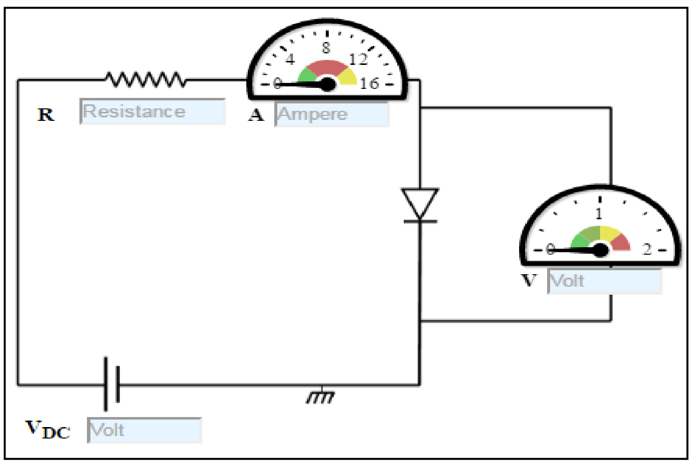
AIM: FIND THE VI- CHARACTERISTICS OF DIODE.

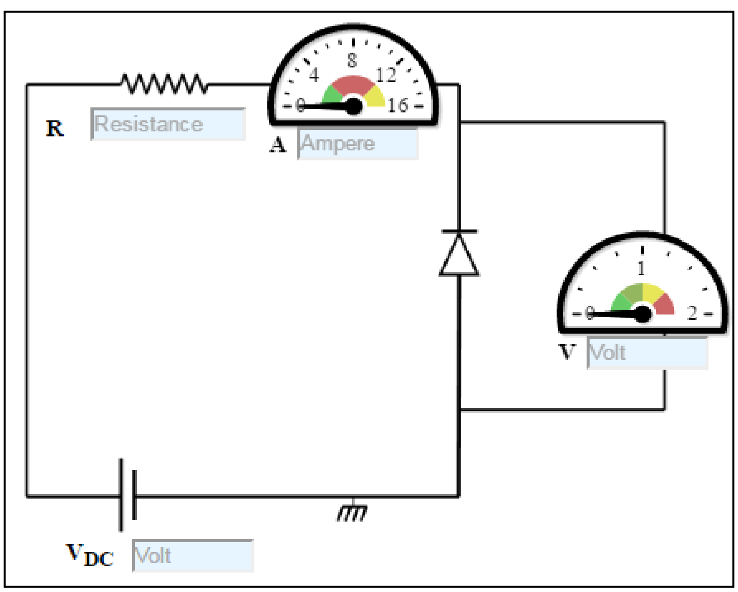
APPARATUS: 1) DC Voltage
2) Wires
3) Ammeter
4) Silicon Diode
5) Resistor
6) Voltmeter

CIRCUIT DIAGRAM:

