كلية مدينة العلم الجامعة

قسم هندسة الحاسوب

محاضرات المرحلة الاولى لمادة الهندسة الالكترونية

اعداد

د.سعيد سلمان كمون

المحاضرة الخامسة

THE CLIPPER

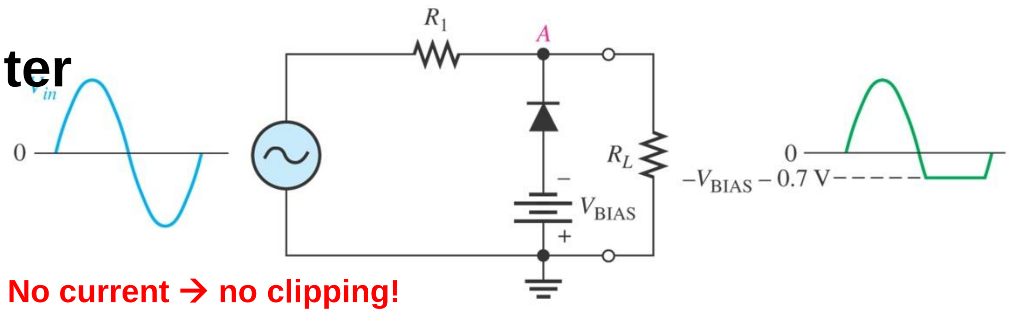
Electronic Devices and Circuit Theory

Eleventh Edition

Robert L. Boylestad and Louis Nashelsky

Diode clipper – Changing the offset

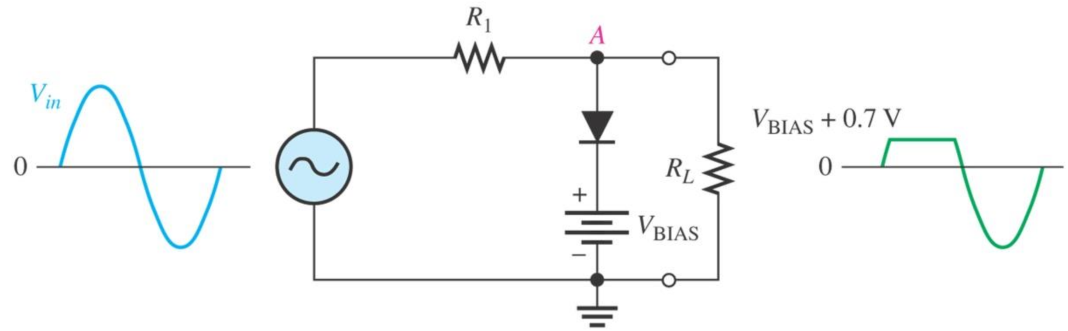
Negative limiter



Remember:

When positive voltage → reverse biased → No current → no clipping!

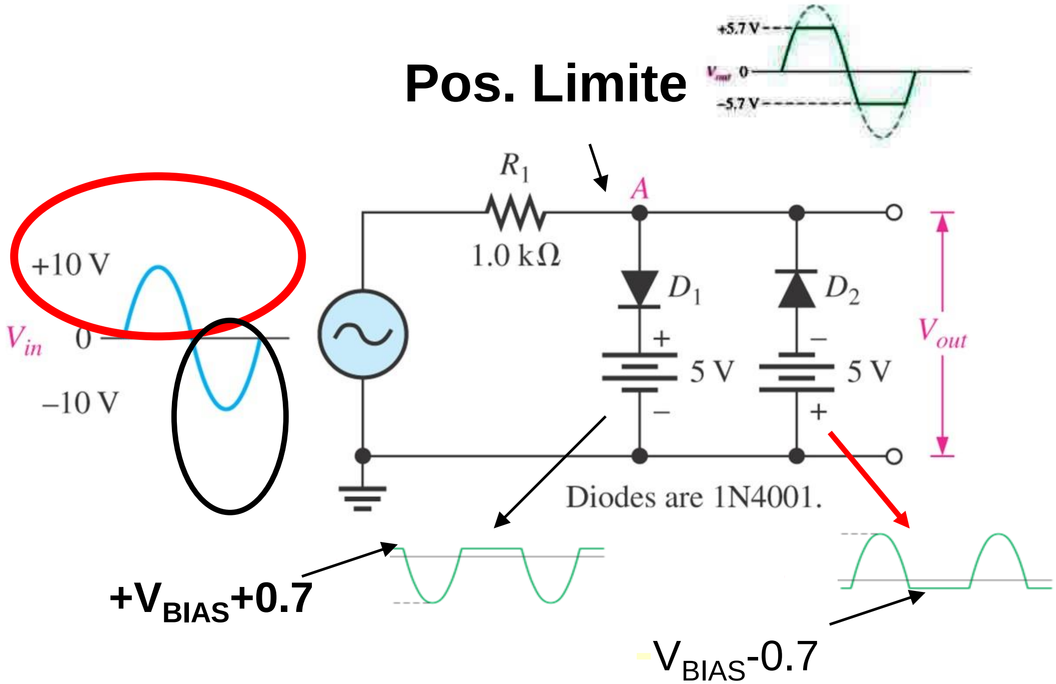
Positive limiter



What if we mix these together?

