Arduino Programming Case Study: Potentiometer and Photoresistor Measurements

ME 120

Mechanical and Materials Engineering

Portland State University

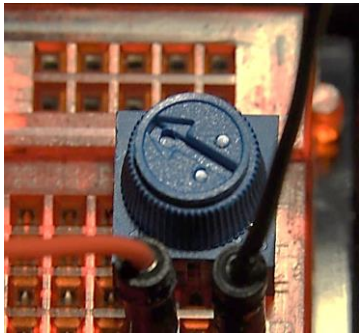
http://web.cecs.pdx.edu/~me120

Overview

- Experiment with a potentiometer
  - Measure of the potentiometer's output
  - Potentiometer values reading and reporting
- Experiment with a photoresistor
  - What is a photoresistor?
  - Measure of the photoresistor's output
  - Photoresistor values reading and reporting
  - Using "if" statements to respond to analog input readings

- See on-line reference:
  - http://arduino.cc/en/Reference/HomePage

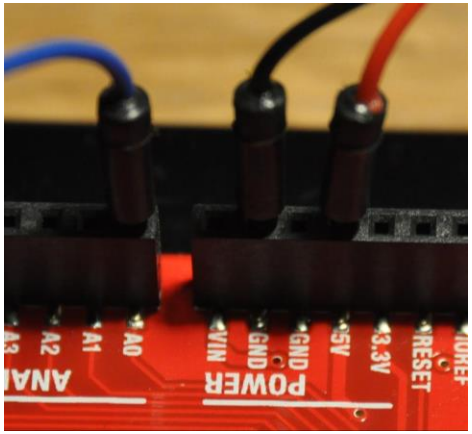
Experiment with a potentiometer



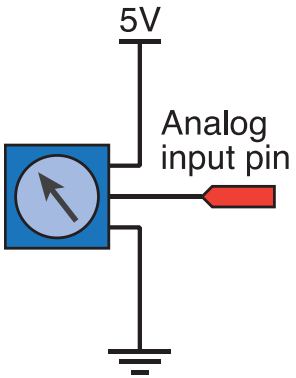
Analog input

`analogRead(pin)`

- Reads the voltage on an analog input pin
- **`pin`** – an integer that specifies the analog input channel: 0 to 5. **`pin`** can also be referred to by name as A0, A1, A2, A3, A4 or A5
- Returns an **`int`** in the range 0 to 1023 (for an Arduino Uno)



Example: Read a potentiometer



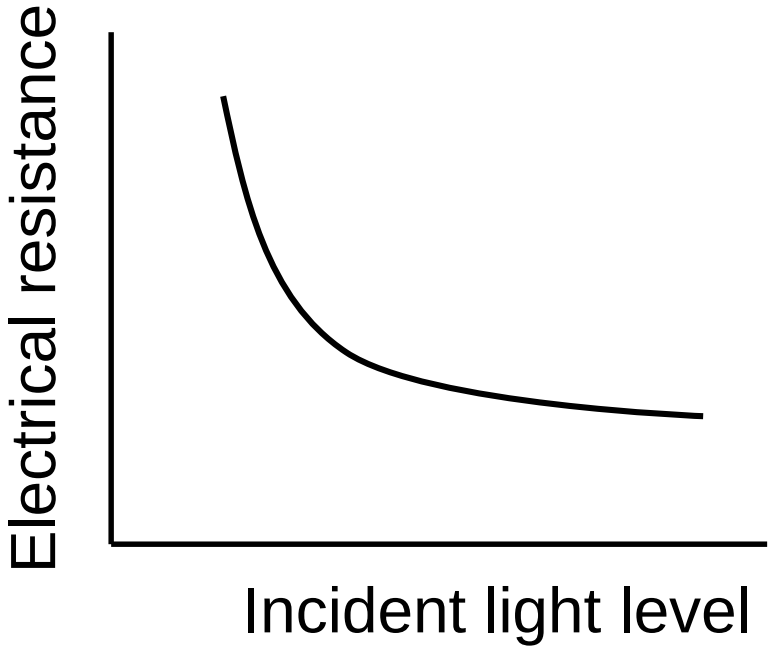

```
void setup() {
  Serial.begin(9600);
}

void loop() {
  int reading;
  reading = analogRead(A0);
  Serial.println(reading);
}
```

See http://arduino.cc/en/Reference/AnalogRead

What is a photoresistor?

A photoresistor is a semiconductor

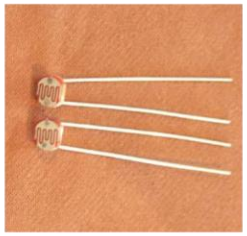
A photoresistor is a two-terminal semiconductor device that has an electrical resistance that depends on the light incident on the exposed semiconductor surface. The resistance decreases with increases in incident.



More information is available via the datasheet

1. Visit sparkfun.com
2. Enter “photoresistor” in the search box
3. Locate product #9088 or its more recent replacement
4. Click on the datasheet link
5. Note that there are many vendors

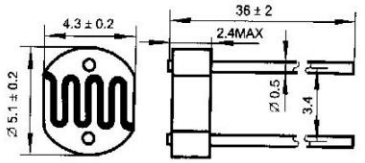
CdS PHOTOCONDUCTIVE CELLS | **GL5528**



- Epoxy encapsulated
- Quick response
- Small size
- High sensitivity
- Reliable performance
- Good characteristic of spectrum

Light Resistance at 10Lux (at 25℃)	8～20KΩ
Dark Resistance at 0 Lux	1.0MΩ(min)
Gamma value at 100-10Lux	0.7
Power Dissipation(at 25℃)	100mW
Max Voltage (at 25℃)	150V
Spectral Response peak (at 25℃)	540nm
Ambient Temperature Range:	- 30～+70℃

