

Object :- The aim of the experiment is to study the characteristic curve of photodiode and to determine the reverse resistance and dark resistance.

Apparatus :- A Kit of Photodiode which consists of

- (1) a photodiode (SI-100)
- (2) a u-ammeter (0-500A)
- (3) a voltmeter with voltage (0-1V/0-10V)
- (4) A 60W lamp with a solid state regulator or variac to vary its intensity.

To be determined :- (1) Dark resistance $R_{dc} = \frac{\text{Dark Voltage } V_{dc}}{\text{Dark Current } I_d}$

$$(2) \text{Photodiode Resistance } R = \frac{\text{Reverse Voltage } V_r}{\text{Reverse Current } I_r}$$

The circuit diagram:- In the given the circuit is connected with all the components and is ready to use (kit) is employed otherwise, it can be connected as shown in the figure.

Theory :- A photodiode is a pn-junction diode which when illuminated generates electrons and holes and current flows through the circuit. When it is not illuminated a small current flows in the circuit. As it is reverse biased a small ^{saturated} current flows through the circuit due to minority charge carriers i.e. thermally generated electron-hole pairs. When the junction is exposed to light, more electron-hole pairs are generated by the incident light, whose energy ($h\nu$) is greater than E_g , the band gap energy. They are swept across the junction as minority carriers. The no. of these minority charge carriers depends upon level of illumination on the junction.

Practical :

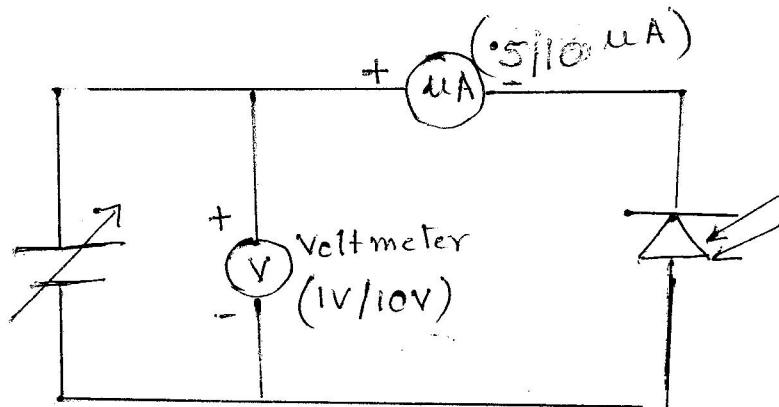


Fig. 1 Circuit diagram of Photodiode

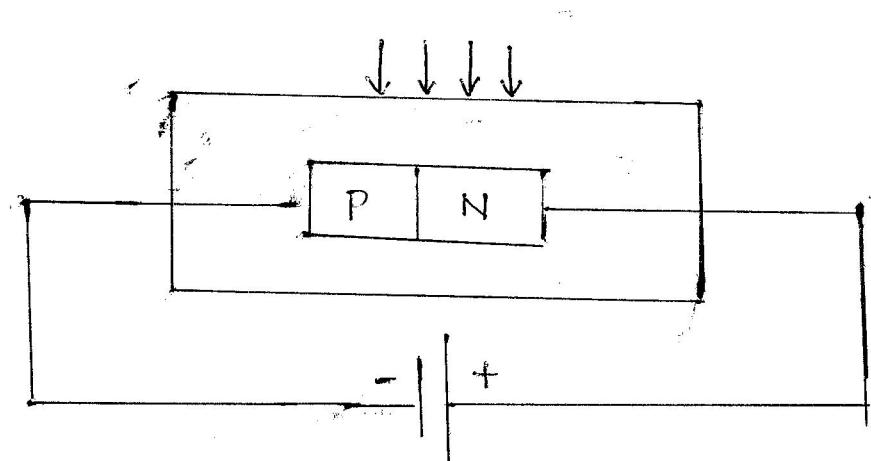


Fig. 2 Photodiode Structure diagram.

