The LED Power Supply with the Integration of Driver

and Management Based on the Power Line Communication

Na Li [1,a,*], Yulin Qi[1,b], Junxiao Yang[1,c] and Yang Li[1,d]

[1]North China Electric Power University, Baoding 071003, China;

[a]lina18730261582@163.com, [b]qiyulin589@163.com,

[c]1348509718@qq.com, [d]1654626486@qq.com

*corresponding author

Abstract: As a new type of light source,LED has been widely used in street lamp lighting system, in order to realize the function of driver and management, a LED power supply with the integration of driver and management based on the power line communication is proposed. There is no requirement for additional wiring. Single lamp controller communication with concentrator through power line carrier wave module. Management center(PC or cell phone) send instructions to the single lamp controller via the concentrator, and the LED power supply can drive LED lights and control their running state, realizing the remote control, remote dimmer.Single lamp controller can also upload data to the management center, and the management center can obtain functional parameters such as current, voltage when lamps run. On the whole, the power supply achieves the integration of driver and management.

Keywords:LED power supply, power line communication, concentrator, single lamp controller.

1. Introduction

As an important measure for the sustainable development of human society, the quality and level of the green lighting have become an important symbol of social civilization and modern city [1].The LED is gradually applied to the road lighting and has become a new generation of energy-saving light source because of the advantages of a small size, low consumption, low voltage drive and easy dimming control.The design of the driving in the lighting system has a great effect on whether the LED street lamp can be used and operate reliably.Therefore, the design of the LED power supply is the key issues in the street lamp lighting control system.

This paper puts forwards the LED power supply is based on the Power Line Communication(PLC)[2-4].It not only holds the the function of driving, but also can control the running state of the lights. The PLC can eliminate the project of cabling and has the obvious advantages of high reliability, less investment, and channel synchronous with the power grid construction,which is of great value and significance for the research of high efficiency and reliable the LED power with the integration

of driver and management.

The LED power source mainly consists of a single lamp controller and concentrator. System overall block diagram is given shown in figure 1.Single lamp controller is is composed of PLC module, MCU, LED constant current drive circuit.Concentrator mainly includes PLC module, MCU, GPS module and GPRS module.On the one hand, single lamp controller will collect the information such as current, voltage, fault through the microcontroller,which are modulated to power line through power modulation , then feedback is made to the concentrator, and the concentrator will upload data to the street lamp monitoring center. On the other hand, concentrator receives the control instruction of monitoring center , which is processed by the single-chip computer and finally arrive at the single lamp controller via PLC module,so the status of LED street lamp is controlled.On the whole, it meets the the integration of driver and management of LED street lamp.
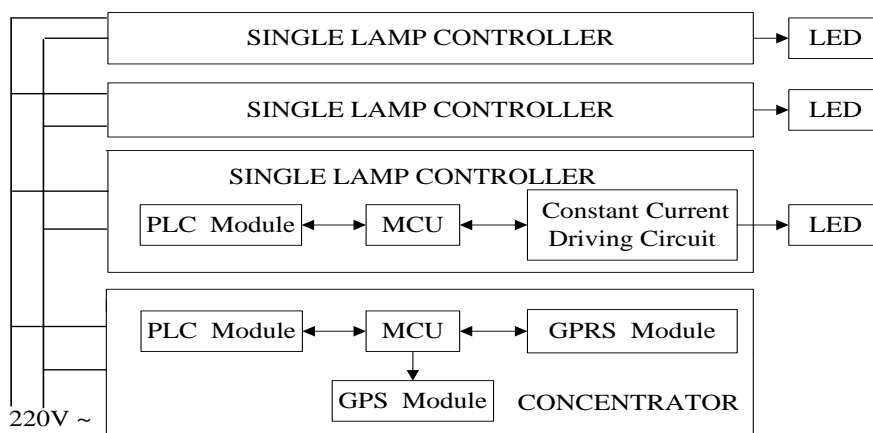

Fig. 1 The design of the overall scheme

2. The Design of Hardware

2.1 The Design of the Single Lamp Controller

Single lamp controller mainly drives LED and receives concentrator's instructions. If it is the control instruction, the state of LED will be controlled, for example, open, close and dimmer. If it is the calling instruction, the data will be uploaded to the concentrator and the management center by the PLC module.

PLC module adopts KQ130F module[5],which mainly includes the coupled circuit, sending and receiving filter circuit, modem chip.Transmission process of PLC module is that the single chip microcomputer sends the data information such as voltage, current by a serial port ,through sending filter circuit and coupling circuit, the signal coupling to a 220v alternating current to the concentrator, and the concentrator transmit them to management center or mobile phone software.Receiving process is to transmit the carrier signal on the 220v alternating current to the carrier chip by coupling circuit and receiving filter circuit, then finally to the single chip microcomputer for processing, controlling the switch of the street lamp and lamp dimming.

