

A SINGLE SWITCH FULLY SOFT- SWITCHING ISOLATED DC-DC CONVERTER FOR RENEWABLE APPLICATION

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Abstract—

This paper proposes a soft switching techniques by using the isolated DC-DC converter in a single switch. To analysis and design of a new DC-DC converter applied for the applications, such as photovoltaic module-integrated converter (MIC) systems, portable fuel cell systems and vehicle inverters. The proposed topology, based on the soft switching technique, uses only one switch to step up the mains voltage with high gain. The proposed converter has able to offer reduced cost and high power density in boost application due to the following features because of the switch has turn on by Zero current switching and turn-off by Zero voltage switching and Zero current switching turn-off and diodes regardless of voltage and load variation and low rated lossless snubber and reduced volume of transformer comparing flyback converter due to low magnetizing current.

Index Terms—Isolated step up DC-DC converter, single switch, soft switching, MATLAB

INTRODUCTION

DC-DC converters are used in both step-up and step down application for step-up mostly used in photovoltaic module-integrated converter (MIC) systems, portable fuel cell systems [1] and hybrid vehicle inverters where high efficiency, high power density and low cost are required [4]. A photovoltaic system is a system which uses one or more solar panels to convert solar energy into electricity. In order to smaller input current ripple, lower diode voltage rating and lower transformer turns ratio, the current-fed isolated converter is most applicable for step-up applications. The current-fed isolated converter has two types: passive-clamped [5] and active-clamped [8] type used. The passive-clamped current-fed converter has simple structure and small switch count, but suffers from excessive power losses dissipated in the RCD snubber and associated with hard switching of main switch. Active-clamped current-fed converters have actively been developed based on three methods: push-pull [5], full-bridge [6] and half-bridge [11]. They achieve not only lossless clamping of voltage spikes caused by transformer leakage inductance but also zero-voltage switching (ZVS) turn on of the switches. The effect of the reverse-recovery-related problems become more significant for high switching frequency at high power level. However, they can't be achieving high efficiency and low cost in relatively low power application since they need at least two or more switches and corresponding gate driver circuits.

By reducing the number of switches in the Isolated converters have been proposed for low power application [8]. Isolated dc-dc converter switches one main switch and one clamp switch achieves ZVS turn on of switches, but switches are turned off with hard switching [11]. Isolated single switch dc-dc converters are more attractive to achieve low cost Z-source converter and flyback converter [14] are hard switched at both turn-on and turn-off instants. Frequency-controlled flyback converter and series-connected forward-flyback converter achieve zero-current switching (ZCS) turn-on of switch, but the switch is hard switched at turn-off instant. The above mentioned single switch topologies have increased transformer volume since magnetizing inductor is used for energy transfer. An isolated single-switch resonant converter achieves [15] both ZCS turn-on and ZCS turn-off of switch, but need high transformer turn ratio for step-up application due to low voltage gain and hence is not suited to boosted application.

This paper proposes a soft switching techniques by using the isolated DC-DC converter in a single switch. The proposed converter has the following features: 1) ZCS turn-on and ZVS turn-off of switch regardless of voltage and load variation 2) ZCS turn-off of all diodes leading to negligible voltage surge associated with the diode reverse recovery 3) small input current ripple due to continuous conduction mode operation 4) transformer volume are reduced due to low magnetizing current 5) low rated lossless snubber, which makes it possible to achieve high efficiency and low cost for step-up application.