ELCT 201 – EE LABORATORY [#2]

[RESISTIVE SENSORS]

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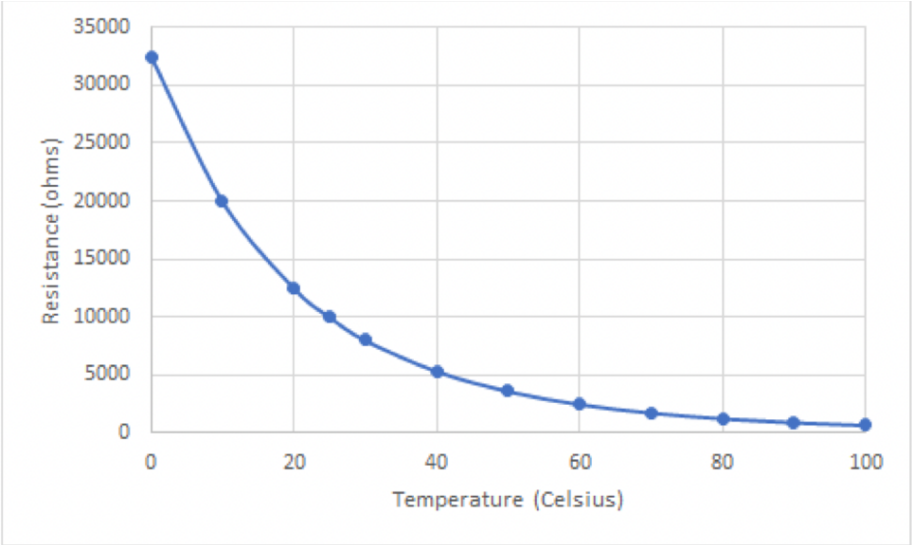
ABSTRACT

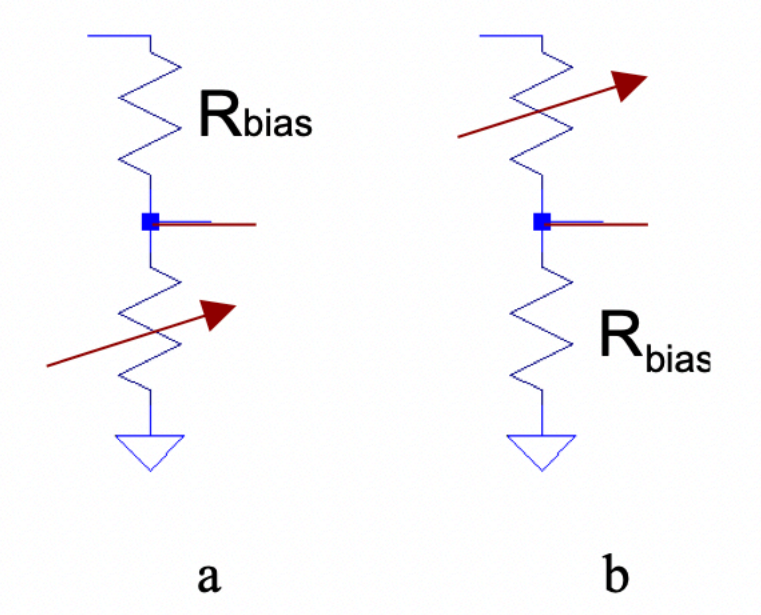
The goal of this project is to learn characteristics of resistive light and temperature sensors. Instruments are used to measure voltage outputs of the sensors, and datasheet information is used to calibrate voltages to the sensed light intensity or temperature.

INTRODUCTION

The pre lab assignment looked at estimating the resistances of the thermistor before and after touching it. For the calculation room temperature was 20 degrees Celsius and body temperature was 40 degrees Celsius. Using a table that was provided here.

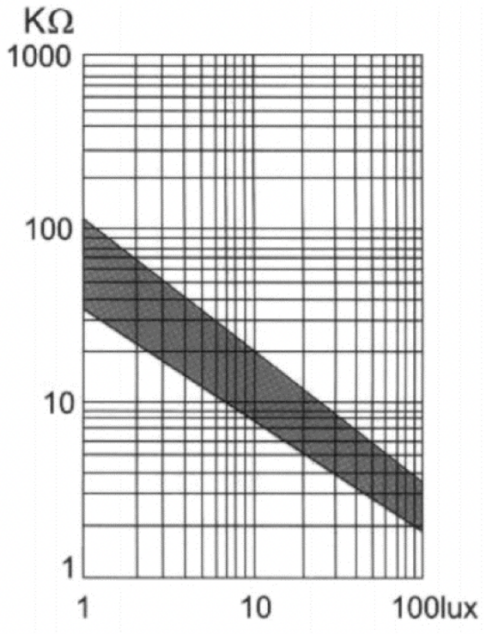


This table shows the relationship between resistance and temperature to visually prove there is a negative temperature coefficient of resistance. To actually measure the resistance it is stated to assume a 5V power source voltage. To calculate this Vout = vin * rsensor/(rbias+rsensor). The rbias in this equation is stated to be 10 thousand ohms. The output voltage for both temperatures is calculated with theses equations respectively Vout = 5*12500/(10+12500) = 4.996v and vout = 5*5000/(10+5000) = 4.990v the same calculations were used following the second configuration.



When observing this the formulas created were Vout = 5*10/(10+12500) = .0039v and Vout= 5*10/(10+5000) = .0099v

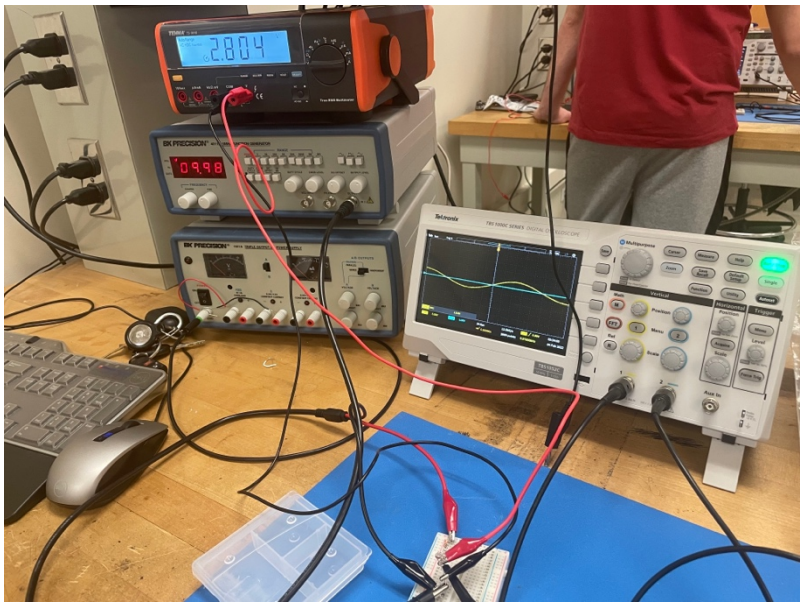
The second part of the pre lab consisted of finding the resistance of the photo conduction according to the chart below. Which illustrates as the light decreases the resistance increases.



