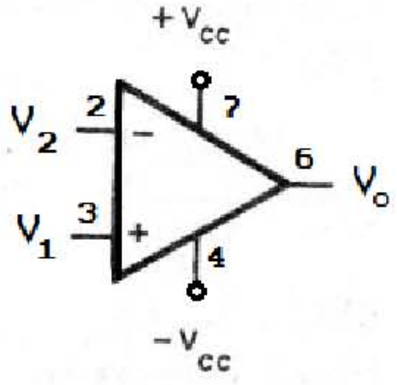
Amplificador Operacional

Características



- 1 e 5 são para correção de off-set
- $Z_{in} \cong \infty$ (cerca de 10 MΩ)
- $Z_o \cong 0$
- A_V = Ganho de malha aberta $\cong \infty$

$$A_V = \frac{V_o}{V_1 - V_2}$$

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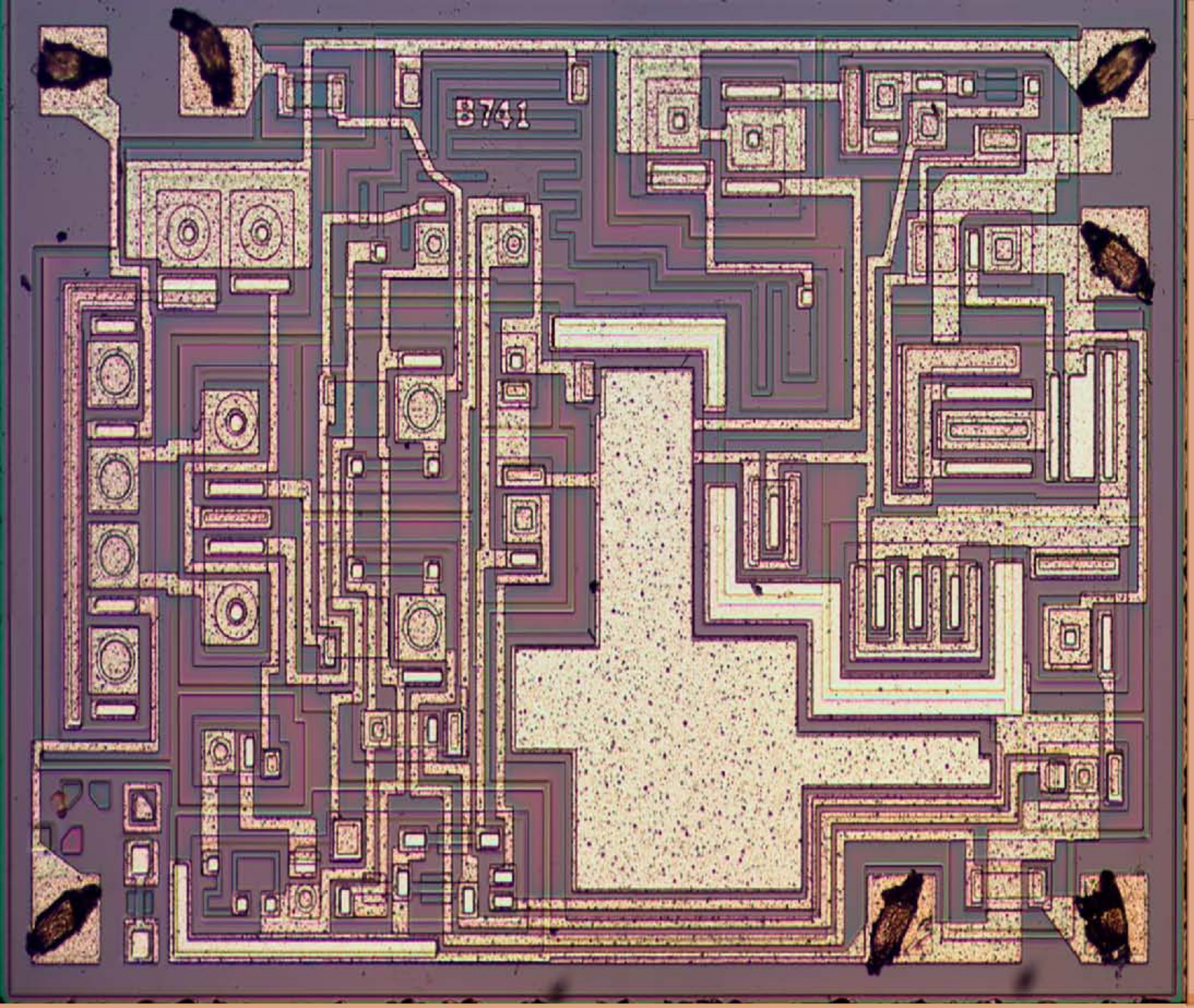

AmpOp LM741

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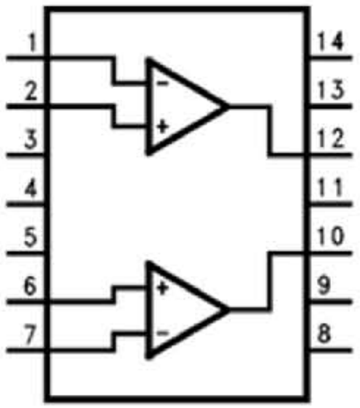
utmel
ELECTRONIC



