Rectifier

A rectifier is nothing but a simple diode or group of diodes which converts the Alternating Current (AC) into Direct Current (DC).

We know that a diode allows electric current in one direction and blocks electric current in another direction. We are using this principle to construct various types of rectifiers.

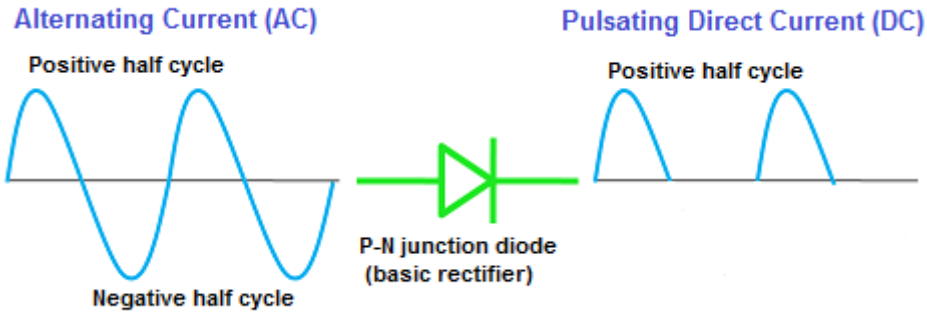
Rectifiers are classified into different types based on the number of diodes used in the circuit or arrangement of diodes in the circuit. The basic types of rectifiers are: half wave rectifier and full wave rectifier.

Half Wave Rectifier

A half wave rectifier is a type of rectifier which converts the positive half cycle (positive current) of the input signal into pulsating DC (Direct Current) output signal.

Or

A half wave rectifier is a type of rectifier which allows only half cycle (either positive half cycle or negative half cycle) of the input AC signal while the another half cycle is blocked.

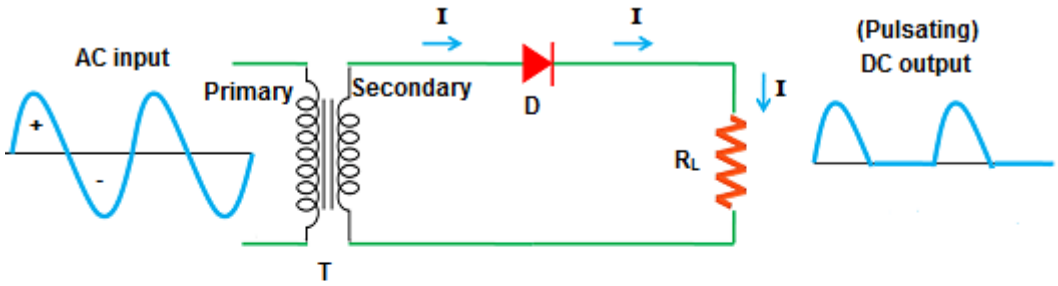


For example, if the positive half cycle is allowed then the negative half cycle is blocked. Similarly, if the negative half cycle is allowed then the positive half cycle is blocked. However, a half wave rectifier will not allow both positive and negative half cycles at the same time.

Therefore, the half cycle (either positive or negative) of the input signal is wasted.

The half wave rectifier is the simplest form of the rectifier. We use only a single diode to construct the half wave rectifier.

The half wave rectifier is made up of an AC source, transformer (step-down), diode, and resistor (load). The diode is placed between the transformer and resistor (load).

