



# SNS COLLEGE OF ENGINEERING

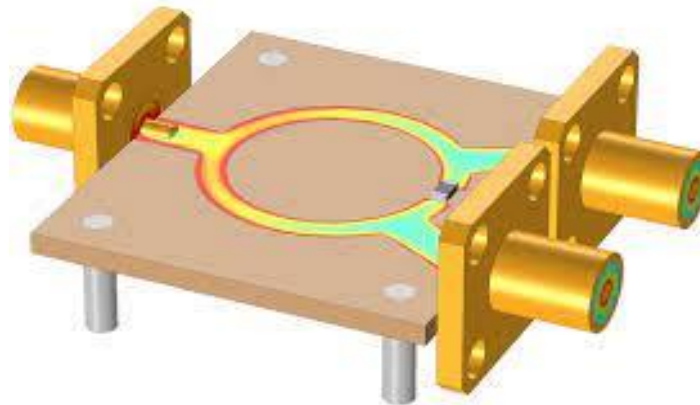
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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING



## 19EC602- MICROWAVE AND OPTICAL ENGINEERING

### UNIT-3 VSWR





## Voltage Standing Wave Ratio VSWR

The standing wave is formed when the incident wave gets reflected. The standing wave which is formed, contains some voltage. The magnitude of standing waves can be measured in terms of standing wave ratios.

The ratio of maximum voltage to the minimum voltage in a standing wave can be defined as Voltage Standing Wave Ratio VSWR . It is denoted by "S".

$$S = \frac{|V_{max}|}{|V_{min}|} \quad 1 \leq S \leq \infty$$





VSWR describes the voltage standing wave pattern that is present in the transmission line due to phase addition and subtraction of the incident and reflected waves.

Hence, it can also be written as

$$S = \frac{1 + \rho}{1 - \rho}$$

The larger the impedance mismatch, the higher will be the amplitude of the standing wave. Therefore, if the impedance is matched perfectly,

$$V_{max} : V_{min} = 1 : 1$$

Hence, the value for VSWR is unity, which means the transmission is perfect.





## VSWR



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

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

The measurement of VSWR can be done in two ways,  
Low VSWR and High VSWR measurements.

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

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.

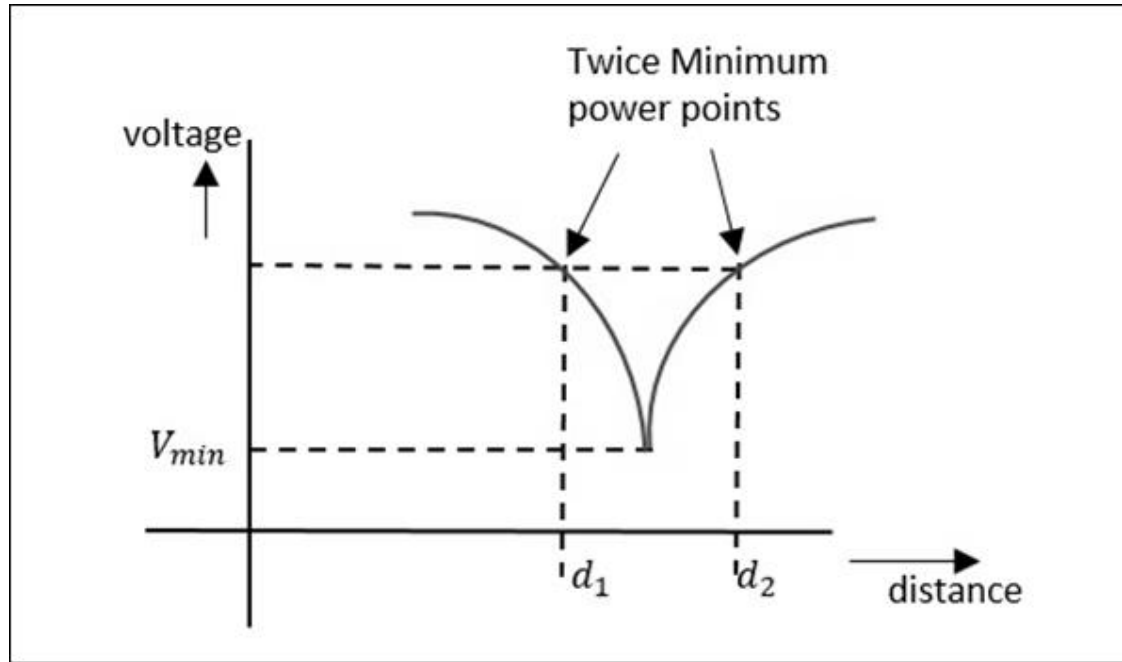




## Measurement of High VSWR $S > 10 > 10$

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. This can be understood by the following figure.







## VSWR



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

$$VSWR = \frac{\lambda_g}{\pi(d_2 - d_1)}$$

Where,  $\lambda_g$  is the guided wavelength

$$\lambda_g = \frac{\lambda_0}{\sqrt{1 - \left(\frac{\lambda_0}{\lambda_c}\right)^2}} \quad \text{where } \lambda_0 = c/f$$





## VSWR



As the two minimum points are being considered here, this is called as double minimum method. Now, let us learn about the measurement of impedance.







Thank  
you

