Electrical and Computer Engineering Department

Group K:

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ECE 2200L

Experiment Number 3

Current-Voltage Characteristics of the Zener Diode

Represented to

Professor Mosatfa ,Yazdy

Fall 2024

Thursday

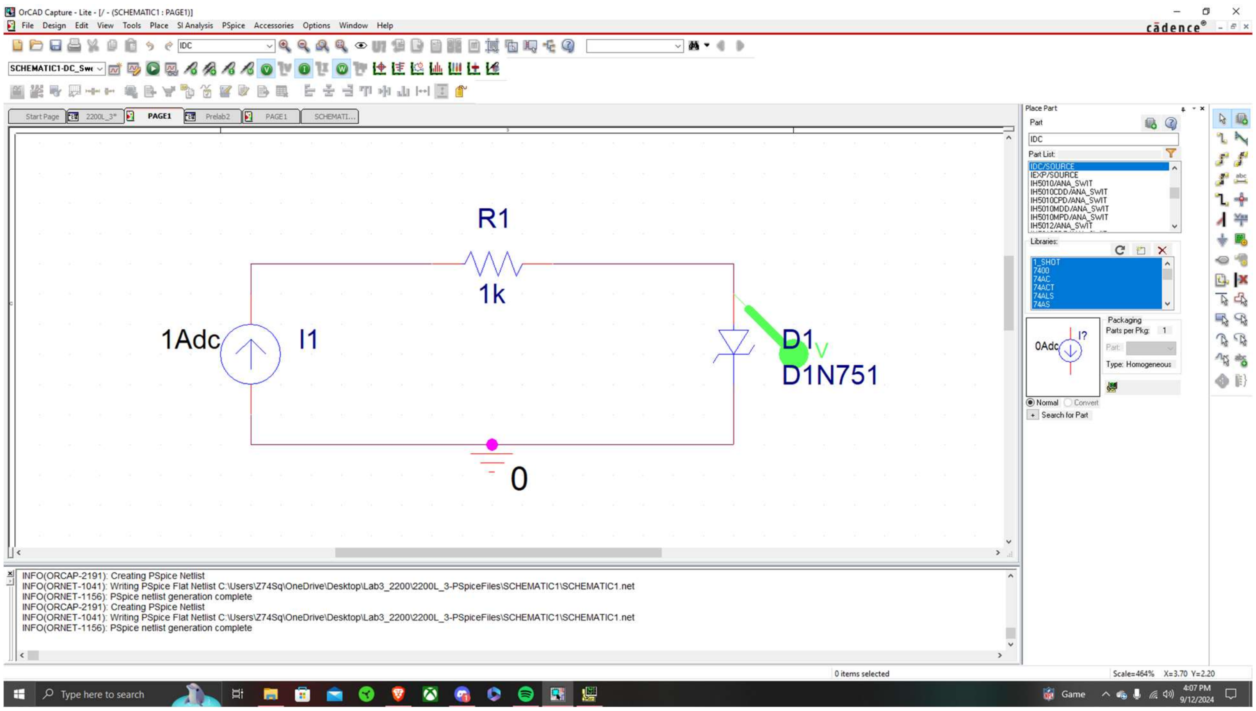
September 19, 2024

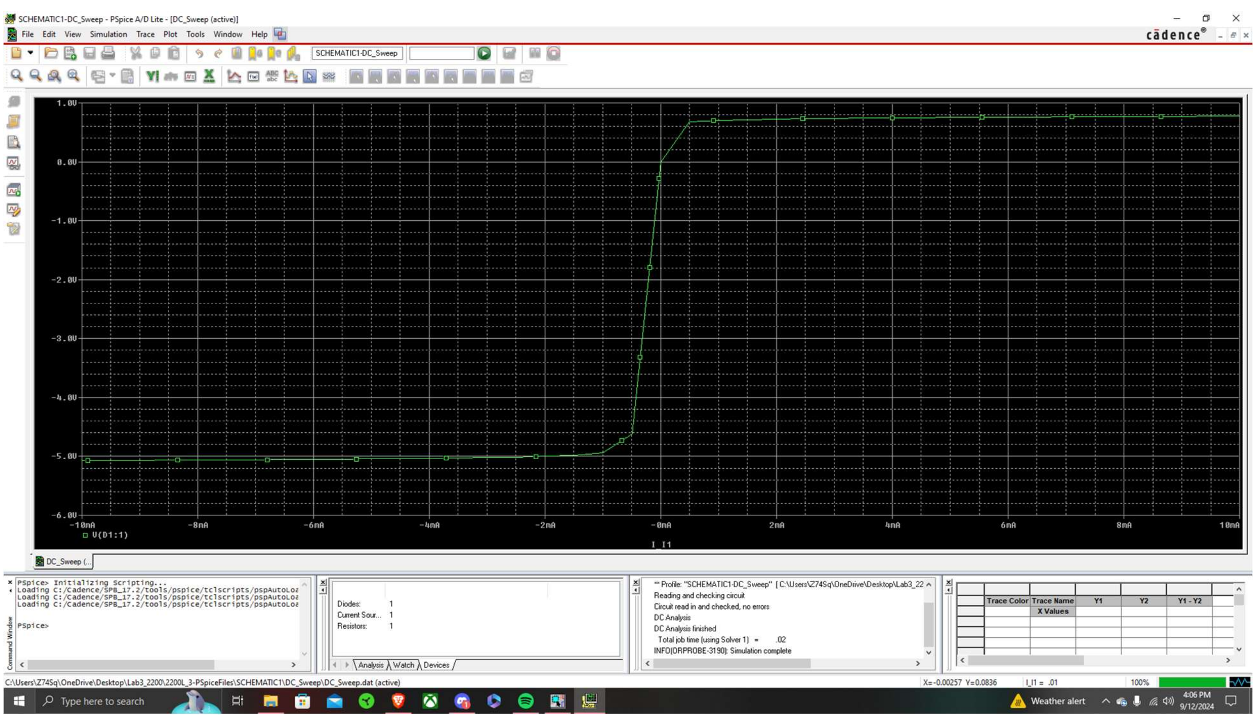
Objective:

The objective of this experiment is to thoroughly analyze the current-voltage (I-V) relationship of Zener diodes, focusing on key parameters such as reverse saturation current and the diode's ideality factor. By plotting the I-V characteristics, we can observe the diode's behavior