UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN OF DEFECTED REFLECTOR ANTENNA

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree in Electronic Engineering Technology (Telecommunications) with Honours

by

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor's Degree in Electronic Engineering Technology (Telecommunications) with Honours. The member of the supervisory is as follow:

……

(Project Supervisor)

ABSTRAK

Dalam projek ini reka bentuk ‘defected reflector antenna’ dijangka menghasilkan mikrojalur antena saiz padat dengan kaedah struktur ‘defected ground structure’ (DGS) untuk sistem komunikasi. Antena akan direka dalam saiz yang padat untuk memenuhi keperluan saiz yang minimum dan sesuai untuk diaplikasikan. Elemen 'ground' antena yang dicadangkan diambil bentuk ‘defected ground structure’ (DGS) di mana merupakan kaedah teknik yang unik untuk mengurangkan saiz antena. Analisis ini dijalankan untuk melihat kehilangan pulangan antena di mana kadar kehilangan pulangan boleh kurang daripada -10dB kerana kehilagan pulangan adalah kehilangan kuasa dalam isyarat yang dipantulkan. Dan keputusan kajian ini menunjukkan perbandingan di antara reka bentuk antena dengan ‘defected ground structure (DGS)’ dan tanpa ‘defected ground structure’ (DGS). Dengan itu, reka bentuk ‘defected reflector antenna’ berjaya direka bentuk oleh perisian simulasi dan perkakasan untuk menunjukkan kegunaannya.

ABSTRACT

In this project the design of defected reflector antenna is expected to presented the compact size microstrip antenna with defected ground structure (DGS) method for communication system. The antenna will designed in the compact size in order to meet the miniaturization requirements and compatible for the applications. The ground element of the proposed antenna is taken the form of defected ground structure (DGS) where that method is a unique techniques to reduce the antenna size. The analysis was conducted to see the return loss of the antenna where the rate of return loss should be less than -10dB because return loss is the loss of power in the signal reflected. The result show the comparison between the design with defected ground structure (DGS) and without defected ground structure (DGS). Thus, the design of defected reflector antenna is successfully design by simulation software and hardware to show the application of the defected.

DEDICATION

To my beloved parents, Mr. Abdul Rahim bin Mat Dom and Madam Zahara binti Mohamed that have sacrificed so much and was always encouraging and support for the sake of your daughter to be good in future and a beneficial person to the family, religion, society and country.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

AIA	-	Active Integrated Antenna
CST	-	Computer Simulation Technology
DGS	-	Defected Ground Structure
MIMO	-	Musical Instrument Museums Online

CHAPTER 1
INTRODUCTION

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1.1 Background

Nowadays, Malaysia's communications systems has grown and developed into the most important tool for communication between the faster and easier to use. In communication systems, antenna has become one among the main medium for transmitting and receiving information. Generally its antenna (or aerial) is an electrical device that converts electrical energy into radio waves, and vice versa, and it is usually used with a radio transmitter or receiver.

For the reflector antenna systems for ground based and line of site communication systems play a vital role in the transfer of information for both military and civilian communication purposes. Previously, these reflector antenna systems have been designed predominantly on the antenna's transmitting and receiving the characteristics.

For the Defected ground structure (DGS) is an etched periodic or non-periodic cascaded configuration defect in ground of a planar transmission line (e.g., microstrip, coplanar and conductor backed coplanar wave guide) which disturbs the shield current distribution in the ground plane cause of the defect in the ground.

In this project is to design of defected reflector antenna by using the compact size microstrip antenna with defected ground structure (DGS) method for communication system. The microstrip antenna is known as printed antenna and it is commonly square in shape rectangular and it have better prospects and more advantages for design antenna in the order to design the compact size antenna. The ground element of the proposed antenna is taken the form of defected ground structure (DGS) where that method is a unique techniques to reduce the antenna size.

The antenna will design and simulate by using the software Computer Simulation Technology (CST) follow by fabricate (hardware). So design the antenna with the defected ground structure, the antenna size is reduced for a particular frequency as compared to the antenna size without the defect in the ground. In case study, research will be focus on how the defected ground structure (DGS) will affect the reflector antenna and change the antenna properties. The parameter and performance of antenna design will be investigated through a number of design simulations. Last but not least, microstrip antenna with defected ground structure method for communication system application will be design to see how far the DGS method can give an advantages in the development of antenna for communication system.

1.2 Problem Statement

Currently in Malaysia the telecommunication field has grown and developed into the most important tool for communication between the faster and easier to use and in the telecommunication the antenna has become one among the main medium for transmitting and receiving information. In communication system and mobile communication it required smaller antenna size in order to meet the miniaturization requirements, low cost, low volume, and low profile antennas. The problem is in the design of the antenna, it is designed with transmission line model for particular frequency is larger and is not compatible for many applications.

