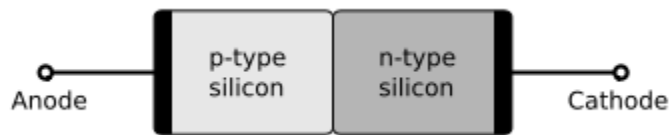


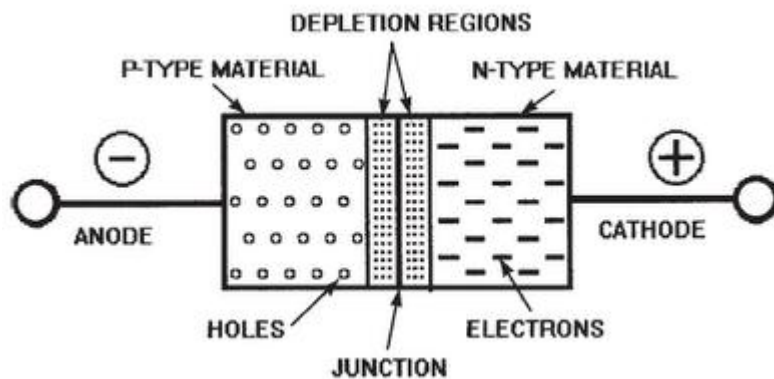
# Characteristics and Working of P-N Junction Diode

Before going to the discussion of diode, we have to check the details of P-N junction. P-N junction can be defined as the junction formed at combining point of P-Type & N-type material. The interface between the two regions is called as metallurgical junction. At this junction we can also observe that depletion region will be formed.



## *Formation of Depletion Region:*

In a step graded P-N junction, there exists a concentration gradient near the junction. There is large number of holes on N side, near the junction. Those holes start moving from P side to N side i.e. from high concentration area to low concentration area. This is nothing but diffusion of holes from P side to N side. Similarly the electrons on N side start diffusing across the junction into the P region.



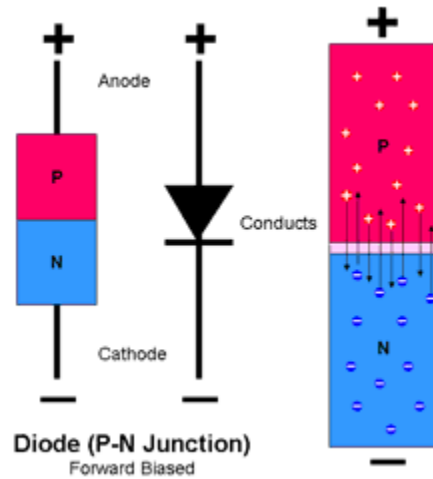
As holes enter the N region, they find number of donor atoms. The holes recombine with donor atoms. As donor atoms accept additional holes, they become positively charged immobile ions. Atoms on P side are acceptor atoms. The electrons diffusing from N side to P side recombine with the acceptor atoms on P side. As acceptor atoms accept additional electrons, they become negatively charged immobile ions. Such a large number of negatively charged ions get formed near the junction on P side.

As more number of holes diffuses on N side, large positive charge will be accumulated on N side near the junction. Eventually in the same way large negative charge will be accumulated on P side near the junction. Such a region is depleted of free mobile charge carriers and hence it is called “depletion region” or “depletion layer”.

The depletion region is also called “space charge region” if the depletion region can become widened up to a point where no further electrons are holes can cross the junction. Thus depletion region can acts as the barrier.

## *P-N Junction Diode:*

The P-N junction forms a popular semiconductor device called “P-N Junction Diode”. The P-N Junction has two terminals called as electrodes: one each from P region and N region. As there are two electrodes, it is called as diode i.e. di + electrode



*Resource site: Circuitstoday.com*

The above figure shows the schematic arrangement of P-N junction diode. The P region acts as anode while the N region acts as cathode.

