HP 4155a
Overview of HP 4155a

• Semiconductor Parameter Analyzer
• HP 4155A/4156A is an electronic instrument for measuring and analyzing the characteristics of semiconductor devices.
• One instrument allows you to perform both measurement and analysis of measurement results.
• Contains many SMUs (Source-Measure Units)
Steps for Use

• Start with the semiconductor of interest
  – Lab 7 will deal with a MOSFET array in the lab kit
• There are different add-ons for using different package types
  – We only need the DIP (dual in-line package) for EE330
• Obtain the data sheet for the pin out - this is important so you connect the device correctly and don’t damage it or the HP 4155
  – This equipment is expensive so pay attention!!
Connecting the DUT to the Test Fixture

Location of the DUT (device under test). This is where you will place the device to be tested. Notice the pin numbers next to the pins. They correspond to the ports above for connecting to the HP 4155a.

Corresponding Pin Locations for connecting to the different channels of the HP 4155
Modes of Operation

• Before continuing, must first understand the 3 basic modes of operation to be used:
  1. Source Voltage / Sense (measure) Current (Mode ‘V’)
  2. Source Current / Sense Voltage (Mode ‘I’)
  3. Common (acts as a reference for voltages)
    • Similar to the black connection on the DC supplies on the lab benches
    • NOT true earth ground!! So be careful!
Plan Your Experiment

• Before touching the parameter analyzer, think of what you want to do.
• For example, which pins are what and how are they going to be sourced or measured?
• Draw a diagram of the pins if necessary or obtain the datasheet
• Decide on sweep parameters
• What is the expected result?
  – If you don’t know, figure it out beforehand so you can realize if the data obtained is erroneous.
  – This will help in troubleshooting if problems occur
Each Channel has 2 pins for Force and Guard – We will use the Force pin for source/sense modes

The SMU Channels

Source/Measure Channels 1-6

These channels will be tied to the pins as needed
Connecting the Pins

For example, channel 2 is connected to pin 3 of the DUT in this image.

- Repeat for all pins that need to be biased and/or measured.
Now the software...

• With the hardware set up (double-check just to be sure), you are now able to set up the software.
• Will use the many keys on the parameter analyzer to set up the channels and set up the various parameters
• Upon completion, we can run a sweep and analyze the results
Six Main Steps

- There are 5 main setup screens that are needed for every experiment
  1. Channel Setup
  2. (Optional) Custom Function Definition
  3. Variable Setup
  4. Display Setup
  5. Graph/List (display the results)
  6. The final step is to run the sweep!

Shortcut keys can be found to the right of the screen
1. Setting Up the Channels

SMU Channels – be sure to match the hardware with the software.

Sweep Mode

Give signals a name using the keypad – remember both current & voltage if needed.

Select the desired mode for each channel (pin) – refer to ‘Modes of Operation’ slide.

If a constant value is needed, choose ‘CONST’. If variable, choose ‘VARx’.

NOTE – Keep in mind that Var1 is swept 1st and followed by Var2, etc.
2. Custom Functions (opt.)

Use the User Function screen to define custom functions

Name the function for use later

Define the function here using the keypad – here the square root of Id is defined using ‘^’ to raise Id to the 0.5 power

Use the variables from the channel definition page to speed up the process.
3. Variable Setup (Sweep Parameters)

Setup Variables for desired sweep values

Setup any constants here
4. Display Setup

Determine which variables are used for each axis – min/max values for each axis can also be determined.
5/6. Graph and Run

- Graph button shows the plot (which is blank at first)
- On the right of the HP4155, hit the ‘Single’ button to run a single sweep using the setup just completed.
- The plot should now display the results.
- If out of range, change the scaling
- No results indicate something has been improperly setup. Double-check all hardware and software.
Analyze the Results

The final step is to use the analysis tools built into the parameter analyzer to find the values of interest.

Some examples – slope of a line (shown), intercepts, cursor pts, regressions, etc.
Further Information

• For the full manual go to

http://www.home.agilent.com/upload/cmc_upload/All/04155-90015.pdf?&cc=US&lc=eng