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Advance Bridgeless Buck PFC Converter and Inverter With Improved Input Current and Power Factor

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ABSTRACT:

The Advance bridgeless buck power factor correction (PFC) converters and inverter feature the merits of low output voltage and high efficiency while their nature existing dead angles in the input current deteriorate the input current harmonics and power factor (PF). Aiming to reduce the dead angles, a new bridgeless buck PFC converter is proposed in this paper. Through integrating the main buck circuit and the auxiliary flyback circuit with one magnetic core, the dead angles in input current of the proposed bridgeless buck PFC converter is eliminated so that the power factor and input current harmonics are improved. The proposed bridgeless buck PFC converter is designed to operate in discontinuous conduction mode (DCM) with the merits of simple controller and nature current shaping ability. A new logic control circuit is provided. The detailed theoretical derivations and design consideration are presented. The experimental comparison among the proposed bridgeless buck PFC converter, the conventional buck PFC converter and the conventional bridgeless buck PFC converter is displayed to validate the effectiveness of the new converter.

1. INTRODUCTION:

The active power factor correction (PFC) converters are widely applied in power electronic equipment to meet the rigorous international input current harmonics standard like IEC 61000-3-2 limits. Commonly, the boost converter is the popular option as the PFC front-end because of its simple topology, excellent current-shaping performance, easy control and low cost [1]-[3]. Nevertheless, the boost PFC converter emerges two main drawbacks [4]. One is that its efficiency exhibits an obvious drop around 1%-3% at low line compared to high line. Another is that its high output voltage (380-400V)is detrimental to the switching losses of boost PFC front-end and its down-stream DC-DC converter. In recent years, the conventional buck PFC converter as an alternative of boost PFC converter in low power level applications has gotten much attentions by researchers and engineers, because it can provide high efficiency at low line and low output voltage. Some theoretical analysis and new topologies of the conventional buck PFC converter have been studied in [4]-[29]. However, when the input voltage is lower than the output voltage, the generated nature dead angles shown in Fig. 1 of the conventional buck PFC converter deteriorate the power factor (PF) and input current harmonics seriously. Thus, it is not easy for the conventional buck PFC converter to meet the input current harmonics standards.In order to improve the power factor and input current harmonics of the conventional buck PFC converter, some newcontrol methods and new topologies were proposed [18]-[29].

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In [18], an improved peak current control scheme was proposed to improve the input current harmonics and the efficiency of the conventional buck PFC converter. In [19], a variable on-time (VOT) control method for conventional buck PFC converter was proposed to improve input current harmonics and power factor. In [20], a prediction of quadratic sinusoidal current modulation for conventional buck PFC converter was proposed to mitigate the dead angles. The above three control methods can alleviate the input current harmonics, but the inherent dead angles still exist so that the input current harmonics are still unsatisfied. In [21], a novel conventional buck PFC converter using one cycle control was proposed, which can reduce them

2. PROPOSED SYSTEM:

An Advance bridgeless buck PFC converter& inverter shown in Fig. 2 is proposed, analyzed, and validated in this paper. In this new bridgeless buck PFC converter, the contribution of eliminated dead angles is achieved by using the auxiliary flyback circuit. Thus, higher PF and lower input current harmonics can be obtained. In the auxiliary flyback circuit of the proposed bridgeless buck PFC converter, two power switches, two input rectifier diodes, and two primary windings are required. The increased components in the auxiliary flyback circuit are not beneficial to the total cost and power density. Since the discontinuous conduction mode (DCM) is applied to the proposed bridgeless buck PFC converter, a simple control method, nature current shaping ability, zero-current turn on in the power switches, and zero-current turn OFF in the output diodes are obtained. Also, a new logic control circuit is designed to further improve the driving loss.$VG1$ and $VG3$ are the control signal of power switches $S1$ and $S3$, respectively. It is clear that the power switch $S1$ is driven in positive half-line cycles and the power switch $S3$ is driven in the flyback mode of positive half-line cycles. The primary inductor LP 1 only operates in the flyback mode and the secondary inductor $LS1$ operates in the whole

3. HARDWARE IMPLEMENTATION

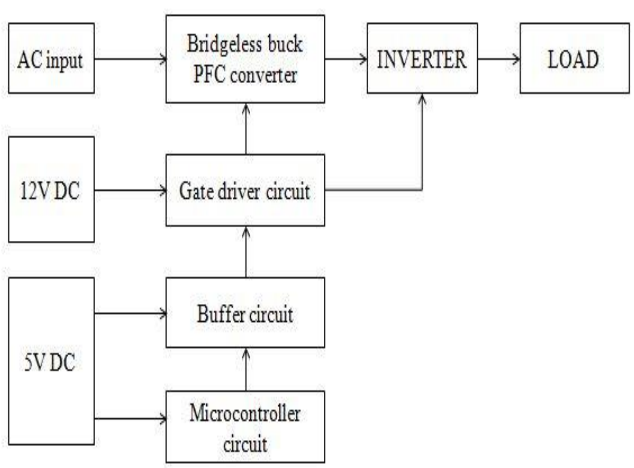

Fig 2.1 Block diagram

2.2 MODULES NAME

- **DC CONVERTERS**
- **INVERTER**
- **NON LINEAR LOAD**
- **POWER QUALITY**

2.3 MODULE DESCRIPTION

DC CONVERTERS

A DC to DC converter takes the voltage from a DC source and converts the voltage of supply into another DC voltage level. They are used to increase or decrease the voltage level. This is commonly used automobiles, portable chargers and portable DVD players. Some devices need a certain amount of voltage to run the device. Too much of power can destroy the device or less power may not be able to run the device. The converter takes the power from the battery and cuts down the voltage level, similarly a converter step-up the voltage level. For example, it might be necessary to step down the power of a large battery of 24V to 12V to run a radio.

