PLANAR ANTENNA DESIGN FOR SHORT RANGE DEVICE (SRD) OF WIRELESS COMMUNICATION

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This Report Is Submitted Partial Fulfillment of Requirements for the Bachelor Degree of Electronic Engineering (Wireless Communication)

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Universiti Teknikal Malaysia Melaka

JUNE 2016

"In the Name of ALLAH, the most Beneficent, the Most Merciful"

Special dedication to My father, Mohd Bin Md Dom, my lovely mother, Khatijah Binti Wan Hassan, Partner of my life Mohamad Lapiz Bin Ramlan and my family.

Thank you for your endless love, support and believe in me.

"I hereby declare that the work in this project is my own except for summaries and quotations which have been duly acknowledge."

Signature : .....

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Date : 14 JUNE 2016

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Tajuk Projek : Planar Antenna Design For Short Range Device (SRD) Of Wireless Communication

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ACKNOWLEDGEMENT

Alhamdulillah, Praise to Allah S.W.T for His blessing and guidance, I am successfully complete my project and thesis.

First of all, I would like to thank my supervisor, Dr.Noor Azwan Bin Shairi and my co-supervisor Dr. Imran Bin Ibrahim for their guide, support, encouragement and supervision in completing my project and thesis.

I also would like to thank PM Dr Zahriladha Bin Zakaria and En. Fauzi Bin Hj Abdul Wahab for their valuable comment in improving my project.

I would also like to express my gratitude and appreciation to my family members especially my father and my mother for their unconditional love, morale support and prayer along my study.

Last but not least, I would to thank to others lecturers and to all my friends for their help, knowledge and assistance to accomplish my project and thesis. To those who indirectly contributed to this thesis, your kindly means a lot to me.

"I acknowledge that I have read this report and in my opinion this report is sufficient in term of scope and quality for the award of Bachelor of Electronic Engineering (Industrial Electronics/ Computer Engineering/ Electronic Telecommunication/ Wireless Communication)* with Honours."

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ABSTRACT

In recent time, many by the consumer for integrated wireless digital applications. Antenna that preferred in this demand should be low profile, light weight, easy to integrated and high performance. Planar antenna is selected to fulfill these requirements. This thesis is focused on design planar antenna at 900MHz of wireless communication for short range device. The term "short range" connotes the signal travel from a few centimeters to several meters. The parameters to be improved in this thesis are included reflected coefficient (S11), gain and radiation pattern. The results of the performances of planar antenna are covered by the simulation of the design using CST Studio Suite Software and measurement by using spectrum analyzer. From the simulation result, the parametric study has been done on order to get the optimum dimension of planar antenna for the design so that the resonant frequency of 900MHz can be achieved. But the resonant frequency is shift to 903.6MHz with the good performance of return loss, radiation pattern and gain. The value of return loss is-67.60 and gain is 6.962dB. The radiation pattern in the simulation pattern is Omni-directional pattern. While, in measurement process, the resonant frequency is shift to 909 MHz with the good performance of return loss, radiation pattern and gain. The value of return loss is-22.267 and gain is 6.351dB. The radiation pattern in the simulation pattern is Omni-directional pattern. The field test has been done at UTeM Sport Complex. The maximum distance can be covered by the antenna is 120 meter after integrated with the R002 URF. At the end of this project, the planar antenna are design with good performance integrate with the URF module.

