CLIPPERS

Wave shaping circuits are the electronic circuits, which produce the desired shape at the output from the applied input wave form. These circuits perform two functions −

- Attenuate the applied wave
- Alter the dc level of the applied wave.

There are two types of wave shaping circuits: **Clippers** and **Clampers**.

Op-amp based Clippers

A **clipper** is an electronic circuit that produces an output by removing a part of the input above or below a reference value. That means, the output of a clipper will be same as that of the input for other than the clipped part. Due to this, the peak to peak amplitude of the output of a clipper will be always less than that of the input.

The main advantage of clippers is that they eliminate the unwanted noise present in the amplitude of an ac signal.

Clippers can be classified into the following two types based on the clipping portion of the input.

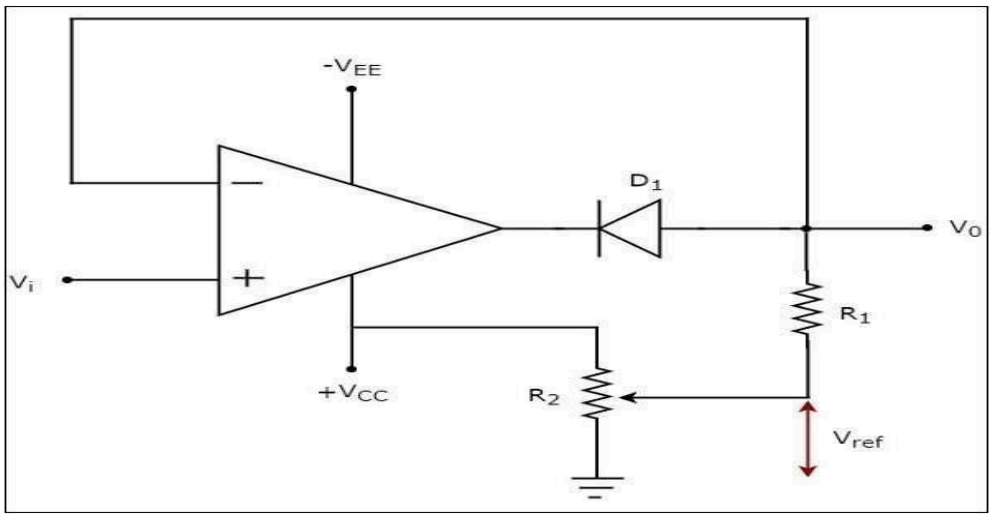
- Positive Clipper
- Negative Clipper

These are discussed in detail as given below −

Positive Clipper

A **positive clipper** is a clipper that clips only the positive portion(s) of the input signal.

