Feng Chia University

Electrical Engineering Fundamentals I Lab

# Laboratory 11

# Diodes Circuit Applications Clipper and Clamper

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I. Introduction

a. Understand the circuit structure and function of the clipper circuits and clamper circuits.

b. Understand the meaning of the voltage transfer characteristics (VTC).

II. Materials

a. DC Power Supply

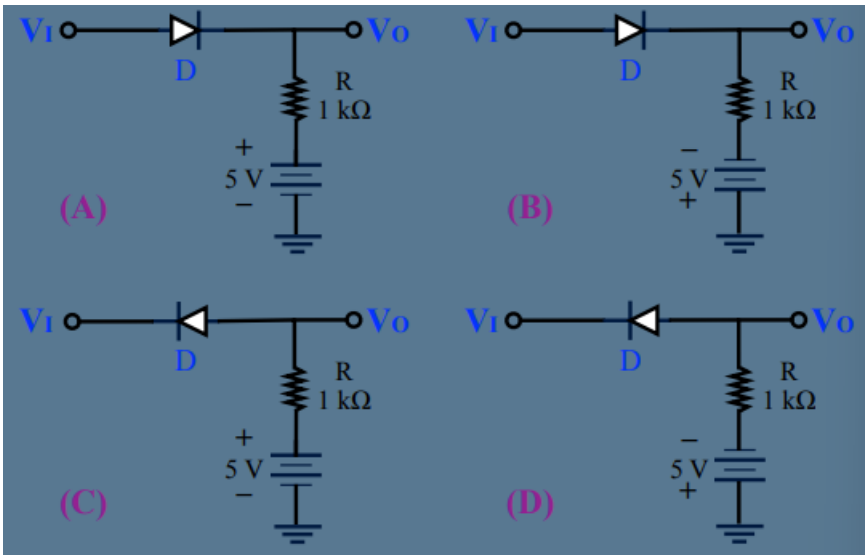
b. Waveform Generator

c. Digital Oscilloscope

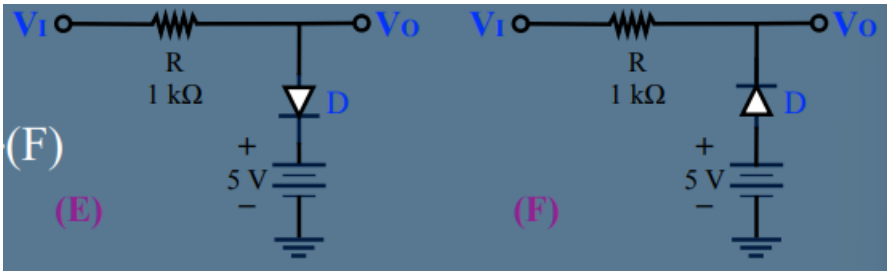
d. Devices

1. Resistors: R = 1 kΩ × 1
   Diode: D = 1N4007 ×1, 1N4148 × 1
2. Resistors: 1 kΩ × 4
   Diode: D = 1N4007 ×4, 1N4148 × 2
3. Resistors: R = 20 kΩ × 1
   Capacitors: C = 1 μF × 1
   Diode: D = 1N4007 × 1

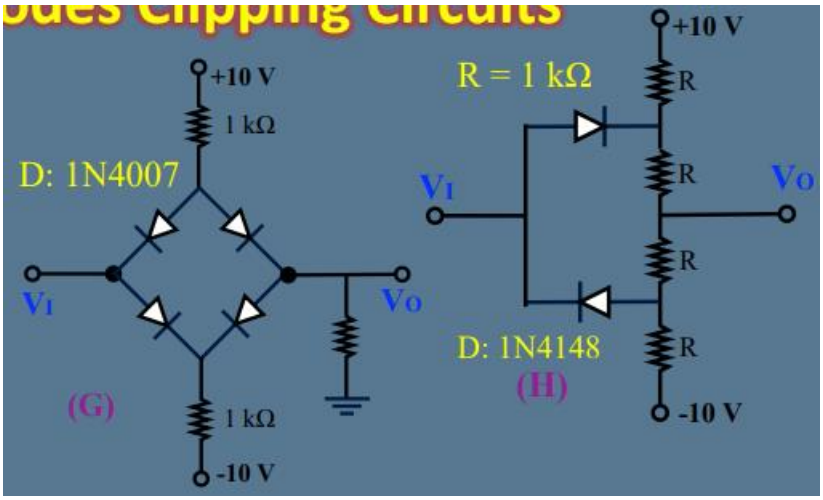
III. Circuit diagram




▲ Figure 1. Circuit of Experiment 11.a.1 Clipper Circuits Series Connections




▲ Figure 2. Circuit of Experiment 11.a.2 Clipper Circuits Parallel Connections




▲ Figure 3. Circuit of Experiment 11.b Multiple Diodes Clipping Circuits

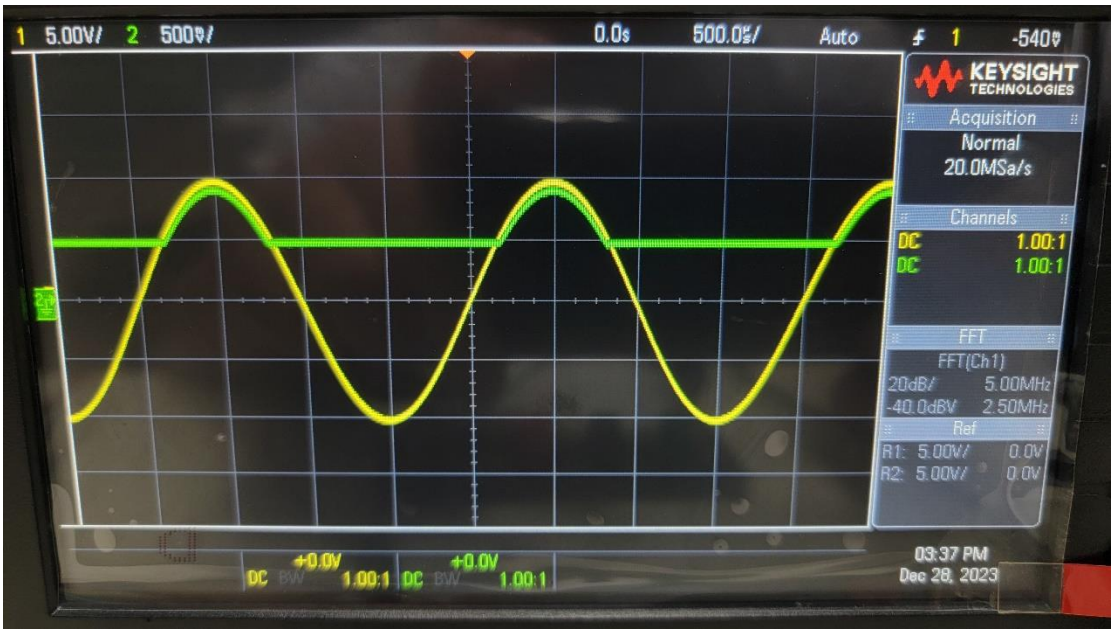
## IV. Methods

Using Digital Oscilloscope to observe the wave through diode.

## V. Experiments data

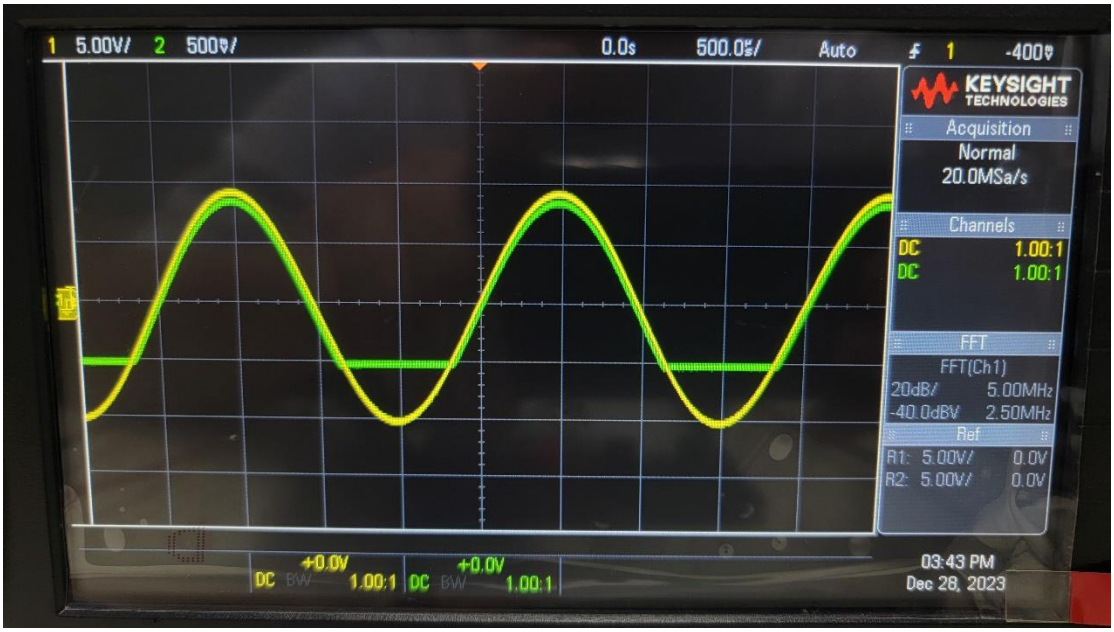
None

## VI. Results

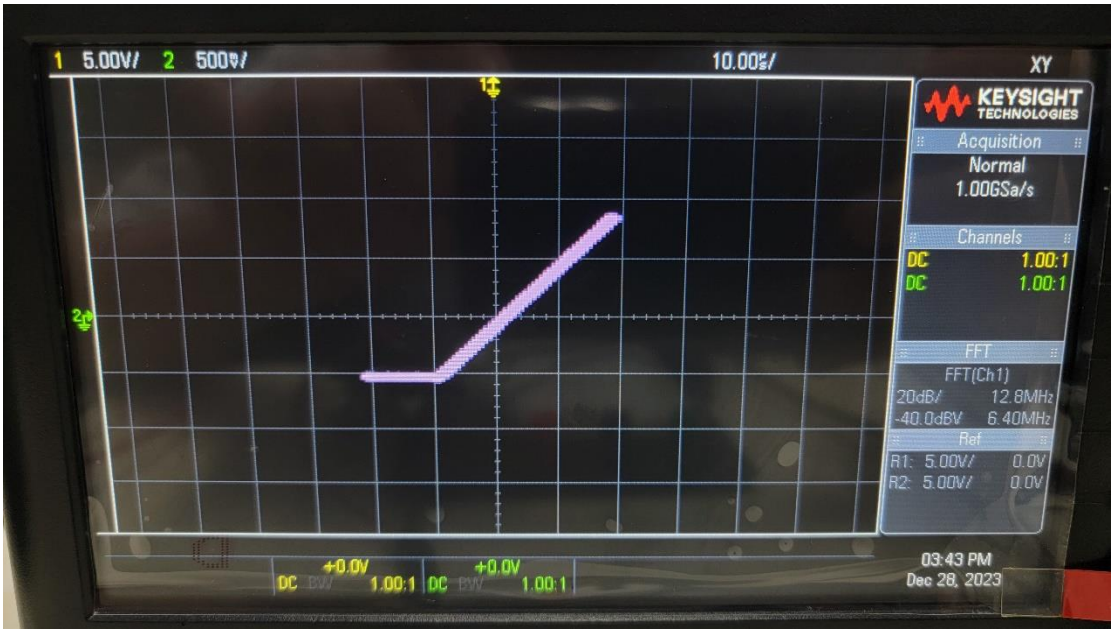



▲ Figure 4. Waveform comparisons of Experiment 11.a.1(A) with 1N4007

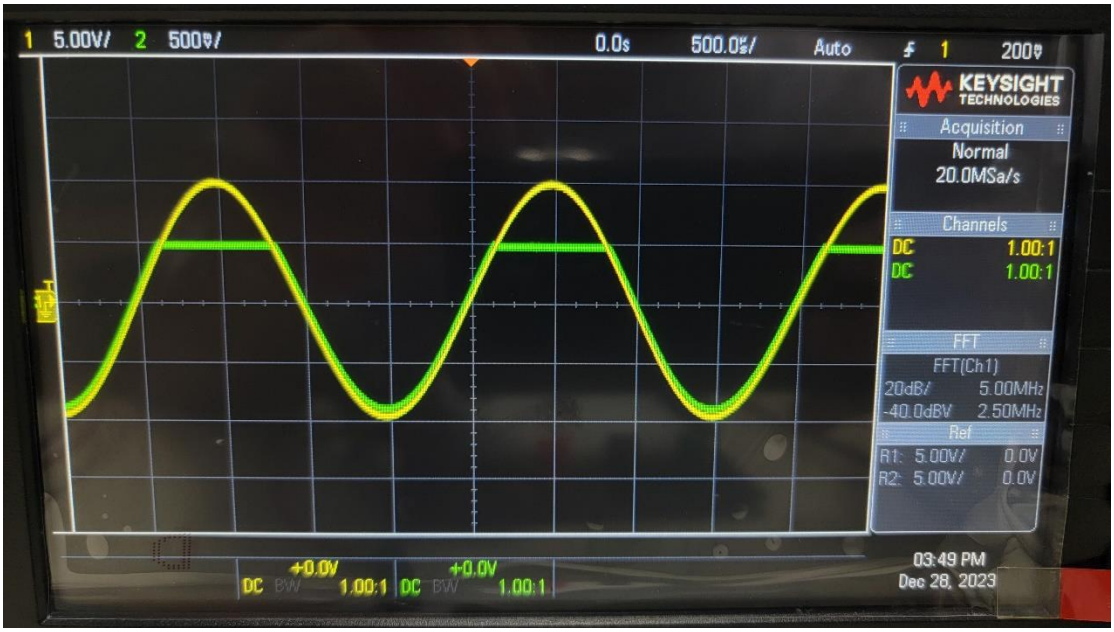

▲ Figure 5. Voltage Transfer Characteristics of Experiment 11.a.1(A) with 1N4007



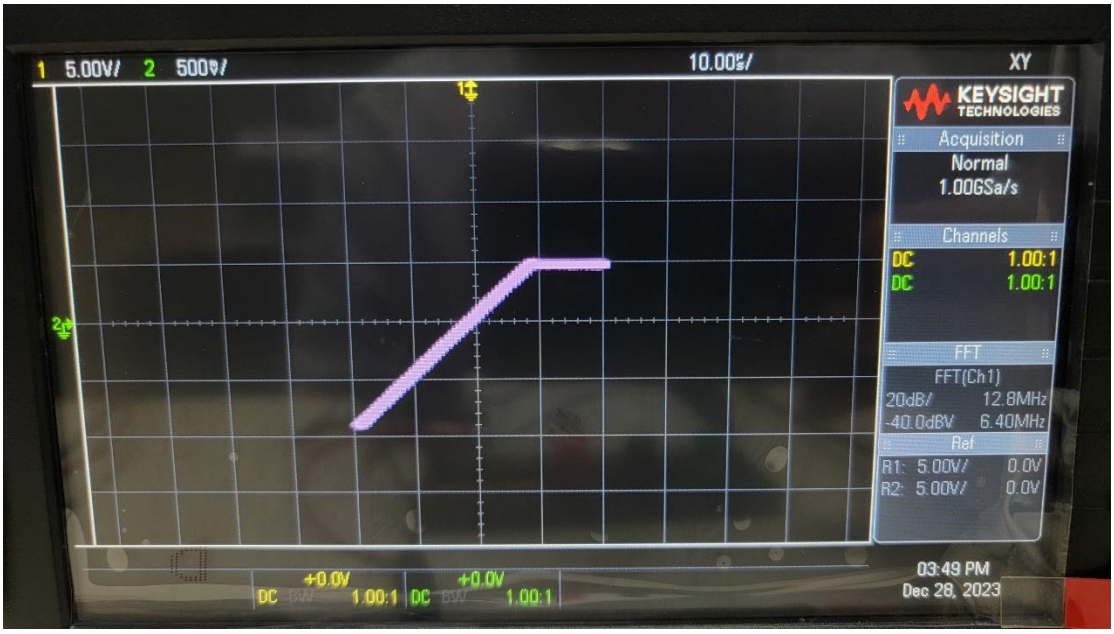

