LECTURE 27

Measurement of S/Z/Y parameters

$$Z_{11} = \frac{V_1}{I_1}\bigg|_{I_2=0} \text{ (o.c. port 2)}, \quad Z_{21} = \frac{V_2}{I_1}\bigg|_{I_2=0}$$

$$Z_{12} = \frac{V_1}{I_2}\bigg|_{I_1=0} \text{ (o.c. port 1)}, \quad Z_{22} = \frac{V_2}{I_2}\bigg|_{I_1=0}$$

$$Y_{11} = \frac{I_1}{V_1}\bigg|_{V_2=0} \text{ (s.c. port 2)}, \quad Y_{21} = \frac{I_2}{V_1}\bigg|_{V_2=0}$$

$$Y_{12} = \frac{I_1}{V_2}\bigg|_{V_1=0}, \quad Y_{22} = \frac{I_2}{V_2}\bigg|_{V_1=0}$$

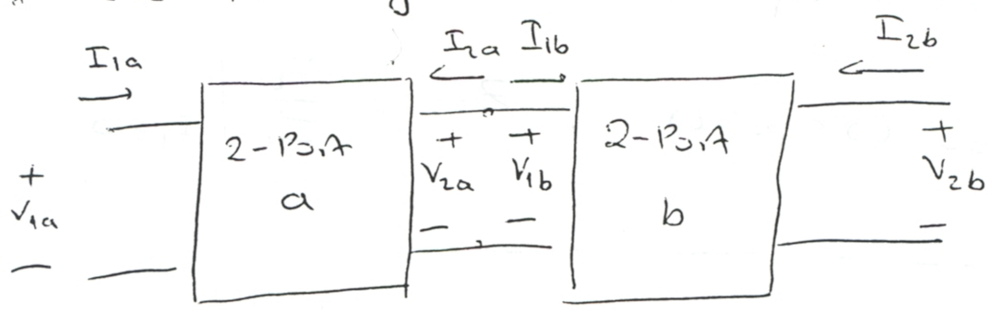
$$S_{11} = \frac{b_1}{a_1}\bigg|_{a_2=0} \text{ (Matched port 2)}, \quad S_{21} = \frac{b_2}{a_1}\bigg|_{a_2=0}$$

$$S_{12} = \frac{b_1}{a_2}\bigg|_{a_1=0}, \quad S_{22} = \frac{b_2}{a_2}\bigg|_{a_1=0}$$

Network analyzers providing
- phase and magnitude
  - ↳ vector analyzers
- magnitude only
  - ↳ scalar analyzers

Cascaded Two Ports

ABCD and T-matrix are especially useful when two ports are connected in tandem or cascade. (output of one network becomes input of the following network)



$$\begin{bmatrix} V_{1a} \\ I_{1a} \end{bmatrix} = \begin{bmatrix} A_a & B_a \\ C_a & D_a \end{bmatrix} \begin{bmatrix} V_{2a} \\ -I_{2a} \end{bmatrix}, \quad \begin{bmatrix} V_{1b} \\ I_{1b} \end{bmatrix} = \begin{bmatrix} A_b & B_b \\ C_b & D_b \end{bmatrix} \begin{bmatrix} V_{2b} \\ -I_{2b} \end{bmatrix}$$

and: $V_{2a} = V_{1b}$, $-I_{2a} = I_{1b}$

$$\begin{bmatrix} V_{1a} \\ I_{1a} \end{bmatrix} = \underbrace{\begin{bmatrix} A_a & B_a \\ C_a & D_a \end{bmatrix} \begin{bmatrix} A_b & B_b \\ C_b & D_b \end{bmatrix}}_{\text{Transfer Matrix of the two cascaded networks}} \begin{bmatrix} V_{2b} \\ -I_{2b} \end{bmatrix}$$

N-networks in cascade:

$$\begin{bmatrix} A & B \\ C & D \end{bmatrix} = \begin{bmatrix} A_1 & B_1 \\ C_1 & D_1 \end{bmatrix} \cdots \begin{bmatrix} A_N & B_N \\ C_N & D_N \end{bmatrix}$$

Similarly for T matrix starting from the last unit, since they give output in terms of input: