# An Improved ZVZCS DC-DC converter with Current Driven Rectifier used for Electric Vehicles

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**Abstract:** This paper is about an improved ZVZCS full-bridge DC/DC converter, which can deliver power efficiently for any type of load variations. The converter presented in the paper is a plug-in AC/DC converter used to charge battery which is a high voltage used in electric vehicles. The converter operates using soft-switching from no load to full load condition and gives satisfying efficiency. The converter in this employs a symmetric passive near lossless auxiliary circuit to provide the reactive power for the full-bridge semiconductor switches. This guarantees zero voltage switching at turn-ON times for all load conditions. The proposed system in this paper is based on a current driven rectifier in order to clamp the voltage of the output diode bridge and to satisfy ZVZCS operation of the converter resulting in good efficiency for all load conditions. The simulation circuit and the result are also shown in the paper.

**Keywords:** DC-DC converter , Full bridge converter , ZVZCS ( Zero Voltage and Zero Current Switching ) , Current driven rectifier..

## I. INTRODUCTION

Power conversion in electric vehicle are using a high energy battery system to store energy for the electric traction purpose. This high energy battery pack is generally charged from the ac mains. Energy conversion during the battery charging is performed by an ac/dc converter. Such converter usually consists of two stages. They are power factor correction for ac/dc converter and dc/dc converter for battery charging. The proposed converter system is part of a plug-in ac/dc converter used for high voltage battery charging in an electric vehicle. The main challenge in this application is to operation of the full-bridge converter from no-load to full-load conditions. Full-bridge topology is the most popular topology used in the DC/DC converters. MOSFET are most commonly used in implementing full bridge converters.To get robust and reliable operation, generally MOSFETs should be operated under zero voltage zero current conditions.

The soft-switching techniques are be divided into two. They are zero-voltage switching (ZVS) and zero-current switching (ZCS). In ZVS technique, the voltage across the transistor is zero during the turned on of the transistor. Therefore, the energy stored in the output capacitance of the transistor is zero at turn-on. During the turn-on the switching loss is also zero giving high efficiency. In ZVS technique, the given semiconductor device turns on at zero voltage. In the ZCS technique, the given semiconductor device turns off at zero current. Zero voltage switching is generally achieved by providing an inductive current flowing out of the full-bridge converter during the switch turn-ON and by placing a snubber capacitor across each switch during the turn off of the switch. ZVS is very important in the case of battery charger because the converter is operating at no load for long period. When the battery is charged, the load is zero and the converter should be able to operate safely

voltage stress in the conventional current-fed full-bridge converter. In the current-fed full-bridge rectifier, the inductor stores energy as the transformer transmits energy from the DC source to the load. This is able to effectively reduce the voltage spikes at the input side of the converter.

## II. CIRCUIT DIAGRAM

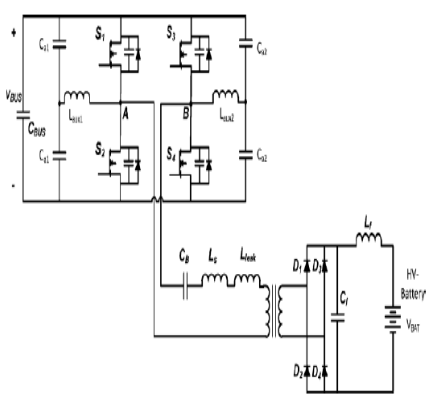

Fig.1. Circuit diagram

The topology introduced in the project presents a simple solution to various problems. The proposed system is essentially a ZVZCS type full-bridge converter with a current driven rectifier. Fig.1 shows the power circuit of the proposed topology. In this topology, the full-bridge inverter converts the DC voltage to a high frequency quasi-square wave voltage. Then the inductor in series with the transformer acts as a current source for a current driven rectifier. The current driven rectifier rectifies

under the zero load condition. The range of the ZVS operation is highly dependent on the load and the transformer leakage inductance. The proposed system provides zero current switching (ZCS) for the output rectifiers, which eliminates reverse recovery losses of the diode rectifiers in the output side. A new current-fed full-bridge is presented in order to reduce the

the output current of the transformer and transfers power to the output (battery).

