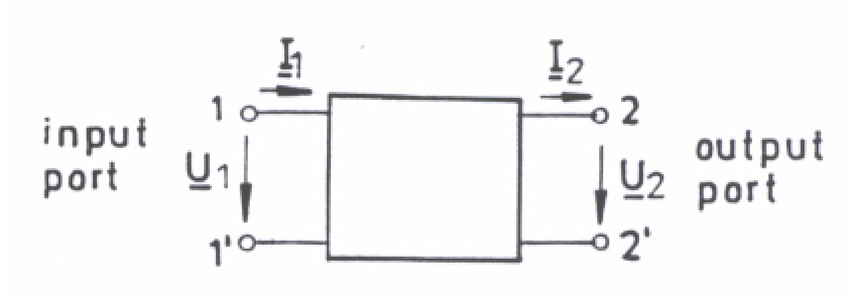
The study of a passive two-port system

Laboratory 20



Port: the current into one of the port terminal is, at every instant of time, equal to the current out of the other terminal of the port (*the port current requirement*).

The fundamental equations. ABCD parameters.

$$\begin{cases} \underline{U}_1 = \underline{A}\underline{U}_2 + \underline{B}\underline{I}_2 \\ \underline{I}_1 = \underline{C}\underline{U}_2 + \underline{D}\underline{I}_2 \end{cases}$$

where $\underline{A}$, $\underline{B}$, $\underline{C}$, $\underline{D}$ are called ***fundamental*** (or ***transmission***) ***parameters***

($\underline{A}$ and $\underline{D}$ – dimensionless, $\underline{B}$ is impedance, $\underline{D}$ is admittance)

$$\underline{A} = \frac{1}{\left(\frac{\underline{U}_2}{\underline{U}_1}\right)_{\underline{I}_2=0}}$$

- is the reciprocal of the *open-circuit voltage transfer ratio* from port 1 to port 2

$$\underline{B} = \frac{1}{\left(\frac{\underline{I}_2}{\underline{U}_1}\right)_{\underline{U}_2=0}}$$

- is the reciprocal of the *short-circuit transfer admittance* from port 1 to port 2.

$$\underline{C} = \frac{1}{\left(\frac{\underline{U}_2}{\underline{I}_1}\right)_{\underline{I}_2=0}}$$

- is the reciprocal of the *open-circuit transfer impedance* from port 1 to port 2

$$\underline{D} = \frac{1}{\left(\frac{\underline{I}_1}{\underline{I}_2}\right)_{\underline{U}_2=0}}$$

- is the reciprocal of the *short-circuit current transfer ratio* from port 1 to port 2.

Fig. 2-a (Lab book) Determining $\underline{C}$

$$\underline{C} = \frac{\underline{I_1}}{\underline{U_2}} = \frac{I_1 \cdot e^{j\varphi_{I1}}}{U_2 \cdot e^{j\varphi_{U2}}} = \underbrace{\frac{I_1}{U_2}}_{C} \cdot e^{j\underbrace{(\varphi_{I1}-\varphi_{U2})}_{\varphi_C}}$$

Where
C – the modulus of the constant C
φ_C – the phase of the constant C

We measured: I_1=; U_2=V; $P=U_2 \cdot I_1 \cdot \cos\varphi_C$

Compute: $C = \frac{I_1}{U_2}$ and $cos\varphi_C = \frac{P}{U_2 \cdot I_1}$

Fig. 2-b (Lab book) Determining $\underline{A}$

$$\underline{A} = \frac{\underline{U_1}}{\underline{U_2}} = \frac{U_1 \cdot e^{j\varphi_{U1}}}{U_2 \cdot e^{j\varphi_{U2}}} = \underbrace{\frac{U_1}{U_2}}_{A} \cdot e^{j\underbrace{(\varphi_{U1} - \varphi_{U2})}_{\varphi_A}}$$

Where
A – the modulus of the constant $\underline{A}$
φ_A – the phase of the constant $\underline{A}$

We measured: U_1=; U_2=; I_R=; $P=U_2 \cdot I_R \cdot \cos \varphi_A$

Compute A and φ_A.

Fig. 2-c (Lab book) Determining $\underline{B}$

$$\underline{B} = \frac{\underline{U_1}}{\underline{I_2}} = \frac{U_1 \cdot e^{j\varphi_{U1}}}{I_2 \cdot e^{j\varphi_{I2}}} = \underbrace{\frac{U_1}{I_2}}_{B} \cdot e^{j\underbrace{(\varphi_{U1}-\varphi_{I2})}_{\varphi_B}}$$

Where

B – the modulus of the constant $\underline{B}$

φ_B – the phase of the constant $\underline{B}$

We measured: U_1=; I_2=; $P=U_1 \cdot I_2 \cdot \cos\varphi_B$

Compute B and φ_{B}.

Fig. 2-d (Lab book) Determining D

$$\underline{D} = \frac{\underline{I_1}}{\underline{I_2}} = \frac{I_1 \cdot e^{j\varphi_{I1}}}{I_2 \cdot e^{j\varphi_{I2}}} = \underbrace{\frac{I_1}{I_2}}_{D} \cdot e^{j\underbrace{(\varphi_{I1} - \varphi_{I2})}_{\varphi_D}}$$

Where
D – the modulus of the constant D
φ_D – the phase of the constant D

We measured: I_1=; I_2=; U_R=; $P=U_R \cdot I_2 \cdot \cos \varphi_D$

Compute D and $\varphi_{D.}$

Fig. 3 (Lab book) Determining $\underline{Z}$

$$\underline{Z}_{10} = \frac{\underline{U}_{10}}{\underline{I}_{10}} = \frac{U_{10} \cdot e^{j\varphi_{U10}}}{I_{10} \cdot e^{j\varphi_{I10}}} = \underbrace{\frac{U_{10}}{I_{10}}}_{Z10} \cdot e^{j\overbrace{(\varphi_{U10} - \varphi_{I10})}^{\varphi_{Z10}}}$$

We measured:

I_{10}=; U_{10}=; $P_{10}=U_{10} \cdot I_{10} \cdot \cos \varphi_{10} =$

I_{1sc}=; U_{1sc}=; $P_{1sc}=U_{1sc} \cdot I_{1sc} \cdot \cos \varphi_{1sc} =$

I_{20}=; U_{20}=; $P_{20}=U_{20} \cdot I_{20} \cdot \cos \varphi_{20} =$

I_{2sc}=0,36A; U_{2sc}=; $P_{2sc}=U_{2sc} \cdot I_{2sc} \cdot \cos \varphi_{2sc} =$

Compute: Z_{10} and φ_{10} ; Z_{1sc} and φ_{1sc} ; Z_{20} and φ_{20} ; Z_{2sc} and φ_{2sc}