# East West University

## Department of CSE

### LAB REPORT

<table>
<tr><td colspan="3">Course Code and Name:<br>CSE251[Electronic Circuits]</td></tr>
<tr><td colspan="3">Experiment no: 02</td></tr>
<tr><td colspan="3">Experiment name: Half-Wave Diode Rectifier Circuit</td></tr>
<tr><td>Semester and Year: Fall-24</td><td colspan="2">GROUP NO: 02</td></tr>
<tr><td>Name of Student:<br>1. Abdul Wadud<br>2. Ajmain Nur Shihab<br>3. Nasrullah Kaisher Sijan<br>4. Md Sabik Hossen<br><br>Student Id:<br>1. (2022-2-60-133)<br>2. (2022-3-60-188)<br>3. (2023-1-60-204)<br>4. (2023-2-60-305)</td><td colspan="2">Course Instructor information:<br>M. Saddam Hossain Khan<br>Senior Lecturer, Department of Computer Science and Engineering, East West University.</td></tr>
<tr><td rowspan="3">Date of Report Submitted:<br>18 November 2024</td><td>Pre-Lab Marks:</td><td></td></tr>
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<tr><td>TOTAL Marks:</td><td></td></tr>
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**Objective:**

The objective of this experiment is to learn about the half-wave diode rectifier circuit and its characteristics and how it affects the output on an AC voltage. We also learn about the effects of a capacitor filter on the output of a rectifier circuit and how it reduces the peak to peak ripple voltage and the voltage disturbance of a rectifier circuit output, effectively regulating the DC output voltage and working as a power supply.

**Circuit Diagram:**

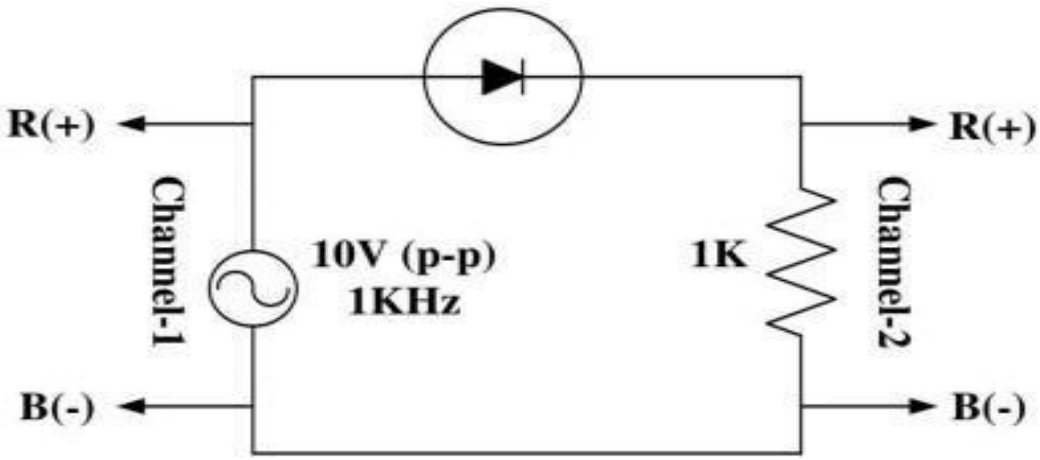


Figure 1. Set up for a half-wave diode rectifier circuit.

**Theory And Experimental Methods**

A rectifier is a circuit which coverts an AC voltage signal to a DC voltage signal. A half-wave rectifier is built using a single diode and can only rectify only the positive or negative half cycle of an AC voltage. And as a result, normally a rectifier circuit only outputs DC voltage for only half of the cycle and does not have any voltage for the other half. To fix this a capacitor is added to the rectifier circuit which acts as a filter and reduces the peak to peak ripple voltage. The higher the time constant, RC of the capacitor is, the lower the peak to peak ripple voltage becomes and the DC voltage becomes more stable.

