East West University

Department of CSE

LAB REPORT

Course Code and Name: CSE251; Electronic Circuits	
Experiment no: 01	
Experiment name: I-V Characteristics and Modeling of Forward Conduction of a Diode	
Semester and Year: Spring 2023, 2023	**GROUP NO: 08**
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	Pre-Lab Marks:	
	Post Lab Marks:	
	TOTAL Marks:	

OBJECTIVE:

1. To measure the I-V characteristics of forward conduction of a p-n junction diode.

2. To determine the models of forward conduction of a p-n junction diode.

Introduction:

Diode is one of the most basic non-linear electronic devices. An ideal diode acts like a switch for electric current, acting as a short circuit for current flow in one direction (forward bias connection) while behaving as an open circuit for current flow in the opposite direction (reverse bias connection). The characteristics of practical diodes are however somewhat different from those of ideal ones. The p-n junction diodes are one of the most popular types of diodes used in the industry. The forward bias current-voltage (I-V) characteristic of a p-n junction diode will be measured in this experiment.

Circuit Diagram:

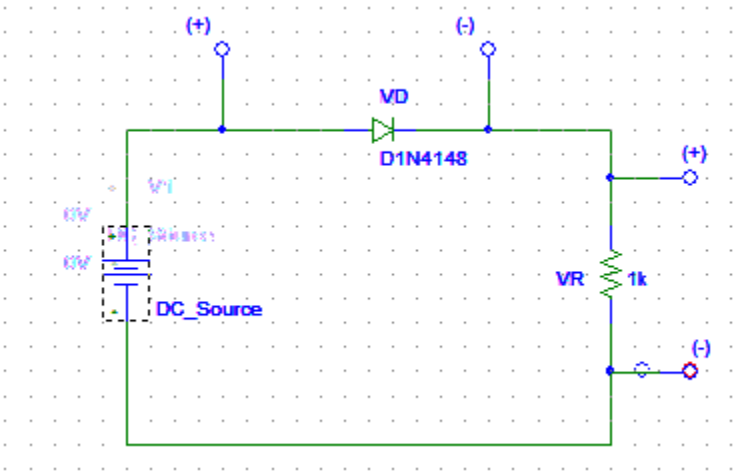


Figure 1. Circuit set up to measure forward bias I-V characteristics of a diode.

Equipment's and Components Needed:

1. DC power supply

2. Digital multi meter

3. Diode (1 pc)

4. Resistor 1K□

5. Breadboard

6. Connecting wires

Lab Procedure:

1. Measure the resistance value of Figure 1 with the multimeter and write it down in K inTable1.

2. Connect the circuit as shown in Figure 1. Use the DC power supply unit as DC source.

3. Change the DC source and measure the values of VD and VR and write them in Table 1. Continue measurement until VD reaches to around 0.68 volts. Take around 25 to 30 readings by increasing the DC power supply with an increment of ≈ 0.5 V after VD reaches to around 0.68 volts.

4. Divide VR by the measured value of resistance in K□. This is diode current ID in mA.

Table 1. Experimental Datasheet.

V_S (V)	V_D (V)	V_R (V)	I_D (mA)=V_R/R(KΩ)	Measured Value of R (KΩ)
0.1	0.0157	0	0	0.98
0.3	0.20	0.0001	$1.02*10^{-4}$	
0.6	0.43	0.0709	0.0723	
0.9	0.479	0.33	0.3367	
1	0.491	0.481	0.4908	
1.5	0.512	0.93	0.9489	
2	0.5253	1.438	1.4683	
2.5	0.535	1.941	1.9806	
3	0.542	2.419	2.4683	
4	0.554	3.463	3.533	
5	0.563	4.37	4.4591	
6	0.569	5.39	5.5	
7	0.5762	6.393	6.82	
8	0.5817	7.44	7.591	
10	0.591	9.481	9.6744	
12	0.598	11.45	11.683	
14	0.604	13.47	13.752	

16	0.609	15.779	15.779	
17	0.612	16.82	16.826	
18	0.614	17.49	17.84	
19	0.616	18.5	18.877	
20	0.619	19.5	19.89	
21	0.621	20.45	20.86	
22	0.623	21.48	21.91	
23	0.624	22.54	23	
24	0.626	23.5	23.97	
25	0.628	24.5	25	
26	0.63	25.47	25.98	
27	0.631	26.47	27.01	

5. Have the datasheet signed by your instructor.

Post-Lab Report Questions and Answers:

1. Using MATLAB, plot the I-V characteristics of the p-n junction diode in forward conduction. Label the axes appropriately and have it printed.

