

## Experiment No: 2

### Full Wave Rectifier With and Without Filter

**Aim:** (i).To Find the following parameters of a Full wave Rectifier with and without filters.

1. Ripple Factor
2. Percentage of Regulation

(ii).and to observe input and output waveforms of a Full wave Rectifier with and without filters.

#### Components:

| Name  | Quantity |
|---|----------|
| Diodes 1N4007(Si)                                 | 2        |
| Digital Multimeter                                | 1        |
| Resistor $1K\Omega$ or Decade Resistance Box(DRB) | 1        |

#### Equipment:

| Name             | Range         | Quantity |
|------------------|---------------|----------|
| CRO              | (0-1)MHz      | 1        |
| CRO probes       | ----          | 2        |
| Transformer      | 220V/9V, 50Hz | 1        |
| Connecting Wires | ----          | ----     |

#### Specifications:

##### **Silicon Diode 1N4007:**

Max Forward Current = 1A

Max Reverse Current =  $5.0\mu\text{A}$

Max Forward Voltage = 0.8V

Max Reverse Voltage = 1000V

Max Power Dissipation = 30mW

Temperature = -65 to  $200^{\circ}\text{C}$

### **Theory:**

A rectifier is a circuit that converts Bi-Directional (pure AC signal) into Uni-Directional (pulsating DC signal).

A rectifier is a circuit that converts a pure AC signal into a pulsating DC signal or a signal that is a combination of AC and DC components.

A half wave rectifier makes use of single diode to carry out this conversion. It is named so as the conversion occurs for half input signal cycle.

During the positive half cycle, the diode is forward biased and it conducts and hence a current flows through the load resistor.

During the negative half cycle, the diode is reverse biased and it is equivalent to an open circuit, hence the current through the load resistance is zero. Thus the diode conducts only for one half cycle and results in a half wave rectified output.

A full wave rectifier makes use of a two diodes to carry out this conversion. It is named so as the conversion occurs for complete input signal cycle.

The full-wave rectifier consists of a center-tap transformer, which results in equal voltages above and below the center-tap. During the positive half cycle, a positive voltage appears at the anode of  $D_1$  while a negative voltage appears at the anode of  $D_2$ . Due to this diode  $D_1$  is forward biased it results in a current  $I_{d1}$  through the load R.

During the negative half cycle, a positive voltage appears at the anode of  $D_2$  and hence it is forward biased. Resulting in a current  $I_{d2}$  through the load at the same instant a negative voltage appears at the anode of  $D_1$  thus reverse biasing it and hence it doesn't conduct.

### **Ripple Factor:**

Ripple factor is defined as the ratio of the effective value of AC components to the average DC value. It is denoted by the symbol ' $\gamma$ '.

$$\gamma_{HWR} = \frac{V_{AC}}{V_{DC}} = 1.21$$

$$\gamma_{FWR} = \frac{V_{AC}}{V_{DC}} = 0.48$$

### **Rectification Factor:**

The ratio of output DC power to input AC power is defined as efficiency.

$$\eta = \frac{(V_{DC})^2}{(V_{AC})^2}$$

$$\eta_{HWR} = 40.6\%$$

$$\eta_{FWR} = 81\%$$

### **Percentage of Regulation:**

It is a measure of the variation of AC output voltage as a function of DC output voltage.

$$\text{Percentage of regulation} = \left( \frac{V_{NL} - V_{FL}}{V_{FL}} \right) * 100 \%$$

$V_{NL}$  = Voltage across load resistance, when minimum current flows through it.

$V_{FL}$  = Voltage across load resistance, when maximum current flows through.

For an ideal rectifier, the percentage regulation is 0 percent. The percentage of regulation is very small for a practical half wave and full wave rectifier.

### **Peak- Inverse – Voltage (PIV):**

It is the maximum voltage that has to be with stood by a diode when it is reverse biased

