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Organic Diode Circuits for Half-Wave and Full-Wave Rectifiers

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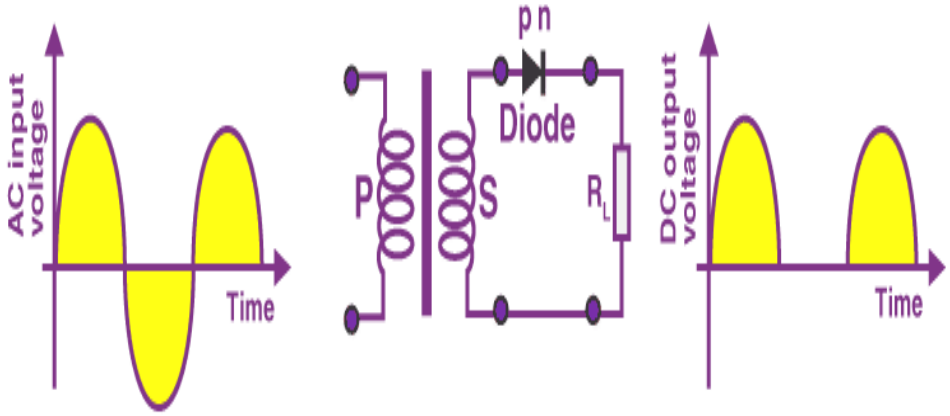
ABSTRACT
Rectifying is the process of changing AC voltage into DC voltage or the need to change AC into DC. Circuit configuration and the determination of the required value take place during the experiment. Diodes are widely used in DC power supplies as rectifiers. DC power supply is an essential part of electronic circuits since it provides energy to all electronic circuits, including oscillators and amplifiers. An electrical device that only changes one way of AC current into DC current is called a rectifier. Diodes are perfect for this because they only permit electricity to travel in one direction.

KEY WORDS
AC current, DC current, Half wave rectifier, Full wave rectifier, Diodes, Voltage, Resistor, Load, Circuit.

INTRODUCTION
One half of each AC input cycle is rectified in a half-wave rectifier. The p-n junction diode has a low resistance when it is forward biased and a high resistance when it is reverse biased. When the input voltage is provided, the diode is forward biased for one half cycle and reverse biased for the other half cycle. The best outcome can be achieved during alternate half-cycles.

Working of Half Wave Rectifier - Both positive and negative cycles are included in the half-wave rectifier. Only a positive half cycle of the AC supply will be produced by the current flowing from positive to negative during the positive half of the input. The voltage at the diode's secondary winding will decrease when the transformer is powered by an AC source. The load resistor will experience a pulsing DC voltage as all of the fluctuations in the AC supply diminish.



The diode will be reverse biases and the current will flow from negative to positive during the second half of the cycle. As a result, no current will be produced at the output side, and power cannot be obtained at the load resistance. Because of minority carriers, a tiny amount of reverse current will flow during reverse bias.

Characteristics of Half Wave Rectifier

Following are the characteristics of half-wave rectifier -

Ripple Factor

The oscillations that occur in DC and are rectified by means of filters like capacitors and inductors are called ripples. These waves are represented by γ and are quantified using the ripple factor. The number of ripples in the output DC is indicated by the ripple factor. There is greater oscillation at the output DC when the ripple factor is higher and less oscillation at the output DC when the ripple factor is lower.

The ratio of the output voltage's AC component's RMS value to its DC component is known as the ripple factor.

$$\gamma = \sqrt{\left(\frac{V_{rms}}{V_{dc}}\right)^2 - 1}$$

DC Current

DC current is given as -

$I_{DC} = \frac{I_{max}}{\pi}$

Where, I_{max} is the maximum DC load current.

DC Output Voltage

The output DC voltage appears at the load resistor R_L which is obtained by multiplying output DC voltage with the load resistor R_L.

The output DC voltage is given as :- $V_{DC} = \frac{V_{Smax}}{\pi}$

Where, V_{Smax} is the maximum secondary voltage.

Form Factor

The form factor is the ratio of RMS value to the DC value. **For a half-wave rectifier, the form factor is 1.57.**

Rectifier Efficiency

Rectifier efficiency is the ratio of output DC power to the input AC power. **For a half-wave rectifier, rectifier efficiency is 40.6%.**

Advantages of Half Wave Rectifier

- Reasonably priced.
- Easy to use due to straightforward connections.
- There are fewer components used.

Disadvantages of Half Wave Rectifier

- There are more ripples produced.
- There is a generation of harmonics.
- There is very little transformer use
- Rectification efficiency is low.