ABSTRAK

Kebelakangan ini, banyak oleh pengguna bagi aplikasi digital tanpa wayar bersepadu. Antena yang pilihan dalam permintaan ini harus profil yang rendah, berat ringan, mudah untuk prestasi bersepadu dan tinggi. antena satah dipilih untuk memenuhi keperluan ini. Tesis ini memberi tumpuan kepada reka bentuk satah antena di 900MHz komunikasi tanpa wayar untuk peranti jarak dekat. Istilah "jarak dekat" membawa maksud perjalanan isyarat dari beberapa sentimeter untuk beberapa meter. Parameter yang perlu diperbaiki dalam tesis ini adalah termasuk mencerminkan pekali (S11), keuntungan dan corak radiasi. Hasil prestasi satah antena adalah dilindungi oleh simulasi reka bentuk menggunakan perisian CST Studio Suite dan pengukuran dengan menggunakan spektrum. Dari hasil simulasi, kajian parametrik telah dilakukan ke atas untuk mendapatkan dimensi optimum satah antena untuk reka bentuk supaya frekuensi salunan 900MHz boleh dicapai. Tetapi kekerapan salunan adalah beralih kepada 903.6MHz dengan prestasi baik kehilangan pulangan, corak radiasi dan keuntungan. Nilai kerugian pulangan adalah-67,60 dan keuntungan adalah 6.962dB. Corak radiasi dalam corak simulasi adalah corak Omni-arah. Sementara itu, dalam proses pengukuran, kekerapan salunan adalah beralih kepada 909 MHz dengan prestasi baik kehilangan pulangan, corak radiasi dan keuntungan. Nilai kerugian pulangan adalah-22,267 dan keuntungan adalah 6.351dB. Corak radiasi dalam corak simulasi adalah corak Omni-arah. Ujian lapangan yang dilakukan di Kompleks sukan UTeM. Jarak maksimum boleh dilindungi oleh antena adalah 120 meter selepas bersepadu dengan R002 urf. Pada akhir projek ini, antena satah adalah reka bentuk dengan prestasi yang baik mengintegrasikan dengan modul urf itu.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

This chapter will discuss briefly the background of the project have been chosen to design and simulate. In this chapter will also discuss the problem statement, main objective and the scope of the project.

In recent year, the demand for faster access and transfer of the high quality data is ever growing. This probes for higher data rates in communication networks. To meet this demand, we need devices which operate at such high data rates. Most of the networks off late being wireless, antennas used in such networks should be able to operate over a wide band width. Antenna will be used in applications such as Short Range Device (SRD). For developing a SRD antenna, factors should be considered are operation band-width, gain and efficiency, directivity and size.

Antenna is like something that we call receiver and transmitter. It design to send information and at the same time it collect data in electromagnetic waves. It turns electrical signal into radio waves so they can travel or even into space and back. The term antenna is sometimes used for electromagnetic devices that couple over distances less than that associated with radiated fields. Antennas and transmitters are the key to virtually all forms of modern telecommunication.

There are many type of antenna which is planar antenna, loop antenna, helical antenna, array antenna, patch antenna and so on. The different types of antenna have different characteristic and different type of application.

1.1 Project Background

This project been proposed to design a planar antenna for Short Range Device (SRD) of wireless communication. The planar antenna is proposed for wireless communication applications because the symmetric arms are etched on the metallic lever of a single side printed circuit board to form the planar dipole antenna. The single metal layer structure is suitable for mass production and reduces the manufacturing cost. Research and study the design and the parameter of the antenna which can be operate at 900MHz successfully. Choose the design antenna and the better parameter to manufacture the proposed antenna will be done by using Computer Simulation Tool (CST) software. The peak gain of the antenna is 6dBi and the return loss is 10dB at 900MHz.

Short Range Device is device that which have low capability to have interference with the others wireless communication, usually because the power transmitted of SRD is low. SRD often benefit from a regulatory compared with other communications equipment. Integral, dedicated or external antenna and all type of modulation and channel pattern can be permitted subject are use in SRD to relevant standards or national regulations.

The communication range is limited by two factors which is SRD need for very strong signals to be received by the power device. Then, SRD limit the reader range, and the small amount of power available for a device to respond to the reader. Short range Device (SRD) operating in adjacent band 863-870MHz include such as; cordless headphones, intruder alarm, radio microphones, smart utility meters, telemetry, medical device and so on.