Answer:

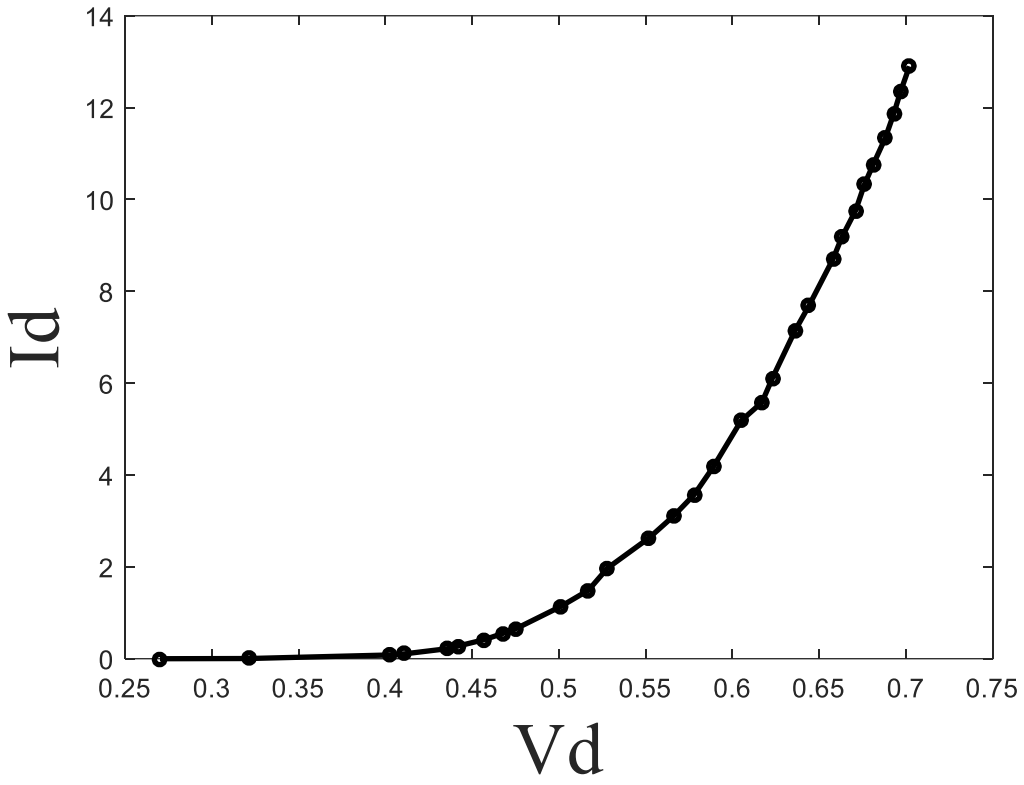


Fig: I-V characteristics of P-N junction diode in forward conduction.

2. Use pencil to identify the points on your graph that are corresponding to I_D = 2mA and I_D = 2.5mA. Use these data points to calculate the diode parameters I_S and n from the equation $I_D = I_S \exp[V_D/nV_T]$. Use V_T = 0.0259V.

Answer:

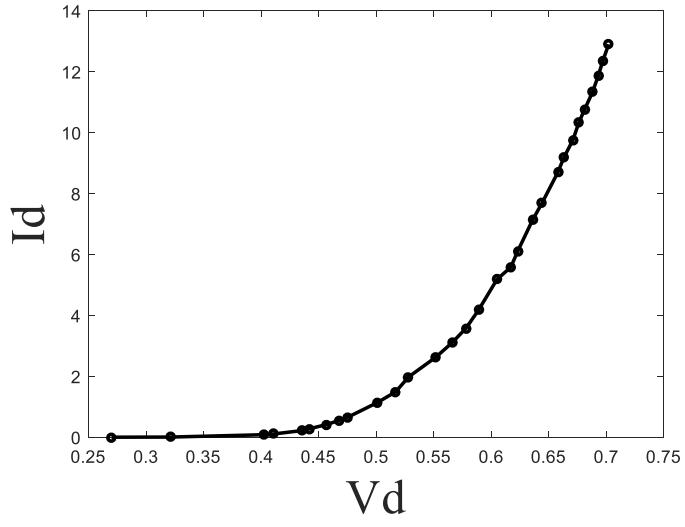


Fig: I-V characteristics of P-N junction diode in forward conduction.

