



## Section: B, Group: 07

### LAB REPORT - 03

#### Study of Diode Clipping and Clamping Circuits

Supervised By

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#### Submitted by

Name	ID	Contribution
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2 LABONY AKTER	23-55196-3	Procedure , Data Table, Discussion
3. MAHMUDUL HASAN	23-55148-3	Analysis, Experimental Data
4. NAHID HOSSAIN DIPU	23-55159-3	Theory, Calculation
5. S.M. TAEEN	23-55181-3	Data Table

## **Abstract:**

In this experiment, the objective is to know about clipper and clamper circuits, which are important in electronics. Clipper circuits use diodes to remove part of an input signal, limiting voltage without changing the remaining waveform. Clamper circuits shift a waveform to a different DC level without changing its shape. A clipper uses a diode and resistor, while a clamper includes a diode, resistor, and capacitor. Clipper circuits help control voltage levels in power supplies. They cut off parts of the signal to prevent it from going too high or too low. Clamper circuits, however, shift the entire signal up or down without altering its shape.

## **Theory:**

### **Clippers:**

Clipper circuits clip off portions of signal voltages above or below certain limits, i.e. the circuits limit the range of the output signal. At least two components: a diode and a resistor are employed for the formation of clippers. In some cases, for fixing the clipping level, a DC battery is also used. There are two general categories of clippers: series clipper and parallel clipper. The series configuration is defined as one where the diode is in series with the load, whereas the parallel variety has the diode in a branch parallel to the load.

**Series Positive Clipper:** It actually removes the positive half cycles of the input voltage. Figure 1 shows a positive series clipper. When the input is positive, the diode is in reverse biased condition (output is zero) and when the input is negative, the diode is in forward biased condition and shows the input of negative half cycle at the load.

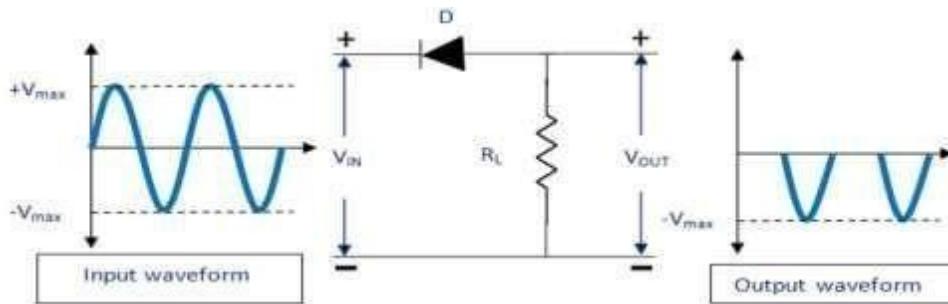


Figure 1: Series Positive Clipper

**Parallel Negative Clipper:** It actually removes the negative half cycles of the input voltage. Figure 2 shows a parallel negative clipper. During the positive half of input, the diode gets reverse biased. Thus no current flows through the resistor. As the output current is observed at the load, output signal is achieved for positive half of the input signal. During the negative half of the input signal, the diode gets forward biased and hence no load current is achieved. Ultimately no output is observed for negative half of the input signal.

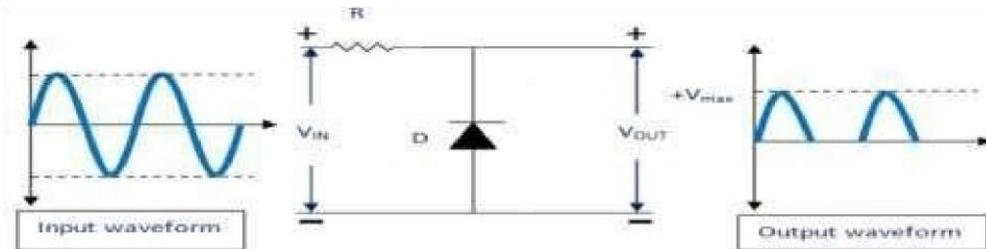


Figure 2: Parallel Negative Clipper

The clippers discussed above in figure 1 and 2 are considered as the circuits with ideal diode. But if the knee voltage ( $V_K$ ) is considered (for example, for Si = 0.7 V and for Ge = 0.3 V), the output voltage of positive and negative clippers is shown below.

