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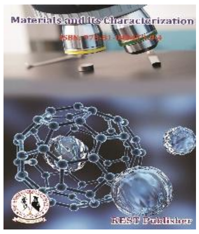

A High StepUp Super Lift Luo Converter for Photovoltic Application

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Abstract: *In this thesis, a dc-dc converter with battery energy storage is proposed for renewable energy systems. This system is named as Voltage Regulator – Battery Energy Storage System (VR-BESS). For wind energy the proposed system is connected to a generator -turbine by means of an uncontrolled rectifier. In case of solar energy, this system is directly connected to photovoltaic array. The VR-BESS is interfaced with the ac utility source by means of a switch-mode dc-ac converter. The Voltage Regulator – Battery Energy Storage System (VR-BESS) is developed by combination of Buck converter and Boost converter operated in a single structure. In normal mode, the load gets feeded from DC grid or DC source by Boost converter operation and battery gets charged in Buck converter operation at a time. This part is presented as mode. When load power is more than DC grid power capability, then battery feeds the load for extra power that can't be supplied by DC grid, through Boost converter operation. This part is termed as mode. When DC grid voltage falls below rated level, then duty cycles of power switches are adjusted such that load feeding and battery charging can reestablish. This part is called as mode. All modes of operation are simulated and experimentally verified in open loop system.*
Keywords: *Buck converter, continuous conduction mode (CCM), Step down converter, Step up converter,*

1. INTRODUCTION

Battery energy storage has beenwidely applied in various applications suchas Uninterruptible Power Supplies (UPS). These systems are standard solution when total outage or voltage sag compensation isrequired. Over the past decades an interest is growing up about the exploration of renewable energies, such as wind and solarenergy, for generation of electrical energy. However, the electric power generated is fluctuating, since the wind presents a random characteristic and the available solar energy depends on the weather conditions. An alternative is to store energyin a battery bank. Another growing applications is the use of battery storage to limits at maximum the power delivered by the supply grid. A bidirectional converter for battery energy storage is connected witha utility grid operates at energy storage andpeak cut modes. The load-adaptive variable-speed generating system comprises two energysources: an engine driven alternator and a battery bank. When the energy from the alternator is insufficient to meet sudden increments in load demand, energy is pumped from the battery to the dc link. When there is excess engine capacity, the battery energy is replenished. An integrated dc UPS topology combination of battery charger and dc-dc converter. The battery charger stage is a buck converter and, when outage occurs, the battery supplies the load in a natural waythrough diode connected between the battery and output capacitor.

2. DC-DC CONVERTERS

Switch mode dc-to-dc converters areused to convert the unregulated dc input intoa controlled dc output at a desired voltage level. Buck (step down) converter and the Boost (step up) converters are basic converter topologies. In following description, the converters are analyzed in steady state. The switches are treated beingideal, and the losses in the inductive and capacitive elements are neglected. The dc input voltage to the converters is assumed as zero internal impedance.

3. BLOCK DIAGRAM

The following figure shows the block diagram of a general system adequate for renewable energy systems. There are two power stages: dc-dc voltage regulator and battery energy storage.

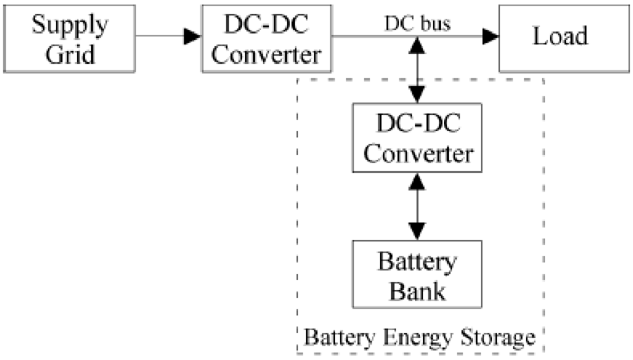

FIGURE 1. Block Diagram

The voltage regulation is accomplished by means of a dc-dc converter, which lifts the supply gridvoltage to a regulated output dc bus voltage.

4. BUCK CONVERTER

Buck converter is a step down dc-dc converter which produces a lower average output voltage than the DC input voltage.

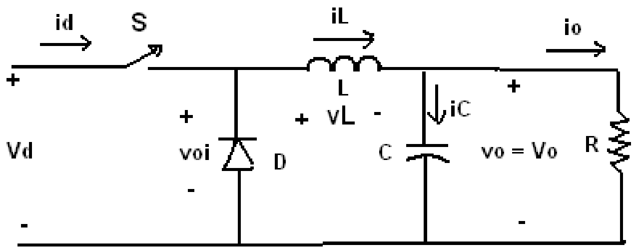

FIGURE 2. Circuit diagram for Buck converter

It consists of dc input voltage sourceVd, controlled switch S, diode D, filter inductor L, filter capacitor C, and load resistance R. Assuming an ideal switch, a constant input voltage Vd, a purely resistiveload, the instantaneous output voltage, voi waveform.

