The City College of New York

EE 22100 EE Lab#4

10/18/2017

Experiment 4: Superposition

Fall 2017

Instructor: Obinna Igbe

Report: Shamim Babul & Hasibul Islam

Objective

The experiment of this lab to understand superposition principle, and determine what type of circuit follows or does not follow the superposition principle.

Introduction

All linear systems follow the superposition theory which states that when using multiple sources, the output voltage or the current in a linear system should be equal when adding up the voltage/current when one of the source is on.

Materials:

1. 2 22k resistor
2. 2 10k resistor
3. 2 1k resistor
4. 0.1 μ Capacitor
5. Diode
6. Digital Multimeter
7. Oscilloscope
8. Function Wave generator
9. Power generator

Part 1: Experiment Procedure

First we placed the circuit, shown in figure 1, on the breadboard. Using the power generator, we connected the 8V and 4V source onto the circuit. Then using the DMM, we measured the Vout which is in node 2. After that we took out the 8V Voltage source and placed the circuit shown in figure 2 on the breadboard. Then, we took the measurement of Vout1. Next,

we took out 4V voltage source and placed the circuit in figure 3 on the breadboard. Then, we took the measurement of Vout2.

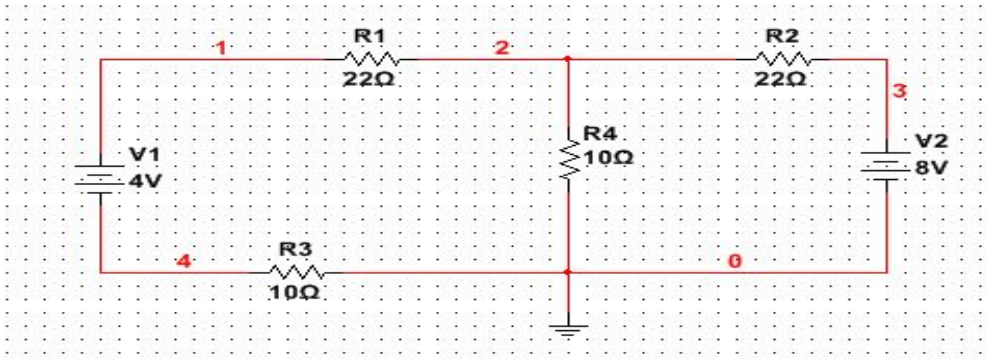

Figure1: Circuit to investigate the Superposition Principle

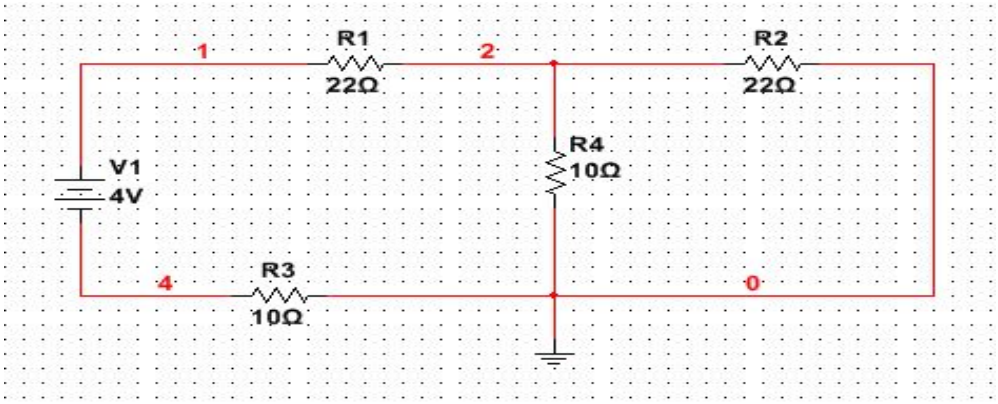

Figure 2: Reduced circuit with right source

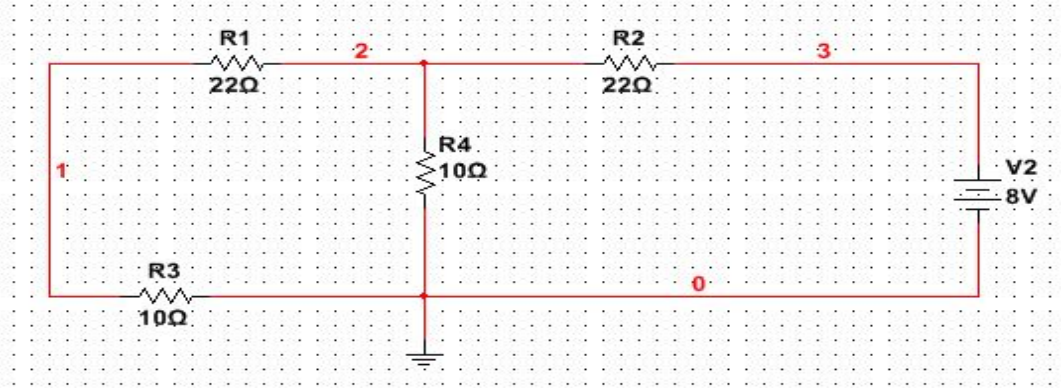

