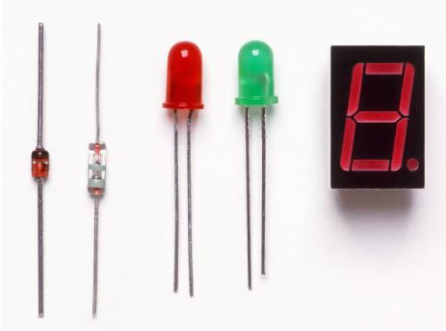
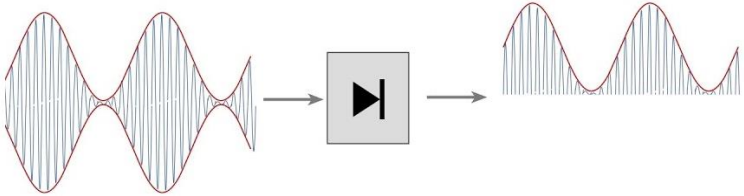
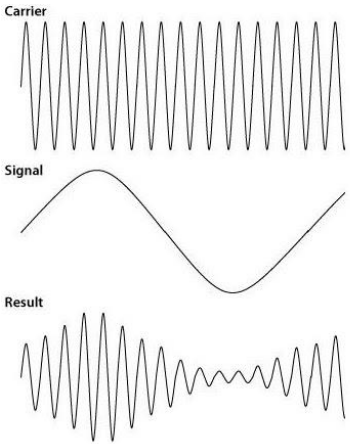
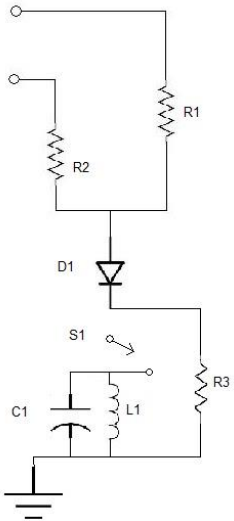
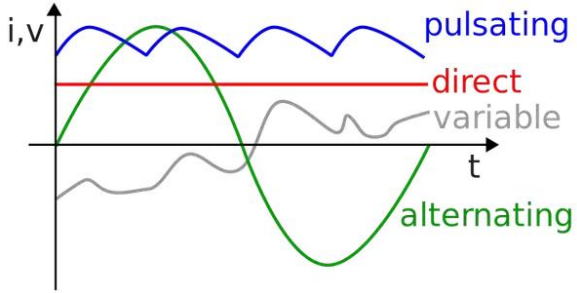
Diode Applications





