Clippers & Clampers

Objectives:-

- Sketch each of the following circuits: series clipper, shunt clipper, biased shunt clipper, zener diode clipper, clamping circuit, and biased clamper circuit.
- Draw input & output waveforms for each of the above circuits and explain the circuit operation.
- Design each of the above circuit and select suitable components.
- Analyze each of the above circuits to determine its performance.

Introduction:-

Because it passes a large current when forward biased and an extremely small current when reverse biased, a semiconductor diode can be employed as a switch. The speed with which a diode can be switched is determined by the reverse recovery time of the device. Diodes are widely applied to chip unwanted portions from a waveform, or to clamp the peak of a waveform at a desired dc level. Zener diodes may be used as reference voltage sources in clipping and clamping circuits.

Experiment No.2

CLIPPING CIRCUITS

Aim:- To design various clipping circuits and check their functionality.

Components and Equipments:-Diode, Zener diodes, Resistors, CRO, Function generator, Power supply, BNC cables, Groove board, clips, transistors.

Circuit diagrams: -

(i) **Biased Positive Clipper**:-

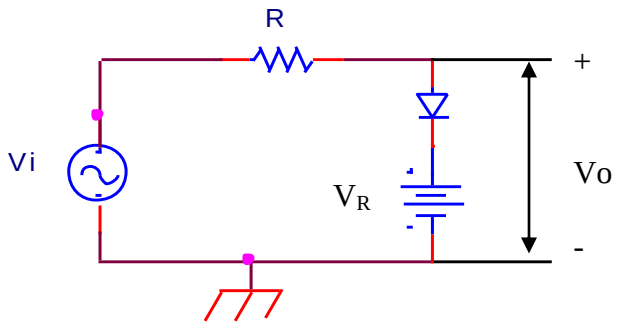
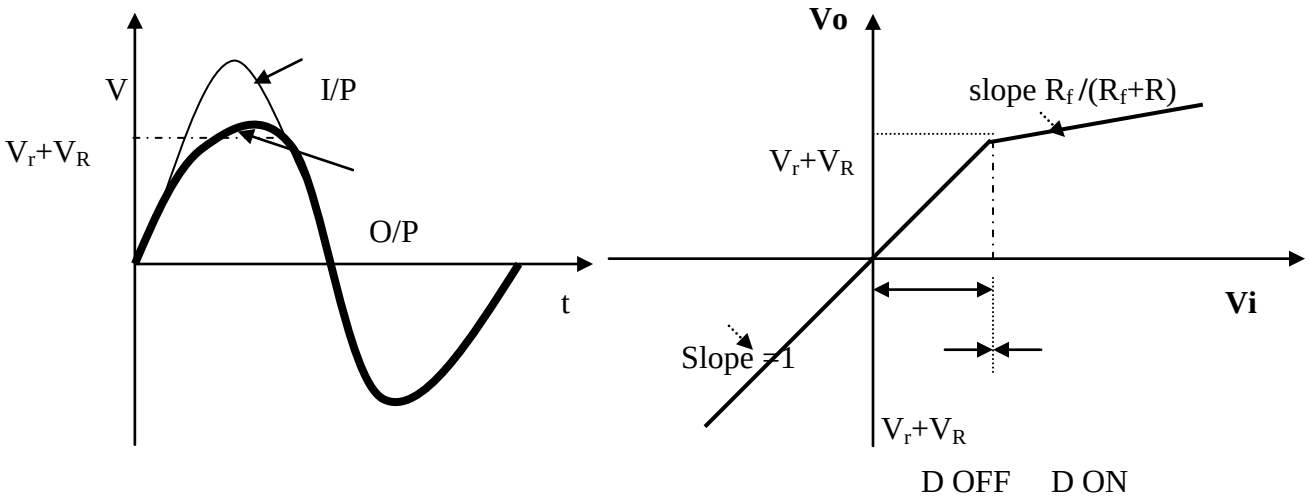


Fig2.1.1: Biased Positive Clipper

Piecewise linear

Transmission characteristics.



