Hardware Implementation of PV fed boost converter with quasi resonant voltage doubler and snubber circuit

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Abstract— In this article, hardware implementation of PV fed boost converter with quasi resonant voltage double and snubber circuit is presented. This method clarifies the improvement of a boost half-bridge (BHB) DC-DC converter with high power transformation efficiency and a wide voltage range for photovoltaic smaller scale inverter. The improvement is accomplished by presenting an isolation Transformer, interfacing the BHB DC-DC converter on the essential side of the transformer and including a voltage doubler with a snubber capacitor on the auxiliary side. Quasi Resonance (QR) strategies are utilized to accomplish zero-voltage exchanging (ZVS) turn-on for the switches, just as ZVS turn-on for the diodes. Furthermore, the new improved converter has no DC-charging current for the transformer because of the DC blocking capacitor, and it duplicates the voltage increase through the voltage doubler and snubber capacitor to diminish spikes Further, an extensive hardware validation show the effectiveness of the system.

Keywords— Photo voltaic Systems, Micro Inverter, DC-DC Converter, Quasi Resonance, Power Conversion.

I. INTRODUCTION

Lately numerous nations satisfy the power need, so the age of renewable power source is expanded, for example, photovoltaic, wind, fuel and so on. The sun gives all that anyone could need vitality to meet the entire world's vitality needs, and not at all like petroleum products, it won't run out at any point in the near future [1-2]. As a sustainable power source, the main impediment of sun oriented force is our capacity to transform it into power in a proficient and savvy way. No ozone depleting substance emanations are discharged into the environment when you utilize sun powered boards to make power. Also, on the grounds that the sun gives more vitality than we'll ever require, power from sun based force is a significant vitality source in the transition to clean vitality creation. After sun based boards have been introduced, operational expenses are very low contrasted with different types of intensity age. Fuel isn't required, and this implies sun based force can make huge sums of power without the vulnerability and cost of verifying a fuel supply. The progression up DC-DC converter for a smaller scale inverter must have a high voltage gain G (V_O/V_{IN}) of a few tens or more [3-4]. In this manner, if a traditional DC-DC help converter is utilized for a small scale inverter, the switch must have an incredibly high duty ratio. Be that as it may, this outcomes in huge current flows, losses due to conduction, and losses due to switching losses of the electric influence segments in the converter. Non-isolated DC-DC converters have been concentrated to defeat these issues in Step-up DC-DC Converters above [5-7].

To accomplish high voltage gain without an amazingly high duty ratio of the principle switch, non-isolated converters utilize detached and dynamic parts rather than a transformer. In any case, non-isolated DC-DC Converters have complex structure, electro-attractive obstruction, grid current contortion, and extra misfortunes because of the spillage current produced by the galvanic association between the PV module and grid [8-9]. The traditional flyback converter has the littlest circuit parts and circuit size. In any case, it has burdens of the low voltage increase, high voltage worry of the rectifier diode, and high voltage spike issue of switch[10-11]. To take care of these issues, the dynamic clamp flyback converter with a voltage doubler was presented.

The proposed converter utilizes the quasi-resonance among C_1 and L_{lk}. Contrasted with the past converter it can decrease the turn off current of S_1 and obligation loss of the circuit in view of the quasi-resonance among C_1 and L_{lk}. Along these lines, this converter of has the littler turn off misfortunes and more extensive voltage at the input side run than that of past converter

PROPOSED SYSTEM

In proposed system shown in Fig 1 the PV panel input voltge is fed to the DC load with the help of half bridge boost converter which converts the DC voltage with AC voltage with some boost ratio and then it converted AC voltage is stepped up using turns ratio of transformer and then voltage doubler circuit converts the doubles the AC voltage to DC voltage which drives the load.

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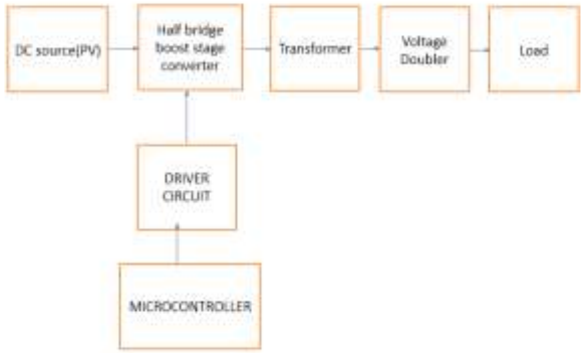

Fig 1. Block Diagram of Proposed System

The siwtching pulses to the switch is given by microcontroller which is amplified by the driver circuit.

