IOSR Journal of Engineering (IOSRJEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
PP 16-19

Review of LED DIMMER

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Abstract: - *Wide utilization of Light Emitting Diodes (LEDs) is one of the most promising tendencies of modern lighting technologies. Implementation of LEDs ensures high efficacy of luminaries, lower power losses and, when equipped with dimmable power supplies, provides also improved. Utilization of Light Emitting Diodes (LEDs) in lighting system has the features of energy efficiency and smart support for control. It is possible to effectively dim light of LED lamps with no negative impact on LEDs.Being able to adjust the light source means to create the perfect atmosphere anytime. The convenient and flexible lighting of dimmable LED allows setting the warm, bright, dim and cozy state of light. The LED dimmer based on Pulse Width Modulation (PWM) with the Smart control is proposed. The Arduino UNO is used to provide the smart support for wire and wireless control. The LED dimmer warm glow dimming effect offer a new experience for Table Lamp with dimmable LEDs. The gradual dimming feature enables light levels to dim to warm tones of traditional bulbs.*

I. Introduction

Constantly growing demand for electrical energy and quite questionable prospects of new sources of electrical energy make the problem of energy efficiency very topical nowadays. There are two basic ways of making the energy consumption efficient: increasing the self-efficiency of electrical equipment and avoiding its unnecessary operation (making it "smart"). One of the most significant energy consumers is lighting .Most of the produced electrical energy in the world is consumed on lighting. So it is quite reasonable to improve efficiency of lighting system. Like it was previously mentioned there are two ways: utilization of the lighting technologies that produce more light per power unit and making lighting systems smart. Utilization of Light Emitting Diodes (LEDs) in lighting system has the features of energy efficiency and smart support for control. It is possible to effectively dim light of LED lamps with no negative impact on LEDs.Being able to adjust the light source means to create the perfect atmosphere anytime. The convenient and flexible lighting of dimmable LED allows setting the warm, bright, dim and cozy state of light. The LED dimmer based on Pulse Width Modulation (PWM) with the Smart control is proposed. The Arduino UNO is used to provide the smart support for wire and wireless control.

II. Literature Review

LED lighting technology is rapidly progressing, and it is very important to know how to control LEDs to ensure success for the end user and to achieve energy savings. A Light Emitting Diode (LED) also referred to as SSL (Solid State Lighting), is an electronic device (chip) that produces light when an electrical current is passed through it.The wavelength (or color) of light that is emitted is dependent on the LED materials. An LED is an electronic device (chip) that produces light when an electrical current is passed through it. There are two distinct types of LEDs: the LED lamp (also called a LEDi or retrofit lamp) and the LED fixture.LED drivers are low-voltage devices that convert the line-voltage 120/220/277 V power to the low voltage needed for the LEDs, and may also interpret control signals to dim the LEDs.LED drivers come in either constant current or constant voltage. These two types of drivers are not interchangeable, and it is the design of the LED load that determines which driver is appropriate. Both LED lamps and LED fixtures require LED drivers. LED driver depends on the dim fixture and dimming performance and life time of the LED device. Wide utilization of Light Emitting Diodes (LEDs) is one of the most promising tendencies of modern lighting technologies. Implementation of LEDs ensures high efficiency of luminaries, lower power losses and, when equipped with dimmable power supplies, provides also improved functionality of the luminaries that, in turn, in principle reduces amount of energy spent for lighting purposes. However, operation of the LED luminaries depends a lot onthe current regulation method implemented in the dimmer. The pulse controlling method reduces the losses and uses the DC chopper i.e. buck converter for dimming of LEDs[1]. The dimmers were the pulse mode circuits. The transistor of these has to be controlled by a pulse signal whose duty cycle defines the amount of energy transferred from the input of the converter to its output. Pulse-Width Modulation was most widely used method for controlling and required duty cycle was obtained with the same period of all pulses. In case of PWM the value of the carrier frequency has significant impact on the losses in the converter. Another approach was Frequency Modulation (FM) at which the required duty cycle was obtained with variable period or frequency [2]. Intelligent LED dimmer demand in lighting market is increasing due to energy saving potential, environment protection as well

