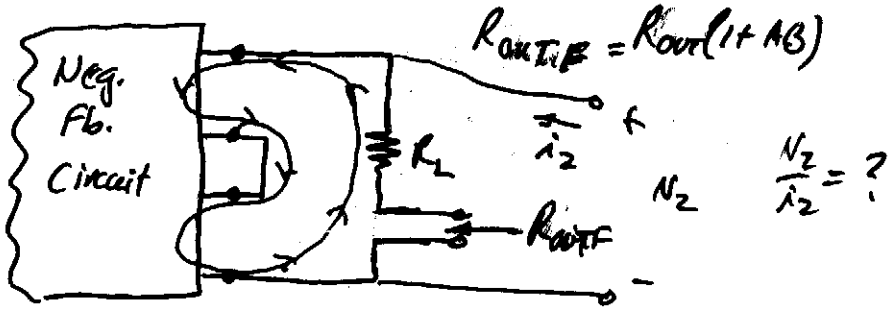
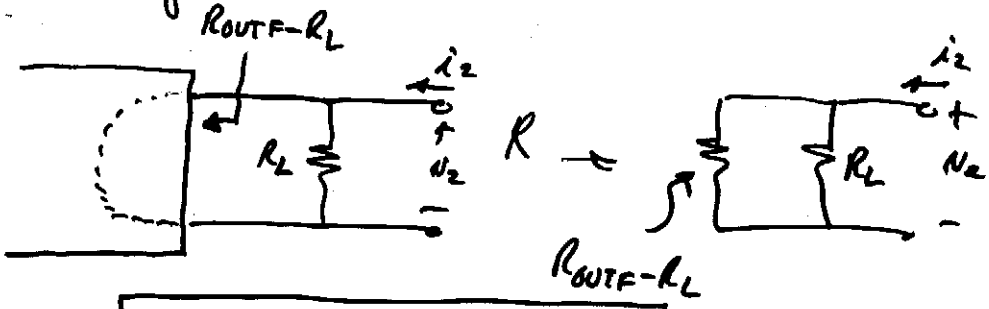
Series output – Output resistance



$R_{OUTF} = R_{out}(1+AB)$

N_2 $\quad \frac{N_2}{i_2} = ?$

Redrawing –



$$\frac{N_2}{i_2} = R_L \,||\, (R_{OUTF} - R_L)$$

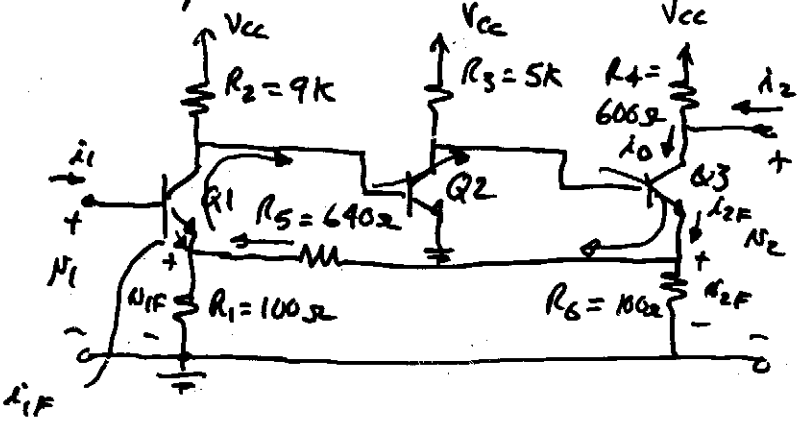
Series-Series Feedback (Transconductance Amplifiers)

$\frac{I_{out}}{V_{in}}$ $\quad A = G_T$

z-parameters –

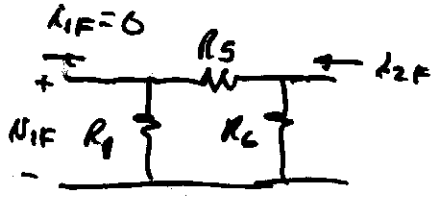
$$z_{12F} = \left.\frac{N_{1F}}{i_{2F}}\right|_{i_{1F}=0} = B$$

Example –



If $h_{fe} = B = 100$ and $I_{C1} = 0.6mA$, $I_{C2} = 1mA$, and $I_{C3} = 4mA$, find $\frac{N_2}{N_1}$, $\frac{N_1}{i_1}$, and $\frac{N_2}{i_2}$ using methods of neg. fb. analysis.

