

**COMPARISON OF REFLECTION-TRANSMISSION METHOD AND METAL-
BACKED METHOD FOR TEXTILE COMPOSITES USING FREE-SPACE
MICROWAVE TECHNIQUES**

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ABSTRACT

For measurements of dielectric materials, a free-space measurement system was developed in the frequency range of 8 – 12.5GHz. The key components of the measurements system are a pair of spot-focusing horn lens antennas, the network analyzer and the coaxial cables. In this project the objective is to analyze, measure the reflection and transmission coefficients S_{11} and S_{21} of the dielectric materials for textile composites using reflection-transmission and metal-backed methods at microwave frequencies and compare the results for getting the better method in measurement. Complex electric permittivity (ϵ^*) is calculated from the measured values S_{11} and S_{21} by using computer program Fortran 77 for metal-backed method and C++ programming for reflection-transmission method.

TABLE OF CONTENTS

CHAPTER		PAGE
1	INTRODUCTION TO MICROWAVES	
	1.1 Introduction	1
	1.2 Advantages of Microwaves	3
	1.3 Applications of Microwaves	4
2	SCATTERING PARAMETERS	
	2.1 What Are Scattering Parameters?	6
	2.2 Definition	7
	2.3 Introduction	8
3	ANTENNA	
	3.1 Antenna	11
	3.2 Microwave Antennas	12
	3.3 Horn Antennas	13
4	TEXTILE COMPOSITES	
	4.1 Textile Composites	14
	4.2 Textile Structural Composites	14
	4.3 Textile Composite Preforms	16
	4.4 Steps In The Production of Textile Composites	16
5	FREE-SPACE MICROWAVE MEASUREMENT SYSTEM	
	5.1 Free-Space Technique	18

CHAPTER 1

INTRODUCTION TO MICROWAVES

1.1 Introduction

Microwaves, as the name indicates, are small waves, specifically, waves having short wavelength. Since frequency is inversely proportional to wavelength, microwaves frequencies are relatively high. The term *microwave* designates the range of frequencies in the electromagnetic spectrum from about 300 MHz (megahertz) to 300 GHz (gigahertz) (3×10^8 Hz to 3×10^{11} Hz). Figure 1.1 shows the electromagnetic spectrum [1].

The frequency range from 300 MHz to 3 GHz is called the ultra high frequency (UHF) band, from 3 to 30 GHz is the super high frequency (SHF) band, and from 30 to 300 GHz is the extremely high frequency (EHF) band. The upper band is also called the millimeter (mm) wave band, since the wavelength of electromagnetic radiation varies from 10mm at 300 GHz to 1mm at 300 GHz. The complete 3-decade frequency range from 300 MHz at the low end to 300 GHz at the high end is considered as the microwave band. It is to be noted that the wavelength of the electromagnetic radiation across the microwave band varies from 1m at 300 MHz to 1 mm at 300 GHz [2].