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Microcontroller Based 1.1Kw Zero Voltage Switched Battery Charger Module

KEYWORDS: Power supply, full-bridge zero voltage switching topology, IGBTs, High frequency transformer, Microcontroller.

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ABSTRACT *Conventional chargers utilize low frequency (50Hz) transformers which are bulky, less efficient and thus costly. As a solution to this, utilization of controllable high frequency power supply with high dynamic and steady state current regulation, performance can be improved. In the design robustness, small size and low weight, low complexity, and high efficiency are the defining criteria. The most suitable approach for a 1.1 kW battery charger module for power supply application is the high frequency Full-Bridge Zero Voltage Switching (FB-ZVS) charger with an isolation transformer.This module not only gives the advantage of zero voltage switching for a wide load current range, it also provides reduced Electromagnetic Interference (EMI) and reduced component stress compared to standard PWM based modules. In this paper a FB-ZVS based charger with 1.1kW power rating is designed for modern battery charging applications. IGBTs are utilized at 25 kHz switching frequency for high efficiency and control bandwidth. The output current of the module is controlled via an ATmega128 microcontroller. The performance of the designed charger is evaluated via the computer simulations and the experimental study of the constructed prototype. The main aim of representing this paper is to deploy this project on commercial basis in market.*

1. INTRODUCTION

A switched-mode power supply (switching-mode power supply, SMPS, or switcher) is an electronic power supply that incorporates a switching regulator to convert electrical power efficiently. Like other power supplies, an SMPS transfers power from a source, like mains power, to a load, such as a personal computer, while converting voltage and current characteristics. An SMPS is usually employed to efficiently provide a regulated output voltage, typically at a level different from the input voltage.Unlike a linear power supply, the pass transistor of a switching-mode supply continually switches between low-dissipation, full-on and full-off states, and spends very little time in the high dissipation transitions (which minimizes wasted energy). Ideally, a switched-mode power supply dissipates no power. Voltage regulation is achieved by varying the ratio of on-to-off time. In contrast, a linear power supply regulates the output voltage by continually dissipating power in the pass transistor. This higher power conversion efficiency is an important advantage of a switched-mode power supply. Switched-mode power supplies may also be substantially smaller and lighter than a linear supply due to the smaller transformer size and weight. Switching regulators are used as replacements for the linear regulators when higher efficiency, smaller size or lighter weights are required. They are, however, more complicated; their switching currents can cause electrical noise problems if not carefully suppressed, and simple designs may have a poor power factor .

This paper is about making a fast battery charger than present battery charger. This battery charger will use SMPS full-bridge ZVS topology due to its high efficiency. The high frequency transformer used here works as isolation between source and load. This is for the safety of the circuit itself. This battery charger will give output current rating of 10amps and output voltage rating of 110v.

The Microcontroller will control the charging of the battery by monitoring the voltage and current over the feedback path. A linear regulator provides the desired output voltage by dissipating excess power in ohmic losses (e.g., in a resistor or in the collector–emitter region of a pass transistor in its active mode).

A linear regulator regulates either output voltage or current by dissipating the excess electric power in the form of heat, and hence its maximum power efficiency is voltage-out/voltage-in since the volt difference is wasted. In contrast, a switched-mode power supply regulates either output voltage or current by switching ideal storage elements, like inductors and capacitors, into and out of different electrical configurations. Ideal switching elements (e.g., transistors operated outside of their active mode) have no resistance when "closed" and carry no current when "open", and so the converters can theoretically operate with 100% efficiency (i.e., all input power is delivered to the load; no power is wasted as dissipated heat).

In an SMPS, the output current flow depends on the input power signal, the storage elements and circuit topologies used, and also on the pattern used (e.g., pulse-width modulation with an adjustable duty cycle) to drive the switching elements.

