Application of Diode: Clippers & Clampers

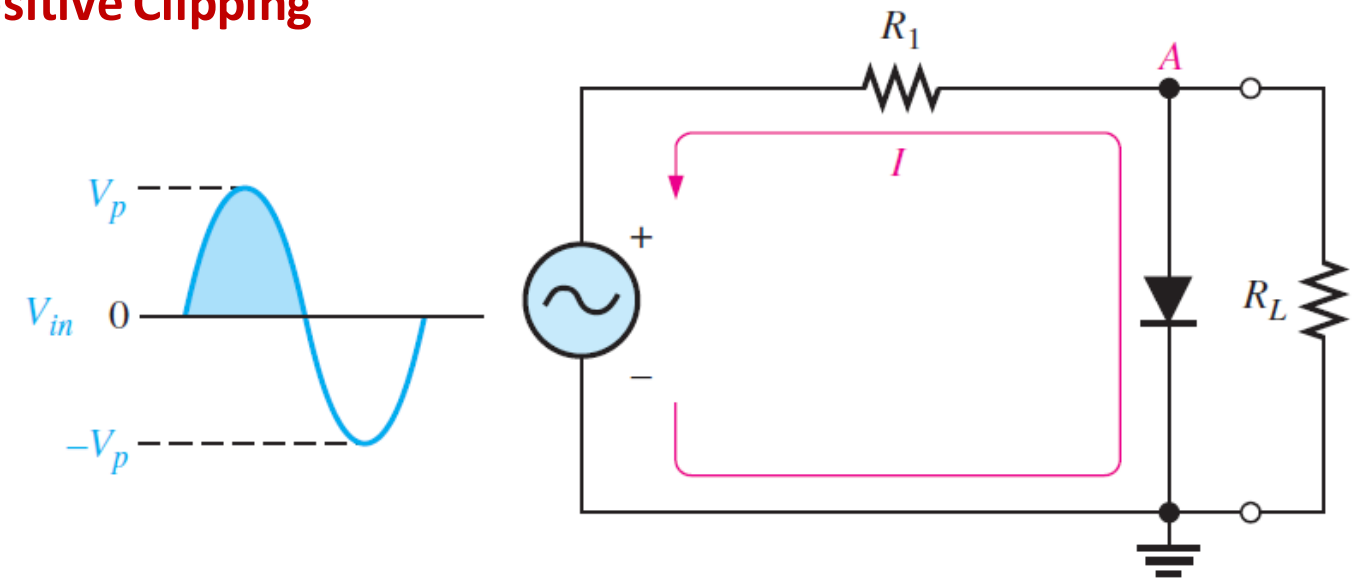
BPT: 401: Electronics and Modern Physics

Tutorial – 8

Diode Clipper (Limiter):

Clippers or limiters is a type of diode network that has the ability to “clip off” a portion of the input ac signal without distorting the remaining part of the ac waveform.

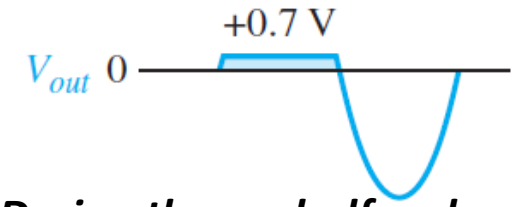
Positive Clipping

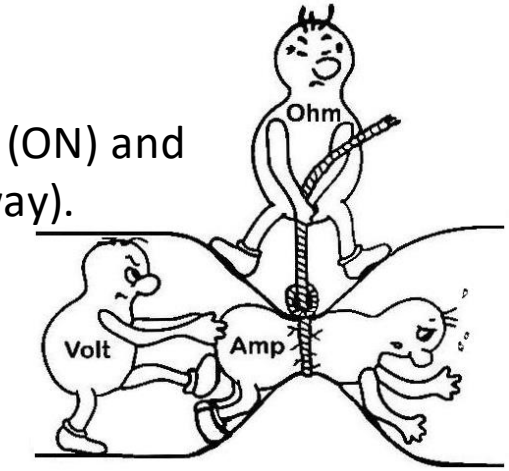


During the +ve half cycle:

The Diode is forward biased (ON) and

$V_{out} = V_D = 0{:}7$ V (Clipped away).



