ELECTRONIC DEVICES & CIRCUITS -Module I

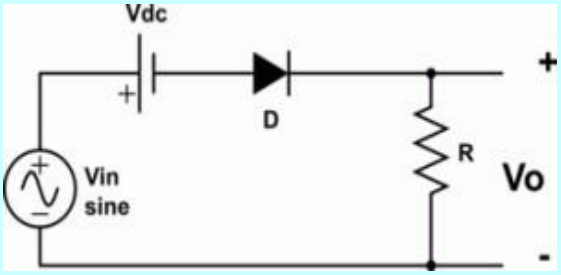
Clippers Circuits

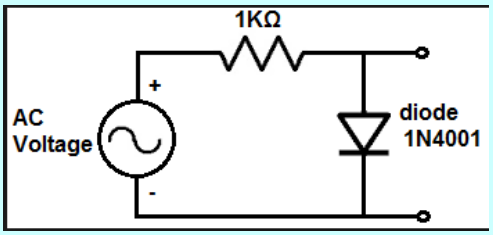
The circuit which are used to clip off unwanted portions of the waveform without disturbing the remaining part of the waveform are called clippers or Clipper circuit or Limiters or Slicers

Eg: Half wave Rectifier (which clips off the –ve portion of the I/P Signal)

When the diode is connected in series with the load, such ckt are called Series clipper

When the diode is connected in parallel or branch to the load, such ckt are called parallel clipper

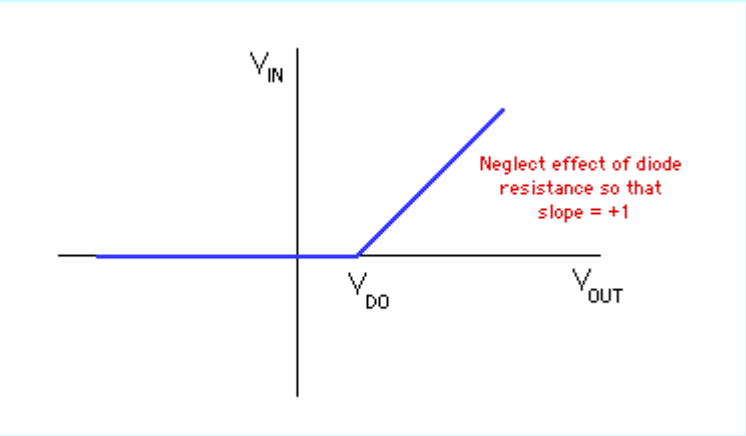




Transfer characteristics Transfer characteristics:

Plots the output against input.

- The graph of O/P variable against the I/P variable of the circuit is called transfer chara.
- Here we use Vo(O/P Voltage) vs Vi(I/P Voltage)



Clipper Types

1. Series Clippers
2. Parallel Clippers

Series negative clipper circuit

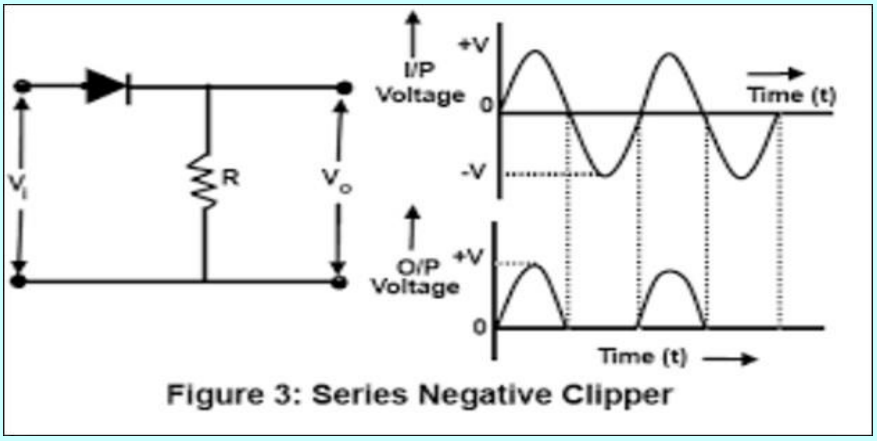
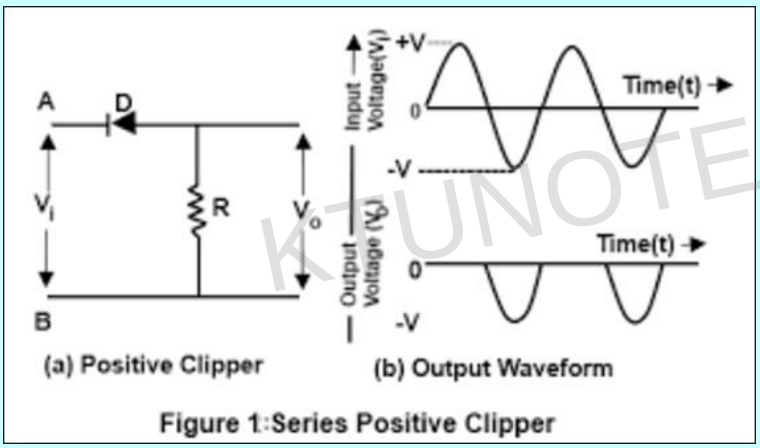


