KU BAND SLOT ANTENNA FOR RADAR AND SATELLITE APPLICATIONS

NOR LIZA BINTI TUMERAN

UNIVERSITI TEKNOLOGI MALAYSIA

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To my beloved mother and father

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ABSTRACT

A new type of slot antenna developed by multiple substrates is proposed for Ku Band frequency. The proposed antenna is very suitable for radar and satellite applications. Many antenna designs have complexity in design. To overcome this drawback, a new slot antenna designed is proposed and investigated. There are two main stages involve in this project. The first stage is simple square slot antenna design using FR-4, RT-Duroid and Tarconic substrates. The second stage is simple square slot antenna design with patch antenna using FR-4 substrate. The antenna performance is measured by CST simulation tool.

ABSTRAK

Reka bentuk baru “slot antenna” dengan menggunakan berbagai material adalah dicadangkan dan berfungsi pada frekuensi Ku Band. Antenna yang direka cipta ini sesuai untuk digunakan untuk kegunaan radar dan satellite. Kebanyakan rekacipta antenna adalah kompleks. Untuk memperbaiki masalah ini, rekabentuk baru “slot antenna” akan dicipta dan dikaji. Terdapat dua bahagian didalam project ini. Bahagian pertama adalah rekacipta segi empat antenna dengan menggunakan FR-4, RT Duroid dan Tarconic material. Bahagian kedua adalah membuat segi empat slot antenna bersama “patch antenna” dengan menggunakan FR-4 material. CST digunakan untuk menguji reka bentuk baru antenna ini.

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LIST OF SYMBOLS

ε_r	- Dielectric constant/permittivity
h	- Conductor thickness
f	- Frequency
f_H	- High frequency
f_L	- Low frequency
λ	- Wavelength
Γ	- Reflection coefficient
tan δ	- Conductor loss
Z_L	- Load impedance a
Z_0	- Characteristic impedance.
ω	- Radian frequency
Pr	- Radiated power
Pt	- Transmitted power
H	- Efficiency
Rr	- Radiation resistance
R_L	- Conductor Loss
D	- Directivity
D o	- Maximum directivity
U	- Radiation intensity
Umax	- Maximum radiation intensity
Uo	- Radiation intensity of isotropic source
Prad	- Total radiated power

LIST OF ABBREVIATIONS

CPW	- Co-planar waveguide
D	- Directivity
dB	- Decibels
FCC	- Federal Communication Commission
HPBW	- Half Power Beamwidth
MMIC	- Monolithic microwave integrated circuit
RL	- Return loss
UNII	- Unlicensed National Information Infrastructure
UWB	- Ultra wideband
VSWR	- Voltage standing wave ratio

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CHAPTER 1

INTRODUCTION

1.1 Project Background

Slot antenna is widely used because of low cost, light weight, less complexity and easy fabrication [1]. The shape of the slot was varied to achieve high performance of the antenna. The advantages for slot antenna are many such as wider bandwidth, simple structure, less conductor loss and easy integration with other circuits [2]. Therefore, simple structure of slot antenna with wide bandwidth and low cost will be implemented in this project. To achieve low cost antenna, FR-4 substrate will be used. The proposed slot antenna is for radar and satellite applications. Ku Band is widely used for radar and satellite application.

1.2 Problem Statement

In applications where size, weight, cost, performance and ease of fabrication are important, low profile antennas like microstrip and printed slot antennas are required. Therefore, to have very simple structure Ku-Band antenna, simple shape of rectangular slot antenna is designed

1.3 Objective

To design Ku-Band rectangular slot antenna for radar and satellite applications with a small size, low cost and low profile antenna on different substrates. Frequency ranges between 10GHz to 20GHz.

1.4 Scope of the Project

The scope consists of three parts; design of rectangular slot antenna using FR-4 substrate, design of rectangular slot antenna using RT Duroid substrate and design of rectangular slot antenna using Tarconic substrate. Each design is simulated and the results are analyzed. Wide bandwidth is obtained for adding patch antenna and thickness of the substrate is 1.6mm.

CST software is used for the simulations while MATHCAD is used for computing mathematical expressions. The performance of the square slot antenna is analyzed in terms of its bandwidth, return loss, radiation pattern, voltage standing wave ratio (VSWR) and beamwidth.

1.5 Layout of Thesis

This thesis is organized into 6 chapters. Chapter 1 is the introduction of the slot antenna design. This chapter covers several topics such as project background, problem statement, objective and scope of the project.

Brief theory of the slot antenna and the characteristics of antenna have been discussed in chapter 2. History of research of slot antenna has been covered in this chapter.

Chapter 3 is the methodology of the research project and the antenna design using CST tool. This chapter covers design specification of the slot antenna.

Chapter 4 is the result and discussion parts. This chapter analyzes the initial simulated result of the slot antenna.

Chapter 5 is the end of the chapter. This chapter covers conclusion of the antenna design. Suggestion for future works also has been covered in this chapter.

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