Application of the MOS Tube on Power Window Switch

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Abstract We use MOS tube as a control element, which decides on–off of current flow, to solve the problem of contact ablation in 24 V power window switch,the relay enclosed in switch is only to shift the direction of current flow, MOS tube is precedent in controlling on–off of current flow than the relay, which itself doesn't participate in the control process, Without electric spark in the contact, the durability of relay is improved, Switch without contact is realized.

Keywords Power window switch · MOS tube · Relay · Heavy truck

1 Introduction

With the development of society, the truck window operation convenience and comfort are put on the agenda, hand-operated window system gradually quit the stage of history, electric window in truck applications become more and more popular. Electric window system by the electric window switch, power windows, power window motor side switch, electric window switch by controlling the window motor to realize the rise or fall of window glass. Power window switch for power and signal model two kinds, power to switch to directly drive the window motor, signal type for vehicle body controller provides a signal switch to BCM, powered by BCM window motor. Signal type switch must be and BCM use BCM,

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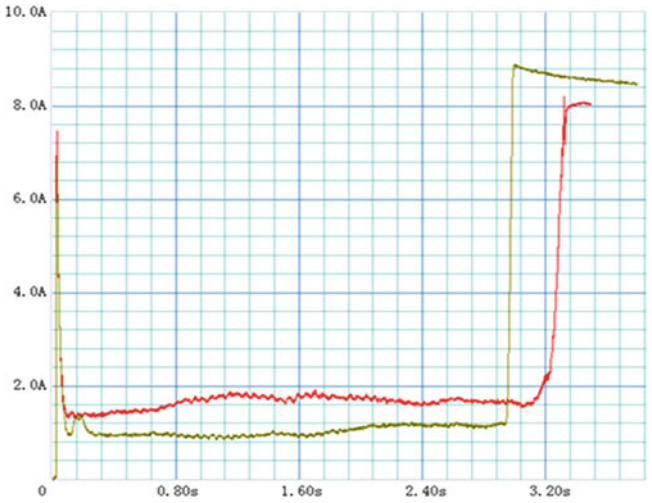

Fig. 1 Motor process current curve

because of higher prices, the switch is used less. Power type electric window switch for convenient use, lower prices in the heavy truck, light truck, commercial vehicle on popularization [1, 2].

2 Jianghuai Heavy Truck Power Window Switch Principle

2.1 Cause Analysis of Relay Contact

Jianghuai heavy truck power window switch is the power switch, prior to the introduction of passenger car of the switch, the 12 V system is changed to a 24 V system, according to the 24 V system requirements to design of switching the internal PCB and matching the 24 V relay. But in the practical use of the relay contact ablation failure rate. The contact problem is easy to be ablated arc sparks temperature exceeds the contacts can stand, arcing is the cause of motor in the up/down movement ended, and the formation of blocking, the switch current detection circuit detects the motor, will release relay, shutting machine. In the motor locked rotor condition, current is about 8–12 A, current curve in Fig. 1, the cut-off relay, will form a strong reverse electromotive force (EMF), the contact of the relay is disconnected from the moment to form an arc, arc spark temperature up to several thousands of degrees, the contact forming ablation, long-term and such finally, burning of relay contact.

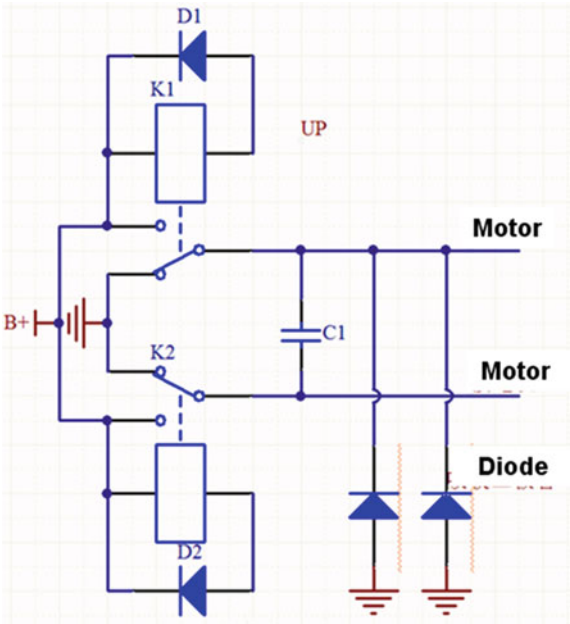

Fig. 2 A diode and a capacitor inhibits reverse EMF diagram

2.2 Reverse Electromotive Force Suppression Method

Reverse electromotive voltage is a reverse of the high voltage pulse, so in return relay contact before, be protection diodes to form a short circuit, absorb part of peak voltage, so as to achieve the purpose of protection relay contacts. Actual tests show that, this method is invalid. The main reason is the switch time is too long, can effectively absorb the peak voltage. Absorption capacitor is a widely used method for eliminating electric spark, so be sure to be effective, because the diode absorption pulse voltage failure, increase the capacity of the capacitor, to 47 uF, because the motor positive inversion, the output line polarity is variable, so the use of non-polar electrolytic capacitor. Motor peak inverse voltage through a capacitor, the capacitor will charge the capacitor, similar to a short circuit, so can the end forming protection. Protection time depends on the charging time of the capacitor, once the capacitor is filled, and the peak inverse voltage exists, protect the function disappeared, a diode and a capacitor inhibits reverse EMF principle is shown in Fig. 2. Laboratory proven: capacitance added to the 47 uF, contact spark is greatly reduced. Proof of actual use has greatly improved, but there are still 1–3 % burning of contact problems.