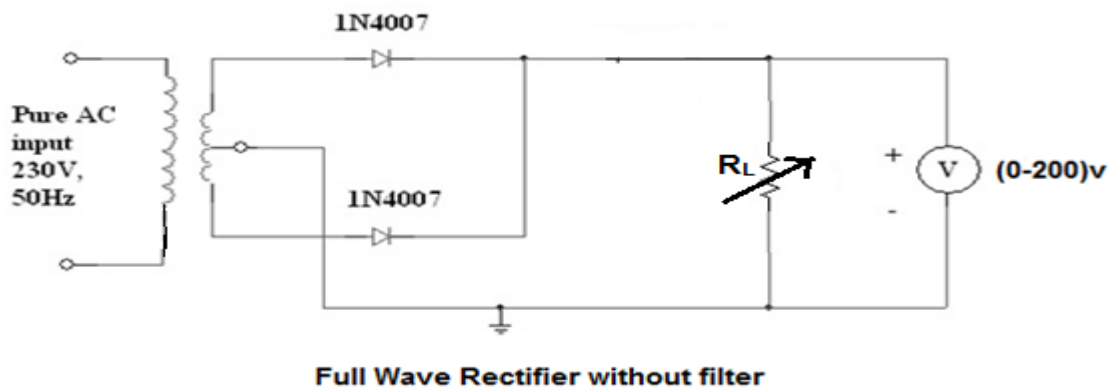
$$PIV_{HWR} = V_m$$

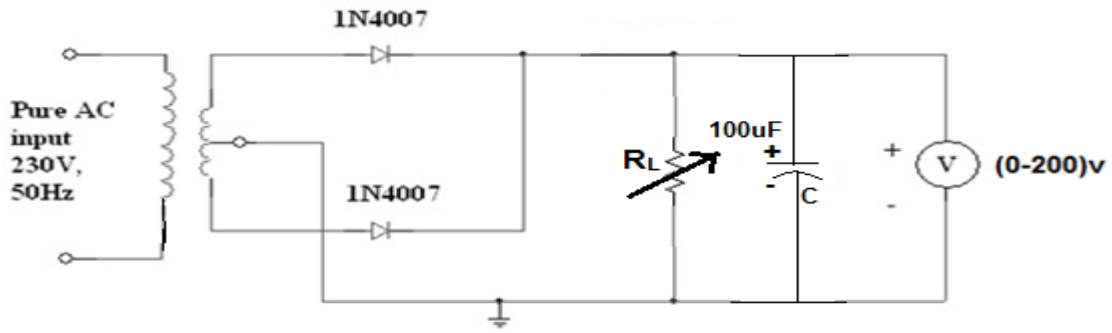
$$PIV_{FWR} = 2V_m$$

## Comparison of Half-wave and Full-wave rectifier

| S.No | Particulars                      | Type of Rectifier |                    |
|------|----------------------------------|-------------------|--------------------|
|      |                                  | Half-Wave         | Full-Wave          |
| 1.   | No. of diodes                    | 1                 | 2                  |
| 2.   | Maximum Rectification Efficiency | 40.6%             | 81.2%              |
| 3.   | $V_{d.c}$ (no load)              | $\frac{V_m}{\pi}$ | $\frac{2V_m}{\pi}$ |
| 4.   | Ripple Factor                    | 1.21              | 0.48               |
| 5.   | Peak Inverse Voltage             | $V_m$             | $2V_m$             |
| 6.   | Output Frequency                 | $f$               | $2f$               |
| 7.   | Transformer Utilization Factor   | 0.287             | 0.693              |

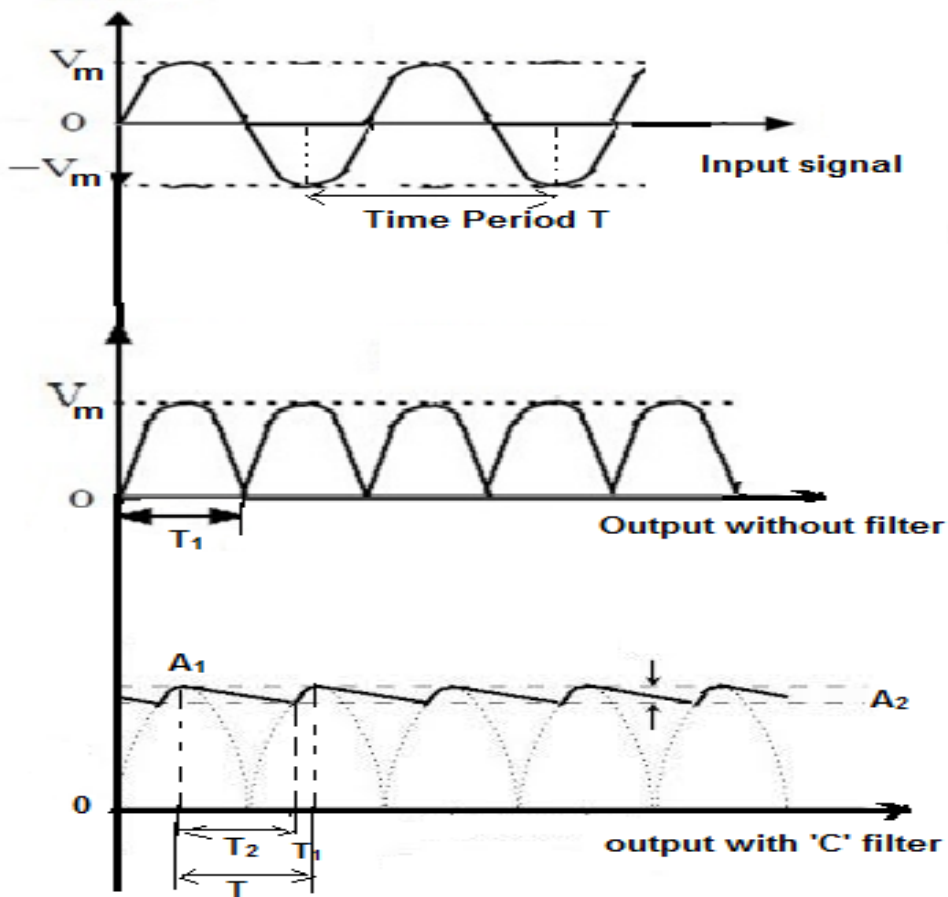
### Circuit Diagram:





Full Wave Rectifier with 'C' filter

Expected Waveforms:



**Procedure:**

**PART-I: Full wave rectifier without filter:**

1. Connect the circuit as shown in the figure-(1).
2. Connect the Multi-meter across the  $1k\Omega$  load.
3. Measure the AC and DC voltages by setting Multi-meter to AC and DC mode respectively.
4. Now calculate the ripple factor using the following formula.

$$\text{Ripple factor } (\gamma) = \frac{V_{AC}}{V_{DC}}$$

5. Find No Load Voltage  $V_{(dc)NL}$  and Full Load Voltage  $V_{(dc)FL}$  and Calculate Percentage of regulation.

$$\text{Percentage of regulation} = \left( \frac{V_{NL} - V_{FL}}{V_{FL}} \right) * 100 \%$$

6. Remove Digital Multi meter and connect the CRO channel-1 across input and channel-2 across output i.e. load and observe the input and output Waveforms.
7. Now measure Amplitude, Time period and frequency of the waveforms.
8. Plot waveforms on the graph sheet by maintaining scale.

**Observations and Calculations:**

Table 1: Full wave rectifier without Filter

| Sl.no | Load Resistance $R_L$ ( $K\Omega$ ) | $V_{AC}$ | $V_{DC}$ | Ripple factor<br>$= \frac{V_{AC}}{V_{DC}}$ | $\% \text{ regulation} = \frac{V_{DC(NL)} - V_{DC(FL)}}{V_{DC(FL)}} \times 100$ |
|-------|-------------------------------------|----------|----------|--|---|
| 1     | 1                                   |          |          |  |   |
| 2     | 2                                   |          |          |  |   |
| 3     | 3                                   |          |          |  |   |

Table 2: Full wave rectifier with ‘C’ Filter

| Sl.no | Load Resistance $R_L$ (K $\Omega$ ) | $V_{AC}$ | $V_{DC}$ | Ripple factor<br>$= \frac{V_{AC}}{V_{DC}}$ | $\% \text{ regulation} = \frac{V_{DC(NL)} - V_{DC(FL)}}{V_{DC(FL)}} \times 100$ |
|-------|-------------------------------------|----------|----------|--|---|
| 1     | 1                                   |          |          |  |   |
| 2     | 2                                   |          |          |  |   |
| 3     | 3                                   |          |          |  |   |

**Result:**

Ripple factor and percentage of regulation of Full wave rectifier without and with filter are found and input and output waveforms were observed.

**Discussion of results:**

1. Ripple factor of FWR with ‘C’ filter is less compared to FWR without filter that means amount of AC in the output is reduced with filter, which is required.
2. The amount of DC component in the output waveform is increased by using ‘C’ filter.

---

## Viva Questions:

### 1. What is a rectifier?

**Ans:** A rectifier is an electrical device that [converts alternating current](#) (AC), which periodically reverses direction, to [direct current](#) (DC), which flows in only one direction. The process is known as rectification.

### 2. What is a ripple factor?

**Ans:** Ripple factor can be defined as the variation of the amplitude of DC (Direct current) due to improper filtering of AC power supply. it can be measured by  $RF = v_{rms} / V_{dc}$

### 3. What is efficiency?

**Ans:** Rectifier efficiency is the ratio of the DC output power to the AC input power.

### 4. What is PIV?

**Ans:** The peak inverse voltage is either the specified maximum voltage that a [diode rectifier](#) can block, or, alternatively, the maximum that a rectifier needs to block in a given application.

### 5. What are the applications of rectifier?

**Ans:** The primary application of rectifiers is to derive DC power from an AC supply. Virtually all electronic devices require DC, so rectifiers are used inside the power supplies of virtually all electronic equipment. Rectifiers are also used for [detection](#) of [amplitude modulated](#) radio signals. Rectifiers are used to supply polarised voltage for [welding](#).

### 6. Give some rectifications technologies?

**Ans:** Synchronous rectifier, Vibrator, Motor-generator set , Electrolytic ,Mercury arc, and Argon gas electron tube.

### 7. What is the efficiency of bridge rectifier?

**Ans:** 81.2%.