MEASUREMENT OF COMPLEX PERMITTIVITY AND COMPLEX PERMEABILITY BY TRANSMISSION - REFLECTION METHOD IN WAVEGUIDE
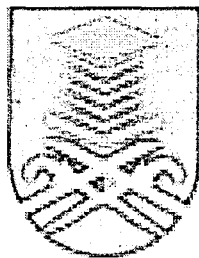
This Project Report is presented in partial fulfillment for the award of the
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ABSTRACT

This microwave measurement of complex permittivity (ε^*) and complex permeability (μ^*) method involve measurement of Forward Transmission coefficient and Forward Reflection coefficients that result when a sample of dielectric material is inserted in a waveguide. Seven types of samples are use in this project. The samples are FGM-125, FGM-40, CISR 50% / 50%, CISR 60% / 40%, CISR 80%/ 20%, Teflon and PVC. These dielectric and magnetic properties were measured by a measurement setup consisting of microwave network analyzer, coaxial cable and coaxial-to- rectangular waveguide adapters. Based on measured value, complex permittivity (ϵ^*) and complex permeability (μ^*) are calculated.

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CHAPTER 1

INTRODUCTION

1.1   Introduction

The knowledge of the complex permittivity and complex permeability of dielectric and magnetic materials is an important issue in many microwave and optical applications. For example, many methods have been proposed to determine the refractive index profile of optical waveguide to predict the waveguide characteristics and to control waveguide production process.

In this project, Transmission – Reflection (TR) method is used to measure complex permittivity and complex permeability. Broadband measurements of complex permittivity and complex permeability are required for multitude of applications. TR method is used because of its relative simplicity.

In this TR measurement method, a sample of material placed in a section of a waveguide and the two – port complex scattering parameters are measured using Vector Network Analyzer (VNA). The scattering equations then relate the measured scattering parameters to the permittivity and the permeability of the sample. In this project, a readily available written program is used to calculate the complex permittivity and complex permeability of the sample. The measured scattering parameters are the Forward Reflection coefficient (S11) and Forward Transmission coefficient (S21).

Seven samples are used in this project. These samples of material are used to measure their dielectric and magnetic properties. The samples are Teflon, PVC, FGM-125, FGM-40, Carbonyl Iron loaded Silicon Rubber (CISR) 50% / 50%, CISR 60% / 40% and CISR 80% / 20%. The

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