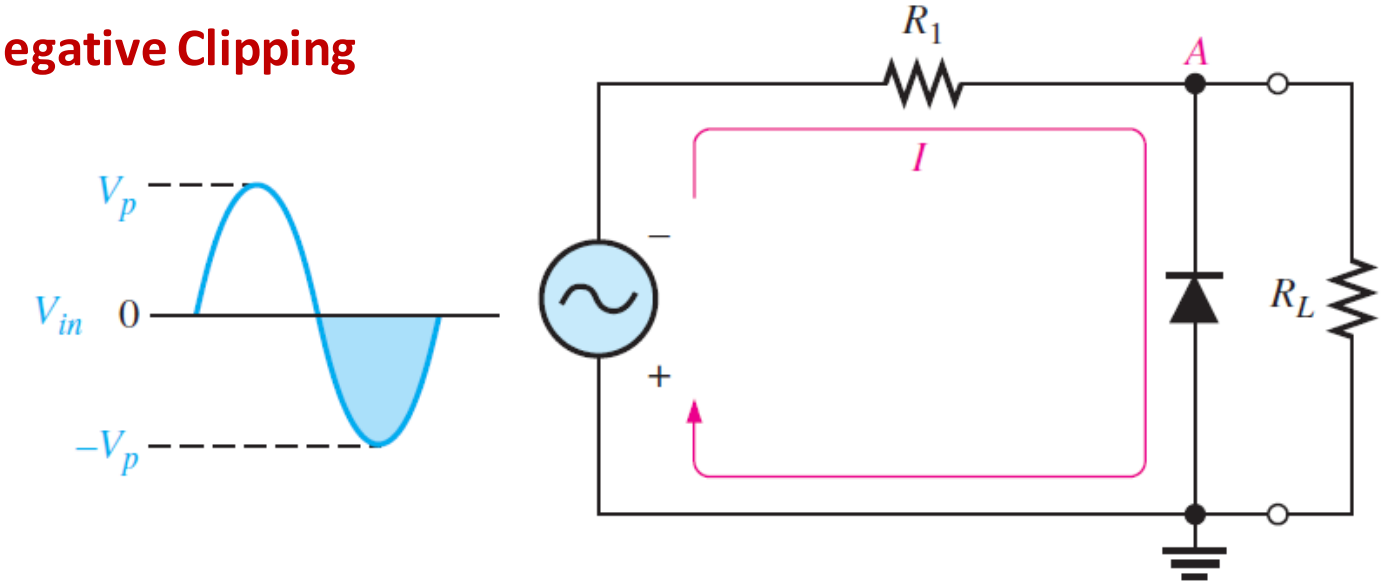


During the -ve half cycle:

The Diode is reverse biased (OFF) and

$V_{out} = V_{in}$ (Remained).

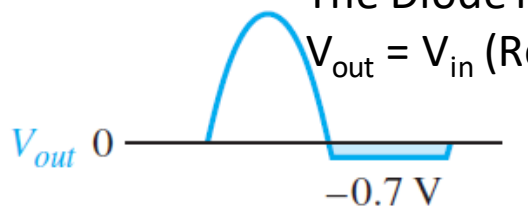
Negative Clipping



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

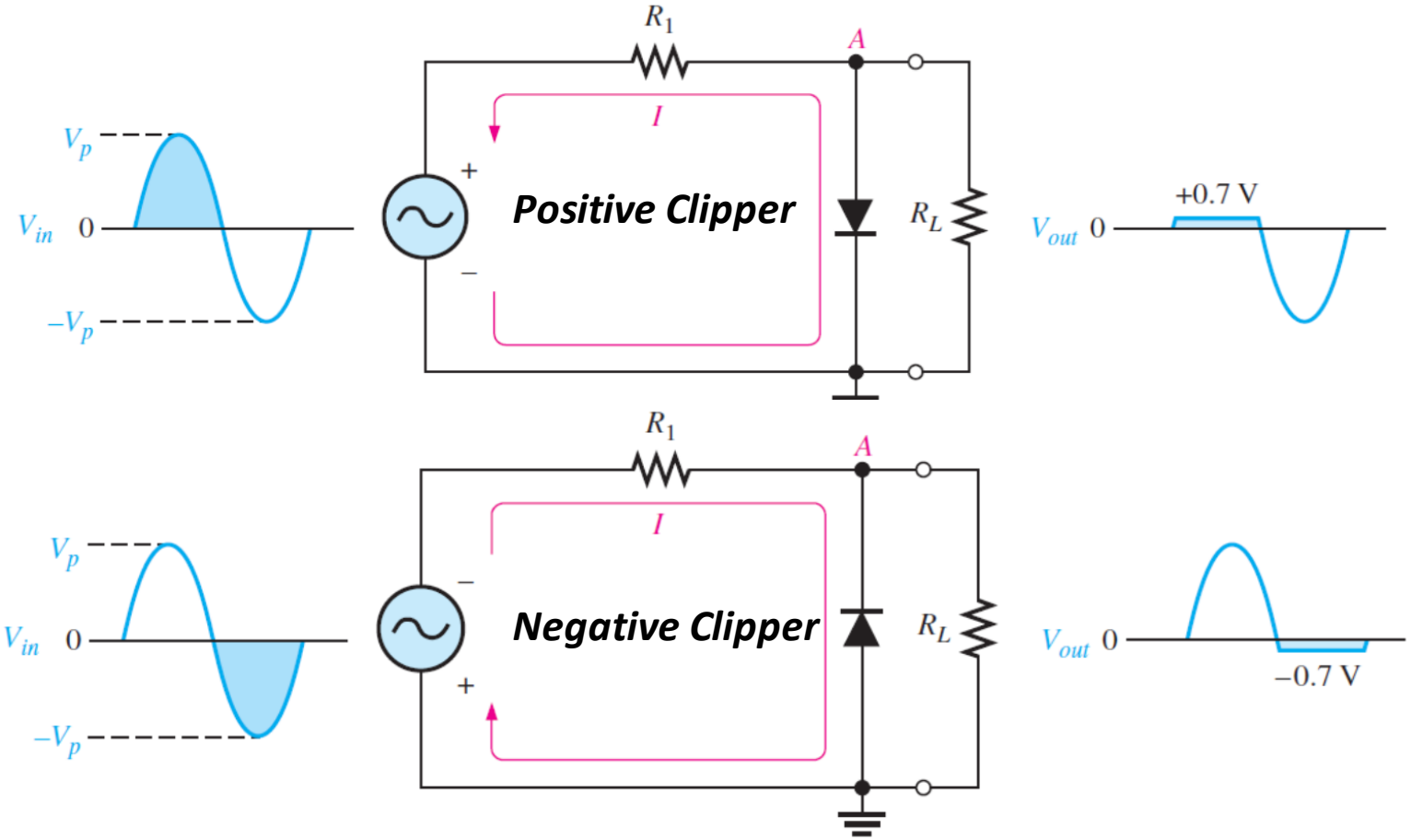
$V_{out} = V_D = 0{:}7$ V (Clipped away).

