

The Improvement of the Two Position Avionic Electric Switch's Fatigue Life Test System

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Abstract:- This article embarks from the avionic electric switch's practical application, realized the fatigue life test of two position switch by measuring the electric resistance. The test system is a virtual instrument testing system combined by computer technology, multi-channel data acquisition technology and modern testing technology. In the aspect of the hardware, the system use PCI-9223 data acquisition card made by ADLINK, and utilize the card's PWM output to control servo motor drive, to realize the control of servo motor speed. In the aspect of software, the system use LabVIEW software as the development platform which have a good man-machine interface. Finally we can implement the 10 road voltage signal acquisition, display and storage by the test system.

Keywords:- avionic electric switch, fatigue life test, PCI-9223, Lab VIEW

I. INTRODUCTION

Avionic electrical switch as the most widely used, the most frequently used components, which directly affects the reliability of the entire system. Original avionic switch fatigue life test system cumbersome and inefficient. With the rapid development of the aerospace industry, the requirement of reliability are also increasing ^[1]. Developing a highly efficient fatigue life test system is significant to promote the progress of avionic switches' industry and provide reliable predicted data of fatigue life. The new system use computer to control and IPC as the core, while fatigue life test the system collect voltage drop across the switch, and implement the display and storage of data, and provide the basis for the fatigue life of the switch.

II. ORIGINAL SYSTEM

Original test system shown in Figure 1, the electric wire from the high-low temperature box attach to the standard resistor, and to displaying table. According to referential lamp on displaying table to judge the switch's work. This test process entirely depend on manual records, work intensity,

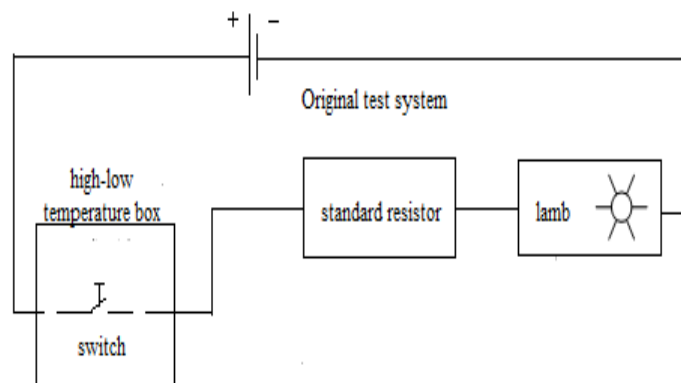


FIG 1. Original test system

The test frequency is single, switch electric resistance can not be measured during the test and the test data can not be saved, low degree of automation, and test systems bulky, large area, it does not meet the development of modern test technology.

III. NEW SYSTEM

The new test system's block diagram shown in Figure 2, the system's structure shown in Figure 3. Using computer to control and IPC as the core, we can measure the contact resistance at the same time fatigue life test.

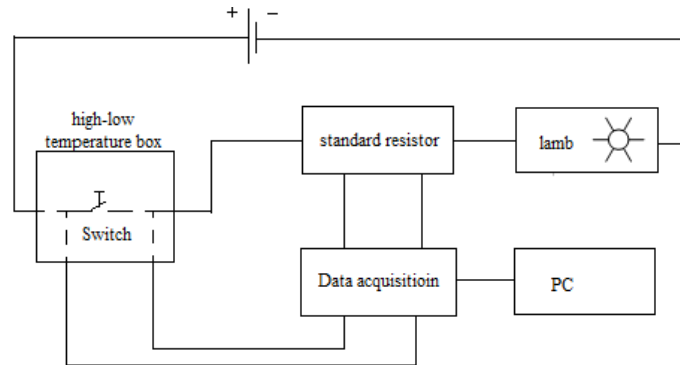


FIG 2. New test system's block diagram

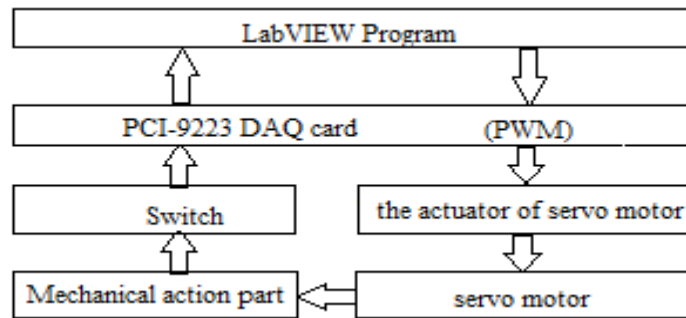


FIG 3. System's structure

New two-position switch fatigue life test equipment is divided into two parts: the mechanical operation part and monitoring part, the two parts connected by detachable cables.

