

# EE 236: Experiment 3

## Photodiode Characteristics and Applications

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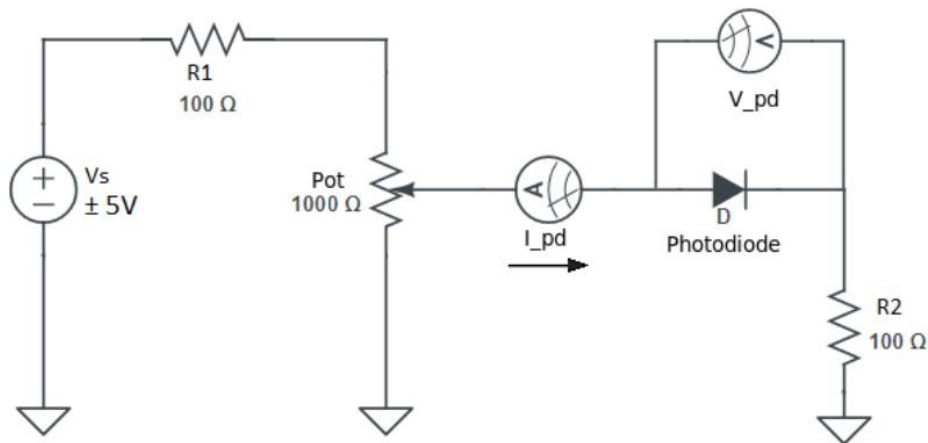
August 24th 2024

### 1 Aim

- 1. Study the forward and reverse bias I-V characteristics of a photodiode.
- 2. Measure the photodiode's response to different light sources and varying intensities using 4 provided LEDs, along with their current vs. intensity data.
- 3. Utilize the photodiode as an optical signal sensor in combination with an infrared LED..

