

Electronic Devices and Circuits Lab (EE2301)

Experiment 6 : Wave shaping circuits

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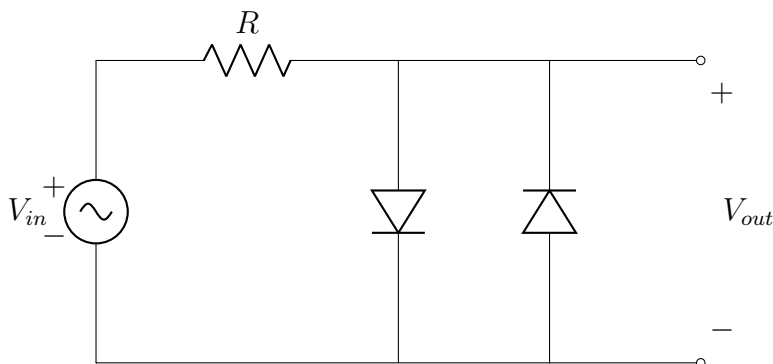
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1 Aim

our aim is to understand clipper and clamper circuits for AC input voltage using capacitors, diodes and resistors.

Clipper

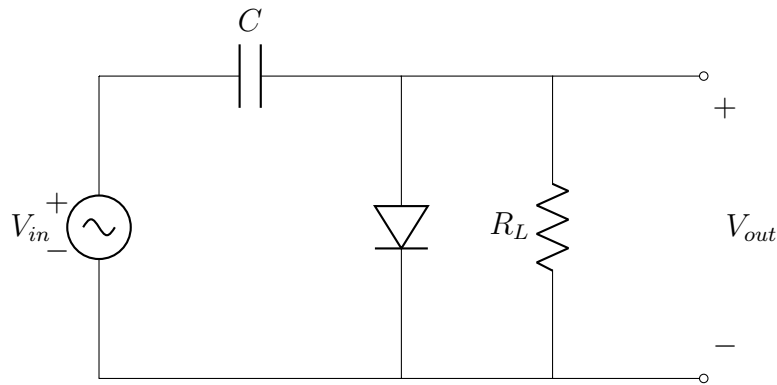
In electronics, a clipper is a circuit designed to prevent a signal from exceeding a predetermined reference voltage level. A clipper does not distort the remaining part of the applied waveform. Clipping circuits are used to select, for purposes of transmission, that part of a signal waveform which lies above or below the predetermined reference voltage level.



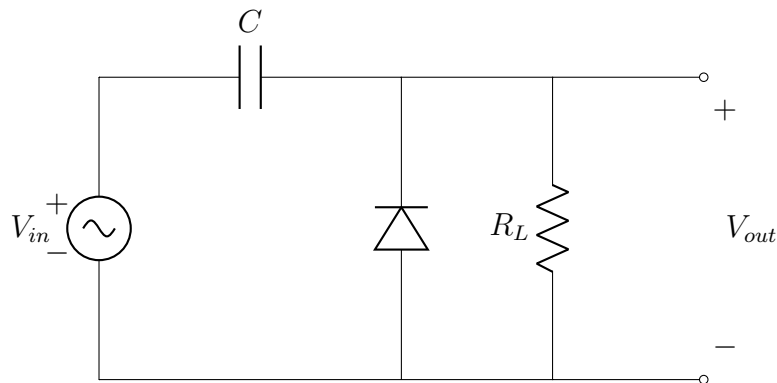
Clipper circuit diagram

Clamper

A clamper is an electronic circuit that fixes either the positive or the negative peak excursions of a signal to a defined value by shifting its DC value. The clamper does not restrict the peak-to-peak excursion of the signal, it moves the whole signal up or down so as to place the peaks at the reference level.



Negative Clipper circuit diagram



Positive Clipper circuit diagram

2 Problem statement(Group 1)

- Inputs.
 - . • Peak $V_{in} = 5V$
 - . • Frequency 1k Hz
 - . • $R = 100 \Omega$ – Clipper Circuit
 - . • $R = 10k \Omega$ – Clamper Circuit

- Write a SPICE script for Clamper Circuit
 - . • Group 1: Positive Clamper
 - . • Group 2: Negative Clamper

- Clipper: Design Clipper circuit (and write SPICE script) for following criteria.
 - . • Group 1: The maximum voltage in the positive half cycle is $+3V_\gamma$ and the minimum voltage in negative half is $-2V_\gamma$.
 - . • Group 2: The maximum voltage in the positive half cycle is $+2V_\gamma$ and the minimum voltage in negative half is $-3V_\gamma$

- Explain the working of the clipper and clamper circuits.

