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Modified Single Stage Bidirectional Power Conversion Converter with Hybrid Input Battery Voltage

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***Abstract*— Power converter is a kind of electronic circuits for energy conversion, which converts electrical energy of the supply into the energy suitable for the load (e.g., voltage or current with suitable frequency and/or amplitude). This paper proposed modified bidirectional converter comprises of a bidirectional DC–AC converter and an unfolding bridge, and the power conversion arrange just corresponds to a bidirectional dc–ac converter. The bidirectional DC-AC converter can perform bidirectional power conversion between the low input battery voltage and a corrected sine wave because of its step-up/down voltage guideline capacities. Proposed model is more stable and give improved result than previous.**

***Keywords*— Power, Conversion, Converter, Energy, Battery, Storage.**

I. INTRODUCTION

Today, with the development and the mass production of power semiconductors, static power converters find applications in numerous domains and especially in particle accelerators. They are smaller and lighter and their static and dynamic performances are better. A static converter is a meshed network of electrical components that acts as a linking, adapting or transforming stage between two sources, generally between a generator and a load.

Power Converter design aims at improving the efficiency. The bidirectional dc-dc converter can perform bidirectional power conversion between the low input battery voltage and an amended sine wave because of its step-up/down voltage guideline capacities. The unfolding bridge unfurls the corrected sine wave into the grid voltage and gives a current way to the grid. The investigation additionally proposes a control algorithm to manage the grid current through a single power-preparing stage. The control algorithm is involved a feed-forward ostensible voltage compensator and a dull control conspire. The feed-forward ostensible voltage compensator presets the working point to help the weight of the grid current control, and the tedious controller gives exact control of the grid current [1].

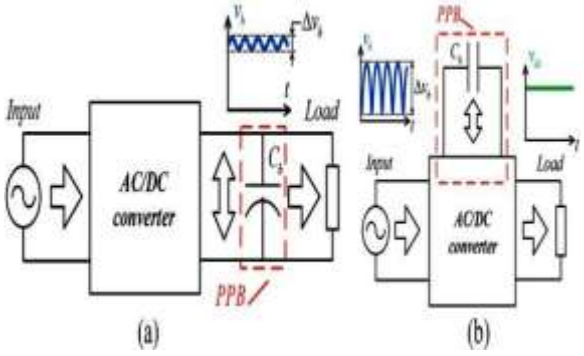

Figure 1: Power converter

Figure 1 shows power converter, the definition an ideal static converter controls the flow of power between the two sources with 100% efficiency.

The quality factor of the bandpass channel is appeared to affect the all out consonant distortion in current, major removal edge, and enduring state dc offset. The ideal estimation of a quality factor, got with help of recreations, gives a superior performance. The current drawn or infused into the grid supposedly lags the grid voltage. The purpose behind a nonunity removal power factor is investigated and a remuneration to accomplish a solidarity relocation power factor is likewise proposed in this work. Point by point reenactment and trial considers are done to approve the proposed control and the elite that can be gotten [2].

The received power hardware (a bidirectional dc-dc converter, ended by an a lot littler capacitance) closely resembles arrangements proposed state-of-the-art, the idea of activity is very extraordinary. As opposed to controlling the current, flowing into the dc connect (i.e., working as a current controlled current sink, likewise to a functioning power channel), recommended arrangement directs the wave by controlling the dc interface voltage (i.e., working as a voltage controlled current sink) consequently letting the grid-interfacing converter OFF the assignment [3]. The control system comprises of a feed-forward controller, a direct input controller with a low-pass channel, and a dreary controller.

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The advancement of the proposed control system thinks about the inalienable powerful attributes of the converter, in this way defeating the limitations on planning criticism control gains originating in right-half-plane zero and LC channel elements. Therefore, the control system guarantees wanted reference following and aggravation dismissal performances while fulfilling stability necessities. Taking everything into account, the proposed converter can accomplish high conversion efficiency through a single power conversion, and its control system makes the usage of the single power conversion in the proposed converter attainable [4]. Converter gives the soft-switching procedure to all segments working at high recurrence, allowing for an improvement in power thickness without an expense of power-conversion efficiency. Furthermore, by utilizing a novel control algorithm that controls both power factor and output power, the converter performs air conditioning dc power conversion in just a single-power-handling step [5].

