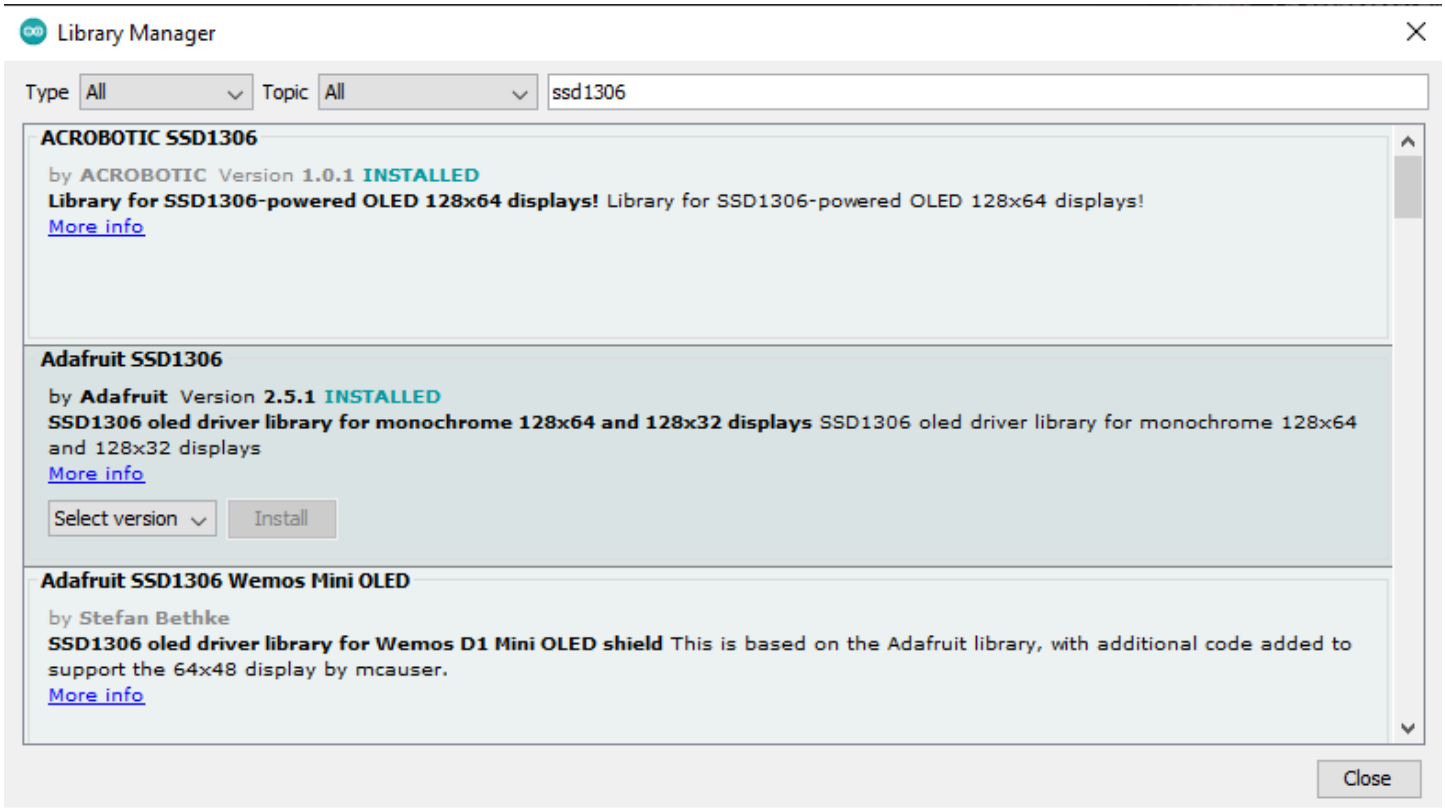
Pre - Requisite

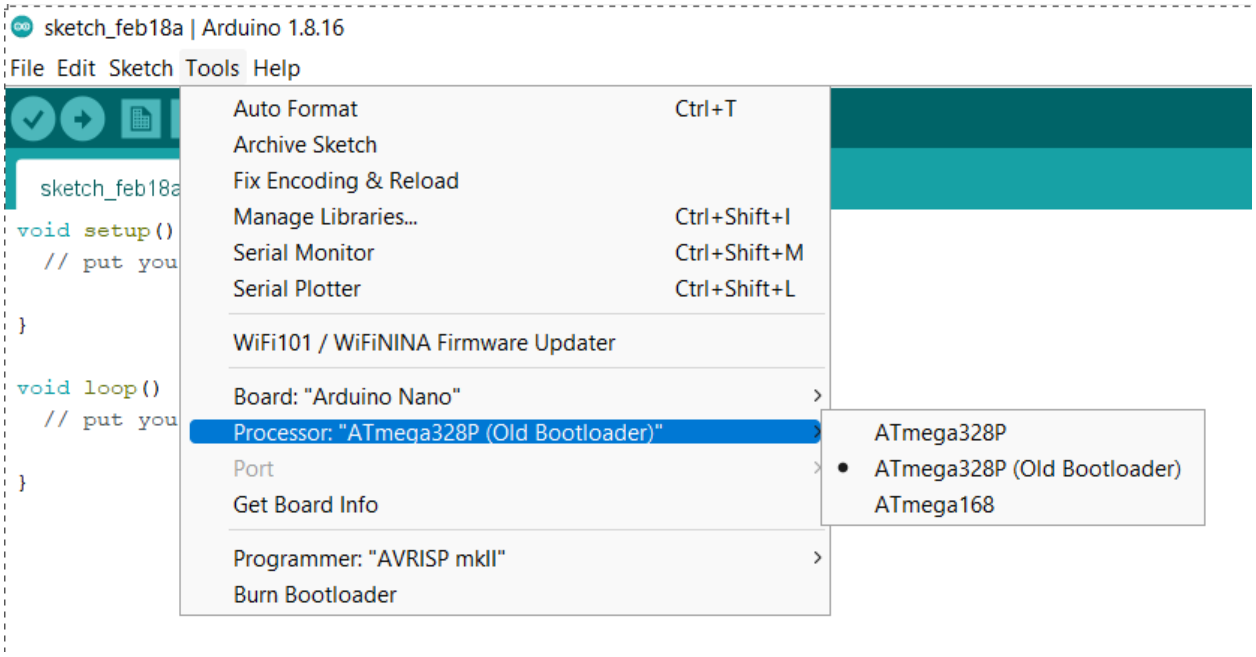
In order to control the OLED display, you will need the **adafruit_SSD1306.h** and **adafruit_GFX.h** libraries.

- Open the Arduino IDE and go to Sketch > Include Library > Manage Libraries.
- You should see the Library Manager open up. From here type in SSD1306



- Pick the 2nd one from the list.

Select to correct Processor and board type listed below:

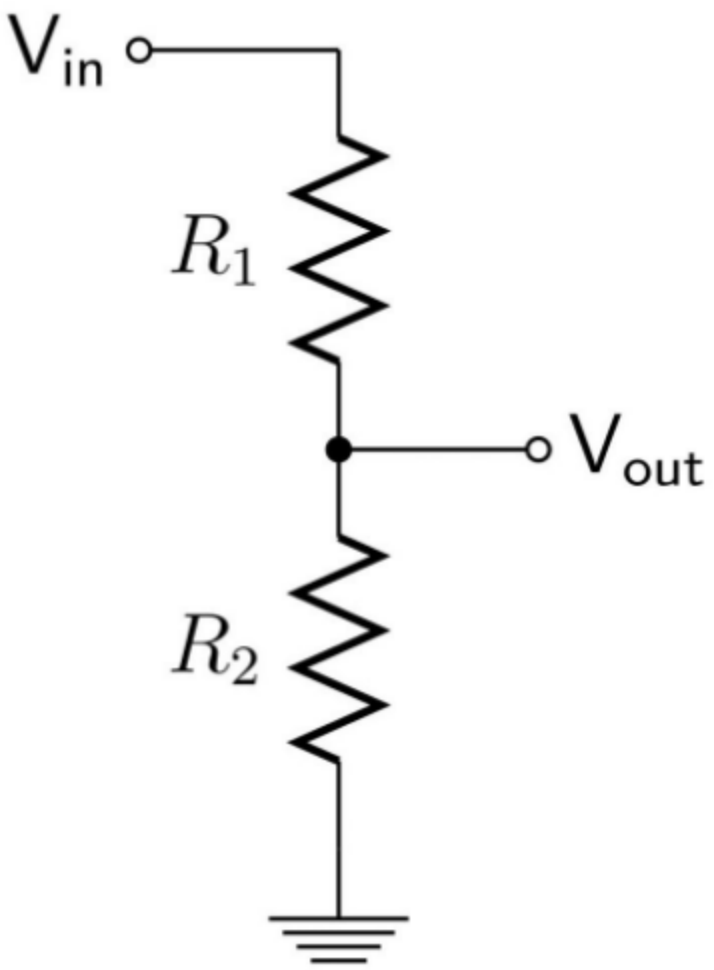


-Top right check-mark is how you upload the code
-the Port selection under Tools will need to be assigned to a specific COM# port once you plug it into your computer

Voltmeter Background

Measuring the Electrical Voltage

Various methods exist for measuring the voltage, such as using the hall effect, the simplest one is the voltage divider.
The voltage divider is a circuit that puts a fraction of the voltage between two resistors.



$$V_{out} = \frac{R_2}{R_1 + R_2} \cdot V_{in}$$

STEP 1:

- Place a 10k ohm resistor on the breadboard and a 4.7k ohm resistor on the breadboard with one end of each being inserted into the same numerical row.

STEP 2:

- Connect a wire from the same row as the previous step to pin A2 on the nano.Connect a wire from the positive terminal of the 9v battery to the other side of the 10k ohm resistor. Connect a wire from the other side of the 4.7k ohm resistor to the - column on the opposite side of the breadboard.

STEP 3:

- Connect a wire from a GND (ground) pin on the nano to the same - column from the previous step. Connect a wire from the 5V pin on the nano to the corresponding + column. Connect one wire from the negative terminal of the 9V battery to the breadboard on the same + column.

STEP 4:

- Connect a wire from the SDA hole on the display to pin A4 on the nano. Connect a wire from the SCL hole on the display to pin A5 on the nano. Connect a wire from the VCC hole on the display to the + column used before. Connect a wire from the GND hole on the display to the - column used before.

STEP 5:

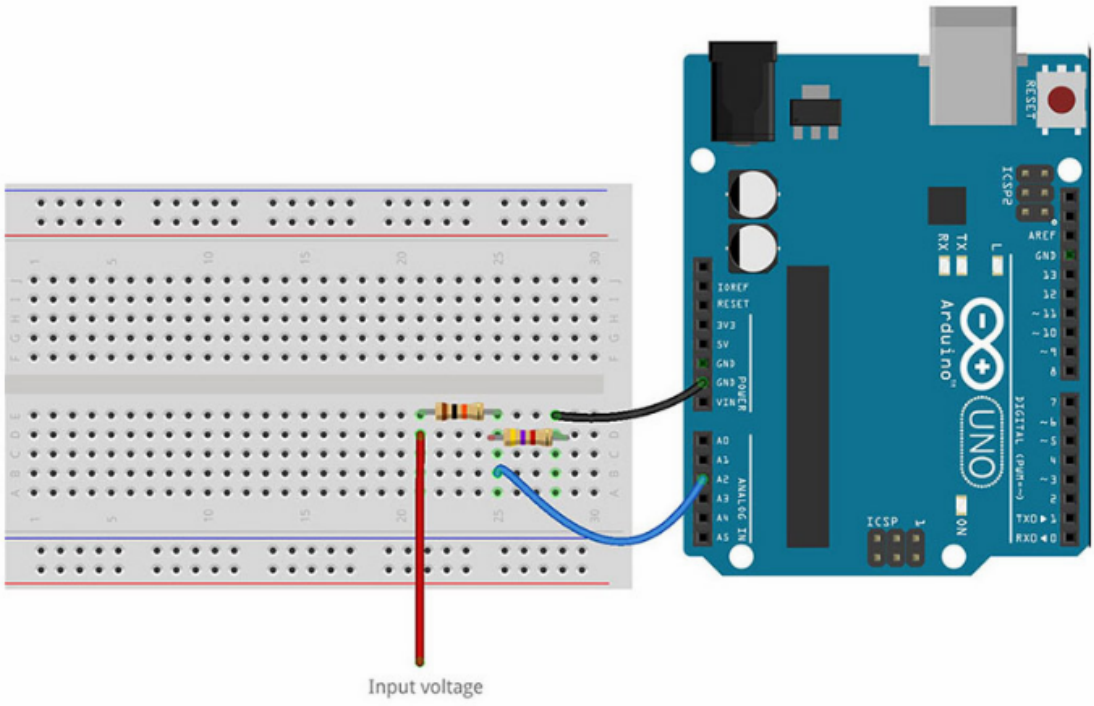
- Upload code!

