Clippers and Clampers

Clipper and Clamper are widely used in analog television receivers and FM transmitters. The variable frequency interference can be removed by using the clamping method in television receivers, and in FM transmitters, the noise peaks are limited to a specific value, above which the excessive peaks can be removed by using the clipping method.

Clippers

The clipper circuit can be designed by utilizing both the linear and nonlinear elements such as resistors, diodes or transistors. As these circuits are used only for clipping input waveform as per the requirement and for transmitting the waveform, they do not contain any energy storing element like a capacitor.

Clippers can be broadly classified into two basic types of circuits.

- series clippers
- shunt or parallel clippers.

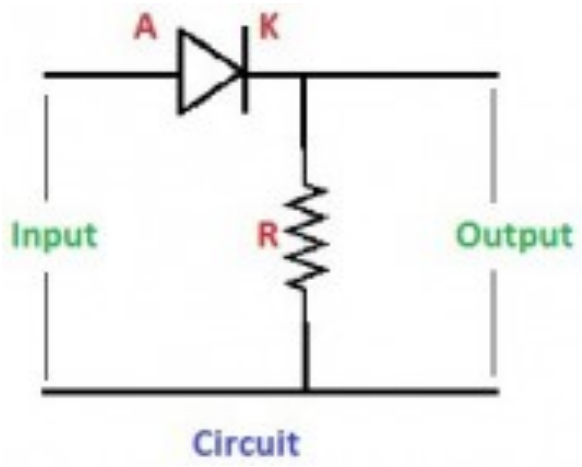
- Series clipper circuit contains a power diode in series with the load connected at the end of the circuit.

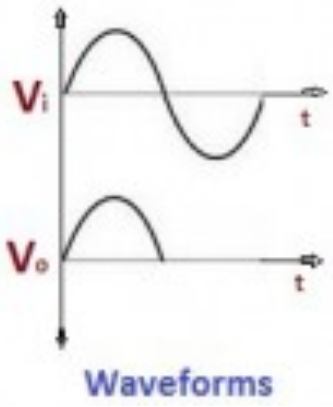
- The shunt clipper contains a diode in parallel with the resistive load.

Series Clippers

Series clippers are again classified into series negative clippers and series positive clippers which are as follows:

a. Series Negative Clipper





- **During Positive Half Cycle:** Output voltage (V_O) = (V_{in} – V_d) Volts
- **During Negative Half Cycle:** Output voltage (V_O) = 0 Volts

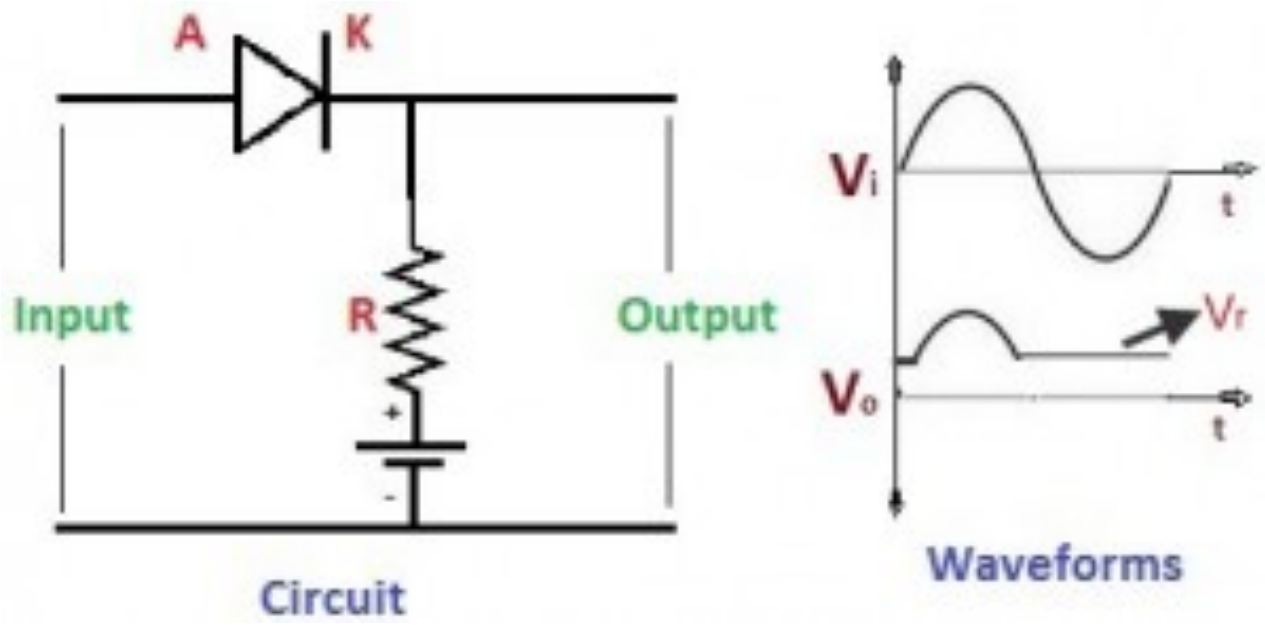
The above figure shows a series negative clipper with its output waveforms. During the positive half cycle the diode (considered as ideal diode) appears in the forward biased and conducts such that the entire positive half cycle of input appears across the resistor connected in parallel as output waveform. During the negative half cycle the diode is in reverse biased. No output appears across the resistor. Thus, it clips the negative half cycle of the input waveform, and therefore, it is called as a series negative clipper.

Series Negative Clipper With Positive Vr

Series negative clipper with positive reference voltage is similar to the series negative clipper

In this a positive reference voltage is added in series with the resistor.