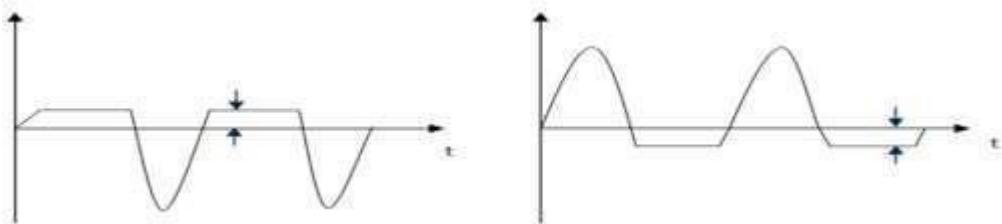


Figure 3: Output of the Circuit of Figure 1 and 2 With the value of  $V_K$

In some cases, a tiny portion of positive or negative half cycles of the input signal voltage needs to be eliminated. In that case, biased clippers are used. In figure 4, the clipping takes place during the positive cycle only when the input voltage is greater than battery voltage.

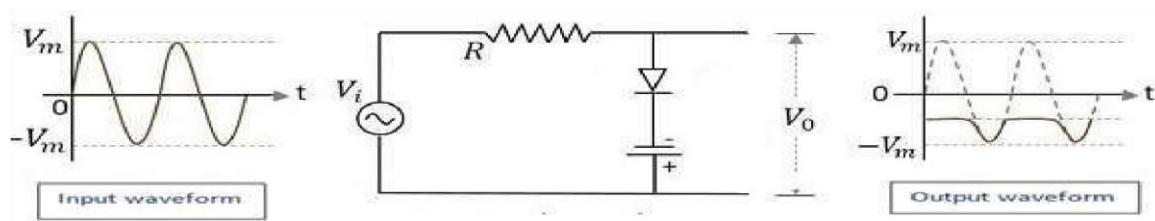
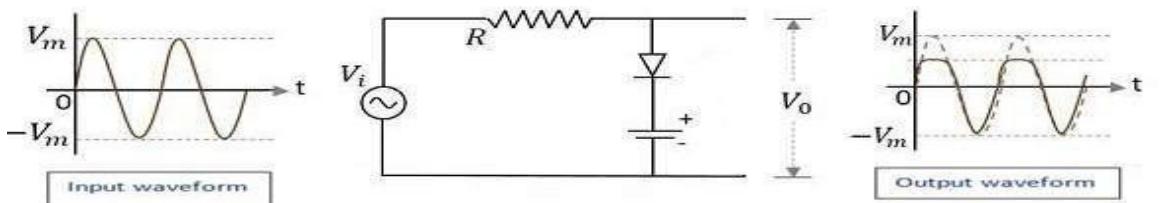


Figure 4: Parallel Positive Clipper with bias

## Clampers:

Clamper circuit adds the DC element which may be positive or negative to the AC input signal. It pushes the signal towards the positive or the negative side as shown in figure 5.

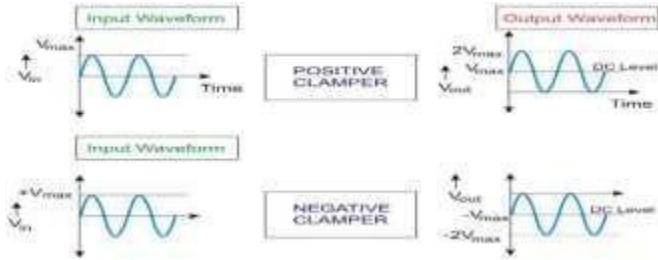


Figure 5: Input and Output Wave Shapes of Basic Clamper Circuit

The minimum components of a clamping circuit are a capacitor, a resistor and a diode. In some cases, DC supply is applied to give an additional shift. The nature of the waveform remains alike, but the difference is in the shifted level. The peak to peak value of the waveform will never change.

The peak value and average value of the input waveform and the clamped output will be different. The time constant of the circuit ( $RC$ ) must have to be ten times the time-period of the entering (input) AC voltage for better clamping action.

**Positive Clamper:** An unbiased positive clamper circuit adds positive DC voltage level (the output waveform is identical to that of the input, but the lowest peak clamped to zero) as shown in Fig. 6 (a) and (b). The biased positive clamper takes the DC level to a more positive direction depending on the applied DC voltage connected in series with the diode as shown in Fig. 7 (a) and (b).

