Electrical and Computer Engineering Department

Written by:

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ECE 2200L:

Experiment Number 4

Some Applications of the PN diode

Represented to

Professor Mostafa Yazdy

Fall 2024

Thursday

September 26th, 2024

Introduction

Background Information:

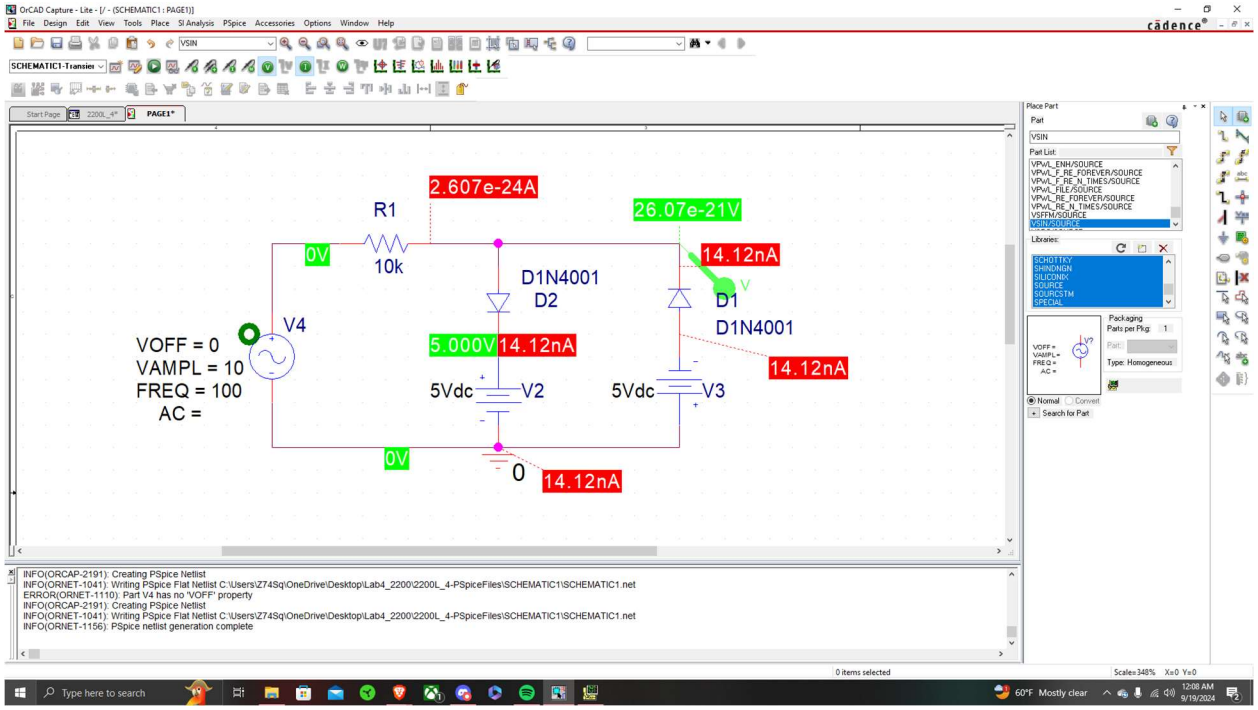
A PN Junction Diode is a basic semiconductor device characterized by its ability to allow current flow in only one direction. When the diode's positive terminal exceeds the voltage of the negative terminal, it operates like a voltage source. Conversely, if the positive terminal is lower than the negative terminal, the diode acts as an open circuit, preventing current flow. Utilizing this principle, a rectifier will be designed, consisting of two diodes in parallel with opposing polarities and a resistor connected in series with the entire rectifier circuit.

