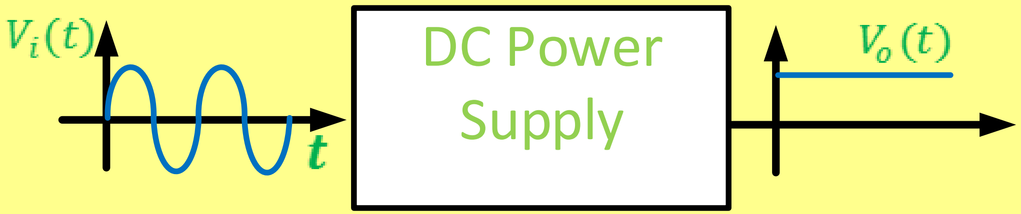
Dc Power Supply

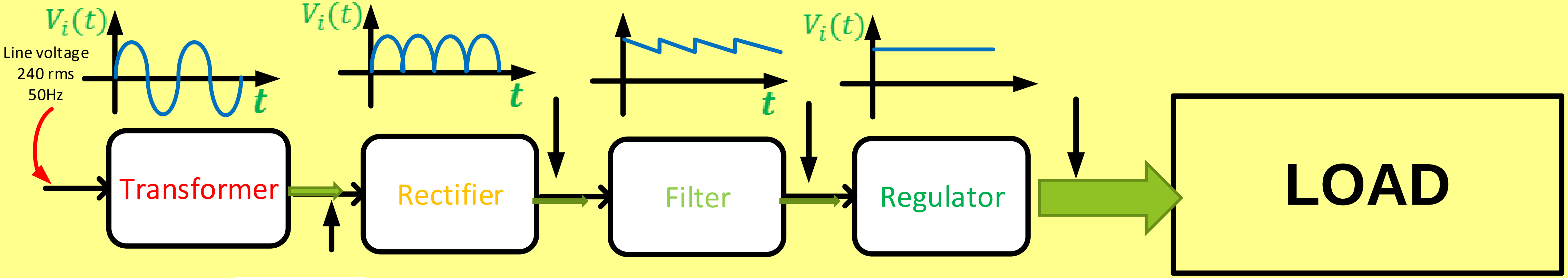
half wave rectifier

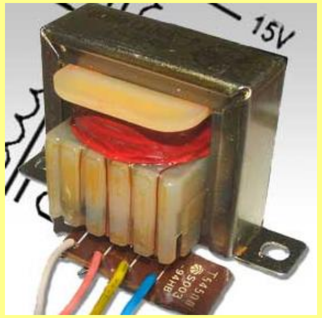
center tapped transformer

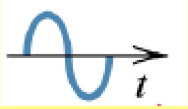
Dc Power Supply

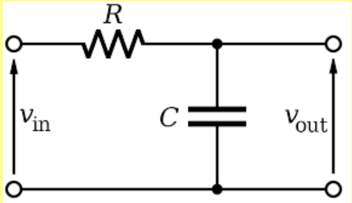


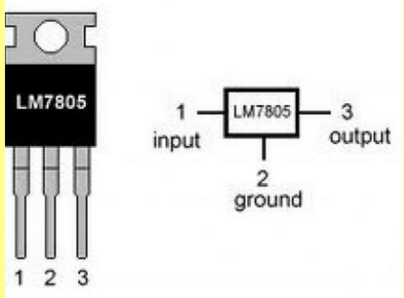
- All electronic circuits and systems require a stable source of dc voltage and current (or dc power) to operate correctly.

