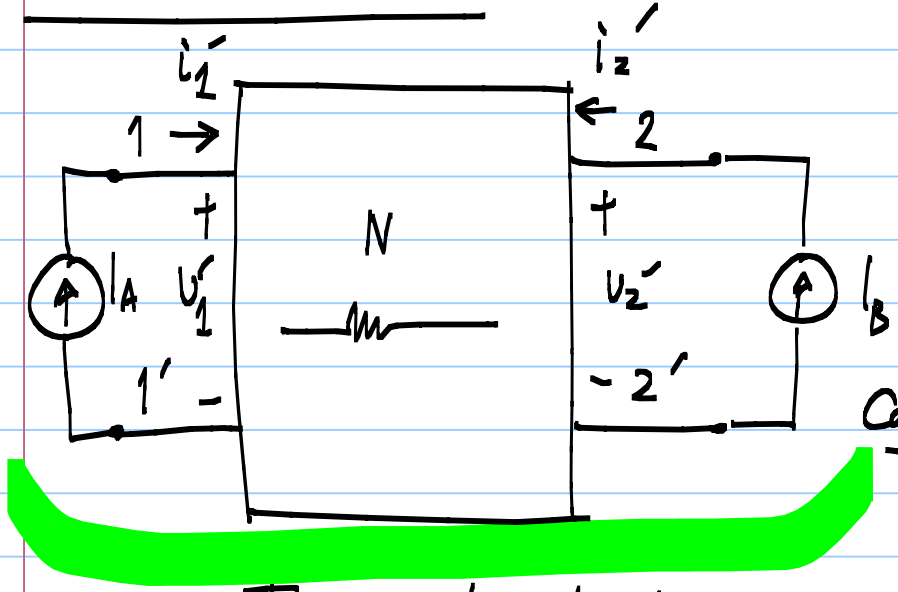
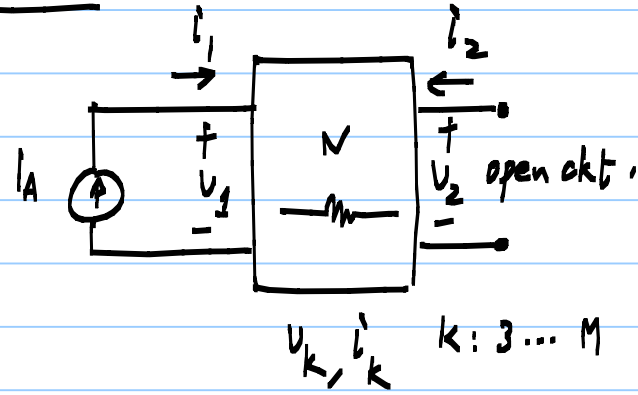
EC1010: Lecture 15