**Experimental Datasheet:**

Measured value of resistance **R** = 0.973 kΩ

Δ**VP** = 960 mV = 0.96V

Δ**t** = 120µs

Peak to peak ripple voltage **Vr** = 360 mV = 0.36 V

Average value of output voltage **Vo** = 2.92 V

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Lab: 02

Date: 12/11/2024

Group: 02

Group members:

Abdul Wadud → 2022-2-60-133

Ajmain-nur-Shihab → 2022-3-60-188

Sabik Hossain → 2023-2-60-305

Nasrullah Sijan → 2023-1-60-204

Experiment name:

Half wave diode rectifier circuit.

Experimental Datasheet:

Measured value of $\Delta V_p$ = 960 mV.

Measured value of $\Delta t$ = 120 µs.

Ripple voltage $V_r$ = 360mV.

Average output voltage $V_0$ = 2.92V

Measured value of Resistance R = 0.973 KΩ

12/11/24

## Post-Lab Report Questions:

From the experiment we get,

1. Measured value of peak to peak voltage, $\Delta VP = 0.96$ V
   Built-in Voltage =0.6 V
   Difference = (0.96-0.6) V = 0.36 V
   So, we have a different peak to peak value of built in voltage which is not desirable.

2. Measured conduction time, $\Delta t = 120$ µs
   Calculated pre-lab conduction time, $\Delta t = 71.78$ µs
   So, we can see that there was a large difference between the measured and calculated value of $\Delta t$ in our experiment.
   The difference between the measured value and calculated value, = (120-71.78) µs = 48.22µs .
   Our calculated and measured conduction time has a difference of 48.22µs .

3. We know, $\omega\Delta t = \sqrt{(2V_r/V_p)}$
   Thus, Peak to peak ripple voltage, Vr= 0.273 V
   Now, Pre-Lab value = 0.5 V
   Measured Value = 0.36 V
   Difference between calculated value and measured value = (0.36-0.273) = 0.087 V
   Difference between pre-lab value and measured value = (0.5 – 0.273) = 0.227 V So all of our values of peak to peak ripple voltage differs slightly, so either our measurement was incorrect or the experiment did not go properly.

4. Average output voltage, $V_{0avg} = V_p - V_r/2 = 0.78$ V
   Measured average output voltage $V_{0avg} = 2.92$ V
   Difference: 2.92-0.78 = 2.14V
   There is a difference between the measured and calculated values which should not normally happen.

5 $I_L = V_0/R = 3.23$ mA

$I_{DAvg} = I_L(1+\pi\sqrt{V_p/V_r}) = 2.40$ mA
$I_{DMax} = I_L(1+2\pi\sqrt{V_p/V_r}) = 3.28$ mA
Measured value of Vr = 0.36 V Now,
Pre-lab values:
$I_{DAvg} = 71.49$ mA
$I_{Dmax} = 138.22$mA
Vr= 0.5V