(ii) **Biased Negative Clipper**:-

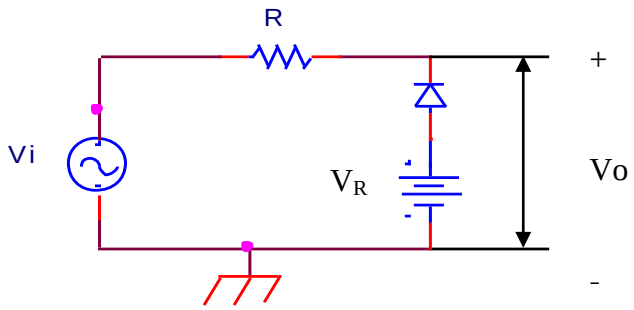
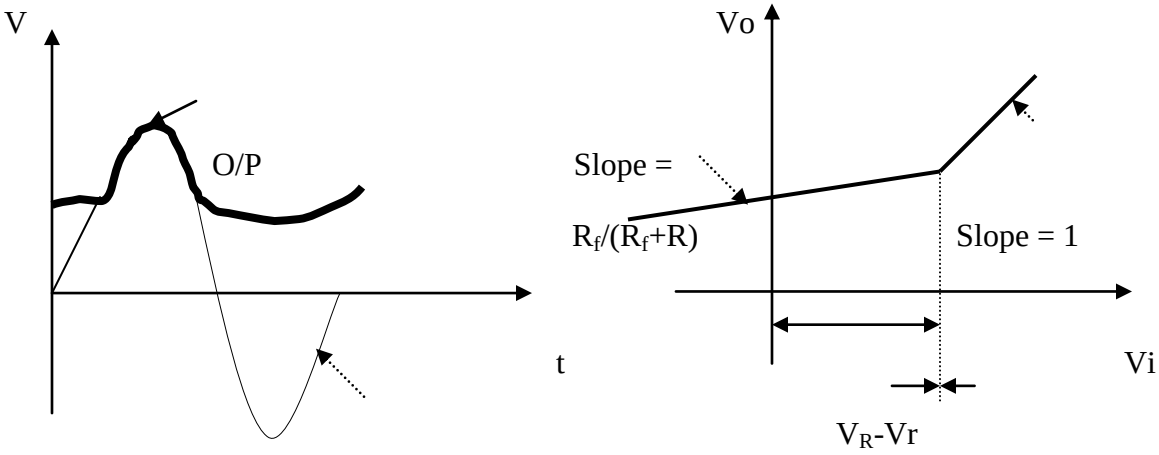