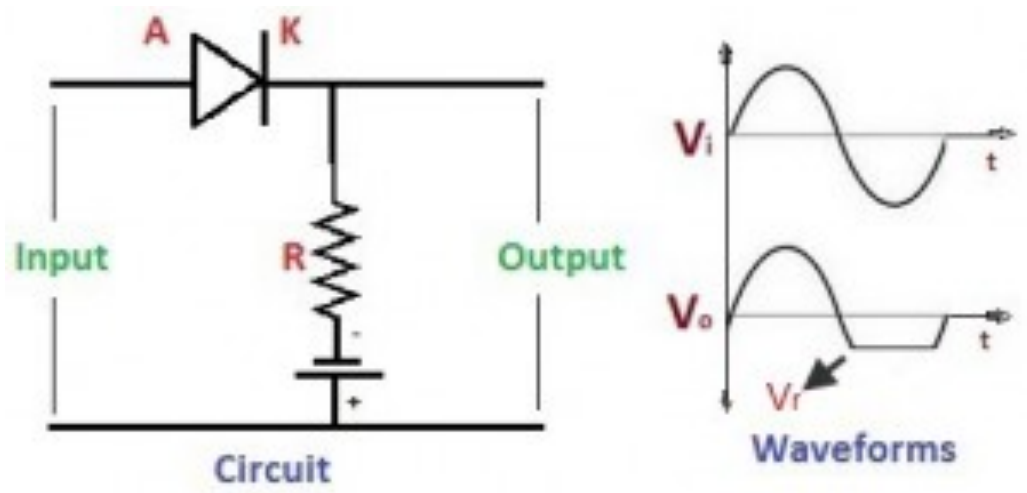
During the positive half cycle, the diode start conducting only after its anode voltage value exceeds the cathode voltage value. Since cathode voltage becomes equal to the reference voltage, the output that appears across the resistor will be as shown in the above figure.



Series Negative Clipper With Negative Vr

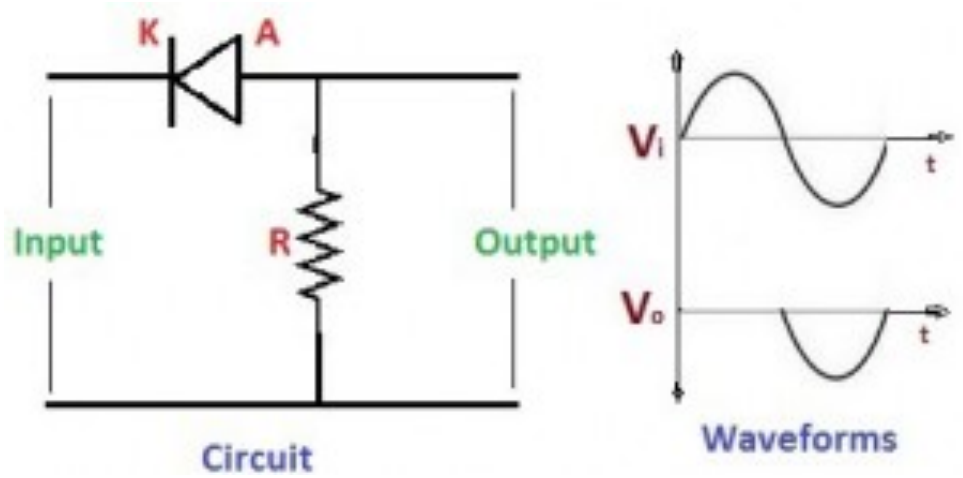
The series negative clipper with a negative reference voltage is similar to the series negative clipper with positive reference voltage, but instead of positive Vr here a negative Vr is connected in series with the resistor, which makes the cathode voltage of the diode as negative voltage.

Thus during the positive half cycle, the entire input appears as output across the resistor, and during the negative half cycle, the input appears as output until the input value will be less than the negative reference voltage, as shown in the figure.



Series Clippers

b. Series Positive Clipper

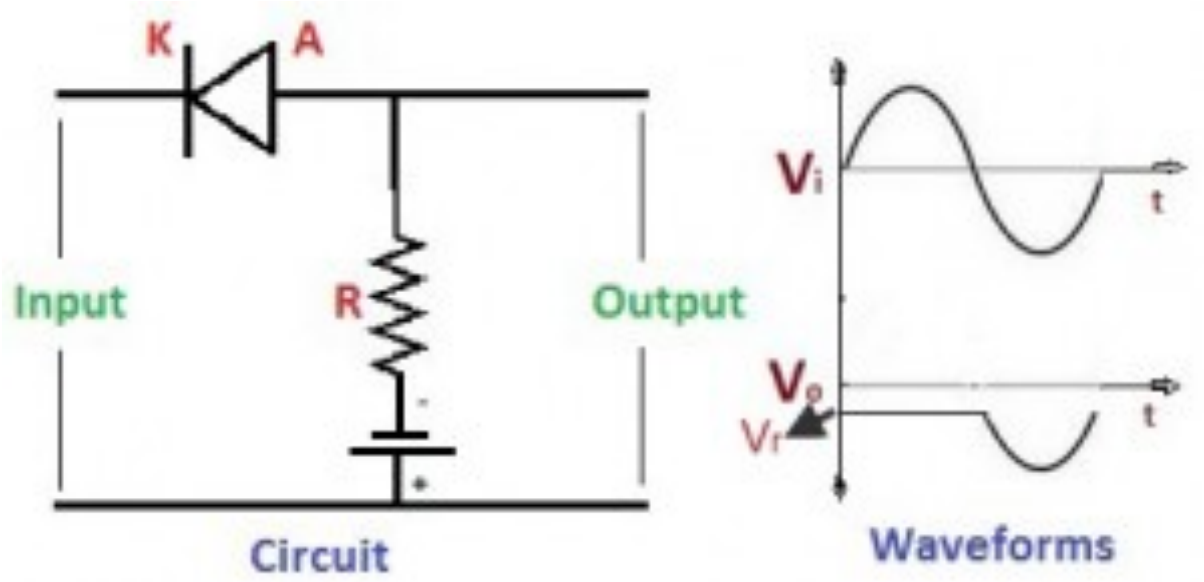


- **During Positive Half Cycle**: Output voltage (V_O) = 0 Volts
- **During Negative Half Cycle**: Output voltage (V_O) = (V_{in} + V_d) Volts

The series positive clipper circuit is connected as shown in the figure. During the positive half cycle, diode becomes reverse biased, and no output is generated across the resistor, and during the negative half cycle, the diode conducts and the entire input appears as output across the resistor.

