

BROADBAND X-POLARIZED MICROSTRIP PATCH ANTENNA

MUHAMMAD AZAMUDDIN BIN AMINUDDIN

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Tajuk Projek : BROADBAND X-POLARIZED MICROSTRIP PATCH ANTENNA

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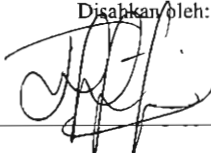
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MOHAMAD ZAINOL ABIDIN BIN ABD. AZIZ
Pensyarah Kanan
Fakulti Kejuruteraan Elektronik Dan Kejuruteraan Komputer
Universiti Teknikal Malaysia Melaka (UTeM)
76100 Durian Janak
Melaka


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Signature : 

Name : MUHAMMAD AZAMUDDIN BIN AMINUDDIN

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Signature : 

Supervisor's Name : MR. MOHAMAD ZOINOL ABIDIN BIN ABD AZIZ

Date : 18 MAY 2011

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ABSTRACT

With the wide spread proliferation of wireless communication technology nowadays, the demand for compact, low profile and broadband antennas has increased dramatically. The best choice that can meet the requirement in microstrip patch antenna. This is because of it is low profile, light weight and low cost. However, the microstrip antenna has inherently narrow bandwidth. To overcome its inherent limitation of bandwidth, many techniques have been suggested such as slotted, stacked, increase substrate, pin loading and proximity coupled. Stack method has been chosen because it is easy to design and easy to be adjusted. Beside bandwidth, world nowadays requires the high performance antenna in term of transmission efficiency, multitask and many more factors. So, the X-polarized antenna design is proposed in order to overcome this problem. The conventional antennas suffer poor performance of point to multipoint application. This is because by the attendance of the obstacles in between the transmitting antenna and receiving antenna, the loss will be high. By using the X-polarized antenna; multilinear polarized antenna, 4 patches will send the same signal at a time and this will increase efficiency of the transmission system. This project is about design, simulate and fabricate the Broadband X-polarized Microstrip Patch Antenna that will operate at 2.4GHz. The antenna will operate at broadband frequency and will radiate the X-polarized EM wave. From the results obtained, the bandwidth of the antenna is successfully increased until 3 times its actual bandwidth.

ABSTRAK

Sejajar dengan perkembangan teknologi tanpa wayar, permintaan untuk antenna yang berprofil rendah, kompak dan berjalur lebar telah meningkat dengan mendadak. Pilihan terbaik untuk memenuhi permintaan ini adalah dengan menggunakan antenna jenis mikrostrip. Namun, antenna jenis ini bermasalah dari segi lebar jalur yang kecil. Untuk mengatasi masalah ini, beberapa teknik telah dicadangkan seperti *slotted*, *stacked*, *increase substrate*, *pin loading* dan *proximity coupled*. Teknik *stacked* telah dipilih kerana ia mudah direka dan mudah di ubah-ubah. Selain dari lebar jalur, permintaan dunia hari ini juga tertumpu kepada antenna yang efisien, pelbagai guna dan macam-macam lagi factor lain. Jadi, antenna X-polarisasi telah dicadangkan untuk mengatasi masalah ini kerana ia efisien dan dapat mengatasi masalah hubungan *point to multipoint application*. Projek ini adalah tentang mereka, membuat simulasi dan menghasilkan Mikrostrip Antenna Berjalur Lebar dengan X-polarisasi yang akan beroperasi pada 2.4GHz. Antenna jenis ini akan beroperasi pada frekuensi 2.4GHz dan akan memancarkan gelombang elektromagnetik berpolarisasi-X.

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	PROJECT TITLE	i
	STATUS REPORT CONFIRMATION FORM	ii
	APPROVAL SHEET	iii
	DECLARATION SHEET	iv
	ACKNOWLEDGEMENT	vi
	ABSTRACT	vii
	ABSTRAK	viii
	TABLE OF CONTENTS	ix
	LIST OF TABLES	xi
	LIST OF FIGURES	xii
	LIST OF ABBREVIATIONS	xv
	LIST OF APPENDICES	xvii
I	INTRODUCTION	1
	1.1 BACKGROUND	1
	1.2 PROBLEM STATEMENT	2
	1.3 OBJECTIVES	2
	1.4 SCOPE OF WORKS	3
	1.5 METHODOLOGY	4

