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MATLAB Simulink for single phase PWM inverter in an uninterrupted power supply

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Abstract: *Now a day's Uninterrupted power supply is very necessary for industry, and domestic purpose. This paper presents the design and implementation of UPS for using personal computer. Here solar energy is used for charging the battery in sunny days and in absence of solar energy it will automatically connect to main AC supply. Also MATLAB simulation work is done for PWM single phase inverter and full bridge rectifier.. Here microcontroller is used for switching between solar plate and main AC supply to Battery. By using this method we can save our electricity bill which is consumed in charging of battery.*
Keywords: *Single-phase Inverter, Battery cell, Sinusoidal pulse-width-modulation and microcontroller.*

I. Introduction

In the last few decades, the traditional power generation methods of burning fossil fuels has affected the environment, causing an increase in the greenhouse gas emissions that lead to global warming. Consequently, thishas become the driving force for the growing interest in alternative energy [1, 2].However, a battery inverter system is more preferable and more flexible to operate in stand-alone modeapplications. The single-phase inverters in stationary battery cell power generation systems have been installedworldwide in case of utility power failures and are widely used in delivering backup power to critical loads,such as for computers and life-support systems in hospitals, hotels, office buildings, schools, utility powerplants, and even in airport terminals, as well as in communication systems [5]. Any UPS system has two operating modes: bypass mode and backup mode. Ideally, a UPSshould be able to deliver a regulated sinusoidal output voltage with low total harmonic distortion(THD) during the two modes, even when feeding nonlinear loads. The first step is to generate 5V smooth DC so that microcontroller may be switched ON i.e. regulated DC power supply.

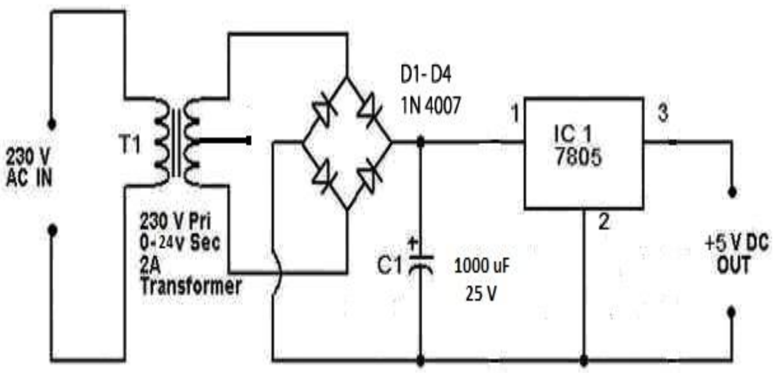

Figure 1: Regulated DC power supply.

This 5v switch ON microcontroller and output of rectifier is given as input to the inverter circuit when main supply is there and when power is cut then inverter circuit is supplied through 12 v battery and power is uninterruptedly provided to the user. Circuit diagram of single phase full wave PWM inverter is shown below:

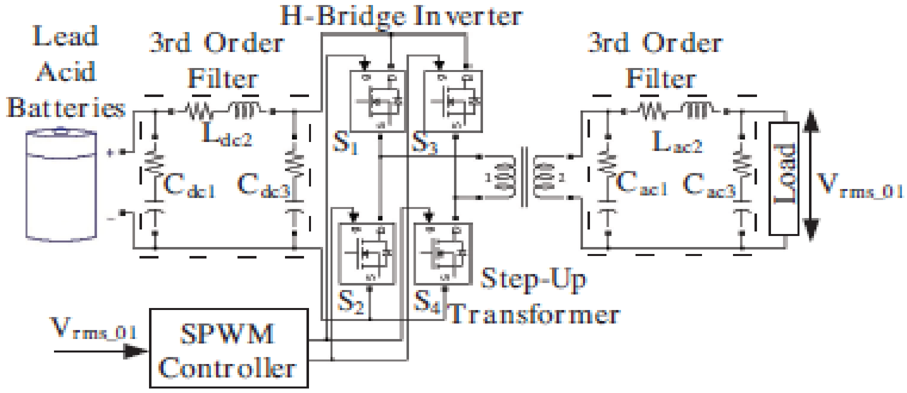

Figure 2: Circuit diagram of single phase inverter

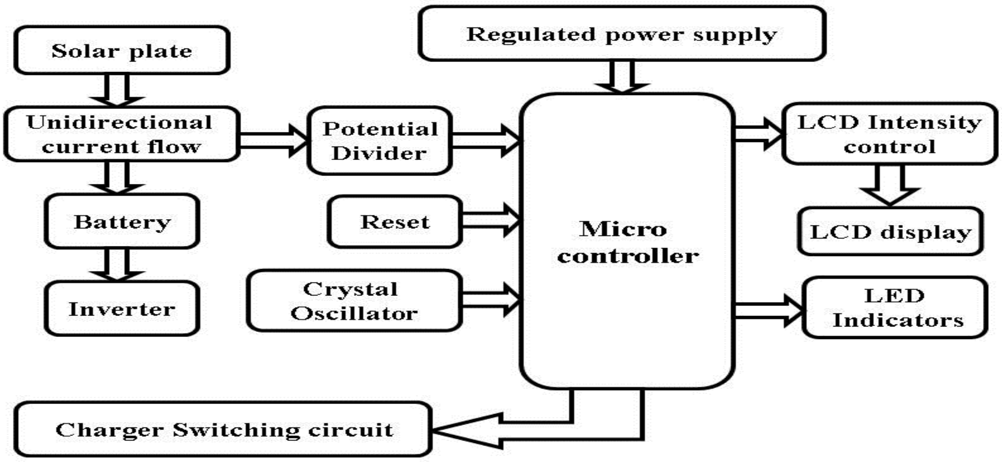

Figure 3: Complete Block Diagram of Proposed design of UPS

II. Spwm Inverter

The sinusoidal PWM (SPWM) method also known as the triangulation,or sub harmonic method, is very popular in industrial applications and is extensively reviewed in the literature.

For realizing SPWM, a high-frequency triangular carrier waveV_c is compared with a sinusoidal reference $V_r$of the desired frequency. The intersection of $V_c$and$V_r$waves determines the switching instants and commutation of the modulated pulse. The PWM scheme is illustrated in Figure 5, in which $V_c$is the peak value of triangular carrier wave and $V_r$that of the reference, or modulating signal. The figure shows the triangle and modulation signal with some arbitrary frequency and magnitude. In the inverter of Figure 2 the switches are controlled based on the comparison of control signal and the triangular wave which are mixed in a comparator. When sinusoidal wave has magnitude higher than the triangular wave the comparator output is high, otherwise it is low.

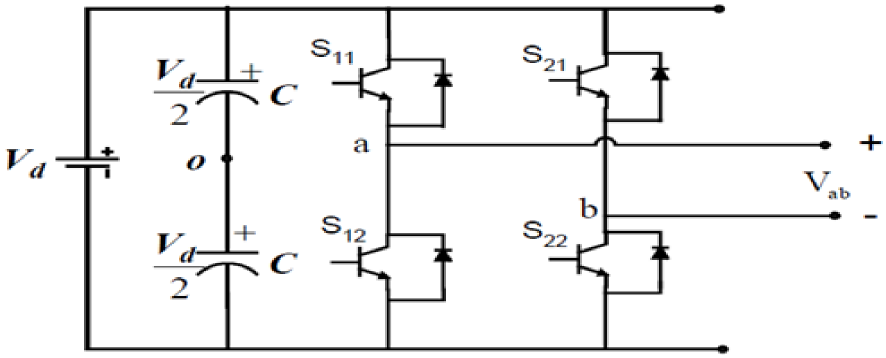

Figure 4: Single phase Full wave inverter

Switching state of the SPWM and the corresponding voltage levels are given and waveform is shown below.

