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## Tema 3: Rectificadores no controlados

Sistemas Electrónicos de Potencia  
E.T.S. Ingenieros Industriales

Dpto. Tecnología Electrónica

# GUIÓN

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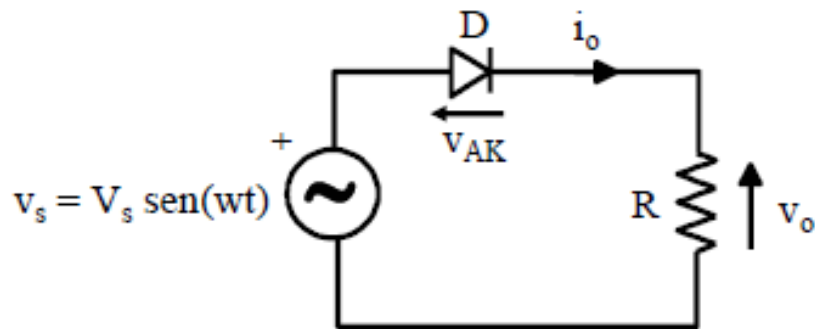
- Notación.
- Rectificadores no controlados monofásicos:
  - De media onda (medio puente):
    - Carga R.
    - Carga RL.
    - Carga R+fem.
    - Carga L+fem.
    - Carga RL+fem.
    - Diodo de libre circulación.
  - De onda completa (puente completo):
    - Carga R.
    - Carga RL.
- Rectificadores no controlados trifásicos:
  - De media onda (medio puente o de 3 pulsos).
  - De onda completa (puente completo o de 6 pulsos).

# NOTACIÓN

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- Letras minúsculas: Valores instantáneos.
- Letras mayúsculas:
  - Valores de continua.
  - Valores medios.
  - Valores eficaces.

# Rectificador monofásico no controlado de media onda. Carga R

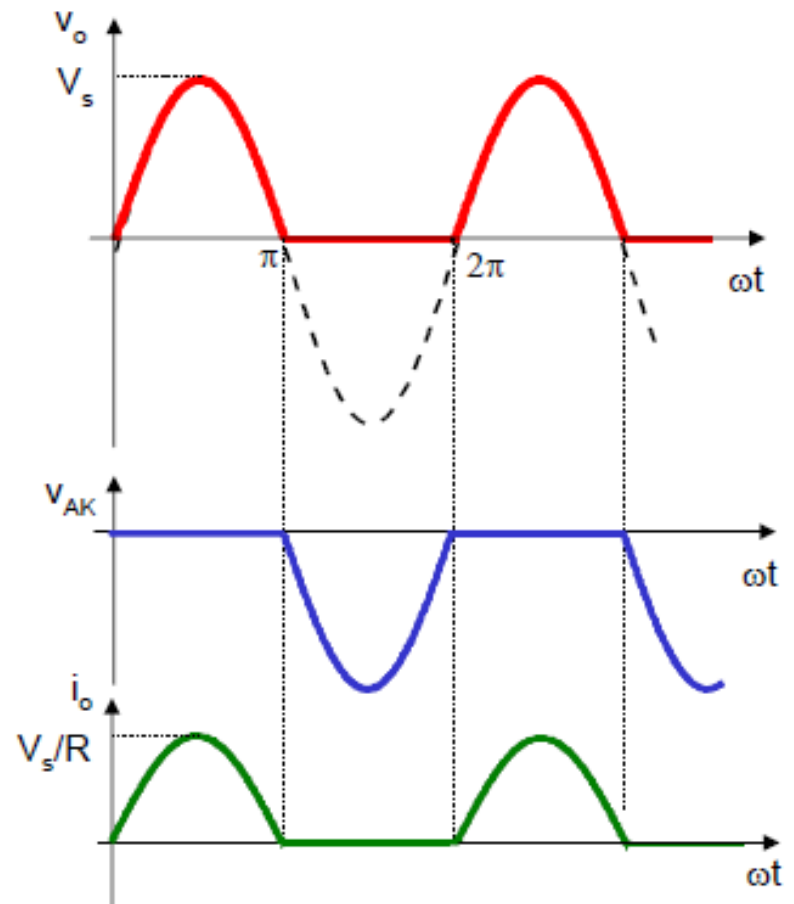


**D ON**      $v_{AK}=0$       $v_o=v_s$

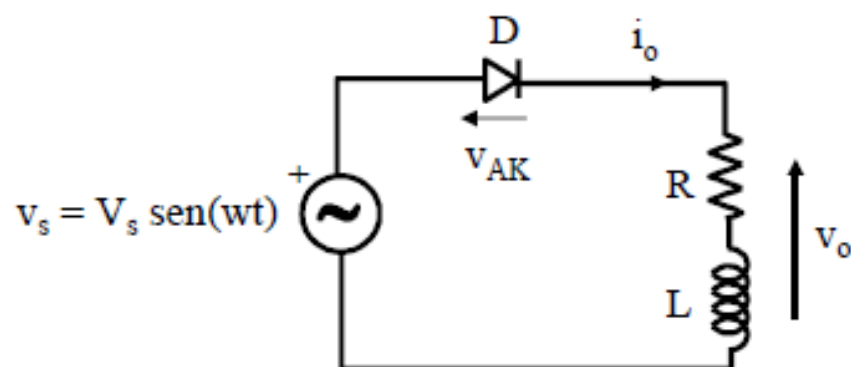
**D OFF**      $v_{AK}=v_s$       $v_o=0$

**VALOR MEDIO EN LA CARGA:**

$$V_o = \frac{1}{2\pi} \int_0^{\pi} V_s \sin(\omega t) d(\omega t) = \frac{V_s}{\pi}$$



