DEVELOPTMENT OF 12VDC TO 240VAC INVERTER

Zairina Binti Othman

Bachelor of Electrical Engineering (Power Industry)

May 2010

"I hereby declare that I have read through this report entitle Development Of 12VDC to 240VAC Inverter, and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Industrial Power)"

Signature : 

Supervisor's Name : EN. AZHAR BIN AHMAD

Date : 10/5/2010

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ZAIRINA BINTI OTHMAN

A Report Submitted In Partial Fulfillment Of Requirement For The Degree of Bachelor In Electrical Engineering (Industrial Power)

Faculty Of Electrical Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2010

I declare that this report entitle Development of 12 VDC to 240 VAC Inverter is the result of my own research except as cited in the references. This report has not been accepted for any degree and not concurrently submitted in candidature of any other degree.

Signature : 

Name : ZAIRINA BINTI OTHMAN

Date : 10 / 5 / 2016

To my beloved parents and family

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ABSTRACT

In the real world today, we are facing with the lag of energy that used to generate the electrical power, as the solution the exploration and development of alternative power become a global issue. Nowadays the alternative power that has been explore such as solar energy, wind energy, tidal energy, geothermal energy and hydro energy. Some of the alternative power such as solar energy produces the direct current (DC) from the solar panel. Most of the electrical appliances today used the alternating current (AC) as the source. The conversion of energy from DC source to AC source become the serious matter. Inverter was the electrical device that has used to convert the DC source to AC source that allow the electrical appliances to run safely, however the power quality issue cannot be separate from inverter, this is because in the market now there are several type of inverter. The type of inverter is classified by the output waveform. The improvement of output wave form to produce the better source and less harmonic should be taken as serious matter to avoid the corruption and damage to the electrical device especially for house appliances. This project will be developing the modesty output wave form that inexpensive, efficient and portable inverter.

ABSTRAK

Dunia pada hari ini semakin hari semakin menghadapi kekurangan sumber kuasa. Sumber kuasa ini digunakan untuk menjana tenaga elektrik.Sebagai jalan penyelesaian kepada permasaalah ini penerokaan dan pembangunan kuasa alternative lain kian giat dijalankan dan menjadi isu dunia pada hari ini. Pada hari ini sumber tenaka alternatif yang telah diterokai adalah seperti tenaga solar, agin, ombak, geothermal dan hidro. Diantara sumber tenaga alternative ini menghasilkan bekalan kuasa arus terus (AT) yang dijana oleh solar panel.Kebanyakan perkakasan elektrik khususnya di rumah, hamper semuanya menggunakan arus ulang alik (AU). Dapat di lihat secara jelas proses penukaran tenaga dari arus terus kepada arus ulang-alik memainkan peranan yang penting. Alat penukar arus dari arus terus kepada arus ulang-alik berfungsi sebagai alat yang menukar satu bentuk tenaga arus terus kepada arus ulang-alik, dengan adanya alat penukar arus ini, kelengkapan elektrik dapat digunakan dengan selamat mengikut standad yang telah di tetapkan. Walau bagaimana pun isu 'kualiti kuasa' tak dapat di pisahkan dalam alat penukar kuasa ini. Kualiti kuasa ini bergantung pada kadar gangguan pada kuasa keluaran, melalui kualiti ini lah juga, bagaimana alat penukar arus ini di kelasifikasikan. Oleh hal yang demikian pembaik pulih perlu dijalankan, untuk meningkatkan kualiti kuasa keluaran ini, untuk mengelakan kerugian dan kerosakkan perkakasan elektrik. Projek ini akan membangunkan alat penukar yang sederhana dari segi kos, cekap dan mesra pengguna.

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INTRODUCTION

1.1 Background

Power inverter, converts DC power or direct current to standard AC power which allows us to run the electrical appliances. Today the explorations and the development of alternative power become a global issue and as a solution that has been taken are by develop and research the renewable energy source and technology that involve to produce the power. Power Inverter was the most important devices or technology that involve in development of alternative power.

