

MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY

Department of Electrical Electronics & Communication Engineering

COURSE NO: EECE- 208 (Electronics Circuit & Simulation Lab-II)

Open Ended Lab

Group No-02

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Name of the Experiment: Analyzing the design and characteristics of an Instrumentation Amplifier circuit for precise signal amplification.

Objective: To investigate the design, characteristics, and analysis of an instrumentation amplifier.

Theory: An instrumentation amplifier is a kind of difference amplifier where three Op-amp and several resistors are used. It is characterized by its high input impedance, low noise, high CMRR, and adjustable gain. Input is given through two biasing Op-amps and the third Op-amp amplifies the difference of the two voltage sources. The output or the gain can be controlled in several way for instrumentation amplifier, controlling the potentiometer, changing voltage sources V2 and V1 and lastly differing the ratio of feedback resistor and input resistance of the final Op-amp. Instrumentation amplifiers are used anywhere where it is necessary to amplify a weak signal in the presence of noise. They are a versatile and powerful tool that is used in a wide variety of applications.

The formula regarding the voltage output of instrumentation

amplifier,

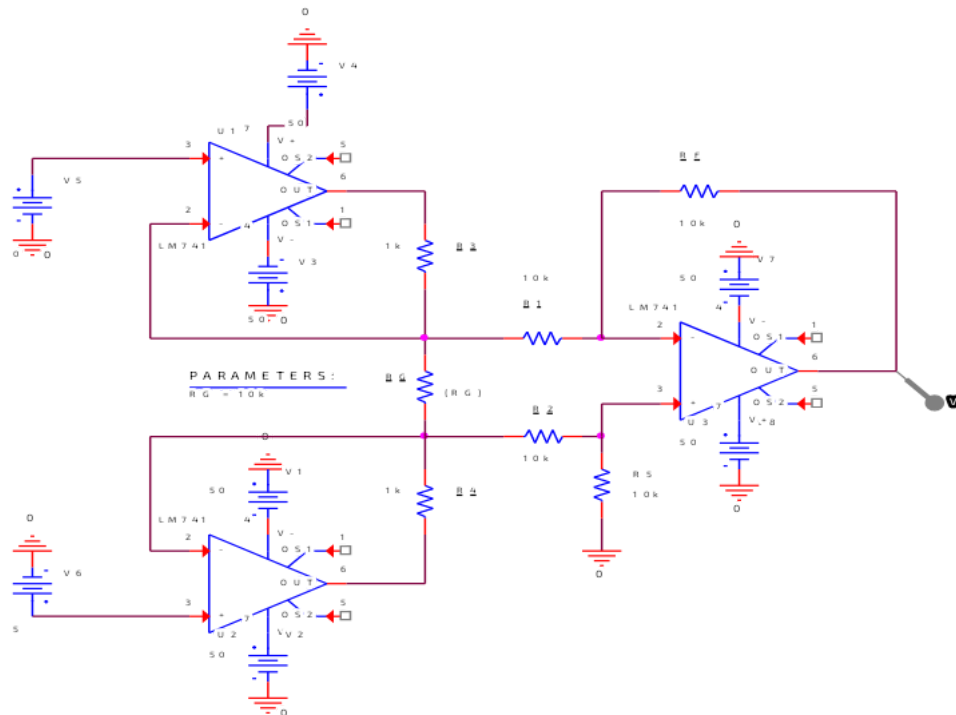
$$V_o = \frac{\left(\frac{R_F}{R_1}\right)(2R_3 + R_G)}{R_G}(V_2 - V_1)$$

$$A_v = V_o/(V_2 - V_1) = \frac{\left(\frac{R_F}{R_1}\right)(2R_3 + R_G)}{R_G}$$

Equipment:

- UA-741 Op-amp (3 pcs)
- Breadboard
- Jumper wires
- Power supply
- 1k ohm (2 pcs) and 10k ohm (4 pcs) Resistors
- 10k Potentiometer

Circuit Diagram:



Procedure:

1. V1 and V2 Inputs:

- V1 is applied to the non-inverting terminal of the first op-amp at the 6th pin, with its inverting terminal connected to a 1k-ohm resistor.

- Similarly, V2 is supplied to the non-inverting terminal of the first op-amp at the 6th pin, with its inverting terminal linked to a 1k-ohm resistor.

2. Connection to 10k-ohm Potentiometer (R_g):

- Both 1k-ohm resistors from the first op-amp are linked to a 10k-ohm potentiometer named R_g .

3. Connection to the Final Op-Amp:

- In the final op-amp, the non-inverting terminal is connected to the 1k-ohm resistor of the second op-amp through a 10k-ohm resistor.
- The inverting terminal is connected to the 1k-ohm resistor of the second op-amp with an additional 10k-ohm resistor.
- Another 10k-ohm resistor is grounded and connected to the non-inverting terminal of the final op-amp.

4. Feedback Resistors (R_f and R_1):

- R_f and R_1 , both equivalent to 10k ohms, are connected to the final op-amp.

5. Biasing and Output:

- All three op-amps are biased using a 12V DC source.
- The output of the final op-amp is taken from the 6th pin.

Report Question:

1. Draw the graph of output voltage vs R_G
2. Derive the output equation of instrumentation amplifier.
3. Draw the graph of output voltage vs V_6
4. If all the value of the resistor is kept equal, what would

be the output voltage?