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Experiment-4

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

Apparatus Required: Power supply, two port kit, patch cords, connecting leads, voltmeter, ammeter, etc

Theory:

T(ABCD) -PARAMETER

- T- Parameter or ABCD - parameter is a another set of parameters relates the variables at the input port to those at the output port.
- T-parameter also called transmission parameters because these parameters are useful in the analysis of transmission lines because these parameters are express sending-end variables (V_1 and I_1) in terms of receiving end variables (V_2 and $-I_2$)

The terminal voltages can be related to terminal current

$$V_1 = A V_2 + B(-I_2) \quad -(1)$$

$$I_1 = C V_2 + D(-I_2) \quad -(2)$$

In matrix form as

$$\begin{bmatrix} V_1 \\ I_1 \end{bmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix} \begin{bmatrix} V_2 \\ -I_2 \end{bmatrix}$$

The T- parameter that we want to determine

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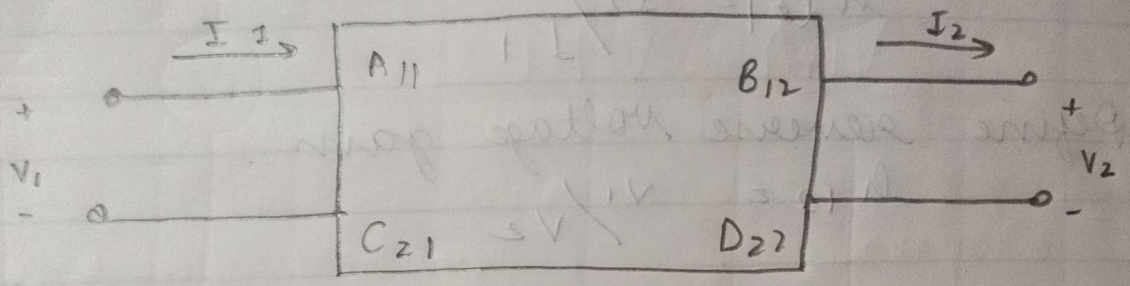
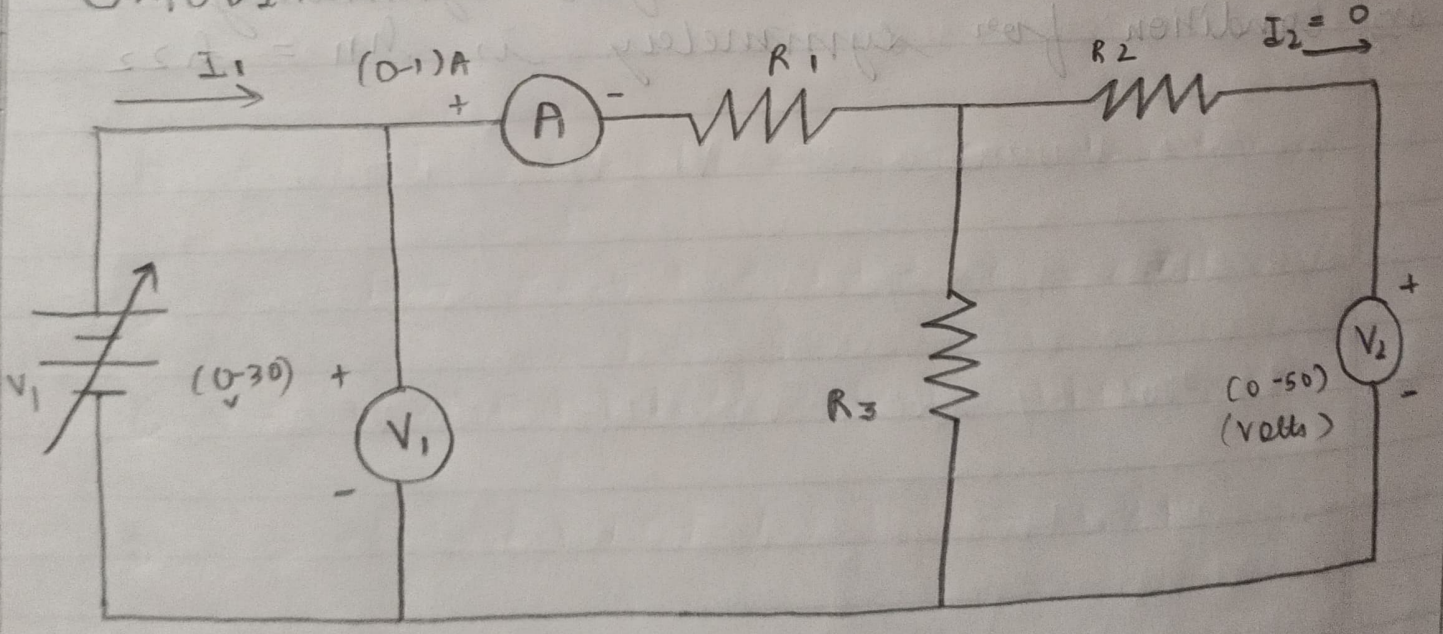
The "black box" that we want to replace with T-parameters is shown below.



