Note: Homework 11 due Wednesday (3/31)

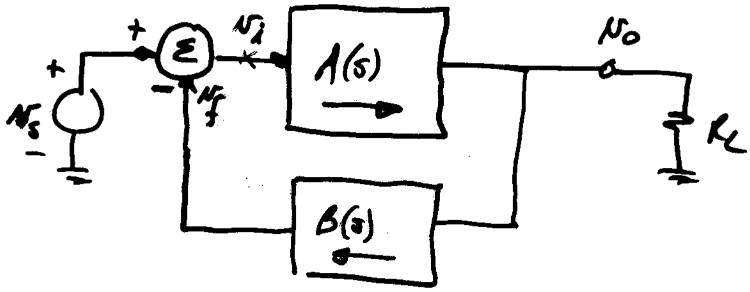
CHAPTER 18 – FEEDBACK, STABILITY AND OSCILLATORS

- Introduction
- Series-shunt
- Shunt-shunt
- Shunt-series
- Series-series

What can feedback do?

- Increase or decrease the resistance at a port
- Increase the accuracy of an amplifier.
- Remove nonlinearity
- Increase f_H and decrease f_L
- Create oscillators

Classical Single-Loop Feedback

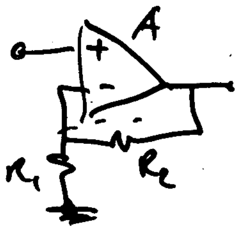


$\frac{v_o}{v_s} = ?$ Closed-loop gain

$$v_o = A(s)v_i = A(s)[v_s - v_f] = A(s)v_s - A(s)[B(s)v_o]$$

$$\frac{v_o}{v_s} = \underline{\frac{A(s)}{1+A(s)B(s)}} = \frac{A(s)}{1+T(s)} \quad \text{where } T(s) = \text{Loop gain}$$

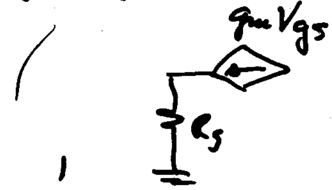
Assume the loop gain $> 1 \rightarrow \frac{v_o}{v_s} \approx \frac{\cancel{A(s)}}{\cancel{A(s)}B(s)} = \frac{1}{B(s)}$



$A = A_{vd}$

$B = \frac{R_1}{R_1+R_2}$

$v_{gs} = v_g - v_s$



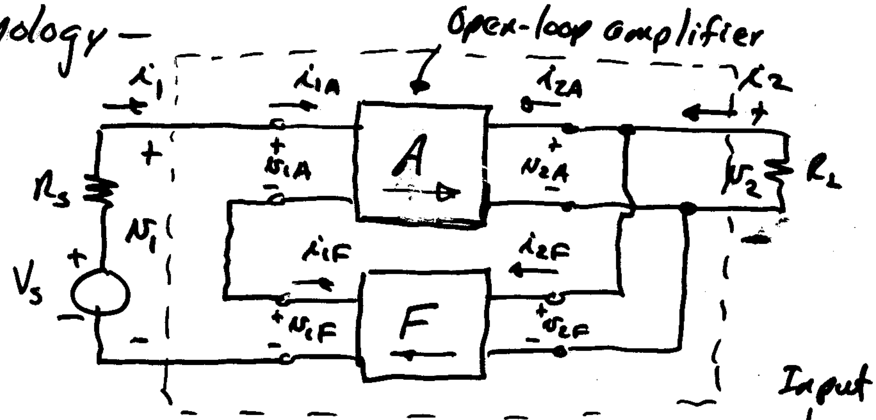
$$\frac{v_{gs}}{v_g} = \underline{\underline{\frac{1}{1+g_m R_s}}}$$

Positive feedback: $T(s) > 0$

Negative feedback: $T(s) < 0$

Voltage Amplifiers – Series-Shunt Feedback

Topology –



Choosing h-parameters to model the series-shunt fb.
output

$$v_1 = h_{11T}\, i_1 + h_{12T}\, v_2$$
$$i_2 = h_{21T}\, i_1 + h_{22T}\, v_2$$

A network: F network

$$\underbrace{\begin{bmatrix} v_{1A} = h_{11A}\, i_{1A} + \cancel{h_{12A}}^{\,0}\, v_{2A} \\ i_{2A} = h_{21A}\, i_{1A} + h_{22A}\, v_{2A} \end{bmatrix} + \begin{bmatrix} v_{1F} = h_{11F}\, i_{1F} + h_{12F}\, v_{2F} \\ i_{2F} = \cancel{h_{21}}_{\,0}\, i_{1F} + h_{22F}\, v_{2F} \end{bmatrix}} =$$

$$v_1 = (h_{11A} + h_{11F})\, i_1 + (h_{12A} + h_{12F})\, v_2$$
$$i_2 = (h_{21A} + h_{21F})\, i_1 + (h_{22A} + h_{22F})\, v_2$$

If $h_{21A} \gg h_{21F}$ and $h_{12F} \gg h_{12A}$, then

$$v_1 = h_{11T}\, i_1 + h_{12F}\, v_2$$
$$i_2 = h_{21A}\, i_1 + h_{22T}\, v_2$$

⋮