

Design of Cold Light Source System for Medical LED Endoscope

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Abstract

With the improvement of LED, high-power white light LED applied to clinical lighting will replace the traditional medical cold light source in the future. The program will design to develop a LED medical endoscope cold light drive light control system based on the main demanding of cold light source lighting and the main character of the high-power white light LED chip. The system use -and + memory buttons to adjust the luminance of the LED and the thermistor temperature sensor will protect the overheating of the ED. This paper shows the design of the hardware and software. The experiment shows that the system has many advantages: stable operation, large light output, environmentally protective and adaptive to the medical clinical lighting.

Keywords

SCM; medical cold light source system; constant current drive; lighting adjustment.

1. Introduction

With the development and population of medical optical instrument, especially the widely application of arthroscope, the laparoscope in clinical minimally invasive surgery, the number and characteristic of medical cold light source has become more and more demanding. The basic function of the medical cold light is to produce cold light. It provides the light source for the various of endoscopes to improve the light for lumen observation and inspection. The medical cold light source not only has ample light quantity, high luminous color temperature but also it has to be stable and safe in operation.

The high power tungsten light used in the first period is low in light efficiency and color temperature, and the observed image color is tend to be red. The Xenon lamp and metal halide lamp used at present have high color temperature, but they are a kind of gas discharge lamp. This kind of lamp need more than thousands of volts high-voltage discharge, a high interference to start and a low color efficiency and a low life span average.

As the develops of the LRD technology, high light efficiency, high color temperature, a long life span and a high environmentally protective power, white light LED has been widely used in the road traffic, mines lighting and other fields, but it is still in the developmental period. If the high power LED would become the main body of medical cold light source, a safe, efficient, convenient and flexible drive light control research is the key technology in promoting the use of high power LED as the medical cold light source.

2. The Overview Of The Led Technology

LED (Light Emitting Diode, a light emitting diode) is a kind of solid state semiconductor device, which can directly convert electricity into light. LED light source has the characteristics of high energy-saving, environment-protecting, long life, small volume, changeable with strong applicability, high stability, short response time and so on. It can be widely used in a variety of fields like instruction, display, decoration, backlight source, common lighting, urban landscape and etc. Although it is more expensive

than the existing lighting equipment, it is still considered as an ideal substitute for them. In terms of energy saving, LED is with characteristics as DC drive, ultra low power-consuming (single tube <0.1W) and so on. Compared to traditional light sources, LED light source is close to point light source, it is single-phase lighting with easy light distribution and high efficiency of light utilization. On the average illuminance, the brightness of a LED light of 50 W is equivalent to a high pressure sodium lamp of 100 W. If only illumination is concerned, it should be higher that a LED light source with the same lighting effect of a traditional light source can save more than 50% in energy (take the actual application of products as an example). LED light source is a kind of solid cold light source, with epoxy resin package, and there is no loose part inside the lamp body, so there are no shortcomings as easy-burning filament, thermal deposition and so on. When the flux attenuation is reduced to 70%, its service life reached 50000 h, while the service life of a high pressure sodium lamp is 10000-20000h. It is more environmental friendly; it is pure in luminous color, and it does not contain ultraviolet and infrared radiation, mercury element; it has no pollution so that it is convenient for waste-recovery. Cold light source is safe to touch, which is a typical green lighting source.

3. The Overall Structure System

Plans to achieve the whole system includes: SCM and the part of the interface circuit, the part controlling light drive, the design of switch invert power source(including the supply the the systemic power source and the supply of LED drive power source), over-current, over-voltage, over heat protection and the keyboard display as well as the alarm function and etc.

The system makes it possible for driving and dimming of high power LED with the application of hardware circuit and software programming. The switching power of this system converts electric supply into those three kinds of direct voltage: +5V、 +12V and +36V. Through the voltage conversion circuit, +5V was converted into 3.3V which supplies to single-chip microcomputer, +12V supplies to cooling fan, +36V supplies to LED cold light source. As the controlling core, msp430F169 single chip will accomplish the LED dimming output, detecting and processing of key input signal, controlling output of alarm display as well as the testing and controlling of PN junction temperature of LED light source with the PWM output driving high power field effect transistor produced by single chip. The achievement frame is shown in Figure1:

