ISSN: 2278 – 909X
International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE)
Volume 5, Issue 8, August 2016

Design and development of Test setup for Testing Power Supply Card of Firing Controller

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Abstract: This project deals with the development of hardware design that focuses on the implementation aspects of automatic PC-based test setup to test power supply card which is one of the PCB's firing control system under development in BDL. With the latest technological changes especially in the field of computers and electronics automation has become the order of the day. Automation improves efficiency and results in better productivity in any industry. Electronic equipments are playing a major role in our present day existence whether it is in our day-to-day household products or in major defense equipments. All these equipments are made up of PCB's. If the production of these boards is considered a major task, testing of these boards is of no less importance. This report provides a brief description of the PCI 1710 card, power supply card under test with architecture and hardware design of the interface card, which acts as mediator between PCI card and power supply card. The test procedure is carried out through a personal computer and the test software is written in C-language. The processor gives the required input signals to the power supply card and reads the output signal (voltages) of power supply card under test through an interface card and then compares the measured data with standard data. Finally the test report will be printed both on computer screen and on the hard copy by using the printer.

Keywords: ADC, DAC, DIO**,** LMSL, LMSR, RMSL, RMSR, LMIL, LMIR, RMIL, RMIR, SPFC/LPFC, RSL/RSR/LSL/LSR

I.Introduction

Basic Principle of measurement is to generate test signals and measure the response of power supply card under test and compare with standard test data. If the test data is within the limit of the standard test data, then the test is passed else the test is failed. If the tests given in the test procedure of PCB's are passed then it is declared that the PCB is serviceable (functional) otherwise not. PCB is becoming not just a part of test system but also, the essential integrating platform the center of test system. The GHz processors, high speed buses, wide availability of software, constantly increasing performance and extremely low price makes PCB an ideal test platform.

II. Firing Control System

This is used in defense applications to control the direction of firing according to the instructions of control panel. This firing control system consists of four cards: Power supply card supplies power to all the other cards of firing control system. CPU the instructions from the control panel and guides the other two firing cards. Firing card takes the instruction from the CPU card and directs the weapons for firing according to the instructions it is switched ON and switched OFF.

III. Description of Test setup

The test setup consists of following basic blocks

A. Personal Computer: The PC is the main control unit with PCI Add-on cards. It executes the application program and monitors the test process and displays the result. It is not just a part of test system but essential integrating platform. The GHz processors, high speed buses, wide availability of software, constantly increasing performance and extremely low price makes PC in fact ideal test platform. Here the test software is written in C-language to test and accept the unit under test.

B. PCI multifunction card: In this project we have used PCI multifunction card of ADVANTECH Computer industries Limited. This card consists of ADC, DAC and DIO with 16 analog input channels, 16 analog output channels and 16 I/O lines respectively. It is also called multifunction card because it consists of multiple functions in one card.

This card is placed in the PCI slots of motherboard of PC.

C. Interface card: This card is interface between power supply card (under test) and PCI Add-on card. The signal between PCI add-on card and power supply card flow through interface card. This card consists of relays, relay drivers, connectors and level converters.

D. Power Supply card: This is DC-DC converter power supply car, which is one of the power supply card of firing control system. This card is required to be inspected for the functionality of all the blocks before acceptance. This power supply card is used to generate several voltages and control signals, which are used for further processing of the other circuitry of control system. This card consists of DC-DC converter circuits, level conversion circuits and voltage control circuits, check circuits and all the inputs and outputs of the card are terminated to edge connector.

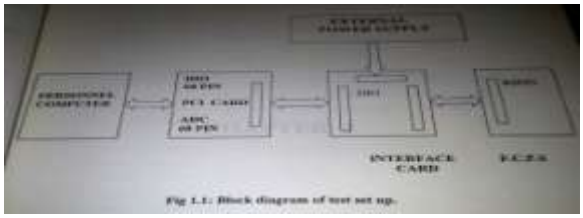

Fig1: Block Diagram of Test Set Up

After connecting the test setup as shown in the figure, run the test program FC_PS.exe in the computer in DOS mode and follow instructions as per computer screen. The test program automatically generates the required test inputs and measures generated outputs as per the details mentioned in test specifications. After completion of testing the results, result sheet will be generated automatically in the form of file as FC_PS.txt in 'C' drive of root directory.