The past decade has witness the growing interest in alternative sources of energy. The so-called renewable energy such as the sun, geothermal, biomass and wind can never be exhausted. They cause less emission and therefore stand out as a potentially viable source of clean and limitless energy. However these renewable sources energy, in particular the solar energy, requires rather sophisticated conversion techniques to make them usable to the end user. For example, the output of the photovoltaic (solar) panel is essentially dc; for it to be commercially viable, it needs to be converted to ac. This is necessary because the power utilization is mostly in ac form. The technology to accomplish this conversion known as inverter is inevitably an integral part of the photovoltaic system (Dr. Zainal Salam, Power Electronic and Drive, Universiti Teknologi Malaysia, Skudai Johor Bahru).

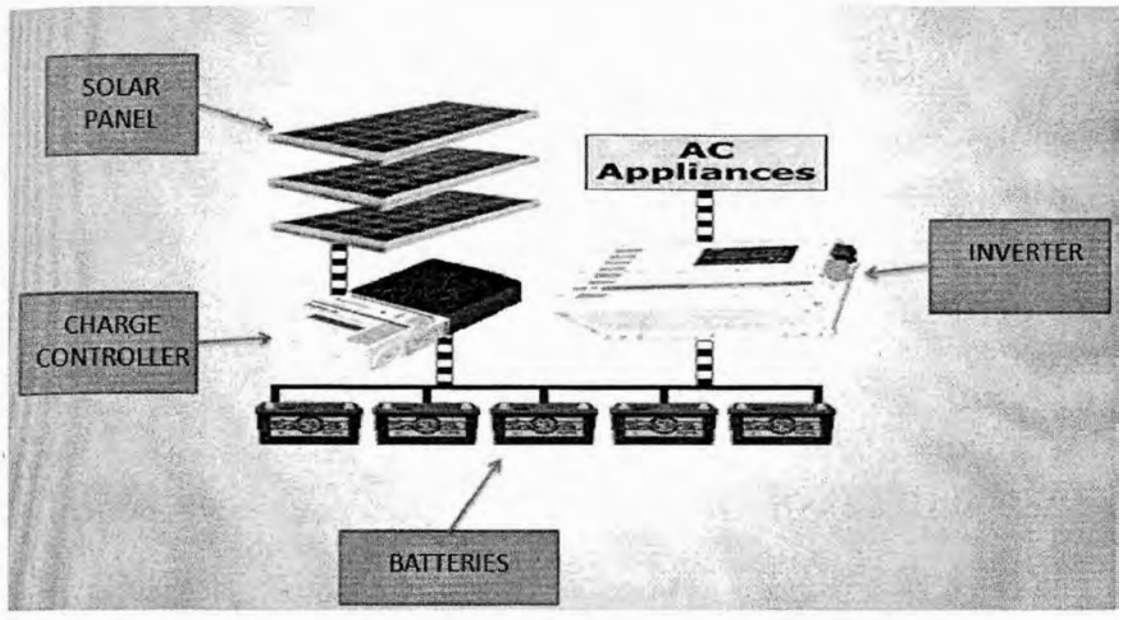

Figure1.1: Application of Inverter in Solar System

In order to fulfill the demand on the electrical power to consumers, we are deals with a cost which means the power that will be used for domestic appliances must be free from disturbances. Disturbance may cause a lot of damage and reduce the life span of the equipment. Power inverter plays important role to ensure the quality of power that will be supply to the electrical equipment is safe to used, most of household appliances and electronic devices require 240 volts at 50 hertz to operate correctly.

1.2 Problem Statement

Since most of the load in modern electrical distribution system are mixture of inductive. There is an ongoing interest in improving the quality of the output of inverter. Harmonic was the normal problem that will be occurs in inverter. The improvement of quality of output of inverter is importance to ensure the safety of each load. To produce the high quality of inverter, the cost is expensive. In the market of power inverters, there are many choices. They range from the very expensive to the very inexpensive, with varying degrees of

quality, efficiency, and power output capability along the way. High quality combined with high efficiency exists, though it is often at a high monetary cost. The high end pure sine wave inverters tend to incorporate very expensive, high power capable digital components. The modified sine wave units can be very efficient, as there is not much processing being performed on the output waveform, but this results in a waveform with a high number of harmonics, which can affect sensitive equipment such as medical monitors. Many of the very cheap devices output a square wave, perhaps a slightly modified square wave, with the proper RMS voltage, and close to the right frequency. My aims are to fill a niche which seems to be lacking in the power inverters market, one for a fairly efficient, inexpensive inverter with a square wave output.

