EL 351 - Linear Integrated Circuits
Laboratory Lab Equipment Familiarization & Basic Op-Amp Review

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Equipment:

- Agilent 54622A Deep-Memory Oscilloscope
- Agilent E3631A Triple-Output DC power supply
- Agilent 33120A Function Generator
- Agilent 34401A Digital Multimeter

Lab Equipment Familiarization

A) Demonstrate to your instructor that you can set your dual power supply to ±15 VDC, with a current limit of 50 mA, on both supplies.

OK_____________

B) Determine the minimum, and maximum, values of current limiting on both adjustable supplies of one of your dual power supplies. Record your data in a table.

OK_____________

C) Demonstrate to your instructor the dual-tracking feature of your dual power supply, using +20 VDC and -10 VDC.

OK_____________

D) Using the equipment at the next bench, or your personal multimeter, measure the DC resistance of the digital multimeter on each DC current range. Record your data in a table.

OK_____________

E) Determine how to construct a power supply that can be adjusted from a minimum of +5 V, to a maximum of +85 V, using both power supplies at your position. Be sure to draw a schematic of it.

OK_____________

F) What is the ***practical useful*** frequency range of the multimeter used to measure AC voltage? (Hint: A digital instrument should provide at least 1% accuracy.)

OK_____________

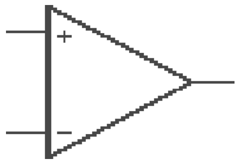
G) Using **ONLY** the function generator (do **NOT** use a power supply), adjust it to provide a 5 KHz, 2.5 V_p sinewave with a DC offset of +1.5 V. Be sure to sketch the waveform.

OK_____________

Basic Op-Amp Review

This part of the experiment is intended to dust off the cobwebs of knowledge you have acquired in prior courses about op-amp basics. Such concepts as predicting gain given parts values, saturation, virtual short and virtual ground will be reinforced.

☞ Since this is the first experiment of the semester, pay particular care to take data carefully, in an organized way, on separate sheets of paper. Be sure to date and number each page of data, line out (do not erase) errors, and record **all** significant information.



This symbol denotes an op-amp (use a 741C for all steps in this experiment), connected to ±15 VDC supplies at pins 7 and 4, respectively, **WITH CURRENT LIMITING SET TO MINIMUM!** Refer to a data book for pinout information and specifications.

Figure 1

A_F = closed-loop voltage gain, with feedback.

I. Unity-Gain Source Follower, with DC Input

1. Connect the circuit shown in Figure 2.
2. Vary Vin from 0 VDC to +16 VDC. Take data to make a graph of Vo vs. Vin. Note when saturation occurs.
3. Vary Vin from 0 VDC to -16 VDC. Take data to make a graph of Vo vs. Vin. Note when saturation occurs.
4. Neatly graph the results of I.2 and I.3, on a single graph where the abscissa runs from -16 V to +16 V.
   See sample lab reports for proper graph format.

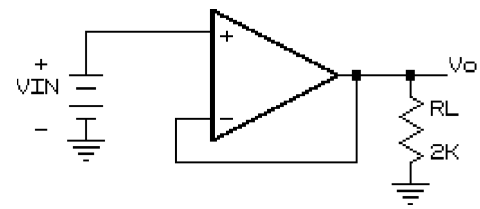


Figure 2

II. Inverting Amplifier, A_F = -2 V/V, with DC Input

1. Connect the circuit shown in Figure 3.
2. Vary Vin from 0 VDC to +10 VDC. Take data to make a graph of Vo vs. Vin. Note when saturation occurs.
3. Vary Vin from 0 VDC to -10 VDC. Take data to make a graph of Vo vs. Vin. Note when saturation occurs.
4. Neatly graph the results of II.2 and II.3, on a single graph where the abscissa runs from -10 V to +10 V.

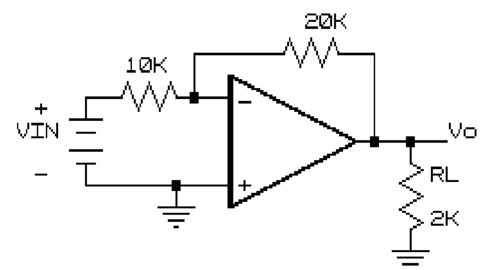


Figure 3

III. Noninverting Amplifier, A_F = +10 V/V, With AC Input, Then With AC + DC Offset Input

1. Connect the circuit shown in Figure 4.
2. Make Vin = 1 sin (6283t) volts (a 1 volt peak, 1 KHz sine).
3. Record Vin and Vo waveforms.
4. Now change Vin so that Vin = 0.6 + 1 sin (6283t) volts. (a 1 volt peak, 1 KHz sine, with 600 mV of DC offset).
5. Record Vin and Vo waveforms. See Figure 5 below for Vin.