2.3 The Application of MOS Tube

Burning of contact reason is arc, so need to solve the electric arc generated by reason. Arcing is the cause of relay in switching process contact exists between the potential difference of voltage. Reverse EMF is simply the higher voltage. If the

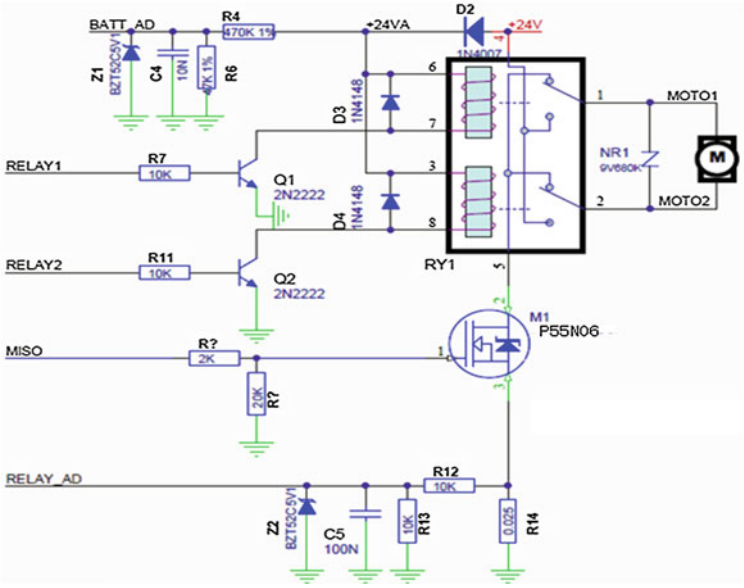

Fig. 3 Power window switch application MOS control schematics

switch relay in the closure and release process, there is no potential difference is zero voltage, so there is no reverse EMF. When the contact only to overcome static wear can maintain better life. To make the contacts and no voltage difference, must let the relay in the circuit opened under the circumstances, namely the need in the switch circuit with electronic switch can do. In the loop gain a big power MOS switch tube, MOS tube control circuit on/off, and other circuit stops working, then operate relay, relay contact without current switching.

The working principle is shown in Fig. 2: starting switch is open, MOS switch is in the off state, the first relay contact closure, the contacts and no potential difference between contacts, so no current, starting relay without contact spark. Relay starting after closure, and then open the MOS switch, motor, glass upward or downward movement. Motor off, shut off the MOS tube, and the motor stops rotating, the contacts are in the operating state, the motor locked rotor current, reverse electromotive voltage of contact without effect. When the MOS tube is disconnected, the motor stops working, then disconnect relay contact, when the motor is in a stop state, the contact has no potential difference, no current. Therefore, no electric spark generated (arc) (Fig. 3).

Based on the MOS tube power control module function

1. Manual mode to achieve the current protection

The original manual mode and no current protection function, which uses the manual rise/decline, even if the motor, as long as the hand is not loosened, the circuit

Table 1 P55N06 MOS tube parameter

Model: P55N06		
Performance	Parameter	Unit
Rated working voltage	60	V
Rated working current of 25 °C	55	A
Rated working current of 100 °C	34.8	A
Pulse voltage	≤400	V
Ambient temperature	−55 ~ 150	°C

has been working, on the motor is great test. Improved after joining the manual mode protection function, as long as the plug is off, MOS tube and release the relay, protection of motor.

2. Join the under abnormal condition, the automatic shutdown function

When entering the automatic mode, 10 s after the still not detected motor stall current, automatic shutdown. Prevent when motor damage/harness off in abnormal condition, the switch has been in a state of abnormal problems caused by burn.

2.4 MOS Tube Parameters Matching

Using MOS tube as a current switch, MOS tube performance requirements are relatively high, but also in the circuit is disconnected, motor peak inverse voltage full on MOS tube ends, so the pressure has certain requirements, motor locked rotor current maximum working voltage of 12 A, the largest 32 V, peak inverse voltage of about 200 V, design 3 times left margin, using P55N06 high power tube (parameters see Table 1), rated current 55 A, rated voltage 60 V, under 400 V following pulse interference. MOS tube has a protection diode, without the need for an external protection.

2.5 Application Effect of MOS Tube

Through in the Jianghuai heavy truck on batch application, market performance is good, the power window switch failure rate plummeted, from 1–3 to 0.1 %, confirmation of MOS tube in the electric window switch application can fundamentally solve the 24 volt power window switch ablation problem.

3 Conclusion

Power window switch adopts MOS technology, in order to solve the traditional switch relay contacts easy ablation problem, using the MOS as the current control switching element, realize contactless switch, high reliability, long service life, is the development direction of automobile power switch.

References

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