

A New Reduced Voltage Stress ZVT-ZVS PWM Full-Bridge DC-DC Converter

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Abstract— A new reduced voltage stress soft switching PWM current fed Full-Bridge DC-DC converter for fuel cells and photovoltaic cells applications is proposed in this study. The snubber cell provides Zero Voltage Transition (ZVT) turn on and Zero Voltage Switching (ZVS) turn off together for main switches in the converter. The voltage stresses of the main switches are reduced and turning them off became better by adding an extra passive component. Besides, all components operate under soft switching, the current or voltage stresses on the auxiliary component are quite in acceptable level, and the main devices do not have any additional current stresses. In addition, the simplified structure makes the novel converter easy to control. Detailed analysis and synthesis of the new converter is introduced, and usefulness of the design is confirmed by simulation studies of a 1.5 kW and 25 kHz full bridge converter.

Keywords—Soft switching, active snubber cells, zero voltage transition, zero voltage switching.

I. INTRODUCTION

Pulse Width Modulation (PWM) full bridge DC-DC converters are being used widely in industry especially in the renewable energy systems, fuel cells and electric vehicles. In order to reduce costs and increase the power density in a converter the switching frequency needs to be increased. However, switching losses and electromagnetic interference (EMI) increase when switching frequency rises.

In order to overcome the problems that occur in high-frequency zero voltage transition (ZVT) or/and zero current transition (ZCT) soft switching techniques should be used instead of hard switching (HS).

For example; in resonant converter, filter design becomes complicated due to the requirement of the changing switching frequency. Additionally, the current stresses are high, total efficiency is reduced due to circulation losses [1]-[3], and some of the energy is dissipated by passive snubber cells [4]-[5]. In the ZCT converters, there are devices on the main current lines [6]-[7] and the turn on of the main switches are with HS [6]. The voltage stresses occur on the main switches in ZVT converters [8]-[9]. In the reduced voltage stress converters, there are many auxiliary components so the design processes of a snubber cell are rather difficult [10]. Finally,

the snubberless soft switching converter has great current and voltage stress and soft switching occurs only in the small power applications [11].

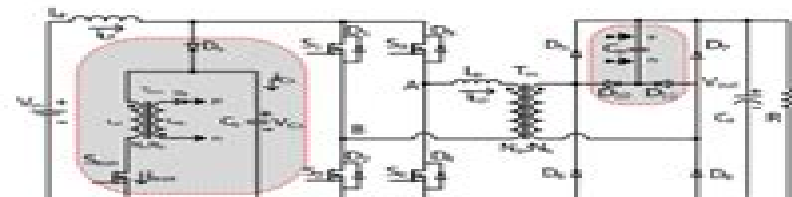


Fig. 1. Proposed PWM full bridge DC-DC converter

In this paper, a new active snubber cell is presented to contrive a new family of current fed full bridge DC-DC converters. The proposed circuit topology is shown in Fig. 1. In the converter, the main switches turn on with ZVT and turn off with ZVS softly. Furthermore, over the main switches does not occur current stress and the voltage stress is reduced to acceptable value with the aid of C_n capacitor. The auxiliary switch is turned on and off with ZCS and ZVS, respectively. Finally, the main diodes and the other auxiliary diodes are not subjected to any additional voltage and current stresses.

II. OPERATION PRINCIPLES AND ANALYSIS

A. Definitions and Assumptions

The circuit scheme of the new proposed ZVT-ZVS PWM full bridge converter is given in Fig. 1. The snubber cell consists of an auxiliary switch (S_{aux}), a magnetic coupled snubber inductor (T_{sn}), a snubber capacitor (C_n), an extra capacitor (C_s) and four auxiliary diodes (D_{s1} , D_{s2} , D_{s3} , D_{s4}). The antiparallel diodes D_{s1-4} can be considered as internal diodes of the main switches S_{1-4} . The parasitic capacitors of main switches are added in C_s .

Zvs Pwm Resonant Full Bridge Converter With Reduced

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