FILTERING ANTENNA FOR WLAN APPLICATION

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To my beloved mother and father who always there for me

Law Thien Fong and Chan Kim Fook

To my siblings Chan Swuei Zheng, Chan Joong Wei and Chan Wai Yan.

To my lecturer and supervisor, for their guidance and encouragement,

Dr. Mohd Rijal Bin Hamid

To my friends, for their unconditionally support.

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ABSTRACT

This project presents the performance enhancement of an integrated circular filter antenna with resonator at operating frequency of 5.8 GHz. The integrated circular filter antenna with resonator provided the better selectivity as well as in bandwidth compared to the conventional microstrip patch antenna. A T-shape radiating patch is utilized as resonator. The integration of T-shape filter and circular microstrip antenna achieved the improvement of the selectivity and the gain. The simulation of the integrated circular filter antenna is done by using CST Microwave Simulation software tool. The result obtained for the value of the reflection coefficient is below the -10dB within the rage of frequencies 5.70 GHz to 5.88 GHz. The integrated circular filter antenna is suitable use in the modern radar and wireless communication devices.

ABSTRAK

Projek ini membentangkan peningkatan pretasi antenna penapis bulat bersepadu dengan “resonator” pada kekerapan operasi 5.8 GHz. Antena penapis bulat bersepadu dengan resonator menyediakan selektiviti yang lebih baik serta lebar jalur berbanding dengan antena mikrostrip konvensional. Radiasi T-bentuk digunakan sebagai “resonator”. Penyepaduan penentukuran T-bentuk dan antenna mikrostrip pekeliling mencapai peningkatan selektif dan gandaan. Simulasi antenna penapis bulat bersepadu dilakukan dengan menggunakan alat perisian “CST Microwave Simulation”. Hasil yang diperolehi untuk nilai pekali pantulan adalah di bawah -10dB dengan julat frekuensi 5.70 GHz hingga 5.88 GHz. Antena penapis bulat bersepadu adalah penggunaan yang sesuia dalam radar moden dan peranti komunikasi tanpa wayar.

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WLAN	-	Wireless Local Area Network
MHz	-	Mega Hertz
GHz	-	Giga Hertz
dB	-	Decibel
VSWR	-	Voltage Standing Wave Ratio
IE3D	-	Integral Equation Three-Dimension
CST	-	Computer Simulation Technology
PTFE	-	Polytetrafluoroethylene
PCB	-	Printed Circuit Board

CHAPTER 1

INTRODUCTION

1.1 Background Study

Antenna plays a crucial role in communication systems which able to transfer information over a distance without any wires used. They transmit electromagnetic waves produced by transmitter or receive electromagnetic waves onto a receiver. Electromagnetic waves carry signals travelling at the speed of light with nearly no transmission loss such as broadcast radio, mobile telephones, WLAN data network, and etc. The antenna operating in microwave frequency is known as microwave antenna, one of the types of microwave antenna is microstrip patch antenna. Microstrip antenna is also known as patch antenna. The microstrip antenna is fabricated by using microstrip technique on a dielectric substrate. Generally, front side of dielectric substrate is bonded with radiating patch in various designed shapes while bottom side of dielectric substrate is mounted a metal foil as ground plane. The radiating patch is composed of conducting materials like gold or copper and it operates at frequency range between 100 MHz and 100 GHz. Microstrip antenna can be manufactured in a large amount of quantities due to its light weight, low volume and low cost of fabrication. The rectangular shape microstrip antenna is shown in the Figure 1.1.

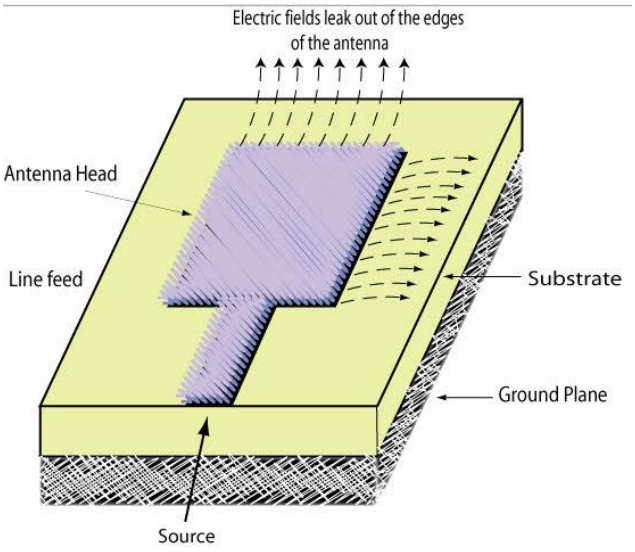

Figure 1.1: Rectangular microstrip antenna.[1]

Filters are often used in the Radio Frequency (RF) front end of wireless communication systems. Filter able to alter the amplitude characteristics of a signal to the specified frequency. More specifically, a filter will not changes any of the component frequencies or add new frequencies to the specific signal but it will changes the amplitudes of the frequency. Filter is normally used in electronic device to enhance signals in certain frequency ranges or reject unwanted signals in other frequency ranges. Basically, there are four types of filter been classified which are low pass, high pass, bandpass and band-stop filters. These four types of filters have different kind of contribution to the applications in microwave systems. As an example, bandpass filter is a signal selection component which is able to receive the selected signal within the range and reject signal out of the range at a certain frequency region. The four types of basic filter responses have been shown in Figure 1.2.