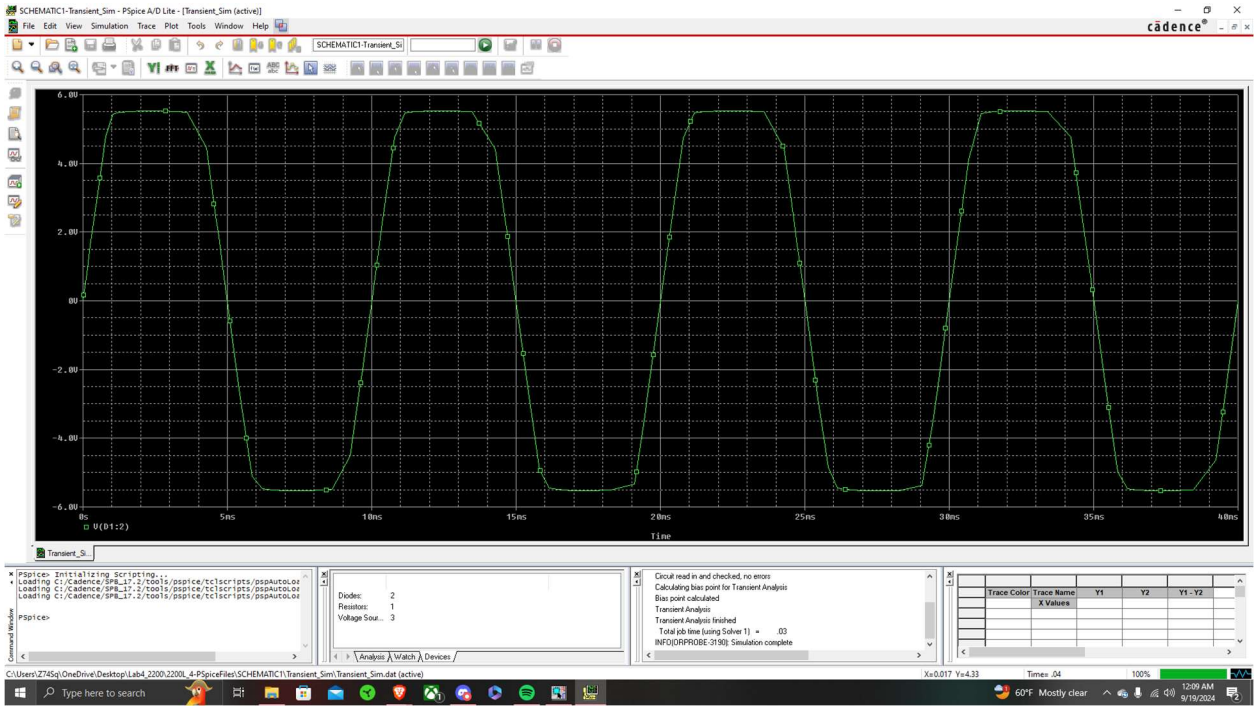
Objective:

To experiment on some examples of the applications of PN diodes as non-linear circuit elements. Specifically, rectifiers, peak detectors as DC power supplies, and clippers/limiters will be studied.

Pre-Lab:

1) For Figure 3, run “Transient Simulation” to display V_{in} and V_{out} for the input voltage (Sinusoid) of 100Hz frequency and 5V amplitude.





Lab Report:

1. ***Figure 1:***

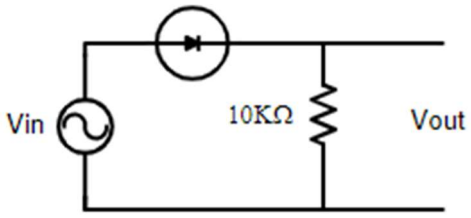
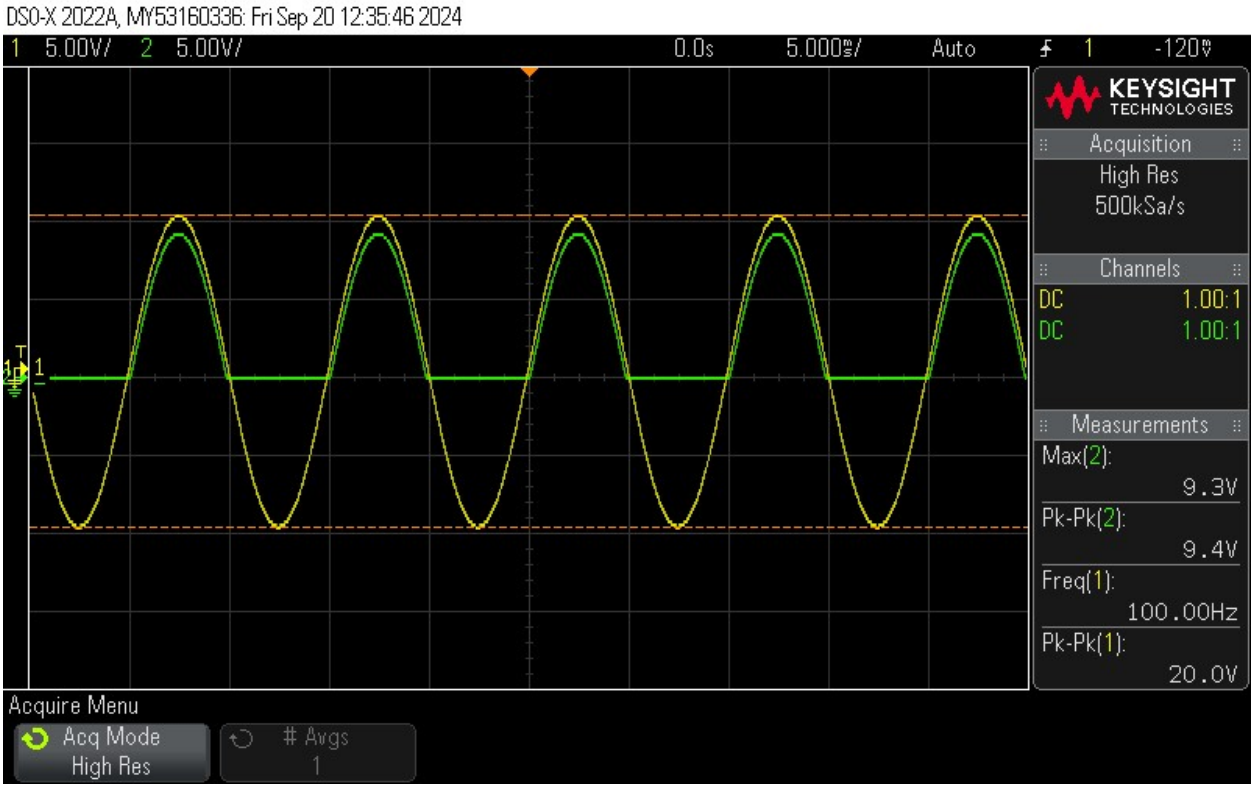


Figure 1

Captures:



Capture 1.2: Oscilloscope image representing V_{out} and V_{in} at $5V_{pp}$

Table of Data:

Part1	
R	
9.97E+03	
Vin(pk)	Vout(pk-pk)
1	5.28E-01
1.5	9.90E-01
2	1.48
2.5	1.97
5	4.45
7.5	7
10	9.4

2. ***Figure 2:***

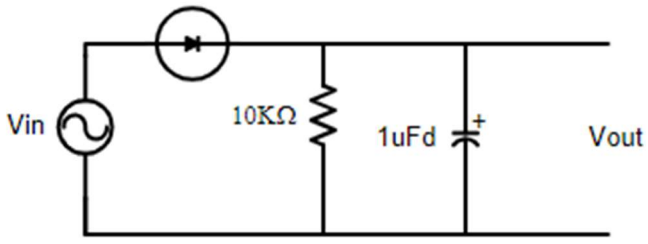


Figure 2

Captures:

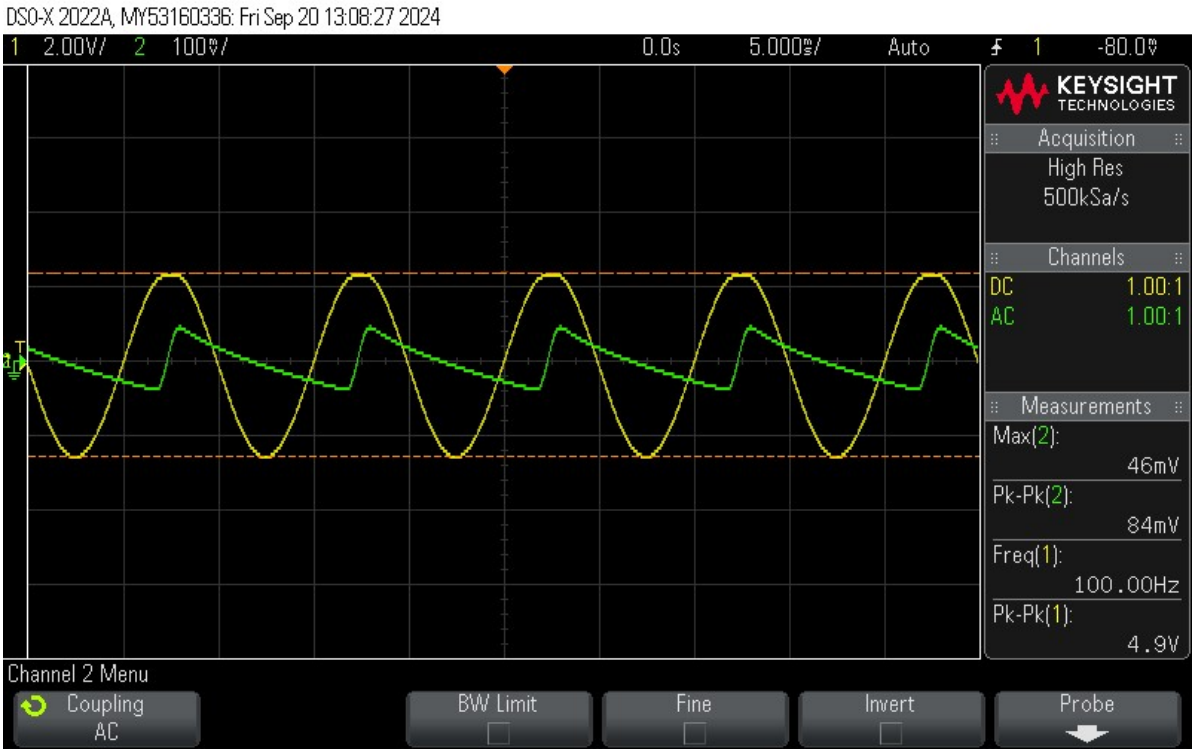


Figure 2.1: Oscilloscope image representing V_{out} and V_{in} for $C = 1\mu F$ $f = 100Hz$ and $R = 10k\Omega$

