EL3004-Circuitos Electrónicos Analógicos

Clase No. 7: Operación del diodo

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1. Repaso Clase #6

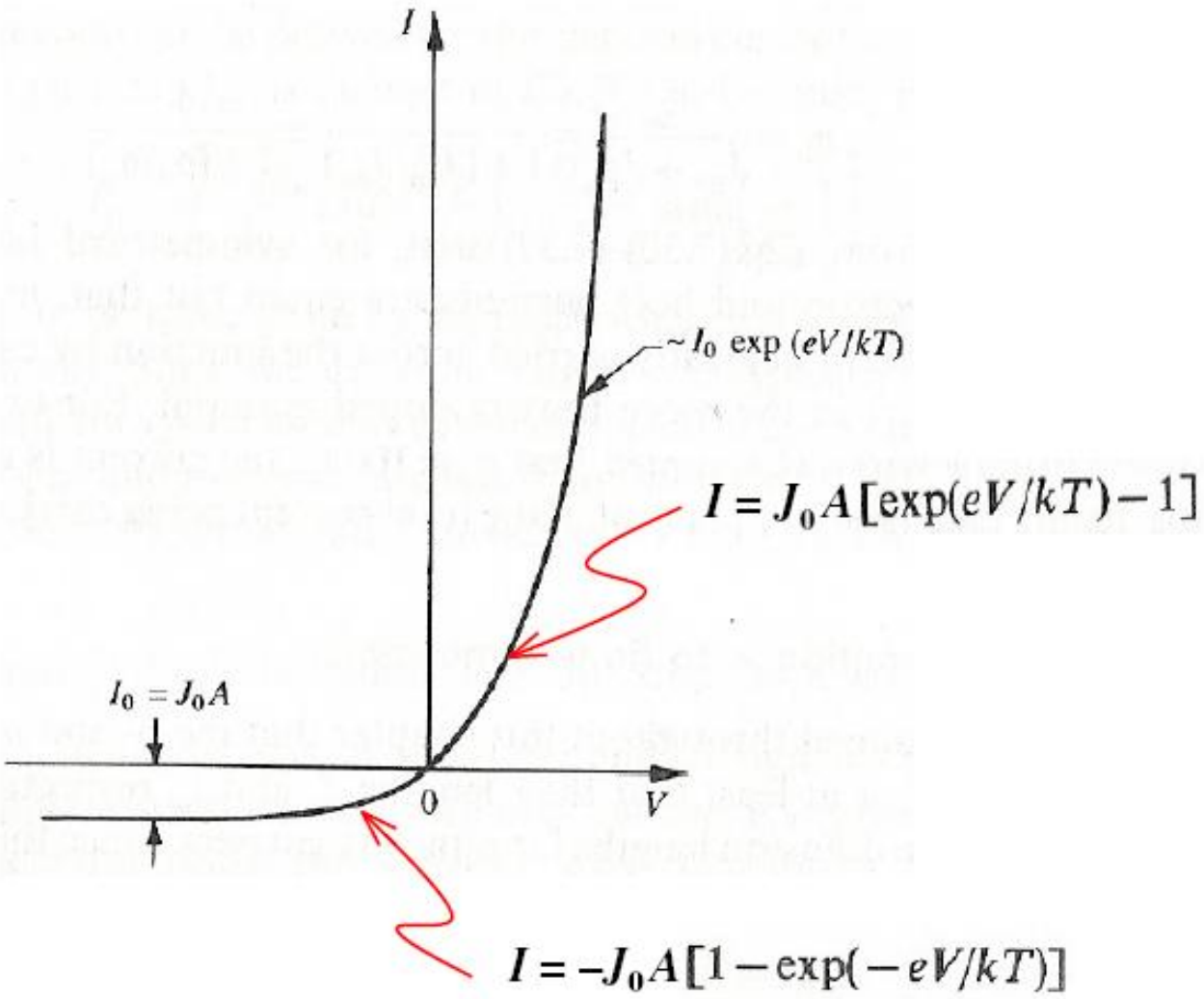
2. Comportamiento del Diodo

3. Aplicaciones del Diodo
   - Circuitos Rectificadores
     - Rectificador de Media Onda
     - Rectificador de Onda Completa
   - Rectificador con Filtro de Capacitancia

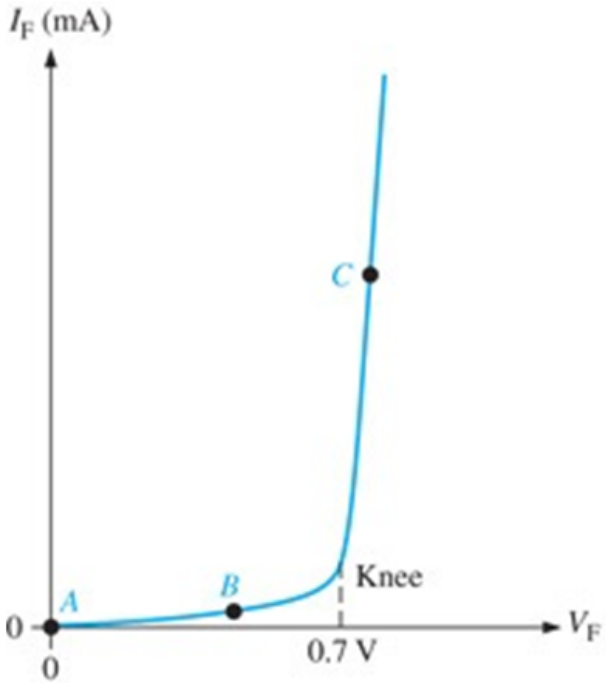
Repaso Clase #6

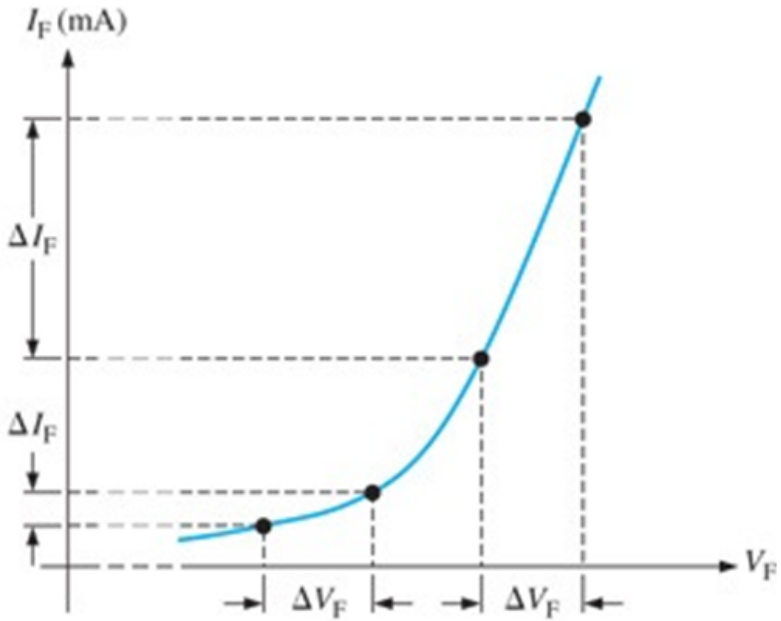
- Junturas np sin polarización
- Junturas np con polarización en directa
- Junturas np con polarización en reversa

