DESIGN AND DEVELOPMENT OF BATTERY Charger FOR ONLINE UPS USING PIC MICROCONTROLLER

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Abstract: The proposed on-line uninterruptible power supply (UPS) offers AC voltage regulation on continuity basis which incorporates with the controllable battery charger. The charge control technique used for battery is constant current charging technique. The Constant Current is achieved by limiting the duty cycle of charger (or step-down chopper). Based upon the proposed constant current charging technique, a digital charger is designed and is control through PIC 16F877A microcontroller software. In proposed scheme, protection of battery over charge and battery under discharge is available with relay trip through PIC 16F877A microcontroller by monitoring voltages on continues basis. The backup of battery takes place the load without spikes or delay when the mains power gets fails or interrupted. Experimental results using PIC 16F877A microcontroller controlled battery charger cum rectifier is presented to shows the effectiveness of the proposed design.

Keywords: UPS - Uninterruptible Power Supply, PIC - Peripheral Interface Controller, LCD - Liquid Crystal Display

I. INTRODUCTION:

An uninterruptible power supply (UPS) is a power conditioner that provides emergency power to a load when the mains power fails. In on-line UPS, the load is always connected to the inverter though the UPS static switch. When the AC main is available, the rectifier circuit will supply the power to the inverter as well as to the battery and battery will be charged. If the supply power fails suddenly, the battery will supply power to the inverter without any interruption and delay. If the UPS fails (inverter fails), then the main static switch is turned-on which automatically transfers the ac line to the load. Figure 1 shows the block diagram of on-line UPS. This paper proposes a new topology for On-line UPS. The proposed system, consist of battery charger cum rectifier which is controllable through PIC microcontroller. Therefore, the battery management will and precise monitoring will be done.

The Proposed Topology:

The AC voltages are applied to Rectifier through the step down transformer and power supply. An uncontrolled rectifier converts AC voltages into DC voltages. The fixed DC is fed to the step-down chopper. The PWM control technique keeps switching frequency constant and also regulates duty cycle to ensure the MOSFET to turn on. In constant current charging method current is set at a fixed rate. Constant current is achieved by switching of the chopper. The step-down chopper produces a lower average output voltage than the input voltage. The battery is connected to the variable DC through the relay. Relay gives the trip on the conditions of overcharging and under discharging. Figure 2 shows the block diagram of Battery Charger.

Battery Charger Circuit Design Considerations:

Fig 1: Block Diagram of On-line UPS

Fig 2: Block Diagram of Battery Charger

Fig 3: Circuit Diagram of Battery Charger
230 AC voltages are applied to the step down transformer of 0-18 V/2 A. The output of 18V ac is converted into 12 V dc through rectifier. Rectifier with filter capacitor converts AC into 12 V DC. The capacitors of 2200 µF/50 V are used to control the heavy current which may damage the MOSFET switch. The switching frequency of MOSFET switch is 8 kHz.

The turn on time and turn off time of MOSFET controlled through the isolated driver which may also regulates the voltage. The turn on time of MOSFET will be different as for constant current charging. Hence, duty ratio will also be different. The inductor used is toroidal type.

The variable DC is fed to the battery through the resistors of 12kΩ and 3kΩ. The voltage sample Vx is taken between 12kΩ and 3kΩ resistor. Also, other voltage sample Vy is taken across the battery. The voltage samples Vx and Vy are given to the PIC microcontroller for comparing purpose for constant current charging of battery.

When the voltage sample Vy is less than 14 V the relay 1 will be turns off, and when the voltage sample Vy is more than 12 V the relay 1 will be turns on. Also, when voltage sample Vy is more than 14 V it will increases the duty cycle of step down chopper and when voltage sample Vy is less than 14 V it will decreases the duty cycle of step down chopper.

The circuit diagram of isolated driver of MOSFET is as shown in Figure 4. The output from pin 17 of port C is given to pin 3 of the level shifter CD4504. At pin 1 of CD4504 the supply of +5V is fed. Also, the capacitors of 100 µf=16V and 104 are connected for high and low frequency input noise suppration.

The level shifter shifts voltages from +5V to +12V (low to high). The output from level shifter CD4504 is fed to pin 10 of MOSFET driver IR2110. The output from pin 7 through the current limiting resistor of 100 Ω is given to the gate terminal of MOSFET.

II. HARDWARE RESULTS:

The results of Battery Charger circuit with constant current charging method are as shown in below Figure 5 & Figure 6.

When the load of 10 KΩ, 40 W is connected in place of 12 V battery, at that time the output voltage is 14 V and constant current is of 1 A is achieved.

The switching frequency of MOSFET is 8 KHz. The total turn on time of MOSFET switch is 0.15 msec.

CONCLUSION

The proposed online UPS schemes will full-fill all the characteristics of online UPS. The Voltage regulation of 230 Volts AC is available on continuity basis. The advanced microcontroller used for digital controlling
is PIC 16F877A. The battery used is Lead-Acid type battery with 12V DC voltage and 20A current.

Constant current charging is best suited for use on lead-acid batteries. This type of charger is usually small and relatively inexpensive. The basic idea is to keep constant current charging by limiting the duty cycle of charger.

REFERENCES


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