Goals: Learn about operational amplifiers
Design a differential (difference) amplifier

Problem statement: Design a differential amplifier using the circuit topology shown in figure 1.
Specifications to be met:
1) Differential input resistance: 100k ohms
2) Voltage gain: 10.
3) Common mode rejection greater than 30 db
4) Output resistance: 50 ohms.

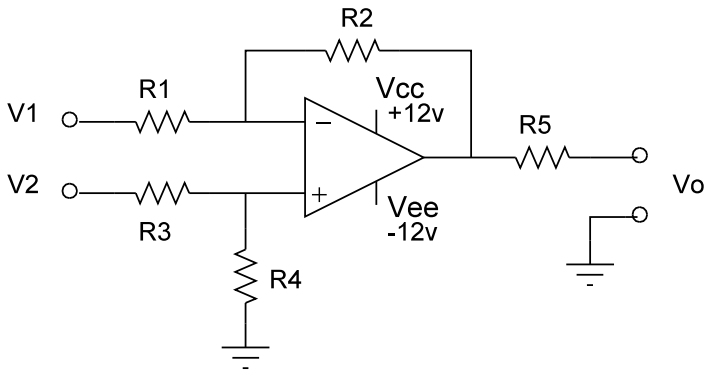

Figure 1

General procedure
1) Design the circuit.
2) Construct on a bread board.
3) Measure circuit performance. Try DC and AC (sine) source signals.
4) Confirm that your design meets the stated specifications.

Measurements & calculations are to include, but not limited to:
1) Differential gain
2) Common mode gain
3) Calculate common mode rejection
4) Measure resistor values used
5) Calculate theoretical common mode rejection based on measured resistor values.

Documentation
Record your design calculations, construction notes, measurements, etc. in your lab notebook. This record of work should be self documenting, i.e. you should be able to pick up your lab notebook some time in the future and understand what you did today. Make sure that units and type of signal (such as DC volts, AC volts rms, etc) are shown. Be neat. Others, particularly your instructor, must be able to read your work. I encourage the use of a circuit template when drawing schematics.

Report - For this lab, your lab notebook documentation will be your primary report. Write a results and conclusions statement in your notebook after recording all the measurements. Include your measured gain, common mode rejection, and slew rate in this statement.

Turn in - A copy of your results and conclusions statement (type or hand copy, xerox, or a readable photo that you print are acceptable. i.e., the hand-in is on paper)

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Notes:

1) With a gain of 10 the input signal (V2 - V1) cannot be too large or the amplifier will be saturated (that means the output voltage becomes as large as possible which is somewhat less than Vcc).

2) To make it easier to create a small voltage figure 2 shows using a 10:1 voltage divider to reduce magnitude of a voltage signal coming from a power supply (DC) or signal generator (AC) by a factor of 10 (or 20 db).

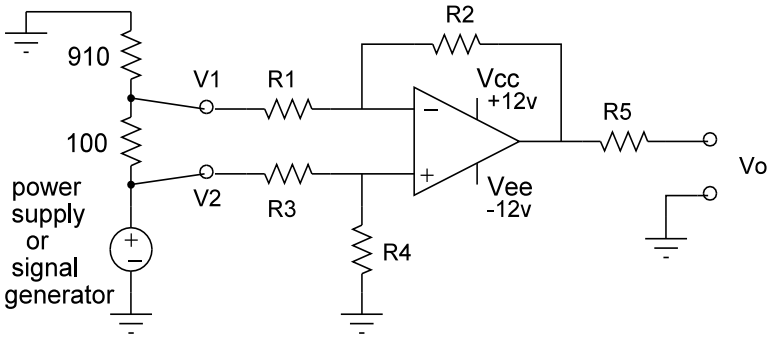

Figure 2

3) The Wavetek model 19 signal generators are somewhat noisy at small output magnitude. By using a voltage divider that is not part of the generator the generator output can be kept reasonably large.

4) To measure common mode gain the same signal needs to be applied simultaneously to V1 and V2. See figure 3. The wire to input V1 can be changed to the same circuit node that connects to V2. The same voltage will thus be applied to both inputs.

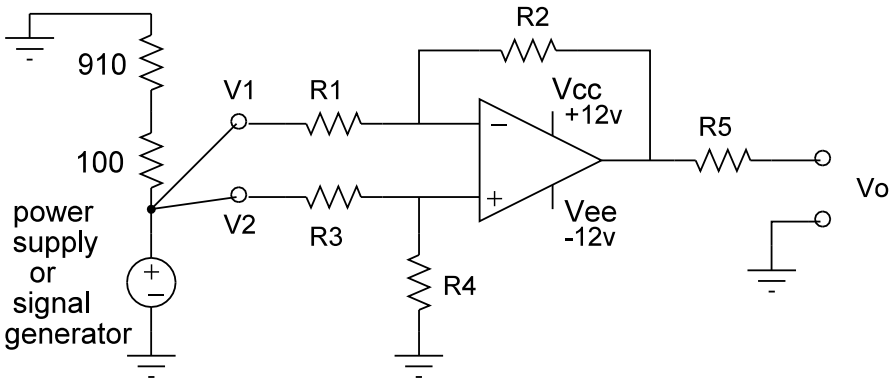

Figure 3

5) Use a TL074 opamp made by Texas Instruments (TI). This opamp package has four amplifiers in it but you only need to use one of them. The data sheet for the TL074 is on the class web page.

6) Op-amps have a finite common mode input voltage range. With +/- 12 power the opamp we are using will have a common mode input range of -8 to +8 volts at minimum, likely more.