Junturas pn
Corriente por la juntura

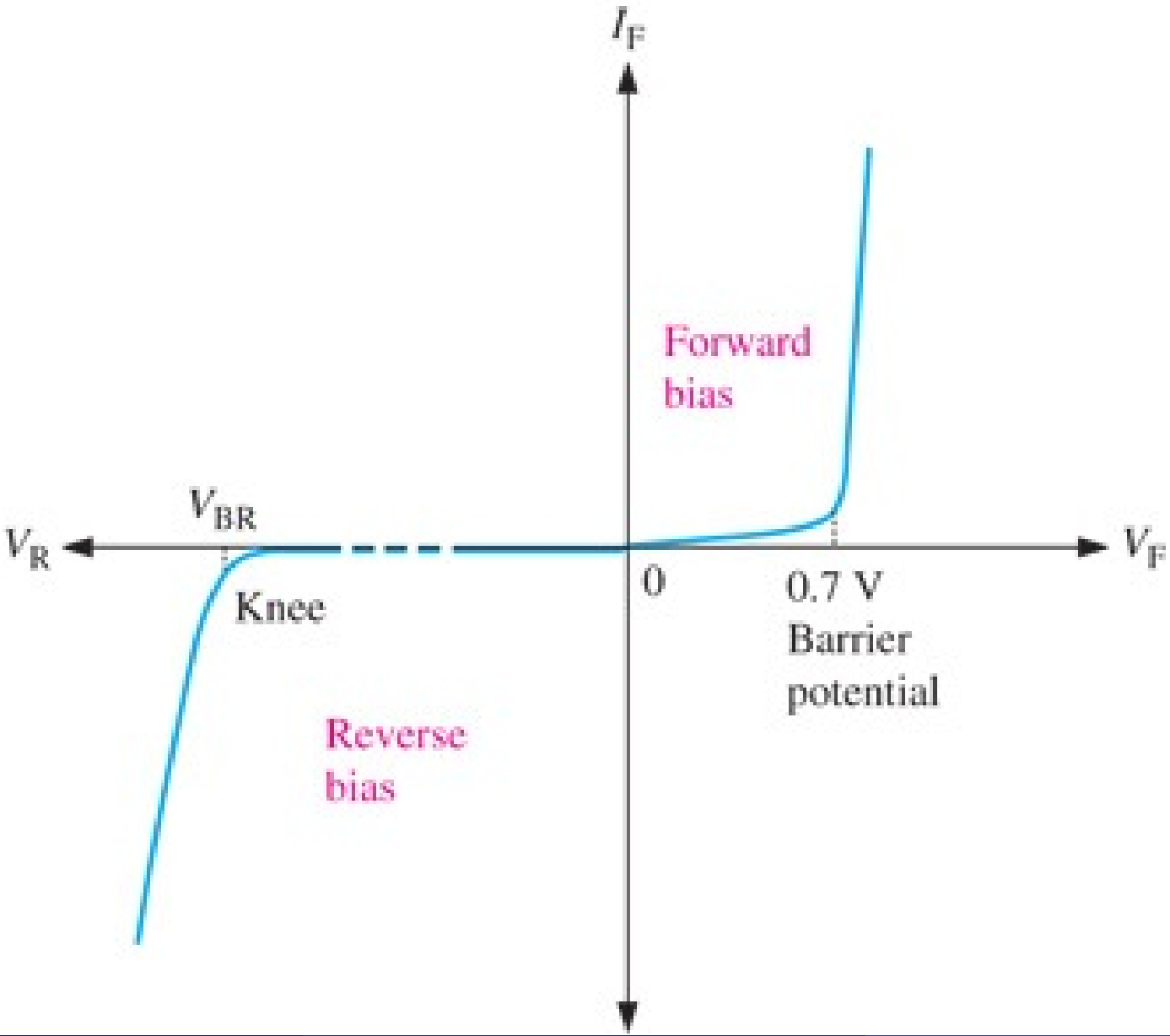


Relación de V e I en polarización directa

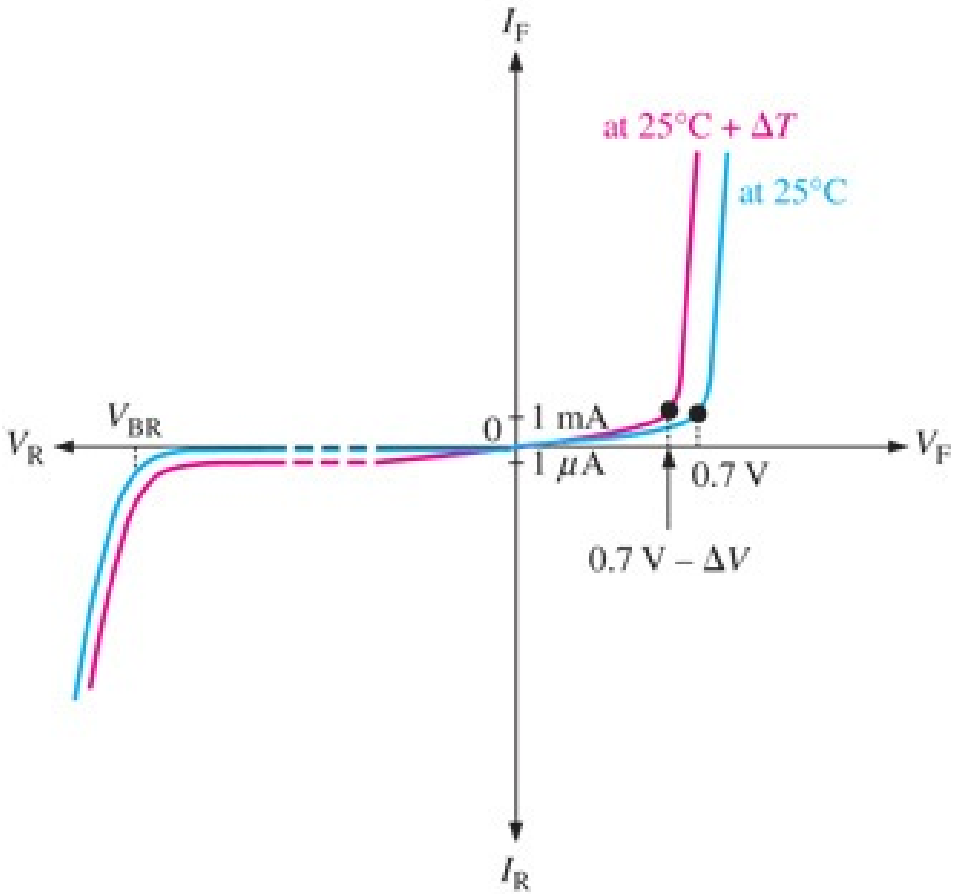




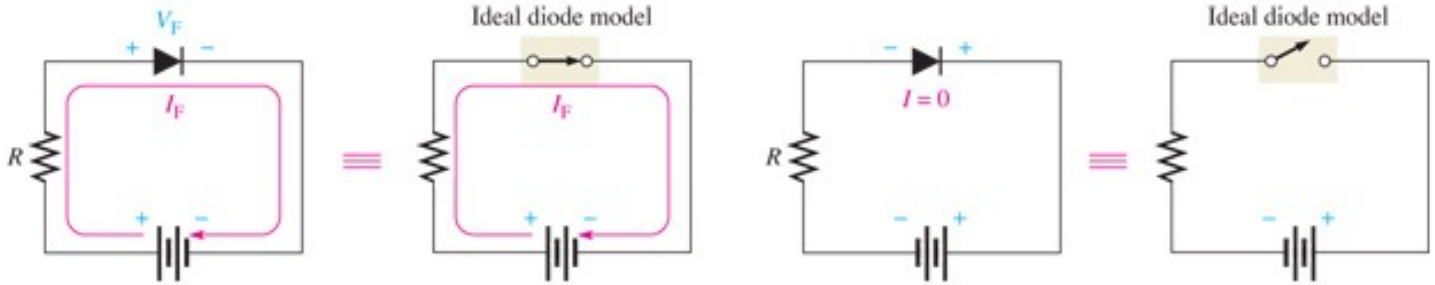
Relación de V e I para todo V



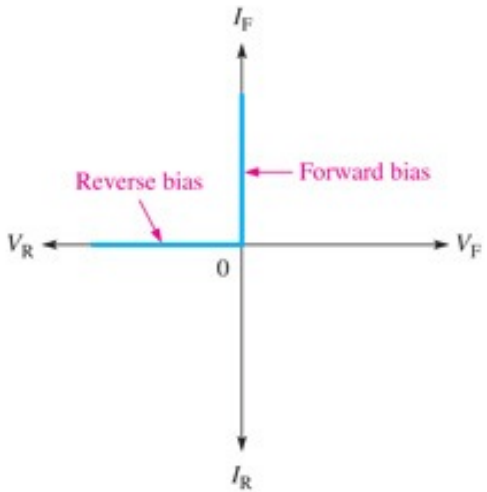
Efecto de T en la curva V-I



Modelo Ideal

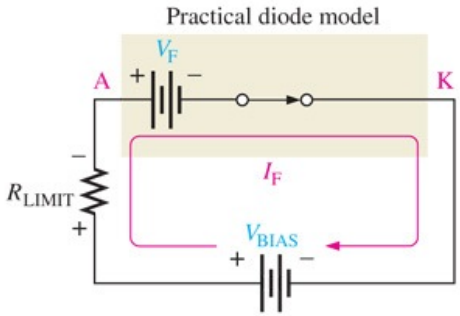


(a) Forward bias (b) Reverse bias

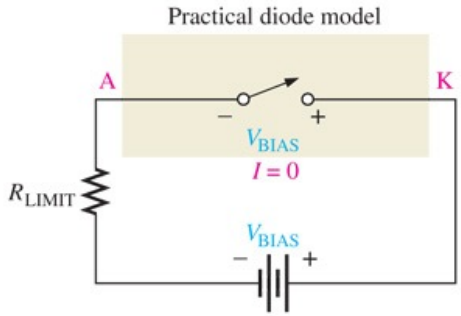


(c) Ideal *V-I* characteristic curve (blue)

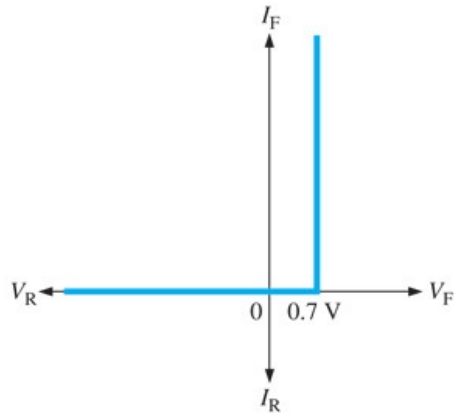
Modelo Práctico



(a) Forward bias

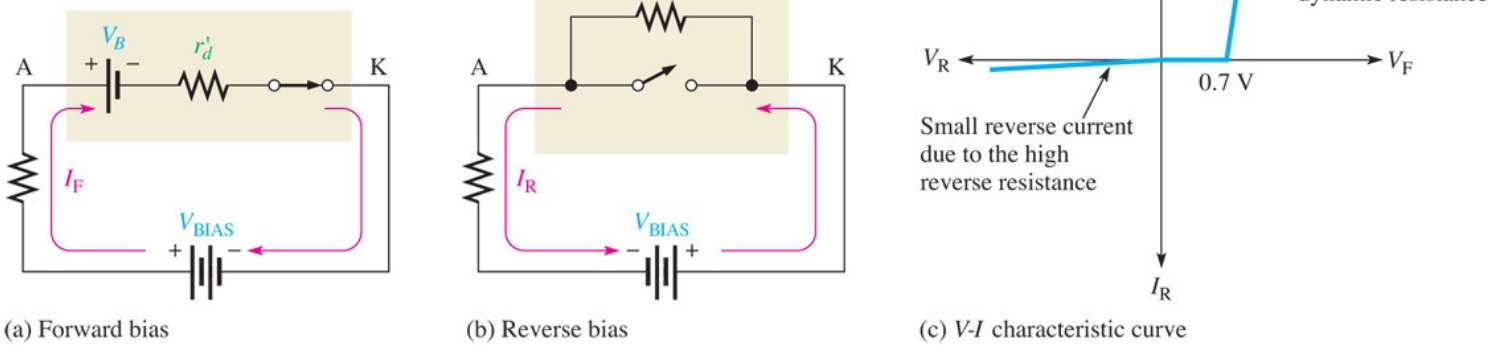


(b) Reverse bias



(c) Characteristic curve (silicon)