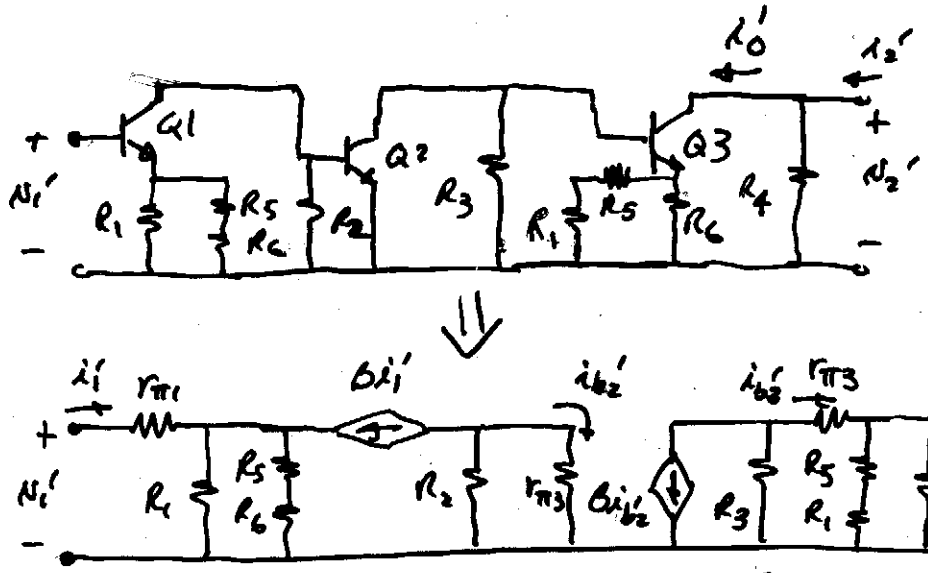
$\beta = ?$



$$\beta = \left.\frac{v_{1F}}{i_{2F}}\right|_{v_{1F}=0} = \frac{R_6}{R_1+R_5+R_6} R_1 = 11.9\,\Omega$$

Probably $\frac{i_o}{v_1} \simeq \frac{1}{11.9\,\Omega}$

$\beta = 0$



$$r_{\pi 1} = \frac{100.25}{0.6} = 4.16\text{K}, \quad r_{\pi 2} = \frac{100.25}{1} = 2.5\text{K}, \quad r_{\pi 3} = \frac{100.25}{6} = 625\,\Omega$$

$$\frac{i_o'}{v_1'} = \left(\frac{i_o'}{i_{b3}'}\right)\left(\frac{i_{b3}'}{i_{b2}'}\right)\left(\frac{i_{b2}'}{i_1'}\right)\left(\frac{i_1'}{v_1'}\right) = A$$

$$= (\beta)\left(\frac{-\beta R_3}{R_3 + r_{\pi 3} + (1+\beta)\left[R_6 \| (R_1+R_5)\right]}\right)\left(\frac{-\beta R_2}{R_2 + r_{\pi 3}}\right)\left(\frac{1}{r_{\pi 1} + (1+\beta)\left[R_1 \| (R_5+R_6)\right]}\right)$$

$$A = (100)(-34.43)(-78.3)\left(\frac{1}{12.97\text{K}}\right) = 20.78\ \frac{A}{V}$$

$\beta \neq 0$

$$\frac{i_o}{v_1} = \frac{A}{1+A\beta} = \frac{20.78}{1+(20.78)(11.9)} = \frac{20.78}{1+247.2} = \frac{20.78}{248.2} = 0.0837\ \frac{A}{V} \simeq \frac{1}{11.9\,\Omega}$$

$$R_{in}(\beta=0) = r_{\pi 1} + (1+\beta)\left[R_1 \| (R_5+R_6)\right] = 12.97\text{K}\,\Omega$$

