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A PATH FOR HORIZING YOUR INNOVATIVE WORK

IMPLEMENTATION OF AUTOMATED JIG FOR PCB TESTIMG

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Abstract: Paper includes hardware designing of PCB test jig using Raspberry Pi that will be used for automated testing of master card PCB used in X ray machines. Automated Test Equipment (ATE) will verify the PCB's functionality and its behavior. Hence Functional Test (FCT) is used as final manufacturing step. It provides final pass/fail determination on finished PCBs before they are shipped. A functional test simulates a product's operational environment to check its correct functionality. The environment consists of any device that communicates with the device under test (DUT), for example, the DUT's power supply or program loads necessary to make the DUT work properly. The PCB is subjected to a sequence of signals and power supplies. Responses are monitored at specific points to ensure functionality is correct. The test is usually performed according to the OEM test engineer, who defines the specifications and test procedures. This test is best at detecting wrong component values, functional failures and parametric failures.

Keywords: Raspberry Pi; ATE; FCT; DUT; OEM.

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INTRODUCTION

Automated Test Equipment (ATE) is any apparatus that performs tests on a device, known as the Device Under Test (DUT) or Unit Under Test (UUT), using automation to quickly perform measurements and evaluate the test results. An ATE can be a simple computer controlled digital multimeter, or a complicated system containing dozens of complex test instruments (real or simulated electronic test equipment) capable of automatically testing and diagnosing faults in sophisticated electronic packaged parts or on Wafer testing, including System-On-Chips and Integrated circuits.

ATE is widely used in the electronic manufacturing industry to test electronic components and systems after being fabricated.

ATE can test a wide range of electronic devices and systems, from simple components (resistors, capacitors, and inductors) to integrated circuits (ICs), printed circuit boards (PCBs), and complex, completely assembled electronic systems[1].

WHY AUTOMATED TESTING?

Automatic test equipment enables printed circuit board test, and equipment test to be undertaken very swiftly - far faster than if it were done manually. As time of production staff forms a major element of the overall production cost of an item of electronics equipment, it is necessary to reduce the production times as possible which can be achieved with the use of ATE, automatic test equipment.

ATE systems are designed to reduce the amount of test time needed to verify that a particular device works or to quickly find its faults before the part has a chance to be used in a final consumer product.

To reduce manufacturing costs and improve yield, semiconductor devices should be tested after being fabricated to prevent even a small number of defective devices ending up with consumer.

ATE architecture consists of master controller (usually a computer) that synchronizes one or more source and capture instruments. Historically, custom-designed controllers or relays were used by ATE systems. The Device Under Test (DUT) is physically connected to the ATE by another robotic machine called a Handler or Prober and through a customized Interface Test Adapter (ITA) or "fixture" that adapts the ATE's resources to the DUT[2].

ATE tests perform two basic functions. The first is to test whether or not the DUT is working correctly. The second is when the DUT is not working correctly, to diagnose the reason. The diagnostic portion can be the most difficult and costly portion of the test[1].

