International Journal of Advanced Technology in Engineering and Science
Vol. No.4, Issue No. 04, April 2016
www.ijates.com
ijates
ISSN 2348 - 7550

COMPACT AND LOW COST EMERGENCY LIGHTING SYSTEM USING HIGH BRIGHTNESS POWER LED'S

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ABSTRACT

This paper presents a compact and low cost emergency lighting system using high brightness power light-emitting diodes (LEDs). The Aim is to develop a compact and low-cost electronic circuit to drive and control the current of LEDs arranged in a series.. Buck and boost converters were working in order to supply the LEDs by mains and by battery, respectively. The converters are designed in order to work without electrolytic capacitors, which have advantages such as reducing size and cost of the circuit, THD reduction, and increasing the useful life of the driver. The main advantage of the proposed idea is to use the same equipment in the daily activities, supplied by the ac line, and under a mains supply failure, supplied by a battery. The another advantage of this proposal to achieve energy saving, higher luminous efficacy, and higher useful life when replacing traditional fluorescent-based emergency lighting systems. The battery can be composed of three rechargeable a Li-ion battery (3.6 V).

Keywords: Compact lamp, dc/dc converters, emergency lighting, light-emitting diode (LED) lamp.

I. INRODUCTION

Light is essential part in the life of human beings. Currently, artificial lighting is present everywhere either in indoor, such as houses, commercial buildings, halls, ladders, garages, elevators, restaurants and industries or in outdoor environments, such as parks and highways. It provides comfort and security, improves the decoration, and improves physical activities. Because of light dependence, the emergency lighting system became an essential element, and it may be considered as a safety item.

Therefore, concerning the increase of energy consumption in various segments, the development of more efficient lighting systems is really important. Nowadays, the incandescent lamps, widely used in residential lighting, are being abolished in many countries due to its low efficiency. The replacement of these lamps with compact fluorescent lamps (CFLs) has been an alternative in reducing the energy consumption since the efficiency of CFLs is higher than the efficiency of incandescent lamps. But CFL has more size lower life span and higher cost. However, researches for efficient lighting systems have led to the development of new sources of light. Semiconductors, which have been used for years in electronic systems for driving and controlling lamp systems, have been able to replace these light sources in many applications. Due to the small size and high efficiency of these devices, semiconductor lighting has attracted researchers and manufacturers to develop new products using this technology. These devices have greater luminous efficiency and long useful life compared to

CFLs. Therefore, a driver is necessary to regulate the voltage and to control the current through the LEDs in order to supply the lamp by the mains.

A compact emergency lamp employing LEDs, allowing greater useful life and higher efficiency compared to the lamps used in the traditional emergency lighting systems the circuit is simple and compact, and it has few components. Its installation is made with the simple replacement of incandescent and CFLs without any change in the electrical installation. The compact emergency lamp uses the same equipment in daily activities, supplied by mains, and under a possible failure of it, supplied by battery.

The proposed systems is not using electrolytic capacitors as traditionally used in application and have advantages, such as reducing size and cost of the circuit, as well as increasing the driver's useful life. The input current harmonic contents, are also reduced. The circuit operates under universal input voltage, and it changes between the normal and emergency modes in a short time.

The system allows more than 4.5 hours of operation, which is higher than the one required by the standards. The devices have their high useful life (50000 hours), which is higher than fluorescent lamps (8000 hours). The main goal of this proposed work is to replace the fluorescent lamp with LED with the same luminaries as of the traditional system. The proposed system of an emergency lighting system uses technique of mains supply battery based on possible mains failure, which is novelty in this application area, keeping power consumption very low as compared to traditional lighting system.

II. EMERGENCY LIGHTING SYSTEM

The traditional emergency lighting systems use fluorescent lamps supplied by batteries. This traditional emergency lighting systems requires batteries with a large capacity of energy, which have high weight, cost, and volume. These characteristics make the installation difficult and affect the decoration of the environment. They are also not efficient to reduce the size of the equipment small tubular fluorescent lamp or CFL have been used, which works 2 hour for the operation with two lamps, and 4 h for the operation with only one lamp[9] [10].

This emergency lighting system lamp, operate on alternate voltage and current. They require a high voltage level for its ignition, which is different from that provided by batteries. To provide high ac current and voltage, they require circuit to charge the battery by mains and another circuit to track the mains voltage. There for these emergency lighting system have more cost, less life span and lower brightness [3].

Power LEDs in emergency lighting systems become more attractive due to its high luminous efficiency, allowing the use of small battery, and LEDs have low weight and size, which contributes to its application in compact lighting systems. Another great advantage of these devices is their high useful life (50 000 hour), which is higher than fluorescent lamps (8000 hour). LEDs are supplied by dc current. They have a small forward voltage (between 2.5 and 4 V), and they do not require ignition, which is different from the fluorescent lamps. These characteristics become advantageous when it is necessary to supply a power using battery [1].

