

EE 2015

~ Conductance

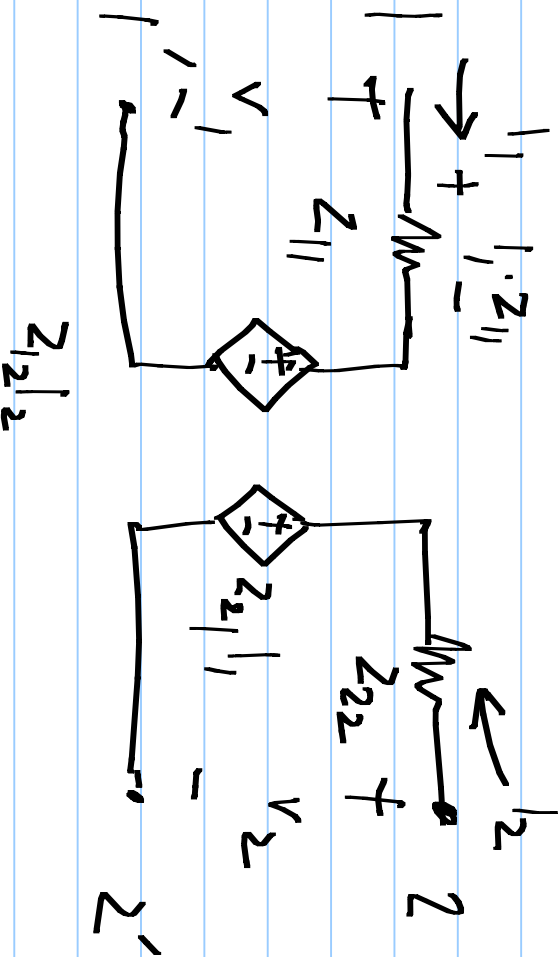
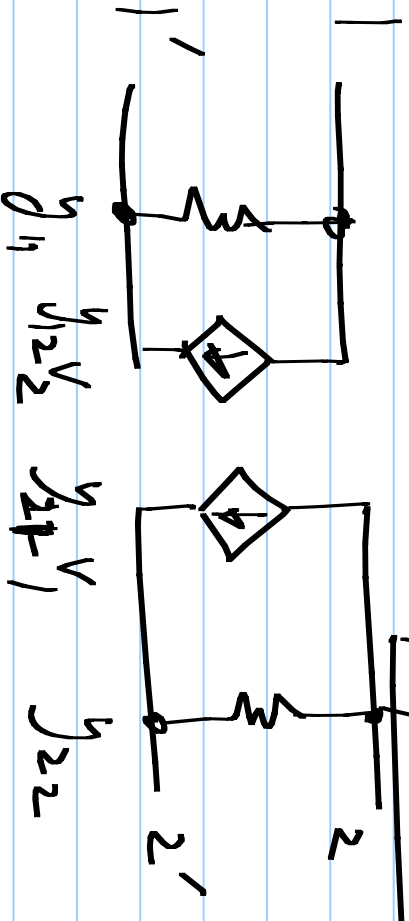
$$\begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} g_{11} & 0 \\ y_{21} & y_{22} \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \end{bmatrix}$$