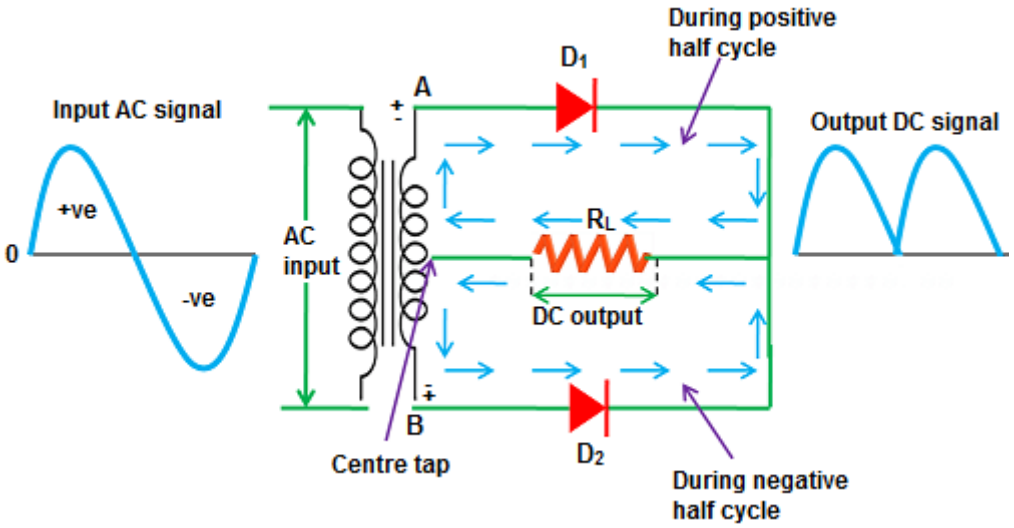


I = Current
D = Diode
R_L = Load resistor
T = Transformer
+ = Positive half cycle
- = Negative half cycle

Half wave rectifier

Full Wave Rectifier

A full wave rectifier is a type of rectifier which converts both half cycles of the AC signal into pulsating DC signal.

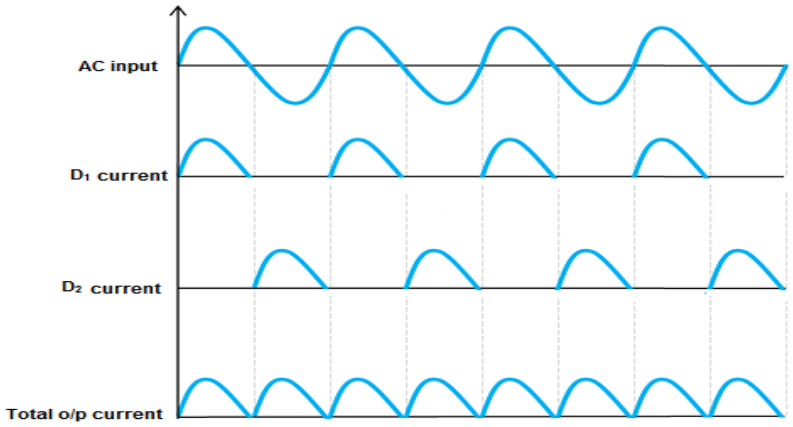


As shown in the above figure, the full wave rectifier converts both positive and negative half cycles of the input AC signal into output pulsating DC signal.

The full wave rectifier is further classified into two types: Center tapped full wave rectifier and full wave bridge rectifier.

Output waveforms of full wave rectifier

The output waveforms of the full wave rectifier is shown in the below figure.



The first waveform represents an input AC signal. The second waveform and third waveform represents the DC signals or DC current produced by diode D_1 and diode D_2. The last waveform represents the total output DC current produced by diodes $D_1$and D_2. From the above waveforms, we can conclude that the output current produced at the load resistor is not a pure DC but a pulsating DC.

Bridge Rectifier

A bridge rectifier is a type of full wave rectifier which uses four or more diodes in a bridge circuit configuration to efficiently convert the Alternating Current (AC) into Direct Current (DC).

Bridge rectifier construction

The construction diagram of a bridge rectifier is shown in the below figure. The bridge rectifier is made up of four diodes namely D_1, D_2, D_3, D_4 and load resistor R_L. The four diodes are connected in a closed loop (Bridge) configuration to efficiently convert the Alternating Current (AC) into Direct Current (DC). The main advantage of this bridge circuit configuration is that we do not require an expensive center tapped transformer, thereby reducing its cost and size.

