ISSN (Print): 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 2, Issue 12, December 2013

A Single-Stage LED Driver for the Street Lighting System using LDR

V.Gomathi, D.Narmatha, M.Nandhini

Associate Professor, Dept. of EEE, Karpagam College of Engineering, Coimbatore,India
Assistant Professor, Dept. of EEE, Karpagam College of Engineering ,Coimbatore-India
Assistant Professor, Dept. of EEE,Karpagam College of Engineering ,Coimbatore-India

ABSTRACT*:* A Single Stage LED driver for the Street Lighting System using LDR is proposed. The system consists of a buck boost circuit and a fly back circuit, which works in PWM mode. The theoretical analysis and the simulation results of the proposed lighting system are discussed in detail in the paper.

KEYWORDS*:* LED, Single-Stage, boost circuit, fly back circuit, LDR.

I. INTRODUCTION

In the recent years the LEDs are applied to the lighting areas such as the car head lighting, the street lighting, etc. The use of LEDs is the development direction of the future lighting system. LEDs are more popularly used in display clocks, audio and video equipment, traffic lights. It is also used as light source in optical fibre communication.

Light Emitting Diode, commonly known as LED is a diode that will give off unstable light when it is energized. It works based on Electroluminescence. Electroluminescence is a process that changes an electrical input to a light output, the opposite of a photovoltaic effect.

The LEDs need constant current. The luminance of a single LED is very low, so the LEDs are used in series. LED driver consists of boost converter circuit and fly back circuit. The boost converter circuit is adopted for constant current circuit and fly back converter is adopted for DC/DC voltage regulate circuit.

In this paper, the boost circuit and the fly back circuit are integrated by using the same switch. Both circuits are work in PWM mode.

II.SPECIFICATION USED

Table.1.Specification of the Devices used

Devices	Range
Diode	UF5408
Capacitor	100µF ,10µF, 1000µF
Inductor	200µH
MOSFET	IRF250
Voltage Regulator	IC 7805, IC 7812
Transformer	230V/6V Step down transformer
PIC Microcontroller	PIC 16F877

A. Features of IC 7805 & IC 7812

ISSN (Print): 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 2, Issue 12, December 2013

- Internal Thermal overload protection
- No external components required
- Output transistor Safe area protection
- Internal Short circuit current limit
- Output current in excess of 1A

B. *Features of MOSFET-IRF250*

- High input impedance
- SOA is power dissipation limited
- Nanosecond Switching speed
- $R_{DS}(ON) = 0.085\Omega$

C. *Features of PIC 16F877*

- High performance RISC CPU
- Only 35 single word instruction to learn
- Eight level deep hardware stack
- Power – on Reset (POR)
- Power – up Timer (PWRT) and Oscillator start – up Timer (OST)
- Programmable code – protection
- Power saving SLEEP mode
- Single 5V In – circuit serial Programming capability
- Wide operating voltage range : 2.0V to 5.5V
- Low – power consumption

III CONFIGURATION OF THE SYSTEM

The Single Stage LED driver for the street lighting system using LDR proposed in this paper is shown in fig.1.

L_1 Q_1,D_1,C_2 form a buck boost circuit, while the fly back converter consists of Q_1,T_1,D_4,C_3& the load.

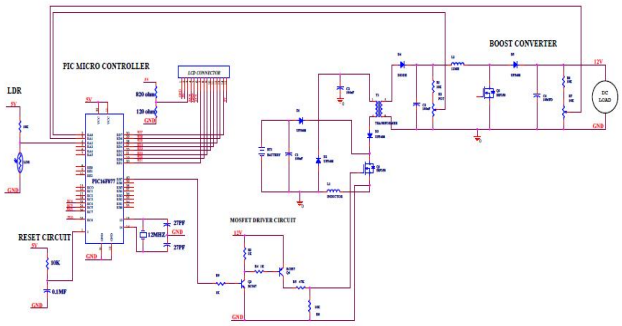

Fig.1. The Single Stage LED driver for the street lighting system using LDR

ISSN (Print): 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 2, Issue 12, December 2013

A. Single – Stage DC- DC Converter

The converter has five working modes and they are described in detail as follows

Mode:1 This mode starts at t_0, when Q_1 is on, the input voltage passes through D_1,Q_1 and the main inductor L_1 is charged by the output capacitor of the buck- boost circuit. This mode ends when Q_1 is turned off.

Mode:2 Q_1 is turned off at t_1, when L_1 starts to discharge through the diode D_2 and the capacitor C_2. Meanwhile D_4 is on, i.e., the secondary side of the transformer starts to provide energy to the load. When the main inductor L_1 stops discharging at t' and the time when D_4 is turned off is t''. If $t'>t''$, this mode ends at $t_2=t''$, else this mode ends at $t_2=t'$.

