Quiz #10 - Series-shunt feedback

Quiz #11 - ? feedback

A Simple Approach to the Analysis of Feedback Amplifiers

1.) Trace the loop (direction and ± feedback)

2.) Identify the F network (feedback path)

3.) Find $y_{12F} = F$

4.) Find A by:

a.) At the input -

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

b.) At the output -

The loading of the fb. network on the amplifier is found by looking back into the fb. network with the input short-circuited (open circuited) if the input of the feedback amplifier is shunt (series).

5.) Helps -

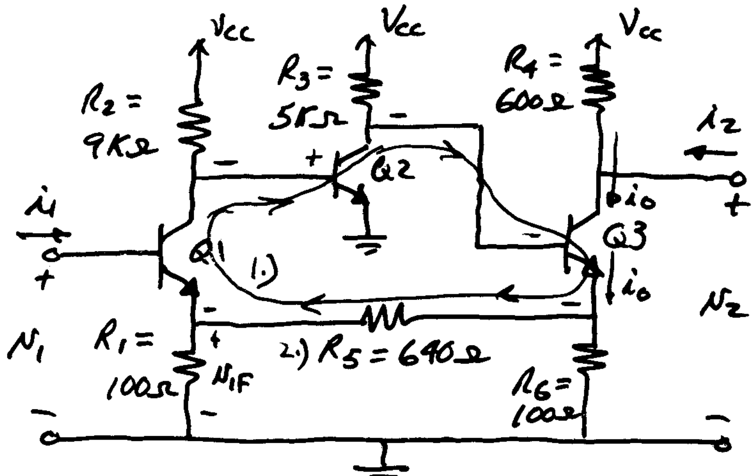
a.) $AF > 0$

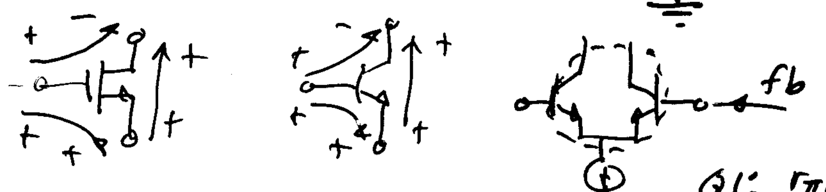
b.) Units of A and F

Feedback	A	F
Series-shunt	V/V	V/V
Shunt-shunt	V/A	A/V
Shunt-series	A/A	A/A
Series-series	A/V	V/A

Series-Series Feedback 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.





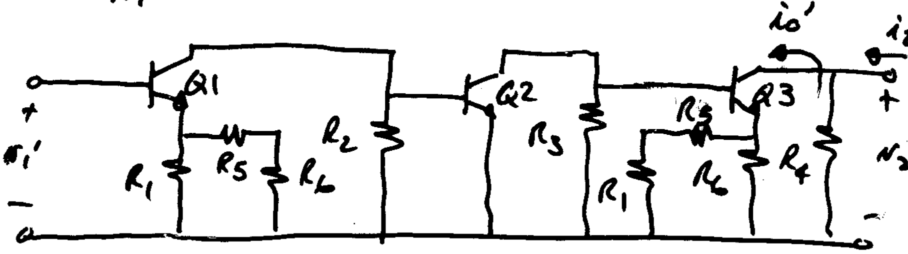
3.) $F = \left.\frac{v_{1F}}{i_o}\right|_{i_{1F}=0} = \frac{R_6 R_1}{R_1 + R_5 + R_6} = 11.9\Omega$