3 Procedure

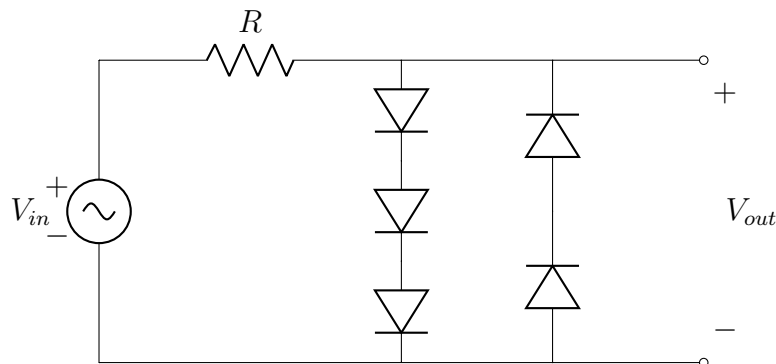
Steps

Positive Clamper

- First we need to write spice scripts for the positive clamper circuit with given values.
- Now we need to plot the output across of positive clamper circuit with respect to time.
- we need to mind the cut-in voltage of the diode and take any corrective action if required.
- We should also choose the capacitance such that it doesn't effect too much on the diode characteristics.
- Now we need to analyse the output and explain the working of the positive clamper circuit.

Clipper

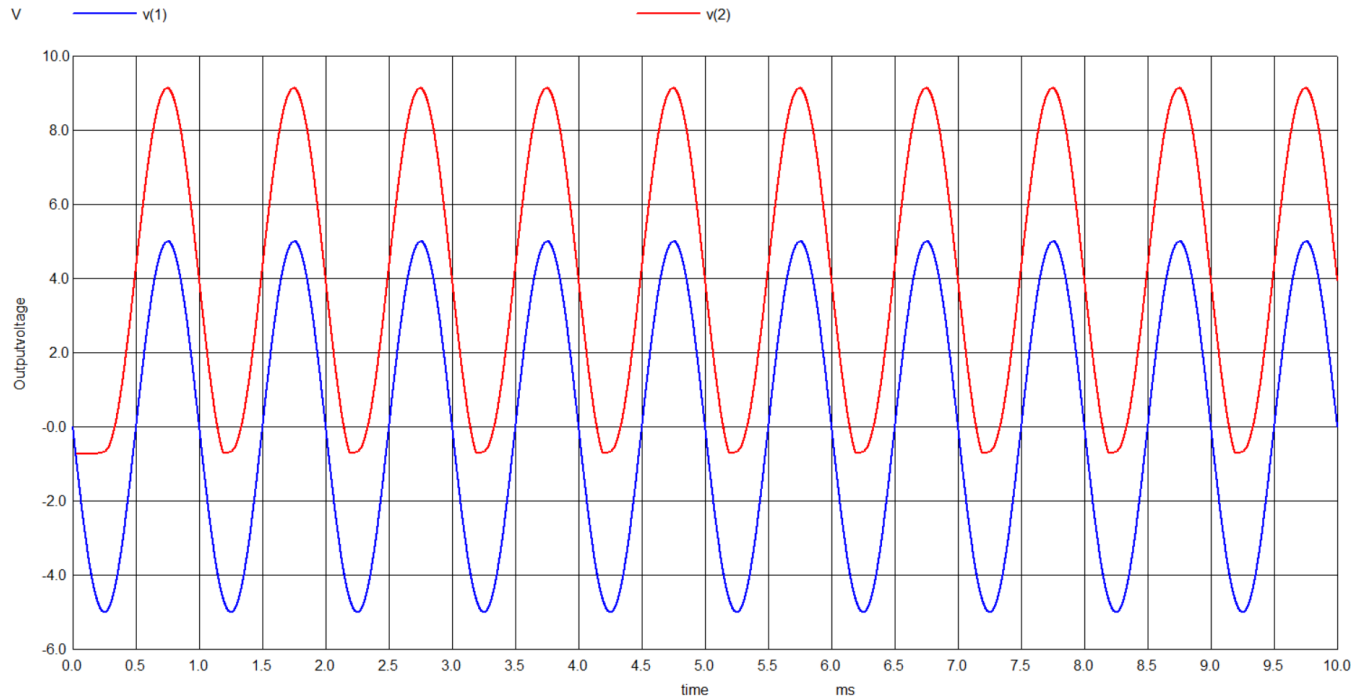
- Now we need to design a clipper circuit such that The maximum voltage in the positive half cycle is $+3V_\gamma$ and the minimum voltage in negative half is $-2V_\gamma$.
- We can design circuit using diode i.e putting 3 diodes in series and the parallel to it 2 diodes in series but in different direction.
- Now we need to plot the output across of clipper circuit with respect to time.
- Now we need to analyse the output and explain the working of the positive clamper circuit.