Thus, difference of $I_{DAvg} = 69.36$ mA
Difference of $I_{DMax} = 134.94$ mA

Difference of Vr = 0.14V

## 6. Simulated half-wave rectifier circuit:

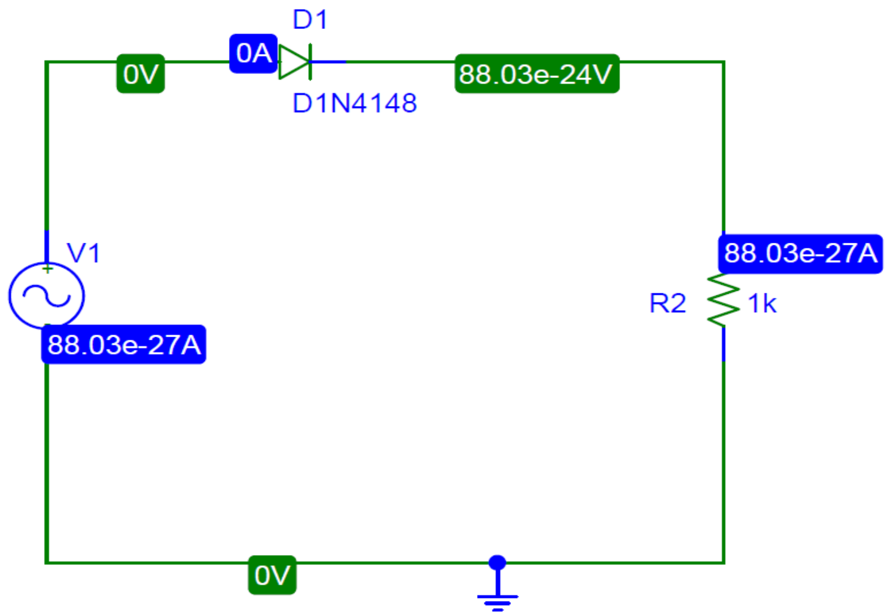



**Figure: Half-wave rectifier circuit without capacitor.**

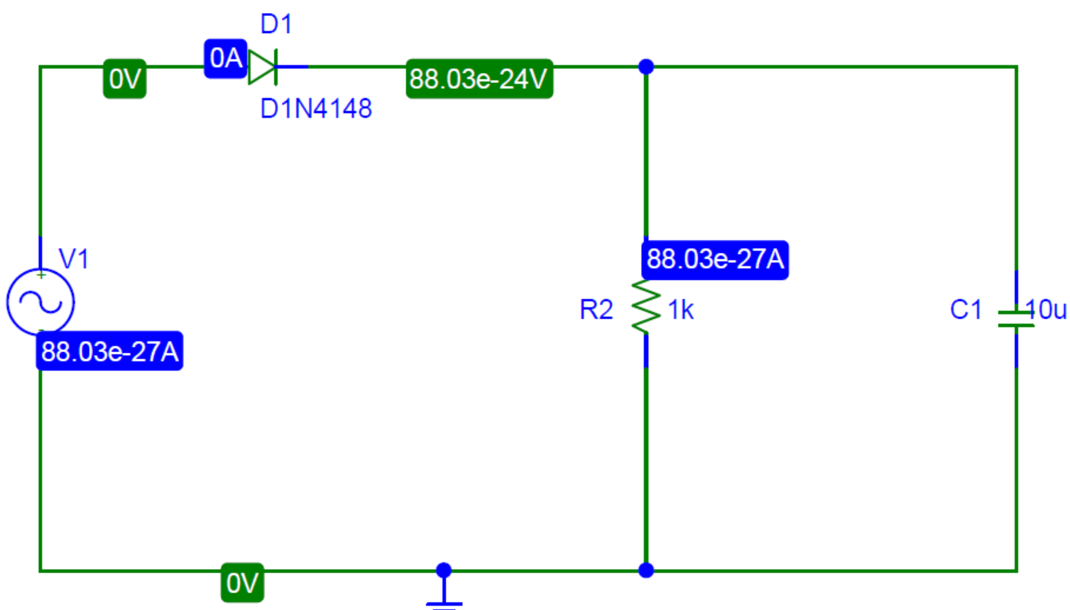



**Figure: Half-wave rectifier circuit with capacitor.**

- **Simulated rectified sine wave without capacitor:**

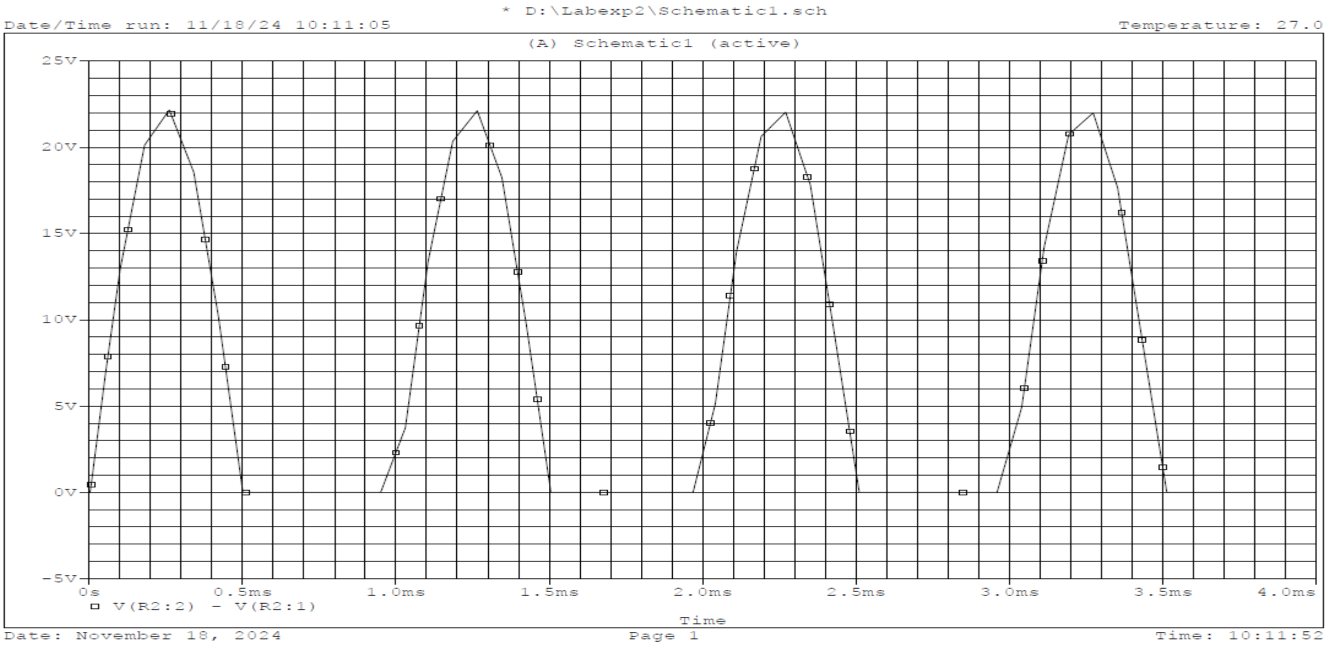



**Figure: Simulated rectified sine wave with capacitor**

- **Simulated rectified sine wave when a capacitor is used:**

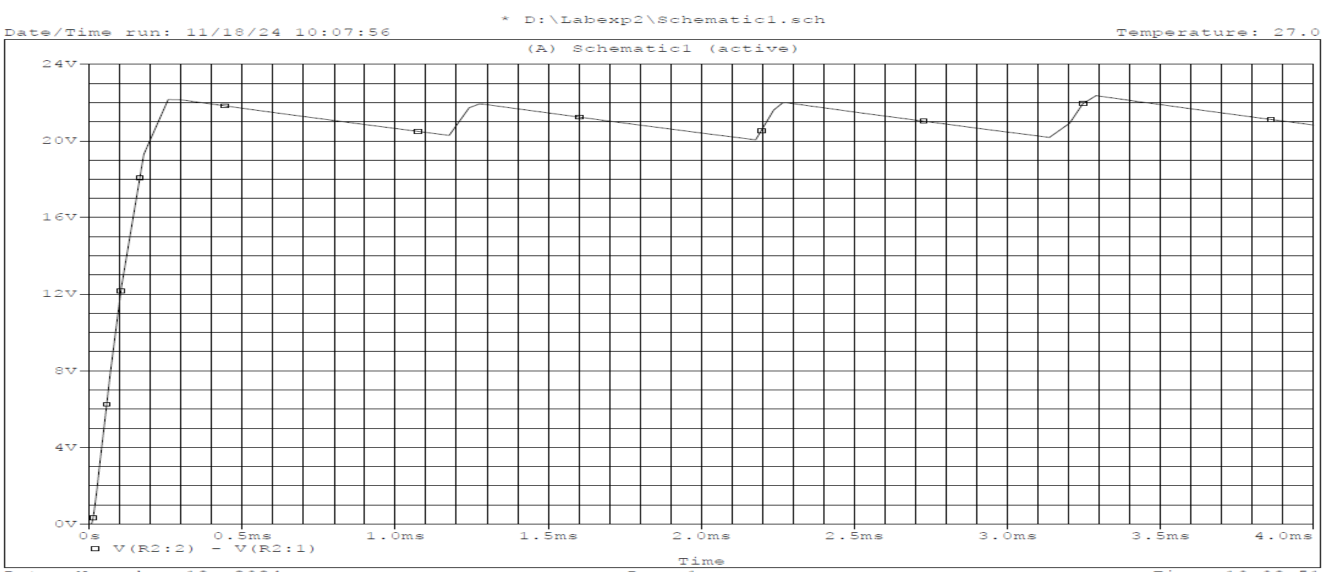



**Figure: Simulated rectified sine wave**

**Conclusion:**

From this experiment it can be concluded that diodes work as a one way rectifier and a half wave rectifier only conducts for half of an AC sinusoid voltage. Using a capacitor it can be turned into a stable DC voltage stream. In this experiment we learned to measure peak to peak voltage, ripple voltage, simulating a sinusoid using the oscilloscope. We learned the shape of the rectified voltage and how the rectified voltage becomes after adding a capacitor in the circuit too. Also from the comparisons between the experimental values and calculated values