

Design of Online UPS and Implementation with Power Factor Correction

^{#1}Kalyani K. Kalukhe, ^{#2}Amruta V. Pawar, ^{#3}Priyanka S. Powar,
^{#4}Shivanjali G. Sutar, ^{#5}Prof. G.A.Bongale.



^{#1234}UG Students at D.Y.Patil Technical Campus Talsande.
^{#5}Assistant Prof. D.Y.Patil Technical Campus Talsande, Kolhapur.

D.Y.Patil Technical Campus Talsande, Kolhapur

ABSTRACT

In this project design and implementation of a microcontroller based single phase online UPS (Uninterrupted power supply) with PFC (power factor correction) is made practically. To improve efficiency power factor correction is made in this project. S-250-24 Switch Mode Power Supply module is used to convert AC to DC voltage and also for protection against overload, over current. Continuity of supply remains constant as battery is provided when the main supply gets fail. For the generation of sinusoidal PWM signals PIC18F4520 microcontroller is used to drive MOSFET in inverter and provide feedback for control and display unit. By using sinusoidal PWM technology harmonics are eliminated. Various parameters are measured at various loads, that is, resistive and inductive loads. Thus in this realized system, improved power factor is obtained.

Keywords: UPS, AC to DC voltage, PIC18F4520.

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I. INTRODUCTION

An Uninterrupted power supply is essentially a back-up battery to power electronic gadgets like Computer in the event of a power failure. If it happens, the Gadget will draw power from the UPS and will run the load for a prescribed time depending on the capacity of the battery. The change over time from the mains to battery power is a fraction of a second, so that the computer will not shut down. This is essential to protect the data in the computer.

Uninterrupted power supply may be AC/AC or AC/DC based on the output power supply. In AC/AC UPS, the energy source is the AC lines and the output is exactly the same voltage generated by the inverter. In AC/DC type, the UPS delivers DC voltage by converting AC to DC [2].

Basically there are two types of UPS. These are Offline UPS and Online UPS. Off line UPS passes the input AC to the output sockets if the AC power is available. It always monitors the voltage level in the mains, and if there is a voltage drop or mains failure, it switches on the inverter to give AC power to the device until the mains supply returns to normal. The switch over time from AC to inverter AC is less than five milli seconds so that the functioning of the gadget is not affected.

II. THE SYSTEM STRUCTURE

2.1. Proposed work

In the case of online systems, the rectifier-inverter combination supplies the load power from the AC mains during normal operation. In the event of mains failure, the battery automatically supplies the DC link to the inverter and there is no time delay involved. When the rectifier-inverter system fails, the load could be transferred to AC mains using a transfer switch. S-250-24 SMPS module is used as rectifier for unregulated AC or DC power supply to regulated DC output.

Single phase bridge inverter consists four MOSFETs for full wave sinusoidal waveform and thus converts from DC to AC. Transformer is used to step up the voltage required for load. Battery is thus used when the mains fail and the supply is being kept to be continuously without any interruption. In proposed work MOSFETs are being used for switching purpose. Due to which more improvement in power factor correction will be achieved than the existing system and thus efficiency increases than regular results. Sensors are used to measure AC voltage/current, DC voltage/current, speed, power factor of the load [5].

Objectives

- 1] Protect against power interruption.
- 2] Provide adequate power during short term interruption and "Ride through" time to convert backup supply.
- 3] Refine the quality of the power as it reaches your building, office and equipment.
- 4] Include a backup source for long term outage, such as generators.

2.2. BLOCK DIAGRAM

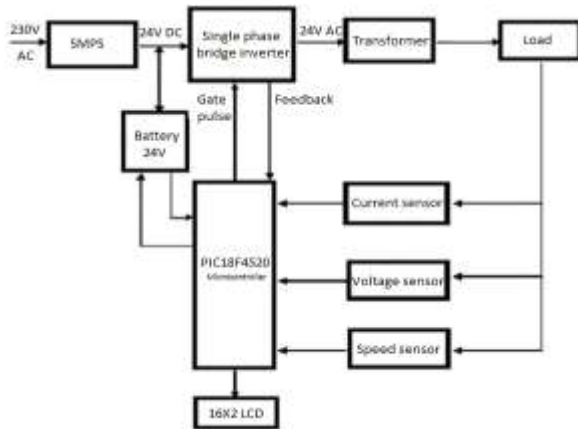


Fig 1. Block diagram

2.3. Switch mode power supply

The prevailing DC power supply architecture in most modern system is the switch mode power supply (SMPS) which is known for its ability to handle changing loads efficiently. The power signal path of typical SMPS includes passive, active and magnetic components. The SMPS minimized the use of lossy components such as resistors and linear mode transistors, and emphasizes components that are loss less: switch mode transistors, capacitor and magnetic.

Like a linear power supply, the switched mode power supply to convert the available unregulated AC or DC input voltage to a regulated output voltage. However, in case of SMPS with input supply drawn from the AC mains, the input voltage is first rectified and filtered using capacitor is then fed to a high frequency AC to DC converter. Most of the AC to DC converter using SMPS circuits have an intermediate high frequency AC conversion stage to facilitate the use of high frequency transformer for voltage scaling and isolation. The high frequency transformer used in SMPS circuit is much smaller in size and weight compared to low frequency transformer of the linear power circuit.

2.4. Inverter

In UPS system, main purpose is to generate ideal output voltage for any kind of load. Generally, 50-400 Hz sinusoidal output in UPS system is necessary. PWM strategy is used in modern inverter. H bridge inverter circuit is shown in fig. Four MOSFET are switched sequentially in the H bridge inverter. All four MOSFETs used in H bridge must be selected with same characteristics. PIC18F4520 generate sinusoidal PWM signal which is used to drive MOSFET in H bridge inverter. When first and third MOSFET is ON when SPWM is applied, the other two

MOSFET is in OFF condition. Current flows through the MOSFET that are in ON condition. In the reverse condition, second and fourth MOSFET are ON and other two are in OFF condition, then the current flows through the MOSFETs that are in ON condition [4].

