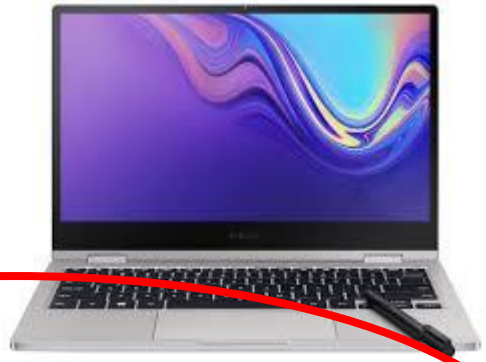
Circuitos con diodos

LABORATORIO 3
1er cuatrimestre 2023

Fuentes de alimentación de CC

Muchos equipos eléctricos y electrónicos funcionan con CC




AC → CC

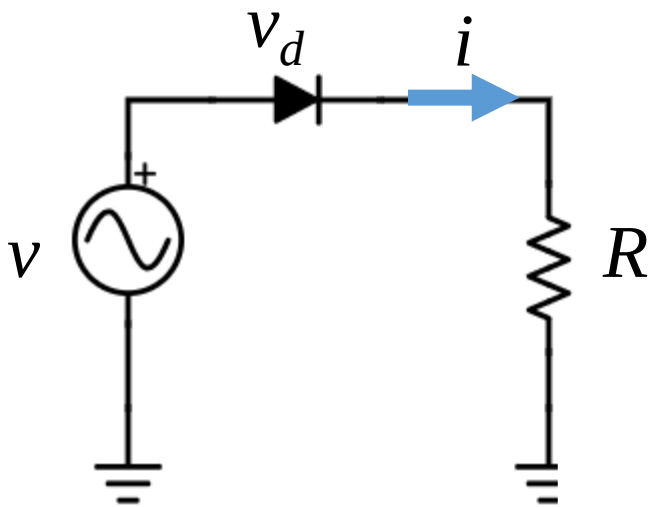
Fuente CC: Cambia el tipo de corriente y el valor de la tensión de salida

