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A PV based current fed Non-Isolated Bidirectional ZCS/ZVS Resonant DC-DC Converter for Energy Storage Interface

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ABSTRACT

Currently, power along with power electronics has developed important share of our existence. Power intakes are growing every single year because of development in our nation. dc-dc converter topologies for example buck, boost, buck-boost, cuk converters offer us through skill to step up and step down the input DC voltage exactly. DC-DC converter is desirable to convert straight to the anticipated voltage after the renewable energy bases for example solar cell and Fuel cell. Solar panel develops the greatest significant renewable energy basis. Solar panel absorbs the solar radiation to the maximum at constant temperature thereby giving its voltage and current. Maximum Power Point Tracking (MPPT) is a technique that absorbs the maximum power from the solar panel. Maximum power point trackers may implement different algorithms and switch between them based on the operating conditions of the array. In this paper, we proposed PV + MPPT based buck-boost DC-DC converter which is used in such system to improve efficiency, performance and also to reduce cost and component count. The features are Current-fed input stage with low input-current ripple ensures long battery life ,Common ground driving at LV side, High frequency soft-switching results in higher efficiency and smaller size, PFM is utilized for output voltage regulation. Switch realization and operating characteristics of proposed PV input buck-boost dc-dc converter is obtained with their voltage transfer ratios in buck and boost modes of operation. The performances of the dc-dc converter are simulated using MATLAB/Simulink.

Keywords—Buck-Boost DC-DC conversion, PV, MPPT, Modes of operation, MATLAB/Simulink.

I.INTRODUCTION

Electrical energy can be transferred to any place with the use of transmission lines and also it can be converted to other forms of energy such as light, heat and kinetic energy. Since power electronic circuits are controllable and relatively small compared with vacuum circuits, they have been widely adopted. Solar power, wind power and Hydro power are abundant and unlimited in many areas in this world. Lots of research has been conducted to improve the converter efficiency for renewable energy sources.[4].Most of the renewable energy sources are connected to the power grid or generators as auxiliary backup power source. In our country most of the isolated areas lack the supply from the power grid. Hence dependence on one renewable energy source is not a reliable method to maintain a stable power in these areas. So connecting all kind of the renewable energy sources to Generate electricity is a best solution in the rural areas. The focus of this paper is to design a multi input dc–dc converter to provide an interface between multiple DC sources and a single DC output. The conservative method of linking the energy storing unit is through by self-governing converter consumes numerous glitches [5]. The self-governing converter with vitality bases can be linked whichever in series or parallel in manifold contribution converters. If the sources are connected in series it has to conduct the same current and if the converters are connected in parallel it should have same Voltage levels [6]-[8]. Both the conditions are practically undesirable. Also, multi input converter is used to connect multi voltage Sources in a single system to give required load demand an also to improve efficiency, reduce overall cost, reduce component count, more stability and simple control. In this Paper, only four feedbacks remain castoff. So it remains same through method of four input DC-DC converter. Multi effort converters can be built by whichever flux additives

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or through uniting the construction of the converters. There is not a systematic approach to design multi feedback converters done origin [1]. Design of new converters from existing converters is complicated task [2].The rechargeable batteries are the common energy sources for EVs. In order to achieve performance comparable to internal combustion engine vehicle (ICEV), the EVs are powered by an energy source consisting of battery and ultra capacitors. The battery pack supplies the main power and the high power requirements, such as during acceleration, is supplied by super capacitor bank. Combination of battery and super capacitor bank enables use of smaller battery pack. In figure above arrangement of an EV through a battery bank then Ultra capacitor bank is exposed.

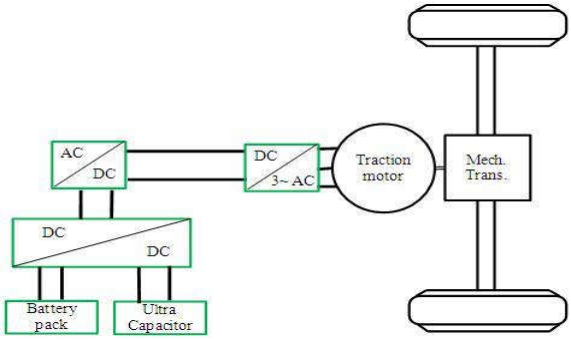


Figure 1: EV with two feedback bases.

