United International University
Department of CSE

Course Code: EEE 2124

Course Name:Electronics Laboratory

Experiment no.-04

Experiment Name: Study of Diode Clipping And Clamping Circuits

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Section: G

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Objective:
To understand:

1. Distinguish between different types of clipper and clamper circuits
2. Construct circuits to shape the output in specific levels
3. Propose a voltage doubler circuit

Components used:

o p-n junction Diode(1N4007)

o Resistor (1K)

o Capacitor (10µF)

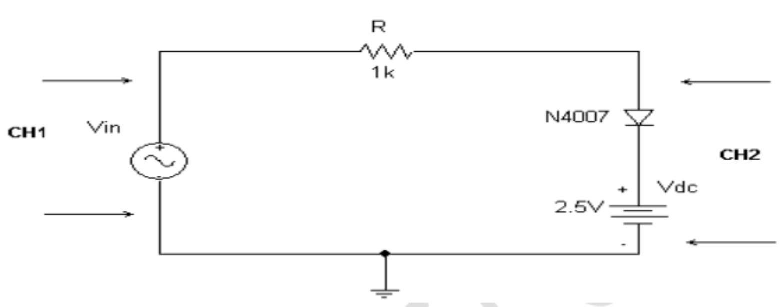
o Digital Oscilloscope

o Chords and wire

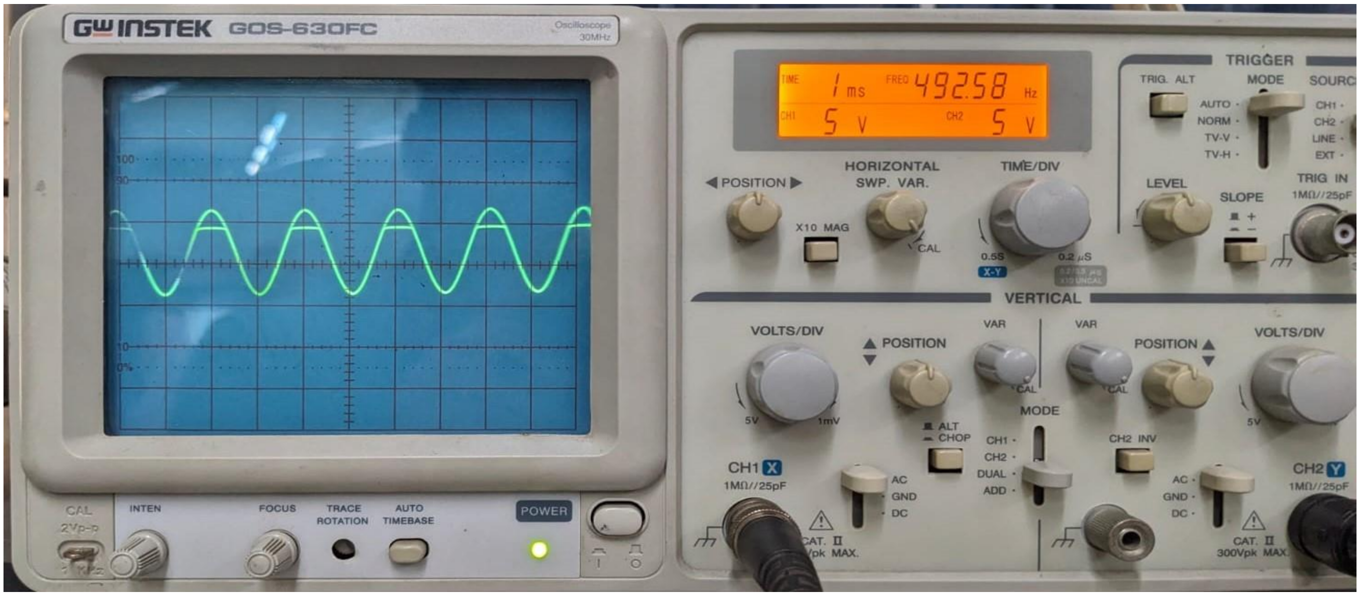
Theory:
Clipper and clamper circuits are essential in signal processing. A clipper circuit limits or "clips" the amplitude of an input signal by removing or flattening parts of the waveform that exceed a specific voltage level, thus protecting circuits from voltage spikes or shaping signals. It typically uses diodes to achieve this effect. On the other hand, a clamper circuit shifts the entire signal waveform up or down by adding a DC level, effectively moving the baseline of the waveform without altering its shape. This is achieved using a combination of diodes, capacitors, and resistors, and is often used in applications like signal restoration and DC level adjustment in various electronic systems.

