# UNIVERSITI TEKNIKAL MALAYSIA MELAKA

## Digital Television (DVB-T2) Ultra High Frequency (UHF) Directional Patch Antenna

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

by

**IEZAIDAH BINTI NOR SAAFRI**
**B071511096**
**940308-07-5632**

FACULTY OF ELECTRICAL AND ELECTRONIC ENGINEERING TECHNOLOGY

2018

# UNIVERSITI TEKNIKAL MALAYSIA MELAKA

## BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **Digital Television (DVB-T2) Ultra High Frequency (UHF) Directional Patch Antenna**

SESI PENGAJIAN: **2018/2019 Semester 1**

Saya **IEZAIDAH BINTI NOR SAAFRI**

mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (✓)

| | | |
|---|---|---|
| ☐ | SULIT | (Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia sebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972) |
| ☐ | TERHAD | (Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan) |
| ☑ | TIDAK TERHAD | |

Disahkan oleh:

_____ _____

Alamat Tetap:

136,
Teluk Tempoyak,
11960 Bayan Lepas,
Pulau Pinang.

Cop Rasmi:

Tarikh: _____ Tarikh: _____

** Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini perlu dikelaskan sebagai SULIT atau TERHAD.

# DECLARATION

I hereby, declared this report entitled "Digital Television (DVB-T2) Ultra High Frequency (UHF) Directional Patch Antenna" is the results of my own research except as cited in references.

| | | |
|---|---|---|
| Signature | : | …….. |
| Author's Name | : | IEZAIDAH BINTI NOR SAAFRI |
| Date | : | …….. |

# APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Electronics Engineering Technology (Telecommunication) with Honours. The member of supervisory is as follow:

……

(EN. MOHD ERDI BIN AYOB)

# ABSTRAK

Antena patch microstrip adalah antena yang sangat terkenal kerana ciri-ciri antena seperti ringan, nipis, mudah dibuat dan lain-lain. Projek ini adalah khusus pada antena patch mikrostrip berarah. Matlamat projek ini adalah untuk merekabentuk antena patch arah untuk berfungsi pada julat frekuensi Ultra Tinggi. Ia akan berdasarkan bahan FR4 Retardant FR4 yang akan direka untuk digunakan dalam televisyen digital (DVB-T2). Projek ini dipisahkan kepada tiga komponen yang menyaksikan parameter antena, simulasi dan reka bentuk perkakasan. Teknologi Simulasi Komputer (CST) digunakan sebagai perisian utama untuk mereka bentuk antena sebelum fabrikasi dilakukan. Kemudian, penganalisis rangkaian dan ruang anechoic akan digunakan sebagai alat untuk menguji antena yang untuk kehilangan kembali, parameter penyebaran (S11) dan corak radiasi. Akhirnya, simulasi dan hasil pengukuran akan dibandingkan.

# ABSTRACT

Microstrip patch antenna is a very well-known antenna because of the characteristics of the antenna such as light weight, thin, easy to fabricate and others. The project is specifically on directional microstrip patch antenna. The goal of this project is to design the directional patch antenna to works at Ultra High Frequency ranges. It will have based on the Flame Retardant FR4 material which will be designed to be used in the digital television (DVB-T2). The project is separated into three components which are realization of the antenna parameters, simulation and hardware design. The Computer Simulation Technology (CST) is used as a main software to design the antenna before the fabrication is performed. Then, the network analyzer and anechoic chamber will be used as tools to test the antenna which for the return loss, scattering parameters (S11) and radiation pattern. Finally, the simulation and the measurement result will be compared.

# DEDICATION

To my beloved parents

(Mr Nor Saafri Bin Hashim and Mrs Marjuana Binti Abdul)

# ACKNOWLEDGEMENT

First of all, I might want to offer my gratitude to the Al-Mighty, ALLAH S.W.T for the gift, I ready to finish my Final Year Project. Thank you to my parents and family members for their invaluable help, consolation, consistent love, significant advices and their comprehension in finishing this project.

