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Experiment No:

Title: To Plot Standing Wave Pattern and Measure SWR for Open, Short, and Matched Termination at Microwave Frequency Using Slotted Section with Probe Carriage

Objectives:

The objective of this experiment is to study the standing wave pattern in a microwave transmission line, measure the Standing Wave Ratio (SWR), and observe the effects of different terminations (open, short, and matched) on the standing wave pattern. This experiment aims to provide students with hands-on experience in working with microwave frequencies and understanding the importance of impedance matching.

Equipment Needed:

1.Signal Generator: This generates the RF signal.

2.Power Meter: Measures the power of the signal.

3.Directional Coupler: Used to sample the signal without affecting the main signal.

4.Load: Represents the desired load (e.g., an antenna).

5.SWR Meter: This can be a standalone unit or a function integrated into some power meters.

Procedure:

Set Up the Equipment:

Connect the signal generator to the input of the directional coupler.

Connect the directional coupler output to the input of the load.

Connect the load to the power meter.

Set Frequency:

Set the signal generator to the frequency you want to test.

Calibrate the Power Meter:

Before taking any measurements, calibrate your power meter according to the manufacturer's instructions. This typically involves setting the meter to read zero when there's no signal.

Measure Forward Power (Pf):

Apply the signal and measure the power going towards the load (forward power).

Measure Reflected Power (Pr):

Measure the power reflected back from the load. This can be done by using a termination on the output of the directional coupler.

Calculate SWR:

Use the formula: $SWR = (1 + \sqrt{(Pr/Pf)}) / (1 - \sqrt{(Pr/Pf)})$

Interpret SWR:

SWR of 1 indicates a perfect match (ideal condition).

SWR above 1 indicates some amount of mismatch, which means not all power is being transferred to the load.

Optional: Plotting the Standing Wave Pattern:

For this, you would need to take measurements at multiple points along the transmission line (at intervals of $\lambda/2$ or $\lambda/4$). Record Pf and Pr at each point.

Plot the SWR along the transmission line. It should show a periodic pattern of high and low SWR points.

Theory:

Standing Waves: When a microwave signal is transmitted along a transmission line, it can create standing waves if it encounters impedance mismatches. These standing waves are characterized by nodes (points of minimum amplitude) and antinodes (points of maximum amplitude).

Standing Wave Pattern: The slotted section with the probe carriage is used to measure the electric field at different positions along the line. By moving the probe carriage, you can obtain readings at various points, allowing you to visualize the standing wave pattern.

SWR (Standing Wave Ratio): SWR is a measure of the degree of impedance matching in the transmission line. It is defined as the ratio of the maximum amplitude of the electric field (E_max) to the minimum amplitude (E_min) along the line. A high SWR indicates poor impedance matching, while a low SWR (typically 1:1 for a perfectly matched system) indicates good impedance matching.

Terminations: The experiment involves using open, short, and matched terminations. Open termination represents a high impedance, short termination represents a low impedance, and matched termination represents the correct impedance. These terminations will cause reflections and affect the standing wave pattern, which you will measure and analyze.

Conclusion: