- Quiz #12 - Feedback including (shunt-shunt, shunt-series and series-series)

- April 22nd at 6:30pm in Student Success Center, Prof. Jaeger will be speaking on the calculation of input resistance for BJT diff. amps. $R_{in} = 2 r_\pi$??? (Quiz #14)

OSCILLATORS

Oscillators use some form of positive feedback to create periodic waveforms.

Classification -

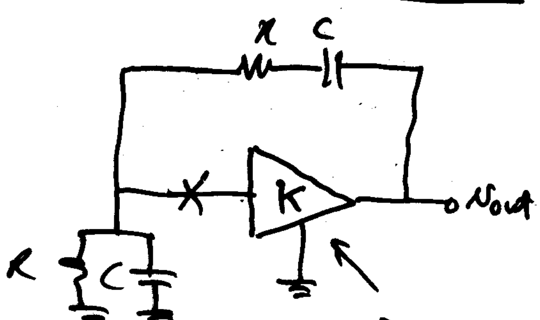
Oscillators
- Tuned (sinusoidal) — LC osc. using CMOS 1-5 GHz
- Untuned (sq. wave)

Criteria for Oscillation -

$$\text{Loop gain} = T(j\omega) = 1 + j0 \text{ or } 1\angle 0^\circ$$

or the determinant $\Delta = 0$

Wien Bridge Oscillator (tuned)



$$T(s) = ? = K \frac{R \| \frac{1}{sC}}{R \| \frac{1}{sC} + R + \frac{1}{sC}}$$

$$= \frac{sKRC}{s^2R^2C^2 + s3RC + 1}$$

$$T(j\omega) = \frac{j\omega KRC}{(1-\omega^2R^2C^2) + j\omega 3RC} \overset{?}{=} 1 + j0$$

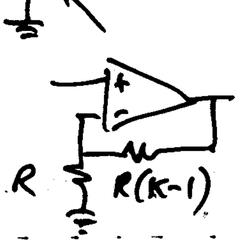
$(1-\omega^2R^2C^2) = 0$

$$\omega_{osc}^2 = \frac{1}{R^2C^2} \rightarrow \underline{\omega_{osc} = \frac{1}{RC}}$$

When $\omega = \omega_{osc}$

$$T(j\omega_{osc}) = \frac{K}{3} = 1 + j0$$

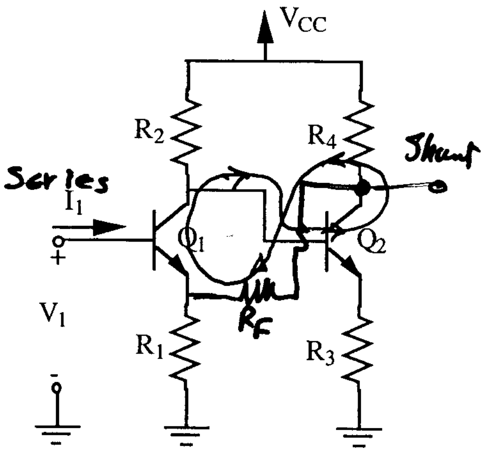
$\underline{K = 3}$



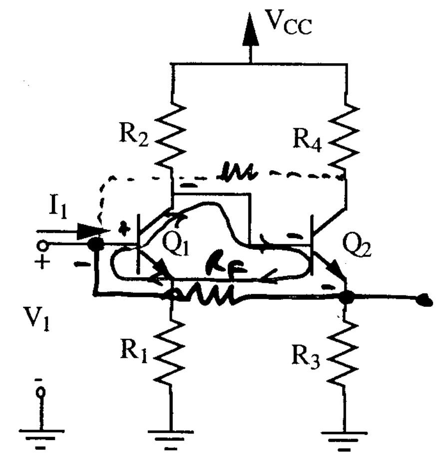
EXAMPLE OF FEEDBACK TOPOLOGY IDENTIFICATION

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

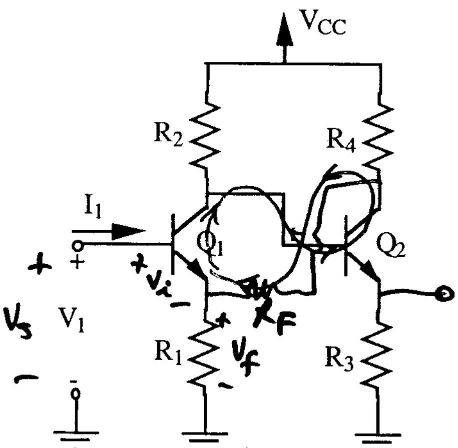
1. Voltage-Voltage (Series-Shunt)



