MODELING AND SIMULATION OF H6 TOPOLOGY USING SINGLE PHASE TRANSFORMERLESS GRID CONNECTED PHOTOVOLTAIC SYSTEM

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 energy sources over reduction of the ordinary reactionary energies each across the world. The systems which are being generated excerpt solar in the most effective manner and utilizethem for the available loads without affecting their performance. In this paper, the development and control issues associated with the development of a1.8 kW prototype single-phase grid- connected photovoltaic system of multilevel protruded inverter are bandied. For the system current regulator, a ramp time zero average current error control system algorithm combined with an optimized cyclic switching conception sequence is suggested. Simulation results of Grid tie inverter have been considered to demonstrate the felicity of the total control system. The Simulation results parade bettered workinganalysis due to errors and the studied system is structured and dissembled in the MATLAB/ Simulink.

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

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I. INTRODUCTION

PV inverter has become a trend due to unattainable centralized MPPT incongruous issue when partial shading events(1- 4) occurs. Integratedmodule motor system is therefore introduced to overcome the issue (5). With each panel upgraded with its own MPP Tracker the resolution is made best. Therefore the system achieves advanced effectiveness. Similar systems are called as AC Modules integrated motor (MIC) or inverters. Various inverter topologies are introduced for PV operations. No-Transformer bones came up for its small size, but they are problematic with the panel's parasitic capacitor (6). Also a DC link capacitor is needed 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 nations with voltage of high grid. To overthrow the voltage boosting issue, slinging insulated motor is introduced to the inverter(7). It also connects to a low frequency unfolding inverter to flip the opposition to produce affair in the sinusoidal wave form. This way the DC- link capacitor is reduced to only the one the panel. Also, away from the MPPT, the only control task is on the DC to 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 zero (8) and system dynamic issue (9) in CCM, the topology is designed to function in DCM. Therefore fusion of operation is suggested for similar systems (10, 11). Using a simple analog regulator (8, 12) The control issue for CCM has been rectified 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. Indeed the system is designed to operate under CCM operation, it also works best in DCM during grid voltage opposition shifting period (12). These structures by design it enhances the topology's efficiency .As a matter of Fact it also shows deformations in the affair current (8, 9, 12). This paper puts forward a topology for interleaved flyback inverter participating two common switches and grid- side sludge with other transformers from variouspanels. For this to be in action, primary current control scheme is demanded (8).

In single stage grid connected inverters, a motor can be used to enhance the voltage at input. The advanced voltage at input will also beneeded than the maximum volts at grid. But this demand isn't fair for Photo voltaic operations since the characteristics of solar panel changes all the time. As the capacitance also has an impact on Maximum power point tracking (MPPT) effectiveness, the highest capacitance leads to advanced effectiveness. Recently, a buck and boost motor connected inverter is formulated.

II. GRID CONNECTED INVERTER (SINGLE STAGE)

Figure 1 shows a single- stage regulator solar inverter system. It contains a sun powered array source of bulk input array sludge, capacitor CBULK, line- sludge, DC to DC motor, 50to 60Hz switching ground, affair sludge and a system regulator design. The system regulator can be perished into 6 introductory control subsystems videlicet(1) highest power point shadowing(MPPT),(2) solar- system array voltage regulation,(3) motor affair normal-current regulation,(4) DCto AC switching ground inverter,(5) current compensated supplying reference creator and(6) mileage high volts prevention.

