

## Session 4

### OBJECTIVES

In this lab, the students will learn the development of a power supply using half and full wave rectifiers.

### INTRODUCTION

In the following circuit you need to add capacitor and observe the output voltage.

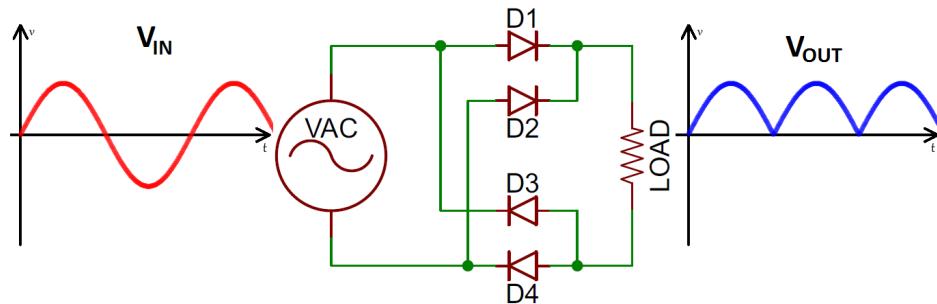


Figure 1

### PER LAB

Prior to the lab, the students should:

- Read lectures 3-6 and text book chapter 3 in order to understand the operation of circuit 1 and 2.
- Read the data sheet of Diode 1N4148
- Read the general manual of electrical/electronic circuit.
- Complete the Table II prior to start the experiment,

### EXPERIMENT

#### Requirement:

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In this lab, the following elements and instruments will be used.

1. Elements
  - a. D1=D2=D3=D4 = 1N4148 DIODE
  - b.  $R_{Load}$ =100 ohms, R=1000 ohms
  - c. C=100 uF and 1000 uF.
2. Instruments:
  - a. Signal generator
  - b. Oscilloscope
  - c. Voltmeter

### Instruction:

1. Use a bread board and assemble the circuit shown in Figure 1.
2. Connect a signal generator A=10 volt and f=100 Hz.
3. Select a resistor (see below table)
4. Add a capacitor in parallel with Load resistor (see below table).
5. Using Oscilloscope or other instruments, find Peak to peak voltages of output voltage.
6. Measure the Mean value of out-put voltage  $V_{out}$ .

## ANALYSIS

1. Based on the circuit analysis discussed in lecture 3-6 calculate fill Table I and compare two tables. If there is a difference, explain what is the reason of difference.
2. Based on the experiments and calculations, complete the following sentences:
  - a. the higher C, the lower Mean value output voltage is generated.
  - b. the higher C, the lower Peak to peak voltage of the ripple output voltage.
  - c. the higher R, the higher the Mean value output voltage is generated.
  - d. the higher R, the higher the Peak to peak voltage of the ripple output voltage.

## DESIGN

1. **Power Supply:**
  - a. In this part you use circuit shown in Figure 1 but with different C and input signal. Design a power supply with the following specifications:
    - i. Output Voltage (Maximum)= 5 Volts
    - ii. Maximum Output power= 100 mWatt
    - iii. Output voltage Error< 10%
  - b. What are T and A in your design ( $V_{in} = A \sin(2\pi t/T)$ )?
  - c. Obtain C and connect to the circuit shown in Figure 1?

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- d. Briefly write the calculations and along with the oscilloscope results show to TA for approval.

