UNIVERSITI TEKNIKAL MALAYSIA MELAKA

PSM TITLE (High Power Inverter in Ambulance)

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree in Electrical Engineering Technology (Industrial Electronic) (Hons.)

by

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FACULTY OF ENGINEERING TECHNOLOGY
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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **High Power Inverter in Ambulance**

SESI PENGAJIAN: **2014/15 Semester 2**

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`

DECLARATION

I hereby, declared this report entitled “PSM Title” is the results of my own research except as cited in references.

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Engineering Technology (Industrial Electronic) (Hons.). The member of the supervisory is as follow:

……

(Project Supervisor)

……

(Project Co-Supervisor)

`

ABSTRAK

Penyongsang elektronik kuasa menjadi lebih popular untuk pelbagai industri yang melibatkan sokongan bekalan kuasa dan aplikasi didalam motor. Pelbagai jenis topologi penyongsang telah dicadangkan dengan kepelbagaian tahap kuasa pada penyongsang samada kuasa tinggi atau penyongsang kuasa yang rendah. Projek ini adalah untuk membangunkan satu penyongsang kuasa tinggi menggunakan komponen elektronik. Projek ini menggabungkan pengetahuan elektrik dan elektronik. Objektif projek ini adalah untuk membangunkan satu litar penyonsang yang akan menukar arus terus (kereta bateri $\mathbf{12}\,\boldsymbol{V}$) kepada voltan arus alternatif ($\mathbf{240}\,\boldsymbol{V}$). Arus terus akan dipisahkan kepada denyutan digital ($\mathbf{0}$ & $\mathbf{1}$) mengunakan bipolar Pusle Witdh Modulation yang menggunakan dua unit $\boldsymbol{ICL}\mathbf{8038}$ digabungkan dengan comparator $\boldsymbol{LM}\mathbf{3908}$ sebelum ia dialirkan ke bahaguan pesuisan mengunakan komponen kuasa yang tinggi untuk mendapatkan voltan alternatif. Hasil keluaran $\mathbf{12}\,\boldsymbol{V}$ akan meningkat kepada $\mathbf{240}\,\boldsymbol{V}$ menggunakan kuasa tinggi untuk meningkatkan pengubah untuk dibekalkan ke peralatan elektronik perubatan di dalam ambulans. Komponen yang akan digunakan mempunyai keupayaan kuasa yang tinggi dan ianya boleh meningkatkan kos kerana kesukaran untuk mendapatnya.

Projek ini memberi tumpuan kepada arus terus untuk penyongsang kuasa arus ulang alik, yang bertujuan untuk mengubah cekap kuasa arus terus ke arus ulang alik voltan tinggi sumber, dan kuasa ini bersesuaian bagi penggunaan peralatan elektrik dalam ambulan. Penyongsang yang digunakan untuk pelbagai aplikasi yang mana sumber voltan berkadar arus terus seperti bateri, panel solar atau sel-sel bahan api mesti ditukar supaya peranti.

`

ABSTRACT

Power electronic inverters are becoming more and more popular for various industrial for power supply backup and drive application. Many kind of inverter topologies have been proposed with many level of power for inverter such high power and low power inverter. This project is to develop an high power inverter using the electronic component. This project focuses on direct current (DC) to alternating current (AC) power inverters, which aim to efficiently transform a low DC input to high AC output, and this power will be suit for usage of electric equipment in ambulance. The objective of this project is to develop an inverter circuit which will convert the car battery to alternate current ($\boldsymbol{240\,V}$). The direct curent will be break into pulses through bipolar pulse width modulation using two unit $\boldsymbol{ICL8038}$ combined with comparator $\boldsymbol{LM3908}$ before it flows through switching high power components to obtain alternate current voltage. The output voltage $\boldsymbol{12\,V}$ will be increase to $\boldsymbol{240\,V}$ using step-up transformer to supply the medical electronic equipment in ambulance. The components that will be use are high power capability and may increase the cost because hard to obtain in marketplace.

This project focuses on converting DC power to AC power, which aim to efficiently transform a DC power to high power AC source, and this power will be suit for usage of electric equipment in ambulance. Inverters are used in many application, such emergency situations where DC sources is available while the application required AC source to switch on the apparatus.

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DEDICATION

This project and research work is dedicated to my wife, my beloved parents and siblings for their devoted caring throughout my life, my loving brother and sisters also my friends for their encouragement and love.

`

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First of all, I would like to express my sincere thanks and indebted to Mr. IR Nik Azran Bin Abd. Hadi as my supervisor, thank you very much for accept me as one of your PSM student and the collaborative leadership that you show will always I remembered. And also special thanks to my co-supervisor Mrs. Raeihah Binti Mohd Zain. I also would like to thank to my PSM 1 panel Mr. Fareez Ezwan Bin Mohd Sani and Mrs. Halma Binti Johari who gave me more idea on my project.