Diode Clipper (Limiter):

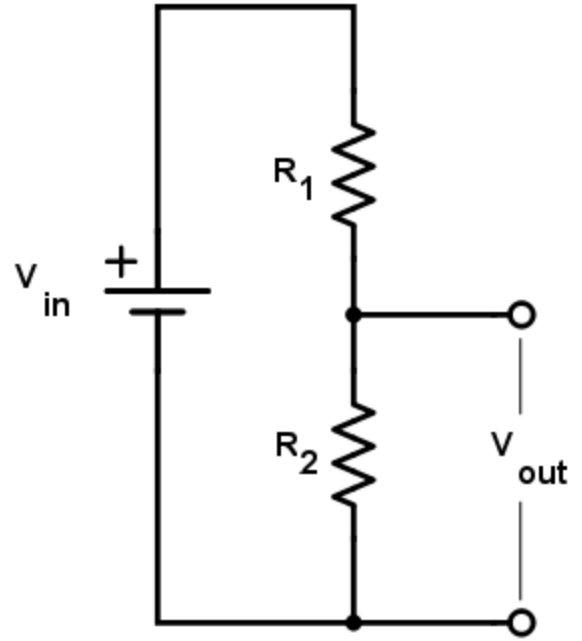
- In both Positive and Negative Clipping, a part of the output voltage looks like the input voltage.
- The output voltage is determined by the voltage divider formed by R_1 and the load resistor, R_L, as follows:

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

- If R_I is small compared to R_L, then $V_{out} = V_{in}$



Voltage divider or Potential divider Circuit

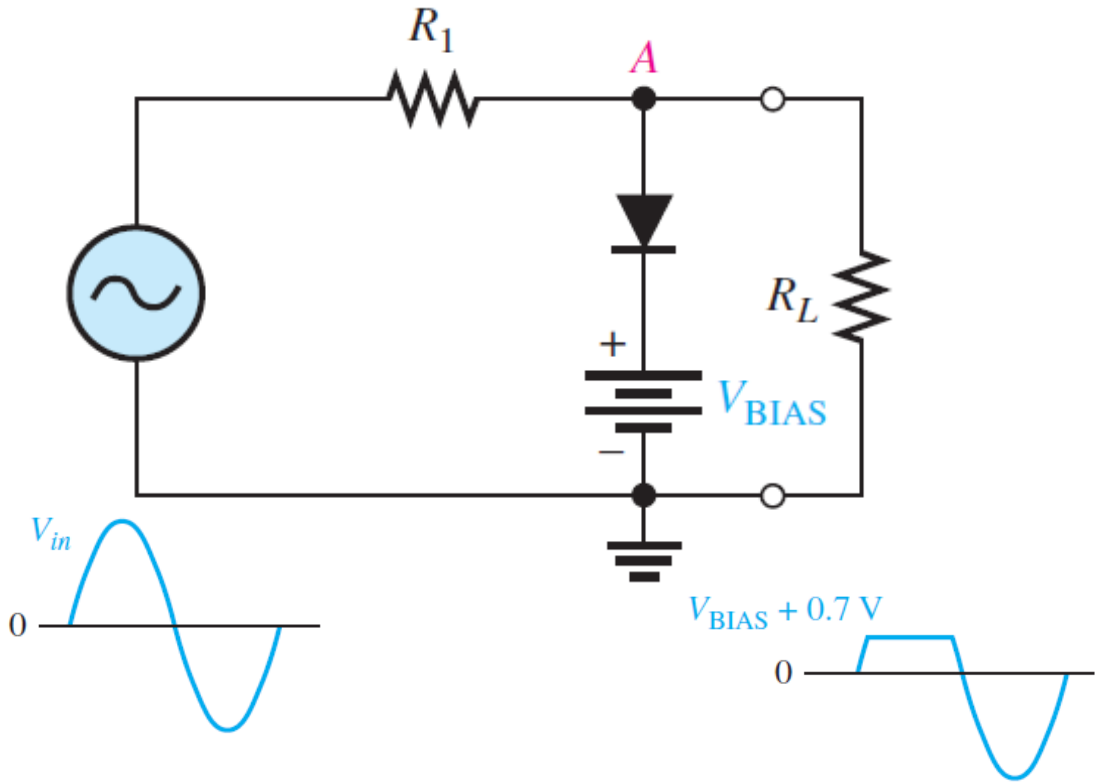


$$V_{out} = \frac{R_2}{R_1 + R_2} V_{in}$$

Biased Clipper

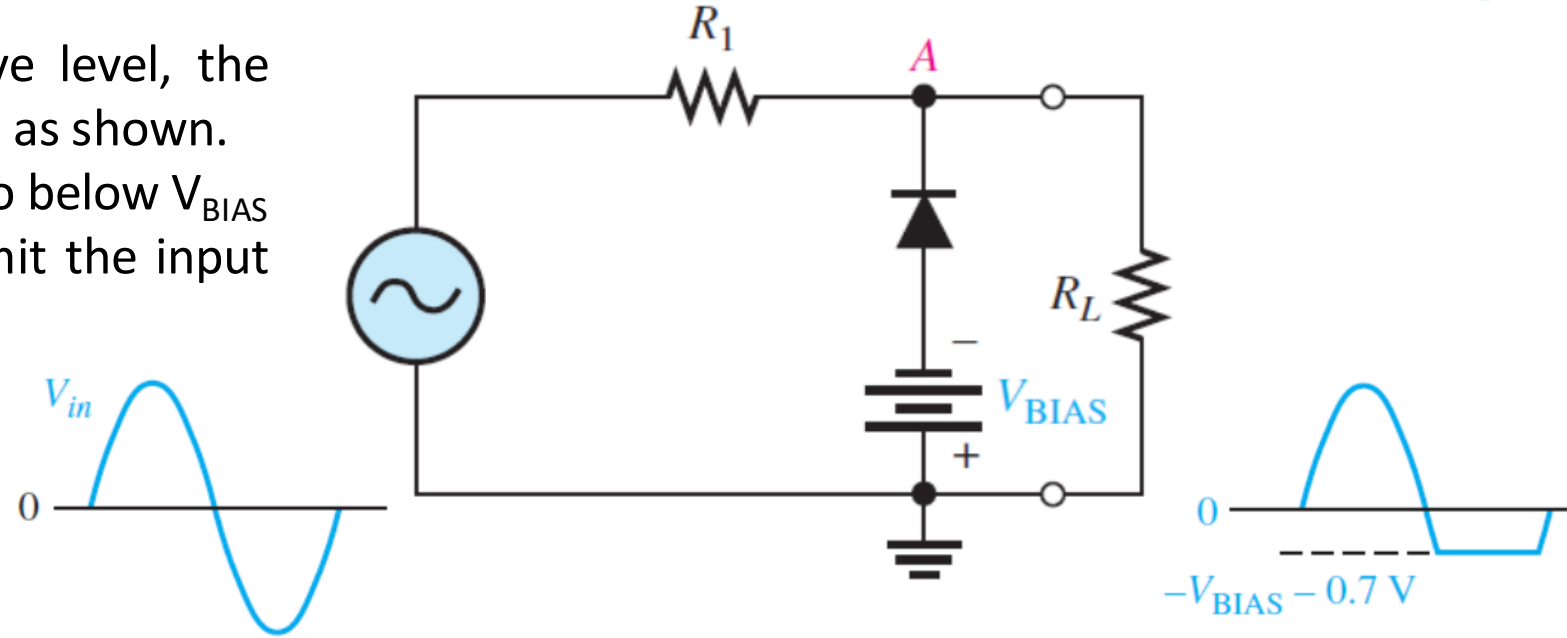
Biased Positive Clipper

- 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.