▲ Figure 6. Waveform comparisons of Experiment 11.a.1(B) with 1N4007



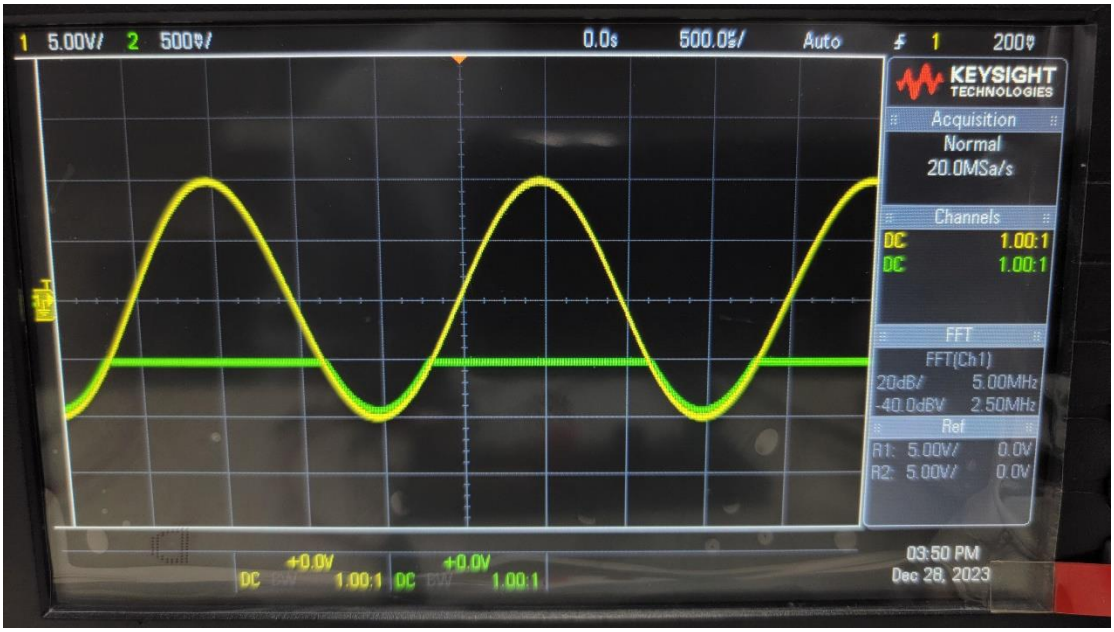

▲ Figure 7. Voltage Transfer Characteristics of Experiment 11.a.1(B) with 1N4007



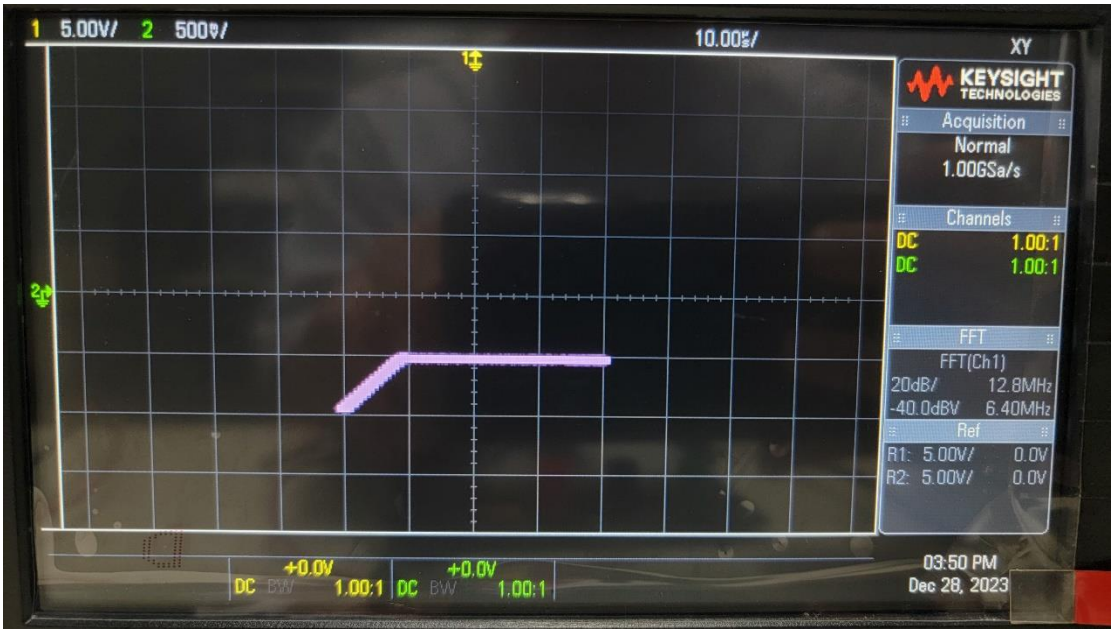

▲ Figure 8. Waveform comparisons of Experiment 11.a.1(C) with 1N4007