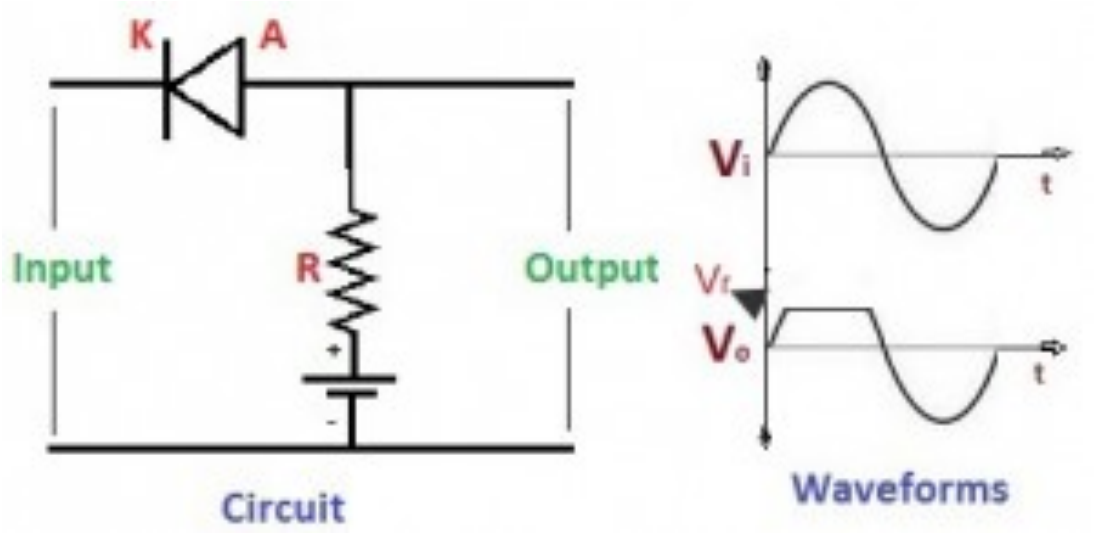
Series Positive Clipper With Negative Vr

It is similar to the series positive clipper in addition to a negative reference voltage in series with a resistor; and here, during the positive half cycle, the output appears across the resistor as a negative reference voltage. During the negative half cycle, the output is generated after reaching a value greater than the negative reference voltage, as shown in the figure.



Series Positive Clipper With Positive Vr

Instead of negative reference voltage a positive reference voltage is connected to obtain series positive clipper with a positive reference voltage. During the positive half cycle, the reference voltage appears as an output across the resistor, and during the negative half cycle, the entire input appears as output across the resistor.

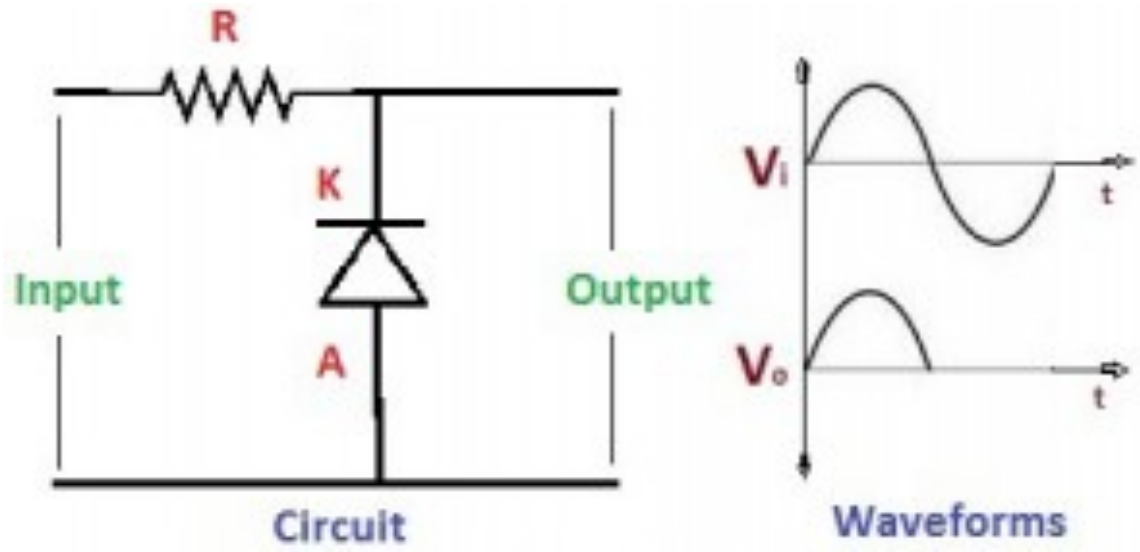


Shunt Clippers

Shunt clippers are classified into two types: shunt negative clippers and shunt positive clippers.