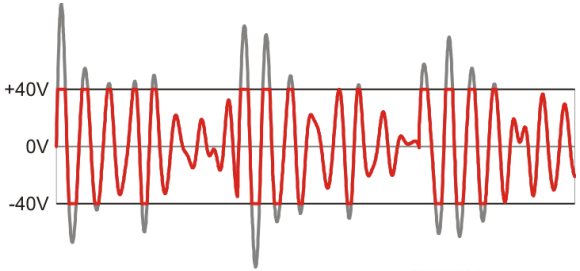

Carrier
Signal
Result

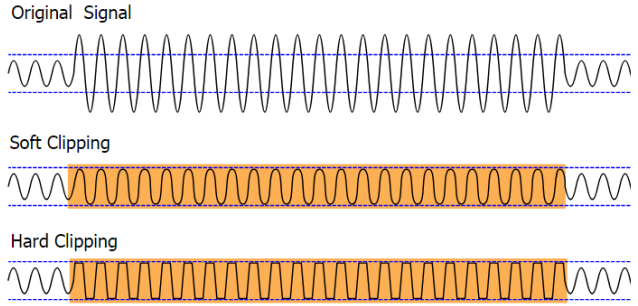

R1
R2
D1
S1
R3
C1
L1

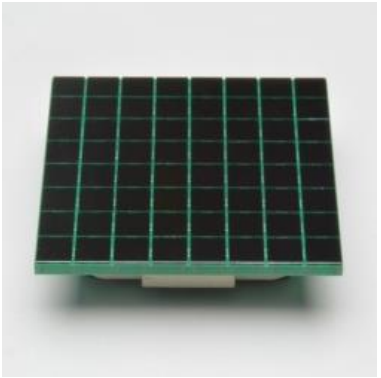

i,v
pulsating
direct
variable
t
alternating


VS550


230


+40V
0V
-40V


Original Signal
Soft Clipping
Hard Clipping



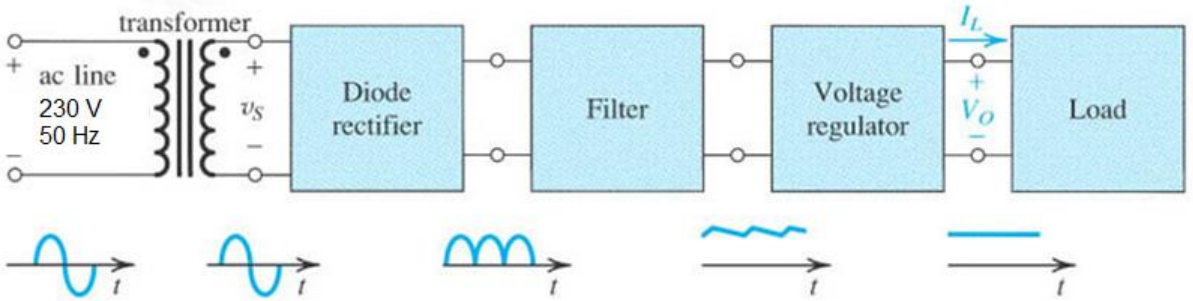
Diode Applications

- Rectifiers
- Signal modulators/demodulators
- Signal mixers
- Voltage regulators
- Light emitting diodes (LED's)
- Circuit Protection
- Wave shaping – limiters / clippers
- Clampers

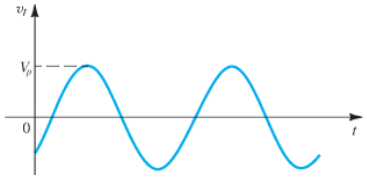
Rectifiers

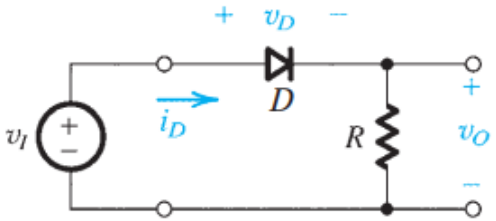
Rectifiers

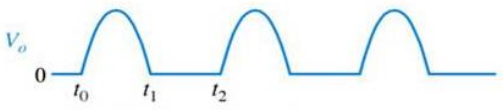
- The basic function of a Rectifier is to convert an AC voltage to a pulsating DC voltage.

