Design of Airport Navigation Aid Lighting System Based on LED

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Abstract

The main light source used in the common airport navigation lights system is mainly the incandescent lamp. It has the disadvantages of low luminous efficiency, high energy consumption, short service life and low strength. With the maturity of LED lighting technology, because of its characteristics, it can make up for the defects of incandescent lamps and is applied in more and more fields. In this paper, a new navigation lighting system is designed by using LED light as the light source. The system uses ATmega88 as the controller, the data acquisition through the ATmega88 A/D sampling, design the main circuit including the rectifier, filter, chopper circuit. In order to prevent the strong and weak electricity part from interference, the photoelectric isolation circuit and bootstrap circuit are designed. The new airport lighting system is more stable, reliable and energy saving than the original system.

Keywords

Navigation aid lighting system, LED lighting, MCU, A/D sampling.

1. Introduction

Under the condition that the night and visibility are not ideal, it is the multiple stage of the flight accident, because it is difficult for the pilot to establish a suitable visual reference in the process of takeoff and landing [1, 2]. The airport navigation lights are used for the driver's visual reference under such conditions. Most domestic airports use incandescent lamps as the main light source of navigation lights. This kind of navigation lighting system has many disadvantages, such as large energy consumption, low luminous efficiency, short service life, complex structure and low strength. In the airport navigation lighting system, compared with the ordinary incandescent light source, LED has the advantages of high luminous efficiency, energy saving, long service life, strong structure and small volume[3, 4].

The number of navigation lights at airports is large, widely distributed, long working hours and large electricity consumption. It can be called local electric power households, and is significant for energy saving and emission reduction of airports [5, 6]. The light source with high light efficiency, long service life and good energy saving effect can not only reduce the investment of construction, reduce the maintenance amount in the later work, but also reduce the annual operating cost. The use of LED as an airfield light source, high reliability, and energy saving, green, low carbon, not only obtain good economic and social benefits, but also can improve the capacity of the airport operation and security. Therefore, the LED light source is included in the navigation lights, and the design of a LED based airport lighting system is very significant.

2. The Overall Design of System

The airport lighting system based on LED lighting is proposed in this paper, which is based on the analysis of the structure and working principle of the general airfield lighting system, which is represented by the ordinary incandescent lamp. That is, the new lighting system based on LED is used instead of the original ordinary control system to work together with the ordinary incandescent lamp. Use. The working process is roughly: alternating current is transformed by AC/DC, and then DC converter is supplied to DC/DC converter, and finally output to LED lamp. As shown in Fig. 1.

The circuit uses a fully controlled device -- MOSFET (Metal-Oxide-Semiconductor Field-Effect Transistor). The working principle is very simple, that is, the load current increases continuously after switch V is opened, and the load on V continues to decrease after shutdown. In this system, the demand for inductance is higher, so that the current can be avoided before the next circulation of V to zero, that is, to eliminate the so-called intermittent phenomenon. In this way, the size of electric energy can be controlled in time by opening and closing time. The effect of inductive energy storage is to smooth the current to the load when the current is turned off.

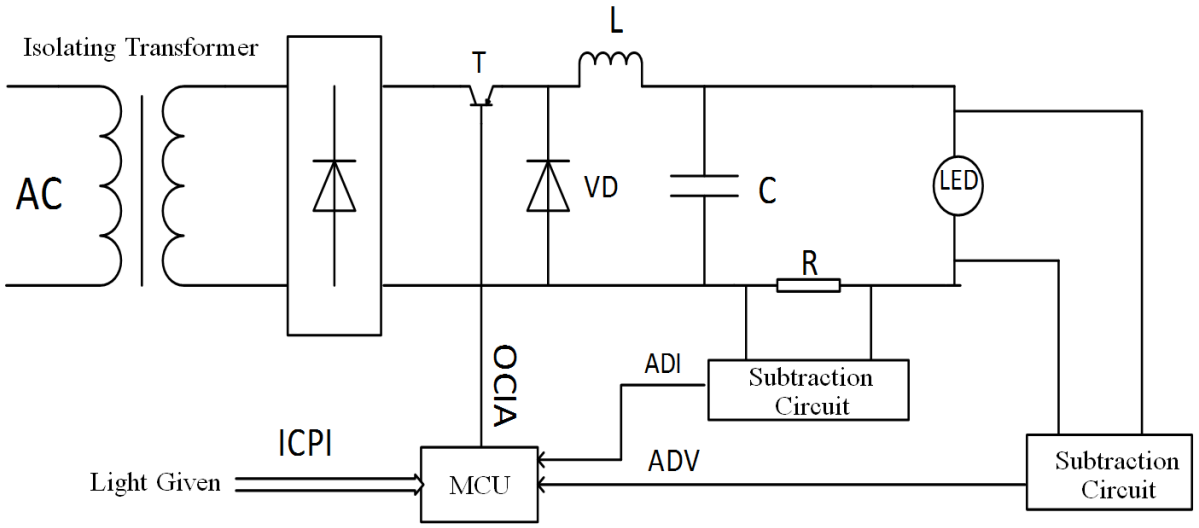

Fig. 1 Control structure of LED light intensity control system

2.1 Selection of Controller

In this design, ATmega88 is used as Core Controller of light intensity control system. The main application of ATmega88 MCU is simple hardware structure, low cost, low energy consumption, good encapsulation performance, controllable PWM waveform output, and powerful I/O function.