we see a lot of differences which indicates that the experiment did not go as expected and there were probably a lot of errors in setting up the oscilloscope and function generator properly. So we should be a lot more careful so that the experimental value matches with our calculated values for proper

## Pre-Lab Report:

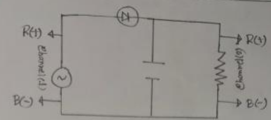
# East West University

## Department of CSE

### PRE-LAB REPORT

| |
|---|
| **Course Code and Name:** CSE251[Electronic Circuits] |
| **Experiment no: 02** |
| **Experiment name:** Half-Wave Diode Rectifier Circuit |
| **Semester and Year:** Fall-24 |

| | |
|---|---|
| **Name of Student:** Md Sabik Hossen<br>**Student Id:** 2023-2-60-305 | **Course Instructor information:**<br>M. Saddam Hossain Khan<br>Senior Lecturer, Department of Computer Science and Engineering, East West University. |




Given,

peak voltage, $V_p = 5V$

Ripple voltage, $V_r = 0.5V$

Here,

$R = 1000\,\Omega$

$f = 1000\,Hz$

$\omega = 2\pi f$

$= 6283.2$

$V_r = V_p / fCR$

$\Rightarrow 0.5 = 5/1000 \times C \times 1000$

$\therefore C = 10\,\mu F$

Conduction time, $\Delta t = 1/\omega \cos^{-1}\left(\frac{V_p - V_r}{V_p}\right)$

$= 1/6283.2 \cdot \cos^{-1}\left(\frac{5-0.5}{5}\right)$