Now instruction to source the traction motor with two sources, multi-input configuration of dc-dc converters is recycled. The multi input dc-dc converters stand categorized Multi-input Converter Consuming High/Low Voltage Bases then Flux additive DC-DC converter.

II.OPERATING PRINCIPLE

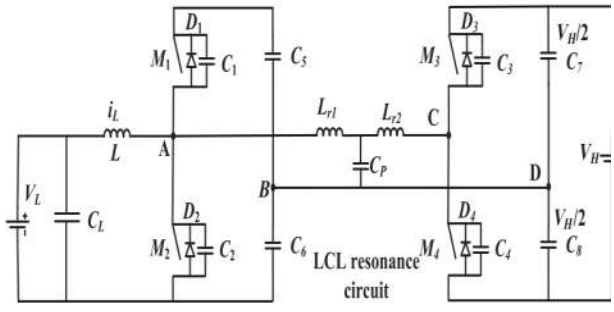
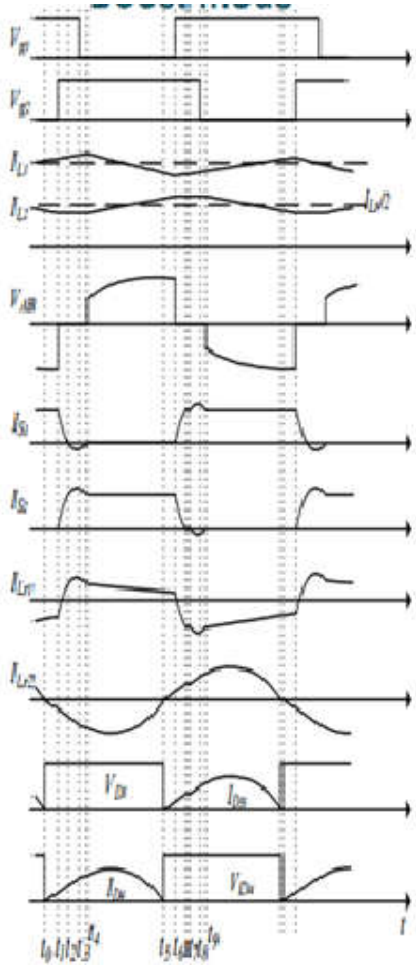


Figure 2: Projected bidirectional LCL resonant DC/DC converter.

BOOST MODE:



Mode1 [t_0-t_1]: With S_1 on & S_2 off, L_1 is charged by V_{in} and L_2 discharges through resonant tank and load.

Mode2 [t_1-t_2]: As both S_1&S_2 is on, i_{l2} free wheels through S_1& S_2 while i_{l1} charges. Also, L_{r1} resonates with Cp, reversing the i_{Lr1} polarity.

Mode3 [t_2-t_3]: As both S_1& S_2 is on, i_{l2} free wheels through S_1& S_2 while i_{l1} charges. Also, L_{r1} resonates with Cp, reversing the i_{Lr1} polarity except negative i_{s1}.

Mode4 [t_3-t_4]: when S1 turned off at t_3, i_{s1} continues to flow through D1 and achieves ZCS turn-off at the end of this mode.

Mode5 [t_4-t_5]: At t_4, with S2 on, L2 starts charging while L1 discharges and the difference in two currents [$i_{L1}(t) - i_{L2}(t)$].

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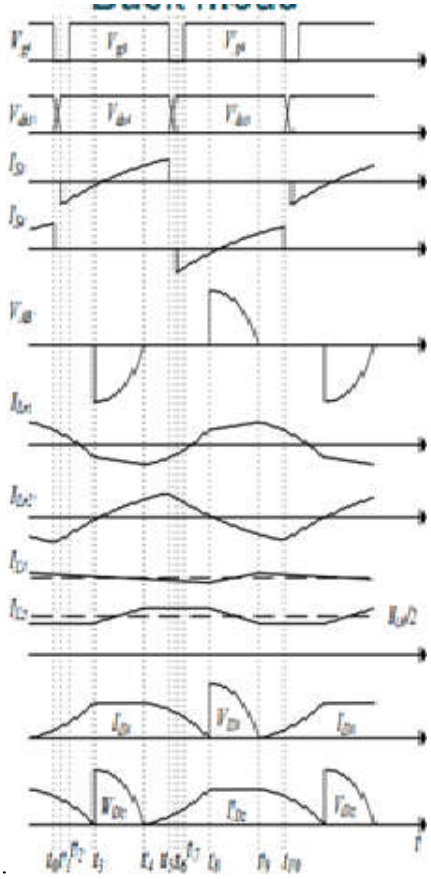
BUCK MODE



