

Development of Automatic Detection System of Miniature Voltage Electromagnetic Relay

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Abstract—With the Electromagnetic relay development, the detection technology of relay is more advanced. At the same time, users are also increasingly high requirements on... quality, performance and reliability of relay. This requires very precise relay detection, in order to ensure the quality and reliability of relay production. The combination of the analog and digital electronic technology and computer technology, completing automatic detection of the relevant parameters on voltage electromagnetic relay is the development direction of electromagnetic relay detection. This paper mainly introduces the main function and work principle of voltage electromagnetic relay detection system based on industrial computer as the core. The miniature relay parameter test instrument is developed and the rate of qualified products is count. The product quality is improved, and it has the advantages of convenient operation and high accuracy rate. The system is suitable for small and medium-sized enterprises voltage electromagnetic relay factory test, it provides a powerful reference for the development of automatic detection system.

Keywords—Relay; Electromagnetic; Industrial Personal Computer; Automatic Measuring; Excitation Current

I. INTRODUCTION

Electromagnetic relay has the high insulation resistance as its off state and Low conduction resistance as its on state thus other electronic components cannot be compared with it. It is one of the most widely used electrical power and other electrical systems. In all fields of national economy, especially it occupies an important position in the national key military engineering. It is used widely in automatic control system, remote control, electric power system, protection system and communication system. It plays the role of control, detection, protection and regulation; it is one of the most basic parts of modern electrical drive [1]. Because its manufacturing process manual procedures is more with using range of relay expand, corresponding to the various aspects performance of relay is also increasing, so

the relay performance test is also very important. Manufacturing test level of electromagnetic relay has already development from manual to automatic test [2].

At present, the automation detection level of relay by the relay-contact control is getting to the PLC control and further development to the computer control. The acquisition and processing technology of the relay electrical parameter is an important sign of advanced equipment in the relay detection. In the general relay testing equipment, the transient waveform of the main current, contact voltage and power voltage are generally measured. The traditional detection is mainly light oscilloscope that is oscilloscope with light sensitive paper light records. Because the record time is long for the this structure, the number of electrical isolation channel for each is more (up to 16), the oscillator adopts suspension structure, mechanical inertia is big, So the detection signal frequency cannot be too high as the equipment caused by detection speed is limited. The power factor, time constant, power frequency etc. cannot be measured [3-4].

This paper presents development of complete parameter test instrument of small relay. Test content includes the contact resistance, voltage, release voltage, excitation current, action time, release time, contact transfer time, noise and light test. Meanwhile it makes statistics on the rate of qualified products, and improves product quality and convenient operation. The device is composed of an industrial control computer and some peripheral circuit equipment, represents the level of automation in low voltage electrical apparatus test.

II. THE SYSTEM DESIGN AND FUNCTION

This testing system is designed for the detection of the relay contact and relay coil portion. The overall system principle detection diagram is shown in Fig .1. The whole test system is divided into the coil loop and contact circuit. Two circuits is isolated full electrical and has logic relation through the computer and its peripheral equipment.

of measurement. Considering that the switch inputs in the "on" and "off" transient very strongly interfere on computer and the strong electric field interference. After the contact signal by the voltage comparator is inputted A/D acquisition card through TLP521-4 opts isolated, the contact signal is collected into the industrial control computer.

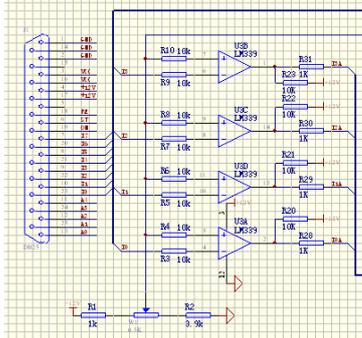


Figure 4. Contact state detection circuit diagram

C. The contact resistance testing circuit

The contact resistance between the contact of the relay is very small, should be less than or equal to 50mΩ in accordance with the design standards. So the pressure drop is very small at both ends of the relay contacts. Measurement of contact resistance is used a constant current source method. The relevant standard in accordance with the constant current source is used 6V, 1A. Using constant current source module provides a steady current for contact. The contact resistance is measured through detecting the voltage at both ends of the relay contacts and calculating by software. The test circuit diagram is shown in Fig .5.