Figure 3: Series Negative Clipper

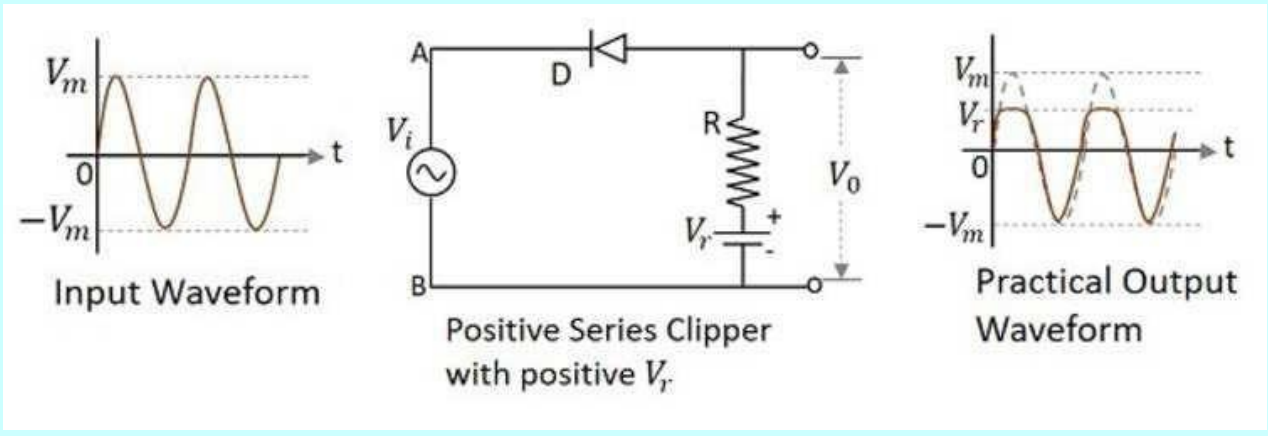
Series positive clipper circuit



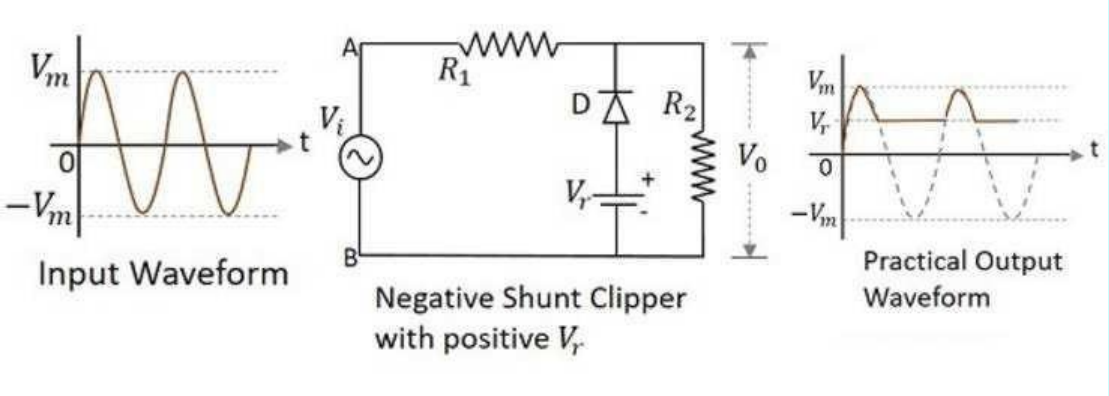
(a) Positive Clipper (b) Output Waveform

