Bidirectional DC-DC Converter with Grid Connected Multi-Array PV/Batteries

Kritika Sahu¹ Anand V. Bakshi²
¹²Department of Electrical and Electronics Engineering
¹²CSIT Durg, CG, India

Abstract—The suggested system is designed to meet load demand, control power flow from various sources, inject excess power into the grid, and charge the battery from the grid as needed. To capture electricity from PV and manage battery charging and discharging, a bidirectional buck-boost converter is employed. For ac load feeding and grid interface, a single-phase full bridge bidirectional converter is utilized. In comparison to existing grid-connected hybrid systems, the suggested converter architecture features fewer power conversion stages, fewer components, and lower losses. This increases the system's efficiency and dependability. A bidirectional photovoltaic battery-based multi-array dc to dc converter for residential usage is suggested. The suggested method is an elegant approach to connect numerous arrays to a grid utilizing PV sources to get the most energy out of them. A standard full-bridge inverter is used after a unique multi-input transformer coupled bidirectional dc-dc converter. A flexible control method is provided for higher PV power consumption, battery capacities without affecting battery life, and power flow management in a grid-connected PV battery-based system serving ac loads. To determine the scheme's feasibility, detailed simulation studies are conducted. The experimental results are consistent with models and support the demonstration of the system's capacity to function in either grid feeding or stand-alone mode. The suggested arrangement can provide uninterruptible power to ac loads while also ensuring that surplus solar electricity is discharged into the grid.

Keywords: PV Battery, Multi Array, Grid, DC-DC Converter

I. INTRODUCTION

AC energy systems are an extremely efficient transmission and distribution method. The emergence of a slew of dispersed energy resources, notably renewable energy generation with a DC output, DC grids are required for the most efficient operation. However, energy is required at the consumer level for products such as battery chargers. The DC voltages are directly responsible for led lights, electrical appliances, and so on. As a result, DC is required for greater power distribution. As a result, solar PV as a source with segregated DC grids in remote locations is preferable than expanding AC networks to the site [1]. [2] summarizes the DC solar micro grid issue and benefits. [3] Describes a segregated grid with a power range of 200W to 600W. The difficulties of micro grids are outlined and explored in [4], and [5], which covers many elements of micro grids, including distribution, local, and central power management units, as well as performance. The DC bus is the most crucial component of the DC micro grid. In a micro grid, a DC bus keeps the voltage constant. Due to solar power, changes in input power result in changes in bus voltage. The voltage on the bus as needed, it can be adjusted in response to changes in load power. Bus voltages must be closely monitored in order to provide loads at the rated voltage. Sliding mode control, self-tuning control, recursive identification process, and small variance control are some of the sophisticated control techniques outlined in [10]. The LED is powered by an AC source. Power factor adjustment and the usage of electrolytic capacitors are examples of this [11]. These may be totally removed by utilizing a DC-powered LED. [11] And [12] explain the bidirectional converter layout and control over. [13] And [14] describe the architecture of a DC to AC bidirectional converter that makes it easier to connect to the AC grid. In [15], [16], the operation of the transformer less inverter with solar PV systems is addressed. The use of rooftop solar panels to charge electric cars was discussed in [17]. These articles describe how the DC bus voltage was controlled along the transmission line. Using the battery as both an energy source and a drain, the tolerance level may be increased. A bidirectional buck and boost type DC to DC converter is used to connect a battery to a DC bus. The combination of a buck and boost DC to DC converter is employed. The bus voltage is 60V, while the battery voltage is 24V. Both the buck and boost actions were handled by two separate PI controllers. The bus voltage determines whether the buck or boost operation is used. The logic circuit alternates between buck and boost modes. The battery is connected to the converter's lower voltage side and the DC side. The bus is connected to the higher-voltage side. When the DC bus voltage reaches a safe level, the controller charges the battery from the DC bus, enabling buck mode. When the bus voltage falls below the nominal value and the DC bus power situation is mutual from the battery, the boost mode is activated.