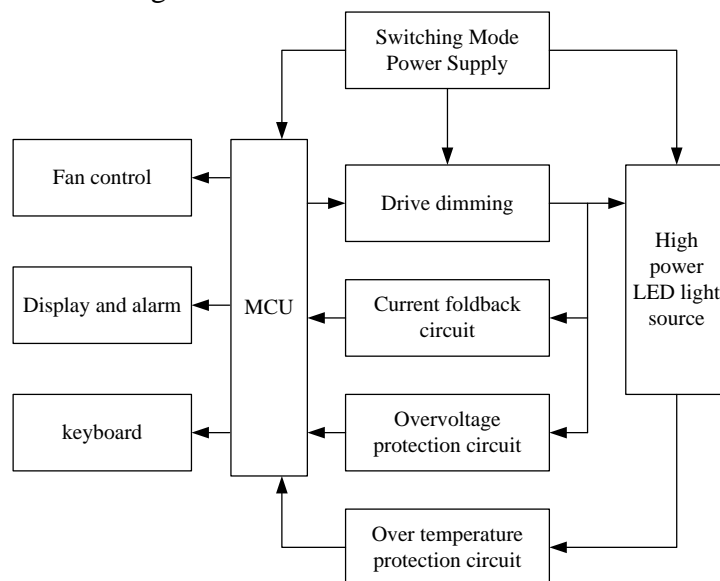


Figure 1 Design block diagram

4. The Design of Systemic Hardware

4.1 MSP430f169 SCM minimal systemic circuit

SCM minimal systemic also called the minimal applied system refers to a system that can work with the SCM composed of the minimalist element. The minimalist system includes: SCM, Crystal resonance circuit, reset circuit. The main resources includes: low power 16bit MSP430 micro processor; 2KB Flash storage, 128B PAM. The circuit is shown in Figure 3.

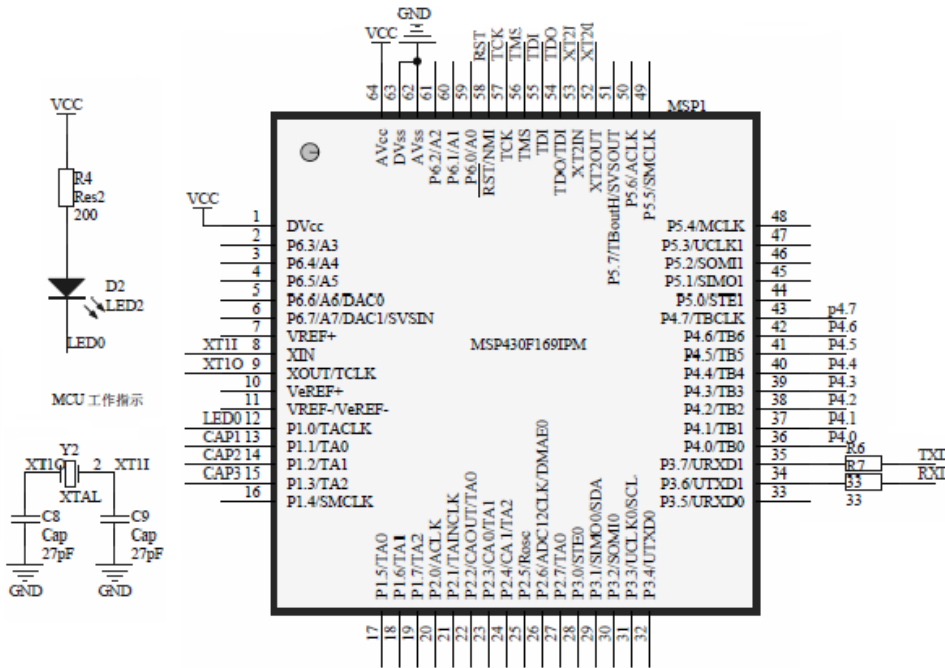


Figure 2The minimum system of the single chip microcomputer

4.2 Drive and light control circuit

The PWM signal is output by SCM isolated by photoelectric coupler, drive high power efficiency to achieve the light control function. The concrete circuit is shown as in figure3.

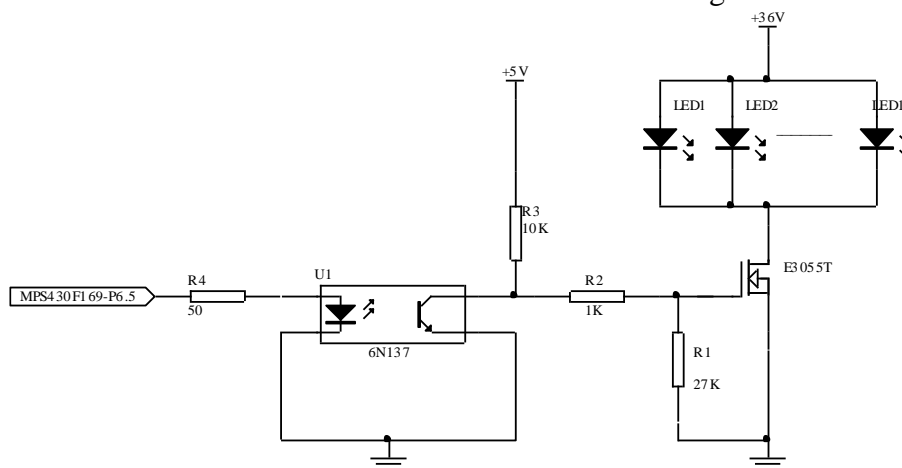


Figure 3 LED pulse width modulation dimming circuit

4.3 SCM interface circuit design

MSP430F169 SCM is the control center in Interface circuit mainly including the keyboard circuit design: LED temperature signal collecting design:indicating circuit design task. The following are the indication and keyboard circuit as the figure 4 and figure 5

