

To Implement AC-DC Converter THD Measurement

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ABSTRACT: In the single stage single switch power factor correction circuit, the power factor is improved by using an auxiliary winding coupled to the transformer of a cascade dc/dc fly back converter. The auxiliary winding is placed between the input rectifier and the low-frequency filter capacitor to serve as a magnetic switch to drive an input inductor. Since the dc/dc converter is operated at high-switching frequency, the auxiliary windings produce a high frequency pulsating source such that the input current conduction angle is significantly lengthened and the input current harmonics is reduced. It eliminates the use of active switch and control circuit for PFC, which results in lower cost and higher efficiency. In order to achieve low harmonic content, the input inductor is designed to operate in discontinuous current mode. Operating principles, analysis, and simulation results of the proposed method are presented.

KEYWORDS- AC/DC converter, power factor correction, single stage

I. INTRODUCTION

Conventional offline power converters with diode-capacitor rectifiers have resulted in distorted input current waveforms with high harmonic contents. A common approach to improving the power factor is a two-stage power conversion approach. The two-stage scheme results in high power factor and fast response output voltage by using two independent controllers and optimized power stages. The main drawbacks of this scheme are its relatively higher cost and larger size resulted from its complicated power stage topology and control circuits, particularly in low power applications. In order to reduce the cost, the single-stage approach, which integrates the PFC stage with a dc/dc converter into one stage, is developed.[1] These integrated single-stage power factor correction (PFC) converters usually use a boost converter to achieve PFC with discontinuous current mode (DCM) operation. Usually, the DCM operation gives a lower total harmonic distortion (THD) of the input current compared to the continuous current mode (CCM). However, the CCM operation yields slightly higher efficiency compared to the DCM operation.

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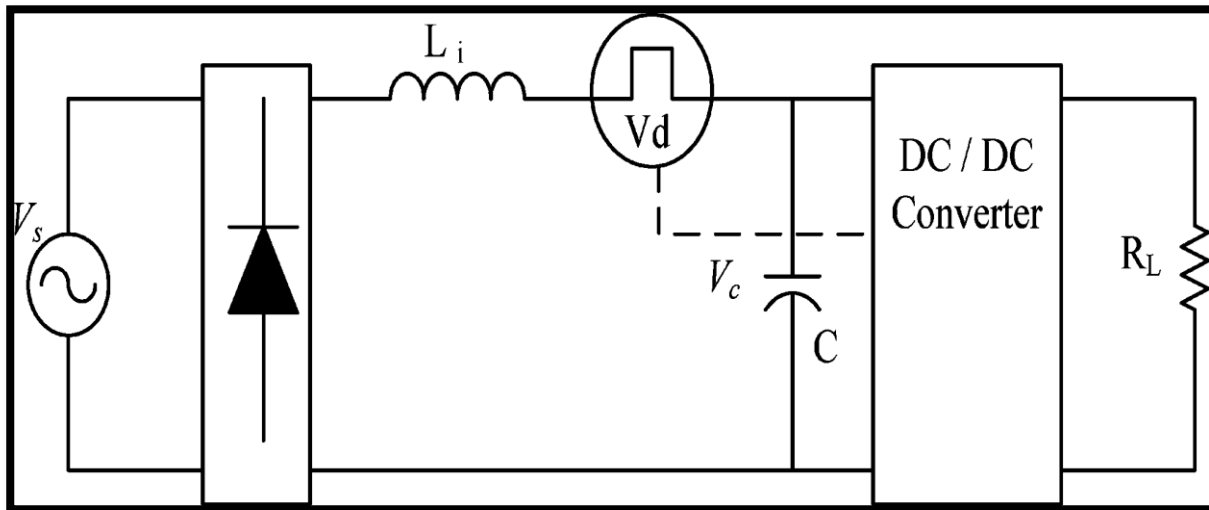


Figure 1. General circuit diagram of dither rectifier with PFC cell

The single-stage scheme is especially attractive in low cost and low power applications due to its simplified power stage and control circuit, major issues still exist, such as low efficiency and high as well as wide-range intermediate dc bus voltage stress. To overcome the disadvantages of the single-stage scheme, many converters with input current shaping have been presented, in which a high frequency ac voltage source (dither signal) is connected in series with the rectified input voltage in order to shape the input current (Figure. 1). Another technique based on parallel connection of this dither signal is presented however; the harmonic content can meet the regulatory standard by a small margin. In a new concept of single stage single switch PFC is proposed to improve the efficiency of a single-stage converter by preventing the input current or voltage stress due the PFC cell from being added to the active switch. In this circuit, the dc/dc cell operates in DCM so that a series of discontinuous pulses is used to shape the input inductor current and the PFC is achieved. As the circuit uses resonance of circuit parameters to achieve PFC, the control of the power factor will be very sensitive to the variation of components values.[2]

