Clipper & Clamper Circuits

Satish Chandra

Clippers

- **Clipping circuit:** A wave shaping circuit which controls the shape of the output waveform by removing or clipping a portion of the applied wave.
  - Half wave rectifier is the simplest example (It clips negative half cycle).
  - Also referred as voltage limiters/ amplitude selectors/ slicers.

Clippers

- **Applications**
  - In radio receivers for communication circuits.
  - In radars, digital computers and other electronic systems.
  - Generation for different waveforms such as trapezoidal, or square waves.
  - Helps in processing the picture signals in television transmitters. - In television receivers for separating the synchronizing signals from composite picture signals

Clippers

Clippers are networks that employ diodes to “clip” away a portion of an input signal without distorting the remaining part of the applied waveform.

Types of Clippers

- **According to non- linear devices used**: -
  - Diode clippers and Transistor clippers
- **According to biasing** –
  - Biased clippers and Unbiased clippers.
- **According to level of clipping** –
  - Positive clippers, Negative clippers and combination clippers

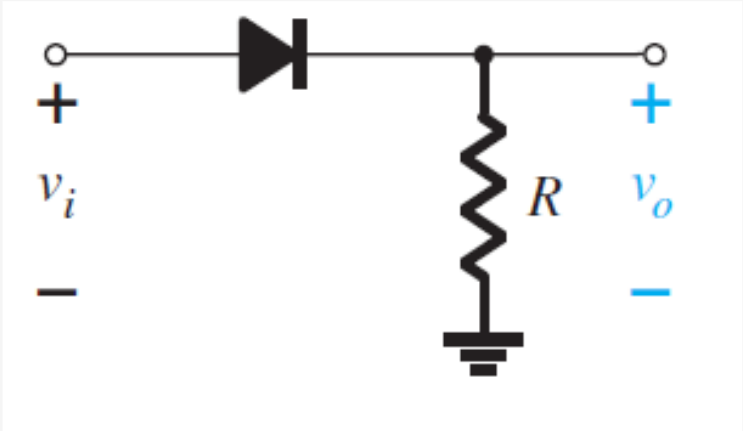
Thumb Rule

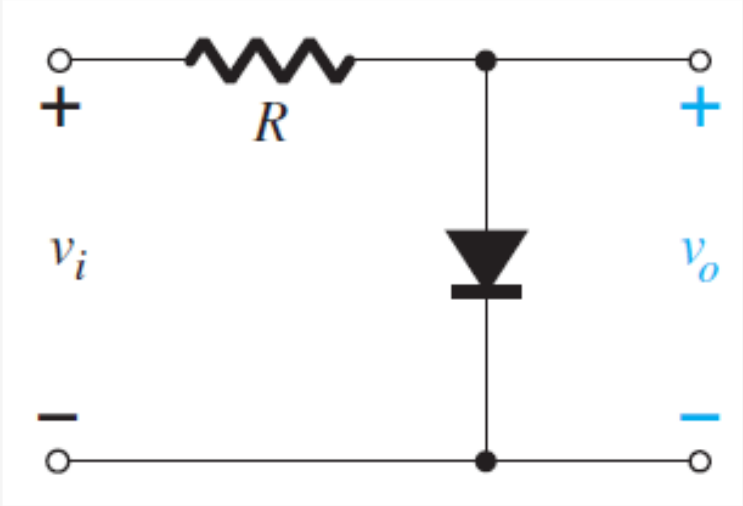
- Action of biasing on diode
  - When diode is forward biased, it acts as a closed switch (ON state).
  - When diode is reverse biased, it acts as a open switch (OFF state).

Clippers

There are two general categories of clippers: ***series*** and ***parallel***.

The series configuration is defined as one where the diode is in series with the load, whereas the parallel variety has the diode in a branch parallel to the load.

