

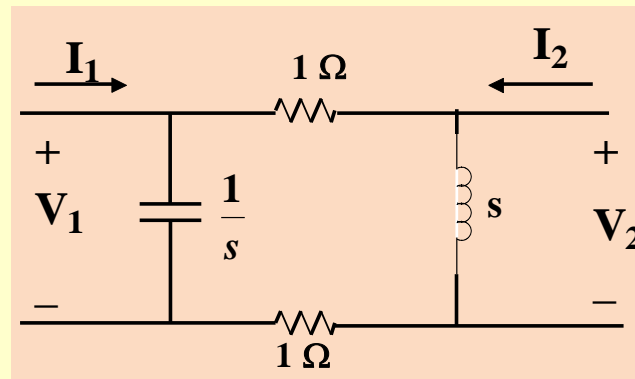
UNIT-2

(Lecture-8)

Relation Between Two Port Parameters

Two Port Networks**Y Parameters and Beyond:**

Given the following network.



(a) Find the Y parameters for the network.

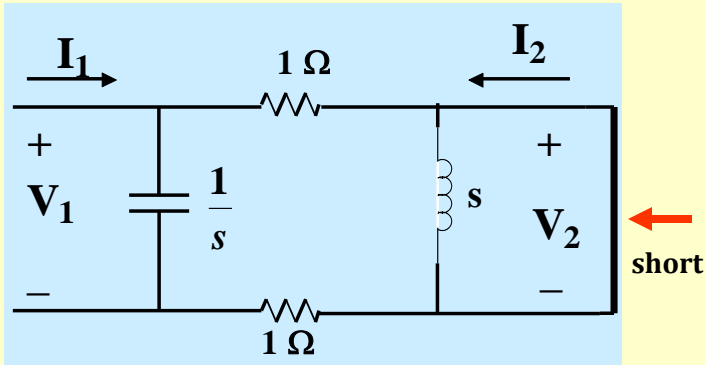
(b) From the Y parameters find the z parameters

Two Port Networks

Y Parameter Example

$$I_1 = y_{11}V_1 + y_{12}V_2$$

$$I_2 = y_{21}V_1 + y_{22}V_2$$



$$y_{11} = \frac{I_1}{V_1} \Big|_{V_2=0} \quad y_{12} = \frac{I_1}{V_2} \Big|_{V_1=0}$$

$$y_{21} = \frac{I_2}{V_1} \Big|_{V_2=0} \quad y_{22} = \frac{I_2}{V_2} \Big|_{V_1=0}$$

We use the above equations to evaluate the parameters from the network.

To find y_{11}

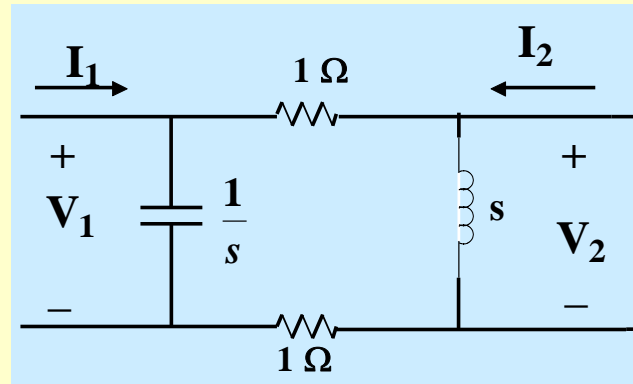
$$V_1 = I_1 \left(\frac{2/s}{2 + 1/s} \right) = I_1 \left[\frac{2}{2s + 1} \right]$$