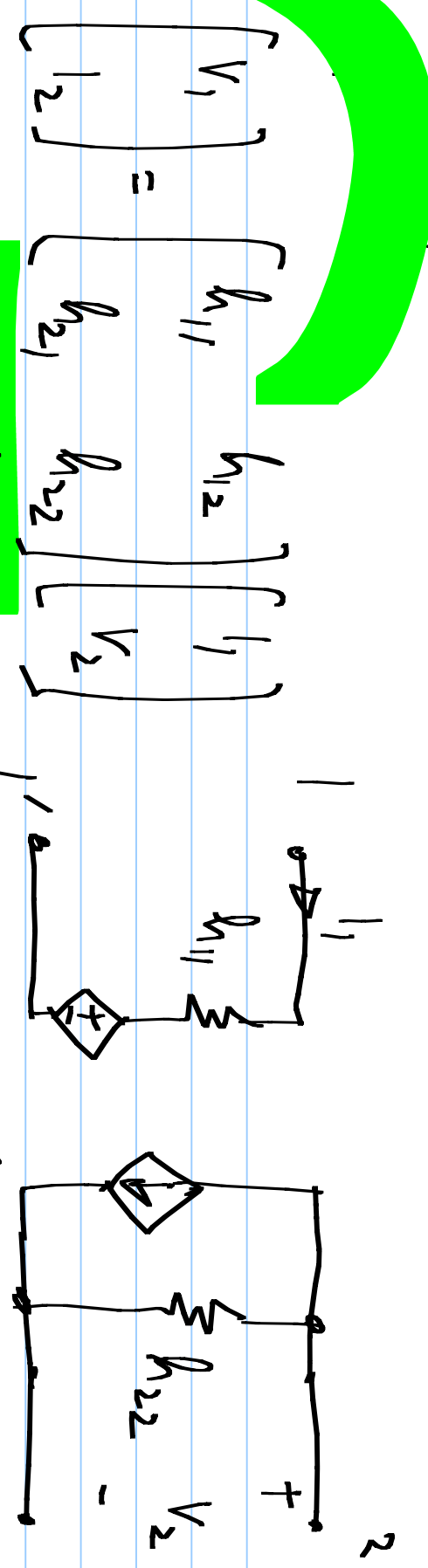
$()^{-1}$

$$\begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix}$$

~ Resistance

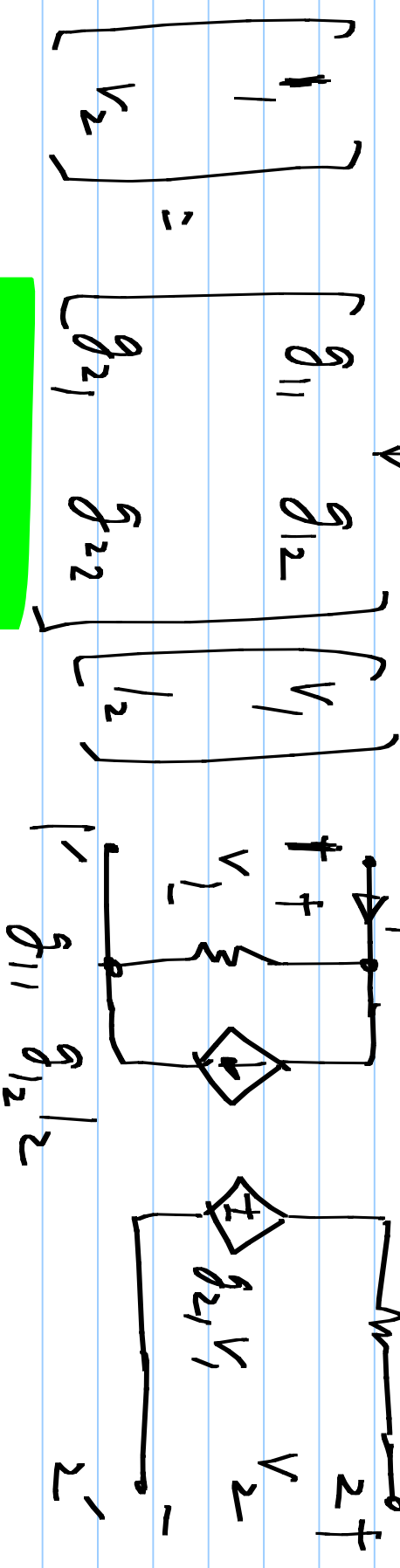
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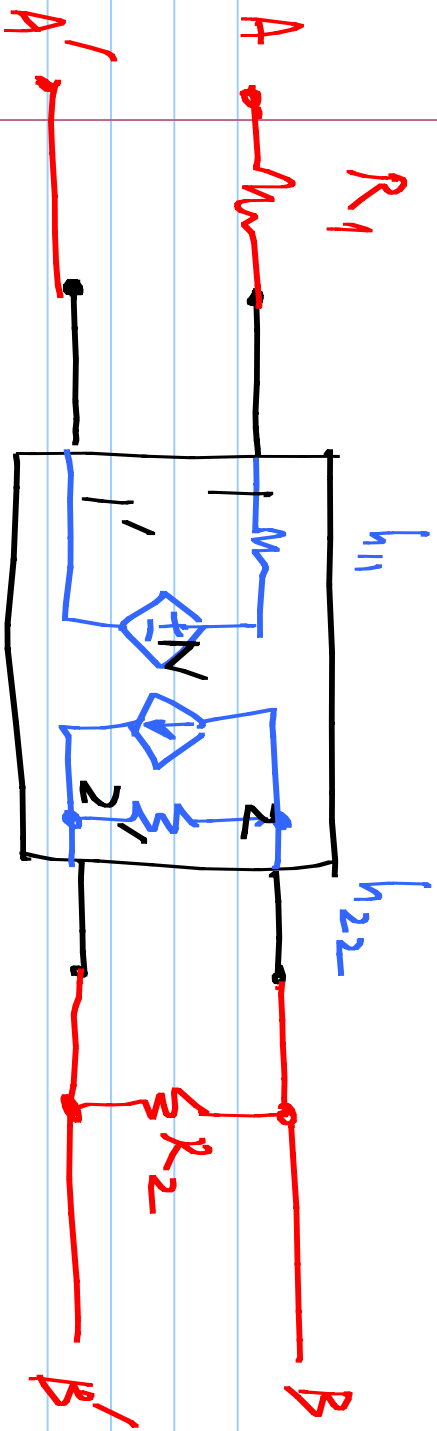
h -parameter