Part -1 (Clipping Circuit)
1.With Diode In Forward Bias And Facing Positive Terminal Of DC Supply

Circuit Diagram



V-t Graph Of Diode

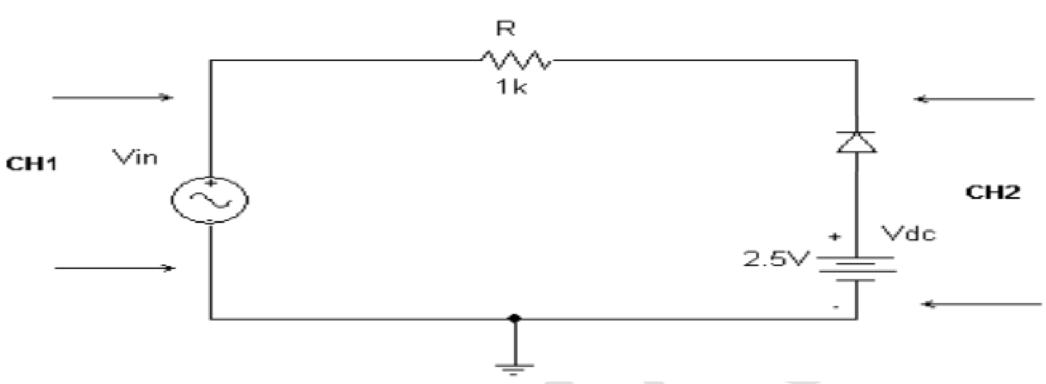


Explanation For Graphs

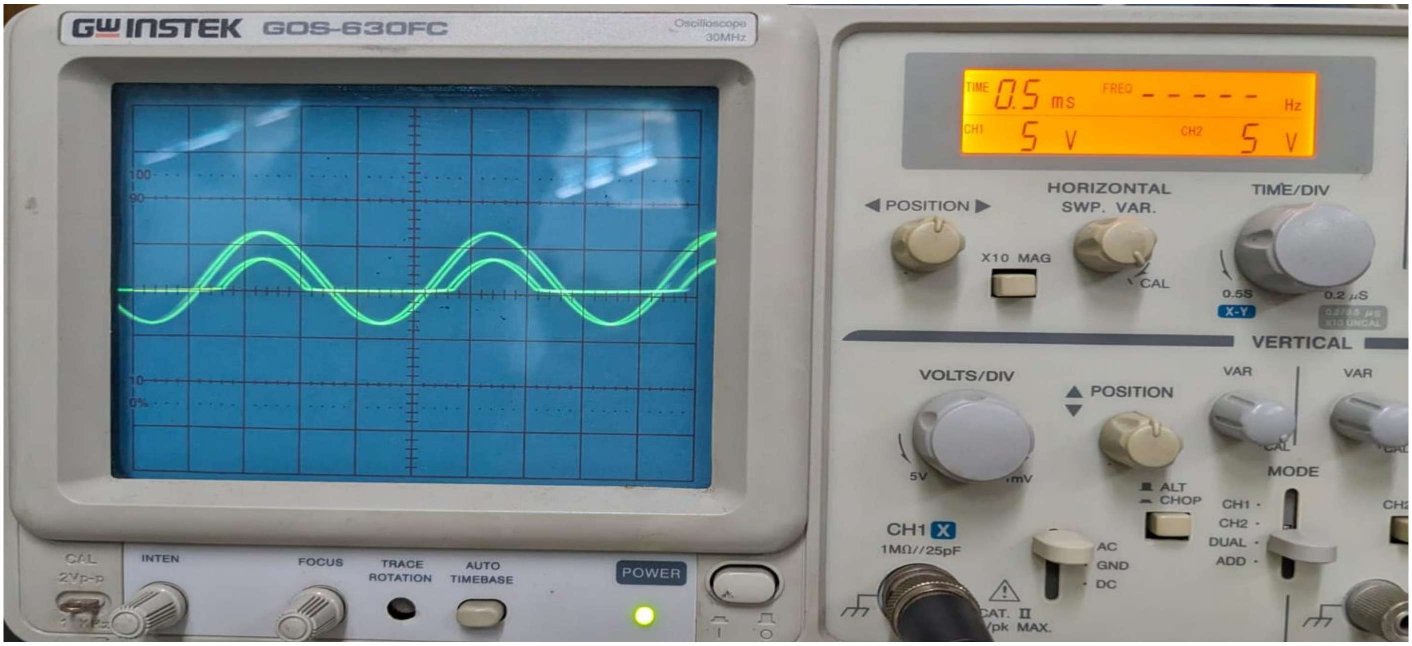
In the positive half-cycle, when the voltage across the diode is greater than turn-on voltage (about 0.5V), the diode is turned on and the voltage across that diode gets fixed at the turn-on voltage. Else, the voltage across the diode is the same as the voltage from the AC Supply as no voltage drops across the resistor.

