UNIVERSITY OF CALIFORNIA
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EE 105 Prof. Pister
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LAB 6 Input/Output impedance and gain

Continuing on where we left off in Lab 5, we now want to measure the input and output impedance of the emitter follower. Note that the input impedance of the emitter follower depends on the impedance hanging off of the emitter.

Part 5 Output Resistance

Apply a 16kHz sine wave to the follower from part 4. Use a small amplitude, <100mV if you can, and a DC offset of a few Volts. Verify that the output is a good copy of the input. Put a 1uF capacitor on the output in series with a 100 Ohm load resistor R_L as in Figure 3A. What is the magnitude of the impedance of the capacitor? Use a few different values for R_L (10, 50 Ohms) and record the gain to V_{out4} and V_{load} vs. load resistance. Estimate the output resistance of the amplifier. Comment on the magnitude and phase of the load voltage vs. the output voltage.

Part 6 Input Resistance

With the same 16kHz sine wave as part 5, put a 10k Ohm resistor, R_S, in series between the function generator and the base, and short the load resistor (R_L=0) as in Figure 3B. Notice that the output waveforms don't look sinusoidal anymore. This is due to the finite discharge rate of the load capacitor from a 1mA current source. Add in enough resistance back to R_L to get the output looking sinusoidal again (around 10 Ohms should do it). Measure the gain from the input, V_{in} , to the base voltage, V_B . Try a couple of different resistors. Remove the load (capacitor and resistor) and again measure the gain from input to base. Estimate the input resistance of your amplifier with and without the capacitive short on the output.

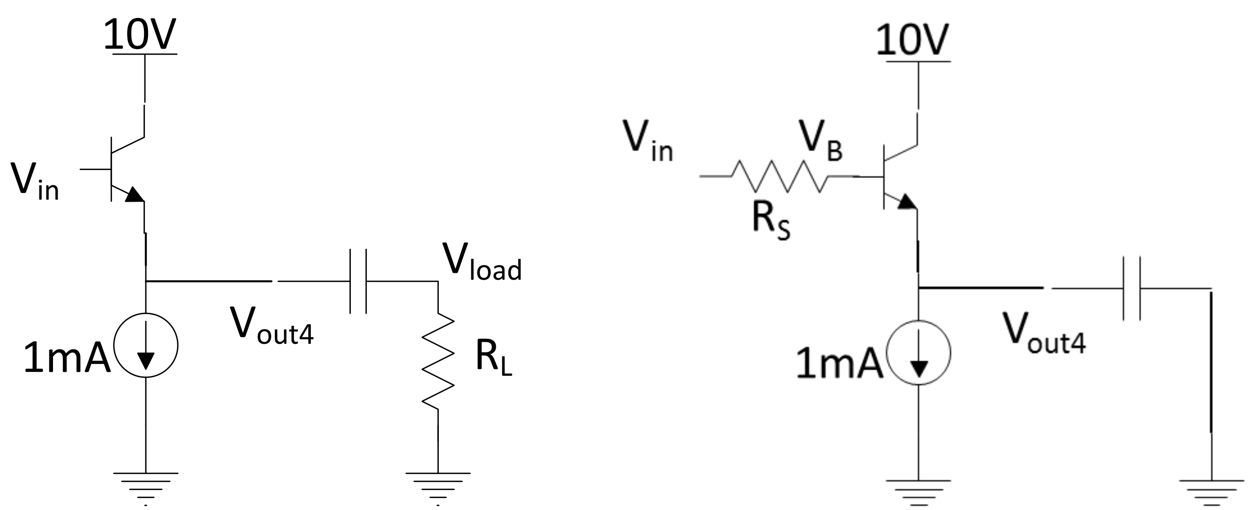

Figure 3AB Capacitively coupled output load R_L , and source resistance R_S .

Part 7 Gain with real sources and loads

Assume that you have a sensor with a 100k output resistance that gives you a 100mV signal at 16kHz. You may set the DC bias on the signal wherever you like. You can simulate this with your function generator with a 100k load in series, similar to what you did in part 4 of Lab 5. You have a load with an impedance of 100 Ohms. Build a circuit that takes the sensor signal, amplifies it and drives the load. The amplitude of the signal across the load must be at least 1V, meaning the overall gain is at least 10 (in magnitude). With the components that you have used in the last few labs there are many ways to solve this problem. A common emitter amplifier with a follower on the input and output would work.

A common source amplifier, or a well-designed common emitter amplifier, might not need the input follower.

When you have a solution, show your TA: a (hand drawn) schematic, your circuit, and the input and output waveforms plus any intermediate waveforms in the signal path.

Make sure that you explain clearly in your report why you chose the topology that you used, as well as the component values and bias points.