ELEC-313
Lab 2: Diode Characterization

September 23, 2013

Date Performed: September 18, 2013
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1 Objective

The objective is to observe the basic operation of a diode. In addition, the Schlockley equation (Eq 2) is used to find the diode's reverse saturation current (I_S) and thermal voltage (V_T) using measured values in the lab.

In part A, first the 470 ohm resistor was measured with a multi-meter and the X. Then the circuit in Figure 1 was built on a breadboard using the HP power supply as the source voltage. The source voltage (Vs) was swept from 0 to -5 volts in .5V increments and the diode voltage (Vd) was recorded with a second multi-meter and the diode current (Id) was measured with an ammeter. The Vd and the Id were recorded in Table Y. Then the Vs was swept from 0V to 5V in .25V increments and Vd and the Id were measured in recorded and Table Y. And finally for part A, the Vs was swept from 5V to 10V in .5V increments and once again, Vd and the Id were measured and recorded in Table Y. In part B, the 470 ohm resistor (Figure 1) was replaced with a 200 resistor using a decade box and Vs (Figure 1) was set to 10V and Vd and the Id were measured and recorded in Table 1. The decade box was adjust with the voltages listed in Table 1 by adjusting the decade box , and the Vd and the Id were measured and recorded for each setting of resistance. In part C of the experiment, the circuit in Figure 2 was built on a breadboard using the HP power supply as the Vs. Vd and the Id were measured and recorded in Table 2. The diode was then removed and the open circuit voltage (VOC) was recorded (Table 2).

2 Equipment

Diode: 1N4002
Resistors: 330 Ω, 470 Ω, 680 Ω
Resistive decade box: HeathKit IN-3117
Power supply: HP E3631A
Multimeter: Fluke 8010A

3 Schematics

3.1 Circuits Tested

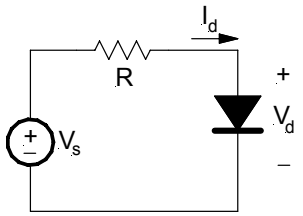

Figure 1: Circuit used for Part A and Part B.

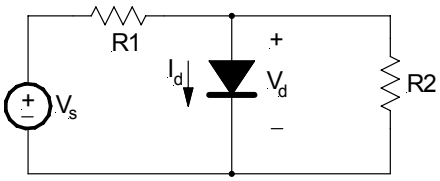

Figure 2: Circuit used for Part C.

4 Procedure

4.1 Part A

The circuit in Figure 1 was constructed, with $R = 470\,\Omega$ and the power supply as V_S. The actual resistance was measured with the multimeter, percent error calculated (Eq 1), and recorded in Table 1.

4.2 Part B

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4.3 Part C

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5 Results

5.1 Part A

Name	**Nominal** (Ω)	**Measured** (Ω)	**% Error**
R_1	470	465.3	1.00

Table 1: Comparison of nominal and measured resistance in Part A.

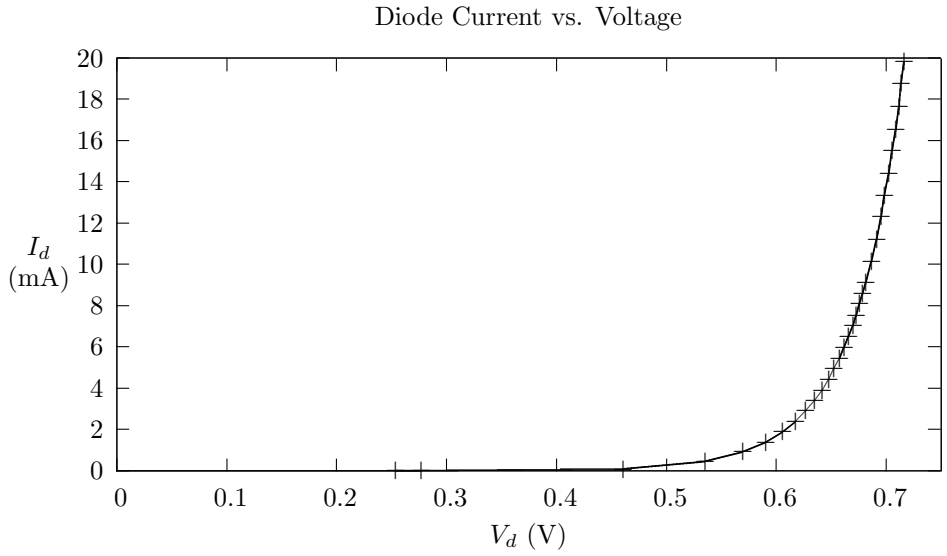

Figure 3: Diode characteristics measured in Part A.

