LAB SESSION 03

HALF WAVE RECTIFIER RECTIFIER

Name of Student: ……

Roll No.: ……Section: ……

Date of Experiment: …….

Report submitted on: ……

Marks obtained:
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Instructor's Signature:
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DEPARTMENT OF MECHANICAL ENGINEERING
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OBJECTIVE:

Because of their ability to conduct current in one direction and block current in the other direction, diodes are used in circuits called rectifiers that convert ac voltage into dc voltage. Rectifiers are found in all dc power supplies that operate from an ac voltage source. A power supply is an essential part of each electronic system from the simplest to the most complex. In this experiment, you will study the most basic type of rectifier, the half-wave rectifier.

EQUIPMENT REQUIRED:

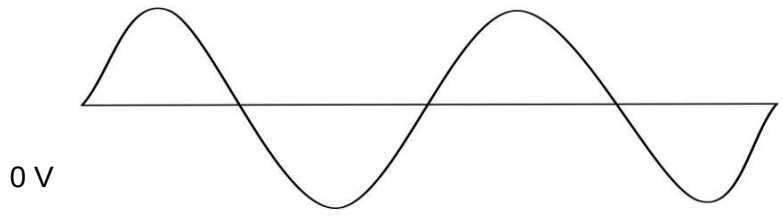
Qty	Apparatus
1	Electricity & Electronics Constructors EEC470
1	Basic Electronics Kit EEC472
1	Power supply unit. A.C supply; 20Vrms; 50 HZ
1	Multimeter or 50V d.c. voltmeter.
1	Oscilloscope.

INTRODUCTION:

In lab 2 you found that a diode conducts current in one direction (from anode to cathode) but not in the reverse direction.

A widely used application of this feature is the conversion of alternating voltages to direct voltages (fig 3.1). This assignment studies the simplest circuits for achieving this conversion,

Which is called RECTIFICATION or in some cases, DETECTION.



A Sinusoidal Alternating Voltage

A Direct Voltage

Fig.3.1

Average Value of the Half-Wave Output Voltage:

The average value of the half-wave rectified output voltage is the value you would measure on a dc voltmeter. Mathematically, it is determined by finding the area under the curve over a full cycle, as illustrated in fig 3.4, and then dividing by 2Pi, the number of radians in a full cycle. The result of this is expressed in Equation 3.1, where Vp is the peak value of the voltage. This equation shows that Vavg is approximately 31.8% of Vp for a half-wave rectified voltage.

Equation: 3.1 $V_{avg} = V_p / \pi$

EXPERIMENTAL PROCEDURE

SIMPLE HALF-WAVE RECTIFICATION:

As shown in the patching of fig 3.2, construct the circuit of 3.3.

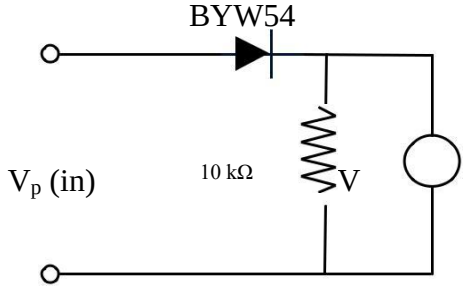


Fig 3.3 Half-wave Rectification

Switch on the oscilloscope and the sinusoidal supply.
With the oscilloscope d.c. coupled adjust the time base and the Y amplifier sensitivity to obtain a steady trace of about 4 cm vertical and 5 ms/cm horizontal. You should see a waveform as in fig 3.4.

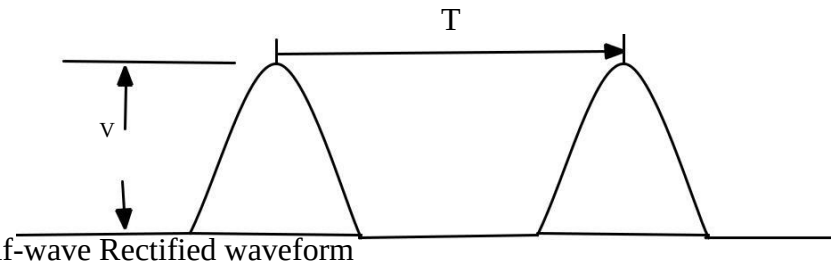


Fig 3.4 half-wave Rectified waveform

Observe the Half-wave rectified waveform together with input voltage signal and draw it to a graph paper.(for diode BYW54)
Measure and record time T and peak voltage Vpk.

