



# **SNS COLLEGE OF TECHNOLOGY**

**Coimbatore-35**  
**An Autonomous Institution**



Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A++' Grade  
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

## **DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING**

### **OPTICAL AND MICROWAVE ENGINEERING**

III YEAR/ VI SEMESTER  
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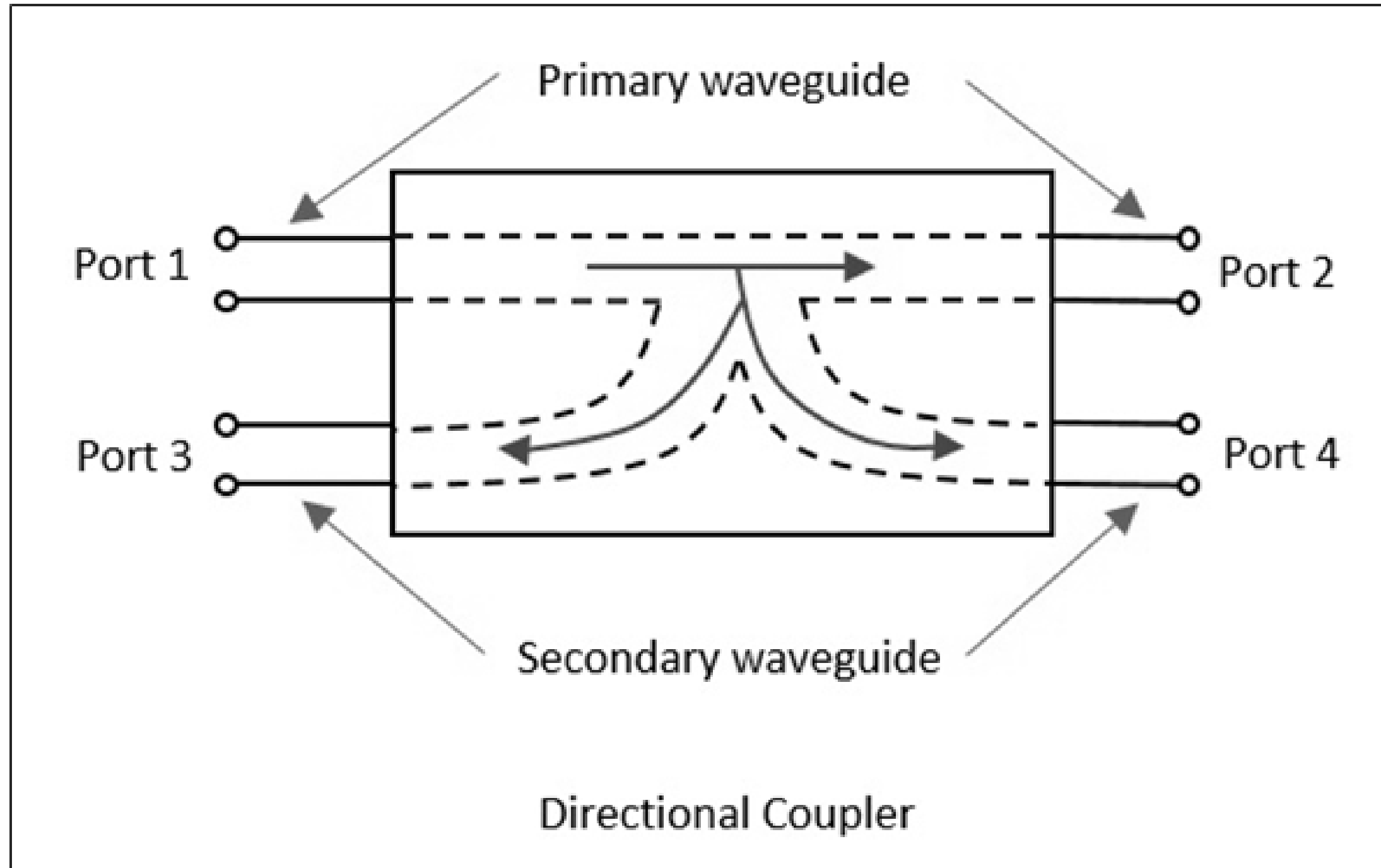
#### **UNIT 1 – MICROWAVE PASSIVE DEVICES**

**TOPIC– Directional Couplers**

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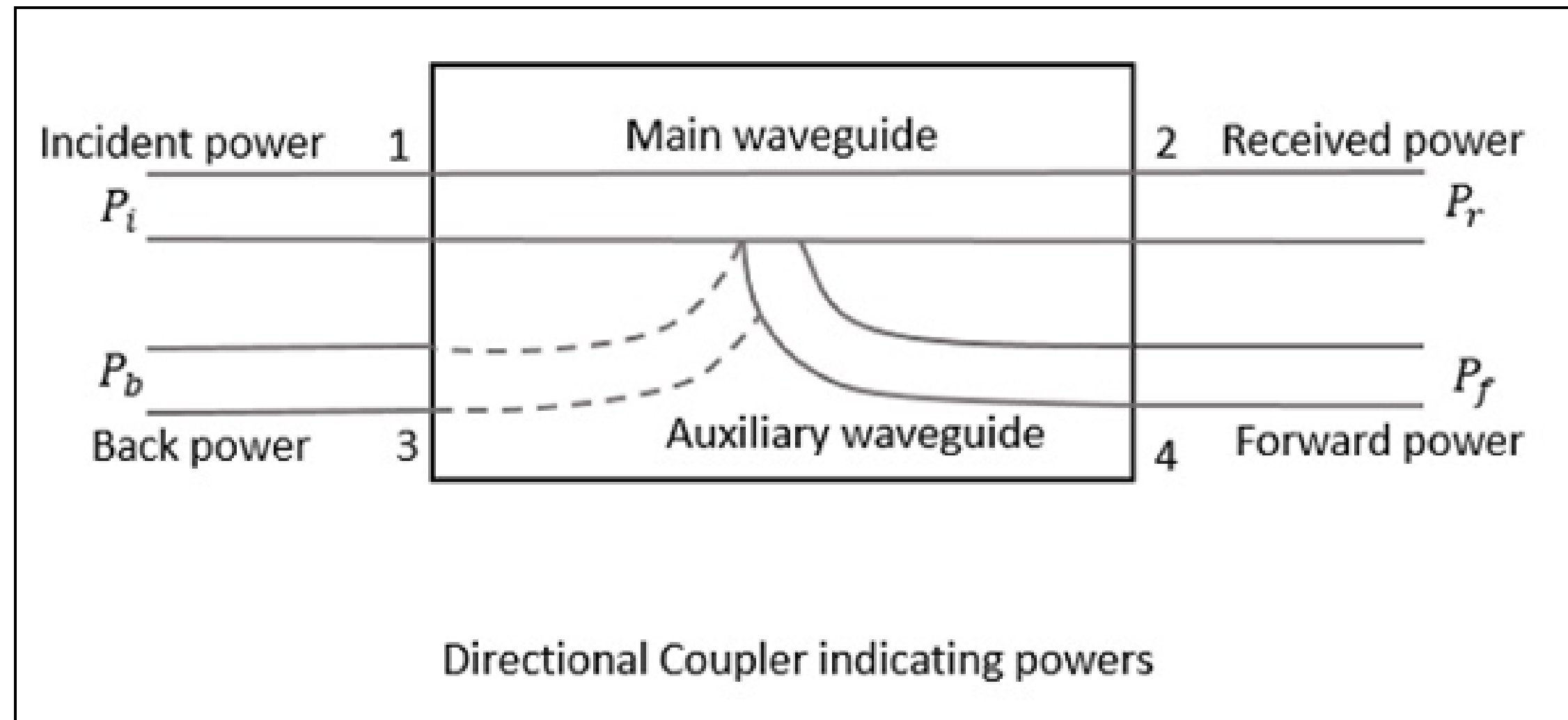


# Directional Coupler



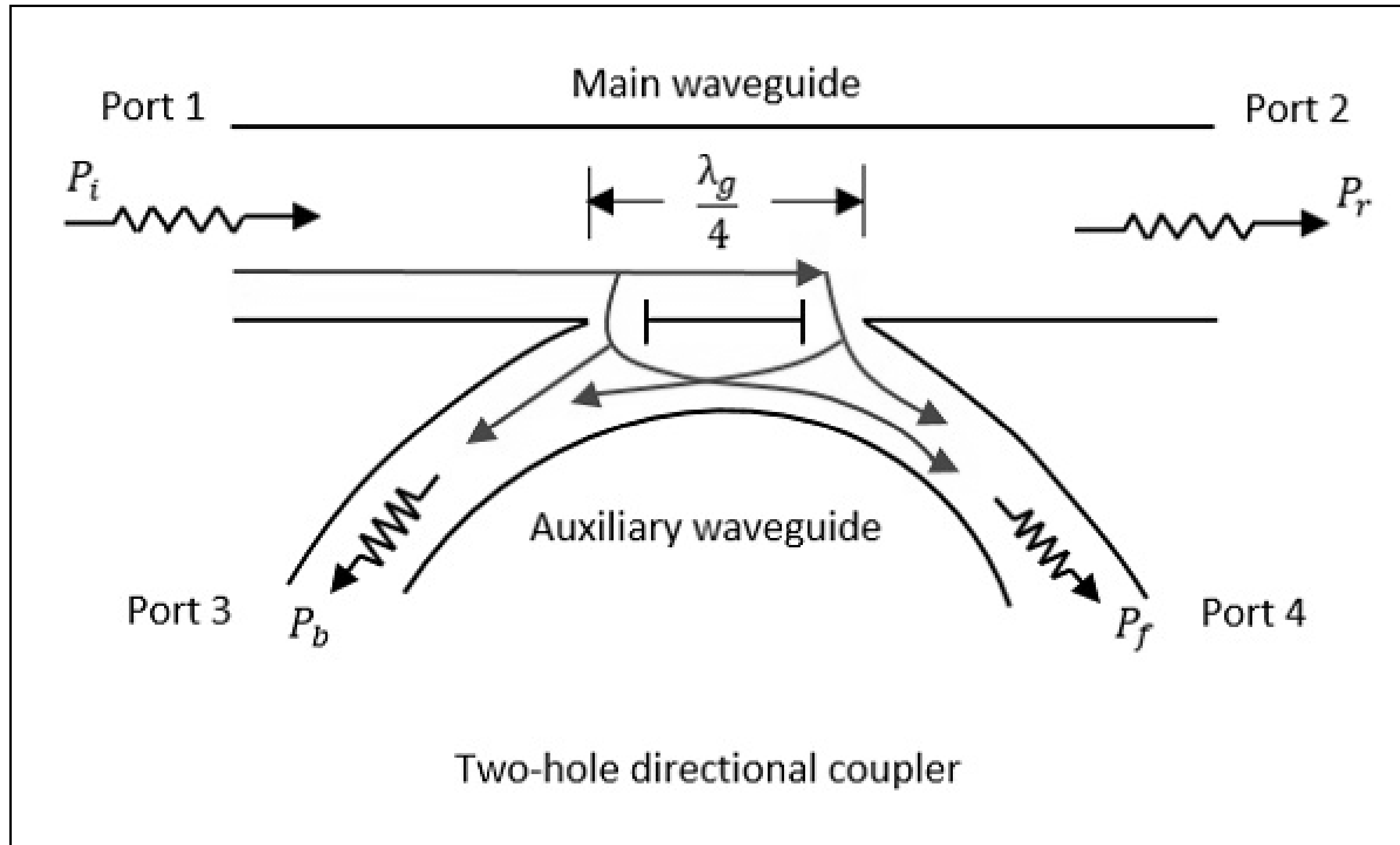


# Properties of Directional Coupler





# Two Hole Directional Coupler





## Directional Coupler Parameter

- The performance of directional coupler is measured in terms of four basic parameters:

### 1. Coupling Factor (C):

- Measure of how much of power is being sampled.
- Ratio of power levels in main and auxiliary waveguides.

$$C_{(dB)} = 10 \log_{10} \left( \frac{P_1}{P_4} \right)$$

### 2. Directivity (D):

- Measure of how well the directional coupler distinguishes between forward and reverse travelling power.
- Ratio of forward coupled power level and reverse power level in auxiliary waveguide.

$$D_{(dB)} = 10 \log_{10} \left( \frac{P_4}{P_3} \right)$$



### 3. Isolation (I):

- Measures the directional properties.
- Ratio of incident power in main waveguide to the reverse power at auxiliary waveguide.
- $I = C.D$
- $I \text{ (dB)} = [C]_{\text{dB}} + [D]_{\text{dB}}$

$$I = 10 \log_{10} \left( \frac{P_1}{P_3} \right) \text{ dB}$$

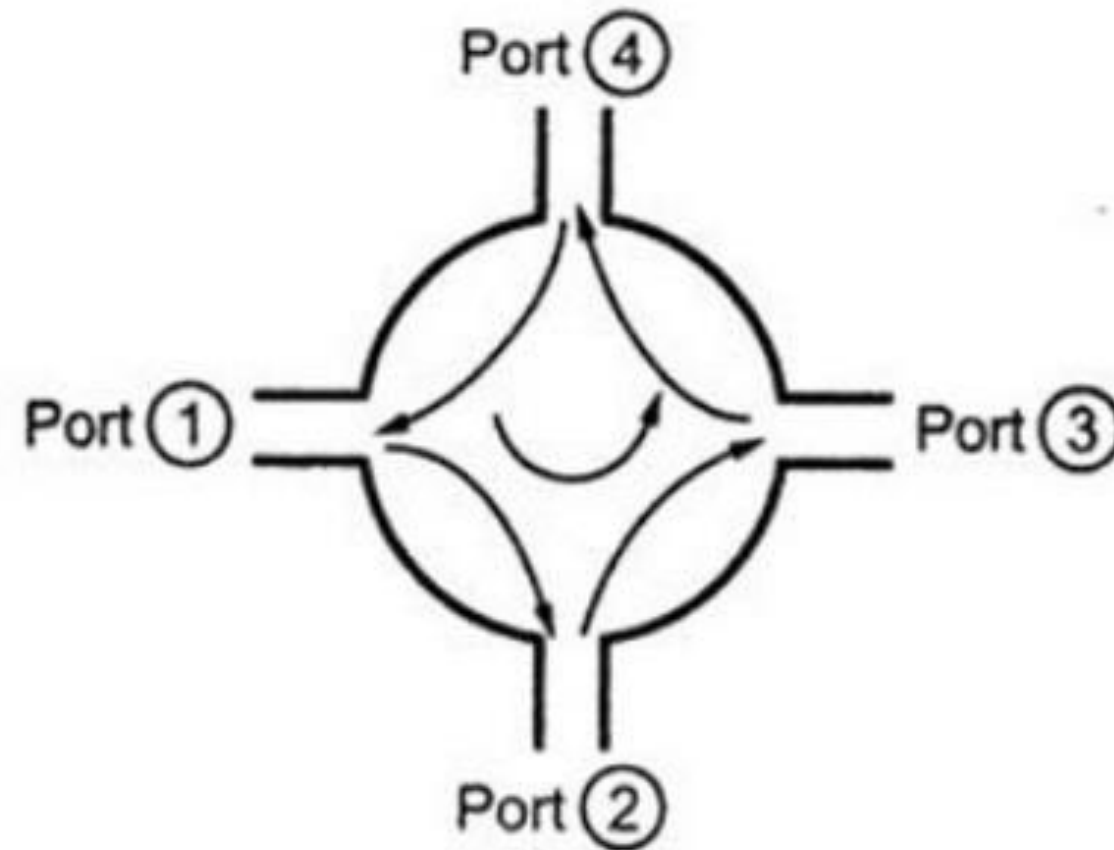
### 4. Return/Insertion Loss (R):

- Ratio of power incident to the power transmitted in the primary arm.

$$R_{\text{(dB)}} = 10 \log \left( \frac{P_1}{P_2} \right) \text{ dB}$$



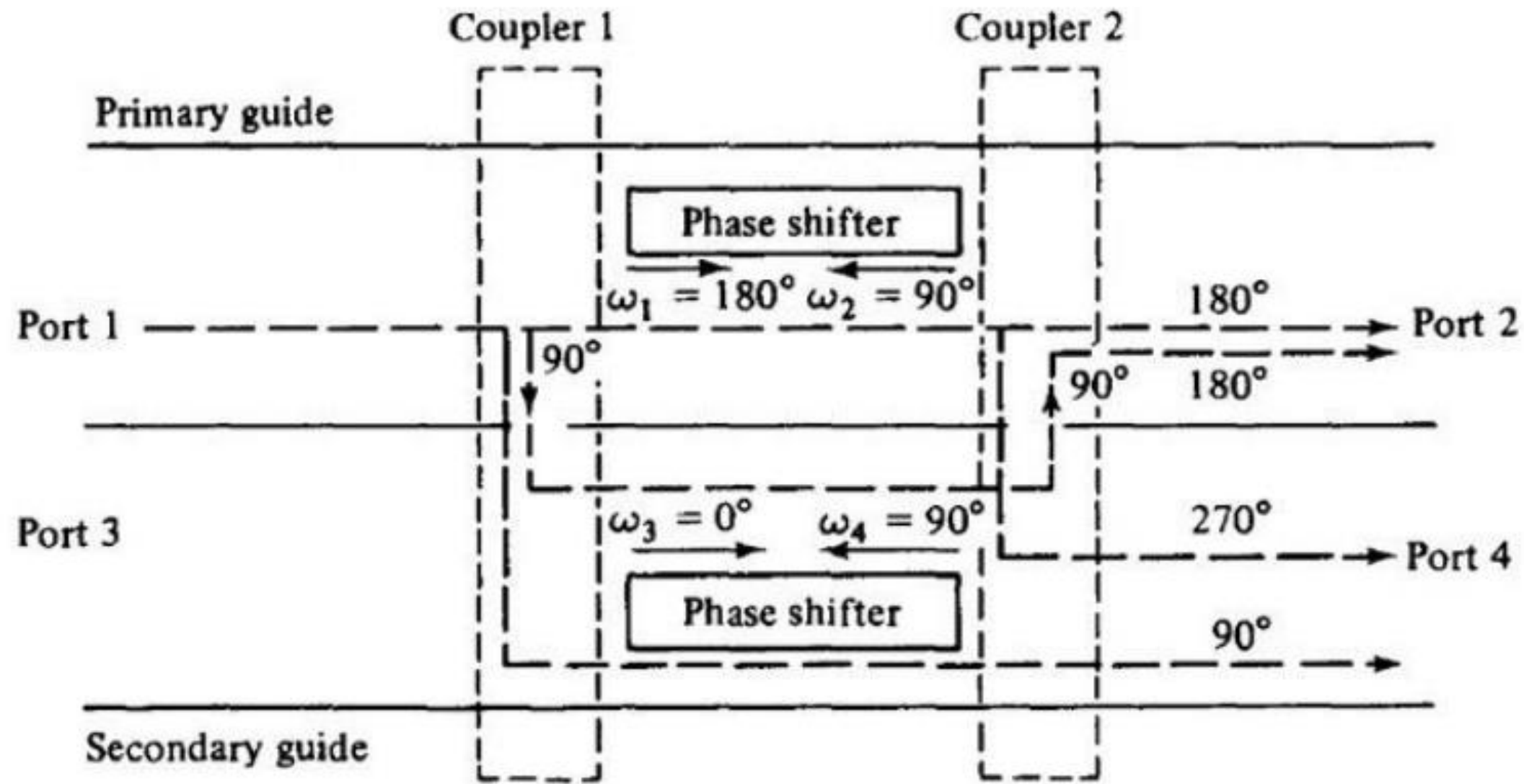
# Microwave circulators



**4-port Circulator Symbol**



# Microwave circulators



**Four-port Circulator Schematic**





A perfectly matched, lossless, and nonreciprocal four-port circulator has an  $S$  matrix of the form

$$\mathbf{S} = \begin{bmatrix} 0 & S_{12} & S_{13} & S_{14} \\ S_{21} & 0 & S_{23} & S_{24} \\ S_{31} & S_{32} & 0 & S_{34} \\ S_{41} & S_{42} & S_{43} & 0 \end{bmatrix}$$

Using the properties of  $S$  parameters as described previously, the  $S$  matrix in Eq.

$$\mathbf{S} = \begin{bmatrix} 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix}$$



# Microwave Isolators

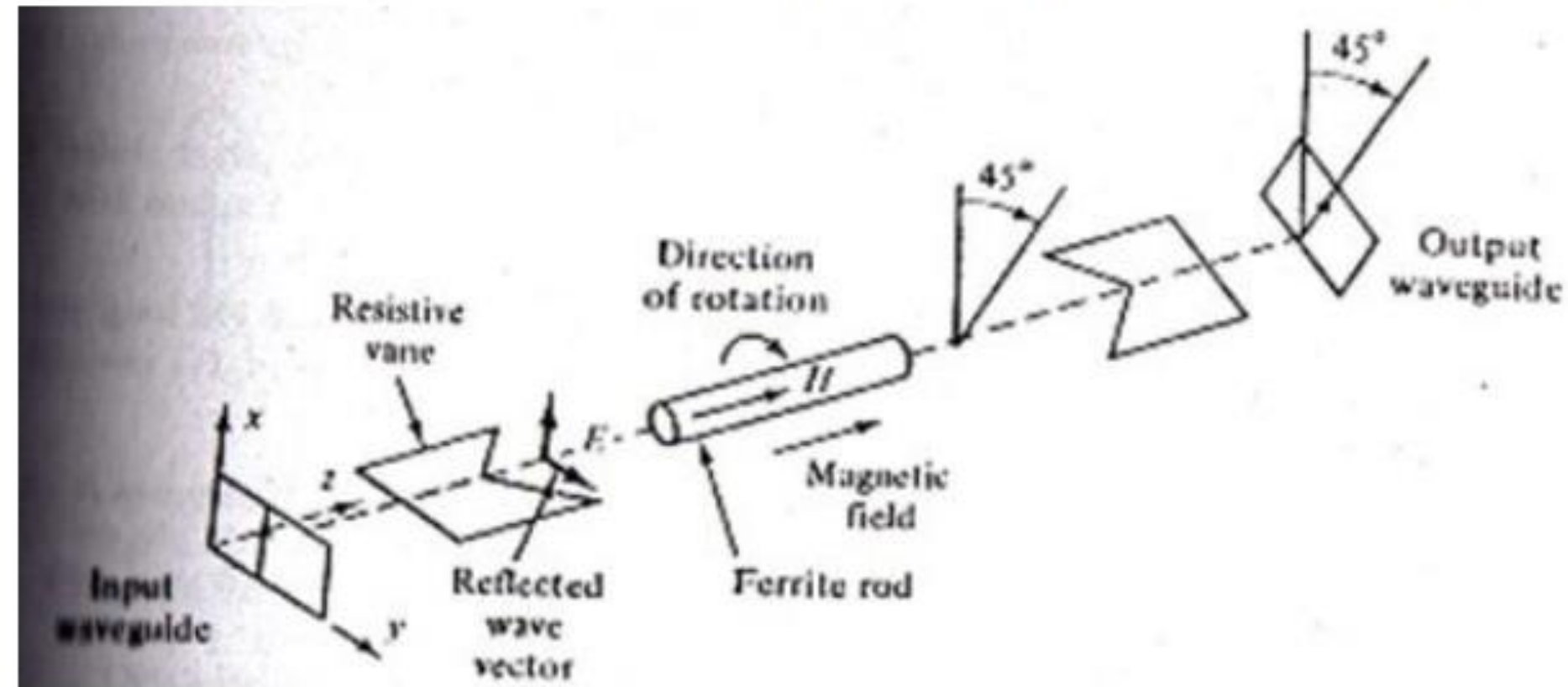
- An *isolator* is a nonreciprocal transmission device that is used to isolate one component from reflections of other components in the transmission line.
- An ideal isolator completely absorbs the power for propagation in one direction and provides lossless transmission in the opposite direction.
- Thus the isolator is usually called *uniline*.
- Isolators are generally used to improve the frequency stability of microwave generators, such as klystrons and magnetrons, in which the reflection from the load affects the generating frequency.

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# Working Principle

- The input resistive card is in the y-z plane, and output resistive card is displaced 45 degree with respect to the input card.
- The DC magnetic field, which is applied longitudinally to the ferrite rod, rotates the wave plane of polarization by 45 degree.





**THANK YOU**