Here,

I_{D1} = 2.5, I_{D2} = 2, V_{D1} = 0.55, V_{D2} = 0. 53 and V_t = 0.0259

We know,

$$V_{D1}-V_{D2} = nV_t\ln(\frac{ID1}{ID2})$$

So,

n = 3.46

Again,

We know,

$I_{D1}= I_S\exp[V_{D1}/nV_T]$

$=>I_S=I_{D1}/\exp[V_{D1}/nV_T]$

$=>I_S=2.5*10^{-3}/\exp[0.55/3.46*0.0259]$

$=>I_S$ = 5.40 Micro A.

3. Determine the cut-in voltage from the printed graph by drawing extrapolated line with pencil.

Answer:

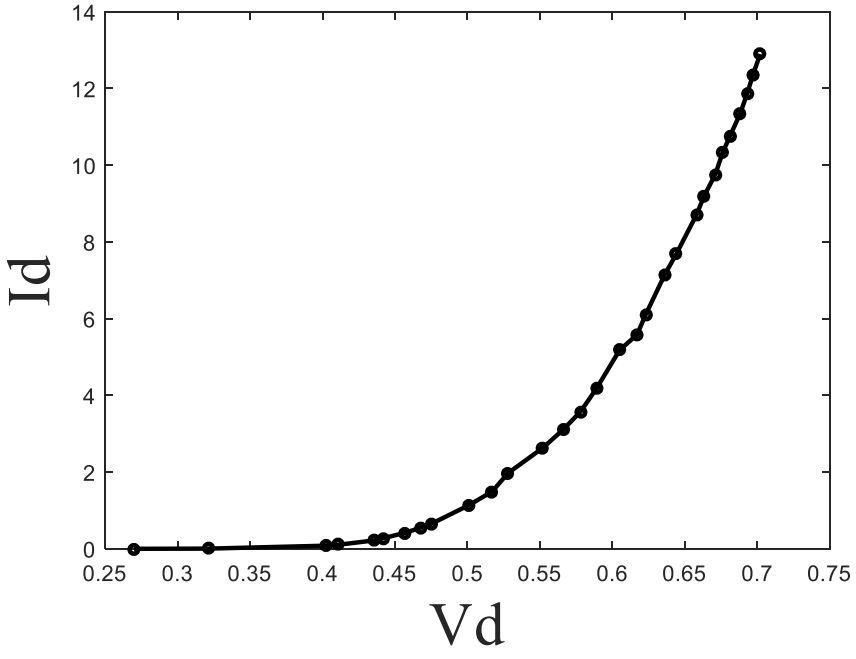


Fig: I-V characteristics of P-N junction diode in forward conduction.

From above graph cut in voltage is 0.53V.

4. If the diode resistance for the piecewise linear model is defined as $1/r_D = \partial I_D / \partial V_d = (I_{D2} - I_{D1})/(V_{D2} - V_{D1})$, calculate the value of r_D from the data points corresponding to I_D = 2mA and I_D = 2.5mA.

Answer:

Here,

I_{D1} = 2.5 mA and V_{D1} = 0.55 V

And for

I_{D2} = 2.0 mA and V_{D2} = 0.53 V

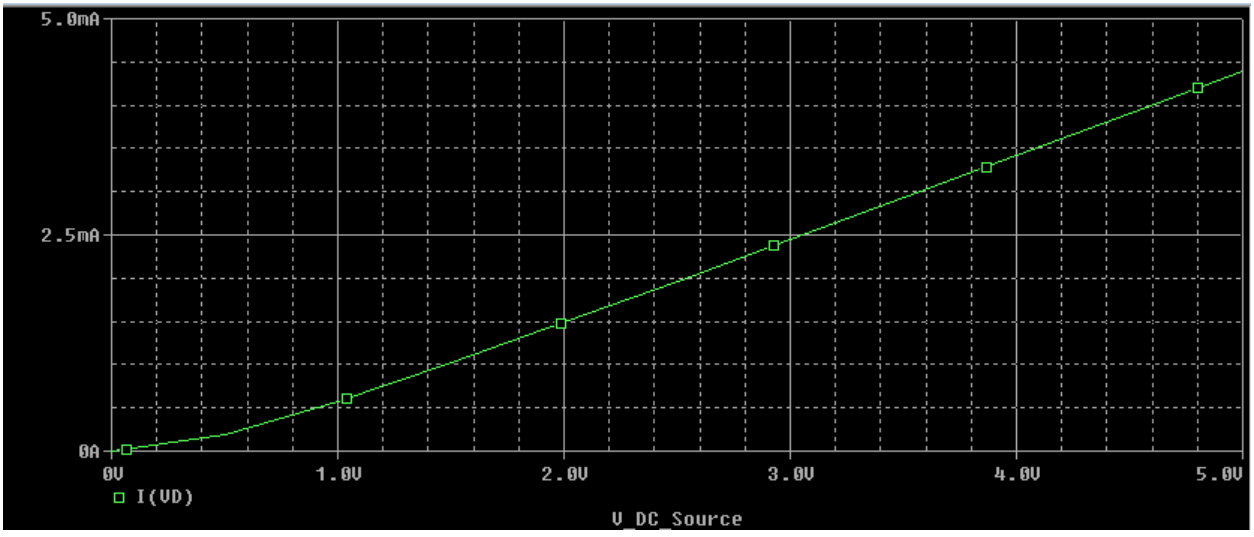
we know,

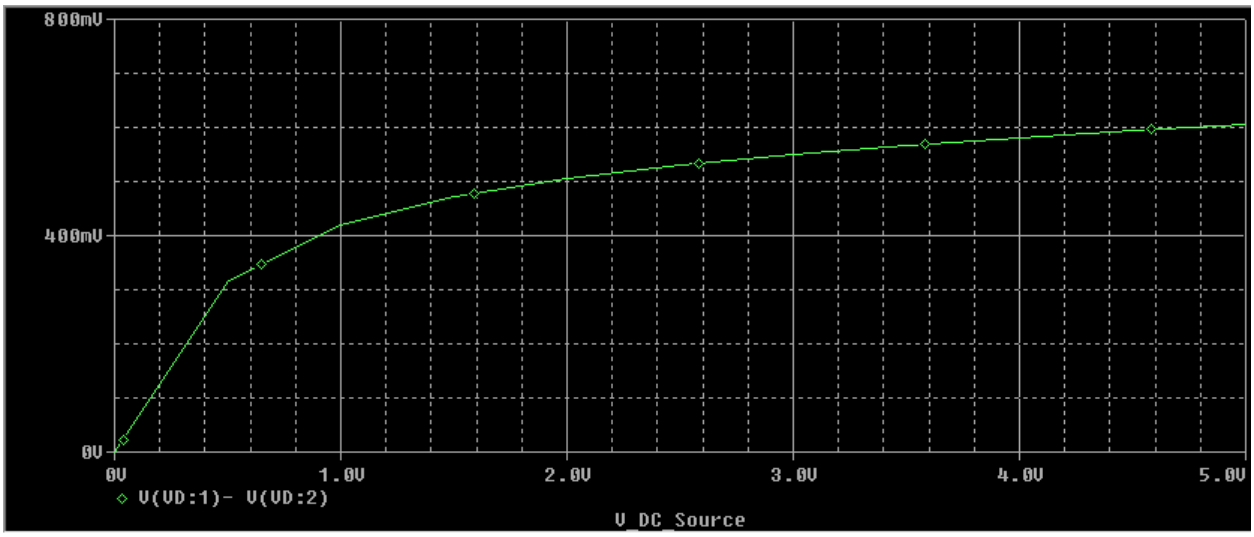
$1/ r_D = (I_{D2} - I_{D1})/(V_{D2} - V_{D1})$

So, the value of r_D = 0.04 kΩ

5. Simulate the circuit of the figure 1 for a DC bias (V_S) range of 0-5 volts using PSpice. Print the I_D vs. V_S and V_D vs. V_S plots generated by PSpice and attach them with your report. For simulation, use the DC SWEEP option of PSpice and the diode D1N4148. To modify the diode parameters, select the diode (it will turn red) and go to Edit → Model→ Edit Instance Model (Text). There, replace the values of I_S, N, V_j by your values calculated in steps 2 and 3 and click OK.

Answer:




800mV
400mV
0V
0V
1.0V
2.0V
3.0V
4.0V
5.0V
V(VD:1)- V(VD:2)
V_DC_Source