### 2 Parts of the Experiment

#### 2.1.1 Circuit

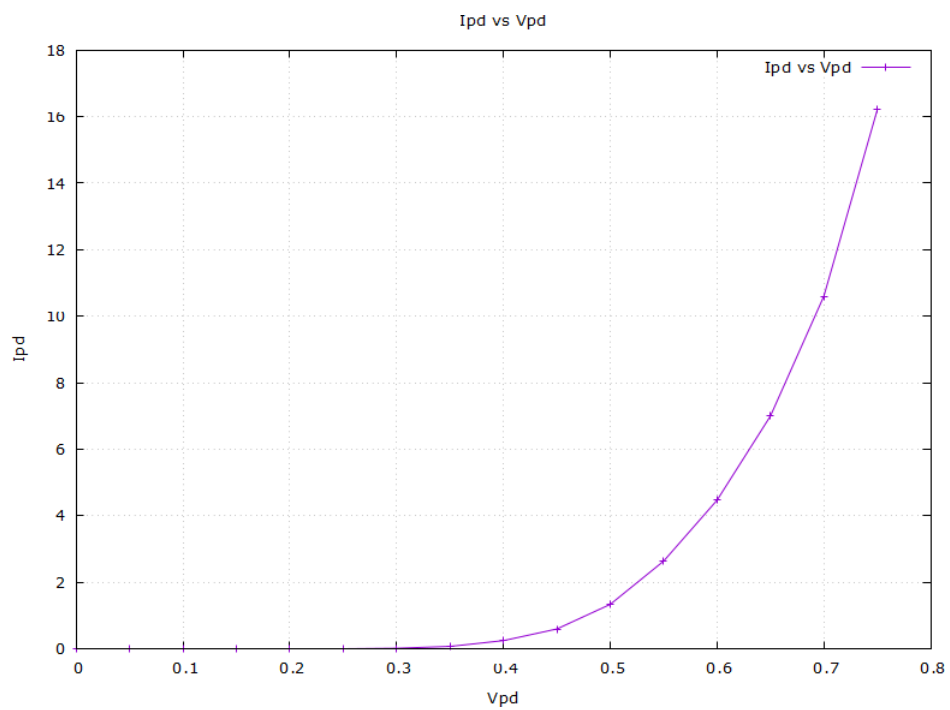


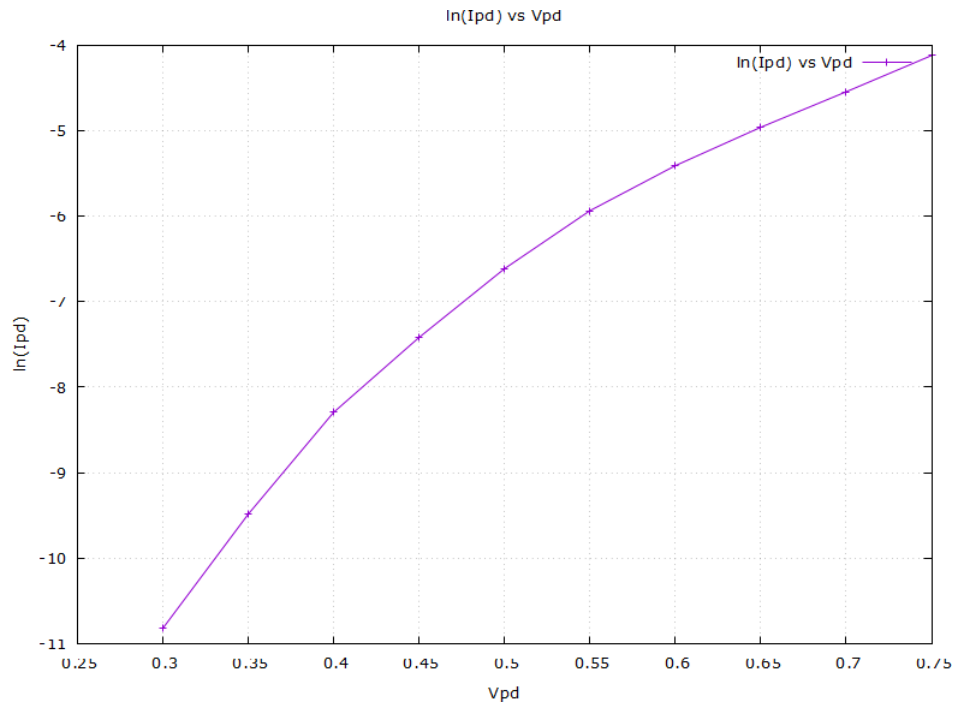
### 2.1.2 I-V data

V <sub>pd</sub>	I <sub>pd</sub> (mA)	ln(abs(I <sub>pd</sub> ))
0	0	
0.05	0	
0.1	0	
0.15	0	
0.2	0	
0.26	0	
0.46	0.65	-7.3385
0.543	1.98	-6.2247
0.567	2.83	-5.8675
0.572	3	-5.8091
0.578	3.22	-5.7384
0.588	3.58	-5.6324
0.592	3.74	-5.5887
0.603	4.16	-5.4822
0.62	4.89	-5.3206
0.63	5.44	-5.2140
0.653	6.66	-5.0116
0.672	7.89	-4.8422
0.708	10.88	-4.5208
0.759	16.77	-4.0882
0.766	17.91	-4.0224

