University of California, San Diego
Department of Electrical and Computer Engineering

ECE65, Fall 2010

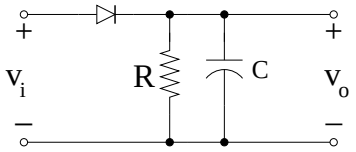
Lab 3, Diode wave-form shaping circuits

In these experiments we examine diode circuits that modify the input wave-form. In these cases (and in many future experiments) you are asked to print out scope traces of input and output voltages of the circuit. You should follow this procedure:

1) Attach Scope channel 1 to v_i, Scope Channel 2 to v_o, and have both traces be "triggered" by channel 1.
2) Move the two traces such that the zero voltage value for both channels are in the middle of the display.
3) Expand the time selection so that only 2 to 4 periods of the wave-form are shown.
4) Adjust the volt per division knob such that the signal is as large as possible (*i.e.,* fills the display). Ensure that both channels have the same volt per division setting.
5) Printout the trace. In this manner v_o and v_i can be directly compared.

Experiment 1: Rectifier & Peak Detector Circuit

Consider the circuit below with a 1N4148 general purpose diode and $R = 100$ kΩ.



Lab Exercise:

1) Assemble the circuit <u>without</u> the capacitor. Set the function generator to produce a sinusoidal wave with an amplitude of 5 V, zero DC offset, and frequency of 2 kHz. Attach the function generator to v_i. Attach Scope channel 1 to v_i and Scope Channel 2 to v_o. Adjust scope according to the instruction above. Print out v_o and v_i.

2) Disconnect the function generator without changing the function generator and scope settings. Attach a 10 nF capacitor (see circuit diagram above). Attach the function generator to the circuit and print out v_o and v_i.

3) Repeat part 2 for C = 1 nF and 100 nF.

4) Compare the four printout. What are your conclusions?

Experiment 2: Clipper Circuit

Design Problem: Design a clipper circuit using 1N4148 general purpose diodes and a $R = 1$ kΩ to clip the input signal voltages that are above 5.7 V or less than −0.7 V.

Simulation: Simulate the circuit you have designed with PSpice with two input voltages: 1) A sinusoidal wave with an amplitude of 8 V and a DC offset of zero and 1) A sinusoidal wave with an amplitude of 8 V and a DC offset of 4 V. In each case, plot v_o and v_i for two period (both traces on the same graph).

Lab Exercise:

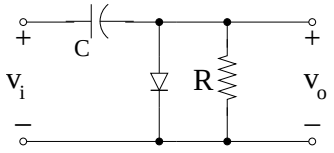
1) Assemble the circuit that you have designed. Apply a sinusoidal wave with amplitude of 8 V and DC offset of zero to the circuit. Adjust the scope and print out v_i and v_o.

2) Increase the DC offset of the input. What do you see? Does it follow your simulation. Explain?

3) Set the DC offset to +4V. Adjust scope similar to Experiment 1 and print out v_i and v_o. Explain the results.

Experiment 3: Clamp Circuit

Consider the circuit below with a 1N4148 general purpose diode, $R = 100$ kΩ, and $C = 100$ nF.



Lab Exercise:

1) Assemble the circuit. Set the function generator to produce a sinusoidal wave with an amplitude of 5 V, zero DC offset, and frequency of 2 kHz. Attach the function generator to v_i. Attach Scope channel 1 to v_i and Scope Channel 2 to v_o. Print out v_o and v_i trace.

2) Disconnect the function generator without changing the function generator and scope settings. Replace the 100 nF capacitor with a 1 nF one. Print out v_o and v_i.

3) Compare the two cases. What are your conclusions?