Engr098 Lab6

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Objective

The goal of this experiment is to create a circuit on a breadboard to demonstrate an inverting amplifier using an operational amplifier (Op Amp). The circuit will be powered by two 6V batteries and one DC power supply. The objective is to understand how the inverting amplifier works, measure its gain, and verify the output signal polarity.

Equipment

- Breadboard
- Operational Amplifier (e.g., LM741)
- Two 6V batteries
- DC power supply
- Resistors: $R_{in} = 1\ k\Omega$, $R_f = 2\ k\Omega$
- Digital Multimeter (DMM)
- Connecting wires and alligator clips

Circuit Design

Figure **??** shows the circuit diagram of the inverting amplifier built on the breadboard. The inverting input $(-)$ is connected to the input voltage V_i through resistor R_{in}. A feedback resistor R_f connects the output V_o to the inverting input. The non-inverting input $(+)$ is connected to ground.

$$V_o = -\left(\frac{R_f}{R_{in}}\right) V_i \tag{1}$$

Substituting the given resistor values:

$$V_o = -\left(\frac{2k\Omega}{1k\Omega}\right) V_i = -2V_i \tag{2}$$

Therefore, the voltage gain $A_v = -2$, meaning the output voltage is inverted and amplified by a factor of 2.

Experimental Setup

The circuit was assembled on a breadboard as shown in Figures 1 to 4. The DC power supply was used to test voltage levels across resistors and op amp terminals. Two 6V batteries were connected in series to provide a $\pm 6V$ dual power supply for the op amp.

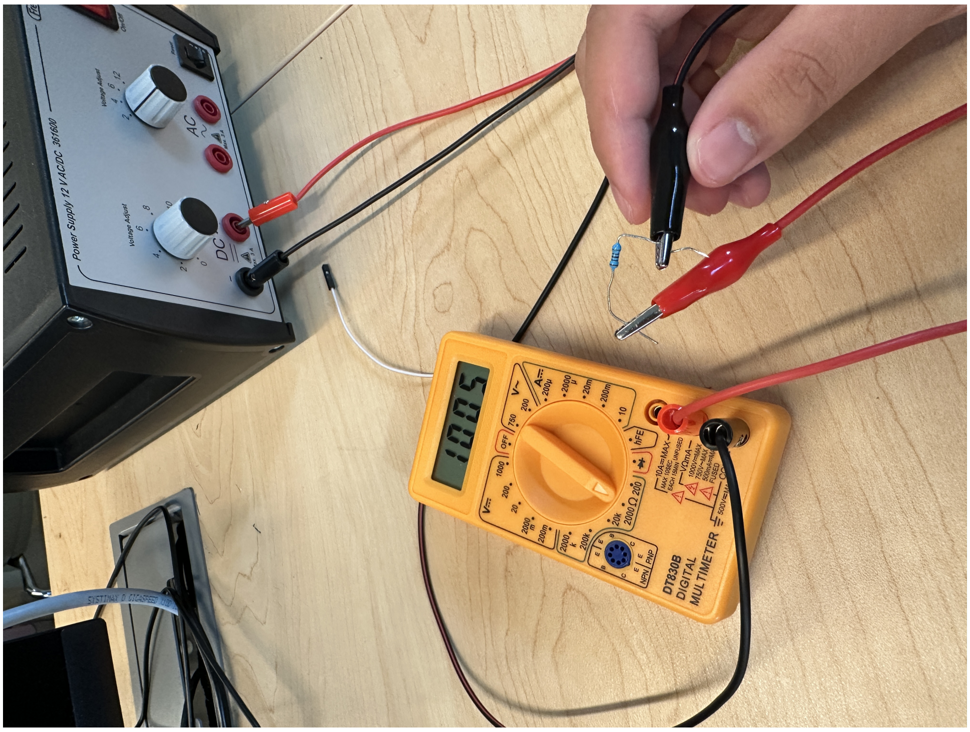

Figure 1: Measuring resistor voltage drop using DMM.