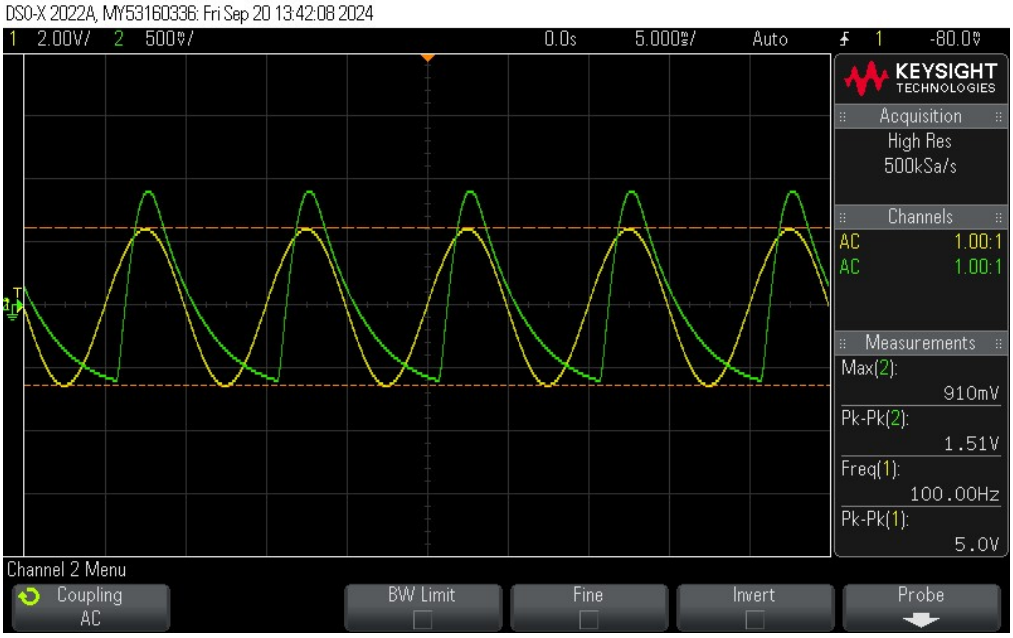


Figure 2.2: Oscilloscope image representing V_{out} and V_{in} for $R = 1K\Omega$ $f = 100Hz$

Table of Data:

$frequency\ (Hz)$	$V_R\ (V)$
100	1.12
500	0.82
1000	0.184

$Capacitance\ (C)$	$V_R\ (V)$
$1\mu F$	1.023
$20\mu F$	0.084

$Resistance\ (R)$	$V_R\ (V)$
$10k\Omega$	1.12
$5k\Omega$	1.51

3. *Figure 3:*

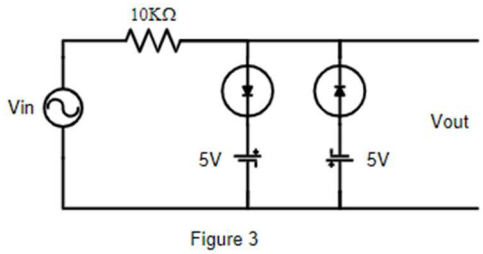


Figure 3

Captures:

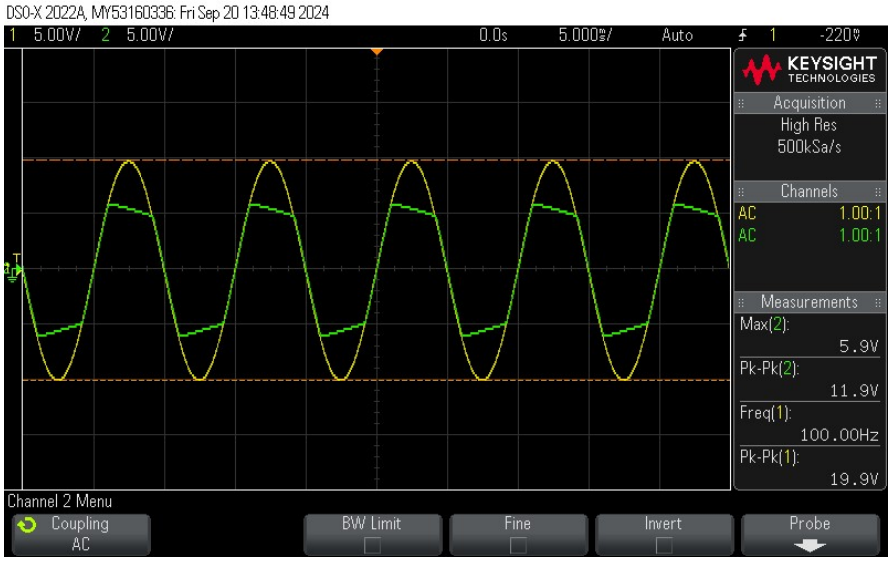
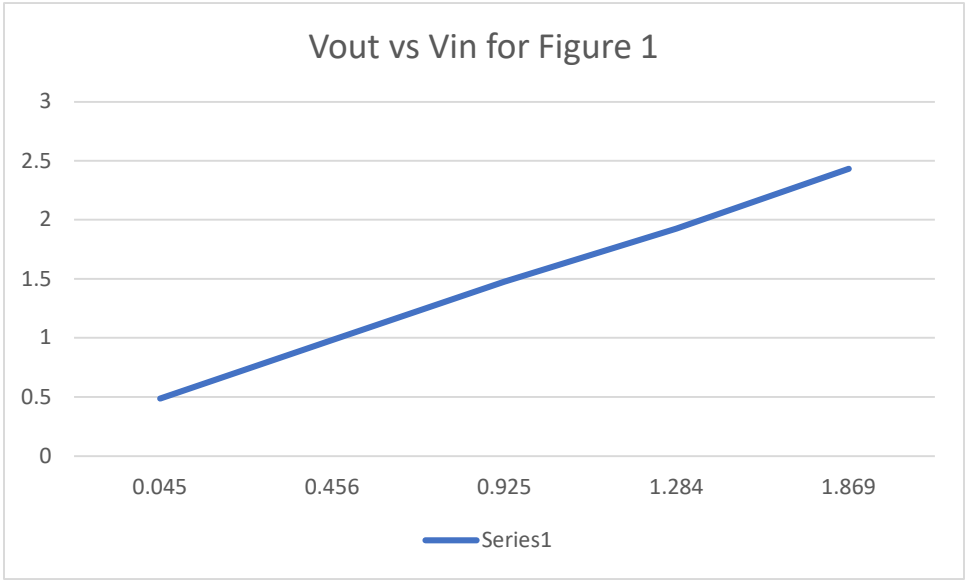


