Aim ↬ To design and study the Clipper & Clamper circuits.

Equipment Required ↬

Diode, resistors, power supply, DSO, breadboard, and connecting wires.

Theory ↬

An electronic clipper and clamper are circuits used to modify signal waveforms. A clipper circuit limits the voltage levels of a signal, effectively "clipping" off the peaks of the waveform at specified levels. This process ensures that the output voltage does not exceed predetermined thresholds, making it useful in applications where signal distortion due to high voltage levels must be avoided. Commonly, clippers can be categorized as series or shunt types, with series clippers being placed in series with the load and shunt clippers connected parallel to the load.

In a clipper circuit, the clipping level is determined by the diode's forward voltage drop (typically around 0.7V for silicon diodes). The output voltage can be expressed as:

- Positive Clipper ↪

$$V_{out} = \begin{cases} V_{in}, & \text{if } V_{in} < V_{clip} \\ V_{clip}, & \text{if } V_{in} \geq V_{clip} \end{cases}$$

- Negative Clipper ↪

$$V_{out} = \begin{cases} V_{in}, & \text{if } V_{in} > -V_{clip} \\ -V_{clip}, & \text{if } V_{in} \leq -V_{clip} \end{cases}$$

The clippers can also be used to create desired waveforms for pulse modulation in communication systems.

In contrast, a clamper circuit adds a DC level to an AC signal without changing its shape. It shifts the entire waveform upward or downward while maintaining its original amplitude and frequency characteristics. The voltage shift in clamper circuits can be calculated based on the input signal and the capacitor's charging characteristics. For a positive clamper, the output voltage can be expressed as:

$$V_{out} = V_{in} + V_{DC}$$

where V_{DC} is the DC level added by the clamper. For a negative clamper, the output can be represented as:

$$V_{out} = V_{in} - V_{DC}$$

Clamping is essential for applications that require the signal to stay within certain voltage ranges or when interfacing with devices that cannot handle negative voltages.

The behavior of both clippers and clampers is primarily determined by the characteristics of the diode used in the circuit. The diode allows current to flow in one direction, enabling the desired waveform manipulation. The calculations for determining the clipping or clamping levels can be derived from the input signal characteristics and the diode's forward voltage drop.

The expected result is a waveform that reflects the clipping action in the clipper circuit, where parts of the waveform will be cut off at the specified levels. For the clamper circuit, the output waveform should show a shifted version of the input signal, demonstrating the effectiveness of the clamping action. The behavior of both circuits can be further verified by comparing the measured waveforms to theoretical predictions, ensuring an understanding of their fundamental operation and application in signal processing.