Figure 1:Series Positive Clipper

Series positive clipper above voltage VR



Negative Shunt Clipper with positive VR

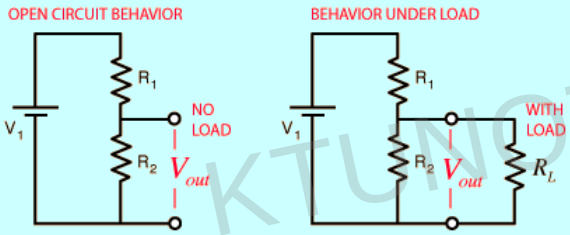


Parallel Clippers

Here the diode is connected across the load terminals It can be used to clip or limit the +ve or –ve part of the I/P signal as per the requirement

Here we uses a R1 resistance for controlling the current in the circuit

Using potential divider rule we get



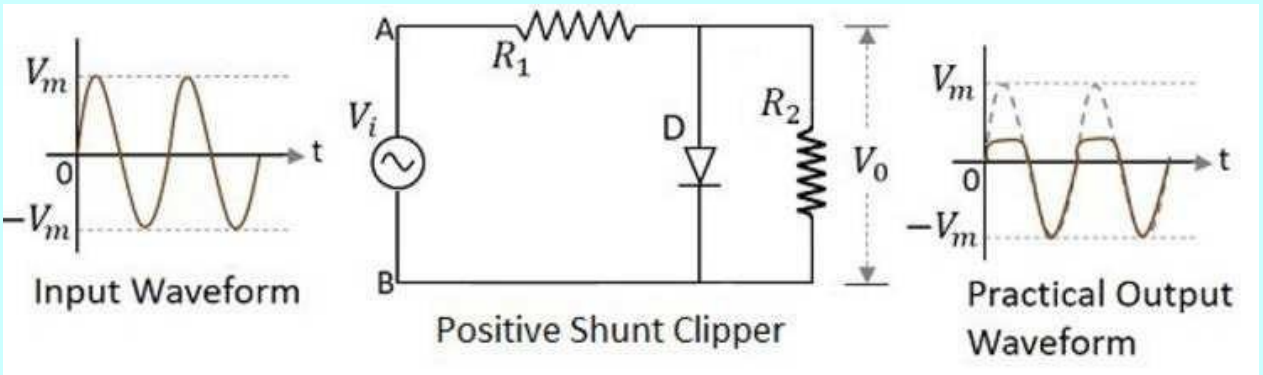
$$V_{out} = V_1 \frac{IR_2}{I(R_1 + R_2)} = \frac{V_1 R_2}{(R_1 + R_2)}$$

OUTPUT VOLTAGE UNDER "NO LOAD" CONDITION (open circuit)

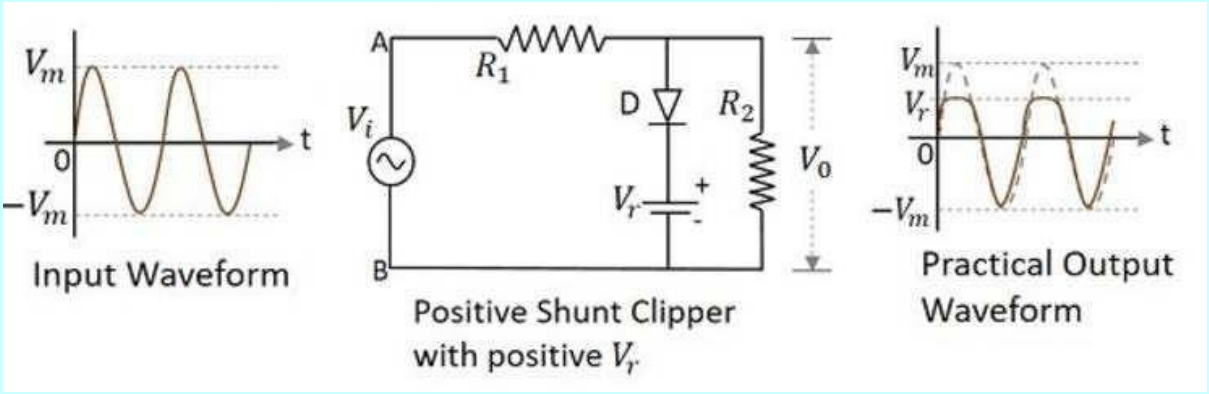
OUTPUT VOLTAGE UNDER LOAD

$$V_{out} = V_1 \frac{IR_2}{I(R_1 + R_2)} = \frac{V_1(R_2 \parallel R_L)}{(R_1 + R_2 \parallel R_L)}$$

