Modernizing Military Flightline Test Sets With the MTS-207 Ultra-Rugged Test Platform

Author: Loofie Gutterman, President of Marvin Test Solutions
Industry: Military/Aerospace
Application Area: Flightline Avionics Test
The Challenge
Modernizing the automated test equipment for the A-10/C Thunderbolt II fighter so that it can fully support testing of the warfighter’s newly upgraded digital avionics.

The Solutions
Developing the PATS-70 by using Marvin Test Solutions’ MTS-207, a next-generation, portable, ultra-rugged PXI-based test platform, and by leveraging MTS’ unique domain expertise and COTS instrumentation.

Updating the A-10/C’s Flightline Test Set
The A-10/C Thunderbolt II, also known as “Warthog,” is the premier attack aircraft used by the United States Air Force (USAF) for close air support. In 2008, this aircraft received upgraded digital avionics and precision weapons capabilities, and was given the new designation “A-10/C.” However, the A-10/C’s flightline tester – the Portable Automated Test Set-30 (PATS-30) – was not updated along with the aircraft, requiring flightline maintenance personnel to employ multiple test sets to maintain the latest A-10/C model.

Faced with the PATS-30’s obsolescence, the A-10 Systems Program Office (SPO) needed a modern replacement. Consequently, the A-10 SPO turned to the 309th Software Maintenance Group (SMXG) at Hill Air Force Base to develop a solution that would meet the aircraft’s requirements.

To ensure program success in the shortest possible time, the 309th SMXG called upon Marvin Test Solutions (MTS) for assistance. Based on its domain expertise and specific experience in providing flightline test solutions for maintenance, MTS was awarded a $5.7 million contract to provide test platforms based on its MTS-207 flightline test set. The 309th SMXG chose MTS because it was the only qualified supplier with a MIL-SPEC COTS test platform that could be customized for the PATS-70, the A-10/C’s next-generation flightline test system.

“By using our military specification, COTS, ultra-rugged test set that is the workhorse for many of our turnkey systems used in more than 15 nations’ militaries, we were able to create a solution for the USAF that allows their test engineers to rapidly develop and qualify a system to test the A-10/C avionics and electronics,” said Major General Steve Sargeant, USAF (Ret.), and CEO of Marvin Test Solutions.

PATS-70 Test Capabilities
The PATS-70 is an automatic test system designed to perform functional tests on the Fairchild Republic A-10C Thunderbolt II’s Anti-skid, Alpha Mach, Stability Augmentation System (SAS), and Fuel Quantity Indicating Systems. The test system provides the logic and hardware control necessary to coordinate and automate control of these system functions. An automated, user friendly, state-of-the-art adaptable test set, the PATS-70 provides robust system diagnostic capability and significantly reduces the time required to bring an aircraft into mission ready status.

The A-10 Aircraft Operational Test System (OTS) consists of a PATS-70 test set and the Operational Test Program (OTP). The OTS performs maintenance activities as well as troubleshooting avionics system faults while the aircraft is on the ground. The PATS-70 utilizes up-to-date, sustainable technology including Operational Flight Program (OFP) software loading and diagnostic avionics system testing as well as supporting additional test programs, enhancing its capabilities while decreasing the A-10 maintainability footprint. By automating and consolidating multiple test capabilities into one, mission ready test set, the PATS-70 offers enhanced combat effectiveness and efficiency for maintainers.

Organically developed using COTS components and industry standard software, the PATS-70’s modular design meets the functionality and environmental requirements for supporting the A-10, as well as offering expansion capabilities. The PATS-70 replaces over a dozen pieces of obsolete and unrepairable flightline support equipment. Additionally, the PATS-70 provides flexibility over other test sets since the software architecture was uniquely designed.
to simplify the addition of new Test Program Sets (TPSs) to support the war fighter’s needs. And with a hardware architecture based on PXI, the PATS-70 has the flexibility to add additional COTS PXI components, supporting future TPS development. With thousands of PXI cards available today, the Air Force has a test platform with the necessary flexibility to tackle a multitude of test requirements and applications.

Making Test Easy with Military-Qualified Products

MTS specializes in creating customized test systems based on its own military-ready, aerospace-quality products that accelerate design time and ensure support for systems’ long life cycles. Therefore, the PATS-70 was built on the MTS-207-3, a state-of-the-art, ruggedized, portable PXI-based platform designed for flightline, back shop, and airborne applications. Its MIL-STD-810G-compliant PXI chassis provides 14 slots that give the USAF the necessary flexibility to add a specific mix of test instrumentation, such as GX6315 and GX2065 PXI cards.

The PATS-70’s current configuration includes the following key components and capabilities:

1) Portable Automated Test Station, MTS-207-3 chassis - The Internal Chassis Assembly is the main assembly of the MTS-207-3 and is suspended via four (4) shock absorbers from the top panel, protecting internal electronics. The Internal Chassis Assembly accommodates all the MTS-207-3 electronics. Its main assemblies are the PXI card cage, and the Power Board circuit card assembly (CCA). The Power Board provides all required PXI chassis power rails as well as additional supplies required for the operating of the display and peripheral PATS-70 equipment. Additionally, the Power Board provides control over the MTS-207-3 heaters, allowing operation at extreme low temperatures. The EMI Filter protects the MTS-207-3 from power surges and eliminates conducted emissions, to ensure compliance with MIL-STD-461 requirements.

2) User Interface Display (Tablet) - A modified Miltope RTCU-2 tablet computer is used as the operator console. The tablet is powered by a 1.06 GHz Intel Core i7-620UE processor with 4MB L2 Smart Cache and 8 GB of RAM. It is dock mounted or extended on the supplied user interface cable. The government modification of the tablet allows for external connection utilizing reliable MIL circular connector technology.

3) Removable Solid State Drives - The removable storage device is a minimum of 120 GB solid state drive (SSD); it is mounted inside the case via a drive slot on the face of the chassis, or stored in the engineering panel cover. It is configured with Windows XP or Windows 7 OS and allows integration of classified software when required.

4) Controller CCA - The controller utilizes a 2.53 GHz Intel Core i7 processor with 4GB Random Access Memory (RAM). Utilizing the rear transition module, this CCA has four Gigabit Ethernet ports, two VGA ports, five USB ports and two RS232 ports, in a 6U cPCI module.

5) GX6315 45 Relay Form C CCA - The Form C relay matrix is a 6U PXI module and provides high current switching requirements. The module includes 45 single pole double throw Form C relays with 7A contact rating per channel.

6) 8x132 2AMP Relay Matrix CCA - This is a very high density electro-mechanical relay matrix with a 132x8 format and 1 pole switching. The matrix is constructed using high reliability 2A electro-mechanical relays with long life and...
stable contact resistance and is a single slot, 6U PXI module.

7) 1553 Communications CCA - The communications card is a 3U PXI module and supports up to 4 dual redundant 1553 channels. Each channel operates simultaneously as a bus controller, bus monitor and remote terminal.

8) GX2065 Digital Multi-Meter (DMM) CCA - The 6.5 digit multimeter is a 3u PXI module and is capable of true AC RMS measurements from 10Hz to 100 KHz, voltage measurements from 1uV to 330V, and frequency counting from 1Hz to 300 KHz. It features a 3 MHz digitizer not offered by other DMMs, and unlike other PXI DMMs, is capable of operating accurately over a wide temperature range. The DMM supports Volts DC, Amp DC, Two-Wire Resistance, Four-Wire Resistance and Frequency measurements.

9) Small Computer System Interface (SCSI) CCA - A single channel SCSI interface, supports up to 320MB/s throughput; it is backwards compatible with ultra2 SCSI and is a 3U PXI module.

10) Differential Oscilloscope CCA - A 2 channel 14 bit resolution, 300MHz bandwidth digitizer features a maximum sample rate of 400MS/s and is a 3U PXI module.

11) Arbitrary Waveform Generator (ARB) CCA - A 2 channel, 14 bit resolution, 50 MHz bandwidth waveform generator features a maximum sample of 200MS/s and is a 3U PXI module.

Using the MTS-207 in conjunction with COTS instrumentation to build the PATS-70 significantly simplified the USAF test engineers’ time and effort, allowing the 309th SMXG to focus on user interface and test program software development, expediting the fielding of the A-10/C flightline avionics test system.

**Making Test Easy with Mil-Spec COTS Systems**

After the selection of the MTS-207 platform and its instrumentation modules, MTS engineers worked with the 309th SMXG to customize the MTS-207 chassis. MTS modified the basic design of the MTS-207 to meet the A-10/C’s unique avionic requirements. A typical MTS-207 is provided with an industrial touchscreen display or industrial laptop, but the USAF needed a removable tablet for remote control of the test system from inside the aircraft. Therefore, MTS engineers designed and built a special tablet docking station with a slot for a removable solid-state disk (SSD).

To accommodate the need for a custom front panel with unique connectors and interfaces, MTS further customized the MTS-207 by changing the orientation of the tester from horizontal to vertical and integrating a folding stand into the case that allows the unit to be tilted back, enhancing usability on the flightline.

In addition, MTS assisted with the ruggedization, testing, and qualifying of non-MTS instruments that the USAF selected for the PATS-70. This provided the customer with the assurance that the PATS-70 would operate flawlessly during and after the qualification test.

By trusting in MTS’s domain expertise and ability to create custom solutions that meet the customers’ requirements, the USAF’s 309th SMXG test professionals were able to streamline many aspects of the project that would otherwise have been difficult, expensive, and lengthy.

**Meeting Customer Needs in Record Time and On Budget**

“We were able to significantly reduce the fielding time of this mission-critical test set to the A-10/C community,” said Major General Sargeant. “The new PATS-70 is a high-performance flightline test set in a portable, ultra-rugged deployable chassis, and allows the A-10/C maintenance community to fully test the A-10C’s critical systems while minimizing logistics and simplifying operation.”

The PATS-70 test set allows the A-10/C maintenance community to fully test the fighter’s avionics with modern equipment, minimizing logistics and simplifying operations. The PATS-70 packs a high-performance flightline tester into a portable, ruggedized system. By using a Mil-Spec, commercial platform based on PXI instruments and software, the 309th SMXG and MTS were able to develop and qualify the system in record time while saving money over the initial budget estimates. With its modular architecture, the PATS-70 can easily be enhanced to support additional USAF test requirements including the A-10/C’s armament and weapons systems.