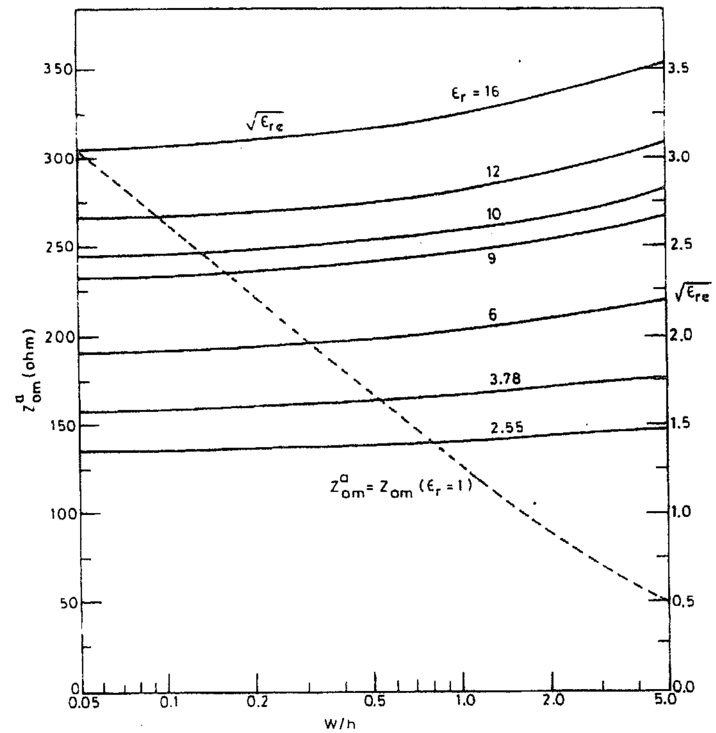
as Figure 2.8. Here ε_{re} is the same as ε_{eff} above.



Wheeler's formulas

In this figure the value of $\sqrt{\varepsilon_{re}}$ is plotted as a function of W/h for various values of the substrate dielectric constant ε_r. The variation of characteristic impedance for air microstrip (Z^a_{om} or $\varepsilon_r = 1$) is also shown by the dotted curve. The impedance for any value of ε_r can be obtained by dividing Z^a_{om} by the corresponding value of $\sqrt{\varepsilon_{re}}$. It may be seen from Figure 2.8 that the impedance value decreases when the strip width to substrate height ratio (W/h) is increased, since an increase in W (or decrease in h) increases the line capacitance.

Since the guided wavelength in the microstrip λ_g is related to ε_{re} by the expression

$$\lambda_g = \frac{\lambda_o}{\sqrt{\varepsilon_{re}}} \tag{2.30}$$

and 2-21. In these figures, the quantities Z_0 and ε_{eff} are plotted as functions of w/h ratios and ε_r values. The parameter range of w/h and ε_r is chosen such that it spans the domain of typically encountered, practical values.

From RF Ckt Design 2nd Ed by Ludwig & Bogdanov

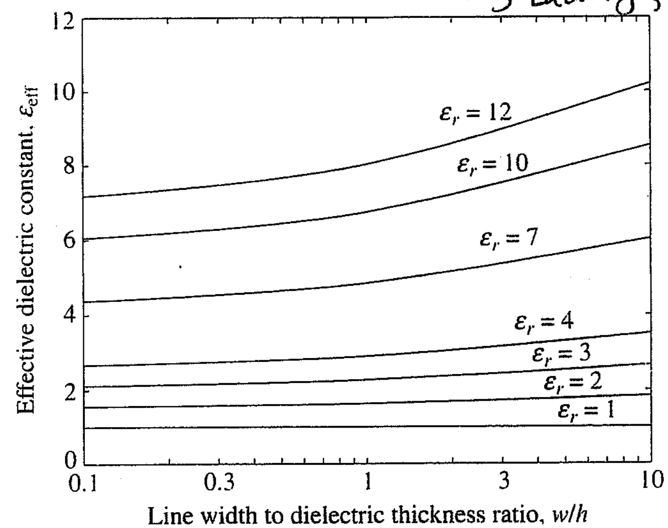


Figure 2-21 Effective dielectric constant of the microstrip line as a function of w/h for different dielectric constants.

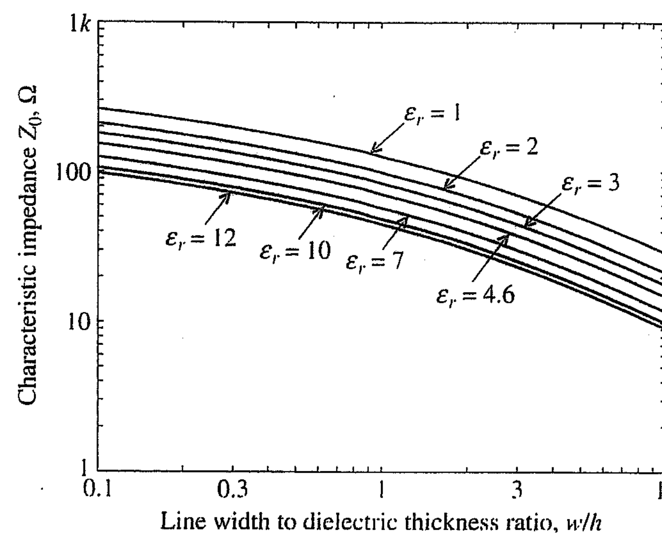


Figure 2-20 Microstrip characteristic impedance as a function of w.