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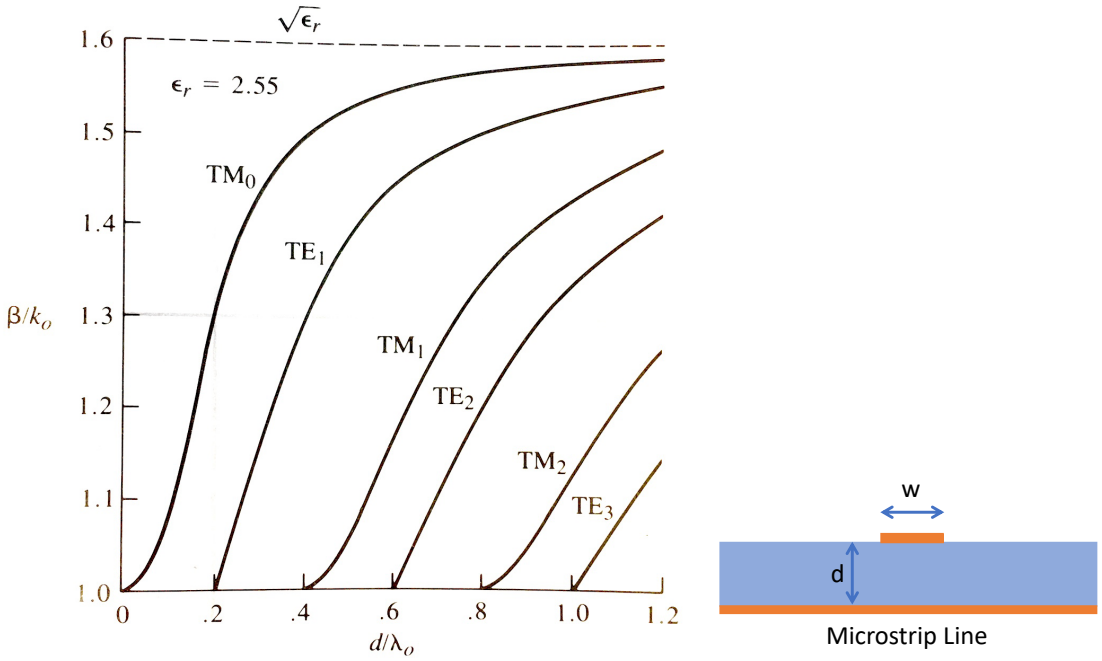
**Microstrip Transmission Lines**

**Example 1:**



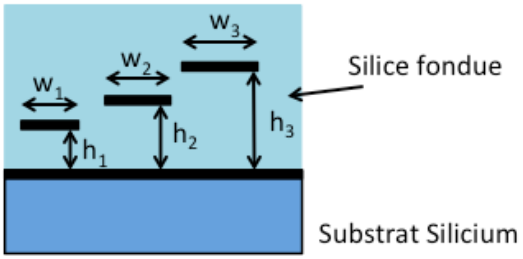

A microstrip line is fabricated on top of a 1mm thick substrate with a relative permittivity of 2,55.

1. Compute the effective permittivity of the transmission line.
2. Compute the width of the line for a characteristic impedance of 50 Ohms.
3. Using the dispersion diagram above, compute the maximum frequency where the transmission line can be used.

**Example 2:**

A modern CMOS fabrication makes it possible to have several levels of metallization above the "active" substrate.

A cross-section of the substrate is shown below:



The metal traces are made in a multilayer stack of silica (dielectric) and metal. Silica, i.e. the medium in which the metal lines are, has a relative permittivity of 3.8. It is considered that this dielectric extends sufficiently above the metal lines so that the medium in which the lines are is infinite.

$h_1$=2µm, $h_2$=5µm, $h_3$=10µm

1) Compute $w_1$, $w_2$, $w_3$ in figure 1 so that characteristic impedance of each transmission line is 50 Ohms.
2) Which line (1,2 or 3) will have the lowest attenuation? Why?