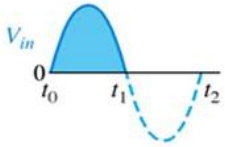


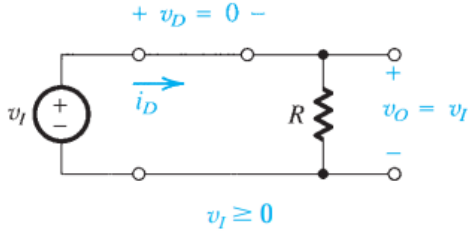
Half-wave Rectifier

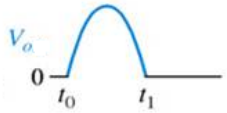


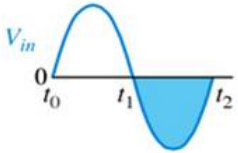


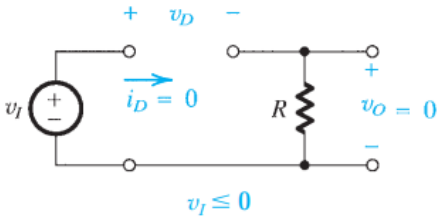


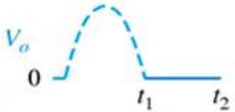




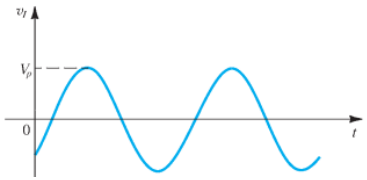


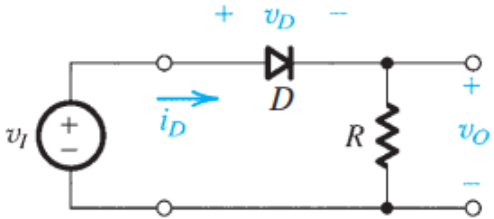


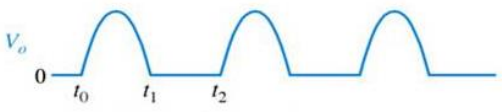




Half-wave Rectifier

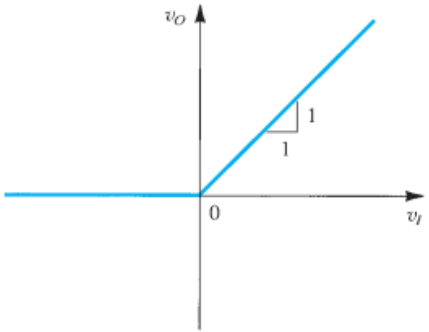




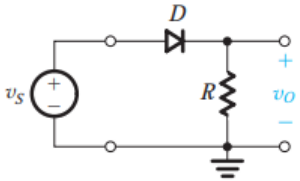


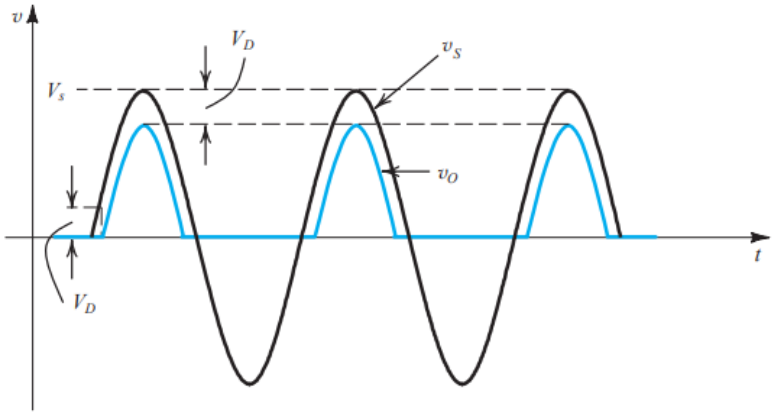
$$v_0 = \begin{cases} v_i, v_i > 0 \\ 0, v_i < 0 \end{cases}$$

Transfer characteristic



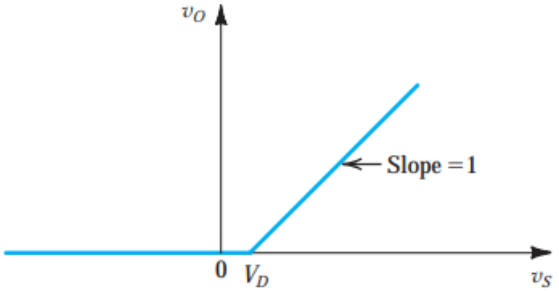
Half-wave Rectifier



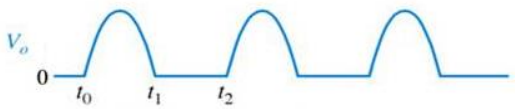


$V_{out} = (V_{in} - 0.7)\ V$

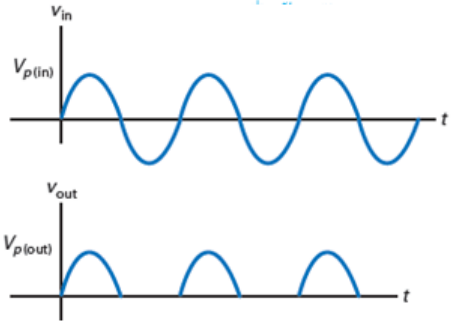
Transfer characteristic



Half-wave Rectifier

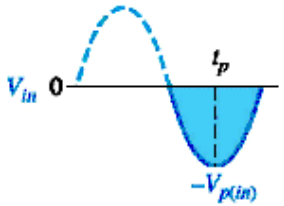


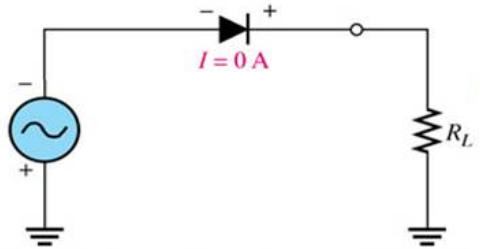
- The average V_{DC} or V_{AVG} = V_p/π



The output frequency is the same as the input frequency.