IV. Power Supply Card:

The card to be tested for its functionality is the Power supply card of firing controller. It is an assembled PCB and is part of control system. The power supply card consists of 80-pin connector WG80PR9SY for communication with external devices. This card consists of DC-DC converter circuits, level conversion circuits, voltage control circuits, constant current source, check circuits etc., which are required for its operation. The card is to be scrutinized for its proper functionality based on check sheet provided. As per check sheet conditions, different input conditions are required to be generated outputs have to be measured. The generated output values are to be verified. The block diagram comprises of

A. EMI filter: It is an inter point module consists of filter circuits, which filters the common mode noise from 28V input and output is fed to DC-DC convertor.

B. DC-DC Converter: The output from EMI filter is fed to the input of DC-DC convertor module. DC-DC convertor is an inter point module which converts 28V input to regulated DC power supplies of +5V,+15V, -15V.

C. Level Conversion circuits: The function of these is to convert 28V input at the edge connector pins of JET ,DIS and ESC to logical high signals at the corresponding output pins of p1.0,p1.1 and P1.2. The basic conversion circuit consists of resistor divider network along with a zener protection diode.

D. Magazine sense circuits: The inputs to the sense circuits are either open circuit or ground condition. The inputs will be given to the edge connector pins of LMSL, LMSR, RMSL, and RMSR and corresponding output signals are taken at LMIL, LMIR, RMIL, and RMIR pins. If sense input is open the corresponding output is logical high and if input is grounded the corresponding output is logical low.

E. Check circuits: These circuits check the power supply conditioning of +15V, -15V and SP28 power supplies. The check circuit consists of comparator and resistive network. This check circuit compares the input voltage with fixed reference voltage and accordingly the output will change to logical high or low.

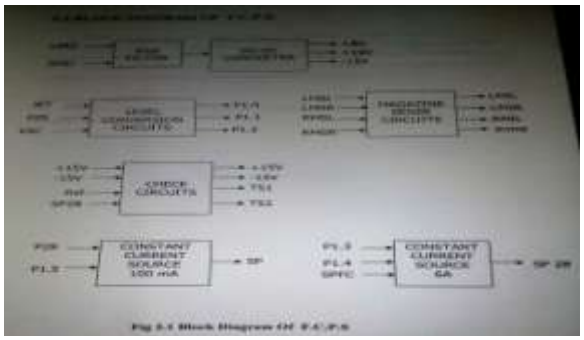
Fig2: Block Diagram of F.C.P.S

F. Constant current sources: There are two constant current sources circuits i.e., 100mA and 6A. The input to the 100mA current source is SP28 i.e., 28V and P1.5 which is logical signal that switches the

SP28 to output circuit. The 6A current source has inputs SPFC (28V) and P1.3, P1.4 logical signals which switches the SP28 to output. Constant current source consists of series pass transistors with current limit protection.

G. Reference Voltage: Reference voltage is generated from 5V supply, fed to the voltage divider network to generate 2.5V.

V. PCI-1710 Multi Function Card:

The Advantech PCI 1710/1710L/1710HG/1710HGL/1711/1711L/1716/1716L/ is a powerful data acquisition (DAS) card for PCI bus. It features a unique circuit designed and complete functions for data acquisition and control, including A/D conversion, digital input, digital output and counter/timer.

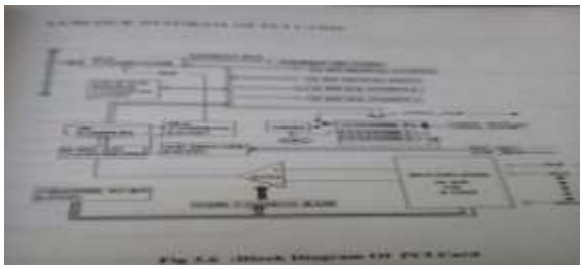

Fig3: Block Diagram of PCI card

VI. Interface Card:

This is placed between the PCI 1710 card and the power supply card. It converts high-level signals for reading through the multifunction card. It consists of level conversion circuits, relay driver, relays, connectors and pull down resistor network. Relay driver IC's drives the relays. In this interface card, we have used IC ULN2803 relay driver, which has six individual driver circuits. The LM324 is used for level conversion and buffering purpose.