The **circuit diagram**of positive clipper is shown in the following figure −

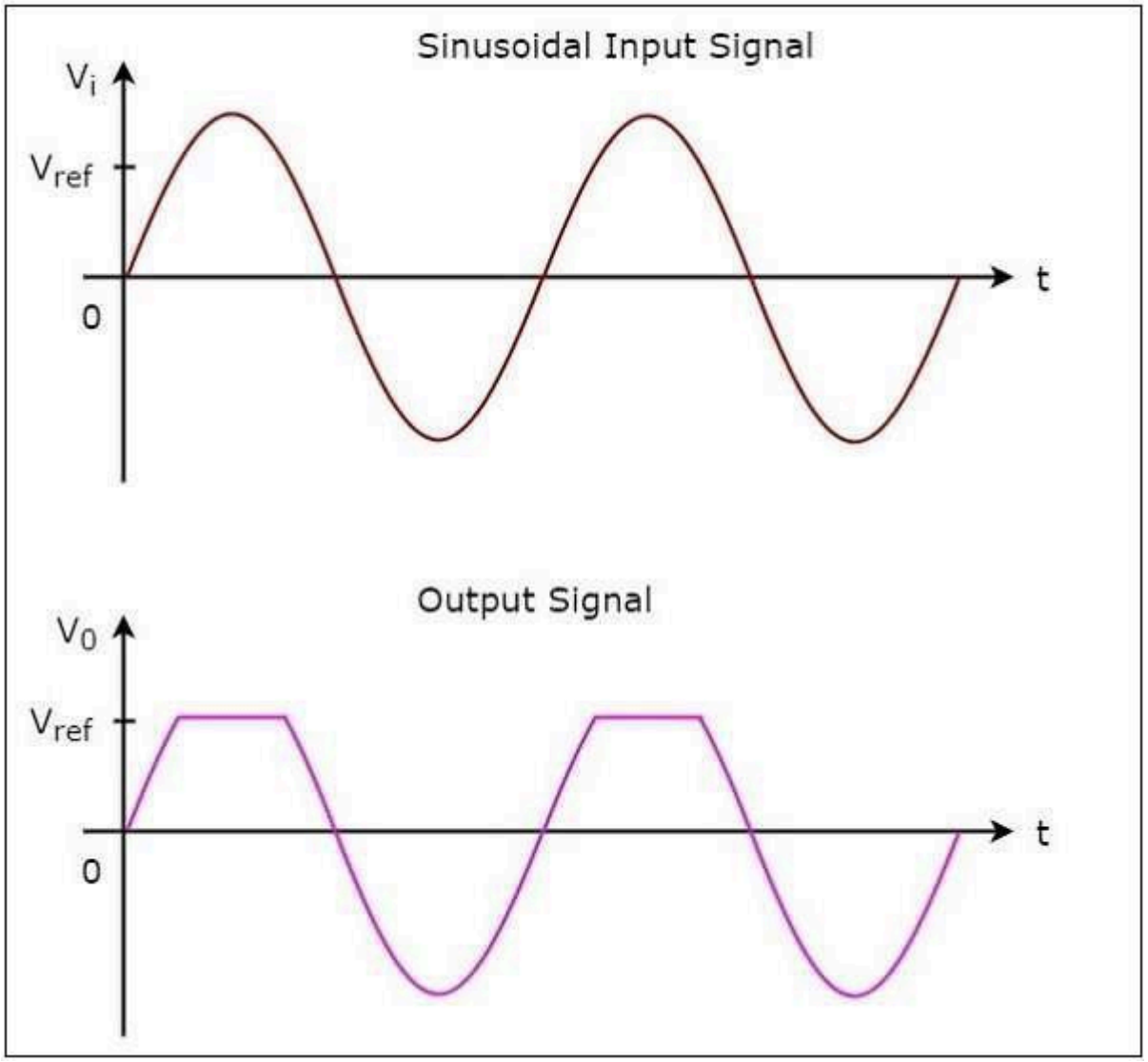


In the circuit shown above, a sinusoidal voltage signal VtVt is applied to the non-inverting terminal of the op-amp. The value of the reference voltage Vref$Vref$ can be chosen by varying the resistor R2$R2$.

The **operation** of the circuit shown above is explained below −

- If the value of the input voltage ViVi is less than the value of the reference voltage $Vref$, then the diode D_1 conducts. Then, the circuit given above behaves as a **voltage follower**. Therefore, the output voltage V0$V0$ of the above circuit will be same as that of the input voltage Vi, for Vi< Vref.
- If the value of the input voltage Vi is greater than the value of reference voltage $Vref$, then the diode D_1 will be off. Now, the op-amp operates in an open loop since the feedback path was open. Therefore, the output voltage V0$V0$ of the above circuit will be equal to the value of the reference voltage $Vref$, for $Vi > Vref$.

