

Table 1
Coax Cable Design Equations

IMPEDANCE (ohms)

$$Z_0 = 138 V_p \log \left(\frac{D}{d \cdot k_s} \right) = 60 V_p \ln \left(\frac{D}{d \cdot k_s} \right)$$

$$Z_0 = \frac{138}{\sqrt{\epsilon}} \log \left(\frac{D}{d \cdot k_s} \right) = \frac{60}{\sqrt{\epsilon}} \ln \left(\frac{D}{d \cdot k_s} \right)$$

$$Z_0 = \sqrt{L/C}$$

VELOCITY OF PROPAGATION (%) AND DIELECTRIC CONSTANT

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

TIME DELAY (nS/foot)

$$T_d = \frac{1.016}{V_p} = 1.016 \sqrt{\epsilon}$$

CAPACITANCE (pF/foot)

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

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

$$C = \frac{1016}{Z_0 \cdot V_p}$$

INDUCTANCE (uH/foot)

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

$$L = \frac{Z_0^2 \cdot C}{1 \times 10^6}$$

ATTENUATION (dB/100 feet)

$$\alpha = \frac{.4343}{Z_0 \cdot D} \left[\frac{D}{d \cdot k_s} + F_{bd} \right] \sqrt{F} + \frac{2.78 \cdot df \cdot F}{V_p}$$

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

BRAID FACTOR

Round Wire Braid: $F_{bd} = \frac{8D + 16 ds}{C \cdot N \cdot ds}$

Flat Strip Braid: $F_{bd} = \frac{2\pi (D + 2t)}{C \cdot W}$

Solid Tube: $F_{bd} = 1.0$

CUTOFF FREQUENCY (GHz)

$$F_{co} = \frac{7.5 \cdot V_p}{(D + (d \cdot k_s))}$$

$$F_{co} = \frac{7.5}{\sqrt{\epsilon} (D + (d \cdot k_s))}$$

ELECTRICAL LENGTH (degrees)

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

$$\phi = \frac{360 \cdot F \cdot L_{TH} \cdot \sqrt{\epsilon}}{984}$$

PHASE TEMPERATURE COEFFICIENT (ppm/C°)

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

PHASE STABILITY (degrees)

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

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 (%)

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

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

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

MISMATCH LOSS (dB)

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

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

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