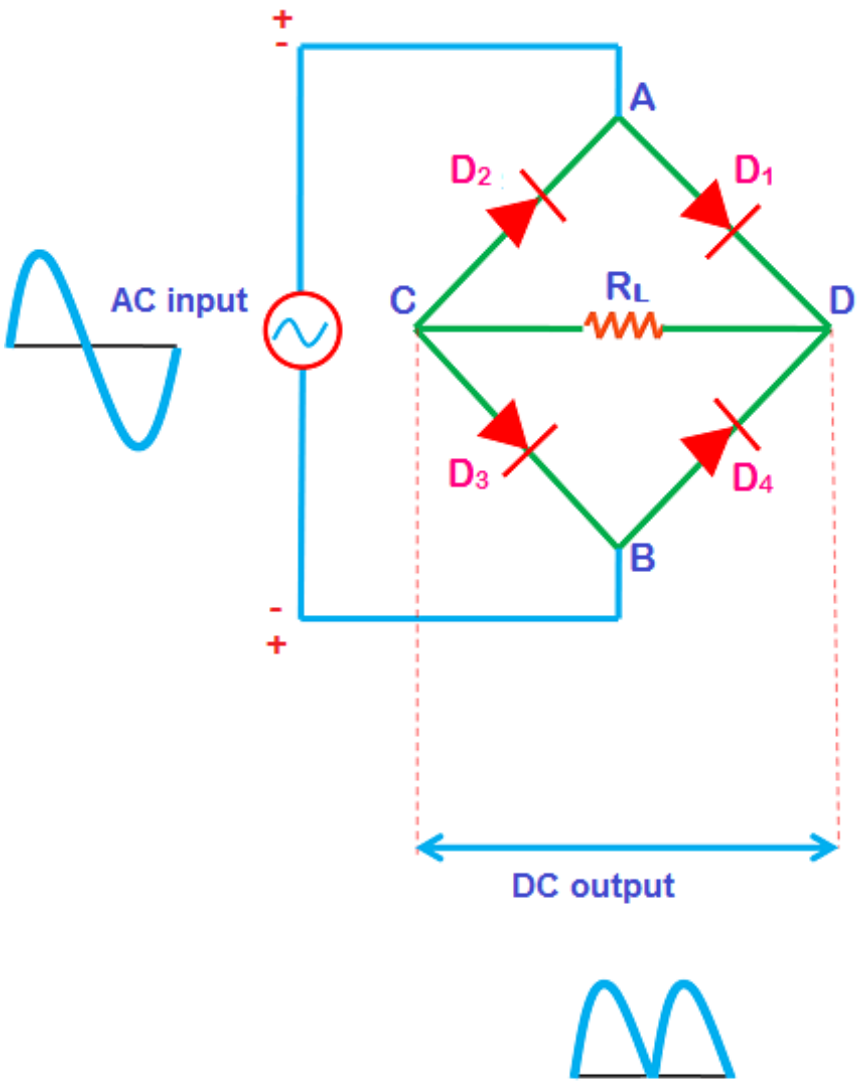


Fig: Bridge Rectifier

How bridge rectifier works?

When input AC signal is applied across the bridge rectifier, during the positive half cycle diodes D_1 and D_3 are forward biased and allows electric current while the diodes D_2 and D_4 are reverse biased and blocks electric current. On the other hand, during the negative half cycle diodes D_2 and D_4 are forward biased and allows electric current while diodes D_1 and D_3 are reverse biased and blocks electric current.

During the positive half cycle, the terminal A becomes positive while the terminal B becomes negative. This causes the diodes D_1 and D_3 forward biased and at the same time, it causes the diodes D_2 and D_4 reverse biased.

The current flow direction during the positive half cycle is shown in the figure A (I.e. A to D to C to B).

