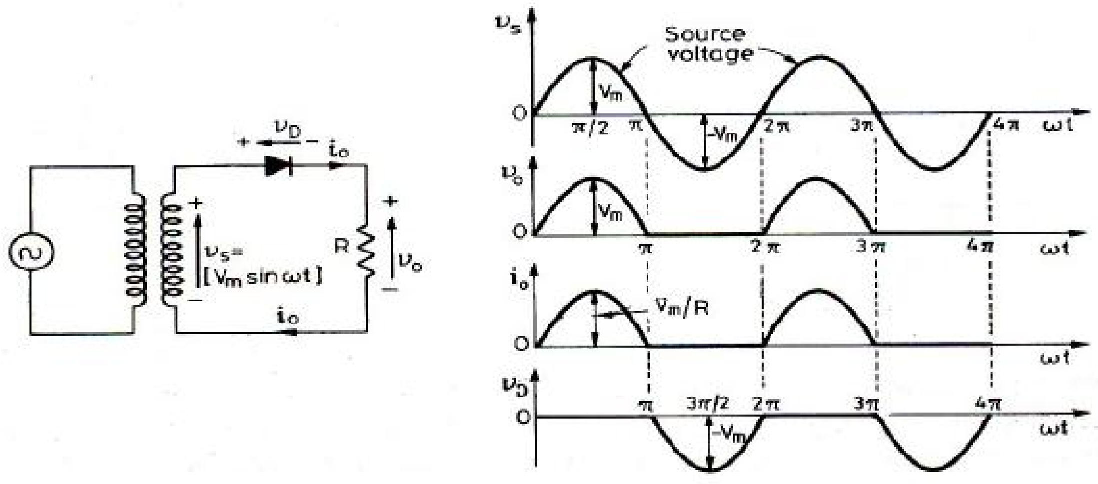
Half Wave Rectifier

Half Wave Rectifier: This is the simplest type of uncontrolled rectifier. It is never used in industrial applications because of its poor performance. Its study is, however, useful in understanding the principle of rectifier operation. In a half wave rectifier, for one cycle of supply voltage, there is one half cycles of output, or load, voltage and other half cycle blocked.



(a) (b)

Fig. (a) Half Wave Rectifier (b) Waveform of Half Wave Rectifier

Half wave rectifier is shown in fig. During the positive half cycle, diode is forward biased, It therefore conducts from $\omega t = 0^\circ$ to $\omega t = \pi$. During the positive half cycle, output voltage V_O = source voltage V_S and load current $i_o = V_O/R$. At $\omega t = \pi$, $V_O = 0$ and for R load, io is also zero. As soon as V_S tends to become negative after $\omega t = \pi$, diode D is reverse biased, it is therefore turned off and goes into blocking state. Output voltage, as well as output current, are zero from $\omega t = \pi$ to $\omega t = 2\pi$. After $\omega t = 2\pi$, diode is again forward biased and conduction begins.

For a resistive load, output current io has the same waveform as that of the output voltage V_O. Diode voltage V_D is zero when diode conducts. Diode is reverse biased from $\omega t = \pi$ to $\omega t = 2\pi$ as shown. Here voltage is sinusoidal $V_S = V_m \sin \omega t$. KVL for the circuit of fig. $V_S = V_O + V_D$.

Average value of output voltage,

$$V_0 = \frac{1}{2\pi}\left[\int_0^{\pi} V_m \sin \omega t \, d(\omega t)\right]$$

$$= \frac{V_m}{2\pi} \left| -\cos \omega t \right|_0^{\pi} = \frac{V_m}{\pi}$$

Rms value of output voltage,

$$V_{or} = \left[\frac{1}{2\pi}\int_0^{\pi} V_m^2 \sin^2 \omega t \cdot d(\omega t)\right]^{1/2}$$

$$= \frac{V_m}{\sqrt{2\pi}}\left[\int_0^{\pi} \frac{1-\cos 2\omega t}{2} \cdot d(\omega t)\right]^{1/2}$$

$$= \frac{V_m}{2}$$

Average value of load current,

Io = Vo /R = Vm / πR

Rms value of load current ,

$Io_{(Rms)}$ = Vo $_{(Rms)}$ / R = Vm /2R

Peak value of load, or diode, current

= Vm /R

Peak inverse voltage, PIV, is an important parameter in the design of rectifier circuits PIV is the maximum voltage that appears across the device during its blocking state. In fig. PIV = √2. VS = √2 (Rms value of transformer secondary voltage).

Power delivered to resistive load = (Rms load voltage) . (Rms load current)

P = $V_{O(Rms)}$. $I_{O(Rms)}$

P = Vm/2 . Vm/2R

P = V2m/4R

P = V_2

$_S$/2R

P = I_{OR}.R