# Rectificador monofásico no controlado de media onda. Carga RL



**D ON:**

$$0 \leq wt \leq \beta$$

$$v_o = v_s \quad v_{AK} = 0$$

$$Ri_o + L \frac{di_o}{dt} = v_s \Rightarrow i_o$$

**D OFF**

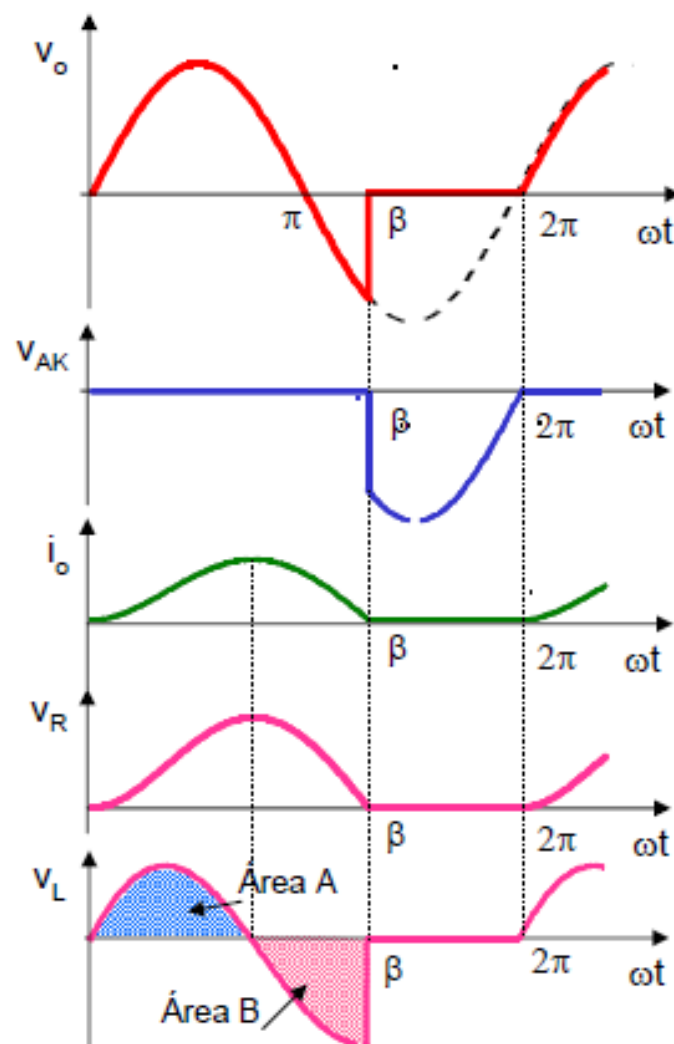
$$\beta \leq wt \leq 2\pi$$

$$v_o = 0 \quad v_{AK} = v_s$$

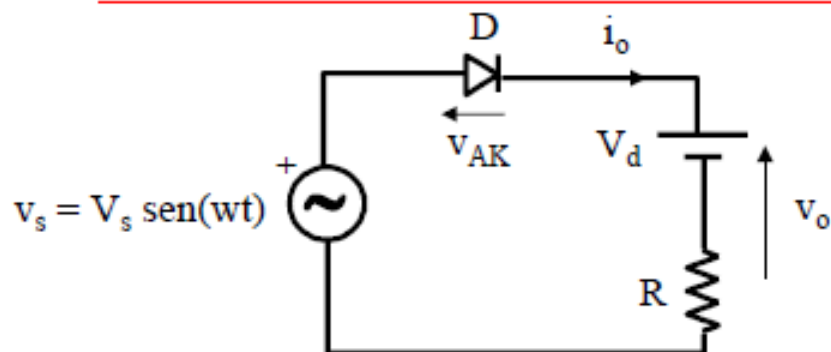
$$i_o = 0$$

**VALOR MEDIO EN LA CARGA:**

$$V_o = \frac{1}{2\pi} \int_0^{\beta} V_s \text{ sen}(\omega t) d(\omega t)$$



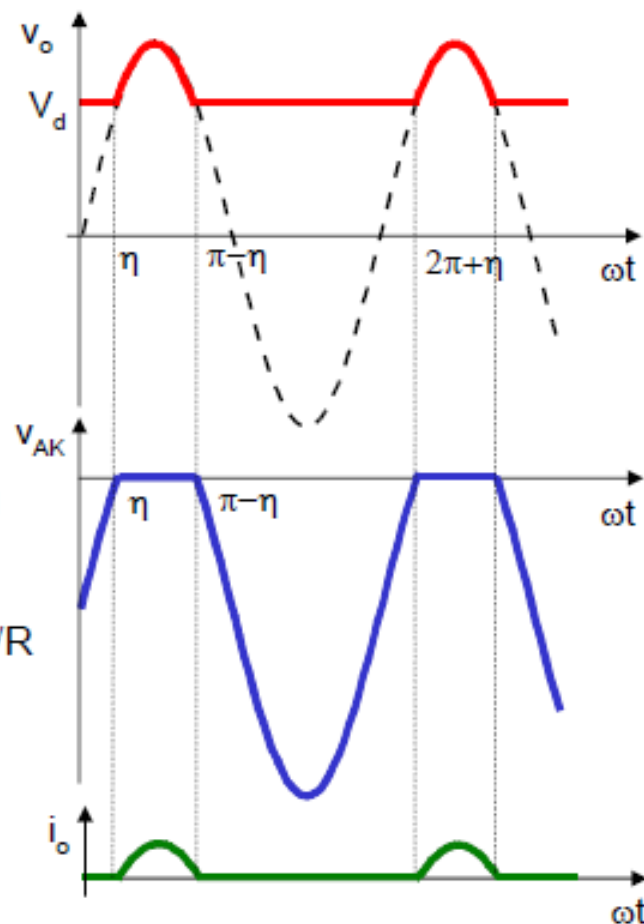
# Rectificador monofásico no controlado de media onda. Carga R y f.e.m.



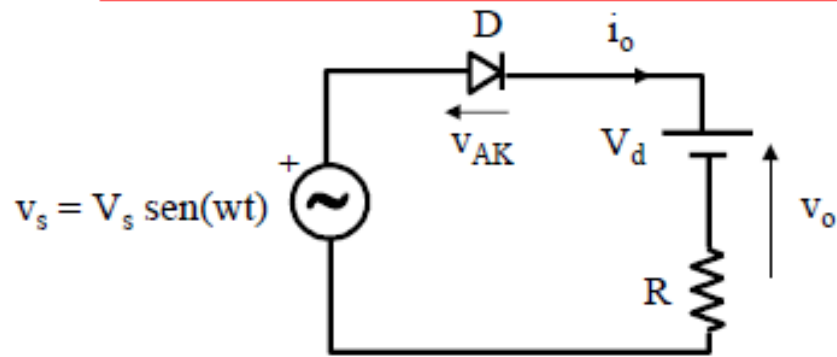
$$V_s \text{ sen } \eta = V_d \Rightarrow \text{sen } \eta = \frac{V_d}{V_s}$$

$$\eta = \arcsen\left(\frac{V_d}{V_s}\right) \text{ rad}$$

- $0 \leq \omega t < \eta$     **D OFF**  
 $v_o(\omega t) = V_d$   
 $i_o(\omega t) = 0$   
 $v_{AK}(\omega t) = v_s - V_d$
- $\eta \leq \omega t < \pi - \eta$     **D ON**  
 $v_o(\omega t) = v_s$   
 $i_o(\omega t) = (v_s - V_d)/R$   
 $v_{AK}(\omega t) = 0$
- $\pi - \eta \leq \omega t < 2\pi$     **D OFF**  
 $v_o(\omega t) = V_d$   
 $i_o(\omega t) = 0$   
 $v_{AK}(\omega t) = v_s - V_d$

