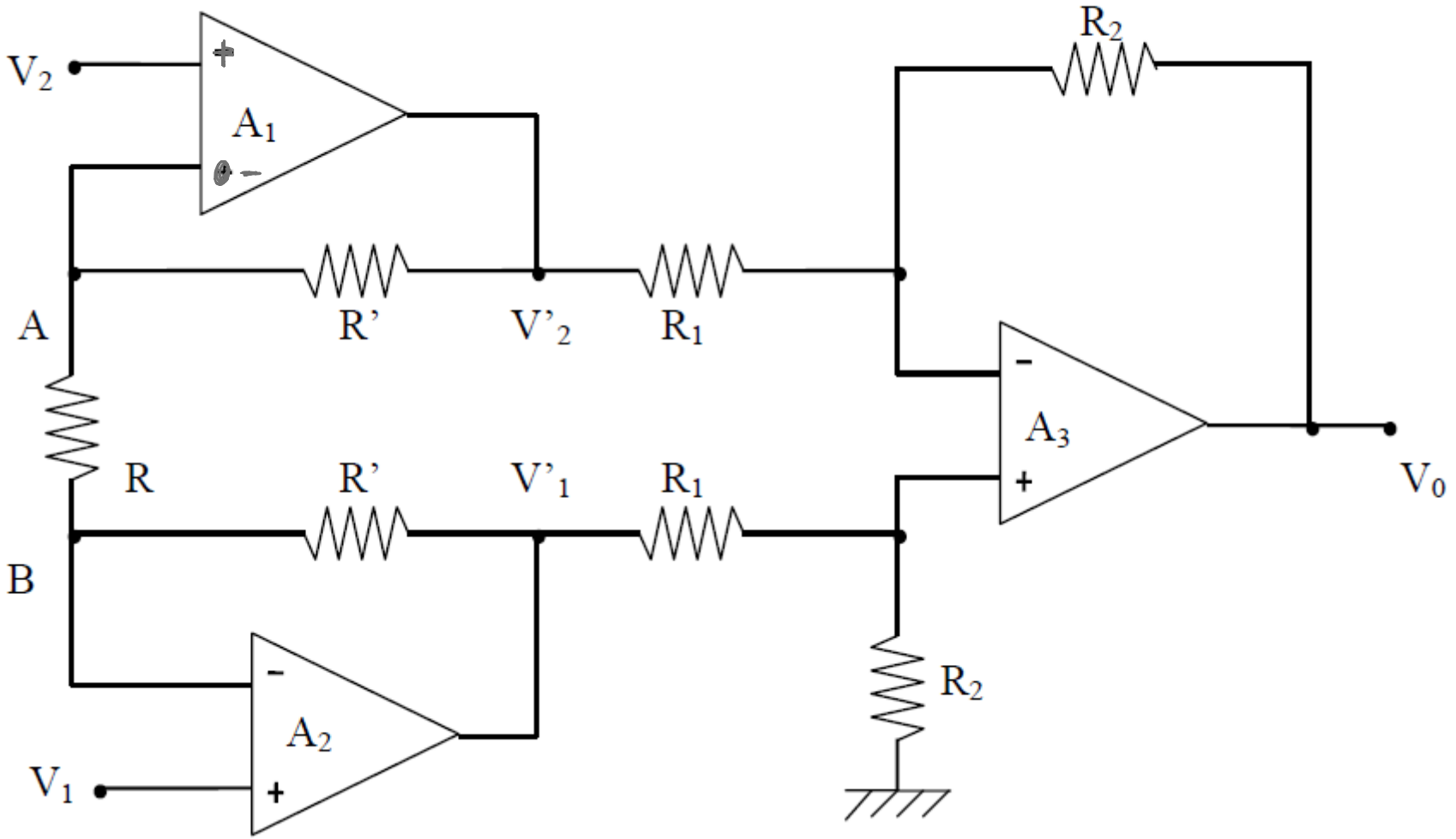
EL AMPLIFICADOR OPERACIONAL

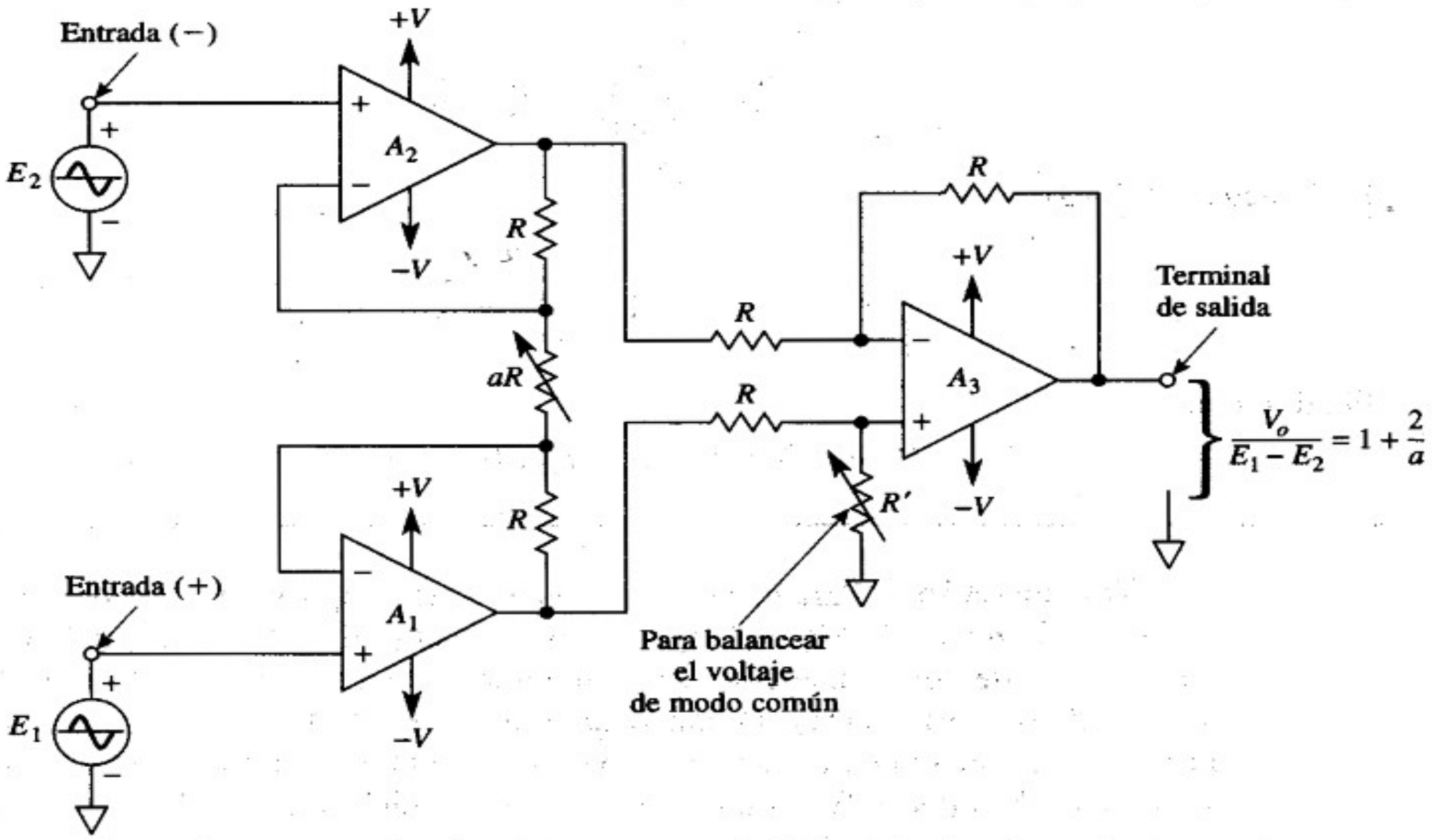
El amplificador de instrumentación (AI)

