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DC-DC Converter with High Step-up Voltage for Maximum Solar Power Generation Integrating Zeta and Boost Converter using Coupled Inductor

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Abstract:

The photovoltaic based dc-dc converter for high step up voltage gain at the load side. The single-switch DC/DC converter for the Future Renewable Electric Energy Delivery and Management (FREEDM) System to employ the Distributed Renewable Energy Resources. The distribution system is used the Maximum Power Point Tracking (MPPT) in PV module. The characteristics of the PV module and the DC-bus, the single power stage must give minimum current ripple in input and output side and produce high voltage gain with high efficiency. The boost and Zeta converter is integrated to attain the maximum power at load side. The future renewable energy has contains the distributed energy and also has the maximum power point tracking method. The integration of two converters for increasing the steady state characteristics and improve the dynamic performance. The maximum solar power is generated in the distributed energy is implemented in MATLAB/Simulink environment.

Keywords: Photovoltaic (PV), Maximum Power Point Tracking (MPPT), Zeta Converter, Boost Converter.

Introduction

A solar based PV networks require a high increase front end dc-de converter. Regular dc-de converters can offer limited gain and their effectiveness drops as the gain increases. This paper proposes a high gain; high effectiveness dc-de converter suitable for low voltage PV applications [1-2]. The converter depends on energy storage in a intermediary capacitor by a coupled inductor. In the proposed converter, a clamp circuit is utilized to reuse the energy stored in the leakage inductance (of the coupled inductor) to build the proficiency. This facilitates realization of high voltage gain without extreme duty cycle. The high step up and high efficiency DC/DC converters is the significant thought in the sustainable characteristics associated and control applications because of low voltage PV exhibits and power devices [3-5]. The current average current-mode control methods endure from switching instability at low duty ratios due to a great ripple in the sensed current [6]. Moreover, the current error amplifier's high-frequency pole positioned at the switching frequency neither improve the stability problem nor advance the dynamic response of the converter. In the proposed method, a low pass filter, which attenuates any high-frequency ripple, is placed in the feedback path of the current loop. Consequently, the m control voltage is nearly dc and proportional to the actual average value of the inductor current [7-8].

Proposed Methodology

The block diagram of proposed method is shown in figure 1. The photovoltaic based hybrid integrated converter for better output voltage. The maximum power point tracking algorithm is used to extract more power from the dc supply [9].

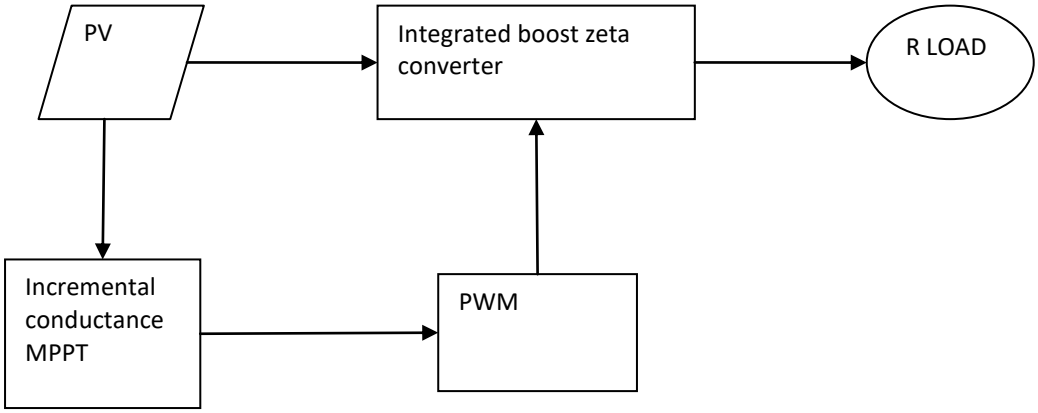

Fig 1: Proposed Block Diagram

Photovoltaic Array

A photovoltaic system is has diode, inductor and capacitor based current source. The radiation from the sun fall on the semiconductor device the electron flows and thus the electricity generated. More photovoltaic cell is connected to generate modules [10]. The modules are integrated to create PV panel. The equivalent circuit diagram is shown in figure 2.