In the negative half-cycle, the voltage across the diode will always be less than or equal to -2.5V, which is less than turn-on voltage of 0.5V. So, diode is off and has the same voltage as the AC Supply.

2. With Diode In Reverse Bias And Facing Positive Terminal Of DC Supply



V-t Graph Of Diode



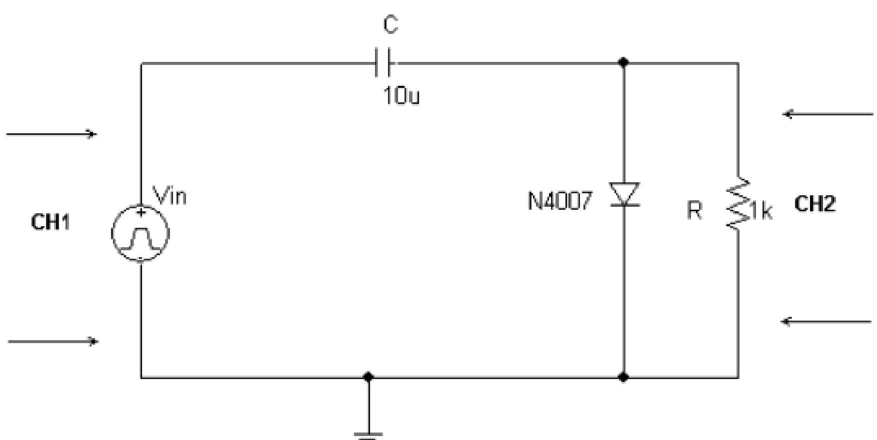
Explanation For Graphs

In the positive half-cycle, when the voltage from the AC Supply is greater than 2V, the voltage across the diode is less than the turn-on voltage(0.5V). So the diode is off and has the same voltage as the AC Supply.

