Boundary-Scan Test Using ScanWorks® with Teradyne's High Speed Subsystem

Application Note

by Michael Johnson

ASSET™

By Michael R. Johnson – Product Manager

Michael R. Johnson presently serves as Product Manager for Boundary-Scan Test (BST) and FPGA-Controlled Test (FCT) for ASSET InterTech. He also serves as manager of ASSET InterTech's Support services. As Product Manager, Michael is responsible for providing strategic direction for these products while coordinating with ASSET's cross-functional teams to bring the company's goals to fruition.

Prior to joining ASSET InterTech in 2007 as a Sr. Applications Engineer, Michael's background included roles as a Cellular System Engineer with Nortel Networks and a Hardware Design Engineer with Alcatel USA. While at Alcatel USA, Michael's emphasis was high-speed PCB design and layout for digital cross-connect and fiber-optic systems.

Michael earned the Bachelors of Science in Electrical Engineering from Southern University and A&M College located in Baton Rouge, Louisiana and the Masters in Business Administration from Amberton University located in Garland, Texas.

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Introduction

PXIe-based test systems fill an important role in satisfying ATE test requirements. These scalable test systems provide a means of functional testing through the UUT's various types of interfaces (e.g. digital, analog, and RF). UUT test and repair can be accomplished through a variety of instruments that fit into the PXIe chassis.

Teradyne's PXIe-based High Speed Subsystem (HSSub) has become the standard for PXIe-based test systems for defense and avionics applications. The HSSub addresses ATE requirements that are common to most recent designs including increasing speeds, protocol complexity, data quantities, and processing demands, along with lower latency interaction with the UUT. The HSSub provides a more economical approach to meeting these requirements than the application-specific approaches of the past.

As the level of integration within UUTs increases, there are more concurrent I/O ports of various types. Digital buses of various speeds and complexity are coupled with equally demanding analog and RF ports. Most ATE is inadequate in meeting this wide range of I/O port requirements, forcing test departments to use multiple single-purpose instruments or fully custom Interface Test Adapter (ITA) based circuitry. The HSSub avoids the use of dedicated, single-purpose hardware. The HSSub's powerful and flexible hardware and software combine to provide reconfigurable, multi-purpose capabilities.

ScanWorks and HSSub Integration

ScanWorks Boundary-Scan Test software can be installed and run on the HSSub. Making the Boundary Scan test available through the HSSub increases diagnostic test capabilities, while reducing test cost and test times significantly over the entire life cycle of a product for new and existing HSSub users.

ScanWorks is integrated into Teradyne's HSSub through its Boundary Scan Runtime Library (TERBSR™), a software facility that gives access to several of its instrument families through an application programming interface. As a result of the integration, ScanWorks is able to test a circuit board through the high-speed communications channels on an HSSub instrument.

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Boundary Scan test vectors are generated by ScanWorks and applied through the high-speed digital channels of an HSSub instrument by accessing the IEEE 1149.1 test access port (TAP) on the unit under test (UUT).

The HSSub instrument functions as a ScanWorks controller. As such, it is well suited for IEEE 1149.1 and IEEE 1149.6 interconnect test, memory test, PLD/FPGA and NOR/NAND/SPI flash programming. Testing cluster devices and other areas on the UUT can be accomplished effectively with the ScanWorks Component Action, macro programming language and various scripting language, all of which are supported on HSSub instruments. Multiple TAP configurations, TAP concatenation, and discrete I/O signal specification is possible using an HSSub instrument, similar to ScanWorks multiple TAP controllers.

Flash programming times are reduced by using the HSSub controller's compiled mode of operation. When the compiled mode is enabled, the ScanWorks Flash programming actions are compiled into an executable program that significantly decreases the application time of Flash programming operations. The Flash actions are automatically compiled the first time they are run and subsequent applications run just the executable, avoiding the compile time for each application.