under different voltage conditions, particularly in the reverse breakdown region. Additionally, the XY mode of the oscilloscope will be utilized to visually display these characteristics, allowing for real-time monitoring and a more precise understanding of the Zener diode's performance in both forward and reverse bias modes. This analysis will provide insights into the diode's efficiency and reliability in various applications.

Prelab:

Run DC Sweep Simulation to find the I-V characteristic of a Zener Diode (1N751) (-10mA to +10mA).





Measurements:

1- Given

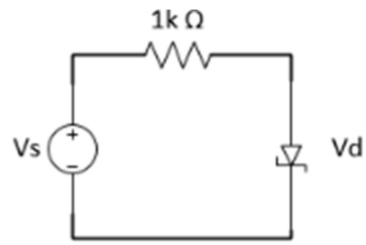
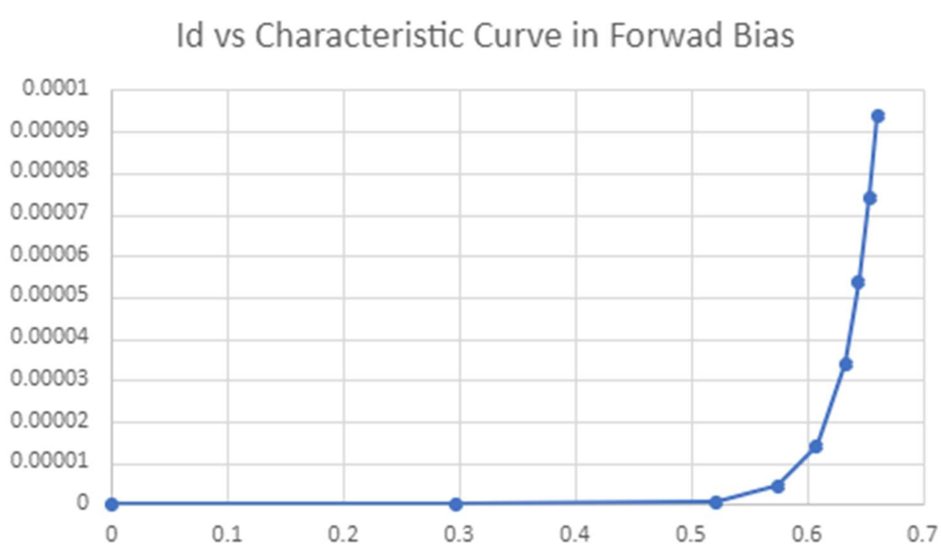


