EAST WEST UNIVERSITY

Lab Report

Course Name : Electronic Circuit-I
Course Code : EEE102
Experiment No :02
Experiment Name : Study of Diode Rectifier Circuits

Group Number : 02
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Report approval status:

- ☐ Approved
- ☐ Partially approved
- ☐ Not approved

Abstract

The Half wave rectifier is a circuit, which converts an ac voltage to dc voltage. It can be used to obtain the desired level of dc voltage (using step up or step down transformers). It provides isolation from the power line. During the positive half cycle of the input voltage the polarity of the voltage across the secondary forward biases the diode. The forward biased diode offers a very low resistance and hence the voltage drop across it is very small. During the negative half cycle of the input voltage the polarity of the secondary voltage gets reversed. As a result, the diode is reverse biased. Practically no current flows through the circuit and almost no voltage is developed across the resistor. All input voltage appears across the diode. In this lab we address about the characteristics of half wave diode rectifier circuits. In half wave rectification of a single-phase supply, either the positive or negative half of the AC wave is passed, while the other half is blocked. Because only one half of the input waveform reaches the output, mean voltage is lower. Half-wave rectifiers produce far more ripple than full-wave rectifiers. In view of this advantage, the half wave rectifier circuit can often be seen within large items of electronics equipment.

2.1 Objective of the experiment

The main objective of this experiment is to know about the characteristics of a half wave diode rectifier circuit, how it works. To do so, following should be performed :

1. To design electrical circuit with diode and other relevant sources.

2. To set up the circuit with osiloscope by proper connections and sources.

3. to find the perfect values and error and comes to an conclusion on how to overcome.

2.2 significance of the experiment

The significance of a half wave rectifier is only that its cheap, simple and easy to construct. It is cheap because of the low number of components involved. Simple because of the straight forwardness in circuit design. The efficiency of half wave rectifier is about 40.6%. This is less when compared to the full wave rectifier (81.2%).

2.3 Theory

The no-load output DC voltage of an ideal half wave rectifier for a sinoidal input voltage is :

$$V_{\mathrm{rms}} = \frac{V_{\mathrm{peak}}}{2}$$
$$V_{\mathrm{dc}} = \frac{V_{\mathrm{peak}}}{\pi}$$

Where:

V_{dc}, V_{av} - the DC or average output voltage,
V_{peak}, the peak value of the phase input voltages,
V_{rms}, the root-mean-square value of output voltage.