This system avoids use of electrolytic capacitors as used in traditional emergency lighting system. If the convertors are designed without electrolytic capacitor, they become smaller in size and cost, also reduces the thermal harmonic distortion, with increasing the life of the driver circuit. The circuit simple compact and it has few components. Its installation is made with the simple replacement of incandescent and CFLs without any change in the electrical installation [1]

International Journal of Advanced Technology in Engineering and Science
Vol. No.4, Issue No. 04, April 2016
www.ijates.com
ijates
ISSN 2348 - 7550

III. PROPOSED CIRCUIT

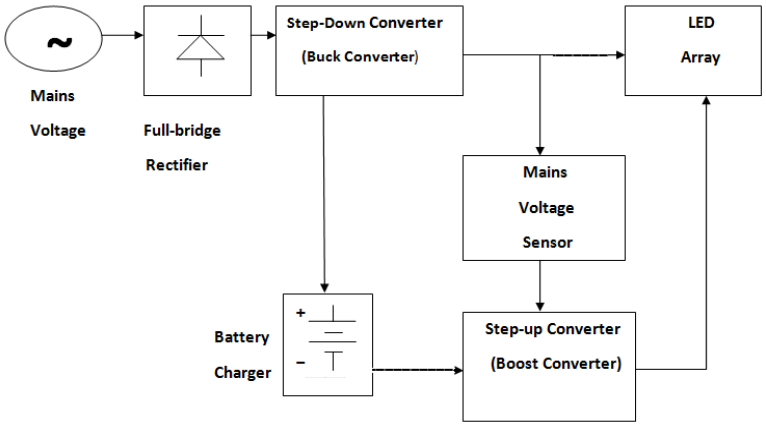

Fig 1

The block diagram of compact and low cost emergency lighting system using high brightness power leds. The proposed circuit has five or more LEDs connected in series array. The LEDs are supplied with nominal power when operated in the normal mode that time main supply voltage is on and with a reduced power in the emergency mode means mains supply is not present to the in put and led supplied by battery. The block diagram of the proposed circuit is shown in Fig. 1A step-down converter is used to supply the LEDs by mains and to charge the battery. To supply the LEDs by battery, a step up converter is used. A voltage sensor circuit is used to track the mains voltage in order to know if the lamp will operate in the normal or emergency mode. While the mains is supplying the lamp, the step-down converter presents an output voltage. Thus, the mains voltage sensor measures the step-down output voltage to enable or disable the step-up converter. The external switches S_1 and S_2 enable or disable the LEDs when they are supplied by mains or by battery

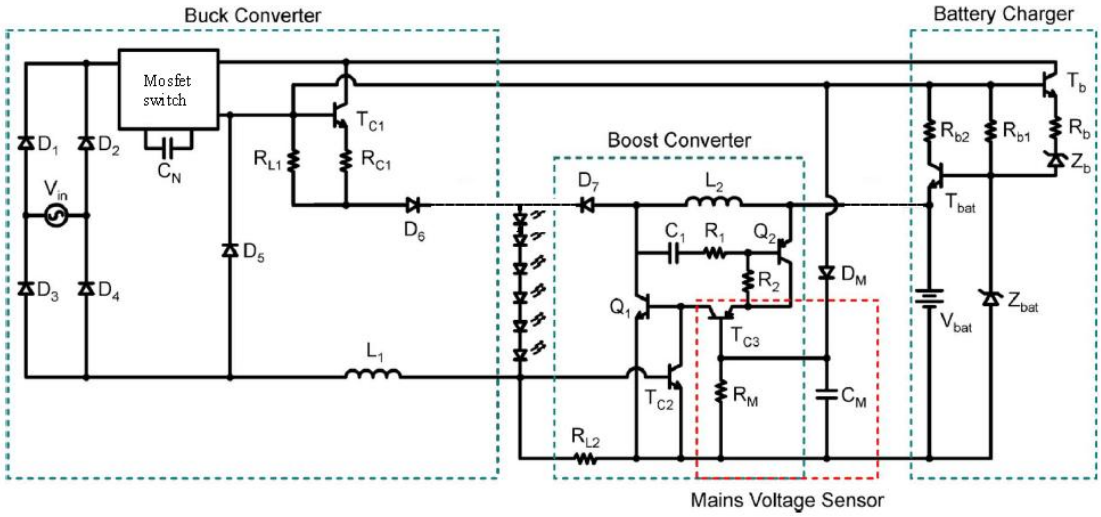

Fig- 2

Fig 2 shows the complete circuit diagram of the compact and low cost emergency lighting system system using high brightness power leds. In this circuit consist of Buck convertor, boost convertor battery charger and mains voltage sensor circuit.

3.1 Step-Down Stage—LEDs Supplied by Mains and Battery Charger (Buck convertor)

The proposed converter that is used to supply the LEDs by mains with a universal input voltage (90–240 V_{ac}) and to charge the battery**.** This converter was chosen due to its simplicity, low cost, and small size While the lamp is operating in normal mode, the step-down buck converter must reduce the input voltage to control the current through the LEDs. To charge the battery, the same converter is used**.** When the switch is turned on, the input source provides energy for the inductor (L_1) and also supplies the load (LEDs). When it is turned off, diode D_5 conducts, and the energy stored in L_1 is transferred to the load.

