PRACTICAL 6

Aim :-To study the characteristics of PN Junction diode under forward and reverse bias conditions.

Apparatus Required

1. R.P.S (0-30)V
2. Diode IN4001
3. Ammeter (0–30)mA
4. Resistor 1k
5. Bread Board
6. Voltmeter(0–1)V
7. connecting Wires

Theory:

A PN junction diode is a two terminal semiconducting device. It conducts only in one direction (only on forward biasing).

Forward Bias

On forward biasing, initially no current flows due to barrier potential. As the applied potential exceeds the barrier potential the charge carriers gain sufficient energy to cross the potential barrier and hence enter the other region. The holes, which are majority carriers in the P-region, become minority carriers on entering the N-regions, and electrons which are the majority carriers in the N-region, become minority carriers on entering the P-region. This injection of minority carriers results in the current flow, opposite to the direction of electron movement.

Reverse Bias

On reverse biasing, the majority charge carriers are attracted towards the terminals due to the applied potential resulting in the widening of the depletion region. Since the charge carriers are pushed towards the terminals no current flows in the device due to majority charge carriers. There will be some current in the device due to the thermally generated minority carriers. The generation of such carriers is independent of the applied potential and hence the current is constant for all increasing reverse potential. This current is referred to as Reverse Saturation Current (IO) and it increases with temperature. When the applied reverse voltage is increased beyond the certain limit, it results in breakdown. During breakdown, the diode current increases tremendously.

Procedure

Forward Bias

1. Connect the circuit as per the diagram.
2. Vary the applied voltage V in steps of 0.1V.
3. Note down the corresponding Ammeter readings I.
4. Plot a graph between V & I

Observations

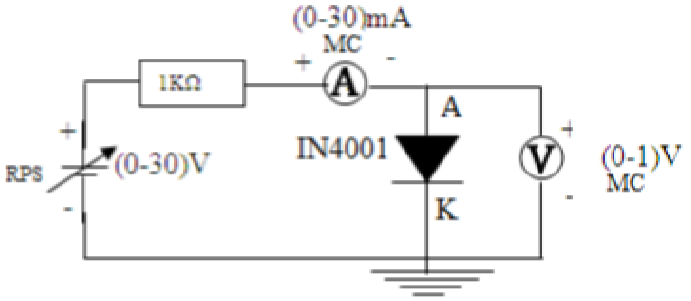
1. Find the d.c (static) resistance = V/I.
2. Find the a.c (dynamic) resistance r = V / I ($r = \Delta V / \Delta I$) =
3. Find the forward voltage drop [Hint: it is equal to 0.7 for Si and 0.3 for Ge]

Reverse Bias

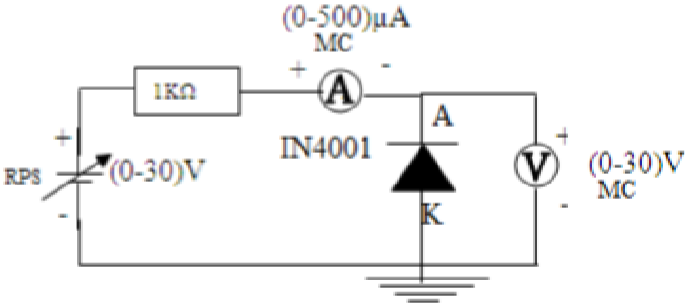
1. Connect the circuit as per the diagram.
2. Vary the applied voltage V in steps of 1.0V.
3. Note down the corresponding Ammeter readings I.
4. Plot a graph between V & I
5. Find the dynamic resistance r = Δ V / Δ I.

