PH102 Lab: Current and Voltage

At this point you should have read the introduction to the lab, and started the tutorial software.

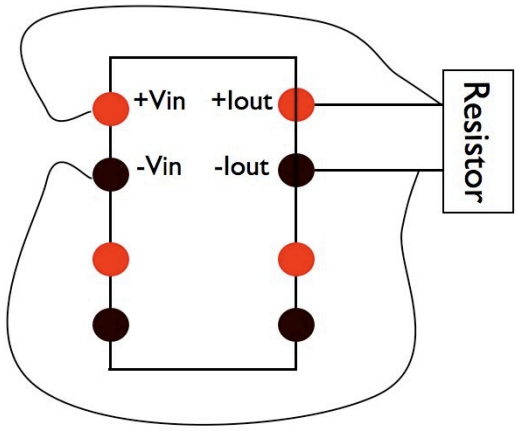
Experiment I: Sourcing Current

1. Resistors

a) Connect your resistor to the “+Iout” and “-Iout” terminals on the black “Labjack” box.

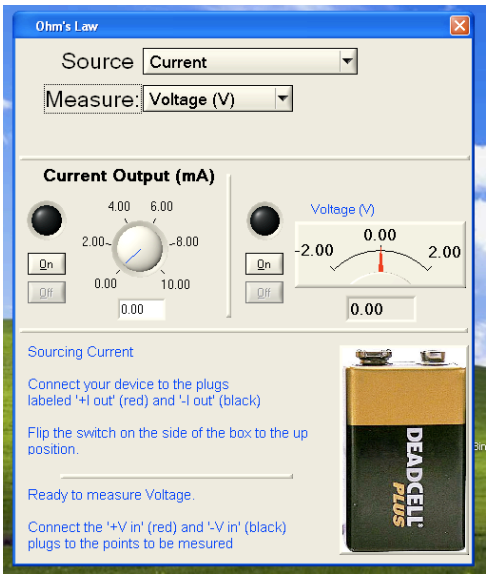
b) ***Flip the switch on the side of the box to the “on” position***. No current is flowing yet.

c) Also connect your resistor to the “+Vin” and “-Vin” terminals. The +Vin connection should be to the same side of the resistor as the +Iout connection. Your connections should resemble those below:



d) From the “Source” pull-down menu, select “Current”

e) From the “Measure” pull-down menu, select “Voltage.” Your screen should look like this:



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You are now set up to send a current (I) through your resistor, and measure the resulting voltage (V). Keep in mind that the current is in units of mA (10^{-3} A).

f) Use 5 different values of I and record the resulting V. If you have done everything correctly, w**hat sign should the voltage have**? **Make a table of V, I, and V/I.**

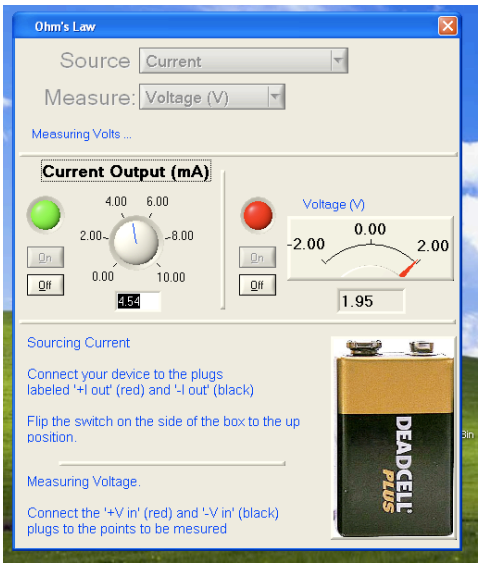
g) **What value is your resistor,** in Ohms?

On your report:

Table of I, V, and V/I

Value of resistor, in Ohms

Is Ohm's law valid?



2. Capacitors

a) Connect your capacitor just like you connected the resistor in the previous section.

b) Try to source several values of current. **What happens? Why?**

On your report: Short narrative on the I - V relationship of a capacitor

3. LED

a) connect your LED as you connected the resistor and capacitor above.

b) Applying various currents, **determine which direction current wants to flow in the LED** - is it from the short leg of the LED to the longer, or *vice versa*? (**How do you know I is flowing?**)

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c) For 5 or more values of I, record the resulting V. **Make a table of I, V, and (V/I). Is Ohm's law valid?**

d) **What is the minimum I (and resulting V) at which you can see the LED glow?**

On your report:

Which direction does current flow in the LED?

Is Ohm's law valid?