as great possibility of control and management of lighting systems. An internet web browser controlled LED lighting systems and ZigBee based using Hall effect based LED dimmer was developed .This dimmer has the efficiency about 96 % [3]. There are many advantages to LEDs such as high efficacy (lumens per watt), product longevity, and lower heat load, and LED products are available in many sizes and shapes. Benefits of dimming LEDs for end users and occupants are energy savings, space flexibility, enhanced safety, and increased. The dimming of LEDs offers the benefits of dimming an lighting source at end users such as restaurant, theater, residence, hotel lobby or presentation space can create the environment that the designer intended, and enhance the ambiance for the end use. In a constant current reduction (CCR) supply, the current flows continuously at a set amount for a given light level. Since the amount of light output is proportional to the current flowing through the LED, the current is reduced to reduce the brightness of the LED. See the following diagram for an example of an LED that is reduced to approximately 25% using CCR. Sometimes this type of dimming is referred to as "Analog Dimming."

III. Controlling Method – PWM And BUCK CONVERTER

Pulse Width Modulation, or PWM, is a technique for getting analog results with digital inputs. In other words Pulse-width modulation (PWM) or pulse-duration modulation (PDM), is a modulation technique used to encode a message into a pulsing signal. Generally, digital control is used to create a square wave, a signal switched between on and off. This on-off pattern can simulate voltages in between full on and off by changing the portion of the time the signal spends on versus the time that the signal spends off. The average value of voltage (and current) fed to the load is controlled by turning the switch between supply and load on and off at a fast rate. The longer the switch is on compared to the off periods, the higher the total power supplied to the load. The duration of "on time" is called the pulse width. The fig 3.1 shows the PWM, the green lines represent a regular time period. This duration or period is the inverse of the PWM frequency. A call to analog Write() is on a scale of 0 - 255, such that analog Write(255) requests a 100% duty cycle (always on), and analog Write(127) is a 50% duty cycle (on half the time) for example.

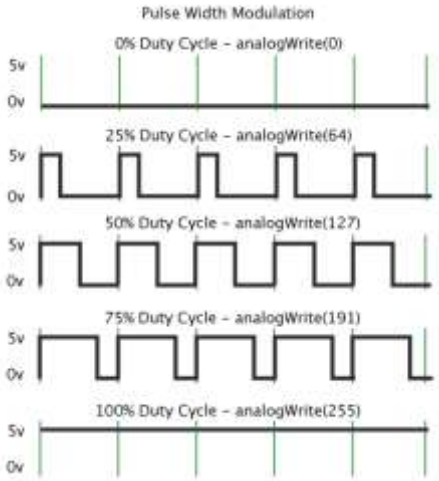

Fig 3.1 Pulse width Modulation

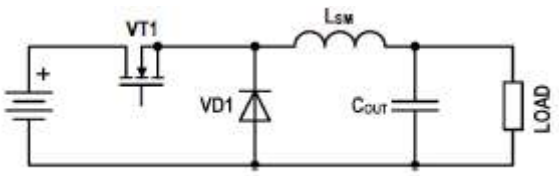

Fig3.2 Buck converter

Fig 3.2shows the buck converter i.e. DC-DC chopper the basic topology used to vary the on and off duration of the controlled output. The MOSFET acts as switch and operated by pulse i.e. the output of the PWM. The basic topology is rearranged as described in next section to design the LED dimmer.

IV. Led Dimmer

The switches SW1 and SW2 are used to provide the manual control on LED dimming. The wireless control is also provided through the Bluetooth module HT2E with Bluetooth android app using smart phone. The Buck converter is DC-DC chopper used to control the LED current to vary the intensity of LED.SMPS is used to provide the low voltage DC 5V, 12 V to operate the LED bank and processor board.

