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Low Cost Sine Wave Portable Inverter With Over Load Protection Using PIC18F452A

Prof. G.M.Phade[#1], PriyankaChaudhari[#2], PoojaDeore[#3], RasikaKulkrni[#4], AshwiniThoke[#5]
[#] Electronics & Telecommunication Department, SavitribaiPhule Pune University,
Sandip Institute of Technology & Research Centre,
Nasik – 422005

Abstract- Energy crisis are of special attention now-a-days. A need for power rating inverter is required to smoothly operate electrical and electronic appliances. In proposed inverter sinusoidal pulse width modulation (SPWM) is used for getting pure sine wave. This can be achieved through low power microcontroller PIC18F452A which is low cost and reduces the complexity of the circuit. This sine wave inverter is developed with overload protection and built in charging circuit for 12V battery all this controlled by PIC18452A.

Keywords-Sinusoidal Pulse Width Modulation, Direct Current, Alternative Current

I. INTRODUCTION

Conventionally, there are two ways in which electrical power is transmitted. Direct current (DC) comes from a source of constant voltage and is suited to short-range or device level transmission. Alternating current (AC) power consists of a sinusoidal voltage source in which a continuously changing voltage (and current) can be used to employ magnetic components. Long distance electrical transmission favors AC power, since the voltage can be boosted easily with the use of transformers. By boosting the voltage, less current is needed to deliver a given amount of power to a load, reducing the resistive loss through conductors [1][2].

There are three types of DC/AC inverters available on the market, which are classified by their output type: square wave, modified-sine wave and pure sine wave. Off-the-shelf inverters are generally either square wave or modified-sine wave. These types of inverters are less expensive to make and the output, though delivering the same average voltage to a load, is not appropriate to delicate electronic devices which rely on precise timing. Pure sine wave inverters offer more accuracy and less unused harmonic energy delivered to a load, but they are more complex in design and less expensive. Pure sine wave inverters will power devices with more accuracy, less power loss, and less heat generation. [3]

Now a days, people are seeking for inverters which are less expensive, more compatible to user load, highly reliable, more efficient and low harmonic distortion. Power inverters are electronic devices which convert direct current into the alternating current. In earlier days, low wattage portable inverter has square wave outputs. Also they are not stable around 50 Hz frequencies and are incompatible to various types of user appliances as it causes damage. These types of inverters uses 8051 micro controller which has very poor tolerance to power supply variations. The motivation behind this project was to develop a prototype of sine wave inverter with over load protection and built in charging circuit for 12v battery. For sine wave generation we need PWM signal modulated with base frequency of 50Hz, therefor for this purpose we need micro controller which has built in PWM generation such as PIC (16F876A).Here overload protection is carried out by monitoring current flowing through switching MOSFETs and if it increase beyond the set point the over load is detected. The main objective of our project is to develop sine wave inverters with least cost and healthier to the user loads. The system

must have very less hardware count and strictly build around low cost and PIC micro controller

II.PROPOSED SYSTEM

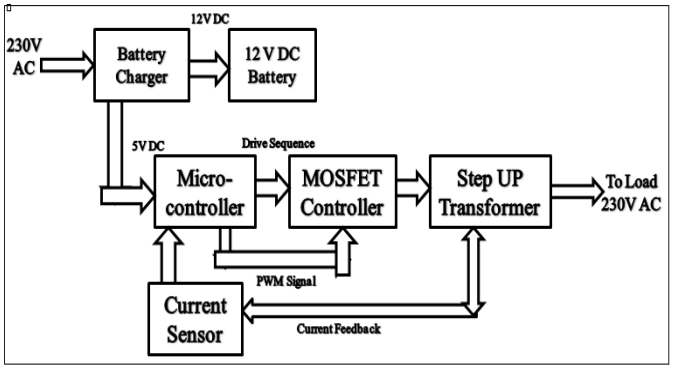

Figure 1: Overview of the Entire System

Explanation of the system

1] 12V BATTERY CHARGER

The 12v battery charger has one change over relay to switch between inverter mode and charging (mains) mode. The charger has one 7812 regulator with shifted output voltage by 2v i.e. 14 v DC output as battery charging voltage must be greater than 2v-1.5v of battery voltage. This is achieved by adding 3 PN junction diodes in the ground path of 7812, as one diode has 0.7 v drop so 3 diodes has 0.7*3=2.1v drop that shifts output to around 14 v.