Mode:3-1 If $t'>t''$, the inductor L_1 will continue to discharge. This mode ends at t_3 when L_1 stops discharging.

Mode:3-2 If $t''>t'$, the secondary side of the transformer will continue providing energy for load until D_4 is turned off. This mode ends at t_3'.

Mode:4 The energy transferred to the load is supplied by the output capacitor C_3 in the secondary side of the transformer. This mode ends at t_4 when the turn – on signal of Q_1 comes again.

B. MOSFET Driver Circuit

The Mosfet driver circuit proposed in this paper is shown in fig.2.

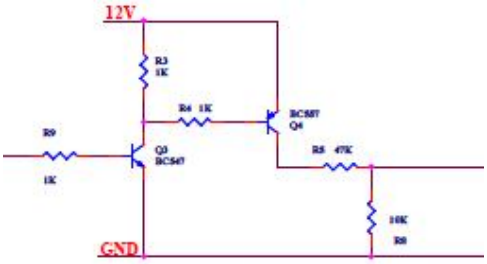

Fig.2. MOSFET driver circuit.

This circuit is designed to control the load. When low pulse is given to base of transistor Q_3, it is turned off. Now 12V is given to base of Q_4 transistor, so the transistor is conducting and Q_1 is turned on.

Table.2. Operation of MOSFET Driver

voltage signal from microcontroller	Q_3	Q_4	Q_1
1	ON	OFF	OFF
0	OFF	ON	ON

C. Light Dependent Resistor (LDR)

A photo resistor is an electronic component whose resistance decreases with increasing incident light intensity. It can also be referred to as a light dependent resistor or photoconductor.

ISSN (Print): 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 2, Issue 12, December 2013

A photo resistor is made of a high – resistance semiconductor. If light falling on the device is of high enough frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electron conducts electricity, thereby lowering resistance.

LDR used in this proposed system is cadmium sulphide cells. Its ability is to vary its resistance according to the amount of light striking the cell. The more light that strikes the cells, the lower the resistances.

The LDR is connected in series with 10k resistor formed as voltage divider network which is connected to the 4th pin of PIC16F877 microcontroller, which acts as analog input 2. The variation in the resistance, produces the voltage. The LDR circuit used in the proposed system is shown in fig3.

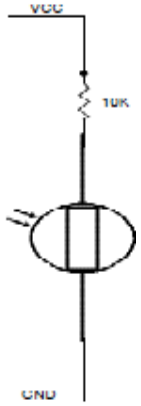

Fig.3. LDR circuit.

D. PIC Microcontroller

The manner in which the use of microcontroller is shaping our lives is breathtaking. Today, this versatile device can be found in a variety of control applications.

The microcontroller that has been used for the proposed system is PIC16F877. PIC microcontroller is the first RISC based microcontroller fabricated in CMOS that uses separate bus for instruction and data allowing simultaneous acess of program and data memory.

The main advantage of CMOS & RISC combination is low power consumption resulting in a very small chip size with a small pin count. The main advantage of CMOS is that it has immunity to noise than other fabrication techniques.

Various microcontroller offer different kinds of memories. EEPROM, EPROM, FLASH etc are some of the memories of which FLASH is the most recently developed.

Technology that is used in PIC16F877 is flash technology, so that data is retained even when the power is switched off. Easy programming and Erasing are other features of PIC16F877.

Device	Program Flash	Data Memory	Data EEPROM
PIC16F877	8K	368 Bytes	256 Bytes

ISSN (Print): 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 2, Issue 12, December 2013

In this proposed system, 4 MHZ crystal Oscillator is used for clock pulse which is connected to 13th & 14th pin of PIC 16F877. The concept applied here is if duty cycle increased, the voltage also increased.

In order to maintain the voltage level constant, the duty cycle is varied by variation in the intensity of LDR. Thus provides variation in the gate pulse of Q_1 and thus constant voltage and current is maintained to Load.

The program required in this proposed system is compiled by using MPLab Software. It is then converted into hexfile & dumped into PIC using Top win software. The constant voltage maintained in this system is made displayed by using LCD.

E. *Power Supply*

The ac voltage is connected to a transformer, which steps that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac variation.

A regulator circuit removes the ripples and also remains the same dc value even if the input dc voltage varies. This voltage regulation is usually obtained by using voltage regulator IC.

The proposed system uses 2 types of power supply circuit. The regulator used is 7805 and 7812 regulators, which provide fixed positive regulated voltages.

For ICs, microcontroller, LCD – 5Volts and for MOSFET driver circuit – 12 Volts are needed. The power supply circuit used in the proposed system is shown in fig4 and fig5.

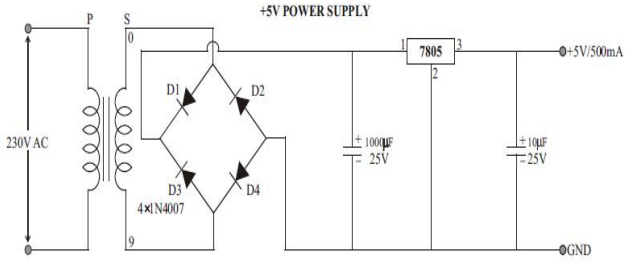

Fig.4. Power supply circuit for +5V.

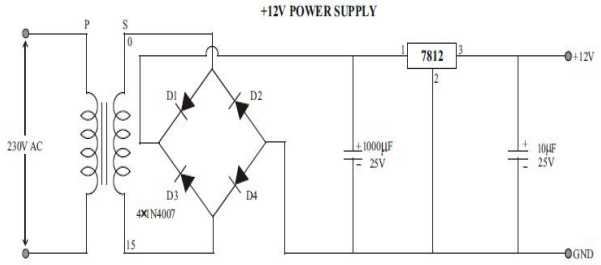

Fig.5. Power supply circuit for +12V.

ISSN (Print): 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 2, Issue 12, December 2013

IV SIMULATION & RESULTS

The below figure shows the simulation schematic for the single stage AC/DC converter.

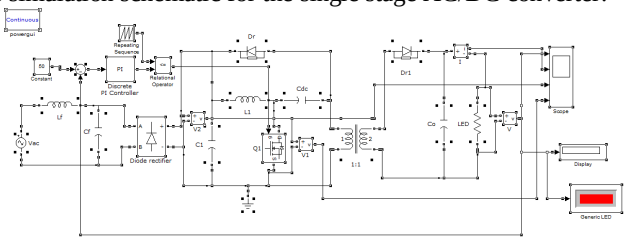

Fig.6. Simulation schematic for the single stage AC/DC converter.

The below figures shows the simulation results of LED.

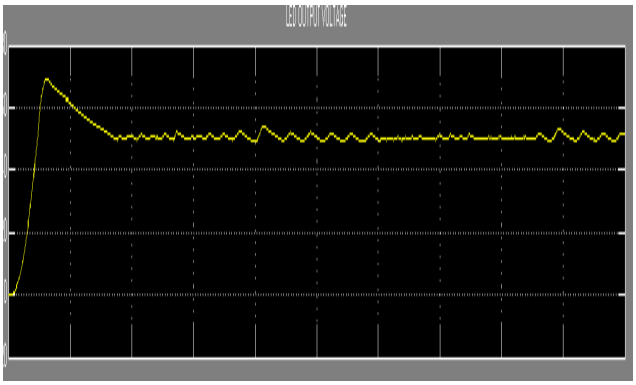

Fig.7.a) LED output voltage

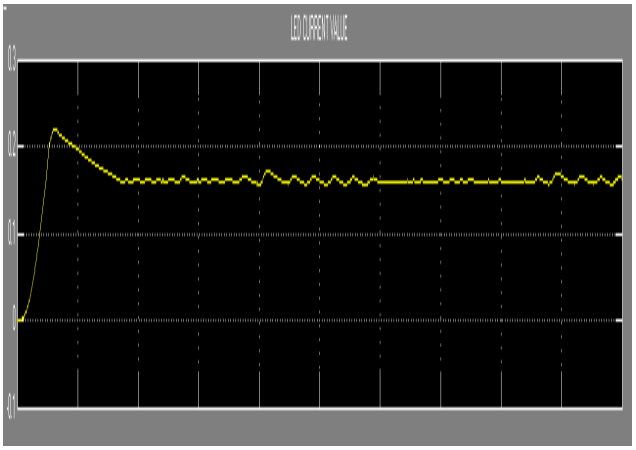

Fig.7.b) LED output current

ISSN (Print): 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 2, Issue 12, December 2013

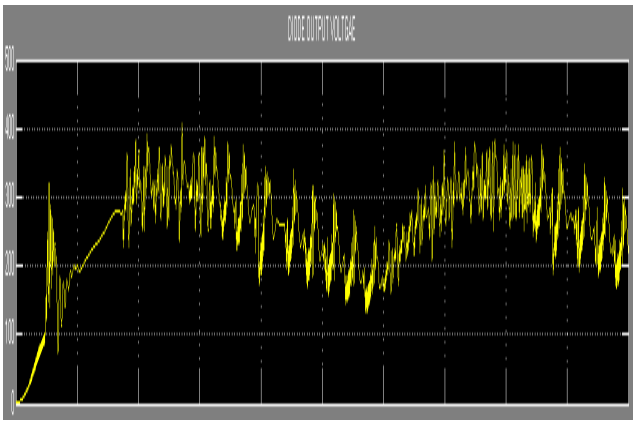

Fig.7.c) Diode output voltage.