Figure 3: Reduced circuit with left source shorted

Part 2: Superposition with Capacitors

For this part we placed the circuit on figure 4 in the breadboard. We used the power generator to supply the 4V DC voltage and the function generator to generate the AC voltage with the following settings: V OFF=0, V AMPL=1Vpp, FREQ=10kHz. Then using the DMM we measured the Vout. After that we turned the DC voltage off, and measured the Vout1. Then we took out the AC voltage off and turned back the DC voltage and measured the Vout2.

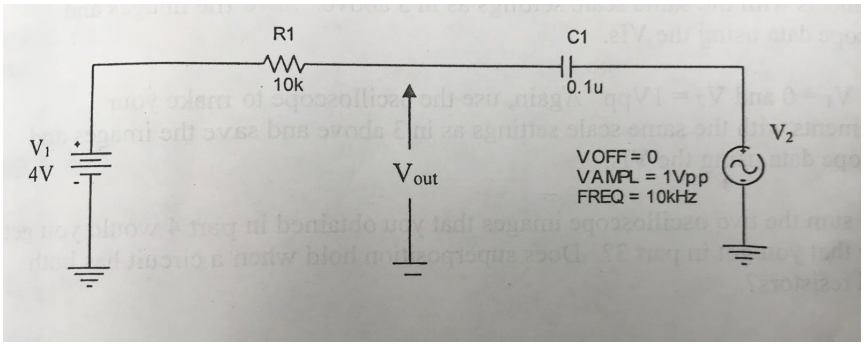

Figure 4: Circuit to investigate superposition with capacitors

Part 3: Superposition with Diodes

For this part we checked to see if diodes follow the law of superposition. First, we placed the same circuit shown on figure 5. Then connected two 4V DC source using the power generator. For the first part, we made the white line of the diode to be near the ground side. Then using the multimeter when both sources are on we measured the Vout. For the next part we measured Vout when one of the source was off. We repeated the experiment using the white part of diode to be near the power side rather than the ground side.

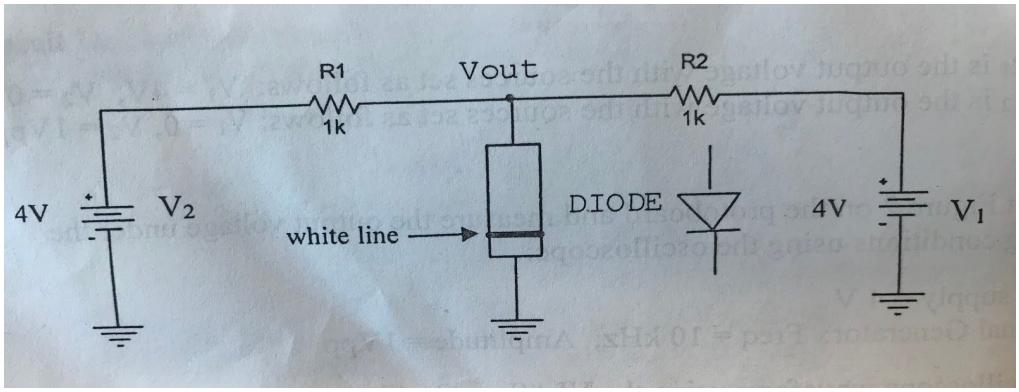

Figure 5: Circuit to investigate superposition with diodes

Data/Analysis/Question

Part 1:

When both sources are: Vout = -1.3529

When only the 4V was on: Vout1= 0.70020 v

When only the 8V was on: +Vout2= -2.0530v

Vout1+Vout2=-1.3528

Part 2:

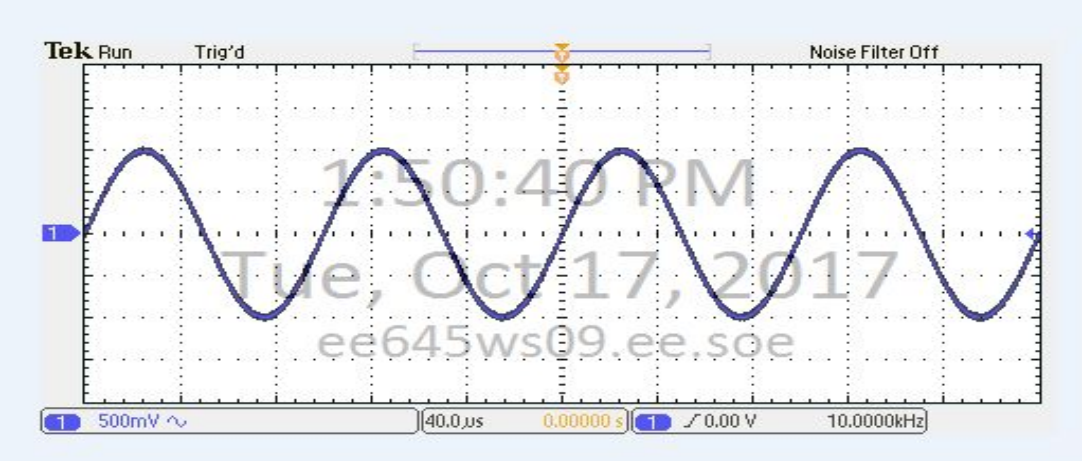

Figure 6: Graph from the oscilloscope when both AC and DC source were on.

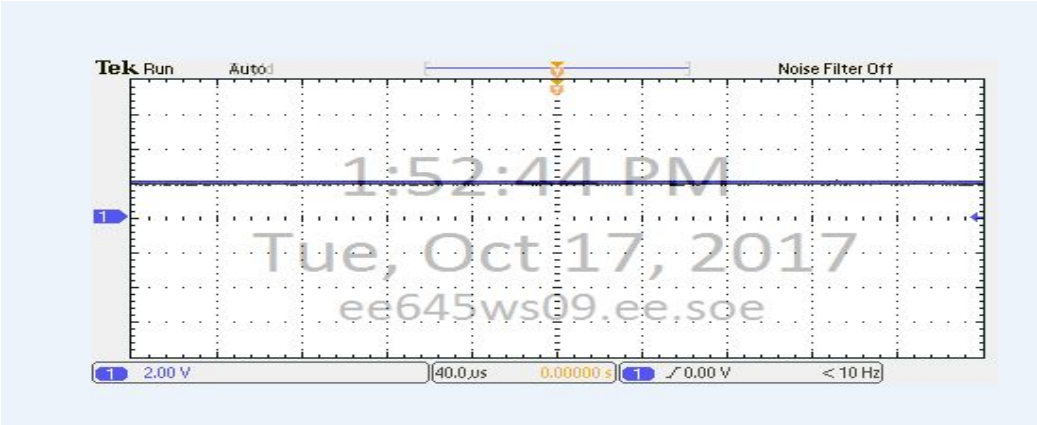

Figure 7: Graph from the oscilloscope when only the DC source was on

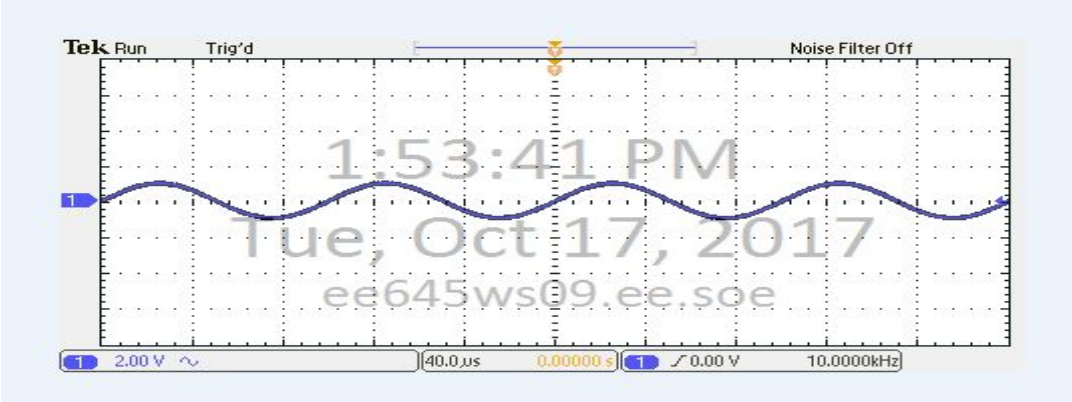

Figure 8: Graph from the oscilloscope when only the AC was on

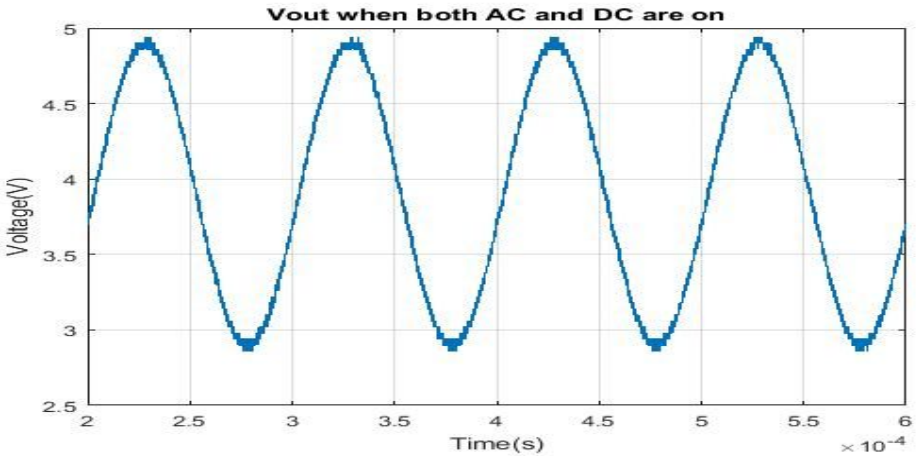

Figure 9: Graph from MATLAB when both sources are on

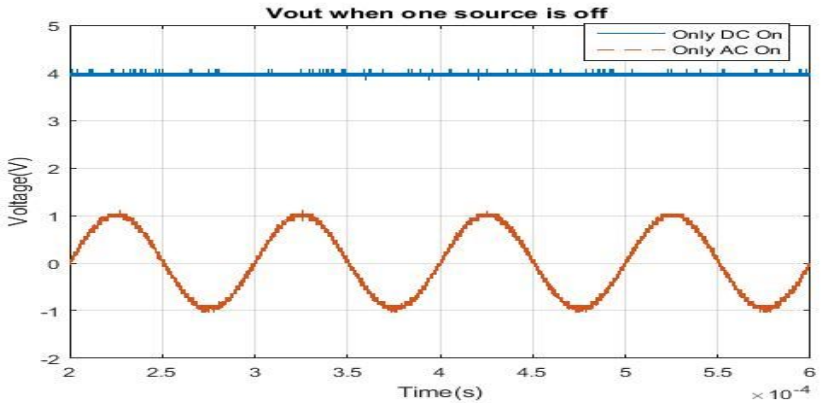

Figure 10: Graph from MATLAB when one source was on at a time

Part 3:

White line towards ground

- Vout = 0.6578

  Vout1 = 0.64877

  Vout2 = 0.6498

White line away from ground

- Both V1+V2 = 3.9988

  V1 = 1.99

  V2 = 2.00

Analysis

For the first part with the 4 resistors and two DC sources the superposition theorem holds because we got Vout equals to the sum of Vo1 (when left source is on only) and the Vo2 (when right source is on only).

For the second part with the capacitors, the superposition theorem also holds. When you add the graph from when the DC source is only on with the graph when the AC source is only on, you will get the almost the same graph when both are on.

For the circuit with the diodes, the superposition theorem doesn't hold. When the white line is towards the ground, Vout1 and Vout2 doesn't add up to the total Vout. This is because diode doesn't have the linearity as the other resistors and the capacitors. But when the diode's white line is away from the ground the superposition holds.

Conclusion

By performing this lab we were able to understand the law of superposition. We learned that law of superposition doesn't hold unless it is a linear system, which is shown by the circuit with the diodes. The theory does hold when dealing the capacitors and the resistors.