$$f_{out} = f_{in}$$

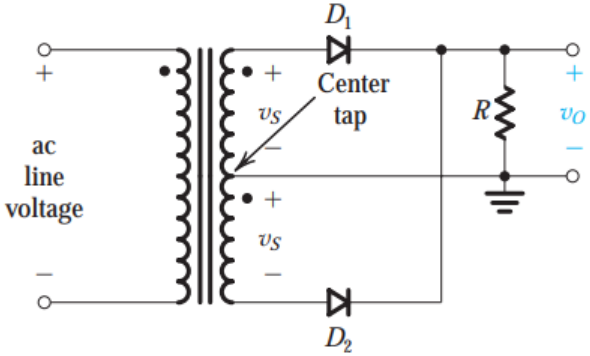


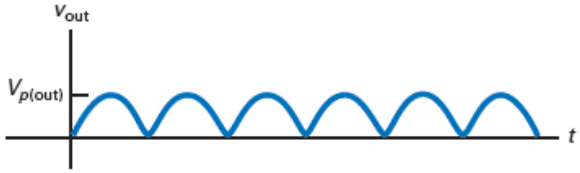


PIV = V_{peak}

Full-wave Rectifier

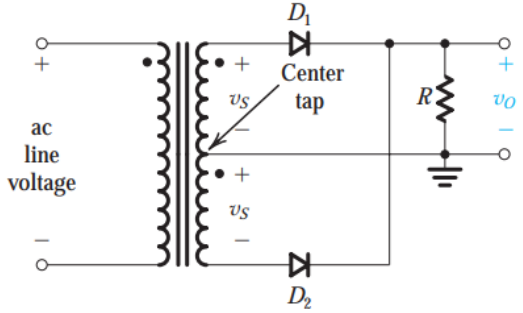
- This method of rectification employs two diodes connected to a center-tapped transformer.

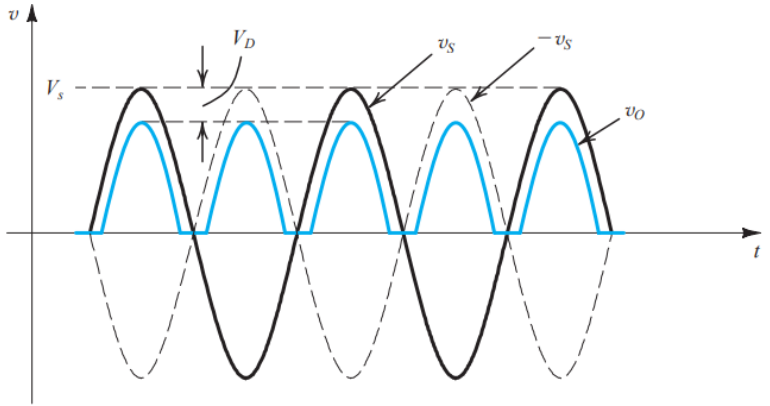




- Full-wave signal has twice as many positive cycles as the half-wave signal.

Full-wave Rectifier

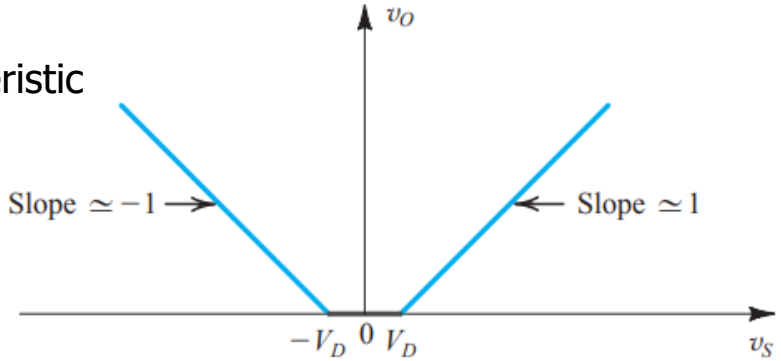




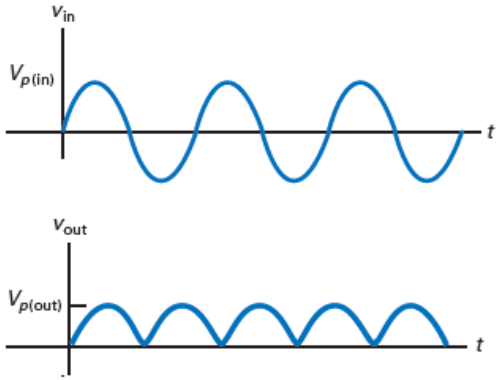
$V_{out} = (V_{in} - 0.7)\ V$

- The dc or average value V_{DC} or $V_{AVG} = 2V_p/\pi$

Transfer characteristic

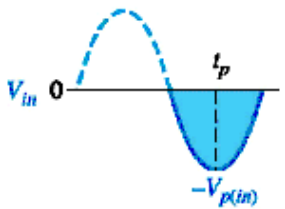


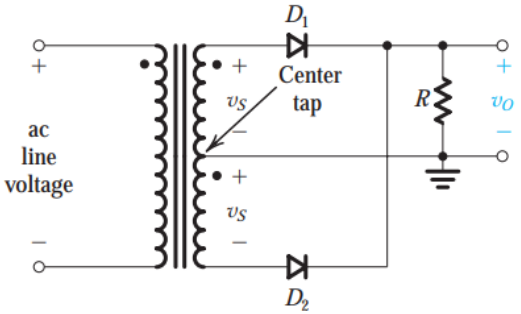
Full-wave Rectifier



- A full-wave output has twice as many cycles as the sine-wave input.
- Frequency of the full-wave signal is double the input frequency