Mode1 [t_0-t_1]: With S3 and S4 off, the parasiticC3 gets discharged while C4 is charged by i_{Lr2}. As V_{AB} is zero, i_{L2} freewheels and i_{L1} supplies the load power.

Mode2 [t_1-t_2]: S3 and S4 off, the parasitic C3 get discharged while C4 is charged by i_{Lr2}. As V_{AB} is zero, i_{L2} freewheels and i_{L1} supplies the load power, except i_{Lr2} continues to conduct via D3.

Mode3 [t_2-t_3]: S3 is switched on with ZVS, while L_{r2} continues its resonance with C_p and C_5, C_6.

Mode4 [t_3-t_4]: L1 continues discharging through load and L2 starts charging upon resonating with L_{r1} and C_p. this mode ends when V_{AB} resonates down to zero, while i_{L2} starts freewheeling.

Mode5 [t_4-t_5]: In this mode diode D2 starts conduction (ZCS turn-on) and gradually takes over diode D1 current.

III.SIMULATIONRESULTS

Now this segment the deliberated circuit of the projected pv+ mppt based non isolated bidirectional Soft Switching Current fed LCL resonant DC/DC Converter to Interface Energy Stowing in DC Micro grid Competency takes organized formerly the untried consequences of the circuit cutting-edge the MATLAB simulation are enlightened briefly.

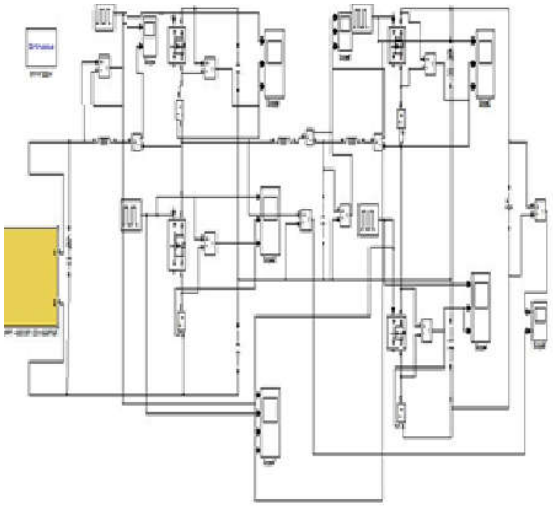


Figure 3: Simulation circuit for bidirectional LCL resonant converter of DC micro grid

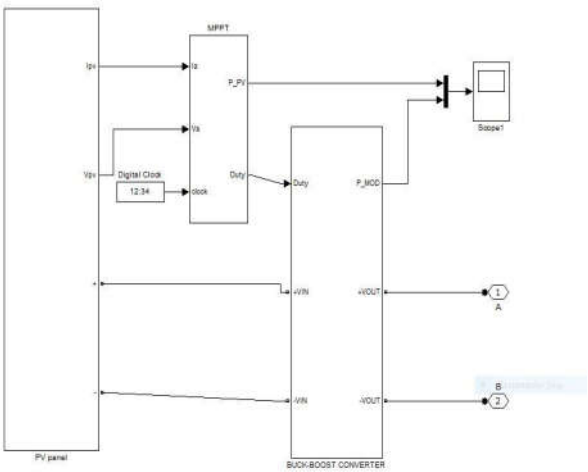


Figure 4: simulation circuit for PV + buck-boost converter.

Ripple current through inductors may not change however there is an additional power supply delivered by Photovoltaic inverter, To make sure there is no effect the following figure will give the nature of ripple current through inductors.

