

LAB No. 05

Familiarization with Microwave Equipment

Objective:

The objective of this exercise is to familiarize the students with the equipment they will be using in this laboratory. All equipment and their description are provided below. We have two type of microwave trainers.

1. Microwave Communication Trainer IT – 8000 (By INFINIT)
2. Microwave Trainer PT 94124 (By PUDAK)

Microwave Communication Trainer IT – 8000:

The IT – 8000 trainer introduces the students to the fundamental principles of microwave communications through a wide range of practical activities. The most important topics covered in the experiments are mentioned in the manual before each experiment / exercise. The microwave trainer consists of different components and peripherals equipment required to perform the experiments.

The Trainer consists of the following equipments:

1. Standard Signal Generator (SSG):

The IT -8001 is a X-band signal generator, this instrument is especially designed for laboratory to carry on a wide range of research activities in the X-band.



Figure 1.1: Standard Signal Generator

Specifications of SSG:

- 1) It is able to generate microwave signal in the range of 7.5 GHz to 12.5GHz.
- 2) Relative error is $\pm 1.5\% \pm 1$. (Output power of less than 5mW pm).
- 3) Frequency stability: $\pm 5 \times 10^{-4}$ /15 minutes (the instrument after warm up).

Signal Selection Portion:

From this part of the SSG we are able to select what type of signal the SSG will generate. The SSG has the ability to generate CW (Carrier Wave), IntAM (Internal Amplitude Modulated Wave), ExtAM (External Amplitude Modulated Wave) and ExtSYNC (External Sync). The Signal Selection Portion is shown below:

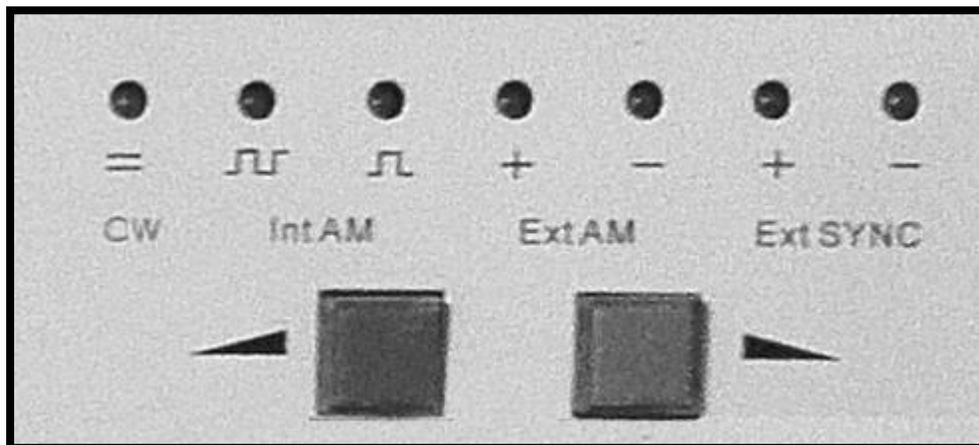


Figure 1.2: Signal Selection Function

ExtAM:

ExtAM stands for "External Amplitude Modulated Wave". This is selected when the SSG is given an external audio signal for AM from any source. The ExtAM connector is shown in figure 1.2.

ExtSYNC:

ExtSYNC stands for "External Synchronization". This is selected when the SSG external sync from any other source. The ExtSYNC is shown in figure 1.2.

IntAM:

IntAM stands for "Internal Amplitude Modulated Wave". It is an internal amplitude modulated wave, modulated using a square wave and pulse wave. This can be controlled using the knobs shown in figure 1.2.

RF Out:

This is the output section of the SSG; whenever we need a signal from SSG to be delivered out to any device we use this connector. You can connect the BNC connector as a frequency source to any RF waveguide adaptor.

2. Power Meter:

Power meter is a dynamic range device used for the measurement of power inside the microwave waveguides. The power meter is shown below:



Figure 1.3: Power Meter

Specifications:

- 1) The power meter needs a 30 minute warm up to function properly and display stable readings.
- 2) The working error of this meter is $\pm 5\%$.
- 3) The N-connector coaxial cable connects to its input port to be able to measure the power of the signal. The N-Connector is shown below:
- 4) The range of the power meter is 0.01uW to 300mW. The range can be varied by the knob (can be seen in picture below). The results on this meter can be displayed in digital and analog.

- 5) Call Factor: The calibration Factor can be adjusted to requirement by using the Cal Factor toggle provided on the power meter.

3. VSWR Meter:

IT-8003 is a frequency selective detector of weak signals using a precision measuring amplifier. This amplifier gives us the ability to measure Standing Wave Ratio and other important parameters.