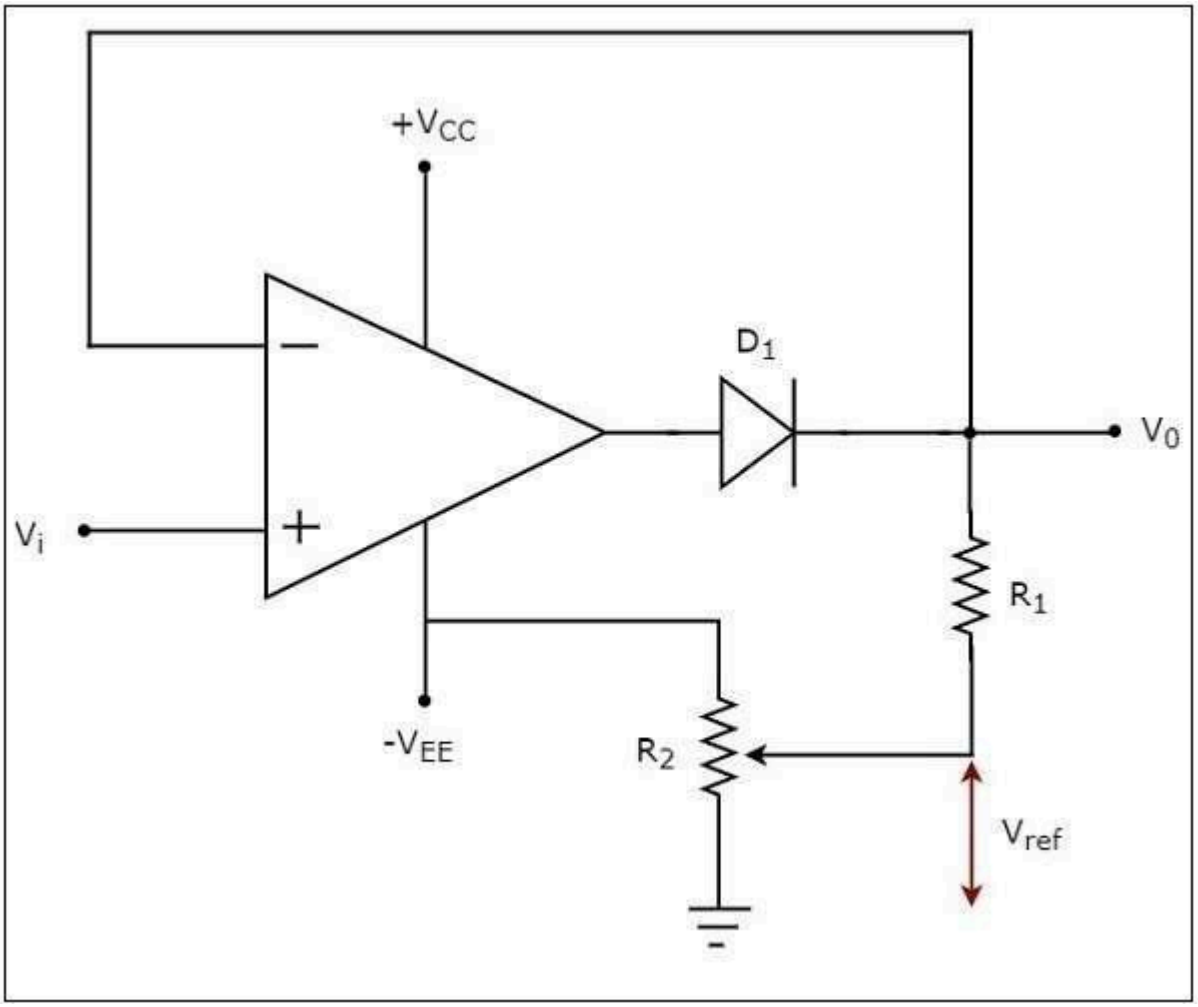
The **input wave form** and the corresponding **output wave form** of a positive clipper for a positive reference voltage Vref$Vref$, are shown in the following figure −



Negative Clipper

A **negative clipper** is a clipper that clips only the negative portion(s) of the input signal. You can obtain the circuit of the negative clipper just by reversing the diode and taking the reverse polarity of the reference voltage, in the circuit that you have seen for a positive clipper.

The **circuit diagram** of a negative clipper is shown in the following figure −



In the above circuit, a sinusoidal voltage signal Vi is applied to the non-inverting terminal of the op-amp. The value of the reference voltage $Vref$ can be chosen by varying the resistor $R2$.