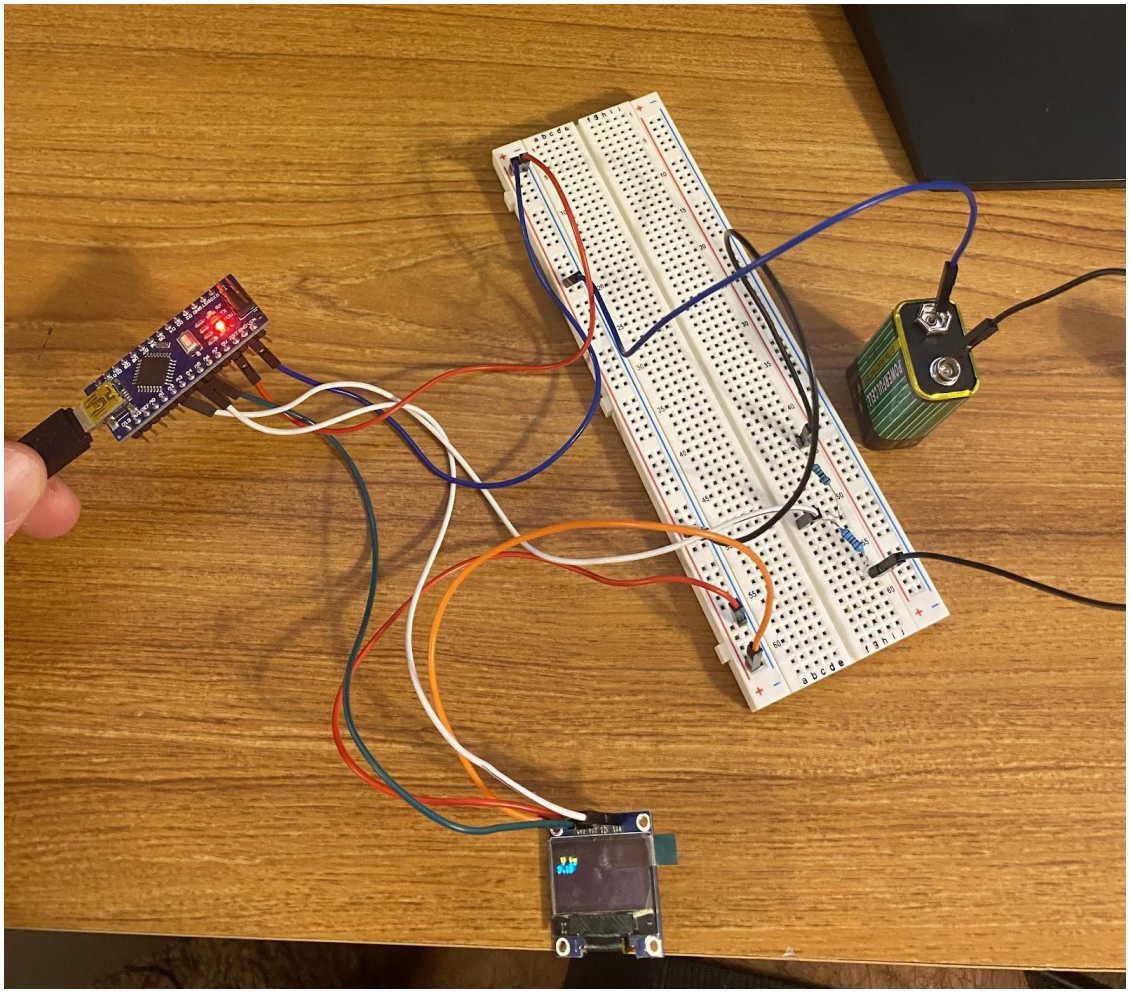
Picking resistor values R1= 10k and R2=4.7k will keep our range of acceptable input voltages up to 15 V