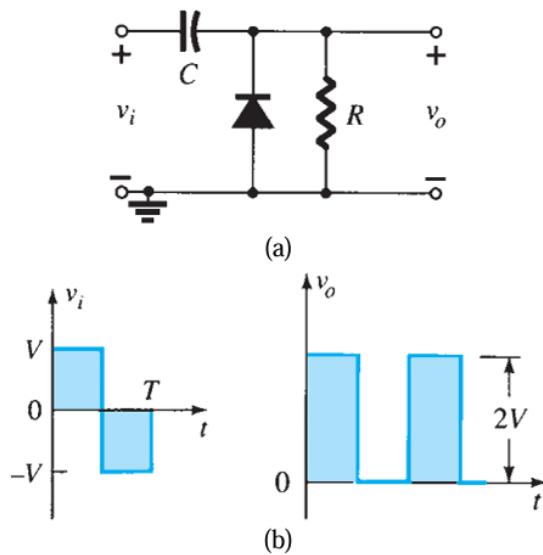


Figure 6: Positive Clamper Circuit

### Apparatus:

- |  |                        |
|--|------------------------|
| 1. Diode (1)                                   | 5. Multimeter (1)      |
| 2. Resistors: 1 K $\Omega$                     | 6. Oscilloscope (1)    |
| 3. Trainer Board (1)                           | 7. DC Power Supply (1) |
| 4. Capacitors: 10 $\mu$ F (1), 0.1 $\mu$ F (1) | 8. Chord (2)           |

