SINGLE PHASE MULTILEVEL INVERTER TO IMPROVE TOTAL HARMONIC

PERPUSTAKAAN UMP
0000113353

MD AZUAN BIN ALIAS

This thesis is submitted as partial fulfillment of the requirement for the award of the Bachelor Degree of Electrical Engineering (Power Systems)

UNIVERSITI MALAYSIA PAHANG

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LIST OF SYMBOLS

C - Capacitance

d - Diameter

D - Duty cycle

f - Frequency

I - Current

L - Inductance

R - Resistance

T - Time

V - Potential difference / Voltage

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LIST OF ABBREVIATION

DC	- Direct Current
PWM	- Pulse Width Modulation
IC	- Integrated Circuit
AC	- Alternating Current
UPS	- Uninterruptable Power Supply
SDCS	- Separate Direct Current Supply
ADC	- Analog to Digital Converter
THD	-Total Harmonic Distortion
HVDC	-High Voltage Direct Current
VR	-Voltage Regulator
ON	-Switch in ON Condition
OFF	-switch in OFF Condition

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ABSTRACT

Nowadays there are many types of single phase multilevel converter. Cascaded multilevel inverter is one of the topologies that meet the specifications in order to get the output waveform similar to sinusoidal waveform. In this project, it has been approved to develop one of the multilevel converters which is using cascaded multilevel inverter to get the output waveform similar to sinusoidal waveform. The primary benefit using this type of converter is to drive an ac load with only using low DC power supply. It is been useful because DC supply proven to be the easiest way to control an AC systems. Basically, this type of converter widely used in motor drives systems, HVDC transmissions, solar systems, Uninterruptable Power Supply (UPS). Cascaded multilevel inverter is a device with high efficiency, stability, and easy to handle. In order to design this project, the main switch must be choosing correctly. MOSFETs IRF740 are used in this project because of high frequency switching and high voltage rating. Switching in this converter will be the main part which is controlled by microcontroller because of high frequency switching. Microcontroller will provide accurate value of the switching angle to each driver of the switch. The microcontroller also used to make the systems works as planned. Because of this converter using 8 pairs of switch, it takes 2 PIC to control the entire switching angle with different duty cycle. Because IRF 740 needs at least 10V in order to operate (Vg), the driver needs to install between the PIC and IRF 740 to amplify the signal from microcontroller. Therefore, the IR 2109 is choosing for the driver of this converter.

ABSTRAK

Dewasa kini terdapat pelbagai jenis berbagai peringkat pengubah arus terus kepada arus ulang alik satu fasa. Sambungan siri berbagai peringkat pengubah arus terus kepada arus ulang alik satu fasa merupakan salah satu daripada sambungan yang memenuhi kehendak dalam memastikan gelombang keluaran hamper sama dengan gelombang sinus arus ulang alik dari pembekal kuasa arus ulang alik. Dalam projek ini, cara terdapat banyak kelebihan berbanding cara sambungan yang lain dalam jenis-jenis berbagai peringkat pengubah arus terus kepada arus ulang alik. Kelebihan utama projek ini ialah kemampuan mengawal beban yang menggunakan arus ulang alik dengan mengawal arus terus. Ini kerana arus ulang alik sememangnya tidak boleh dikawal melainkan dengan penggunaan alatan ini. Projek ini mudah didapati didalam aplikasi memacu motor arus ulang alik, talian voltan terus berkuasa tinggi, bateri solar, dan juga pembekal kuasa tidak terputus. Alat ini diguanakan secara meluas kerana kecekapan yang tinggi, stabil, dan mudah dikawal. Untuk memastikan kejayaan projek ini, pemilihan komponen dititik beratkan. Suis berfrekuensi tinggi MOSFET IRF740 digunakan kerana kestabilan beroperasi dalam kelajuan yang tinggi dan kemampuannya menanggung beban sehingga 400V. Kerana penukar ini menggunakan frekuensi yang sangat tinggi untuk suis, PIC dipilih sebagai pengawal dalam memastikan sudut pensuisan dikawal secara tepat. PIC digunakan untuk menghsilkan PWM mengikut seperti yng telah diprogramkan. Oleh kerana MOSFET IRF740 memerlukan sekurang-kurangnya 10V untuk menggerakkan Vg, litar penggerak digunakan untuk membawa voltan dari PIC kepada MOSFET. Dalam projek ini, IR2109 telah dipilih sebagai litar penggerak disebabkan kesesuaianya.

