

## PH102 Lab II: Current and Voltage / Introduction

In this laboratory, we will explore the relationship between current and voltage for several types of devices: a resistor, a capacitor, and a diode.

### LAB REPORT

You will be asked below to record specific measurements, and answer qualitative questions. The required questions are listed under subheadings "*In your report.*" You may type and print these reports, or simply write them out at your discretion. **At the end of the class period, one hard copy should be turned in per group.**

### HARDWARE

**Labjack box:** This is a computer controlled, USB-driven box that has four basic functions: (1) sourcing current, (2) sourcing voltage, (3) measuring current, (4) measuring voltage. In this lab, you will apply potential differences (voltages) to devices and measure the resulting current, and *vice versa*.

*Current sourcing:* current must always have a closed path to flow through. When using the current source (+ lout, - lout), imagine that current flows from the RED positive terminal (+lout), through your device, back to the BLACK negative terminal.

*Voltage sourcing:* the red terminal is the positive voltage, the black is the negative voltage. Applying a potential difference of, e.g.,  $\Delta V = 1$  Volt means that  $V_{\text{red}} - V_{\text{black}} = 1$  Volt.

*Voltage measurement:* the same polarity convention applies - red is positive, black is negative. Measuring a potential difference of, e.g.,  $\Delta V = 1$  Volt means that  $V_{\text{red}} - V_{\text{black}} = 1$  Volt.

*Current measurement:* the same polarity convention applies - red is positive, black is negative. Measuring current is slightly different, however: current must flow into the "+I in" terminal and back out the "-I in" terminal to be measured, so the current measurement is in *series* with your device.

**Resistor:** A resistor in general obeys Ohm's law,  $\Delta V = IR$ . Current can pass through a resistor, and the amount of current grows linearly with the potential difference  $\Delta V$ . The flow is not perfect however. For a given potential difference  $\Delta V$ , the current that can flow is  $I = \Delta V/R$  - the larger the R, the less I one gets for the same  $\Delta V$ . Your resistor should look something like the image below - it has several colored stripes:



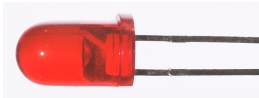
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**Capacitor:** A capacitor stores electrical energy, and can be charged to a potential difference  $\Delta V$ , but will not support a current flow. If we apply a potential difference to a capacitor, it stores energy (in the amount  $1/2 C \Delta V^2$ ) by building up a *static* charge separation. If we increase  $\Delta V$ , the capacitor will store more energy, but no current will flow until the capacitor suffers breakdown. Your capacitor should look something like the image below, a little metal can:



**Diode:** A diode allows current to flow, but only in one direction. More precisely, it has an enormously high resistance if current flows through it in one direction, and a fairly low resistance in the other. Diodes have two wires, just like resistors or capacitors, but when you apply a potential difference to a diode, current will only flow if it is connected in the right direction

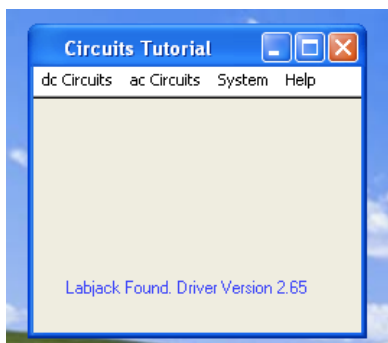
Diodes are useful for controlling current flow in devices, but we will use a special sort of diode: the Light Emitting Diode (LED). When connected in the right direction current flows through the LED, and when there is enough current, it lights up. Your diode looks like this:



The schematic on the right shows the polarity - the longer leg of the LED should be connected to the **positive** potential or current (red plugs), the shorter leg to the negative (black plugs).

### **Starting the Software:**

(1) From the Start menu / All Programs, open "A Circuits Tutorial". You should get this:



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If you see “Labjack Found” on the window, everything is functioning properly. If your window says “Demo Mode” on it, ask for assistance.

(2) From the “dc Circuits” menu, select “Multimeter.” This should bring up a new window like this one:

