

EE301L (Spring 2009)- Laboratory Project 4

Applications of Voltage and Current Division

Note: There is preliminary on page 2 also

Potentiometer in a Voltage Divider

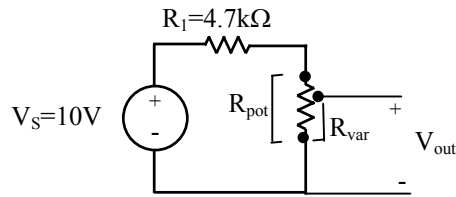


Figure 1: Potentiometer Schematic

Preliminary:

- Obtain an equation that relates V_{out} to V_s , R_1 , R_{pot} and R_{var} .
- **Plot** the V_{out} as a function of R_{var} as R_{var} varies from 0 to $5k\Omega$ and $R_{pot} = 5k\Omega$.

Experimental:

- Measure the resistance of the potentiometer and discover how it works.
- Take measurements at different values of R_{var} and record V_{out} .

Analysis:

- Compare to your predictions.
- If the input to your microprocessor (V_{out}), could not exceed 3.5 volts, what fixed resistor size would you use?
- List three applications for this circuit.

Thermometer

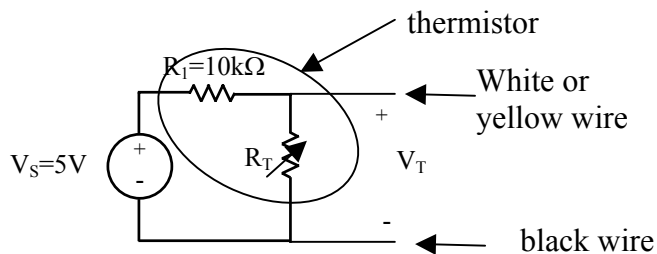


Figure 2: Thermistor Schematic

We will be using a thermistor as a variable resistor. The amount of resistance depends on the temperature and an equation can be determined experimentally. (not part of this lab) The resistance R_T can be determined from the voltage division equation and by measuring V_T .

Preliminary:

- Obtain an equation that relates V_T to V_s , R_1 , R_T .

Experimental:

- For 2 different temperatures (room temp and warmed in your hands or ice bags), measure the resistance, R_T and the voltage V_T . Hint: If the voltage and resistance don't change you are measuring the fixed $10k\Omega$ resistor.

Analysis:

- Describe an application for the themistor and this circuit.

Wheatstone Bridge

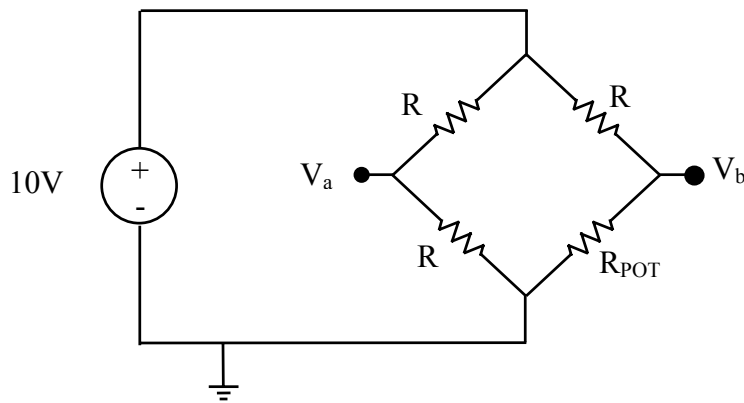


Figure 3: Wheatstone Bridge Schematic

Preliminary:

- Solve for the difference between V_a and V_b where $R_{POT} = R + \Delta R$ – Hint: DO NOT relabel the R 's with separate numbers. The algebra is much easier if they are the same. Assume $R = 2.4k\Omega$.
- Plot $V_a - V_b$ for ΔR equal to -2000 to $+2000$ ohms. **(Done before lab)**

Experimental:

- Pick 2 adjacent pins on the potentiometer, and adjust it so that the resistance is about $2.4k\Omega$.
- Using three $2.4k\Omega$ resistors from the hallway and a breadboard, construct the circuit above. To install R_{POT} , attach one of the two pins to ground and the other to V_b .
- Note the actual values of the resistors and their locations in the bridge.
- Place your multimeter to read the voltage difference between V_a and V_b .
- Balance the bridge so $V_a - V_b = 0$. What is the value of the R_{POT} . Show that this makes sense through calculations.
- Increase and decrease the resistance in the potentiometer to see if it matches your predictions.
- Make sure you understand the concept of measuring with respect to a non-ground node.

Analysis:

- For the same change in resistance in the voltage divider circuit and the Wheatstone bridge, the output voltage (V_{out} on the voltage divider and $V_a - V_b$ on the Wheatstone bridge) will change by the same amount, for example, from 4 to 4.00007 on the voltage divider and from 0 to 0.00007 on the bridge. Why would the bridge circuit be preferred?

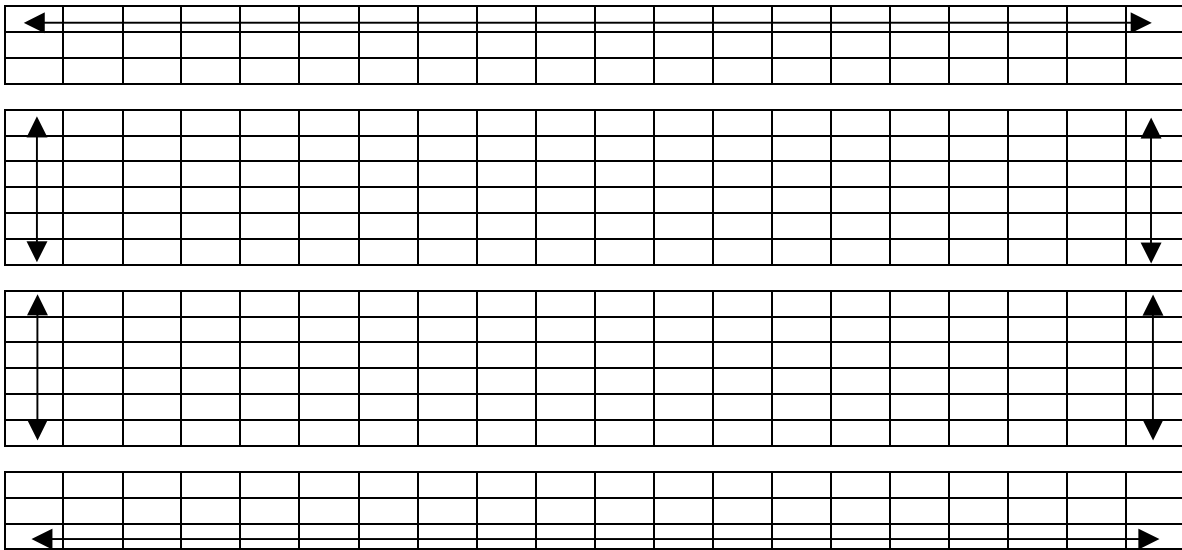


Figure 6: Breadboards have connectivity in rows/columns shown by the arrows