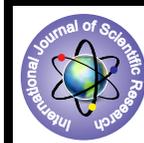


Double Buck Boost Converter Driver For Power Led Lamps



Engineering

KEYWORDS : IDBB Converter, LED, power factor, lighting, etc.,

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ABSTRACT

High brightness LEDs are an inexpensive, robust, and green replacement for halogen light bulbs. LEDs offer a much longer lifetime and eliminate the safety hazards of the inert gas, the expense of the UV filter encasement, and the handling sensitivity of halogens. Since halogen bulbs typically are driven with 12 or 24 V due to their excellent efficacy at those voltages, buildings have been wired with 12- and 24-V ac transformers for halogen lighting. Therefore, replacing existing halogen lighting with LEDs requires only an LED driver to convert the 12- or 24-V ac to an appropriate dc voltage.

A suitable circuit is a switch mode regulator LED driver designed for ac lighting that requires a high power factor (PF). The ideal load, with 100% power factor, is a pure resistor. In contrast to the resistive load, an LED driver with constant (dc) LED current, as is often used to power LEDs from a dc source, has a very poor power factor when used with an ac source.

In this paper, an integrated double buck–boost (IDBB) converter is proposed as a high-power-factor offline power supply for power-LED lamps. The IDBB converter features just one controlled switch and two inductors and is able to supply a solid-state lamp from the mains, providing high power factor and good efficiency.

Introduction:

LED lighting is one of the most promising solutions to deal with the increasing energy demands as natural resources around the world are becoming more expensive and less viable to sustain the needs of ever increasing populations around the world. Since the encapsulation technology of LEDs has become mature in the recent years, the LEDs are applied to the lighting areas such as the LCD backlight, the street lighting and the car head lighting. Generally, the use of LEDs is the development direction of the future lighting system.

LEDs can be divided into three categories: indicative LEDs, high-brightness LEDs, and power LEDs. Of these white power LEDs are becoming an attractive light source, owing to their high reliability, long life, high color rendering index, and small size. In addition, there are commercially available units that can reach light efficacies as high as 100 lm/W. All these features make white LEDs a good candidate to override fluorescent and other discharge lamps in many applications, including street lighting, automotive lighting, decorative applications, and household appliances. However, power LEDs are still far from being a panacea since they suffer from several drawbacks. First, due to their nearly constant-voltage behavior, they cannot be supplied from the dc or ac input voltage directly. Therefore, some kind of current-limiting device must be used, similarly to the ballast used to limit the current through a discharge lamp. On the other hand, the high efficacy of power LEDs is only maintained under strict operating conditions, which include low direct current and low junction temperature. All these mean that the development of power supplies that achieve correct driving of the LED-based lamp is an important topic of research.

Power LEDs suffer from drawbacks like:

- Their nearly constant-voltage behavior, they cannot be supplied from the dc or ac input voltage directly. So the LEDs need constant voltage as input and they need current limiter before the input of the LED.
- The high efficiency of power LEDs is only maintained under strict operating conditions, which include low direct current and low junction temperature.

This means that development of power supplies that achieve correct driving of the LED based lamps is important.

IDBB Converter:

In a Buck converter the average voltage is less than the input voltage, and it is vice-versa in a Boost converter. In a buck boost

converter we can have the output voltage level as required by adjusting the duty ratio and the output is very much sensitive to duty ratio.

The IDBB converter behaves as two buck–boost converters in cascade. The IDBB converter is proposed to supply power-LED lamps from the ac mains, providing high power factor (PF), low LED current ripple, and high efficiency. The operation of the converter is equivalent to two buck–boost converters in cascade, in which the controlled switch is shared by the two stages. Thus the proposed converter includes two inductors, two capacitors, three diodes, and one ground-referenced controlled switch, featuring affordable low cost and good reliability for this kind of applications.

