SIMULATION OF A ZVS INTERLEAVED BOOST DC-DC CONVERTER BY USING PHOTOVOLTAIC SYSTEM

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ABSTRACT: This paper a novel yet simple zero-voltage switching (ZVS) interleaved boost power factor correction (PFC)DC/DC converter used to charge the traction battery of an electric vehicle from the utility systems. The proposed topology consists of a passive auxiliary circuit, placed between two phases of the interleaved front-end boost DC-DC converter, provides enough current to charge and discharge the MOSFETs' output capacitors during turn-ON times. Therefore, the MOSFETs are turned ON at zero voltage. Now-a-days renewable energy resources are plays an important role in our globe which decreases the global warming, decreases the pollution, noise free and availability of energy for to fulfill the user interests. It decreases the cost of the proposed system and also improves the system voltage with the same ZVS interleaved boost converter with the help of the photovoltaic system for the battery energy storage of an electrical vehicle application. This solar based novel interleaved DC-DC boost converter can be controlled with the controlled input voltage, input current and the output voltage by using a sinusoidal pulse width modulation with the different carrier signals for the interleaved switches and the converter switches with 180 degrees phase shift which increase the efficiency of the system.

1. Introduction

With increasing concern of global warming and the depletion of fossil fuel resources, many are looking at sustainable energy solutions to preserve the earth for the future generations. Other than hydro power, wind and photovoltaic energy holds the most potential to meet our energy demands. Alone, wind energy is capable of supplying

large amounts of power but its presence is highly unpredictable as it can be here one moment and gone in another way. Solar energy is present throughout the day but the solar irradiation levels vary due to sun intensity and unpredictable shadows cast by clouds, trees, birds, etc. And the common inherent drawback of wind and photovoltaic systems are their intermittent natures that make them unreliable. When a source is unavailable or insufficient in meeting the load demands, the other energy source can compensate for the variations. The Boost converters are generally used to realize input PFC and ac/dc conversion in the front end of an ac/dc converter system. In the high power applications, interleaving continuous current mode (CCM) PFC boost stages, as shown in Fig. 2, is a very common approach to effectively decrease the inductor footprint and volume as well as the output capacitor current ripple. A typical boost PFC utilizes a switch and diode devices. In the range of a few KW, power MOSFETs are usually used to realize the boost converter. Fig.1: Block diagram
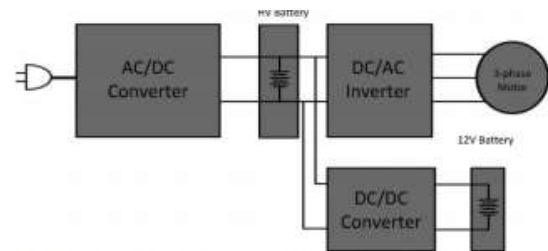

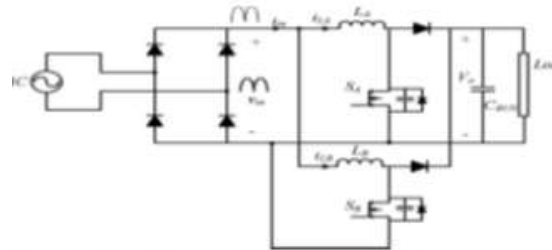Fig.1: Block diagram with integrated different converters

Fig.2: Interleaved boost PFC circuit diagram

2. PROPOSED CIRCUIT OPERATION

The the implementation of the proposed converter by using DC-DC boost converter with the photovoltaic system of the HAL and RTOS. The power circuit of the ZVS interleaved boost PFC converter. In this converter, two boost converters operate with 180° phase shift in order to reduce the input current ripple of the converter. This 180° phase shift can be used to provide reactive current for realizing ZVS for power MOSFETs. This auxiliary circuit consists of a HF inductor and a dc-blocking capacitor. Since there may be a slight difference between the duty ratios of the two phases, this dc-blocking capacitor is necessary to

eliminate any dc current arising from the mismatch of the duty ratios of the main switches in the practical circuit.

