Design of Thermal Battery Test System Based on Virtual Instrument

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Keywords: thermal battery, test system, LabVIEW.

Abstract. Based on LabVIEW virtual instrument technology, the research project of a testing system is put forward to solve the problems of automation and intelligence. The virtual instrument technology is used to establish the virtual instrument of high integration and high intelligence. According to the test demands of the thermal battery the test software is programmed, and the computer is used to control the test system. It raised the accuracy and the efficiency of the system.

1. Introduction

With the development of information and intelligence, the power supply system on the new ammunition has become increasingly complex, which gives the power performance testing difficult. Currently the onboard power supply disposable thermal batteries commonly used as a power source [1]. The test system based on the technical of the GPIB bus is designed to meet the thermal battery status missile testing requirements, improve test efficiency and accuracy. This test system have the characteristics of high integration, compatibility and extensible.

2. Thermal battery theory

Thermal batteries are thermally activated disposable molten salt batteries, mainly by the heating system and stack components. It uses molten salt as an electrolyte, the electrolyte is solid at room temperature, non-conductive; the activation mechanism electrical igniter detonator ignited heating system inside the battery in a very short period of time, then cell stack is melted, battery positive and negative make electrochemical reaction by conducting electrolyte, the chemical energy turns to electrical energy to power an external line [2]. Thermal battery discharge test schematic shown in Figure 1.

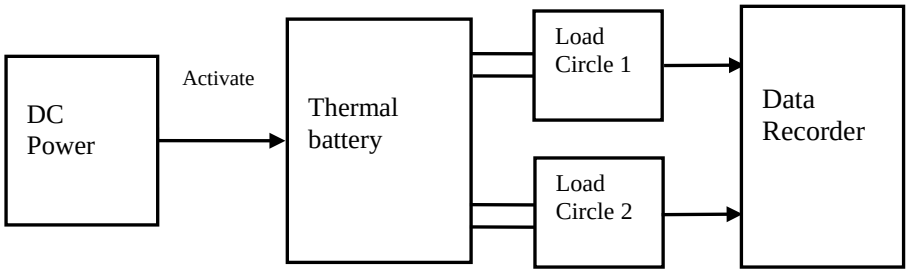

Fig.1 Principle diagram of thermal battery discharging

The contents that the thermal battery tests mainly are activation time, working hours, working voltage, current and surface temperature and other technical parameters.As the thermal battery test system has the activated electric circuit and many roads exportation, it needs to link many instruments in the meantime [3]. Therefore, the design of a system controlled computer, to ensure the thermal battery test system accuracy and achieve the thermal performance of the battery is very necessary.

Test system has the following features:

(1) The computer controls the DC power supply module, achieving automatic activation of the thermal battery.

(2) Computer controls electronic load, to implement different loads flexibility.

(3) All test data is automatically saved to the specified data file. In the testing process, some of the key output signal can be real-time collected and monitored; also the test data can be converted into a standard format data files.

(4) The test signal that user may be interested in can be lead to a text file for viewing and post-processing and analysis.

3. Components and Features of the Test System

3.1 GPIB Bus

GPIB (General Purpose Interface Bus) is a standard interface with a variety of instrument controller (such as computers). A typical GPIB test system consists of a monitoring and control computer, a GPIB interface card and a number of GPIB instrument. Each GPIB instrument has particular address; they are all operated and controlled by computer. GPIB is the prevalent parallel bus connected with the instruments, the test system and the computer. Almost each company instrument has the GPIB connector. The structure of the test system is presented in Fig. 2.