Diode clipper

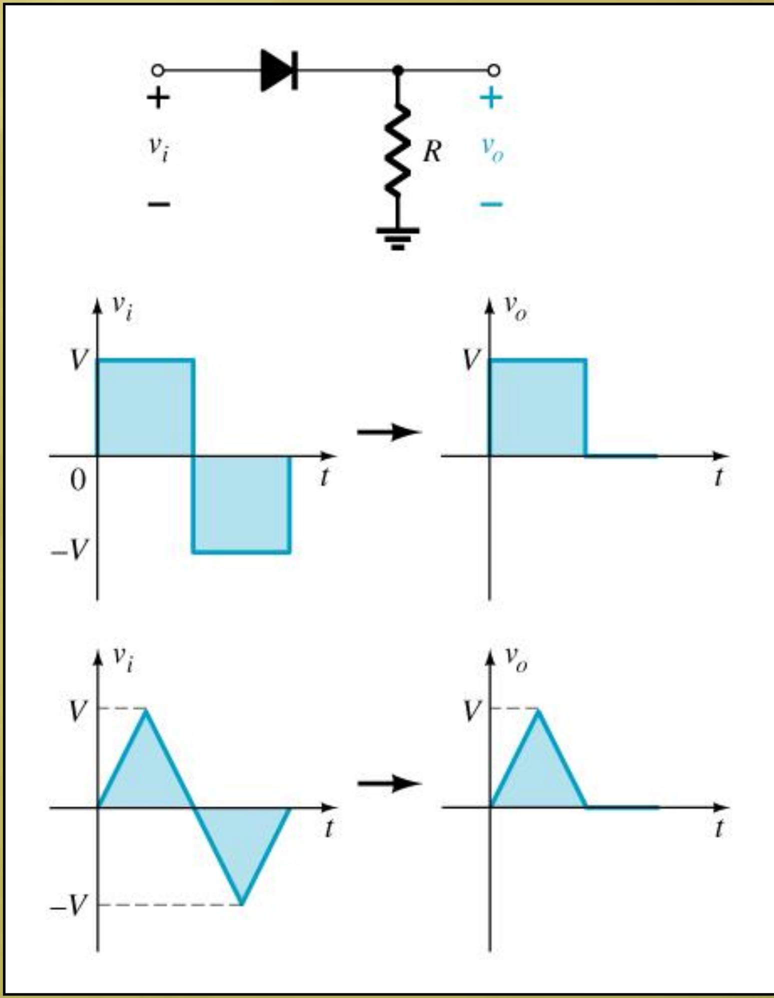
- When the input signal is positive D1 is forward biased; acting as positive clipper



Diode Clippers

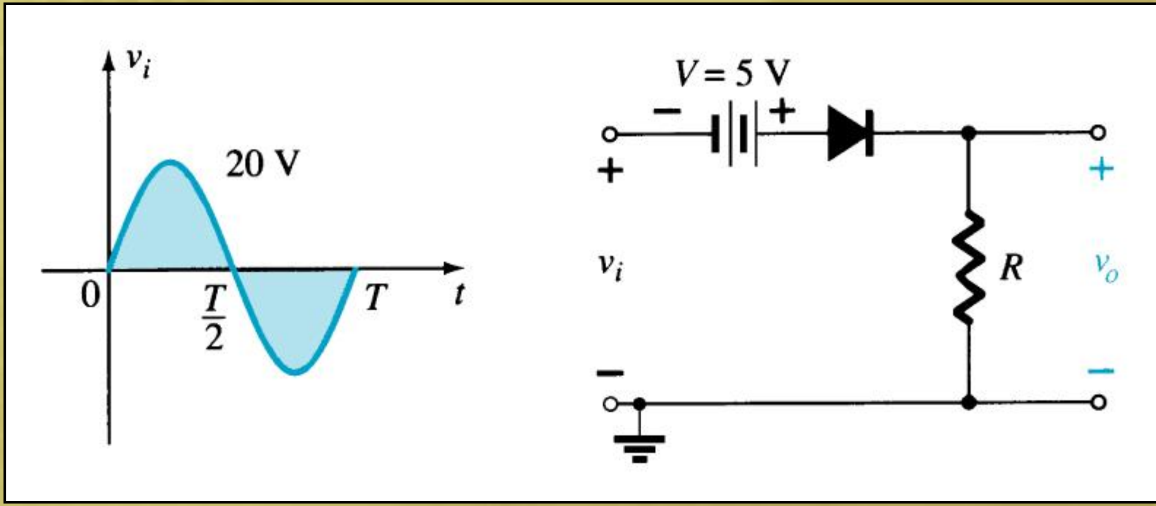
The diode in a series clipper "clips" any voltage that does not forward bias it:

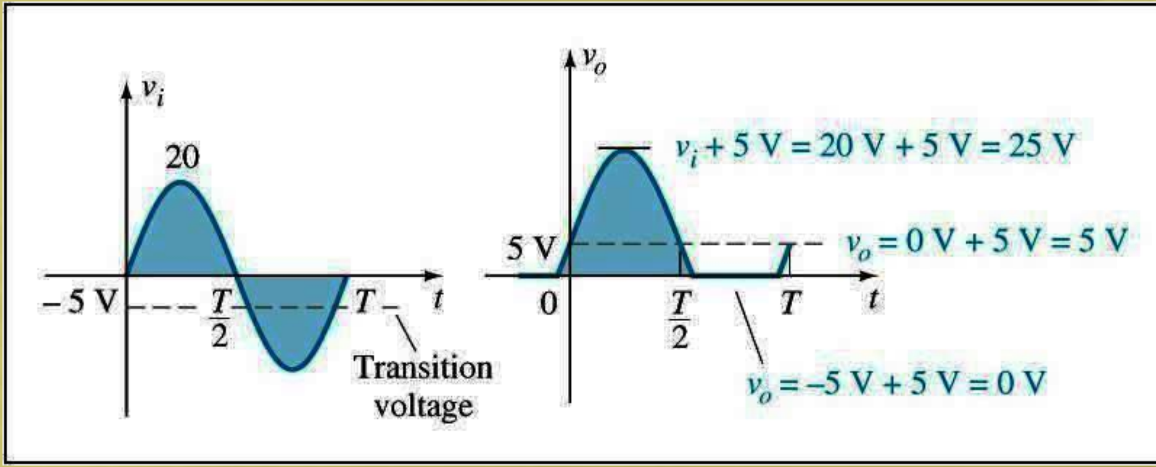
- **A reverse-biasing polarity**
- **A forward-biasing polarity less than 0.7 V (for a silicon diode)**