In this paper, a new technique of quasi-active PFC is proposed. As shown in Figure. 2, the PFC cell is formed by connecting the energy buffer (L_B) and an auxiliary winding (L_3) coupled to the transformer of the dc/dc cell, between the input rectifier and the low-frequency filter capacitor used in conventional power converter. Since the dc/dc cell is operated at high frequency, the auxiliary winding produces a high frequency pulsating source such that the input current conduction angle is significantly lengthened and the input current harmonics is reduced. The input inductor L_B operates in DCM such that a lower THD of the input current can be achieved.[3]

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II. PROPOSED CIRCUIT

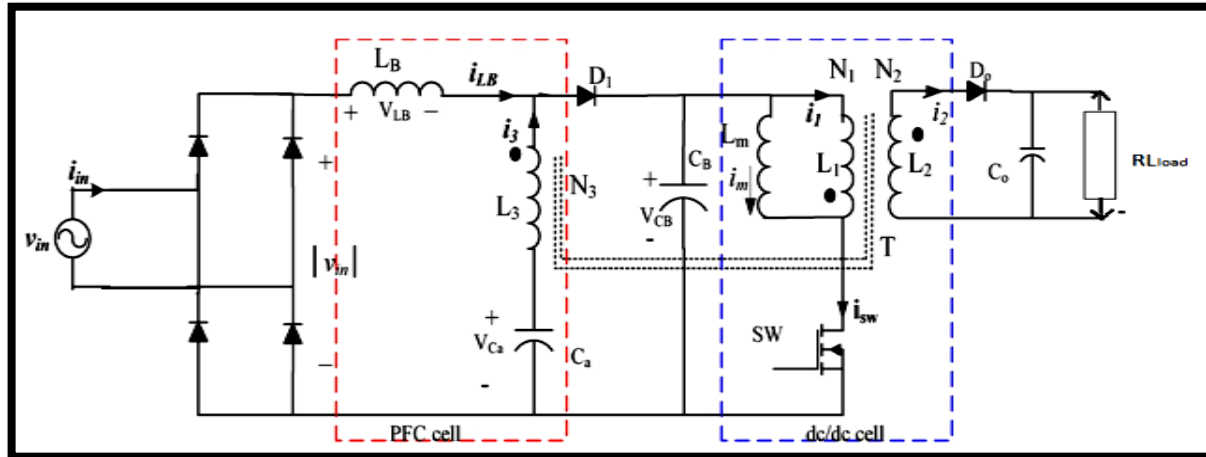


Figure 2. Proposed single stage PFC circuit diagram

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The proposed single stage PFC circuit is analyzed in this section. As shown in Figure 2, the circuit comprised of a bridge rectifier, boost inductor L_B , a bulk capacitor C_a in series with the auxiliary windings L_3 , an intermediate dc-bus voltage capacitor C_B , and a discontinuous input current power load, such as flyback converter. The flyback transformer (T) has three windings N_1 , N_2 , and N_3 . The secondary winding $N_2=1$ is assumed. In the proposed PFC scheme, the dc/dc converter section offers a driving power with high-frequency pulsating source. The single stage single switch PFC cell can be considered one power stage but without an active switch.[5][6].

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III.SIMULATION RESULTS

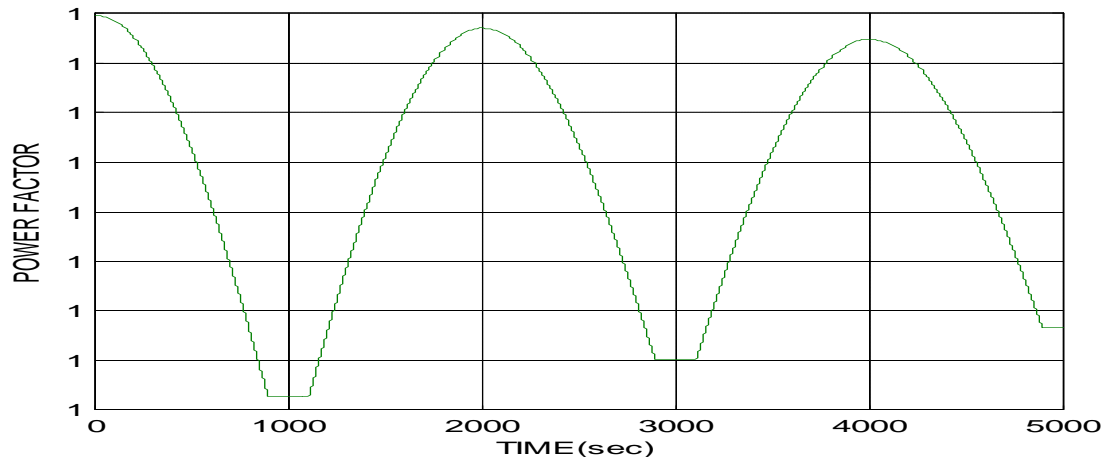


Figure 3 .Measured dc bus voltage V_{CB}

IV. CONCLUSION

The power factor improvement was obtained in ac-dc converter. It may be seen, that the proposed converter presents a high quality input current with THD <10% and high efficiency. However, the proposed converter has additional winding N_3 in series with capacitor (C_a), but they are small in size since N_3 operate at the converter switching frequency.

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