American International University- Bangladesh
Department of Electrical and Electronic Engineering
EEE2104: Electronic Devices Laboratory

Title: Study of Diode Clipping and Clamping Circuits

Abstract:

In electronics, a **clipper** is a device designed to prevent the output of a circuit from exceeding a predetermined voltage level without distorting the remaining part of the applied waveform. Whereas, a **clamper** is an electronic circuit that fixes either the positive or the negative peak excursions of a signal to a defined value by shifting its DC value.

Introduction:

The main objective of this experiment is to study the behavior of different types of-

1) clipper circuits and
2) clamper circuits

Theory and Methodology:

Clipper circuits clip off portions of signal voltages above or below certain limits, i.e. the circuits limit the range of the output signal. The level at which the signal is clipped can be adjusted by adding a dc bias voltage in series with the diode as shown in Fig. 1 of the circuit diagram part.
In a series positive clipper, a diode is connected in series with the output, as shown in Fig 1(a). During the positive half of the input voltage, the terminal A is positive with respect to B. This reverse biases the diode and it acts as an open switch. Therefore all the applied voltage drops across the diode and none across the resistor. As a result of this there is no output voltage during the positive half cycle of the input voltage.

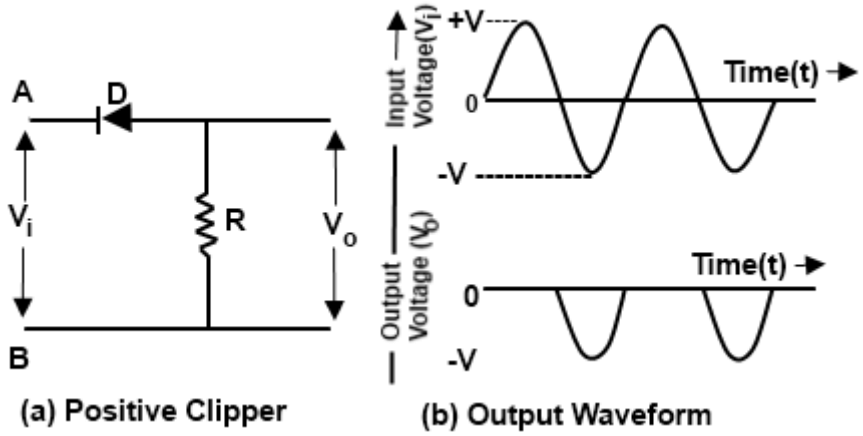

Figure: Series Positive Clipper

During the negative half cycle of the input voltage the terminal B is positive with respect to A. Therefore it forward biases the diode and it acts as a closed switch. Thus there is on voltage drop across diode during the negative half cycle of the input voltage. All the input voltage is dropped across the resistor as shown in the output waveform.

Sometimes it is desired to remove a Small portion of positive or opposite half cycle of the signal voltage (input signal). For this purpose a biased clipper is used. Fig 2 shows the circuit of a biased series positive clipper. It may be observed that the clipping takes place during the positive cycle only when the input voltage is greater thence battery voltage (i.e. $V_i > V_B$). The chipping level can be shifted up or down by varying the bias voltage (V_B)

