Dual Purpose Optimized Low Consumption Home Inverter with PV cell and PWM Charge Controller

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Abstract: This project presents the effective utilization of an home inverter by changing it to a dual purpose inverter which acts as an normal home inverter as well as solar inverter, A solar panel and a PWM charging controller are the few requirements for accomplishing this task, The system is implemented using an inexpensive PIC microcontroller The main advantage in this method is *the already existing inverter and battery will be used by the PWM charging controller thus reducing the resources needed and hence the cost, As far as possible the charger controller charges the battery from the PV cell and hence less Single phase line consumption is achieved, Battery management system which increases the life time of the battery is an added advantage to this project*

Keywords: PWM charging controller,PV cell, PIC microcontroller, Battery management system

1. Introduction

Typical home inverter obtains power from a battery of 12 volts and must be recharged using single phase power. Sine wave and square wave are the two types of inverter, A pure sine wave inverter produces a nearly perfect sine wave output (less than 3% total harmonic distortion) that is essentially the same as utility-supply grid power. Thus it is compatible with all AC electronic devices. The square wave output has a high harmonic content, not suite for certain AC load such as motors or transformers. The charger controller we use in or project can be used with both kinds, The primary function of a charge controller in a stand-alone PV[1] system is to maintain the battery at highest possible state of charge while protecting it from overcharge by the array and from over discharge by the loads. Although some PV systems can be effectively designed without the use of charge control, any system that has unpredictable loads, user intervention, optimized or undersized battery storage (to minimize initial cost) typically requires a battery charge controller[7]. The algorithm or control strategy of a battery charge controller determines the effectiveness of battery charging and PV arrays utilization, and ultimatelthe ability of the system to meet the load demands. Additionally 0special algorithms can enhance the ability of a charge controller[2] to maintain the health and extend the lifetime of a battery, as well as providing an indications of operational status such as solar and Battery levels, mode of source i.e whether solar are single phase is beign used for charging to the system caretaker through LCDImportant function of battery charge controllers and system controls are to :

Prevent Battery Overcharge*:* limit the energy supplied to the battery by the PV array[6] when the battery becomes fully charged.

Prevent Battery Over discharge: disconnect the battery from electrical loads when the battery reaches low state of charge.

Provide Load Control Functions*:* automatically connect and disconnect an electrical load at a specified time, for example operating a lighting load from sunset to sunrise.

Simple charge controllers stop charging a battery when they exceed a set high voltage levels, and re-enable charging when battery voltage drops back below that level. Pulse width modulation (PWM) [2] and maximum power point tracker (MPPT)[4] technologies are more electronically sophisticated, adjusting charging rates depend on the battery level, to allow charging closer to its maximum capacity. our charge controller systems uses PWM technology, Addionally battery management system which increases the life time of the battery by proper adaptive charging .

2. PIC Microcontroller

An overview

The PIC (Programmable Interface Controller)[5] line of microcontrollers was originally developed by the semiconductor division of General Instruments Inc. The

first PIC were a major improvement over existing microcontroller because they were programmable, high output current, input/output controller built around a RISC (Reduced Instruction Set Code) architecture. The first PICs ran efficient at one instruction per internal clock cycle, and the clock cycle was derived from oscillator divided by 4. Early PICs could run with high oscillator frequency of 20 MHz. This made them relatively fast for 8-bit microcontroller, but the main feature was 20 mA of source and sink current capability on each I/O (Input/Output) pin. Typical micros of the time were advertise high I/O currents of only 1 milliampere (mA) source and 1.6 mA sink [5].

PIC16F887A Microcontroller

The PIC16F887A is one of the latest products from *Microchip*. It feature all the components which modern microcontrollers normally have. Because of it low price, wide range of applications, high quality and easy availability, it is an ideal solution in application such as: the control of different processes in industry, machine control device, measurement of different values etc..

Figure 2 depicts an overview of proposed algorithm for vehicle segmentation. For a given image, a background subtraction algorithm is applied to obtain foreground.

