

## Experiment # (2)

### Half wave and full wave rectification

#### Objectives

- To convert AC to DC.
- To be familiar with different types of rectifiers.

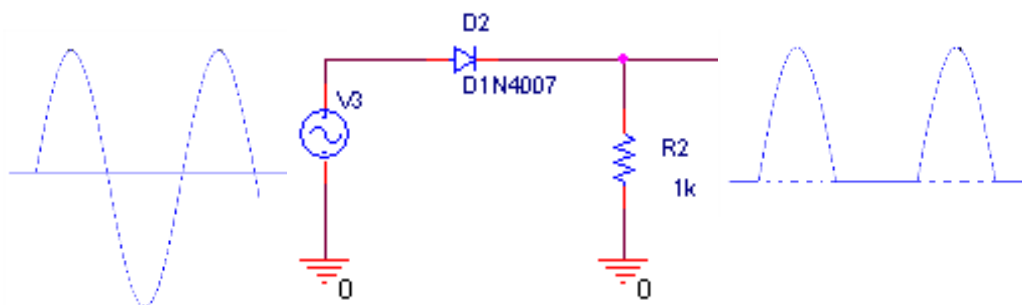
#### Equipment

- Simple diode and resistors.
- Rectifier diode.
- Center-tap transformer.
- Function generator and oscilloscope.

#### Background Theory

##### 1) Half Wave Rectifier

The half wave rectifier is a circuit that allows only part of a sinusoidal input signal to pass. The circuit is simply a combination of a single diode in series with a resistor, where the resistor is acting as a load.



Half- Wave Rectifier Schematic

**The basic parameters of the half wave rectifier circuit are:**

##### 1) The DC Voltage

$$V_o(\text{dc}) = \int_0^T V_o(t) dt = \frac{V_m}{\pi}$$

##### 2) The root mean square value of output

$$V_o(\text{rms}) = \sqrt{\left(\frac{1}{T} \int_0^T V_o(t)^2 dt\right)} = \frac{V_m}{2}$$

### 3) The ripple Factor

$$R = \frac{V_o(ac)}{V_o(dc)} = \sqrt{\frac{V_o(rms)^2}{V_o(dc)^2}} - 1 = 1.211$$

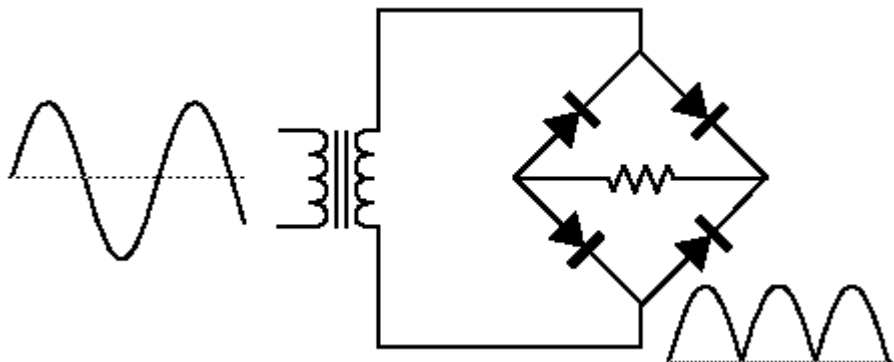
### 4) Efficiency( $\eta$ )

$$\eta = \frac{P_o(dc)}{P_i(ac)} = 40.5\%$$

## 2) Full Wave Rectification

### a) The Bridge Rectifier

The full wave rectifier is a circuit that allows two part of a sinusoidal input signal to pass in positive side. The circuit is simply the combination of the four diodes in series with a resistor, where the resistor is acting as a load.



For both positive and negative swings of the transformer, there is a forward path through the diode bridge. Both conduction paths cause current to flow in the same direction through the load resistor, accomplishing full-wave rectification.