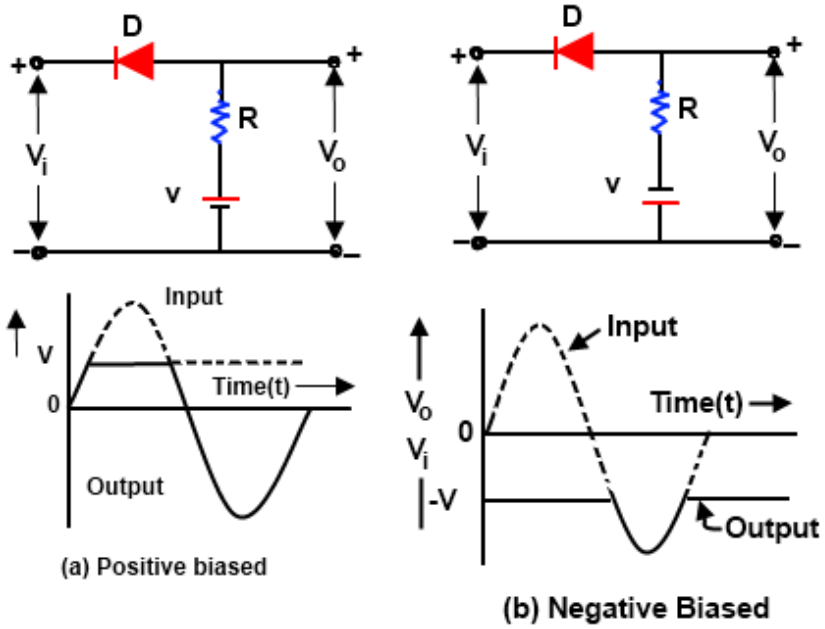

Figure: Series Positive Clipper with bias

Clamper circuits are used to add a dc voltage level to a signal. It is designed to shift a waveform above or below a dc reference voltage without altering the shape of the waveform. A positive clamper circuit adds positive dc voltage level (the output waveform will be identical to that of the input but the lowest peak clamped to zero), while the negative clamper circuit adds negative dc voltage level. A dc bias voltage can be added to increase or decrease the signal to a reference voltage. The clamper circuits can be used to restore dc levels in communication circuits that have passed different filters.

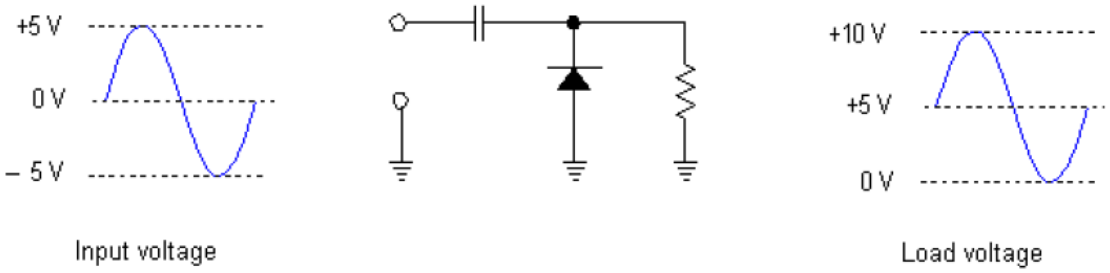

Figure: Basic Clamper Circuit

Apparatus:

1)	Diode	:	[1 pc]
2)	Trainer Board	:	
3)	Resistors	: 1KΩ	[1 pc]
		100Ω	[1 pc]
		220Ω	[1 pc]
		470Ω	[1pc]
4)	Oscilloscope		
5)	Multimeter	:	[1pc]

6) Chord : [2pcs]
7) Capacitor 10µF [1pc]
0.1µF [1pc]
8) DC Power Supply :

Circuit Diagram:

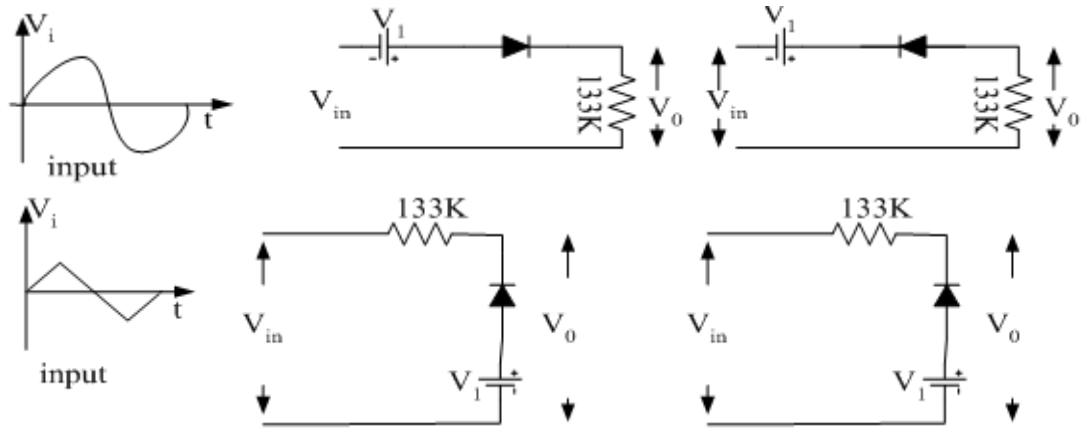

Figure 1: Clipper Circuits

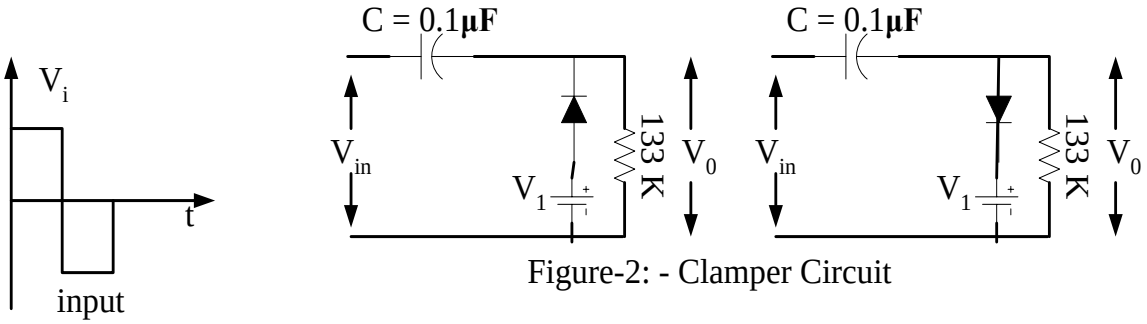

Figure-2: - Clamper Circuit

Precautions:

The following is a list of some of the special safety precautions that should be taken into consideration when working with diodes:

1) Never remove or insert a diode into a circuit with voltage applied.
2) When testing a diode, ensure that the test voltage does not exceed the diode's maximum allowable voltage.
3) Ensure a replacement diode into a circuit is in the correct direction.

Pre-Lab Homework:

Implement the circuits (Figure 1 and Figure 2) using PSpice. Observe the input output waveshapes using the simulation tool.

Experimental Procedure:

1) Construct the circuits as shown in figure – 1. Observe V_i and V_o simultaneously on the oscilloscope in dual mode and sketch the waveforms for $V_1 = 0$, $V_1 = V_m/2$, $V_1 = V_m$, Where V_m is the maximum value of the input signal.

2) Construct the circuit as shown in figure – 2. Follow the procedure as in step – 1.

Simulation and Measurement:

Compare the simulation results with your experimental data/ wave shapes and comment on the differences (if any).

Questions for report writing:

1) Sketch all the waveforms observed on the oscilloscope.
2) Discuss about the wave shapes of each circuit with appropriate circuit diagrams.
3) What is the difference between diode clipping circuit and clamping circuit?
4) Explain the operation of clipper and clamper circuits.
5) Discuss the experiment as a whole.

Discussion and Conclusion:

Interpret the data/findings and determine the extent to which the experiment was successful in complying with the goal that was initially set. Discuss any mistake you might have made while conducting the investigation and describe ways the study could have been improved.

References:

1) Adel S. Sedra, Kennth C. Smith, Microelectronic Circuits, Saunders College Publishing, 3rd ed., ISBN: 0-03-051648-X, 1991.
2) David J. Comer, Donald T. Comer, Fundamentals of Electronic Circuit Design, John Wiley & Sons Canada, Ltd.; ISBN: 0471410160, 2002.