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MAXIMUM POWER POINT TRACKING OF PHOTO VOLTAIC SYSTEM BASED ON A SINGLE ENDED PRIMARY INVERTER CONVERTER USING SLIDING MODE CONTROLLER

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ABSTRACT

This manuscript proposes the Maximum power point tracking (MPPT) process of Photovoltaic system based on a Single Ended Primary Inverter Converter (SEPIC) .this dissertation intends to remedy this issue the handling of a voltage controlled converter that performs as a shunt controller, improving the electrical energy first rate in case of tiny voltage plunges and within the presence of nonlinear loads. Shunt controllers might be employed as a static var generator in favor of alleviating and improving the voltage profile in energy systems and to balance modern harmonics and unstable load current. This paper provides a distinct segment photo voltaic device that gives grid voltage assist and compensation of harmonic deformation at the point of not unusual coupling approach to a repetitive controller. In this article, the photovoltaic inverter now not simplest materials the strength produced by means of the photovoltaic panels but additionally improves the voltage profile. The offered topology adopts a repetitive controller that is capable of compensate the selected harmonics. Most of the maximum latest maximum power point tracking algorithms, an algorithm based totally at the incremental conductance approach has been chosen. It's been changed with a view to don't forget strength oscillations at the photovoltaic facet, and it controls the segment of the photovoltaic inverter voltage. The designed photovoltaic system offers grid voltage aid at essential frequency and compensation of harmonic distortion on the point of common coupling. An inductance is brought on the grid side so as to compose the grid mainly inductive.

KEYWORDS: *MPPT (Maximum Power Point Tracking) algorithm, sliding mode controller, PHOTO VOLTAIC (photovoltaic) cells, distributed power generation system (DPGS), shunt controller, P & O, phase-locked loop (PLL)*

I.INTRODUCTION

Solar power is the maximum readily to be had supply of energy and it's far unfastened. Furthermore, solar power is the exceptional amongst all of the renewable energy resources in view that, it's far non-polluting [1]. Energy furnished via the sun in one hour is identical to the quantity of strength required by way of the human in 365 days. Photo voltaic arrays are used in lots of applications along with water pumping, road lighting fixtures in rural city, battery charging and grid related photo voltaic structures. solar power is amply to be had that has made it viable to reap it and put it to use properly[2].

The Single Ended Primary Inverter Converter (SEPIC) working as a buck enhance dc-dc converter, wherein its output voltage receives varied as in line with its duty cycle. It's very crucial to pick out the proper dc-dc converter which plays critical role for optimum strength factor tracking operation. There are many elements such as price, performance; flexibility and power glide which might be taken into consideration for selection of proper photo voltaic converter. The Maximum Power Point Tracking is one of the mainly imperative functions of a system that methods the power produced by way of a photovoltaic generator. It is essential to layout a controller this is able to set the value of voltage or modern-day of the generator and continually make certain the operating within its maximum power factor. This point can notably change its position at some stage in the day, essentially because of weather versions, then sunshine and temperature. So, the monitoring manager of the maximum power point is a complex trouble, to conquer those troubles and make certain the excessive efficiency of the photo voltaic device, unique solar regulators based on several Maximum Power Point Tracking approaches have been developed, inclusive of fractional open-circuit voltage (FOCV), fractional short-circuit current (FSCC), perturbation and observation (P & O) and incremental conductance algorithms.

Distribution networks are not as much of vigorous as transmission networks, and their consistency, since of the radial configuration, drop off as the voltage level reduces. Because of this, photo voltaic structures connected to low-voltage grids need to be designed to conform with these requirements but can additionally be designed to enhance the electrical machine, subsequently, they could contribute to enhance the distribution grid, preserving proper first-class of deliver that avoids additional investments. however, low-voltage distribution lines have a especially resistive temperament, and when a DPGS(distributed power generation system) is attached to a low-voltage grid, the grid frequency and grid voltage can't be controlled with the aid of independently adjusting the energetic and reactive powers [3][4].