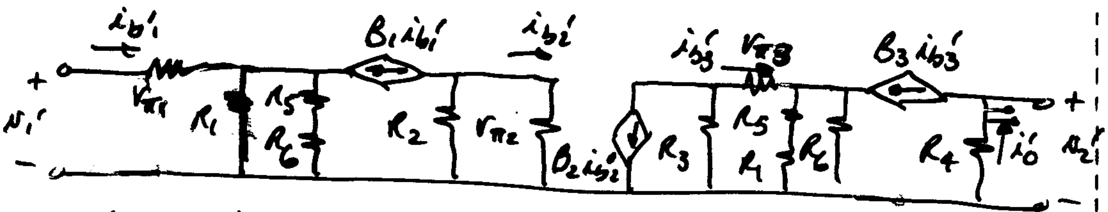
Q1: $r_{\pi 1} = \frac{100 \cdot 25}{0.6} = 4.16k$

Q2: $r_{\pi 2} = \frac{100 \cdot 25}{1} = 2.5k$

Q3: $r_{\pi 3} = \frac{100 \cdot 25}{4} = 625\Omega$

4.) $A = \frac{i_o'}{v_1'}$





$R_o = R_4 + \infty = \infty$???

$$A = \frac{i_o'}{v_1'} = \left(\frac{i_o'}{i_{b3}'}\right)\left(\frac{i_{b3}'}{i_{b2}'}\right)\left(\frac{i_{b2}'}{i_{b1}'}\right)\left(\frac{1}{R_{in}}\right)$$

$$= (\beta_3)\left(\frac{-\beta_2 R_3}{R_3 + r_{\pi 3} + (1+\beta_3)[R_6 \| (R_1 + R_5)]}\right)\left(\frac{-\beta_1 R_2}{R_2 + r_{\pi 2}}\right)\left(\frac{1}{r_{\pi 1} + (1+\beta_1)[R_1 \| (R_5 + R_6)]}\right)$$

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

5.) Back to closed loop

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

6.) Post processing -

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

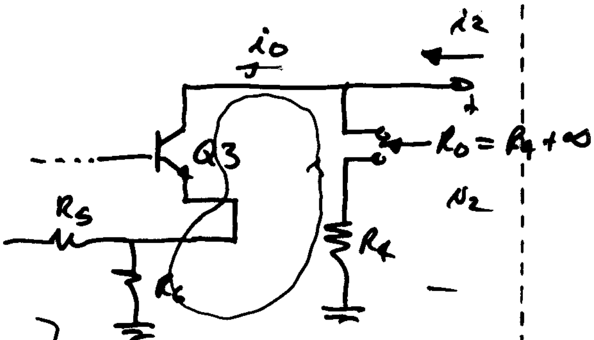
$$\frac{v_2}{v_1} = \frac{-i_o R_4}{v_1} = \left(\frac{i_o}{v_1}\right)(-R_4) = \underline{\underline{-50.2\ V/V}}$$

$$\frac{v_2}{i_2} = R_4 = \underline{\underline{600\Omega}}$$

Principle: If R_{in} or R_o is not in the feedpath, it is not influenced by the feedback.

Proof:

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



$$R_{out} = \frac{v_2}{i_2} = (R_{outF} - R_4) \| R_4$$

$$R_{outF} = 248.2 \times \infty = \infty$$

$$\Big\} \; R_{out} = \infty \| R_4 = \underline{\underline{R_4}}$$

ANALYSIS OF TRANSISTOR FEEDBACK AMPLIFIERS

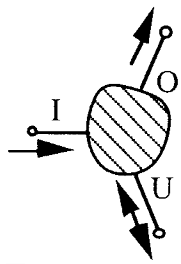
Steps In Analyzing Transistor Feedback Amplifiers

1. Identify the topology.
2. Determine whether the feedback is positive or negative.
3. Open the loop and calculate A, ß, R_i, and R_o.
4. Use the Table to find A_f, R_{if} and R_{of} or A_F, R_{iF}, and R_{oF}.
5. Use the information in 4.) to find whatever is required (v_{out}/v_{in}, R_{in}, R_{out}, etc.)

Generic Transistor Concept

Properties of a Generic Transistor

A signal can *only* go in the I terminal



A signal can *only* go out the O terminal

A signal can go *in or out* the U terminal

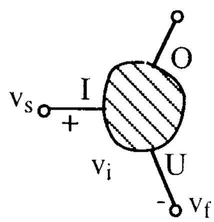
Identification of the Feedback Topology

Isolate the input and output transistor(s) and apply the following identification.

