2016 International Conference on Intelligent Manufacturing and Materials (ICIMM 2016)
ISBN: 978-1-60595-363-2

Design of Airtight Test for Aircraft Air-conditioning System

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ABSTRACT

This paper put forward a new design scheme of air tightness testing equipment mainly for the air conditioning system of a certain aircraft, with the introduction of pressure transmitter, temperature transmitter and single chip microcomputer. the system in the original basis, aimed at some problems in the optimization, the manipulation of the measuring equipment to improve automation, increasing the automatic data acquisition, recording and judgment, adopting touch screen technology, and improves the human-computer interaction.

INTRODUCTION

Air conditioning system as a kind of cabin environmental control system for Aircraft, its working safety, stability and reliability are very important. Under the different flight outside conditions, it makes the aircraft cockpit and cabin, equipment cabin and cargo be in a good environment to ensure the normal working conditions of flight crew and passengers and the normal work of the living environment.[1] When the aircraft flight hours or to use rules to the expected duration of the calendar, it is need to check airplane air conditioning system.

EQUIPMENT DESIGN

This equipment is designed for hand-held portable devices, compact structure, small volume, light weight, and the shape size is 400 mm (L) and 500 mm (W) and

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400 mm (H), forward-looking face for interface and display interface, interface with the power switch, the heating button, emergency vent button, start button and touch screen.

After self-check program, press the start button on the panel, air conditioning system can be completely automatic gas tightness detection; Detection on the screen after the completion of detect qualified conclusion, every time the test results are recorded and stored for a long time. With the power of the light switch is used to connect or disconnect the power of the detector; After pressure to press the start button and start automatically detect three minutes of air leakage; Shown on the display in the middle of the pressure and temperature measurements and the final test conclusion.

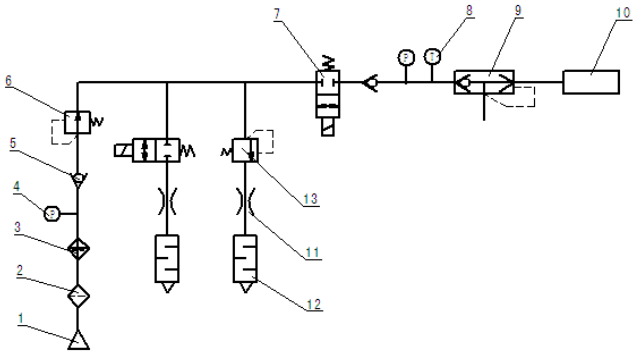

Figure 1. pneumatic schematic diagram of the equipment.

Working Principle

Air power provides gas for the system. Reducing valve is used to make the pressure of gas from air-power stability. Adjust reducing valve, and the gas pressure is regulated to 400 kPa. Controlling valve working, gas goes to air conditioning system. One-way valve is to prevent reversals and leakage of gas pipeline. Pressure sensor is used to measure the pressure of air pressure and air conditioning systems. temperature sensor is used to measure the temperature. the gas pipeline is shown in figure 1.1-air power, 2-filter, 3-heating, 4-pressure sensor, 5-one-way valve, 6-reducing valve, 7-derection valve, 8-tempreture sensor, 9-bleed valve, 10-conditioning system, 11-cut-off valve, 12-muffler, 13-safety valve.

The control circuit part of the system is mainly composed of MCU, A/D converter, display, pressure sensors, temperature sensors, relays, controlling valve and the safety valve, as shown in figure 2.

After pressing "start" button, gas passes through the controlling valve to conditioning system according program, when the pressure of air conditioning system is 400 kPa, cut off the power and check continuous pressure. If the air leakage is less than 4 kg/h in 3 minutes, then the air conditioning system is good, otherwise, as not qualified.

After checking, single-chip microcomputer make safety valve working, slow release air conditioning system of pressure pipeline gas. In order to prevent too much noise, in the process of gas in air bleeder road also set up a choke and muffler.

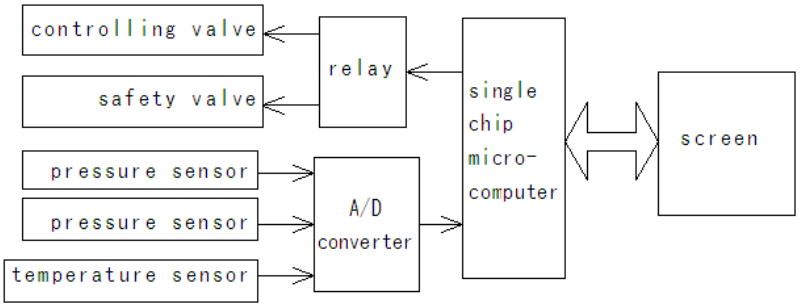

Figure 2. control structure.

