ELG3336: Experiment 2

BJT Common Emitter (CE) Amplifier

Objective

- Design the amplifier for voltage gain A_V and choose resistor values of R_C, R_e, R_1 and R_2 by calculation.
- Measure the voltage gain of the amplifier to see how it compares with your calculated voltage gain.
- Simulate and measure CE amplifier gain at different frequencies.

Common-Emitter Amplifier

The common emitter amplifier in Figure 1 is characterized by high voltage (A_V) and current gain (A_i). The amplifier typically has a relatively low input resistance (1 - 10 kΩ) and a fairly high output resistance. Therefore it is generally used to drive medium to high resistance loads. The circuit for the common-emitter amplifier can be seen in Figure 1. It is typically used in applications where a small voltage signal needs to be amplified to a large voltage signal.

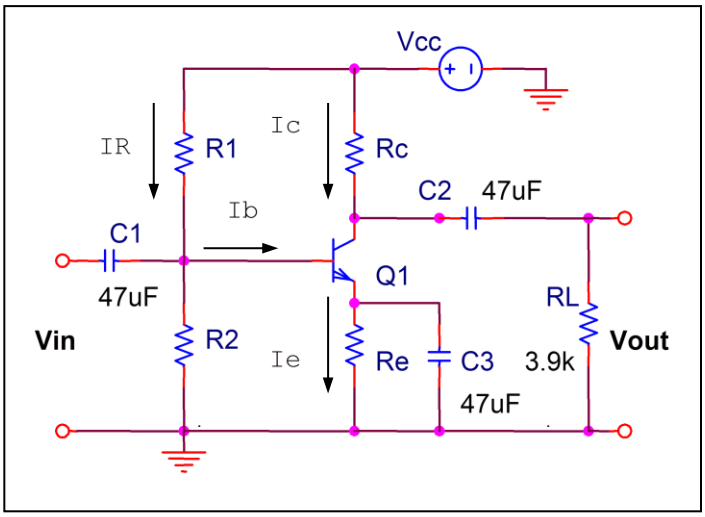

Figure 1 Common emitter amplifier circuit.

Pre-Lab Preparation

The lab preparation using MULTISIM simulation tool must be completed before coming to the lab. Show it to your TA for checking and grading at the beginning of the lab and get the TA's signature.

Equipment and Components

- 2N3904 transistor
- DC power supply
- Oscilloscope
- Function generator
- Digital multimeter
- Resistors
- Capacitors

Experimental Procedure

- Build the circuit in Figure 1 using the components values calculated in the pre-lab. Use standard parts when building the amplifier. Also, measure the actual value of the resistors using the multimeter.

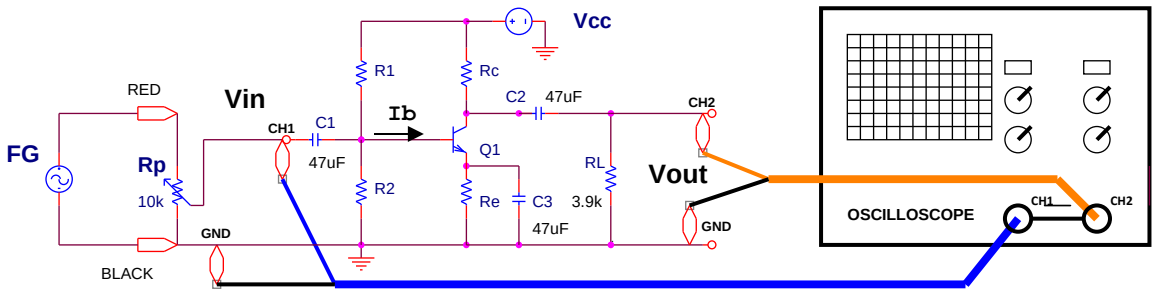

Figure 2 Common emitter amplifier circuit measurements.

- Apply DC power to the circuit and measure the amplifier's *Q* point using the Digital Multimeter. Measure the DC quiescent conditions. Make sure your circuit is biased correctly, your measurements should deviate no more than 10% from the chosen values for I_c and V_{ce}. If your values deviate more than that, adjust the resistance values, and provide an explanation in your report. Remember that inserting any meter, like an ammeter, will add additional resistances in your circuit. Measure all currents as voltage drops across a resistor. It becomes critical not to damage the BJT; otherwise you may have to start over again.
- Connect the Function Generator (FG) to supply the input AC signal to the CE amplifier circuit.
- Connect CH1 of the Oscilloscope in parallel with the input of the CE amplifier to measure the parameters of the input signal V_{in}. Connect CH2 of the Oscilloscope in parallel with the load resistor R_L to measure the parameters of the output signal V_{out}.
- Set the input voltage level to V_{in}= 20 mV, as measured by the CH1 of the oscilloscope. Set up the frequency values according to Table 1. For each of the selected frequencies

read the root mean squared (RMS) voltage of the V_{in} (CH1) and V_{out} (CH2) from the oscilloscope display and record the data in Table 1.

- Draw the input and output waveforms at f = 1 kHz on top of your MULTISIM plots. Compare the obtained gain with the simulation results. For each of the measurements, calculate the voltage gain in A_V (dB).

$$A_V\,(dB) = 20\log\left|\frac{V_{out}}{V_{in}}\right| \qquad (1)$$

Table 1 CE Amplifier Measurements

f [Hz]	**MULTISIM results**			**Measurements**		
	V_{in} [V]	**V_{out} [V]**	**A_v[dB]**	**V_{in} [V]**	**V_{out} [V]**	**A_v[dB]**
50						
100						
200						
500						
1k						
10k						
20k						
100k						

- Comment on the obtained data in terms how the CE amplifier gain changes at various frequencies and how close your measurements are to your MULTISIM simulation results.
- Increase the input signal level until output voltage clipping occurs. Record the maximum input and output levels of undistorted sine wave signal.
- Observe the phase shift between output and input signals. Is the configuration of your amplifier inverting or non-inverting?

Lab Report Questions

- Do your experimental results agree with the MULTISIM simulation results? Comment on both the DC and the AC values. Explain any differences.
- What will the voltage gain of your CE amplifier be if R_L = 8 Ω (input resistance of a speaker)?
- Is your CE amplifier suitable for an audio amplifier?