### Circuit Diagram:

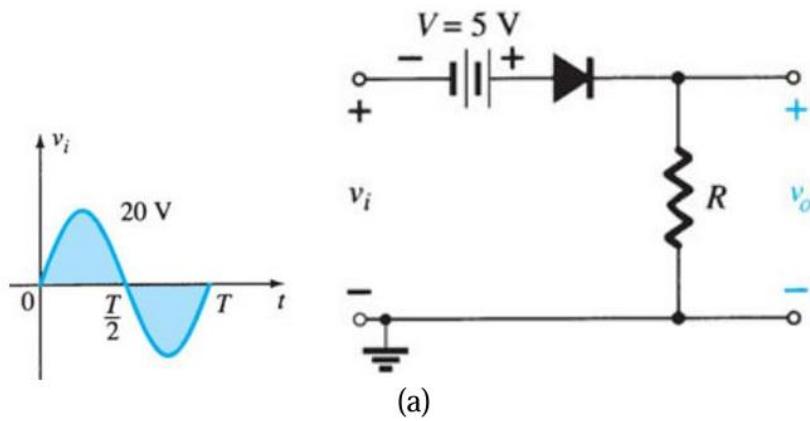


Figure 2: Biased series clipper

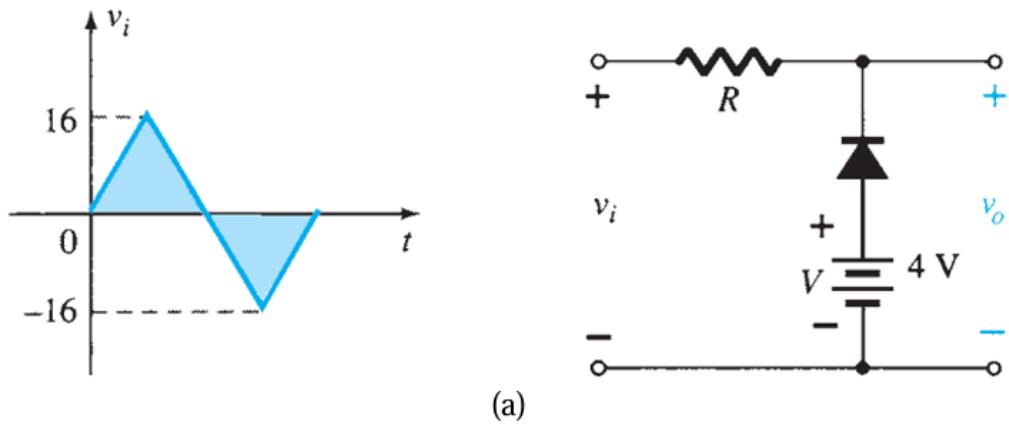


Figure 4: Biased parallel clipper

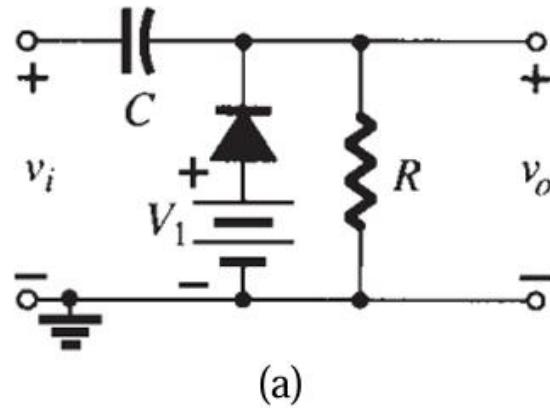