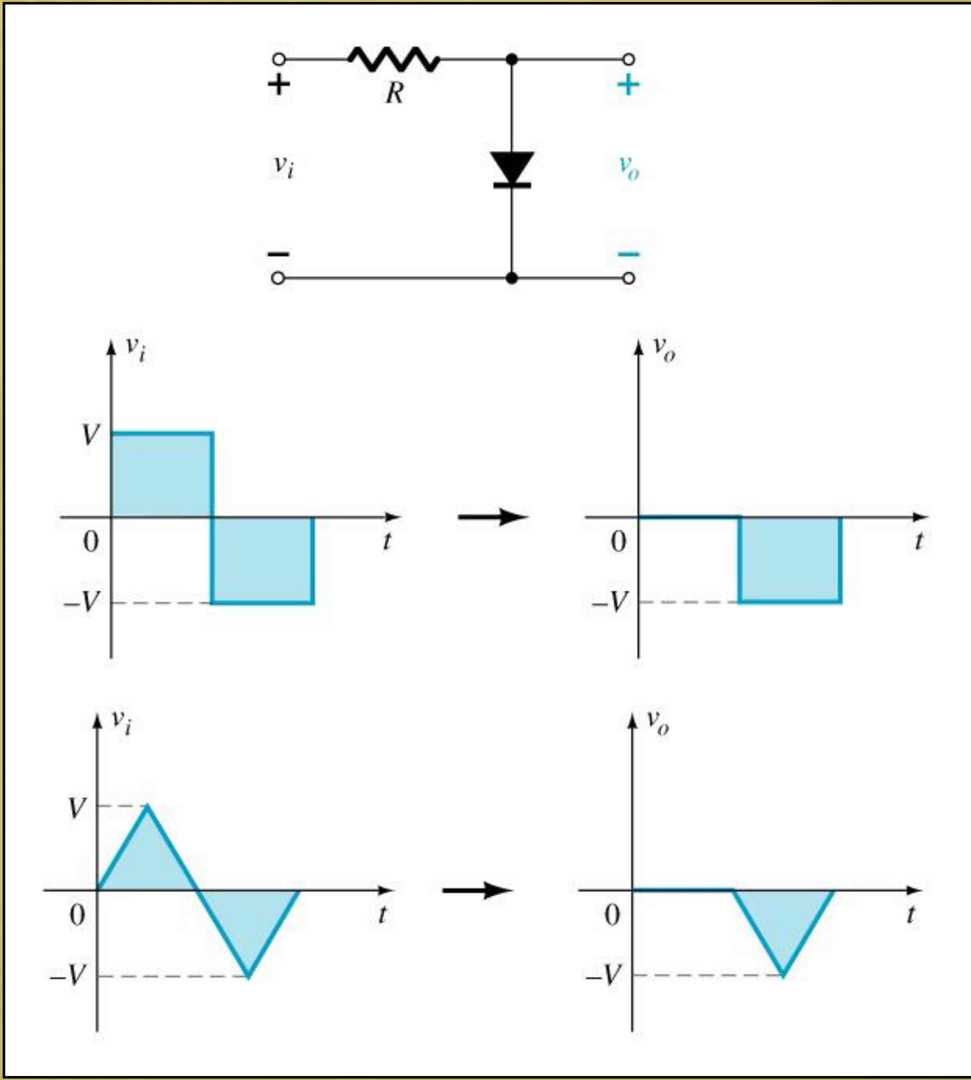
Biased Clippers

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





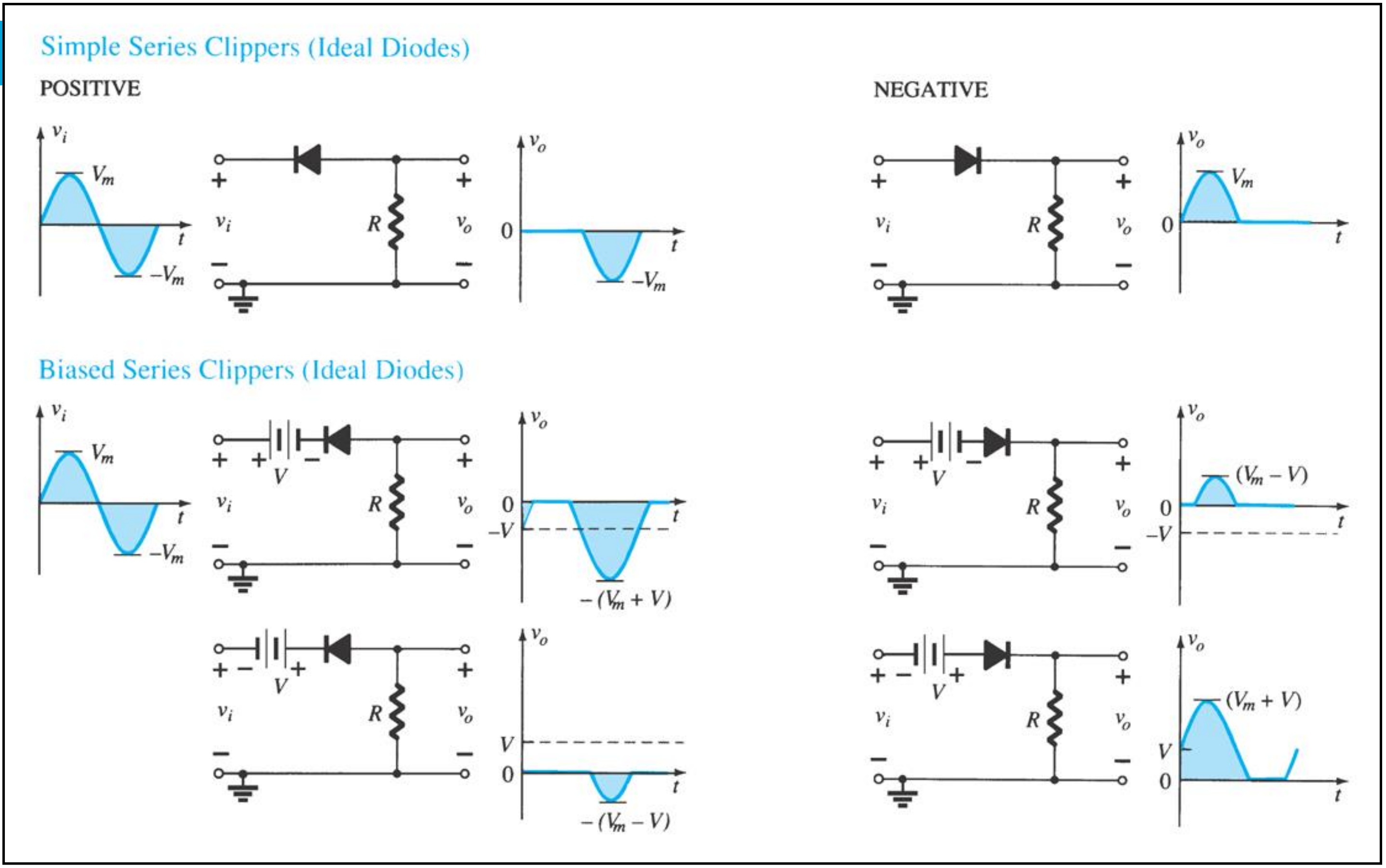