S_{11}	S_{12}	S_{21}	S_{22}	V_{An}	V_{Bn}	$V_o = V_{An} - V_{Bn}$
ON	-	-	ON	V_d	0	V_d
-	ON	ON	-	0	V_d	$-V_d$
ON	-	ON	-	V_d	V_d	0
-	ON	-	ON	0	0	0

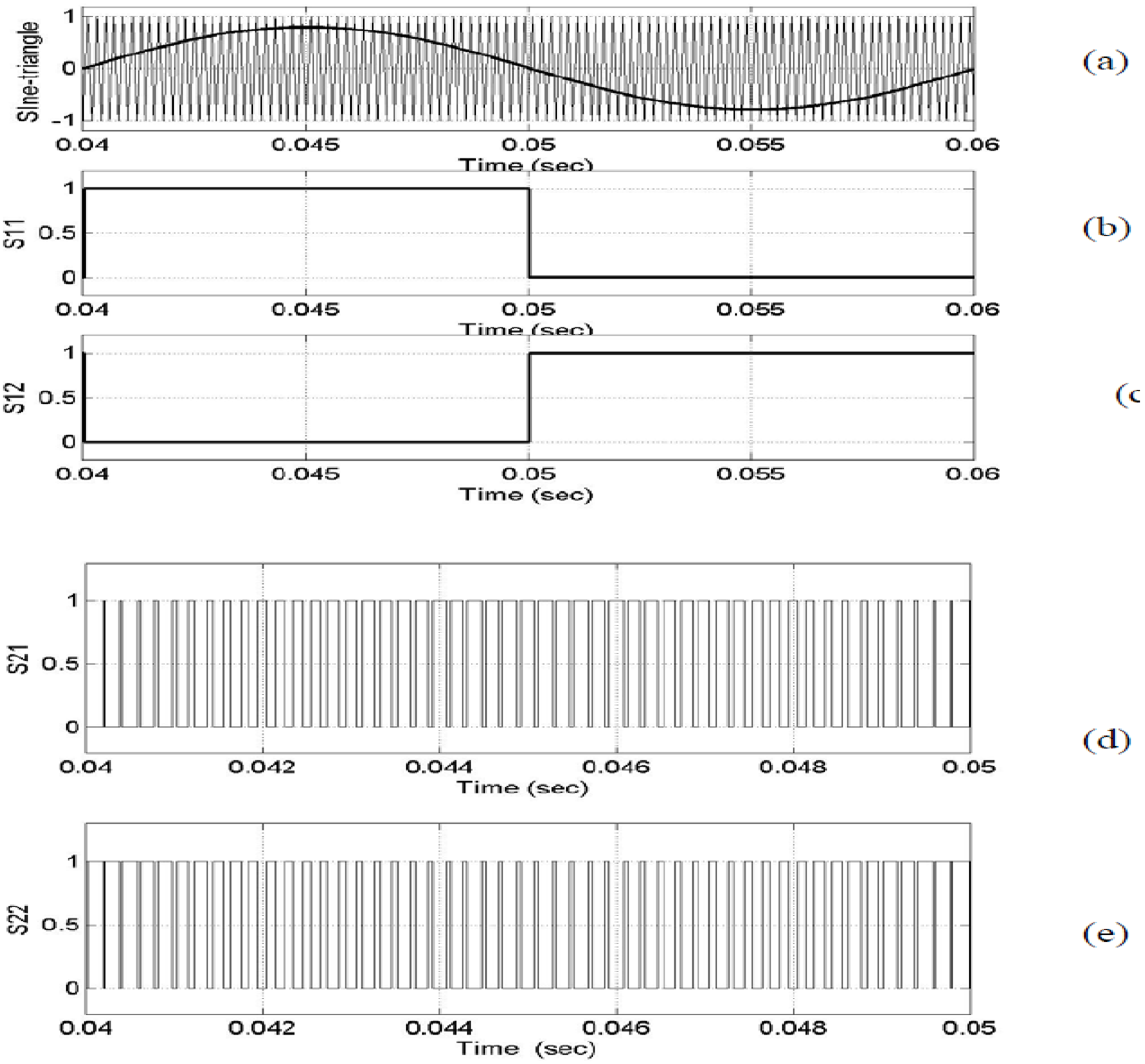

Figure 5: PWM waveform

III. Simulation and simulation Result

In MATLAB simulation is done for regulated power supply and inverter. After simulation a constant dc supply voltage is found for inverter input. Heresimulation blockand its output result is shown.