2] 12V BATTERY

12v battery is at 4.5Ah rating with lead acid type.4.5Ah is unit of backup time. If we draw 4.5A from that battery then battery going to discharge after 1hr.

3] MICROCONTROLLER

The microcontroller 16F876A has internal 10 bit ADC and strong I/O drive. So we select this one because in our application we need to measure few analog quantities such as battery voltage, current etc. and also we require strong I/O drive to trigger MOSFET gates. The microcontroller has CCP module used to generate PWM signal and timer 1 used to generate 50Hz gate sequence.

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4] MOSFET CONVERTER & STEP- UP TRANSFORMER

Two MOSFETs and step up transformer combines forms unipolar to bipolar converter i.e. inverter. Alternate switching of MOSFET generates alternating signal at primary. This gets coupled wiring step up transformer.

5] CURRENT SENSOR

Current sensor is the breakout board for the fully integrated Hall Effect based ACS712 current sensor. The sensor gives precise current measurement for both AC and DC signals. It will be used for sensing the temperature.

III.METHODOLOGY

This section gives the brief idea of methodology of low cost sine wave portable inverter with over load protection using PIC18F452A and PWM generation.

Inverter means it is an electronic device or circuitry that changes direct current (DC) to alternating current (AC). The input voltage, output voltage and frequency, and overall power handling depend on the design of the specific device or circuitry. The inverter does not produce any power; the power is provided by the DC source.In earlier days low wattage portable inverters has square wave output and also they are not stable around 50Hz frequency and also they causes damage to various types of user appliances.Hence we are developing sine wave inverter with overload protection. For sine wave generation we need PWM signal modulated with base frequency of 50Hz, therefore we need micro controller which has in built in PWM generation such as PIC (16F876A).The project aims to develop sine wave inverter with least cost & healthier to user loads. The system must have very less hardware count & strictly build around low cost 8 bit microcontroller and

MOSFET's, instead of DSP & IGBT. Also they must be avoided to minimize the cost.

Types of Inverter –

1] Sine Wave Inverter
2] Modified Sine Wave inverter
3] Square Wave inverter

A. PWM Generation

The most common and popular technique of digital pure-sine wave generation is pulse-width modulation (PWM).The PWM technique involves generation of a digital waveform, for which the duty cycle is modulated such that the average voltage of the waveform corresponds to a pure sine wave as shown in Fig 2. The simplest way of producing the PWM signal is through comparison of a low-power reference sine wave with a triangle wave. Using these two signals as input to a comparator, the output will be a 2level PWM signal. Fig. 3 shows unfiltered output of PWM signal. [4]

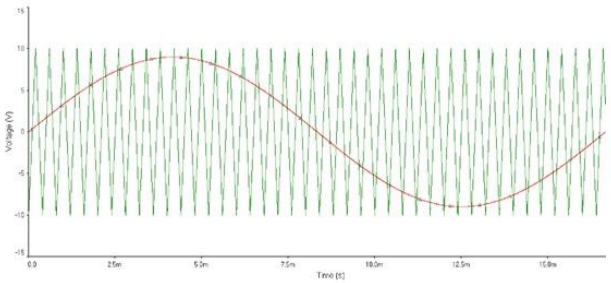

Figure2: PWM Comparison Signals [4]

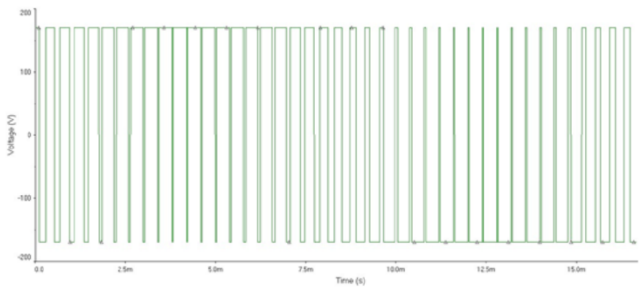

Figure3: PWM output (Unfiltered) [4]

Different PWM techniques for single phase inverter

I. Single pulse width modulation
II. Multiple pulse width modulation
III. Sinusoidal pulse width modulation (SPWM)

In our project we are using SPWM technique. In which inverter produces an AC output voltage from a DC input by using switching circuits to simulate a sine wave by producing one or more square pulses of voltage per half cycle. If the widths of the pulses are adjusted as a means of regulating the output voltage, the output is said to be pulse width modulated.