II. MODELS

A. PROPOSED CONVERTER

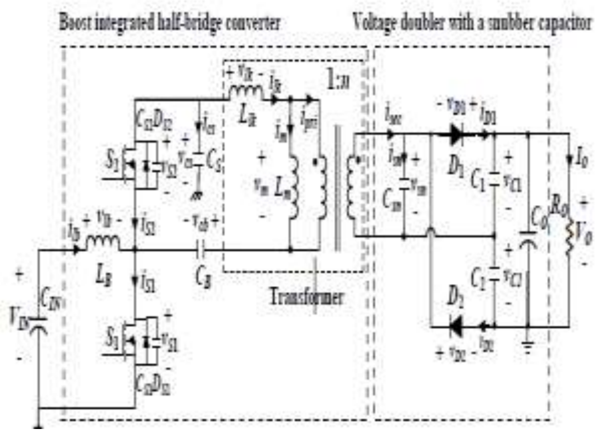

Fig 2. Circuit Diagram of Quasi Z source inverter

The proposed converter has a combined structure of a boost integrated half-bridge converter on the primary side of the transformer and a voltage doubler with a snubber capacitor on the secondary side. The boost integrated half-bridge converter consists of a boost inductor (L_b), two switches (S_1, S2), a storage capacitor (C_s), a blocking capacitor (C_b), and a transformer with a leakage inductance (L_{lk}), turn ratio of 1:n, and a magnetizing inductance (L_m). It performs the operation of the boost converter of stepping up the input voltage (V_{in}) to the higher voltage (V_{Cs}) of C_s. It then performs the operation of the half-bridge converter of transferring the electric energy from Cs to the load (R_0). An Isolation Transformer is used to step up the Voltage of BHB Converter. The voltage doubler with a snubber capacitor consists of two diodes (D_1, D_2), a snubber capacitors (C_{sn}), two capacitors(C1, C_2), and an output capacitor (C_O). It generates a DC output voltage (V_O) of twice the secondary voltage of the transformer and reduces the voltage stresses of D_1 and D_2 to V_O. The simple PWM circuit has been used to give the switching pulses to the switches. The swithces S_1 and S_2 works complemetary for giving the AC like signals. The circuit diagram of proposed converter is shown in Fig 2.

The operation includes when switch S_1 is in ON condition the positive cycle is generated, switch S_2 is responsible for the negative cycle generation. The input boost inductor L_b charges and discharges linearly with respect of switching condition of switches S_1 and S_2.

B. DRIVER CIRCUIT

A driver is an electrical circuit or other electronic component used to control another circuit or component, such as a high-power transistor, liquid crystal display (LCD), and numerous others. They are usually used to regulate current flowing through a circuit or to control other factors such as other components, some devices in the circuit. The term is often used, for example, for a specialized integrated circuit that controls high-power switches in switched-mode power converters. Typically the driver stage(s) of a circuit requires different characteristics to other circuit stages. For example in a transistor power amplifier circuit, typically the driver circuit requires current gain often the ability to discharge the following transistor bases rapidly, and low output impedance to avoid or minimize distortion.

C. MICROCONTROLLER(PIC16F877A)

The term PIC, or Peripheral Interface Controller, is the name given by Microchip Technologies to its single – chip microcontrollers. PIC micros have grown to become the most widely used microcontrollers in the 8- bit microcontroller segment. The PIC16F877A CMOS FLASH-based 8-bit microcontroller is upward compatible with the PIC16C5x, PIC12Cxxx and PIC16C7x devices. It features 200 ns instruction execution, 256 bytes of EEPROM data memory, self-programming, an ICD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital (A/D) converter, 2 capture/compare/PWM functions, a synchronous serial port that can be configured as either 3-wire SPI or 2-wire I2C bus, a USART, and a Parallel Slave Port.

III. Results

Fig 3 shows the overall hardware setup of proposed converter for the measurement and acquisition of Input & Output Waveforms.

Fig 3. Overall hardware setup

Fig 4. Input voltage of 12V

Fig 5. Output voltage of 175V

Fig 4 & 5 show the input and output voltage of proposed converter

IV. Output waveforms

The Input and Output Waveforms were captured in Digital Storage Oscilloscope (DSO). Fig 6 shows the the Input DC voltage fed from a Solar Panel or any DC source (12.5 Volts).

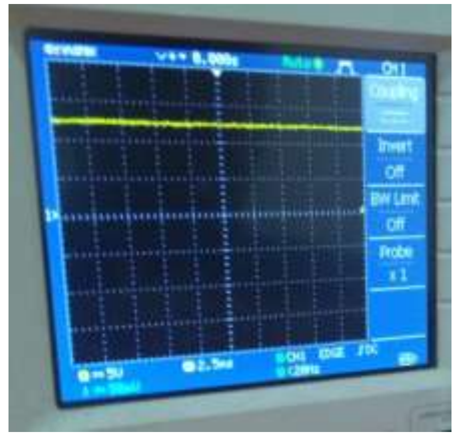

Fig 6. DC Input to BHB Converter

Fig 7 shows the Switching Pulse to MOSFET so that the DC input given to the BHB Converter Switches ON and OF the S1 & S2 pair of MOSFETS.