Observation table :-

S.No	Reverse Voltage	Intensity = I_1	Intensity = I_2	Intensity = I_3	Intensity = I_4
		Reverse current (μA)			

Practical :

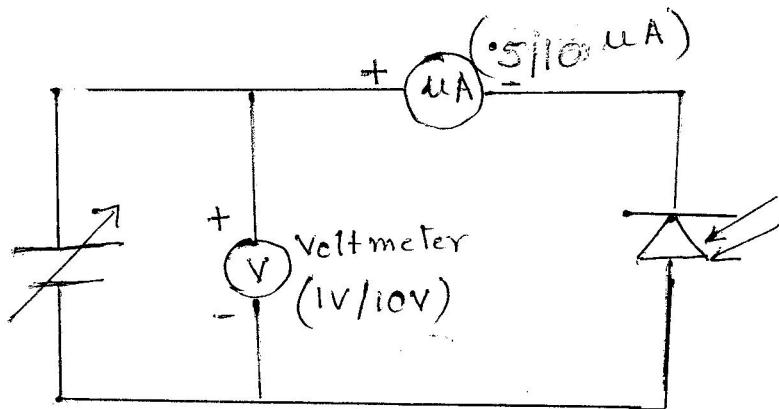


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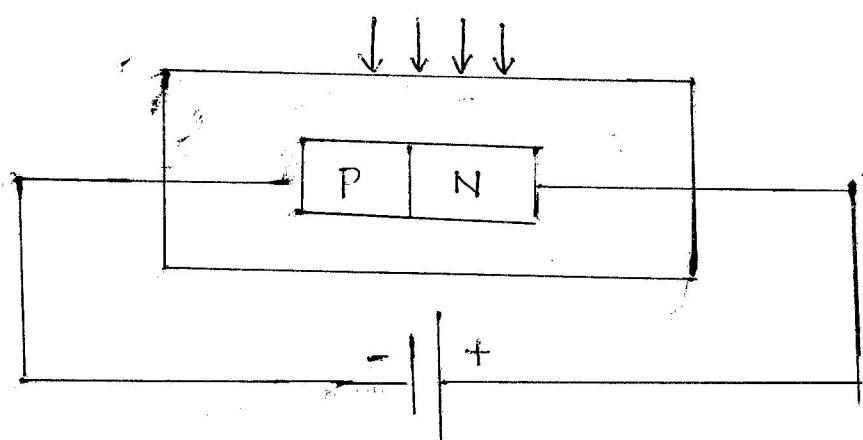


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Observation table :-

S.No	Reverse Voltage	Intensity = I_1	Intensity = I_2	Intensity = I_3	Intensity = I_4
		Reverse current (mA)	Reverse current (mA)	Reverse current (mA)	Reverse current (mA)

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Light of larger intensity causes an increase in the conductivity of the device, hence the increase in the reverse current however, increasing the reverse voltage does not cause significant change in the current. The current which flows through the junction in the absence of illumination is called the "dark current". It is the usual reverse saturation current I_{dc} . It flows because the minority charge carriers are swept across the junction by the external potential. Further, even when the reverse bias is made zero, a small current flows across the junction by the barrier potential. The current will become zero, when the junction is forward biased by a voltage, equal to the barrier potential.

The photodiode when operated in the forward biasing its characteristic curve will be similar of an ordinary diode. Only difference is in the material used. As its conductivity is due to illumination of the diode. The diode is packed in a glass coating and a lens is used to focus the light falling on it.

Operation :-

The circuit diagram of a photodiode is shown in fig.-1 For operation in reverse bias condition the p-type of material is connected with -ive terminal of the power supply and n-type of material is connected with the

five terminal of the power supply. The voltage is varied with the help of potential divider in steps and current change is noted.

Initially when the diode is not illuminated there is some current flowing through the circuit and that current is noted and this current is noted which is called dark current (I_{dc}) and the voltage applied in the circuit is also noted. It is denoted by V_{dc} . The ratio of these two is called Dark Resistance $R_{dc} = \frac{V_{dc}}{I_{dc}}$.

Next variation of current with change of voltage with different illumination is noted. For changing the illumination different tungsten bulbs of different Wattage say - 40W, 60W, 80W, 100W can be used or the voltage of bulb can be varied by using a variac or potential divider. So the different illuminations are I_1, I_2, I_3 and I_4 are shown in the observation tables. The readings of change in current with change in voltage are noted and graph is drawn between Voltage and current for four different illuminations.

The values of photo resistance are calculated by the formula $R_{pc} = \frac{V_{pc}}{I_{pc}}$ for different illuminations.

Result: The graph shows that with rise in voltage the photocurrent first increases then it becomes constant which is called saturation. The saturation reaches when the rate of formation of electron hole pair is equal to rate of recombination.

$$R_{dc} = \frac{V_{dc}}{I_{dc}}, R_{pc} = \frac{V_{pc}}{I_{pc}}$$

Precautions :-

1. The circuit should be checked for proper biasing before it is switched on.
2. The lamp should be placed in the same position throughout the experiment.
3. Before illuminating the diode the dark current should be noted.