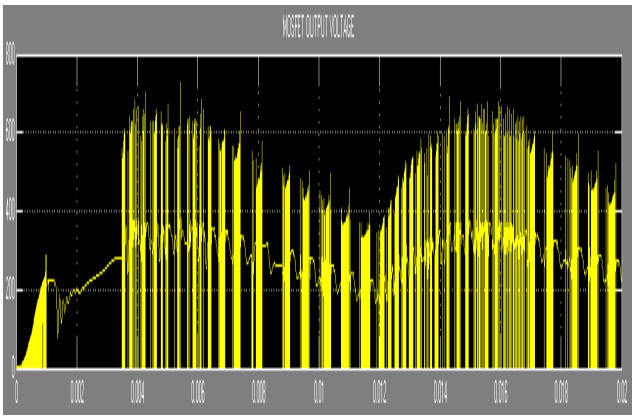

Fig.7.d) MOSFET output voltage

Fig.7.a) shows the waveform of LED output voltage, which is maintained constant.
Fig.7.b) shows the waveform of LED current value also maintained constant.
Fig.7.c) shows the waveform of diode output voltage.
Fig.7.d) shows the waveform of MOSFET output voltage.

A low watts prototype is made and 250mA/3.5V white LEDs are used in the experiment. The variation in the intensity of LDR automatically controls the ON/OFF condition of LED.

V. CONCLUSION

A Single stage LED driver for street Lightning system using LDR is presented in this paper. The system can work automatically, which reduces manual support. The driver with DC/DC converter decreases the cost and increases the reliability of the system. The PWM dimming will optimise the usage of power. So as to reduce the cost and increase the efficiency of the system, converter circuits are integrated into one single stage circuit by using the same switch. This LED driver is suitable for cost sensitive application because this circuit has a minimal parts count and a control circuit.

ISSN (Print): 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 2, Issue 12, December 2013

REFERENCES

[1] Chui H.J, Lo Y.K, Lee H.C., (2010), A Single Stage Soft –Switching fly-back converter for power factor corrections, IEEE Trans. Ind.Electron., 57.No. 6, 218 – 2190.
[2] D.Gacio, J.M. Alonso, L.Campa, M.Crespo, M. Rico Secardes,(2010) High frequency PWM dimming technique for high power converters in LED lighting, IEEE Applied Power Conference and Exposition, 743 - 749.
[3] K.H.Loo, Lun W.K, Tan S.C, (2009), On driving techniques for LEDs: towards a generalized methodology,IEEE Trans. Power Electron.,24 NO 12, 2967 - 2976.
[4] Liu Yu and Jimming Yang, 2009, "The topologies of white LED lamps power drivers," in prac. IEEE PESA, pp 1 – 6.
[5] Lo Y.K, Wu K.H, Pai K.J, (2009), Design and implementation of RGB LED drivers for LCD back light modules, IEEE Trans.Ind. Electron, 56 NO 12, 4862 – 4871.
[6] Qu Xiaohui, Wong Siu Chung, Tse. C.K.,(2009), Ballast for indepent control of multiple lamps,IEEE lamps,IEEE Trans. Ind. Energy conversion Congress and Exposition, 2821 – 2826.
[7] Ye Zhongming Ye, F Greenfeld, Liang Zhixiang,(2009), Single – stage Offline SEPIC converter with Power Factor Correction to Drive High Brightness LEDs, IEEE Applied Power Electronics Conference and Exposition, 546-553.
[8] Y.K. Cheng and K.W.E.Cheng, 2006, " General study for using LED to replace traditional lighting devices", in Proc. IEEE ICPESA, pp 173 – 177.
[9] Yongbing Yang, Zhaoming Qian, Xinke Wu,(2005), A novel single stage low frequency square wave electronic ballast for wattage HID lamps, IEEE Applied Power Electronics Conference and Exposition, 2, 1048 – 1052.
[10] S.Muthu and J.Gaines, 2003 " Red, Green and Blue LED – based white Light source: Implementation Challenges and Control Design", Industry Application Conference IAS Record, 2003. Vol 1, pp 515 – 522,.