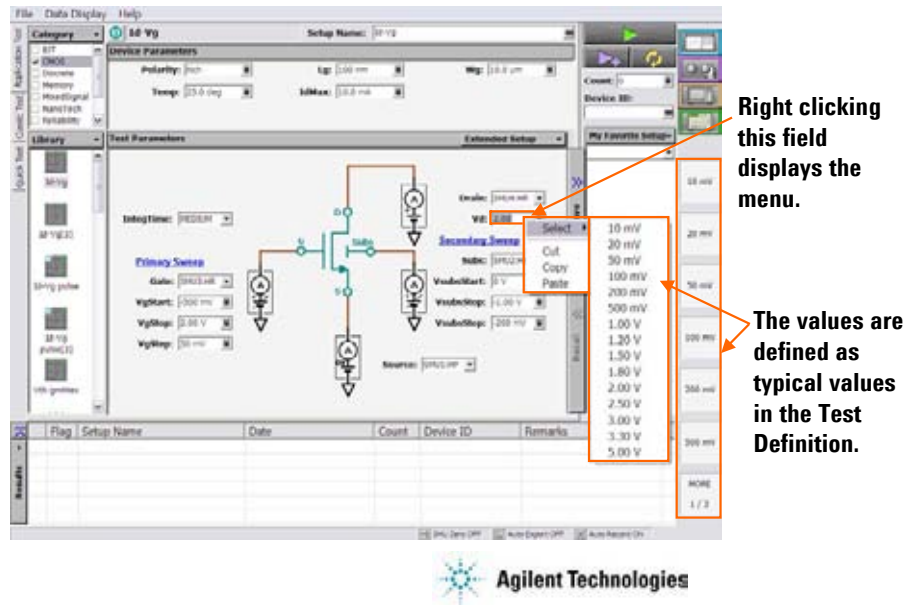
Application Test Description



To know about the application test, click the (i) icon. This icon displays the message box that explains the application test definition. This function will help you to know what is and how to use the application test.

Typical Value Selection

You do not need to hit the keyboard.



When you set a test condition of application test, you do not need to use keyboard. You can select the value from the typical values as shown below.

- Click the entry field of a setup parameter by using the touch screen or the mouse. This displays the typical values for the specified parameter on the softkeys.
- Select one of the softkeys.

Also you can use the following manner.

- Point the entry field of a setup parameter by using the mouse.
- Right click the mouse to display the popup menu.
- Click the Select menu to display the typical values for the specified parameter.
- Select one from the typical values.

Note:

The typical values are defined in the test definition. And you can change the values by using the Define typical values window opened by clicking the Typical Values button on the Test Specification screen of the Test Definition window. For the Test Definition window, see Module 4.

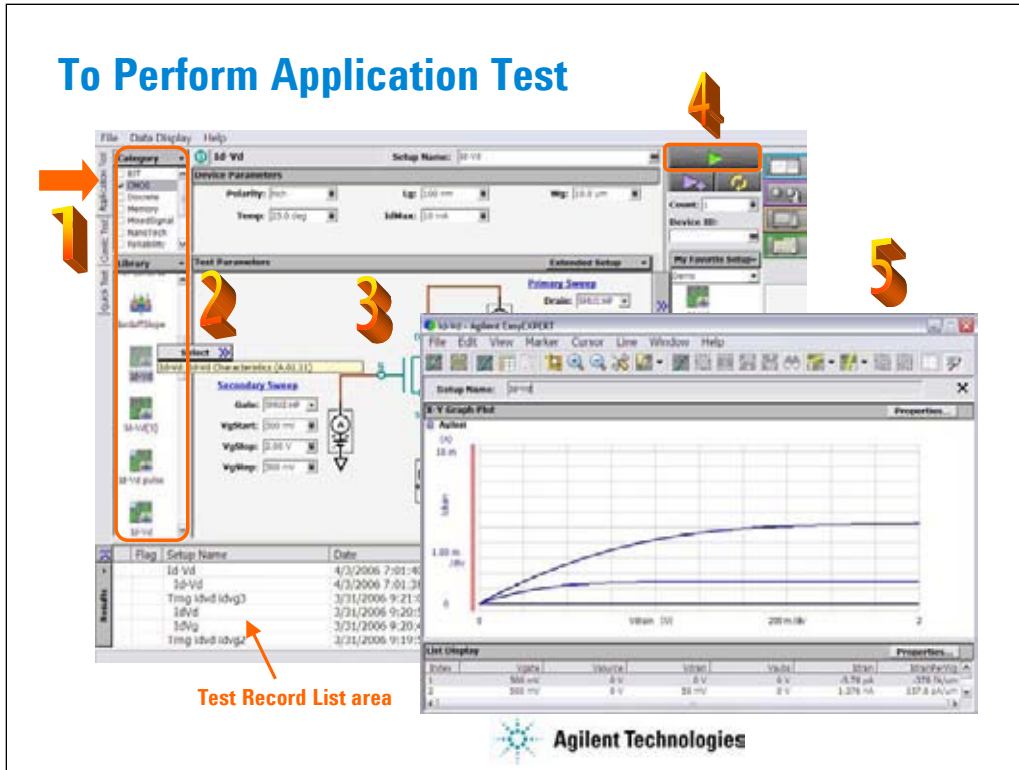
Screen Keyboard



When you need to enter numeric characters in an entry field, you will see the icon at the right side of the entry field. This icon opens the Numeric Keypad. You can use this screen keypad instead of the USB keyboard.

When you need to enter alphabetic characters in an entry field, you will see the icon at the right side of the entry field. This icon opens the On Screen Keyboard. You can use this screen keyboard instead of the USB keyboard.

To Perform Application Test



Step 1: Click Application Test tab.

Step 2: Select one or more technology categories, and select a desired test from the list of tests associated with the selected technology categories.

Step 3: Change the setup parameters (Device parameters and Test parameters) if you want.

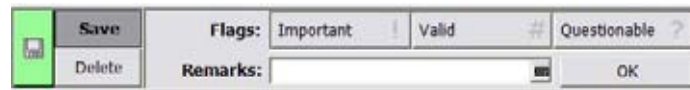
Step 4: Connect DUT, and click the Single button. The B1500A starts the selected test.

After the test, the test result data is displayed on the Data Display window. And the Test Result Editor is also displayed on the lower left area of the B1500 screen. See the next page.

Step 5: Analyze the measurement result data.

The measurement result record is automatically stored in the internal hard disk drive.

Test Result Editor



- **Save/Delete**
- **! Important**
- **# Valid**
- **? Questionable**
- **Remarks**
- **OK**



The Test Result Editor provides the following GUI to set a flag and remarks to the test result record. Set the flag and remarks to the test record.

•Save button and Delete button

Divides test records into groups, Save and Delete.

Test records in Save-group are always listed in the lower area of the EasyEXPERT main screen.

Test records in Delete-group can be listed when Results > Filter > Show Deleted Data is checked.

•Flags buttons

The following buttons are available. You can set one of the following flags.

•Important ! Button

Sets the important flag (!) to the test result record.

•Valid # button

Sets the valid flag (#) to the test result record.

•Questionable ? Button

Sets the questionable flag (?) to the test result record.

•Remarks field

You can enter characters into this field. The characters will be recorded as the Remarks value of the test result record.

•OK button

Applies the setup on the Test Result Editor, and closes this dialog box.

Test Record List Area

Results > Filter > Show Deleted Data

	Flag	Setup Name
...	#	Vth gmMax
...		ID-VD1
	!	Vth gmMax
*		ID-VD1

Expand Application Test Results

	Flag	Setup Name
...	#	Vth gmMax
...	#	Vth gmMax
...		ID-VD1
		ID-VD1
	!	Vth gmMax
	!	Vth gmMax
*		ID-VD1

	Flag	Setup Name
A	#	Vth gmMax
A	#	Vth gmMax
S	?	Vth gmMax
S	?	Vth gmMax
A		ID-VD1
A		ID-VD1
S		ID-VD1
		ID-VD1
!		Vth gmMax
!		Vth gmMax
*		ID-VD1

Show All Append Data

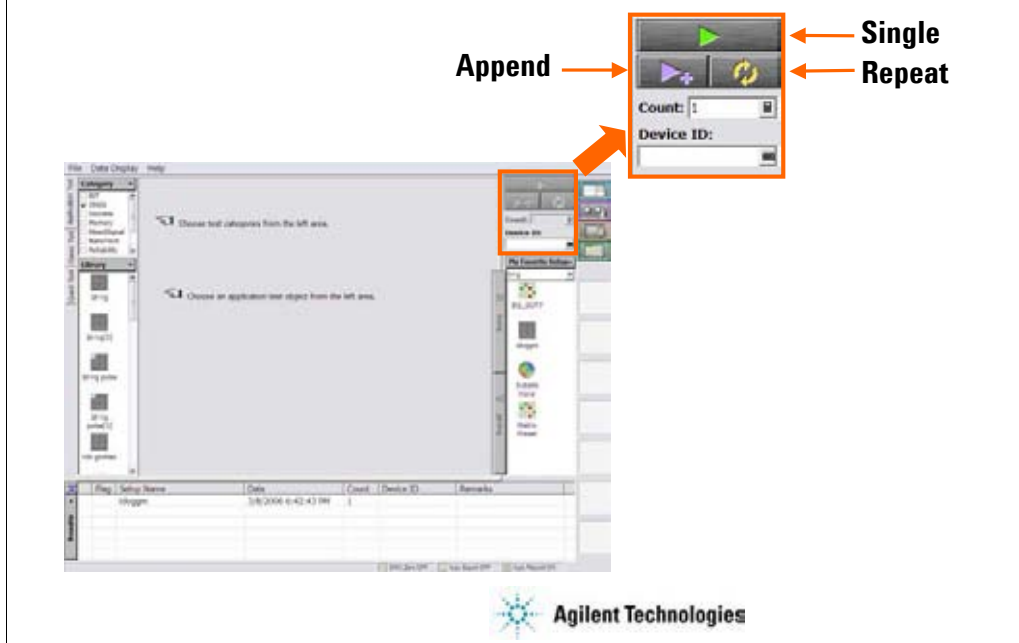


The test result records are listed in the test record list area. The area also lists the following data.

- Append measurement data marked with ...
- Deleted data marked with * if Results > Filter > Show Deleted Data is checked
- Test name defined in the application test definition if Results > Filter > Expand Application Test Results is checked

If Results > Filter > Show All Append Data is checked, all append data will be listed and the symbol will be changed to A for the data obtained by the Append measurement or S for the data obtained by the Single measurement.

Single/Append/Repeat measurement



The EasyEXPERT provides three execution modes, Single, Append, and Repeat.

Single button triggers a single measurement.

Append button triggers an append measurement. The measurement results will be appended to the Data Display window that shows the previous measurement results. The Data Display window can have maximum 10 layers for displaying measurement results.

Repeat button opens the Repeat Measurement Setup dialog box used to set the repeat measurement condition. To perform the repeat measurement, see Module 7.

To abort measurement, click Stop button that appears instead of the Single button.

To Save/Recall Your Test Setup

My Favorite Setup button
Preset Group name.
Use this field to select
preset group.

Flag	Setup Name	Date	Count	Device ID	Remarks
	Vth_gndMax	4/3/2006 7:07:37 PM	1		
	Vth_gndmin	4/3/2006 7:07:35 PM	1		
	Id-Vd	4/3/2006 7:01:40 PM	1		
	Id-Vd	4/3/2006 7:01:38 PM	1		
	Trng_kVd_kVg2	3/31/2006 9:21:00 PM	1		
	IdVd	3/31/2006 9:20:55 PM	1		

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The test setups you create or modify **MUST** be saved in a preset group (My Favorite Setup).

To save the setup, click the Save button.

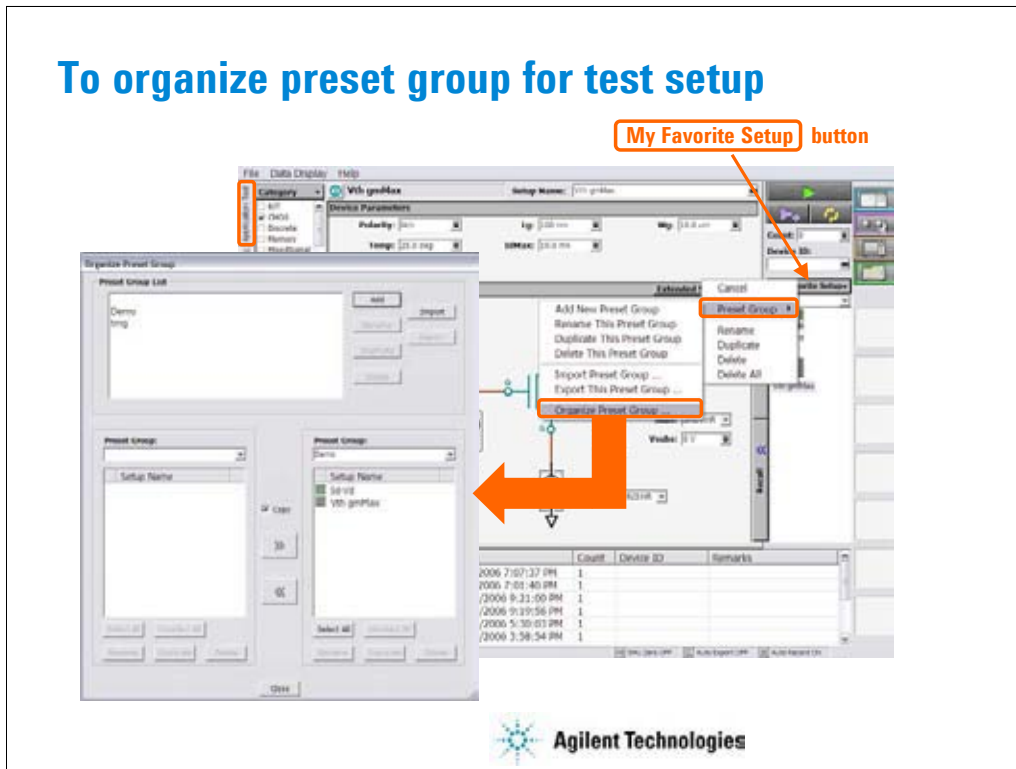
To recall the setup, click the Recall button.

You can organize the setups by using the My Favorite Setup button.

To select the available preset group, use the field below the My Favorite Setup button. In the above example, the Demo group is selected and listed in the My Favorite Setup list.

To rename, duplicate, or delete the setups, and to add, rename, duplicate, delete, import, or export the preset group, use the function of the My Favorite Setup button menu or the Organize Preset Group dialog box shown in the next page.

To organize preset group for test setup



This dialog box is opened by selecting the Organize Preset Group function of the My Favorite Setup button menu, and is used to organize the preset group.

- Preset Group List

Lists the preset groups saved in the workspace. The Add, Rename, Duplicate, Delete, Import, and Export buttons are available to organize the preset groups.

- Copy

Sets the operation of the >> button and the << button. They work as Copy when this check box is checked, and as Move when this check box is blank.

- >>

Copies or moves the preset setup selected in the left Preset Group box to the right Preset Group box.

- <<

Copies or moves the preset setup selected in the right Preset Group box to the left Preset Group box.

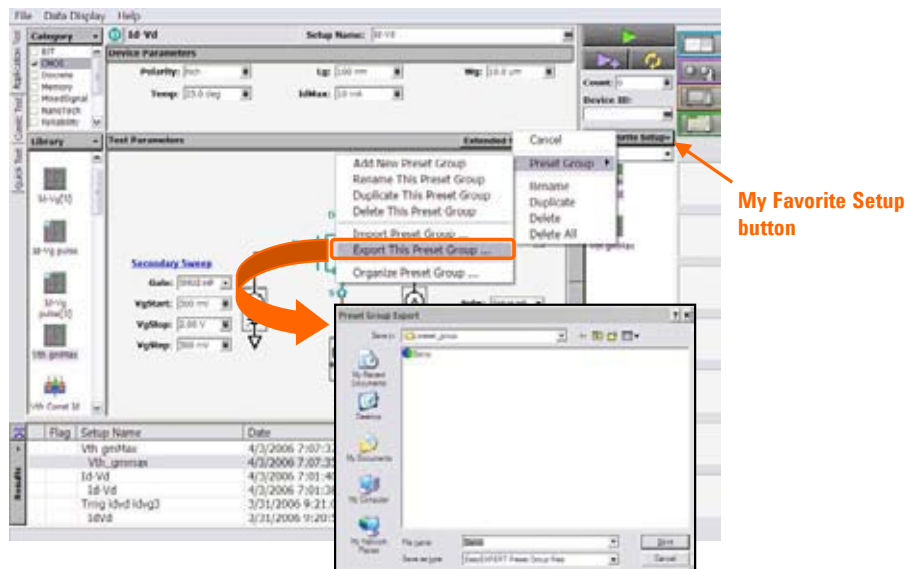
- Close

Closes the Organize Preset Group dialog box.

- Preset Group

Lists the preset setups saved in the preset group. The Select All, Unselect All, Rename, Duplicate, and Delete buttons are available to select or organize the setups saved in the preset group.

To Export/Import Your Preset Group



You can export/import your preset group.

To export the present preset group, click the My Favorite Setup button, select Export, and specify the folder and the name of the preset group to export.

To import the preset group, click the My Favorite Setup button, select Import, and specify the preset group to import.

To Export/Import Test Record

1. Select data record to export, and right click.
2. Select Transport Data > Export As xxxx.

Flag	Default Name	Date	Class
	VM_gmtest	4/3/2008 7:07:27 PM	3
	VM_gmtest	4/3/2008 7:07:27 PM	3
	VM_gmtest	4/3/2008 7:07:27 PM	3
	VM_gmtest	4/3/2008 7:07:27 PM	3
	VM_gmtest	4/3/2008 7:07:27 PM	3
	VM_gmtest	4/3/2008 7:07:27 PM	3
	VM_gmtest	4/3/2008 7:07:27 PM	3
	VM_gmtest	4/3/2008 7:07:27 PM	3
	VM_gmtest	4/3/2008 7:07:27 PM	3
	VM_gmtest	4/3/2008 7:07:27 PM	3

Default File	Applicatio	Name	Date	Source	Dest	Date	VgStart	VgStop	Vg
Default File	Applicatio	Name	Date	Source	Dest	Date	VgStart	VgStop	Vg
TestParam	Value	SMU2 HP	SMU2 HP	SMU2 HP	SMU2 HP	05	2	05	
TestParam	Name	Priority	Lp	Temp	Imax				
OutParam	Value	1	1.00E-07	1.00E-05	25	0.002			
MetaData	TestRecor	true							
MetaData	TestRecor	04/07/2008 12:43:56							
MetaData	TestRecor	2							
MetaData	TestRecor	true							
MetaData	TestRecor	true							
MetaData	TestRecor	true							
MetaData	TestRecor	09587e95-9d37-4844-a013-ct Test d631a7							



To export the test result record, specify the data records and select the Transport Data > Export As xxx menu.

You can save the data records as an EasyEXPERT file, a CSV file, a XML spreadsheet file, or a XML file created by using the specified XML style sheet.

You can import the data record exported as the EasyEXPERT file or the XML spreadsheet file.

To import the file, select the Transport Data > Import... Then the Test Result Import dialog box is opened. On the dialog box, select the file to import.

You can read by using a text editor or a spreadsheet software as shown above. This example reads a test record exported to a CSV file.

Exercise 1

Perform Application Test.

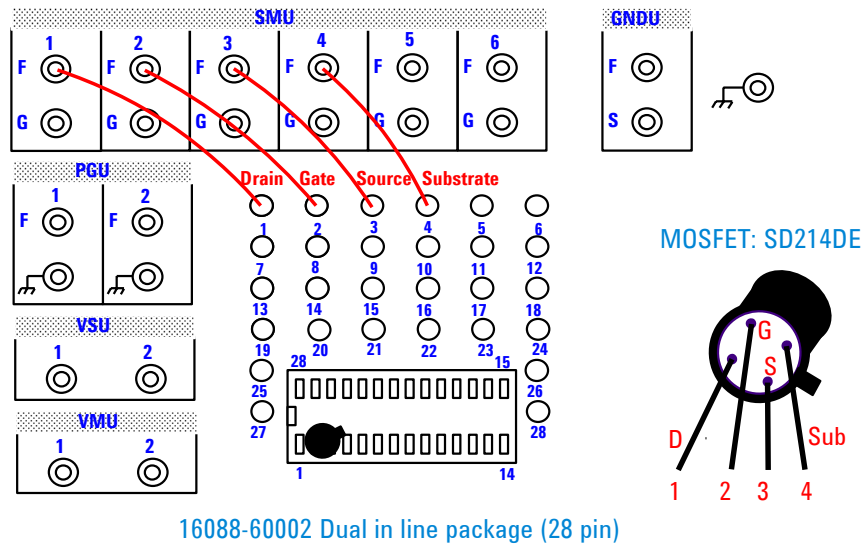
1. **Open Vth gmMax test definition in the CMOS library.**
2. **Change the setup (SMU, output value, etc.)**
3. **Create your preset group, and save your setup.**
4. **Connect device (MOSFET).**
5. **Perform Application Test.**

Time to complete: 5 minutes.



Note:

Device Connection Example



For all class exercises, you need the 28-pin dual in line socket which comes standard with the 4145 fixture (16058A) or the 4156 fixture (16442A/B). Either fixture works fine.

With the 16442A/B fixture, note that there are two SMU numbering schemes....3 SMUs with force and sense, or six SMUs with force only. For this class example we will use the six (6) SMU scheme.

To mount the MOSFET, the leads must be re-arranged into a straight line as shown.

IMPORTANT:

The MOS FET is highly sensitive to electrostatic damage. Touching the bare leads will definitely destroy the device. The device comes with a special shorting wire attached. Bend the leads the way you want, insert the device in the socket, and then remove the shorting wire. The wire has a tab. Just grab the tab and pull straight out. The wire will spiral out as you pull.

Setup Example

2. selected

3. changed

3. changed

3. changed

3. changed

3. changed

3. changed

5. created

5. saved

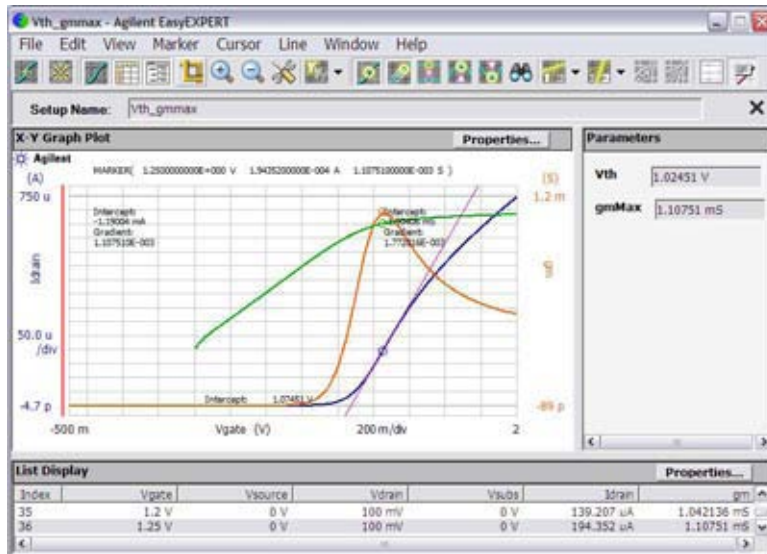
Flag	Setup Name	Date	Count	Device ID	Remarks
	Vth_gmMax	4/3/2006 7:07:37 PM	1		
	Vth_gmMax	4/3/2006 7:07:35 PM	1		
	Id-Vth	4/3/2006 7:01:40 PM	1		
	Id-Vth	4/3/2006 7:01:38 PM	1		
	Trim Id-Vth	3/31/2006 9:21:00 PM	1		
	Id-Vth	3/31/2006 9:20:55 PM	1		

Test result data (record) is automatically saved after measurement.



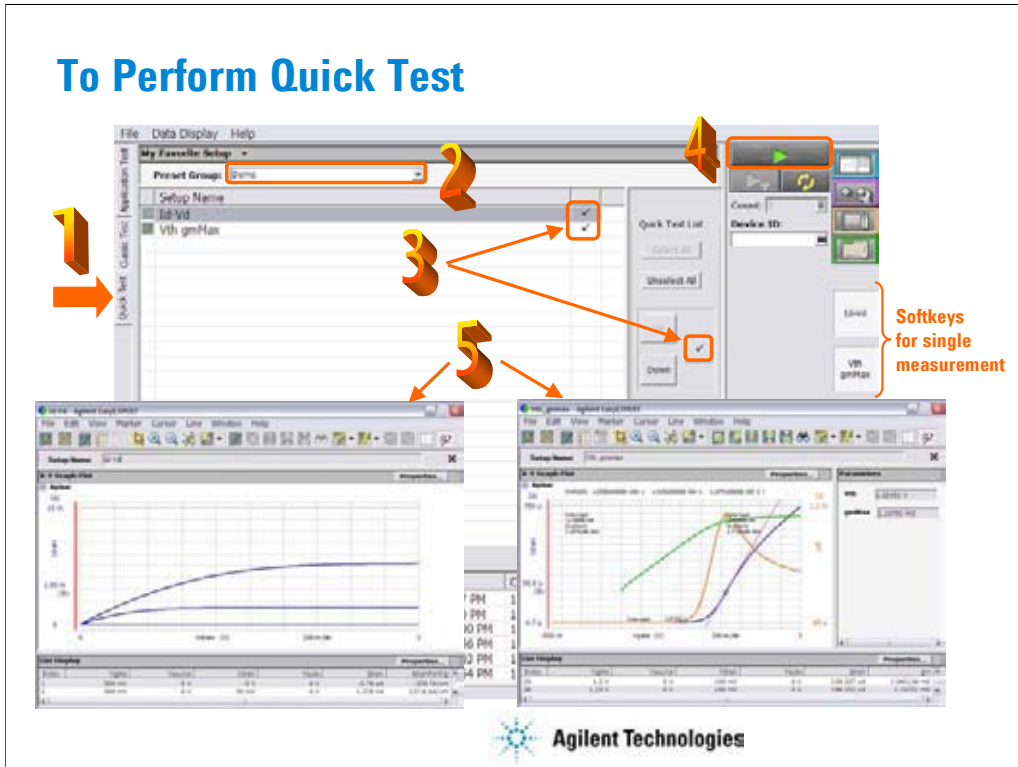
Note:

Result Example



Note:

To Perform Quick Test



Step 1: Click Quick Test tab.

Step 2: Select the Preset Group.

Step 3: Mark (check) the test setups to be executed while the Quick Test is executed.

Step 4: Connect DUT, and click the Single button. The B1500A starts the selected tests from top to bottom in the list.

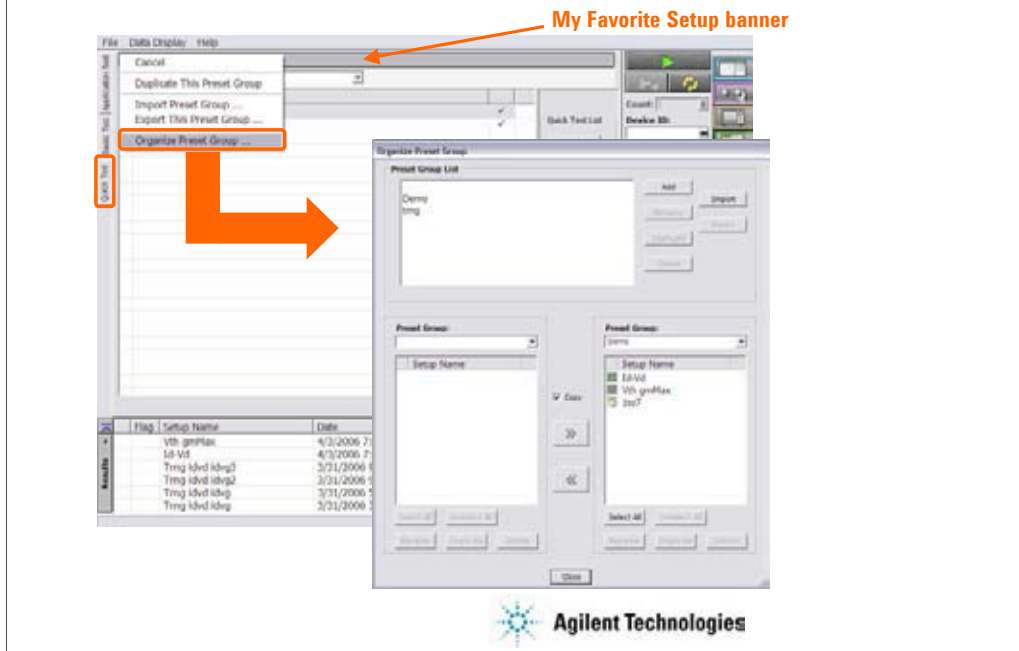
After the test, the test result data is displayed on the Data Display window. And the Test Result Editor is also displayed on the lower left area of the B1500 screen.

Step 5: Analyze the measurement result data.

The measurement result record is automatically stored in the internal hard disk drive.

The softkeys placed right side of the LCD are used to trigger a single measurement of the associated test.

To organize preset group for test setup



This dialog box is opened by selecting the Organize Preset Group function of the My Favorite Setup banner menu, and is used to organize the test preset group.

- Preset Group List

Lists the preset groups saved in the workspace. The Add, Rename, Duplicate, Delete, Import, and Export buttons are available to organize the preset groups.

- Copy

Sets the operation of the >> button and the << button. They work as Copy when this check box is checked, and as Move when this check box is blank.

- >>

Copies or moves the preset setup selected in the left Preset Group box to the right Preset Group box.

- <<

Copies or moves the preset setup selected in the right Preset Group box to the left Preset Group box.

- Close

Closes the Organize Preset Group dialog box.

- Preset Group

Lists the preset setups saved in the preset group. The Select All, Unselect All, Rename, Duplicate, and Delete buttons are available to select or organize the setups saved in the preset group.

Exercise 2

Perform Quick Test.

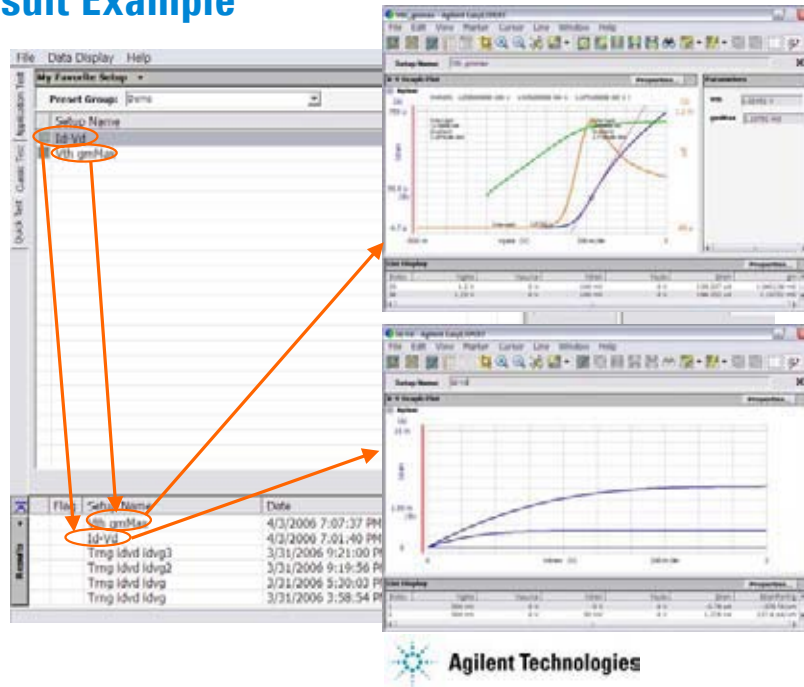
1. **Open or create your preset group.**
2. **Edit your preset group as you want (changing the test execution order etc.).**
3. **Save your preset group.**
4. **Connect device (MOSFET).**
5. **Perform Quick Test.**

Time to complete: 5 minutes.



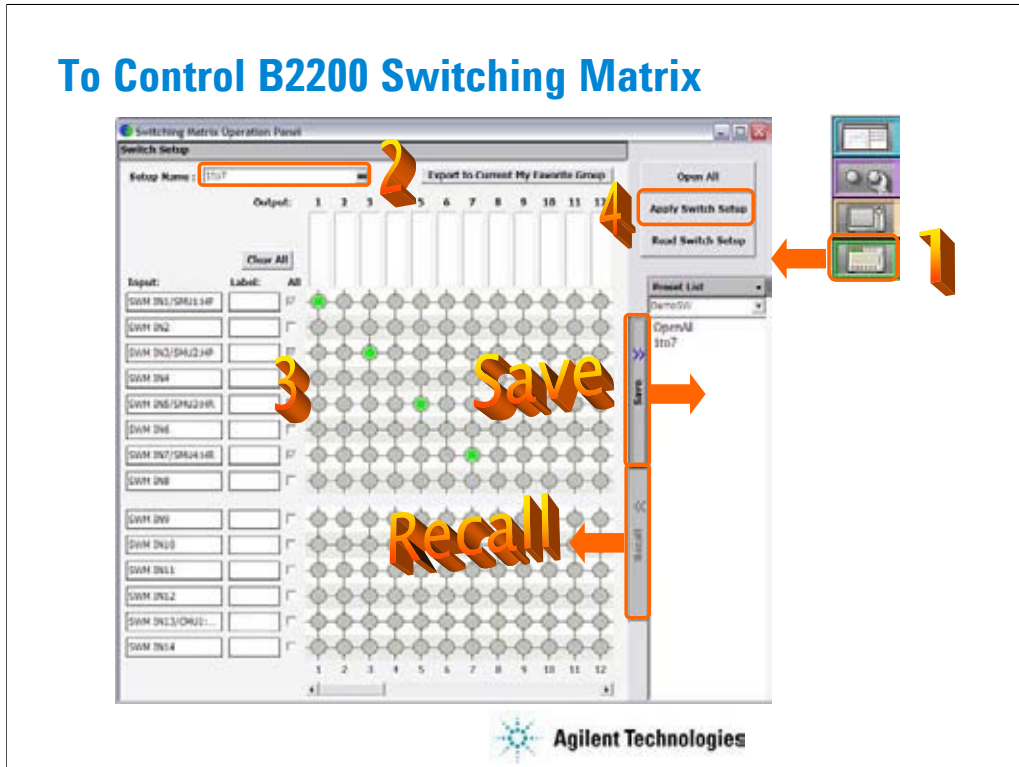
Note:

Result Example



Note:

To Control B2200 Switching Matrix



Step 1: Click Switching Matrix button to open the Switching Matrix Operation Panel.

Step 2: Enter the switch setup name.

Step 3: Define the switch setup by using the matrix on the operation panel window. Label can be set to input ports and output channels.

Step 4: Click the Apply Switch Setup button to send the switch setup to the B2200 switching matrix.

Note:

Before clicking this button, connect the B2200 to the B1500 via GPIB, and set the configuration. To set the configuration, see Module 8.

The switch setups you create or modify **MUST** be saved in a preset group.

To save the setup, click the Save button.

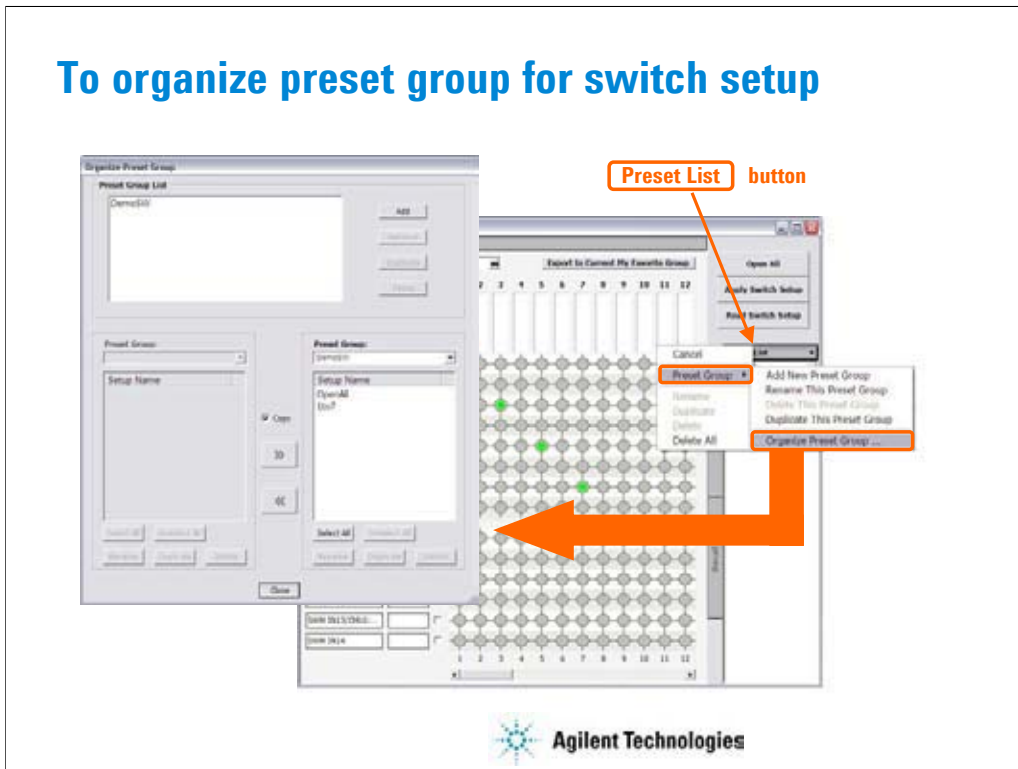
To recall the setup, click the Recall button.

You can organize the setups by using the Preset List button.

To select the available preset group, use the field below the Preset List button. In the above example, the DemoSW group is selected and listed in the Preset List list.

To rename, duplicate, or delete the setups, and to add, rename, duplicate, or delete the preset group, use the function of the Preset List button menu or the Organize Preset Group dialog box shown in the next page.

To organize preset group for switch setup



This dialog box is opened by selecting the Organize Preset Group function of the Preset List button menu, and is used to organize the switch preset group.

- Preset Group List

Lists the preset groups saved in the workspace. The Add, Rename, Duplicate, and Delete buttons are available to organize the preset groups.

- Copy

Sets the operation of the >> button and the << button. They work as Copy when this check box is checked, and as Move when this check box is blank.

- >>

Copies or moves the preset setup selected in the left Preset Group box to the right Preset Group box.

- <<

Copies or moves the preset setup selected in the right Preset Group box to the left Preset Group box.

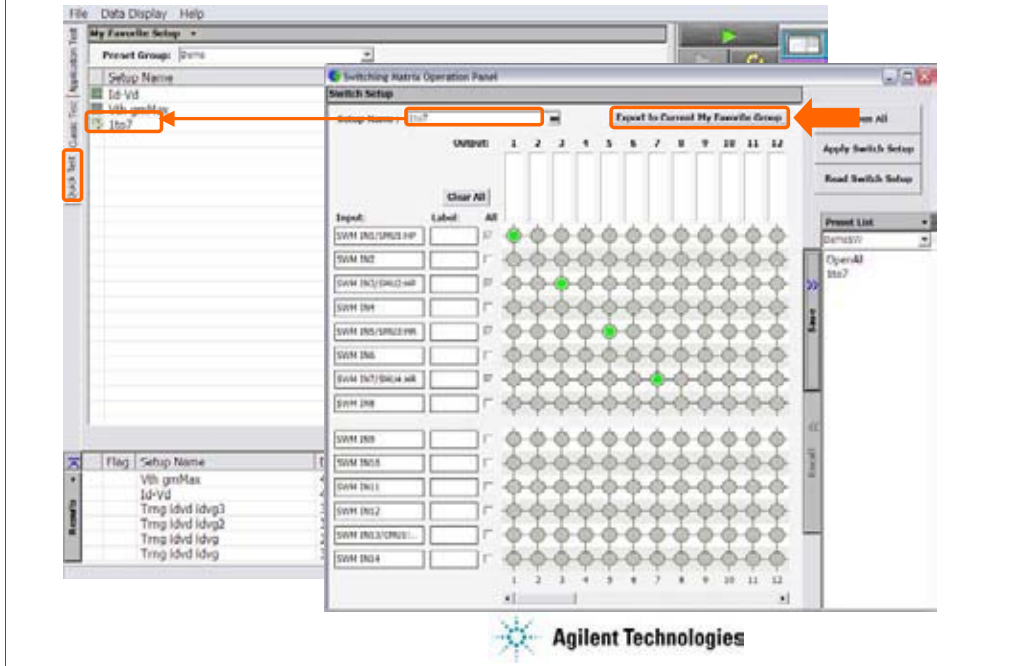
- Close

Closes the Organize Preset Group dialog box.

- Preset Group

Lists the preset setups saved in the preset group. The Select All, Unselect All, Rename, Duplicate, and Delete buttons are available to select or organize the setups saved in the preset group.

To add switch setup to test preset group



Switch setups can be saved in the preset group for test setups.

Click the Export to Current My Favorite Group button. The switch setup will be converted to a classic test setup and saved in the My Favorite Setup group opened in the main screen.

To select the available preset group, use the Preset Group field. In the above example, the Demo group is selected and listed in the quick test setup list.

To duplicate, import, or export the preset group, use the function of the My Favorite Setup banner menu or the Organize Preset Group dialog box shown in the next page.

Exercise 3

Add switch setup to test preset group.

1. Create a switch setup.
2. Create your switch preset group, and save your setup.
3. Add the switch setup to your test preset group.
4. Save your test preset group.

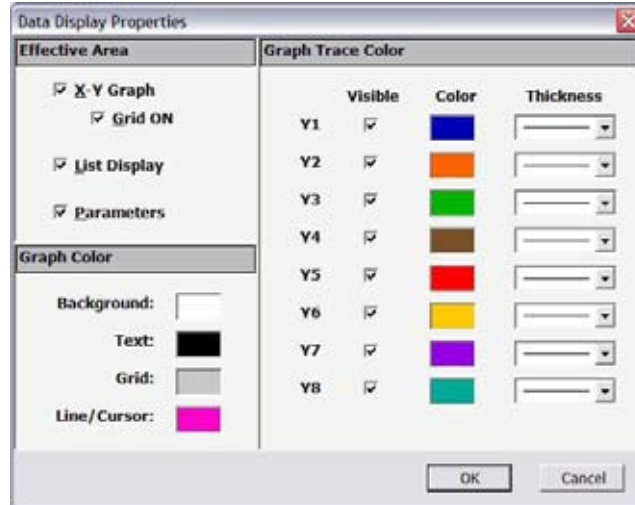
Time to complete: 5 minutes.



Note:

To Manage Data Display Window

Data Display > Default Data Display Properties...



The Data Display Properties window is used to set the default setting of the Data Display window. This window is opened by selecting the Data Display > Default Data Display Properties... menu of the main screen.

The Effective Area is used to select the area effective when the Data Display window is opened, and provides the following check box.