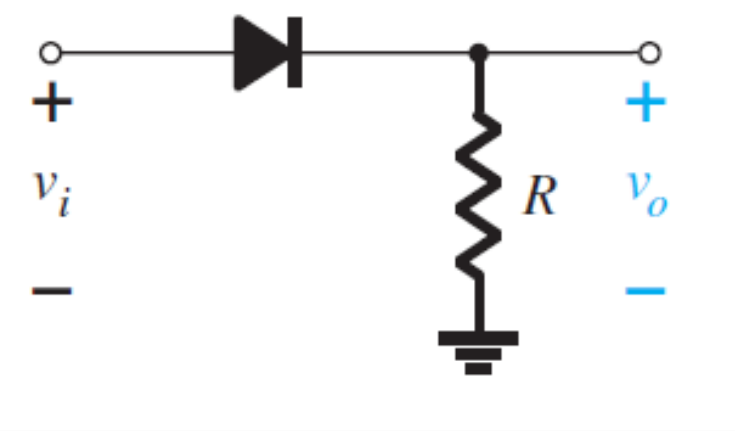


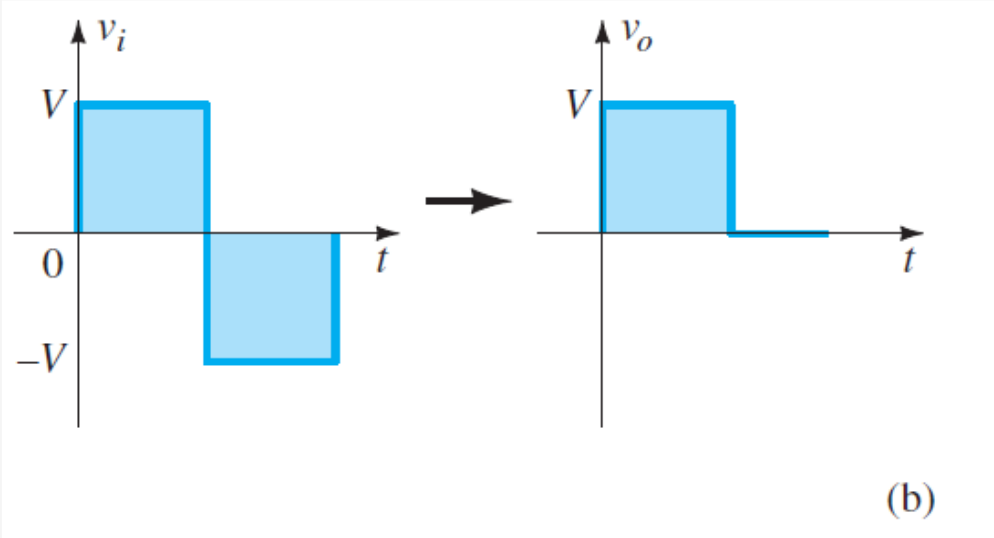


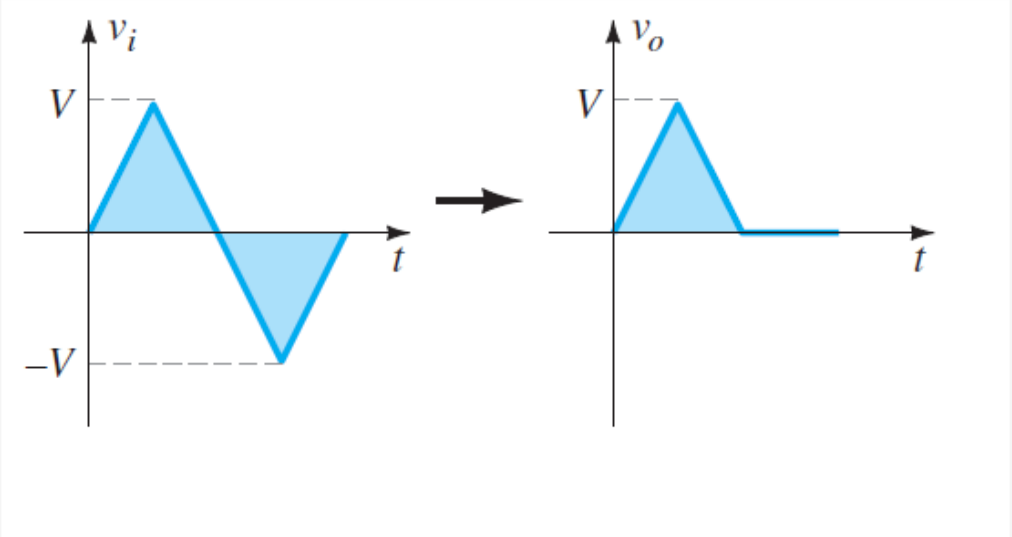
Diode Clippers

The diode in a series clipper "clips" any voltage that does not forward bias it:

- A reverse-biasing polarity
- A forward-biasing polarity less than 0.7 V (for a silicon diode)