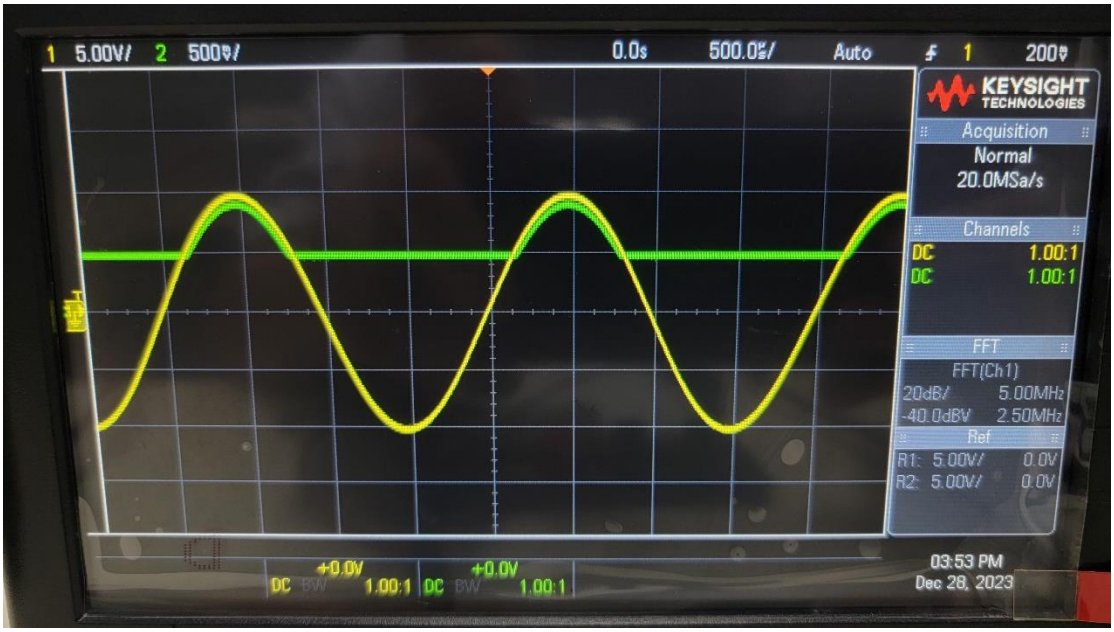

▲ Figure 9. Voltage Transfer Characteristics of Experiment 11.a.1(C) with 1N4007



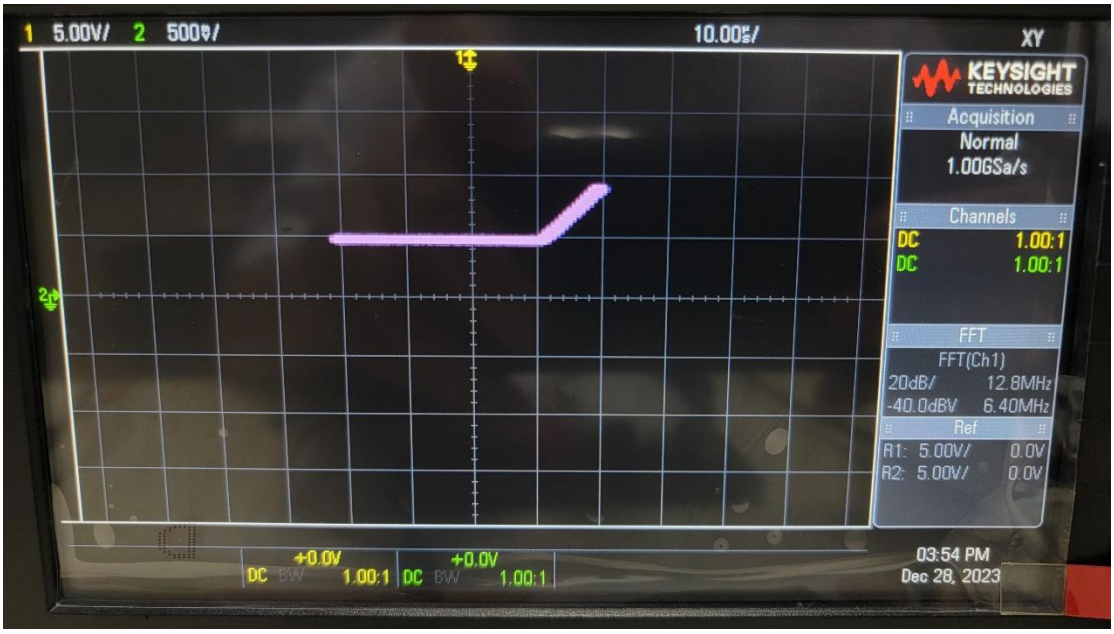

▲ Figure 10. Waveform comparisons of Experiment 11.a.1(D) with 1N4007



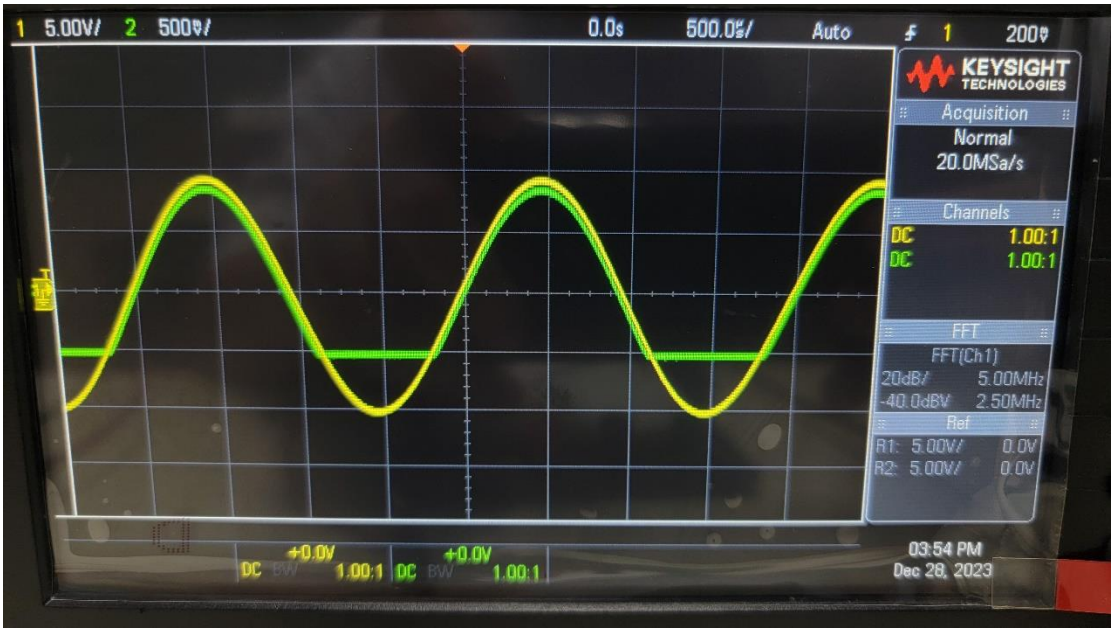

▲ Figure 11. Voltage Transfer Characteristics of Experiment 11.a.1(D) with 1N4007