1.2 Problem statement

Planar antenna is preferred due to some advantage for example light weight, compact size, low power, lower cost, easy fabrication and has directivity radiation pattern. However, there are some limitations in planar antenna such as low gain, narrow bandwidth with low efficiency. Nowadays, the demand for faster access and transfer of the high quality data is ever growing. This probes for higher data rates in communication networks. To meet this demand, we need devices which operate at such high data rates. Most of the networks off late being wireless, antennas used in such networks should be able to operate over a wide band width. Planar antenna is one such structure which has wide band width and end fire Radiation pattern. So a Planar antenna design which can operate at such high data rates for short range communications is proposed in this paper. Because it operates at low power and has directive radiation pattern, interference can easily be avoided during the data transfer. So, the improvement need to be simulating by CST Studio Suite to prove that planar antenna is the better antenna in term of performance.

1.3 Objective

To design and develop the antenna of 900MHz for Short Range Device that produce high gain at a limited given space with good return loss and gain performance.

1.4 Project scope

The main purpose of this project is to design a planar antenna for Short Range Device of wireless communication at 900MHz. the design's performance will more focus on return loss, bandwidth, directivity, radiation pattern and gain. The project will be simulated and tested by CST Studio Suite software.

i. To design and simulate a planar antenna for Short Range Device of wireless communication at 900 MHz
ii. To fabricate a planar antenna and adding it to the RF module for Short Range Device of wireless communication at 900MHz

To evaluate the performance of the antenna in distance range 1km to 2km.

1.5 Thesis Outline

Chapter 1-In this chapter, briefly explains about the introduction or the background of project. Some of the information about the definition of antenna and types of antenna also explained. This chapter also includes the project background, problem statement, objectives and project scope.

Chapter 2-In this chapter, the literature review is where the explanations of past research and journal that related with this project. Past research included the results, formulas and calculation based on the antenna and the SRD.

Chapter 3 -Methodology is a guideline to complete and run the project smoothly. Start from the research on the related antenna and SRD so that it fulfils all the requirements in order to meet desired results.

Chapter 4 -In this chapter, it will present all the tabulation data and results. As the results have been tabulated, the analysis of data can be done. There will also a discussion about the results.

Chapter 5- There wills a suggestion and future work based on this project. As well as, the explanation of overall conclusion for the whole project.

CHAPTER 2

LITERATURE REVIEW

This chapter review theoretically to get an idea that related with this project so that it can helps to design and simulate the project by using an appropriate concept. From the collected information, it can be a guideline in this project to improve the proposed project so that it works successfully.

2.1 Antenna Definition

Antenna is a specialized transducer that converts frequency (RF) fields into alternating current (AC) or vice versa. Antenna usually use in communication, broadcasting and radar system. Usually we use antenna to send and receive data information. In communication system, antenna is an important part of radio equipment. The antenna has to be tuned to the right frequency or the radio waves can neither be emitted nor captured efficiently. In transmission, a radio transmitter applies a radio frequency to the terminals of the antenna and then the antenna radiates the energy from the antenna as electromagnetic waves. In receiver, an antenna intercepts the power of an electromagnetic wave to produce a radio frequency at its terminals that is applied to a receiver in order to amplify and

demodulate. In some cases the same antenna can be used for both transmitting and receiving.

Antennas are generally categorized in various techniques which are operating frequency, bandwidth, gain, radiation pattern and resonant frequency. One of the techniques is the frequency band of operation. The rest comprised of physical structure and design.

Basically, non-directional antennas are simple dipoles or monopoles. Much more complex, directional antennas consist of arrays of elements, such as dipoles, or use one active and several passive elements, as in the Yagi antenna. Other than that, there are also many types of antenna included the wire antenna, aperture antenna, microstrip antenna and array antennas.

2.2 Microstrip antenna

Microstrip antenna also called as patch antenna. It consists of metal patch on top of a grounded dielectric substrate. This antenna also have variety of shapes which is rectangular, circular, elliptical, square, triangle but the most common shape is rectangular and circular. Microstrip antenna became popular starting in the 1970s and be inverted by Bob Munson in 1972.