TEST PROCEDURE

General scheme to test inputs

1. Tester drives appropriate input DUT.

2. Tester sends command to DUT on UART to read the input

3. Upon reception of the command, the FPGA logic on DUT senses the input and reports the read value back to tester.

4. Tester compares the data sent by DUT with expected result and concludes on PASS or FAIL.

General scheme to test outputs

1. Tester sends command to DUT on UART with data to be driven on certain output pin.

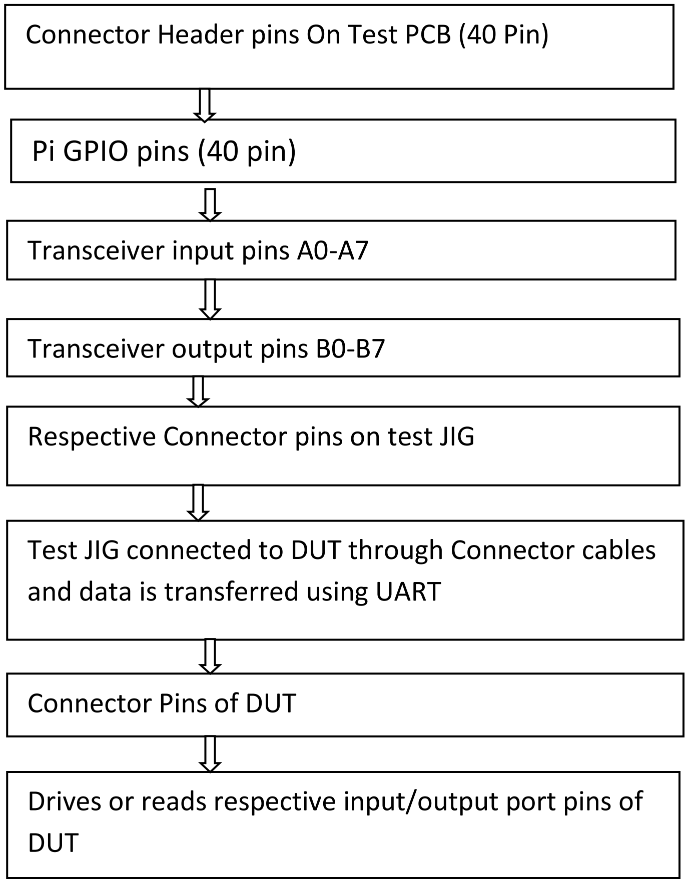
2. Upon reception of the command, the FPGA logic on DUT drives the requested outputs and sends ACK to back to tester.

3. Tester senses the outputs on DUT connectors.

4. Tester compares the output values generated by DUT with expected result and concludes on PASS or FAIL.

DESIGN OF JIG

The Jig comprises raspberry pi model B+ as the controller. The GPIO pins of the Pi are interfaced to the input/output pins of the DUT through transceiver. The transceiver sends and receives the 8bit data parallely to/from the DUT. Output of the transceiver is given to the DUT input/output pins through the connectors. JIG and DUT are interfaced using connectors and connector pins are then routed to the respective input/output pins of DUT. Electrostatic Diodes (ESD) are used in order to protect the transceiver and Pi if there are any voltage surges. The data flow chart is given below.



The Pi provides 3.3v and 5v voltage supply whereas +15v and -15v is provided by the SMPS.

The DUT is FPGA based and is programmed using Altera's USB blaster FPGA Programmer. First input port pins of DUT are driven by applying appropriate voltages, Logic 0 – 0v +/- 0.2v and Logic 1- 5v +/- 0.2v. Command frames (64 bits) are then sent from the Jig to the DUT to either drive the output or to read the input pins. The tester sends the command frame to DUT via UART to read the input ports.

A5	D1	C1	D1	Ignored	Ignored	Ignored	Ignored

The FPGA logic on DUT reads the input ports and sends back the acknowledge signal via response frame.

A5	C1	D1	D2	Data0	Data1	Data2	Data3

Data 0,1,2,3 are 8 bits each contains the information of input port pins. These data is then compared with the expected value which depend on what input was sent at earlier step, and concludes PASS or FAIL.

Similarly test Jig sends the command frame to drive the output port pins of the DUT via UART.

A5	C1	D1	D3	Data0	Data1	Data2	Data3

The FPGA logic on the DUT extracts the data frame, each data is 8 bits and drives the output pins on DUT. Later DUT sends back the acknowledgment signal to test Jig using response frame.

A5	A1	D1	AC	5A	5A	5A	5A

Tester reads the output available on the connector pins and compares the read value with expected value, which depend on what data was sent at earlier step and concludes PASS or FAIL.

Raspberry Pi over PIC controller

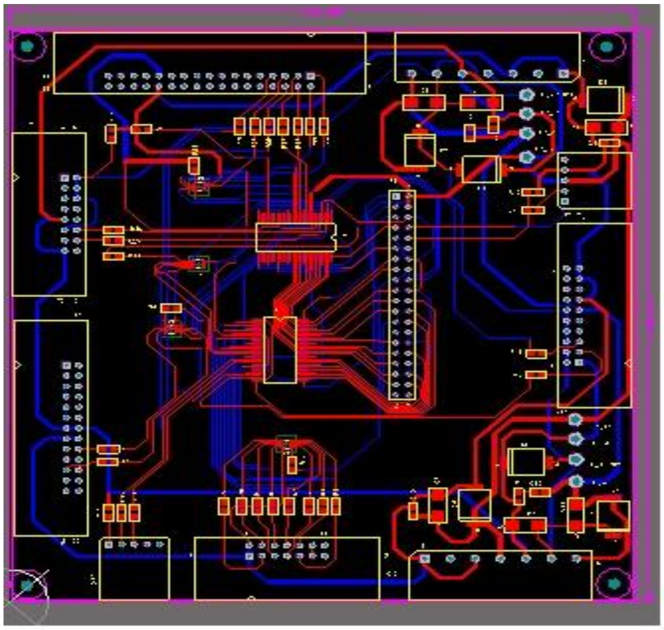
The advantages of using PI over PIC controller are as follows:

1. More number of GPIO pins compared to PIC controller.
2. Can be easily configured as input or output pins where as in PIC controller setting up of registers are required in order to use the output pins as by default pins are configured as input for PIC controller.4
3. Can be directly interfaced using jumper wires unlike in PIC controller which requires RS232 interfacing.
4. No need of interfacing protocols like I2C or SPI as required in PIC controller for connecting components.
5. U art interfacing is much easier than in the PIC controller.
6. Interfacing Pi to PC is simple than PIC to PC which requires MAX 232 interfacing PI to PC required LAN port.

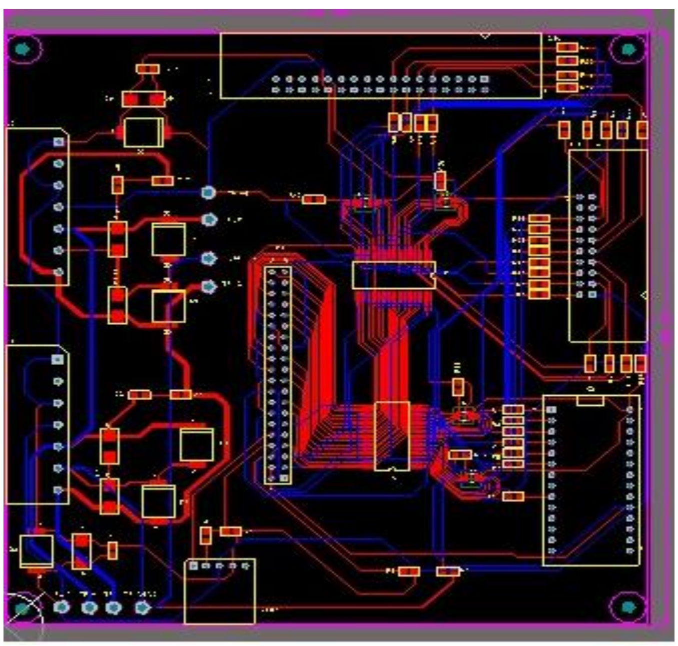
The schematic each for testing input pins and output pins are drawn using above mentioned components in Altium Designer Tool. The schematics are then extracted in PCB layout where components are placed one by one, routing between the components is carried out and final fabrication files which is Gerber files is generated.

RESULT

The Jig PCB for input port pins



The Jig PCB for output port pins



Decreased testing time.

Automated testing can perform actions faster than humans can. The time it takes to run automated test is likely dramatically less than the time it would take a manual tester to perform those same actions.

As the automated test suite is built, the time is invested in creating tests that can be run again and again. Whereas manual testing requires that a human tester put in work every single time a particular feature is to be tested, automated testing means devoting time once to write a test that can be run automatically countless times and be updated when needed.

Automated testing performs parallel test runs. The response frame received is 64bit and each bit signifies the functionality of input/output pin, So it is possible to verify multiple functionality features simultaneously decreasing the overall testing time.

Increased efficiency of testing process.

Single automated test can be reused on multiple features.

Automating repetitive tasks frees up the testers to perform exploratory and manual testing on other parts of DUT that may not be suited to automation.

Automated test can help to remove human error from testing process, providing you with consistent, reliable, repeatable tests and results.

Increased application quality.

By running the automated tests regularly, tester can find bugs earlier in development process, leaving developers with time they need to resolve any issues prior to promotions.

Automated testing lends itlsef to agile development and continuous integration practices. As new functionality is added to test PCB, we can run the relevant tests from the automated suite at the click of a button.

Performing a combination of automated and exploratory testing of test PCB helps to discover “our-users-will-definitely-run-into-that” bugs and “discovered-completely-by-accident” bugs.

CONCLUSION

Automated test jig is still in process of development as changes in test cases, test procedures to verify functionalities features other than input output pins and also how can these PCB design can be modified to test input output ports in one single jig instead of two. In this paper we have successfully investigated the automated testing of PCB is much faster, appropriate and human error free than manual testing. Test automation when carried out in a planned manner, offers great benefits and is therefore worth considering.

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