

# Portable Intermittent Fault Detector™ (PIFD-512™)

C-130 EHSI Cable Harness

## Test Summary



**Prepared and Submitted by:**

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## Introduction:

The Lockheed Martin (LM) / Universal Synaptics (USC) Team performed the testing on the C-130 EHSI wiring cables at NAS Joint Reserve Base ██████████ utilizing the following equipment:

- Portable Intermittent Fault Detector™ (PIFD™) the test was conducted with a 512 version of the test set – NSN:6625-01-696-1235
  - Two PIFD Interface Test Adapters (ITAs) to electrically connect the PIFD to the EHSI wiring harnesses
  - A handheld vibration tool to stimulate the wiring harnesses during PIFD testing
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## Location:

- NAS Joint Reserve Base ██████████ hangar bay

## Background:

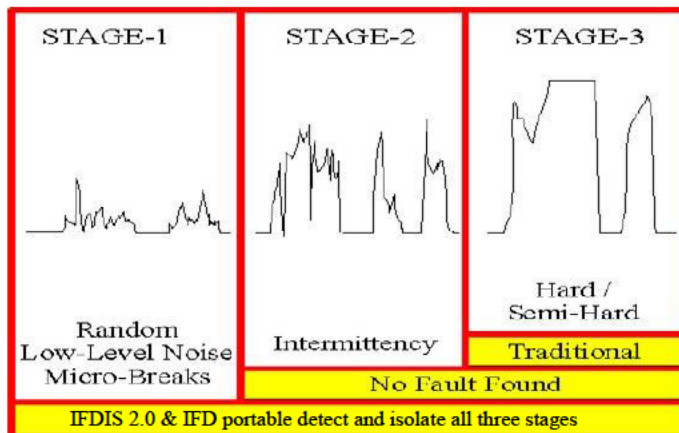
The C-130 (tail number ██████) EHSI wiring harness was selected by ██████ leadership due to repeated intermittent functionality complaints during flight operations. ██████ maintenance teams have been chasing this problem for the last 11 months. Conventional single-circuit test equipment and troubleshooting methods have been proven by ██████ maintenance teams insufficient to remediate this long-standing A-799 cannot duplicate (CND) issue. The aircraft regularly passes ground tests but continues to fail during flight operations.

The use of PIFD will significantly reduce the time to troubleshoot in-flight discrepancies once on the ground. Conventional test equipment was developed to find open circuits and short circuits in a static environment. The PIFD has these conventional test capabilities, however, the PIFD is the only objectively proven to reliably detect and isolate intermittent faults.

Testing was conducted in situ. USC and LM arrived with the PIFD test set and C-130 EHSI ITA cables. No tech pubs, wiring schematics, or other maintenance or aircraft data was provided to the LM / USC team. No Test Program Set (TPS) or AutoMap™ was developed before arrival on 22 February 2024 to demonstrate the PIFDs AutoMap™ capability, ease of use with minimal training, and advanced diagnostic capability.

## IFD Test Procedures

1. **AutoMap** – discovered the as-wired configuration
2. **Continuity** – tests for open circuits and measured resistance against established AutoMap baseline (open circuits / high resistance tests)
3. **Shorts** – provides shorts indication and shorts tracing
4. **Intermittence** – monitors all circuits simultaneously and continuously to detect and isolate all *Three Stages of an Intermittent Fault (Figure 1)*
5. **Fault Isolation** – detected intermittent faults through programmatic isolation



**Stage 1** – random low-level nanosecond micro-breaks, likely not operationally evident yet, but on curve of degradation to become Stage 2

**Stage 2** – intermittent failure evident to pilot in operation, reported to ground crew, passes ground test, and labeled No Problem Found (NPF). On curve of degradation to become Stage 3

**Stage 3** – semi-hard or hard failures, Automatic Test Equipment (ATE) and troubleshooting tools, such as DMMs, designed to detect hard faults (open circuits or shorted circuits)