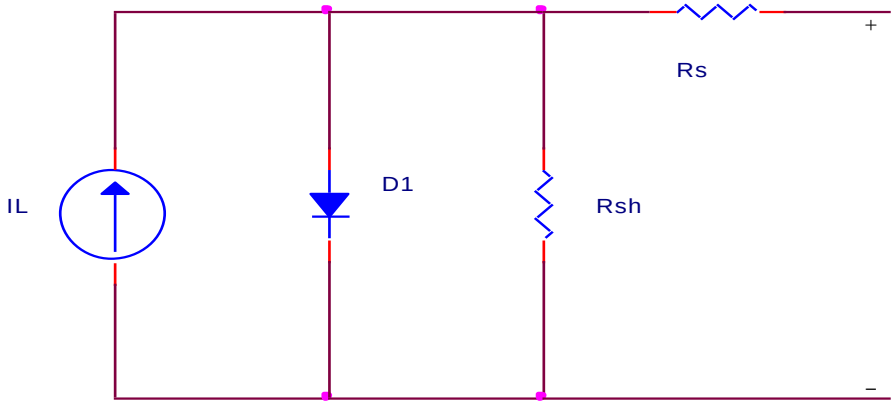

Fig 2: PV Equivalent Circuit

The photovoltaic effect refers to photons of light knocking electrons into a higher state of energy to create electricity. The term photovoltaic denotes the unbiased operating mode of a photodiode in which current through the device is entirely due to the transuded light energy. Virtually all photovoltaic devices are some type of photodiode. The integrated boost zeta converter using coupled inductor. The circuit diagram of proposed circuit diagram is shown in figure 3.

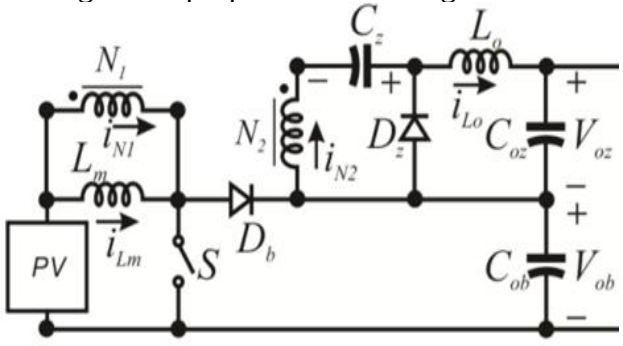

Fig 3: Circuit diagram of proposed method

Incremental Conductance MPPT:

The maximum power point tracking has to calculate the changes in voltage generated from a solar due to changes in PV factor the incremental conductance method implement a method to calculate only incremental variations in PV current. The perturb and observe algorithm by tracking the rapid variations in the solar parameters. In this method to find the sign of ratio between $\frac{dP}{dV}$generated powers to voltage incremental conductance $\frac{dI}{dV}$ is calculated. The array conductance value $\frac{I}{V}$ that is ratio between current and voltage is balanced with array incremental conductance $\frac{dI}{dV}$ to derive the maximum power point in this method. When the computed array conductance and incremental conductance are same the present PV voltage is MPP voltage and this method keeps this as MPP until the controller observe any changes in irradiation. A variation of Proportional Integral Derivative (PID) control is to utilize only the proportional and integral terms as PI control. The PI controller is the change, even more than full PID controllers. The value of the controller output u(t)u(t) is fed into the system as the manipulated variable input.

Simulation Result

The overall simulation circuit is shown in figure 4. The photovoltaic based integrated converter fed load has generated high voltage value by using the pulse width modulation. The PV voltage source is shown in 5. The output voltage is shown in figure 6. The output current in solar fed integrated converter is shown in figure 7. The photovoltaic array generates high power at the output. The PI based pulse width modulation is used. The integrated converter has both the advantages of boost and Zeta converter.