Customers only need to invest in a single piece of HSSub hardware to run Boundary Scan test and other UUT specific test. The debugging capabilities with HSSub instruments are as powerful as those supported by all ScanWorks controllers. From the ScanWorks action debug tool, actions can be run step-by-step in real time. Immediate diagnostic information leads to quicker UUT repair. Integrating the structural testing and programming capabilities provided by ScanWorks and functional test capabilities of the HSSub provides complete UUT structural and functional test coverage.

ScanWorks and HSSub Integration Benefit Summary

Advantages of using ScanWorks with Teradyne's HSSub instruments:

- No need to purchase additional hardware
- Significant reduction of tests costs & test times
- Quick deployment with large scale ATE systems

- Use tests developed in the product design stage throughout the product life cycle
- Enhanced diagnostic test capabilities
- No POD is required for ScanWorks
- TAP delay is adjustable for maximum TCK

ASSET ScanWorks and Teradyne HSSub Integration

Obtained from Teradyne

- Boundary Scan Runtime Library (TERBSR)
- Teradyne instrument drivers and related libraries
- Teradyne instrument hardware components

Obtained from ASSET InterTech

- ScanWorks Boundary Scan Test software
- ScanWorks license file (license file options from ASSET include: Development, Diagnostics and Repair, or Manufacturing). The license file must include authorization for use of Teradyne controllers

Cabling Teradyne Instruments to the Unit Under Test

The UUT must be connected to the Teradyne instrument in order to perform a Boundary Scan test.

To connect the UUT to the Teradyne instrument, first examine the test channel configurations of each instrument as described in the instrument documentation. Please see "Cabling Teradyne Instruments to the Unit Under Test" under Teradyne Help for information and cable requirements based on the Teradyne instrument in use.

Implementation Procedure

The following lists the general implementation of a Boundary Scan test on the High Speed Subsystem LVTTL instrument.

1. Install the High Speed Subsystem LVTTL instrument in the High Speed Subsystem chassis.

2. Install the TERBSR software on the High Speed Subsystem PC.

3. Install ScanWorks Boundary Scan Test software on the High Speed Subsystem PC (contact ASSET for installation questions).

4. Obtain and install a ScanWorks license from ASSET on the High Speed Subsystem PC. This license must include authorization for Boundary Scan test and for the use of Teradyne controllers.

5. Connect the UUT to the Teradyne High Speed Subsystem LVTTL instrument hardware, cabling to complete the desired test. Cables to connect the HSSub controller to your UUT are not provided by ASSET or Teradyne.

6. Create an Instrument Definition File taking into account the following:

    ▪   Mapping TAP signals to Physical Channel Numbers

    ▪   Mapping PIOs to Physical Channel Numbers

    ▪   High Speed Subsystem resource string definition

        ▪   (see Teradyne help: Creating a Boundary Scan Instrument Definition File for complete instructions)

    ▪   Static Output Channels – Disable during JTAG Tests

    ▪   Initializer – Disable before and during JTAG Tests

7. Start ScanWorks

    ▪   Develop (or import) a Boundary Scan project for the UUT

    ▪   Select Teradyne controller from the hardware menu

    ▪   Adjust TCK and TAP voltage according to UUT design

    ▪   Run project (individual actions or sequence of actions)

    ▪   Once the test has been developed, it can be used to test production UUTs, using ScanWorks to run the tests and to display the results

