



$$\Delta l_p = |L_2 - L_1|$$

$$\phi = \beta l$$

$$\beta = k_0 \sqrt{\epsilon_{eff}}$$

$$k_0 = \frac{2\pi}{\lambda}$$

$$\Rightarrow \phi = \frac{2\pi}{\lambda} \sqrt{\epsilon_{eff}} l \Rightarrow$$

$$c = \lambda f$$

$$\phi = 2\pi f l \frac{\sqrt{\epsilon_{eff}}}{c}$$

$$\Delta \phi = 2\pi f \Delta l \frac{\sqrt{\epsilon_{eff}}}{c}$$

$$\begin{cases} \phi_1 = 2\pi f L_1 \frac{\sqrt{\epsilon_{eff}}}{c} \\ \phi_2 = 2\pi f L_2 \frac{\sqrt{\epsilon_{eff}}}{c} \end{cases}$$

$$\Delta \phi = \phi_2 - \phi_1$$

$$\begin{cases} \phi_1 = \angle S_{21} (\text{linea } L_1) \\ \phi_2 = \angle S_{21} (\text{linea } L_2) \end{cases}$$