

## Experiment No. 12: Half Wave Rectifier

### 1. Objective

The objective of this experiment is to implement the half wave rectifier.

### 2. Apparatus

- Resistor ( $470\Omega$ ,  $1k\Omega$ )
- Bread Board
- Digital Multi-meter
- Function generator
- Diode (1N4007)
- Oscilloscope

### 3. Theory

The primary objective of rectification is to establish a DC level from a sinusoidal input signal that has zero average (DC) level. Most of the electronic equipment requires DC voltage for their operation. Yet our electrical distribution system is an AC system. Therefore it must be changed to DC before the electronic equipment can be operated. The diode, because of its one-way conduction characteristic, is the basic element for rectification process.

A half wave rectifier is a special case of a clipper. In half wave rectification, either the positive or negative half of the AC wave is passed easily, while the other half is blocked, depending on the polarity of the rectifier. Because only one half of the input waveform reaches the output, it is very inefficient if used for power transfer. Half-wave rectification can be achieved with a single diode in a single phase supply as shown in the Figure 12.1.

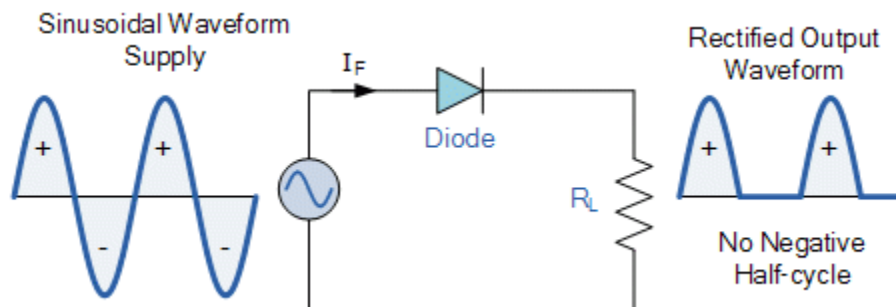
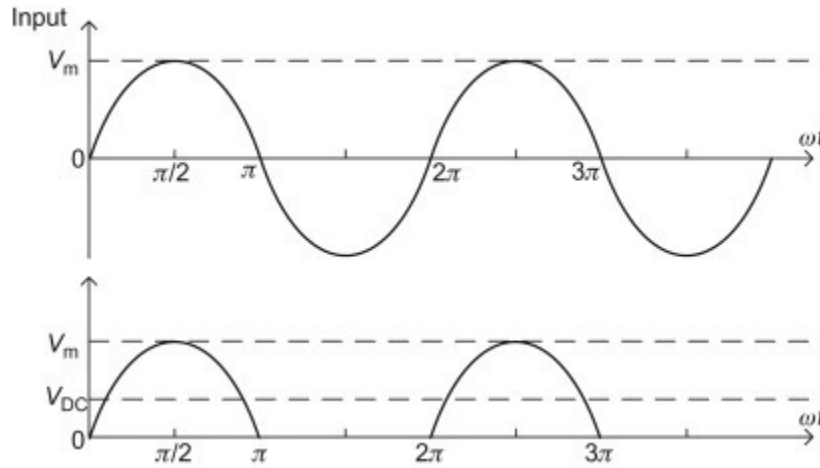


Figure 12.1: Half Wave Rectifier

The input and output voltage waveforms of an example rectifier with a resistive load are shown in Figure 12.2. In the diagram, only the positive part of the input waveform does useful work. Thus the efficiency of the half-wave rectifier is very low.



**Figure 12.2: Half Wave Rectifier**

According to the waveform in Figure 12.2, the voltage relationship of the input and output can be calculated. The average voltage on the load is:

$$V_{av} = V_{DC} = \frac{1}{2\pi} \int_0^{2\pi} V_m \sin \theta \cdot d\theta$$

$$V_{DC} = \frac{1}{2\pi} \int_0^{\pi} V_m \sin \theta \cdot d\theta + \frac{1}{2\pi} \int_{\pi}^{2\pi} V_m \sin \theta \cdot d\theta$$

From the Figure 12.2, output is zero from  $\pi$  to  $2\pi$ , so

$$V_{DC} = \frac{1}{2\pi} \int_0^{\pi} V_m \sin \theta \cdot d\theta$$

$$V_{DC} = \frac{V_m}{2\pi} [-\cos\theta]_0^{\pi}$$

$$V_{DC} = \frac{V_m}{2\pi} [-\cos\pi - \cos 0]$$

$$V_{DC} = \frac{V_m}{2\pi} [2]$$

$$V_{DC} = \frac{V_m}{\pi} = 0.318V_m \quad (12.1)$$

Which is 31.8 % of  $V_m$ .

#### **4. Procedure**

26. Construct the circuit as shown in the Figure 12.1.
27. Do not switch on the function generator. Connect the resistor  $R_L$  of value  $470\Omega$  and oscilloscope across the resistor  $R_L$ .
28. Turn on the function generator and observe the waveform displayed on the oscilloscope.
29. Paste the output wave form in the Figure 12.3.
30. Calculate the average value from the Equation (12.1) and conclude your observation.

**Figure 12.3: Output of Half Wave Rectifier**

**Figure 12.4: Waveform across the Diode**

## 5. Questions

1. For the Figure 12.1, what type of waveform you expect across the diode. Draw in the Figure 12.4 and comment.

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## 6. Conclusions

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