Batch: A2 Roll No.: 16010322014
Experiment / assignment / tutorial No. 1
Grade: AA / AB / BB / BC / CC / CD /DD

Signature of the Staff In-charge with date 29/7/25

TITLE: To study waveguide test bench components

AIM: To understand functioning and specifications of various waveguide test bench components at X- band

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

Study Rectangular Waveguide Test Bench (X-band) for its functioning and various components with specifications using hardware setup and manual provided.

Based on your study answer following questions:

Q1. What are different types of waveguides? Give advantages and applications of each type of waveguide.

Q2. Explain with suitable diagrams following microwave bench components

1. Slotted waveguide section
2. Detector Mount
3. Absorption type frequency meter
4. TEEs : E-plane, H-Plane, Magic Tee
5. Multi-hole Bidirectional Coupler

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1 The different types of waveguides are:

Rectangular waveguide

Advantages → a) Low attenuation

b) Wide frequency bandwidth for single mode propagation.

c) excellent mode stability for fundamental propagation modes.

Applications → 1) Radar communication

2) Transport of AR RF signals at frequencies in SHF band & higher.

Circular waveguide

Advantages → a) Easy to manufacture and join

b) TM01 modes are rationally symmetrical hence, rotation of polarization can be overcome.

Applications → 1) Relating it in radars to connect the horn of antenna feeding a polarized reflector.

2) Short and medium distance broadband communication.

3) Used for handling high power of energy

4) Used in airborne radar.

Elliptical waveguide

Advantages → a) Allows smaller bending radas than purely round waveguide

b) Cost economically as microwave feeders.

Applications → 1) In elliptical form are the most effective feeder for microstrip Antenna.

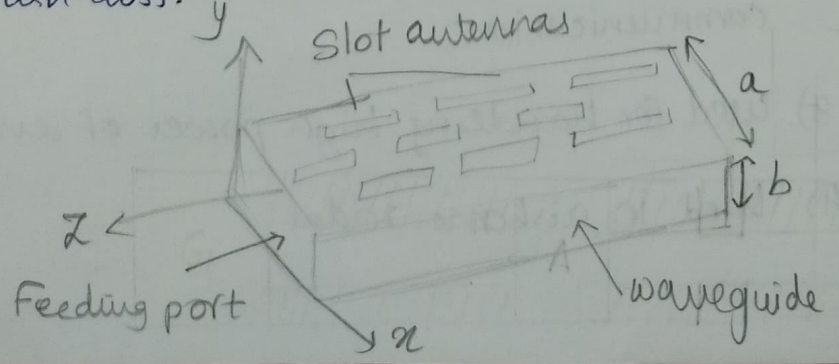
2) In particle accelerators, they are used to guide and manipulate microwave signal for accelerating particles.

A2] The following microwave bench components are as follows:-

1. Slotted waveguide section

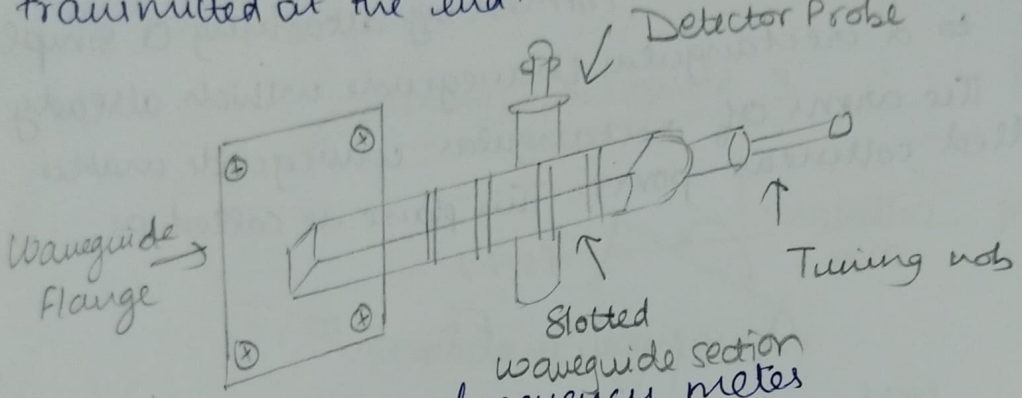
It is used to measure VSWR. It consists of transmission line. A travelling probe carriage and a facility for attaching and detaching instruments.

The slot is in the centre of the broad face to not radiate for any power of dominant mode. The precision built, probe carriage having cm scale with a vernier reading of 0.1mm least count is used to note the position of probe. Additionally, it can be used to measure impedance, reflections coeff, & return loss.