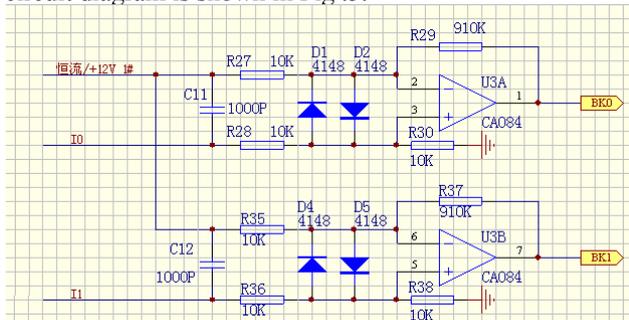


Figure 5. Contact resistance test circuit diagram

Through testing relay contacts the pressure drop at both ends of each pair of contacts and then the operational amplifier amplifies. Fig .only give the test circuit of single contact. The test system can test four pairs contact relay. By analog switch controlled in the testing process, to 8 test circuits is collected and selected. Operational amplifier selects CA084. The voltage drop value is enlarged to 0~10V voltage range that A/D data acquisition card can collect. A/D data acquisition card converts analog signals into digital signals, and calculated the contact resistance of relay contacts by IPC acquisition [6].

IV. SOFTWARE DESIGN

Software design of the test equipment mainly includes: three modules of the user interface design, testing and monitoring functional design, parameter input module design. The program of the user interface is loaded into memory in software system initialization and provides the operating environment of software. The program of testing and monitoring is in charge of motion control of test samples, equipment line switching, sample contact signal monitoring, test failure judgment and recording failure data during the whole experiment. The main function of parameter input module program is inputting test operation parameters by the test person before the beginning of the test run. And add up number of qualified in the process of test. Allow users to test data on the hard disk copy to the floppy disk after the completion of the test. The system software block diagram is shown in Fig .6.

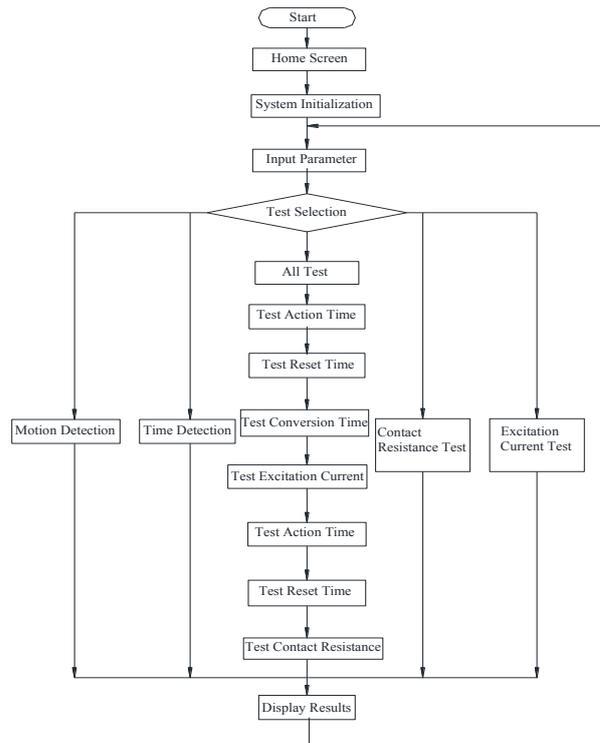


Figure 6. Block diagram of system software

The system software was programmed by C language. As the system on power and initialization, the corresponding relay parameters is inputted by the keyboard, and converted into a test logic circuit through the relay array. Press the start button to start the test. Screen real-time display the current detection qualified or unqualified. After testing, system through the buzzer told the qualified and unqualified. The system automatically statistics the number of qualified and unqualified.

A. Contact resistance test module design

Because the contact resistance is generally less than 50mΩ. So the system resistance influence on measurement must be excluded. The measure is corrected in designing this equipment. Check the equipment through standard relay before detection.

Software calculation eliminates the effects of measuring the system resistance.

B. Design of action detection module

The action performance testing includes relay action voltage test and reset voltage test. This system adopts step method confirmatory test. That is only testing action voltage and the reset voltage Whether or not qualified without testing the specific value of action voltage and the reset voltage [9].