y circuitos comparadores con AO’s

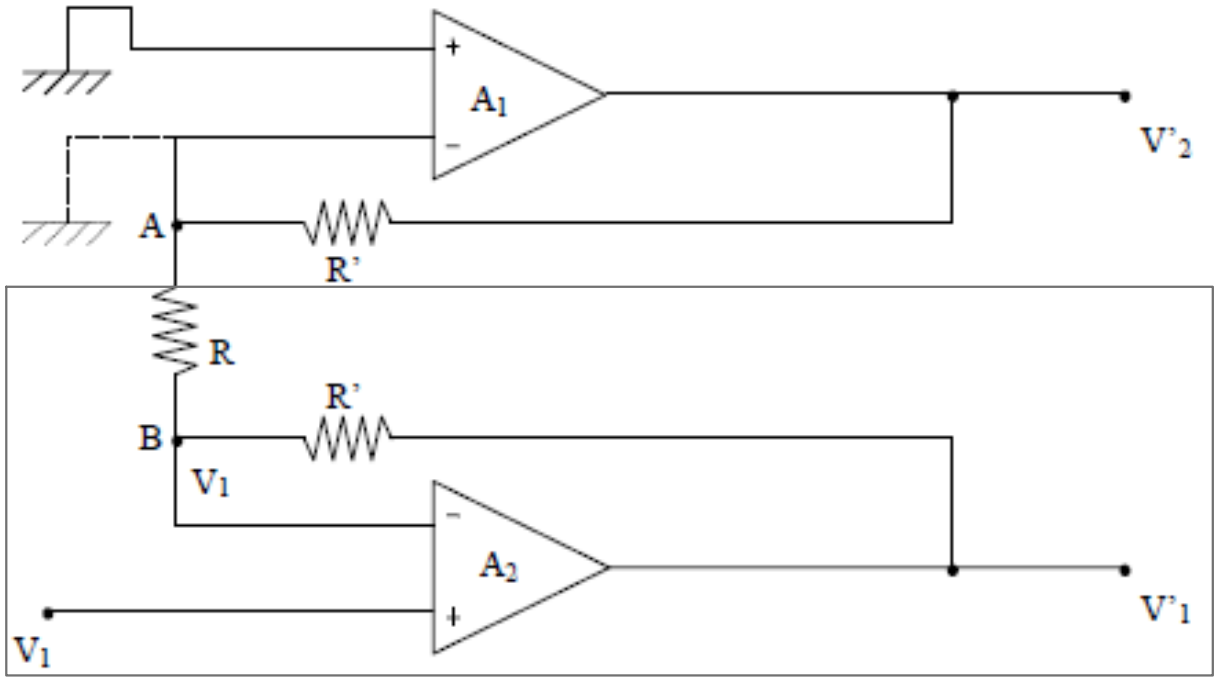
El Amplificador de Instrumentación (AI) ERRATA



El Amplificador de Instrumentación (AI)