Designed Clipper circuit diagram

4 Results and observations

Positive clamper



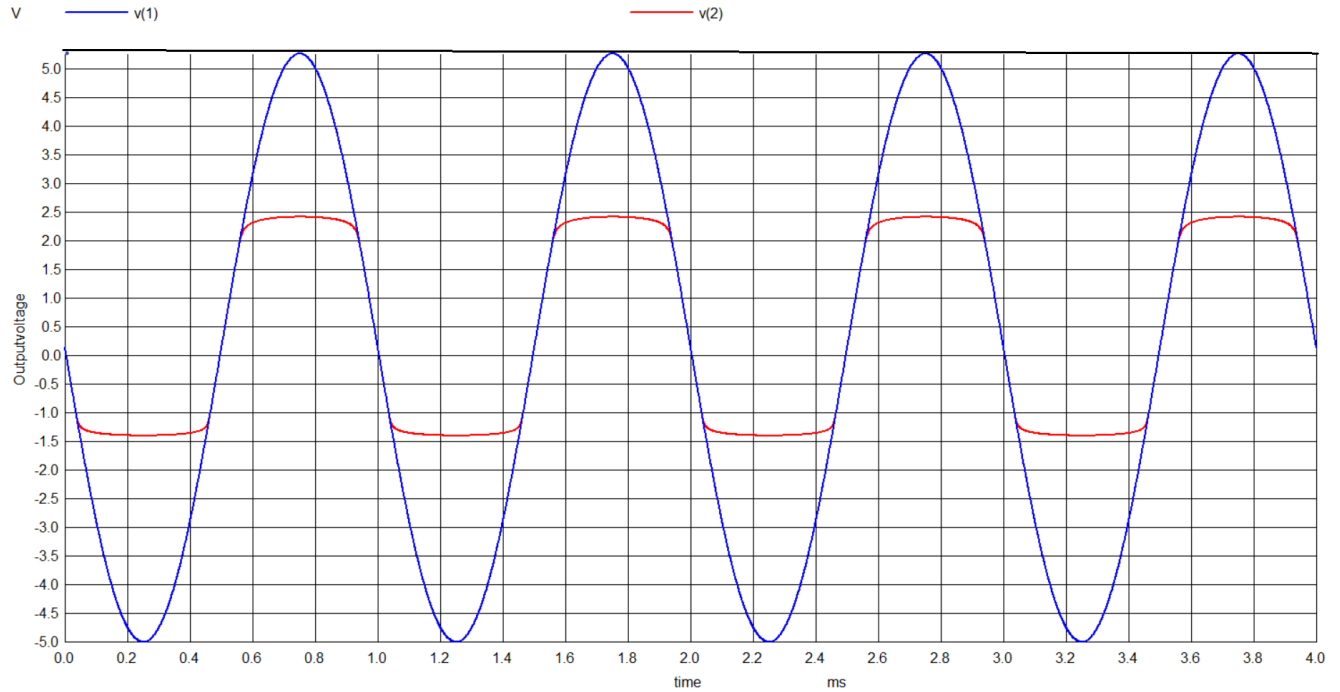
Plot: V_{out} (red), V_{in} (blue) Vs Time(ms)

- The above plots shows that the output is input shifted by a DC offset to positive axis.

Working of positive clamper

- We can also observe that the minimum voltage is not zero because of the cut-in voltage of the diode.
- 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 V_p . The diode is forward biased and conducts heavily.
- During the next positive half cycle, the capacitor is charged to positive V_p while the diode gets reverse biased and gets open circuited. The output of the circuit at this moment will be $V_{out} = V_{in} + V_p$.

Designed clipper



Plot: V_{out} (red), V_{in} (blue) Vs Time(ms)

- In the above plot we can see that the maximum voltage is $+3V_\gamma$ and the minimum voltage is $-2V_\gamma$ for $+V_\gamma = 0.73V$

Working of clipper

- In the positive half cycle input the 3 diodes in series across output are in forward bias and the 2 diodes in series are in reverse bias hence they become open switch.
- As the input increases the current across the diode increases slowly and after $V_{in} = +3V_\gamma$, the 3 diodes in series act as a dc voltage $+3V_\gamma$, we can understand this from the I-V characteristics of the diode.
- In the negative half cycle input the 3 diodes in series across output are in reverse bias hence they become open switch and the 2 diodes in series are in forward bias.
- As the input magnitude increases the current across the diode increases slowly and after $V_{in} = -2V_\gamma$, the 2 diodes in series act as a dc voltage $-2V_\gamma$, we can understand this from the I-V characteristics of the diode.

5 Conclusions

- The main difference between clipper and clamper is their function; clipper limits the voltage while clamper shifts in upwards or downwards..
- Also we don't use any energy storing element like capacitor in clipper but we use it in clamper.
- We should also keep in mind the non ideality of diode i.e. cut-in voltage of the diode.
- we should note that output voltage is Less than the input voltage in clipper but Multiples of input voltage in clamper.
- Clipper circuits are used in transmitters, receivers, amplitude selector, noise limiter etc.
- Clamper circuits are used in voltage multiplying circuits, Sonar, Radar system etc.

Thank you