C. Design of time detector module

The time detection module test the specific value of the relay action time, the reset time, the actions conversion time and the reset conversion time. Test block diagram is shown in Fig .7. After system test automatic all time parameter compare with the parameter input values. The qualified time parameters display with white font and the unqualified time parameters display with red font.

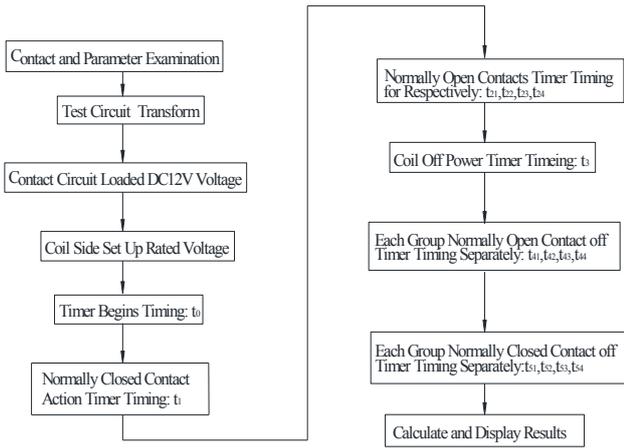


Figure 7. Time detection module diagram

D. Design of excitation current detection module

The excitation current testing is loading rated voltage in coil circuit. Then test current in coil circuit. Test block diagram is shown in Fig .8. Measurement of excitation current is converted by the I/V and the A/D acquisition card collecting voltage. Then calculate the magnetizing current value.

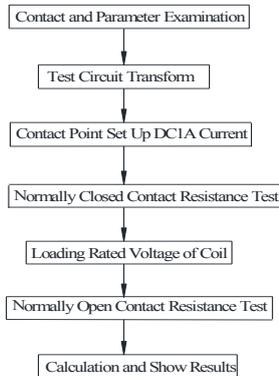


Figure 8. The excitation current detection module diagram

V. EXPERIMENT

The overall block diagram of test software is shown in Fig .9.

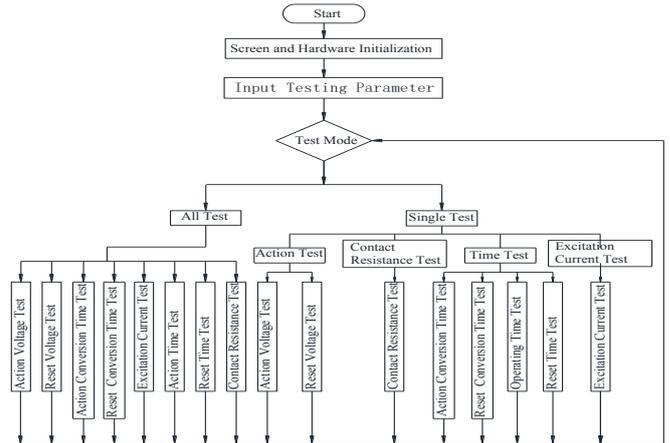


Fig .9. The overall block diagram of test software

Each test has to set up or modify the parameters at the start of the system:

- Type the detection: This system may carry on the comprehensive test for a single product. That is carrying on the continuous uninterrupted test for the electrical parameters on all the requirements of the product. Also can be single test for a single product. That is only the one phase electrical parameter of the product test. In the detection mode drop-down menu, select project of all the detection, the motion detection, the time detection, the contact resistance detection, the excitation current detection etc. One of them can be selected.
- The basic models to test products: The basic models of detection products have DY2, DY3 and DY4. The different of basic models determines the number of different relay contacts.
- Rated voltage type and rated voltage value of tested products: the AC or DC must be selected before detection rated voltage. Rated voltage value is adjusted on the external transformer by manual way. AC adjustable range is 0 ~ 280V and DC adjustable range is 0 ~ 36V.
- Set up action voltage value of detected products: Select the action voltage settings from the menu bar. Then DC or AC power supply is adjusted to set numerical requirements by the manual adjustment. The action voltage is 78% of rated voltage value.
- Set up reset voltage value of detected products: Select the reset voltage settings from the menu bar. Then DC or AC power supply is adjusted to set numerical requirements by the manual adjustment. The reset voltage is 17% of rated voltage value.
- Set up excitation current: Select the excitation current setting bar. Then input excitation current value by the keyboard.
- Set up action time: Select the action time setting bar. Then input action time value by the keyboard.

