WIDEBAND ANTENNA WITH SRR WAVEGUIDE

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WIDEBAND ANTENNA WITH SRR WAVEGUIDE

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This Report is Submitted in Partial Fulfillment of Requirements for the Bachelor Degree of Electronic Engineering (Telecommunication Electronics) with Honours

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DEDICATION

Special Dedicated To

My beloved father and mother,

My supervisor,

My family,

And all my friends

For their Love, Encouragements and Best Wishes.

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ABSTRACT

Nowadays, ultra-wideband technology has evolved rapidly in wireless communication system due to the requirements on large data capacity and high data transmission rate. Thus, a wideband antenna supports for devices which can operate at wide range of frequencies band has become high demand in the market. The main purpose of this project is to design, simulate and fabricate a wideband antenna with split-ring resonator (SRR) waveguide. In this antenna designed process, a wideband antenna by using planar structure is designed first. Then, it will be inserted into a rectangular waveguide followed by the SRR structure waveguide. The ground slot technique is used in order to achieve the desired broader of bandwidth and low return loss. The wideband antenna with SRR waveguide designed is simulated by using CST software and fabricated by using chemical etching techniques. The antenna without the SRR waveguide should be able to operate from frequency of 2GHz to 6.5GHz with the return loss lower than -10dB. It can operate at wideband frequencies band which covered the IEEE Bluetooth/WLAN (2.4-2.485GHz), WLAN (5.2G/5.8GHz) and WiMax application 2.5GHz (2.5-2.69GHz), 3.5GHz (3.3-3.8GHz) and 5GHz (5.25-5.85GHz). The antenna with SRR waveguide manages to enhance the gain and directivity of the antenna. The directivity is expressively increased at all simulated frequency range. Meanwhile, the gain is increased at least 1dB at frequency of 4.5GHz, 6.5GHz and 7GHz-10GHz.

ABSTRAK

Pada masa kini, teknologi ultra jalur lebar telah berkembang pesat dalam sistem komunikasi tanpa wayar. Hal ini disebabkan oleh keperluan kapasiti data yang besar dan kadar penghantaran data yang tinggi. Oleh itu, peranti yang mempunyai antena jalur lebar beroperasi pada pelbagai jalur frekuensi telah menjadi permintaan tinggi di pasaran. Tujuan utama projek ini adalah untuk mereka bentuk, mensimulasi dan memfabrikasi antena jalur lebar dengan split-ring resonator (SRR) pandu gelombang. Dalam proses antena yang direka ini, antena jalur lebar dengan menggunakan struktur satah direka dahulu. Kemudian, antenna itu akan dimasukkan ke dalam pandu gelombang segi empat tepat diikuti oleh pandu gelombang struktur SRR. Teknik slot tanah digunakan untuk mendapat jalur yang lebih lebar dan pulangan kehilangan signalyang lebih rendah. Antena jalur lebar pandu gelombang dengan SRR direka adalah disimulasi dengan menggunakan perisian CST fabrikasi dengan menggunakan teknik punaran kimia. Antena tanpa pandu gelombang SRR boleh beroperasi dari frekuensi 2GHz kepada 6.5GHz dengan pulangan kehilangan signal kurang daripada -10dB. Ia boleh beroperasi pada frekuensi jalur lebar yang meliputi IEEE Bluetooth / WLAN (2.4-2.485GHz), WLAN (5.2G / 5.8GHz) dan WiMax permohonan 2.5GHz (2.5-2.69GHz), 3.5GHz (3.3-3.8GHz) dan 5GHz (5.25-5.85GHz). Antena dengan SRR pandu gelombang berjaya meningkatkan gain dan directivity. Directivity meningkat jelas sekali di semua simulasi jualt frekuensi. Sementara itu, gain bertambah sekurang-kurangnya 1dab pada frekuensi 4.5GHz,6.5GHz dan 7GHz-10GHz.