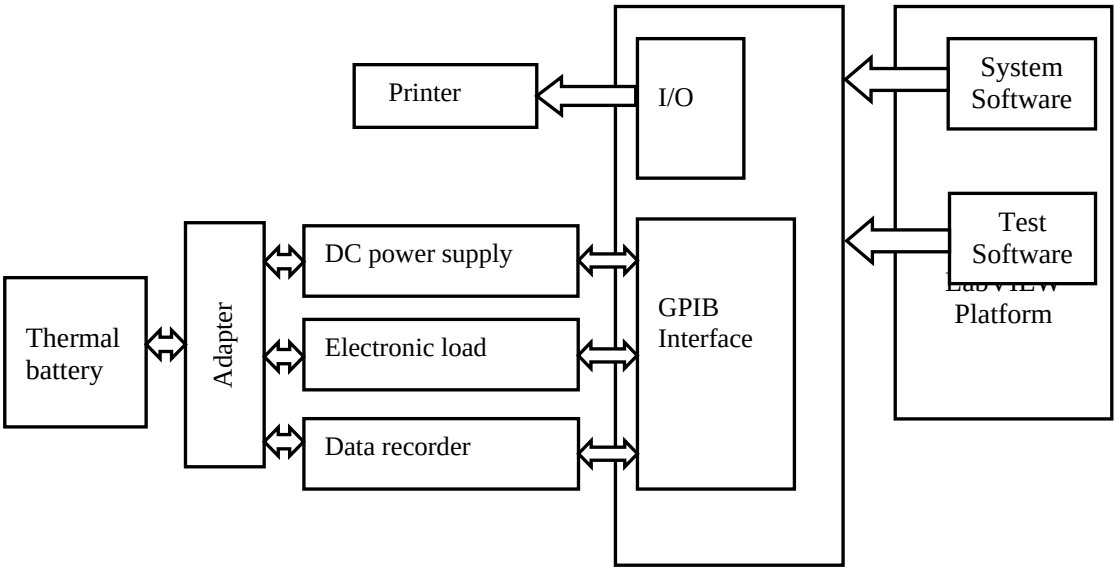

Fig.2 Structure diagram of test system

3.2 Hardware

The core of the test system is master computer .The computer controls the instruments' working condition, analysis and dispose the data, show and print the result. The GPIB test equipment is used to engender the signal and collect the data of the battery measured .The adapter provide the connector for the component and the equipment.

System connects multiple sets of electronic loads and programmable power supply [4], you can combine freely any of them, depending on the thermal battery of tests requirements to be switched or splicing equipment, and achieving test system general-purpose and scalability.

This test system is mainly optional modules include:

(1) Programmable power supplies. 6653A programmable DC power supply is mainly used to provide an electrical signal to activate the required thermal batteries, with universal interface bus GPIB .It can be programmed and controlled by a computer.

(2) Electronic load. The system uses a multi-channel programmable electronic load FT6600A, FT6600A with a constant voltage, constant current, constant resistance and constant power capabilities, standard GPIB interface bus. It can install six modules, each module operates independently. Through computer-controlled programmable load, thermal battery discharge process by computer dynamically select and switch to achieve specific load characteristics capacitive, resistive and function changes.

(3) The data recorder. WR1000 thermal array recorder is a high-performance multi-channel high-speed data logger. It features high speed sampling, wide measuring range, anti-interference,

dependability, etc. [5]. The sampling frequency should be set necessarily before testing. In the sampling process the sampled data can be recorded on the paper or stored in the storage.

4. Software Design

4.1 Software Components

Software is the core of the system, mainly through computer programming to complete the measurement instrument remote control. Programs include GPIB card detection and initialization, equipment testing and initialization and a variety of test functions for testing procedures.

Before thermal battery test, the test procedures need to be prepared, the general thermal battery test program should include the following several modules [6]:

(1) Activation module: Responsible for the thermal battery activation task, thermal battery is only activated to work properly.

(2) Timing Module: Responsible for timing after program begins.

(3) Load Module: Perform procedures written for electronic load.

(4) Data sampling module: Real-time acquisition of test data.

(5) Data output modules: Real-time data will be output.

4.2 LabVIEW Environment

The system is based on LabVIEW programming, controlling on the virtual instrument panel. LabVIEW is a graphical programming language, which provides a powerful configuration tool, the Measurement & Automation Explorer (abbreviated MAX), can help you properly set including instrument interface a variety of test equipment. After the GPIB cables connected correctly and instruments, MAX can find GPIB instruments connected to the bus. Each instrument's main address number can be configured in the instrument prior running the system for each module, as shown in Fig.3.

