DESIGN OF PROXIMITY MICROSTRIP ANTENNA

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This report is submitted in partial fulfillment of requirements for the award of Bachelor of Electronic Engineering (Telecommunication Electronics Engineering) With Honours.

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Supervisor's Name	: Mohamad Zoinol Abidin Bin Abd Aziz
Date	: 02 May 2008

To My Loving and Parents

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ABSTRACT

The 2.4GHz frequency used in Wireless *LAN* applications. The investigations on a new proximity microstrip antenna, which can be operated at *WLAN* frequency bands of wireless communication are reported. The project presents the design of inset fed and proximity feeding technique using microstrip antenna. The behavior of these antennas are investigate such as return loss, radiation pattern, bandwidth, half power bandwidth (*HPBW*), first null bandwidth (*FNBW*) and gain. The project includes the simulation process using microwave office software, fabrication process using chemical etching and measurement process by using network and spectrum analyzer. The inset fed antenna produced greater return loss at -19dB while the *PCMA* designed gives return loss value at -29dB. The array antenna design for *PCMA* including 1x2, 1x4 and 2x4 configurations. The 2x4 *PCMA* design is the best array configuration that produced bandwidth enlargement up to 25 %. The Microstrip antennas with a proximity-coupled feed enjoy a greater bandwidth as well as easier impedance matching than those with an edge feed. The results show that the antenna has sufficient bandwidth and gain necessary for the above frequency bands and may be used for *WLAN* applications. The array configuration of *PCMA* gives larger bandwidth up to 25% compared to inset fed antenna. Array configuration improved the gain of the antenna as well.

ABSTRAK

Komunikasi tanpa wayar beroperasi pada frekuensi 2.4GHZ. Kajian yang dijalankan adalah tentang *Proximity Micro strip Antenna* yang beroperasi pada frekuensi *WLAN*. Projek ini merangkumi 2 jenis kaedah perambatan isyarat iaitu *inset fed* dan *proximity* menggunakan antenna *microstrip.* Antara parameter yang dititikberatkan di dalam projek ini termasuk kehilangan kuasa, bentuk radiasi, lebar jalur, *half power bandwidth (HPBW), first null bandwidth (FNBW)*, dan gandaan kuasa. Projek ini juga melibatkan proses simulasi, fabrikasi dan pengujian ke atas setiap rekabentuk antenna. Teknik *inset fed* dan *Proximity Coupled Microstrip Antenna,PCMA* direkabentuk menggunakan perisian *microwave office*. Rekabentuk *inset fed* menghasilkan kehilangan kuasa sebanyak -19dB dan teknik *PCMA* menghasilkan kehilangan kuasa paling minimum iaitu sebanyak -29dB. Ciri istimewa dalam antenna *microstrip* ialah melalui konsep *array*. Rekabentuk *array* untuk *PCMA* termasuk susunan 1x2, 1x4 and 2x4. Rekabentu 2x4 menghasilkan lebar jalur yang paling baik hingga mencapai 25%. Antena *microstrip* dengan teknik *PCMA* bukan sahaja mempunyai lebar jalur yang luas tetapi lebih mudah dalam prose *impedance matching*. Keputusan kajian menunjukkan antenna yang mempunyai lebar jalur yang besar dan gandaan kuasa yang tinggi sesuai untuk aplikasi komunikasi tanpa wayar. Konfigurasi *array* untuk teknik *PCMA* menghasilkan lebar jalur yang lebih besar berbanding teknik *inset fed*. Konfigurasi *array* juga meningkatkan gandaan kuasa bagi antenna.

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LIST OF ABBREVIATIONS

w	Width
h	Dielectric Thickness
t	Copper Thickness
L	Length
L_{eff}	Effective Length of the Patch
f_r	Resonance Frequency
Yo	Feed Line
λ	Wavelength
ε_r	Dielectric Constant
ε_o	Permittivity of Free Space
μ_o	Permeability of Free Space
Zo	Load Impedance
ΔL	Dimensions of the patch along its length
w/h	Width-to-height ratio
a	Radius
ℓ	Inset Feed
Q	Antenna Quality Factor
dB	Decibel
dBi	Decibel Isotropic
RL	Return Loss
G	Gain
Pr	Radiated Power
Pi	Input Power
Rin	Real Part
Xin	Imaginary Part

Cc	Coupling Capacitance
S	Distance
MPA	Microstrip Patch Antenna
EM	Electromagnetic
PCMA	Proximity Coupled Microstrip Antenna
IEEE	Institute of Electrical and Electronics Enginerring
WLAN	Wireless Local Area Network
MW2004	Microwave Office 2004
FR4	Frame Resistance 4
ξ	Tangent Loss
MMIC	Monolithic Microwave Integrated Circuit
TEM	Transverse Electric-Magnetic
TX line	Transmission Line
UI	User Interface
UV	Ultra Violet
EM	Electromagnetic
S_{11}	Input Port 1 to Output Port 1
VSWR	Voltage Standing Wave Ratio

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CHAPTER I

INTRODUCTION

1.1 Introduction

This report documents the design process of Proximity Microstrip Antenna at 2.4GHz. Microstrip patch antennas are low-profile radiators that are typically lightweight, small in size, and conformable to planar and non-planar surfaces. Since patch elements are fabricated using printed-circuit technology, they can be manufactured in large quantities to reduce cost and are compatible with monolithic microwave integrated circuit (MMIC) designs. Microstrip antenna consists of dieletric subtsrate, radiated patch and antenna ground plane. The microstrip antennas have disadvantage which narrow bandwidth and low gain.