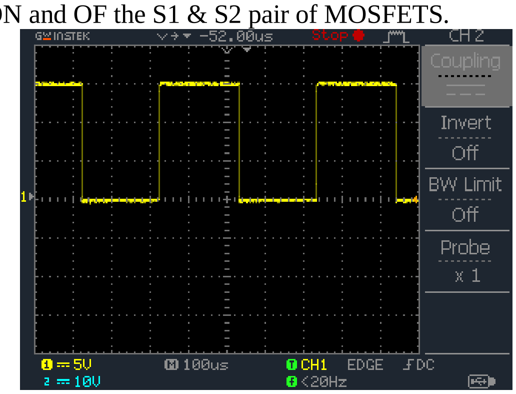

Fig 7. Switching Pulse to MOSFETs S1 & S2

The Output of BHB Converter and input to primary of the Transformer is shown in Fig 8.

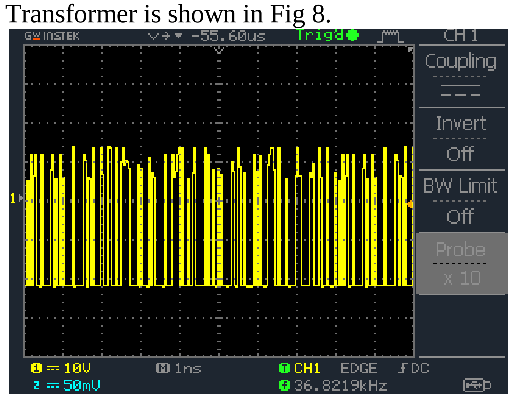

Fig 8. Input to Primary of Transformer

Fig 9 shows the waveform available in the secondary of the Transformer. The voltage is stepped up here and is fed to the Voltage Doubler.

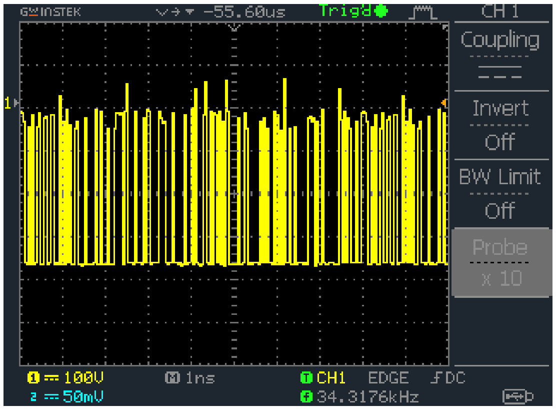

Fig 9. Voltage avaialbe at Transformer Secondary

The Voltage Doubler doubles the Voltage and then to eliminate the spikes Snubber Capacitors are introduced. Fig 10 shows the Output wave form of the Voltage Doubler and Fig 11 shows the final DC output after Snubber Circuit.

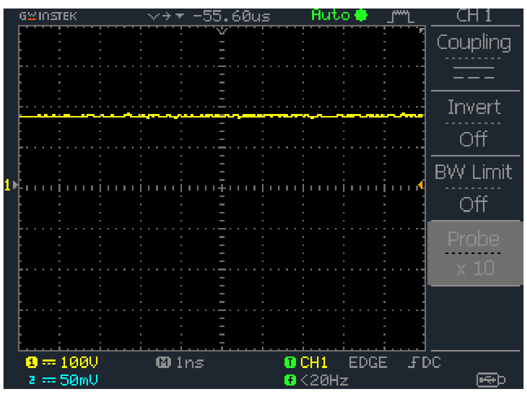

Fig 10. Output after Voltage Doubler.

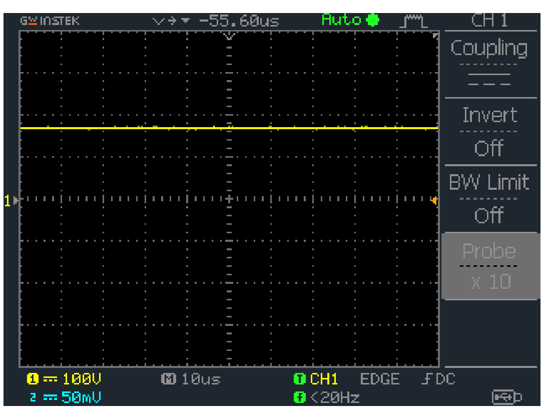

Fig 11. Final DC Output after Snubber Circuit

V. Conclusion

This paper presented a hardware implementation quasi-resonant boost half-bridge (BHB) DC-DC converter with high power conversion efficiency (η%) and a wide input voltage range. Moreover, the proposed converter had no DC-magnetizing current of the transformer, and the voltage gain was increased by using the voltage doubler with a snubber capacitor to reduce spikes.

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