- Set up reset time: Select the reset time setting bar. Then input reset time value by the keyboard.
- Set up conversion time: Select the conversion time setting bar. Then input conversion time value by the keyboard.
- Set up contact resistance: Select the contact resistance setting bar. Then input contact resistance value by the keyboard.
- Set up contact current: Select the contact current setting bar. Then input contact current value by the keyboard.

The program automatically save parameters the last input values. Adjust automatically parameter for the values of last set.

The main screen is the initialization window after switch on. That it is always the main window of static display during the test. On this basis, it can display the drop-down menu and pop-up windows and other information. It can be divided into four areas: Title display area, main menu area, work area, additional District title. As shown in Fig. 10.



Figure 10. The main screen display window

The controlling coil side load voltage waveform by software is shown in Fig. 11 when select all tests. This waveform is the loading wave of detecting DC24V. The first 5 pulse wave is used to test the relay action voltage and the reset voltage. Sixth to eighth pulse test relay time characteristic. Ninth pulse test relay contact resistance and excitation current.

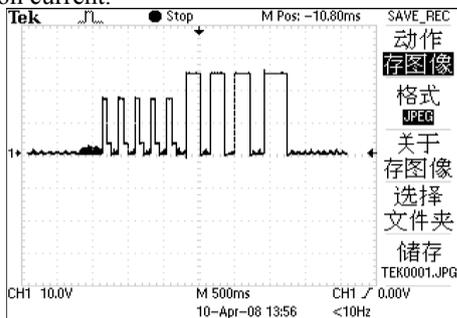


Figure 11. The software waveform of control coil side load voltage by select all testing

The device has been putted into use in three months in the factory. The system runs well. After repeated verification, its accuracy and reliability successfully passed. The device makes the factory to improve greatly detection efficiency and precision.

VI. CONCLUSION

The equipment is combined with various means and technology at home and abroad relay testing. The relay tester of comprehensive parameters is developed in accordance with the actual needs of the product. The system can meet the accurate measurement of the operation parameters of small voltage electromagnetic relay, time parameter and contact resistance. Due to the adoption of the computer automatic control, greatly improves the efficiency and quality of production. At present the system used in the plant is good.

REFERENCES

- [1] HU Zhenmin, LIU Xiaowe, JIANG Xiangang, ZHANG Hongbin and LI Guangli, "Design and Research of Relay Test System Based on PC," Journal of East China Jiaotong University, vol. 20, May. 2003, pp. 70-73.
- [2] WU Jincan, LIU Chengbo and WU Yongjun, "Research of an Continuous — testing Technology of Electromagnetic Relay's Electrical Performance Parameters," Electromechanical Components, vol. 32, Mar. 2012, pp. 45-52.
- [3] LU Jianguo and GUO Hui, "Development of Measurement and Test Technology for Low Voltage Electrical Apparatus," Low Voltage Apparatus, vol. 1, Jan. 2002, pp. 48-52.
- [4] JIANG Jingjing, "Research of Automation Test Instrument for Relay Parameter," D: Dalian. Dalian University of Technology. 2013.
- [5] J. Papouřkov'a, S. Dos Santos and V. Kus, "Hysteresis of electromagnetic relays for PM Space Density Identification" CA: 13th Biennial Baltic Electronics Conference, Dec. 2012, pp. 323-326.
- [6] Lee Jietae Sung, Su Whan Edgar and Thomas F, "Area methods for relay feedback tests," Industrial and Engineering Chemistry Research, vol. 49(17), 2010, pp. 7807-7813.
- [7] GuofuZhai, WeiweiFan and WeiyangLiang, "Study on Contact Resistance Dynamic Characteristics of Space Electromagnetic Relay," Computational Engineering in Systems Applications, vol. 10, Oct. 2006, pp. 1074-1081.
- [8] Software interface design principles. <http://netschool.lzu.edu.cn>.
- [9] HU Hongbin and FU Bin, "Testing the release value of electromagnetic relay," Electromechanical Components, vol. 2, Feb. 2004, pp. 48-52.
- [10] Li Xingwen, Chen Degui and Li Zhipeng, "Numerical analysis and experimental investigation of dynamic of AC contactors concerning with the bounce of contact," CA: IEICE Transactions on Electronic, Aug. 2004, pp. 1318-1323.