El AI – ANÁLISIS POR SUPERPOSICIÓN



$1 = i$

$$\frac{0 - V_{[2]}}{R} = \frac{V_{[2]} - V_{s1}'}{R'}$$

$$-\frac{V_1}{R} = \frac{V_1}{R'} - \frac{V_{s1}}{R}$$

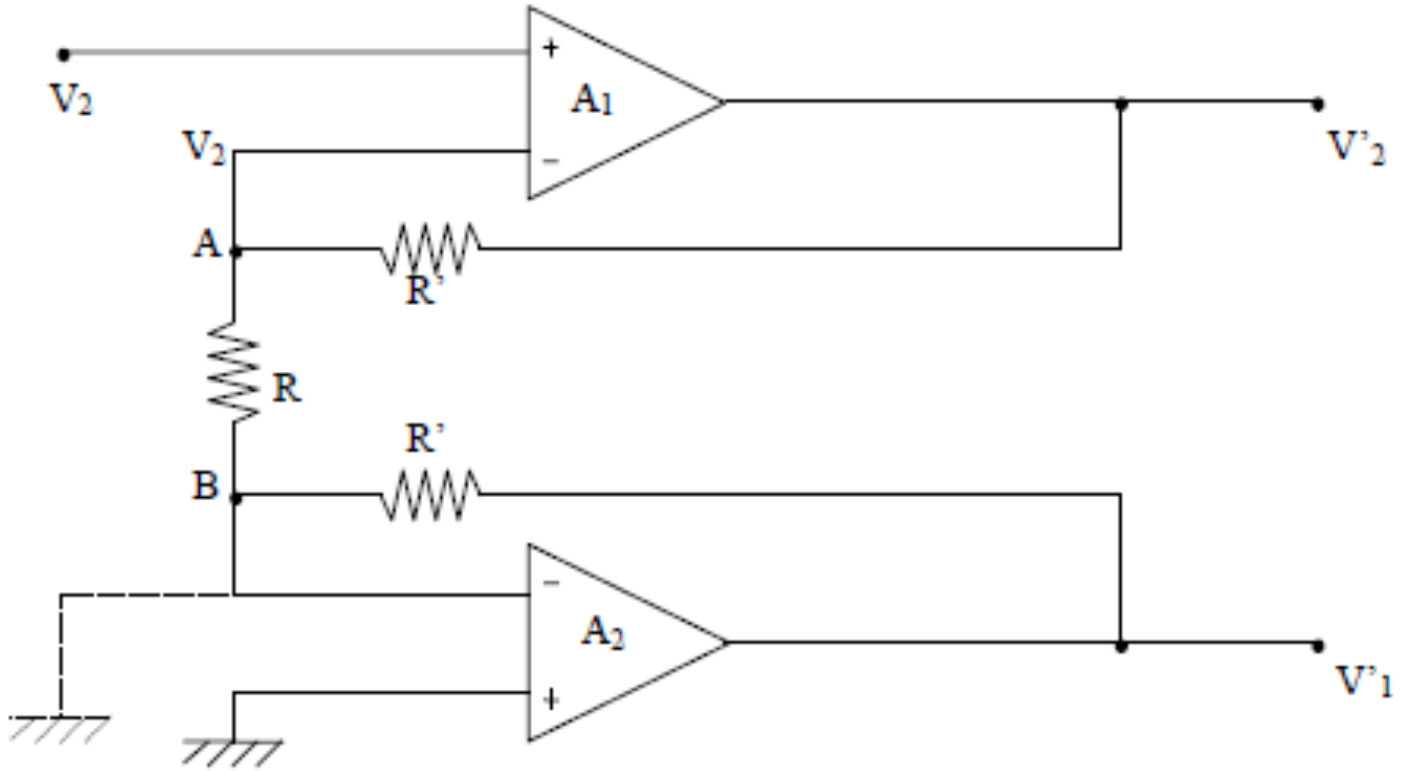
$$\frac{V_1}{R} + \frac{V_1}{R'} = \frac{V_{s1}}{R}$$

$$V_{[3]} = V_{[2]} = V_1 \qquad V_{s1}' = V_1\left(\frac{R'}{R} + 1\right)$$

$$V_{s2}' = V_2\left(1 + \frac{R'}{R}\right)$$

$$V_{01} = \frac{R_2}{R_1}(V'_1 - V'_2) = \frac{R_2}{R_1}\left[\left(\frac{R+R'}{R}\right)V_1 + \frac{R'}{R}V_1\right] = \frac{R_2}{R_1}\left(\frac{R+2R'}{R}\right)V_1$$

El AI – ANÁLISIS POR SUPERPOSICIÓN (y 2)



$V'_2 = [(R+R')/R]\, V_2$ (A.O. no inversor A_1)

