# Demonstration of a Voltage Divider With A Variable Resistor

Circuits Fundamentals Lab, (ENGR-UH 2019-LAB)

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Table Number: #TBA

***Abstract*—In this experiment a voltage divider was built using 1KΩ, 5KΩ, and 1KΩpotentiometer. Different combinations of the resistors were tested on the breadboard and results were recorded.**

## I. Introduction

The voltage divider is a simple circuit that provides an output voltage, which is a fixed fraction of its input voltage [1]. Simply, a voltage is applied across a series connection of two resistors and the voltage drop is measured between the first and last resistor (see Figure 1).

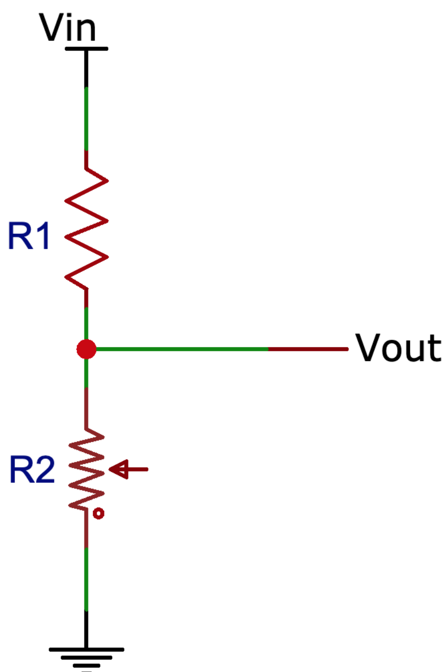


Fig. 1: A schematic for a voltage divider

A potentiometer is a variable resistor used to create an adjustable voltage divider. Depending on its position in the circuit, Equation 1 can be used to determine the output voltage.

$$V_{out} = V_{in}(\frac{R_1}{R_1 + R_2}) \quad (1)$$

## II. Experimentation

### A. Simple Voltage Divider

Using a multimeter, the resistance of the two provided resistors was measured. $R_1$ was measured to be 1KΩ, while $R_2$ was measured as 5KΩ. Two cables from the VIN (at 5V) and ground of a DC power supply were connected to the appropriate power rails on the breadboard. $R_1$ and $R_2$ were connected in series, with the positive terminal of the multimeter connected to VIN and the negative terminal connected to in between $R_1$ and $R_2$ (see Figure 2).

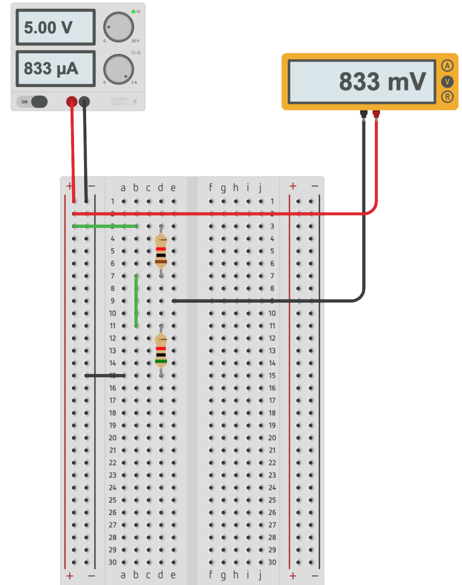


Fig. 2: A layout for a simple voltage divider

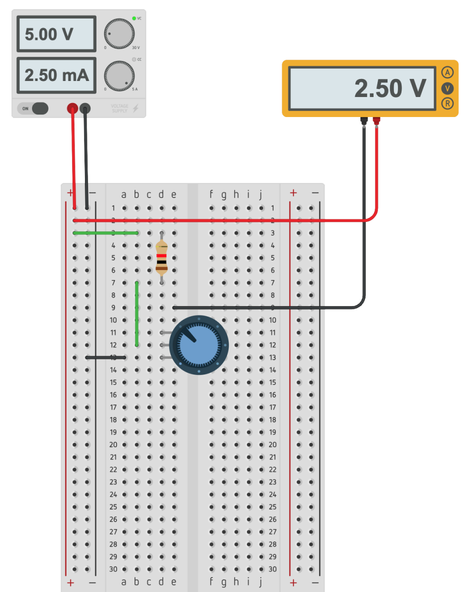


Fig. 3: A layout for an adjustable voltage divider

The $V_{out}$ for the simple voltage divider was calculated as follows:

$$V_{out} = V_{in}(\frac{R_1}{R_1 + R_2}) = 5V(\frac{1K\Omega}{1K\Omega + 5K\Omega}) = 833mV \quad (2)$$

### B. Adjustable Voltage Divider

Similarly constructed, the adjustable voltage divider used a 1K potentiometer for $R_2$ and $R_1$ was measured to be 1KΩ. The middle pin of the potentiometer was connected to VIN and the third pin connected to common ground. The positive terminal of the multimeter was connected to VIN and the negative terminal was connected to in between $R_1$ and $R_2$

(see Figure 3).

The $V_{out}$ for the adjustable voltage divider (as pictured in Figure 3 was calculated as follows:

$$V_{out} = V_{in}(\frac{R_1}{R_1 + R_2}) = 5V(\frac{1K\Omega}{1K\Omega + 1K\Omega}) = 2.5V \quad (3)$$

Figure 4 shows the breadboard prototype of the adjustable voltage divider. The knob on the potentiometer was tuned to produce a different output voltage.

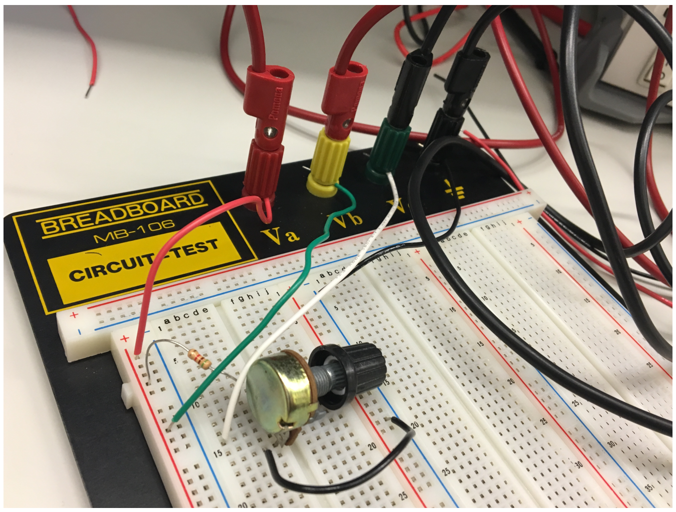


Fig. 4: Breadboard prototype of the adjustable voltage divider

## III. Discussion and Conclusion

It was assumed that the $V_{out}$ was to be calculated relative to ground. Thus, in a few of the initial trials, the output voltage reading from the multimeter was $V_{in} - V_{out}$, causing some confusion. It was learned that in order to calculate $V_{out}$ relative to ground, the numerator in Equation 1 would have to be $R_2$. However, the task was to calculate relative to VIN, leading the multimeter's terminals to be relocated.

## References

[1] W. H. Hayt, J. E. Kemmerly, and S. M. Durbin, *Engineering circuit analysis*. McGraw-Hill New York, 1986.