PARAMETRIC EFFECT OF DEFECTED GROUND STRUCTURE (DGS) ON 6GHZ OF A BANDPASS FILTER

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JUNE 2015

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This Report Is Submitted In Partial Fulfillment of Requirement for the Bachelor Degree of Electronic Engineering (Wireless Communication) With Honours

Fakulti Kejuruteraan Elektronik Dan Kejuruteraan Komputer

Universiti Teknikal Malaysia Melaka

June 2015

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN

PROJEK SARJANA MUDA II

Tajuk Projek : PARAMETRIC EFFECT OF DEFECTED GROUND STRUCTURE (DGS) ON 6GHz OF A BANDPASS FILTER

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DECLARATION

I hereby, declared this report entitled 'Parametric Effect Of Defected Ground Structure (DGS) On 6GHz Of A Bandpass Filter' is the results of my own research except as cited in references.

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Date : 15 June 2015

"I hereby declare that I have read this report and in my opinion this report is sufficient in terms of the scope and quality for the award of Bachelor of Electronic Engineering (Wireless Communication) With Honours"

Signature : 

Supervisor's Name : Dr. Mohd Azlishah Othman

Date : 17/6/15

To my beloved parents and family, Supervisor, all FKEKK lecturers and my friends for their continuous support, advice, and guidance to complete this final year project.

ACKNOWLEDGEMENT

In the Name of Allah, most Gracious, most Merciful.

Alhamdulillah, all of honors are just for Allah Azza Wajalla, the almighty, because gives His blessing for me within strength and enough time in finishing this final year report with titled "Parametric Effect of Defected Ground Structure (DGS) on 6GHz of a Bandpass Filter".

Then I want to express my sincere thanks to my supervisor, Dr. Mohd Azlishah Bin Othman for his valuable guidance, encouragement, and suggestion which are very helpful in finishing this project. Besides, I would like to thank my parents for their affection, advices, guidance, instruction and help in all my life, your love is beyond any words. Last but not least, special thanks also to all my friend whose have given me a cheerful and always support me when i have hard time until i can finished up the raport for my final year project as well.

ABSTRACT

This report explains the design of Bandpass filter with Open Loop Dumbbell Shaped Defected Ground Structure (DGS). The developed of Bandpass filter started with constructed the circuit by using lumped element such as capacitors and inductors. This project has three main phases which are designing phase, fabricating phase and measuring phase. The Bandpass filter with Open Loop Dumbbell Shaped DGS is required to operate at 6GHz with 700 MHz of 3dB bandwidth for satellite broadcast and microwave relay application. The Bandpass filter is designed by using FR-4 printed circuit board. A comparison, the design of Open Loop Dumbbell Shaped DGS were analyzed to identify the better performance of the Bandpass filter. In this report there will be an overview on how to design, fabricate and measure the required filter that meet the given specification. The Advanced Design System (ADS) software 2011 which will be used in developing the filter will be overview. Lastly, the results of simulated and measured filter is analyzed and discussed. In the meantime, the future work and improvements to the performance of Bandpass filter will be further discussed.

ABSTRAK

Laporan ini menerangkan reka bentuk penapis laluanlulus dengan Open Loop Dumbbell Shaped Defected Ground Structure (DGS). Rekabentuk penapis laluanlulus bermula dengan pembinaan litar dengan menggunakan elemen tergumpal seperti kapasitor dan induktor. Projek ini mempunyai tiga fasa yang utama iaitu fasa mereka bentuk, fasa reka dan fasa mengukur. Penapis laluanlulus dengan Open Loop Dumbbell Shaped DGS diperlukan untuk beroperasi pada frekuensi 6GHz dengan 700 MHz daripada 3dB bandwidth untuk siaran satelit dan aplikasi gelombang mikro relay. Penapis laluanlulus direka diatas papan litar bercetak FR-4. Perbandingan dibuat dengan menganalisis Open Loop Dumbbell Shaped DGS untuk mengenal pasti prestasi penapis laluanlulus yang lebih baik. Dalam laporan ini akan ada gambaran mengenai bagaimana untuk mereka bentuk, reka dan mengukur penapis yang diperlukan yang memenuhi spesifikasi yang diberikan. Perisian Advanced Design System (ADS) 2011 yang akan digunakan dalam pembentukan penapis akan di dibincangkan secara keseluruhan. Akhir sekali, keputusan simulasi penapis dianalisis dan dibincangkan. Dalam pada itu, kerja-kerja masa depan dan penambahbaikan kepada prestasi penapis laluanlulus akan terus dibincangkan.