CHAPTER 1

INTRODUCTION

1.1 Introduction

Numerous industrial applications begun to demand many applications which require some easy methods to control an Alternating Current (AC) loads which cannot be controlled. As time emerged human being starting to create a brilliant device which can be the evolution for controlling an AC loads. To control an AC loads, one can obtain the controlled voltage using Direct Current (DC) supply. The DC supply can control an AC loads by injecting the DC voltage into Full Bridge circuit and the switching in the Full Bridge will produce output voltage which have same properties of AC from DC supply. A semiconductors switch will provide a high frequency switching to convert the DC supply into an AC output. This converter device called Inverter. It enables one to control an AC load using DC supply. When this application begin to be the important and widely use in industrial field, the basic idea of inverter being merged with new idea which operates as inverter too but improved in output waveforms. Basic inverter's output waveform only have positive and negative values but in square wave. In order to make sure that output voltage produced by inverter, multilevel inverter are introduced. The series connection of inverter will provide the output voltage similar to AC voltages. In high power applications, multilevel inverter used in High Voltage Direct Current (HVDC) Transmissions System. The way of multilevel inverter operates reduced the Total Harmonic Distortion (THD). THD will decrease the efficiency of the systems. In electric vehicle applications, multilevel inverter use as motor drives because the supply for the vehicles are DC supply. A semiconductor switches provide high frequency switching to converts DC into AC at different switching angles. In Cascaded Multilevel Inverter (four levels), it requires sixteen power switch which divided into two pairs. Each pairs of power switch will conducts the positives and negatives output. The pairs of the power switch divided into four different switching angles. So sixteen power switch need eight different switching angles. In power switches, system features

essentially looking for higher performances especially in power handling. Thus this project will consider the factor such as power handling performance based on system efficiency of power deliver to output.

1.2 Research Problem

This project is concentrate in power electronic conversion techniques for Cascaded Multilevel Inverter topology. Therefore, the parameters necessary for implement this converter based on system design. In addition to do this, the PWM generator needs to be accurate as it needs eight switching angles to control eight different switches. HPWM from two microcontrollers will apply in order to maintain the desired output system due to any changing given in input supply.

1.3 Objective

The objective of this project:

i. To build a DC to AC converter using Cascaded Multilevel Inverter topologies. The choosing of this type of topologies is because the connection between the circuits is not complicated as other topologies.

ii. Able to produce output waveform similar to an AC sinusoidal waveform. Due to its multilevel connection and switching angles, the output voltages will be the sum of four levels power supply and will resulted the different DC power supply follow the right path and produced output similar to sinusoidal.

iii. Remove the Total Harmonic Distortion to make sure this multilevel converter operates with full efficiency. The type of Cascaded Multilevel Inverter is already one of the ways to produce output with low THD.

1.4 Scope of Project

The scope of the project:

i. Develop multilevel converter using Cascaded Multilevel Inverter topologies with combinations of hardware and software. The converter then will able to convert four different DC power supply to an AC output.

DC power supply will provide 30Vdc. Final output will be the sum of all DC power supply resulting 120Vdc.

ii. The switching angles for power switch using PIC 18F4550 generates accurately witch will provide the timing for the power switch. Power switches using IRF740 witch drive by the driver IR2109.

1.5 Importance of Study

This project is essential in terms of power efficiency and power handling deliver to output system. It is important because this aspect related to the most electrical and electronic equipment requirements.

1.6 Limitation

This multilevel converter project limited to develop Cascaded Multilevel Inverter.

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