

ANALYSIS ON TWO PORT NETWORK

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Abstract- This paper will tell about the two port network and give you a brief knowledge that will tell about this subject and will help you to enhance your know regarding the topics that come under the two port network. This will brief you about the parameters in two port network i.e., h, t, z and y parameter and hence give a brief knowledge about them.

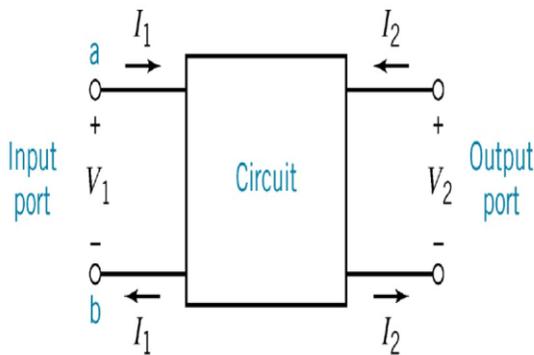
I. INTRODUCTION

This paper will give idea or tell about two port network that are used in network theory and about the parameter that are present in two port network. We know that the two port network is a special case of the multiport network.

Port is the pair of nodes that need to connected through a device and hence lead to the formation of two port network.it is call a four terminal network or two port network.

II. DISCUSSION

Two port networks consist of V_1, V_2, I_1, I_2 .which are parameters that are based on voltage and current. Few parameters are independent of variable and dependent on quantities.



Parameter Type	Independent Variables	Dependent Variables	Parameterization
Impedance (Z) Parameters	I_1, I_2	V_1, V_2	$\begin{pmatrix} V_1 \\ V_2 \end{pmatrix} = \begin{pmatrix} Z_{1,1} & Z_{1,2} \\ Z_{2,1} & Z_{2,2} \end{pmatrix} \begin{pmatrix} I_1 \\ I_2 \end{pmatrix}$
Admittance (Y) Parameters	V_1, V_2	I_1, I_2	$\begin{pmatrix} I_1 \\ I_2 \end{pmatrix} = \begin{pmatrix} Y_{1,1} & Y_{1,2} \\ Y_{2,1} & Y_{2,2} \end{pmatrix} \begin{pmatrix} V_1 \\ V_2 \end{pmatrix}$
Hybrid (h) parameters	V_1, I_2	I_1, V_2	$\begin{pmatrix} V_1 \\ I_2 \end{pmatrix} = \begin{pmatrix} h_{1,1} & h_{1,2} \\ h_{2,1} & h_{2,2} \end{pmatrix} \begin{pmatrix} I_1 \\ V_2 \end{pmatrix}$
Inverse Hybrid (g) parameters	V_1, I_2	I_1, V_2	$\begin{pmatrix} I_1 \\ V_2 \end{pmatrix} = \begin{pmatrix} g_{1,1} & g_{1,2} \\ g_{2,1} & g_{2,2} \end{pmatrix} \begin{pmatrix} V_1 \\ I_2 \end{pmatrix}$
Transmission (ABCD) parameters	V_1, I_1	V_2, I_2	$\begin{pmatrix} V_1 \\ I_1 \end{pmatrix} = \begin{pmatrix} A & B \\ C & D \end{pmatrix} \begin{pmatrix} V_2 \\ -I_2 \end{pmatrix}$

Z-parameters (IMPEDANCE)

Equation:

$$(V_1, V_2) f (I_1, I_2)$$

$$\begin{pmatrix} V_1 \\ V_2 \end{pmatrix} = \begin{pmatrix} Z_{1,1} & Z_{1,2} \\ Z_{2,1} & Z_{2,2} \end{pmatrix} \begin{pmatrix} I_1 \\ I_2 \end{pmatrix}$$

$Z_{2,2}$ is the input impedance of port 2 with port 1 open circuited.

$Z_{1,2}$ is the trans-impedance with port 1 open circuited.

Similarly,

$Z_{1,1}$ is the input impedance of port 1 with port 2 open circuited.

$Z_{2,1}$ is the trans-impedance with port 2 open circuited.

$$z_{11} = \left. \frac{V_1}{I_1} \right|_{I_2=0}$$

$$z_{21} = \left. \frac{V_2}{I_1} \right|_{I_2=0}$$

$$z_{12} = \left. \frac{V_1}{I_2} \right|_{I_1=0}$$

$$z_{22} = \left. \frac{V_2}{I_2} \right|_{I_1=0}$$

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

H 1 1 is short circuit input impedance
 H 1 2 is open circuit reverse voltage gain
 H 2 1 is short-circuit forward current gain
 H 2 2 is open-circuit output admittance

Y-Parameters (ADMITTANCE)

Equation:

(I1, I2) f (V1, V2)

$$\begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} Y_{1,1} & Y_{1,2} \\ Y_{2,1} & Y_{2,2} \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \end{bmatrix}$$

$$h_{11} = \left. \frac{V_1}{I_1} \right|_{V_2=0} \quad h_{12} = \left. \frac{V_1}{V_2} \right|_{I_1=0}$$

$$h_{21} = \left. \frac{I_2}{I_1} \right|_{V_2=0} \quad h_{22} = \left. \frac{I_2}{V_2} \right|_{I_1=0}$$

Y 2 2 is the input admittance of port 2 with port 1 short circuited

Y 1 2 is the trans-admittance with port 1 short circuited

Similarly

Y 1 1 is the input admittance of port 1 with port 2 short circuited

Y 2 1 is the trans-admittance with port 2 short circuited

$$y_{11} = \left. \frac{I_1}{V_1} \right|_{V_2=0} \quad y_{12} = \left. \frac{I_1}{V_2} \right|_{V_1=0}$$

$$y_{21} = \left. \frac{I_2}{V_1} \right|_{V_2=0} \quad y_{22} = \left. \frac{I_2}{V_2} \right|_{V_1=0}$$

H-Parameters (HYBRID)

Equation:

(V1, I2) f (I1, V2)

T parameters (ABCD PARAMETERS)

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

A is open-circuit voltage ratio
 B is negative short-circuit transfer impedance
 C is open-circuit transfer admittance
 D is negative short-circuit current ratio

$$A = \left. \frac{V_2}{V_1} \right|_{I_1=0} \quad B = \left. \frac{V_2}{I_1} \right|_{V_1=0}$$

$$C = \left. -\frac{I_2}{V_1} \right|_{I_1=0} \quad D = \left. -\frac{I_2}{I_1} \right|_{V_1=0}$$

III. CONDITION FOR RECIPROCITY AND SYMMETRY

A network is said to be reciprocal if the ratio of the response transform to the excitation transform is invariant to an interchange of the positions of the excitation and response of the network.

A two port network will be reciprocal if the interchange of an ideal voltage source at one port with an ideal current source is the other port does not alter the ammeter reading.

A two port network is said to be symmetrical if the input and output ports can be interchanged without altering the port voltages and currents. [8]

<i>Parameter</i>	<i>Condition of Reciprocity</i>	<i>Condition of Symmetry</i>
<i>Z</i>	$Z_{12} = Z_{21}$	$Z_{11} = Z_{22}$
<i>y</i>	$y_{12} = y_{21}$	$y_{11} = y_{22}$
<i>T(ABCD)</i>	$(AD - BC) = 1$	$A = D$
<i>h</i>	$h_{12} = -h_{21}$	$(h_{11}h_{22} - h_{12}h_{21}) = 1$

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