II. Proposed Converter Model

The main objective is to design a simulation modelof modified bidirectional grid connected single power conversion converter. To make a solar panel and giving output to the battery input so that battery input become more reliable and stable. To useMOSFET switch instead of IGBT switch.

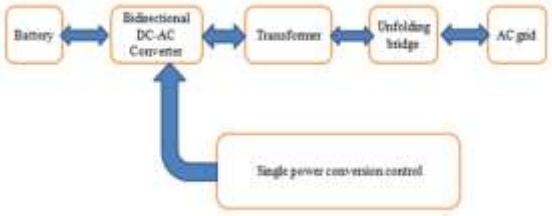

Figure 2: Existing model Flow Chart [1]

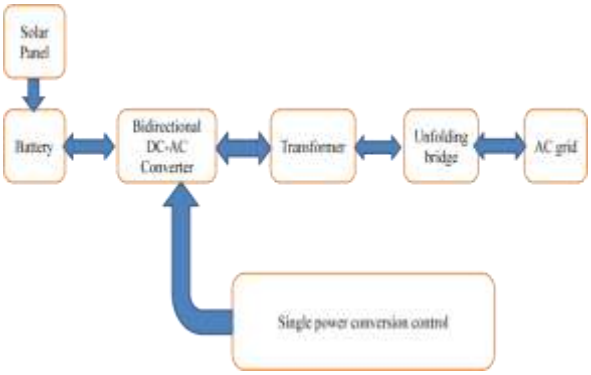

Figure 3: Proposed simulation model flow chart

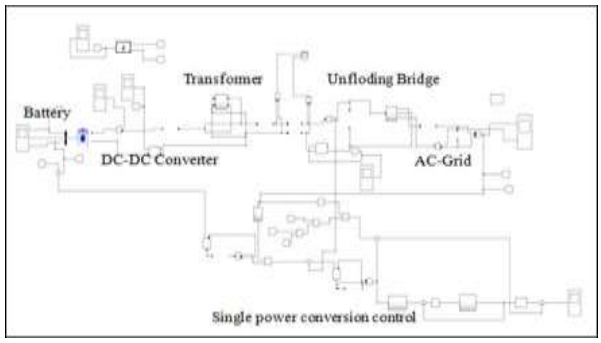

Figure 4: Existing simulation model of Power ConversionConverter [1]

Figure 4 presents the existing work simulation model, in which the power conversion converter has battery input and AC grid output and vice versa.

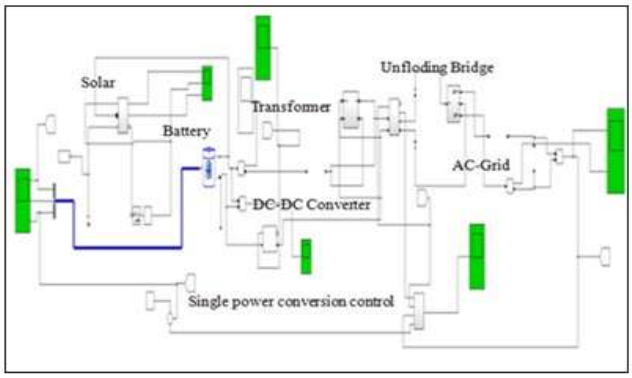

Figure 5: Proposed simulation model of PowerConversion Converter

Figure 5 shows proposed simulation model of modified bidirectional grid-connected single-power-conversion converter with low-input battery voltage. Showing proposed power conversion converter model which have hybrid voltage source is connected to the DC battery. Proposed model is made from sub models like DC-AC converter, unfolding bridge, AC grid, pulse width modulation etc. MOSFET switch uses instead of IGBT in this model. It is necessary for the proposed converter to perform bidirectional power flow control and satisfy utility interface standards, with only a single power- processing stage. The folded grid current input and output represents the power flow direction and the transferred power level. It also includes the power quality on the grid side. Thus, controlling the folded grid current input and output leads to the feasibility of single-power conversion in the proposed converter.