1.3 Project Objective

The objective of this project is to propose design, simulate, and fabricated the defected reflector antenna by using the Microstrip antenna and with a consider structure of defected ground structure (DGS). This is because the Microstrip antenna with defected ground structure (DGS) is a best choice to meet the requirements in order to create the antenna with size reduction for communication system or mobile communication.

1.4 Project Scope

In the scope of this project are limitation to the design of the microstrip antenna with Defected Ground Structure (DGS) and the applications are for the communication system or mobile communication. In this part it will design by using Computer Simulation Technology (CST) software which is this software offers the accurate, efficient computational solutions and follow by hardware components. The design of this antenna involves the antennas available and consider the defected ground structure (DGS) and the rate of antenna reflections occur.

1.5 Project Significant

The significance in this project is by design of defected reflector antenna it will give the benefit and it is the best choice to design Microstrip antenna with defected ground structure (DGS) to meet the requirements in order to create the antenna for communication system or mobile communication.

1.6 Conclusion

Since the telecommunication field has grown and developed into the most important tool for communication and antenna has become one among the main medium for transmitting and receiving information, so the consideration for the design of antenna should compatible for many applications with the reduction size of antenna become the first consideration for applications.

CHAPTER 2
LITERATURE REVIEW

Literature review is a evaluation of previous research. It is actually the summary and synopsis the same topic or at least the related article belongs to the research to be done. All the important topic that related with project will be in summarized together and show the reasons why me is pursuing this particular research program.

2.1 Introduction

In order to design of defected reflector antenna, research had been made in scope of this project to studying the concept use, their method, do the comparison and select the best one, to be design in this project. Research is done by comparing the suitable antenna to be design with defected ground structure. All the aspect will be compared to determine the advantages and disadvantages for each aspect to be design.

This chapter is discussing briefly about the suitable methods used in order to complete this project. Research about the antenna use, selection of microstrip antenna, and method use for defected ground structure (DGS) had been done before start doing this project. Meanwhile, the choice to meet the requirements in order to create the antenna for communication system or mobile communication also had been studies. In the research of microstrip antenna, the specification and feature of microstrip antenna with defected ground structure (DGS) is study to fulfill the requirement of this project.

2.2 Antenna

The IEEE Standard Definitions of Terms for Antenna defines the antenna or aerial as "a means for radiating and receiving radio waves". In other words, the antenna is a transitional structure between free space and guiding device. For wireless communication systems, the antenna is one of the most critical components[1]. Antennas, by definition are devices that convert time-varying voltages into a radiated electromagnetic field (transmitting) and vice-versa (receiving)[6].

In that journal, the authors state that antenna is one of the devices that radiate and receiving radio waves to make a communication or to sending information. Antenna a design of transducer for transmission or receiving electromagnetic waves. In the other words, the antenna is a transitional structure between free space and guiding devices. The antenna become the most critical components because nowadays in Malaysia we are using the wireless communication systems as a primary communication to connect with others in the distance. For the antenna the guiding device or transmission line may take the form of a coaxial line or a hollow pipe (waveguide), and it is used to transport electromagnetic energy from the transmitting source to the antenna, or from the antenna to the receiver.

Slot antenna has many attributes of low profile, ease fabrication, wide bandwidth and easy integration with circuit, etc. Slot antenna has its widespread use in the fields of wireless communication, such as UHF RFID communication, Radar system and aircraft industry. Now, study of slot antenna is gradually becoming a hot spot of research on antennas[7]. The study of the antenna becomes attract more attention on the issue of the selection of the antenna and to the application. This is because the antenna has a widespread use in the field of wireless communications is used widely throughout the country, particularly in developing countries.

2.3 The Microstrip Antenna

The antenna is device or transducer, it is used to transport electromagnetic energy from the transmitting source to the antenna, or from the antenna to the receiver. Microstrip antennas have several advantages over conventional microwave antenna and therefore are widely used in many practical applications.

Micro strip antenna also known as printed antenna, it is commonly square in shape, rectangular, circular and elliptical. This antenna is narrow band, wide-beam fabricated by etching the antenna element pattern in metal race; some patch antennas do not use electric dielectric spacers and are usually cheap to manufacture. This Micro strip antenna is possibly used as a sensory device alternatively it can be used for keeping balance in air craft's, missiles, satellite and also used in Musical Instrument Museums Online (MIMO). [13]

A microstrip antenna is a kind of antenna used to process ultra-high frequency signals. It is often used as a satellite radio or cell phone receiver or is mounted on an aircraft or spacecraft. This type of antenna has the advantage that it costs little to make but the disadvantage that it has limited bandwidth.

An antenna is a device designed to transmit or receive electromagnetic waves. It is used in radio equipment to convert radio waves into electrical currents or electrical currents into radio waves. The only difference between a transmitting antenna and a receiving antenna is the direction the signal is travelling. A microstrip antenna is used to transmit or receive signals in the ultra-high frequency spectrum. These are waves with frequencies between 300 MHz and 3000 MHz (3GHz).

Microstrip antennas in its simplest configuration are shown in Figure 2.3.1. It consists of a radiating patch on one side of dielectric substrate ($\epsilon r \leq 10$), which has a ground plane on other side.