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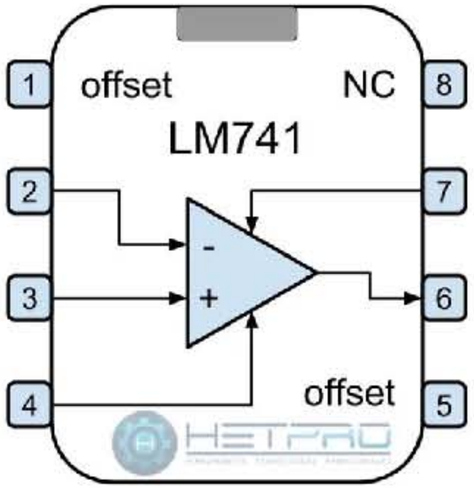
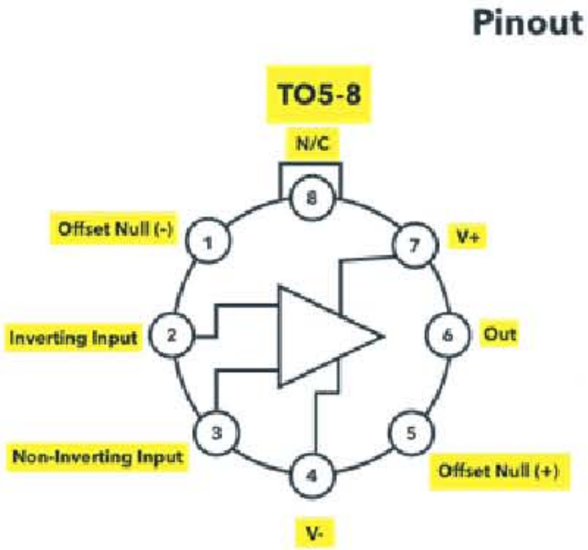
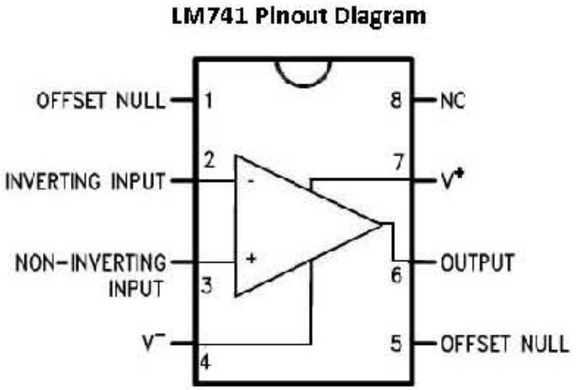
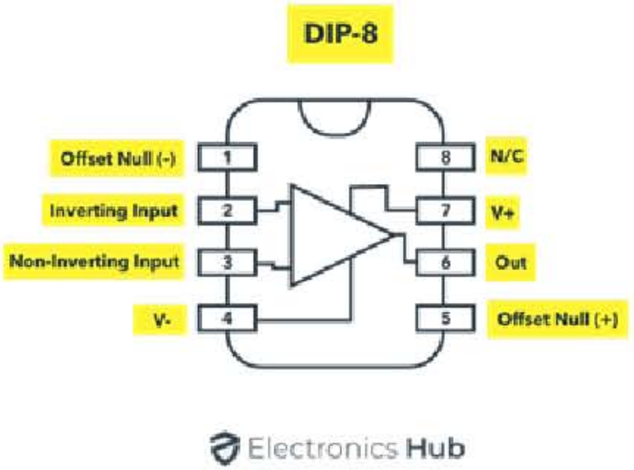
Encapsulamento









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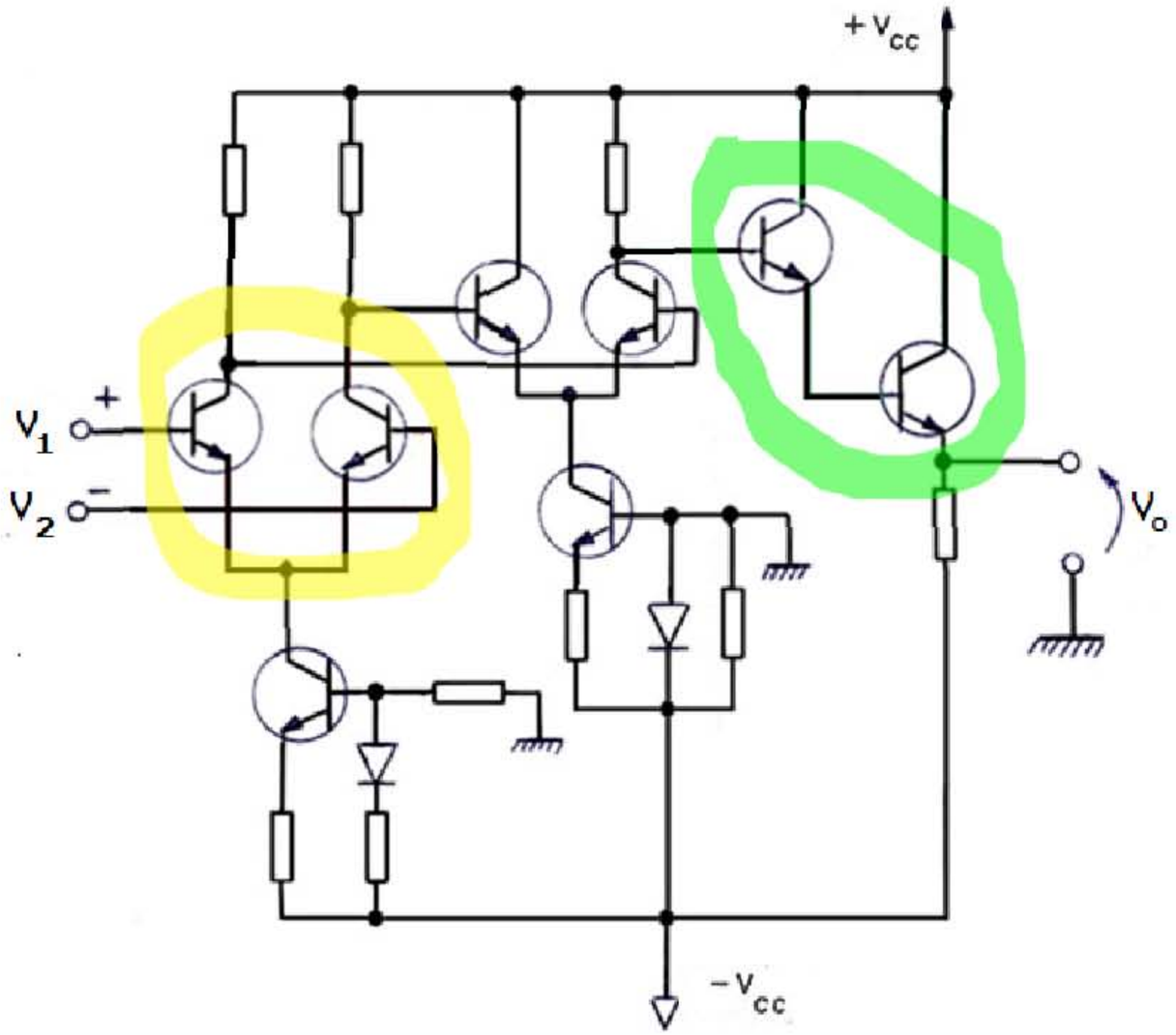
Estrutura Interna