Apart from a large number of digital I/O lines, the PIC16F887 contains 14 analog inputs. They enable the microcontroller to recognize, not only whether a pin is drive to logic zero or one (0 or +5V), but to precisely measure its voltage and convert it into a numerical value, i.e. digital format. The whole procedures takes place in the A/D converter module which has the following features:

The converter generates a 10-bit binary results using the method of successive approximation and stores the conversion results into the ADC registers (ADRESL and ADRESH); There are 14 separate analog inputs; The A/D converter allows the conversions of an analog input signal to a 10-bit binary representation of that signal; and • By selecting voltage references Vref- and Vref+, the minimal resolution or quality of conversion may be adjusted to various needs.

CCP Modules

The abbreviation CCP stands for *Capture/Compare/PWM*. The CCP module[5] is a peripheral which allows the user to time and control different events. Capture Mode, allow timing for the duration of an events. This circuit gives insight into the current state of a register which constantly changes its value. Estimate Mode compares values contained in two registers at some point. This circuit also allows the user to trigger an external event when a predetermined amount of time has expired. PWM - *Pulse Width Modulation* can generate signals of varying frequency and duty cycle. The PIC16F887 microcontroller has two such modules - CCP1 and CCP2. Both of them are identical in normal mode, with the exception of the Enhanced PWM features available on CCP1 only. .

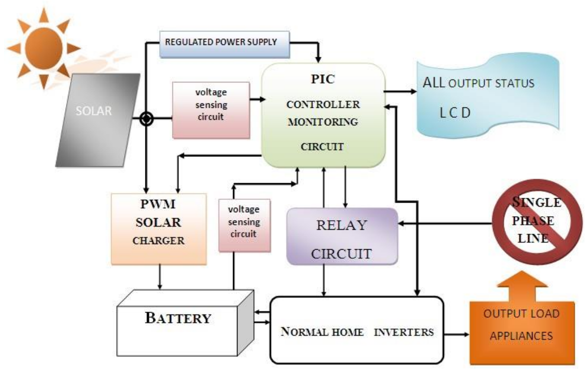

Figure 1 Simplified Hardware Block Diagram of a Solar Home System

The proposed charge controller consist of four parts:
The adaptive algorithm to control the duty cycle of the pulse is given PV cell, solar charge controller, storage battery ,and load

input: two Measured values (VBat,Vcell)
Output: Duty_cycle of PWM
if (Vbat<14.4)
if (Vcell>Vbat+2) Set Dutycycle=90%
elseif(Vcell>Vbat+1&Vcell<Vbat+2)Set Dutycycle=40%
else if (Vcell<Vbat+1) Set Dutycycle=25%
else Set Dutycycle=0
else
Set Dutycycle=0

Flow chart of the algorithm is showns in the Fig 2

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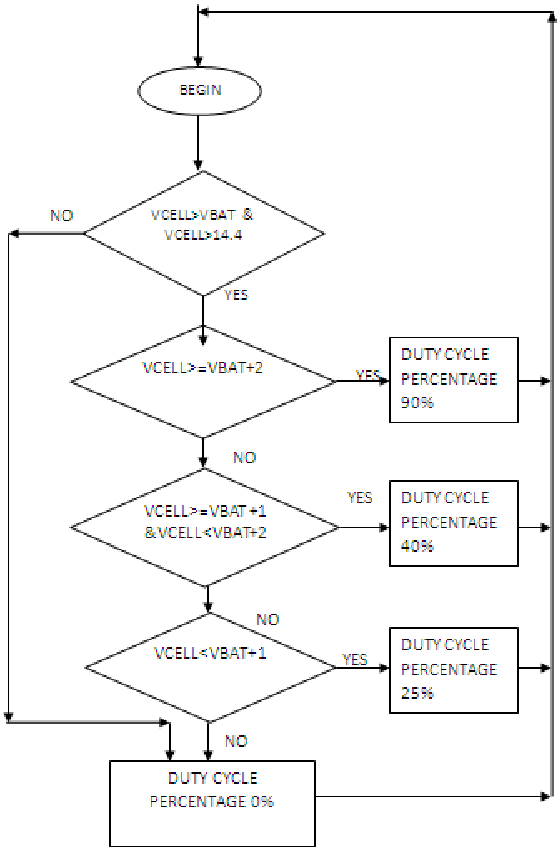

