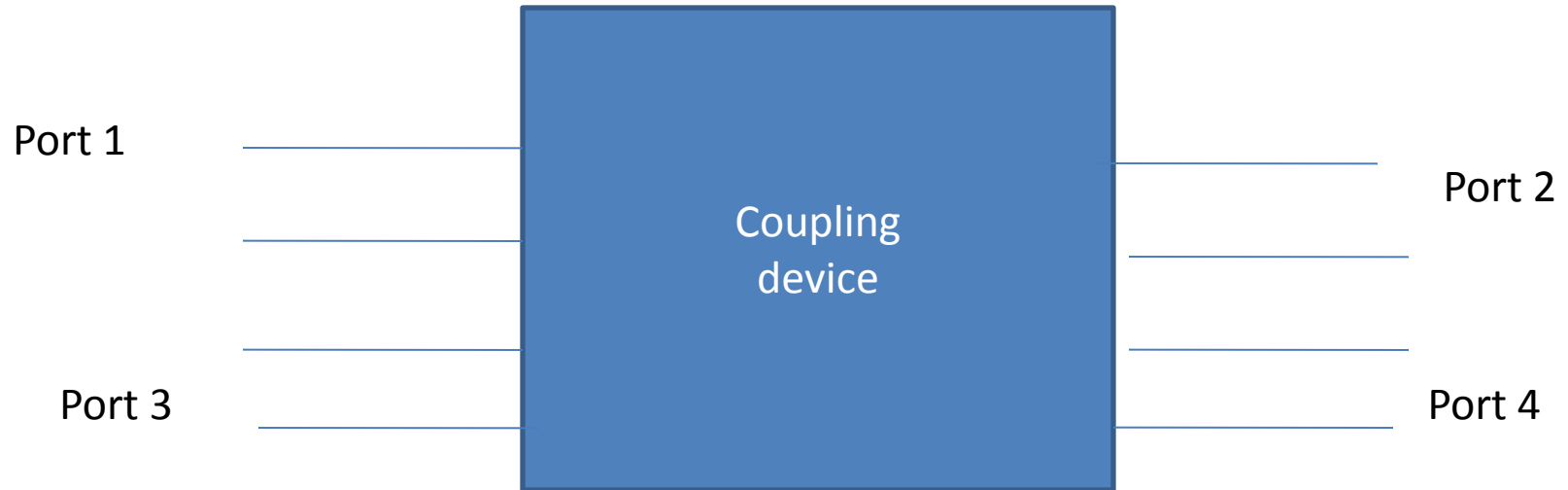


Directional coupler

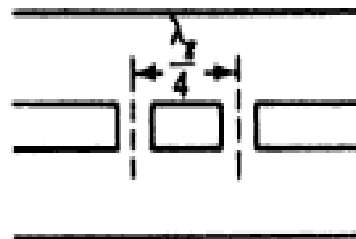
- Four port junction
- Primary waveguide 1-2
- Secondary waveguide 3-4



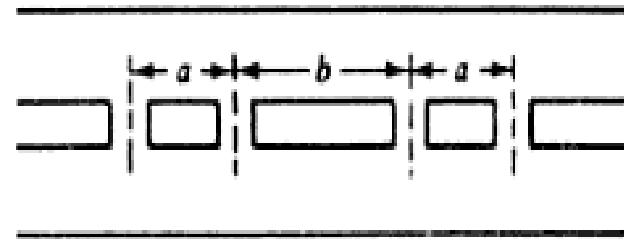


- Coupling factor (db) = $10 \log_{10} p_1/p_4$
- Directivity (db) = $10 \log_{10} p_4/p_3$
- Isolation = $10 \log_{10} p_1/p_3$

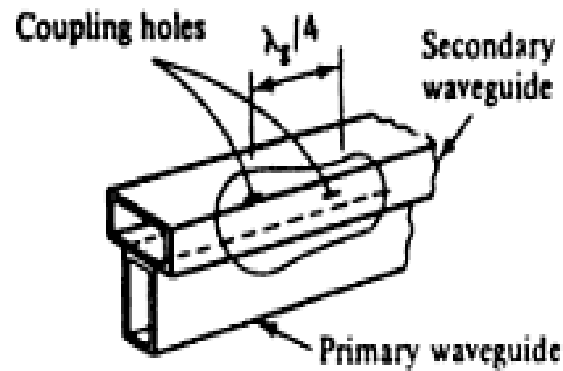
the very commonly used **two-hole directional coupler** is described here.



