Laboratory 3: DC Circuits: Parallel and Series Connections

One of the most basic laws of electricity is Ohms Law. In this lab, you will verify Ohms Law, become familiar with the digital multimeter and work with resistors and capacitors connected together in different configurations. With the digital multimeter you can measure voltage, current and resistance. We will first use it to measure voltage and resistance. Later, we will use it to characterize a solar cell and check Ohms Law for a light bulb.

Part 1: Internal resistance of a battery. Find a battery and measure the voltage across it with the digital multimeter. (If you have difficulty setting the digital multimeter to make a particular measurement at any time, ask for help from your TA.) Connect a 51 Ohm resistor across the battery and measure the voltage across the battery again. Use this data to calculate the internal resistance of the battery.

Part 2: Measuring resistances. Find four carbon resistors and measure their resistance with the digital multimeter. If necessary, ask the TA for help adjusting the meter.

Part 3: Series resistances. Set up a series resistance circuit with two different resistors greater than 100 Ohm. (Why greater than 100 Ohm?) Put 6.0 V across the two resistors with a power supply. Measure the voltage across each resistor. Compare your measured results to calculated values.

Part 4: Parallel resistances. Set up a parallel circuit with two different resistors. Again, use resistors that are greater than 100 Ohm and put 6.0 V across the two resistors. Measure the current through each resistor with the digital multimeter. (Note that you may have to move the leads on the multimeter to measure current; if you have difficulty, ask the TA for help.) Compare your measured results to calculated values.

Part 5: Ohms Law. In this section, we will compare the behavior of two different components to Ohms Law. The components will be a resistor of about 500 Ohm and a light bulb. Use the circuit shown in Fig. 1. Measure the voltage across and the current through the component for a number of different power supply voltages below 15V. Do this for both the resistor and the light bulb. Calculate the power dissipated in the resistor or light bulb at each power supply setting. Graph the voltage versus current for each component and determine from the graphs if the resistor and the light bulb follow Ohms Law. You should make at least a rough plot in class.

Part 6: Solar Cells. Solar cells are gradually becoming economical sources of electricity. In this section, we will test a silicon solar cell and find the best way to get the power out.

Place a cell 4 or 5 cm away from a light source and measure the open circuit voltage and the short circuit current. Now measure the voltage the cell produces when using a load resistor of 10,000 Ohm, 1000 Ohm, 100 Ohm, 10 Ohm, 4.7 Ohm and 1 Ohm. You might also try using two 1 Ohm resistors in parallel. Make a plot of the power produced by the cell versus the load resistance connected across the cell. Under what conditions does the cell produce the most power?
Fig. 1. Circuit for use in Part 5.