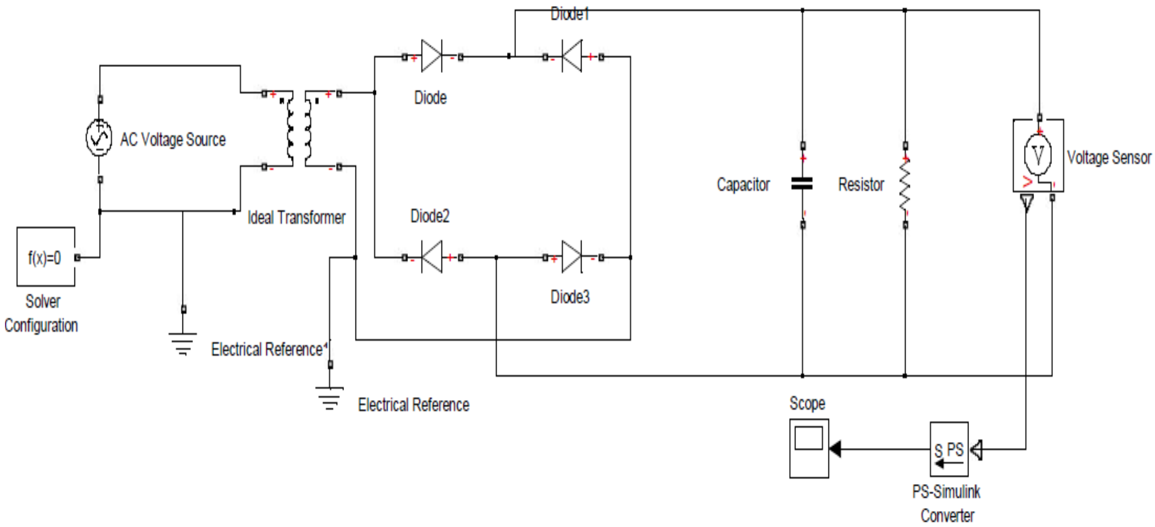

Figure 6: Simulation for DC re regulated power supply

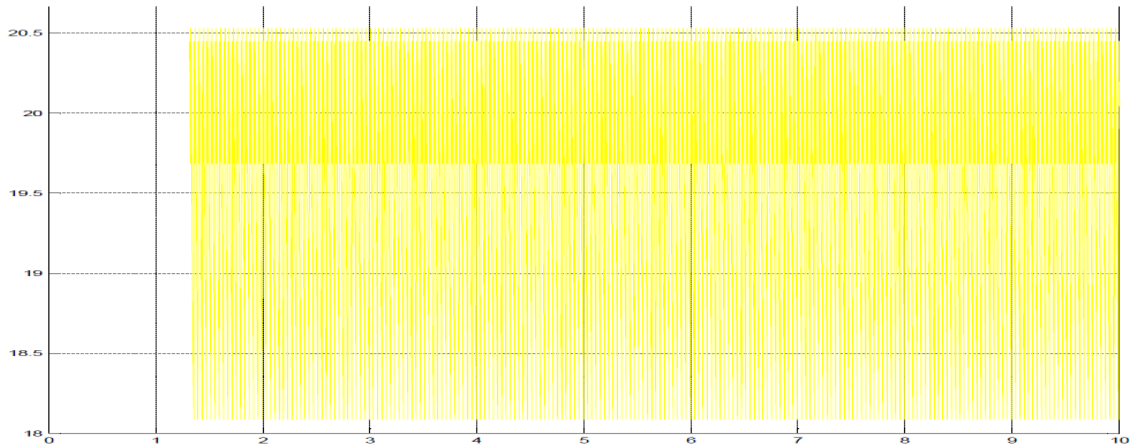

Figure 7: Simulation Result of regulated power supply.

For single phase inverter circuit also simulation work is carried and its result is analysed.