Circuit Diagram ↬

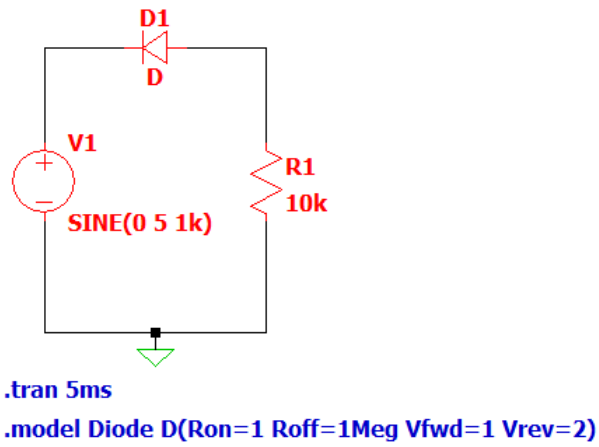

Fig. i) Series Clipper

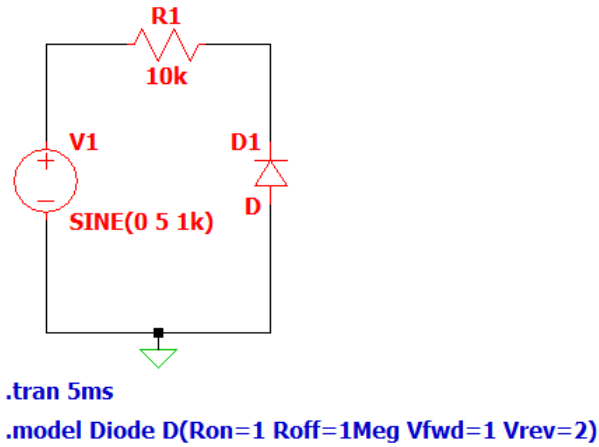

Fig. ii) Shunt Clipper

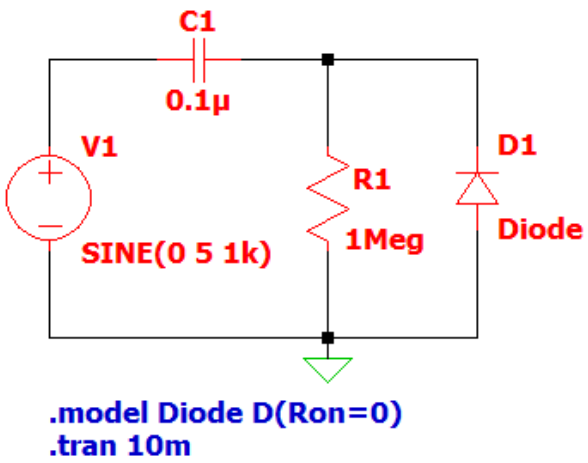

Fig. iii) Positive Clamper

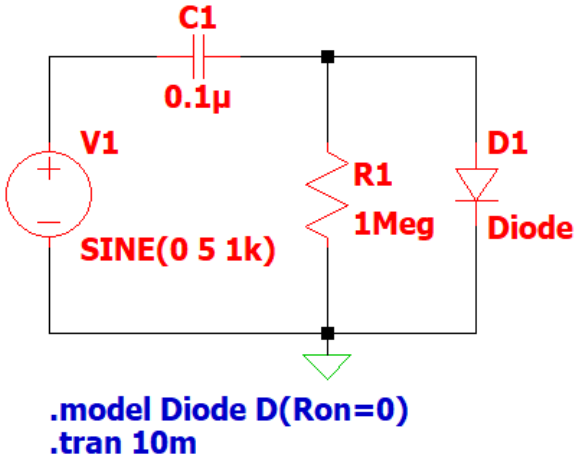

Fig. iv) Negative Clamper

Graphs ↬

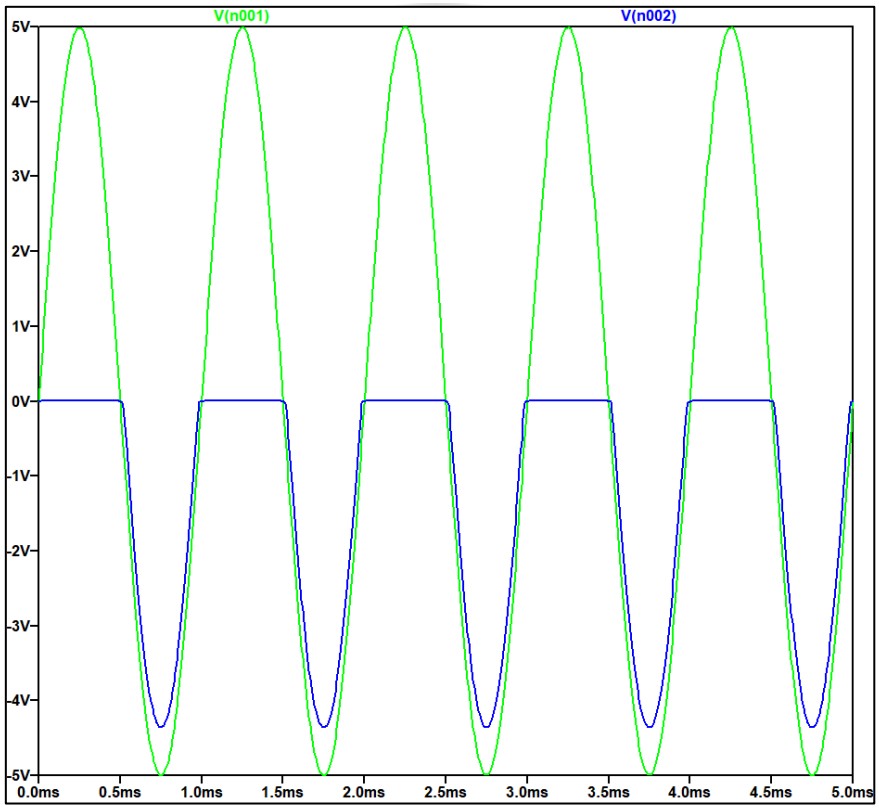

Fig. v) Output – Series Clipper

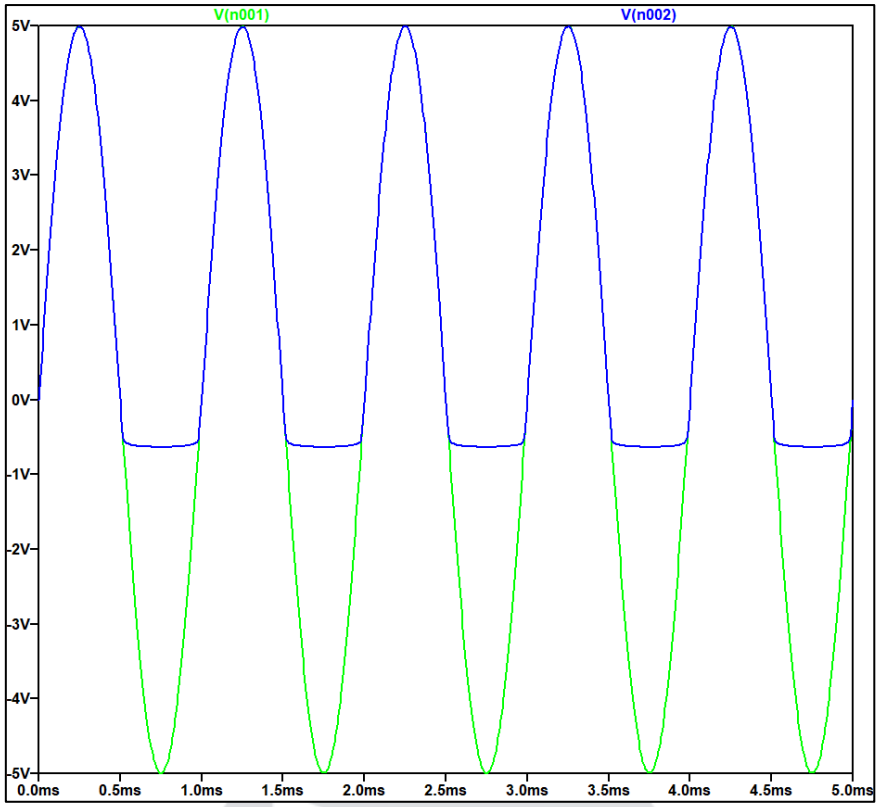

Fig. vi) Output – Shunt Clipper

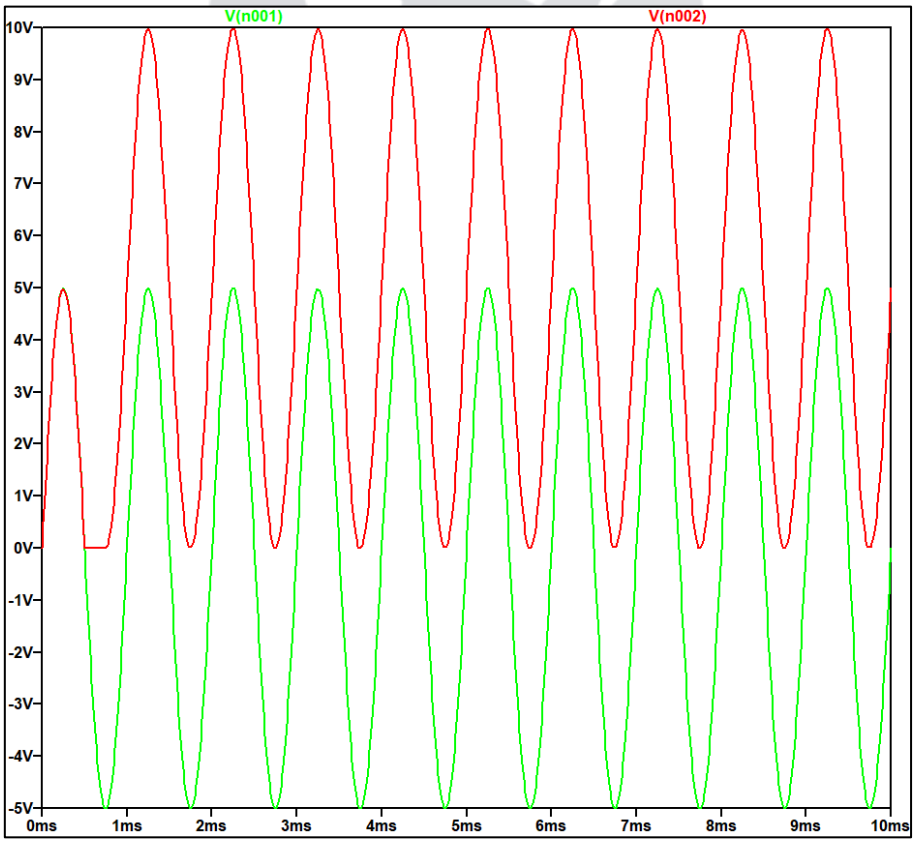

Fig. vi) Output – Positive Clamper

