Faculty of Electronic and Computer Engineering

ENHANCEMENT PERFORMANCE OF SPLIT RING RESONATOR STRUCTURE ON MICROSTRIP PATCH ANTENNA

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DECLARATION

I declare that this thesis entitle ñEnhancement Performance of Split Ring Resonator Structure on Microstrip Patch Antennaò 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.

Signature :é é é é é .....

Name :é é é é é é é é é .....

Date :é é é é é é é é .. ..

APPROVAL

I hereby declare that I have read this report and in my opinion this report is sufficient in terms of scope and quality for the award of Doctor of Philosophy (PhD)

Signature :é é é é é .....

Supervisor Name :é é é é é é é é é .....

Date :é é é é é é é é .. ..

DEDICATION

Thanks to Allah S.W.T and Rasulullah S.A.W. Thanks also to my beloved mother, Puan Asmah bt Abu, my father, Mej (B) Hassan b. Mahadi and to all my siblings.

ABSTRACT

Metamaterial is a type of artificial structure that is not found in the nature. This structure has become an interest among many due to its extraordinary response to electromagnetic waves. The split ring resonator is an example of a metamaterial structure, which has the potential to improve the performances of components in microwaves without changing the materials or with additional radiators. First, the possibility to reduce the size of patch antenna while maintaining the acceptable performance at 2.4 GHz with various split ring resonator configurations studied. Next, the ability to produce multi bandwidth performance for Minkowski Island antenna with Minkowski Island split ring resonator had performed. The antenna had designed and simulated with Microwave CST software. Then, the proposed antenna had been fabricated and measured. Meanwhile, the Minkowski Island split ring resonator possessed the ability to reduce the overall physical size of Minkowski patch antenna up to 75.6 % compare with basic rectangular antenna. Then, the Minkowski Island split ring resonator could create multiband resonant frequency at 2.4 GHz, 3.5 GHz, and 5.2 GHz for the Minkowski Island antenna with return loss of - 21.945 dB, - 17.154 dB and - 16.536 dB with gain of 0.874 dB, 1.410 dB and 2.940 dB, respectively. Besides, the resonant frequency could also be controlled by using different combinations size and location of Minkowski Island split ring resonators. The overall size of the antenna still could be maintained although additional split ring resonators were used. Therefore, the multiband system with compact design can be realized to improve the mobility of wireless communication system devices.

ABSTRAK

Metamaterial adalah struktur buatan yang tidak dapat ditemui secara semula jadi. Struktur ini menjadi subjek yang penting kerana ianya memberi kesan yang luar biasa terhadap sistem gelombang elektromagnet. Resonator cincin terbelah adalah contoh struktur metamaterial yang mempunyai potensi untuk meningkatkan prestasi komponen gelombang mikro tanpa mengubah bahan atau dengan menambah radiatornya. Pertama, kajian mengenai kemungkinan resonator cincin terbelah untuk mengurangkan saiz antena tampalan dengan mengekalkan prestasi yang boleh diterima pada 2.4 GHz dijalankan. Kemudian, kebolehan untuk penghasilan pelbagai lebarjalur untuk antena Minkowski Island menggunakan resonator cincin terbelah berbentuk Pulau Minkowski telah dilaksanakan. Antena ini direkabentuk dan disimulasikan dengan menggunakan perisian Microwave CST. Kemudian, antena yang dicadangkan itu difabrikasi dan diukur prestasinya. Selain itu, resonator cincin terbelah berkembar berbentuk Pulau Minkowski mampu untuk mengecilkan saiz fizikal keseluruhan antena Minkowski sehingga 75.6 % berbanding antena segi empat tepat biasa. Kemudian, resonator cincin terbelah berbentuk Pulau Minkowski boleh menghasilkan pelbagai jalur frekuensi resonan pada 2.4 GHz, 3.5 GHz dan 5.2 GHz untuk antena Pulau Minkowski dengan kehilangan balik - 21.945 dB, - 17.154 dB dan - 16.536 dB dan dengan kekuatan 0.874 dB, 1.410 dB dan 2.940 dB. Di samping itu, frekuensi resonan juga boleh dikawal dengan menggunakan kombinasi resonator cincin terbelah berbentuk Pulau Minkowski yang berbeza saiz dan lokasi. Ukuran keseluruhan antena masih dapat dikekalkan meskipun jumlah resonator cincin terbelah ditambah jumlahnya. Oleh itu, sistem pelbagai frekuensi dengan reka bentuk kompak dapat diwujudkan untuk meningkatkan mobiliti peranti sistem komunikasi tanpa wayar.

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