

PXI Based RF Component Testing System for Wireless Security Systems

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The Challenge

To develop a system for testing the power, frequency and bit pattern transmitted from wireless security system components. The test system is to be used in the manufacturing plant by a production operator to test the various components and determine whether they receive a pass or fail rating. Thousands of tests may need to be performed each day.

The NTS Solution

A NI PXI-5660 RF Vector Signal Analyzer and a NI PXI-8186 P4 2.2 GHz Controller were housed in a NI PXI-1024 8 slot chassis. An antenna was mounted to the chassis and connected to the 5660.

Abstract

A test system is needed to assist quality control in identifying defective Radio Frequency (RF) components for use in wireless security systems. Each component has to meet or exceed a specified minimum power level, be within a specified frequency range and match a recognized bit pattern for it to be accepted. A production engineer will enter the test parameters into the software and a production operator will perform the testing. The operator starts the test from within the software and presses the button on the transmitter. A 400 MHz signal is received by the NI PXI-5660 then demodulated to determine the bit pattern. The bit pattern, measured power and measured frequency are compared to the test parameters entered by the engineer and a pass/fail indicator is displayed. The system is then ready for the next test. All data is saved in a test file along with the pass/fail statistics for the test.

Testing Requirements

Two types of RF components needed to be tested for each wireless security system. The first was a key chain remote, which arms and disarms the master alarm unit. It consists of two buttons (ARM and DISARM). When each button is pressed, a signal, which consists of two peaks is transmitted. If both buttons are pressed simultaneously (PANIC mode), the alarm is activated on the master alarm unit. The peaks are expected to be centered around 400 MHz and be about 50kHz apart from one another. The test system measures the peak positions and peak deviations. The demodulated data results in a communication packet consisting of 108 bits transmitted at 2 kbps. Multiple packets are transmitted each time a button is pressed to ensure a packet is received. The measured bit pattern is then compared to the expected bit pattern to determine if they match. The average power over the duration of the transmission is also measured. Finally, the test system displays a PASS or FAIL indicator on the computer monitor depending on whether or not all measured values are within specification. If the component fails, a message is displayed with the failed parameter(s) and its value.

The second type of component is a motion detector. When motion is detected, a signal is transmitted and the receiver sets off the alarm. Each transmission is similar to that of the key chain remote. The same criteria are used for testing with the exception of using a different power specification. The reason for this testing is to eliminate components that are out of spec even if they still communicate with the system. This will reduce the chances of components failing in the future.

Hardware

The manufacturer of the security system was looking for a compact, inexpensive test system, to be in operation at the plant within a two-week period. We selected a NI PXI-5660, which consists of a 2.7 GHz downconverter, and a 64MS/s high-spectral-purity digitizer, a NI PXI-8186 2.2 GHz Pentium 4 Embedded Controller and a NI PXI-1042, 8-slot chassis. An antenna was connected to the input of the downconverter using RG58 cable and a gold SMA connector. The antenna assembly was connected to an L-bracket that was mounted on a 2-slot wide blank faceplate on the front of the PXI chassis (Figure 1). By choosing this hardware we were able to acquire signals from the RF components within minutes using the LabVIEW RFSA and NI-SCOPE examples. In addition, the high measurement throughput of the PXI-5660 allowed us to keep the test time short so that thousands of tests can be performed each day.



Figure 1. RF Components Tester for Wireless Security Systems

Software

As a newly hired system integrator and beginner LabVIEW programmer, with no prior experience testing RF systems, I suspect that successful completion of the project within the specified timeframe would not be possible if we had not used LabVIEW. The large selection RFSA examples along with the Spectral Measurements and Modulation Toolkits allowed us to quickly develop the software.

Using LabVIEW 8.0 we developed a user interface that would be easy to operate in a production environment. Large buttons that could be activated using keyboard shortcuts along with large indicators were used to simplify testing for the operator.

Configuration

The first step for operating the RF component tester is to enter the test settings such as minimum power, acceptable frequency range, bit patterns and test timeout.

Start Batch

The operator enters a filename, which describes the batch of components being tested. The test results for that batch of components will be stored in this file.

Test

A separate test window appears when the TEST button is pressed on the main panel. An indicator displays the batch name, and test number. When the operator is ready, testing can begin by clicking on the test button or pressing the space bar. The test timeout that was entered in the configuration step defines the maximum amount of time that the tester will continuously look for a signal. The test ends as soon as a signal with a recognizable bit pattern is detected. All measured values are display in the test window after each test. If a signal is not detected within the time allowed the test fails and the operator can choose to retest to accept the failure. If a signal is detected with an acceptable bit pattern but does not meet the frequency or power specification, the operator again has the option to retest or accept.

Analyze Data

The engineer or operator can analyze the test data by opening the data file. The file consists of a header with date, start time, type of component, and configuration settings. For each component tested all measured values are recorded along with the pass/fail result. The pass rate, total number of components tested and stop time are also written to the file.

Results

We provided the customer with a compact, inexpensive, flexible and expandable system for testing its product in about two weeks. The test system is flexible enough to quickly make changes such as increasing resolution bandwidth and frequency span. Upon completion of the RF component tester the manufacturer realized that about 25 percent of its components did not meet the specification event though they were able to arm, disarm and alarm the master alarm unit. The manufacturer was able to quickly resolve the problem before sending out security systems with a potential for failure.

Products used in this Program

- NI PXI-5660 2.7 GHz RF Vector Signal Analyzer
- NI PXI-1042 8 Slot 3U PXI Chassis
- NI PXI-8186 P4 2.2 GHz Controller with Windows XP
- LabVIEW 8.0
- RFSAs 1.5
- NI Scope
- NI Tuner
- Modulation Toolkit
- Spectral Measurements Toolkit
- Antenna

About NTS Test Systems Engineering

NTS TSE, located in Albuquerque, NM, designs and integrates test, measurement, automation, data acquisition and control systems utilizing diverse hardware platforms, operating systems, and instrumentation standards. Our expertise involves projects ranging from LabVIEW instrument drivers to full-blown automated turnkey systems. The dedicated staff of electrical and mechanical engineers, project managers and technicians of NTS are well versed in designing, integrating and programming real world solutions for industrial applications for a diverse set of operating systems and standards.

Test & Automation Services Include

- Requirements Analysis & Development
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- Software Design & Architecture
- Instrument Drivers
- Test System Management (TestStand)
- Software Development (LabVIEW)
- Data Management & Analysis (DIAdem)
- Enterprise Solutions
- Fabrication
- Integration
- Installation & Training
- Maintenance & Support



Contact

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