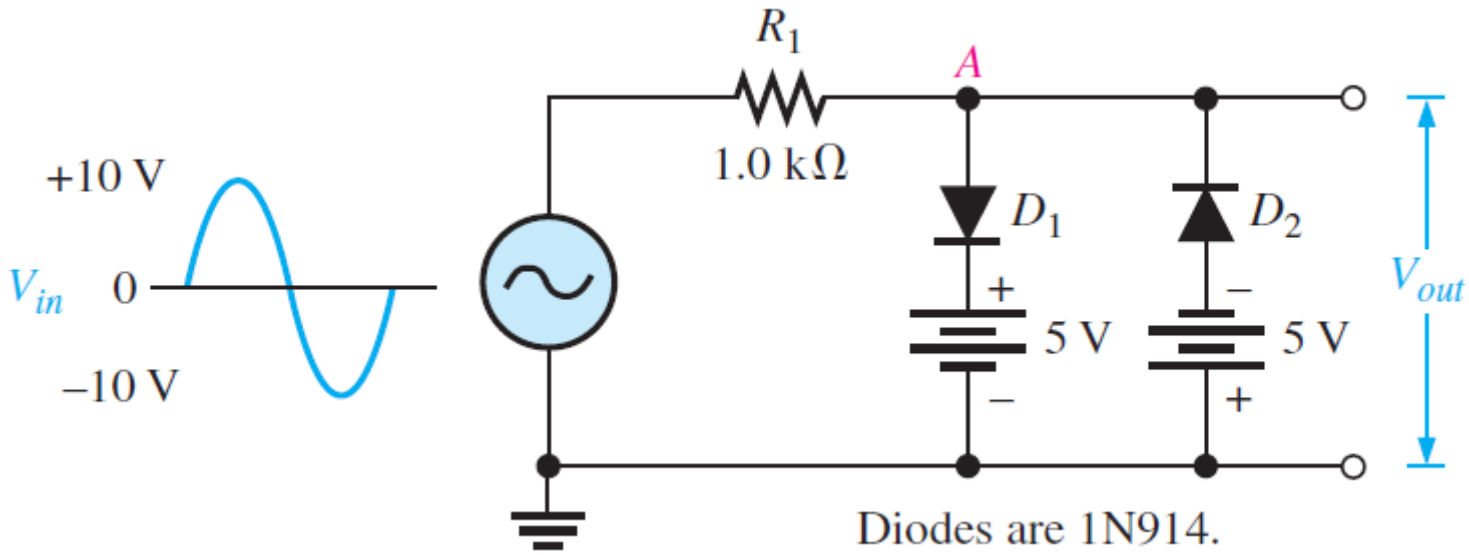


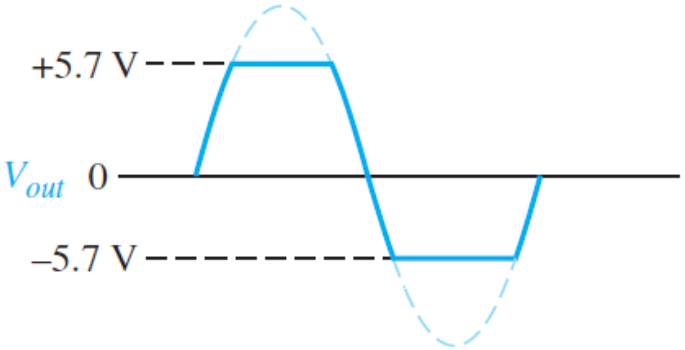
Biased Negative Clipper

- 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.



Combination of Positive and Negative Clippers:





- When the voltage at point A reaches + 5.7 V (5 + 0.7), diode D_1 conducts and limits the output waveform to +5.7 V.
- Diode D_2 does not conduct until the voltage reaches – 5.7 V.
- Therefore, positive voltages above +5.7 V and negative voltages below – 5.7 V are clipped off
- It can be used for sinusoidal to square-wave conversion.

Diode Clamping Circuits

A clamper is a network constructed of a diode, a resistor and a capacitor that shifts the waveform to a different dc level without changing the appearance of the applied signal. In other words, adding dc voltage (V_C) to the ac signal.

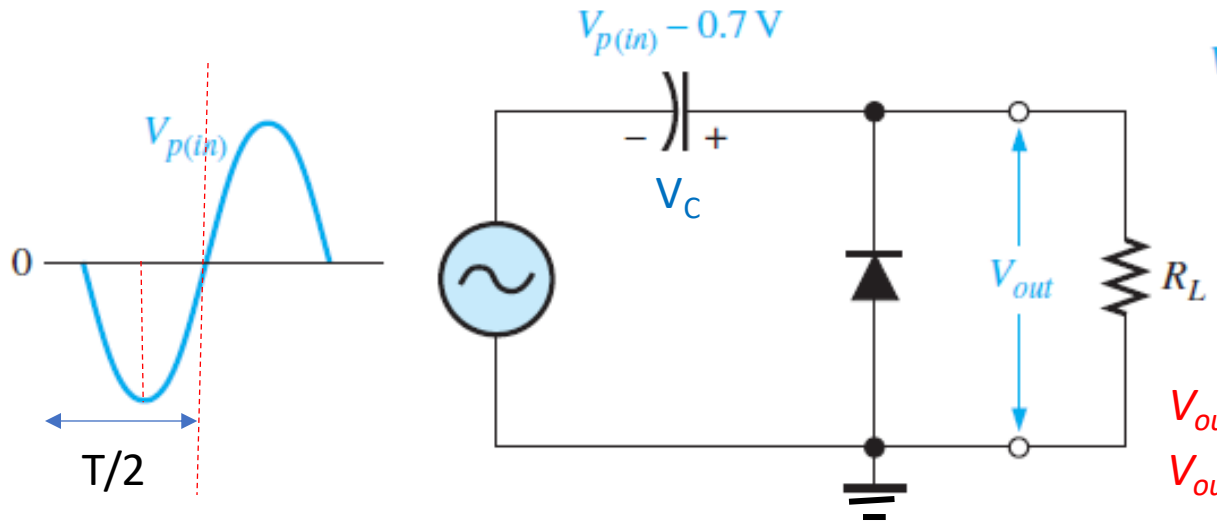
Positive Clamping

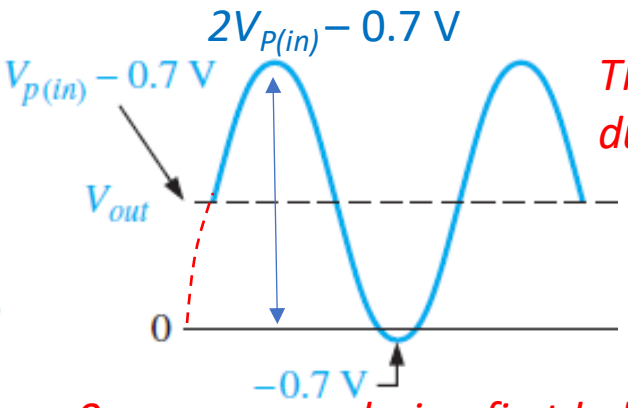
A positive clamper adds a positive dc level to an ac voltage.