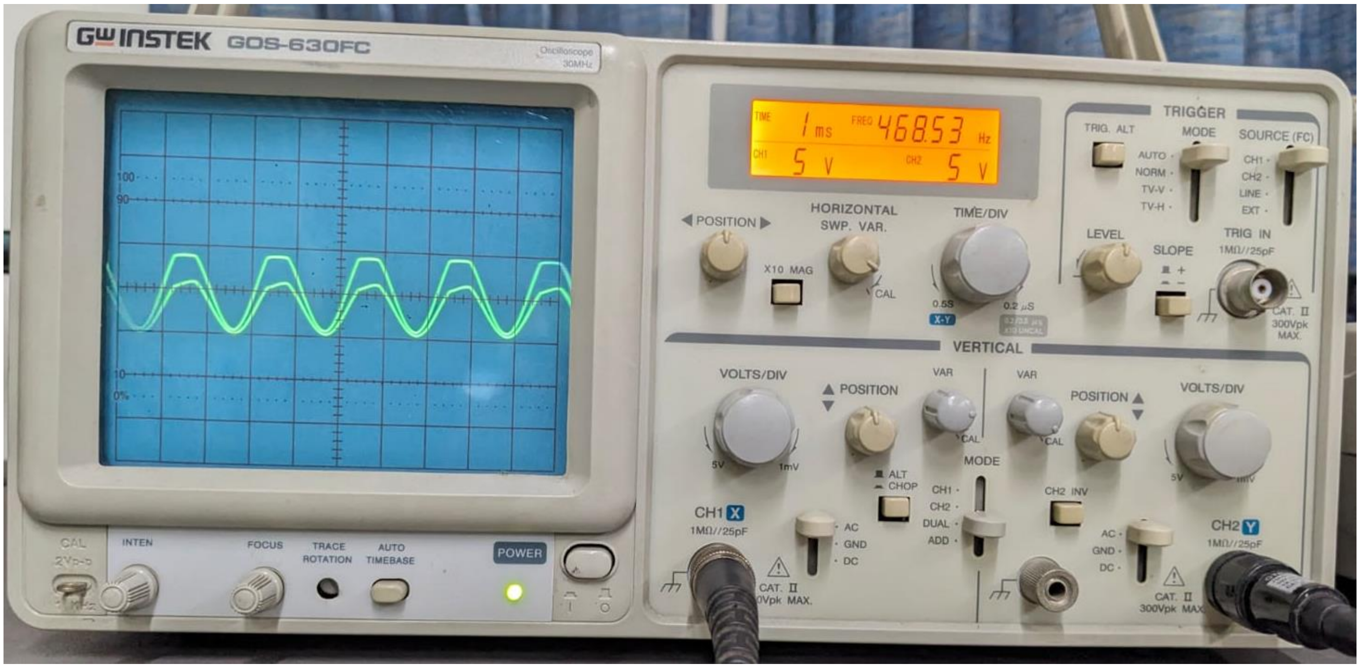
In the negative half-cycle, the voltage across the diode will always be greater than turn-on voltage of 0.5V when the AC voltage is less than or equal to 2V. So, diode is on and has the fixed voltage of 0.5V.

