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

EE105 Lab Experiments

Report 3: Bipolar Junction Transistor Characterization

Name:

Lab Section:

3.1 & 3.2 For each measurement of V_{BE}, V_{BC}, I_B, and I_C, fill in the corresponding entry in Table 1 and compute the resulting β and α.

Parameters	Forward Active	Saturation	Cutoff	Reverse Active
V_{BE}				
V_{BC}				
I_B				
I_C				
β		N/A	N/A	
α		N/A	N/A	

Table 1: Regions of operations and measurements

3.1.2 Measure V_{BE} and V_{BC}. What is the region of operation?

$V_{BE} =$
$V_{BC} =$

3.1.3 Measure I_B and compute β.

$I_B =$
$\beta =$

3.1.4 Calculate I_E using α and measure I_E. Do the results agree?

	$\alpha =$
(Calculated)	$I_E =$
(Measured)	$I_E =$

3.1.5 Measure I_B and I_C with your fingers around the BJT. How do the values compare to the values without heating the BJT?

$I_B =$
$I_C =$

3.1.6 Explain, using the equation you know for collector current, how you'd expect I_C to vary with temperature. Does this agree with your experimental results? If not, explain why this might be the case. *Hint: I_S depends on the intrinsic carrier concentration n_i and the diffusion coefficients D_n and D_p. Intuitively, how would n_i, D_n, and D_p change with temperature? How would I_S change with temperature as a result?*

3.1.7 Does β agree with the value listed in the datasheet? If not, explain why you might see discrepancies.

3.1.8 Set V_{BB} to 4 V and V_{CC} to 2 V. Measure I_B, I_C, V_{BE}, and V_{BC}. What is the region of operation?

$I_B =$
$I_C =$
$V_{BE} =$
$V_{BC} =$

3.1.9 Set V_{BB} to -3 V and V_{CC} to 5 V. Measure I_B, I_C, V_{BE}, and V_{BC}. What is the region of operation?

$I_B =$
$I_C =$
$V_{BE} =$
$V_{BC} =$

3.1.10 Swap the emitter and collector. Set V_{BB} to 4 V and keep V_{CC} at 5 V. Measure I_B, I_C, V_{BE}, and V_{BC}. What is the region of operation?

$I_B =$
$I_C =$
$V_{BE} =$
$V_{BC} =$

Use all of the data you've collected up to this point to fill out Table 1.

3.2.2 Attach the plot of the I-V curve to this worksheet. Label the two regions of operation and draw the boundary between them.

3.2.3 Use the I-V curve to determine V_A.

$V_A =$

3.2.4 Repeat your calculation of V_A for base voltages of 0.625 V, 0.65 V, 0.675 V, and 0.7 V (you can step the base voltage in ICS to get this data). Does V_A depend on V_B? Why?

V_B	V_A
0.600 V	
0.625 V	
0.650 V	
0.675 V	
0.700 V	

Table 2: Early voltage calculations

3.3.2 Attach the plot of the I-V curve to this worksheet. What semiconductor device does this I-V curve look like?

3.4.2 Measure I_{B1}, I_{C1}, I_{B2}, and I_{C2}. Calculate β_1 and β_2.

$I_{B1} =$
$I_{C1} =$
$I_{B2} =$
$I_{C2} =$
$\beta_1 =$
$\beta_2 =$

3.4.3 What is the overall current gain, β_{tot}? Use the formula you derived in the prelab to calculate the total current gain from β_1 and β_2 and compare the calculation to your measurement.

(Measured)	$\beta_{tot} =$
(Calculated)	$\beta_{tot} =$