

## Motor Control System Based on BP6380A

Lan Sun, Xin Ma

Suzhou Vocational Institute of Industrial Technology, Suzhou 215104, China

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*Abstract: The development of BLDCM is based on the development of BLDCM. At present, although a variety of AC motors and DC motors play a leading role in the drive application, the BLDCM is being paid more and more attention. At present, the BLDCM has penetrated into every field of our life, it is almost difficult to find any field without the trace of the BLDCM. BLDCM has the advantages of low noise, smooth operation, no brush, low interference, long service life, low maintenance cost, etc. This paper has some research on BP6380A chip. Therefore, this design focuses on the BP6380A chip control system. The BP6380A chip needs to be made in kind when selecting the real carrier, which can not be too complex and has certain practicability. Therefore, the design of the control system of the BLDCM Based on BP6380A chip is selected.*

*Keywords: BP6380A chip, Brushless motor, BP6901 chip.*

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### 1. INTRODUCTION

In 1978, at the Hanover Fair, Mannesmann officially launched their latest products, brushless motor and driver, which caused a lot of influence at that time, thus promoting the research and production of brushless motor in the world. From then on, the brushless motor began to enter the use stage. With the deepening of the research on brushless motor, the theory of brushless motor is becoming more and more perfect. In 1986, a scientist named h.r.bolton made a comprehensive and systematic summary of the brushless motor for the first time, pointed out the research direction to the people who studied the brushless motor at that time, and became the founder of the brushless motor, which also marked the maturity of the theory of the brushless motor. The research on brushless motor in China was relatively late. Until 1987, the brushless motor and drive system were displayed at the German Metalworking Exhibition held in Beijing, which attracted the attention of domestic researchers at that time. Since then, China began to research and produce brushless motor, and formed a certain scale. Brush motor is a traditional product with stable performance. Brushless motor is developed on the basis of brush motor, so it is better than brush motor in cost maintenance. But the control circuit of brushless motor is more complex, and the requirements of components are more strict. Through the comparison between brushless motor and brushless motor, the advantages of brushless motor are greater than that of brushless motor, but some advantages and characteristics of brushless motor can not be replaced by brushless motor now. However, with the in-depth study of brushless motor, convenience and the decline of controller cost, brushless motor system is developing and popularizing at a high speed. This design studies the control system design based on BP6380A chip. The chip integrates Hall position decoder, MOSFET Driver, oscillator and other modules and

peripheral components to form a brushless DC motor drive system. BP6380A has multiple protection functions, including under voltage protection, current limiting protection, locked rotor protection, over temperature protection, etc. Through the design and production, complete the control circuit board, debug and analyze, and apply the motor system to the actual products [1-7].

## 2. SYSTEM HARDWARE DESIGN

Brushless motor is composed of motor and drive, which is a kind of electromechanical product. Because the brushless motor is automatic operation, so the brushless motor will not produce oscillation and out of step when the load changes suddenly. At present, there are two ways to control the speed of brushless motor. One is that the microprocessor is used as the control core to constitute the hardware system. This method can be programmed and controlled, which has a wide range of applications and is flexible and convenient. The other is to use integrated circuit, which can reduce the cost and improve the reliability and feasibility of the device. In this paper, we use the latter scheme to design the motor control system with ASIC.

At present, the commonly used ASIC master chips on the market are MC33035 developed by Motorola company and BP6380A chip of Jingfeng Mingyuan company. Compared with MC33035, BP6380A has better performance, lower cost, more functions and multiple protection functions than MC33035. It can be seen that BP6380A is a high-performance low-cost three-phase brushless DC motor sine wave control chip, more in line with the design requirements.

BP6380A is a high-performance and low-cost control chip for brushless DC motor. The chip integrates Hall position decoder, MOSFET Driver, oscillator and other modules. Only a few peripheral components are needed to form a complete brushless DC motor control system. The internal structure of BP6380A chip is shown in Figure 1.

Pin 1-6 of BP6380A chip is Hall signal input signal port. The signal detected by Hall position sensor of hall encoder is input to BP6380A. The chip receives the signal for internal calculation and feeds back to the output port. Hall encoder interface J2 adopts standard 5-wire hall connection mode, which is composed of pull-up resistance and current limiting resistance to ensure that the collected signal is clean and free of clutter. When wiring, pay attention to the wiring sequence. There is hall line sequence in the motor parameters, which is generally distinguished according to the color. Hall encoder interface J3 adopts standard 3-wire hall connection mode. When wiring, pay attention to the wiring sequence. There is hall line sequence in the motor parameters, which is generally distinguished according to the color. The 14 pin of BP6380A chip is the brake signal input port. As shown in Figure 3-7, when the 14 pin receives the low level, the BP6380A chip will output the motor running signal. If the 14 pin receives the high level, the BP6380A chip will give the motor brake signal. The BRK is designed to be grounded, this pin is a low-level input, and the chip output is a motor running signal, so there is no brake function. If the brake function is required at this time, a NPN type triode can be added. When the base input of the triode is high, the triode is saturated and the collector voltage of the triode is less than 0.4V, which is a low level; when the base input of the triode is low, the triode is cut off, and the voltage of the triode collector is VCC, which is high level. The 15 pin of BP6380A chip is the positive and reverse signal input port. As can be seen from figure 3-8, when the chip 15 pin receives the low level, the internal pull down,  $u \rightarrow V \rightarrow W$ , the motor runs forward; when the