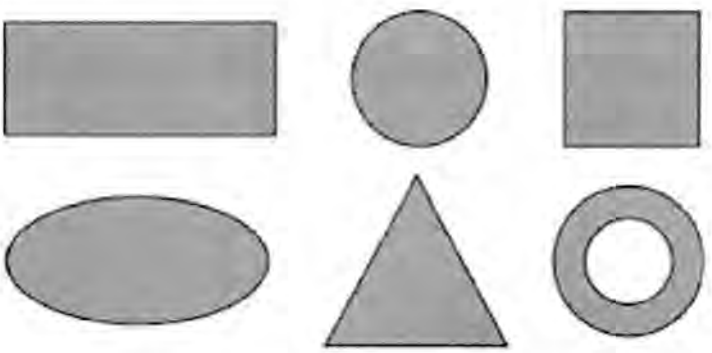

Figure 2.1: Common shape of microstrip patch antenna

The advantage of microstrip antenna is low profile, easy to fabricate by using etching and photolithography, easy to intergarted, capable of dual and triple frequency operation, and high performance. While the disadvantages of microstrip antenna are narrow bandwidth, low gain, high level of cross polarization radiation and the efficiency may be lower than others antenna. But it can be improved by a variety of techniques and the value of efficiency actually is limited by conductor and dielectric losses and by surface-wave loss.

Microstrip antenna fed by a microstrip transmission line. The patch antenna, transmission line and ground plane are made of high conductivity metal. Usually the material that use is copper. The patch consists of length L, width W, and sitting on top of a substrate of thickness h with permittivity.

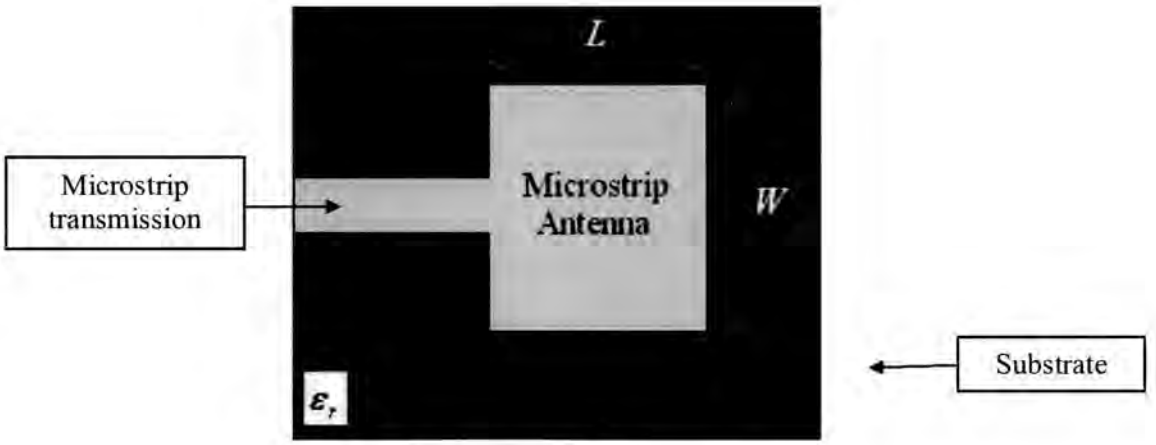

Figure 2.2: Top view of microstrip antenna

The basic principle of operation in microstrip antenna is the patch acts approximately as a resonant cavity (short circuit walls in top and bottom, open-circuit walls on the sides). In a cavity, only certain models are allowed to exist, at different resonant frequencies. If the antenna is excited at resonant frequency, a strong field is set up inside the cavity, and a strong current on the bottom surface of the patch. This produces significant radiation a good antenna.

2.3 Antenna at Frequency 900MHz

In the age of rapid technological growth and development, the need to have more wireless system is ever growing. Many industries demand want a portable device that can access many service with a compact size. But, there only have for the high frequency range, and not commercial for the low frequency.

