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# Performance of Distributed Power Generation System using MPPT

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**ABSTRACT**: In this paper, non-conventional energy sources are employed for grid-connected distributed power generation system (DPGS) to maintain the continuous power output. Based on the input power generated by the wind or solar cell, the grid power is maintain the constant AC supply. The maximum power point tracking (MPPT) techniques are employed in the source side, the source voltage are fed to the controller, based on the source voltage the controller adjusts the duty cycle of boost chopper switches. This boost DC voltage are given as an input for single phase inverter, hence the grid power is maintain constant. The performance of DPGS using wind and solar was carried out using MATLAB/Simulink software.

**Keywords:**DC-DC Converter; Maximum power point tracking (MPPT); Wind and Solar power; DPGS.

## I.INTRODUCTION

The distributed power generation systems (DPGSs) based on non-conventional are no longer regarded as one of the engineering challenges but as a potential player that can have a major part to the entire energy production worldwide. In the last decade, exponential growth of both wind turbines (WTs) and photovoltaic (PV) power generation systems is registered. The controllability of the input power for both wind and PV is a main issue to be measured when these systems are linked to the utility system. Due to the great diffusion of renewable systems in some of the European countries, more inflexible interconnection demands are requested by the power system operators.

The power quality and robustness to the grid voltage and frequency variations are two of the main points demanded in the latest issues of grid codes for WTs in Germany, Denmark, and Spain. Due to the grid fault condition, there is a large interest in studying the control capabilities of distributed network. To fulfil the grid demands and power quality issues, DPGS problem was concern majorly [2]. Because the demands are harsher in the Wind case, focus is set on these systems fairly than PV systems. First DPGS general task and describes the control structure. Second, the grid converter control is analysed in detail, and possible control loops and considerations in case of grid faults are given. Further on, the considered controllers are investigated and evaluated in terms of power quality, input power variations, and low-voltage grid ride-through. In the development of e industry and human sophistication are also improving hence the power demand are increase day by day. But the fossil fuel quantities are reducing day by day. The available conventional sources may sufficient another 100 year, after that world become dark. Hence we are moving to non-conventional sources also it's a solar power generation system, the solar energy converted into AC supply by boosting the solar output then given to VSI.

This can be achieved with help of chopper and inverter by available power switches like IGBT, MOSFET. The energy that a switching power converter delivers to a grid is controlled by Pulse Width Modulated (PWM) signals applied to the gates of the power transistors [4]. PWM signals are pulse trains with fixed frequency and magnitude and variable pulse width. When a PWM signal is applied to the gate of a power transistor, it causes the output voltage of the inverter to vary according to its turn on time. The inverter converts DC power to AC power at the required frequency and amplitude. The inverter consists of six power MOSFETs that turn on and off in a desired pattern to produce single phase AC output voltage. The control IC is programmed and implemented in controller to generate PWM gating pulses for the MOSFETs.Analog control scheme possesses the advantage of fast dynamic response, but suffers the disadvantages of complex circuitry, limited functions, high cost, low processing speed and difficulty in circuit modification [3]. The rapid development in high-performance low-cost controllers has encouraged research on digital

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PWM control technique [1]. This control scheme has the advantages of simple circuitry, software control, and flexibility in adaptation to various applications.

## II.POWER GENERATION (DPGS) OVERVIEW

A common arrangement of a distributed generation system is shown in Fig 1. Depending on the input power nature, i.e., hydrogen, wind and sun frequent hardware configurations are possible. In this paper, a system having a back-to-back converter arrangement is considered. In this condition, there is a controller in input side that controls the input side converter and a grid side controllerthat takes care of the DPGS communication with the utility grid. In this project Solar and wind has been taken for power generation. One of the foremost tasks of input side controller is to pull out the maximum power from the input power source and to send out this to the grid side controller. In the case of grid failure, this controller should also care for the input power source.

