CHAPTER 1
INTRODUCTION

1.1. Background

Telecommunications technology is developing very rapidly and covers many fields including aviation. Satellite-based Communication Navigation Surveillance/Air Traffic Management (CNS/ATM) technology has been agreed upon and has become an international standard in air space management in every country in the 10 Air Navigation Conferences held in Montreal in 1991 to anticipate high aviation growth without compromising aspects of safety and operation [1].

Automatic dependent surveillance-broadcast (ADS-B) is a surveillance technology that allows aircraft to broadcast identification, status and position information to neighboring aircraft and nearby ground stations. ADS-B is an important composition of CNS/ATM and a surveillance method recommended by the International Civil Aviation Organization (ICAO) in the next generation of air traffic management (ATM) [2].

In ADS-B Space-based aircraft data broadcasts are received on satellites which then the signal is then forwarded to the earth station, which will then provide data to the air navigation service provider. The satellite requires several components to be able to receive and transmit ADS-B data. Antenna is one of the important components so that the satellite can receive and send data properly.

Microstrip antenna is an antenna that has small and thin dimensions, an affordable price to realize [3]. Microstrip antenna was chosen because it has a simple material (low profile), lightweight structure, easy to integrate with other systems, making it suitable for nano satellite communication systems, namely CubeSat [4]. The microstrip antenna which is designed as a receiver component has circular polarization and omnidirectional radiation pattern because the CubeSat does not have control, antennas are needed from all directions. To obtain ADS-B frequency coverage, a microstrip antenna with a wide bandwidth is designed.

The term CubeSat is used to describe a small satellite whose basic unit form is a 10 cm edge cube, namely 1U. CubeSat units can be put together to form bigger artifacts, like 2U, 3U, 6U, and so forth. CubeSats must follow the standards defined by the CubeSat Design Specification, which includes compliance with flight safety

guidelines. Compact antenna required to support protocol on CubeSat. Microstrip antenna is one of the antennas several types of antennas for CubeSats that are easy to build, easy to make, and small in size. Microstrip antenna can easy to place on a variety of surfaces, making it relatively easy to install on CubeSat [5].

Based on previous research. From the measurement results on the microstrip antenna, it can be seen that the antenna has a wide bandwidth and can work at a frequency of 1090 MHz with a VSWR value of 2, return loss - 10 dB, and a minimum gain of 3 dB. However, the system that has been built cannot use 2 frequencies [6].

Based on this research, this research will use the title "Design of Multiband Microstrips Antenna on CubeSat for ADS-B Communication". This antenna will work on the ADS-B frequency of 1.09 GHz to receive ADS-B data from the aircraft and in the 2.4 GHz s-band to send ADS-B data to ground. The s-band frequency was chosen because it supports the amount of data sent from the satellite to the ground and the need for high-speed communication for ADS-B.

1.2. Problem Formulation

Based on the background that has been described, the formulation of the problem to be studied is as follows:

1. How to design a multi band microstrip antenna for ADS-B applications that can work at 1.09 GHz and 2.4 GHz frequencies with a return loss value < -10 and a VSWR < 2?
2. How to optimize the design that has been made in order to achieve the specified target specifications?
3. How to do the fabrication of a design that has been optimized and has reached the specified target?
4. How to measure and evaluate the results of the antenna that has been fabricated?

1.3. Objectives

The objectives and benefits to be achieved in this research are:

1. Designing multi-band microstrip antennas for ADS-B applications that can work at 1.09 GHz and 2.4 GHz frequencies with return loss values < -10 and VSWR < 2.

2. Optimizing the design that has been made in order to achieve the specified target specifications.
3. Performing the fabrication of a design that has been optimized and has reached the specified target.
4. Take measurements and evaluate the results of the antenna that has been fabricated.

1.4. Scope of Works

The problem limitation in this final project is used because in accordance with the purpose of this thesis to design a multi band microstrip antenna for CubeSat that can work at 1.09 GHz and 2.4 GHz frequencies, the limitations of the problem include:

- Using microstrip type antenna.
- The size of the antenna follows from the size of the 3u CubeSat.
- Using the CST Studio Suite 2019 software for the design and simulation.
- Field testing was carried out at PT. Radio Telekomunikasi Indonesia with applicable standards

1.5. Research Methods

Research methodology is a technique for collecting data or facts which where be studied and finally used as material for analysis. The techniques used in this thesis research are as follows:

- Literature Study

  This study aims to study the object of research, in this case the antenna. In designing a multiband microstrip antenna for ADS-B applications in CubeSat that can work at frequencies of 1090 MHz and 2.4 GHz and testing with ADS-B required interior material. The sources of material in this research are journals, reference books, papers, and information on the internet related to this research.

- Discussion with the supervisor

  Discussions with lecturers were conducted to obtain solutions and additional information about the research conducted.

- Simulation and design

  Simulations and designs are carried out in CST Microwave Software, in the

previous design process, measurements or manual calculations are carried out from existing formulas, and after the design, optimization will be carried out to match the specifications of the designed antenna.

- Realization

  At this stage, the microstrip antenna design that we have created and optimized using CST software is then fabricated or printed using FR4 material for the substrate and cooper for the dielectric.

- Measurement and Test

  Measurements were made using a Network Analyzer and Spectrum Analyzer to measure the parameters needed in this final project. Such as Bandwidth, VSWR, Impedance, Loss and Insertion loss. And use spectrum and signal generator to measure gain, polarization and radiation polarization.

- Analysis and Evaluation

  The analysis was carried out after the simulation, realization, measurement and testing processes were carried out. This is done by comparing the simulation results with the original measurement results to identify deviations or errors so that it is known how to overcome these problems.

1.6. Bachelor Thesis Organization

For the next writing systematics this final task is as follows:

- Chapter II BASIC CONCEPT

  This chapter provides the necessary background about multiband microstrips antenna on CubeSat for ADS-B communication system development and some reference systems.

- Chapter III SYSTEM MODEL

  This chapter provides a detailed description of the simulation and experimental model developed multiband microstrips antenna on CubeSat for ADS-B communication.

- Chapter IV MEASUREMENT AND ANALYSIS

  This chapter contains an analysis of measurements of reviewed antenna parameters such as VSWR, return loss, bandwidth, ringing levels, and radiation patterns.

- Chapter V CONCLUTION AND SUGGENTIONS

  This chapter contains conclusions drawn from the design process as well as analysis

and suggestions for further research development.