Automated Amplifier Circuit Board Test System

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Category

Manufacturing Functional Test

Products Used

TestStand 2.0
LabVIEW 6.1
PXI-1010 Chassis
PXI-PCI8330 MXI Card
PXI-6070E Multifunction E-Series DAQ Board
TB-2705 Terminal Block for 6070E
PXI-GPIB
SCXI-1160 (Relay Module)
SCXI-1324 (Relay Terminal Block)

The Challenge

Decrease the time required to perform complicated tests on circuit boards to keep up with high speed production demands. Improve the reliability of test data and reports, and reduce human errors.

The Solution

Automate the test procedure including fixture manipulation, data acquisition, and instrument configuration and control, as well as report generation of circuit board tests.

Introduction

A circuit board contract manufacturer specializing in bare-dye assembly and Chip-On-Board manufacturing has the need of automating the process of testing circuit boards. In order to comply with all their customer's requirements the tests are long and complicated involving a large number of steps of data collection and interpretation, manipulation of the test fixtures, as well as configuration and control of stand-alone signal generator and signal analyzer instruments.

To complete a test, operators must follow a long test procedure that details the steps to follow to complete a test. The test procedure requires operators to turn on and off a power supply, toggle switches in the test fixture, take voltage measurements manually using a voltmeter, configure an external dynamic signal analyzer and manually record measurements on a test report. The test report contains the tolerance limits and operators must judge whether each test passes or fails. The accuracy and speed of the tests relies solely on the operators. A fast operator could complete a circuit board test in approximately 30 minutes for each unit. The speed is not fast enough to keep up with production and human errors affect the reliability of the tests.

The company turned to Data Science Automation (DSA), a National Instruments Select Integrator Partner, for its Measurement and Automation expertise to design and develop an automated test system for the circuit boards.

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Setting up the Test System

DSA implemented a computer-based circuit board test system using National Instruments LabVIEW and TestStand. LabVIEW was used to develop test modules for fixture manipulation, configuration and control of external devices, data acquisition. In order to accomplish this, the LabVIEW Virtual Instruments (VIs) developed interact with National Instruments hardware embedded in a PXI chassis. The system consists of a PXI-1010 chassis with a General Purpose Interface Bus (GPIB) board, a Multifunction Data Acquisition (DAQ) board and two SCXI relay modules. The software runs from a desktop PC and uses MXI-3 technology to communicate with the devices in the PXI chassis.

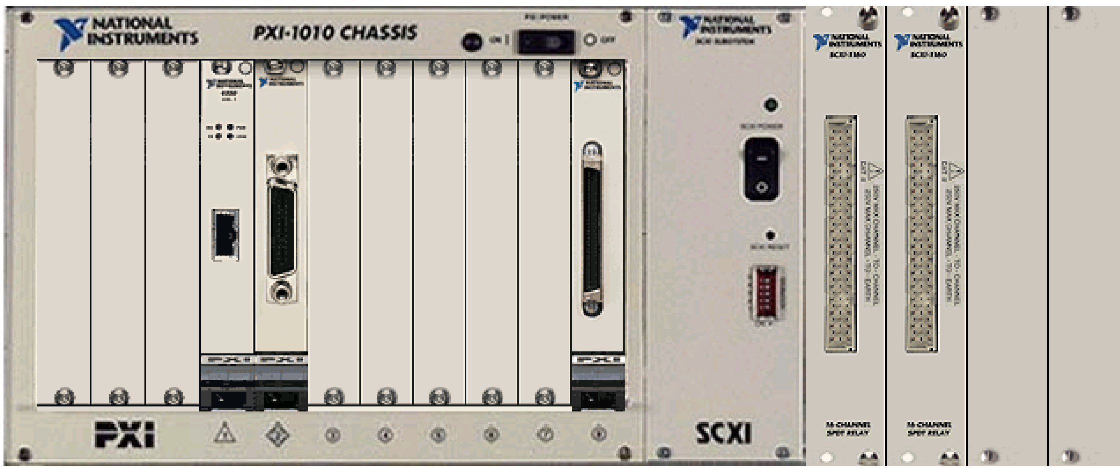

Figure 1. PXI-1010 chassis with both PXI and SCXI slots in one

Automating the test requirements

The test procedure requires the operators to toggle switches, swap cables to different connectors, and turn on and off a power supply in the test fixture. Using the two SCXI relay modules, DSA built VIs that actuate the relays and consequently allow the automation of fixture manipulation. The programming was simple using high-level digital input/output (DIO) VIs, which are an inherent part of LabVIEW.

Acquiring data from multiple test points is also required as part as the test procedure. Using the LabVIEW Data Acquisition (DAQ) functions, VIs were built to acquire data from the PXI DAQ board. The DAQ board is also being used to control the SCXI relay modules. It takes advantage of the PXI back plane bus avoiding the need of a cable between the DAQ board connector and one of the SCXI modules. This kept the connector of the DAQ board free for a terminal block that was used to wire the connections to the signals being measured without requiring an SCXI feed through module.

Finally, the operators are also required to configure and take measurements of power spectrum and frequency response of signals from an external Dynamic Signal Analyzer (HP-3562A). The configuration and data acquisition from a HP instrument was automated by controlling it from the PC through GPIB. An instrument driver was not available for this instrument so and DSA developed a limited instrument driver using the LabVIEW Virtual Instrumentation Software Architecture (VISA) functions for communicating to the instrument via GPIB.

Integrating a Test Sequence

TestStand was used to integrate the test modules into the required test procedure. DSA build a test sequence, which calls the LabVIEW VIs. It configures parameters, records and analyzes the results. Two different methods were used to share information between TestStand and our LabVIEW modules. The simplest one is passing information directly to and from predefined clusters in the VI's front panel wired to its connector pane. This cluster was used to pass configuration parameters such as the position of the switch, configuration for the dynamic signal

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analyzer, the connection of a cable and so on from TestStand to the VIs. Also, TestStand used the clusters in the VIs to retrieve result and run-time error information.

For more complicated steps, such as steps that measure multiple set points and an array of data needs to be returned to TestStand the TestStand API was used allowing access to TestStand objects and its methods and properties.

Customizing the Test

The test sequence might call the same LabVIEW VI several steps but with different configurations or state of the test fixture. Therefore, the measurements taken are different and the criteria to define whether the step passes or fails is different as well. For this, TestStand numeric limit test steps were used, which allow the configuration of the limits. These limits could change between tests since the error tolerance might decrease with time and changes to the test specifications are possible. To provide flexibly to a test engineer to modify the test limits, the steps properties were exported to a file and are programmatically imported to the sequence every time the test is ran.

Conclusion

The use of LabVIEW and TestStand made the implementation of the automated circuit board test fast and complete under budget. The LabVIEW VIs can be independently tested and troubleshot speeding up the detection of problems with the software or with the test fixture itself. Using TestStand as the off-the-shelf test executive software saved engineering time for developing and maintaining a custom test executive. TestStand provide all the functionality required and much more that will be used for further add-ons to the test system. The automated test is now in use, and a complete series of tests only consume seven minutes and it provides unrivaled reliability and accuracy.