▲ Figure 12. Waveform comparisons of Experiment 11.a.1(A) with 1N4148

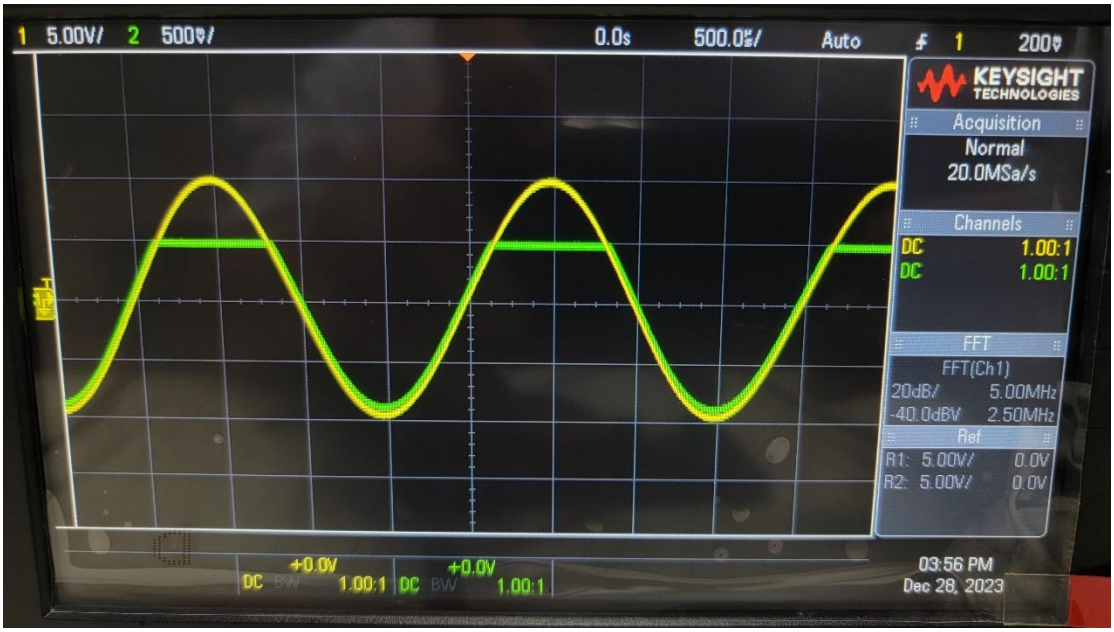



▲ Figure 13. Voltage Transfer Characteristics of Experiment 11.a.1(A) with 1N4148



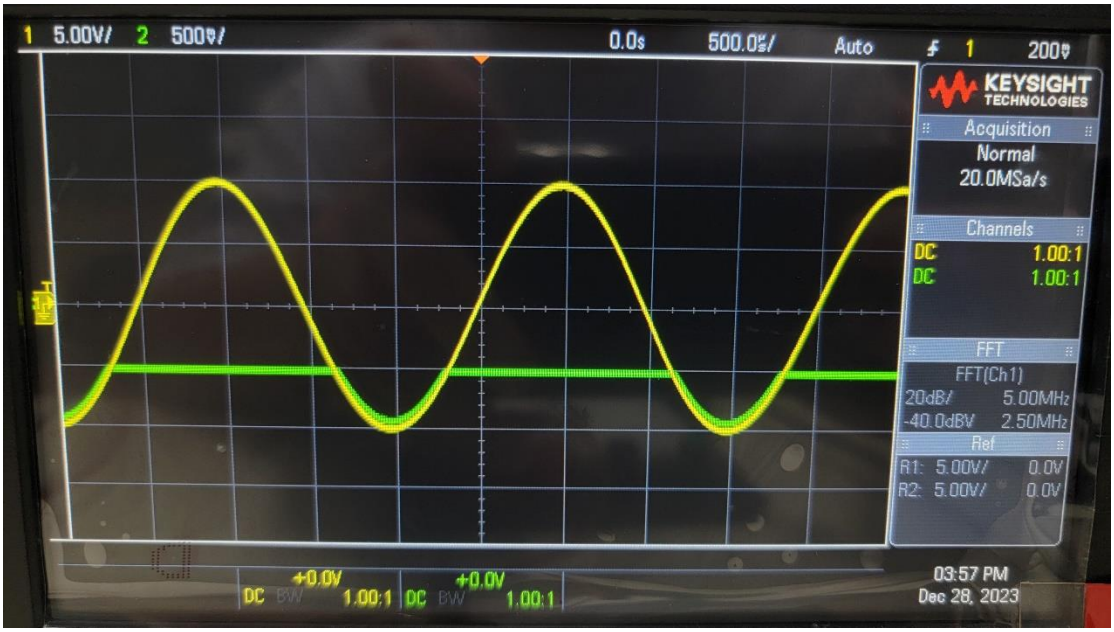

▲ Figure 14. Waveform comparisons of Experiment 11.a.1(B) with 1N4148


▲ Figure 15. Voltage Transfer Characteristics of Experiment 11.a.1(B) with 1N4148

