UNIVERSITI TEKNIKAL MALAYSIA MELAKA

PATCH ANTENNA BY USING DEFECTED GROUND STRUCTURE FOR 5G MOBILE COMMUNICATION

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electronics Engineering Technology (Telecommunications) with Honours

by

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APPROVAL

This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfillment of the requirements for the degree of Bachelor of Electronics Engineering Technology (Telecommunications) with Honours. The member of the supervisory is as follow:

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ABSTRAK

Antena adalah asas bagi setiap sistem komunikasi. Ciri-ciri antenna patch adalah keuntungan kuasa yang rendah. Terdapat beberapa cara untuk meningkatkan prestasi antenna patch yang menggunakan kecacatan struktur tanah (DGS). Dalam projek ini, antenna direka bentuk yang berfungsi pada 28 GHz. Antenna yang direka terdiri daripada patch segi empat tepat pada Rogers RT/ Duroid 5880 (free loss) dengan ketebalan 0.127 mm, manakala untuk bahagian bawah teruja dengan teknik penyambungan jarak dekat. Antena patch disepadukan dengan beberapa DGS. Oleh kerana struktur E DGS, jalur lebar ditingkatkan dari 0.717 GHz berbanding dengan antena konvensional. Keuntungan antena yang bekerjasama dengan DGS adalah 5.996 dB yang bertambah baik kepada 6.143 dB pada frekuensi operasi 28 GHz. Tambahan pula, kecekapan menunjukkan 85.66 % daripada antena.

ABSTRACT

Antenna is a fundamental part of every wireless telecommunication system. The characteristics of patch antenna is low power gain. There are several ways to improve the performances of the patch antenna which is by using Defected Ground Structure (DGS). In this project, the antenna was designed which is work at 28 GHz. The designed antenna consists of rectangular patch on Rogers RT/Duroid 5880 (loss free) with a thickness 0.127 mm, while for the bottom is excited by the proximity coupled feeding technique. The patch antenna is integrated with several DGSs. Due to E DGS structure, the bandwidth is improved from 0.717 GHz compared to conventional antenna. The gain of the antenna in cooperated with the DGS is 5.996 dB which got improve to 6.143 dB at 28 GHz operating frequency. Furthermore, the efficiency shows 85.66 % of the antenna.

DEDICATION

Special dedication to my parent, Mr Abd Razak Bin Zainuddin and Mrs Norhayati Bte Dakir also super supportive supervisor, En Adib Bin Othman with love and care.

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TABLE OF CONTENTS

		PAGE
TABLE OF CONTENTS		ix
LIST OF TABLES		xiii
LIST OF FIGURES		xv
CHAPTER 1	**INTRODUCTION**	**1**
1.1	Introduction	1
1.2	Background	1
1.3	Problem Statement	2
1.4	Objective of the study	3
1.5	Scope of study	3
1.6	Project Outline	4
CHAPTER 2	**LITERATURE REVIEW**	**5**
2.1	Introduction	5
2.2	Microstrip Patch Antenna	5
2.3	Basic Characteristics of Microstrip Patch Antenna	6
2.4	Type of Microstrip Patch Antenna	7
2.5	Feeding Method of Microstrip Patch Antenna	8

2.6 Application of Microstrip Patch Antenna 11

2.7 Defected Ground Structure 12

2.8 Application of Defected Ground Structure 12

2.8.1 Filters 13

2.8.2 Amplifier 16

2.8.3 Antenna 16

2.9 DGS Design Shaped 17

2.10 5G Mobile communication network 18

2.11 Related Research 20

2.11.1 A Rectangular Defected Ground Structure (DGS) for Reduction of Mutual Coupling Between Closely-Spaced Microstrip Antenna. 20

2.11.2 Multi-Technique Broadband Microstrip Patch Antenna Design 23

2.11.3 Dual of Defected Ground Structure for Coplanar Stripline 24

2.11.4 Design and analysis of defected ground structure transformer for dual-band antenna 28

2.11.5 Bandwidth Enhancement of Microstrip Patch Antenna using Defected Ground Structure 30

2.11.6 Compact Ultra-Wideband Antenna with Band-Notched Based On Defected Ground Structure. 35

2.11.7 Design of Ultra-Wide Band Slot Antennas for Future 5G Mobile Communication Application 36

2.11.8 A Small Microstrip Patch Antenna for Future 5G Applications 39

2.11.9 Design and Performance Evaluation of a Dual-Band Antenna for The Mobile Communication 42

2.11.10 Millimiterwave (5G) Broadband Compact Slot Antenna for the Automotive Shark-fin Mobile and 5G Mobile Communications 46

