

UNIVERSITY OF CALIFORNIA AT BERKELEY
College of Engineering
Department of Electrical Engineering and Computer Sciences

How to Use the HP 4145B / 4155A / 4155C Semiconductor Parameter Analyzers

EE 105
Prof. Wu

Spring 2007

1. Turn on the semiconductor parameter analyzer, and wait for it to initialize.
2. Start the Metrics ICS program (Fig. 1). (You may get an error message when you try to start the program; just click OK and ignore it.) This program provides a software interface to the parameter analyzer.

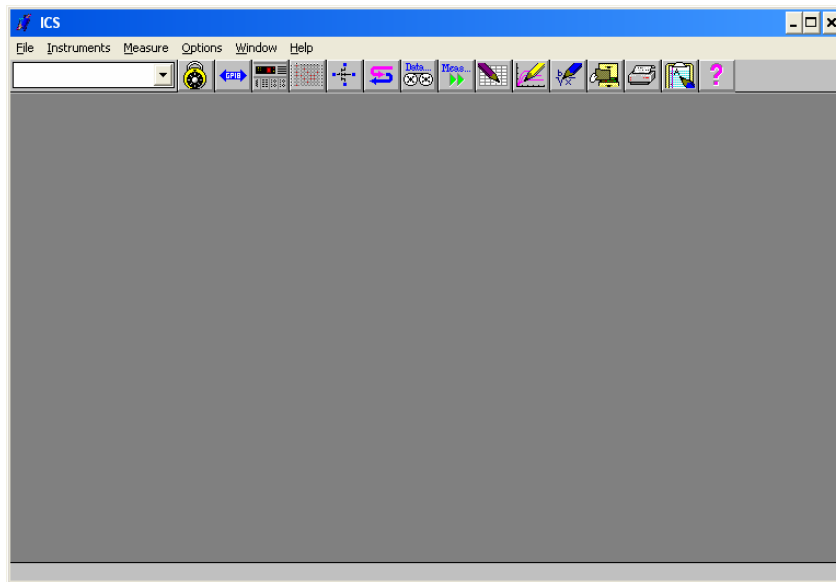


Fig. 1: The Metrics ICS program

3. You will need to tell the program which instrument to interface with. Do this by selecting **Instruments** → **Select Instrument...** from the menu bar.
4. Now highlight the appropriate instrument (In this case it's the **HP4145**; you may have to choose the **HP4155**, depending on the model of the parameter analyzer at your workstation), and click on the **Connect** button. The name of the parameter analyzer will now appear on the right side of the dialog box (Fig. 2). Click on **OK**.

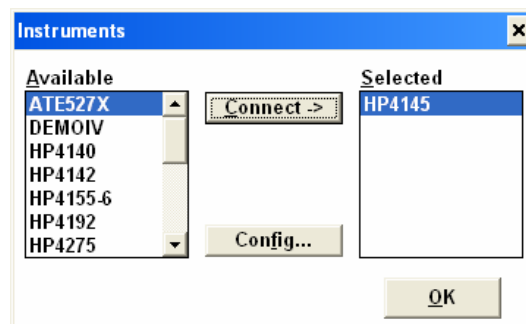



Fig. 2: Selecting the parameter analyzer

- Now we need to create our test setup. Select **Measure → Edit Setup...** from the menu bar, or click this icon in the toolbar: . The **Setup Editor** window will pop up. Click on the **New** button in the upper left, and type in a name for your test setup.
- By default, the software is setup to test a MOSFET. Let's change this, and test a resistor. Click on the **Device** button to bring up the **Device** dialog box (Fig. 3). Click on **RES** to select a resistor as the device. Similarly, we can select diodes, BJTs, capacitors, etc. Click on **OK** when you're done.

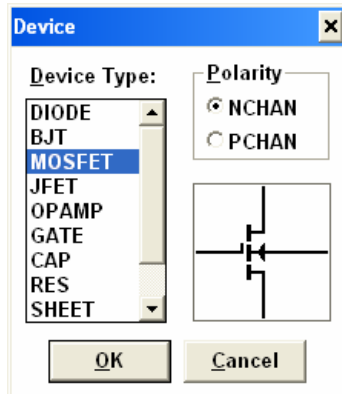


Fig. 3: Selecting a device to test

- We now need to add stimuli to each end of the resistor. To do this, click on the **Source Units** button to bring up the **Source Units** dialog box (Fig. 4). The **SMUs** (Sensing Measuring Units) provide voltage or current stimuli, and can also measure the voltage/or current through them. In addition, if you need them, the **VS** terminals are voltage sources, and the **VM** terminals are voltmeters.

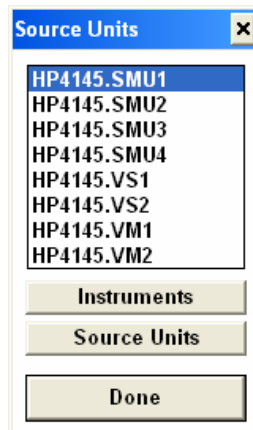


Fig. 4: Available connections from the parameter analyzer

- Let's assign **SMU1** to the **A** terminal of the resistor, and **SMU2** to the **K** terminal of the resistor. Do this by highlighting **SMU1** in the **Source Units** dialog box, then clicking on terminal **A**. Similarly, assign **SMU2** to terminal **K**. Click **Done** on the **Source Units** dialog box after you have placed **SMU1** and **SMU2**. Your window should now look like Figure 5.

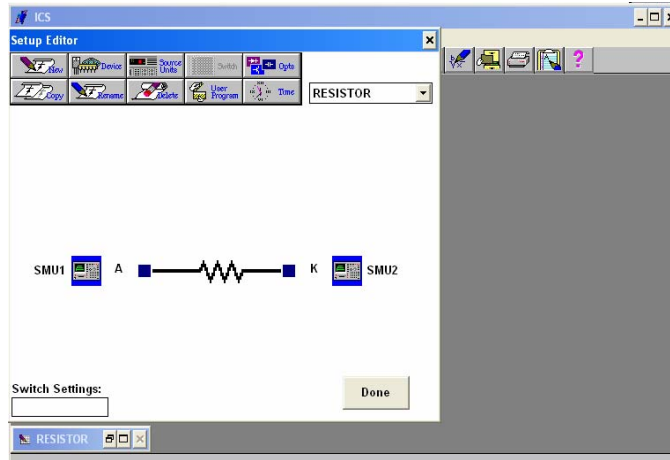


Fig. 5: SMUs assigned to the resistor terminals

9. Now we need to program what the SMUs will do. Click on **SMU1** to bring up the **SMU Setup** dialog box. We want to provide a voltage stimulus, so make sure **Voltage** is selected under **Stimulus**. Check the boxes under **Measure** to measure both voltage and current at this SMU. The variable names for voltage and current can be renamed by the user; here they are renamed to **VRES** and **IRES** (Fig. 6).
10. We want to measure the I-V curve of the resistor from -5V to 5V, so select **SWEEP** as the **Mode** (under **Force Conditions**). Set the start and stop voltages, and the number of points or the step size. Your dialog box should look like Figure 6. Click **OK** when done.