II. METHODOLOGY

Simulink representation of the system (Fig. 2.1). The main power point tracking block is a capacitor. MPPT is the MPPT block. A photovoltaic block would be used to remove a significant amount of power. The output from the primary power point tracking the block is sent via a boost converter, which increases the amount of power gained. via way of the PV cells. The converter has been charged with power through a boost converter. The sounds would be filtered out by the converter using the power charge signal. That the converter would increase the signal until it became a signal that could be used as an input supply to a larger system. The charge from a converter is transferred to a battery system, which stores the charge from the PV array. The grid connectivity mechanism is then set up. After obtaining a supply from the voltage source controller and being connected to the grid, the universal bridge would fire.
Bidirectional DC-DC Converter with Grid Connected Multi-Array PV/Batteries
(IJSRD/Vol. 9/Issue 10/2021/030)

Fig. 2.1: Simulink model of the system

Grid connected with PV-wind-battery based on primarily system for house devices, which will operate in full or grid connected mode. This procedure is appropriate for home devices where a low-cost, simple, and compact topography is required. It's fascinating to watch an autonomous process. The suggested system's core is a multiple input electrical system with a two-way dc to dc converter that connects diverse power sources and therefore this storage component. The electrical appliances are connected to a boost dual half-bridge and two-way system that is integrated with a two-way buck and boost converter and a single phase full-bridge electrical converter in this suggested system. In comparison to existing grid-connected structures, the suggested system has a lower number of power conversion stages, a lower part count, and a higher potency.

Fig. 2.2: Block diagram of the proposed system

The topography is straightforward, and just the six power switches are required. The Boost dual half-bridge system features two dc links on either side of the higher frequency electrical device, with one of the dc links providing the operator with the highest voltage. As a result, strategy management becomes easier. Other converters, on the other hand, are commonly used with any two dc connections. Through the first face dc link, the two-way buck and boost dc to dc converter is included, and the single phase full-bridge and two-way appliances are connected to the dc linked with a secondary face. Almost all of the process's objectives are as follows:

1) To get a clean and cost-effective energy supply from renewable energy sources, therefore reducing all environmental pollution and energy reliance.
2) To empower hundreds of people.
3) To break down the number of power conversion processes and validate the emigration of surplus power to the grid via two renewable resources, as well as the requirement for a grid. The system's block diagram is depicted in Fig. 2.2.

III. RESULT

A. Battery Storage:
The solar cell's charge is stored in the battery. The battery's stored voltage and current charge are depicted in the diagram below.

Fig. 3.1: Battery storage voltage (V) and current (A) vs time plot

B. VSC Voltage and Current:
The power is reversed by reversing the current polarity in a voltage source converter, which transforms DC into AC with one polarity of dc voltage. As depicted in Fig. 3.2.

Fig. 3.2: VSC output

C. Grid Power:
An electrical grid, also known as an electric grid or power grid, is a network of linked power lines that transport energy from generators to consumers. It consists of the following components: generating stations for the production of electricity Stepping electrical voltage up for transmission or down for distribution in electrical substations Transmission lines carrying electricity from distant sources to demand centers at high voltages Individual customer-to-customer distribution lines to Grid Electricity Fig. 3.3.

Fig. 3.3: Grid Power
IV. CONCLUSION
The efficacy of a novel type of high ratio transformer less step-up dc-dc modular multilevel converter is demonstrated in this paper. It demonstrates how multilevel converters may be used to connect low-voltage non-conventional energy sources to a medium-voltage dc grid, such as solar PV systems. The suggested converter's ability under medium voltage settings was demonstrated using detailed MATLAB-Simulink simulations. It is apparent through simulation and study of the findings that Renewable energy foundations may be staged up to almost 10 times the input value, which is not only desired, but also possible and practicable.

V. FUTURE SCOPE
The upcoming investigate possibilities are:
1) The research area would be urbanized in order to verify the efficacy of the proposed controllers for an unbiased PV scheme.
2) The expected labor will be total by focusing on the efficiency of the web to trade power from PV to net and vice versa.
3) A highly developed organization policy comparable to descending approach control would be used to the organization dynamics in order to increase the structure's resistance to constraint amendment and structure disruption.
4) Micro spring numbers are linked together to form a micro grid outline. Our outlook investigation is the load contribution between the sources.

REFERENCES
[18]Himadry Shekhar Das, Chee Wei Tan, A.H.M. Yatim, Kwan Yiew Lau, “Feasibility analysis of hybrid photovoltaic/battery/fuel cell energy system for an...


