VANIER COLLEGE - Computer Engineering Technology
247-205 Circuit Analysis and Simulation II

Lab 7: Diode and Rectifiers

Purpose:

a) To examine the characteristics of a silicon diode.
b) To demonstrate the application of diodes as rectifier

To be submitted:

1. **Deadline**: At the end of the lab session, submit the hardcopy of the result/report.
2. **No formal report required**.
   a. Answer all the questions in the lab in the blank space provided. If calculation is involved, clearly show all the working steps involved.
   b. Attach table/plot, screen shots, to the lab sheets, clearly labelled, whenever apply.
   c. Include a final discussion and conclusion session.

Equipment:

Oscilloscope, multimeter, waveform generator, resistors, capacitor, variable DC power supply.

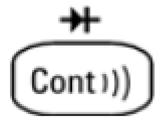
Theory:

When a diode's anode is at higher potential than is the cathode, the diode is forward biased, and current will flow through the diode from anode to cathode. Unlike a resistor, in which the current is directly proportional to the voltage across it, the diode is a ***nonlinear*** device. When the diode is forward biased, a small but infinite voltage drop, called the barrier potential, occurs across the diode. For germanium diodes, this value is typically 0.3 V, for silicon diodes, it is approximately 0.7 V.

Lab Work:

Part 1: Diode basic characteristic

1. DVM can be used to perform a quick test on diode. Using the standard Main Input (HI and LO) Terminals, and continuity measurements button as shown below, perform a continuity test on a new diode 1N914 (hint : try to test by reversing the DVM leads too). Explain your findings and observations.



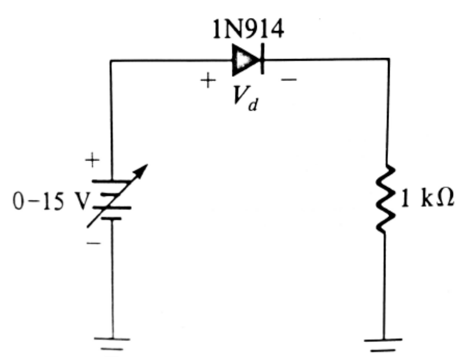
The continuity function on the digital millimeter is designed to test diodes. Placing the digital millimeter into continuity mode, I tested a 1N914 diode. The diode conducts 0.6V one way and doesn't conduct the other way. This is because the current flows only one way with this type of diode.

2. Wire the circuit shown in figure below. Design and perform a set of procedures to obtain the diode characteristic curve (I vs Vd) for forward bias only, as seen during the theory session (note of week 5, page 10).

   Briefly describe the procedures conducted. Show all the details of your experimental data collection, and plot the corresponding characteristic curve.

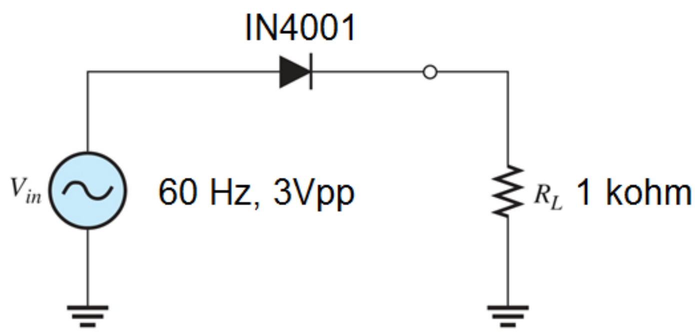
   Refer to attached excel spreadsheet for graph

   The trick to doing this question is to take incremental steps. Essentially, between 100mV and 15V, measurements for I and Vd were taken. The values for each measurement when taken was placed into an excel spreadsheet to create a visual representation of the diode characteristic curve. The result was a positive diode characteristic curve (forward biased only).



