	Wave in Low loss Dielectric	Wave in Low Loss Transmission line
Velocity	$v_p=\frac{1}{\sqrt{\mu\epsilon}}$	$v_p=\frac{1}{\sqrt{LC}}$
Wavenumber	$\beta=\frac{2\pi}{\lambda}$	$\beta=\frac{2\pi}{\lambda}$
Impedance	$\eta=\sqrt{\frac{j\omega\mu}{\sigma+j\omega\epsilon'}}\approx\sqrt{\frac{\mu}{\epsilon}}$	$Z_0=\sqrt{\frac{R+j\omega L}{G+j\omega C}}\approx\sqrt{\frac{L}{C}}$
Loss Tangent	$\tan(\theta)=\frac{\sigma}{\omega\epsilon'}$	$\tan(\theta)=\frac{G}{\omega C}$
attenuation	$\alpha\approx\frac{1}{2}\left(\sigma\sqrt{\frac{\mu}{\epsilon'}}\right)$	$\alpha\approx\frac{1}{2}\left(R\sqrt{\frac{C}{L}}+G\sqrt{\frac{L}{C}}\right)$
Phase constant	$\beta\approx\omega\sqrt{\mu\epsilon'}\left[1+\frac{1}{8}\left(\frac{\sigma}{\omega\epsilon'}\right)^2\right]$	$\beta\approx\omega\sqrt{LC}\left[1+\frac{1}{8}\left(\frac{R}{\omega L}-\frac{G}{\omega C}\right)^2\right]$

	Wave in Good Conductor $\frac{\sigma}{\omega\epsilon'}\gg 1$	Wave in Low loss Dielectric $\frac{\sigma}{\omega\epsilon'}\ll 1$
Velocity	$v_p=\omega\delta$	$v_p=\frac{1}{\sqrt{\mu\epsilon}}$
Wavenumber	$\beta=\frac{2\pi}{\lambda}$	$\beta=\frac{2\pi}{\lambda}$
Impedance	$\eta=\frac{1+j}{\sigma\delta}$	$\eta=\sqrt{\frac{\mu}{\epsilon}}$
Loss	$R=\frac{1}{2a\sigma\pi\delta}(\Omega/m)$	$\tan(\theta)=\frac{\sigma}{\omega\epsilon'}$
attenuation	$\alpha\approx\sqrt{\pi f\mu\sigma}$	$\alpha\approx\frac{1}{2}\left(\sigma\sqrt{\frac{\mu}{\epsilon'}}\right)$
Phase constant	$\beta\approx\sqrt{\pi f\mu\sigma}$	$\beta\approx\omega\sqrt{\mu\epsilon'}\left[1+\frac{1}{8}\left(\frac{\sigma}{\omega\epsilon'}\right)^2\right]$
Skin depth	$\delta=\frac{1}{\sqrt{\pi f\mu\sigma}}$	-

General case: $\alpha=\omega\sqrt{\frac{\mu\epsilon'}{2}}\sqrt{\sqrt{1+\left(\frac{\epsilon''}{\epsilon'}\right)^2}-1}$ $\beta=\omega\sqrt{\frac{\mu\epsilon'}{2}}\sqrt{\sqrt{1+\left(\frac{\epsilon''}{\epsilon'}\right)^2}+1}$