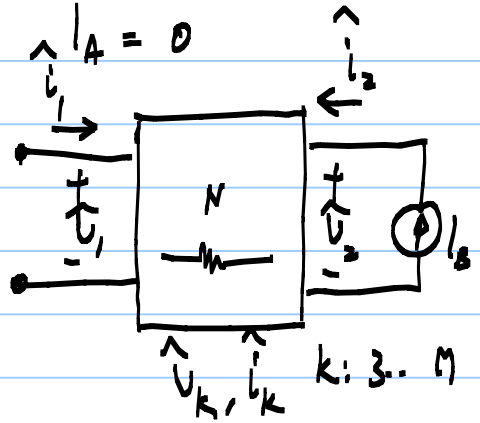
EC1010: Lecture 14



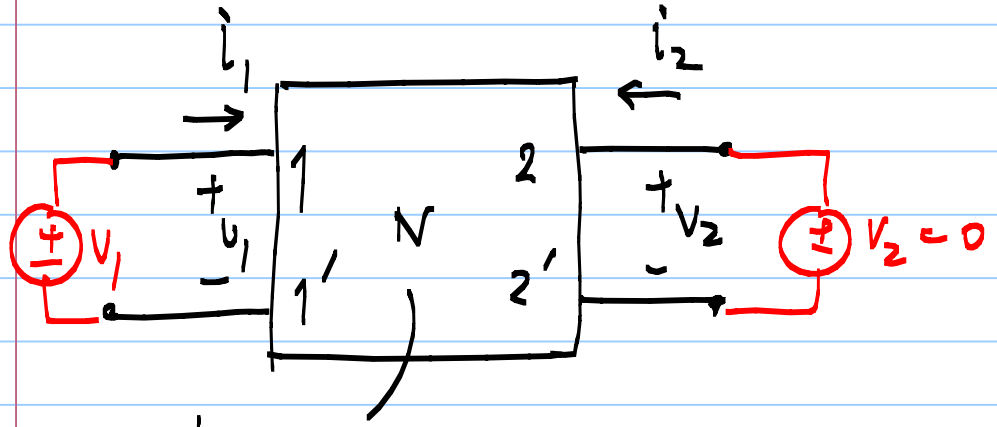
Case 1: $I_B = 0$



Case 2: $I_A = 0$



Two port network:



lin. resistors & controlled sources

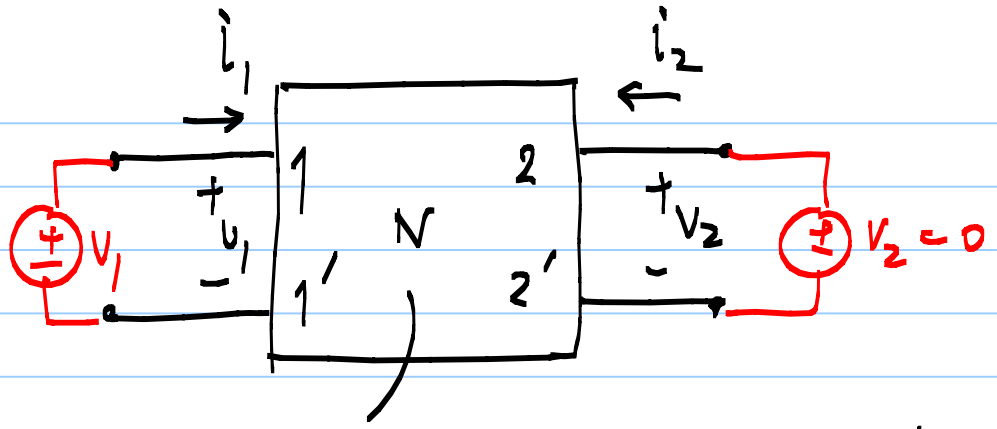
effect — cause

$$i_1 = y_{11} \cdot v_1 + y_{12} \cdot v_2$$

$$i_2 = y_{21} \cdot v_1 + y_{22} \cdot v_2$$

$$\begin{bmatrix} i_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \end{bmatrix}$$

