Lab 2
Diode Applications

Purpose

In this lab, several applications of the diode will be studied. These include clipping and clamping.

Material and Equipment

NI ELVIS
1N5404 Diodes(4)
1N4148 Diode(1)
Assorted Resistors
Assorted Capacitors

Pre Lab

a) Review clipper and clamper circuits.
b) Design a clipper circuit which limits input signals to +1V and -1.5V.
c) Make sure you know the what to except at the output of the clipper. (Remember you are using real diodes. There will be diode cut-in voltages.)

Theory

The diode has many applications. In this lab, a few of them will be investigated. The first is the clipper circuit. This circuit limits an input voltage to certain minimum and maximum values. In the circuit in Figure 2-1, one can see that as long as V_I is less than V_{B1}, then the diode will be reverse biased(an open circuit). In this case, the output voltage will track the input voltage. If V_I exceeds V_{B1} then the diode turns on and then Vo will be V_{B1} thus this circuit limits the output voltage to less than V_{B1}. (We ignored diode cut-in voltages, but in real circuits you need to consider). By rearranging the components, variations on this circuit can be achieved.

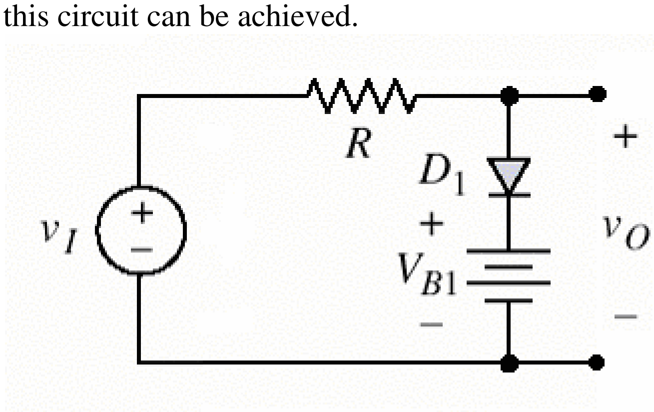

Figure 2-1: Schematic of a clipper circuit.

The next circuit is the clamping current. This circuit works by allowing the capacitor to charge up and act like a battery. This is the voltage across the capacitor depends on the input waveform, the output maximum(or the minimum depending on the orientation of the diode) will be clamped to a fixed reference point (in this case, ground potential). The only design constraint is that $2\pi RC$ be five times larger than the period of the input waveform.

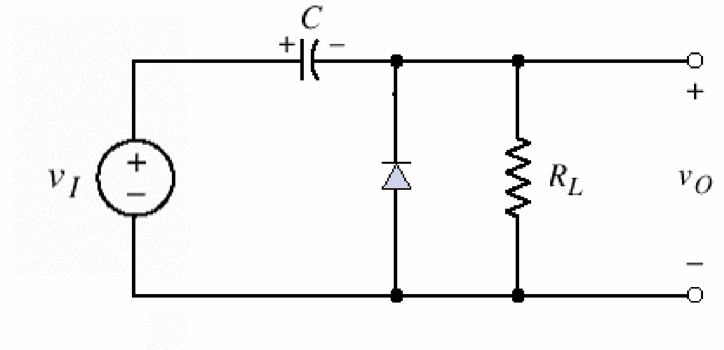

Figure 2-2: Schematic of a clamper circuit.

Procedure

1) Diode Clipper Circuits

   Diode clipper circuits can be used to limit a voltage to some maximum or minimum value. This is useful for designing protection circuits.

