International Journal of Engineering and Techniques - Volume 4 Issue 2, Mar-Apr 2018

RESEARCH ARTICLE OPEN ACCESS

Implementation of Multi Chanel Single Stage Constant Current Control Topology for LED Driver Application

Mr.Fayaz Ahamed.A, Kaviyarasan V, Pradeep.M , Prasanth.K

[1]Assistant Professor,[2,3,4] UG-Scholar,

Department of Electrical and Electronics, R.M.K. Engineering College, Thiruvallur, Chennai.

Abstract:

Light-Emitting-Diode(LED) has become increasingly common in our daily lives for its high luminous efficacy, long lifetime, etc. The features of high luminous efficacy and long life make it use particularly attractive in applications such as street lighting, where costs associated with system maintenance and power consumption could be greatly decreased. In many applications, such as large-scale LCD panel backlighting, street lighting, tunnel lighting. In this proposed system. A novel multichannel constant current LED driver with a low cost and simple structure is proposed. which is composed of a high-frequency resonant ac/ac converter and as many passive LCL-T resonant rectifiers as the number of the output channels. The high frequency resonant ac/ac converter is focused on in this paper, which converts the ac-line input voltage into high frequency sinusoidal output voltage.

Keywords – **LED, LCL-T resonant rectifiers, the ac-line input voltage.**

I. INTRODUCTION

Many electronic appliances powered up by the utility, utilize the classical method of ac-dc rectification which involves a diode bridge rectifier (DBR) followed by a large electrolytic capacitor. The uncontrolled charging and discharging of this capacitor instigates harmonic-rich current being drawn from the utility which goes against the international power quality standard limits. Modern ac-dc converters incorporate power factor correction (PFC) and harmonic current reduction at the point of common coupling (PCC) which improves voltage regulation and efficiency at the load end. The Personal computer (PC) is one of the electronic equipment which is severely affected by power quality problems. Single stage and two stage conversions of ac voltage into dc voltage have been used in computers to maintain harmonic contents within limits and also to obtain stiffly regulated multiple outputs. Single stage power conversion is simple, compact and cost-effective. However, it suffers from poor dynamic response, control complexity, the high capacitance value and high component stress. So, two-stage conversion of ac voltage into multiple dc voltages is mostly preferred in computers.The component count in a two-stage power supply is much higher than its single stage counterpart. But, it provides better output voltage regulation, fast dynamic response and blocks the second harmonic (100Hz or 120Hz) component in the first stage itself so that large capacitors at the output side are avoided.Various front-end converters have been employed in the power supplies for providing PFC and output voltage regulation. A boost converter is a common choice for providing PFC in power supplies. However, it is not the preferred choice in computer power supplies due to its requirement for a large input voltage range. The output voltage of a boost converter cannot be controlled to a value less than 300V for a 220V ac input. So, a buck-boost converter is preferred in PCs where wide variations in input voltages and load are expected. Low output voltage ripple is preferred in a computer power supply as it is connected to various ICs. Single stage power supplies are used in many applications where power quality improvement and voltage regulation take place in a single stage. However, in computers, single stage configuration increases the stress across the switches and slows the voltage regulation under varying loads. Hence, two-stage PFC ac-dc converters based SMPSs are being employed to improve the input power quality and also to obtain an acceptable output voltage regulation. But, the efficiency of a two-stage SMPS is lower than the conventional SMPS. To eliminate this disadvantage, a new bridgeless front endconverter is proposed in this paper for computer power supplies which offer low switching ripple, sinusoidal input current and good dynamic response as compared to other non-isolated buck-boost converters. The elimination of DBR at the front-end results in reduced conduction losses and supports a larger output voltage range with enhanced efficiency. At the output of the front-end converter, a half bridge converter is used which provides isolation, regulation and multiple dc outputs with a better core utilization. It is observed from the available literature that the power quality improvement in SMPSs using bridgeless PFC converter has not been attempted by many researchers so far. In this work, a bridgeless single-ended primary inductance converter (SEPIC) operating in discontinuous conduction mode (DCM) is being used at the front end of the SMPS which offers excellent PFC at the rated as well as light load condition.The upper converter operates in the positive half cycle of the ac voltage while the lower converter operates in the negative half cycle. The output of the bridgeless PFC converter is connected to the isolated converter. Test results of the proposed multiple-output SMPS are found in line with the simulated performance demonstrating its improved power quality and output voltage regulation.