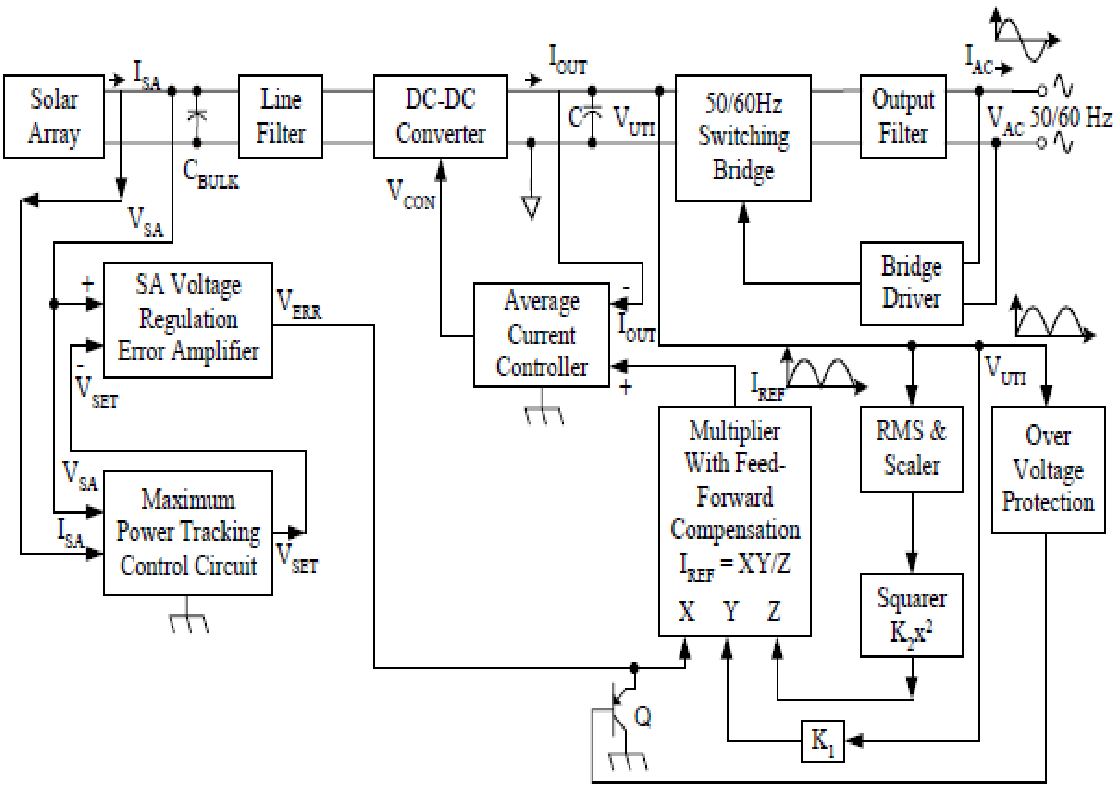


Figure 1: MPT Solar Inverter (Single stage)

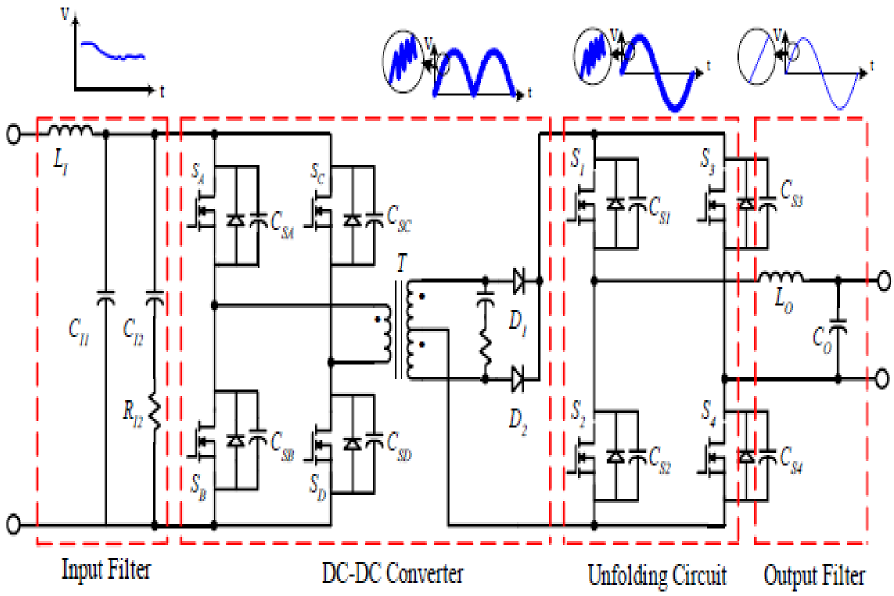


Figure 2: DC/DC Converter (Phase-Shift) and Unfolding Circuit(Full-Bridge)