This paper proposes to resolve this issue the use of a voltage managed converter that behaves as a shunt controller, enhancing then voltage eminence in case of tiny voltage dips and in the existence of nonlinear masses. Shunt controllers may be employed as a static var generator for steady and enhancing the voltage report in energy systems and to reimburse current harmonics and unstable load current [5]–[7]. In this manuscript, the Photo Voltaic inverter not just stores the energy formed by the photo voltaic panels but moreover develops the voltage profile, as already noted out [8]. The existing topology implements a monotonous controller [9]–[11] with the purpose of capable to compensate the preferred harmonics. Among the mainly modern Maximum Power Point Tracking algorithms [12], an algorithm support on the incremental conductance scheme has been chosen [13]–[15]. It has been adapted in order to acquire into report power oscillations on the Photo Voltaic plane, and it manages the phase of the Photo Voltaic inverter voltage. The exploit of the most modern power control method entitled the Maximum Power Point Tracking algorithms has guide to the boost in the efficiency of process of the solar elements and as a result is effectual in the field of exploitation of renewable sources of power.

II. PROPOSED SYSTEM

In case of low-power applications, it could be tremendous to use the converter this is parallel connected to the grid for the reparation of tiny voltage sags. This selection may be considered as an ancillary service that the method can afford to its limited loads. The projected Photo Voltaic converter controls by providing active and reactive powers while the sun is presented. At low irradiation, the Photo Voltaic converter simply works as a harmonic and reactive energy compensator. It is complicated to develop the voltage eminence with a shunt controller given that it cannot give concurrent control of the output voltage and current. Similarly, a huge-rated converter is essential to be able to compensate voltage sags. But, this topology is appropriate in photo voltaic applications while the photo voltaic shunt converter have to be rated for the peak energy generated by the panels. in the proposed method, the photo voltaic converter works as a shunt controller; it is associated to the load all the way through an LC filter and to the grid during an additional inductance L_g of 0.1 pu, as shown in fig 1

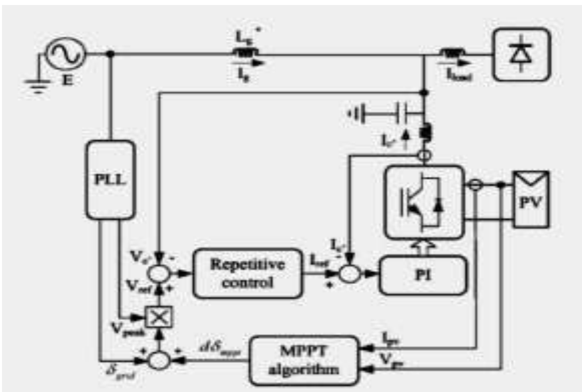

Fig1. Grid connected Photo Voltaic arrangement with shunt controller.

Generally, in case of low-power applications, the structures are attached to low-voltage distribution lines whose impedance is normally resistive. Though, in this projected topology, the grid be capable of considered primarily inductive on account of L_g adding together on the grid side. But, since the voltage regulation is without delay exaggerated by the voltage plunge on the inductance L_g, it isn't always convenient selecting an inductance L_g of peak value to be able to limit the voltage fall throughout grid normal conditions. It shows the major disadvantage of the projected topology.

The projected converter is voltage controlled by a repetitive algorithm. An Maximum Power Point Tracking algorithm changes the phase dislocation amid the grid voltage and the ac voltage formed as a result of the converter in order to force it to infuse the most available energy within the given atmospheric conditions. Consequently, current injection is obliquely managed. The amplitude of the current relies upon at the difference among the grid voltage and the voltage at the AC capacitor Vc . The phase displacement among these two voltages resolves the injected active power which is determined with the Maximum Power Point Tracking algorithm, and the voltage amplitude variation find out the reactive energy switch over with the grid. The instilled reactive power is restrained through the reality that a voltage plunge advanced than 15% will vigor the photo voltaic structure to disconnect. The dynamic power is restricted through the photo voltaic system evaluation and ends in a limit lying on the highest displacement angle dδ Maximum Power Point Tracking. Furthermore, the inverter has its internal proportional integral PI -based current control loop and more current protections. A phase locked loop perceives the amplitude V_{peak} and phase δ_{grid} of the grid voltage.