II	LITERATURE REVIEW	6
2.1	Antenna	6
2.1.1	Fundamental of Antenna Parameter	6
2.1.2	Type of Antennas	13
2.2	Feed Techniques	19
2.2.1	Microstrip line feed	20
2.2.2	Coaxial Feeding	22
2.2.3	Aperture Coupling	22
2.2.4	Proximity Coupling	23
2.3	Bandwidth Enhancement	24
2.3.1	Increase the antenna volume	24
2.3.2	Implementation of matching network	26
2.3.3	Perturbing the antenna geometry	27
III	METHODOLOGY	29
3.1	Method of Design	29
3.1.1	Rectangular Patch	29
3.1.2	Stacked Patch	32
3.1.3	Single layer X-Pol Patch	33
3.1.4	Stacked X-Pol Patch	35
3.2	Simulation	37
3.2.1	Rectangular Patch Simulation	37
3.2.2	Stacked Patch Simulation	38
3.2.3	Single layer X-Pol Patch Simulation	39
3.2.4	Stacked X-Pol PatchvSimulation	40
3.3	Fabrication	41
3.4	Measurement	44
3.4.1	Return loss and bandwidth measurement	44
3.4.2	Radiation pattern	45

3.4.3	Gain and directivity	45
IV	RESULTS, ANALYSIS AND DISCUSSION	47
4.1	Rectangular Patch	47
4.1.1	Simulation results for rectangular patch	48
4.1.2	Measurement results for rectangular patch	51
4.2	Stacked rectangular microstrip patch antenna	53
4.2.1	Simulation results for stacked rectangular patch	54
4.2.2	Measurement result for stacked rectangular patch	57
4.3	Single layer x-polarized microstrip patch antenna	59
4.3.1	Simulation Results for single layer X-polarized patch	61
4.3.2	Measurement results for single layer X-polarized patch	63
4.4	Stacked x-polarized microstrip patch antenna	63
4.4.1	Simulation results for stacked X-polarized patch	65
4.4.2	Measurement results for stacked X-polarized patch	67
V	CONCLUSION AND RECOMMENDATION	69
5.1	Conclusion	69
5.2	Future work	70
	REFERENCES	71
	APPENDIX A	72
	APPENDIX B	76
	APPENDIX C	84

LIST OF TABLES

TABLE	TITLE	PAGE
4.1	Dimension of the rectangular MSA	47
4.2	Simulation and measurement results for single patch	52
4.3	Dimension of the lower patch	53
4.4	Dimension of the lower patch	53
4.5	Simulation and measurement result for stacked patch	58
4.6	Dimension of the single layer X-polarized MSA	59
4.7	Simulation results of single layer X-polarized MSA	63
4.8	Measurement results for single layer and stacked X-pol	63
4.9	Dimension for the stacked X-polarized MSA	64
4.10	Simulation results for the stacked X-polarized MSA	67
4.11	Measurement results of the stacked X-polarized patch	68

LIST OF FIGURES

FIGURE	TITLE	PAGE
2.1	Coordinate system for antenna analysis	8
2.2	Return loss for 20GHz rectangular patch antenna	9
2.3	Rotation of a plane electromagnetic wave and its polarization	11
2.4	commonly used polarizes wave	12
2.5	Radiating patch	15
2.6	Top view	15
2.7	Fringing effect	16
2.8	Types of circular polarized MSA	19
2.9	Microstrip-line inset-feed; width (W), length (L), distance of feedline from edge (y_0) and inset width (W_f)	20
2.10	Coaxial feed	22
2.11	Aperture coupled	23
2.12	Proximity coupled	23
2.13	Capacitive effect	24
2.14	Stacked patch	25
2.15	Equivalent Circuit of antenna	27
2.16	Segmentation technique	28
3.1	Rectangular patch	29
3.2	Dimension of feeding line	31
3.3	Stacked patch	32
3.4	Upper and lower patch for stacked patch	32