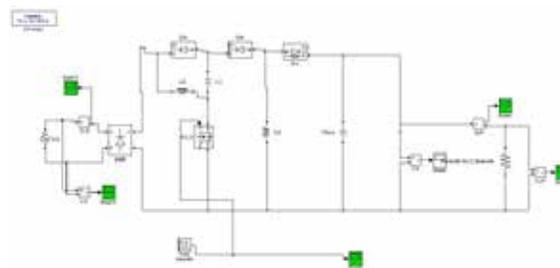


Fig 1: Simulation Model

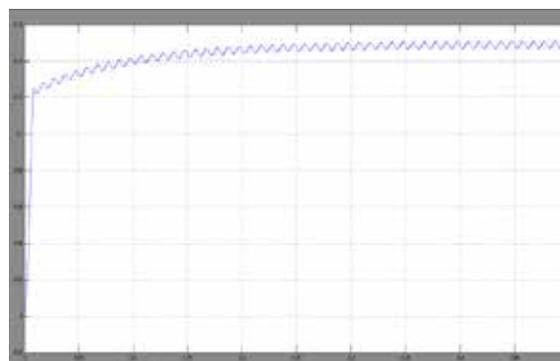


Fig 2: Current through LED Lamps

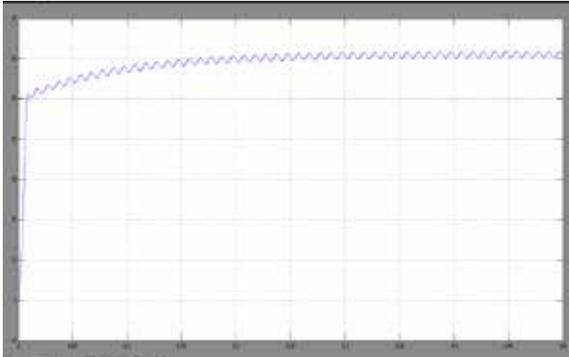


Fig 3: Voltage through LED Lamps

Conclusion:

The topology features two buck–boost converters in cascade but using only one controlled switch. By operating the input converter in DCM, a high input PF can be obtained. On the other hand, the operation of the second stage in CCM assures a low-ripple current through the LED load without using a very high output capacitance.

In this way, the converter can be implemented using only film capacitors, avoiding the use of electrolytic capacitors and increasing the converter mean time between failures. A laboratory prototype for a 70-W solid-state lamp supplied from a 230-Vrms line voltage has been developed. Experimental results have shown that the proposed converter can provide high PF, good efficiency, and low cost.

In this Paper, the converter was intended for a street lighting application where only two lighting levels are used. Thus, the low dimming level was implemented by reducing the mean current

through the LED lamp. It is proven that this method is more efficient compared with the PWM solution, because the LED efficiency increases for lower current values. Nevertheless, since the converter is formed by two stages integrated in a single one, its dynamics response can be made quite fast.

Therefore, it is expected that a PWM dimming feature could be added for dimming frequencies up to 200–500 Hz. In regard to galvanic isolation, the idea in this converter was to maintain it as simple as possible in order to reduce cost and achieve high efficiency. For these reasons, and taking into account that, at this moment, galvanic isolation is not required by the standards, the converter was designed without isolation. Nevertheless, it can be achieved very easily by simply including a secondary winding coupled to the output inductor. In this manner, the second stage will behave as a fly back converter instead of a buck–boost converter. The operation of the converter will be exactly the same, having just an extra design parameter given by the winding turn ratio.

Future Scope:

As a future scope, the low dimming level can be implemented by reducing the mean current through the LED lamp. It is proven that this method is more efficient compared with the PWM solution, because the LED efficiency increases for lower current values. Nevertheless, since the converter is formed by two stages integrated in a single one. Its dynamic response can be made quite fast. Therefore it is expected that a PWM dimming feature could be added for dimming frequencies up to 200 – 500 Hz. Also an EMI filter can be used to avoid high frequency current circulating through the line.

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