MPPT Technique

Maximum power point tracking algorithms are essential in photo voltaic applications because the Maximum power point of a solar plate varies with the irradiation and high temperature, so, the use of Maximum power point tracking algorithm is mandatory in order to acquire the highest power from a solar arrangement. The P & O method is one of the most commonly used methods in practice, it is operate by periodically perturbing, i.e., incrementing or decrementing, the array terminal voltage and comparing the photo voltaic output power with that of the previous perturbation cycle. If the photo voltaic array operating voltage changes and power increases, the control system moves the photo voltaic array operating point in that direction. Otherwise, the operating point is moved in the opposite direction, Fig. 2 demonstrates the principle of the P & O algorithm.

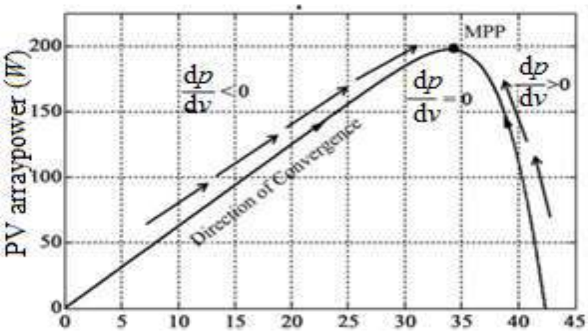

Photo Voltaic array voltage (V)

Fig. 2 Principle of P and O algorithm

A flowchart of the Maximum Power Point Tracking algorithm is shown in Fig.3, explaining how the angle of the reference voltage is modified in order to keep the operating point as close to Maximum Power Point as possible. The Maximum Power Point can be tracked by comparing the instantaneous conductance I_{pvk}/V_{pvk} to the incremental conductance dI_{pv}/dV_{pv}, as shown in the flowchart. Considering the power vs voltage characteristic of a photo voltaic array, it can be observed. That, operating in the area on the left side of the Maximum Power Point, dδ mppt has to decrease. This decrement is indicated in Fig. with side = −1. Moreover, operating in the area on the right side of the Maximum Power Point, dδ mppt has to increase, and it is indicated with side =+1. The increment size determines how fast the Maximum Power Point is tracked. The measure of the power oscillations on the photo voltaic side is used to quantify the increment that is denoted with incr in Fig.3

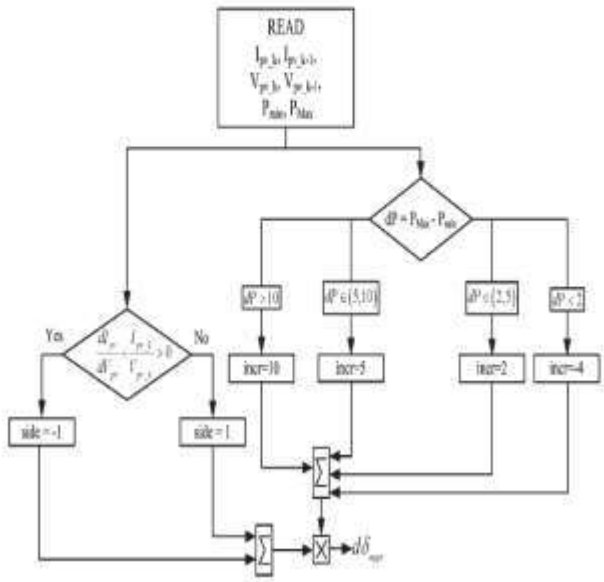

Fig 3. Flowchart of the modified Maximum Power Point Tracking algorithm.

Single ended primary inductor Converter SEPIC

Single ended primary inductor converter is a kind of dc to dc converter permits the potential energy on its output either to be greater than(>) or less than(<) or equal(=) to that its input, and the output of the Single ended primary inductor converter is constrained by the duty cycle of that control transistor. These Single ended primary inductor converters are helpful in applications in which a battery power can be above and below that of the regulator's proposed output.