↓

Transformador + Rectificador

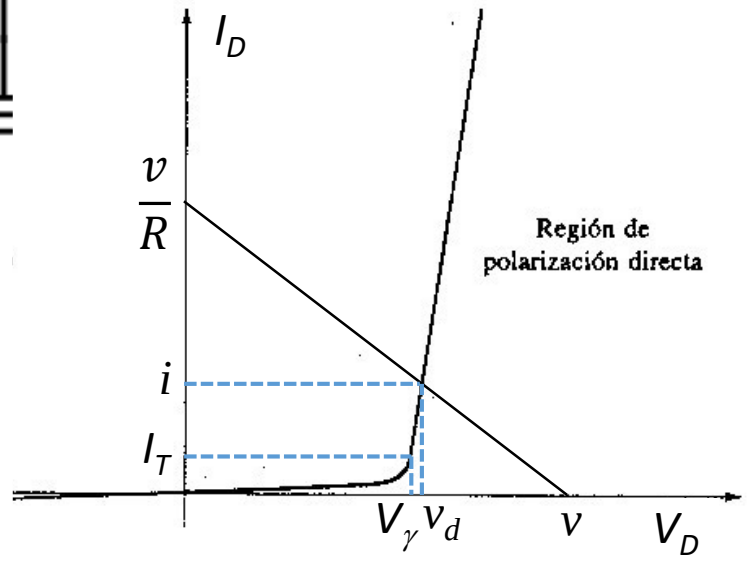
↳ Diodos

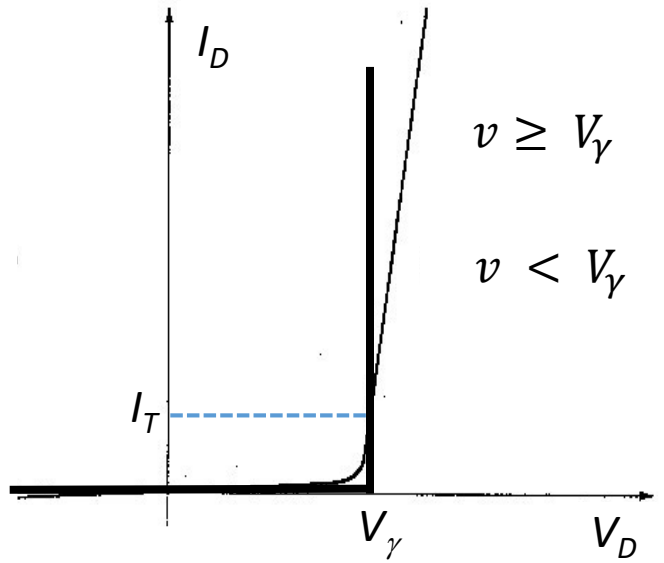
Diodo en circuitos AC



$$v(t) = V_0 \sin \omega t$$

$$v = v_d + iR \qquad v_d = v - iR$$



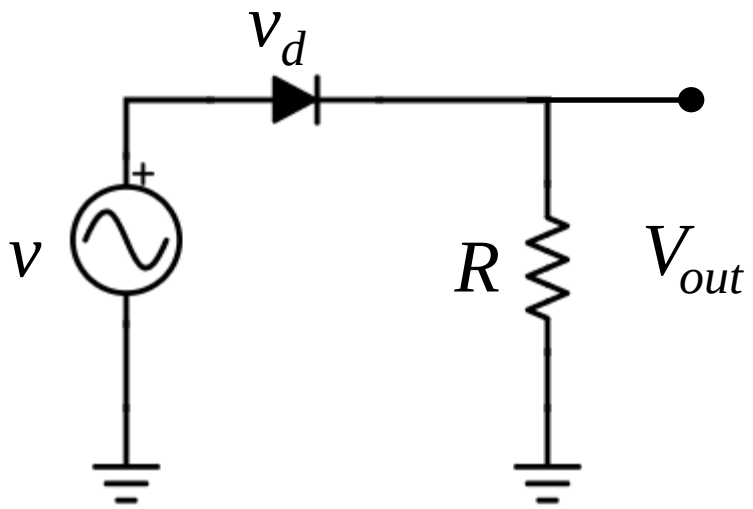


$v \geq V_\gamma$ $\quad v_d = V_\gamma$

$v < V_\gamma$ $\quad i_d = 0$

Circuito abierto

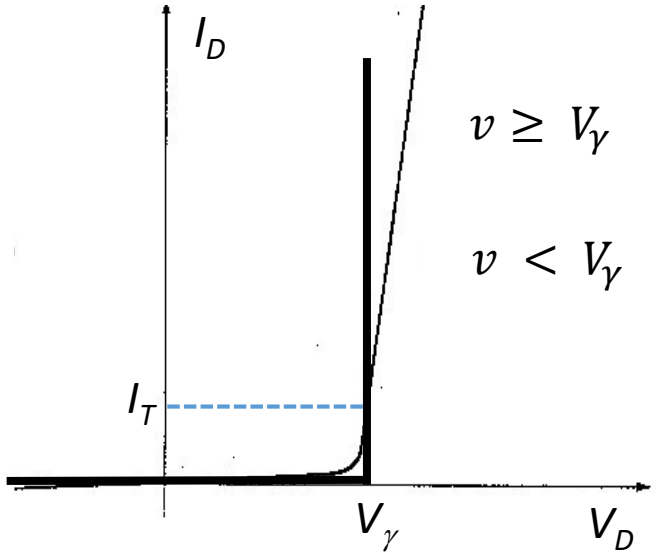
Diodo en circuitos AC



$$v(t) = V_0 \sin \omega t$$

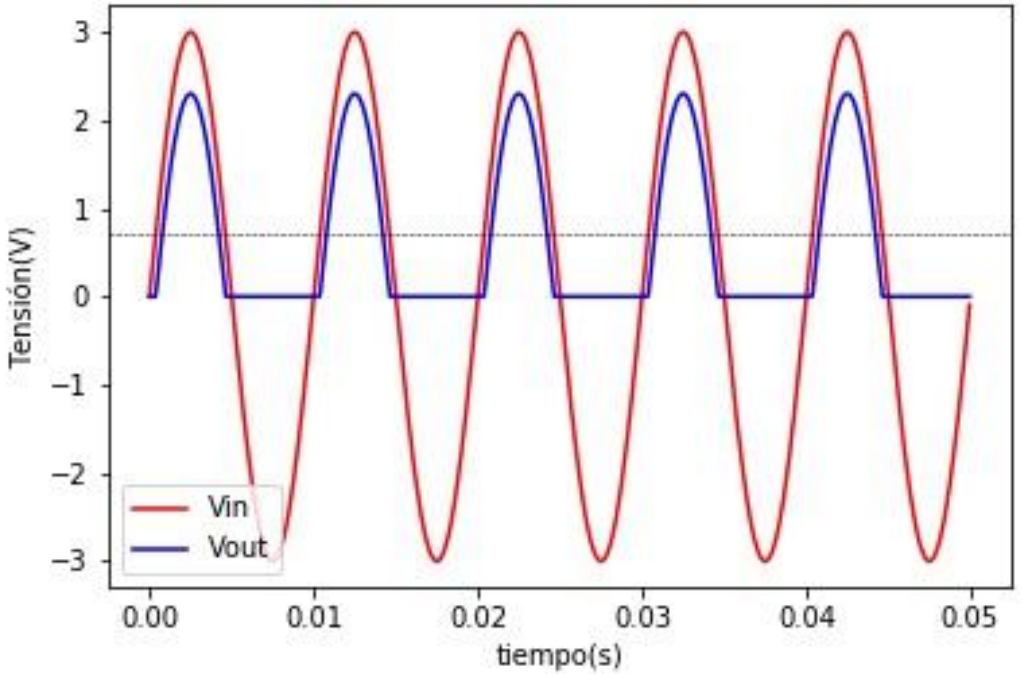
$$v = v_d + iR \qquad V_{out} = iR = v - v_d$$

$$v \geq V_\gamma \quad V_{out} = v - V_\gamma \qquad v < V_\gamma \quad V_{out} = 0$$

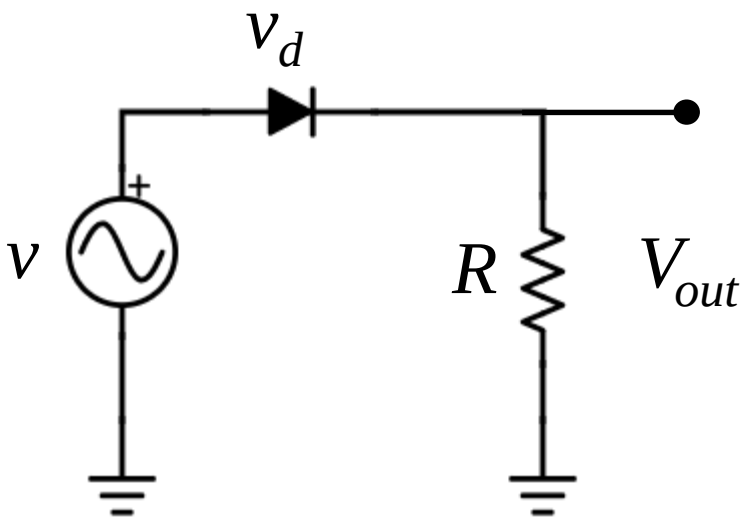


$$v \geq V_\gamma \qquad v_d = V_\gamma$$

$$v < V_\gamma \qquad i_d = 0$$



Rectificador de media onda



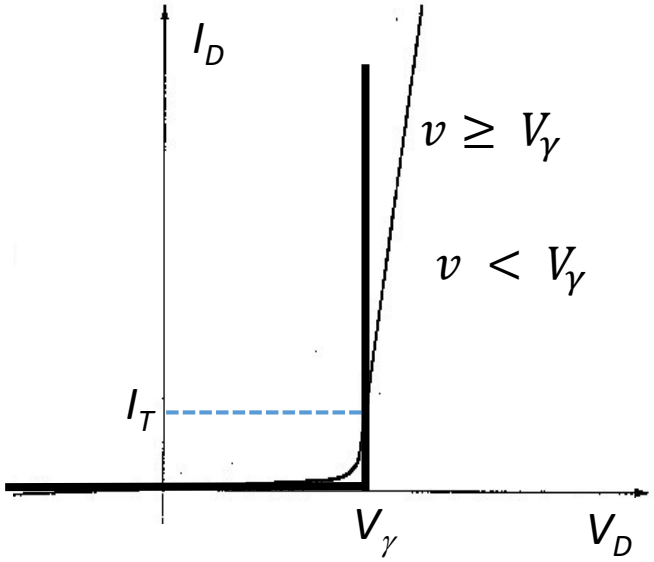
$$v(t) = V_0 \sin \omega t$$

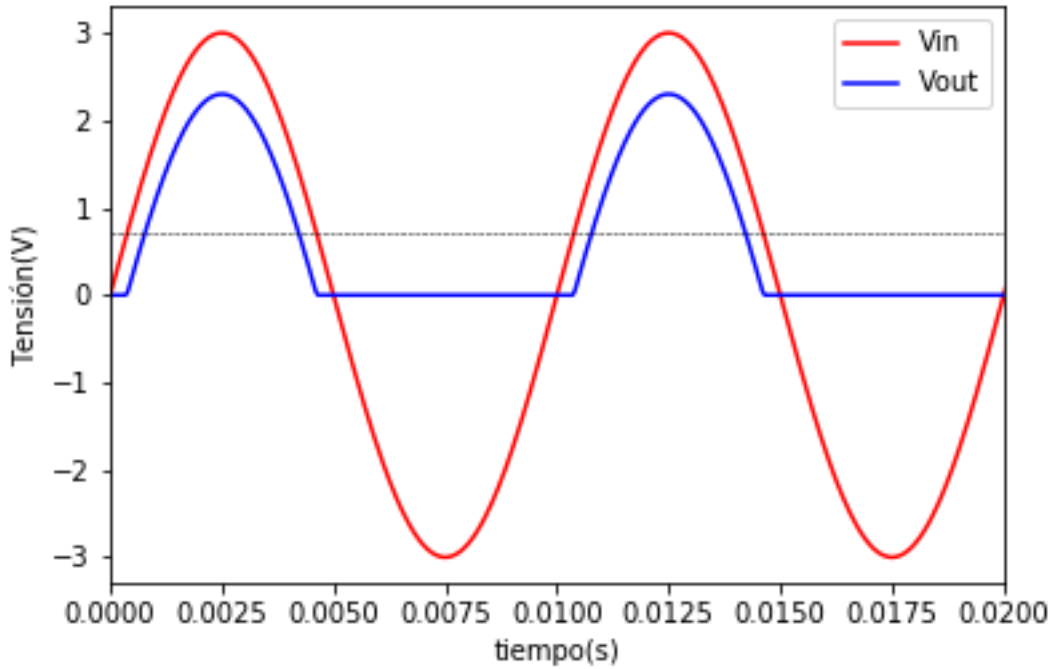
$$v = v_d + iR$$

Amplitud de v : 5V

R≈ 1 kΩ

$v \geq V_\gamma \quad V_{out} = v - V_\gamma \qquad v < V_\gamma \quad V_{out} = 0$

