7 May 2008

ENEL 434 Electronics II

Microstrip design. Lecture 15

(1) Given a PC Board substrate, find ϵ_r and h.

(2) Get W/h that gives you the Z_o desired.

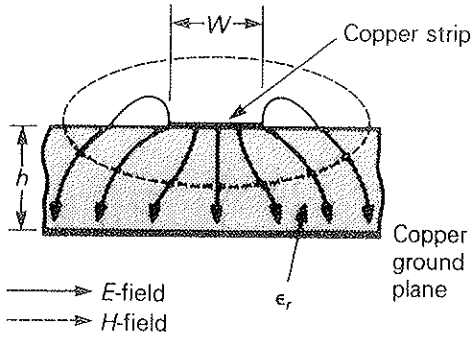

FIGURE 14–22 Electric and magnetic field lines of propagating signal on microstrip transmission line.

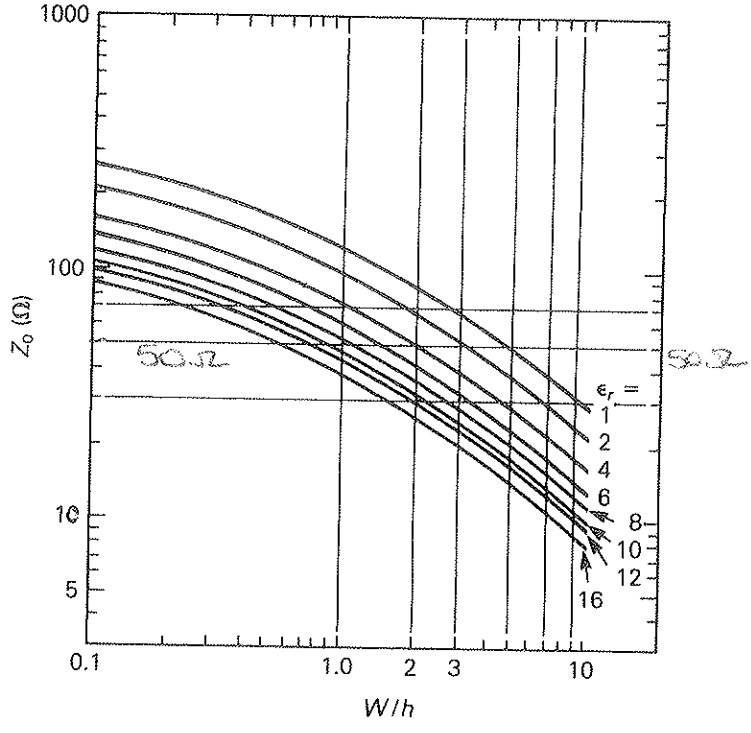

FIGURE 14–23 Characteristic impedance versus width-to-height ratio of microstrip line.

(3) Find $\epsilon_{r,effective}$

$$\epsilon_{reff} = \frac{\epsilon_r + 1}{2} + \frac{\epsilon_r - 1}{2}\left[\left(1 + \frac{12h}{W}\right)^{-\frac{1}{2}} + \left(1 - \frac{W}{h}\right)^2/25\right] \quad W/h < 1$$

OR.

$$\epsilon_{r,eff} = \frac{\epsilon_r + 1}{2} + \frac{\epsilon_r - 1}{2}\left[\left(1 + \frac{12h}{w}\right)^{-\frac{1}{2}}\right] \qquad \frac{w}{h} > 1.$$

Note the two eqns match at $\frac{w}{h} = 1$.

finally $$\lambda_g = \frac{c}{\sqrt{\epsilon_{r,eff}} \cdot f}$$

[Also $v_p = c/\sqrt{\epsilon_{r,eff}}$.]

Example. Rogers PCB, $\epsilon_r = 4$.

$Z_0 = 50\,\Omega$ $\therefore w/h = 2 \quad (> 1)$

$$\therefore \epsilon_{r,eff} = \frac{4+1}{2} + \frac{4-1}{2}\left[1 + 12 \times \frac{1}{2}\right]^{-\frac{1}{2}}$$

$$= 3.07$$

$$\therefore \lambda_g = \frac{c}{\sqrt{\epsilon_{eff}} \cdot f} = 171.3\ \text{mm}.$$

Example $Z_0 = 120\,\Omega$ $\therefore w/h = 0.292 \quad (< 1)$

$$\epsilon_{r,eff} = 2.78$$

$$\lambda_g = 180\ \text{mm}.$$