Rectangular Microstrip GPS Antenna Using Metamaterial Structure with Defected Ground Structure (DGS)

Thesis is presented in partial fulfillment for the award of the Bachelor of Engineering (Hons.) Electronics (Communication) UNIVERSITI TEKNOLOGI MARA (UiTM)

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JULY 2013

ACKNOWLEDGEMENT

All praises to Allah S.W.T, the Almighty for granting me the will and the way to complete this research and thesis.

I would like to express my deepest gratitude towards my advisor, Dr. Nur Emileen Abd Rashid. Her support, patience, guidance and motivation assist me in completing this research and thesis.

I would also like to offer sincere thanks to each and every UiTM lecturers and staffs, which have contributed directly or indirectly in this research. All of their contributions are invaluable to me.

Finally, I would like to thank my family, my parents specifically for their unyielding cooperation in assisting in which wherever way possible in helping throughout my entire time to complete this project.

ABSTRACT

This thesis proposes the miniaturization and performance increment of a conventional microstrip antenna through the incorporation of Defected Ground Structure (DGS) to a metamaterial substrate. The substrate Rogers RO3003 ($\varepsilon_r = 3$ and $h = 0.75$mm) is used to design the antenna, as it is suitable to be applied in Global Positioning System (GPS). The antenna is designed to be applied to the civilian GPS frequency; 1.575 GHz. Hence the parameters signifying the performance of the antenna are return loss, bandwidth, VSWR, total efficiency and gain. The Nicholson-Ross-Weir Method (NRW) is applied to ascertain the double negative properties of the metamaterial substrate. Performance variation will be observed from three antennas; conventional antenna, metamaterial antenna and miniaturized metamaterial antenna.

Results obtained show increased performance when substrate gains the double negative properties, despite the antenna's dimension. However, performing miniaturization deteriorates the performance of a metamaterial antenna.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

The first proposition for microstrip antenna was in 1953, by Deschamps, however, not until 1970 is the first design of a microstrip is realized [2]. Microstrip antenna or patch antenna; generally is a conducting structure which is made up of a radiating patch on the top layer and a ground plane on the bottom layer. Intermediary to both the layers is a dielectric substrate. The dielectric substrate is chosen due to the relative permittivity, ε_r of the material. The relative permittivity or the dielectric constant determines the material's capability of concentrating electrical energy, ergo; it determines how the material will react to any incident electromagnetic waves.

To achieve a desired performance level, the shape of the radiating patch could be altered [2]. Rectangular and circular shape are the most commonly used structure, however, shapes such as square, elliptical, triangular, disc sector and ring sector are also viable option in constructing an antenna [1]. Feeding mechanisms too, are not limited to an option. Available feeding techniques include, microstrip line feed (inset feed), probe feed, aperture coupled feed and proximity coupled feed. These are available in order to achieve a more versatile and flexible design of a microstrip antenna.