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Replacing M9-Series with Di-Series on DATS

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Abstract: WesTest successfully replaced Teradyne's VXI M910 DTI cards with Teradyne's VXI Di-Series cards on the WesTest 2000 DATS. As technology becomes obsolete or no longer supported, it is appropriate to upgrade ATE for long-term support. Our experience with Teradyne has been one of continual product improvement as technology advances.

Technology advancement is critical in test and diagnosis. The key to product improvement is to have an open, state-of-the-art system where new technology can be integrated. Of vital importance was compatibility to protect our United States Air Force (USAF) customers' investment in test programs employing legacy Teradyne equipment. Our goal was achieved by getting existing M9 TPS's to work using Di-series cards. Di-series software included an M9 programming interface, which is required for compatibility and clean runs.

The Di-Series boasts the following product features:

- Addresses multiple improved performance issues for more flexibility and an improved TPS development environment
- Configurable in software
- Instruments can be split into Multiple Independent Virtual Instruments
- Channels double up for True Differential Logic, including LVDS
- Per-channel programming, which allows the TPS developer to concentrate on the UUT testing requirements
- Eliminates shared resources with per-channel programming for I/O level programming, drive, and detect timing and driver transition speed programming

This paper is a discussion on the issues encountered by replacing Teradyne's VXI M910 DTI cards with Teradyne VXI Di-series cards on the WesTest 2000 DATS. The discussion focuses on how issues were resolved to achieve WesTest and Government satisfaction.

Introduction

The Di-series DTI first level of testing was to ensure that WT-2000/DATS (see Figure 1) Operational and Fault Isolation (OAFI) digital tests passed. These tests verify that all the digital outputs change states as programmed and will detect the most common DTI failures. However, the M9 DTI has more capability that needs to be fully tested and verified. The Di-Series M9 compatibility mode allows all programs developed for the M9 to run as is without recompiling into DI native mode; it is absolutely necessary for the Di-series DTI to be selected as a suitable replacement for the M910 DTI.

The M9 capabilities were evaluated and specific functions or capabilities were identified and selected to verify that the Di-series DTI emulates the M9 system properly. Once these capabilities were identified, existing TPS's were reviewed and selected to verify the applicable capability or function.

Figure 1. WesTest 2000 DATS in shop

We worked closely with the F16 shop at Hill Air Force Base (AFB) to obtain the applicable assets necessary to perform these tests. The specific functions tested and verified were:

1. LASAR Modules – Go-path (dtb), Guided Probe (gpd) for Fault Isolation and Fault Dictionary
2. Non TTL (ECL) Voltage Levels
3. LASAR Modules and ATLAS Digital Combined
4. ATLAS Digital Statements combined with DTB Modules
5. External Non-ATLAS DTI Modules
6. Free-Run, Internal and through Test Executive
7. External Clock
8. Partial DTB Execution
9. Deskew Capability

LASAR Modules

A TPS was selected for these tests. It used a large number of DIO pins (>300) defined as Input, Output, and Bi-Directional. In addition, there were two LASAR modules to be executed as part of the go-path. The test program ran a complete end-to-end go-path with no failures (i.e. all tests passed). Faults were then selected and inserted to verify the Guided Probe and Fault dictionary. During probing of the first fault, the guided probe did not isolate properly. This was a minor error with the default probe mapping. The original probe file did not specify probe mapping. The default for M910 was “One-to-One,” whereas the DI default was “Settled”. Teradyne provided a patch that set the DI default to “One-to-One” and it isolated properly.

Another TPS was also used as a test case due to some custom developed models and unique probing. This TPS required an oscillator to have its output pin unsoldered and isolated from the circuit for testing. This TPS ran go-path, and all tests passed. A fault was then inserted and it was isolated properly.

Non TTL (ECL) Voltage Levels

A TPS was selected to verify the use of non-TTL levels. Upon initial run, this TPS failed the automatic self-test. The problem was related to the ECL levels. The failing pins were connected to a 510 ohm resistor to the -5.2V bus. During self-test, the DI detected an overvoltage and displayed an overvoltage error message, opening the DI output relays on the card. Upon investigation, we observed that the DI cards check for less than -4.7V, whereas the M910 checks for less than -5.7V. Teradyne provided a patch that only provided an overvoltage message, but did not open the output relays, and self-test executed properly.