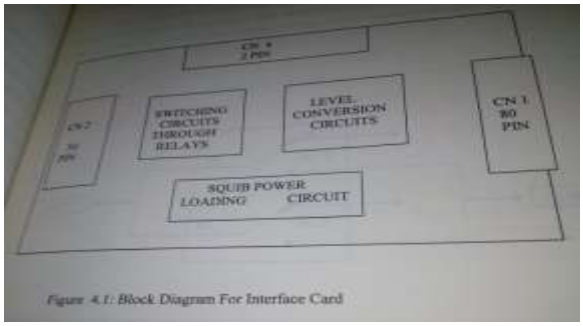

Fig4: Block Diagram of Interface Card

VII. Switching circuits through relays:

This circuit is designed for connecting and disconnecting various inputs to the card under test. This circuit consists of three double pole (DP) relays RL1, RL2, RL3 which will operate at +16V DC power supply.

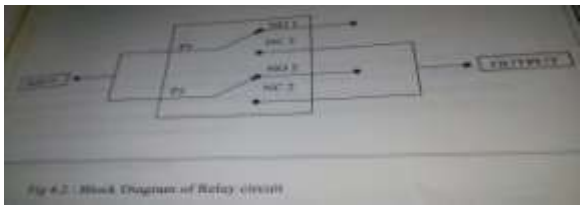

Fig5: Block Diagram of Relay Circuit

The poles (switch contacts) P1, P2 in relay circuit are normally connected to No. 1 and No. 2 respectively which are open. When a current of about 600mA flows through the control circuit coil, a small magnetic field is developed which causes the switches to close down at NC1 and NC2 respectively generating the desired output signals. In our project the input for relays RL1, RL2 are 28V and for RL3 the input is ground voltage (zero voltage).The outputs of corresponding relays are SPFC/LPFC and RSL/RSR/LSL/LSR respectively. Relay driver IC ULN2803 drives these relays RL1, RL2 and RL3. This IC consists of seven open collector Darlington pairs with common emitters. The input to the transistor is obtained from DIO, when logic 1 is to the base of the transistor, the transistor is switched ON and a current of about 600mA is generated at the collector terminal. This current is used to drive a relay by energizing its control circuit coil. This IC ULN2803 includes of suppression diodes for inductive load driving. In our project we are using only three transistors out of seven.

A. Level Conversion circuit:

This is used to step down the voltage levels of the signals obtained from F.C.P.S some signals generated on the target board may be beyond 10V, but the PCI card which is used for measuring these signals operates below 10V. So there is need to down convert these voltage level signals into voltage level measurable by PCI card. Level Conversion circuits serve this purpose. They consist of a resistive network and buffering network. The inputs for this circuit are power1 signal, +15V and 15V and power 2 signals that are obtained from the power supply card under test. These inputs are applied through the network of 10K each for the process of voltage conversion. During this process current is maintained

constant even though voltages levels are altered. The buffering network consists of an IC LM324 that is a quadruple operational amplifier. It consists of four high gain frequency compensated op-amps. The inputs for this IC are the level converted outputs from the resistive network. For the operation of four op-amps present supply of +15V and -15V for +Vcc and –Vcc is applied respectively. The outputs obtained are then applied to ADC for further operation.

B. SQUIB power loading circuit:

To measure constant current sources on the target board we make use of these circuits. The sp28 signal on the target board may draw huge amount of the currents. In order to regulate the current, we are using squib load circuit which is turned ON for only 15ms (by programming the software) and voltage is measured.