INVERTER

An inverter is an electrical device that converts direct current (DC) to alternating current (AC); the converted AC can be at any required voltage and frequency with the use of appropriate transformers, switching, and control circuits. Solid-state inverters have no moving parts and are used in a wide range of applications, from small switching power supplies in computers, to large electric utility high-voltage direct current applications that transport bulk power. Inverters are commonly used to supply AC power from DC sources such as solar panels or batteries. There are two main types of inverter. The output of a modified sine wave inverter is similar to a square wave output except that the output goes to zero volts for a time before switching positive or negative. It is simple and low cost (~$0.10USD/Watt) and is compatible with most electronic devices, except for sensitive o specialized equipment, for example certain laser printers. A pure sine wave inverter produces a nearly perfect sine wave output (<3% total harmonic distortion) that is essentially the same as utility-supplied grid power. Thus it is compatible with all AC electronic devices. This is the type used in grid-tie inverters. Its design is more complex, and costs 5 or 10 times more per unit power (~$0.50 to $1.00USD/Watt). [1] The electrical inverter is a high-power electronic oscillator. It is so named because early mechanical AC to D converters was made to work in reverse, and thus was "inverted", to convert DC to AC. The inverter performs the opposite function of a rectifier.

NON LINEAR LOAD

A nonlinear load in a power system is characterized by the introduction of a switching action and consequently current interruptions. This behaviour provides current with different components that are multiples of the fundamental frequency of the system. These components are called harmonics. The amplitude and phase angle of a harmonic is dependent on the circuit and on the load it drives. For a fundamental power frequency of 60 Hz, the 2nd harmonic is 120 Hz, the 3rd harmonic is 180 Hz, and so on. The harmonic currents flow toward the power source through the path of least impedance.

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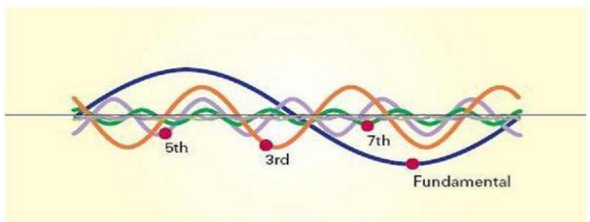
Some examples of nonlinear loads that can generate harmonic currents are computers, fax machines, printers, PLCs, refrigerators, TVs and electronic lighting ballasts. Personal computers constitute nonlinear loads since they incorporate switched-mode power supplies. The PC current is mainly dominated by the third and fifth harmonic components. Current harmonics deteriorate the power factor of the system, what is the ratio between the average power of a certain load and the average power calculated for a pure resistive load with equal voltage amplitude.



POWER QUALITY

Power quality is an issue that is becoming increasingly important to electricity consumers at all levels of usage. Sensitive power electronic equipment and non-linear loads are widely used in industrial, commercial and domestic applications leading to distortion in voltage and current waveforms. With ongoing regulatory, policy and structural changes in the Indian electricity industry, following the Electricity Act 2003, the issue of PQ is poised to become a figure-of-merit amongst the competing distribution utilities. Improvement of PQ has a positive impact on sustained profitability of the distribution utility on the one hand and customer satisfaction on the other.The main objective of the course is to enhance the knowledge of the participants in the emerging area of power quality and several key issues related to its modelling, assessment and mitigation. The course will provide a platform to an in-depth discussion on the various challenges and their possible remedies with respect to maintaining power quality in electricity sector, which will benefit participants from academic and R & D institutions, professional engineers from utilities, industries and policy maker.

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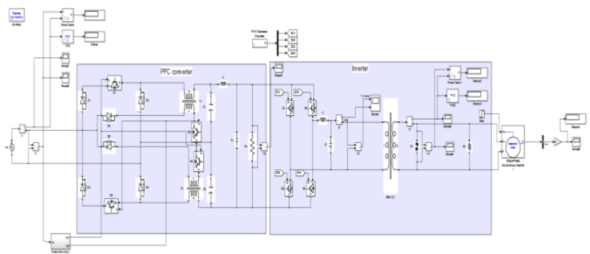
2.4 CIRCUIT EXPLANATION:



A. . CIRCUIT DIAGRAM

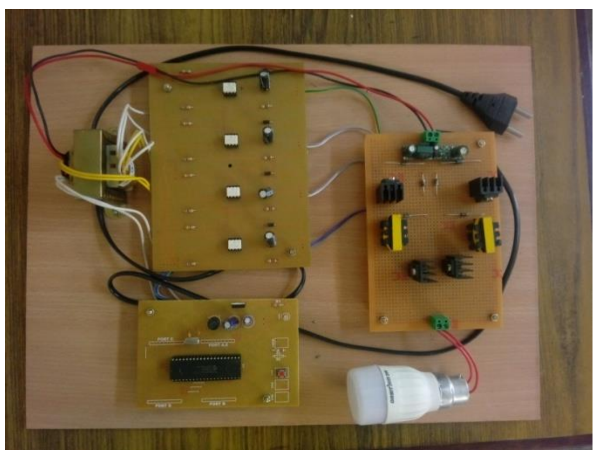


Fig 4.1 Hardware image

CONCULSION

A new bridgeless buck PFC converter with eliminated dead angles by using auxiliary flyback circuit is proposed, analyzed and validated in this paper. Due to the no-dead-angle input current, the power factor and input current harmonics are improved significantly. A simple controller and nature input current-shaping ability are achieved in DCM. The experimental results verify the theoretical derivation and show that the proposed bridgeless buck PFC converter has a higher power factor compared to the conventional buck PFC converter and the conventional bridgeless buck PFC converter, and its input current harmonics are improved and satisfy the IEC61000-3-2 class D limits completely.

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