4-13

解：

(a)

$$a=\frac{\dot{U}_1}{\dot{U}_2}\bigg|_{\dot{I}_2=0}=1.$$

$$b=-\frac{\dot{U}_1}{\dot{I}_2}\bigg|_{\dot{U}_2=0} \quad \dot{I}_2=-\dot{I}_1 \quad b=Z.$$

互易、对称网络：

$a=d=1.$

$a^2-bc=0.$

$$[A]=\begin{bmatrix}1 & Z\\ 0 & 1\end{bmatrix}$$

$$[\bar{A}]=\begin{bmatrix}\sqrt{\frac{Z_{02}}{Z_{01}}} & \frac{Z}{\sqrt{Z_{01}Z_{02}}}\\ 0 & \sqrt{\frac{Z_{01}}{Z_{02}}}\end{bmatrix}.$$

(b) $a=\frac{\dot{U}_1}{\dot{U}_2}\Big|_{\dot{I}_2=0}=1.$

$c=\frac{\dot{I}_1}{\dot{U}_2}\Big|_{\dot{I}_2=0}=Y.$

互易对称网络. $a=d=1.$ $b=0.$

$$[A]=\begin{bmatrix}1 & 0\\ Y & 1\end{bmatrix}.$$

$$[\bar{A}]=\begin{bmatrix}\sqrt{\frac{Z_{02}}{Z_{01}}} & 0\\ Y\sqrt{Z_{01}Z_{02}} & \sqrt{\frac{Z_{01}}{Z_{02}}}\end{bmatrix}$$

(e)

$$a=\frac{\dot{U}_1}{\dot{U}_2}\bigg|_{\dot{I}_2=0}.$$

端口2开路 有 $\begin{cases}\dot{U}_2=\dot{U}_{i2}+\dot{U}_{r2} \cancel{=2\dot{U}_{i2}}\\ \dot{I}_2=\dot{I}_{i2}-\dot{I}_{r2}\end{cases}$ $\quad \dot{U}_{i2}=\dot{U}_{r2}$

$\dot{I}_{i2}=\dot{I}_{r2}$

$$\begin{cases}\dot{U}_{i1}=\dot{U}_{i2}e^{j\beta l}\\ \dot{U}_{r1}=\dot{U}_{r2}e^{-j\beta l}.\end{cases}$$

$\dot{U}_1=\dot{U}_{i1}+\dot{U}_{r1}=2\dot{U}_{i2}\cos\beta l.$

$a=\cos\beta l.$

$$\begin{cases}\dot{I}_{i1}=-\dot{I}_{i2}e^{j\beta l}\\ \dot{I}_{r1}=-\dot{I}_{r2}e^{-j\beta l}.\end{cases}$$

$\dot{I}_1=\dot{I}_{i1}-\dot{I}_{r1}=-\dot{I}_{i2}\cdot 2j\sin\beta l.$

$$c=\frac{\dot{I}_1}{\dot{U}_2}\bigg|_{\dot{I}_2=0}=\frac{-\dot{I}_{i2}\cdot 2j\sin\beta l}{2\dot{U}_{i2}}=\frac{1}{Z_0}j\sin\beta l.$$

对称、互易：

$$[A]=\begin{bmatrix}\cos\beta l & jZ_0\sin\beta l\\ \frac{j\sin\beta l}{Z_0} & \cos\beta l\end{bmatrix}$$

$$[\bar{A}]=\begin{bmatrix}\cos\beta l & j\sin\beta l\\ j\sin\beta l & \cos\beta l\end{bmatrix}.$$

4-14.

解： $Z_{11} = \frac{\dot{U}_1}{\dot{I}_1}\Big|_{\dot{I}_2=0} = \frac{2}{j\omega}$

$Z_{22} = \frac{\dot{U}_2}{\dot{I}_2}\Big|_{\dot{I}_1=0} = j\omega + \frac{2}{j\omega}$

$Z_{12} = \frac{\dot{U}_1}{\dot{I}_2}\Big|_{\dot{I}_1=0} = \frac{2}{j\omega}$

$Z_{21} = \frac{\dot{U}_2}{\dot{I}_1}\Big|_{\dot{I}_2=0} = \frac{2}{j\omega}$.

$$[Z] = \begin{bmatrix} \frac{2}{j\omega} & \frac{2}{j\omega} \\ \frac{2}{j\omega} & j\omega + \frac{2}{j\omega} \end{bmatrix}.$$

$$[A] = \begin{bmatrix} 1 & j\omega \\ \frac{j\omega}{2} & 1-\frac{\omega^2}{2} \end{bmatrix}$$

$$[S] = \begin{bmatrix} \frac{1-j\omega}{3+j\omega+\frac{4}{j\omega}} & \frac{4}{-\omega^2+3j\omega+4} \\ \frac{4}{-\omega^2+3j\omega+4} & \frac{1+j\omega}{3+j\omega+\frac{4}{j\omega}} \end{bmatrix}.$$

4-15

解：

(a). $\dot{U}_1 = -\dot{U}_2 \qquad \dot{I}_1 = \dot{I}_2$

$$[A] = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$$

$$[\bar{A}] = \begin{bmatrix} -\sqrt{\frac{Z_{02}}{Z_{01}}} & 0 \\ 0 & -\sqrt{\frac{Z_{01}}{Z_{02}}} \end{bmatrix} = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}.$$

$$[S] = \begin{bmatrix} 0 & -1 \\ -1 & 0 \end{bmatrix}.$$

(b).

$$\begin{cases} [A_1] = \begin{bmatrix} 1 & -jX_A \\ 0 & 1 \end{bmatrix}. \\ [A_2] = \begin{bmatrix} \cos\beta l & jZ_0\sin\beta l \\ \frac{j\sin\beta l}{Z_0} & \cos\beta l \end{bmatrix} \\ [A_3] = \begin{bmatrix} 1 & -jX_A \\ 0 & 1 \end{bmatrix} \end{cases}$$

$$[\check{A}] = [A_1]\cdot[A_2][A_3]$$

$$= \begin{bmatrix} \cos\beta l + \frac{X_A}{Z_0}\sin\beta l & -2jX_A\cos\beta l - j\frac{X_A^2}{Z_0}\sin\beta l + jZ_0\sin\beta l \\ \frac{j\sin\beta l}{Z_0} & \cos\beta l + \frac{X_A}{Z_0}\sin\beta l. \end{bmatrix}$$

$$[S] = \frac{1}{2\cos\beta l\left[1-j\frac{X_A}{Z_0}\right] + j\left[2-\frac{X_A^2}{Z_0^2}+\frac{2X_A}{jZ_0}\right]\sin\beta l}.$$

$$\cdot\begin{bmatrix} -j\frac{2X_A}{Z_0}\cos\beta l - j\frac{X_A^2}{Z_0^2}\sin\beta l & 2 \\ 2 & -j\frac{2X_A}{Z_0}\cos\beta l - j\frac{X_A^2}{Z_0^2}\sin\beta l \end{bmatrix}$$