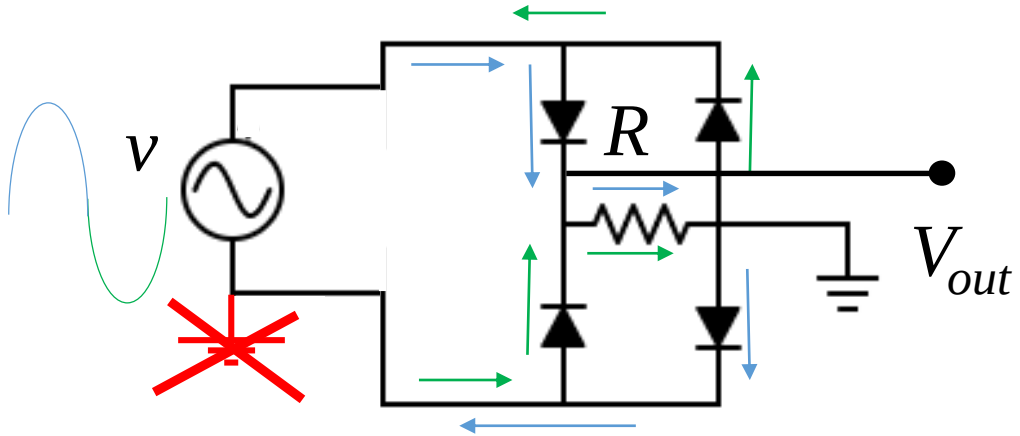


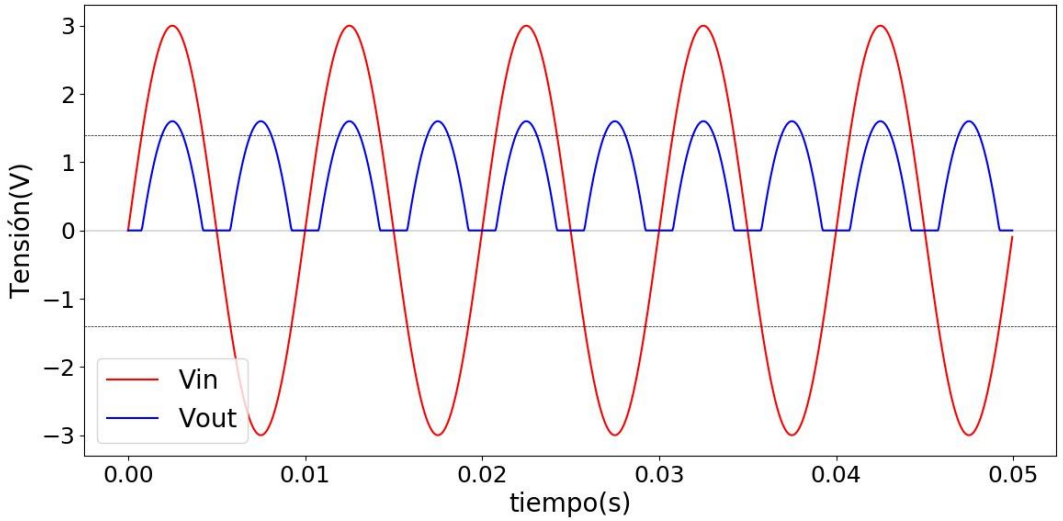


Rectificador de onda completa

Circuito puente de diodos

$$v \geq 2V_\gamma \qquad V_{out} = v - 2V_\gamma$$
$$-2V_\gamma \leq v \leq 2V_\gamma \qquad V_{out} = 0$$
$$v \leq -2V_\gamma \qquad V_{out} = -(v + 2V_\gamma)$$





¿¿Conexión a tierra de la fuente??

Rectificador de onda completa

$$v \geq 2V_\gamma \qquad V_{out} = v - 2V_\gamma$$
$$-2V_\gamma \leq v \leq 2V_\gamma \qquad V_{out} = 0$$
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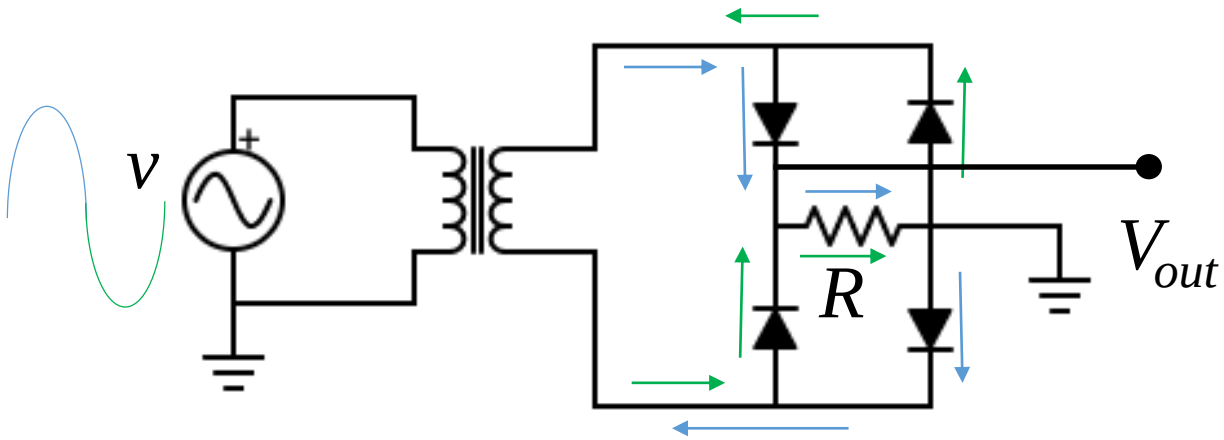
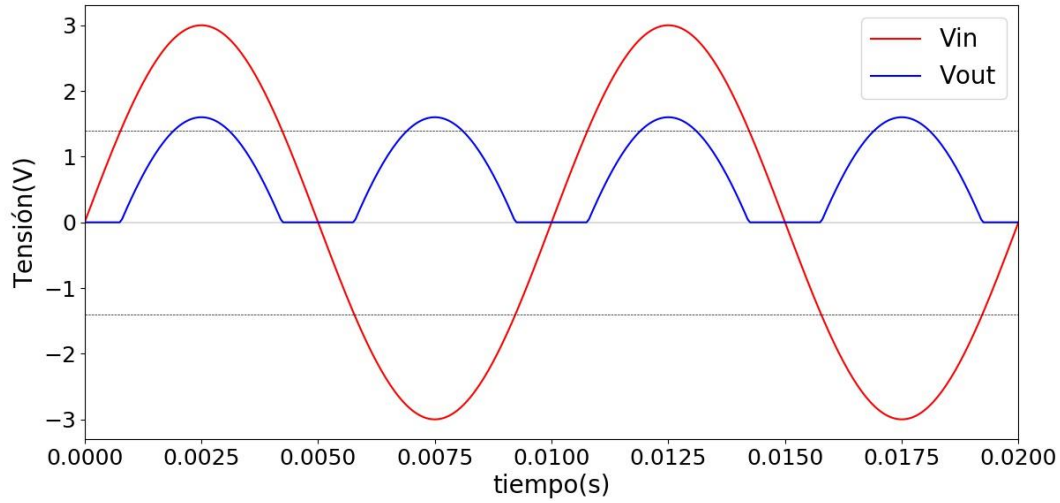
Circuito puente de diodos





Transformador
- Separa las conexiones de tierra
- Permite ajustar la tensión

Factor de ripple (rizado)

$$V_{med} = \frac{1}{T}\int_0^T v_R(t)dt$$

$$v_R(t) = V_{med} + v_{ripple}(t)$$

Componente debida a los armónicos

$$FR = \frac{V_{rip\ RMS}}{V_{med}}$$

$$V_{rip\ RMS} = \sqrt{\frac{1}{T}\int_0^T (v_R(t) - V_{med})^2 dt} = \sqrt{V_{RMS}^2 - V_{med}^2}$$