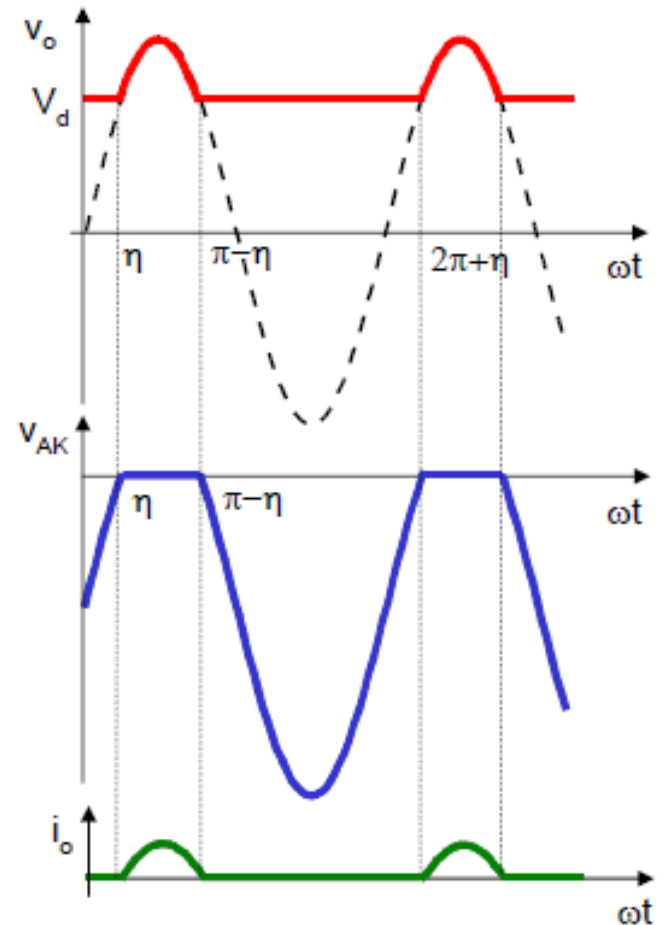


# Rectificador monofásico no controlado de media onda. Carga R y f.e.m.

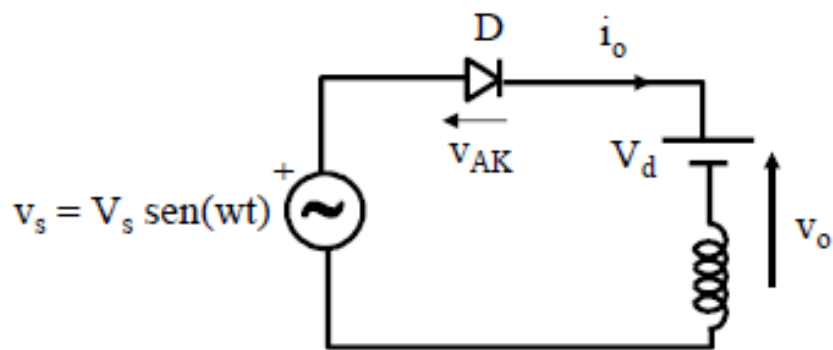


**VALOR MEDIO EN LA CARGA:**

$$V_o = \frac{1}{2\pi} \left[ \int_{\eta}^{\pi-\eta} V_s \text{ sen}(\omega t) d(\omega t) + \int_{\pi-\eta}^{2\pi+\eta} V_d d(\omega t) \right]$$



# Rectificador monofásico no controlado de media onda. Carga L y f.e.m.



**D ON**

$$\eta \leq \omega t \leq \beta$$

$$v_o(\omega t) = v_s \quad v_{AK} = 0$$

$$L \frac{di_o}{dt} + V_d = v_s \Rightarrow i_o$$

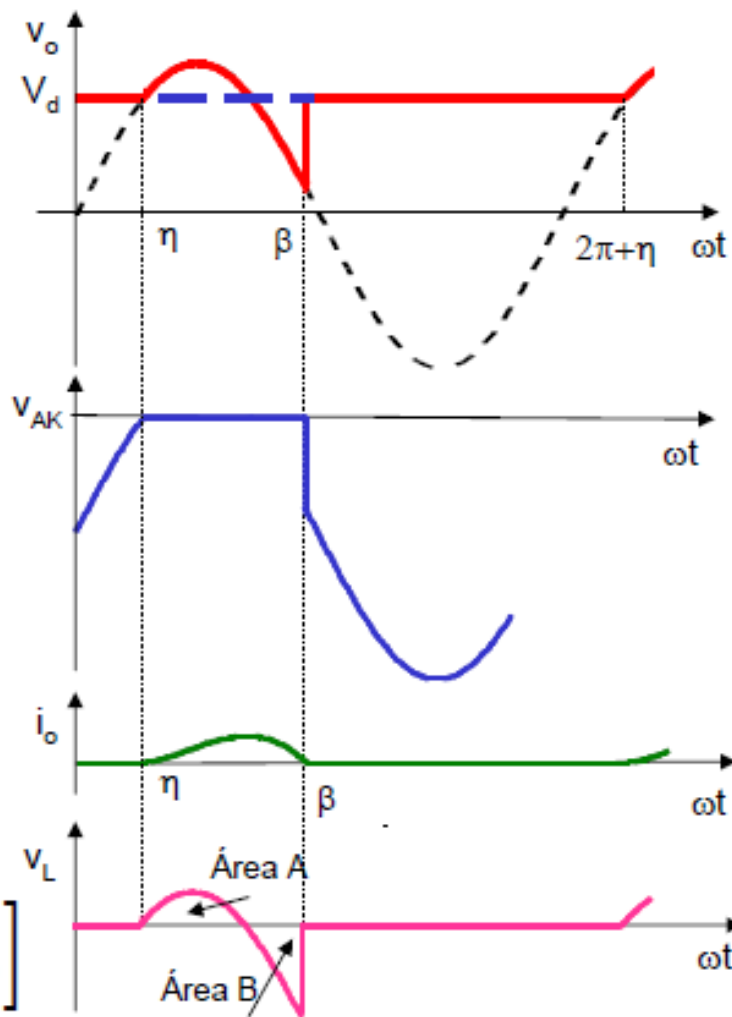
**D OFF**  $0 \leq \omega t \leq \eta, \beta \leq \omega t \leq 2\pi$

$$v_o(\omega t) = V_d \quad v_{AK} = v_s - V_d$$

$$i_o(\omega t) = 0$$

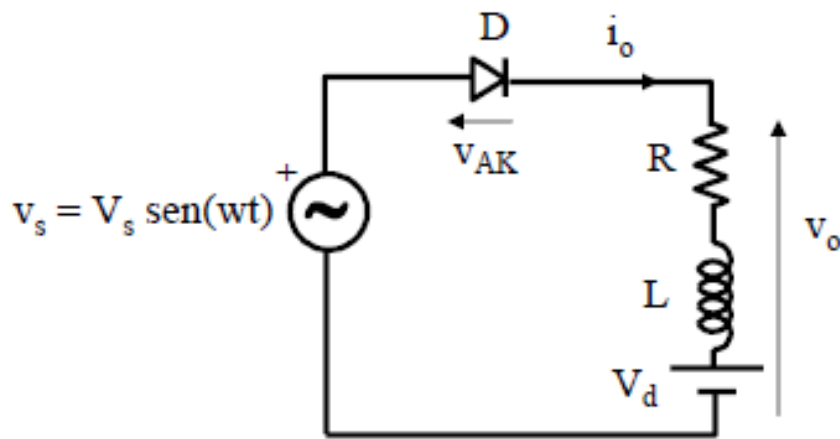
**VALOR MEDIO EN LA CARGA:**

$$V_o = \frac{1}{2\pi} \left[ \int_{\eta}^{\beta} V_s \text{ sen}(\omega t) d(\omega t) + \int_{\beta}^{2\pi+\eta} V_d d(\omega t) \right]$$