Figure 1

Table 1.1

R 1047.4000Ω			
Vs	Vd	Vr	Id
0.0000	0.0006	-0.0006	0.0000
0.3300	0.3300	0.0000	0.0000
0.6600	0.6361	0.0239	0.0000
1.0000	0.7002	0.2998	0.0003
2.0000	0.7376	1.2624	0.0012
4.0000	0.7625	3.2375	0.0031
6.0000	0.7756	5.2244	0.0050
8.0000	0.6200	7.3800	0.0070
10.0000	0.6200	9.3800	0.0090



2- Given

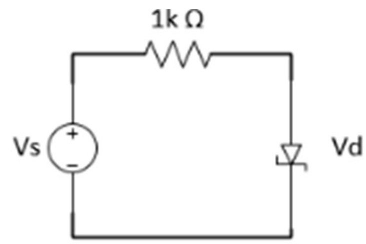
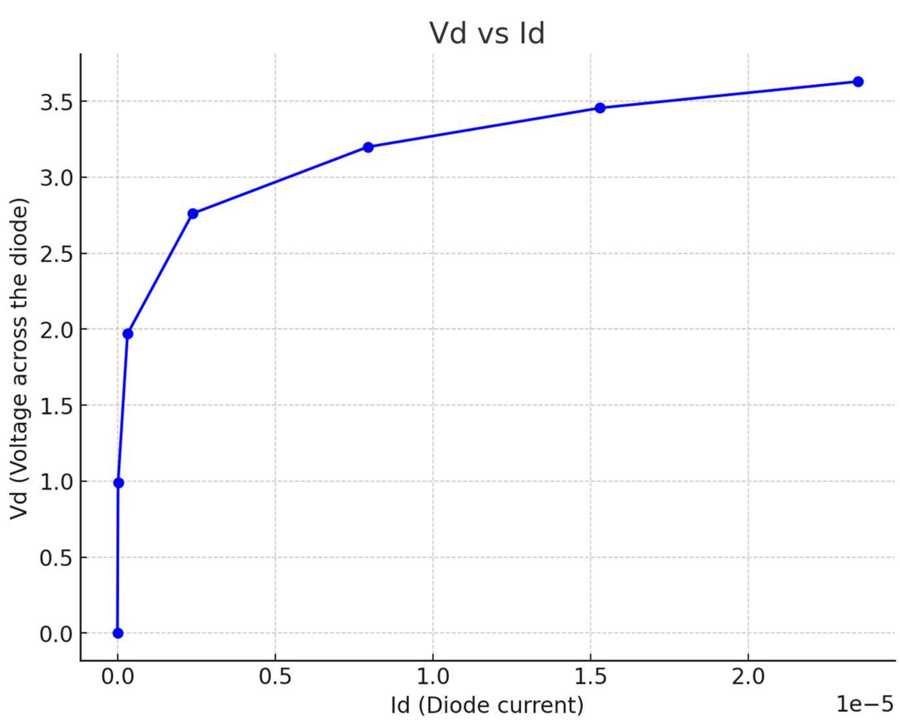


Figure 1

Table 1.2

R			
100950.0000			
Vs	Vd	Vr	Id
			-
0.0000	0.0006	-0.0006	0.00000001
1.0000	0.9910	0.0090	0.00000009
2.0000	1.9692	0.0308	0.00000031
3.0000	2.7605	0.2395	0.00000237
4.0000	3.1990	0.8010	0.00000793
5.0000	3.4556	1.5444	0.00001530
6.0000	3.6295	2.3705	0.00002348