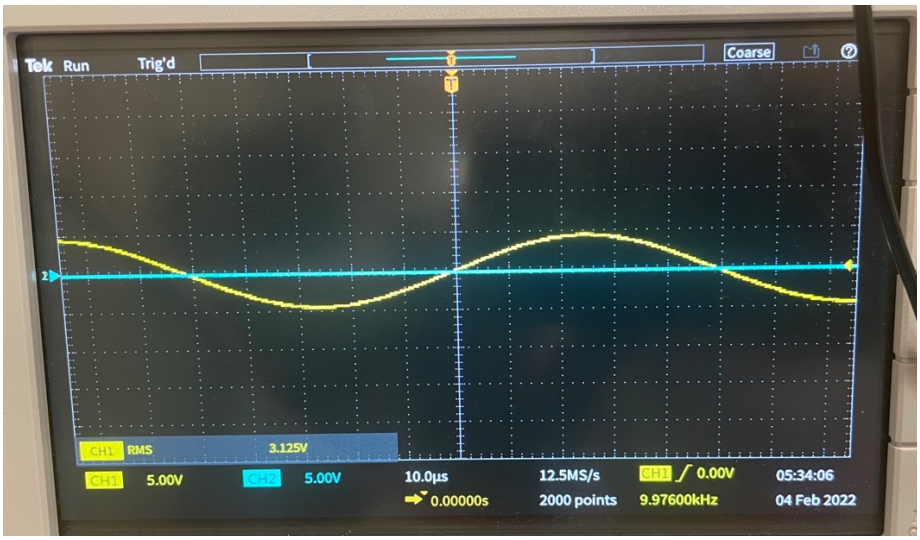
The following equations were used to solve for the resistances at 500 lux and 10 lux. The equation will still be Vout = vin * rsensor/(rbias+rsensor). Based on the chart 10 lux is determined to be 10k ohms and 500 lux is determined to be 2k ohms. Solving the equation to the output voltage the equations are Vout = 5*10000/(10+10000). = 4.995v vout= 5*2000/(10+2000) = 4.975v. when solving for the second configuration 5*10/(10+10000) = .0049v and 5*10/(10+2000) = .0248v.

RESISTIVE DIVIDER

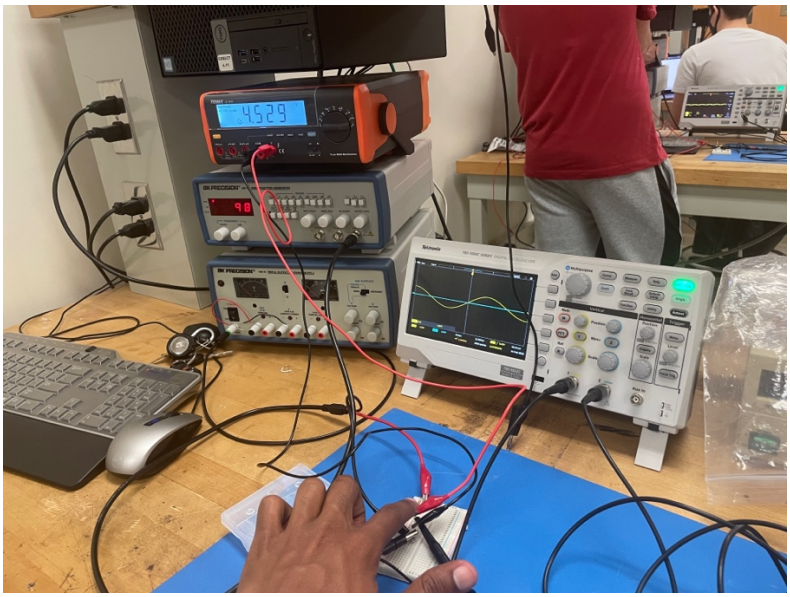
The executed experiment starts by building the circuit for the light sensor, and using the digital multimeter and oscilloscope to measure the response. An ac waveform is supplied to the circuit to measure the response. The circuit is shown in the figure below.