P.S: You can change and pick your own resistor values how the accuracy

Circuit Setup:

- Instead of using an Arduino Uno, we will be using an Arduino Nano the pin layout should be the same.


Input voltage



Now for the OLED Display:

Vin	5V
GND	GND
SCL	A5
SDA	A4

Voltmeter Code:

```
#include <Wire.h>
#include <Adafruit_GFX.h>
#include <Adafruit_SSD1306.h>
#define SCREEN_WIDTH 128 // OLED display width, in pixels
#define SCREEN_HEIGHT 64 // OLED display height, in pixels

// Declaration for an SSD1306 display connected to I2C (SDA, SCL pins)
Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT, &Wire, -1);


const int VoltMeter = 2;
float V = 0.00;

void setup() {
  Serial.begin(115200);

  if(!display.begin(SSD1306_SWITCHCAPVCC, 0x3C)) { // Address 0x3D for 128x64
    Serial.println(F("SSD1306 allocation failed"));
    for(;;);
  }

  delay(2000);
  display.clearDisplay();
  display.setTextColor(WHITE);

}
void loop() {

  float R1 = 10000;//5100.00;
  float R2 = 5100;//2000; //4700.00;
  float resistor_ratio = 0.00;
  float adc_value = 0.00;
  float voltage = 0.00;
```

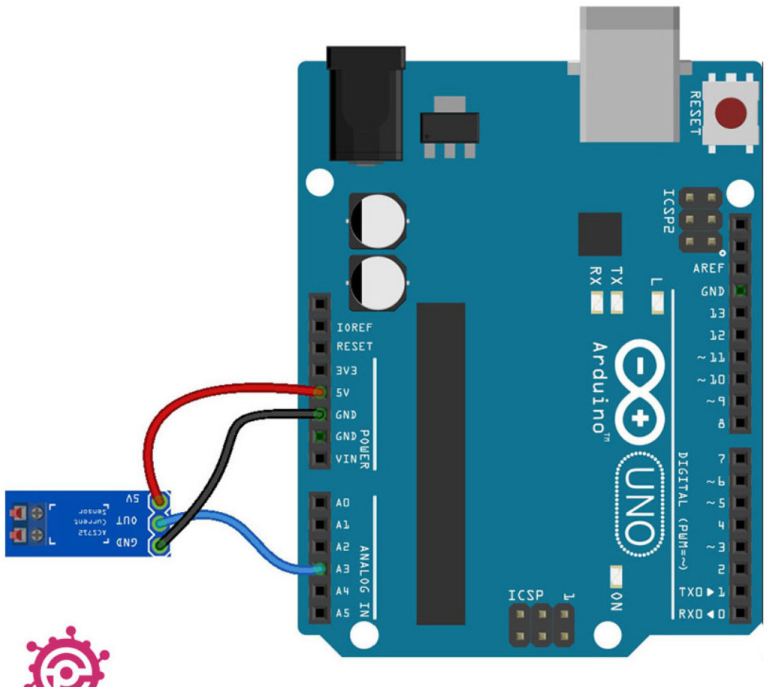
```
  resistor_ratio = (R2 / (R1 + R2));

  for (int i = 0; i < 20 ; i++)
  {
    adc_value = adc_value + analogRead(VoltMeter);
    delay(3);
  }
    adc_value = adc_value / 20;
    voltage = ((adc_value * 5) / 1024);
    V = voltage / resistor_ratio;


display.setCursor(0,10);
  // Display static text
  display.println(" V is");
  display.print(V);
  display.print(" ");
  display.display();
  display.clearDisplay();

}
```

