$$i = \frac{dq}{dt} \quad V_B - V_A = \frac{dU_{BA}}{dq} \quad P = \frac{dU}{dq} \cdot \frac{dq}{dt} = i \cdot V \quad R = \frac{L}{\sigma \cdot S} = \rho \cdot \frac{L}{S} \quad C = \frac{q}{V}$$

$$q = \int_{-\infty}^{t} i \cdot dt \quad V = \frac{1}{C} \cdot \int_{-\infty}^{t} i(t) \cdot dt \quad C = \frac{\varepsilon \cdot A}{d} \quad V = L \cdot \frac{di}{dt}$$

$$V = I \cdot R \Rightarrow V = I \cdot \frac{\rho L}{A} \quad \rho = \rho_0 (1 + \alpha \cdot T); \alpha > 0 \quad n = p = n_i \quad n = p + N_D^+ \quad n + N_A^- = p$$

$$n \cdot p = n_i^2 \quad n + N_A^- = p + N_D^+ \quad \vec{J}_A = \sigma \cdot \vec{E} \quad \sigma_n = e \cdot \mu_n \cdot n; \; \sigma_p = e \cdot \mu_p \cdot p \quad \vec{J}_A = e(\mu_n n + \mu_p p) \cdot \vec{E}$$

$$I = I_0 (e^{V / n \cdot V_t} - 1) \quad V_t = \frac{KT}{Q} \cong \frac{T}{11600}$$

$$I_E = A\left(e^{\left(\frac{V_{BE}}{V_T}\right)} - 1\right) - B\left(e^{\left(\frac{V_{BC}}{V_T}\right)} - 1\right) \quad I_E = I_B + I_C \quad \frac{I_C}{I_B} = \frac{C}{E} = \beta$$

$$I_E \cong A \cdot e^{\left(\frac{V_{BE}}{v_T}\right)}$$

$$I_C = C\left(e^{\left(\frac{V_{BE}}{V_T}\right)} - 1\right) - D\left(e^{\left(\frac{V_{BC}}{V_T}\right)} - 1\right) \quad I_C \cong C \cdot e^{\left(\frac{V_{BE}}{v_T}\right)} \quad I_E = \frac{\beta + 1}{\beta} I_C = \frac{I_C}{\alpha}$$

$$I_B = E\left(e^{\left(\frac{V_{BE}}{V_T}\right)} - 1\right) - F\left(e^{\left(\frac{V_{BC}}{V_T}\right)} - 1\right) \quad I_B \cong E \cdot e^{\left(\frac{V_{BE}}{v_T}\right)} \quad \beta = \frac{\alpha}{1 - \alpha} \; ; \; \alpha = \frac{\beta}{\beta + 1}$$

$$I_C = I_o e^{V_{BE}/V_T} \quad g_m = \frac{I_c}{V_T} \quad I_{C2} = \frac{I_0}{1 + e^{\left(\frac{V_d}{v_T}\right)}}$$

-

$$I_D = K_n' \cdot \frac{W}{L}\left[(V_{GS} - V_T) \cdot V_{DS} - \frac{1}{2} V_{DS}^2\right] \quad I_D = \frac{1}{2} K_n' \cdot \frac{W}{L} \cdot (V_{GS} - V_T)^2 \quad I_D \cong K_n' \frac{W}{L} \cdot (V_{GS} - V_T) \cdot V_{DS}$$

$$R_{DS} = \frac{V_{DS}}{I_D} = \frac{1}{K_n' \cdot \frac{W}{L} (V_{GS} - V_T)} \quad I_D = \frac{1}{2} K_n' \left(\frac{W}{L}\right) \cdot (V_{GS} - V_T)^2 \cdot (1 + \lambda \cdot V_{DS}) \quad r_o \cong \frac{1}{\lambda \cdot I_D}$$

$$V_{DS}^T > V_{GS}^T - V_T \quad g_m = \frac{i_D}{v_{GS}} = K_n' \cdot \frac{W}{L} (V_{GS} - V_T) \quad \frac{v_D}{v_{GS}} = -g_m \cdot R_D \quad I_o = I_{REF} \cdot \frac{W_2 / L_2}{W_1 / L_1}$$

$$\int_{-\infty}^{\infty} y(t)u(t)dt = \int_{0}^{\infty} y(t)dt \quad \int_{-\infty}^{\infty} y(t)\big(u(t-a)-u(t-b)\big)dt = \int_{a}^{b} y(t)dt \quad \int_{-\infty}^{\infty} f(t)\delta(t-a)dt = f(a)$$

