EXAMPLE 8-1

Neglecting losses and fringing effects and assuming the substrate of a stripline to have a thickness 0.4 (mm) and a dielectric constant 2.25, (a) determine the required width w of the metal strip in order for the stripline to have a characteristic resistance of 50 (Ω); (b) determine L and C of the line; and (c) determine u_p along the line. (d) Repeat parts (a), (b), and (c) for a characteristic resistance of 75 (Ω).

SOLUTION

a) We use Eqs. (8-17) and (8-18) in Eq. (8-43) to find w:

$$w = \frac{d}{Z_0}\sqrt{\frac{\mu}{\epsilon}} = \frac{0.4 \times 10^{-3}}{50}\frac{\eta_0}{\sqrt{\epsilon_r}}$$

$$= \frac{0.4 \times 10^{-3} \times 377}{50\sqrt{2.25}} = 2 \times 10^{-3} \text{ (m)}, \quad \text{or } 2 \text{ (mm)}.$$

b) $$L = \mu\frac{d}{w} = 4\pi 10^{-7} \times \frac{0.4}{2} = 2.51 \times 10^{-7} \quad \text{(H/m)}, \quad \text{or } 0.251 \quad (\mu\text{H/m}).$$

$$C = \epsilon_0\epsilon_r\frac{w}{d} = \frac{10^{-9}}{36\pi} \times 2.25 \times \frac{2}{0.4} = 99.5 \times 10^{-12} \quad \text{(F/m)},$$

99.5 (pF/m). or,

c) $$u_p = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{\mu\epsilon}} = \frac{c}{\sqrt{\epsilon_r}} = \frac{c}{\sqrt{2.25}} = \frac{c}{1.5} = 2 \times 10^8 \quad \text{(m/s)}.$$

d) Since w is inversely proportional to Z_0, we have, for $Z_0' = 75$ (Ω),

$$w' = \left(\frac{Z_0}{Z_0'}\right)w = \frac{50}{75} \times 2 = 1.33 \quad \text{(mm)}.$$

$$L' = \left(\frac{w}{w'}\right)L = \left(\frac{2}{1.33}\right) \times 0.251 = 0.377 \quad (\mu\text{H/m}).$$

$$C' = \left(\frac{w'}{w}\right)C = \left(\frac{1.33}{2}\right) \times 99.5 = 66.2 \quad \text{(pF/m)}.$$

$$u_p' = u_p = 2 \times 10^8 \quad \text{(m/s)}.$$