1. FORWARD BIAS SILICON DIODE



2. REVERSE BIAS SILICON DIODE



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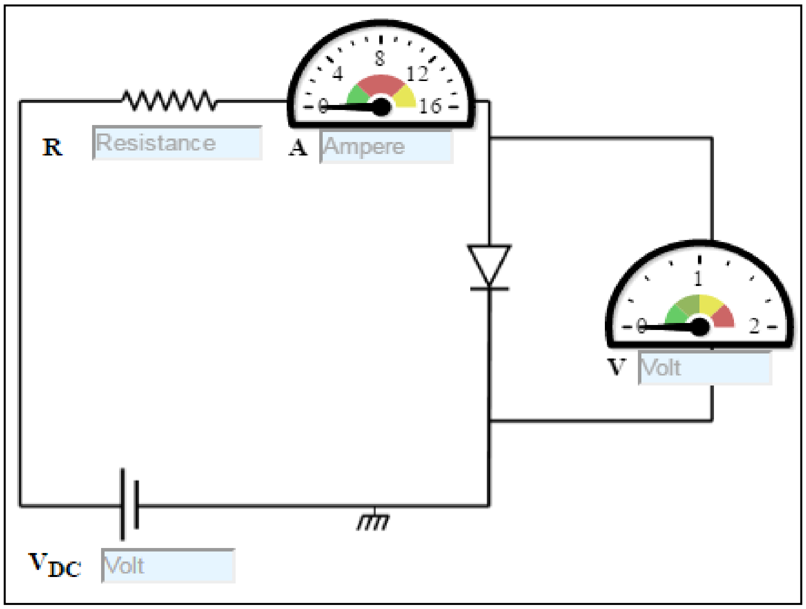
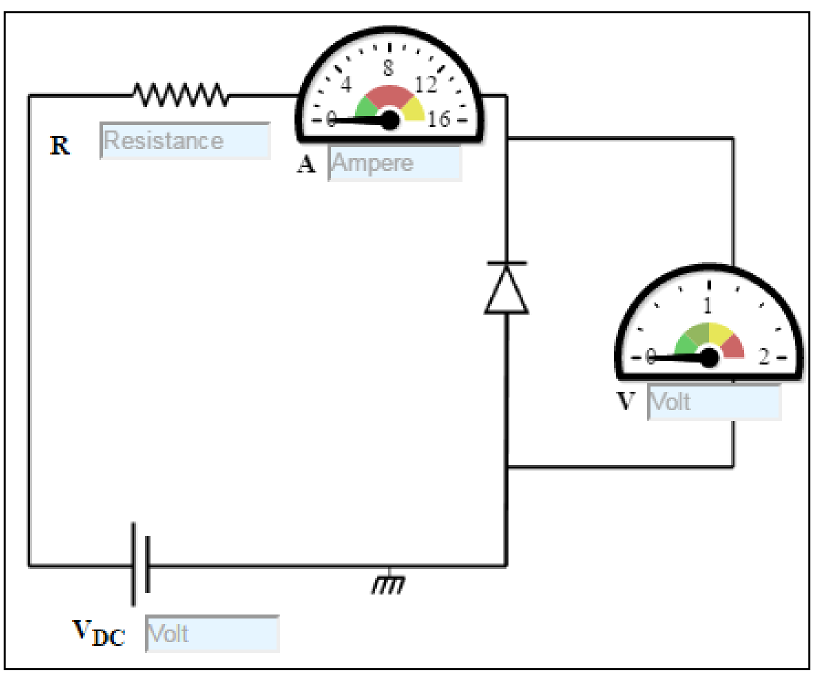
3.FORWARD BIAS GERMANIUM DIODE



4. REVERSE BIAS GERMANIUM DIODE



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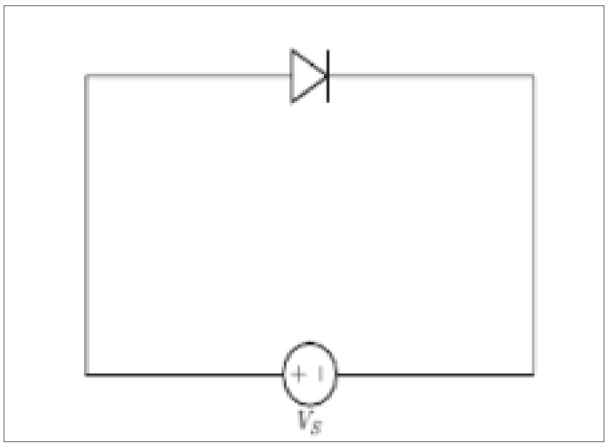
THEORY:

Function of a P-N junction diode in Forward Bias

The positive terminal of battery is connected to the P side(anode) and the negative terminal of battery is connected to the N side(cathode) of a diode, the holes in the p-type region and the electrons in the n-type region are pushed toward the junction and start to neutralize the depletion zone, reducing its width. The positive potential applied to the p-type material repels the holes, while the negative potential applied to the n-type material repels the electrons. The change in potential between the p side and the n side decreases or switches sign. With increasing forward

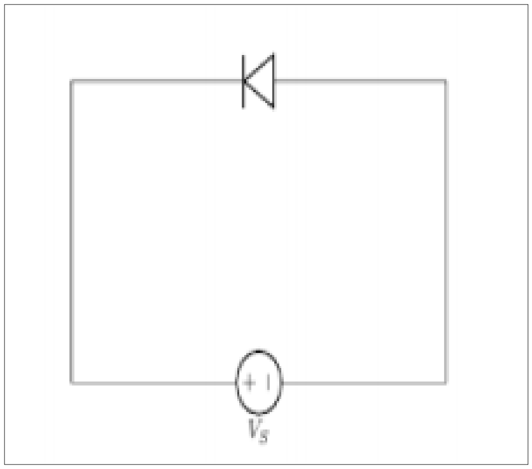
bias voltage, the depletion zone eventually becomes thin enough that the zone's electric field cannot counteract charge carrier motion across the p–n junction, which as a consequence reduces electrical resistance. The electrons that cross the p–n junction into the p-type material (or holes that cross into the n-type material) will diffuse into the nearby neutral region. The amount of minority diffusion in the near-neutral zones determines the amount of current that may flow through the diode.



