EE236: Electronics Devices Lab
Lab No. 7 - Characterization of BJTs and Frequency Response Analysis

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1 Analysis of BJT Parameters in Common-Collector Configuration

1.1 Aim of the Experiment

The objective of this experiment is to thoroughly analyze various parameters of the Bipolar Junction Transistor (BJT), including current gain (α, β) and the γ factor. Additionally, the experiment seeks to measure and plot the collector current (I_C) and collector-emitter voltage (V_{CE}) for different values of emitter current (I_E), keeping the emitter current constant.

1.2 Experimental Setup and Design

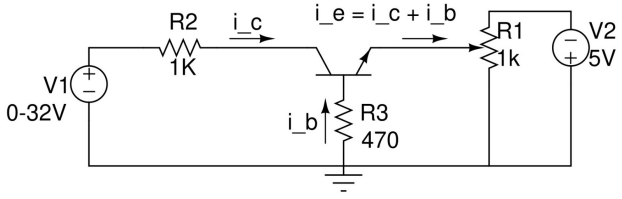


Figure 1: Circuit setup for BJT parameter measurement

1.3 Experimental Results

The following tables summarize the experimental observations recorded during the BJT parameter measurements at different emitter current values.

Table 1: Measurements for $I_E = 3mA$

S.No	I_C **(mA)**	V_{CB} **(V)**
1	2.98	1.47
2	2.98	1.92
3	2.98	1.94
4	2.98	2.12
5	2.99	2.42
6	2.99	2.88
7	2.99	4.47
8	2.99	4.97
9	2.99	5.24
Average I_C	**2.9856**	
α_1	**0.9952**	

Table 2: Measurements for $I_E = 6mA$

S.No	I_C **(mA)**	V_{CB} **(V)**
1	5.90	-0.63
2	5.91	-0.20
3	5.93	-0.06
4	5.97	0.18
5	5.97	0.64
Average I_C	**5.936**	
α_2	**0.9893**	

Table 3: Measurements for $I_E = 9mA$

S.No	I_C **(mA)**	V_{CB} **(V)**
1	6.85	-0.95
2	7.91	-0.49
3	8.89	-0.45
4	8.97	-0.38
5	8.97	0.31
Average I_C	**8.318**	
α_3	**0.9242**	

Table 4: Summary of BJT Parameters

Parameter	**Value**	**Equation**
α	0.9696	$\alpha = \frac{I_C}{I_E}$
β	31.87	$\beta = \frac{\alpha}{1-\alpha}$
γ	1	$\gamma = \frac{i_{en}}{i_e}$

1.4 Plots of the Experimental Data

The following plots were generated based on the experimental data collected during the lab session.

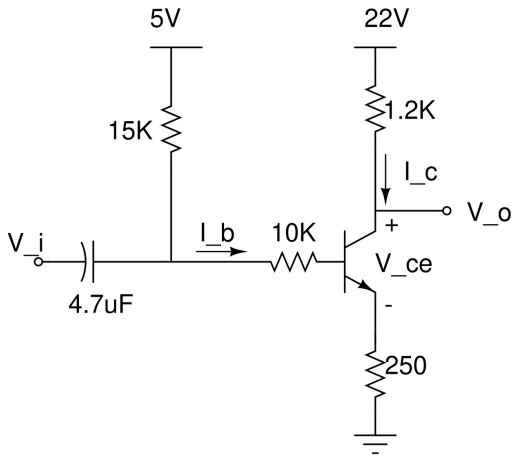


Figure 2: Plot 1: Current vs Voltage Characteristics

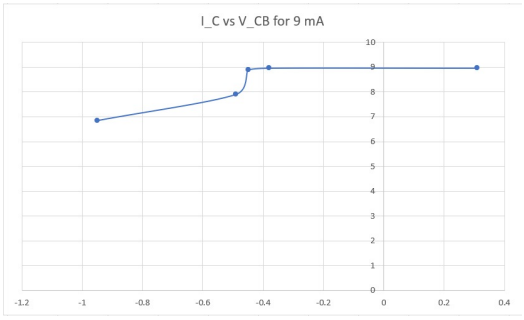


Figure 3: Plot 2: Current Gain vs Input Voltage

1.5 Conclusions and Observations

- The value of current gain α is found to be approximately 1, which indicates that the collector current I_C is significantly larger than the base current I_B. This is characteristic of BJTs in active mode.
- The base current I_B is minuscule compared to the collector current I_C, which is clearly evident from the experimental plots and measurements.

1.6 Experiment Completion Status

The experiment was successfully completed, and all expected results were achieved during the lab session.

2 Frequency Response of the BJT (BC-547) in Common-Emitter Configuration

2.1 Aim of the Experiment

This experiment aims to investigate the frequency response of the BJT (BC-547) when configured in a common-emitter (CE) setup. The goal is to measure and plot the frequency-dependent parameters and determine the 3 dB cut-off frequency for the amplifier circuit.

2.2 Design and Experimental Setup

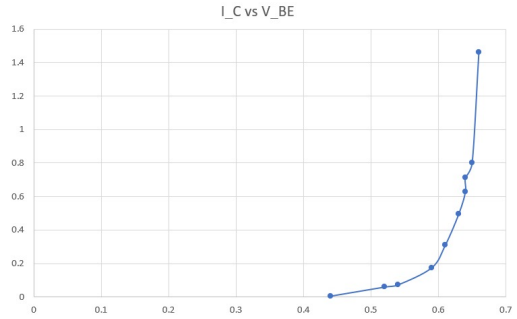


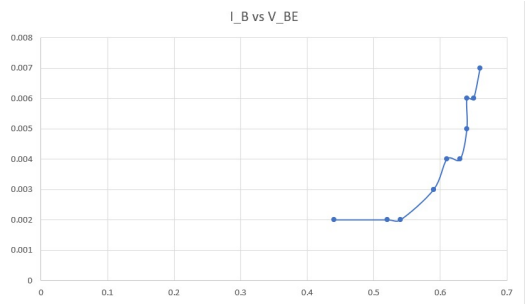
Figure 4: Circuit setup for frequency response analysis

2.3 Experimental results

The observations made by us during the experiment are listed below :

Frequency (Hz)	**Log(f)**	**V_out_HBT**	**Gain_HBT**
1000	3	1.8	3.7
5000	3.69897	1.8	3.8
10000	4	1.8	3.4
50000	4.69897	1.8	3.5
100000	5	1.8	3.7
150000	5.176091	1.8	3.8
200000	5.30103	1.8	3.7
250000	5.39794	1.9	3.9
300000	5.477121	1.9	3.8
350000	5.544068	1.9	3.7
400000	5.60206	1.9	3.9
450000	5.653213	1.9	4
500000	5.69897	2.1	3.9
550000	5.740363	2.1	4.4
600000	5.778151	2.2	4.1
650000	5.812913	2.3	4.3
700000	5.845098	2.3	4.1
750000	5.875061	2.4	4.1
800000	5.90309	2.4	4.2
850000	5.929419	2.4	4.3
900000	5.954243	2.6	4.4

2.4 Plots



The 3dB cutoff frequency is around 35kHz

2.5 Conclusion and Inference

- The 3dB cutoff frequency of the BJT is around 35kHz
- The Gain produced by the HBT is way much smaller as compared to the gain that is produced by the BJT as evident from the data collected

2.6 Experiment completion status

We have successfully completed the given experiment in the lab itself.