Applications of Half Wave Rectifier

Following are the uses of half-wave rectification

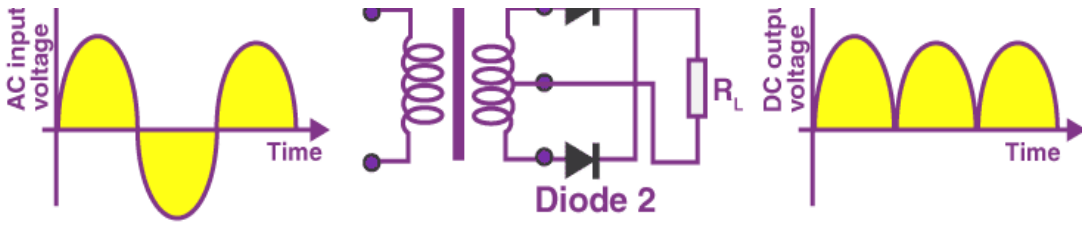
- **Power rectification:** Half wave rectifier is used along with a transformer for power rectification as powering equipment.
- **Signal demodulation:** Half wave rectifiers are used for demodulating the AM signals.
- **Signal peak detector:** Half wave rectifier is used for detecting the peak of the incoming waveform.

Introduction Of Full Wave Rectifier

Circuits using full-wave rectifiers are used to produce only DC output voltages and currents. The primary benefit of a full-wave rectifier over a half-wave rectifier is that, in addition to having a greater average output voltage, full-wave rectifiers produce less ripple than half-wave rectifiers.

Working of Full Wave Rectifier

Every AC input is used in both halves by the full-wave rectifier. The diode provides low resistance when the p-n junction is forward biases and high resistance when it is reverse biases. The diode is constructed in the circuit so that if it is forward biases in the first half cycle, it is reverse biases in the second half cycle, and so on.



Characteristics of Full Wave Rectifier

Following are the characteristics of full-wave rectifier

Ripple Factor

Ripple factor for a full-wave rectifier is given as:

$$\gamma = \sqrt{\left(\frac{V_{rms}}{V_{dc}}\right)^2 - 1}$$

DC Current

Currents from both the diodes D_1 and D_2 are in the same direction when they flow towards load resistor R_L. The current produced by both the diodes is the ratio of $2I_{max}$ to π, therefore the DC current is given as :- $I_{DC} = \frac{2I_{max}}{\pi}$

Where, I_{max} is the maximum DC load current.

DC Output Voltage

DC output voltage is obtained at the load resistor R_L and is given as :- $V_{DC} = \frac{2V_{Smax}}{\pi}$

Where, V_{max} is the maximum secondary voltage

Form Factor

The form factor is the ratio of RMS value of current to the output DC voltage. The form **factor of a full-wave rectifier is given as 1.11**

Rectifier Efficiency

Rectifier efficiency is used as a parameter to determine the efficiency of the rectifier to convert AC into DC. It is the ratio of DC output power to the AC input power. The rectifier **efficiency of a full-wave rectifier is 81.2%.**

Types of Full Wave Rectifier

There are two main types of full-wave rectifiers, and they are

- **Two diodes full-wave rectifier circuit** (requires a center-tapped transformer and is used in vacuum tubes)
- **Bridge rectifier circuit** (doesn't require a centre-tapped transformer and is used along with transformers for efficient usage)

Advantages of Full Wave Rectifier

- The rectifier efficiency of a full-wave rectifier is high
- The power loss is very low
- Number of ripples generated are less

Disadvantages of Full Wave Rectifier

- Very expensive

Applications of Full Wave Rectifier

Following are the uses of full-wave rectifier

- Full-wave rectifiers are used for supplying polarized voltage in welding and for this bridge rectifiers are used.
- Full-wave rectifiers are used for detecting the amplitude of modulated radio signals.

CONCLUSION

A half-wave rectifier lets one half-cycle of the waveform pass while blocking the other, converting an AC signal to DC. Compared to full-wave rectifiers, half-wave rectifiers are less efficient, but they are easier to construct using just one diode. We can supply power to our DC circuit in both the positive and negative half waves by using a full-wave rectifier.Not just one half-wave, but an equitable distribution of load is present on the AC source. To obtain a steady DC voltage, the rectified signal still needs to be stabilised.

A full wave rectifier is a type of rectifier used in electrical engineering that pulses direct current (DC signal) into an alternating wave (AC signal) by converting both halves of each cycle. Multiple diodes are required in the building of full-wave rectifiers, which are used to convert alternating current to direct current. Full wave rectification is the process of changing an alternating current signal into a direct current signal.

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