

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 Shockley 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.

## 2 Equipment

Diode: 1N4002

Resistors:  $330\ \Omega$ ,  $470\ \Omega$ ,  $680\ \Omega$

Resistive decade box: HeathKit IN-3117

Power supply: HP E3631A

Multimeter: Fluke 8010A

## 3 Schematics

### 3.1 Circuits Tested

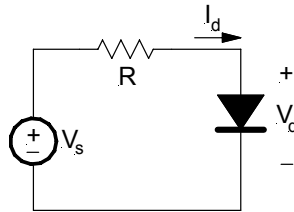


Figure 1: Circuit used for Part A and Part B.

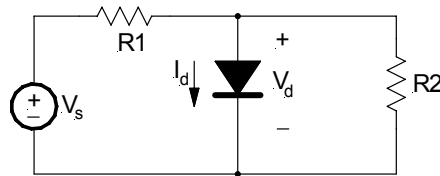


Figure 2: Circuit used for Part C.

## 4 Procedure

### 4.1 Part A

The circuit in Figure 1 with  $R = 470\ \Omega$  and the power supply as  $V_S$ .

## 4.2 Part B

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## 4.3 Part C

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# 5 Results

## 5.1 Part A

Name	Nominal ( $\Omega$ )	Measured ( $\Omega$ )	% Error
$R_1$	470	465.3	1.00

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

## 5.2 Part B

$R$ ( $\Omega$ )	$V_d$ (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.

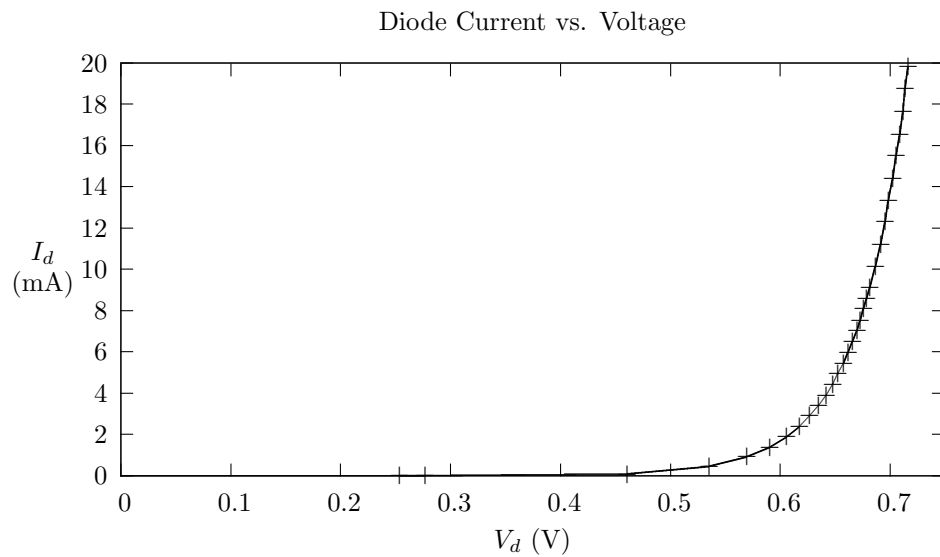


Figure 3: Diode characteristics measured in Part A.

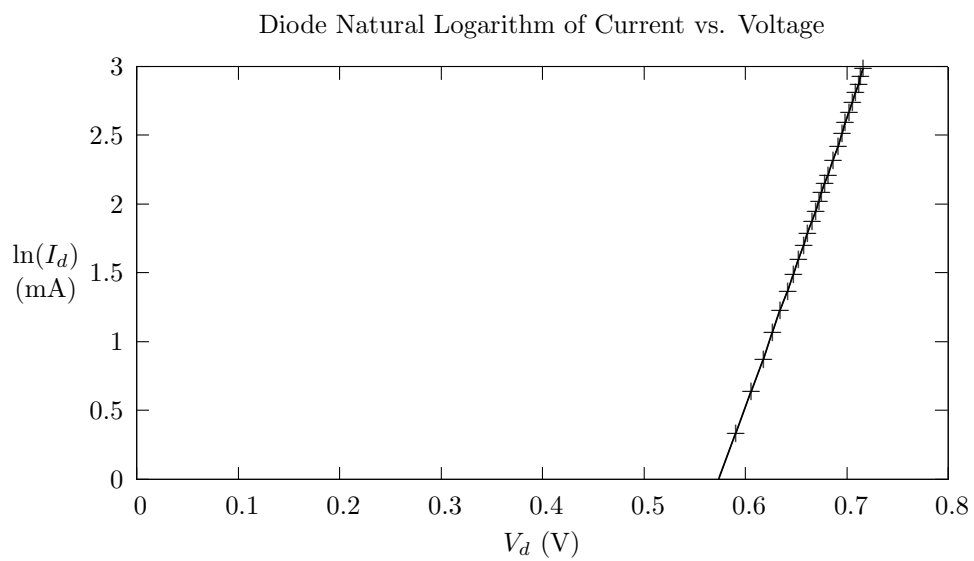


Figure 4:  $\ln(I_d)$  vs.  $V_d$ .

### 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

## 7 Equations

$$\%_{error} = \frac{|nominal - measured|}{nominal} 100\% \quad (1)$$

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

## 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.