STEPPED IMPEDANCE RESONATOR (SIR) BANDPASS FILTER ON METAMATERIAL SUBSTRATE

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MOHD ROSDI BIN ABU BAKAR
FACULTY OF ELECTRICAL ENGINEERING
UNIVERSITI TEKNOLOGI MARA
40450 SHAH ALAM,
SELANGOR, MALAYSIA

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ABSTRACT

Bandpass filter is a very popular filter used in mobile and radio wireless communication. Recent development of wireless communication system demand an efficient bandpass filter to select the required signal from the adjacent signals. This paper presents a Stepped Impedance Resonator (SIR) Bandpass filter (BPF) incorporated with Defected Ground Structure (DGS) for Wimax application. The arrowhead DGS was introduced in the design to obtain metamaterial characteristics with negative values of permittivity (εr) and permeability (μ). The advantage of metamaterial is reducing the size of the filter without effecting the performance of the device that resonates at 3.5GHz. Two filters were designed and simulated: conventional and metamaterial SIR BPF using Computer Simulation Technology (CST) and Genesys Software. Both filters were fabricated on a same substrate, Rogers RO3003 with permittivity, $\varepsilon r = 3.0$ and thickness, $h = 0.5$mm. The measurement of the fabricated filters was done using Vector Network Analyzer (VNA). The metamaterial filter shows 25.29% smaller in size compared to the conventional and it is also improves the return loss by 29.04%. It was proven that the DGS approach in designing the filter can reduce the size of the device.

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CHAPTER 1

INTRODUCTION

This chapter consists of a brief introduction about the whole project. It includes problem statement, objectives of the project, scope of work, and outline of the thesis.

1.1 INTRODUCTION

Microwave resonators are used in a variety of applications including filters, oscillators, and tuned amplifiers. They are highly demanded due to their relatively simple structure and cost-effectiveness[1]. At low frequencies, resonant structures are invariably composed of lumped element. As the frequency goes higher, lumped element in general cannot be used. Microstrip resonant circuit can be realized using distributed element such as transmission line, rectangular, circular waveguides and dielectric cavities. One example of resonator is Stepped Impedance Resonator (SIR). The SIR are well known and used to shift or suppress the higher order frequencies [2]. SIR have been found advantageous in designing bandpass filters [3].

The typical features of SIR are having a wide degree of freedom in structure and design. It also have a wide range of applicable frequency through the use of various types of transmission lines (coaxial, stripline, microstrip, coplanar) [3]. There are several type of SIR which is Quarter-Wavelength ($\lambda_g/4$), Half-Wavelength ($\lambda_g/2$) and One-Wavelength type. For miniaturization, $\lambda_g/4$ type SIR is proven to be most suitable structure. The $\lambda_g/4$ type also have the capability of controlling spurious frequency by design. This two properties make the $\lambda_g/4$ type SIR are suitable resonator element for