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Foundations of Electromagnetic Wave Propagation – 2nd part

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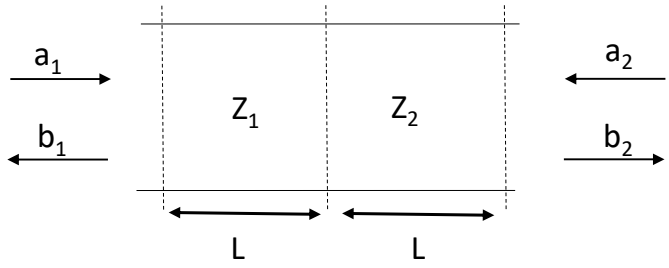
Chapters:

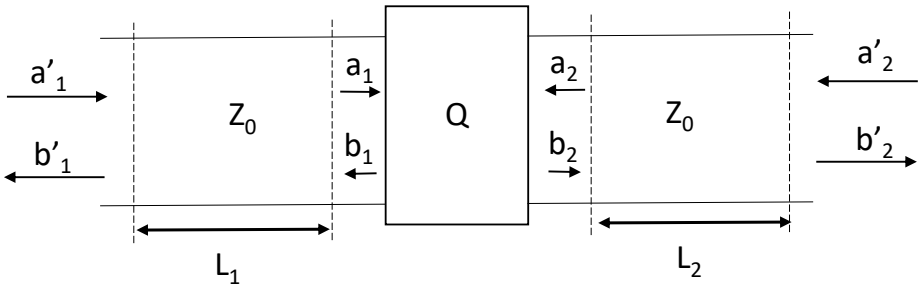
Exercise #3 : S matrix of impedance step



the matrix S is normalized with respect to:
- Z_1 at port 1
- Z_2 at port 2

From Kirchoff's and Ohm's laws and the expressions (1) of slide 1-4, give the S matrix of this diagram

Exercise #4 : S matrix of a quadripole connected to 2 transmission line



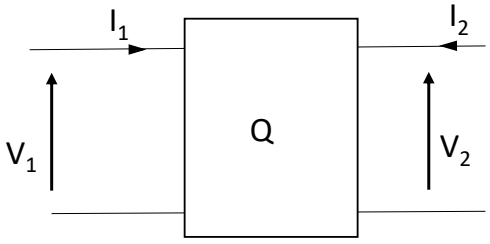
The S matrix of the quadripole Q, normalized with respect to Z_0, is assumed to be known.
The connection lines are assumed to be lossless, with characteristic impedance Z_0

Give the S matrix of this diagram

Chapters:

Unfortunalely, if quadripoles are cascaded, the S matrices of the quadripoles cannot be chained to obtain the S matrix of the set.

To remove this defect, the chain matrix has been developed:



…… with $V_1 = A.V_2 - B.I_2$
$I_1 = C.V_2 - D.I_2$

……
……
……

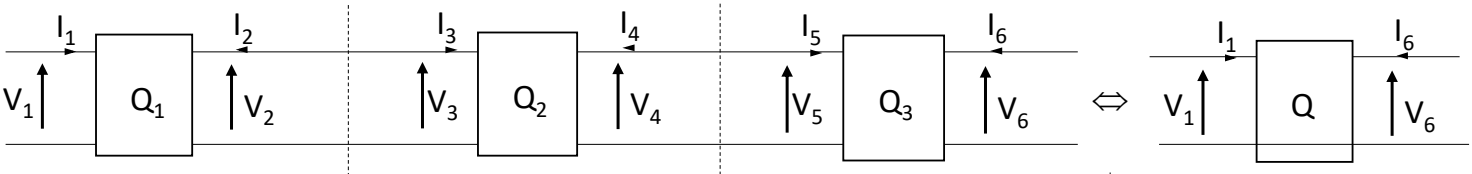
And the relationships between coefficients are : $AD - BC = 1$

1. S-parameters and transmission line

2. Description of microwave devices by chain matrix

and input impedance of the quadripole loaded by Z_L : $Z_{in} = \frac{A.Z_L + B}{C.Z_L + D}$

Cascaded quadripoles :



$$\begin{pmatrix} V_1 \\ I_1 \end{pmatrix} = \begin{bmatrix} A_1 & B_1 \\ C_1 & D_1 \end{bmatrix} \begin{pmatrix} V_2 \\ -I_2 \end{pmatrix} \quad \begin{pmatrix} V_3 \\ I_3 \end{pmatrix} = \begin{bmatrix} A_2 & B_2 \\ C_2 & D_2 \end{bmatrix} \begin{pmatrix} V_4 \\ -I_4 \end{pmatrix} \quad \begin{pmatrix} V_5 \\ I_5 \end{pmatrix} = \begin{bmatrix} A_3 & B_3 \\ C_3 & D_3 \end{bmatrix} \begin{pmatrix} V_6 \\ -I_6 \end{pmatrix} \quad \begin{pmatrix} V_1 \\ I_1 \end{pmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix} \begin{pmatrix} V_6 \\ -I_6 \end{pmatrix}$$

thus $$\begin{pmatrix} V_1 \\ I_1 \end{pmatrix} = \begin{bmatrix} A_1 & B_1 \\ C_1 & D_1 \end{bmatrix} \begin{bmatrix} A_2 & B_2 \\ C_2 & D_2 \end{bmatrix} \begin{bmatrix} A_3 & B_3 \\ C_3 & D_3 \end{bmatrix} \begin{pmatrix} V_6 \\ -I_6 \end{pmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix} \begin{pmatrix} V_6 \\ -I_6 \end{pmatrix}$$

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