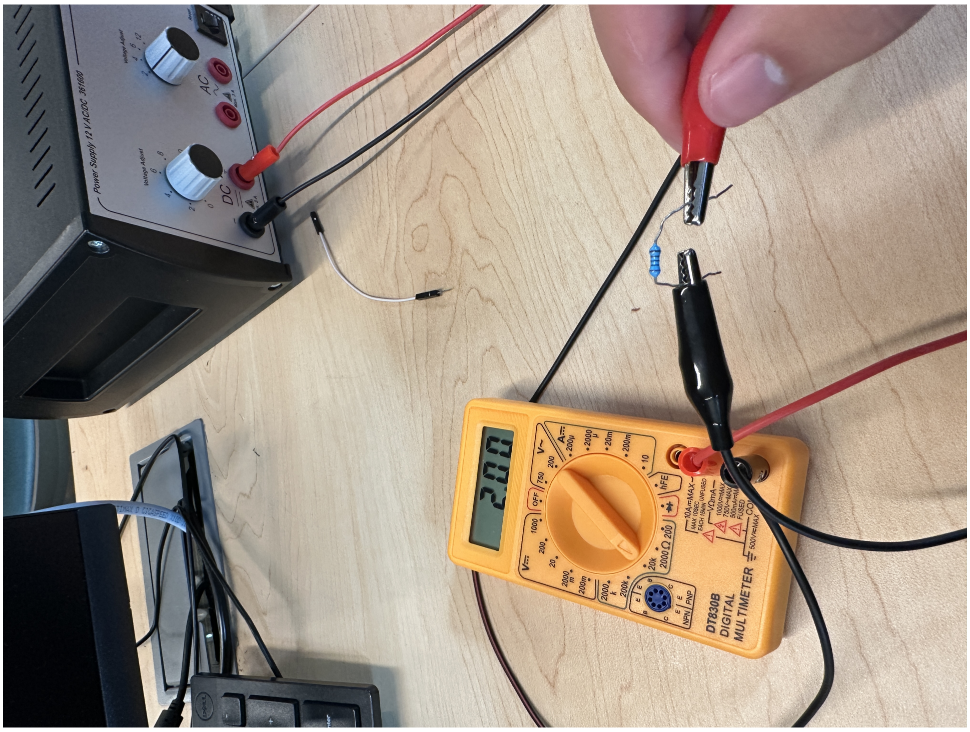

Figure 2: Testing input resistor with DC power supply.

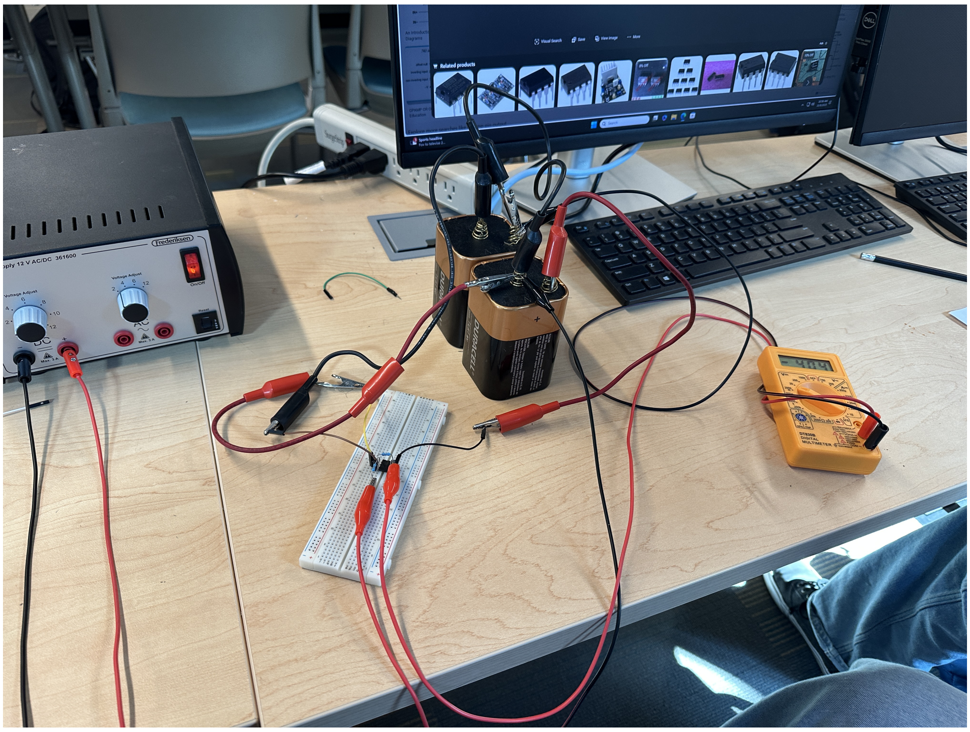

Figure 3: Complete breadboard setup with op amp and dual 6V batteries.