$$\begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \end{bmatrix}$$



g -parameter

$$\begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} g_{11} & g_{12} \\ g_{21} & g_{22} \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix}$$



Two-port parameters of the new network (A-A' & B-B')

$$h_{11} \rightarrow h_{11} + R_1$$

$$h_{22} \rightarrow h_{22} + R_2$$

$$\begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \end{bmatrix}$$

$$I_1 = y_{11} V_1 + y_{12} V_2 \quad V_1 = \frac{1}{y_{11}} \cdot I_1 - \frac{y_{12}}{y_{11}} \cdot V_2$$

$$I_2 = y_{21} V_1 + y_{22} V_2 \quad I_2 = \frac{y_{21}}{y_{11}} \cdot I_1 + \frac{y_{11} y_{22} - y_{12} y_{21}}{y_{11}} \cdot V_2$$

$$I_2 = y_{21} \cdot \frac{I_1 - y_{12} V_2}{y_{11}} + y_{22} V_2$$

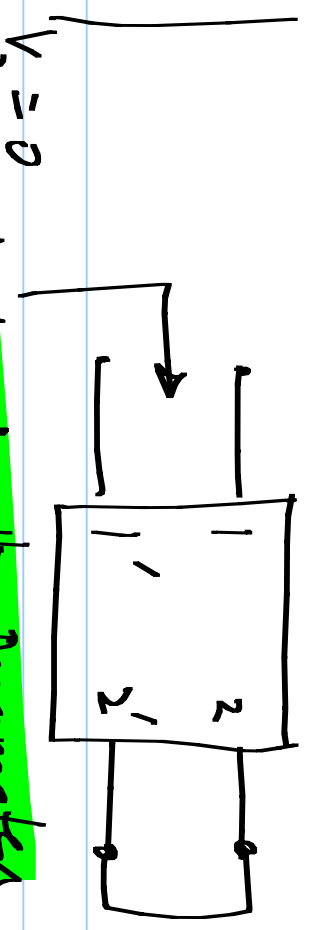
$$V_2 = y_{21} V_1 + y_{22} V_2$$

$$y_{12} = 0$$

$$V_2 = \frac{1}{y_{22}} \cdot I_2 - \frac{y_{21}}{y_{22}} \cdot V_1$$

$$[h] = \begin{bmatrix} \frac{1}{y_{11}} & -\frac{y_{12}}{y_{11}} \\ \frac{y_{11}y_{22} - y_{12}y_{21}}{y_{11}} & \frac{y_{22}}{y_{11}} \end{bmatrix} \quad [g] = \begin{bmatrix} \frac{y_{11}y_{22} - y_{12}y_{21}}{y_{22}} & \frac{y_{12}}{y_{22}} \\ -\frac{y_{21}}{y_{22}} & \frac{1}{y_{22}} \end{bmatrix}$$