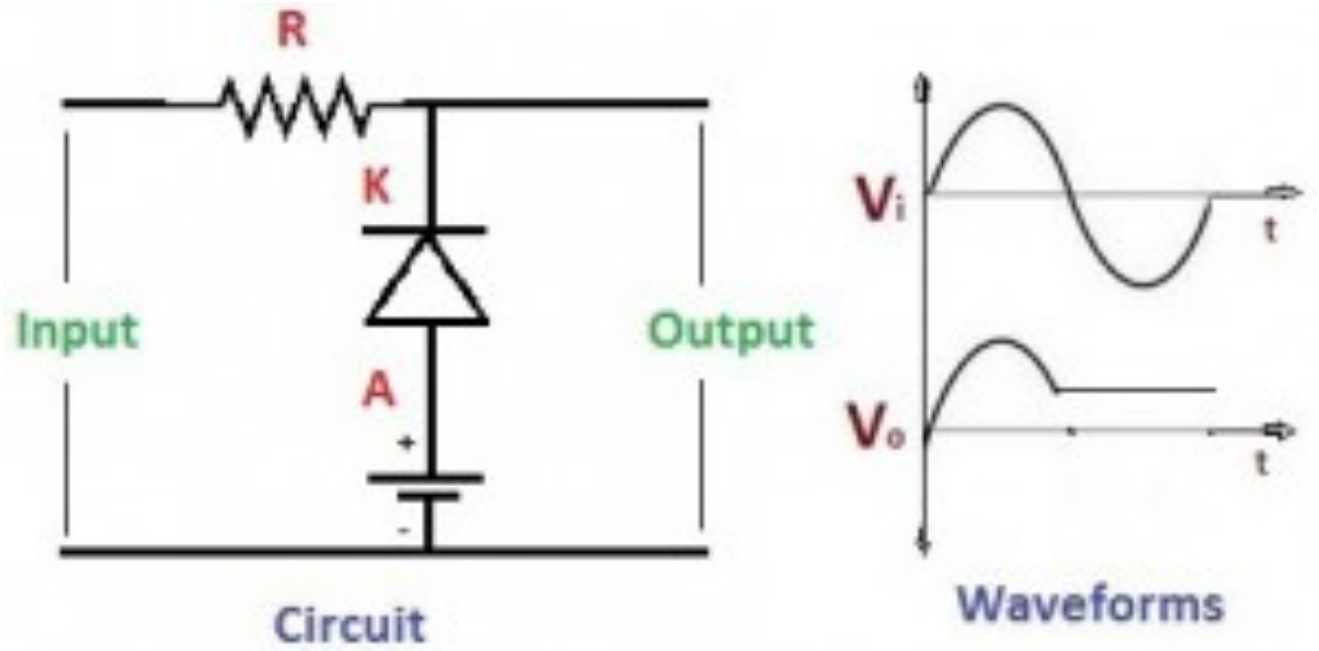
a. Shunt Negative Clipper

Shunt negative clipper is connected as shown in the above figure. During the positive half cycle, the entire input is the output, and during the negative half cycle, the diode conducts causing no output to be generated from the input.

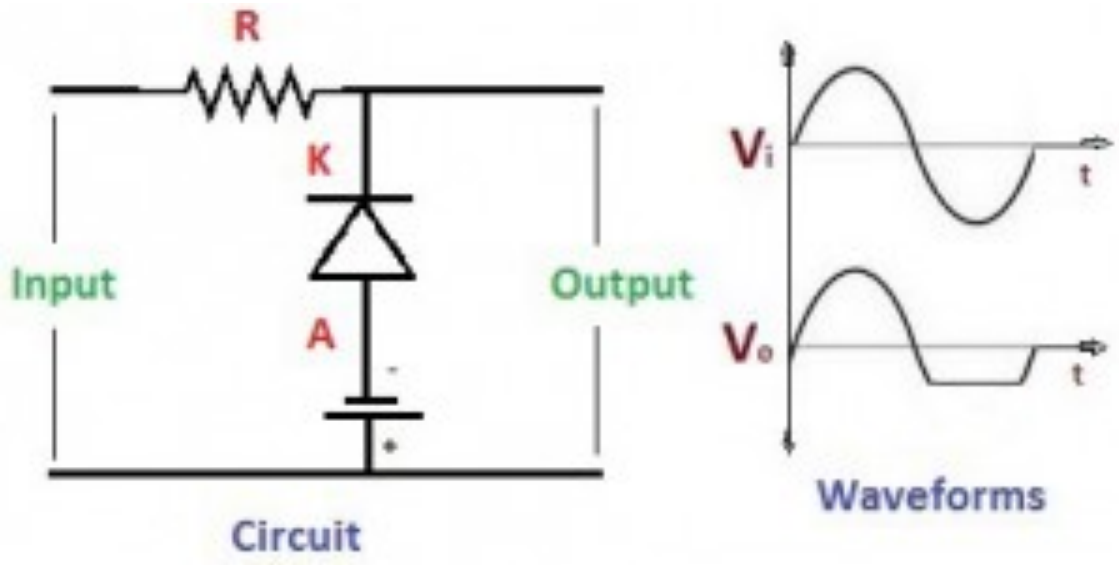


Shunt Negative Clipper With Positive Vr

A series positive reference voltage is added to the diode as shown in the figure. During the positive half cycle, the input is generated as output, and during the negative half cycle, a positive reference voltage will be the output voltage as shown