3.2 Step-Up Stage—LEDs Supplied by Battery (Boost convertor)

When the circuit is operating at the emergency mode, a step-up boost converter starts its operation, and the LEDs are supplied by the battery with a reduced power. The input voltage of the boost converter is obtained by the Li-ion battery (3.6 V). In boost converters, the output voltage is proportional to the input voltage. Therefore, the decrease in the input voltage causes a decrease in the output.

3.3 Mains Voltage Sensor and Complete Circuit

Fig 2 shoes the mains sensor circuit is used to track the mains voltage in normal mode when mains is gone that time mains sensor circuit turn on the boost convertor and leds supplied by battery. Fig. shows the complete circuit composed of the step down converter, the battery charger, the step up converter, and the mains voltage sensor. The mains must be tracked in order to know if the lamp will operate in the normal or emergency mode. While the mains is supplying the lamp, the buck converter presents an output voltage. When the mains voltage is below the output voltage, the buck converters is turned off, and boost convertor start automatically.

IV. EXPERIMENTAL RESULTS

Some comparison result of LED Emergency lighting versus compact flour cent light**.**

Sr. No.	Parameter	CFL Bulb	LED Emergency Lighting system.
1	Measuring current in Amp	23.50mA	5mA
2	Power wattage of bulb	5.405W	1.105W
3	Voltage	230v	230v
4	Intensity obtained in lux	150 lux	50 lux
5	Power consumption in one hour	5.405mW	1.15mW
6	Power consumption in twelve hour	64.86mW	13.800mW
7	Power consumption in twenty four hour	129.72mW	27.6mW

4.1 Parameter Explanation

4.1.1 Measuring Current in amp-

Measuring current across the CFL bulb is 23.50ma and measuring current across the one led is 5ma. Power

4.1.2 wattage of bulb-

Power is equal to the voltage into current power of CFL bulb is equal to the 5.40w. the power of each Led is equal to 1.105w.

4.1.3 Voltage -

In put voltage of both CFL and compact Flour cent light system is 230

4.1.4 Intensity measurement -

Intensity is measured by using Intensity meter. The intensity of CFL bulb is 150 lux and Intensity of emergency lighting system is 50 lux. The intensity or brightness of CFL bulb is more as compare to the emergency lighting system.

4.1.5 Power consumption one hour-

The calculation of how much power consumption of CFL and led bulb as fallows

The power wattage of CFL bulb=5.405w

Divide the wattage by 1000**.** This will convert the rating from watts to kilowatts.

Then calculate power in kilo watt = 5.405/1000 = 5.403*110^-3 w

Power X Time = Energy Consumption

5.405mw ✕ 1 hour = 5.405 m

The power wattage of LED bulb = 1.105W

Divide the wattage by 1000**.** This will convert the rating from watts to kilowatts.

Then calculate power in kilo watt = 1.105/1000 = 1.105*110^-3 w

Power X Time = Energy Consumption

1.105mw ✕ 1 hour = 1.105mW

4.16 Power consumption in 12 hours-

For EFL Bulb

Power ✕ 12 hours = 12 hours energy consumption

5.405mW ✕ 12 hours = 63.86mW

Power consumption in 12 hours is equal to 64.86mW

For LED Bulb

Power ✕ 12 hours = 12 hours energy consumption

1.15 mW ✕ 12 hours = 13.800mW

Power consumption in 12 hours is equal to 13.800mW

4.17 Power consumption in 24 hours –

For CFL bulb

Power ✕ 24 hours = 24 hour energy consumption

5.405mW × 24 hours = 129.76 mW

Power consumption in 12 hours is equal to 129.76 mW

For LED bulb

Power × 24 hours = 24 hour energy consumption

1.15mW × 24 hours = 27.6mW

Power consumption in 24 hours is equal to 27.6 mw

V. CONCLUSION

This compact emergency lamp employing LEDs, allowing greater useful life and higher efficiency compared to the lamps used in the traditional emergency lighting systems. Moreover, the proposed circuit is simple and compact, and it has few components. Its installation is made with the simple replacement of incandescent and CFLs without any change in the electrical installation. Moreover, the compact emergency lamp uses the same equipment in daily activities, supplied by mains, and under a possible failure of it, supplied by battery, which is a novelty in this application area. The boost converter supplies the LEDs with a low input voltage (3.6 V), which can be obtained from Li-ion or Ni-MH batteries which are smaller than the one used in the traditional systems. The proposed circuit does not use auxiliary sources nor electrolytic capacitors. The absence of these capacitors has advantages such as reducing size and cost of the circuit, as well as increasing the driver's useful life. Moreover, the input current harmonic content is reduced.

VI. ACKNOLEGMENT

Special thanks to Mr. Mane V A for his generosity, as he provided us with the material which made possible the study presented in this paper.

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