CIRCUIT DIAGRAM:



Circuit for determining A and C

$$A = \left.\frac{V_1}{V_2}\right|_{I_2=0} \qquad C = \left.\frac{I_1}{V_2}\right|_{I_2=0}$$

are A, B, C and D where A and D are dimensionless, B is in ohm (Ω) and C is in Siemens (S)

The values can be evaluated by setting
- $I_2 = 0$ (output port open circuit)
- $V_2 = 0$ (output port short circuit)

Thus,

$$A = \frac{V_1}{V_2}\Big|_{I_2=0} \qquad B = \frac{V_1}{I_2}\Big|_{V_2=0}$$

$$C = \frac{I_1}{V_2}\Big|_{I_2=0} \qquad D = \frac{V_1}{I_2}\Big|_{V_2=0}$$

In the term of the transmission parameter, a network is reciprocal if:

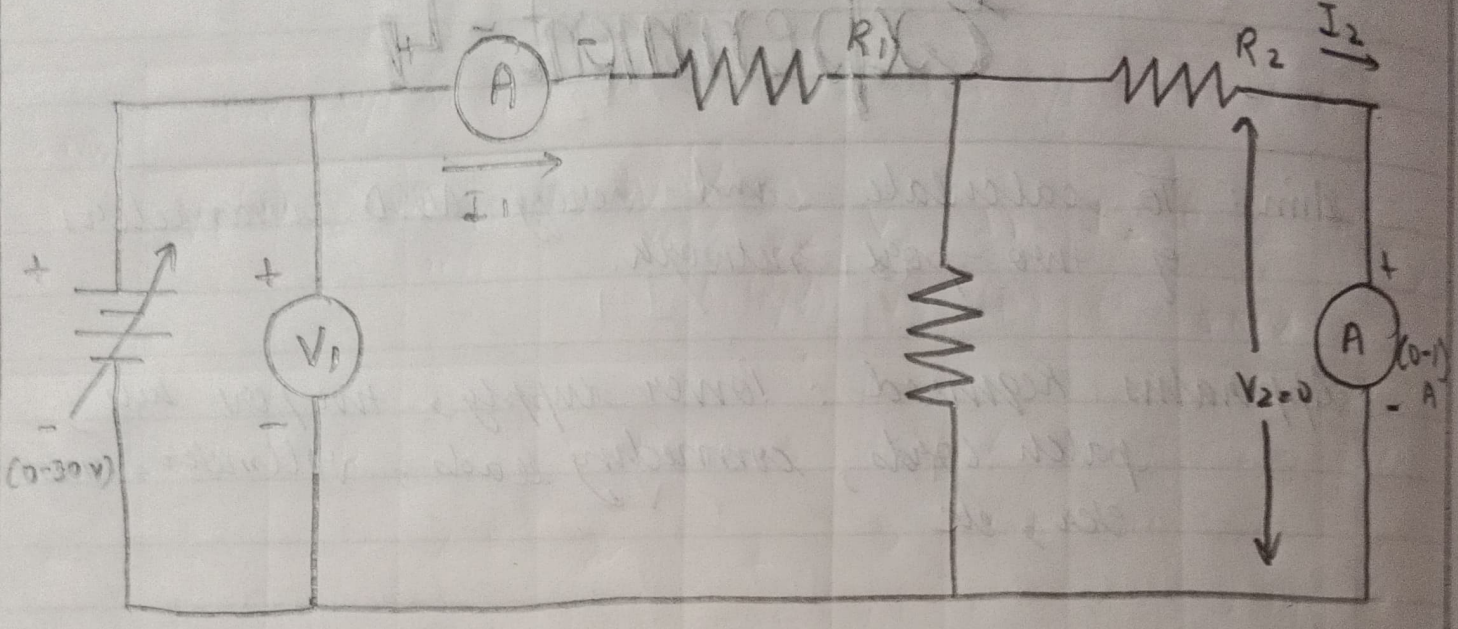
$$AD - BC = 1$$

Procedure :

a) Connect the variable voltage to port 1 and keep port - 2 open circuit i.e. $I_2 = 0$ as shown in figure. Set different voltages on V_1 and measure V_1, V_2 and I_1 for each setting and tabulate A and C.

b) Connect the variables voltages to port 1 and keep the port 2 short circuit i.e. $V_2 = 0$ as shown in the figure. Set different voltages at V_1 and measure V_1, I_2, I_1 for each setting and tabulate B and D

Circuit for determining B and D



$$B = \left.\frac{V_1}{I_2}\right|_{V_2=0} \qquad D = \left.\frac{I_1}{I_2}\right|_{V_2=0}$$

$$A = \frac{1.67 + 2 + 1.87 + 2}{4} = 1.885 \text{ mA/V}$$

$$B = \frac{-2.5 + -2.5 + -2.14 + 2.22}{4} = 2.34 \text{ mA/V}$$

$$C = \frac{1.33 + 1 + 1.25 + 1}{4} = 1.145 \text{ mA/V}$$

$$D = -\frac{(2 + 2 + 1.57 + 1.67)}{4} = 1.81$$

Error (A-D) = 0.075

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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 'T (ABCD)' parameters of the two port network has been calculated and verified.

VIVA VOICE

Ques 1. Define transmission parameters.

Ans In these parameters the voltage and current at the sending end terminals can be expressed in terms of voltage and current at the recieving end.