I would hereby wish to express my deepest appreciation and gratitude to Encik Mohd Erdi Bin Ayob and Encik Fakhrullah Bin Idris, my respected supervisor and co-supervisor for her on-going dedication, commitment, motivation and valuable guidance in making this project a success. Their consideration, profitable counsel and valuable criticism are extremely essential and have given huge commitment towards my task.

And last, I would like to thank all my lecturers and friends who taught me throughout my education at University Technical Malaysia Melaka.

# TABLE OF CONTENT

# LIST OF TABLES

# LIST OF FIGURES

# LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

| | | |
|---|---|---|
| MHz | - | Megahertz |
| GHz | - | Gigahertz |
| IEEE | - | Institute of Electrical and Electronics Engineers |
| DVB | - | Digital Video Broadcasting |
| DVB-T2 | - | Second Generation DVB |
| UHF | - | Ultra High Frequency |
| VHF | - | Very High Frequency |
| Mbps | - | Megabits per second |
| CST | - | Computer Simulation Technology |
| FR4 | - | Flame Retardant 4 |
| dB | - | Decibels |
| dBi | - | Decibels-isotropic |
| dBd | - | Lossless half-wave dipole antenna |
| HPBW | - | Half-Power Beamwidth |
| FNBW | - | First-Null Beamwidth |
| GPS | - | Global Positioning System |
| RFID | - | Radio Frequency Identification |
| WiMax | - | Worldwide Interoperability for Microwave |
| RF | - | Radio frequency |
| IF | - | Intermediate frequency |
| NTSC | - | National Television System Committee |
| PAL | - | Phase Alternating Line |
| SECAM | - | Sequential Couleur Avec Memoire |
| ATSC | - | Advanced Television Standards Committee |

| | | |
|---|---|---|
| CVBS | - | Composite Video Baseband Signal |
| T-DAB | - | Terrestrial Digital Audio Broadcasting |
| DVB-T | - | Digital Video Broadcasting - Terrestrial |
| MPEG | - | Moving Picture Experts Group |
| TV | - | Television |
| DTV | - | Digital Television |
| HDTV | - | High Definition Television |
| MYTV | - | Malaysian Television |
| COFDM | - | Coded Orthogonal Frequency Division Multiplexing |
| ITU | - | International Telecommunication Union |
| OFDM | - | Orthogonal Frequency Division Multiplexing |
| QAM | - | Quadrature Amplitude Modulation |
| LAN | - | Local Area Network |
| DTT | - | Digital Terrestrial Television |
| HDMI | - | High Definition Multimedia Interface |
| VSWR | - | Voltage standing wave ratio |
| MCMC | - | Malaysian Communications and Multimedia Commission |
| PCB | - | Printed circuit board |
| MMIC | - | Monolithic Microwave Integrated Circuit |
| PTFE | - | Polytetrafluoroethylene |
| fr | - | Resonant frequency |
| εr | - | Dielectric constant |
| hsub | - | Height of substrate |
| hpec | - | Height of copper |
| tan δ | - | Tangent loss of substrate |
| S11 | - | Reflection Coefficient |

# LIST OF APPENDICES

# CHAPTER 1

# INTRODUCTION

## 1.0 Introduction

Nowadays, Malaysia is in the process towards the new technological adoption of digital television broadcasting which is the DVB-T2. DVB-T2 is the second-generation standard for digital terrestrial television. It is the new advanced technology in the world with the robustness, flexibility and more efficiency of designing networks for the delivery of various services such as HDTV (High Definition Television), multichannel SDTV (Standard Definition Television), fixed, portable, mobile and handheld reception. (Shukla, Dixit, Shukla, & Tiwari, 2016)

The project, specify frequency range of the antenna for the DVB-T2 usage will be made. Definition of an antenna according to the Webster's Dictionary generally defined as a metallic gadget (as a bar or wire) for emanating or accepting radio waves while the definition from IEEE standard for terms antennas is the antenna or aerial as methods for emanating or getting radio waves. Aside from getting and transmitting electromagnetic vitality, an antenna is similarly normally required to highlight the radiation in a couple of headings and smother it in others. The outcome, the antenna can likewise be required to work a directional gadget. An antenna can take various structures to satisfy the specific need close by. It can be produced using bits of directing wire, a leading patch, an opening or possibly a get together of such components. In wireless verbal trade frameworks, the antenna is a standout amongst the essential segments considering that it can unwind framework necessities and improve general framework execution. A general illustration

is a television for which the quality communicate gathering might be ventured forward essentially through utilizing a superior antenna. The various types of antenna are (Balanis, 2005).

