

What is Zener Diode?

Zener diode is defined as

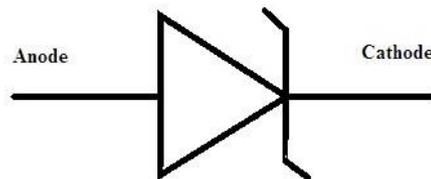
The semiconductor which is heavily doped to operate in reverse direction or in breakdown region.

The **Zener diode** behaves just like a normal general-purpose diode consisting of a silicon PN junction and when biased in the forward direction, that is Anode positive with respect to its Cathode, it behaves just like a normal signal diode passing the rated current.

However, unlike a conventional diode that blocks any flow of current through itself when reverse biased, that is the Cathode becomes more positive than the Anode, as soon as the reverse voltage reaches a pre-determined value, the zener diode begins to conduct in the reverse direction.

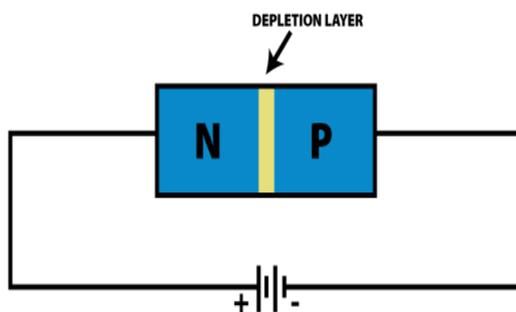
Zener Diode Symbol

The symbol for Zener diode is represented as below,



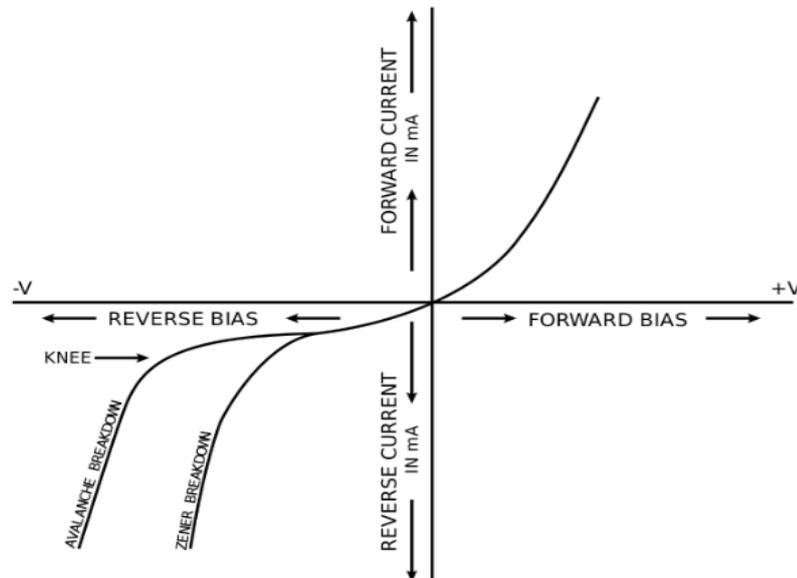
Zener Diode Circuit

We can define Zener diode as a single diode connected in a reverse bias. It can be connected in reverse bias positive as in the circuit shown below:



V-I Characteristics of Zener Diode

The diagram given below shows the V-I characteristics of the Zener diode. When the Zener diode is connected, in forward bias, diode acts as a normal diode. But Zener breakdown voltage occurs when the reverse bias voltage is greater than a predetermined voltage.



Working of Zener Diode

The basic principle behind Zener diode working is based on the cause of breakdown when the diode is in the reverse biased condition. For a Zener diode there are two types of breakdown:

- Zener breakdown
- Avalanche breakdown

Avalanche Breakdown

- A conventional reverse biased diode, when subjected to its breakdown voltage allows a significant amount of current. But when this reverse breakdown voltage is exceeded, the diode experiences an avalanche breakdown.
- When we increase the voltage through Zener in reverse bias mode, first current increases uniformly with it but after it reaches the breakdown state, the current increases massively for a very small or negligible change in voltage. The change is sharper in Zener than the normal diode.

Causes of Breakdown

- The breakdown is caused by two effects, the Avalanche effect and the Zener effect. The Zener effect is dominant in voltages up to 5.6 volts and the avalanche effect takes over above that.
- They are both similar effects, the difference being that Zener effect is a quantum phenomenon and the avalanche effect is the movement of electrons in the valence band like in any electric current.
- Avalanche effect also allows a larger current through the diode than the Zener effect.

Application of Zener Diode

Following are the applications of Zener diode:

Zener diode as voltage regulator:

Zener diode is used as Shunt voltage regulator for regulating voltage across small loads. The breakdown voltage of Zener diodes will be constant for a wide range of current. Zener diode is connected parallel to the load to make it reverse bias and once the Zener diode exceeds knee voltage, the voltage across the load will become constant.

Zener diode in over-voltage protection:

When the input voltage is higher than the Zener breakage voltage, the voltage across the resistor drops resulting in short circuit. This can be avoided by using Zener diode.

Zener diode in clipping circuits:

Zener diode is used for modifying AC waveform clipping circuits by limiting the parts of either one or both the half cycles of an AC waveform.

What are the advantages of Zener diode?

Following are the advantages of Zener diode:

- The size of the Zener diode is so small that it can be used in smaller circuits and also in cell phones.
- Zener diodes are less expensive when compared to other diodes.
- Zener diodes can be used for controlling, regulating, and stabilizing the voltage in the circuit.
- These diodes have a very high performance standard.
- The compatibility of the Zener diodes is good that they are used in regulating voltage.

What is Zener voltage?

Zener voltage is defined as the voltage at which the Zener diode breaks down.

How to control the breakdown voltage of Zener diode?

The breakdown voltage of Zener diode can be controlled either by adding impurities or by increasing the doping level.

When does the Zener Diode allow reverse flow of current?

It allows the current flow in the opposite direction when the voltage is above a certain value known as Zener Voltage or Avalanche Point or Breakdown Voltage.

State true or False. Zener Diode exhibit controlled breakdown.

True. Zener Diode does exhibit controlled breakdown.

How does breakdown occur?

The breakdown is caused by two effects, the Avalanche effect and the Zener effect.

What is the difference between the Zener effect and the avalanche effect?

The Zener effect is a quantum phenomenon whereas, the avalanche effect is the movement of electrons in the valence band like in the case of any electric current.