ATLAS Digital Statements Combined with DTB Modules

A TPS was selected first due to a large number of dtb modules. The program executes over 40 dtb files, which were developed using LASAR. There were two main dtb files – front and rear, which both experienced the same failure during execution. They failed the first run, but then passed all subsequent runs. This program uses a non-ATLAS module to reset the DTI prior to executing the front or rear LASAR tests. This caused a problem with the DI Hardware getting out of sync with the DI software (i.e. only the hardware was getting reset). WesTest modified the Test Executive (see Figure 2) temporarily, so the reset was executed internally on any Non-ATLAS Module (NAM). This kept the DI Hardware and Software in sync.

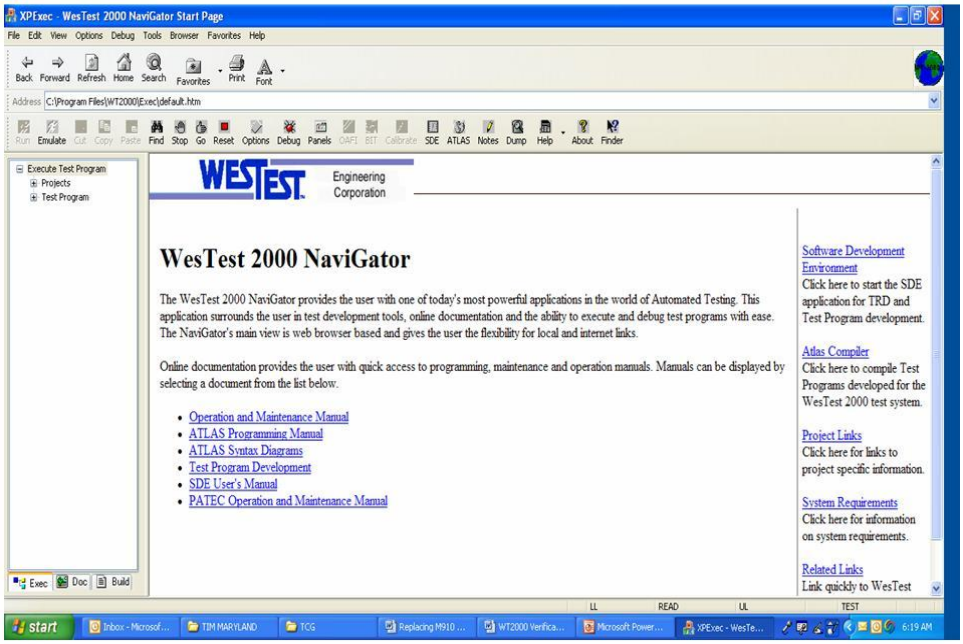

Figure 2. WesTest Test Executive Navigator

A TPS was selected to verify a mix of both ATLAS digital statements and DTB files being executed within the same ATLAS module. During execution, it had intermittent failures. Upon further investigation, it would fail first run of the dtb file, but pass all subsequent runs. This required a variation of the test executive temporary mod for this TPS. Rather than perform reset for all NAM, the test executive was changed to only perform a DTI reset on a DTI NAM. Once this update was implemented, all tests passed. (Note: The TPS was re-run to ensure this change did not affect it and verified that all test passed.)

A TPS was selected to verify digital control in the test executive process, and in an external process using a NAM. This was similar to the reset problem of the TPS discussed above. However, this applied to all NAM, and again, caused a problem with having sessions in two different synchronized processes. In order to ensure all NAM's would not have a synchronization problem with multiple sessions, the test executive was modified to close the current session when a NAM was encountered. The test executive then ran the NAM and opened a new session with false parameters to ensure the DTI did not change states from opening a new session. This approach would ensure that only one session would be open at a time, which would subsequently ensure that the hardware and M9 emulation software remained in sync. In addition to the reset NAM issue demonstrated by these TPS's, this approach ensures that all NAM's will execute properly. This TPS was re-run with the updated test executive and all tests passed.

External Non-ATLAS DTI Modules

A TPS was selected to verify the ability to run non-ATLAS modules within the ATLAS program. Initially, a problem was identified with the probe button. There was an error in the Teradyne software that did not clear the interrupt register properly. This caused a problem when the probe button was enabled to advance the program. It appeared to be getting probe button activation, even though the probe button was not being depressed. Teradyne provided a patch that solved the problem.

This TPS also had an issue when running the Front.dtb file. An internal error was generated. We provided some files and information to Teradyne and they were able to provide a patch that solved the problem.

Free-run DTI Capability

No assets were available to test and verify this capability. A test case was developed using the Soft Front Panel (see Figure 3). Several frequencies were tested and verified with no problems. If a physical asset becomes available, we will run and verify that the TPS passes all functional tests.