$$V(s) = L(v(t)) = \int_{0^-}^{\infty} u(t)e^{-st}\,dt$$

L (v(t)) = V(s) → L^{-1} (V(s)) = u (t) · v (t)
L^{-1} L (v(t)) = u (t) · v (t)

funció	**Funció v(t)**	**TransfV(s)**
Impuls	δ(t)	1
Esglaó	U(t)	1 / s
Constant	K	K / s
Rampa	t u(t)	1 / s^2
Exponencial	e^{-at}	1 / (s + a)
Rampa esmorteïda	$t\cdot e^{-at}$	$\frac{1}{(s+a)^2}$
Sinus	$\sin\beta t$	$\frac{\beta}{s^2+\beta^2}$
Cosinus	$\cos\beta t$	$\frac{s}{s^2+\beta^2}$
Sinus esmorteït	$e^{-at}\sin\beta t$	$\frac{\beta}{(s+a)^2+\beta^2}$
Cosinus esmorteït	$e^{-at}\cos\beta t$	$\frac{s+a}{(s+a)^2+\beta^2}$

Propietat	**Funció v(t)**	**Transformada V(s)**
Linealitat	$Av_1(t)+Bv_2(t)$	$AV_1(s)+BV_2(s)$
Integració	$\int_0^t v(t)dt$	$\frac{V(s)}{s}$
Derivació	$\frac{dv(t)}{dt}$ $\frac{d^2v(t)}{dt^2}$	$sV(s)-v(0^-)$ $s^2V(s)-sv(0^-)-v'(0^-)$

$$V(s) = \frac{b_m s^m + b_{m-1}s^{m-1} + \cdots + b_1 s^1 + b_0}{a_n s^n + a_{n-1}s^{n-1} + \cdots + a_1 s^1 + a_0}$$

$$V(s) = K\,\frac{(s-z_1)(s-z_2)\cdots(s-z_m)}{(s-p_1)(s-p_2)\cdots(s-p_n)}$$

$$V(s) = \frac{K_1}{s-p_1} + \frac{K_2}{s-p_2} + \cdots + \frac{K_n}{s-p_n} \qquad v(t) = u(t)\left\{k_1 e^{p_1 t} + k_2 e^{p_{21}t} + \cdots + k_n e^{p_{n1}t}\right\}$$

v(t) → V(s) i(t) → I(s)

$$R \qquad v_R(t) = Ri_R(t) \;\rightarrow\; V_R(s) = RI_R(s)$$

$$L \qquad v_L(t) = L\frac{di_L(t)}{dt} \;\rightarrow\; V_L(s) = LsI_L(s) - Li_L(0)$$

$$C \qquad v_C(t) = \frac{1}{C}\int_0^t i_C(t)dt + v_c(0) \;\rightarrow\; V_C(s) = \frac{I_C(s)}{Cs} + \frac{1}{s}v_C(0)$$

Z_R = R
Z_C = 1 / Cs
Z_L = Ls

$$I_R(s) = \frac{1}{R}V_R(s)$$

$$I_L(s) = \frac{1}{Ls}V_L(s) + \frac{1}{s}i_L(0)$$

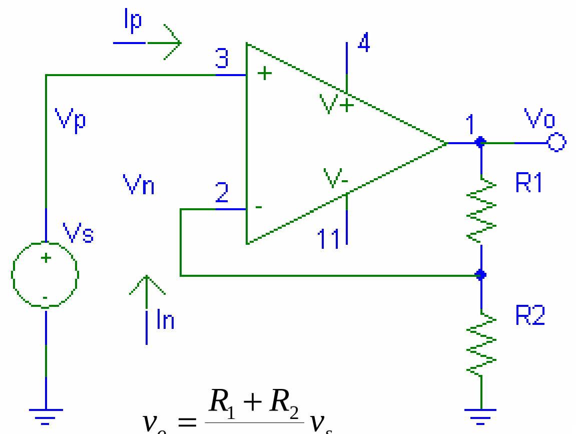
$$I_C(s) = CsV_C(s) - Cv_C(0)$$

$$T(s) = \left.\frac{V_0(s)}{V_I(s)}\right|_{CI=0} \quad ó \quad T(s) = \left.\frac{I_0(s)}{I_I(s)}\right|_{CI=0}$$