AVR microcontroller small system design, as shown in Fig. 2.

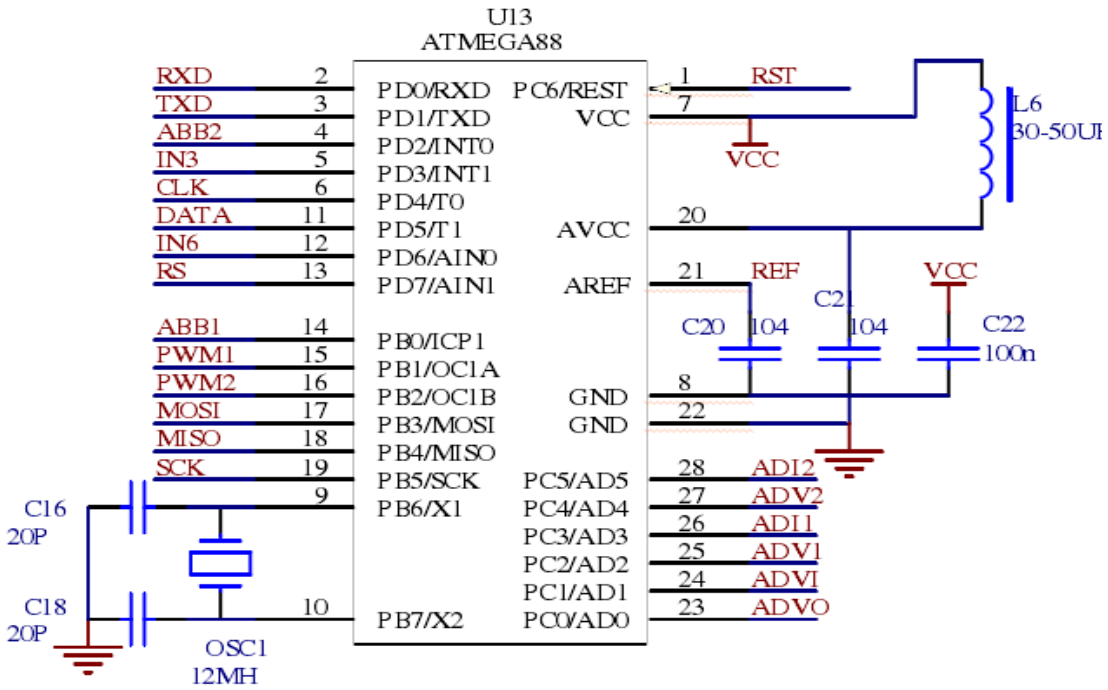

Fig. 2 Minimum system of ATmega88

2.2 A/D Sampling Hardware Design

The collection of required data can be sampled by ATmega88, which is A/D. In order to keep the voltage of ADC kept constant during transformation, ADC sampling circuit is needed. ADC is supplied by AVCC pin separately, and the deviation between AVCC and VCC is not higher than that of 0.3V. In order to select the more suitable reference voltage flexibly, we can use AREF pin to access the voltage that the user wants, for example, the design can connect 3.3V constant voltage.

The voltage sampling circuit of the hardware part is shown in Fig. 3. The completion of A/D sampling requires the proper operation and amplification link to transform the measured voltage to the working range of ADC 0~3.3V.

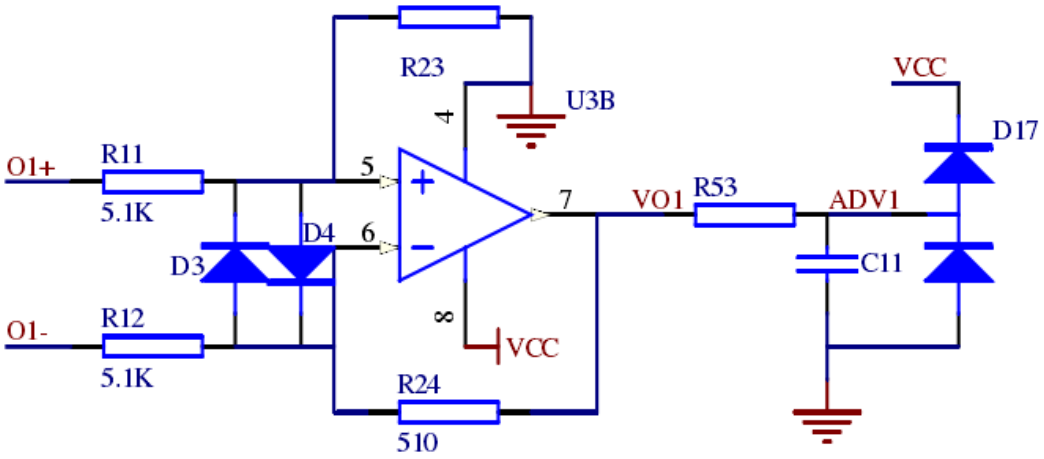

Fig. 3 Sampling voltage diagram

2.3 Design of Main Circuit and Closed Loop Control System

The structure circuit of the system includes rectification, filtering and chopping circuit, as shown in Fig. 4.