$$f_{out} = 2f_{in}$$

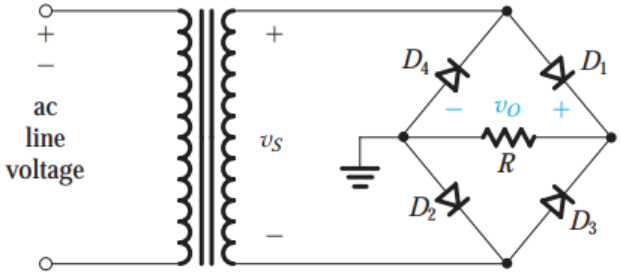


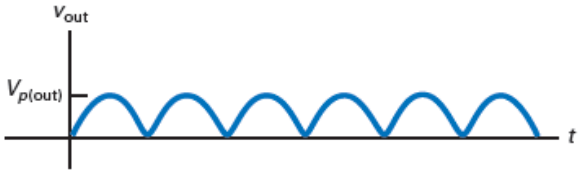


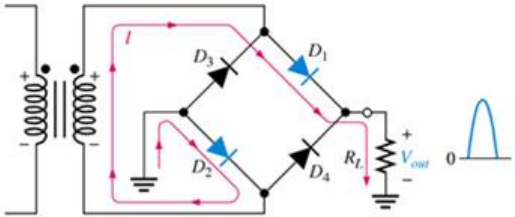
PIV = $2V_{peak}$

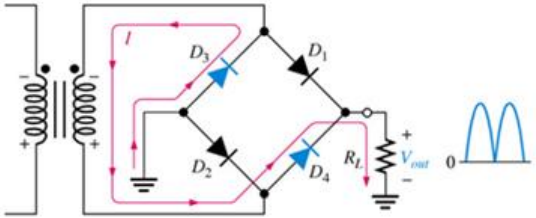
Bridge Rectifier

- Similar to full-wave rectifier as it produces a full-wave output voltage
- The entire secondary voltage can be used