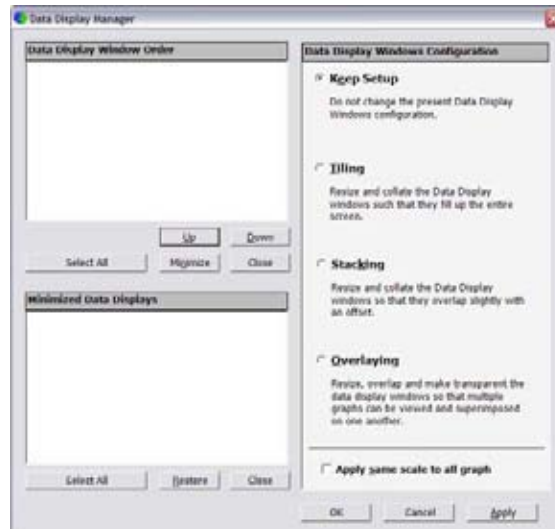
- X-Y Graph: Check this box to enable the X-Y Graph area.
- Grid ON: Check this box to display the grid in the X-Y Graph.
- List Display: Check this box to enable the List Display area.
- Parameters: Check this box to enable the Parameters area.

The Graph Color area is used to set the color map of the Data Display window. You can change the color of the graph background, text, graph grid, and line. The color palette is opened by clicking the pattern of the item.

The Graph Trace Color area is used to set visibility, color, and thickness of the data traces Y1 to Y8 plotted in the graph.

To Manage Data Display Window

Data Display > Manage Data Display...



The Data Display Manager is used to control the appearances of the Data Display windows. This window is opened by selecting the Data Display > Manage Data Display... menu of the main screen.

The Data Display Window Order area lists the Setup Name of the Data Display windows opened. The list items from top to bottom correspond to the windows from front to back in the screen image.

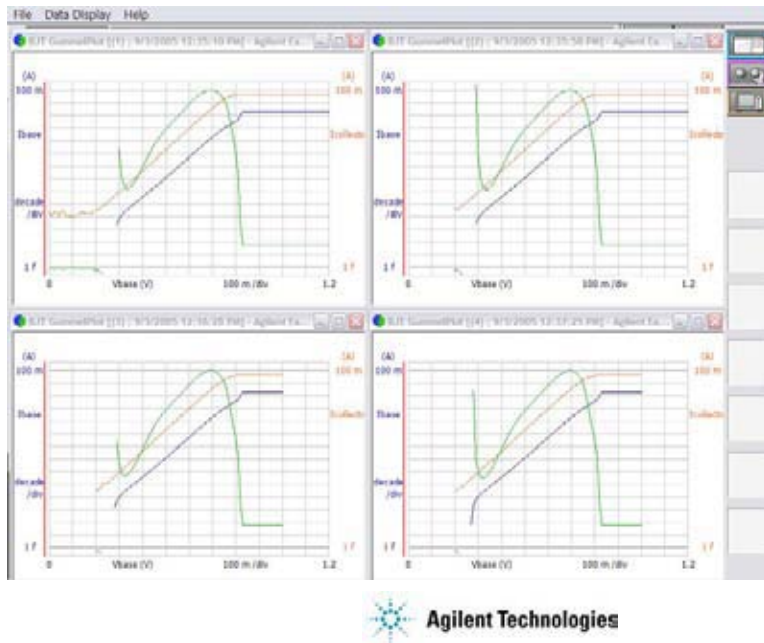
The Minimized Data Displays area lists the Setup Name of the Data Display windows minimized. The Data Display Window Configuration area provides the following radio buttons and a check box to change the appearances of the Data Display windows. All functions are available for the opened windows. See following slides for the display examples.

- Keep Setup: Keeps the present configuration of the Data Display windows.
- Tiling: Resize and collate the data display windows such that they fill up the entire screen.
- Stacking: Resize and collate the data display windows so that they overlap slightly with an offset.
- Overlaying: Resize, overlap, and make transparent the data display windows so that multiple graphs can be viewed and superimposed on one another.

The following check box must be checked to apply the same graph scale to all graphs.

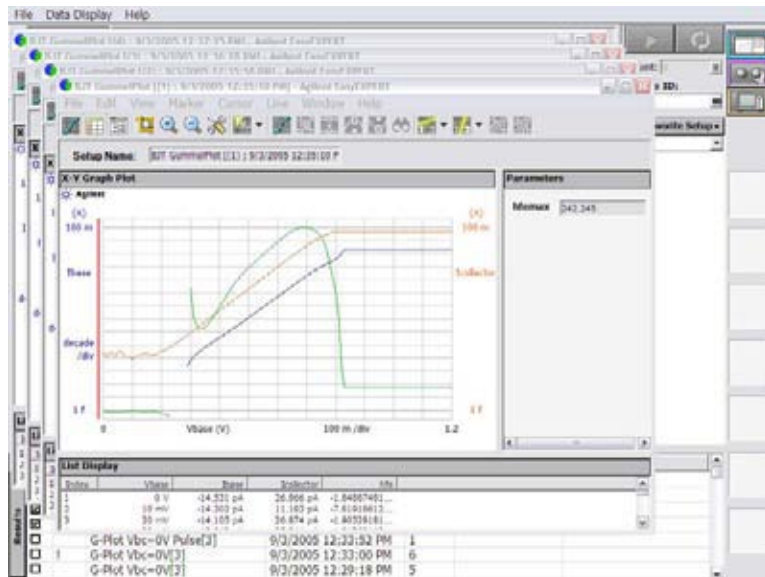
- Apply same scale to all graph

Tiling



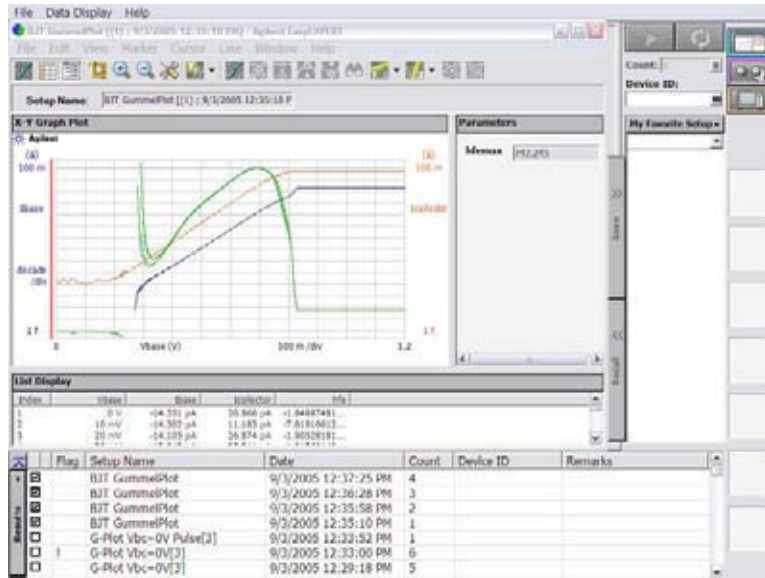
This is a display example of Tiling.

Stacking



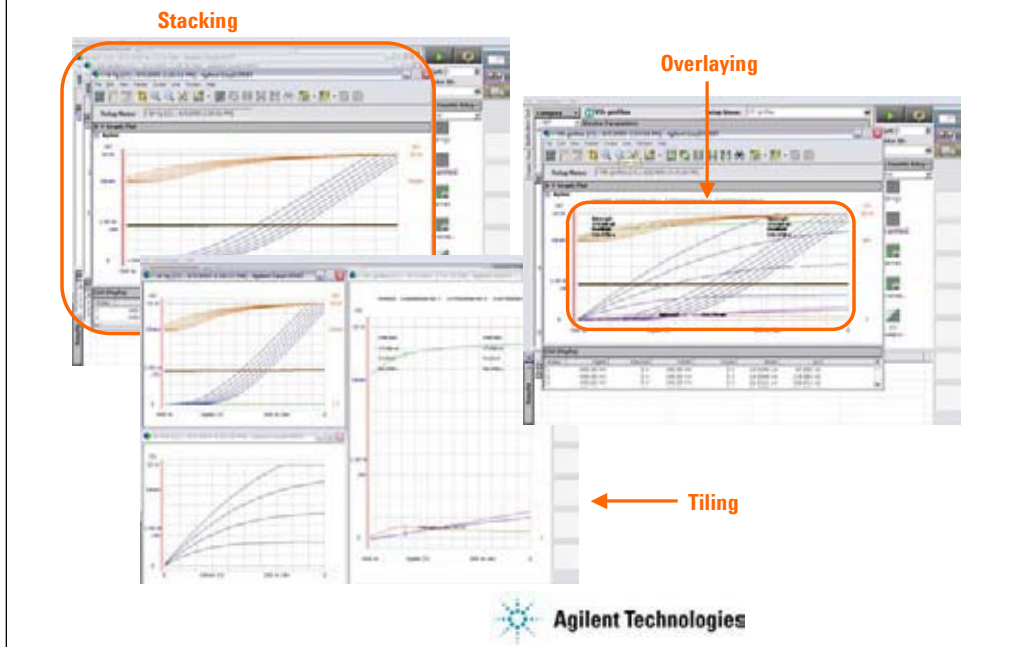
This is a display example of Stacking.

Overlaying



This is a display example of Overlaying.

To tile/stack/overlay windows



When some Data Display windows are opened, the following Windows menu functions are useful.

Tiling

Tiles all Data Display windows on the screen.

Stacking

Stacks all Data Display windows on the screen.

Overlaying

Overlays all Data Display windows on the screen. Then the position, window size, and visibility of the most front window are applied to all windows on the screen.

The background of the X-Y Graph area is cleared except for the most back window.

Module 3. Data Display and Management



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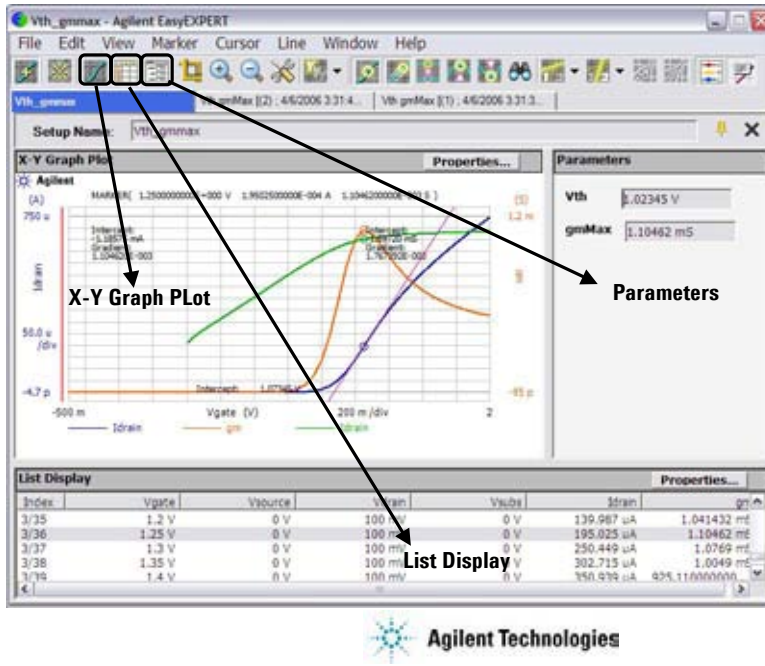
In This Module

- **Data Display window**
- **Graph Analysis Tools**
- **Data Status**
- **To Change Graph/List/Display Setup**
- **To See Print Preview**
- **To Print Display Data**
- **To Copy Graph Plot/List Data**
- **To Save Analysis Result**
- **To Use Preview Window**



This section describes the above topics. You will understand how to use analysis tools, how to change display setup, and how to print/export test result.

Data Display window



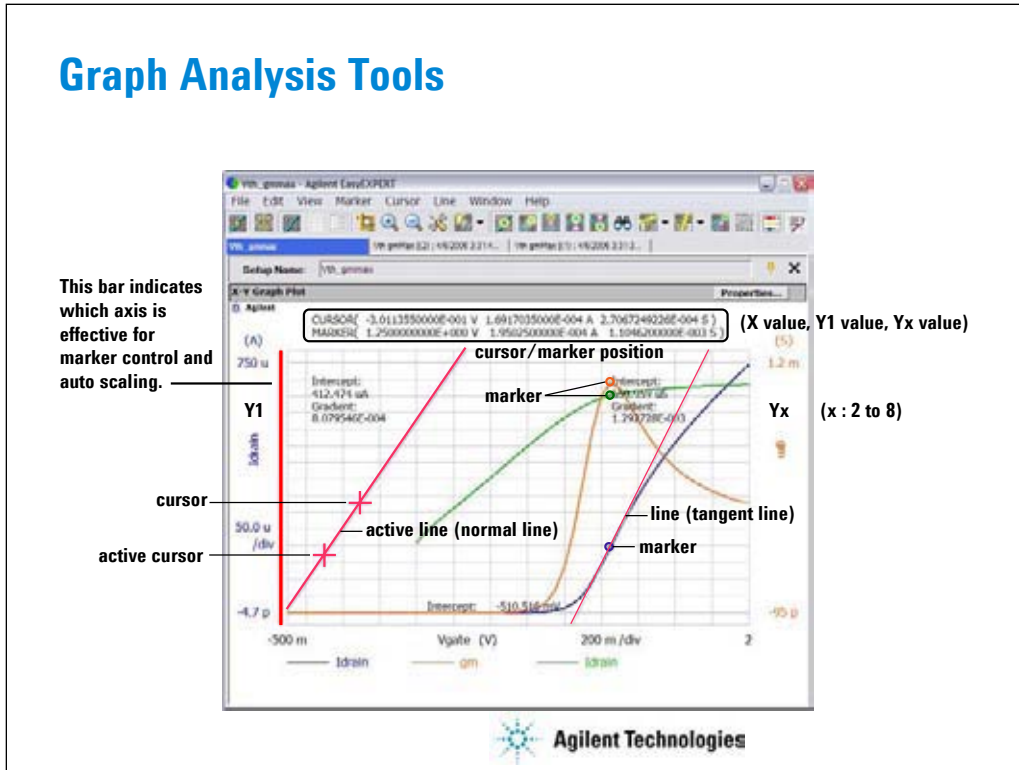
The Data Display window is opened after measurement automatically, or by clicking the Data Display button. And the window is used to display measurement data and analyze the data.

The Show X-Y Graph icon displays/hides the X-Y Graph Plot area. This is the same as the View > X-Y Graph menu.

The Show List Display icon displays/hides the List Display area. This is the same as the View > List Display menu.

The Show Parameters icon displays/hides the Parameters area. This is the same as the View > Parameters menu.

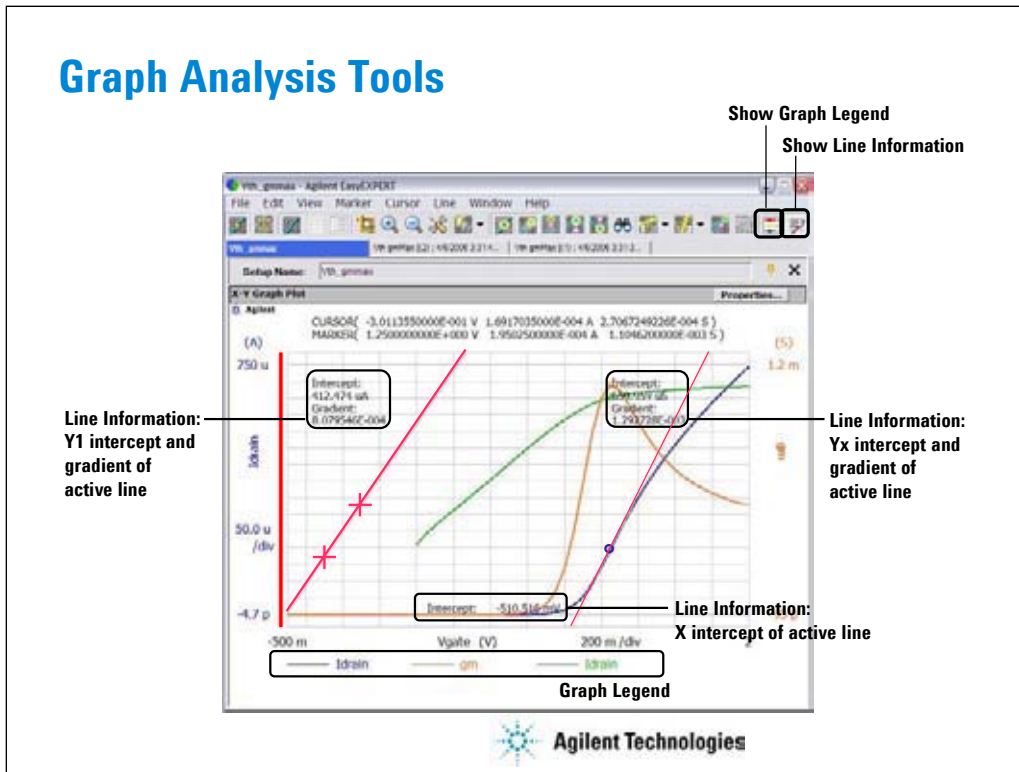
Graph Analysis Tools



The Data Display window provides marker, cursors, and lines for analyzing test result data. Marker is used to read measurement data and draw a tangent line. Cursors are used to read the cursor position and draw a normal line, gradient line, or regression line. The cursor/marker position data is displayed top of the graph plot area.

Clicking Y axis can select the Y axis effective for the analysis tools. On the graph, left axis is always Y1 axis. And the right axis is selectable from Y2 to Y8 axes.

Graph Analysis Tools

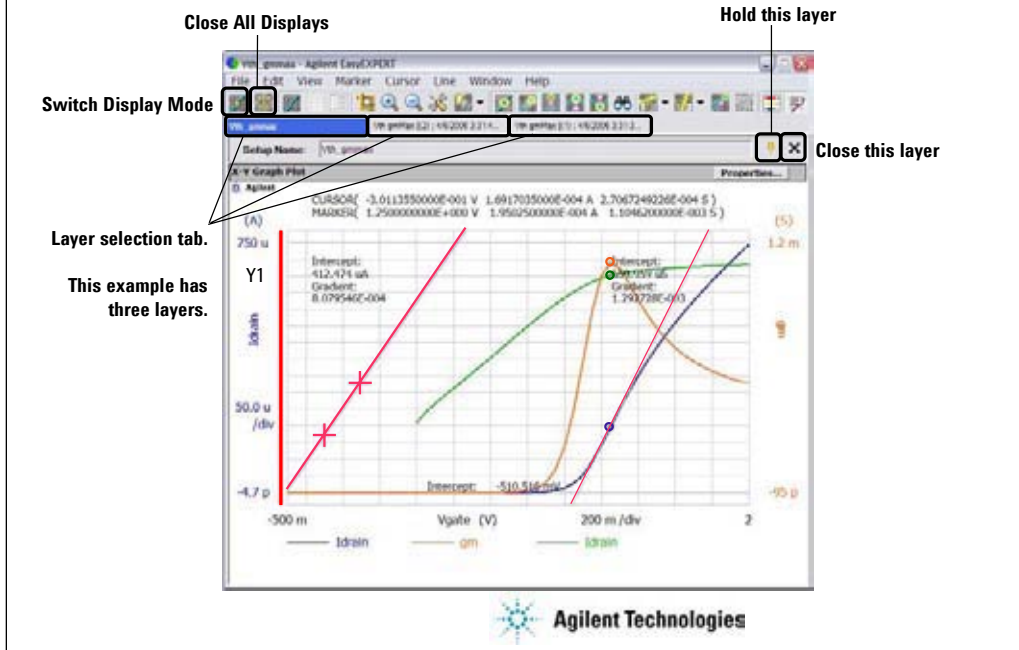


When a line is displayed, the line information can be displayed in the graph plot area.

The Show Line Information icon displays/hides the line information. This is the same as the View > Line Information ON/OFF menu.

The Show Graph Legend icon displays/hides the graph legend. This is the same as the View > Graph Legend ON/OFF menu.

Graph Analysis Tools



If the append measurement is performed, the data display layer is added to the Data Display window. In this example, the Data Display window has three layers.

Use the icons shown above to organize the data display layers.

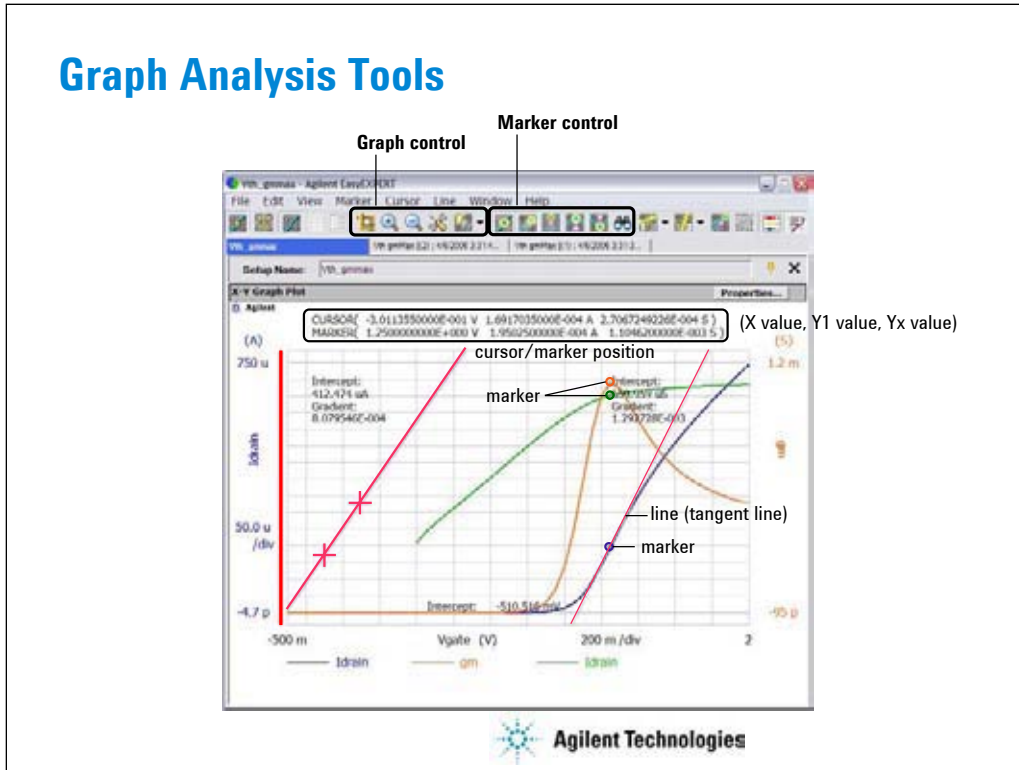
Switch Display Mode icon switches the mode, overwrite or append.

In the overwrite mode, the data is displayed in a new Data Display window.

In the append mode, the data is displayed on a new display layer in the present Data Display window.

The Data Display window can hold up to 10 display layers. And the earliest layer over 10 will be automatically deleted. The Hold this layer icon is available when the window holds at least two layers. If this icon shows the standing pin, the layer will be held. If this icon shows the laid pin, the layer can be deleted. Double clicking the tab gives the same result as this icon.

Graph Analysis Tools



Graph control:

Auto Scale icon changes graph scale to fit the trace in the graph automatically for the Choose Active Y Axis.

Zoom In icon zooms the data graph in. This enlarges the trace in the graph. Then the center of zooming will be the cursor position.

Zoom Out icon zooms the data graph out. This reduces the trace in the graph.

Graph Setup icon opens the Graph Setup dialog box used to change the graph axis setup.

Choose Active Y axis icon selects the Y axis that is effective for the analysis tools (marker control and auto scaling).

Marker control:

Marker ON/OFF icon enables or disables the marker.

Interpolation ON/OFF icon enables or disables the interpolation function of measurement data. You can read the interpolation data between two actual measurement points.

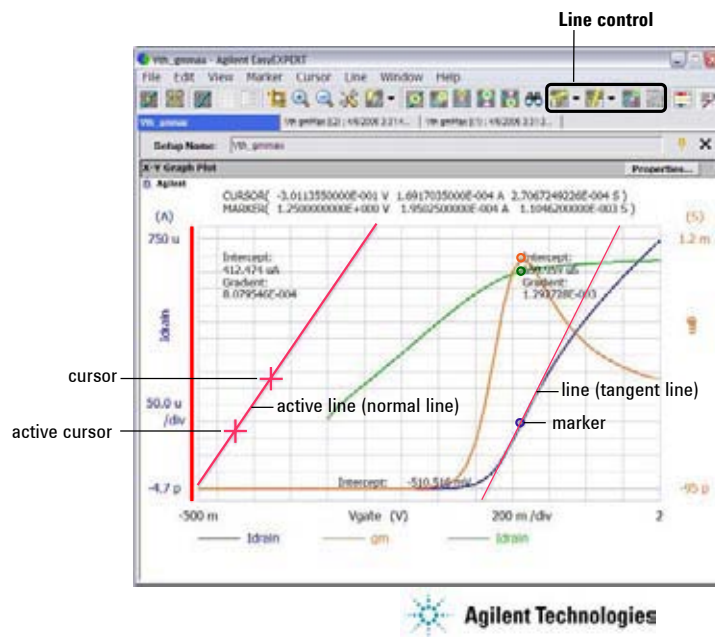
Marker Skip icon moves the marker to the next measurement curve that is added by the VAR2 variable.

Marker Maximum icon moves the marker to the maximum measurement point.

Marker Minimum icon moves the marker to the minimum measurement point.

Marker Search icon opens the Direct Marker/Cursor dialog box used to specify the coordinate values to move the marker.

Graph Analysis Tools



Line control:

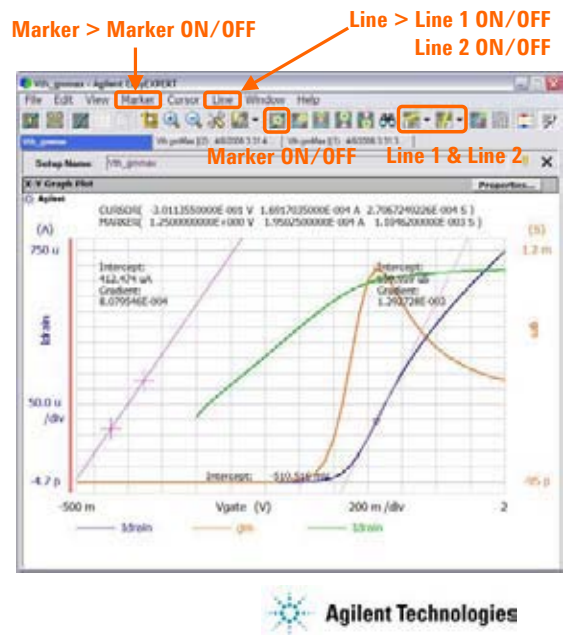
Line 1 State icon enables or disables line 1 and its function: normal, gradient, tangent, or regression.

Line 2 State icon enables or disables line 2 and its function: normal, gradient, tangent, or regression.

Cursor to Marker icon moves the cursor to the marker position.

Adjust Gradient icon is available when a regression line is active. Clicking this icon enables the rotary knob and the mouse wheel to increase/decrease the gradient of the line. Clicking this icon again, clicking the rotary knob, or clicking the mouse wheel disables this function.

To Enable Analysis Tools



To enable maker, click the Marker ON/OFF icon, or select the Marker > Marker ON/OFF menu.

To enable the Line 1, click Line 1 icon and select one of the line mode. Or select the Line > Line 1 ON/OFF menu and select one of the line mode.

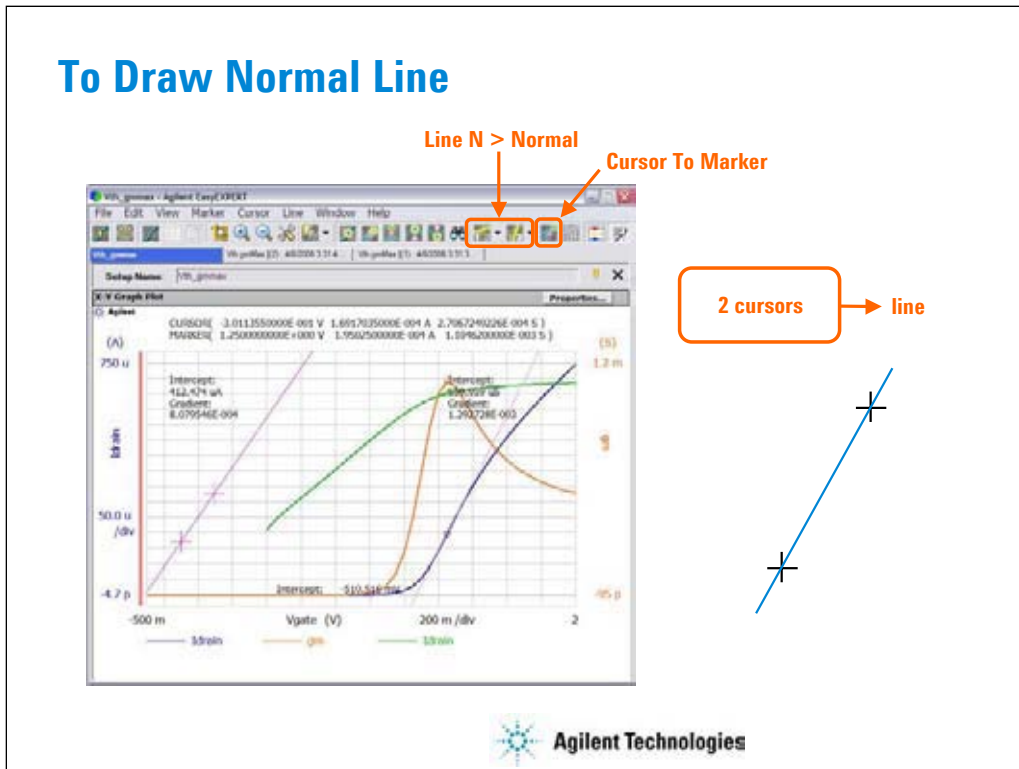
To enable the Line 2, click Line 2 icon and select one of the line mode. Or select the Line > Line 2 ON/OFF menu and select one of the line mode.

If you enable the Normal line, two cursors are available. The cursors specify the points that the line passes through.

If you enable the Gradient line, a cursor is available. The cursor specifies the point that the line passes through.

If you enable the Regression line, two cursors are available. The cursor specify the measured data used to draw the regression line.

To Draw Normal Line

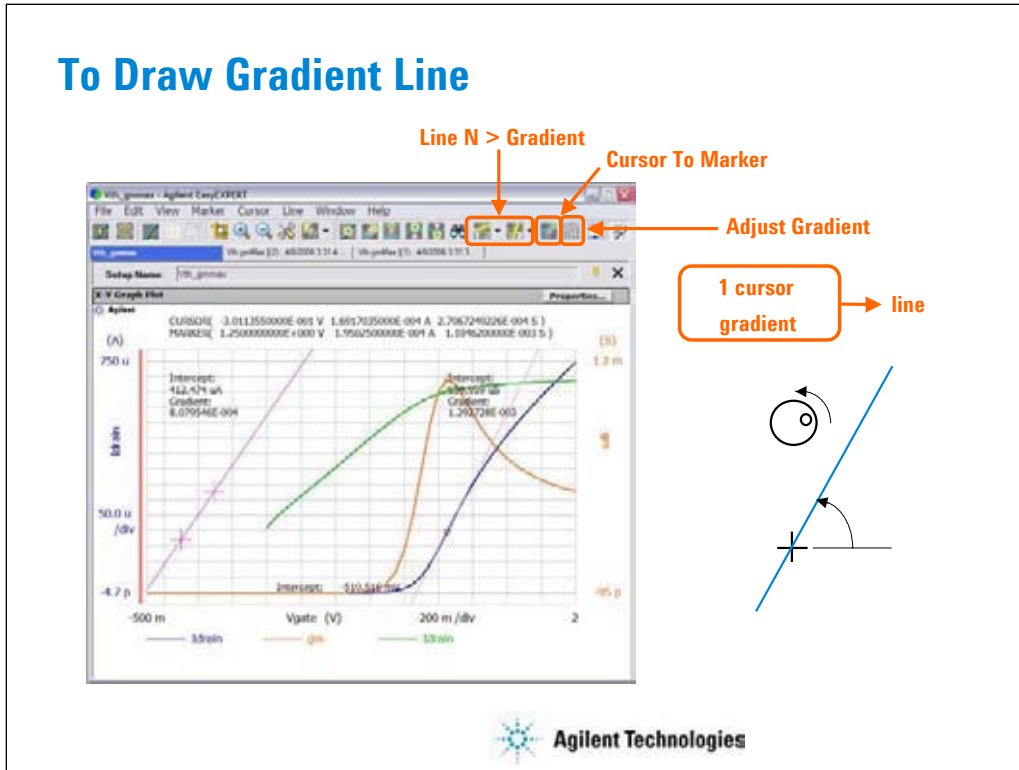


Enable the Normal line by clicking the Line 1 (or Line 2) icon and Normal.

Move cursors to draw the line. The line passes through the cursor points.

To move the cursor, you can use the Cursor To Marker icon. The cursor will move to the marker point.

To Draw Gradient Line



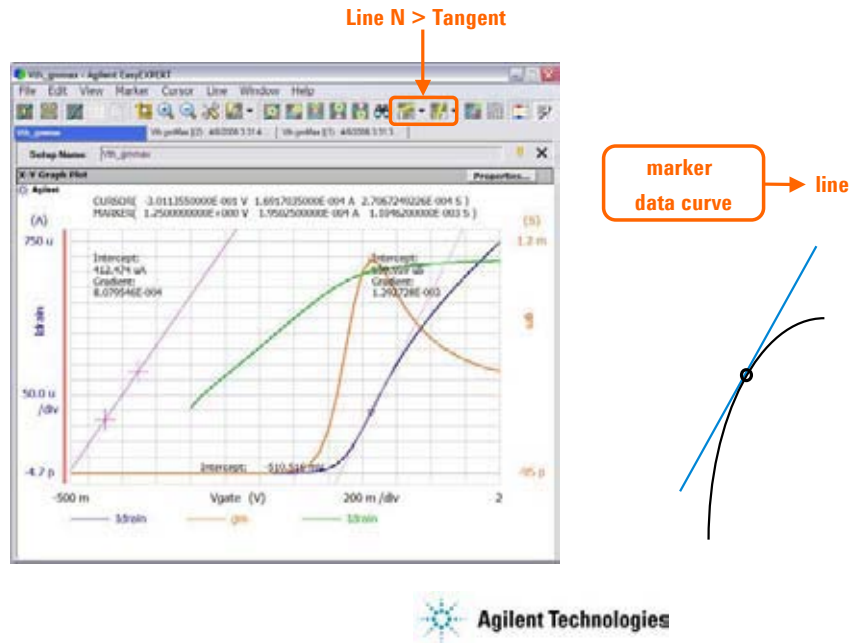
Enable the Gradient line by clicking the Line 1 (or Line 2) icon and Gradient.

Move the cursor to specify the point that the line passes through. And click the Adjust Gradient icon.

Use the rotary knob or the marker scroll button to adjust the gradient of the line.

To move the cursor, you can use the Cursor to Marker icon. The cursor will move to the marker point.

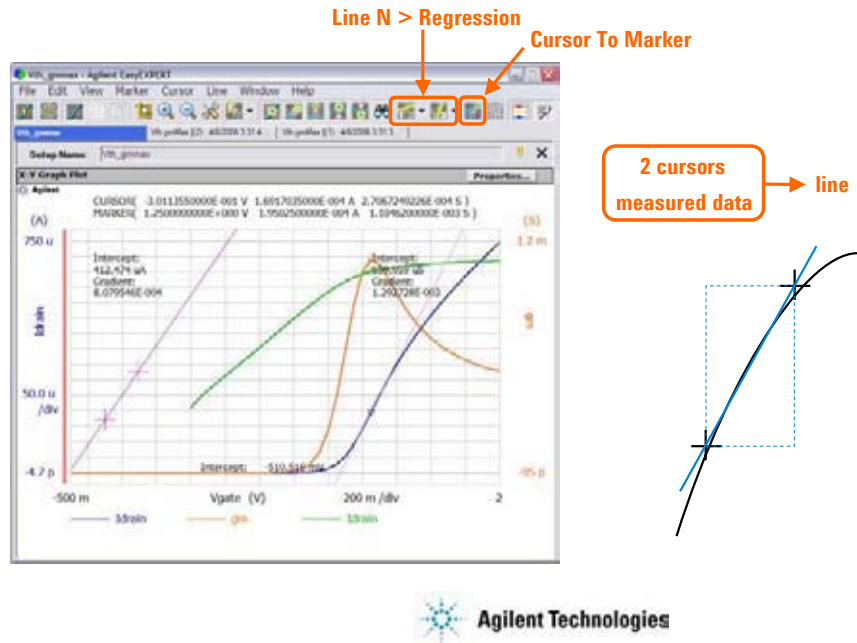
To Draw Tangent Line



Enable the Tangent line by clicking the Line 1 (or Line 2) icon and Tangent.

Move marker to draw the line. The tangent line will pass through the marker point.

To Draw Regression Line

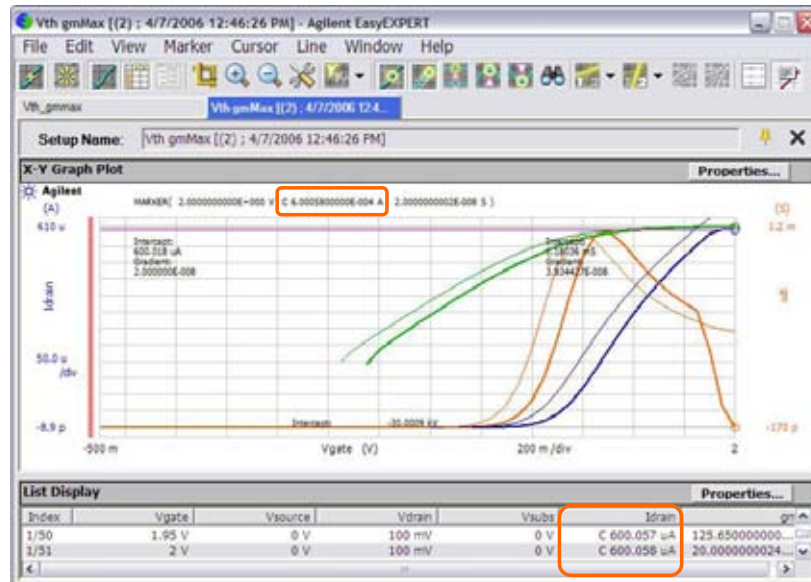


Enable the Regression line by clicking the Line 1 (or Line 2) icon and Regression.

Move cursors to specify the region of the measurement data used for the regression calculation.

To move the cursor, you can use the Cursor to Marker icon. The cursor will move to the marker point.

Data Status



If measurement unit detects any status while measurement, the status code is recorded with the measurement data. In this example, a SMU detected the compliance condition in the drain channel, so the status code C is put just before the Idrain value.

SMU status code:

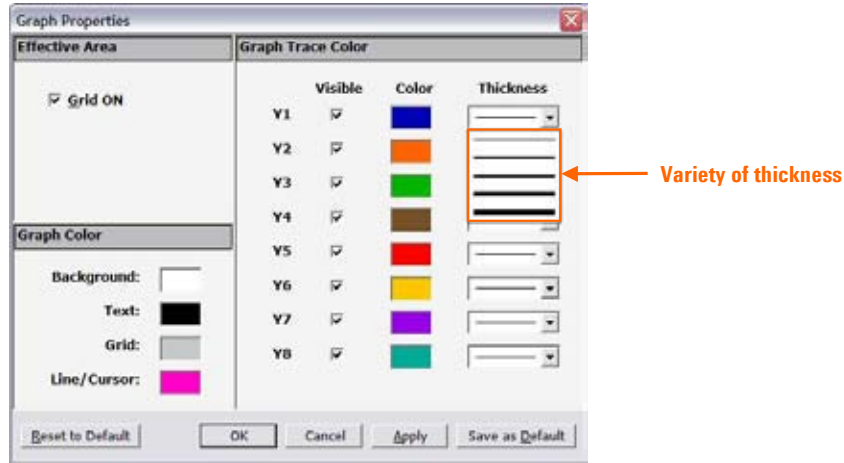
- C: Compliance
- T: Other channel compliance
- X: Oscillation
- V: Overflow

MFCMU status code:

- U: Unbalance
- D: I/V amp saturation
- V: Overflow

To Change Graph Properties

Edit > Graph Properties...



The Graph Properties dialog box is used to set the following setting of the selected Data Display window. This dialog box is opened by clicking the Properties... button in the X-Y Graph Plot area or by selecting the Edit > Graph Properties... menu of the Data Display window.

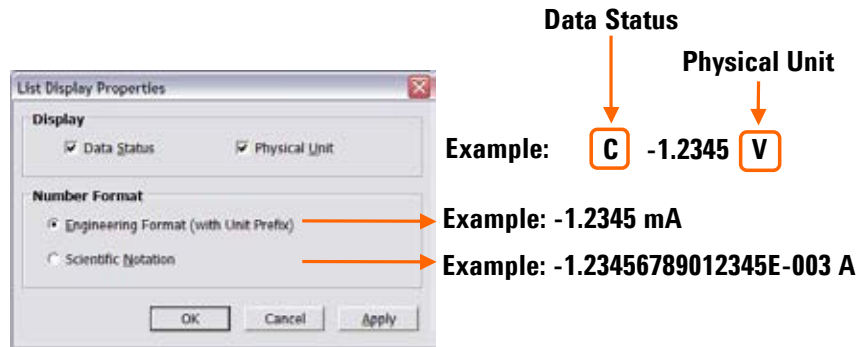
The Grid ON check box in the Effective Area is used to display the grid in the X-Y Graph.

The Graph Color area is used to set the color map of the Data Display window. You can change the color of the graph background, text, graph grid, and line. The color palette is opened by clicking the pattern of the item.

The Graph Trace Color area is used to set visibility, color, and thickness of the data traces Y1 to Y8 plotted in the graph.

To Change List Display Properties

Edit > List Display Properties...



This dialog box is used to set the data display format in the List Display area. This dialog box is opened by clicking the Properties... button in the List Display area or by selecting Edit > List Display Properties... menu of the Data Display window.

Display:

Check the following check box to add the data status or the physical unit to data. Unchecking the box removes it.

- Data Status: Adds or removes the status code before data.
- Physical Unit: Adds or removes the physical unit after data.

Number Format:

Selects the data display format from the following formats.

- Engineering Format (with Unit Prefix):

Data display with arithmetic point, SI prefix, and unit.

Example: -1.2345 mA

- Scientific Notation:

Data display with arithmetic point, exponential part (E, +/- sign, and three-digit number), and unit.

Example: -1.23456789012345E-003 A

To Change Display Setup

View > Display Setup...



This dialog box is used to change the graph scale and data displayed in the Data Display window.

The X-Y Graph area sets the X axis and Y axis of the X-Y Graph Plot area.