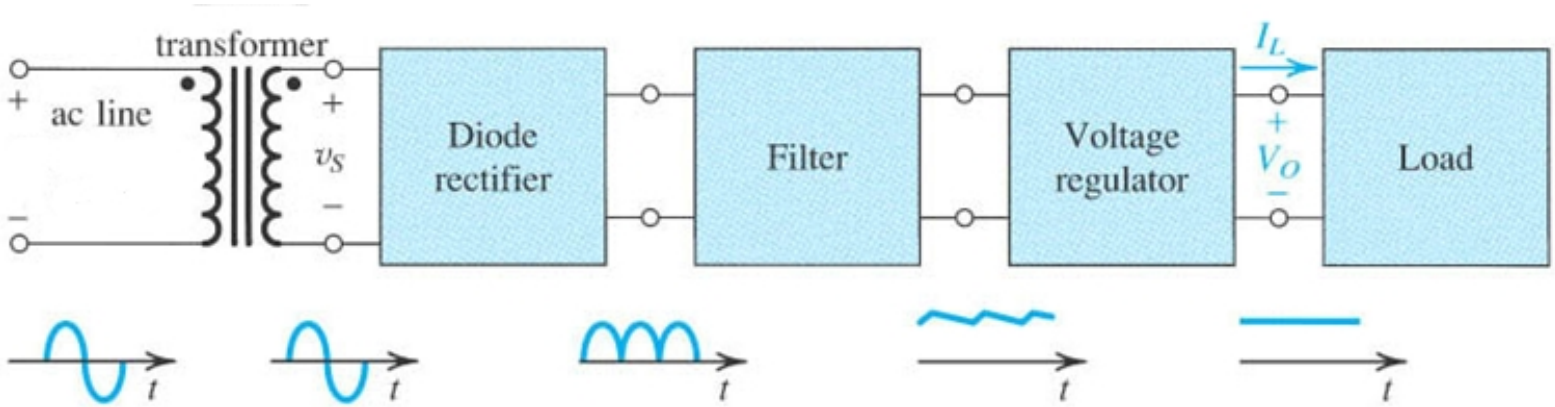
Modelo Completo-Lineal



(a) Forward bias (b) Reverse bias (c) *V-I* characteristic curve

Circuitos Rectificadores

Diagrama de bloques de una fuente de voltaje continuo:



El sistema está compuesto por 4 bloques:

(I) Transformador de poder

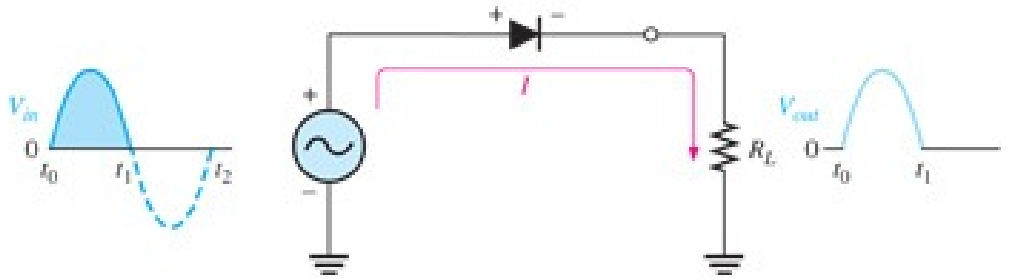
(II) Rectificador

(III) Filtro

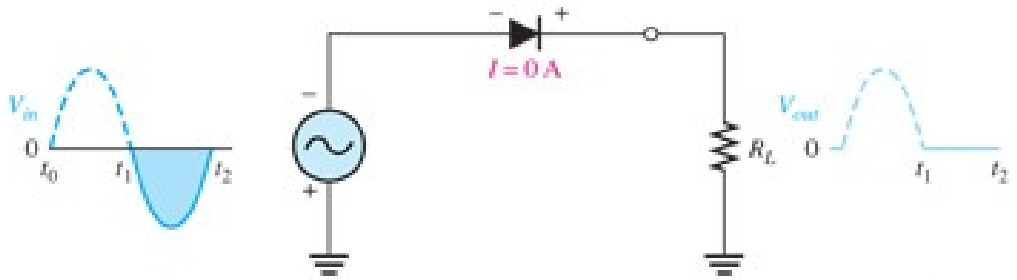
(IV) Regulador de voltaje

Rectificador de Media Onda

Rectificador de media onda utilizando modelo de fuente más resistencia:



(a) During the positive alternation of the 60 Hz input voltage, the output voltage looks like the positive half of the input voltage. The current path is through ground back to the source.

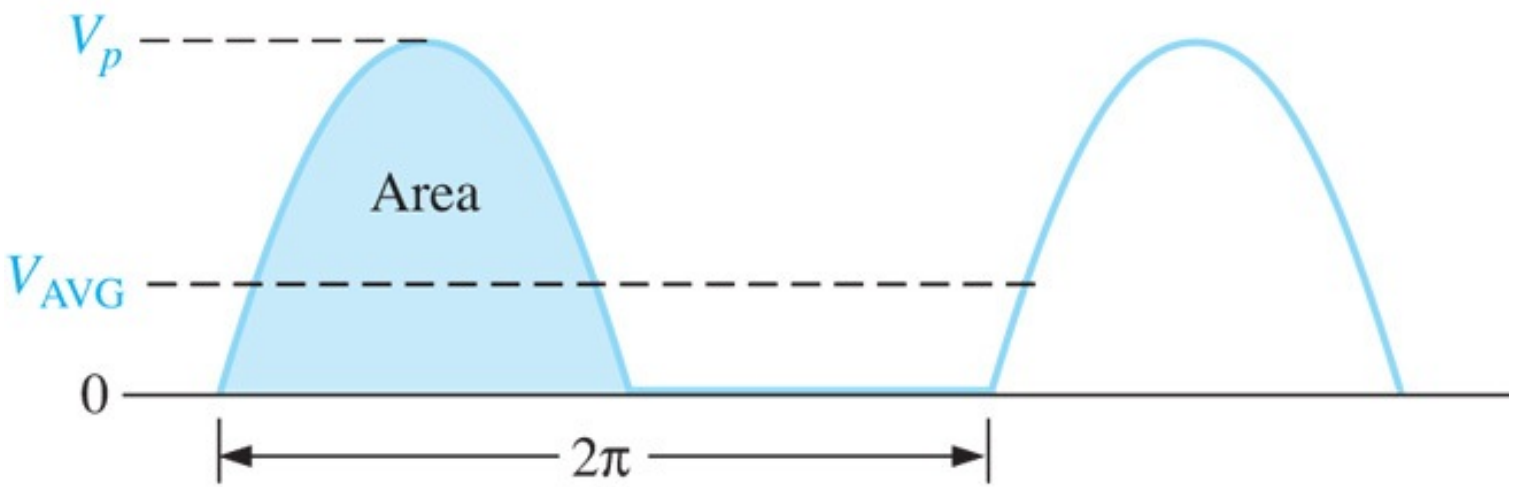


(b) During the negative alternation of the input voltage, the current is 0, so the output voltage is also 0.

(c) 60 Hz half-wave output voltage for three input cycles

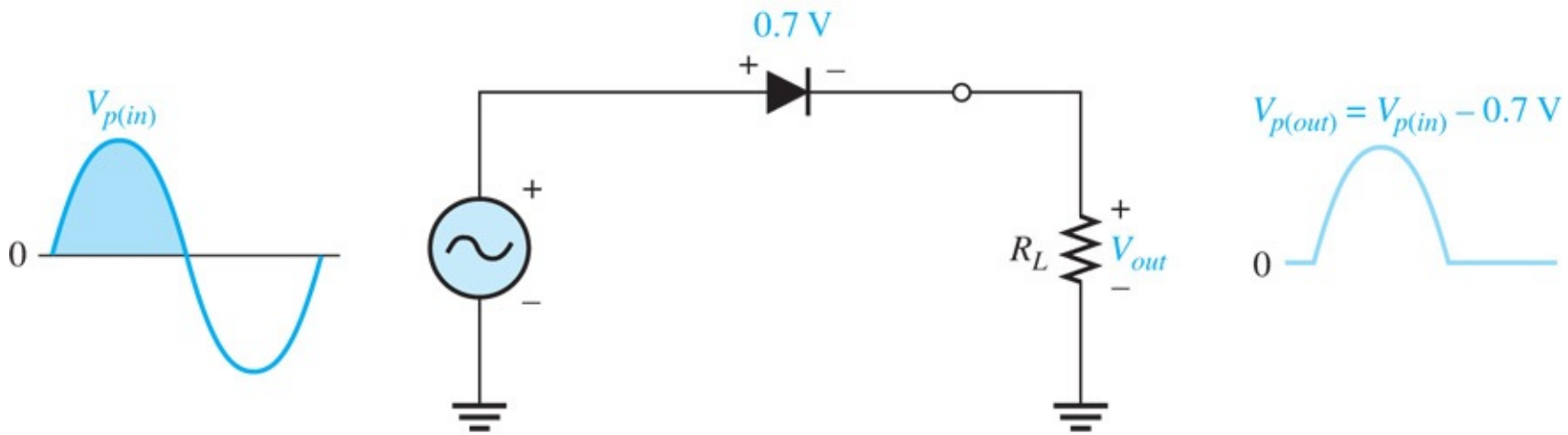
Rectificador de Media Onda

Rectificador de media onda utilizando modelo de fuente más resistencia:



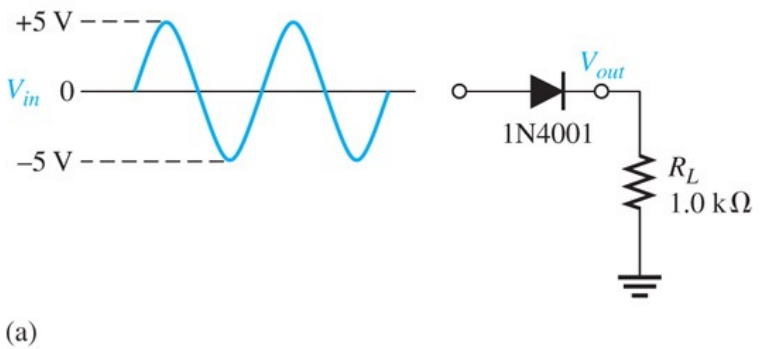
Rectificador de Media Onda

Rectificador de media onda utilizando modelo de fuente más resistencia:

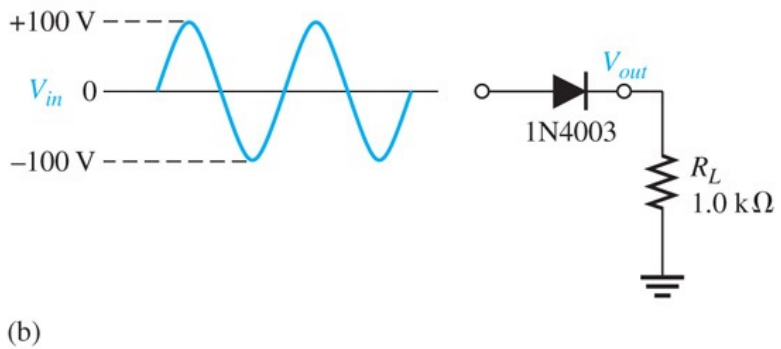


Rectificador de Media Onda

Rectificador de media onda utilizando modelo de fuente más resistencia:



(a)



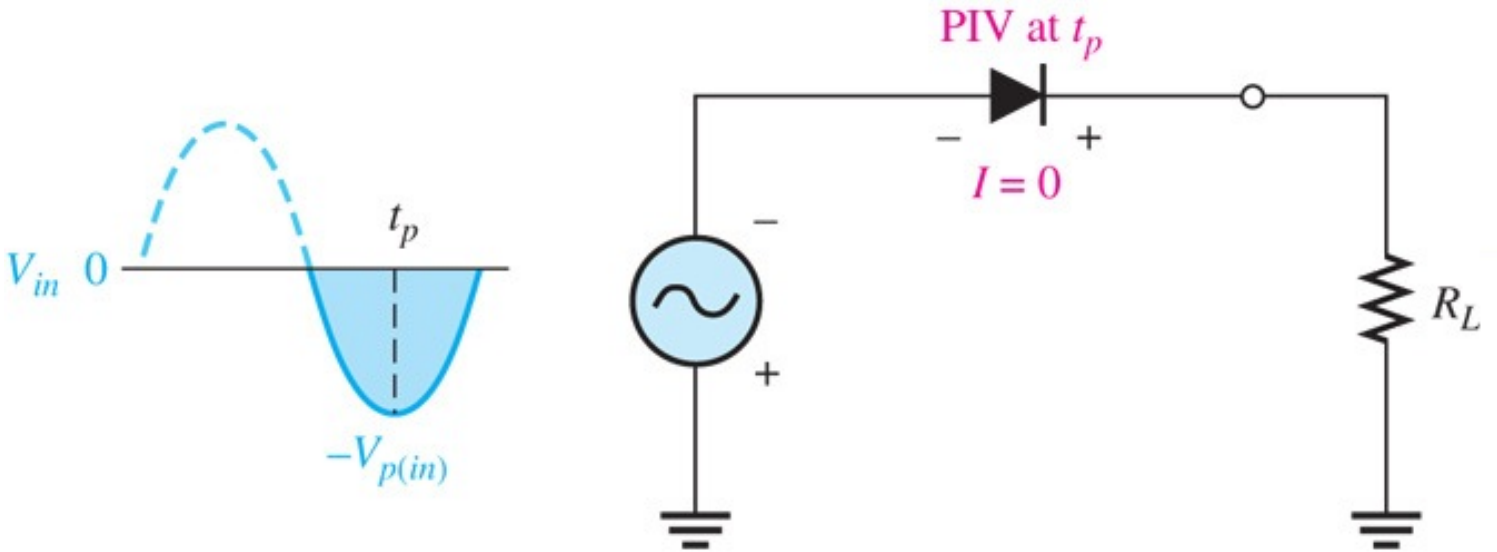
(b)

(a)

(b)

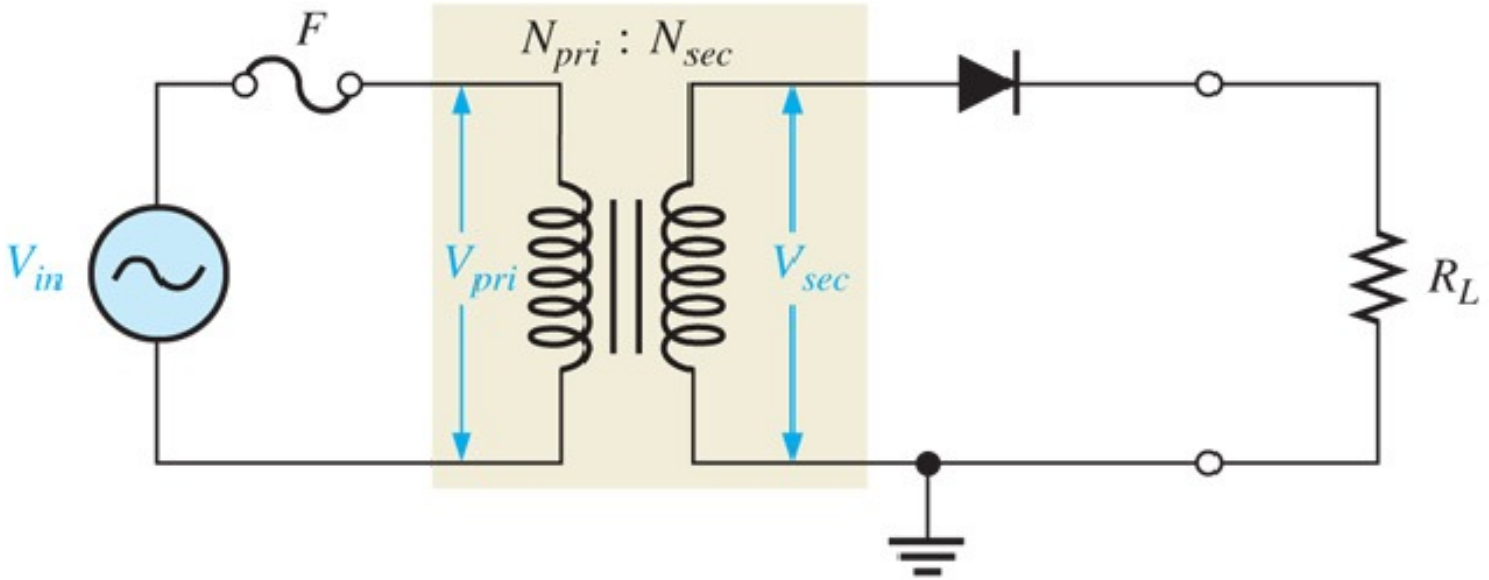
Rectificador de Media Onda

Rectificador de media onda utilizando modelo de fuente más resistencia:

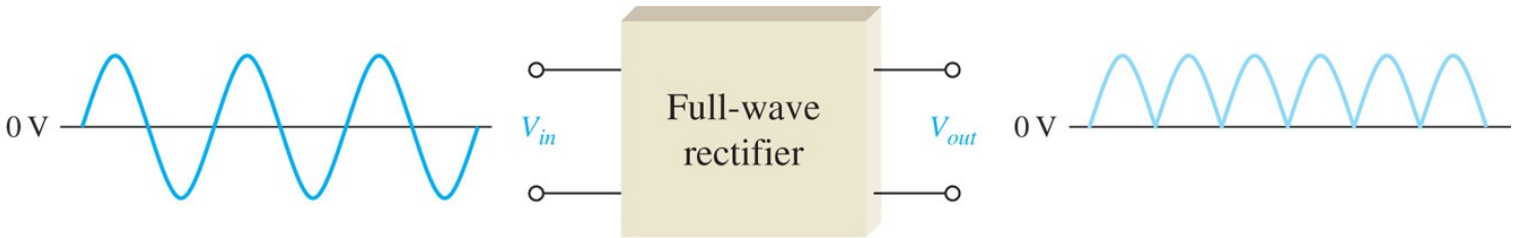


Rectificador de Media Onda

Rectificador de media onda utilizando modelo de fuente más resistencia:

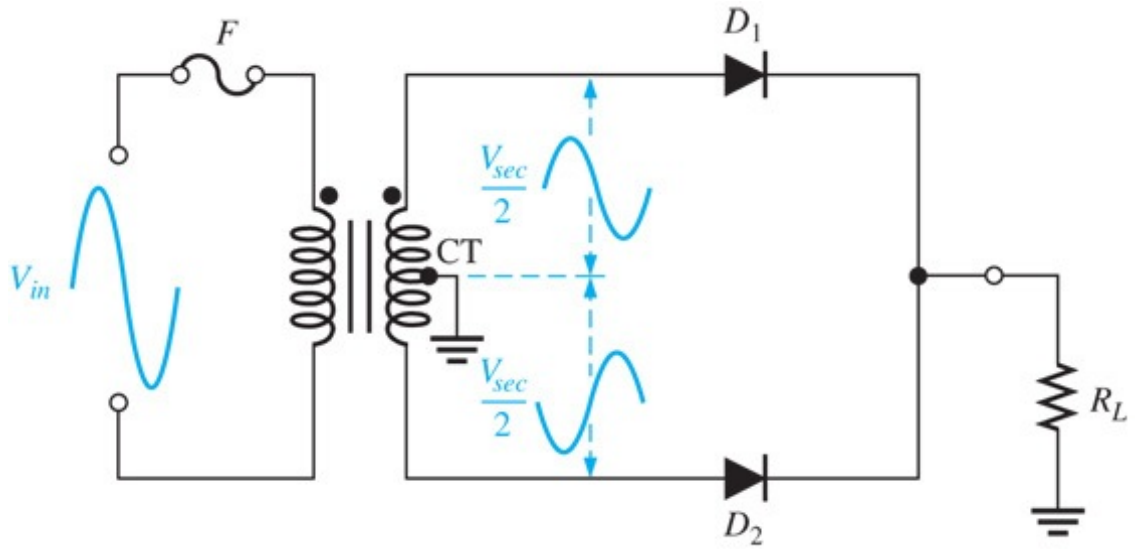


Rectificador de Onda Completa



Rectificador de Onda Completa

Al implementarlo con derivación central, se tiene la siguiente configuración:

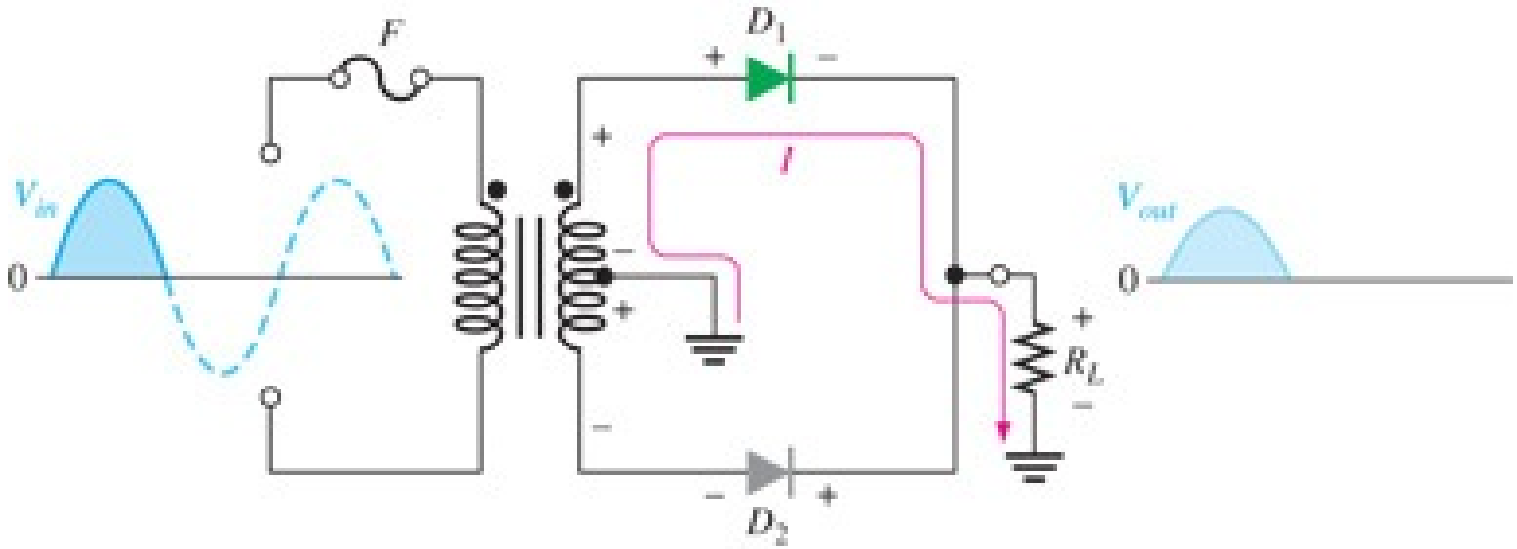


El funcionamiento consta de 2 partes:

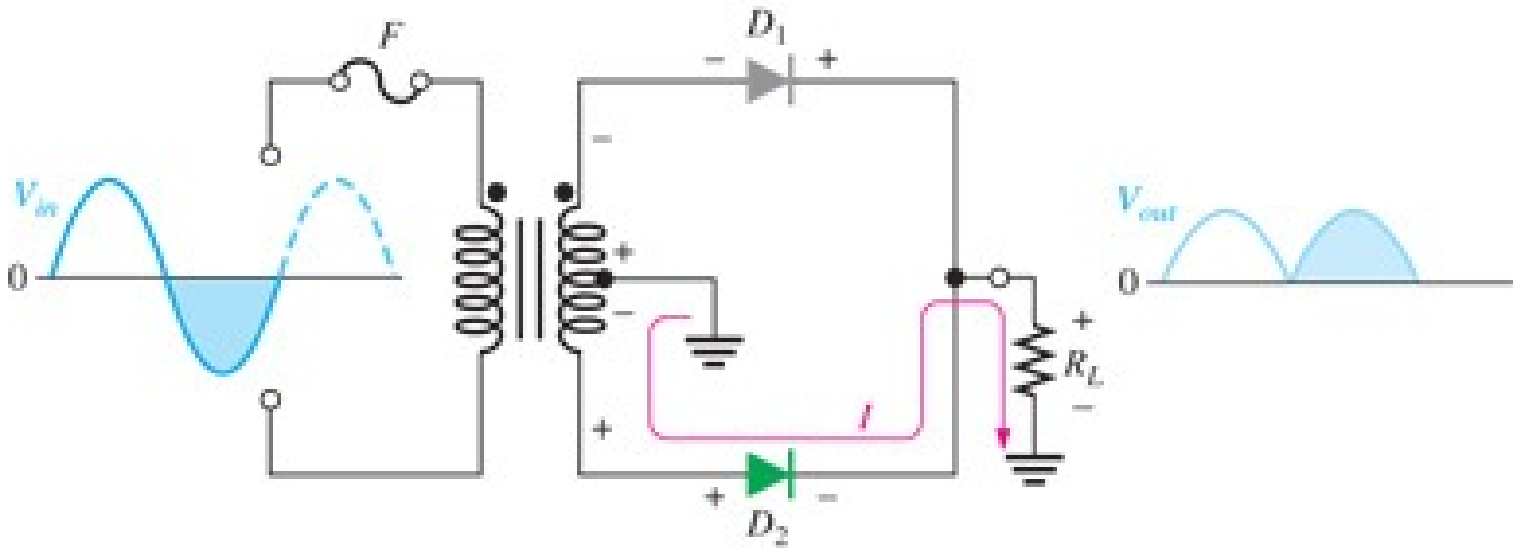
(I) Ciclo positivo: $v_{in} > 0$ D_1 conduce y D_2 está polarizado de forma inversa.