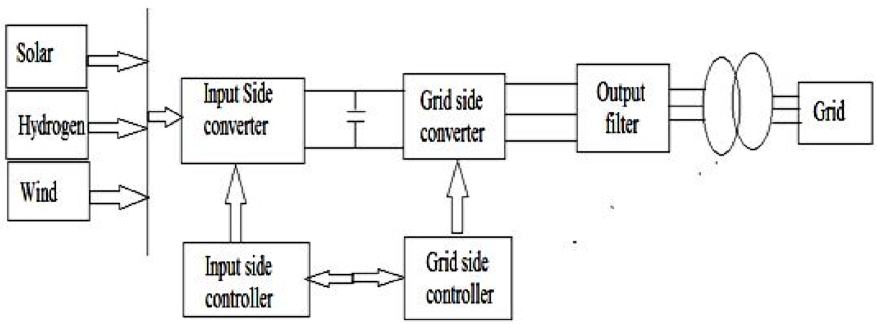


Fig. 1 DPGS Structure

## III.BOOST CONVERTER

The main principle of the DC/DC converter is to convert the DC input from the PV into a higher DC output. The maximum power point tracker uses the DC/DC converter to adjust the PV voltage at the maximum power point. The boost topology is used for stepping up the low voltage input from the PV. A boost type converter steps up the PV voltage to high voltage necessary for the inverter. Fig 2 shows the Boost converter. The DC input voltage is in series with an inductor L that acts as a current source. A switch T is in parallel with the current source that turns on and off periodically, providing energy from the inductor and the source to increase the average output voltage.

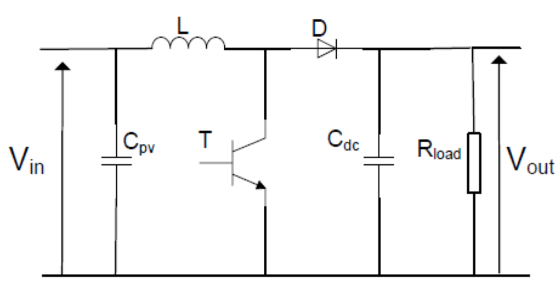


Fig. 2 Topology of Boost Converter

The voltage ratio for a boost converter is derived based on the time integral of the inductor voltage equal to zero over switching period.

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## IV.MAXIMUM POWER POINT TRACKING

MPPT's operate at very high frequencies, usually in the 20-80 kHz range. Here our input sources are wind, sunlight, and PV cell. If the intensity of input sources is uniform for whole day, hence we need MPPT technique. The MPPT controller does is look for the exact point, then performs the voltage conversion to change it to exactly what the battery needs. Hence in that particular point it produces maximum power. Based on that maximum power, power electronic converters will respond and generate PWM pulses for constant output irrespective of intensity of the input sources [5].

The design consists of a 12V solar panel, 12V variable power supply, Boost chopper module, MPPT module and 3phase voltage source inverter module. The voltage generated from solar panel is given to the 12V rechargeable battery through a diode. The voltage input depends on the light intensity of solar hence to maintain the constant AC voltage in the output side by maximum power point tracking MPPT technique. Proposed structure illustrated in fig 3.

Based on the voltage generated from the solar cell the duty cycle of boost chopper can be adjustable with help of controller [5]-[7]. The PWM pulses are generated in the controller are 5V amplitude, this voltage is not sufficient to drive the MOSFET switching device. Hence the driver module is essential to drive the switching device through opto isolator, the MOS FET is used to switch on/off the circuit based on instruction coming from controller, and the device name is IRFZ40.

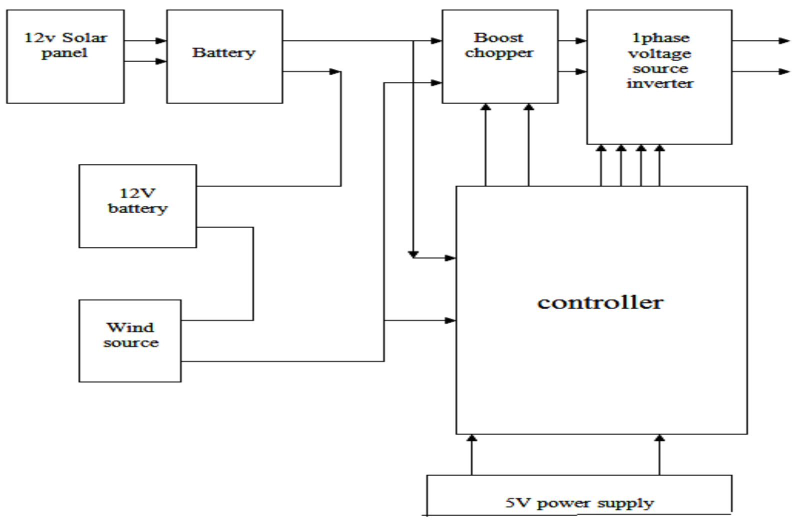


Fig. 3 Proposed block diagram

The boost DC voltage is given to the single phase voltage source inverter; the output of the inverter is 36V AC maintains as constant for any change in DC input. The design maintains constant output with the variation of input from 12V- 20V. The controller is used to generate the switching pattern for the boost chopper and 3phase voltage source inverter. This design is interconnecting more than one source to inject the supply to the grid, here interconnecting solar and battery sources.