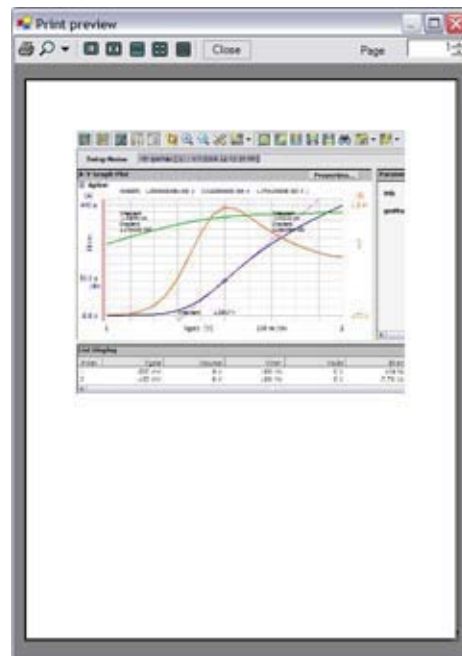
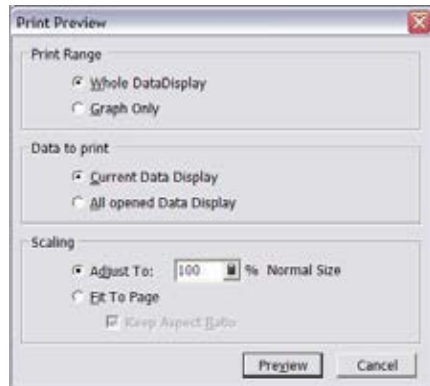
- Name: Name of variable to plot on the X axis
- Scale: Linear or Log
- Min: Minimum value of the specified axis
- Max: Maximum value of the specified axis

The List Display area selects the variables to be listed in the List Display area. Up to 20 variables can be set.

The Parameters area selects the variables to be listed in the Parameters area. Up to 20 parameters can be set.

To See Print Preview

File > Print Preview...



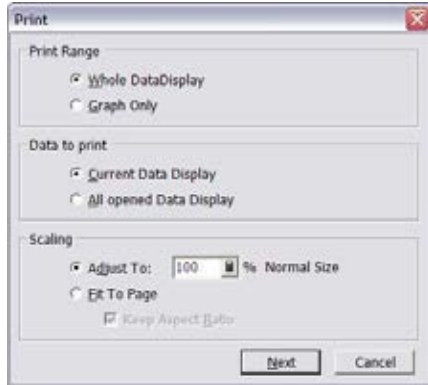
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The Data Display window provides the File > Print Preview... function to show the print preview. This is an example of the print preview.

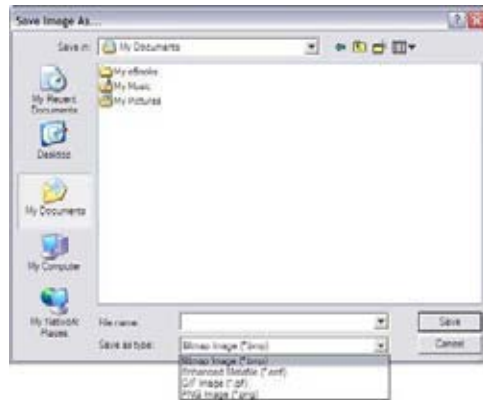
- Select the File > Print Preview menu to open the Print Preview dialog box.
- Set the Print Range, Data to print, and Scaling.
- Click Preview button. The Print preview window is displayed.

To Print Display Data

Edit > Graph Properties...



Edit > Save Image As...



bmp, emf, gif, or png format



The Data Display window provides the display image output capability to a printer or a file.

Before printing, connect a printer to the B1500A via the parallel interface or the LAN, and set up it by using the Add Printer Wizard of Windows. After that, do following.

- Select the File > Print menu to open the Print dialog box.
- Set the Print Range, Data to print, and Scaling.
- Click Next button.
- Select the printer, and set the Properties.
- Click OK button.

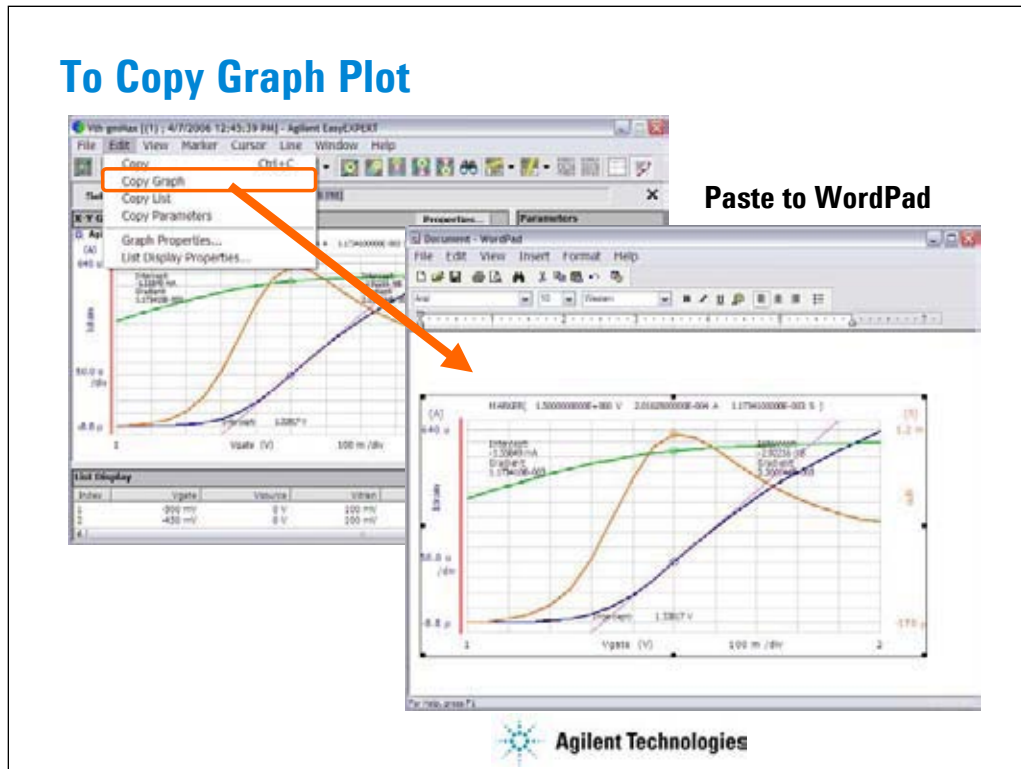
You can export the display image to a file as shown below.

- Select the File > Save Image As... menu to open the Save Image As... dialog box.
- Select the format (file type) from Save As Type menu.
- Enter the file name.
- Click Save button.

The file can be imported by the graphics software that supports the exported file type. The EasyEXPERT supports the following types.

- bmp: Bitmap image
- emf: Enhanced metafile
- gif: GIF image
- png: PNG image

To Copy Graph Plot



You can copy graph image to the clipboard, and paste it to a word processing software. In the above example, the graph image is pasted to the WordPad.

This is an example of the copy and paste operation.

- Select the Edit > Copy Graph menu on the Data Display window.
- Select the Edit > Paste menu on the WordPad.

To Copy List Data

Paste to Notepad

Read by Spreadsheet software

Index	vgate	vsource	vdrain	vsubs	sdrain	gs	IGL	FA	183.88	PS	
1	0 v	100 mv	0 v	0 v	-7.79	µA				81.10	µS
2	0 v	100 mv	0 v	0 v	-7.79	µA				2.1	µS
3	0 v	100 mv	0 v	0 v	-7.79	µA				2.1	µS
4	0 v	100 mv	0 v	0 v	-7.79	µA				2.1	µS
5	0 v	100 mv	0 v	0 v	-7.79	µA				2.1	µS
6	0 v	100 mv	0 v	0 v	-7.79	µA				2.1	µS
7	0 v	100 mv	0 v	0 v	-7.79	µA				2.1	µS
8	0 v	100 mv	0 v	0 v	-7.79	µA				2.1	µS
9	0 v	100 mv	0 v	0 v	-7.79	µA				2.1	µS
10	0 v	100 mv	0 v	0 v	-7.79	µA				2.1	µS
11	0 v	100 mv	0 v	0 v	-7.79	µA				2.1	µS
12	0 v	100 mv	0 v	0 v	-7.79	µA				2.1	µS
13	0 v	100 mv	0 v	0 v	-7.79	µA				2.1	µS
14	0 v	100 mv	0 v	0 v	-7.79	µA				2.1	µS
15	0 v	100 mv	0 v	0 v	-7.79	µA				2.1	µS

You can copy the data list to the clipboard, and paste it to a word processing software. In the above example, the data list is pasted to the Notepad.

This is an example of the copy and paste operation.

- Select the Edit > Copy List menu on the Data Display window.
- Select the Edit > Paste menu on the Notepad.

You can save the data as a text file, and read it by using a spreadsheet software. Data elements are separated by a tab.

Note:

As same as the Copy List function, the Copy Parameter function is used to copy the data in the Parameter area.

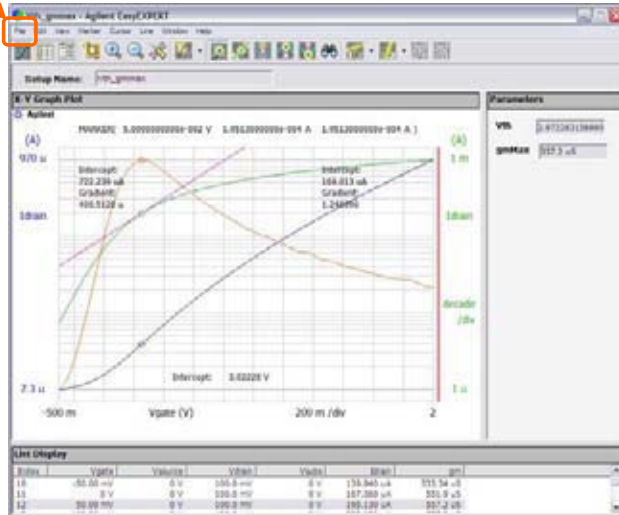
To Save Analysis Result

Select File > Update Test Result

Saves graph information to data record.

Select File > Save Image As...

Saves graph image as a file.



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To leave the graph modification information such as scaling, marker, cursor, and line on the graph, select the File > Update Test Result menu.

You can see the all information when you open the graph again. Note that the modification information will be destroyed if you did not do it.

To save the graph image as a file, select the File > Save Image As... menu.

You can save the image as a bmp, emf, gif, or png file.

Exercise 4

Use the analysis tools.

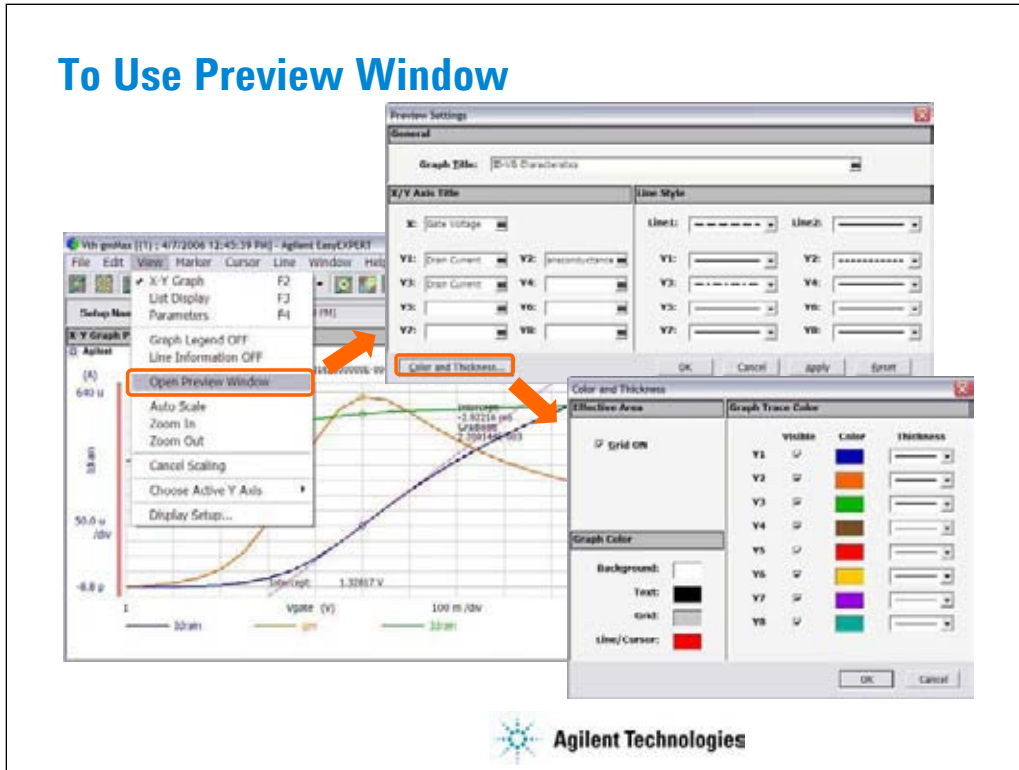
1. Use your test setup and perform measurement as shown in Exercise 1.
2. Enable marker and draw line. Try it for all line types.
3. Copy/paste/save data list, and open it by using a spreadsheet software (optional, if you can).
4. Save analysis condition. Re-open the test record.
5. Export your test record. And import it.

Time to complete: 10 minutes.



Note:

To Use Preview Window



The Data Display window provides the File > Print... function to print the graph image. However, you may want to set the graph title and change the line style. Then use the Preview window. The Preview window is used to see and print the graph image you modified.

Select the View > Open Preview Window to open the Preview window and the Preview Settings dialog box. And use the Preview Settings dialog box to set the title of graph, X axis, and Y axis, and change the line style. To change the color and thickness, use the Color and Thickness dialog box opened by clicking the Color and Thickness... button.

Clicking OK button in the Preview Settings dialog box applies the modification to the Preview window and closes the dialog box.

Note:

The graph image in the Preview window cannot be saved.

To Use Preview Window



This example is result of the changes shown in the previous page.

Line style was changed as shown above. The titles are set as follows.

Graph title: ID-VG Characteristics

X axis title: Gate Voltage

Y1 axis title: Drain Current

Y2 axis title: Transconductance

Y3 axis title: Drain Current

Also color of line1 was changed to red, and thickness of trace was changed.

To change the setup again, open the Preview Settings dialog box by selecting the View > Preview Settings... menu.

Exercise 5

Use the Preview window.

- 1. Use your test record used in Exercise 4.**
- 2. Change the graph image as you want.**
 - Add graph title and change axis title.**
 - Change line style**
 - Change color and thickness**
- 3. Print the graph image if a printer is available.**

Time to complete: 5 minutes.



Note:

Module 4. Modifying Application Test Definitions



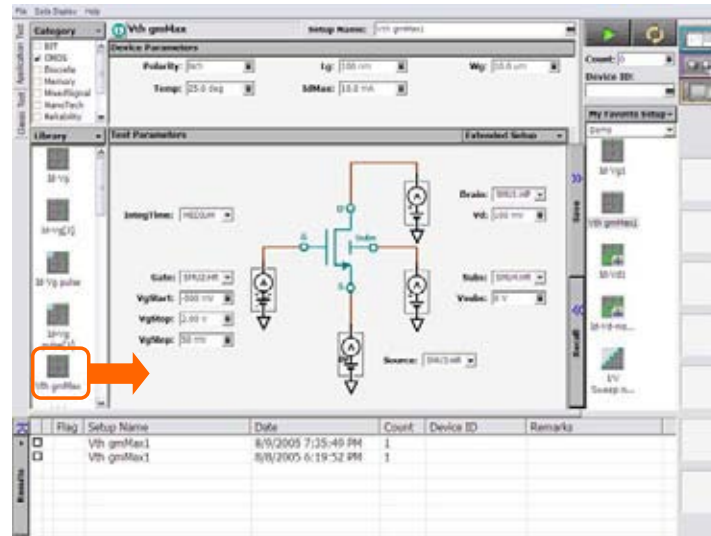
Modification Overview

- 1. Open an application test definition to be modified**
- 2. Open test definition editor**
- 3. Save the definition as your test definition**
- 4. Modify the definition as you like**
- 5. Resave and close the definition**
- 6. Export your test definition**
- 7. To Use Built-in Functions**
- 8. To Use Auto Analysis Function in Test Contents**



To Open an Application Test Definition

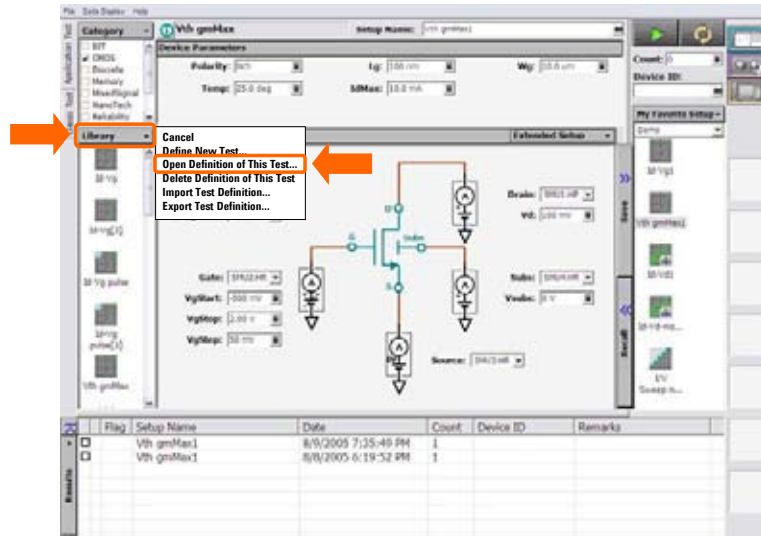
Example: Select Vth gmMax as template



Click a test definition in Library list area, and click Select button to open the test definition.
For example, open Vth gmMax.

To Open Test Definition Editor

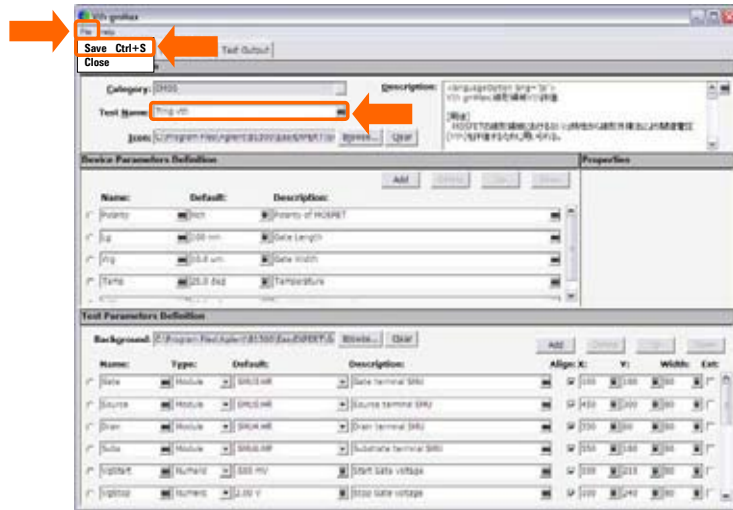
Click Library/Open Definition of This Test...



Click Library and select Open Definition of This Test... to open the test definition editor.

To Save Definition As Your Definition

Save the definition as your definition (ex: Trng vth)



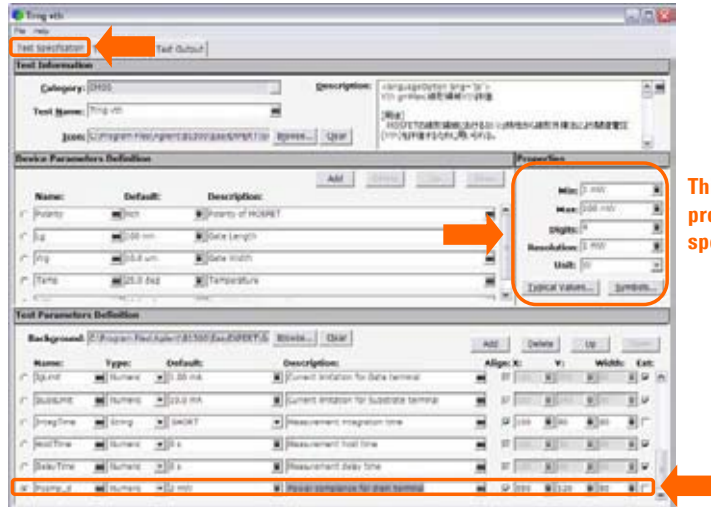
Test Definition editor



After changing test name, save as new name (ex. Trng vth). Saving the definition changes the window title to the new test name. Window title will be changed from Vth gmMax to Trng vth in this example.

To Modify Test Definition

Change default values, and add parameters (ex: Pcomp_d)



Test Definition editor



On the Test Specification tab screen, you can add new parameters or change parameter settings. The above example adds the Pcomp_d test parameter.

For example:

Name=Pcomp_d, Type=Numeric, Default=1 mV, Description=Power compliance for drain terminal, Align=check, X=550, Y=120, Width=80, Ext=unchecked

Properties: Min=1 mW, Max=100 mW, Digits=4, Resolution=1 mW, Unit=W

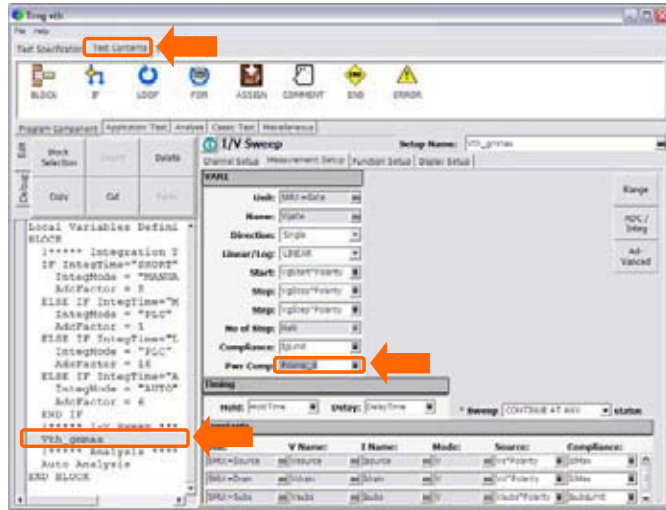
For Align, X, Y, and Width values, see the values of the entry fields for the same terminal. For example, Pcomp_d must be put between Vd and Subs entry fields.

Typical Values... button opens a dialog box used to define the typical values used for the selections of the parameter value in the Application Test mode. For example, set 1 mW to 10 mW in 1 mW step.

Symbols... button opens a dialog box used to map a numeric value to a string. For example, Value=1 and Symbol=ON are set, typing ON enters 1, and typing 1 enters ON. The value must satisfy the Min, Max, Digits, and Resolution settings. The value and the symbol must be one by one. The definition is effective only for the parameter.

To Modify Test Definition

Change or set test parameters (ex: Pcomp_d)



Test Definition editor

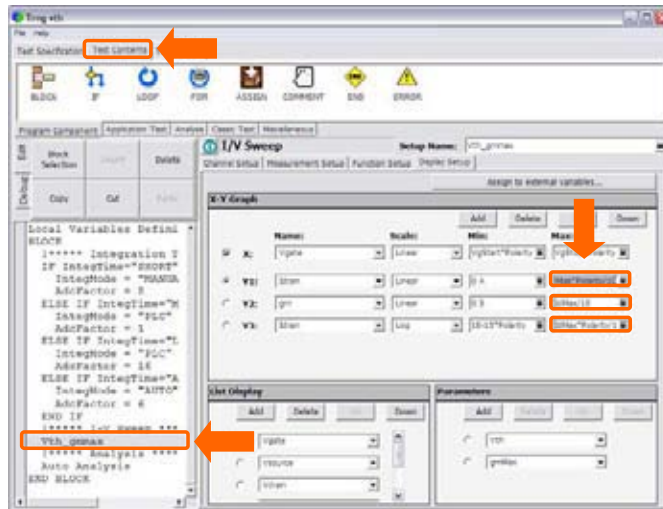


On the Test Contents tab screen, you can change the test execution flow (program flow), measurement conditions, display setup, and so on.

To add the Pcomp_d parameter to the measurement setup, click the Vth_gmmax line in the program list. Then I/V Sweep setup editor is displayed. In the editor, display the Measurement Setup tab screen. And enter Pcomp_d to Pwr Comp entry field.

To Modify Test Definition

Change display setup (ex: Y axis Max value)



Test Definition editor

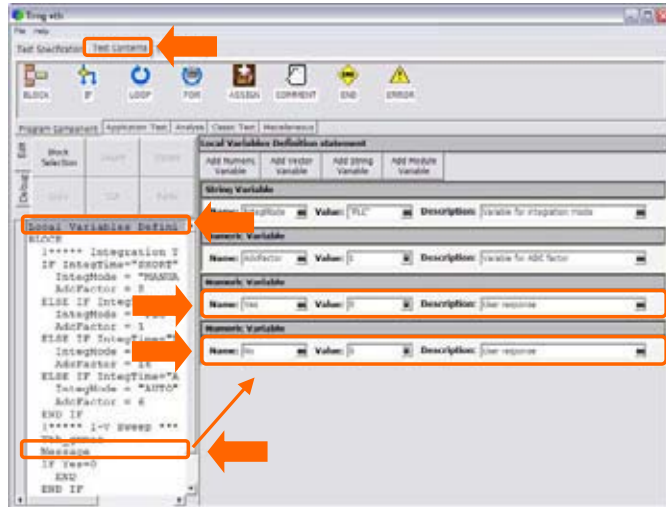
For example, change Max value to 1/10.



Next, display the Display Setup tab screen. And change the Y axis Max values. For example, add /, 1, and 0 at the last of entry field to change the Max value to 1/10.

To Modify Test Definition

Add local variable (ex: Yes and No) for Message box



Variables Yes and No are used in the message box.

Test Definition editor



On the Test Contents tab screen, add program lines in the test execution flow. In this section, the following lines are inserted between the Vth_gmmx line and the Auto Analysis line.

Message

IF Yes=0

END

END IF

This will open the message box after the measurement is completed and before the auto analysis is performed.

At first, the variables used in the message box. For example, Yes and No variables are defined.

Click Local Variables Definition line to display the local variable list shown above. And define the variables.

Example:

Name=Yes, Value=0, Description=User response

Name=No, Value=0, Description=User response

To Modify Test Definition

Define Message box

Test Definition editor

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Variables.
Yes=1/No=0 if Yes button is clicked.
Yes=0/No=1 if No button is clicked.

This message box asks if you want to perform auto analysis or do not.

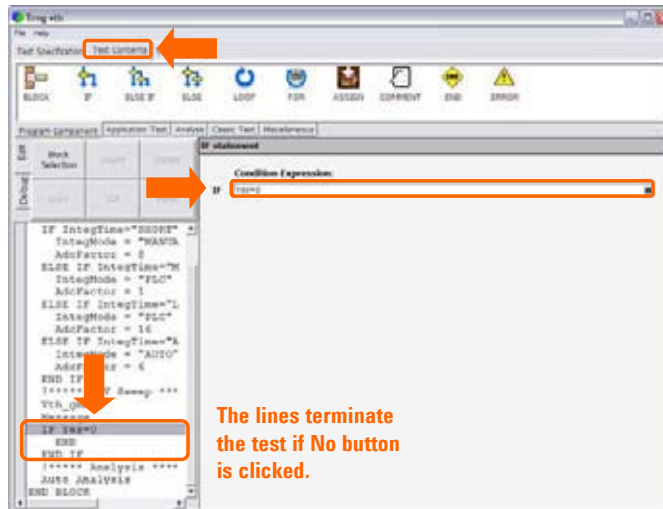
Yes and No buttons are made on this message box.

Next, click the Message line in the program list. The editor change the display as shown above.

1. Enter the message.
2. Enter the button name.
3. Select the variable used to keep the status of the button.
4. Repeat 2 and 3 for all buttons you want to add.

To Modify Test Definition

Add branching (ex: auto analysis is performed if Yes button is pressed)



Test Definition editor



At last, insert the branching lines. The example above terminates the test execution if the No button is clicked on the Message box, without performing auto analysis.

To Modify Test Definition

Example: Displaying Message box



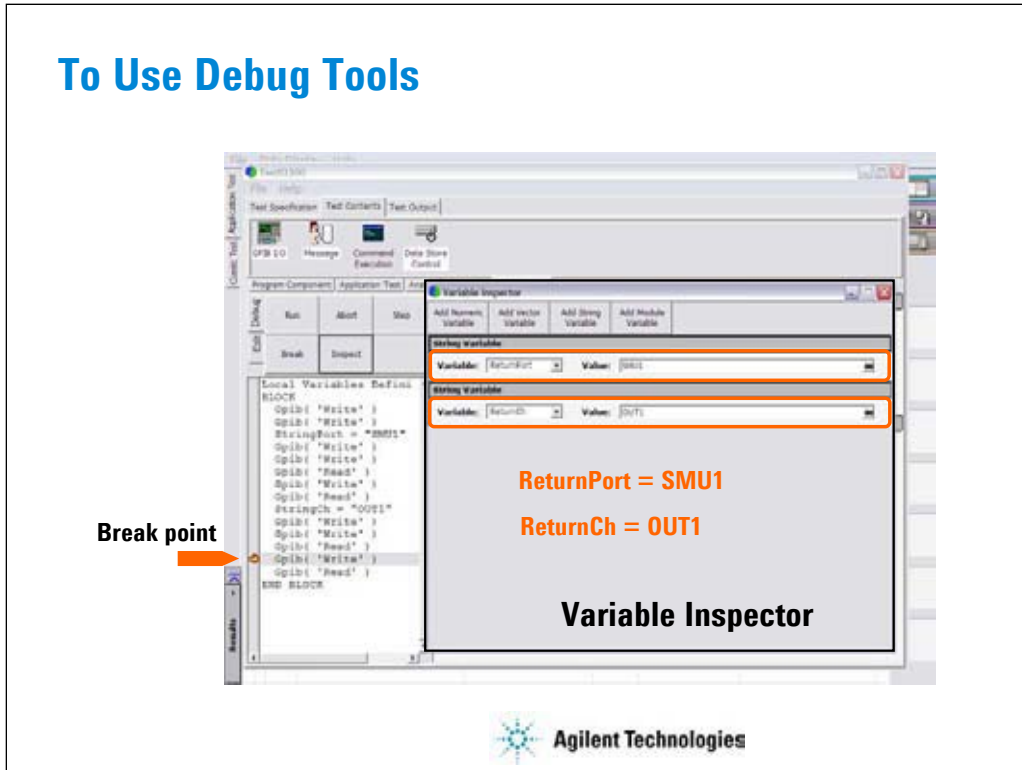
After measurement is performed, the message box will be displayed.

The message box asks if you want to perform auto analysis or not.



This is the example image when the Message box is displayed on the screen after the measurement is completed.

To Use Debug Tools

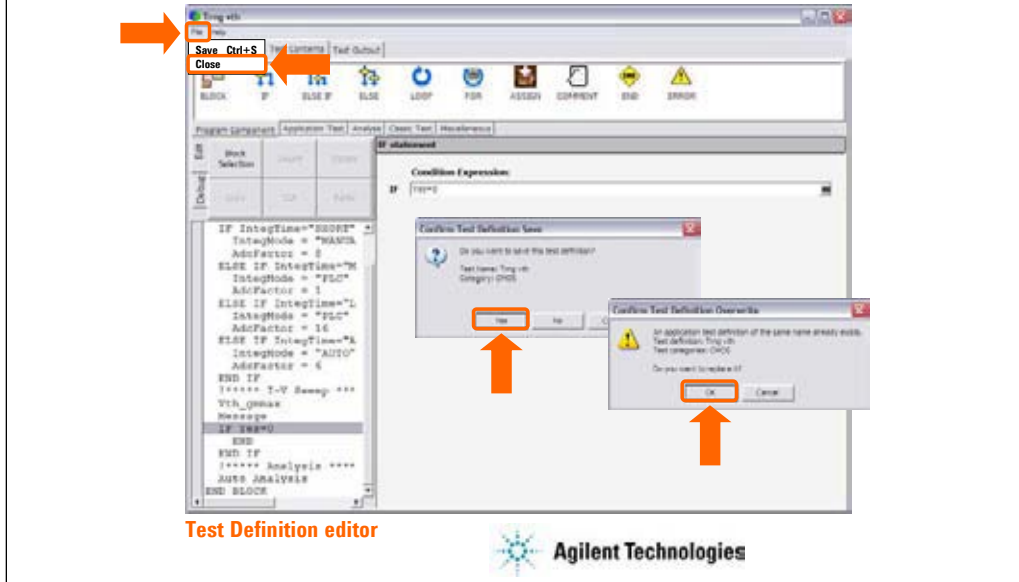


This slide shows an example of using the Variable Inspector for debugging. Confirm whether the correct values are passed to the variables properly.

Set the break point, and click the Run button. After the program is paused, click the Inspect button. The Variable Inspector is displayed. You can check the values by using the variable display fields. The field can be displayed by using the Add XXXX Variable button. XXXX will be Numeric, Vector, String, or Module.

To Resave and Close Your Test Definition

Close the definition editor, and overwrite your test definition

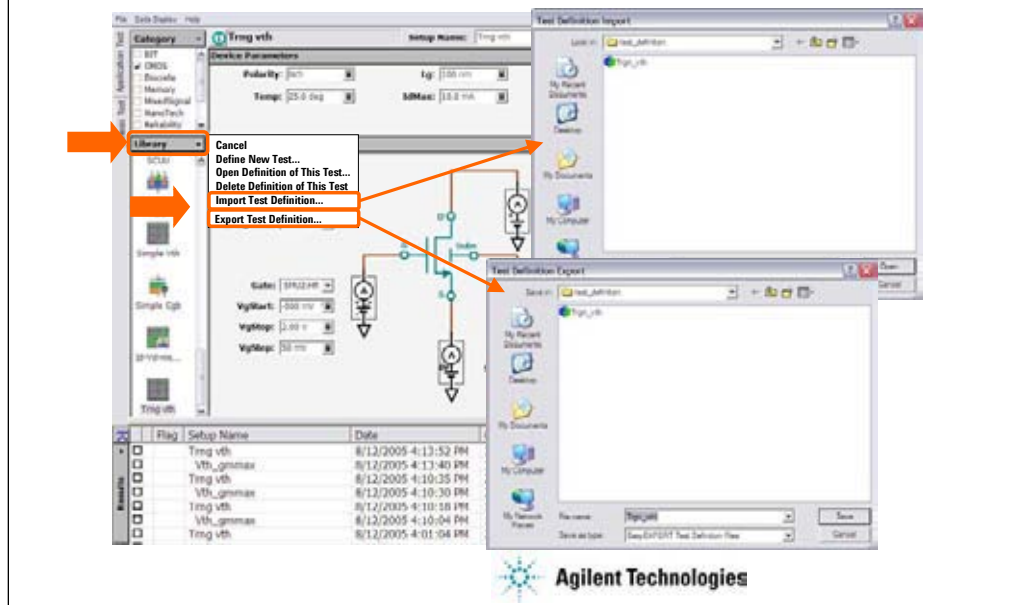


After you create your test definition, save the definition and close the Test Definition editor.

Click File > Close. Confirm Test Definition Save dialog box is opened. Click Yes to save your test definition and continue the close operation. The Confirm Test Definition Overwrite dialog box is opened. Click OK to overwrite your test definition.

To Export/Import Test Definition

Click Library/Export Test Definition or Import Test Definition



The test definition can be exported as the EasyEXPERT test definition file format or XML file format. And the file can be imported to the EasyEXPERT later.

Exercise 6

Modify test definition.

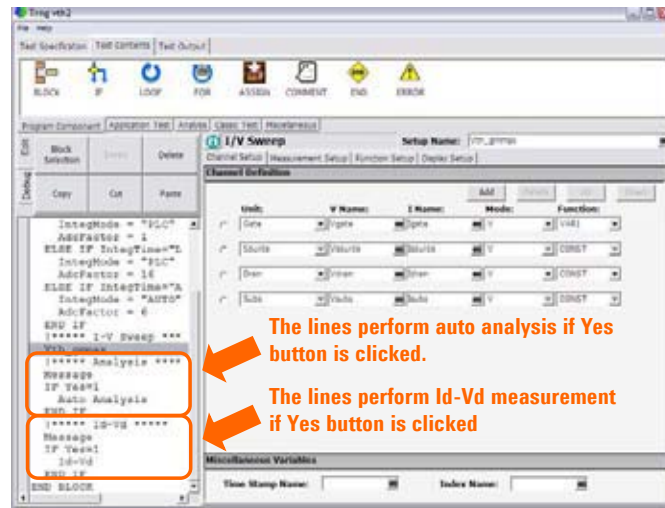
1. **Select Vth gmMax test definition and open it.**
2. **Modify it as shown in page 4-6 to 4-11.**
3. **Save it as Trng vth, and perform test.**
4. **Add program lines to start Id-Vd test by Yes button.**
5. **Save it as Trng vth2, and perform test.**
6. **Export it, and import it.**

Time to complete: 10 minutes.



Note:

Modification Example



Test Definition editor



Modification example for step 4.

```
! ***** Analysis *****
```

```
Message
```

```
If Yes=1
```

```
    Auto Analysis
```

```
END IF
```

```
! ***** Id-Vd *****
```

```
Message
```

```
If Yes=1
```

```
    Id-Vd
```

```
END IF
```

Setup example of the first message box:

Message=Do you want to perform auto analysis?

Button 1: Label=Yes, Selected=Yes

Button 2: Label=No

Setup example of the second message box:

Message=Do you want to perform Id-Vd measurement?

Button 1: Label=Yes, Selected=Yes

Button 2: Label=No

To Use Built-in Functions

Absolute value:	abs(A)
Averaging:	avg(A), mavg(A,B)
Data conversion:	string(A), value(A)
Difference:	delta(A)
Differentiation, integration:	diff(A,B), integ(A,B)
Exponent, logarithm:	exp(A), lgt(A), log(A)
Maximum, minimum:	max(A), min(A)
Reading data :	getNumericData(A), getVectorData(A)
Square root:	sqrt(A)
Trigonometric function:	acos(A), asin(A) , atan(A), atan2(A,B), cos(A), sin(A), tan(A)



The EasyEXPERT software provides the built-in functions to calculate the display data and parameter and to get the test result data. The built-in functions can be used in the user function and analysis function of the test setup, and in the test execution flow of the test contents. For details of the functions, see User's Guide or online help.

The following functions are also available.

at(A,B), at(A,B,C), ceil(A), cond(A,B,C,D), dim1Size(A), dim2Size(A), floor(A), index(A,B), isValid(A), setDeviceId(A), storeAt(A,B,C,D), substring(A,B,C), swmToModule(A)

To Use Built-in Functions

User function setup example

The screenshot shows the 'Keysight Auto Area' software interface. The 'Local Variables Define' block contains the following code:

```
VG = getVectorData(Vg)
ID = getVectorData(Id)
GM = getVectorData(gm)
VTH = getNumericData(Vth)
GM_MAX = getVectorData(gmMax)
END IF
END BLOCK
```

The 'User Function' block contains the following code:

```
gm = diff(Id,Vg)
gmMax = max(gm)
```

The 'Analysis Function' block contains the following code:

```
VTH = 1
```

Arrows point from the code in the 'Local Variables Define' block to the corresponding function calls in the 'User Function' block. The Agilent Technologies logo is located at the bottom center of the screenshot.

This is an user function setup example. This example uses the diff function to calculate gm values and the max function to get the maximum gm value.

Also, the getVectorData and getNumericData functions are used in the test execution flow to get the test result data.

To Use Read Out Functions

Marker index value:	@MI
X coordinate value:	@MX, @CX
Y coordinate value:	@MY, @MYn, @CY, @CYn
Regression line parameter:	@L1C0, @L2C0
Line slope:	@L1G, @L1Gn, @L2G, @L2Gn
Line X intercept:	@L1X, @L2X
Line Y intercept:	@L1Y, @L1Yn, @L2Y, @L2Yn
Intersection of lines:	@IX, @IY, @IYn

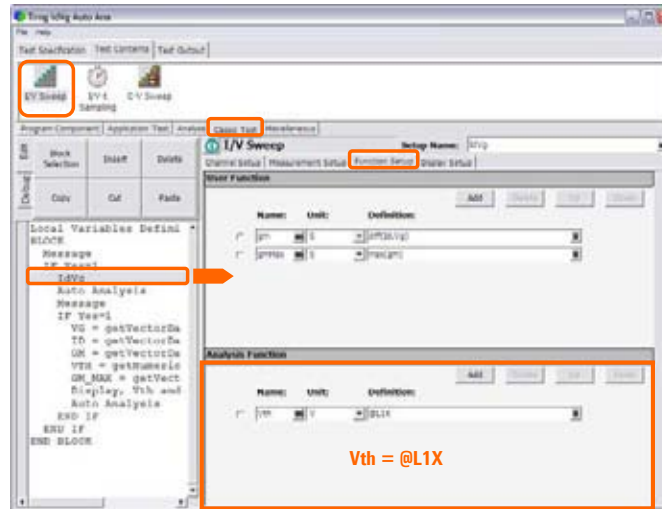
n: integer. 1 to 8.



The EasyEXPERT software provides the read out functions to read the marker position, cursor position, line slope, line intercept, and so on. The read out functions can be used in the analysis function of the test setup.

To Use Read Out Functions

Analysis function setup example

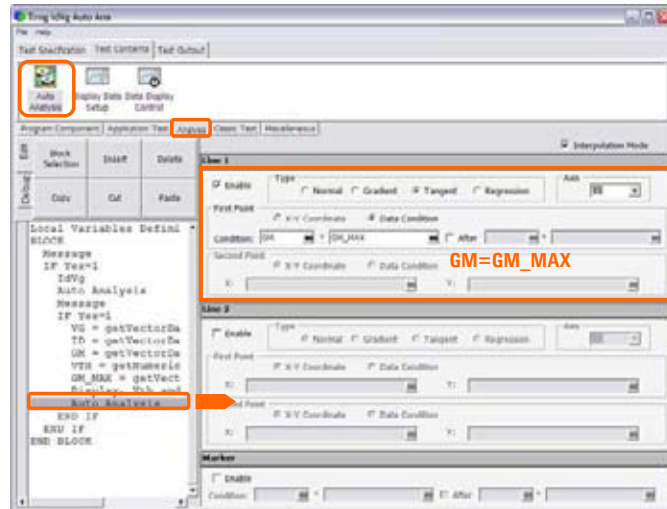


This is an analysis function setup example. This example uses the @L1X function to get the X intercept value of the line 1.

To Use Auto Analysis Function

Analysis: Auto Analysis

- Line 1
- Line 2
- Marker



The Auto Analysis statement provides the setup editor used to set up the automatic analysis function. When a measurement finishes, the function automatically draws lines, a marker, or both on the X-Y Graph of the Data Display window.