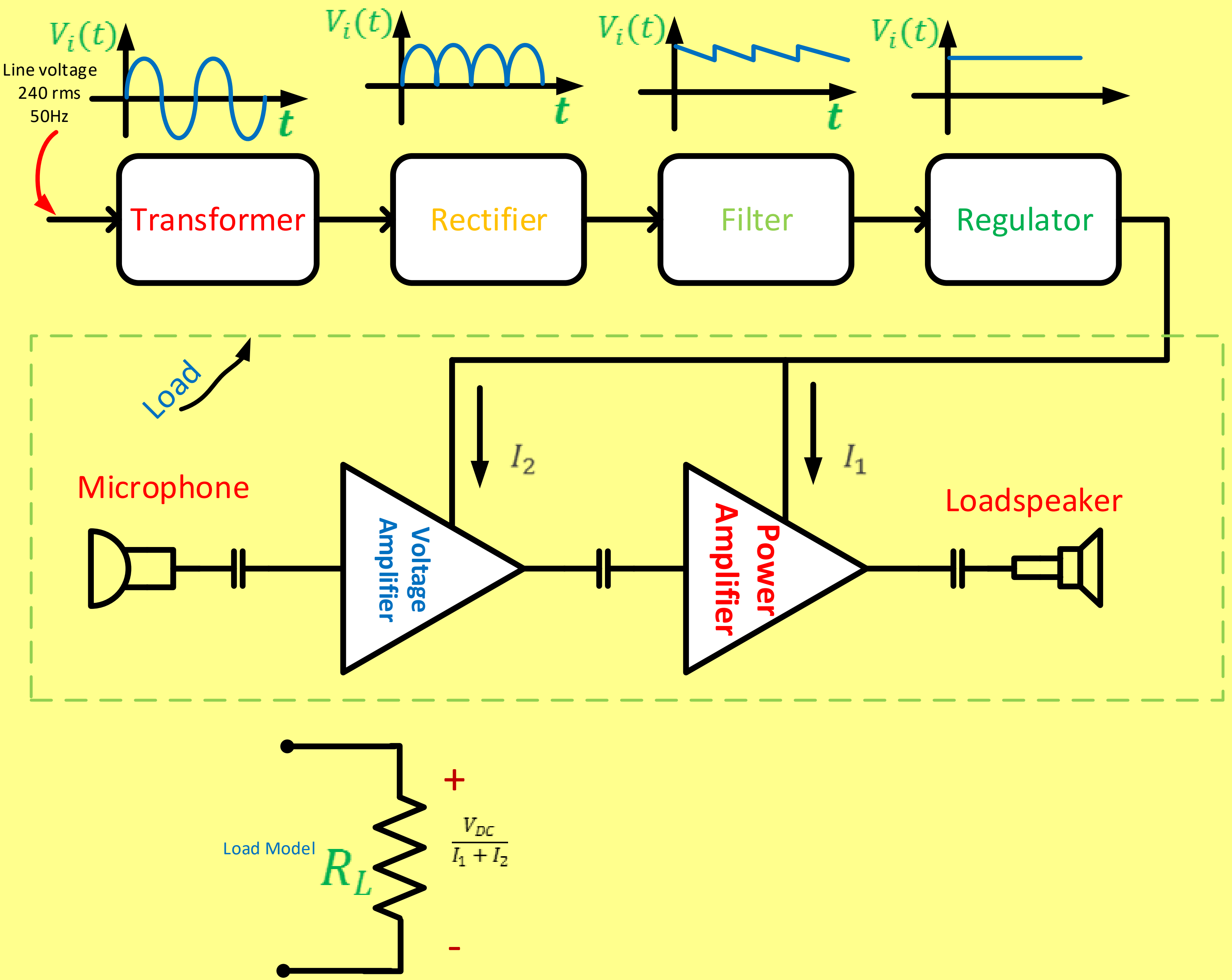






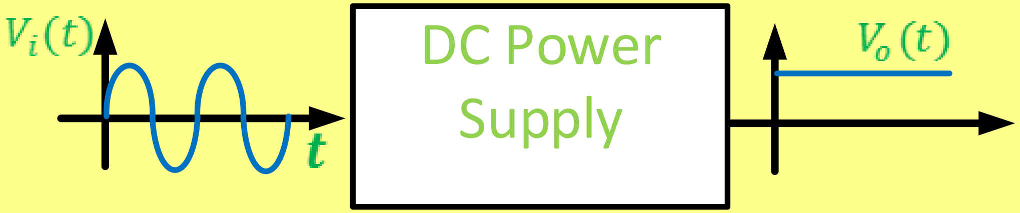






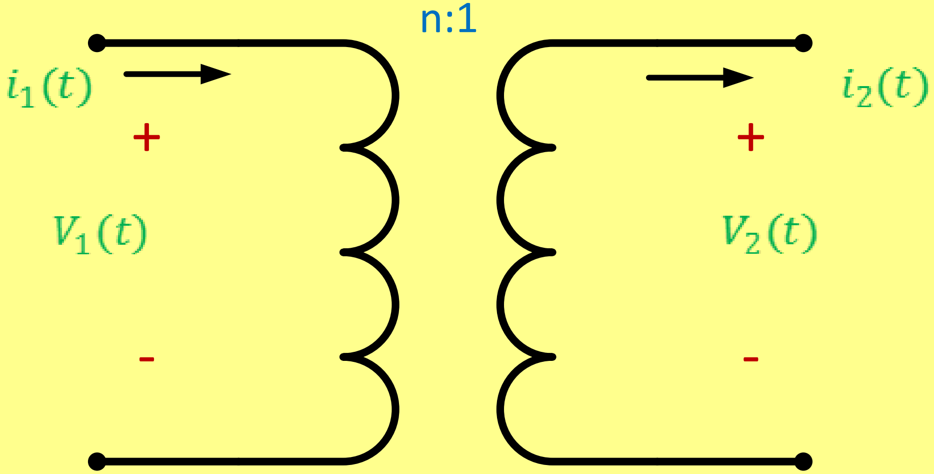
$V_i(t)$
Line voltage
240 rms
50Hz
t
Transformer
Rectifier
Filter
Regulator
Load
I_2
I_1
Microphone
Voltage Amplifier
Power Amplifier
Loadspeaker
+
Load Model
R_L
$\frac{V_{DC}}{I_1 + I_2}$
-

Dc Power Supply



- The basic power supply consists of a transformer, rectifier, filter, and a regulator.
- Transformer: Used to increase or decrease the amplitude of the line voltage
- $$\boldsymbol{V_2(t) = \frac{1}{n}\, V_1}$$

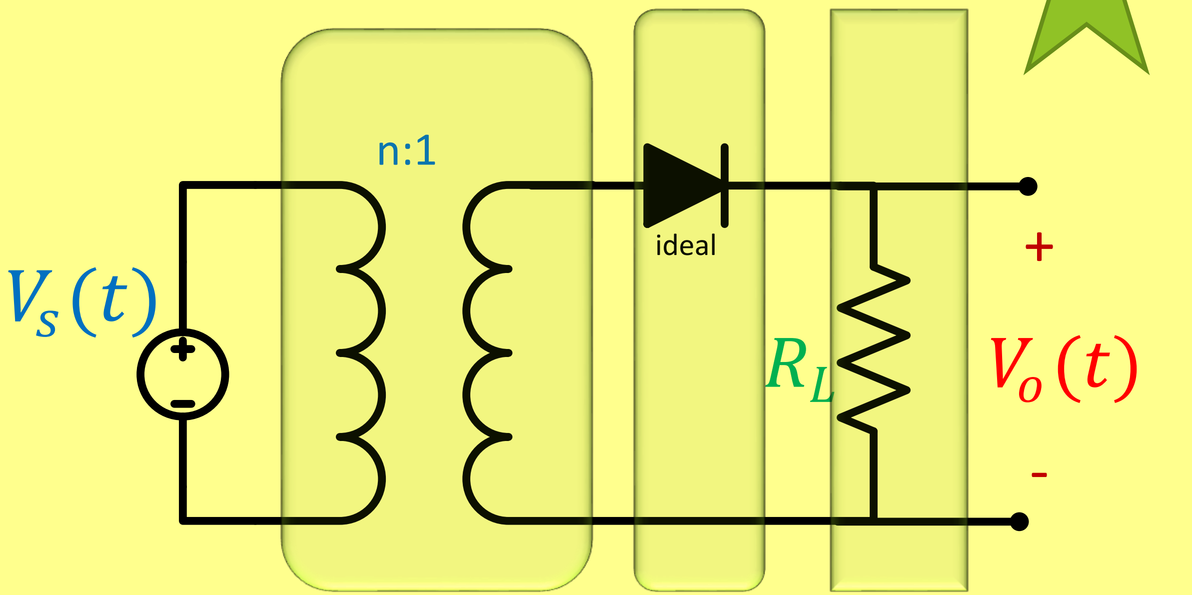
$$i_2(t) = n\, i_1(t)$$



Dc Power Supply

- **Rectifier**: used to convert the ac voltage (zero- average value) into either positive and negative pulsating dc.

- 1) Half- Wave Rectifier

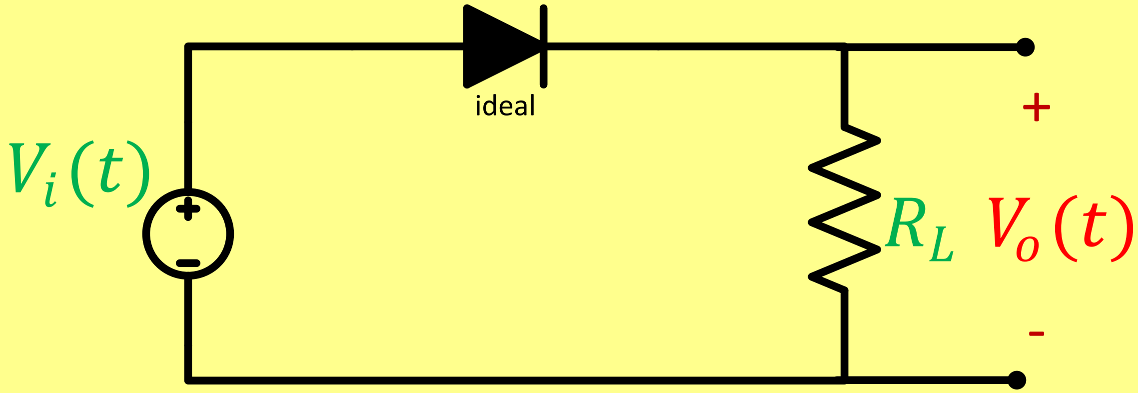


- $V_i(t) = \frac{V_s(t)}{n}$

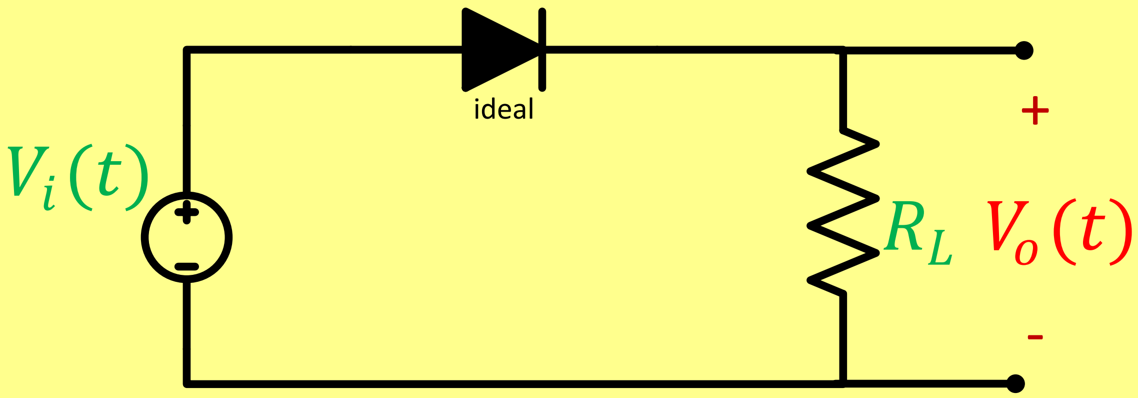
- **A)** when $V_i(t) > 0$, Diode is on (short circuit)

