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IMPLEMENTATION OF TWO STAGE CONVERTER FOR ISOLATED PV SYSTEM

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Abstract: In places without a grid, standalone solar PV systems have come to be seen as viable solutions to electrical issues. When creating these devices, it is quite challenging to get a photoelectric system, DC-DC inverter, DC-AC converter, and control system to operate at maximum capacity. In this study, a boost converter, an inverter, and batteries with a bidirectional converter are introduced as a freestanding two stage method. In order to modify the inverter output, a unique virtual synchronous generator (VSG) controller is created and put into practise in this study. To regulate the inverter output and realise the maximum power of the PV system, the VSG element and the maximum power point tracking (MPPT) are utilised in this study. Extensive MATLAB simulations were implemented to verify and evaluate the new control strategy design in a variety of scenarios, including load fluctuations. With the help of several MATLAB simulations, the system output was assessed. Console testing was used in a hands-on experiment for the VSG. We were unable to test the full system since the laboratory lacked the necessary tools.

Keywords: MPPT, DC-DC boost converter, PV array, virtual synchronous generator.

I. INTRODUCTION

PV systems are increasingly being used as distributed generators worldwide because they are environmentally sustainable and clean. PV panels are now much more affordable; however, they mainly use DC power, which is unstable. Therefore, DC-DC or DC-AC conversions are necessary before the PV signals may be sent to the output load or connected to the grid power. However, as PV power is unreliable, standalone PV systems require a component for energy storage, which is typically carried out by a battery bank.

Due to the changeable nature of the source and condition under the load or grid specification demand, PV supplies change over time. The two processes used to integrate solar energy with the load or grid are one-stage and two-stage processes. The first approach uses inverters to convert DC to AC in accordance with the demands of the load. The second, however, inverts the DC voltage generated by the PV cells into AC as needed after the first has been boosted.

Recent research on freestanding two-stage grid converter topologies has been scarce. It had been demonstrated how to operate a two-stage single-phase PV system without batteries in a self-supporting arrangement. The method of operation may successfully offer stand-alone power without the need for batteries, according to the authors' observations.

II. EXISTING SYSTEM

In Existing system, a Boost converter is used for the voltage regulation. The power from the panel is given to the boost converter and the boost converter is connected to the inverter for AC Supply to the load. It is not efficient and does not give constant voltage regulation.

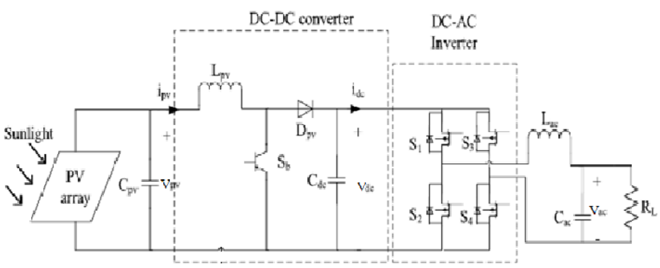

Fig. 1. PV System using boost converter

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III. PROPOSED SYSTEM

A. MAIN CIRCUIT:

A two-stage converter's schematic is shown in the picture. It is seen that the load is supplied by a storage unit, a DC-DC and DC-AC converter, as well as a PV power source through a bidirectional converter. The two stages' control systems are also included in the system.

B. PV ARRAY:

Solar PV arrays are made by connecting solar PV modules in parallel and series configurations to increase power output. The PV array in this article contains four series and six parallel rows. Panels having a 5 kW total input capacity. The given table displays the characteristics of the solar module.

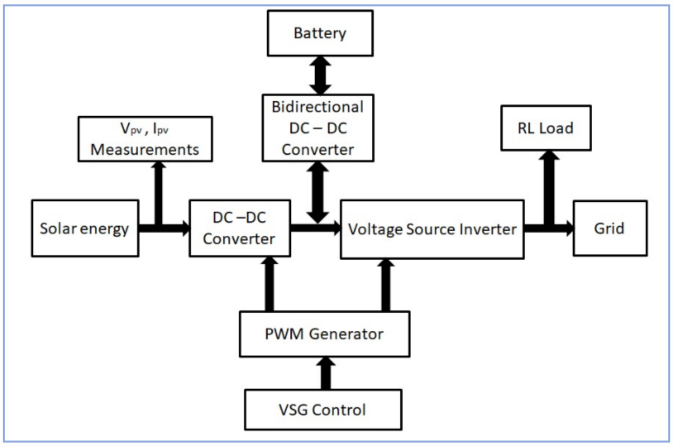

Fig. 2. PV System using two-stage converter with VSG control

C. DESIGN OF THE CONVERTER DC-DC:

For the purpose of obtaining the requisite voltage, a boost converter is used.

The design specifications are defined as follows:

Input voltage V_{in} = 100 to 150 V,
Switching frequency f_{sw} = 5 kHz,
Output voltage V_{out} = 500 V_{dc},
Rated power P = 5 kW,
Current ripple **Δ**I = 5%, voltage ripple **Δ**V = 1%.
Then, I_{in} = 33 to 50 A and **Δ**I = 1.65 to 2.5.

The inductance and capacitance is calculated as:

$$L = \frac{Vin(Vout - Vin)}{fsw * \Delta I * Vout}$$

=6.4 to 12.7 mH

$$C = \frac{Iout(Vout - Vin)}{fsw * 1V * Vout}$$

= 280 to 320 µF

Quantity	Value
Module power	213.15 W
Module voltage	29 V
Module current	7.35 A
Open-circuit module voltage	36.3 V
Short-circuit module current	7.84 A

Table. 1. Characteristics table

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IV. CONCLUSION

In the study, two-stage converter PV systems with a battery unit are suggested. The suggested control technique employs VSG control and MPPT algorithms. A bidirectional converter control is also provided. The rapid and responsive control capabilities of the suggested approach enabled the combined control to successfully track under diverse irradiation circumstances. The bidirectional battery approach demonstrates that the control of battery modes also has greater control capacity, in addition to the positive impacts on the entire system and the combined control performance tests. An investigation of the MPPT control's efficiency was performed. The control effectiveness of the MPPT system is 99%. The experiment demonstrated that the frequency dynamics are significantly enhanced by an increase in inertia. This indicates that VSG is able to accurately and faithfully simulate a synchronous generator.

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