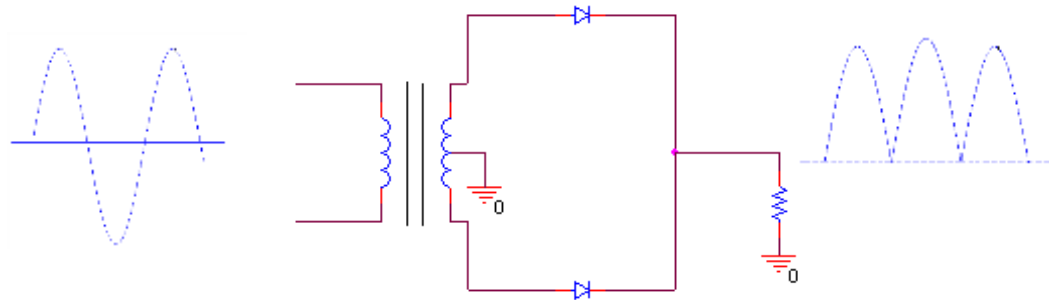
While one set of diodes is forward biased, the other set is reverse biased and effectively eliminated from the circuit.



## b) Center-tap transformer

The center-tap circuit employs two diodes as shown below. A center tapped secondary winding is used with two diodes connected so that each uses one half cycle of input a.c voltage.

In other words the first diode utilizes the ac voltage across upper half of secondary winding for rectification while the second diode uses the lower half winding of the transformer.



**The basic parameters of the full wave rectifier circuit are:**

### 1) The DC Voltage

$$V_o(\text{dc}) = \int_0^T V_o(t) dt = \frac{2V_m}{\pi}$$

### 2) The root mean square value of output

$$V_o(\text{rms}) = \sqrt{\left(\frac{1}{T} \int_0^T V_o(t)^2 dt\right)} = \frac{V_m}{\sqrt{2}}$$

### 3) The ripple Factor

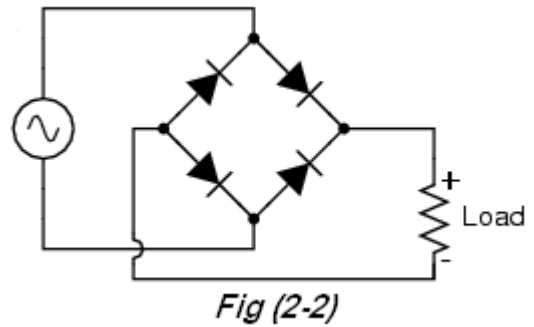
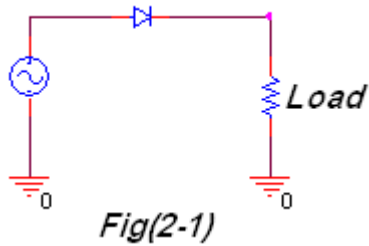
$$R = \frac{V_o(\text{ac})}{V_o(\text{dc})} = \sqrt{\frac{V_o(\text{rms})^2}{V_o(\text{dc})^2}} - 1 = 0.483$$

### 4) Efficiency( $\eta$ )

$$\eta = \frac{P_o(\text{dc})}{P_i(\text{ac})} = 81\%$$

## Procedures

1. Connect the circuit as shown in figure (2-1).
2. Set the function generator to a sin wave with 10Vp, 50Hz.
3. Complete the table (2-1).
4. Connect the circuit as shown in figure (2-2).
5. Repeat step 1 to 3.
6. Complete the table (2-2).
7. Comment on the results of each circuit, showing the difference between half and full wave rectifiers.



RL(K $\Omega$ )	Vo(dc)	Vo(ac)	Vo(rms)	Io(dc)	Io(ac)	Io(rms)	Ripple(r)
1K $\Omega$							
2.2K $\Omega$							
4.7K $\Omega$							

Table (2-1)

RL(K $\Omega$ )	Vo(dc)	Vo(ac)	Vo(rms)	Io(dc)	Io(ac)	Io(rms)	Ripple(r)
1K $\Omega$							
2.2K $\Omega$							
4.7K $\Omega$							

Table (2-2)