Experiment 1
Biasing of Common-Emitter Amplifers

Laboratory Report for ENGE 312
Applications of Electronic Devices
George Fox Unversity
Newberg, OR
Jan 29, 2026

Daniel Blue, Ethan Searls, Levi Interian-Uc

I.   PROJECT DESCRIPTION

The gain and bias stability of a common-emitter amplifier circuit was investigated in this laboratory experience. The gain of the amplifier was measured and compared between β values. Max Voltage Swing ($V_{o,p-p}$) was also measured and compared between β values.

II.   THEORETICAL BACKGROUND

Consider the circuit shown in Fig. 1. It is a bjt amplifer in the common-emitter configuration. It consists of a NPN Bipolar Junction Transistor (BJT), some resistors, a power source, and some DC filtering capacitors. A BJT has three operating regions. They are the active, saturation, and cutoff regions. In order to amplify an input signal with minimal distortion, the most linear region must be used. Crossing into a nonlinear region adds distortion to the output signal. The linear region for a BJT is the active region.

How does a BJT in a common-emitter configuration amplify?

Why is biasing required, and how is the Q-point established?

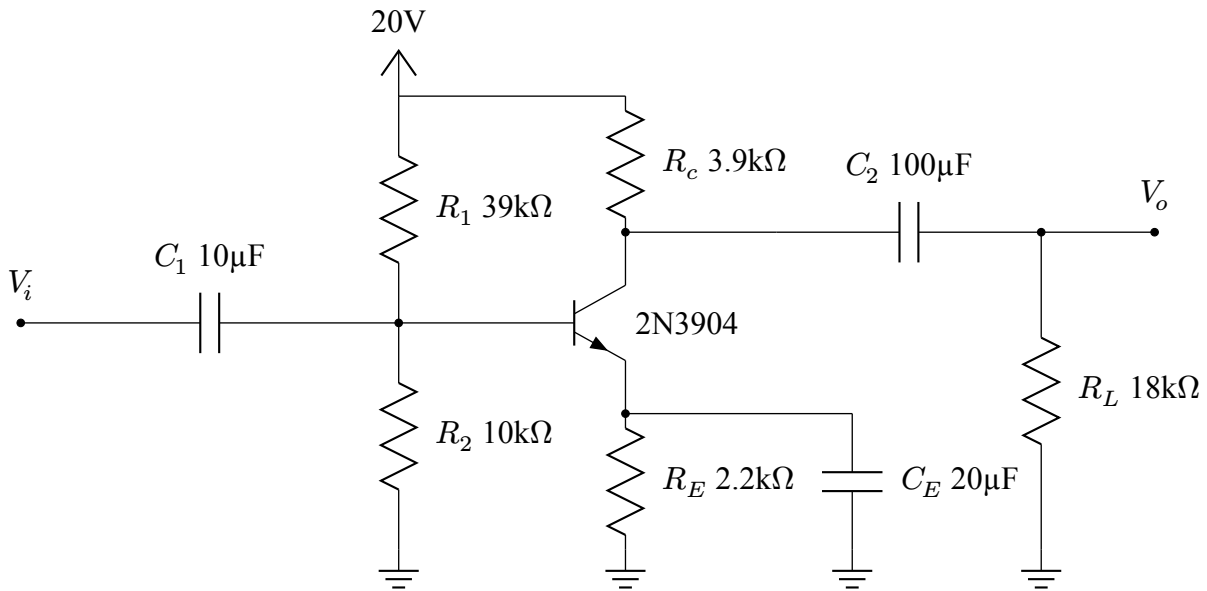How do the node voltages and currents relate to operating region and linearity?

Fig. 1. BJT Amplifier in the Common Base Configuration

$$R_B = R_1 \parallel R_2 \tag{1}$$

$$V_{\text{BB}} = \left(\frac{R_2}{R_1 + R_2} \right)(V_{\text{CC}}) \tag{2}$$

$$I_{CQ} = \frac{V_{BB} - V_{BE}}{\left(\frac{R_E}{\alpha}\right) + \left(\frac{R_B}{\beta}\right)} \tag{3}$$

$$V_{CEQ} = V_{CC} - \left(R_{CC} + \frac{R_E}{\alpha}\right) I_{CQ} \tag{4}$$

III.   METHODS AND MATERIALS

A. Equipment

Table 1. Bench laboratory equipment used in this procedure.

Manufacturer	Serial Number	Function
Tektronix	CPS250	Power Supply
Tektronix	TDS2024C	Oscilliscope
Fluke	45	Digital Multimeter
VOLTEQ	SFG-1010	Functon Generator

B. Experimental Procedure

The circuit in Fig. 1 was constructed as shown, save for the R_E resistor, which was changed to $2k\Omega$ due to insuffcient resistor values in the lab. V_i was connected to connected to the function generator. V_{CC} was connected to the benchtop power supply. All Q-point node voltages were recorded and verified, as well as verifying that $V_{BE} = +0.7V$. The DC blocking of the capacitors was also verified. From the data, I_{CQ} and V_{CE} were calculated. These were then compared to the prelab results. β was calculated using the measured and calculated voltages, and then compared to the measuread β from the multimeters hfe measurement mode.

The function generator was then turned on and set to 50 kHz. Using the oscilliscope, the v_i and v_o were measured, and the amplitude of the waveform from the function generator was adjusted until the v_o waveform appeared to be a pure sine wave (with the exception of some noise). The max output peak-to-peak voltage was measured by adjusting the input voltage until just before it started clipping. To verify the voltage swing was measured with a waveform that had minimal harmonic distortion or clipping, an FFT was taken of the output signal. The peak-to-peak values of v_i and v_o.

Similar steps were then repeated with a different BJT transistor to verify the effects of a change in β, and how effective the bias stability provided by R_E is.

Bandwidth measurements were taken by using the function generator to scan through the frequency spectrum to observe if the amplifiers gain increased substantially. High and low drop off frequencies were recorded, these became f_{upper} and f_{lower} respectivly. These are the points are the 3dB down points where the output has dropped by a factor of 0.707. The midband frequency f_{mid} was calculated using the geometric mean.

Laboratory analysis included comparing theoretical and experimental Q values, gain results, as well as differences between the two transistors used based on their differing β values. Bias stability conditons were also checked.

IV.   RESULTS

Parameter	Theoretical Value	Experimental Value	Percent Difference
V_("BE")	0.7	0.67	4.38
V_("BQ")		4	200.00
V_("EQ")		3.33	200.00
V_("CQ")		11.7	200.00
I_("CQ")		1.9	200.00
V_("CEQ")	9.3	8.75	6.09

A. Sample Calculations

(if needed)

V.   DISCUSSION

Your discussion…

VI.   CONCLUSIONS

Your conclusions…