

**Electronic Circuits Laboratory**

ELEC 375

Department of Electrical Engineering

United Arab Emirates University

Experiment # 3

Diode Applications

Voltage regulator and Rectifiers

# **Objectives**

1. To construct half-and full-wave rectifiers.
2. To investigate the use of capacitor filters to reduce ripple.
3. To demonstrate how loading of power supplies affects ripple.
4. To demonstrate the use of RC- filters to reduce ripple.

# **Theory**

The Zener diode is used in reverse biased as a simple voltage Regulator.

Half wave and full wave rectifier circuits causes AC input voltage to be converted into a pulsed waveform having an average, or, DC, voltage output. A filter that consists of an R-C circuit smooths out the pulsating output voltage of the rectifier.

# **Prelab**

In the prelab part, the students are supposed to simulate the experiments of procedures before the lab and record their notice accordingly.

# **Equipments**

1. 1N4004 (ECG116) silicon diode or the equivalent
2. 1N4736 silicon 6.8V Zener diode or the equivalent
3. DC power supplies (±15V and 6.8V with isolated ground and current-sinking capability)

4. Analog signal generator (5-10Vp-p sine wave at 1kHz)

5. Resistors

6. Capacitors

7. Dual-trace oscilloscope

# **Procedures**

## **Procedure I: Zener Diode as voltage regulator**

1. Wire the circuit shown in Figure 1 , where DC source VS is set according to the values in Table 1.

|  |
| --- |
| Figure 1 Zener Diode Voltage regulator Circuit |

1. For each Vs value in Table 1, measure the load voltage VRL across RL with Zener diode removed.
2. Insert the Zener diode (Vz = 6.8 V) and measure VRL, IZ, and IRL for each value of VS in Table 1.
3. For each value of in Table 1, calculate the power dissipated in the Zener diode. Does any value exceed the rated dissipation of the diode?

Table

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| VS | VRL (volts)  With diode ON | VRL (volts)  With diode OFF | IZ | I\_RL | Power dissipated in Zener |
| 8V |  |  |  |  |  |
| 10V |  |  |  |  |  |
| 11V |  |  |  |  |  |
| 12V |  |  |  |  |  |

1. For the same circuit, set VS=12V, then replace the load resistor with any other available five resistors and fill in the following table. Recommended to use (100Ω, 200 Ω, 500 Ω, 2 KΩ, and 10 KΩ), then measure and fill in the following table.

Table Variable Load resistance for Voltage regulator

|  |  |  |  |
| --- | --- | --- | --- |
| RL | VRL (volts) | I\_RL (Amp) | Regulation % |
| 100Ω |  |  |  |
| 500Ω |  |  |  |
| 2 KΩ |  |  |  |
| 10 KΩ |  |  |  |
| 30 KΩ |  |  |  |

## **Procedure II: Half wave Rectifiers**

1. Connect the following circuit in figure 2, and show on the oscilloscope V1 and Vo and record the AC and DC (Ripple) components of Vo.
2. To investigate the effect of the load resistance and the capacitor on the % ripple:

(without 4.7 and POT)



*Figure 2: Zener Diode Voltage regulator Circuit*

1. Fix the input voltage at a peak of 10V (with the capacitor is Disconnected) Measure and sketch output voltage wave form for RLoad = 470 Ω, 22 KΩ.
2. Now connect the capacitor (4.7 µF), and then using the oscilloscope to measure and sketch the DC mean value of the output, and the ripple (AC distortion). (Set the oscilloscope to DC coupling)
3. Explain the results.
4. Repeat step ***b*** for RL =22KΩ and capacitor = 220µF).
5. Comment on your results and observations.
6. Insert a Zener diode in parallel to RL and change the input Peak to (5V, 10V),

(RL =22KΩ and capacitor = 47µF)

1. Discuss the effect of the Zener.

## **Procedure III: Full wave Rectifiers (Simulation only)**

Connect the following circuit in figure 3:



Figure 3: Full wave circuit

1. With the capacitor is disconnected; Change the input voltage until the output peak is 10V.
2. Measure and sketch the output voltage wave form.
3. Connect the capacitor to obtain a dc voltage from this circuit.
4. (Note the difference between the ac and dc coupling of the oscilloscope).
5. Measure and sketch the output voltage wave form (dc and ac components).
6. Calculate the % ripple using the measured data. .
7. Replace the capacitor by 47μF the repeat parts 5 and 6.
8. Now, connect the following circuit in figure 4.



Figure4: Regulated Full wave circuit

1. Measure the ripple and the dc value of the output. For output peak is 5V and 10V
2. Discuss the results.

*Note :( Calculating the value of the capacitor)*

*If the ripple is a small percentage of the total output voltage, then the voltage across the capacitor decays almost linearly. For a full-wave rectifier, the next input voltage peak occurs one half-period (T/2, where T is the period) the time derivative of the output voltage over the half-cycle can therefore be approximated as:*

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= 

 

*For example: If the percentage ripple is 5%, then* Δ*vr*/*vo,avg* = 0.05).