LAB2
Diode Circuits

Reading:Malvino: Ch. 3 and Ch. 4.
Hayes and Horowitz: Class 3, Worked Example and Lab 3.

This experiment will demonstrate the fundamentals of semiconductor diodes and some of their applications.

1. Diode Characteristic and Half-wave Rectifier

a) Construct the circuit of Fig 2.1. Display the I-V characteristic of the diode on the oscilloscope. Use dc coupling and set zero volts at the centre of the screen. Explain the I-V curve.

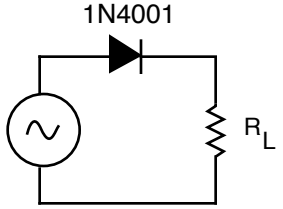

Fig 2.1
Half-wave Rectifier. You may use a transformer for the floating-output ac signal.

An ohmmeter (VOM) can be used to measure the polarity of a diode. The band on the diode represents the cathode, i.e., the negative terminal when connected for forward conduction.

Caution: Use the diode specifications at the end of the lab script to calculate the value and power rating of R needed to safeguard the diode.

b) Display *I* vs time. Explain the dependence of the observed waveform on the applied voltage.

c) Now replace the 1N4001 diode with an LED and record its characteristic curve. Keep this LED and its curve for future use.

2. Full-wave Rectifier Bridge

a) Construct the full-wave bridge rectifier circuit of Fig 2.2 using four 1N4001 rectifier diodes. Explain the output wave form. Remove one of the diodes and look at the symptoms.

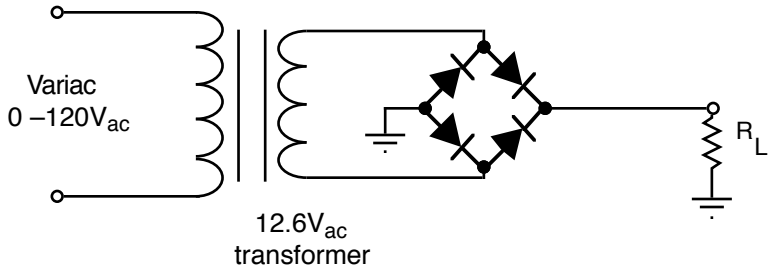

Fig 2.2
Full-wave Bridge Rectifier

b) Replace the missing diode and connect a 15 μF electrolytic filter capacitor across the output. Measure the peak-to-peak ripple voltage and compare with your calculations.

Caution: Respect the polarity of the capacitor.

c) Repeat with a 400 μF filter capacitor. You now have a respectable voltage source. How much current can the load draw without exceeding the diode specifications?

3. Voltage Doubler

Connect the voltage doubler circuit of Fig 2.3 using 1N4001 diodes and explain its action.

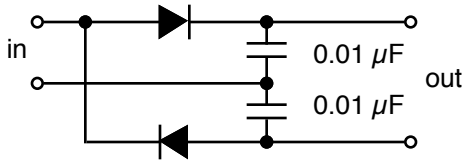

Fig 2.3
Voltage Doubler

4. Diode Clipper

The circuit of Fig 2.4 limits the range of a signal. Use the 1N914 signal diode when you build it. Drive it with a sine wave (maximum output amplitude) and observe and measure the output voltage. Explain the operation. Suggest how you can clip a sine wave symmetrically around zero and draw the circuit diagram.

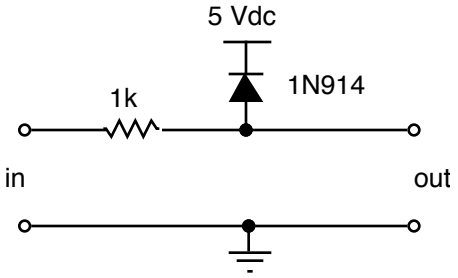

Fig 2.4
Voltage clipper

5. Diode Voltage Clamper

The circuit of Fig 2.5 is used to clamp the negative peak of a signal at about 4 V. Try it with sine, triangle and square waves. Explain the operation.

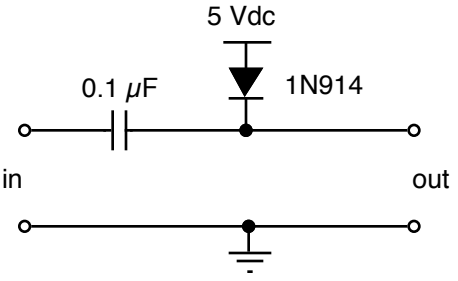

Fig 2.5
Voltage clamper

6. Signal Rectifier

The next circuit (Fig 2.6) will pass one polarity only of a pulse-train. Apply a square wave, generate pulses at point A by differentiating and observe the rectified output. Note the forward drop of the diode.

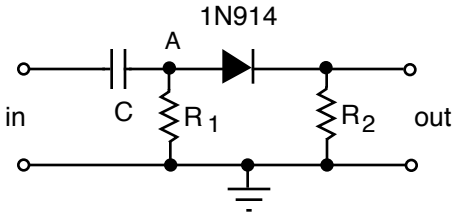

Fig 2.6
Signal Rectifier

7. Zener Diode (optional)

Substitute a Zener diode ($_{1N4733}$) for the ordinary diode in Fig 2.1. Display the I-V characteristic of the Zener diode and explain.

Caution: Incorporate the necessary current-limiting resistor R. Consult the specification in the data sheet.

Diode Specifications

Rectifier diode	
1N4001	Silicon
$V_{reverse(max)}$	50 V
$I_{forward(max)}$	30 A
$I_{forward(cont)}$	1 A
Signal Diode	
1N914	Silicon
$V_{reverse(max)}$	75 V
$I_{forward(max)}$	2000 mA
$I_{forward(cont)}$	200 mA
Zener Diode	
1N4733	Silicon
$I_{forward(max)}$	49 mA
V_{Zener}	5.1 V