MICROWAVES IN THE LABORATORY

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The place for increasing interest and enhancing learning in the area of Microwave/ EM Wave propagation is in the laboratory. If possible the following should be conducted:

(i) computer simulations should be used to demonstrate important concepts. An example of how computers can enhance learning and increase interest is in the area of standing waves. Undergraduates can usually understand standing waves using opposite rotating phasors, but do not realise that each point on the line will vary from a positive to a negative value. A computer simulation of the resultant wave propagating in time will demonstrate that the magnitude of the envelope of the resultant pattern gives the standing wave pattern. The simulation should be shown for a short-circuit, an open-circuit, a match load, and a 25Ω load, see Fig.1.

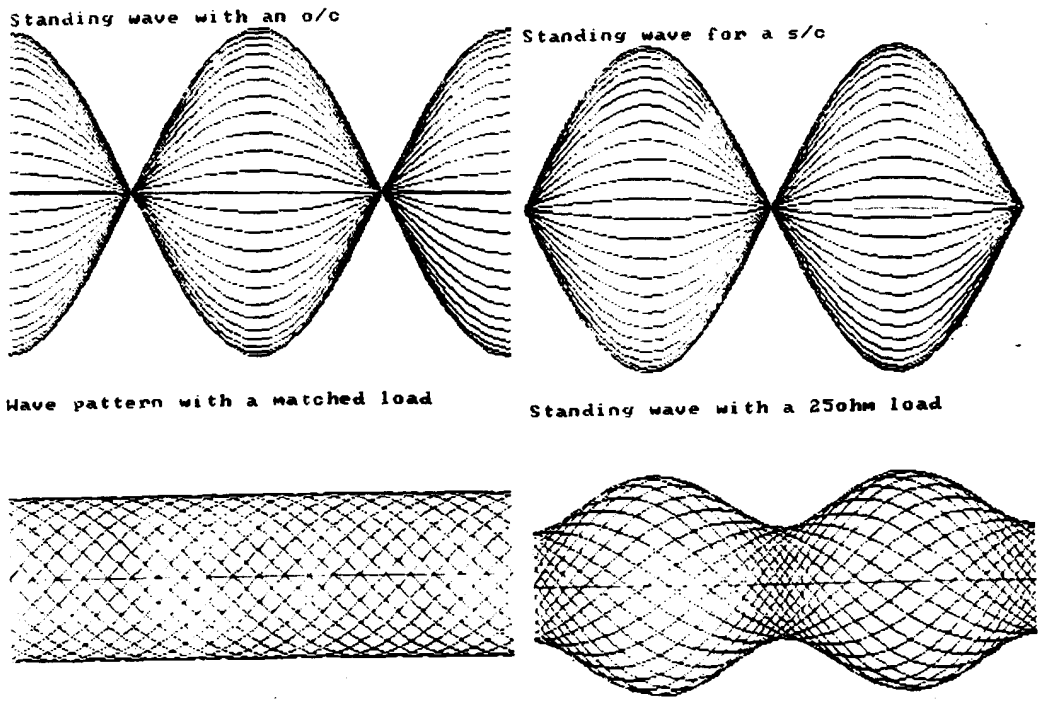

Fig 1: Demonstration of a standing wave pattern in the time domain.

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(ii) a full explanation of all components should be given as well as a demonstration of the experiment, and the reason why it is being conducted. Many people have difficulties understanding how many microwave components operate, or why they are used.

Instruments such as moving coil VSWR meters give little information of the propagation of the waves and are often misread. Oscilloscopes are a much better method of determining guide wavelength, antenna field patterns, wave frequency, attenuation, etc.

An oscilloscope can also be used to determine the VSWR, rather than reading the value from a moving coil display.

The VSWR on the line is simply

$$\text{VSWR} = \frac{V_{max} \text{ on line}}{V_{min} \text{ on line}} = \sqrt{\frac{\text{Max voltage on scope}}{\text{Min voltage on scope}}}$$

The reason for the square-root is simply explained by the fact that detectors measure power levels.

This type of measurement improves accuracy and increases understanding. It should be noted that to improve accuracy the wave should be modulated;

(iii) in the laboratory, and in the report, undergraduates should be encouraged to use computers to obtain results, simulate, etc. This gives the student a taste of 'real-life' computing;

(iv) the mathematics in the laboratory should be kept to a minimum and use of analogies should be maximised. Mathematics tends to turn many undergraduates 'off' and can hide important concepts whereas analogies will stimulate further thought away from the classroom/lab environment. Useful analogies to use are sound, waterwaves and light applied to wave reflections, Doppler shifts, propagation, etc;

(v) the applications of microwaves should be discussed as applied to real-life such as medical, radar, satellite communications, space research, etc;

(vi) the high demand and high salaries paid to RF/Microwave Engineers can also be discussed in an informal manner as well as mentioning local/international companies involved in this field such as Hewlett Packard, Ferranti, Marconi, etc,

(vii) if possible a demonstration of the latest Microwave CAD should be conducted such as Touchstone, Super Compact and MICAD. Reference should be made to the use of modern equipment such as automatic network analysers, and modern test equipment.