3- Given

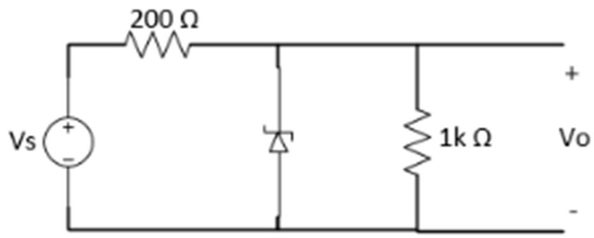


Figure 3

Schematic

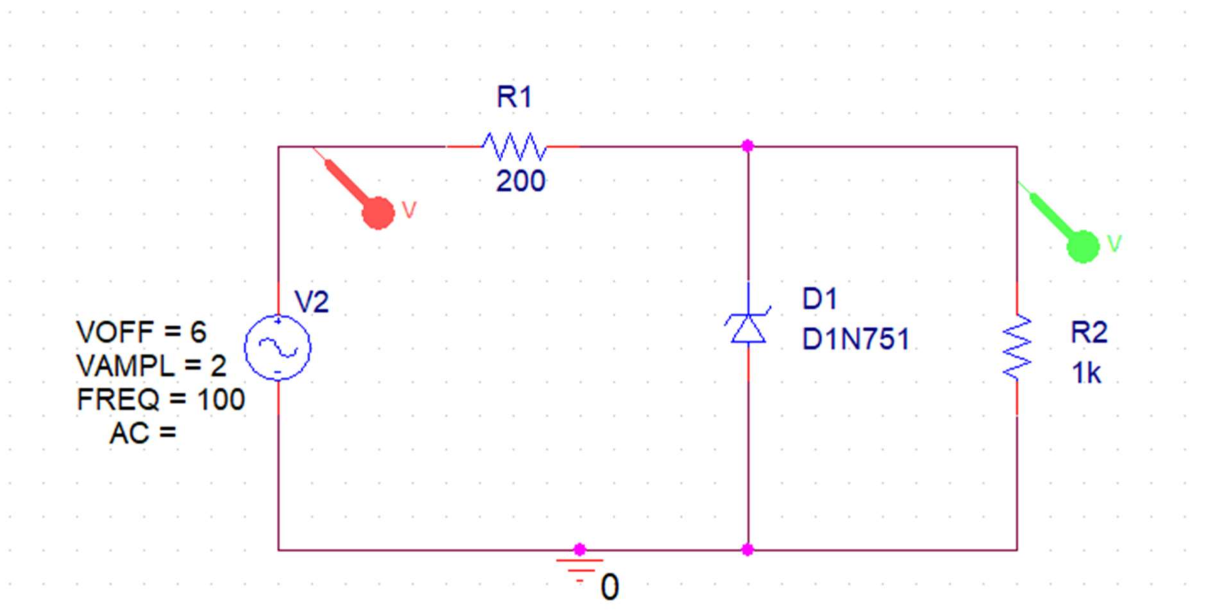
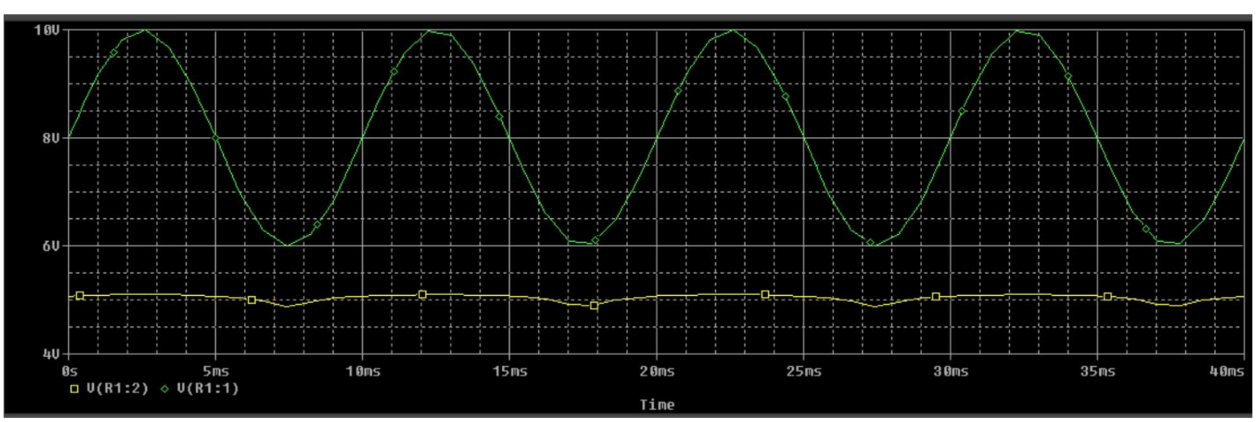