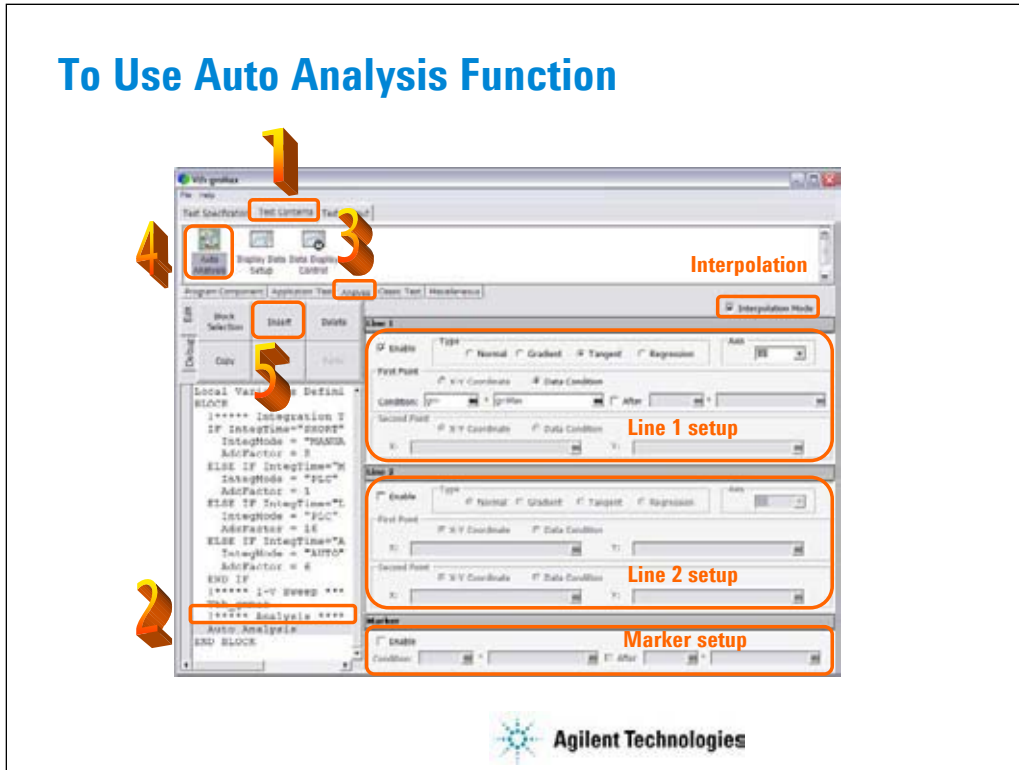
You can set up two lines and one marker for the automatic analysis function by using the setup editor.

In the Line 1 and Line 2 areas, you can set up the lines to be drawn.

In the Marker area, you can set up the marker.

The above example draws the tangent line for the Y1 data at the maximum GM point.

To Use Auto Analysis Function



The auto analysis capability allows you to display/move the marker/line on the data graph automatically after measurement. The above example is the Vth gmMax test definition.

To add the auto analysis operation to your test definition, open your test definition and do the procedure shown above (1 to 5). The Auto Analysis component can be added to your definition.

Interpolation Mode

Check this box to enable the interpolation mode. You can position marker between measurement points.

Line 1, Line 2

This area sets the line 1 or line 2 automatically displayed and moved to the specified position after the measurement.

Check Enable box to enable the line.

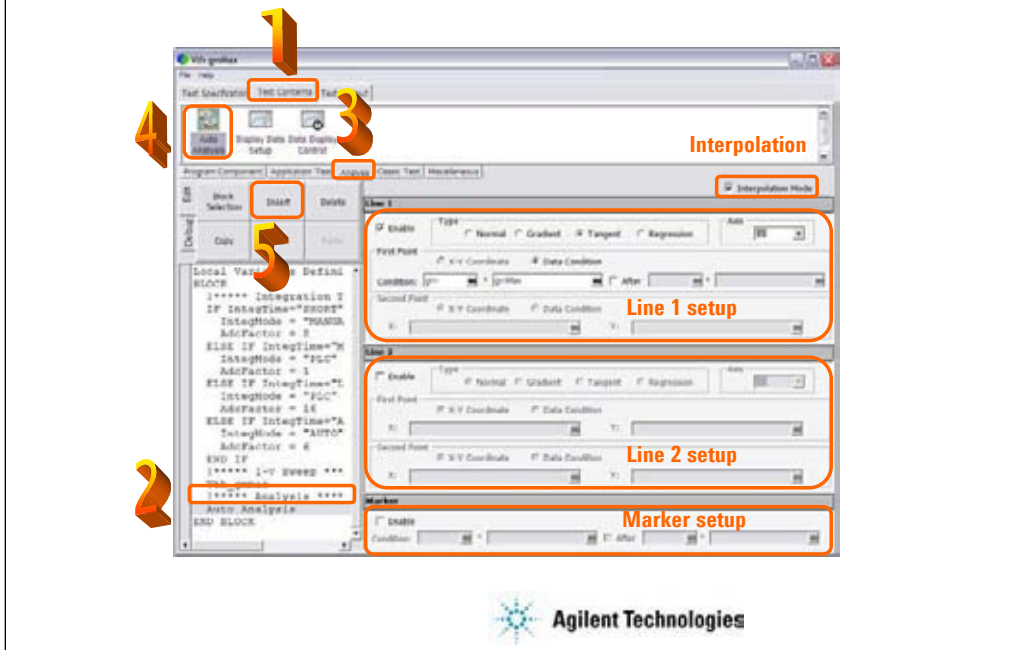
For Type, select a line type, Normal, Gradient, Tangent, or Regression.

For Axis, select the axis effective for the line.

In First Point and Second Point, specify the cursor points used to draw line.

In Gradient, specify the slope of the Gradient line.

To Use Auto Analysis Function



Marker

This area sets the marker automatically displayed and moved to the specified position after the measurement.

Check Enable box to enable the marker.

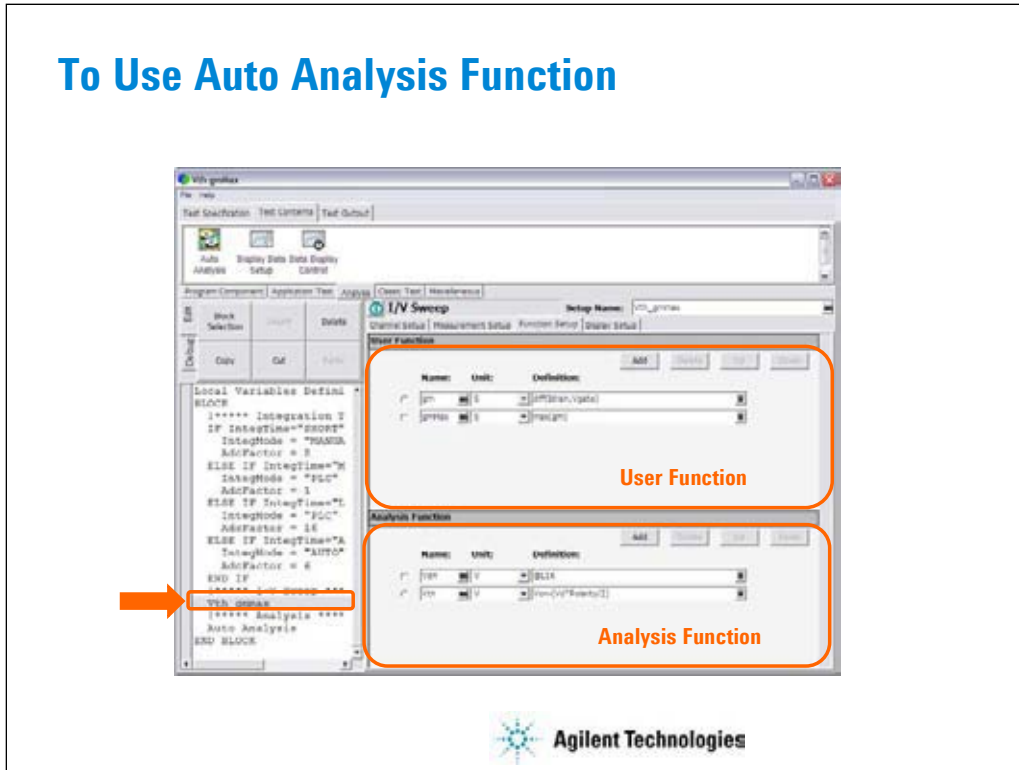
For Condition, enter a variable name and a condition expression to specify where you want the marker to display.

For After, check this box to enable the additional condition. And enter a second variable and condition expression. This sets up a search start condition for finding specified point.

For example, you can specify the following expressions to search for a measurement point that satisfies the first condition after the second condition is satisfied.

Condition: $[DGM] = [MAX(DGM)*0.01] [x]$ After $[DGM] = [MAX(DGM)]$

To Use Auto Analysis Function



In the Vth gmMax test definition, the user functions and analysis functions are defined to use the auto analysis function. See the previous slide. The analysis function enables the line 1 for the Y1 data and displays the tangent line at the X-coordinate that takes the maximum gm value.

The following user function is used to calculate the gm value.

$$Gm = \text{diff}(I_{\text{drain}}, V_{\text{gate}})$$

The following user function is used to get the maximum gm value.

$$gm_{\text{Max}} = \text{max}(gm)$$

The following analysis function is used to get the Von value. The readout function @L1X gives the X intercept value of the line 1.

$$V_{\text{on}} = @L1X$$

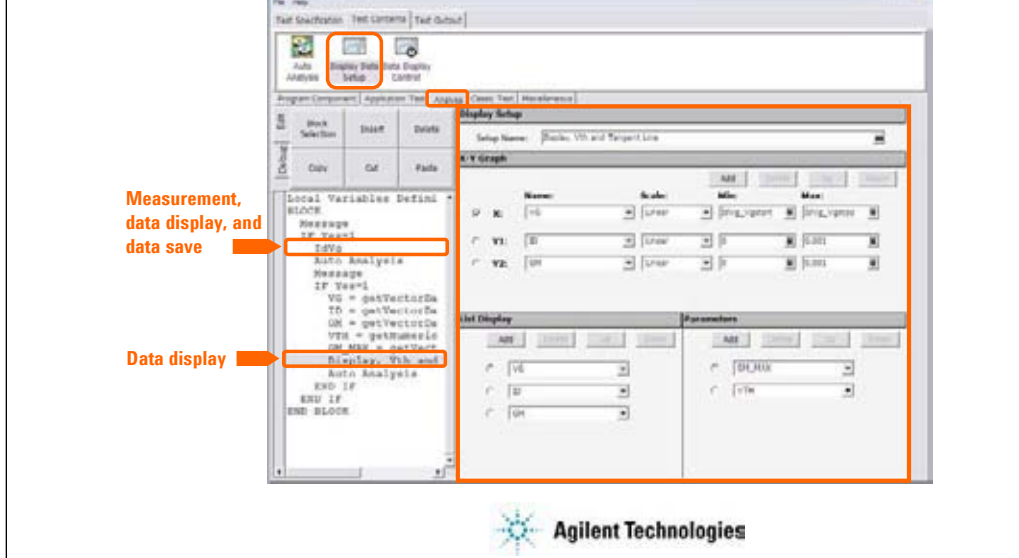
The following analysis function is used to calculate the Vth value.

$$V_{\text{th}} = V_{\text{on}} - (V_{\text{d}} * \text{Polarity}) / 2$$

Where, Polarity is -1 for P-ch MOSFET or 1 for N-ch MOSFET.

To Add Data Display

Analysis: Display Data Setup



The test setup performs measurement and displays the test result as defined in the channel setup, measurement setup, and display setup. And the test result data will be stored to the test record.

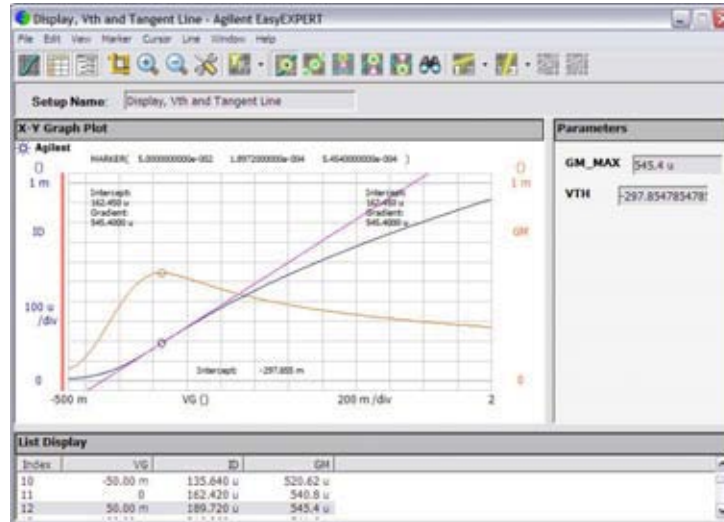
In addition to the default test result display, you can make additional data display by using the Display Data Setup statement. The statement provides the user interface as same as the Display Setup of the Classic Test or the Test Output of the test definition. The above example displays the ID-VG/GM-VG curves, GM_MAX and VTH values, and tangent line by using the extra Data Display and Auto Analysis function. See next slide.

Note:

The additional display data cannot be saved to the data record. However only the last display data can be saved if the Test Output is not defined in the test definition.

To Add Data Display

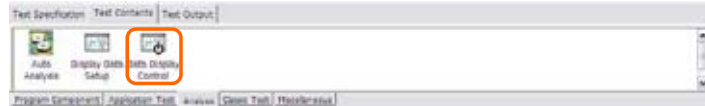
Additional data display example



This is a test result example displayed on the Data Display window.

To Control Test Result Data Outputs

Analysis: Data Display Control



Data Display: OFF/ON

Miscellaneous: Data Store Control



Data Store: OFF/ON



By the default setting, the results of the tests defined in your test definition are displayed on the Data Display window and are stored to the data record.

You can control the data display of the tests by using the Data Display Control statement. Insert the statement, and remove the check from the Enable Data Display box to disable the data display.

You can control the data storage of the tests by using the Data Store Control statement. Insert the statement, and remove the check from the Enable Creating Test Result Record box to disable the data storage.

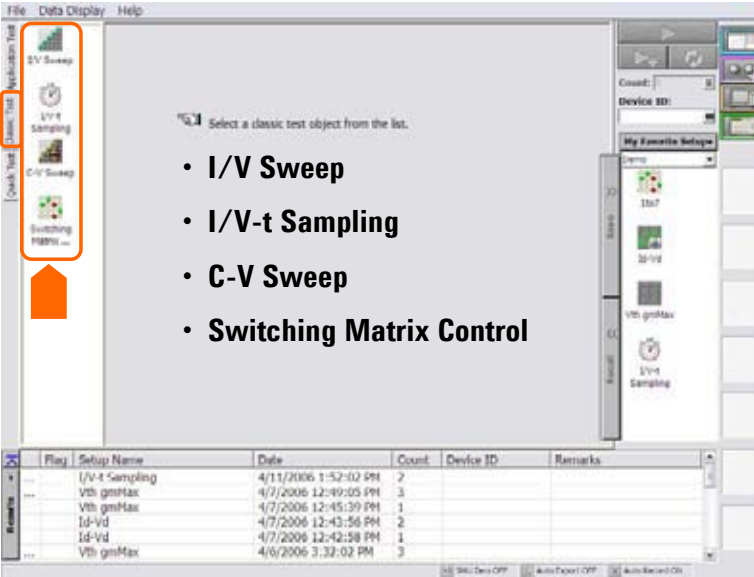
This function is not available for the following data. The data output is always enabled.

- Data output set to the Test Output of the test definition
- Data output of the last test setup if the Test Output is not set

Module 5. Using Classic Test Environment



Classic Test Execution Mode



Select a classic test object from the list.

- **I/V Sweep**
- **I/V-t Sampling**
- **C-V Sweep**
- **Switching Matrix Control**

Flag	Setup Name	Date	Count	Device ID	Remarks
...	I/V-t Sampling	4/11/2006 1:52:02 PM	2		
...	Vth gmMax	4/7/2006 12:49:05 PM	3		
...	Vth gmMax	4/7/2006 12:45:39 PM	1		
...	Id-Vd	4/7/2006 12:43:56 PM	2		
...	Id-Vd	4/7/2006 12:42:58 PM	1		
...	Vth gmMax	4/6/2006 3:32:02 PM	3		

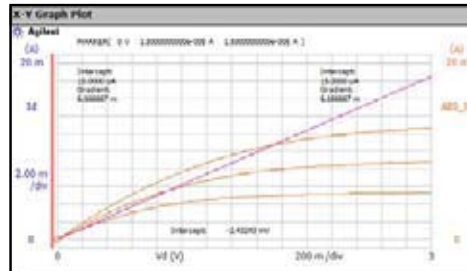
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To use the classic test mode, click the Classic Test tab. And select the execution mode. The following modes are available.

- I/V Sweep: For X-Y characteristics measurement of I or V.
- I/V-t Sampling: For time-Y characteristics measurement of I or V.
- C-V Sweep: For DC bias-impedance characteristics measurement.
- Switching Matrix Control: For B2200 switching matrix control.

I/V Sweep Measurement

- To Define Source/Measurement Channels
- To Read Time Stamp Data and Data Index
- To Set Source Outputs (VAR1, VAR2, VAR1', Pulse, CONST)
- To Set Timing Parameters
- To Set Sweep Abort Function
- Range, ADC/Integ, Advanced
- To Set User Functions
- To Set Analysis Functions
- To Set Auto Analysis Function
- To Set Display Parameters (X-Y Graph, Data List, Parameter)

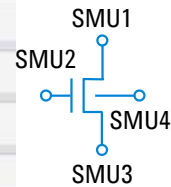
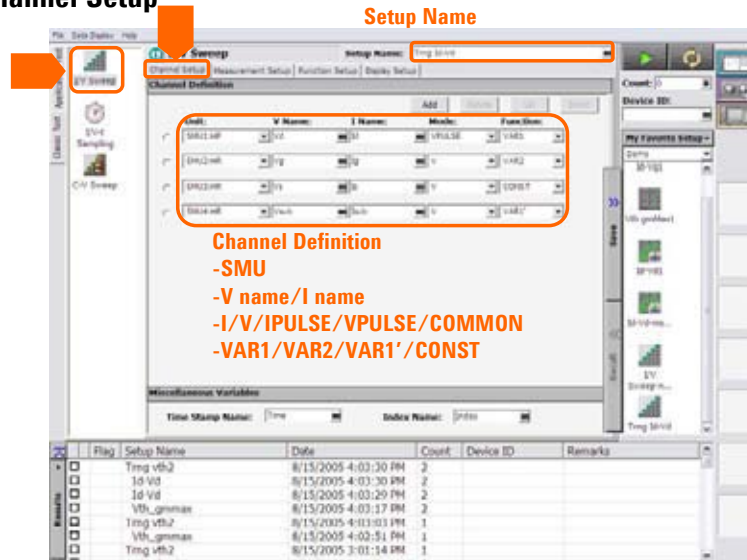


This section explains how to perform I/V sweep measurement. You will perform the above tasks to execute the I/V sweep measurement.

To Define Source/Measurement Channels



Channel Setup



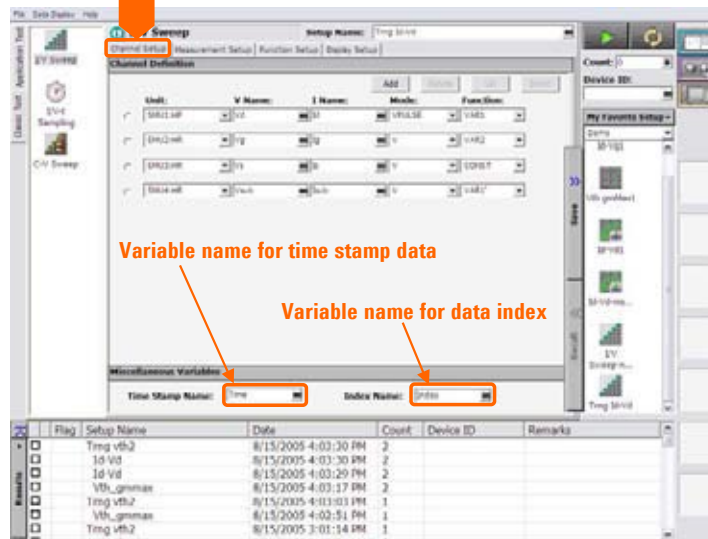
Click the I/V Sweep icon and open the setup editor. Then click the Channel Definition tab to display the channel definition screen.

- Enter the Setup Name for the test setup to be defined on the setup editor.
- List SMUs used for source output or measurement, and set the following parameters.
 - Unit: SMU name or number
 - V Name: Variable name for the voltage measurement or source data
 - I Name: Variable name for the current measurement or source data
 - Mode: Source output mode, V (voltage), I (current), VPULSE (voltage pulse), IPULSE (current pulse), or COMMON (ground)
 - Function: Source output function, VAR1 (primary sweep), VAR2 (secondary sweep), VAR1' (synchronous sweep), CONST (constant)

V Name and I Name are used to specify the parameters displayed on the Data Display window. The display parameters are selected on the Display Setup tab screen.

To Read Time Stamp Data and Data Index

Channel Setup



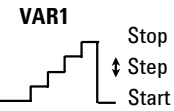
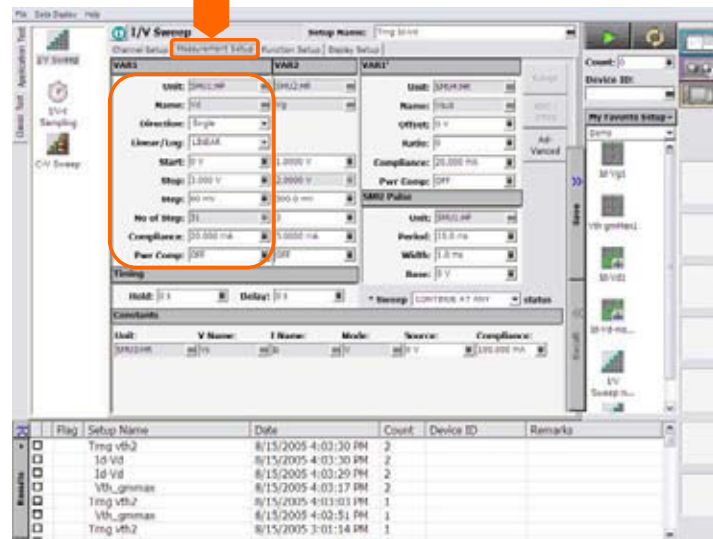
You can read measurement data by using the Data Display window. Parameters displayed on the window are selected on the Display Setup tab screen. If you enter the variable name in the V Name, I Name, Time Stamp Name, and/or Index Name entry fields, you can choose the variables as the display parameters.

- The time stamp is the time the measurement is started for each measurement point.
- The index is the index number for each measurement data.

To Set Primary Sweep Source



Measurement Setup



The Measurement Setup tab screen is used to set the source output value and timing parameters.

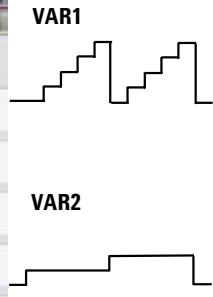
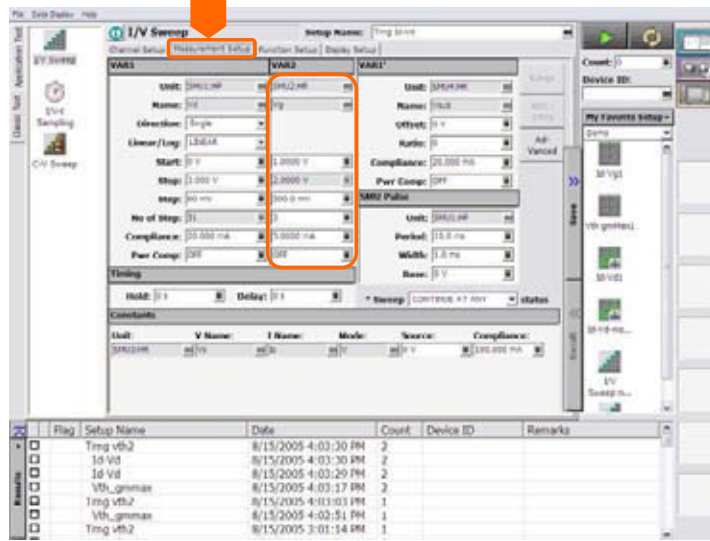
At the VAR1 area, you set the primary sweep source output.

- Unit: SMU name or number
- Name: Variable name of source output
- Direction: Single (start to stop) or Double (start to stop to start)
- Linear/Log: Linear sweep or Log sweep
- Start: Source output start value
- Stop: Source output stop value
- Step: Source output incremental step value
- No of Step: Number of sweep steps
- Compliance: SMU compliance value
- Pwr Comp: SMU power compliance value

To Set Secondary Sweep Source



Measurement Setup



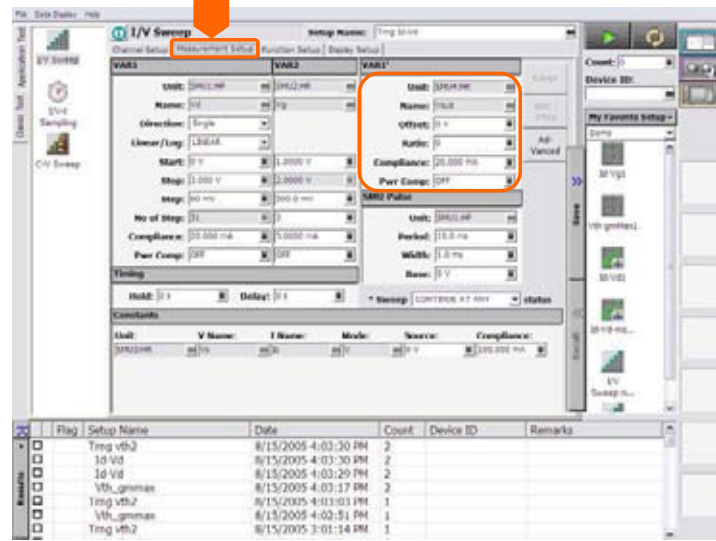
At the VAR2 area, you set the secondary sweep source output.

- Unit: SMU name or number
- Name: Variable name of source output
- Start: Source output start value
- Stop: Source output stop value
- Step: Source output incremental step value
- No of Step: Number of sweep steps
- Compliance: SMU compliance value
- Pwr Comp: SMU power compliance value

To Set Synchronous Sweep Source



Measurement Setup



At the VAR1' area, you set the synchronous sweep source output.

- Unit: SMU name or number
- Name: Variable name of source output
- Offset: B value of the above formula.
- Ratio: A value of the above formula.
- Compliance: SMU compliance value
- Pwr Comp: SMU power compliance value

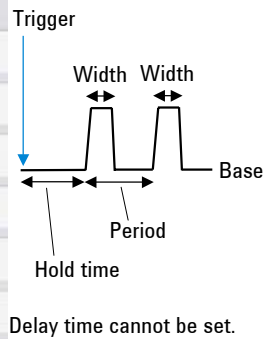
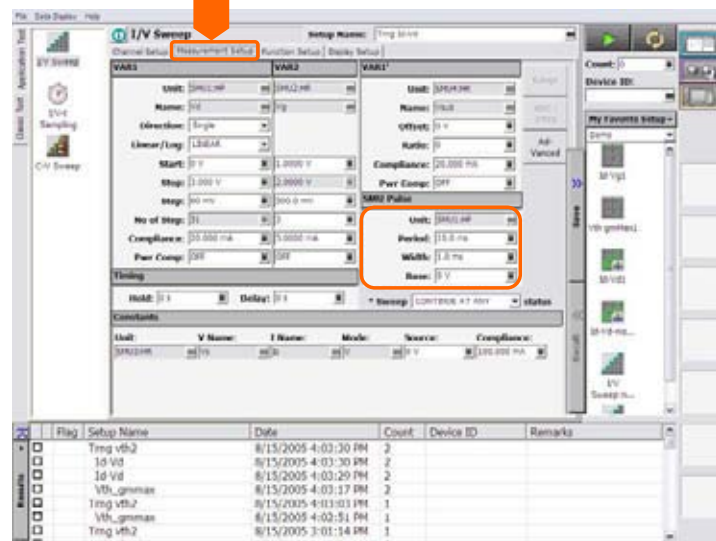
The VAR1' output is expressed by the following formula.

$$\text{VAR1}' \text{ output} = A \times (\text{VAR1 output}) + B$$

To Set Pulse Output



Measurement Setup



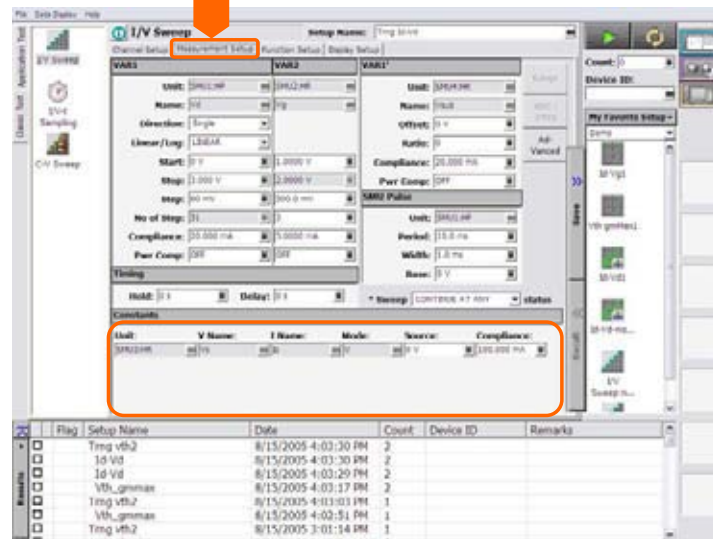
At the SMU Pulse area, you set the SMU pulse timing parameter and the pulse base value.

- Unit: SMU name or number
- Period: Pulse period
- Width: Pulse width
- Base: Pulse base value

Only a SMU can be set to the pulse source.

To Set Constant Output

Measurement Setup

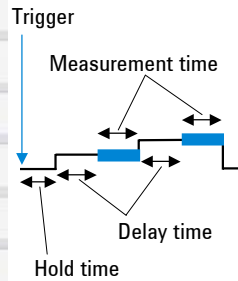
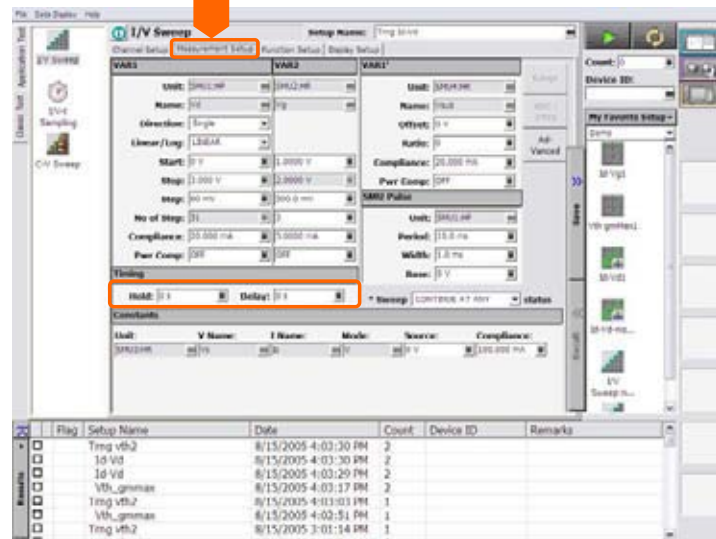


At the Constants area, you set the SMU constant output.

- Unit: SMU name or number
- V Name: Variable name for the voltage measurement or source data
- I Name: Variable name for the current measurement or source data
- Mode: Source output mode, V (voltage), I (current), VPULSE (voltage pulse), IPULSE (current pulse), or COMMON (ground)
- Source: SMU output value
- Compliance: SMU compliance value

To Set Timing Parameters

Measurement Setup



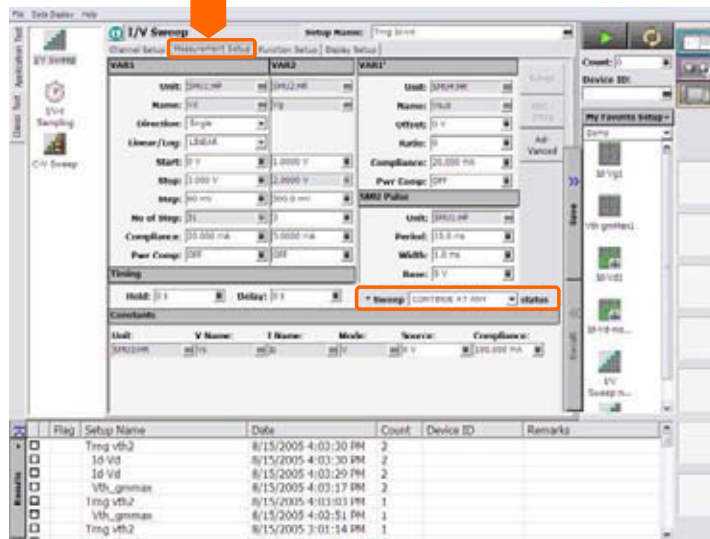
At the Timing area, you set the source output and measurement timing.

- Hold: Source output hold time. Time after the measurement trigger until starting delay time.
- Delay: Measurement start delay time. Time after the hold time until starting measurement.

When a SMU forces pulse, the delay time is ignored. Source output and measurement timing will be controlled by the pulse width and pulse period.

To Set Sweep Abort Function

Measurement Setup



CONTINUE AT ANY
STOP AT ANY ABNORMAL
-Range overflow
-SMU compliance
-SMU oscillation



This field sets the sweep abort function.

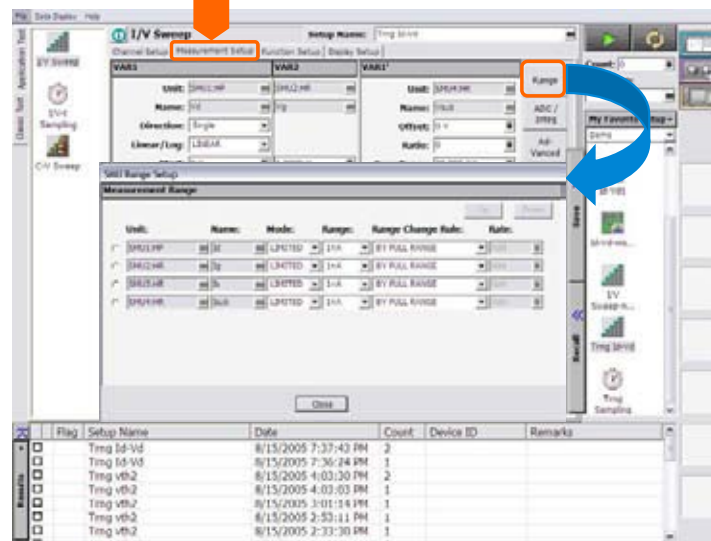
When this field is CONTINUE AT ANY, the sweep measurement is not aborted.

When this field is STOP AT ANY ABNORMAL, the sweep measurement will be aborted when one of the following conditions is detected.

- Measurement range overflow
- SMU compliance
- SMU oscillation

To Set Ranging Mode

Measurement Setup



Not available when a pulse source is used



The Range button opens the SMU Range Setup dialog box. The dialog box is used to set the measurement ranging mode. This button is not available when a pulse source is used.

- Unit: SMU name or number
- Name: Variable name for the measurement data
- Mode: Ranging mode, AUTO, LIMITED, or FIXED
- Range: Range value
- Range Change Rule: BY FULL RANGE, GO UP AHEAD, or UP AND DOWN AHEAD
- Rate: Value used for range changing. See the following formula.

For the AUTO or LIMITED, SMU automatically selects the minimum range that covers the measurement value, and performs the measurement by using the range. For the limited auto ranging, the instrument does not use the range lower than the specified range value. For example, if you select the 100 nA limited auto ranging, the instrument never uses the 10 nA range and below.

BY FULL RANGE performs normal auto ranging operation.

For the GO UP AHEAD and UP AND DOWN AHEAD rules, specify the *Rate* value, 11 to 100, which fixes the boundary of the ranging. The ranging occurs when the measurement data goes across the *boundary* values shown below.

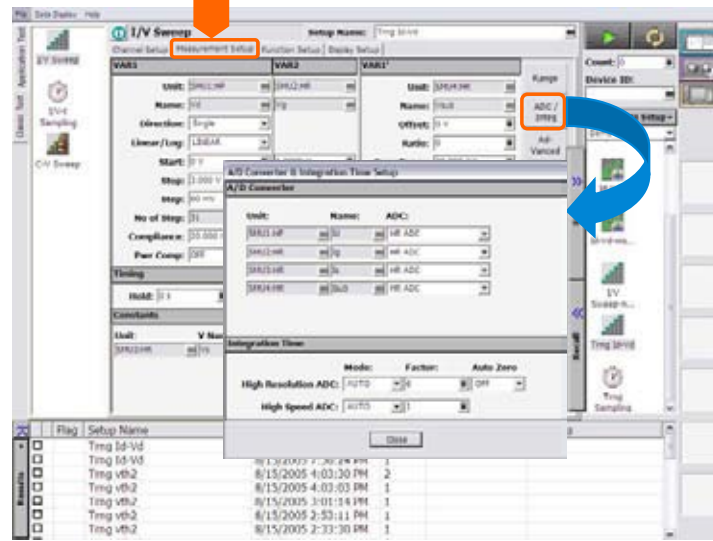
$$\text{go up boundary} = \text{present measurement range} \times \text{Rate} / 100$$

$$\text{go down boundary} = \text{present measurement range} \times \text{Rate} / 1000$$

The *go down boundary* is available only for the UP AND DOWN AHEAD rule.

To Set ADC/Integration Time

Measurement Setup



Not available when a pulse source is used



The ADC/Integ button opens the A/D Converter & Integration Time Setup dialog box. The dialog box is used to select the ADC for each SMU and set the integration time for each ADC (high resolution or high speed). This button is not available when a pulse source is used.

A/D Converter:

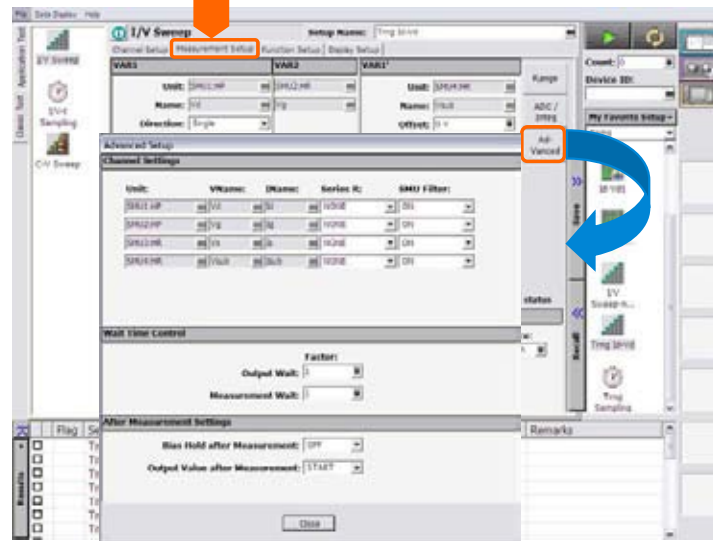
- Unit: SMU name or number
- Name: Variable name of the measurement data
- ADC: ADC type, HR ADC (high resolution) or HS ADC (high speed)

Integration Time:

- Mode: AUTO, MANUAL, or PLC. Rule to decide the integration time. For details, see online help or User's Guide.
- Factor: Coefficient for the reference value of the integration time.
- Auto Zero: Auto Zero function ON or OFF. For HR ADC.

Advanced Setup

Measurement Setup



The Advanced button opens the Advanced Setup dialog box. The dialog box is used to set the SMU filter and SMU series resistor settings, and set the wait time.

Channel Settings:

- Unit: SMU name or number
- V Name: Variable name for the voltage measurement or source data
- I Name: Variable name for the current measurement or source data
- Series R: SMU series resistor NONE or 1MOHM (1000000 ohm)
- SMU Filter: SMU filter ON or OFF

Wait Time Control:

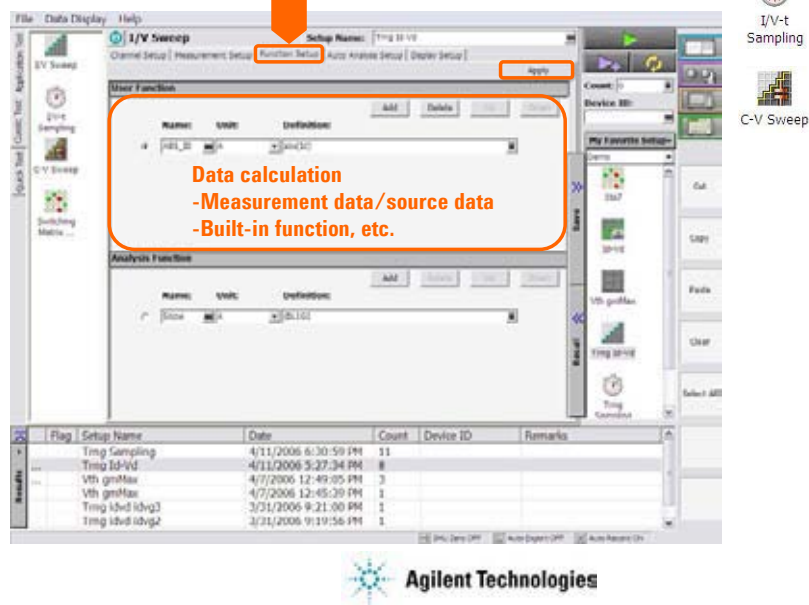
- Factor: Coefficient for the reference value of the wait time. For details, see online help or User's Guide.

After Measurement Settings:

- Bias Hold after Measurement: Bias hold function ON or OFF.
- Output Value after Measurement: Source output value after measurement. START (sweep start value), STOP (sweep stop value), SOURCE (sampling output source value), or BASE (sampling output base value)

To Set Analysis Functions

Function Setup



Click the Function Setup tab to display the User Function/Analysis Function setup screen. The user functions can be displayed on the X-Y Graph Plot, List Display, and Parameters area of the Data Display window. Up to 20 functions can be set.

Name: Function name

Unit: Unit of the function

Definition: Definition of the function. The following identifiers can be used.

- Variables for the measurement/output data used in this test
- Functions defined in the above lines
- Local variables passed from the application test that calls this test as a component
- Built-in functions and global variables

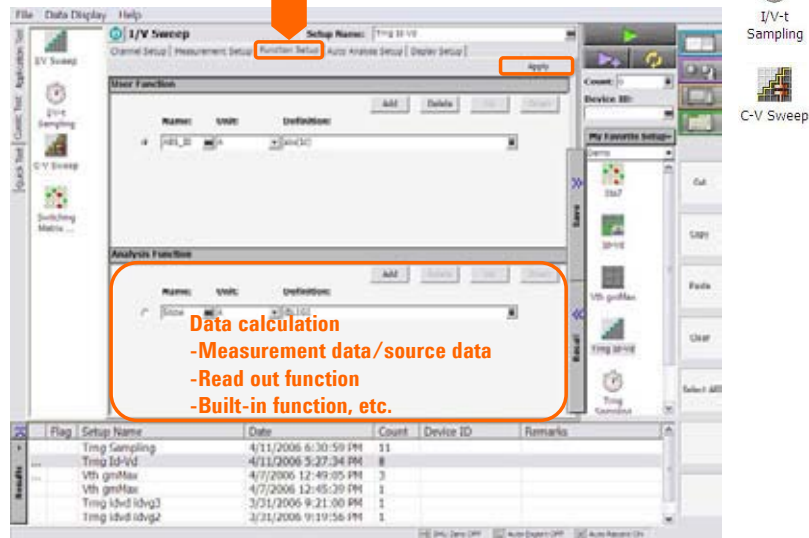
For details, see online help or User's Guide.