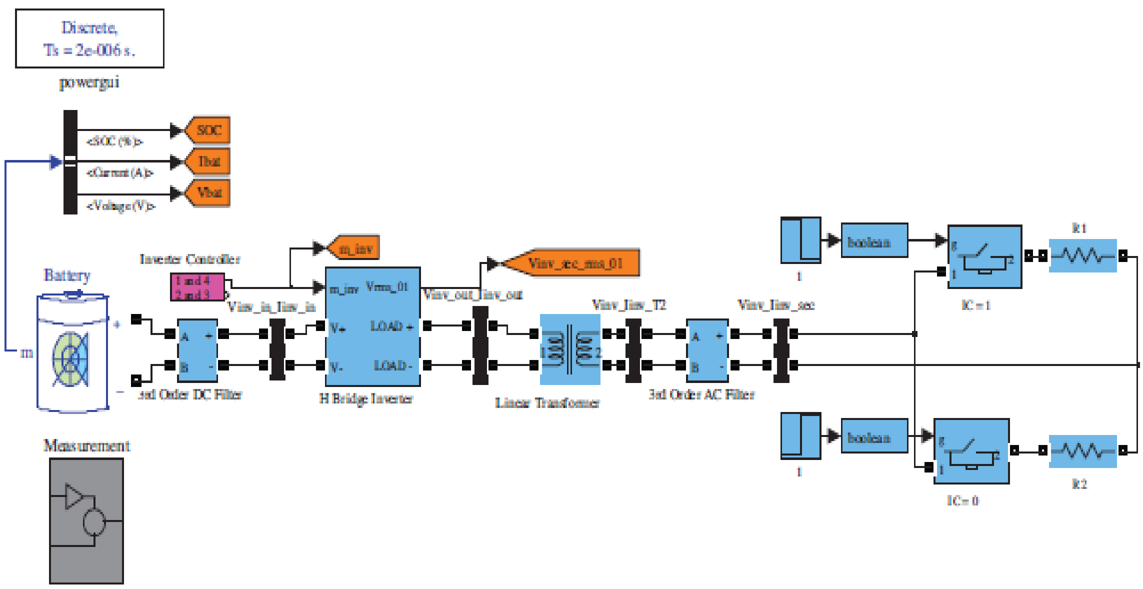

Figure 8: Simulink Model for single phase Inverter.

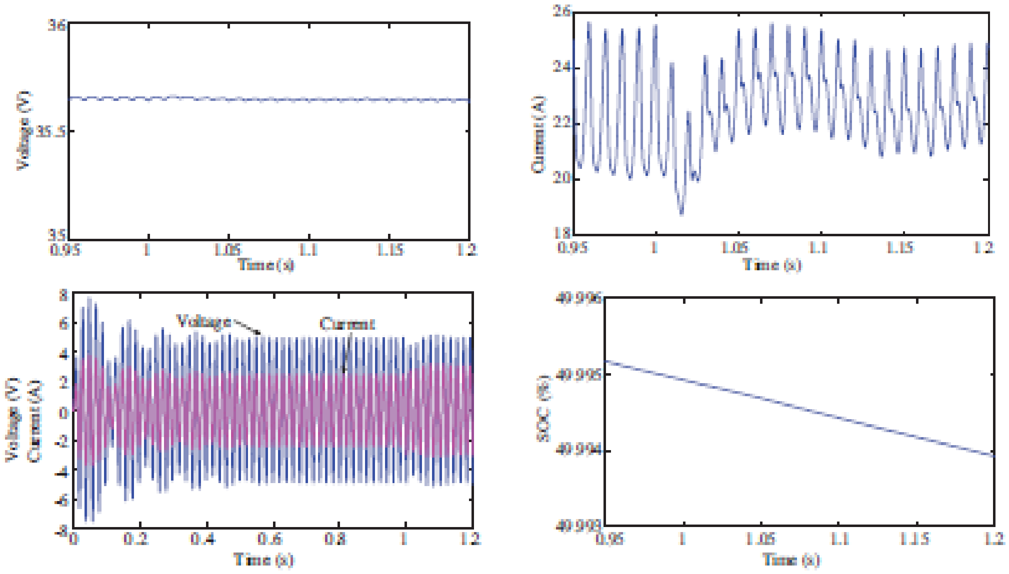

Figure 9:**(a)** Terminal current of the battery when the loadchanges from a resistive load of 400 W to an inductive loadof 500 W with 0.85 PF lagging.**(b)** Output voltage after the load changes from a resistive load of 400 W toan inductive load of 500 W with 0.85 PF lagging.