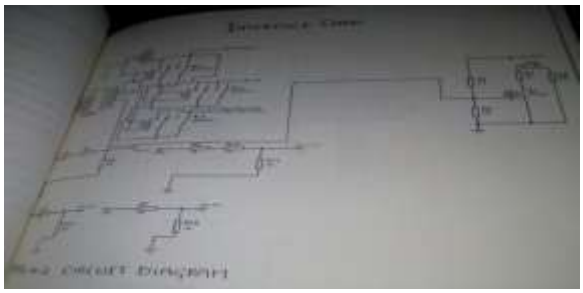

Fig6: Circuit Diagram of Interface Card

VIII. Test Procedure:

This is carried out through a PC and test software is written in C- language. The processor gives the required input signals to the power supply card, this is done with the help of an interface card which acts as a connection between the power supply card and PCI card which is placed in the PCI slots of the mother board of the PC. For giving the required input signals to the power supply card, the relay driver which is present on the interface circuit is switched on by the software program. Then the relay DOI is set by which the power is supplied to the power supply card. Now when the power is supplied to power supply card next its turnoff supplying input signals to different components of the power supply card to in turn measure the output signals. To measure the output of the EMI filter the input signal LPFC, SPFC are given to the EMI filter as input this is given by setting the DO2 bit. The output produced as such is given to the DC-DC converter as input which generates output voltages of +15V, -15V, +5V, _5V. The input to the check circuits is given by setting the DO3 relay driver, the inputs of check circuits are control signals JET, DIS, ESC and control signal p1.0,p1.1, p1.2 The fixed reference voltage is compared with the input voltage and the output is given as logical high or low according to that comparisons. The inputs to the magazine sense circuits are control signals which are taken from the firing control system. The output of the magazine sense circuits is LMSR, RMSR, LMSL, and LMSR. To measure constant current source on the target board we make use of squib power loading circuit on the interface card. The sp28 signal on the target board may draw huge amount of current. In order to regulate the current we are using squib load circuit which is tuned on only for 50ms and voltage is measured.

IX. Results

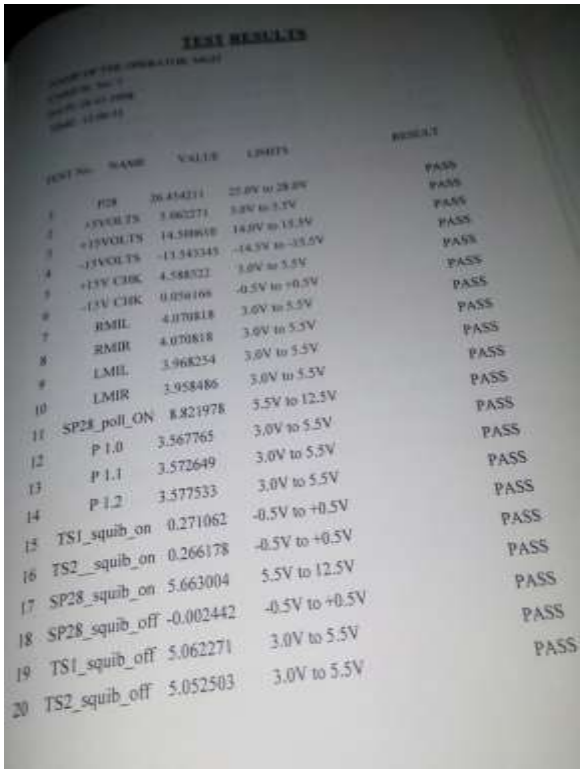

Fig7: Test Results

X. Conclusion

The development of PC based test setup for testing the power supply card will not only the time but is also an efficient and accurate way of testing. Though this project deals with the testing of power supply card this concept will be applicable where ever testing of similar PCB's is involved. By using the above test concept the other PCB's like CPU board, buffer card, firing card etc can be tested automatically by development of different interface card, interconnection cables and application software as per check sheets. We have successfully designed and developed the test setup and application software in C-language for testing the power supply card of the control system. The results were demonstrated on the computer screen this project has given a very good knowledge and confidence to design such PC based setup in future.

XI. Acknowledgment

We express our profound gratitude to Mr. Visheshwar Rao (SE, CDO), Mr. N. SatyaNarayana (Dy. Mgr, ISTM) for giving us this opportunity to do the project work and use the infrastructure and facilities in this esteemed guidance. Finally we also convey our thanks to all the people who have directly or indirectly help us through the course of our project.

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