$$\therefore V_o(t) = V_i(t)$$

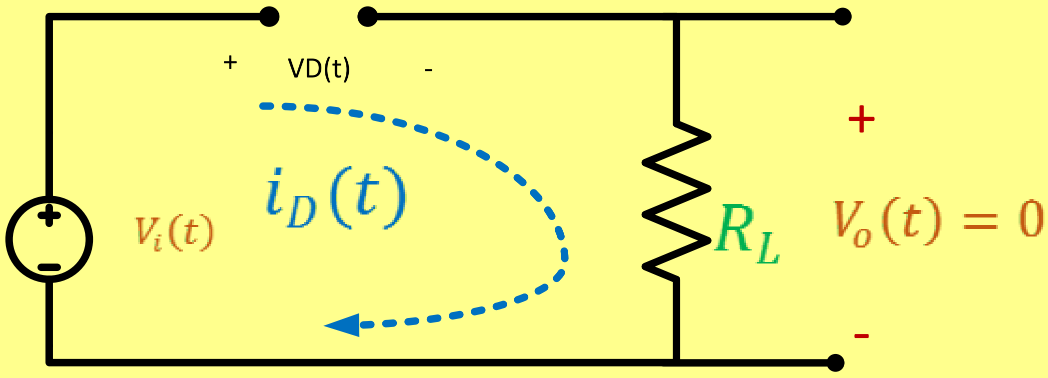
$$\therefore V_D(t) = 0$$

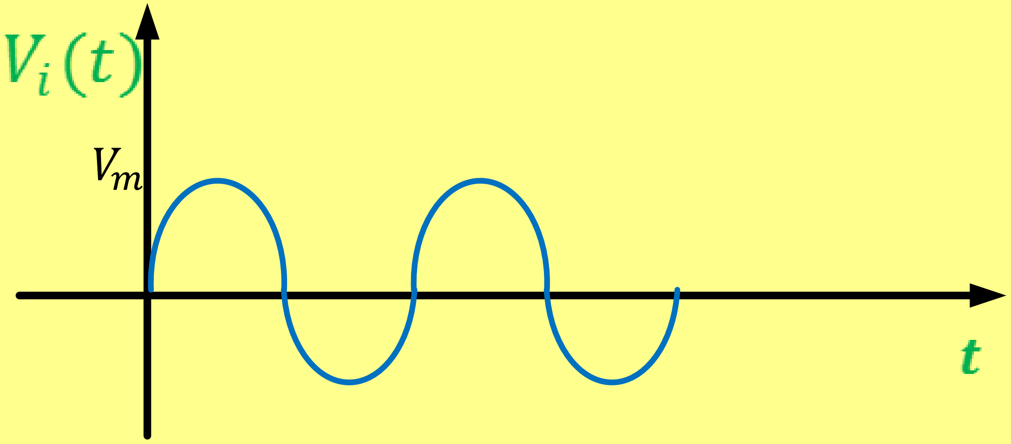


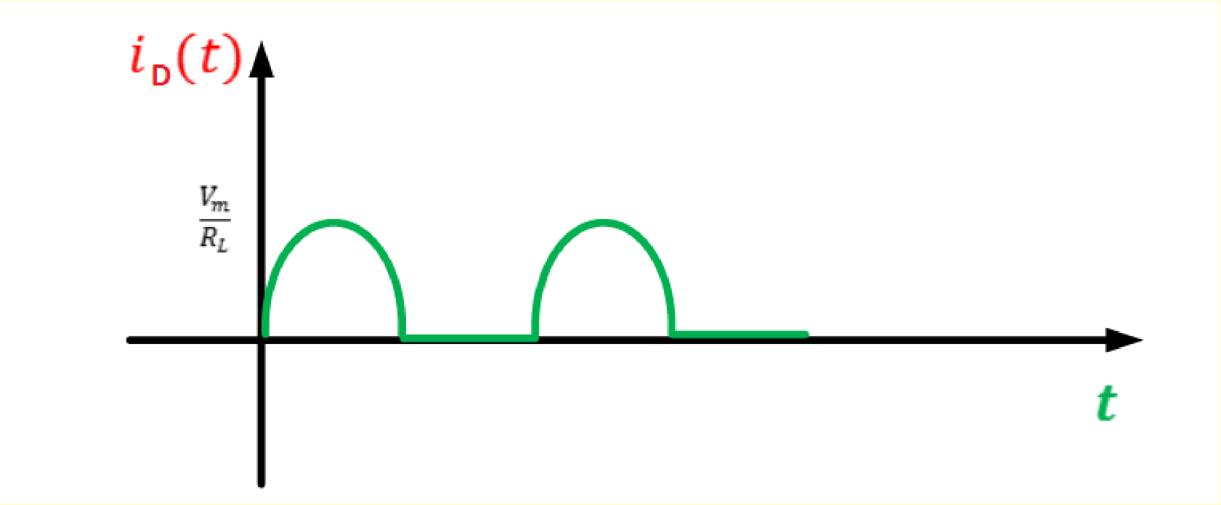
B) when $V_i(t) < 0$, Diode is off (open circuit)

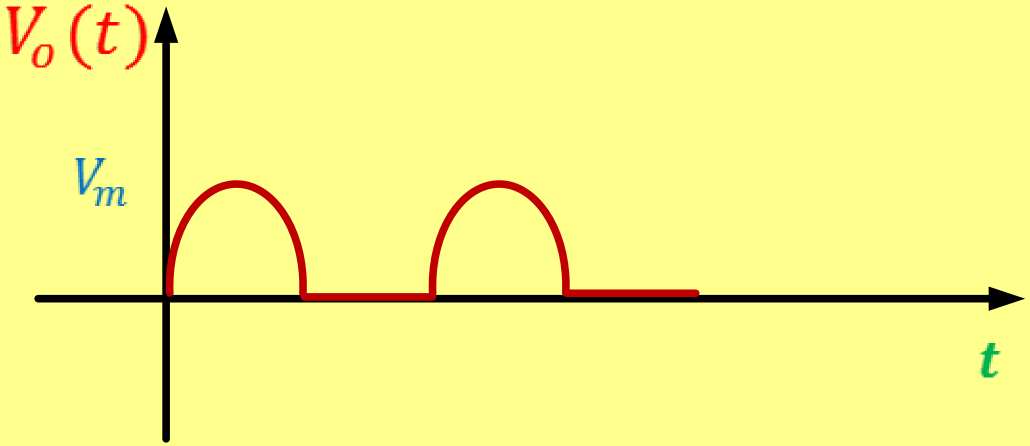


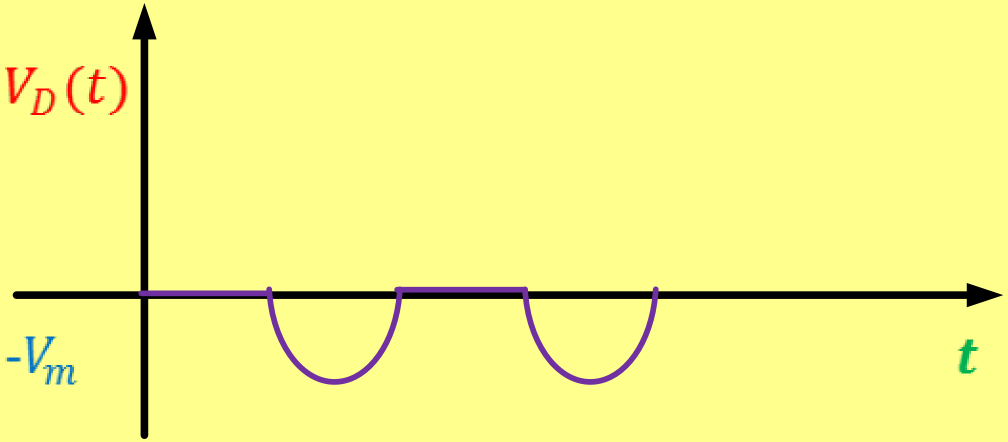
$$\therefore V_o(t) = 0$$
$$\therefore V_D(t) = V_i(t)$$