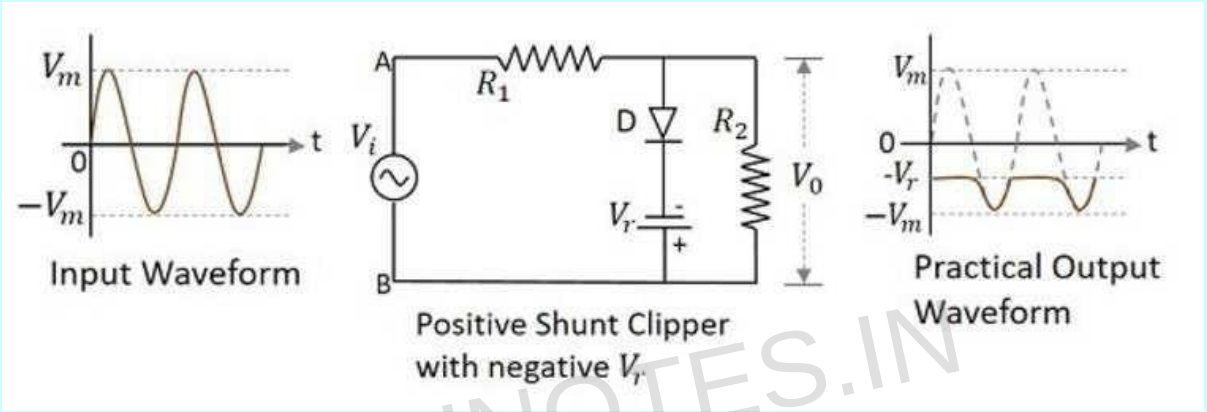
Positive Shunt Clipper



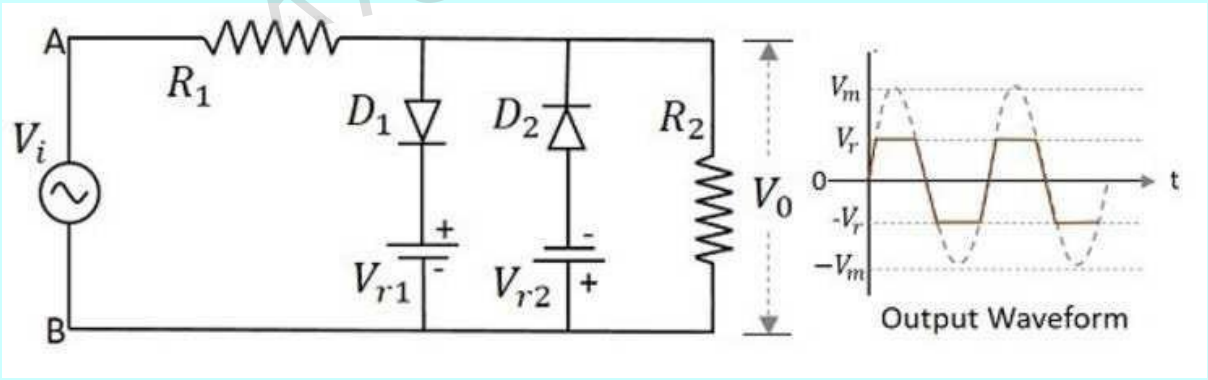
Positive Shunt Clipper with positive VR



Positive Shunt Clipper with negative



Two-way Clipper



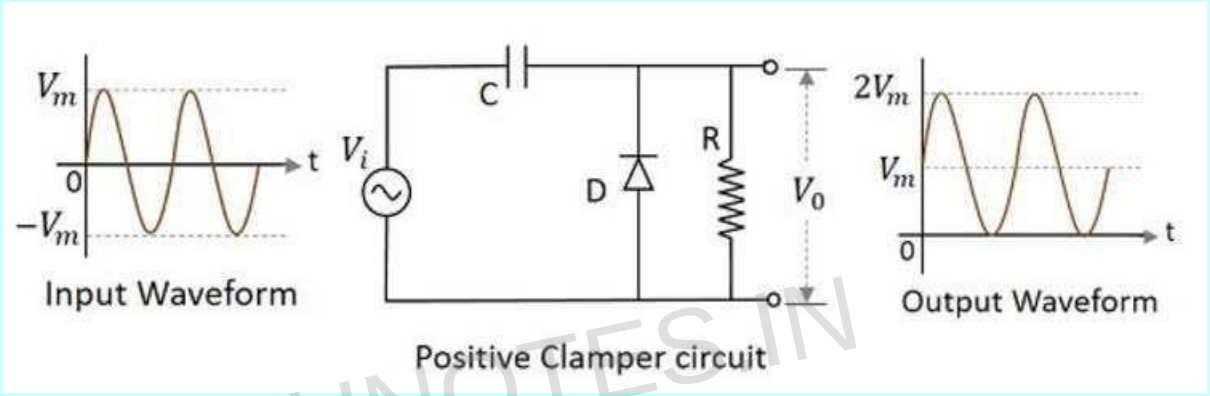
Clamper Circuits

They are used to add a DC level as per the requirements to the AC output signal

- The capacitor, diode and resistance are the three basic elements of a clamper circuit
- Also called DC Restorer or DC inserter circuits
- Depending upon the shift +ve & -ve clampers are classified as □Negative Clampers □ Positive Clampers

