EE105 Lab Experiments

Agilent4155C/HP4145B Parameter Analyzer Tutorial

Contents

1 Introduction

The Agilent4155C/HP4145B is a parameter analyzer. It can apply test signals (voltages or currents) to one or more nodes of a circuit and then measure the voltages and currents at other nodes in the same circuit. What makes the parameter analyzer particularly useful is that it can sweep a test voltage across hundreds of values in a matter of seconds. You can think of its capabilities like those of a DC analysis in SPICE.

2 Interface Notes

2.1 Front Panel

There are two types of keys on the front panel of Agilent 4155C/HP4145B:"hard" keys, which are dedicated buttons on the front panel, and a column of "soft" keys, located at the bottom and to the right of the screen (as marked by the red box in Figure 1), which are used to select items on the right/bottom of the screen.

2.2 Test Fixture

The test fixture is a metallic box located at every lab station. Inside the test fixture, you'll notice a socket, many numbered slots, and eight labeled terminals: 4 SMU, 2 VS, and 2 VM (newer models have more terminals, but all models have at least these eight). The SMU is the most flexible terminal: it can be used to apply or measure a current or a voltage. The VS can act only as a voltage source, and the VM can act only as a voltmeter. For any measurement you're conducting having fewer than five nodes, you should use the SMU terminals for all of the nodes since they provide the most functionality. There are two kinds of test fixture in the lab: HP 16058 (shown in Figure 2)and HP 16147 (shown in Figure 3). SMU terminals are labeled with red, VS with blue, VM with black, and ground with green. Note the HP 16147 test fixture has two numbering schemes for the SMU terminals-use the numbering scheme with blue numbers on a white backgroud (as labeled in Figure 3).

When using the Agilent4155C/HP4145B, you can either connect a pin to the ground terminal in the test fixture or you can connect it to an SMU or VS and set the SMU/VS to supply 0V. According to the test fixture documentation, the ground terminals are just connected to the chassis of the test fixture, so using the ground terminal can mean a noisy ground. For best results (in particular with small signals or sensitive circuitry), you should use an SMU or VS for ground.

Figure 1: Agilent 4155C Front Panel

In order to actually hook up a circuit to the Agilent4155C/HP4145B, you'll need special cables provided by your TA. These are extremely expensive ($70 a piece!), so be careful not to break or lose them. Build your circuit on the breadboard provided in lab, then use the special cables to connect nodes in your circuit to the SMU, VS, and VM terminals.
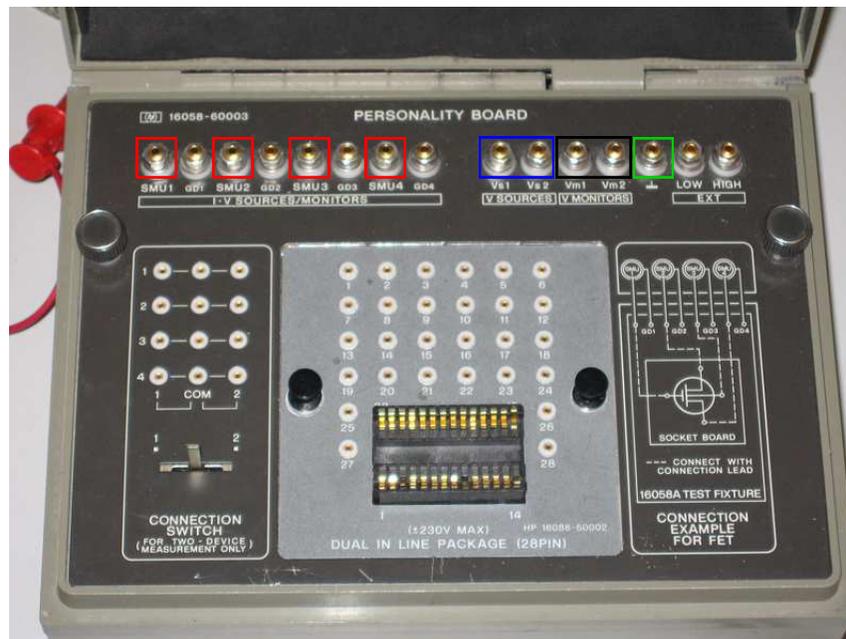

Figure 2: HP 16058 test fixture

3   Examples

3.1   I-V Measurement of a Diode

1. Press the power button on the bottom left hand corner of the parameter analyzer. It may take 20-30 seconds for the machine to start.

Figure 3: HP 16147 test fixture

2. Insert a diode into the socket and use the provided cables to connect the corresponding pins to SMU terminals. For example, if you insert a diode between slot 1 and slot 6 in the socket, use a cable to connect pin 1 to SMU1 and a cable to connect pin 6 to SMU2.

3. Channel Setup: Here, we are programming the parameter analyzer to ground SMU1 and to sweep the voltage applied to SMU2 and measure the current through SMU2. Press "Chan" button in the "PAGE CONTROL" area on the front panel and make sure measurement mode is "SWEEP". In the channel table, set "MODE" of SMU1 to "COMMON", "MODE" of SMU2 to "V", and "FCTN" of SMU2 to "VAR1". You cannot assign the same variable to two different SMUs. Also, ensure that "FCTN" of SMU1 is "CONST". In this process, you need the arrow buttons in the "MARKER/CURSOR" area to scroll to the desired cell in the table and to use the soft button to select the correct options.

4. Measurement Setup: In this screen, we program the V2 voltage sweep. Press "Meas" in "PAGE CONTROL" area or use soft key on the right corner and press "Next Page". In this screen you should set the variable table: you would need use keys in the "Entry" area in the front panel to input the "START", "STOP", and "STEP" value. Sweep V2 from ± 2 Volts.

5. Display Setup: In this screen, we set the scale and choose the variables for the graphical plot. Press "Display" in "PAGE CONTROL" area or use the soft key in the right corner and press "Next Page". Set reasonable "SCALE", "MIN", and "MAX". Make sure that you plot I2 versus V2.

6. Press "Single" button in the "MEASUREMENT" area in the front panel to execute the measurement. You should notice a rectifying I-V curve if your connection and setup are correct. Use a soft key to enable the marker and use the knob to scroll the marker to read data on the points of the curve.

Side Notes: if you are using HP4145B, most operation is similar, except you would need to use "Next" button in the "PAGE CONTROL" area to proceed to display page before you press "Single" to start the measurement.

3.2   C-V Measurement of Diode

1. Turn on the device and connect the diode as in the I-V measurement.

2. Channel Setup: Press "Chan" button in the "PAGE CONTROL" area and use a soft key to change the measurement mode to "QSCV" (quasi-static C-V). In the channel table, set "MODE" of SMU1 to "COMMON", "MODE" of SMU2 to "V", and "FCTN" to "VAR1". Make sure that "FCTN" of SMU1 is "CONST".

3. Measurement Setup: Press "Meas" in "PAGE CONTROL" area or use the soft key in the right corner and press "Next Page". Set variable table correctly to make sure that the diode remains in reverse bias during the C-V measurement. You may need to adjust the "STEP" values to get a good capacitance measurement.

4. Display Setup: Press "Display" in "PAGE CONTROL" area or use the soft key in the right corner and press "Next Page". Set reasonable "SCALE", "MIN", "MAX". Again, make sure to plot I2 versus V2.

5. Press "Single" button in the "MEASUREMENT" area to execute the measurement. Use a soft key to enable the marker and use the knob to scroll the marker to read data on the points of the curve.