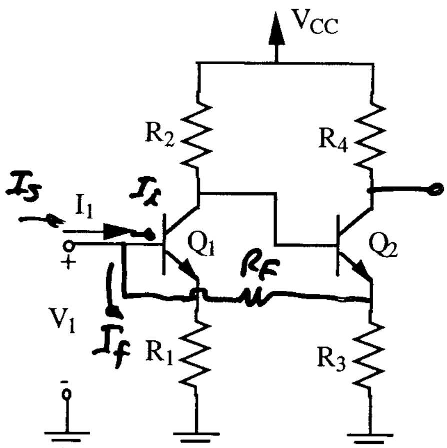
2. Current-Voltage (Shunt-Shunt)

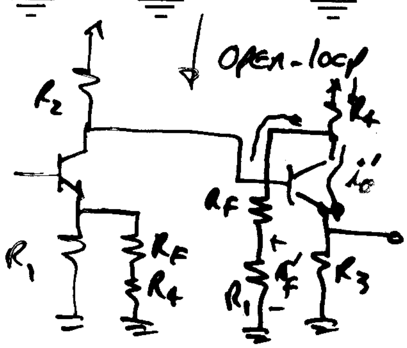


3. Voltage-Current (Series-Series)

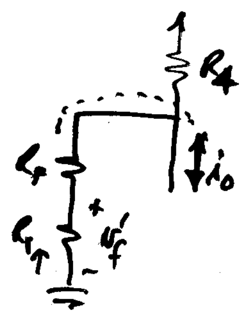


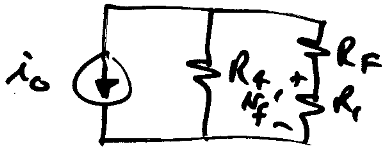
4. Current-Current (Shunt-Series)





$$F = \frac{-\cancel{R_1+R_F}\;R_4}{R_1+R_F+R_4} \times R_1$$





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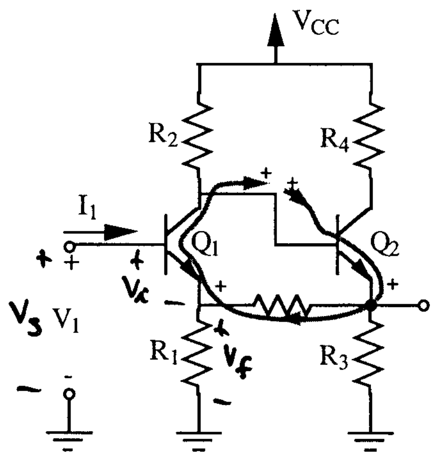
RULES FOR IDENTIFYING POSITIVE AND NEGATIVE FEEDBACK

1. Identify the feedback loop by tracing its path on the diagram. If there are alternate paths, always choose the path with the highest loop gain. (Remember that a signal can go in the "I" or "U" terminal of a transistor and can only come out the "O" or "U" terminal.)

2. At any point on the feedback loop, assume the signal is positive and put a "+" mark at that point. Trace the signal around the loop remembering that the signal only inverts when it goes in a "I" terminal and out the "O" terminal of a transistor. All other paths through a transistor do not invert (i.e., "I" to "U" and "U" to "O").

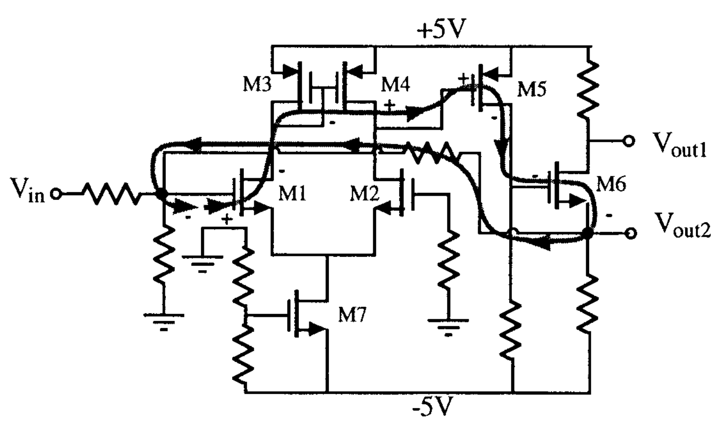
3. When you have traced the polarity of the signal around the feedback loop back to the point where you placed the "+", the feedback is negative if the signal polarity is "-" and positive if the signal polarity is "+".