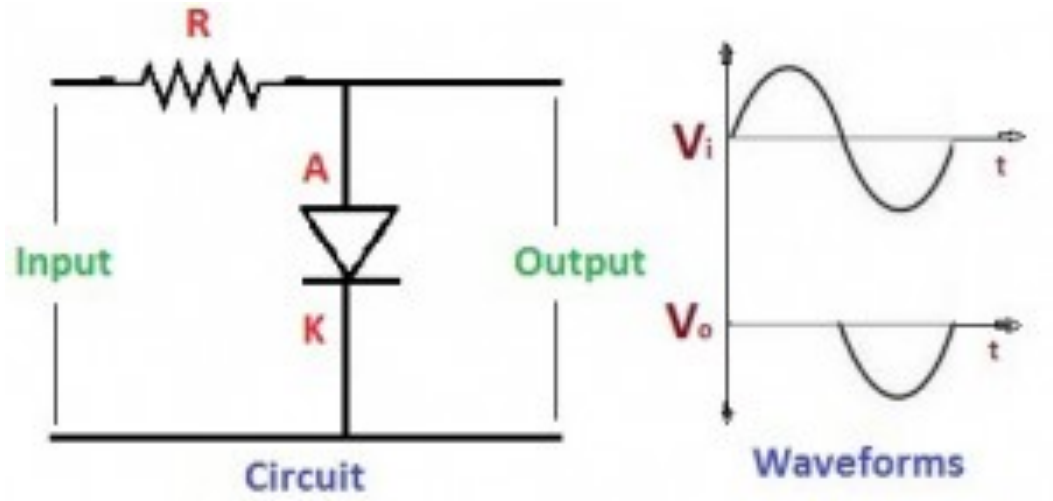


Shunt Negative Clipper With Negative Vr



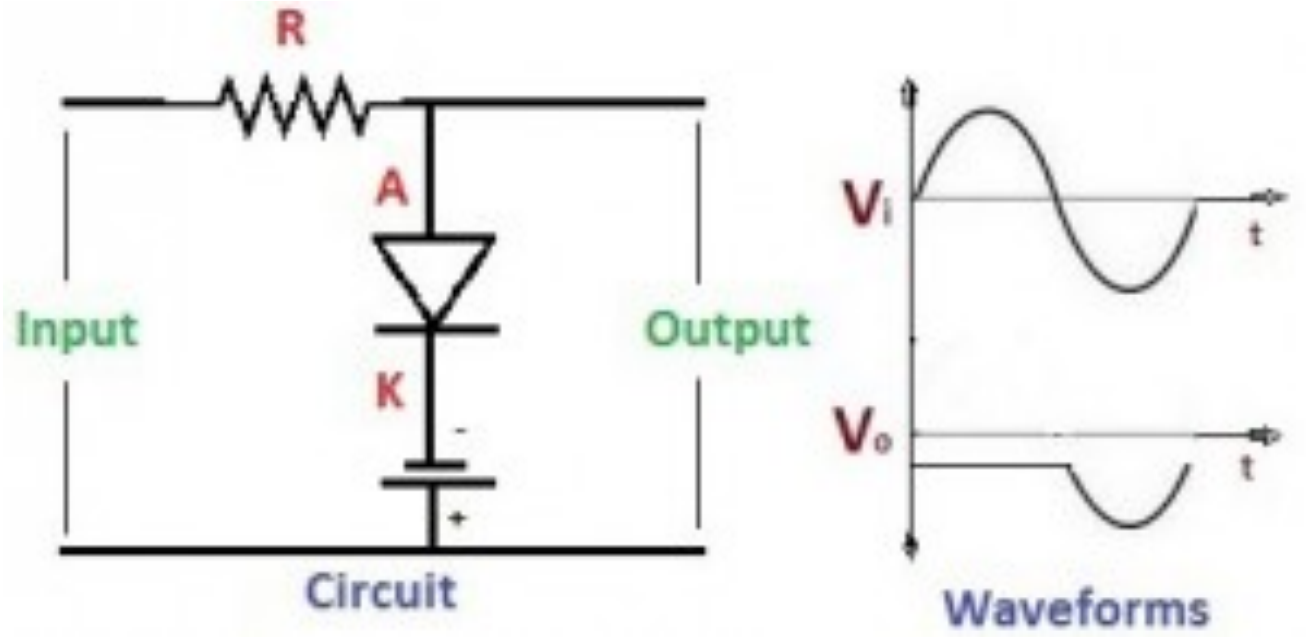
Instead of positive reference voltage, a negative reference voltage is connected in series with the diode to form a shunt negative clipper with a negative reference voltage. During the positive half cycle, the entire input appears as output, and during the negative half cycle, a reference voltage appears as output as shown in the above figure.

b. Shunt Positive Clipper



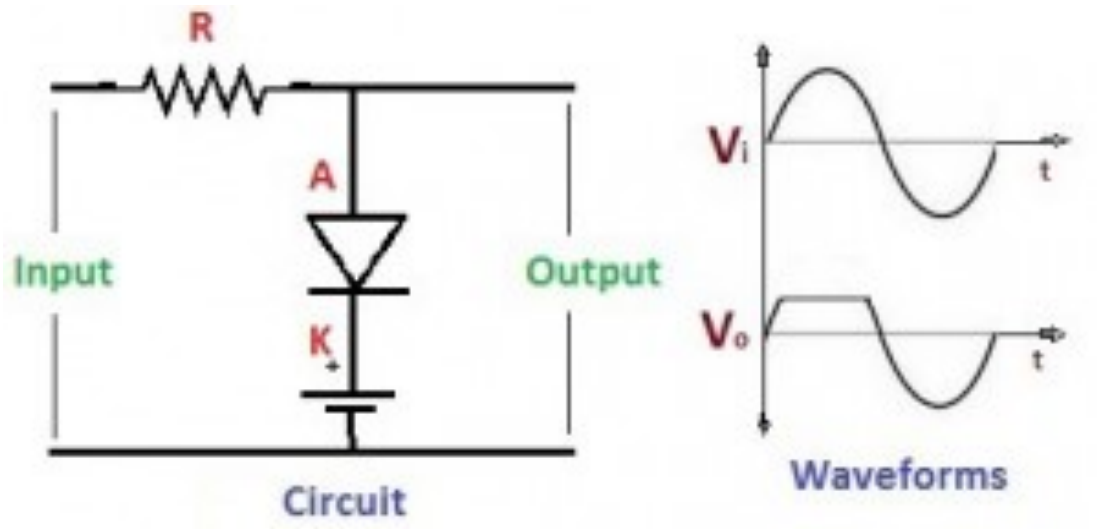
During the positive half cycle the diode is in conduction mode and no output is generated; and during the negative half cycle; entire input appears as output as the diode is in reverse bias as shown in the above figure.

Shunt Positive Clipper with Negative Vr



During the positive half cycle, the negative reference voltage connected in series with the diode appears as output; and during the negative half cycle, the diode conducts until the input voltage value becomes greater than the negative reference voltage and output will be generated as shown in the figure.

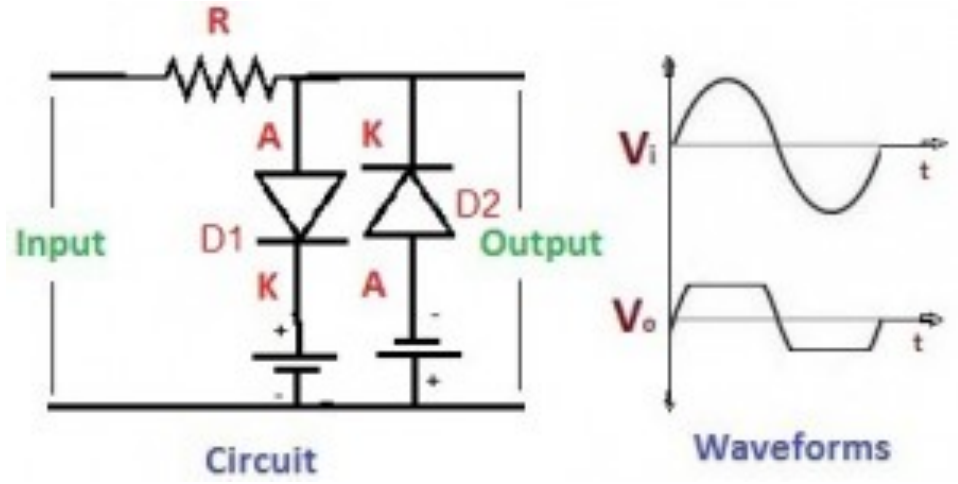
Shunt Positive Clipper with Positive Vr



During the positive half cycle the diode conducts causing the positive reference voltage appear as output voltage; and, during the negative half cycle, the entire input is generated as the output as the diode is in reverse biased.

Positive-Negative Clipper with Reference Voltage Vr

In addition to the positive and negative clippers, there is a combined clipper which is used for clipping both the positive and negative half cycles as discussed below.



The circuit is connected as shown in the figure with a reference voltage Vr, diodes D1 & D2. During the positive half cycle, the diode the diode D1 conducts causing the reference voltage connected in series with D1 to appear across the output.

During the negative cycle, the diode D2 conducts causing the negative reference voltage connected across the D2 appear as output, as shown in the above figure.

