Unit scaling

m = milli = 10^{-3}

u = μ = micro = 10^{-6}

k = kilo = 10^{3}

MEG = 10^{6}

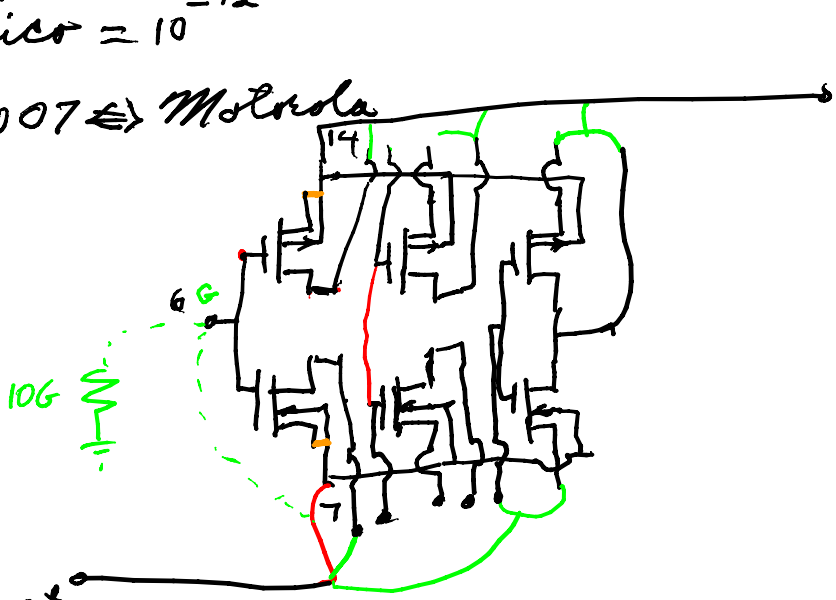
p = pico = 10^{-12}

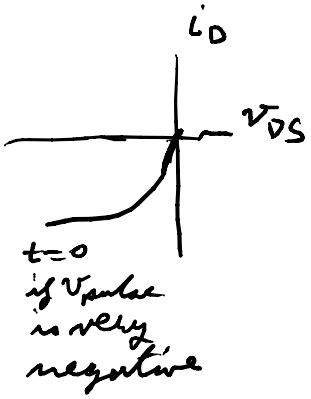
n = nano = 10^{-9}

f = femto = 10^{-15}

G = giga = 10^{+9}

RCA 3600 = 4007 ⇔ Motorola



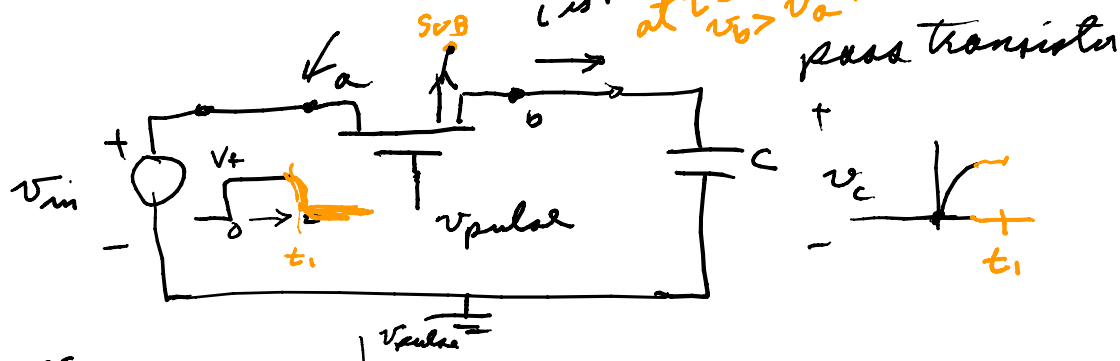


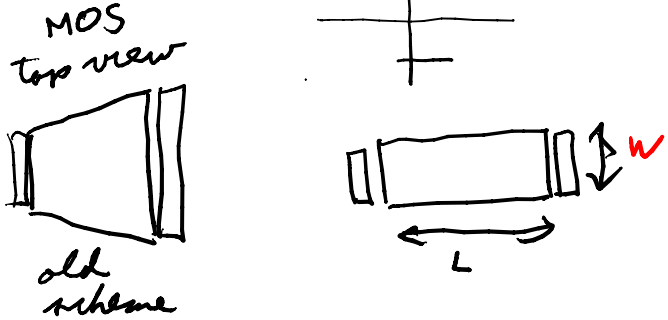
at t = 0+, a = S, b = drain

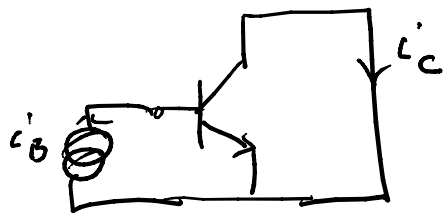
i is pos at t = 0+

at $t = t_1$ (when v_{in} drops) $v_b > v_a \Rightarrow b = S, a = D$

pass transistor

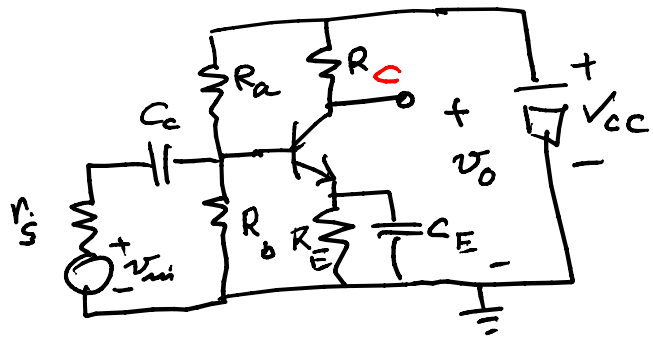






f_T is the frequency where $\left|\frac{i_c}{i_B}(j\omega)\right| = 1$

Small signal gain



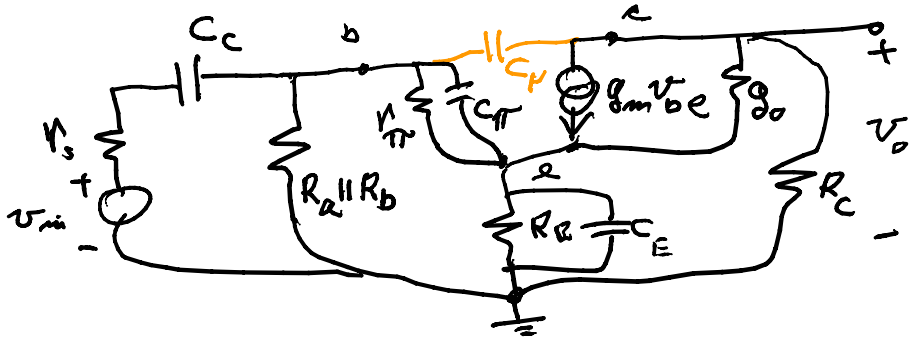
$r_\pi = \frac{1}{g_\pi}$

g = conductance

$g_m = \frac{|I_c|}{V_T}$

$g_o = \frac{|I_c|}{V_A}$

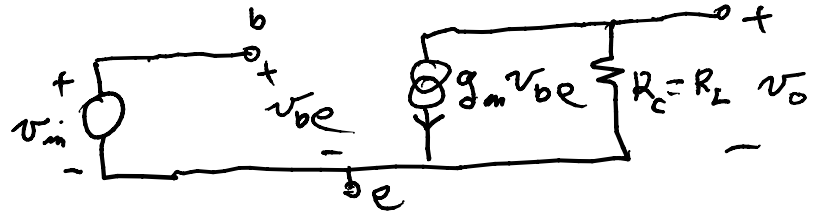
$g_\pi = \frac{g_m}{\beta_o}$



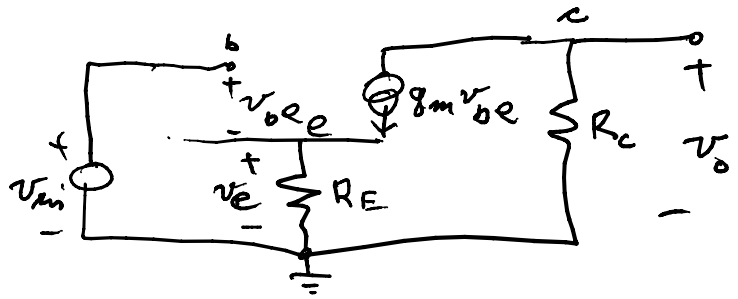