Circuit Diagram

Forward Bias



Reverse Bias



Specification for 1N4001: Silicon Diode

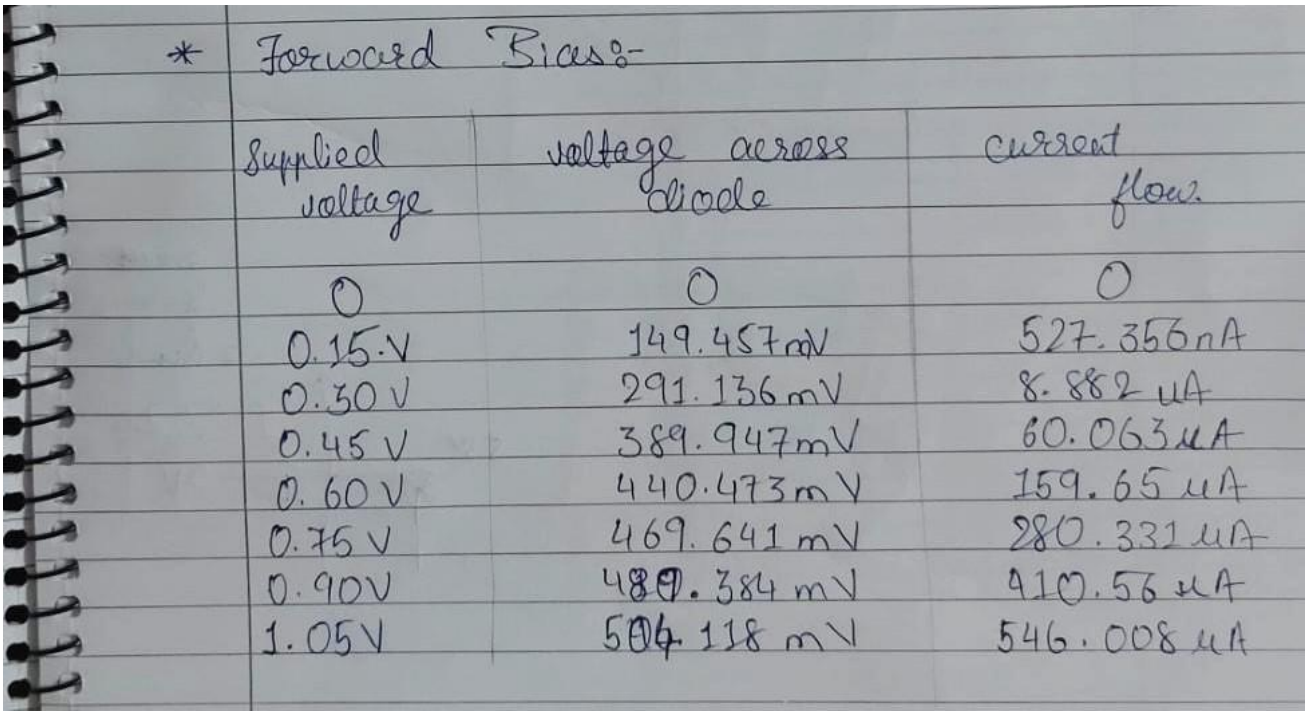
Peak Inverse Voltage: 50V

I_{dc} = 1A.

Maximum forward voltage drop at 1 Amp is 1.1 volts

Maximum reverse current at 50 volts is 5μA

Observation Table



* Forwoard Bias:-

Supplied voltage	voltage across diode	current flow.
0	0	0
0.15 V	149.457 mV	527.356 nA
0.30 V	291.136 mV	8.882 uA
0.45 V	389.947 mV	60.063 uA
0.60 V	440.473 mV	159.65 uA
0.75 V	469.641 mV	280.331 uA
0.90 V	489.384 mV	410.56 uA
1.05 V	504.118 mV	546.008 uA

1.20 V	515.806 mV	684.341 uA
1.35 V	525.463 mV	824.452 uA
1.50 V	533.677 mV	966.116 uA
1.65 V	540.815 mV	1.109 mA
1.80 V	547.122 mV	1.253 mA
1.95 V	552.769 mV	1.398 mA
2.10 V	557.879 mV	1.541 mA
2.25 V	562.544 mV	1.688 mA
2.40 V	566.835 mV	1.833 mA
2.55 V	570.806 mV	1.979 mA
2.70 V	574.501 mV	2.125 mA
2.85 V	577.956 mV	2.272 mA
3.00 V	581.200 mV	2.419 mA

* Reverse Bias

Supplied voltage	voltage across diode	current flow
0 V	0 mV	0 A
0.15 V	149.97 mV	0 A
0.30 V	299.968 mV	0 A
0.45 V	449.968 mV	0 A
0.60 V	591.	
0 V	0 mV	0 A
3.5 V	3.5 mV	0 A
7 V	7 mV	0 A
10.5 V	10.5 V	0 A
14 V	14 V	0 A
17.5 V	17.5 V	0 A
21 V	21 V	0 A
24.5 V	24.5 V	0 A
28 V	28 V	0 A
31.5 V	31.5 V	0 A
35 V	35 V	0 A
38.5 V	38.5 V	0 A
42	42 V	false value 7.1 nA (0 A
45.5	45.5 V	0 A
49	49 V	0 A
52.5	52.5 V	0 A
56	53.087	2.89 mA
59.5 V	53.108 V	6.381 mA
63 V	53.119 V	9.877 mA
66.6 V	53.127 V	13.387 mA
70 V	53.133 V	16.868 mA

