Phy 415/515 Lab 4 2009 Diodes

1. Wavetek and Voltage probes

1.1. Breadboard

Connect the Wavetek "hi" output to the breadboard so that it is taking the place of a power supply. Create columns for +V and ground.

1.2. Measure voltage

Connect banana cables from the breadboard to the DVM, which should be set on the 20V scale. Check that the voltmeter reading changes with the dc offset, using the dc setting of the Wavetek.

1.3. Computer Voltage Probes

Connect the voltage probes using wires from the red and black alligator clips to the "+V" and ground columns of the breadboard. Calibrate the sensors:
Click on "calibrate" in the "experiment" menu. Select Ch1 and CH2 and then click "calibrate now". Set the DC offset on the Wavetek to zero. Enter the voltage displayed on the meter. Select "keep". Raise the voltage to about 5 Volts, enter the displayed voltage, and click on "keep". Click on "done".

1.4. Set collection rate

In the "experiment" menu, click on the "Data Collection" tab and set the experiment length to 0.05 seconds and the sampling speed to 4000 samples/s. Click on collect and make sure the probes are displaying the voltage properly on the computer as you change the dc offset. Remove DVM from the breadboard setup.

2. The Diode with ac input

2.1. AC

Set the Wavetek to 50 Hz with 3 V amplitude, centered at ground.

2.2. Diode

Wire the diode circuit Figure 1. Use the Germanium diodes with the two black stripes (the red ones seem to act slightly odd). Set black stripes in direction of arrow in circuit diagram. The Wavetek supplies the "Vs" through the breadboard column, which is measured with probe 1, and the output across the resistor is measured with probe 2. Set the plot to have time on the horizontal axis, and both probes on the vertical axis. Click on collect. **For what part of the sinewave input is there a sine wave output? How much is the output amplitude reduced compared to your input? Print your plot.**

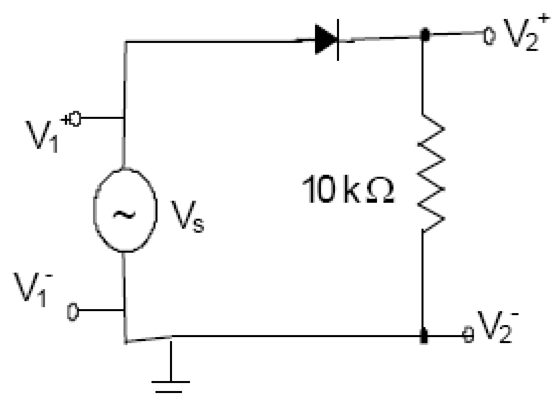


Figure 1. Diode circuit with computer probes.

3. Diode characteristic

3.1. Change the offset

Adjust the dc offset so that the input voltage (read on probe 1) oscillates from about -1 to +5 Volts.

3.2. Diode circuit: diode current vs voltage.

Move probe 1 to read the voltage across the diode, as shown in Figure 2. Click on the scales of the plot to change the horizontal scale to probe 1.
Change the vertical scale to eliminate 1 (so it is just probe 2). Probe 2 is still measuring the current through the diode by measuring the voltage drop across the resistor.

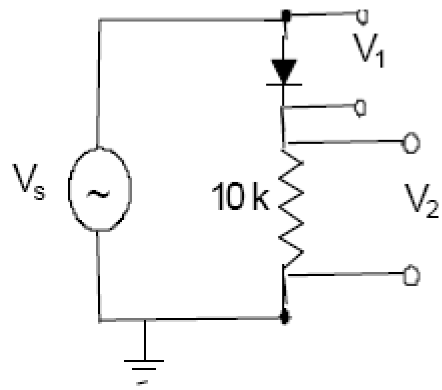


Figure 2. The diode characteristic circuit.

3.3. Diode characteristic.

Click on collect. You should see an abrupt "turn on" of the diode current when V_1 is about a half a volt. Because the noise is about 0.1 V, the signal will not be clean, but it should demonstrate the effect. Adjust the amplitude and dc offset of the generator and see the effect on the signal. **Print your plot.** Save your data to an Excel file. The easiest way to get a copy of the file is probably to email it to yourself using the available web connection.

3.4. Analysis (for later)

Plot the data and the diode function (from Prelab) in Excel (or some other software). Change the diode drop (V_o) in the theoretical function until you get a good fit. **What V_0 results in best fit? Print this plot.**

3.5. Zener

Replace the diode with a zener diode and repeat part 4.3 and 4.4. Adjust the DC offset so the breakdown region of the diode can be seen. **What is the turn on voltage? What is the breakdown voltage?**

3.6. LED

Replace the diode with an LED and repeat part 4.3 and 4.4. **What is the turn on voltage**?

