RF and GPS Common Core Production Testing

G Systems *developed an automated common core production test system to test both an RF transceiver subassembly and it's mating GPS receiver and tracking controller assembly. Production testing can easily switch from one assembly to the other with interchangeable test adapters (ITA) mating to a Virginia Panel custom receiver, which is directly connected to an NI PXI chassis.*

Several PXI modular instruments were used to provide stimulus and response measurements for mixed-signal and RF devices on each assembly, control switching of RF and power signals, and to provide device communication and configuration for each test.

The Challenge

Automate production testing of both 3.5 GHz satellite transceiver (subassembly) and GPS tracking modules (top assembly). Maximize production throughput while minimizing test system footprint and overall cost in overseas manufacturing.

The Solution

Design and build an automated, single-rack, common core test system with interchangeable test fixtures for current and future products using National Instruments PXI modular instruments and Virginia Panel mass interconnect solutions.

Introduction

A manufacturer of GPS tracking modules needed an automated test stand to perform functional test and device programming for their overseas manufacturing operation in China. G Systems developed a system that programs the devices, simulates real GPS satellite signals (over-the-air), and performs mixed-signal and RF measurements. All test modules were developed in LabVIEW™ and test sequencing and data management was provided by TestStand™. NI Switch Executive was used to control all power and RF switching functions through TestStand sequence steps.

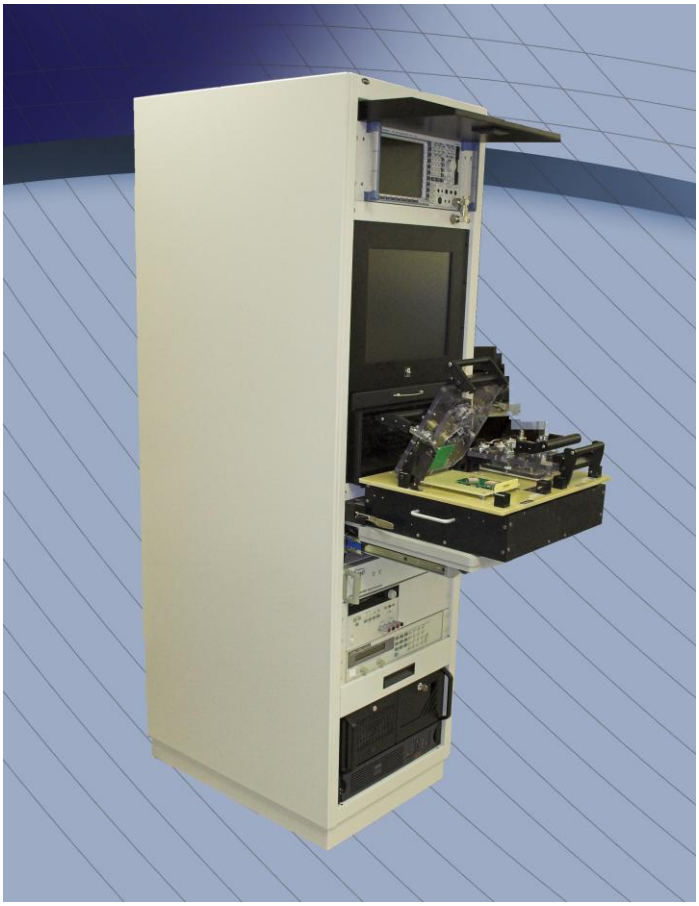

Figure 1: Production ATE System

Common Core Test Hardware

The following figure shows the overall hardware design and PXI instrumentation used in the common core production test system (reference Figure 2).

