HAIRPIN BANDPASS FILTER ON METAMATERIAL SUBSTRATE

This thesis is presented in partial fulfilment for the award of the Bachelor of Engineering (Hons.) Electronics (Communication)

of

UNIVERSITI TEKNOLOGI MARA MALAYSIA

MUHAMMAD ADAM BIN MAZLAN
FACULTY OF ELECTRICAL ENGINEERING
UNIVERSITI TEKNOLOGI MARA
40450 SHAH ALAM,
SELANGOR, MALAYSIA

JULY 2013

ACKNOWLEDGEMENT

The author gratefully acknowledge the contributions of Dr Ahmad Asari Sulaiman from Fakulti Kejuruteraan Elektrik (FKE), Universiti Teknologi MARA (UiTM) as supervisor for guiding author throughout author's project and correcting the errors made during the project.

Author also takes this opportunity to express a great gratitude to Metamaterial group members and friends with their cooperative support and sharing knowledge with a great deal of time with author throughout completing this project.

ABSTRACT

Hairpin bandpass filter, (BPF), is a very popular filter used in mobile and radio wireless communication. Hairpin BPF is easy to fabricate and has good return loss characteristics. Recent developments of wireless communication systems demand an efficient BPF to select the required signal from the adjacent signals. The limitation of conventional BPF is that the size of the filter, which relates to performance of the filter. To overcome this limitation, a new solution method of defected ground structure (DGS) having metamaterial characteristic can improve the performance of the BPF. Metamaterial bandpass filters are class of filters which use metamaterials to increase performance of miniaturized (physically small) filter systems. In this paper a metamaterial hairpin BPF with defected ground structure was designed for centre frequency of 2.3 GHz and 10% Fractional bandwidth (FBW) for WiMax application. The filters was simulated using CST MICROWAVE Studio® and Genesys Software on Rogers 3003 with εr = 3 and h = 0.5mm. Hairpin filter was designed on metamaterial properties to enhance the result of the conventional filter. The simulation and measured results will be used to analyse the s-parameter, bandwidth and size of the filter. From simulation results, the performances of the metamaterial BPF have been increased in terms of return loss. By implementing metamaterial concept, the return loss, S_{11}, have been improved 38.51% from the conventional BPF, and the filter dimension have been reduced by 33.88%.

TABLE OF CONTENT

CHAPTER 1

INTRODUCTION

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

1.1 INTRODUCTION

Filter is one of the important elements in the RF system for selecting or allowing signals to be sent or received. A good filter is essentially able to as it will determine the range of frequency passes through or rejects the signal. Filters have been designed to suit with most devices and applications. One of the most renowned types of filter is the hairpin BPF. The microstrip filter has been said to be the most innovative area in the filter engineering with its low material cost and easy to fabricate, meaning it can be made by universities student or researchers.

Hairpin BPF is used in microwave applications. It uses conductive strips and it is formed on the top surface of a thin dielectric substrate that is separating them from a conductive layer on the bottom surface which is the ground plane for hairpin BPF. The microstrip shapes and dimension are important features of the filter.