Parallel Clippers



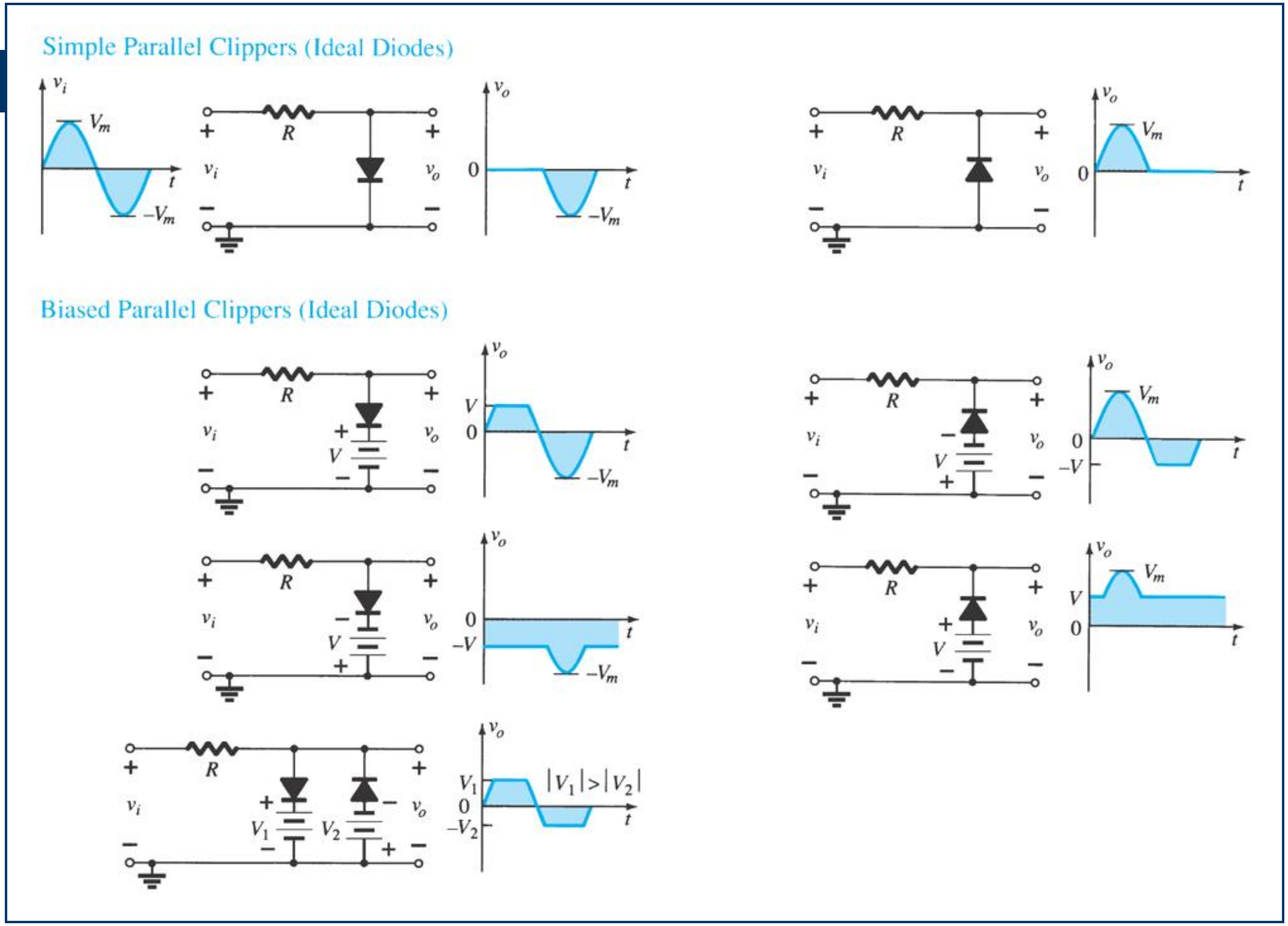
The diode in a parallel clipper circuit "clips" any voltage that forward biases it.