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

A dc- dc motor with buck to boosttype circuit is consideredlike the prime stage ofregulated output current at inductor. A full- bridge motor circuitunfolding with 50 or 60 Hz input frequency is supplied to the dc to ac step, which will be unfolding clamp remedied sinusoid current which has been channelized by the dc- ac stage into a pure sinusoidal current, as shown in Figure 3. 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 -super quick rear recovery diode.

In this interpretation, IGBT is turned at logic 1 and 0 at ease with gate control.
In addition to the before mentioned, trust ability can be greatly enhanced because of the presence of a single more functioning frequency power processing stage in this complete PCS. Figure 3shows the illustration of Buck- boost grounded PV inverter.

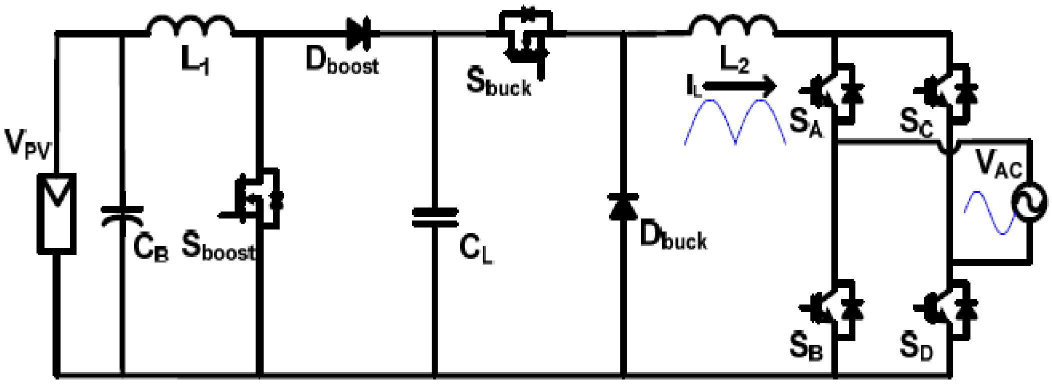
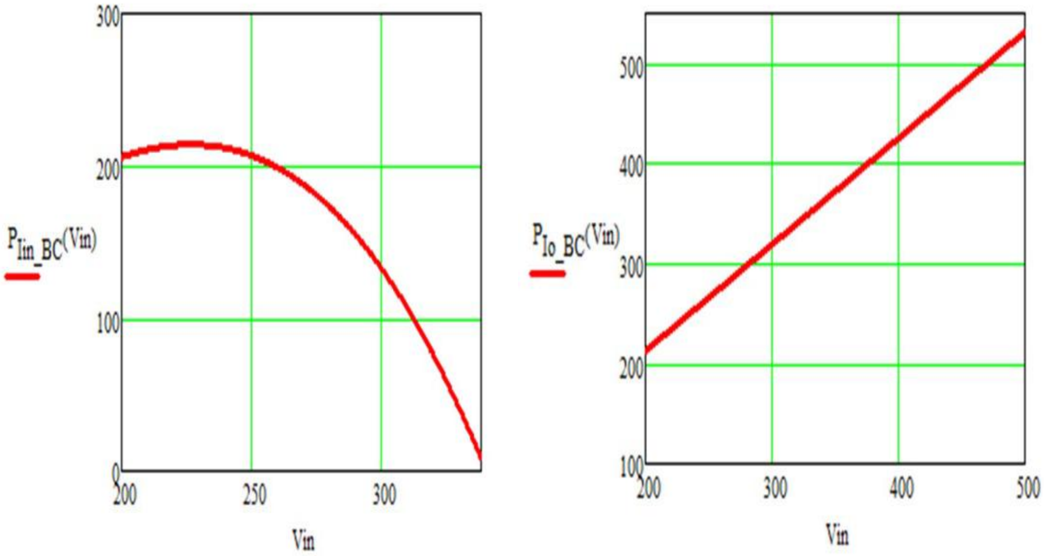