(II) Ciclo negativo: $v_{in} < 0$

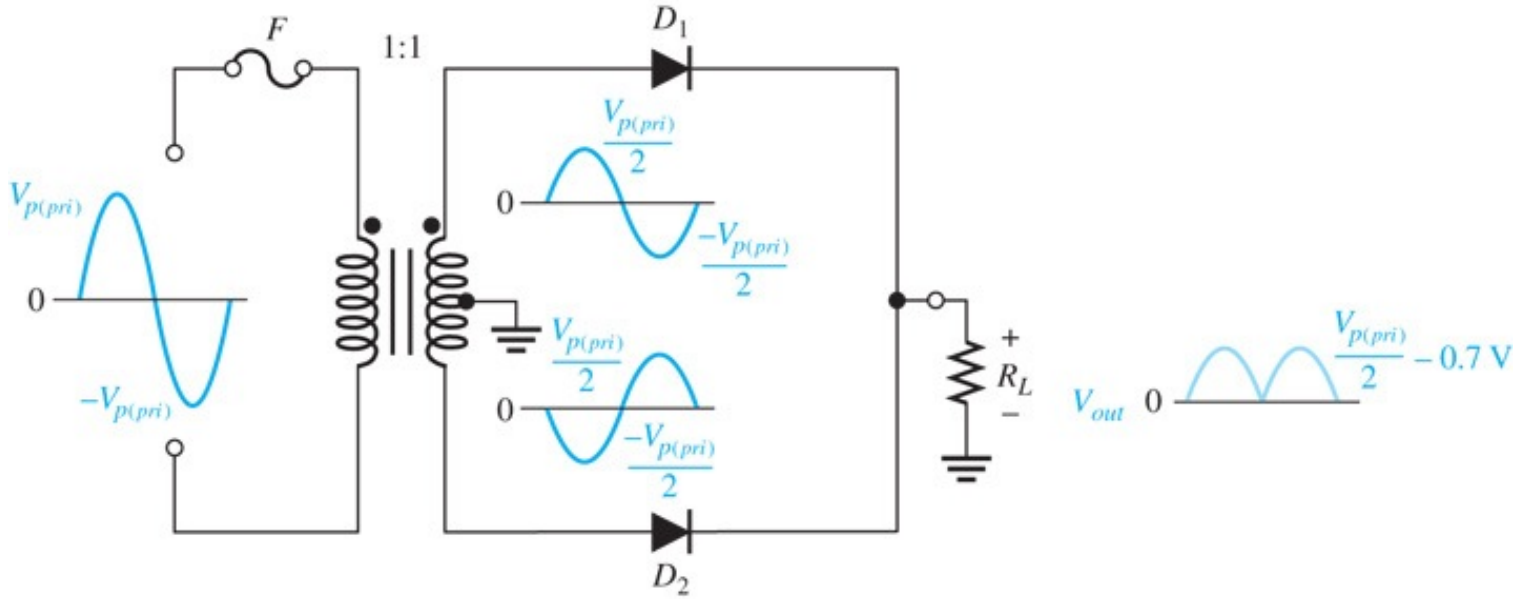
Rectificador de Onda Completa



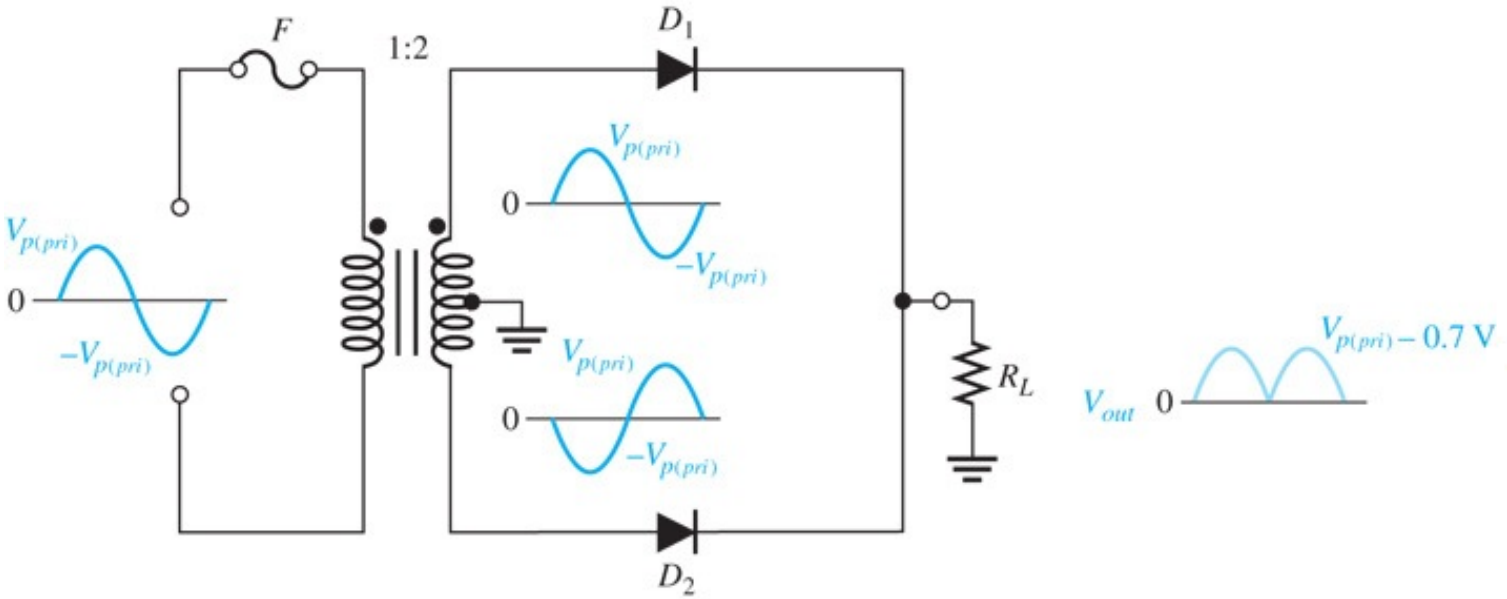
(a) During positive half-cycles, D_1 is forward-biased and D_2 is reverse-biased.