Detector Mount

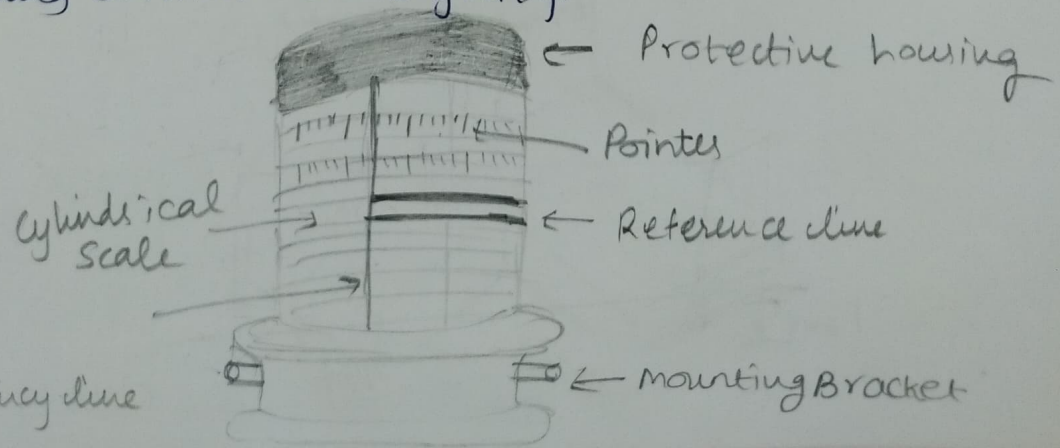
Detector Mounts are used to detect the low frequency signals with the help of IN23 detector diode. The detector diode is mounded on the broad wall of waveguide. A shorting plunger is used to tune the maximum power near detector diode. To provide a match b/w the microwave transmission system and the detector mount is the final stage on a microwave bench which is transmitted at the end.



3. Absorption type frequency meter

It is a device which measures the frequency of signal with its frequency meter the micrometer type frequency.

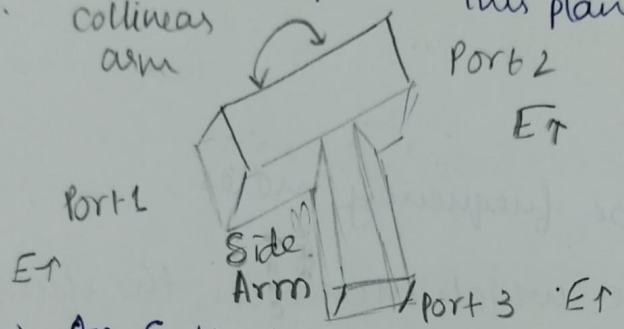
It also gives provision to couple the signal to waveguide. For an x-band frequency meter, the micrometer type frequency meter is absorption type & uses a high TEm tuned cavity & precision piston. The drive mechanism is coupled to a micrometer designed to given wideband working without ambiguity.



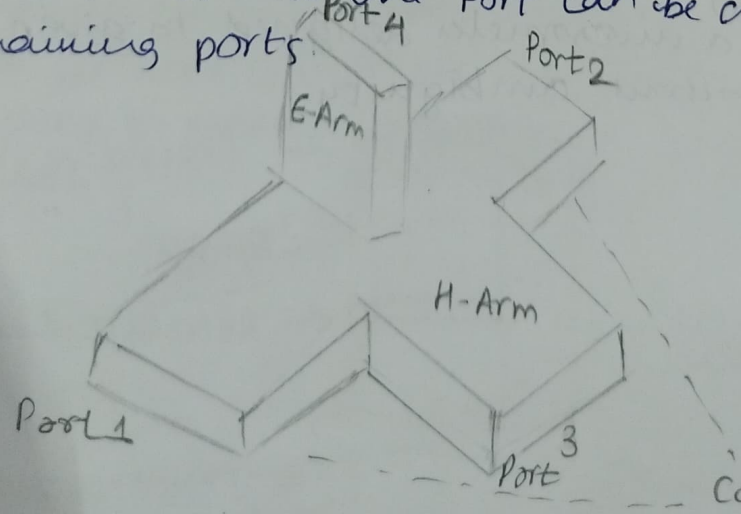
4. TEEs.

E-Plane → TEE junction is formed by attaching a waveguide to the broader dimension of a rectangular waveguide which already has 2 ports.
The arms of the rectangular waveguide make two ports called collinear ports i.e. port1 in port2 while the new port3 is called as side arm. The E-plane is called as series TEE.

H-Plane → TEE junction is formed by attaching a simple waveguide to a rectangular waveguide which already has 2 ports. The arms of rectangular waveguide makes 2 ports called collinear ports. This plane is called as shunt TEE.



Magic Tee → An E-H plane TEE junction is formed by attaching two simple waveguides one parallel and other series to a rectangular waveguide which already has two ports. This is called as magic TEE, like all the couplers splitters structures the magic TEE can be used as a power combiner/divider. It is ideally lossless so that all powers into one port can be assumed to exit the remaining ports.



Multi-hole Bidirectional Couples

It is a device which samples a small amount of microwave power for measurement purposes.

The power measurement includes incident power, reflected power VSWR.

They can be samples of a small amount of microwave power for measurement purposes.

The coupling is done through holes on broad side of the waveguide.