

**AC-DC SINGLE PHASE MATRIX CONVERTER WITH
REDUCED SWITCH COUNT AND UNITY POWER FACTOR
WAVE SHAPING CURRENT CONTROL LOOP**

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This Thesis is approved by:

Mr. Rahimi Baharom

(Project Supervisor)



**PENNSYLVANIA AK MAGIN
FACULTY OF ELECTRICAL ENGINEERING
UNIVERSITI TEKNOLOGI MARA
40450 SHAH ALAM
SELANGOR, MALAYSIA**

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ABSTRACT

This thesis presents the implementation of AC-DC single phase matrix converter with reduced switch count and unity power factor wave shaping current control loop. Basic operation of rectifier by using PWM was used to calculate the switch duty ratio to synthesis the output. Safe commutation strategy was implemented to avoid voltage spikes due to inductive load. The reduce switches were proposed after analyze the all operation in switching scheme; AC state, safe commutation strategy and power factor correction making it less complexity. A current control (CCL) using standard proportional integral control was used to develop power factor correction to correct the pulsating nature of the input current to almost unity power factor form with low total harmonic distortion (THD) level well below the acceptable limit that was defined in the IEEE 519 Std. Active current wave shaping control was used to ensure the supply current waveform could perform corrections making it continuous, sinusoidal and in phase with the voltage supply. Prior to its practical realization a computer simulation model is developed to investigate the behavior of the SPMC using MATLAB/Simulink. Selected simulations results are presented to verify proposed operation.

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1.2 PROBLEM STATEMENT

Most of electronic devices are supplied by frequency of 50 Hz from utility power company. More than 50% of this power is processed through power converter. Basically power converters use capacitor to convert AC voltage to DC voltage. Since the power converters absorb energy from the AC line only when the line voltage is higher than the DC bus voltage, the input line current contains rich harmonics, which pollute the AC line and interfere with other electric equipment. These converters usually have a low power factor of 0.65[8].

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

The AC-DC converter is by far the largest group of power switching circuits applied in industrial applications [1-3]. Conventionally, AC-DC converters which are also called rectifiers are developed using thyristors and diodes to provide uncontrolled and controlled dc power with unidirectional and bi-directional power flow [4]. However, this development has their weakness due to high total harmonic distortion, poor quality of power factor, and causing current distortion at main input AC, and slow varying a ripple at output DC load end, requiring large size ac and dc filters. Because of severity power quality problem some other options such as passive filters [5] and active filters [6] have been extensively developed to solve this problem [7].

Matrix converter has been described to offer "all silicon" solution for AC-AC conversion, removing the need for reactive energy store component used in conventional rectifier-inverter based system. It has distinct advantage of affording bi-directional power flow with any desired number of input and output phases. By proper modulation, it may be possible to generate various types of input [7].

In this work, the AC- DC controlled rectifier is developing by SPMC topology with suitable switching scheme where IGBTs act as main switching devices for all purpose. Apart from converting AC to DC, investigation also carried to improve a power factor and commutation problems that leads to voltage spike that will present for controlled rectifier operation incorporated with PFC is analyses and investigated to improve the power factor up to unity power factor and also reduce the number of switch to reduce the complexity of the circuit.