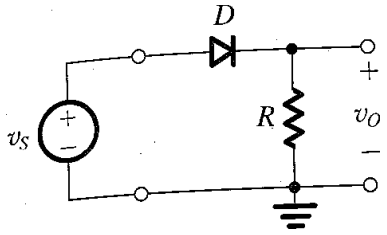
Lab 5
Diode Rectifier Circuits

Pre-Lab

1. Find the junction capacitances for the 1N4001 and the 1N4148.
2. Write the equation you need to compute the correct resistor size in step 14.
3. Derive a formula for estimating the size of the ripple from the capacitor size, the resistor size, and the period of the output (we did this in class).

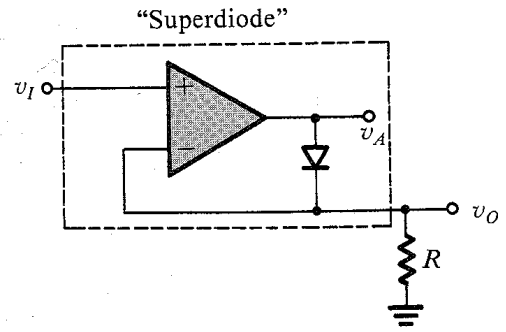
In this lab we will look at the voltage characteristics of rectifier circuits built from diodes.

Half-wave rectifier



1. Build the half-wave rectifier, using a 1N4001, and the function generator as input.
2. Apply voltage inputs between 1 V and 20 V at a frequency of 100 Hz. Plot two sample input and output waveforms, one set for small voltage, one for large voltage.
3. Make several measurements of, and plot, the peak output versus the amplitude of the input.
4. Discuss the results.
5. For a 1 V amplitude signal, increase the frequency to between 10 kHz and 1 MHz. Plot one or two examples of how the output changes as you increase the frequency. For example, make a plot at low frequency with some number of periods across the screen, then a plot at high frequency with the same number of periods across the screen, and compare the two. What do you see?
6. Replace the diode with a 1N4148. What changes?
7. What is the reason for the difference? Hint: diodes have capacitance associated with their junction, and the junction capacitance of the 1N4001 is larger than the junction capacitance of the 1N4148.

Super diode

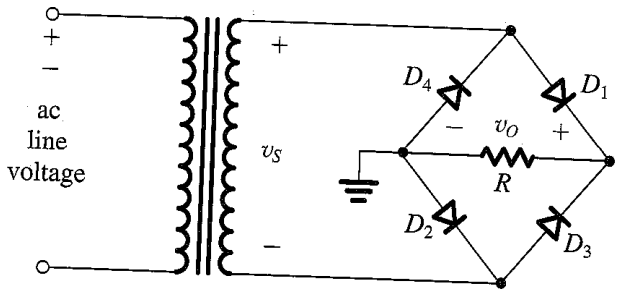


8. Build the super-diode circuit with the 1N4001 and using the function generator as input again. Make a note of the supply voltages you choose for the op-amp.

9. Apply inputs at 100 Hz with varying amplitudes as in step 2. Plot one example showing v_I, v_A, and v_O. Since the scopes have only two inputs, make two plots with v_I on both.

10. Discuss the reason why v_A looks the way it does. How is the output different from the half-wave rectifier?

Bridge rectifier



11. Build the bridge rectifier using 1N4001 diodes. Use a transformer to float the entire function generator, and attach the oscilloscope ground as shown in the figure.

12. Apply both a small and a large amplitude input voltage at 100 Hz and plot the input and output together. To get the input to the oscilloscope you will need to connect the second input probe and ground to the input through capacitors.

13. What is different about this output, compared to the output of the half-wave rectifier?

14. Attach a load and a large capacitor to the output. Size the resistor to get a time-constant which is many times (10-100) the period of the output.

15. Measure the ripple (AC couple) and compare to the theoretical prediction from class.

16. Next, choose a resistor to make the time-constant only 2 times the period of the output, and repeat the measurement and calculation.

17. Is the formula from class more accurate for large or small amplitude ripple?