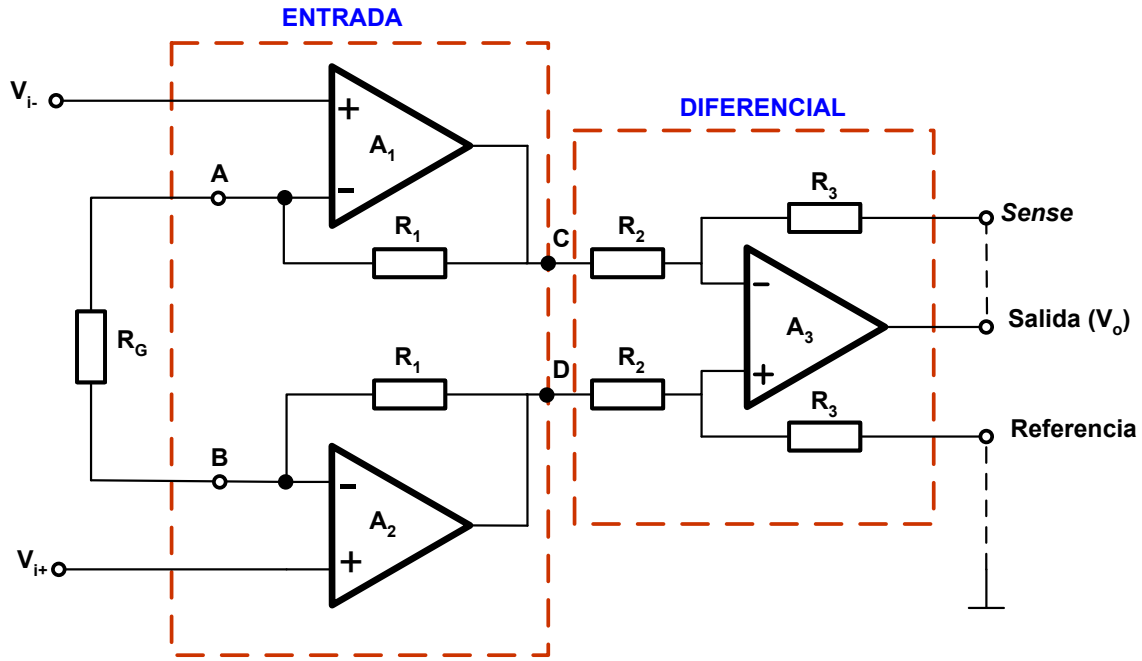
$V'_1 = -(R'/R)\, V_2$ (A.O. inversor A_2)

$$V_{O1} = \frac{R_2}{R_1}(V'_1 - V'_2) = \frac{R_2}{R_1}\left[\left(-\frac{R'}{R} - \frac{R+R'}{R}\right)V_2\right]$$

Sumando ambas salidas queda:

$V_o = V_{o1} + V_{o2} = (R_2/R_1)\,[(R+2R')/R]\,(V_1 - V_2)$

Amplificador de instrumentación



$$v_o = \frac{R_3}{R_2} \cdot \left(1 + \frac{2R_1}{R_G}\right)(v_{i+} - v_{i-})$$

$$A_d = 1 + \frac{2R_1}{R_G}$$

$V_1 = 1V \quad V_d = 1$
$V_2 = 0V \quad V_c = 1$

$V_1 = 10 \quad V_d = 1$
$V_2 = 1 \quad V_c = 9$

$CMRR = 20 \log_{10} \frac{A_d}{A_c}$

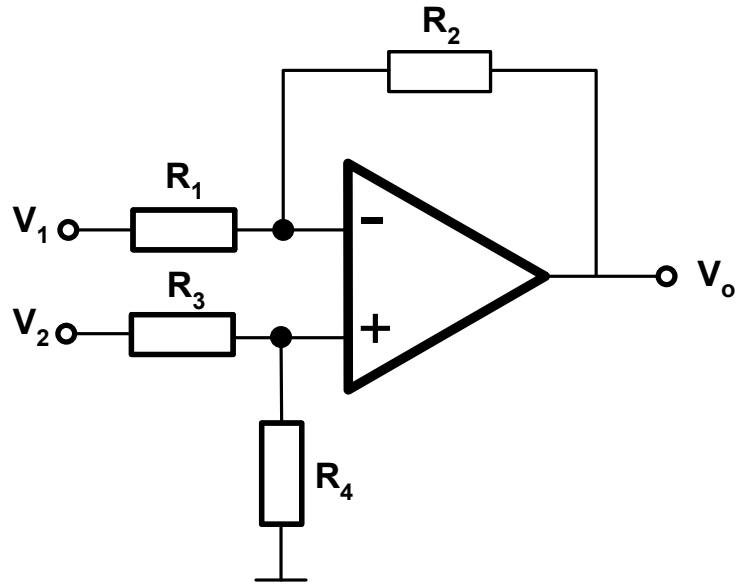
$$\begin{cases} V_d = V_1 - V_2 \\ V_c = \frac{V_1 + V_2}{2} \end{cases}$$

"R" "R'I

$V_S = \boxed{A_d} V_d + \boxed{A_c} V_c$

Amplificador diferencial.

$$v_o = \frac{R_2}{R_1 + R_2} \cdot \frac{R_3 + R_4}{R_3} v_2 - \frac{R_2}{R_1} v_1$$