2.12 Comparison Result of Related Research 50

CHAPTER 3 METHODOLOGY 55

3.1 Flow Chart 55

3.2 Calculation in Designing Microstrip Patch Antenna 57

3.3 Design Process of Conventional Antenna 60

3.4 Design Process of Defected Ground Structure (DGS) 1 62

3.5 Design Process of Defected Ground Structure (DGS) 2 63

3.6 Design Process of Defected Ground Structure (DGS) 3 64

CHAPTER 4 RESULT AND DISCUSSION 66

4.1 Introduction 66

4.2 Simulation Result for Conventional PatchAntenna 66

4.3 Design of Rectangular Patch Antenna with Single Dumbbell shaped DGS 70

4.4 Design of Rectangular Patch Antenna with Double Dumbbell shaped DGS 73

4.5 Design of Rectangular Patch Antenna with E shaped DGS 77

4.6 Comparison with Different shapes in DGS Ground 81

CHAPTER 5 CONCLUSION AND FUTURE WORK 83

5.1 Conclusion 83

5.2 Future Work 83

REFERENCES 84

APPENDIX 1 88

APPENDIX 2 91

LIST OF TABLES

TABLE	TITLE	PAGE
Table 2. 1:	Various comparisons between proposed DGSs and Filtering Structures in (Farahani et al. 2010) [22] and (Bait-Suwailam et al. 2010) [23]	22
Table 2. 2:	Design parameters of simple rectangular patch antenna	31
Table 2. 3:	Comparison table of different shape in DGS ground	34
Table 2. 4:	The value of the geometrical parameters of the proposed antennas	38
Table 2. 5:	Dimensions of Proposed Patch Antenna	40
Table 2. 6:	Presented Antenna Dimension	44
Table 2. 7:	Optimized dimension of the proposed MMW 5G antenna.	47
Table 2. 8:	Summarization of previous researcher's journal	52
Table 3. 1:	Dimension of Conventional Antenna	60
Table 3. 2 :	Dimension of the antenna with Single Dumbbell shape of DGS	62
Table 3. 3:	Dimension of the antenna with Double Dumbbell shape of DGS.	63
Table 3. 4:	Dimension of the E shaped DGS	65
Table 4. 1:	Value Obtained after Simulation of Simple Rectangular Patch Antenna	68

Table 4. 2: Value obtained after simulation of Patch Antenna with Dumbbell shaped DGS 72

Table 4. 3: Value obtained after simulation of Patch Antenna with Double Dumbbell shaped DGS 76

Table 4. 4: Value obtained after simulation of Patch Antenna with E shaped DGS 79

Table 4. 5: Comparison table of different shapes in DGS Ground 81

LIST OF FIGURES

FIGURE	TITLE	PAGE
Figure 2. 1:	Simple Design of Microstrip Patch Antenna	6
Figure 2. 2:	Different shape may represent the patch	8
Figure 2. 3:	Microstrip patch antenna with microstrip line feed	9
Figure 2. 4:	The coaxial probe feed	9
Figure 2. 5:	Aperture Coupling Feed	10
Figure 2. 6:	Proximity Coupling feed	11
Figure 2. 7:	Low pass filter with cascaded dumbbell shaped DGS integrated with microstrip transmission line along with T-junction stub: (a) schematic diagram; (b)simulated parameters (Ahn et al. 2001) [13]	14
Figure 2. 8:	Schematic of the tuneable band-stop filter	15
Figure 2. 9:	BPF with interdigital slot DGS	16
Figure 2. 10:	The microstrip line with DGS patterns on the ground plane	17
Figure 2. 11:	Example of defected ground structures (DGS): (a) Concentric ring shaped, (b) Dumbbell-shaped, (c) Arrow head dumbbell, (d) Spiral-shaped, (e) U-shaped, (f) Circular head, g) Split-ring resonators, (c) H-shaped dumbbell, (i) Cross-shaped,(j) Meander line	18

Figure 2. 12: Geometry of the purposed antenna array structure 21

Figure 2. 13: (Habashi et al. 2012) [21] Surface current distribution on the ground plane, (a) without triple DGS and (b) with DGS 21

Figure 2. 14: Circular-E Patch Optimized Dimensions 24

Figure 2. 15: Dual of DGS CPS. Red structure is on the bottom side of the substrate 25

Figure 2. 16: Photograph of dual of DGS on the (a) bottom of the substrate (b) top of the substrate 25

