What is a rectifier? Show that a PN diode acts as a rectifier

The process of converting the alternating voltages and currents to pulsating direct current is called rectification. The pulsating direct current must be filtered, so that output voltage is constant.

An electrical device which offers a low resistance to the current in One Direction ,but a high resistance to the current in the opposite direction is called a rectifier and is shown in the figure

Such a device is capable of converting a sinusoidal input waveform, whose average value is zero, into unidirectional though it is not constant wave form with a non zero average component.

PN junction diodes can be used for the rectifier circuits as they offer lower resistance when forward bias and high resistance when reverse biased. consider PN diode as a circuit element to which an AC signal is applied.

When Vi>Vr then diode conducts and Vo=Vi [ positive cycle of input]

When Vi<Vr[negative cycle of input]then diode doesn’t conduct and Vo=0

From the above discussion we can conclude that the diode is capable to convert an a AC signal with zero average value to a pulsating DC with non zero average value . thus,PN junction diode acts as a rectifier.

Photodiode

Also called as photo detector photo sensor at light detector dot

It is an PN junction devices that consumes light energy to generate electric current dot

Photo diodes are specially designed to operate in reverse bias condition

Example solar cell down

Downward arrows striking the diode represents light or photo

Example materials used to construct photo diodes are Si, Ge, Gap, In Ga As, In As Sb[antimony]

Operation photodiode is designed to generate more number of charge carriers in depletion region.

Here, we use light or photons as the external energy to generate charge carriers in depletion region in reverse bias more.

Due to strong depletion region electric field [light], an external electric field[applied voltage] increase the drift velocity of the free electrons.

Because of this height drift velocity, minority carriers generated in the depletion region will cross the PN junction before they recombine with atoms . As a result minority carrier current increases.

LED light emitting diode

Energy released when an electron falls from the conduction into the valence bond appears in the form of radiation. Such a PN diode is called a light emitting diode led.

Led is an optical semiconductor device that converts electrical energy into light energy.

Example; gallium scenic- red infrared light.

Gallium nitride- blue

Gallium phosphide- red, yellow, green

Aluminium gallium nitride- UV light

Aluminium gallium phosphide- green

Led operated in forward bias condition only.

Because light is produced due to recombination process.

Silicon and Ge emits low energy photons have low frequency which is invisible to human eye.

Ga As,Ga N, Etc are high energy photons have high frequency which is visible to human eye.

Led can be switched on and off at a very fast speed of 1 NS.

Advantages;

Consumes low energy, cheap and reliable and long last lifetime.

Light in weight, smaller size, emits different colours of light.

Operates very fast, they can be turned on and off in very less time .

Applications;

Burglar alarm systems, calculators, traffic signals, digital computers, multimeters, automotive heat lamps, camera flashes, aviation lighting, picture phones, digital display, digital watches.

Q25.With necessary diagram, describe the characteristics of a forward And reverse biased PN junction diode.

Diode is the most fundamental 2 terminal non linear circuit element. The relationship between the current flowing through the diode and the voltage appearing across it is non linear. In other words, the diode has non linear v- I characteristics .

Figure illustrates the v- I characteristics of a PN junction diode. The characteristics curve contains 3 distinct regions as,

1. Forward bias region.
2. Reverse bias region.
3. Breakdown region.
4. Forward bias region; on forward biasing, P side of the PN junction is connected to the positive of the voltage supply and inside of the PN junction is connected to the negative of the voltage supply. Simply, forward bias region is the characteristics of the diode for V>O. From figure it can be seen that initially, the diode current is very small because the barrier potential prevents the flow of current through it. If the applied voltage exceeds the barrier potential, then for a small increase in the voltage produces a sharp increases in the current. The voltage at which the current starts to increase rapidly is called cut in or or knee voltage of the diode. It is denoted as Vr.

For silicon diode Vr=0.7V and germanium diode Vr=0.3V.

1. Reverse bias region; on reverse biasing, P side of the PN junction is connected to the negative terminal of the voltage supply and north side of the PN junction is connected to the positive terminal of the voltage supply simply reverse bias region is the characteristics of the diode for V>0. From figure it can be seen that the diode current is very small, almost equal to zero for all values of voltage less than the breakdown voltage Vz. This is because in reverse bias the width of the potential barrier increases. As a consequence, the junction resistance becomes very high and practically no current flows through the circuit.
2. Breakdown region; the diode enters the breakdown region when the magnitude of the rivers voltage exceeds a threshold value of that particular diode call the breakdown voltage. In this region for very small variation in the voltage the current increases rapidly as shown in figure. PN junction diode should not be operated for VD>VDn because the diode will be damaged.

12 b explain full wave rectifier with capacitor filler?

The main function of full wave rectifier is to connect an AC into DC. As the name implies this rectifier rectifier both the half cycles of the i/p X signal, but the DC signal acquired at the O/p still have some waves. To decrease these waves at the o \ P this filter is used.

In the full wave rectifier circuit wing a capacitor filter, the capacitors C is located across the RL load resistor.

When input AC voltage is applied, during the positive half cycle the diode one is forward biased n allows electric current. Whereas the diode D2 is reverse biased n blocks electric current on the other hand during the negative half cycle D2 is forward bias and the diode D1 is reverse biased.

The capacitor is charged through D1. The capacitor is parallel to the load, soda voltage across the capacitor is the output voltage of the rectifier circuit . when the capacitor value is large charging current for the capacitor IS ALSO LARGE, so we can see the current through diode D1 increases.

