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

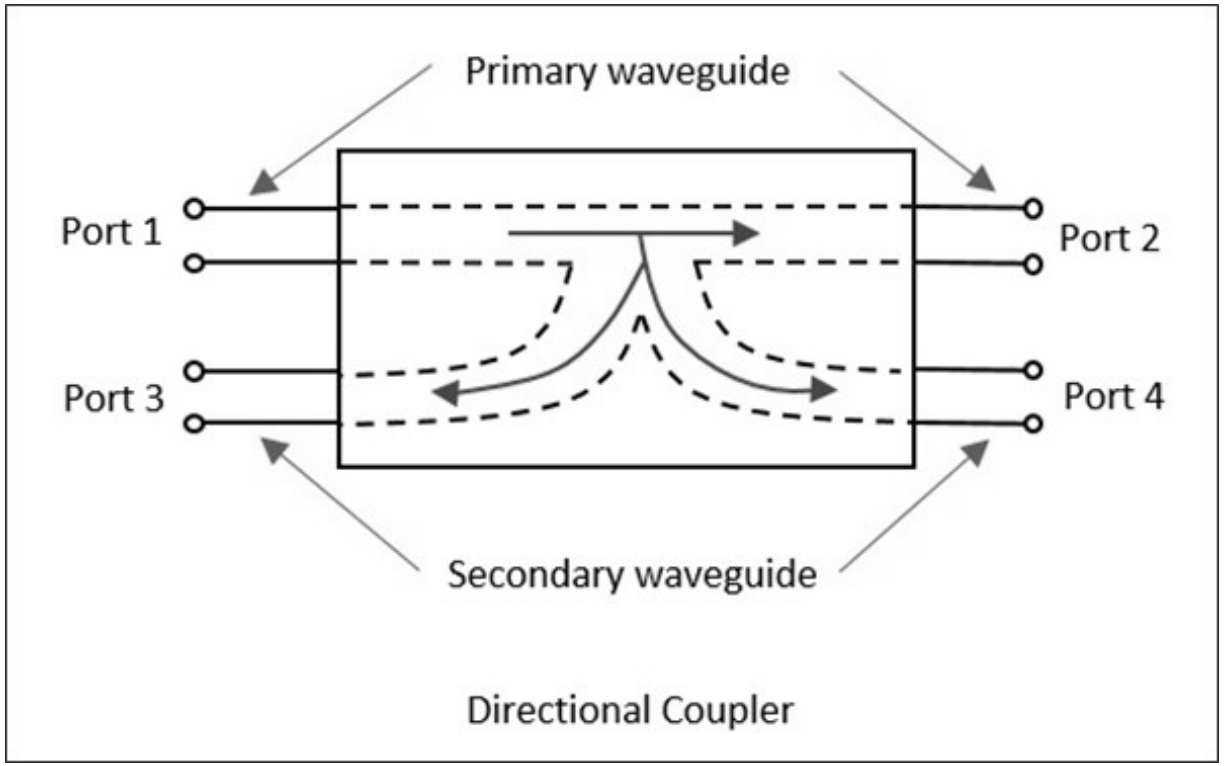
OPTICAL AND MICROWAVE ENGINEERING

III YEAR/ VI SEMESTER

UNIT 1 – MICROWAVE PASSIVE ELEMENTS

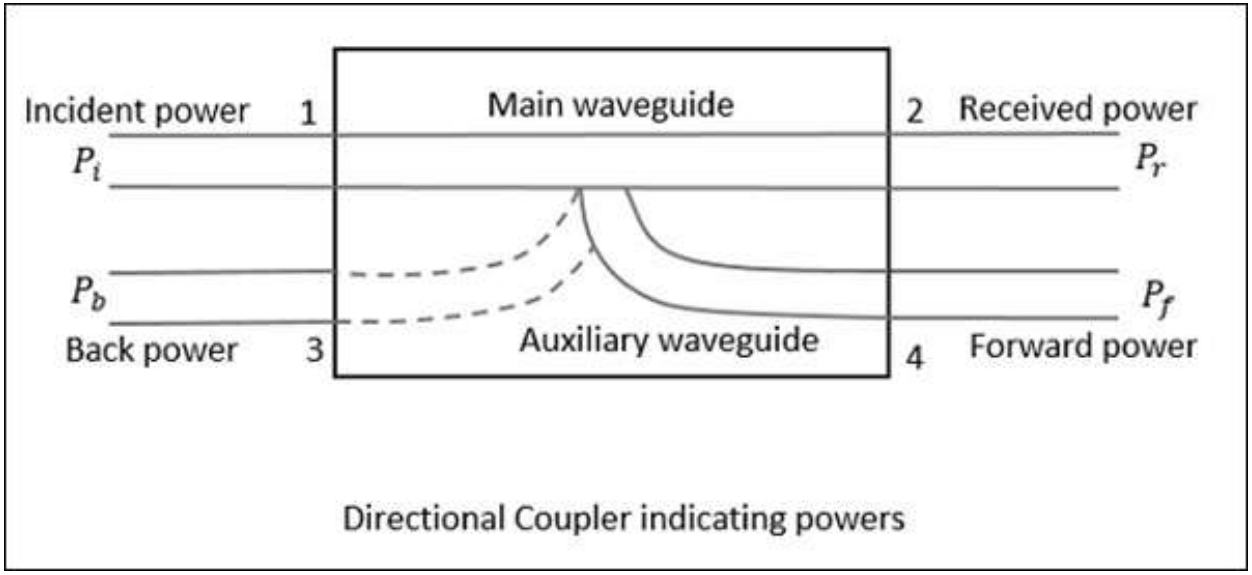
TOPIC– Directional Couplers

Directional Coupler



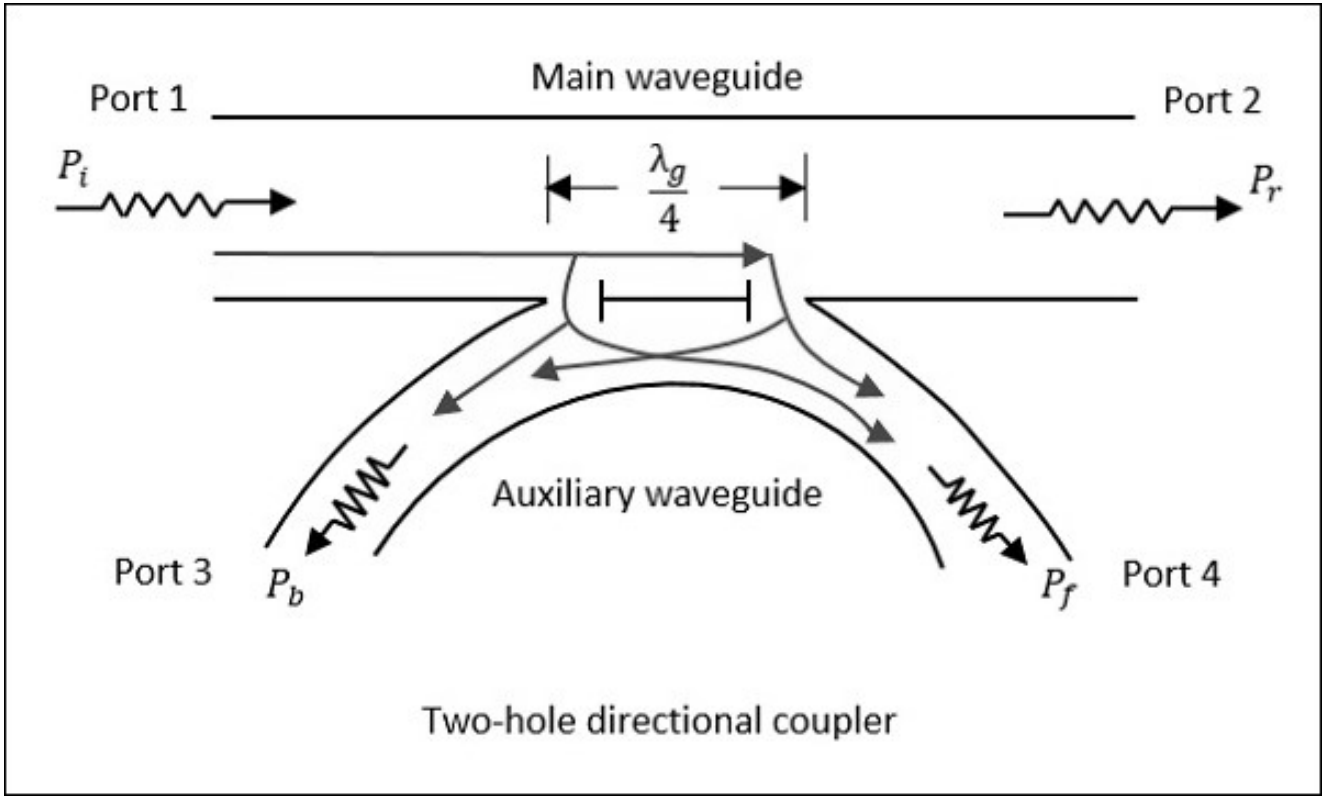
Directional Coupler

Properties of Directional Coupler



Directional Coupler indicating powers

Two Hole 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 (dB)= $[C]_{dB}+[D]_{dB}$

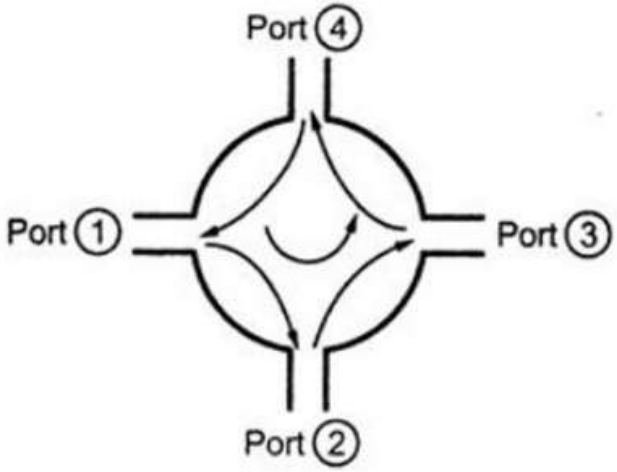
$$I = 10 \log_{10}\left(\frac{P_1}{P_3}\right) \text{ dB}$$

4. Return/Insertion Loss (R):

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

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

Microwave circulators



4-port Circulator Symbol

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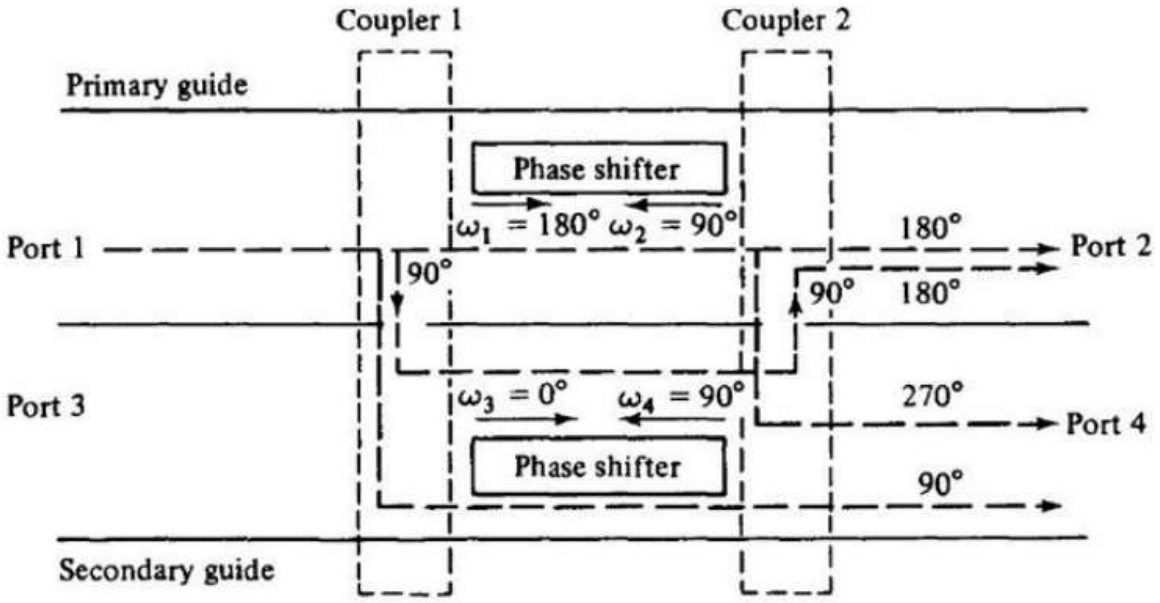
Microwave circulators



Four-port Circulator Schematic

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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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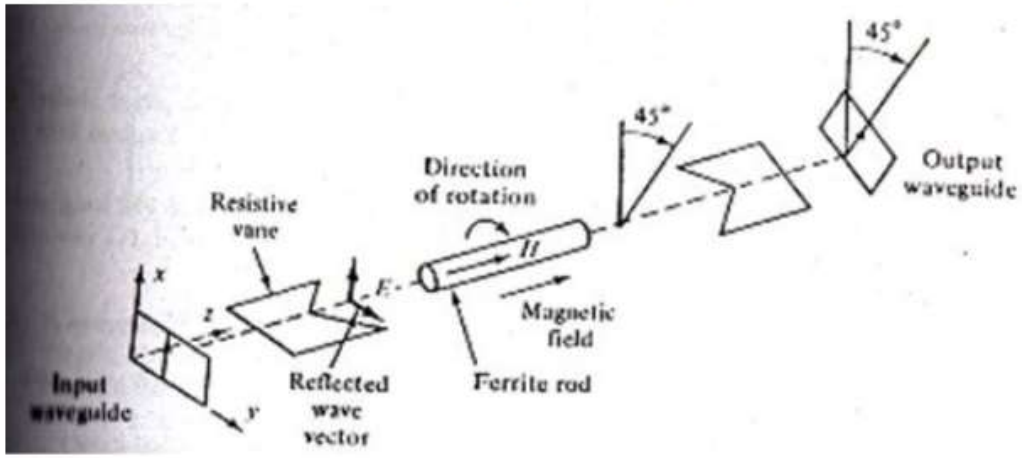
Working Principle

- 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.



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THANK YOU