Q- FACTOR OF A CAVITY

1. OBJECTIVE: Measurement of the Q-Factor of a Cavity.

Apparatus

1. Gunn/Klystron source
2. Isolator
3. Variable attenuator 20db.
4. Wave meter.
5. Slotted line
6. Tunable detector   2 Nos
7. VSWR meter.

2. THEORY:

The microwave cavities are basically of two types:

   a) Transmission type

   b) Absorption type

The transmission type cavity transmits maximum power at resonant frequency and absorption type absorbs the power at the resonant frequency. Cavities are used both as circuit elements and as measuring instruments.

The Q-factor of a cavity has the same meaning as the Q of a resonant circuit lower frequency. It is defined as

$$Q = w\frac{Maximum\ Energy\ stored}{Power\ Loss}$$

Energy stored in the cavity depends on the volume, and the power loss depends on the losses in the conducting walls of the cavity. Approximate value of the Q of the cavity is

$$Q = \frac{V}{A\ S}$$

V = Volume of the cavity

A = Surface area

S = Skin depth.

The intrinsic or unloaded Q_L is greater than the total or loaded Q which includes the effect of coupling mechanism. The loaded Q_L of a cavity may be measured very simply by observing the shape of its resonance curve as a function of frequency. The Q_L of the cavity is determined from

$$Q_L = \frac{f_0}{f_2 - f_1}$$

F_0 resonant frequency.

F_1 & F_2 the 3 dB points.

3. PROCEDURE:
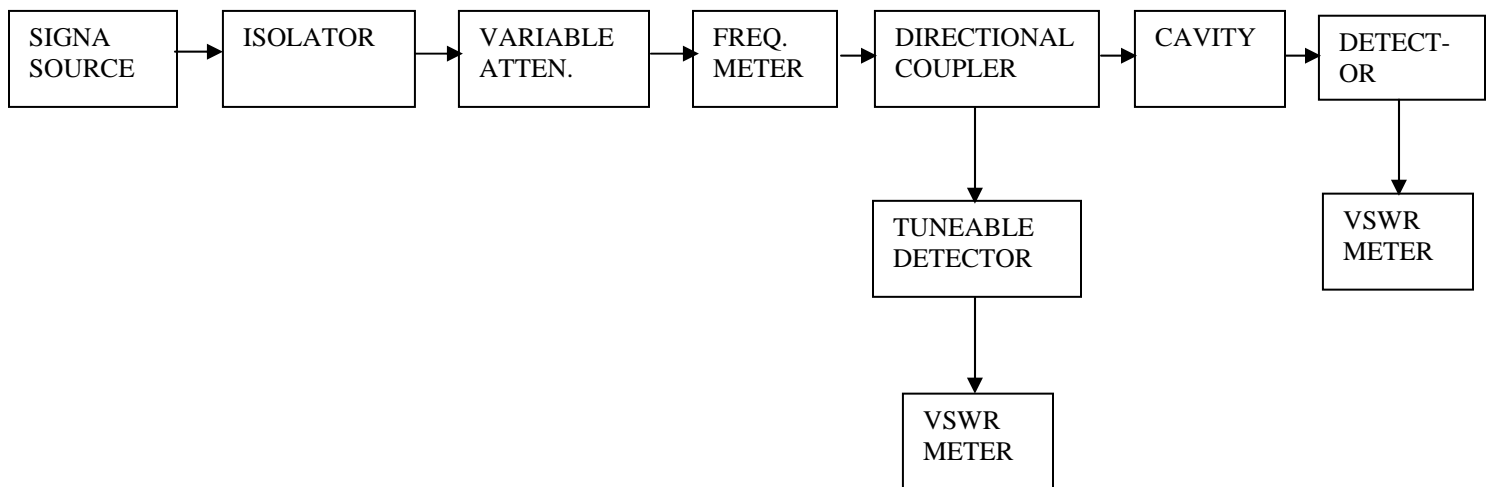
1. Set the microwave bench as shown in the figure.
2. Set the cavity of any position. Set the source frequency output shows a dip if it is a absorption type of vice-versa.

3. keeping the input power to the cavity constant (by using variable attenuator, if necessary), measure the frequencies $(F_1 \& F_2)$ of signal source setting where the output power changes by 3 dB from the resonant frequency value.
4. The graph between frequency and power output may also be drawn.
5. Calculate the value of Q using the given formula. Repeat the different cavity settings.

4. PRECAUTIONS:

1. For calculating Q-factor of the cavity of particular resonant frequency, the cavity position should remain unchanged?
2. For a cavity which has a high/good Q-factor, the signal source should be very stable and it should have capability of frequency variation of at least one megahertz.
3. A tunable detector should be used and it should be tuned for each operating frequency.

6. REFERENCES:

1. Introduction to Microwaves by G.J. Wheeler.
2. 'Microwave Principles' by H.J. Reich.