Lab 4: Operational Amplifier Application: Electronic Security System

ECEN 214 - 517

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Date Performed: October 6, 2020

Due Date: October 7, 2020

Procedure

Task 1

In task 1, students were asked to find a combination of resistors to connect to an IR emitter and detector which would cause the greatest difference between the voltage across the detector with the IR beam unobstructed and the voltage across the detector with the IR beam obstructed. First, a set of resistors was tested with the emitter, and the different currents through the emitter were measured. In general, the current decreased as higher resistances were tested, thus decreasing the intensity of the IR beam. Next, the same tests were performed with the detector, finding the difference between the voltage when obstructed and the voltage when unobstructed.

Task 2

In task 2, the same procedures were performed as task 1. However, instead of using a resistor with the detector, an LM741 op-amp was used instead. In this case, the detector was connected to the negative input of the op-amp. Different resistances between the negative input and the output were tested to find the greatest difference between the voltage measurements obstructed and unobstructed.

Deliverables

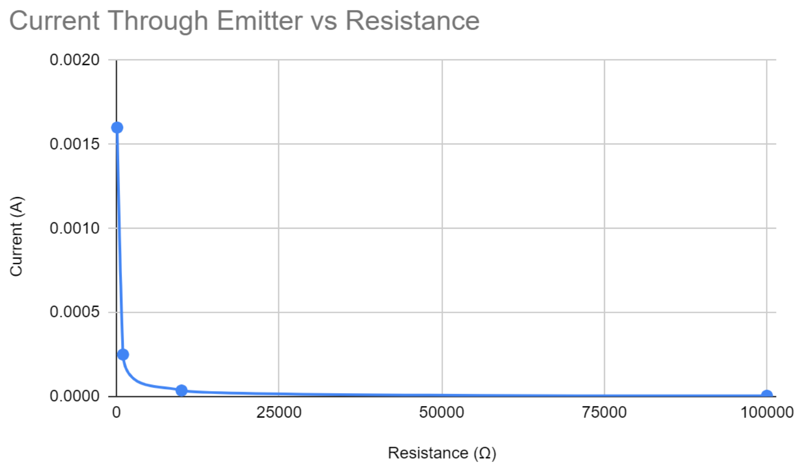
Task 1

1. **Provide plots characterizing the operation of the emitter and detector circuits.**

Source: 1.34 V

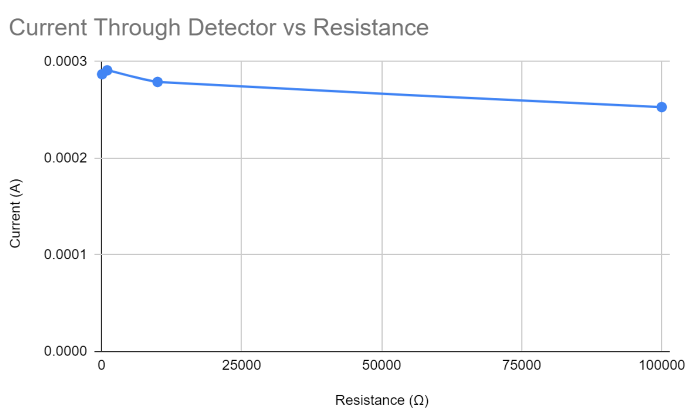
Emitter:

R_E (Ω)	Voltage Across Emitter (V)	I_E (A)
100	1.18	0.0016
1000	1.09	0.00025
10000	0.98	0.000036
100000	0.87	0.0000047



Detector:

R_D (Ω)	Voltage Across Detector (V)	I_D(A)
100	2.82	0.000287
1000	3.67	0.000291
10000	4.29	0.000279
100000	4.88	0.000253



2. **What resistor values did you finally decide upon and why?**

In choosing resistors, we found that for the emitter, it was best to use the smallest resistor possible without damaging the emitter. Since the emitter is rated at a maximum continuous forward current of 50 mA, the smallest resistor we could use without damaging the emitter was 100 Ω. On the other hand, for the detector, it was best to choose the largest resistor available to us, since the voltage would increase for larger values of R_D. The largest resistor immediately available to us was 100000 Ω.

3. **What was the maximum distance at which you were able to distinguish between the unobstructed and obstructed cases and what were the detector voltages that you measured for both cases?**

The maximum distance to distinguish between unobstructed and obstructed was around three-fourths of the breadboard to keep the circuit running. The voltage for obstructed was 0.026V and the voltage for unobstructed was 0.65V.

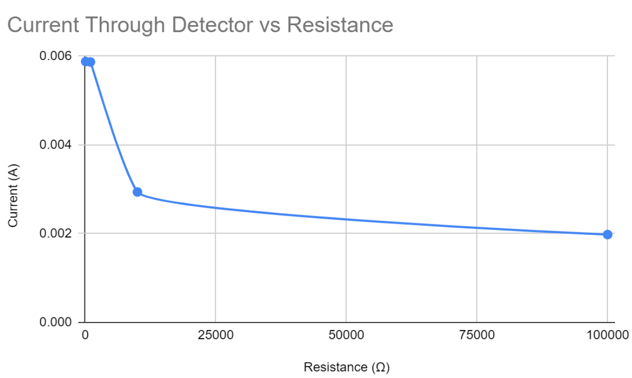
Task 2

1. **Provide plots characterizing the operation of the detector circuits.**

OP-Amp Based Detector

R_D (Ω)	Voltage Across Detector (V)	I_D(A)
100	0.615	0.00588
1000	5.79	0.00587
10000	10.98	0.00294
100000	16.17	0.00198

The obstructed voltage value with the OP Amp is 9.15V and the unobstructed value is 0.411V.



2. **Comment on any significant difference between the detector circuits in Task 1 and Task 2.**

Overall, the detector circuits between task 1 and task 2 seemed to follow the same trend. However, the changes between voltages as different resistors are tested seem to be amplified. The obstructed to unobstructed values increased in task 1 and decreased in task 2.