ECEN 214 - Lab Report

Lab Number: 4

Lab Title: Electronic Security System Design: Part 1 of 2

Section Number: 502

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Due Date: March 10, 2023

TA: Pranabesh Bhattacharjee

Introduction:

In this lab, we explored the application of operation amplifiers to get a better understanding of their use.During this lab, we learned to work with IR emitters and detectors. One of our tasks involved plotting the relationship between current and resistance in emitter and detector circuits. We also constructed a voltage inverter using an op amp, this allowed us to amplify low voltage signals to high ones, and vice versa. In task 2, we created a non-inverting amplifier circuit, which we compared to the inverting amplifier to determine which is the better amplifier for the alarm system. Lastly, we built a comparator that changed the output voltage to standard digital logic levels.

Task 1:

a) **Provide plots characterizing the operation of the emitter circuit.**

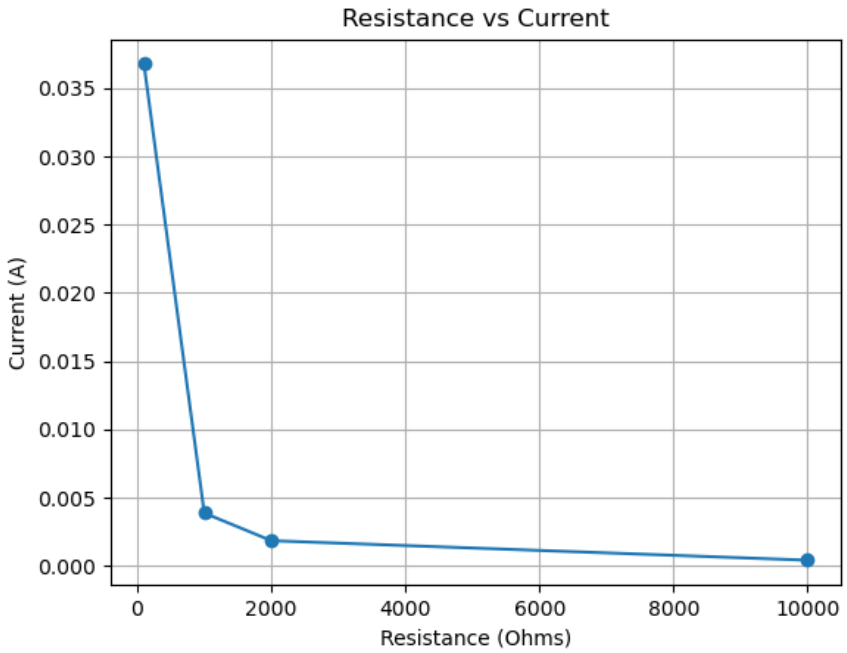
For the emitter:

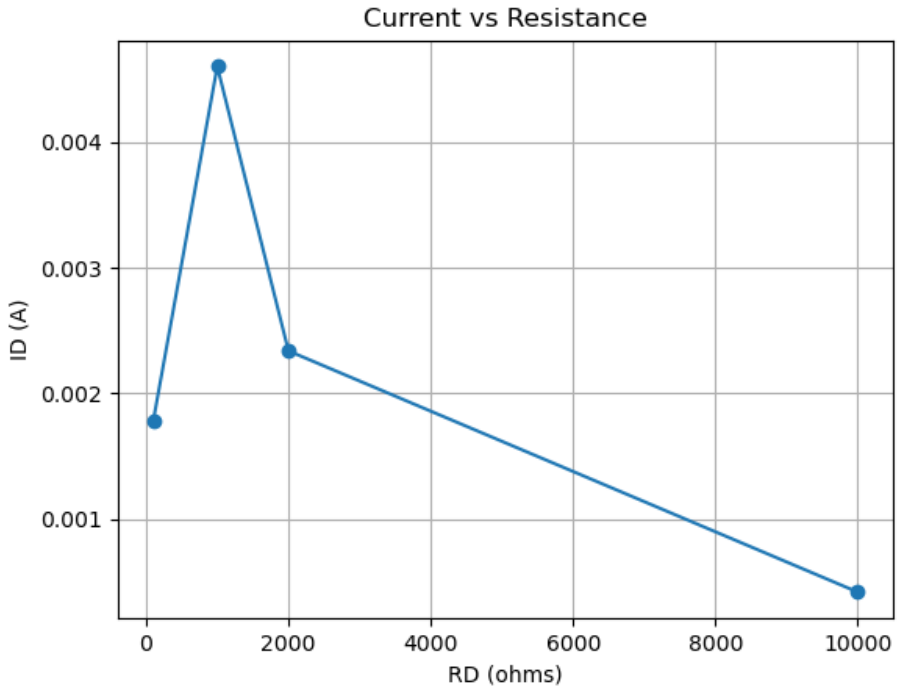
R_E (Ω)	Voltage over emitter (V)	Voltage over R_E (V)	I_E (A)
100 Ω	1.276	3.678	0.03678
1kΩ	1.130	3.877	0.003877
2kΩ	1.104	3.701	0.0018505
10kΩ	.925	4.206	0.0004206