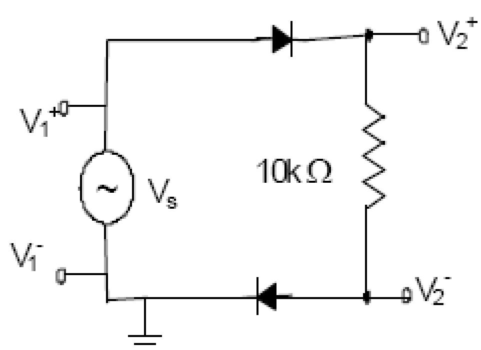
3.7. DC input

Switch the Wavetek to DC and observe the light as you adjust the DC offset. Use the DVM to determine the Wavetek voltage you need to light up the LED. **What is the turn on voltage?**

4. Power Supply

4.1. No rectifier

Move probe 1 back to the Wavetek, as in Figure 1. Turn off the dc offset. Replace the LED with the original diode. Set the dc offset to zero, and amplitude to 3V (frequency should still be at 50Hz).



4.2. Half-Wave rectifier

Add a second diode as shown in Figure 3. Note that it is important that probe 2 measures the voltage across the resistor, neither side of which is attached to ground. Reset Probe 1 to the vertical scale (vertical scale should now read probe 1 and probe 2) and time to the horizontal scale. Click on collect. **For what part of the sine wave input is there a sinewave output? How much is the amplitude reduced? Print your plot.**

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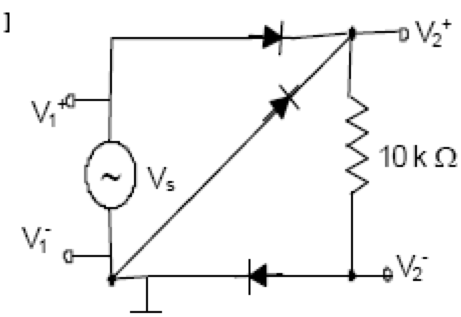

Figure 4. Half wave rectifier with an extra diode.

4.3. Almost a full wave rectifier

Add the third diode as shown in Figure 4. **Does it change the output?**

4.4. Full wave rectifier

Add the fourth diode, as shown in Figure 5. Note that where the two lines cross in the center of the circuit diagram is NOT a connection. Connections are black dots. This circuit is the same as that shown in Figure 6. Click on collect.

For what part of the sine wave input is there a nonzero output? What are the maximum and minimum output voltages?

4.5. DC output

Add a 4.7 μF capacitor in parallel with the resistor to the circuit as shown in Figure 7. Note: electrolytic capacitors explode if plugged in with reverse polarity. Do not do this. **What is the magnitude of the voltage ripple**?

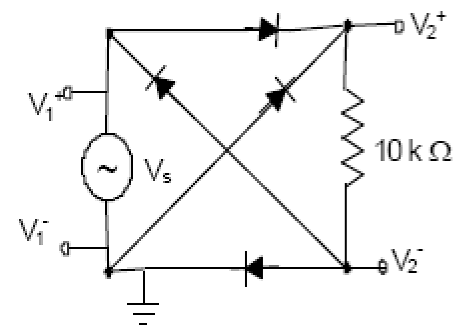

Figure 5. Fourth diode.

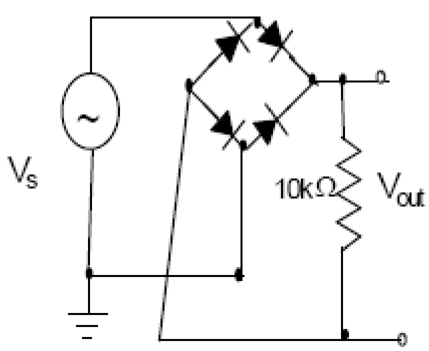

Figure 6. Full Wave Bridge Rectifier. the same as Figure 5.

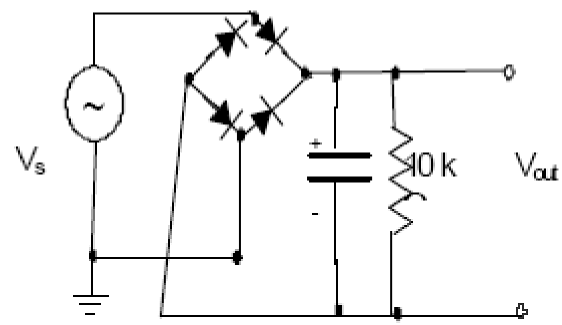

Figure 7. DC power supply.

Name: ____

Partner's Name: ____

2. The Diode with ac input

2.2. Diode

For what part of the sinewave input is there a sinewave output?

____

How much is the output amplitude reduced compared to your input? _____________________

3. Diode characteristic

3.4. Analysis

What V_0 gives the best fit? _____________________

3.5. Zener

What is the turn on voltage? ________________

What is the breakdown voltage? ______________________

What V_0 gives the best fit? ____________________

3.6. LED

What is the turn on voltage? __________________

What V_0 gives the best fit? ___________________

3.7. DC input

What is the turn on volyage? ___________________

4. Power Supply

4.2. Half Wave Rectifier

For what part of the sinewave input is there a sinewave output?

____

How much is the amplitude reduced? ________________

4.3. Almost a full wave rectifier

Does the output change? _____________

4.4. Full wave rectifier

For what part of the sinewave input is there a nonzero output?

____

What are the maximum and minimum voltages? Max ________________ Min __________________

4.5. DC output

What is the magnitude of the voltage ripple? _____________________