Note:

The Apply button performs calculation of the definition in this screen. If this button is clicked when the Data Display window associated with this test has been opened, the display is also updated. The associated Data Display window will be the Data Display window that displays the last measurement data or that is recalled at last.

To Set Analysis Functions

Function Setup



Data calculation
-Measurement data/source data
-Read out function
-Built-in function, etc.

The analysis functions can be displayed on the Parameters area of the Data Display window. Up to 20 functions can be set.

Name: Function name

Unit: Unit of the function

Definition: Definition of the function. The following identifiers can be used.

- Variables for the measurement/output data used in this test
- Functions defined in the above lines
- Local variables passed from the application test that calls this test as a component
- Built-in functions and global variables
- Read out functions

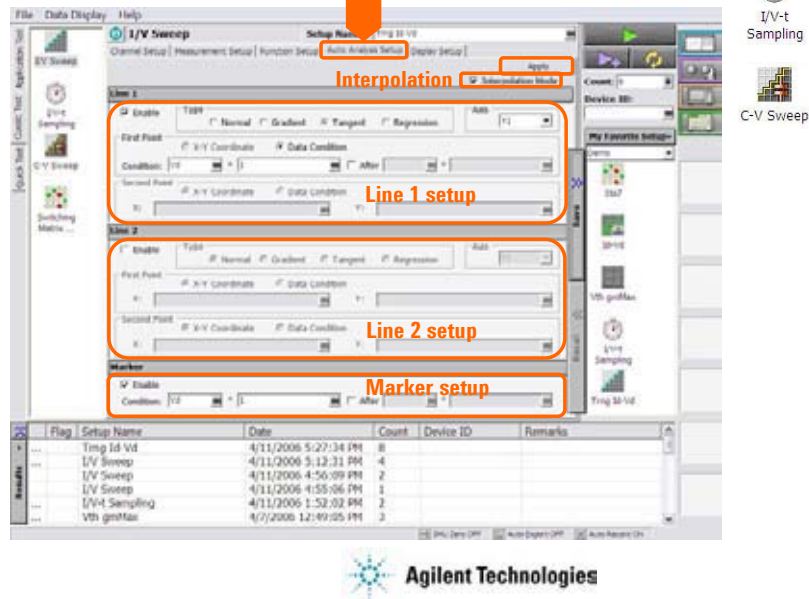
For details, see online help or User's Guide.

Note:

The Apply button performs calculation of the definition in this screen. If this button is clicked when the Data Display window associated with this test has been opened, the display is also updated. The associated Data Display window will be the Data Display window that displays the last measurement data or that is recalled at last.

To Set Auto Analysis Function

Auto Analysis Setup



Click the Auto Analysis Setup tab to display the auto analysis setup screen. The auto analysis capability allows you to display/move the marker/line on the data graph automatically after measurement. The above example displays marker at $V_d=1$ V point and draw a tangent line for this point.

Interpolation Mode: Check this box to enable the interpolation mode. You can position marker between measurement points.

Line 1, Line 2: This area sets the line 1 or line 2 automatically displayed and moved to the specified position after the measurement. Check Enable box to enable the line.

For Type, select a line type, Normal, Gradient, Tangent, or Regression.

For Axis, select the axis effective for the line.

In First Point and Second Point, specify the cursor points used to draw line.

In Gradient, specify the slope of the Gradient line.

Marker: This area sets the marker automatically displayed and moved to the specified position after the measurement. Check Enable box to enable the marker.

For Condition, enter a variable name and a condition expression to specify where you want the marker to display.

For After, check this box to enable the additional condition. And enter a second variable and condition expression. This sets up a search start condition for finding specified point.

For example, you can specify the following expressions to search for a measurement point that satisfies the first condition after the second condition is satisfied.

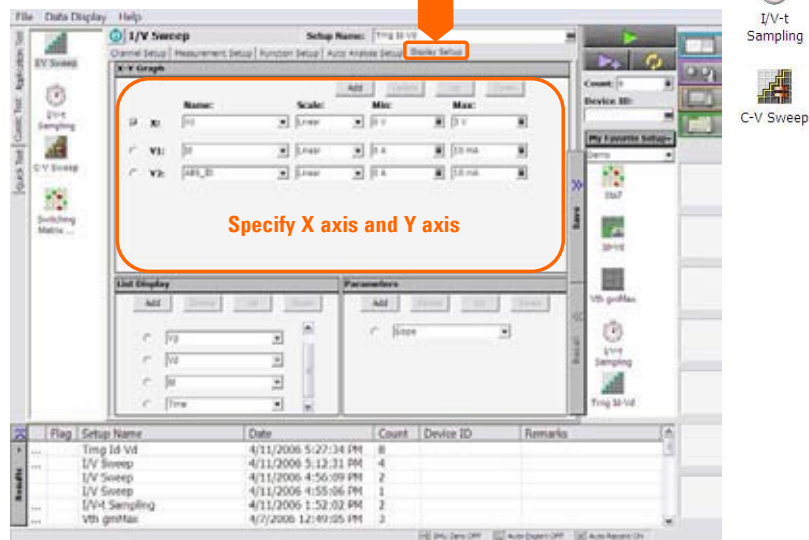
Condition: $[DGM] = [MAX(DGM)*0.01]$ [x] After $[DGM] = [MAX(DGM)]$

Note:

The Apply button performs calculation of the definition in this screen. If this button is clicked when the Data Display window associated with this test has been opened, the display is also updated. The associated Data Display window will be the Data Display window that displays the last measurement data or that is recalled at last.

To Set X-Y Graph Display

Display Setup



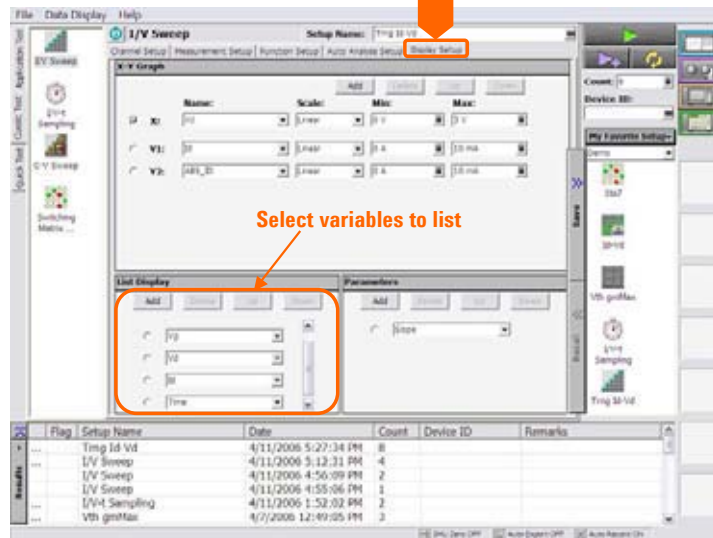
Specify X axis and Y axis

Click the Display Setup tab to display the display setup screen. The X-Y Graph area is used to set the X axis and Y axis of the X-Y Graph Plot area in the Data Display window.

- Name: Name of variable to plot on the X axis
- Scale: Linear or Log
- Min: Minimum value of the specified axis
- Max: Maximum value of the specified axis

To Set Data List Display

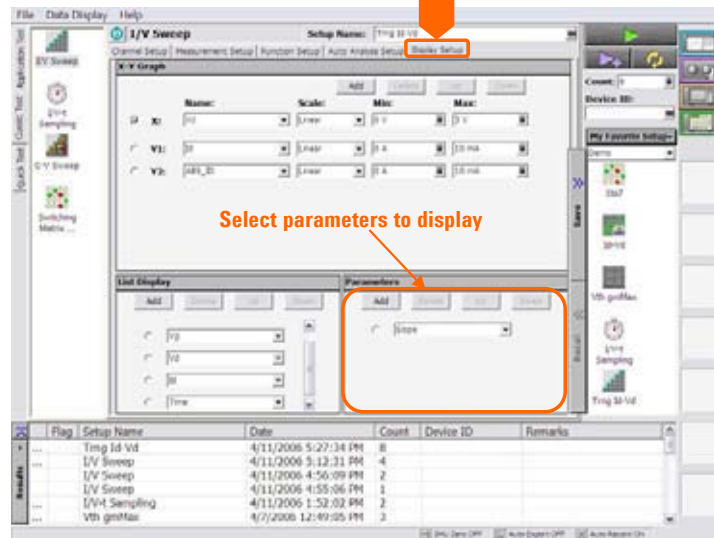
Display Setup



The List Display area selects the variables to be listed in the List Display area of the Data Display window. Up to 20 variables can be set.

To Set Parameters to Display

Display Setup



The Parameters area selects the variables to be listed in the Parameters area of the Data Display window. Up to 20 parameters can be set.

To Save Test Setup

Save

Recall

My Favorite Setup button

Preset Group name. Use this field to select preset group.

Flag	Setup Name	Date	Count	Device ID	Remarks
	Temp Id Vd	4/11/2006 5:22:34 PM	8		
	I/V Sweep	4/11/2006 5:12:31 PM	4		
	I/V Sweep	4/11/2006 4:56:09 PM	2		
	I/V Sweep	4/11/2006 4:55:06 PM	1		
	I/V-t Sampling	4/11/2006 1:52:02 PM	2		
	Vth gmMax	4/7/2006 12:49:05 PM	2		

The test setups you create MUST be saved to the internal hard disk drive as "My Favorite Setup".

To save the setup, click the Save button.

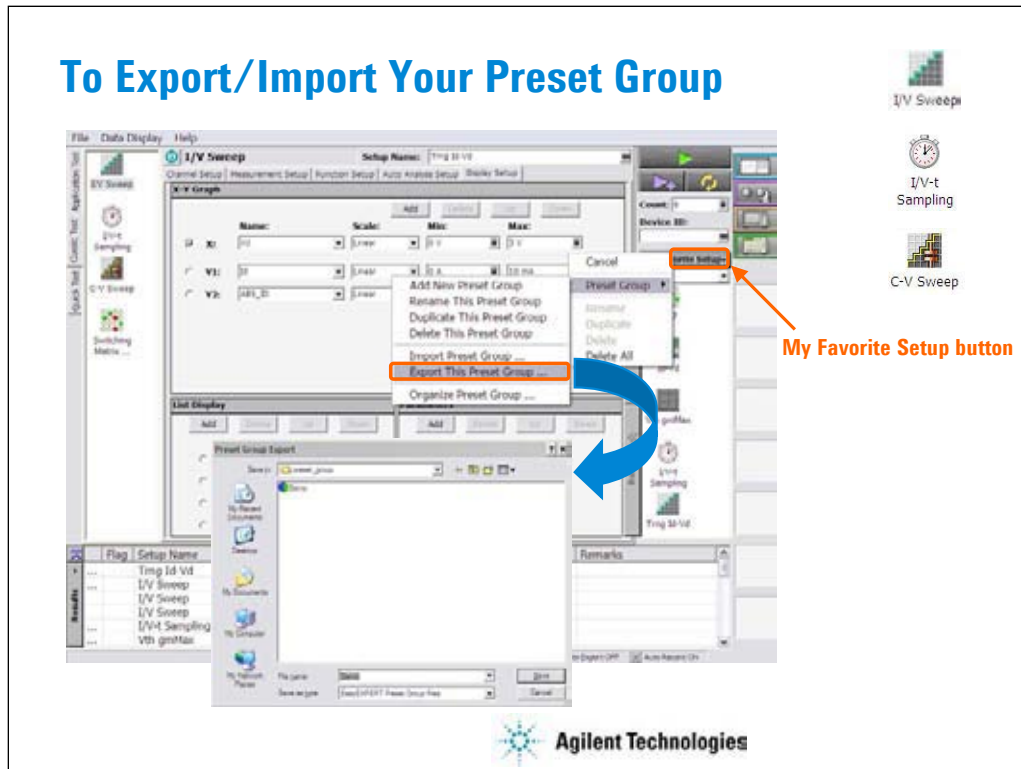
To recall the setup, click the Recall button.

You can organize the setups by using Preset Group. In the above example, the Demo group is selected and listed in the "My Favorite Setup".

To create a new preset group, click the My Favorite Setup button to display the function menu, and select Add New Preset Group.

To select the available preset group, use the field below the My Favorite Setup button.

To Export/Import Your Preset Group



You can export/import your preset group.

To export the present preset group, click the My Favorite Setup button, select Export, and specify the folder and the name of the preset group to export.

To import the preset group, click the My Favorite Setup button, select Import, and specify the preset group to import.

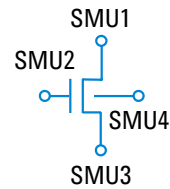
Exercise 7



Define test setup and perform test.

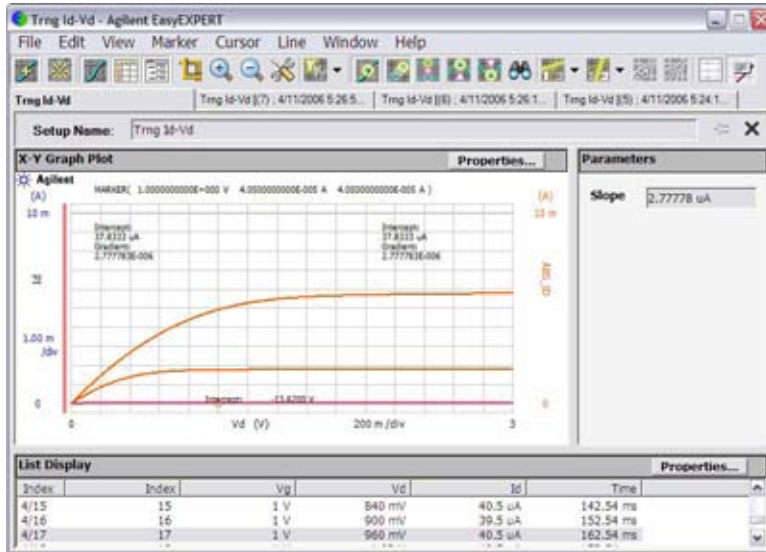
1. Click I/V Sweep icon and open setup editor.
2. Define test setup as shown in page 5-4 to 5-21.
3. Save it as Trng Id-Vd.
4. Connect device, and perform test.
5. Export preset group, and import it.

Time to complete: 10 minutes.



Note:

Measurement Result Example



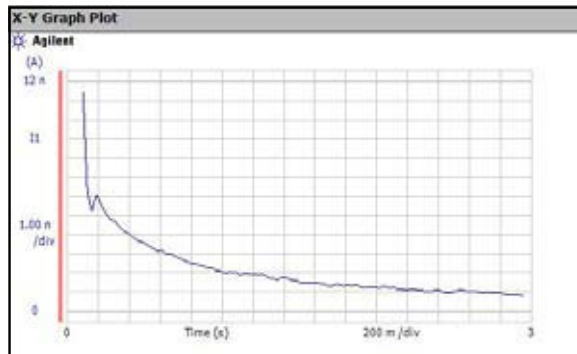
This is a test result example displayed on the Data Display window.

I/V-t Sampling Measurement



I/V-t
Sampling

- To Define Channels and Variables
- To Set Sampling Parameters
- To Set SMU Outputs (CONST)
- To Set Ranging Mode
- To Set User Functions/
Analysis Functions
- To Set Data Display



This section explains how to perform I/V-t sampling measurement. You will perform the above tasks to execute the I/V-t sampling measurement.

To Define Channels and Variables



Channel Setup

Setup Name

Channel Definition

- SMU
- V name/I name
- I/V/COMMON
- CONST

Variable name for time stamp data

Variable name for data index

SMU5

GNDU

Flag	Setup Name	Date	Count	Device ID	Remarks
	Trng Sampling	8/17/2005 4:08:52 PM	23		
	Trng Sampling	8/17/2005 4:08:01 PM	22		
	Trng Sampling	8/17/2005 4:07:06 PM	21		
	Trng Sampling	8/17/2005 4:05:34 PM	20		
	Trng Sampling	8/17/2005 4:05:06 PM	19		
	Trng Sampling	8/17/2005 4:03:56 PM	18		
	Trng Sampling	8/17/2005 4:02:50 PM	17		

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Click the I/V-t Sampling icon and open the setup editor. Then click the Channel Definition tab to display the channel definition screen.

- Enter the Setup Name for the test setup to be defined on the setup editor.
- List SMUs used for source output or measurement, and set the following parameters.
 - Unit: SMU name or number
 - V Name: Variable name for the voltage measurement or source data
 - I Name: Variable name for the current measurement or source data
 - Mode: Source output mode, V (voltage), I (current), or COMMON (ground)
 - Time Stamp Name: Variable name for the time stamp data
 - Index Name: Variable name for the data index

You can read measurement data by using the Data Display window. Parameters displayed on the window are selected on the Display Setup tab screen. If you enter the variable name in the V Name, I Name, Time Stamp Name, and/or Index Name entry fields, you can choose the variables as the display parameters.

- The time stamp is the time the measurement is started for each measurement point.
- The index is the index number for each measurement data.

To Set Sampling Parameters



Measurement Setup

Click the Measurement Setup tab to display the setup screen for the sampling timing parameters and the SMU source output parameters. At the Sampling Parameter area, you set the following sampling timing parameters.

Linear/Log:

Sampling mode. LINEAR for linear sampling. LOG10, LOG25, LOG50, LOG100, LOG250, or LOG500 for logarithmic sampling. For the logarithmic sampling, the number after LOG indicates the number of measurement data in a decade. For example, LOG10 mode is used to get 10 data/decade.

For the log sampling, the B1500A holds only the data that can be plotted on the log scale in the same distance as close as possible. Only the held data is counted in the number of measurement result data.

For the linear sampling with Interval < 2 ms, if the total measurement time runs over the specified time Interval × No of Samples, the sampling measurement will be stopped even if the number of measurement result data is less than the specified No of Samples.

Interval:

Interval of the sampling, in seconds. 0.002 to 65.535 s, 0.001 s resolution.

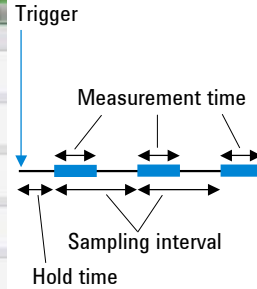
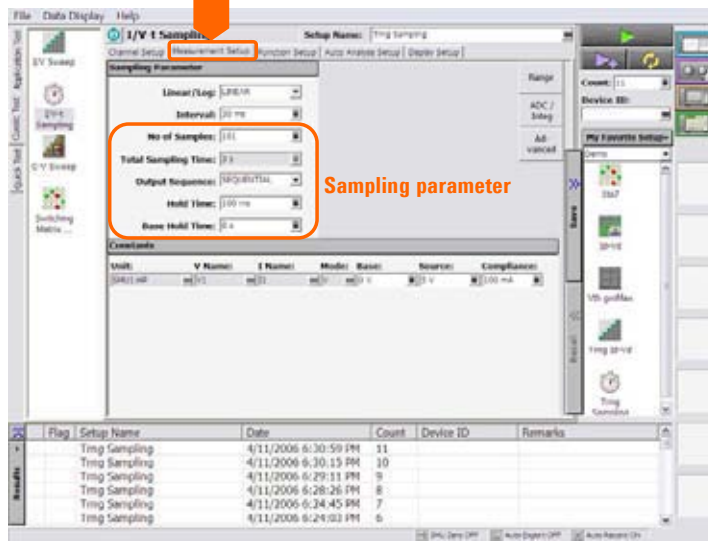
Interval < 0.002 s in 0.00001 s resolution is also available for the linear sampling. It must satisfy the following formula. For details, see online help or User's Guide.

Interval ≥ 0.0001 + 0.00002 × (number of measurement channels-1)

To Set Sampling Parameters



Measurement Setup



No of Samples:

Number of samples. Integer. 1 to the following value.

For linear: $100001 / (\text{number of measurement channels})$

For logarithmic: $1 + (\text{number of data for 11 decades})$

Total Sampling Time:

This field just displays the total sampling time that is the time from the measurement start time for the first point to the end of sampling measurement. It does not include the hold time.

Total Sampling Time = Interval \times No of Samples

Output Sequence:

Source output sequence. SIMULTANEOUS or SEQUENTIAL.

Hold Time:

Time since the Source value output until the first sampling point, in seconds. 0 to 655.35 s, resolution 0.01 s.

The following values are also available for Interval < 0.002 s. |Hold Time| will be the time since the sampling start until the Source value output.

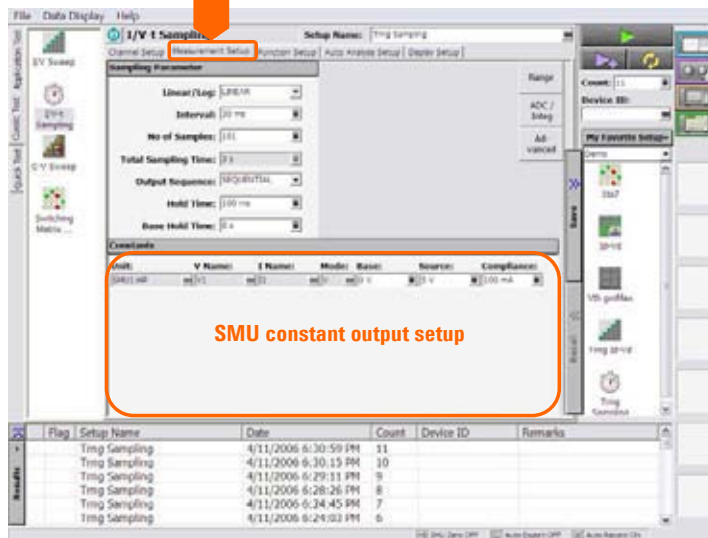
-0.09 to -0.0001 s, resolution 0.0001 s.

Base Hold Time:

Hold time of the Base value output until the Source value output, in seconds. 0 to 655.35 s, resolution 0.01 s.

To Set SMU Outputs (CONST)

Measurement Setup



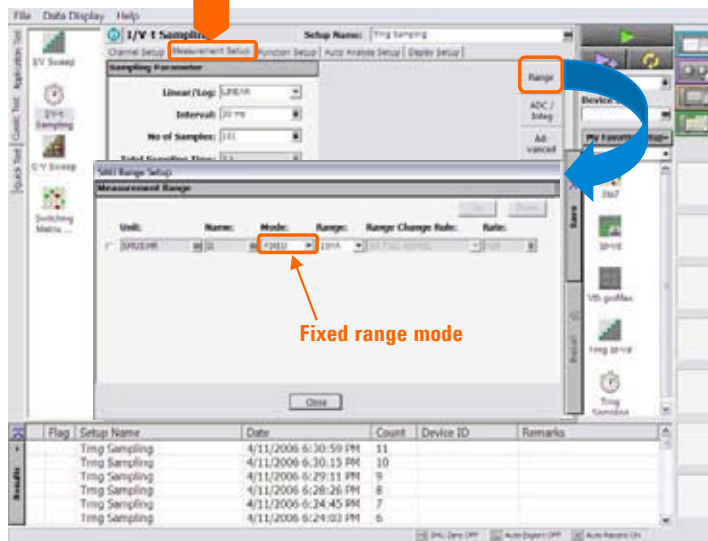
At the Constants area, you set the SMU constant output.

- Unit: SMU name or number
- V Name: Variable name for the voltage measurement or source data
- I Name: Variable name for the current measurement or source data
- Mode: Source output mode, V (voltage), I (current), or COMMON (ground)
- Base and Source: SMU output value
- Compliance: SMU compliance value

Base value is available for all output channels for the SIMULTANEOUS mode and the last source channel for the SEQUENTIAL mode.

To Set Ranging Mode

Measurement Setup

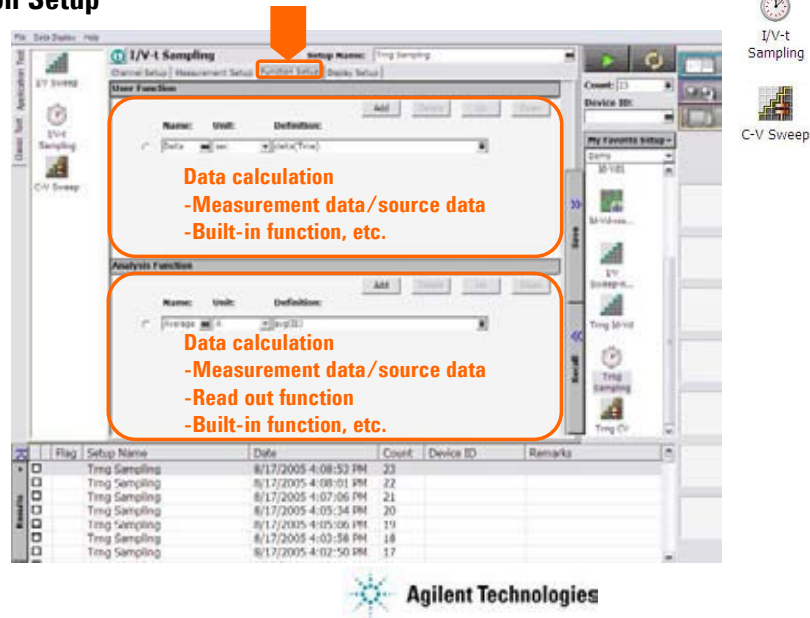


The Range button opens the SMU Range Setup dialog box. For details of the dialog box, see page 5-13.

If the range changing occurs during measurement, the SMU may not complete measurement within the sampling interval. So use FIXED range if the sampling interval is top priority and the resolution/sensitivity is second priority.

To Set User Functions/Analysis Functions

Function Setup



Click the Function Setup tab to display the User Function/Analysis Function setup screen.

The user functions can be displayed on the X-Y Graph Plot, List Display, and Parameters area of the Data Display window. Up to 20 functions can be set.

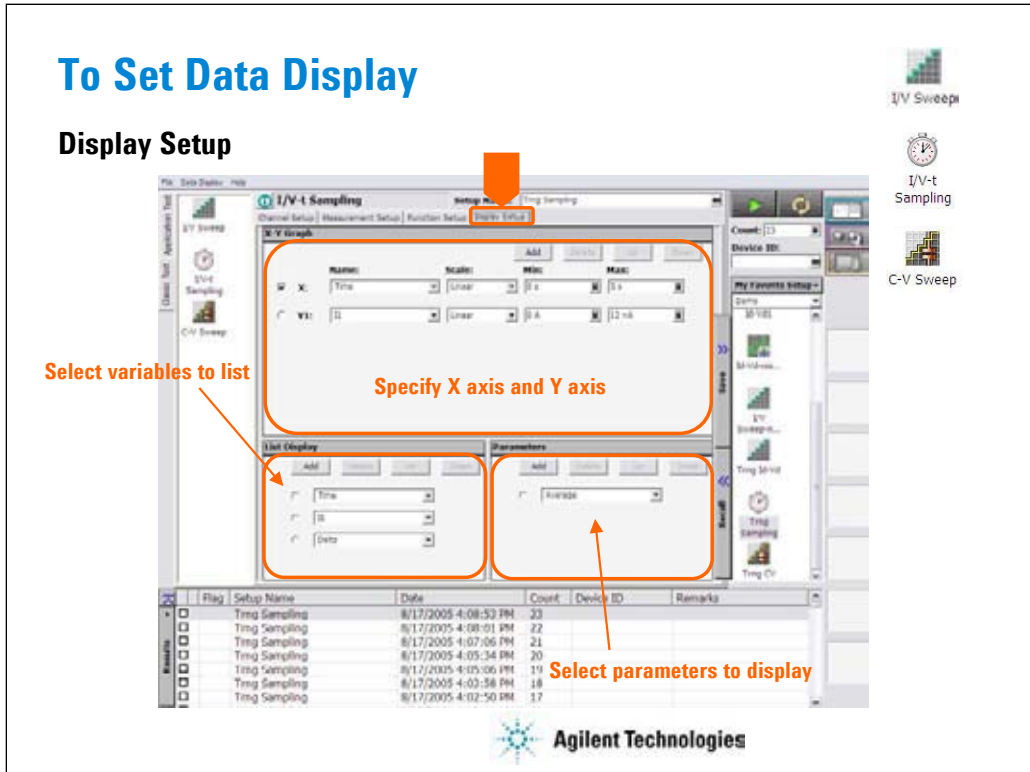
- Name: Function name
 - Unit: Unit of the function
 - Definition: Definition of the function. The following identifiers can be used.
 - Variables for the measurement/output data used in this test
 - Functions defined in the above lines
 - Local variables passed from the application test that calls this test as a component
 - Built-in functions and global variables
- For details, see online help or User's Guide.

The analysis functions can be displayed on the Parameters area of the Data Display window. Up to 20 functions can be set.

- Name: Function name
 - Unit: Unit of the function
 - Definition: Definition of the function. The following identifiers can be used.
 - Variables for the measurement/output data used in this test
 - Functions defined in the above lines
 - Local variables passed from the application test that calls this test as a component
 - Built-in functions and global variables
 - Read out functions
- For details, see online help or User's Guide.

To Set Data Display

Display Setup



Click the Display Setup tab to display the display setup screen. The X-Y Graph area is used to set the X axis and Y axis of the X-Y Graph Plot area in the Data Display window.

- Name: Name of variable to plot on the X axis
- Scale: Linear or Log
- Min: Minimum value of the specified axis
- Max: Maximum value of the specified axis

The List Display area selects the variables to be listed in the List Display area of the Data Display window. Up to 20 variables can be set.

The Parameters area selects the variables to be listed in the Parameters area of the Data Display window. Up to 20 parameters can be set.

Exercise 8



Define test setup and perform test.

1. Click I/V-t Sampling icon and open setup editor.
2. Define test setup as shown in page 5-27 to 5-32.
3. Save it as Trng Sampling.
4. Connect device (capacitance), and perform test.
5. Export preset group, and import it.

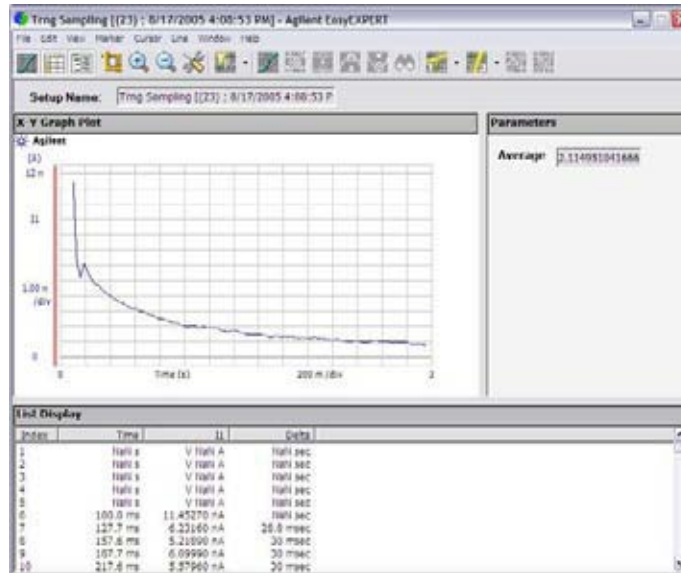
Time to complete: 10 minutes.



Note:

Measurement Result Example

I/V-t
Sampling



This is a test result example displayed on the Data Display window.

C-V Sweep Measurement



C-V Sweep

- To Define Channels and Variables
- To Set Sweep Source
- To Set Signal Source
- To Set Measurement Timing and Abort Function
- To Set SMU Outputs (CONST)
- To Set User Functions/
Analysis Functions
- To Set Data Display
- To Perform Compensation
and Correction



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This section explains how to perform C-V sweep measurement. You will perform the above tasks to execute the C-V sweep measurement.

To Define Channels and Variables



Channel Setup

Setup Name

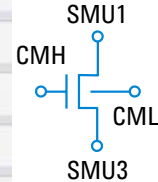
Channel Definition
 -CMU/SMU
 -V name/I name
 -I/V/COMMON

Time Stamp Name: [] **Index Name:** []

Variable name for time stamp data

Variable name for data index

Flag	Setup Name	Date	Count	Device ID	Remarks
	Timg CV	8/17/2005 12:43:32 PM	20		
	Timg CV	8/17/2005 12:42:53 PM	18		
	Timg CV	8/17/2005 12:41:58 PM	18		
	Timg CV	8/17/2005 12:40:35 PM	17		
	Timg CV	8/17/2005 12:39:33 PM	16		
	Timg CV	8/17/2005 12:39:02 PM	15		
	Timg CV	8/17/2005 12:37:36 PM	14		



Click the C-V Sweep icon and open the setup editor. Then click the Channel Definition tab to display the channel definition screen.

- Enter the Setup Name for the test setup to be defined on the setup editor.
- List units used for source output or measurement, and set the following parameters.
 - Unit: MFCMU/SMU name or number
 - V Name: Variable name for the voltage measurement or source data
 - I Name: Variable name for the current measurement or source data
 - Mode: Source output mode, V (voltage), I (current), or COMMON (ground)
 - Time Stamp Name: Variable name for the time stamp data
 - Index Name: Variable name for the data index

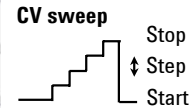
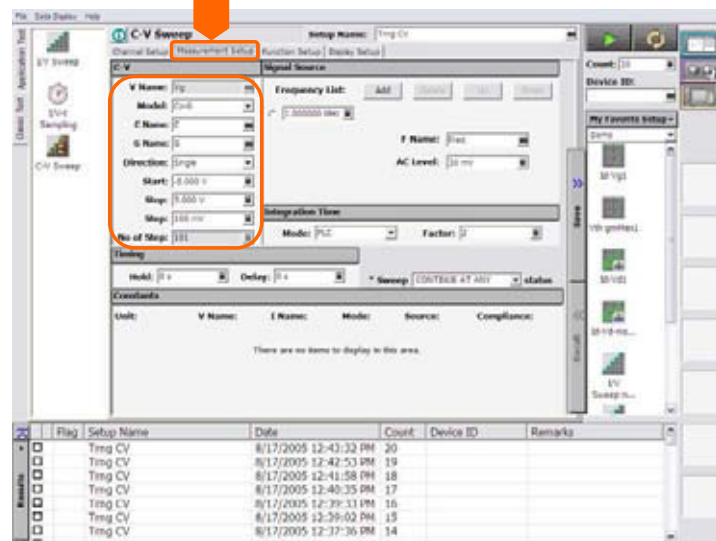
You can read measurement data by using the Data Display window. Parameters displayed on the window are selected on the Display Setup tab screen. If you enter the variable name in the V Name, I Name, Time Stamp Name, and/or Index Name entry fields, you can choose the variables as the display parameters.

- The time stamp is the time the measurement is started for each measurement point.
- The index is the index number for each measurement data.

To Set Sweep Source



Measurement Setup



The Measurement Setup tab screen is used to set the source output and timing parameters.

At the C-V area, you set the DC bias output of the MFCMU.

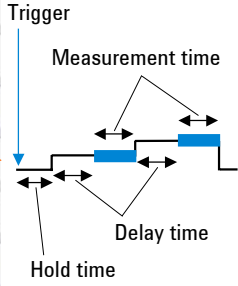
- V Name: Variable name of the MFCMU output
- Model: MFCMU measurement mode. Primary and secondary measurement parameters. Select one from the following four models.
 - Cp-G: Parallel capacitance (F) and Conductance (S)
 - Cp-D: Parallel capacitance (F) and Dissipation factor
 - Cs-Rs: Series capacitance (F) and Series resistance ($\Omega\mu$)
 - Z-Th: Impedance ($\Omega\mu$) and Phase (degree)
- C/Z Name: Variable name of the primary measurement parameter, C or Z
- G/D/R/Th Name: Variable name of the secondary measurement parameter, G, D, R, or Th
- Direction: Sweep direction, single (start to stop) or double (start to stop to start)
- Start: Source output start value
- Stop: Source output stop value
- Step: Source output incremental step value
- No of Step: Number of sweep steps

To Set Meas. Timing and Abort Function



Measurement Setup

- CONTINUE AT ANY STOP AT ANY ABNORMAL**
- Range overflow
 - MFCMU error
 - SMU compliance
 - SMU oscillation



At the Integration Time area, you set the integration time of the impedance measurement by the MFCMU.

- Mode: AUTO or PLC. Rule to decide the integration time. For details, see online help or User's Guide.
- Factor: Coefficient for the reference value of the integration time.

At the Timing area, you set the source output and measurement timing.

- Hold: Source output hold time. Time after the measurement trigger until starting delay time.
- Delay: Measurement start delay time. Time after the hold time until starting measurement.

The Sweep [] status field sets the sweep abort function.

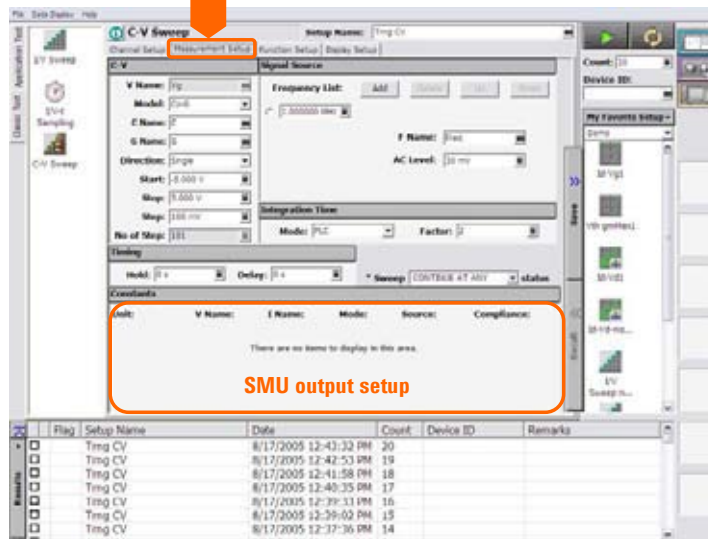
When this field is CONTINUE AT ANY, the sweep measurement is not aborted.

When this field is STOP AT ANY ABNORMAL, the sweep measurement will be aborted when one of the following conditions is detected.

- Measurement range overflow
- MFCMU error
- SMU compliance
- SMU oscillation

To Set SMU Outputs (CONST)

Measurement Setup

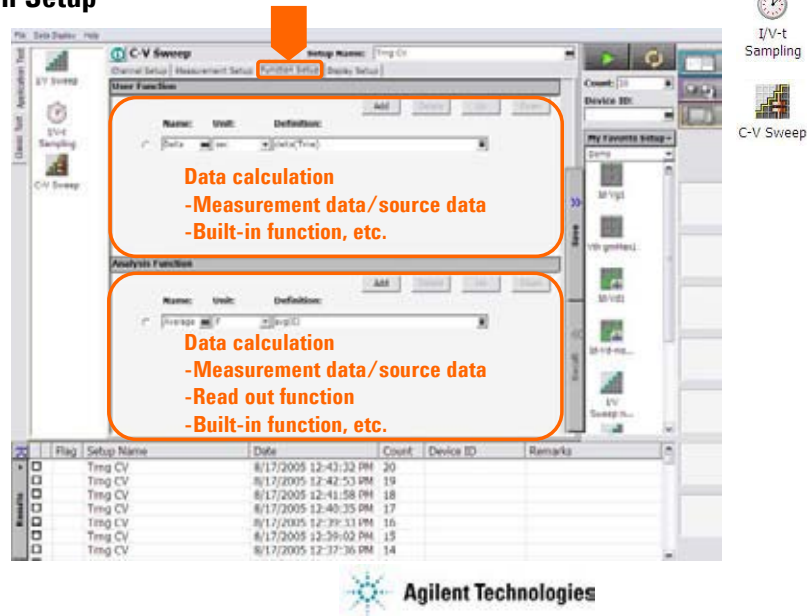


At the Constants area, you set the SMU constant output.

- Unit: SMU name or number
- V Name: Variable name for the voltage measurement or source data
- I Name: Variable name for the current measurement or source data
- Mode: Source output mode, V (voltage), I (current), or COMMON (ground)
- Source: SMU output value
- Compliance: SMU compliance value

To Set User Functions/Analysis Functions

Function Setup



Click the Function Setup tab to display the User Function/Analysis Function setup screen.

The user functions can be displayed on the X-Y Graph Plot, List Display, and Parameters area of the Data Display window. Up to 20 functions can be set.

- Name: Function name
- Unit: Unit of the function
- Definition: Definition of the function. The following identifiers can be used.
 - Variables for the measurement/output data used in this test
 - Functions defined in the above lines
 - Local variables passed from the application test that calls this test as a component
 - Built-in functions and global variables

For details, see online help or User's Guide.

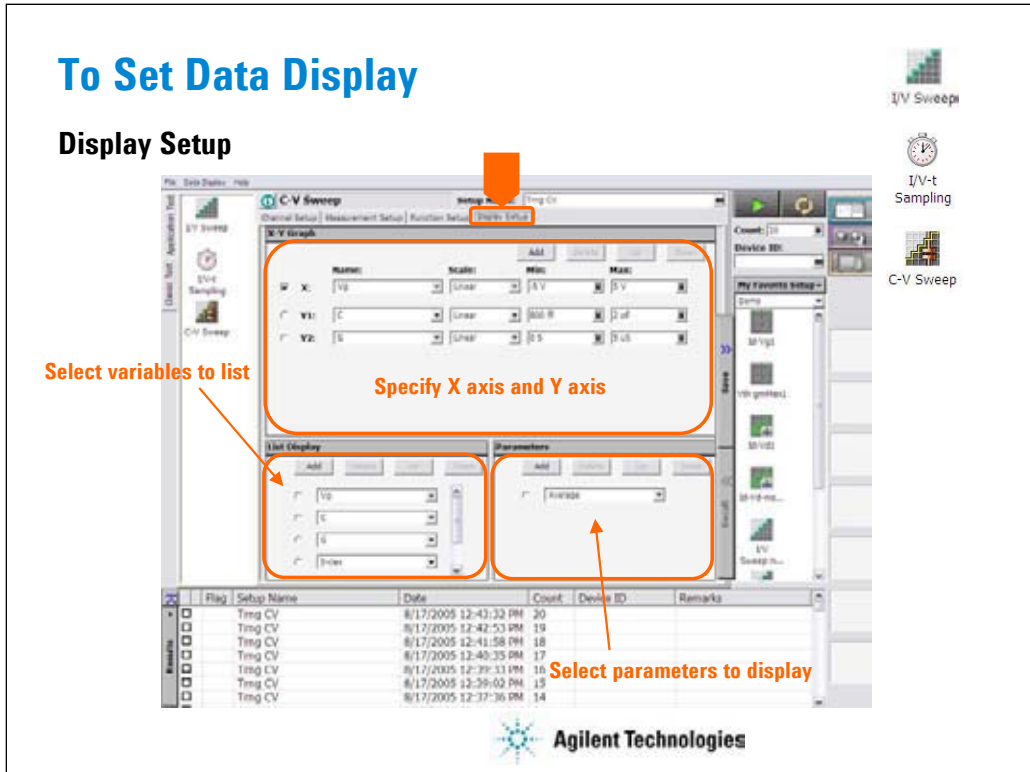
The analysis functions can be displayed on the Parameters area of the Data Display window. Up to 20 functions can be set.