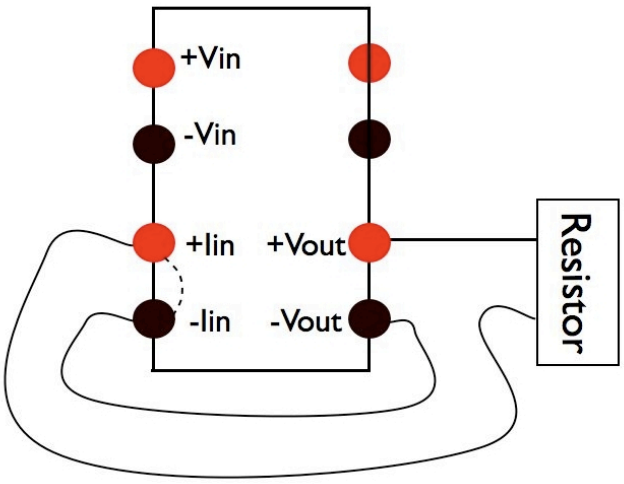
If not, does V increase more quickly or more slowly than you expect?

If so, what is "R" for a diode?

Experiment II: Sourcing Voltage

1. Resistor

a) Connect your resistor as shown below. We are applying a potential difference across the resistor and current inputs in *series*.



One end of the resistor goes to "+Vout, the other goes to "+Iin". Then "-Iin" connects back to "-Vout." **Why are the connections this way?**

b) In the "multimeter" window, turn off current sourcing and voltage measurement.

c) Select from the pull-down menus "Voltage Source" and "Current Measurement"

d) For several values of applied voltage, record the resulting current. **Make a table of V, I, and V/I. Do you get the same resistance value as before?**

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On your report:

Table of V, I, and (R=V/I) (5 points or so)

Brief explanation of the connections

2. LED

a) Connect the LED in the same way you just connected the resistor.

b) Increase the voltage until you see a clear glow. **What is the minimum V needed for a clearly discernible glow?**

c) **What happens to the current when the LED begins to glow?** Once it starts to glow, increase the voltage and monitor current. **Compare this behavior** to what happens as you increase V for lower V, when there is no glow.

On your report:

Minimum V for observed glow, and resulting I.

What happens to I when the LED glows?

Current-voltage sweep:

Close the multimeter panel and open "Current vs. Voltage" from the "dc Circuits" menu. The connections you need are the same as for the last part, but now you can graph measured Voltage versus sourced Current in real time. Try this for the LED and resistor. (Sweeps from 0 to 8mA are good.)

Experiment III: Photoresistors

1. Connect a photoresistor just as you connected the resistor in part 2 (i.e., wire the same circuit shown with the photoresistor in place of the regular resistor.

2. Supply a voltage sufficient to produce a current of about 1mA. Now vary the amount of light incident on the photoresistor (e.g., by covering it or shining a small flashlight on it). **What happens to the current as the photoresistor receives more or less light?**

3. Connect an LED in series with the photoresistor, and set the voltage such that the LED glows noticeably (but not at maximum brightness). Now cover the LED. **What is the relationship between the LED brightness and the amount of light the photoresistor receives?**

On your report:

How does the photoresistor's resistance vary with incident light intensity?

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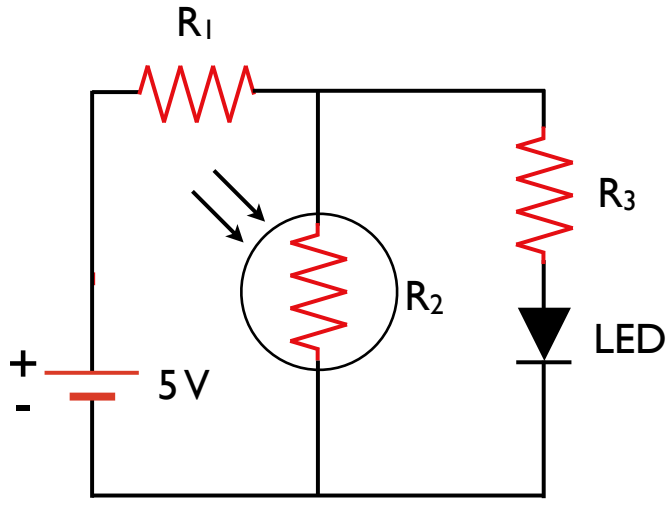
BONUS circuit construction (+10% bonus)

Wire up the circuit below (perhaps with the help of your TA). Resistors R_1 and R_3 should be ~500Ω, and R_2 is your photoresistor. The "5V" supply corresponds to the "V_{out}" connections on the lab box.

Adjust the source voltage until the LED just barely glows while the photoresistor is under normal illumination (for a red LED, this is about 1.8-2V; for other colors, the voltage will be slightly higher. Now shine a bright light (e.g., another LED or a flashlight) onto the photoresistor. You should find that the LED goes out when the photoresistor receives too much light. This circuit is a crude electronic eye/automatic night light - the LED gets brighter when the photocell sees less ambient light.

Can you explain, qualitatively, why the LED goes out when the photoresistor sees a bright light?



When you are finished:

- *Turn the switch on the side of the box "off."*
- *Close the Tutorial software.*
- *Straighten up your components and wires*
- *Turn in a hard copy of your report.*