$V_i(t)$
V_m
t


$i_D(t)$
$\frac{V_m}{R_L}$
t

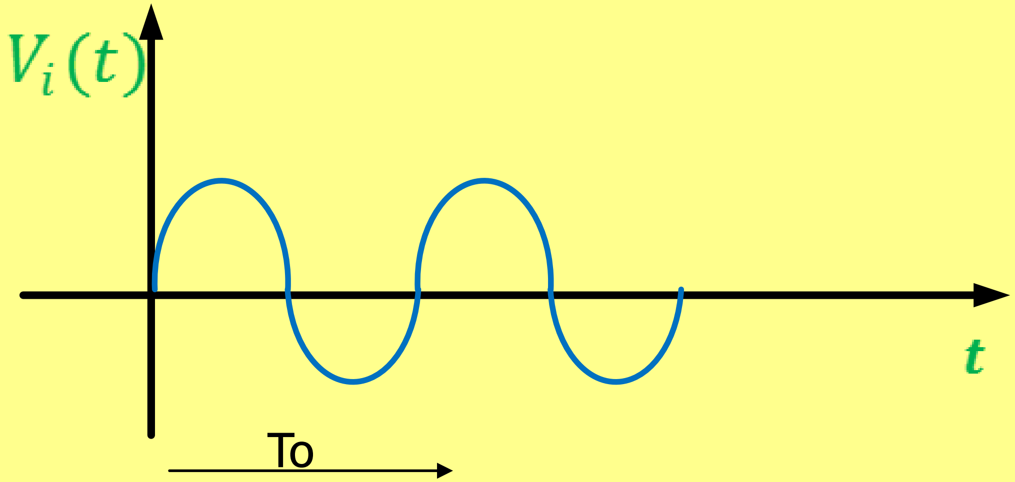

$V_o(t)$
V_m
t

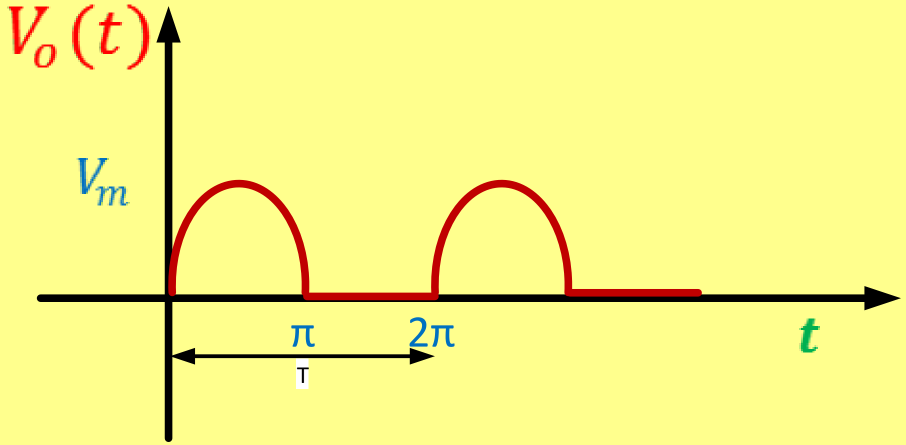

$V_D(t)$
$-V_m$
t

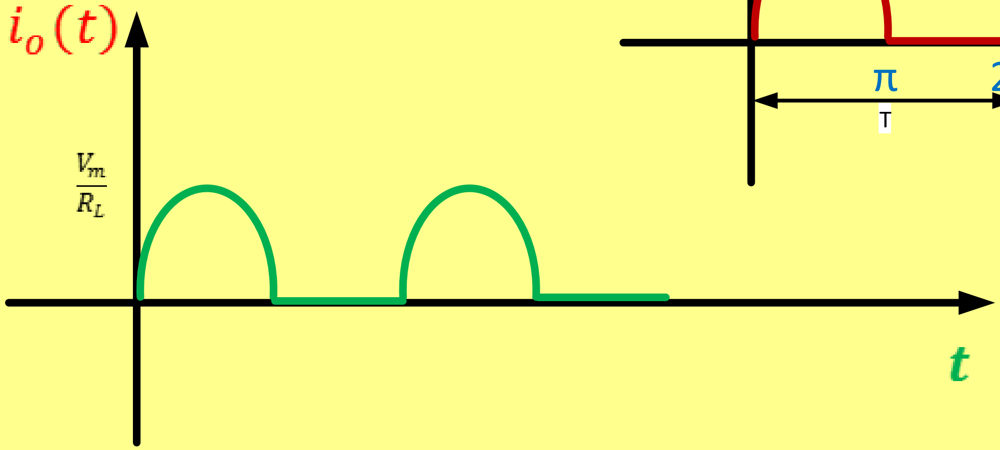
- $V_{o,av} = \frac{1}{T}\int_0^T V_o(t)dt$

$$= \frac{V_m}{2\pi}\int_0^{\pi} \sin\theta \; d\,\theta$$

- $V_{o,av} = \frac{V_m}{\pi}$
- $\mathrm{T} = T_o$
- $f = f_o$
- $i_{D(t),av} = \frac{V_m}{\pi R_L}$

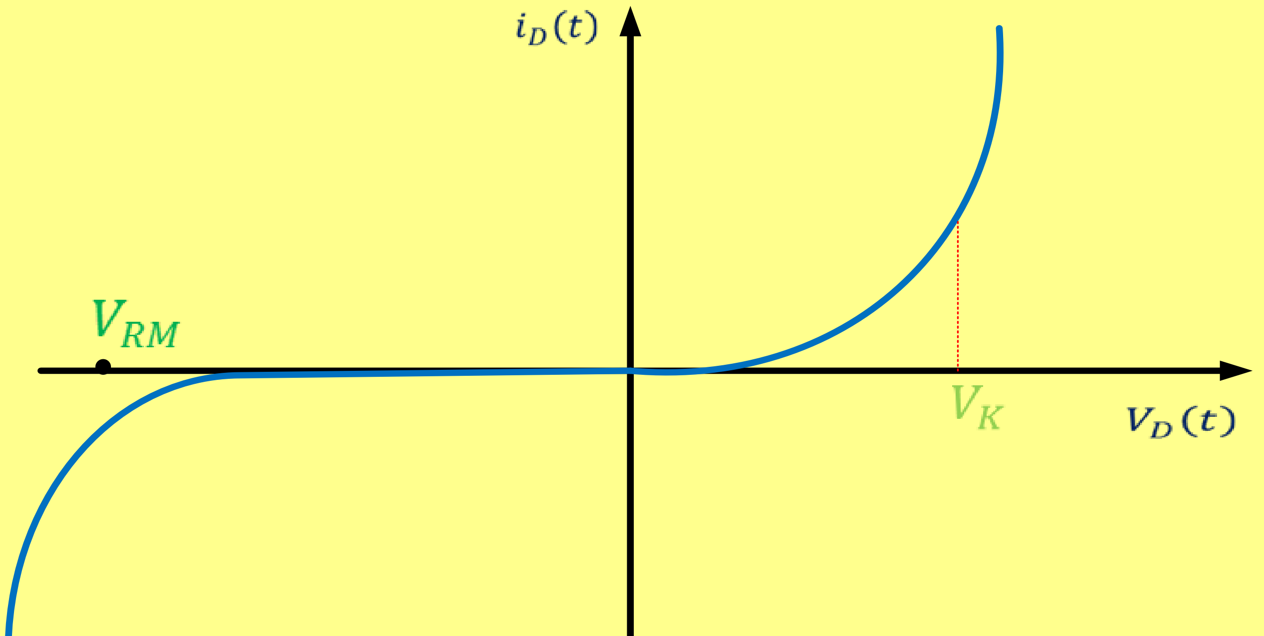






Important Electrical Ratings

- I_{FM} = Maximum Forward Current
- I_{FM} = Maximum average current that can safely be sustained by the diode when it is forward biased
- V_{RM} = Maximum Reverse Voltage
- V_{RM} = Maximum voltage that can be applied to the diode in the Reverse bias polarity before voltage break down occur
- PIV ≡ Peak Inverse Voltage
- PIV = V_{RM}



- ∴ For the have-wave rectifier

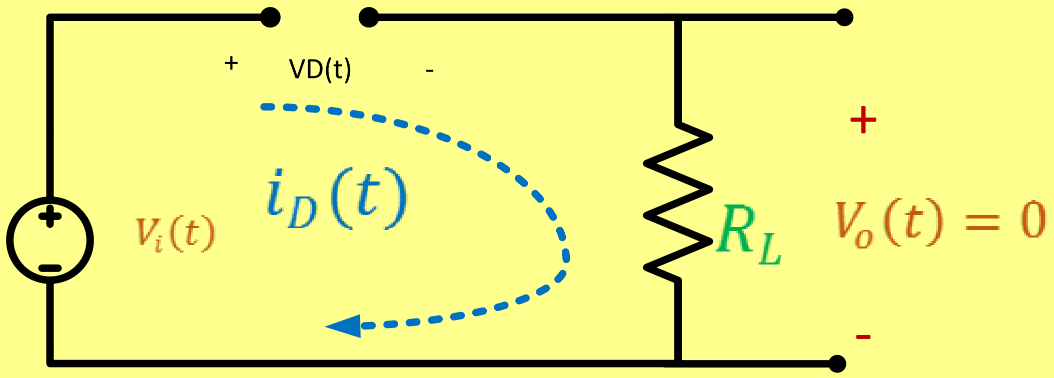
$$V_{o,av} = \frac{V_m}{\pi}$$

$$I_{FM} = \frac{V_m}{\pi R_L}$$

$\text{PIV} = -V_m$ Prove ????

To calculate PIV

When $V_i(t) < 0$, Diode is off



- $V_D(t) = V_i(t) < 0$

$$V_D(t)_{,max} = -V_m$$

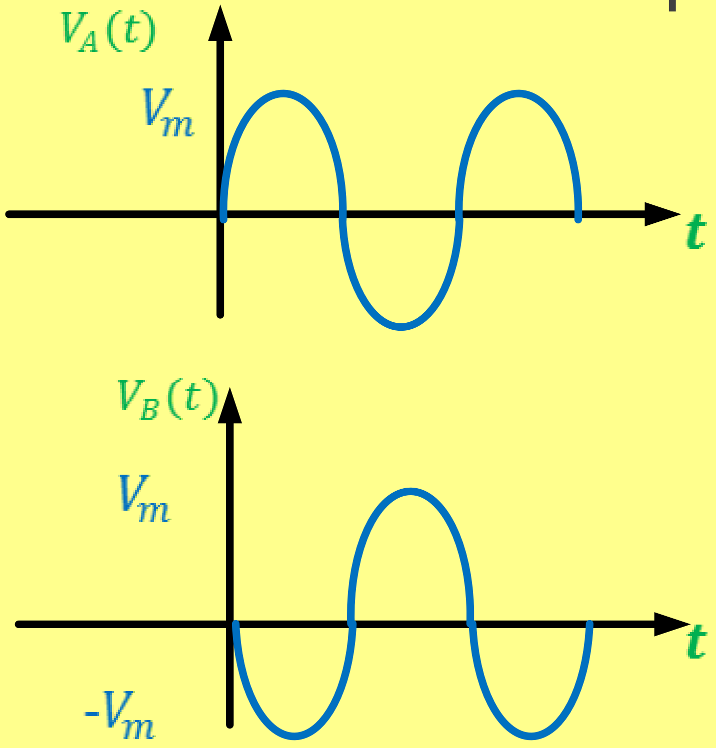
Full-Wave Rectifier

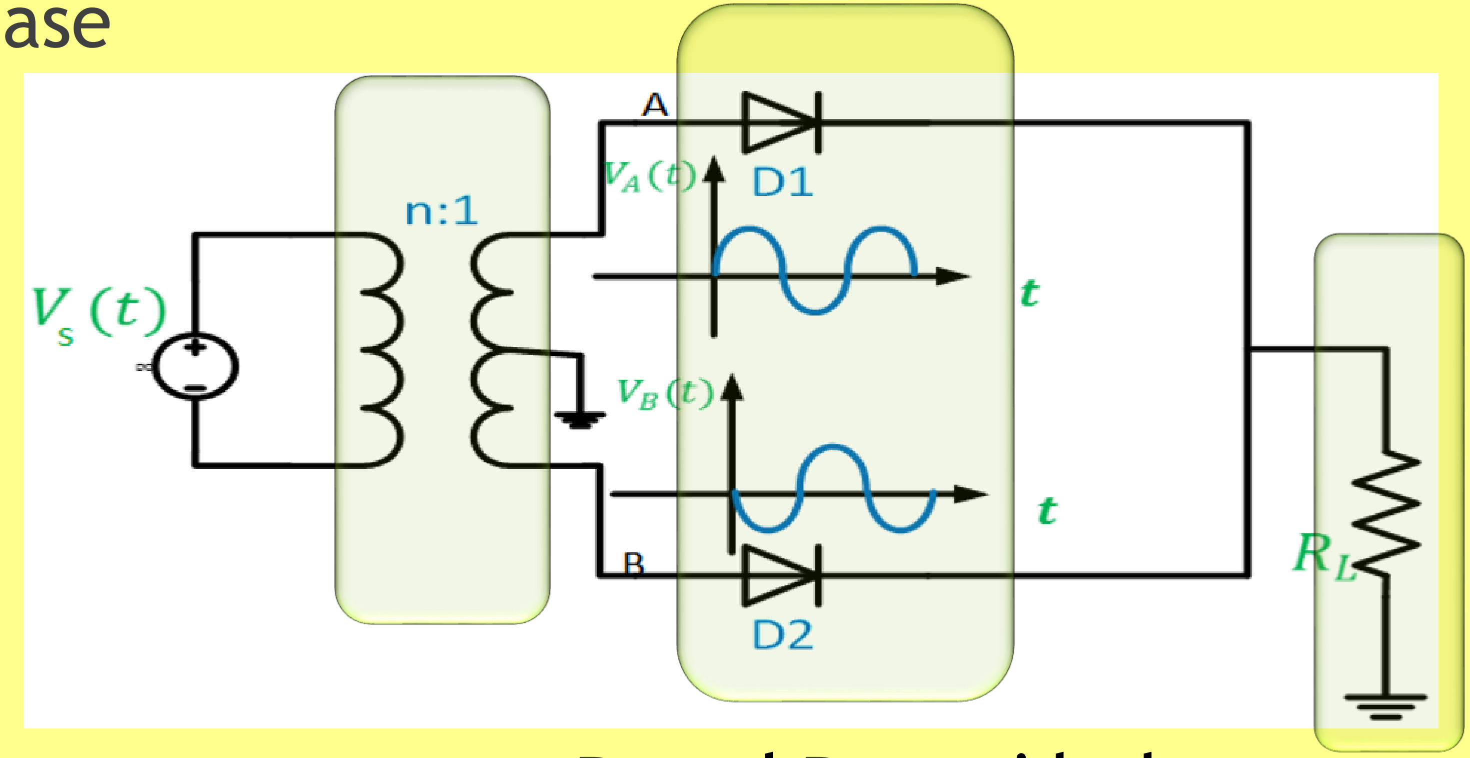
$$V_A(t) = -\ V_B(t)$$

$$V_A(t) = \frac{1}{n} V_s(t)$$

$$V_B(t) = -\frac{1}{n} V_s(t)$$

- A) Center-tapped transformer full-wave **Rectifier**
- V_A , V_B have the same amplitude but 180° out of phase