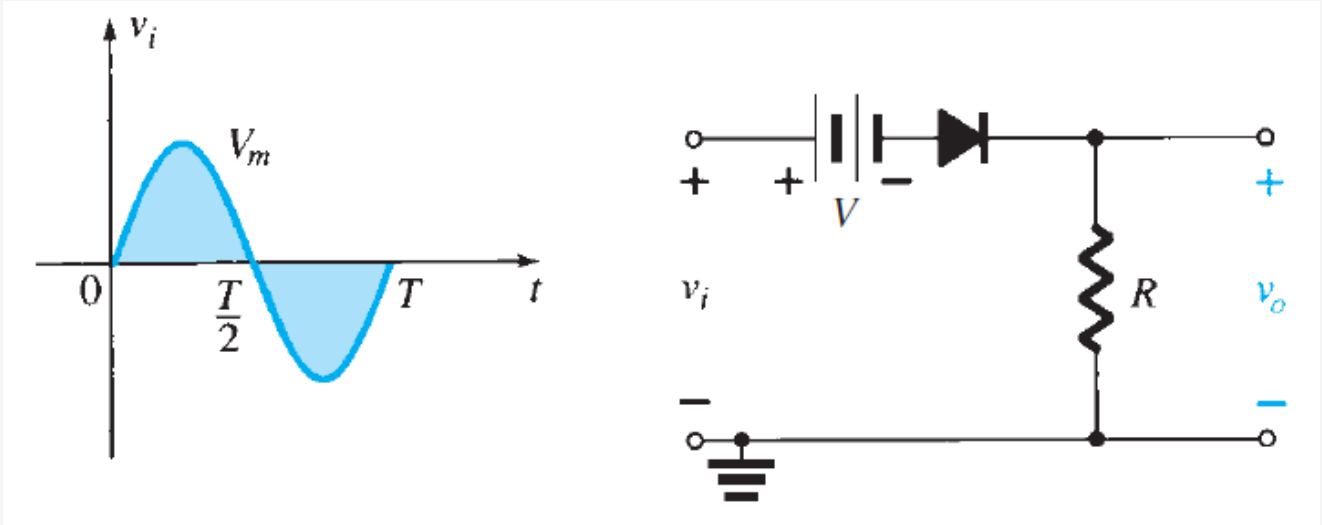




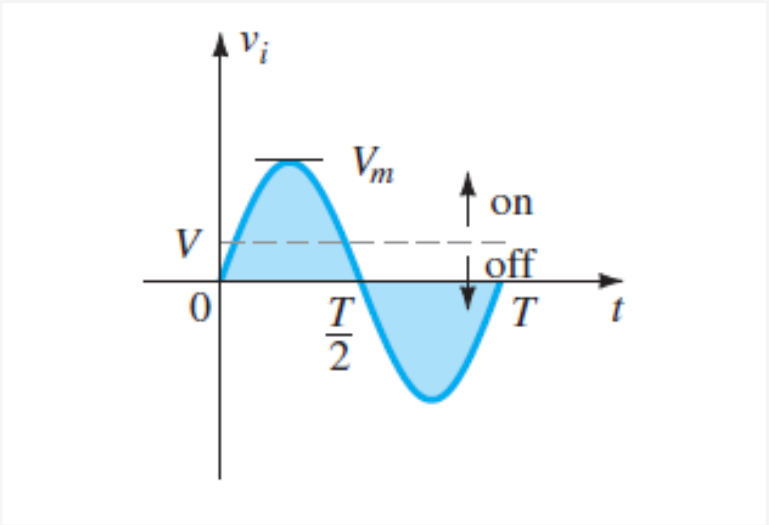


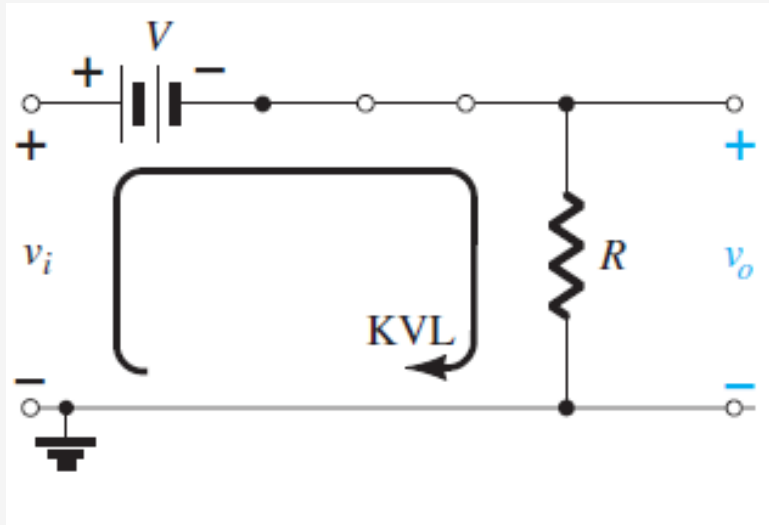
Biased Clippers

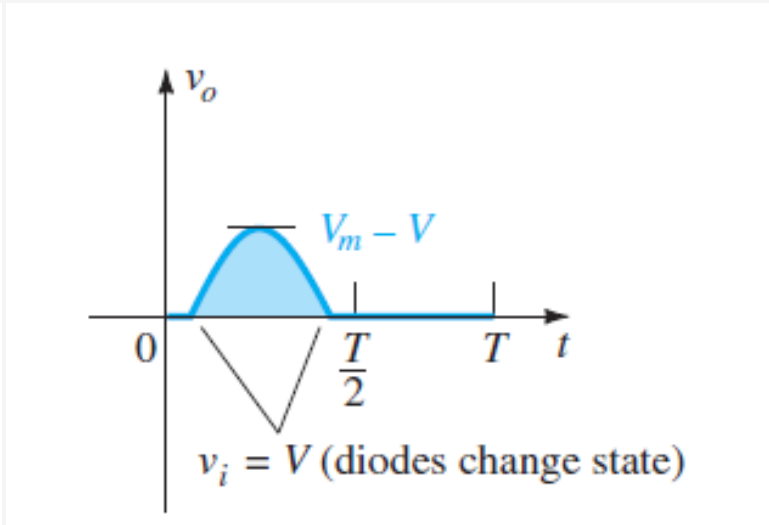
Adding a DC source in series with the clipping diode changes the effective forward bias of the diode.



Biased Clippers

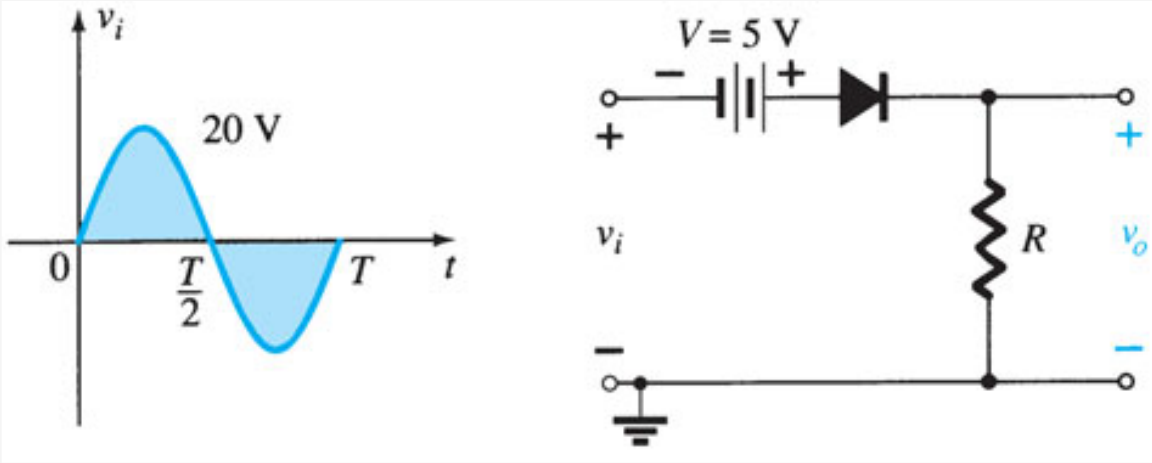


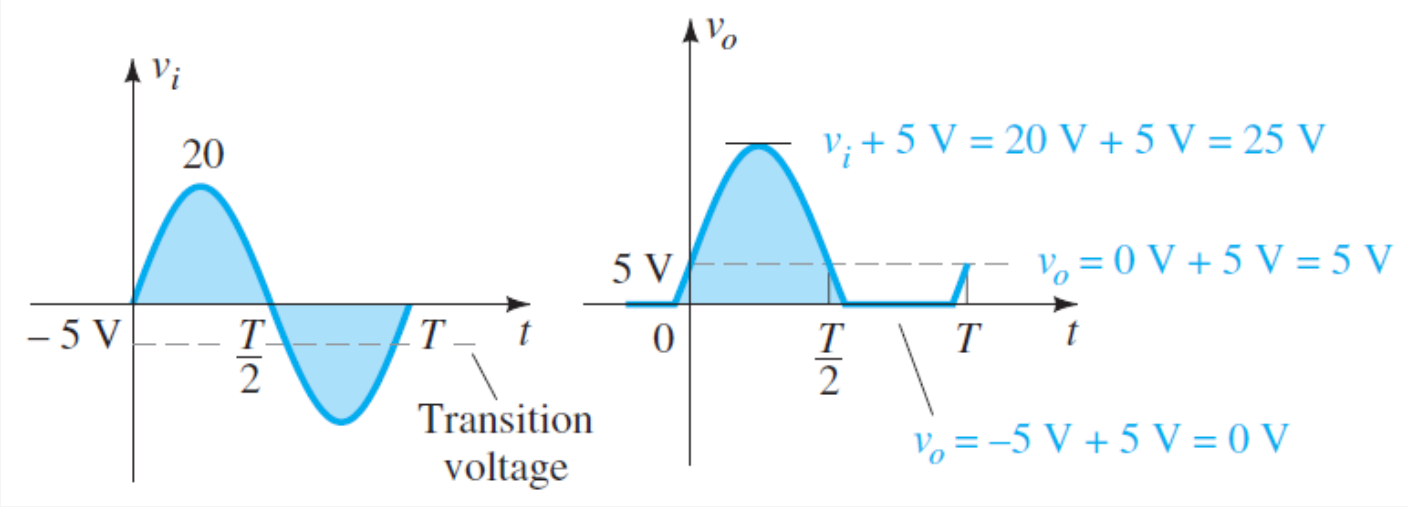




Biased Clippers

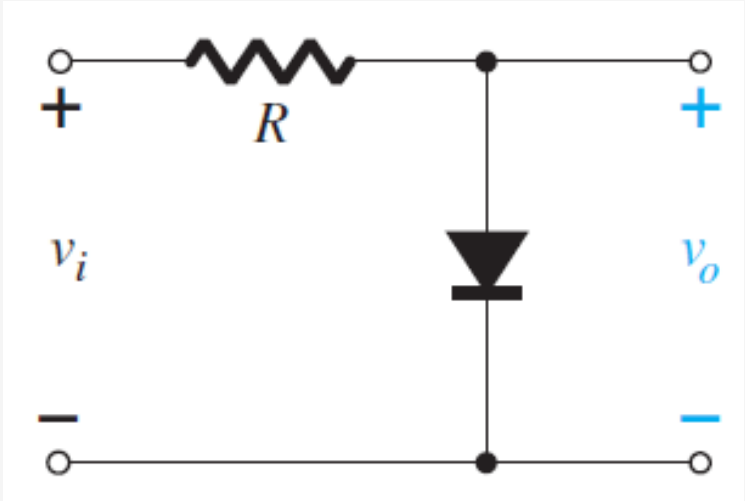
Example:

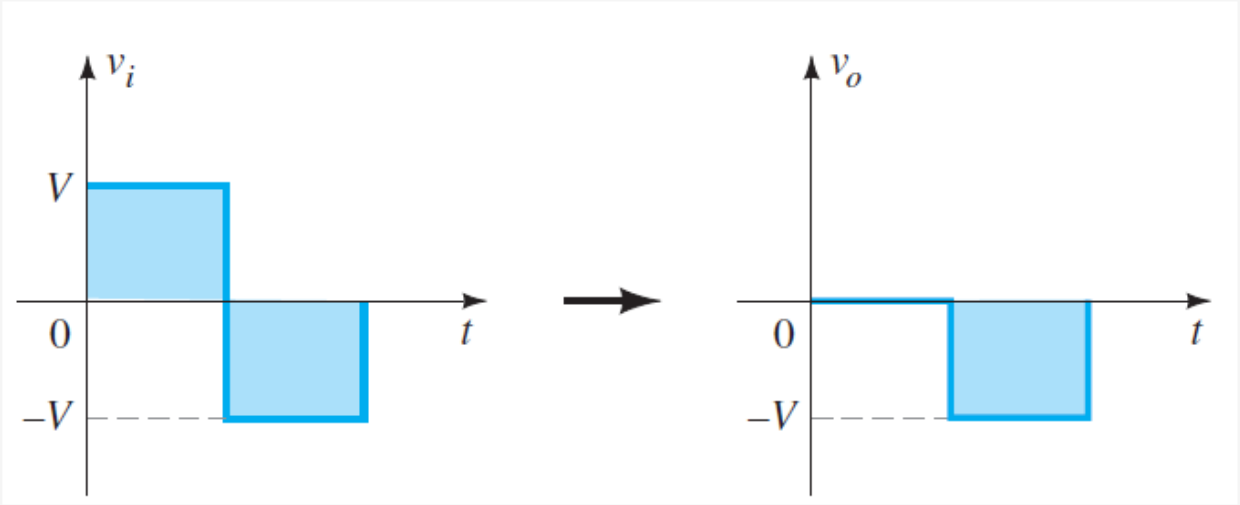


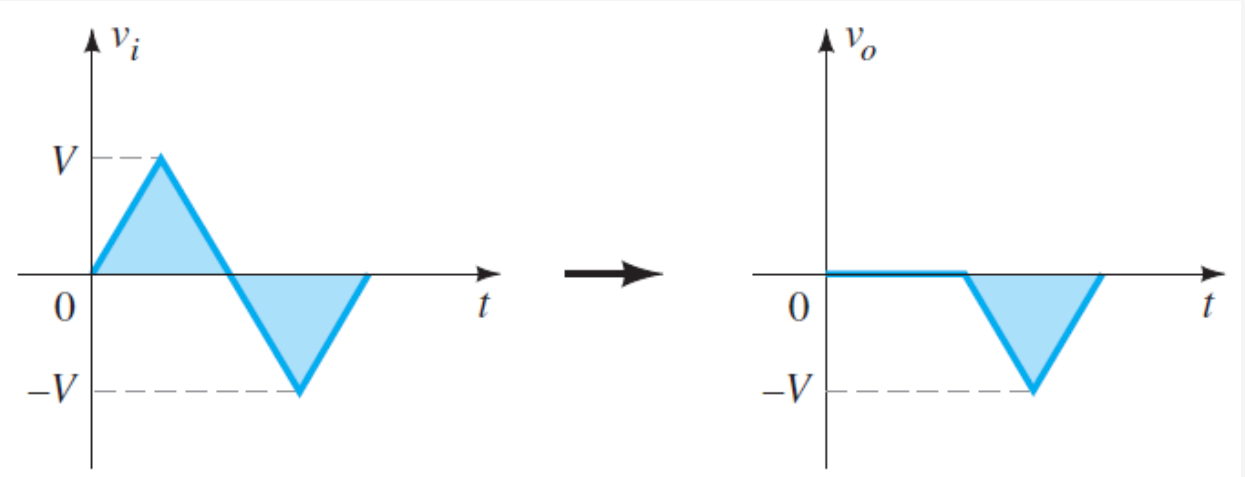


Parallel Clippers

The diode in a parallel clipper circuit "clips" any voltage that forward bias it. DC biasing can be added in series with the diode to change.