The rms value of the unshaded light sensor is 2.804 ohm

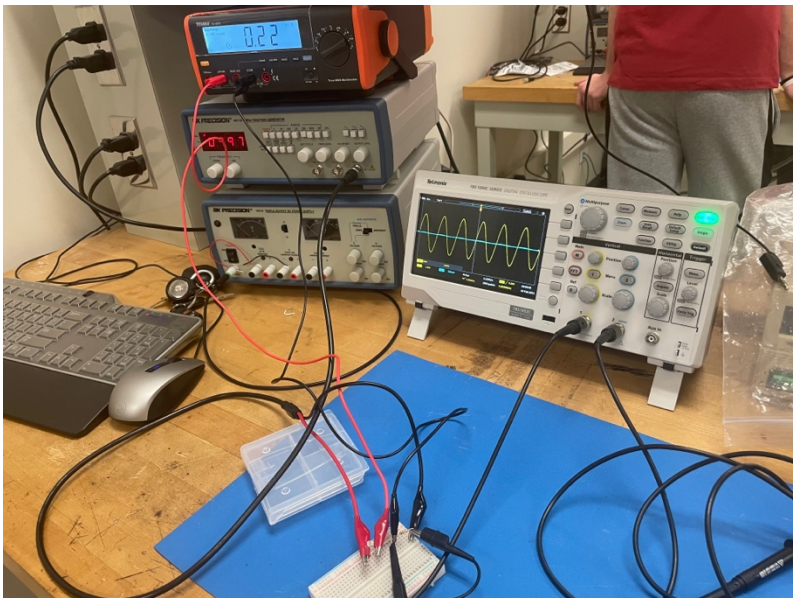


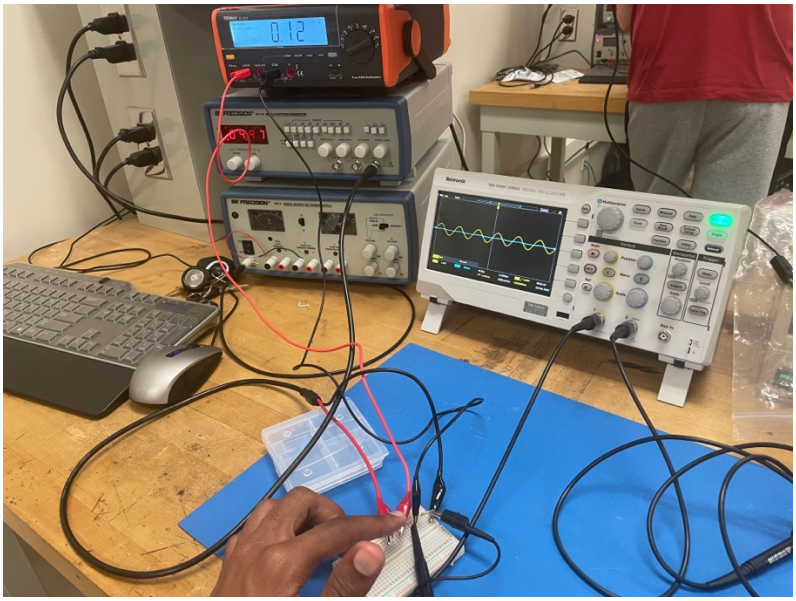
Oscilloscope reading.



The shaded rms value is 4.529 ohms and the oscilloscope reading is shown below.

When measuring the current of the circuit in mili amps the values are shown below.