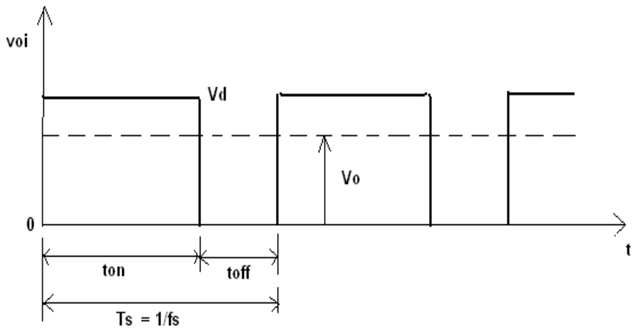

FIGURE 3. Voi Voltage Waveform

5. LOGIC GATES USED

OR gate: CD 4071BM AND gate: HCF 4081B EX-OR gate: HCF 4070B
The signals from logic gates are given to toggle switches to select particularmode of operation. After toggle switch the pulses were given to driver ICs. For driving the mosfets MIC 4425 ICs were used. The two MOSFETs were like single inverter leg, where the high end MOSFET should be driven independently w.r.t power circuit ground. For driving high end MOSFET, afterdriver IC, a pulse transformer (in 1:2 ratio) was used. The output from pulse transformer was given to high end MOSFET, S1. Circuit diagram of UC 2875with controlling components is shown in following figure:

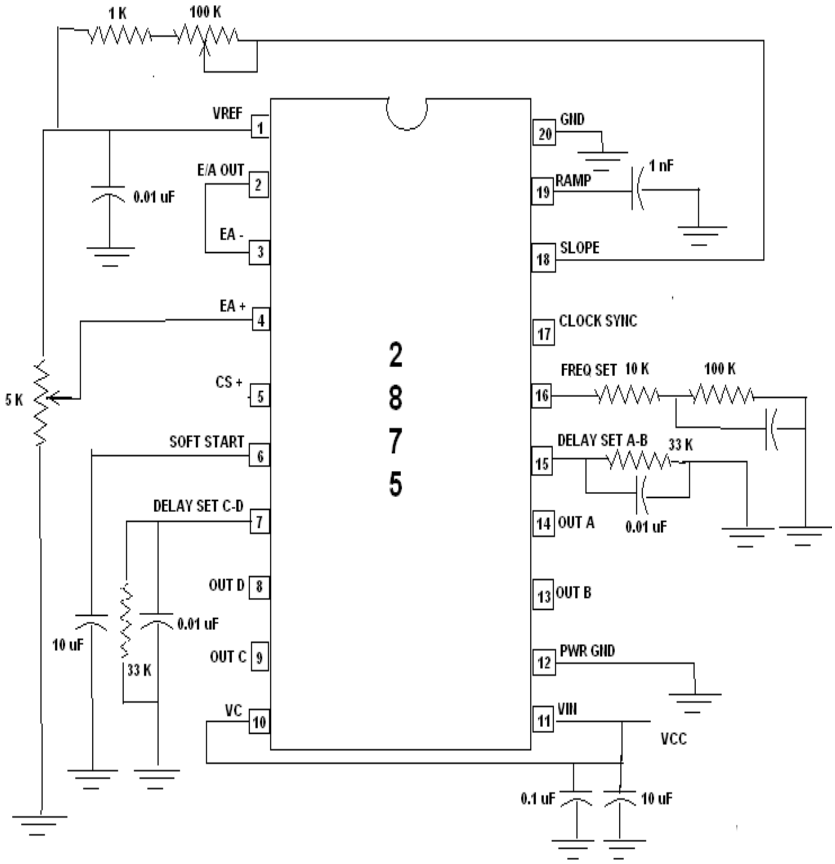

FIGURE 4. Control circuit of UC 2875

6. CONCLUSIONS

The thesis presented an analysis of system composed of voltage regulator and battery energy storage. Voltage regulation, peak power leveling and compensation for power fluctuations were realized by a simple structure. The proposed system becomes adequate for applications in renewable energy system, such as wind andsolar power. Functionally, Voltage Regulator – Battery Energy Storage System(VR-BESS) operates like a conventionalboost converter to provide voltage regulation and to step up the battery bank voltage to output dc bus. For battery charging the VR-BESS operates like a conventional buck converter. Variousmodes of operation were analyzed in open circuit. Mathematical expressions, digital simulations and experimental results for various modes of operation were developedin order to describe the operation of the VR-BESS. The results validate the operational concept.

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