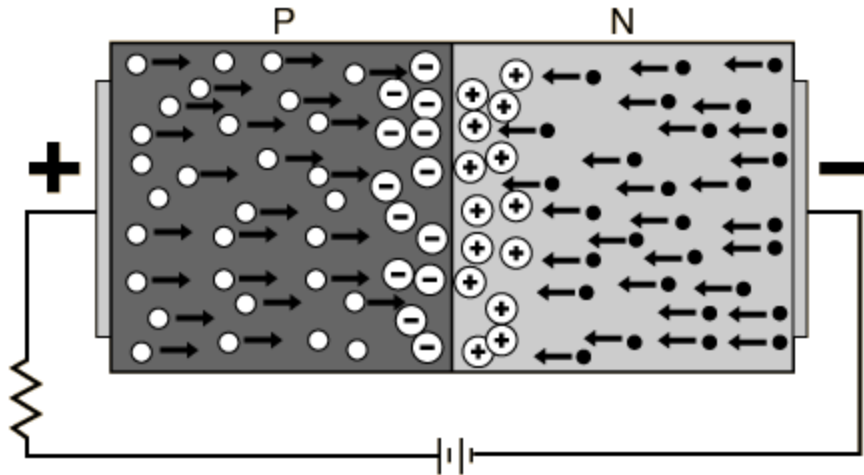
We can connect the diode in circuits in two ways. This is also called as biasing which means applying an external voltage.

The biasing is of two types

1. Forward biasing
2. Reverse biasing

## *Forward Biasing of P-N Junction Diode:*

If an external voltage is connected in such a way that the P region terminal is connected to the positive of DC voltage and the N region is connected to the negative of the DC voltage, the biasing condition is called forward biasing.



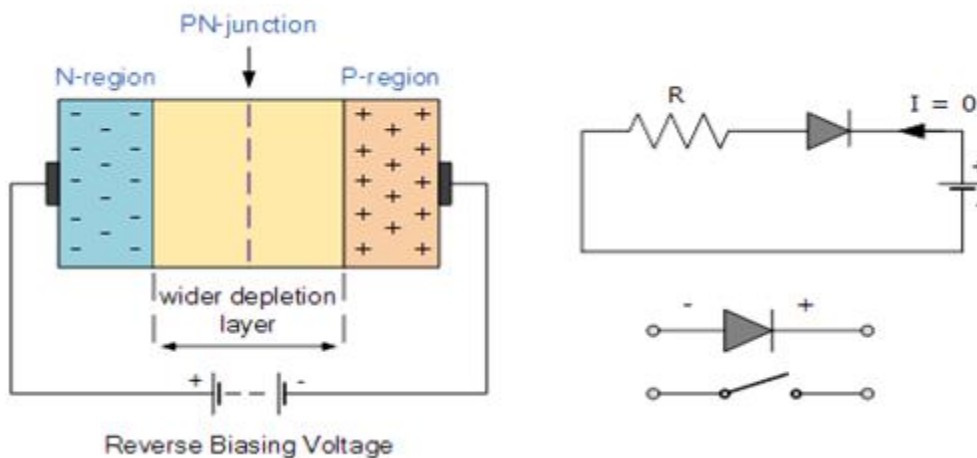
### Forward Biasing Operation:

When we apply an external voltage more than the barrier potential, the negative terminal of battery pushes the electrons against barrier from N to P region. Similarly positive terminal pushes the holes from P to N region. Thus holes get repelled by positive terminal and cross the junction against barrier potential. This reduces the width of depletion region. As forward voltage increased, at a particular value the depletion region becomes very much narrow such that large number of charge carriers can cross the junction.

In this way the flow of charge increases through the diode by increasing the applied voltage. The motion of charge particles can be observed in above picture.

### Reverse Biasing of P-N Junction Diode:

If P region of battery is connected to the negative terminal of the battery and N region is connected to the positive terminal of the battery, the biasing condition is called reverse biasing of a P-N junction.