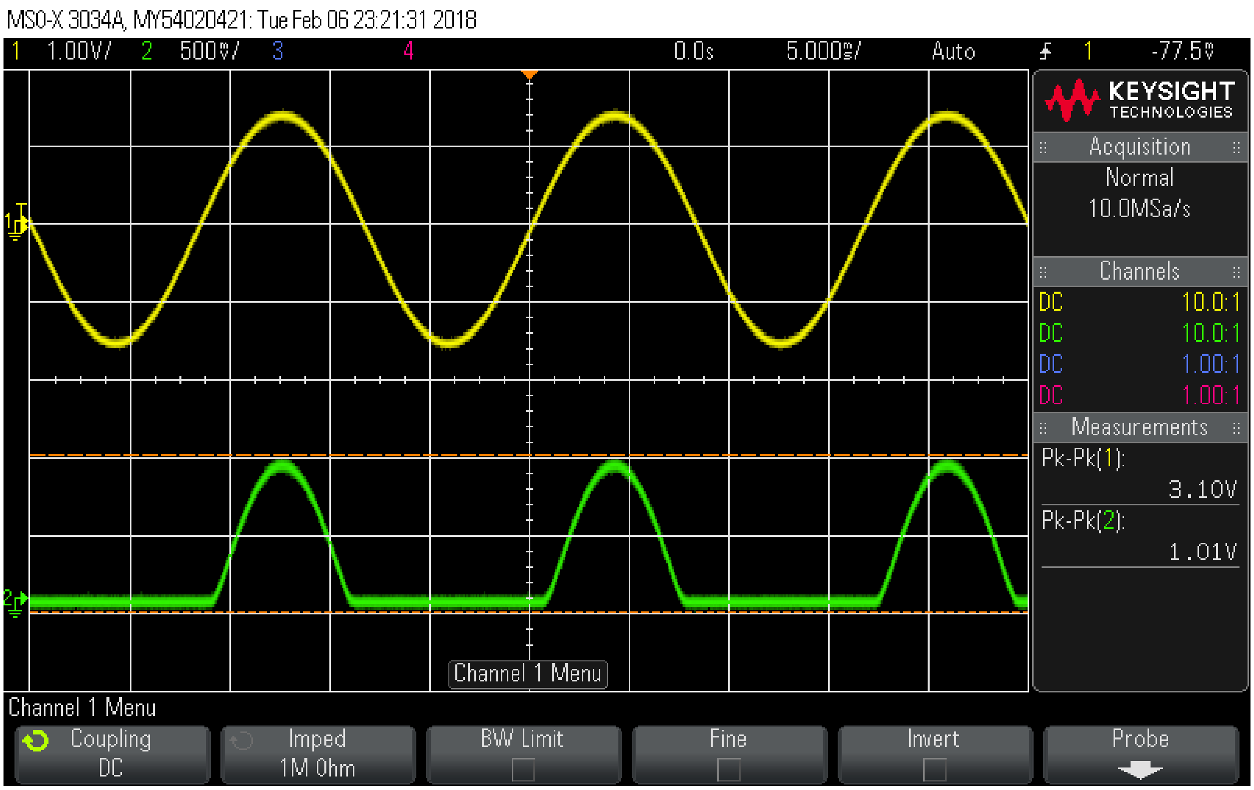
Part 2: Half wave rectifier

3. Wire and setup the half-wave rectifier circuit as shown below.



4. Connect channel 1 of oscilloscope to Vin, and channel 2 across R_L. Observe the 2 waveforms and perform a screen shot. Explain the waveform

   The waveform I am seeing is the waveform from the waveform generator (on channel 1: yellow) and the half-wave rectifier waveform (on channel 2: green). The reason why the two waveforms are not the same is because this circuit is a half-wave rectifier. The diode is forward biased causing only positive cycles to appear on channel 2.



Half-wave rectifier circuit (Yellow: waveform generator, Green: output from resistor)

5. Measure the Vin peak voltage, as well as the peak voltage across the resistor. Are the 2 readings the same? Explain your observation.

   The peak voltage is roughly 3.10V_P for the Vin peak voltage. Also, 980mV_P for the peak voltage across the resistor. As you can see, the readings are not quite the same. The peak voltage across the resistor is nearly 2.5x less than the Vin peak voltage. The difference lies between the 1N4001 diode and 1kΩ resistor. Refer to screenshot above for measurements obtained.

6. Using DVM, measure **dc voltage** across the resistor, and record your result. Compare this result with that obtained from the equation for the average voltage of a half-wave rectifier. Comment on your results and findings.

   The measured DC voltage across the resistor was ~225mV.