- Ideality factor : 3.7531

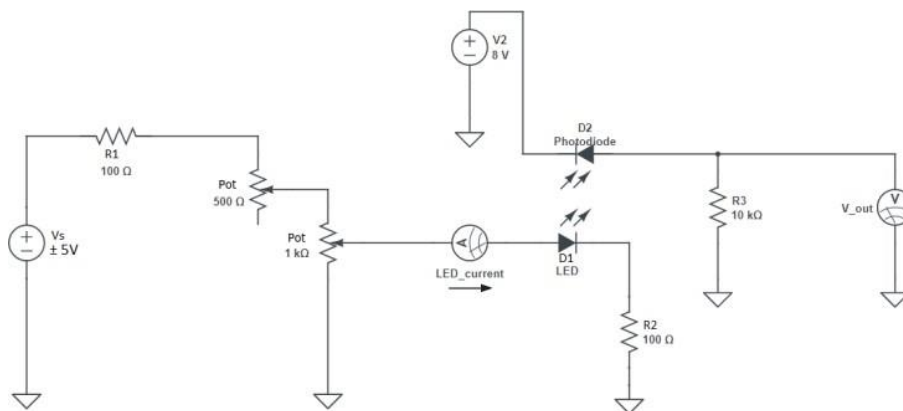
### 2.1.3 Plots





## 2.2 Part 2

### 2.2.1 Circuit



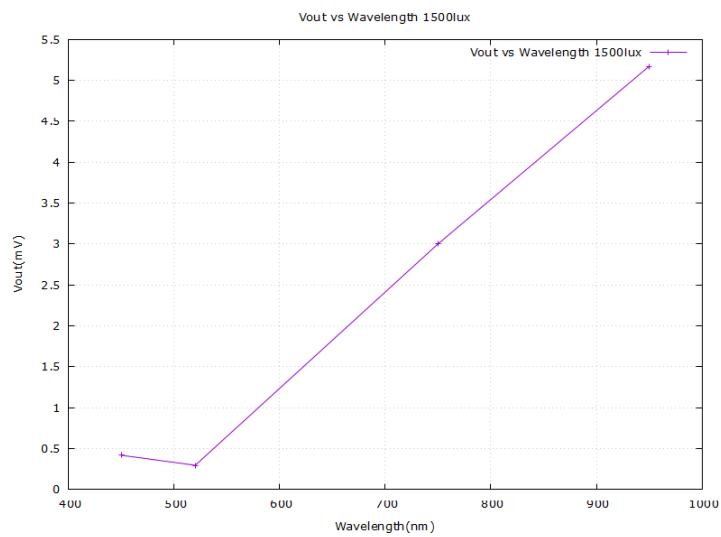
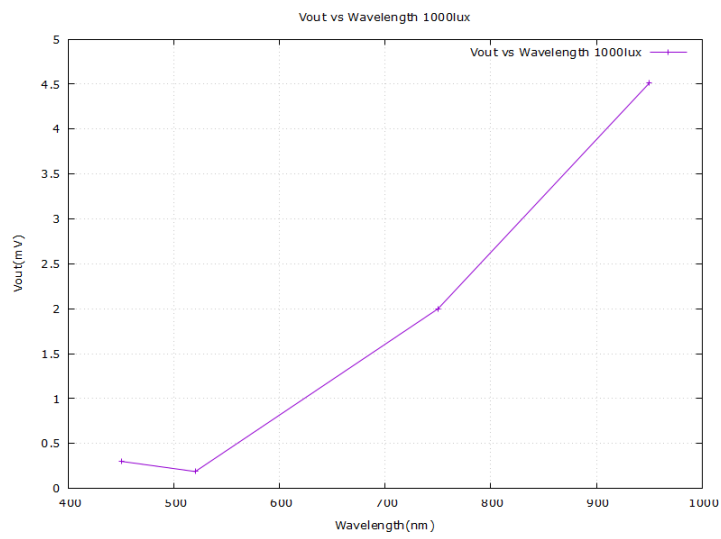
### 2.2.2 Data

