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Voltage Clamped Dc-Dc Convertor with Reduced Reverse Recovery Current And Stability Analysis

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Abstract: *this paper in vest gates a high-efficiency clamped-voltage dc–dc converter with reduced reverse-recovery current And switch-voltage stress. In the circuit topology, it is designed by way of the combination of in duct or and transformer to increase the corresponding voltage gain. Moreover, one additional inductor provides the reverse-current path of the transformer to enhance the utility rate of magnetic core. In addition, the voltage-clamped technology issued to reduce the switch-voltage stress so that it can select the Scotty diode in the output terminal for all aviating the reverse recovery current and decreasing the witching and conduction losses. Fur the more; the closed-loop control methodology is utilization the proposed scheme to overcome the voltage-drift problem of power source under the variation of loads. Thus, the proposed converter topology has a favor able voltage-clamped effect and superior conversion efficiency. Some experimental results via an example of a proton exchange membrane fuel cell (PEMFC) power source with a 250-W nominal rating are given to demonstrate the effectiveness of the proposed power-conversion strategy.*

Index Terms: *Converter, fuel cell, proton-exchange membrane (PEM), reverse recovery, voltage clamped.*

I. INTRODUCTION

INRECENT years, dc–dc converter switch steep voltage ratio are usually require din many industrial applications, e.g., the front-end stage for clean energy sources, the dc backup energy system for an uninterruptible power supply (UPS),high-intensity discharge (HID) lamps for automobile head lamps, And the telecommunication industry[1]–[3].The conventional boost converters cannot provide such a high dc-voltage ratio due to the losses associated with the inductor, filter capacitor, main switch, and output diode. Even for an extreme duty cycle, It will result in serious reverse-recovery problems and increase The rating of the output diode. As a result, the conversion efficiency is degraded, and the electromagnetic interference (EMI) problem is severe under this situation [4].In order to increase the conversion efficiency and voltage gain, many modified boost converter topologies have been investigated in the past decade[5]–[10].

Although voltage-clamped techniques are manipulated in the converter design to overcome the severe reverse-recovery problem of the output diode in high-level voltage applications, there still exist over large switch-voltage stresses, and the voltage gain is limited by the turn-ON time of the auxiliary switch [5], [6].da Silva et al. [7] presented a boost soft-single-switch converter, which has only one single active switch. It is able to operate with soft switching in a pulse width modulation (PWM) way without high voltage and current stresses. Unfortunately, the voltage gain is limited below four in order to achieve the function of soft switching. In [8] and [9], coupled inductors were employed to provide ea high step-up ratio and to reduce the switch-voltage stress substantially, and the reverse-recovery problem of the output diode was also alleviated efficiently.

In this case, the leakage energy of the coupled inductor is another problem as the main switch was turned OFF. It will result in a high voltage ripple a cross the main switch due to the resonant phenomenon induced by the leakage current. In order to protect the switch devices, either a high-voltage-rated device with higher RDS (ON) or a snubber circuit is usually adopted to deplete the leakage energy. Consequently, the power-conversion efficiency will be degraded. Zhao and Lee [10] introduced a family of high-efficiency high-step-up dc–dc converters by only adding one addition diode and a small capacitor. It can recycle the leakage energy an

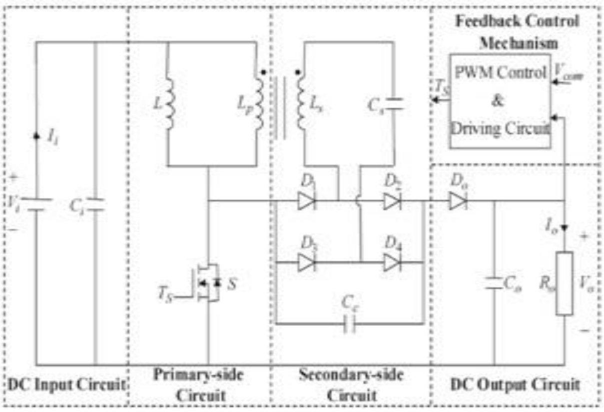

Fig. 1. System configuration of a high -efficiency voltage-clamped dc–dc converter.

Alleviate the reverse-recovery problem. However, a snubber circuit is still required in the output diode terminal with extra energy losses.

Nowadays, fuel cells are in the news because they appear to be one of the most efficient and effective solutions to the environmental pollution problem [11]–[17]. A fuel cell is an energy conversion device that produces electricity by electrochemically combining fuel (hydrogen) and oxidant (oxygen from the air) gases through electrodes, across an ion conduction electrolyte. This process produces much higher conversion efficiency than any conventional thermal-mechanical system, because it operates without combustion and extracts more electricity from the same amount of fuel. This system has the merits of high efficiency, energy security, reliability, pollution free, and quiet operations. Fuel cells have been known to science for more than 160 years and have recently become the subject of intense research and development. Up to the present, many demonstration projects have shown fuel-cell systems to be feasible for portable power, transportation, utility power and on-site power generation in a variety of building applications.