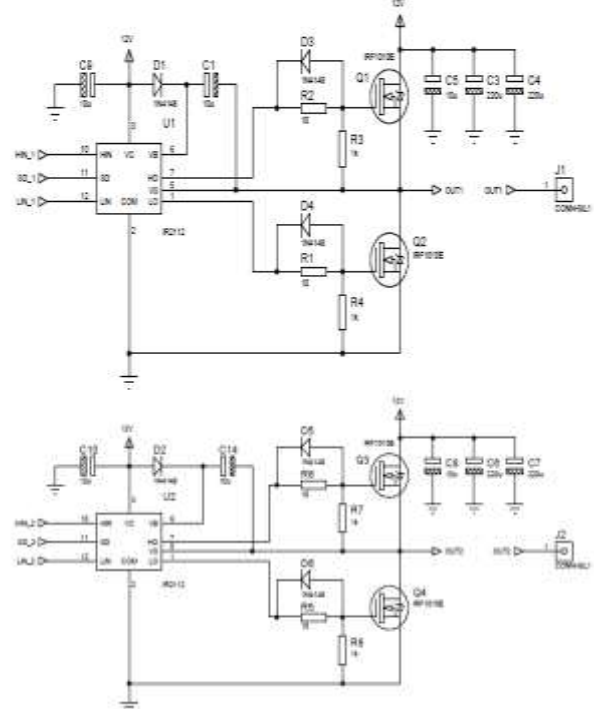


Fig.2. Single phase full bridge inverter

PWM technique is used for harmonic reduction. Thus **Pulse Width Modulation (PWM)** is a technique in which the width of a pulse is modulated keeping the time period of the wave constant. The ON time and OFF time can have any different values in the wave cycles, but the sum of the ON time and OFF time remains same for the entire cycles. PWM is a digital wave that can be generated using digital circuits which are not capable of generating analog voltages. With the help of the modulation of the width of a pulse in a period of the wave, they can generate any required voltage with the help of a proper filter circuits. The filter circuits are used for generating the voltage corresponding to a modulated wave. Hence the PWM wave is always associated with a filter circuit [3]. This feature of the PWM wave is making use in so many digital systems like DC motor control, audio devices, simple decoration light controls etc. The PIC18F4520 has an inbuilt PWM module which can generate continuous PWM waves. This project

This feature of the PWM wave is making use in so many digital systems like DC motor control, audio devices, simple decoration light controls etc. The PIC18F4520 has an inbuilt PWM module which can generate continuous PWM waves. This project explores the PWM module of the PIC18F4520 and tries generating a sine wave with the help of a filter circuit [1]. Generating a sine wave has a great deal of importance since the sine wave is the most natural waveform and all other kind of waves can be generated as a combination of sine waves with different frequencies and amplitude.

III. MEASUREMENT, CONTROL AND DISPLAY UNIT

ON/OFF process of the system are assured by the control unit. Output parameters are measured and they are displayed at the 16X2 LCD display. Communication with LCD is assured by reading 4bits data with microcontroller. Current transformer and voltage transformer are used to measure AC current and voltage. Current sensor is used to measure DC current. Speed sensor is used to measure the speed of the motor used as inductive load. Thus parameters to be measured are DC current and voltage, AC current and voltage, power factor and speed.

In this project output parameters of loads are measured. Inductive and resistive type of loads are used to show the variations in voltage, current, power factor, and speed at three conditions, that is, R, L, and RL load. Single phase induction motor is used as inductive load and lamp load is used as resistive load.

Measurement and control section is shown in fig. below.

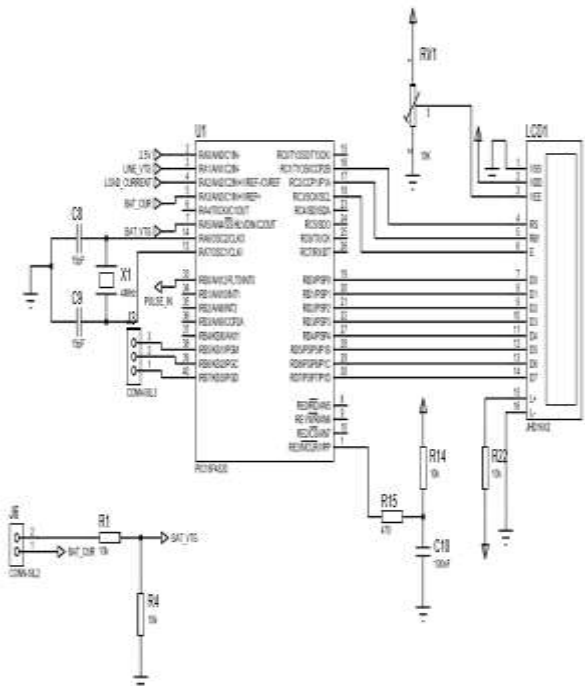


Fig3. Control and display unit

IV. EXPERIMENTAL RESULT



Fig4. Experimental kit



Fig5. Result of resistive load



Fig6. Result of inductive load



V. CONCLUSION

The solution for power factor correction is made by implementing the online UPS. By using PWM technique harmonics are eliminated and thus sinusoidal waveform is obtained. Various output parameter is measured at resistive and inductive load condition. Thus power factor correction takes place by eliminating negative effects of device with the help of UPS.

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