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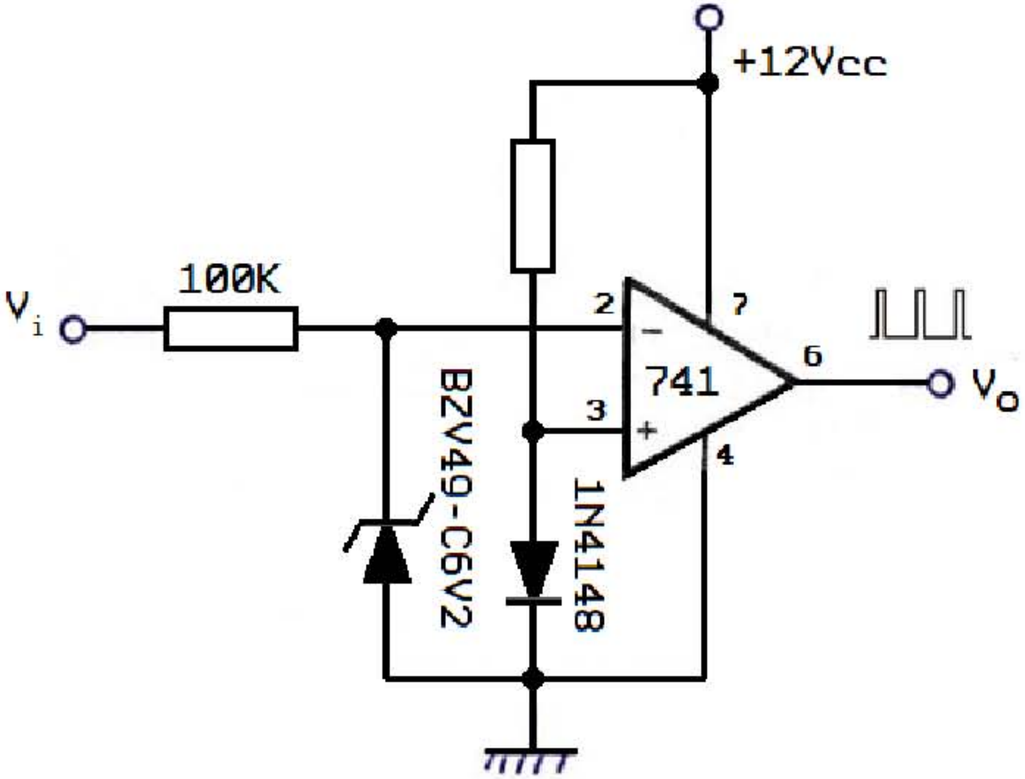
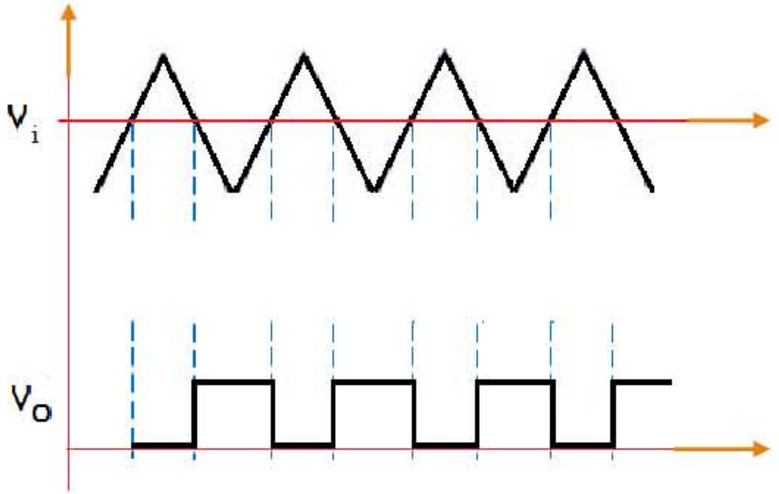
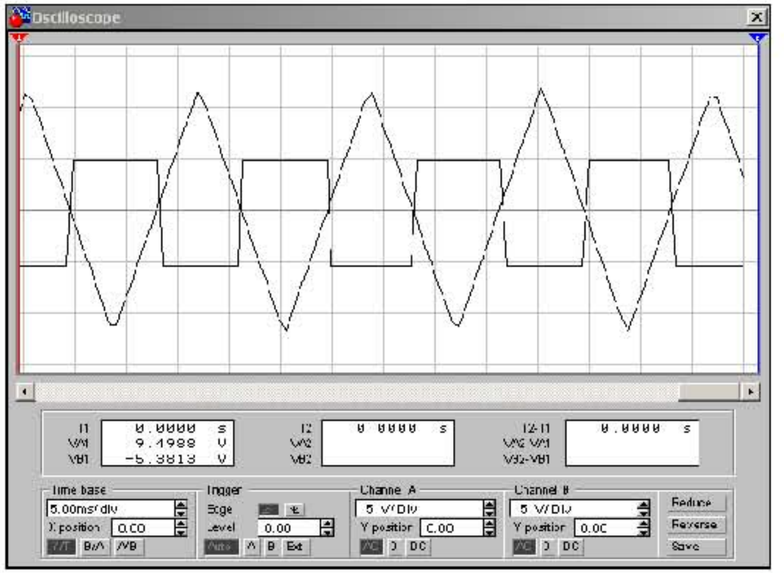
Detector de passagem por Zero







