

**RECTIFIER USING SINGLE PHASE MATRIX
CONVERTER (SPMC) TOPOLOGY CONTROLLED USING
XILINX FPGA**

**The project thesis is presented as fulfillment for the award of the
Bachelor in Electrical Engineering (Hons)**

Of

UNIVERSITI TEKNOLOGI MARA (UiTM)



NORAZMAN BIN ABU HASSAN

Faculty Of Electrical Engineering

UNIVERSITI TEKNOLOGI MARA

40450 SHAH ALAM

ACKNOWLEDGEMENTS

This work would not have been possible without the support from Puan Siti Zaliha Binti Mohammad Noor. I am especially indebted to Puan Siti Zaliha, who have been supportive of my career goals and who worked actively to provide me with the protected academic time to pursue those goals.

I am grateful to all of those with whom I have had the pleasure to work during this and other related projects whom had provided me extensive personal and professional guidance and taught me a great deal about both scientific research and life in general. I would especially like to thank Puan Siti Zaliha. As my lecturer and mentor, she has taught me more than I could ever give her credit for here. She has shown me, by her example, what a good engineer (and person) should be.

Nobody has been more important to me in the pursuit of this project than the members of my family. I would like to thank my parents, whose love and guidance are with me in whatever I pursue. They are the ultimate role models. Most importantly, I wish to thank my loving and supportive wife, Noorjamaatulurul, and my four wonderful children, Nasrul, Nazmi, Nazhan and Nazira, who provide unending inspiration.

Thank you

Norazman Bin Abu Hassan

ABSTRACT

This work presents development of basic rectifier operation using Single Phase Matrix Converter (SPMC) topology. An outline of the basic principle of rectifier operation is defined, Insulated Gate Bipolar Transistor (IGBTs) are used as a power switch and Pulse Width Modulation (PWM) technique is used to synthesize the output waveform. The proposed design enabled the user to do variation of output voltage of 5 kHz and 10 kHz switching frequency using Modulation index. MATLAB/Simulink model is developed to study the basic behavior of SPMC. Safe commutation strategy is implemented to avoid voltage spike due to inductive load. A basic load represented by R load is used for this investigation. Xilinx FPGA is used as a heart of the control electronics employing the use of digital technique.

TABLE OF CONTENTS

Items	PAGE
Acknowledgement	i
Abstract	ii
Table of Contents	iii
List of Figures	vi
List of Tables	viii
List of Symbols and Abbreviations	ix

CHAPTER 1: INTRODUCTION

1.0	Introduction	1
1.1	Problem Statement	2
1.2	Significant Of Study	2
1.3	Research Objective	3
1.4	Scope of Work	3
1.5	Research Methodology	4
1.6	Thesis Organization	5

CHAPTER 2: REVIEW OF SINGLE PHASE CONVERTER

2.0	Introduction To Power Electronic	6
2.1	Power Switch Devices	8
	2.1.1 Insulated Gate Bipolar Transistor (IGBT)	8
	2.1.2 Diode	9
2.2	Converter Classification	10
2.3	Bidirectional Switch	12
2.4	Conclusion	13

CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

Development of advanced power semiconductor devices, increased usage of power switching circuits and other power electronic applications are becoming a common place within modern commercial and industrial environment [1]. The Single phase matrix converter (SPMC) was first realized by Zuckerberger [2, 7, 9]. All previous works have focused attention to direct AC to AC single phase converter and DC chopper but none on inverter as well as rectifier operation [3]. Therefore this research will focus on Single Phase matrix Converter topology as rectifier operation. Major in Power electronics and controlling using embedded system is what the purpose of this subject [4]. Methodology that was used is SPMC topology and using IGBT as switching frequency. This work presents a single phase matrix converter topology operation as rectifier. Insulated Gate Bipolar Transistor (IGBTs) is used as a power switches and Pulse Width Modulation (PWM) technique is used to synthesize the output waveform. The proposed design enabled to do variation of output voltage and change the switching frequency externally. Safe commutation strategy will be developed to avoid voltage spike due to inductive load [5]. Basic loads represented by R load and non-linear loads are used for this investigation. Xilinx FPGA is used as a heart of the control electronics employing the use of digital technique. Computer simulation model will be developed using MATLAB/SIMULINK (MLS) to study the basic behavior of SPMC.