- Name: Function name
- Unit: Unit of the function
- Definition: Definition of the function. The following identifiers can be used.
 - Variables for the measurement/output data used in this test
 - Functions defined in the above lines
 - Local variables passed from the application test that calls this test as a component
 - Built-in functions and global variables
 - Read out functions

For details, see online help or User's Guide.

To Set Data Display

Display Setup



Click the Display Setup tab to display the display setup screen. The X-Y Graph area is used to set the X axis and Y axis of the X-Y Graph Plot area in the Data Display window.

- Name: Name of variable to plot on the X axis
- Scale: Linear or Log
- Min: Minimum value of the specified axis
- Max: Maximum value of the specified axis

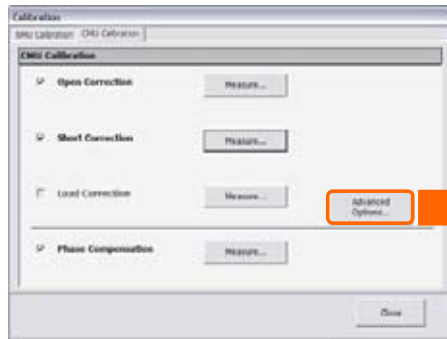
The List Display area selects the variables to be listed in the List Display area of the Data Display window. Up to 20 variables can be set.

The Parameters area selects the variables to be listed in the Parameters area of the Data Display window. Up to 20 parameters can be set.

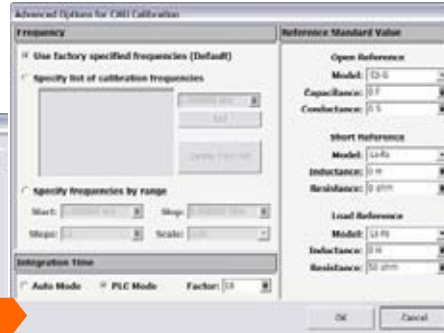
To Perform Compensation and Correction



Calibration button



Calibration



Advanced Options...



The MFCMU is equipped with the error correction function used to realize accurate impedance measurements. The correction function minimizes the effects of the error elements in the extension cables and the DUT interface such as manipulator and probe card.

- Phase compensation: Corrects phase error caused by extending measurement cables.
- Open correction: Corrects for stray admittance. Effective for high impedance measurements.
- Short correction: Corrects for residual impedance. Effective for low impedance measurements.
- Load correction: Corrects any error by using the working standard (load standard).

Click the Calibration button to open the Calibration window. And click the CMU calibration tab on the window to perform the compensation and correction data measurement.

- To measure the phase compensation data, open the measurement terminals at the end of the device side and click the Measure... button.
- To measure the open correction data, open the measurement terminals at the end of the device side and click the Measure... button.
- To measure the short correction data, connect the measurement terminals together at the end of the device side and click the Measure... button.
- To measure the load correction data, connect the load standard that has the reference value or calibration value. Then, click the Measure... button.

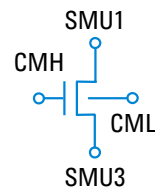
For details of the error correction (CMU calibration) and the Advanced Options, see online help or User's Guide. The Advanced Options window is used for the compensation/correction data measurement setup.

Exercise 9



Define test setup and perform test.

1. Click C-V Sweep icon and open setup editor.
2. Define test setup as shown in page 5-36 to 5-42. And save it as Trng CV.
3. Open measurement terminals, and perform phase compensation and open correction.
4. Connect device, and perform test.
5. Export preset group, and import it.

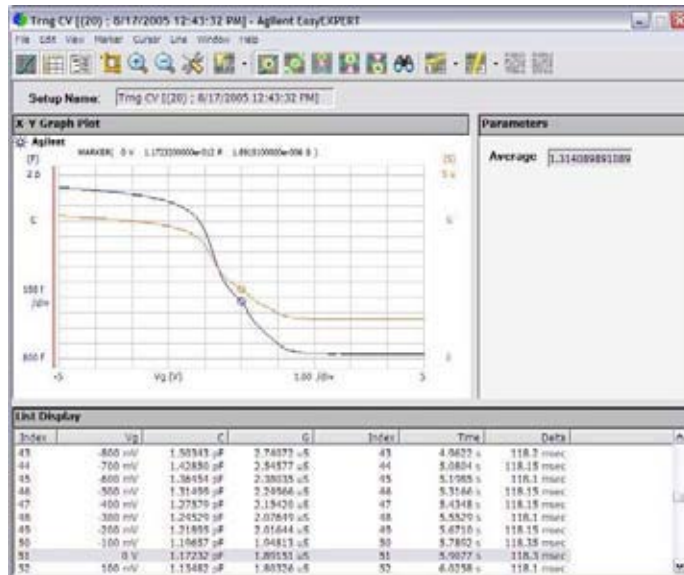


Time to complete: 10 minutes.



Note:

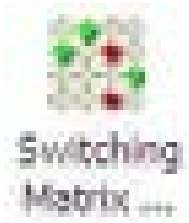
Measurement Result Example



This is a test result example displayed on the Data Display window.

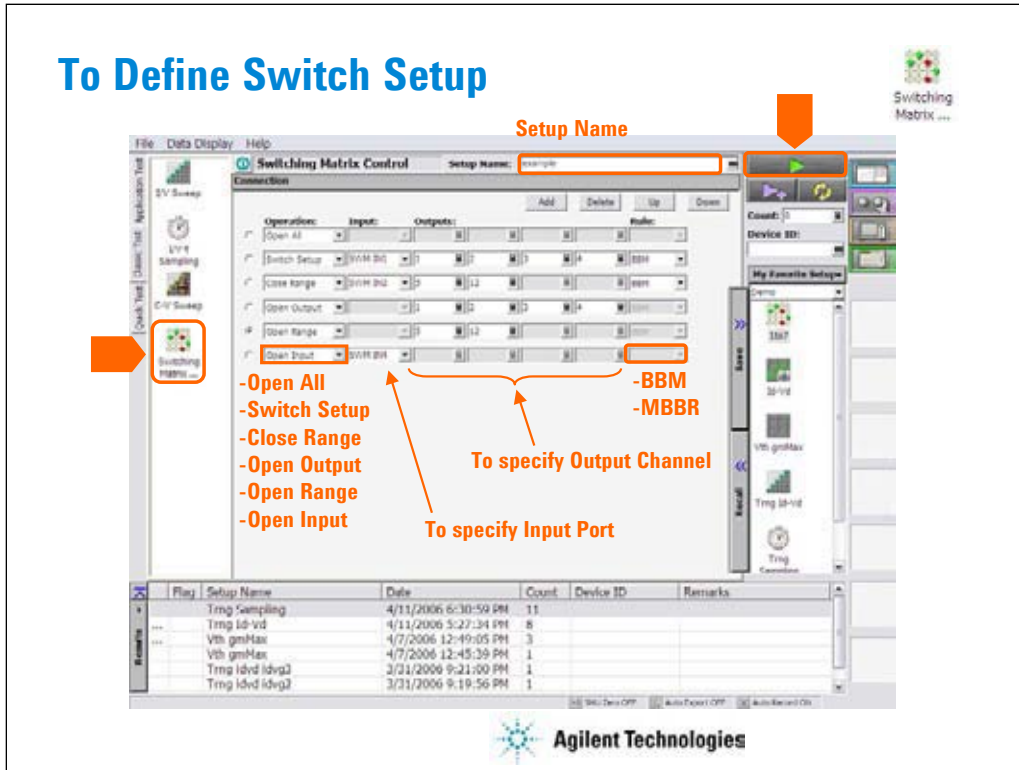
Switching Matrix Control

- To Define Switch Setup



This section explains how to define the switch setup for B2200 Switching Matrix.

To Define Switch Setup



This setup screen is used to create the relay control setup (switch setup) for Agilent B2200A/B2201A Switching Matrix.

To send the switch setup to B2200, click the Single button. Before doing this, you have to establish the GPIB connection to B2200 by using the Switching Matrix tab screen of the Configuration window. See Module 8.

This screen provides the following GUI.

Add: Adds a setup row for relay connection.

Delete: Deletes the setup row. To select the setup row, use the left radio button.

Up: Moves the selected setup row upward.

Down: Moves the selected setup row downward. The setup row provides the following entry fields.

Operation: Relay control operation. Open All, Switch Setup, Close Range, Open Output, Open Range, or Open Input. See the next page.

Input: B2200 input port number or label. Available for the Switch Setup, Close Range, and Open Input operations.

Outputs: B2200 output channel number or label. Four entry fields are available for the Switch Setup and Open Output operations to specify the output channels. Two entry fields are available for the Close Range and Open Range operations to specify the range of output channels.

Rule: Relay connection rule. BBM or MBBR.

- BBM:** Breaks the previous connection and then makes the new connection for the specified outputs.

- MBBR:** Makes the new connection and then breaks the previous connection for the specified outputs.

Operation and number of Outputs



Operation	Description	Number of Outputs
Open All	Opens all relays.	0
Switch Setup	Makes the connection from the specified input port to the specified output channels. Up to four output channels can be specified at once.	4
Close Range	Makes the connection from the specified input port to the specified output channels. They are between two channels given by the Outputs fields.	2
Open Output	Opens the relays connected to the specified output channels. Up to four output channels can be specified at once.	4
Open Range	Opens the relays connected to the specified output channels. They are between two channels given by the Outputs fields.	2
Open Input	Opens the relays connected to the specified input port.	0



Note:

Exercise 10



Define switch setup and send it to B2200.

1. **Click Switching Matrix Control icon and open setup editor.**
2. **Define switch setup as you want. And save it as Trng Switch.**
3. **If B2200 is available, establish the GPIB connection between B1500 and B2200, and apply your switch setup.**

Time to complete: 5 minutes.



Note:

Module 6. Creating Your Test Definitions



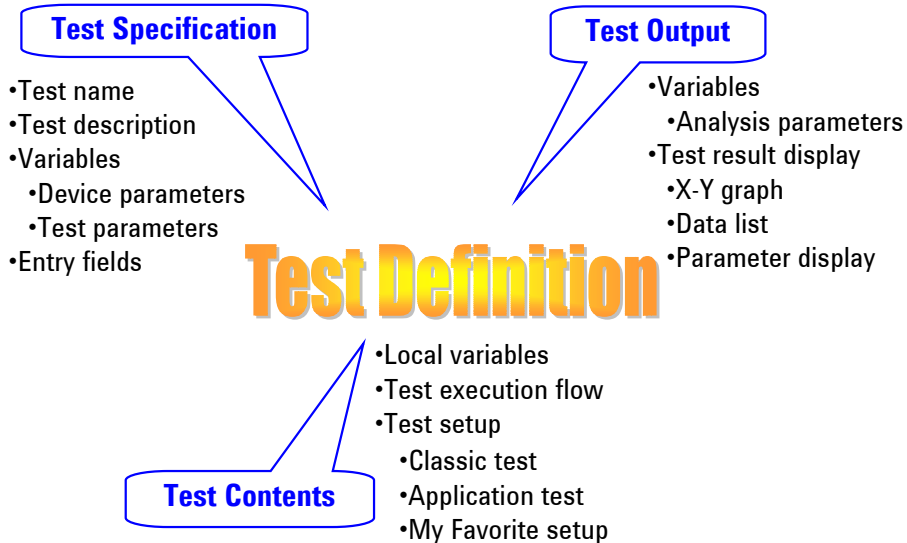
In This Module

- **What is Test Definition**
- **What is Test Contents**
- **To Open Test Definition Editor**
- **To Define Test Specification**
- **To Define Test Contents**
- **To Save and Close Your Test Definition**
- **To Export/Import Test Definition**
- **If You Define Application Test Output**



This section explains how to create your test definition. You will perform the above tasks to create the definition.

What is Test Definition



Test definition consists of test specification, test contents, and test output setup. The test specification contains test name, description, device parameters, and test parameters. The parameters will be the variables used to pass the test conditions to the test execution flow or test setup defined in the test contents. Especially for the test parameters, you can specify the position of entry field for each parameter. You can see the entry fields when the main screen displays this application test setup. The test contents are the core of the test definition. You will define the local variables, test execution flow, and test setup. You can define the test setup by selecting application tests, classic tests, or my favorite setup, and entering the test conditions.

The test output setup is optional. If you need the test result output (test result display and record) of the test definition, declare the variables (analysis parameters) and define the display parameters. See "If You Define Application Test Output".

You can use the device parameters, test parameters, and analysis parameters in the test execution flow (program flow) of the test contents without declaration of local variables.

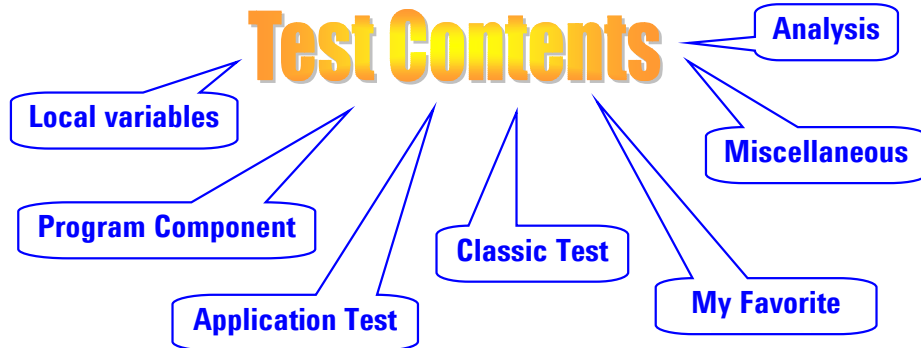
What is Test Contents

Test Specification

Variables
•Device parameters
•Test parameters

Test Output

Variables
•Analysis parameters

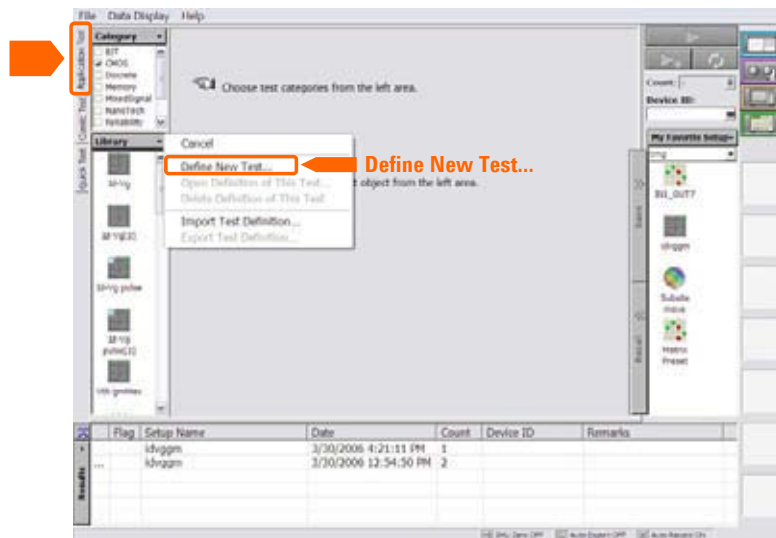


Test contents are the test execution flow (program flow), and is the core of the test definition. In the test contents, the following elements can be defined.

- Local variables
- Program components
- Application tests
- Classic tests
- My Favorite setup
- Analysis components
- Miscellaneous components
- Device parameters defined in the test specification
- Test parameters defined in the test specification
- Analysis parameters defined in the test output

The program is executed from top to bottom in the test execution program list.

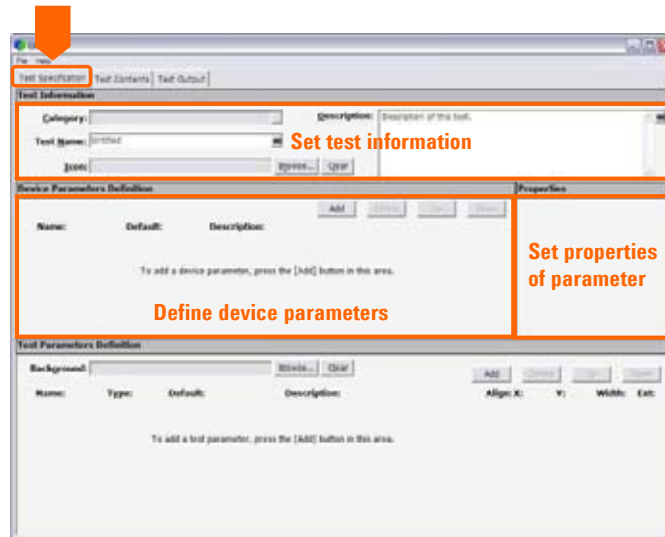
To Open Test Definition Editor



To start test definition, open the test definition editor.

Select the Application Test tab, click the Library button, and select the Define New Test... function. The test definition editor will be opened. See next slide.

To Define Test Specification



The test definition editor provides three tabs, Test Specification, Test Contents, and Test Output. At first define the test specification. Click the Test Specification tab.

In the Test Information area:

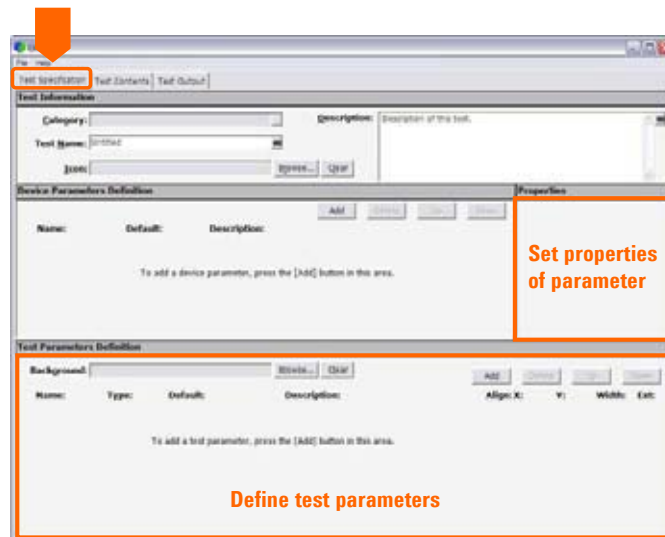
- Click the right button in the Category field to specify the category the new test definition belongs.
- Enter the Test Name.
- Select the Icon that will be displayed on the list area below the Library button of the main screen. It is the image file used to select the test definition. See previous slide.
- Enter the Description of the test.

In the Device Parameters Definition area:

- Click Add button to display the entry fields for the parameter.
- Set the Name, Default value, and Description for the parameter. When you add a parameter, you will see the entry fields at the Properties area. The area shows you the properties (minimum value, maximum value, number of effective digits, resolution, and unit) for the device parameter or the test parameter specified by the radio button put on the left of the parameter name.

For the Typical Values... button and the Symbols... button, see online help or User's Guide.

To Define Test Specification

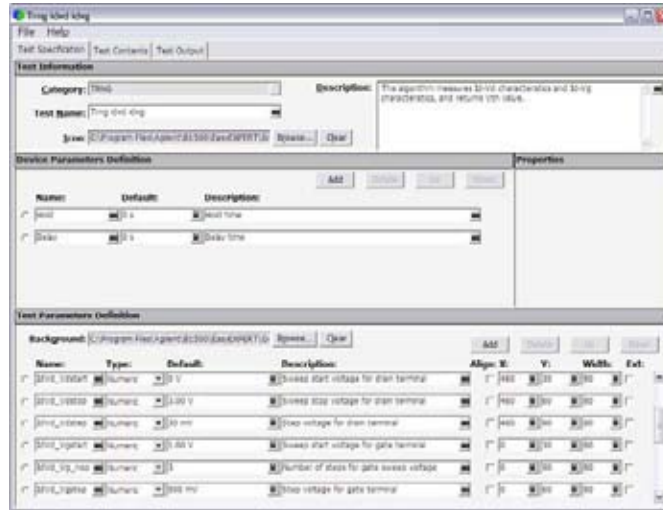


In the Test Parameters Definition area:

- Select the Background that will be displayed on the application test setup area of the main screen. Usually it is the image that shows the device connections.
- Set the Name, data type, Default value, and Description for the parameter. When you add a parameter, you will see the entry fields at the Properties area. The area shows you the properties (minimum value, maximum value, number of effective digits, resolution, and unit) for the device parameter or the test parameter specified by the radio button put on the left of the parameter name.
- Set the X, Y, and Width values to specify the position of entry field displayed on the application test setup area.
- Check the Align box to set the X origin of entry field to the left edge of the entry field. Uncheck this box to set it to the left edge of the parameter name placed left next to the entry field.
- Check the Ext box. The entry field will be put on the Extended Test Parameters dialog box that is displayed by clicking the Extended Setup button on the application test setup area of the main screen.

Setup example

Test Specification



This example sets:

Category: TRNG (newly created)

Test Name: Trng idvd idvg

Icon: IdVg.bmp

Device parameters:

Hold and Delay

Background: Vth_gmmax.PNG

Test parameters:

Drain, Gate, Source, Subs

IdVd_Vdstart, IdVd_Vdstop, IdVd_step, IdVd_Vgstart, IdVd_Vg_nop, IdVd_Vgstep

IdVg_Vdout, IdVg_Vgstart, IdVg_Vgstop, IdVg_Vgstep

Vsub, Vs, Icomp, Igcomp

Entry field properties: 80 (width) x 30 (distance in vertical direction)

Result example

Parameter entry fields

The screenshot displays the Agilent Test Setpoint Manager software interface. The main window shows a test setup configuration for a device under test (DUT). The setup name is "Tmg idvt idvg". The interface includes a circuit diagram of the test setup, showing a DUT connected to a power source and a measurement point. The parameters for the test setup are listed in the "Test Parameters" section:

- Device Parameters: Hold: [0 s], Delay: [0 s]
- Test Parameters: ΔV_{idV_start} : [1.00 V], ΔV_{idV_stop} : [200 mV], ΔV_{idV_step} : [3 mV]
- Extended Setup: ΔV_{idV_start} : [0 V], ΔV_{idV_stop} : [2.00 V], ΔV_{idV_step} : [3 mV], $\Delta V_{idV_V_{dout}}$: [0.00 V]
- Additional parameters: ΔV_{idV_start} : [0.00 mV], ΔV_{idV_stop} : [2.00 V], ΔV_{idV_step} : [3 mV]

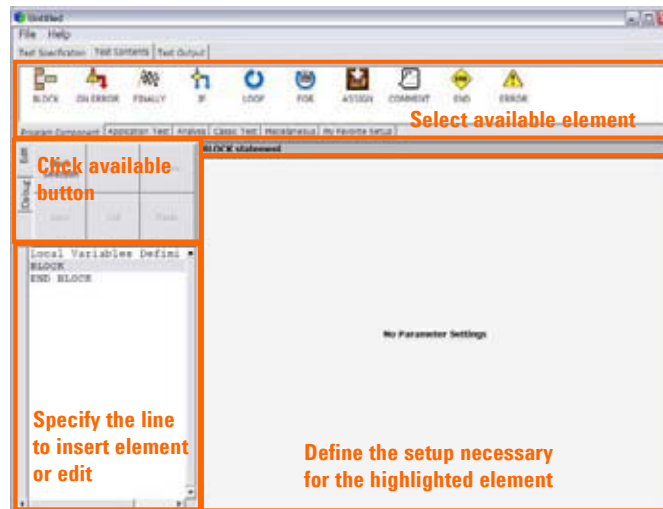
The results table at the bottom of the window shows the following data:

Flag	Setup Name	Date	Count	Device ID	Remarks
	Tmg idvt idvg	3/31/2006 3:58:54 PM	1		
	idVg	3/31/2006 3:58:53 PM	1		
	idVd	3/31/2006 3:58:56 PM	1		
	Tmg idvt idvg	3/31/2006 3:57:03 PM	1		
	idVg	3/31/2006 3:57:02 PM	1		
	idVd	3/31/2006 3:56:44 PM	1		



This is a result example of the test specification setup shown in the previous slide.

To Define Test Contents



Define the test contents as shown below:

- Click the Test Contents tab.
- Click the Local Variable Definition line to highlight the line. The right open space displays the Local Variables Definition statement setup editor.
- Define the local variables used in this test execution flow (program flow).
- Click the line that an element has to be inserted.
- Click an element of Program Component, Application Test, Analysis, Classic Test, or Miscellaneous tab menu.
- Click the Insert button of the Edit tab menu. The element will be inserted between the highlighted line and the next line.
- Repeat this to create the test execution flow.

Available elements



Program Component



Application Test



Analysis



Classic Test



Miscellaneous



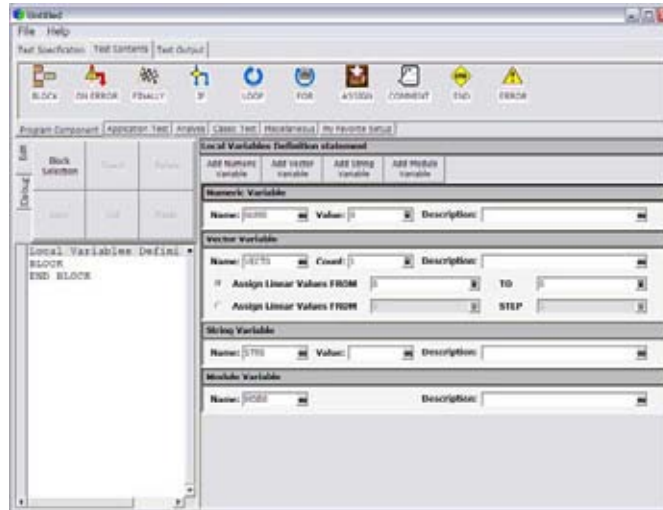
My Favorite



Available elements are shown above. The Program Component provides the typical program statements such as IF, LOOP, FOR, and so on. They are used to control the test execution flow. The Application Test, Classic Test, and My Favorite are used to define the test setup/test condition. The Analysis provides the elements used to control auto analysis function and data display. And the Miscellaneous provides other useful elements. For details of elements, see online help or user's guide.

Defining Local Variables

Local Variables Definition



Add Numeric Variable button displays the Numeric Variable area that provides the following fields.

- Name: Numeric variable name
- Value: Initial value of the variable
- Description: Additional information for the variable

Add Vector Variable button displays the Vector Variable area that provides the following fields.

- Name: Vector variable name. Two dimensional array.
- Count: Number of elements, or array size
- Description: Additional information for the variable

This area also provides the following radio button used to specify how to set the initial value of the array data automatically.

- Assign Linear Values FROM [value of first element] TO [value of last element]

If $Count > 1$, this sets $first\ value + (N-1) \times (last\ value - first\ value) / (Count - 1)$ to the N -th element. If $Count = 1$, this sets $first\ value (= last\ value)$ to the element.

- Assign Linear Values FROM [value of first element] STEP [step value]

This sets $first\ value + (N-1) \times step$ to the N -th element.

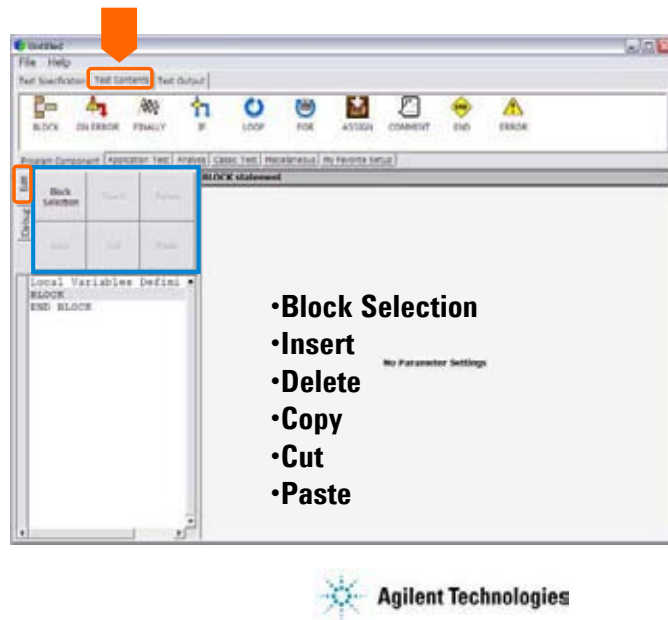
Add String Variable button displays the String Variable area that provides the following fields.

- Name: String variable name
- Value: Initial value of the variable
- Description: Additional information for the variable

Add Module Variable button displays the Module Variable area that provides the following fields.

- Name: Module variable name
- Description: Additional information for the variable

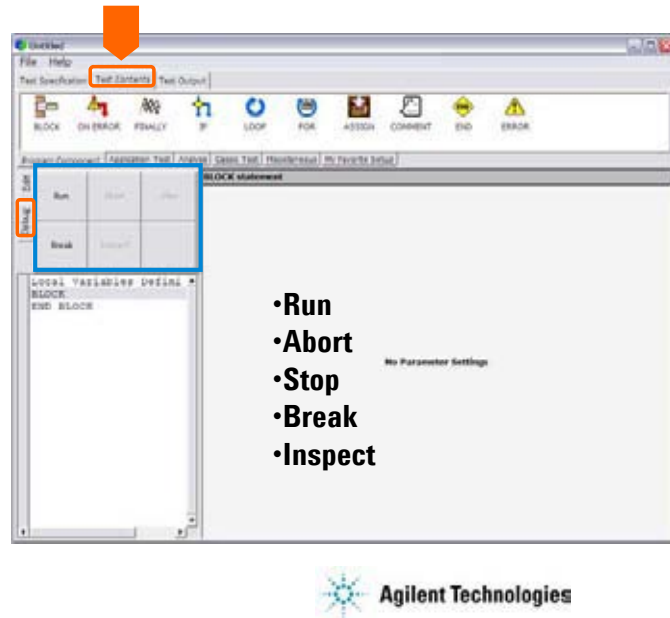
Editing test contents



The Edit tab provides the following buttons:

- Block Selection/Line Selection toggle button selects the edit target selection mode. In the line selection mode, clicking line just selects the line. In the block selection mode, clicking line selects the block the line belongs.
- Insert button inserts the specified element between the highlighted line and the next line.
- Delete button deletes the highlighted line.
- Copy button copies the highlighted line to the clipboard.
- Cut button moves the highlighted line to the clipboard.
- Paste button inserts the line in the clipboard between the highlighted line and the next line.

Debugging test contents

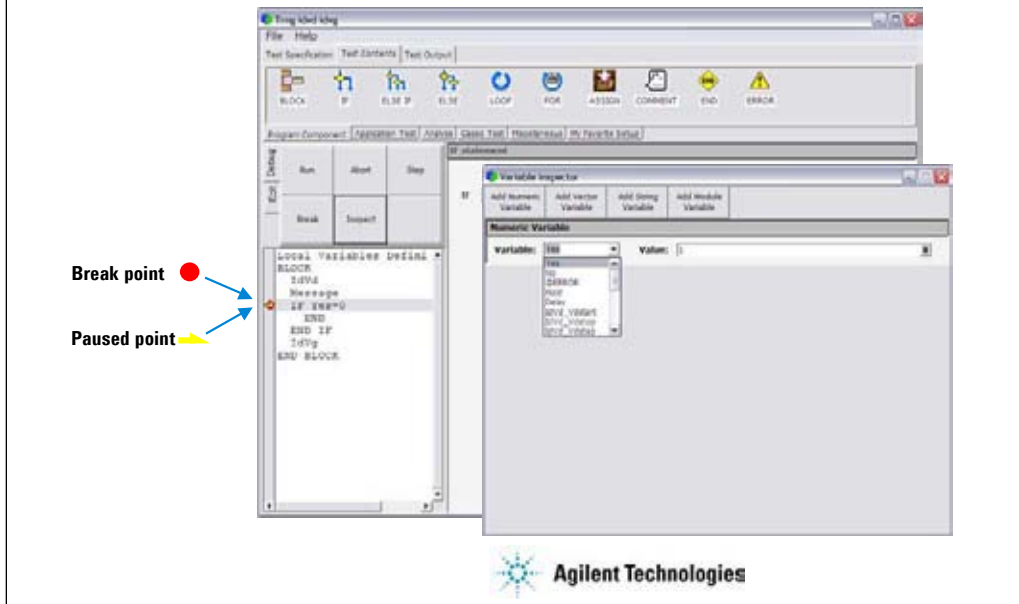


The Debug tab menu provides the following buttons:

- Run button starts the debug (executes the test flow). During execution, the label changes to Pause. Clicking Pause button pauses the execution, and changes the label to Run that is used to continue the debug (execution).
- Abort button aborts the debug (execution).
- Step button executes the highlighted line of the test flow. Clicking the button repeatedly continues the execution by a line.
- Break button sets/releases the break point. For the break point, this button releases the break point from the highlighted line. Program execution will break at the break point automatically.
- Inspect button is available when the debug (execution) is paused or broken. This button opens the Variable Inspector used to monitor value of device parameters, test parameters, analysis parameters, local variables, or system variables.

Monitoring Variable Values

Debug: Inspect button



The Variable Inspector is displayed by clicking the Inspect button after the program is paused, and is used to monitor or change the value of the device parameters, test parameters, analysis parameters, local variables, or system variables. For the vector variables, only data monitor is available. The Variable Inspector provides the following buttons to add the variable monitor area.

- Add Numeric Variable
- Add Vector Variable
- Add String Variable
- Add Module Variable

The following functions are available for the menu displayed by clicking the banner of the variable monitor area.

- Up: This button shifts the variable monitor area upward.
- Down: This button shifts the variable monitor area downward.
- Remove: This button deletes the variable monitor area.


Available variables

Test Contents
•Local variables

Test Specification
•Device parameters
•Test parameters

Test Output
•Analysis parameters

Do not set the same name for variables and parameters. The name must be unique.



Assign to external variables...

You can connect the variables in test setup with

- Local variables
- Device parameters
- Test parameters
- Analysis parameters



In the test execution flow (program flow), you can use the following variables.

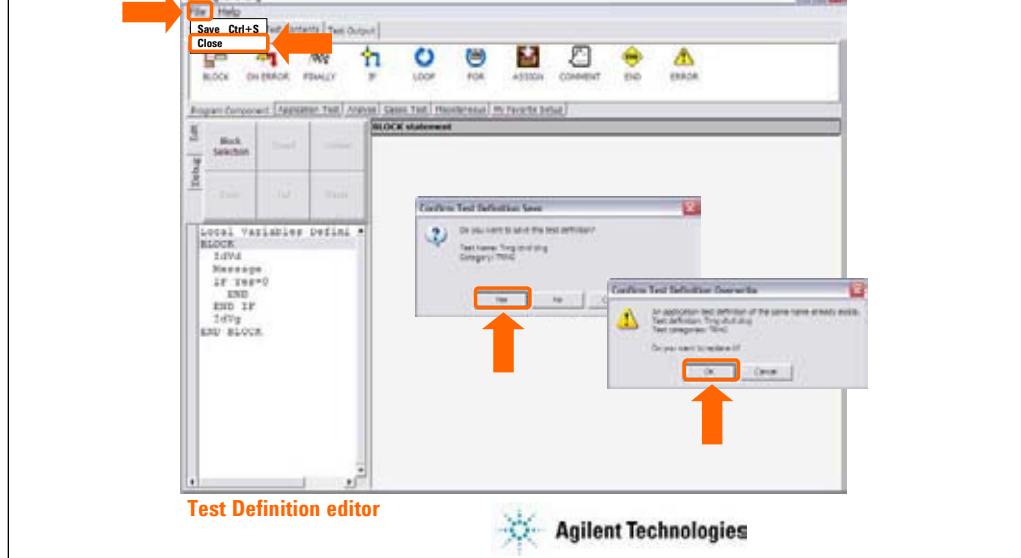
- Local variables defined in the test contents
- Device parameters defined in the test specification
- Test parameters defined in the test specification
- Analysis parameters defined in the test output

You need to declare the variables used in the test contents definition by using the Local Variables Definition. You can use the device parameters, test parameters, and analysis parameters without declaration of local variables.

You can read the value of parameters/variables used in the Application Test setup or Classic Test setup defined in a test contents. To do so, use the External Variables Setup dialog box or built-in functions. The read values can be used for the calculation of test result and the display and record of calculation result. See “If You Define Application Test Output”.

To Save and Close Your Test Definition

Close Test Definition editor, and save your test definition



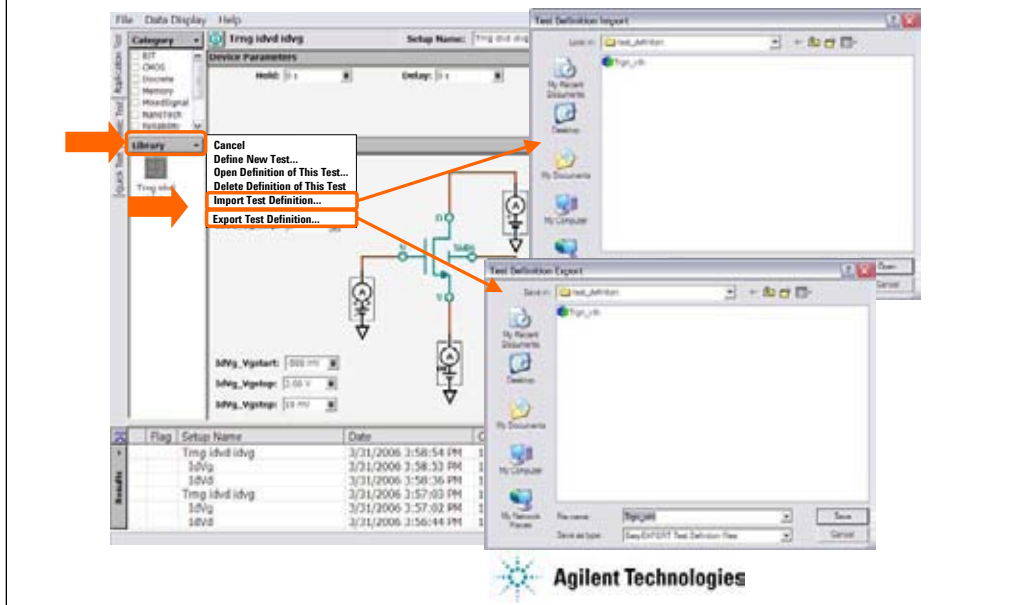
After you create your test definition, save the definition and close the Test Definition editor.

Select File/Close menu. Confirm Test Definition Save dialog box is opened. Click Yes to save your test definition and continue the close operation.

If the same file name exists, the Confirm Test Definition Overwrite dialog box is opened. Click OK to overwrite your test definition.

To Export/Import Test Definition

Click Library/Export Test Definition or Import Test Definition

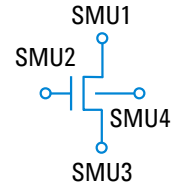


The test definition can be exported as the EasyEXPERT test definition file format or XML file format. And the file can be imported to the EasyEXPERT later.

Exercise 11

Define test definition and perform test.

1. Open test definition editor.
2. See setup examples and define your test definition.
3. Save the definition as Trng idvd idvg.
4. Connect device, and perform test.
5. Export your test definition, and import it.

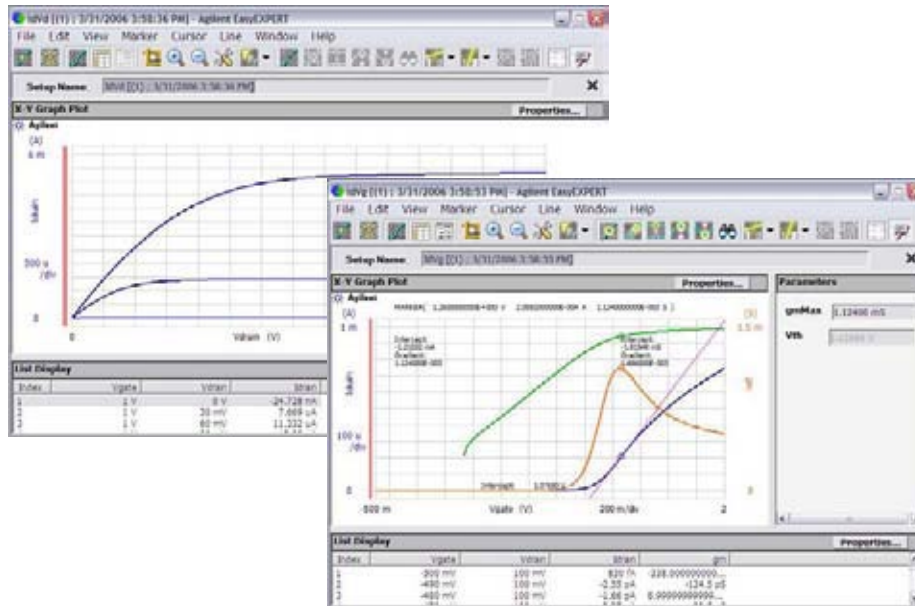


Time to complete: 10 minutes.



Note:

Measurement Result Example



This is a test result example displayed on the Data Display window.

If You Define Application Test Output

- **Defining Test Output**
 - Step 1. To define analysis parameters**
 - Step 2. To set display parameters**
- **Reading test setup internal parameters**
 - Case 1. To use External Variables Setup dialog box**
 - Case 2. To use built-in functions**

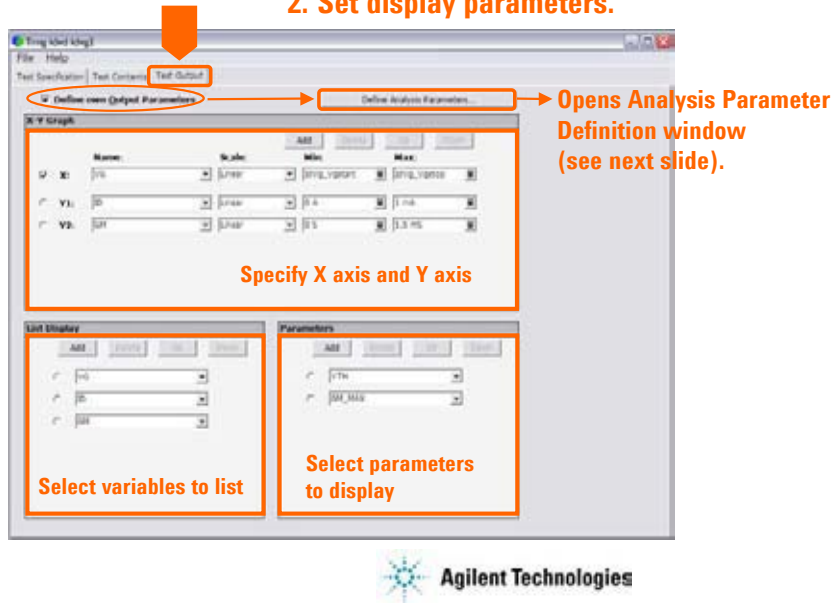


If you want to get the output of the application definition, define analysis parameters and set display parameters in the Test Output tab screen. See the following pages.

