

Transition

SBIR Topic Number:
 AF 01-296

An example of Air Force supported SBIR technology that has been transitioned into an Air Force or other DoD system or subsystem or used by Air Force test ranges and facilities or maintenance depots.

SBIR Title:
 Tracking Current Flow Through Units Under Test

Contract Number:
 Phase I & II
 FA2650-02-C-0081
 Phase III
 FA8201-06-C-010

Contract Title:
 Intermittent Fault Detection and Isolation System (IFDIS)

SBIR Company Name:
 Total Quality Systems Inc., Ogden, UT

Technical Project Office:
 AFRL/ 00-ALC/LHH,
 Hill AFB, UT

Air Force Transition Office:
 Ogden Depot,
 Hill AFB, UT



Intermittent Fault Detection and Isolation System (IFDIS)

Developed to Isolate Problems In Avionics Equipment

- Intermittent faults in electronic equipment is a growing and costly problem for the Air Force
- Substantial cost savings and more reliable testing will result from this SBIR project
- With support from the Air Force SBIR Program a tool was developed to isolate intermittent faults in avionics Line Replaceable Units (LRU) circuit connections and wiring

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DISTRIBUTION A:
 Approved for public
 release; distribution
 unlimited.

Air Force Requirement

Intermittent faults are a growing problem in electronic equipment and the government experiences their share of this phenomenon. As integrated circuits (ICs) and other electronic discrete parts become increasingly capable and reliable, an ever growing portion of the electronic equipment maintenance problems encountered are not caused by component failure, but rather continuity problems between the electronic piece parts, or continuity between the piece parts and other electronic boxes or devices. When the discontinuity is consistent (referred to as a "hard failure"), it is not usually difficult to isolate and repair. However, often the discontinuity is of very short duration, manifesting itself only during stress situations such as high G loading, vibration, thermal extremes, or some combination of stresses. These intermittent discontinuities can be extremely difficult to identify and isolate. Many times the intermittent open circuit will manifest itself during an initial troubleshooting test, such as in the electronic back shop of an Air Force flying wing, but by the time the equipment item has been transported to an Air Force Depot for repair, the intermittent circuit is no longer open. This results in "No Fault Found (NFF)." The NFF rate is increasing for many Government electronic equipment items, especially in aging weapon systems. A common rule-of-thumb for older aircraft is that 50% of all pilot-reported aircraft system malfunctions which occur in the air go undetected during follow-on ground testing. These equipment items with documented in-flight failures, operate properly, or NFF, during post-flight testing, and thus the problems remain as undetected, un-repaired latent defects. The unit is placed back into service, repeatedly wasting maintenance and operational resources. NFF resulting from age-induced intermittency is now one of the biggest aircraft maintenance cost drivers today.

SBIR Technology

Total Quality Systems, Inc. won SBIR contracts to investigate how using test current measurements could augment traditional testing methods for F-16 avionics equipment. After investigating several approaches involving non-intrusive, intrusive, and neural network techniques, a tool was identified which could isolate intermittent faults in avionics Line Replaceable Unit (LRU) circuit connections and wiring. This tool uses current measurements and an analog neural network system to concurrently and continuously monitor hundreds of circuit paths and detect intermittent faults as short as 320 nanoseconds in duration. The company received a Phase III SBIR contract to refine a prototype IFDIS test bed system, ultimately resulting in production-delivery of two fully functional IFDIS units.

Potential Air Force Impact

For the F-16 Weapon System, Air Combat Command (ACC) pays the Air Force Material Command (AFMC) Ogden Depot an "exchange cost" to exchange failed F-16 electronic boxes for repaired and fully operable boxes. Many of the "failed" electronic boxes end up testing NFF at the depot and are subsequently turned right around and returned to ACC as fully operable boxes, because the depot is unable to detect a problem in these boxes with the test equipment currently available to them. The exchange cost for F-16 avionics boxes that test NFF on the depot testers is over \$13,000,000 annually. Not only do these expended funds accomplish nothing useful, but the electronic boxes experience the needless "wear and tear" of being shipped from the field to the depot and back again. A substantial share of these inconsistent test results, or NFF activity, is attributed to intermittent circuits.

With the IFDIS, the depot will have a tool that fills a serious test void. The IFDIS will provide a repeatable and vigorous test scenario, leading to high confidence that the circuit intermittencies will be detected and isolated, enabling subsequent repair. Repairing an intermittent circuit is not usually difficult; it is detecting and isolating the intermittency that presents the challenge.

Company Impact

"The product development of the Intermittent Fault Detection and Isolation System (IFDIS), being funded by this Phase III SBIR, promises to provide a breakthrough in resolving a major problem of diagnosing faults in aging aircraft avionics. The No Faults Found (NFF) problem is complex, multifaceted and a major consumer of operational resources in aging aircraft fleets. Preliminary results from very complex avionics boxes indicate that the IFDIS will help reduce a substantial portion of the NFF problem. Any significant contribution that reduces the chronic NFF problem should create a market for this type of testing services as well as for turn key IFDIS test systems. We are confident that IFDIS will at least help the Air Force reduce its avionics maintenance costs for aging aircraft fleets. Our sustained company growth reflects the return on investment that we have provided the Air Force over the past ten years."

Tony Pombo
President
Total Quality Systems, Inc.



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SBIR/STTR

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