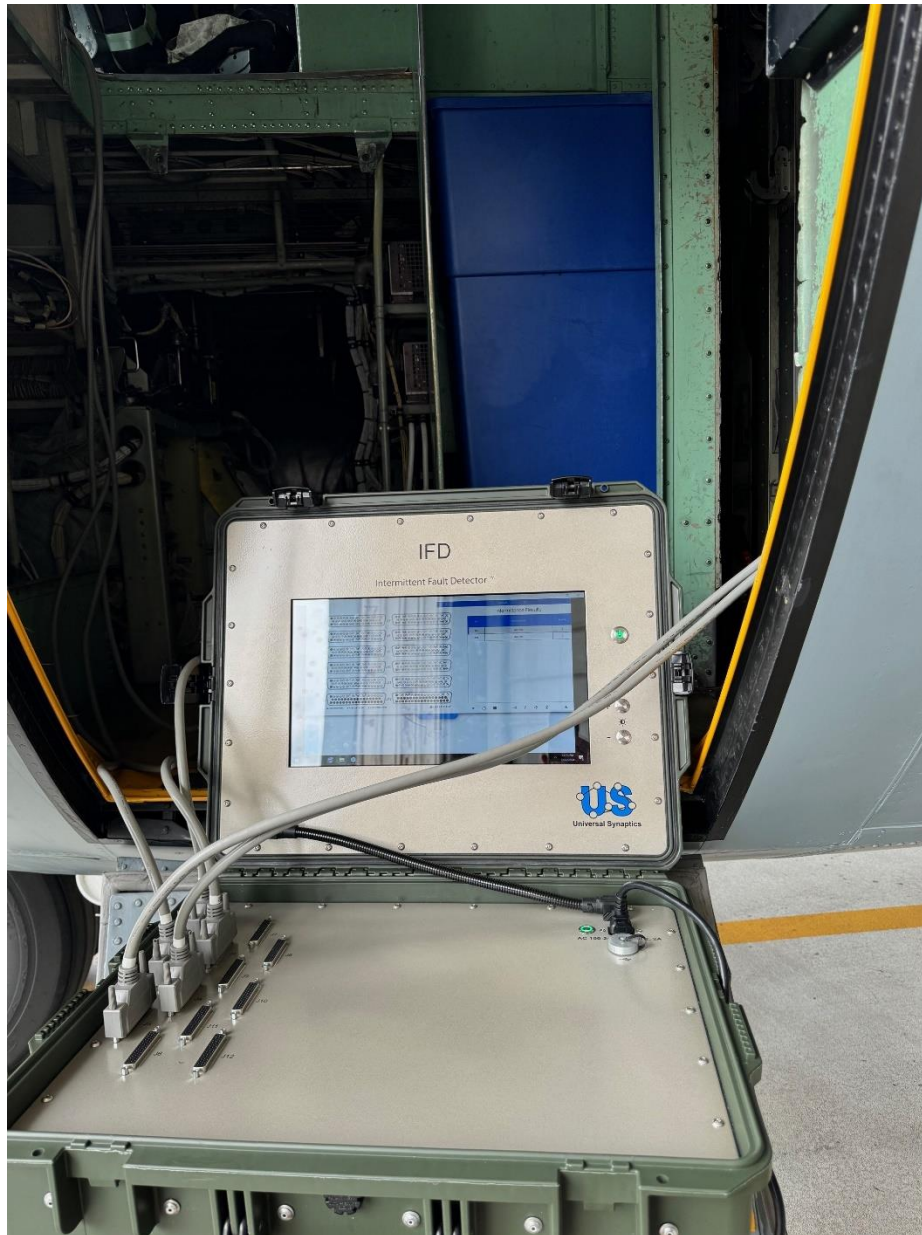


Hector Knudsen, Universal Synaptics' Principal Engineer provides [REDACTED] personnel with a quick walk-through of the PIFD test capabilities before testing begins

## Test Procedures:

Test:

1. **AutoMap™** – discovered the as-wired configuration of the wiring harness. This step took approx. 60 seconds to complete. No information was entered into the PIFD to demonstrate the time savings provided by utilizing AutoMaps' artificial intelligence, and machine learning process.
2. **Continuity** – tested for open circuits and measures resistance against established AutoMap baseline (open circuits / high resistance tests)
3. **Shorts** – provided shorts indication and shorts tracing
4. **Intermittence** – monitored all circuits to detect and isolate intermittent faults
5. **Fault Isolation** – programmatic isolation of detected intermittent faults



PIFD is connected to the C-130 EHSI wiring harnesses.