y-parameters of the two port



$$i_1 = y_{11} \cdot v_1 + y_{12} \cdot v_2$$

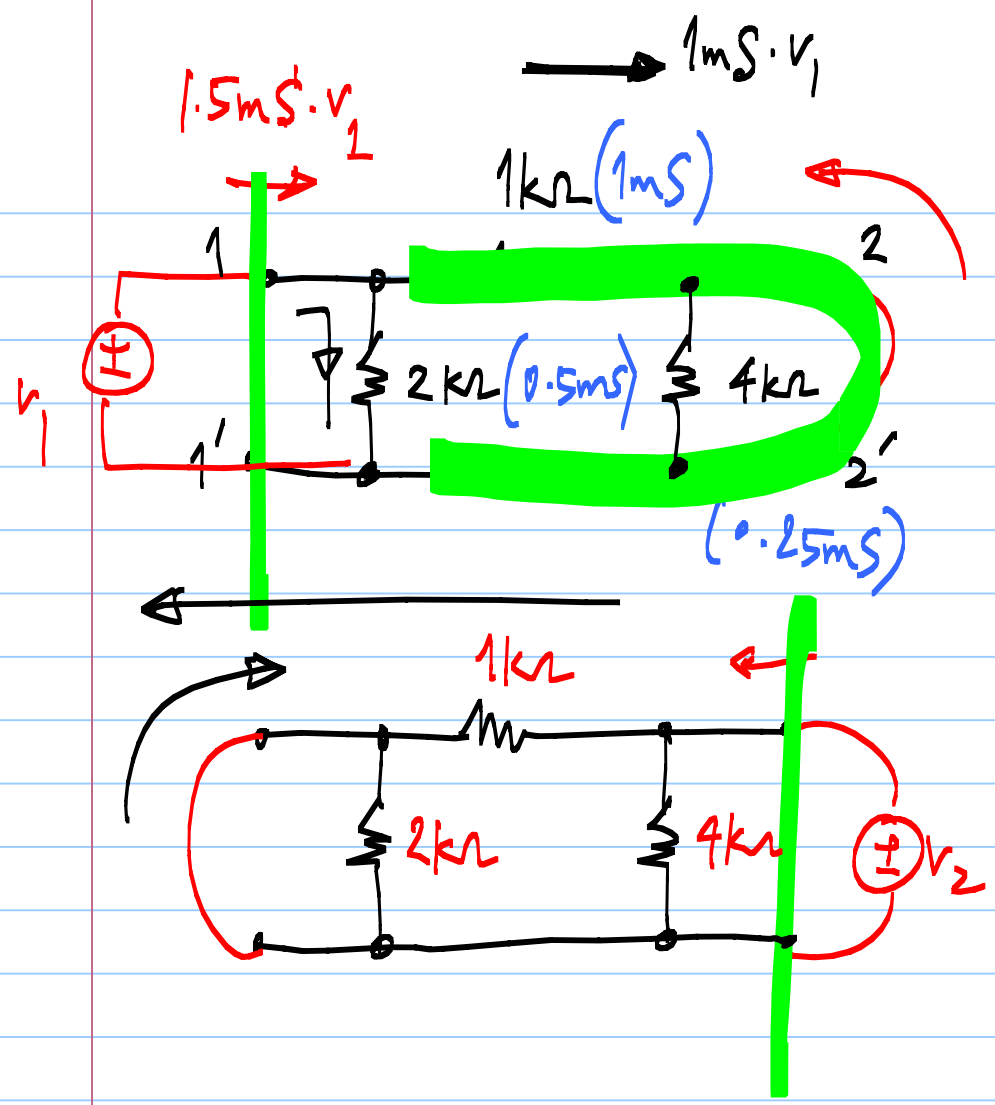
$$i_2 = y_{21} \cdot v_1 + y_{22} \cdot v_2$$

$$y_{11} = \left.\frac{i_1}{v_1}\right|_{v_2 = 0} \; ; \quad y_{12} = \left.\frac{i_1}{v_2}\right|_{v_1 = 0} \; ; \quad y_{21} = \left.\frac{i_2}{v_1}\right|_{v_2 = 0} \; ;$$

