USING COMMERCIAL-OFF-THE-SHELF (COTS) PRODUCTS IN THE DESIGN OF MISSILE FLIGHT-QUALIFIED HARDWARE

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ABSTRACT

During these times of acquisition reform in the federal government, various missile systems are being forced into using Commercial-off-the-Shelf (COTS) products in the design of their subsystems. However one problem that this presents is the lack of configuration management. There is a concern that the manufacturer will modify the product without informing the end user. This may have a severe effect on the performance of an already flight qualified subsystem. An example of how one program is dealing with this issue will be discussed.

KEYWORDS

Antenna, coupler, certification, testing, telemetry

INTRODUCTION

Currently the JAMI (Joint Advanced Missile Instrumentation) Program is using a GPS Receiver in the design of a tracking system for airborne vehicles. Due to limited funding and resources, the GPS Receiver is a COTS item. During the course of development, several questions and concerns arose. How will the traditional reliability analysis be performed? How will the configuration management of the item be controlled? (e.g. How is the modification/upgrade of parts used on the receiver controlled?) These questions will be addressed and one possible solution to these problems will be discussed.

BACKGROUND

What is JAMI? JAMI is a Tri-Service CTEIP (Central Test and Evaluation Investment Program) that has been chartered to investigate GPS Tracking Systems into airborne vehicles for TSPI (Time, Space, Position Information), Scoring, and Flight Termination purposes. It is a “Proof of Concept” Program and part of it will demonstrate the integration of GPS as a means of tracking on the Test Ranges. In order to accomplish this, COTS GPS Receivers are being used in the GPS tracking systems. Currently, receivers from Ashtech and Parthus are being considered.

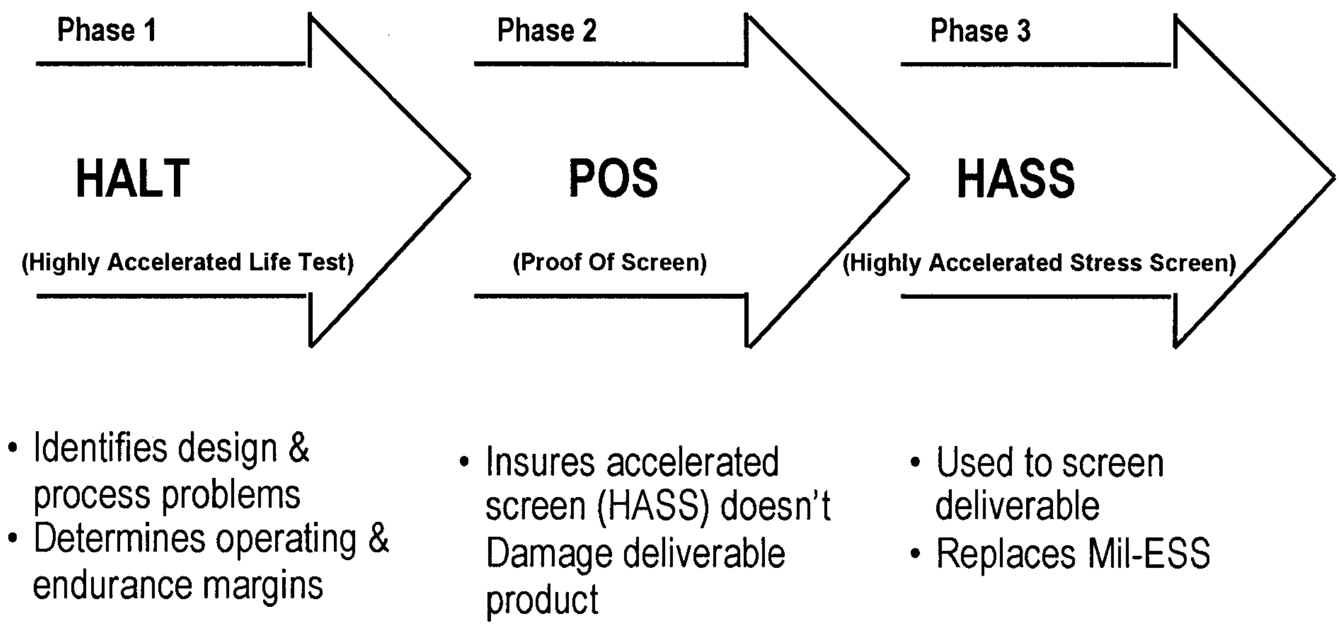
TRADITIONAL RELIABILITY METHODS

Traditional reliability analysis on airborne systems consists of Parts Stress Derating and MTBF (Mean Time Between Failures) calculations. However this analysis requires that the manufacture divulge the parts list of every component used in the construction of the receiver. This is not always possible due to the fact that manufacturers may be unwilling to provide this information (this is similar to asking a chef or baker to divulge the ingredients that comprise their award winning creations). The parts stress derating analysis, which is usually a portion of all product item specifications, cannot be performed without the parts list. ESS (Environmental Stress Screening) is usually performed, however it may not truly gauge how reliable the unit will be in actual use. Also, it is not uncommon for a COTS vendor to change some parts in order to upgrade and modernize their product. How can one be certain that an already flight qualified product will continue to meet specification?

NEW RELIABILITY METHOD

Parts of Reliability, mainly Parts Stress Derating Analysis and ESS Testing, can be eliminated in favor of HASS (Highly Accelerated Stress Screening) Testing.

What is the HASS Process and how does it address the reliability and configuration management issues? The HASS process provides increased effectiveness of screening out latent product defects. It also provides a substantial reduction of field failures as well as screening times versus ESS testing. This can prove to be a significant cost savings to any project in repair costs and production testing.



The HASS Process is broken down into three phases (HALT, POS, & HASS). In Phase 1, HALT (Highly Accelerated Life Test) is performed. This test identifies design and process problems and determines operating and endurance margins. Therefore the receiver is usually tested until failure occurs. The parameters tested are High and Low temperature, Thermal cycling with voltage cycling, Random six DOF (degree of freedom) vibration, and lastly combined Thermal cycling with vibration.

After the operating and endurance limits have been established, Phase 2, POS (Proof of Screening) is begun. The main purpose of this stage is to ensure that the useful life of the receiver has not in any way been degraded. First of all, a HASS screening criteria is determined based on the results of the HALT process. These criteria must be severe enough to screen out latent failures, however not too,severe as to create destructive failures. A sample POS scenario is as follows. Two rounds of thermal cycling with vibration (called the regimen) are established, using the established HALT levels. The receiver is subjected to this screening regimen ten (10) times. It is then subjected to selected Qualification Test Environments. These POS levels will later become the levels used for HASS acceptance testing provided the following: All failures occur in the first application of the screening regimen- No failures occur in the next nine applications; No failures occur at qualification test environments. If any of these three criteria are not met, the POS levels are modified until the criteria are met. The final POS levels

(HASS Limits) are usually 80% of the operating temperature limits (high and low) and 50% of the endurance vibration limits determined in the HALT Phase. It should be notes that these levels are usually more stringent than the ones established in the Product Item Specification.

In Phase 3, HASS is used to screen all deliverable products. It replaces Mil-ESS (NAVMAT P-9492) Testing and like ESS is performed on all units. Its' main objective is to ensure that any latent defects are detected. The HASS process is performed at the circuit card assembly (receiver) level as well as the box level. It should be noted that HASS requires two operating cycles of combined temperature and vibration, with the stress levels defined by HALT and confirmed by the POS process.

CONCLUSIONS

HASS has been discussed as a new method for determining the reliability of a COTS GPS Receiver. It eliminates the need for the traditional Parts Stress Derating Analysis and ESS Testing. Since manufacturers of GPS Receivers are constantly upgrading them to reduce their size as well as increase their tracking capability, HASS provides an economic process to verify that the receiver will still meet specifications without incurring the expense of flight requalification.

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