Fig2.1.2: Biased Negative Clipper



Transfer characteristics

For good clipping, we should have $R_f << R << Rr$

$$R = \sqrt{(R_f.Rr)}.$$

(iii) **Two Level Clipper**:-

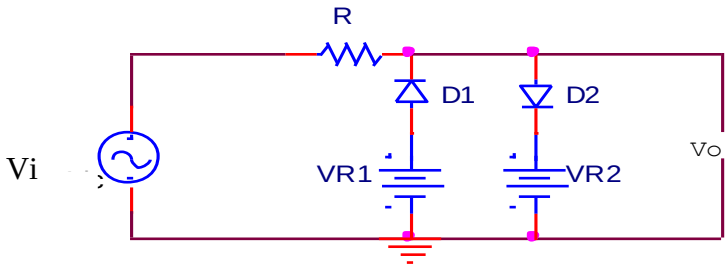
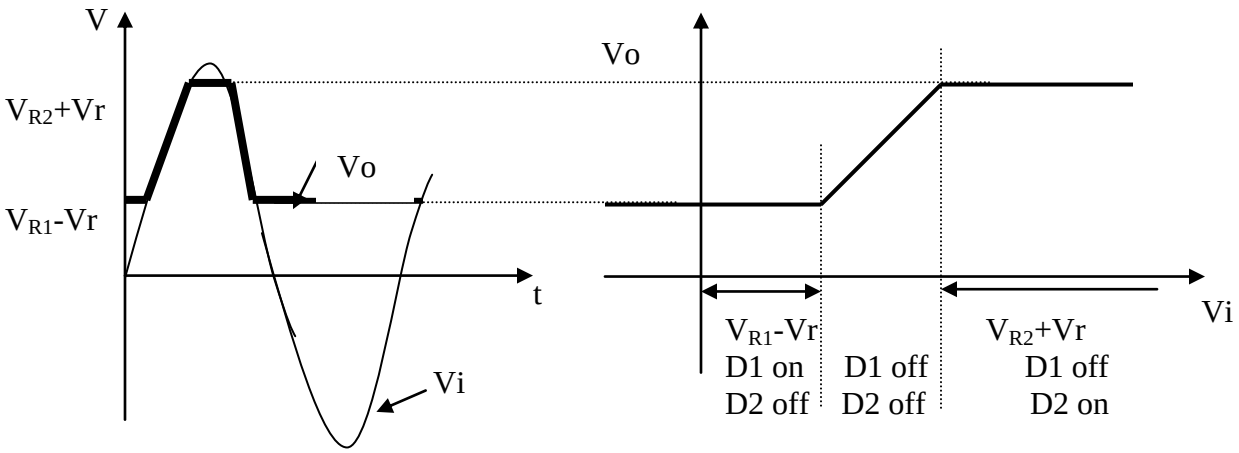


Fig2.1.3: Two Level Clipper

Transfer characteristics



(iv) **Double ended clipper**:-

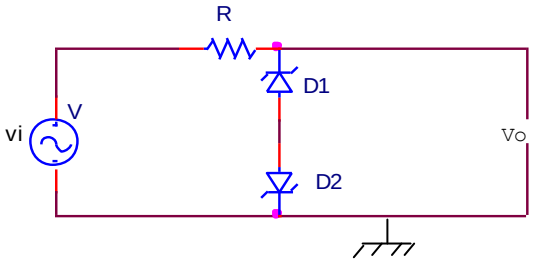
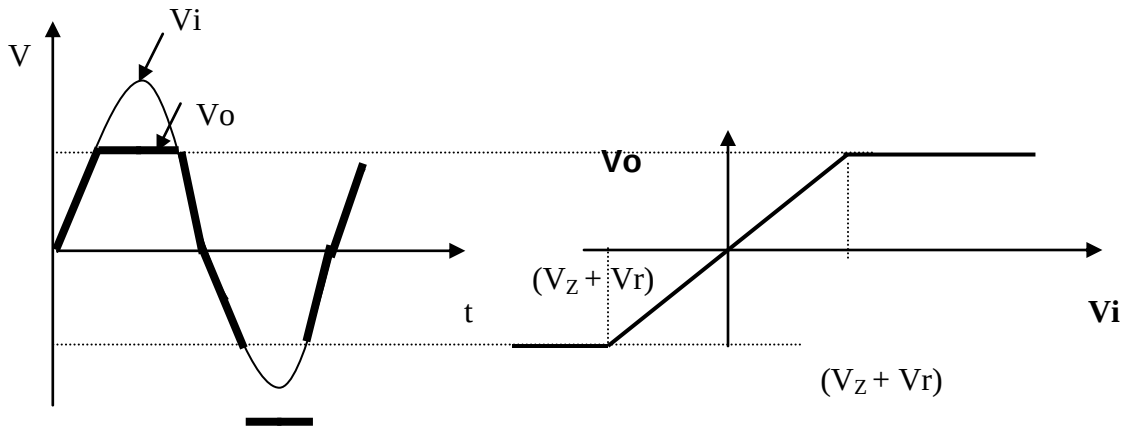