Rectificador media onda

$$V_{med} = \frac{V_{R0}}{\pi} \qquad V_{RMS} = \frac{V_{R0}}{2}$$

$$FR \sim 1{,}2 \rightarrow 120\%$$

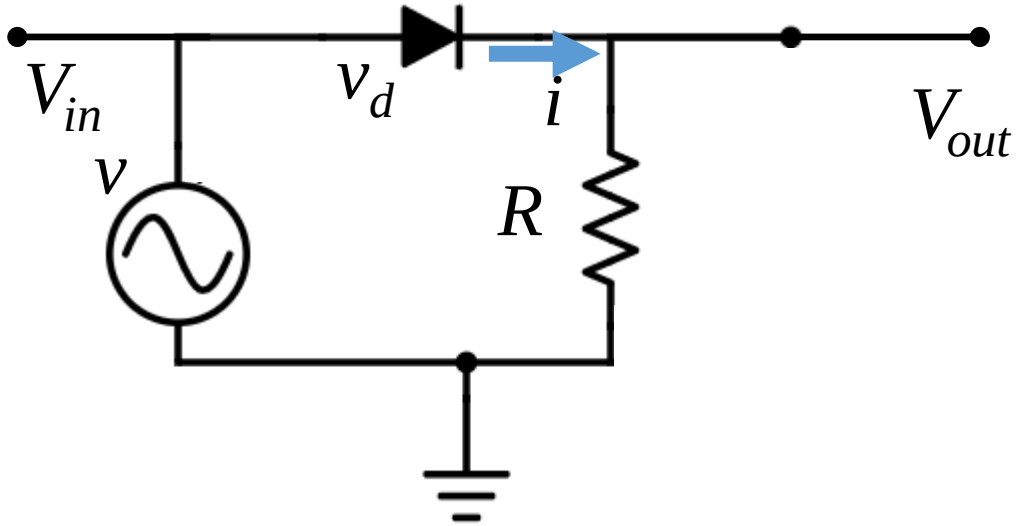
Rectificador onda completa

$$V_{med} = \frac{2V_{R0}}{\pi} \qquad V_{RMS} = \frac{V_{R0}}{\sqrt{2}}$$

$$FR \sim 0{,}5 \rightarrow 50\%$$

¿Cómo disminuir el ripple?

Rectificador de media onda



$$v(t) = V_0 \sin \omega t$$

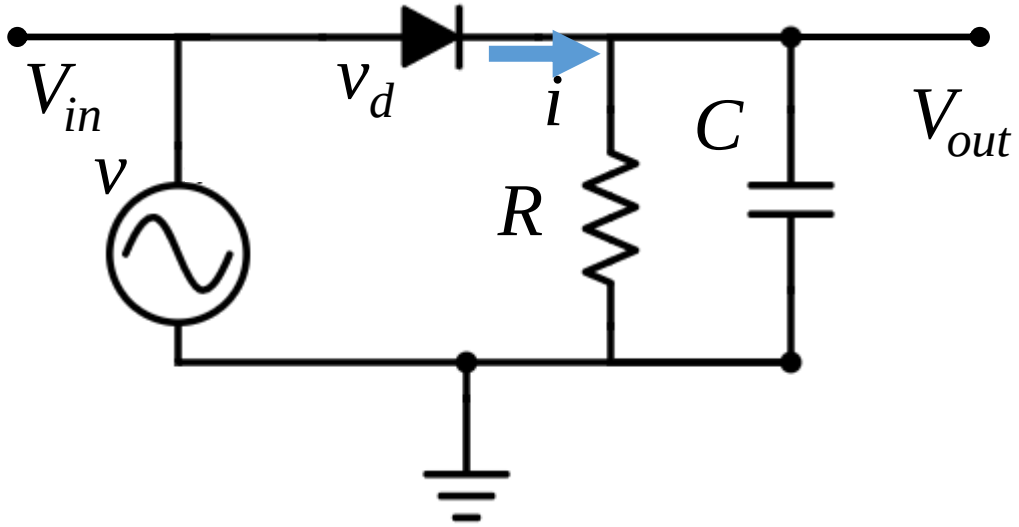
$$v \geq V_\gamma \quad V_{out} = v - V_\gamma$$

$$v < V_\gamma \quad V_{out} = 0$$

¿Cómo disminuir el ripple?

Rectificador de media onda

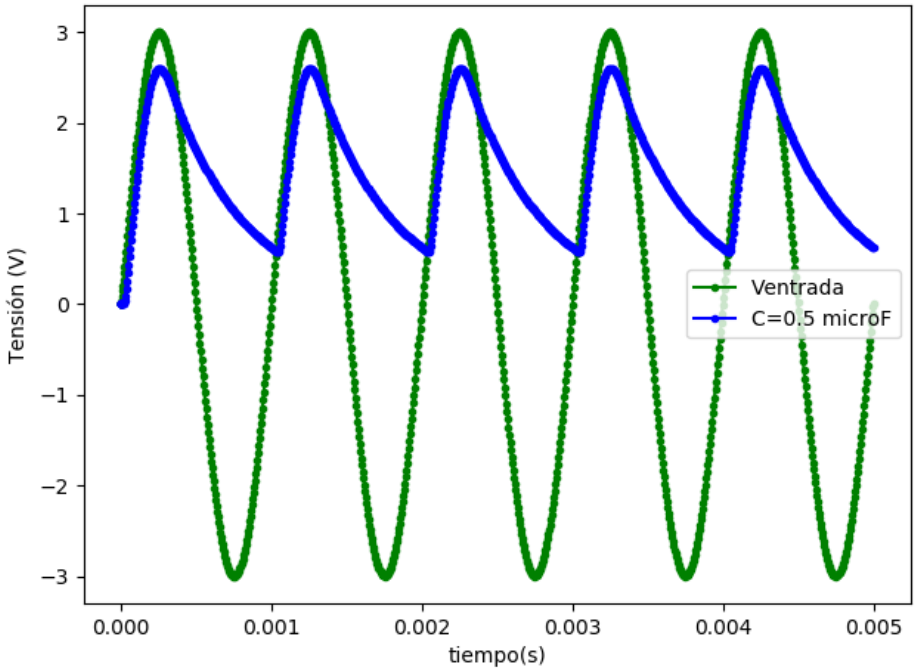
- Agregar un capacitor en paralelo



$$v(t) = V_0 \sin \omega t$$

$v \geq V_\gamma \quad V_{out}$ ⟹ Carga el capacitor

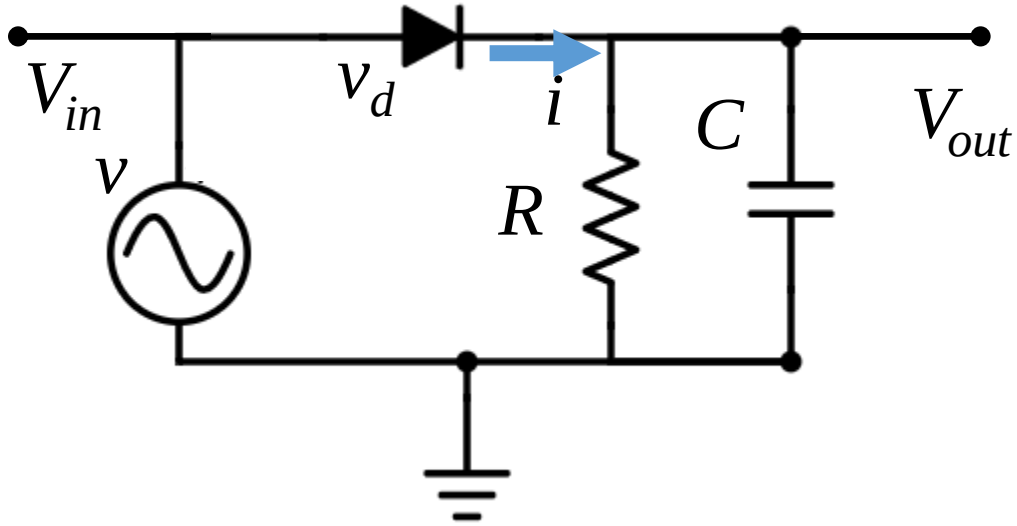
$v < V_\gamma \quad V_{out}$ ⟹ Descarga el capacitor sobre R



- $RC < T$

¿Cómo disminuir el ripple?