$$y_{22} = \left.\frac{i_2}{v_2}\right|_{v_1 = 0}$$

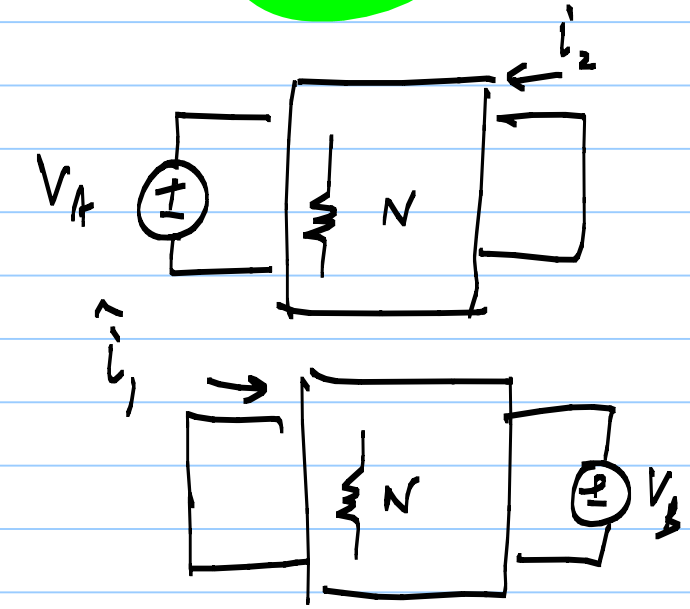
y –

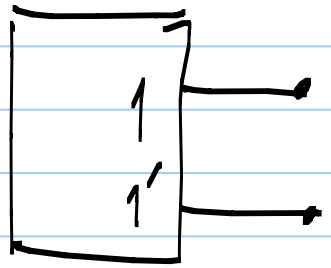
Short circuit parameters

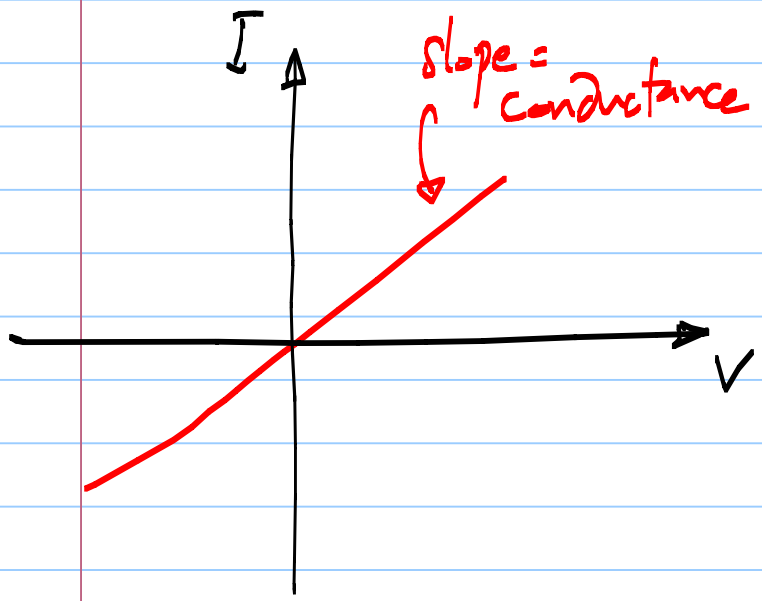


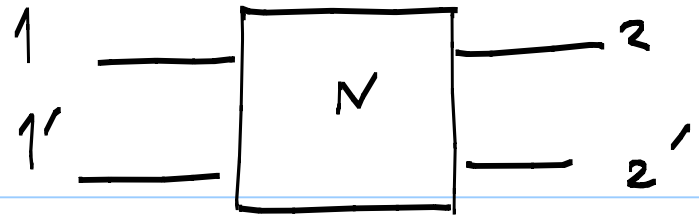
$y_{12} = y_{21}$ for a resistive 2 port (reciprocal)

