7.22 Design a single-section coupled line coupler with a coupling of 19.1 dB, a system impedance of 60 Ω, and a center frequency of 8 GHz. If the coupler is to be made in stripline (edge-coupled), with $\epsilon_r = 2.2$ and $b = 0.32$ cm, find the necessary strip widths and separation.

- Also, draw labeled sketch of design.

$C(dB) = -20\log_{10} C \rightarrow C = 10^{\frac{-19.1}{20}} = 0.11092$

Per (7.87a) and (7.87b), the even and odd mode characteristic impedances are

$$Z_{oe} = Z_0\sqrt{\frac{1+C}{1-C}} = 60\sqrt{\frac{1+0.1109}{1-0.1109}} = 67.06889\,\Omega$$

$$Z_{oo} = Z_0\sqrt{\frac{1-C}{1+C}} = 60\sqrt{\frac{1-0.1109}{1+0.1109}} = 53.67615\,\Omega$$

For stripline (Fig 7.29), we need

$\sqrt{\epsilon_r}\, Z_{oe} = \sqrt{2.2}\, 67.069 = \underline{99.4792\,\Omega}$

$\sqrt{\epsilon_r}\, Z_{oo} = \sqrt{2.2}\, 53.676 = \underline{79.6146\,\Omega}$

} Plot on Fig 7.29

From Fig 7.29, (next page) $S/b = 0.37$ & $\underline{W/b = 0.592}$

Using $b = 0.32\text{ cm} = 3.2\text{ mm}$,

$\underline{S = 0.37(3.2) = 1.18\text{ mm}}$ & $\underline{W = 0.592(3.2) = 1.89\text{ mm}}$

$$v_p = \frac{c}{\sqrt{\epsilon_r}} = \frac{2.9979\times10^8}{\sqrt{2.2}} = 2.021184\times10^8\ \text{m/s}$$

$$\lambda = \frac{v_p}{f} = \frac{2.02118\times10^8}{8\times10^9} = 25.2648\text{ mm}$$

$\hookrightarrow \underline{\lambda/4 = 6.316\text{ mm}}$

Bonus! From MWI, $\underline{W_{60\Omega} = 3.9455\text{ mm}}$.

Drawing on next page.

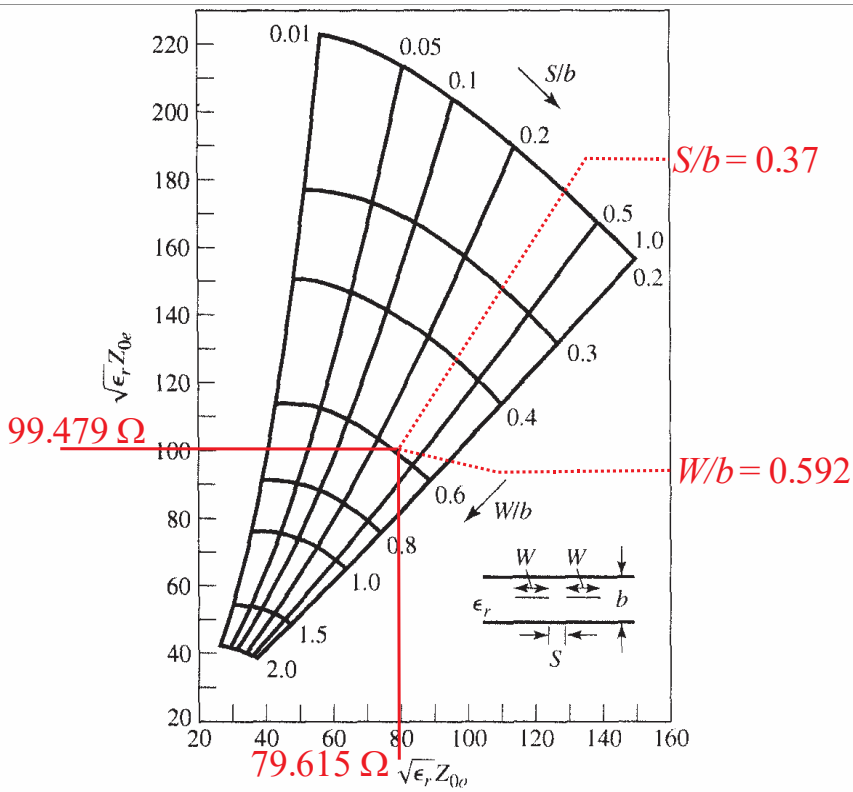
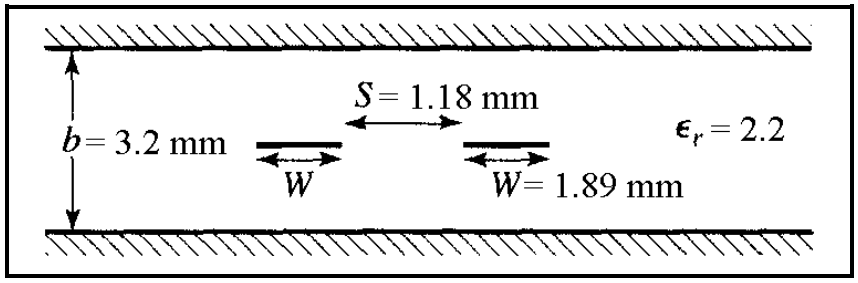


FIGURE 7.29 Normalized even- and odd-mode characteristic impedance design data for symmetric edge-coupled striplines.

Side View



Top View