

Phase-shifted Series Resonant Converter with Zero Voltage Switching Turn-on and Variable Frequency Control

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ABSTRACT

This paper presents a phase shifted series resonant converter with step up high frequency transformer to achieve the functions of high output voltage, high power density and wide range of Zero Voltage Switching (ZVS). In this approach, the output voltage is controlled by varying the switching frequency. The controller has been designed to achieve a good stability under different load conditions. The converter will react to the load variation by varying its switching frequency to satisfy the output voltage requirements. Therefore in order to maintain constant output voltage, for light load (50% of the load), the switching frequency will be decreased to meet the desired output, while for the full load (100%) conditions, the switching frequency will be increased. Since the controlled switching frequency is limited by the range between the higher and lower resonant frequencies, the switches can be turned on under ZVS. In this study, a laboratory experiment has been conducted to verify the effectiveness of the system performance.

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1. INTRODUCTION

Switching mode of dc-dc converters have been extensively researched and developed to satisfy most industrial power electronics requirements such as efficient conversion, higher power density, small size with light weight, and so on [1]-[3]. In order to achieve these demands, the converters must be switched by high frequency. However, it is impractical to raise the frequency of operation due to increase of the switching losses and electromagnetic interferences (EMI) [4]-[6]. Resonant converters with soft switching (Zero-voltage switching and Zero-current switching) have been proposed, and undoubtedly they are favored than hard switching conventional converters due to their ability to work at high frequency and reduce switching losses [2],[7]-[12]. The behavior of the resonant converter can be classified into many categories based on frequency ratio, switching technique and operating mode. When the resonant frequency is lower than the converter switching frequency, the converter will operate in continuous mode with turned on ZVS [13]-[15]. Meanwhile, ZCS can be achieved if the switching frequency is lower than operating frequency [16]-[18]. Series resonant converter has been recommended by several researchers according to its simplicity and popularity in many applications, where the LC components are connected in series with the rectifier-load network [19]-[22]. The drawback of the series resonant converters is that the input voltage is split between the resonant impedance and the load, which makes the DC gain of SRC is always lower than unity [9],[23]. In case of light load or no-load condition, it is difficult to control the output voltage. Thus, the zero voltage switching is limited to specific load conditions and input voltage ranges [16]. Several schemes have been