# Rectificador monofásico no controlado de media onda. Carga RL y f.e.m.



**D ON:**  $\eta \leq \omega t \leq \beta$

$$v_o(\omega t) = v_s$$

$$Ri_o + L \frac{di_o}{dt} + V_d = v_s \Rightarrow i_o$$

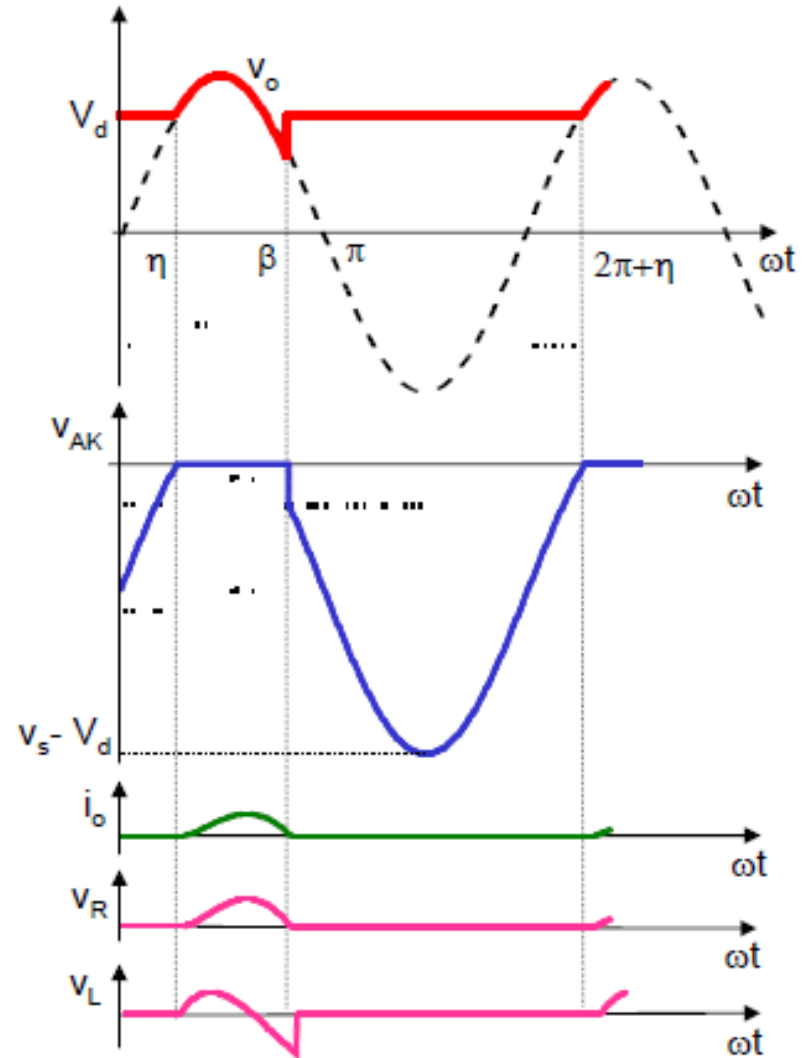
$$v_{AK}(\omega t) = 0$$

**D OFF:**  $0 \leq \omega t \leq \eta, \beta \leq \omega t \leq 2\pi$

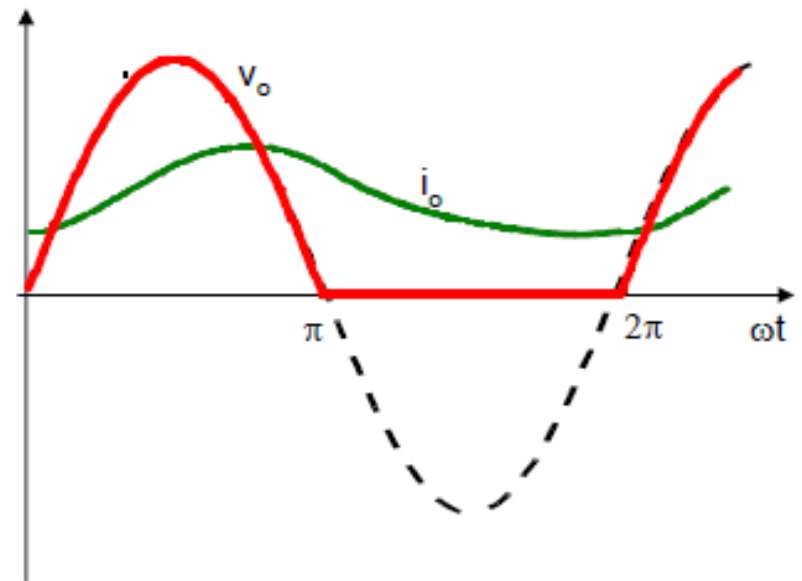
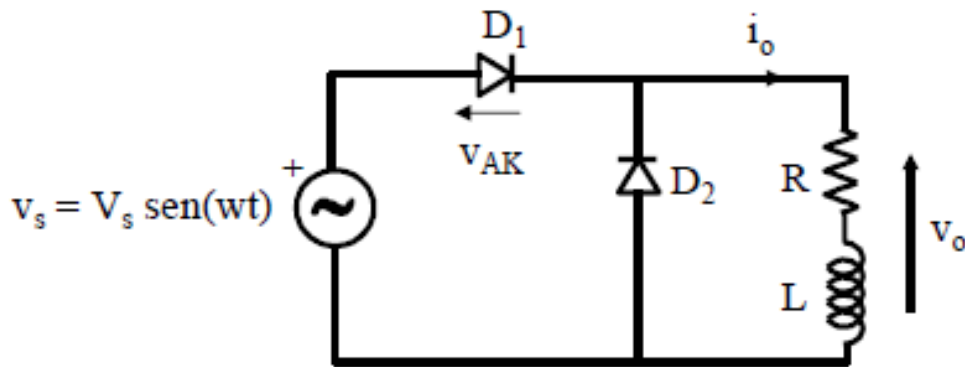
$$v_o(\omega t) = V_d$$