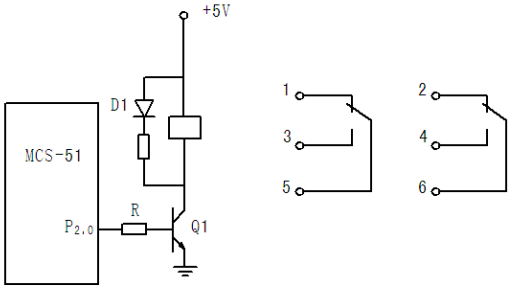

Figure 3. solenoid valve control circuit.

SYSTEM HARDWARE

The core of Control module is the MCS - 51 single chip microcomputer produced by the Intel company. Inside, it integrates 8-bit, 16-bit timer/counter, CPU serial I/O mouth, multilevel interrupt system, RAM and ROM with a large capacity.[2]

Solenoid Valve Control Module

Choose HK4100F-DC5V as the relay type. It driven by a single chip driver circuit as shown in figure 3. With small output current from the I/O port of MCS-51,the triode amplifier is designed to drive the relay. When the transistor by conduction into globe, induce a larger self-induction voltage relay winding, it added to the triode after the supply voltage superimposition collector and emitter, making it possible for the emitter to be breakdown. In order to eliminate the harmful effects of the induced electromotive force, the reverse parallel diode inhibition on both ends of the relay coil, to absorb the electromotive force. Self-induction voltage and power supply voltage for the diode is forward biased, the sum of the diode conduction form a circulation. Induction of high voltage will be released through the loop, guarantee the safety of the triode.

Sensor and Sampling Circuit

Choose PTG-501 type pressure sensor, the sensor structure of pressure measurement and signal processing, has the characteristics of high precision, high reliability, high stability, is a kind of traditional pressure instrument good alternatives. Temperature sensor is chosen PT5100, PT100 temperature sensor is a kind of platinum as resistive sensors, as the change of temperature, metal platinum resistance changes with temperature, and has good stability, when the temperature 0 C degree, the temperature sensor in the platinum resistance is 100 Ω, resistance rate is 0.3851 Ω per C degree, with high accuracy, good stability, wide application temperature, is in the low temperature area one of the most commonly used temperature detector.[3] PTG-501 pressure sensor and PT-100 as the main technical parameters of the temperature sensor are shown in table I.

Table I. MAIN TECHNICAL PARAMETERS OF SENSOR.

Name	Type	Measuring Range	Power	Output	Characteristic
Pressure Sensor	PTG501	0 to 5MPa	24V (DC)	voltage	linear
Temp. Sensor	PT100	-200 to 600 C degree	1mA	resistance	linear

Signal collection and A/D conversion module selects the ADC0809 successive approximation type A/D converter, 8-bit resolution, input channels, the advantages of high speed, high precision, is mainly composed of two parts: eight channels multi-channel analog switch and corresponding address latch and decoding circuit; one successive approximation A/D converter, it is composed of the comparator, control logic, tristate output buffer, successive approximation register.

SYSTEM SOFTWARE

In the process of test, the screen should not only have the basic function of the display parameters, and to participate in the records of the operator, the environment and the plane model and so on a series of data, and to save the data permanently in the MCU, for later invocation, inspection. In order to reduce the development cost, combined with the function requirements of the equipment, choose programmable intelligent LCD, has the following advantages: 1, intuitive interface design, the configuration interface development, 2, without graphics programming program, "0" code can easily implement a graphical interface; 3, simple communication method. Set the login screen, and then through JavaScript statements for each of these programming text box.[4]

System software adopts modular structure program design method, system programming using C language to write, easy to debug and maintain, has quick speed, high execution efficiency, easy to transplant, software development environment for ADS1.2. Software system is the basic function of the overall architecture of the surrounding air tightness test to design, mainly divided into four parts: 1, hardware, anti-fuzzy initial program, responsible for the initialization of the control chip and LCD, etc.; 2, LCD display module, responsible for human-computer interaction, including: login information input, after the inspection parameters real-time display and the tightness of qualified judgments, 3, storage management, responsible for detecting data storage; 4, real-time control, to control the solenoid valve and safety in the process of testing solenoid valve control. [5]

CONCLUSIONS

According to customers' requirements, design an aircraft air conditioning system air tightness testing equipment based on single chip microcomputer controlling. Introducing a pressure sensor, automatically process the signal and give the final result, greatly reduces the operator's ability requirements. With simple operation, high automation, it can be widely used in the aircraft air conditioning system of air tightness test.

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