1.2.1 Harmonic

Since most loads in modern electrical distribution system are inductive, there is an ongoing interest in improving the energy output in aspect of harmonic and power factor. The Harmonics are electric voltages and currents that appear on the electric power system as a result of certain kinds of electric loads. Harmonic frequencies in the power system are a frequent cause of power quality problems. Harmonic can cause:

- Reduced equipment life
- Equipment malfunction
- Higher power losses
- Reduced effective power factor.

The performance of inverter (power efficiency) is effected by what kind of load that been used, the characteristic of load sometimes will contribute of decreasing of performance of an inverter. Source of harmonic came from the load such as:

1. Power Electronic Equipment;
   - UPS system.
   - Personal computer.
2. Arcing equipment;
   - Fluorescent lamp.
   - Arc furnaces.
3. Saturable device;
   - Transformer.
   - Motors.
   - Generators.

The reactive load and harmonic is relate, and produce the power factor problem, where reactive(inductive) load are not used all the power that been delivered in other word the inductive load are not used all the power sent to the load, some is reflected back to the source, this tendency is measured by the so-called 'power factor'.

1.3 Project Objective

The objective of this research is to study, design, build and modified the user friendly, low cost and efficient, 12VDC to 240VAC power inverter. The inverter that will be built in this project is the simple 12VDC to square-wave 240 volt, 50 Hz inverter that can be used for normal AC equipment such as lighting and motor but maybe not be suitable for sensitive electronic equipment such as computer. The research can be simply broke up in to six sections

To learn and studied in detail the every part, and component that should involve in the simple square wave power inverter. To design the less cost inverter and very efficient power inverter circuit.

- To design construct the simple square-wave 240V, 50 Hz and power up to 200W inverter
- To simulate by using the soft ware to prove the circuit can be run.
- To assemble and soldering the circuit.
- To testing the circuit whether it success or not.

1.4 Project Scope

The scope of this project is to design an inexpensive, efficient and portable square wave power inverter. The scope of project will be start from design the power inverter circuit by using the simulation software, then by using relatively inexpensive surplus component, the circuit will assemble by soldering the component base on design. The next process, the circuit will be troubleshoots; the output of the circuit will be the square wave form.

CHAPTER 2

LITERATURE REVIEW

2.1 Classification of Inverter

Inverter is circuits that convert DC (direct current) to AC (alternating current). More precisely, inverter transfer power from a DC source to an AC load (Jim Doucet, Dan Eggleston, Jaremy shaw-MQP Term A-B-C 2006-2007). An inverter is an electrical device that widely used to convert the DC supply to AC supply, an inverter are used in applications such as adjustable-speed ac motor drives, uninterruptable power supply(UPS), and most domestic appliances instrument and devices. Most of the energy renewable supply are in form of DC, as a solutions the inverter as a converter that will convert the energy to Ac form, besides that an inverter was the solutions for electrical energy problem that occur at remote area, most of remote area around the earth used the renewable energy to solve the energy problem. A Solar Energy System was the most alternative energy are used at remote area, most of the renewable energy in form of DC (direct current) , in order to convert the direct current from the batteries and solar panels to standard mains AC alternating current, an inverter is needed.

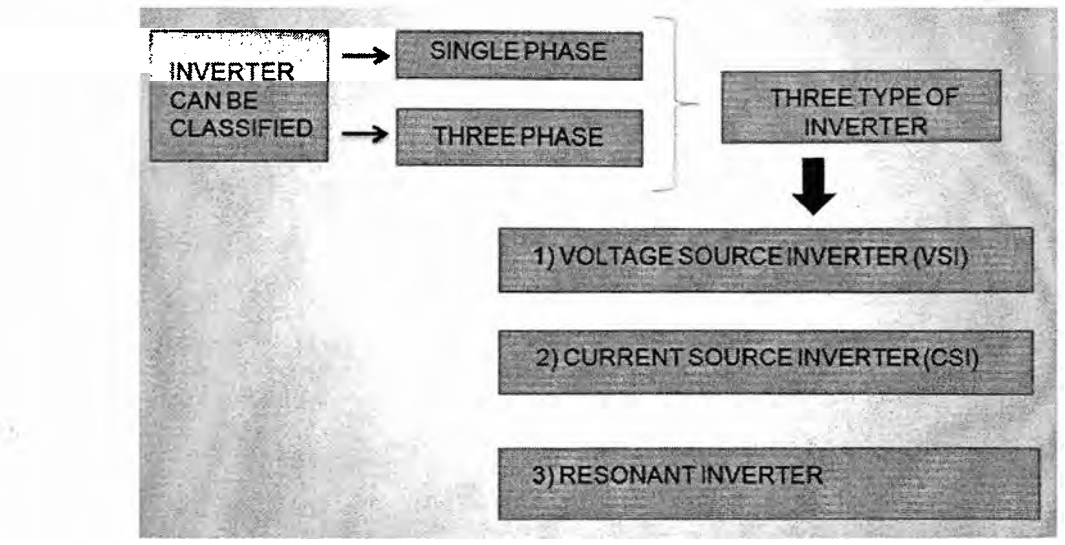

Figure 2.1:Block Diagram- Type of Inverter

2.2 Type of Inverter

Inverter is mainly designed base on three methods or type it was:

- Voltage Source Inverter (VSI)
- Current Source Inverter (CSI)
- Resonant Inverter (high frequency sine-wave inverter)

2.2.1 Voltage Source Inverter (VSI)

This type of inverter is fed by a DC source of small internal impedance. Looking from a ac side, the terminal voltage remains almost constant irrespective of the load current drawn. Depending on the circuit configuration, the voltage source may be being able to classify as half bridge and full bridge inverter. VSI may further be classified as:

- Pulse-width-modulated (PWM) inverters
- Square-wave inverter

Pulse -width modulated inverter (PWM) in PWM inverter, the output has one or more pulses in each half-cycle. Varying the width of these pulses. The output voltage may be controlled. The magnitude of input DC voltage is essentially constant in this type of inverter. Square-wave inverter produces a square wave AC voltage of constant magnitude. The output of voltage of this type of inverter can only be varied by controlling the input DC voltage Power *Electronics By M.S jamil asghar Aligarh muslim university, Aligarh(PRITICE-HALL OF INDIA PRIVATE LIMITED -2006)*. There are three circuit topologies of VSI:

- Full bridge inverter
- Half bridge inverter
- Push pull inverter

2.2.2 Current Source Inverter (CSI)

Current source inverter, this type of inverter is fed by current DC source with high-internal impedance (using current limiting chokes or inductors in series with a DC source). There for, supply current does not change quickly (Ashoka k.s Bhat University of Victoria-the electronic hands book (inverter). The load current is varied by controlling the input DC voltage to the current source inverter. CSI is used in very high-power ac drives. The input to the inverter is a current source, which is usually obtained by using a large inductor in series with the voltage source at the input. The voltage source at the input in some cases (for example, in AC motor drive), is obtained by employing a phase controlled converter for AC input or DC-DC chopper (DC input). This allows the voltage to be controlled and in turn, a controlled current source. The output of CSI can be shorted, but cannot be open the circuit. The peak current rating of the switches is equal to the DC current source and is lower compare to the VSI. The disadvantage of CSI are:

- Slower dynamic response
- Filter are required at the output to suppress the output voltage spike
- Less popular compare to VSI

2.2.3 Resonant Inverter

Resonant inverter mostly used in high frequency in electrical power conversion.

2.3 Voltage Source Inverter Type

Voltage source inverter is classified in to two type there are single phase inverter and three phase inverter. From two type of inverter it can be divide to several types it depends on the output wave form of inverter, there are three type of inverter, first type of inverter was a square wave inverter, this type of inverter produces is inefficient and is hard on many types of equipment. These inverters are usually fairly inexpensive, 500 watts or less however square wave inverter was the chipper then the other type of inverter. The output of inverter was the square wave, square wave is not suitable used for very sensitive device such as electronic device and inductive load.

Second type of inverter was a modified sine wave inverter, this is probably the most popular and economical type of power inverter. It produces an AC waveform somewhere between a square wave and a pure sine wave. Modified Sine Wave inverters, sometimes called Quasi-Sine Wave inverters are not real expensive and work well in all but the most demanding applications and even most computers work well with a Modified Sine Wave inverter. However, there are exceptions. Some appliances that use motor speed controls or that use timers may not work quite right with a Modified Sine Wave inverter. And since more and more consumer products are using speed controls & timers this type of inverter doesn't not suitable to used.

The third type of inverter was the true sine wave inverter; A True Sine Wave power inverter produces the closest to a pure sine wave of all power inverters and in many cases produces cleaner power than the utility company itself. It will run practically any type of AC equipment and is also the most expensive. Many True Sine Wave power inverters are

computer controlled and will automatically turn on and off. Most of domestic appliances are suitable to use this type of inverter ant it's suited for sensitive electrical devices.

Classification of three type of inverter are base on the quality of the output waveform, the output wave form is classified in to three type because of factor of harmonic that produce at the output wave form, normally the simple and less cost inverter (square wave inverter) consist of highly harmonic, modified sine wave inverter was the intermediate type of inverter the output wave form is consider acceptable for most electrical appliances because of harmonics is less. Pure sinusoidal inverter was the highly efficient inverter, where the harmonic is most not absent, pure sinusoidal inverter was expensive inverter among three type of inverter.

