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To Increase System Efficiency for Portable Electronics Devices with DC-DC Converter

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Abstract:
Non conventional energy based on photovoltaic system with storage energy battery is necessary to load requirement for supply to electric grid.. Due to use of dc-ac convertor, the efficiency does not improve. The power conditioning is done by a dc–dc converter and a dc–ac inverter stages to produce the desired ac source. This is also done even when the load is of dc type, such as typical portable electronic devices that require ac adaptors to be powered from the ac mains. The aim of this project is to propose a hybrid PV-battery-powered dc bus system that eliminates the dc–ac conversion stage, resulting in lower cost and improved overall energy conversion efficiency. A high-gain hybrid boost fly back converter is introduced with higher voltage conversion ratio than conventional boost convertor topology.

KEYWORDS: DC bus system, dc–dc converter, hybrid fly back boost converter, solar cell ,pv power system.

1. INTRODUCTION

Recently, we know that due to population growth, Industrialization, and Increasing leaving of standard the electricity demand is sharply increase. To fulfill these demand conventional sources of energy contributes around 80% demand. The conventional sources are coal, petroleum, natural gas etc .As this sources are non renewable there is fear that they will get exhausted eventually in the next century .so ,predicting the future demand and future scenario of energy ,it is mandatory to promote the renewable sources of energy ,as these sources has much potential. Solar energy is the most readily available and free source of energy since prehistorically times. It is estimated that solar energy equivalent to over 15000 times the world annual commercial energy consumption reaches the earth every year. Solar energy stored in the form of dc. This dc energy is converted into ac as per our load requirement. But in ac fluctuation is more that results in poor efficiency and voltage instability. To avoid and get maximum output, we in this paper mainly concentrate on dc to dc convertor. However, when a renewable energy source such as solar power is available and since it is dc in nature. The dc to ac inversion followed by ac to dc conversion can be eliminated and the output is dc. Inserting solely a dc to dc converter with maximum power point tracking (MPPT) capability in between the renewable energy source and load would save the extra conversion[1]. Also the losses are associated with the unnecessary conversion stages. For example, a dc–dc buck–boost powering an array of LED's from the photovoltaic (PV) panels is introduced in [1]. To fit in the renewable energy sources(RES). It is costly to again make different dc to dc converters for different equipment voltages when this equipment has already a switching ac adapter. The replaced switching ac adapter will become a harmful waste to the environment. It is therefore attractive to reuse these ac adapters as most of them are made up of switching dc to dc converters[2]. It is experimentally proven and documented in this letter that the switching ac adapters operate properly with dc input voltage. By providing a common dc bus all the switching ac adapters can take power from such a bus to power the various common portable electronic devices.[2]. Generally speaking, the high step-up dc–dc converters for these applications have the following common features.

1) High step-up voltage gain. About a tenfold step-up gain is required.

2) High efficiency.

3) No isolation is required[2].

There are two major concerns related to the efficiency of a high step-up dc–dc converter large input current and high Output voltage. The large input current results from low input Voltage therefore, low-voltage-rated devices with low (Rds) on are necessary in order to reduce the conduction loss of the system. Another concern is the severe reverse-recovery problem that occurs in the output rectifier due to the high output voltage [3].

2. Related Work

One of the major concerns with solar power is its intermittent nature, so that it needs some kind of storage typically provided by a battery to assist output voltage regulation at all times. A common practice is to adopt a cascaded connection of a battery charger and a converter (or inverter) to provide dc (or ac) voltage for the load. The drawback of this configuration is the repeatedly processed input power that degrades the overall conversion efficiency [1].

The PV-battery dc–dc converter for the proposed dc bus system has to achieve charging of the battery, MPPT function and provide tight output regulation, i.e., a dc–dc converter with high voltage gain and simple circuitry is required [1].

The objectives of this paper are to:

1) Confirm experimentally that ac adapters operate properly even when powered from a dc bus instead.

2) Propose a new dc/dc converter configuration Powered by a combination of a PV source and battery, while fulfilling the dc bus system requirements.

3) Propose a new high step-up ratio dc/dc converter for the dc bus system with lower voltage stress.

2.1. Proposed PV-Battery-Powered dc Bus System

A dc bus system presented in this paper with the PV-battery-powered dc bus, the ac adapters can share this bus to power the various devices. In general, the requirements of implementing the proposed dc bus system involving PV panels, Batteries and dc–dc converters are listed as follows:

1) Regulation of the dc bus voltage;

2) Dc bus voltage ranges between 120 and 383 Vdc;

3) MPPT for the PV panels;

4) Ability to charge the battery independent of the load; and

5) Capability of the battery to support the dc bus voltage when the solar source is not present [2].

It should be noted that the dc bus could also be powered from a rectified ac mains voltage .The rectified voltage with low-frequency ripple would not affects the dc bus system because the switching ac adapters can provide tight output regulation for the loads for ac and dc inputs[2]. The proposed dc bus system cannot use ac adapters built with 50/60 Hz transformers that cannot transfer energy to the dc input voltage. Besides, there are battery recycling programs in place in many countries to reduce the harmful waste caused by the old or dead batteries, for example, the lead–acid battery recycling program in the US [26].The proposed dc bus system could be scaled up for higher power applications by increasing the number of PV panels, the size of the battery, and the power ratings of the components of each converter. The possible modular approach. Each module contains a PV panel (or a string of PV panels or paralleled PV panels), a battery bank, the proposed dc/dc converter, and a dc circuit breaker[2]. This modular approach has several advantages. First, it enhances system reliability over the centralized approach as when one module fails, it can be isolated from the dc bus[2]. Second, each module has its own control of MPPT to maximize the utilization of the PV power. However, parallel operation of modules needs to be studied to ensure even load sharing among the modules, but it is beyond the scope of this letter. In this letter, a novel integrated high-voltage gain step-up dc–dc converter, combining a buck–boost converter and a new hybrid boost–fly back converter, capable of achieving battery charging, MPPT function, and tight output regulation, is proposed[2]. The proposed solution overcomes all the previously mentioned problems with capacitor voltage imbalance, single sourced converters, and ringing/resonance due to leakage inductances.