1. Wire Antennas
2. Aperture Antennas
3. Microstrip Antennas
4. Array Antennas
5. Reflector Antennas
6. Lens Antennas

Numerous components enter into the choice of whether to utilize transmission lines or antenna. At low frequencies and short separations, transmission lines are reasonable. As the two separations and frequency increment, the signal misfortunes in transmission lines notwithstanding their cost end up being expansive, making the utilization of antenna more encouraging. Antenna, however, should be used in cell interchanges including airship, rocket, ships, or land vehicles. An antenna is additionally celebrated in communicated conditions wherein one transmitting terminal can serve an unbounded number of recipients, which can likewise or not be a cell. Individually specialized gadgets including cell phones additionally require antennas (Balanis, 2005).

## 1.1 Problem Statement

The emerging of digital television broadcasting and reception in Malaysia is fairly new since the year 2015. The digital video broadcast – terrestrial 2 (DVB-T2) is being used for the standards in DVB-T2 broadcasting. The previous analog system will phase out in first quarter 2019 in Malaysia. The DVB-T2 utilized the UHF band from 510 MHz to 798 MHz (Communications & Commission, 2004). It has been reported that a few locations of the DVB-T2 reception were not at optimal states (Norsuzila et al., 2017). The penetration of the DVB-T2 system can be greatly increased by having an optimal long-range UHF directional antenna with the usage of a small and portable patch antenna. The patch antenna is about to be effective by having a good design to attain a sufficient signal to noise ratio and balanced gain versus antenna size which later to begins deployed into the DVB-T2 setup box or decoder.

## 1.2 Objectives

i. To design a microstrip patch antenna for Second Generation DVB (DVB-T2) with the frequency of Ultra-High Frequency range.

ii. To analyze the performance of the microstrip patch antenna in term of S-parameter and radiation pattern.

iii. To deploy the microstrip patch antenna to the DVB-T2 decoder.

## 1.3 Scopes of Project

The scope of the project is limited to the microstrip patch antenna specifically to the usage of DVB-T2 digital television reception. The frequency band is in UHF ranges from 510 MHz to 798 MHz. It comprises of two section which are the simulation and hardware design. The microstrip antenna will be designed and simulated by using the CST software for the fabrication process by using the FR4 copper board. Next, the physical microstrip antenna will be measured for its performance by using a network analyzer for the scattering parameter, gain, VSWR, and input impedance. On the other hand, correct radiation pattern shall be tested inside the anechoic chamber for better visibility of the antenna reception beam. The microstrip patch antenna also will be installed to the DVB-T2 decoder to get the actual reception and performance readout. Lastly, the area to be tested is around Klang, Selangor.

## 1.4 Structures of Project Report

The project report is organized as follows:

Chapter 1 – Introduction: This chapter gives a short introduction to the analysis which consists of background, problem statement, objective and scope of the project.

Chapter 2 – Literature review: This chapter provides background information that is related to the research work inclusive of the antenna operation, antenna parameters, types of antenna, microstrip patch antenna with the application in television broadcasting. The aims are to design directional patch antenna that can operate in UHF ranges, a literature review of previously designed techniques was study and measured.

Chapter 3 – Methodology: The process and the method used for this project are discussed inclusive the antenna design specifications which is a comparison to the standard and hardware development including selection types of substrate, feeding method and fabrication of antenna were determined. The software development and measurement by using CST is addressed in this chapter.

Chapter 4 – Result & Discussion: The simulation and hardware results are discussed in this chapter by taking the considerations for the antenna design and explaining the decision taken.

Chapter 5 – Conclusion & Future Work: This chapter gives a short conclusion and future work that can be done to improve the antenna performance in the context of antenna testing.