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

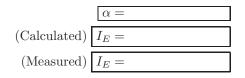
3.1.2 Measure V_{BE} and V_{BC} . What is the region of operation?

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

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?



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_{I}	$_{BE} =$
V_{i}	$_{BC} =$

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 .

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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
$0.600 \mathrm{V}$	
$0.625 \mathrm{~V}$	
$0.650 \mathrm{~V}$	
$0.675 \mathrm{~V}$	
$0.700 \mathrm{V}$	

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)	$\beta_{tot} =$