



# SNS College of Engineering

An Autonomous Institution

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Redesigning Common Mind & Business Towards Excellence



Build an Entrepreneurial Mindset Through Our Design Thinking FrameWork

## DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

**COURSE NAME : 19EC602 – Microwave and Optical Engineering**

**III YEAR / VI SEMESTER**

### **Unit III- MICROWAVE MEASUREMENTS**

**Topic VSWR Measurement**



# INTRODUCTION

- VSWR is a measure of how well a microwave signal is transmitted through a system, specifically a transmission line, to a load (like an antenna).
- It's the ratio of the maximum voltage to the minimum voltage of the standing wave pattern created when there's an impedance mismatch.
- A VSWR of 1 indicates a perfect match (no reflection), while higher values indicate greater mismatch and more power reflected back.



# MEASUREMENTS OF VSWR



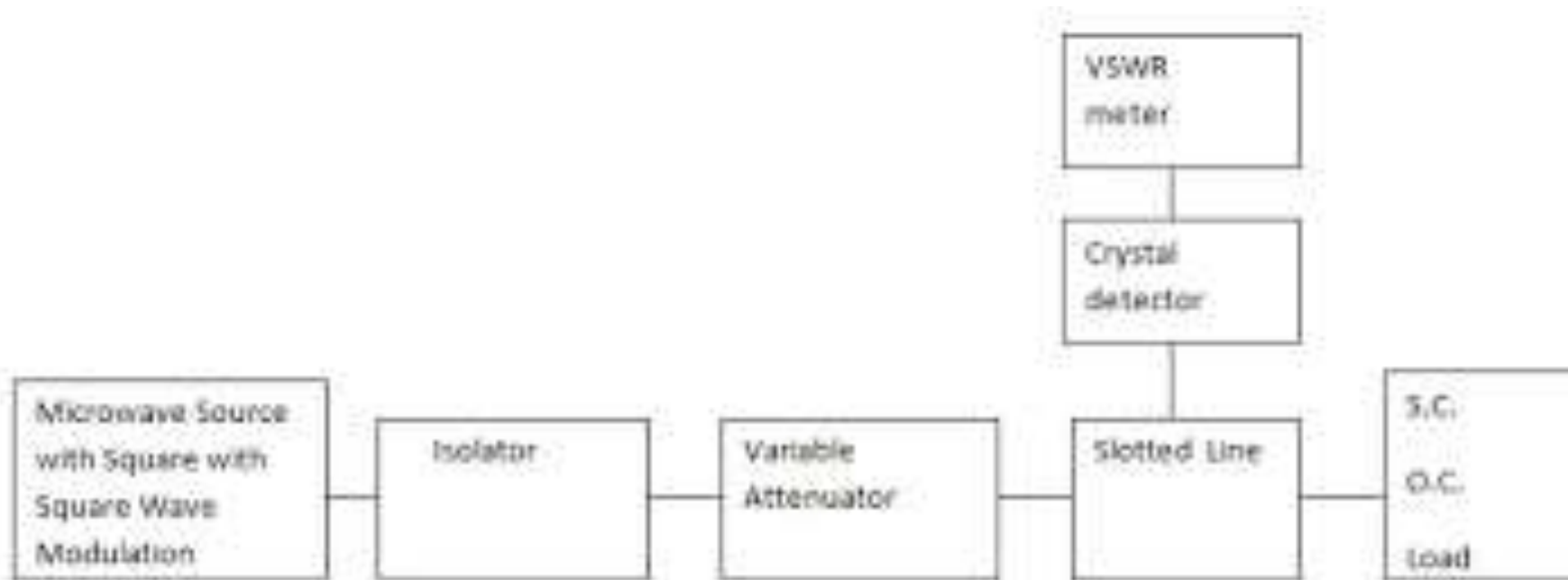
- The strength of these standing waves is measured by Voltage Standing Wave Ratio (VSWR).
- The ratio of maximum to minimum voltage gives the VSWR, which is denoted by S.

$$S = V_{\max} / V_{\min} \\ = 1 + \rho / 1 - \rho$$

- Where,  $\rho$  = reflection co-efficient =  $P_{\text{reflected}} / P_{\text{incident}}$



# BLOCKDIAGRAM



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# TYPES OF VSWR MEASUREMENT



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The measurement of VSWR can be done in two ways,

- Low VSWR measurements ( $S < 10$ )
- High VSWR measurements ( $S > 10$ )

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# LOW VSWR MEASUREMENT

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## Measurement of Low VSWR ( $S < 10$ )

- The measurement of low VSWR can be done by adjusting the attenuator to get a reading on a DC millivoltmeter which is VSWR meter.
- The readings can be taken by adjusting the slotted line and the attenuator in such a way that the DC millivoltmeter shows a full scale reading as well as a minimum reading.
- Now these two readings are calculated to find out the VSWR of the network.