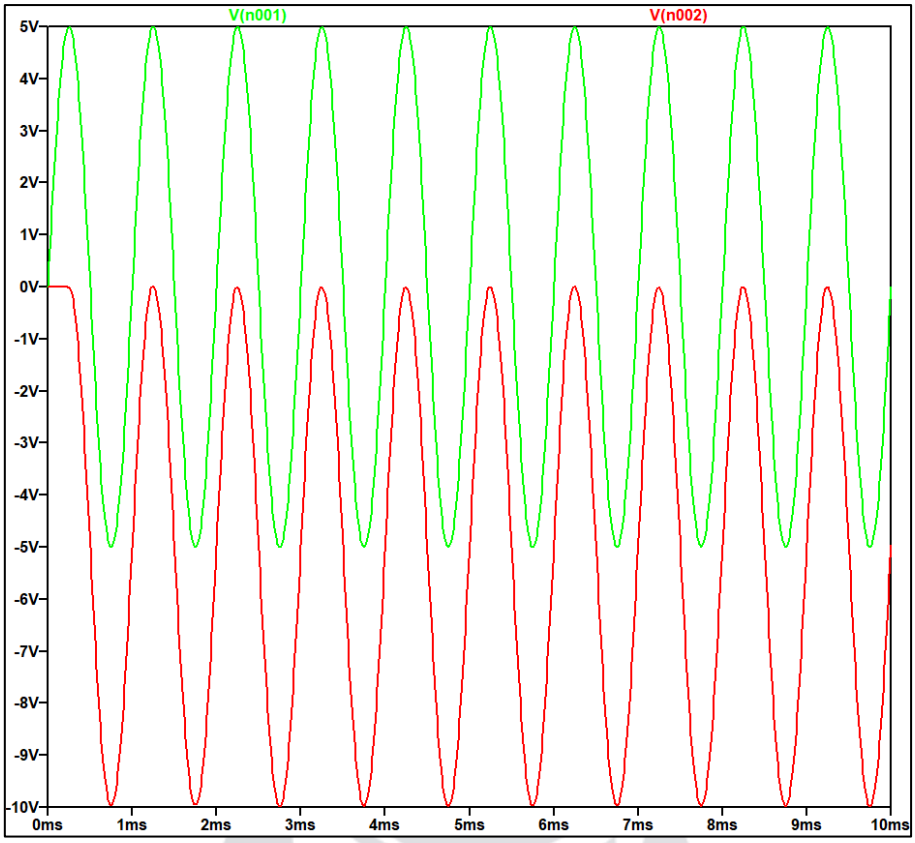

Fig. vi) Output – Negative Clamper

Result ↬

Both the clipper and clamper circuits functioned as intended, with the clipper successfully removing portions of the input waveform and the clamper effectively shifting the entire waveform vertically. The measured output waveforms closely matched the theoretical predictions, confirming the design's accuracy.

Conclusion ↬

The experiments demonstrated that the clipper circuit could selectively eliminate unwanted portions of a waveform without distortion, while the clamper circuit effectively shifted the waveform's average value. The results validated the functionality of both circuits in waveform-shaping applications.

Precautions ↬

- Ensure proper diode orientation to achieve the desired clipping or clamping effect.
- Check all connections to prevent short circuits or misconfigurations that could damage components.
- Use appropriate resistor and capacitor values to prevent excessive current flow through the diode.