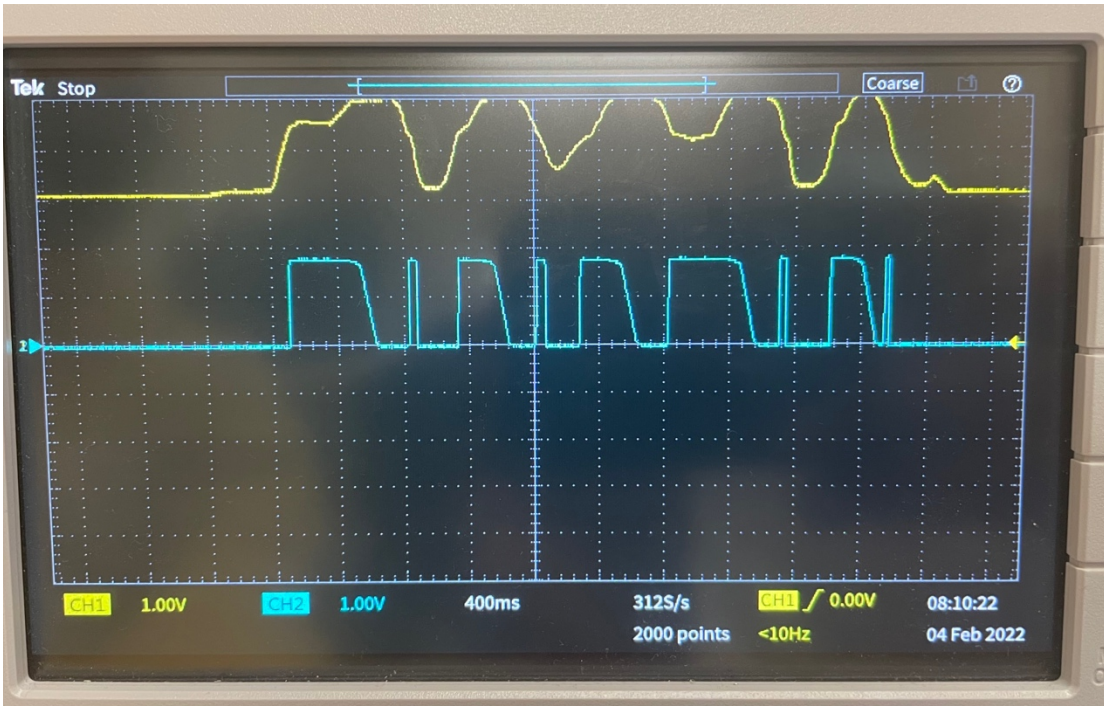


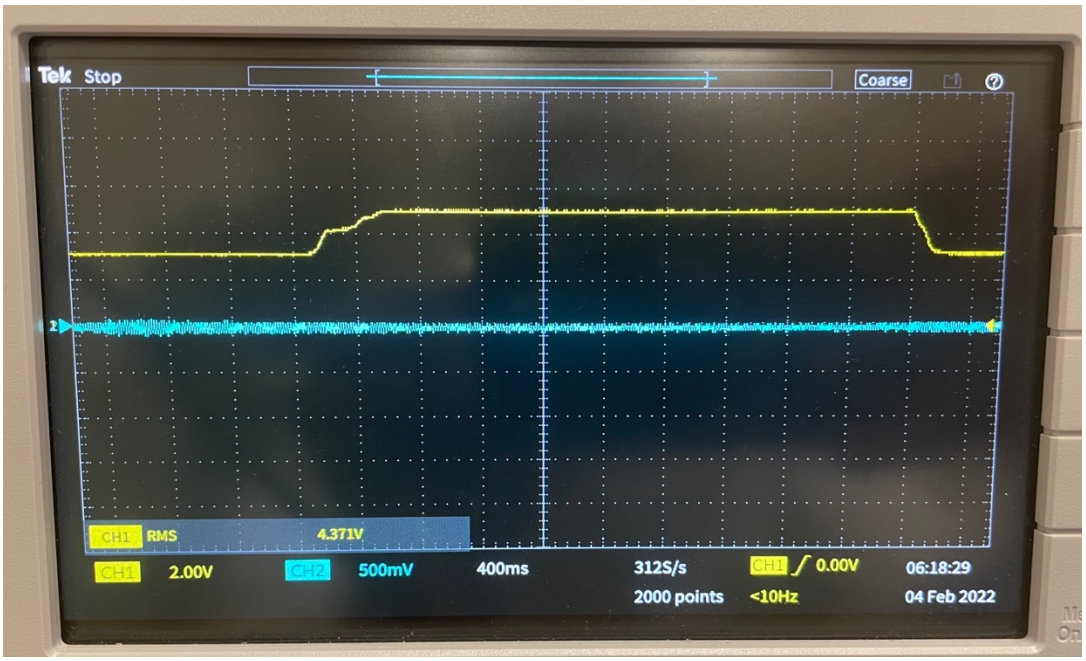
Unshaded it is .22 milliamps and shaded it is .12 milliamps. When setting up the circuit alternatively the current stays the same.

When comparing the values in the first step divided by the rbias 10k ohms the values are, .2804 unshaded and .4529 the values are not very similar except for in the case of the unshaded values. The order of the photoresistor and the bias resistor were reversed and it is shown that the output voltage increases.