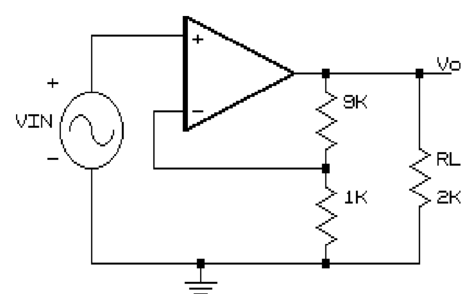


Figure 4

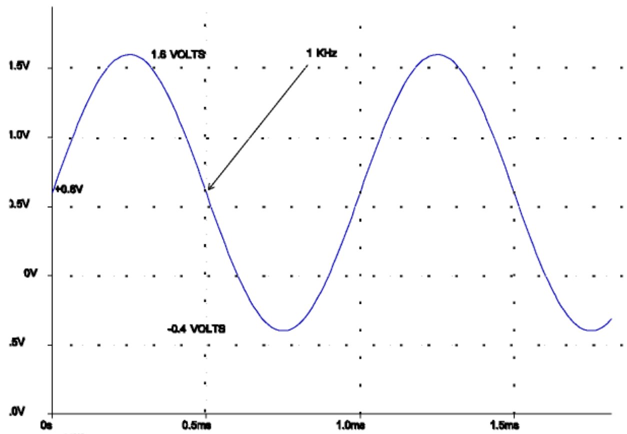


Figure 5

Notice that the waveform displayed shows all the needed data that you should include when you sketch waveforms. The ***frequency*** *is shown, all* ***significant voltages*** *(DC offset = +0.6 V, waveform maximum = +1.6 V, waveform minimum = -0.4 V) are shown.* ***A sketch need not be neat, and need not take large amounts of time to produce; it must, however, include all necessary information.***

IV. Inverting Amplifier, A_F = -10 V/V, With AC Input, Then With AC + DC Offset Input

1. Connect the circuit shown in Figure 4.
2. Make Vin = 1 sin(6283t) volts.
3. Record Vin and Vo waveforms.
4. Now change Vin so that Vin = 0.6 + 1 sin(6283t) volts.
5. Record Vin and Vo waveforms.

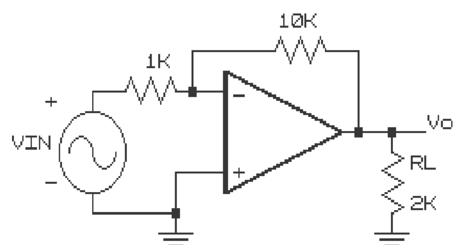


Figure 6

V. Noninverting Amplifier, A_F = +10 V/V, Operating in Linear Range

1. Connect the circuit shown in Figure 7. Vin = +1 V.
2. **Measure the following:**
   a. voltage at + terminal___________
   b. voltage at – terminal___________
   c. voltage at Vo terminal _________

   Now determine:

   d. voltage gain = ____________
   e. are + and - terminals a virtual short?__________Why?
   f. is any terminal a virtual ground?_____________Why?

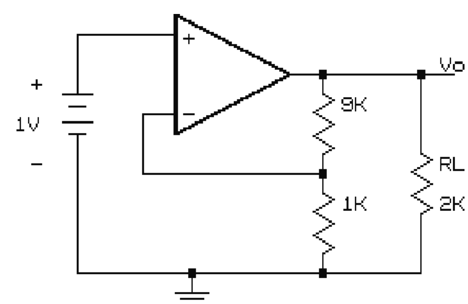


Figure 7

VI. Noninverting Amplifier, A_F = +10 V/V, Operating in Saturation

1. Using the circuit of Figure 7, change Vin so that Vin = +2 V.
2. **Measure the following:**
   a. voltage at + terminal__________
   b. voltage at – terminal__________
   c. voltage at Vo terminal_________

   Now determine:

   d. voltage gain = _______________
   e. are + and - terminals a virtual short?___________ Why?
   f. is any terminal a virtual ground?_______________Why?

VII. Inverting Amplifier, A_F = -10 V/V, Operating in Linear Range

1. Connect the circuit shown in Figure 8. Vin = +1 V.
2. **Measure the following:**
   a. voltage at + terminal __________
   b. voltage at - terminal __________
   c. voltage at Vo terminal ________

   Now determine:

   d. voltage gain = _______________
   e. are + and - terminals a virtual short?___________ Why?
   f. is any terminal a virtual ground?_______________ Why?

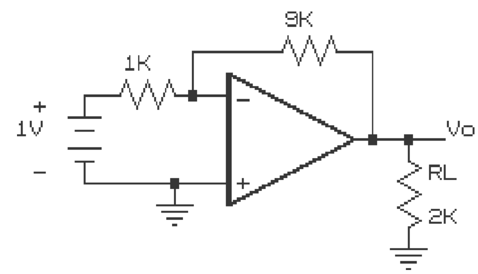


Figure 8

VIII. Inverting Amplifier, A_F = -10 V/V, Operating in Saturation

1. Using circuit shown in Fig. 8, change Vin so that Vin = +2 V
2. **Measure the following:**
   a. voltage at + terminal __________
   b. voltage at – terminal__________
   c. voltage at Vo terminal ________

   Now determine:

   d. voltage gain = _______________
   e. are + and - terminals a virtual short?___________ Why?
   f. is any terminal a virtual ground?_______________ Why?