الجامعة الألمانية الأردنية
German Jordanian University

Electronics 1 Lab (CME 2410)

School of Informatics & Computing
German Jordanian University

Laboratory Experiment (1)

Diode Characteristic

1. Objective:

To explore the characteristics of ordinary diodes through the use of mathematical modelling and implement circuit testing.
Upon completion of this laboratory experiment, you should have a good understanding of the electrical characteristics and the parameters affecting the design of semiconductor junction diodes.

2. Theory:

A diode is a semiconductor device that conducts current much more readily in one direction than in the other. Its familiar shape is shown in Fig. 1.1:

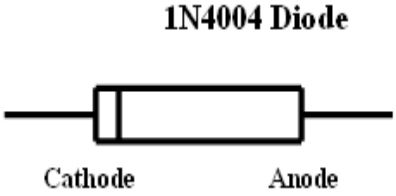


Fig. 1.1

The standardized symbol (IRC 60617, ANSI/IEEE 315A-1986) is shown in Fig. 1.2a but all along you will find variations like in Fig. 1.2b.

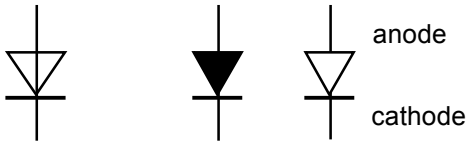


Fig. 1.2a Fig. 1.2b

V_D

When the diode's anode is at higher potential than the cathode, the diode is "forward biased" by the "forward voltage" V_F. The "forward current" I_F will flow from the anode to the cathode in the direction the symbol's arrowhead (see also the definition of the polarities of I_F and V_F in Fig. 1.3).

Unlike a resistor in which the current is proportional to the voltage drop, the diode is a nonlinear device. When the diode is forward biased a small voltage drop (often called the threshold voltage V_{th}) occurs across the diode (for germanium $V_{th} \sim 0.3$ V, silicium $V_{th} \sim 0.7$ V).
This relationship between the voltage across diode and the current passing through it can be seen in the following detailed characteristic curve diagram, Fig. 1.3.

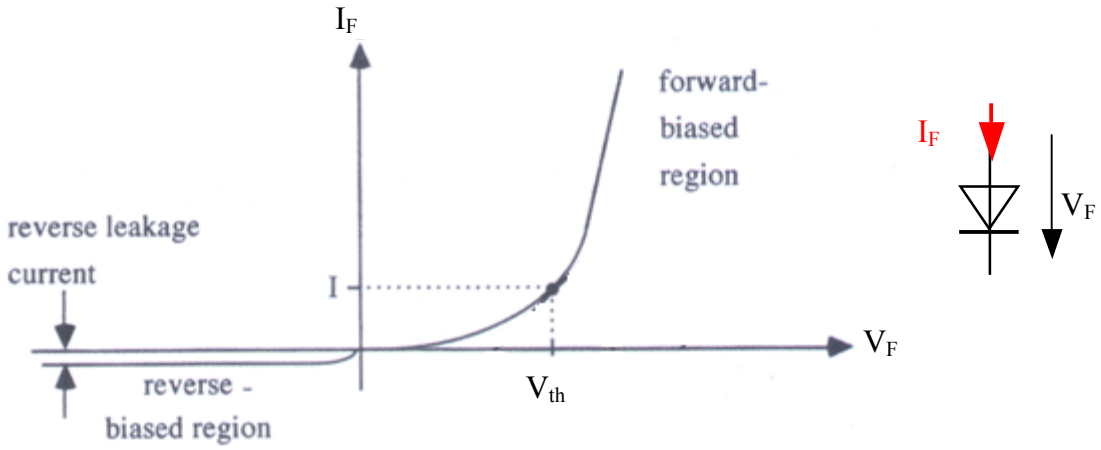


Fig. 1.3

3. Equipment & Instruments

Oscilloscope
Function Generator
Multimeter
Module no. Dl3155E12
Breadboard
Resistors and Diodes

4. Pre-lab

1. Use your favourite circuit simulation software and simulate the circuit in Fig 1.5. Set the input voltage to the values: 0.5V, 0.7V, 1V, 5V, and record the diode voltage and current in each case.
2. Simulate the circuit in Part II and record the voltages V_1 and V_o with the diode and without the diode.
3. Write a short pre-lab report with results.