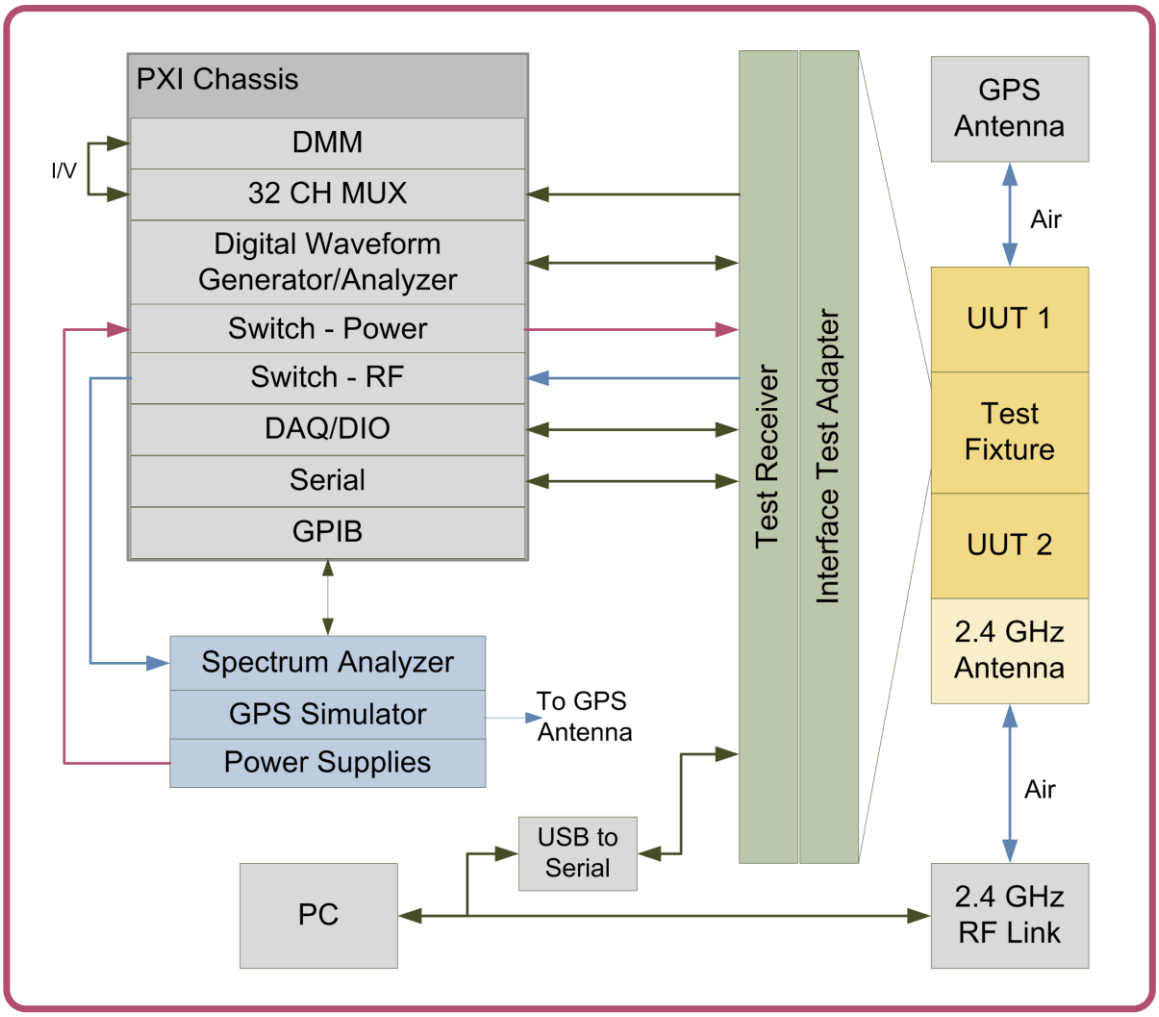

Figure 2 - RF and GPS Common Core ATE Design

The units under test (UUT) required serial communication for device setup and configuration, which was either direct serial over PXI-8420/4 or via 2.4 GHz USB serial communications device (final test over-the-air interface).

Digital and analog IO were achieved using PXI-6541 high-speed DIO (for any pattern generation needs) and PXI-6221 (static control lines and fixture relay control). A PXI-4070 DMM was used for a majority of voltage and current tests through a PXI-2527 multiplexer. Some fixture relay design was needed to accommodate switching the DMM for power-on and sleep current tests (routed through power supply) as well as regular voltage tests.

Rack instruments were controlled using PXI-GPIB including Agilent DC power supplies, a spectrum analyzer, and a GPS simulator.

Each test adapter is capable of testing two modules either in series or parallel, which meant all tester resources had to be designed with parallelism in mind (duplicate and/or dedicated connections).

Production ATE Automation Software

National Instruments LabVIEW was used for all instrumentation control and encapsulated tests which enabled efficient and hierarchical programming from the TestStand sequence development environment. With a modular approach to software design, some tests could be implemented with a simple series of LabVIEW instrumentation driver calls whereas more intensive tests or analysis could be pushed to higher level LabVIEW modules.

NI Switch Executive proved to be a useful tool for designing the switch software. All switch connections and switch groups (routes) were defined and documented in Switch Executive for easy calling from within the TestStand sequence. Switch route connect/disconnect was handled at each test step using the built-in TestStand switching capabilities (test step properties tab). Using Switch Executive eliminated the need for developing custom switch management software and a more robust switch definition mechanism for testing and documentation.

The high level of integration between TestStand and LabVIEW allowed for a clean software architecture design with easily modified test parameters, limits, switching, and data reporting. All aspects of the production testing were automated with minimal user interaction which helps to speed production throughput and minimize testing errors.

Conclusion

Production test goals for throughput and accuracy were met by utilizing the speed and modularity of PXI based instrumentation, the control and flexibility of LabVIEW and TestStand, and the accessibility of Virginia Panel mass interconnects in a fully automated common core production ATE system. (see *Figure 1*).

Overall cost was minimized in PXI hardware and software development as well as modular expansion and system reuse available for new products. Test time for both programming and test was under 2 minutes, which allowed the customer to meet production requirements of thousands of units per week.

Key Contributor

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Products

NI PXI hardware
NI LabVIEW
NI TestStand
NI Switch Executive
Agilent 6644A
Agilent 3646A
Virginia Panel S6/G12

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