Figure 3: Buck-boost inverter (PV Based)

IV. BOUNDARY MODE ANALYSIS

During the buck mode, due to low input current of filter’s inductor, input current is considered, In boost mode, the output current can be the outputting circuit filters and current at inductor, whose ripple is also much reduced. Circuit operates perpetually in continuous current mode (CCM) for current at source (buck mode) and current at load (boost mode). In addition, discontinuous current mode (DCM) or boundary mode can occur only in output current (buck mode) and source side current (boost mode). Based on the current at sourceripple for boost mode and current at output ripple for reducing mode, boundary condition can be obtained and are shown in figures 4(a and b)



a) b)

Figure 4: Boundary power condition with various input voltage (a-Input current With various input voltage, b- output current)

V. LEAKAGE CURRENT ANALYSIS

It is inferred that the range of capacitance is above100 below 400pF between a single PV module andthe point of contact. Its value relies on rainfall terms, and in the case that is awful as stormy periods, the capacitance can be maximum as 80 nF KW. Leakage current in the grid tied inverter is shown in Figure. 5.

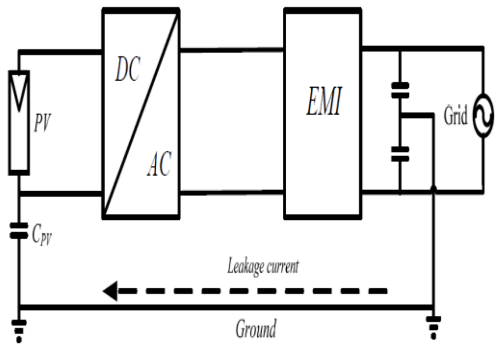


Figure 5: Grid tied inverter system with leakage current

To maintain the safety and follow the safety protocol , the wasted current must be of minimum value as possible for transformer less inverter. For the proposed topology, the negative outstation of sun powered modules is fixed a like the set point, and the middle points on the bridge legs are fixed as phase and neutral for the affair outstations. Because grid voltage is varied with 60 Hz, tiny souce frequency wasted current is in the formulated inverter. For a 2.5 kW system, the 200 nF capacitance is considered in middle of the PV modules and the ground CPV.

VI. THE BOOST –BUCK MODE PV INVERTER CONTROL

Current at inductor will be treated as normal reducing voltsmotor's affair Current at inductor during buck mode. Still, it is hard to control Current at inductor in volt increasing mode.Therefore, there is a need to design a compensator for boost mode and should be a applied into in volt decreasing mode. In practice, if the boost mode is steady and well controlled, buck mode will be steady and well controlled. It clearly shows that the RHP zero and double pole make 2700 phase detention, which makes it intricate to be compensated. therefore, the compensated crossover frequency should be implemented first before double-pole's frequency of the volt increasingand assured that the peak Q value is lower than 0 dB. In order to have a compensator development 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. Here, when voltage at input is the smallest defined value 200 V and load voltage is the maximum voltage of the grid 340V then poor condition happens

For getting smooth waveform in between volts increasing and decreasing modes, the saw tooth (offset) carrier right on the top of thevolt reducing mode PWM modulator can be applied to volts increasing mode and it is shown in Figure 6.
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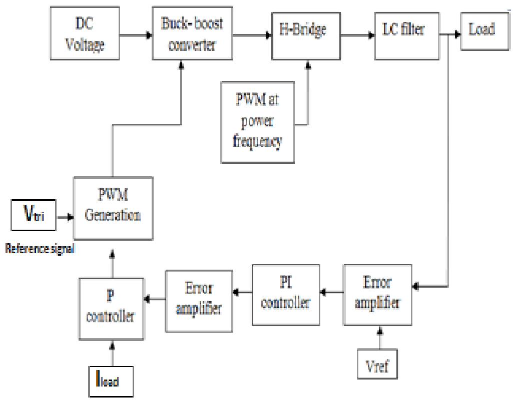