## V. RESULT AND DISCUSSION

The designed DPGS system with MPPT technique has been realized using controller. Owing to the advantages of digital over analog six gate pulses from S1 through S6 from the controller are given to the switches of the inverter/ chopper module [12]. In the simulation model the input is varying from 350V to 400V DC the output is maintain 415V AC. The overall Simulink diagram for the proposed system is shown in fig 4.

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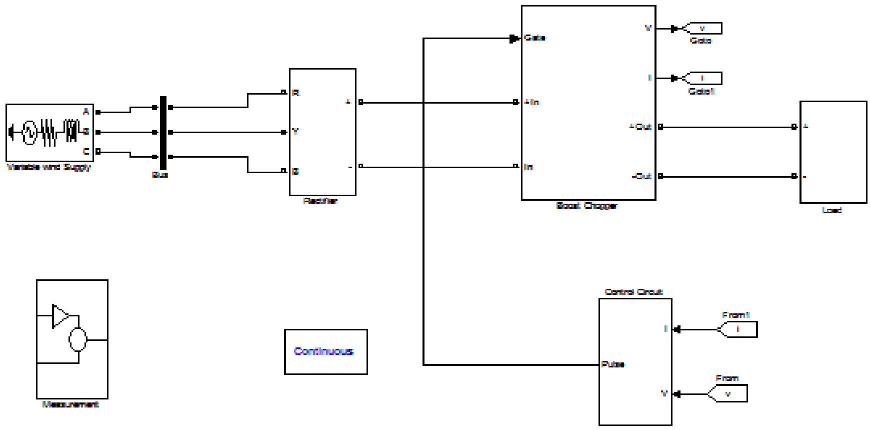


Fig. 4 Simulink model of proposed system

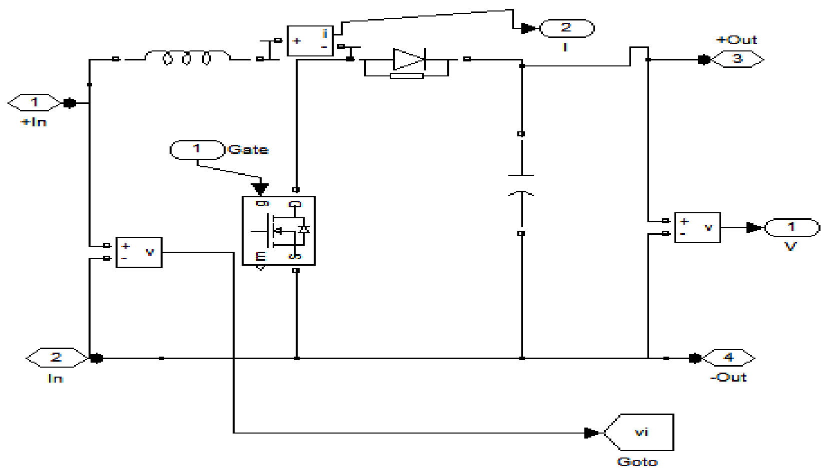


Fig. 5Simulink model ofBoost chopper

Synchronization with the grid voltage and voltage grid and frequency grid monitoring is also an important task of this controller. Since in the considered topology, the output power is completely decoupled from the input power by a dc link, the grid side converter is mainly responsible for the fault tolerance of such a power generation system.