II. EXISTING SYSTEM

Many two-stage solutions are proposed earlier by integratingconstant current source stage and the front-end dc/dc stageinto a second multichannel constant current source stage in order to simplify the circuit structure, boost efficiency, andreduce cost. A multichannel constant currentsource is constructed by asymmetrical half bridges(AHBs) as LED strings. An LLC resonant converter with voltage doubler and multi transformer to serve as a multichannelconstant current source is implemented. Due to the series connection ofthe primary side windings of the transformers and the chargebalancing of the dc block capacitors, all output currents are automaticallybalanced. Then the structure is simplified and the costis reduced when compared with the solution above. In a multichannelconstant current source with only one transformer is proposedbased on charge balancing principle of the dc block capacitors.Inspired by the above structure that the passive LCL-T resonant rectifier is analyzed can achieve constant output current withoutany control circuits provided that the amplitude of its inputsinusoidal voltage is regulated to a constant value and the frequencyof it is equal to the resonant frequency of the LCL-Tresonant tank, another two-stage multichannel constant currentac/dc LED driver is proposed, which is composedof a high-frequency resonant ac/ac converter and as manypassive LCL-T resonant rectifiers as the number of the LEDstrings needed. The main advantageof this system is that it is a modular andcheap solution to realize multichannel outputs as only a passiveresonant rectifier is needed to increase a constant currentoutput channel, and only eight passive components are includedto build a LCL-T resonant rectifier. The main disadvantage isthat the output current of each output channel is not closed-loopregulated and the accuracy of it is affected by the tolerance of thepassive components.

There are two cascadedpower conversion units included in the high-frequency resonantac/ac converter, which are PFC unit and high-frequency resonantdc/ac unit. If the two units are independent, which meanseach unit has its own power stage and controller, the converter iscalled two-stage high-

There are two cascadedpower conversion units included in the high-frequency resonantac/ac converter, which are PFC unit and high-frequency resonantdc/ac unit. If the two units are independent, which meanseach unit has its own power stage and controller, the converter iscalled two-stage high-frequency resonant ac/ac converter. Thetwo-stage solution has good performance, however, the componentcount is large

and the cost is high, which can be used forhigh power applications. For the low-to-medium power applications,such as LED driver, single-stage solution is preferredbecause the component count and the cost can be obviouslyreduced by sharing the switches of the two power conversionunits and adopting only one controller. A low-frequencyac to high-frequency ac inverter is presented in the existing system, the cost is reducedwhen compared with the two-stage solution becauseonly oneunified controller is employed. Here, the power stage of theinner two power conversion units are considered as independent. In the existing paper, atrue single-stage high-frequency resonant ac/ac converter is proposedby integrating the PFC unit and high-frequency resonantdc/ac unit into one power stage and adopting only one controller,thus the component count and cost are reduced further.

A. Problems in Existing System

- Power factor correction.
- Multi channel constant current control.
- Galvanic isolation.
- Poor current sharing in LED string.

III. PROPOSED SYSTEM

A. Block Diagram Representation

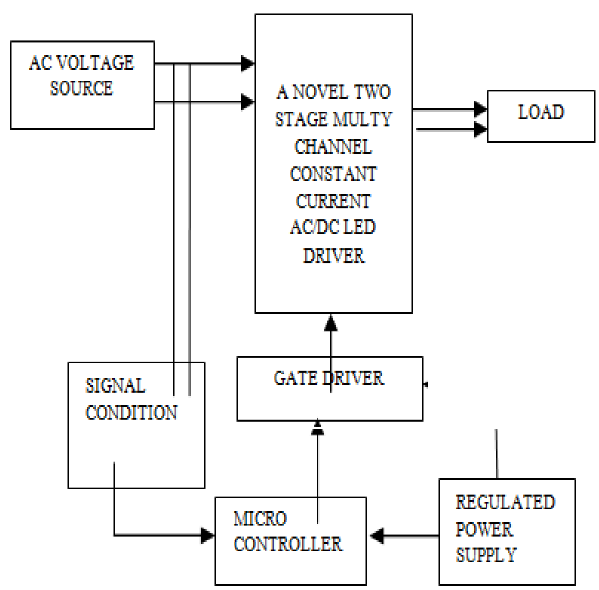

FIG 1 Block Diagram of the proposed system

In our proposed system A two stage multi channel nt current LED driver is proposed. In this system high-frequency resonant ac/ac converter is present. It provides the high frequency ac output voltage.The input voltage is ac voltage source. The proposed converter was control the output voltage and frequency. The microcontroller was control overall system. The RPS system was give the power supply was Micro controller and Gate driver. The gate driver used to provide isolation between converter and controller. The circuit representation of the proposed system is shown

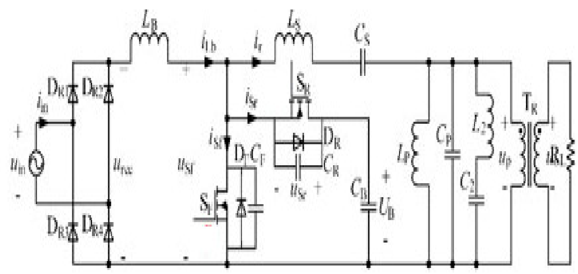

FIG 2 Circuit Diagram of Proposed System

The working procedure of the system is represented through the circuit functioning in the below figure.

