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

EE105 Lab Experiments

Prelab 3: Bipolar Junction Transistor Characterization

Name:

Lab Section:

1. For the NPN device shown below in Figure 1, fill in I_C, I_B, and I_E next to the current arrows.

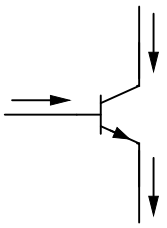

Figure 1: A simple NPN device for warming up

2. What is β in terms of I_C and I_B? What is α in terms of I_C and I_E? Express α in terms of β.

$\beta\,(I_C, I_B) =$
$\alpha\,(I_C, I_E) =$
$\alpha\,(\beta) =$

3. SPICE

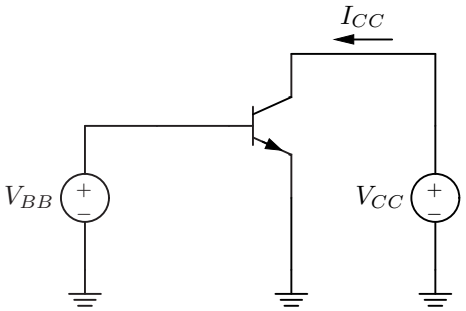

Figure 2: Circuit to simulate in SPICE

- Write a SPICE netlist for the BJT test circuit shown in Figure 2. *Refer to the HSPICE Tutorial if you have trouble with SPICE.*
- Use the 2N4401 SPICE model provided on the course website.

- Using the `.dc` command, sweep V_{CC} from 0 V to 5 V in 0.01 V increments and step V_{BB} from 0.6 V to 0.7 V in 0.025 V increments.
- Run the simulation and check the output file for any errors.
- If there are no errors, plot I_{CC} versus V_{CC} and print out a copy of the plot. *Note: If you notice that I_{CC} is negative, use Awaves to plot the absolute value of I_{CC}. I_{CC} appears to be negative because SPICE defines I_{CC} to be going out of the BJT.*

4. The configuration shown below in Figure 3 is known as the Darlington pair. Assume Q_1 has a DC current gain of β_1 and Q_2 has a DC current gain of β_2. Derive the overall current gain, $\beta_{tot} = I_{C2}/I_{B1}$, as a function of β_1 and β_2. Do not neglect any currents.

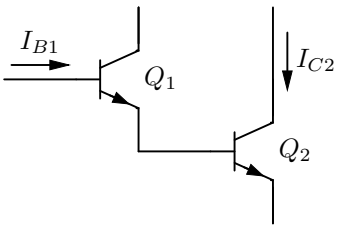

Figure 3: Darlington configuration

$\beta_{tot} =$