

DUALBAND MICROSTRIP ANTENNA (2.4GHz & 5.8GHz) WITH NOVEL BACK TRANSMISSION LINE FEED TECHNIQUE

Md. Fazlul Hasan

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Pusat Khidmat Maklumat Akademil-UNIVERSITI MALAYSIA SARAWAK

DUALBAND MICROSTRIP ANTENNA (2.4GHz & 5.8GHz) WITH NOVEL BACK TRANSMISSION LINE FEED TECHNIQUE.

MD. FAZLUL HASAN

A final year project report Submitted in partial fulfilment of the requirement for the degree of Bachelor of Engineering (Hons) Electronics Engineering (Telecommunication)

> Faculty of Engineering University Malaysia Sarawak

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ABSTRACT

Antenna plays a very significant role in wireless communication system. Day by day antenna is developing very fast to be used in various kind of application. Analysis and design of different types of antenna leading crucial parts for wireless applications. Microstrip antenna is a low profile and popular antennas that has been designed and being used in many important areas of the applications. Microstrip antenna is designed by Microstrip technology. It only works with microwave frequency. These are very useful with their relative applications. Feeding technique is very important to design microstrip antenna. From past researchers, they have designed and developed microstrip antenna by using different types of feed technique. Feeding technique is used to create the results of S_{1,1} parameter. Such as, return loss, resonance frequency, radiation pattern. In this project, it has been designed a dual band microstrip antenna at 2.4 GHz and 5.8 GHz with novel back transmission line feed technique. The most interesting and main part of this project is using a new feeding technique to get S_{1,1} parameter result with less harmonics. Harmonics create an effect on the bandwidth because harmonics is not same with the magnitude of resonance frequency. So, this project has found the way to solve the problem by using novel back transmission line feed technique in microstrip antenna and compared between novel back transmission line feed technique with transmission line inset feed technique. The concluding design of dual band antenna is fabricated by using PCB technology.

ABSTRAK

Antenna memainkan peranan yang sangat penting dalam sistem komunikasi tanpa wayar. Antenna telah berkembang dengan cepat dalam pelbagai jenis aplikasi. Pelbagai jenis antenna yang dianalisis dan direka bentuk memainkan peranan penting untuk aplikasi tanpa wayar. Antena microstrip adalah salah satu antenna yang paling popular untuk mereka bentuk dan banyak digunakan dalam bahagian aplikasi. Selain itu, antenna Microstrip direka oleh teknologi Microstrip. Ia hanya berfungsi dengan frekuensi gelombang mikro. Ini sangat berguna dengan aplikasi yang berkenaan. Teknik feeding sangat penting untuk mereka bentuk antenna microstrip. Berdasarkan penyelidik vang lalu, pelbagai jenis Teknik feeding telah digunakan untuk merancang dan membangunkan antenna microstrip. Teknik feeding digunakan untuk memdapatkan keputusan parameter S_{1,1}. Contohnya, return loss, frekuensi resonans, corak radiasi. Dalam projek ini, antenna microstrip dua jalur direka bentuk pada 2.4 GHz dan 5.8 GHz dengan teknik novel back transmission line feed. Bahagian utama dalam projek ini adalah menggunakan teknik feeding baru untuk mendapatkan keputusan parameter S1.1 dengan harmonic yang sedikit. Harmonik membawa kesan kepada jalur lebar kerana harmonik tidak sama dengan magnitud frekuensi resonans. Oleh itu, projek ini dapat menyelesaikan masalah ini dengan menggunakan teknik feeding baru dalam antenna microstrip berbanding dengan teknik novel back transmission line feed dengan inset teknik line feed. Akhir sekali, teknologi PCB telah digunakan dalam reka bentuk terakhir antena jalur dua.

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CHAPTER 1

INTRODUCTION

1.1 Project Background

The interest of wireless communication system has picked up terribly amid the most recent economics and the market request stays to create. As an essential piece of these procedures, the antenna is a standout amongst the most amazing structure issues in current mobile communication system. If need to manage both monetary and military tasks then wideband, multiband and low-profile antennas are popularity for current wireless communication system. This has awed the investigation on antenna in many directions.

Generally, every single antenna works in a single frequency or dual frequency bands, which are the reason different antennas, are required for various applications. Be that as it may, it is important narrow space and place issue. In plan to decrease these obstacles, the arrangement of multiband antenna has created which is a single band antenna that can work frequency bands. Also, the significant enhancement of multiband antenna is the straight forwardness of its plan. In general, it can decide a multiband antenna as a system which works at a partitioned or an irrelevant frequency bands yet not at the varied frequencies among the band. What's more, the frequency bands worked in this project are Narrow band (1-3) GHz and Wide band (3-7) GHz.

1.2 History of An Antenna

In 1888, by German physicist Heinrich Hertz found the early antenna. He appeared in his analyzes of the continuation of electromagnetic waves finished up by the method for James Clark Maxwell. Hertz worked out to set up dipole antenna at the central position of parabolic reflectors for transmitting and receiving (Saturday, Udofia, & Jimoh, 2016). He built up a wireless system in which he moved an electrical spark to take place in the hole of a dipole antenna. An uncertain outline of some main antennas and their design or fabrication dates are recorded:

- Yagi antenna (1920s)
- ➢ Horn antenna (1939s)
- Antenna Arrays(1940s)
- Parabolic Reflectors (1940-1950) s
- ➢ PIFA (1980s)
- Patch Antenna(1970s)

By the base on direction, antenna can be three types:

- > Omni-directional.
- > By directional.
- > Arbitrary.