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LIST OF ABBREVIATION

AUT	-	Antenna Under Test
CST	-	Computer Simulation Technology
dB	-	Decibel
DCS	-	Digital Cellular Service
GHz	-	Gigahertz
GPS	-	Global Positioning System
IEEE	-	Institute of Electrical and Electronics Engineering
PCS	-	Personal Communication System
RL	-	Return Loss
SRR	-	Split Ring Resonator
UMTS	-	Universal Mobile Telecommunication System
VSWR	-	Voltage Standing Wave Ratio
WLAN	-	Wireless Local Area Network

CHAPTER I

INTRODUCTION

1.1 INTRODUCTION

Antenna is a transmission medium between a transmitter and a receiver in a basic wireless communication system. Wireless communication system is defines as information transfer between two or more points that without connected by electrical conductor. The examples of wireless communication devices include personal digital assistants (PDAs), satellite television, cellular telephones and wireless networking. Hence, antenna is a metallic device which plays an important role for radiating or receiving signal in radio waves [1]. Today, there are many different frequencies range of communication system applications and each of the system has their standard of operating frequency. For example, Global Positioning System, GPS (1575MHz), Digital Cellular Service, DCS (1710-1880MHz), Wireless Local Area Network, WLAN (2.4, 5.2 and 5.8GHz) and Ultra-wide band (3.1 – 10.6GHz). Antenna must has the same resonant frequency just is able to communicate with the communication system. Hence, every antenna must be well-designed to fulfill the human demands and the demand such as people request for having different applications in a single device. During designing an antenna, designers always encounter many typical problems which include low cost, narrow bandwidth, compactness and multifunction. In order to have a sufficient bandwidth to support the signals radiated or received by antenna, a wideband antenna is used to overcome the problem instead of using two or more single band antenna.

1.2 PROBLEM STATEMENT

Along with the science and technology are becoming advances, the way of people communicate with each other are more and more progressive. People communicate to each other at anytime and anywhere has become a reality and human demands on the application of communication system have increased. For example, they do not only want to deliver a text via phone, they also want to send videos, pictures, voice, location and other. People communicate through a communication model and there is a communication device which is capable of transmitting signal or data over telephone, other communication wire or wirelessly.

Inside the telecommunication device, there is a device called antenna which use for transmit and receive signals such as microwave, radio or satellite signals. Antenna with broader operating bandwidth can send and receive much frequency bands of information signals. Different communication applications have the different frequencies range, for example GSM 800 (824-894MHz and 880-960MHz), Personal Communication System, PCS (1850-1990MHz), Universal Mobile Telecommunication System (UMTS, 1920-2170 MHz) and WiMax (2G to 11GHz).

A wideband antenna is proposed to use since it has a wider bandwidth and its frequency range covered is over 2GHz. However, typical challenges are faced when designing this kind of antenna which include narrow operating bandwidth and low radiation efficiency. Nowadays, many compact antennas still insufficient bandwidth to support the signals transmitted or received by the antenna and low efficiency means that most of the power absorbed as losses within the antenna. Beside that, antenna also lack of gain and directivity.

1.3 OBJECTIVE

The objective of this project is to design, simulate and fabricate a wideband antenna with split ring resonator (SRR) waveguide. The antenna must be able to operate for the application of wideband frequency range from 2GHz to 6.5GHz which cover the IEEE Bluetooth/WLAN(2.4-2.485GHz), WLAN (5.2G/5.8GHz) and WiMax application 2.5GHz (2.5-2.69GHz), 3.5GHz (3.3-3.8GHz) and 5GHz (5.25-5.85GHz). The antenna should have to achieve wider fractional bandwidth and the specification of the return loss has been set to be -10dB. Thus, the antenna with the SRR waveguide can enhance the gain and directivity.

1.4 SCOPE OF WORK

The scope of this project is to design a wideband antenna with SRR waveguide which operates at frequency 2GHz to 6.5GHz. All antenna designed work will be simulated by using CST software in order to find the basic parameters such as return loss, gain, radiation pattern, directivity and efficiency. After that, fabrication process will be done by using chemical etching technique. The material used is FR4 epoxy board which has the dielectric constant of substrate 4.4, tangent loss of substrate 0.019, thickness of substrate 1.6mm and thickness of copper 0.0035mm. After the fabrication process, measurement of antenna parameter such as return loss, radiation pattern, gain and directivity will be measured by using Agilent Network Analyzer, signal generator, Fieldfox Rf Analyzer and anechoic chamber which are provided in the lab.

1.5 METHODOLOGY