

NETWORK ANALYSIS AND SYNTHESIS

Two Port Networks

Y Parameter Example

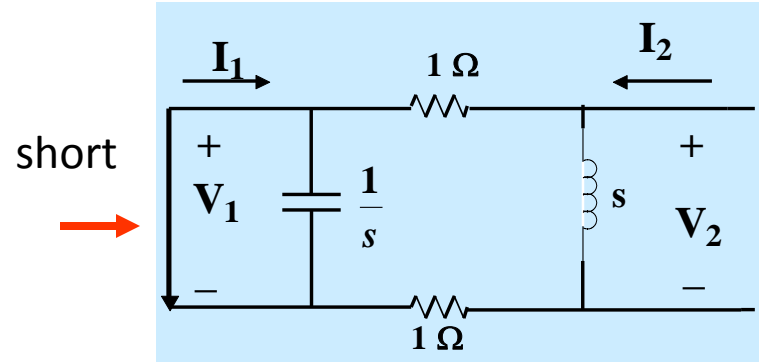
To find y_{12} and y_{21} we reverse things and short V_1

$$y_{12} = \frac{I_1}{V_2} \Big|_{V_1=0}$$

We have

$$V_2 = -2I_1$$

$$y_{12} = \frac{I_1}{V_2} = 0.5 \text{ S}$$



$$y_{22} = \frac{I_2}{V_2} \Big|_{V_1=0}$$

We have

$$V_2 = I_2 \frac{2s}{(s+2)}$$

$$y_{22} = 0.5 + \frac{1}{s}$$

Two Port Networks

Y Parameter Example

Summary:

$$\mathbf{Y} = \begin{bmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{bmatrix} = \begin{bmatrix} s + 0.5 & -0.5 \\ -0.5 & 0.5 + 1/s \end{bmatrix}$$

Now suppose you want the Z parameters for the same network.

Two Port Networks

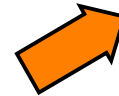
Going From Y to Z Parameters

For the Y parameters we have:

$$I = Y V$$

For the Z parameters we have:

$$V = Z I$$



From above;

$$V = Y^{-1} I = Z I$$

Therefore

$$Z = Y^{-1} = \begin{bmatrix} z_{11} & z_{12} \\ z_{21} & z_{22} \end{bmatrix} = \begin{bmatrix} \frac{y_{22}}{\Delta_Y} & \frac{-y_{12}}{\Delta_Y} \\ \frac{-y_{21}}{\Delta_Y} & \frac{y_{11}}{\Delta_Y} \end{bmatrix}$$

where

$$\Delta_Y = \det|Y|$$

Two Port Parameter Conversions:

$$\begin{bmatrix} \mathbf{z}_{11} & \mathbf{z}_{12} \\ \mathbf{z}_{21} & \mathbf{z}_{22} \end{bmatrix} \quad \begin{bmatrix} \frac{\mathbf{y}_{22}}{\Delta_Y} & \frac{-\mathbf{y}_{12}}{\Delta_Y} \\ \frac{-\mathbf{y}_{21}}{\Delta_Y} & \frac{\mathbf{y}_{11}}{\Delta_Y} \end{bmatrix} \quad \begin{bmatrix} \frac{\mathbf{A}}{\mathbf{C}} & \frac{\Delta_T}{\mathbf{C}} \\ \frac{1}{\mathbf{C}} & \frac{\mathbf{D}}{\mathbf{C}} \end{bmatrix} \quad \begin{bmatrix} \frac{\Delta_H}{\mathbf{h}_{22}} & \frac{\mathbf{h}_{12}}{\mathbf{h}_{22}} \\ \frac{-\mathbf{h}_{21}}{\mathbf{h}_{22}} & \frac{1}{\mathbf{h}_{22}} \end{bmatrix}$$

