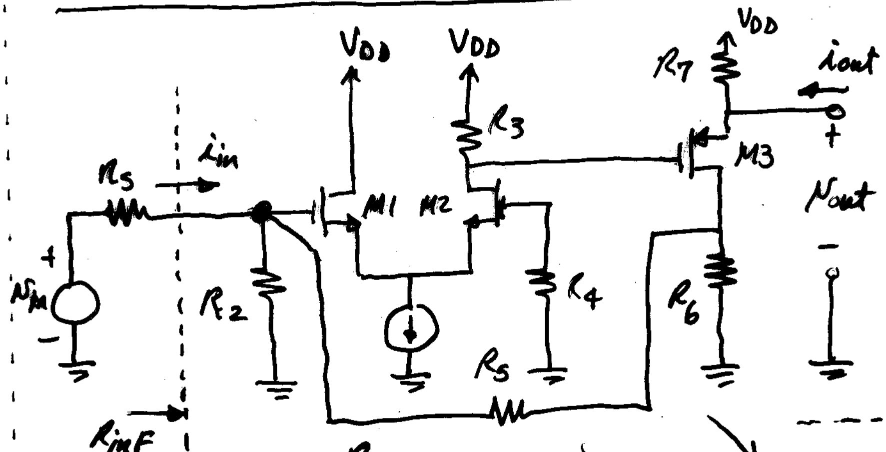
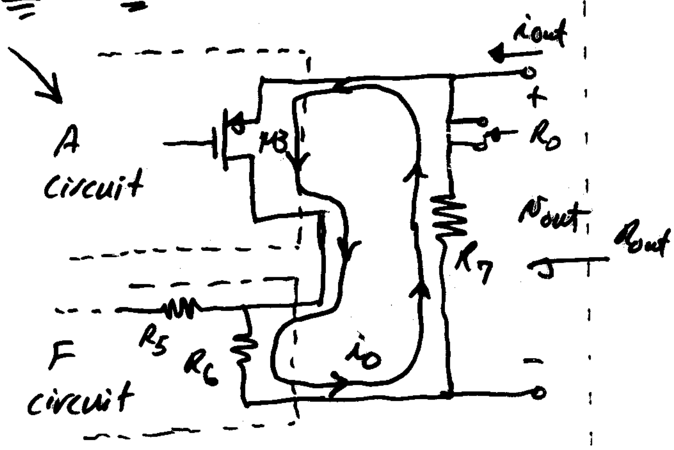
Shunt-Series Feedback Example - Cont'd

Quiz 11
Series-~~series~~ shunt
feedback



$$R_{inF} = \frac{R_{in}}{1+AF}$$

$$\frac{v_{in}}{i_{in}} = R_S + R_{inF} = 1301\,\Omega$$



What is the output resistance of a series output fb. amplifier? (Note: The example wants v_{out}/i_{out}.)

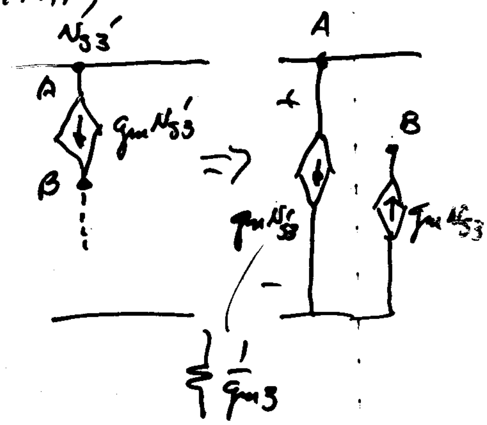
R_o = resistance in series with the output loop with the fb. loop open.

R_{oF} = "R_o" when the fb. loop is closed.

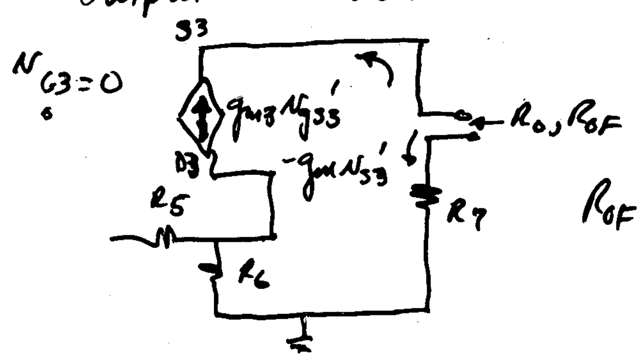
The example requires $R_{out} = \frac{v_{out}}{i_{out}}$

R_o is the resistance that the fb formulas apply to:

$$R_{oF} = R_o(1+AF)$$



Output ss model:

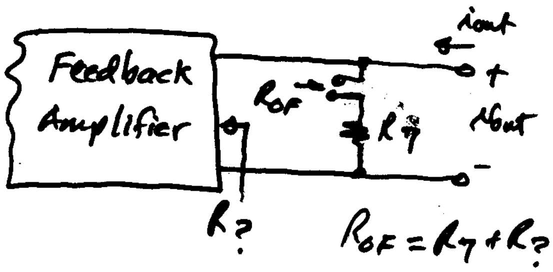


$$R_o = \frac{1}{g_{m3}} + R_7$$

$$R_o = 1.1K$$

$$R_{oF} = R_o(1+AF) = 1.1(3.164)K = \underline{3.48\,K\Omega}$$

How do you get R_{out} from all this?