3.1 The mechanical operation part

Mechanical operation portion is operative part of switch fatigue life test, this part should be placed in high-low temperature box.

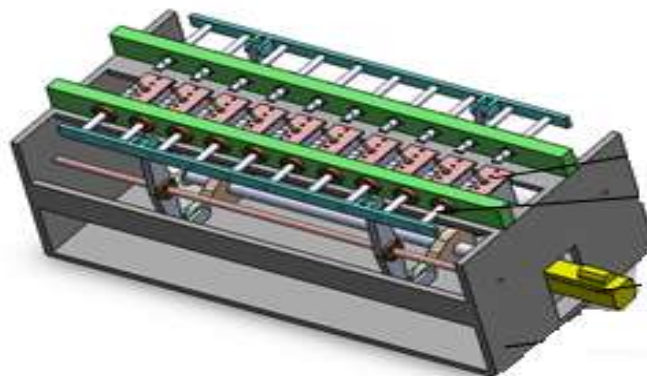


FIG 4. Mechanical operation portion

This part includes drive portion, and switch install components. The principle is driven by a motor shaft and cam, push rod moved back and forth through the drive fork, enabling automatic toggle switch. Primarily through mechanical transmission to achieve, with a simple structure, good stability. Structure shown in Figure 4.

3.2 Monitoring part

3.2.1 Principle of measurement

Because of the avionics switch resistance is milliohms level, conductor resistance test with considerable resistance switch, so you need a four-wire resistance measurement method. As shown in Figure 5. And a constant current source connected to the data acquisition card measured across the switch through different conductors. Since the data acquisition card in the amplifier impedance is very large, the connection data acquisition card sampling voltage conductor almost no current flows through, the voltage across the amplifier is measured voltage across the switch ^[2]. A constant supply voltage, the voltage is measured across the switch for added resistance standard.

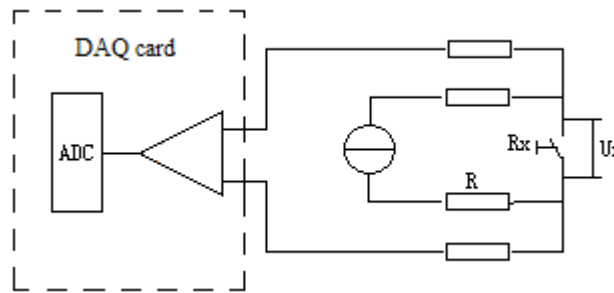


FIG 5. Four wire principle of measurement

Switch's resistant can be expressed as

$$R_x = \frac{U_x}{U - U_x} \cdot R = \frac{1}{\frac{U}{U_x} - 1} \cdot R \quad (1)$$

Because U/U_x more than one (at least 1000, so

$$R_x \approx \frac{1}{U/U_x} \cdot R = \frac{U_x}{U} \cdot R \quad (2)$$

Then avionics switch contact resistance measurement accuracy and only standard resistance, constant current source about accuracy. Just ensure both accuracy and contact resistance measurement accuracy can be guaranteed.

3.2.2 Data acquisition

10 Switch test loop independent of each other, the contact resistance test in a 32-channel multi-function data acquisition card (drawn two lines on the test switch, take the differential input^[3], the test voltage, the voltage is determined based on the state of the switch, and calculate the contact resistance), 10 voltage sampling channels are independent, according to the DI input acquisition card to trigger the start of the corresponding analog channel sampling in the mechanical test body per spindle revolution range, 10 to switch at different times the interval is closed by DI input on the board to trigger AD sampling, realize the collection voltage signals.

3.2.3 Test frequency

By adjusting the motor speed to control the switch test frequency, AC motor servo motor, and a corresponding drive and motor connections [4], with PWM output on selected projects multifunction data acquisition card, enter the PWM motor drive, by adjusting the PWM duty cycle to achieve motor speed control, thus achieving adjust the test frequency.

3.2.4 Upper computer software

PC software with LabVIEW development [5], and its main features are:

- (1) Test frequency control. Setting switch test speed by man-machine interface, adjustable in the range of 5-20 times / min.
- (2) Test data automatically recorded and saved. Test data (test time, number of tests, the switch voltage drop, the contact resistance) is automatically recorded
- (3) saved Graph is automatically generated ^[6]. It can automatically generate test data and graph display, intuitive view the entire testing process varies with the number of tests increases avionics switch contact resistance.

IV. CONCLUSION

After a period of observation, after the transformation of the fatigue life test switch avionics system is stable, effective solution to the original test system totally dependent on manual records, work intensity, the switching frequency of a single test, the switch can not be measured during the test switch contact change in resistance, the test data can not be saved, the degree of automation and low key issues.

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