Experiment - 7

Aim : Interconnection of 2 two port network in parallel - parallel interconnection and determination of overall Y- parameter.

Apparatus required :
D.C. power supply (variable), carbon resistors of 1kΩ and 1/4W - 6, Panel type DC voltmeter (0-20V), panel type DC Ammeter (0-25 mA), connecting wires and patch cords.

Theory :
In a parallel-parallel interconnection both input and output ports are connected in parallel.
The overall Y-parameter matrix for parallel connected two-port network is simply the sum of Y-parameters matrices of each individual two port networks connected in parallel.

$$[Y] = [Y_a] + [Y_b]$$

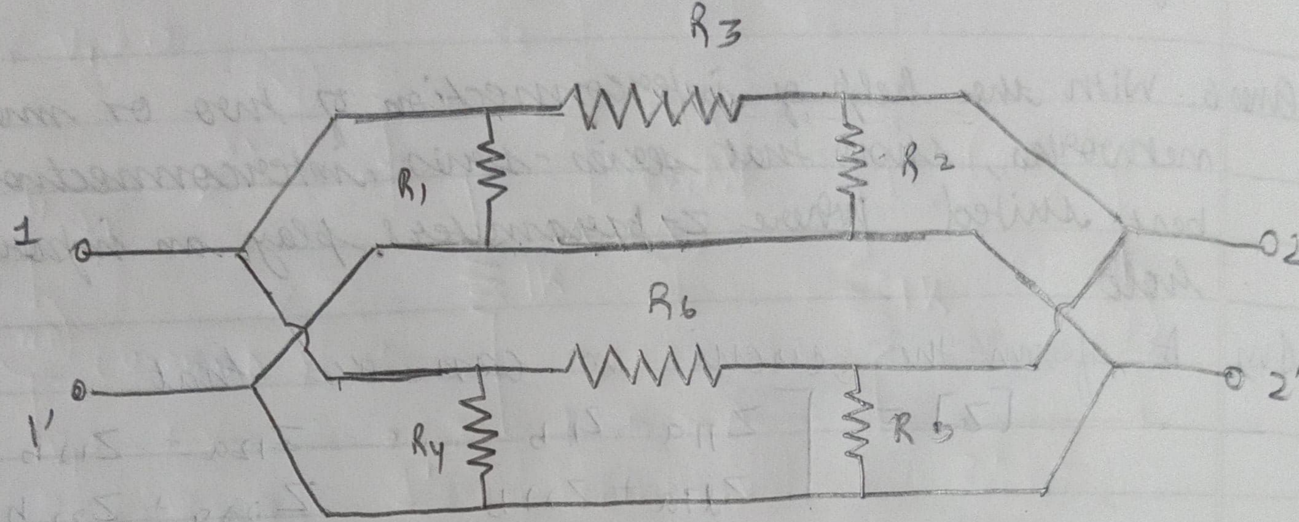
The figure shows two two-port networks Na and Nb. The resultant of two admittance connection is $Y_1 + Y_2$. So, in parallel connection the parameters are Y parameter

$$\begin{bmatrix} I_{1a} \\ I_{2a} \end{bmatrix} = \begin{bmatrix} Y_{11a} & Y_{12a} \\ Y_{21a} & Y_{22a} \end{bmatrix} \begin{bmatrix} V_{1a} \\ V_{2a} \end{bmatrix}$$ for network Na
lly from Nb

$$V_1 = V_{1a} = V_{1b} \; ; \; V_2 = V_{2a} = V_{2b}$$

Equating $[Y] = [Y_a] + [Y_b]$

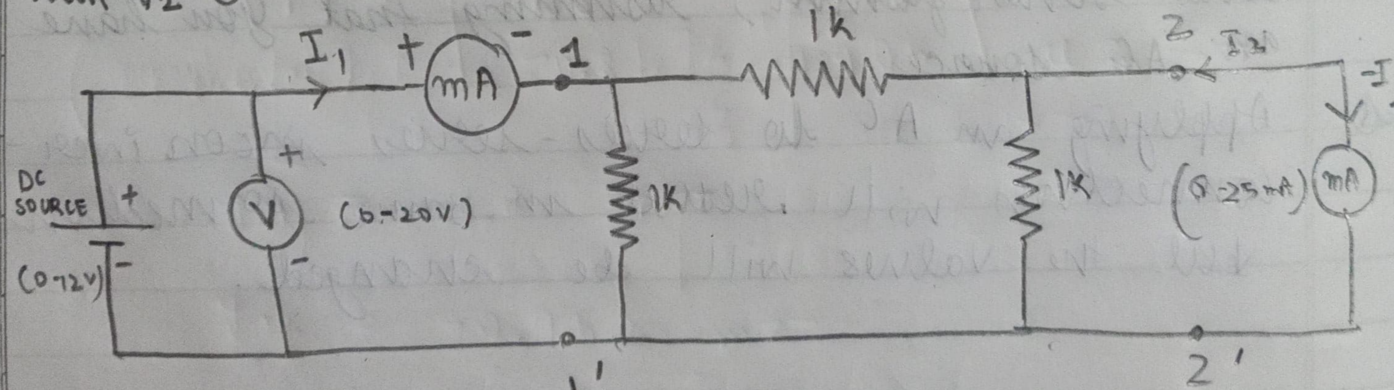
Aim : Interconnection of 2 two port networks in parallel parallel interconnection and determination of overall y parameter