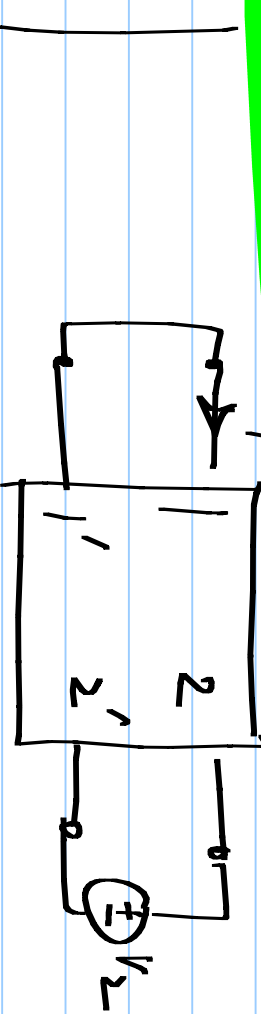
$$y_{11} = \frac{I_1}{V_1}$$



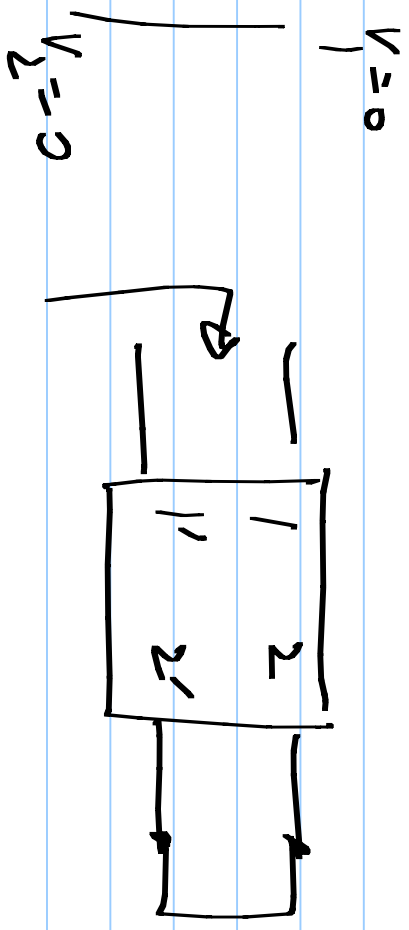
Short circuit
port-2
Measure conductance
@ port-1

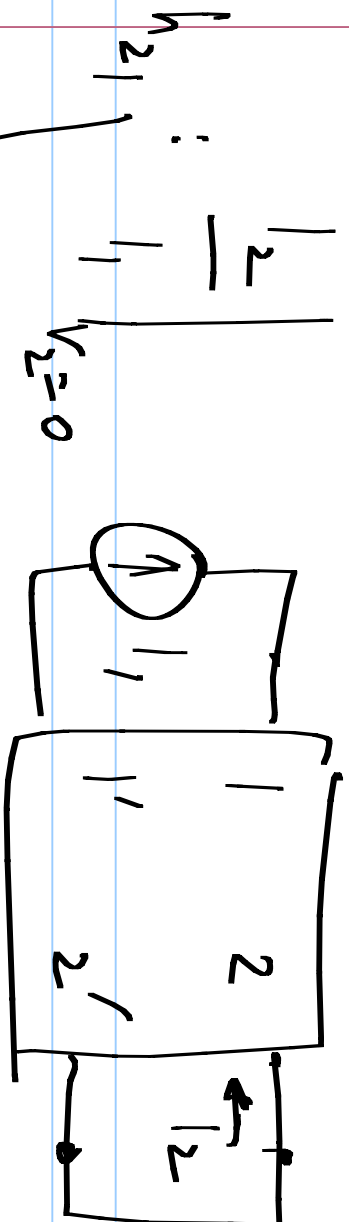
y-parameter \equiv Short-circuit parameters