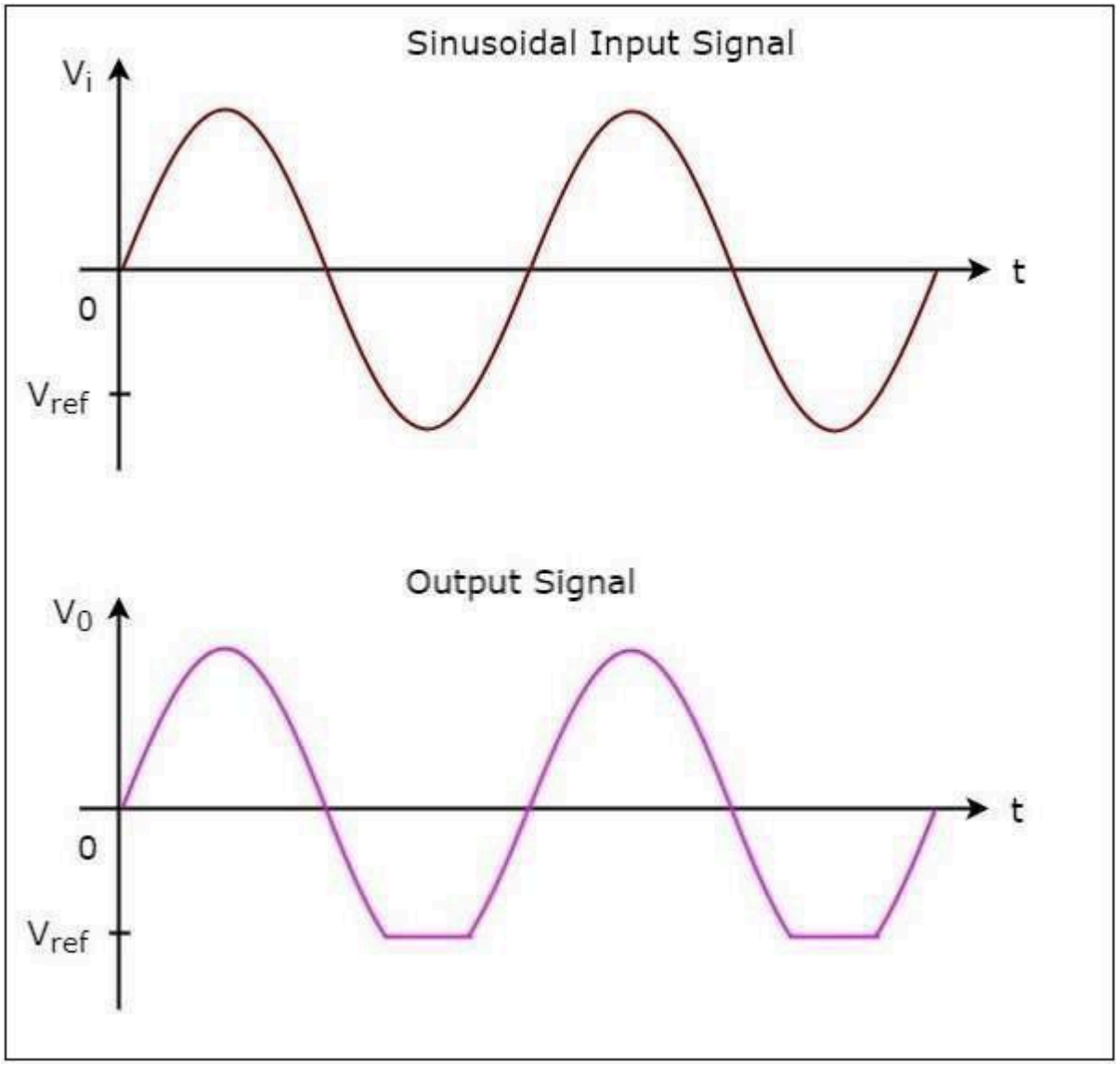
The **operation** of a negative clipper circuit is explained below −

If the value of the input voltage VtVt is greater than the value of reference voltage $Vref$, then the diode D_1 conducts. Then, the above circuit behaves as a **voltage follower**. Therefore, the output voltage $V0$ of the above circuit will be same as that of the input voltage Vi for $Vi > Vref$.

If the value of the input voltage ViVi is less than the value of reference voltage , then the diode D_1 will be off. Now, the op-amp operates in an open loop since the feedback path is

open. Therefore, the output voltage V0$V0$ of the above circuit will be equal to the value of reference voltage ,$Vref$ for $Vi < Vref$.

The **input wave form** and the corresponding **output wave form** of a negative clipper, for a negative reference voltage $Vref$, are shown in the following figure −



CLAMPERS

Op-amp based Clampers

A **clamper** is an electronic circuit that produces an output, which is similar to the input but with a shift in the DC level. In other words, the output of a clamper is an exact replica of the input. Hence, the peak to peak amplitude of the output of a clamper will be always equal to that of the input.

Clampers are used to introduce or restore the DC level of input signal at the output. There are **two types** of op-amp based clampers based on the DC shift of the input.