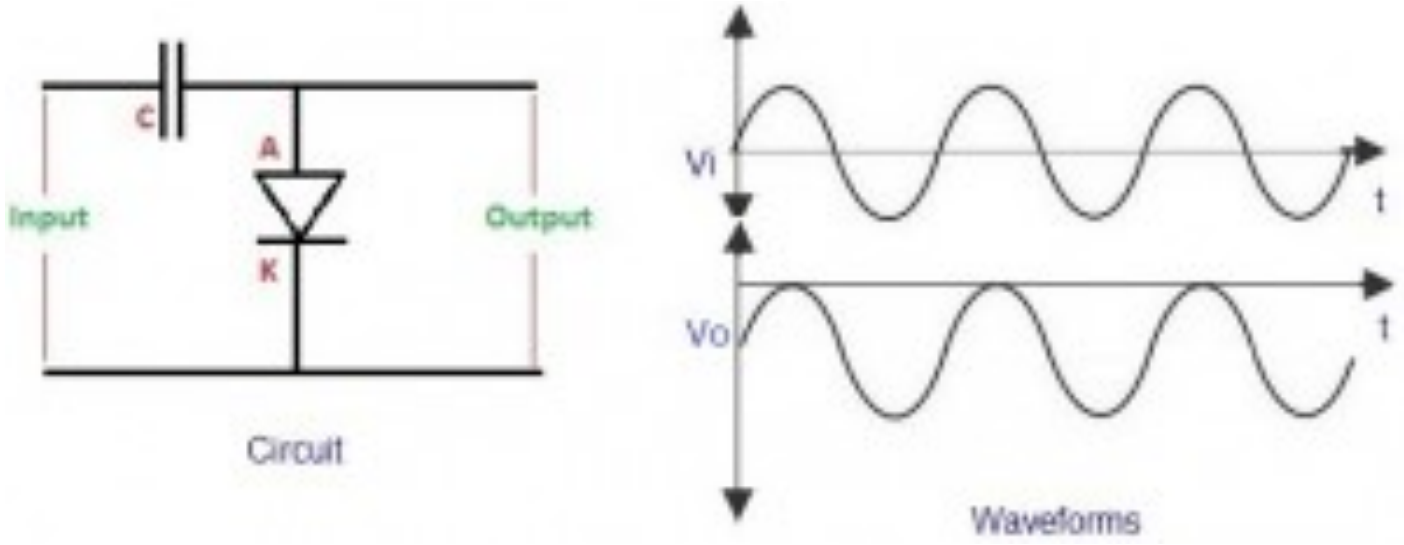
CLAMPER CIRCUIT

Working of Clamper Circuit :

The positive or negative peak of a signal can be positioned at the desired level by using the clamping circuits. As we can shift the levels of peaks of the signal by using a clamper, hence, it is also called as level shifter.

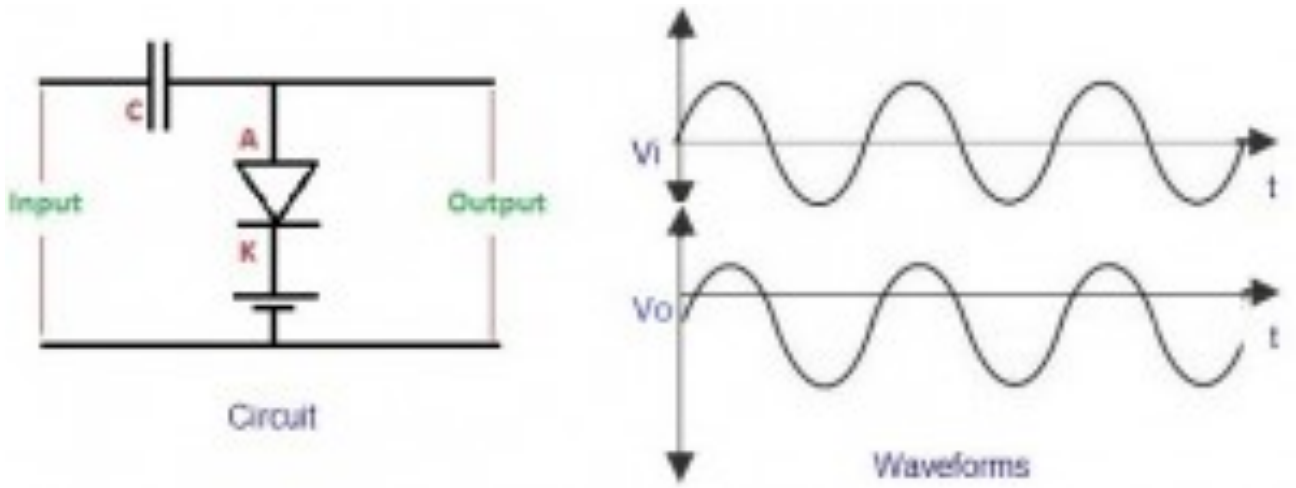
- The clamper circuit consists of a capacitor and diode connected in parallel across the load.
- The clamper circuit depends on the change in the time constant of the capacitor.
- The capacitor must be chosen such that, during the conduction of the diode, the capacitor must be sufficient to charge quickly and during the nonconducting period of diode, the capacitor should not discharge drastically.
- The clampers are classified as positive and negative clampers based on the clamping method.