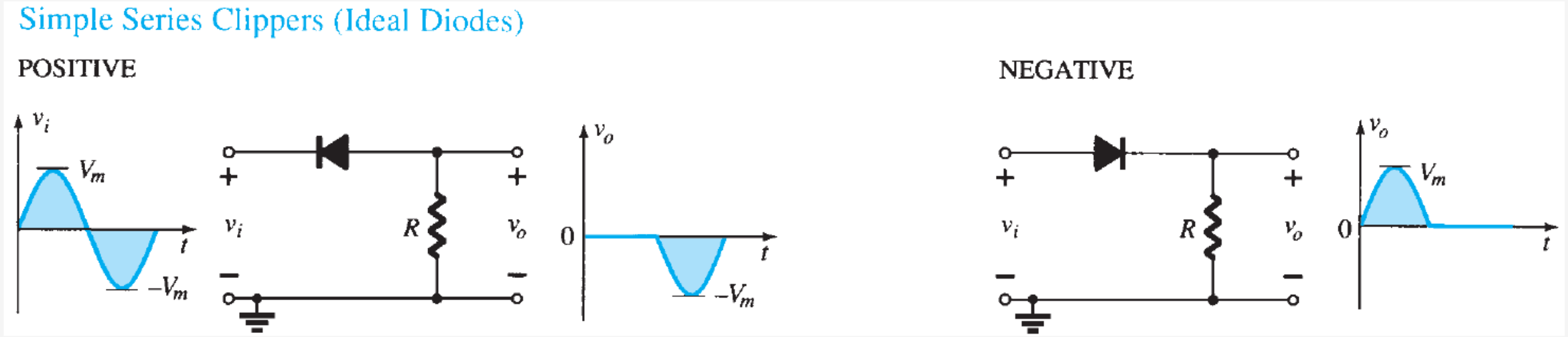






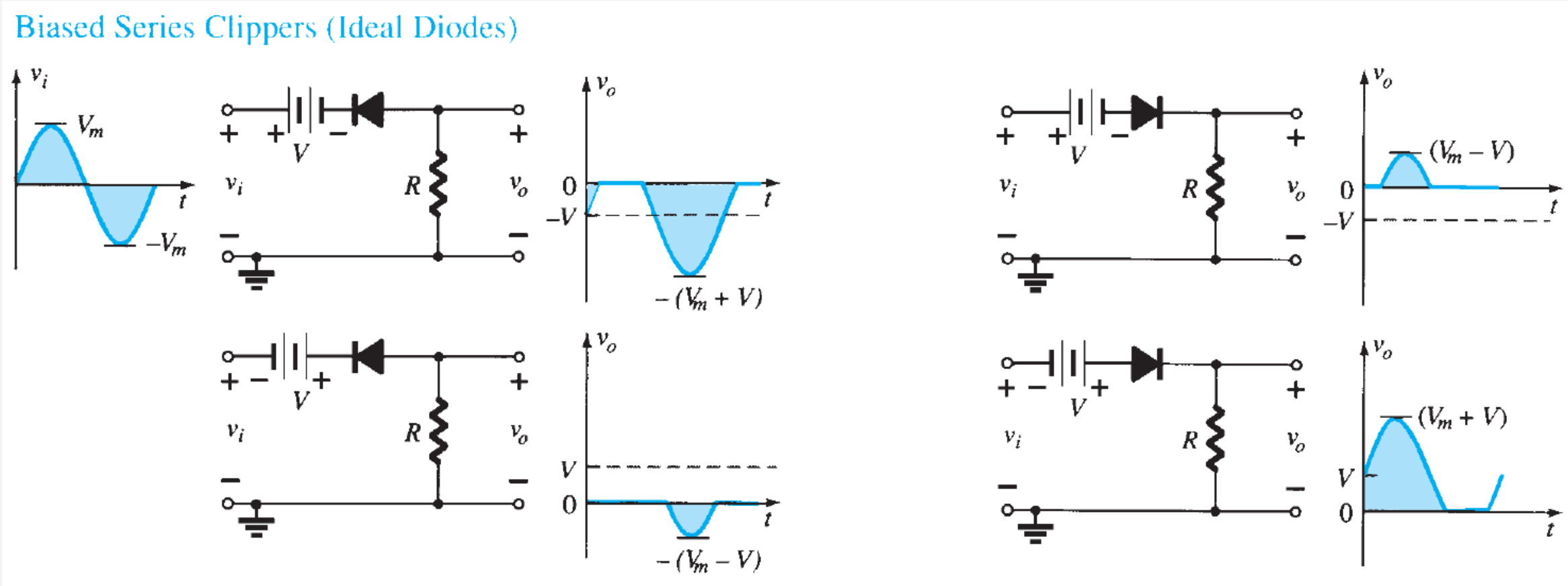
Summary of Clipper Circuits

Simple Series



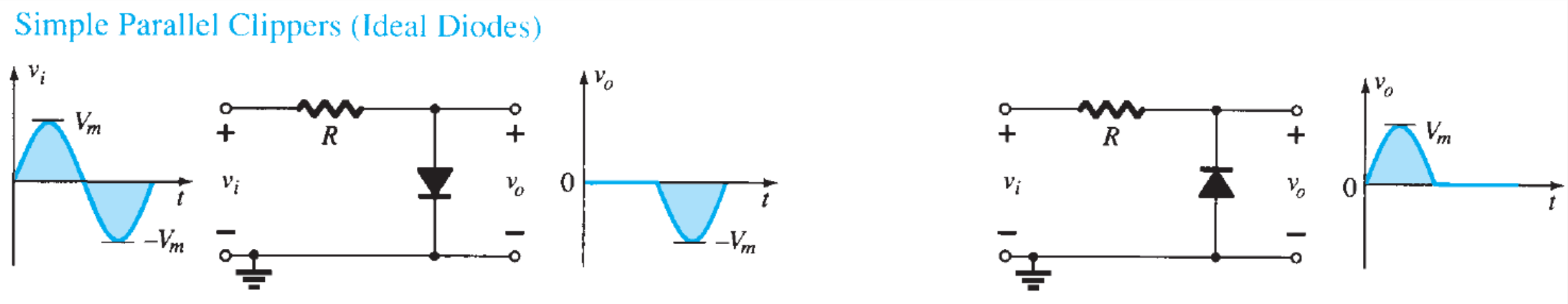
Summary of Clipper Circuits

Biased Series



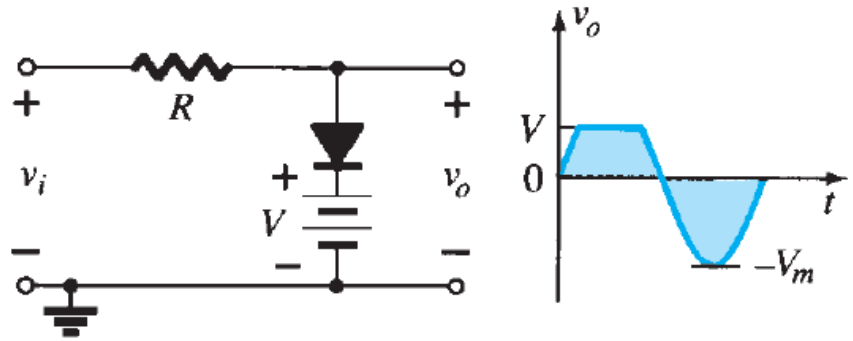
Summary of Clipper Circuits

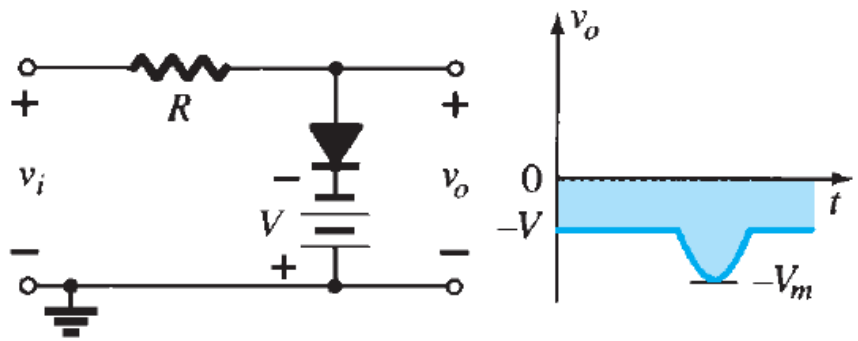
Simple Parallel

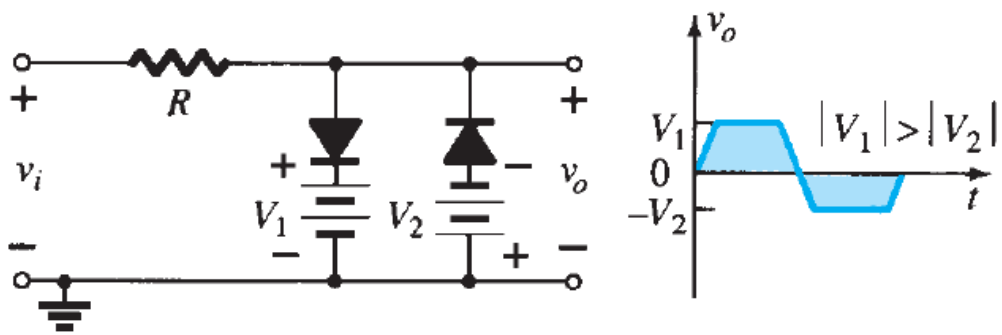


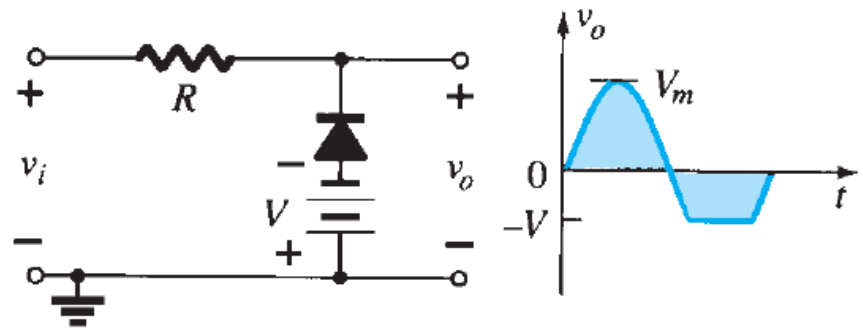
Summary of Clipper Circuits

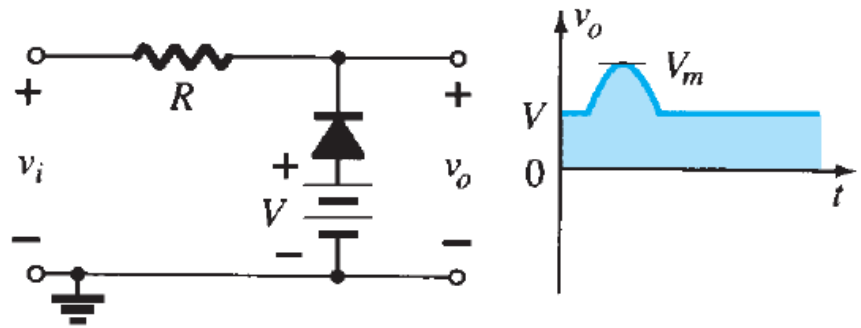
Biased Parallel Clippers (Ideal Diodes)











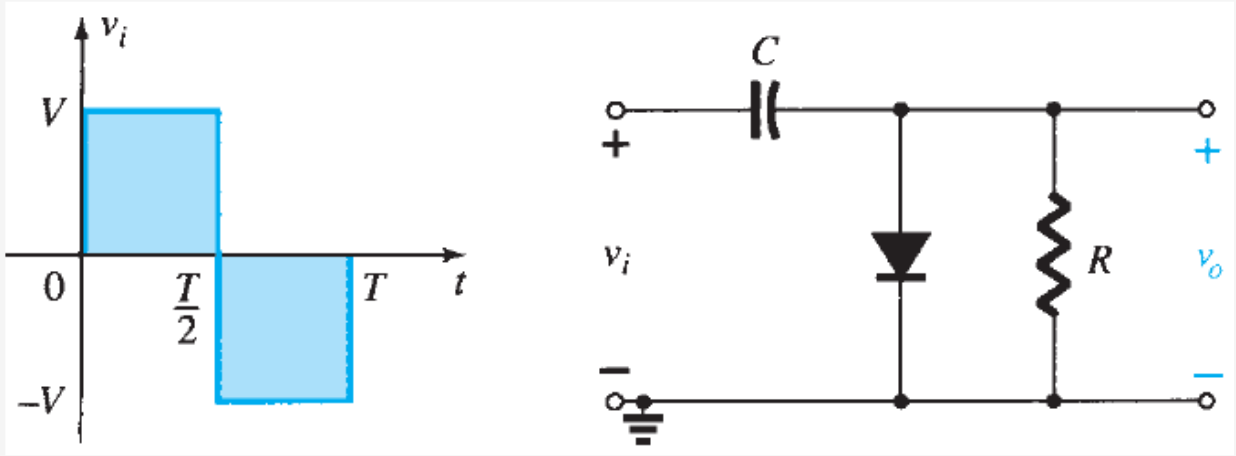
Drawbacks

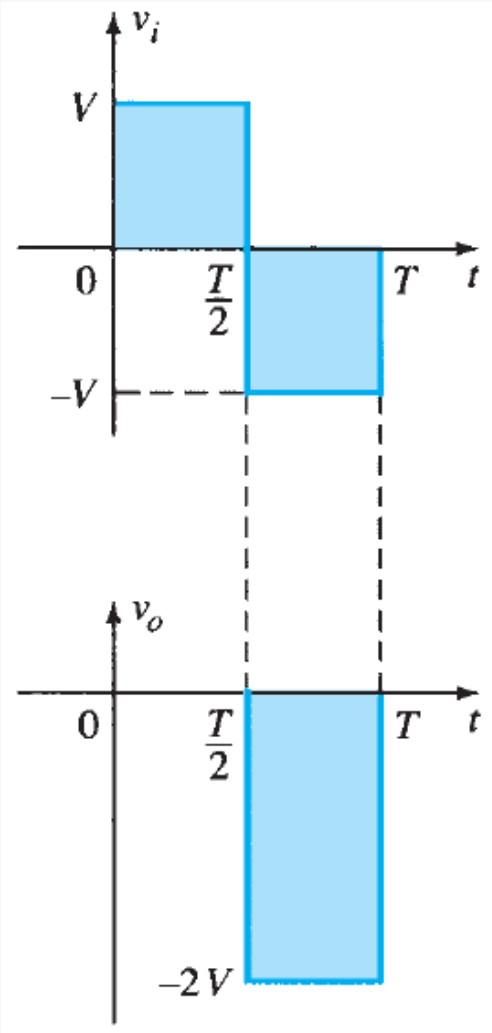