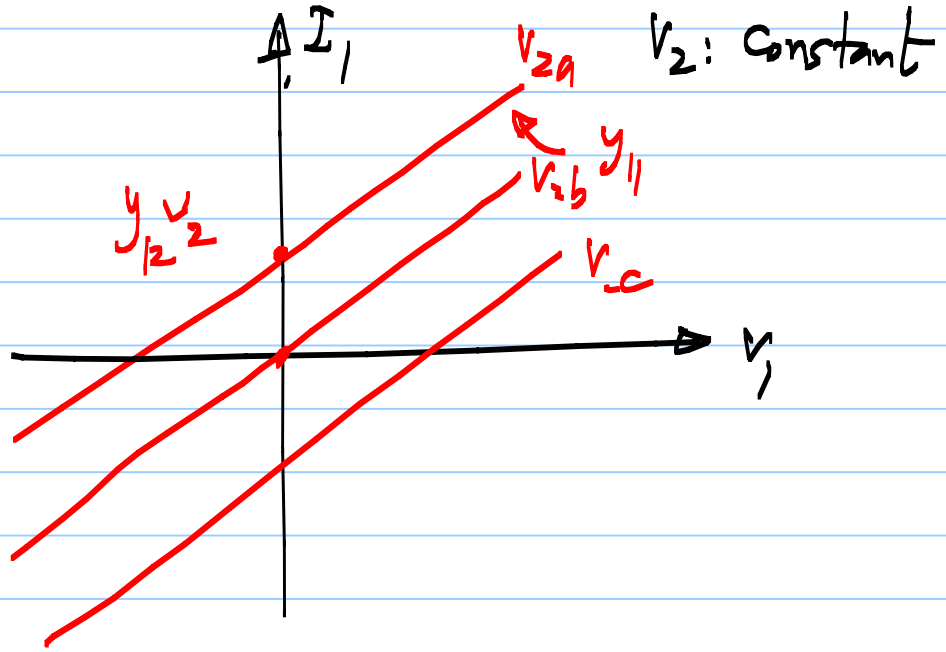
$$[y] = \begin{bmatrix} 1.5\text{mS} & -1\text{mS} \\ -1\text{mS} & 1.25\text{mS} \end{bmatrix}$$



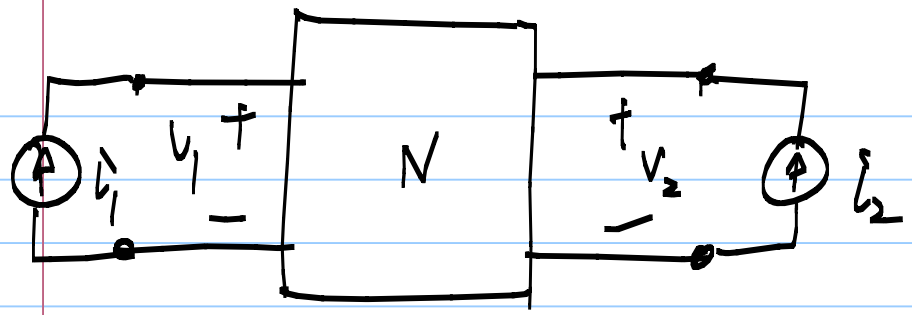

1
1′

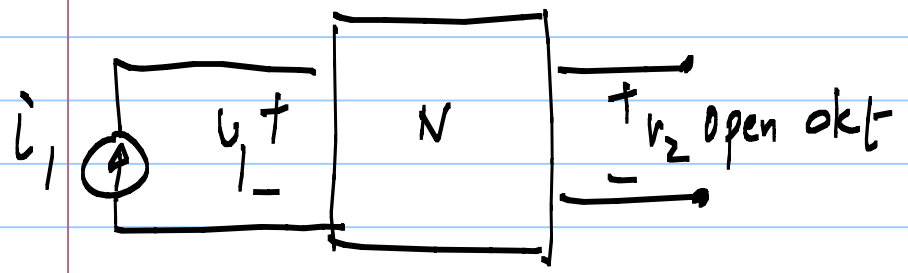

I
V
slope = conductance


1
1′
N
2
2′


I_1
V_2: constant
V_{2a}
V_{2b}
y_{11}
y_{12} V_2
V_c
V_1

y_{11}
y_{12}
y_{21}
y_{22}
v_{1a}
v_{1b}
v_{1c}
v_{2a}
v_{2b}
v_{2c}
v_{3a}
v_{3b}
v_{3c}
v_{4a}
v_{4b}
v_{4c}





$$\left.\frac{v_1}{i_1}\right|_{i_2=0} = Z_{11} \qquad \left.\frac{v_2}{i_1}\right|_{i_2=0} = Z_{21}$$