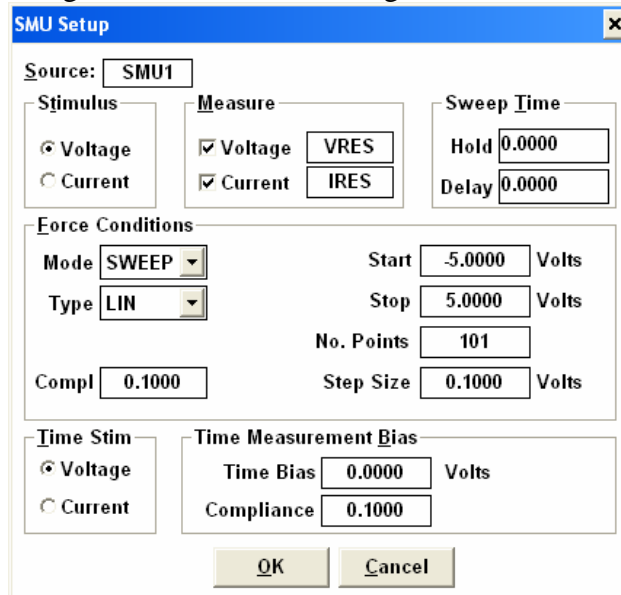


Fig. 6: Setting up an SMU

11. Now set **SMU2** to be the common (ground) terminal (Fig. 7).

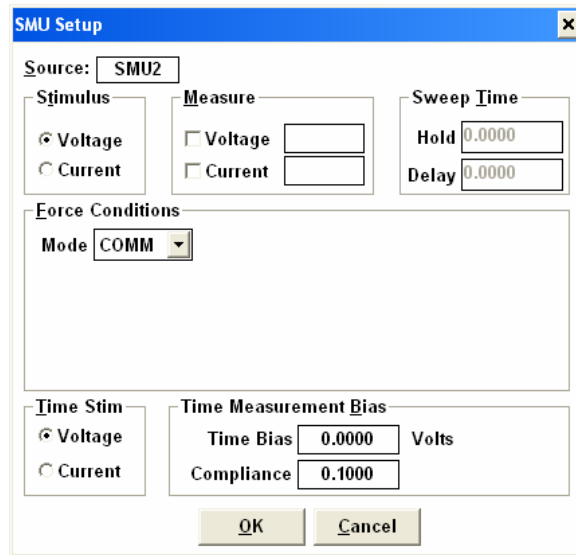



Fig. 7: Grounding an SMU

12. The test setup is finished. Click on **Done** in the **Setup Editor** window. Now make the physical connections from the parameter analyzer test fixture to the resistor under test (ask your GSI how to do this). Make sure you're plugging your cables into the correct SMU ports. Take care of the cables! Each one is \$70!

13. Now select **Measure** → **Measure...** or click on this button  to bring up the measurement controls (Fig. 8). Make sure the name of your test setup (**RESISTOR**, in this case) is selected, then click on the **Single** measurement button. The parameter analyzer has an LED that will light up to indicate that its taking a measurement. You will also see a message at the bottom of the ICS program window. When the message disappears, the measurement is finished.

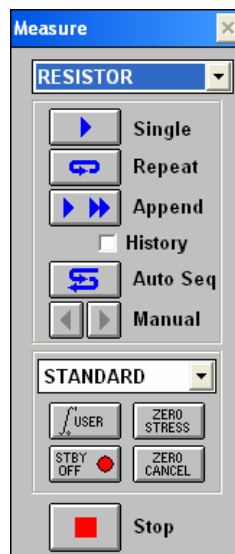


Fig. 8: Measurement control window

14. After the measurement is finished, your data will be displayed in a spreadsheet. You now have 2 options: copy and paste the data into Excel or another graphing program, or create a

graph directly in Metrics ICS. To do the latter option, click on the graph button, which looks



like this: You can label and scale your axes in the window that pops up.

15. The resistor I-V curve is as expected: linear, with a slope = $1/R$ (Fig. 9). If you're going to print this graph, please help us conserve printer toner by changing the plot colors. Go to **Setup** → **Colors...** from the menu bar, and select **Monochrome**.

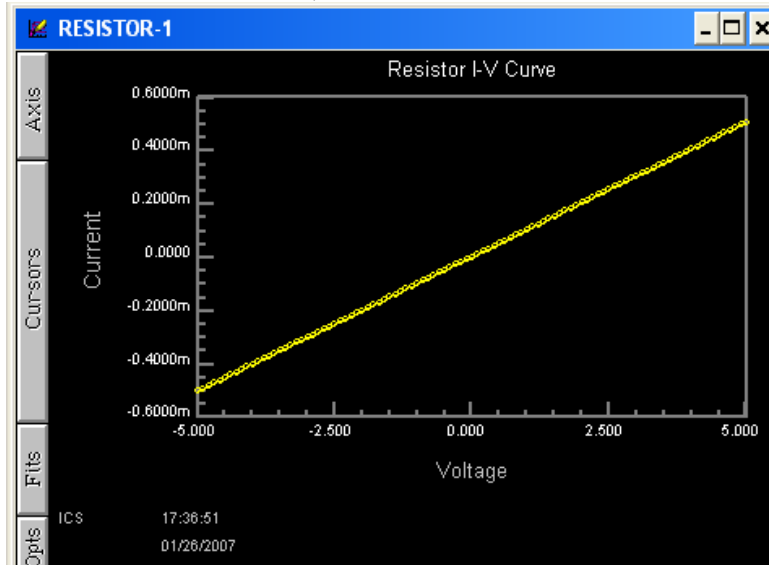


Fig. 9: I-V curve of a resistor

16. That's it! If you have any more questions, consult your GSI.