MEANDER LINE ANTENNA DESIGN FOR WLAN APPLICATION

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Specially for my loving mum, dad and to all my family

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ABSTRACT

Microstrip antenna is one of the popular techniques uses today. This project objective is to design meander line antenna for WLAN application that is 2.4 GHz has been achieve. The meander line microstrip antenna has been designed base on the wavelength of the interested frequency. In this project, a 2.4 GHz meander line microstrip antenna has been designed, constructed, and measured. The microstrip element is quarter of a wavelength at the design frequency. The properties of the antenna like return loss, number of iteration, bandwidth and radiation pattern have been measured. The design starts with calculation of the dimension like the width, effective dielectric constant of microstrip line, and the length of the antenna. Then by using the Microwave Office software, the antenna has been designed and simulated. Simulation methods like EM Structure simulation has been introduced as apply to this design. As the result, the antenna can radiate the signal at WLAN frequency and provide good return loss, bandwidth, and sufficient gain. This antenna can operate less that -10 dB that is 2.4 GHz with at S_{11} measured at -37.70 dB. After finish with the simulation, the design has been fabricate on the FR4 board using the etching technique. Finally the design has been tested with the Network Analyzer.

ABSTRAK

Microjalur antenna ialah salah satu daripada teknik yang popular yang digunakan pada masa kini. Objektif projek ini untuk mereka bentuk antena berlekuk untuk rangkaian tempatan tanpa jalur, WLAN iaitu pada frekuensi 2.4GHz telah tercapai. Mikrojalur antena berlekuk direka bentuk berpandukan kepada panjang gelombang menggunakan frekuensi yang digunakan. Dalam projek ini, 2.4 GHz mikrojalur antena berlekuk telah direka bentuk, dibina dan diukur. Mikrojalur antena ini telah direka kepada separuh daripada panjang gelombang pada frekuensi yang digunakan. Mikrojalur antena teori telah pun dibincangkan. Sifat antena seperti perubahan kehilangan kembali, bilangan iterasi yang dilaksanakan dan corak sinaran telah dikaji. Rekabentuk ini telah dimulai dengan mengira dimensi antena seperti ketebalan,, dan panjang antenna. Kemudian, dengan menggunakan Perkakasan Microwave Office, antena ini direka bentuk dan di simulasi. Kaedah simulasi seperti simulasi EM struktur juga telah diterangkan semasa membuat rekabentuk. Sebagai keputusan, antenna ini dapat berfungsi pada applikasi WLAN dan menghasilkan kehilangan kembali, dan lebar jalur yang baik. Antenna ini dapat beroperasi pada kurang daripada -10 dB iaitu pada frekuensi 2.4 GHz pengukuran pada S_{11}, menghasilkan -37.70dB. Selepas selesai dengan simulasi, proses rekabentuk di sambung kepada keadah fabrikasi dengan menggunakan papan litar FR4 menggunakan teknik 'etching'. Akhirnya reka bentuk ini telah diuji dengan menggunakan peralatan network analyzer.

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WLAN	-	Wireless Local Area Network
GHz	-	Giga Hertz
VSWR	-	Voltage Standing Wave Ratio
f	-	Frequency
MHz	-	Mega Hertz
RF	-	Radio Frequency
KHz	-	Kilo Hertz
UHF	-	Ultra High Frequency
W	-	Width of line
ε_r	-	Dielectric Constant of a microstrip line
h	-	Substrates thickness
t	-	Conductor thickness
Z_o	-	Impedance
ε_e	-	Effective dielectric constant of a microstrip line
mm	-	mile meter
Z_{in}	-	Input Impedance
λ_0	-	Waveguide of free space
λ_g	-	Guided wavelength

CHAPTER 1

INTRODUCTION

1.1 Introduction

Microstrip antenna is one of the popular technique uses today. The meander line microstrip antenna is design base on the wavelength of the interested frequency. Modern designs of wireless communication systems are featured in light weight, small size, high frequency operation, and transmission efficiency. In the future use of higher frequency communication, the possible of applying the antenna design for wireless communication that should be expanded in scope to cover the frequency range from the 0.9-3.0 GHz is design. In this project, the characteristic of a printed meander line antenna for WLAN application, 2.4GHz has been studied. The design of the meander line antenna has small dimension, and approximately 50Ω input impedance. It begun with designed using Microwave Office (MoM) software and printed on FR4 board used the etched techniques. Lastly it has been measured and compare to the simulation result.

1.2 Problem Statement

The problem having by the antenna designed today is intent of size, and weight. Meander line antenna is an interesting class of resonant antennas and they have been study in order to reduce the size of the radiating elements in wire antenna; monopole, dipole and folded dipole type antenna. In meander line antenna the wire is continuously folded intended to reduce the resonant length. When the resonant occur at the same frequency, the performance characteristics of these antennas are independent of the differences in their geometry or total wire length.