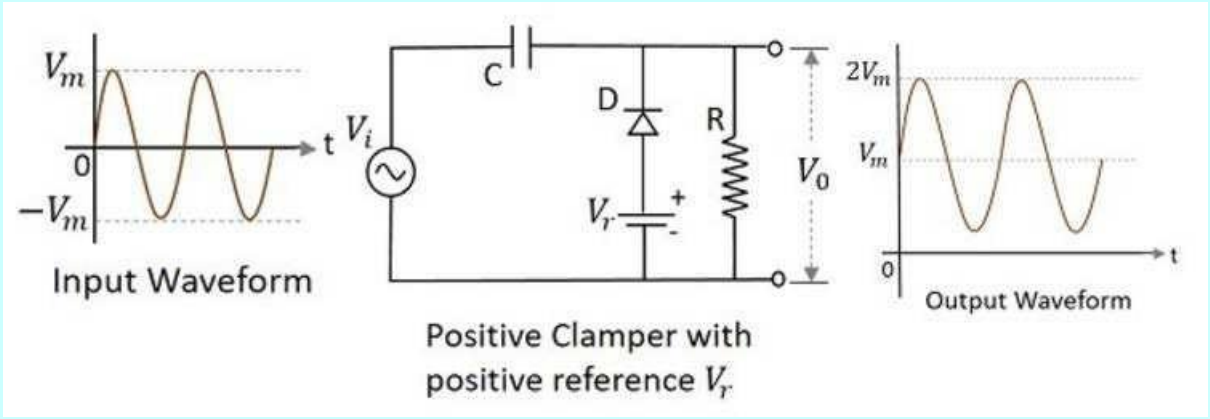
Positive Clamper Circuit

- shifts the output signal to the positive portion of the input signal
- Initially when the input is given, the capacitor is not yet charged and the diode is reverse biased. The output is not considered at this point of time. During the negative half cycle, at the peak value, the capacitor gets charged with negative on one plate and positive on the other. The capacitor is now charged to its peak value VmVm. The diode is forward biased and conducts heavily.
- During the next positive half cycle, the capacitor is charged to positive Vm while the diode gets reverse biased and gets open circuited. The output of the circuit at this moment will be
- V0=Vi+Vm



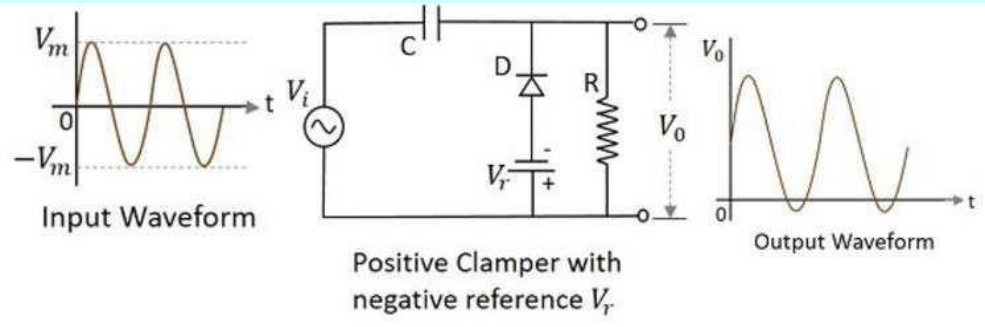
Positive Clamper with Positive Vr

- During the positive half cycle, the reference voltage is applied through the diode at the output and as the input voltage increases, the cathode voltage of the diode increase with respect to the anode voltage and hence it stops conducting. During the negative half cycle, the diode gets forward biased and starts conducting. The voltage across the capacitor and the reference voltage together maintain the output voltage level.