Fig2.1.4: Double ended clipper using Zener Diodes



Transfer characteristics

Transistor Clipper: -

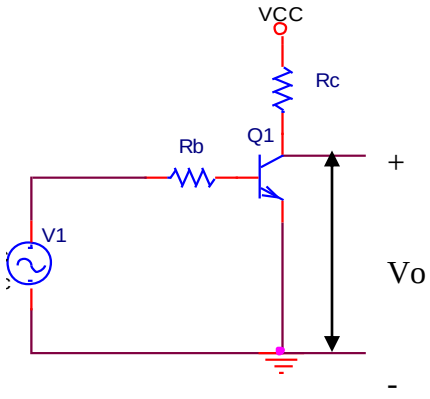
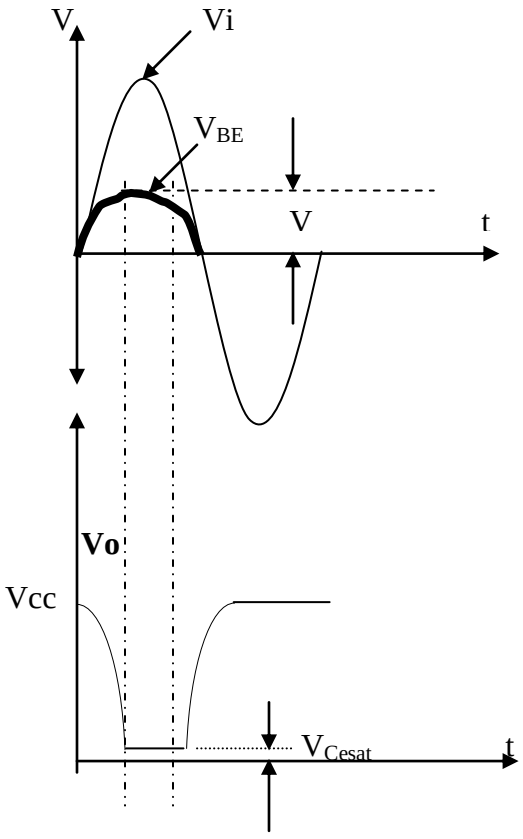


Fig2.1.5: Transistor as a clipper



Design:- The input Vi is sinusoidal and large enough to carry the transistor both into saturation and below cutoff. The base is biased so that cutin occurs at the voltage V.

In saturation, however, the collector current will remain constant at

$Ic = (Vcc-V_{cesat})/Rc = Ics$

This limiting occurs when $i_b > Ics/h_{fe}$

Let us take binary Q (2.5V, 1mA).

Vcc = 5V

IcRc = 5-2.5

Then Rc = 2.5kΩ.

1) When the transistor is in active region Vo = -hfe.Rc.Vi/Ri
2) When it is in cutoff region Vo = Vcc
3) When it is in saturation Vo = Vcesat.

Procedure:-

- Construct a Biased positive clipper circuit as in figure2.1.1 using a 1N4001 or BY127 diode and a 2.2KΩ resistor.
- Apply a ±10V, 1KHz square wave input & monitor both input & output waveform ON a (dc-coupled) oscilloscope.
- Sketch the input & output waveforms carefully notify the precise output amplitudes with respect to ground level
- Construct a two level clipper circuit using zener diode. Sketch the input & output waveforms. Carefully notify the output amplitude

CLAMPERS

Aim:-To design clamping circuits and observe their outputs.

Components and Equipments:-Capacitor, Resistors, Diode, Function Generator, CRO, RPS and Transistors.

