

Analysis of Guided Modes in Shielded Slot Line

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Guided modes in a shielded slot transmission line were analyzed. This transmission line consists of slotted metal strips inserted in a below cutoff parallel metal plate waveguide as shown in Fig. 1. The TEM mode as shown in Fig. 2(a) can propagate in the slot area as the lowest dominant mode, while the higher modes as shown in Fig. 2(b) may propagate in the metal strip regions. With this in mind, we calculated the cutoff wavelength based on the transverse resonant method. Figs. 3(a) and (b) show the quarter cross section and its transverse equivalent transmission-line circuit. From this equivalent circuit, the cutoff wavelength of the N th higher mode was given by

$$\lambda_c = \frac{1}{N - \frac{1}{\pi} \tan^{-1} \frac{B_s}{Y_0^{(1)}}} \left\{ w - s + \frac{\lambda_c}{\pi} \tan^{-1} \frac{B_a}{Y_0^{(1)}} \right\},$$

where B_a and B_s correspond to susceptances at the side edges of the metal strip, and $Y_0^{(1)}$ is the characteristic admittance of the TM mode propagating along the transverse equivalent transmission-line. The susceptances were calculated by the variational method for waveguide discontinuities. Fig. 4 shows the calculated and measured dispersion curves of the dominant TEM mode and the 1st higher mode. Agreement between the theory and measurement was quite satisfactory, and thus the validity of this analytical procedure was confirmed.

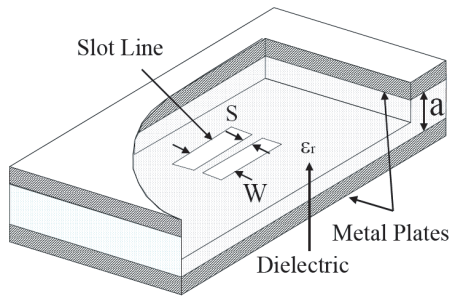


Figure 1: Structure of shielded slot line.

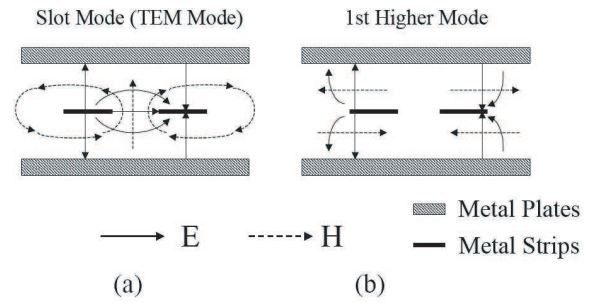


Figure 2: Field distributions of (a) slot mode and (b) 1st higher mode.

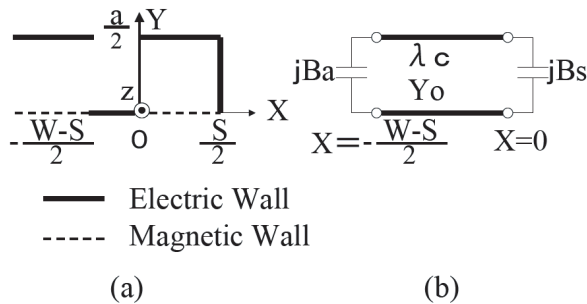


Figure 3: Analytical model. (a) Quarter cross sectional view, (b) Transverse equivalent transmission-line circuit.

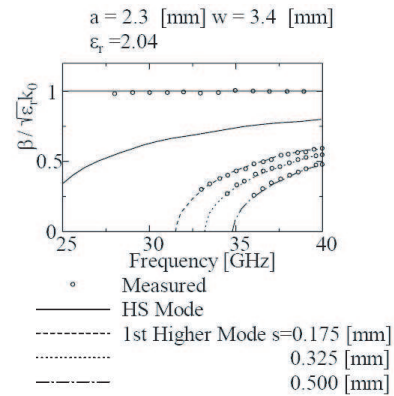


Figure 4: Calculated and measured dispersion curves of guided modes in shielded slot line.