ECE121: Electronics (1)

Lecture 2: Diode Clipping and Calmping Circuits

Dr. Haitham El-Hussieny

Electronics and Communications Engineering
Faculty of Engineering (Shoubra)
Benha University

Spring 2017

Lecture Outline:

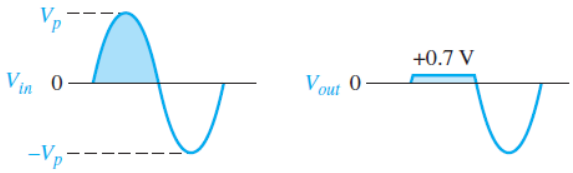
1. Introduction.
2. Diode Clipping Circuits.
3. Diode Clamping Circuits.

Table of Contents

Introduction:

Diode Clipper (Limiter):

Clippers or limiters are sometimes used to **clip off** portions of signal voltages above or below certain levels.

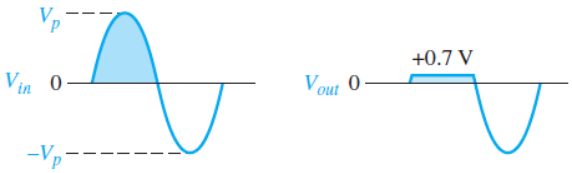


Clipping

Introduction:

Diode Clipper (Limiter):

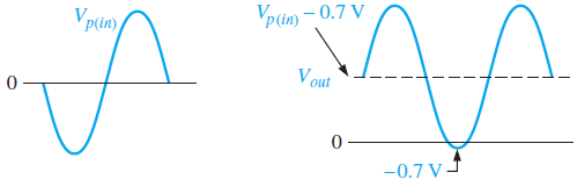
Clippers or limiters are sometimes used to **clip off** portions of signal voltages above or below certain levels.



Clipping

Diode Clamper:

Clamper circuit is used to **add or restore a dc level** to an electrical signal.