Ques 2. Why ABCD parameters are also called as the transmission parameters ?

Ans ABCD parameters are also called as transmission parameters. because these are used in the analysis power transmission lines.

Ques 3. Where they are used ?

Ans Transmission lines theory and cascade network.

OBSERVATIONS:

S. no.	When O/P is open ckt $I_2 = 0$					When O/P is closed ckt $V_2 = 0$				
	V_1 (V)	V_2 (V)	I_1 (mA)	$A = V_1/V_2$	$C = I_1/V_2$ (mA/V)	V_2 (V)	I_1 (A)	I_2 (A)	$B = V_2/I_2$ mA/V	$D = I_1/I_2$
1.	2.5	1.5	2	1.67	1.33	2.5	2mA	1mA	-2.5	-2
2.	5	2.5	2.5	2	1	5	4mA	2mA	-2.5	-2
3.	7.5	4	4.5	1.87	1.25	7.5	5.5	3.5	-2.14	-1.57
4.	10	5	5	2	1	10	7.5	4.5	-2.22	-1.67

$A = D \ (\approx 2)$

$\Rightarrow$ The circuit is symmetric

Result:

The 'T (ABCD)' parameters of the two port network has been calculated and verified

Ques 4. Define reverse voltage ratio (A).
Ans It is defined as the ratio of sending end voltage to the receiving end voltage.

Ques 5. Define transfer impedance (B).
Ans It is defined as the ratio of sending end voltage to the receiving end current with the receiving end current assumed to be in reverse direction.

Ques 6. Define transfer admittance (C).
Ans It is defined as the ratio of sending end current to the receiving end voltage.

Ques 7. Define reverse current ratio (D).
Ans It is defined as the ratio of sending end current to the receiving end current with the receiving end current assumed to be in reverse direction.

Ques 8. Write the units of parameters B and C.
Ans Units of parameter B is ohm and C is mho.

Ques 9. Write the units of parameters A and D.
Ans Both parameters A and D are unit less.

Ques 10. Write the condition for symmetry and reciprocity.
Ans condition for symmetry → $A = D$
condition for reciprocity → $AD - BC = 1$