2. RESEARCH FINDINGS

This has been a dynamic field of research in power electronics. The modules available in present market are large in size. So we mainly focused on reducing the size along with gaining good efficiency. Therefore, this paper shows designing and implementation of the prototype with these advantages. In addition to this other advantages offered are robustness, small size and low weight, low complexity, and high efficiency. Block Diagram for this prototype is as shown below.

3. BLOCK DIAGRAM

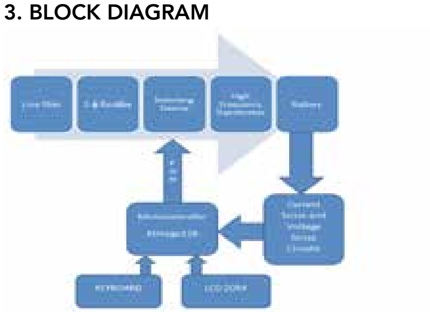

Fig 1. Block Diagram

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4. DESCRIPTION OF BLOCK DIAGRAM

First and foremost block is the line filter which attenuates EMI. Next is the rectifier which rectifies the input. The Switching devices are connected to obtain FB-ZVS topology. The output from switching devices is given to high frequency transformer. Finally, the block of "battery" indicates the battery to be charged. The battery ratings are set in the Microcontroller with the help of keyboard which is displayed too on the LCD. Now according to the ratings set Microcontroller monitors the current and voltage of battery with the help of Current Sense Circuit and Voltage Sense Circuit respectively. According to the data received Microcontroller varies the PWM pulses which are given out to control the IGBT switching. Thus, if the battery is to be charged further than Microcontroller increases the PWM pulses but if the battery is about to get fully charged than then it reduces the PWM pulses and thereby reducing the charging voltages.

5. PHOTOGRAPH OF THE PROTOTYPE SYSTEM

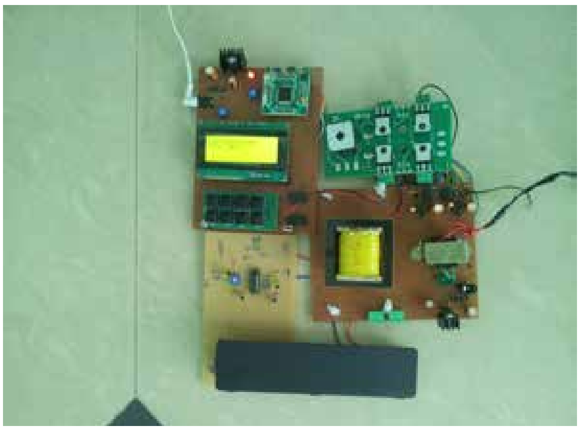
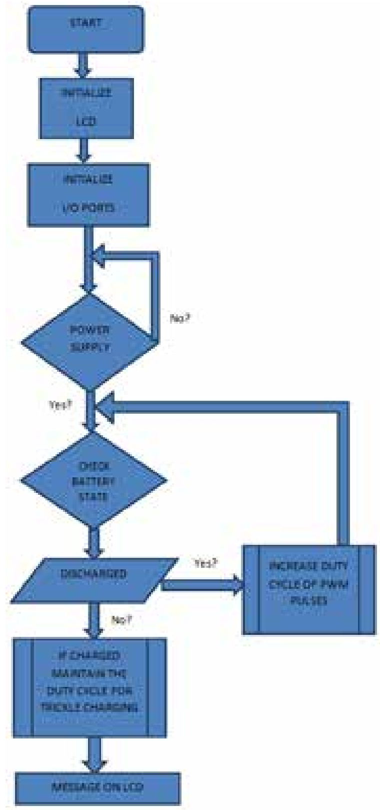


FIG 2.THE PROTOTYPE SYSTEM

6. FLOW CHART



7. CONCLUSION

Thus, we can improve efficiency of battery charger and get advantages of FB-ZVS topology and SMPS. Also we can reduce the size without compromising on performance of the module by using a high frequency transformer. Also by the use of microcontroller the charging ratings can be pre-set and controlled and hence automated.

8. ACKNOWLEDGEMENT

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