The main switches S p and Ss in the proposed converter operate at a significantly higher frequency than the grid frequency fg.

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Thus, the grid voltage vg can be considered as constant during the switching period Ts, and the folded grid voltage vo is assumed as the same as the absolute value of the grid voltage vg. The proposed converter only has the following two subintervals: on-state of the primary main switch Sp with off-state of the secondary main switch Ss or off- state of the primary main switch Sp with on-state of the secondary main switch Ss in both operation modes. It is assumed that the duty of the primary main switch Sp defines the primary switch duty D.

The main component of proposed model is as followings-

- Bidirectional DC-AC converter
- Unfolding bridge
- AC grid
- Single power conversion control

This power converter can be operated in five different modes:

1) Power flow from the battery to the dc grid,
2) Power flow from the dc grid to the battery,
3) Traction mode,
4) Power flow from the battery to single-phase ac grid and
5) Power flow from a single-phase ac grid tothe battery

The most significant advantage is that MOSFETs don't need current on their control pin, but require more voltage. Some don't turn on fully at 5v, some do. A BJT is limited to something like 0.3v for the lowest voltage drop on the current path, but MOSFETs are only limited by their resistance. MOSFETs are usually more efficient switches for power supplies, etc where we want a switch rather than an amplifier. FET's are only more efficient because they can be switched a lot faster and thus small SMPS can be used. MOSFETs can easily be placed in parallel; bipolars unless external emitter resistors are added.

III. Simulation Results

The MATLAB SIMULINK 8.3 version is used to implement the simulation model, it is extended model of the existing model present in the base paper [1]. This research work present the PV or solar power based dual input to the converter. In the conventional model, there are multi stages for the power conversion converter but in the proposed simulation model have only single stage to power conversion. The simulated results are shows following.

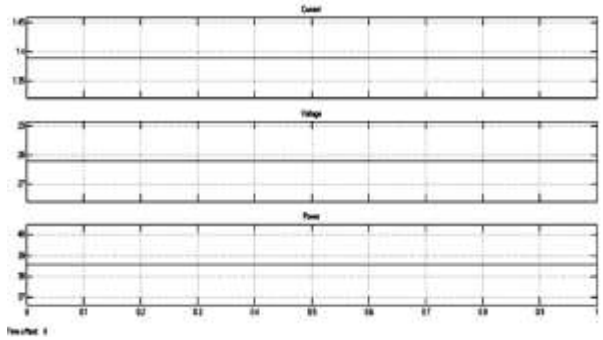

Figure 6: Solar Panel output

Figure 6 is showing solar panel output current of the simulation model, voltage and power. Therefore, according to this output graph the value of current is approx 1.4 A. The value of voltage is approx 28V and value of power is 38.5W approx.

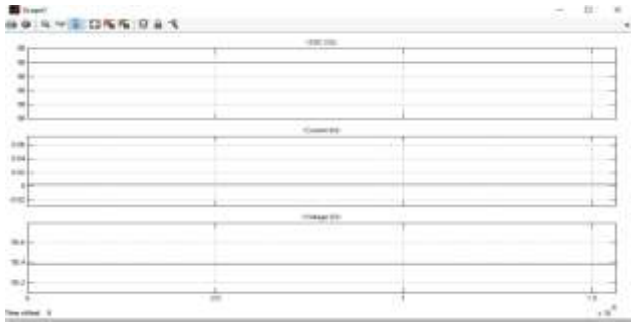

Figure 7: Battery Performance

In figure 7, it is clear that the state of charge (SOC) is 98% of battery, the value of voltage is approx 55.4V.