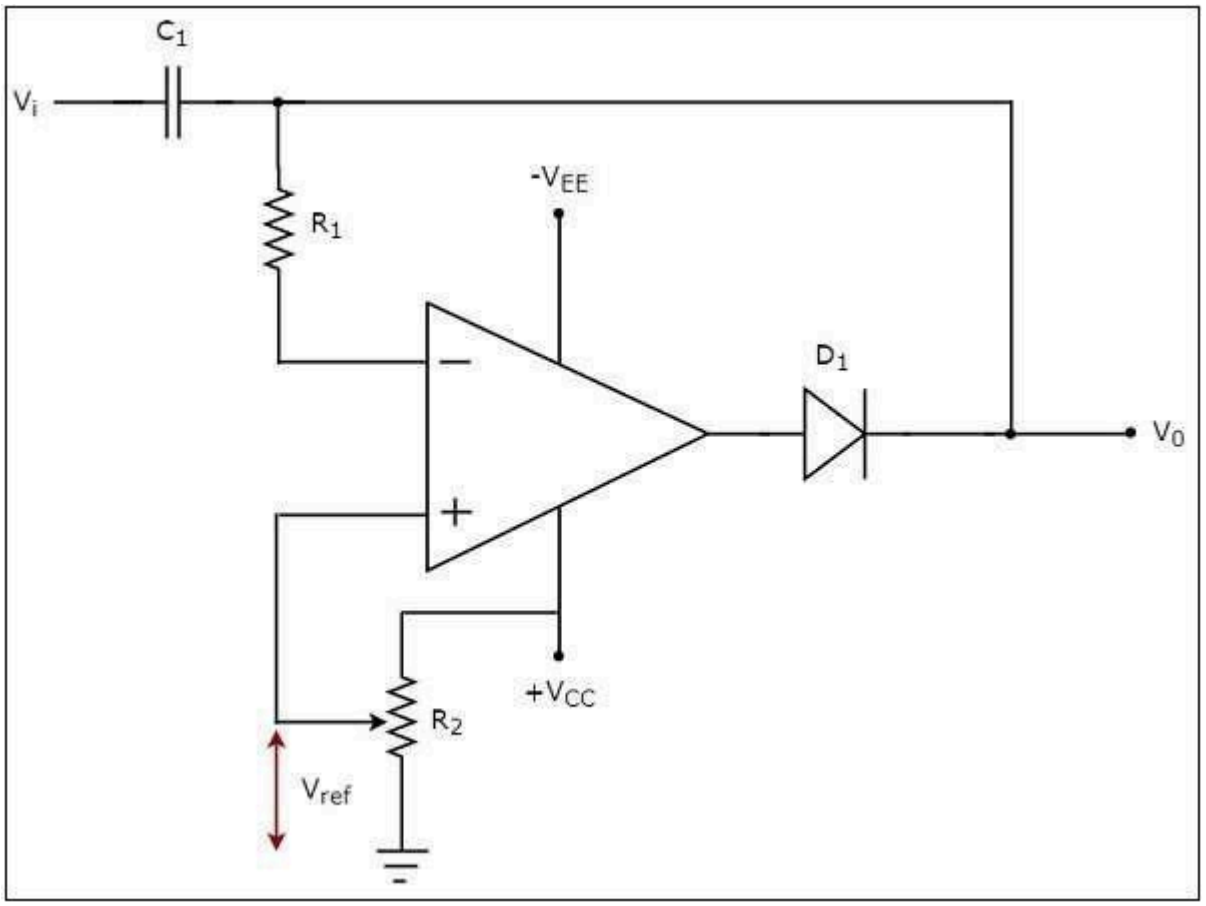
- Positive Clamper
- Negative Clamper

This section discusses about these two types of clampers in detail.

Positive Clamper

A positive clamper is a clamper circuit that produces an output in such a way that the input signal gets shifted vertically by a positive DC value.

