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Experiment No:

Title: Verification of Port Characteristics of Isolator and Circulator. Also calculation of insertion loss and isolation in dB.

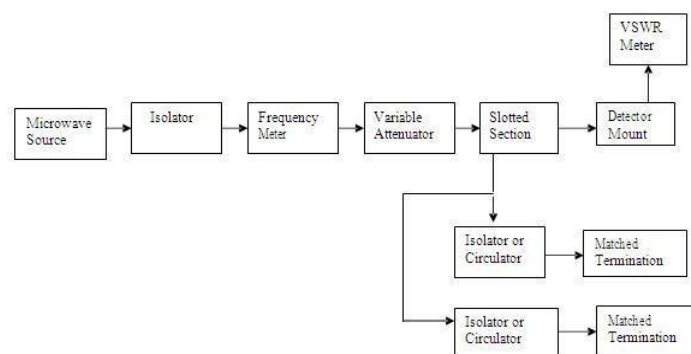
Objectives:

1. To measure the power distribution on various ports of Isolator and Circulators.
2. To verify operation of Isolator and Circulator

Apparatus:

1. Klystron Power Supply and Klystron with mount
2. Isolator
3. Frequency meter
4. Variable Attenuator
5. Slotted section with Probe carriage
6. CRO/VSWR meter
7. Movable Short/Matched termination
8. Circulator.

Circuit diagram:



Theory:

Isolator:

It is a two-port device where wave propagate from one port to second without any attenuation and when wave moves in back direction there will be maximum attenuation therefore it is a online device. Isolator is mostly used to couple microwave generator to load so with this arrangement efficiency of reflex klystron will increase and also avoid the damage of microwave source generator due to the reflected wave because of mismatching at the output load. Its construction is very much similar to Gyrator except uses a 45-degree twist and 45-degree rotation in addition to these two thin resistive cards are inserted in the input and output wave guide parallel to the broaderwall of wave guide. If the wave will not fully be absorbed by resistive card 1 then reflection taking places move toward port 2 which is absorbed by the resistive card at port 2.

Circulator: It is a multiport microwave junction device providing one-way sequential transmission of powerbetween the ports. It has a property that terminal is connected to next clockwise terminal depending upon thedirection of wave-guide.

Following the different ways to construct a circulator.

- 1) Circulator using faradays rotation isolator.
- 2) Using two magic Tee and Gyrator.
- 3) Using 2 side hole and 3db coupler, 2 non reciprocal & 1 reciprocal phase shifter

Two additional ports 3&4 place the construction of faradays circulator using isolator without twist except the resistive card 1&2 respectively. Port 3 is a rectangular wave guide fastened in perpendicular to the circular wave guide near port 1 such that the narrow dimension of port 3 is parallel to the broad dimension of port 1 ie port 3 is perpendicular to port 1 similarly every time.

The isolation factor and Insertion loss can be found from the following expressions

1. Isolation (I) = $20 \log (V_i/V_t)$ db

2. Insertion loss (L) = $20 \log (V_i/V_o)$ db

Precautions: -

1. Use fan to keep the Klystron temperature low.
2. Ensure tight connections of the apparatus
3. Avoid cross connections of the threads.
4. Use stabilized power supply.

Procedure:

1. Connect the set up as per the block dig. Set mode selector switch to AM position.
2. Adjust beam voltage between 250 to 300v.
3. Set Repeller voltage to any value between 50 to 100v.
4. Apply input to port 1 of (Isolator/Circulator).
5. Observe output on CRO/ VSWR meter at port 2.
6. Calculate insertion loss by $(P_1 - P_2)$ and isolation loss. $(P_1 - P_3)$

Repeat this process for various ports of Isolator/Circulator and prepare the observation table

Observations and calculations:

Beam voltage=
Beam current=

Isolator:

| Sr. No. | Input Port (Voltage/Power) | Output port (Voltage/Power) |
|---------|----------------------------|-----------------------------|
| 1 | P1= | P2= |
| 2 | P2= | P1= |

Circulator:

| Sr. No. | Input Port (Voltage/Power) | Output port (Voltage/Power) | Terminated Port |
|---------|----------------------------|-----------------------------|-----------------|
| 1 | P1= | P2= P3= | P3/P2 |
| 2 | P2= | P3= P1= | P1/P3 |
| 3 | P3= | P1= P2= | P2/P1 |

Sample calculations of Insertion Loss and Isolation factor:

Conclusion:

Questions:

1. What is the basic concept of Isolator?
2. What are the different types of Isolators?
3. What is the basic concept of Circulator?
4. What are the different types of Circulators?
5. What is Insertion loss?
6. What is Isolation?
7. What is input VSWR of a circulator or isolator?
8. What is Faraday rotation in Ferrites?
9. What are the applications of circulator?

References:

- 1.M. Kulkarni, "Microwave and Radar engineering", 3rd edition, Umesh Publications
- 2.M L Sisodia& G S Raghuvanshi, "Basic Microwave Techniques and Laboratory Manual", New Age International (P) Limited, Publishers.