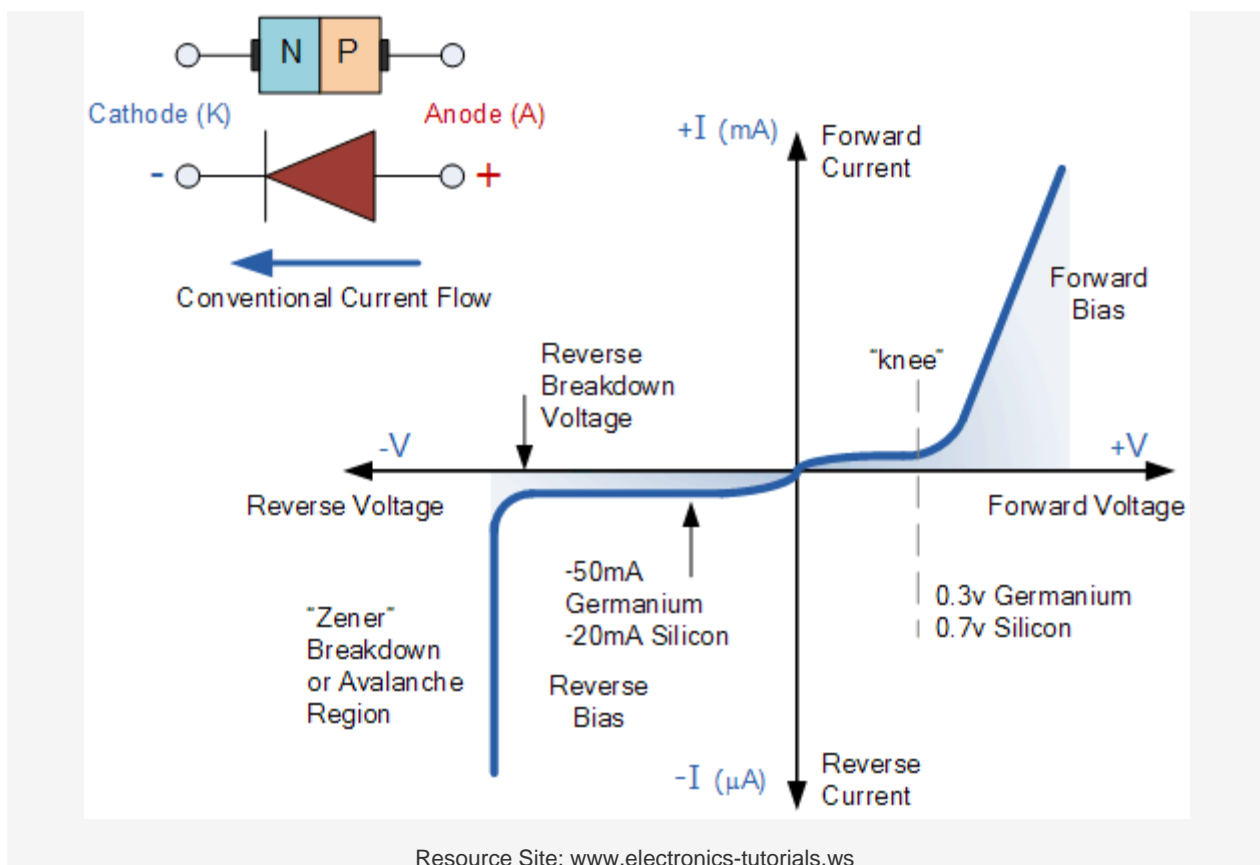
## Reverse Biasing Operation:

In reverse bias, the negative terminal attracts the holes in the P region away from the junction. The positive terminal attracts the free electrons in the N region and no charge carrier is able to cross the junction. In this way the depletion width increases highly and acts as a resistor, but it does not exist for more time. In steady state, majority current ceases the holes and electrons stop moving away.

In this way there is a reverse current flow due to minority charge carriers which are small in number.

## *P-N Junction Diode Characteristics:*

Forward and Reverse Characteristics of a Diode: The response of a diode can be easily indicated using the characteristics which called as V-I characteristics of diode.



Source: <http://www.electronicshub.org/characteristics-and-working-of-p-n-junction-diode/>