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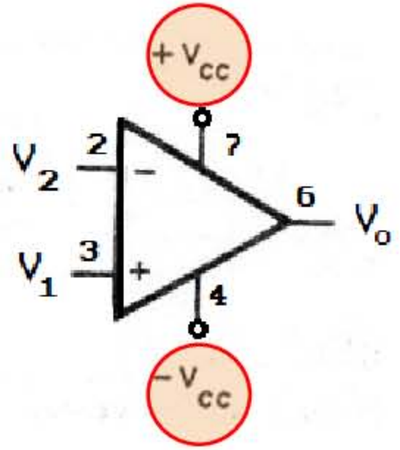
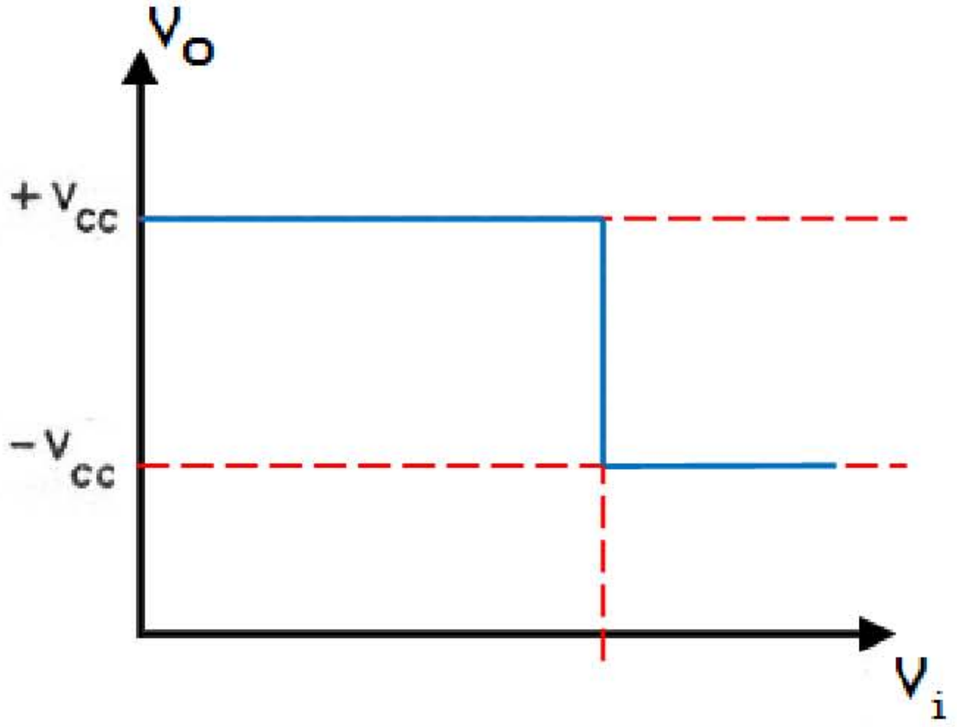
Comparadores



$$A_V = \frac{V_o}{(V_1 - V_2)}$$



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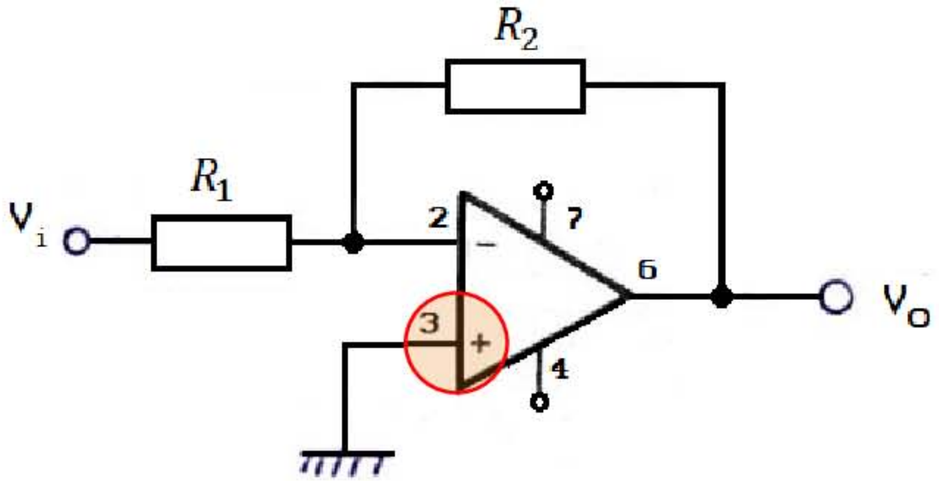
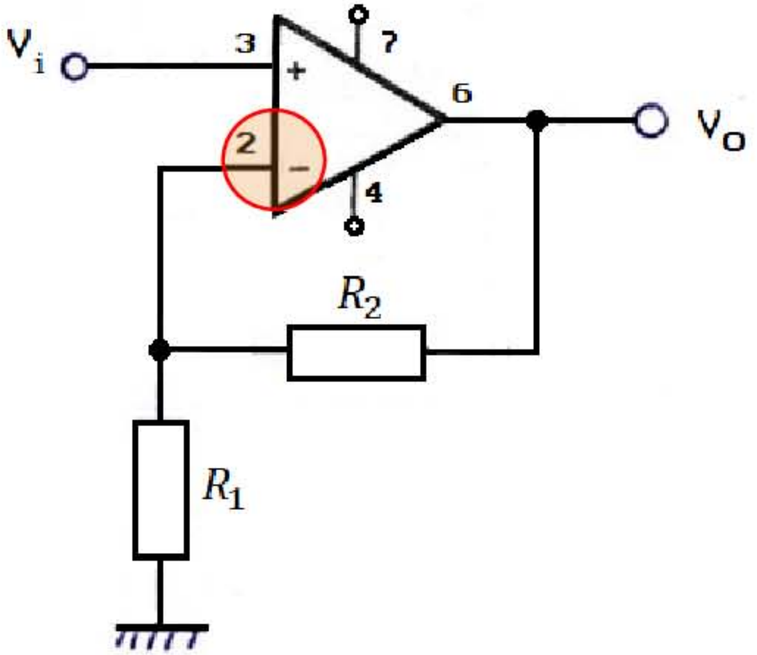
Configurações