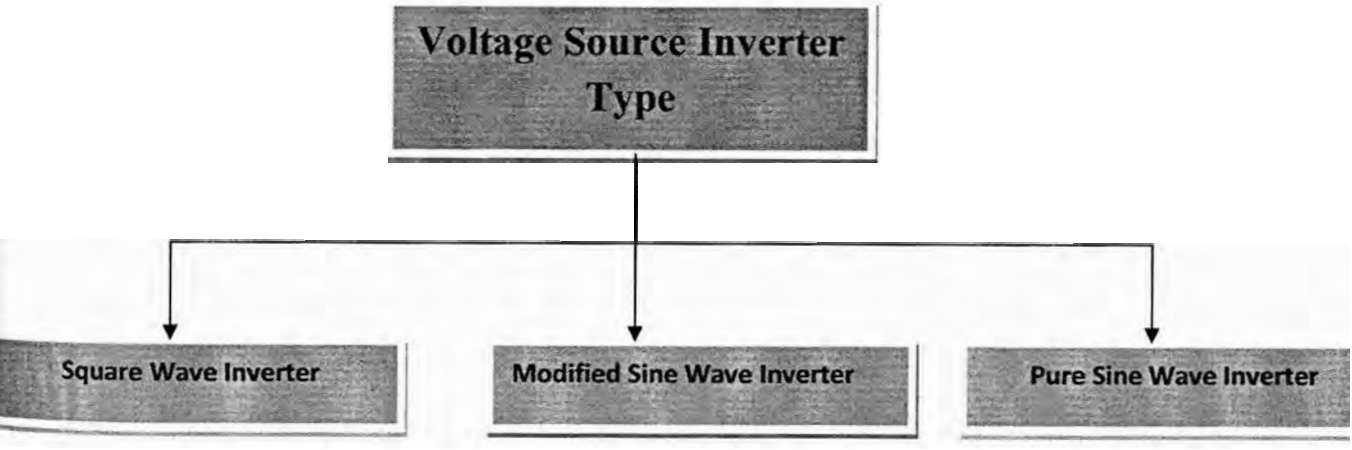

Figure 2.3.1: Voltage source inverter type

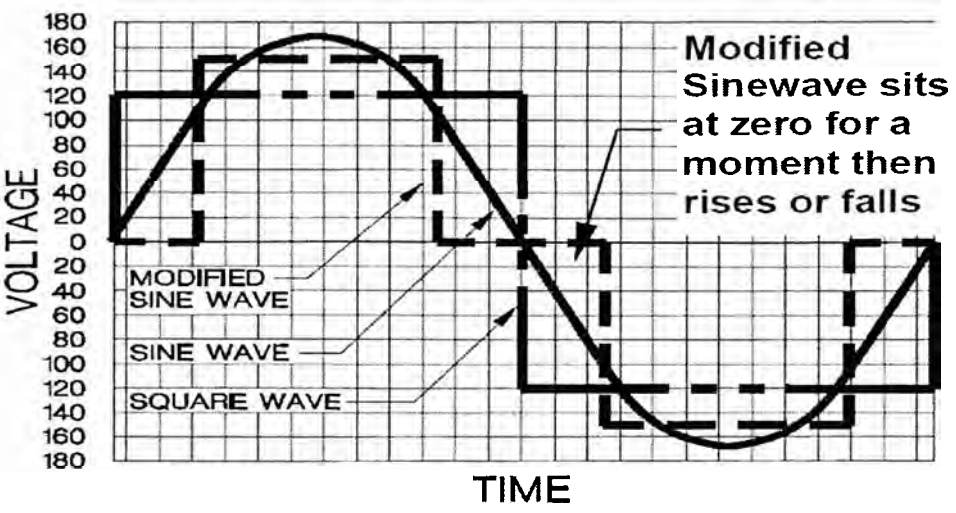

Figure 2.3.2: Square, Modified, and Pure Sine Wave

2.4 Voltage Source Inverter circuit Topologies

VSI mainly can divide in to three circuit topologies:

2.4.1 Single Phase -Full Bridge Inverter

Full bridge inverter circuit was the most powerful circuit. Full bridge (single phase) is built from two half-bridge leg. The switching in the second leg is "delayed by 180 degrees" from the first leg. The voltage across the transistor (switch) is equal to supply voltage. The load could be ac supplied via transformer.

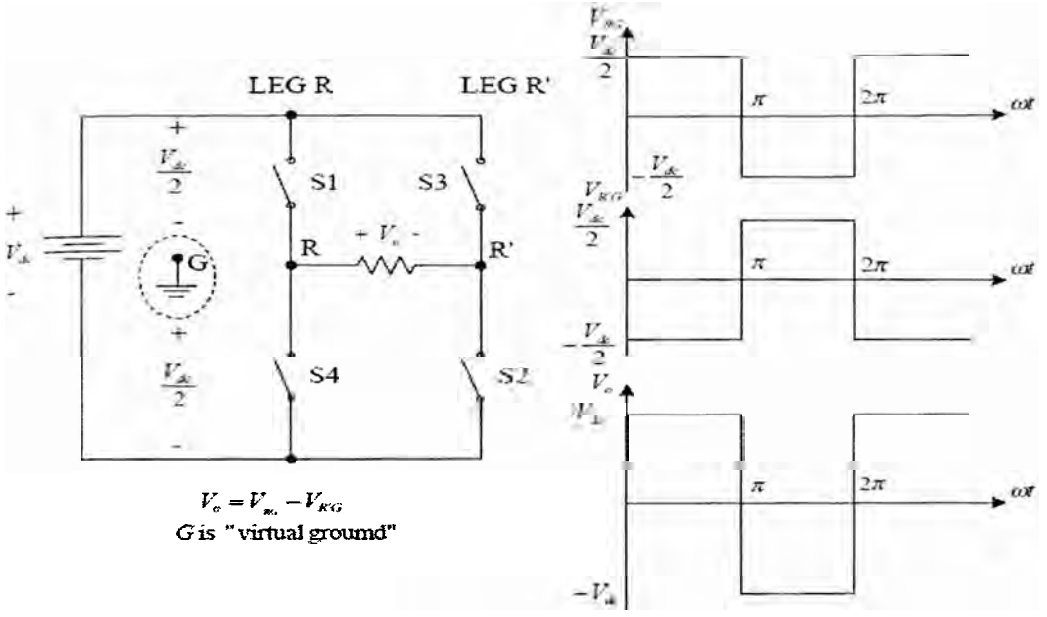

Figure2 4.1: Full Bride Inverter (single phase) and Output Wave-Worm