Advances in Computer Science Research (ACSR), volume 61
7th International Conference on Education, Management, Computer and Society (EMCS 2017)

Research on Switch Power Supply Device

Ping Xin[1, a], Jian Xue[1, b*] and Hongtao Mi[1, c]

[1]School of BeiHua University, Jilin 132021, China

[a]359411897@qq.com, [b]14145277@qq.com, [c]17207527@qq.com

*The corresponding author

Keywords: Switching power supply; Power electronics technology; 89C51; PWM technology; MOSFET

Abstract. PWM type switching power supply with high efficiency and energy saving features is very suitable for portable electronic devices, and has been widely used in the fields of communication, computer and other fields. The PWM control link in the switch power chip is the key and the core of the technology. The design of the PWM pulse control part is a combination of hardware and software program is established, the software programming of PWM pulse duty cycle adjustable through 89C51, MOSFET controlled by pulse tube breaking fixed value of DC can be input into DC adjustable.

Introduction

Today, with the rapid development of science and technology and information, our life is full of all kinds of electronic products. Electronic products change rapidly, the rapid development of today, because the power electronic circuit, electric equipment and various power sources of electric equipment, so the supply position is like the heart in electronic products for human status as important [1]. The electronics industry to the development of various fields, the electronic industry has also put forward many new requirements. The performance parameters and stability of the whole system will be directly affected by the performance of the power supply. The importance of power supply in the whole circuit system is self-evident [2, 3].

The large scale equipment used in the industry and the precision instruments in the laboratory need the support of the voltage stabilized power supply. Different electronic devices also need different power performance, so has a stable and good performance has become a necessary condition for power supply, so that the normal operation of electrical equipment can be guaranteed. Due to the special nature of the power supply, in the field of high energy physics, atomic energy research, if the need to ensure the smooth conduct of the test requires the power supply must be made before the instrument, equipment and devices. With the rapid development of PC and IT machine industry, the power industry is the foundation of all kinds of high-tech electronics industry development, so sophisticated technology equipment require power system technical support and support [4, 5].

Composition of Switch Power Supply

Fig. 1 shows the overall structure of the pulse power supply, switching power supply part and PWM pulse generator part of the circuit. After rectification filter, the input 220V AC into 300V DC high voltage. The DC voltage is adjustable, which is obtained by the DC-DC transform structure. The MCU is the core of the controller, and the pulse control part can change the value of the pulse parameters. By changing the value of the pulse parameters to control the frequency and duty cycle, and achieve a level adjustment [6]. The output of the pulse signal is controlled by a single chip microcomputer, and the pulse signal is controlled by the chopper in the switching power supply, and then the output voltage is controlled by the pulse. The process is mainly carried out by the power switching device [7, 8].

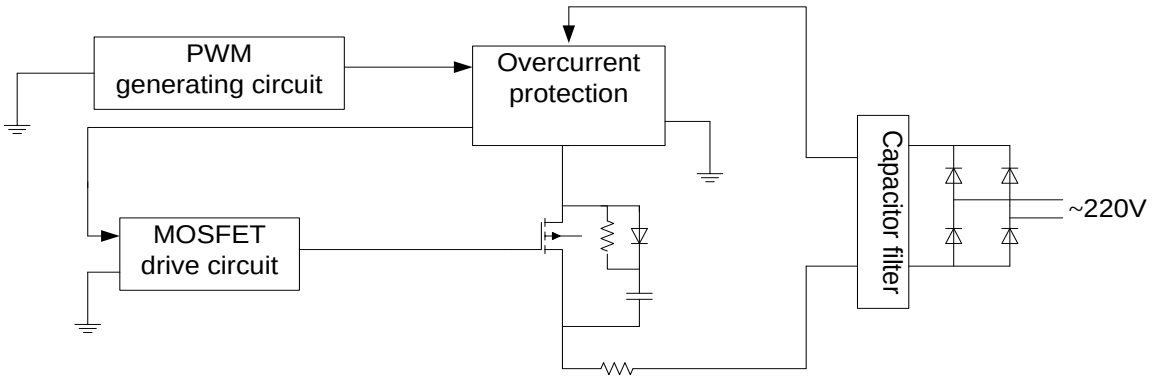

Figure 1. General structure of pulse power supply

PWM Pulse Generating Circuit

Control Strategy. The output voltage is controlled by the switch tube, and the turn-on time of the switch tube directly affects the output voltage of the switching power supply. The turn-on time of the switch is controlled by the pulse width modulation signal. Changing the output voltage value can be achieved by changing the duty cycle, the output voltage is constant, the load current can be changed in a large range. In order to ensure the reliability of PWM waveform, and try to make the circuit structure is simple, the design uses the 89C51 micro controller as the smallest system of rectangular wave generator. Including the reset circuit and oscillator circuit smallest system [9, 10].

When there is a failure in the single chip microcomputer, the reset circuit can reset the system. As shown in Fig. 2 for the reset circuit, this module is connected to the RST pin (9) circuit capacitance is 10uF, the resistance is 10K. SCM power is 5V, charging up to 0.7 times to reach 3.5V, takes time 10K*10uF=0.1S. So in the SCM has just started, the capacitor voltage is in the range of 0~3.5V value increased, resistance decreased voltage value is 5~1.5V, the critical voltage level signal to the micro controller work properly when the 1.5V, it is more than a high level, so start at about 0.1S MCU RST pin high level, single chip microcomputer automatic reset [11]. The circuit is designed by pressing the button KS button, can also make the system reset: in normal operation, the MCU reset pin is in a low state, when you press the button, the capacitors discharge, the resistor voltage begins to rise, so that the reset pin voltage up to 1.5V or more, the MCU reset.

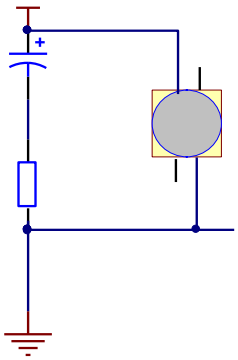

Figure 2. Reset circuit

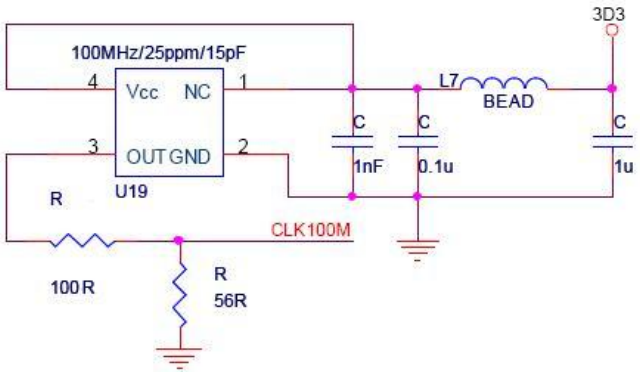

Figure 3. Crystal oscillator circuit

As shown in Fig. 3 for crystal oscillator circuit, both ends are respectively connected with a capacitor, the other end to ground capacitance. A crystal oscillator circuit connected to the inverting amplifier at both ends. The value of the load capacitance is the capacitance value of the two series resistors. The crystal can be seen as a capacitor and a first resistor in parallel, and then connected to a capacitor components. There are two resonant oscillator, due to the nature of its own to its parallel

resonance and series resonance is very close, so it can be regarded as a equivalent inductance [12]. Both ends of the capacitor in the oscillator with appropriate resistance equivalent parallel resonant circuit. This circuit consists of sinusoidal oscillator circuit in the feedback circuit, the frequency change of the crystal oscillator by the frequency range limit, the other parameters of the circuit have little effect on the oscillator.

MOSFET Drive and Protection Circuit. This design is used in driving circuit of photocopier isolation, using TLP521-2 photoelectric couple. As shown in Fig. 4 for MOSFET drive and protection circuit, the electric power control routing + 15V single power supply, the control signal is sent to the photocopier trigger circuit, when the input terminal (2) is high when the T1 is switched on, resulting in a medium voltage level, the input to the T2, so in the T2 conduction T3 can stop working in the off state.

The gate of the MOSFET by the charge conduction; (2) when the end is high level, and make the deadline, deadline, the power supply, and accelerate the network to provide the base current, the conduction, thus forcing the MOSFET off at the gate of the MOSFET in the ground state. In order to avoid the saturation of the circuit, the circuit is equipped with a Becker clamp circuit. The position is an accelerating network, so the switching speed is high.

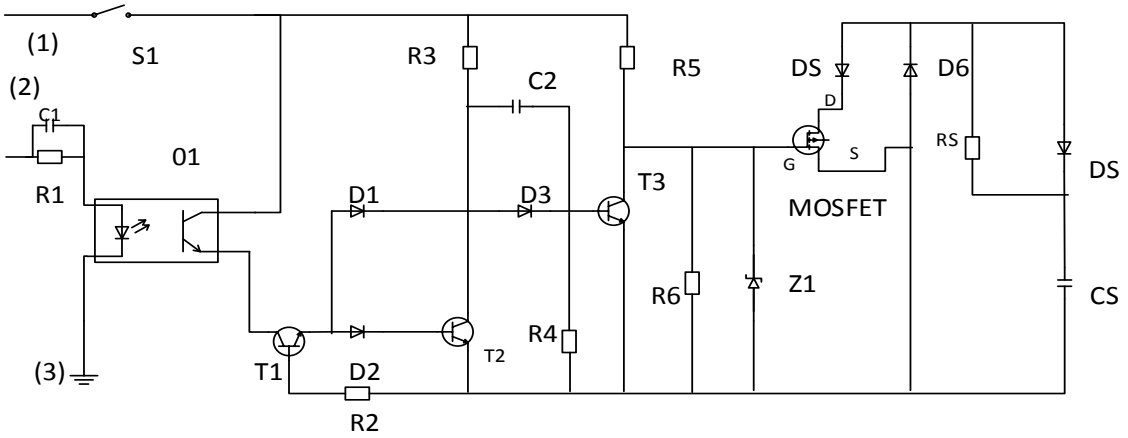

Figure 4. MOSFET drive and protection circuit

The voltage drop on the on state resistance of the MOSFET tube is the conduction voltage drop. The conduction voltage drop increases with the increase of temperature, and accordingly, there will be a larger switch safe working area which will not be affected by the two breakdown. The safe operating area of the MOS tube is a load region where the device is not damaged, a rectangular boundary, which is determined by the maximum peak current rating and the maximum drain source voltage. The safe working range of the switching power supply is wider than that of the DC voltage, and the working frequency of the switch power supply is 45 KHz, which is equal to the order pulse period of about 22us. In the limit of the input voltage is 342V, the maximum output current is 2.3A, and the working state of the tube is still within the safe working area .

Experimental Data

The main circuit of the power and driving power supply, do not open the pulse generating device, MOSFET is in continuous conduction mode, the voltage representing the number of close to the main circuit voltage value, taking into account the conductor loss, the voltage value of 19.431V within the acceptable range. Shows that MOSFET has a good on state. With the increase of the duty cycle of the pulse signal, the turn-on time of MOSFET is shorter and shorter, so the effective voltage value is getting smaller and smaller. It is shown that the pulse supplied by the pulse generator can change the voltage of the current. Table 1 shows the measured data.

Table 1 Measured data

Duty cycle	Not open	Not open	0.2	0.4	0.6	0.8
Main circuit voltage [V]	20	20	20	20	20	20
Drive voltage value [V]	0	15	15	15	15	15
Voltmeter display value [V]	0	19.431	15.422	11.335	7.328	3.254

Summary

A realization of the intelligent duty cycle adjustable pulse control using single chip switching power supply design. SCM through the keyboard control, pulse width modulation, so that the output voltage can be adjusted in a large range. Compared with the traditional linear power supply, the efficiency of the power supply is higher, and the volume and weight of the power supply are also reduced. Due to the application of SCM in the power supply, not only improve the reliability of the system, but also make the power supply has better maneuverability.

Acknowledgements

This research was financially supported by Jilin Provincial Department of Education Science and technology research project (201656); The Education Department Project of Jilin Province (201632); The Education Department of the Ministry of education higher education professional teaching steer (DQJZW2016002); Education and teaching research topics of Beihua University (BHDQ31).

References

[1] J.X. Yang : Journal of Qinghua University, Vol.27(2011), No.6, p.1 (in Chinese)

[2] T.Q. Qing :*Common DC regulated power supply circuit used in 200 cases* (China power press,China 2013), p.10-22. (in Chinese)

[3] Z.M. Qian, J.M Zhang and K.Sheng: Power Electronic Devices and Its Application Chinese CSEE, Vol. 34(2014), No.29, p.5149 (in Chinese)

[4] Y.S Zhang, Z.G. Zhang: China New Technology and New Products, Vol. 29(2014), No.3, p.11 (in Chinese)

[5] F. Xue: Science and Technology News, Vol. 28(2014), No.9, p.11 (in Chinese)

[6] A.C. Wu: Silicon Valley, Vol. 27(2013), No.4, p.12 (in Chinese)

[7] J. Luo: Computer Programming Skills and Maintenance, Vol. 17(2014), No.4, p.15 (in Chinese)

[8] J. Xiong, K. Zhang: New Technology of Electrical Energy, Vol. 28(2012), No.7, p.44 (in Chinese)

[9] L.X. Yang, Z.W. He: Journal of Henan Polytechnic University-Natural Science Edition, Vol. 40(2014), No.9, p.5 (in Chinese)

[10] Y. Yang, X.A. Fang: China New Technology and New Products, Vol. 17(2012), No.6, p.15 (in Chinese)

[11] Luiz A C, Maged F N: IEEE Transactions on Power Electronics, Vol. 25(2011), No.4, p.1055

[12] Navid R, Xinbo Ruan: IEEE Transactions on Industrial Electronics, Vol. 58(2011), No.7, p.2772