Inversor



$$A_v = -\frac{R_2}{R_1}$$

Não inversor



$$A_v = \frac{R_1 + R_2}{R_1}$$

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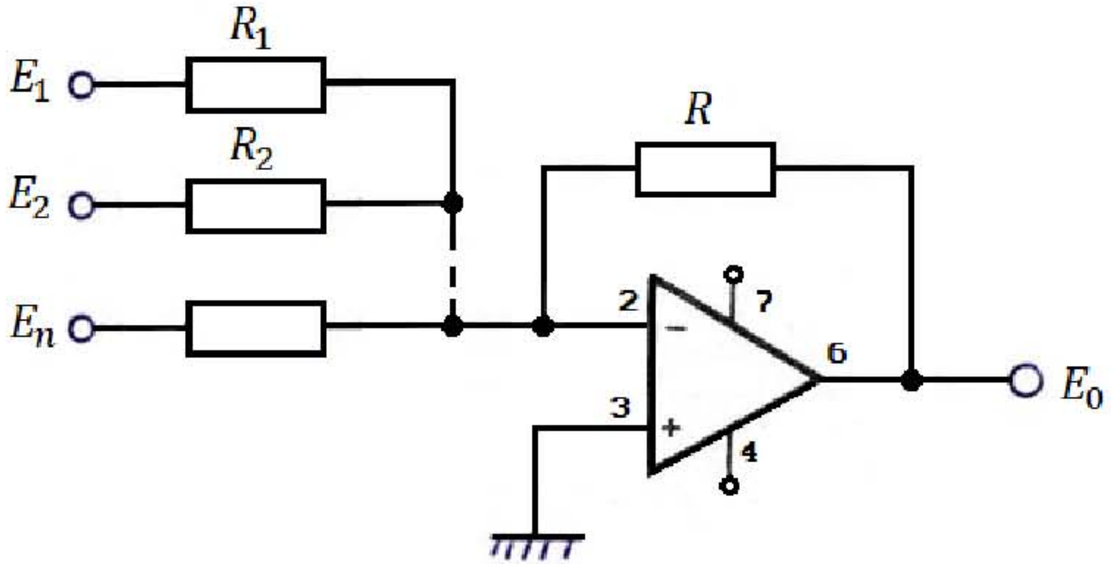
Somador



$$E_0 = -\left(\frac{R}{R_1}E_1 + \frac{R}{R_2}E_2 + \cdots + \frac{R}{R_n}E_n\right)$$

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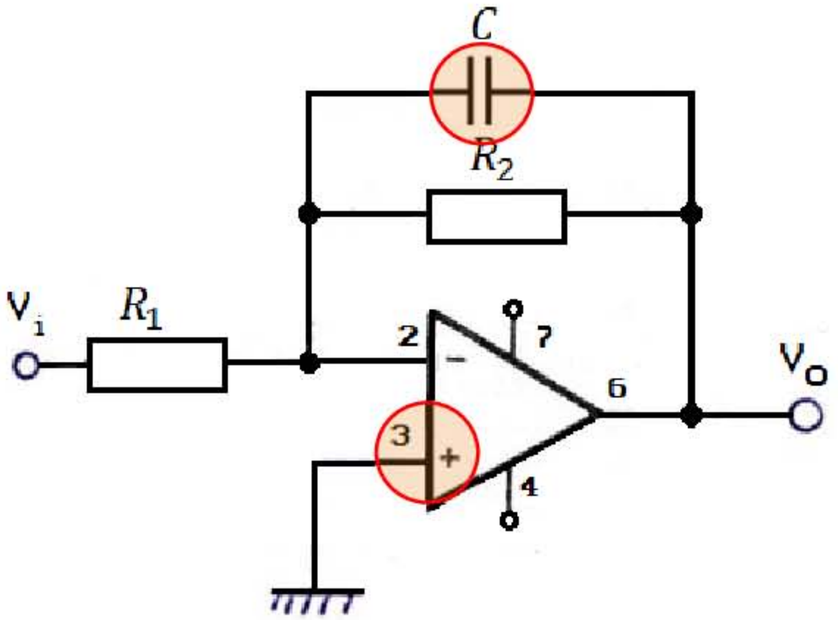
Filtro Passa Baixa