TYPE OF ANTENNA	FREQUENCY	RETURN LOSS	GAIN	ADVANTAGE
Planar Antenna	868MHz	-15 dB	Close to -0.5dBi	-small size -low cost and economical. -has good gain and acceptable return loss.
Binocular Antenna	866-869 MHz		868MHz : 1.68dBi	-reduce size -maximum power transfer
PIFA Antenna	865-868MHz	865MHz-868MHz:-15dB	865MHz - 868MHz :-3dBi	-small size -low cost -low resonant frequency.
Planar Horn Antenna	800MHz to 6GHz		-3dBi	-maintain constant phase center. -offer more gain and directivity
Wideband Monopole Antenna	800MHz to 6GHz	6dB	Between 1.5-7dBi	Can generate all modern wireless frequency

Compact Planar Antenna	867.5MHz	-20dB	0.3dBi	-low cost -easy fabricate

Table 2.1: Example of antenna that use in SRD

2.3.1 Miniaturized UHF Planar Antenna, for Wireless Indoor Systems

Ultra high frequency planar microstrip antenna is presented, which can be used in wireless indoor systems [1]. Nowadays, people demand want the device have small, compact and economical wireless systems, low cost microstrip antenna for the wireless systems. In order to make the antenna low cost, they do not use extra passive lumped components like capacitor and inductor. And do not uses extra matching network while do the match. Then, to achieve the objective to make small antenna, use technique shorting point similar to PIFA antenna. By using technique shorting point, it can reduce size of antenna, decrease the input impedance, gain and bandwidth. This is because the antenna is used to transform a bounded wave into a radiated wave [1]. Other than, by increasing size of feeding point will help to improve the impedance and the return loss. Then, in the shorting antenna the current flow on the ground plane is higher than the current flow on upper part. In the result, it will make the antenna more stable to the external effect. Figure below shows the design for this project

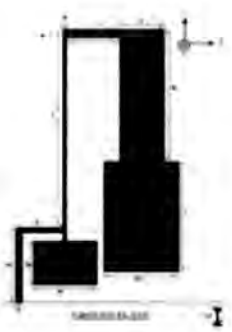

Figure 2.4: Antenna design for 868MHz

Figure 2.5: Antenna model for 868MHz

By using this antenna model, the value of return loss is around -15dB. The value of gain antenna is -0.5dBi. Figure below show the result:

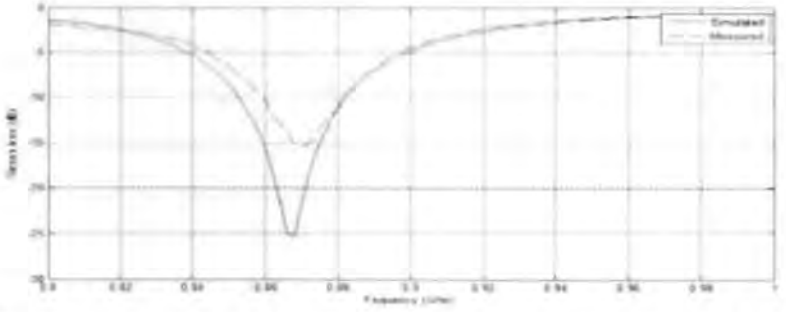

Figure 2.6: Result simulated and measured return loss at 868 MHz

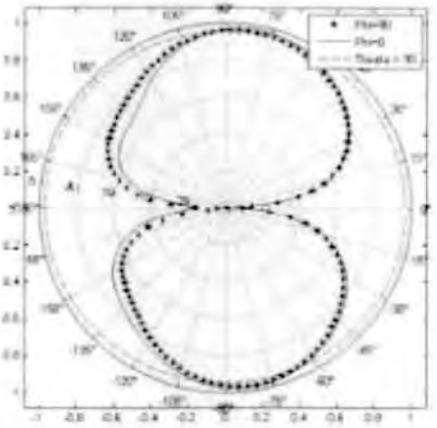

Figure 2.7: Result radiation pattern of antenna at 868 MHz