

Experiment No.1

Semiconductor diode characteristics

1. Objectives:

Study and plot the voltage-current characteristics of the forward and reverse-biased semiconductor diodes.

2. Components and equipment

- DC power supply.
- Two AVO meters.
- Breadboard, Semiconductor Diode, and $1\text{K}\Omega$ Resistor.

3. Theory:

The diode is a device made up of a junction of n-type and p-type semiconductor material. An ideal diode has two regions: a conduction region of zero resistance and a non-conduction region of infinite resistance. **In forward bias** operation, the silicon diode will not conduct significant current until the voltage reaches the **barrier potential** about $(0.3 - 0.7)\text{V}$, called cut-in or knee voltage, based on its material. After the point of cut-in voltage (Knee voltage), a slight change in voltage causes a significant increase in current.

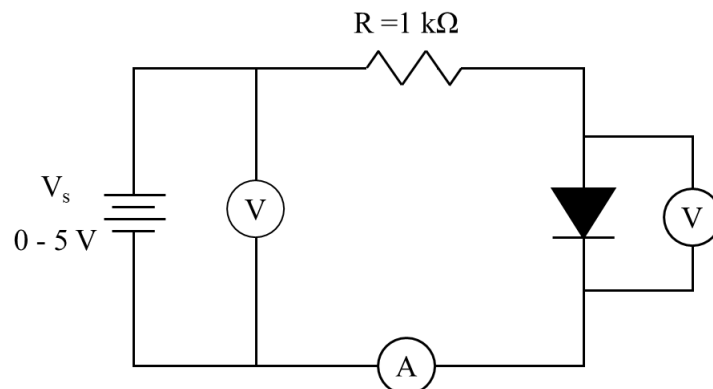


Figure 1: Forward bias

In **reverse bias** operation, the diode will not conduct significant current until a specific threshold voltage is called the **breakdown voltage**.

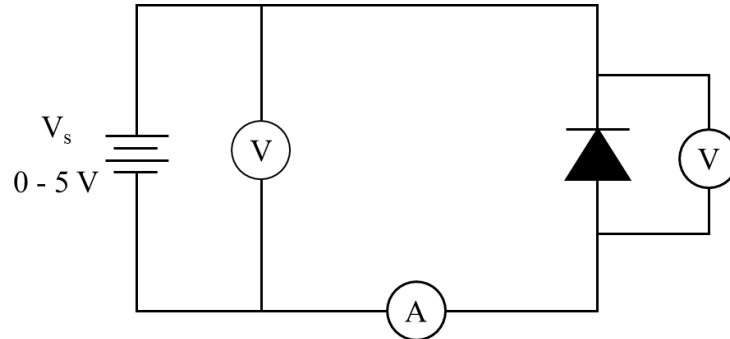


Figure 2: Reverse bias

4. Diode Characteristic Curve

Fig.3 is a graph of diode voltage versus current, known as a V-I characteristic curve. The upper right quadrant of the graph represents the forward-biased condition. As you can see, there is very little forward current (I_F) for forward voltages (V_F) below the barrier potential. As the forward voltage approaches the value of the barrier potential, the current begins to increase. Once the forward voltage reaches the barrier potential, the current increases drastically and must be limited by a series resistor. The voltage across the forward-biased diode remains approximately equal to the barrier potential.

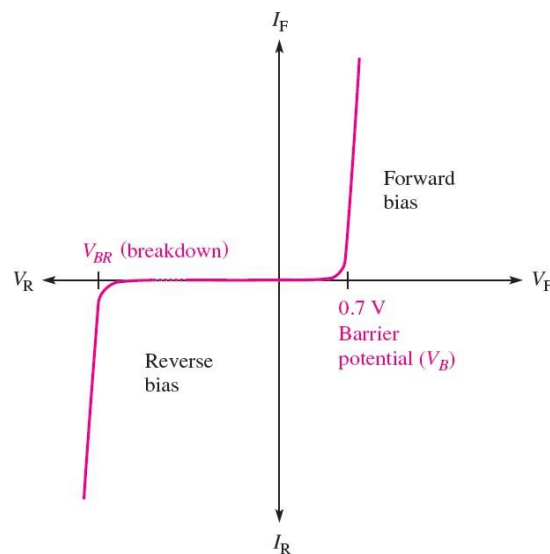


Figure 3: General diode V-I characteristic curve

The lower left quadrant of the graph represents the reverse-biased condition. As the reverse voltage (V_R) increases to the left, the current remains near zero until the breakdown voltage (V_{BR}) is reached. When breakdown occurs, there is a large reverse current which, if not limited, can destroy the diode.

5. Experiment procedure

1. Connect the circuit as shown in Fig. 1 using a diode.
2. Increase the DC voltage from zero in steps of (0.1 volts) up to (1 volts), then in step of (0.5 volt) up to (5 volt), and record the voltage across the 1 k Ω resistor (R)
3. Tabulate your results in a table as shown in table (1).
4. Connect the circuit shown in Fig. 2 using a diode.
5. Increase the DC voltage from zero in steps of (0.2 volts) up to (1 volt), then in steps of (1 volt) up to (4 volts) and for each step record the current flowing in the circuit.
6. Tabulate your result in a table as shown in table (2).

V_S (Volt)	V_R (Volt)	V_f (mA)	I_f (mA)

Table 1

V_R (Volt)	I_R (mA)

Table 2

6. Discussion

1. Why the voltage V_F is not increasing when increasing the V_S ?
2. On a graphic paper, draw the V-I characteristic curve from the experimental result you recorded