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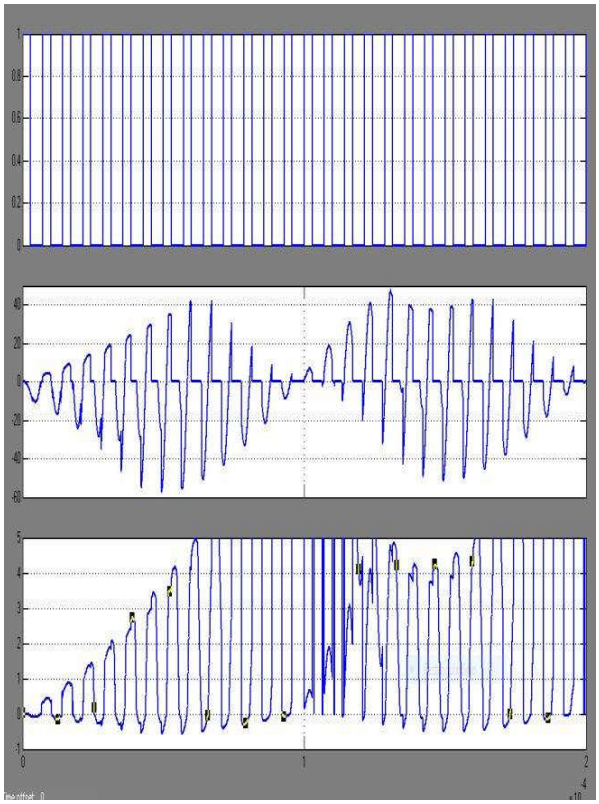

Figure 5: Ripple currents through inductors.

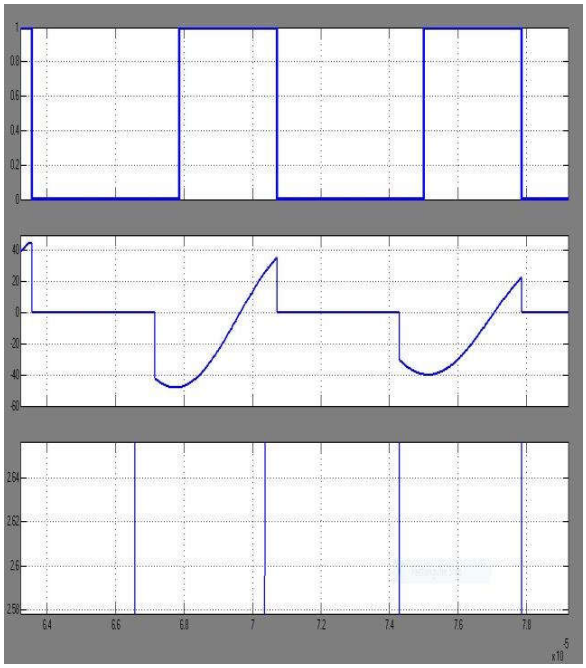

Figure 6: simulation of zoomed voltage and current waveforms

Extreme control view follower remains an electronic dc to dc converter that enhances the game between the solar collection (PV boards), then the battery bank before usefulness grid. To abode this one modestly, they alteration industrialized voltage DC manufacture afterward solar boards (formerly a infrequent wind producers) down to the mediocre voltage wanted to charge batteries.

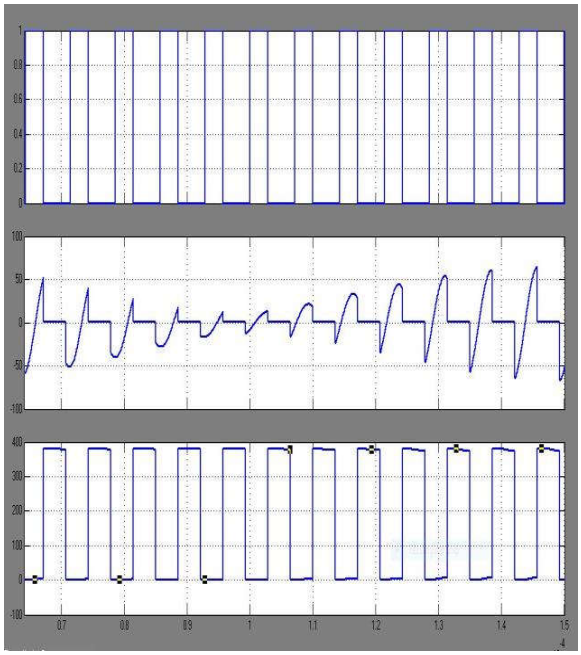

Figure 7: Simulation of Voltage & Current waveforms.