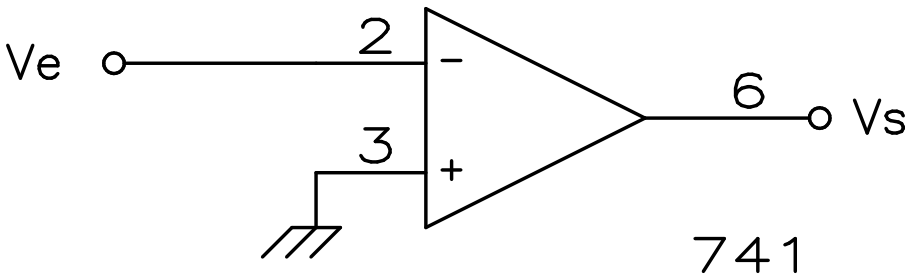


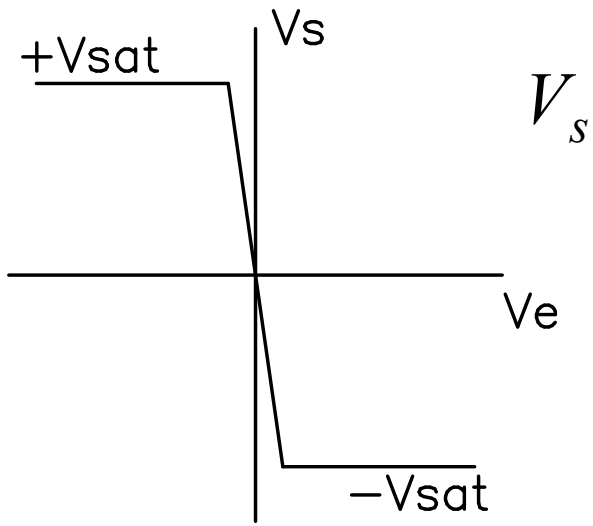
Si $v_1 = v_2 = v_{ic}$

$$v_{oc} = \left(\frac{R_2}{R_1 + R_2} \cdot \frac{R_3 + R_4}{R_3} - \frac{R_2}{R_1} \right) v_{ic}$$

Si $R_2 = R_4$ y $R_1 = R_3$

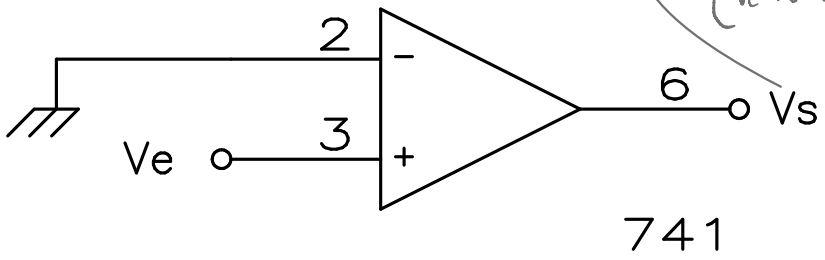
$$v_o = \frac{R_4}{R_3}(v_2 - v_1)$$

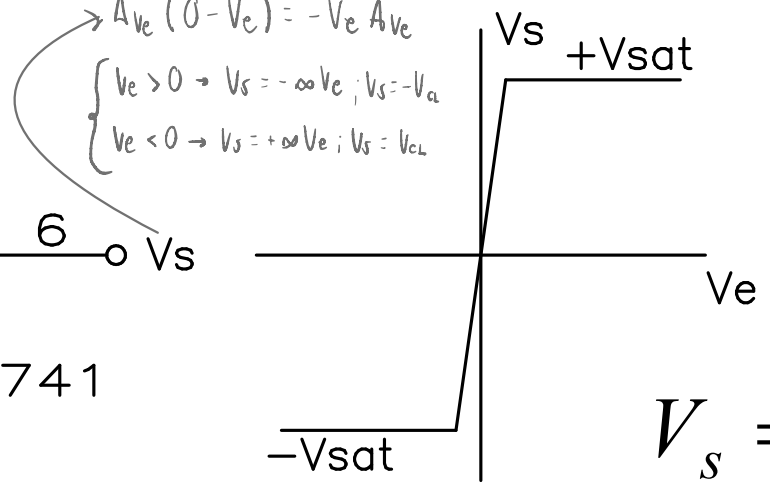




$$V_s = \begin{cases} +V_{sat}, & cuando \quad V_e < 0 \\ -V_{sat}, & cuando \quad V_e > 0 \end{cases}$$

Comparador inversor .

