

**SINGLE PHASE INVERTER CONTROLLED USING XILINX FPGA TO
PRODUCE SINUSOIDAL PWM**

This thesis is presented in partial fulfillment for the award of the Bachelor of
Electrical Engineering (Honors)
UNIVERSITI TEKNOLOGI MARA
MALAYSIA



YUSHARMIZRAN B. YUROZIAN
Faculty of Electrical Engineering
UNIVERSITI TEKNOLOGI MARA
40450 Shah Alam
Selangor Darul Ehsan

ACKNOWLEDGMENT

Thanks to Allah who has given me the strength and ability to completed this final project and thesis. With this opportunity I would like to express a special gratitude to my project supervisor Tuan Haji Ishak bin Ismail for the guidance and support throughout the development of this project. I would also like to express my utmost gratitude to Dr. Ahmad Maliki Omar for his help and all who have been involved directly or indirectly.

I also would like to thank to my parent for their support an understanding to me in order to do this project. Thanks also to all my friends who had given me support and contribution to finish this project. May Almighty Allah bless and reward them for their generosity.

Thank you

Yusharmizran b. Yurozian
Universiti Teknologi MARA,
Shah Alam, Selangor Darul Ehsan

ABSTRACT

The aim of this project is to study how to generate Sinusoidal Pulse Width Modulation (SPWM) controlled by XILINX chip XC4005XL field programmable gate array (FPGA) and how inverter converts DC to AC voltage process. The XILINX FPGA send pulse width variation signal that sets the gate voltage of the inverter, which in turn provides the required voltage for desired output. XILINX FPGA software has been used to control the input voltage of a fully controlled single-phase isolated gate bipolar transistor (IGBT) bridge inverter. Sinusoidal PWM technique has been employed in this inverter to supply the single phase loads (R load and RL load) and single phase induction motor with ac voltage. In this project also determined the output load result in different load value. This project is simulated using Matlab/simulink and PSIM. The simulation results produced are compared with the experimental result.

TABLE OF CONTENTS

CHAPTER	DESCRIPTION	PAGE
1	INTRODUCTION	
	1.1 Introduction	1
	1.2 Scope of the thesis	2
2	OVERALL VIEW	
	2.1 Introduction	3
	2.2 XILINX FPGA	3
	2.3 Driver circuit	4
	2.4 Inverter	4
	2.4.1 Voltage Control in Single - Phase Inverter	4
	2.4.2 Sinusoidal Pulse Width Modulation (SPWM)	5
	2.4.3 Type of Switching	10
	2.5 Switching Technique	13
	2.6 Insulated Gate Bipolar Transistor (IGBT)	14
	2.7 Snubber circuit	15
	2.7.1 Reduction of switching losses	16
	2.7.2 Value determine	17
	2.8 Single phase induction motor	18
	2.8.1 Operation	18
	2.8.2 Capacitor starter	18

3 SOFTWARE SIMULATION

3.1	Introduction	20
3.2	Matlab/Simulink	20
3.2.1	Matlab/Simulink switching pulses	21
3.2.2	Single-phase inverter simulation load result using Matlab/Simulink	23
3.3	PSIM	27
3.3.1	PSIM switching pulses	28
3.3.2	Single-phase inverter simulation load result using PSIM	29

4 XILINX FPGA

4.1	Design Schematic Producing SPWM Signal Using Xilinx FPGA	32
4.2	The Logic Cell Operation	34
4.3	Xilinx FPGA Simulation Result	38
4.4	Xilinx FPGA Board	39

5 EXPERIMENTAL RESULTS

5.1	Introduction	40
5.2	SPWM Waveform from Xilinx FPGA Chip	41
5.3	SPWM Waveform from IGBT Gate Terminal	42
5.4	Output Waveform at Load	43