Experiment : 2. Date 31-08-2020
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EXPERIMENT - 2

Aim : To Calculate and verify 'Y' parameters of two-port network

Apparatus Required : Power Supply, Two port kits, Patch cords, connecting lead, Voltmeter, Ammeter, etc.

Theory :

Y- PARAMETER - Y-parameter also called short circuit Admittance parameter and unit is siemens (S).

Y- Parameter is used in power, electronics and telecommunication. These parameters are used to describe the electrical behaviour of linear electrical networks. The two-port network may be voltage-driven or current driven.

The terminal voltage can be related to the terminal current as

$$I_1 = y_{11} V_1 + y_{12} V_2 \quad — (1)$$

$$I_2 = y_{21} V_1 + y_{22} V_2 \quad — (2)$$

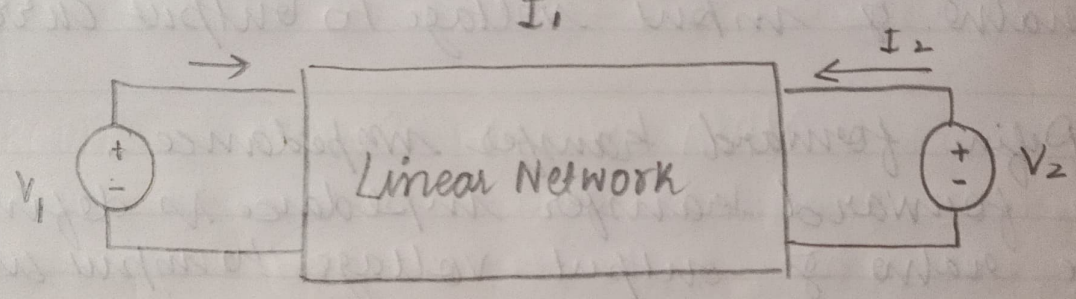
In matrix form as :

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

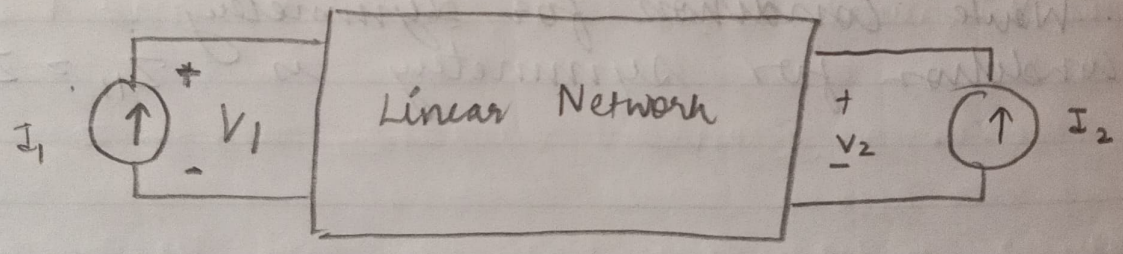
Aim: To calculate and verify 'Y' parameters of two-port network.

CIRCUIT DIAGRAMS

TWO-PORT NETWORK DRIVEN BY VOLTAGE SOURCE :



TWO-PORT NETWORK DRIVEN BY CURRENT SOURCE :



$$I_1 = Y_{11} V_1 + Y_{12} V_2 \quad — (1)$$

$$I_2 = Y_{21} V_1 + Y_{22} V_2 \quad — (2)$$

The y-parameter that we want to determine are Y_{11}, Y_{12}, Y_{21}, Y_{22}. The values of the parameters can be evaluated by setting.

1) $V_1 = 0$ (input port short-circuited)
2) $V_2 = 0$ (output port short-circuited)

Thus,

$$Y_{11} = \frac{I_1}{V_1}\Big|_{V_2=0} \qquad Y_{12} = \frac{I_1}{V_2}\Big|_{V_1=0}$$

$$Y_{21} = \frac{I_2}{V_1}\Big|_{V_2=0} \qquad Y_{22} = \frac{I_2}{V_2}\Big|_{V_1=0}$$

where,

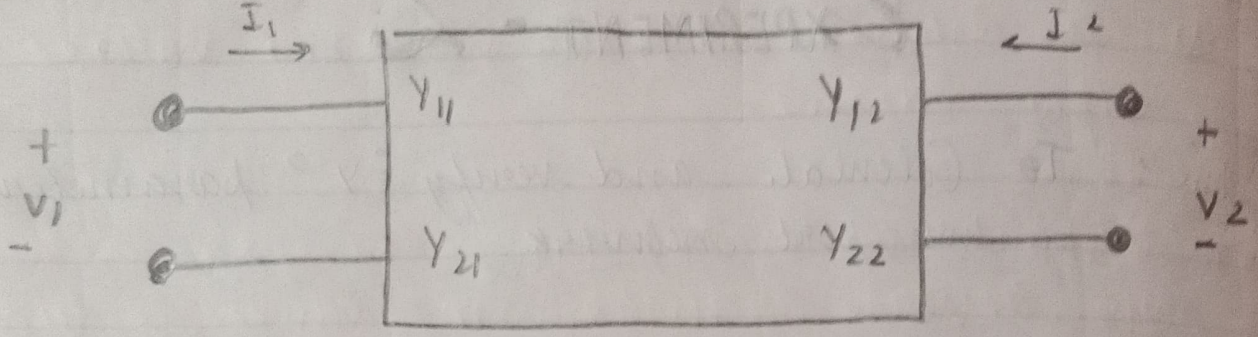
Y_{11} = short circuit input admittance
Y_{12} = short-circuited transfer admittance from port 1 to port 2
Y_{21} = short-circuit transfer admittance from port 2 to port 1
Y_{22} = short circuit output admittance

