Engineering Applications

Coax Cable Design Equations

Impedance (Ohms)

$Z_0=138\bullet V_p\bullet\log(D/d\bullet k_s)= 60\bullet V_p\bullet\ln(D/d\bullet k_s)$

$Z_0=138\bullet\log(D/d\bullet k_s)/\sqrt{\varepsilon}= 60\bullet\ln(D/d\bullet k_s)/\sqrt{\varepsilon}$

$Z_0=\sqrt{L/C}$

Velocity of propagation and Dielectric constant (ε)

$V_p=1/\sqrt{\varepsilon}$

$\varepsilon=1/(V_p)^2$

Time delay (nS/m)

$Td=3.33/Vp=3.33\bullet\sqrt{\varepsilon}$

Capacitance (pF/m)

$C=24\bullet\varepsilon/\log(D/d\bullet k_s)= 55.6\bullet\varepsilon/\ln(D/d\bullet k_s)$

$C=24/(V_p^2\bullet\log(D/d\bullet k_s))= 55.6/(V_p^2\bullet\ln(D/d\bullet k_s))$

$C=1016/(Z_0\bullet V_p)$

Inductance (uH/m)

$L=0.46\bullet\log(D/d\bullet k_s)= 0.199\bullet\ln(D/d\bullet k_s)$

$L=Z_0^2\bullet C\bullet 1x10^{-6}$

Attenuation (dB/100m)

$\alpha=K_1\bullet\sqrt{F}+K_2\bullet F$

Cut off frequency (GHz)

$F_{co}=190\bullet Vp/(D+d\bullet k_s)$

$F_{co}=190/(\sqrt{\varepsilon}\bullet(D+d\bullet k_s))$

Wavelength (mm)

$Lw=300\bullet Vp/F_{GHz}$

$Lw=300/(F_{GHz}\bullet\sqrt{\varepsilon})$

Length/Degree (mm/°)

$D_L=300\bullet Vp/(F_{GHz}\bullet 360)$

$D_L=300/(F_{GHz}\bullet\sqrt{\varepsilon}\bullet 360)$

Electrical Length (°)

$\Phi=L_{TH}\bullet F_{GHz}\bullet 360/(300\bullet Vp)$

$\Phi=L_{TH}\bullet F_{GHz}\bullet 360\bullet\sqrt{\varepsilon}/300$

Frequency (GHz)

$F=300\bullet Vp/Lw$

$F=300/(Lw\bullet\sqrt{\varepsilon})$

Phase Temperature coefficient (ppm/C°)

$PTC=\Delta\Phi\bullet 1x10^6/(\Phi\bullet\Delta T)$

Phase Stability (ppm)

$\Delta\Phi=\Phi\bullet PTC\bullet 1x10^{-6}$

$\Delta\Phi=L_{TH}\bullet F_{GHz}\bullet 360/(300\bullet Vp)\bullet PTC\bullet 1x10^{-6}$

$\Delta\Phi=L_{TH}\bullet F_{GHz}\bullet 360\bullet\sqrt{\varepsilon}/300\bullet PTC\bullet 1x10^{-6}$

Return Loss(dB)

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

$RL=-20\bullet\log((VSWR-1)/(VSWR+1))$

VSWR

$VSWR=1+\Gamma/(1-\Gamma)$

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

Match Efficiency (%)

$ME=[1-(VSWR-1/(VSWR+1))^2]\bullet 100$

Mismatch Loss (dB)

$MML=-10\bullet\log[1-(VSWR-1/(VSWR+1))^2]$