The **circuit diagram** of a positive clamper is shown in the following figure −

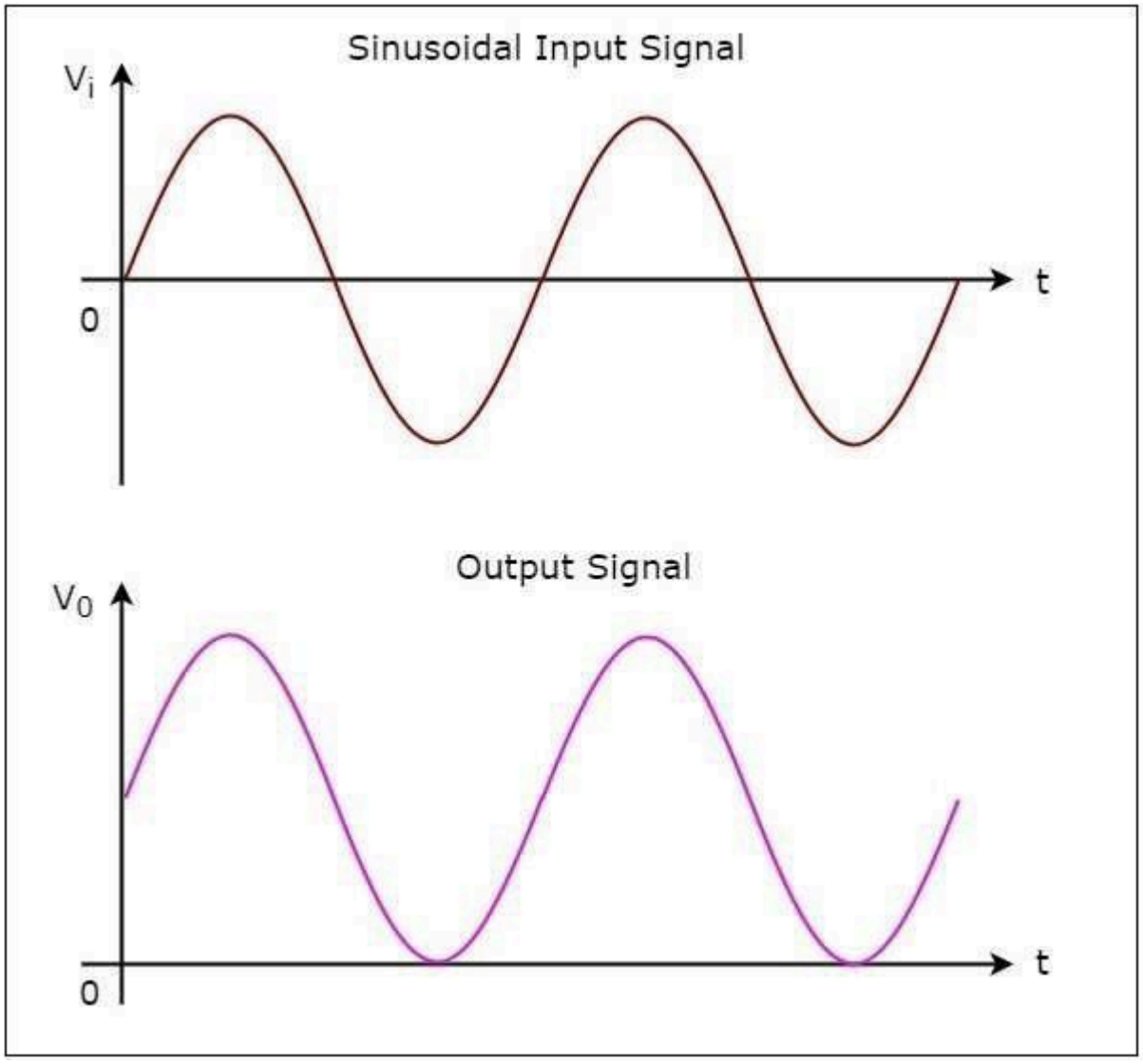


In the above circuit, a **sinusoidal voltage signal**, Vi is applied to the inverting terminal of op-amp through a network that consists of a capacitor C1 and a resistor R1. That means, AC voltage signal is applied to the inverting terminal of the op-amp.

The **DC reference voltage** Vref is applied to the non-inverting terminal of the op-amp. The value of reference voltage Vref can be chosen by varying the resistor R2. In this case, we will get a reference voltage Vref of a positive value.

The above circuit produces an **output,** which **is the combination (resultant sum)** of the sinusoidal voltage signal Vi and the reference voltage Vref. That means, the clamper circuit produces an output in such a way that the sinusoidal voltage signal Vi gets shifted vertically upwards by the value of reference voltage Vref.

The input wave form and the corresponding output wave form of positive clamper are shown in above figure −

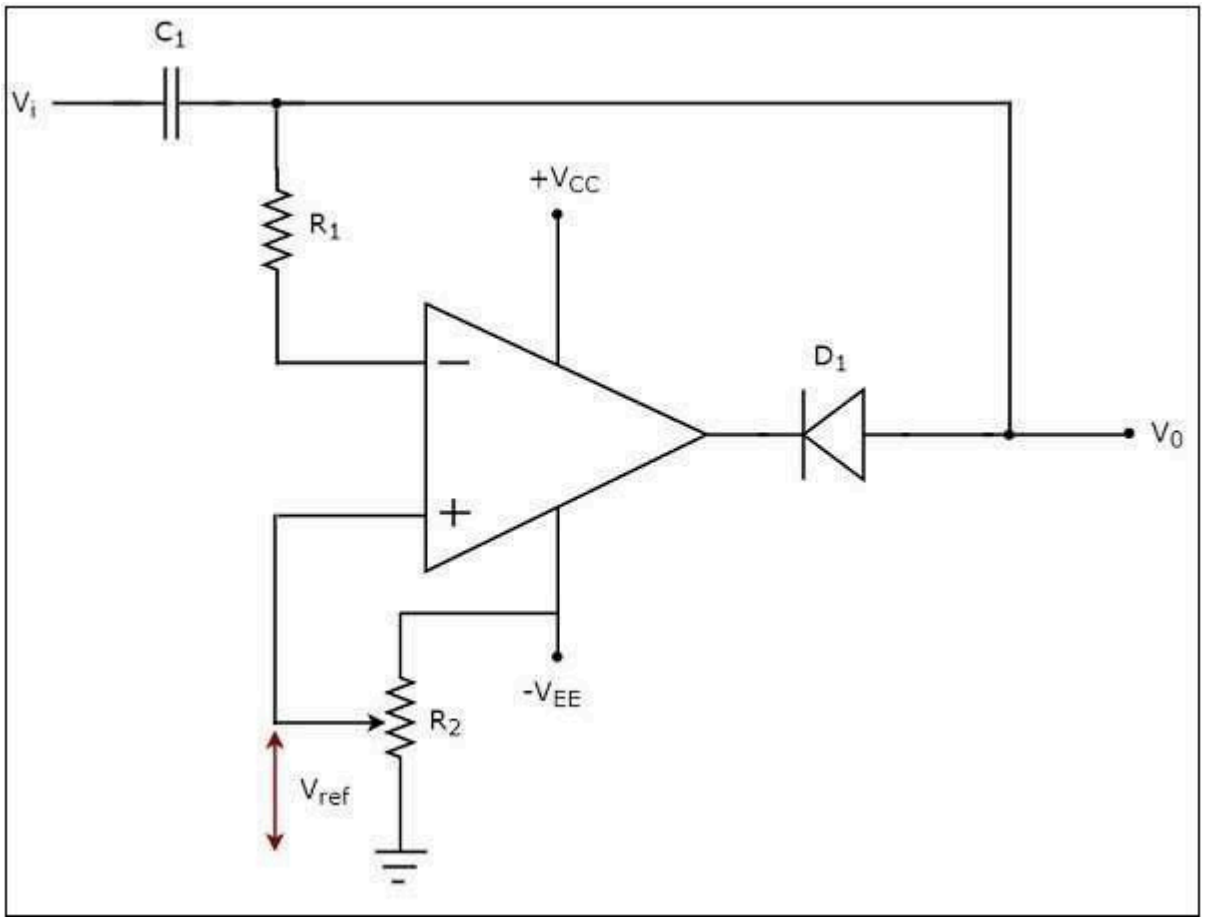


From the figure above, you can observe that the positive clamper shifts the applied input waveform **vertically upward** at the output. The amount of shift will depend on the value of the DC reference voltage.

Negative Clamper

A **negative clamper** is a clamper circuit that produces an output in such a way that the input signal gets shifted vertically by a negative DC value.

