Lab 2: Sensor Calibration

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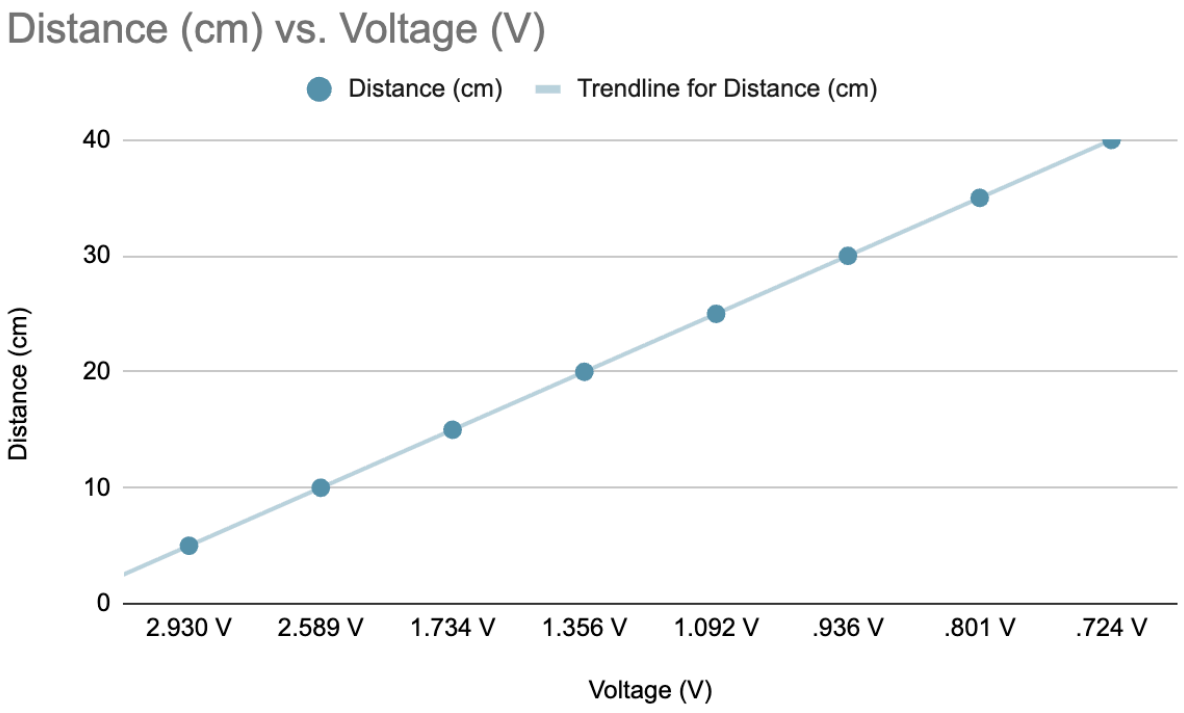
Part 1

Distance (cm)	Voltage (V)
5	2.930 V
10	2.589 V
15	1.734 V
20	1.356 V
25	1.092 V
30	.936 V
35	.801 V
40	.724 V

Voltage v.s. Distance Graph



Distance to the Wall Program

```
volatile float sensor_val = 0;
volatile float y1, y2, x, x1, x2;
volatile float voltage[8]={2.930, 2.589, 1.734, 1.356, 1.092, 0.936, 0.801,
0.724};
volatile float distance[8]={5, 10, 15, 20, 25, 30, 35, 40};
volatile float answer;


// the setup function runs once when you press reset or power the board
void setup() {
  Serial.begin(9600);
  pinMode(2, INPUT_PULLUP);
  pinMode(A0, INPUT);
  attachInterrupt(0, isr0, FALLING);
}


// the loop function runs over and over again forever
void loop() {

}


void isr0() {
 //Measures the analog input voltage from the sensor
 sensor_val = (analogRead(A0) / 1024.00) * 5.00;
 delay(200);


 //calculate the distance to the wall
 for(int i = 0; i < 10; i++)
 {
   if (sensor_val > voltage[i+1] && sensor_val < voltage[i])
   {
     x1 = voltage[i+1];
     x2 = voltage[i];
     y1 = distance[i+1];
```

```
    y2 = distance[i];
   //  Serial.print("x1 ");
   //  Serial.println(x1);
   //  Serial.print("x2 ");
   //  Serial.println(x2);
   //  Serial.print("y1 ");
   //  Serial.println(y1);
   //  Serial.print("y2 ");
   //  Serial.println(y2);


    answer = (((y2 - y1)/(x2 - x1)) * (sensor_val - x1)) + y1;
   //  Serial.println(sensor_val);

  }
 }


 //print to monitor
 Serial.println(answer);
}
```

Part 2

LTE-5208A Infrared LED: dot denotes cathode

LTR-4206E Phototransistor: flat denotes collector

Measured voltage drop: 1.207 V

Calculated current through LED: (5v-1.207v)/47ohms= 80.7mA

Distance (cm)	Voltage (V)
5	4.678
10	2.256
15	1.349
20	0.958
25	0.850
30	0.775
35	0.736
40	0.713

Add a voltage follower circuit using an LM324 op-amp. Measure Vbuf and Vout at 5 and 10cm. How do they compare to the prior measurements?