Outline



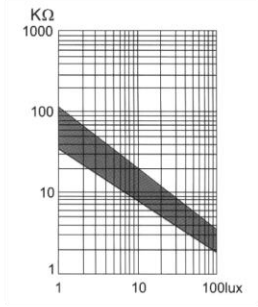
Measuring Conditions

1. Light Resistance:
   measured at 10 lux with standard light A (2854k color temperature) and 2h pre-illumination at 400-600 lux prior to testing.
2. Dark Resistance:
   measured 10 seconds after pulsed 10 lux.
3. Gamma Characteristic:
   between 10 lux and 100 lux and given by

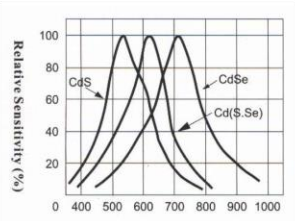
   $$T = \frac{\log (R10/R100)}{\log (100/10)} = \log (R10/R100)$$

   R10, R100 cell resistance at 10 lux and 100 lux.
   The error of T is +0.1.
4. Pmax:
   Max. power dissipation at ambient temperature of 25℃.
5. Vmax:
   Max. voltage in darkness that may be applied to the cell continuously.

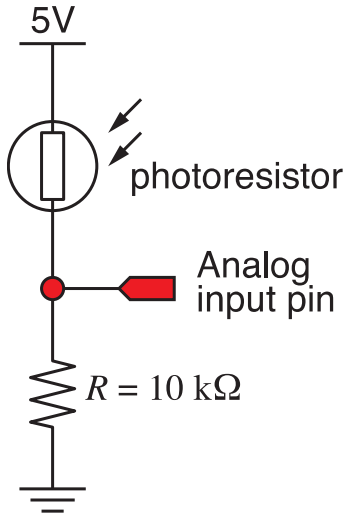
Illuminance Vs. Photo Resistance

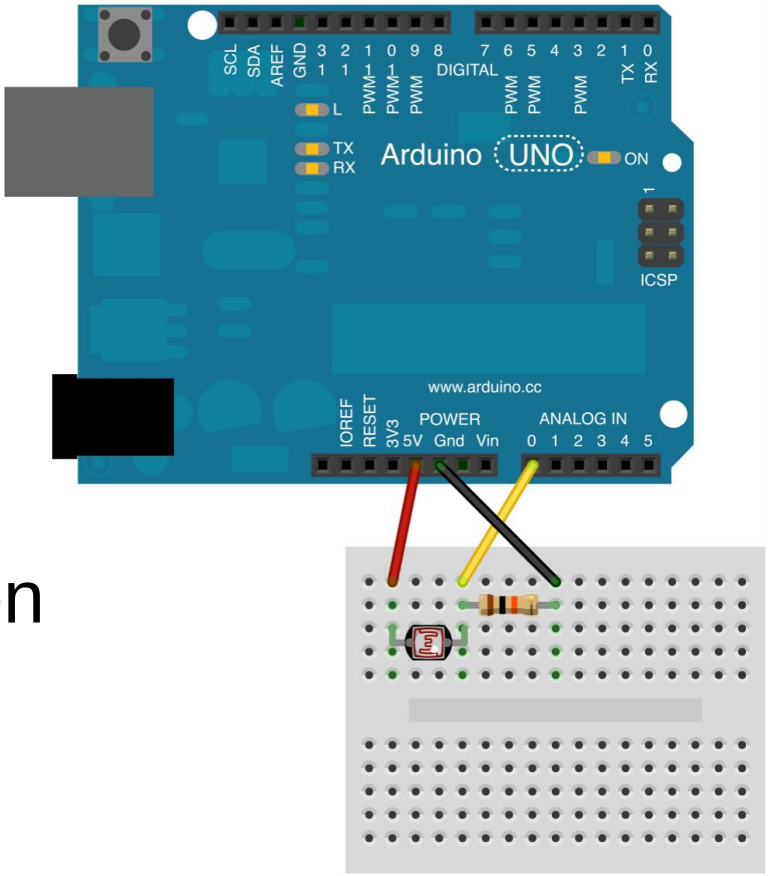


Spectral Response



Voltage divider circuit for photoresistor





Why is the fixed resistor on the bottom of the voltage divider?

Basic Arduino code to read and report photoresistor output

Display voltage divider output on the serial monitor

Connect the voltage divider output to analog pin 0

```
void setup() {
  Serial.begin(9600);          //  Initialize serial port object
}

void loop() {
  int reading;
  float voltage;

  reading = analogRead(A0);          //  Read analog input channel 0
  voltage = reading*(5.0/1023.0);    //  and convert to voltage

  Serial.print(reading);             //  Print the raw reading
  Serial.print("  ");                //  Make a horizontal space
  Serial.println(voltage);           //  Print voltage value
}
```

See http://arduino.cc/en/Reference/AnalogRead

Use an “if” statement to respond to analog input readings

Output dependent on photoresistor reading

```
void setup() {
  Serial.begin(9600);         //  Initialize serial port object
}

void loop() {
  int reading;
  float voltage;

  reading = analogRead(A0);         //  Read analog input channel 0
  voltage = reading*(5.0/1023.0);  //  and convert to voltage

  if ( voltage < 2.5 ) {
    Serial.println(”Getting dark”);     //  Print the raw reading
  }
}
```

Output dependent on photoresistor reading

- Next step
  - Add a second test at 1.75 V (or some value). Print a different message for very low analog input (low ambient light values)

- Study questions
  - What are minimum and maximum voltage levels for photoresistor outputs?
  - Will the test for darkness work without converting to voltage first?