## III. BLOCK DIAGRAM

A dc source is connected to the power electronic converter which converts the dc energy into ac. This ac is given to a high frequency transformer and then to a full bridge rectifier which is now ac. Then it is filtered using filter circuits to eliminate unwanted ac. Finally it is given to battery. Control circuit is given to battery and power electronic converter.

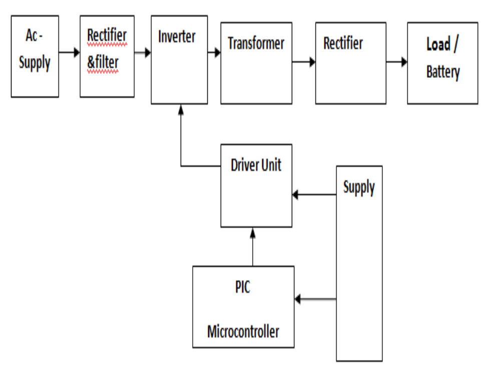


Fig.2.Block diagram

## IV. SIMULATION CIRCUIT

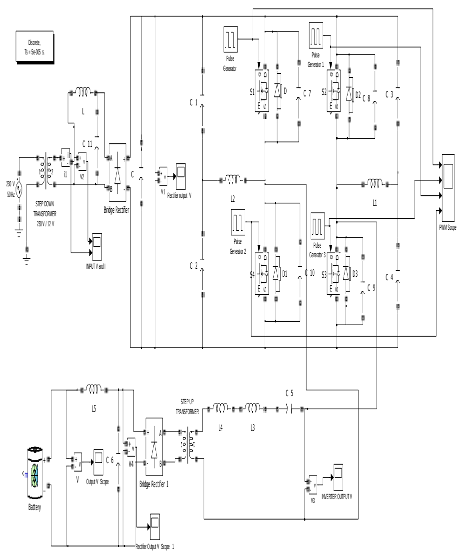

Fig.3.Simulation circuit.

It is done in MATLAB Simulink. Simulink is a software package for modeling, Simulink, and analyzing Dynamic system. It supports linear and nonlinear systems, modeled in continuous Time, sample time, or a hybrid of the two.

## V. RESULTS

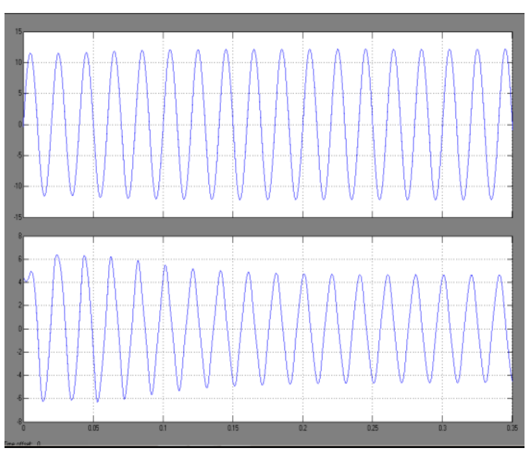

Fig.4.Input Voltage & Current.

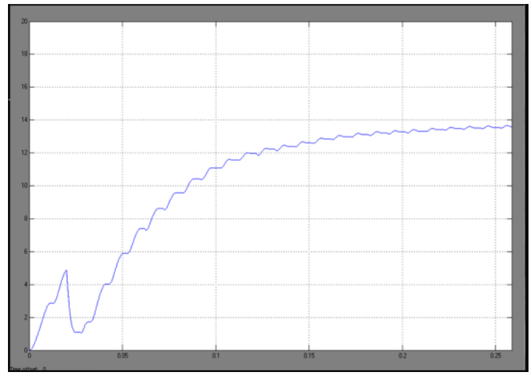

Fig.5.Rectifier output

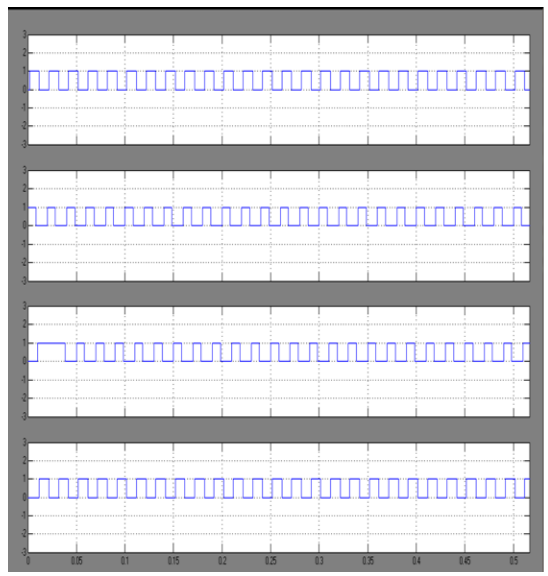

Fig.6.(a) Gate pulses

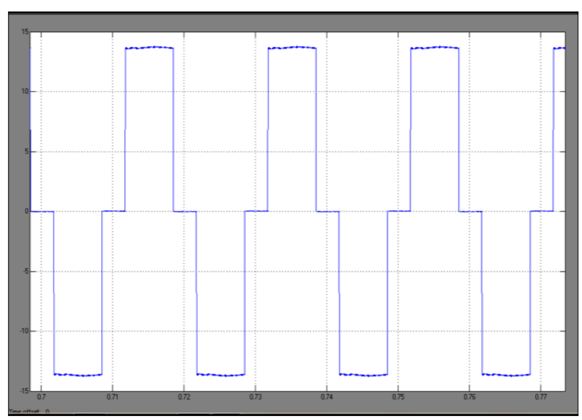

Fig.6. (b) Inverter output .

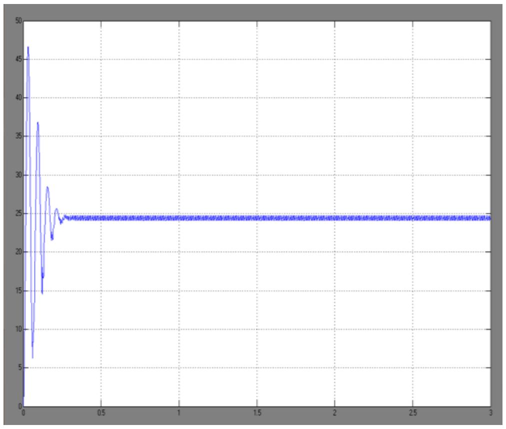

Fig.7.Rectifier output.

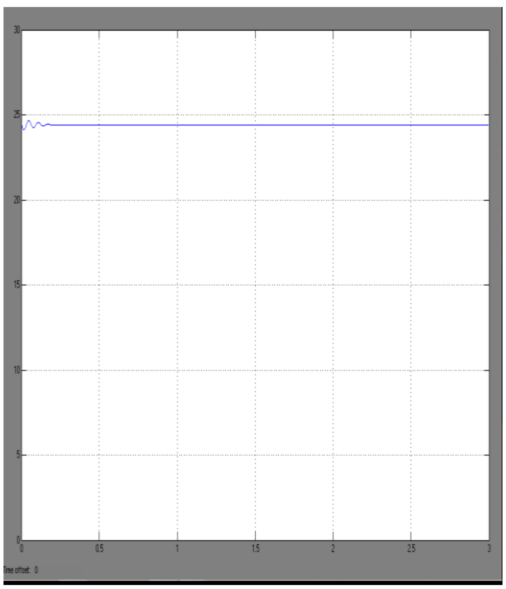

Fig.8.Output voltage

## VI. CONCLUSION

In this, an improved ZVZCS full-bridge topology is introduced for high voltage battery charging applications in electric vehicles. The proposed converter system eliminates the voltage spikes at the secondary side of the transformer, as well as the freewheeling mode of operation. The converter proposed in this paper assures reliable operation at no load by applying the symmetrical auxiliary circuits on both legs of the full-bridge converter. Simulation results and better efficiency of the proposed converter system over full range of operation not only explains the operation of the converter but also confirm the superiority of the proposed converter system

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