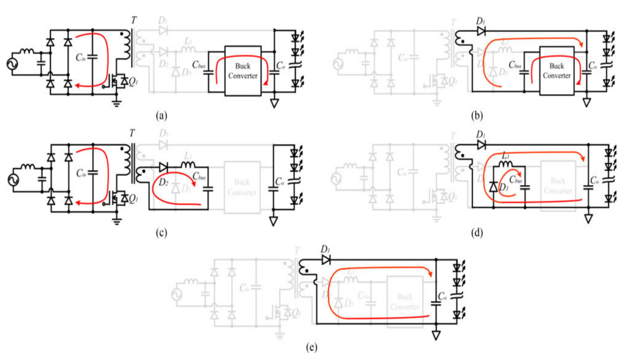

FIG 3 Functioning of the Circuit

B. Advantages of the system

- The power factor is improved.
- To obtain the constant current output.
- It provides the isolation.
- The current sharing of the converter is improve.
- Achieve the Low THD and High power factor.
- Improve the overall efficiency.

C. Hardware Components

The Hardware Component

1. IC 16F887
2. MOSFET Drivers
3. SignalC sensing)
4. Regulat wer Supply
5. Zero Crossing Detectors

1) IC 16F887

PIC microcontroller is widely used for experimental and modern applications because of its low price, the wide range of applications, high quality and ease of availability. It is ideal for machine control applications, measurement devices, and study purpose and so on.

a)Analog ToDigital Converter Module

When configuring and using the ADC the following functions must be considered. Port configuration: The ADC can be used to convert both analog and digital signals. When converting analog signals, the I/O pin should be configured for analogy by setting the associated TRIS and ANSEL bits.Port configuration

• Channel selection

• ADC voltage reference selection

• ADC conversion clock source

• Interrupt control

• Results formatting

2) MOSFET Drivers

The driver is nothing but an OPTO isolator. This is used to prevent the 100v directly affecting the PIC microcontroller. Here we are using isolator 4135.it is a six pin device It is used in following applications.

a)IsolationApplication

- Power supply regulators
- Digital logic inputs

The gate drive circuit forms the interface between the microcontroller and the power MOSFETs shown in the figure. The gate drive circuit has two purposes. Firstly, it buffers the gate signals generated by the micro controller. The microcontroller can only source a maximum of 20mA from each pin. The peak charging current required to turn

MOSFETs may be as high as 2 amps. This is due to the high switching frequency used along with the inherent gate capacitance of the MOSFET.

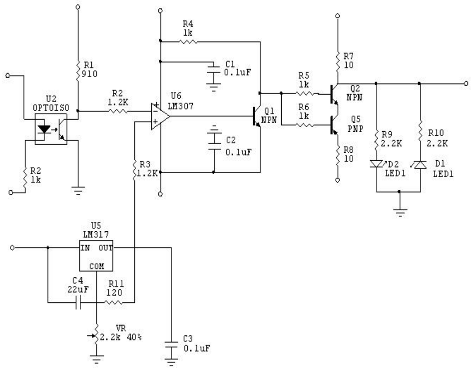

FIG 4 MOSFET Gate Driver Cicuit

The microcontroller output is given to the optocoupler. When the light source is emitted the switch is closed and the switch becomes short circuit and the output signal is given to the comparator. When the light source is not emitted the switch is open and the output signal is given to the comparator.The output of the OPTO-coupler is given to the inverting terminal of the comparator and the reference voltage is given to the Noninverting terminal by the adjustable voltage regulator. The comparator compares both the voltage and the higher voltage will pass through the comparator. If the inverting terminal output is 1 then the switch is closed and the negative supply passes from the comparator to the pushpull amplifier.The pushpull amplifier consists of NPN and PNP transistor If the output of the comparator is positive then the NPN transistor will allow the signal and the LED (red colour) will be indicated. If the output of the comparator is negative then the PNP transistor will allow the signal and the LED (green colour) will be indicated. If the positive supply is given to the gate terminal of the MOSFET then it will be turned ON.