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LIST OF ABBREVIATIONS

ADS	-	Advanced Design System
DGS	-	Defected Ground Structure
EBG	-	Electronic Band Gap
EM	-	Electromagnetic
FR4	-	Fire Retardant 4
QoS	-	Quality of Service
SIW	-	Substrate Integrate Waveguide

CHAPTER I

INTRODUCTION

1.1 Project background

Nowadays, the modern of telecommunication technology developed more frequently rise and increases the biggest market demand. The governmental effort supportly toward the invention and innovation of new application in wireless communication. The examples of wireless communication include in microwave application, satellite application and WiMAX. These new application offer the good advantage and improvement in the telecommunication services and it offer the three important items to the customer which are coverage, capacity and Quality of Service (QoS). In term of coverage, the customer get the minimal signal level of electromagnetic waves. For the capacity, the rate of uploading and downloading more satisfactory and adequate to the customer. Then, the good quality of service (QoS) provide with no error of transmission of data as well so that no problem occurred to the service. [5]

The microwave application such as filter is chosen to achieve the frequency selectivity in the various wireless system operating. Bandpass Filter act as the backbone component that provide overall performance of various communication system. [6] Bandpass Filter will allow the selected frequency to pass through and reject the frequency outside the range. Normally, there are two different types of structure to produce the compact design and high performance of microwave components. It named as the Defected Ground Structure (DGS) and the

Electromagnetic Band gap (EBG). DGS mostly used in many microwave design technique due to simple in it modelling rather than EBG.

In this project, the microstrip Bandpass Filter with Open Loop Dumbbell shaped Defected Ground Structure (DGS) for 6GHz was designed. The DGS was put in the metallic ground plane of planar transmission line. This DGS will disturb the shield current distribution in the ground plane cause of the defect in the ground. [8]Then, this disturbance will modify characteristic of transmission line and it will ensure the effective capacitance and inductance were produced.

1.2 Objective of the Project

This project embarks on the objectives that are listed below:-

i- To study and understanding of Bandpass filter and Defected Ground Structure (DGS).

ii- To design, fabricated and analyze the Bandpass filter with Open Loop Dumbbell Shaped Defected Ground Structure (DGS).

iii- To investigate the parametric effect of Open Loop Dumbbell Shaped Defected Ground Structure (DGS) on 6GHz of a Bandpass filter.

iv- To gain the knowledge and experience on how to use ADS 2011 to simulate the Bandpass filter.

1.3 Problem Statement

In the new era of modern technology, every people in the world have desired to communicate with others throughout the device especially to connect them within the far communication. This scenario different from a hundred years before. So, the changing type of communication required the more advanced telecommunication system. In order to provide the good service of communication, it attempts to produce the component that can improve the better performance of telecommunication system. Since this problem occurs, the communication system

must provide the service with less number of interference among the users to achieve the high quality of service (QoS).

Emerging application in this system continue to challenge RF/ Microwave filter with ever requirement higher performance, smaller size, lighter weight and lowest cost. The desired specification of the microwave filter have to achieve in order to provide the smoothly and faster of transmitting information of signal to the customer around the world.

1.4 Scope of Project

This project will focus on several scope of work:

i- Hardware part
- using FR4 board as substrate with permittivity of 4.4, thickness of 1.6mm and copper thickness of 0.035mm.

ii- Software part

-using Advanced Design System (ADS) 2011

1.5 Structure of the project

This report will divided into five main chapter. The first chapter discussed about the introduction of the project. Introduction includes the project background, problem statement, objectives of the project, and scope of project. Introduction act as the initial overview of the overall project.

The second chapter discussed about the literature review. In this chapter, the previous journal and article related to Bandpass filter and defected ground structure will be elaborated more detail to gain the specified information to this project.

Next, the third chapter will focus on the methodology. Methodology is the flow of process and technique use from the first step until the project was done. This

process very important in order to make sure the project is conducted can achieved the goal and objective of the project.

Then, the forth chapter will discuss on result and discussion of the project. The result from the simulation of software and hardware will put in this chapter. The output expected value and measured value will be compared between both element of software and hardware.