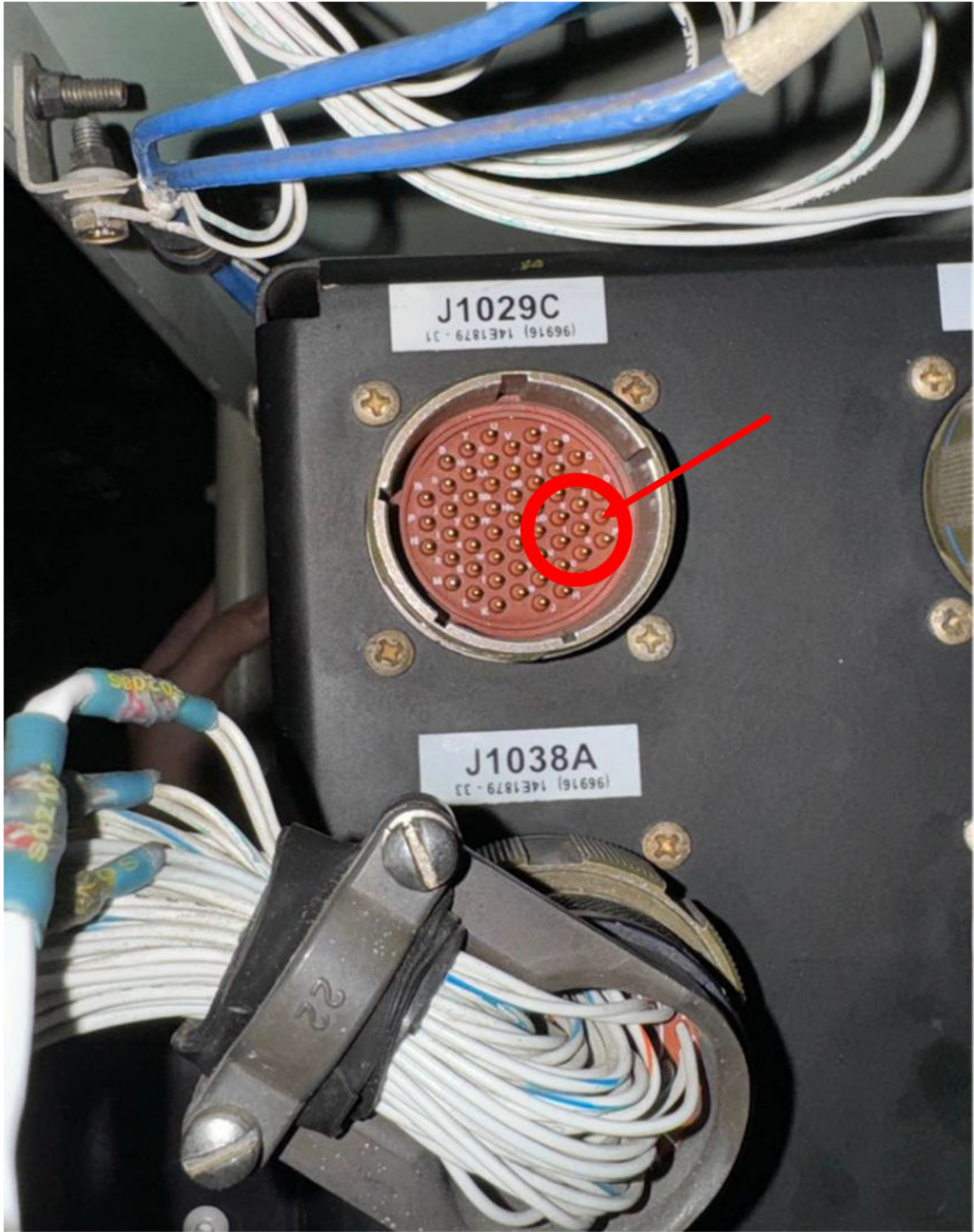
## Results: C-130 EHSI Wiring Harness

### Test #1:

1. Automap discovered that the junction box harness cannon plug connector two is not connected to the cockpit portion of the EHSI wiring harness.
2. ITA connector was moved to connector one and re-mapped. Automap discovered all connections in less than one minute.
3. Continuity testing conducted – no open circuits present in the wire harness
4. Shorts testing conducted – no short circuits were present. During this portion of the test VR-54 maintenance personnel informed the LM / USC team that they had repaired two shorted wires before PIFD testing. The PIFD confirmed that this repair action was successful.
5. Intermittence testing conducted - light vibration was applied via a handheld vibration tool. VR-54 maintenance personnel utilized the vibration tool starting at the LRU connection point from the left to the right across the wiring bundle into the upper section to the termination in the bulkhead.
  - o Intermittent fault was detected on J4 Pin 36 traced to "little m"
  - o This was taken to root cause utilizing the PIFD and the schematics on the female connector side (nomenclature "little m") to the signal "Compass Synchro X" on the HSI
  - o A recessed connector receptacle was discovered on the mating connector



Intermittent fault detected by the PIFD due to a recessed connector receptacle (Pin 36, "little m")



A slightly bent, loose pin 36 on the LRU side caused the recessed connector receptacle that was intermittent during PIFD testing

## Test #2:

█████ Maintenance personnel replaced the slightly bent pin 36 on the LRU side of the connector and repaired the cannon plug recessed receptacle “little m”.

1. Continuity testing conducted – PASSED.
2. Shorts testing conducted – PASSED.
3. Intermittence testing conducted – PASSED.
4. █████ will power up, ground test, and flight test within the coming days/weeks.

## Observations:

- Conventional single-circuit scanning test sets, digital multi-meters, and functional ATE are limited and were not designed to find intermittent faults detected and isolated by the PIFD