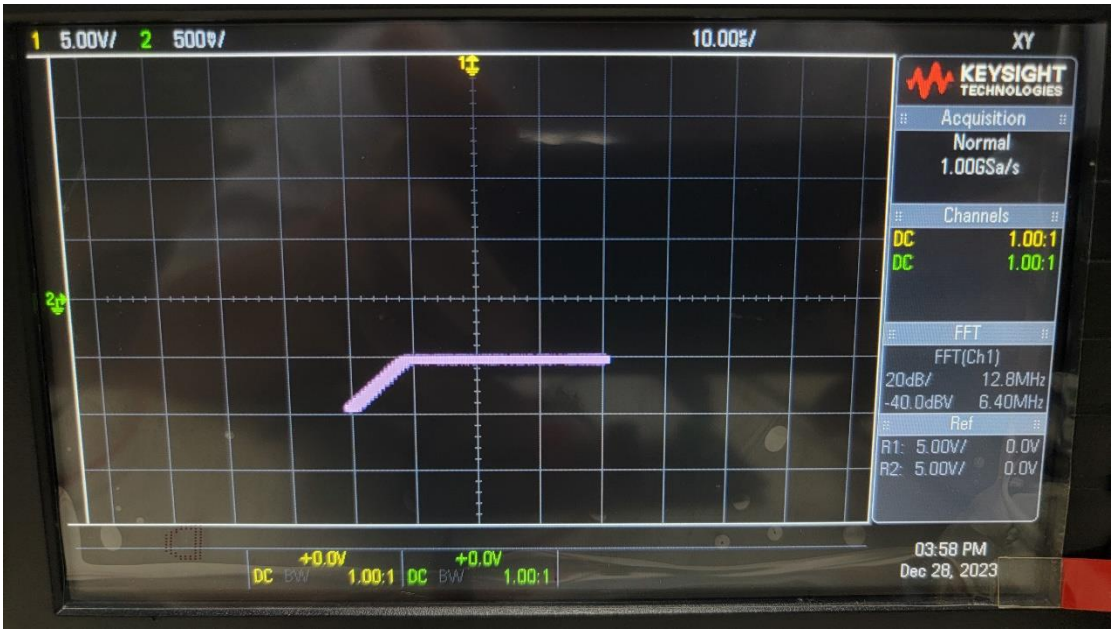



▲ Figure 16. Waveform comparisons of Experiment 11.a.1(C) with 1N4148

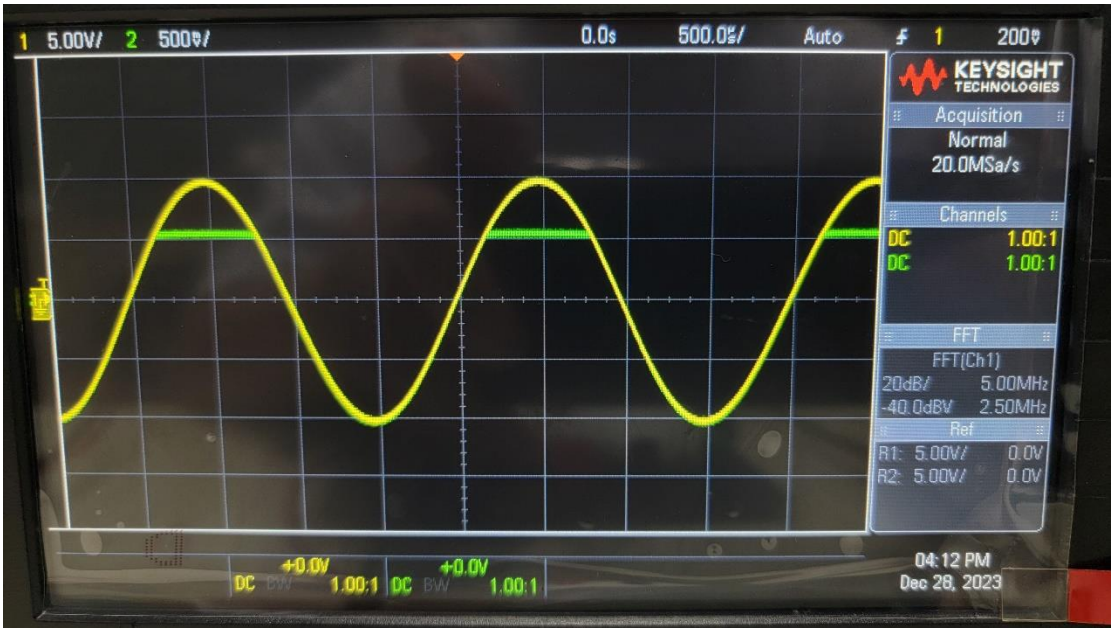

▲ Figure 17. Voltage Transfer Characteristics of Experiment 11.a.1(C) with 1N4148



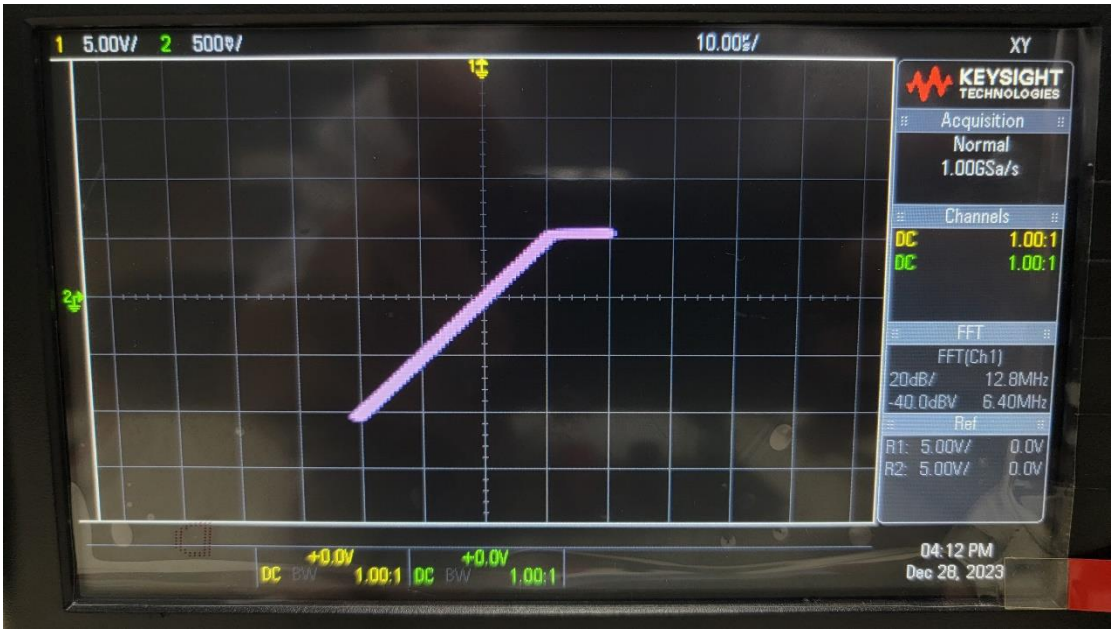

▲ Figure 18. Waveform comparisons of Experiment 11.a.1(D) with 1N4148



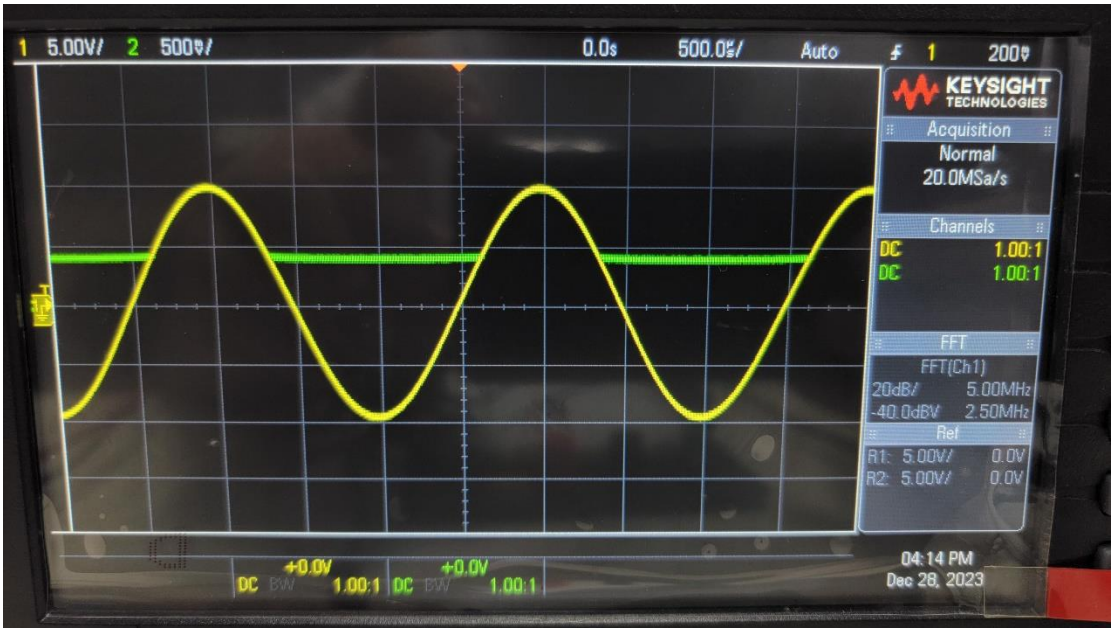

▲ Figure 19. Voltage Transfer Characteristics of Experiment 11.a.1(D) with 1N4148




