EE 610,

Note Title 9/3/2003

This is EE 610 — Richard's functions

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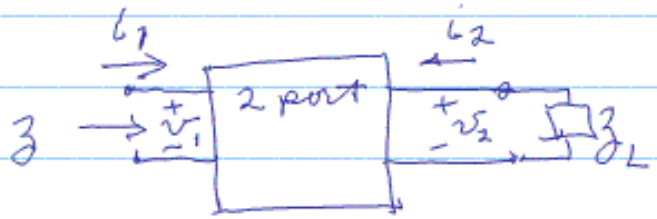
$$R_{ich} = \frac{k\,z(s) - s\,z(k)}{k\,z(k) - s\,z(s)}$$

k = constant

$s = \sigma + j\omega$



$$\begin{bmatrix} v_1 \\ v_2 \end{bmatrix} = \begin{bmatrix} z_{11} & z_{12} \\ z_{21} & z_{22} \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \end{bmatrix}$$

$v_2 = v_L = -z_L i_2$

$v_1 = z_{11} i_1 + z_{12} i_2$; $v_2 = -z_L i_2 = z_{21} i_1 + z_{22} i_2$

$i_2 = -(z_L + z_{22})^{-1} z_{21} i_1$

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$$v_1 = \left[z_{11} - z_{12}(z_L + z_{22})^{-1} z_{21} \right] i_1$$

$$z = z_{11} - \frac{z_{12} z_{21}}{z_L + z_{22}} = \frac{z_{11} z_L + [z_{11} z_{22} - z_{12} z_{21}]}{z_L + z_{22}}$$

$$= \frac{z_{11} z_L + \Delta_z}{z_L + z_{22}} \Rightarrow z_L z + z z_{22} = z_{11} z_L + \Delta_z$$

$$z_L = \frac{\Delta_z - z z_{22}}{z - z_{11}}$$

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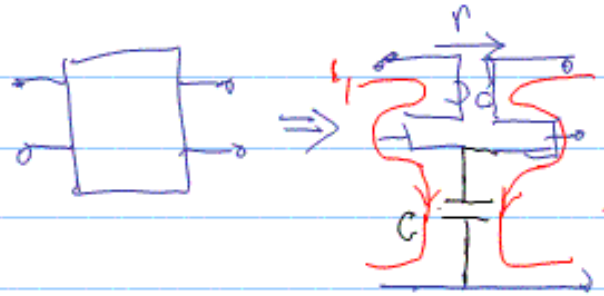

$$Z_1 + Z_2 = Z$$

$$\begin{bmatrix} 0 & r \\ -r & 0 \end{bmatrix} + \begin{bmatrix} 1/sC & 1/sC \\ 1/sC & 1/sC \end{bmatrix} = Z$$

$$\det Z = \Delta_Z = \frac{1}{sC}\cdot\frac{1}{sC} - \left(r + \frac{1}{sC}\right)\left(-r + 1/sC\right) = r^2$$

$$Z_{in} = \frac{\Delta_Z - Z_{22}}{Z - Z_{11}} = \frac{r^2 - \frac{1}{sC}Z}{Z - 1/sC} = \frac{sCr^2 - Z}{sCZ - 1}$$

$$R_{in} = \frac{kZ(s) - sZ(k)}{kZ(k) - sZ(s)} = \frac{sZ(k) - kZ(s)}{sZ(s) - kZ(k)} = \frac{\frac{s}{k} - \frac{Z(s)}{Z(k)}}{\frac{s}{k}\cdot\frac{Z(s)}{Z(k)} - 1}$$

$$\frac{Z_L}{r} = \left[\frac{scr - \frac{z}{r}}{scz - 1}\right]$$

$p = Z(s)$

$cr = 1/s \Rightarrow C = \frac{1}{sZ(s)}$

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identifies $Z_L \leftrightarrow$ Richards

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