DC biasing can be added in series with the diode to change the clipping level.

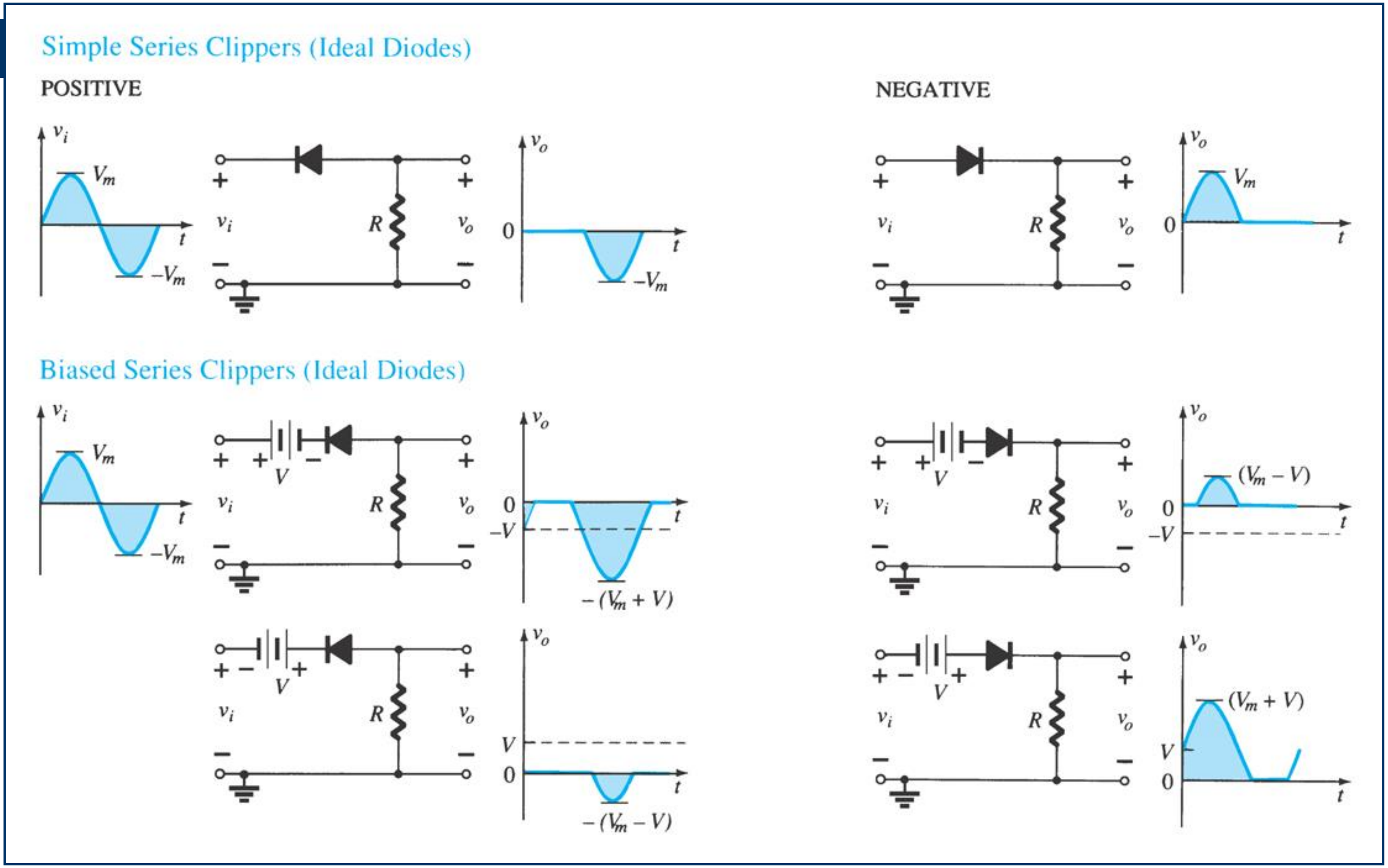
Summary of Clipper Circuits



Summary of Clipper Circuits

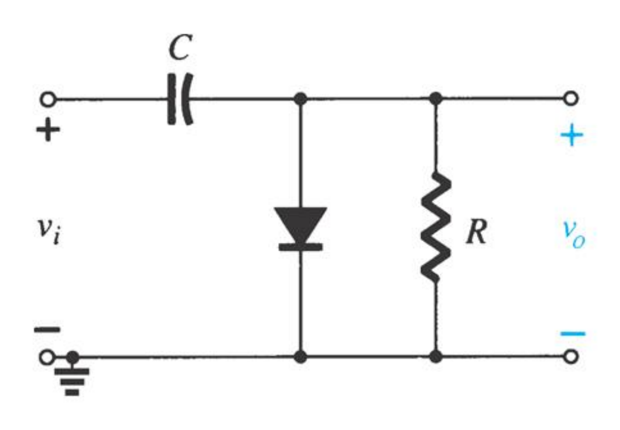


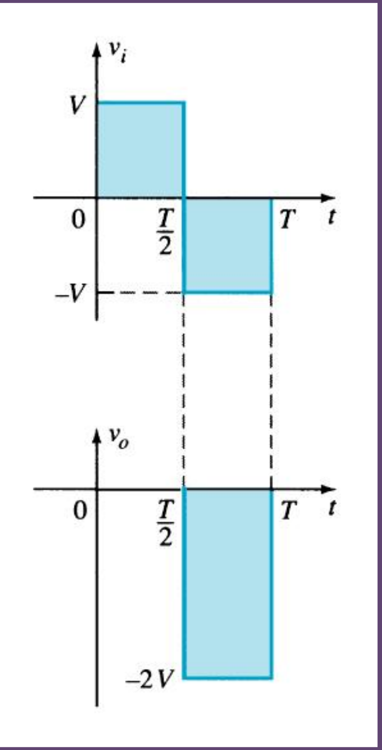
Summary of Clipper Circuits



Clampers

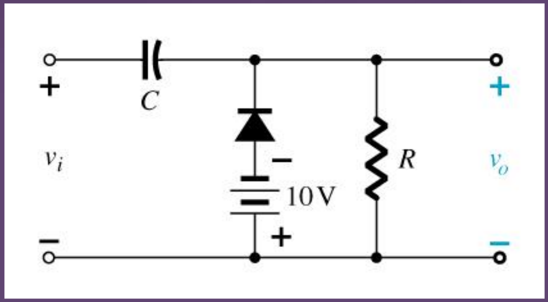
A diode and capacitor can be combined to "clamp" an AC signal to a specific DC level.