Procedure :

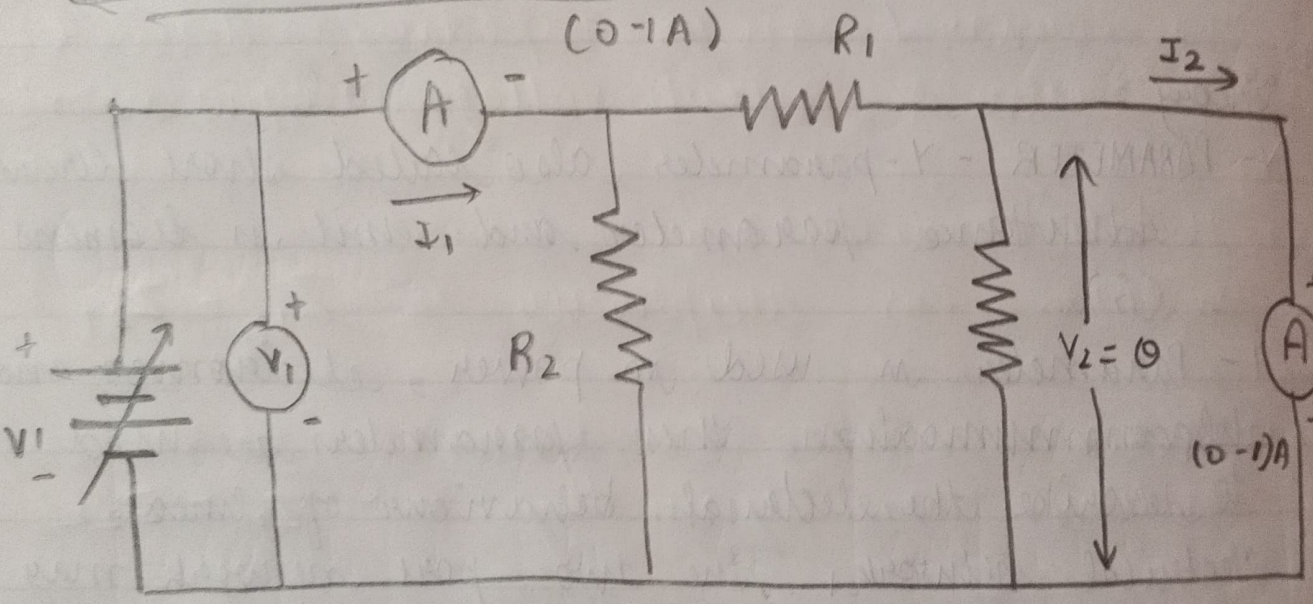
a) Connect the variable voltage to port 1 and keep the port 2 short circuited i.e. $V_2 = 0$ as shown in the figure. Set of voltages on V_1 and measure V_1, I_2 and I_1 for each setting and tabulate Y_{11} and Y_{21}.

b) Connect the variable voltage to port 2 and keep the port 1 short circuited i.e. $V_1 = 0$, as

The 'black box' is replaced with Y-parameters is as shown below:



CIRCUIT DIAGRAMS



Circuit for determining Y_{11} and Y_{21}

$$Y_{11} = \left.\frac{I_1}{V_1}\right|_{V_2=0} \qquad Y_{21} = \left.\frac{I_2}{V_1}\right|_{V_2=0}$$

$$Y_{12} = \left.\frac{I_1}{V_2}\right|_{V_1=0} \qquad Y_{22} = \left.\frac{I_2}{V_2}\right|_{V_1=0}$$

shown in the figure. Set different voltages at V_2 and measure V_2, I_1, I_2 for each setting and tabulate Y_{12} and Y_{22}

Precautions:

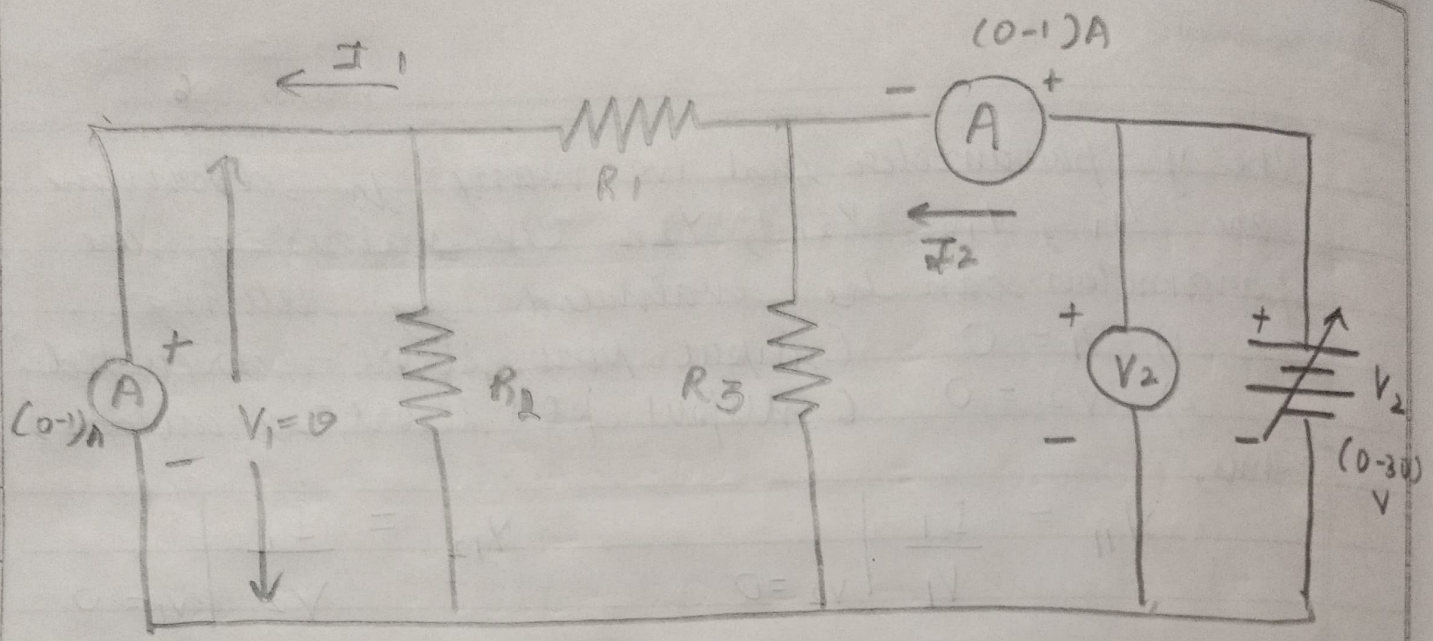
a) Make the connections according to the circuit diagram. Power supply should be switched off.
b) Connections should be tight
c) Note the readings carefully.

Result:
The 'Y' parameter of the two port network has been calculated and verified.

VIVA QUESTIONS

Ques 1. Define Y parameters?
Ans In Y parameters the input and output currents I_1 and I_2 can be expressed in terms of input and output voltages V_1 and V_2

Ques 2. List the four variables used in Y parameter representation
Ans The four variables are I_1, I_2, V_1 and V_2.



Circuit for determining Y_{12} and Y_{22}

OBSERVATIONS

S.no.	When O/P is short ckt $V_2 = 0$					When I/P is shot ckt $V_1 = 0$				
	V_1 (V)	I_1 (mA)	I_2 (mA)	Y_{11} I_1/V_1 (℧)	Y_{21} I_2/V_2 (℧)	V_2(V)	I_1 mA	I_2 mA	Y_{12} I_1/V_2 (℧)	Y_{22} I_2/V_1 (℧)
1.	2.5	5	2.7	0.002	0.00108	4.5	4.4	7.5	0.0009	0.0016
2.	10	17.5	9	0.00175	0.0009	5	5	10	0.001	0.002

Ques 3. List the two dependent variables used in Y- parameter representation.

Ans The two dependent variables are I_1 and I_2.

Ques 4. List the two independent variables used in Y-parameter representation.

Ans The two independent variables are V_1 and V_2.

Ques 5. Define input driving point admittance.

Ans The input driving point admittance is defined as the ratio of input current to the input voltage.

Ques 6. Define output driving point admittance.

Ans The output driving point admittance is defined as the ratio of output current to the output voltage.

Ques 7. Define reverse transfer admittance.

Ans The reverse transfer ratio is defined as ratio of input current to the output voltage.

Ques 8. Define forward transfer admittance.

Ans The forward transfer ratio is defined as ratio of output current to input voltage.

Calculations :

$$Y_{11} = \frac{0.002 + 0.00175}{2} = 0.001875 \text{ ℧}$$

$$Y_{21} = \frac{0.00108 + 0.0009}{2} = 0.00099 \text{ ℧}$$

$$Y_{12} = \frac{0.0009 + 0.001}{2} = 0.00095 \text{ ℧}$$

$$Y_{22} = \frac{0.0016 + 0.002}{2} = 0.0018 \text{ ℧}$$

$Y_{21} \approx Y_{12}$ Error = 0.00004

∴ The circuit is reciprocal

Result :

The 'Y' parameters of the two-port network has been calculated and verified.

Ques 9. Write the condition for reciprocity

Ans Condition for reciprocity is $Y_{12} = Y_{21}$

Ques 10. Write the condition for symmetry.

Ans Condition for symmetry is $Y_{11} = Y_{22}$