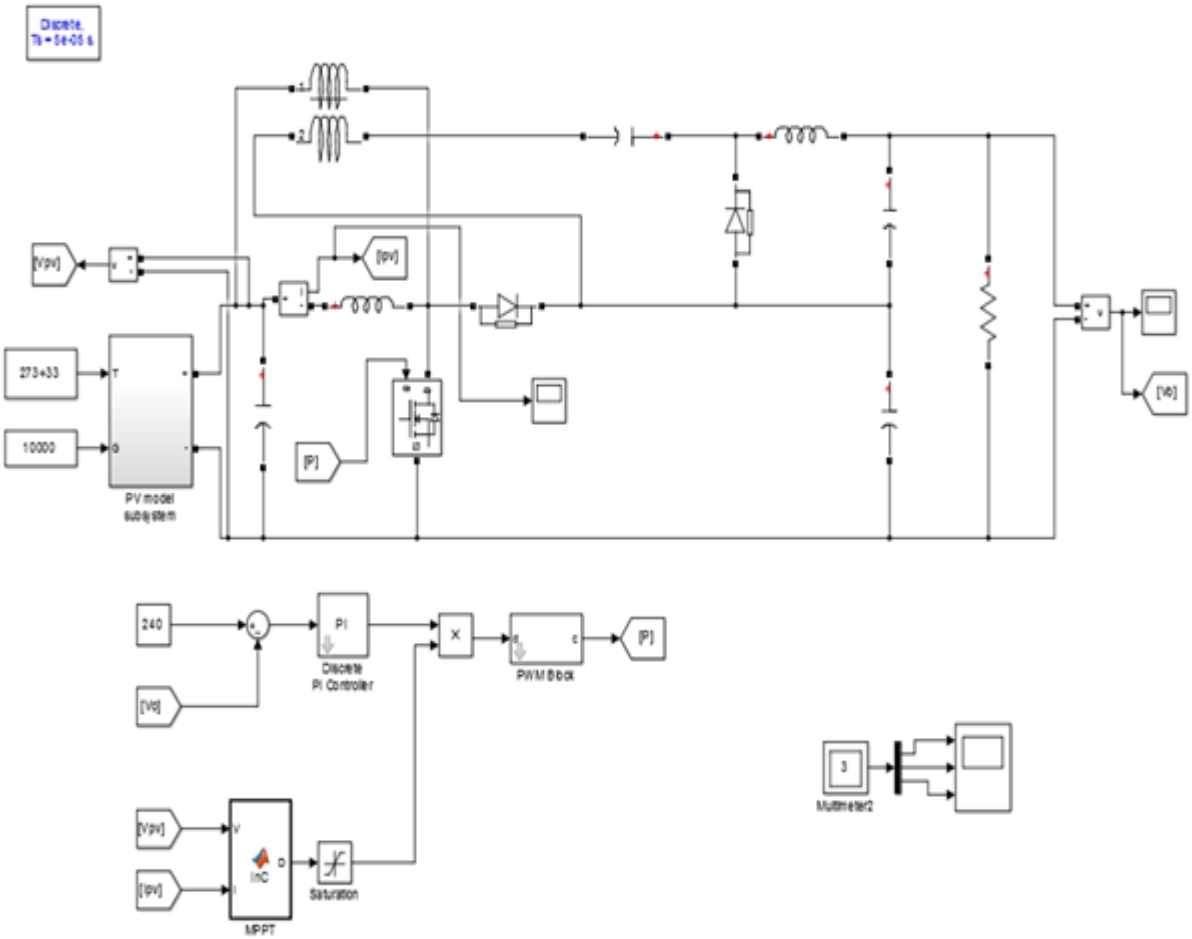

Fig 4: Overall simulation Circuit of Photovolatic based Integrated Circuit

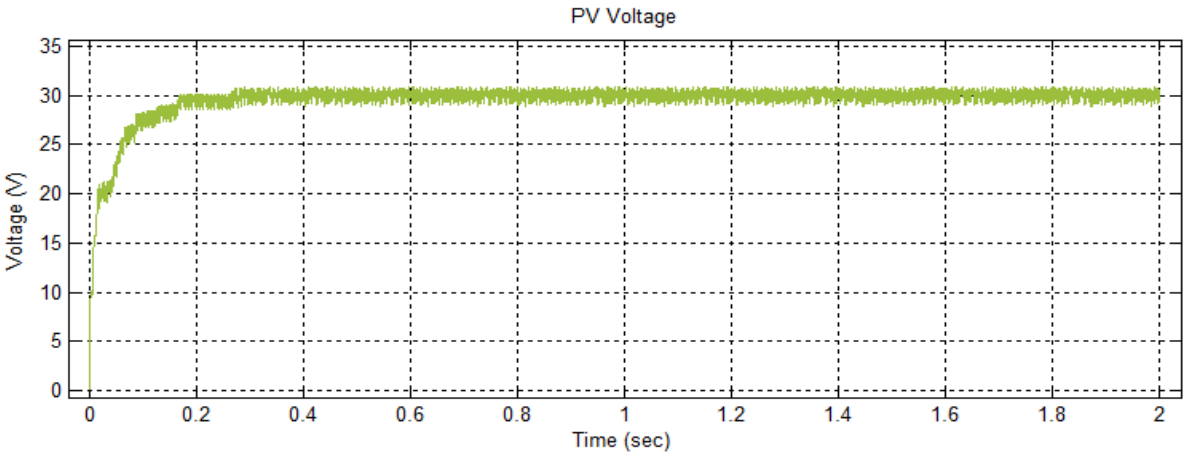

Fig 5: Photovolatic Voltage waveform

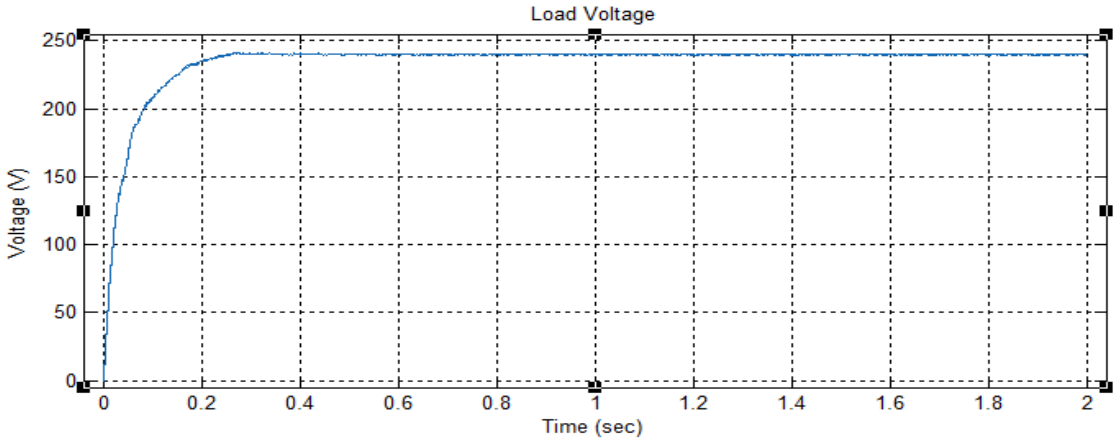

Fig 6: Output Voltage

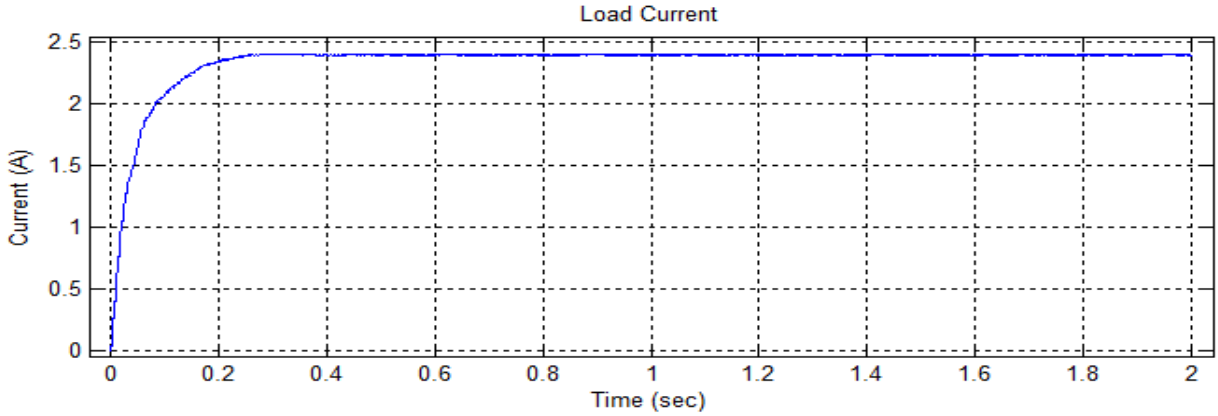

Fig 7: Output Current of an integrated converter

Conclusion

The PV converters have high advantage based on the future renewable energy distribution systems to decrease their complication as well as costs. The hybrid Boost-Zeta converters with increase the voltage gain and minimum dc bus voltage in the modified FREEDM system. The maximum power point tracking algorithm is used to enhance the power generation from the renewable energy and regulate the power by using the controller. The merits of zeta converter has high gain and minimum ripple current across the central energy device storage. The solar photovoltaic current is not intermittent and increases the voltage gain of Boost cell converter was analyzed and implemented.

This combination of the cells attains the qualities of each cell and also adds quality to decrease stress on the components of passive elements.

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