

**3<sup>rd</sup> ORDER MICROSTRIP SYMMETRICAL DBR FILTER AT 5GHz**

**HASIF BIN MOHAMAD**

**A dissertation submitted in partial fulfilment  
of the requirements for the award  
of the degree Engineering  
(Electrical – Electronics & Telecommunications)**

**FACULTY OF ELECTRICAL ENGINEERING  
UNIVERSITY TEKNOLOGI MARA**

**APRIL 2010**

## **ACKNOWLEDGEMENTS**

My first thanks is for my supervisor, Dr. Mohd Khairul bin Mohd Salleh, whose constant support, patience and unbounded of his invaluable help. His devotion to the needs of students and the encouragements has working with him a true delight. Thanks for helping me to kick start and finish this valuable research.

I would also like to thank all the staff members and my co-students who were always there at the need of the hour and provided with all the help and facilities, which I required for the completion of my project and thesis.

My greatest thanks are to all who wished me success especially my parents. Above all render my gratitude to the Almighty who bestowed self-confidence, ability and strength in me to complete this work for not letting me down at the time of crisis and showing me the silver lining in the dark clouds.

## ABSTRACT

This research reports on the design of 3<sup>rd</sup> order microstrip symmetrical dual-behaviour resonators (DBRs) filter. The filter is centered at 5GHz. The DBR filter is designed on FR4 substrate (dielectric thickness  $h=1.6\text{mm}$ , relative permittivity  $\epsilon_r = 5.4$ ). Throughout the paper, simulations are proposed to illustrate the possibilities offered by the idea. Experimental results in microstrip technology are also presented in order to validate the idea. Lastly, benefit and drawbacks of the design are discussed.

# TABLE OF CONTENTS

DECLARATION .....	iii
ACKNOWLEDGEMENTS .....	iv
ABSTRACT .....	v
TABLE OF CONTENTS .....	vi
TABLE OF FIGURES .....	viii
LIST OF TABLES .....	ix
<b>CHAPTER 1</b> .....	<b>1</b>
<b>INTRODUCTION</b> .....	<b>1</b>
1.1 BACKGROUND.....	1
1.2 OBJECTIVES.....	2
1.3 PROBLEM STATEMENT .....	2
1.4 SCOPE OF WORK .....	2
1.5 PROJECT ORGANIZATION.....	3
<b>CHAPTER 2</b> .....	<b>4</b>
<b>LITERATURE REVIEW</b> .....	<b>4</b>
2.1 MICROWAVE FILTER .....	4
2.2 FREQUENCY RESPONSE .....	6
2.3 IMPORTANT PROPERTIES OF FILTERS .....	8
2.4 CLASSIFICATION OF FILTER.....	11
2.4.1 Digital Filters and Analog Filter .....	12
2.4.2 Continuous Time and Switched Capacitor Filters .....	12
2.4.3 Lowpass, Highpass, Bandpass, Allpass, Bandstop Filters .....	14
2.4.4 Butterworth and Chebyshev Filters.....	16
2.5 VARIOUS TOPOLOGY OF MICROWAVE FILTER.....	19
2.5.1 Stub Filter.....	19
2.5.2 Coupled Line Filter .....	21
2.5.3 Ring Filter Resonator .....	22
2.5.4 DBR Filter .....	23

<b>CHAPTER 3</b> .....	25
<b>METHODOLOGY</b> .....	25
3.1 INTRODUCTION.....	25
3.2 DESIGN FLOWCHART.....	26
3.3 THE THEORY AND SYNTHESIS.....	27
3.4 DESIGN (ideal case).....	31
3.5 DESIGN (microstrip).....	33
<b>CHAPTER 4</b> .....	36
<b>RESULTS AND DISCUSSIONS</b> .....	36
4.1 MEASUREMENT PROCESS .....	36
4.2 DUAL-BEHAVIOUR RESONATORS ON THE FR4 .....	37
4.2.1 BENEFITS AND DRAWBACKS OF THE STRUCTURE.....	43
<b>CONCLUSION</b> .....	44
<b>REFERENCES</b> .....	45
<b>APPENDIX-A</b> .....	46
PROJECT PROPOSAL .....	46
<b>APPENDIX-B</b> .....	52
TECHNICAL PAPER.....	52