Discussion 12 - Cory

Wednesday, May 01, 2013 4:12 PM

Feedback Examples

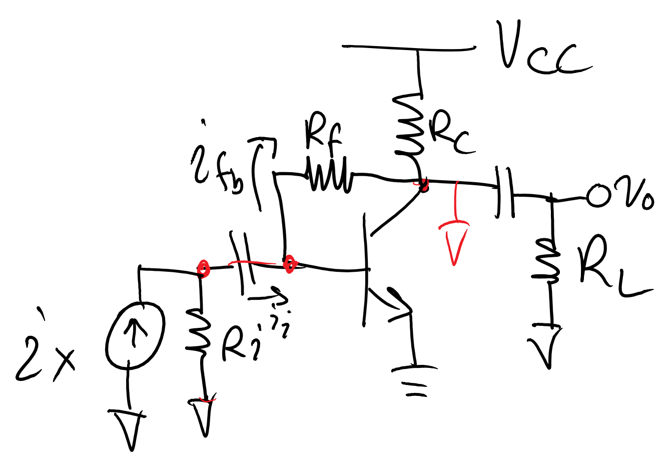
(2) $V_{DD} = 3v$, $k_n, k_p [\mu A/V^2]$

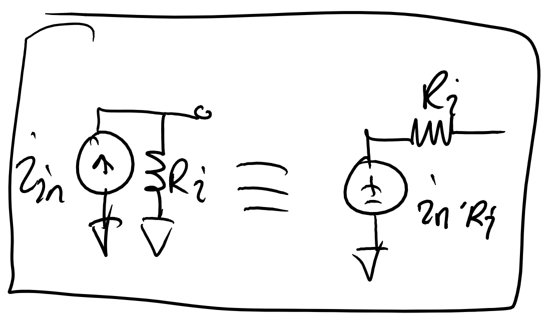
Feedback Configurations

4 - types

input		output	
Variable	Connection	Connection	Variable
Voltage	Series	Series	Current
Current	Shunt	Shunt	Voltage

example



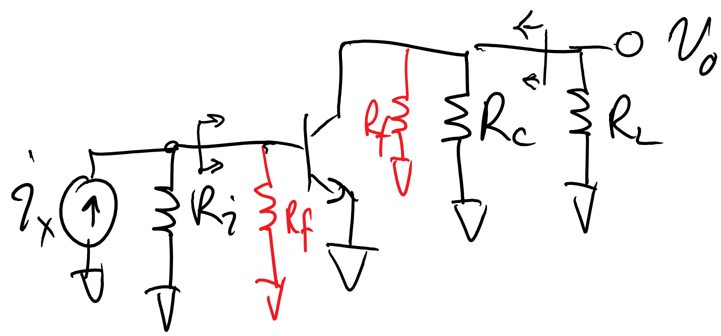


(1) identify the fb type

input: Shunt (i_i is Summed w/ i_{fb})

output: Shunt (V_o is sampled)

② Redraw open Loop Ckt w/ fb loading effects



open loop r_i, r_o

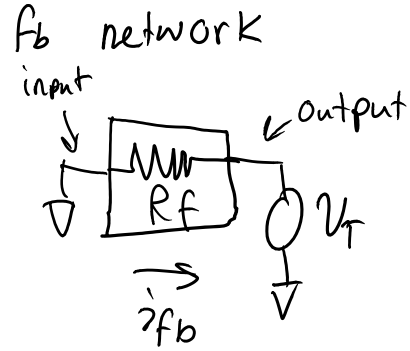
$r_i = R_f \| r_\pi$, $r_{out} = R_c \| R_f \| r_o$

