DESIGN AND FABRICATION OF MICROSTRIP SPLIT RING ANTENNA

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This report is submitted in partial fulfilment of the requirements for the degree of Bachelor of Electronic Engineering Technology (Telecommunications) with Honours

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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DECLARATION

I hereby, declared this report entitled "Design And Fabrication Of Microstrip Split Ring Antenna" is the results of my own research except as cited in references.

Signature: ashikin

Author : NURASHIKIN BINTI ROSNAN

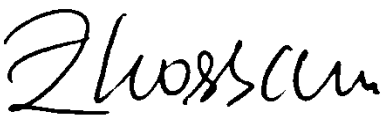
Date: 9 Feb 2021

APPROVAL

This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Electronics Engineering Technology (Telecommunications) with Honours. The member of the supervisory is as follow:

Signature: .....

Supervisor : NURULHALIM BIN HASSIM



Signature: .....

Co-supervisor: DR. A K M ZAKIR HOSSAIN

ABSTRAK

Antena mikrostrip banyak digunakan dalam aplikasi sistem telekomunikasi. Antena mikrostrip mempunyai kelebihan iaitu bersaiz kecil, kos yang rendah dan mudah untuk di fabrikasi. Walau bagaimanapun, antena ini mempunyai kekurangan seperti lebar jalur yang sempit, gain yang rendah, dan efisiensinya yang rendah. Masalah paling serius yang dihadapi antena mikrostrip adalah lebar jalur yang terhad. Dalam Projek Akhir ini, antena cincin perpecahan mikrostrip (Microstrip Split Ring Antenna) akan dihasilkan untuk meningkatkan lebar jalur dan memastikan bahawa antena dapat beroperasi dalam jangkauan lebar jalur 300 MHz hingga 3 GHz pada frekuensi rendah. Antena terlebih dahulu akan disimulasikan dalam perisian CST Microwave Studio 2019 sehingga memenuhi spesifikasi yang diinginkan, setelah itu antena akan difabrikasi pada PCB. Setelah difabrikasi, parameter antena akan dianalisis dengan menggunakan Network Analyzer.

ABSTRACT

Microstrip antennas are widely used for applications in telecommunications system. Microstrip antennas have the advantage of being small in size, low cost and easy to fabricate. These antennas, however, have disadvantages such as limited bandwidth, low gain and low performance. The most serious problem faced by microstrip antennas is their limited bandwidth. The microstrip split ring antenna will be designed in this Final Project to increase the bandwidth and ensure that the antenna will work at low frequency at 300 MHz until 3 GHz of bandwidth. The designed antenna will be simulated in CST Microwave Studio 2019 software until it reaches the necessary requirements and then the antenna will be fabricated on the PCB. After fabrication, the parameter of the antenna will be analysed by using Network Analyser.

DEDICATION

I dedicate this project to my creator God Almighty, He was my source of strength and inspiration throughout the journey in completing this project. This project is also dedicated to my supervisor Encik Nurulhalim Bin Hassim, who has help me through completing this project. I would also like to thank my family members who have given so much moral support in completing this project. In addition, I also like to thank, Dr. A M Zakir Hossain and my colleagues for their generous support and cooperation in making this project a success.

ACKNOWLEDGEMENTS

Alhamdulillah, thank and praise to Allah the Almighty because with His permission I was able to complete this Bachelor Degree Project. During the course of this project, I have gained many valuable and meaningful experiences in my lives as a student. The experience I have gained while working on this project will be used when working. It was a meaningful experience of my lives. As a result, I have gained a lot more information and knowledge on this project on how to designed the antenna to achieve the required parameters.

On this occasion, I would like to thank all those involved in making this assignment possible. Especially to my supervisor, Nurulhalim Bin Hassim as he has given a lot of guidance throughout the course of this project. His guidance has helped me a lot in completing this design project.

Therefore, I would also like to thank my family members who have given so much moral support in completing this project. In addition, I also like to thank, Dr. A M Zakir Hossain and my colleagues for their generous support and cooperation in making this project a success. This speech also addressed to all those who have been involved in this project either directly or indirectly. I appreciate all the help you have given to me because without your help and support, this project would not have been possible.

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CHAPTER 1

INTRODUCTION

1.1 Background

The microstrip antennas has evolved in communication systems, this antenna can be seen used in radar systems, satellite communications, GPS Systems (Global Positioning Systems), even in telephone systems. This antenna structure consists of a patch on both side of the structure. Situated in between the patch antenna and ground plane is the dielectric material.

The microstrip antennas are preferred compared to other types of antenna because it is small and thin, lightweight, easily fabricated, capable of producing both a linear polarization and circular polarization by using a simple rationing, easy to integrate with other electronic devices, and affordable prices (Ali *et al.*, 2017). In addition, these microstrip antennas use the feeding rationing technique that is patched directly to them through the microstrip feed line. In addition to its advantages, the microstrip antennas also have weaknesses such as narrow bandwidth, limited gain and relatively low power handling capabilities. Therefore, in this final task this Microstrip Ring antenna will be designed with the intent to increase the bandwidth to achieve the objectives of the project.