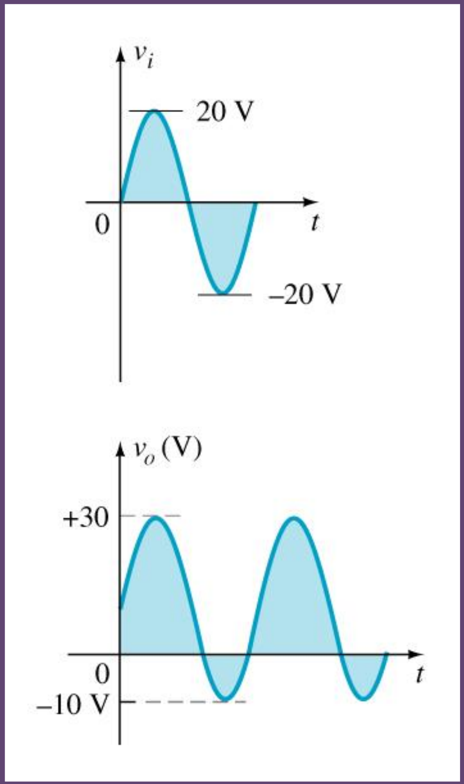


Biased Clamper Circuits

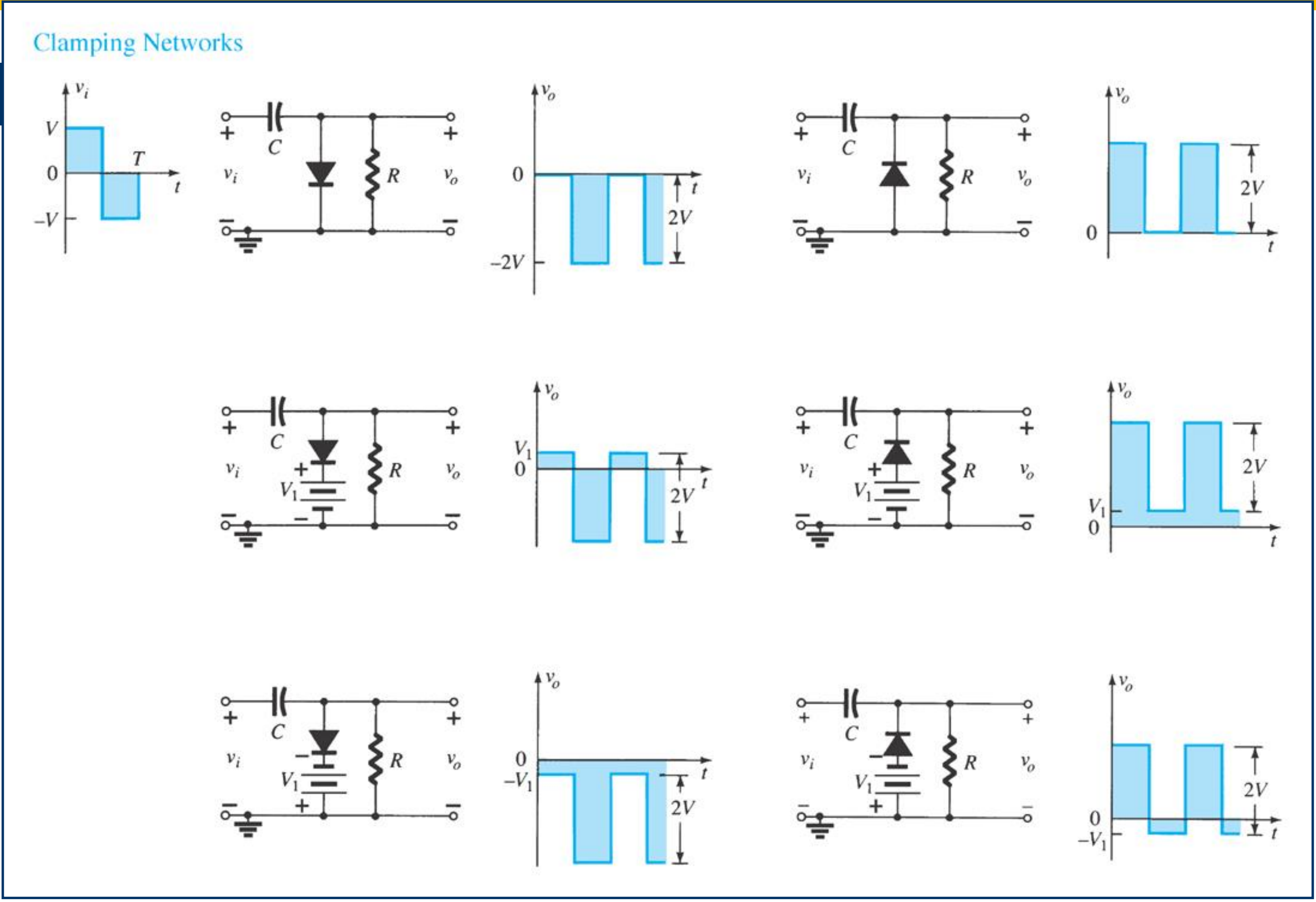
The input signal can be any type of waveform such as a sine, square, or triangle wave.



The DC source lets you adjust the DC camping level.

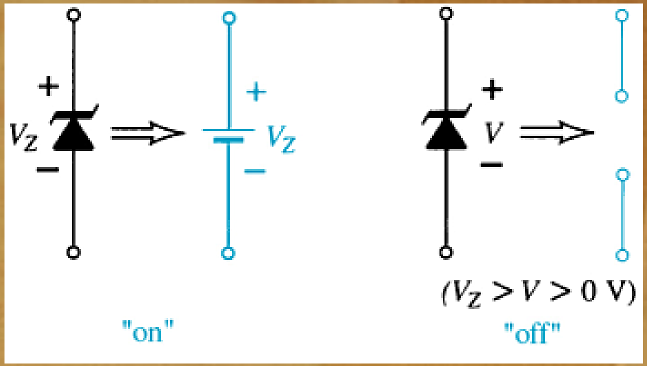


Summary of Clamper Circuits



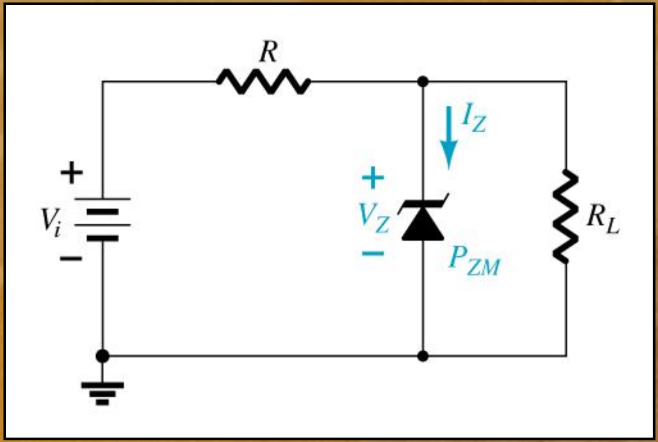
Zener Diodes

The Zener is a diode that is operated in reverse bias at the Zener Voltage (V_z).