1.3 Microstrip Antenna

Microstrip antenna was first built up during the 1950s. (Zhang, Member, Zhang, Pan, & Duan, 2017) be that as it may, this hypothesis had to wait for about twenty years to be finished after the improvement of the printed circuit board (PCB) innovation during the 1970s. Seeing as once more, microstrip antenna is one of the most familiar type of antenna with wide range of tasks anticipated that would their conceivable preferences of lightweight, planar shape, simple of conformal, superior flexibility, low profile, low cost, planar shape, appropriate for array with the simplicity of fabrication and assimilation with microwave monolithic integrate circuits technology, (Verma, 2016).They have been extensively involved for the civil and military applications such as radio-frequency identification, television, vehicle collision avoidance system, surveillance systems, direction founding, remote sensing, missile guidance, satellite communications, multiple-input multiple-output systems, broadcast radio, and so. Nowadays microstrip antenna can be designed as single band, dual band, tri band and so on.

According to (Naji, 2018), dual band microstrip antenna is developed by Defected Ground Plane for present Wireless Applications. The structure idea is to have two spaces scratched out from the ground plane of a microstrip patch antenna developed for initial frequency band administration to empower second frequency band service.

1.4 Working Principles of Microstrip Antenna

In Microstrip antenna, the radiations oversee by the fringing fields (Alsaleh, Islam, Aminah, Nordin, & Al-askari, 2016). The fringing fields in the region of an antenna able to help to clarify how microstrip antenna transmits. Think about the sideways perspective of a patch antenna, appeared in Figure 1.4.1. The current in the direction offend of the patch is zero and the current is maximum extreme at the center point of the half-wave patch. Because, the patch antenna has an open circuited transmission line, the voltage reflection coefficient will be 1. At the point when it happens, the voltage and current are out of phase. Thus, (+V volts) voltage is most extreme towards end of the patch. Toward the beginning of the patch antenna a half wavelength away, the voltage must be at least (- V) Volts. Thus, the fields under the patch will look like, which generally shows the fringing of the fields around the edges.

Radiated patch



Figure 1.4.1: Side view of a patch antenna with Fringing field.

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Fringing fields located very near to the surface of the patches are both in the +y heading. Thus, the fringing Electric fields on the edging of microstrip antenna include in stage and create the radiation of an antenna. The microstrip antenna's radiation emerges from the fringing fields, which are reasons of favorable voltage conveyance; subsequently the radiation emerges because of the voltage but not the current (Alsaleh et al., 2016). The patch antenna is subsequently a "voltage radiator", rather than the wire antenna, which transmit as to flows include in phase and are along these lines "current radiators".

1.5 Problem Statements

To design a microstrip antenna feeding system is very important. Previous designs of antenna were built by different kind of feeding system. And the result of S_{11} parameter had harmonics in the curve (Verma, 2016). This cause for unwanted change of bandwidth of an antenna. There have some problems which are found from the design antenna by using software.

- It is very important that, if there is large mismatch between the antenna and the feed line technique, S_{1,1} will be always relatively high and it is caused for undesired output return loss & gain of antenna.
- Return loss and gain are mostly affected and control with a feed line technique. It will produce harmonics which can be affect the bandwidth performance of an antenna.

1.6 Objective

Objectives in this project are stated below:

- Study and design a Dual band Microstrip Antenna (2.4GHz & 5.8GHz) with FR-4 properties by using CST Microwave Studio.
- Simulate a return loss and gain with less harmonics by using novel back transmission line feed technique.
- iii. Compare the performances between line inset feedtechnique and novel back line feed technique.
- iv. Fabricate the final design of a dual band microstrip antenna.

1.7 Project Scopes

The scopes of the projects are stated below:

- Develop the design and simulate the dual band (NB & WB) antenna with FR-4 operate at resonance frequencies of 2.4 GHz and 5.8 GHz.
- ii. Investigate and observe about the performance of these antennas through several parametric studies.
- iii. Study and observe the performance of these antennas by different feeding technique.

1.8 Chapter Outline

Chapter one is about the introduction of this project. This chapter provides simple introduction about microstrip antenna. Besides that, there will be explained about objectives, problem statements and project scopes about this project.

Chapter two is about literature review of this project. In this chapter, theories about dual band microstrip antenna, parameters of microstrip antenna and different types of feeding system was explained in deep. The previous research and their research gap about this project also mentioned in this chapter.

Chapter three will be explain the details about methodology. This chapter is mainly about the method used to develop the feeding system of an antenna. Design an antenna, project observation and flow chart also discuss more deeply in this chapter.

Chapter four will be explain about the results and analysis about the designed antenna. This chapter will focus on also the comparison between two feeding technique.

Chapter five will be explained the conclusion about overall summary of the project. Future recommendation, advantages and disadvantages will be focus also in this chapter.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Before starting the main study about this project, it is very important to understand about the antenna. Nowadays microstrip patch antenna is developed by many researchers. They developed microstrip antenna with different types of method and software. In this project a design of dual band microstrip antenna with novel back transmission line feed technique is investigated. For designing an antenna, the basic parameters that characterize the antenna or define how that specific antenna will work and which will be the usage needs to be understood. There are some parameters which are very important in the design and simulate antenna via software. These parameters are frequency, frequency bands, polarization, VSWR, return loss, gain, impedance, bandwidth, efficiency, effective area or aperture, substrate, field regions, ground plane, directivity and radiation pattern. In antenna design, to know about the parameters and design methods it is very important to investigate about the past research. Importance of research area is that related to design antenna is very helpful to find out the problem and objectives of this project. It will help to create a new idea to develop antenna. In this chapter it is related to the case study of microstrip antenna design and the research about designing antenna with different feeding technique. Here, will be explained the investigated information about an antenna design. This information got from the different case studies from different researchers and discuss this thoroughly in this thesis which will help to understand the design of proposed dual band microstrip antenna with novel back transmission line feed technique.