IV. Microcontroller

In this project PIC microcontroller is used. Although in simulation microcontroller is not shown but in hardware part microcontroller is used by which battery charging is done by solar energy whenever it is available otherwise it is connected to main supply. The complete circuit diagram is shown below of this project in which microcontroller plays as a brain of this UPS system.

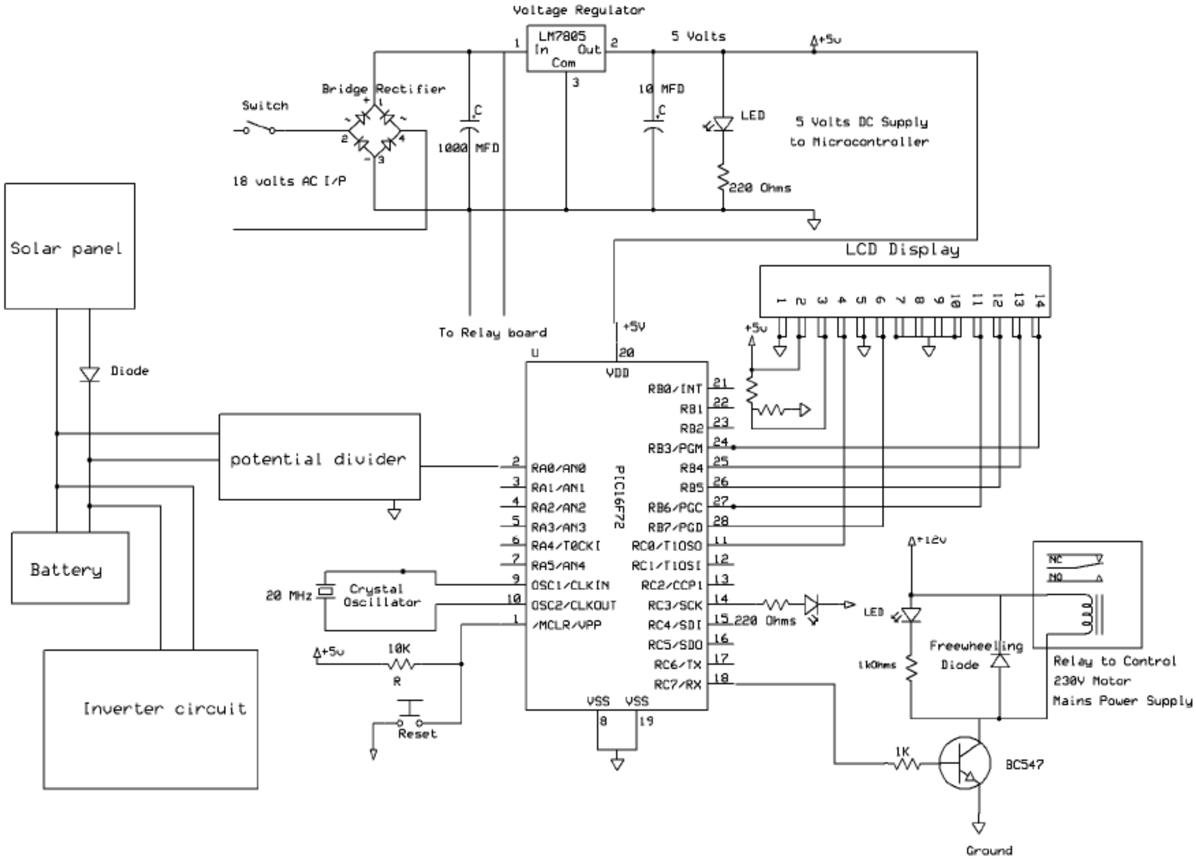

Figure 10: Complete circuit diagram of project

V. Conclusion

The inverter unit consists of four, IGBTs connected as a bridge and drivewith a low cost driver. The experimental result matched with simulation results. Although any parameters are adjusted for giving fundamentalfrequency rms output voltage of 220V at 50 Hz. With this inverter unit, furtherresearch on single-phase inverters can becarried out such as soft switching inverters. By using this proposed UPS we can save electricity bill and also can use better alternate renewable energy source. In this project there is future scope is that during presence of solar energy we can use solar energy instead of main supply.

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