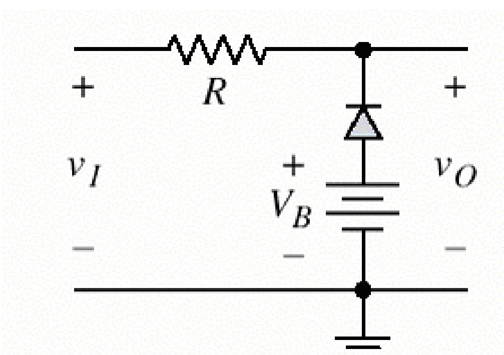

Fig 2-3a

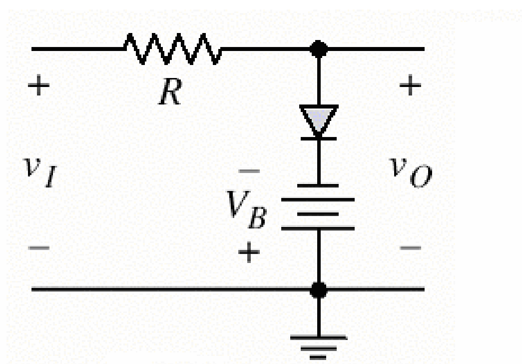

Fig 2-3b

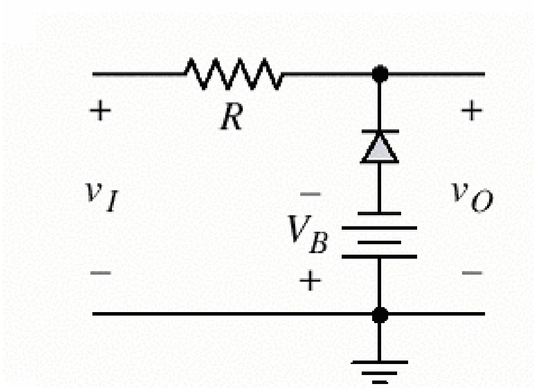

Fig 2-3c

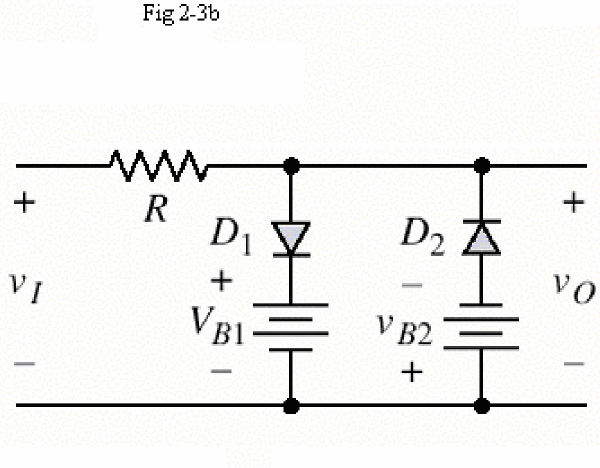

Fig 2-3d

Figure 2-3: Clipper Circuits

a) Connect the circuit in Figure 2-3a. Use R = 100 kohm and a 1N5404 diode. For the input signal v_I, use 5Vp-p, 1kHz sine wave and use variable power supply (VPS) to provide the battery voltage. Set V_B=1 V. Measure and sketch the input and output waveforms.

Warning: When you set the VPS source to 1V, make sure this is in fact at 1V by measuring it with Elvis Voltmeter. Some units may have calibration issues. You may need to re-adjust until you see desired voltage on the Voltmeter

b) Repeat the procedure for the remaining circuits. For Fig 2-3d, set V_{B1}=0.5 V, V_{B2}=1 V. Again verify Variable Supply Source output voltages using Voltmeter. Re-adjust if necessary.

2) Clamper Circuits

a) Design a clamper to clamp the upper limit of the input voltage to 0 V. Assume that the input signal is 1 kHz and that the load is 5.1 k ohms. Construct the design circuit and use a 1 kHz, 3Vp-p square wave input signal. Use a 1N4148 diode. Measure and capture the input and output waveforms. Note what happens when the input amplitude is varied.

b) Lower the load resistance to 100 Ohms, measure and roughly sketch the output waveform.

Questions for the Lab Report

1) Discuss the output waveforms from the clipper circuits. How do these waveforms differ from those expected if ideal diodes were used? Why?

2) Discuss how lowering of the load on the clamper circuit affects the output.