Ammeter Walkthrough



Step 1)

- Connect a wire from the ground (GND) pin of the NANO to the ground (GND) pin of the Current Sensor.
    - 5V on the NANO to 5V pin on the sensor
    - Analog pin 3 (A3) on the NANO to the output (OUT) pin of the sensor

Step 2)

- Connect 2 wires to the back of green component of the current sensor
    - Connect a wire to one end of the load resistor and the other to the ground terminal of the 9 volt battery

Step 3)

- Connect the positive terminal of the 9 volt battery to the other end of the load resistor

Step 4)

- Connect a wire from the SDA hole on the display to pin A4 on the nano. Connect a wire from the SCL hole on the display to pin A5 on the nano. Connect a wire from the VCC hole on the display to the + column used before. Connect a wire from the GND hole on the display to the - column used before.

Step 5)

- Upload the provided ammeter code onto the NANO
- Run it Baby!!!!!

P.S: To measure the current the ammeter has to be in series with the intended component that is meant to be measured.

Ammeter Code:

```
#include <Wire.h>
#include <Adafruit_GFX.h>
#include <Adafruit_SSD1306.h>
#define SCREEN_WIDTH 128 // OLED display width in pixels
#define SCREEN_HEIGHT 64 // OLED display height in pixels

// Declaration for an SSD1306 display connected to I2C (SDA, SCL pins)
Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT, &Wire, -1);


const int Ammeter = A2;
float I = 0.00;

void setup(){

Serial.begin(115200);

 if(!display.begin(SSD1306_SWITCHCAPVCC, 0x3C)) { // Address 0x3D for 128x64
   Serial.println(F("SSD1306 allocation failed"));
   for(;;);
 }
 delay(2000);
 display.clearDisplay();
 display.setTextColor(WHITE);
}
void loop() {
//void calculate_current() {

  int sensitivity = 66;                 //in millivolts/A, based off of specific current sensor, outputs 66 millivolts per Amp read
  int adc_value = 0;                    //initializing variable for adc conversion
  float v_ref = 4.94;                   //reference voltage for arduino uno
  float voltage = 0.00;                 //initializing variable for output voltage being read
  float pure_voltage = 0.00;            //the fluctuation in output voltage by the current sensor caused by the load of whatever circuit is being measured
  float offset_voltage = 2.49;          //the amount of volts outputted by the sensor when its free of any load
  for (int i = 0; i < 40 ; i++)
  {
    adc_value = adc_value + analogRead(Ammeter);
```

