Q- FACTOR OF A CAVITY

Objective: Measurement of the Q-Factor of a Cavity.

List of Equipment

1. Microwave source with square wave modulation
2. Isolator
3. Variable attenuator
4. Slotted line
5. Tunable detector
6. VSWR meter.

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 is greater than the total or loaded Q_L 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

Procedure:

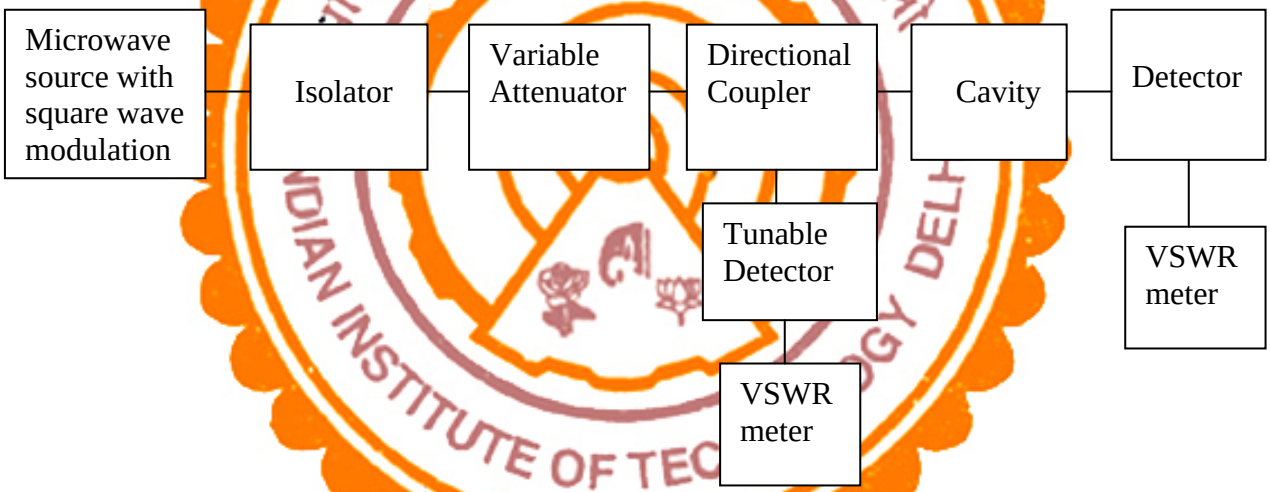

Fig 1. Experimental arrangement for measurement of Q factor of a Cavity

1. Set the frequency and amplitude of the source by slider and knob respectively. Do square wave modulation using modulator.
2. Press "**Forward Direction**" in isolator and adjust attenuator to minimum by slider.
3. Now in cavity window first set the '**Resonant Frequency**' by using slider.

4. Move the slider given below to get the power at the resonance. Fix the value by pressing "**Power (dB) at resonance**" button.
5. Move the slider to get the first 3 dB point corresponding to the resonant frequency and fix the value by pressing the "**First 3 dB point**" button.
6. In the same manner fix the "**Second 3 dB"** point.
7. Now to know the calculated bandwidth press "**Bandwidth**" button.
8. Press "**Q-Factor**" button to fix the Q factor.

Discussions

1. Does the Q-depend on the coupling of the cavity?
2. What are the different types of coupling to cavity?
3. Give the equivalent circuit of a cavity at the resonant frequency, and also below and above the resonance frequency.
4. What are the dimensions of rectangular, cylindrical & coaxial cavity to achieve maximum Q?
5. Where the fixed and variable cavities used?

References

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