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Stable Power Supply Control of Numerical Control Based on Single Chip Microcomputer

Xiyan Zhang,[1],Peipei Yang[2]

Qingdao Engineering Vocational College, Qingdao, Shandong Province, 266012, China

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Abstract: This paper mainly discusses the design principle and implementation method of a kind of digital control power supply based on stc12c5a32ad MCU. The output voltage of the power supply can be set by keyboard, the step level is 0.1V, the output voltage range is 0 ~ 9V, and the actual output voltage value can be displayed by LCD.

1. Introduction

Power supply technology, especially numerical control power supply technology, is a practical engineering technology. Serving all walks of life, is a hot issue in recent years. DC regulated power supply is a necessary instrument and equipment in the process of electronic circuit analysis and design. A DC power supply with stable voltage is needed to supply the power. If the power supply voltage is unstable, the stability of the whole system will be affected, resulting in many adverse consequences. The traditional DC regulated power supply is composed of four parts: power transformer, rectifier, filter and regulated voltage. It has the advantages of simple function, difficult control, low reliability, large interference, low precision, large volume and high complexity. For example: the output voltage of the traditional DC regulated power supply is adjusted by coarse adjustment (band switch) and fine adjustment (potentiometer). In this way, when the output voltage needs to be accurately output or needs to be changed in a small range, the difficulty is greater. In addition, with the increase of use time, the band switch and potentiometer will inevitably have poor contact, which will affect the output. The voltage stabilization mode adopts series connection The circuit structure is complex and the precision of voltage regulation is not high. Compared with the traditional regulated power supply, the DC regulated power supply based on single-chip microcomputer control can solve the shortcomings of the traditional regulated power supply. Compared with the traditional regulated power supply, it has the characteristics of convenient operation and high voltage stability. Its ripple voltage is low. Accurate voltage regulation, digital display of output voltage, intuitive and easy to read. Most of the circuits use integrated circuits, which have the advantages of simple debugging, excellent performance, low failure rate and long service life.

2. Hardware System Design

This design uses stc12c5a32ad as the control unit of the whole machine, and sets the output voltage of the power supply through the keyboard. The setting step value can reach 0.1V. The set

value of voltage can be displayed by LCD. The digital signal is output by program control of single chip microcomputer. Analog quantity is output by D, a conversion chip (TLC5615), and then is isolated and amplified by optocoupler. The base pole of output power transistor is controlled. Different voltages are output with the change of base pole voltage of power transistor. The single chip microcomputer system also monitors the constant voltage source in real time. The output voltage is sampled by a / D of stc12c5a32ad single chip microcomputer to convert the real-time analog quantity to analog quantity. Through the analysis and processing of single chip microcomputer and the feedback link of data form, the voltage is more stable and a stable voltage controlled voltage source is formed[1]. The overall design of the system is mainly composed of microcontroller module, voltage control module, voltage sampling module, display module, keyboard module and power supply module.

2.1 Controller Selection and Function Characteristics of Stc12c5a32ad

Stc12c5a32ad is a processor developed by macrocrystal technology, which has the characteristics of high speed, low power consumption and strong anti-interference. The instruction code is fully compatible with the traditional 8051 single chip microcomputer, but the speed is 8 ~ 12 times of the traditional 80C51. The maximum frequency can reach 35MHz. The maximum speed can reach 35mips. The chip has 32kbe pr0m and 1280b RAM data memory, and the working voltage is wide, 3.3 ~ 5.5V. Ma × 810 special reset circuit is integrated in the chip. 8-channel 10 bit high speed ADC. 2-channel PWM has external power failure detection circuit. It can save data into E2PROM in time when power failure occurs. It is not sensitive to clock and serial communication speed. Internal R / C oscillator circuit can be used Because the internal has integrated independent baud rate generator. The serial communication rate of this series of MCU can not be determined by the overflow rate of internal timer T1. This allows T1 to realize the function of timing or counting. There are power on reset circuit and watchdog. It can greatly reduce the cost and volume of the simplest system[2]. There are many kinds of packages, which are easy to choose. The biggest advantage of this SCM is: STC adopts MCS-51 architecture. It has great software advantages and a large number of user groups, which makes the shipment of this product very large. It can fully guarantee the supply and low cost. So this system uses stc12c5a32ad as the core of the whole hardware system. It is not only the controller to coordinate the whole machine, but also the data processor. It has the function of a / D conversion and can sample the real-time voltage.

2.2 D / a Conversion Module and Its Peripheral Circuit

The digital to analog conversion chip adopts TLC5615 of TI company. TLC5615 is a 10 bit digital voltage output with buffered reference input (high impedance)-- Analog to digital converter (DAC): the DAC has the output voltage range of 2 times of the reference voltage. The DAC is monotonous. The device is easy to use. It works with a single 5V power supply. The device has the power on reset function to ensure repeatable startup. The digital control of TLC5615 is via three wire serial bus. It is CMOS compatible and easy to be controlled by industry standard microprocessor and micro controller Device interface: the device receives 16 bit data words to generate analog output; the characteristics of digital input terminal include having a sehmitt trigger, which has high noise suppression capability; digital communication protocols include spitm, qspitm, MICROWIRETM standards. The D / a converter chip (TLC5615) is controlled by single chip microcomputer to output analog quantity. Its working process is summarized as follows: the output of TLC5615 has the same polarity as the reference input. When power on, the internal circuit resets the DAC register to all zero TLC5615 uses a resistor network buffered by an op amp with a fixed gain of 2 to convert 10 bit digital data to analog voltage level[3]. Because the DAC input latch is 12

bit wide, two bits lower than LSB (sub LSB.) with a value of 0 must be written in the 10 bit data word, so the analog output voltage is: out = 2 × refin × (DIN > > 2) / 1024. The analog signal is isolated and amplified by the optocoupler (817c) to control the base of the output power transistor. The output voltage varies with the base voltage of the power transistor.

2.3 Nd Sampling Circuit

Because the P1 port of stc12c5a32ad has the function of a / D conversion, the P1.0 port is selected as the sampling input E1. Because the maximum output voltage is 12V, and the maximum voltage limit of the P1 port of stc12c5a32ad is 3.3V, a 5.1k voltage divider is enough. In addition, a 47pf capacitor is connected to stabilize the sampling voltage.

2.4 Lcd Display Module

Jyg12864 is selected as LCD display module. This module can display words, letters and numbers with rich content, simple operation and clear display. The interface with microcontroller is simple and easy to operate. Jyg12864 is a kind of graphic dot matrix LCD. It is mainly composed of row driver / column driver and 128 × 64 full dot matrix LCD. It can complete graphic display and display 8 × 4 (16 × 16 dot matrix)[4]. The data line do-d7 is connected to the P2 port of stc12c5a32ad for data transmission; the rst pin is connected to P0.4 for reset; the / CS pin is connected to p0.3 for chip selection; the D / I pin is connected to p0.7 for setting display instructions or data; the R / W pin is connected to po.5 for setting data reading and writing direction; the e pin is connected to p0.6 for data latch and reading.

2.5 Key Interrupt Circuit

In the application system of microcontroller, keyboard is usually used to realize the function of man-machine conversation. It includes the user's state intervention and data input to the application system, and the application system reports the running state and running results to the user. The number of keyboard keys used in the system design is relatively small, so independent keys are used, the circuit configuration is flexible, and the software structure is simple. As shown in Figure 6, press S2 to add 0.1V voltage, S3 to subtract 0.1V voltage, and S4 to save the current voltage[5]. In order to maintain the current voltage after power off, press S1 to realize the reset function. In order to achieve the above functions, only two keys need to be connected to the two interrupt pins of stc12c5a32ad to realize the function of key interrupt. In order to adjust the voltage, there is also a reset pin connected to stc12c5a32ad to realize the function of system reset.

3. Software Overall Design Process

Keil c51 is used as the program compiling software in this system. It is one of the excellent software in many SCM application development software. It supports MCS51 architecture chips of many different companies, integrates editing, compiling, simulation and other functions, and also supports PLM, assembly and C language program design Its interface is similar to that of Microsoft VC + +. It has friendly interface, is easy to learn and use, and has powerful functions in debugging program and software simulation. The source program of the system is written in C language. Then the source program is compiled into the object file with Keil C51, that is. He × file. Then the file with the extension of. He × is written into stc12c5a32ad chip with programmer.

The software system consists of the following modules: main function module: the main function initializes the system first. When the system is started, the initial set voltage is displayed first. Then

it starts to scan whether the key is pressed. If the key is pressed, the output voltage is adjusted by D / a chip. Key interrupt function module: the system uses two keys to connect to p3.2 and p3.3 ports. These two interrupts El can be directly used to generate interrupt signal. Every time the key is pressed, the interrupt signal will be generated. The system will automatically call the interrupt sub function to achieve the purpose of changing the voltage. A / D sampling function module: This design uses a channel of a / D sampling. The A / D sampling function samples the change of output voltage in real time and feeds it back to stc12c5a32ad single chip microcomputer, so as to achieve the effect of stable voltage output[6]. The D / a conversion function module stc12c5a32ad controls the output voltage of the D / a converter according to the change of the A / D sampling voltage, and then controls the base of the output power transistor through the isolation amplification of the operational amplifier. With the change of the base voltage of the power transistor, different voltages are output. Voltage fine-tuning function module: due to the external power supply voltage, output power tube, key may make the output voltage produce relatively large error. This requires a voltage fine-tuning function to achieve the effect of voltage stabilization.

4. Conclusion

When the input voltage is 12V and the load is 2001 Ω, 150 Ω and 100 Ω respectively, the accuracy of the output voltage of the numerical control power supply is tested. The error is less than ± 0.02v. It is proved that the system has met the design requirements. The numerical control power supply has strong practicability. The voltage can be adjusted in the range of 0 ~ 9V. It can be applied to the power system which needs to provide high stability and low power constant voltage source.

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