$= 7.178 \times 10^{-5}\,s$

Conduction Angle, $\omega\Delta t = \cos^{-1}\left(\frac{V_p - V_r}{V_p}\right)$

$= \cos^{-1}\left(\frac{5-0.5}{5}\right)$

$= 0.451^{\circ}$ ~~rad~~.

Average of diode currents;

$$i_{Davg} = \frac{V_p - V_r/2}{R}\left(1+\pi\sqrt{\frac{2V_p}{V_r}}\right)$$

$$= \frac{5-0.5/2}{1000}\left(1+3.1416\sqrt{\frac{10}{0.5}}\right)$$

$$= 0.07149\,A$$

$$= 71.49\,mA$$

Peak value of diode currents;

$$i_{Dmax} = \frac{V_p - V_r/2}{R}\left[1+2\pi\sqrt{\frac{V_p}{V_r}}\right]$$

$$= \frac{5-0.5/2}{1000}\left[1+2\times3.1416\times\sqrt{\frac{2\times5}{0.5}}\right]$$

$$= 0.1382\,A$$

$$= 138.2\,mA$$

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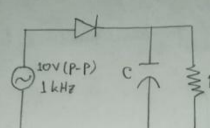
Name: Nasrullah Kaishen Sijan | Section - 07

ID: 2023-1-60-204 | CSE251 (SHK)




Its given that,

$V_r = 0.5V$ $\quad R = 1k\Omega$

$f = 1kHz$ $\quad V_p = \cancel{10V}\ 5V$

$V_r = \frac{V_p}{fCR}$

$\Rightarrow C = \frac{V_p}{V_r f R} = \frac{\cancel{10}\ 5V}{0.5 \times 1\times10^3 \times 1000} = 10\,\mu F$

Conduction ~~agle~~ angle, $\omega\Delta t = \cos^{-1}\left(\frac{V_p - V_r}{V_p}\right) = 25.84^{\circ} = 0.14\pi$

" time $\Delta t = \frac{0.14\pi}{\omega} = \frac{0.14\pi}{2\pi \times 1kHz}$ 0.451 rad