$$100\text{mW} = 5\text{V} * I$$

$$I = 20\text{mA}$$

$$R = V / I$$

$$R = 5\text{V} / 20\text{ohm}$$

$$R = 0.25\text{kohm}$$

We can create this resistor with two 500ohm resistors in parallel

$$500*500 / (500+500) = 250$$

$$1.1 = 1 - e^{-1/2RCf}$$

$$0.9 = e^{-1/2RCf}$$

$$\ln 0.9 = -1/RCf$$

$$0.105 = 1 / RCf$$

$$f = 1 / (0.105 * 250\text{ohm} * 0.0001\text{F})$$

$$f = 381 \text{ Hz}$$

$$V_{out} = V_{in} * e^{-1/2RCf}$$

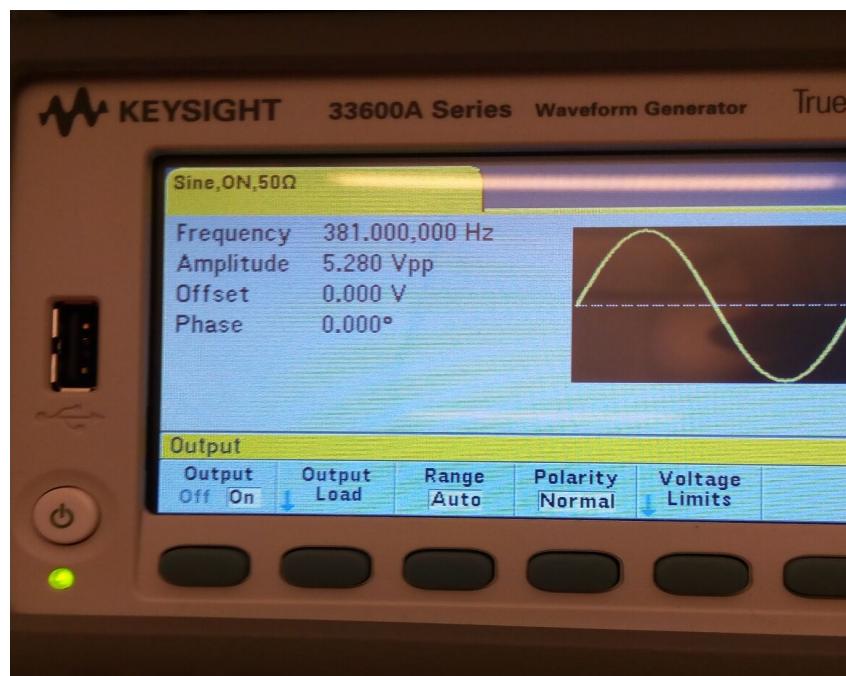
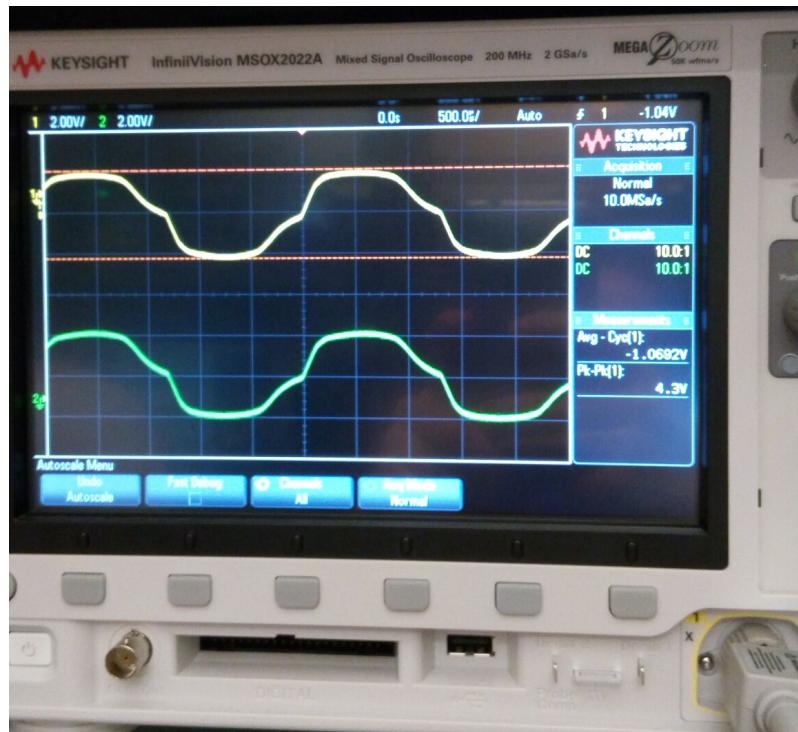
$$5 = V_{in} * e^{-1/(2*250 * 0.0001 * 381)}$$