$Time\ constant\ of\ capacitor, \tau = RC$

τ >>T/2

The capacitor should not discharge during the off state of diode





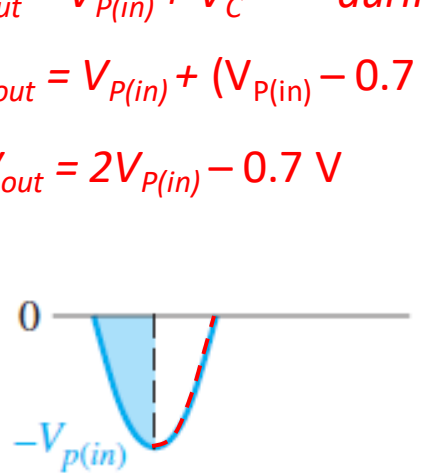
- During the -Ve half cycle: the diode is forward biased, allowing the capacitor to charge to near the peak of the input
- During the +Ve half Cycle: the diode is reverse-biased. The capacitor can only discharge through the resistance of R_L.
- The amount that is discharged capacitor depends on the value of R_L.

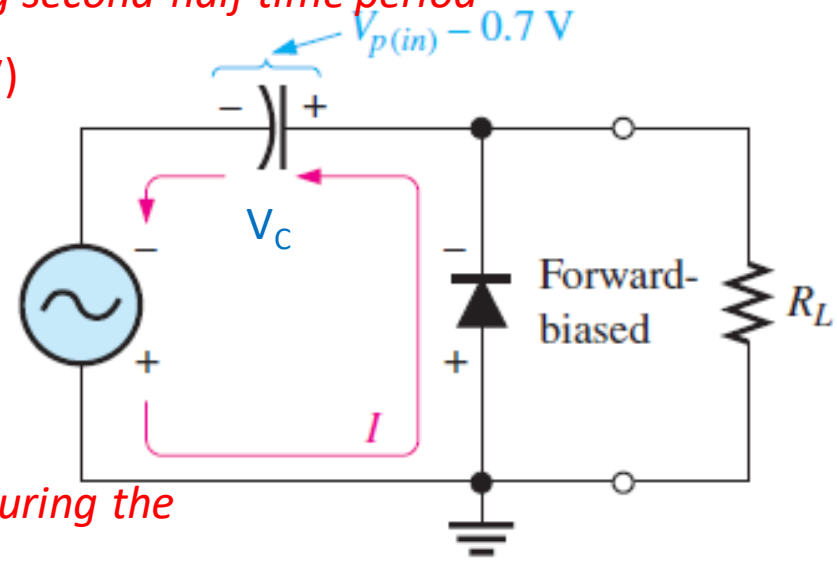
$V_{out} = 0$ *during first half time period*

$V_{out} = V_{P(in)} + V_C$ *during second half time period*

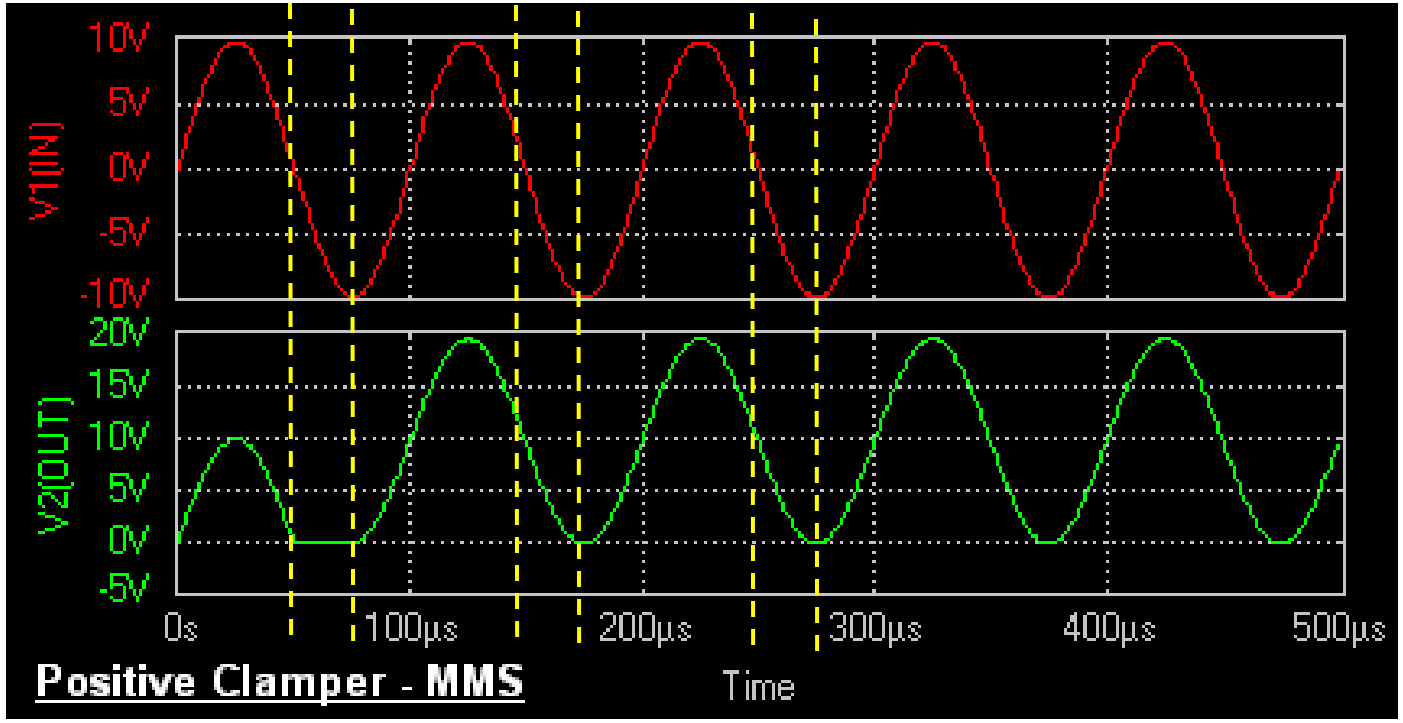
$V_{out} = V_{P(in)} + (V_{P(in)} - 0.7\ V)$