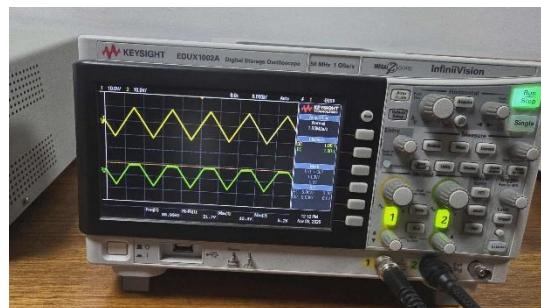
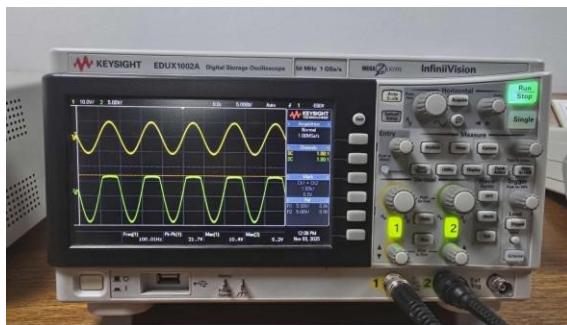
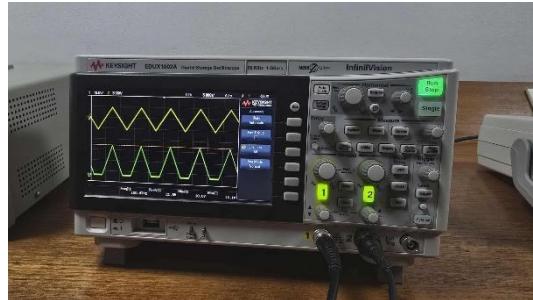
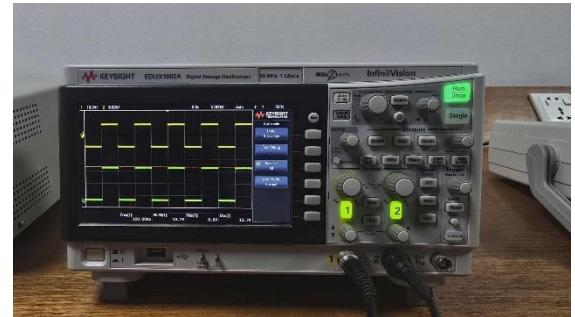
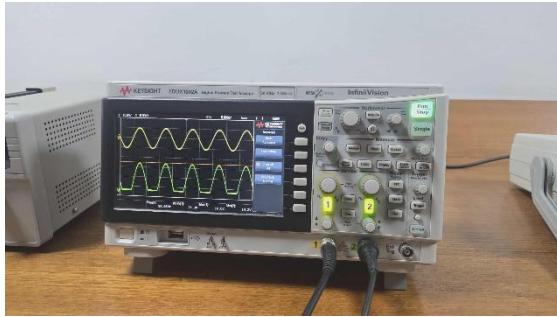
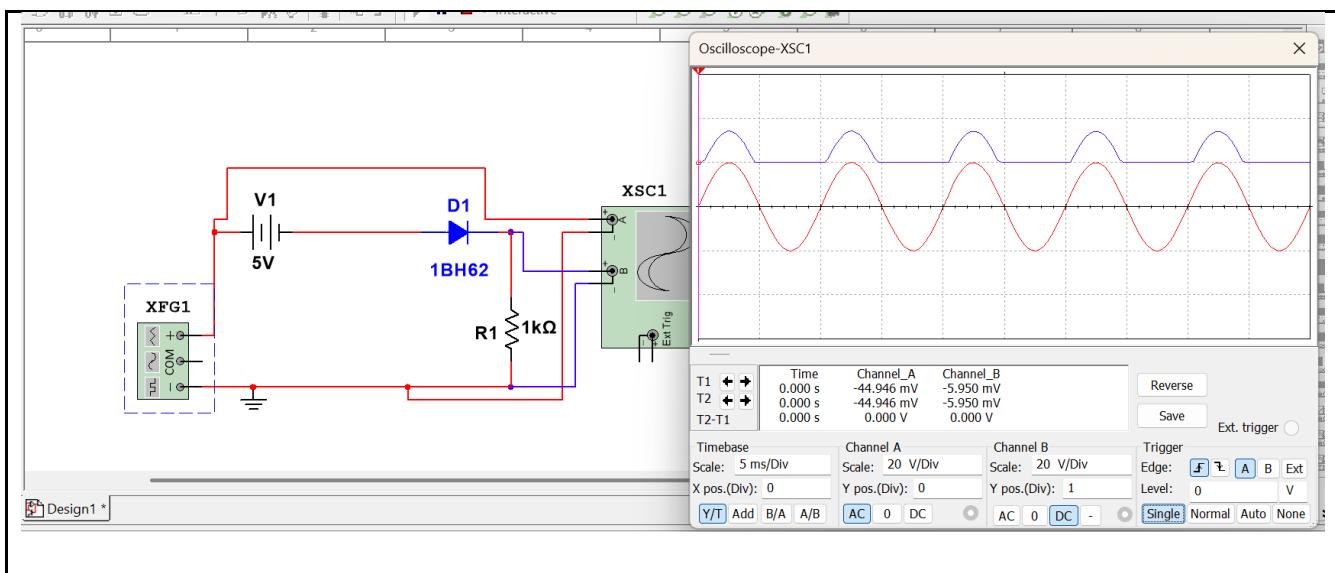