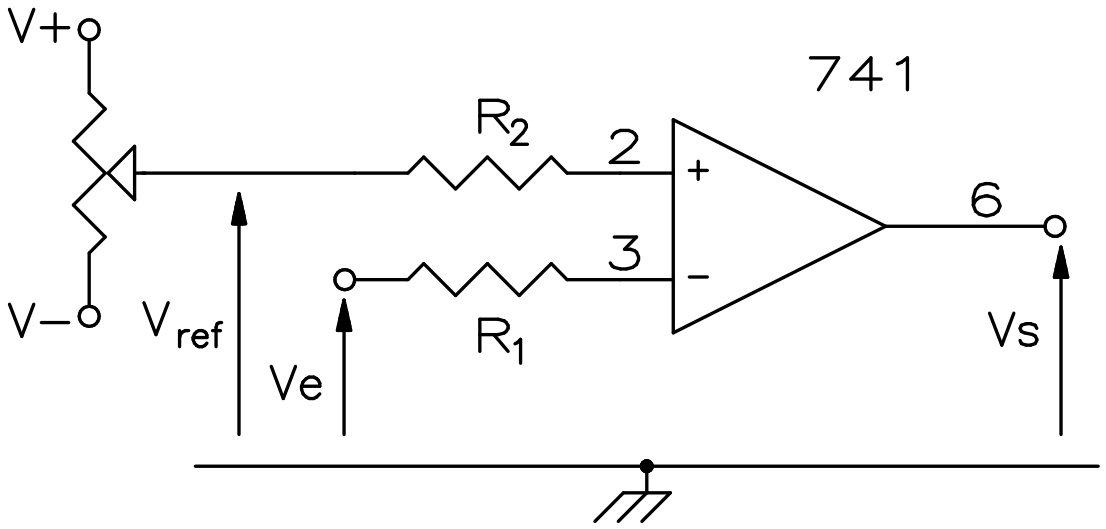


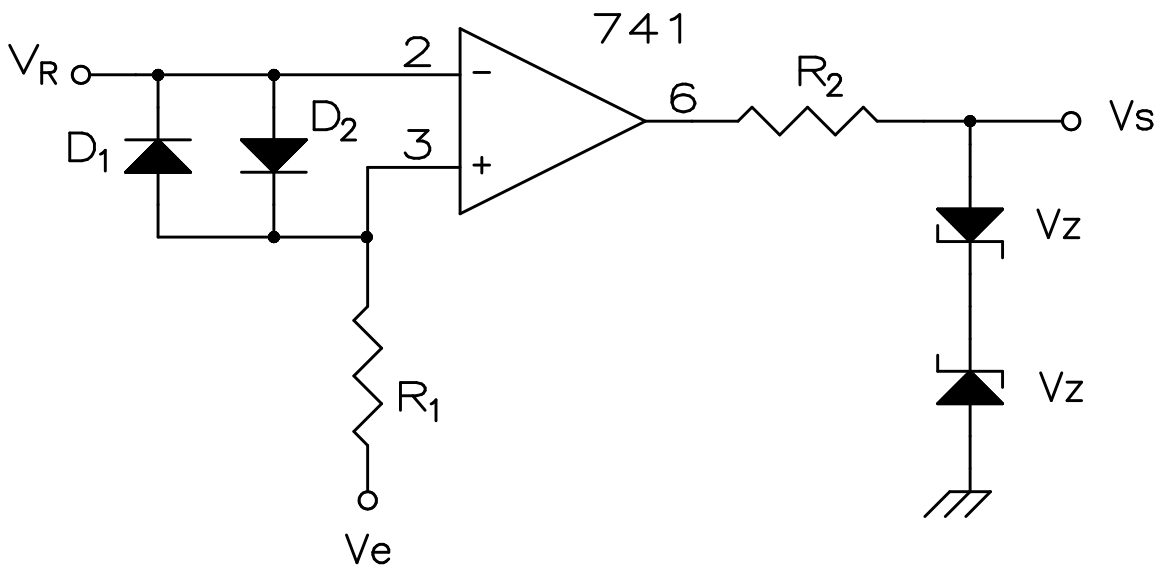


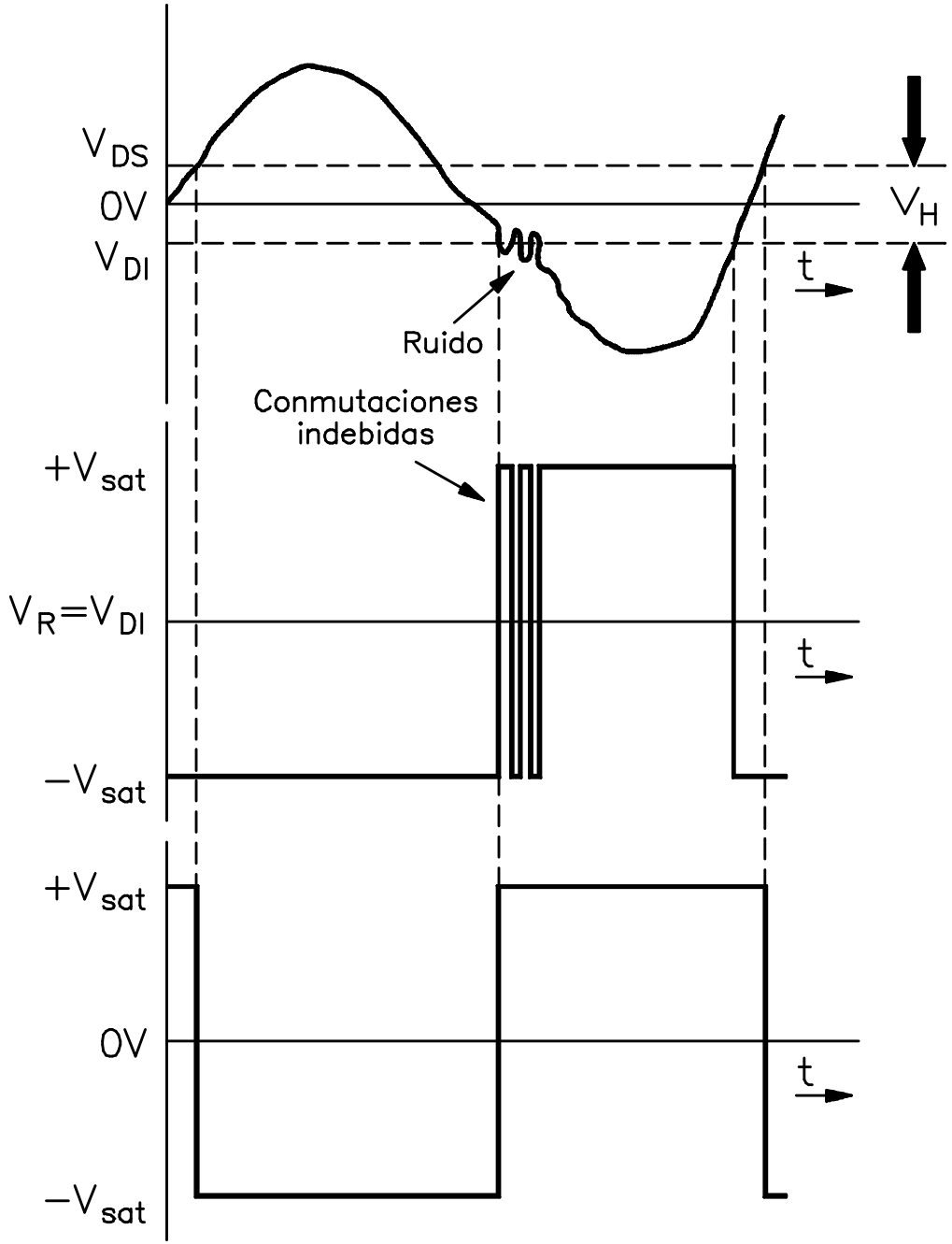
AO Ideal $R_e = \infty$, $R_s = 0$, $A_{Ve} = \infty$

Comparador no inversor .

