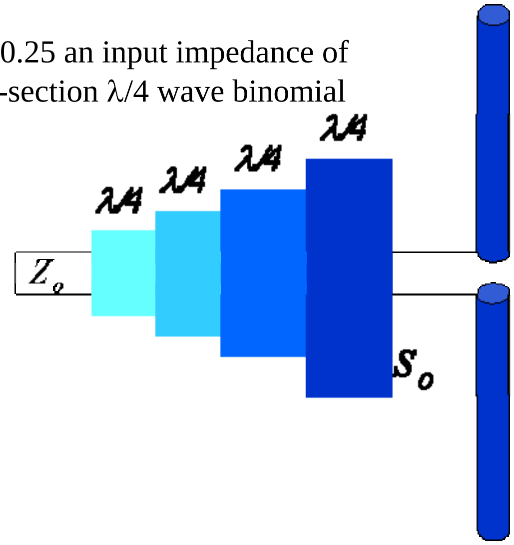
Capitulo 9.8 : Matching Techniques for Antenas – quarter-wave Xmer

A 0.47λ folded dipole operating at 100MHz with a $\Delta f/f_o$=0.25 an input impedance of 306+j75.3 ohms is to be fed with a 75-ohm line using a 3-section λ/4 wave binomial transformer.

Find s_o, ρ_m, $VSWR_{max}$ over the bandwidth and the Z_n's.



Solution:

Using the Smith Chart find the distance to the closest real input impedance. De-normalize it. This yields R_L= 330 Ω

$$\rho_n = 2^{-N}\left(\frac{R_L - Z_o}{R_L + Z_o}\right)C_n^N$$

$$\rho_0 = 2^{-3}\left(\frac{330-75}{330+75}\right)\frac{3!}{3!0!} = 0.0787037 = \frac{Z_1 - 75}{Z_1 + 75} \qquad Z_1 = 87.75\Omega$$

$$\rho_1 = 2^{-3}\left(\frac{330-75}{330+75}\right)\frac{3!}{2!1!} = 0.234211111 = \frac{Z_2 - 87.75}{Z_2 + 87.75} \qquad Z_1 = 141.42\Omega$$

$$\rho_0 = 2^{-3}\left(\frac{330-75}{330+75}\right)\frac{3!}{2!1!} = 0.234211111 = \frac{Z_1 - 141.42}{Z_1 + 141.42} \qquad Z_1 = 227.92\Omega$$

$$\frac{\Delta f}{f_o} = \frac{2(f_o - f_m)}{f_o} = 2 - \frac{4}{\pi}\cos^{-1}\left[\frac{\rho_m (R_L + Z_o)}{(R_L - Z_o)}\right]^{1/N}$$

$$0.45 = 2 - \frac{4}{\pi}\cos^{-1}\left[\frac{\rho_m (405)}{(255)}\right]^{1/3}$$

or

$$\rho_m = \frac{255}{405}\cos^3\left[(.45-2)\left(-\frac{\pi}{4}\right)\right] = 0.00472$$

and

$$VSWR_{max} = \frac{1+\rho_m}{1-\rho_m} = 1.009$$

To plot the magnitude of the reflection coefficient versus frequency, use:

$$|\Gamma_{in}| = \rho_{in} = \left|\frac{R_L - Z_o}{R_L + Z_o}\right|\cos^N\theta = \left|\frac{R_L - Z_o}{R_L + Z_o}\right|\cos^3\left[\frac{\pi}{2}\left(\frac{f}{f_o}\right)\right]$$