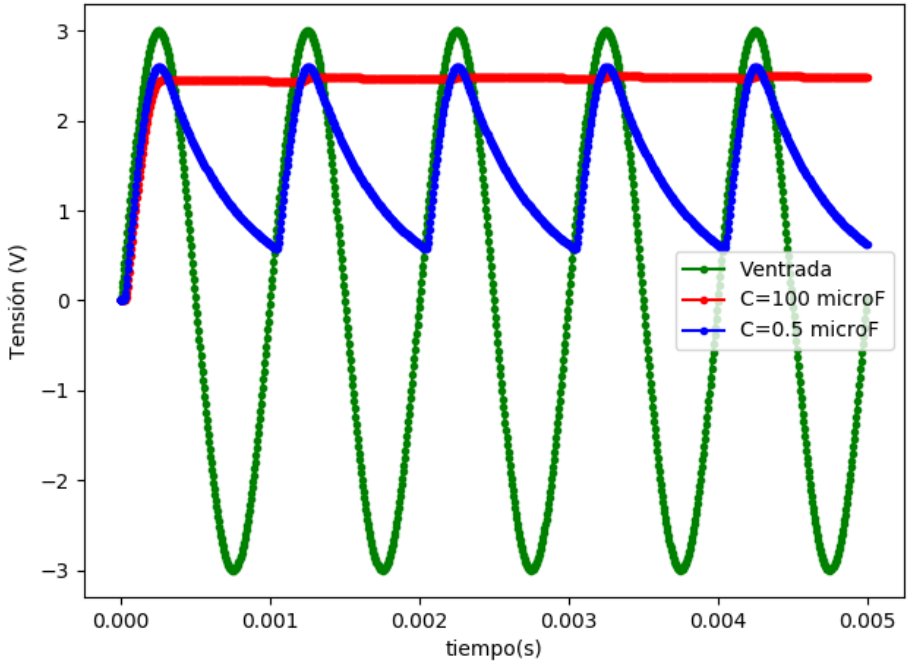
Rectificador de media onda



$$v(t) = V_0 \sin \omega t$$

$v \geq V_\gamma \quad V_{out}$ ⟹ Carga el capacitor

$v < V_\gamma \quad V_{out}$ ⟹ Descarga el capacitor sobre R



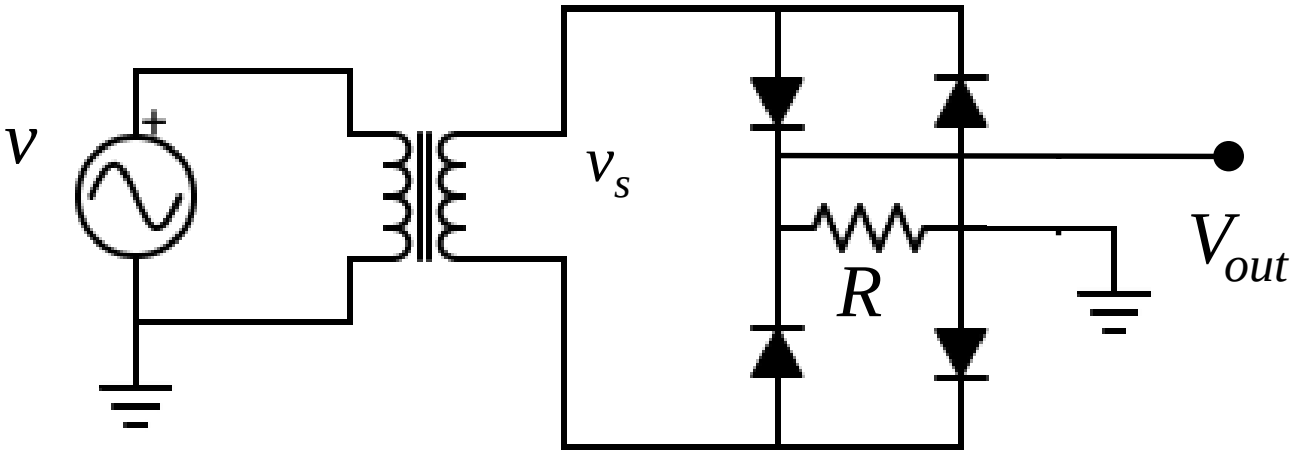
- $RC \gg T$
- $RC < T$

Amplitud de v : 5V; R≈ 1 kΩ

C=100nF, 10 μF, 100 μF

¿Cómo disminuir el ripple?

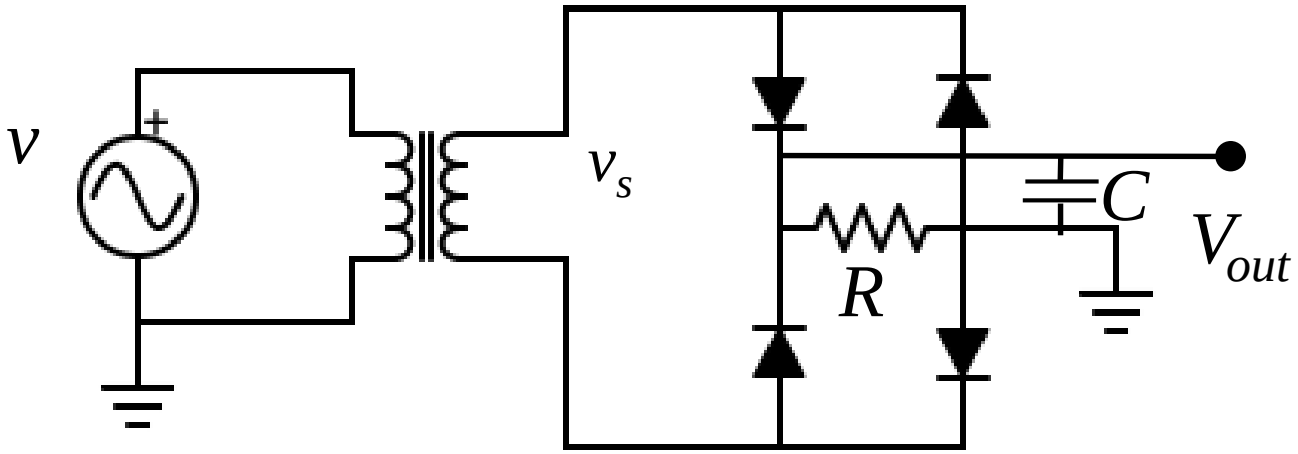
Rectificador onda completa

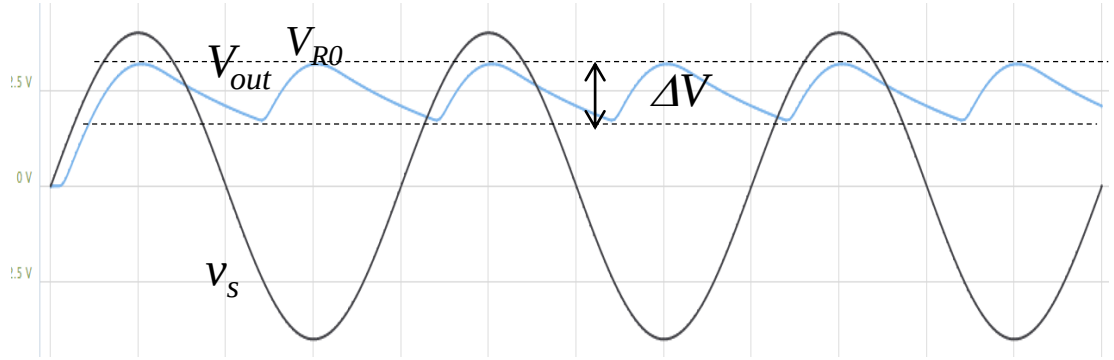


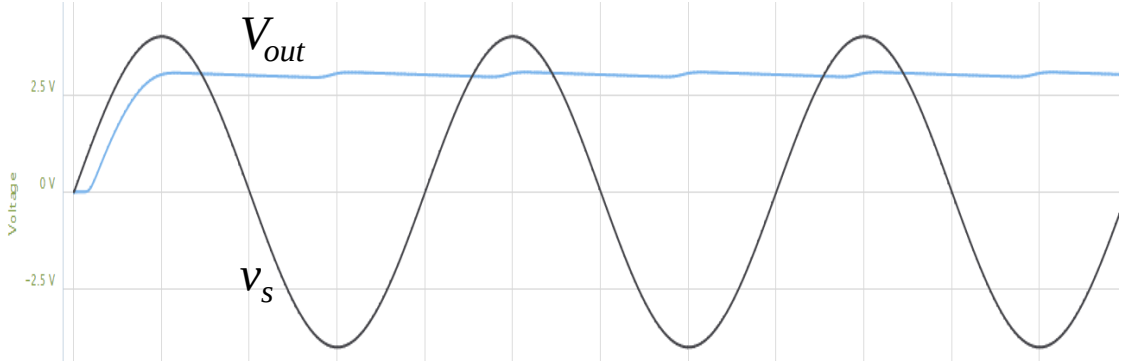
¿Cómo disminuir el ripple?