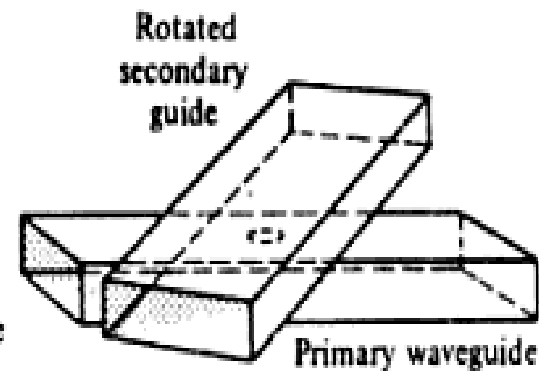
(a)



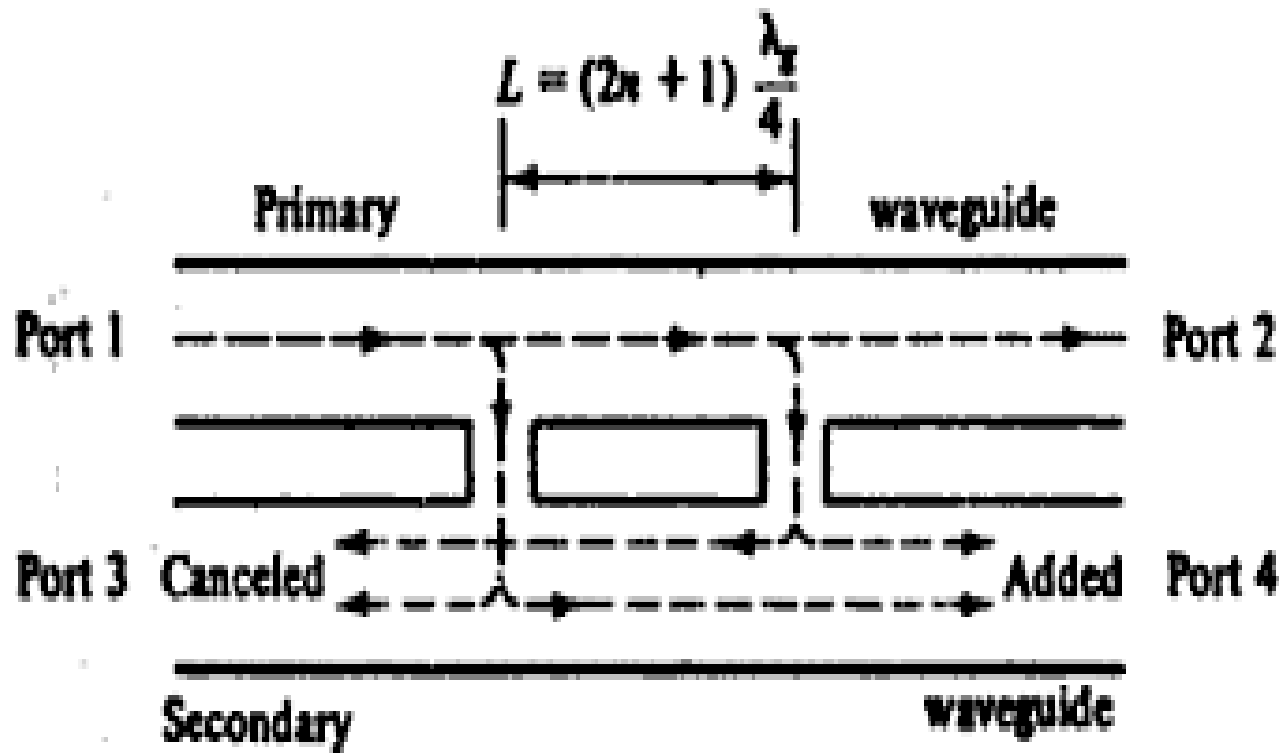
(b)



(c)



(d)



$$\begin{bmatrix} 0 & S_{12} & 0 & S_{14} \\ S_{12} & 0 & S_{23} & 0 \\ 0 & S_{32} & 0 & S_{34} \\ S_{41} & 0 & S_{41} & 0 \end{bmatrix}
 \begin{bmatrix} 0 & *S_{12} & 0 & *S_{14} \\ *S_{12} & 0 & *S_{23} & 0 \\ 0 & *S_{32} & 0 & *S_{34} \\ *S_{41} & 0 & *S_{41} & 0 \end{bmatrix} =$$

$$\begin{bmatrix} 1000 \\ 0100 \\ 0010 \\ 0001 \end{bmatrix}$$

$$|S_{12}| = |S_{34}|$$

$$|S_{14}| = |S_{23}|$$

put

$$S_{12} = S_{34} = p$$

$$S_{12}S_{23}^* + S_{41}S_{43}^* = 0$$

$$p(S_{23}^* + S_{41}) = 0$$

$$S_{23} = S_{41} = jq$$

$$p^2 + q^2 = 1$$

$$\begin{bmatrix} 0 & p & 0 & jq \\ p & 0 & jq & 0 \\ 0 & jq & 0 & p \\ jq & 0 & p & 0 \end{bmatrix}$$