I would like to express my special thanks and a very down to earth and full with sense of humour-great experience to the Faculty of Engineering Technology (FTK) on putting into practice the Final Year Project as a compulsory chore for the third year students prior to complete their course.

I also wish to extend heartfelt thanks to my friends Fidaus Zainal, Nizam, Ikhwan, Syira Sufian, Ida Fairuz, Ibrahim and my entire classmate for your help and support during this three years in University Technical Malaysia Melaka. The memory we spent together will not I forget.

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Thank you.

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TABLE OF CONTENT

`

TABLE OF CONTENT

`

TABLE OF CONTENT

CHAPTER 3: METHODOLOGY

`

TABLE OF CONTENT

`

LIST OF TABLES

`

LIST OF FIGURES

`

LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

W	-	Watt
AC	-	Alternative current
DC	-	Direct current
PWM	-	Pulse Width Modulation
A / Amp	-	Ampere
V	-	Volt
PIC	-	Programmable Integrated Circuit
V_{DC}	-	Voltage of direct current
V_{IN}	-	Voltage input
V_O	-	Voltage output
V_{AC}	-	Voltage of alternative current
I_{DC}	-	Current of direct current
I_{AC}	-	Current of alternative current
L	-	Inductor
C	-	Capacitor
BJT	-	Bipolar junction transistor
FET	-	Field effect transistor
MOSFET	-	Metal Oxide Semiconductor Effect Transistor
etc	-	et cetera
H	-	Hours
Hz	-	Hertz
<	-	Less than
>	-	More than
Q	-	MOSFET
+VE	-	POSITIVE
-VE	-	NEGETIVE

`

CHAPTER 1
INTRODUCTION

1.0 Introduction

Power electronic is a rapidly growing in Electrical Engineering. The field of power electronics deal with application of solid-state electronics to the control and conversion of electric power.[1] It also refers to a subject of research in electronic and electrical engineering which deals with the design, control, computation and integration of nonlinear, time-varying energy-processing electronic systems with fast dynamics.

Electrical power can be converted into two different types of power: direct current (DC) and alternating current (AC). [2] These two types of power can be converted through four different methods. These methods include AC to DC, DC to AC, DC to DC and AC to AC. The conversion of DC to AC can be done through an inverter circuit while a rectifier (full bridge) is an electronic circuit that will convert AC power to DC power. The other two methods require either a DC to DC convert or an AC to AC converter only convert the input to another voltage level for output without changing the type of input. As the world become more innovative, each of four different type of circuit can be further expanded depending on what output are desired.

There are many methods of building inverter such as multilevel inverter, half bridge inverter and full bridge converter (H-bridge) with using low pass LC filter to get the smooth of sinusoidal output. And the only way to control the switching is only using generating signal.

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For low power inverter, it can be done by combinations of 555 timer and flip flop, also can generate using PIC microcontroller since it has their own PWM in the package. But for high power of inverter, PWM is widely used to control the switching especially for induction motor, photovoltaic solar power and etc. PWM technique is divided into two ways includes unipolar and bipolar inverters method.

1.1 Problem Analysis

The failure of main power supply or the power line causes interruption in emergency situation because of unexpected phenomena happened Malaysia today. This problem is worst when emergency operation need to be done to save the life immediately. Such example undelivered mother needs minor operation to deliver the baby in time but the main power supply cannot be reach at the moment. Besides that, a situation an accident at highway, it will take time to reach to hospital and the patience need to be treat immediately but there are no electrical supply to switch ON the electric medical equipment such as monitoring the pulse and respiratory assistance equipment.

Therefore, the inverter is designed to overcome this problem since every house has one car. [8] The inverter circuit will convert DC voltage from the battery to AC voltage which can be used by the most of medical electronic equipment. These combinations will produce a high power inverter that possibly reach to 1000 watt of power that can last long depend on the power of each equipment needs.

The high power inverter consist three main circuits:

i. Generating signal circuit.
ii. Switching / control circuit.
iii. Filtering and step up circuit.