Series Diode Clipper When diode is “OFF”, there should be no transmission of input signal to output. But in case of high frequency, signal transmission occurs through diode capacitance which is undesirable.

Parallel Diode Clippers When diode is “OFF”, transmission of input signal to output should take place. But in case of high frequency input signals, diode capacitance affects the circuit operation and signal gets attenuated.

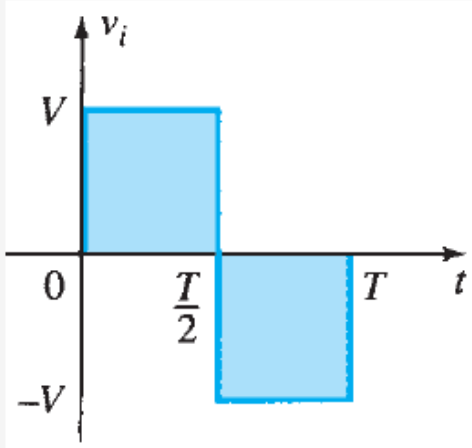
Clamper

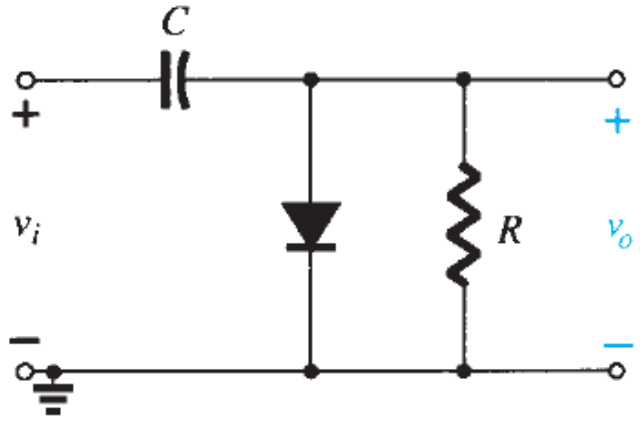
A diode and capacitor can be combined to “clamp” an AC signal to a specific DC level.

