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Charge Current Controlled Single Phase Integrated Switched Mode Power factor Correction Converter

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Abstract

Integration of converters reduces the number of control switches and increases the power handling capacity. Charge current control have the features like fast dynamic response, design of compensator is easy and low switching noise, so this controller is applicable for power factor correction application. In this paper analysis, design and implementation of charge current controlled integrated buck flayback converter is proposed. A universal range of ac input (90-230V), 48V dc output, 100W load, 100 KHz switching frequency integrated converter is implemented using MATLAB/ Simulink software. Experimental results conform and validate the analysis.

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Keywords: Charge current control; Integrated converter; PFC; Switched Mode Power Converter;

1. Introduction

Growing use of AC/DC power converters in industrial, transport, utility systems and home appliances introduces harmonic currents on low voltage AC public mains networks [1]. To minimize these harmonics and to meet IEC 6100-3-2 and other international regulations, the traditional method of using passive components network is not suitable for medium and high power levels due to increase in component size and lower efficiency [2]. Another method proposed in the past literature was active power factor correction technique [3]. The active power factor

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correction done with the help of simple single converter module is referred as single stage active power factor correction, but high current stress in switch and EMI problems makes it unattractive[4]. The next approach is two stage approaches, in which two separate converters are connected in cascade and out of two converters, one converter acts like a power factor correction converter and another acts as a voltage regulator. These two converters are controlled independently with two different controllers to realize the goal. Therefore it is expensive and more suitable for high power applications. This paper proposes an integration of converters approach which has the features of both single converter approach and two stage approaches.

Buck converter is integrated with flyback converter and named as integrated buck-flyback converter which is considered as the ISMPC in this paper[5-15]. The proposed converter operates as a flyback converter when input voltage is greater than buck capacitor voltage and as a buck converter when input voltage is less than buck capacitor voltage. It requires no dead zone, there by PF is improved and meets the IEC-61000-3-2 class C limits.

Charge control is a new and modern technique for PFC converters. In literature this controller was used in multi resonant and quasi resonant dc-dc converters [16, 17]. The origin of this controller is from the peak current controller, but having of features like using of external ramp is not required and better noise immunity.

2. Integrated Switched mode power Converter

In this buck converter is power factor correction converter and flyback converter as a power control converter. Buck Converter consists of L_b,D_c,D_a,SW_1,C_b,V_p and Flyback Converter consists of C_b,SW_1,1:m,D_b,D_a,D_d,C_o. Here SW1 is common for both the converters.

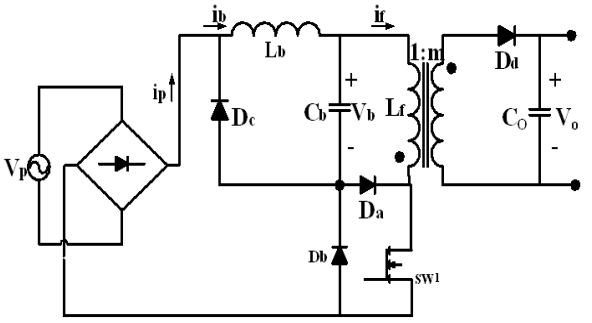

Fig. 1 Integrated Switched Mode Converter

This converter operates in four stages,

First Stage: When SW1 is on, buck inductor (L_b) and flyback primary inductor (L_f) are storing energy and output capacitance (Co) feeding load.

Second Stage: When SW1 is off, buck inductor (L_b) is discharging and flyback secondary inductance is discharging.

Third Stage: before completion of discharge of flyback secondary inductor energy already buck inductor completes its energy completely.

Fourth Stage: In this flyback secondary inductor discharges energy completely and output capacitor feeds load.

The above four stages of working is shown in Fig.2.

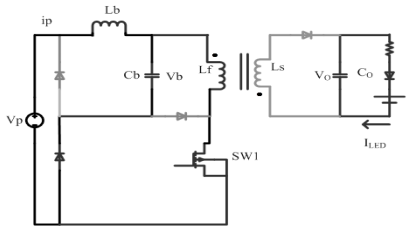

Fig. 2 .a First stage

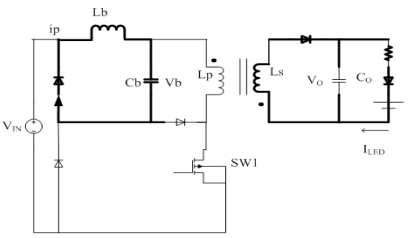

Fig. 2. b Second stage