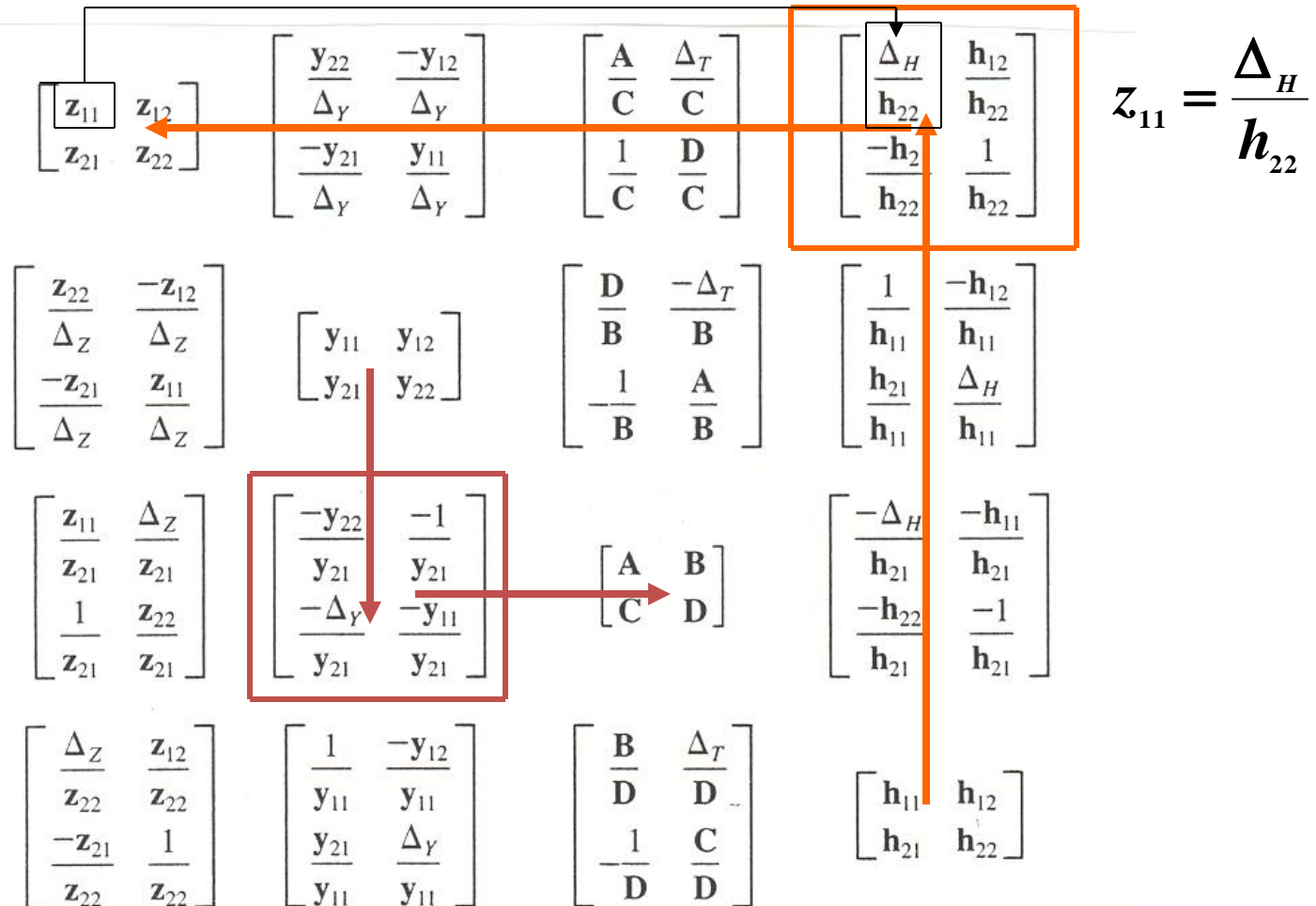
$$\begin{bmatrix} \frac{\mathbf{z}_{22}}{\Delta_Z} & \frac{-\mathbf{z}_{12}}{\Delta_Z} \\ \frac{-\mathbf{z}_{21}}{\Delta_Z} & \frac{\mathbf{z}_{11}}{\Delta_Z} \end{bmatrix} \quad \begin{bmatrix} \mathbf{y}_{11} & \mathbf{y}_{12} \\ \mathbf{y}_{21} & \mathbf{y}_{22} \end{bmatrix} \quad \begin{bmatrix} \frac{\mathbf{D}}{\mathbf{B}} & \frac{-\Delta_T}{\mathbf{B}} \\ \frac{1}{\mathbf{B}} & \frac{\mathbf{A}}{\mathbf{B}} \end{bmatrix} \quad \begin{bmatrix} \frac{1}{\mathbf{h}_{11}} & \frac{-\mathbf{h}_{12}}{\mathbf{h}_{11}} \\ \frac{\mathbf{h}_{21}}{\mathbf{h}_{11}} & \frac{\Delta_H}{\mathbf{h}_{11}} \end{bmatrix}$$

