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Harmonic Elimination in High Power Led Lighting System using Fuzzy Logic Controller

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ABSTRACT: High-power LED drivers with high power factors require large capacitances to limit the low frequency LED current ripples. Electrolytic capacitors are used oftenly because they are the only capacitors with required energy density toaccommodate high-power applications. Thus, the LED power regulation with high power efficiency and a long lifetime of LED operation can be simultaneously performed by multi-stage switching circuits. The LED power, power factor can be calculated and controlled by micro controller unit (MCU). Our paper proposes a bipolar ripple cancellation method with two different full-bridge power structures to cancel the low-frequency ac ripple in the LED current and minimize the output capacitance. Our proposed prototype has achieved a peak power factor of 0.92-0.93 benefiting from the conventional method.

KEYWORDS: Power Factor Correction (PFC), Microcontroller unit (MCU), Fuzzy Logic Controller, SVPWM, Fly-back Converter.

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I.INTRODUCTION

LED lamp technology becoming mature, cost-effective and energy-efficient power LED light will become dominant in the high-power lighting applications due to its high luminous flux, high efficiency, and long life span. The quality of LED lighting systems can be determined by the commonly used specifications, which are mainly dependent upon LED driver topologies. Recently, Energy Star has announced specifications for LED light bulbs, which include specific criteria for LED light bulbs that qualify their requirement. The conventional LED driver solutions for high-power LED drivers include two categories: 1) two-stage configuration and 2) single-stage configuration. Conventional lamps such as fluorescent lamps and incandescent lamps are being replaced with LED lamps due toits higher efficacy and longer lifetime, i.e., the lifetime of LED lamps is generally superior to that of the other lamps. Therefore, it is important for LED drivers have a long lifetime so that it can be used until the lifetime of LED lamps

The two-stage configuration, can Achieve high power factor (PF) and tight output current regulation, making it a mainstream solution for high-powerLED drivers. However, it exhibits a poor efficiency and low power density. Usually, capacitors of high capacitance value are needed at the output of the PF correction (PFC) stage to buffer the power difference of the ac input and dc output. With increasing demands in energy-saving, durable and low-cost lighting fixtures, there has been intensive research on LED technology for lighting application. At present, LED chip and packaging continue to improve with better efficiency and reliability. However, the LED drivers still suffer from high cost and reliability issues. The power supply driver starts to play a more important role in a high quality LED lighting system. It satisfies high input power factor (PF) and low total harmonic distortion (THD), and

Provides LED lamps with constant LED current, which ensures the stable operation of LED lamps. Have fairly a low power efficiency and short lifetime due to a high frequency switching loss and high junction temperature of the switching devices. Compared to the lifetime of LED lamps having more than 50,000 hours, theSMPS type LED drivers have relatively a short lifetime. In order to overcome these demerits, passive type LED drivers have been recently developed for very high efficiency. The LED power can be statically controlled by multi-stage switching circuits and a micro controller unit (MCU), which select the number of operating LEDs in series appropriately. The design procedure for the proposed LED driver was introduced and fully verified by experiments.

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II. CONFIGURATION OF PROPOSED SYSTEM

The proposed LED driver, as shown in Fig. which is mainlycomposed of one inductor and three capacitors in LC3 passive components, satisfying the Power Factor. The LED voltage and current feedback circuits are introduced to sense the LED voltage and current, respectively. The feedbacksignalsare connected to the MCU, which calculate the LED power *P* in MCU. DC power supply circuit, which is a step-down capacitive transformer , is adopted to provide the MCU with constant DC voltage *Vc* for MCU power supply.

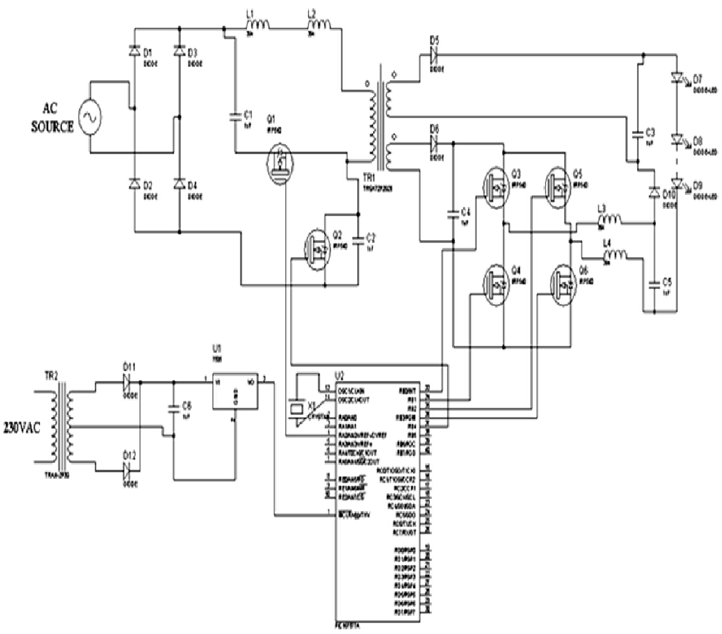

Fig 1.Configuration of Proposed System

The input supply is given to fly back stage for power factor correction; the switching pulse is given from microcontroller in fuzzy logic based. Then the inductor is used to boosting the dc voltage with help of gate driver circuit. In this circuit 7805 is used to give the constant 5v to micro controller. The svpwm is generated by the microcontroller and fed to MOSFET for switching process. Then the set led is connected to output side with reduced harmonics. Since the LED only conducts in one direction, the full wave rectifier allows the detection of an alternate leakage current signal. The two transient voltage suppressors (transports) protect the sensor from transients which may occur in the high voltage line. The transducer, is comprised of a ceramic cup in which the circuits are located, a polymeric insulator and a POF cable to transmit the current signal to the receiver system. For a high voltage TL application, the sensor taps the leakage current from the top skirt of the insulator string. The medium voltage distribution line version is intended to be installed on the top of the insulator.

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III.BLOCK DIAGRAM

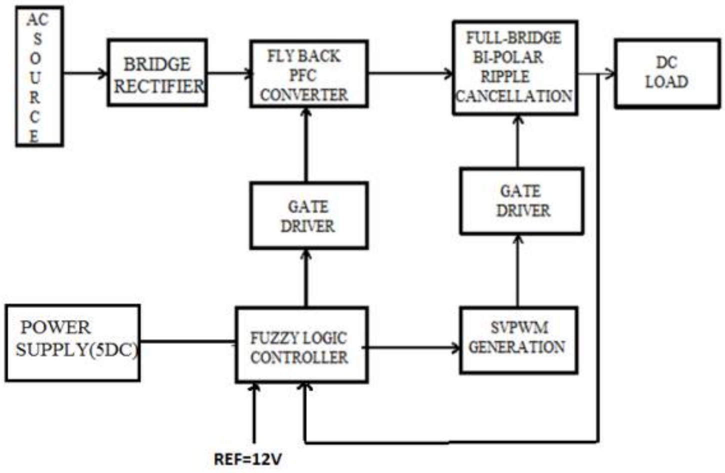

Fig 2 Block Diagram

The block diagram is shown in the fig 2,the various components like Bridge rectifier,FlybackPFC converter,Full bridge bipolar ripple cancellation and SVPWM Generation with Gate Driver and Fuzzy Logic Controller are implement to control the harmonic and to improve the system efficiency.

IV. HARDWARE

Fig 3 Hardware

Power Efficiency and Power Factor Performance

Since the proposed FB RCC only processes the ac ripple component, the efficiency loss during ripple cancellation is minimal. The power efficiency and PF performances of the two different bipolar ripple cancellation power structures (blue lines are with auxiliary winding and the red lines are with a floating capacitor) are measured. The experimental results show that both of the two bipolar ripple cancellation power configurations have exceeded 90.6% power efficiency and 0.97 PF given a universal ac input (110–220 V). The peak efficiency of the system is 92% with Power factor correction of 0.92 for the improved bipolar ripple cancellation with floating capacitor. In general, the floating capacitor bipolar ripple cancellation method presents a slightly higher efficiency.

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V. RESULT AND DISCUSSION

S.no	Condition	% Harmonics	Power factor		System efficency %	
			Before Implementing Proposed system	After Implementing Proposed System	Before Implementing Proposed System	After Implementing Proposed System
1	WITHOUT LOAD	11.5	0.85	0.93	65	90
2	WITH LOAD	5.5	0.65	0.92	55	95

Table 1 Proposed Method Result

Discussion:

High power LED System without load condition

In High power LED System without load condition the percentage harmonic level was found 11.5% and same is reduced by implementing proposed system .Now the power factor of the system is improved from 0.83 to 0.93 at the same time system efficiency is increased from 65% to 90%.

Likewise with the load condition

In High power LED System with load condition the percentage harmonic level was found 5.5% and the power factor is 0.65% and the percentage of the system efficiency is 55% in the existing condition and with the implementation of the proposed system the PF is increased upto 0.92 and system efficiency increased from 55% to 95%.

VI.CONCLUSION

This paper has proposed a new high-power LED driver configuration with a bipolar ripple cancellation stage (FB RCC). As a result, the required output capacitor value is significantly reduced and the electrolytic capacitors can be replaced by long-life power film capacitors. The experimental results demonstrate that, using a output capacitor, the double line frequency LED ripple current. a high power factor (PF), and a compact module size simultaneously, a light emitting diode (LED) driver based on a fixed LED current regulation scheme and a new PF enhancement (PFE) technique is proposed. The theoretical analysis of the proposed LED driver indicates that the LED forward voltage drop Vf has an optimal value considering the trade-off between the PF and the power conversion efficiency as a function of Vf. multi-stage switching circuits has been verified for a 9W LED application.

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