With sinusoidal or sine weighted pulse width modulation, several pulses are produced per half cycle. The pulses near the edges of the half cycle are always narrower than the pulses near the center of the half cycle such that the pulse widths are proportional to the corresponding amplitude of a sine wave at that portion of the cycle. To change the effective output voltage, the widths of all pulses are increased or decreased while maintaining the sinusoidal proportionality. With pulse width modulation, only the widths (on-time) of the pulses are modulated. The amplitudes (voltage) during the "on-time" is constant unless a multi-step circuit is used. The line-to neutral voltage of a 3-phase inverter has two voltage levels. [4]

IV.FLOWCHART

Flowchart is the diagram with the help of this we define the design flow of our project. Flowchart depends on the algorithms which we described in above section.

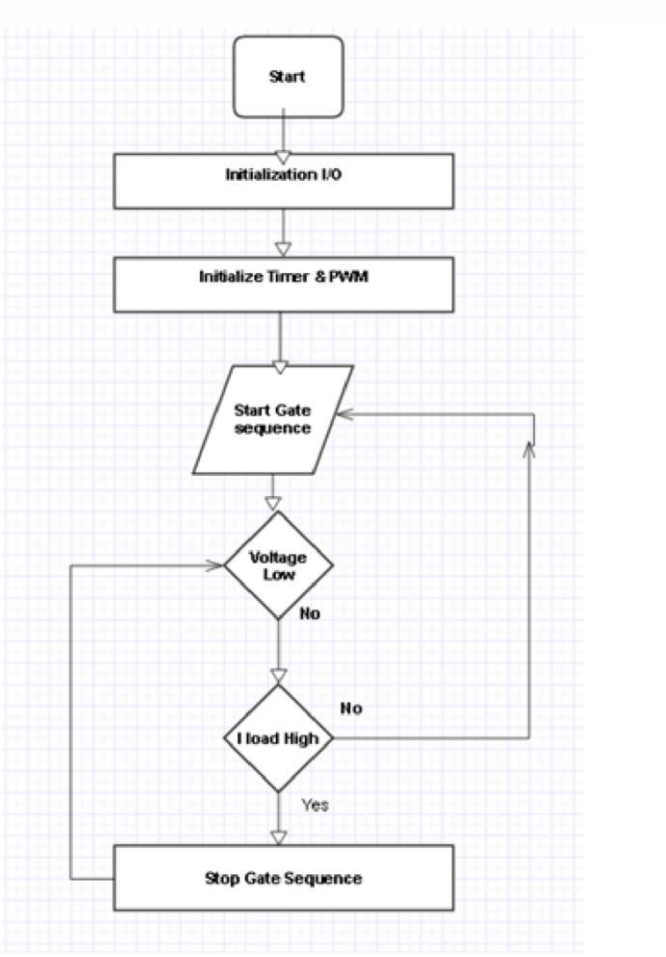

Figure 4: Flowchart for the PWM generation

- First we start the system.
- Initialize input.
- Initialize timer and PWM.
- Start gate sequence, if sequence is not started then the load is high.
- If load is high then stop the gate sequence.
- After the gate sequence is stop again check the voltage.

V. RESULT ANALYSIS

In our project circuitry we achieve pure sine wave by using PWM techniques at 230V.

Here we design and test low cost sine wave portable inverter with over load protection using PIC 18F452A.

Figure 5. Experimental set up for sine wave portable inverter.

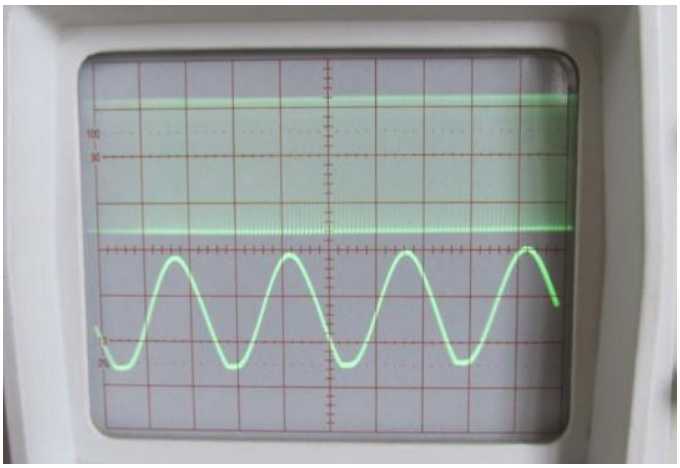

Figure 6. Experimental result of sine wave portable inverter.

