AN ULTRA WIDEBAND (UWB) MICROSTRIP PATCH ANTENNA

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ABSTRACT

Rapid changes in the field of wireless communications has to an increasing demand of higher data transfer rate and even higher bandwidths to supplement existing operating frequencies. The UWB band is an area of interest due to the fact that it can accommodate higher data transfer rate on a large bandwidth. One of the issues faced in the use of this band is the antenna design issue. A cost effective hexagonal microstrip design with a partial ground plane is presented here. This design was able to achieve a return loss of < - 8 dB in the 3.1 to 10.6 GHz band and exhibited an uniform radiation profile at frequencies of 3, 5, 7, and 9 GHz.

ABSTRAK

Kemajuan deras dalam bidang komunikasi tanpa wayar telah mewujudkan permintaan untuk kadar pertukaran data yang tinggi, dan juga jalur frekuensi yang lebar sebagai tambahan kepada frekuensi yang sedia ada. Jalur UWB mendapat minat kerana ia dapat memberi kadar pertukaran data yang tinggi di atas jalur yang lebar. Antara isu tentang penggunaan jalur UWB adalah rekabentuk antenna. Satu rekabentuk mikrostrip heksagon dengan separa "ground plane" telah dianalisa. Rekabentuk ini telah memberikan "return loss" yang kurang daripada – 8 dB dalam julat frekuensi 3.1 GHz dan 10.6 GHz. Rekabentuk ini telah juga menunjukkan profil radiasi yang seragam pada frekuensi – frekuensi 3, 5, 7 dan 9 GHz.

CONTENTS

LIST OF TABLES

LIST OF DIAGRAMS

CHAPTER 1

INTRODUCTION

1.1 ULTRA WIDEBAND ANTENNA DESIGN

The growing use of wireless devices has forced the need of larger bandwidths. As a result of this, larger bit rates or the use of different standards using different frequency bands have been proposed (Yazdandoost and Kohno, 2004). The ultra wideband (UWB) has attracted interest because it can realize a bit rate of several hundred Mbps.

Antennas are a challenging part of UWB technology. Antennas need to be specifically designed and optimized for the task. Normal wideband antennas will not transmit fast transients because they have not been corrected for dispersions since an important consideration for transient antenna is minimising both frequency and spatial dispersion. Conventional antennae are designed only to radiate over relatively narrow range of frequencies used in conventional narrow band systems, which is with a fractional bandwidth of no more than about 25 %. If an impulse is fed to such an antenna it tends to ring, severely distorting the pulse and spreading it out in time. A variety of ultra – broadband antennae exist for many years, including

the log periodic antenna and spiral antennae, but these antennae are unsuitable for short pulse applications since both these antennae transmit different frequency components from different parts of the antenna that distorts and stretches out the radiated waveform. In addition, for UWB communications applications, there is a great need for omni – directional, radiation efficient, low – cost, easy to manufacture antenna, which should have stable UWB response as well.

1.2 OBJECTIVE

The objective of this project is to design, simulate and fabricate a hexagonal microstrip patch antenna capable of operating in the 3.1 GHz to 10.6 GHz bandwidth. This bandwidth is synonymous with the Ultra Wideband (UWB) bandwidth. The basic requirement of this antenna is that it should exhibit a return loss of less than – 10 dB in the operating frequency range. A return loss of less than – 10 dB indicates that at least 90 percent of the power (energy) is transmitted and the remainder is reflected. This value also corresponds to a Voltage to Standing Wave Ratio (VSWR) of approximately 2 : 1. The hexagonal design is chosen since a similar design for an edge feed microstrip hexagonal monopole exhibits return loss values of less than – 10 dB in the UWB range as reported (Kumar and Ray, 2003). In addition, since the hexagon is geometrically similar to a circle, the radiation pattern will also be similar to that of a circular microstrip patch.

1.3 SCOPE

As mentioned in the section 1.2 above, the purpose of this project is to design, simulate, fabricate and verify the simulation results of a hexagonal microstrip patch antenna for UWB use. The hexagonal patch would be the basic design for the microstrip patch antenna. In this project, the commercially available AWR Microwave Office electromagnetic simulation tool was used. This tool is capable of generating radiation patterns of the electric field (E – field) and magnetic field (H – field) for selected frequencies as well as plotting return loss values for the S(1,1) port parameters in the desired operating frequency range. In addition, current flow patterns would also be simulated. The design that exhibits the optimum return loss and radiation pattern was fabricated and tested using a Marconi network analyzer to compare the computer simulated results with the results obtained in a laboratory environment to conclude on its suitability for UWB use.

1.4 THESIS OUTLINE

This thesis is divided into 5 chapters. The first chapter outlines the objective and scope of the project. The second chapter explains on some basic fundamentals of UWB technology, including antenna parameters and previous work on UWB antennae. The third chapter explains the methodology used in this work from simulation to fabrication and testing. The fourth chapter presents the obtained results from simulation and testing. The fifth and final chapter provides the conclusion and suggests some future recommendations.

1.5 SUMMARY

This chapter presented the one of the problems faced in the use of UWB technology, particularly the design of UWB antennae. This chapter also discussed the objective and scope of this project outlined what will be presented in this thesis.

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