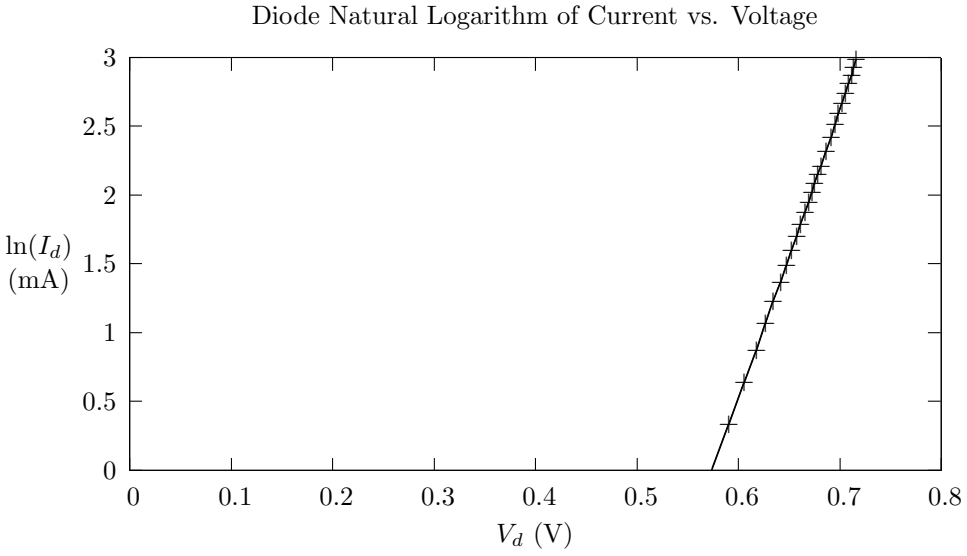

Figure 4: $\ln(I_d)$ vs. V_d.

5.2 Part B

R (Ω)	V_d (V)	I_d (mA)
200	0.751	46.00
500	0.713	18.60
1k	0.682	9.30
2k	0.650	4.70
5k	0.605	1.85
10k	0.571	0.94
20k	0.538	0.47
50k	0.494	0.19
100k	0.464	0.10

Table 2: Diode characteristics measured in Part B.

5.3 Part C

V_d (V)	I_d (mA)	V_{OC} (V)
0.712	27.2	6.70

Table 3: Diode characteristics measured in Part C.

6 Conclusion

As seen in Table A, the measured values of Vd and the Id taken in Part B of the experiment were very close to the theoretical values calculated in PSpice. The largest in Table B, the measured values of Vd and the Id taken in Part C of the experiment were very close to the theoretical values calculated in PSpice. The largest

7 Equations

$$\%_{error} = \frac{|nominal - measured|}{nominal} 100\% \tag{1}$$

$$I_D = I_S \left(e^{\frac{V_D}{V_T}} - 1 \right) \tag{2}$$

8 Apendix

V_s (V)	V_d (V)	I_d (mA)	$ln(I_d)$ (mA)
-5.00	-5.000	0.01	-4.605170
-4.50	-4.500	0.01	-4.605170
-4.00	-4.000	0.01	-4.605170
-3.50	-3.500	0.01	-4.605170
-3.00	-3.000	0.01	-4.605170
-2.50	-2.500	0.01	-4.605170
-2.00	-2.000	0.01	-4.605170
-1.50	-1.500	0.01	-4.605170
-1.00	-1.000	0.01	-4.605170
-0.50	-0.500	0.01	-4.605170
0.00	0.277	0.01	-4.605170
0.25	0.254	0.01	-4.605170
0.50	0.461	0.10	-2.302585
0.75	0.536	0.46	-0.776529
1.00	0.570	0.92	-0.083382
1.25	0.591	1.40	0.336472
1.50	0.606	1.89	0.636577
1.75	0.618	2.39	0.871293
2.00	0.627	2.90	1.064711
2.25	0.635	3.41	1.226712
2.50	0.642	3.92	1.366092
2.75	0.648	4.44	1.490654
3.00	0.653	4.95	1.599388
3.25	0.658	5.47	1.699279
3.50	0.662	5.99	1.790091
3.75	0.666	6.51	1.873339
4.00	0.670	7.03	1.950187
4.25	0.673	7.55	2.021548
4.50	0.676	8.08	2.089392
4.75	0.679	8.60	2.151762
5.00	0.682	9.13	2.211566
5.50	0.687	10.18	2.320425
6.00	0.692	11.23	2.418589
6.50	0.696	12.30	2.509599
7.00	0.699	13.36	2.592265
7.50	0.703	14.42	2.668616
8.00	0.706	15.49	2.740195
8.50	0.709	16.56	2.806990
9.00	0.712	17.66	2.871302
9.50	0.714	18.75	2.931194
10.00	0.717	19.84	2.987700

Table 4: Diode characteristics measured in Part A.