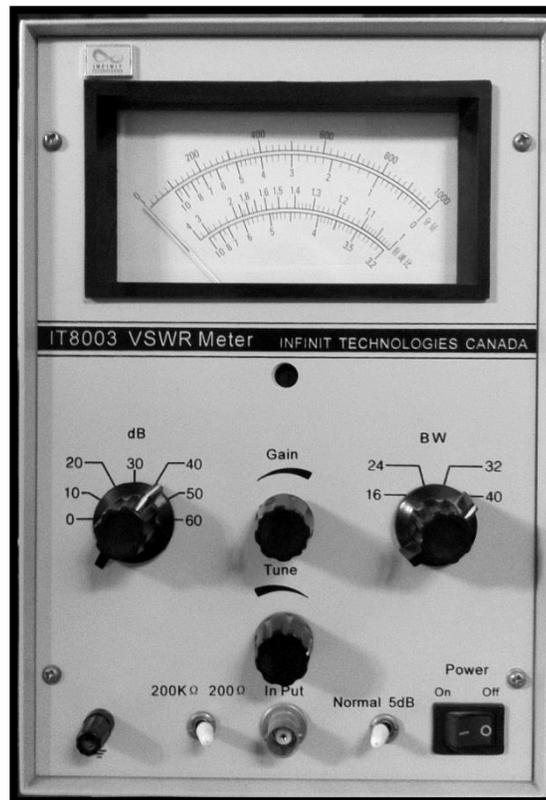


Figure 1.4: VSWR Meter

Specifications:

- 1) Gives you the ability to adjust dB toggle, BW toggle, Gain and Tune as per your requirements
- 2) Adjustment of the meter on normal or 5dB mode can be made through the following switch

4. The Variable Attenuator:

As the name suggests a variable attenuator is a device that is used to reduce power level at the input of the microwave component and the attenuation measurements.

There are two types of variable attenuators; they are Rotary Vane Attenuator (not available in laboratory) and Side Vane Attenuator (available in laboratory). In the Side Vane Attenuator a plastic fiberglass blade with a resistive coating is used to produce attenuation. The blade is inserted vertically into the waveguide, parallel to the short side's walls. The resulting attenuation depends upon the position of the blade in the waveguide. Attenuation is increased by the moving the blade towards the center of the waveguide. Attenuation characteristics differ from one attenuator to the next hence each attenuator has to be individually calibrated.

5. Waveguide Detect Mount:

A Waveguide Detect Mount is a resistive element whose resistance is a function of its internal temperature. If a detector is placed in the path of a microwave signal, the detector will absorb the energy thereby increasing its own temperature. This increase in temperature causes the resistance of the detector to decrease. Variations in the resistance of the detector can be measured with Wheatstone bridge.

The waveguide detector mount in this manual is permanently housed in a section of a waveguide. The two matching screws and the movable short circuit are used to maximize the power reaching the waveguide detector mount.

Microwave Trainer PT-94124:

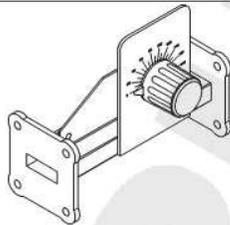
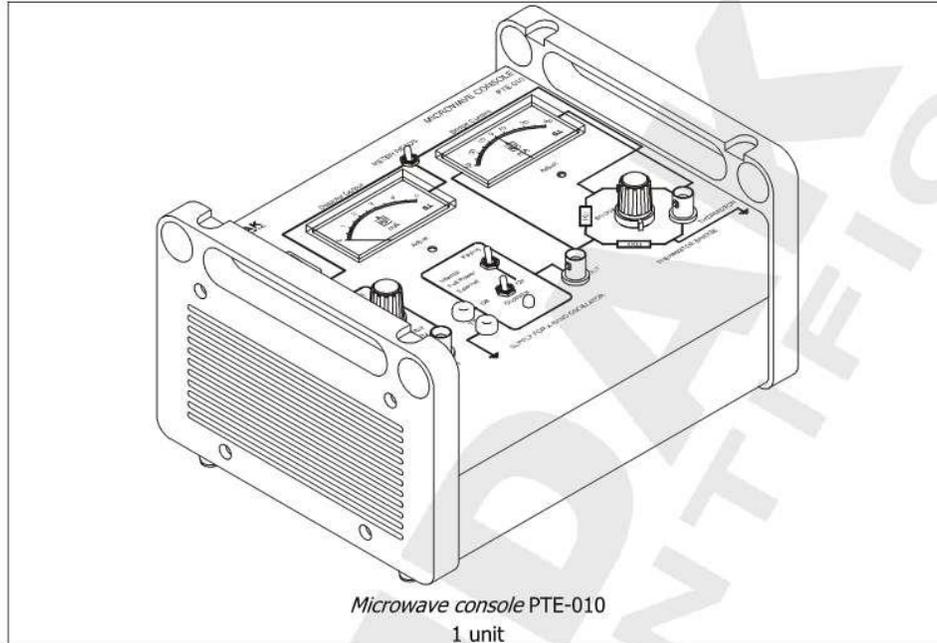
The PT – 94124 trainer by PUDAK introduces the students to the fundamental principles of microwave communications through a wide range of practical activities. The most important topics covered in the experiments are mentioned in the manual before each experiment / exercise. In the manual for each experiment / exercise we have:

1. **Objective:** This shows the target to be achieved after completing the experiment.
2. **Introduction:** This gives a brief prerequisite knowledge for the required experiment.
3. **Reading book:** This gives a list of book to strengthen the knowledge of the topic.
4. **Apparatus needed:** Gives the list of apparatus required to carry out the experiment.
5. **Experiment Procedure:** This is the guide that must be followed in the process of doing the practical activities, since it is closely related to the result.