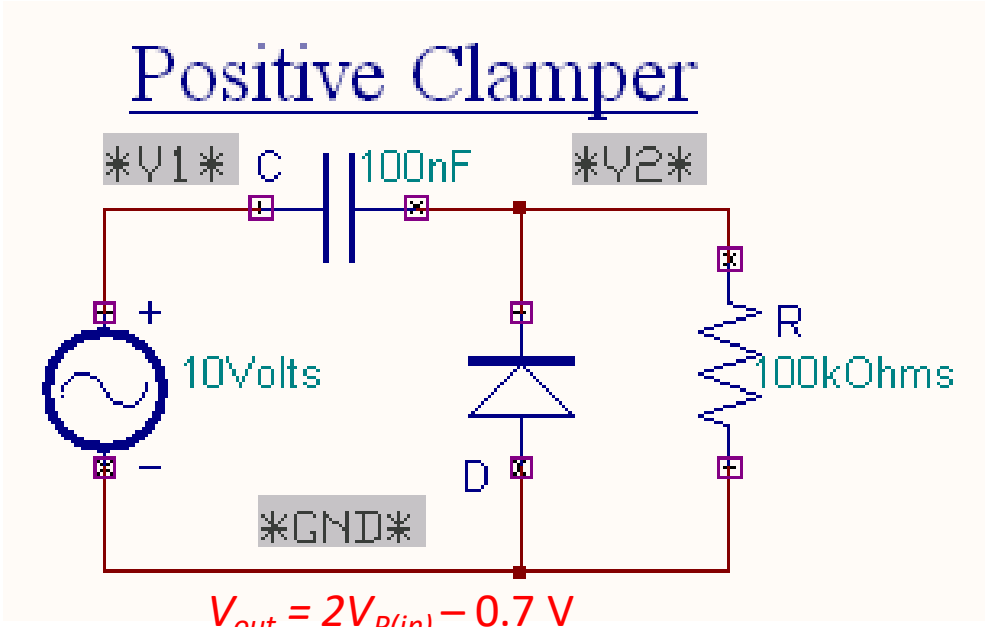
$V_{out} = 2V_{P(in)} - 0.7\ V$



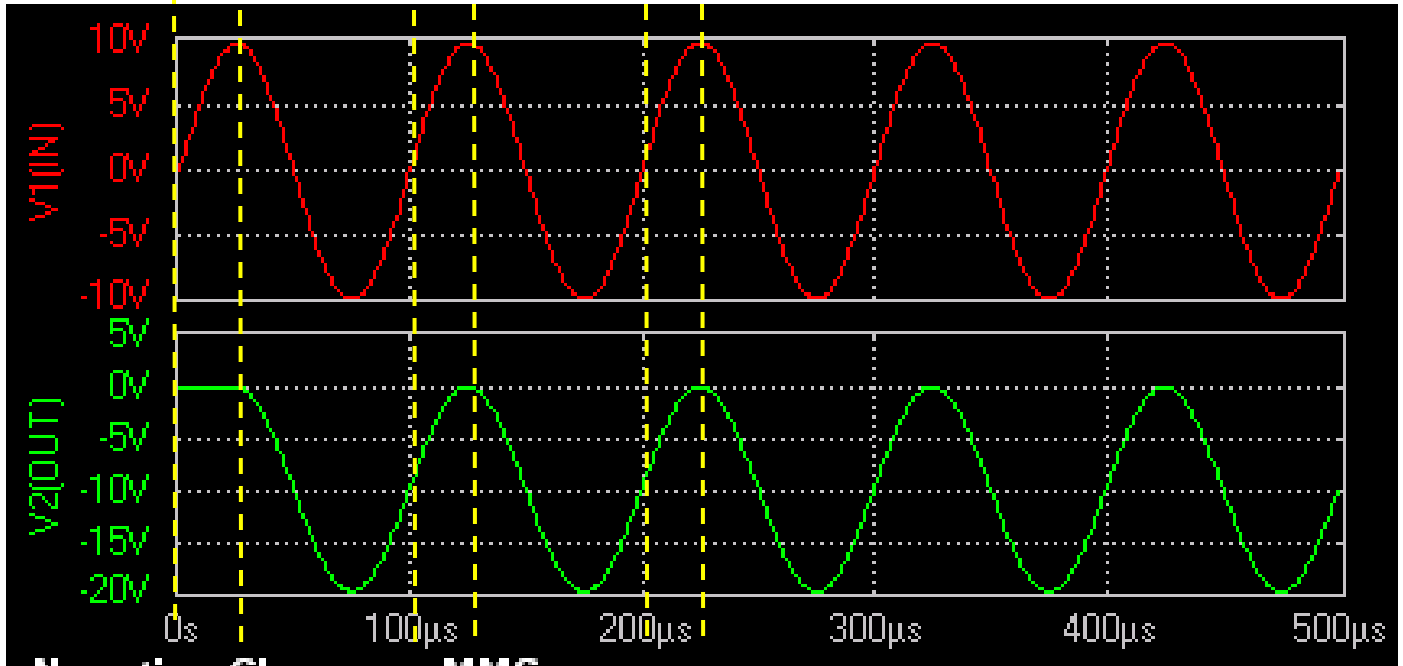


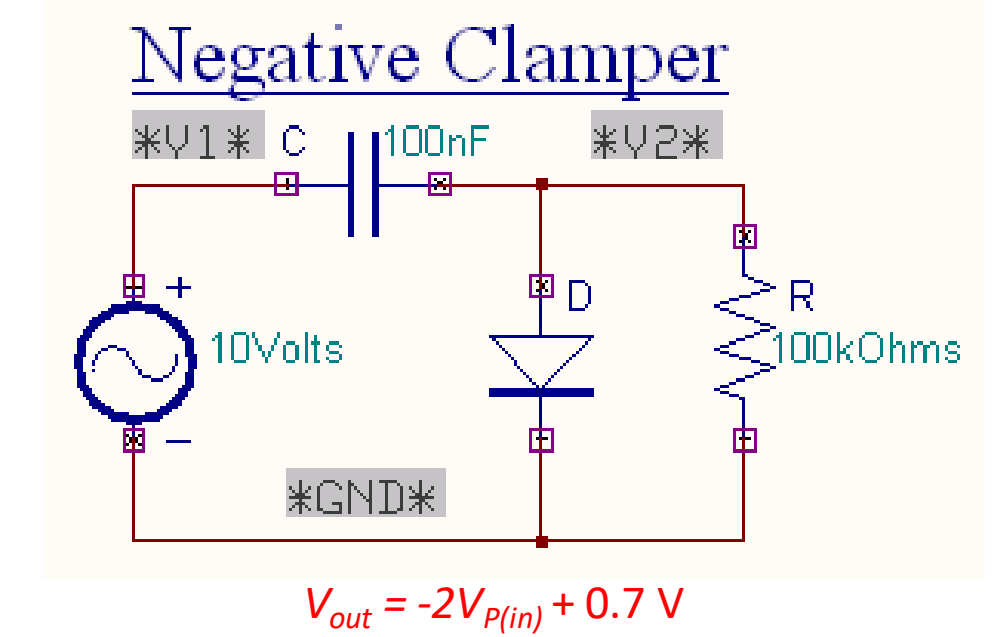
the capacitor charges during the shaded portion





$V_{out} = 2V_{P(in)} - 0.7\ V$



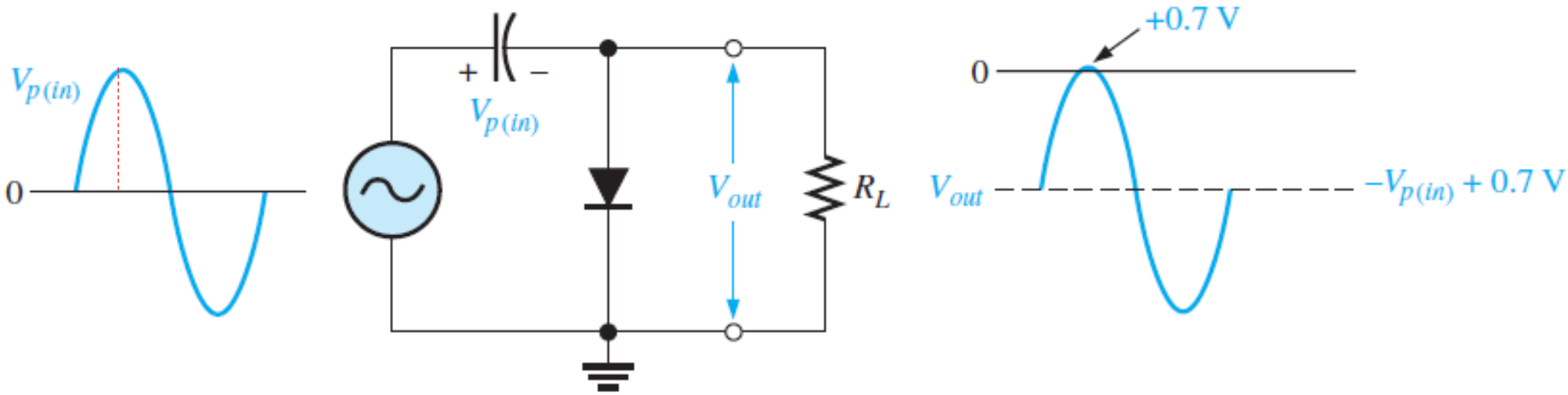


$V_{out} = -2V_{P(in)} + 0.7\ V$

Diode Clamping Circuits

Negative Clamping

A negative clamper adds a negative 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.