Sketch the waveform and label it to show the periods when the diode is conducting and those when it is not. Time t depends upon the frequency of your power supply. For a 50Hz supply it should be 20 ms and for 60Hz it should be 17 ms.

Confirm this. Vpk should be nearly equal to the peak voltage of the alternating supply: b) By using a d.c. voltmeter

Determine the average voltage (Vav) and compare with Vp(in)/ π

PRACTICAL CONSIDERATIONS AND APPLICATIONS:

When rectification is used to provide a direct voltage power supply from an alternating source, the ripple is an undesirable feature. For a given capacitor value, a greater load current (smaller or resistor) discharges the capacitor more and so increases the ripple obtained fig 3.7 shows this.

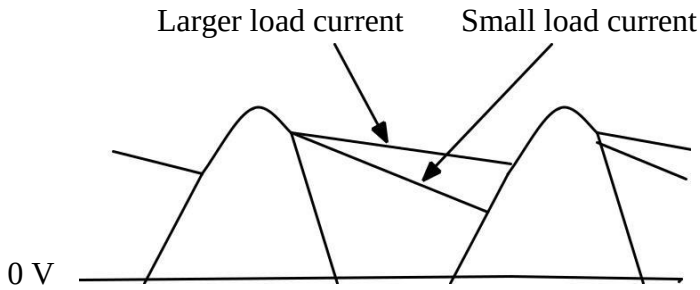


Fig 3.7 the Effect of Load Current

Several methods are available to reduce ripple:

1. Larger capacitors, the uses of which are limited due to cost and size, and also because large capacitors can require very large charging currents to be supplied trough the diode.
2. Electronic stabilization this reduces ripple as well as keeping the output voltage steady when the load or input voltage changes.
3. Full-wave rectification. With this, the ripple is much reduced as every half-cycle of the input, instead of every other half-cycle, contributes to the rectified output.

In figure 3.8 it can be seen that capacitor charging occurs at half the previous interval and the amount of discharge for a given load current is therefore less.

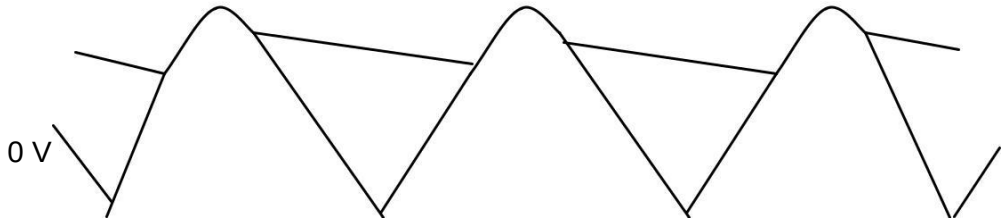


Fig 3.8 Full-wave Rectification

Assignment 4 deals with methods of achieving full-wave rectification.

When diodes are used for detection purposes in the reception of modulated radio signals, quite different considerations apply. These cannot be discussed in detail here but Feedback's manual ACS2956, Analogue Communications Systems, will provide full information on this application.

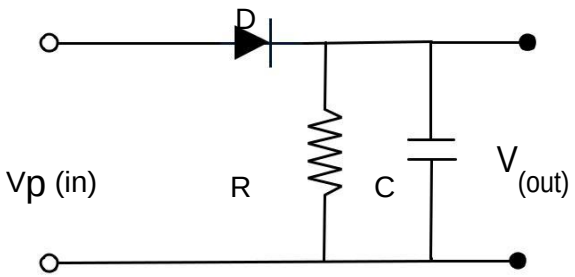
SUMMARY:

In this assignment you learnt that:

1. A simple diode circuit can convert an alternating voltage to a direct voltage.
2. The mean value of the rectified voltage can be increased by using a reservoir capacitor across the load.
3. A half-wave rectified voltage gives appreciable ripple which however, can be reduced by several means.

EXERCISE:

A half-wave rectifier, as in fig 3.9, produces a certain amplitude (from peak-to peak) of ripple.



If the load resistor is reduced to half of its original value, what increase in capacitor value will restore the ripple to the same values as before?

Confirm your answer by practical experiment, starting with:

R= 10kΩ and C=22μF, D (6F60)