Shunt-Shunt Feedback (Transresistance Amplifiers)

1.) Find $y_{11F} = \left.\frac{i_{1F}}{v_{1F}}\right|_{v_{2F}=0}$ (input conductance of fb. ntwk w. output SC)

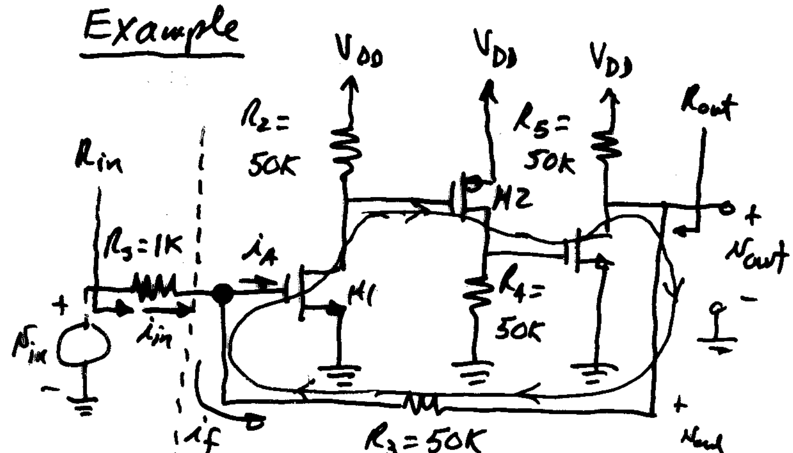
2.) Find $y_{22F} = \left.\frac{i_{2F}}{v_{2F}}\right|_{v_{1F}=0}$ (output conductance of fb. ntwk. w. input SC)

3.) Find $y_{12F} = \left.\frac{i_{1F}}{v_{2F}}\right|_{v_{1F}=0}$ (transconductance of the fb. ntwk. from output to input w. input SC)

4.) Find A (units of Ω)

Etc.

Example

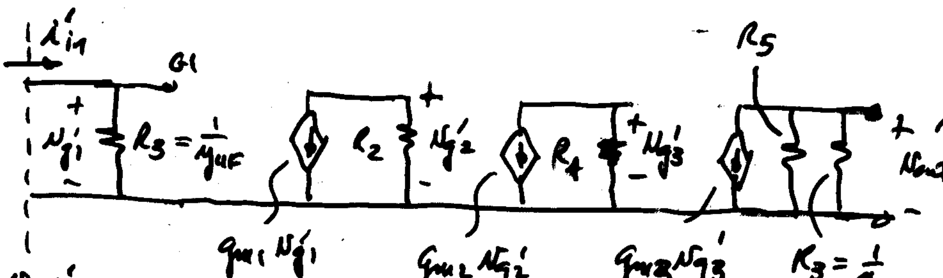


Find $\frac{v_{out}}{v_{in}}$, R_{in} & R_{out}

if $g_{m1} = g_{m2} = g_{m3} = 0.2mS$ and $r_{ds} = \infty$.

1.) $y_{11F} = \frac{1}{R_3} = \frac{1}{50K}$ 2.) $y_{22F} = \frac{1}{R_3} = \frac{1}{50K}$ 3.) $y_{12F} = \frac{-1}{50K} = F$

4.)



$$A = \frac{v_{out}'}{i_{in}'} = \left(\frac{v_{out}'}{v_{g3}'}\right)\left(\frac{v_{g3}'}{v_{g2}'}\right)\left(\frac{v_{g2}'}{v_{g1}'}\right)\left(\frac{v_{g1}'}{i_{in}'}\right)$$

$$A = (-g_{m3} R_3 \| R_5)(-g_{m2} R_4)(-g_{m1} R_2)(R_3) = -25M\Omega$$

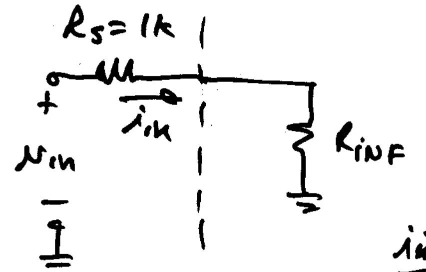
AF is ALWAYS positive

Continuing –

$$A_F = \frac{v_{out}}{i_{in}} = \frac{A}{1+AF} = \frac{-25M\Omega}{1+(-25M\Omega)\left(\frac{-1}{50k}\right)} = \frac{-25M\Omega}{1+500} = -49.9k\Omega$$

$$R_{inF} = \frac{R_{in}}{1+AF} = \frac{R_3}{501} = 99.8\,\Omega$$

$$R_{outF} = \frac{R_{out}}{1+AF} = \frac{R_3 \| R_5}{501} = 49.9\Omega$$



$$\frac{v_{in}}{i_{in}} = R_S + R_{inF} = 1099.8\Omega$$

$$\frac{i_{in}}{v_{in}} A_F = \frac{v_{out}}{i_{in}} \times \left(\frac{i_{in}}{v_{in}}\right) = \frac{v_{out}}{v_{in}} = \frac{A_F}{R_S + R_{inF}}$$

$$= -45.5\ \frac{V}{V}$$

Download the 2 page handout on comparing the 2 approaches to solving the shunt input feedback problem.