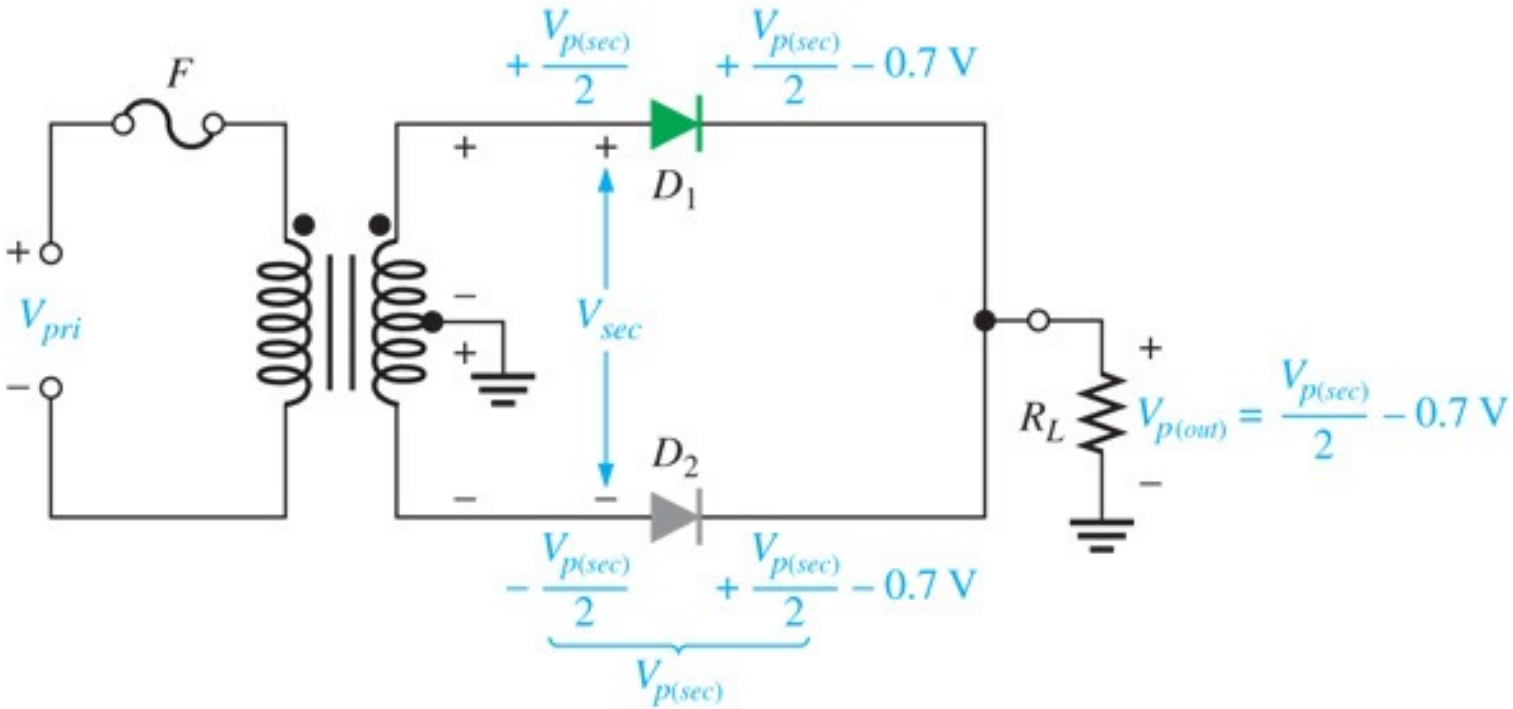
Rectificador de Onda Completa



Rectificador de Onda Completa

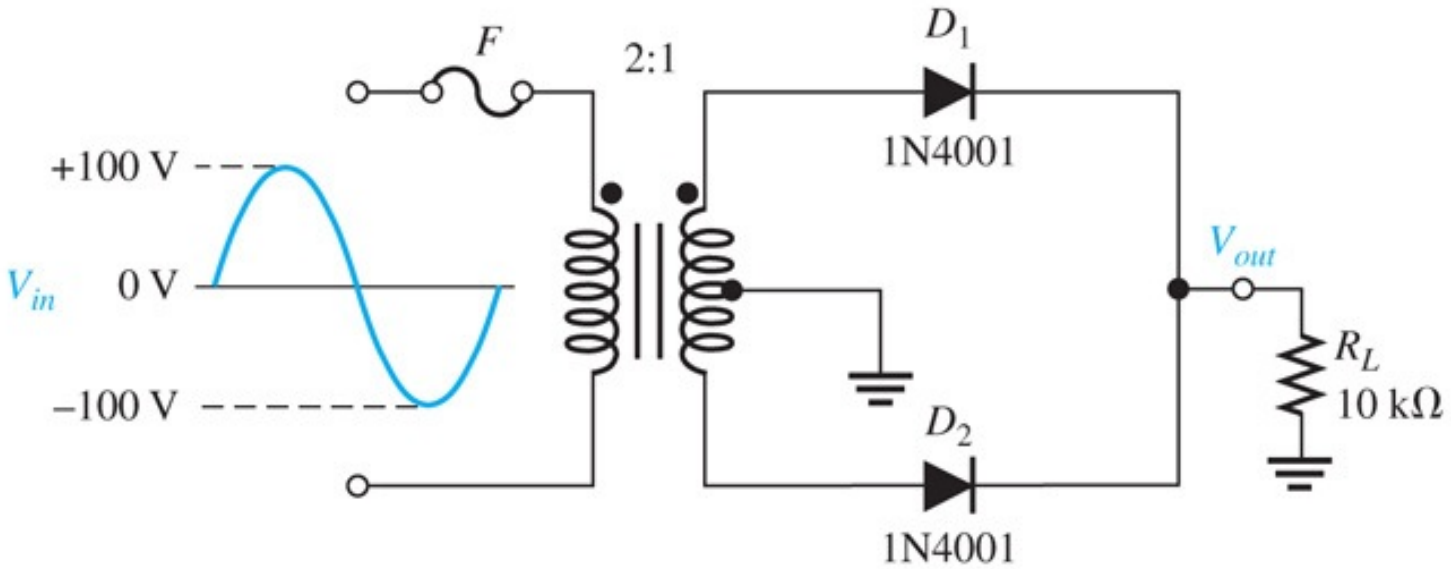


Rectificador de Onda Completa



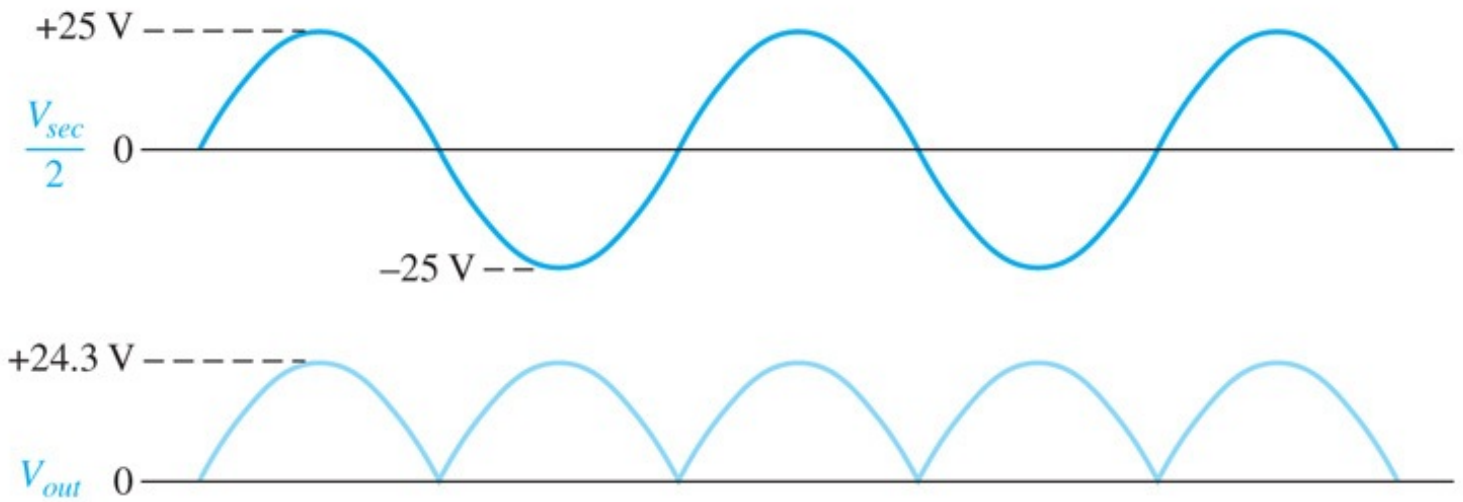
Rectificador de Onda Completa

Ejemplo



Rectificador de Onda Completa

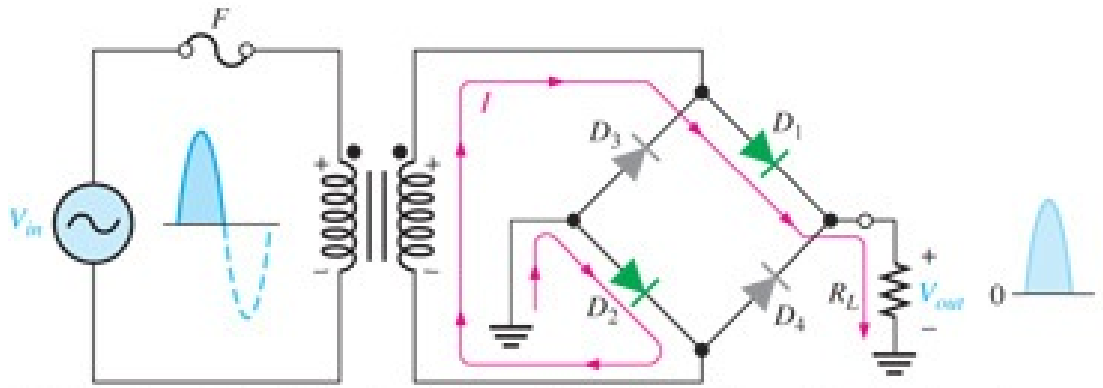
Ejemplo



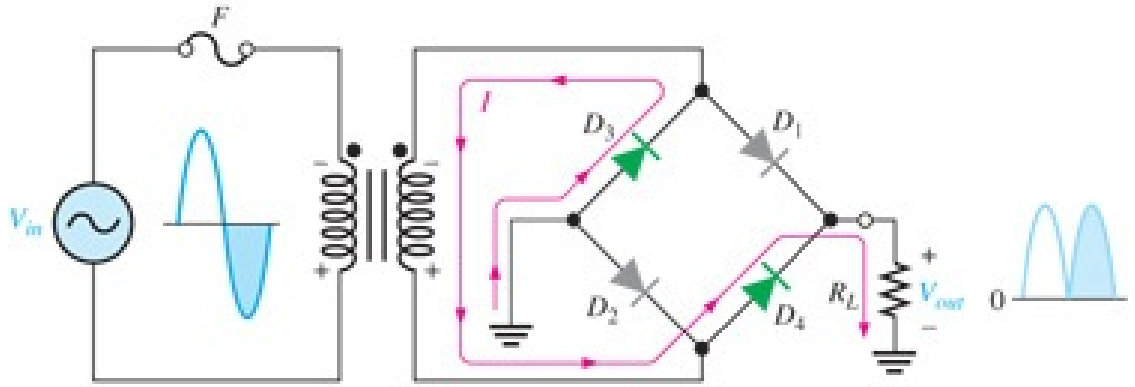
Rectificador de Onda Completa

Puente Rectificador

Sirve como un rectificador de onda completa. Su circuito es el siguiente:



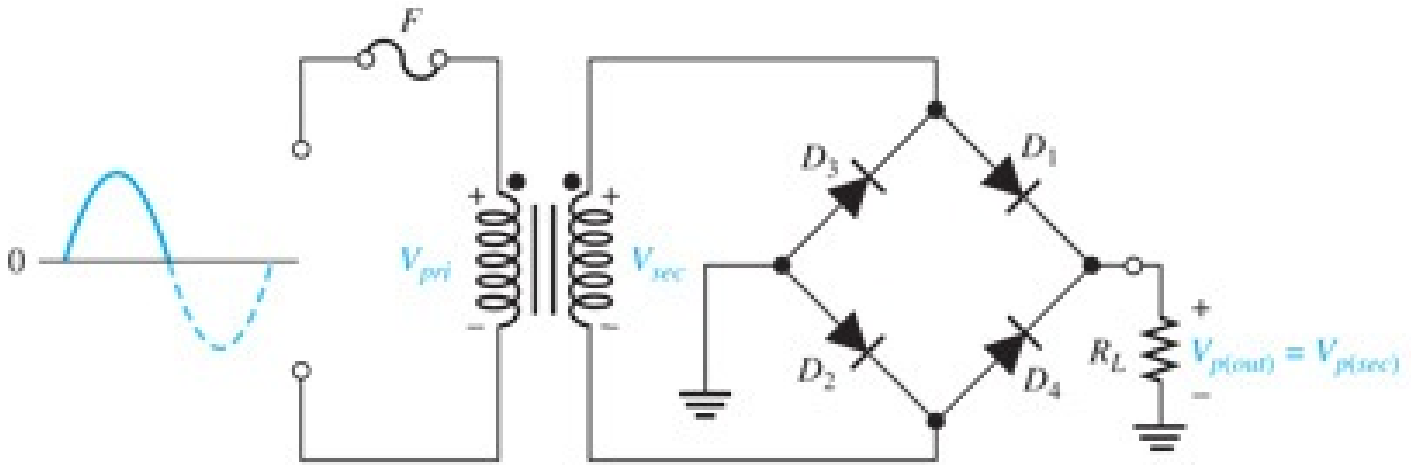
(a) During the positive half-cycle of the input, D_1 and D_2 are forward-biased and conduct current. D_3 and D_4 are reverse-biased.



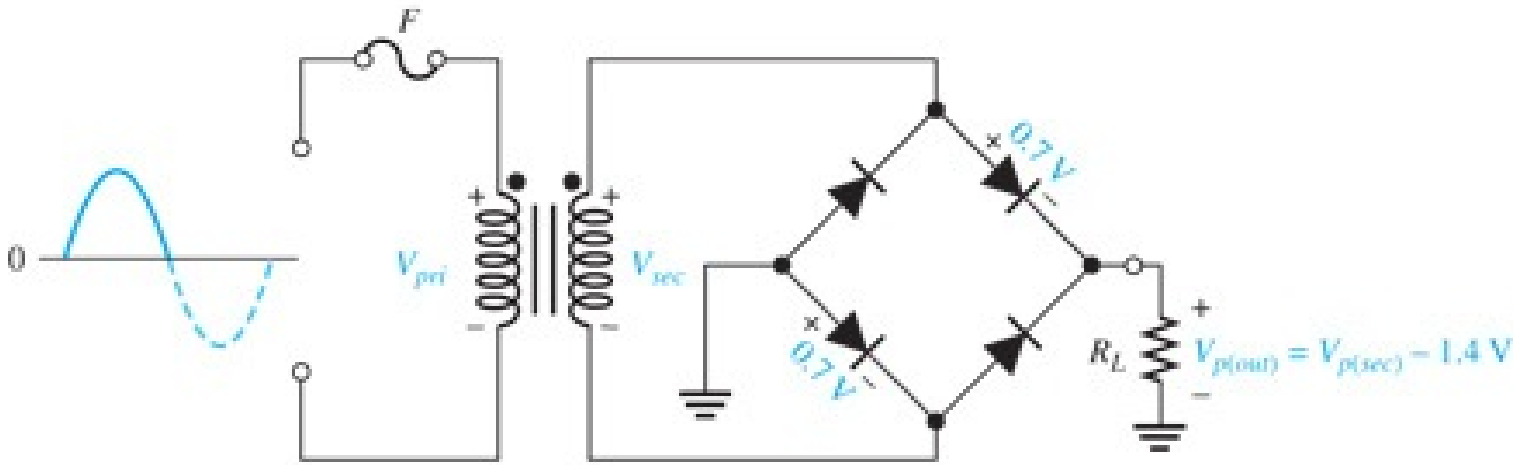
(b) During the negative half-cycle of the input, D_3 and D_4 are forward-biased and conduct current. D_1 and D_2 are reverse-biased.