so $y_{11} = \frac{I_1}{V_1} \Big|_{V_2=0} = s + 0.5$

Two Port Networks

Y Parameter Example

$$y_{21} = \frac{I_2}{V_1} \quad \left| \quad V_2 = 0 \right.$$



We see

$$V_1 = -2I_2$$

$$y_{21} = \frac{I_2}{V_1} = 0.5 \text{ S}$$

Two Port Networks

Y Parameter Example

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

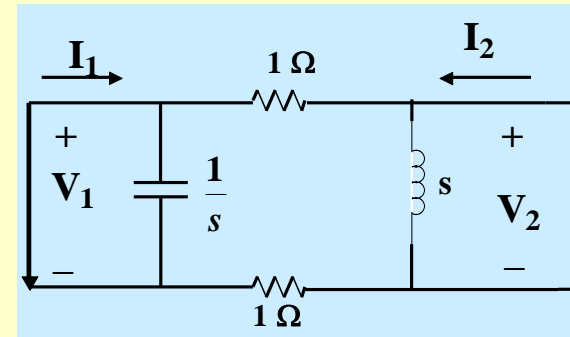
$$y_{12} = \frac{I_1}{V_2} \Big|_{V_1=0}$$

We have

$$V_2 = -2I_1$$

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

short



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

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

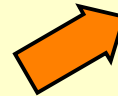
Going From Y to Z Parameters

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:

$$\begin{bmatrix} z_{11} & z_{12} \\ z_{21} & z_{22} \end{bmatrix} \quad \begin{bmatrix} \frac{y_{22}}{\Delta_Y} & \frac{-y_{12}}{\Delta_Y} \\ \frac{-y_{21}}{\Delta_Y} & \frac{y_{11}}{\Delta_Y} \end{bmatrix} \quad \begin{bmatrix} \frac{A}{C} & \frac{\Delta_T}{C} \\ \frac{1}{C} & \frac{D}{C} \end{bmatrix} \quad \begin{bmatrix} \frac{\Delta_H}{h_{22}} & \frac{h_{12}}{h_{22}} \\ \frac{-h_{21}}{h_{22}} & \frac{1}{h_{22}} \end{bmatrix}$$

$$\begin{bmatrix} \frac{z_{22}}{\Delta_Z} & \frac{-z_{12}}{\Delta_Z} \\ \frac{-z_{21}}{\Delta_Z} & \frac{z_{11}}{\Delta_Z} \end{bmatrix} \quad \begin{bmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{bmatrix} \quad \begin{bmatrix} \frac{D}{B} & \frac{-\Delta_T}{B} \\ \frac{1}{B} & \frac{A}{B} \end{bmatrix} \quad \begin{bmatrix} \frac{1}{h_{11}} & \frac{-h_{12}}{h_{11}} \\ \frac{h_{21}}{h_{11}} & \frac{\Delta_H}{h_{11}} \end{bmatrix}$$

$$\begin{bmatrix} \frac{z_{11}}{z_{21}} & \frac{\Delta_Z}{z_{21}} \\ \frac{1}{z_{21}} & \frac{z_{22}}{z_{21}} \end{bmatrix} \quad \begin{bmatrix} \frac{-y_{22}}{y_{21}} & \frac{-1}{y_{21}} \\ \frac{-\Delta_Y}{y_{21}} & \frac{-y_{11}}{y_{21}} \end{bmatrix} \quad \begin{bmatrix} A & B \\ C & D \end{bmatrix} \quad \begin{bmatrix} \frac{-\Delta_H}{h_{21}} & \frac{-h_{11}}{h_{21}} \\ \frac{-h_{22}}{h_{21}} & \frac{-1}{h_{21}} \end{bmatrix}$$

$$\begin{bmatrix} \frac{\Delta_Z}{z_{22}} & \frac{z_{12}}{z_{22}} \\ \frac{-z_{21}}{z_{22}} & \frac{1}{z_{22}} \end{bmatrix} \quad \begin{bmatrix} \frac{1}{y_{11}} & \frac{-y_{12}}{y_{11}} \\ \frac{y_{21}}{y_{11}} & \frac{\Delta_Y}{y_{11}} \end{bmatrix} \quad \begin{bmatrix} \frac{B}{D} & \frac{\Delta_T}{D} \\ \frac{1}{D} & \frac{C}{D} \end{bmatrix} \quad \begin{bmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{bmatrix}$$

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