The new hybrid boost–fly back converters combine the advantages of boost and fly back converters and have the following features:

1) Higher step-up ratio than that of the boost converter or fly back converter.

2) Lower voltage stress on the power switch. For the boost converter, the voltage stress on the power switch equals the output voltage, but for the proposed converter, the voltage stress is less than the output voltage. This implies less switching loss of the switch; and

3) Voltage clamping of the switch of the proposed converter, same as that of a boost converter. For the fly back converter, an extra voltage clamping switch or a snubber network is needed to protect the power switch [2].

2.2. Comparison Between dc and ac Inputs for Selected ac Adaptors

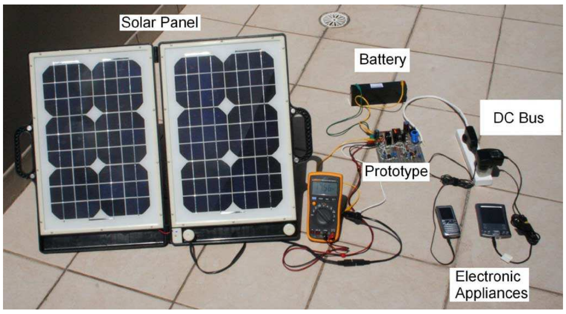

Fig.1: Hardware implementation of the proposed dc bus system with common portable electronics devices [2].

To verify the idea of ac adapter working properly with dc voltage, two common portable electronic devices were tested with different dc and ac voltages. The results of the Nokia mobile phone charger AC-4X & an iPod charger, respectively. The comparable efficiencies at both dc and ac voltages for both cases confirm that the chargers work properly on dc input. The difference in efficiency at different voltages may be due to the optimized operating point at certain voltage such as the magnetic component. However, the difference is only 1%–2% at full load[2].

3. Proposed Methodology

The requirements of implementing the dc bus system consists of PV panels, batteries, and dc–dc Converter are listed as follows:

Regulation of the dc bus voltage, MPPT for the PV panels, Ability to charge the battery independent of the load, Capability of the battery to support the dc bus voltage when the solar source is not present.

Phase-I

Detailed literature survey.

To study MPPT and PWM controller.

Phase –II

To study and design dc-dc converter, Implementation of dc-dc converter with MPPT and PWM controller and Preparation of Project Report

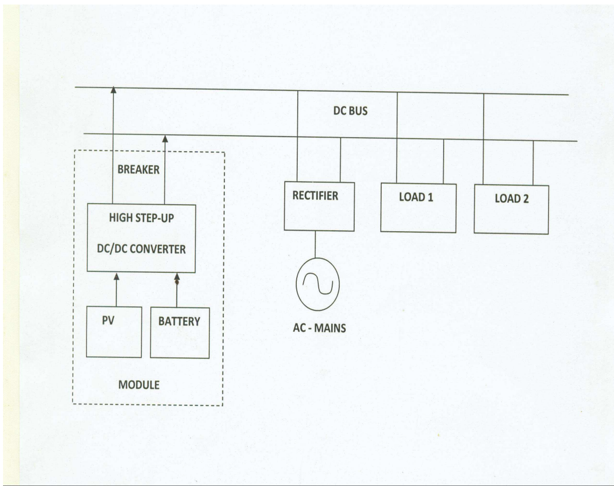

Fig. 2: Block diagram

A dc bus system presented in this letter is shown in Fig.1. The PV-battery-powered dc bus, the ac adapters can share this bus to power the various devices. In general, the requirements of implementing the proposed dc bus system involving PV panels, Batteries and dc–dc converters are listed as follows:

1) Regulation of the dc bus voltage.
2) Dc bus voltage ranges between 120 and 289 volts dc.
3) MPPT for the PV panels.
4) The ability to charge the battery independent of the load.
5) The capability of the battery to support the dc bus voltage, when the solar source is not present.

It should be noted that the dc bus could also be powered from rectified ac mains voltage (Fig. 1).The rectified voltage with low-frequency ripple would not affects the dc bus system because the switching ac adapters can provide tight output regulation for the loads for ac and dc inputs. The proposed dc bus system cannot use ac adapters built with 50/60 Hz transformers that cannot transfer energy to the dc input voltage. Besides, there are battery recycling programs in place in many countries to reduce the harmful waste caused by the old or dead batteries for example, the lead–acid battery recycling program in the US [4].In summary, the new hybrid boost–fly back converter combines the advantages of boost and flies back converters and has the following features: 1) higher step-up ratio than that of the boost converter or fly back converter. 2) Lower voltage stress on the power switch. For the boost converter, the voltage stress on the power switch equals the output voltage but for the proposed converter the voltage stress is less than the output voltage. This implies less switching loss of the switch. 3) Voltage clamping of the switch of the proposed converter same as that of a boost converter. For the fly back converter an extra voltage-clamping switch or a snubber network is needed to protect the power switch [2].

4. Conclusion

We conclude that, when the load is of dc type, such as typical portable electronic devices that require ac adaptors to be powered from the ac mains. The aim of project is to propose a hybrid PV-battery-powered dc bus system that eliminates the dc–ac conversion stage, resulting in lower cost, improved overall energy conversion efficiency. A high-gain hybrid boost–fly back converter is, also introduced with several times higher voltage in higher dc bus levels and lower cable conduction losses.

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