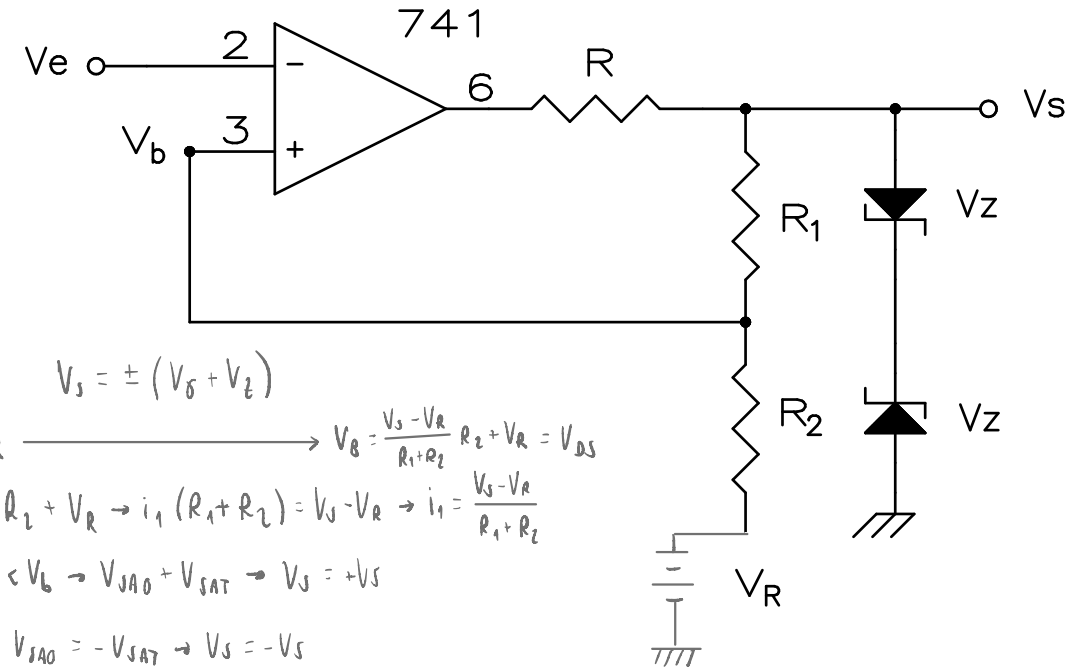
$$V_s = \begin{cases} +V_{sat}, & cuando \quad V_e > 0 \\ -V_{sat}, & cuando \quad V_e < 0 \end{cases}$$


V+
V−
741
R2
2
3
6
+
−
R1
Vref
Ve
Vs


741
VR
2
3
6
+
−
R2
D1
D2
R1
Ve
Vz
Vz
Vs


V_{DS}
0V
V_{DI}
V_H
t
Ruido
Conmutaciones indebidas
$+V_{sat}$
$V_R=V_{DI}$
t
$-V_{sat}$
$+V_{sat}$
0V
t
$-V_{sat}$

Comparador de Schmitt (inversor)



$V_s = \pm (V_\delta + V_z)$

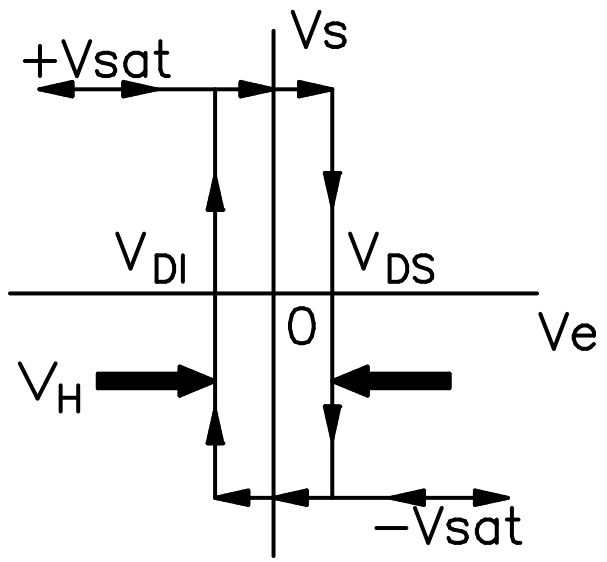
$V_1 = i_1 R_2 + V_R \longrightarrow V_B = \frac{V_s - V_R}{R_1 + R_2} R_2 + V_R = V_{DS}$

1) $V_s = i_1 R_1 + i_1 R_2 + V_R \rightarrow i_1 (R_1 + R_2) = V_s - V_R \rightarrow i_1 = \frac{V_s - V_R}{R_1 + R_2}$

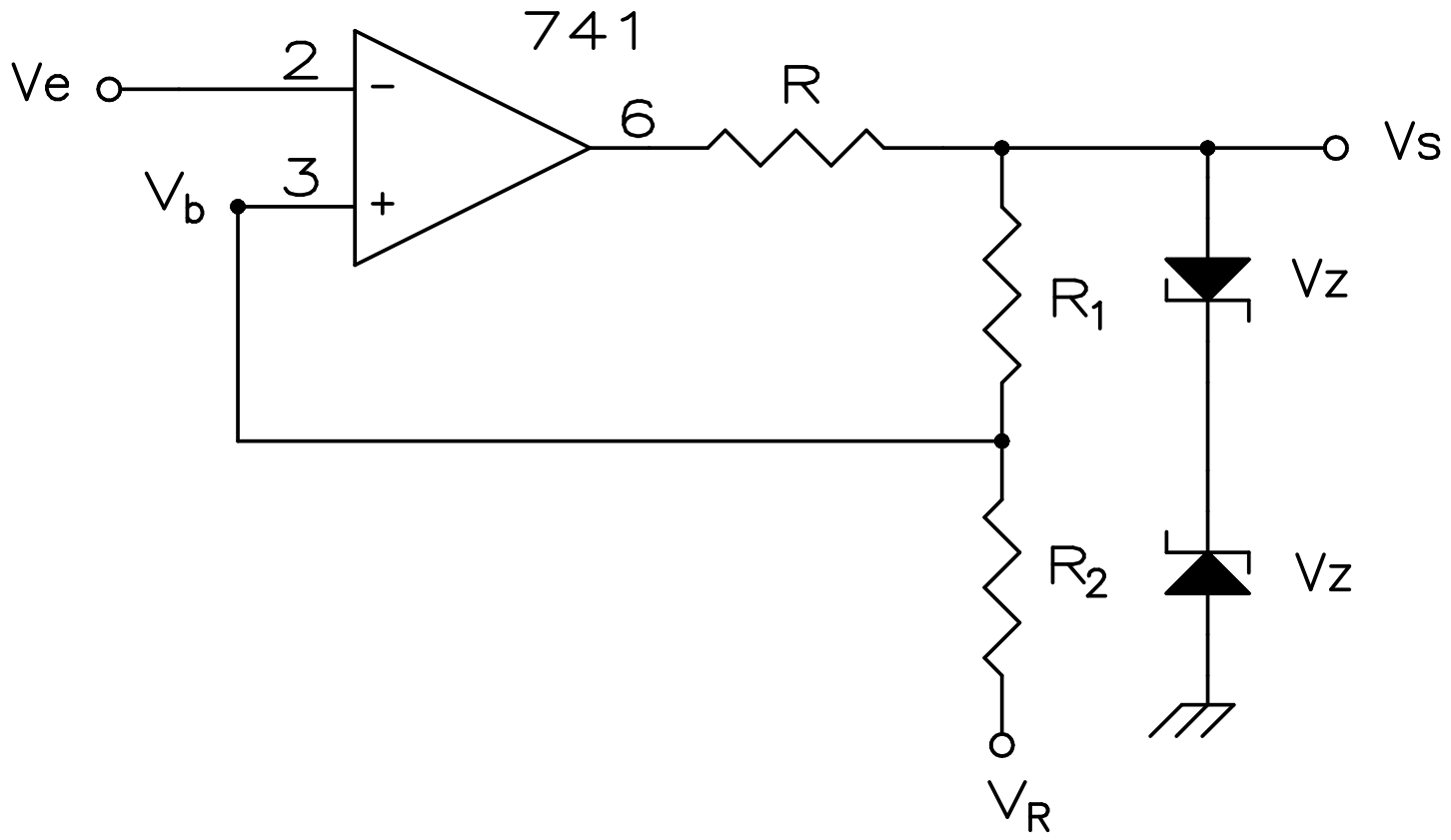
Suponemos $V_e < V_b \rightarrow V_{SAO} + V_{SAT} \rightarrow V_s = +V_s$

2) Si $V_e > V_b \rightarrow V_{SAO} = -V_{SAT} \rightarrow V_s = -V_s$

$-V_\delta = i_1 R_1 + i_1 R_2 + V_R \rightarrow -V_s - V_R = i_1 (R_1 + R_2) \rightarrow i_1 = \frac{-V_s - V_R}{R_1 + R_2} \rightarrow V_B = \frac{-V_s - V_R}{R_1 + R_2} R_2 + V_R = V_{DI}$

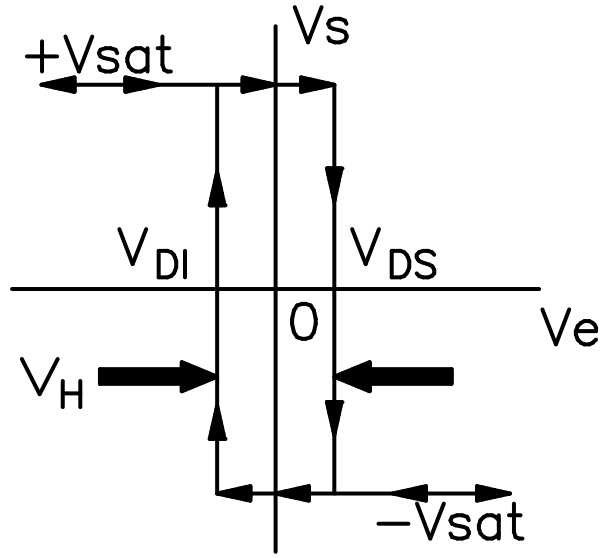


Comparador de Schmitt (inversor)



$$V_b = V_R + \frac{R_2}{R_1 + R_2}\left(V_s - V_R\right) \equiv V_{DS}$$

$$V_b = V_R - \frac{R_2}{R_1 + R_2}\left(V_s + V_R\right) \equiv V_{DI}$$



Fin tema 6