Figure 2. 17: (a) Measured |S21| of dual of DGS CPS lines with DGS on the bottom of the substrate and (b) |S11|smoothed of dual of DGS on the bottom of the substrate. (c) Measured |S21| of dual of DGS CPS lines with DGS on the top of the substrate 27

Figure 2. 18: Dual-band monopole antenna 28

Figure 2. 19: Photo of the fabricated dual-band monopole antenna. 29

Figure 2. 20: Measured radiation patterns of the dual-band monopole antenna at 950 MHz 29

Figure 2. 21: Measured radiation patterns of the dual-band monopole antenna at 2270 MHz 30

Figure 2. 22: Design of Rectangular Microstrip Patch Antenna 32

Figure 2. 23: Design of Microstrip Antenna with U shape DGS 32

Figure 2. 24: Design Antenna with E shape DGS 33

Figure 2. 25: Design Antenna with Double E shape DGS 33

Figure 2. 26: Design Antenna with Psi Shape DGS 34

Figure 2. 27: Geometry of the proposed band notched UWB antenna (a)Front(b)Bottom (c) Photograph of fabricated antenna 35

Figure 2. 28: Radiation patterns of the proposed antenna 36

Figure 2. 29: The designed prototypes: (a),(b) the initial classical prototype, PA, of CPW fed slot antenna (c) antenna type PB (d) antenna type PC and antenna type PD 37

Figure 2. 30: 3D View of Proposed Patch Antenna in HFSS 39

Figure 2. 31: Simulated VSWR Plot of Proposed Antenna 40

Figure 2. 32: Simulated VSWR Plot of Proposed Antenna 41

Figure 2. 33: 2D Radiation Pattern of Patch Antenna with phi = 0° & 90° 41

Figure 2. 34: Prototype of antenna (a) Top View (b) Bottom View 43

Figure 2. 35: Simulated VSWR of antenna with optimal dimension 44

Figure 2. 36: Simulated radiation patterns 45

Figure 2. 37: Simulation and measurement S11 plot of the MMW 5G antenna 48

Figure 2. 38: Radiation pattern simulation of 5G antenna at θ= 0° 48

Figure 2. 39: 3D Radiation pattern of the proposed 5G antenna simulation 49

Figure 2. 40: (a) Antenna design sizes, (b) Automotive Sharkfin with Presented 5G antenna. 50

Figure 3. 1 : Flow chart of the project flow 56

Figure 3. 2: Front of the Antenna 61

Figure 3. 3: Bottom of the antenna 61

Figure 3. 4: The single Dumbbell Shaped of the DGS 63

Figure 3. 5: The double Dumbbell shape of DGS 64

Figure 3. 6: The E shaped of the DGS 65

Figure 4. 1: Return Loss of Rectangular Patch Antenna 66

Figure 4. 2: Bandwidth of Rectangular Patch Antenna 67

Figure 4. 3: Radiation Pattern in Polar form for Full Ground Plane 67

Figure 4. 4: Radiation in 3D form for Full Ground Plane 68

Figure 4. 5: Return Loss with Single Dumbbell shaped DGS 70

Figure 4. 6: Bandwidth Graph with Single Dumbbell shaped DGS 71

Figure 4. 7: Radiation Pattern in Polar form for Single Dumbbell Shape DGS 71

Figure 4. 8: Radiation in 3D form for Single Dumbbell Shape DGS 72

Figure 4. 9: Return Loss Graph with Double Dumbbell Shape DGS 74

Figure 4. 10: Bandwidth Graph with Double Dumbbell Shape DGS 74

Figure 4. 11: Radiation Pattern in Polar form for Double Dumbbell Shape DGS 75

Figure 4. 12: Radiation in 3D form for Double Dumbbell Shape DGS 75

Figure 4. 13: Return loss Graph with E shape DGS 77

Figure 4. 14: Bandwidth Graph with E shape DGS 78

Figure 4. 15: Radiation Pattern in Polar form for E Shape DGS 78

Figure 4. 16: Radiation in 3D form for E Shape DGS 79

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter briefly an overview of the project introduction. Next, this chapter describe the problem statement and problem background. This is followed by the study's research goal and scope. This section will describe more from start to the end of the project.

1.2 Background

The mobile industry is growing very rapidly, starting from 1G and now deploying 4G for commercial use on the market. The main difference between the other generations of mobile communication is the data rate that is increasing day by day from Kbps to Mbps and now aim at Gbps. The fourth generation of mobile communications has already been launched in many countries due to spectrum scarcity and very high energy consumption. For wireless system designers, high data rates and mobility that could not even be resolved by 4G are becoming major challenges. The research is being carried out on the 5th generation wireless system (5G) to solve the above - mentioned challenges and may be deployed on the market after 2020. Haraz et al. 2015 [1] said, during the second half of 2014, the sound started to come beyond the research community that what is 5G and who will dominate the above technology. Due to its advanced features, 5G technology will be in huge demand in the near future. Haraz et al. 2015 [1]

said, the 5G technology will be in huge demand in near future due to its advanced features. It will provide lower battery consumption, high bit rate and better coverage as compared to 4G.