Figure 6: Block diagram of the buck boost single phase voltage source inverter

With lower bandwidth control, the peak power point scanning power can be formulated as an outer loop, considering the magnitude of the load current sample for smooth transition between modes of volts increase and decrease respectively.

VII. SIMULATION MODEL AND RESULTS

A. Simulation of Grid And PLL: The PLL is an intrinsic part of the inverter function. Here DC/ AC change is handled consequently with the AC line. Every state operation and inversion- related control operations are accompanied to the input. The ripple cancellation control algorithm is the single operation that is not connected to the line though it could be done. The PLL operation is slightly else than that of other PLLs.. Simulation model of proposed System and Interleaved Fly back Inductor Simulation System are shown in figure 7..

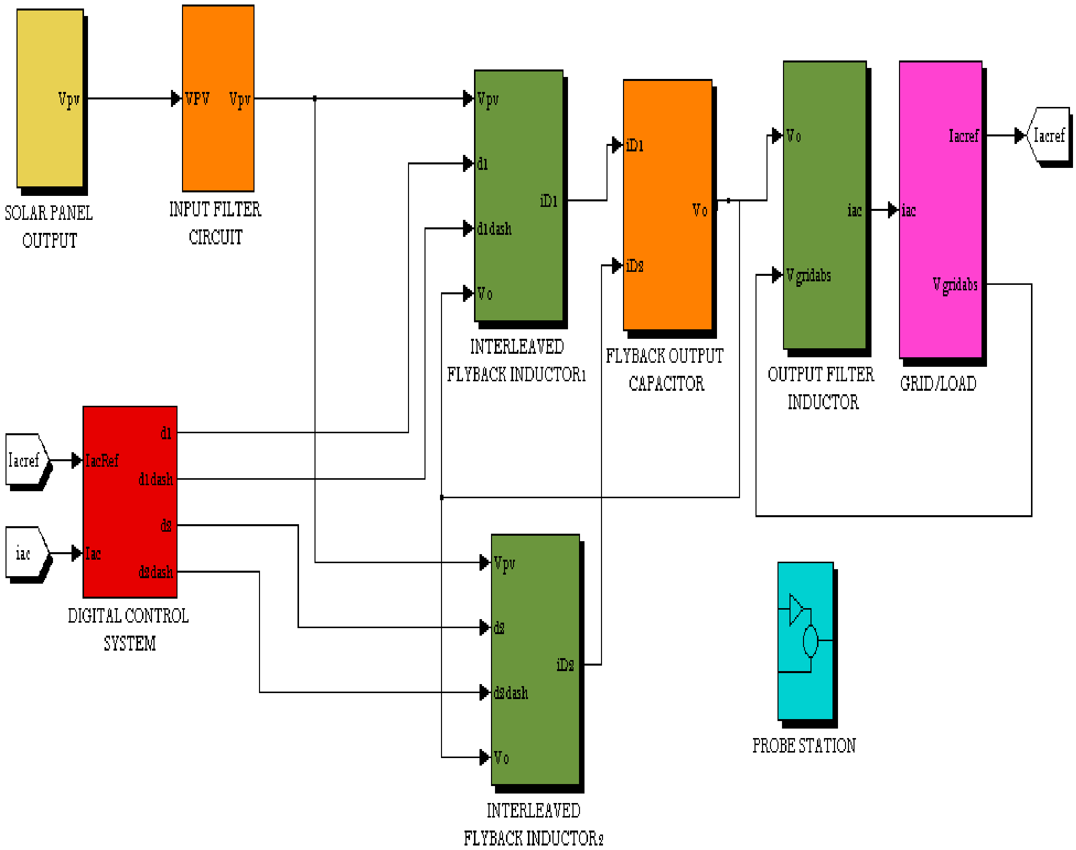

Figure 7: Simulation model of proposed System

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. The sine sample information is always the similar that is a huge advantage. Figure 8 and 9 represents Average flyback input currents and Current error.

