V-I characteristic of PN Junction Diode

Object: To draw V-I characteristic of PN Junction diode and to determine knee or cut in voltage.

Apparatus used: PN Junction diode, voltmeter (0-2volt), voltmeter (0-20 volt), mili-ammeter, micro-ammeter, variable source (0-2 volt and 0-40 volt).

Formula: The current voltage equation for PN junction is given by following expression.

$$I = I_0\left(e^{V/\eta V_T} - 1\right) \qquad (1)$$

Here, I: current through diode; V=Applied voltage to the diode

V_T: voltage equivalent to temperature (KT/e)

η: constant (=1 for distances Ge and 2 for Si)

In forward bias When V_F=+V, then $e^{V/\eta V_T} > 1$ thus eq.(1) becomes as

$$I_F = I_0\, e^{V/\eta V_T} \qquad (2)$$

Hence the theoretical analysis indicates that forward current increases exponentially with voltage. But practically it is not found. Since PN junction diode has a certain barrier/threshold/knee potential. Initially the applied forward potential to diode is used to neutralize this barrier potential. Therefore the current is approximately zero. The current increases appreciably after the barrier potential.

In reverse bias When V_R= -V, then $e^{V/\eta V_T} < 1$ thus eq.(1) becomes as

$$I_R = -I_0 \qquad (3)$$

Thus in reverse bias of diode, a constant current flows through the diode whose direction is opposite to forward bias current. This current is known as reverse saturation current and it is independent of voltage. At large reverse bias voltage, the reverse bias current increases gradually to maximum due to avalanche breakdown.

Circuit

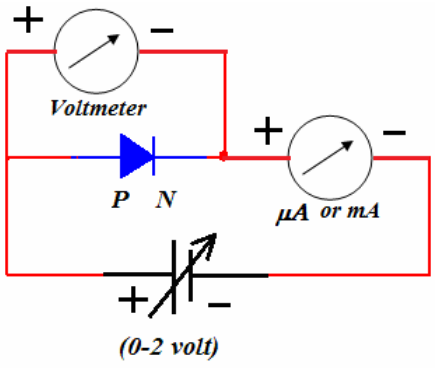


Fig1: Diode in FB

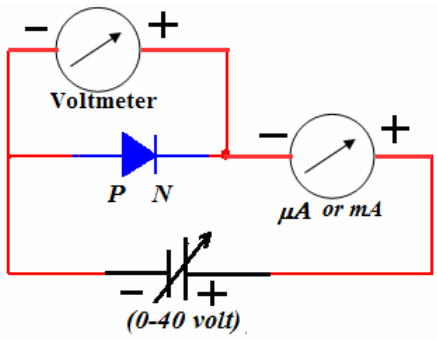


Fig 2: Diode in RB

***Procedure*:**

1. *First of all, connect the circuit as shown in figure 1. Now increase the voltage (V_F) in very small intervals up to 1volt. Note the corresponding currents; this will give the value of I_F.*
2. *Now connect the circuit as shown in figure 2. Increase the voltage (V_R) in intervals of 1volt up to 40volt. Note the corresponding currents; this will give the value of I_R.*
3. *Plot the graph in V and I.*

Observation:

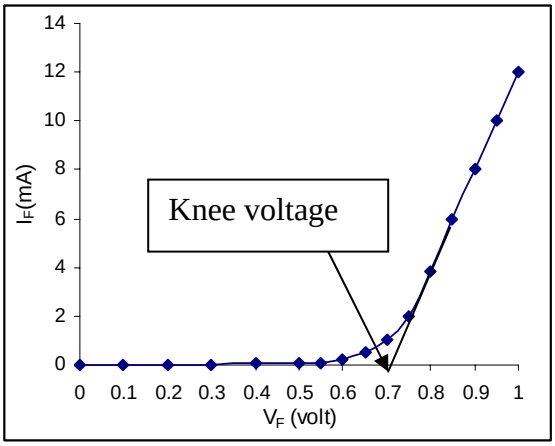
1. Least count of voltmeter=……..volt
2. Least count of miliammeter =……..mA
3. Least count of micro-ammeter =…….µA
4. *Table for V_F and I_F (Diode in FB)*

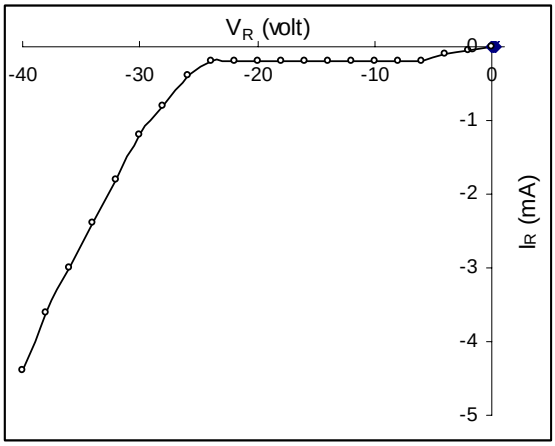
Sr. No.	*V_F (Volt)*	*I_F (mA)*
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

5. *Table for V_R and I_R (Diode in RB)*

Sr. No.	*V_R (Volt)*	*I_R (mA)*
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

Result: The V-I characteristic of diode in shown in graph. This indicates that the forward current is negligible up to the knee voltage. After that it increases appreciably. The knee voltage for diode is ……volt. In reverse bias the constant current of µA order flows through the diode.





***Precautions*:**

1. The connection should be tight otherwise fluctuation in voltage and current will happen.
2. At the turning point of curve, more reading should be taken.
3. For the plot of Graph, current should be taken mA for both forward and reverse biased diode.
4. The reading should be in multiple of least count.