

BOLOMETER AND RF POWER MEASUREMENT USING BOLOMETER

Introduction:

In many industrial applications, the measurement of power is very important aspect. The considerations for the measurement of power are different for different frequency ranges. The direct measurement of power is very difficult in A.F. and RF. ranges. But it is convenient to measure voltage or current in A.F. and RF. ranges. Hence indirectly power is obtained by using relation,

$$P = \frac{V^2}{R} = I^2 \cdot R$$

If we consider a frequency range well above RF. range, then it is a microwave frequency range. In the microwave ranges, the parameters such as voltage, current, impedances are distributed throughout the length of the circuit. Moreover these parameters change their values with the variation in geometry of the circuit. So it is difficult to measure voltage and current at microwave frequency ranges, but the power can be measured accurately. Thus the direct measurement of power is possible with actual load replaced by dummy load

Power measurement at audio frequency:

The power measurement at audio frequencies (upto 20 kHz) is carried out using a substitute load for the actual load. This is called dummy load. The dummy load is generally a resistance whose value is known. The dummy load is connected at the output of the device under test. The voltage across the dummy load or current through the dummy load is measured using instruments like rectifier, thermocouple type meters which can work at high frequencies. As the resistance of dummy load is known, the output power can be measured as,

$$P = \frac{V^2}{R} = I^2 R$$

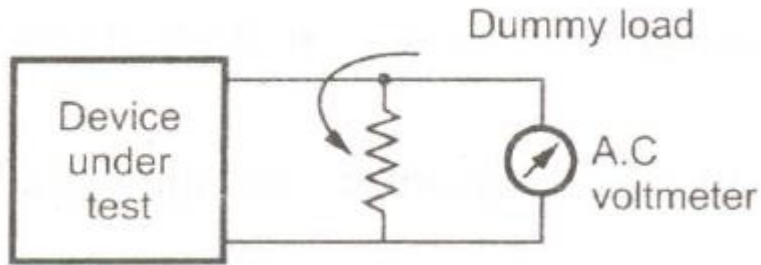
where

P = Output power to be measured

V = Voltage across dummy load

I = Current through dummy load

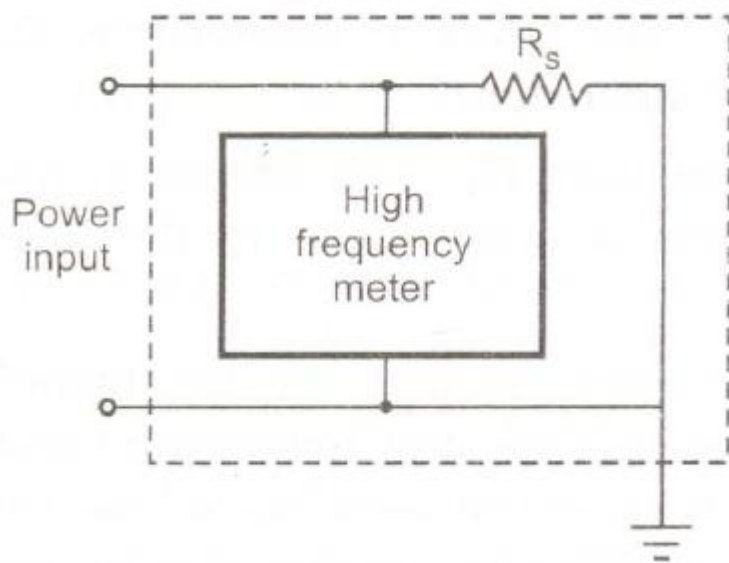
R = Resistance of dummy load



The resistance of dummy load is approximately equal to the output impedance of the device under test. It is connected across the device under test. The resistance R should be able to dissipate the power applied to it. The A.C. voltmeter which is a high resistance rectifier type instrument is used to measure voltage across the dummy load. As the dummy load resistance R is fixed and known then power is V^2 / R where V is voltage measured by a.c. voltmeter. In such a case the scale of the a.c. voltmeter can be calibrated to measure the power output of the device under test. This scale is calibrated in decibels as the power measured at audio frequency range is generally specified in decibels (dB).

Power measurement at radio frequency:

The method of using a dummy load and a voltmeter can be used at radio frequencies upto 500 MHz also. In such a case, the voltmeter and load resistor are usually combined into a single absorption type power meter as shown in the Fig.



The resistance R_s is so designed that its value remains constant over the entire range of frequencies of interest. The voltmeter is a high frequency meter which is capable of responding to high frequency signals with high accuracy. The power is calculated by using the basic relationship as,

$$P = \frac{V_s^2}{R_s}$$

where $V_s =$ Voltmeter reading

In practice the standard resistors are available which have constant value for frequencies ranging from d.c. to 4 GHz. This type of power meter is used to measure power below 500 MHz only.

To measure power at high frequencies from 500 MHz to 40 GHz two special type of absorption meters are popularly used. These meters are,

1. Calorimeter power meter
2. Bolometer power meter

Both these meters use the sensing of heating effects caused by the power signal to be measured.

Source : <http://elearningatria.files.wordpress.com/2013/10/ece-iii-electronic-instrumentation-10it35-notes.pdf>