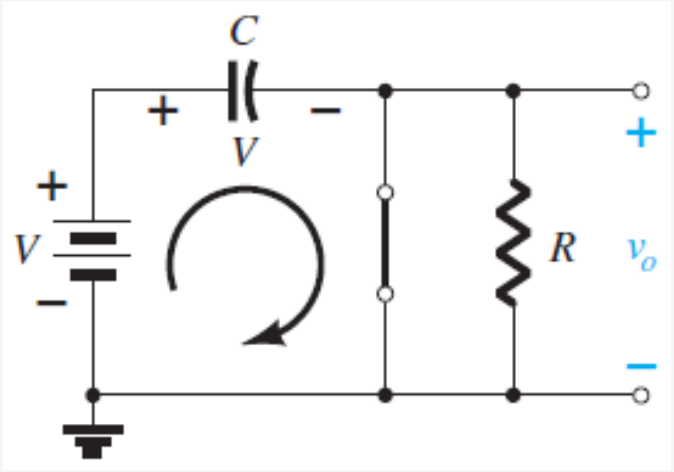




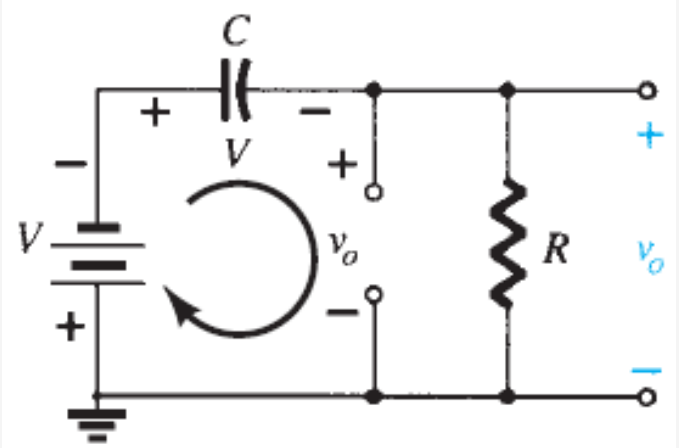
Clamper



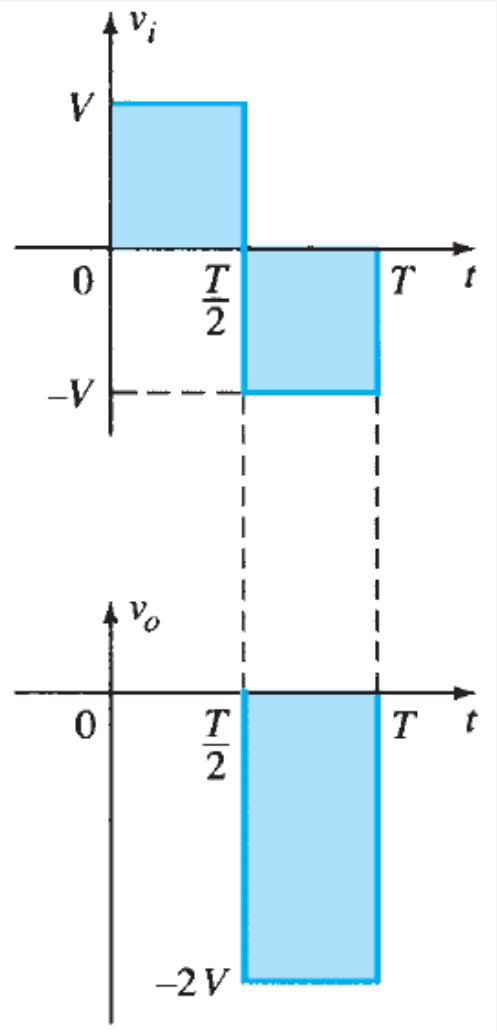




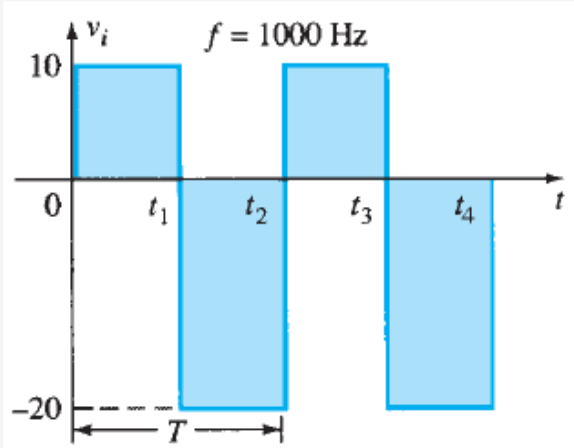
Diode “on” and the capacitor charging to V volts.

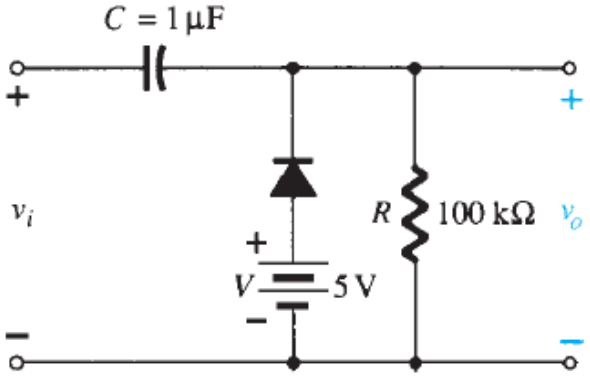


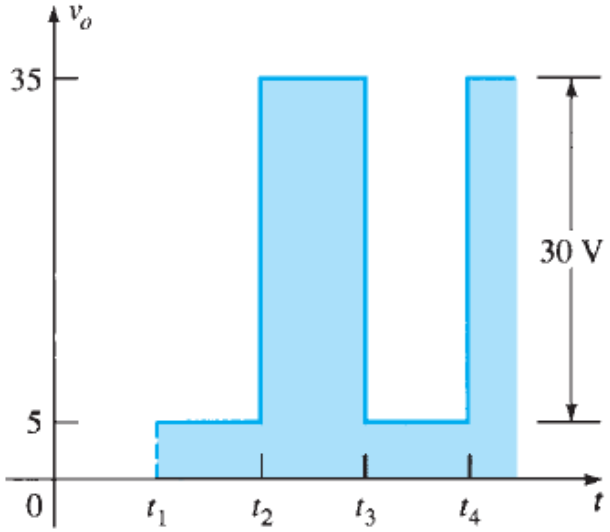
Determining v_o with the diode “off.”