Open loop gain $\left[\frac{v_o}{i_x}\right] = a_v = r_m$

$$\frac{v_o}{i_x} = -g_m[R_c \| R_f \| R_L] \cdot (R_i \| R_f \| r_\pi) = r_m$$

③ find feedback factor

fb network

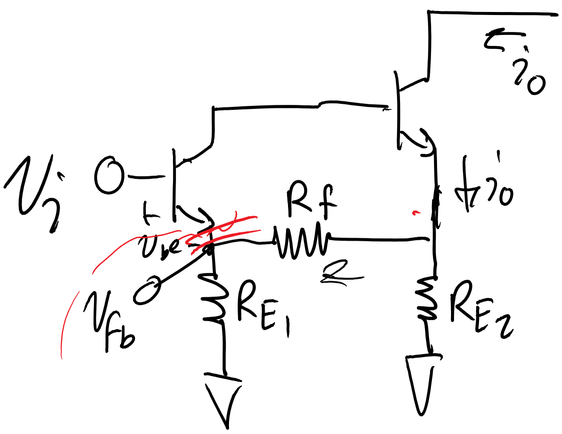


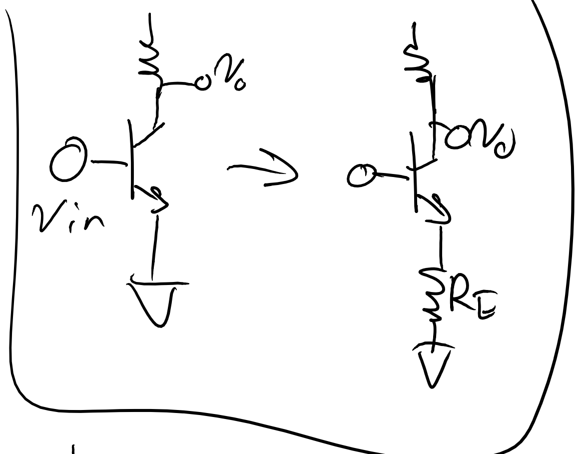
$$f = \frac{i_{fb}}{v_T} = -\frac{1}{R_f}$$

r_m, f, r_i, r_{out} ✓ $T = r_m \cdot f$

$$R_m = \frac{r_m}{(1+T)} = \frac{1}{f} \cdot \frac{T}{(1+T)}$$

$$R_i = \frac{r_i}{(1+T)}, \quad R_{out} = \frac{r_{out}}{(1+T)}$$

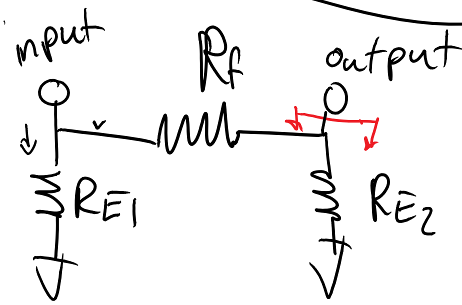




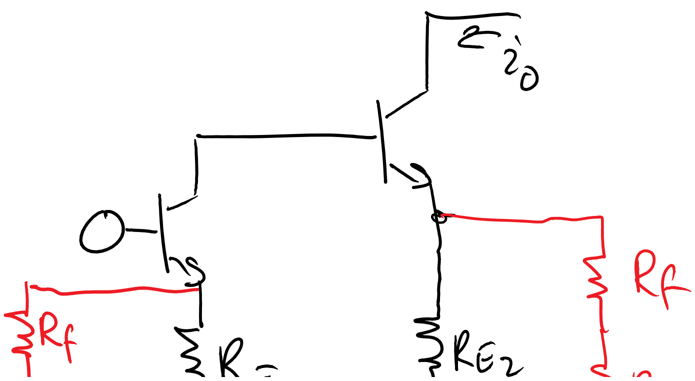
① identify fb type

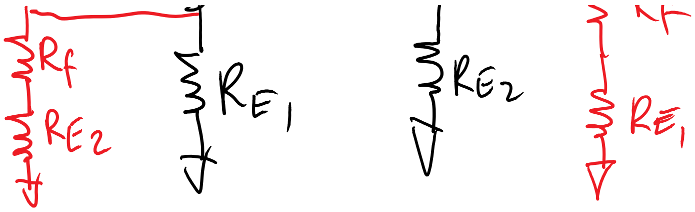
input: series

output: series



② Consider Loading on open-Loop ckt

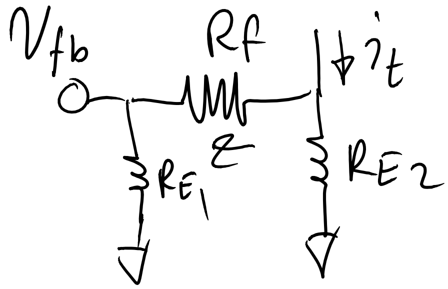




from this calculate $\frac{i_o}{v_{in}} = g_m$ ← closed loop

r_i, r_{out}

③ find feedback factor



$$f = \frac{v_{fb}}{i_t} = R_{E_1} \cdot \frac{R_{E_2}}{R_{E_1} + R_f + R_{E_2}}$$

$$T = g_m f$$

$$G_m = \frac{g_m}{(1+T)}$$

$$R_i = r_i(1+T)$$

$$R_o = r_{out}(1+T)$$

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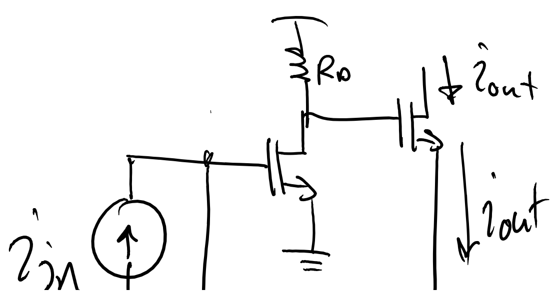
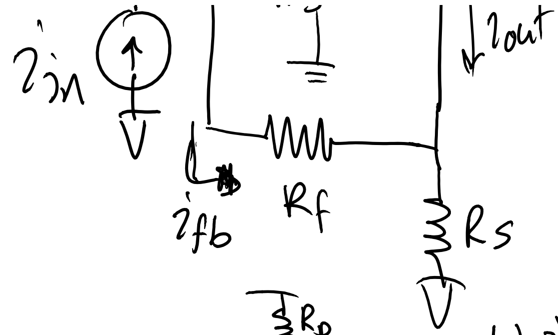
①