Positive Clamper with Negative

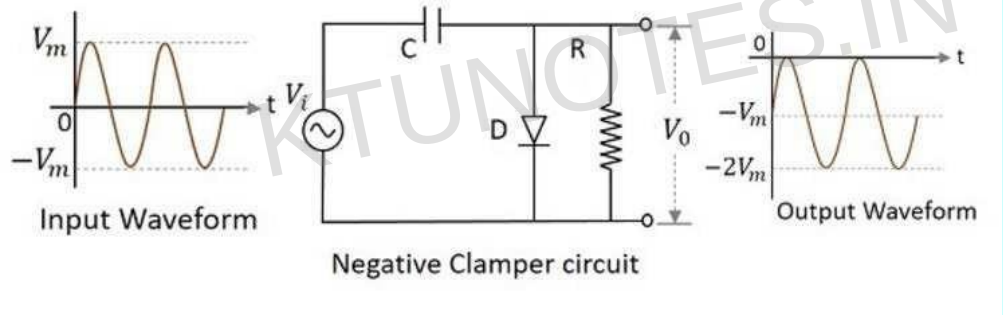
During the positive half cycle, the voltage across the capacitor and the reference voltage together maintain the output voltage level. During the negative half-cycle, the diode conducts when the cathode voltage gets less than the anode voltage. These changes make the output voltage as shown in the above figure.



Negative Clamper

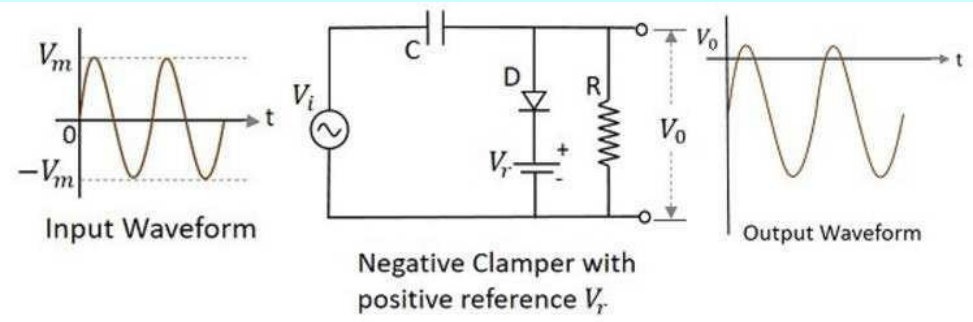
During the positive half cycle, the capacitor gets charged to its peak value vmvm. The diode is forward biased and conducts. During the negative half cycle, the diode gets reverse biased and gets open circuited. The output of the circuit at this moment will be

- V0=Vi+Vm



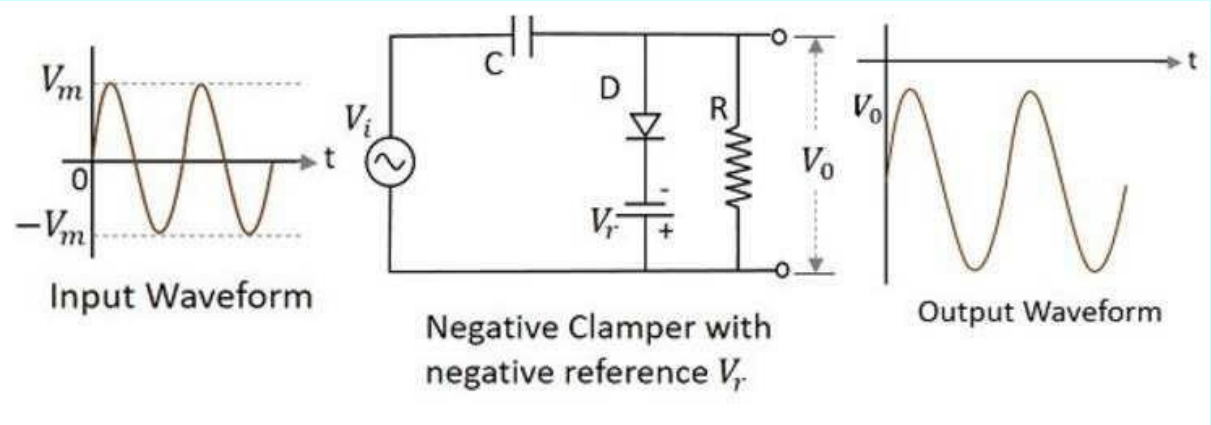
Negative clamper with positive Vr

Though the output voltage is negatively clamped, a portion of the output waveform is raised to the positive level, as the applied reference voltage is positive. During the positive half-cycle, the diode conducts, but the output equals the positive reference voltage applied. During the negative half cycle, the diode acts as open circuited and the voltage across the capacitor forms the output.