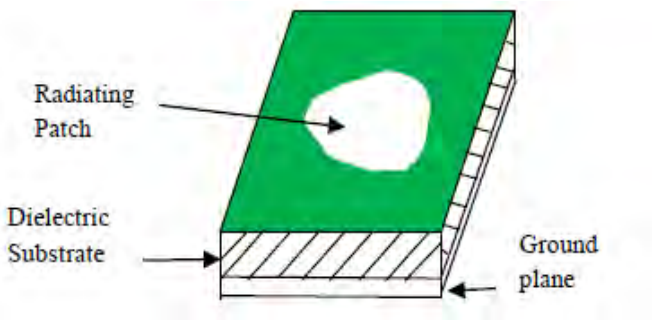

Figure 2.3.1: Microstrip antennas configuration

2.3.1 Characteristics of Microstrip antennas

Microstrip antennas are characterized by a larger number of physical parameters than are conventional microwave antennas. They can be designed to have many geometrical shapes and dimensions [2]. The microstrip antennas can be divided into the four basic categories as show in Figure 2.3.2

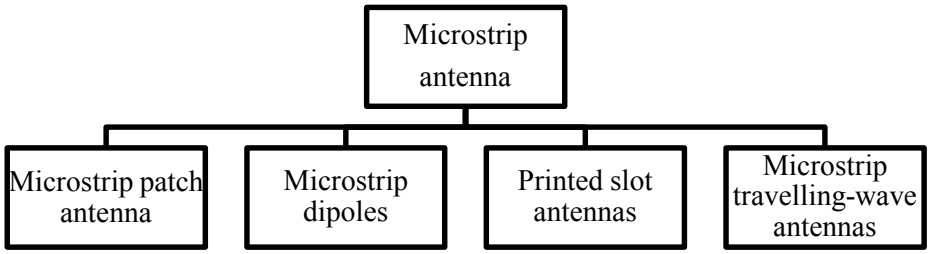

Figure 2.3.2: Four basic categories microstrip antennas

2.3.2 Comparison the microstrip antenna

In my design of antenna the microstrip patch antenna have been selected because the microstrip patch antenna have more advantages and better prospects. They are lighter in weight, low volume, low cost, low profile, smaller in dimension and ease of fabrication and conformity[2]. Microstrip antenna design for different applications such as cross polarization reduction and mutual coupling reduction etc., it can also be used for the antenna size reduction[4]. In the part to choose the type of antenna to be design the characteristics of three type microstrip antenna are compared in table 2.3.3.

Based on the comparison the microstrip patch antenna have more advantages compared with the other especially in part of fabrication, shape flexibility and bandwidth. The rectangular and circular patches are the basic and most commonly used microstrip antennas. These patches are used for the simplest and the most demanding applications[2]. For the part of spurious radiation it exist in any type of antenna so the minimization of spurious radiation and its effect on the radiation pattern is one of the important factors for the evaluation of the feed [14].

Table 2.3.3: Characteristics of three type microstrip antenna

No	Characteristics	microstrip patch antenna	Microstrip Slot Antenna	Printed Dipoles antenna
1.	Profile	Thin	Thin	Thin
2.	Fabrication	Very easy	Easy	Easy
3.	Polarization	Both linear and circular	Both linear and circular	Linear
4.	Dual-Frequency operation	Possible	Possible	Possible
5.	Shape flexibility	Any shape	Mostly rectangular and circular shape.	Rectangular and triangular
6.	Bandwidth	2-50%	5-30%	-30%
7.	Spurious radiation	Exists	Exists	Exists

The most common type of microstrip antenna is the microstrip patch antenna. It is made by etching the antenna pattern into metal trace. This etching is bonded to a layer of insulating material, such as plastic, certain ceramics, glass, or certain types of crystal, then the insulating layer, known as the dielectric substrate, is bonded to a layer of metal. It is possible to create a microstrip antenna without a dielectric substrate. The resulting antenna is not as strong but gets better bandwidth, meaning it can process more information at once.

A microstrip antenna can also be printed directly onto a circuit board. Since the microstrip antenna requires few materials, it is low cost, easy to manufacture and light weight. These characteristics make microstrip antennas ideal for use in cell phones and other small electronic devices.

The size of the microstrip antenna is inversely proportional to its frequency. That means the larger the antenna, the lower the frequency it is able to detect. For this reason, microstrip antennas are generally used for ultra-high frequency signals. A microstrip antenna capable of sensing frequencies lower than microwave would be too large to use.

The microstrip concept was first proposed by G.A. Deschamps in 1953. The concept did not become practical to implement until the 1970s, when soft substrate materials, such as plastics, became readily available. At that time, the idea was further developed by Robert E. Munson and John Q. Howell. Research is still being done to improve microstrip antennas. Scientists are especially looking for ways to reduce the size of the microstrip antennas to allow for their use in even smaller electronic devices [15].