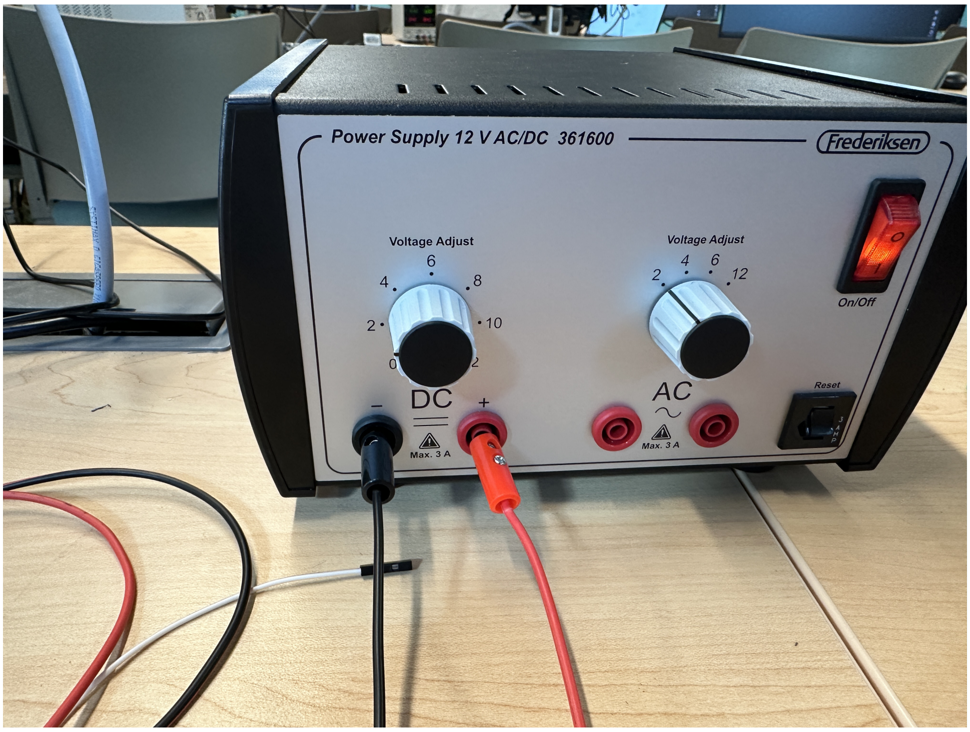

Figure 4: DC power supply connected to the circuit.

Measurements and Results

The input and output voltages were measured using the multimeter. The results confirmed that the output voltage was approximately twice the input voltage and inverted in polarity.

Example measurement results:

- Input Voltage (V_i): 2.0 V
- Output Voltage (V_o): -4.04 V

The measured gain is:

$$A_v = \frac{V_o}{V_i} = \frac{-4.04}{2.0} = -2.02 \tag{3}$$

This experimental gain matches the theoretical value of -2.

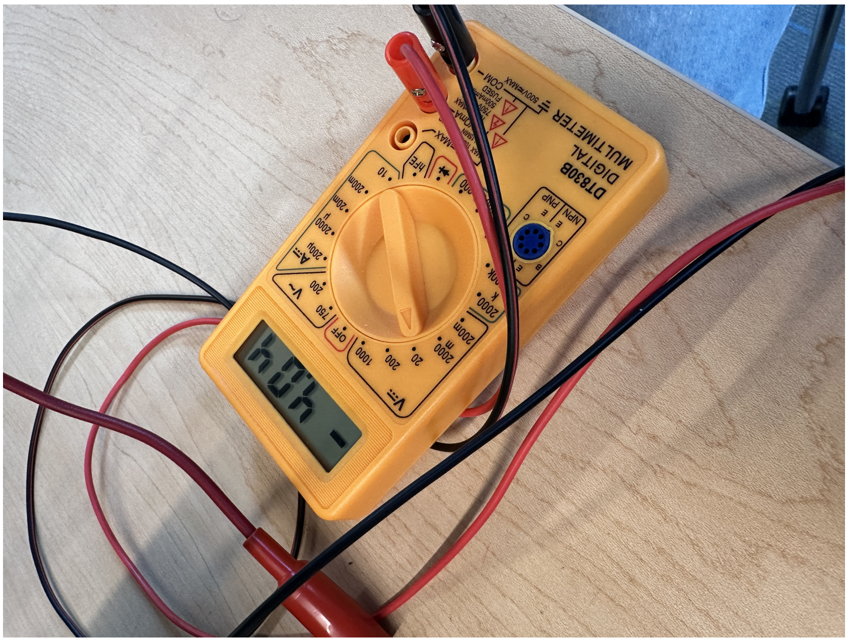

Figure 5: Measured output voltage showing inversion.

Discussion

The inverting amplifier configuration demonstrates a phase inversion between input and output. When a positive input is applied, the output becomes negative. The ratio of feedback resistor to input resistor determines the gain magnitude. Any minor discrepancies between theoretical and measured values may result from resistor tolerances or voltage supply variations.

Conclusion

The experiment successfully demonstrated an inverting amplifier using an operational amplifier. The measured gain closely matched the theoretical prediction of -2. This confirms the principle that the inverting amplifier provides output voltage proportional to the input but with inverted polarity.