Maximum Power Point Tracking is electric tracing typically alphanumeric. The charge manager arrivals on the production of the boards formerly connect this one towards the battery voltage. It previously facts out what remains the finest power that the board can place available to custody the battery. It receipts this then changes it to finest voltage to become extreme AMPS into the battery. (Recall, it is Amplifiers hooked on the battery that sums). Greatest contemporary MPPT's remain about 93-97% well-organized in the change. You characteristically get a 20 to 45% power increase in wintertime and 10-15% in summertime. Real gain can differ extensively contingent climate, temperature, battery state of charge, and additional issues.

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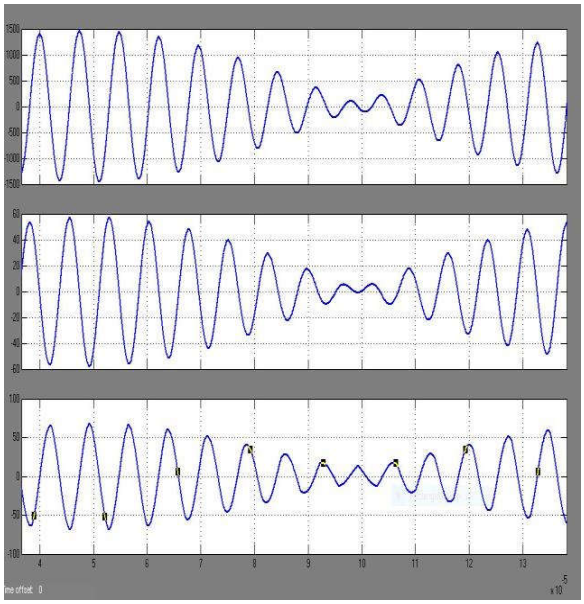

Figure 8: Voltage drop across inductors.

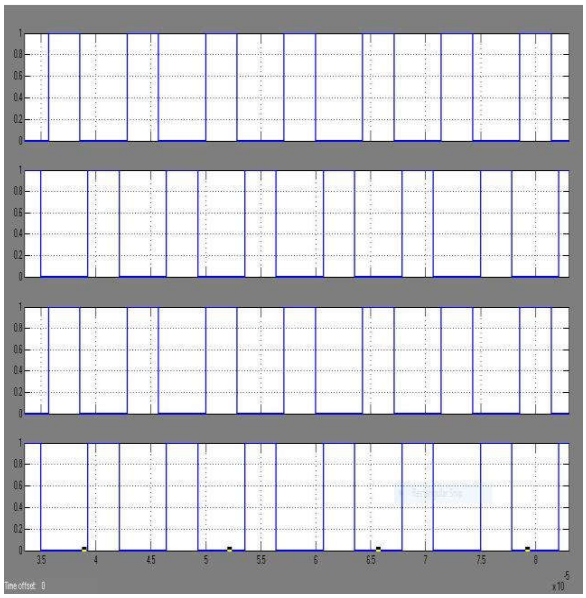

Figure 9: Simulation of Gate Pulse waveforms.

IV.CONCLUSION

The proposed snubber less DC-DC converter with bidirectional power transfer capability has forward boost and reverse buck operation. The multi-resonant tank along with the output voltage double circuit adds substantial voltage gain leading to the elimination of bulkier magnetic. Reduced switching loss by achieving ZCS in the low-voltage side and ZVS in the high voltage-side devices. The operating performances of the multi-input buck-boost dc-dc converter remained fake through continuous input powers by mutable duty percentages. The planned converter offers effectual production voltage cutting-edge buck and boost styles. It container be cast off through Ultra Capacitor, Battery, Photovoltaic arrangement, Fuel cell classification aimed at renewable liveliness requests. An advanced topology of the proposed converter is being developed in Matlab/Simulink to validate the performance and verify the operation.

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