

**IMPLEMENTATION OF MEMRISTOR USING 0.13 $\mu\text{m}$  TECHNOLOGY  
IN NAND & NOR FOR HYBRID CMOS INTEGRATED**

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## **ABSTRACT**

This thesis describes the use of nanoelectronic device known as memristor as an alternative device structure to CMOS in forming digital logic gates. The purpose of this research project is to develop a new model parameter based on actual measured data with all parameter described from the fabrication data. The I-V characteristic of the fabricated memristor is studied to form a Spice Macro model to represent the memristor and implemented into NAND and NOR gate. The NAND and NOR logical circuit will be designed and it will be simulated using LTspice software and producing designated layout using 0.13 $\mu\text{m}$  of Silterra technology in Mentor Graphic software and it will be compared with an existing spice model. The Hybrid CMOS NAND circuit designed, in comparison to conventional CMOS NAND using the Spice Macro model, is 68.90% times smaller and 47.90% times lower power consumption while the Hybrid CMOS NOR is 71.82% times smaller and 82.13% times lower power consumption than conventional CMOS NOR. This device will be beneficial to the technology as it is smaller with a high density and faster with low power consumption compared with the CMOS NAND and NOR.

## TABLE OF CONTENTS

<b>CHAPTER</b>	<b>LIST OF TITLE</b>	<b>PAGE</b>
	<b>DECLARATION</b>	ii
	<b>DEDICATION</b>	iii
	<b>ACKNOWLEDGEMENT</b>	iv
	<b>ABSTRACT</b>	v
	<b>TABLE OF CONTENTS</b>	vi-vii
	<b>LIST OF FIGURES</b>	viii
	<b>LIST OF TABLES</b>	ix
	<b>ABBREVIATIONS</b>	x
<b>1.0</b>	<b>INTRODUCTION</b>	
	1.1 Background Of Study	1
	1.2 Problem Statement	2
	1.3 Objective of Project	2
	1.4 Scope of Study	2
	1.5 Significant of Work	3
	1.6 Organization of Thesis	3
<b>2.0</b>	<b>LITERATURE REVIEW</b>	
	2.1 Introduction	4
	2.2 Previous Work	4-6
	2.3 Memristor	6-8
	2.4 Spice Macro Model	8
	2.5 Windows Function	9-10

# CHAPTER 1

## INTRODUCTION

### 1.1 BACKGROUND OF STUDY

Moore's Law has stated that the size of transistor will be shrinking and the chip will be doubling every two years. However, the Moore's Law has its limit, due to the transistor that would eventually reach the limits of miniaturization at atomic levels. Therefore, the electronic designs need to shift to another alternative device that is not just smaller in size but increasingly capable [1]. Thus, a new nanoelectronic device being proposed by the name of memristor. The performance of digital circuits can be improved by combining transistor with memristor in a hybrid chip [1].

A memristor is the device in nanoscale where the memristance then will become the dominant effect on circuit components. In fact, on this scale, memristance becomes one million times more important than any other circuit.

When memristors are combined with transistors in a hybrid chip, memristors would be expected to improve the performance of digital circuits without shrinking transistors from their current day dimensions.