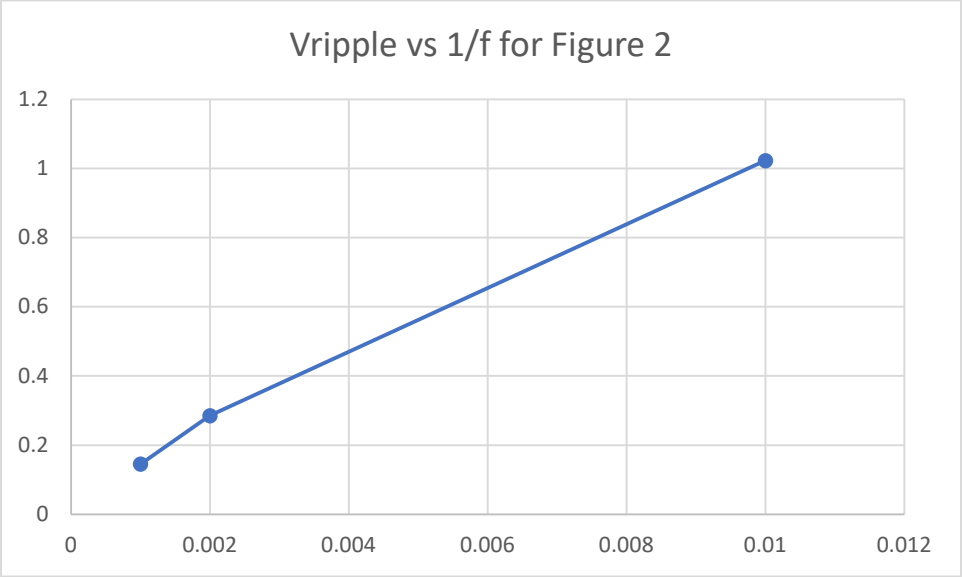
Figure 3.1: Oscilloscope image representing V_{out} and V_{in} for Figure 3 at $5V_{pp}$

Data Analysis:

1. Plot the peak output voltage vs the peak input voltage for figure 1.



2. Plot the peak-peak ripple voltage vs. reciprocal of frequency characteristics for the data taken for Figure 2.



Conclusion:

In this experiment, we constructed three circuits in the lab. The sinusoidal voltage source was increased from 1V to 5V, with the frequency set at 100 Hz. We measured the output voltage relative to the input voltage and observed that when the sinusoidal voltage reached a certain level, the diode consumed 0.7V, with the remaining voltage dropping across the resistors. To achieve more stable and accurate readings, a capacitor was connected in parallel with the resistor. Additionally, we plotted the ripple voltage as a function of the inverse of the frequency (1/f) and found that it formed a straight line with a positive slope, indicating a direct proportionality between ripple voltage and the inverse of the frequency. We can also see that from the equation:

$$V_R = \frac{V_{DC}}{f.R.C}$$