Figurer:3

Function of a P-N junction diode in Reverse Bias:

The positive terminal of battery is connected to the N side(cathode) and the negative terminal of battery is connected to the P side(anode) of a diode. Therefore, very little current will flow until the diode breaks down.



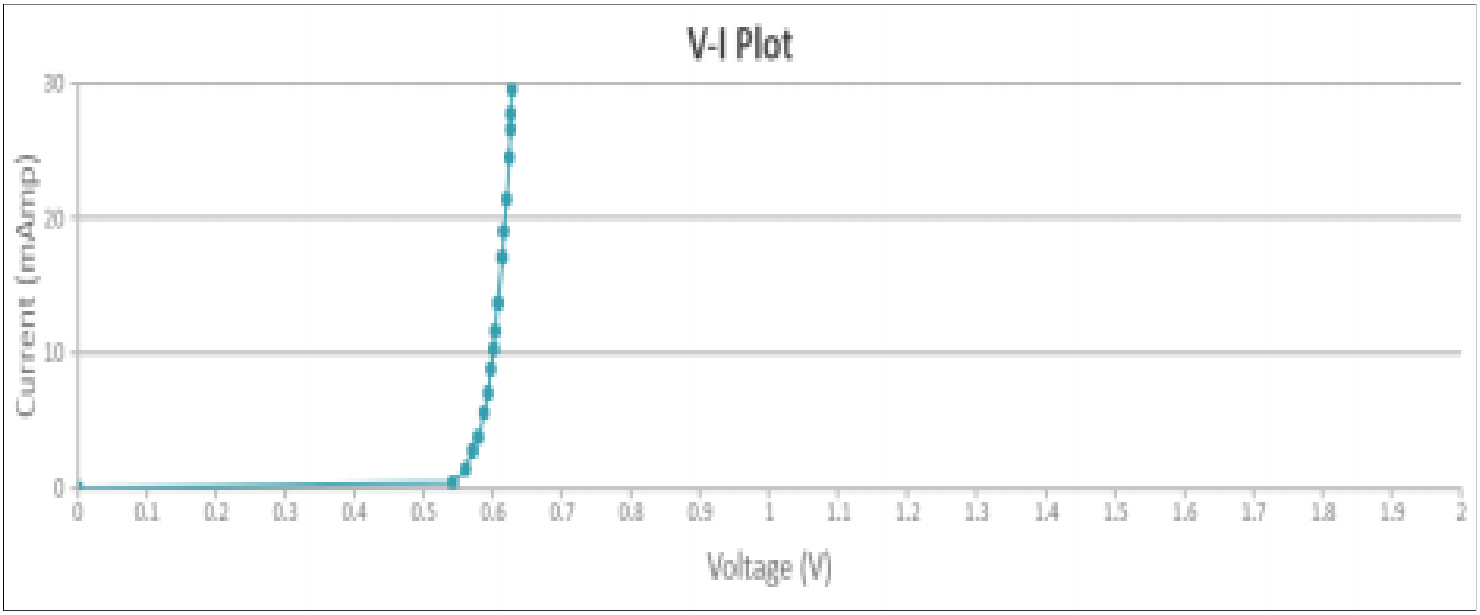
Figurer:4

The positive terminal of battery is connected to the N side(cathode) and the negative terminal of battery is connected to the P side(anode) of a diode, the 'holes' in the p-type material are pulled away from the junction, leaving behind charged ions and causing the width of the depletion region to increase. Likewise, because the n-type region is connected to the positive terminal, the electrons will also be pulled away from the junction, with similar effect. This increases the voltage barrier causing a high resistance to the flow of charge carriers, thus allowing minimal electric current to cross the p–n junction. The increase in resistance of the p–n junction results in the junction behaving as an insulator. The strength of the depletion zone electric field increases as the reverse-bias voltage increases. Once the electric field intensity increases beyond a critical level, the p–n junction depletion zone breaks down and current begins to flow, usually by either the Zener or the avalanche breakdown processes. Both of these breakdown processes are non-destructive and are reversible, as long as the amount of current flowing does not reach levels that cause the semiconductor material to overheat and cause thermal damage.