Example 1



Series-shunt

Example 2



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EXAMPLE OF FEEDBACK TOPOLOGY IDENTIFICATION

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

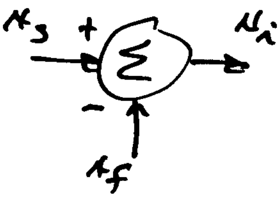
Circuits 1 and 2

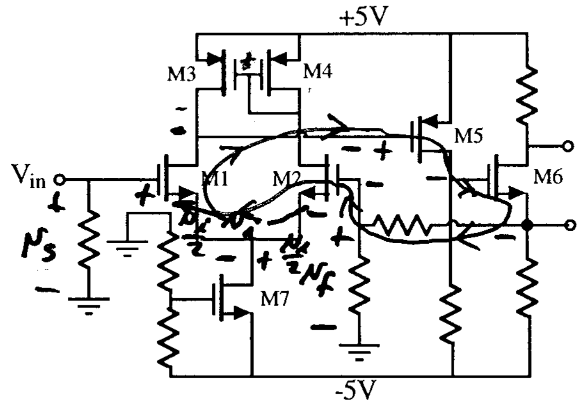
Series –

$v_i = v_s - v_f$

Shunt –

$i_i = i_s - i_f$

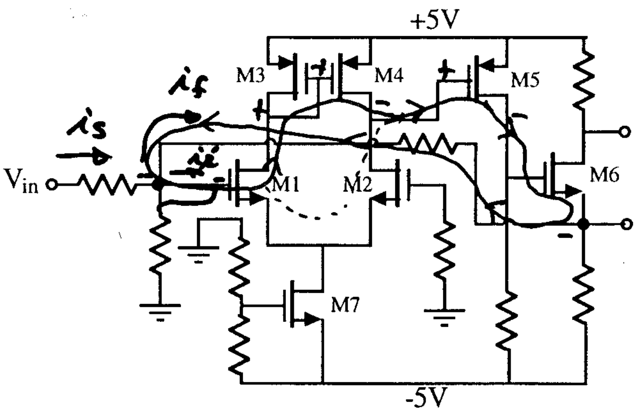




Series - series

Series - shunt

Circuits 3 and 4



Shunt - series

Shunt - shunt

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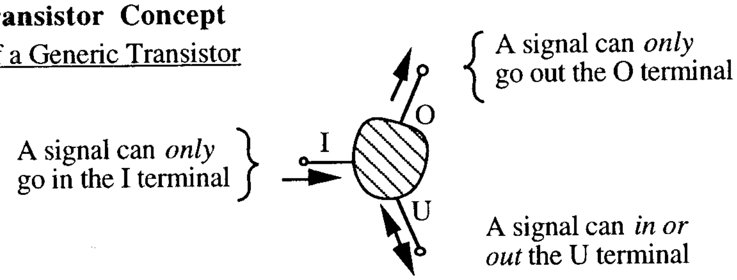
ANALYSIS OF TRANSISTOR FEEDBACK AMPLIFIERS

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

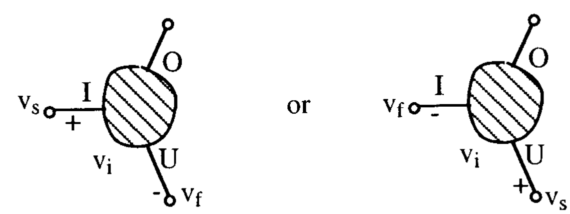


Identification of the Feedback Topology

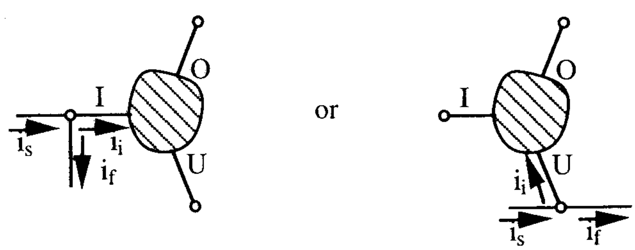
Isolate the input and output transistor(s) and apply the following identification.

Input

Series:

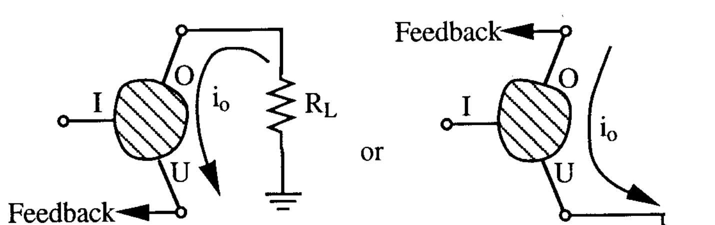


Shunt:

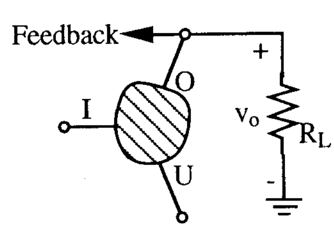


Output

Series:



Shunt:



or