

EE 140/240A

Loading f/ the FB Network

CTN

141

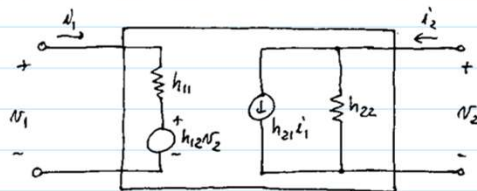
Loading from the FB Network

Ex: Series-Shunt FB (now including loading from the FB network)

Series Connection: resistors & voltage sources add when in series  $\rightarrow$  so represent amplifier & FB networks by  $R$ 's &  $V$ 's to make the math simpler

Shunt Connection: conductances & current sources add when in parallel  $\rightarrow$  so represent amplifier & FB network by  $G$ 's &  $I$ 's to make the math simpler

For these representations, use h-parameter networks for a & f.



Port Equations:

$$V_1 = h_{11}i_1 + h_{12}V_2$$

$$i_2 = h_{21}i_1 + h_{22}V_2$$

Elements:

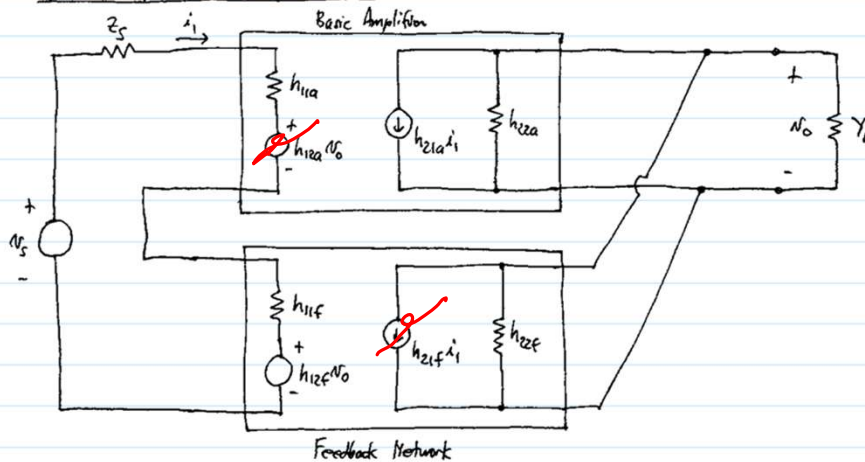
$$h_{11} = \left. \frac{V_1}{i_1} \right|_{V_2=0}$$

$$h_{12} = \left. \frac{V_1}{V_2} \right|_{i_1=0}$$

$$h_{21} = \left. \frac{i_2}{i_1} \right|_{V_2=0}$$

$$h_{22} = \left. \frac{i_2}{V_2} \right|_{i_1=0}$$

h-parameter representation of the series-shunt FB ckt:



In general, transfer amplifiers & FB networks are uni-directional  $\rightarrow$  they have large gains in the forward direction, but very small gains in the reverse:

$$|h_{12a}| \ll |h_{12f}| \rightarrow \text{neglect } h_{12a} \text{ (set to 0)}$$

$$|h_{21a}| \gg |h_{21f}| \rightarrow \text{neglect } h_{21f} \text{ (set to } \infty)$$

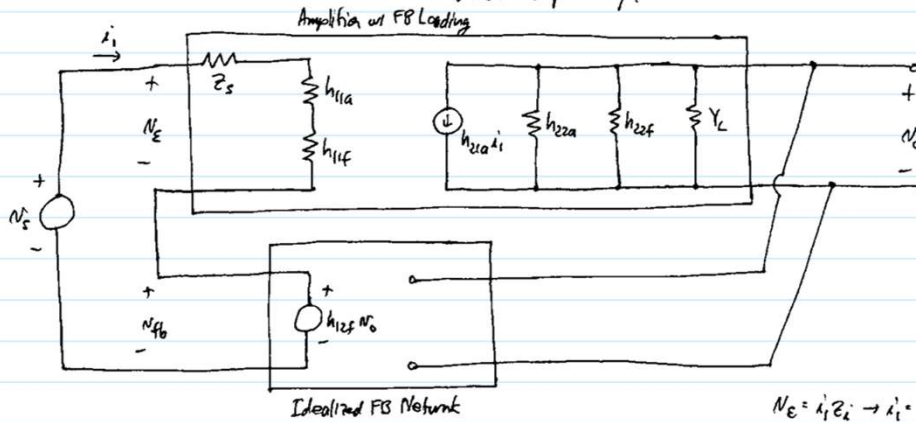
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⇒ more impedances to idealize the FB return → once ideal, we can use the general equations we derived previously!



$$Z_i = Z_s + h_{11a} + h_{11f}$$

$$Y_o = Y_L + h_{22a} + h_{22f}$$

$$\frac{N_o}{N_s} = A = \frac{a}{1+af}$$

where

$$a = -\frac{h_{21a}}{Z_i Y_o}$$

$$f = h_{12f} \left( = \frac{N_{fb}}{N_o} \right)$$

$$N_E = i_i Z_i \rightarrow i_i = \frac{N_E}{Z_i}$$

$$N_o = h_{21a} i_i / Y_o$$

$$\therefore \frac{N_o}{N_E} = a = \frac{-h_{21a} Y_i}{Y_o Z_i Y_i}$$

Thus, the key to inspection analysis of FB ckt: X for FB impedances to load the basic amplifier, then use our "inspection" formulas.