

**Indian Institute of Information Technology, Allahabad**

**Electronics and Communication Engineering Department**

**Course Name: Microwave Engineering Lab**

## **Experiment-6**

**Aim – To Study the Attenuation & Insertion Loss of Fixed and variable Attenuator.**

# To study the Attenuation and Insertion Loss of Fixed and Variable Attenuator

## Study of Attenuators

### Apparatus required:

- 1 Microwave source
- 2 Isolator
- 3 Frequency meter
- 4 Variable attenuator
- 5 Slotted line
- 6 Tunable probe
- 7 Detector mount
- 8 Matched termination
- 9 SWR meter.

### Theory:

The attenuators are two port bi-directional devices which attenuate power when inserted into the transmission line.

$$\text{Attenuation A (dB)} = 10 \log_{10} \left[ \frac{P_1}{P_2} \right]$$

Where

$P_1$  = Power absorbed or detected by the load without the attenuator in the line.

$P_2$  = Power absorbed/detected by the load with attenuator in line.

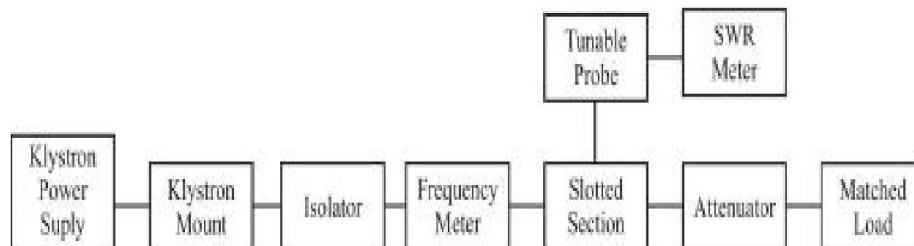
The attenuators consist of a rectangular wave guide with a resistive vane inside it to absorb microwave power according to their position with respect to side wall of the wave-guide. As electric field is maximum, at center in TE<sub>10</sub> mode, the attenuation will be maximum if the vane is placed at center of the wave-guide. Moving from center toward the side wall, attenuation decreases in the fixed attenuator, the vane position is fixed where as in a variable attenuator, its position can be changed by help of micrometer or by other methods.

Following characteristics of attenuators can be studied

1. Input SWR.
2. Insertion loss (in case of variable attenuator).
3. Amount of attenuation offered into the lines.
4. Frequency sensitivity i.e. variation of attenuation at any fixed position of vane and frequency is changed.

## Procedure:

1. Input SWR Measurement
  - a. Connect the equipments as shown in the figure.
  - b. Energize the microwave source for maximum power at any frequency of operation.
  - c. Measure the SWR with the help of tunable probe, Slotted line and SWR meter as described in the experiment of measurement of low and medium SWR.
  - d. Repeat the above step for other frequencies if required.



**Setup for VSWR, Insertion Loss & Attenuation measurement of Attenuator**

2. Insertion Loss /Attenuation Measurement
  - a. Remove the tunable probe, attenuator and matched termination from the slotted section in the above set up.
  - b. Connect the detector mount to the slotted line, and tune the detector mount also for maximum deflection on SWR meter (Detector mount's output should be connected to SWR meter).
  - c. Set any reference level on the SWR meter with the help of gain control knob of SWR meter. Let it be  $P_1$ . Now connect the attenuator in between slotted line & detector mount.
  - d. Set the variable attenuator to zero attenuation position and record the reading of SWR meter. Let it be  $P_2$ . Then the insertion loss of test attenuator will be  $P_1 - P_2$  dB.
  - e. Now, change the micrometer reading and record the SWR meter reading in dB. Find out Attenuation value for different position of micrometer reading and record the readings to plot a graph.
  - f. In the same way you can test the fixed attenuator which can give you only the single attenuation value.
  - g. Now change the operating frequency and all the step can be repeated for finding frequency sensitivity of variable attenuator.

**Note:** For measuring frequency sensitivity of variable attenuator the position of micrometer reading of the variable attenuator should be same for all frequencies in operation.

<b>Micro meter reading of variable attenuator (mm)</b>	<b>SWR reading (dB)</b>