ELEC 313 Lab 8
Bipolar Junction Transistor Characterization

REFERENCE: Appropriate chapters of ELEC 306 text.

OBJECTIVE: The objective of this experiment is to plot the output characteristic of a common emitter transistor circuit, and use it to determine the current gain, and output conductance.

EQUIPMENT: Transistor 2N2222A
Resistors 22K Ω , 33K Ω , 220 Ω (2), Capacitor 0.1μF
Power Supply (Vdc) , Multi Meter(s),

PRIOR PREPARATION (Pre-Lab):

Go onto the Internet (e.g., http://www.st.com/stonline/) and print the data sheet for a 2N2222A transistor.

EXPERIMENT

2N2222A Transistor

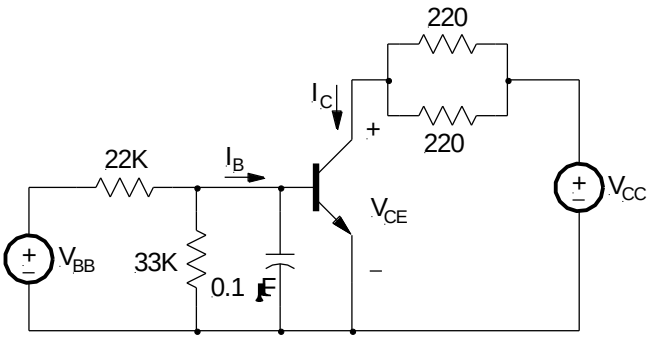

Figure 1: Common emitter transistor circuit.

1) Construct the circuit of Figure 1. Use the HP multi-meter to measure the base current, I_B, and Fluke multi-meters to measure the collector voltage and current (V_{CE} and I_C). Use the +6 V power supply for V_{BB} and the +25 V supply for V_{CC}. Be sure to keep the connection distance between the capacitor and the transistor short. Measure the base current on the source side of the capacitor.
2) Adjust V_{BB} for 20 μA of base current, I_B. (Note: The adjustment resolution will be about 1 μA, so adjust it as close to 20 μA as possible.)
3) Adjust V_{CC} from 0.5 to 1.5 V in 0.25-V steps and from 2 to 20 V in 2-V steps.
4) At each step measure the collector current, I_C, and the collector-to-emitter voltage, V_{CE}. If I_B has drifted from its set value, readjust V_{BB} for the I_B set in step 4 before recording the values of I_C and V_{CE}.
5) Adjust V_{BB} for a base current of 50 μA, 80 μA, and 100 μA. At each I_B value, repeat steps 3 and 4.

DATA ANALYSIS

1) Plot the data with V_{CE} on the horizontal axis and I_C on the vertical axis. Make a family of curves; i.e., plot of the data for each of different values of I_B so that the graph contains 4 loci. Use MATLAB, Excel, or any other program of your choice to plot the data. The result should resemble figure 5.13 in the Neaman text.

2) Determine the dependence of the current gain, β, on I_C and V_{CE}.
   a) Find the average value of β at V_{CE} = 5, 10, and 15 volts using the recorded value of I_C, for each of the 4 different values of I_B. Make a table showing the average value of β at V_{CE} = 5, 10, and 15 volts.
   b) Find the average value of β for each of the 4 different values of I_B, by using the recorded value of I_C at a variety of V_{CE} values along the same I_B curve. Make a table showing the average value of β at I_B = 20 μA, 50 μA, 80 μA, and 100 μA.

3) Compute the output conductance of the transistor. (This parameter is called h_{oe} and is measured in Siemens.) For each I_B curve on the I_C vs. V_{CE} plot made in step 1, find the slope of the line for $V_{CE} \geq 3$ V. Thus, a value of h_{oe} will be computed for each value of I_B. Make a table of h_{oe} versus I_B.

LAB REPORT

Your report should be completed in the format requested by the instructor. The lab report should be in standard format and include the following additional items:

1) Measured results of I_C and V_{CE} in tabular form, plus the graph from the data analysis section showing the data as a family of curves with I_B as a parameter.
2) The two tables from step 2 of the data analysis section. Discuss any conclusions drawn from this analysis.
3) The table from part 3 of the data analysis section. Discuss these results as well.