▲ Figure 20. Waveform comparisons of Experiment 11.a.2(E) with 1N4007

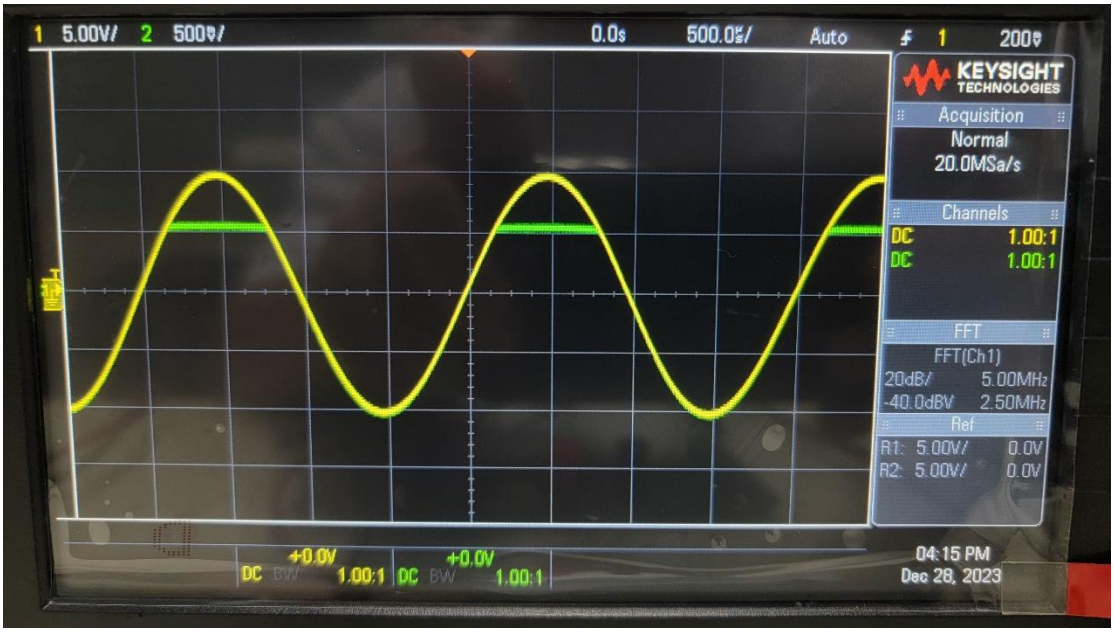



▲ Figure 21. Voltage Transfer Characteristics of Experiment 11.a.2(E) with 1N4007

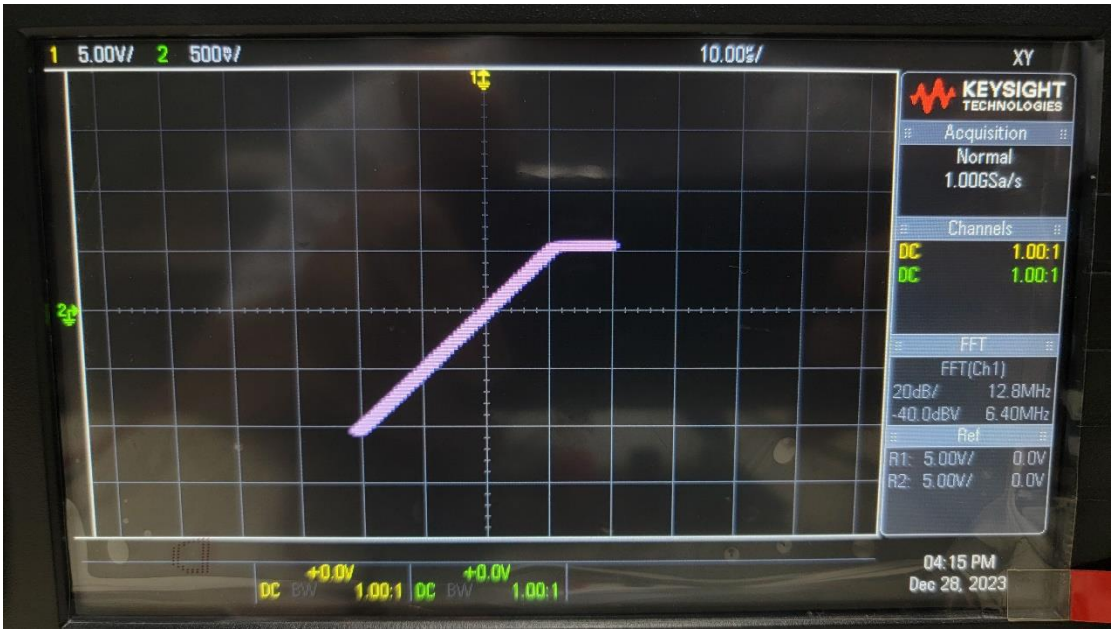



▲ Figure 22. Waveform comparisons of Experiment 11.a.2(F) with 1N4007

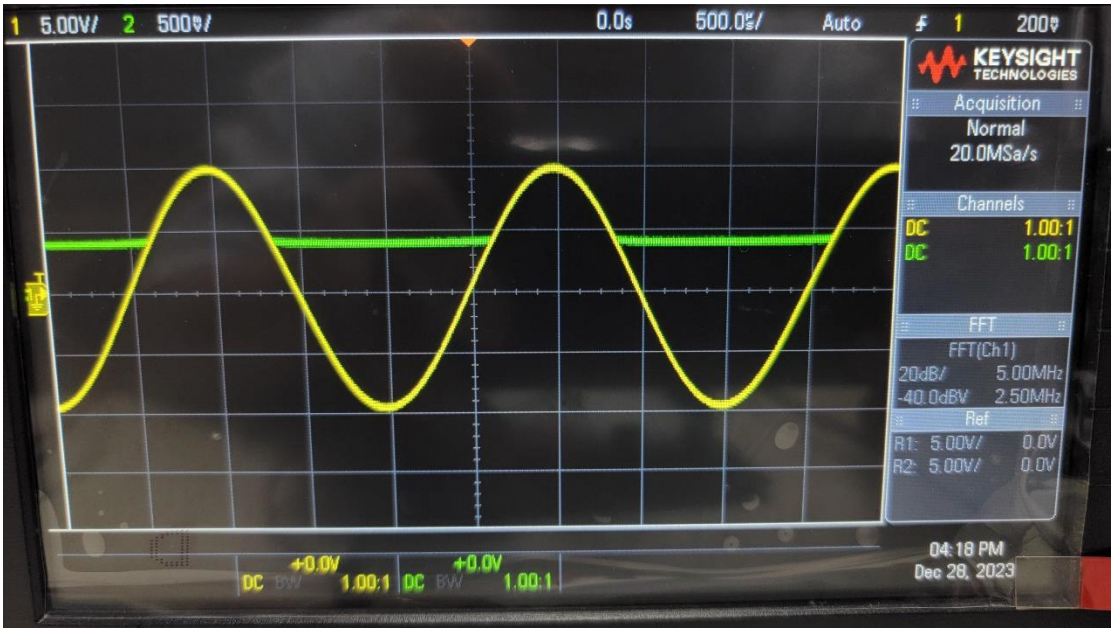

▲ Figure 23. Voltage Transfer Characteristics of Experiment 11.a.2(F) with 1N4007