$$v_1 = Z_{11}\, i_1 + Z_{12}\, i_2$$

$$v_2 = Z_{21}\, i_1 + Z_{22}\, i_2$$

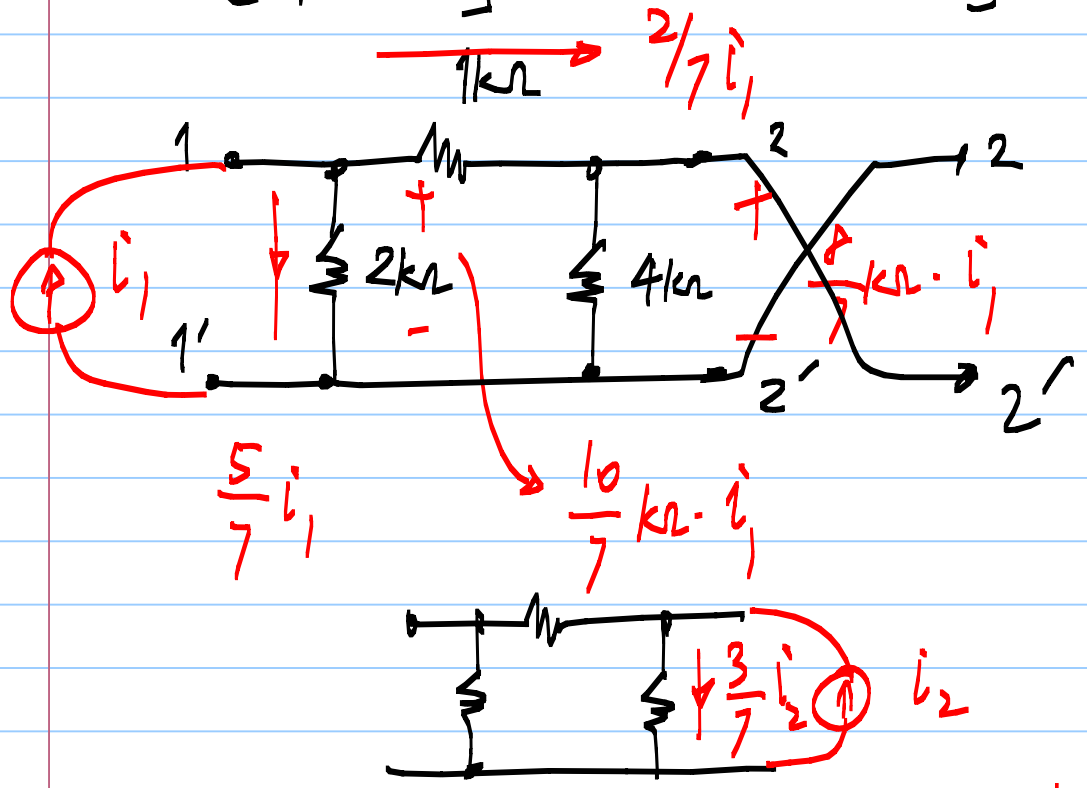
$$\begin{bmatrix} v_1 \\ v_2 \end{bmatrix} = \begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \end{bmatrix}$$

Z-parameters

open-circuit parameters

$$\left.\frac{i_1}{v_1}\right|_{v_2=0} = y_{11}$$

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



$$\begin{bmatrix} \frac{10}{7}\,k\Omega & \frac{8}{7}\,k\Omega \\ \frac{8}{7}\,k\Omega & \frac{12}{7}\,k\Omega \end{bmatrix}$$

hybrid parameters.

h-parameters

RECIPROCITY?

$$\begin{bmatrix} V_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{bmatrix} \begin{bmatrix} i_1 \\ V_2 \end{bmatrix}$$

inverse-hybrid

g-parameters

$$\begin{bmatrix} i_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} g_{11} & g_{12} \\ g_{21} & g_{22} \end{bmatrix} \begin{bmatrix} V_1 \\ i_2 \end{bmatrix}$$