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# HIGH VSWR MEASUREMENT

## Measurement of High VSWR ( $S > 10$ )

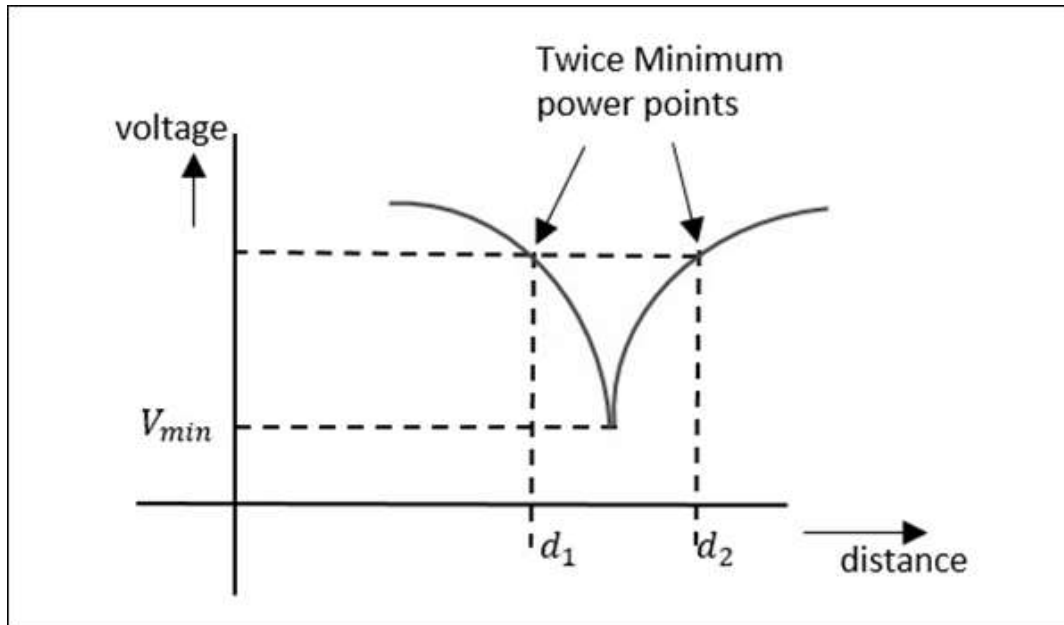
- The measurement of high VSWR whose value is greater than 10 can be measured by a method called the **double minimum method**.
- In this method, the reading at the minimum value is taken, and the readings at the half point of minimum value in the crest before and the crest after are also taken.

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# WORKING



Now, the VSWR can be calculated by a relation, given as

$$VSWR = \frac{V_{max}}{V_{min}} = \frac{V(d_2)}{V(d_1)}$$

Where,  $\lambda_g$  is the guided wavelength

$$\lambda_g = \frac{\lambda_0}{\sqrt{1 - (\lambda_0/\lambda_c)^2}}$$

Where ,  $\lambda_0 = c/f$





# ADVANTAGES

- Simple and Quick Measurement:**

VSWR measurements are relatively straightforward to perform using readily available equipment, offering a quick way to assess the impedance matching of a microwave system.

- Indication of Mismatch:**

A high VSWR value (deviation from 1:1) clearly indicates a mismatch between the load and the transmission line, alerting engineers to potential problems.

- Easy to Interpret:**

VSWR values are easy to understand and interpret, allowing engineers to quickly assess the quality of the impedance match.



# DISADVANTAGES

- **Limited Information:**

VSWR only provides information about the magnitude of the reflected signal, not its phase or frequency dependence, which can be crucial for characterizing more complex systems.

- **Susceptible to Errors:**

VSWR measurements can be affected by errors in the measurement system, such as cable imperfections, poor connector quality, and calibration issues.

- **Not Ideal for Complex Systems:**

For highly complex microwave systems with multiple components and frequency bands, VSWR measurements may not provide a complete picture of the system's performance.



Any Query????

Thank you.....

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