5. Procedure

Part I: Diode Characteristics

1. Check the functionality of the Silicon Diode D1 using the DMM.
2. Make a wired connection between +V from the base frame Power Supply to input terminal 1 and ground of the power supply terminal to the ground of the circuit in block no. 4.
3. Turn the knob +V on the base frame power supply to fully counter-clockwise.
4. Vary the voltage V_R (using knob +V) from $V_R = 0.1$ V to $V_R = 0.9$ V in steps of $\Delta V_R = 0.1$ V, and from $V_R = 1$ V to $V_R = 10$ V in steps of $\Delta V_R = 1$ V, in each step measure the diode voltage V_F and the diode current I_F.
   Record the data in tables like Tab.1.1, Tab.1.2 and Tab.1.3.
5. Sketch $I_F = f(V_F)$; describe the nature of the curve. Note that we are using the diode in the forward bias mode.

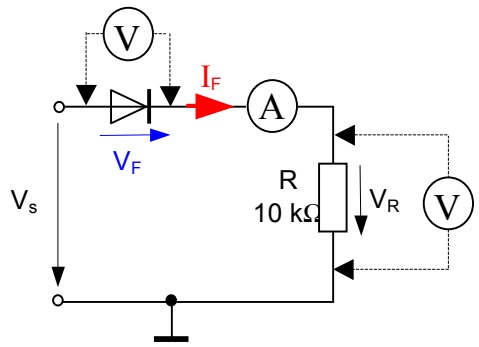


Fig. 1.5

V_s /V	0.1	0.2	0.3	0.4	0.44	0.46	0.48	0.50	0.52	0.54
V_F /V										
I_F / mA										

Tab. 1.1

V_R /V	0.56	0.58	0.60	0.62	0.64	0.70	0.75	0.80	0.85	0.90
V_F /V										
I_F / mA										

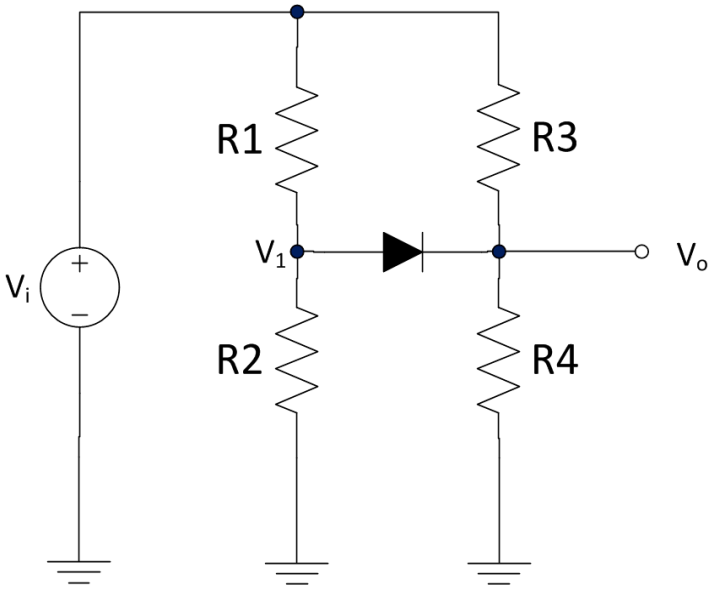
Tab. 1.2

V_R /V	1	2	3	4	5	6	7	8	9	10
V_F /V										
I_F / mA										

Tab. 1.3

Part II: Diode Circuits

1. Build the following circuit on a breadboard with R1=1kΩ, R2=R3=R4=2kΩ and V_i=10V DC.



2. Measure the voltages V_1 and V_o.
3. Remove the diode and measure the voltage V_1 and V_o.
4. Explain the difference in the voltages measured in steps 2 and 3.

Part III: Diode Circuit Design

1. Given only 1 resistor, diodes and capacitors, design a circuit that outputs 1.2V DC (+/- 5%) when the input is 5V DC.
2. Implement and test the circuit.