$$i_o(\omega t) = 0$$

$$v_{AK}(\omega t) = v_s - V_d$$



# Rectificador monofásico no controlado de media onda con diodo de libre circulación



**D1 ON, D2 OFF:**  $0 \leq \omega t \leq \pi$

$$V_o = V_s$$

$$Ri_o + L \frac{di_o}{dt} = v_s \Rightarrow i_o$$

**D1 OFF, D2 ON:**  $\pi \leq \omega t \leq 2\pi$

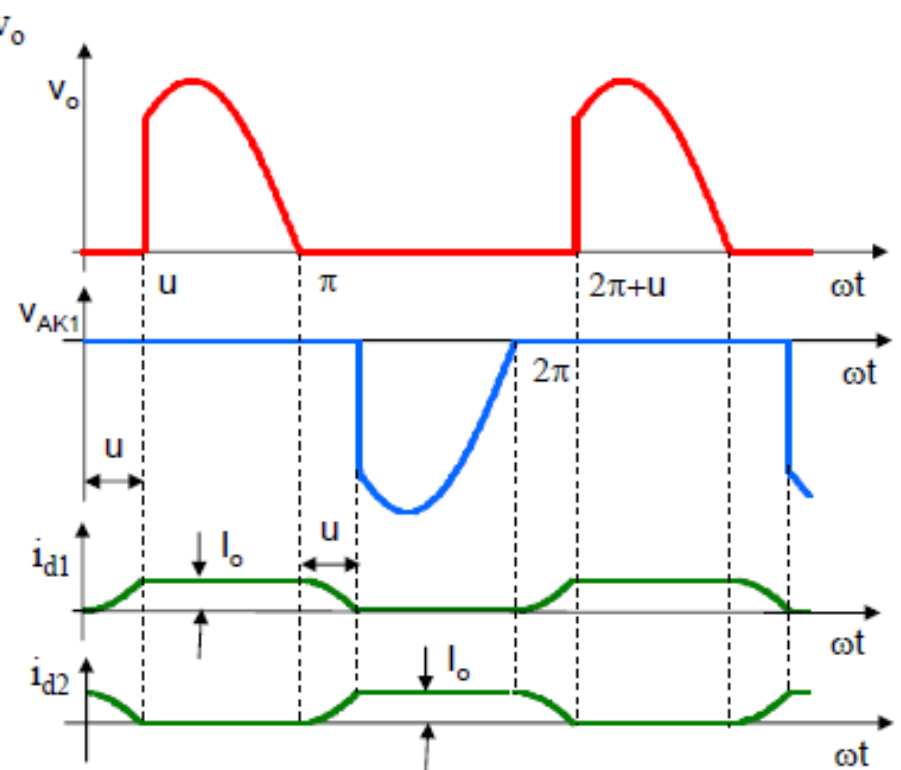
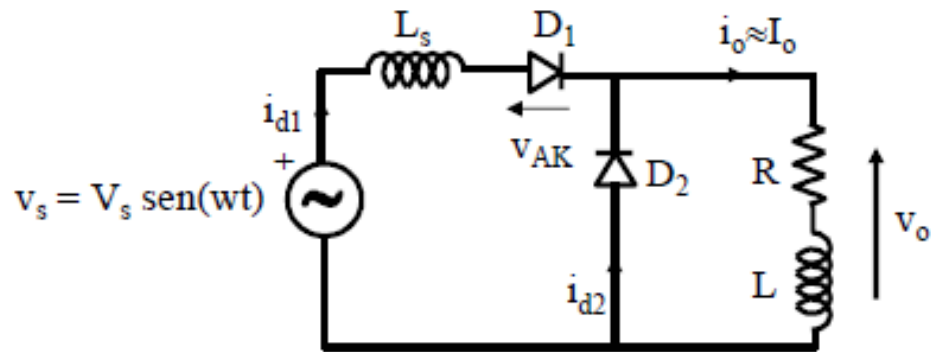
$$V_o = 0$$

$$Ri_o + L \frac{di_o}{dt} = 0 \Rightarrow i_o$$

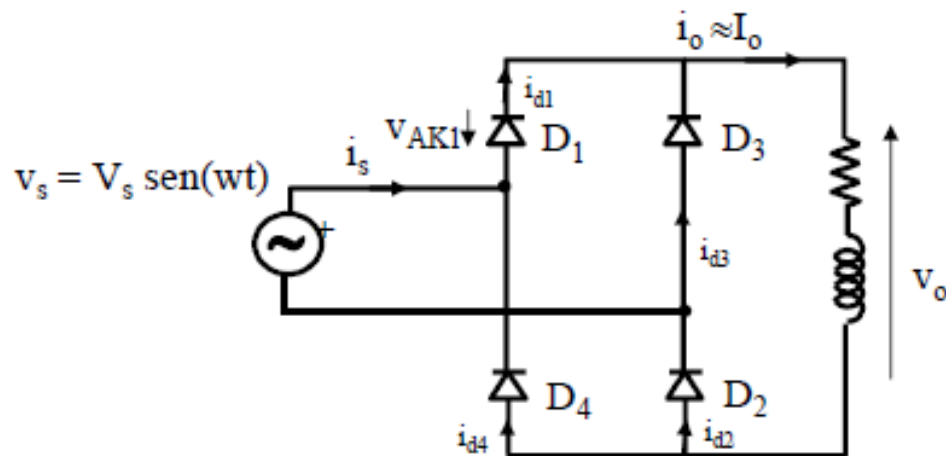
**VALOR MEDIO EN LA CARGA:**

$$V_o = \frac{1}{2\pi} \int_0^{\pi} V_s \text{sen}(\omega t) d(\omega t) = \frac{V_s}{\pi}$$

# Rectificador monofásico no controlado de media onda con diodo de libre circulación: Efecto de la inductancia de la fuente

