

5.4.4: Difference Amplifier

Overview:

In this assignment, we implement a simple operational amplifier-based circuit. Since operational amplifiers are used commonly in circuits used to implement mathematical operations, we implement the process of taking the difference between two voltages.

Before beginning this lab, you should be able to:

- Analyze operational amplifier-based circuits

After completing this lab, you should be able to:

- Design and build an operational amplifier-based difference amplifier

This lab exercise requires:

- Analog Discovery module
- Digilent Analog Parts Kit
- Digital multimeter (optional)

Symbol Key:

	Demonstrate circuit operation to teaching assistant; teaching assistant should initial lab notebook and grade sheet, indicating that circuit operation is acceptable.
	Analysis; include principle results of analysis in laboratory report.
	Numerical simulation (using PSPICE or MATLAB as indicated); include results of MATLAB numerical analysis and/or simulation in laboratory report.
	Record data in your lab notebook.

General Discussion:

The circuit shown in Figure 1 is called a difference amplifier. v_a and v_b are the applied (input) voltages to the circuit. v_{out} is the output voltage from the circuit.

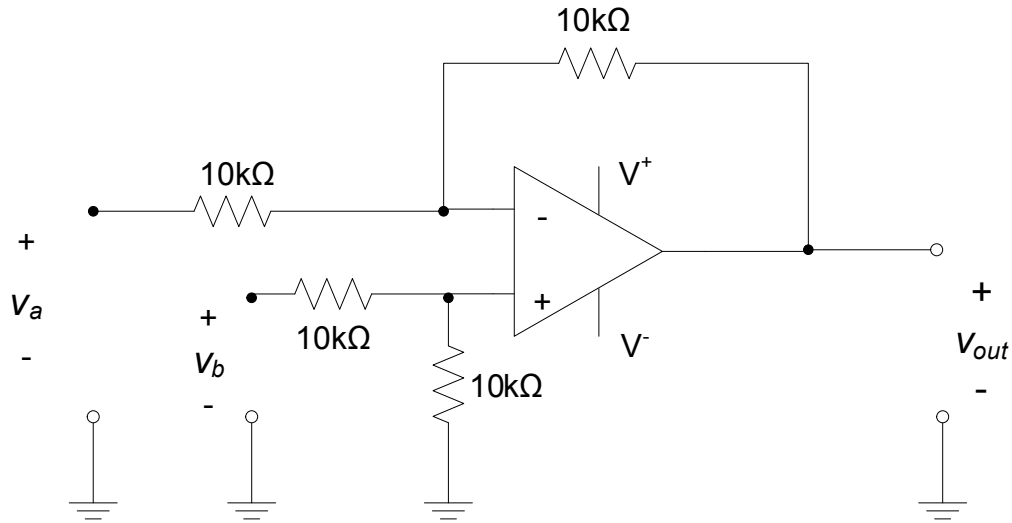


Figure 1. Difference amplifier circuit.

Pre-lab:

ANALYSIS

Determine the relationship between v_a , v_b and V_{out} for the circuit shown in Figure 1. Why is the circuit called a difference amplifier?

Lab Procedures:

DATA

1. Implement the amplifier shown in Figure 1, using an OP27 operational amplifier. Create a schematic of the circuit in your lab notebook, record actual resistance values, and label supply voltages on your schematic. Recommended connections are as follows:
 - Use V- on the Analog Discovery to set the negative op-amp supply V^- to -5V; use V+ on the Analog Discovery to set the positive op-amp supply V^+ to +5V.
 - Use AWG1 on your Analog Discovery to provide the input voltage v_a to your circuit. Use AWG2 on your Analog Discovery to provide the input voltage v_b to your circuit.
 - Measure V_{OUT} .

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2. Set $v_b = 1V$. Test your design with $v_a = -4V, -2V, -1V, 0V, 1V, 3V$, and $5V$. Tabulate your results (v_a , v_b and v_{out}) in your lab notebook. You may assume that the set values for v_a and v_b are correct, and that you do not need to measure them. Also in your lab notebook, comment on your results (including a comparison between your test results and your expectations based on your pre-lab).

DATA

3. Repeat the above tests with $v_b = -1V$. Tabulate your results (v_a , v_b and v_{out}) in your lab notebook. Also in your lab notebook, comment on your results (including a comparison between your test results and your expectations based on your pre-lab).

DEMO

4. Demonstrate operation of your circuit to the Teaching Assistant. Have the TA initial the appropriate page(s) of your lab notebook and the lab checklist.