Negative Clamper



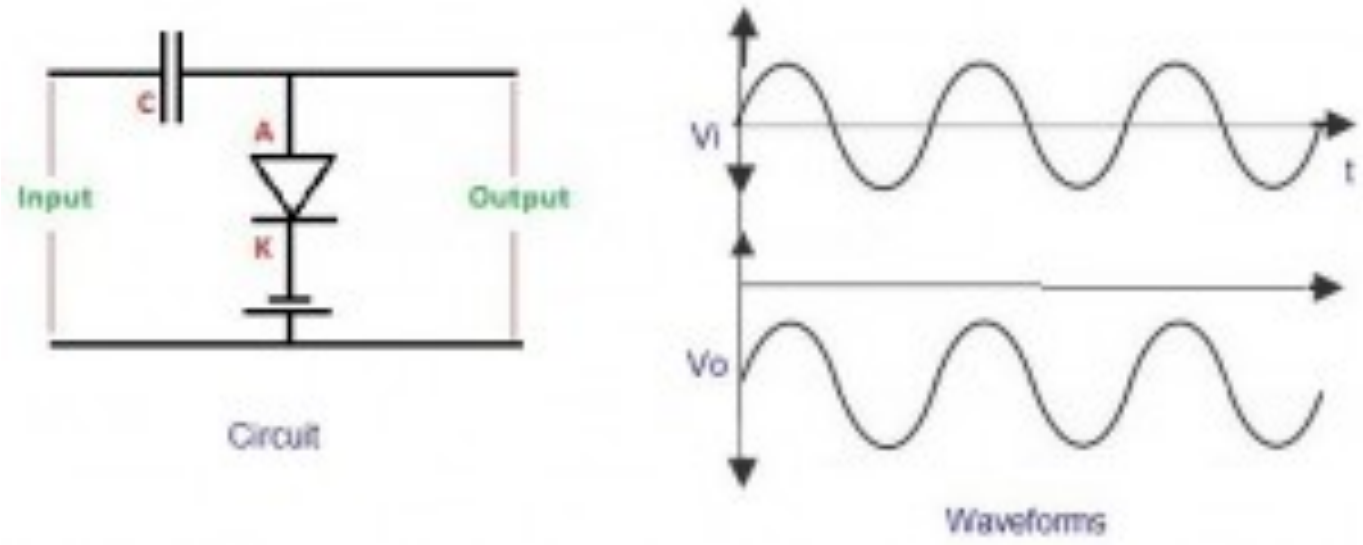
During the positive half cycle, the input diode is in forward bias- and as the diode conducts-capacitor gets charged (up to peak value of input supply). During the negative half cycle, reverse does not conduct and the output voltage become equal to the sum of the input voltage and the voltage stored across the capacitor.

Negative Clamper with Positive Vr



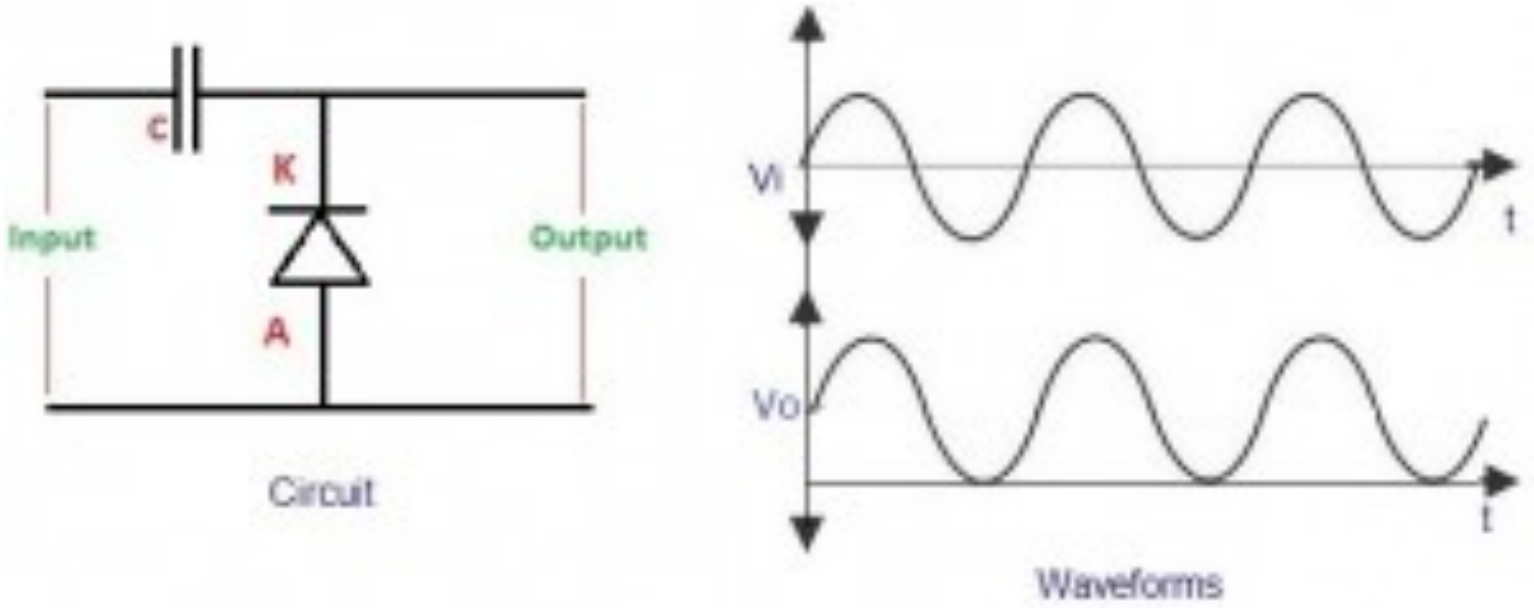
It is similar to the negative clamper, but the output waveform is shifted towards the positive direction by a positive reference voltage. As the positive reference voltage is connected in series with the diode, during the positive half cycle, even though the diode conducts, the output voltage becomes equal to the reference voltage; hence, the output is clamped towards the positive direction as shown in the above figure.