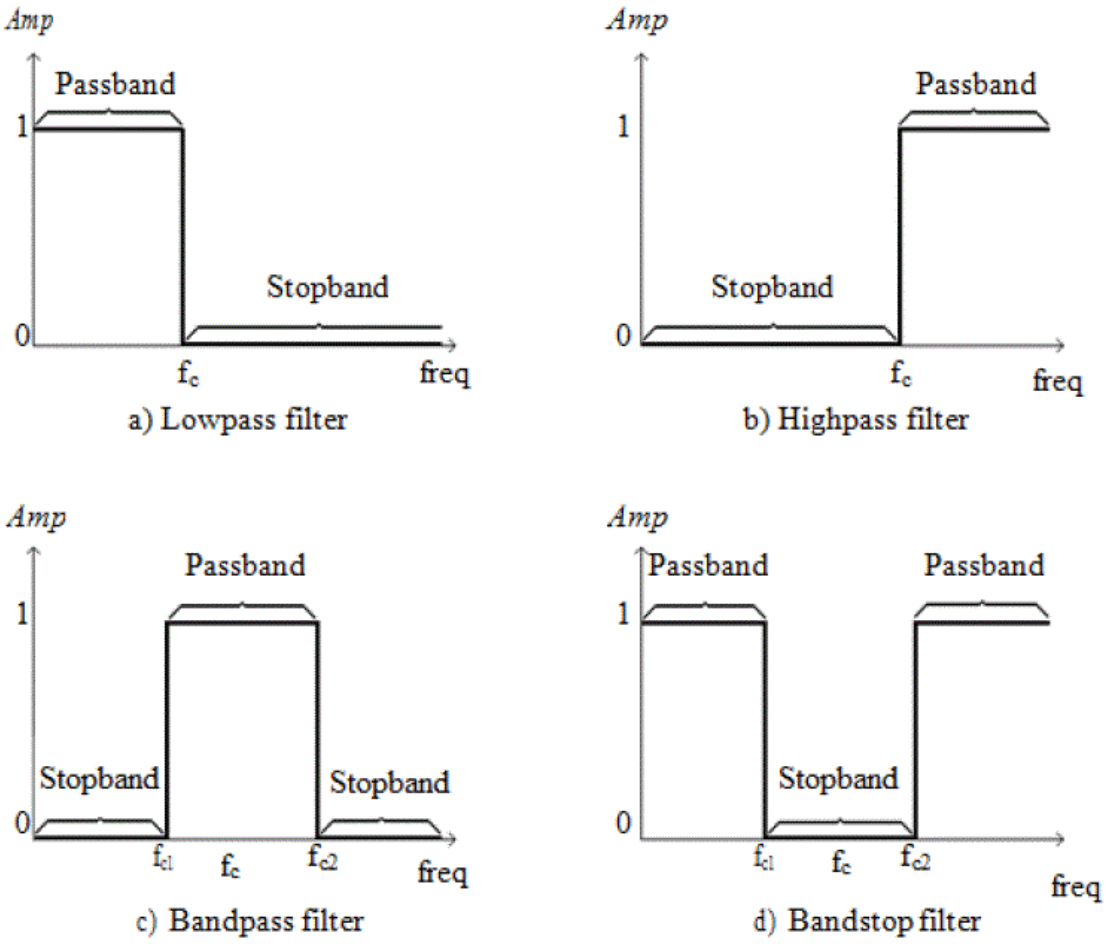

Figure 1.2: Filter Responses

1.2 Problem Statement

A bandpass filter able to receive the particular frequency ranges of signal and does not allow out of the frequency ranges to pass through. Meanwhile, a stopband filter is to prevent just a specific frequency ranges from passing through without affecting the rest of the frequency ranges of the signal. The out-of-band rejection is the attenuation of a signal outside of the chosen frequency band. The conventional microstrip antenna is

suffered from bad antenna's selectivity. In order to increase the performance of the antenna isolation, good selectivity is a method to suppress the out-of-band signal. RF filter is one of the examples to reduce the out-of-band signal of particular frequency ranges by tens of dB.

1.3 Research Objective

Research topic that has been done by researcher must have their goals and objectives to achieve.

- To study the behavior of the filter-antenna in term of return loss, radiation pattern and antenna gain.
- To analyze the performance of simulation and measurement results between microstrip and filter antenna.

1.4 Scope

The scope of work is to focus on the analytic of the performance between microstrip and filter-antenna where all of the simulation process are simulated by using CST Simulation software. In the beginning stage, the shape of radiating patch is in circular while the TLY-5 substrate of the microstrip antenna is designed in rectangular shape with permittivity 2.2 at operating frequency of 5.8GHz. Then, a filter is implemented into microstrip antenna with the effect of dual band frequencies. The selectivity of filter antenna is better with dual band compared with microstrip antenna.

Moreover, a slot is added at the ground plane which is able increase the out-of-band rejection of the frequencies. After the best dimension of the filtenna is obtained by using the CST Simulation software, the filtenna without and with slot were fabricated and the return loss are measured. The simulation and measurement results were analyzed and compared.

1.5 Thesis Organization

This thesis is divided into five chapters where it will discuss about the microstrip antenna and filter-antenna. The first chapter consists of introduction to the basic microstrip antenna which focuses on filter response, problem statement, research objective and scope of work. The second chapter is literature review on microstrip antenna and filtering antenna are discussed. This chapter included the discussion on different shapes are used on microstrip antenna. The third chapter presents about the methodology in this project. The contents include flow chart of the research, the overall designing process of microstrip and filter antenna, the details of the design technique to perform the task. These are described in this chapter. The fourth chapter discussed about the simulation result of the microstrip antenna, as well as filter-antenna to investigate the parameters that able affect the performance of the antenna including the return loss, radiation pattern and antenna gain. Finally, the last chapter concludes the overall research work and challenge faced in future.

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