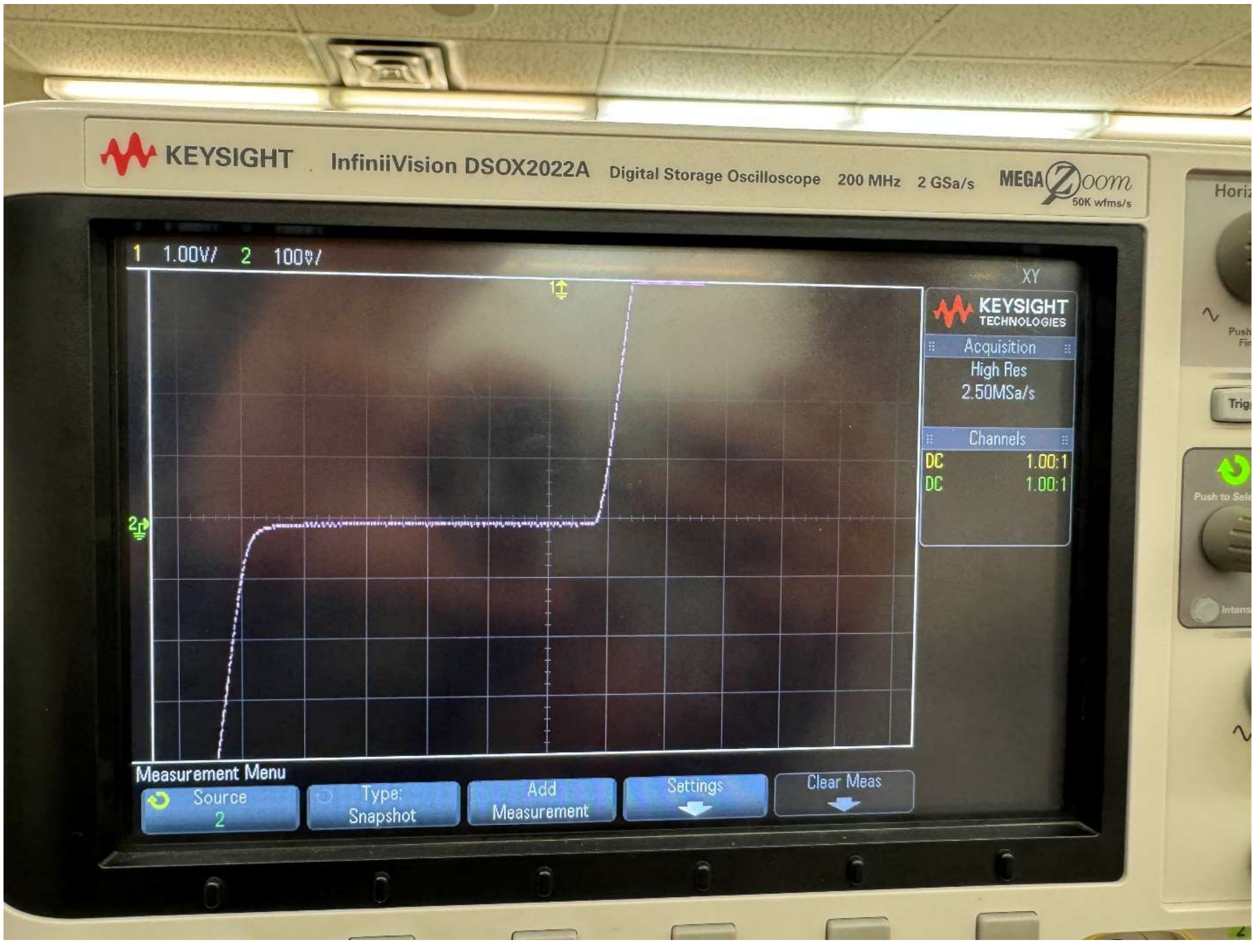
Figure 3:

Vd.t Vs Id



Data Analysis:

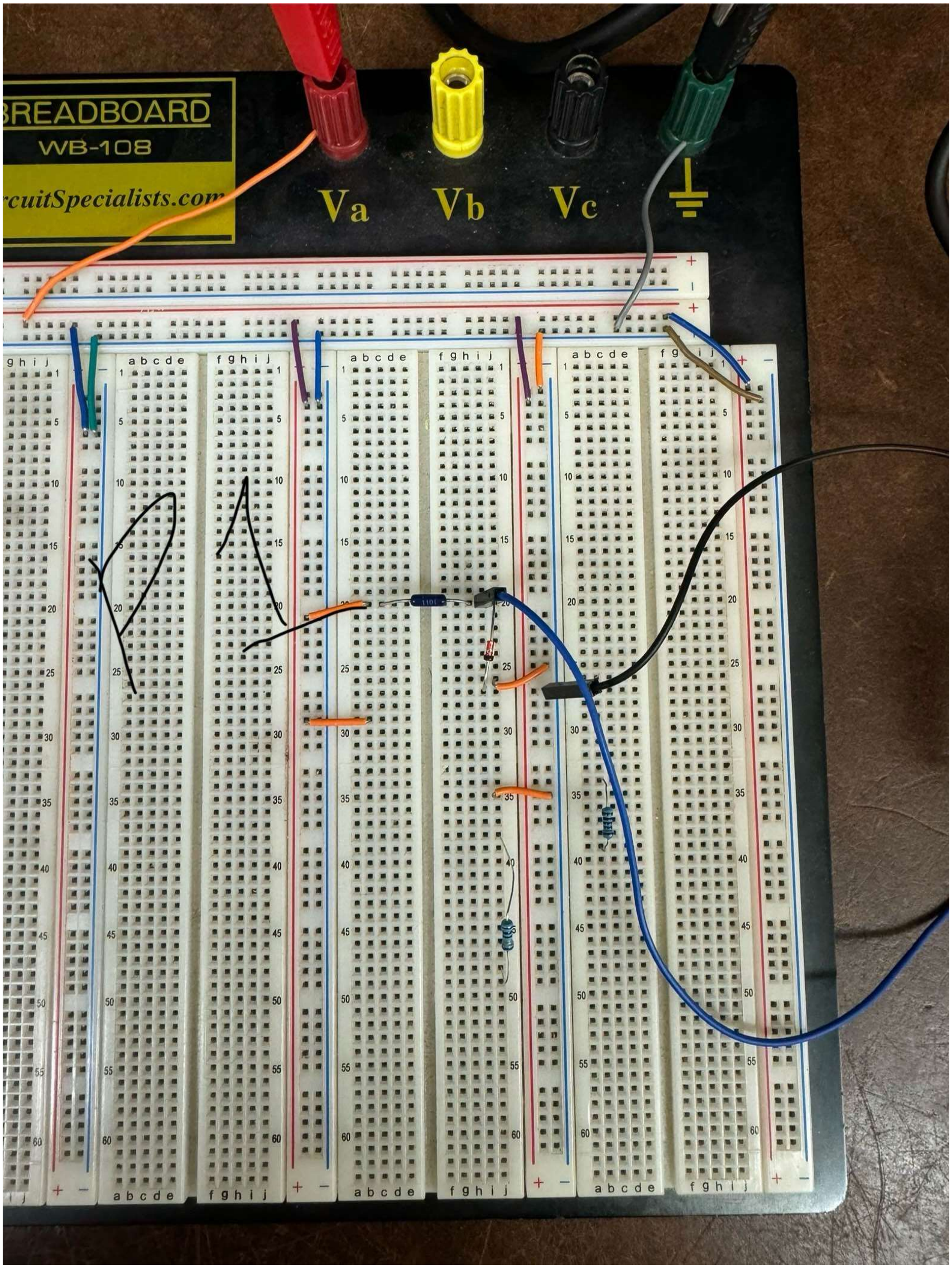
Plot forward and reverse I_d vs. V_d from the data obtained from your measurements from figure 1 and figure 2.



