# PARALLEL COUPLED BANDPASS FILTER

# ON METAMATERIAL SUBSTRATE

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# ABSTRACT

Filters play important roles in many radio frequencies (RF) or microwave applications including cellular radio, satellite communication, and radar to separate or combine different frequencies. Filter is used to select and confine the RF or microwave signals within assigned spectral limits. Parallel Coupled Bandpass Filter (BPF) on Metamaterial Substrate was designed using CST Microwave Studio Software. There were two filters; conventional and metamaterial parallel coupled BPF. The parallel coupled filter was designed using the basic knowledge of odd and even wave coupling of transmission lines, which results in odd and even characteristic line impedances. Defected ground structure (DGS) was used to obtain the metamaterial properties on the substrate so that the characterization of return loss, insertion loss, bandwidth and the size of both filters can be analyzed. The return loss was improved about 22.5%, bandwidth about 15.53% and the size of the filter was reduced about 27% from the conventional by applying the metamaterial.

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# CHAPTER 1

# INTRODUCTION

## 1.0 INTRODUCTION

This chapter consists of brief introduction the project, problem statements, objectives, scope of works and outline of the project. This chapter also highlights the important of the project and the arrangement of this thesis.

## 1.1 BACKGROUND OF STUDY

Artificial material that can be designed to exhibit specific electromagnetic properties that can transcend those of natural media is called metamaterial. Meta means beyond in Greek. Metamaterial commonly referred to as left-handed medium (LHM) have gained lot of research. Over the past decade, the novel class of artificial materials, have become a field of research in many branches of science including engineering. The concept of Left Hand Materials (LHMs) was theorized by Veselago in 1967 [1]. Shelby *et al.* succeeded in experimentally demonstrating his prediction of the existence of left-handed (LH) medium [2] by combining an array of metallic wires to attain the negative permittivity, $\varepsilon$ and an array of split-ring resonators to achieve negative permeability, $\mu$ [3]. The discoveries of metamaterial make it possible to reduce the size without sacrificing the key performance of the filter. The advantage of using this kind of method in filter design is significantly contributes to a smaller in size compared to conventional