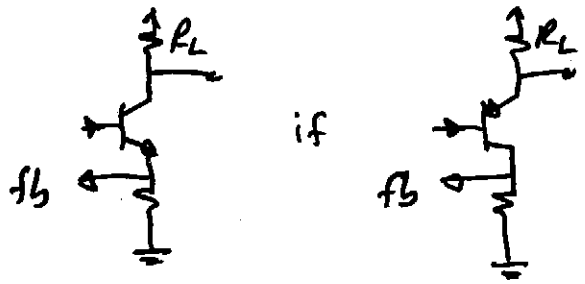
$$\therefore R_{inF} = \frac{v_1}{i_1} = 12.97\text{K}(1+A\beta) = 12.97\text{k}\,(248.2) = \underline{\underline{3.22\,\text{M}\Omega}}$$

$$\frac{v_2}{v_1} = \frac{-i_o R_4}{v_1} = \left(\frac{i_o}{v_1}\right)(-R_4) = (0.0837)(-600) = \underline{\underline{-50.2\ \text{V/V}}}$$

$R_{out}(\beta=0) = \infty$

$R_{outF} = R_{out}(\beta=0)(1+A\beta) = \infty$

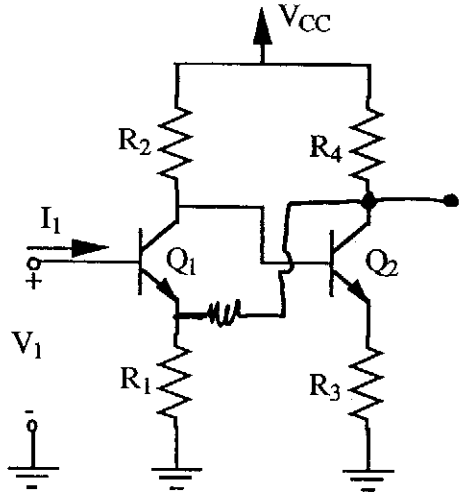
$\frac{N2}{\lambda_2} = (R_{outF} - R_f) \| R_f = \infty \| R_f = R_f = \underline{\underline{600\Omega}}$



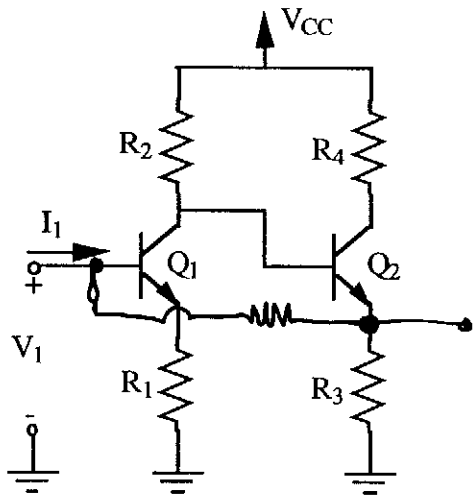
EXAMPLE OF FEEDBACK TOPOLOGY IDENTIFICATION

Use the rules of identifying feedback topologies to create the four different negative feedback topologies using the identical starting structure.

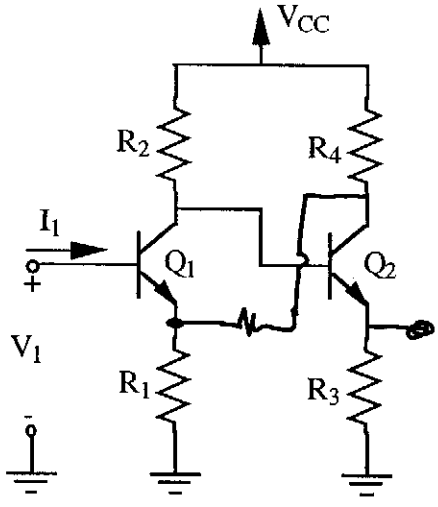
1. Voltage-Voltage (Series-Shunt)



2. Current-Voltage (Shunt-Shunt)



3. Voltage-Current (Series-Series)



4. Current-Current (Shunt-Series)