Design Assignment 1 – Transistor Curves

1 Introduction

Transistor curves represent the amount of current that is sinked by the output terminal as a function of the voltage at the output terminal and the control applied. The control for a MOSFET is the gate-source voltage, the control for a BJT is generally considered to be the base current.

2 Set up Keithley 4200 Semiconductor Characterization System

Get one BS170 (similar to 2N7000) n-channel MOSFET OR one P2N2222A NPN BJT. Use the Keithley Curve tracer to determine the characteristics of your transistor. If the results do not look "right" please get my attention – it is not hard to burn out devices!

Use the following connections:

Source – connect to 0V via GNDU→Force on back of instrument

Drain – connect to SMU1→Force on back of instrument

Gate – connect to SMU2→Force on back of instrument

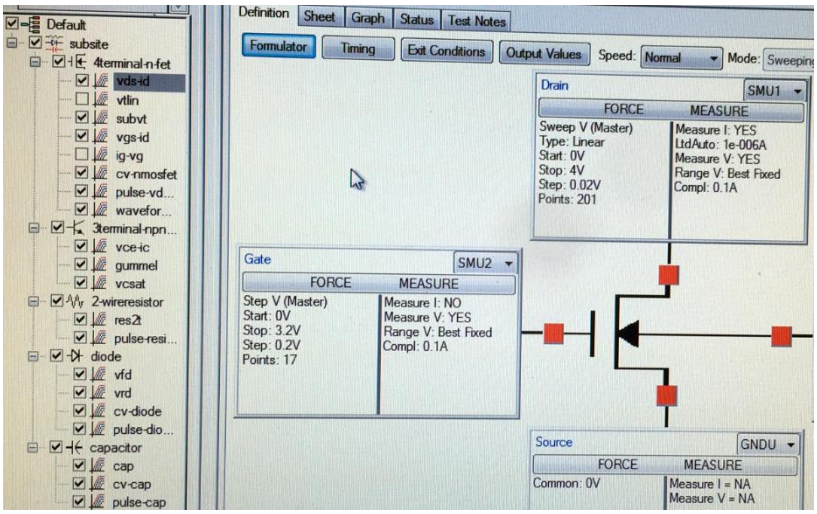
For the BJT measurements plug the base pin into the 'G' socket, the collector pin into the 'D' socket and the emitter pin into the 'S' socket. NOTE: absolutely do not run a MOSFET test configuration with a BJT plugged in, or vice versa!!! You will burn out the part, or worse!

3 Generate Curves using Keithley Interactive Test Env. (KITE)

Plug your part into the measurement pod. Select the appropriate test for your device:

- MOSFET: 4terminal-n-fet→vds/id
- BJT: 3terminal-npn→vce/ic

Make sure that on-screen the top terminal uses SMU1, and the left terminal uses SMU2, as shown to the right.



Ensure that the sweeps are set as follows:

	Start	Stop	Step
NMOS Drain	0 V	3 V	0.02 V
NMOS Gate	2.2 V	3.2 V	0.2 V
BJT Collector	0 V	5 V	0.02 V
BJT Base	0 uA	500 uA	100 uA

4 ANALYZE THE RESULTS

Take a photo of the results screen. Redraw the curves by hand on graph paper, or transfer your data as an .xls file to a flash drive, and replot it.

For MOSFET:

- **Label each trace. Annotate your drawing highlighting how Vt can be discerned, and estimate its value.**
- **Compare your curves against the BS170 datasheet**
- **For a fixed drain-source voltage of 3 V, plot the drain current vs. gate-source voltage**

For BJT:

- **Label each trace.**
- **For a fixed collector-emitter voltage of 5 V, plot the collector current vs. base current.**
- **Estimate current gain**
- **Compare your results against the P2N2222A datasheet**

5 WRITE A REPORT

Write a report, which will be due by the date announced in class.

The report is to include, but not limited to the following:

a) Introduction.
b) Discussion of results including development of any equations, detailed graphs and schematics, oscilloscope pictures, and any other component that you think helps you to explain what, why and how you did what you did.
c) The report must be understandable to another engineer or supervisor not working on this project.
d) A conclusion of your results and discussion of anything you found especially interesting or not expected from your work on this project.

Specific items that I will look for:

a. **Briefly explain the electrical characteristics of your device, referring to the curves.**
b. **Explain how you estimated the information that I requested.**
c. **From the datasheet determine the maximum current that the device can sink when the output (collector or drain) is at the voltage listed in the 'Stop' column, based on the device's absolute maximum power rating.**

REPORT FORMAT:

- One report per team
- Cover sheet with Title, Class, Names, etc. (Dr. Adegbege's IEEE format is also fine)
- Microsoft Word, .docx file or Adobe .pdf file.
- Upload file and reports via Canvas

6 GRADING RUBRIC

70% - completeness based on specifically requested elements, and quality of those elements

30% - overall professionalism, language

7 APPENDICES