Rectificador de Onda Completa

Operación del Circuito Puente Rectificador

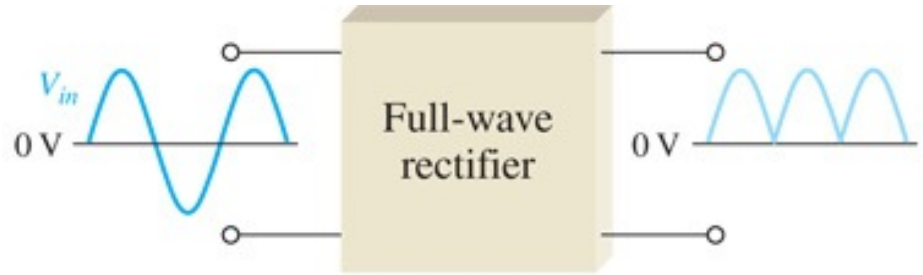


(a) Ideal diodes



(b) Practical diodes (Diode drops included)

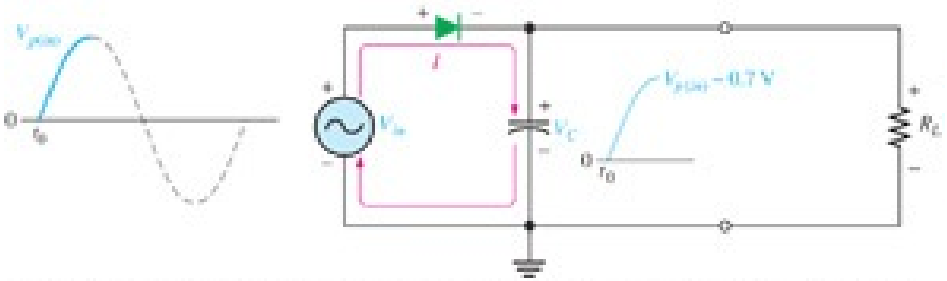
Rectificador con Filtro de Capacitancia



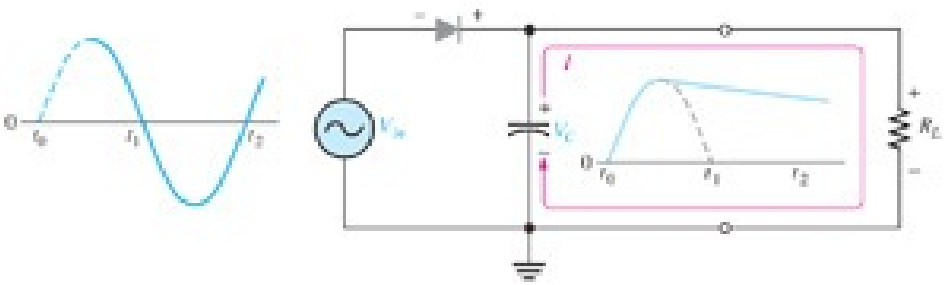
(a) Rectifier without a filter

(b) Rectifier with a filter (output ripple is exaggerated)

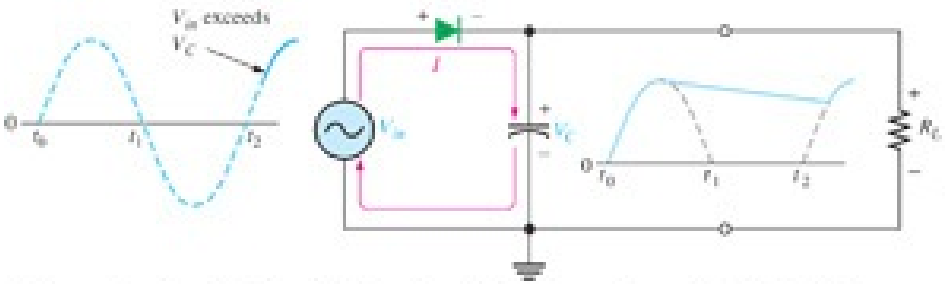
Rectificador con Filtro de Capacitancia



(a) Initial charging of the capacitor (diode is forward-biased) happens only once when power is turned on.

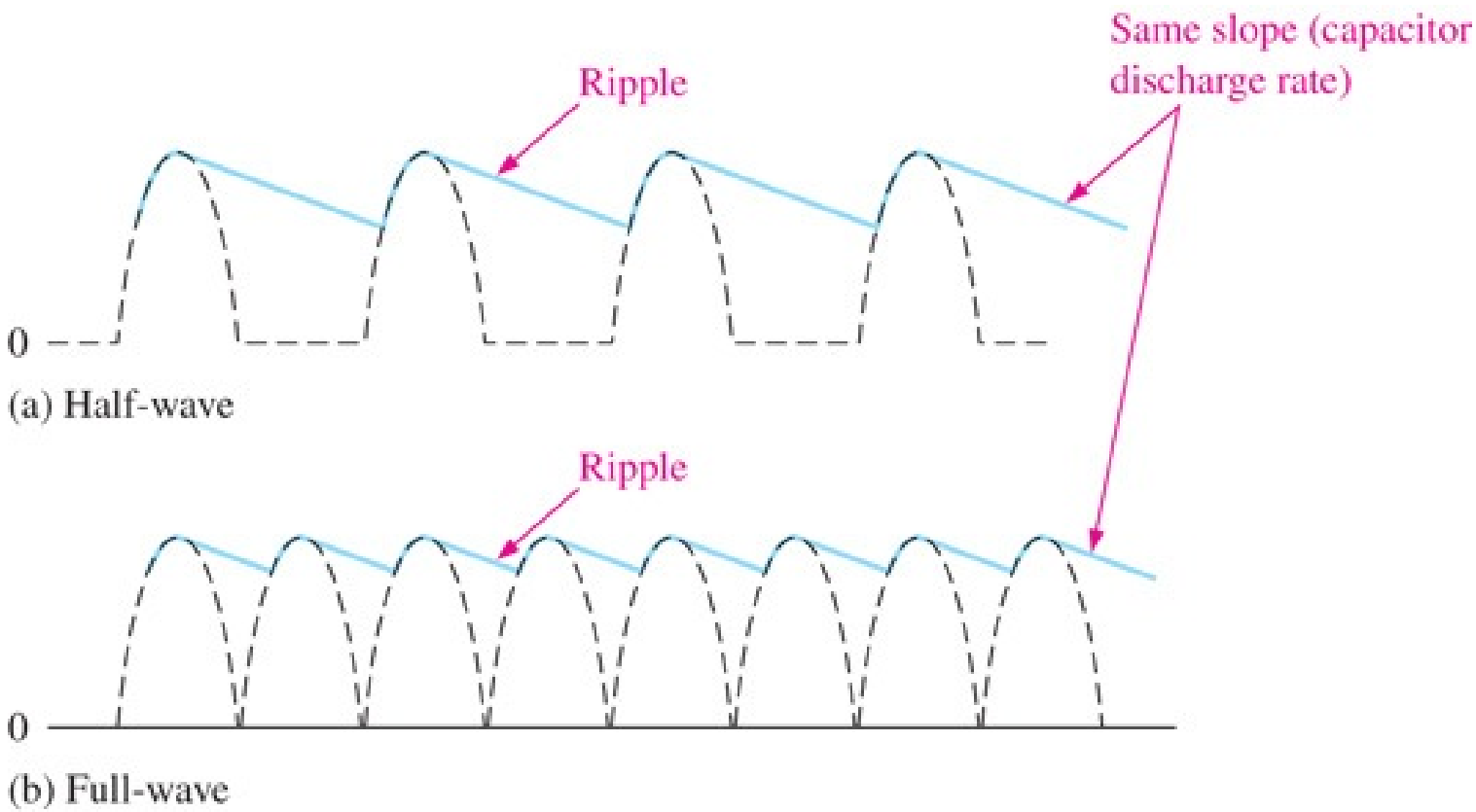


(b) The capacitor discharges through R_L after peak of positive alternation when the diode is reverse-biased. This discharging occurs during the portion of the input voltage indicated by the solid dark blue curve.

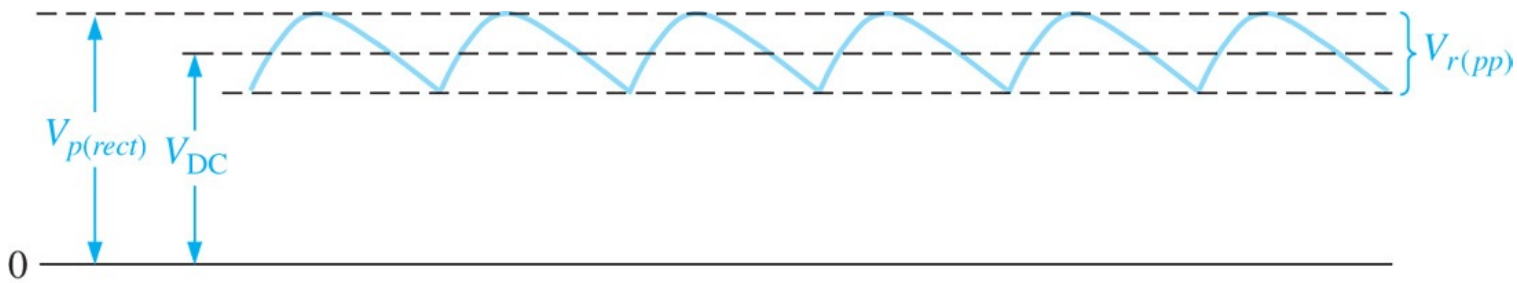


(c) The capacitor charges back to peak of input when the diode becomes forward-biased. This charging occurs during the portion of the input voltage indicated by the solid dark blue curve.

Rectificador con Filtro de Capacitancia



Rectificador con Filtro de Capacitancia



Factor de Rizo

$$r = \frac{V_{r(pp)}}{V_{CD}} \tag{135}$$

donde

$$V_{r(pp)} \approx \left(\frac{1}{f\ R_L C}\right) V_{p(\text{rect.})} \tag{136}$$

$$V_{CD} \approx \left(1 - \frac{1}{2\ f\ R_L C}\right) V_{p(\text{rect.})} \tag{137}$$

con f la frequencia.

Resumen Clase #7

- Comportamiento del Diodo
- Aplicaciones del Diodo
  - Rectificador de Media Onda
  - Rectificador de Onda Completa
  - Rectificador con filtro de capacitancia