CIRCULAR POLARIZED MICROSTRIP ANTENNA FOR WIRELESS BODY AREA NETWORKS

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To,
My beloved parents and all my family's member for their unwavering love, sacrifices and inspirations.

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ABSTRACT

Design and construction of circular polarized (CP) microstrip antenna for Wireless Body Area Networks (WBANs) is proposed. The proposed antenna is operating at 2.4-2.4835GHz frequency. The design is etched on FR4 substrate material with a relative dielectric constant of 4.6 and thickness of 1.6mm.The single fed scheme has been used. The patch shape of the antenna is square/rectangular with truncate corner to excite two orthogonal modes with equal amplitude and in phase quadrature. L- slot is introduced to extend the bandwidth.

ABSTRAK

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Rekabentuk antenna mikrojalur polarisi bulat untuk alatan perhubungan komunikasi bahagian badan telah dicadangkan.Antenna yang dicadangkan beroperasi pada 2.4-2.4835GHz. Rekabentuk antenna ini difabrikasikan dia atas material FR4 dengan pemalr dielektirk 4.6 dan ketebalan 1.6mm. Saiz antenna adalah segiempat sama ataupun segiempat tepat dengan potongan penjuru untuk memperoleh dua mod bertentangan dengan sama keluasan dan 90° perbezaan fasa. “L-slot” diperkenalkan utntuk mendapatkan lingkaran yang lebar.

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LIST OF SYMBOLS

h	-	substrate thickness
t	-	copper thickness
F_H	-	High frequency
F_L	-	Low frequency
λ	-	Wavelength
$tan\ \delta$	-	Loss tangent
ω	-	Radian frequency
n	–	Efficiency
mm	-	milimeter
dB	-	decibel
Hz	-	hertz
L	-	length
W	-	width
Γ	-	reflection coefficient
Z_0	-	characteristic impedance
λ_0	-	free-space wavelength
εr	-	dielectric constant of the substrate
c	-	speed of light 3x 10-8 m/s

LIST OF ABBREVIATIONS

CPW	-	Co-planar waveguide
FCC	-	Federal Communication Commission
HPBW	-	Half Power Beamwidth
RL	-	Return loss
VSWR	-	Voltage standing wave ratio

CHAPTER 1

INTRODUCTION

1.1 Project Background

Wireless body area network (WBAN) is one type of wireless networks that utilized for communication among sensor nodes. It operates on, in or around the human body to monitor some crucial parameters and body movements [1]. The WBAN technology has been developed in 1995 by viewing wireless personal area network (WPAN) technologies for communications on, near and around the human body [1]. Afterward in 2001, the name of WPAN has been changed to body area network (BAN) to signify the communications on, in and near the body only [1]. In November 2007, IEEE 802.15 Task Group 6 (BAN) has been launched by IEEE to build up a communication standard optimization for low power devices that operating on, in or around the human body in order to provide a wider range of applications such as personal healthcare, consumer electronics and so forth [2].

Nowadays, WBAN technology has been paid a lot of attentions among medical professions and health care practitioners including engineers in information and communication technology field. This technology is a key element that can contribute to the future e-health initiative to make major improvements in patient care and health screening. For example, by looking on the service delivery point of views, this WBAN technology could make some of the specialist treatments more accessible and efficient as well as cost-effective.

As these wireless networks are implanted or body worn, they require specific studies and investigations under stringent constraints include minimum radiated power, low power consumption, flexibility, small device size and low weight. Conflict between requirements of BANs like security, efficiency and safety are also the challenges that

need to be addressed and monitored [3]. All of these issues are particular true at the antenna design level and its propagation.

An antenna is any structure that acts as a transducer that converts electromagnetic waves to electrical energy or vice versa. It is significantly impacts on the system link performance between transmitting and receiving mode. The design of an antenna in wireless communication either for transmitting or receiving mode can be in many different shapes and types which are based on their applications. In this project, microstrip antenna has been chosen due to some advantageous features like low profile, lightweight, ease of fabrication, inexpensive, conformability, and not difficult to integrate with feeding lines and active devices. This microstrip antenna is developed in circular polarization (CP) with single feed scheme.

1.2 Project Objectives

One of the main elements of WBAN is an antenna. There are numerous concerns to think about during designing an on-body antenna, for instance the dimension of the antenna itself, operating frequency bandwidth, power consumption, reflection coefficient and the unique radio frequency (RF) transmission challenges posed by the human body tissues. In this project, a CP microstrip antenna at 2.4GHz operating frequency will be designed, simulated and fabricated in order to achieve the requirements as following:-

1. The effectiveness of antenna in terms of gain and sensitivity.
2. The sufficient bandwidth to cover the required operating band.
3. The design should be low profile and easily incorporated with physical robustness to cope with normal movements.
4. The design should be miniaturized and low cost.

1.3 Project Scope

This project is started by designing and then simulating the CP microstrip antenna using the Computer Simulation Technology (CST) Microwave Studio software. Based on the simulation results, the more promising antenna will be fabricated using

photolithography process. Then, the return loss parameter, S11 of fabricated antenna is measured by using Network Analyzer. If the fabricated antenna meets the S11 requirement, other antenna parameters like gain, radiation pattern and efficiency of the antenna will be measured in Anechoic chamber. Lastly, the simulation and measurement results will be discussed and analyzed.

1.4 Statement of Problem and Summary of Issues

A major challenge of BAN applications is designing an antenna. For on-body situations, some criteria to take care like antennas are required to be miniaturized, light weight, conformal to the body and resistant from unwanted frequency or interference and also the polarization detuning. For that reason, antennas have to be designed by taking into account all their integration situations. This project is purposely to propose a CP microstrip antenna dedicated to WBAN applications. In order to achieve this obejctive, some aspects will be reviewed.

Firstly, a brief explanation about WBAN technology and basic antenna theory are presented in Chapter 2. Also some related papers and journals that discussed the theoretical aspects of CP microstrip antenna and limitations of antenna design have also been reviewed in this chapter. This chapter can remind the reader of the things that need to be considered in designing a good antenna.

Chapter 3 will be devoted to the method of investigation like selection of materials and tools, design modeling and description of design methodology. In this chapter, it will mention the simulation process as well as the fabrication process of the CP microstrip antenna. Then it will follow by chapter 4; result and discussion from simulation and measurement in the forms of graphs, tables, figures and interpretation of data.

Lastly, the result and discussion is wrapping up with a summary and conclusion and some future works recommendation to improve the performance of the result.

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