For the detector:

R_D (Ω)	Voltage over emitter (V)	Voltage over R_D (V)	I_D (A)
100 Ω	0.038	0.178	0.00178
1kΩ	0.360	4.603	0.004603
2kΩ	0.722	4.679	0.0023395
10kΩ	0.170	4.200	0.00042

b) Provide plots characterizing the operation of the detector circuits (both the one in Figure 4.9(b) and the one in Figure 4.11).





c) **What resistor values did you finally decide upon and why?**

After reviewing the manual given, we decided to use the resistors with the value of 100 Ohms. This is due to this being a resistor value that does not fry our components. After we observe how the circuit and its components would react using the highest resistor value, which is 10,000 ohms. Finally, two random resistor values were selected to test the circuit without the highest resistor. We used a 1,000 ohm resistor and 2,000 ohm resistor. This allowed the testing of the emitter at a low voltage.

d) **How far apart were you able to place the emitter and detector and still have the circuit function as intended?**

To test how far the circuit would still work, we tested the emitter and detector to be 4 inches apart. We wanted to get the emitter and the detector to be on the very other side of the circuit. The length of 4 inches was the farthest that these two components would still be operable.

Task 2:

a) **Provide a plot of measured *Vout* vs. *Vin* for both amplification circuits in Figure 4.12. Be sure to indicate what your saturation voltages are.**

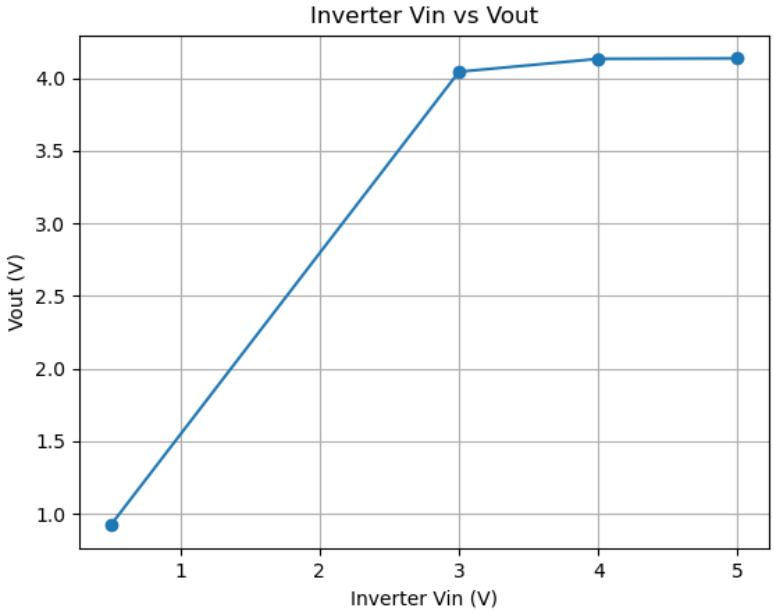
Inverter:

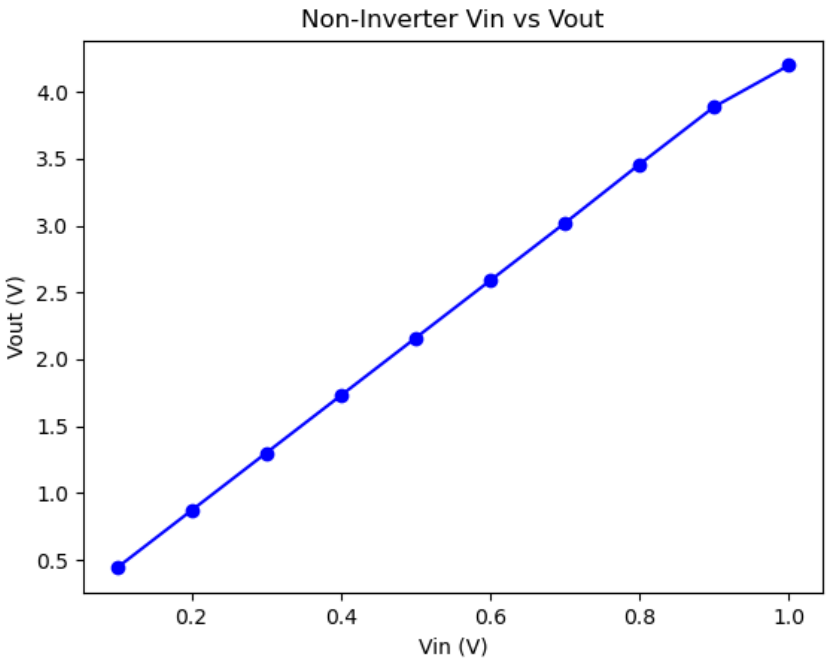
Vin	Vout
0.5V	0.921V
3.0V	4.045V
4V	4.134V
5V	4.137V

Non-Inverter:

Vin	Vout
0.1V	0.44V
0.2V	0.87V

0.3V	1.3V
0.4V	1.73V
0.5V	2.16V
0.6V	2.59V
0.7V	3.02V
0.8V	3.46V
0.9V	3.89V
1.0V	4.20V





b) Comment on which amplifier circuit would couple better with the detector circuit(s) of Task 1? Why?

We decided to use the non-inverting amplifier circuit. This is due to this style of the amplified circuits being one that allows the highest input impedance of any op- amp. Allowing The highest input impedance allows for the detector to work at a far distance as previously tested.

Task 3:

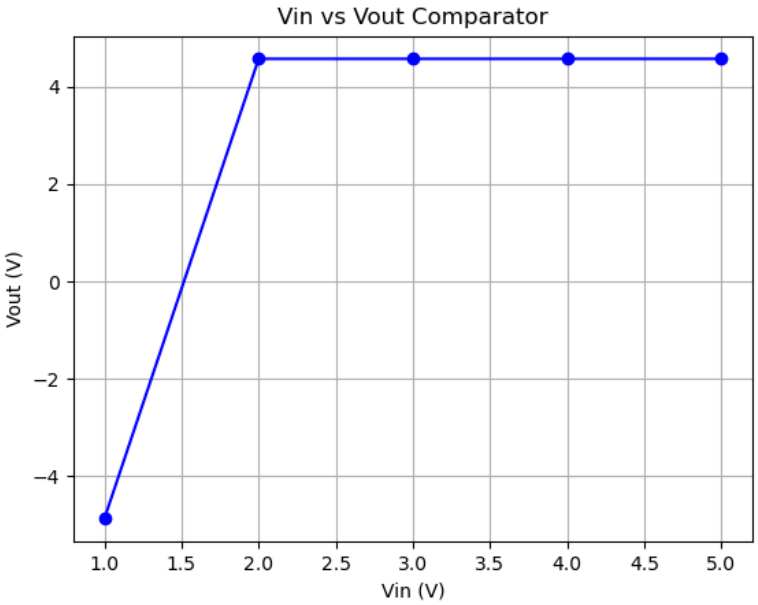
a) Discuss what resistance values you chose and why.

The resistor values that were used in task 3 were 1,000 ohms and 2,000 ohms. These values were used as part of Task 2 in this lab. To receive an accurate value of voltage output. Using these values allowed for a low voltage to the circuit and the detector.

b) Provide a plot of measured *Vo* vs. *Vi* for the comparator circuit.

Vin	Vout
5V	4.57V

4V	4.57V
3V	4.57V
2V	4.57V
1V	-4.87V



c) Discuss what the input voltages need to be to cause the output to produce each of the desired logic levels.

The voltage output when the voltage input is 5 volts needed to be the same value as the positive voltage source, in this case 5 volts. As we dropped the voltage by 1 volt, the voltage output did not drop further. This was the case until the voltage input was 1 volt. This made the voltage output be the same as the negative voltage source, which is -5 volts.