$R_{out} = \frac{v_{out}}{i_{out}} =$ ~~$R_7 \| (R_{OF} - R_7)$~~

$R_{OF} = R_7 + R_? \rightarrow R_? = R_{OF} - R_7$

$R_{out} = R_7 \| (R_{OF} - R_7) = 100\Omega \| (3480 - 100) = \underline{97.12\Omega}$

A simpler Approach to fb. amplifier analysis

1.) Find A_{12F}

2.) Find A by the following:

At the input:

The loading of the fb. network on the amplifier is found by looking in the fb. network and shorting the output (output shunt) or opening the output (output is series).

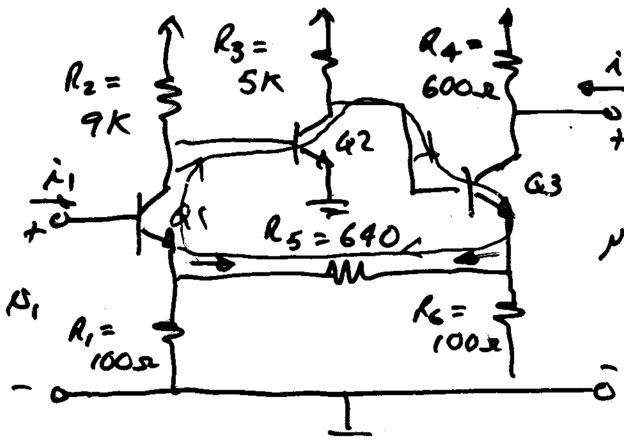
At output:

The loading of the fb. ntwk. on the amplifier is found by looking back into the fb. ntwk. with the input s.c (shunt input) or o.c (series input)

Series-Series – Transconductance Amplifier

$$z_{12F} = \left.\frac{v_{1F}}{i_{2F}}\right|_{i_{1F}=i_1=0} \qquad A\ \left(\frac{A}{V}\right)$$

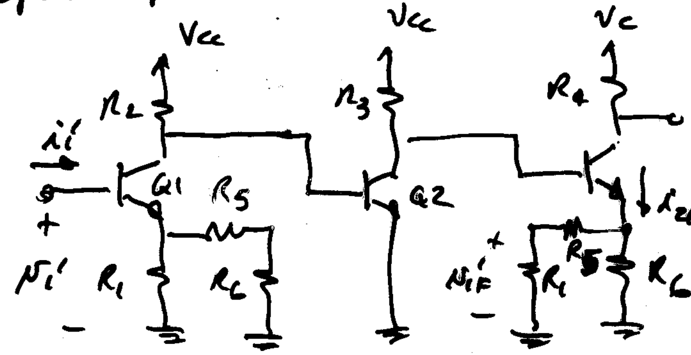
Example



If $\beta = h_{fe} = 100$ and $I_{C1} = 0.6mA$, $I_{C2} = 1mA$ and $I_{C3} = 4mA$, find $\frac{v_2}{v_1}$, $\frac{v_1}{i_1}$, and $\frac{v_2}{i_2}$ using fb. analysis methods.

$r_{\pi1} = 4.16K$, $r_{\pi2} = 2.5K$, $r_{\pi3} = 625\Omega$

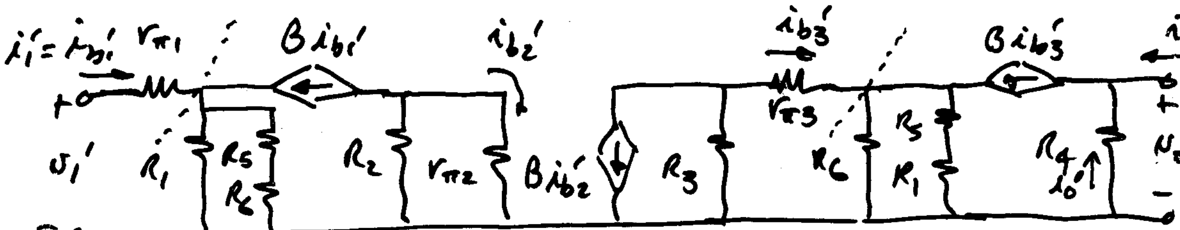
Open-loop –



$$F = \frac{v_{1F}'}{i_{2F}'}$$

$$v_{1F}' = \frac{R_6}{R_1+R_5+R_6} R_1\, i_{2F}'$$

$$F = \frac{R_1 R_6}{R_1+R_5+R_6} = 11.9\Omega$$



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

$$= (\beta)\left(\frac{-\beta R_3}{R_3 + r_{\pi3} + (1+\beta)[R_6 \| (R_1+R_5)]}\right)\left(\frac{-\beta R_2}{R_2 + r_{\pi2}}\right)\left(\frac{1}{r_{\pi1} + (1+\beta)[R_1 \| (R_5+R_6)]}\right)$$

$$= (100)(-3.443)(-78.3)\left(\frac{1}{12.97K}\right) = 20.78\ \frac{A}{V}$$

$$\frac{i_o}{v_1} = A_F = \frac{A}{1+AF} = \frac{20.78}{1+(20.78)(11.9)} = \frac{20.78}{1+247.2} = 0.0837 \text{ A/V}$$

$$\frac{v_1}{i_1} = R_{inF} = R_{in}(1+AF) = 12.97K\,(1+247.2) = \underline{\underline{3.22\,M\Omega}}$$

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

$$\frac{v_2}{i_2} = R_4 = 600\Omega \qquad ???$$

R_4 is not in the fb. loop so it is not influenced by feedback.