Part 2 :Clamping Circuit

With Pulse Voltage And 10µF Capacitance Circuit Diagram



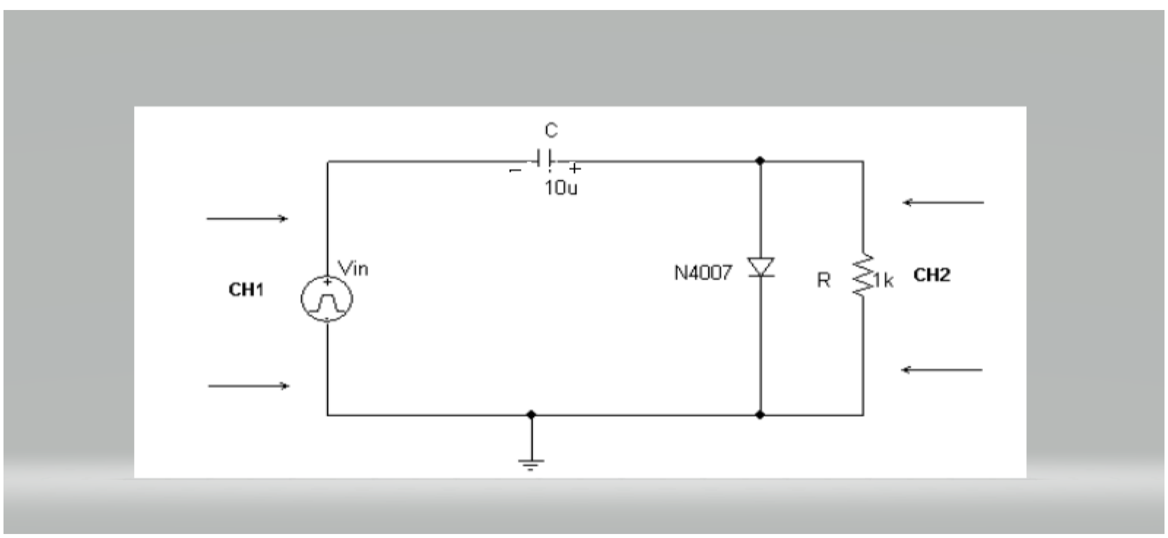
V/t Graphs Of Diode



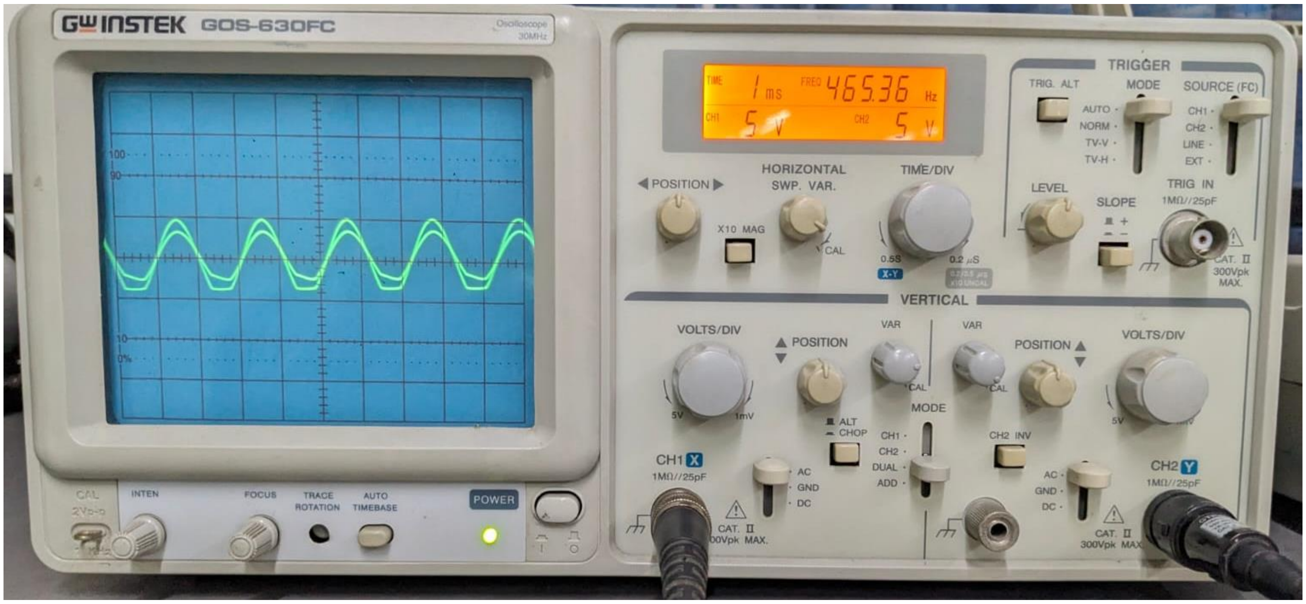
Explanation For Graph

When the AC supply in is the positive half-cycle, the voltage drops across the capacitor. So, the voltage across the diode is 0V (a bit greater than 0, which is the turn-on voltage).
When the AC supply is in the negative half-cycle, the voltage from the source and the stored voltage from the capacitor contribute to the voltage across the diode. So, the diode has a voltage of about -10V across it. It is a bit greater than -10V since the charge from the capacitor keeps decreasing, so the voltage also decreases.

