Automated Production Circuit Board Test System

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Category:
Test and Quality

Products Used:
LabVIEW™ 5.1
NI-DAQ™ 6.5.1
SQL Toolkit
Internet Developers Toolkit
PXI™-8156B
PXI-6040E
PXI-6533
PXI-8420

The Challenge:
To develop a highly automated, user-friendly product test system that can thoroughly test the functionality of electronic circuit control boards and generate powerful reports based on a detailed database generated from the test system.

The Solution:
Using LabVIEW, the test system combines instrument control, data acquisition, database operation and an e-mail alarm utility. With this production test hardware/software platform, the operator can run all required tests on the device under test (DUT) and the test results are then automatically saved to the database on the server. A powerful Microsoft Access program is also provided to generate numerous different test reports.

Introduction
V I Engineering, Inc., a National Instruments Premier Alliance Member and Select Integrator, was contracted by Invensys Appliance Controls to develop a production test system for their electronic circuit control boards. The system is designed with two testing bays on the complete test fixture. They testing bays are switched one at a time to test DUTs, in order to allow loading or unloading of one DUT while the other one executes a production test. The entire test script is highly automated, so that operators are focused on manually removing and replacing DUTs within each testing bay. The tests contain bar code label verification, serial communication, EEPROM verification, a voltage test, LED test, UV voltage sense circuit verification, resonator accuracy verification, reset switches test, speaker volume test, UV Bulb voltage test, and interlock input test. All test results and pass/fail status for each test is recorded in the database. The test system measures different aspects of a board’s functionality to determine if it meets quality standards

System Design
The test fixture provides a mechanical means to mount the DUT. A limit switch is used to detect whether a board is physically mounted into the test bay. A locking mechanism will fasten the circuit board and activate the “board present” limit switch. The software will then control the lock and read the status of the limit switch. All the necessary connectors of the DUT are accomplished using pogo pins, and hence no hard manual connection to the DUT are required. Photo sensors are used to detect the LED output and a microphone is used to detect the speaker audio output. A customized interface board is used for signal conversion and conditioning.

Test Mode
There are three test modes available in the test system, product test mode, quality inspect mode, and debug test mode.

• Product Test Mode
This mode is used to test all new build boards. The operator can load a board into either Bay 1 or Bay 2 and start the automated test. During the test, the operator can abort testing at any time.

Only one bay is active at a time. The intent is for the operator to unload and load a board into one bay while the other bay is testing a separate board. Upon completion of a test in one bay, if the board is properly installed in the other bay, and the board has not been tested before, the tester will automatically start the test in the other bay.

While the board is being tested the appropriate bay screen will list the current test being performed and the status, see fig. 1. The automated execution of tests will stop if a board fails. After the test is complete, all test data are saved to the database assigned by the user.

![Test System Main Screen](image)

**Fig. 1 Test System Main Screen**

- **Quality Inspect Mode**
  The Quality Inspect mode is used to run the functional tests on a board and compare the results with the previously recorded data. The main purpose of this mode is to allow Quality Control to retest boards form production without reprogramming the EEPROM on the board. The auditor can also verify that a board has passed all tests.

- **Debug Test Mode**
  This mode allows the operator to choose the desired tests. The selected tests can be repeated endlessly or a defined number of times by entering a value from 1 to 99 in the loop counter. This mode is mainly used for debugging purpose.
The product database program is a Microsoft Access based solution designed for creating comprehensive reports on all production based testing. The data for the database is generated by the LabVIEW production test system. The MS Access database is used as a reporting tool for tracking the performance of the control units and for product feedback towards further control improvements. As controls are run on the production test stands, the testing records are stored in the appropriate tables. There are a total of four relational tables, which contain all data acquired during each of the test runs.

When the user enters the program, the main screen (fig. 2) is displayed, from which the user can select from a list of choices to generate a predefined report or exit from the Application (Exit Microsoft Access).

When a report is selected, a dialog box is displayed and the user is prompted to enter in “from / to” dates. These dates will be used to constrain the data search. A part number is also required and only records related to the appropriate part number will be used for a specific report. Once a report has been generated, the user also has an option to select which field the report data will be sorted on. The user can select to sort by Bar Code, Sequence No. Manufacturer Date, Test Date, Test Start Time, Bay No. Failed Test Name, and # of Times Tested.

Summary
V I Engineering has implemented a PXI-based test system using LabVIEW with the internet developers toolkit. This highly automated, powerful system allows for testing of hundreds of thousands of boards every year and is capable of tracking comprehensive statistical data on the production system by recording the production test data into a database. The database is then used to create custom automated reports.