Forward and reverse biased characteristics of a Silicon diode

In forward biasing, the positive terminal of battery is connected to the P side and the negative terminal of battery is connected to the N side of the diode. Diode will conduct in forward biasing because the forward biasing will decrease the depletion region width and overcome the barrier potential. In order to conduct, the forward biasing voltage should be greater than the barrier

potential. During forward biasing the diode acts like a closed switch with a potential drop of nearly 0.6 V across it for a silicon diode. The forward and reverse bias characteristics of a silicon diode. From the graph, you may notice that the diode starts conducting when the forward bias voltage exceeds around 0.6 volts (for Si diode). This voltage is called cut-in voltage.

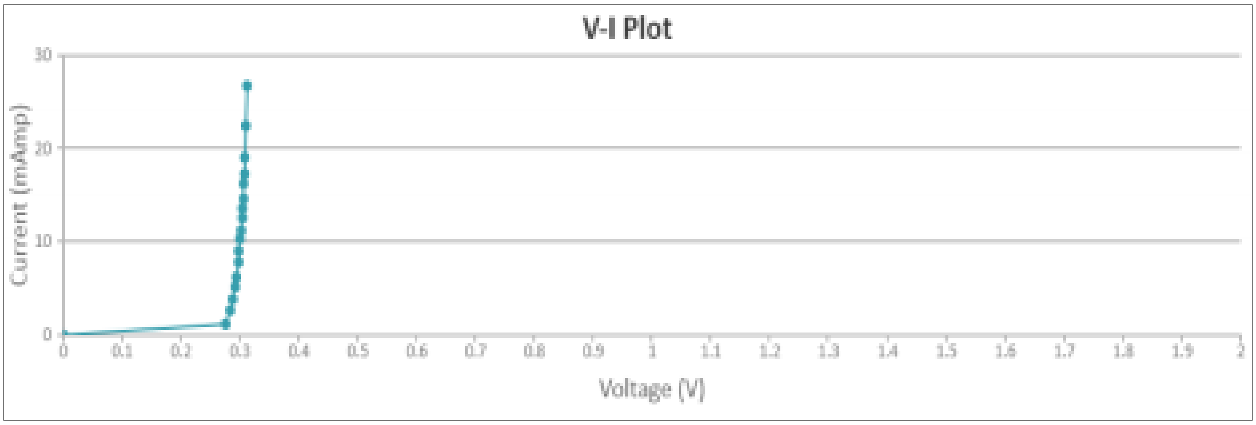


Figurer:5

In reverse biasing, the positive terminal of battery is connected to the N side and the negative terminal of battery is connected to the P side of a diode. In reverse biasing, the diode does not conduct electricity, since reverse biasing leads to an increase in the depletion region width; hence current carrier charges find it more difficult to overcome the barrier potential. The diode will act like an open switch and there is no current flow.

Forward and reverse biased characteristics of a Germanium diode

In forward biasing, the positive terminal of battery is connected to the P side and the negative terminal of battery is connected to the N side of the diode. Diode will conduct in forward biasing because the forward biasing will decrease the depletion region width and overcome the barrier potential. In order to conduct, the forward biasing voltage should be greater than the barrier potential. During forward biasing the diode acts like a closed switch with a potential drop of nearly 0.3 V across it for a germanium diode. The forward and reverse bias characteristics of a germanium diode. From the graph, you may notice that the diode starts conducting when the forward bias voltage exceeds around 0.3 volts (for Ge diode). This voltage is called cut-in voltage.



Figurer:6

In reverse biasing, the positive terminal of battery is connected to the N side and the negative terminal of battery is connected to the P side of a diode. In reverse biasing, the diode does not conduct electricity, since reverse biasing leads to an increase in the depletion region width; hence current carrier charges find it more difficult to overcome the barrier potential. The diode will act like an open switch and there is no current flow.