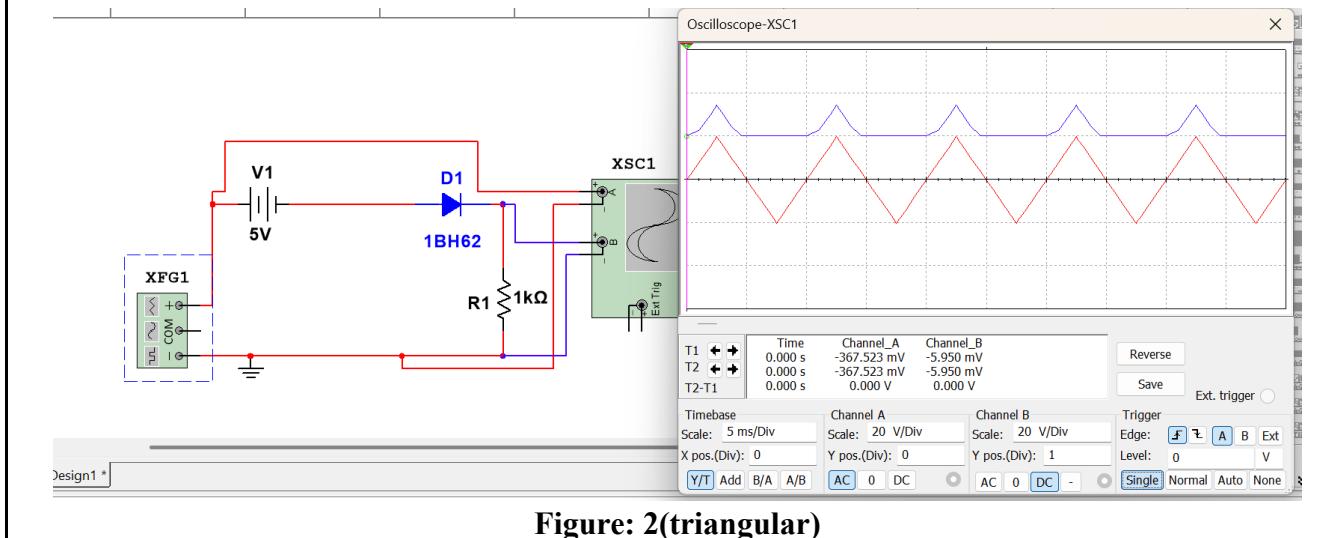
Figure 7: Biased positive clipper

- Procedure: The actual value of the  $1\text{ k}\Omega$  resistor is measured for each circuit.
- The circuit diagram specified by the respective figure (Figure 2(a), Figure 4(a), or Figure 7(a)) is connected on the project board.
- The voltage control knob of the AC power supply or function generator is set to 0 V and the supply is turned on.
- The amplitude of the input signal is gradually increased from 0 V to the desired maximum voltage (typically up to 10 V).
- The appropriate input waveform is selected in accordance with the figure being studied, and the frequency is set to 100 Hz.
- The oscilloscope is used in dual-channel mode so that the wave shapes of both the input and output voltages can be observed across the load resistor.
- The peak AC voltages of the input and output waveforms are measured from the oscilloscope screen.
- Snapshots of the waveform images appearing on the oscilloscope are recorded.
- The amplitude and frequency of the input signals are varied, and the effects of these changes on the waveform are observed.
- If required, the waveform shape is changed (e.g., from sinusoidal to triangular or square) and the corresponding effects are observed.
- All measured results and observations are recorded in the appropriate data tables located in the lab manual.
- The power supply is turned off after measurements are completed.





**Figure: 2(sinusoidal)**



**Figure: 2(triangular)**

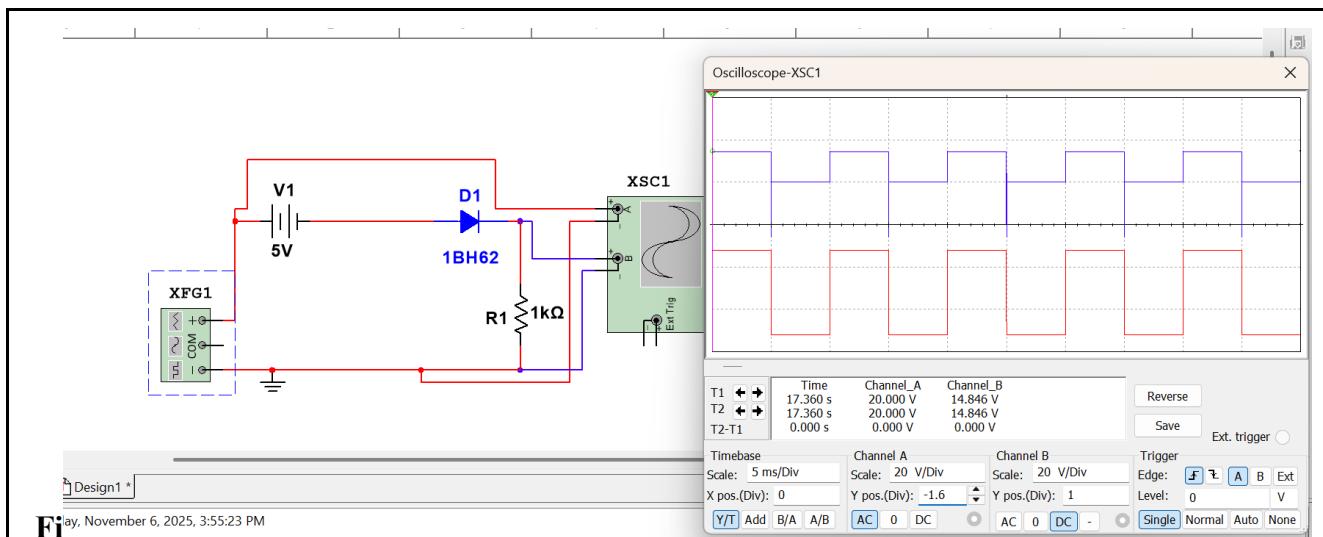


Figure 2(Rectangular)

Figure: 2(Rectangular)

