18373038 钱思远

4-4.

解：$\cancel{\text{由}}$ $\begin{pmatrix} b_1 \\ b_2 \end{pmatrix} = \begin{pmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{pmatrix} \begin{pmatrix} a_1 \\ a_2 \end{pmatrix}$

物理意义：

$S_{11} = \frac{b_1}{a_1}\Big|_{a_2=0}$ 1接波源，2接匹配负载 1的电压反射系数

$S_{12} = \frac{b_1}{a_2}\Big|_{a_1=0}$ 2波源，1匹配负载 2至1的电压传输系数。

$S_{21} = \frac{b_2}{a_1}\Big|_{a_2=0}$ 1波源，2匹配负载 1至2的电压传输系数。

$S_{22} = \frac{b_2}{a_2}\Big|_{a_1=0}$ 2波源，1匹配负载 2的电压反射系数。

内移

$$\begin{cases} a_1' = a_1 e^{-j\beta l_1} \\ b_1' = b_1 e^{j\beta l_1} \\ a_2' = a_2 e^{-j\beta l_2} \\ b_2' = b_2 e^{j\beta l_2} \end{cases}$$

$S_{11}' = S_{11} e^{j2\beta l_1}$ $\quad S_{12}' = S_{12} e^{j\beta(l_1+l_2)}$

$S_{21}' = S_{21} e^{j\beta(l_1+l_2)}$ $\quad S_{22}' = S_{22} e^{j\beta 2 l_2}$

$[S'] = [P][S][P] \qquad [P] = \begin{bmatrix} e^{j\beta l_1} & 0 \\ 0 & e^{j\beta l_2} \end{bmatrix}$

外移

$[S''] = [P'][S][P'] \qquad [P'] = \begin{bmatrix} e^{-j\beta l_1} & 0 \\ 0 & e^{-j\beta l_2} \end{bmatrix}$

4-6

解：$[\bar{Y}] = \frac{([1]-[S])([1]+[S])^{-1}}{\cancel{[1]+[S]}}$

$$= \begin{pmatrix} 1 & \frac{1}{\sqrt2} & \frac{j}{\sqrt2} & 0 \\ \frac{1}{\sqrt2} & 1 & 0 & \frac{j}{\sqrt2} \\ \frac{j}{\sqrt2} & 0 & 1 & \frac{1}{\sqrt2} \\ 0 & \frac{j}{\sqrt2} & \frac{1}{\sqrt2} & 1 \end{pmatrix} \begin{pmatrix} 1 & -\frac{1}{\sqrt2} & -\frac{j}{\sqrt2} & 0 \\ -\frac{1}{\sqrt2} & 1 & 0 & -\frac{j}{\sqrt2} \\ -\frac{j}{\sqrt2} & 0 & 1 & -\frac{1}{\sqrt2} \\ 0 & -\frac{j}{\sqrt2} & -\frac{1}{\sqrt2} & 1 \end{pmatrix}^{-1}$$

$$= \begin{pmatrix} 0 & 0 & \sqrt2 j & j \\ 0 & 0 & j & \sqrt2 j \\ \sqrt2 j & j & 0 & 0 \\ j & \sqrt2 j & 0 & 0 \end{pmatrix}$$

4.7 $\quad Z_{01} = 50\Omega \quad Z_{02} = 50\Omega$

解：$a_1 = \frac{1}{2}(\bar{U}_1 + \bar{I}_1)$

$= \frac{1}{2}\left(\frac{\dot{U}_1}{\sqrt{Z_{01}}} + \dot{I}_1\sqrt{Z_{01}}\right) = \frac{\sqrt6+4\sqrt2}{8} + j\frac{\sqrt2}{8} \quad V/\Omega$

$b_1 = \frac{1}{2}(\bar{U}_1 - \bar{I}_1)$

$= \frac{1}{2}\left(\frac{\dot{U}_1}{\sqrt{Z_{01}}} - \dot{I}_1\sqrt{Z_{01}}\right) = \frac{4\sqrt2-\sqrt6}{8} - j\frac{\sqrt2}{8} \quad V/\Omega$

$a_2 = \frac{1}{2}(\bar{U}_2 + \bar{I}_2)$

$= -\frac{3\sqrt2}{16} + j\left(\frac{3\sqrt2}{5} + \frac{3\sqrt6}{16}\right)$

$b_2 = \frac{1}{2}(\bar{U}_2 - \bar{I}_2)$

$= \frac{3\sqrt2}{16} + j\left(\frac{3\sqrt2}{5} - \frac{3\sqrt6}{16}\right)$

4-8

解：① $S_{21} = S_{12}$ 具互易性.

$$[S] = \begin{pmatrix} 0.1 & 0.8j \\ 0.8j & 0.2 \end{pmatrix}$$

$$[S]^{+}[S] = \begin{pmatrix} 0.1 & -0.8j \\ -0.8j & 0.2 \end{pmatrix}\begin{pmatrix} 0.1 & 0.8j \\ 0.8j & 0.2 \end{pmatrix}$$

$$\neq [1]$$

不具无耗性.

② 2 接匹配负载

$$\Gamma_1 = S_{11} = 0.1$$

③
$$\begin{cases} b_1 = S_{11}a_1 + S_{12}a_2 \\ b_2 = S_{21}a_1 + S_{22}a_2. \\ a_2 = -b_2. \end{cases}$$

$$b_1 = S_{11}a_1 + \left(-\frac{S_{12}S_{21}}{1+S_{22}}\right)a_1.$$

$$\Gamma_1 = \frac{b_1}{a_1} = S_{11} - \frac{(S_{12})^2}{1+S_{22}} \approx 0.63$$