Another issues in antenna designed today is to reduce the cost. The meander line offer low cost and efficient design. This is because the meander line antenna can be design by using cheaper microstrip board that is FR4 board.

1.3 Objective

The objective of this project is to design meander line antenna for WLAN application that is 2.4 GHz. It is because the WLAN frequencies operate in unlicensed bands using both radio and wireless communication technologies. Then the second objective is to simulate the design using Microwave Office Software. The simulation process has used MoM methods. Then the microstrip antenna design has been fabricated on the FR4 board used etched techniques. Finally, the design antenna has been tested with the WLAN environment.

1.4 Scope of Project

The designs parameters of the antenna consider in this project are the width, effective dielectric constant of microstrip line, and the length of the antenna. Then the antenna has been designed and simulated by using the Microwave Office Software. The circuit design has been simulated by using EM structure simulation. Then from the simulation, the return loss and the radiation pattern has observed and recorded. From the simulation, the microstrip antenna has been fabricated on the FR4 board with substrate material (ε_r = 4.2, h = 1.6mm). Lastly, the design circuit has been tested with the WLAN environment to measure the return loss and the radiation pattern.

THEORY

INTRODUCTION

2.1 Introduction

For wireless communication systems, the antenna is one of the most critical components. A good design of the antenna can relax system requirements and improve overall system performance. A typical example is TV for which the overall broadcast reception can be improved by utilizing a high performance antenna. An antenna is the system component that is designed to radiate or receive electromagnetic waves. In other words, the antenna is the electromagnetic transducer which is used to convert, in the transmitting mode, guided waves within a transmission line to radiate free-space waves or to convert, in the receiving mode, free-space waves to guided waves. In a modern wireless system, the antenna must also act as a directional device to optimize or accentuate the transmitted or received energy in some directions while suppressing it in others [1].

The antenna serves to a communication system the same purpose that eyes and eyeglasses serve to a human. To analyze an antenna system, the sources of excitation are specified, and the objective is to find the electric and magnetic fields radiated by the elements. Once this is accomplished, a number of parameters and figures-of-merit that characterize the performance of the antenna system can be

found. To design an antenna system, the characteristics of performance are specified, and the sources to satisfy the requirements are sought [3].

2.2 Type of antenna

To design an antenna system, the characteristic of performance are specified, and sources to satisfy the requirements are sought [1]. In a modern wireless system, the antenna must also act as a directional device to optimize or accentuate the transmitted or receive energy in some direction while suppressing it in other [3]. A qualitative understanding of the radiation mechanism may be ended conducting wire, which may be obtained by considering a pulse source attached to an open-ended conducting wire, which may be connected to ground through a discrete load at its open end.

When the wire is initially energized, the charges (free electron) in the wire are set in motion by the electric lines of force created by the source. When the charges are accelerated in the source-end of the wire and decelerated (negative acceleration with respect to original motion) during reflection from its ends, it is suggested that radiate fields are produced at each end and along the remaining part of wire [2]. In this report project, some types of antenna will be discussed.

2.2.1 Wire Antennas

Wire antennas are familiar to the layman because they are seen virtually everywhere on automobiles, buildings, ships, aircraft, spacecraft, and so on. There are various shapes of wire antennas such as a straight wire (dipole), loop, and helix. Loop antennas need not only be circular. They may take the form of a rectangle,

square, ellipse, or any other configuration. The circular loop is the most common because of its simplicity in construction.

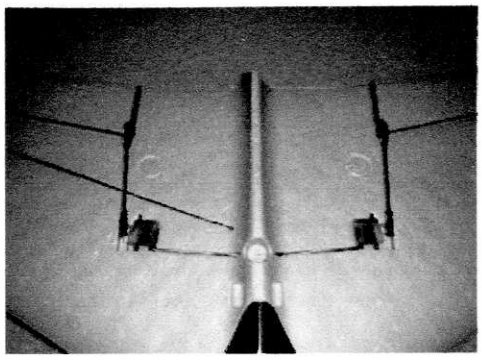

Figure 2.1: Antenna Wire

2.2.2 Aperture Antennas

Aperture antennas may be more familiar to the layman today than in the past because of the increasing demand for more sophisticated forms of antennas and the utilization of higher frequencies. Antennas of this type are very useful for aircraft and spacecraft applications, because they can be very conveniently flush-mounted on the skin of the aircraft or spacecraft. In addition, they can be covered with a dielectric material to protect them from hazardous conditions of the environment.