Another One:



V/t Graphs Of Diode



In Positive Half-Cycle of the AC Input during the positive half-cycle, the diode is forward-biased, and the voltage across it is near 0V, apart from the slight increase due to the turn-on voltage of the diode.The capacitor in the circuit charges to the peak AC input voltage, ensuring minimal voltage drop across the diode.
In the negative half-cycle, the diode becomes reverse-biased.The voltage across the diode now includes the combined effects of the negative AC voltage and the capacitor's discharging voltage.This results in the diode experiencing a negative voltage swing (for example, near -10V or slightly less, depending on the rate of capacitor discharge.

Write a short note on clipping circuit and its use in electronics?

Answer: A clipping circuit is an electronic circuit which is a specific arrangement of a diode with a resistor. It is also referred to as a diode limiter circuit. The basic function of a clipping circuit is to prevent the signal from exceeding a predetermined reference level by clipping it off at the set value. Clipping circuits can be used:- 1) To remove the excess amount of ripples in the FM transmitter. 2) In power supply units. 3) To generate and shape waveforms by clipping off the undesired part.

Write a short note on clamping circuit and its use in electronics?

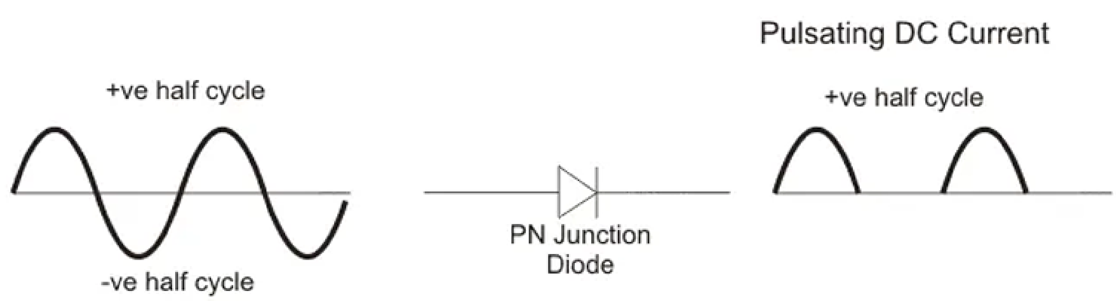
Answer: A **clamping circuit** shifts the voltage level of a signal without altering its shape. It adds a DC offset to an AC waveform, moving it upward or downward as needed. The circuit typically consists of a diode, a capacitor, and sometimes a resistor. During one half-cycle, the diode conducts and charges the capacitor, while in the opposite half-cycle, the capacitor maintains the voltage shift. Clamping circuits are widely used in electronics for signal conditioning, waveform shaping, and maintaining reference levels in systems like televisions, oscilloscopes, and communication devices. They are crucial for ensuring voltage stability and proper signal processing.

How is energy stored in a capacitor? Explain in detail.

Answer: A capacitor acts like a tiny battery, storing electrical energy in an invisible vault. When charged, it separates positive and negative charges on its plates. This creates an electrostatic field between them, like a stretched spring holding potential energy. The greater the voltage applied (think pressure on the spring), the stronger the field and the more energy the capacitor can store. This energy, dependent on both voltage and capacitance, is then available to be released back into the circuit when needed.

Prove that half-wave rectifier is a clipping circuit

Answer: : A half wave rectifier is defined as a type of rectifier that only allows one half-cycle of an AC voltage waveform to pass, blocking the other half-cycle. Half-wave rectifiers are used to convert AC voltage to DC voltage, and only require a single diode to construct. When a standard AC waveform is passed through a half-wave rectifier, only half of the AC waveform remains. Half-wave rectifiers only allow one half-cycle (positive or negative half-cycle) of the AC voltage through and will block the other half-cycle on the DC side, as seen below.



Discussion:

The experiment successfully demonstrated the working principles of diode clipping and clamping circuits. The hardware implementation validated theoretical concepts such as signal amplitude limitation and DC level shifting. Understanding these circuits' functionality is vital for designing signal processing systems, waveform generators, and protection circuits in real-world electronics applications.

The results obtained matched the theoretical predictions, confirming the reliability of the designed circuits. Any minor discrepancies observed were due to non-idealities in the components or practical limitations in measurement equipment.