3)Signal Conditioner

Signal conditioning can include amplification, filtering, converting, range matching, isolation and any other processes required to make sensor output suitable for processing after conditioning.

a) Filtering

Filtering is the most common signal conditioning function, as usually, not all the signal frequency spectrum contains valid data. The common example is 60 Hz AC power lines, present in most environments, which will produce noise if amplified.

b) Amplifying

Signal amplification performs two important functions: increases the resolution of the inputted signal, and increases its signal-to-noise ratio. For example, the output of an electronic temperature sensor, which is probably in the mill volts range, is probably too low for an Analogy-to-digital converter (ADC) to process directly. In this case it is necessary to bring the voltage level up to that requirement. Commonly used amplifiers on signal conditioning include Sample and hold amplifiers, Peak Detectors, Log amplifiers, Antilog amplifiers, Instrumentation amplifiers or programmable gain amplifiers.

c) Isolation

Signal isolation must be used in order to pass the signal from the source to the measurement device without a physical connection: it is often used to isolate possible sources of signal perturbations. Also notable is that it is important to isolate the potentially expensive equipment used to process the signal after conditioning from the sensor.Magnetic or optic isolation can be used. Magnetic isolation transforms the signal from voltage to a magnetic field, allowing the signal to be transmitted without a physical connection (for example, using a transformer). Optic isolation takes an electronic signal and modulates it to a signal coded by light transmission (optical encoding), which is then used for input for the next stage of processing.

d) Application

It is primarily utilized for data acquisition, in which sensor signals must be normalized and filtered to levels suitable for analog-to-digital conversion so they can be read by computerized devices. Other uses include pre-processing signals in order to reduce computing time, converting ranged data to Boolean values, for example when knowing when a sensor has reached the certain value.Types of devices that use signal conditioning include signal filters, instrument amplifiers, sample-and-hold amplifiers, isolation amplifiers, signal isolators, multiplexers, bridge conditioners, analog-to-digital converters, digital-to-analog converters, frequency converters or translators, voltage converters or inverters, frequency-to-voltage converters, voltage-to-frequency converters, current-to-voltage converters, current loop converters, and charge converters.

3) Regulated Power Supply

A power supply circuit was needed to provide power to logic level components as well as other components that were unable to operate from the 42-volt supply rail.

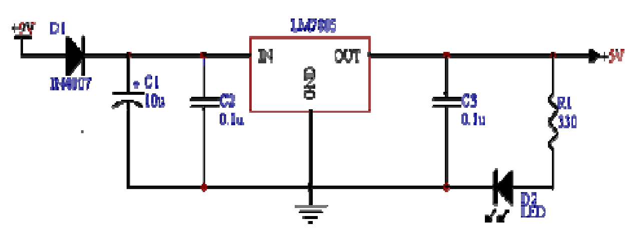

FIG 5 CIRCUIT DIAGRAM OF +5V SUPPLY

The gate drive circuitry, signal amplifier, and Hall Effect sensors required 12 volts to operate while all of the digital hardware needed 5V. It was decided to create a +12 volt rail from which the 5volt supply would be derived Most digital logic circuits and processors need a +5 volt power supply. To use these parts we need to build a regulated +5 volt source.

a) Transformer

A transformer is a static piece of which electric power in one circuit is transformed into electric power of same frequency in another circuit. It can raise or lower the voltage in a circuit but with corresponding decrease or increase in current. Step down transformer has been used for providing a necessary supply for the electronic circuit. In this paper, 230/12v transformer is used.

b) Filter

Filtering should be done in order to reduce the harmonics and ripples. For this purpose, we use capacitors for the filtering. They are rated at 100 v. here output voltage from the rectifier is 100 v. the capacitors are used in two arms. They share this voltage equally. The capacitors are therefore rated at 100micro F/100v. Each of the capacitors shares 50v. The capacitors are electrolytic in nature.

4) Zero Crossing Detector

As we are using nonlinear loads that are both ac and dc loads the load current will be distorted. This, in turn, affects the supply voltage. This will end by providing multiple zero crossings at the voltage waveforms. So in order to find the accurate amount of magnitude of filter current and its phase angle, we need to know whether the current is lagging or leading. For that, we go for the synchronous circuit. It does consist of two low pass filter circuits; all-pass filters and a zero crossing circuit. The multiple zero crossings caused by the harmonic current, if it is lesser we can use only one second order low pass filter or else for severe cases we use two such filters. After that the ripples may also be caused by the second order low pass filter, will be eliminated by the all-pass filter. Then the voltage wave is fed to the ZCD circuit. The ZCD will provide an uprising pulse for positive rising voltage and down going pulses for negative voltage.