Figure 2 Folw chart of the PWM charger Algorithm

PWM Driving Circuit: It is used in order to drive the correct charging voltage to the battery by using the PWM technology[2]. The MOSFET transistor is a specialized type of transistor that is used for high current applications. IRF3205 an N Channel MOSFET is chosen., Depending on the difference between the voltages of the battery and solar panel different PWM signal with different cycles are generated if the voltage of battery is closer to the PV system then PWM duty must be of less percentage means it will slow down the charging of the battery, Voltage scaling is used in order to proportionate the changes in PIC[5] controller to the changes in the battery and solar panel

The Complete Schematic Diagram of a Solar Charge Controller is shown in the figure3

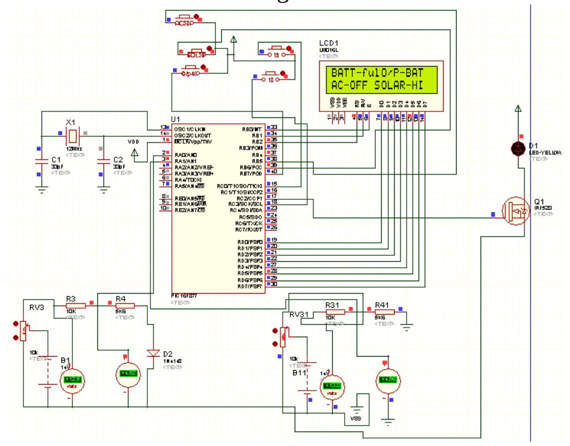

Figure 3 Complete Schematic Diagram

4.Simulation

The proposed charge controller is simulate by using Proreus ISIS 7 Professional for 5 cases listed in table 1 and the simulation results shown in figures 4-7

Table 1 Simulation Tests

Test number	Vcell (V)	Vbattery (V)	Duty cycle (%)
1	15	12	90
2	15	13	40
3	15	14	25
4	14	15	0
5	10	10	0

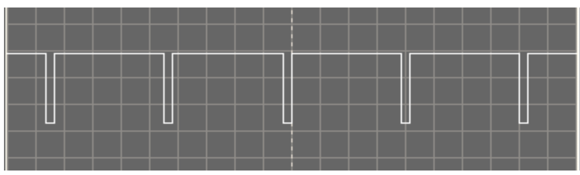

Figure4 Simulation Result for Test number 1 (represents the output of the PIC PWM)

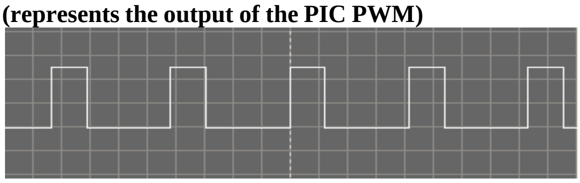

Figure 5 Simulation Result for Test number2

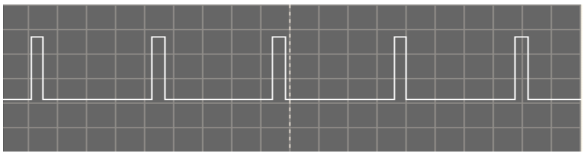

Figure 6 Simulation Result for Test number 3

Figure 7 Simulation Result for Test number 4

5.Conclusions

The Single phase usage bill as well as the overall cost of a stand-alone PV system can be reduced with proper battery-charging control techniques, which achieve high battery state of charges and lifetime, under continuously varying atmospheric condition, In this paper, a novel battery charging regulation system has been presented, consisting of a DC/DC converter control by a low-cost microcontroller unit. Merits of the proposed method are:

(a) The controller circuit let the energy transfer from the solar cell instead of the single phase line and there by decreases the single phase line consumption

(b) The PWM technique employed in the control algorithm assures maximization of the energy transferred to the battery bank, and thus a betters exploitation

(c) The battery lifetime is increased because the battery is operating at a higher state of charge.

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