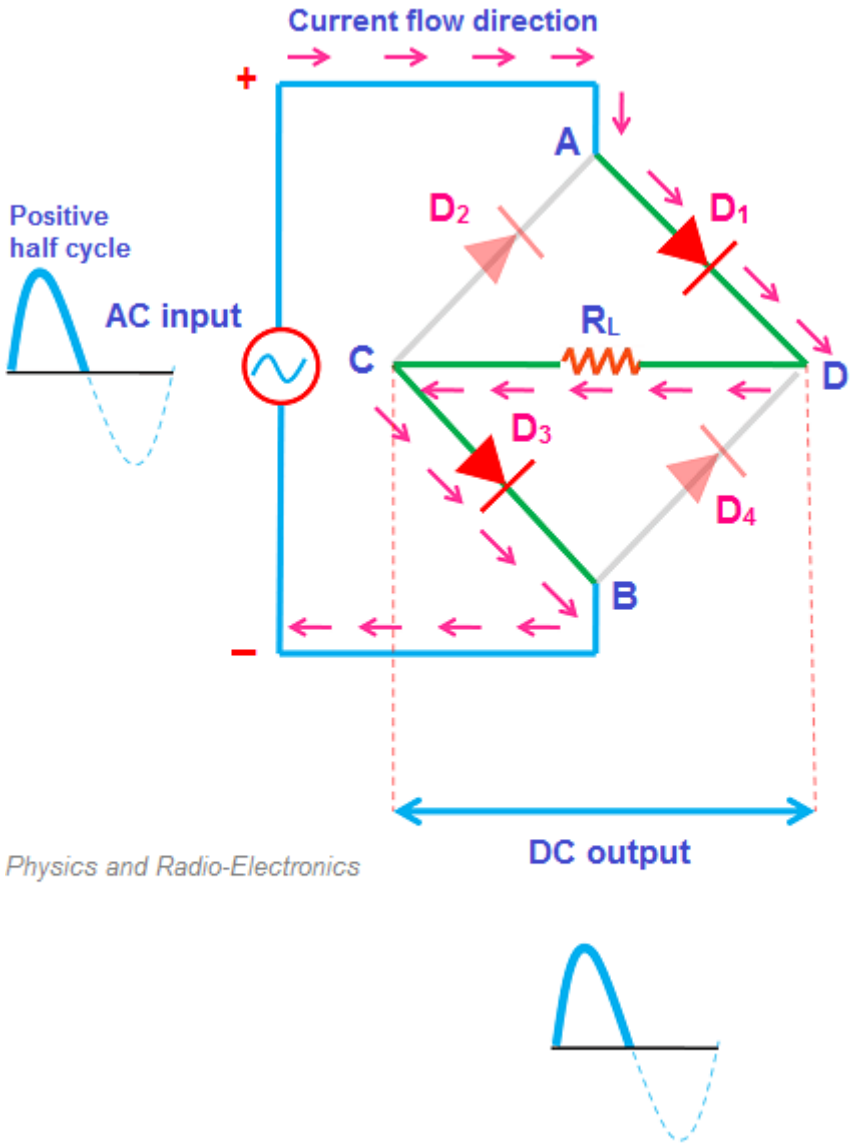


Fig A: Bridge rectifier during positive half cycle

During the negative half cycle, the terminal B becomes positive while the terminal A becomes negative. This causes the diodes D_2 and D_4 forward biased and at the same time, it causes the diodes D_1 and D_3 reverse biased.

The current flow direction during negative half cycle is shown in the figure B (I.e. B to D to C to A).