Reverse Bias

Graph: -

For 1st quadrant

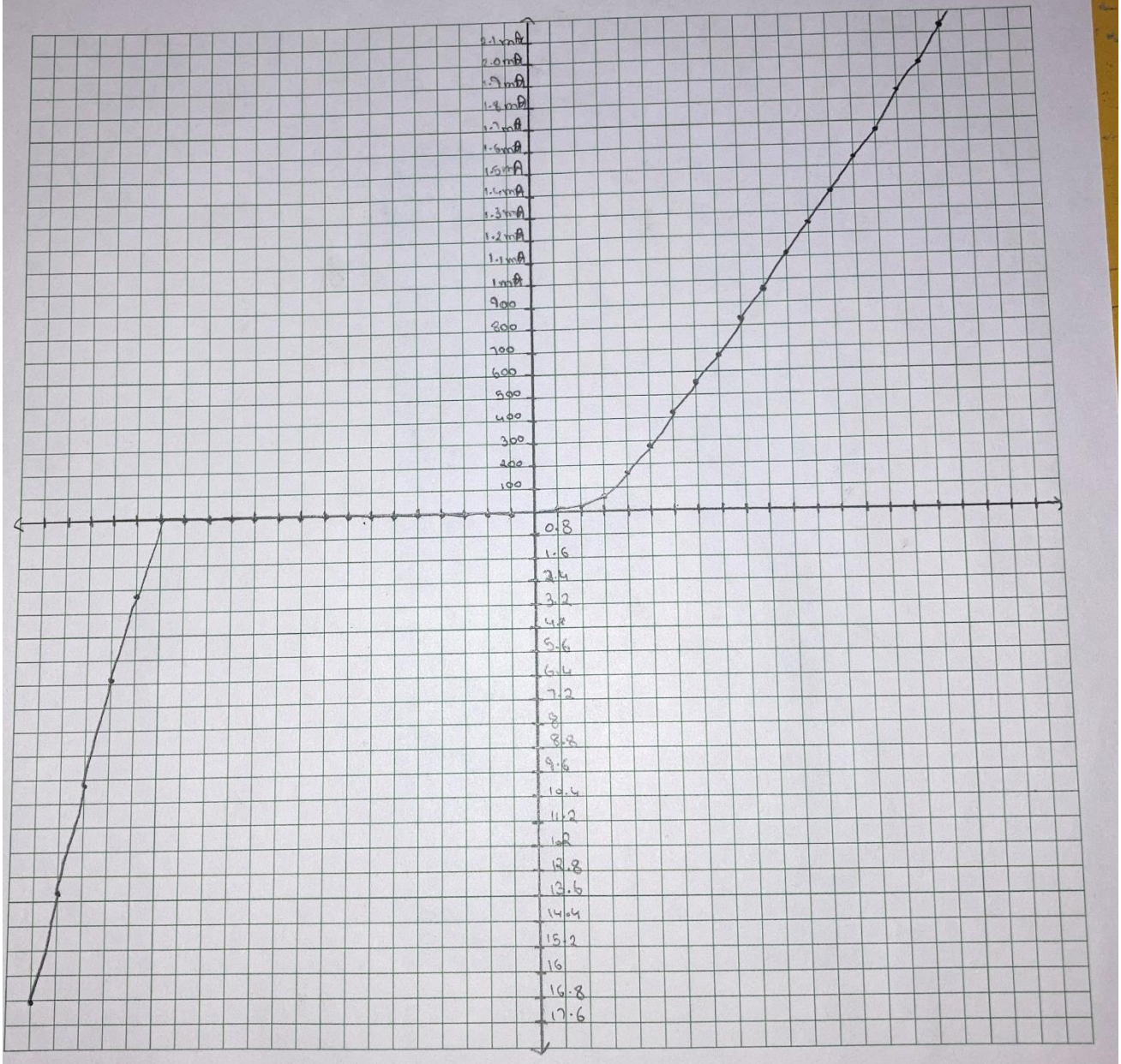
X-axis: 1 unit = 0.15 V

Y-axis: 1 unit = 100 μA

For 3rd quadrant

X-axis: 1 unit = 3.5 V

Y-axis: 1 unit = 0.8 mA



Calculation: -

Forward Resistance(DC)= (Vd /Id)

Forward Resistance(AC)= Δ Vd/ Δ Id

Conclusion: -