8. Execute the Boundary Scan test using ScanWorks and verify that it operates properly; debug if necessary.
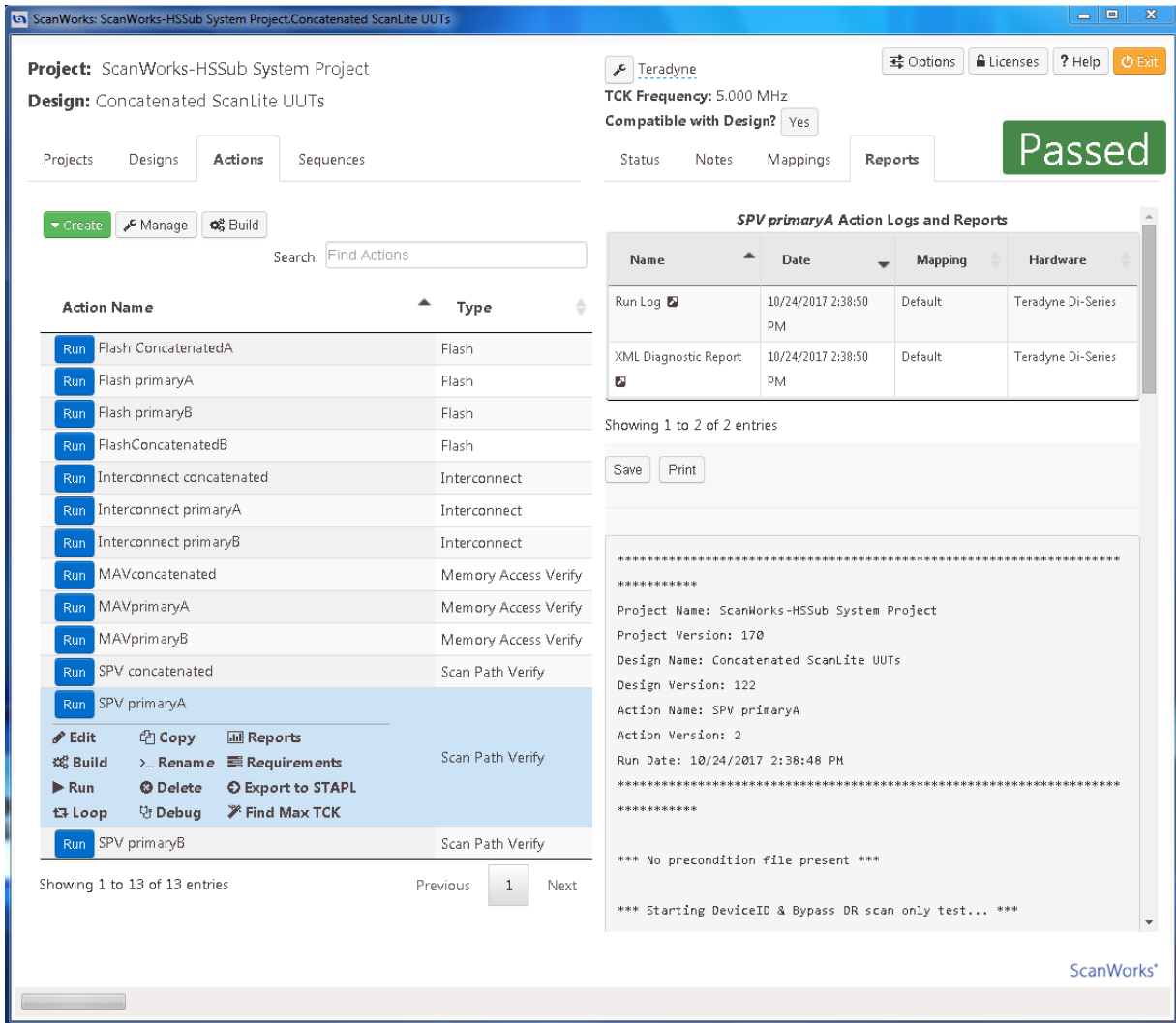
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Figure 1: ScanWorks GUI-Scan Path Verification Test with HSSub

Teradyne Documentation

Teradyne has created a comprehensive guide to the TERBSR software installation, HSSub instrument descriptions, and hardware cable configuration. This documentation can be found in "C:\Program Files (x86)\Teradyne\Shared\Help\TERBSR.chm or TERBSR.pdf"

ScanWorks Documentation

Support documentation for ScanWorks can be found under the Help button within the tool. Support documentation can also be found in "C:\ScanWorks\doc". Example ScanWorks Projects can be found in "C:\ScanWorks\Examples".