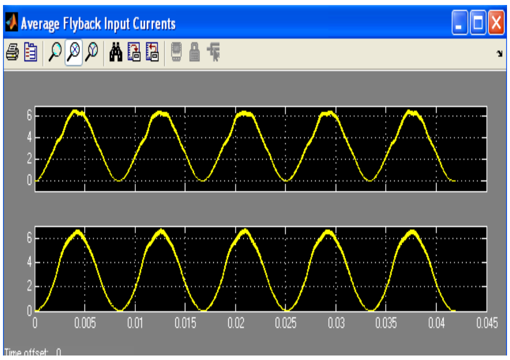

Figure 8: Fly back input currents (Average)

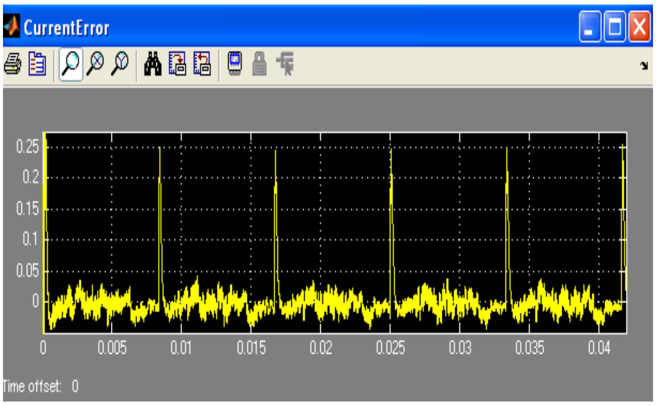

Figure 9: Current error representation

The load which shares between the load locally and control grid circle continuously scans the error between the source currents of the transformers which helps in reducing the error. It also firmly adjusts the duty rate of every transformer by the inclusion/deduction of a correction factor value based on the error sign.

The presence of joined feed- forward and feedback system improves the system performance of the control system to a high range If and when there is a major computable trouble. In utopian events with zero measurement of disturbance, gain of the feed forward compensator will completely eradicate the calculated disturbance signal at best than the compensator operating alone. The important role of the feed-forward compensator in the solar inverter system is to provide the steady state duty rate D(t), to the sharing system, thereby allowing the compensated value to the system finding error . The cargo resistance is added in Rf, coming bone for a sludge inductor and DCR is in series to the cargo resistance in the AC-original circuit. By looking at the open- circle forebode plot, it can be noted and viewed that periphery of both gain and phase of the system are low in. value which makes the system innately to has a poor relative stability. Also, it is vividly observed that the ripples of switching frequency attenuation requires improvement and that the system gain at the needed system operating frequency (100/120 Hz) is definitely low. Grid current, current reference and voltage are shown in figures 11 and 12.

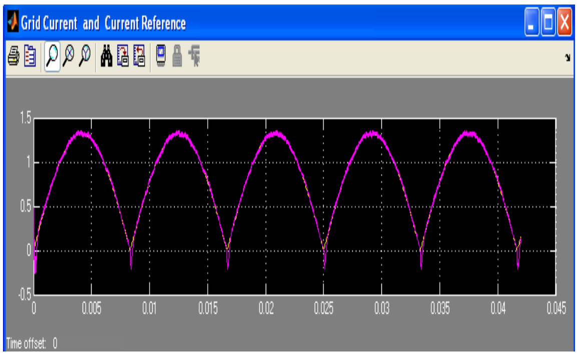

Figure 10: Current and current reference (Grid)