$$V_{in} = 5.28 = A$$

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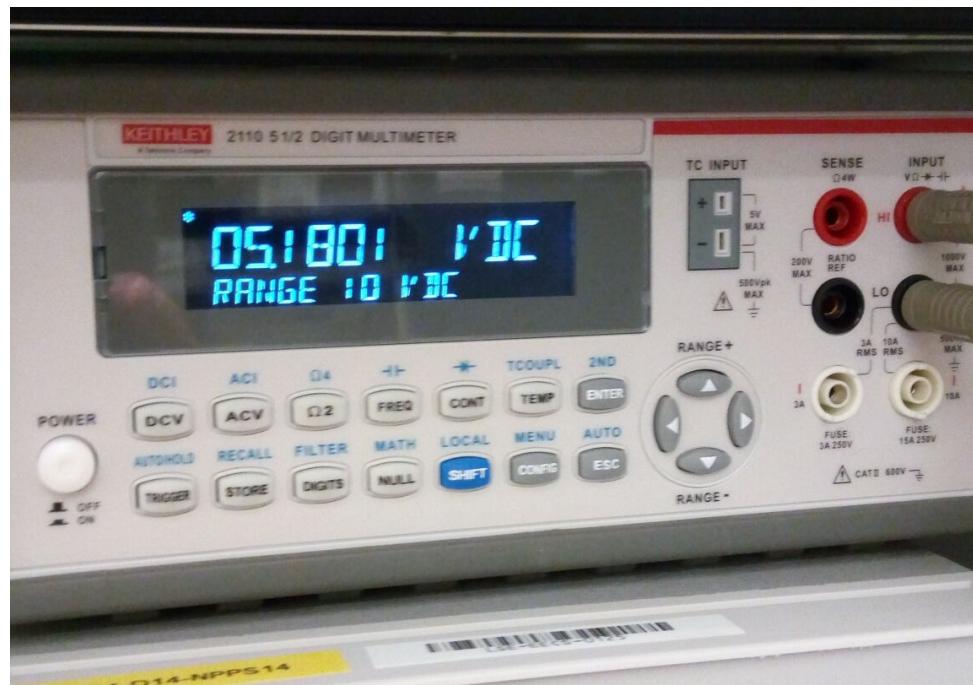
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2. Voltage Multiplier

- a. Design a voltage multiplier using 2 capacitors and 2 diodes, by assuming the input voltage is  $A\sin(2\pi ft)$ , where  $f=200\text{Hz}$ ,  $A=5\text{volts}$ .
- b. Choose the capacitors and diodes (can be the same as one used in Figure 1) and assemble the new circuit on breadboard.
- c. Observe the maximum DC output voltage that can be obtained from the circuit.
- d. Briefly write the calculations and along with the oscilloscope results show to TA for approval.