Circuit diagram:-

1) Negative Clamper:-

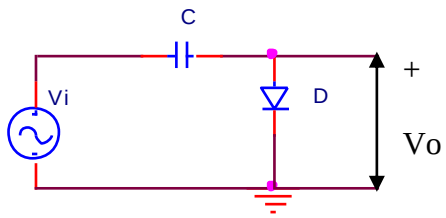
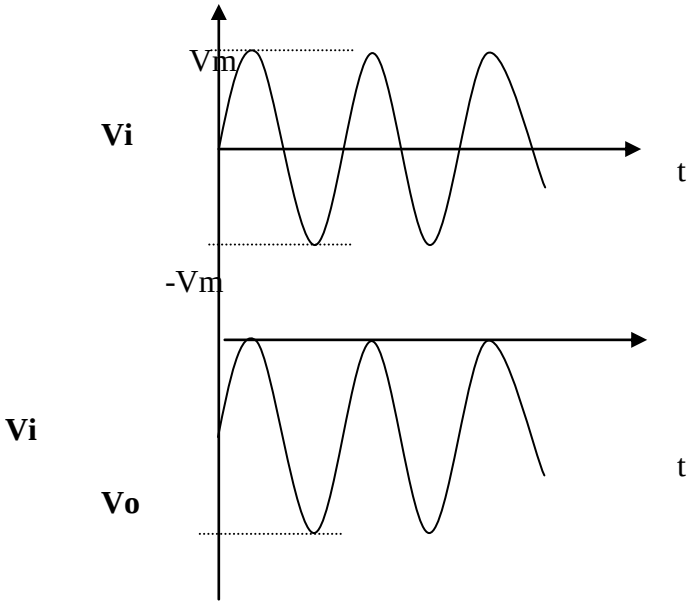
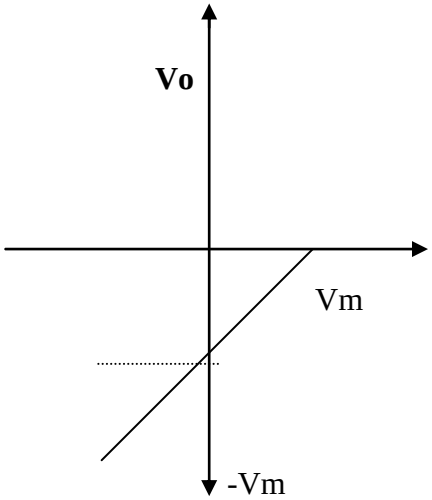


Fig2.2.1: Negative Clamper circuit

Input and output wave forms:-



Transfer characteristics



Procedure:-

- Construct a negative clamping circuit as in figure2.2.1 using the componenet values determined in design R1 = 56KΩ & C1 = 1μf.
- Apply a ±10V, 1KHz square wave input from a source with a reisstance of approximately 500Ω and monitor both input & output waveform on a (dc-coupled) oscilloscope.
- Sketch the input & output waveforms carefully noting the precise output amplitudes with respect to ground level.
- Adjust the signal frequency to 100KHz and measure the tilt on the output.