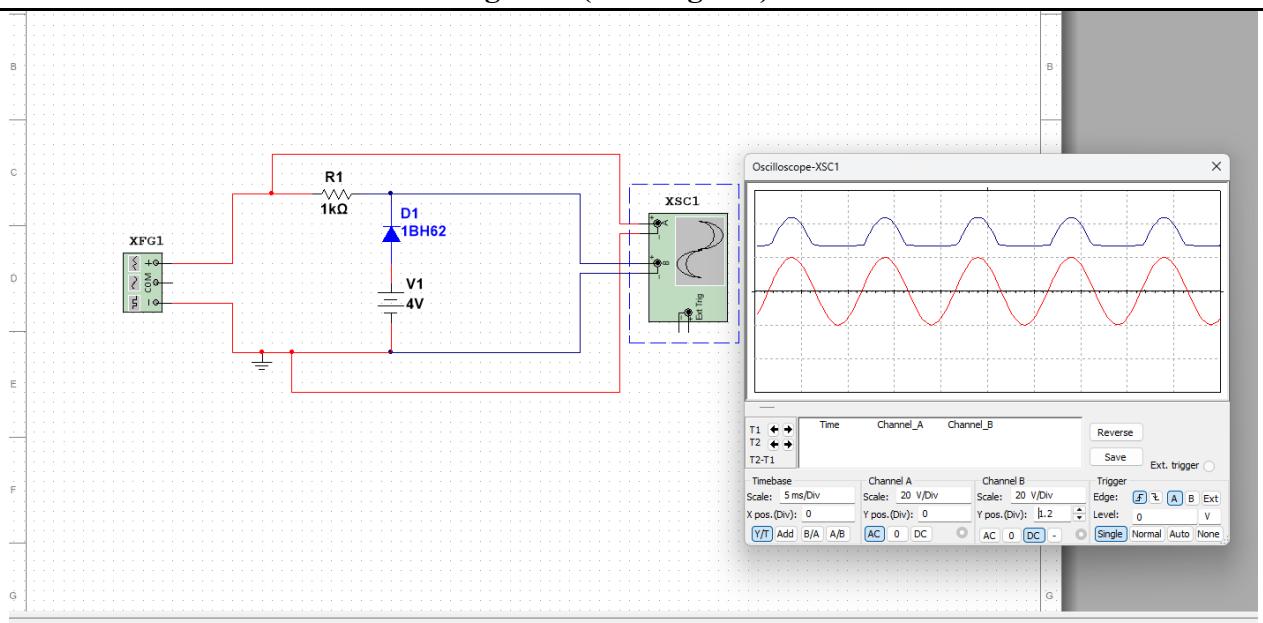


Figure: 4(Sinusoidal)

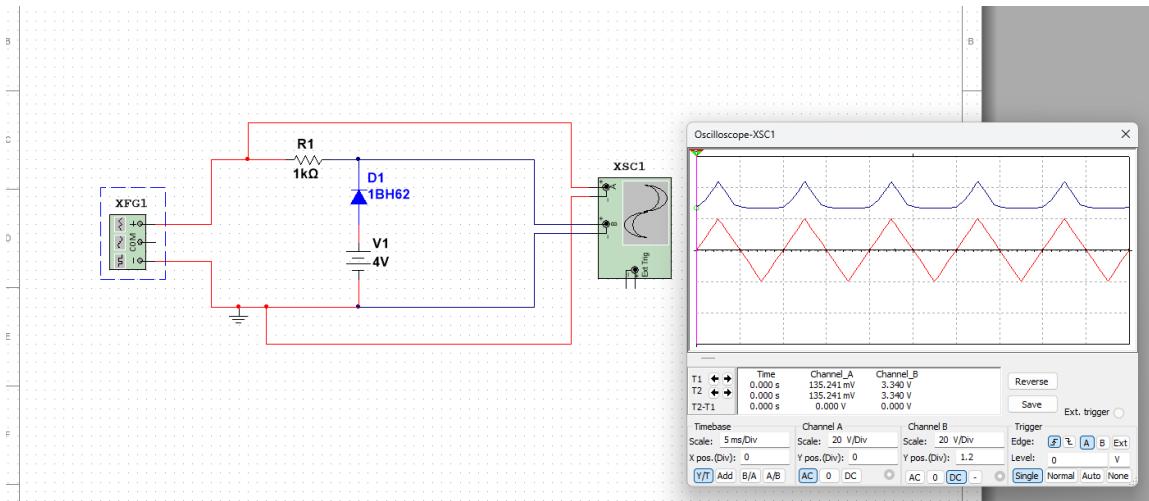


Figure: 4(Triangular)