$$y_{12} = \frac{I_1}{V_2}$$



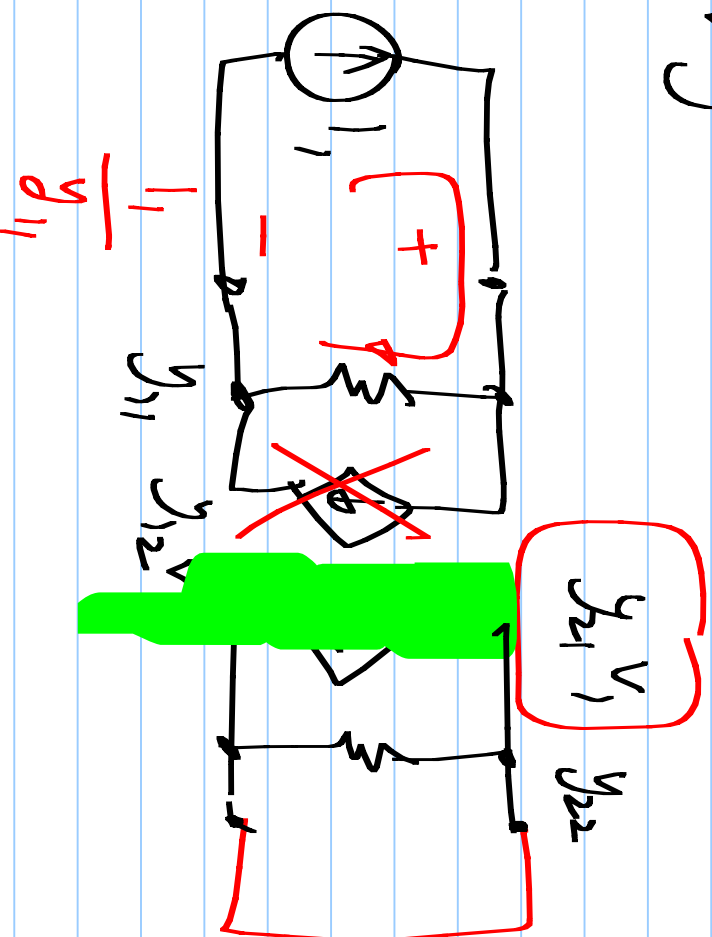
$$h_{11} = \frac{V_1}{I_1}$$





Current gain

$$\frac{h_{21}}{g_{11}} \cdot 1$$



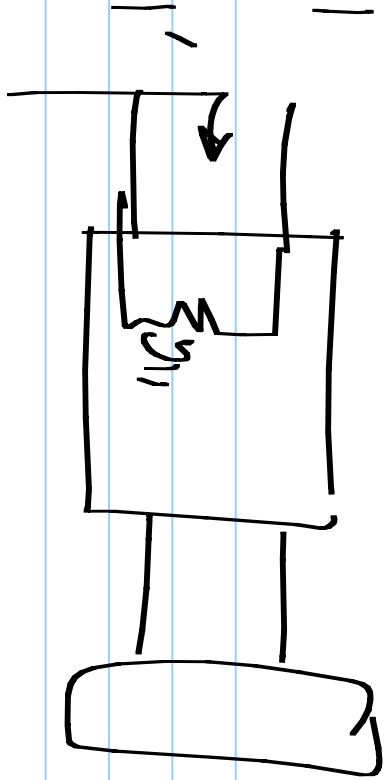
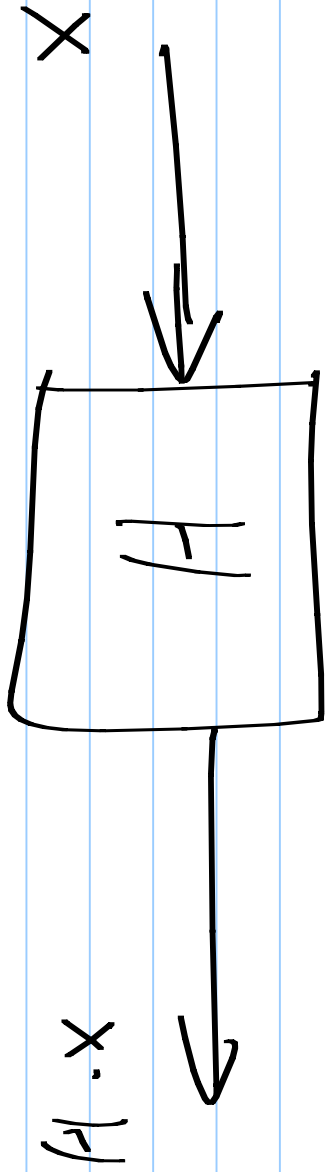
$$\text{If } y_{12} = 0 \quad (y_{21} \neq 0) \Rightarrow \begin{matrix} z_{12} = 0 \\ h_{12} = 0 \end{matrix}$$

