Shunt-Series Feedback Example—Cont'd

\[ R_{\text{in}} = \frac{R_{\text{in}}}{1+AF} \]
\[ N_{\text{in}} = R_0 + R_{\text{in}} = 1301 \Omega \]

What is the output resistance of a series output fb. amplifier? (Note: the example wants \( V_{\text{out}}/I_{\text{out}} \).)

\( R_0 = \) resistance in series with the output loop with the fb. loop open.

\( R_{\text{of}} = R_0 \) when the fb. loop is closed.

The example requires \( V_{\text{out}} = \frac{N_{\text{out}}}{V_{\text{out}}} \).

Output ss model:

\[ R_0 = \frac{1}{g_{m3}} + R_7 \]
\[ R_{\text{of}} = R_0 (1+AF) = 1.1 (3.16 \Omega) K = 3.45 K\Omega \]
How do you get $R_{Out}$ from all this?

![Feedback Amplifier Diagram]

\[
R_{out} = \frac{R_{out}}{R_{in}} = \frac{100}{3450 - 100} = 0.02922
\]

A Simpler Approach to FB Amplifier Analysis

1.) Find $4_{12e}$

2.) Find $A$ by the following:

   - At the input:
     - The loading of the FB network on the amplifier is found by looking into the FB network and shorting the output (output short) or opening the output (output is series).

   - At output:
     - The loading of the FB network on the amplifier is found by looking back into the FB network with the input S.C (short input) or A.C (series input)
Series-Series Transconductance Amplifier

\[ Z_{12F} = \frac{N_{1F}}{i_{1F}}, \quad A = \frac{A}{V} \]

**Example**

If \( B = h_{fe} = 100 \) and 
\( I_C1 = 0.6mA, I_C3 = 1mA \)
and \( I_C8 = 4mA, I_C9 = 2mA \)

\[ \frac{R_2}{R_1}, \frac{R_3}{R_1}, \text{ and } \frac{R_5}{R_2} \]

Using feedback analysis method,

\[ R_1 = 4.16K, \quad V_{re} = 2.5K, \quad R_3 = 625K \]

**Open-loop**

\[ F = \frac{N_{1F}'}{i_{1F}'} \]

\[ N_{1F}' = \frac{R_6}{R_1+R_{5+}R_6} \]

\[ F = \frac{h_{re}R_6}{R_1+R_{5+}R_6} = 11.9 \Omega \]

\[ i_{1F}' = \frac{h_{re}V_{re}}{R_1} \]

\[ A = \frac{\Delta O}{\Delta i} = (\frac{\Delta O}{\Delta i}) (\frac{\Delta O}{\Delta i})(\frac{\Delta O}{\Delta i})(\frac{\Delta O}{\Delta i}) = \]

\[ (100) (-3.443) (-78.3) \left( \frac{1}{12.77K} \right) = 20.78 \frac{A}{V} \]
\[ \frac{A_0}{N_1} = A_F = \frac{A}{1+AF} = \frac{20.78}{1+20.78(169)} = \frac{20.78}{1+2472} = 0.0037 \ \text{k}\Omega \]

\[ \frac{N_2}{N_1} = R_{FE} = R_{in}(1+AF) = 12.97 \text{k}\Omega (1+2472) = 3.22 \text{M}\Omega \]

\[ \frac{N_2}{N_1} = \frac{A_0}{A_F} = -\frac{A_0}{N_1} R_4 = -50.2 \ \text{V/V} \]

\[ \frac{N_2}{Z_2} = R_4 = 600 \ \text{ohms} \]

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