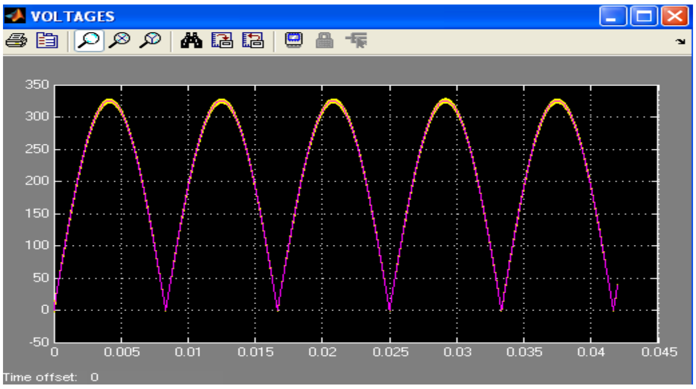

Figure 11: 3Grid voltage

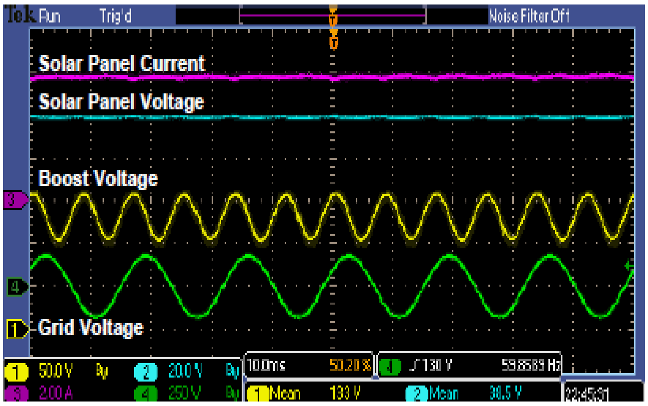

Figure 12: Output for Ripple control

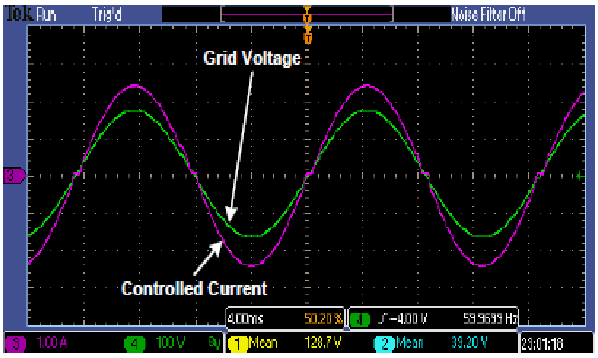

Figure 13: output current (DC/AC controlled)

Thus, the MPPT circle and the current control circle appears as a balanced gain system with zero or minimum phase error. The current circle in the circuit shifts the motor current to a remedied signal as a sine surge affair. Ripple control result and DC/ AC controlled affair current are shown in figures 13 and 14. The MOSFET full- ground needs to unfold 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 steady- state duty cycle can be clearly measured with the PV panel voltage and grid voltage. Steady- state modulation is being supplied through the feed-forward compensator, the current control circle takes into account non steady variations and modulates 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 Up to date approach exhibits superior signal-to-noise ratio for feedback signals, ensuring safe and robust highest Power Point Tracking (MPPT), while also tightly scanning the sine waveform of Alternating current supplied to the grid with a harmonious PF. By employing 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. Notably, this discussion introduces a high-performance grid connected solar PV inverter with a single-stage boost-buck topology, leveraging its unique operating mode to propose an appropriate control system for seamless mode transitions. Building on this analogous concept, 3 additional inverters with both buck and boost capabilities are 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 the input voltage to exceed the peak voltage of the grid's alternating current. This widens the input voltage range, reduces switching losses, and significantly improves the overall system efficiency. Achieving high effectiveness is made possible by implementing an innovative Zero Voltage Switching (ZVS) technology combined active-clamp flyback topology. 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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