Somaiya Vidyavihar University
K J Somaiya School of Engineering

Batch: A12 Roll No.: 16010322014
Experiment / assignment / tutorial No. 5
Grade: AA / AB / BB / BC / CC / CD /DD

Signature of the Staff In-charge with date 2/9/25

**TITLE: Measurement of Impedance by the reflectometer technique**
**AIM:** Measurement of Impedance by the reflectometer technique using the Directional Coupler.

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

**Purpose:**

1. Impedance measurement of any microwave device is important for matching.
2. If the device is not properly matched with characteristic impedance of wave-guide, there will be reflections resulting in standing wave pattern.
3. If the device impedance is perfectly matched with characteristic impedance of wave-guide, maximum power will be transferred and there will be no reflections.
4. Reflectometer technique is superior to slotted wave-guide method since it measures ratio of two dissimilar magnitudes of (incident, reflected) voltages while later measures the ratio of nearly equal magnitudes:
   (incident voltage + reflected voltage)/(incident voltage – reflected voltage)
   So accuracy of result is high.

**Method:**

Reflection coefficient, $\rho = \sqrt{(P_r / P_i)} = V_r / V_i$

Knowing $\rho$ we can calculate VSWR and impedance by using the relations,

$$S = (1 + \rho)/(1 - \rho) \quad \text{and} \quad \rho = (z - z_o)/(z + z_o)$$

Where $z_o$ is the known wave impedance and z is the unknown impedance.

**Procedure:**

1. Klystron Power Supply Setting:
   a) Beam Voltage 230-300 V D.C.
   b) Beam current 20-30 mA.
   c) Modulation Frequency "FIXED".
   d) Modulation Signal in "AM" mode or "INT"
2. Energize microwave power source and tune the detector for maximum output on the C.R.O.
3. This experiment can be performed using a single unidirectional coupler.

4. The forward/incident voltage ($V_i$) is measured by connecting the directional coupler in forward direction, as shown in fig.
5. To measured reflected voltage ($V_r$), the directional coupler is reversed, as shown in fig.
6. Compute ρ, VSWR and impedance by using the above relations.

$Z_0 = 50\,\Omega$

**Observation:**

1. Forward voltage ($V_i$) = 1.04 V.
2. Reflected voltage ($V_r$) = 21.2m V.

**Calculations:**

Reflection coefficient( ρ): $\frac{V_r}{V_i} = \frac{21.2 \times 10^{-3}}{1.04} = 0.020$

VSWR: ~~1+9~~ $\frac{1+\rho}{1-\rho} = 1.408$

Impedance: $0.020 = \frac{Z-50}{Z+50}$

$Z = ?$ $\rho = \frac{Z-Z_0}{Z+Z_0}$

**Result:**

The unknown impedance of the load is found to be 52.0408 Ω.

$0.0202 + 1 = Z - 50$

$Z - 0.0202 = 51$

$0.982 = 51$

$Z = 52.0408\,\Omega$

**Conclusion:**

(The conclusion should discuss briefly about results.)

In this experiment, we have measured impedance by reflectometer technique using a directional couples.
It is found that impedance matching is achieved as result is close to 50Ω

**Hardware Setup:**