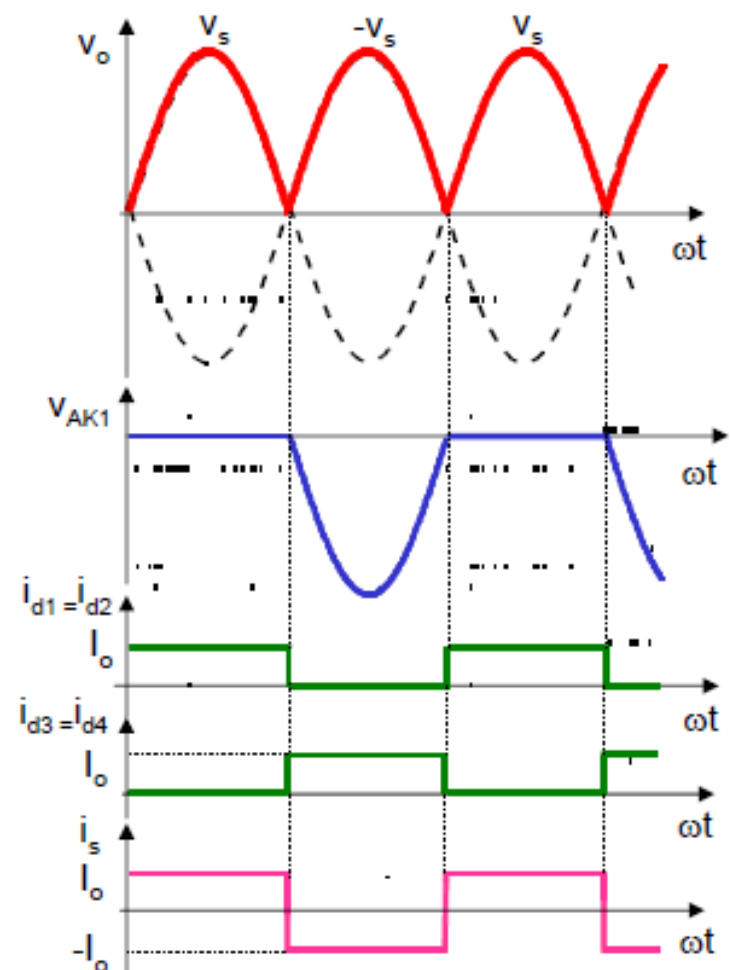


# Rectificador monofásico no controlado de onda completa: Carga altamente inductiva

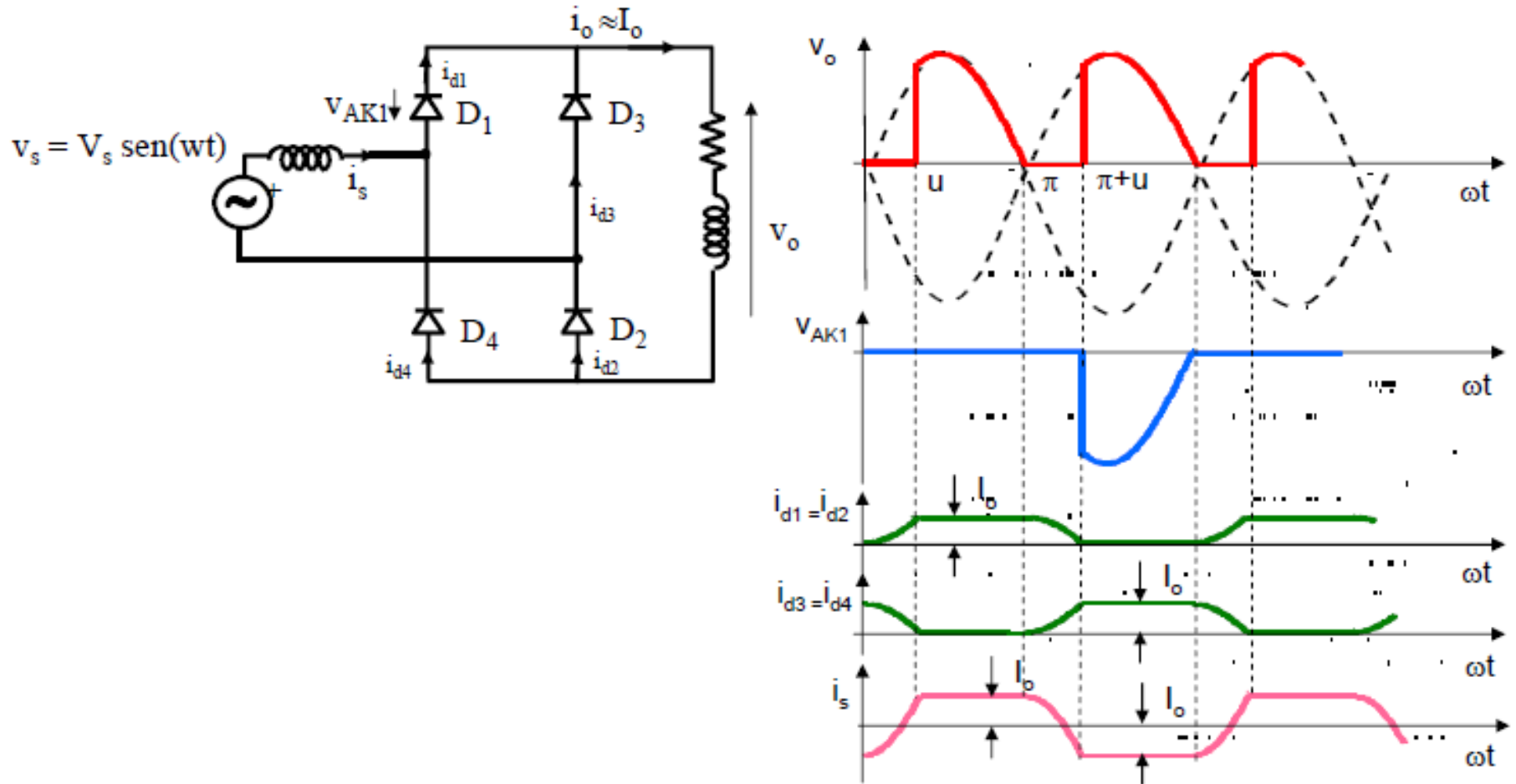


**D1, D2 ON**  $\Rightarrow v_o(\omega t) = v_s$  ,  $v_{AK1}(\omega t) = 0$

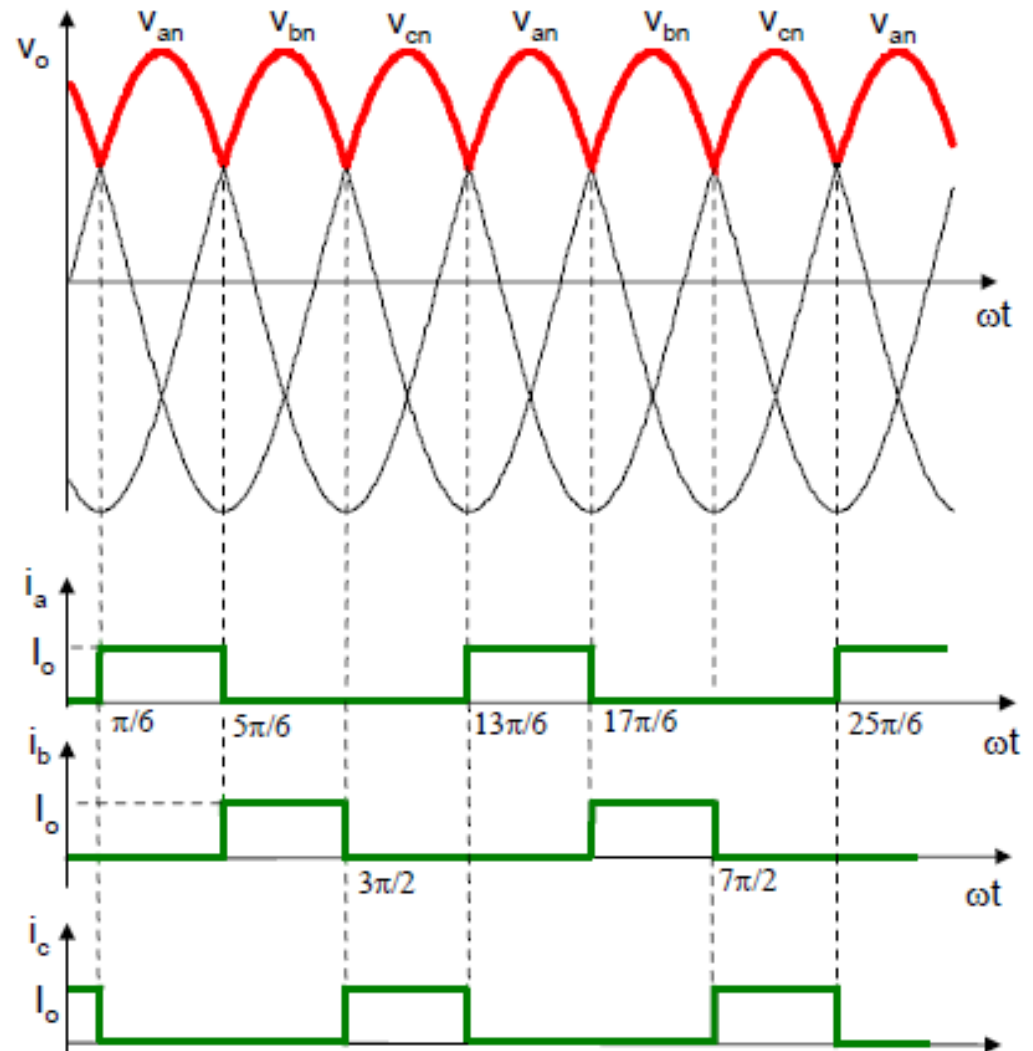
