

UNIVERSITI TEKNOLOGI MARA

**SINGLE MODE RING RESONATOR
FOR BANDPASS FILTER
APPLICATIONS**

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of the requirements for the degree of
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AUTHOR'S DECLARATIONS

I declare that the work in this thesis entitled was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

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ABSTRACT

Technology advancements in microwave systems demand for high performance electronic devices. This leads to the creation and development of new microwave filter topologies to achieve better selection and control of response. Ring based filter topologies become immediately attractive options as they offer dual resonance in their response which will ensure high selectivity and physical compactness of the filter. However, in some cases, the ring filters do not come with complete mathematical synthesis, making them difficult to design and to be generalized at higher order. This thesis introduces a single mode ring resonator, fed via one of the resonator's quarter-wavelength coupled-line for simplification, with less control parameters. A global synthesis is developed to fix the transmission zeros and experiments are conducted to prove the validity of the synthesis and subsequently can be generalized for higher-order filters. To prove this concept, higher-order filters were realized by cascading the single mode ring to form multiple cells and additional coupled-lines were introduced in the structure to create additional poles. The global synthesis of the single mode ring was applied to demonstrate the flexibility of the single mode ring topology and its synthesis. Higher-order filters of up to 5th-order were implemented in the range of 1 GHz to 2 GHz to give a different range of fractional bandwidth between 10% - 26%. Further advancement on the application of single mode ring topology is presented in this thesis for reconfigurable filter application. By manipulating the electrical length of the ring lines using external tunable elements, the electrical length of the ring was varied, hence, shifting the frequency response to a desired position. The reconfigurable filter with its tunable scheme synthesis was developed to control the frequency response at arbitrary center frequency. Based on this reconfigurable concept and its synthesis, two reconfigurable designs were achieved using two different techniques. The first technique made use of lumped capacitors and was successfully reconfigured from 2 GHz to 984.4 MHz; while miniaturisation achieved up to 71% as compared to the conventional filter designed directly at 1 GHz. The second design made use of varactor-diodes and shifted the resonance frequency from 1.10 GHz to 1.38 GHz, spreading over 280 MHz frequency range to give 25% tuning range with fractional bandwidth below 9%. All the filters were realized using microstrip technology. The simulated and measured results are then presented and compared to demonstrate the excellent performance of the proposed filters.

TABLE OF CONTENTS

	Page
AUTHOR'S DECLARATIONS	iii
ABSTRACT	iv
ACKNOWLEDGEMENTS	v
TABLE OF CONTENTS	vi
LIST OF TABLES	x
LIST OF FIGURES	xii
LIST OF ABBREVIATIONS	xxi
LIST OF SYMBOLS	xxii
CHAPTER ONE: INTRODUCTION	1
1.1 Background and Motivation	1
1.2 Problem Statement	3
1.3 The Research Proposal	4
1.4 The Research Objectives	5
1.5 Scope of Work	7
1.6 Thesis Contributions	11
1.7 Thesis Outline	12
CHAPTER TWO: LITERATURE REVIEW	13
2.1 Introduction	13
2.2 Overview of Filter Theory	14
2.2.1 General Filter Function	14
2.2.2 Filtering Function Synthesis	16
2.2.2.1 The Maximally Flat Filtering Function or Butterworth Filtering Function	16
2.2.2.2 The Chebyshev Filtering Function	18
2.2.2.3 The Elliptic Filtering Function	20

2.2.2.4 The Generalized Chebyshev (Pseudo-Elliptic) Filtering Function	21
2.3 Filter Synthesis by the Insertion Loss Method	22
2.4 Microwave Filter Implementation Using Transformation Tools	24
2.5 Utilization of Coupled-Line	25
2.6 Transformation of Coupled-Line Network	28
2.7 Microwave Bandpass Filter	31
2.8 Theory of Ring Resonator	37
2.8.1 Coupling of Ring Resonator	39
2.9 Ring Topology in Microwave Bandpass Filter Designs	41
2.9.1 Advance Bandpass Filter Applications	44
2.9.1.1 Higher-Order Bandpass Filter	44
2.9.1.2 Reconfigurable Bandpass Filter	48
2.10 Summary	54
CHAPTER THREE: RESEARCH METHODOLOGY	55
3.1 Introduction	55
3.2 Procedure of Development of Synthesis for Single Mode Ring Resonator	55
3.3 Proposed Method for the Development of Higher-Order Filters	57
3.4 Proposed Method for the Implementation of Reconfigurable Ring Filter	61
3.4.1 Schematic Diagram of a Varactor-Diode with Biasing Circuit	66
3.5 Summary	69
CHAPTER FOUR: MODELLING, DESIGN AND SYNTHESIS OF SINGLE MODE RING RESONATOR	70
4.1 Introduction	70
4.2 Single Mode Ring Resonator Topology	72
4.3 Parametric Study of the Ring Resonator	75
4.3.1 Characteristics of the Resonator on Microstrip Lines	78
4.4 Synthesis of the Ring Resonator	81
4.4.1 Equivalent Circuit of the 3-Port Coupled-Line	82
4.4.2 Full Equivalent Circuit Diagram of the Ring Resonator	84