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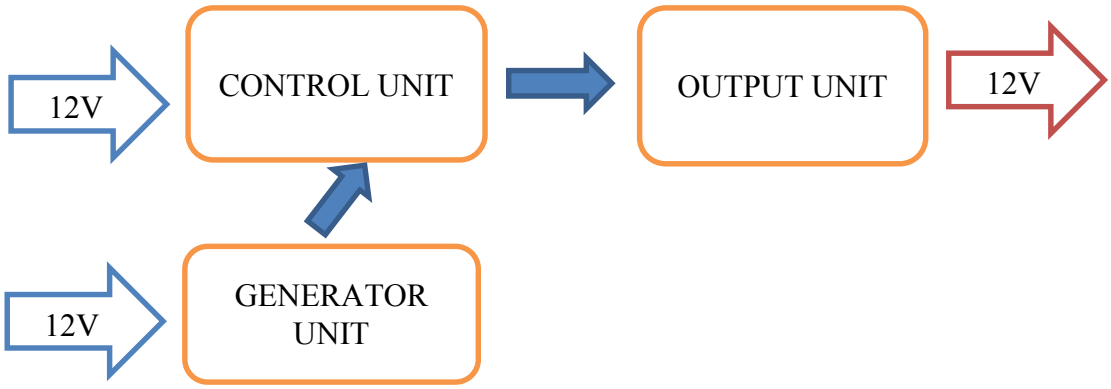

Figure 1.1: Inverter block diagram

The control unit and generator unit will be powered by 12 V_{DC} battery. [3] The generator circuit will use PWM method by using generator IC while the control unit will use power MOSFET that capable to handle the max power expected is 800 W. The output after filtering will boost up using step-up transformer to the 240 V then will supply the electrical equipment wherever the DC supply (12 V car battery) is available.

1.2 Project Objective

The objectives of this project are:

i. To develop an inverter circuit which can convert dc voltage to ac voltage
ii. To boost the output voltage to 240V ac from 12V by using a transformer
iii. To build the inverter that capable to handle the max power of 1000Watt.

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1.3 Project Scope

To realize this project, a few scopes were determined. The project scopes are very important to make sure that the project is on the right rails. The scopes of this project are shown in Figure 1.2 below.