When the voltage value on the capacitor is higher than the value of source voltage D1 IS reversed. The capacitor starts to discharge through the load, the larger the capacitor value, the smaller the voltage drop rate. When the voltage across capacitor is less than their source voltage, the capacitor will charge again.

If the capacitor value is large enough then after the circuit stabilises, out put current and voltage wave form will be a straight line.

Q48. Explain the operation of a half wave rectifier and derive its various parameters

Half wave rectifier

The circuit diagram of a half wave rectifier is as shown in the figure one stop it contains a stepdown transformer and a diode in series with a load resistance. A 230 v AC supply is given as input to the primary side of the stepdown transformer.

Operation; the transformer converts the 230 vac supply to a desired lower level Vi. The output of the transformer is shown in figure 2. This acts as an input to the diode d.

Assuming the diode to be the ideal. For positive half cycle of the input voltage VI. The diode is forward biased and acts as short circuit or closed switch and the equivalent circuit is as shown in figure 3

For negative half cycle of the input voltage Vi, the diode is reverse biased and it acts as open circuit or open switch.

The equivalent circuit is as shown in Figure 4

From the above operations, it is observed that the diode is conducting only during positive half cycles of input voltage Vi end in negative half cycles the diode is not conducting a result, the output voltage Vo across the load RL further input Vi is as shown in figure 5.

In figure 5, only positive half cycles at present because the diode conducts only in One Direction. The negative half cycle is clipped off because the diode is not conducting in the other direction .

Disadvantages

* 1. Only ½ of the input waveform reaches the output. Therefore the output is low.
  2. Much more filtering is needed to eliminate harmonics of the AC frequency from the output and producer study DC voltage.

Clippers;

Clipping means cutting or removing a part

E clipping circuit is a circuit which removes the considered part of the waveform n transmits only the desired part of the signal with cheese above or below some particular reference level.

Clipping circuits are also called as voltage or current limiters or amplitude limiters or slicers.

In clipping circuits, the entire i/p amplitude range is divided into transmission region alternation regions.

Q38. Explain in detail about Clippers and its types

Answer; types of slippers

The classification of Clipper circuit is as follows

1. Depending upon the type of active device used, the Clippers are cute can be classified as,

Diode Clippers

In this, diodes are used as the active devices in order to clip their required part of the input.

Transistor Clippers

In this, transistors are used as active devices in order to clip the required part of the input.

1. Depending upon the shape of the output waveform the clipt circuit can be classified as ,

Positive Clipper

In this, the positive part at the output is clipped of that is, the output contains only negative part of the input.

Negative Clipper

In this negative part of the output is clipped off that is, the output waveform contains only positive part of the input.

1. Depending upon the connection of active device the Clipper circuit can be classified as

Series Clipper

In this, the active device is connected in series with the input signal. These are essentially half wave rectifier circuits. There are 2 types of series Clippers

A] positive series Clipper

B] negative series Clipper

Shunt Clippers

In this the active device is connected in shunt or in parallel with the input signal. There are 2 types of shunt clippers

A positive shunt Clipper b negative shunt Clipper

1. Depending upon the biasing supply, the Clipper circuit can be called classified as,

Biased Clippers

In this a DC biasing supply is used as reference source there are 2 types of biased Clippers

A] one level Clipper

B] 2 level Clipper

Moreover depending upon the polarity of biasing source there are 2 types of bias the Clippers,

A] positive biased Clippers; in this the biasing sources positive

B] negative biased Clippers; in this the biasing sources negative.

Unbiased Clipper

In this the Clippers does not have any biasing source

Q25. With necessary diagram describe the characteristics of a forward and reverse biased PN junction diode?

Answer; diode is the most fundamental to terminal non linear circuit element. The relationship between the current flowing through the diode and the voltage appearing across it is non linear . in other words the diode has non linear VI characteristics.

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1, forward bias region

2.Reverse bias region

* 1. Breakdown region

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For silicon diode Vr= 0.7 v and germanium diode Vr=0.3V.

1. Reverse bias region; on reverse biasing, P side of the PN junction is connected to the negative terminal V supply and north side of the PN junction is connected to the positive terminal of the voltage supply. Simply, reverse region is the characteristics of the diode for V<O. From figure it can be seen that the diode current is small, almost equals to zero for all values of voltage less than the breakdown voltage vz. This is because in reverse the width of potential barrier increases. As a consequence the junction resistance becomes very high and prac and practically no current flows to the circuit.
2. Breakdown region; the diode enters the breakdown region when the magnitude of the reverse voltage exceeds exceeds value of that particular diode called the breakdown voltage first stop in this region for very small variation in voltage this circuit increases rapidly as shown in the figure. PN diode should not be operated for because the diode will be damaged.

Effect of temperature of PN diode

The rise in temperature increases the generation of electron hole pair in semiconductor and increases their conductivity fill stop

As a result the current through the PN junction diode increases with temperature is given by the diode equation I=I0[e v/vr n -1]

Reverse saturation current increases approximately 7% for both germanium and silicone

Since 1.07 power 10 is equals to 2, I not approximately doubles for every 10 degrees rise in temperature.

Hence if temperature is increased at fixed voltage the current I increases.

To bring the current to its original value voltage we has to be reduced.

Hence cut in voltage decreases if temperature increases in forward bias.

Breakdown voltage increases if temperature increases in reverse bias .

Reverse saturation current increases as temperature increases .

The increase in reverse current in naughty is such that it doubles at every 10 degrees Celsius rise in temperature.