

EXPERIMENT - 3

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

Apparatus Required: Power Supply, 2 port kits, patch cords, connecting leads, voltmeter, ammeter, etc.

Theory:

H-Parameter: In these network there are four parameters called the hybrid parameters or H-parameters, called the one is measured in terms of ohm one in mho and other two are dimensionless. Since these parameters has mixed dimension, so they are called as hybrid parameters.

The terminal voltage can be related to the terminal current as:

$$V_1 = h_{11} I_1 + h_{12} V_2 \quad \text{--- (1)}$$

$$I_2 = h_{21} I_1 + h_{22} V_2 \quad \text{--- (2)}$$

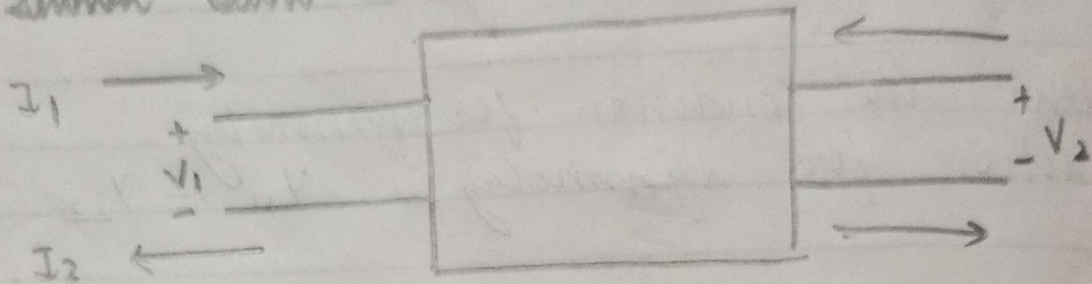
In matrix form as:

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

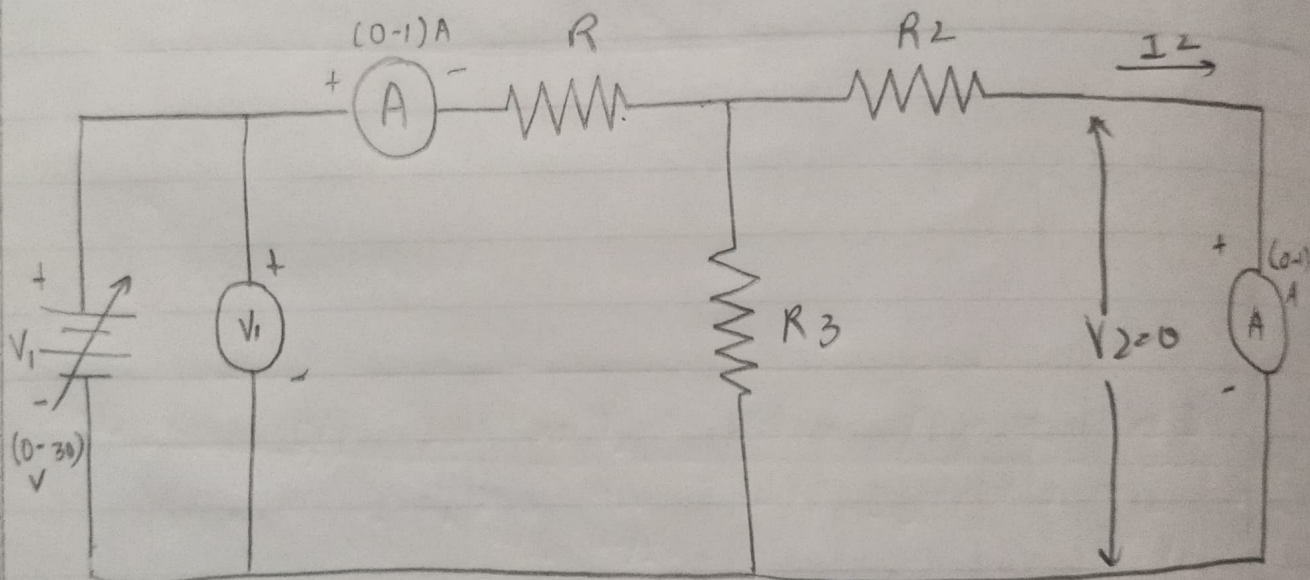
The h-parameters that we want to determine are h_{11} , h_{12} , h_{21} , h_{22} . The value of the parameters can be evaluated by setting:

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The 'black box' is replaced with Z-parameter as shown below



CIRCUIT DIAGRAM



circuit for determining h_{11} and h_{22}

$$h_{11} = \frac{V_1}{I_1} \bigg|_{V_2=0}$$

$$h_{12} = \frac{V_1}{V_2} \bigg|_{I_1=0}$$

$$h_{21} = \frac{I_2}{I_1} \bigg|_{V_2=0}$$

$$h_{22} = \frac{I_2}{V_2} \bigg|_{I_1=0}$$

- 1) $V_2 = 0$ (output port short circuited)
- 2) $I_1 = 0$ (input port open circuited)

$$h_{11} = \frac{V_1}{I_1} \bigg|_{V_2=0}, \quad h_{12} = \frac{V_1}{V_2} \bigg|_{I_1=0}, \quad h_{21} = \frac{I_2}{I_1} \bigg|_{V_2=0}, \quad h_{22} = \frac{I_2}{V_2} \bigg|_{I_1=0}$$

