DESIGN EQUATIONS

IMPEDANCE (ohms)

$$Z_o = 138\, V_p \log\left(\frac{D}{d \bullet k_s}\right) = 60\, V_p \ln\left(\frac{D}{d \bullet k_s}\right)$$

$$Z_o = \frac{138}{\sqrt{\varepsilon}} \log\left(\frac{D}{d \bullet k_s}\right) = \frac{60}{\sqrt{\varepsilon}} \ln\left(\frac{D}{d \bullet k_s}\right)$$

$$Z_o = \sqrt{L/C}$$

VELOCITY OF PROPAGATION (%) AND DIELECTRIC CONSTANT

$$V_p = \frac{1}{\sqrt{\varepsilon}} \quad \varepsilon = \frac{1}{V_p^2}$$

TIME DELAY (nS/foot)

$$Td = \frac{1.016}{V_p} = 1.016\sqrt{\varepsilon}$$

CAPACITANCE (pF/foot)

$$C = \frac{7.36\varepsilon}{\log\left(\frac{D}{d \bullet k_s}\right)} = \frac{16.95\varepsilon}{\ln\left(\frac{D}{d \bullet k_s}\right)}$$

$$C = \frac{7.36}{V_p^2 \log\left(\frac{D}{d \bullet k_s}\right)} = \frac{16.95}{V_p^2 \ln\left(\frac{D}{d \bullet k_s}\right)}$$

$$C = \frac{1016}{Z_o \bullet V_p}$$

INDUCTANCE (uH/foot)

$$L = .140 \log\left(\frac{D}{d \bullet k_s}\right) = .0606 \ln\left(\frac{D}{d \bullet k_s}\right)$$

$$L = \frac{Z_o^2 \bullet C}{1 \times 10^6}$$

ATTENUATION (dB/100 feet)

$$\alpha = \frac{.4343}{Z_o \bullet D}\left[\frac{D}{d \bullet k_s} + Fbd\right]\sqrt{F} + \frac{2.78 \bullet df \bullet F}{V_p}$$

$$\alpha = k_1\sqrt{F} + k_2 F$$

BRAID FACTOR

Round Wire Braid: $Fbd = \frac{8D + 16\, ds}{C \bullet N \bullet ds}$

Flat Strip Braid: $Fbd = \frac{2\pi\,(D + 2t)}{C \bullet W}$

Solid Tube: $Fbd = 1.0$

CUTOFF FREQUENCY (GHz)

$$Fco = \frac{7.5 \bullet Vp}{(D + (d \bullet ks))}$$

$$Fco = \frac{7.5}{\sqrt{\varepsilon}\,(D + (d \bullet ks))}$$

ELECTRICAL LENGTH (degrees)

$$\phi = \frac{360 \bullet F \bullet L_{TH}}{984 \bullet V_p}$$

$$\phi = \frac{360 \bullet F \bullet L_{TH} \bullet \sqrt{\varepsilon}}{984}$$

PHASE TEMPERATURE COEFFICIENT (ppm/C°)

$$PTC = \frac{\Delta\phi \bullet 1 \times 10^6}{\phi \bullet \Delta T}$$

PHASE STABILITY (degrees)

$$\Delta\phi = \frac{PTC \bullet \phi \bullet \Delta T}{1 \times 10^6}$$

RETURN LOSS (dB)

$$RL = -20 \log \Gamma$$

$$RL = -20 \log \frac{VSWR-1}{VSWR+1}$$

$$RL = -10 \log \frac{RFL}{FWD}$$

VSWR

$$VSWR = \frac{1 + \Gamma}{1 - \Gamma}$$

$$VSWR = \frac{1 + 10^{(RL/20)}}{1 - 10^{(RL/20)}}$$

$$VSWR = \frac{1 + \sqrt{RFL/FWD}}{1 - \sqrt{RFL/FWD}}$$

REFLECTION COEFFICIENT

$$\Gamma = 10^{-RL/20}$$

$$\Gamma = \frac{VSWR - 1}{VSWR + 1}$$

$$\Gamma = \sqrt{RFL/FWD}$$

MATCH EFFICIENCY (%)

$$ME = (1 - \Gamma^2) \bullet 100$$

$$ME = \left[1 - \left(\frac{VSWR - 1}{VSWR + 1}\right)^2\right] \bullet 100$$

$$ME = \left(\frac{FWD-REL}{FWD}\right) \bullet 100$$

MISMATCH LOSS (dB)

$$MML = -10 \log (1 - \Gamma^2)$$

$$MML = -10 \log \left[1 - \left(\frac{VSWR-1}{VSWR+1}\right)^2\right]$$

$$MML = -10 \log \left(1 - \frac{RFL}{FWD}\right)$$