1.2 Scopes Of Work

This project consists of three major parts. The first scope of the project is to study the concept of proximity microstrip antenna for WLAN applications. The calculation of the parameter for rectangular patch antenna being studied. The simulation processed has been done by using microwave 2006. Then, the comparison between calculation and simulation were investigate. The calculation has been done at frequency 2.4 GHz. The array antenna are designed at 1x2, 1x4 and 2x4 configurations. The designed antenna are fabricated using the FR4 board with dielectric constant of 4.7. Finally, the characteristics of the antenna such as return loss, gain, bandwidth and radiation pattern were measured using appropriate equipments such network and spectrum analyzer.

1.3 Problem Statements

Microstrip patch antennas suffer from a number of limitations as compared to conventional antennas. Microstrip patch antennas have a very high antenna quality factor (Q). Q represents the losses associated with the antenna and a large Q leads to narrow bandwidth and low efficiency. Q can be reduced by increasing the thickness of the dielectric substrate. But as the thickness increases, an increasing fraction of the total power delivered by the source goes into a surface wave. This surface wave contribution can be counted as an unwanted power loss since it is ultimately scattered at the dielectric bends and causes degradation of the antenna characteristics. Other problems such as lower gain and lower power handling capacity can be overcome by using an array configuration for the elements

1.4 Project Objectives

There are 3 main objectives declared for this project to ensure the obtainable of project target. The objectives of this project is to design Proximity Microstrip Antenna and to simulate the design antenna by using Microwave Office software. The designed antenna will be fabricate on the FR4 board. All the objectives will ensure the project progress go fluency and the designed antenna will successfully operate at WLAN frequency, 2.4GHz.

1.5 Project Methodology

There are four main methodology used in this project implementation. The methodology is as listed below:-

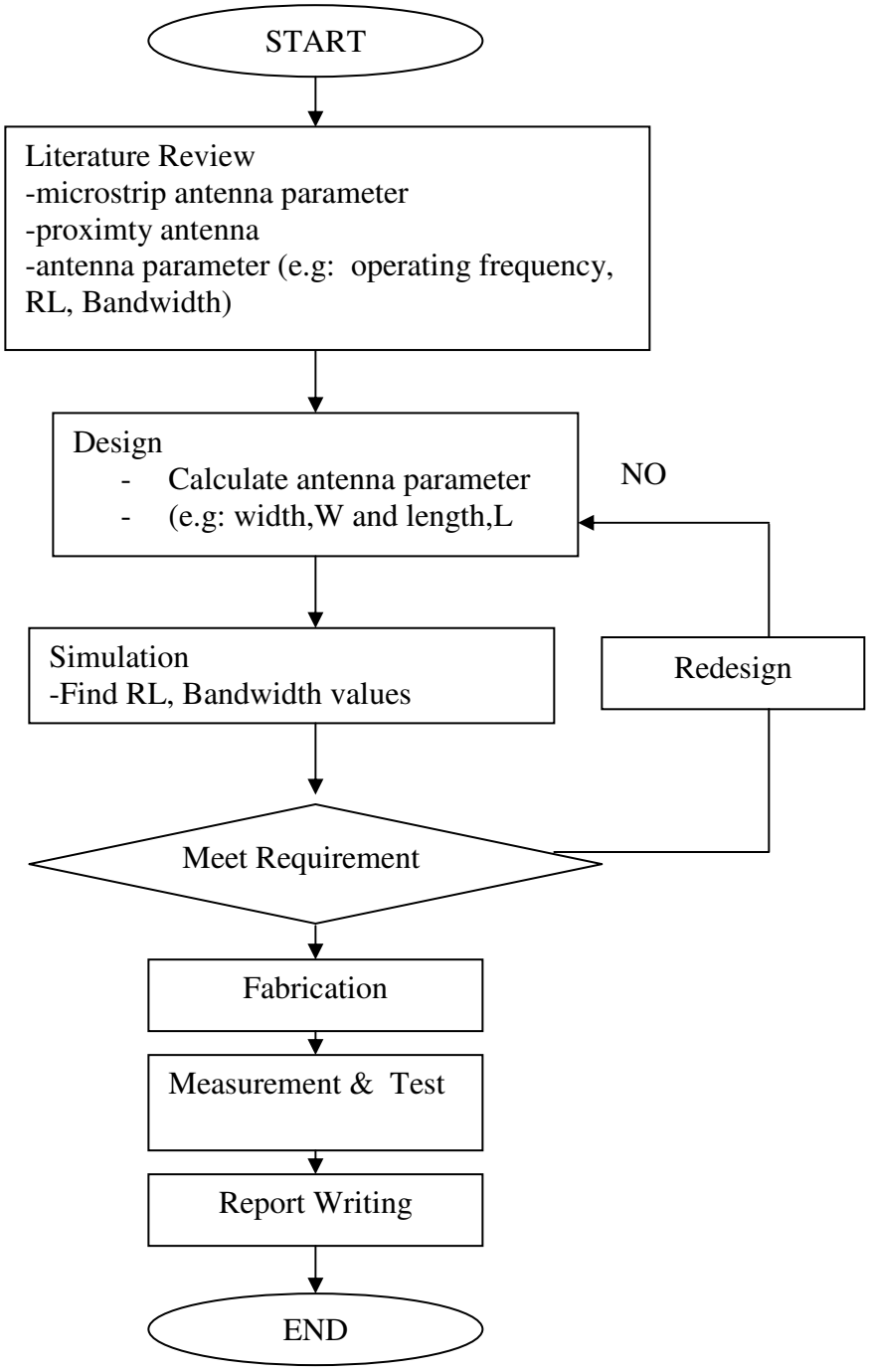

Figure 1.1: Project Methodology in a flowchart