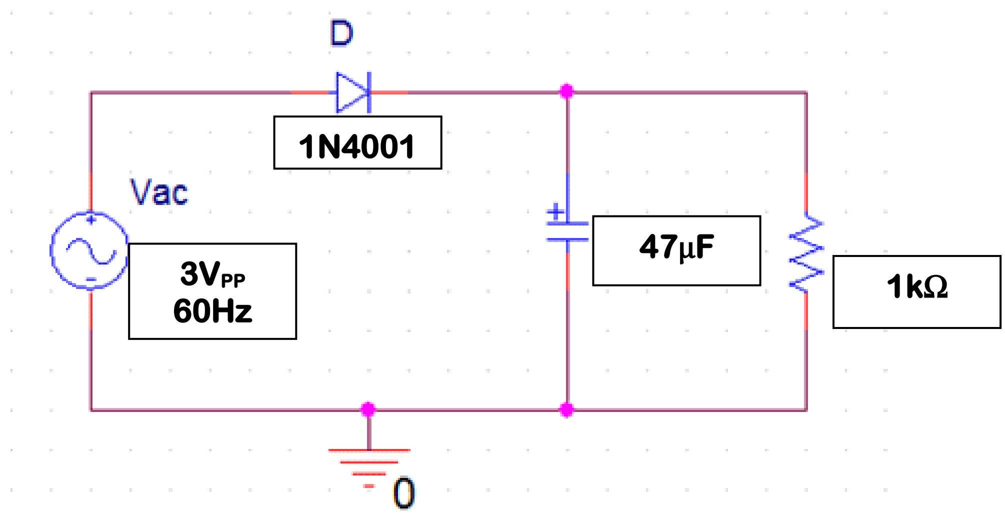
$$V_{AVG} = \frac{V_P}{\pi}$$

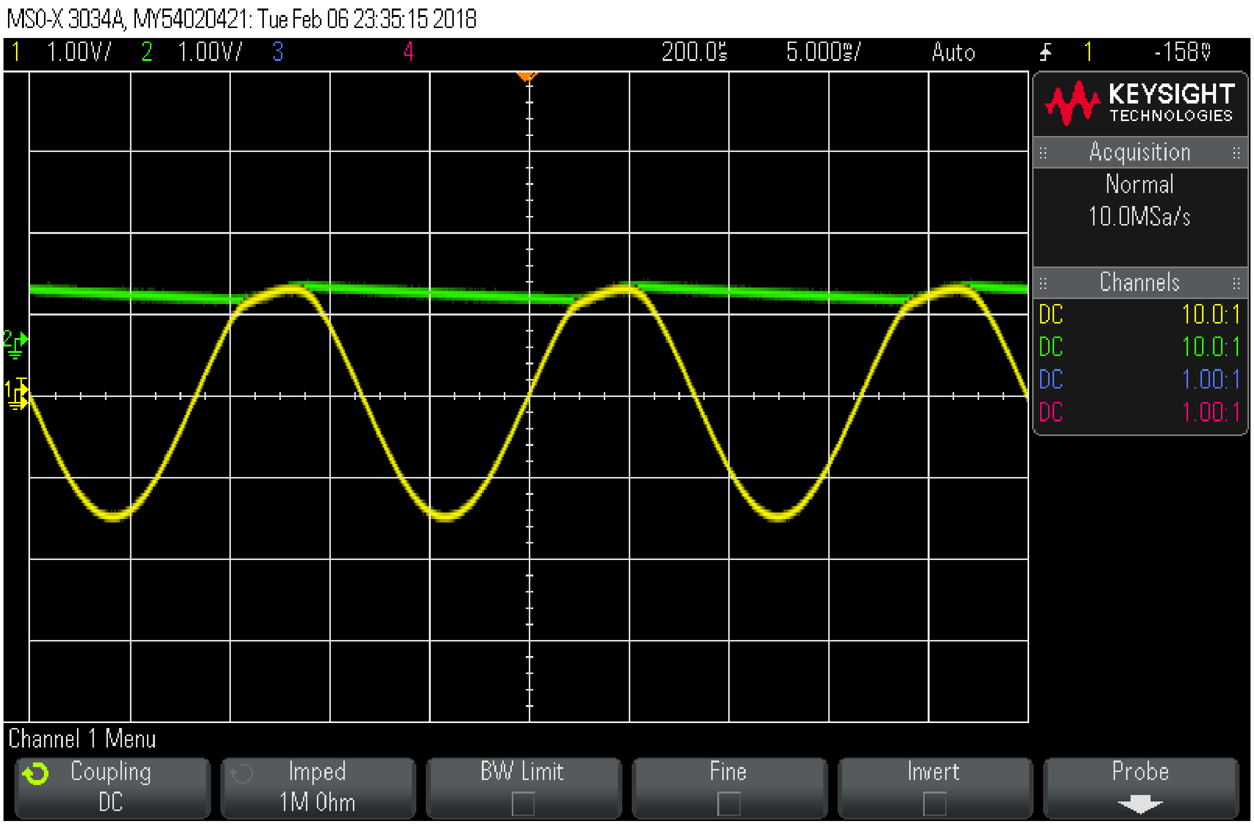
$$V_{AVG} = \frac{980mV}{\pi}$$

$$V_{AVG} = 300mV$$

   My measured result was not as close to my calculated values. I measured 225mV across the resistor and 300mV was my theoretical value. The values are not close, but confirm my findings. When using the DC multimeter, the reading is supposed to represent the V_{AVG} of the waveform.

7. Add a simple 47µF capacitor filter at your pulsating output voltage. Draw this circuit in your lab report, and **verify with your instructor**. Perform a screen shot and explain your waveform.





Half-wave rectifier circuit with 47μF filtering capacitor

Comment: *The waveform being displayed here is the result of a simple rectifier circuit. The AC signal (Yellow) is being converted into an almost linear DC signal (Green). The added 47μF capacitor is the magic behind making this possible. The 1N4001 diode creates a half-rectifier circuit, then the added capacitor filters out the rectified signal into an almost linear DC signal.*