

ELE339, Electronics I Laboratory

LAB 4 - Diode Applications

Pre-Lab

Objective:

This lab introduces some very typical applications of PN junction diodes such as a peak detector, a voltage doubling circuit, various clamping circuits and an (active) full-wave rectifier.

Note: All diodes used are 1N540 (Silicon junction diode) and 1N747 (Zener diode). Unless otherwise stated, V_S represents a 1 kHz sinusoidal voltage with 10V amplitude.

Tasks:

Use PSpice to simulate the given circuits in Figures 1 to 3.

1. Simulate the circuits shown in figure 1 as shown and then with a 10 k load resistor across V_O ($C = 1 \text{ F}$).
2. Explain the operation of circuit 1c in terms of circuit 1a (or 1b), which is the first part of it.
3. Vary the amplitude of V_S for the three circuits in figure 2 from 0 to 10 V (peak value). Where does the output become non-sinusoidal?
4. Use Pspice to determine the breakdown voltage of the 1N747 Zener diode and simulate the circuits of figure 2b and 2c by PSpice.
5. Simulate the circuit in figure 3 and record both op-amp output voltages (V_1 and V_2) as well as V_{out} (use an LF353 chip for the 2 op-amps with $\pm 10 \text{ V}$ supplies). Test the circuit with a 1kHz sinusoidal input of 5V amplitude and observe both op-amp outputs and V_{out} on the digital scope. To maintain reasonable current levels, select the value of R between 2.2k and 22k .
6. What is the purpose of the RC section between V_2 and V_{out} ? Can you explain how this simple passive circuit impacts the final output? (Hint: think about the different frequency components of V_2 , i.e., its Fourier decomposition).
7. Repeat task 5 with an input swing of 0.5V. Did you expect the result? Explain.

Experimental

Tasks:

Build the circuits in figures 1 to 3 and record the values of the required variables. Compare your experimental results to those in the simulations and discuss.

8. Test the circuits shown in figure 1 as shown and then with a 10 k load resistor across V_o ($C = 1\text{ F}$).
9. Vary the amplitude of V_s for the three circuits in figure 2 from 0 to 10 V (peak value). Where does the output become non-sinusoidal?
10. Determine the breakdown voltage of the 1N747 Zener diode.
11. Build the circuit you simulated in task 5 of the Pre-Lab and record the values of the required variables.

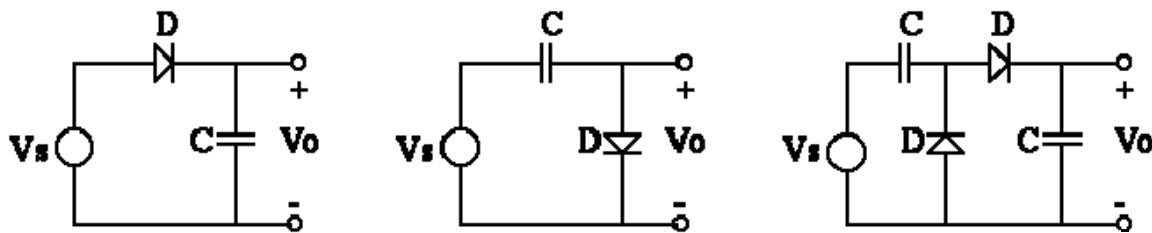


Figure 1: Peak detector and voltage doubling circuit.

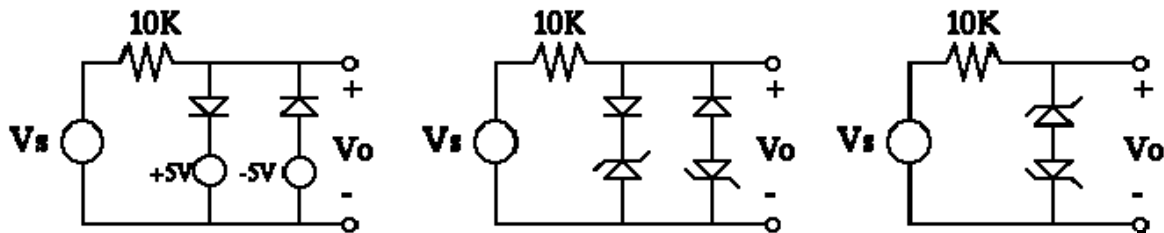


Figure 2: Clipping circuits with diodes and Zener diodes.

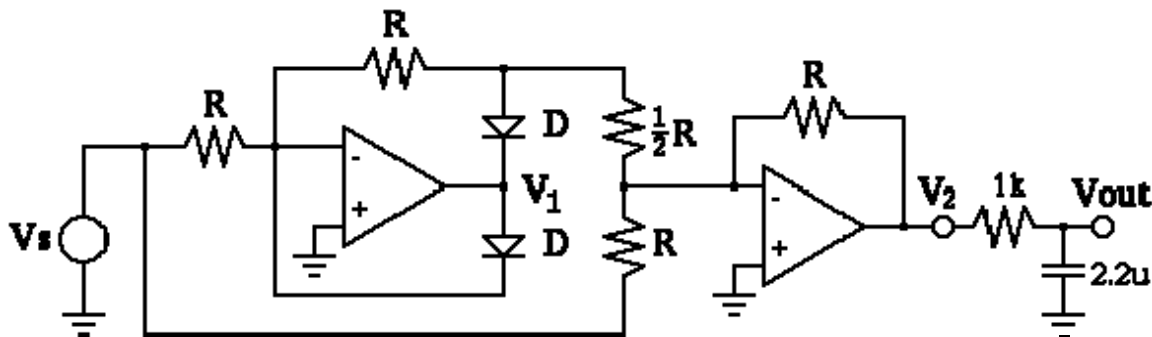


Figure 3: Full-wave rectifier with op-amps.