DC POWER SUPPLY

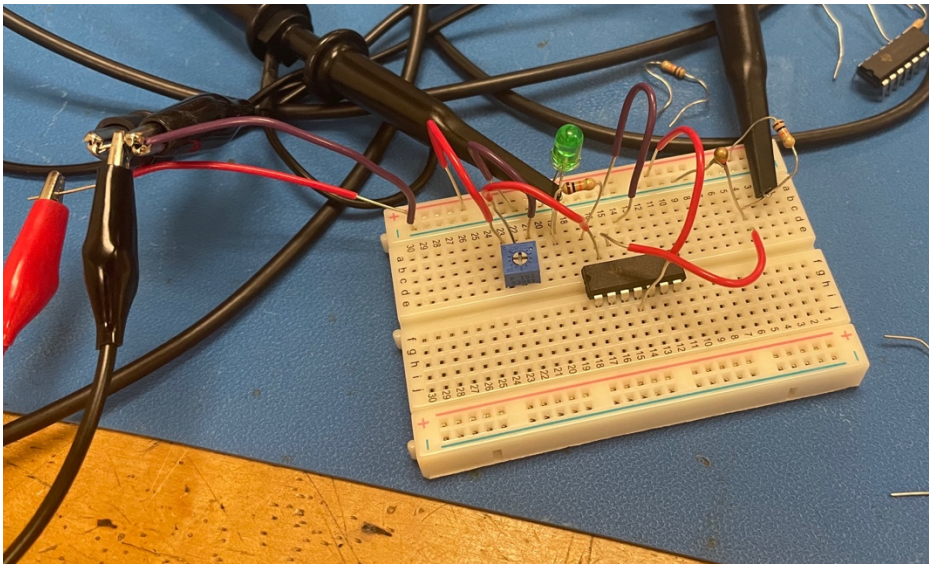
When repeating the experiment with a 5v dc power supply the oscilloscope is changed to a slow time scale to observe the relationship between the output voltage and the shading of the photoresistor. The reading is shown in the picture below.



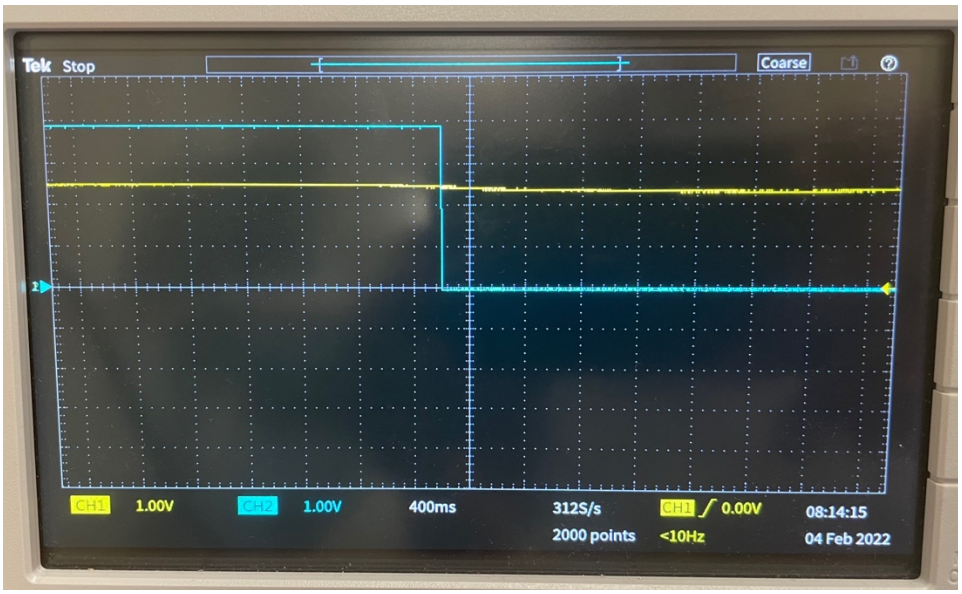


AMPLIFICATION

A difference amplifier circuit is built with a voltage difference ten times larger than between the sensor and reference voltage. The exact resistors originally requested in the project description where not available. The ones used instead are 2 10k 2 56k 2 470k respectively. The circuit is configured in the figure below for adjustable threshold detection.



The quad op amp chip was is used to build a threshold detector circuit which is powered by a 5 volts. The first channel measures the voltage from the light sensor and the second channel measures the voltage across the led. When light is fluctuated across the sensor the values of the voltage change as shown in the picture below. When conducting the experiment no noticeable light came from the led at any time, but it is shown to be changed in the oscilloscope figure below.


Tek Stop
Coarse
CH1 1.00V
CH2 1.00V
400ms
312S/s
2000 points
CH1 0.00V
<10Hz
08:14:15
04 Feb 2022