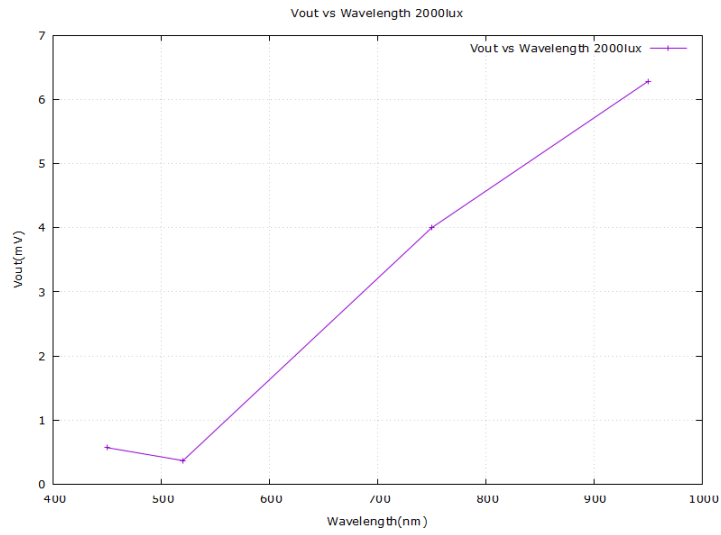
	Vout(V)			
Intensity(lux)	IR	Red	Green	Blue
1000	4.51E-03	2.00E-03	1.88E-04	3.01E-04
1500	5.17E-03	3.00E-03	2.94E-04	4.16E-04
2000	6.28E-03	4.00E-03	3.71E-04	5.72E-04

	IR	Red	Green	Blue
Lambda (m)	9.50E-07	7.50E-07	5.20E-07	4.50E-07

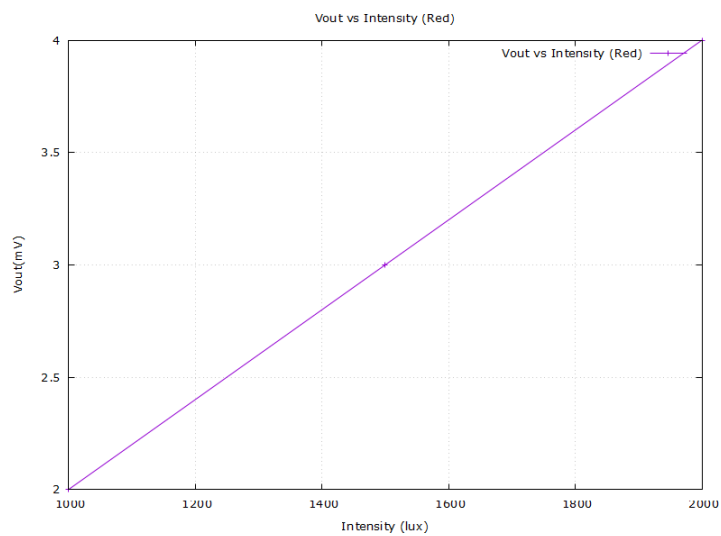
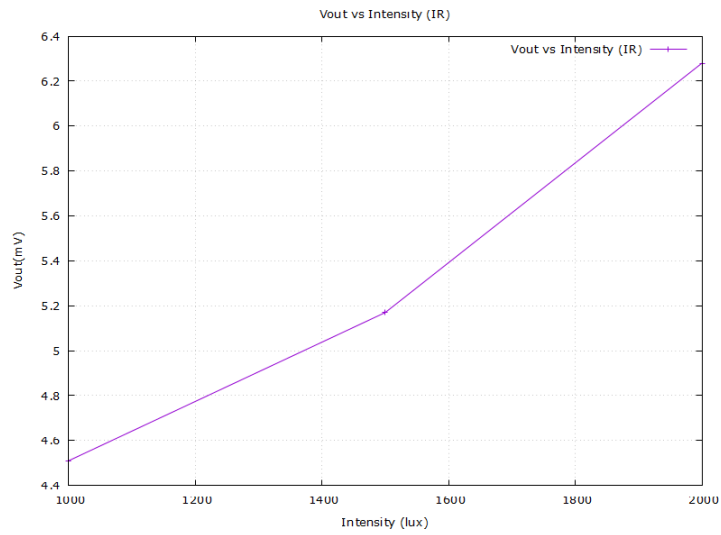
### 2.2.3 Plots