Negative Clamper with Negative Vr

The cathode of the diode is connected with a negative reference voltage, which is less than that of zero and the anode voltage. Hence the diode starts conducting during positive half cycle, before the zero voltage level. During the negative half cycle, the voltage across the capacitor appears at the output. Thus the waveform is clamped towards the negative portion.



Applications

There are many applications for both Clippers and Clampers such as

Clippers

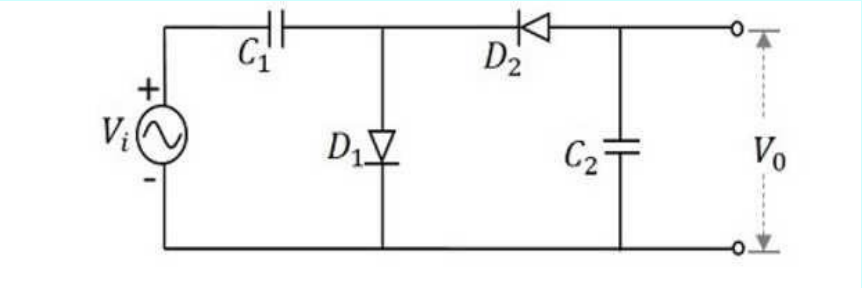
1. Used for the generation and shaping of waveforms
2. Used for the protection of circuits from spikes
3. Used for amplitude restorers
4. Used as voltage limiters
5. Used in television circuits
6. Used in FM transmitters

Clampers

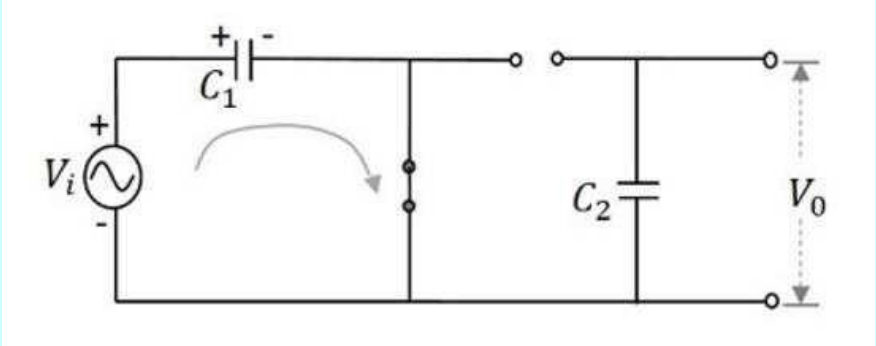
1. Used as direct current restorers
2. Used to remove distortions
3. Used as voltage multipliers
4. Used for the protection of amplifiers
5. Used as test equipment
6. Used as base-line stabilizer

Voltage Multipliers

There are applications where the voltage needs to be multiplied in some cases. This can be done easily with the help of a simple circuit using diodes and capacitors. The voltage if doubled, such a circuit is called as a Voltage Doubler.



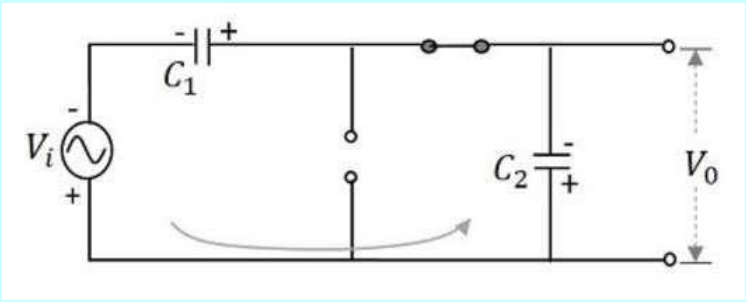
During the first positive half cycle − When the input signal is applied, the capacitor C1C1 is charged and the diode D1D1 is forward biased. While the diode D2D2 is reverse biased and the capacitor C2C2 doesn't get any charge. This makes the output V0V0 to be VmVm



First Positive Half Cycle

Hence, during 0 to ππ, the output voltage produced will be VmaxVmax. The capacitor C1C1 gets charged through the forward biased diode D1D1 to give the output, while C2C2 doesn't charge. This voltage appears at the output.

During the negative half cycle − After that, when the negative half cycle arrives, the diode D1D1 gets reverse biased and the diode D2D2 gets forward biased. The diode D2D2 gets the charge through the capacitor C2C2 which gets charged during this process. The current then flows through the capacitor C1C1 which discharges. It can be understood from the following figure.