- Agregar un capacitor en paralelo

Rectificador onda completa







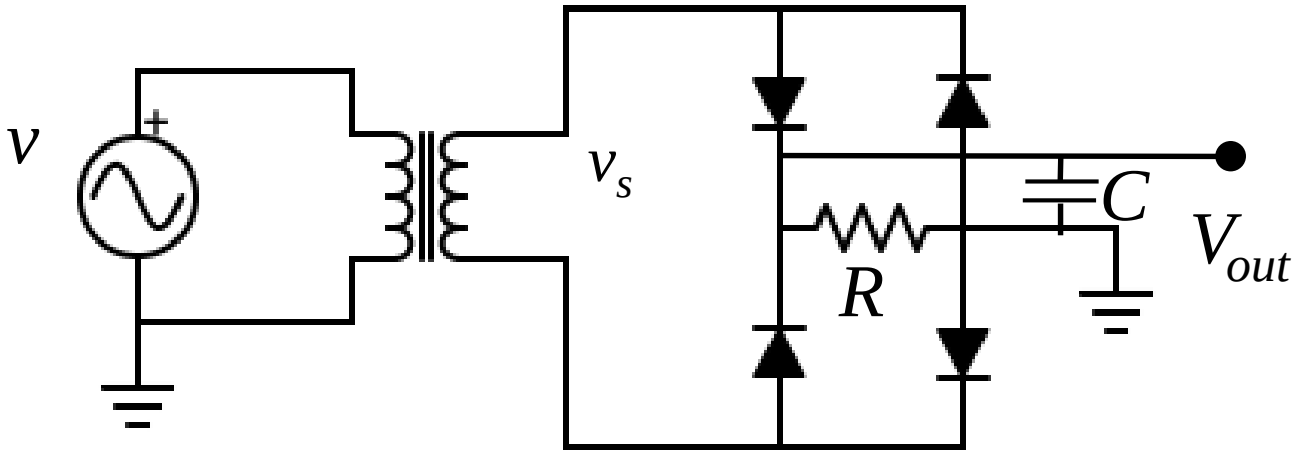
$\tau \gg T \quad FR \approx \frac{\Delta V}{V_{medio}}$