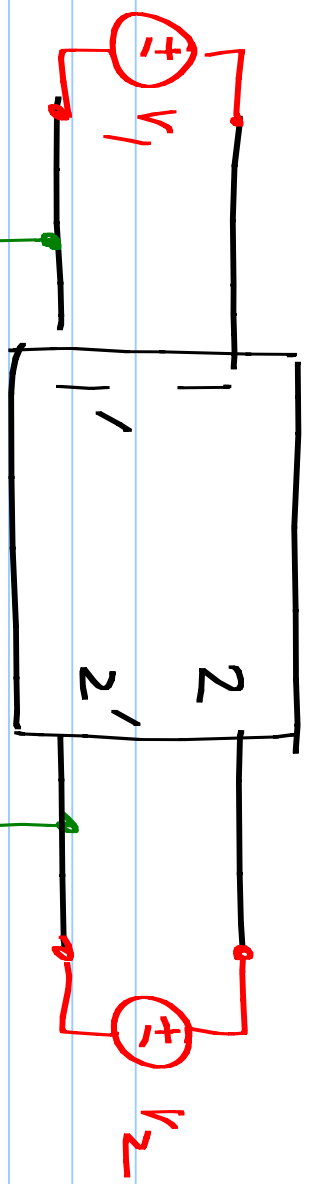
$$g_{12} = 0 \quad \checkmark$$

Part 2 has no influence on part 1
part 1 influences part 2

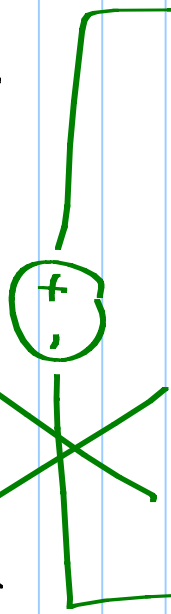
Unilateral two-part

$$\text{or } \frac{y_{12} = 0 \quad \& \quad y_{21} \neq 0}{y_{12} \neq 0 \quad \& \quad y_{21} = 0}$$

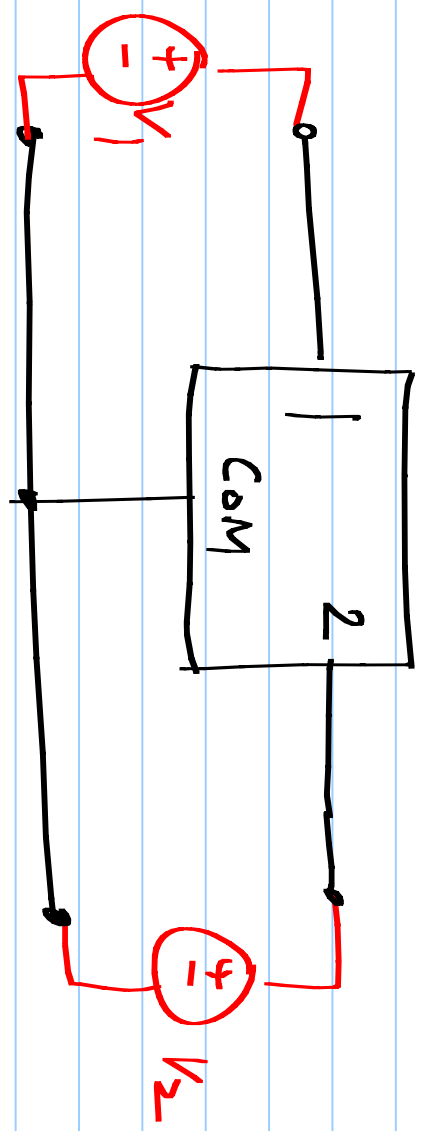




{ 4. terminals }
2. source }



3. terminal 2. part ($1' = 2'$)



2-ports with only
resistors