You can read the value of parameters/variables used in the Application Test setup or Classic Test setup defined in a test contents. To do so, use the External Variables Setup dialog box or built-in functions. The read values can be used for the calculation of test result and the display and record of calculation result.

Defining Test Output

1. Define analysis parameters.
2. Set display parameters.



The test output setup is optional. If you need the test result output (test result display and record) for this application test, declare the variables (analysis parameters) and define the display setup.

At first, declare the analysis parameters:

- Check the Define own Output Parameters box.
- Click the Define Analysis Parameters... button. The Analysis Parameter Definition window is opened.
- Declare the analysis parameters. See next slide.
- Click the Close button.
- Set the display parameters. See below.

The X-Y Graph area is used to set the X axis and Y axis of the X-Y Graph Plot area on the Data Display window.

- Name: Name of variable to plot on the X axis
- Scale: Linear or Log
- Min: Minimum value of the specified axis
- Max: Maximum value of the specified axis

The List Display area selects the variables to be listed on the List Display area of the Data Display window. Up to 20 variables can be set.

The Parameters area selects the variables to be listed on the Parameters area of the Data Display window. Up to 20 parameters can be set.

Step 1. To define analysis parameters

Define Analysis Parameters...



Name:	Unit:	Description
VG	V	Gate Voltage
ID	A	Drain Current
GM	S	Transconductance
GM_MAX	S	Maximum Transconductance

Name:	Unit:	Description
VTH	V	Threshold Voltage



Declare the analysis parameters as shown below:

At the Vector Parameters area or the Scalar Parameters area:

- Click the Add button.
- Enter the Name, Unit, and Description of the parameter.

For the sweep output/measurement data, use the vector parameter.

For the spot output/measurement data, use the scalar parameter.

For the data given by the $\max()$ and $\min()$ built-in function, use the vector parameter.

In this example, VG, ID, and GM are the vector parameter and VTH is the scalar parameter.

GM_MAX is the vector parameter because the $\max()$ built-in function is used to calculate this value.

Step 2. To set display parameters



This example sets:

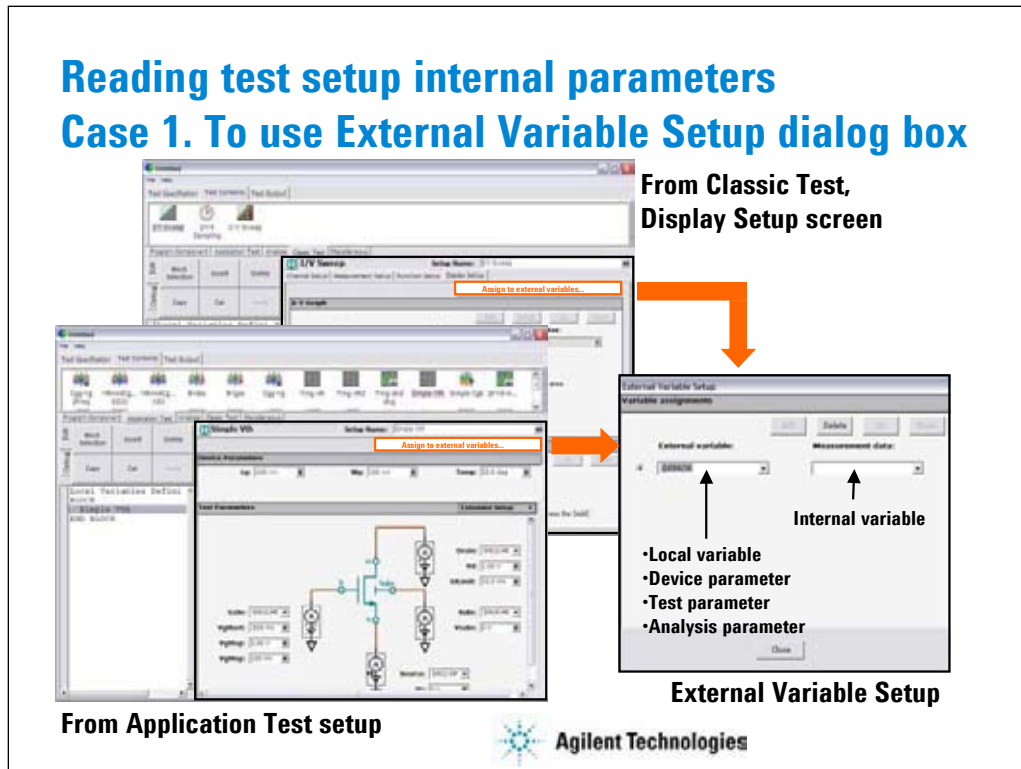
X-Y Graph: ID-VG plot for Y1-X graph and GM-VG plot for Y2-X graph

List Display: VG, ID, and GM

Parameters: GM_MAX and VTH

All parameters must be declared by using the Analysis Parameter Definition window shown in the previous slide or displayed on the last data display.

Reading test setup internal parameters Case 1. To use External Variable Setup dialog box



To read the value of variables used in an Application Test setup or a Classic Test setup, make a mapping table between the test setup internal variables and the external variables which mean the local variables, device parameters, test parameters, and analysis parameters defined in the test contents.

To open the External Variable Setup window from a classic test setup:

- Specify the classic test.
- Click the Display Setup tab.
- Click the Assign to external variables... button.

To open the External Variable Setup window from an application test setup:

- Specify the application test.
- Click the Assign to external variables... button.

Setup example

Assign to external variables...



The screenshot shows the 'External Variable Setup' dialog box with the 'Variable assignments' section. It contains two columns: 'External variable' and 'Measurement data'. The 'External variable' column has five entries: VTH, GM_MAX, VG, ID, and GM. The 'Measurement data' column has five entries: Vth, gmMax, Vgate, Idrain, and gm. Each entry is in a dropdown menu. Above the dropdowns are buttons for 'Add', 'Delete', 'Up', and 'Down'. A 'Close' button is at the bottom.

External variable	Measurement data
VTH	Vth
GM_MAX	gmMax
VG	Vgate
ID	Idrain
GM	gm

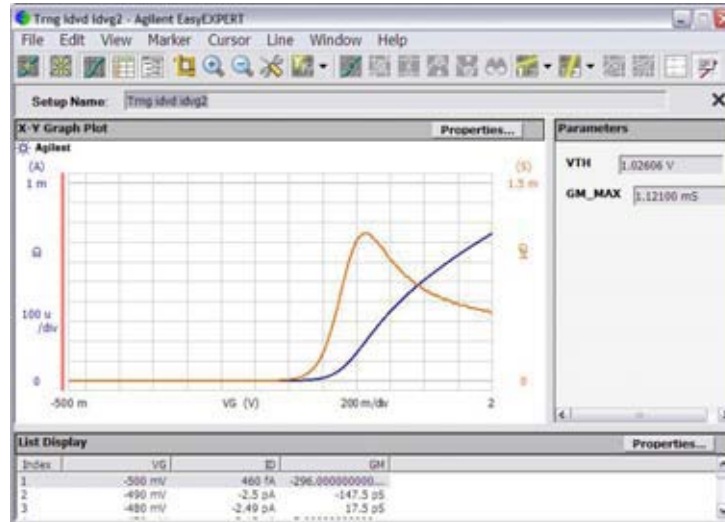


This example makes the mapping table between the test setup internal parameters and the analysis parameters.

- Define VTH, GM_MAX, VG, ID, and GM as the analysis parameters.
- Set these analysis parameters to the display parameters.
- Open the External Variable Setup dialog box.
- Match VTH with the internal parameter Vth.
- Match GM_MAX with the internal parameter gmMax.
- Match VG with the internal parameter Vgate.
- Match ID with the internal parameter Idrain.
- Match GM with the internal parameter gm.

Result example

Data Display window



This is a result example of the test output setup shown in the previous pages.

Reading test setup internal parameters Case 2. To use built-in functions

Local Variables Definition

BLOCK

IdVg ← Test setup

VG = getVectorData("Vg")

ID = getVectorData("Id")

GM = getVectorData("gm")

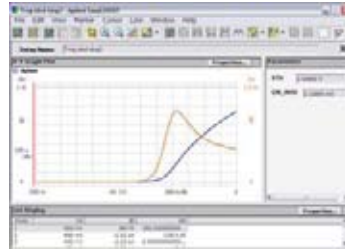
GM_MAX = getVectorData("gmMax")

VTH = getNumericData("Vth")

IdVd ← Test setup

END BLOCK

Display parameters of the last Data Display window



Vg, Id, gm, gmMax, and Vth
must be the display parameters
of IdVg.



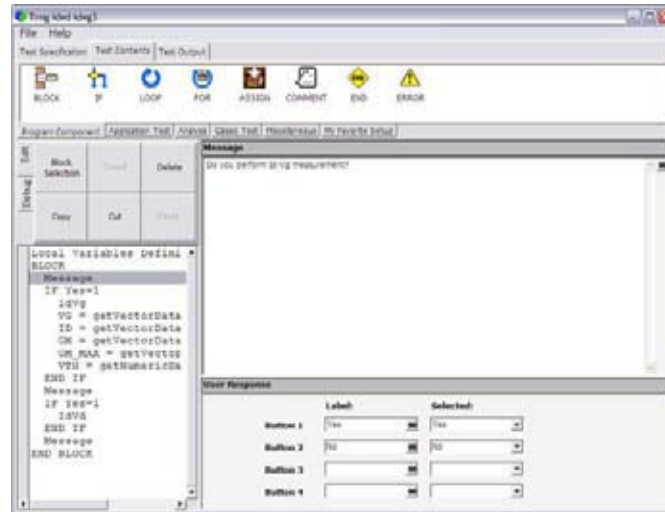
This example shows another way to read the value of the internal variables (Vg, Id, gm, gmMax, and Vth). In this example, you do not use the mapping table but use the getVectorData and getNumericData built-in functions. The functions can be used to read the value of parameters displayed on the last data display.

To read the value:

- Define VG, ID, GM, GM_MAX, and VTH as the analysis parameters.
- Set these analysis parameters to the display parameters.
- Insert the ASSIGN statements to add the formula shown above.

Setup example

Test Contents



This example sets the following test flow:

Local Variables Definition ! Defines Yes variable

BLOCK

Message ! Do you perform Id-Vg measurement?

IF Yes=1

IdVg ! Classic test setup for Id-Vg measurement

VG=getVectorData("Vg")

ID=getVectorData("Id")

GM=getVectorData("gm")

GM_MAX=getVectorData("gmMax")

VTH=getNumericData("Vth")

END IF

Message ! Do you perform Id-Vd measurement?

IF Yes=1

IdVd ! Classic test setup for Id-Vd measurement

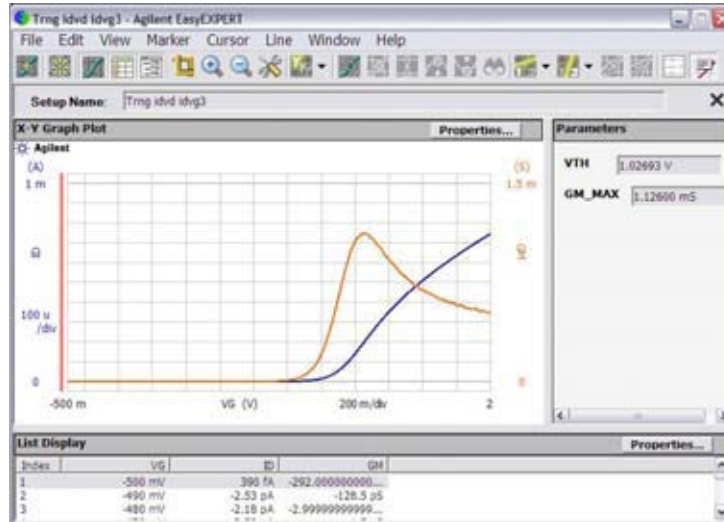
END IF

Message ! Click OK to display VTH and GM_MAX values and end the test

END BLOCK

Result example

Data Display window



This is a result example of the test output setup shown in the previous pages.

Module 7. Advanced Definitions and Operations



Agilent Technologies

In This Module

- **To Control External GPIB Devices**
- **To Call Execution Files**
- **To Perform Repeat Measurements**
- **Prober Control Script**



To Control External GPIB Devices

Miscellaneous: GPIB I/O

Write String	to send a string command to GPIB device
Write Value	to send a command to GPIB device
Read String	to read a string value from GPIB device
Read Value	to read a numeric value data from GPIB device
Read List	to read a vector data from GPIB device
Read STB	to read status byte of GPIB device
GP-IB Control	Group Execution Trigger
	Device Clear
	Go To Local
	Local LockOut



You can control external GPIB devices from the EasyEXPERT by using the GPIB I/O statement. The GPIB I/O statement provides the write/read functions shown above. Select a write function and enter the necessary parameters to send a command to the GPIB device. Select a read function and enter the necessary parameters to read response from the GPIB device. For details, see online help or User's Guide.

The followings are the GPIB Control functions.

- Group Execution Trigger: Sends a trigger to the specified GPIB device.
- Device Clear: Sends a device clear to the specified GPIB device.
- Go To Local: Returns the specified GPIB device to the local state.
- Local LockOut: Locks the specified GPIB device.

Note:

Before starting, enable System Controller. See Module 8. Also establish the GPIB connection with the external GPIB devices.

To Control External GPIB Devices

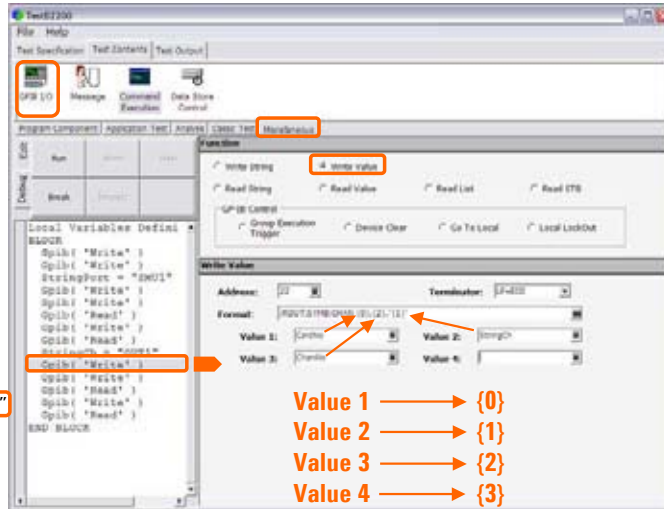
Agilent B2200 control example

To send command

Programming image:

```

*RST
:ROUT:FUNC ACON
(enter "SMU1" to StringPort)
:ROUT:SYMB:PORT {0},"{1}"
:ROUT:SYMB:PORT? {0}
(reads string data)
*OPC?
(reads operation complete flag)
(enter "OUT1" to StringCh)
:ROUT:SYMB:CHAN {0},{2},"{1}"
:ROUT:SYMB:CHAN? {0},{2}
(reads string data)
*OPC?
(reads operation complete flag)
    
```



This slide shows an example setup of the GPIB I/O statement. This is a component of the test contents used to control the Agilent B2200 switching matrix.

This example uses the Write Value function to send the following command to the B2200.

```
:ROUT:SYMB:CHAN {0},{2},"{1}"
```

where, {0} is CardNo, {1} is StringCh, and {2} is ChanNo.

The followings are the reference of the setup editor.

- Address: GPIB address of the device
- Terminator: EOI, LF, CR/LF, LF+EOI, CR/LF+EOI, or NONE (no terminator)
- Format: Command (header and parameters) sent to the device
- Value 1: Value for {0}
- Value 2: Value for {1}
- Value 3: Value for {2}
- Value 4: Value for {3}

{0}, {1}, {2}, and {3} are variable available in the Format field only.

Note:

Use double quotes to enter a string to a local variable by using the Assign statement.

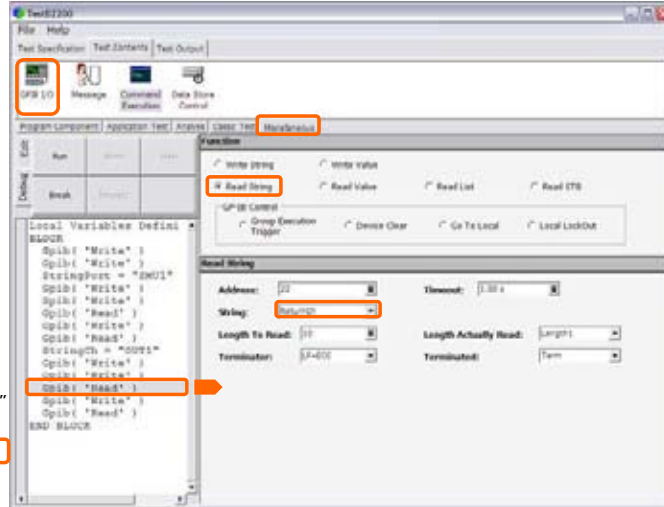
To Control External GPIB Devices

Agilent B2200 control example

To read data

Programming image:

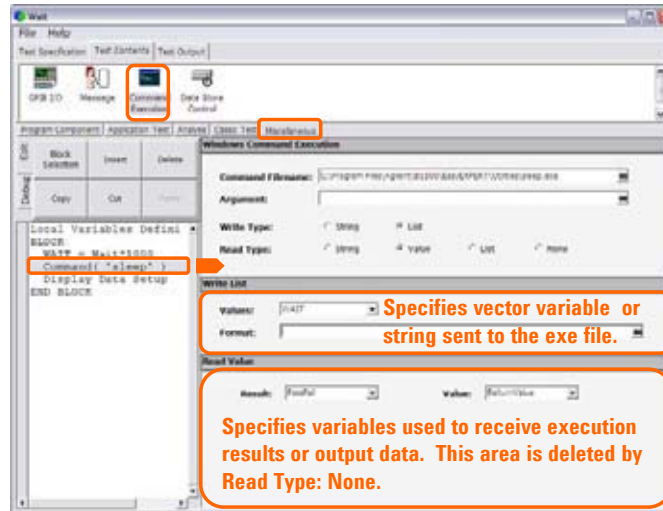
```
*RST  
:ROUT:FUNC ACON  
(enters "SMU1" to StringPort)  
:ROUT:SYMB:PORT {0},"{1}"  
(reads string data)  
:ROUT:SYMB:PORT? {0}  
(reads operation complete flag)  
*OPC?  
(enters "OUT1" to StringCh)  
:ROUT:SYMB:CHAN {0},{2},"{1}"  
:ROUT:SYMB:CHAN? {0},{2}  
(reads string data)  
*OPC?  
(reads operation complete flag)
```



This example uses the Read String function to read the response from the B2200. This example reads the :ROUT:SYMB:CHAN? query command response. The result (ReturnCh value) must be OUT1.

To Call Execution Files

Miscellaneous: Command Execution



You can call the execution file (EXE file) from the EasyEXPERT. Use the Command Execution statement and define the setup editor as shown in this example.

- Command Filename: Execution file name (command name)
- Argument: Command parameter or argument
- Write Type: String or List (vector data)
- Read Type: String, Value (numeric data), List (vector data), or None (no read data)

If you specify Write String, enter the string sent to the command.

If you specify Write List, enter the name of vector variable sent to the command, and specify the format of data element sent to the command. See next slide.

In the Read String/Value/List area, specify the variables used to receive execution result and output data. There is no entry field for Read Type: None.

- Result: Numeric variable name. Used to store the execution result.
- Value: Numeric variable name for Read Value, or vector variable name for Read List. Used to store the returned data.
- String: String variable name. Used to store the returned data.
- Length Actually Read: Numeric variable name. Used to store the byte length of the returned data.

The above example calls the sleep.exe file used to insert the wait time for program execution. The WAIT value must be defined in msec. After the normal command execution, the sleep.exe returns 1 for Value and 0 for Result. The sleep.exe file is stored in the following folder.

C:\Program Files\Agilent\B1500A\EasyEXPERT\Utilities

To set Format field

{I[,A][:F]}

- **I** List data index. Or index of element. Integer.
- **[,A]** Character length of the specified data element. Positive integer for right-aligned, or negative integer for left-aligned. Optional.
- **[:F]** Format identifier. C, D, E, F, G, N, P, R, or X. Lower case is available. Optional.

Example:

{0,5:E} First element, 5 characters, exponential notation.

{1:G} Second element, general.

{2,10} Third element, 10 characters, general.



The Format field is used to specify the data format of List (vector variable). The strings shown in the above example can be defined in the Format field.

In the strings, the list data index is mandatory. The character length and format identifier are omissible. Then the length is not limited, and the format G is set.

C or c: Circulation

D or d: Decimal numeral

E or e: Exponential notation

F or f: Fixed point

G or g: General

N or n: Numeric

P or p: Percent

R or r: Round trip

X or x: Hexadecimal numeral

For the format, see online help or manual of the Agilent T&M Programmers Toolkit.

Exercise 12

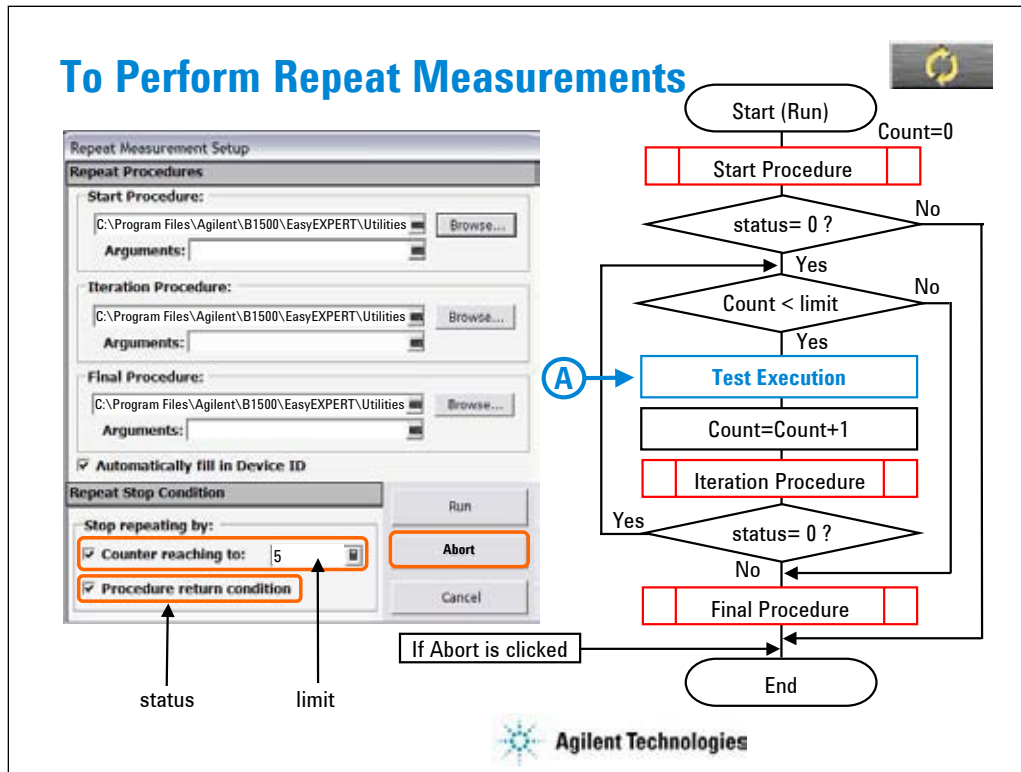
Try to improve your test definition as you want.

- **To Use Built-in Functions**
- **To Use Read Out Functions**
- **To Control External GPIB Devices**
- **To Call Execution Files**



Note:

To Perform Repeat Measurements



Repeat measurement is performed as shown in this flowchart. The status is a response returned by the start/iteration procedure. The Count is the accumulated number of test executions. They are the stop condition of the repeat measurement.

The repeat measurement stop function is enabled by the following check boxes.

- Counter reaching to
- Procedure return condition

If the first box is checked and the limit value is specified, the repeat measurement will be stopped if $\text{Count} \geq \text{limit}$. To perform the repeat measurement, set the limit value more than the number of devices under test or remove check from this box.

If the second box is checked, the repeat measurement will be stopped if status is not 0.

When the second box is checked, the device ID automatic setup function is available and is enabled/disabled by using the following check box. The function enters the device_id value to the Device ID of the test result record. The device_id is a response returned by the start/iteration/subsite procedure.

- Automatically fill in Device ID

The Repeat Measurement Setup dialog box provides the following action buttons.

- Run: Starts repeat measurement.
- Abort: Stops repeat measurement immediately.
- Cancel: Closes the Repeat Measurement Setup dialog box.

Start/Iteration/Final Procedure:

Enter the full path name of the procedure. For example, enter as follows.

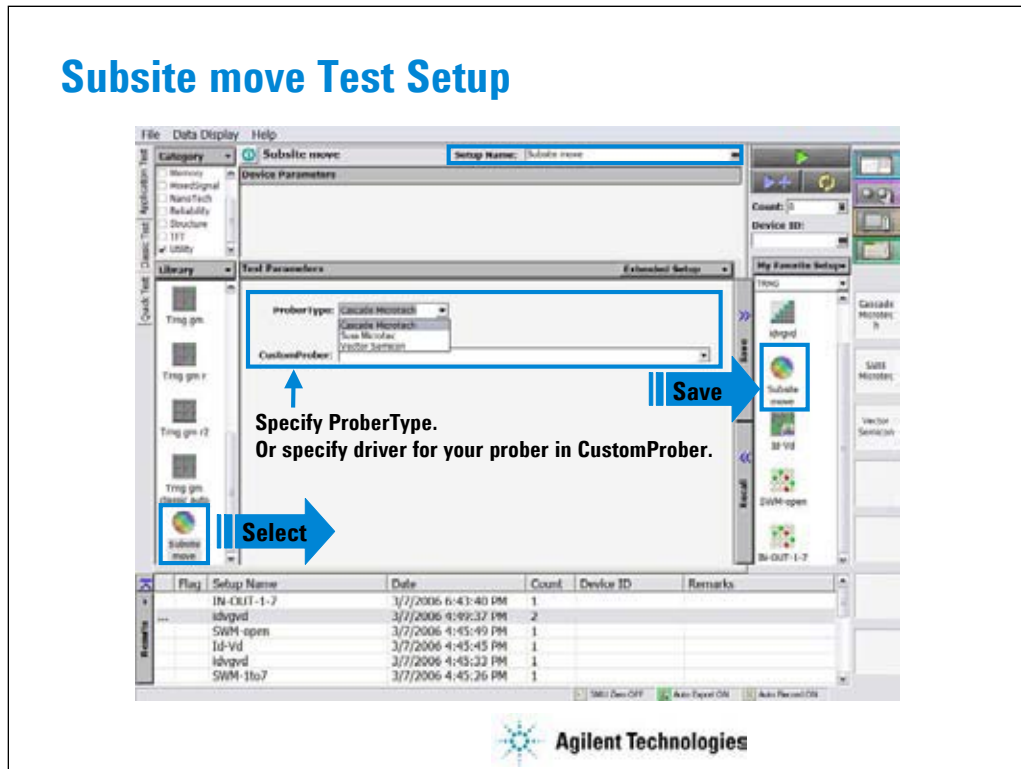
C:\Program Files\Agilent\B1500\EasyEXPERT\Utilities\ProberControl\suss\Start_suss.exe

Arguments:

Enter the options of the procedure. See the following pages describing about procedures. For example, enter `-a GPIB0::5::INSTR -l C:\temp\prb.log`.

If you use the sub die move operation (subsite procedure), the flowchart must be changed. See page 7-18.

Subsite move Test Setup



If you do not use the sub die (subsite) move operation, skip this page.

Click Application Test tab and open the Subsite move test setup in the Utility category. On the Subsite move setup screen, specify ProberType (Cascade, Suss, or Vector) or driver for your prober in CustomerProber, and save it as a setup in your preset group (My Favorite Setup). Then you can use the setup for your quick test. See next page.

The Subsite move setup moves wafer chuck to the next subsite, reads device ID from the prober, and sets it to the Device ID of the test result record.

For more details of the test setup, open the Test Definition window.

In the Subsite move test definition, an execution file callProbeDvr.exe is used. This file is used to send Subsite_XXXX.exe to the prober specified by the prober_info.ini file and receive the response; status and device_id. The callProberDvr.exe has the following input/output parameters.

Input: Full path of Subsite_XXXX.exe

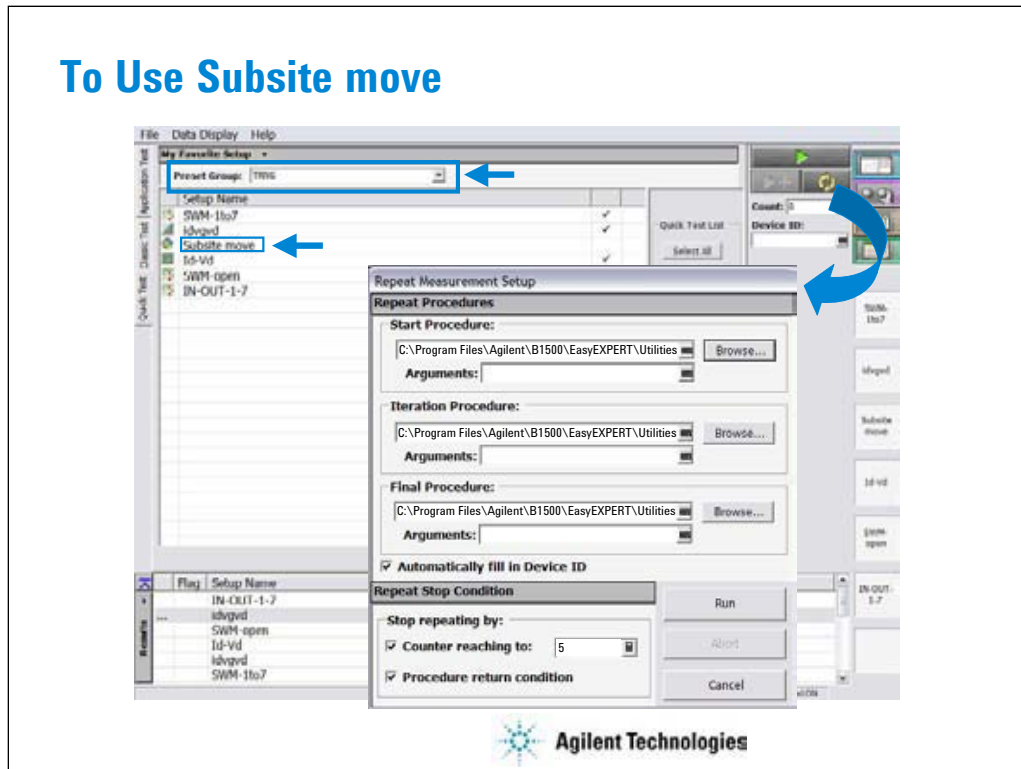
Output: status; 0 (no error) or 1 (error)

Output: device_id

Note:

The callProberDvr.exe refers to the prober_info.ini file for the GPIB address and log file name. Do not set the Arguments of Subsite_XXXX.exe.

To Use Subsite move



If you do not use the sub die (subsite) move operation, skip this page.

To perform the test with the sub die move operation, do as follows.

1. Add the Subsite move test setup to your preset group (My Favorite setup).
2. Set your preset group and test setups in the Quick Test tab screen.
3. Open the Repeat Measurement Setup dialog box.
4. Specify the procedures and the repeat measurement condition.
5. Start repeat measurement.

The Subsite move setup must be entered after measurements for a sub die.

Prober Control Script

- **Prober information file**
prober_info.ini
- **Start Procedure**
Start_XXXX.exe
- **Iteration Procedure**
Iterator_XXXX.exe
- **Final Procedure**
Final_XXXX.exe
- **Subsite Procedure**
Subsite_XXXX.exe

- XXXX:**
- **cascade**
 - **suss**
 - **vector**

Use prober control script in EasyEXPERT
Repeat Measurement Setup window



Prober control script is sample program used for semi-automatic prober control. The Agilent EasyEXPERT can call the script by using the Repeat Measurement Setup window.

See page 7-9 to call the script and perform repeat measurement.

See page 7-14 for the prober information file.

See page 7-13 for the start procedure.

See page 7-15 for the iteration procedure.

See page 7-16 for the final procedure.

See page 7-17 for the subsite procedure.

To use the prober control script, specify the start/iteration/final procedure in the Repeat Measurement Setup dialog box (see page 7-9). And use the Subsite move test setup in your quick test to control sub die move. The Subsite move setup uses the subsite procedure for moving wafer chuck to the next subsite. See page 7-10 and 7-11.

Start_xxxx.exe

- **Arguments:** -a GPIB_address
-l log_file_name

Example:
-a GPIB0::5::INSTR -l C:\temp\prb.log

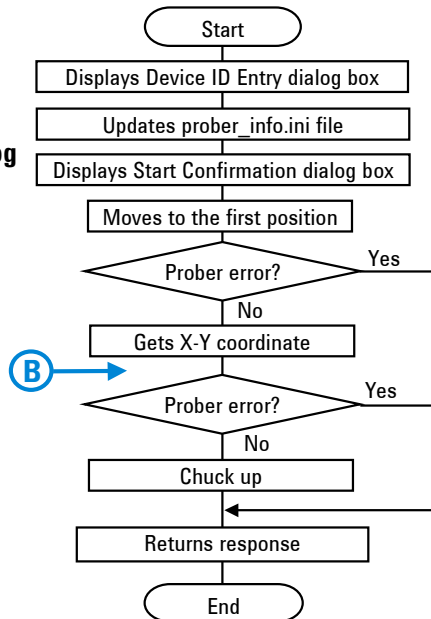
- **Response:** XML format data

```
<Response>
  <Break>status</Break>
  <Target>device_id</Target>
</Response>
```

status: 0 (no error) or 1
device_id: prefix:coordinate

Example:

```
<Response>
  <Break>0</Break>
  <Target>waf1a:3 1</Target>
</Response>
```



To specify the start procedure in the Repeat Measurement Setup dialog box, enter the full path name of Start_xxxx.exe into the Start Procedure field.

After the repeat measurement is started, this procedure displays the Device ID Entry dialog box and waits for your input. On the dialog box, enter a string used for the prefix of device_id. After that, you will see the Start Confirmation dialog box that is used to confirm your wafer setup status. Load wafer and perform wafer alignment, then click OK on the dialog box. The procedure moves wafer chuck to the first probing position, checks the prober status, gets the X-Y coordinate of the probing position, and sets the wafer chuck to the UP position. At last, the procedure returns the response.

The status is 0 or 1. It is used for the EasyEXPERT repeat measurement stop function. When the Procedure return condition box is checked in the Repeat Measurement Setup dialog box, the repeat measurement will be stopped if status is not 0.

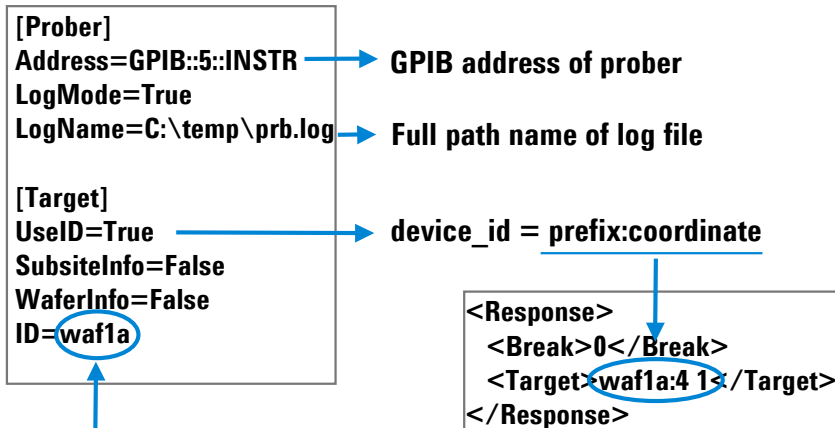
The device_id is a string for the Device ID of the test result record. When the Automatically fill in Device ID box is checked in the Repeat Measurement Setup dialog box, the device_id will be entered to the Device ID of the test result record.

If you use the subsite procedure, the flowchart must be changed. See page 7-18.

Note:

To ignore the Arguments, set the GPIB address and log file name in the prober_info.ini.

Prober_info.ini



Prefix you enter in the Device ID Entry dialog box.
ID is automatically recorded in the prober_info.ini file.
The Device ID Entry dialog box is opened by Start_xxxx.exe.



The prober information file is necessary to execute the prober control script. Before starting tests, open this file, edit it as you want, and overwrite it. The name must be prober_info.ini.

The prober_info.ini file stores the information shown below.

- Address: GPIB address of prober
- LogMode: Log file creation mode; True or False
- LogName: Log file name (full path)
- UseID: Device ID creation mode; True or False
- SubsiteInfo: Set always False. This is just a place holder.
- WaferInfo: Set always False. This is just a place holder.
- ID: Ignore this variable. This is just a pass parameter.

If the procedures specify the `-a` option, the Address value is not used.

If the procedures specify the `-l` option, the LogName value is not used.

To create a log file, set LogMode=True.

To use the prefix:coordinate format for the device_id value, set UseID=True. If UseID=False, the device_id value will be coordinate, not prefix:coordinate. The prefix will be the value entered in the Device ID Entry dialog box that is opened by Start_xxxx.exe. This function is available when the Automatically fill in Device ID check box is checked.

Iterator_xxxx.exe

- Arguments: -a GPIB_address
-l log_file_name

Example:
-a GPIB0::5::INSTR -l C:\temp\prb.log

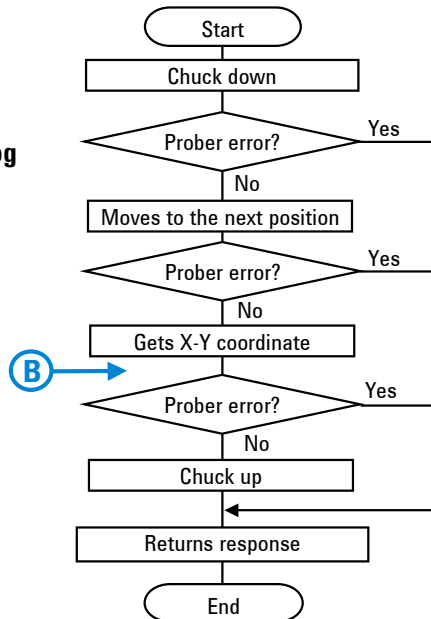
- Response: XML format data

```
<Response>
  <Break>status</Break>
  <Target>device_id</Target>
</Response>
```

status: 0 (no error) or 1
device_id: prefix:coordinate

Example:

```
<Response>
  <Break>0</Break>
  <Target>waf1a:4 1</Target>
</Response>
```



To specify the iteration procedure in the Repeat Measurement Setup dialog box, enter the full path name of Iterator_xxxx.exe into the Iteration Procedure field.

The procedure is called after the measurement is completed for a die. This procedure sets wafer chuck to the DOWN position, moves it to the next probing position, checks the prober status, gets the X-Y coordinate of the probing position, and sets the wafer chuck to the UP position. At last, the procedure returns the response.

The status is 0 or 1. It is used for the EasyEXPERT repeat measurement stop function. When the Procedure return condition box is checked in the Repeat Measurement Setup dialog box, the repeat measurement will be stopped if status is not 0.

The device_id is a string for the Device ID of the test result record. When the Automatically fill in Device ID box is checked in the Repeat Measurement Setup dialog box, the device_id will be entered to the Device ID of the test result record.

If you use the subsite procedure, the flowchart must be changed. See page 7-18.

Note:

To ignore the Arguments, set the GPIB address and log file name in the prober_info.ini.

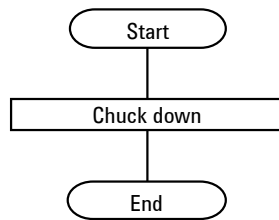
Final_xxxx.exe

- Arguments: -a GPIB_address
-l log_file_name

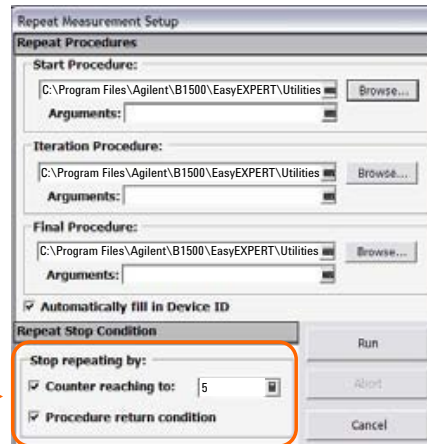
Example:

-a GPIB0::5::INSTR -l C:\temp\prb.log

- Response: none



Stop condition →



To specify the final procedure on the Repeat Measurement Setup dialog box, enter the full path name of Final_xxxx.exe into the Final Procedure field.

The procedure is called after one of the stop condition is detected. This procedure sets wafer chuck to the DOWN position.

Note:

To ignore the Arguments, set the GPIB address and log file name in the prober_info.ini.

Subsite_xxxx.exe

- Arguments: -a GPIB_address
-l log_file_name

Example:
-a GPIB0::5::INSTR -l C:\temp\prb.log

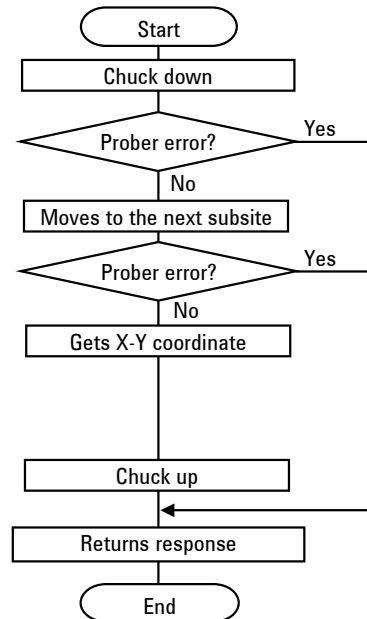
- Response: XML format data

```
<Response>
  <Break>status</Break>
  <Target>device_id</Target>
</Response>
```

status: 0 (no error) or 1
device_id: prefix:coordinate

Example:

```
<Response>
  <Break>0</Break>
  <Target>waf1a:3 1</Target>
</Response>
```



To realize sub die move operation, you need to define Subsite_xxxx.exe in your test definition and create your application test setup. However, you do not need to take care of this procedure by using the Subsite move test setup included in the application library. The Subsite move setup moves wafer chuck to the next subsite, reads device ID from the prober, and sets it to the Device ID of the test result record.

Open the Subsite move test setup and save it as a setup in your preset group (My Favorite Setup). Then you can use the setup for your quick test.

Note:

To use the Subsite move setup, set the GPIB address and log file name in the prober_info.ini. And ignore the Arguments for Subsite_xxxx.exe.