PROCEDURE:

1. **Forward Bias-Si Diode**
   - Set DC voltage to 0.2 V .
   - Select the diode.
   - Set the resistor.
   - Voltmeter is placed parallel to Silicon diode and ammeter series with resistor. e. The positive side of battery to the P side(anode) and the negative of battery to the N side(cathode) of the diode.
   - Now vary the voltage upto 5V and note the Voltmeter and Ammeter reading for particular DC voltage .
   - Take the readings and note Voltmeter reading across Silicon diode and Ammeter reading.
   - Plot the V-I graph and observe the change.
   - Calculate the dynamic resistance of the diode. $rd=\Delta V/\Delta I$
   - Therefore from the graph we see that the diode starts conducting when the forward bias voltage exceeds around 0.6 volts (for Si diode). This voltage is called cut-in voltage.

2. **Reverse Bias-Si Diode**
   - Set DC voltage to 0.2 V .
   - Select the diode.
   - Set the resistor.
   - Voltmeter is placed parallel to Silicon diode and ammeter series with resistor.
   - The positive terminal of battery is connected to the N side(cathode) and the negative terminal of battery is connected to the P side(anode) of a diode.
   - Now vary the voltage upto 30V and note the Voltmeter and Ammeter reading for DC voltage .
   - Take the readings and note Voltmeter reading across Silicon diode and Ammeter reading.
   - Plot the V-I graph and observe the change.

3. **Forward Bias-Ge Diode**

- Set DC voltage to 0.2 V .
- Use the resistor of 1K ohms and a Germanium diode.
- Voltmeter is placed parallel to Germanium diode and ammeter series with resistor.
- The positive terminal of battery is connected to the P side(anode) and the negative terminal of battery is connected to the N side(cathode) of the diode.
- Now vary the voltage upto 30V and note the Voltmeter and Ammeter reading for particular DC voltage .
- Take the readings and note Voltmeter reading across Germanium diode and Ammeter reading.
- Plot the V-I graph and observe the change.
- Therefore from the graph we see that the diode starts conducting when the forward bias voltage exceeds around 0.3 volts (for Ge diode). This voltage is called cut-in voltage.

4. **Reverse Bias-Ge Diode**

- Set DC voltage to 0.2 V
- Use the resistor of 1K ohms and a Germanium diode.
- Voltmeter is placed parallel to Germanium diode and ammeter series with resistor.
- The positive terminal of battery is connected to the N side(cathode) and the negative terminal of battery is connected to the P side(anode) of a diode.
- Now vary the voltage upto 30V and note the Voltmeter and Ammeter reading for DC voltage .
- Make the readings and note Voltmeter reading across Silicon diode and Ammeter reading.
- Plot the V-I graph and observe the change.

OBSERVATION TABLE:

1. Forward Bias Silicon Diode:

Serial No.	Forward Voltage(Volt)	Forward Current(mAmp)
1	0	0
2	0.589	0.997
3	0.596	2.99
4	0.599	3.99
5	0.601	4.99
6	0.605	6.98
7	0.609	8.97
8	0.611	9.97
9	0.612	11.0
10	0.615	13.0
11	0.617	14.0
12	0.620	16.9
13	0.622	18.9
14	0.624	19.9
15	0.628	24.9
16	0.630	26.9
17	0.632	29.9
18	0.633	31.9
19	0.634	32.9
20	0.636	35.9
21	0.638	38.9
22	0.639	40.9

2. Reverse Bias – Silicon Diode:

Serial No.	Reverse Voltage(Volt)	Reverse Current(μAmp)
1	0.170	0.100
2	0.668	0.100
3	1.27	0.100
4	1.75	0.100
5	1.94	0.100
6	2.61	0.100
7	3.29	0.100
8	4.36	0.100
9	5.29	0.100
10	6.18	0.100
11	7.07	0.100
12	8.02	0.100
13	8.66	0.100
14	9.36	0.100
15	10.3	0.100
16	11.4	0.100
17	12.3	0.100
18	13.0	0.100
19	14.0	0.100
20	14.9	0.100
21	16.3	0.100
22	17.2	0.100
23	17.9	0.100
24	19.4	0.100
25	20.7	75.5

3. Forward Bias – Germanium Diode :

Serial No.	Forward Voltage(Volt)	Forward Current(mAmp)
1	0	0
2	0.264	0.350
3	0.275	1.25
4	0.280	1.95
5	0.282	2.40
6	0.286	3.30
7	0.287	3.55
8	0.290	4.65
9	0.292	5.60
10	0.295	6.75
11	0.296	7.65
12	0.298	8.80
13	0.300	9.95
14	0.301	11.0
15	0.302	12.2
16	0.304	13.6
17	0.305	15.4
18	0.306	16.8
19	0.307	17.7
20	0.308	18.8
21	0.309	20.9
22	0.310	21.8
23	0.311	23.6
24	0.312	26.1
25	0.313	28.0
26	0.314	29.6