Where,

h_{11} = Short-circuit input impedance

h_{12} = Open-circuit reverse voltage gain

h_{21} = Short-circuit forward current gain

h_{22} = Open-circuit output ~~admittance~~ admittance

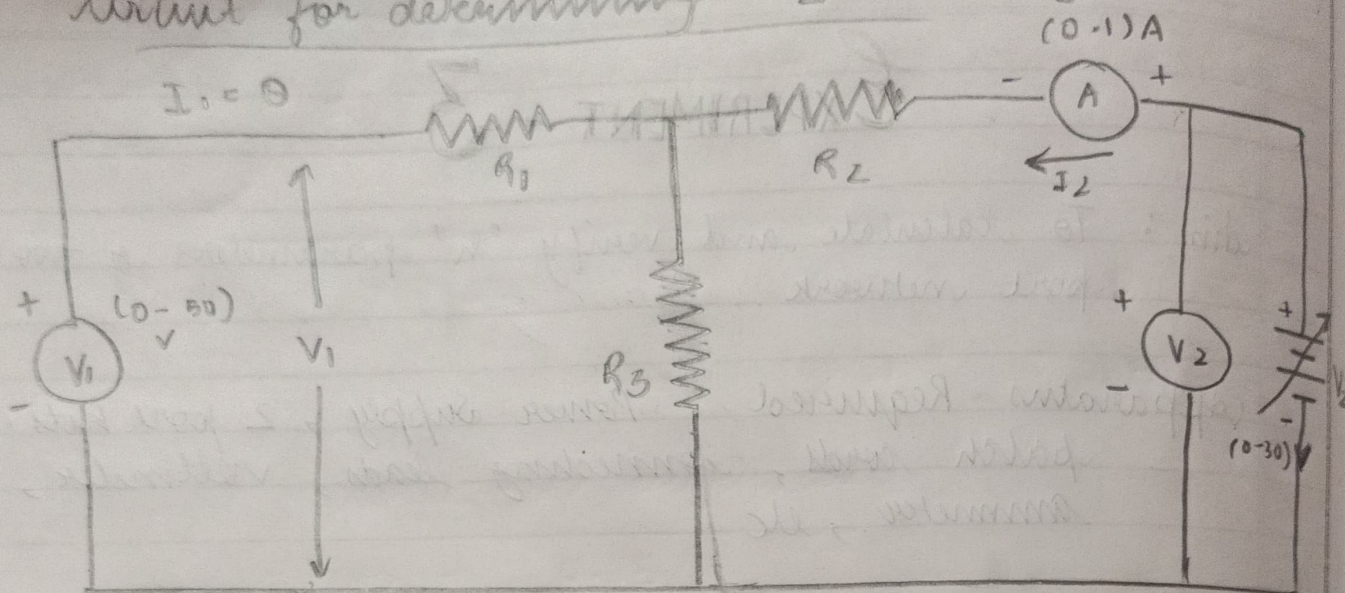
Procedure

- 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 different voltages on V_1 and measure V_1 , I_2 and I_1 for each setting and tabulate h_{11} and h_{21} .
- b) Connect the variable voltage to port 2 and keep the port 1 open circuit i.e. $I_1 = 0$ as shown in the figure. Set different voltages at V_2 and measure V_2 , I_2 , V_1 for each setting and tabulate h_{12} and h_{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.

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



OBSERVATIONS :

S.no.	When O/P is short ckt $V_2 = 0$					When I/P is open ckt $I_1 = 0$				
	$V_1(V)$	$I_1(mA)$	$I_2(mA)$	$h_{11} = \frac{V_1}{I_1}$ (Ω)	$h_{21} = \frac{I_2}{I_1}$	$V_2(V)$	$I_2(mA)$	$V_1(V)$	$h_{12} = \frac{V_1}{V_2}$	$h_{22} = \frac{I_2}{V_2}$ (Ω)
1.	8.5	5	+3.25	$\frac{1.7}{V/mA}$ 1700 Ω	+0.65	10	5	5	0.5	$\frac{0.5}{mA/V}$ ≈ 0.0005 Ω

$$h_{12} = h_{21}$$

\therefore Circuit is reciprocal (≈ 0.5)

Result :

The 'h' parameters of the two port network has been calculated and verified

VIVA VOICE

Ques 1. Define h parameters ?

Ans In 'h' parameters of a two port network voltage of the input port are expressed in terms of the current of the input port and voltage of the output port.

Ques 2. List the four variables used in h parameter representation

Ans The four variables are V_1 , V_2 , I_1 and I_2

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

Ans The two dependent variables are V_1 and I_2 .

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

Ans The two independent variables are I_1 and V_2 .

Ques 5. Define input impedance.

Ans
$$h_{11} = V_1 / I_1$$

Result :

The h parameters of the two port network has been calculated and verified.

$$h_{11} = 1700 \Omega$$

$$h_{21} = 0.65$$

$$h_{12} = 0.3$$

$$h_{22} = 0.0005 \Omega$$

Circuit is reciprocal

$$\text{error} = 0.15$$

Ques 6. Define output admittance.

Ans

$$h_{22} = I_2 / V_2$$

Ques 7. Define forward current gain.

Ans

$$h_{21} = I_2 / I_1$$

Ques 8. Define reverse voltage gain.

Ans

$$h_{12} = V_1 / V_2$$

Ques 9. Write the condition for reciprocity.

Ans

Condition for reciprocity is $h_{12} = h_{21}$

Ques 10. Write the condition for symmetry.

Ans

Condition for symmetry is $h_{11} = h_{22}$