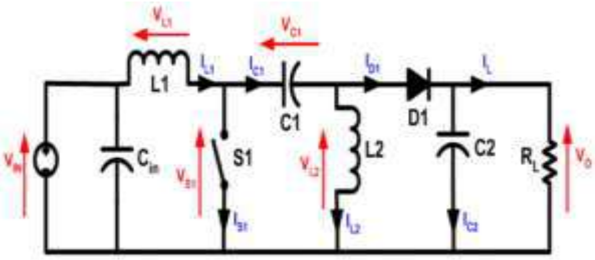

Figure 4. Schematic representation of a Single ended primary inductor Converter

Fig 4 explains the schematic representation of a Single ended primary inductor converter, like by additional switched mode power supplies particularly dc to dc converters, the Single ended primary inductor converter interactions power among the capacitors & inductors in order to translate from one voltage to another voltage. The quantity of power translated is controlled by using switch S1, which is usually a transistor such as a MOSFET.

MOSFETs recommend much greater input impedance and lesser voltage fall than bipolar junction transistors, and do not entail biasing resistors as MOSFET switching is operated by variations in voltage relatively than a current, as with BJTs number of switches.

III. SIMULATION RESULTS

The Photo Voltaic structure with power quality conditioner functionality has been analyzed in the simulation by the subsequent system parameters- the LC filter prepared by 1.4 mH inductance, 2.2 μF capacitance, 1 Ω damping resistance and an inductance Lg of 0.1 pu, & a 1-kW load. The control has been authorized in the existence of impulsive transforms of the Photo Voltaic energy power caused, for e.g., with irradiation deviations. The reported analyses illustrate the performance of the Maximum Power Point Tracking for voltage drop. The end results submit to the case of a controlled inverter in array to gather the maximum obtainable power (that is 2 kW). The controller parameters are kFIR = 0.3, N = 128 (sampling frequency fs = 6400 Hz), Na = 0, kp = 4.5, and ki = 48. The set of analysis intends to exhibit the behavior of the structure through voltage droop and the communication of the voltage control algorithm with the Maximum Power Point Tracking algorithm.

The simulation consequences, shown in Figs 5, are attained in case of a voltage plunge of 0.15 pu.

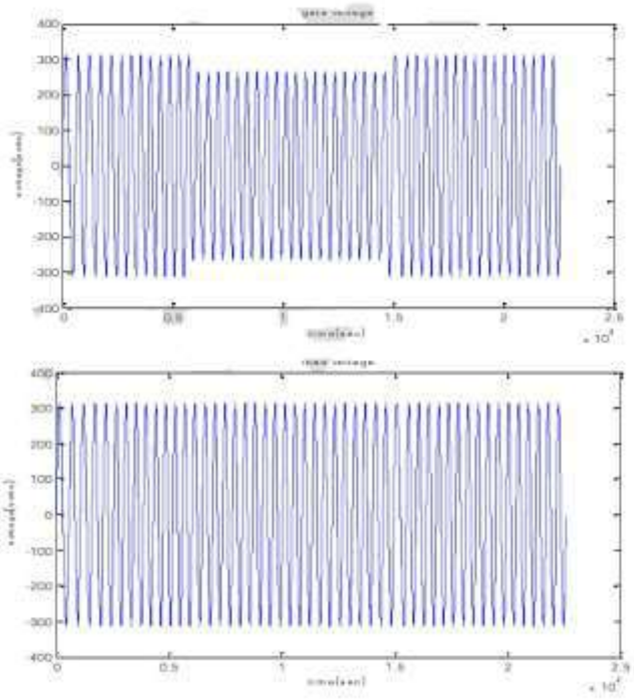

Fig 5(i). Performance of the voltage controlled shunt converter with Maximum Power Point Tracking algorithm- grid voltage E and load voltage V_{load}

