IMPLEMENTATION OF ZVS AND ZCS TECHNIQUE FOR DC-DC CONVERTER FOR SOLAR APPLICATION

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ABSTRACT

The soft switching range of operation of the ZVS and the ZCS are largely affected by the maximum switch voltage and switch current respectively. In contrary, these factors have a negligible effect on the ZVZCS operation which results in an extended range of soft switching operation. In this paper, a DC–DC converter with ZVS and ZCS control methods is proposed for solar application. In this paper, this method is implemented in buck-boost converter and the results are verified using MAT LAB simulation.

I.INTRODUCTION:

Renewable energy systems became highly regarded. As a result, many new kinds of converters from the source to the grid have emerged. so as to increase the voltage regulation capability, the intermediate boost DC–DC converters are often used. At the identical time, the challenges faced within the field are to decrease the price [1],[2], size, and weight and to extend the reliability. of these parameters rely upon the converter efficiency, switching frequency of semiconductors, and EMI problems, particularly within the system where galvanic isolation is required. so as to realize afore mentioned responsibilities, main efforts of the facility electronics research are targeting the soft-switching converter topologies [4-7]. These techniques permit reducing the losses in semiconductors, and as a result, the switching frequency are often raised or the warmth sink may shrink in size. There are several ways to realize soft switching. The implementation of resonance circuits seems to be best suited [7]. This method is thought to contain the disadvantage of increased conduction losses and also the presence of additional passive components. The resonance frequency may float, and complicated zero crossing control circuits sometimes make its practical implementation complicated.

II. PROPOSED CONVERTER

This section describes the operating principle of the proposed converter. Initially, this solution was intended for FC and PV power systems, i.e. low-voltage applications that need galvanic isolation along with a good range of input voltage regulation. Within the converter discussed, the quasi-zero switching network can accelerate the input voltage using an additional switching state, the direct trip state (ST).The ST state is now the instantaneous conduction of both switches of the similar phase span of the inverter. The ST states are used to amplifying the magnetic energy stored in the DC side inductors (L1 and L2) without shorting out capacitors C1 and C2.This increases the inductive energy and in turn supplies the input winding voltage increase observed on the transformer during the switch-on states of the inverter. Therefore, the changing input voltage is first pre-regulated by setting the duty cycle ST [6]. The isolating transformer is then supplied with a voltage with a constant amplitude value.

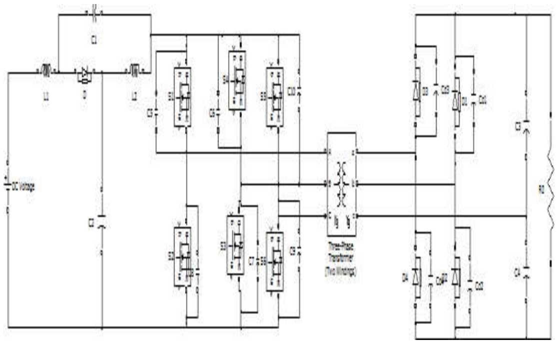


Fig 1: Quasi Zero Switching DC–DC Converter.

The main aim of our study was to realize the complete soft-switching operation of the ZVS-based DC-DC converter. The key idea is to operate within the limit conduction mode of the ZVS network together with snubber capacitors within the two of the 4 transistors and small snubbers across the diodes. Figure 2 shows the proposed control algorithm for FB transistors. It differs for the extra change of control signals resulting in all three conducting transistors simultaneously instead of four within conventional overlay control.

Figure 2 shows the working principle of the proposed solution. Inductor current IL2 has BCM operation, while the current IL1 from inductor L1 can have BCM or continuous conduction mode, close to BCM.As a result, complete ZVS switching on of transistors S2 and S4 can be achieved.

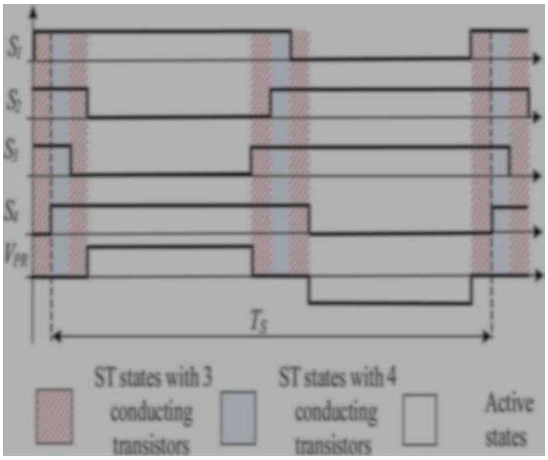


Fig 2: Gate pulses of switches of the ZVS DC-DC Converter

The ZVS switching off of the highest transistors S1 and S3 can be achieved for the same reason. At the same point in time to eliminate the turn-on switching losses, the inductor current IL2 is forced into the BCM by the transistors S1 and S3.As a result, turning on the transistors S1 and S3 corresponds to the start of the conduction mode ST[6] under the condition ZCS [1] .

III. MODES OFOPERATION

MODE 1: $t1$ - $t2$: At time $t1$, transistor $S3$ turns on and the qZS network is transferred to ST conduction mode. Initially, the snubber capacitor $CS2$ is partially discharged through the leakage inductance and the upper transistor $s1$.At the end of this transient process, the transistor $S2$ can be turned on. **The** final simulation and **the** experimental waveforms would depend on the certain rel**ationship** 40 **to** 4between the snubber capacitor and the leakage inductance values. Time interval. T**he** transistors$S3$ and $S4$ conduct. **They** correspond **to** the ST **l**ine mode **if** only one **branch** is involved in the ST generation. MOD**US** 3: $t3$ - $t4$: during the time interval**$t3$ - $t4$**.All transistors conduct. Since all transistors are **below** zero voltage, there are no dynamic losses after **switching on** transistor$S2$.The current is shared between two **branch**es of FB. MODE 4: $t4$ - $t5$: when transistor $S1$ is off. It occurs **i**n the full ZVS condition and does not influence the behavior **of the drive** because the ST state is still valid. : $t5$ - $t6$: At time $t5$, transistor $S4$ turn**s** off under the full ZVS condition due to the snubber capacitor. **Damping** capacitor $CS4$ **is** charge**d** through network **qZS** and transistor S3.This process **is** continue**d** **until** the time $t6$. MODE 6:$t6$ - $t7$: during the time interval**$t6$ - $t7$**.The**above** time intervals correspond to the operation **of half the period**. **The** further switching process **is** symmetrical. It should be noted that **the** time intervals $t1$ - 3 and $t4$ - $t5$ correspond to the ST conduction mode when only one leg is conducting. These time intervals are n**ecessary** to **ensur**e full soft-switching operation**,** but at the same time should be as short as possible to reduce **l**ine losses.

IV. RESULTS ANDDISCUSSION

Using PSIM, the simulation is done in 100 W prototype. Simulation parameters are given in Table 1.

Table 1 – Parameters of the system

Input voltage/ Output voltage	15-30 V
Maximum Power	100 W
L1/L2	0.75μH, 0.35H
C1,C2/C_{S2},C_{S4}	26.5μF/24nF
Transformer leakage inductance L_L/Magnetizing inductance L_M	1400nH/60 μH
C_{d1},C_{d2}/C_3,C_4	120pF/22 μF
ST Switching frequency	600KHz
diode, forward voltage drop	0.62V
VDR diodes, forward voltage drop	1.5V
MOSFET, Open drain-source Resistance/ R_S	0.25m Ohm/10hm

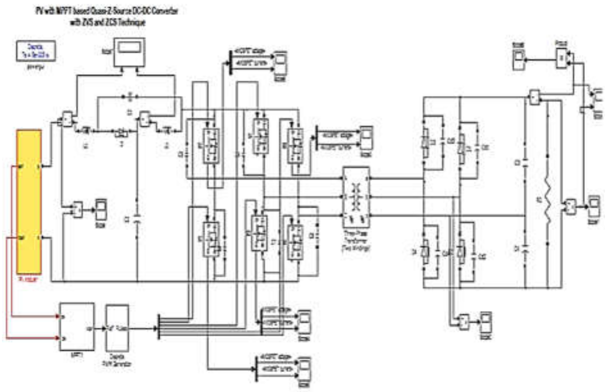


Fig 3: Simulink model of proposed converter

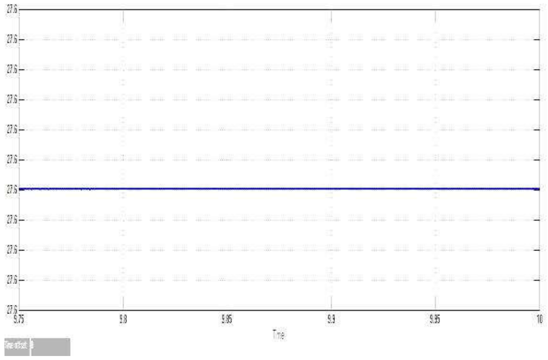


Fig 4: Input Voltage

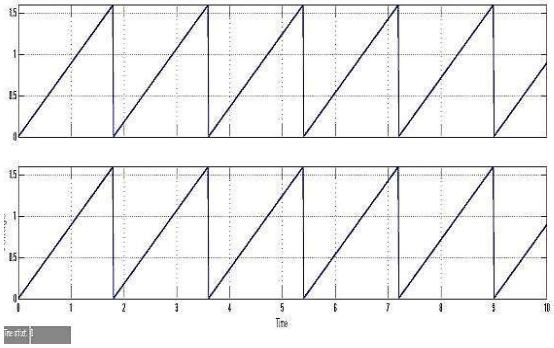


Fig 5: Inductor Voltage

Fig6: Switching Pulses

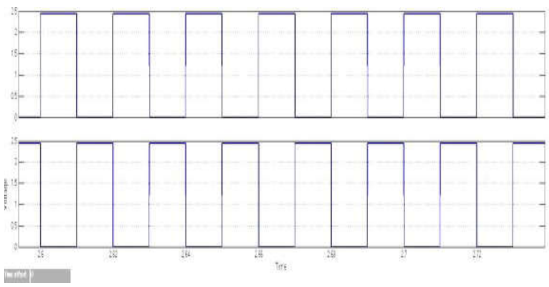
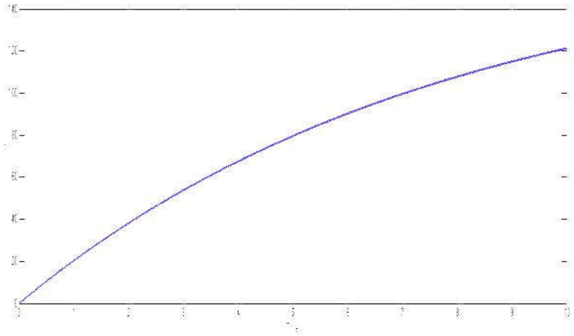


Fig 7: Output voltage



Working points were tested. Fig 4 illustrates simulation results of the operation point with the proposed control approach where the maximum ST duty cycle is required (*DS* = 0.25). In this working point, the ST states consist of *DSF*=0.23and*DSH*=0.02. It means that the ST state is realized by means of only one leg for a very short moment of time. This short moment of time is enough to realize full soft switching conditions. Fig 5 shows the inductor currents I_{L1} ,I_{L2} . It can be seen that, despite the DCM mode in the inductor current I_{L2} , the input current has the CCM. The input voltage $V_{IN}$was about 14 V, and the input power was about 80W. The output voltage was about 300V.fig 5 presents the study of the transistors' switching conditions. It can be seen that the diagrams correspond to the theoretical expectation.

V. CONCLUSION

In this paper, quasi Z source DC-DC converter with ZVS and ZCS technique is implemented. Switching losses and switching frequency are reduced with reduced passive elements.

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