LED has the characteristic of negative temperature, in order to ensure the stability of LED brightness, power needs constant current driver, which mainly adopts the

method of pulse width modulation (PWM)[6]. The design of driving circuit is shown in figure 2.System is supplied by 220AC, firstly through the EMC circuit, which mainly filters system itself and external electromagnetic interference.Rectifier and filter circuit complete the function of transforming the alternating current into direct current. The adjustment of power-factor is completed by PFC. The IGBT driver circuit complete the open and closed of IGBT and the control circuit of IGBT accomplish the control of the IGBT, so as to the IGBT can work by a constant frequency, pulse width modulation (PWM) way.Output voltage and current sampling circuit complete the sample of output voltage and current, making the output current constant, and ensure the LED street lamp run normally.
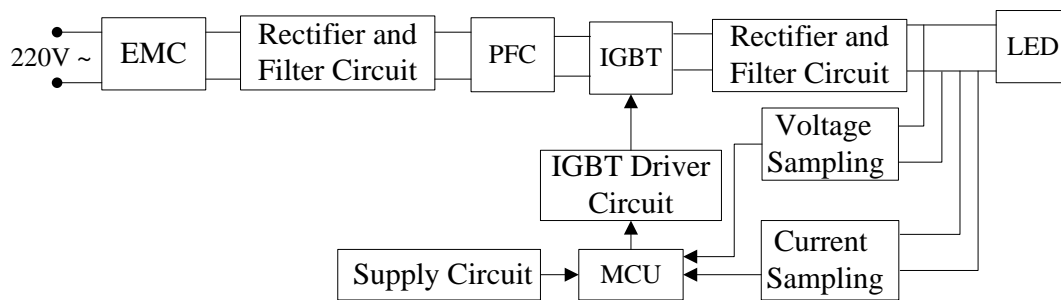

Fig. 2 The design of the driving circuit

2.2 The design of The Concentrator

Concentrator is mainly composed of PLC module, MCU, GPRS module and GPS modules.On the one hand, concentrator receives the control orders of street lamp management center or mobile phone software,then transmit them to single lamp controller by power carrier module;Receiving the data of single lamp controller, on the other hand, through PLC module , and then giving the data feedback to the street lamp management center or a mobile phone by the cloud servers, on the whole, it realizes the centralized management of the single lamp controller to control region, having the function of data transfer in the power supply.

GPRS module implements network communication of the LED street lamp. This paper adopts KS-97 module of the pin structure,and it is connected to the microcontroller through the serial port, transferring data and instructions transparently.

HOLUX M-89 module as the GPS module, it has exquisite appearance and can achieve accurate positioning.This paper mainly uses GPS module to gain the local information such as time, longitude, latitude, through certain calculation by the single-chip microcomputer ,we can obtain the local sunrise and sunset time, so as to realize the running state of LED street lamp, such as open and close operation, low light running .

3. The Design of Software

The software of LED power supply mainly includes the communication among the GPRS module, KQ130F module, GPS module and the MCU.The MCU uses c8051f310, which is produced in Silicon Labs.It provides two asynchronous, full duplex serial, UART0 and UART1,it has enhanced the baud rate generator circuit and

there is multiple clock source can be used to produce standard baud rate., which responds to the communication requirements of the power supply.

3.1 The Process of Upward Communication

The process of upward communication is that the single lamp controller node sends the information of the LED to the concentrator through the PLC module, and the concentrator will upload the data to the management center. Software flow chart is shown in figure 3. Firstly, serial port and a timer of MCU are initialized, then sending data on the basis of relevant communication protocol, finally the data will be uploaded to the management center through PLC module and KS-97.
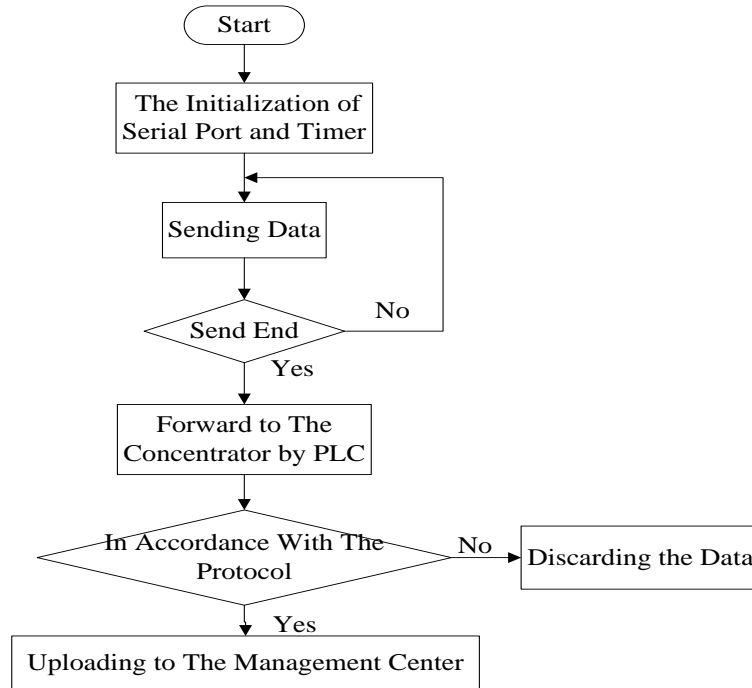
Fig. 3 The Process of Upward Communication