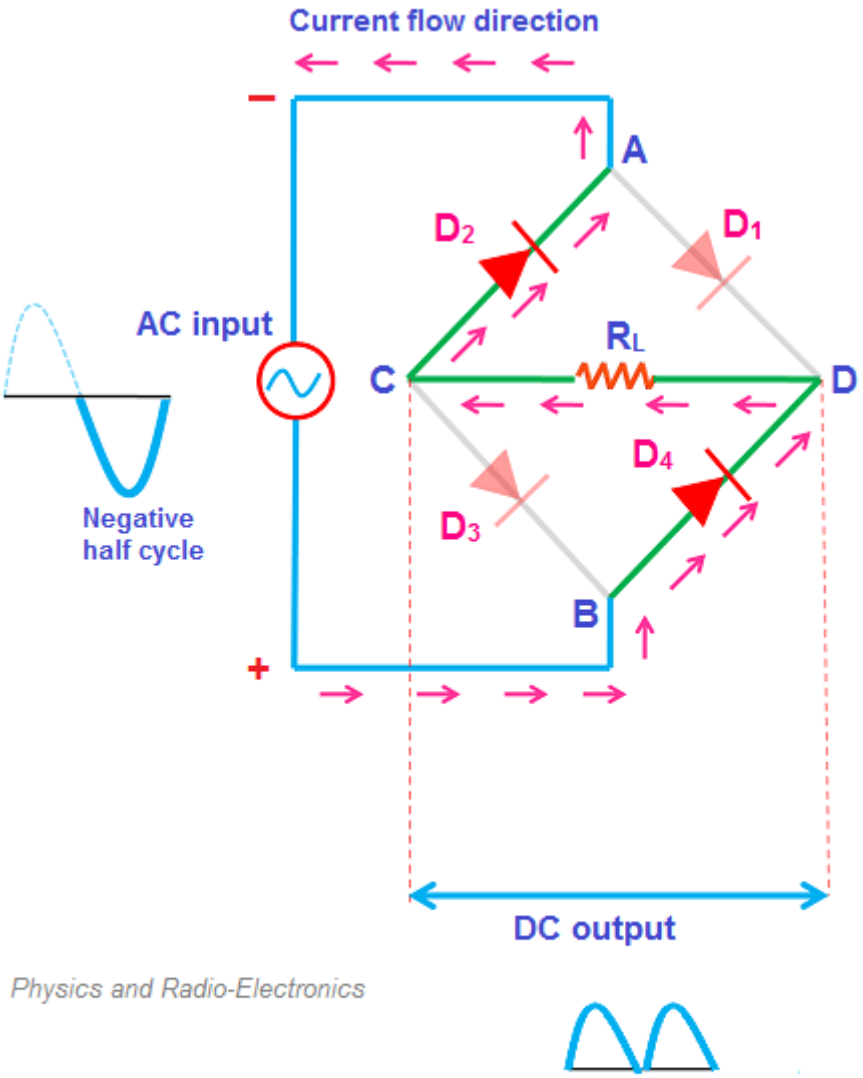
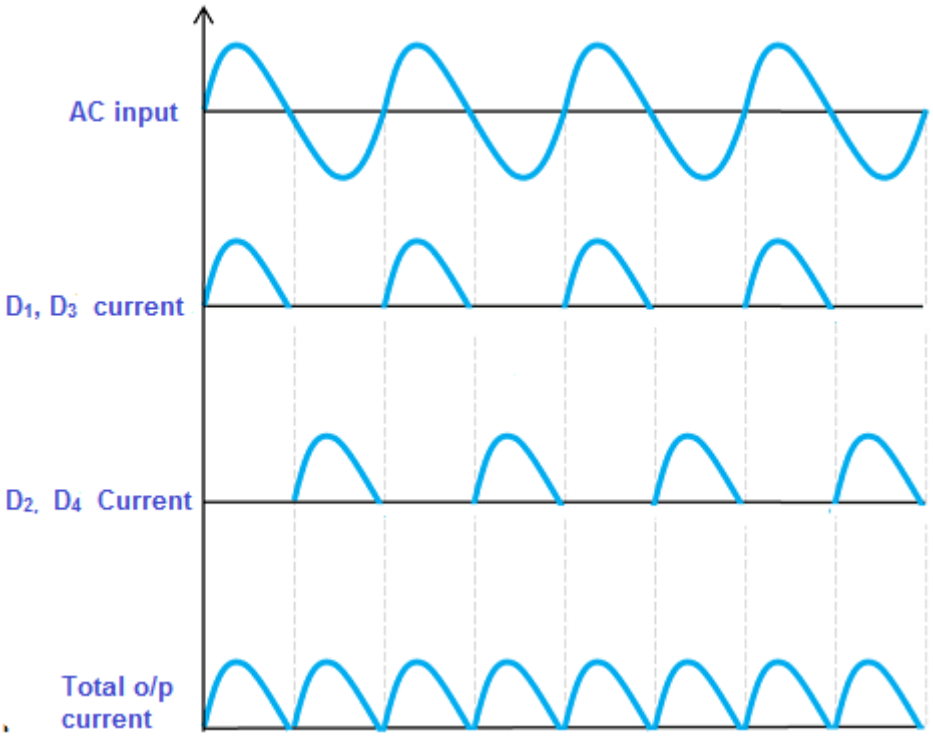


Fig B: Bridge rectifier during negative half cycle

From the above two figures (A and B), we can observe that the direction of current flow across load resistor R_L is same during the positive half cycle and negative half cycle. Therefore, the polarity of the output DC signal is same for both positive and negative half cycles. The output DC signal polarity may be either completely positive or negative. In our case, it is completely positive. If the direction of diodes is reversed then we get a complete negative DC voltage.

Thus, a bridge rectifier allows electric current during both positive and negative half cycles of the input AC signal.

The output waveforms of the bridge rectifier is shown in the below figure.


AC input
D1, D3 current
D2, D4 Current
Total o/p
current