Parallel - Parallel Interconnection

DETERMINATION OF SHORT CIRCUIT ADMITTANCE PARAMETER

with $V_2 = 0$



$V_1 = 7.5\,V$

$I_1 = 13.5\,mA$

$-I_2 = 6\,mA$

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

Precautions :

1) Never connect ammeter directly across the supply.
2) Keep the pot of the power supply at zero position initially and gradually increase the voltage
3) Connecting wires must be properly connected
4) Don't pull the connecting wires cords as it would get damaged

Sources of Error :

1) Parallax error in taking readings
2) Zero error of instruments
3) The resistance of connecting wires.
4) The internal resistance of the supply
5) High Least Count of the instruments

Result :

By observation,

$$[Y] = \begin{bmatrix} 3.6 & -1.904 \\ -1.6 & 3.810 \end{bmatrix} (m\mho)$$

By Calculation,

$$[Y] = \begin{bmatrix} 3.7 & -1.72 \\ -1.8 & 3.63 \end{bmatrix} (m\mho)$$

% error in each case

$y_{11} = 2.78\%$

$y_{12} = 9.67\%$

$y_{21} = 12.5\%$

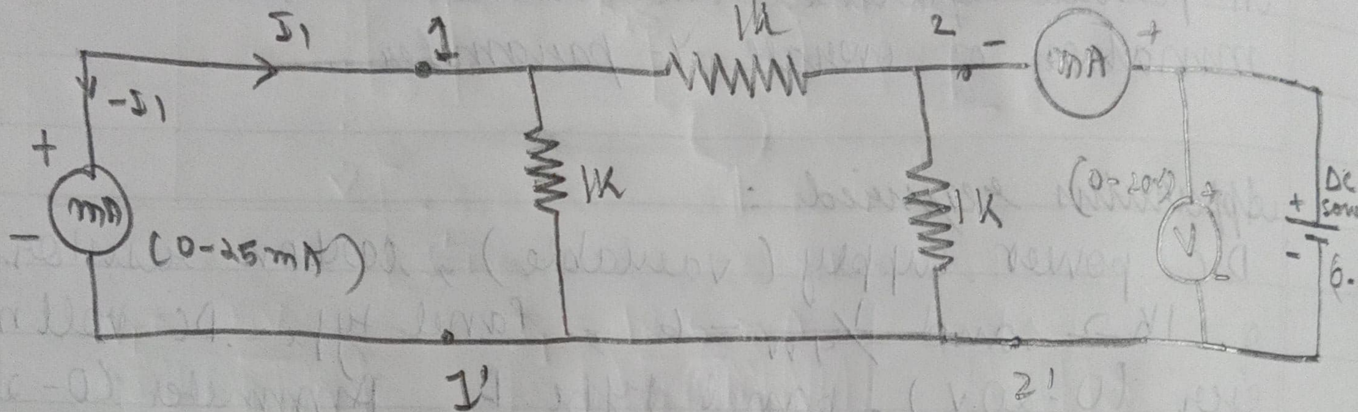
$y_{22} = 4.72\%$

Error $= \underline{1.85\%}$

$$y_{11} = \left.\frac{I_1}{V_1}\right|_{V_2=0} = \left(\frac{13.5}{7.5}\right) = 1.8\ m℧$$

$$y_{21} = \left.\frac{I_2}{V_1}\right|_{V_2=0} = \left(\frac{-6}{7.5}\right) = -0.8\ m℧$$

With $V_1 = 0$



$V_2 = 10.5\ V$

$I_2 = 20\ mA$

$-I_1 = 10\ mA$

$$y_{12} = \left.\frac{I_1}{V_2}\right|_{V_1=0} = \frac{(-10)}{10.5} = -0.952\ m℧$$

$$y_{22} = \left.\frac{I_2}{V_2}\right|_{V_1=0} = \frac{20}{10.5} = 1.905\ m℧$$

$$[Y] = \begin{bmatrix} 1.8 & -0.952 \\ -0.8 & 1.905 \end{bmatrix} \text{ all in } m℧$$

