PHYS 605 Lab #6

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PHYS 605
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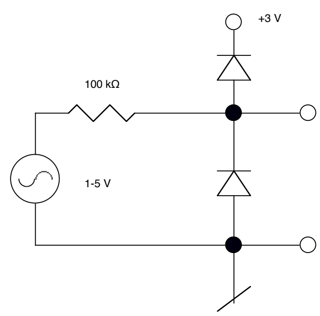
Diodes

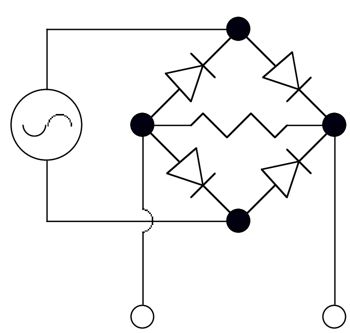
PART A: In two steps, build the following circuit. Step (1) does not include the upper diode to the 3 V reference voltage. That part of the circuit is open. For Step (2) insert the upper diode into the circuit. Both diodes should be the same part number (1N914 or 1N4148), depending on what is available.



For each step, sketch and label the output voltage wave form as a function of input amplitude (try varying the frequency of the input frequency, too, and comment on your observations). There is no need to use anything but a sine wave input, but you are welcome to try different waveforms once you have finished step (2). How would you use such a circuit?

PART B: READ ALL THE WAY THROUGH THIS PART BEFORE YOU BEGIN!! Many power systems use AC currents because it is easy to change the voltage using transformers. (The worlds electric power grids are huge examples.) On the other hand, electronic circuits use DC power, which means the AC power has to be converted into DC.

In Part A, you constructed a simple rectifier using a diode. Build the circuit below (a bridge rectifier) and measure its characteristics. How does it compare with the rectifier from Part A? Is it more efficient in terms of passing power onto a circuit? If so, why and by approximately how much?



For each step, sketch and label the output voltage wave form as a function of input amplitude (try varying the frequency of the input frequency, too, and comment on your observations). There is no need to use anything but a sine wave input, but you are welcome to try different waveforms once you have finished step (2). How would you use such a circuit?

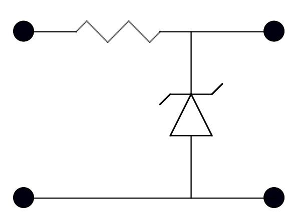
GROUNDING: One complication with this circuit is grounding. It is important to avoid having the *ground* side of the 'scope connected to both an input lead and an output lead; this would modify and possibly damage the circuit and/or the equipment! In other words, if the input signal went to channel 1 on the scope and the output to channel 2, the ground sides would connect (short) an input line to an output line internally and you would no longer have the circuit as drawn.

For this same reason, you will not be using the signal generators on you proto-boards as *they* are grounded through the third prong to the building ground. Some signal generators anticipate this problem and allow the user to disconnect the ground so that the generator "floats". We have a batch of old signal generators with this feature. On the back you should find two screw-down contacts (often marked with two different ground symbols) with a metal bridge connecting them. Remove this bridge (unless it is missing) and put it aside. Please do not lose it! You should put it back when you are done. Connect this signal generator to your circuit and all should work.

IMPORTANT:

1. Do NOT plug the circuit into your proto-board! Even with the power off, you can still have problems with the ground. Let it float.
2. Use only one channel and one set of leads, on the scope. You can attach it to the input to measure what goes into the circuit, then to the output. This way you cannot accidently create a ground loop through the scope.

PART C: Zener diodes differ from ordinary diodes in being able to "turn-on" at a certain reverse bias without damage. They are often used to regulate voltages (i.e., to provide a "voltage source" or to limit voltages. Build the circuit below. The size of the resistor does not matter greatly, around 1 kΩ should work.



First, explore the response to variable voltage DC inputs. Map out the output voltage vs. input voltage in as best you can. Try the circuit with a sinusoidal input. Does this look as you would expect?

Try this circuit with a different Zener diode. How do the responses compare? Put the two in series in the same direction; how does the response change? One use of Zeners is to "clip" an AC signal. Modify your circuit to clip both the positive and negative portions of the AC input.