$$A_f = -\frac{R_2}{R_1}$$

$$C_1 = 150\,pF$$
$$R_1 = R_2 = 100K$$

$$f_c = \frac{1}{2\pi C R_2}$$

$$f_c = 1061032.95\,Hz$$

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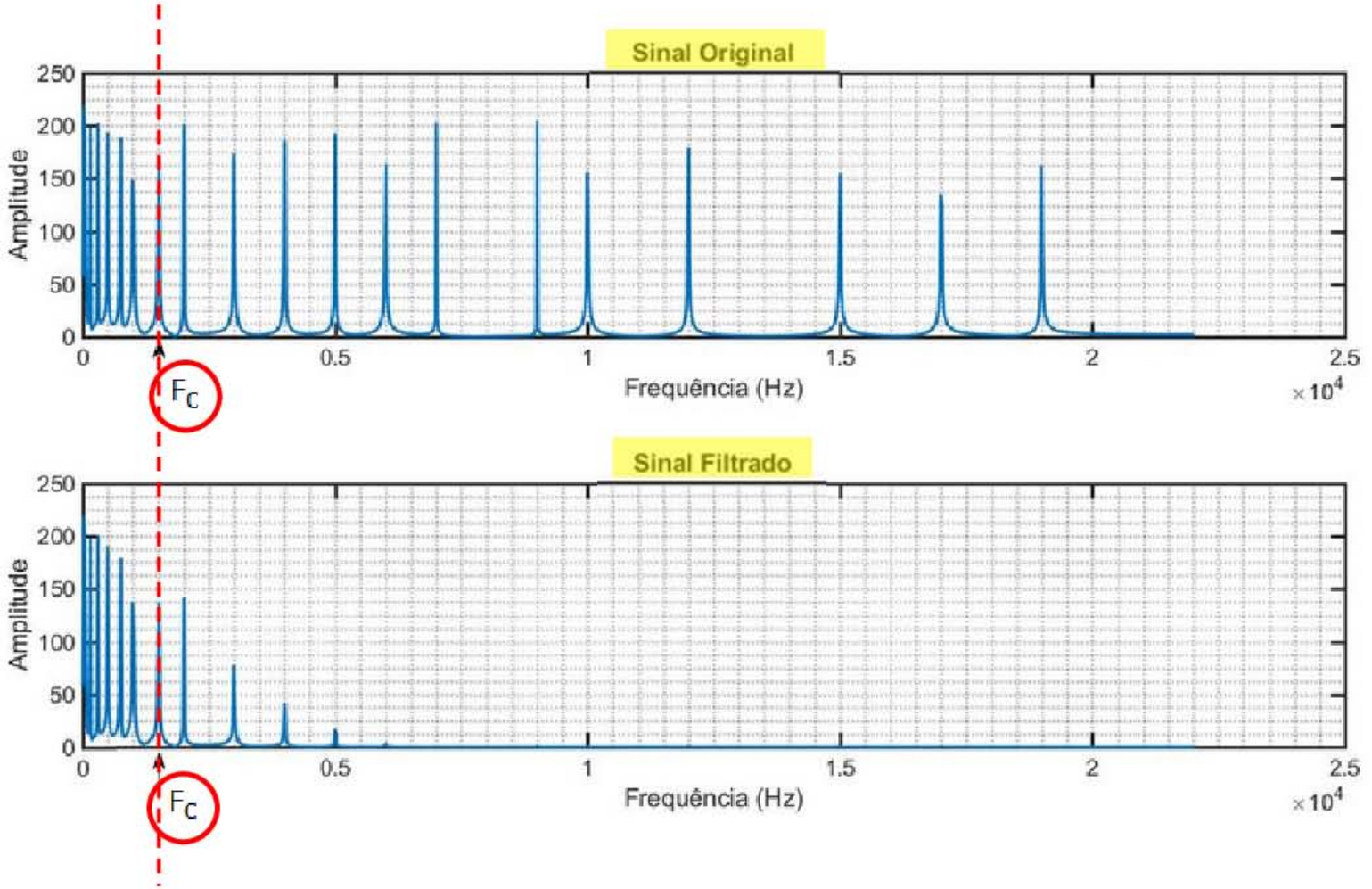
Efeito da filtragem passa baixa



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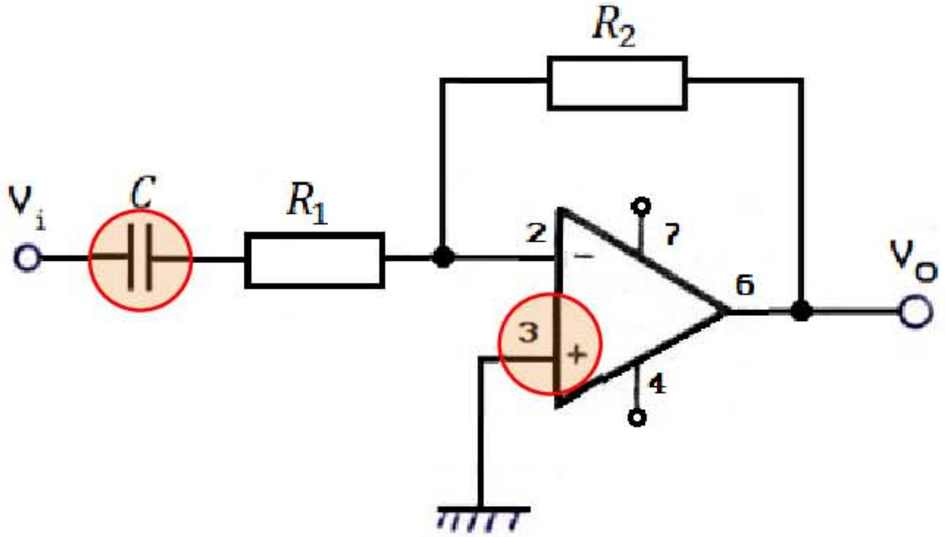
Filtro Passa Alta



$$A_f = -\frac{R_2}{R_1}$$

$$C = 150\,pF$$
$$R_1 = R_2 = 1K$$

$$f_c = \frac{1}{2\pi C R_2}$$

$$f_c = 1061032.95\,Hz$$

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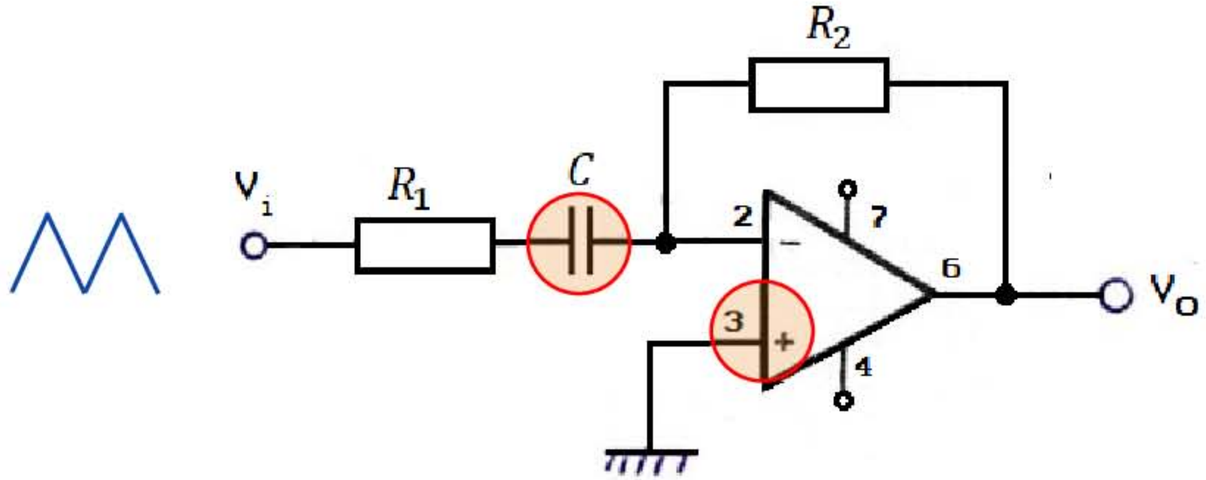
Diferenciador

