**Modeling and Simulation of H6 Topology using Single Phase Transformerless Grid Connected Photovoltaic System**

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**ABSTRACT**

This paper proposes a new technology of solar energy system, which is gaining immense fashion ability due to the increase of significance to exploration on indispensable sources of energy over reduction of the conventional reactionary energies each around the world. The proposed system excerpts energy from the sun and utilize the energy for the existing loads without disturbing their concert. Here, design and control issues associated with the development of a 1.8 kW single- phase grid- connected photovoltaic system of multilevel protruded inverter are bandied.A ramp time zero average current error control system algorithm with an optimized cyclic switching conception sequence is suggested for the system current regulator. Obtained results of Grid tie inverter are considered to explain the felicity of the total system. The Simulated results parade bettered performance analysis due to harmonics. MATLAB/ Simulink is used to model the proposed system

**Keywords−** Grid tied inverter, MPPT, H6 topology, Photo Voltaic System.

# INTRODUCTION



PV inverter has became a trend due to unattainable centralised maximum power point tracking( MPPT) incongruous problem during partial shading situations( 1- 4). Module integrated motor system is introduced to clear the issue (5). With each upgraded panel, the determination is made best. Therefore the network attains advanced effectiveness. Such networks are called as AC Modules integrated motor or inverters. Several inverter configurations are introduced for PV operations. Transformer-less bones came up for its small size, but they are problematic with the panel’s parasitic capacitor (6). Also a DC- link capacitor is required in between the inverter and the motor. Impotent to gauge its affair voltage by several times advanced also makes the topologies unfit to serve in countries with high grid voltage. To overthrow the voltage boosting issue, slinging insulated motor is introduced to the inverter(7). Also, away from the MPPT, the only control task is on the DC- DC motor to shape its affair as asked. Flyback motor has its dynamic analogous to that of buck boost motor, and it utilizes a motor to deliver a huge voltage step- up rate and galvanic insulation. Because of the existence of a non-minimum phase (NMP) zero (8) and system dynamic issue (9) in CCM, the topology is designed to operate in DCM. Therefore fusion of operation is suggested for similar systems (10- 11). Using a simple analog regulator (8, 12) The CCM control problem is overcome for the current regulator. Another system is built for testing the affair from grid side sludge rather (9), making it possible to control the system using digital regulator. The mentioned design by design it enhances the topology’s efficiency .As a matter of Fact it also shows deformations in the affair current (8- 12).

In single stage grid connected inverters, a motor can be used to enhance the voltage. Advanced input voltage will also be needed than the maximum grid voltage. But this demand isn't fair for Photo voltaic operations since the characteristics of solar panel changes all the time.

**II. GRID CONNECTED INVERTER (SINGLE STAGE)**

Figure 1 shows regulator solar inverter system with regulator. In this inverter, solar- array source, input array sludge, CBULK, line- sludge, DC-DC motor, switching ground, affair sludge and a system regulator design. The subsystems of system regulator are maximum power point shadowing( MPPT), solar- system array voltage regulation, motor affair normal-current regulation, DC/ AC switching ground inverter, compensated current supplying reference creator and mileage over-voltage protection.

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**Figure 1. MPT Solar Inverter (Single stage)**



Figure 2 . DC/DC Converter (Phase-Shift) and Unfolding Circuit(Full-Bridge)

A full- bridge unfolding circuit with the inverter for converting the modified sinusoid current into sinusoidal current, switched in 50/ 60Hz frequency is considered.

**III BUCK-BOOST BASED ON PV INVERTER**

Figure 3 shows the illustration of Buck- boost grounded PV inverter. A dc- dc motor with boost buck type of circuit is considered as the prime stage with regulated output inductor current. Its first stage can be absolutely effective due to buck or boost mode if the low conduction voltage drop switching power MOSFET is considered and ultra-fast rear recovery diode. In this interpretation, IGBT is on and off at ease with gate terminal.



Figure 3. Buck-boost inverter (PV Based)

**IV BOUNDARY MODE ANALYSIS**

During the buck mode, due to low input current of filter’s inductor, input current is considered. In boost- mode, current from circuit filters and inductor current is the output current. Circuit operates perpetually in continuous current mode for input current which is in buck mode and output current which is in boost mode. Based on the input and output current ripples for boost mode and buck mode, boundary condition generated and are shown in figures 4 a and b



**Fig 4a Figure 4b**

**Figure 4 . Boundary power condition with various input voltage ( a-Input current**

with various input voltage, b- output current )

**V LEAKAGE CURRENT ANALYSIS**

Range of capacitor value is within 100 – 400 pF between a single PV module and the point of contact. Its value relies on rainfall circumstances, and in the vilest situation as stormy periods, the capacitor value will be maximum ie 80 nF KW. Leakage current in the grid tied inverter is shown in Figure. 5.