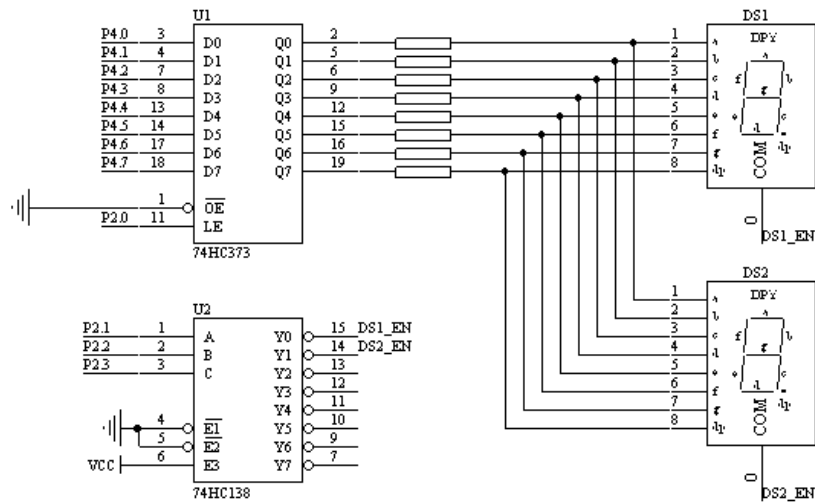


Figure4 Design of LED display circuit

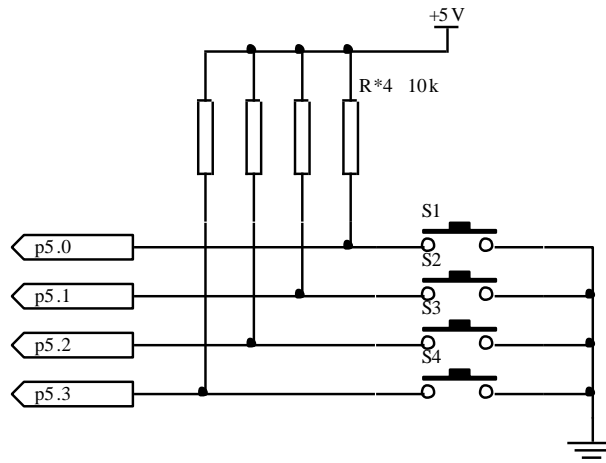


Figure 5 Keyboard circuit design

4.4 MSP430 SCM power supply circuit design

Due to the use of 3.3V to MSP430 SCM, the +5V is turned into +3.3V by LM1117. The circuit is shown in figure 6

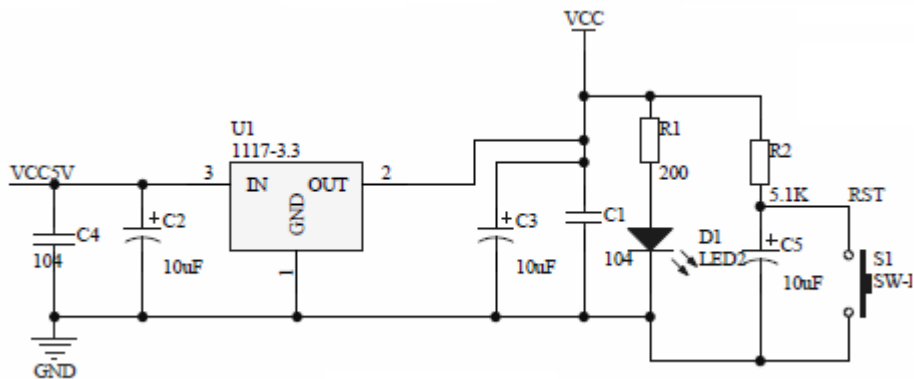


Figure6 Design of power supply circuit of MSP430

5. Conclusion

Due to the strong need of Medical cold light source, this paper mainly analyzed a dimming control system whose function was based on msp430F169 SCM. This system was used to control "LED" a kind of light resource with high power. This system can not only successfully drive LED whose power was so high that even its single electric current is as high as 3.5A, but also ensure the stability of electric current originated from light source. It also realized the effective control for the PWM in LED, having greatly enlarged the dimming control range, and satisfying the clinical need.

This system can also protect LED, when its PN junction is overheating, which can extend its service time to make sure medical operation continuously going. The clinical practice proved that medical cold light source with a high power own some special strengths, including much brighter light, more light output, more safe, energy saving, intelligent function, etc. Because of these strengths, it is an ideal light source for medical use.

Reference

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