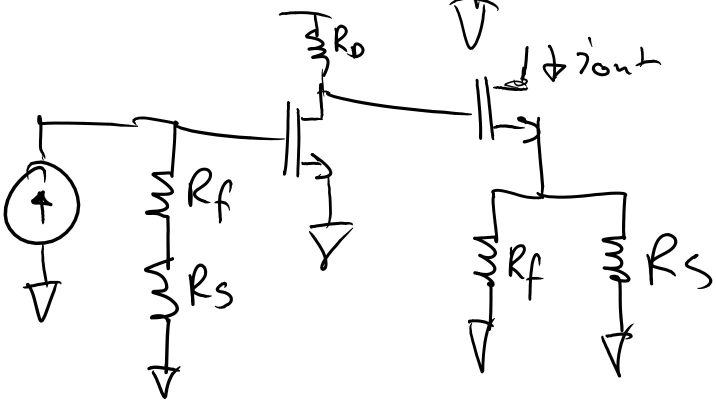


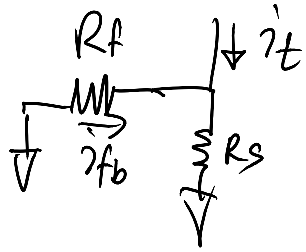
Type

input: shunt



input: Shunt
Output: Series





$$f = \frac{i_{fb}}{i_o} = \frac{-R_s}{R_f + R_s}$$

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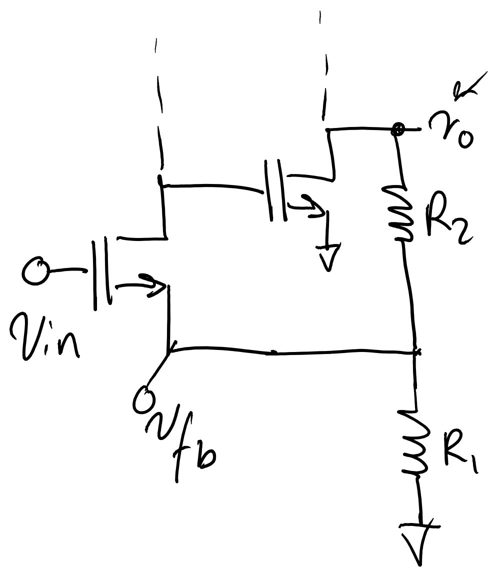
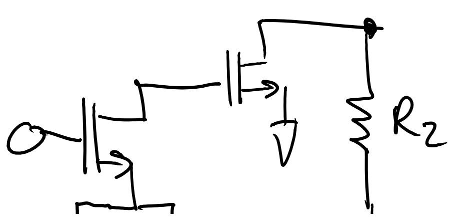
(2)

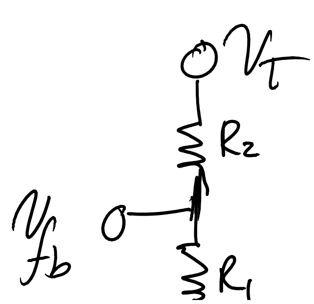


type
input: Series
Output: Shunt

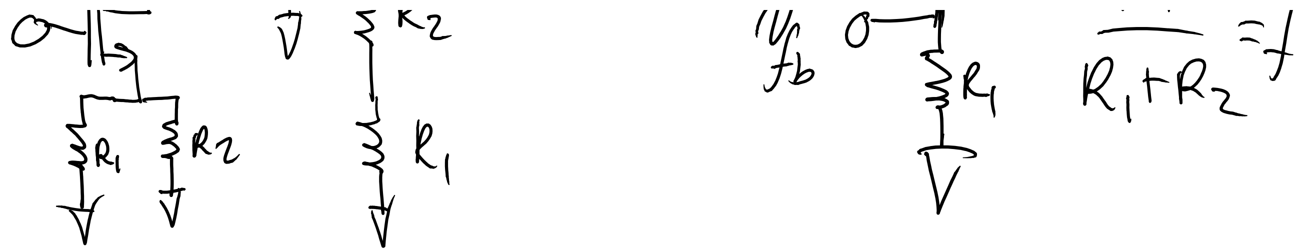
Loaded Ckt



f



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



③ Inner Xsistor: Shunt-Shunt

Overall 2-stage: Series Shunt