

# **RF OSCILLATOR BASED ON A PASSIVE RC BANDPASS FILTER**

This thesis is represented in partial of fulfillment for the award of the

**Bachelor of Engineering (Hons.) in Electronic Engineering**

**UNIVERSITI TEKNOLOGI MARA**

**(MARCH 2013 – JANUARY 2014)**



**MOHD AZRUL AMINUR RASHID B. ROFIEE (2009310547)**  
**FACULTY OF ELECTRICAL ENGINEERING**  
**UNIVERSITI TEKNOLOGI MARA**  
**40450 SHAH ALAM SELANGOR**  
**MALAYSIA**

## ACKNOWLEDGEMENT

*In the name of Allah S.W.T, the Most Gracious and the Most Merciful*

All praises and glories to Allah who gave me the courage and patience to carry out this project.

In such a great opportunity, I would like to express my acknowledgements and appreciations to those who had contributed and assisted in completing my Final Year Project (FYP).

Foremost, I would like to express my sincere gratitude to my project supervisor, **Madam Wan Rosmaria Wan Ahmad** for the continuous support of my project, for her patience, motivation, enthusiasm and immense knowledge. Her guidance helped me in all the time of research and writing this thesis.

My sincere thanks also go to **Universiti Teknologi MARA (UiTM)** for the facilities provided. To all lecturers and staff in Faculty of Electrical Engineering, very big thanks you to all because of their sincerity and patient. My fellow colleagues should be noted for their endlessly support. I would like to extend my gratitude to everyone who has been helping me directly or indirectly throughout this project.

Last but not least, I would like to thank my family for their concern, encouragement and support throughout my life. They are one of the most valuable gifts in my life. I am very thankful because have been surround with people that always give me support and guidance.

Thank you very much.

## ABSTRACT

The purpose of this paper is to design a passive RC bandpass filter (BPF) based voltage-controlled-oscillator (VCO) operating at 2.5 GHz. A preferred type of an oscillator to operate in the GHz frequency range is either an LC oscillator or a ring oscillator. In fabrication, an LC oscillator involving high cost due to the inductors even it exhibits an excellent phase noise performance. On the other hand, ring oscillator resulting a cheap fabrication cost because it can be built with standard CMOS devices. However, it has a poor phase noise and jitter performance and is sensitive to power supply noise. This paper proposes an RC BPF-based oscillator. Its purpose is to close the performance of an LC oscillator than a ring oscillator, as a result to improve the phase noise performance. Furthermore, it can be fabricated in a standard CMOS process since there is no inductor. To prove the proposed concept, a RC BPF-based oscillator was designed with operating frequency of 2.5 GHz and phase noises -98.1 dBc/Hz at 1MHz offset frequency. The power consumption extracted from the simulation is 2.38 mW for 1.8 V supply voltage

# TABLE OF CONTENTS

CHAPTER	CONTENTS	PAGE
	<b>CANDIDATE'S DECLARATION</b>	i
	<b>ACKNOWLEDGEMENT</b>	ii
	<b>ABSTRACT</b>	iii
	<b>TABLE OF CONTENTS</b>	iv
	<b>LIST OF FIGURES</b>	vi
	<b>LIST OF TABLES</b>	viii
	<b>LIST OF ABBREVIATIONS</b>	ix
<b>1</b>	<b>INTRODUCTION</b>	
	1.1 INTRODUCTION	1
	1.2 BACKGROUND OF STUDY	2
	1.3 PROBLEM STATEMENT	3
	1.4 SIGNIFICANCE OF STUDY	4
	1.5 OBJECTIVES	4
	1.6 SCOPE OF WORK	5
	1.7 THESIS ORGANIZATION	5
	1.8 SUMMARY	6
<b>2</b>	<b>LITERATURE REVIEW</b>	
	2.1 INTRODUCTION	7
	2.2 BACKGROUND OF BPF OSILLATOR	7
	2.3 WEIN BRIDGE OSCILLATOR	8
	2.4 AN OSCILLATOR USING AN OTA	10
	2.5 CIRCUIT IMPLEMENTATION OF THE RC BPF- BASED OSCILLATOR	12
	2.6 DESIGN OPTIMIZATION	16
	2.7 SUMMARY	21

# **CHAPTER 1**

## **INTRODUCTION**

### **1.1 INTRODUCTION**

Oscillators are important in many different types of electronic equipment. For example, a quartz watch uses a quartz oscillator to keep track of what time it is. An AM radio transmitter uses an oscillator to create the carrier wave for the station, and an AM radio receiver uses a special form of oscillator called a resonator to tune in a station. There are many application of oscillator to applied in electronic and communication field.

Voltage-controller-oscillator(VCO) is the type of oscillator whose oscillation frequency is controlled by a voltage input. The applied input voltage determines the instantaneous oscillation frequency. Consequently, modulating signals applied to control input may cause frequency modulation(FM) or phase modulation(PM). VCOs has a highly linear relation between applied voltage and frequency. They are used to convert a slow analog signal to a digital signal for transmission over a long distance, since the frequency will not drift or be affected by noise. VCOs may have sine and/or square wave outputs. Function generators are low-frequency oscillators which feature multiple waveforms, typically sine, square, and triangle waves. Monolithic function generators are voltage-controlled. Analog phase-locked loops typically contain VCOs. High-frequency VCOs are usually used in phase-locked loops for radio receivers. Phase noise is the most