D_1 and D_2 are ideal

Simplified Circuit

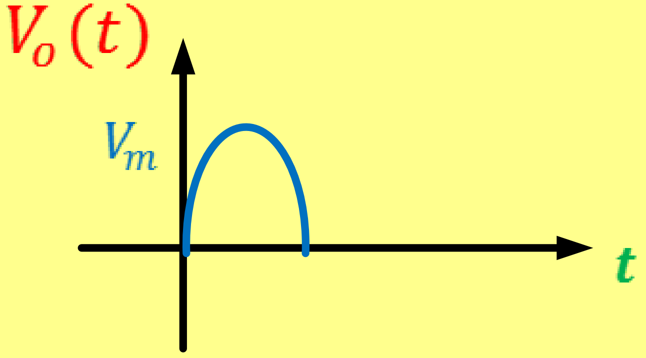
D_1 and D_2 are ideal

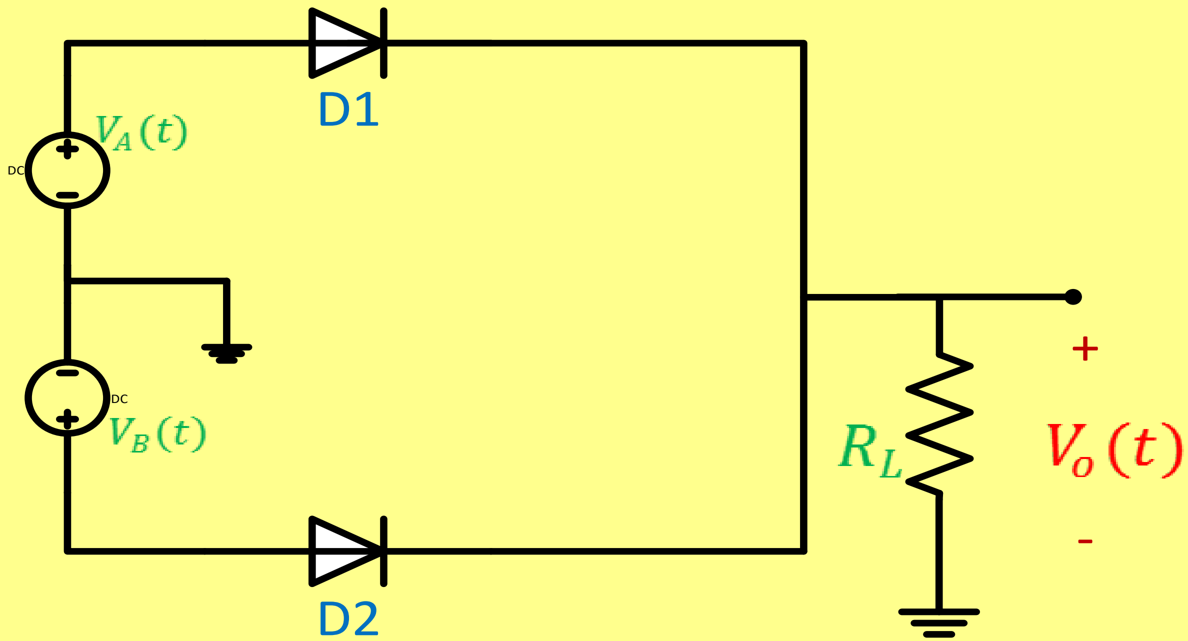
- 1) when $V_s(t) > 0$

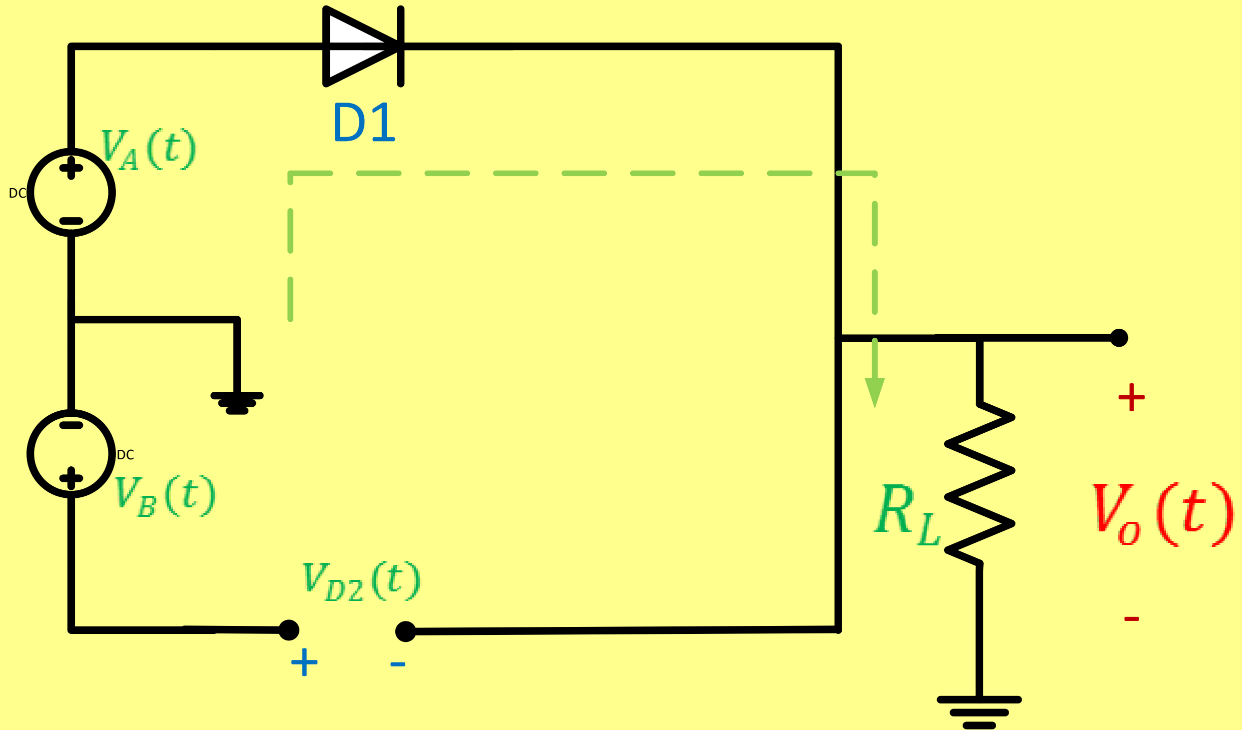
$V_A(t) > 0$, D_1 is on

$V_B(t) < 0$, D_2 is off

- $V_o(t) = V_A(t)$





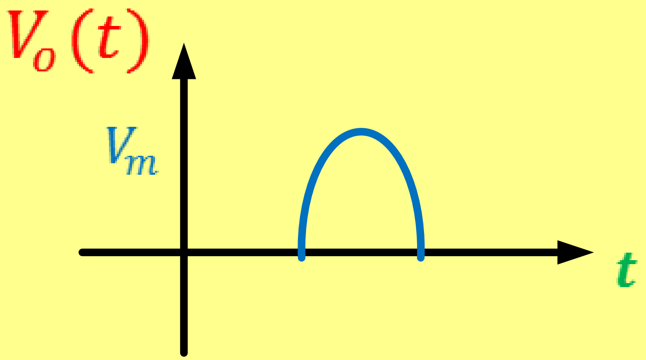


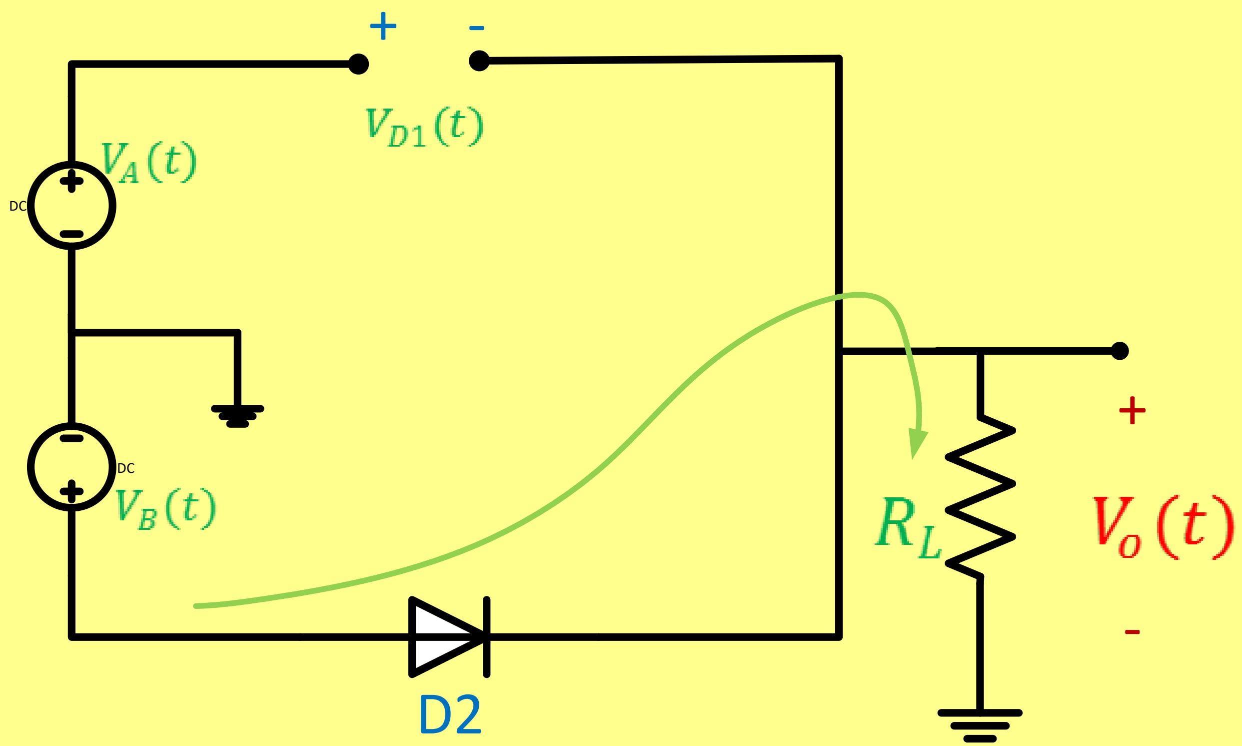