2.4 Experimental setup

1. Diode (4 pcs)

2. Resistor (1KΩ)

3. Capacitor (1uF)

4. digital multimeter

2.5 Experimental procedure

1. Measure the resistance by multimeter. The circuit being setup shown in fig

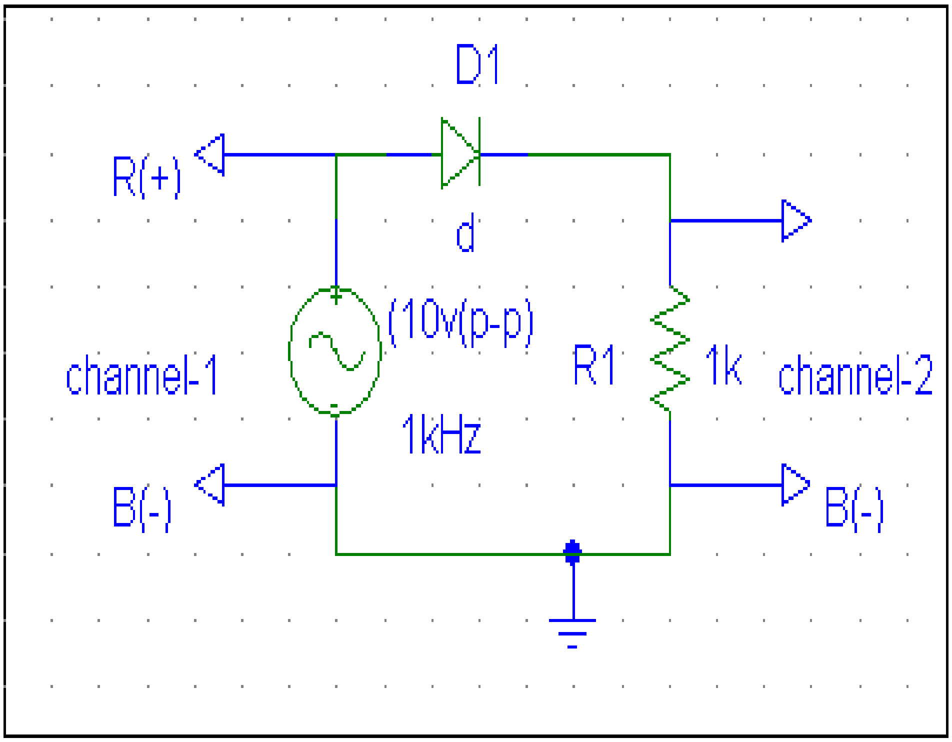

Fig: A half wave diode rectifier circuit

2. Set up a 10 volts p-p, 1 KHz sine wave signal generator and observe it in oscilloscope.

3. Give input to the circuit and observe the output in channel-2 of the oscilloscope.

4. Observe both the input and the output signals by settings dual mode in the oscilloscope.

5. The peak values of the input, $V_{IP,}$ and output, $V_{OP,}$ signals being measured.

6. The charging time, Δt of the capacitor in a period being measured.

7. Lower $V_{LP,}$ and upper V_{UP} peak values being measured.

8. The average value of output voltage (V_O) using the DC mode of the multimeter being measured.

2.6 Measurement and Data

$R = 0.98\ K\Omega$

$V_{IP} = 10V$

$V_{OP} = 9.2V$

$\Delta V_P = (V_{IP} - V_{OP})$

$= (10 - 9.2)\ V$

$= 0.8V$

$V_{LP} = 4.2V$

$V_{UP} = 4.8V$

$V_r = V_{UP} - V_{LP}$

$= (4.8 - 4.2)\ V$

$= 0.6V$

$\Delta t = 0.196ms$

$V_O = 2.72V$

$C = 1uF$

2.7 necessary calculation

2.8 results

2.9 key find

2.10 answer to Report question

Answer to Report question 01

$V_{IP} = 5V$

$V_{OP} = 4.2V$

$\Delta V_P = (V_{IP} - V_{OP})$

$= (5 - 4.2)\ V$

$= 0.8V$

In experiment 01 the built in voltage is 0.7V

$V_{DO}(V)$	$\Delta V_P(V)$
0.7V	0.8V

Comment : there is a little bit difference between built in voltage of experiment 01 and ΔV_P

Most probably 0.001V.

Answer to Report question 02

Compare of both Δt:

Measured Δt (ms)	0.196
Calculated Δt (ms)	0.0071

Comment : There is a little bit difference between Measured Δt and calculated Δt.

Answer to Report question 03

Peak-peak ripple voltage

$V_r = V_P(\omega\Delta t)^2/2$

$= 5(2\times3.1416\times1000\times.1\times10^{-3})^2/2$

$= 0.987V$

From measured value:

$V_r = V_{UP} - V_{LP}$

$= (4.8 - 4.2)\ V$

$= 0.6V$

Compare of measured, calculated and pre-lab voltage:

Calculated V_r(V)	0.987V
Measured V_r(V)	0.6V
Pre- lab V_r(V)	0.5V

Comments: There is a little difference between calculated, measured value and prelab values.

Answer to Report question 04

Here,

$V_r = 0.6V$

$V_{OP} = 4.20V$

$V_o = V_{OP} - V_r/2$

$= 4.20-(.6/2)$

$= 3.9V$

Calculated V_o(V)	3.9V
Measured V_o(V)	2.72V

Answer to Report question 05

$I_L = V_o/R$

$= \frac{3.9}{0.98}$

$= 3.98$ mA

$I_{Davg} = I_L \times (1 + \prod\sqrt{(2V_P/V_r)})$

$= 3.98\times (1+3.1416\sqrt{(2\times5/0.6)})$

$= 55.03$mA

$I_{Dmax} = I_L \times (1 + 2\prod\sqrt{(2V_P/V_r)}$

$= 3.98\times (1+2\times3.1416\sqrt{(2\times5/0.6)})$

$= 106.08$mA

Current	Measured value	Prelab value
$I_{D\ avg}$	55.03 mA	75.25 mA
$I_{D\ max}$	106.08 mA	145.49 mA

Comment: The measured and prelab values are very close , so it can be granted .

2.11 discussion and conclusion

From this lab we know how to build a half wave rectifier circuit. For building we must choose a diode that can safely withstand the current the circuit will have to provide, and also the reverse bias voltage that will be applied to it. Diodes are rated for maximum average forward current, which, since the diode conducts only half the time (positive-going half-cycles only), is roughly $1/2(V_{av}/R_L)$, where V_{av} is the average voltage and R_L is the load resistance. The peak inverse voltage (PIV), or maximum repetitive reverse voltage (V_{RRM}) is the maximum reverse bias that the diode can withstand. For the unfiltered rectifier, this is just the peak voltage.

The half-wave rectifier is used most often in low-power applications because of their major disadvantages being. The output amplitude is less than the input amplitude, there is no output during the negative half cycle so half the power is wasted and the output is pulsed DC resulting in excessive ripple. By performing this experiment we know all this stuff.

2.12 References

1) Howard V. Malmstadt, Christie G. Enke and Stanley R. Crouch. Electronics and Instrumentation for Scientists (Menlo Park, California: The Benjamin/Cummings Publishing Company, Inc., 1981), pp.57-58, 61-62.

2) Paul Horowitz and Winfield Hill. The Art of Electronics, Second Edition (New York: Cambridge University Press, 1994), pp. 45-46, 329-330.

3) Fairchild Semiconductor Corporation. Data Sheet for 1N/FDLL 914/A/B / 916/A/B / 4148 / 4448 Small Signal Diode (2002).

4)http://en.wikipedia.org/wiki/Rectifier

5)http://www.visionics.a.se/html/curriculum/Experiments/HW%20Rectifier/Half%20Wave%20Rectifier1.html

6) http://www.circuitstoday.com/half-wave-rectifiers

7) Microelectronic circuit by Adel S. Sedra and Kenneth C. smith 5th edition (Oxford University Press, 198 Madison Avenue, New York, New York 10016 www.oup.com)

2.14 Appendices

1) To realize the lab easily, different parameters for **half wave rectifier** is given below

The average of load current (I_{dc}) :

Let, the load current be $i_L = I_m \sin\omega t$

$$I_{dc} = \frac{1}{2\pi}\int_0^{\pi} I_m sin\omega\, t = \frac{I_m}{\pi}$$

The rms value of the load current (I_{rms})

$$I_{rms} = \frac{I_m}{4}$$

2) V_{DC} across the load resistor is calculated as follows,

$V_{DC} = 0.318V_M$

Where V_m is the maximum or peak voltage value of the AC sinusoidal supply, and V_S is the RMS (Root Mean Squared) value of the supply. It helps us to realize the experiment.

2.15 Further Reading

1) http://www.futureelectronics.com/en/diodes/bridge-rectifiers.aspx
2)http://www.radio-electronics.com/info/circuits/diode-rectifier/half-wave-rectifiers-circuits.php
3)http://www.electronics-tutorials.ws/diode/diode_5.html