When $V_i \geq V_Z$

- **The Zener is on**
- **Voltage across the Zener is V_Z**
- **Zener current: $I_Z = I_R - I_{RL}$**
- **The Zener Power: $P_Z = V_Z I_Z$**



When $V_i < V_Z$

- **The Zener is off**
- **The Zener acts as an open circuit**

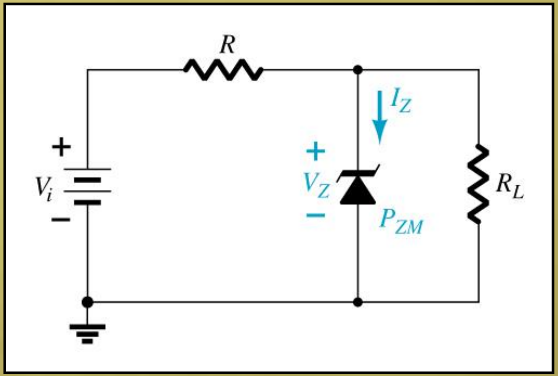
Zener Resistor Values

If *R* is too large, the Zener diode cannot conduct because $I_Z < I_{ZK}$. The minimum current is given by:

$$I_{Lmin} = I_R - I_{ZK}$$

The *maximum* value of resistance is:

$$R_{Lmax} = \frac{V_Z}{I_{Lmin}}$$



If *R* is too small, $I_Z > I_{ZM}$. The maximum allowable current for the circuit is given by:

$$I_{L\max} = \frac{V_L}{R_L} = \frac{V_Z}{R_{L\min}}$$

The *minimum* value of resistance is:

$$R_{L\min} = \frac{RV_Z}{V_i - V_Z}$$

Voltage-Multiplier Circuits

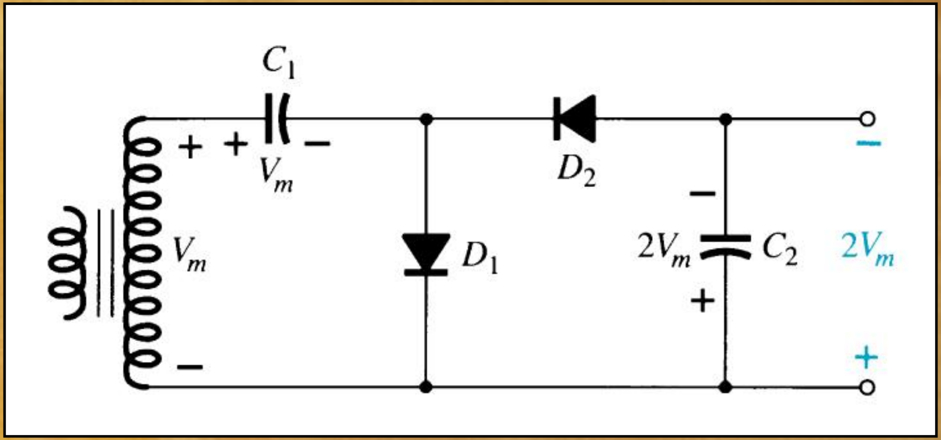
Voltage multiplier circuits use a combination of diodes and capacitors to step up the output voltage of rectifier circuits. Three common voltage multipliers are the:

Voltage Doubler

Voltage Tripler

Voltage Quadrupler

Voltage Doubler



This half-wave voltage doubler's output can be calculated using:

$$V_{out} = V_{C2} = 2V_m$$

where V_m = peak secondary voltage of the transformer

Voltage Doubler

Positive Half-Cycle

D_1 conducts

D_2 is switched off

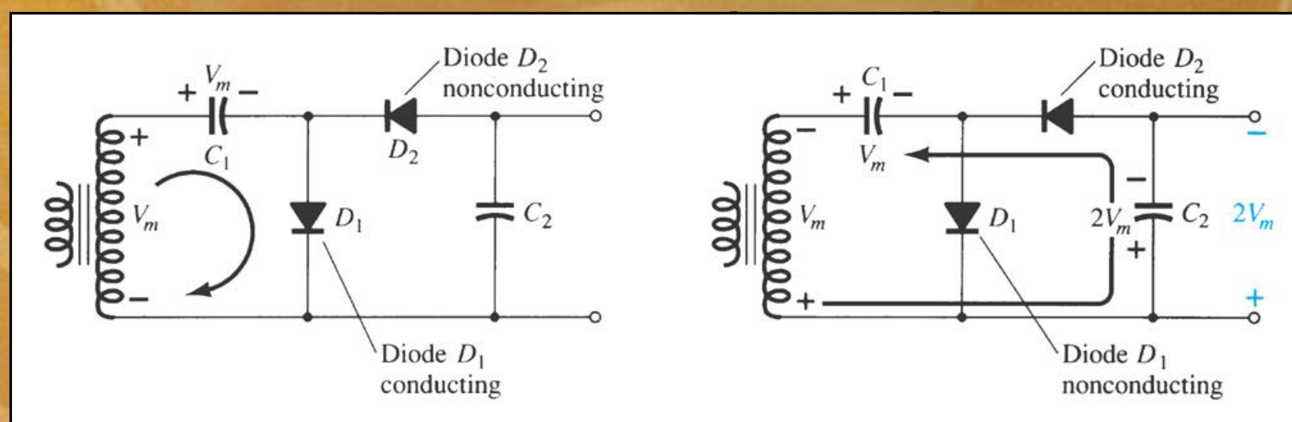
Capacitor C_1 charges to V_m

Negative Half-Cycle

D_1 is switched off

D_2 conducts

$V_{out} = V_{C2} = 2V_m$



Voltage Tripler and Quadrupler