Figure 3. Soft Front Panel

External Clock Capability

A TPS was selected to verify the ability to use an external clock to time the DTI in dynamic mode. Running these tests produced intermittent failures, as shown in Figure 4. We worked with Teradyne to try to isolate and resolve the problem. It was determined that a hardware change was required to the utility card. Teradyne provided an updated utility card, as well as updated firmware, for the channel cards. The TPS was then re-run and it functioned correctly with no intermittent failures. These tests were repeated several times and all tests passed.

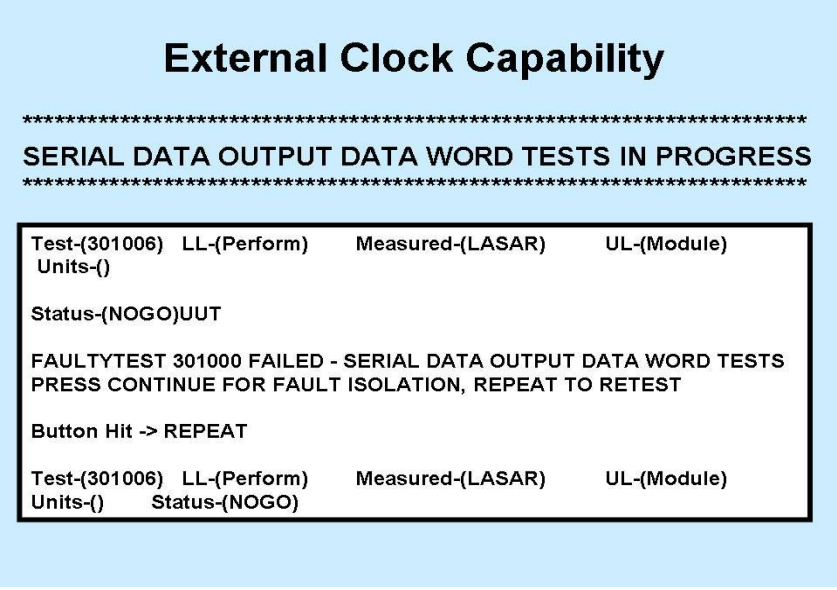

Figure 4. External Clock

Partial DTB Execution Capability

No assets were available to test and verify this capability. A test case with partial DTB execution was performed with no problems. If an USAF asset using partial DTB execution capability becomes available, we will run and verify that the TPS passes all functional tests.

Deskew Capability Testing

No assets were available to test and verify this capability. However, the deskew function was verified to execute properly. If a physical asset becomes available, we will run and verify that the TPS passes all functional tests.

Operational and Fault Isolation (OAFI) Self-Test Testing

All DTI cards were tested independently, as standalone instruments and individually, in OAFI by running the applicable entry point. Once this testing was completed and the test results were verified, an end-to-end run of all OAFI tests was performed to ensure that all instruments correctly functioned together.

A complete end-to-end run of OAFI tests, with the WT-2000/DATS configured using all alternate Di-series instruments, was performed. The test results demonstrate and validate that all alternative instruments are acceptable substitutes and provide 100% compatibility for the WT-2000/DATS P/N 9000301-1 Test System.

Calibration Testing

WesTest modified the Calibration Test Program to detect which DTI system is present in the WT-2000/DATS being calibrated and to run the appropriate tests. A new module was created to perform the calibration tests required, if the new Di DTI was detected.

The calibration tests were performed successfully and ensure that the WT-2000/DATS, regardless of the configuration of instruments, will calibrate correctly and allow all developed test programs to perform successfully.

DTI Testing Summary

WesTest and Teradyne worked together to test and verify that the DI-series instruments were a suitable replacement to the M910 DTI system in the WT-2000/DATS Test System. Extensive testing was performed on a number of assets to ensure that the USAF current CPIN test programs were compatible and executed without any modifications to the existing CPIN TPS software. During this testing and verification, some minor issues were identified and corrected in either the Teradyne DI software or WesTest's Test Executive. Only one problem regarding the external clock was identified that required a hardware change to the DI Utility card P/N DI-050-31. Teradyne is working on a solution, and we expect an update shortly that will resolve this issue.

One other issue is the self-test execution times on the Di-series are longer than expected. Teradyne is currently investigating this issue and is committed to resolving these issues, as well as any future issues that may arise.

Upon completion of the DTI testing, WesTest continued to test and verify the non-DTI alternate instruments. During this time, Teradyne implemented a hardware change to the utility card and provided

updated firmware for the channel cards that resolved the external clock issue identified above. An official software update from Teradyne will be released soon. Updates were also provided to address multiple process executions and excessive self-test execution times.

At this time, all issues identified during the DTI testing have been resolved pending official software updates. WesTest and Teradyne have a good working relationship and we will continue to support USAF F-16 DATS programs for any Di-Series issues that may arise in the future.