(experimental)

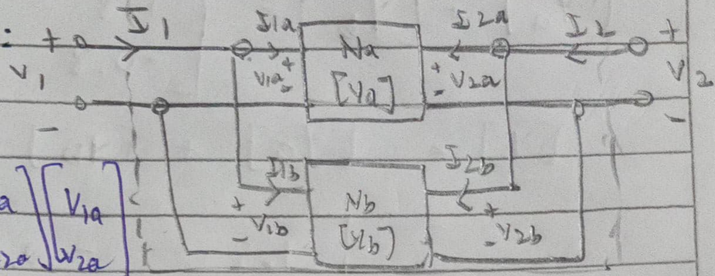
$y_{11} = 1.8\ m℧$

$y_{12} = -0.952\ m℧$

$y_{21} = -0.8\ m℧$

$y_{22} = 1.905\ m℧$

Theoritical verification :



for Network Na,

$$\begin{bmatrix} I_{1a} \\ I_{2a} \end{bmatrix} = \begin{bmatrix} Y_{11a} & Y_{12a} \\ Y_{21a} & Y_{22a} \end{bmatrix} \begin{bmatrix} V_{1a} \\ V_{2a} \end{bmatrix}$$

lly for network Nb,

$$\begin{bmatrix} I_{1b} \\ I_{2b} \end{bmatrix} = \begin{bmatrix} Y_{11b} & Y_{12b} \\ Y_{21b} & Y_{22b} \end{bmatrix} \begin{bmatrix} V_{1b} \\ V_{2b} \end{bmatrix}$$

$V_1 = V_{1a} = V_{1b}$, $\quad V_2 = V_{2a} = V_{2b}$

$I_1 = I_{1a} + I_{1b}$, $\quad I_2 = I_{2a} + I_{2b}$

Now, $I_1 = I_{1a} + I_{1b} = (Y_{11a} V_{1a} + Y_{12a} V_{2a}) + (Y_{11b} V_{1b} + Y_{12b} V_{2b})$

$= (Y_{11a} + Y_{11b}) V_1 + (Y_{12a} + Y_{12b}) V_2$

(since $V_1 = V_{1a} = V_{1b}$ and $V_2 = V_{2a} = V_{2b}$)

lly. $I_2 = I_{2a} + I_{2b} = (Y_{21a} + Y_{21b}) V_1 + (Y_{22a} + Y_{22b}) V_2$

$\Rightarrow$

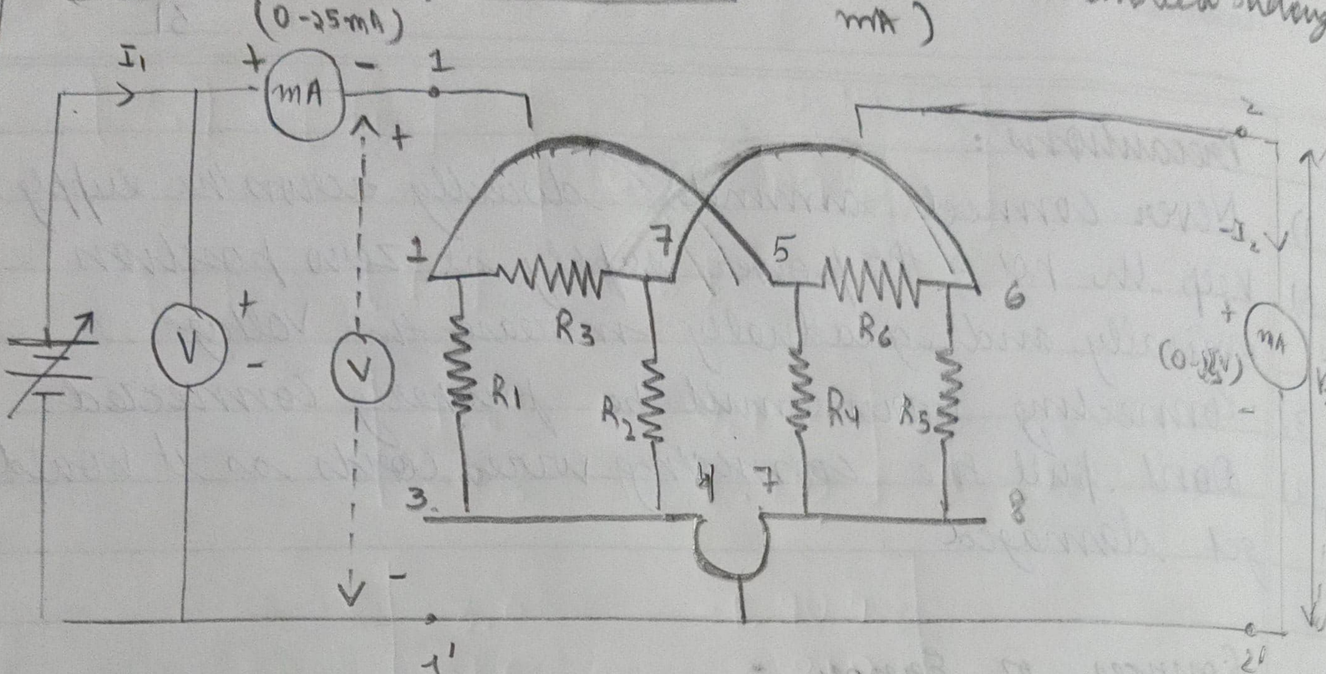
$$\begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} Y_{11} & Y_{12} \\ Y_{21} & Y_{22} \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \end{bmatrix}$$