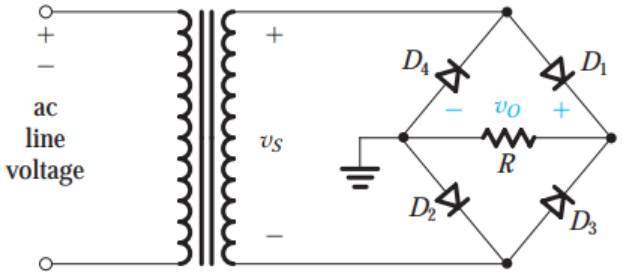




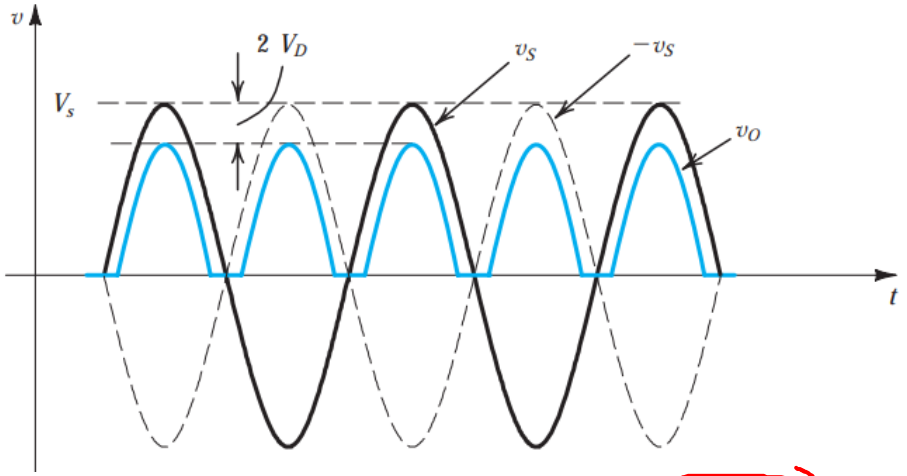




Bridge Rectifier

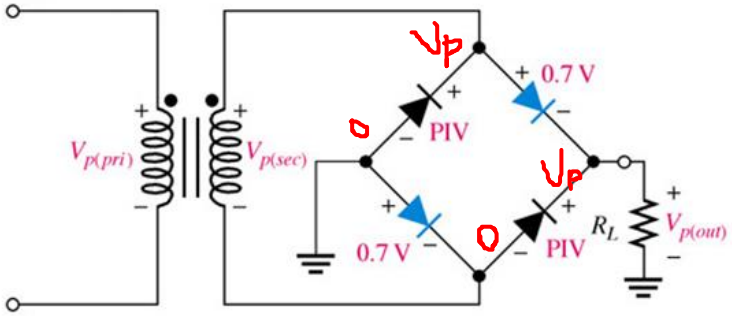


$V_{out} = (V_{in} - 1.4)\ V$



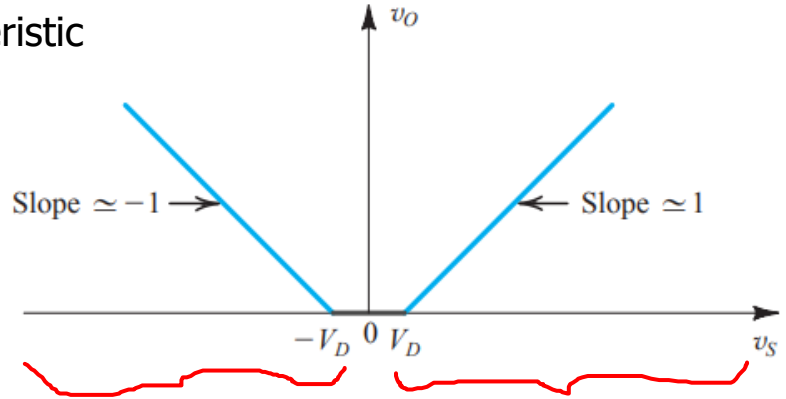
The dc or average value V_{DC} or $V_{AVG} = 2V_p/\pi$

Bridge Rectifier



PIV = V_{peak}

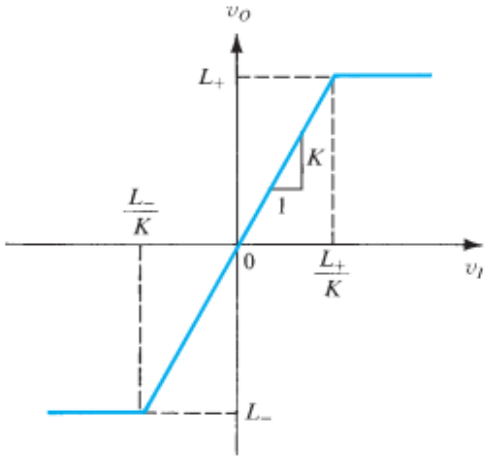
Transfer characteristic

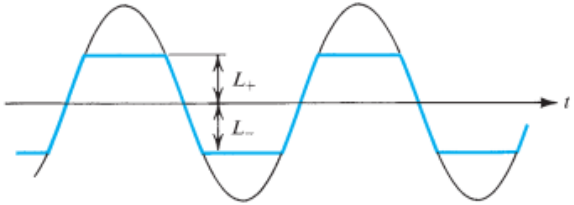


Clippers

Clippers

- “clip” away a portion of an input signal without distorting the remaining part of the applied waveform

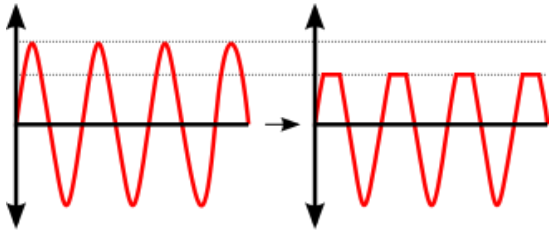


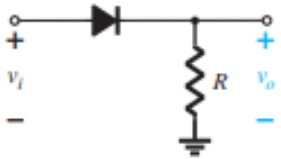


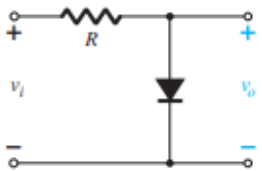
Clippers

- Depending on the orientation of the diode, the positive or negative region of the applied signal is “clipped” off