3.2 The Process of Downward Communication

Software flow chart is shown in figure 4. The process of downward communication is that remote management center sends commands to the concentrator, and the MCU of concentrator will response through the judgment whether it is in accordance with the agreement.If it meets the requirements, it can be sent to single lamp controller by the PLC module and KS-97.Otherwise the data will be discarded.
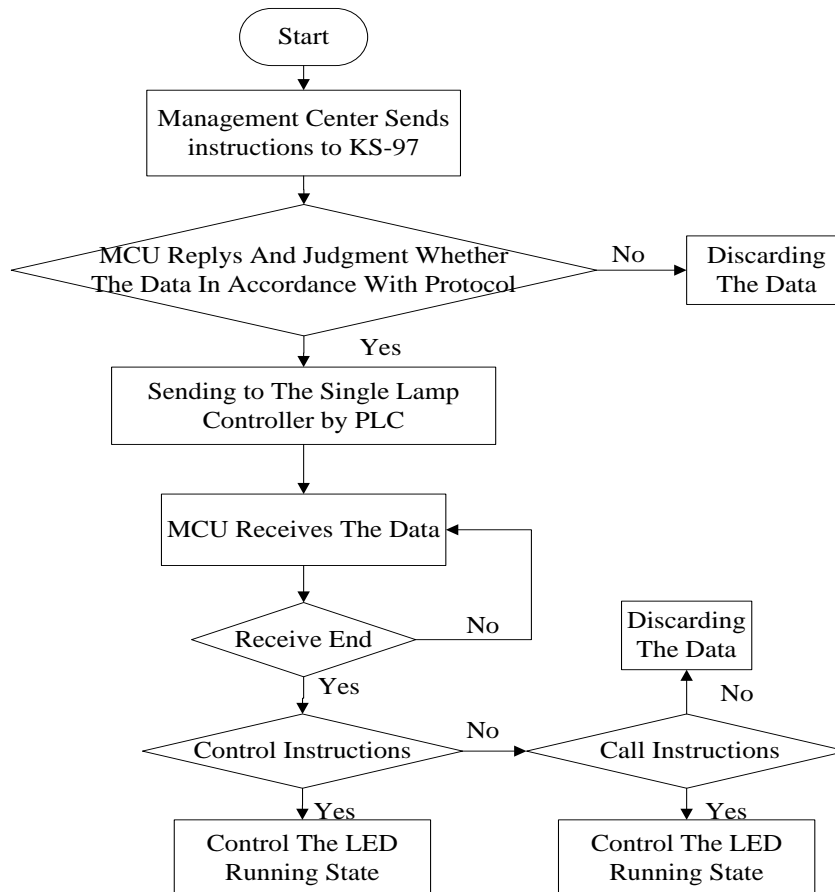
Fig. 4 The Process of Downward Communication

4. Conclusions

Based on the design of hardware circuit and software program, the power supply can not only drive LED street lamp, management center also can realize the control of street lamp for example, the remote dimmer and the remote control.After testing, GPS can also intelligently control LED running state, which realizes the integration of driver and management of the LED power supply.

5.References

[1] Wang Wei, Wang ning. Green lighting - semiconductor lighting intelligent control principle and realization, Beijing: electronic industry press, 2014. 1.

[2] WU Hairong, CHEN Qing. Design of Urban Street Lamp Control System Based on Ethernet, Ship ElectronicEngineering, 2011, 31(5):134-136.

[3] ZHANG Yan, ZHAO Yanjuan, YANG Mei. Design and Implementation of street light control system based on WSN technology, Journal Of Northeast Dianli University, 2011, 31(1) : 84-87.

[4] ZHU Xu, TANG Xianding.Design of LED Road Lighting Lantern Control System Based on Power Line Carrier Communcation Technology, China Illuminating Engineering Journal, 2012, 23(2) : 66-70.

[5] Information on http:/www.kq100.com/,2012.

[6] Meng Julian. Noise analysis of power line communications using spread-spectrum modulation, IEEE Transactions on Power Delivery, 2007, 22(3):1470-1476.

[7] PEREZA, SANCHEZ A M, REGUE J R, etal.Circuital and modal characterization of the power-line network in the PLC band, IEEE Transactions on Power Delivery, 2009, 24(3) : 1182-1189.