DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE NAME : 19EC602 – Microwave and Optical Engineering

III YEAR / VI SEMESTER

Unit III- MICROWAVE MEASUREMENTS

Topic : Power measurement

INTRODUCTION

The Microwave Power measured is the average power at any position in waveguide.

Power measurement can be of **three** types.

•Measurement of Low power (0.01mW to 10mW)

Example − Bolometric technique

•Measurement of Medium power (10mW to 1W)

Example − Calorimeter technique

•Measurement of High power (>10W)

Example − Calorimeter Watt meter

Measurement of low power

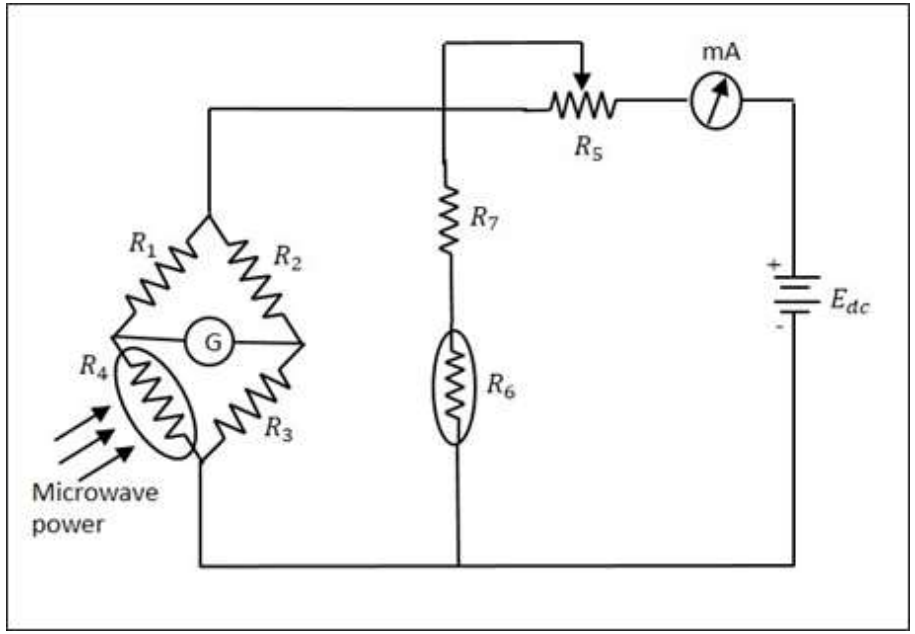
- Measurement of Low Power The measurement of Microwave power around 0.01mW to 10mW, can be understood as the measurement of low power.
- Bolometer is a device which is used for low Microwave power measurements. The element used in bolometer could be of positive or negative temperature coefficient.
- For example, a barrater has a positive temperature coefficient whose resistance increases with the increase in temperature.

Measurement of low power

- Thermistor has negative temperature coefficient whose resistance decreases with the increase in temperature.
- Any of them can be used in the bolometer, but the change in resistance is proportional to Microwave power applied for measurement.
- This bolometer is used in a bridge of the arms as one so that any imbalance caused, affects the output. A typical example of a bridge circuit using a bolometer is as shown in the following figure

Bolometer Measurement

The milliammeter here, gives the value of the current flowing. The battery is variable, which is varied to obtain balance, when an imbalance is caused by the behavior of the bolometer. This adjustment which is made in DC battery voltage is proportional to the Microwave power. The power handling capacity of this circuit is limited



Measurement of medium power

•The measurement of Microwave power around 10mW to 1W, can be understood as the measurement of medium power. A special load is employed, which usually maintains a certain value of specific heat.

•The power to be measured, is applied at its input which proportionally changes the output temperature of the load that it already maintains. The difference in temperature rise, specifies the input Microwave power to the load.

•The bridge balance technique is used here to get the output. The heat transfer method is used for the measurement of power, which is a Calorimetric technique

Measurement of high power

•The measurement of Microwave power around 10W to 50KW, can be understood as the measurement of high power. The High Microwave power is normally measured by Calorimetric watt meters, which can be of dry and flow type.

• The dry type is named so as it uses a coaxial cable which is filled with di-electric of high hysteresis loss, whereas the flow type is named so as it uses water or oil or some liquid which is a good absorber of microwaves.

•The change in temperature of the liquid before and after entering the load, is taken for the calibration of values. The limitations in this method are like flow determination, calibration and thermal inertia, etc

ADVANTAGES

•**Non-Intrusive and Non-Invasive:** Microwave sensors can perform measurements from a distance without physically interfering with the process or system, which is beneficial in various applications.

•**Stability:** Microwave measurements are stable in various conditions because the resonant frequency depends on the physical dimensions of the sensor.

•**Penetration and Volume Measurement:** Microwaves can penetrate most materials (except metals), allowing for measurements on the volume of the material, not just the surface.

•**Permittivity Difference:** Microwave sensors can exploit the difference in permittivity between water and other materials, making them well-suited for measuring water content in multiphase flow.

DISADVANTAGES

Cost: Microwave measurement systems, especially those operating at higher frequencies for better results, can be expensive.

Spatial Resolution: Microwave measurements, due to the long wavelengths involved, have limited spatial resolution..

Calibration and Compensation: Microwave measurements often require separate calibration for each material under test.

Universality: Microwave measurement techniques are often application-specific, limiting their universality.

Any Query????

Thank you……