where
$y_{11} = Y_{11a} + Y_{11b}$
$y_{12} = Y_{12a} + Y_{12b}$
$y_{21} = Y_{21a} + Y_{21b}$
$y_{22} = Y_{22a} + Y_{22b}$

Hence, $[Y] = [Y_a] + [Y_b]$

VIVA VOCE

Connection diagram on kit (with 2-2' shorted through mA)



$V_1 = \underline{5V}$ $\quad$ $I_1 = \underline{18.5}$ mA

$-I_2 = \underline{9}$ mA

OBSERVATION FOR DIRECT CALCULATION

For $V_1 = 0$ $\quad V_2 = \underline{5.5}$ V

$I_2 = \underline{20}$ mA

$-I_1 = \underline{9.5}$ mA

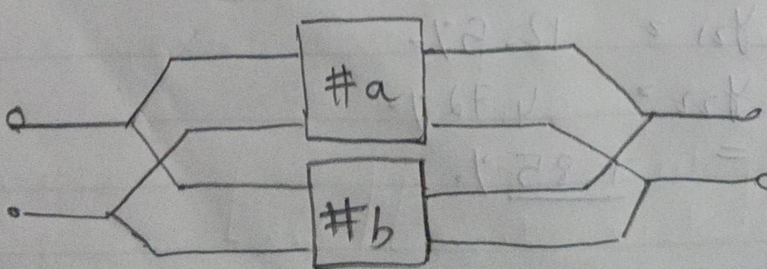
For $V_2 = 0$ $\quad V_1 = \underline{5V}$

$I_1 = \underline{18.5}$ mA

$-I_2 = \underline{9}$ mA

$$[Y] = \begin{bmatrix} 3.7 & -1.72 \\ -1.8 & 3.63 \end{bmatrix}$$ all in (m℧)

observed $\begin{bmatrix} 4 & -2 \\ -2 & 4 \end{bmatrix}$



Experiment :

Date

Ques 1. Is it preferable to connect bulbs in series ?

Ans No, its preffered to connect them in parallel so that if one bulb blow out others continue to get a current supply.

Ques 2. What is the short circuit admittance of composite network and how is it evaluated ?

Ans Short circuit admittance of a composite network is sum of short circuit admittance of each individual networks

$$[Y_{total}] = [Y_1] + [Y_2] + [Y_3] + \cdots + [Y_n]$$

Ques 3. What are the applications of parallel network ?

Ans They are used in dc supply from automobile industry, computer hardware, etc.

Ques 4. Why study of 2-port network is important ?

Ans Two port network model is used in circuit analysis techniques to isolate portions from a larger circuit. This allows response of network to signal applied to ports to be calculated easily without solving for all internal voltages and currents in the network.

Result Obtained Using Property of Interconnection

$$[Y_a] = [Y_b] = \begin{bmatrix} 1.8 & -0.952 \\ -0.8 & 1.905 \end{bmatrix}$$

$$[Y] = [Y_a] + [Y_b]$$

$$= \begin{bmatrix} 1.8 & -0.952 \\ -0.8 & 1.905 \end{bmatrix} + \begin{bmatrix} 1.8 & -0.952 \\ -0.8 & 1.905 \end{bmatrix}$$

$$= \begin{bmatrix} 3.6 & -1.904 \\ -1.6 & 3.810 \end{bmatrix}$$

COMPARISON OF EXPERIMENTAL RESULTS :

Direct calculation $[Y] = \begin{bmatrix} 3.7 & -1.72 \\ -1.8 & 3.63 \end{bmatrix}$ (mʊ)

Using property $[Y] = \begin{bmatrix} 3.6 & -1.904 \\ -1.6 & 3.810 \end{bmatrix}$ (mʊ)

% error in each case $y_{11} = 2.78\%$

$y_{12} = 9.67\%$

$y_{21} = 12.5\%$

$y_{22} = 4.72\%$

avg error = 1.85 %