Reduz o grau da função da entrada



$$V_o = -\frac{R_2}{R_1} C \frac{dV_i(t)}{dt}$$

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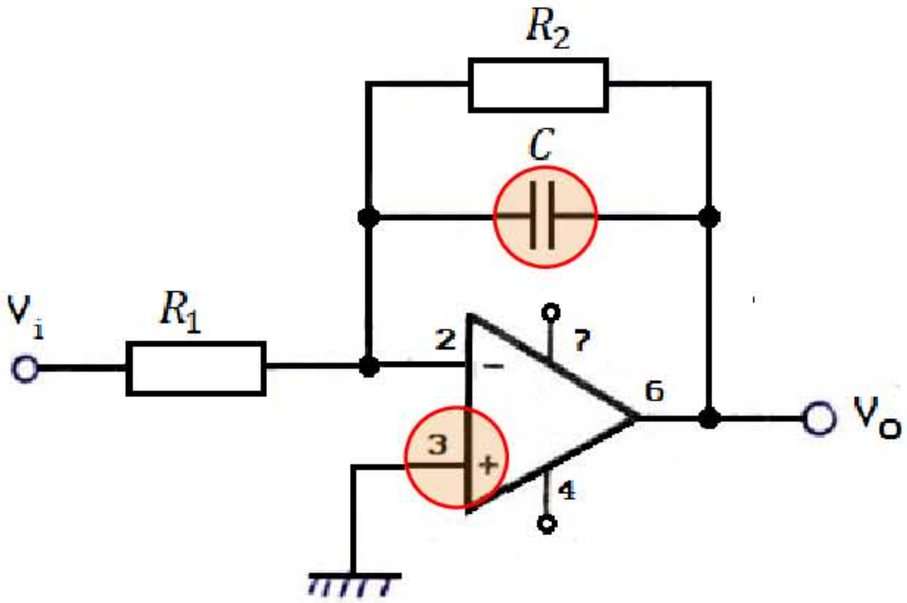
Integrador



$$V_o(t) = -\frac{1}{R_1 C}\int V_i(t)dt \; - \frac{R_2}{R_1} V_{dc}$$

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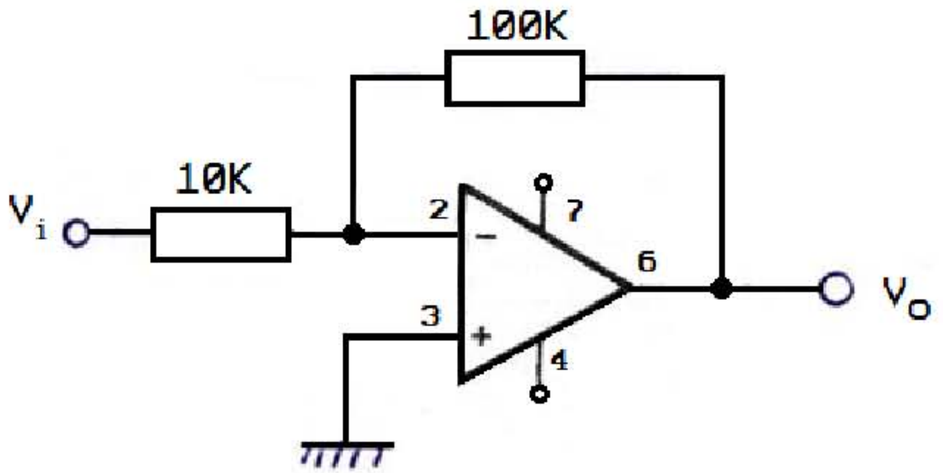
Exercícios

- Calcule o ganho para o circuito:



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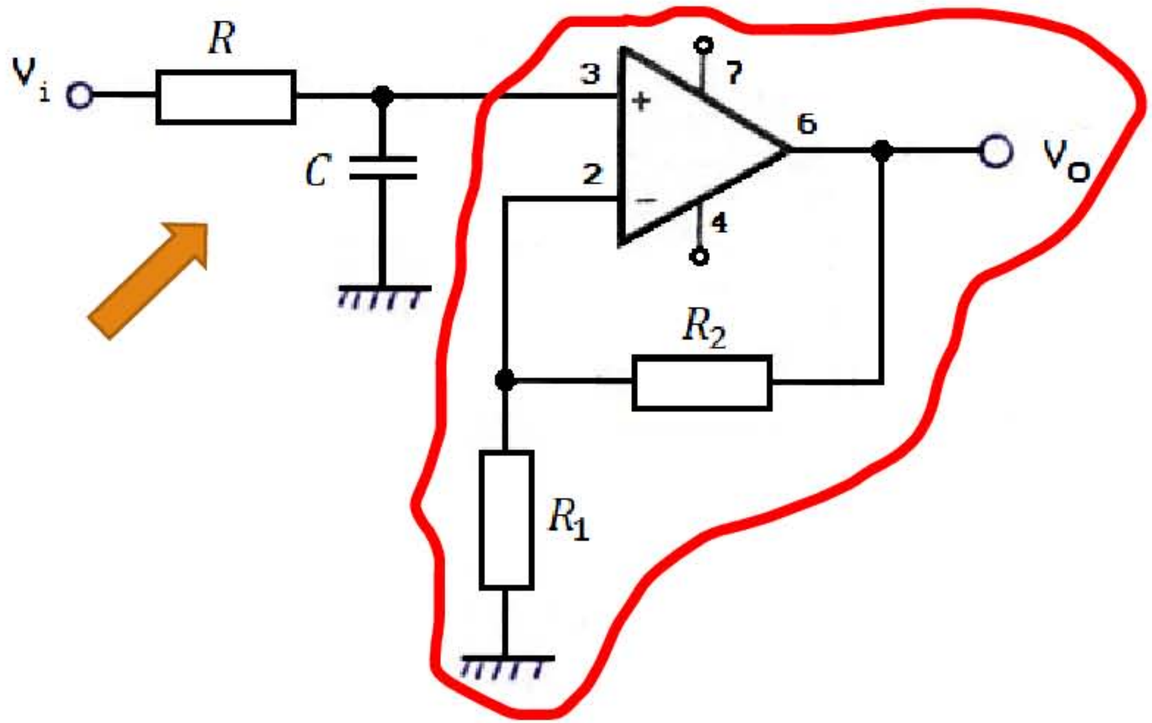
Filtro PB

- Calcule o valor de R e C para obter F_c = 1 KHz e Ganho = 10

Daí:



$$f_c = \frac{1}{2\pi R C}$$

$$R = \frac{1}{2\pi C f_c}$$

$$R = \frac{1}{2\pi \times 10 \times 10^{-9} \times 1000}$$

$$R = 15915.49\,\Omega$$

$$A_v = \frac{R_1 + R_2}{R_1} \Longrightarrow 10 \times R_1 = R_1 + R_2$$

$$Adotando\ R_1 = 10K$$

$$10 \times 10000 = 10000 + R_2$$

$$R_2 = 100000 - 10000 = 90000\,\Omega$$

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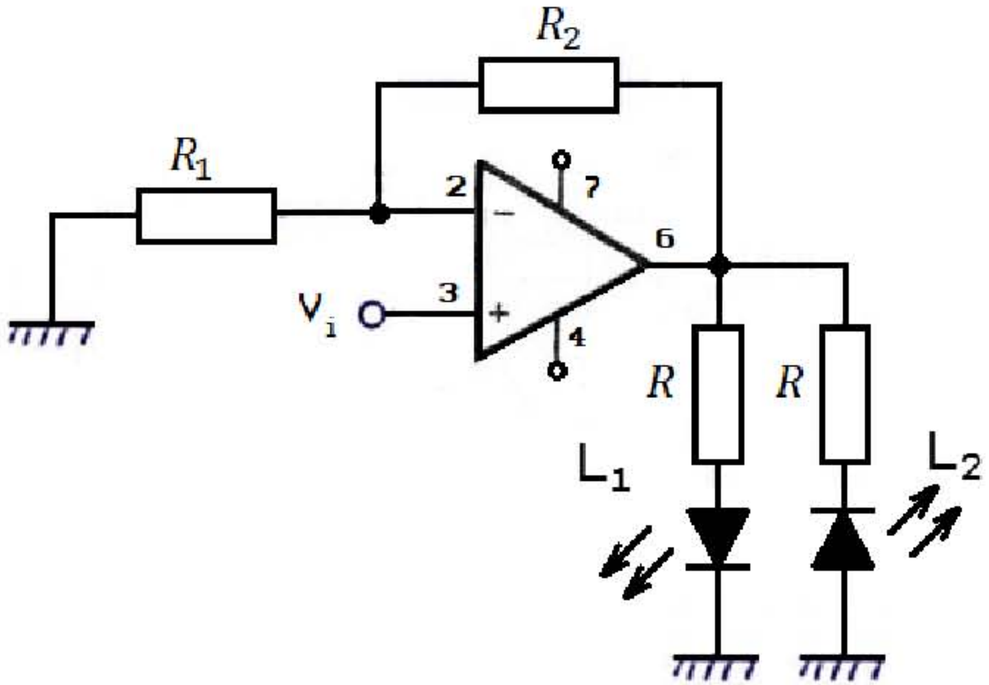
- Dado um AmpOp LM741, determine R_1 e R_2 para obter $A_f = 11$
- Se aplicarmos V_i alternado, o que ocorrerá na saída ?
- Explique como ele poderia ser usado para indicar $V_i < 0$ e $V_i > 0$.



$$A_v = \frac{R_1 + R_2}{R_1} \Longrightarrow 11 \times R_1 = R_1 + R_2$$

$$Adotando \boxed{R_1 = 10K}$$

$$11 \times 10000 = 10000 + R_2$$

$$\boxed{R_2 = 110000 - 10000 = 10K}$$

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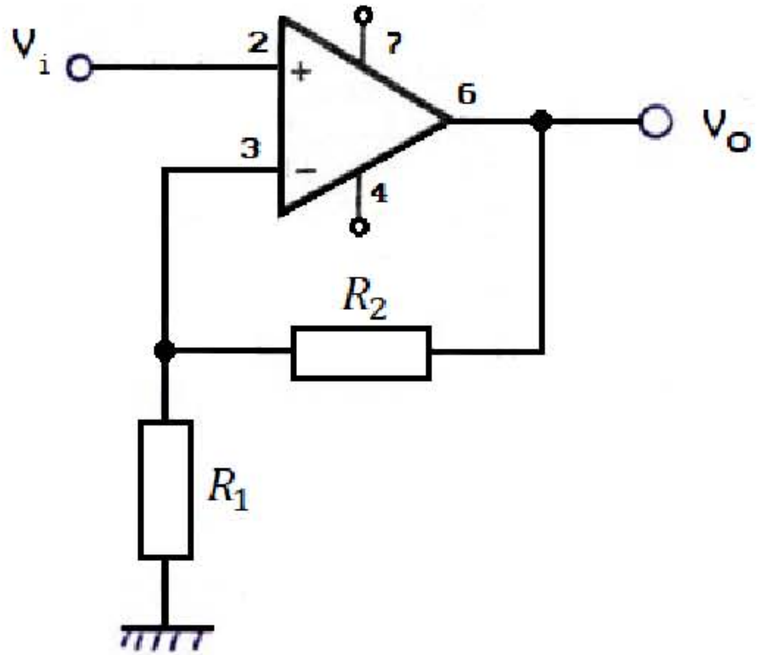
- Sendo V_i = 0,5V e V_o = 10V, calcule:



a) O Ganho A_f

b) R_1 e R_2

$$A_v = \frac{10}{0.5} = \boxed{20}$$

$$A_v = \frac{R_1 + R_2}{R_1} \Longrightarrow 20 \times R_1 = R_1 + R_2$$

$$Adotando \boxed{R_1 = 1K}$$

$$20 \times 1000 = 1000 + R_2$$

$$\boxed{R_2 = 20000 - 1000 = 19000\,\Omega}$$

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- Projete um circuito que execute a função:

  $f(x,y,z) = 5x + 2z + 4y$

- Projete um circuito que sintetize a função:

$$V_o = \frac{1}{RC}\int_0^t V_1\,dt + \frac{dV_2}{dt}\,RC$$

Referências bibliográficas

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