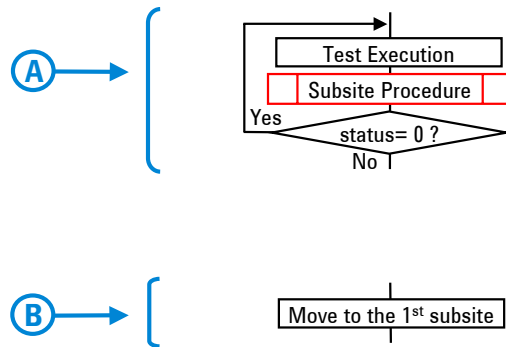
Note:

If you use a Suss prober, the number of Subsite move setups used in your quick test (die test) is important. It must be N-1; N is the number of subsites defined in the prober.

The status is 0 or 1. It is used for the EasyEXPERT repeat measurement stop function. When the Procedure return condition box is checked in the Repeat Measurement Setup dialog box, the repeat measurement will be stopped if status is not 0.

The device_id is a string for the Device ID of the test result record.

To Change Execution Flow



If you use the subsite procedure, change the flowchart as follows.
On the page 7-9, replace the box A with the block A shown above.
On the page 7-13 and 7-15, insert the box B shown above to the position B of the flowchart.

Module 8. Miscellaneous Operations



Agilent Technologies

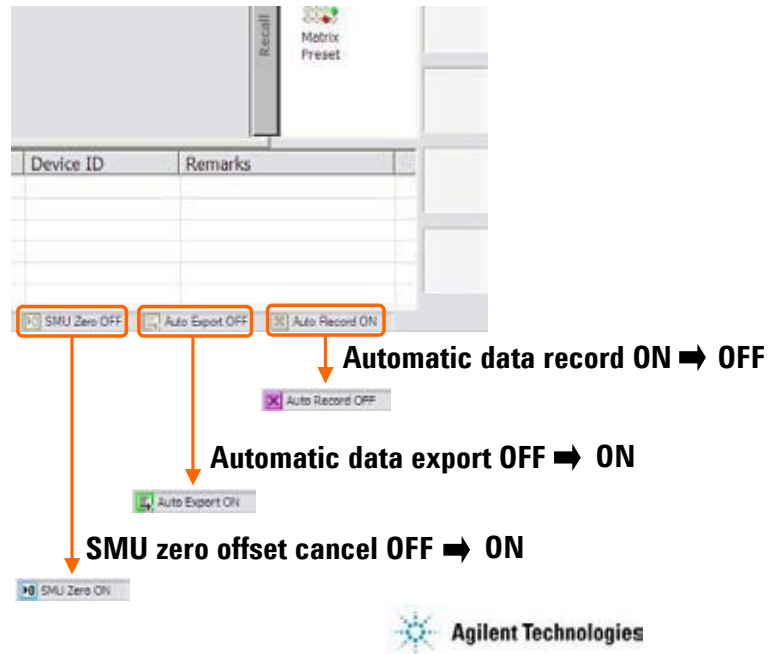
In This Module

- **Function Status Indicator**
- **Automatic Data Export and Data Record**
- **Calibration**
- **Configuration**
- **XSLT Samples**
- **To Enable System Controller**
- **To Start Desktop EasyEXPERT**
- **To Use Setup File Converter**



This module describes the above topics. You will understand what is the status indicator, what is the automatic data export function and the automatic data record function, how to perform selftest and calibration, how to perform SMU zero offset cancel, and so on.

Function Status Indicator



Status indicator lets you know the status OFF or ON of the following functions. The indicators are placed at the bottom of the main screen.

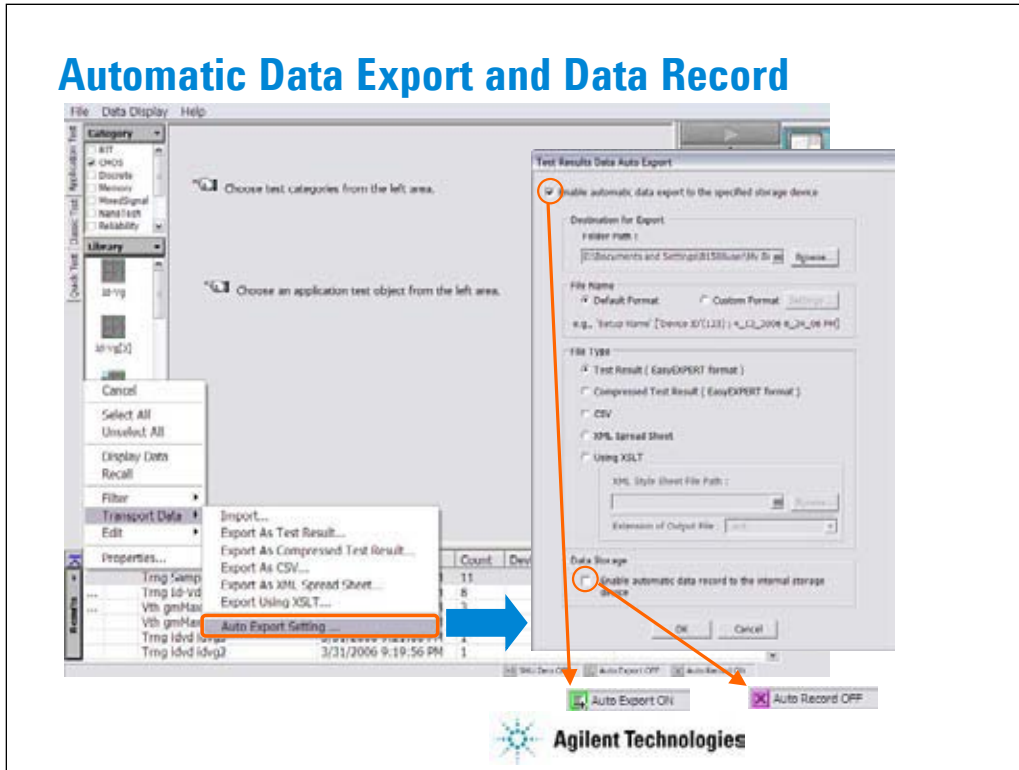
SMU Zero OFF/ON: Shows the status of the SMU zero offset cancel function OFF or ON.

Auto EXPORT OFF/ON: Shows the status of the automatic data export function OFF or ON.

Auto Record ON/OFF: Shows the status of the automatic data record ON or OFF.

The functions can be set to ON or OFF as shown in the following pages.

Automatic Data Export and Data Record



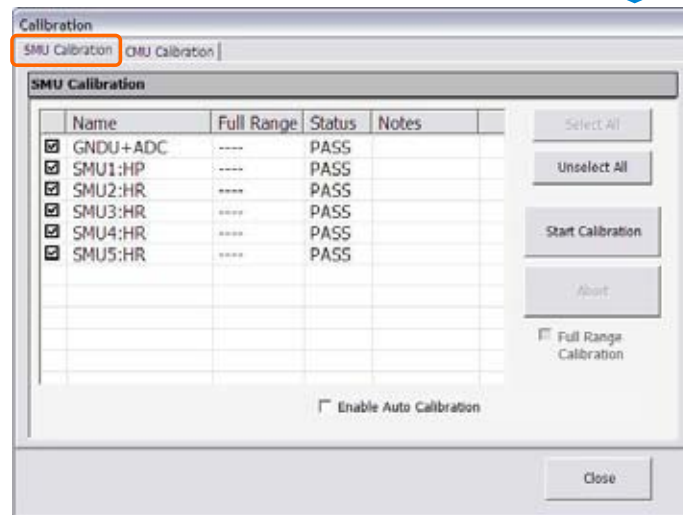
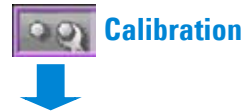
The automatic data export function and the automatic data record function can be enabled or disabled by using the Test Results Data Auto Export dialog box. This dialog box is displayed by selecting the Results > Transport Data > Auto Export Setting... menu.

The automatic data export function is used to export the test result data to the storage device you specify. You can specify the destination (storage device), exported file name, and file type. To set the automatic data export function to ON, check the Enable automatic data export to the specified storage device check box.

The automatic data record function is used to save the test result data to the internal HDD automatically. This function can be disabled (set to OFF) if the automatic data export function is enabled (set to ON). To set the automatic data record function to OFF, uncheck the Enable automatic data record to the internal storage device check box.

For more information, see online help or User's Guide.

SMU Calibration



The Calibration window is opened by clicking the Calibration button. The SMU calibration screen of this window is used to perform the calibration of SMUs. The list area of this screen lists Name, Full Range, and Status.

Name: Name of module. To select, check the left check box.

Full Range: For the high resolution SMU (HRSMU) connected to the atto sense/switch unit (ASU). Full range calibration on or off.

Status: Calibration status. Pass or fail.

Notes: Error information when calibration failed.

To perform the self-calibration, specify the modules, open the measurement terminals of the corresponding modules, and click the Start Calibration button.

Full Range Calibration:

For the HRSMU connected to the ASU. Enables or disables the full range calibration. If this box has been unchecked, the B1500 does not use the 1 pA range.

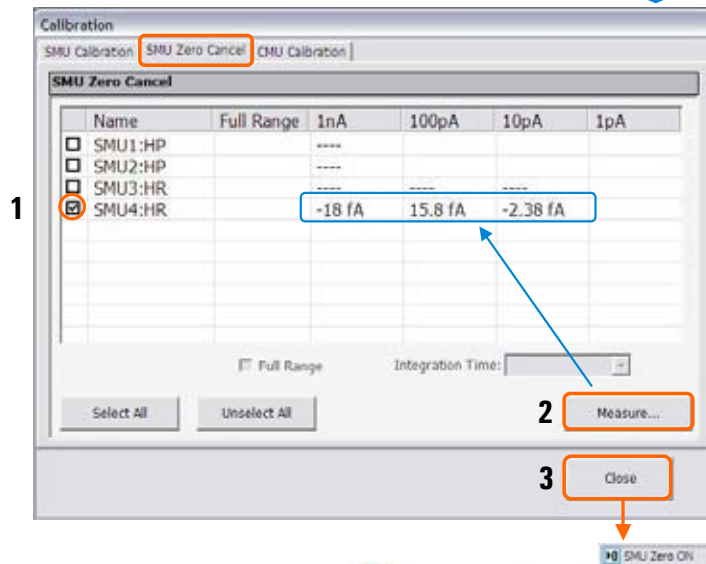
Enable Auto Calibration:

Enables or disables the auto-calibration capability. If this box has been checked (function ON), and the B1500 automatically starts calibration for all modules every 30 minutes if the output switches of all modules are off for 30 minutes.

NOTE:

To perform calibration correctly, open the measurement terminals. If auto-calibration is enabled, do not forget to open the measurement terminals or disconnect the device under test from the terminals after measurement.

SMU Zero Cancel



1

2

3



The SMU Zero Cancel screen is used to perform the SMU zero offset current measurement and set the SMU zero offset cancel function.

This function subtracts the offset current from the current measurement raw data, and returns the result as the measurement data. This function is used to compensate the error factor (offset current) caused by the measurement path such as the measurement cables, manipulators, or probe card.

To enable this function, perform the following procedure.

1. Check the left box of the Name column to specify the module to enable this function.
2. Click the Measure... button to perform the zero offset current measurement and wait until the measurement is completed. The measurement data will be displayed in the appropriate cell.
3. Click the Close button to enable the zero offset cancel function.

To disable the function, uncheck the left box of the Name column, and click the Close button.

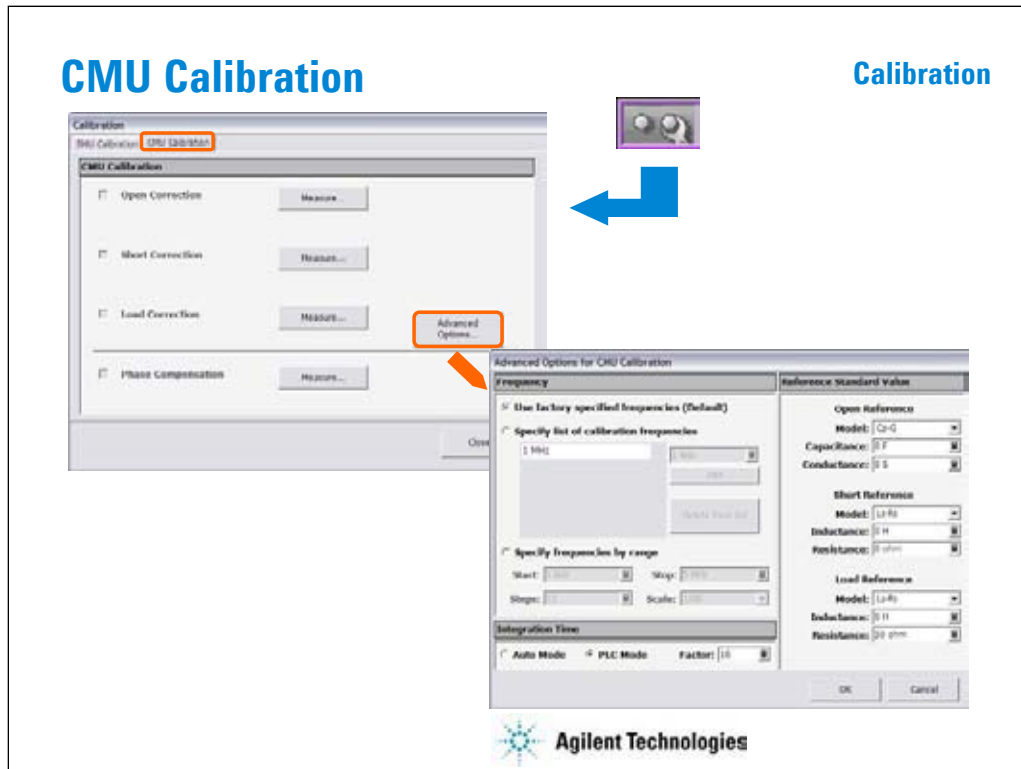
Note:

The offset cancel is not available for measurement over 100 nA range. For 10 nA range measurement, the offset cancel is performed by using the 1 nA range offset value. For measurement by a range less than 10 nA, the offset value measured by each range is used.

For more information, see online help or User's Guide.

CMU Calibration

Calibration



The CMU Calibration screen is used to perform the measurement data correction of the multi frequency capacitance measurement unit (MFCMU). For the easy way, perform the phase compensation and the open correction at least. The check boxes left of the Open/Short/Load Correction and the Phase Compensation are effective after the corresponding measurement is performed.

Measure...: Opens a dialog box used to perform correction/compensation data measurement. To perform the measurement, follow the dialog box.

Advanced Options...: Opens the "Advanced Options for CMU Calibration" dialog box used to set the frequencies for the correction data measurement and the reference values of the working standard. See the next page.

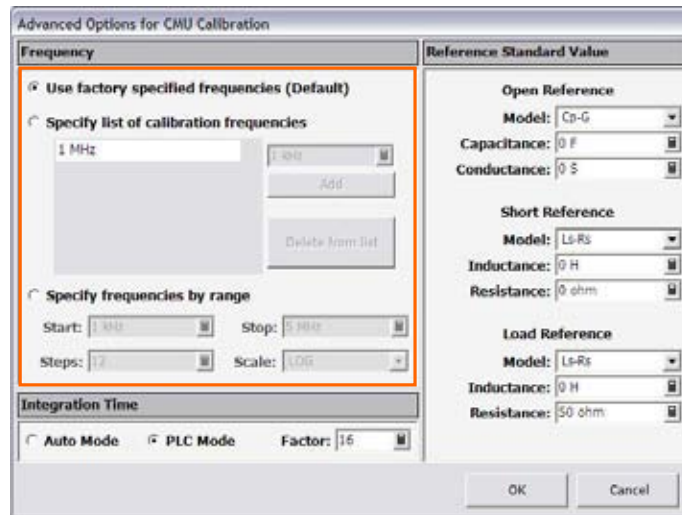
To perform the open correction and the phase compensation, open the measurement terminals.

To perform the short correction, connect the measurement terminals together.

To perform the load correction, connect your load standard between the high terminal and the low terminal.

Advanced Options for CMU Calibration

Calibration



This dialog box is opened by clicking the Advanced Options... button, and is used to set the information required to measure the open/short/load correction data and the phase compensation data. This dialog box provides the following action button.

OK: Applies the setup changes and closes this dialog box.

Cancel: Cancel the setup changes and closes this dialog box.

Frequency: You can select the measurement frequency setup mode from the following modes.

Measurement frequency setup modes:

Default (Use factory specified frequencies): Usually, select this mode. Twelve points are automatically set. They are 1 k, 2k, 5 k, 10 k, 20 k, 50 k, 100 k, 200 k, 500 k, 1 M, 2 M, and 5 MHz.

Specifies by list: Select this mode when you want to set the frequencies independently. The frequency must be 1 kHz to 5 MHz. The number of frequencies must be 1 to 101. Click Add to open a dialog box, and enter the value. For the unnecessary value, highlight the value and click Delete.

Specifies by range: Select this mode when you want to set the frequencies sequentially and automatically. Specify the start frequency, the stop frequency, the number of steps, and the scale LINEAR/LOG. The start frequency must be less than the Stop value and at least 1 kHz. The stop frequency must be more than the Start value and no more than 5 MHz. The number of steps must be 2 to 1001.

NOTE:

If the device measurement frequency is not equal to the correction data measurement frequency, calculation will be performed automatically to get the correction data for the device measurement frequency, and the calculated correction data will be used for the data correction of the measurement data.

Advanced Options for CMU Calibration

Calibration

Advanced Options for CMU Calibration

Frequency

Use factory specified frequencies (Default)

Specify list of calibration frequencies

1 MHz

Add

Delete from list

Specify frequencies by range

Start: Stop:

Steps: Scale: LOG

Integration Time

Auto Mode PLC Mode Factor:

Reference Standard Value

Open Reference

Model: Cp-G

Capacitance: F

Conductance: S

Short Reference

Model: Ls-Rs

Inductance: H

Resistance: ohm

Load Reference

Model: Ls-Rs

Inductance: H

Resistance: ohm

OK Cancel



Integration Time area defines the integration time used for measuring phase compensation data or open/short/load correction data. The number of averaging samples (Mode=AUTO) or the averaging time (Mode=PLC) is set.

Mode: A/D converter operation mode, AUTO or PLC.

Factor: Factor for the initial value. For details, see online help or user's guide.

Advanced Options for CMU Calibration

Calibration

Advanced Options for CMU Calibration

Frequency

Use factory specified frequencies (Default)

Specify list of calibration frequencies

1 MHz

Add

Delete from list

Specify frequencies by range

Start: Stop:

Steps: Scale: LOG

Integration Time

Auto Mode PLC Mode Factor: 16

Reference Standard Value

Open Reference

Model: Cp-G

Capacitance: 0 F

Conductance: 0 S

Short Reference

Model: Ls-Rs

Inductance: 0 H

Resistance: 0 ohm

Load Reference

Model: Ls-Rs

Inductance: 0 H

Resistance: 50 ohm

OK Cancel



Reference Standard Values area provides the following entry fields used to set the reference values of the open/short/load standard. If you use the standard, enter the reference values to the entry fields.

OPEN Reference: Capacitance and Conductance. If you do not use the reference, enter 0 in the both fields.

SHORT Reference: Inductance and Resistance. If you do not use the reference, enter 0 in the both fields.

LOAD Reference: Inductance and Resistance

Main Frame



Configuration

Man Frame | Modules | Switching Matrix | Event Log

System Information

Model Identification: B1500A Line Frequency: 50Hz

EasyEXPERT Rev.: A.02.00.2006.0411 Firmware Rev.: A.02.00.2006.0412

Main Frame Diagnosis

Item	Status	
<input checked="" type="checkbox"/> Trigger I/O	----	
<input checked="" type="checkbox"/> Digital I/O	----	
<input checked="" type="checkbox"/> Touch Panel Switch	----	
<input checked="" type="checkbox"/> LCD	----	
<input checked="" type="checkbox"/> High Voltage LED	----	
<input checked="" type="checkbox"/> Measurement LED	----	
<input checked="" type="checkbox"/> Front Key	----	

Select All

Unselect All

Start Diagnosis

Close



The Configuration window is opened by clicking the Configuration button, and is used to display the system information and event log, as well as to perform diagnostics and self-test.

The Main Frame screen is used to display the system information and perform diagnostics.

Model Identification: Displays the instrument ID. B1500A.

Line Frequency: Sets the power line frequency, 50 Hz or 60 Hz.

EasyEXPERT Rev.: Displays the revision number of the EasyEXPERT.

Firmware Rev.: Displays the revision number of the B1500 firmware.

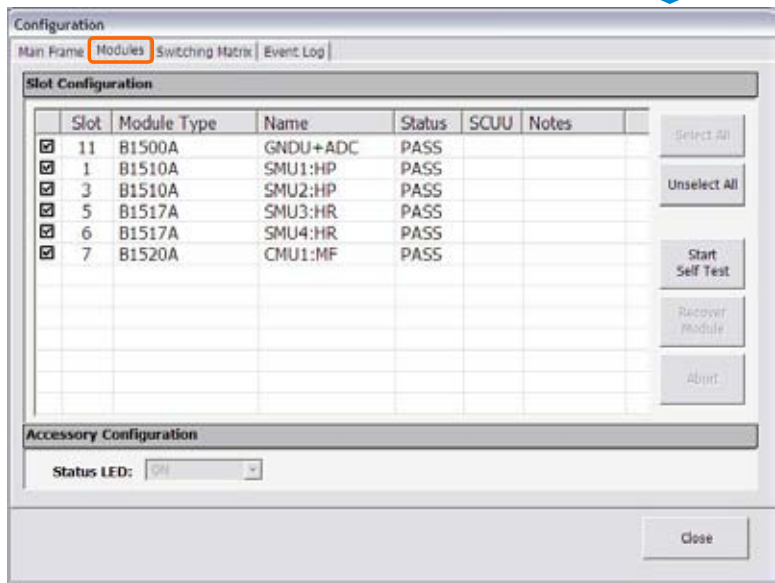
Main Frame Diagnosis: This area lists Item and Status.

Item: Name of diagnostics item. To select, check the left check box.

Status: Diagnostics status. Pass or fail.

To perform diagnostics, specify the items to perform and click the Start Diagnosis button. A dialog box is opened. Follow the dialog box to perform the diagnostics. Some items need your judgement, pass or fail. Also you will need to connect an adapter, press keys, check LEDs, and so on.

Modules



The Modules screen is used to perform self-test of modules.

Slot: Slot number where the module is installed. To select, check the left check box.

Module Type: Module model number

Name: Module name

Status: Self-test status, Passed, Failed, Recovered, or ---- (self-test has not been performed)

SCUU: Specifies if the module is connected to the SCUU.

Notes: Error information when the module self-test failed.

To perform self-test, specify the modules, open the measurement terminals of the corresponding modules, and click the Start Self Test button.

Recover Module button is for the service use only. This button makes the failed modules respond again. This button does not solve the problem that causes the Failed status.

Status LED: Enables (ON) or disables (OFF) the status indicator (LED) of the ASU (Atto Sense and Switch Unit) and the SCUU (SMU CMU Unify Unit).

Switching Matrix

A screenshot of the Agilent Configuration software window. The window has a title bar 'Configuration' and a menu bar with 'Main Frame', 'Modules', 'Switching Matrix', and 'Event Log'. The 'Switching Matrix' tab is selected. Below the menu bar is a 'General Information' section with a text field for 'Switching Matrix Type' containing 'B2200A Femto Leakage Switch MainFrame', a 'GIPIB Address' dropdown set to '22', a 'Poll' button, and a 'Start Self Test' button. Below this is a 'B2200A/B2201A Input Port Configuration' section with a dropdown for 'Extended Configuration'. It contains two columns of input fields: SWM IN1 through SWM IN14. SWM IN1, 3, 5, 7, and 9 have dropdown menus with values like 'SMU1:HP', 'SMU2:HP', 'SMU3:HR', 'SMU4:HR', and 'CMU1:MF' respectively. SWM IN2, 4, 6, 8, 10, 11, 12, and 14 are empty. There are 'Kelvin' checkboxes next to SWM IN1, 3, 5, 7, and 9, and a 'CMU' checkbox next to SWM IN13. A 'Close' button is at the bottom right.

The Switching Matrix screen is used to establish the GPIB connection with Agilent B2200A/B2201A switching matrix and define the B2200A/B2201A input port connections.

Switching Matrix Type: Displays the type of the switching matrix. B2200A Femto Leakage Switch Mainframe, B2201A 14ch Low Leakage Switch Mainframe, or No Switching Matrix.

GPIB Address: Specifies the GPIB address of the B2200A/B2201A. 1 to 30.

Poll: Confirms if the B2200A/B2201A with the specified GPIB Address is connected to the B1500A.

Start Self Test: This button starts the B2200A/B2201A selftest.

SWM IN: SWM IN1 to SWM IN14 mean the B2200A/B2201A input ports 1 to 14 respectively. Enter the label used to specify the input port to the right entry field. The port name and the connected module name can be the label. : (colon) cannot be used.

If the Kelvin check box is checked, the coupled even number port is grayed out.

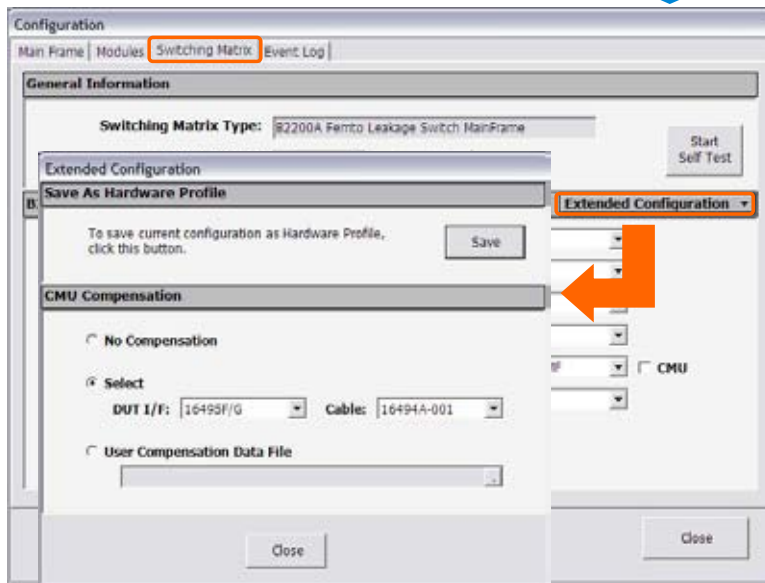
If the CMU check box is checked, the SWM IN14 is grayed out.

Kelvin: Check this box if this port is used for the Kelvin connection.

CMU: To perform capacitance measurement, check this check box and set SWM IN13 to CMU1:MF. And connect MFCMU to B2200A/B2201A Input 13 and 14. To perform capacitance compensation, see User's Guide.

Extended Configuration: This button opens the Extended Configuration dialog box.

Extended Configuration



This dialog box is opened by clicking the Extended Configuration button in the Configuration window Switching Matrix screen.

Save as Hardware Profile is used to save the hardware profile that is the B2200A/B2201A hardware configuration and the measurement module connection. Click the Save button to save the present hardware profile. The hardware profile can be made for each workspace individually.

CMU Compensation is used to select the compensation mode of the capacitance measurement using the B2200A/B2201A. Click one of the radio buttons, No Compensation, Select, and User Compensation. For the capacitance compensation, see User's Guide.

- **No Compensation:**

Select this radio button if you do not need the capacitance compensation. The raw data without compensation is displayed and saved.

- **Select:**

Select this radio button to perform the capacitance compensation for the path from the B2200A/B2201A input ports to Agilent 16495F/G connector plate or Agilent B2220A probe card interface. The data after compensation is displayed and saved.

DUT I/F field is used to specify the model number of the path you use. The selections are the 16495F/G and B2220A.

Cable field is used to specify the model number of the cable from the B2200A/B2201A output to the DUT I/F. The selections are the 16494A/B/C-001/002/005. This mode cannot perform the capacitance compensation for the cables to positioner/manipulator or the probe card.

- **User Compensation Data File:**

Select this radio button to perform the capacitance compensation for the path from the B2200A/B2201A input ports to the end of positioner/manipulator or probe card. See User's Guide. The data after compensation is displayed and saved.

Event Log



Date/Time	Message	ID	Process	User	Host
4/12/2006 3:00:35 PM	Configuration query completed.	110001	StaDaemon	B1500user	B1500A-0...
4/12/2006 3:00:29 PM	Service started successfully.	102001	StaDaemon	B1500user	B1500A-0...
4/12/2006 2:25:56 PM	Service stopped successfully.	102002	AppSetup	B1500user	B1500A-0...
4/12/2006 2:00:41 PM	Service started successfully.	102001	AppSetup	B1500user	B1500A-0...
4/12/2006 2:00:38 PM	Service stopped successfully.	102002	StaUpd	B1500user	B1500A-0...
4/12/2006 2:00:37 PM	Service started successfully.	102001	StaUpd	B1500user	B1500A-0...
4/12/2006 1:52:48 PM	Service stopped successfully.	102002	StaDaemon	B1500user	B1500A-0...
4/12/2006 12:44:00 ...	Configuration query completed.	110001	StaDaemon	B1500user	B1500A-0...
4/12/2006 12:43:51 ...	Service started successfully.	102001	StaDaemon	B1500user	B1500A-0...
4/12/2006 12:40:29 ...	Service stopped successfully.	102002	AppSetup	B1500user	B1500A-0...
4/12/2006 12:14:57 ...	Service started successfully.	102001	AppSetup	B1500user	B1500A-0...
4/12/2006 12:14:53 ...	Service stopped successfully.	102002	StaUpd	B1500user	B1500A-0...
4/12/2006 12:14:52 ...	Service started successfully.	102001	StaUpd	B1500user	B1500A-0...
4/11/2006 6:50:48 PM	Service stopped successfully.	102002	StaDaemon	B1500user	B1500A-0...
4/11/2006 6:50:47 PM	GPB timeout occurred.Int...	103008	StaDaemon	B1500user	B1500A-0...
4/11/2006 4:51:15 PM			StaDaemon	B1500user	B1500A-0...
4/11/2006 4:48:55 PM			StaDaemon	B1500user	B1500A-0...



- The Event Log screen displays the event log.
- Date/Time: Displays date and time of the event.
- Message: Event message
- ID: Process ID of the event
- Process: Process name
- User: User name. Windows login name.
- Host: Host name of the B1500
- The Refresh button refreshes the event log.

ASU



Configuration



Configuration

Man Frame | Modules | **ASU** | Switching Matrix | Event Log

ASU List

Slot	Module Type	Name	ASU Serial Number	ASU I/O Path
1	B1510A	SMU1:HP		
3	B1517A	SMU2:HR		
4	B1517A	SMU3:HR		
5	B1517A	SMU4:HR		
6	B1517A/E5288A	SMU5:HR/AS	* s/n mismatch	SMU
7	B1511A	SMU6:MP		
8	B1511A	SMU7:MP		
9	B1511A	SMU8:MP		
10	B1520A	CMU1:MF		

* NOTE: The specifications are satisfied and guaranteed for the exclusive combination of the ASU and the HRSMU. So confirm the serial number of the ASU and connect it to the dedicated HRSMU properly.

ASU I/O Path:

Close



The ASU screen is available if the B1500A installs the HRSMU connected to the ASU (Atto Sense/Switch Unit), and shows the ASU information.

Slot: Slot number

Module Type: Type of module

Name: Module name or SMU name

ASU Serial Number: Serial number of the ASU connected to the HRSMU. This cell does not show the serial number if no ASU is connected or unpaired ASU is connected.

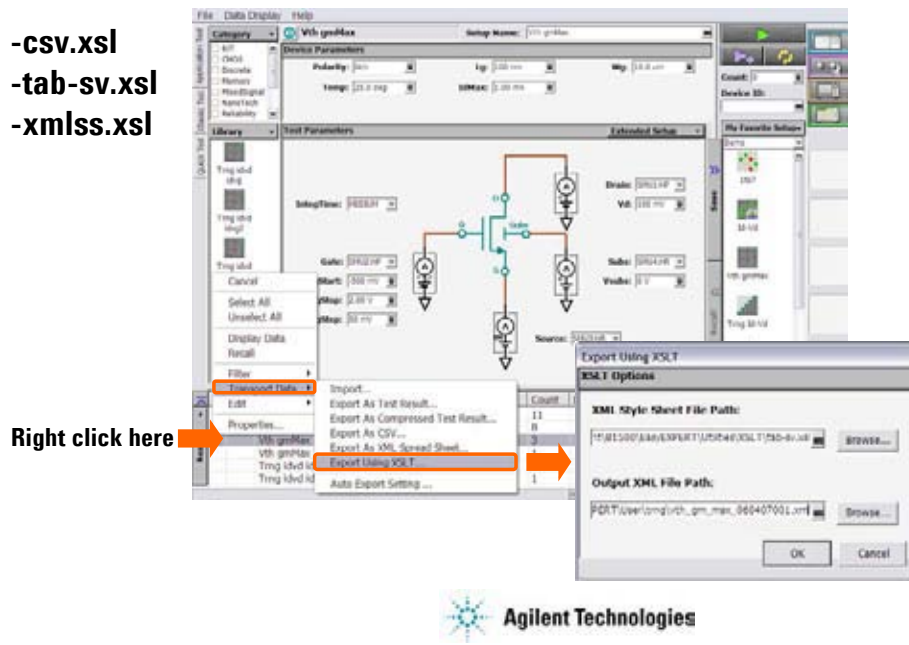
ASU I/O Path: ASU input to output connection, SMU or AUX

If the ASU I/O Path field is set to SMU, the ASU makes the path from the ASU Force input to the ASU output.

If the ASU I/O Path field is set to AUX, the ASU performs automatic switching in every test. The ASU makes the path from the AUX In input to the ASU output for the test without the HRSMU and makes the path from the ASU Force input to the ASU output for the test with the HRSMU.

XSLT Samples

- csv.xsl
- tab-sv.xsl
- xmlss.xsl



The XSLT sample files are stored in the following folder. The files can be used as a XML style sheet file for exporting test data record.

C:\Program Files\Agilent\B1500A\EasyEXPERT\Utilities\XSLT

csv.xsl:

This file can be used to export test record in the format that uses a comma (,) as data separator.

This file is used to realize the Export As CSV... function.

tab-sv.xsl:

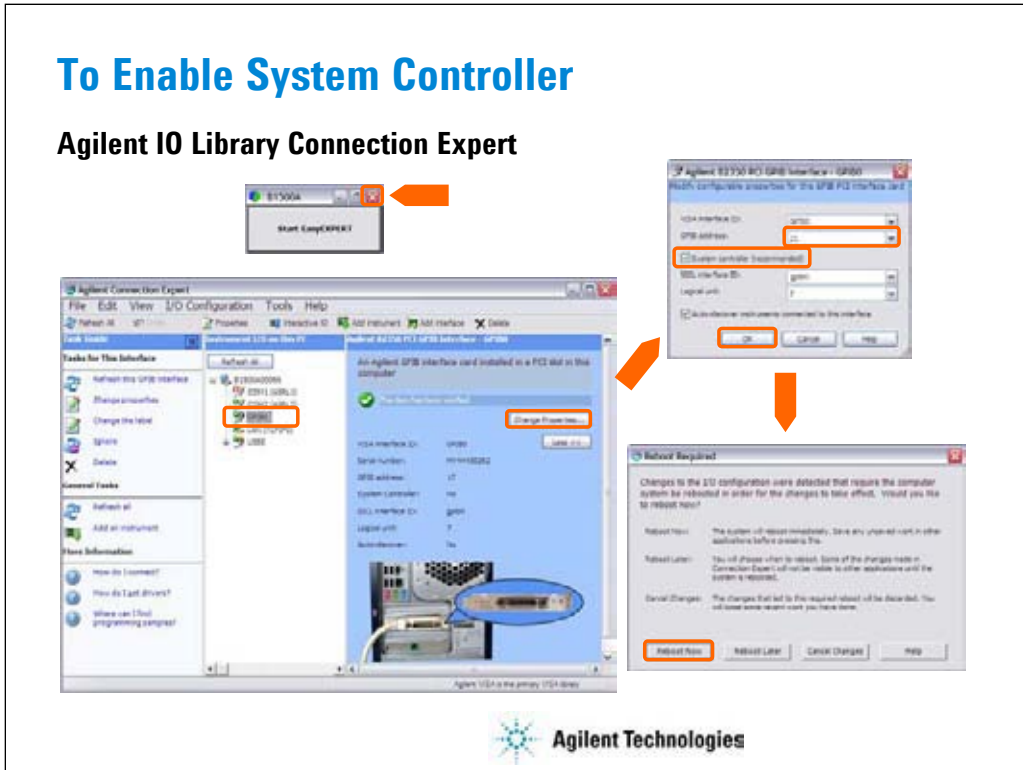
This file can be specified in the XML Style Sheet File Path field in the Export Using XSLT dialog box if you want to export a test record in the format that uses a tab as data separator.

xmlss.xsl:

This file can be used to export test record in the XML Spread Sheet format. This file is used to realize the Export As XML Spread Sheet... function.

To Enable System Controller

Agilent IO Library Connection Expert

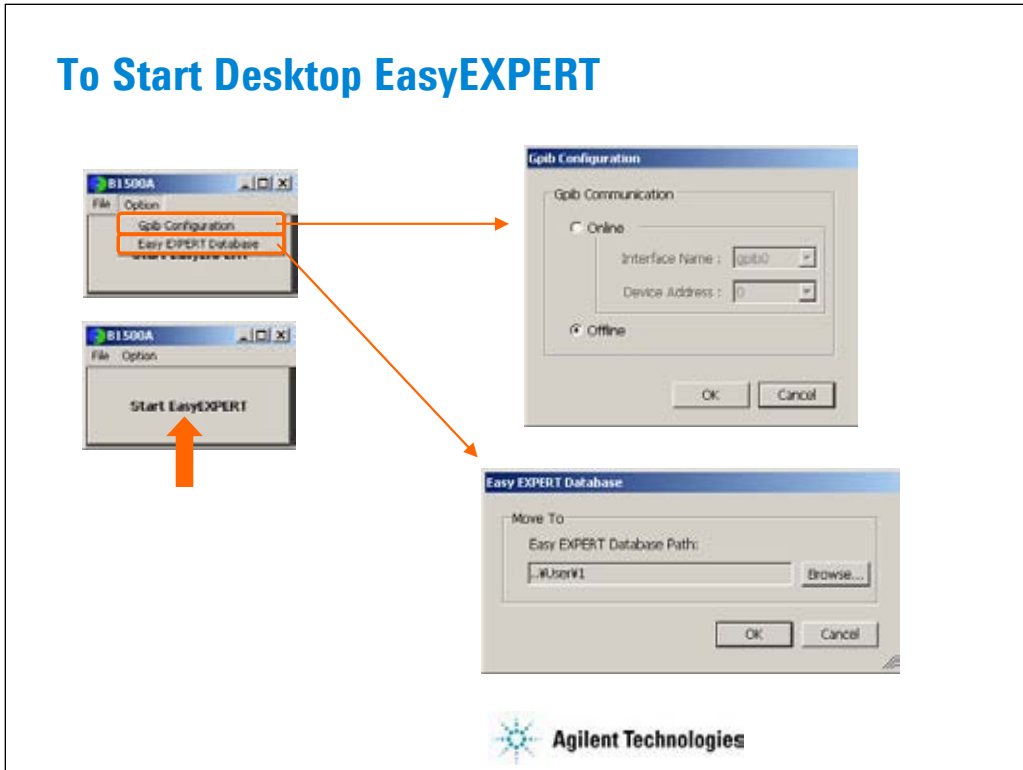


To control external GPIB devices, the B1500A must be set to system controller. Exit the EasyEXPERT, and close the Start EasyEXPERT window. After that, launch the Agilent Connection Expert by clicking Start, All Programs, Agilent IO Library Suite, and Agilent connection Expert.

On the Agilent Connection Expert, change the GPIB configuration of the B1500A.

- Select GPIB0.
- Click Change Properties... button.
- Change GPIB address to 21 that is the typical address number for the system controller.
- Check System controller box.
- Click OK button.
- Reboot the B1500A.

To Start Desktop EasyEXPERT



To open the Start EasyEXPERT window, click Start > Programs > Start EasyEXPERT menu. The Option menu provides the functions used to open the following dialog box.

Gpib Configuration:

Select Online if the B1500A is connected to your computer and you want to control the B1500A via GPIB. Or select Offline.

EasyEXPERT Database:

Specify the EasyEXPERT Database path if you want to move the database to the other folder.

After that, click the Start EasyEXPERT button to launch Desktop EasyEXPERT.

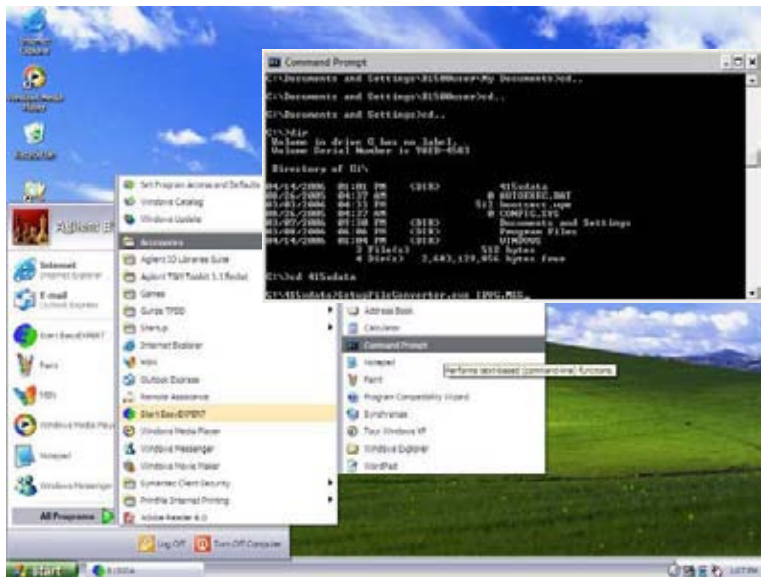
Note:

Desktop EasyEXPERT supports most B1500A/EasyEXPERT functions. However, some functions are not supported on an external computers due to differences in hardware and so on.

Note:

For the installation procedure, see the readme file stored in the Desktop EasyEXPERT CD-ROM.

To Use Setup File Converter



 Agilent Technologies

To convert the 4155/4156 setup file (.MES file) to the EasyEXPERT setup file (.XTS file), use SetupFileConverter.exe, and perform the following procedure. The SetupFileConverter.exe file is stored in the following folder.

C:\Program Files\Agilent\B1500A\EasyEXPERT\Utilities

1. Create your working folder (for example, C:\415xdata).
2. Copy your .MES files to this folder.
3. Copy SetupFileConverter.exe file to this folder.
4. Launch the DOS Prompt window.
5. Go to your working folder (for example, C:\> cd 415xdata).
6. Execute SetupFileConverter.exe as shown below.

Example:

C:\415xdata> SetupFileConverter.exe *.MES

All .MES files in your working folder will be converted to the EasyEXPERT setup file format. And the .XTS files will be created in this folder.

If you do not specify the parameter, help message will be displayed by executing the file. For more information, see the setup converter readme file, online help, or User's Guide.