UNIVERSITI TEKNOLOGI MARA

BACK LOBE REDUCTION OF APERTURE COUPLED MICROSTRIP ANTENNA

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AUTHOR'S DECLARATION

I declare that the work in this dissertation was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as reference work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

A novel design of 2 by 2 aperture coupled microstrip antenna (ACMSA) with back lobe reduction and gain enhancement is presented in this thesis. The basic design of the proposed antenna uses a 2 by 2 planar array structures with aperture coupler feeding technique. Both of the substrates are Rogers Duroid 5880 of thickness 0.787mm with dielectric constant of 2.2 and named as Structure 1. Electromagnetic Band Gap (EBG) is first integrated onto the antenna, Structure 2, via two approaches; by placing them onto the feedline layer and also onto the patch layer to study and analyze the effect on the ACMSA. The gain of the antenna slightly improved but the back radiation does not give any good reduction. Next, the Defected Ground Structure (DGS) concept was proposed in Structure 3 to realize the back radiation reduction effect. Four DGS with dumbbell shape were etched on the ground plane, which is sandwiched between the upper and lower substrates. Structure 4 was introduced as twelve trapezoidal-shaped parasitic elements are placed onto the first substrate, three elements besides each patch of Structure 3. The antenna design is simulated in CST Microwave Studio software with operating frequency of 5.8 GHz. The results show that back lobe level is reduced from 4.6 dB to -0.06 dB. The gain of the antenna dropped from 11.8 dB to 11.2 dB when DGS is added. However with the parasitic element, the gain is improved to 11.5 dB. An improvement can be seen to the front-to-back ratio of the antenna. With the addition of DGS and parasitic element, the ratio improves from 7.2 dB to 11.37 dB. Return loss of the antenna is -27.50 dB. This design concept can be useful in reducing the back radiation of aperture coupled microstrip antenna and improve the front-to-back ratio.

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CHAPTER ONE
INTRODUCTION

1.1 RESEARCH BACKGROUND

Recently microstrip antenna has attracted much attention in wireless communication systems. The demand for higher gain and lower side lobe pattern antenna has also increased dramatically over the past few decades. The application of microstrip antennas has become so popular because of their compact size, low profile, light weight, low cost and ease of fabrication. Due to its versatility, microstrip antenna is likely to be chosen in adding new features to the existing antenna. In designing microstrip antenna, a few characteristic must be taken into considerations such as gain, return loss, radiation pattern and bandwidth.

Aperture coupled microstrip antenna (ACMSA) is an antenna which radiating patch and the feedline are fabricated separately on different substrates. Apertures used to couple the patch and feedline together. This kind of feeding technique can reduce the unwanted signal generated by the feedline from interfering the signal radiated by the patch. However, the drawback of antenna having this kind of feeding is its bad back radiation pattern which represents power loss [1]. Radiation from aperture directly contributes to the rear-directed fields. This backward radiation may cause interferences to neighboured cell. Because of that problem, ACMSA becomes unfavourable in mobile applications. So this research will look through this matter and will find a new approach to reduce the back lobe.

In antenna radiation pattern, back lobe is in the direction of opposing main lobe radiation (180°). Because of that, it is actually indicates power loss and creates interferences. Back lobe is undesirable because of two reasons; first, it represents some radiation power loss and second, if the antenna used in handset, there is an electromagnetic exposure to mobile phone users [2-3]. In antenna design, the back lobe should be taken into consideration. A good antenna should have a low level of back lobe radiation.

For aperture coupled antenna, solutions often used to reduce the back lobe is by placing a shielding plane behind the antenna. Nevertheless, it allows the