

Fundamentals of Applied EM- Ulabg © PrentHall 1999

Table 2-1: Transmission-line parameters R' , L' , G' , and C' for three types of lines.

Parameter	Coaxial	Two Wire	Parallel Plate	Unit
R'	$\frac{R_s}{2\pi} \left(\frac{1}{a} + \frac{1}{b} \right)$	$\frac{R_s}{\pi a}$	$\frac{2R_s}{w}$	Ω/m
L'	$\frac{\mu}{2\pi} \ln(b/a)$	$\frac{\mu}{\pi} \ln \left[(d/2a) + \sqrt{(d/2a)^2 - 1} \right]$	$\frac{\mu d}{w}$	H/m
G'	$\frac{2\pi\sigma}{\ln(b/a)}$	$\frac{\pi\sigma}{\ln \left[(d/2a) + \sqrt{(d/2a)^2 - 1} \right]}$	$\frac{\sigma w}{d}$	S/m
C'	$\frac{2\pi\epsilon}{\ln(b/a)}$	$\frac{\pi\epsilon}{\ln \left[(d/2a) + \sqrt{(d/2a)^2 - 1} \right]}$	$\frac{\epsilon w}{d}$	F/m

Notes: (1) Refer to Fig. 2-4 for definitions of dimensions. (2) μ , ϵ , and σ pertain to the insulating material between the conductors. (3) $R_s = \sqrt{\pi f \mu_c / \sigma_c}$. (4) μ_c and σ_c pertain to the conductors. (5) If $(d/2a)^2 \gg 1$, then $\ln \left[(d/2a) + \sqrt{(d/2a)^2 - 1} \right] \simeq \ln(d/a)$.

Table 2-2: Characteristic parameters of transmission lines.

	Propagation Constant $\gamma = \alpha + j\beta$	Phase Velocity u_p	Characteristic Impedance Z_0
General case	$\gamma = \sqrt{(R' + j\omega L')(G' + j\omega C')}$	$u_p = \omega/\beta$	$Z_0 = \sqrt{\frac{(R' + j\omega L')}{(G' + j\omega C')}}$
Lossless ($R' = G' = 0$)	$\alpha = 0, \beta = \omega\sqrt{\epsilon_r}/c$	$u_p = c/\sqrt{\epsilon_r}$	$Z_0 = \sqrt{L'/C'}$
Lossless coaxial	$\alpha = 0, \beta = \omega\sqrt{\epsilon_r}/c$	$u_p = c/\sqrt{\epsilon_r}$	$Z_0 = (60/\sqrt{\epsilon_r}) \ln(b/a)$
Lossless two wire	$\alpha = 0, \beta = \omega\sqrt{\epsilon_r}/c$	$u_p = c/\sqrt{\epsilon_r}$	$Z_0 = (120/\sqrt{\epsilon_r}) \cdot \ln[(d/2a)^2 - 1]$ $Z_0 \simeq (120/\sqrt{\epsilon_r}) \ln(d/a),$ if $d \gg a$
Lossless parallel plate	$\alpha = 0, \beta = \omega\sqrt{\epsilon_r}/c$	$u_p = c/\sqrt{\epsilon_r}$	$Z_0 = (120\pi/\sqrt{\epsilon_r}) (d/w)$
Notes: (1) $\mu = \mu_0$, $\epsilon = \epsilon_r \epsilon_0$, $c = 1/\sqrt{\mu_0 \epsilon_0}$, and $\sqrt{\mu_0/\epsilon_0} \simeq (120\pi) \Omega$, where ϵ_r is the relative permittivity of insulating material. (2) For coaxial line, a and b are radii of inner and outer conductors. (3) For two-wire line, a = wire radius and d = separation between wire centers. (4) For parallel-plate line, w = width of plate and d = separation between the plates.			

