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Batch: A2 Roll No.: 16010322014
Experiment / assignment / tutorial No. 3
Grade: AA / AB / BB / BC / CC / CD /DD

Signature of the Staff In-charge with date 12/8/25

TITLE: Measurement of VSWR by using slotted waveguide

AIM: To Measure VSWR of following loads :Open circuit ,short circuit, Matched termination & Horn antenna

OUTCOME: Analyse microwave passive components for RF measurements
Understand microwave communication system aspects

Purpose:

Any mismatched load leads to reflected waves resulting in standing waves along the length of line. VSWR is the measure of value of this mismatch.

Stepwise-Procedure:

1. Klystron Power Supply Setting:
   Beam Voltage 230-300 V D.C.
   Beam Current 20-30 mA
   Modulation Frequency "FIXED".
   Modulation Signal in "AM" mode or "INT"
2. Adjust the values of beam voltage to less than 300V and beam current to less than 30mA.
3. Adjust the repeller voltage from power supply for any mode to get sufficient output on C.R.O.
4. Measure Vmax and Vmin for different loads such as Short, Open, Horn antenna and Matched termination.

   Calculate S= VSWR= Vmax / Vmin (for all given loads),

5. Knowing VSWR, calculate reflection coefficient (τ), by using the relation:

   Reflection Co-efficient=(S-1)/(S+1)

6. Knowing reflection coefficient, we can calculate transmission coefficient by using the relation
   Transmission Co-efficient T= 1+ $|\tau|$

Calculations:

VSWR= S=Vmax/ Vmin for given load

VSWR =S = $(1+\tau) / (1-\tau)$

Reflection Co-efficient= $\tau = (S-1)/(S+1)$

Transmission Co-efficient $T = 1 + |\tau|$

Observations:

	Short circuit	Open circuit	Horn Antenna	Matched Termination
Vmax	490	252	180	212
Vmin	24	144	148	186
VSWR (S)	20.41	1.75	1.21	1.13
Reflection Coefficient (τ)	0.906	0.272	0.095	0.061
Transmission Coefficient (T)	1.906	1.272	1.095	1.061

Conclusion:

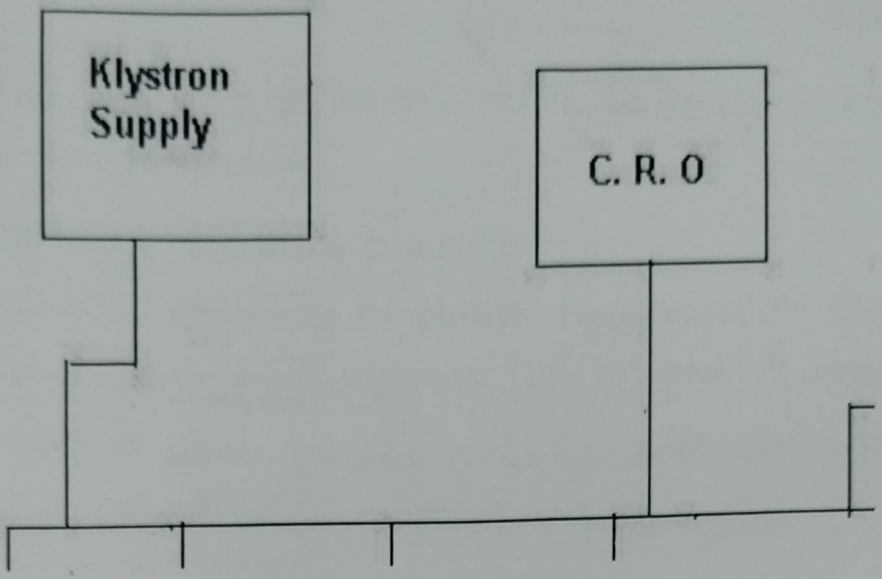
Compare the theoretical and practical values of VSWR, Reflection coefficient and comment on the variation in results.

In this experiment, we have measured VSWR, reflection coefficient and transmission coefficient for four different types of load

→ Short circuit
→ Open circuit
→ Horn Antenna
→ Matched Load

We have observed that SC has the highest VSWR indicating highly unmatched load (20.41) whereas the matched termination has the least VSWR

Microwave Bench Set up:



Measurement of VSWR

Signature of faculty in-charge

Practical Calculations

Short circuit $V_{max} = 490$ $V_{min} = 24$

$$S = \frac{(1+\Gamma)}{(1-\Gamma)} = \frac{V_{max}}{V_{min}} = \frac{490}{24} = 20.41$$

$$\Gamma = \frac{(S-1)}{(S+1)} = \frac{20.41-1}{20.41+1} = 0.906$$

$$T = 1+|\Gamma| = 1+0.906 = 1.906$$

Open circuit $V_{max} = 252$ $V_{min} = 144$

$$S = \frac{V_{max}}{V_{min}} = \frac{252}{144} = 1.75 \qquad \Gamma = \frac{(S-1)}{(S+1)} = 0.272$$

$$T = 1+|\Gamma| = 1+0.272 = 1.272$$

Horn Antenna $V_{max} = 180$ $V_{min} = 148$

$$S = \frac{180}{148} = 1.21 \qquad \Gamma = \frac{1.21-1}{1.21+1} = 0.095$$

$$T = 1+|\Gamma| = 1+0.095 = 1.095$$

Matched Termination $V_{max} = 212$ $V_{min} = 186$

$$S = \frac{212}{186} = 1.13 \qquad \Gamma = \frac{1.13-1}{1.13+1} = 0.061$$

$$T = 1+|\Gamma| = 1+|0.061| = 1.061$$

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Theory Questions:-

Q1] Explain the concepts of VSWR, Reflection coefficient and transmission coefficient.

→ VSWR [Voltage Standing Wave Ratio]
It measures the efficiency of power transmission from a source through a transmission line to load. A high VSWR means more power is being reflected back, & a low VSWR means efficient transmission.

→ Reflection coefficient
It indicates how much of the incident signal is reflected back due to impedance mismatch.

$$\Gamma = \frac{Z_L - Z_0}{Z_L + Z_0}$$

[$Z_L \rightarrow$ load impedance
$Z_0 \rightarrow$ characteristic impedance]

If $\Gamma = 0$: No reflection
$\Gamma = 1$: Total reflection

→ Transmission coefficient(T)
It represents the portion of the signal that passes through to the load.

$$T = 1 - |\Gamma|^2$$

If $T = 1$ All power transmitted
$T = 0$ No power transmitted

Q2] Find ideal values of VSWR, Reflection coefficient and Transmission coefficient for Short, Open & Matched load.

Short circuit

$Z_L = 0$

$$\Gamma = \frac{Z_L - Z_0}{Z_L + Z_0} = \frac{-Z_0}{Z_0}$$

$$\Gamma = -1$$

$$VSWR = \frac{1+|\Gamma|}{1-|\Gamma|} = \frac{1+|-1|}{1-|-1|} = \infty$$

$$T = 1 + |\Gamma| = 1+1 = 2$$

Open circuit

$Z_L = \infty$

$VSWR = \infty$

$$\Gamma = \frac{Z_L - Z_0}{Z_L + Z_0} = 1$$

$$VSWR = \frac{1+|\Gamma|}{1-|\Gamma|} = \infty$$

$$T = 1 + |\Gamma| = 2$$

Matched circuit

$Z_L = Z_0$

$$\Gamma = \frac{Z_L - Z_0}{Z_L + Z_0} = 0$$

$$VSWR = \frac{1+|\Gamma|}{1-|\Gamma|} = \frac{1+0}{1-0} = 1$$

$$T = 1 + |\Gamma| = 1$$