chip 15 pin receives the high level, the internal pull up,  $W \rightarrow V \rightarrow u$ , the motor runs in reverse. The 20-25 pin of BP6380A chip is the driving output. As can be seen from figure 3-9, when the BP6380A chip receives the signal, through internal calculation, the drive output end outputs the signal to the 2 and 3 pins of the bp6901 driver chip, and then drives the motor to react. BP6380A chip 7 pin when a Hall switch to select the signal port. BP6380A has both analog voltage and digital signal switch input, using the hsel terminal to select the input mode. When hsel is suspended or connected to high level, hall analog differential signal is input from H + and H-terminal, as shown in Fig. 2.

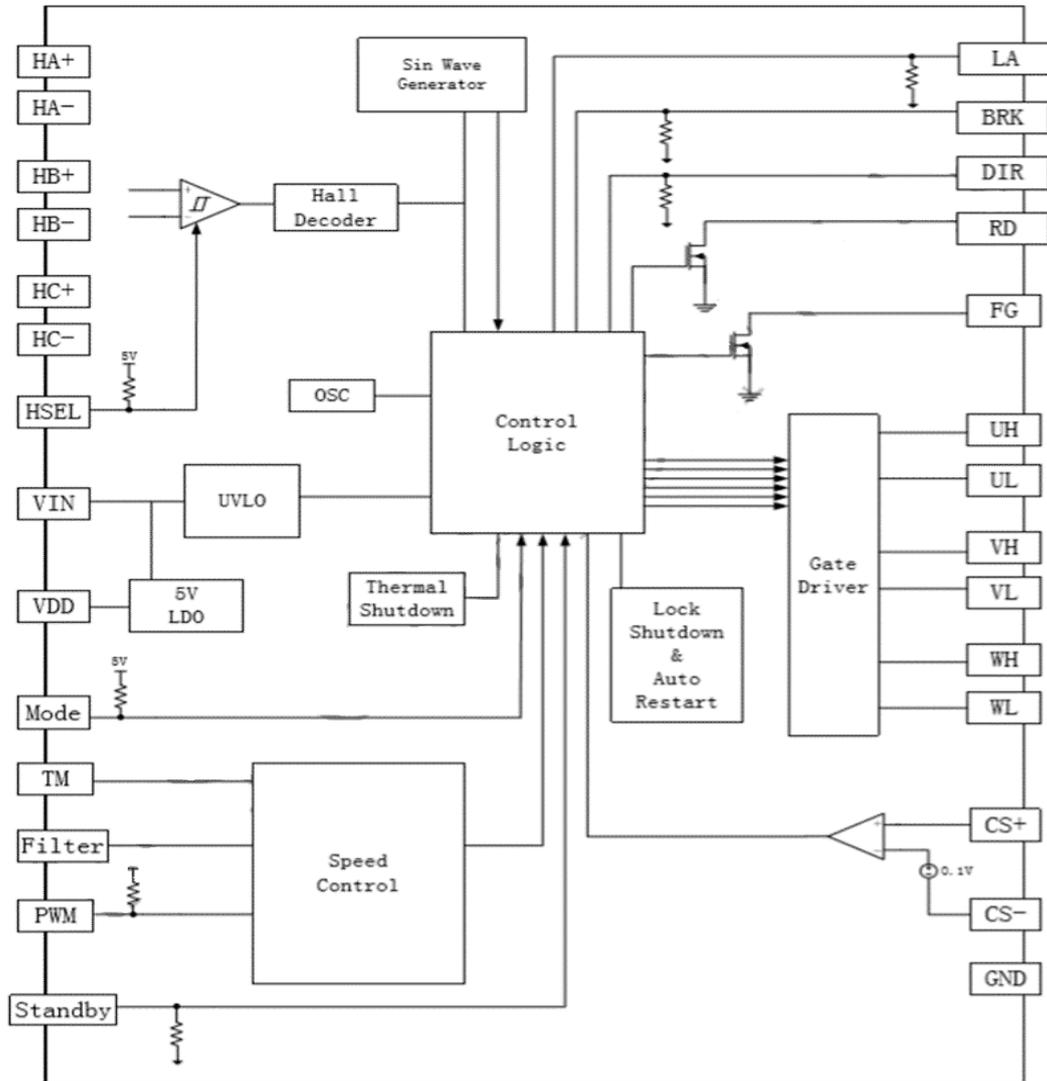


Fig.1 internal structure of the chip

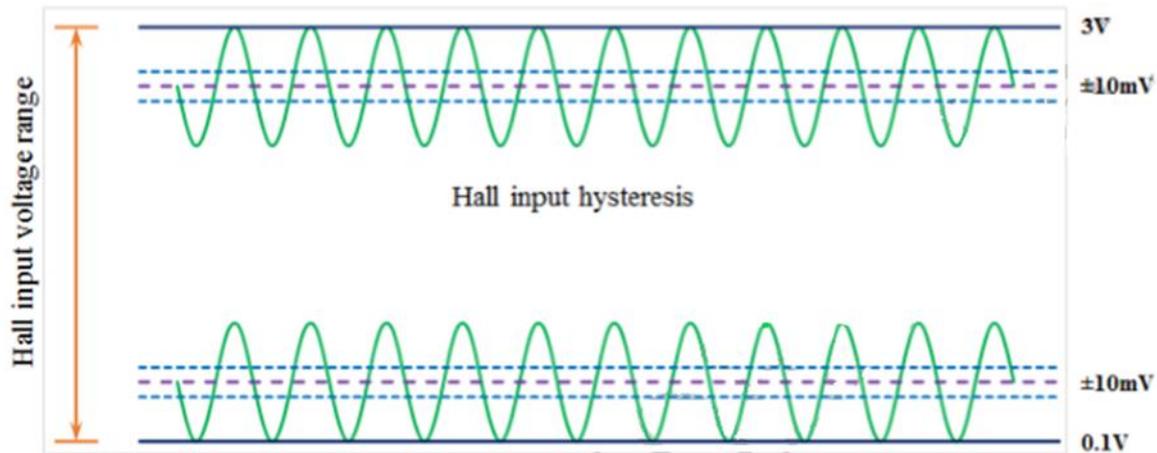


Fig.2 hall signal input range

The range of Hall signal voltage is 0.1-3v, and the threshold value of validity period is  $\pm 10\text{mV}$ . Generally, hall differential voltage is not less than 50mV. When the hall signal is disturbed by noise, small capacitors can be added to the H + and h-terminals to eliminate the noise. When the hsel terminal is connected to the low level, the hall switch signal is input from the H + terminal and h-ground. The input voltage range is 0v-5v, and the flip point is 2.5V. To prevent noise interference, the hall input is designed with 20us shielding time to eliminate jitter. The 9 pin of bp6308a chip is lead angle input circuit. In the brushless DC control of Brushless DC motor, lead angle is usually used for sensorless or sensorless motor. Because the motor coil is an inductive load, the current in the coil will have a certain delay relative to the load voltage on the coil, which will affect the efficiency of the motor and produce noise and vibration. For the sine wave / square wave control of Brushless DC motor, without changing the basic control algorithm, adjusting and selecting the appropriate lead angle can significantly improve the control efficiency and vibration noise level of the motor. Especially for the motor with sensor, the lead angle in the control sequence is equivalent to adjusting the sensor position inside the motor. By using simple and easy software method, the effect of adjusting the physical position of the sensor can be realized. The 10 pin of bp6308a chip is the standby mode selection circuit; the 18 pin of bp6308a chip is the system status signal output port. Bp6308a has designed the standby function. The chip can reduce the power consumption and control the peripheral components by using nready output signal. When the voltage of standby pin is low, the filter voltage is less than 0.1V, which can control the motor to enter the standby state, and at the same time, the nready output is turned off; when the voltage of standby pin is high, the filter voltage is less than 0.1V, the motor maintains the minimum speed state, and the nready output keeps on low level. The 12 pin of bp6308a chip is the input circuit of filter DC voltage speed regulation. Bp6308a is divided into PWM and DC voltage speed regulation modes. The range of DC voltage is 0.25v-5v. The voltage is proportional to the speed. The 13 pin of bp6308a chip is PWM input circuit. When the PWM duty cycle is close to 0, it can be selected whether to maintain 10% minimum speed or stop rotating and standby through standby input. Bp6308a chip 17 pin is the speed signal output circuit. The signal is received by bp6308a chip, and FG makes rotation speed action. As shown in Figure 3, U3 is bp6901, D4 and C18 constitute the upper bridge bootstrap circuit, and R35 and R36 are MOS transistor base limiting current resistance.

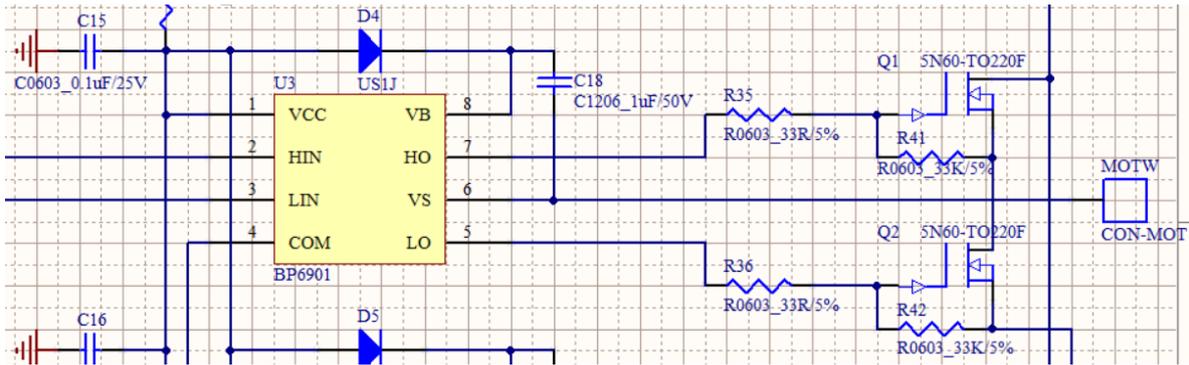


Fig. 3 schematic circuit diagram

Bootstrap circuit is also called boost circuit (which plays a key role in three-phase inverter bridge circuit). Its principle is to use diodes, capacitors and other components, so that the voltage of the capacitor and the power supply voltage are superimposed, so that the voltage rises. Some circuits can increase the voltage several times as much as the power circuit. This is the use of guidance to raise the voltage. In general, capacitors and diodes are used to store charges. The diode prevents the current from flowing back. When the frequency is high, the voltage of the bootstrap circuit is the input voltage of the circuit and the voltage of the capacitor, which plays a role of boosting. At the same time, the capacity of bootstrap capacitor should not be too large or too small, and the appropriate capacity should be selected according to the switching frequency. Bp6308a control system has designed the current limiting protection circuit. When the control system detects the system current through the 26-27 pin sampling resistor, the two ends of the resistor are connected with CS + and CS - terminals respectively. When the bp6308a control system current increases, the voltage VR at both ends of the sampling resistor also increases. After the shielding time, if the voltage VR at both ends of the sampling resistor is greater than 0.1V, the upper and lower drives are immediately turned off and the next carrier cycle is turned on. When Vin voltage of 19 pin is lower than 5.3v, bp6308a control system will turn on undervoltage protection and drive output will be closed. When the VIN voltage is greater than 5.8v again, the bp6308a control system will restart. Bp6308a control system is designed with over temperature protection function. When the temperature is above 160 °C, the control system will detect the roller temperature and turn off the drive output. When the temperature drops below 160 °C, the bp6308a control system will restart.

Before the hardware debugging, we can test the basic situation of the circuit through the simulation and debugging of the equipment, so that we can reduce unnecessary mistakes. It can realize a series of functions such as forward rotation, reverse rotation and speed regulation. Only when all the problems are eliminated can the test be carried out normally.

The design of bp6308a control system scheme, flexible and diverse control mode, with perfect control function, has practical value, can be applied to various fields. Such as electronic equipment, electric vehicles, household appliances can be applied in practice. Because most of the electronic equipment is supplied by DC power supply, the motor is required to have the characteristics of speed regulation and stability. This requires that the brushless motor control chip has good performance. But bp6308a control system is more than the general system in speed regulation, stability, and also has multiple protection functions, so bp6308a control system has a good prospect in this field. As one of the pollution-free vehicles in the future, electric vehicles have been attached great importance to by major

enterprises, so the brushless DC motor is the most ideal power. The brushless motor with bp6308a control system can carry out forward rotation, reverse rotation, braking and acceleration functions, and has very good performance. Because bp6308a control system has a wide speed range, high efficiency and low noise, it is more convenient and easy to use in the family. And bp6308a control system has current limiting protection, under voltage protection, over temperature protection, etc. through the control of bp6308a chip, the power supply can be cut off to reduce the occurrence of disaster, and it can also play a protective role in the use of the family.

### 3. SUMMARY

Because of its good stability, high performance and low cost, bp6308a control system is welcomed by most users. Through the test, bp6308a control system can carry out the functions of forward and reverse, speed regulation and multiple protection. However, due to the impact of the epidemic, the experimental conditions and time, leading to some functional tests such as lead angle and PWM wave have not been verified. After the later correction, the control system will be further improved and tested. Through the whole process of design, production and debugging, the system has independent and perfect circuit function, and has the value of practical application. In the future, we will further study the application effect of the system in the actual equipment products, and think deeply about how to increase the load efficiency and improve the performance.

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