Negative Clamper with Negative Vr



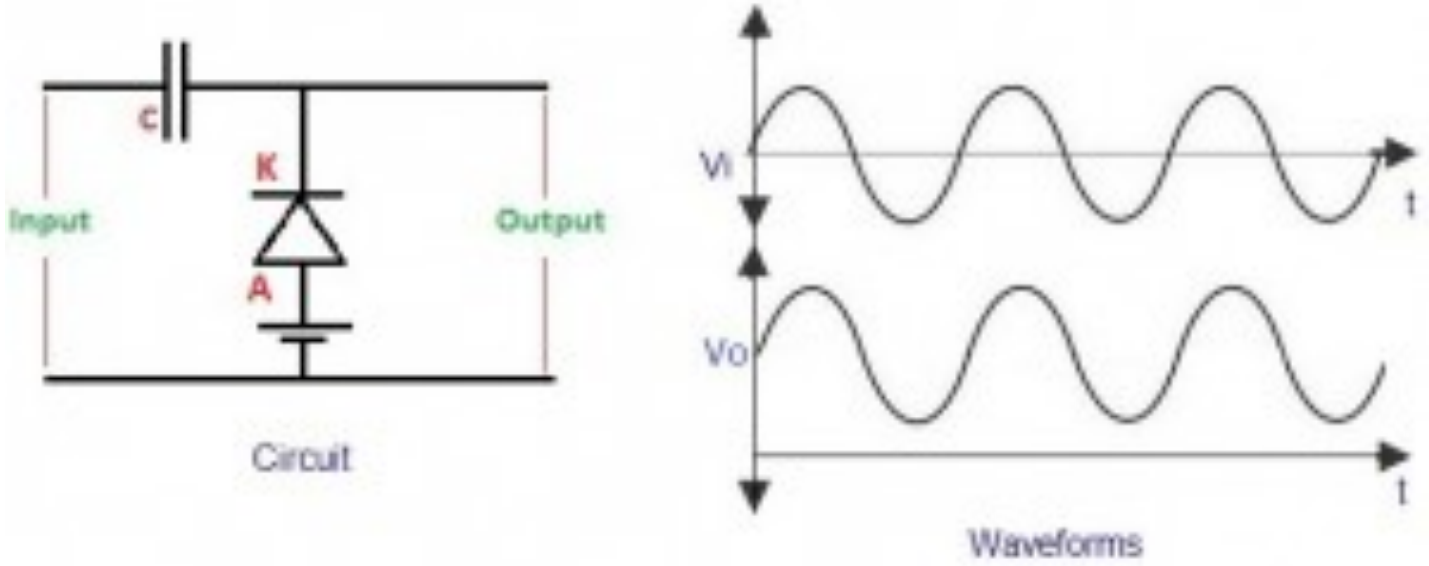
By inverting the reference voltage directions, the negative reference voltage is connected in series with the diode as shown in the above figure. During the positive half cycle, the diode starts conduction before zero, as the cathode has a negative reference voltage, which is less than that of zero and the anode voltage, and thus, the waveform is clamped towards the negative direction by the reference voltage value.

Positive Clamper



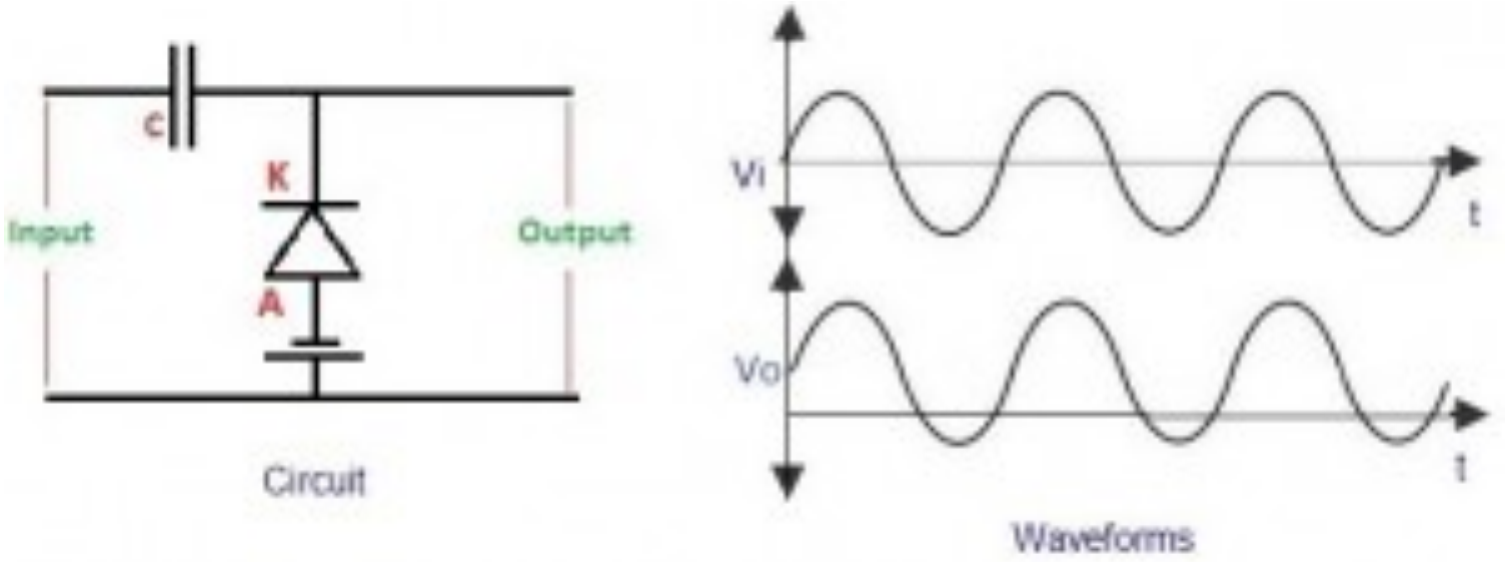
It is almost similar to the negative clamper circuit, but the diode is connected in the opposite direction. During the positive half cycle, the voltage across the output terminals becomes equal to the sum of the input voltage and capacitor voltage (considering the capacitor as initially fully charged). During the negative half cycle of the input, the diode starts conducting and charges the capacitor rapidly to its peak input value. Thus the waveforms are clamped towards the positive direction as shown above.

Positive Clamper with Positive Vr



A positive reference voltage is added in series with the diode of the positive clamper as shown in the circuit. During the positive half cycle of the input, the diode conducts as initially the supply voltage is less than the anode positive reference voltage. If once the cathode voltage is greater than anode voltage then the diode stops conduction. During the negative half cycle, the diode conducts and charges the capacitor. The output is generated as shown in the figure.

Positive Clamper with Negative Vr



The direction of the reference voltage is reversed, which is connected in series with the diode making it as a negative reference voltage. During the positive half cycle the diode will be non conducting, such that the output is equal to capacitor voltage and input voltage. During the negative half cycle, the diode starts conduction only after the cathode voltage value becomes less than the anode voltage. Thus, the output waveforms are generated as shown in the above figure.

PARAMETERS	CLIPPER	CLAMPER
Defintion	Clipper delimit the amplitude of the output voltage.	Clamper shifts the DC level of the output voltage.
Output Voltage	Less than the input voltage.	Multiples of input voltage.
Energy storage component	Not required	Requires (Capacitor is used as energy storage element)
Shape of Output Waveform	Shape changes (Rectangular, sinusoidal, triangular etc.)	Shape remains same as input waveform.
DC Level	Remains same	DC level get shifted
Applications	In transmitters, receivers, amplitude selector, noise limiter etc.	In voltage multiplying circuits, Sonar, Radar system etc.