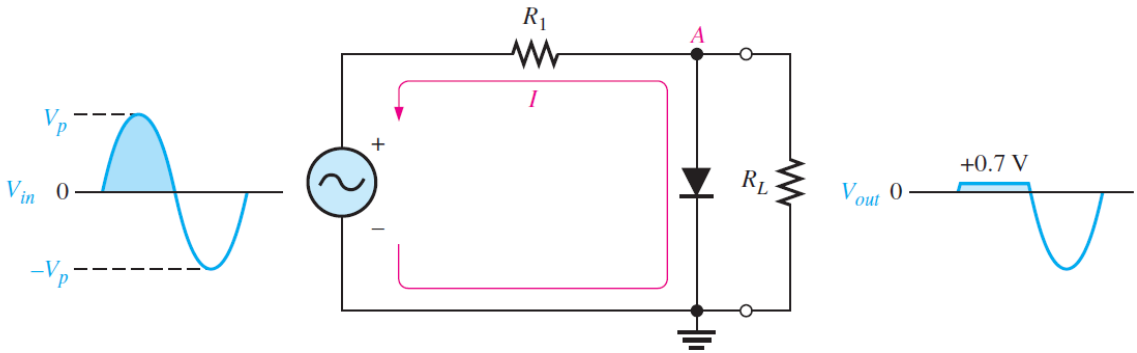


Clamping

Table of Contents

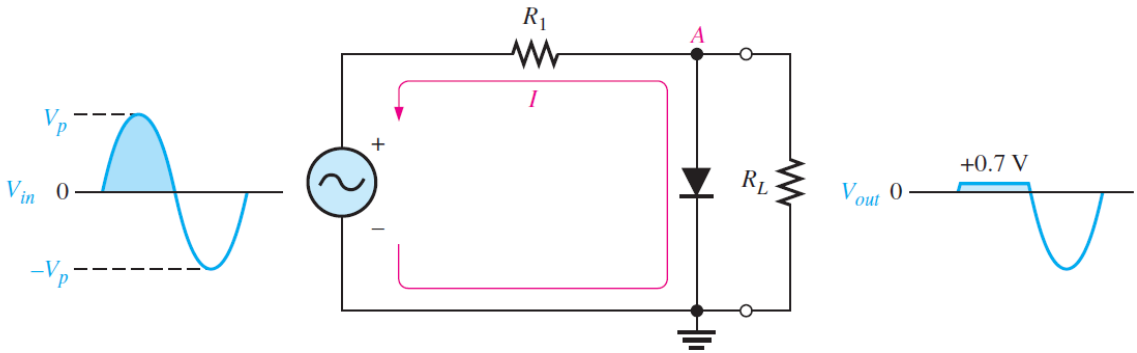
Diode Clipping Circuits:

Positive Clipping:



Diode Clipping Circuits:

Positive Clipping:

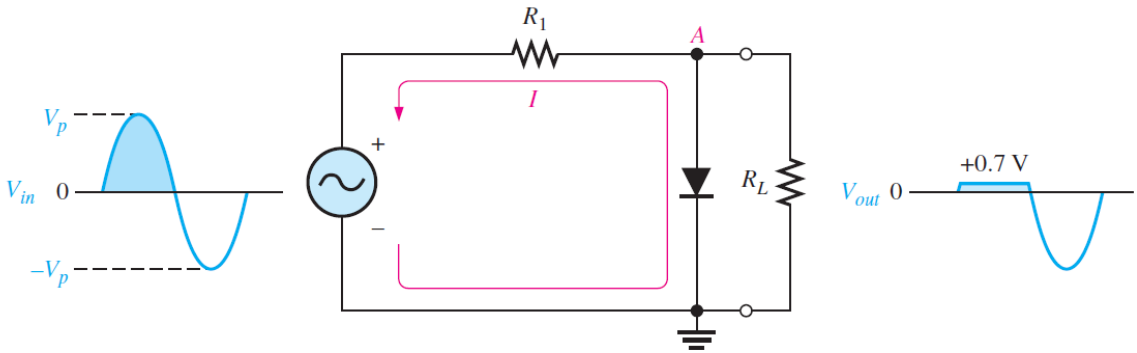


During the +ve half cycle:

The Diode is forward biased (ON) and $V_{out} = V_D = 0.7\ V$ (Clipped away!).

Diode Clipping Circuits:

Positive Clipping:

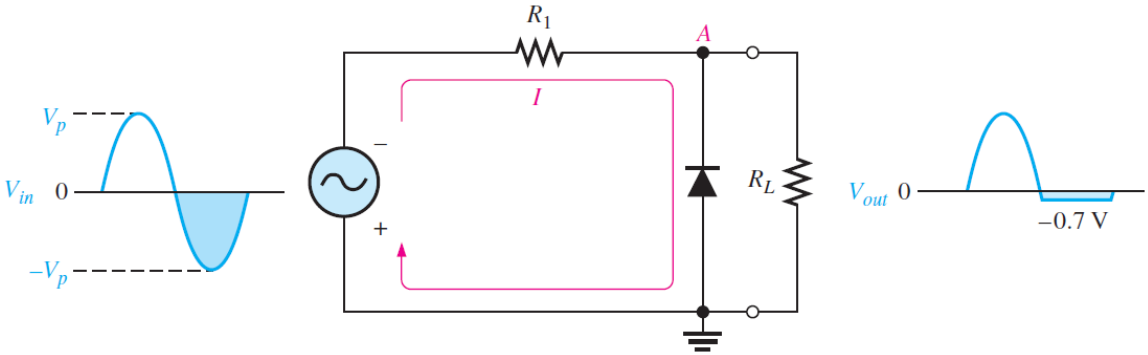


During the +ve half cycle:
The Diode is forward biased (ON) and $V_{out} = V_D = 0.7\ V$ (Clipped away!).

During the -ve half cycle:
The Diode is reverse biased (OFF) and $V_{out} = V_{in}$ (Remained!).