Last but not least, the fifth chapter discussed about the conclusion and the future work of the project. It will conclude about the project either it achieve the desired goal and objective or not. The recommendation of future work also stated in this chapter.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

This chapter will discuss about the literature review. To develop the project, the researcher need to make analysis the previous journal first before to conduct the project. This step is very important in order to gain the knowledge and make the discussion about the related topic to the project. All the information and data of the related to the filter especially bandpass filter from the various type of sources such as journal, article and technical reprt were analyze. The method that use to increase the performance of bandpass filter is introduced. The structure is put in the metallic ground plane of FR4 and the analysis carried on to observe the effect of DGS to the performance of bandpass filter. The defected ground structure (DGS) will be discuss further. This structure is the most simple design structure and compact compared to the other type of structure. There are many type of DGS structure such as rectangular square, dumbbell shape, open loop dumbbell shape, and hairpin DGS. The best one type is choose to fixed with the desired frequency of 6GHz of a bandpass filter.

2.2 C-Band

The C band is often used to provide fixed communications and broadcast services. This band also provides a number of important strategic services including maritime communications, aeronautical services along with robust and reliable Virtual Private Networks (VPNs) for government and private corporations. It also provides vital connectivity services such as backhaul and rural telephony to remote areas. C band is the focus of next-generation satellite services in many rural areas. Rugged IP networks for banks and other businesses are being developed using C band spectrum.

Many regions rely heavily on the use of C band satellite capacity. Other frequencies such as Ku band (11/14 GHz) are readily available in other parts of the world and some regions rely heavily on it for backhaul services. However, the lack of Ku-band satellite coverage and terrestrial fiber in some regions means that there is no other option than the C band for offering many essential services. Users of receive-only satellite antennas have no need for license and are not registered with the regulator. This means that the total usage of C band satellite services is impossible to measure.

Microwave are radio waves with the wavelength ranging from the 300MHz (0.3 GHz) up to 300GHz of the frequencies. [14] Microwave is widely used in point-to point communication. Microwave application are widely used in most developed country in the world.

Band	Frequency range	Applications
L	1 to 2 GHz	Satellite, navigation (GPS, etc.), cellular phones
S	2 to 4 GHz	Satellite, SiriusXM radio, unlicensed (Wi-Fi, Bluetooth, etc.), cellular phones
C	4 to 8 GHz	Satellite, microwave relay
X	8 to 12 GHz	Radar
K_u	12 to 18 GHz	Satellite TV, police radar
K	18 to 26.5 GHz	Microwave backhaul
K_a	26.5 to 40 GHz	Microwave backhaul
Q	30 to 50 GHz	Microwave backhaul
U	40 to 60 GHz	Experimental, radar
V	50 to 75 GHz	New WLAN, 802.11ad/WiGig
E	60 to 90 GHz	Microwave backhaul
W	75 to 110 GHz	Automotive radar
F	90 to 140 GHz	Experimental, radar
D	110 to 170 GHz	Experimental, radar

Figure 2.1 : Frequency band

C-band is a band that allocated frequencies from 4GHz up to 8GHz. Primarily, C-band is used for full time TV satellite network. Commonly this band use in the tropical rainfall because it have the characteristic less dispose to rain fade rather than Ku band. [4]

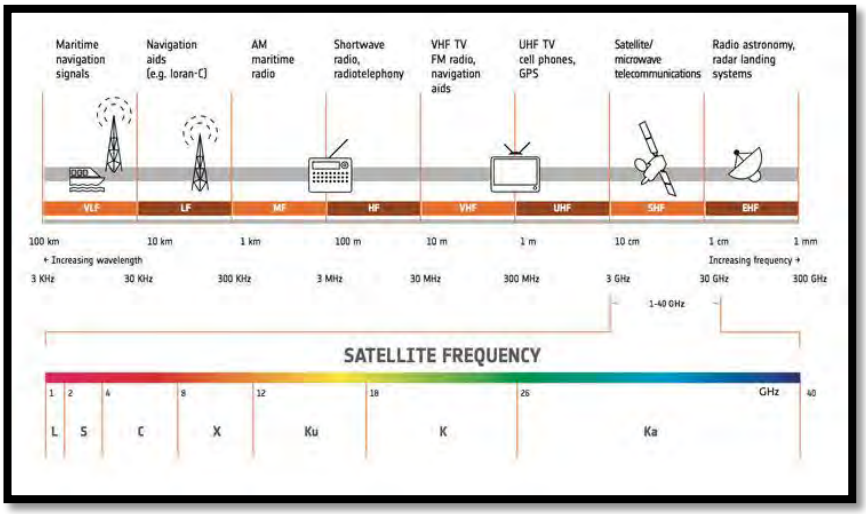

Figure 2.2 : Applications of satellite comunication