IV. CONCLUSION

In this paper, the concept of energy channeling LED driver has been proposed. It is a true single-stage solution with high power factor and flicker-free LED driving performance. The input power is split into two portions to produce two output voltages. The main output provides energy storage and contains a 120Hz twice-line-frequency ripple voltage. The auxiliary output is controlled to cancel the ripple voltage of the main output. This way, a DC LED driving voltage is produced and drives the LED load with flicker-free performance. Both simulation and experiment have beenperformed to verify the proposed energy channeling LED driving method.

V. REFERENCE

[1] J. Y. Tsao, "Solid-state lighting: lamps, chips, and materials for tomorrow,"*IEEE Circuits and Devices Magazine,* vol. 20, pp. 28-37, May/Jun. 2004.

[2] T. Komine and M. Nakagawa, "Fundamental analysis for visible-light communication system using LED lights,"*IEEE Trans. ConsumerElectron.,* vol. 50, pp. 100-107, Feb. 2004.

[3] C. Chun-An, C. Hung-Liang, and C. Tsung-Yuan, "A Novel Single- Stage High-Power-Factor LED Street-Lighting Driver With Coupled Inductors,"*IEEE Trans. Ind. Appl.,* vol. 50, pp. 3037-3045, 2014.

[4] L. Jun-Young and C. Hyung-Jun, "6.6-kW Onboard Charger Design Using DCM PFC Converter With Harmonic Modulation Technique and Two-Stage DC/DC Converter,"*IEEE Trans. Ind. Electron.,* vol. 61, pp. 1243-1252, 2014.

[5] D. G. Lamar, M. Arias, A. Rodriguez, A. Fernandez, M. M. Hernando, and J. Sebastian, "Design-Oriented Analysis and Performance Evaluation of a Low-Cost High-Brightness LED Driver Based on FLYBACK Power Factor Corrector,"*IEEE Trans. Ind. Electron.,* vol. 60, pp. 2614-2626, 2013.

[6] M. Mahdavi and H. Farzanehfard, "Bridgeless SEPIC PFC Rectifier with Reduced Components and Conduction Losses,"*IEEE Trans. Ind.Electron.,* vol. 58, pp. 4153-4160, 2011.

[7] F. Musavi, M. Edington, W. Eberle, and W. G. Dunford, "Control Loop Design for a PFC Boost Converter With Ripple Steering,"*IEEE Trans.Ind. Appl.,* vol. 49, pp. 118-126, 2013.

[8] X. Xiaogao, Z. Chen, L. Qiang, and L. Shirong, "A Novel Integrated Buck-FLYBACK Non-isolated PFC Converter with High Power Factor,"*IEEE Trans. Ind. Electron.,* vol. 60, pp. 5603-5612, 2013.

[9] A. Shrivastava and B. Singh, "Zeta converter based power supply for HB-LED lamp with universal input," in *Proc. IEEE InternationalConference on Power Electronics, Drives and Energy Systems (PEDES)*, 2012, pp. 1-5.

[10] J. Reginaldo de Britto, A. E. D. Junior, L. C. De Freitas, V. J. Farias, E. A. A. Coelho, and J. B. Vieira, "Zeta DC/DC converter used as led lamp drive," in *Proc. European Conference on Power Electronics andApplications*, 2007, pp. 1-7.

[11] X. Xiaogao, W. Jian, Z. Chen, L. Qiang, and L. Shirong, "A Novel Output Current Estimation and Regulation Circuit for Primary Side
Controlled High Power Factor Single-Stage FLYBACK LED Driver,"*IEEE Trans. Power Electron.,* vol. 27, pp. 4602-4612, Nov. 2012.

[12] L. Yan-Cun and C. Chern-Lin, "A Novel Primary-Side Regulation Scheme for Single-Stage High-Power-Factor AC-DC LED Driving Circuit,"*IEEE Trans. Ind. Electron,* vol. 60, pp. 4978-4986, 2013.

[13] "Limits for harmonic current emissions, International Electro technical Commission Standard 61000-3-2," ed, 2004.

[14] B. Singh and V. Bist, "A PFC based BLDC motor drive using a Bridgeless Zeta converter," in *Proc. IEEE 39th Annual Conference ofIndustrial Electronics Society, IECON*, 2013, pp. 2553-2558.