UNIVERSITI TEKNOLOGI MARA

PSEUDO-ELLIPTIC SIDE-COUPLED RING FILTER MINIATURIZATION

NOOR ZAREENA ZAKARIA

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ABSTRACT

This thesis presents miniature microwave dual-mode pseudo-elliptic filters due to new stringent specification in microwave application. All presented filters are in ring filter topology, known as quarter wavelength side-coupled ring resonator filter and being implemented on FR-4 substrate. There are two miniaturization methods involved which are called miniaturization without topology alteration method and miniaturization alteration topology method. Filters which are designed using the first miniaturization method will maintain the original topology with the size reduce based on the meander line concept. While the original topology of the second method filter on the other hand, is added by four shunt capacitors at the edge of the ring. The additional capacitors; either in distributed or lumped capacitor are able to shift the filter's resonance frequency to lower value, leading to filter's size reduction. Nevertheless, the presence of these extra shunt capacitances causes in-band matching problem in its passband response which can be improved by modifying the line impedance of the ring. All the filter layouts are presented along with the comparison between the simulation and measured results.

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TABLE OF CONTENTS

CHAPTER ONE
INTRODUCTION

1.1 BACKGROUND

The rapid growth in communication technology today has led to the enhancement of high frequency application where its utilization can be clearly in military environments and also in public for both fixed and mobile communications. This scenario has increase the tendency of the interference problem as frequency congestion becomes one of the major issues in communication technology. Consequently, new specifications in designing high frequency component architecture is now needed. This specification will meet the stringent requirements of high frequency applications in order to provide better performance.

In microwave filter design for instance, the design process needs to follow several strict specifications. The first specification is in selectivity [1]–[6] which will ensure that microwave frequency can be used efficiently which can also prevent the interference problem. For example, microwave filter's response must present steeper skirt shape for its out-of-band rejection and offer transmission zero in its pass band. This is because transmission zeros and steeper skirt shape are usually taken as indicators of high selectivity in microwave filter design.

Besides high selectivity, size dimension of a microwave filter is also one of the important specifications [7]–[11]. This is because size dimension is related to the microwave filter's production cost in which the cost of a microwave filter will decrease when the filter's size is reduced. It can also be said that the size of a microwave filter is directly proportional to its production cost. As a result, microwave filter is now targeted to be as small as possible or in compact structures to reduce its production cost.

Amongst microwave planar filter topologies, the ring-based topology has gained more attention as it offered dual resonance that leads to circuit compactness, while its pseudo-elliptic characteristics with transmission zeros in its response help to ensure filter selectivity [12]–[16]. These advantages have been further enhanced by the introduction of the quarter-wavelength side-coupled ring filter where the use of quarter-