

Experiment No.-06

Introduction to Microwave Test Bench

Aim:

To understand the functioning of various components of a microwave test bench and to perform basic measurements using microwave sources, isolators, frequency meters, attenuators, slotted lines, tunable probes, and detector mounts.

Apparatus Required:

1. Microwave Source (Gunn diode/Klystron)
2. Isolator
3. Frequency Meter
4. Variable Attenuator
5. Slotted Line
6. Tunable Probe
7. Detector Mount
8. Waveguide Setup
9. Power Supply Unit
10. Oscilloscope or Power Meter
11. Cables and Connectors

Theory:

A microwave test bench is a laboratory setup used for generating, transmitting, and analyzing microwave signals. These signals operate at frequencies typically above 1 GHz and require specialized components for measurement and manipulation. The basic components of a microwave test bench are as follows:

(Students are required to draw the block diagram of microwave test bench noted during lab session).

Microwave Source

A microwave source generates electromagnetic waves in the microwave frequency range. Common sources include Gunn diodes and Klystrons, which produce a stable and tunable signal. The frequency of the signal can be varied, and the output is fed to the waveguide system for testing.

Isolator

The isolator is a non-reciprocal device that allows the microwave signal to pass in one direction only, preventing reflected signals from reaching the source and potentially damaging it. It ensures stable operation by blocking reverse power flow.

Frequency Meter

A frequency meter measures the exact frequency of the microwave signal. The meter operates by resonating at specific frequencies, which allows the operator to adjust and determine the source frequency accurately.

Variable Attenuator

The variable attenuator is used to adjust the power level of the microwave signal without altering its frequency. By changing the attenuation, the signal strength can be controlled to test different power levels in the waveguide and detectors.

Slotted Line

A slotted line is a waveguide section with a longitudinal slot. It is used to study standing wave patterns and to measure the Voltage Standing Wave Ratio (VSWR). By moving a tunable probe along the slotted line, the position of voltage maxima and minima can be identified.

Tunable Probe

The tunable probe is inserted into the slotted line to measure the intensity of the electric field at various points along the waveguide. This measurement helps in visualizing the standing wave pattern.

Detector Mount

The detector mount houses a detector (such as a diode or thermistor) that converts microwave energy into an electrical signal. The output is then connected to a power meter or oscilloscope for analysis.

Observations:

1. Record the operating frequency measured by the frequency meter.
2. Note down the power levels observed at different attenuation settings.
3. Record the positions of maxima and minima along the slotted line.
4. Calculate the wavelength of the microwave signal.
5. Plot the field distribution based on probe measurements.

Conclusion:

In this experiment, we have successfully studied the various components of a microwave test bench, including the microwave source, isolator, frequency meter, variable attenuator, slotted line, tunable probe, and detector mount.