Niu et al. 2015 [2] said, the 5G communications may shift wireless signals to a higher frequency range from 30 to 300 gigahertz (GHz), and it will reduce the wavelength from centimetre to millimetre. Due to its advanced features, the 5G technology will be in overwhelming demand throughout the near future. This will produce a great amount of bandwidth and help in wireless traffic problems, but this could create some issues for the designer. A few of the greatest challenges is that we increase the frequency on the higher band the modulation range becomes smaller due to which some of the signals may not easily regenerate walls. Another challenge that the technology may face is attenuation if the line of sight communication around transmitter and receiver is not possible. Furthermore, when we start operating in a higher frequency range, the antenna size becomes smaller and the manufacturing becomes challenging. To achieve a high signal-to-noise-ratio uniformly throughout a cell, mm wave network must require high-gain directional antennas.

1.3 Problem Statement

Shanzhi Chen and Jian Zhao 2014 [3] said, the rapid decrease in the dimensions of the mobile phone has led to the evolution of compact antenna structures. The conventional antennas are replaced by various structures of antennas used in mobile communication. Microstrip Patch Antenna shows multi - band characteristics and has a compact structure, making it a promising candidate for handheld devices. The Microstrip

Patch Antenna has several advantages, such as low cost, light weight, easy to manufacture, etc. However, microstrip patch antenna has limitations which is low power gain, narrow bandwidth and low directivity. Paper 2015 [4] said as the size of the antenna becomes less than $\lambda/2$, the bandwidth of the antenna degrades. Microstrip antenna is easier to feed with coaxial cable and microstrip lines. Naibaho et al. 2017 [5] said DGS is a method of intentionally changes or defects the ground plane on a planar transmission line including microstrip line in order to improve the electromagnetic device performance. Due to the ability to disturb the distribution of shield current, it can be represented to this research.

1.4 Objective of the study

a) To design a patch antenna with defected ground structure that operate at 5G communication system.
b) To analyses the antenna parameters in term of bandwidth, directivity, gain, and efficiency.

1.5 Scope of study

This project will cover the overview antenna like feature and application. The rectangular patch antenna was the microstrip patch antenna's basic patch. The dielectric substrate that have been used for unit sell of material slab and the microstrip patch antenna were Rogers RT/Duroid 5880 substrate. The radiating patch antenna is made from copper that have been connected to the feed line. The combined structure and investigate the simulated result can be performed using software programs such as CST simulation tools

in terms of antenna properties along with return loss, gain and bandwidth. The combined structure between microstrip patch antenna with DGS have been simulated to operate at 28GHz.

1.6 Project Outline

This report consists of five chapters. The initial part of Chapter 1 explains the project background, the problem statement, the project goals and the scope of the project. Chapter 2 deals with the literature review of the project, references and understandings derived from different sources such as book, journals, the internet and past projects. The main source for this whole project is those materials. Chapter 3 discusses the project methodology, the methodology flowchart, the software overview and the project flow. In Chapter 4 the progress of PSM 1 and the planning of PSM 2 will be shown. In Chapter 5, the discussion, suggestion and the conclusion of the project will be discussed.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

A literature review is a complete synopsis of past research on a journal or thesis. The literature reviews are studies about the academic articles, books, and different sources significant to a specific area of research that related to the project. It's also conveyed the idea that have been established the topic and explain the strengths and weaknesses. The facts and characteristics of the patch antenna, defected ground structure and material are explained on this chapter. This chapter provides the summary of literature review on the design of patch antenna with defected ground structure for 5G mobile communication.

2.2 Microstrip Patch Antenna

Zainol et al. 2018 [6] said antenna is a part of transmitting or receiving system that is designed to radiate or to receive electromagnetic waves. It's also an apparatus to change a RF signal, travelling on a conductor into an electromagnetic wave. Through its several decades of research it is known that the ability to operate the microstrip antenna is regulated primarily by the geometric shape of the patch element. Most of the antenna are resonant devices, which perform efficiently over a moderately limited frequency band. While a sign is fed into an antenna, the antenna will emit radiation released into space in a certain way. Patch antenna is easily to fabricate, low profile antenna and low-cost lithographic method.