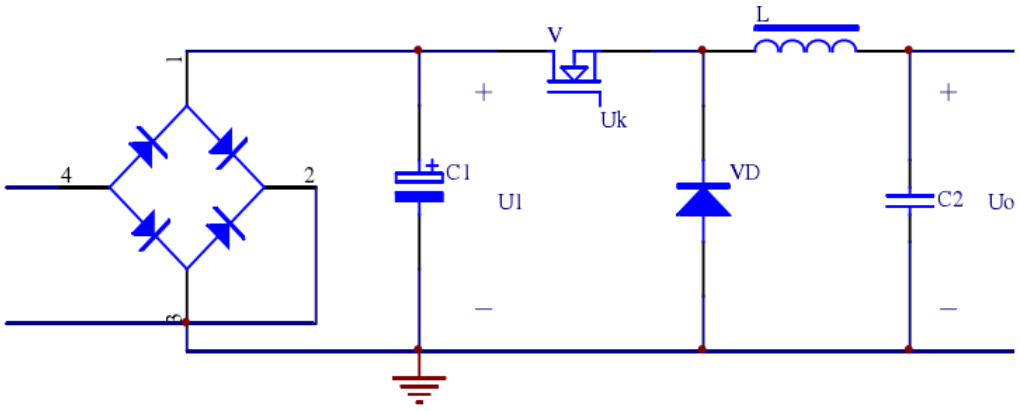

Fig. 4 Main circuit

The rectifier circuit converts the input AC to pulsating DC, and the pulsating DC becomes smooth DC after the filter circuit, then the DC voltage regulation can be realized through the chopper circuit, and the constant output voltage value is finally realized.

2.4 Photoelectric Isolation and Bootstrap Circuit

The main circuit of the power supply and the control circuit based on the single chip microcomputer belong to the strong part and the weak part respectively. In order to prevent mutual interference, we need to isolate the strong and the weak. Therefore, the photoelectric isolation device is introduced, as shown in Fig. 5. Light isolation needs the stable voltage of 16V to drive, but the amplitude of input voltage can not satisfy the driving light isolation and output load simultaneously, so we need to design a boost circuit.

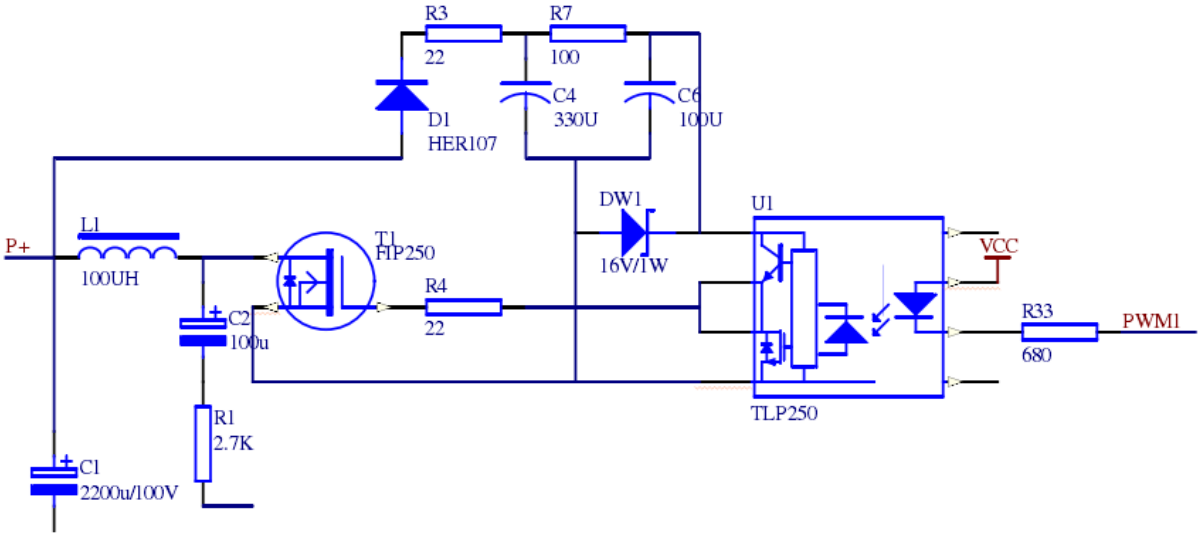

Fig. 5 Photoelectric isolation and bootstrap circuits

3. Conclusion

This paper analyzes the shortcomings of the existing common navigation lights and the advantages of LED lighting, and puts forward the use of LED lights as airport navigation lights. The overall design plan of LED airport navigation lighting system is given, and its hardware system is designed in detail. The system uses ATmega88 as the controller, and data acquisition is designed by means of A/D sampling of ATmega88, including rectifier, filter and chopper circuit.

Acknowledgements

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