$= 0.07\,s$

Average value of diode currents, $I_{Davg} = \frac{\left(V_p - \frac{V_r}{2}\right)}{R} \times \left(1+\pi\sqrt{\frac{2V_p}{V_r}}\right)$

$= 71.486\,mA$

Peak value of diode currents, $I_{Dmax} = \frac{V_p - \frac{V_r}{2}}{R} \times \left(1+2\pi\sqrt{\frac{2V_p}{V_r}}\right)$

$= 137.1341685\,mA$

East West University

Exp: Half-Wave Diode Rectifier circuit

Name: Ajmain Nur Shihab

ID: 2022-3-60-188

Section: ~~10~~ 7

Course: CSE 251

Given that,

peak voltage, $V_P = 5V$

Ripple voltage, $V_R = 0.5V$

Here,

$R = 1000\,\Omega$

$f = 1000\,Hz$

$\omega = 2\pi f$

$= 6283.2$

$V_R = V_P / f C R$

$\Rightarrow 0.5 = 5 / 1000 \times C \times 1000$

$\Rightarrow C = 10\,\mu F$

conduction time, $\Delta t = \frac{1}{\omega} \cos^{-1}\left(\frac{V_P - V_R}{V_P}\right)$

$= \frac{1}{6283.2} \cos^{-1}\left(\frac{5-0.5}{5}\right)$

$= \cos^{-1}\left(\frac{5-0.5}{5}\right)$

$= 0.451$ rad

Average of diode currents:

$i_{D\,avg} = \frac{V_P - V_R/2}{R}\left(1+\pi\sqrt{\frac{2V_P}{V_R}}\right.$

$= \frac{5 - 0.5/2}{1000}\left(1 + 3.1416\sqrt{\phantom{x}}\right.$

$= 0.07149\,A$

$= 71.49\,mA$

Peak value of diode currents:

$i_{D\,max} = \frac{V_P - V_R/2}{R}\left[1 + 2\pi\sqrt{\frac{V_P}{V_R}}\right.$

$= \frac{5 - 0.5/2}{1000}\left[1 + 2 \times 3.1416\right.$

$= 0.1382\,A$

$= 138.2\,mA$

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East West University

Exp: Half wave Diode Recifier circuit

Pre-lab-02

Names Abdul Wadud

ID: 2022-2-60-133

Section: 07

Course: CSE251

Date: 12/11/2024

Prelab

Name: Abdul Wadud

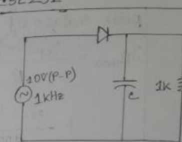
ID: 2022-2-60-133

CSE251

Given,

$V_R = 0.5V$, $R = 1k\Omega$

$f = 1KHz$, $V_P = 5V$




$V_R = \frac{V_P}{fCR}$

$\Rightarrow C = \frac{V_P}{f V_R R}$

$= \frac{5V}{1\times10^3 \times 0.5 \times 1000} = 10\,\mu F$

$\omega = 2\pi f$

$= 6283.2$

Conduction angle, $\omega\Delta t = \cos^{-1}\left(\frac{V_P - V_R}{V_P}\right)$

$= 25.84° = \frac{0.14\pi}{\omega} = 0.451$ rad

Conduction time $\Delta t = \frac{0.14\pi}{\omega} = \frac{0.14\pi}{\omega} = 0.451$ rad

Average value of diode currents

$I_{P\,avg} = \frac{\left(V_P - \frac{V_R}{2}\right)}{R} \times \left(1+\pi\sqrt{\frac{2V_P}{V_R}}\right)$

$= \frac{5 - \frac{0.5}{2}}{1000} \times \left(1 + \pi\sqrt{\frac{2\times5}{0.5}}\right)$

$= 71.486\,mA$

peak values of diode currents

$I_{P\,max} = \frac{V_P - \frac{V_R}{2}}{R} \times \left(1 + 2\pi\sqrt{\frac{2V_P}{V_R}}\right)$

$= \frac{5 - \frac{0.5}{2}}{1000} \times \left(1 + 2\pi\sqrt{\frac{2\times5}{0.5}}\right)$

$= 137.134\,mA$