VI. CONCLUSION

The electronics field is developing so fast and people are demanding for desired and convenient products. The ultimate goal of developing low cost portable sine wave inverter is fulfillments of all requirements of the customers. Regardless of the massive work put in by the prior researchers, the cost and simplicity had been main design constraints of our project. Also It would have brought with it higher efficiency, less noise, and

easier filtering capacity. In this project for sine wave generation we need PWM signal modulated with base frequency of 50Hz, therefore for this purpose we need micro controller which has built in PWM generation such as PIC18F452A. Also overload protection is carried out by monitoring current flowing through switching MOSFETs and if it increase beyond the set point the over load is detected. The main objective of our project is to develop sine wave inverters with least cost and healthier to the user loads.is an enormous scope for research for further growth in this field power electronics.

VII. FUTURE SCOPE

This project can be extended greatly in the future from the point of view of electricity saving by including solar charging function. With the help of conventional energy source such as solar for charging of inverter we can able to save the electricity which would be global problem in the future. Also use of full converter provide better current capability to the user load and prevention of damage carried out.

VIII. REFERENCES

1] Maria D. Bellar, Tzong-Shiann Wu Aristide Tchamdjau, JavadMahdavi and M. Ehsani, " *AReview of Soft-switched DC-AC Converter*," IEEE trans. On Industry Appl, vol. 43, no. 4, pp 847-858, 1998.

2] Danny Li and Christian Ramos, *"Design Of High-Low Unipolar Pulse Width Modulated Inverter*", Electrical EngineeringDepartment, California PolytechnicState University, San Luis Obispo, spring 2010.

3] Shireen, W., Kulkarni, R.A., "A *soft switching inverter module with modified DC-link circuit for high frequency DC-AC power conversion*," *Applied Power Electronics Conference and Exposition, 2003. APEC '03. Eighteenth Annual IEEE*, vol.1, pp. 507- 511 vol.1, 9-13 Feb. 2003.

4] Pankaj H. Zope,Pravin G. Bhangale, SSBT COET, Bhambhori, Jalgaon, "*Design & Implementation of carrier based sinusoidal PWM inverter*'', ISSN: 2278-8875, VOL.1, Issue 4, October 2012.

5] B. Ismail, s.taibmieee, a. R mohdsaad, m. Isa, C. M. Hadzer, "*Development Of A Single Phase SPWM Microcontroller-Based Inverter*"First International Power And Energy CoferencePecon 2006 November 28-29, 2006, Putrajaya, and Malaysia .PN.437-440.

6] Owen, E.L., "History [origin of the inverter]," *Industry Applications Magazine, IEEE*, vol.2, no.1, pp.64-66, Jan/Feb 1996

7] Maria D. Bellar, Tzong-Shiann Wu Aristide Tchamdjau, JavadMahdavi and M. Ehsani, " *A Review of Soft-switched DC-AC Converter*," IEEE trans. On Industry Appl, vol. 43, no. 4, pp 847-858, 1998.

8] Edelmoser, K.H., Himmelstoss, F.A., "Improved 1kW solar inverter with wide input voltage range," *Signals, Circuits and Systems, 2003. SCS 2003. International Symposium on*, vol.1, pp. 201- 204 vol.1, 10-11 July 2003

9] Chien-Ming Wang, "*A novel single-stage full-bridge buck-boost inverter*," *Applied Power Electronics Conference and Exposition, 2003. APEC '03. Eighteenth Annual IEEE*, vol.1, no., pp. 51- 57 vol.1, 9-13 Feb. 2003

10] Baharuddin Bin Ismail, "*Design And Development Of Unipolar Spwm Switching Pulses For Single Phase full bridge Inverter application"*, MSUniversitySains Malaysia, 2008

11] L. Bowtell and T. Ahfock are with Faculty of Engineering Survey-ing, University of Southern Queensland, Australia (bowtelll@usq.edu.au), "*Comparison between Unipolar and Bipolar Single Phase Grid connected Inverters for PV Applications*" September 20, 2007.

12] B. Ismail, S. T. (November 28-29, 2006), "*Development of a Single Phase SPWM Microcontroller -Based Inverter"*,FirstInternational Power and Energy Conference PEC (p. 437). Putra jaya, Malaysia: IEEE

13] Danny Li and Christian Ramos, *"Design of High-Low Unipolar Pulse Width Modulated Inverter*", Electrical EngineeringDepartment, California PolytechnicState University, San Luis Obispo, spring 2010.