- Two categories:
  - Series clipper
  - Parallel clipper

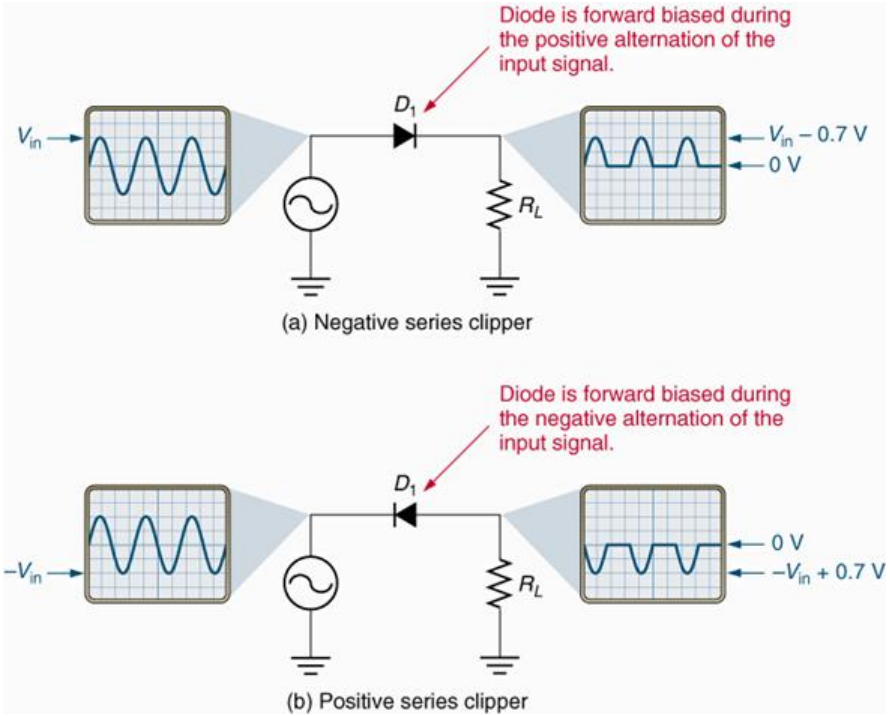




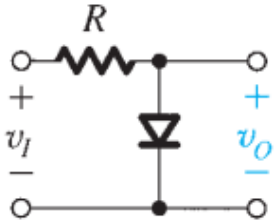


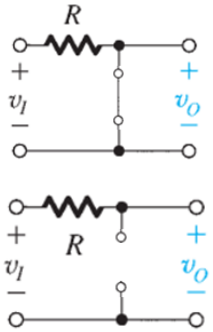
Clippers

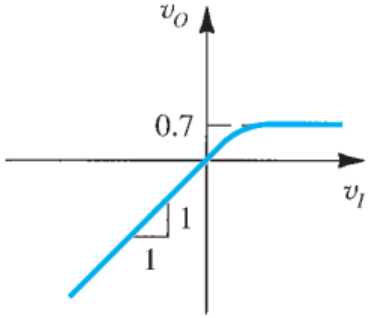
- The half-wave rectifier is an example of the simplest form of diode clipper

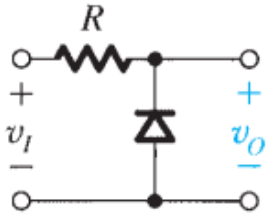


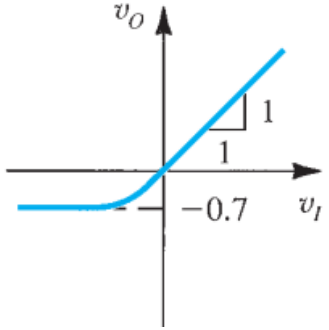
Clippers



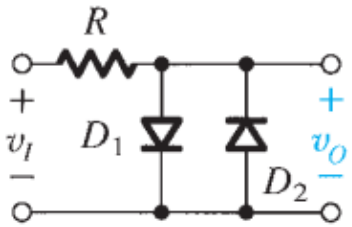


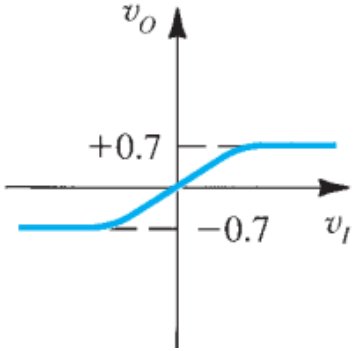


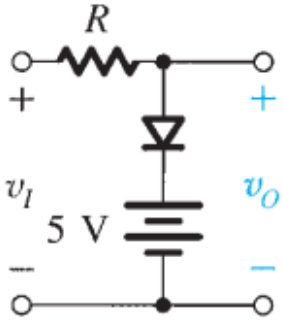


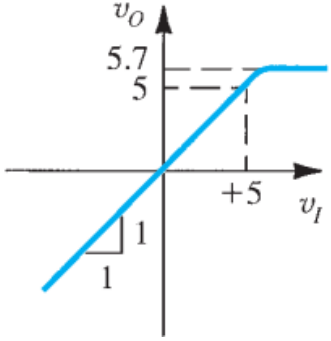


Clippers



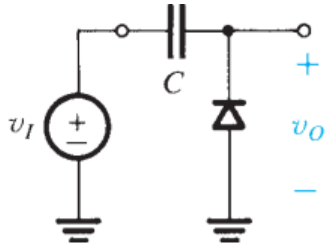




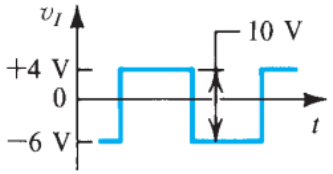


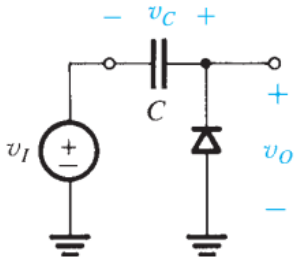
Clampers

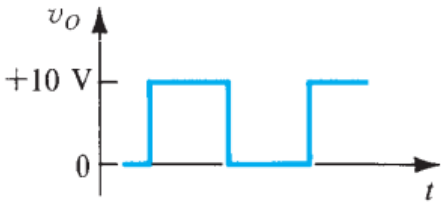
- shifts a waveform to a different dc level without changing the shape of the applied signal.
- adds a dc level to an ac voltage - known as dc restorers
- capacitor is connected directly between input and output signals