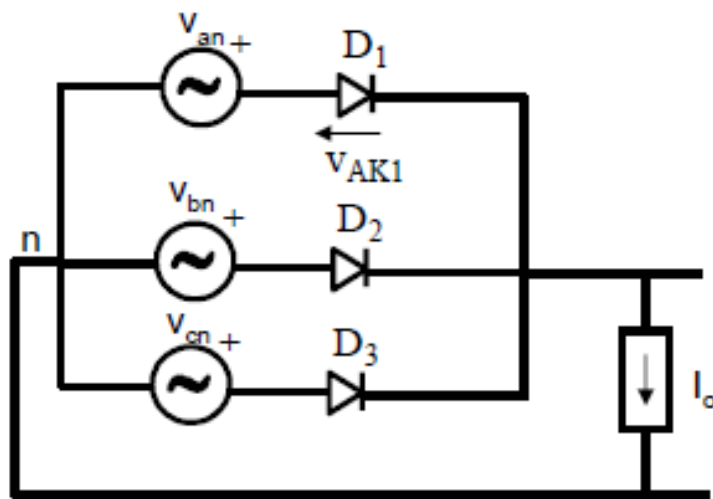
**D3, D4 ON**  $\Rightarrow v_o(\omega t) = -v_s$  ,  $v_{AK1}(\omega t) = v_s$



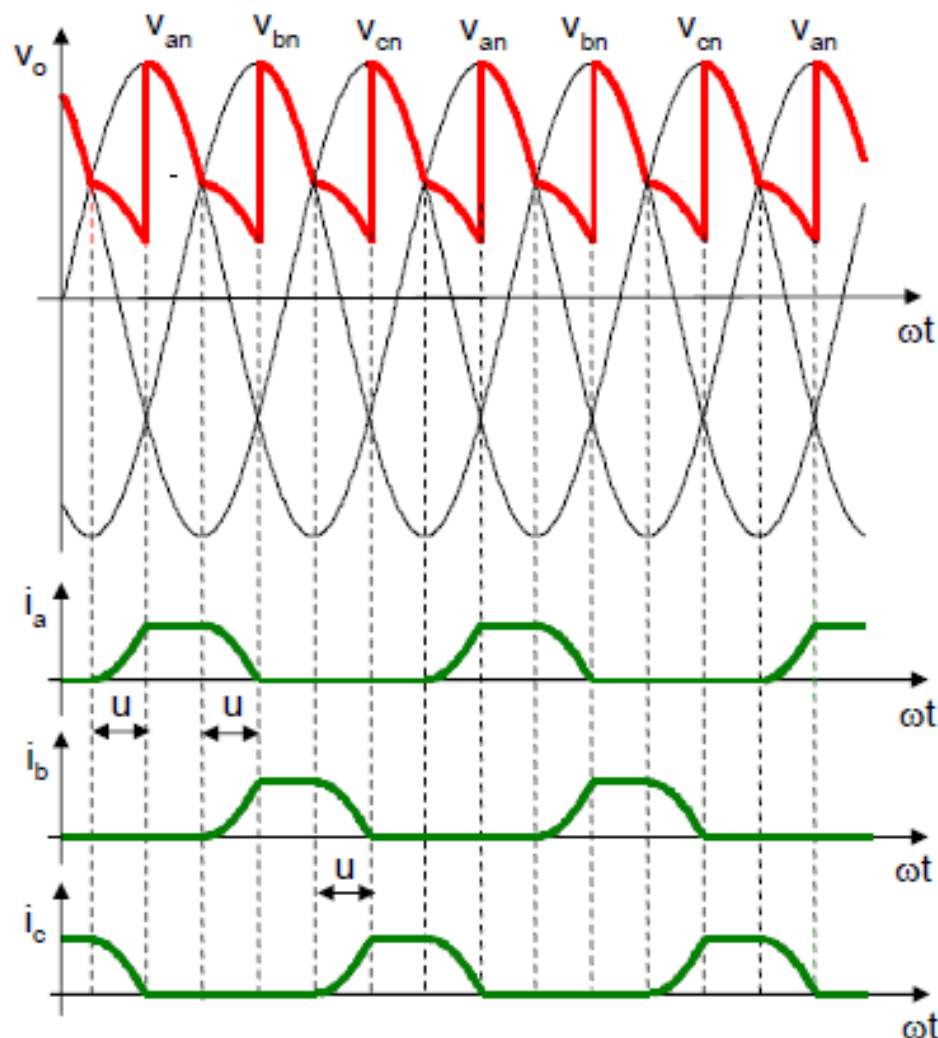
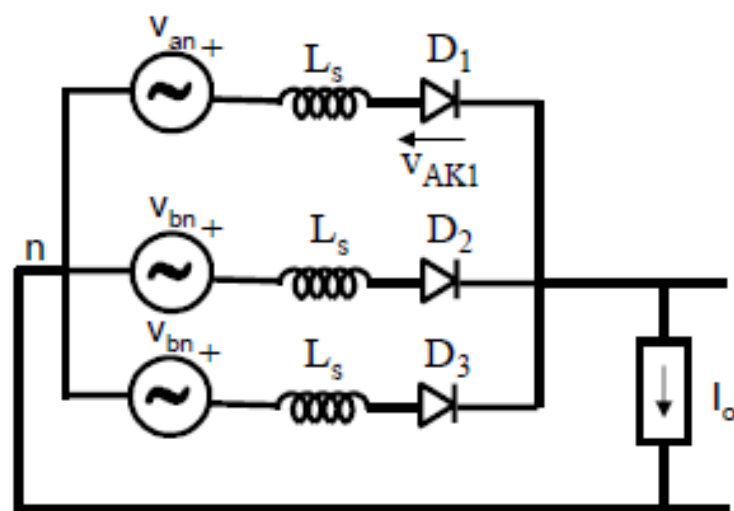
# Rectificador monofásico no controlado de onda completa: Efecto de la inductancia de la fuente