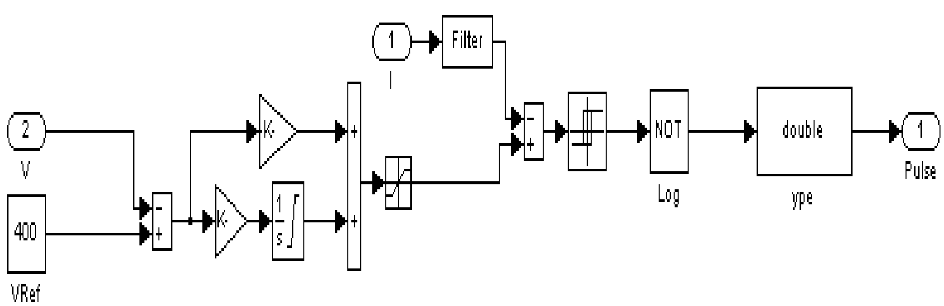


Fig. 6 Simulink model of control circuit

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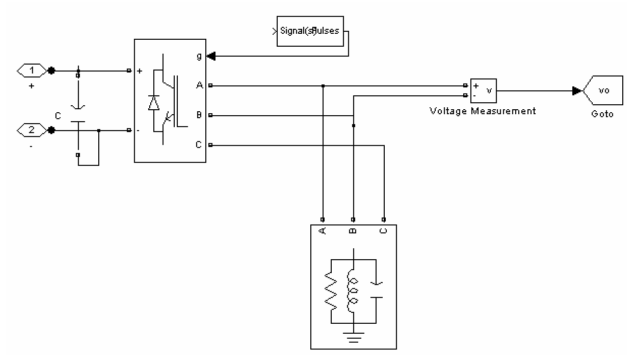


Fig. 7Simulink model of inverter

The output voltage of the inverter is varied by varying the PWM switching frequency of the gating pulses given to the power transistors (MOSFETs) of the inverter. The PWM switching frequency can be varied to a maximum of 10KHz. High switching frequency is achieved which improves the performance by reducing total harmonics distortion and switching loss [8]-[9].

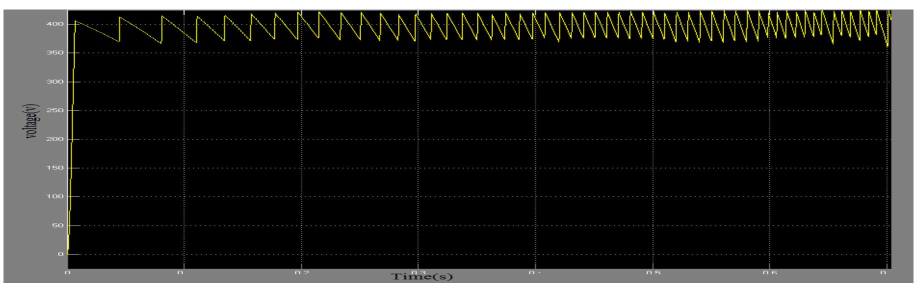


Fig.8Output voltages for inverter

The boost chopper output voltage is 400V DC which is shown in fig 8. This boost DC voltage are given as an input for single phase inverter, hence the grid power is maintain constant. The inverter and boost chopper are designed using MOSFET and the PWM pulses are generated by the controller [10].

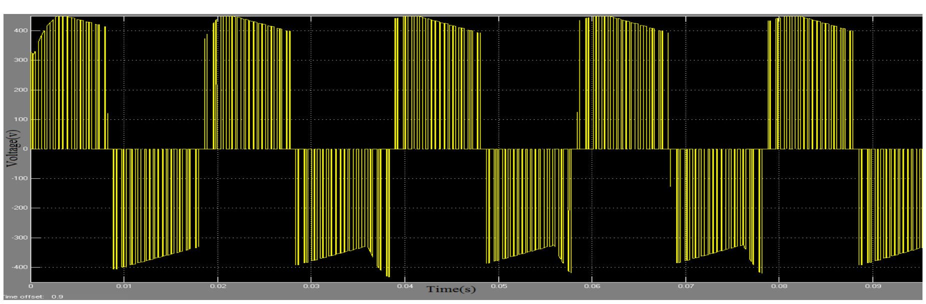


Fig. 9 Output voltages for Boost converter

The waveform shown in fig 9 is the single phase inverter output, the output voltage is 400V. Non-conventional energy sources are seasonal dependent; hybrid system which helps the DPGS to obtain expected output power at the utility side.

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## VI.CONCLUSION

This paper has given a description of achievable control structures for DPGSs connected to utility network. In this paper, wind and PV source is considered for obtaining the continuous output power at the grid side. Based on the input power generated by the wind or solar cell, the grid power is maintained constant AC supply. Here, based on the source voltage from the MPPT the controller adjusts the duty cycle of boost chopper switches, hence the grid power is maintained constant. The design for grid connected application was described using PI controller. Moreover performance of DPGS was implemented in MATLAB/Simulink software. The control structures were illustrated and their major characteristics were described. This type of control strategies reduces the grid fault and synchronization problem.

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## BIOGRAPHY

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