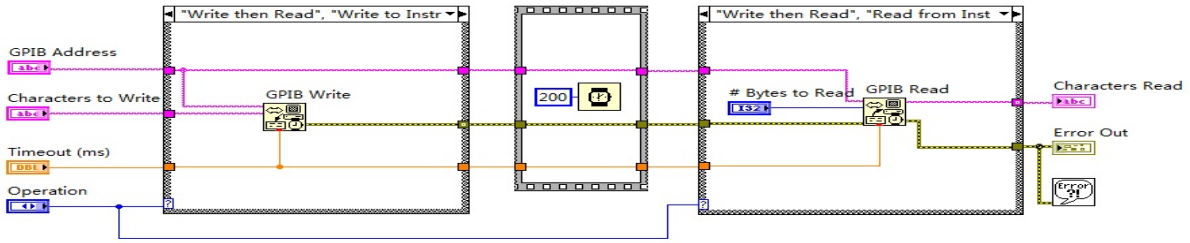

Fig.3Program frame diagram of setting GPIB instrument address

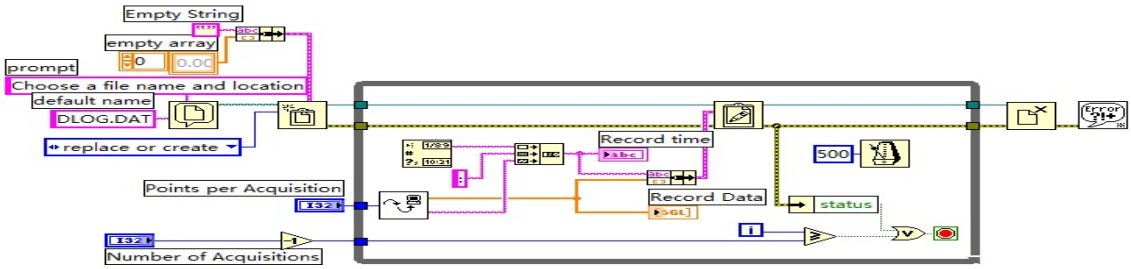

Fig.4 Program frame diagram of writing data

GPIB interface initialize one by one in LabVIEW .When all initialized properly completed, the test begins[7].The main program uses virtual instrument software architecture (virtual instrumentation software architecture, VISA), to achieve communication between different stand-alone instruments and industrial control machines. It is as independent of the various instruments on the standardization of software specifications, so that the test system is highly scalable and versatile. VISA provide initialization function, configuration functions, read function, shutdown function and other functions, and the control program is written based VISA functions[8].

After the block diagram of the functional modules finished, the port battery and test systems are connected, and then perform battery tests program [9], the computer program in accordance with

pre-set load is applied to the thermal battery. Programmable power supply to the object to be measured at the same time the implementation of ignition, activate the thermal battery, collected by the data collector thermal battery discharge voltage and current signals, the whole process is completely controlled by computer, enabling ignition activation, tensile load discharge, data collection, data storage automation. As shown in Fig.4.

5. Conclusion

The system uses the computer to control the GPIB interfaces achieving real-time control, to coordinate the various instruments action, so that the test will complete automatically. The programming language based on LabVIEW has the characteristics of easy expansion and enhances the system's vitality. Practice shows that the system has been greatly improved in general, intelligence, convenience and reliability than traditional testing methods.

References

[1]CAI Shao-wei. Technical development and application of primary battery for air defense missile[J]. Chinese Journal of Power Sources, 2012.6,Vo1.36 No.6:908-911

[2]LU Rui-sheng, LIU Xiao-jiang. Thermal Batteries[M]. Beijing: National Defense Industry Press, 2005.8:80-82

[3]AN De-yu. Discussion of Missile's Power Supply System Measurement Technique[J]. Aero Weaponry,2006 No.5:30-33

[4]ZHANG Qiong, YAN Guo-ping. Design and Application of the Virtual Instrument Based on GPIB Bus. Computer & Digital Engineering, 2006,Vol.34,No.18:132-134

[5]BAO Jun, LIU Wei. Control and Data-Transmission about Thermal Arraycorders Based on GPIB Interface[J]. Microcomputer Information. 2007,Vol.23,No.7-1:172-174

[6]GU Miao,LIU Xiao-lei, LI Na, et al. Development of Power Control System Using LabView Platform[J]. Equipment Environmental Engineering,2012,6(3):23-26

[7]JIANG Xin-guang, LIU Wei-qi, JIANG Zhi-bao ,et al. Automatic Testing System About Guide System of an Ammunition Based on LXI Bus[J]. Ordnance Industry Automation,2013-05:46-49

[8]XUE Wen-qi, ZHAI Zhengjun. Design and implementation of power test system based on virtual instrument[J]. Computer Engineering and Design, 2010,31(6):1330-1334

[9]DONG Cheng-lin, CHONG Jin. Development software of thermal battery automatic test system based on Agilent VEE[J]. Chinese Journal of Power Sources, 2009.1 Vol.33 No.1:47-50