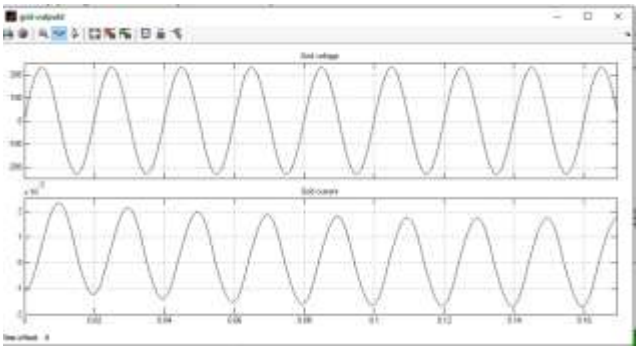

Figure 8: AC Grid outputs

Figure 8 is showing output voltage and current of applied AC grid. So the value of AC grid voltage is 220v and current value is 1.5 mA.

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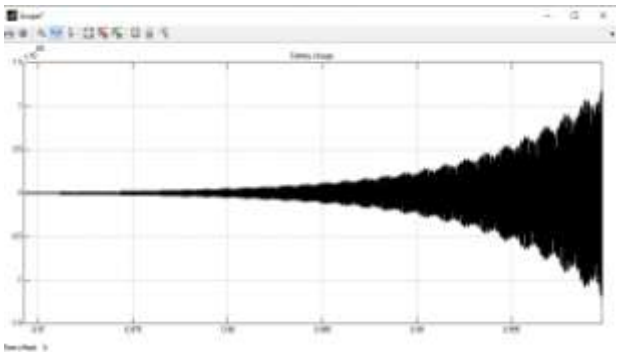

Figure 9: Battery Charges

Figure 9 shows battery charges state from input source. SOC characteristics shows the charging and discharging (i.e) It increasing means Charging and it decreasing means Discharging Also this will occurred on - Terminal voltage is lower than the battery voltage means, battery get Discharge. Terminal voltage is greater than the battery voltage means, battery will get charge.

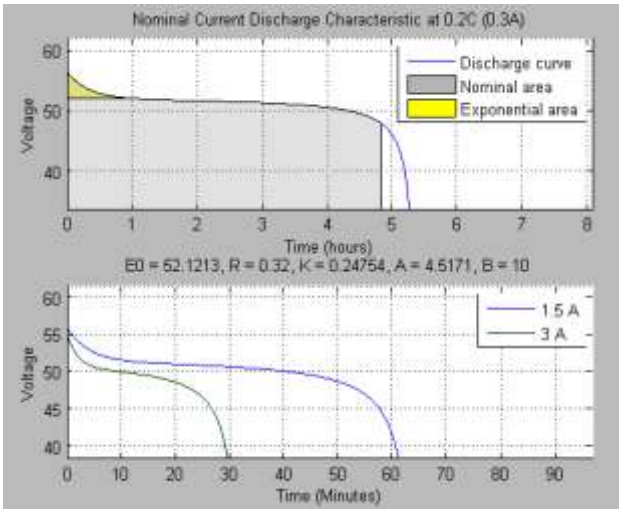

Figure 10: Battery discharge time

Figure 10 is showing the battery discharge characteristic in terms if ampere-hour (Ah) and time (minutes)

Table 1:
Result comparison

Sr No.	Parameter	Previous Results [1]	Proposed Results
1	The number of series connected 12-V battery pack	2	1-4
2	Renewable Energy Source	NA	48 Cell
3	DC-link voltage	24V	28V
4	Output voltage	220 Vrms	230 Vrms
5	Battery Voltage	48V	55.2V
6	Battery Charge	95%	98%

Table 1 showing comparison of proposed simulation model results with previous simulation design model results in terms of output voltage, rated power, State of charge etc. It is clear from the above results; proposed simulation model gives significant improved result rather than then the existing model.

IV. Conclusion

The simulation model results showed that the proposed research work involved investigating a bidirectional grid connected single-power-conversion converter with a low-input battery voltage and a control system. A single power-conversion technique was used by the proposed converter to perform bidirectional power conversion between the battery and the grid through a single-power processing stage. The simulated result shows 230V at AC grid and 55V at battery or DC output. The number of series connected 12-V battery pack in the previous paper is 2 while in the proposed work it is 1-4. The renewable energy source i.e PV number of cell is 48. The DC-link voltage of the previous work is 24Vwhile proposed work achieved 28V. The state of charge of the battery is 98% in the proposed work while previous it is 95%. Therefore the proposed work is giving the improved simulation results in this research.

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