UNIVERSITY OF CALIFORNIA AT BERKELEY
College of Engineering
Department of Electrical Engineering and Computer Sciences

EE105 Lab Experiments

Report 4: Single Stage BJT Amplifiers: Common Emitter

Name:

Lab Section:

1 Lab Questions

3.1.2 DC values and gain when biased at maximum gain:

$V_{IN} =$

$V_{OUT} =$

$A_v =$

3.1.3 Using a load line for the pull up resistor on a BJT I-V curve, explain why a BJT has very low gain if it is not biased in the forward active region.

3.2.1 What is the input resistance?

$R_{in} =$

3.2.2 What is the gain measured with the oscilloscope? Is the gain measured with the oscilloscope roughly the same as the gain you measured with ICS?

$A_v =$

3.2.3 Why does clipping happen at the top? Why does clipping happen at the bottom? What is the output voltage swing?

Output Voltage Swing =

3.2.4 Why is the capacitor needed when we attach the load?

3.2.5 What is the output resistance of the amplifier?

R_{out} =

3.3.2 DC values and gain biased at maximum gain:

V_{IN} =

V_{OUT} =

A_v =

Is the gain more or less than the gain found without the degenerating resistor? Give an explanation for what's going on in the circuit that causes this change in gain.

3.3.3 Measured amplifier parameters:

R_{in} =

R_{out} =

How are these values affected by the emitter degeneration resistor? Why?

3.3.4 Theoretical amplifier parameters:

$\boxed{R_{in} =}$

$\boxed{R_{out} =}$

$\boxed{A_v =}$

3.3.5 Why might emitter degeneration be useful?

3.5.1–4 Compare the loudness of the speaker for the two following cases: 10 mV, 1 kHz amplitude sine wave applied directly to speaker, and speaker placed on the output of the CE amplifier biased with a 1 kΩ resistor. Which is the loudest and why?

2 Post-Lab Questions

2.1 Amplifier Two-Port Model

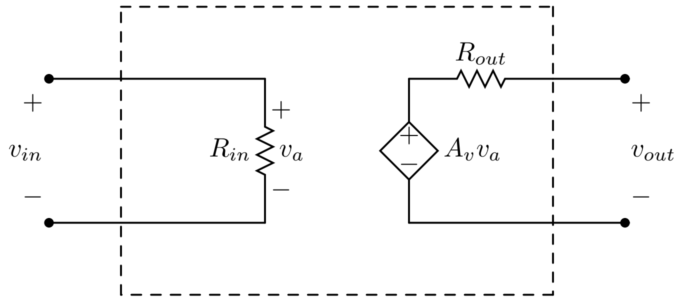

Figure 1: Generalized voltage amplifier

1. A CE amplifier can be represented as a generalized voltage amplifier shown in Figure 1, where R_{in}, R_{out}, and A_v are the values you found for input resistance, output resistance, and voltage gain, respectively. This generalization was accomplished by applying the concept of a Thévenin equivalent circuit on its small signal model. Now suppose that v_{in} is an ideal source supplying a 1 kHz, 20 mV peak-to-peak sine wave. What is v_{out}? Use the values obtained from the lab (no emitter degeneration, 10 kΩ biasing resistor) for R_{in}, R_{out}, and A_v.

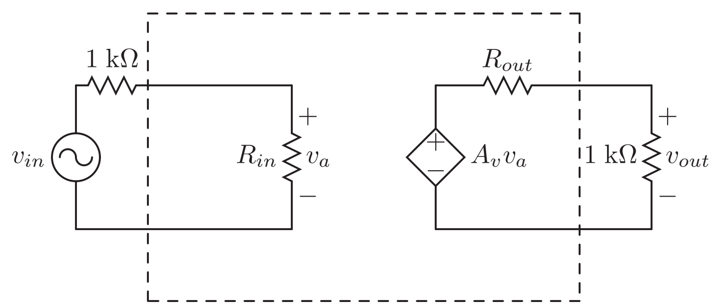

Figure 2: Voltage amplifier with non-ideal source and load attached

2. Now suppose a non-ideal voltage source with an internal source resistance of 1 kΩ was attached at v_{in}, and a load resistance of 1 kΩ was attached at the output as shown in Figure 2. If a 20 mV peak-to-peak sine wave was applied at the input, what would be the signal across the load?

3. A good voltage amplifier is one that can create the greatest possible voltage swing across the load given an input. Given a fixed gain, what input and output impedances would the ideal voltage amplifier have? Why?

4. A CE amplifier can also be generalized as a transconductance amplifier (input is a voltage, but output is a current related to the input voltage by the transconductance G_m). Using a Norton equivalent ci-cuit on the CE small signal model, draw the CE amplifier as a generalized transconductance amplifier (*Hint: It will look similar, but not completely identical to Figure 1*). Find G_m using the data you have collected from the lab (no emitter degeneration, 10 kΩ biasing resistor).

5. A good transconductance amplifier is one that can get the greatest possible current through the load given an input voltage. Given a fixed gain, what input and output impedances would the ideal transconductance amplifier have? Why?

6. Extending the idea further, we can also talk about current amplifiers. If a good current amplifier is one that can get the greatest current through the load, what input and output impedances would the ideal current amplifier have? Why?