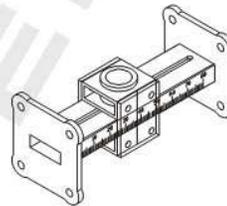
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The Trainer consists of the following equipments:

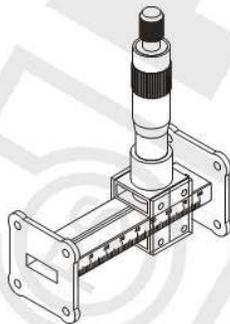
D. Apparatus Figures



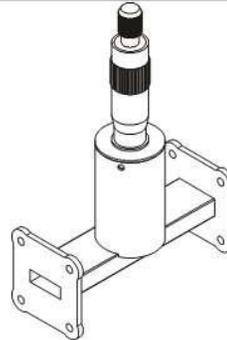
A – Variable Attenuator
2 pieces



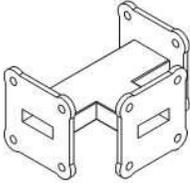
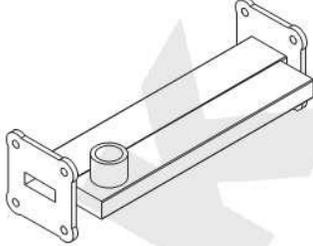
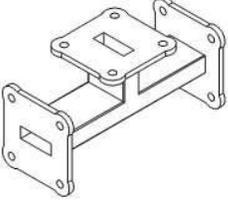
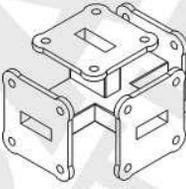
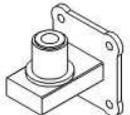
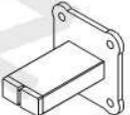
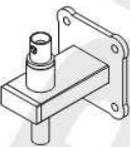
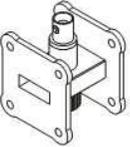
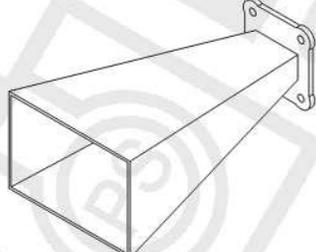
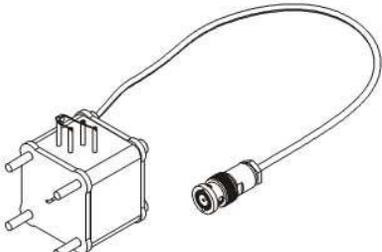
B – Slotted line for use with detector (S)
1 piece

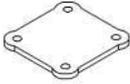
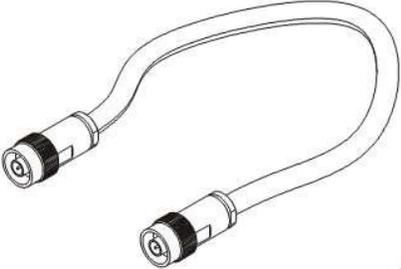
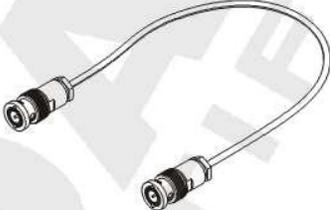
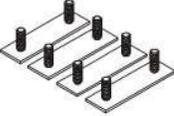
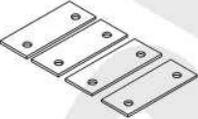


C – Slotted line tuner
1 piece



D – Cavity resonator
1 piece

 <p>E – Shunt tee 1 piece</p>	 <p>F – Directional couple 1 piece</p>
 <p>G – Series tee 1 piece</p>	 <p>H – Hybrid tee 1 piece</p>
 <p>J – Wave guide / coaxial adapter 2 piece</p>	 <p>K – Resistive terminator 1 piece</p>
 <p>L – Bolometer (Thermistor type) 1 piece</p>	 <p>M – Diode detector 1 piece</p>
 <p>N – Horn antenna 2 pieces</p>	 <p>P – X-band oscillator & cable assembly 1 piece</p>

 <p>R – Short circuit terminator 2 pieces</p>	 <p>S – Probe detector assembly for use with B or F 2 pieces</p>
 <p>Coaxial cable (RG8AU) with N connector 1 piece</p>	 <p>Coaxial cable (RG174AU) with BNC connector 2 pieces</p>
 <p>Coupling plates 24 pieces</p>	 <p>Thumb nuts 48 pieces</p>
 <p>Support plates 4 pieces</p>	