3.5	X-Polarized Microstrip Patch Antenna with Coaxial Feed	33
3.6	Single Layer X-Polarized Patch	34
3.7	Stacked X-Polarized Patch	35
3.8	Upper and lower patches for stacked X-Polarized patch	36
3.9	Rectangular Patch in CST 2009	37
3.10	Waveguide Port	38
3.11	Stacked Patch in CST 2009	38
3.12	Single Layer X-Polarized Patch in CST 2009	39
3.13	Waveguide Port for the Coaxial Feed	40
3.14	Stacked X-Polarized Patch in CST 2009	40
3.15	Fabrication process	42
3.16	The fabricated patch antenna	43
3.17	Spectrum analyzer	44
3.18	Measuring radiation pattern	45
3.19	Measuring the power received	46
4.1	Single Patch Antenna	48
4.2	Return Loss Graph of the single patch	49
4.3	Radiation Pattern for E-and H-plane of the single patch	50
4.4	Gain and directivity of the single patch	50
4.5	Return loss graph of the single patch	51
4.6	Radiation Pattern for E Plane of the single patch	52
4.7	Stacked Patch Antenna	54
4.8	Return Loss Graph	55
4.9	Radiation Pattern for E-and H-plane	56
4.10	Gain and directivity of the antenna	56
4.11	Return Loss Graph for stacked patch	57
4.12	Radiation Pattern for E Plane	58
4.13	Design of X-polarized antenna in CST2009	60
4.14	Return loss of the X-pol antenna	61
4.15	2D radiation pattern for E-plane of the X-pol antenna	62
4.16	Gain and directivity of X-pol antenna	62

4.17	Design of stacked X-pol antenna in CST2009	65
4.18	Return loss of the stacked X-pol antenna	65
4.19	Radiation pattern of the stacked X-pol antenna	66
4.20	Gain and directivity of stacked X-pol antenna	67

LIST OF ABBREVIATIONS

CST	-	Computer Simulation Technology
RL	-	Return Loss
S-parameter	-	Scattering Parameter
MWO	-	Microwave Work Office
MSA	-	Microstrip Antenna
Z_L	-	Impedance load
Z_o	-	Characteristic Impedance 50Ω
GHz	-	GigaHertz
MHZ	-	MegaHertz
dB	-	Decibel
mm	-	Millimeter
Hz	-	Hertz
Ω	-	Ohms
V	-	Voltan
λ	-	Wavelength
ϵ_{eff}	-	Effective Dielectric Constant
P_{RX}	-	Received power
P_{TX}	-	Transmitted power

η	-	Efficiency of the antenna
D	-	Directivity
G	-	Gain
G_T	-	Gain transmitted
G_R	-	Gain received
C	-	Capacitance
S	-	Plate area
d	-	Distance between plate
ϵ_0	-	Constant
ϵ_r	-	Dielectric constant

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
A	Design Method of Patch with Inset feed	72
B	Simulation results for Inset Feed patch	74
C	Return Loss of the stacked X-polarized patch when adjusting the upper patch position	81

CHAPTER 1

INTRODUCTION

1.1 Background

With the rapid growth of the wireless mobile communication technology, the future technologies need very small antenna and also need the wide band antenna is increased to avoid using two antennas and to allow video, voice, and data information to be transmitted. Microstrip patch antenna is promising to be a good candidate for the future technology. Microstrip patch antenna consists of a dielectric substrate, with a ground plane on the other side.

Due to its advantages as low profile planar configuration, low fabrication costs and capability to integrate with microwave integrated circuits technology, the microstrip patch antenna is very well suited for applications such as wireless communications system, cellular phones pagers, radar systems and satellite communications systems[1].

There are numerous and well known methods to increase the bandwidth of antennas. However, the bandwidth and the size of antenna are mutually conflicting properties that is improvement of one of the characteristics normally results in degradation of the other[2].

1.2 Problem statement

With the development of microwave integrated circuit (MIC) and high frequency semiconductor devices, microstrip has drawn the maximum attention of the antenna community in recent years. In spite of its various attractive features like, light weight, low cost, easy fabrication, conformability on curved surface and so on, the microstrip element suffers from an inherent limitation of narrow impedance bandwidth. Broad bandwidth has become major demand in these recent years.

A wide bandwidth is needed because with a wide bandwidth, a lot of application can be include with the antenna as nowadays a lot of applications are using wireless medium to transmit and receive data. So, many things can be done at a time with broad bandwidth. Therefore, along with other developments, widening the bandwidth of microstrip elements, in general, has become a major branch of activities in the field of printed antennas.

The conventional linear polarized antenna suffered of poor performance point to point or point to multipoint application. This is because by the attendance of the obstacles in between the transmitting antenna and receiving antenna, the loss will be high. By using the X-polarized antenna; multilinear polarized antenna, 4 patches will send the same signal at a time and this will increase efficiency of the transmission system. The X-polarized antenna is the answer to enhance the performance quality whether for point to point or point to multipoint application.

1.3 Objective

Design, simulate and fabricate the broadband X-polarized microstrip patch antenna that will operate at 2.4GHz. The antenna will operate at broadband frequency and will radiate the X-polarized EM wave.

1.4 Scope of work

This project will be focusing on the broadband X-polarized microstrip patch antenna using stacked method. The designed was first calculated and then simulated using the CST 2009 software.