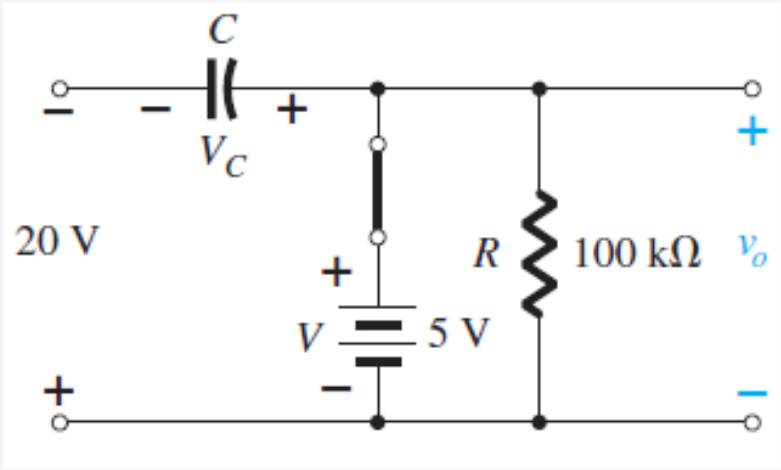


Clamper

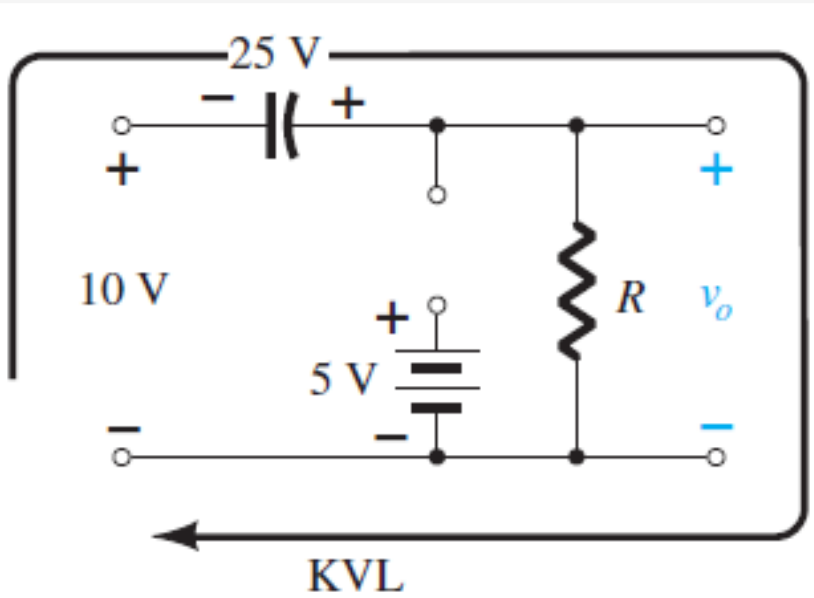








The diode in the “on” state.



The diode in the “off” state.

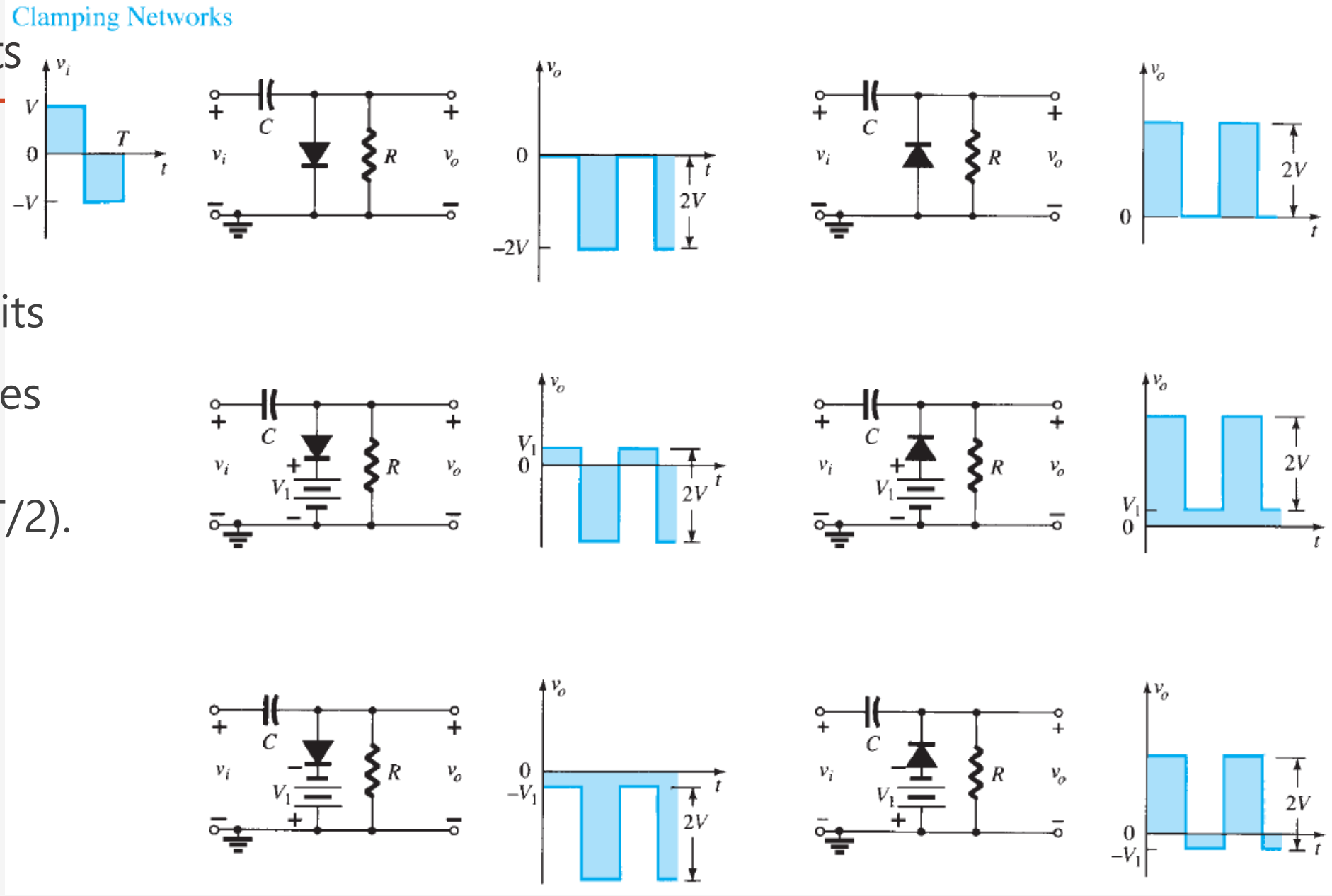
Thumb Rule

- Start the analysis of clamping network, by considering that part of the input signal that will forward bias the diode.
- During the period that the diode is in the “ON” state, assume that capacitor will charge up instantaneously to a voltage level determined by the network.
- Assume that during the period when the diode is in “OFF” state, capacitor will hold on its established voltage level.

Keep in mind the general rule, that

Total swing of total output = Swing of input signal

Summary of Clamper Circuits



Clamping circuits

with ideal diodes

(5τ = 5RC >> T/2).

Clamper

Clamping network with a sinusoidal input.