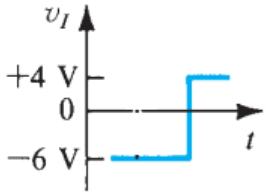


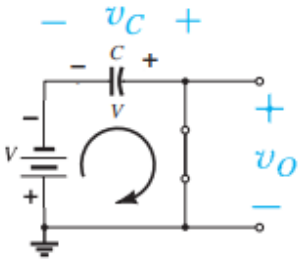
Clampers





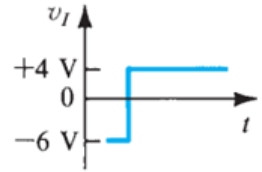


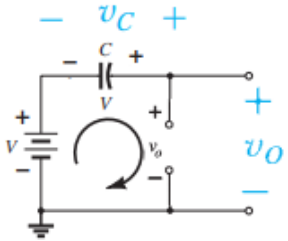




$v_C = 6\text{V}$

$v_O = 0.7\text{V}$

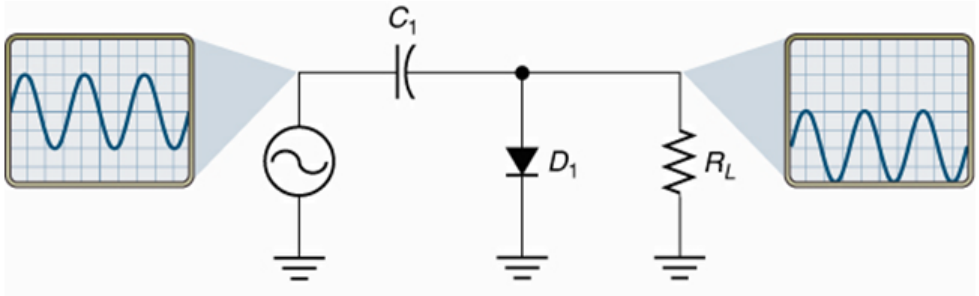


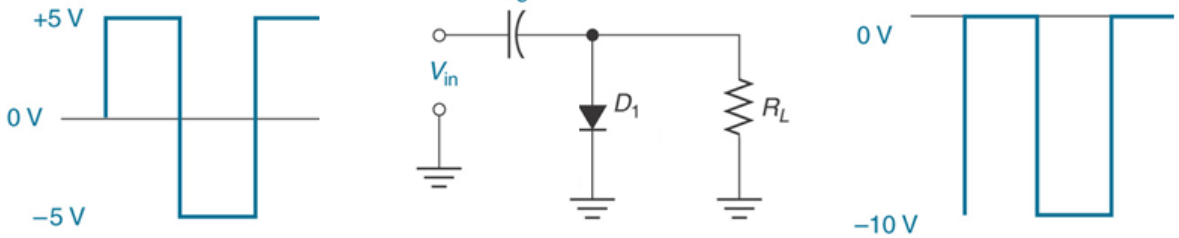


$v_O = v_I + v_C$

$v_O = 4 + 6 = 10\text{V}$

Clampers

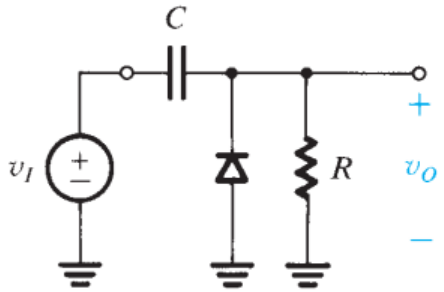


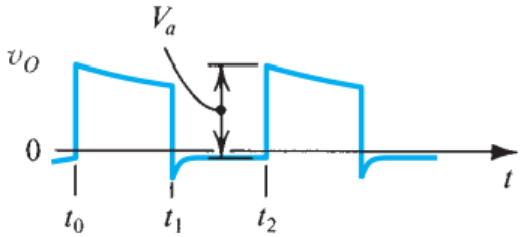


Clampers

Effect of load resistance

- causes the capacitor to discharge and the output voltage to fall when diode is not conducting





- Large value of time constant RC is selected