- The LM / USC team collaboration with █████ contributed to the overall success of the PIFD technology demonstration.
- This project started on 29 January 2024, resulting in PIFD ITA parts being ordered, and manufactured, with testing taking place on 22 February 2024 – less than 30 days.
- The █████, LM, and USC teams began the testing project at 0845, AutoMapped, tested, repaired, and retested completing all test and repair tasks at 1150.
- User feedback:
  - ✓ easy to hook up and press start on the screen and watch for the results
  - ✓ testing aircraft wiring modification programs would quickly ensure wiring system install alignment with design integrity, replacing pin-by-pin labor-intensive time and expense
  - ✓ this tester will save us a lot of time
  - ✓ The test report is simple and easy to read



█████ artisan takes intermittent fault to root cause.



## **Summary:**

Universal Synaptics' patented Intermittent Fault Detection technology has proven to increase aircraft availability and reliability. As proven by this demonstration, the PIFD once implemented will increase the reliability of C-130 aircraft wiring systems by ensuring open circuits, shorted circuits, and intermittent circuits are rapidly identified in wiring harnesses installed on C-130 aircraft (breaking the cycle of No Fault Found and A-799 Cannot Duplicate). The PIFD is wholly agnostic and can be utilized on any / all aircraft wiring systems and subsystems.

The ability to detect and isolate intermittent faults in wiring harnesses and resolve problems instead of No Fault Found (NFF) and A-799 Cannot Duplicate (CND) test scenarios (on tails which are commonly measured in months). This outcome will save the Navy unnecessary expenses associated with troubleshooting wiring harnesses with conventional test methods and equipment. Reductions in CND / NFF, root cause failure data, and accurate repair have proven to significantly increase aircraft readiness in every instance where the PIFD has been applied.