Physics 4700 Experiment 6
Operational Amplifiers

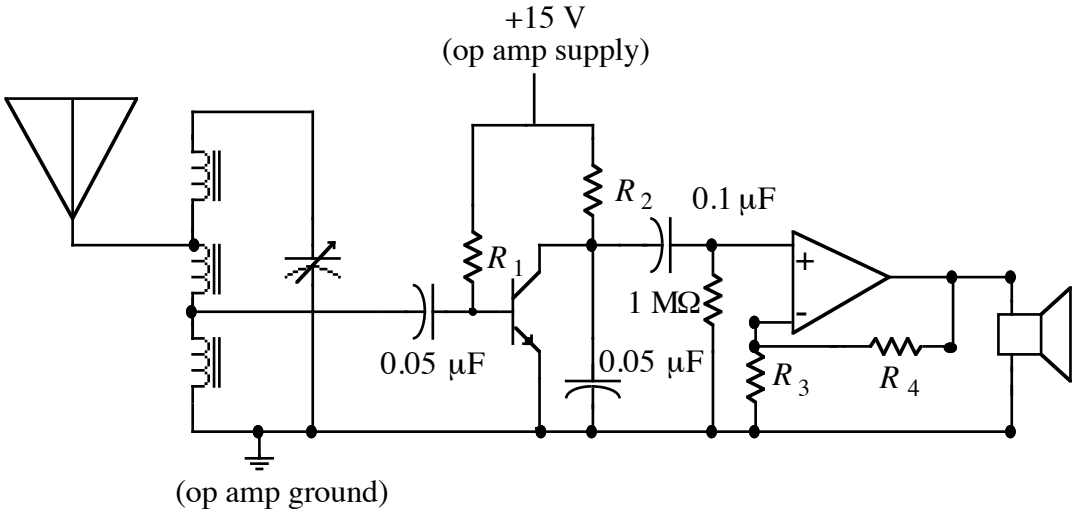
Review the discussion of a potential DC offset in the generated sine wave at the top of the Lab 3 instruction sheet. The same comment apply to square and triangular waves.

1) Measure the voltage gain vs. frequency for a non-inverting amplifier with a gain of 0, 20, and 60 dB. Scan the frequency range 10 Hz (or as low as you can go) to 100 kHz. Plot all measurements on one Bode plot together with the open loop gain from the op amp's spec sheet (see next page).

2) Do one of the following:
a) Build an inverting amp with a gain of 40 dB. Measure the gain vs. frequency over the range 10 Hz -100 kHz. Present the measurements in a Bode plot together with the open loop gain from the op amp's spec sheet.
b) Build a summing amplifier. The input voltages can be DC. Test the summing amp with various combinations of input voltages using two power supplies or various combinations of resistors in a resistor divider. Summarize your result in a table.
c) Build a difference amplifier with gain of 20 dB. Summarize your result in a table for various combinations of input voltages.

3) Build a circuit to perform integration of a 1 kHz square wave, sine wave, and triangular wave. Capture the input and output waveforms. Based on the amplitude of each input signal, calculate (show work) the expected amplitude of the output signal for comparison with the measurement.

4) Return of the Radio from Hell:
In the previous lab you built a 3-stage AM radio. The last two stages of the radio amplified the signal so that it would be audible. Replace the last two transistors with a non-inverting amplifier of gain 40 dB. See the circuit below. Pick R_1 and R_2 in the same fashion that they were chosen for the AM radio lab. Pick R_3 and R_4 to give a gain of 40 dB. Compare this version of the radio with the 3-stage version (i.e. which works better). Measure the base and collector voltages. Capture three waveform pictures: 1) the base of the transistor at the time scale of 50 ns/division, 2) the collector at 250 μs/division, 3) input and output of the op-amp at the time scale of 250 μs/division. Discuss what you see.



Note: *All circuits use a 741 (or equivalent) op amp and the op amp breadboard.*

Open loop gain for 741: The op-amps used in the lab were fabricated by TI. Unfortunately we cannot find the spec sheet for the open loop gain. We will use the gain below from Analog Devices which should be a good approximation:

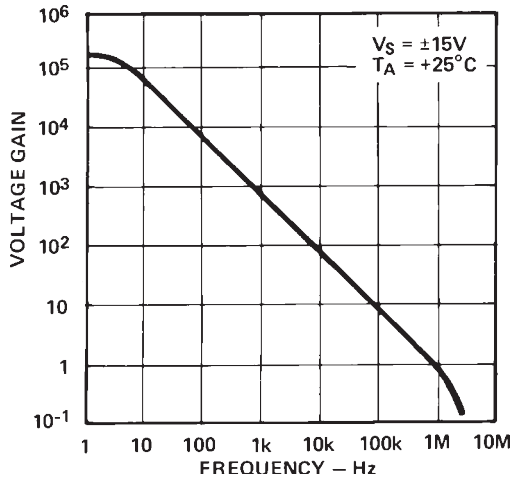


Figure 3. Open-Loop Gain vs. Frequency