1.2 Problem Statement

The previous designs of microstrip split ring antenna were able to work at high frequency, however it was found to be unsuitable for lower frequency applications within the mega-hertz (MHz) region. Nevertheless, the structure has pointed to be improved especially the limited gain, return loss, and narrow bandwidth in order for it to work for energy harvesting application.

1.3 Objective

- To design and simulate Microstrip Split Ring Antenna with a frequency range from 300MHz to 3GHz for RF Energy Harvesting.
- To fabricate the Microstrip Split Ring Antenna on PCB.
- To benchmark the design with existing work.

1.4 Scope of Study

- The antenna acts as a Receiver
- The antenna should work between the bandwidth of 300MHz to 3GHz
- The return loss (S11) should less than -10dB
- The radiation pattern and surface current analysis will be investigated.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

To solve problems, that arise in the first chapter. Comparisons between other literature review are performed based on the current available antenna parameters. The purpose of this literature is to bring a clear understanding of the concept of a design an project.

2.2 Basic of Antenna Theory

The antenna was first introduced by Thomas Edison in 1885. Later in 1888, Heinrich Hertz testified to James Clerk Maxwell's theory of the existence of electromagnetic waves. Antennas is an important component in electrical wave communication system. The electromagnetic radiation signal travels at the speed of light in a free space and has a lower transmission loss at high frequency when compared to the same signal transmitted through the conductor cable. In the microwave communication system, antennas will transmit signal from one location to another without the need of a cable connection. The receiving side antenna will receive the signal transmitted by the transmitter and transmit the signal to other parts of the receiving circuit such as the filtering circuit.

2.3 Previous Related Research

Divyabharathi stated that FR4 substrate and feed line strip are used to reduce antenna production cost (Divyabharathi *et al.*, 2019). A strip line feed can be used in micro strip antenna to gain a lower radiation loss and less dispersion.

The author proposed that a circular ring antenna is suitable for wideband application and the design consist of finite ground plane structure. The type and size of the substrate able to control gain and bandwidth received by the antenna.

This paper presents the frequency designed for the antenna is in a range of 2 GHz until 5 GHz. It is stated that the antenna was designed by using ADS 2014 Software.

Figure 2.4.1-1 Layout design for finite ground plane

The bottom layer is designed with a thickness of 1.6 mm while the dielectric constant is 4.4. The author stated that different dielectric can be used to get a better performance.

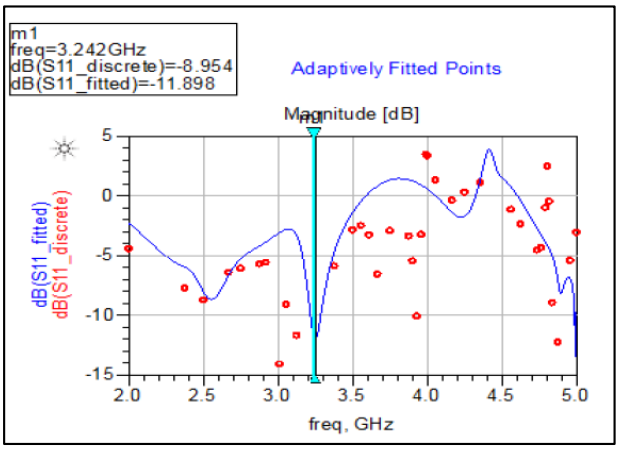

Figure 2.4.1-2 Return Loss graph and Phase plot for 3.24 GHz

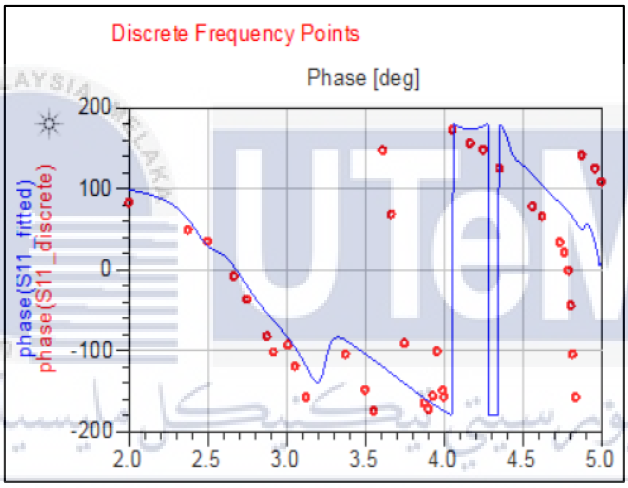

Figure 2.4.1-3 Infinite ground plane graph

At operating frequency 3.24 GHz, the return loss obtained is -11.898 dB. According the result from the studied, the return loss will be better if it greater than -10 dB.

Pirooj (Pirooj *et al.*, 2017) proposed that split ring resonator. By using a dual-band characteristic, the wide bandwidth can be achieved. The author stated that the antenna with a bi-directional pattern has a circular polarization of 2.9 GHz to 3.65 GHZ with a bandwidth of 2 GHz until 3.6 GHz. The author stated that the used of FR4 in the designed reduced the cost. The dielectric of substrate is ε_r = 4.4 and the thickness is 1.6mm.