

## Photodetector

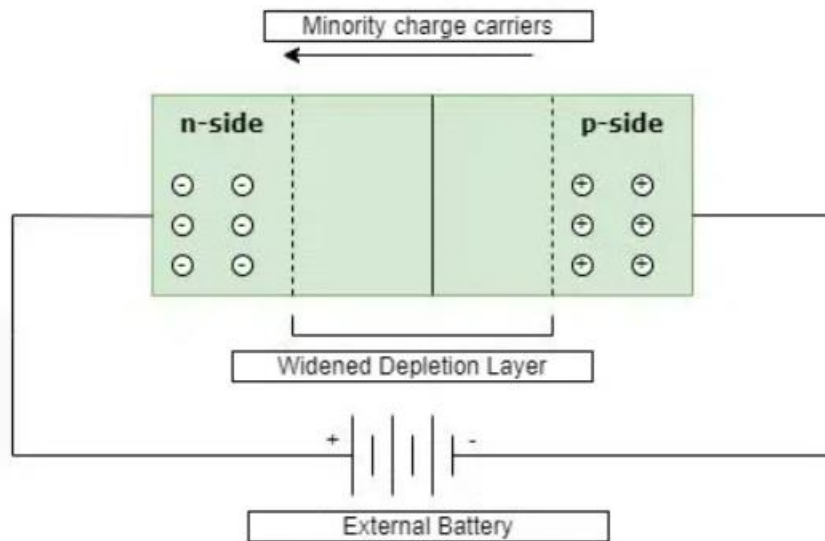
A photodetector is a device that is used to detect light radiations by absorption. It converts light pulses (or radiations) energy into electrical signals in the form of current & voltage.

### Working principle of Photodetector

The basic principle of the photodetector is that when an incident light or radiation falls on the surface of detector and get absorbed, it converts it into electrical signals.

### Structure of Photodetector

When the incident radiation falls on the surface of the material of the photoconductor the photons present in the light are absorbed by the surface material which then next generates newly charged particles as electron-hole pairs which are further responsible for the production of electrical signals.



*Fig 1: Reversed biased P-N junction*

The suitable material use for making photodetector is semiconductor. Graphene (an allotrope of Carbon) is best known material for making of photodetectors.

### Types of Photodetector

Many types of photodetectors are classified based on the mechanism of the absorption of photons, photoelectric effect, temperature effect and other emission effects.

These are also depend upon the type of material used and also the junctions that are found in the photodetector.

Some of the important photodetector types as follow:

- Photoconductors
- Photo Diodes
- Metal-semiconductor metal Photodiodes
- Phototransistors
- Phototubes
- Photo Multiplier Tube
- Charge Coupled Device

## **Characteristics of Photodetector**

- The detector should be sensitive.
- It should have a fast response.
- It should have the ability to detect a considerable range of wavelengths,  $\lambda$ .
- The electrical energy produced by the detector must be directly proportional to the transmitted intensity of the radiation.

**Dark Current:** It is defined as a photocurrent that flows even in the absence of the incident light.

**Response time:** It is defined as the speed or response of the photodetector in the form of a function of the frequency of photon pulses.

**Sensitivity:** The ratio of output signal (e.g. a photocurrent) and the strength of the optical input (as an optical power).

**Noise:** It is the disturbance on the signal level that hinders an accurate measurement of the photodetector.

## **Photo Diodes**

The Photo Diodes can be categorized as

- a. p-n Photo diodes,
- b. p-i-n Photodiodes and
- c. Avalanche Photodiodes.

### **p-n Photodiodes**

It depends upon the photo generated charged carriers for their operation. A photodiode is a p-n junction whose current in reverse bias increases when the material absorbs photons. Since an electric field can only support in the depletion region of the p-n junction, photocarriers are desirable to generate in this region. So it is required to increase the length of depletion region for fast response.

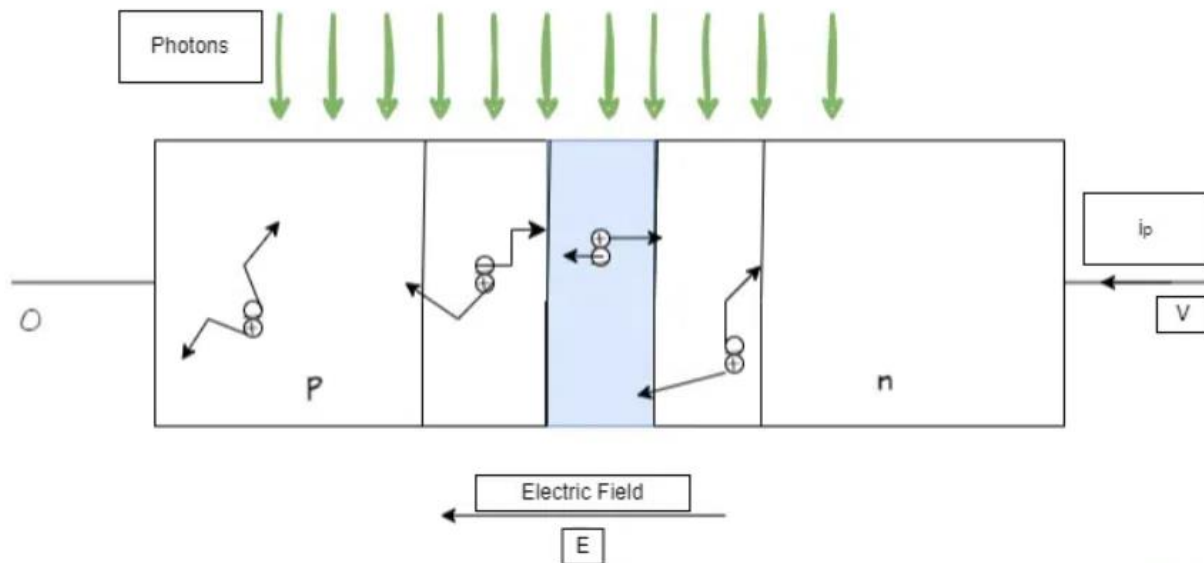


Fig 2: Photons (charged carriers) irradiating an ideal reverse-biased p-n photodiode detector.

### Photo Multiplier Tube

It is very sensitive device in which electrons emitted from photosensitive cathode strike a second surface called as dynode. Dynode is positive +ve with respect to the original cathode. Electrons are this accelerated and can knock out more than one electron from the dynode.

The above process is repeated several times, so more than  $10^6$  electrons  $e^-$ s are finally collected for each photons striking the first cathode surface. So more amount of photocurrent we get.