An Array of LED Driven by DC-DC CUK Converter using Arduino Control

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***Abstract*:- The LEDs are now approaching performance levels that make them attractive for use in several illumination applications. One of the main advantages of LEDs is their very long life that it is also related directly with the maintenance of the LED current, preventing the device overheating. To contribute with the advantages of the LEDs, the same ones need efficient drivers with optimized control circuitry. The main focus of this paper is to improve the LED driver characteristics using Arduino based converter, therefore, greater durability and efficiency can be achieved and working for different nominal values of voltage, from an universal input voltage or battery.**

General Terms:- Duty Cycle, Inductor, Capacitor, MOSFET

Keywords:- LED, CUK converter, Arduino.

1. INTRODUCTION

In recent years, Light Emitting Diodes (LEDs) have become a viable alternative to conventional light sources. Several factors have lead to the displacement, in ever increasing numbers, of incandescent bulbs. The LEDs present the following advantages: Extremely long life, 100.000 hours.

However, lamp life must be redefined for LEDs as a lamp module is composed of many LEDs, when one LED fails there are many more for back-up;

1. Extreme robustness: As there are no glass components or filaments they are virtually insensitive to vibration and movement;

2. No need for an external reflector because it is enclosed in the lamp casing to a predetermined beam width

3. A modular construction, which can be chosen to provide any required shape or light output

4. Relatively high efficiency compared with other colored light sources as there is no need for colored filters.

Previous works had presented proposals of circuits for drive string of LEDs with current regulation and pulse modulation based dimming techniques. The proposal of this work is to present an alternative to drive LED Lamps. Differently of the previous works, the circuit proposed in this paper is used for drive of LED Lamps at different nominal values of voltage, from an universal input voltage or battery. In this case, this paper proposes the use of the converter with digital control based on UNO ARDUINO. The converter is considered the optimum topology with non pulsating input current, non pulsating output current, minimum storage elements, minimum switch number, and high energy storage density using a capacitor instead of an inductor, which can operate capacitor instead of an inductor, which can operate as step-up/down. [1]

2. METHODOLOGY

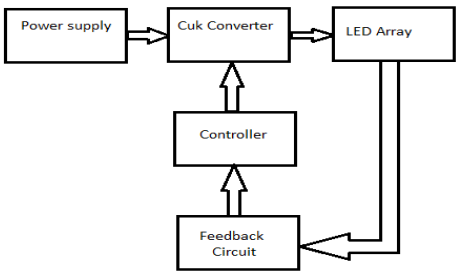
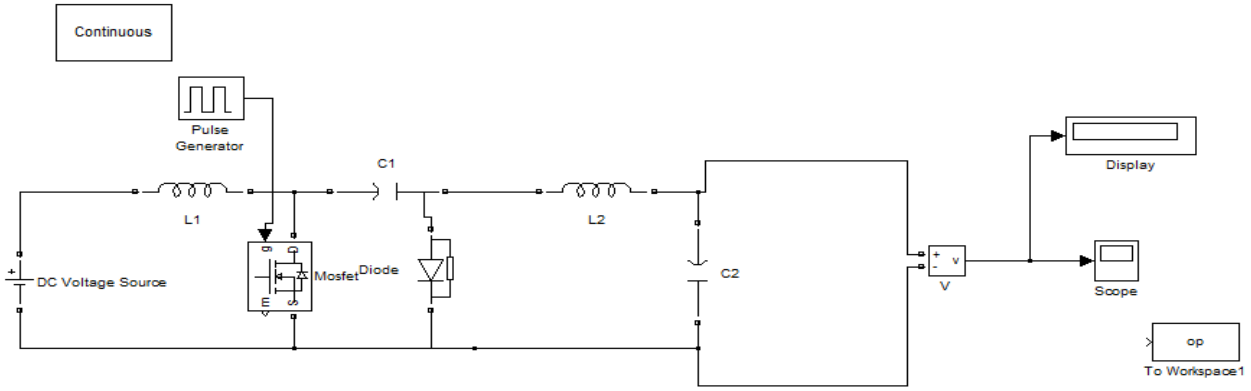


Fig.2 Block diagram of CUK LED driver

The above block diagram (Figure 2) shows the LED driver. Here the CUK converter is used to regulate the LED current supplied with a wide range dc input voltage source. Based on the equivalent circuits of the employed LEDs and driver, the transfer function of the control-to-output current gain can be derived. Converter is a DC -to- DC Converter of which output voltage is either greater than or less than the input voltage. The output voltage can be varied based on the duty cycle of the gate pulse to the MOSFET switches. Converter behaves both as a buck andboost depending of the duty cycle of the pulse. ARDUINO is used to control the converter.

SIMULINK MODEL



Figa.Simulink model of CUK Converter

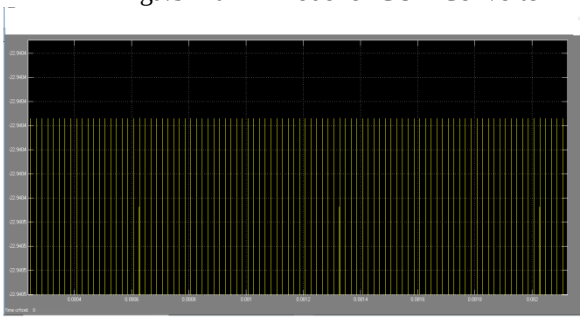


Fig a. Simulink result of CUK converter (Boost Mode)

Simulation output of -11V for a input of 6V and duty cycle of 63.