these expressions in Eq. (2.45), we obtain

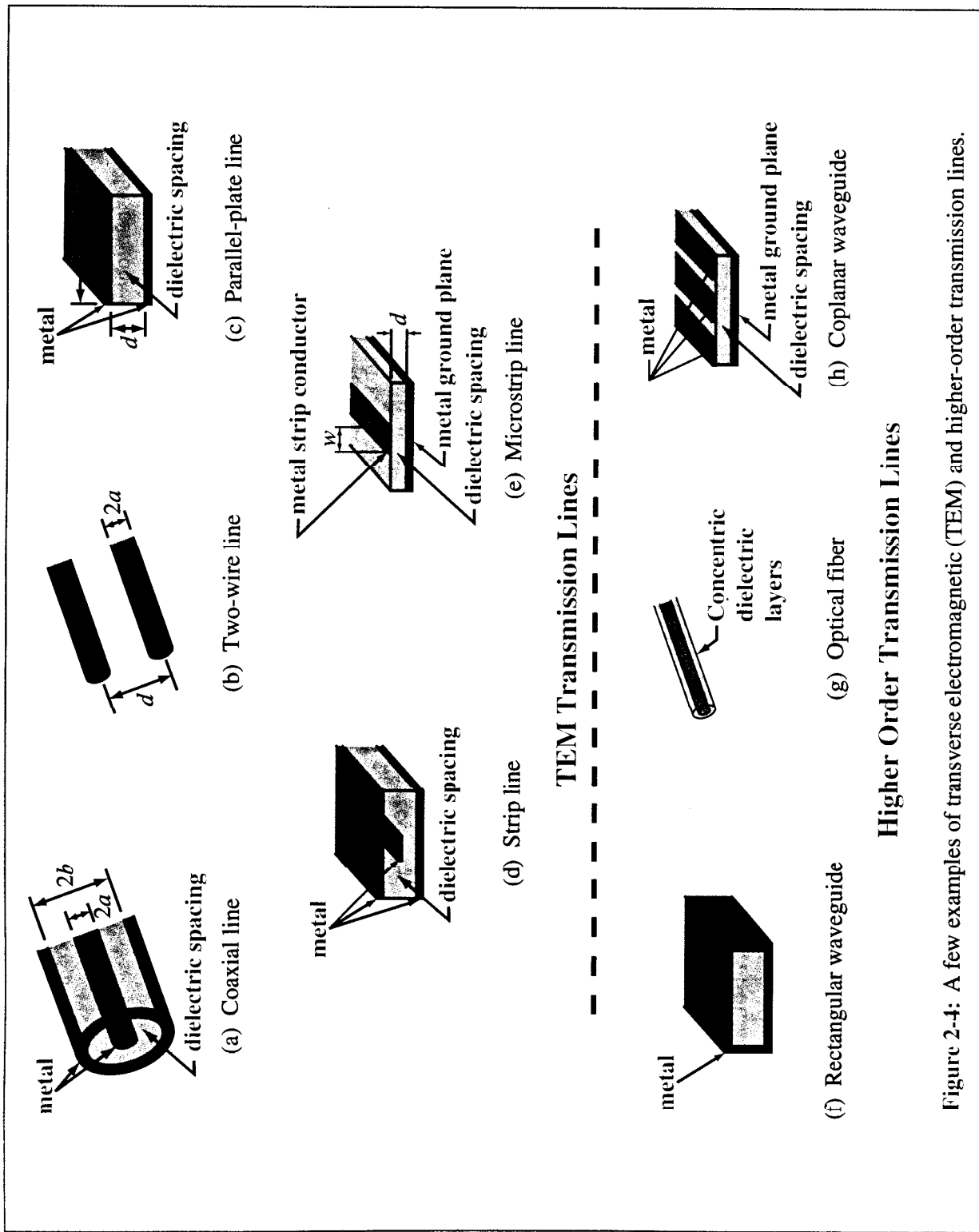


Figure 2-4: A few examples of transverse electromagnetic (TEM) and higher-order transmission lines.