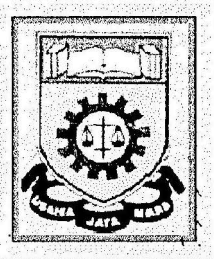
COMPARISON OF DIELECTRIC PROPERTIES USING METAL-BACKED AND TRANSMISSION-REFLECTION METHOD

This thesis is presented in partial fulfilment for the award of the
Bachelor of Electrical Engineering (Honours)
INSTITUT TEKNOLOGI MARA



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APRIL 1999

ACKNOWLEDGEMENT

I would like to express sincere thanks especially to my project advisor, Associate Professor Dr. Deepak. Kumar Ghodgaonkar for his generous contribution and support in completing this project.

A special thanks also goes to the Communication Laboratory Assistant such as Mr. Khalim, Mr. Kamarulzaman and Mr. Azman for their cooperation.

ABSTRACT

This paper presents free-space measurements on metal-backed samples and planar samples such as teflon, polyvinyl-chloride (PVC), polypropylene (PP), polyethylene (PE) and nylon in free-space. This free-space measurement is conducted in an anechoic chamber and operated in the frequency range of 8.0-12.5 GHz.

For metal-backed samples, loss tangents are calculated from the measured reflection coefficient, S_{11}. As for the planar samples, complex permittivity and complex permeability can be calculated from the measured reflection and transmission coefficient S_{11} and S_{21}.

The measurement system consist of transmit and receive horn lens antennas, Wiltron Vector Network Analyzer, mode transitions, printer and coaxial cables. Diffraction effects at the edges of the samples are minimized by using spot-focusing horn lens antennas. Errors due to the multiple reflections between antennas and via the surface of the sample are eliminated by performing a free space LRL (Line, Reflect, Line) calibration technique.

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CHAPTER 1

INTRODUCTION TO MICROWAVES

1.1 Microwave Definition [9]

The term microwaves is used to define all electromagnetic radiation waves whose frequencies lie between 300 MHz and 300 GHz. These frequencies correspond to a range of free-space wavelengths in vacuum from one meter to one millimeter, respectively. In vacuum or air, microwaves travel at the velocity of light, c.

$$c = 2.997 \times 10^8 \text{ meters per second}$$

Microwaves are fairly commonplace in our daily lives. The public first became familiar with them as the form of energy used for radar. Microwaves ovens are commonly used both to cook and to dry foods. Telephone and communication circuits use microwave relay stations to transmit signals over distances of many miles.

Television signals are often transported by means of microwaves, and are sent and received by the typical dish antennas which, in larger sizes, are used also for space communications and for radio astronomy. Guidance, tracking and control of spacecraft also employ microwaves. To a much lesser degree, microwaves are used for nondestructive testing and spectroscopy.

1.2 Microwave for Testing [11]

Basic property of microwaves allowed the penetration of microwave frequencies through a non-conducting material easily compared to a good conducting materials. Non-conducting materials can be categorized as plastics, polymers and composites as