▲ Figure 24. Waveform comparisons of Experiment 11.a.2(E) with 1N4148

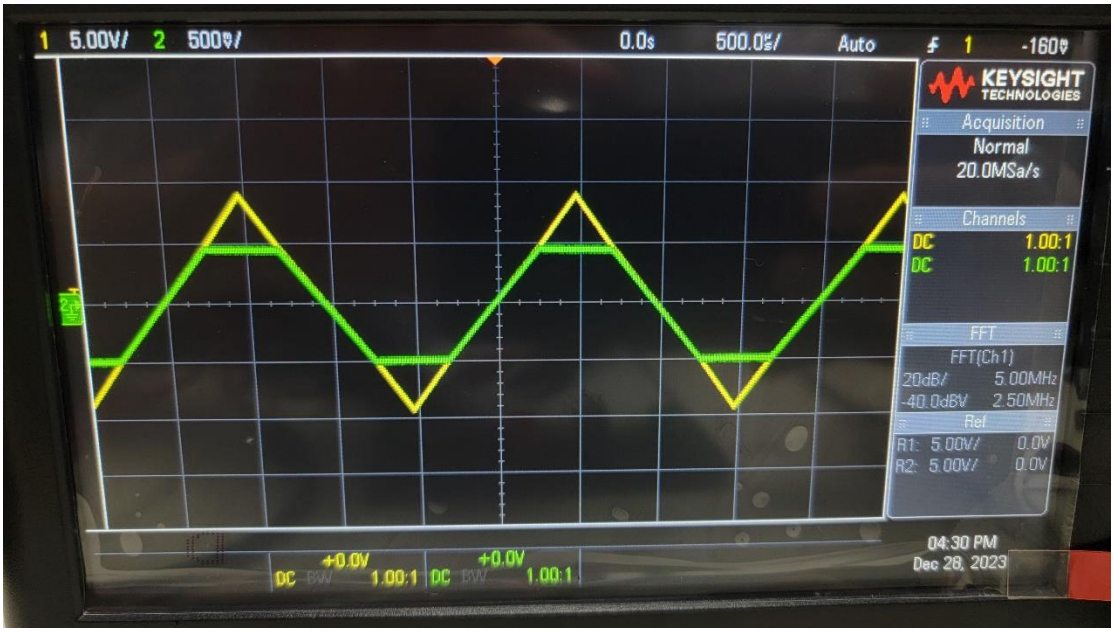



▲ Figure 25. Voltage Transfer Characteristics of Experiment 11.a.2(E) with 1N4148



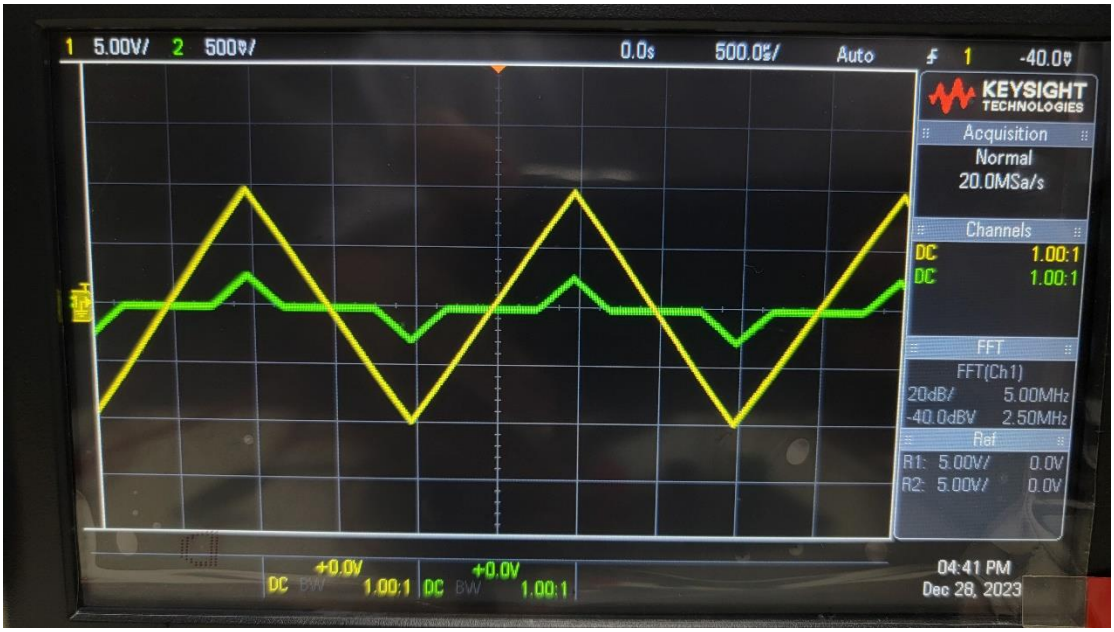

▲ Figure 26. Waveform comparisons of Experiment 11.a.2(F) with 1N4148


▲ Figure 27. Voltage Transfer Characteristics of Experiment 11.a.2(F) with 1N4148




▲ Figure 28. Waveform comparisons of Experiment 11.b(G) with 1N4007


▲ Figure 29. Voltage Transfer Characteristics of Experiment 11.b(G) with 1N4007




▲ Figure 30. Waveform comparisons of Experiment 11.b(H) with 1N4148


▲ Figure 31. Voltage Transfer Characteristics of Experiment 11.b(H) with 1N4148

## VII. Discussion

- **What is a "Clipper Circuit"? What are its main applications?**
  A Clipper Circuit is an electronic circuit that clips off or removes a portion of an AC signal, without causing any distortion to the remaining part of the waveform. The main component of a clipper circuit is a diode or any other type of diode. The diode clips a portion from the input waveform. The main purpose of the clipper circuit is to modify the waveform of the signal which can be used in several applications such as in protection against overvoltage, noise removal, transmission, etc.
- **Please explain the effect of the two different diode models, 1N4007 & 1N4148, on the behavior of the clipper circuits. Indeed, this is the difference for the diode choice for the use in a switch and in a rectifier.**
  The 1N4148 and 1N4007 are both semiconductor diodes, but they have different characteristics which can affect the behavior of clipper circuits. The 1N4148 diode is used in applications that demand fast switching because of its fast recovery time of 8ns at a forward current of 10mA. On the other hand, the 1N4007 diode has a maximum current carrying capacity of 1A, and it can withstand peaks of up to 30A. Therefore, the choice of diode can significantly impact the performance of the clipper circuit.
- **Please compare your experimental VTCs with theoretical sketches by assuming an ideal diode model.**
  As for the comparison of experimental VTCs with theoretical sketches by assuming an ideal diode model, it's important to note that real-world diodes do not behave exactly as the ideal diode model predicts due to various factors such as manufacturing variances, temperature effects, and more. Therefore, there can be discrepancies between the experimental VTCs and the theoretical sketches.
- **Discuss the differences between two circuits, (A~D) and (E~F), as the clipper diode was in series or in parallel connection with the load.**
  Regarding the differences between two circuits, (A~D) and (E~F), as the clipper diode was in series or in parallel connection with the load, it's important to note that the configuration of the diode (series or parallel) can significantly impact the operation of the clipper circuit. In series clipper circuits, the diode is connected in series with the output. In such clippers, the input signal appears at the output when the diode is forward biased and conducting. On the contrary, the shunt clippers pass the input signal when the diode is reverse biased or blocking.

- **Please compare experimental VTCs with theoretical sketches with ideal diode model, and explain the reason for the differences.**
  When comparing experimental VTCs with theoretical sketches with an ideal diode model, the differences can be attributed to the non-ideal behaviors of real-world diodes. These include factors such as forward voltage drop, reverse leakage current, and junction capacitance, which are not accounted for in the ideal diode model.

## VIII. Conclusion

Diode clipper and clamper circuits are wave-shaping circuits that modify the input signal waveform by using diodes, resistors, capacitors, and biasing voltages.