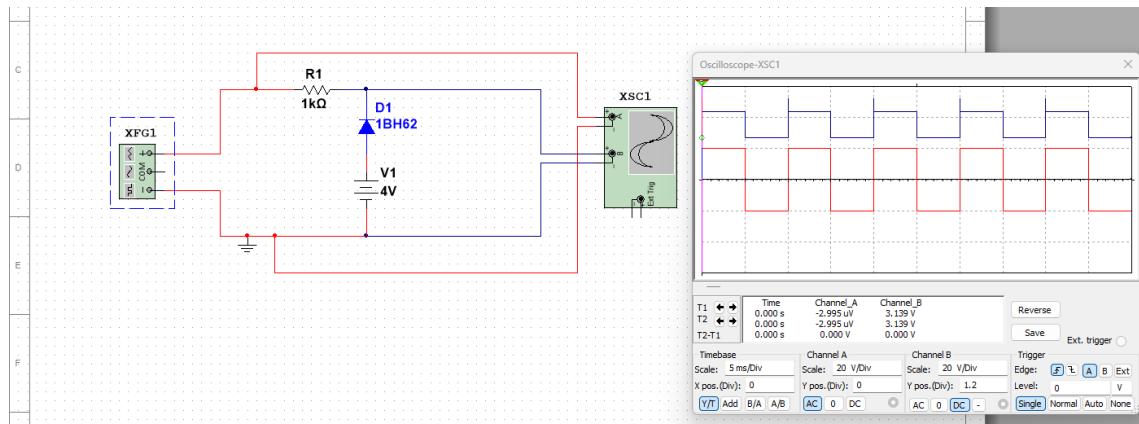


Figure: 4(Rectangular)

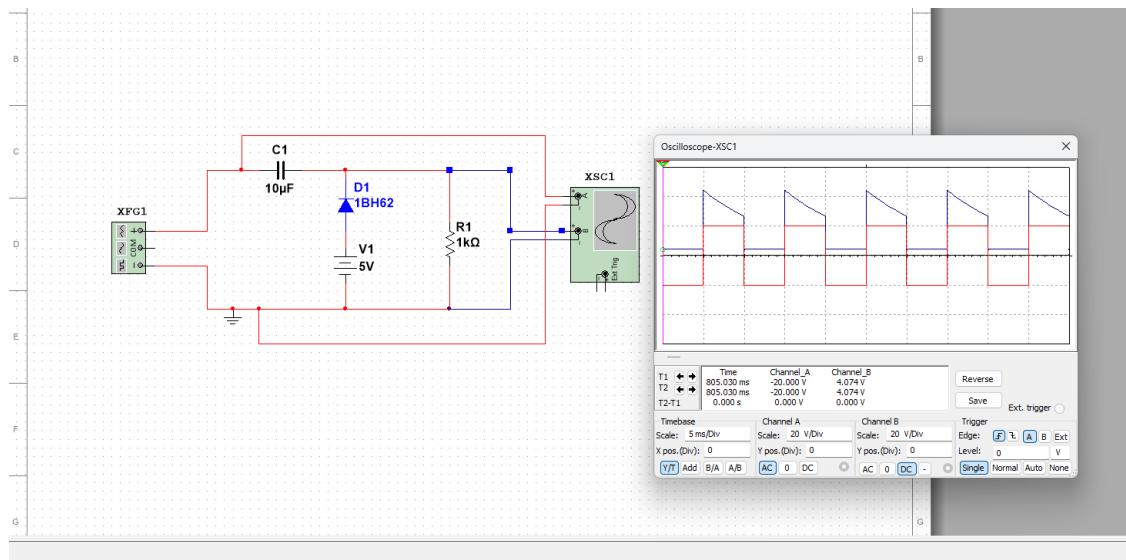


Figure:7(Rectangular)

### **Discussion:**

In this experiment, different types of clipper and clamper circuits were studied and discussed. A sine wave was used as the input signal for all clipper circuits, while a rectangular waveform was used for the clamping circuit. The experiment covered positive series clippers, negative series clippers, parallel negative and positive clippers, and the clamper circuit. It also explored how changing the load resistor affects the waveform.

### **Conclusion:**

Although the purpose of this experiment was achieved, the oscilloscope rarely showed a difference in the waveshape for the Si diode compared to the ideal diode. This is because the voltage drop across the Si diode is only 0.7V, which is too small to cause a noticeable change in the waveform. The results were almost identical to those of an ideal diode.

### **Reference:**

- [1] Adel S. Sedra, Kenneth C. Smith, Microelectronic Circuits, Saunders College Publishing, 3rd ed., ISBN: 0-03-051648-X, 1991.
- [2] American International University–Bangladesh (AIUB) Electronic Devices Lab Manual.
- [3] David J. Comer, Donald T. Comer, Fundamentals of Electronic Circuit Design, John Wiley & Sons Canada, Ltd.; ISBN: 0471410160, 2002.

