



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**MICROSTRIP ANTENNA WITH RECTANGULAR
PATCH SENSOR FOR SOIL CHARACTERIZATION**

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electronic Engineering Technology (Telecommunication) with Honours.

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ABSTRAK

Antena ialah peranti metalik yang direka untuk memancar atau menerima gelombang radio. Antena tampalan microstrip adalah popular dalam komunikasi tanpa wayar yang mengandungi metalisasi kandungan pada substrat tanah elektrik tampalan. Pada masa kini, tidak ada antena khusus untuk mengukur komposit bahan seperti tanah. Jadi, projek ini adalah untuk membangunkan antena microstrip dengan sensor tampalan segi empat tepat untuk pencirian tanah pada kekerapan resonans 2 GHz dan untuk menganalisis prestasi antena berdasarkan hasil perbandingan antara simulasi dan pengukuran. Antena microstrip yang digunakan sebagai aplikasi penderiaan. Sensor tampalan segi empat tepat telah direka menggunakan Perisian Studio Suite CST dan direka menggunakan papan litar bercetak FR4 dan diuji ke tanah yang merupakan tanah organik dan pasir. Antena microstrip dengan sensor tampalan segi empat tepat memancarkan dengan cara refleksi untuk menghasilkan peralihan frekuensi resonans. Dengan antena ini, lebih mudah untuk mengukur kepelbagaian tanah.

ABSTRACT

An antenna is a metallic device designed for radiating or receiving radio waves. Microstrip patch antenna are popular in wireless communication that consist of a patch of metallization on an electric ground substrate. Nowadays, there is no specific antenna to measure the composite of materials such as soil. So, this project is to develop microstrip antenna with rectangular patch sensor for soil characterization at resonance frequency 2 GHz and to analyze the performance of the antenna based on comparison result between simulation and measurement. The microstrip antenna that was used as a sensing application. The rectangular patch sensor has been design using CST Studio Suite Software and fabricated using FR4 printed circuit board and tested towards soil which is organic and sand soil. The microstrip antenna with rectangular patch sensor is radiate in a reflection way to produces a resonance frequency shifting. With this antenna, it easier to measure the permittivity of the soil.

DEDICATION

Specially dedicated to my beloved parents and family with love and care.

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LIST OF SYMBOLS

W	-	Width
L	-	Length
r	-	Reflection Coefficient
Ω	-	Ohm
∞	-	Infinity
%	-	Percent
ϵ_r	-	Permittivity
$\tan \delta$	-	Loss of Tangent
h	-	Thickness
GHz	-	Giga Hertz
MHz	-	Mega Hertz
dB	-	Decibel

LIST OF ABBREVIATIONS

CST	Computer Simulation Technology
FR-4	Flame Retardant 4
VNA	Vector Network Analyzer
VSWR	Voltage Standing Wave Ratio
GPR	Ground Penetrating Radar
RL	Return Loss
PCB	Printed Circuit Board
FDTD	Finite Difference Time Domain
TDR	Time Domain
RMSA	Rectangular Microstrip Antenna
UV	Ultra Violet
AUT	Antenna Under Test

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter discussed a microstrip antenna with rectangular patch sensor for soil characterization that consists of the project background, problem statement, objectives and scope of work.

1.2 Project Background

An antenna may be an electrical device designed to transmit or receive magnetic force waves [1]. It usually works on air and exterior surface but can even be controlled under water or else through soil and ordinary for short distance at certain frequencies. Microstrip patch antennas are popular in wireless communication that consist of metallization on an electric ground substrate of a patch. The patch consists of any shape, but the available shape that is most often used for configuration is rectangular, circular and triangular. A three-layer structure that contains in the simple microstrip patch antenna is substrate, a ground and a patch layer. A microstrip patch antenna on the side view is shown in Figure 1.1 below.

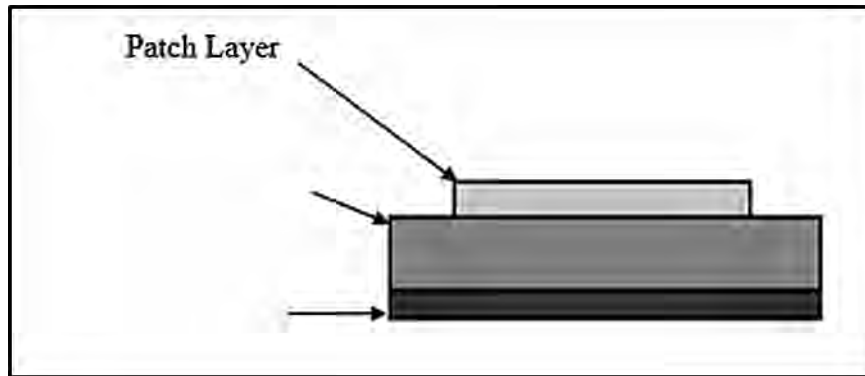


Figure 1.1: Microstrip Patch Antenna on The Side View

In designing of patch sensor are to give a frequency at 2 GHz. The sensor is used to estimate the characterization of soil by using two types of soil which is organic and sand soil. This project can be applied for the sensing application.

In the part of designation and simulation of the antenna, the computer simulation software (CST) were used. To generate antenna designing simulation vary fast the CST software were used compared to other software such as Microwave Office and CST also are able to draw a 3-D configuration of antenna.

The characteristics of associate antenna radiation are investigated by learning parameters like electrical resistance, field pattern form, and radial asymmetry in free area. graph in free area of straight forward antennas, at the side of additional wide used industrial GPR antennas are created. Forms of associate antennas over superimposed mass media are developed for associate off-ground horn antenna exploitation linear transfer functions [2] and so for an antenna operational within the near-field exploitation comparable sets of minute electrical dipoles. The energy division of a protected antenna over varied lossless half-space was studied by [3], associated within the same manner [4] used for model of an antenna to check simulated and measured knowledge. Totally different principles of material constant, and a unique sorts and distribution of soil

characterization are compared. Principal electrical and force field habits are analysed at a range of observation distances from the antenna by employing a total energy metric.

1.3 Problem Statement

Nowadays, an antenna is developed to satisfy the challenge arise and upgrade the antenna for the technology advances but, there is no have a specific antenna to measure the composite of materials. So, the antenna is developed to measure the dielectric constant in a composite material such as the soil which have permittivity. Every material has their own permittivity. Without this antenna, it hard and difficult to measure the permittivity of the material. The rectangular microstrip patch antenna is that the most well-liked uses. In order, supported the issue, the rectangular microstrip patch antenna is appropriate to design for sensing applications, additionally for the advanced technologies. This antenna provides a straight forward of patch sensor for testing and observance soil to detect the soil characterization at 2 GHz of frequency.

1.4 Objectives

This project contains the objectives as:

- i. To study microstrip antenna with rectangular patch sensor for soil characterization.
- ii. To develop a microstrip antenna with rectangular patch sensor for soil characterization at frequency 2 GHz.
- iii. To analyze the performance of the antenna based on the comparison result in the simulation and measurement.