$FR \approx \frac{T}{2RC}$

$\Delta V \cong V_{R0}(1 - e^{-T/2\tau}) \approx V_{R0}\frac{T}{2\tau}$

Rectificador de onda completa

Rectificador onda completa



- Agregar un capacitor en paralelo

Amplitud de v : 1V

Transformador: $v_s > v$

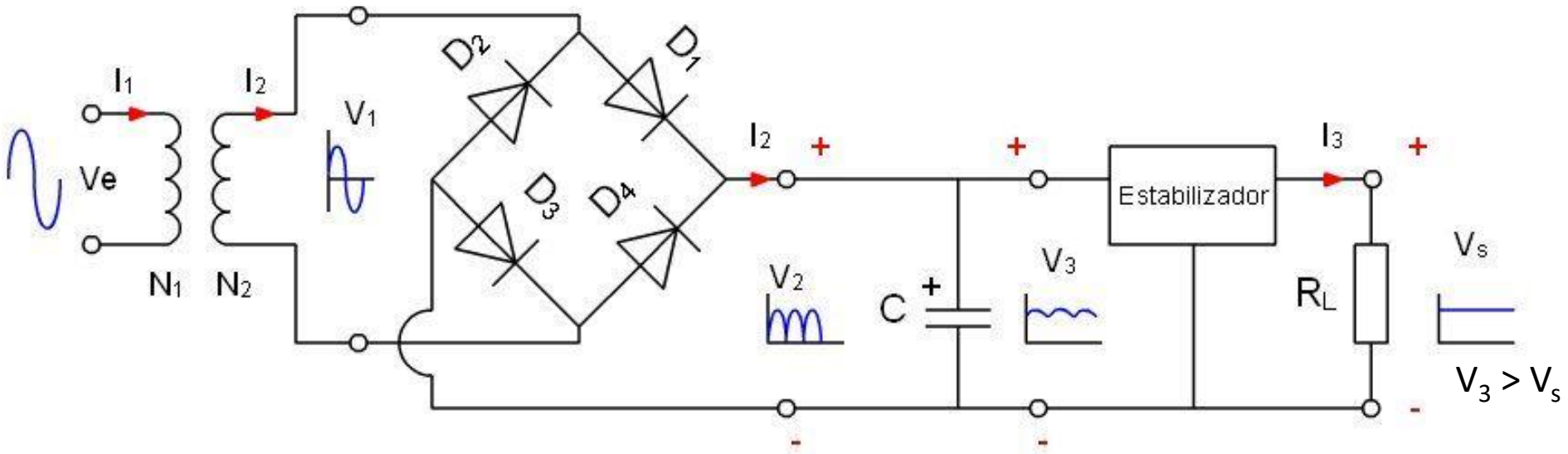
R≈ 1 kΩ

C = 1μF, 10 μF y 100 μF

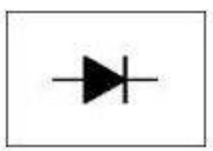
Medir V_{out}

Estimar el FR

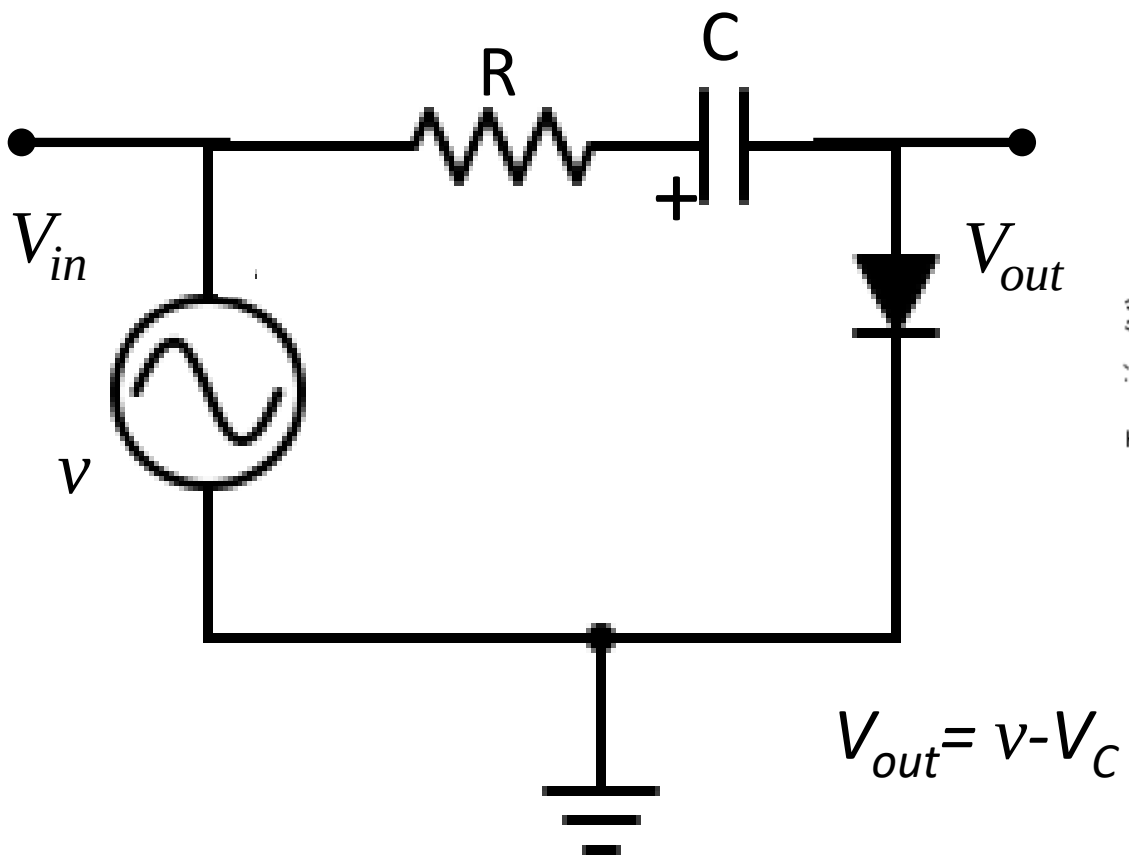
Esquema de una fuente CC

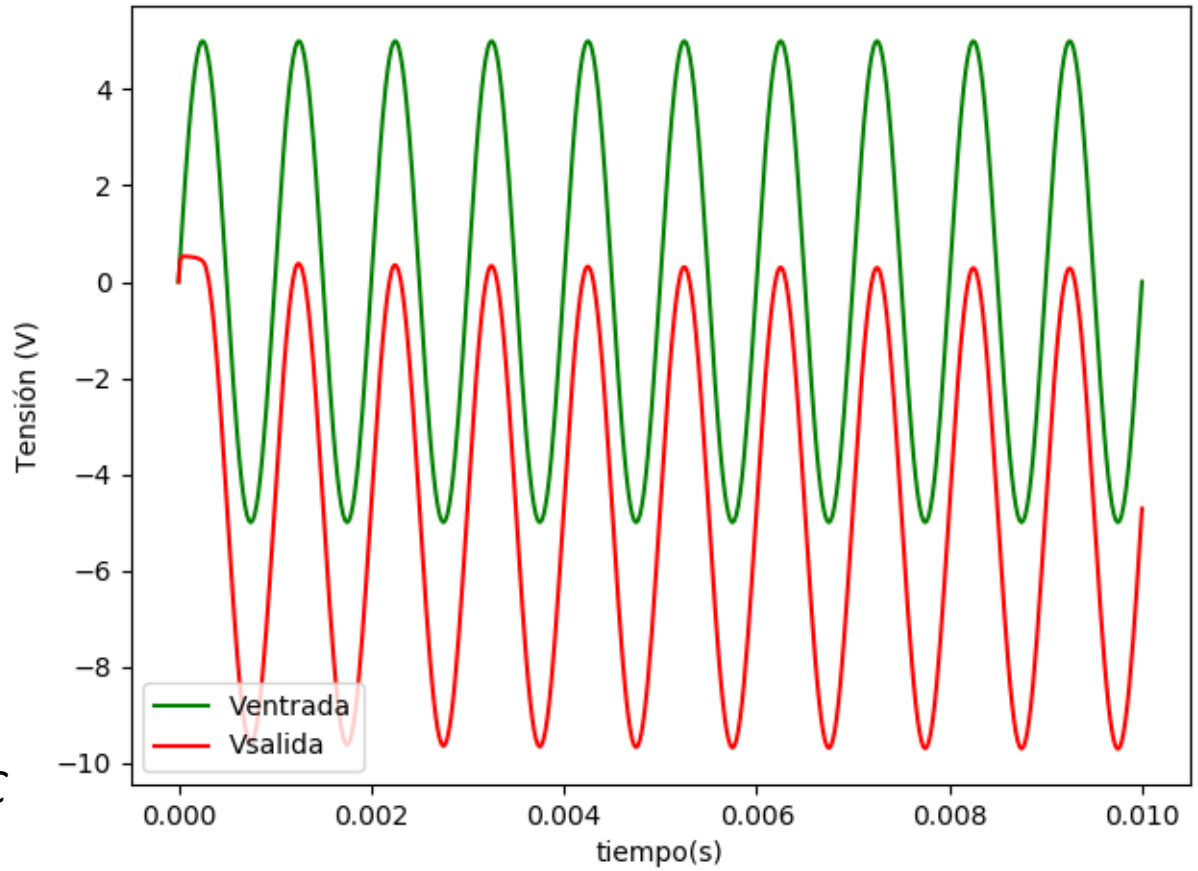


Puente de diodos



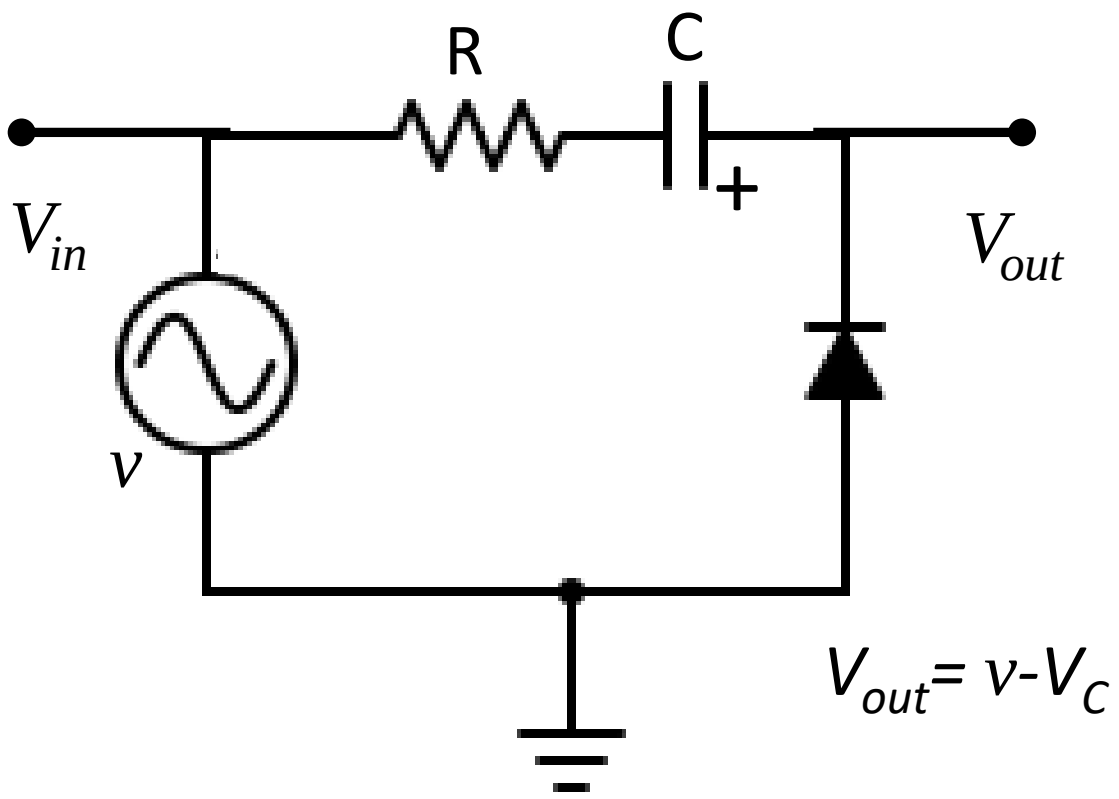
Circuito enclavador

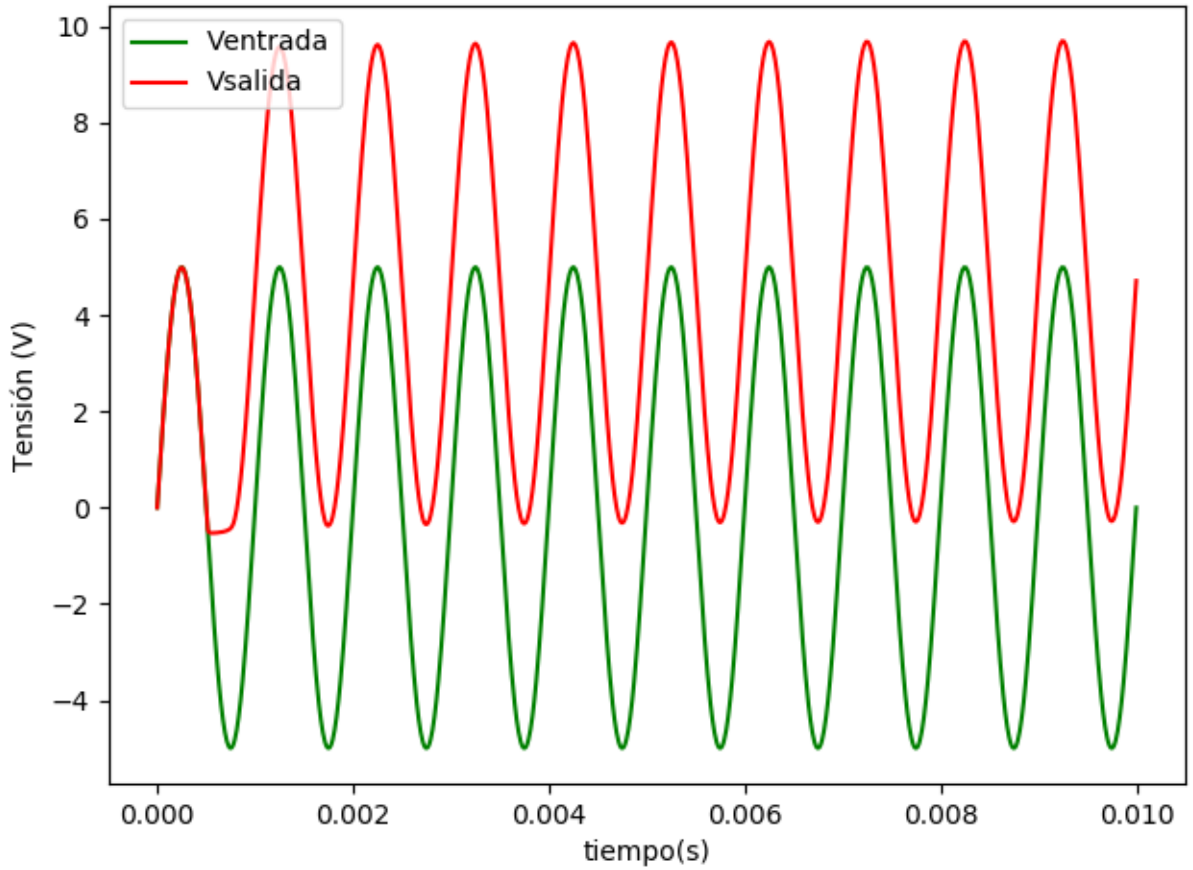




Amplitud de v : 5V; R≈ 1 kΩ; C=100nF

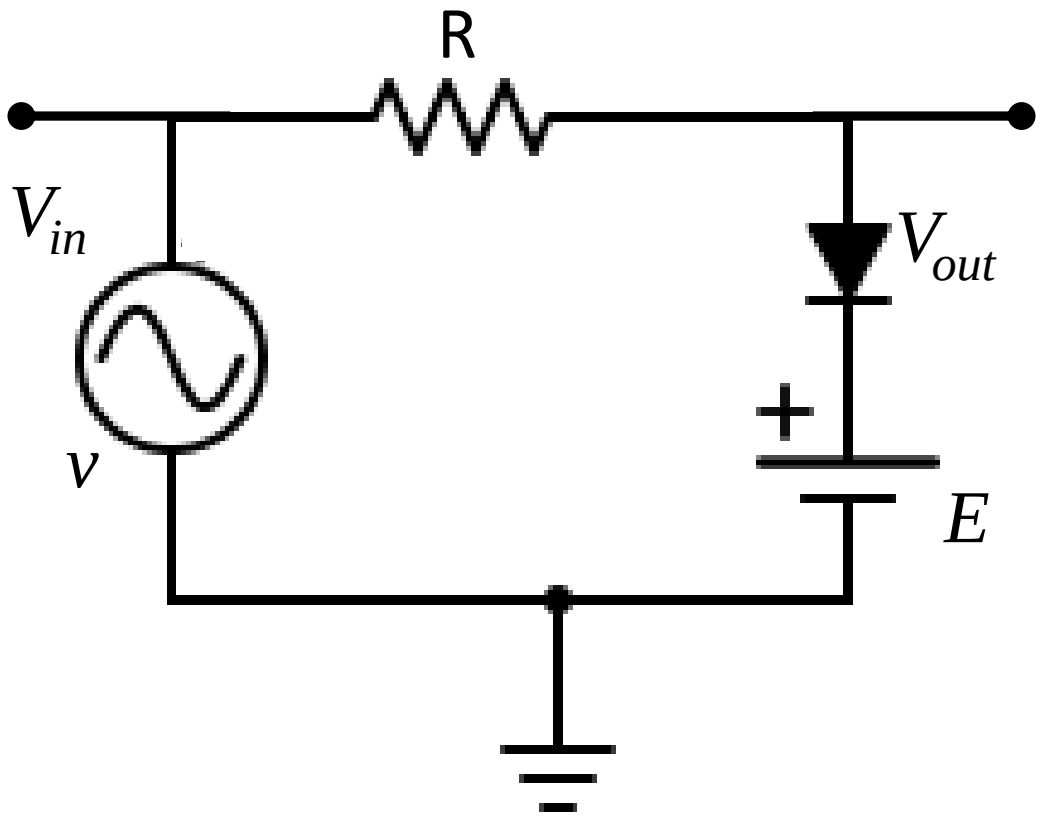
Circuito enclavador

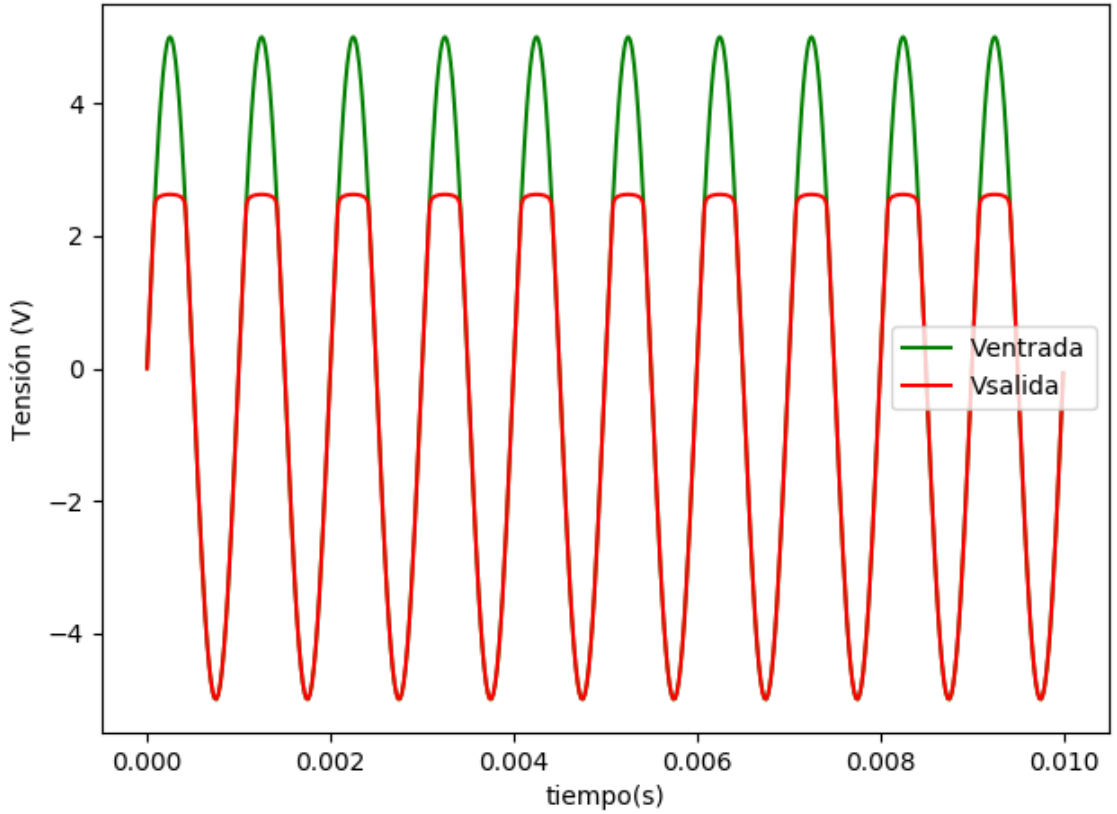




Amplitud de v : 5V; R≈ 1 kΩ; C=100nF

Circuito limitador





Amplitud de v : 5V; R≈ 1 kΩ; E=2V