- 2) when $V_s(t) < 0$

  $V_A < 0$; D_1 is off

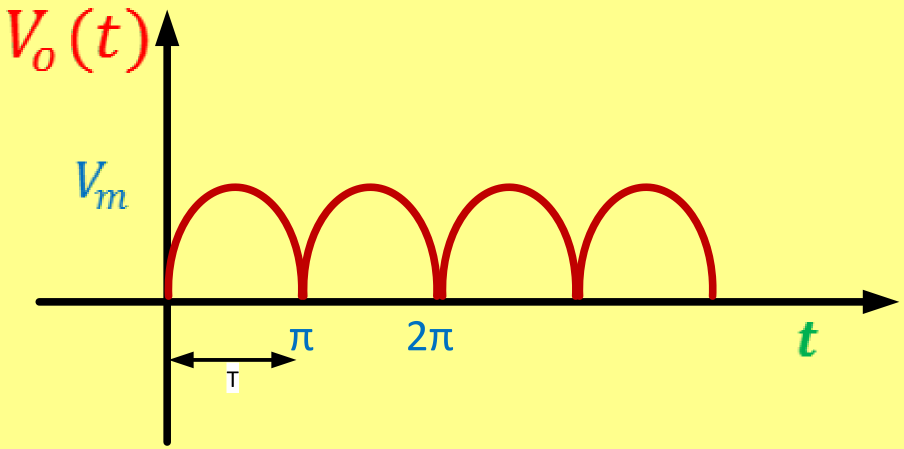
  $V_B > 0$; D_2 is on

- $\therefore V_o(t) = V_B(t) > 0$





For a complete cycle of $V_s(t)$



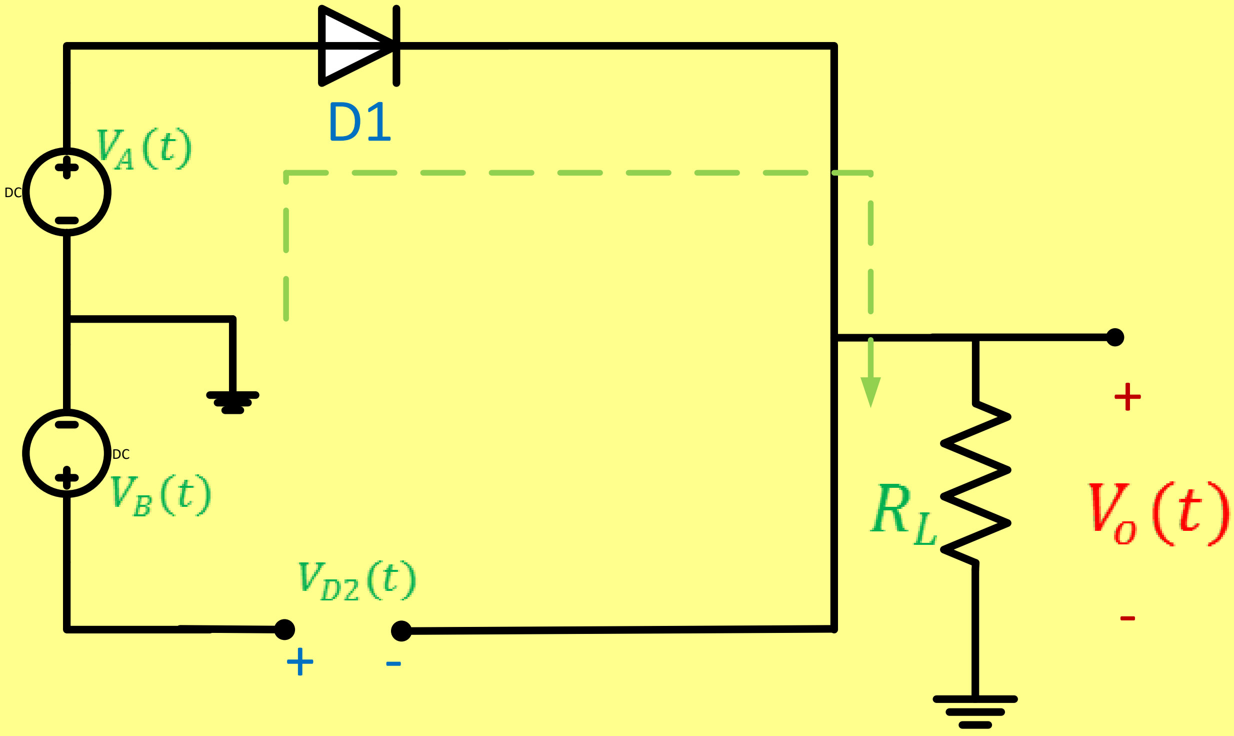
To calculate PIV

$$V_{D2}(t) = V_B(t) - V_A(t)$$

$$V_{D2}(t)_{,max} = -V_m - V_m$$

$$V_{D2}(t)_{,max} = -2V_m$$