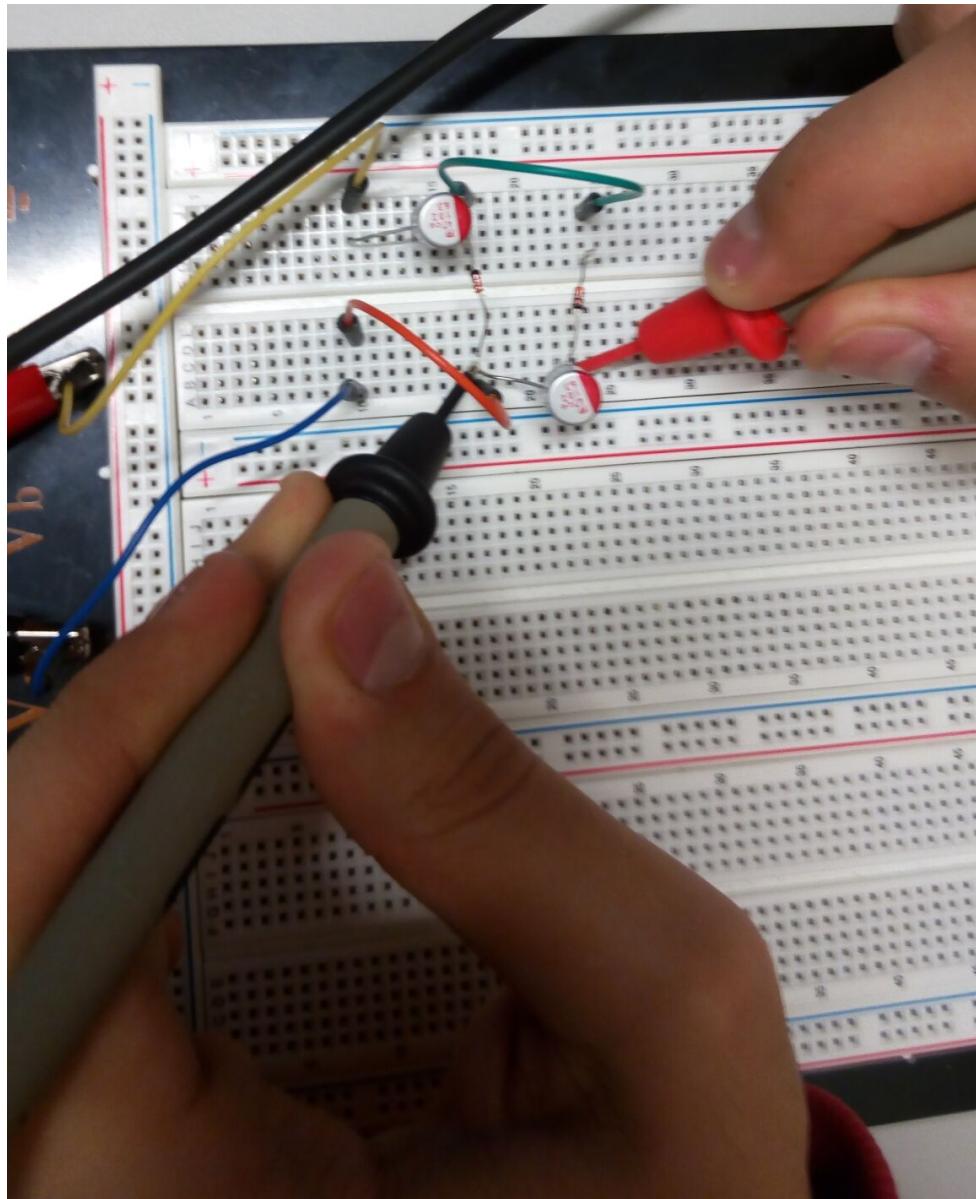
*Important Notice: If you use electrolyte capacitor the positive and negative pins should connected correctly.*

We choose the 1000uF capacitors and we had no choice in the diodes.



The input voltage was 5V so were able to get a higher output voltage than we input showing that our circuit increased the voltage. We had some trouble with the capacitors so we showed the signal on the voltmeter instead of the oscilloscope.

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***REPORT:***

1. Call the TA to confirm the completion of your experiment
2. Email the results using the computer of the Lab before leaving the lab.

**Session 4****Table I: Experiments**

R	C	Mean value of $V_{out}$	Peak to peak of $V_{R,0}$	Reason
100	100	3.5	1.2	The resistor creates the output voltage and the capacitor controls the voltage ripple
100	1000	3.5	0.5	Increasing the capacitor reduced the voltage ripple in the circuit but did not significantly affect the mean voltage.
1000	100	6.8	1.4	Increasing the resistor for the circuit caused the Vout to increase due to ohm's law. Increasing the resistance also increases the ripple voltage.
1000	1000	5.0	0.8	With both the resistance and capacitance increased, the circuit produces a higher output voltage and the increased

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				capacitance controls the increased ripple voltage.
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