UNIVERSITY OF CALIFORNIA AT BERKELEY

College of Engineering Department of Electrical Engineering and Computer Sciences

EE105 Lab Experiments

Report 3: Bipolar Junction Transistor Characterization

	Characterization	
Name:		

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 .

Lab Section:

$$I_B =$$

$$\beta =$$

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.

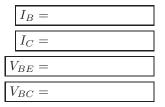
3.1.8 Set V_{BB} to 4 V and V_{CC} to 2 V. Measure I_B , I_C , V_{BE} , and V_{BC} . What is the region of operation?

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

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?



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 .



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	worksh	neet.	What	semico	nductor	device	${\rm does}$	this	$\operatorname{I-V}$	curve
	look like	2?																	

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) $\beta_{tot} =$