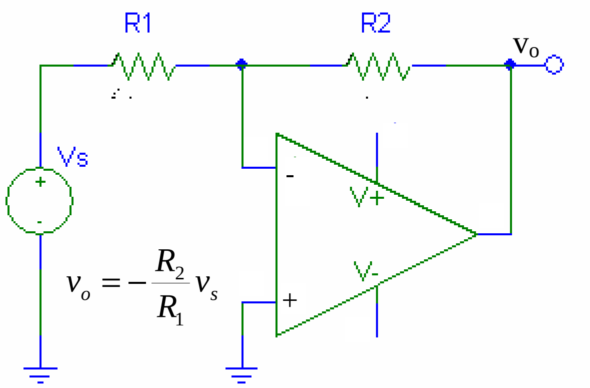
$$A_p(dB) \equiv 10\log_{10}\frac{p_0}{p_I}$$

A_v(dB)=20$\log_{10}$ |T(jω)|

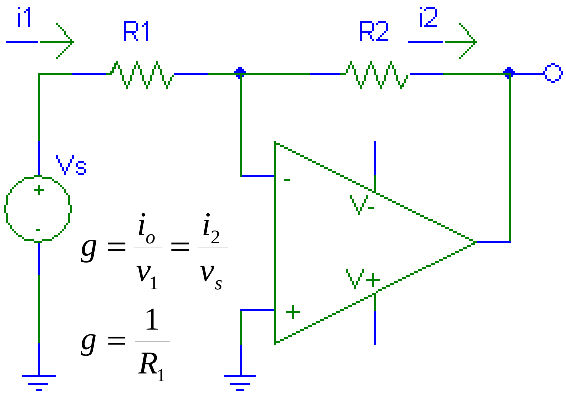
$i_o = I_{C+} + I_{C-} + i_p + i_n \qquad V_o = (v_p - v_n)\mu$



$$v_o = \frac{R_1 + R_2}{R_2} v_s$$

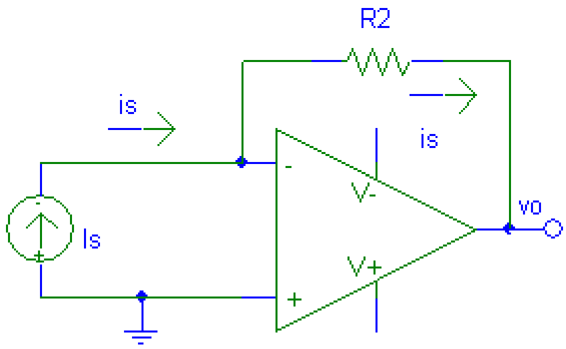


$$v_o = -\frac{R_2}{R_1} v_s$$

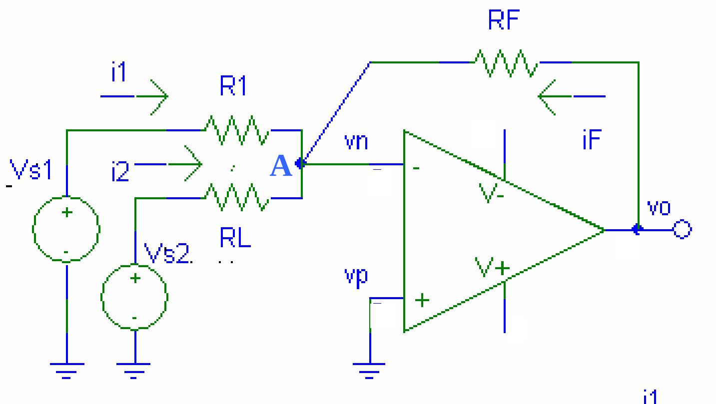


$$g = \frac{i_o}{v_1} = \frac{i_2}{v_s}$$

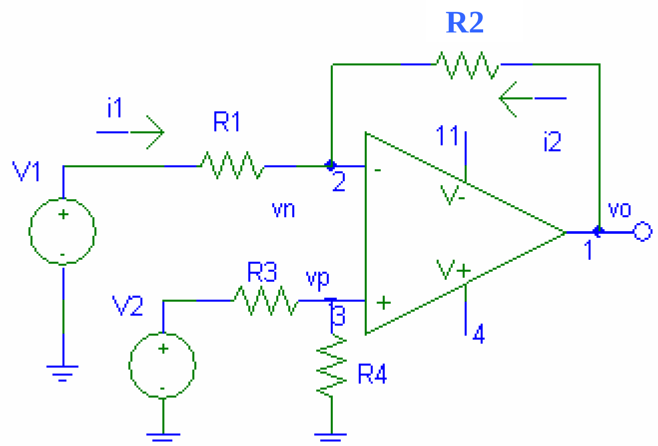
$$g = \frac{1}{R_1}$$



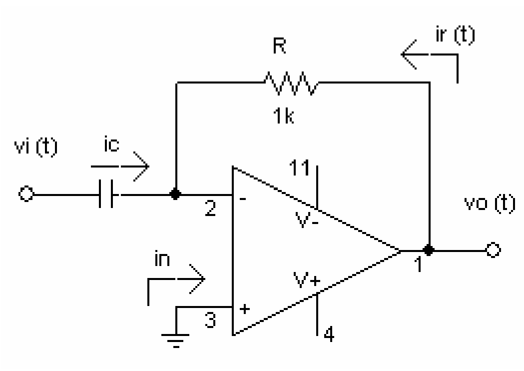
$V_o = -R_2 \cdot i_s \quad r = -R_2$



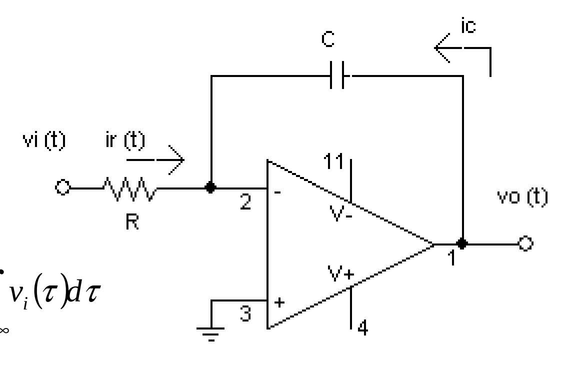
$$v_o = -\frac{R_F}{R_1} v_{s1} - \frac{R_F}{R_L} v_{s2}$$



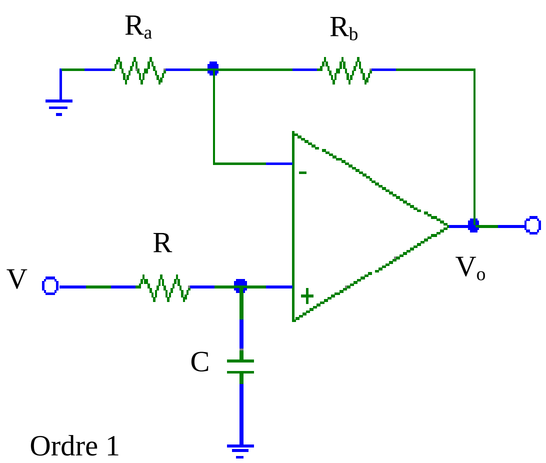
$$v_o = \frac{R_4}{R_3 + R_4} \cdot \frac{R_1 + R_2}{R_1} \cdot v_2 - \frac{R_2}{R_1} v_1$$



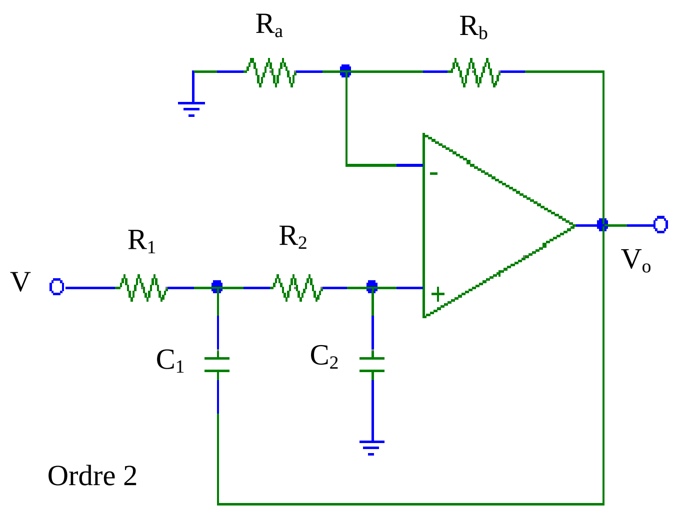
$$v_o(t) = -RC\frac{dv_i(t)}{dt}$$



$$v_o(t) = -\frac{1}{RC}\int_{-\infty}^{t} v_i(\tau)d\tau$$



Ordre 1



Ordre 2

$$H_s = \frac{H_0}{SRC+1}$$

$$H_s = \frac{H_0}{R^2C^2s^2 + RCS(3-A_V)+1}$$

$$\omega_o = \frac{1}{RC} \quad i \quad H_0 = 1 + \frac{R_B}{R_A} \text{ on } R1 = R2 = R \text{ i } C1 = C2 = C$$