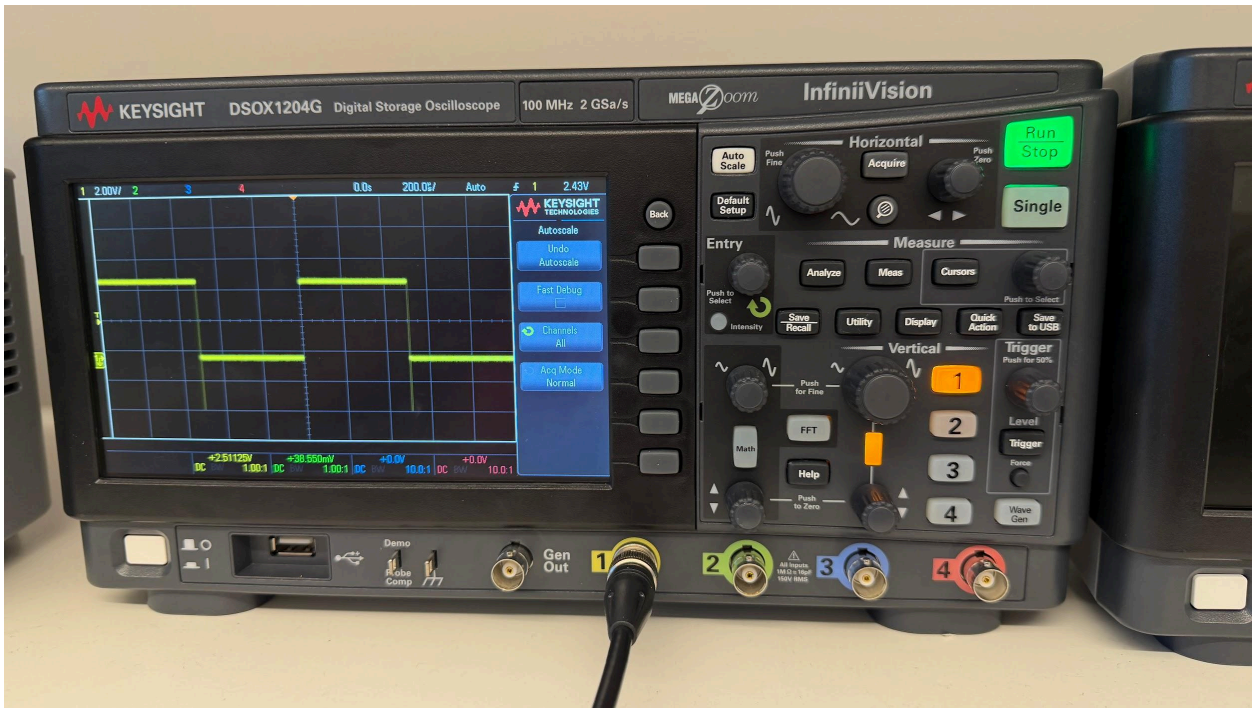
Distance (cm)	Vbuf	Vout
5	3.735	3.331
10	2.003	1.786

Vbuf seems to be ~0.6-0.7V higher than Vout. As they move further away, both voltages drop around 1.6-1.7V.

1KHz square wave program:

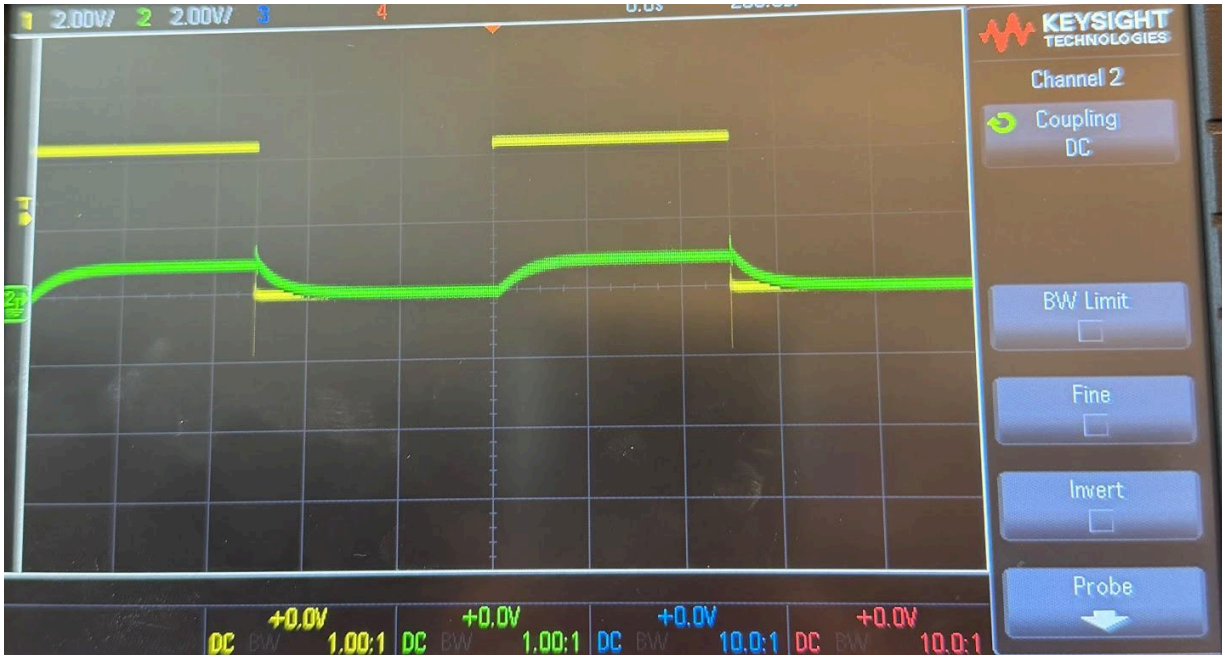
```
void setup() {
 // put your setup code here, to run once:
 pinMode(12, OUTPUT);
}

void loop() {
 // put your main code here, to run repeatedly:
 digitalWrite(12, HIGH);
 delayMicroseconds(500);
 digitalWrite(12, LOW);
 delayMicroseconds(500);
}
```

Oscilloscope:

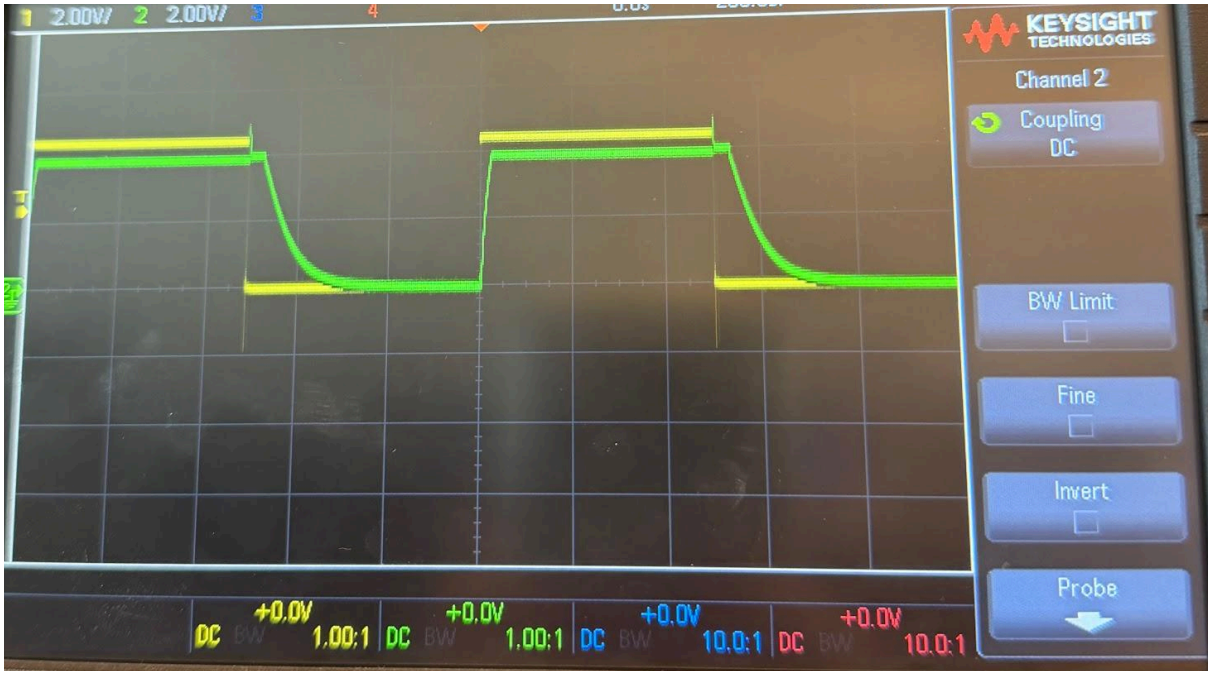


New LED circuit oscilloscope:

Far away:



Close up:



Problems We Encountered:

We spent the most time on our sensor circuit as we could not get out expected output. We found that this was due to two different incorrect resistor values which respectively took an embarrassing amount of time to find. Lesson learned hopefully? We also made a mistake in our code by using just the analogRead function without converting our value to volts. Once we did further research on the function, we implemented a conversion and were able to see the expected output.