(ii) **Positive Clamper**:-

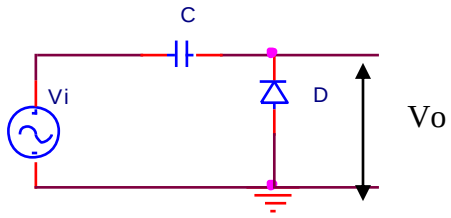
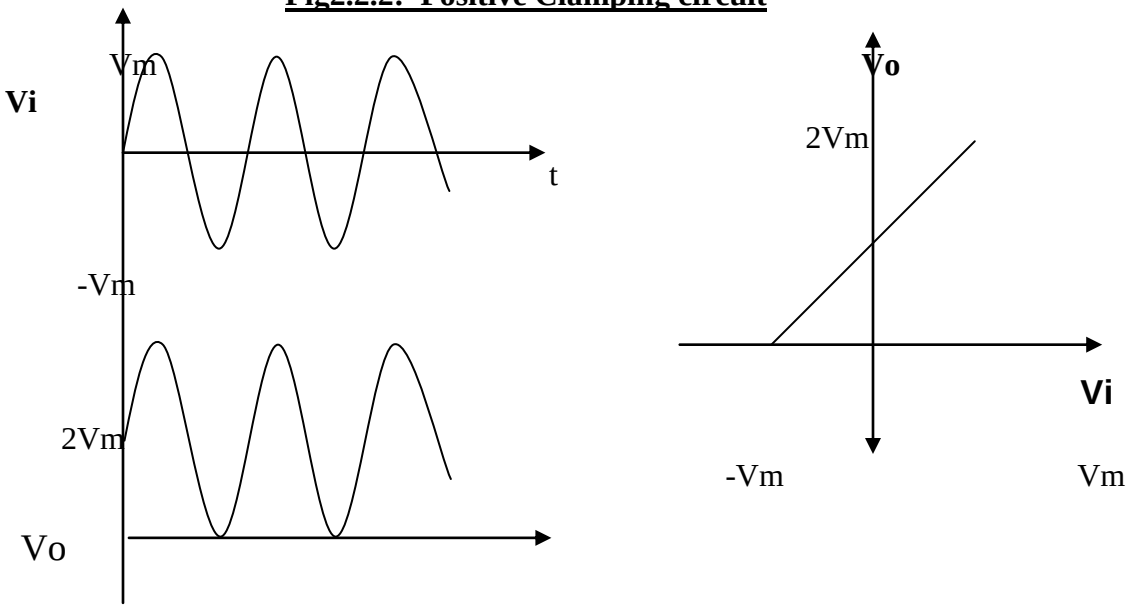


Fig2.2.2: Positive Clamping circuit



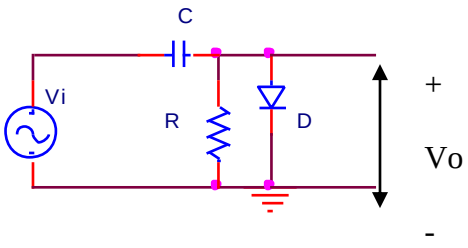
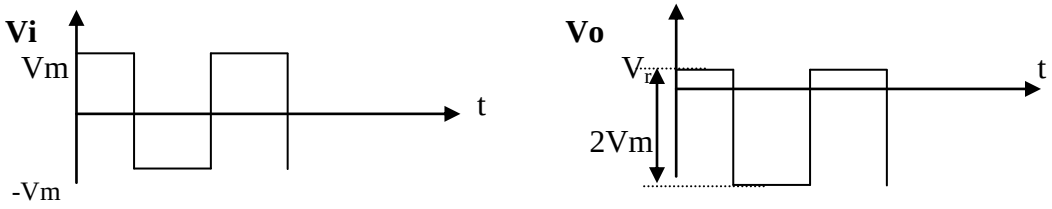


Fig2.2.3: Negative Clamper circuit

I/P & O/P Waveforms:-



(iv) **Biased Negative Clamper:-**

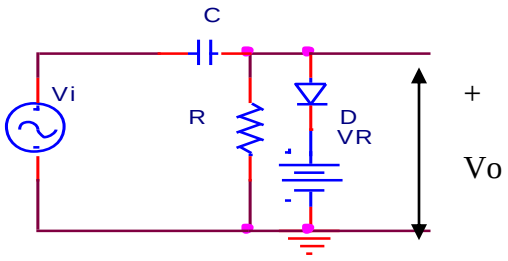
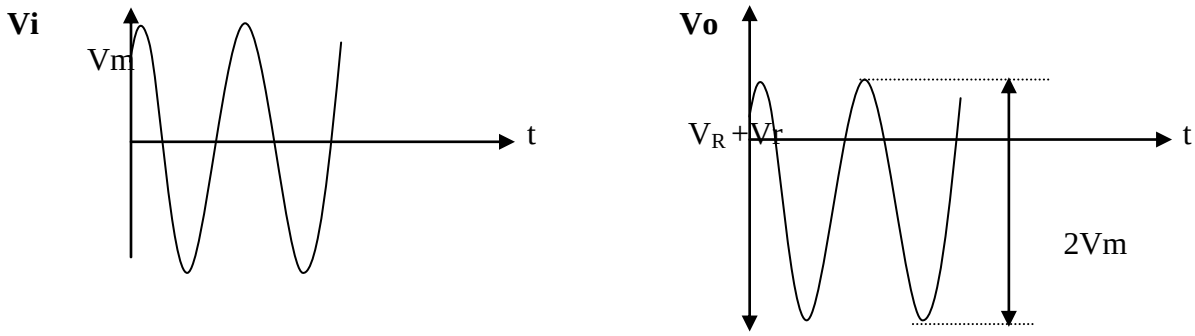