The designed was done by using the FR4 with 1.6mm thickness, 0.018 tangent loss and 4.4 dielectric constant as the substrate. During the simulation, the return loss, radiation pattern, gain, directivity and bandwidth was obtained for simulation results.

After the designed was finalized, the designed was fabricated using the chemical etching process. Then, the antenna will be measured in lab. The measurement was focusing on finding the antenna's center frequency, return loss, bandwidth, gain, directivity, and radiation pattern.

The last part of work is the analysis part. In this part, the result of simulation and the actual result were compared and analyzed.

1.5 Methodology

Methodology used in order to achieve the objective of this project is as follow:

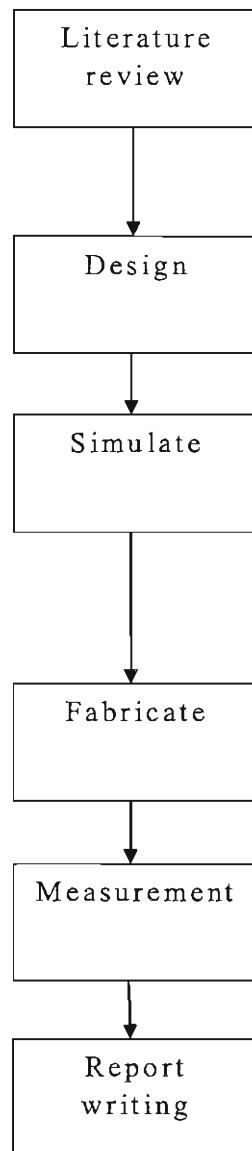


Figure 1.1: Methodology flow chart

Literature review is done by gathering the information from books, journals and papers in order to study the details about the antenna and the design. The literature review was focusing on the methods to enhance the microstrip patch antenna's bandwidth such as slot, stacked, segmentation and electromagnetic coupling. After the antenna's design method has been studied, the design process started; using the chosen method, stacked method.

Designing process is calculating the dimension for the patch including upper patch and lower patch for stacked design. Using the calculated design, the antenna was draw and simulated using the CST 2009 software. Then, the design was fabricated. The fabrication process is the process to develop the patch design on the FR4 board. There are some procedures to be followed in order to get the desired patch.

The fabricated patches were then being measured the measurement was focusing on measuring the antenna's center frequency, bandwidth, radiation pattern, gain and directivity. The measurement results were then being analyzed and troubleshoot. Lastly, from all the information gathered, the report is wrote.

CHAPTER 2

LITERATURE REVIEW

This chapter explains about the microstrip patch antenna and the way to enhance the bandwidth. The principle ideas are established before the design being done. The previous research work also been described in this chapter.

2.1 Antenna

The antenna is the transitional structure between free-space and guiding device. Its main purpose is to convert the energy of a guided wave into the energy of a free space wave (or vice versa) as efficiently as possible, while in the same time the radiated power has a certain desired pattern of distribution in space.

2.1.1 Fundamental of Antenna Parameter

In order to describe the performance of an antenna, definitions of various parameters are necessary. Some of the parameters are interrelated and not all of them need be specified for complete description of the antenna performance.

(a) Resonance Frequency

The resonance frequency for the (1, 0) mode is given by

$$f_o = \frac{c}{2L_e\sqrt{\epsilon_r}} \quad (2.1)$$

Where c is the speed of light vacuum To account for the fringing of the cavity fields at the edges of the patch, the length, the effective length L_e is chosen as

$$L_e = L + 2\Delta L \quad (2.2)$$

The Hammerstad formula for the fringing extension is like equation shown in (2.3):

$$\Delta L = 0.412d \frac{(\epsilon_{eff} + 0.3) \left(\frac{W}{d} + 0.264 \right)}{(\epsilon_{eff} - 0.258) \left(\frac{W}{d} + 0.8 \right)} \quad (2.3)$$

Where the effective dielectric constant, ϵ_{eff} :

$$\epsilon_{eff} = \frac{\epsilon_r + 1}{2} + \left(\frac{\epsilon_r - 1}{2} \frac{1}{\sqrt{1 + 12 \frac{d}{W}}} \right) = 4.5276 \quad (2.4)$$

(b) Radiation Pattern

Radiation pattern of an antenna is defined as a graphical representation of the radiation properties of the antenna as a function of space coordinates. In most cases, the radiation pattern is determined in the far-field region. It is represented as a function of the directional coordinates.