Mode I (t0 < t < t1): This mode starts when the gate pulse is applied to SA1 . Once the voltage is applied to the gate, SA1 is turned ON under zero voltage. Since SA1 and SB 1 are ON during this interval, the voltage across the auxiliary Simulation of a ZVS Interleaved Boost DC-DC Converter by using Photovoltaic System International Journal of Scientific Engineering and Technology Research Volume.03, IssueNo.34, November-2014, Pages: 7271-7276 inductor is zero. Thus, the current through the auxiliary circuit remains constant at IAux,p . During this interval, the switch SA1 current, iSA1, is given by:

$$i_{SA1}(t) = I_V - I_{Aux,p} - \frac{v_{in}}{L_A}(t - t_0) \qquad (1)$$

Mode II (t1 < t < t2): This mode is the dead time between the phase B MOSFETs. During this interval, the auxiliary circuit current charges the output capacitance of SB 1 and discharges the output capacitance of SB 2. In this mode, the average voltage across the boost inductance LB is zero. Therefore, the current through LB remains constant at its peak value. The voltage across the auxiliary inductor is given by

$$v_{AUX}(t) = -\frac{V_o}{(t_2 - t_1)}(t - t_1). \qquad (2)$$

Mode III (t2 < t < t3): Once the output capacitors of SB 1 and SB 2 have been charged and discharged completely, the gate signal of SB 2 is applied and SB 2 is turned ON under ZVS. During this interval, the voltage across the auxiliary circuit is −Vo. The current through the auxiliary inductor, inductor LA and switch SA1, is given by:

$$i_{AUX} = I_{Aux,p} - \frac{V_o}{2L_{AUX}}t_d - \frac{V_o}{L_{AUX}}(t - t_2)$$

$$i_{LA}(t) = I_V + \frac{v_{in}}{L_A}(t - t_0).$$

$$i_{SA1}(t) = I_V - I_{Aux,p} - \frac{v_{in}}{L_A}(t - t_0)$$
$$+ \frac{V_o}{2L_{AUX}}t_d + \frac{V_o}{L_{AUX}}(t - t_2). \qquad (3)$$

3. CONTROLLER SYSTEM DESIGN

The below figure shows the controller design of interleaved DC-DC boost converter for improving the efficiency of the switching conditions. The voltage controller and current controllers controls the voltage and current from the input and the output. And the pulse width modulation can

generate the pulses depending on the carrier signal and the reference signal with the high switching frequency

4 OVERVIEW OF A PHOTOVOLTAIC (PV) MODULE

To understand the PV module characteristics it is necessary to study about PV cell at first. A PV cell is the basic structural unit of the PV module that generates current carriers when sunlight falls on it. The power generated by these PV cell is very small. To increase the output power the PV cells are connected in series or parallel to form PV module.

5.Simulation Result

The below figures shows the simulation diagrams of proposed and extended DC-DC interleaved converter and their output voltage and output current simultaneously. In the proposed converter the input is 170 V which is increased to the 233V by using an AC-DC interleaved boost converter as shown in below graphs. As coming to the extended converter the DC-DC interleaved boost converter with the solar system getting
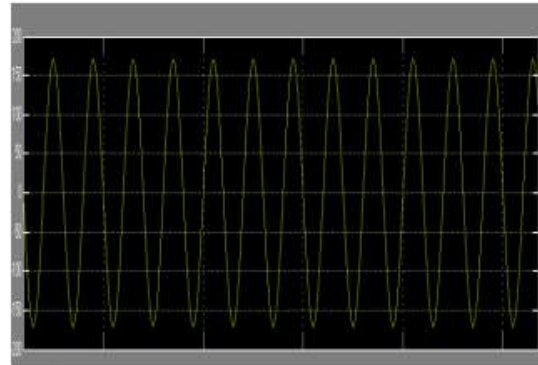
voltage as 27 V to nearly 100 V as the output
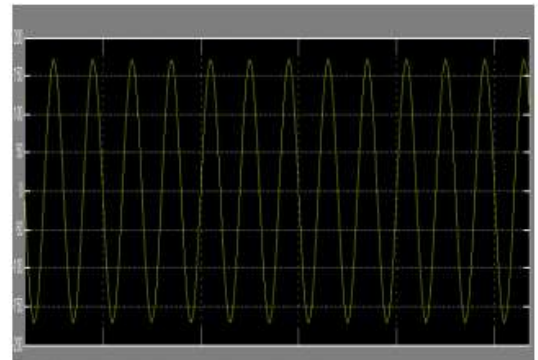

Fig1: Input Voltage

Fig2: OutputVoltage

6. Conclusion

In this paper, a new interleaved boost PFC converter is proposed with the renewable energy applications, which provides soft switching for the power MOSFETs through an auxiliary circuit. This auxiliary circuit provides reactive current during the

transition times of the MOSFETs to charge and discharge the output capacitors of the MOSFETs. In this DC-DC interleaved converter is operated on the PV system with the auxiliary circuit decreases the harmonics and provides the lagging current at switching timings. The control system effectively optimizes the amount of reactive current required to achieve ZVS for the power MOSFETs. The frequency loop, which is introduced in the control system, determines the frequency of the modulator based on the load condition and the duty cycle of the converter. The simulation results and efficiency curves show the superior performance of the proposed converter compared to the conventional one.

7. References

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