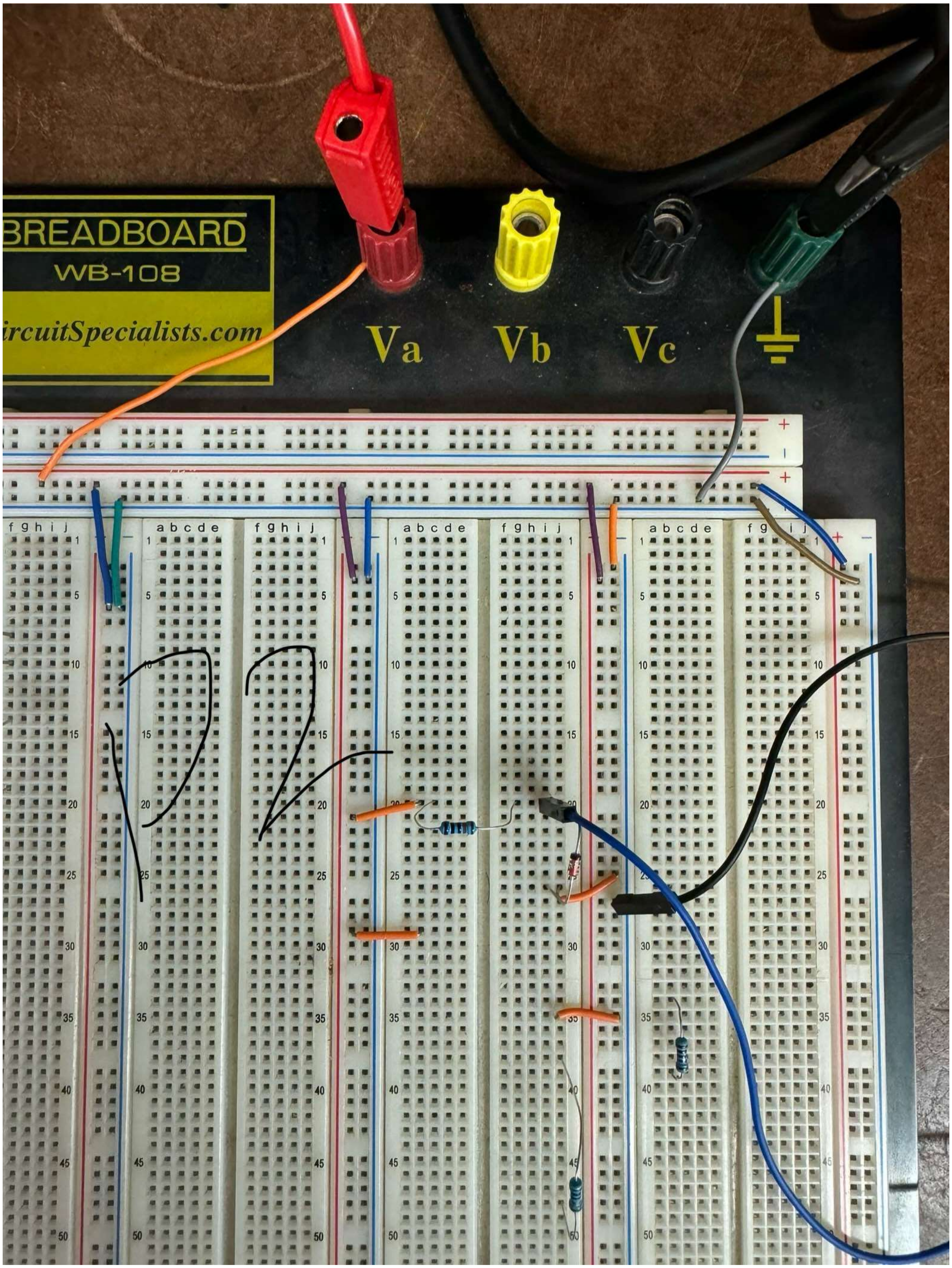
Circuit pictures

BELOW

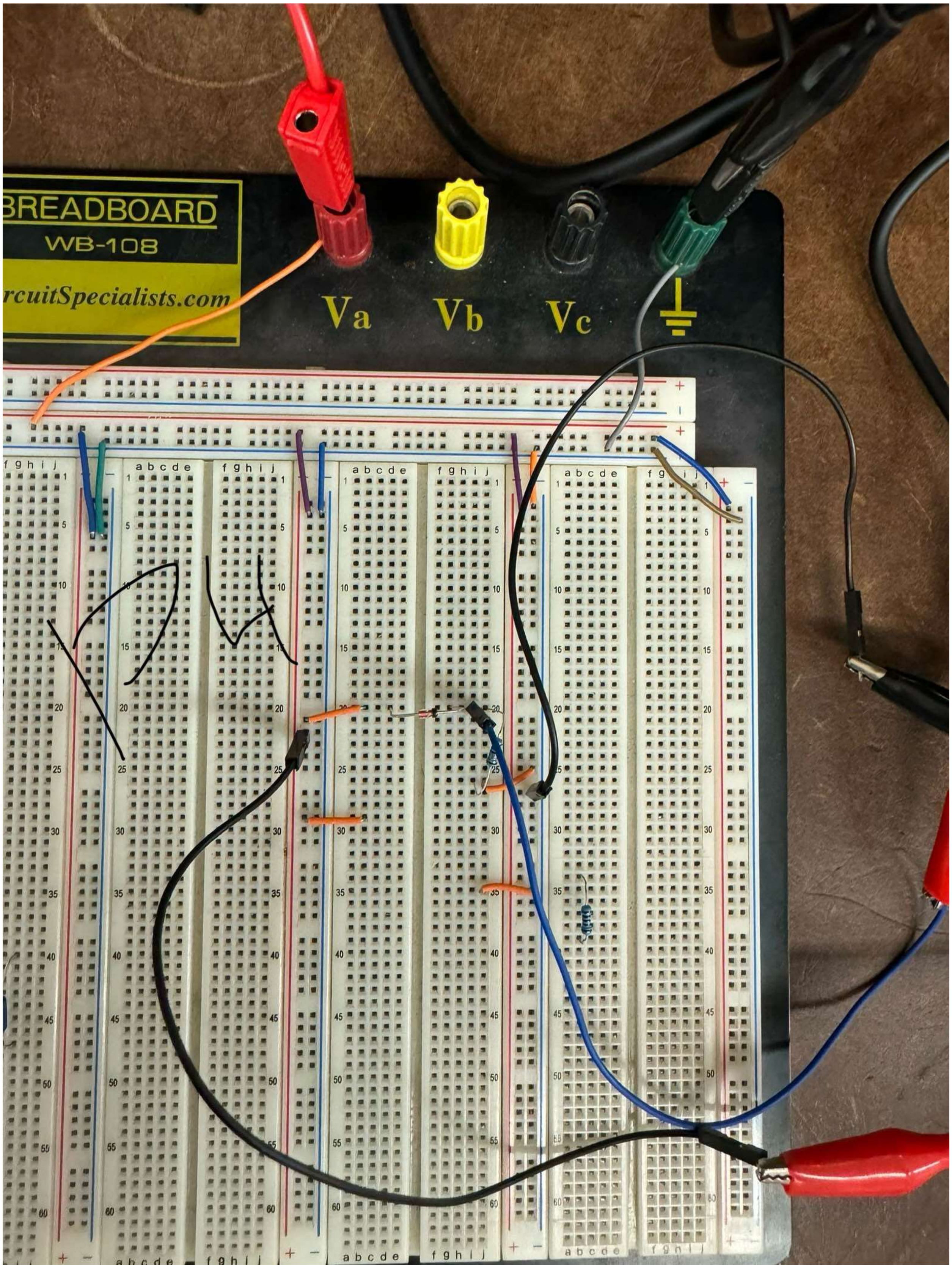
Part 1:



Part 2



Part 4



Post-Lab:

To get both the Ideality factor n and I_s, we would need to have 2 equations with 2 unknowns from our data

$$Equation\ 1\ \&\ 2: I_{D_{1|2}} = I_s e^{\frac{V_{D1|2}}{\mu V_T}}$$

$$\frac{I_{D_1}}{I_{D_2}} = e^{\frac{V_{D_1} - V_{D_2}}{\mu V_T}}$$

$$n = \frac{V_{D_1} - V_{D_2}}{V_T \ln\left(\frac{I_{D_1}}{I_{D_2}}\right)}$$

$$V_S = 1V\ and\ 10V$$

$$n_{Ze} = \frac{0.57501 - 0.66101}{26mV \times \ln\left(\frac{4.27\mu A}{0.939\mu A}\right)} = 2.18$$

$$I_s = \frac{I_D}{e^{\frac{V_D}{\mu V_T}}} = \frac{4.27\mu A}{e^{\frac{0.57501}{2.18 \times 26mV}}} = 1.67 \times 10^{-10} = 0.167nA$$

Conclusion:

In this lab, we explored the current-voltage (I-V) characteristics of Zener diodes, focusing on understanding the diode's behavior under both forward and reverse bias conditions. We utilized PSpice to perform a DC sweep, which allowed us to observe the Zener diode’s response to varying current sources. The XY mode of the oscilloscope was also employed to display the I-V characteristics graphically, facilitating real-time monitoring of the diode's behavior. By analyzing our experimental data, we were able to determine key parameters such as the reverse saturation current (Is) and the ideality factor (μ) of the Zener diode. These values were derived by comparing the forward and reverse bias characteristics, highlighting the diode’s efficient performance in regulating voltage. This experiment reinforced our understanding of Zener diodes' practical applications in circuits where voltage regulation and control are crucial.