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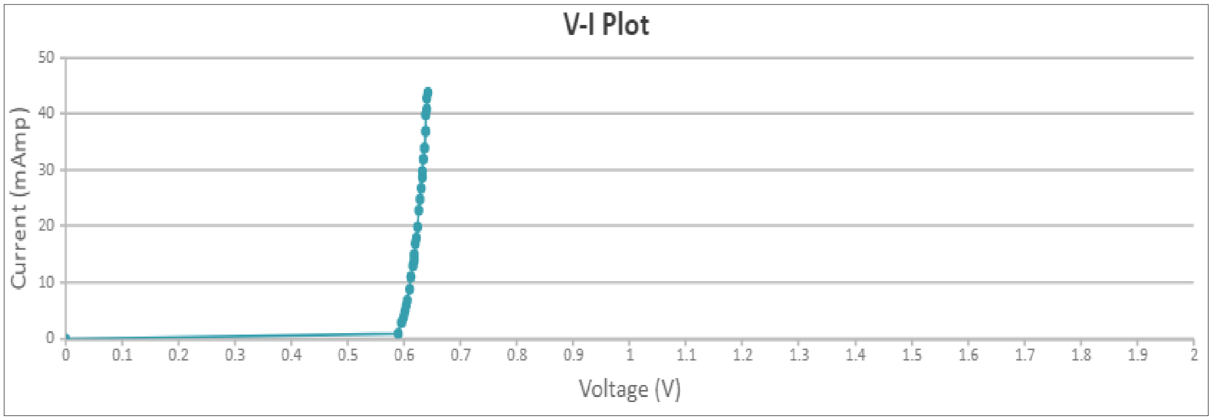
4. Reverse Bias – Germanium Diode :

Serial No.	Reverse Voltage(Volt)	Reverse Current(μAmp)
1	0.200	0
2	0.400	0
3	0.650	0
4	2.25	0
5	3.35	0
6	4.30	0
7	6.10	0
8	6.80	0
9	8.65	0
10	10.3	0
11	11.8	0
12	13.7	0
13	15.5	0
14	17.1	0
15	19.4	0
16	21.2	0
17	21.6	0
18	23.3	0
19	24.9	0
20	26.7	0
21	28.8	0
22	30.2	30199.999999999996

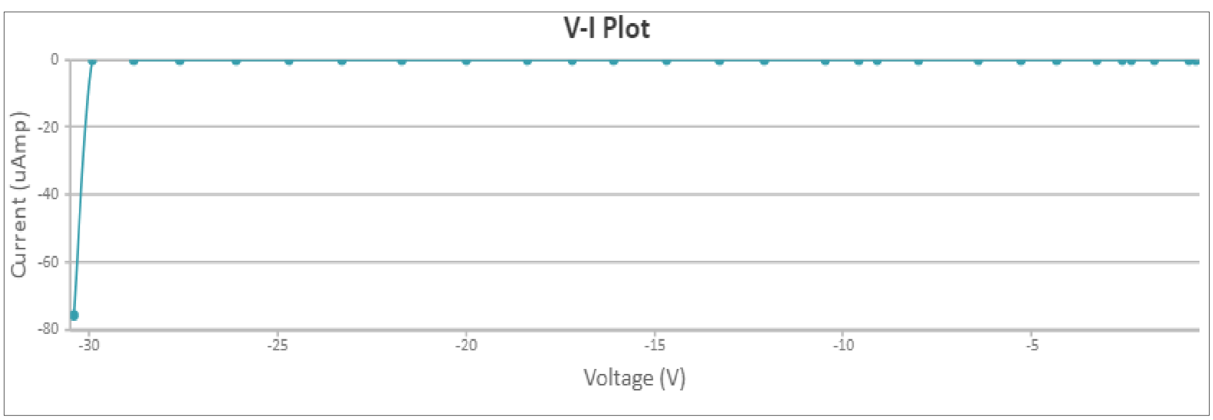
GRAPH:

1. **Forward Bias Silicon Diode: :**



[1]

2. **Reverse Bias – Silicon Diode :**



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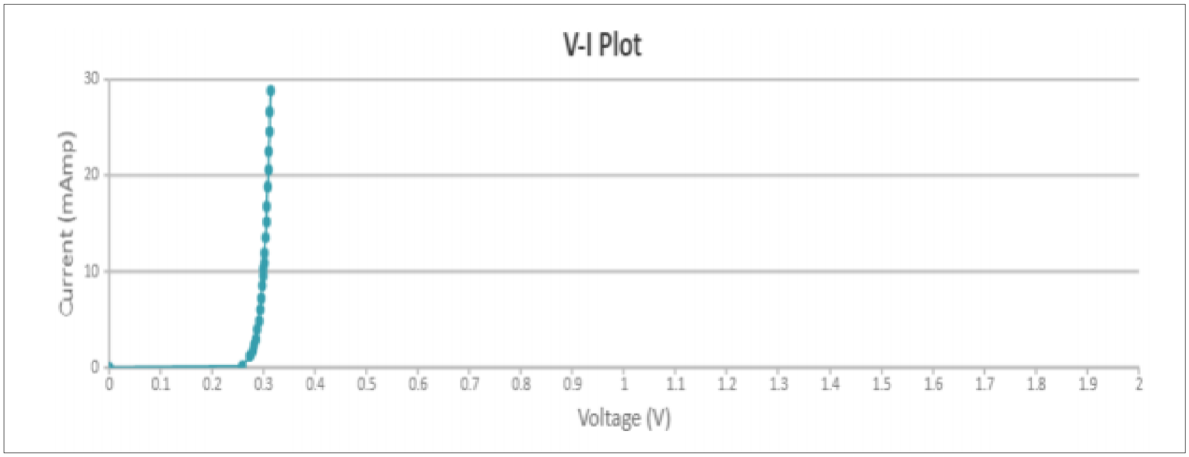
3. **Forward Bias – Germanium Diode :**



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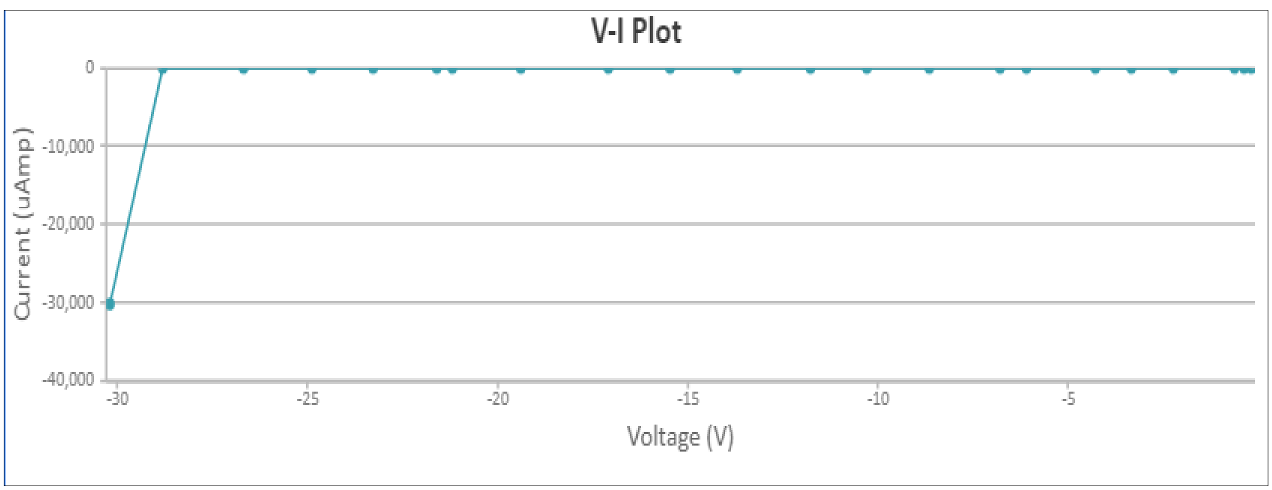
4. **Reverse Bias – Germanium Diode :**



[4]

CONCLUSION:

During forward bias, the **diode** conducts current with increase in voltage. During reverse bias, the **diode** does not conduct with increase in voltage (break down usually results in damage of **diode**).

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