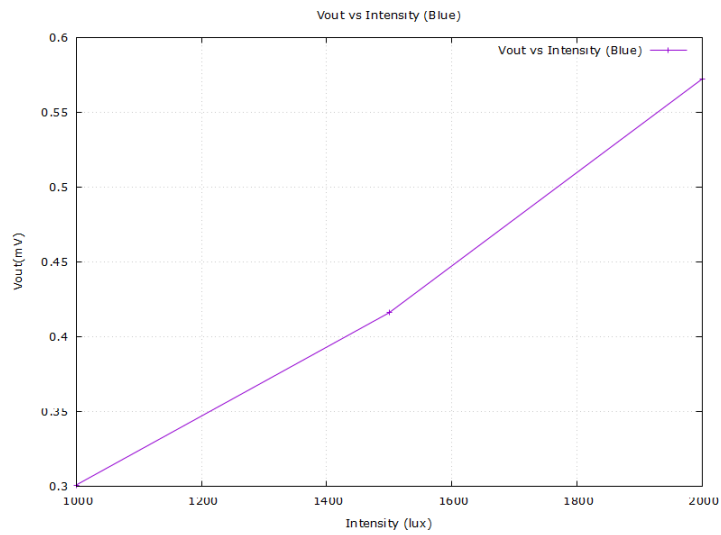
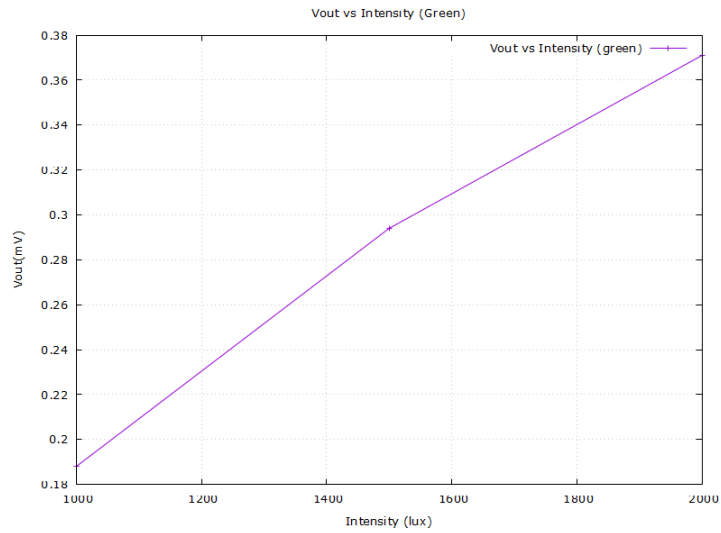
#### 2.2.4 Vout vs Wavelength





## 2.2.5 Vout vs Intensity

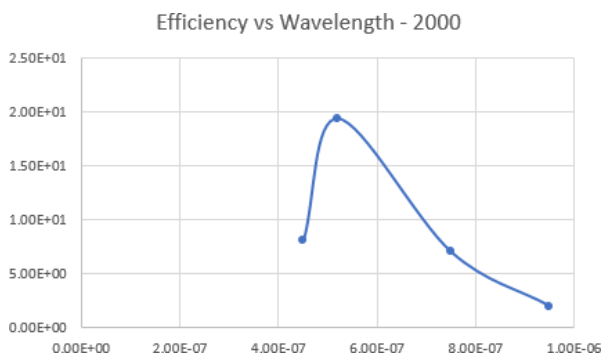
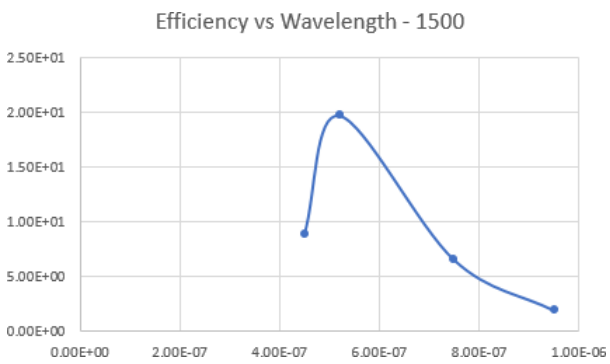
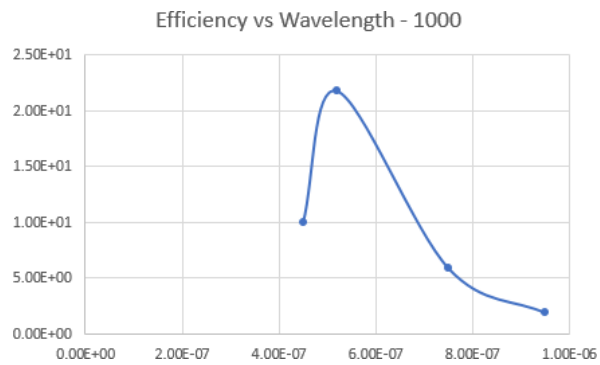