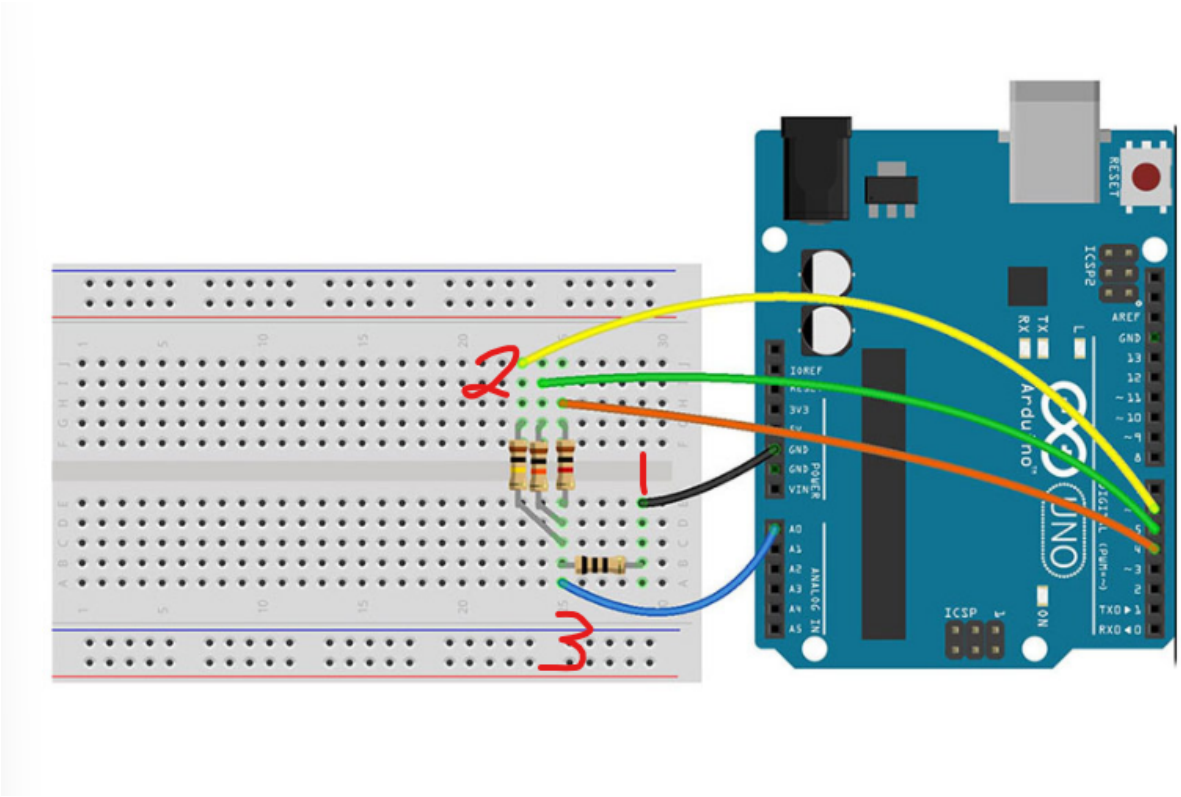
```
    delay(2);
  }
  adc_value = adc_value / 40;                //reads the output voltage of the current sensor 40
times then averages it out
  voltage = ((adc_value * v_ref)/ 1024) ;    //converts output voltage to a binary number that
can be displayed and manipulated by arduino
  pure_voltage = voltage - offset_voltage;  //measures how much of a change in voltage
was caused by connecting current sensor to whatever is supplying the current

  pure_voltage = pure_voltage * 1000;     //since this is going to be tiny this converts it
milliamps, also puts in in the same units as the sensitivity
  I = pure_voltage / sensitivity;        //I(A) = pv(mV) / sens(mV/A)

display.setCursor(0,8);
  // Display static text
  display.println("IA is");
  display.print(I);
  display.print(" ");
  display.display();
  display.clearDisplay();


}
```

Ohmmeter Walkthrough



Step 1)

- Connect a wire from the ground (GND) pin of the NANO to any column on the breadboard.
    - Whichever row you select will then become the ground relative to the rest of the circuit.
    - The orientation of the ground when directly connected to the breadboard is vertical as in the image above.
    - You may choose to utilize the ground on the breadboard indicated by the blue minus sign at the top and bottom of the breadboard (Note: this will change the relative orientation of GND to the horizontal row to which the wire is connected).

Step 2)

- Connect 3 wires to the digital pins 4, 5, & 6 on the arduino nano
    - Digital pin 4 will connect to the 1 kΩ resistor
    - Digital pin 5 will connect to the 10 kΩ resistor
    - Digital pin 6 will connect to the 100 kΩ resistor

Step 3)

- Connect the opposite ends of the resistors specified above and one end the mystery resistor in a single column
    - Connect a wire for analog pin zero (A0) on the nano to the same column as the one you just hooked up the multiple resistors to
    - Connect another to the opposite end of the mystery resistor to the ground

Step 4)

- Connect a wire from the SDA hole on the display to pin A4 on the nano. Connect a wire from the SCL hole on the display to pin A5 on the nano. Connect a wire from the VCC hole on the display to the + column used before. Connect a wire from the GND hole on the display to the - column used before.

Step 5)

- Upload the provided ohmmeter code onto the NANO
- Run it Baby!!!!!