

COMPARATIVE STUDY OF REGTANGULAR MICROSTRIP PATCH  
ANTENNA ARRAY DESIGN

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*This project is dedicated to my beloved family*

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## ABSTRACT

Antennas play a very important role in the field of wireless communications. Modern wireless communication systems require the development of low cost, low profile, light weight, high gain, and simple structure antennas. Microstrip antenna satisfies such requirements. The key features of a microstrip antenna are relative ease of construction, light weight and low cost. These advantages of microstrip antennas make them popular in many wireless communication applications such as satellite communication, radar and medical applications. Microstrip antenna has also several limitations such as low gain, narrow bandwidth and low efficiency. To overcome these limitations, the microstrip patch antenna can be constructed in array configuration. This study presents the design, simulation and fabrication of rectangular microstrip patch antenna arrays at 2.45GHz. Since, the resonance frequency of these antennas is 2.45 GHz; they are suitable for industrial, scientific and medical (ISM) radio bands and wireless local area network (WLAN) applications. The configurations of the designed antennas are single patch, 4x1 and 2x2 rectangular microstrip patch array antennas. The simulation of the designs has been performed by using Computer Simulation Tool (CST) software which is a commercially available antenna simulator. The simulated and fabricated result of the designs has been obtained and comparative study between the arrays and the single patch has been done in order to analyze the performance of each configuration. Result parameters compared include return loss (S11), Voltage Standing Wave Ratio (VSWR), bandwidth, directivity, radiation pattern, gain, front to back ratio and efficiency.

## ABSTRAK

Antena memainkan peranan yang amat penting dalam bidang komunikasi tanpa wayar. Sistem komunikasi tanpa wayar moden memerlukan pembangunan kos dan profil yang rendah, ringan, mempunyai 'gain' yang berkupayaan tinggi, dan struktur yang lebih mudah. Antena Microstrip memenuhi kehendak itu. Ciri-ciri utama antena microstrip adalah pembinaan yang lebih mudah, ringan dan kos yang rendah. Kelebihan antena microstrip menjadikan ianya popular dalam banyak aplikasi komunikasi tanpa wayar seperti komunikasi satelit, radar dan aplikasi perubatan. Antena Microstrip juga mempunyai beberapa keterbatasan seperti 'gain' yang rendah, lebar jalur yang sempit dan kecekapan yang rendah. Untuk mengatasi keterbatasan ini, antena patch microstrip boleh dibina dalam konfigurasi tatasusunan. Kajian ini mempersembahkan rekabentuk, simulasi dan fabrikasi tampalan antena microstrip dengan tatasusunan segi empat tepat pada 2.45GHz. Dengan frekuensi salunan antena 2.45 GHz; ia sesuai untuk jalur radio industri, saintifik dan perubatan (ISM) serta aplikasi rangkaian tanpa wayar di kawasan tempatan (WLAN). Konfigurasi antena yang direka adalah tampalan tunggal, 4x1 dan 2x2 tampalan antena microstrip dengan tatasusunan segi empat tepat. Simulasi rekabentuk yang telah dijalankan dengan menggunakan Computer Simulation Tool (CST) yang merupakan perisian untuk simulasi antenna yang boleh didapati secara komersial. Hasil simulasi dan fabrikasi rekabentuk telah diperolehi dan kajian perbandingan antara tatasusunan dan tampalan tunggal telah dilakukan untuk menganalisis prestasi setiap konfigurasi. Parameter keputusan perbandingan termasuklah return loss ( $S_{11}$ ), Nisbah gelombang Voltan Tetap (VSWR), jalur lebar, kebolearahan, corak sinaran, gain, nisbah depan ke belakang dan kecekapan.

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## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 Background of Study**

Antennas play a very important role in the field of wireless communications. Some of them are parabolic reflectors, patch antennas, slot antennas and folded dipole antennas. Each type of antenna is good in its own properties and usage. We can say antennas are the backbone and almost everything in the wireless communication without which the word could have not reached at this age of technology [1]. A good design of the antenna can relax system requirements and improve over-all system performance. In high performance aircraft, spacecraft, satellite and missile applications, where sizes, cost, performance, ease of installation are constraints, low profile antennas may be required.

Presently, there are many other civilian applications such as mobile radio, medical equipments, solid state radar systems and wireless communication that have similar specifications. To meet these requirements, microstrip patch antennas can be used [2].

A microstrip patch antenna is very simple in the construction using a conventional microstrip fabrication technique. The patch can take any shape but rectangular and circular configurations are the most commonly used configurations [2]. Compared with conventional antennas, microstrip patch antennas have more advantages and better prospects. They are lighter in weight, low volume, low cost, low profile, smaller in dimension and ease of fabrication and conformity. Moreover, the microstrip patch antennas can provide dual and circular polarizations, dual-frequency operation, frequency agility, broad band-width, feedline flexibility, beam scanning omnidirectional patterning [1].

## **1.2 Problem Statement**

These days, there is a very large demand by the end user for integrated wireless digital applications. Antennas which are used in these applications should be low profile, light weight, low volume and broad bandwidth [1]. To meet these requirements, microstrip antenna is preferred.

Although microstrip antenna has several advantages, it also has several disadvantages such as low gain, narrow bandwidth and low efficiency. These

disadvantages can be overcome by constructing the patch of the microstrip antennas in array configuration.

This project is about designing and simulating rectangular microstrip single patch, 4x1 and 2x2 patch array antenna configurations to list the advantages of each configuration and decide which configuration is best suited for the desired center frequency of 2.45 GHz. The 4x1 and 2x2 patch array configuration is then fabricated to verify the simulated results with measurement.

### **1.3 Research Objective**

The objectives of this study are stated as follow:

- 1- To design, Simulate and fabricate 4x1 and 2x2 rectangular microstrip patch antenna arrays.
- 2- To compare and analyze the performance of the designed Antennas.

#### **1.4 Scope of Study**

This study has two phases. Phase one is about designing and simulating rectangular microstrip single patch, 4x1 Patch Array and 2x2 Patch Array Antennas. The simulation of the designs has been performed by using Computer Simulation Tool (CST). Phase two is fabricating the designed 4x1 and 2x2 Patch Array Antennas to verify the simulated results and to make comparative study on the performance of the results from the two array designs.

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