The **circuit diagram** of negative clamper is shown in the following figure −

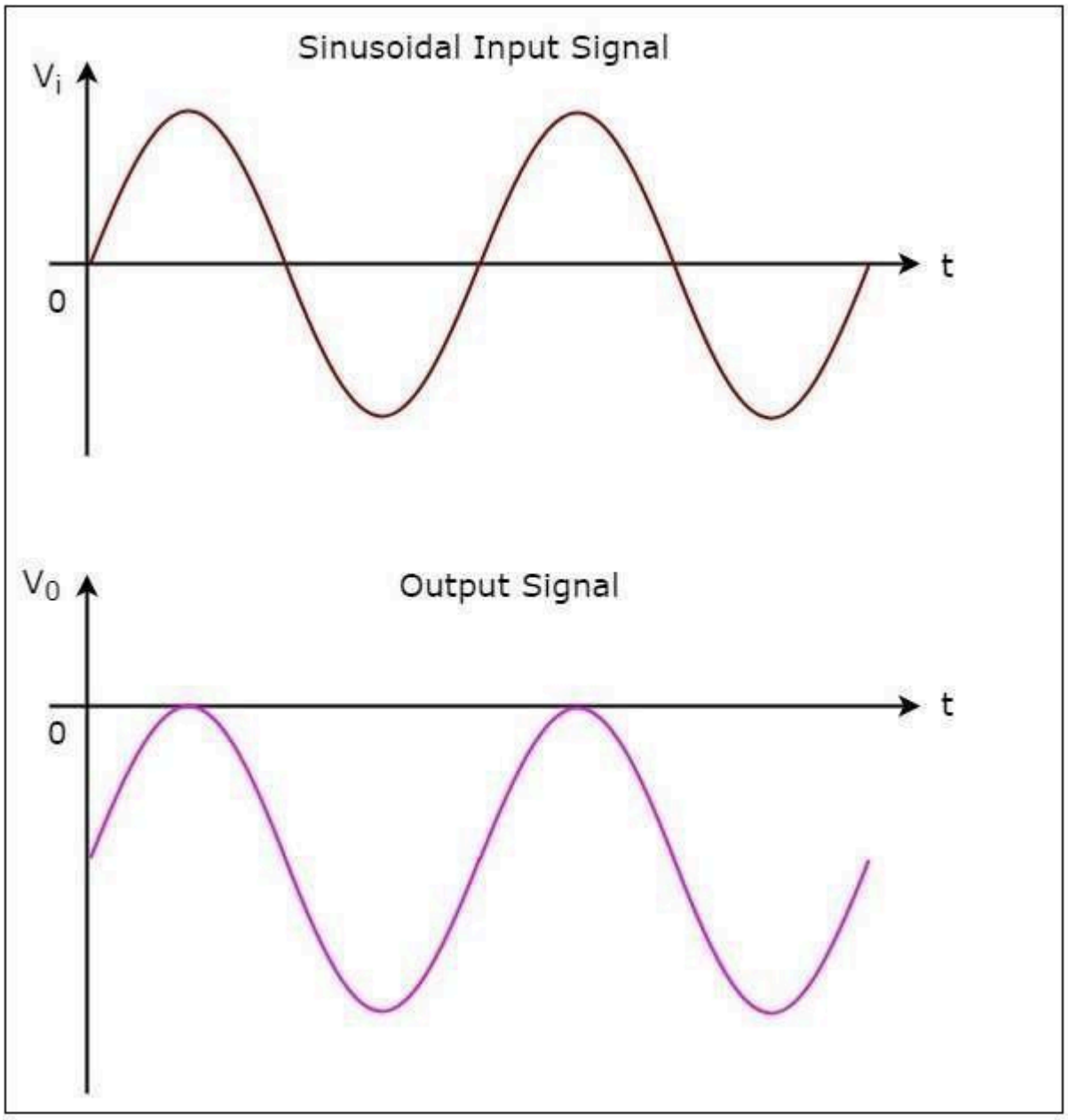


In the above circuit, a **sinusoidal voltage signal** ViVi is applied to the inverting terminal of the op-amp through a network that consists of a capacitor C_1 and resistor R1. That means, AC voltage signal is applied to the inverting terminal of the op-amp.

The **DC reference voltage** Vref is applied to the non-inverting terminal of the op-amp.The value of reference voltage Vref can be chosen by varying the resistor R2. In this case,we will get reference voltage Vref of a negative value.

The above circuit produces an output, which is the combination (resultant sum) of sinusoidal voltage signal ViVi and reference voltage Vref. That means, the clamper circuit produces an output in such a way that the sinusoidal voltage signal Vi gets shifted vertically downwards by the value of reference voltage Vref.

The input wave form and the corresponding output wave form of a negative clamper are shown in the following figure −



We can observe from the output that the negative clamper shifts the applied input waveform **vertically downward** at the output. The amount of shifting will depend on the value of DC reference voltage.