Figure 5. Grid tied inverter system with leakage current

To maintain the safety and follow the safety protocol , the leakage current should be of minimum value for transformer less inverter.In the proposed work, the negative outstation of solar PV modules can be fixed since the set point, and the middle points are fixed due to the phase and neutral for the affair outstations. As the grid voltage is varied with 60 Hz, tiny line frequency leakage current is in the introduced inverte. 200 nF capacitance is considered between the solar Photo voltaic modules and the ground CPV.

**VI. BOOST BUCK MODE PV INVERTER CONTROL**

Inductor current will be considered as buck motor’s affair current during buck mode. Still, it can be hard to control current in boost mode. Therefore, there is a need to design a compensator for boost mode an should be a applied into buck- mode.If the boost- mode is steady and good controlled, it will be stable and controlled. It clearly indicates that the RHP zero and double pole make 2700 phase detention, which creates it intricate to be compensated. therefore, the compensated crossover frequency should be implemented first before double- pole’s frequency of the boost mode and assured that the peak Q value is lower than 0 dB. In order to have a compensator that's good for every operation point, the compensator design is system grounded on the worst conditions, which is defined as a condition with loftiest Qpk and the foremost phase drop. Figure 6 shows smooth waveform for buck and boost modes

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Figure 6. Block diagram of the buck boost single phase voltage source inverter

With lower bandwidth control , the outer loop indicates power under maximum power point tracking mode considering the output current reference.

**VII SIMULATION MODEL AND RESULTS**

1. **SIMULATION OF GRID AND PHASE LOCKED LOOP**

The Phase locked loop is an essential part of the inverter task .Here DC-AC conversion is handled consequently with the line. Entire operation and controls are accompanied to the considered line. Ripple cancellation control algorithm is the single operation that is not connected to the line though it could be done. Simulation model of proposed System and Interleaved Flyback Inductor Simulation System are shown in figure 7.



**Figure 7. Simulation model of proposed System**

1024 slices are generated in a line cycle , or 512 slices per half- sine with no change in the number of slices. No restriction for varying the distance between each slice. Figure 8 and 9 represents Average flyback input currents and Current error.



Figure 8 Flyback input currents (Average)



Figure 9 Current error representation

Sharing of load between grid and local loads to monitor the error of transformer input currents helps to reduce the error.

 It also firmly adjusts the duty rate of every transformer by the inclusion/deduction of a correction factor considering the error sign.

Presence of feed- forward and feedback network improves the system efficiency to an high range at the time of severe measurable disturbance. Under ideal situation with zero disturbance measurement, gain of the feedforward compensator can eradicate the disturbed signal at best level. Feedforward compensator in the solar inverter system is to create the steady state duty rate, to the sharing system. Cargo resistance is added in Rf, coming bone for a sludge inductor and DCR in series to the cargo resistance . Periphery of both gain and phase of the network will be minimum in value which will make the system innately to has a low relative stability. Also, it can be vividly observed that the ripples of frequency reduction requires enhancement and that the gain at the needed operating frequency (100-120 Hz) is definitely minimum. Grid current, current reference and voltage are shown in figures 10 and 11.



Figure 10. Current and current reference (Grid)



Figure 11. Grid voltage



 Figure 12 Output for Ripple control



 Figure 13 output current (DC/AC controlled )

Thus, the Maximum power point tracking circle and the current control circle shows as balanced gain network with 0 or minimum phase error. Ripple control result and DC/ AC controlled affair current are shown in figures 12 and 13. The MOSFET full- ground needs to unfolds this remedied current and commute an interspersing current to be delivered to the grid. Gain feed forward compensator is used to improve the current circle bandwidth efficiently. The duty cycle in steady state is calculated with the Photo voltaic panel voltage and grid voltage. Steady- state modulation is being supplied through the feed-forward compensator, the current control circle considers dynamic variations and modifies the controlled current consequently.

**VIII.CONCLUSION**

A novel control approach has been successfully implemented for a solar-grounded inverter, aimed at efficiently harnessing available power while maintaining a near unity power factor. The proposed method exhibits superior signal-to-noise ratio for feedback signals, confirming reliable and stout MPPT, though firmly controlling the AC sinusoidal waveform given to the grid. By engaging a simplified feed-forward compensation mechanism and integrating a single stage of DC/DC power conversion, the proposed inverter system surpasses conventional designs in terms of complexity. Building on this analogous idea, additional inverters with step-up and step-down capabilities have been presented, accompanied by three advanced control strategies. Multiple topologies can be explored based on the operating mode concept, with the option to integrate a boost stage when the inverter operates on the buck mode principle. Consequently, the new inverter eliminates the input voltage limitations, rendering it unnecessary for exceeding the input voltage than the peak voltage of the alternating current. This widens the input voltage range, reduces switching losses, and significantly improves the overall system efficiency. Effectiveness of ripple control and the resulting DC/AC controlled output current are shown in the simulated results. Utilizing a MOSFET full-bridge configuration, the rectified current is then converted into alternating current for the transmission to the grid. To enhance the current loop's bandwidth, a gain feed-forward compensator can be employed.

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