UNIT-2

Microwave Engineering

Directional Couplers

The coupling C is :

$$C = 10 \log \frac{P_i}{P_f}$$

The directivity D is :

$$D = 10 \log \frac{P_f}{P_b}$$

For ideal coupler $S_{14} = S_{23} = 0$

$$S_{11} = S_{22} = 0$$

$$[S] = \begin{bmatrix} 0 & S_{12} & S_{13} & 0 \\ S_{12} & 0 & 0 & S_{24} \\ S_{13} & 0 & S_{33} & S_{34} \\ 0 & S_{24} & S_{34} & S_{44} \end{bmatrix}$$

$$[S][S]^{*t} = U$$

$$S_{13}S_{33}^{*} = 0 \quad , \quad S_{24}S_{44}^{*} = 0$$

$$S_{33} = 0 = S_{44}$$

$$[S] = \begin{bmatrix} 0 & S_{12} & S_{13} & 0 \\ S_{12} & 0 & 0 & S_{24} \\ S_{13} & 0 & 0 & S_{34} \\ 0 & S_{24} & S_{34} & 0 \end{bmatrix}$$

$$S_{12}S_{24}^{*}+S_{13}S_{34}^{*}=0 \quad , \quad S_{12}S_{13}^{*}+S_{24}S_{34}^{*}=0$$

$$\left|S_{12}\right|\ \left|S_{24}\right|+\left|S_{13}\right|\left|S_{34}\right|$$

$$\left|S_{12}\right|\ \left|S_{13}\right|+\left|S_{24}\right|\left|S_{34}\right|$$

$$\left|S_{13}\right|=\left|S_{24}\right|$$

$$\left|S_{12}\right|=\left|S_{34}\right|$$

$$\left|S_{12}\right|^{2}+\left|S_{13}\right|^{2}=1$$

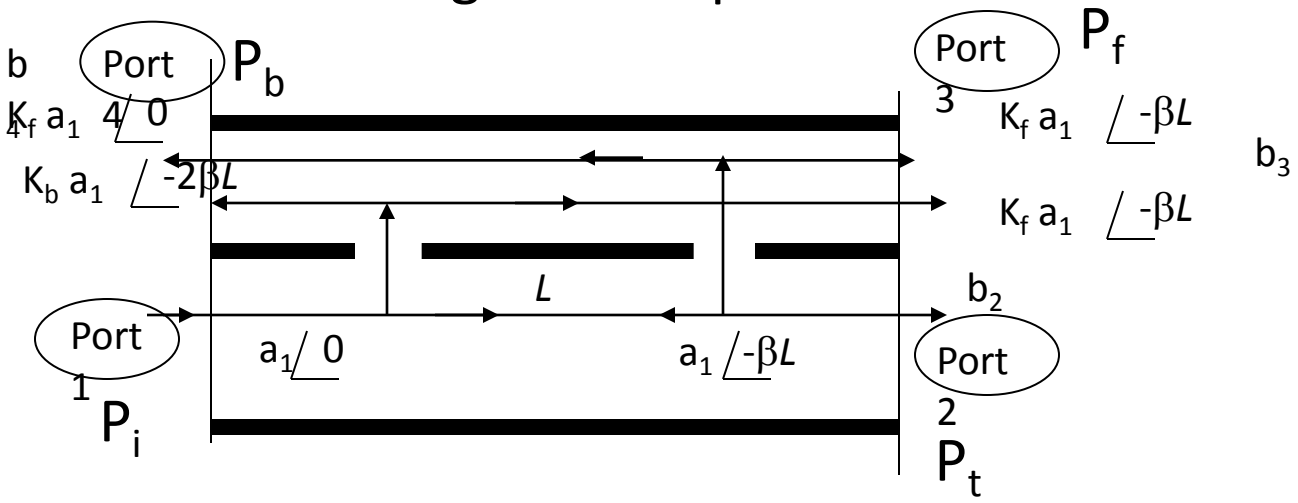
$$\left|S_{12}\right|^{2}+\left|S_{24}\right|^{2}=1$$

$$S_{12}=C_{1} \quad , \quad S_{13}=jC_{2}$$

$$[S]=\begin{bmatrix} 0 & C_1 & jC_2 & 0 \\ C_1 & 0 & 0 & jC_2 \\ jC_2 & 0 & 0 & C_1 \\ 0 & jC_2 & C_1 & 0 \end{bmatrix}$$

Directional Couplers

Two-hole Waveguide Couplers



K_f and K_r are the forward

and reverse aperture coupling coeffiecients

The coupling C is :

$$C = -20 \log 2\left|K_f\right|$$

The directivity D is :

$$D = 20\log\frac{2\left|K_f\right|}{\left|K_r\right|\left|1+e^{-2j\beta L}\right|} = 20\log\frac{\left|K_f\right|}{\left|K_r\right|\left|\cos\beta L\right|}$$

$$= 20\log\frac{\left|K_f\right|}{\left|K_r\right|} + 20\log\left|\sec\beta L\right|$$

The directivity is the sum of the directivity of the single aperture plus a directivity associated with the array.

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$$[S] = \begin{bmatrix} 0 & S_{12} & S_{12} & 0 \\ S_{12} & 0 & 0 & S_{24} \\ S_{12} & 0 & 0 & -S_{24} \\ 0 & S_{24} & -S_{24} & 0 \end{bmatrix}$$

$$[S] = \begin{bmatrix} 0 & 1 & 1 & 0 \\ 1 & 0 & 0 & -1 \\ 1 & 0 & 0 & 1 \\ 0 & -1 & 1 & 0 \end{bmatrix}$$