Objectives The objective of this experiment is to study the properties of the photo resistor using the Wheatstone bridge.

Background A photo resistor (See Figure 1) is a resistor made of a high resistance semiconductor whose resistance decreases with increasing incident light. The principle is that when light of high enough frequency falls on the device, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electrons conduct electricity, thereby lowering resistance.

The photo resistor can indicate the variation of light intensity by varying resistance, so it has many applications such as camera light meters, street lights, clock radios, alarms and outdoor clocks.

Figure 1: Photo resistor
(http://en.wikipedia.org/wiki/Photoresistor)

Equipment/components required

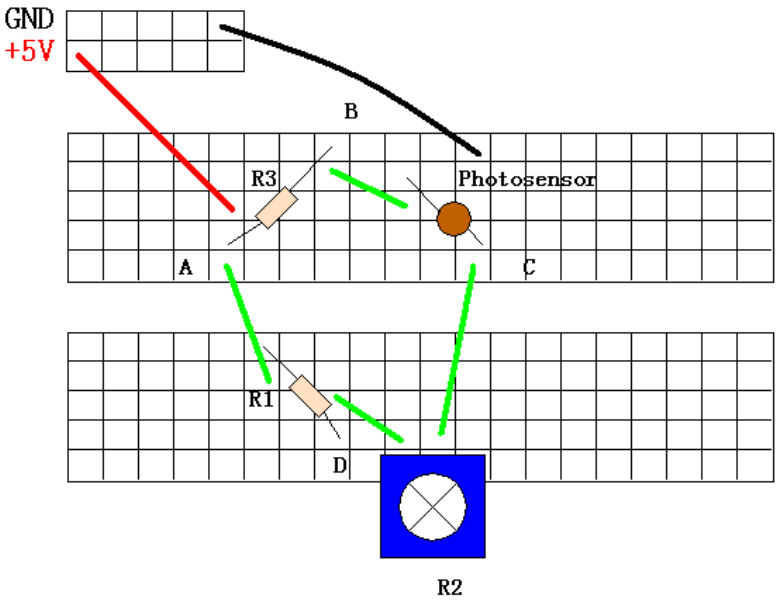
The equipment and components required to perform this experiment are:

- Wheatstone bridge built in Lab In A Box Workshop 1
- one Photo resistor with resistance $5\,k\Omega \sim 6\,k\Omega$ in normal light
- one $10\,k\Omega$ Resistor (Color **Brown** **Black** **Orange** Gold)
- two $1\,k\Omega$ Resistor (**Brown**, **black**, **red**)

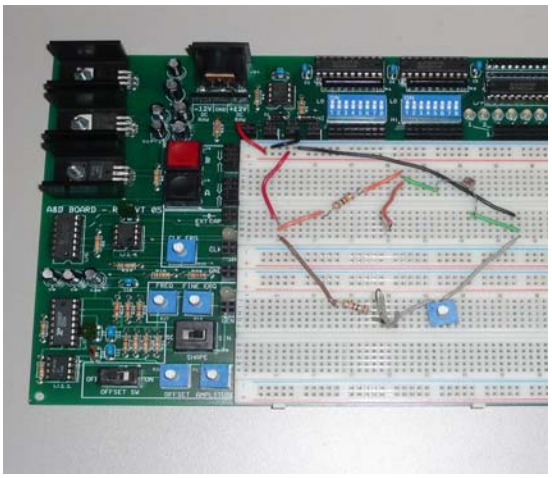
Procedure

1. Unpack the Lab in a Box materials and prepare for their use.
2. Locate the photo resistor
3. Use your digital multimeter to observe the resistance of the photo resistor as you vary the amount of light allowed to get to the photo resistor. Note your observations below:

4. Now, reconstruct the Wheatstone bridge built in Lab In A Box Workshop 1, letting R_3 = $10\,k\Omega$, R1 = 1K ohm and replacing R_x with the photo resistor, as shown in Figure 2.



(a)



(b)

Figure 2: Wiring diagram for the bridge with photo resistor

5. Balance the bridge with the appropriate voltage measurement as you did in the previous workshop. (Note: you may not be able to adjust the voltage to exactly 0, an error of +/- 0.1 volts is acceptable)

6. Vary the light intensity on the sensor: Record the voltage outputs for different cases.

7. Analyze the relationship between light intensity, the resistance of the photo resistor and the voltage change across the appropriate points on the bridge qualitatively. Make sure that your positive lead is on point B. Circle the appropriate answers in the table below.

Light intensity	Resistance of photoresistor	Change in voltage
Increase	Increase / Decrease	Increase / Decrease
Decrease	Increase / Decrease	Increase / Decrease

Building a "Voltage Divider"

Objectives The objective of this experiment is to construct and study the properties of a simple voltage divider.

A **voltage divider** (also known as a **potential divider**) is a simple linear circuit that produces an output voltage (Vout) that is a fraction of its input voltage (Vin). Voltage **division** refers to the partitioning of a voltage among the components of the divider.

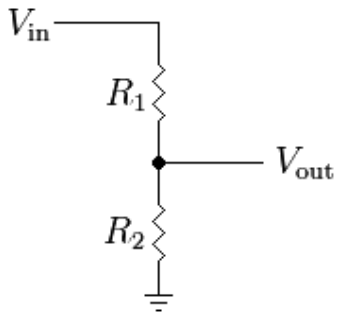


Figure 1

Derive a relation between Vout and Vin for the circuit in Figure 3. (Vout in terms of Vin)

Hint: Apply Ohm's Law across each resistor. Note that the current flowing through the resistors is the same because we are using the ideal approximation that the current flowing through the branch labeled V_{out} is negligible.

Record the derived relationship here:

Now build the above circuit with V_{in} = +5V and test your derivation. Record your observations below.