desire $\frac{v_o}{v_{in}}$; $20\log_{10}\left|\frac{v_o}{v_{in}}(j2\pi f)\right|$ = Bode plot

Key parts $\Rightarrow$ $C_c \to$ short, $C_E \to$ short

$g_{m\pi} \to 0$, C_π & $C_\mu \to 0$, $r_s \to 0$; $g_o \to 0$



$v_o = -(g_m v_{be}) R_L = -g_m R_L v_{in}$; $G_v = \frac{v_o}{v_{in}} = -g_m R_L$



$$v_e = R_E \cdot g_m v_{be} \; ; \quad v_{be} = v_{in} - v_e$$

$$= R_E \cdot g_m (v_{in} - v_e) \rightarrow v_e = \frac{R_E g_m v_{in}}{1 + g_m R_E}$$

get $v_{be} = v_{in} - v_e = \left(1 - \frac{R_E g_m}{1 + g_m R_E}\right) v_{in}$

$$= \frac{1}{1 + g_m R_E} v_{in} = v_{be}$$

$$v_o = -R_c g_m v_{be} = -\frac{R_c g_m}{1 + g_m R_E}$$

with C_E : C_E is in parallel with R_E

$$y_E = \frac{1}{R_E} + \omega C_E = \frac{1 + \omega C_E R_E}{R_E} \Rightarrow R_E \Rightarrow \frac{R_E}{1 + \omega C_E R_E}$$

$$\frac{v_o}{v_{in}} = \frac{-R_c g_m}{1 + g_m \frac{R_E}{1 + \omega C_E R_E}} = \frac{-R_c g_m (1 + \omega C_E R_E)}{(1 + g_m R_E) + \omega C_E R_E}$$