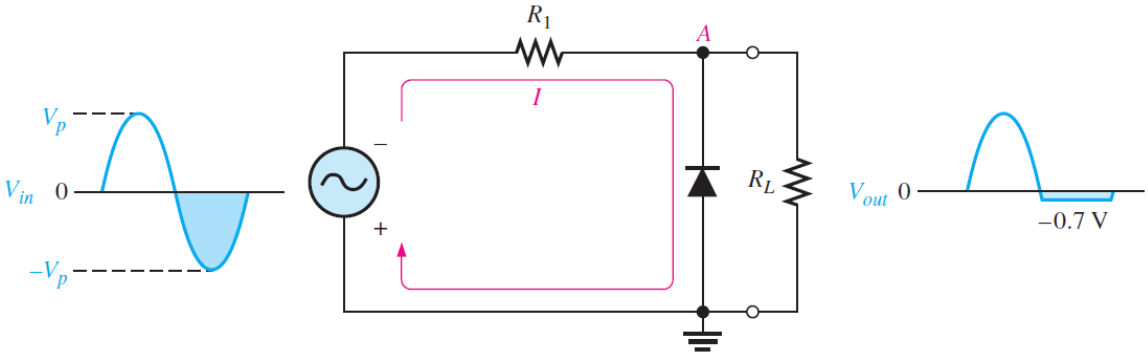
Diode Clipping Circuits:

Negative Clipping:



Diode Clipping Circuits:

Negative Clipping:

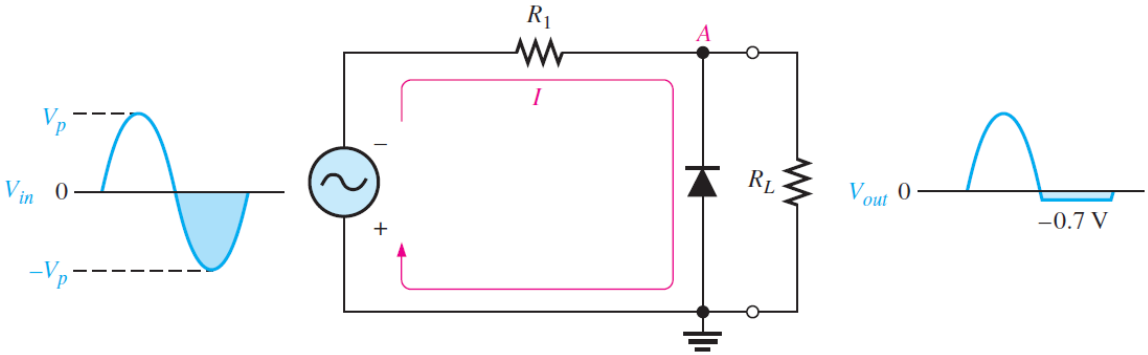


During the +ve half cycle:

The Diode is reverse biased (OFF) and $V_{out} = V_{in}$ (Remained!).

Diode Clipping Circuits:

Negative Clipping:



During the +ve half cycle:
The Diode is reverse biased (OFF) and $V_{out} = V_{in}$ (Remained!).

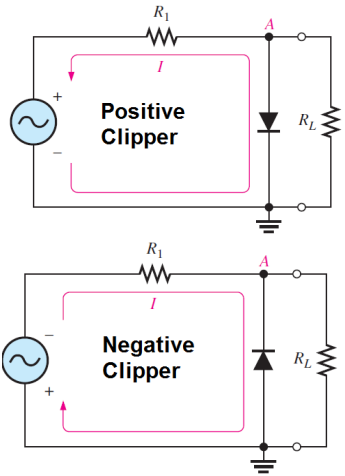
During the -ve half cycle:
The Diode is forward biased (ON) and $V_{out} = V_D = 0.7\ V$ (Clipped away!).

Diode Clipping Circuits:

- both Positive and Negative Clipping, a part of the output voltage looks like the input voltage.
- The output voltage magnitude determined by the voltage divider formed by R_1 and the load resistor, R_L, as follows:

$$V_{out} = \frac{R_L}{R_1 + R_L} V_{in}$$

- If R_1 is small compared to R_L, then $V_{out} \approx V_{in}$.



Diode Clipping Circuits:

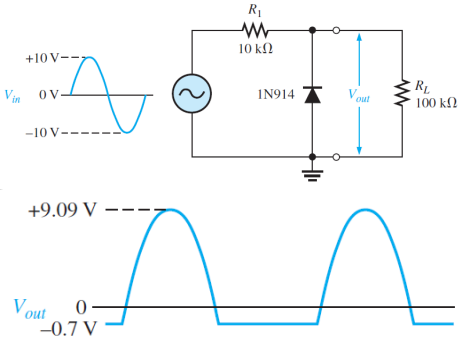
Example

What would you expect to see displayed on an oscilloscope connected across R_L in the limiter shown ?

Solution:

The diode is forward-biased and conducts when the input voltage goes below $-0.7V$. So, for the negative clipper, the peak output voltage across R_L is:

$$V_{p(out)} = \frac{R_L}{R_1 + R_L} V_{p(in)} = \frac{100}{100 + 10} 10 = 9.09 \ V$$

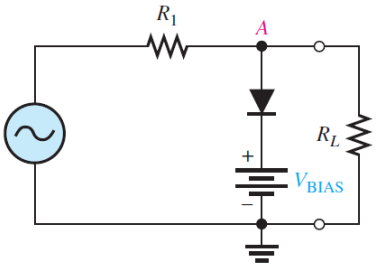


Diode Clipping Circuits:

Biased Clippers:

Biased Positive Clipper:

- The level to which an ac voltage is clipped can be **adjusted** by adding a bias voltage, V_{BIAS}, in series with the diode.
- The voltage at point **A** must equal $V_{BIAS} + 0.7\ V$ before the diode will become forward-biased and conduct.
- Once the diode begins to conduct, the voltage at point A is limited to $V_{BIAS} + 0.7\ V$ so that all input voltage above this level is **clipped off**.

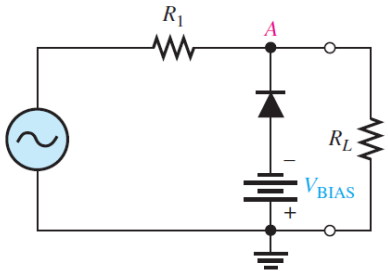


Diode Clipping Circuits:

Biased Clippers:

Biased Negative Clipper:

- To limit a voltage to a specified negative level, the diode and bias voltage must be connected as shown.
- In this case, the voltage at point A must go below $-V_{BIAS} - 0.7\ V$ to forward-bias the diode and limit the input voltage.



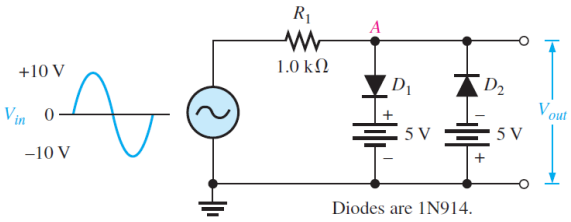
Diode Clipping Circuits:

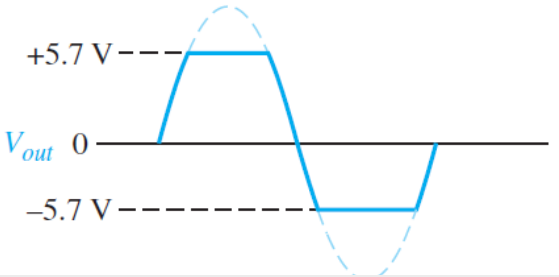
Biased Clippers:

Combination of Positive and Negative Clippers:

1. When the voltage at point A reaches $+5.7\ V$, diode D_1 conducts and limits the waveform to $+5.7\ V$.
2. Diode D2 does not conduct until the voltage reaches $-5.7\ V$.
3. Therefore, positive voltages above $+5.7\ V$ and negative voltages below $-5.7\ V$ are **clipped off**.

Application: sinusoidal to square-wave conversion.

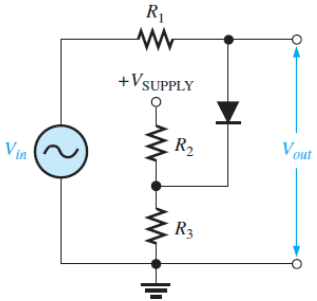




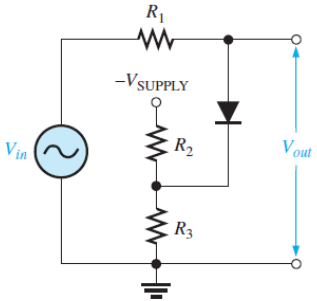
Diode Clipping Circuits:

Voltage Divide Biased Clippers:

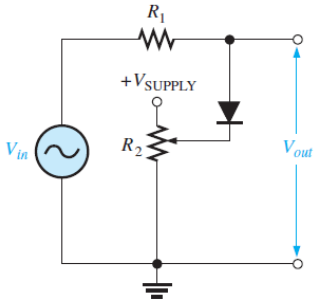
To change the bias voltage value V_{BIAS}, we can replace it by a resistive voltage divider.



(a) Positive limiter



(b) Negative limiter



(c) Variable positive limiter

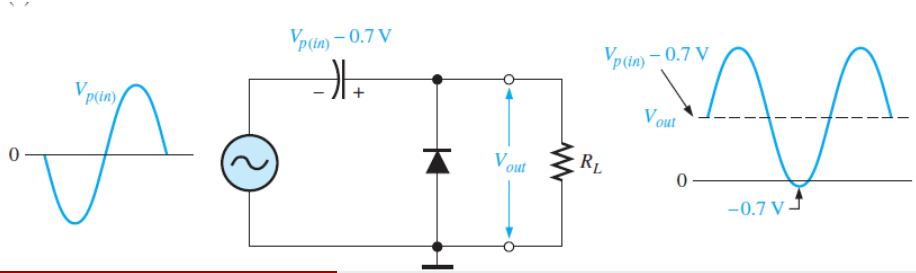
$$V_{\text{BIAS}} = \left(\frac{R_3}{R_2 + R_3}\right) V_{\text{SUPPLY}}$$

Table of Contents

Diode Clamping Circuits:

[1] **Positive Clamper:**

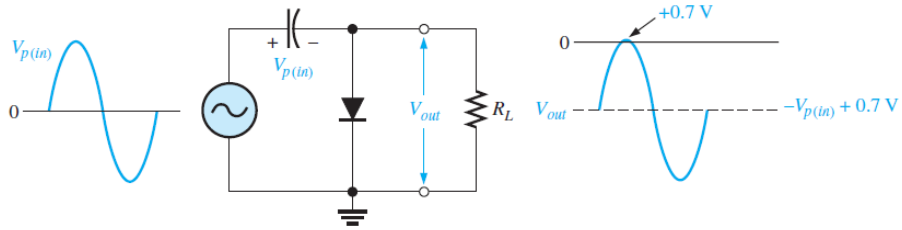
- A clamper adds a **positive** dc level to an ac voltage.
- **During the -Ve half cycle:** the diode is forward biased, allowing the capacitor to charge to near the peak of the input
- **During the +Ve half Cycle:** the diode is reverse-biased. The capacitor can only discharge through the resistance of R_L.
- The amount that is discharged capacitor depends on the value of R_L.



Diode Clamping Circuits:

[2] **Negative Clamper:**

- A clamper adds a **negative** dc level to an ac voltage.



Discuss it's operation by your self.

End of Lecture

Best Wishes

haitham.elhussieny@gmail.com