Faculty of Electronic and Computer Engineering

DESIGN AND ANALYSIS OF MICROWAVE TRANSMISSION GLASS BY USING COMPLEMENTARY FSS

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DECLARATION

I declare that this thesis entitle "Design and Analysis of Microwave Transmission Glass By Using Complementary FSS" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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Name : NOOR AZAMIAH BINTI MD FAUZI

Date :……..

APPROVAL

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Master of Science in Electronic Engineering.

Signature :…….....

Supervisor Name : PROF. MADYA DR MOHAMAD ZOINOL ABIDIN BIN ABD. AZIZ

Date :……..…….....

DEDICATION

Dedicated to ALLAH Almighty, my loving husband, parents and my families for your infinite and unfading love, sacrifice, patience, encouragement and best wishes

ABSTRACT

The rapid development of communication system has witnessed changes from signal transmitted physically to signal transmitted via microwave. However, the effects of microwaves to the environment has also raised concern to community even when the applications of the modern wireless communication systems have offered many benefits. Thus, several solutions to overcome that problem have been made in the technology such as Frequency Selective Surface (FSS). FSS can exhibit the characteristic band stop and band pass filters which can allow or block the electromagnetic waves. The aim of this research is to design, simulate and analyze new FSS structure based on complementary structure for Global System for Mobile Communication (GSM) and Wireless Local Area Network (WLAN) applications. There are few parameters in this project that had been analyzed such as reflection coefficient, transmission coefficient and the impedance of FSS. The basic shapes of FSS such as square, circle and rectangular had been designed to produce the frequency pass band. The design structure of FSS was designed based on materials FR4 and glass. Design *A* has two designs; Design *A1* (circle) and *A2* (square). The designs that produce the best reflection and transmission coefficient is Design *A1.9* with -20.981 dB and -0.179 dB compared to other designs. Meanwhile, Design *B* has three types; the combination of two circles (Design *B1*), the combination of two squares (Design *B2*) and the combination of circle and square (Design *B3*). This design has been designed based on Design *A* but a square loop was added at the outer FSS. The best reflection and transmission obtained from Design *B* is Design *B2* with -16.152 dB and -1.281 dB. The tri-band FSS (Design *C*) has been designed by the combination of double square loop and the combination of two circles. The complementary FSS of Design *D1* and *D2* has been designed based on Design *B2* and *C* with a parallel line at the back side. The result revealed that a new band is created when the complementary FSS is used. In addition, the reflection coefficient also increased for Design *D2* compared to Design *C* at frequency response 2.4 GHz and 5.2 GHz with -16.045 dB compared to -12.592 dB and -12.584 dB compared to -10.873dB. When the reflection coefficient increased, the bandwidth also increased from 201.39 MHz to 306.52 MHz and 390.53 MHz to 532.9 MHz. In addition, the mathematical modeling for the impedance modeling has been done in certain frequency response for all FSS designs. The application of this design is suitable for green smart house or in modern office building.

ABSTRAK

Perkembangan sistem komunikasi yang pesat telah menyaksikan perubahan dari isyarat yang dihantar secara fizikal kepada isyarat yang dihantar melalui gelombang mikro. Walau bagaimanapun, kesan gelombang mikro kepada alam sekitar juga telah menimbulkan kebimbangan kepada masyarakat walaupun aplikasi sistem komunikasi tanpa wayar banyak menawarkan manfaat. Oleh itu, beberapa penyelesaian telah dibuat dalam teknologi seperti Kekerapan Permukaan Terpilih (FSS). FSS boleh mempamerkan ciri penapis jalur henti dan jalur hantar yang dapat membenar atau menghalang gelombang elekromagnet. Tujuan kajian ini adalah untuk merekabentuk, membuat simulasi dan menganalisis struktur baru FSS berdasarkan struktur pelengkap bagi aplikasi Sistem Global untuk Komunikasi Mudah Alih (GSM) dan Rangkaian Kawasan Setempat Tanpa Wayar (WLAN). Terdapat beberapa parameter dalam projek ini yang telah dianalisis seperti pekali pantulan, penghantaran dan galangan FSS. Bentuk asas FSS seperti persegi, bulatan dan segi empat tepat telah direka untuk menghasilkan jalur hantar. Struktur reka bentuk FSS direka berdasarkan bahan FR4 dan kaca. Reka bentuk A mempunyai dua jenis; Reka bentuk A1 (bulatan) dan A2 (persegi). Reka bentuk yang menghasilkan pantulan dan penghantaran yang terbaik adalah Reka bentuk A1.9 dengan -20,981 dB dan -0,179 dB berbanding dengan reka bentuk yang lain. Sementara itu, Reka bentuk B mempunyai tiga jenis; gabungan dua bulat (B1), gabungan dua persegi (B2) dan gabungan bulatan dan persegi (B3). Reka bentuk ini direka berdasarkan Reka bentuk A tetapi gelung persegi telah ditambah pada luar FSS. Pantulan dan penghantaran terbaik pada Reka bentuk B diperolehi pada Reka bentuk B2 dengan -16.152 dB dan -1.281 dB. Tiga jalur FSS (Reka bentuk C) telah direka oleh kombinasi dua kali ganda gelung persegi dan gabungan dua bulat. Pelengkap FSS, Reka bentuk D1 dan D2 telah direka berdasarkan Reka bentuk B2 dan C dengan garis selari di sebelah belakang. Hasilnya menunjukkan bahawa dengan menggunakan pelengkap FSS akan mewujudkan jalur baru. Disamping itu, pekali pantulan juga meningkat untuk Reka bentuk D2 berbanding C pada sambutan frekuensi 2.4 GHz dan 5.2 GHz dengan -16.045 dB berbanding -12.592 dB dan -12.584 dB berbanding -10.873dB. Apabila pekali pantulan telah meningkat, jalur lebar juga meningkat dari 201.39 MHz hingga 306.52 MHz dan 390.53 MHz hingga 532.9 MHz. Disamping itu, pemodelan matematik telah dilakukan ke atas sambutan frekuensi tertentu untuk semua reka bentuk FSS. Penggunaan reka bentuk ini adalah sesuai untuk rumah pintar hijau atau di dalam bangunan pejabat moden.

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