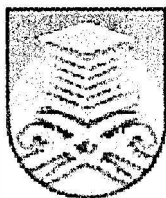


**MEASUREMENT OF S-PARAMETERS CHARACTERIZATION  
USING DIELECTRIC ROD ANTENNA**

This thesis is presented in partial fulfillment for the award of  
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## ABSTRACTS

The rectangular dielectric waveguide (RDWG) technique using dielectric rod antenna is one of a method for the determination of S-parameters and complex permittivity of wide class of dielectric materials of various thickness and cross-section. This project used the RDWG technique experiment setup together with TRL calibration method and Vector Network Analyzer (VNA) to measure S-parameters ( $S_{11}$  and  $S_{21}$ ) and complex permittivity of dielectric samples at X-band frequency (8-12GHz). The dielectric antenna was designed and fabricated using 3D CAD programming.

Measurement is compared with actual published value of material properties to demonstrate the benefit of RDWG technique. Measurement also compared with theoretical model based on microwave mathematical equations. The results of experiments almost close to theoretical data and further suggestion are presented to improve the technique.

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# CHAPTER 1

## INTRODUCTION

The need for accurate and convenient measurement of complex permittivity and complex permeability of material media cannot be overemphasized. Besides providing understanding of electromagnetic wave interaction with matter, complex permittivity and complex permeability information is desirable in many areas of basic and applied research in science and engineering, including process and quality control in industries, diagnostic and therapeutic applications of microwaves in biomedicine, government radiation policy formulation, characterization of reservoir rocks in bore-hole formations and prospecting in geophysical logging. Because of these reasons, it is important to find the best method to measuring complex permittivity and complex permeability which can give an accurate value and economical.

Several methods for the measurement of dielectric properties of materials are available at radio and microwave frequency. They may be classified into destructive and nondestructive technique: the nondestructive technique require laborious sample preparation e.g. partially filled transmission lines, while nondestructive techniques can easily accommodate the sample e.g. free space methods, RDWG method and open-ended method.

In measuring S-parameters characterization and furthermore the complex permittivity of materials, free space measurement technique is usually used. Recently, a new technique using Rectangular Dielectric Waveguide (RDWG) technique has been introduced to determine the S-parameters of specified materials. This technique employs the use of dielectric rod antenna in a form of dielectric-filled rectangular waveguide as a transmitter and a receiver. It has advantages over free space and other methods of measuring S-parameters and complex permittivity because it is fast and efficient for measuring materials with various thickness and cross sections. RDWG technique treats the sample as a double-step discontinuity in an open dielectric waveguide, where the sample inserted between the dielectric rod antennas.