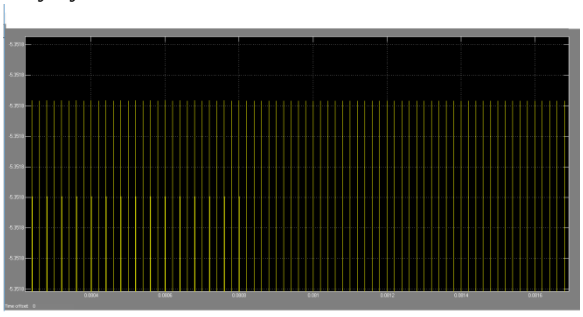


Fig b. Simulink result of CUK converter (Buck Mode)

Simulation output of -5V for a input of 6V and duty cycle of 45.

3. CUK CONVERTER

The CUK Converter [2] is a type of DC -to- DC converter that has an output voltage is either greater than or less than the input voltage. The CUK converter uses capacitive energy transfer between the input and output stages rather than the inductive energy transfer of other converters. The excellent frequency response characteristics of the CUK converter design allow highly stable feedback regulation to be achieved with simple circuitry. The circuit operation can be separated into two modes i.e, persistent conduction mode and intermittent conduction mode. Amid mode1,when the switch S is on, figure 3, current flows through the input inductor L1 and switch S, and then the power source stores energy in L1. Amid mode2, when S turns off, figure 2, current in L1 flows into the capacitor C and through diode D and transfer the energy to capacitor Co. Inductor current in L2 free wheels through D.

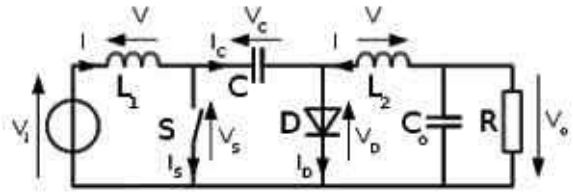


Fig.3.Circuit diagram of CUK converter

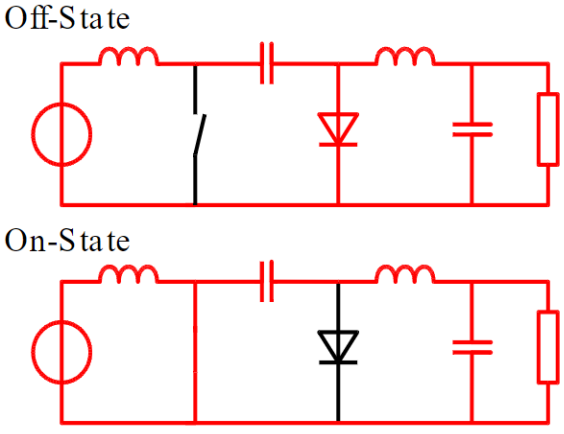


Fig.3.1 Two modes of operation
(a) OFF State, (b) ON State

5.LED

An LED display is a flat panel display which uses an array of light-emitting diodes as pixels for a video display. LED array drivers, with accurate current regulation offers a solution that is suitable for most of the applications. The use of LEDs in application like displays, information and advertising panels, signs, traffic signals and architectural lighting is becoming more and more use. Subsequently the primary drawback of these LEDs is that they require consistent input voltage and they require current limiter before the contribution of the LED. Thus unique kind of current –constraining gadget must be utilized, likewise to the solidness used to confine current through a release light. With the advancement there has been parcel of change in technology. As the innovation enhances high-proficiency, little switch-mode control supply for thedriving circuits have been produced as power supply to LEDs.

This project presents the optimal combination design of LED array for the single-loop continuous-conduction-mode CUK LED driver.

An n ×m LED array with m paralleled strings of n LEDs in series is shown in fig.5

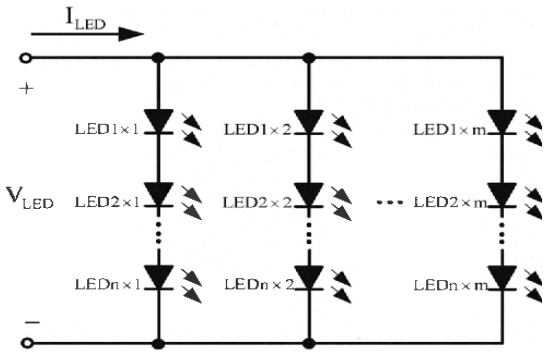


Fig.5. n×m LED array

In this project we use 9×9 led array which allows 100mA current. [4]

6.CONTROLLER

Arduino boards are equipped with sets of digital and analog input/output pins that may be interfaced to various expansion boards or breadboards and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus on some models, which are also used for loading programs from personal computers. It is used as a feedback controller in the project in order to buck or boost the given input by controlling duty cycle of the MOSFET switch in the simulation using Matlab.

7.RESULT AND CONCLUSION

In this project ideal design of LED array for CUK LED driver has been carried out. This project has presented the optimal combination design of the LED array for the closed loop CUK LED driver. In order to fulfil the requirements of the system stability and the power conversion with maximum efficiency, unity quality factor is preferred for the design of the LED array

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9.REFERENCES

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