Appendix F

Derivation of Approximate Equations for the Colpitts Oscillator

The input impedance can be written as

$$Z_L = \frac{jX_2(R_e + jX_1 + jX_e)}{jX_2 + jX_1 + jX_e + R_e}.$$

Assuming that $X_1 + X_2 + X_e = 0$ gives

$$= \frac{-X_2(X_1 + X_e) + jR_eX_2}{}$$

Again applyin

$$\frac{jR_e)}{}.$$

If we now a $\gg R_e$,

$$Z_L = \frac{X_2^2}{R_e}.$$

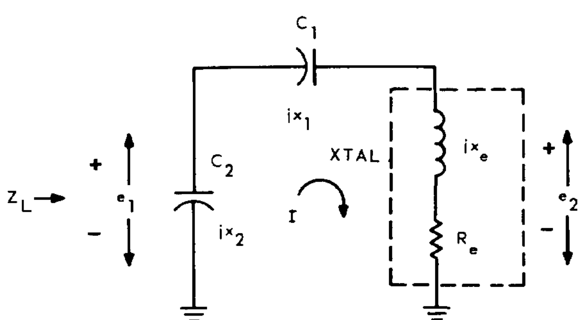

Figure F-1. Colpitts oscillator phase shift circuit: simplified diagram.

The voltage e_2 may be written as

$$e_2 = I(R_e + jX_e),$$

where

$$I = \frac{e_1}{jX_1 + R_e + jX_e}.$$

Combining these gives

$$\frac{e_2}{e_1} = \frac{R_e + jX_e}{R_e + jX_1 + jX_e}.$$

If we again assume that $X_1 + X_2 + X_e = 0$, then $X_e = -(X_1 + X_2)$ and $X_1 = -(X_2 + X_e)$. Substituting these gives

$$\frac{e_2}{e_1} = \frac{R_e - j(X_1 + X_2)}{R_e - jX_2}.$$

Assuming now that $R_e << X_2$ and $R_e << X_1$, we have

$$\frac{e_2}{e_1} = \frac{X_1 + X_2}{X_2}.$$