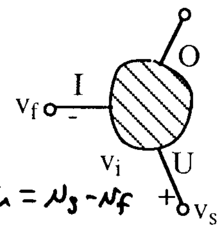
Input

Series:

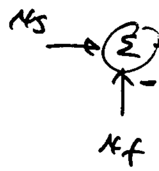
$v_i = v_s - v_f$



or



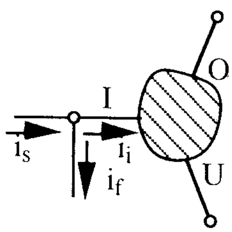
$v_i = v_s - v_f$



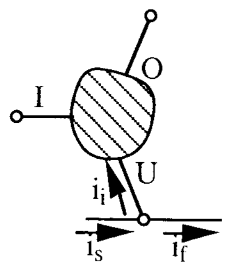
$v_i = v_s - v_f$

Shunt:

$i_i = i_s - i_f$



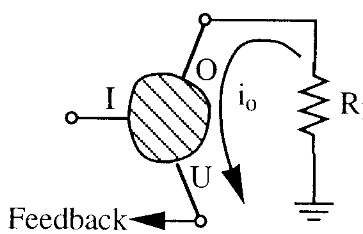
or



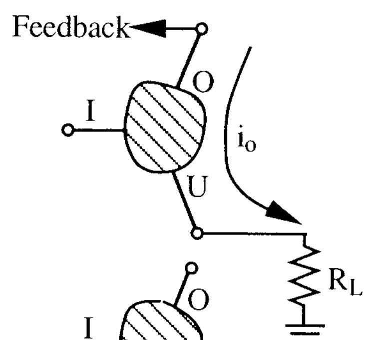
$i_i = i_s - i_f$

Output

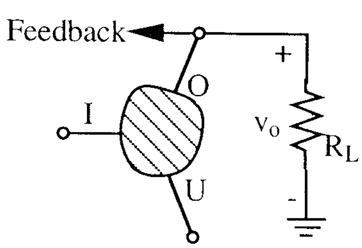
Series:



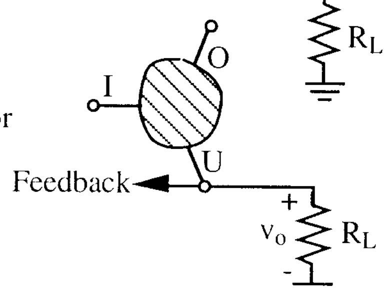
or



Shunt:



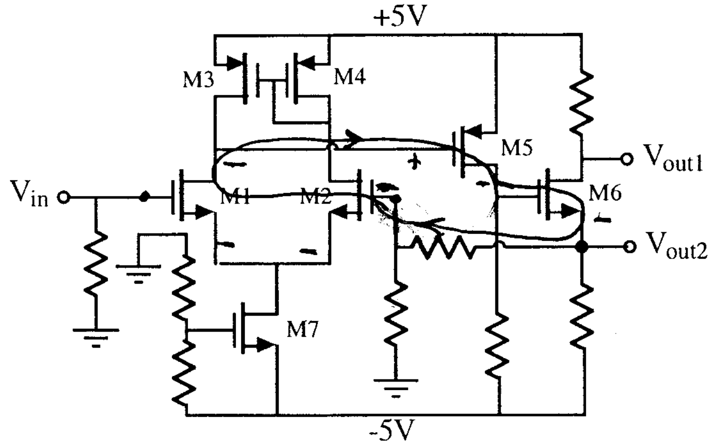
or



EXAMPLE OF FEEDBACK TOPOLOGY IDENTIFICATION

Use the rules of identifying feedback topologies to identify the four different topologies for the circuits shown below.

Circuits 1 and 2



Series – shunt (V_{out2})
Series – series (V_{out1})

Circuits 3 and 4