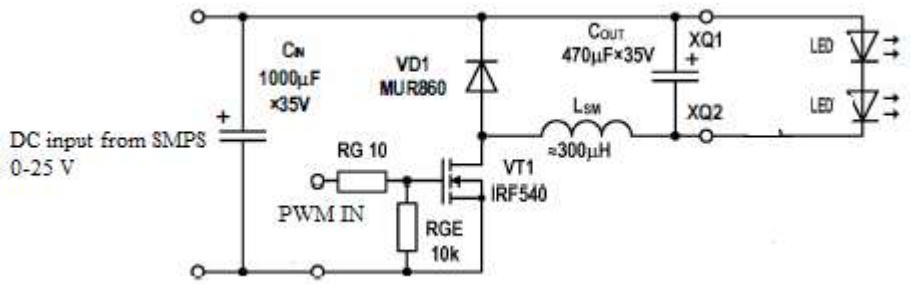

Fig 4.2 Buck converter for LED Dimmer

The basic configuration of the buck convertor i.e.step-down converter as shown in fig 3.2 is adopted in control mechanism of LED dimmer and suitable buck converter operated using Arduino is shown in fig.4.2. The converter has been designed to supply 1W LEDs. This string has rated voltage of about12 V at current 100mA. The most significant passive components - the current smoothing coil LSM and output capacitor COUT have been chosen taking into account the ripple considerations and in discontinuous mode of operations. The duty cycle is considered 50 % for calculating the values of LSM and COUT.

$$Lsm = \frac{(Vlmax)(\Delta tmax)}{\Delta Imin} \approx 300\mu H \quad (1)$$

$$Cout > \frac{Icmax\ \Delta tmax}{\Delta Vmin} \approx 250\mu F \quad (2)$$

The LED dimmer is a pulse mode converter whose operation is defined by the duty cycle and varied by the controlling pulses. The total time duration of pulse is kept constant. The operating frequency of the converter 244Hz and decided by the pulse width mode (PWM) of the Arduino processor. Arduino processor has 6 PWM outputs and one of them is used to control ON and OFF switching time of the MOSFET IRF540. The ON time varied from 0 to 4ms in 256 steps. The duty cycle or witching time is varied using switches SW1 and SW2. The SW1 increases the ON time of the pulse and SW2 decreases the ON time of the pulse. This pulse decides the switching time of the MOSFET IRF540. The wireless control is also provided using Bluetooth model HT2E and serially communicated with the android handheld device. The controlling mechanism is operated in open loop.

V. Led Dimmer In Table Lamp

Lighting or illumination is the deliberate use of light to achieve a practical or aesthetic effect. Lighting includes the use of both artificial light sources like lamps and light fixtures, as well as natural illumination by capturing day light. Proper lighting can enhance task performance, improve the appearance of an area, or have positive psychological effects on occupants.Being able to the light source means able to create the perfect atmosphere anytime. The light atmosphere can be warm, bright, dim and cozy. The LED dimmer warm glow dimming effect offer a new experience for Table Lamp with dimmable LEDs. The gradual dimming feature enables light levels to dim to warm tones of traditional bulbs. Unlike standard LEDs, this offer a dimmable warm glow in a familiar shape. The dimmable LED provides the comfort level and brightness.

VI. Conclusion

The intensity of the LED bank is varied in 256 steps using switches SW1 and SW2 as well as the wireless control. The intensity is varied from low to high i.e. from OFF state to Full ON state by varied the duty cycle of the pulse. This is basically changing the forward biasing voltage of the LED. The device is operated on 230V, 50Hz supply with the help of low watt (1W) constant current SMPS source. This helps to maintain the intensity constant by increasing or removing the number of LEDs but limited to 1W only. The controller is in open loop system hence free from fluctuating intensity. The intensity mode i.e. Warm, bright, dim and cozy may be selected directly using four additional switches.

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