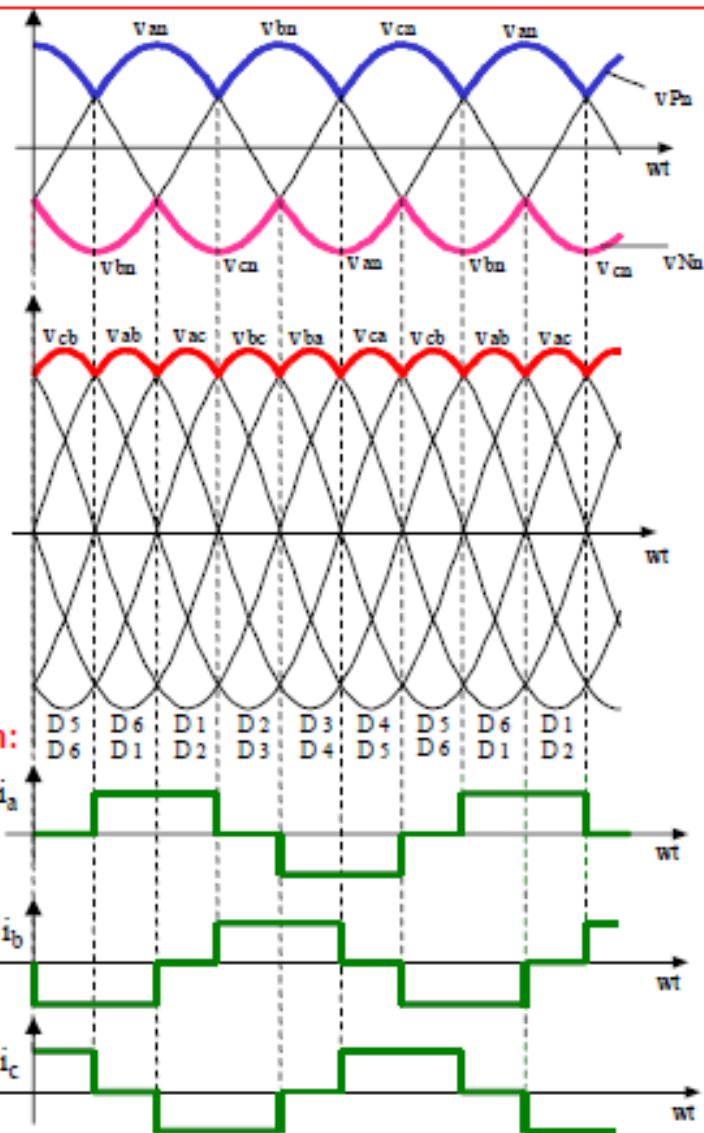
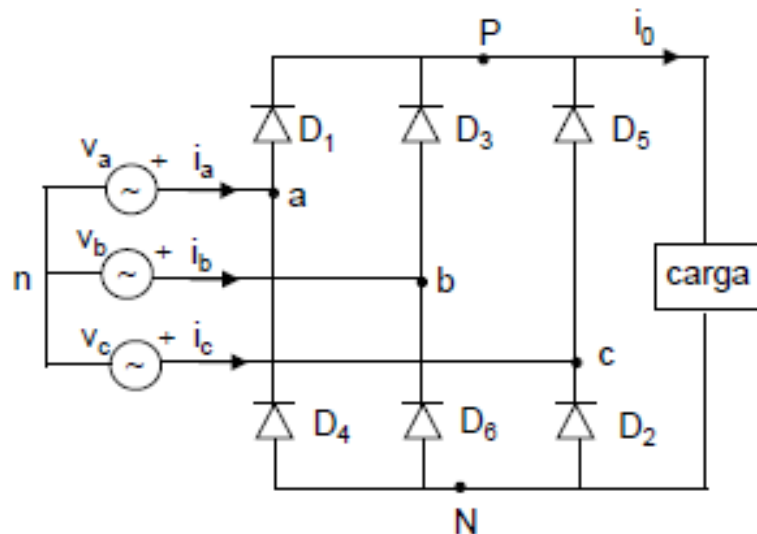
# Rectificador trifásico no controlado de media onda (3 pulsos)



# Rectificador trifásico no controlado de media onda (3 pulsos): Efecto de la inductancia de la fuente

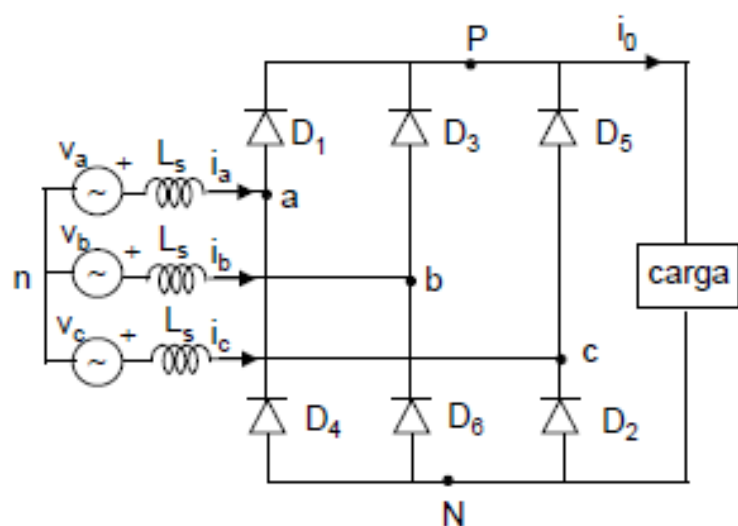


# Rectificador trifásico no controlado de onda completa (6 pulsos)





# Rectificador trifásico no controlado de onda completa (6 pulsos): Efecto de la inductancia de la fuente



Durante la conmutación conducen 3 diodos a la vez