$$\therefore \text{PIV} = -2V_m$$

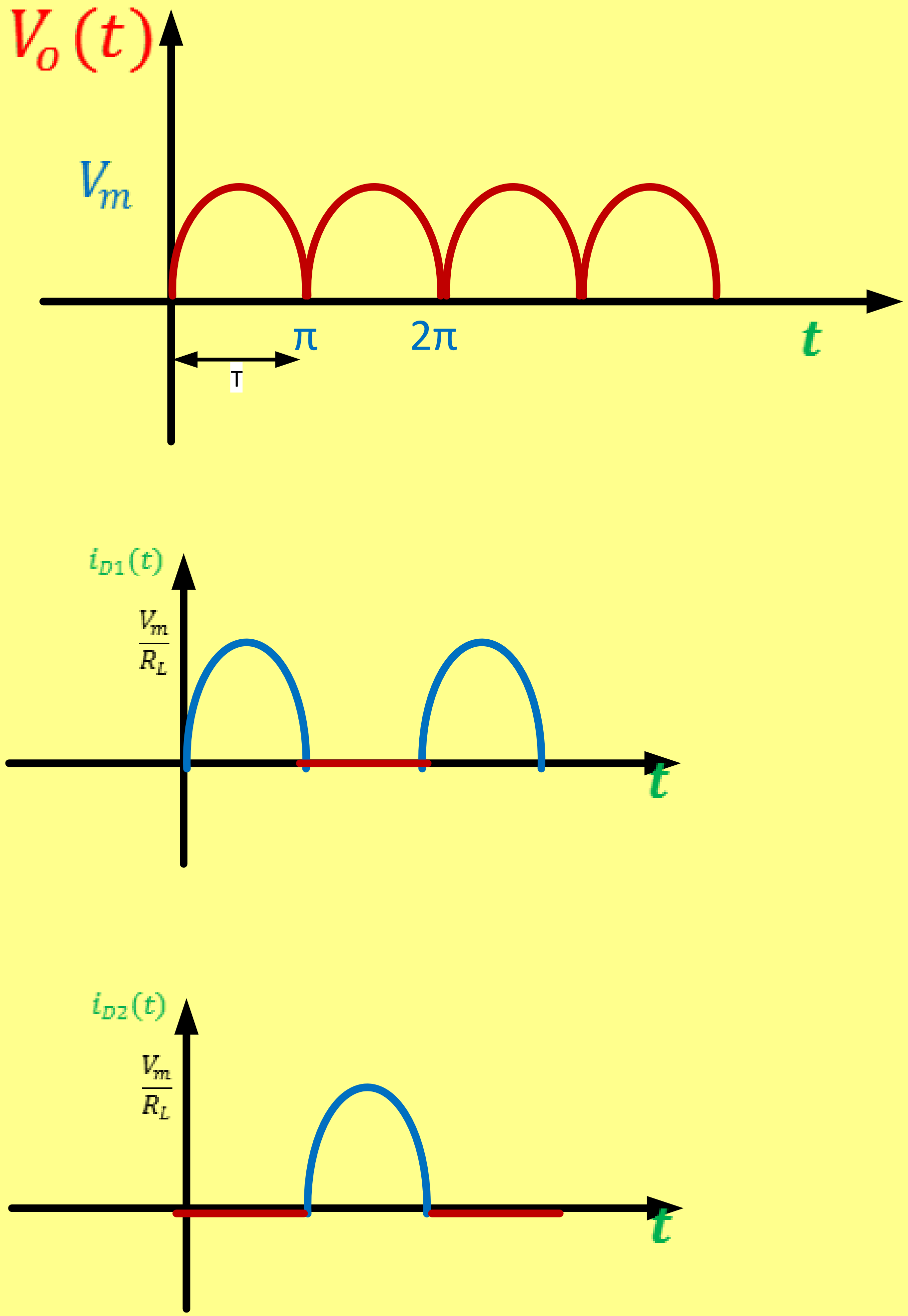


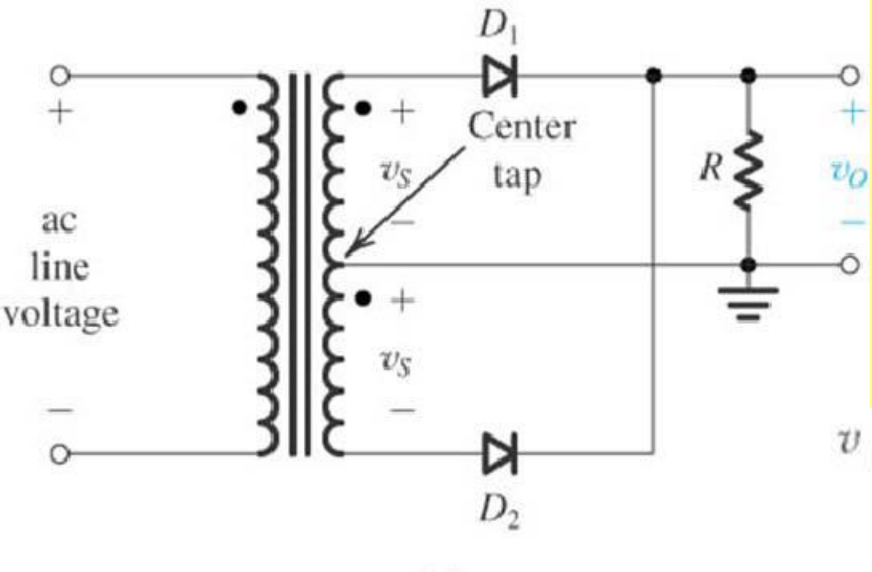
$V_A(t) > 0$, D_1 is on

$V_B(t) < 0$, D_2 is off

- $V_{o,av} = \frac{2V_m}{\pi}$
- PIV = $-2V_m$
- T = $\frac{1}{2}T_o$
- $f = 2\,f_o$

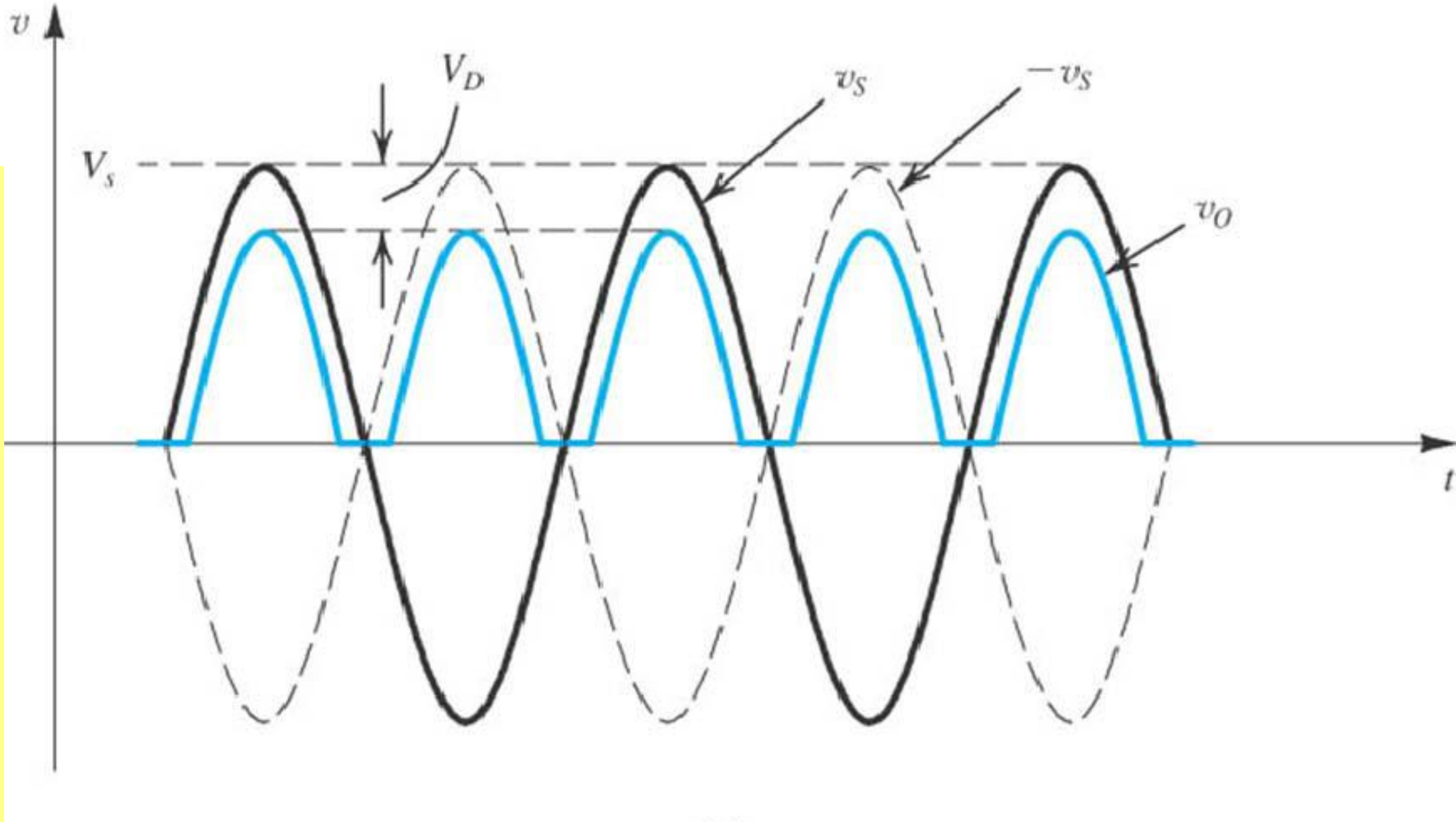
Diodes currents





(a)

If the diodes have Vk



(c)