	Uniform Plane Wave	Transmission line
Reflection coefficient	$\Gamma=\frac{\eta_2-\eta_1}{\eta_2+\eta_1}$	$\Gamma=\frac{Z_2-Z_1}{Z_2+Z_1}$
Transmission coefficient	$\tau=1+\Gamma=\frac{2\eta_2}{\eta_2+\eta_1}$	$\tau=1+\Gamma=\frac{2Z_2}{Z_2+Z_1}$
Reflected Power Ratio	$\frac{\langle S_{1r}\rangle}{\langle S_{1i}\rangle}=\lvert\Gamma\rvert^2$	$\frac{\langle S_{1r}\rangle}{\langle S_{1i}\rangle}=\lvert\Gamma\rvert^2$
Transmitted power ratio	$\frac{\langle S_{2t}\rangle}{\langle S_{1i}\rangle}=1-\lvert\Gamma\rvert^2$	$\frac{\langle S_{2t}\rangle}{\langle S_{1i}\rangle}=1-\lvert\Gamma\rvert^2$
Standing wave ratio	$SWR=\frac{1+\lvert\Gamma\rvert}{1-\lvert\Gamma\rvert}$	$SWR=\frac{1+\lvert\Gamma\rvert}{1-\lvert\Gamma\rvert}$
Impedance transfer	$\eta_w=\eta_2\frac{\eta_3+j\eta_2\tan(\beta_2 l)}{\eta_2+j\eta_3\tan(\beta_2 l)}$	$Z_i=Z_2\frac{Z_3+jZ_2\tan(\beta l)}{Z_2+jZ_3\tan(\beta l)}$
Quarter-wave matching	$\eta_2=\sqrt{\eta_1\eta_3}$	$Z_2=\sqrt{Z_1Z_3}$

TRL	Low Frequency				High Frequency			
	R	L	G	C	R	L	G	C
Parallel Plate $d \ll b$	$\frac{2}{\sigma_c \delta b}$	$\frac{\mu d}{b}$	$\frac{\sigma b}{d}$	$\frac{\epsilon' b}{d}$	$\frac{2}{\sigma_c \delta b}$	$\frac{\mu d}{b}$	$\frac{\sigma b}{d}$	$\frac{\epsilon' b}{d}$
Coaxial	$\frac{1}{\pi \sigma_c}\left(\frac{1}{a^2}+\frac{1}{c^2-b^2}\right)$	$\frac{\mu}{2\pi}\left[\ln\frac{b}{a}+\frac{1}{4}+\frac{1}{4(c^2-}\right.$	$\frac{2\pi\sigma}{\ln(b/a)}$	$\frac{2\pi\epsilon'}{\ln(b/a)}$	$\frac{1}{2\pi\sigma_c\delta}\left(\frac{1}{a}+\frac{1}{b}\right)$	$\frac{\mu}{2\pi}\ln\left(\frac{b}{a}\right)$	$\frac{2\pi\sigma}{\ln(b/a)}$	$\frac{2\pi\epsilon'}{\ln(b/a)}$
Two wire	$\frac{2}{\pi a^2 \sigma_c}$	$\frac{\mu}{\pi}\left[\frac{1}{4}+\cosh^{-1}\left(\frac{d}{2a}\right)\right]$	$\frac{\pi\sigma}{\cosh^{-1}\left(\frac{d}{2a}\right)}$	$\frac{\pi\epsilon'}{\cosh^{-1}\left(\frac{d}{2a}\right)}$	$\frac{1}{\pi a \delta \sigma_c}$	$\frac{\mu}{\pi}\cosh^{-1}\left(\frac{d}{2a}\right)$	$\frac{\pi\sigma}{\cosh^{-1}\left(\frac{d}{2a}\right)}$	$\frac{\pi\epsilon'}{\cosh^{-1}\left(\frac{d}{2a}\right)}$
Microstrip line	$C_0=\begin{cases}\frac{2\pi\epsilon_0}{\ln\left(\frac{8d}{w}+\frac{w}{4d}\right)}; \frac{w}{d}\le 1 \\ \epsilon_0\left[\frac{w}{d}+1.393+0.667\ln\left(\frac{w}{d}+1.4444\right)\right]; \frac{w}{d}>1\end{cases}$ $\epsilon_{r_{eff}}=\frac{\epsilon_r'+1}{2}+\frac{\epsilon_r'-1}{2}\left(1+\frac{12d}{w}\right)^{-\frac{1}{2}}+\begin{cases}0.002(\epsilon_r'-1)\left(1-\frac{w}{d}\right)^2; \frac{w}{d}<1 \\ 0; \frac{w}{d}>1\end{cases}$ $Z_0=\sqrt{\frac{\mu_0\epsilon_0}{\epsilon_{r_{eff}}}}\frac{1}{C_0}$				No closed form			