Negative Half Cycle

Hence during ππ to 2π2π, the voltage across the capacitor C2C2 will be VmaxVmax. While the capacitor C1C1 which is fully charged, tends to discharge. Now the voltages from both

the capacitors together appear at the output, which is 2Vmax2Vmax. So, the output voltage V0V0 during this cycle is 2Vmax2Vmax

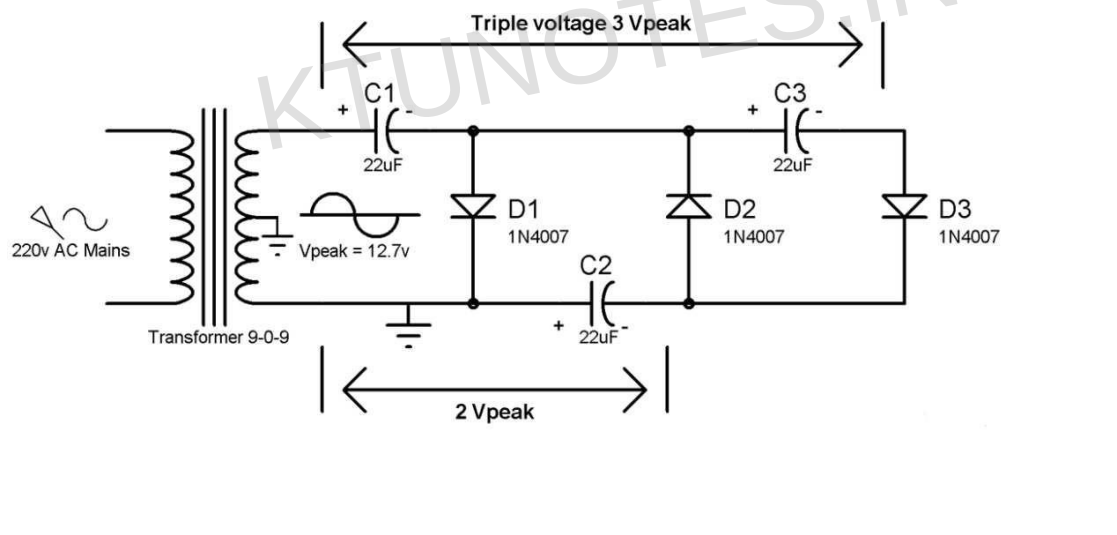
During the next positive half cycle − The capacitor C1C1 gets charged from the supply and the diode D1D1 gets forward biased. The capacitor C2C2 holds the charge as it will not find a way to discharge and the diode D2D2 gets reverse biased. Now, the output voltage V0V0 of this cycle gets the voltages from both the capacitors that together appear at the output, which is 2Vmax2Vmax.

During the next negative half cycle − The next negative half cycle makes the capacitor C1C1 to again discharge from its full charge and the diode D1D1 to reverse bias while D2D2 forward and capacitor C2C2 to charge further to maintain its voltage. Now, the output voltage V0V0 of this cycle gets the voltages from both the capacitors that together appear at the output, which is 2Vmax2Vmax.

Hence, the output voltage V0V0 is maintained to be 2Vmax2Vmax throughout its operation, which makes the circuit a voltage doubler.

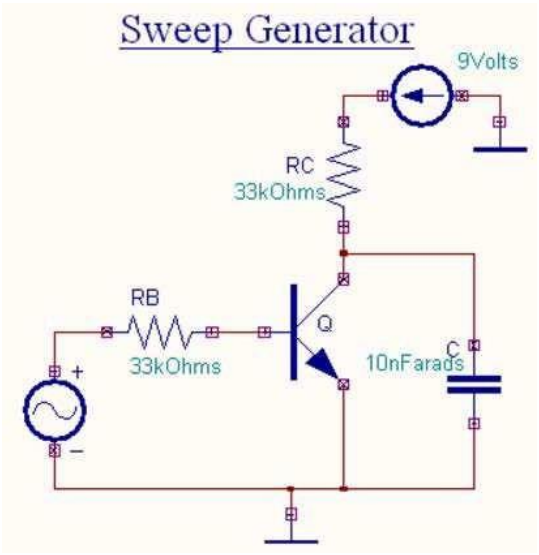
Voltage multipliers are mostly used where high DC voltages are required. For example, cathode ray tubes and computer display.

Voltage Tripler



Sweep generator

- A sweep generator is a piece of electronic test equipment similar to a function generator which creates an electrical waveform with a linearly varying frequency and a constant amplitude
- Sweep generators are commonly used to test the frequency response of electronic filter circuits.
- These circuits are mostly transistor circuits with inductors and capacitors to create linear characteristics.



Output waveform