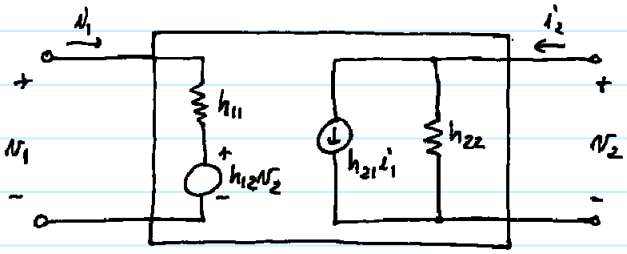
Loading From the FB Network

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

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

Shunt Connection: conductances & current sources add when in parallel → so represent amplifier & FB networks by G's & i's to make the math simpler

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



Port Equations:

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

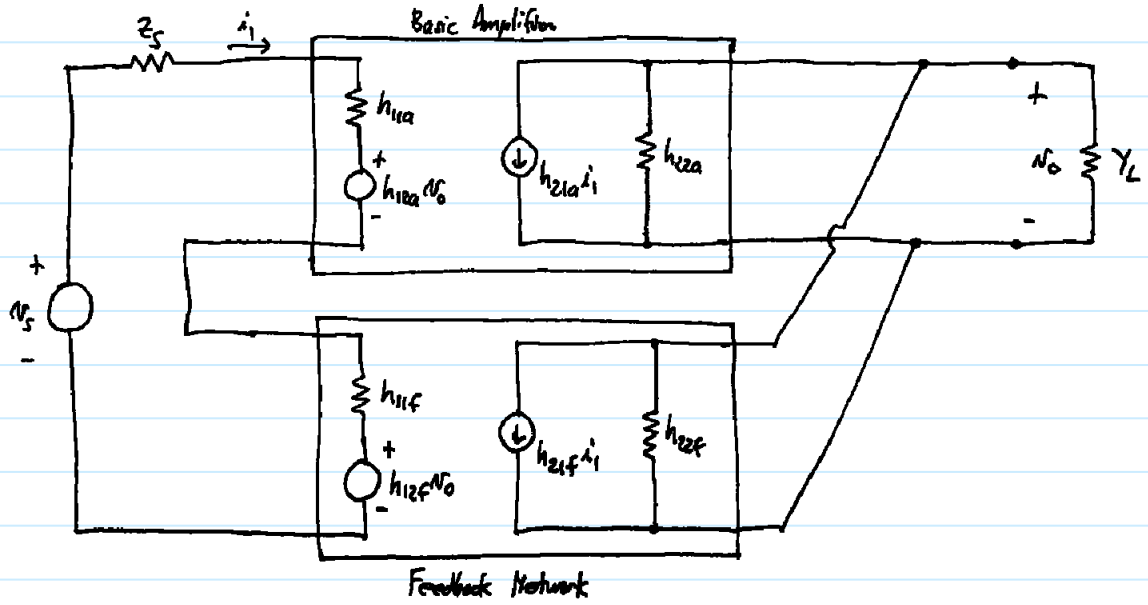
$i_2 = h_{21} i_1 + h_{22} V_2$

Elements:

$$h_{11} = \left.\frac{V_1}{i_1}\right|_{V_2=0} \qquad h_{12} = \left.\frac{V_1}{V_2}\right|_{i_1=0}$$

$$h_{21} = \left.\frac{i_2}{i_1}\right|_{V_2=0} \qquad h_{22} = \left.\frac{i_2}{V_2}\right|_{i_1=0}$$

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

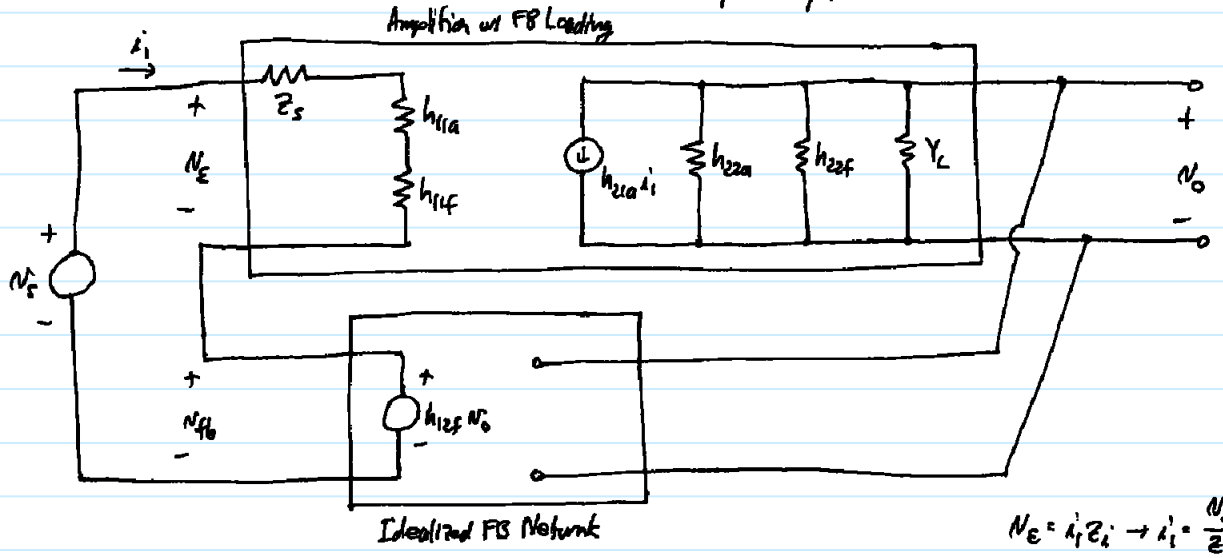


In general, transistor amplifiers & FB networks are uni-directional → they have large gains in the forward direction, but very small gains in the reverse:

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

$|h_{21a}| \gg |h_{21f}|$ → neglect h_{21f} (set to ∞)

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



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

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

$$\frac{V_o}{V_s} = A = \frac{a}{1+af}$$, where $\begin{cases} a = -\dfrac{h_{21a}}{Z_i Y_o} \\ f = h_{12f} \left(= \dfrac{V_{fb}}{V_o}\right) \end{cases}$

$$V_\varepsilon = i_i Z_i \rightarrow i_i = \frac{V_\varepsilon}{Z_i}$$

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

$$\therefore \frac{V_o}{V_\varepsilon} = a = \frac{-h_{21a} i_i}{Y_o Z_i i_i}$$

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