Fig2.2.4: Biased Negative Clamper circuit

I/P & O/P Waveforms:-



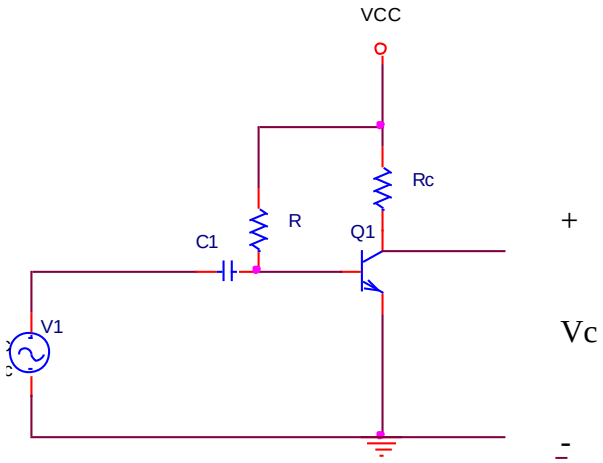
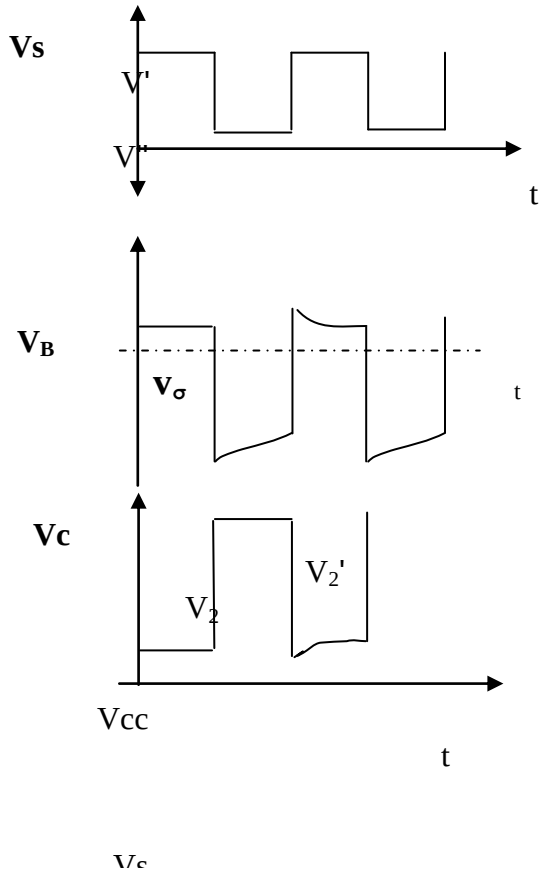


Fig2.2.5: clamping in the input circuit of an amplifier

Voltage Waveforms at Different Nodes:-



Analysis:-

- Explain the shape of the output waveforms from each of the clipping circuits.
- Explain the shape of the output waveforms from each of the clamping circuits.
- Calculate the expected output tilt for the clamping circuit in example 1 (class Note Book) when the signal frequency is 100KHz. Compare to the tilt measured in procedure 2-4.

Conclusion:-

In clamping circuit it is observed that an extremity can be set for positive or negative signal excursion. Hence it is also called DC restorer. We can limit a particular voltage up to some voltage level by reference voltage.