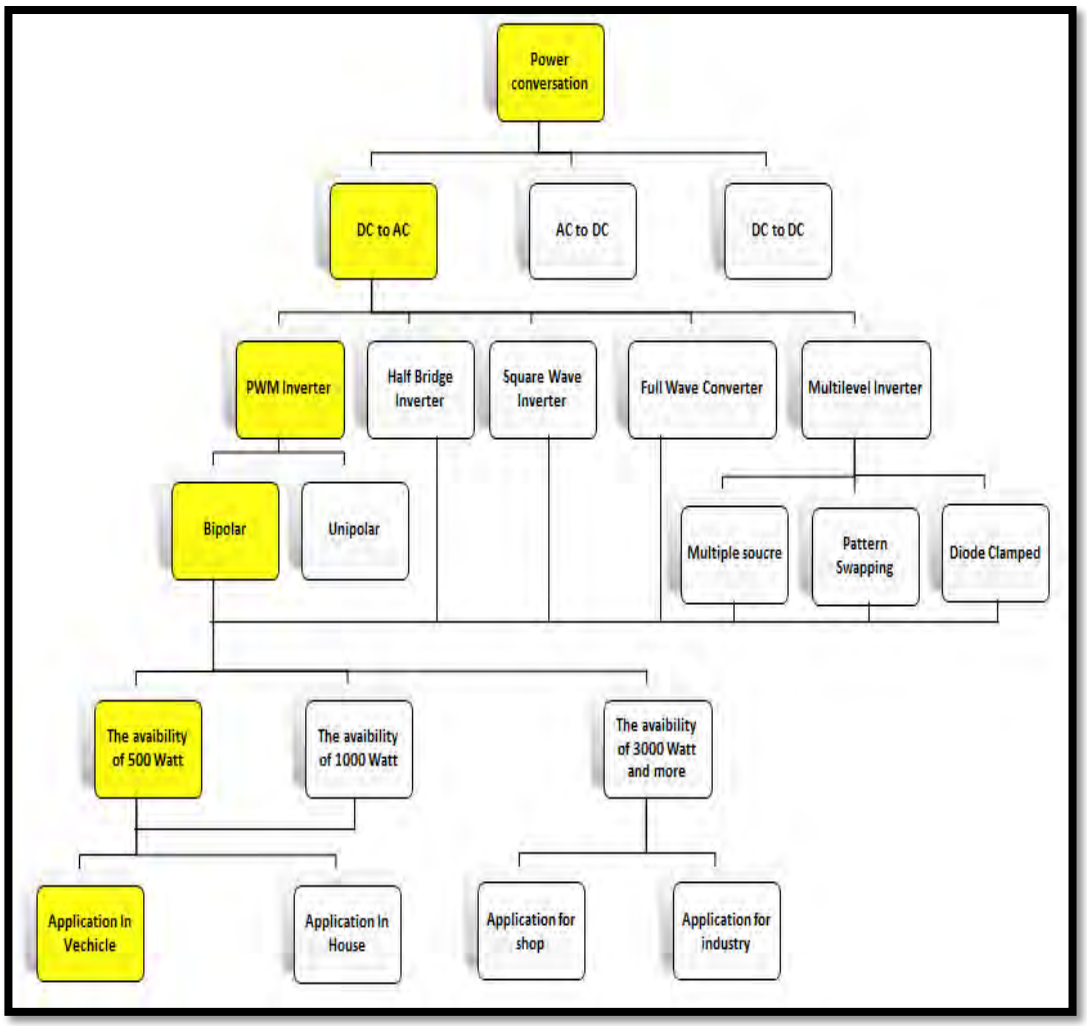

Figure 1.2: Chart of workscope

It start from get knowing the power conversation then choosing the circuit required and set the type of inverter method that want to build. The type of inverter choosing base on capability to handle the power, capability to produce sinusoidal AC voltage and mainly cost to build these inverter.

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CHAPTER 2
LITERATURE REVIEW

To do this research it required focusing on the main point of inverter and absolutely understands for each part of circuit that will be used in project such the diagram show in Figure 2.1 below.

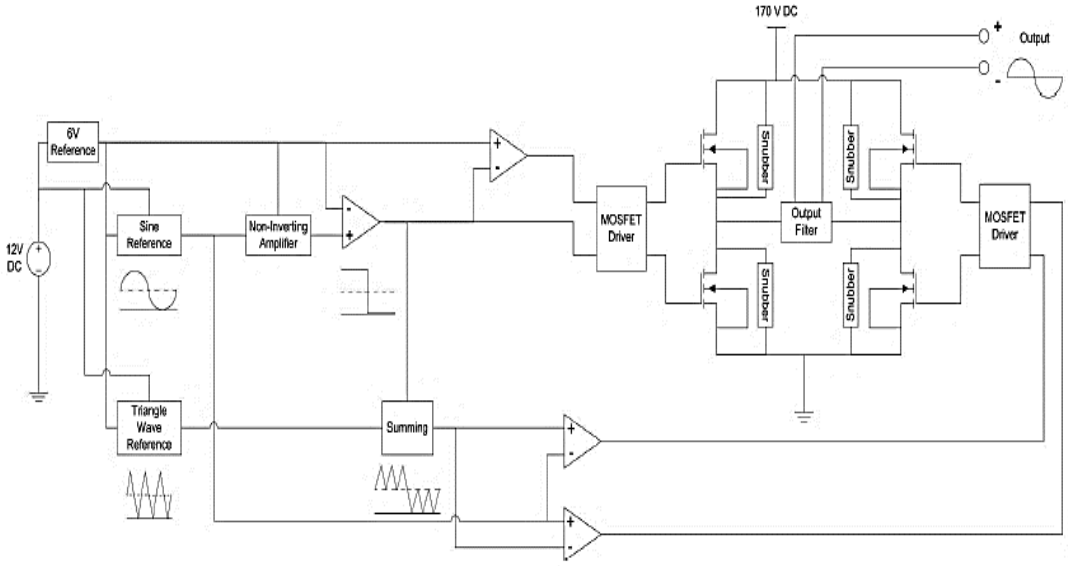

Figure 2.1: Block diagram to build an inverter

2.1 Direct Current Input Voltage

An inverter circuit does not increase any of power; it will only change the polarity of input. The power is controlled by input DC battery which the voltage of car battery is $12\,V$ and the different of each model is the capacity of current. [2] By conservation of energy of real and reactive this said that:

$$\boldsymbol{Power\ input\ (Pi) = Power\ output\ (Po)} \quad \text{..... (2.1)}$$

`

A DC power supply is one that supplies a voltage of fixed polarity (either positive or negative) to its load. Direct current is the unidirectional flow of electric charge with other means that the current flowing in one direction only from positive (+) to negative (-). In DC analysis we basically know the basic of formula are:

$$\boldsymbol{Voltage\ (V) = Current(I) x\ Resistance(R)} \quad \text{..... (2.2)}$$

$$\boldsymbol{Power\ (P) = Current(I)\ x\ Voltage(V)} \quad \text{..... (2.3)}$$

Direct current is produced by sources such as batteries, thermocouples, solar cells, commutator-type electric machines of the dynamo type and generator.

2.1.1.1 Car Battery

A lead-acid storage battery is an electrochemical device that produces voltage and delivers electrical current. [4] The battery is the primary "source" of electrical energy used in vehicles today. It's important to remember that a battery does not store electricity rather it stress a series of chemicals, and through a chemical process electricity is produced. Basically, two different types of lead in an acid mixture react to produce electrical pressure called voltage. This electrochemical reaction changes chemical energy to electrical energy and is the basic for the all automotive batteries.

Figure 2.2: Car Battery (12V) Die Hard