Laboratory Exercise 2:
BME 373 Electronics II

OBJECTIVE:
The goal of this lab is to design an ECG Medical Instrumentation Amplifier using 3 operational amplifiers. There will be three steps to this lab.

I. BASIC OP AMP CIRCUITRY

1. Design an inverting amplifier with unity gain using the LM324 Quad Op Amp. The design should use the 9 volt batteries and 100k feedback resistor.

   1.1. Connect the function (sine wave) generator to the input and show the input and output signals on the scope.

   1.2. In your report, show that the amplifier is unity gain and is inverting.

   1.3. Also answer the following questions in your report:
      1.3.1. What are the values of the resistors used in the circuit?
      1.3.2. What is the maximum input voltage that this amplifier can support without distorting the output signal?
      1.3.3. Why?

2. Repeat part 1 except that the gain is 2

3. Repeat part 1 except that the gain is 0.5.

4. Design a non-inverting amplifier with a gain of 2 using the LM324 Quad Op Amp. The design should use the 9 volt batteries and 100k feedback resistor.

   4.1. Connect the function (sine wave) generator to the input and show the input and output signals on the scope.

   4.2. In your report, show that the amplifier gain is 2 and is non-inverting.

   4.3. Also answer the following questions in your report:
      4.3.1. What are the values of the resistors used in the circuit?
      4.3.2. What is the maximum input voltage that this amplifier can support without distorting the output signal?
      4.3.3. Why?

5. Repeat part 4 except that the gain is 1.

6. Repeat part 4 except that the gain is 1.

7. Repeat part 4 except that the gain is 0.5.

8. DIFFERENCE AMPLIFIER

9. Design a Difference Amplifier with unity gain using the LM324 Quad Op Amp. The design should use the 9 volt batteries and use 100k feedback resistors.

    9.1. Connect the ECG simulator to the input and show the output signal on the scope.

    9.2. Also answer the following questions in your report:
        9.2.1. What are the values of the resistors used in the circuit?

10. Repeat part 1 except that the gain is 10.

11. ECG Medical Amplifier

12. Design an ECG Medical Amplifier using the LM324 Quad Op Amp. The design should use the 9 volt batteries and use 100k feedback resistors use the variable resistor as the input resistor the first stage.

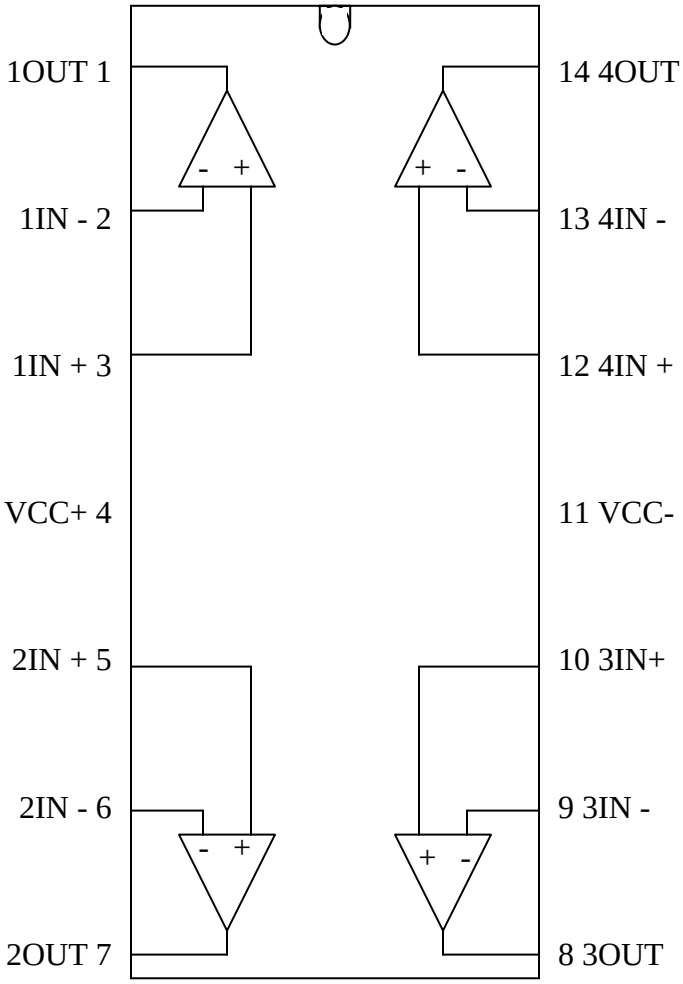
    12.1. Connect the ECG simulator to the input and show the output signal on the scope.

    12.2. Also answer the following questions in your report:
        12.2.1. What are the values of the resistors used in the circuit?

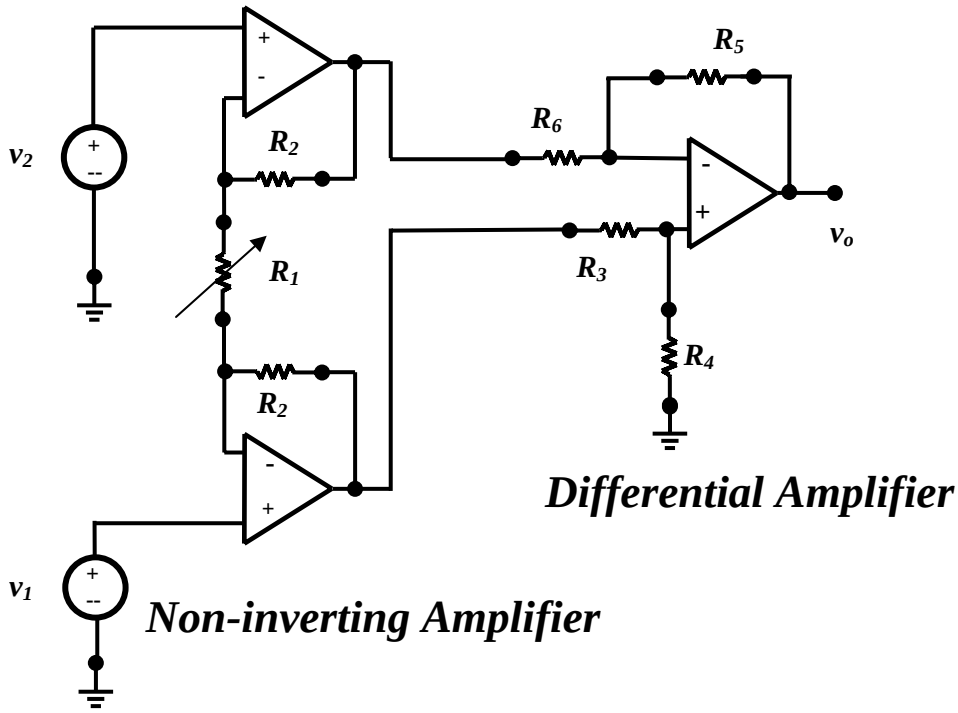
    12.3. Increase the gain of this circuit to show a non-distorted ECG signal on the output.

    12.4. Calculate the gain of this circuit. Show your calculations.

LM324 Quad OP AMP



Non-inverting Amplifier



Differential Amplifier

Non-inverting Amplifier