## 2.2.6 Efficiency

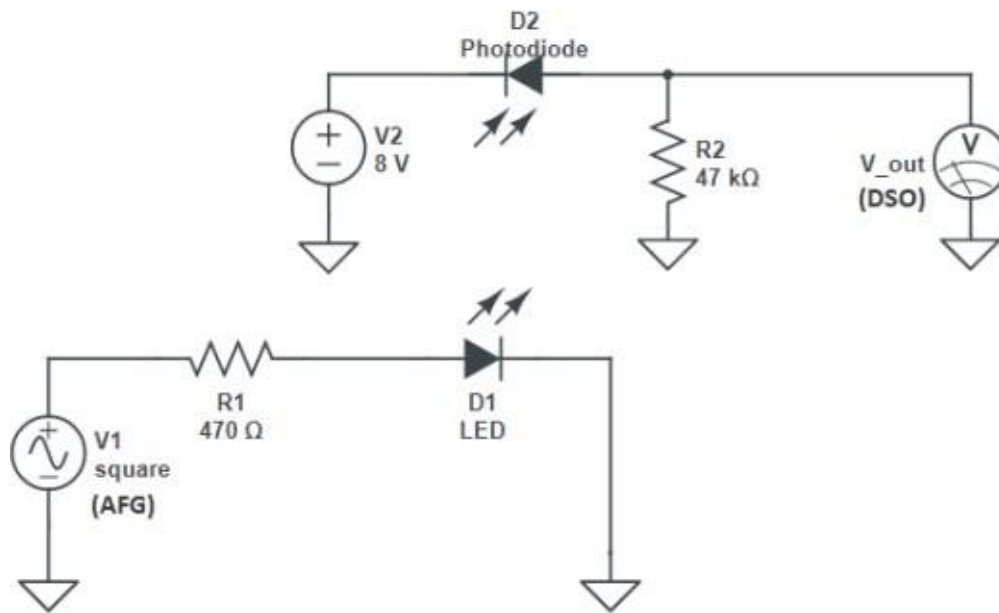
Intensity	IR/Intensity	Red/Intensity	Green/Intensity	Blue/Intensity
1000	1.91E-03	5.90E-03	2.18E-02	9.97E-03
1500	1.27E-03	4.35E-03	1.31E-02	5.93E-03
2000	9.85E-04	3.50E-03	9.70E-03	4.02E-03
Lambda	9.50E-07	7.50E-07	5.20E-07	4.50E-07

Most efficient: Green



## 2.3 Part 3

### 2.3.1 Circuit



### 2.3.2 Data

Frequency (Hz)	Rise time (us)	Fall time (us)
1000	15.37	15.72
5000	11.37	11.62
10000	11.98	11.34
15000	12.31	12.15
20000	12.19	12.03

### 2.3.3 Observations and Reasoning

1. Distortion: Significant distortion is observed at 20 kHz.
2. Reason for Slow Photodiode Response: The photodiode's response speed is limited by its "detection bandwidth," which determines how quickly its output can adapt to a changing input signal. This bandwidth is influenced by two factors:
  1. The junction capacitance of the diode.
  2. The transit time of the photocurrent within the junction.

## 3 Completion Status

The experiment was meticulously performed and successfully completed in the lab. All objectives were achieved, and the procedures were executed as planned, resulting in the expected outcomes.