$$\begin{bmatrix} \frac{\mathbf{z}_{11}}{\mathbf{z}_{21}} & \frac{\Delta_Z}{\mathbf{z}_{21}} \\ \frac{1}{\mathbf{z}_{21}} & \frac{\mathbf{z}_{22}}{\mathbf{z}_{21}} \end{bmatrix} \quad \begin{bmatrix} \frac{-\mathbf{y}_{22}}{\mathbf{y}_{21}} & \frac{-1}{\mathbf{y}_{21}} \\ \mathbf{y}_{21} & \mathbf{y}_{21} \\ \frac{-\Delta_Y}{\mathbf{y}_{21}} & \frac{-\mathbf{y}_{11}}{\mathbf{y}_{21}} \\ \mathbf{y}_{21} & \mathbf{y}_{21} \end{bmatrix} \quad \begin{bmatrix} \mathbf{A} & \mathbf{B} \\ \mathbf{C} & \mathbf{D} \end{bmatrix} \quad \begin{bmatrix} \frac{-\Delta_H}{\mathbf{h}_{21}} & \frac{-\mathbf{h}_{11}}{\mathbf{h}_{21}} \\ \mathbf{h}_{21} & \mathbf{h}_{21} \\ \frac{-\mathbf{h}_{22}}{\mathbf{h}_{21}} & \frac{-1}{\mathbf{h}_{21}} \\ \mathbf{h}_{21} & \mathbf{h}_{21} \end{bmatrix}$$

$$\begin{bmatrix} \frac{\Delta_Z}{\mathbf{z}_{22}} & \frac{\mathbf{z}_{12}}{\mathbf{z}_{22}} \\ \frac{-\mathbf{z}_{21}}{\mathbf{z}_{22}} & \frac{1}{\mathbf{z}_{22}} \end{bmatrix} \quad \begin{bmatrix} \frac{1}{\mathbf{y}_{11}} & \frac{-\mathbf{y}_{12}}{\mathbf{y}_{11}} \\ \mathbf{y}_{11} & \mathbf{y}_{11} \\ \frac{\mathbf{y}_{21}}{\mathbf{y}_{11}} & \frac{\Delta_Y}{\mathbf{y}_{11}} \\ \mathbf{y}_{11} & \mathbf{y}_{11} \end{bmatrix} \quad \begin{bmatrix} \frac{\mathbf{B}}{\mathbf{D}} & \frac{\Delta_T}{\mathbf{D}} \\ \frac{1}{\mathbf{D}} & \frac{\mathbf{C}}{\mathbf{D}} \end{bmatrix} \quad \begin{bmatrix} \mathbf{h}_{11} & \mathbf{h}_{12} \\ \mathbf{h}_{21} & \mathbf{h}_{22} \end{bmatrix}$$

Two Port Parameter Conversions:

To go from one set of parameters to another, locate the set of parameters you are in, move along the vertical until you are in the row that contains the parameters you want to convert to – then compare element for element



THANKS....

Queries Please...