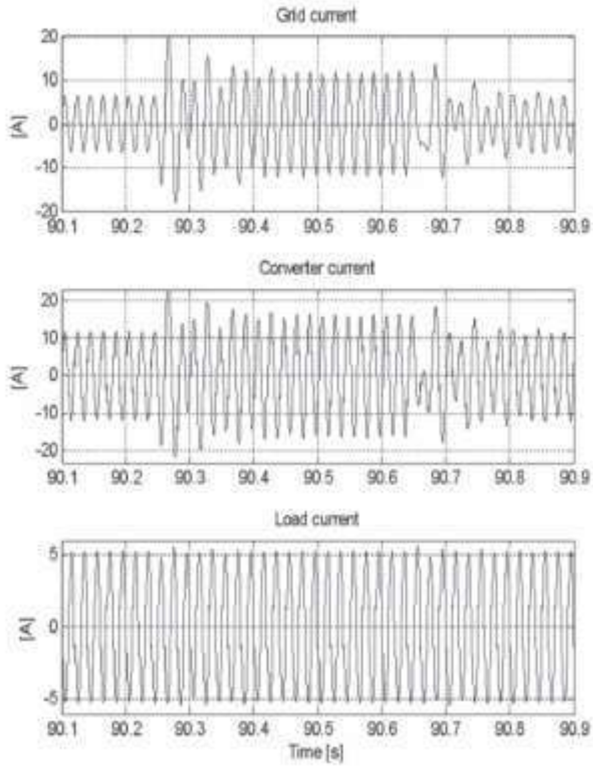

Fig.5 (ii) Performance of the voltage controlled shunt converter with Maximum Power Point Tracking algorithm- grid current I_g, converter current I_c and load current I_{load}

IV. EXPERIMENTAL ANALYSIS

In order to validate the earlier tests, various experiments have been conceded out on a laboratory setup to check the recital of the photo voltaic structure with shunt controller functionality. The hardware system consists of the subsequent apparatus- a Danfoss VLT 5006 7.6-kVA inverter (whose merely two legs are employed), two series linked dc voltage sources to replicate the photo voltaic panel string & the dSPACE 1104 system.

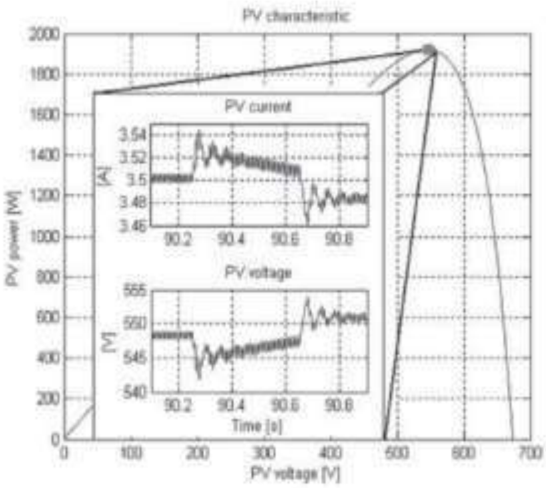

Fig.7 Power and voltage characteristic of the photo voltaic array and current - voltage on the photo voltaic side in the existence of a grid voltage droop of 0.85 pu.

A. Voltage droop Compensation

The machine has been checked in the tracking conditions that is dc voltage V_{dc} = 460 Volts. The results received in the simulation in the case of voltage droop of 0.15 pu are experimentally confirmed. For the period of the dip, the load voltage stays constant and identical to the preferred voltage. The shunt associated converter infuses a reactive current inside to the grid in array to give back the load voltage. The current is principally capacitive.

B. Analysis with Solar Panel Simulator

This segment proves the potential of the device to compensate a voltage plunge while the inverter is fed by two photo voltaic systems coupled in parallel. In detail, the 2 dc voltage sources utilized in the laboratory to provide for the inverter had been operated by software that implements the photo voltaic voltage and current characteristics as a characteristic of irradiance. The experiment has been performed considering a predetermined power value of 700 W and a voltage plunge of 0.15 pu happening for 1.5 s.

V. CONCLUSION

In this manuscript, a Sliding Mode Controlled SEPIC for Photo Voltaic MPPT Applications has been presented. The photo voltaic converter is voltage controllable by a repetitive algorithm. An MPPT algorithm has mainly been intended for the proposed voltage controlled converter. This is mainly focused on the incremental conductance process and it's been adjusted to modify the phase displacement among the grid voltage and the converter voltage exploiting the power extraction from the photo voltaic plates. The considered photo voltaic device gives grid voltage assist at fundamental frequency and recompense of harmonic distortion on the point of general coupling. An inductance is supplemented on the grid surface that allows you to make the grid primarily inductive (it can represent the major disadvantage of the proposed system). Experimental results verify the legitimacy of the proposed solution in case of voltage plunges and nonlinear loads.

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