Universal Synaptics

Intermittent Fault Detector™ (IFD-256™)

F-16 Nose Landing Gear (NLG)

Wiring Harness

Test Summary

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29 June 2020

F-16 NLG Wiring Harness

Introduction:

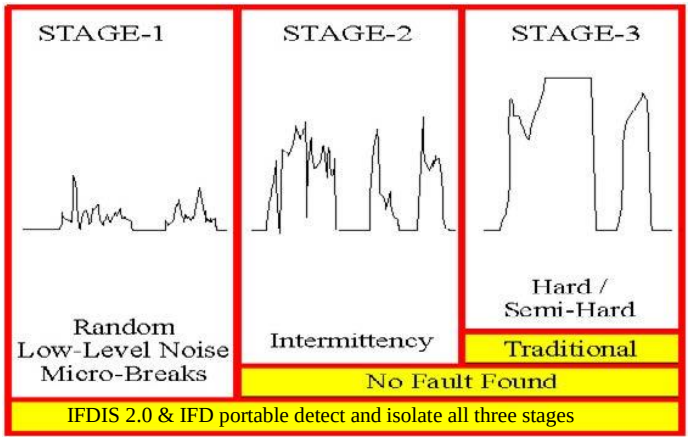
The Lockheed Martin (LM) / Universal Synaptics (USC) Team performed Intermittent Fault Detector™ (IFD™) testing on the F-16 Nose Landing Gear (NLG) wiring harness.

The F-16 NLG wiring harness assembly was selected due to impacts of No Fault Found (NFF) of this critical system and length of time to troubleshoot with conventional test equipment.

Testing was conducted in-situ to demonstrate the advanced prognostic / diagnostic capability of IFD™ technology. USC and LM arrived with the portable IFD™ test set and F-16 NLG Interface Test Adapter (ITA) that was designed, developed, and manufactured by USC. No Test Program Set (TPS) was developed prior to arrival to demonstrate the portable IFDs AutoMap™ capability.

Test Procedures:

1. **AutoMap™** – discovered the F-16 NLG wiring harness as-wired configuration in under two minutes
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 *all three Stages* of intermittent faults (see Graphic 1)
5. **Fault Isolation** – programmatic isolation of detected intermittent faults



Graphic 1 – Three Stages of an Intermittent Fault

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 Trouble Found (NTF) or No Fault Found (NFF). 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)

Results:

F-16 NLG Wiring Harness

Test Date: 29 June 2020

1. IFD-256 Continuity testing conducted – no open circuits present in the NLG wire harness
2. IFD-256 Shorts testing conducted – no shorted circuits were present in the NLG wire harness
3. IFD-256 Intermittence testing conducted – multiple intermittent events detected and isolated in the NLG wire harness (Events Column indicates the number of discrete /intermittent events the IFD test set noted during the test (as short as 50 Nanoseconds)):

IFD Test Point	Nomenclature	Events
74	9154-J561-02	3
97	9154-J531-01	1
98	9154-J531-02	1
73	9154-J561-01	1
67	3251-P1-C	1
71	3251-P1-G	2
76	9154-J561-04	1
66	3251-P1-B	1
53	3251-P1-05	12

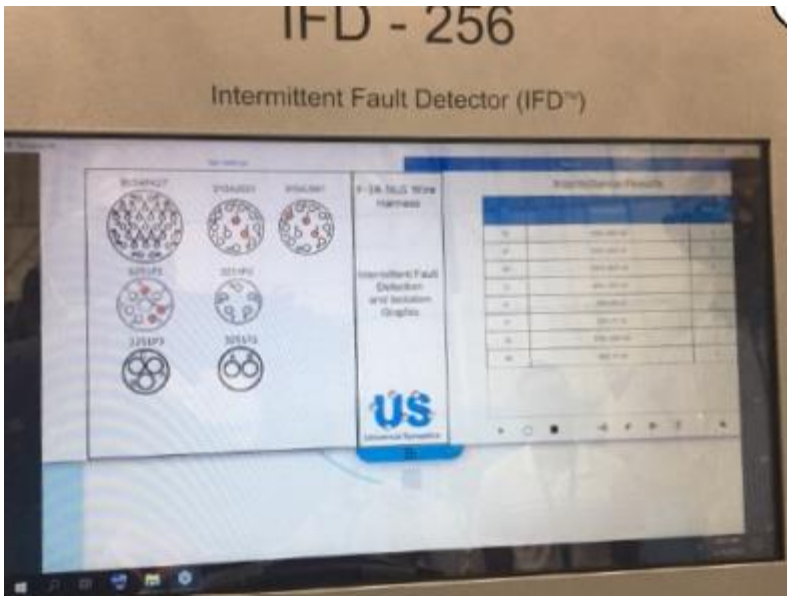
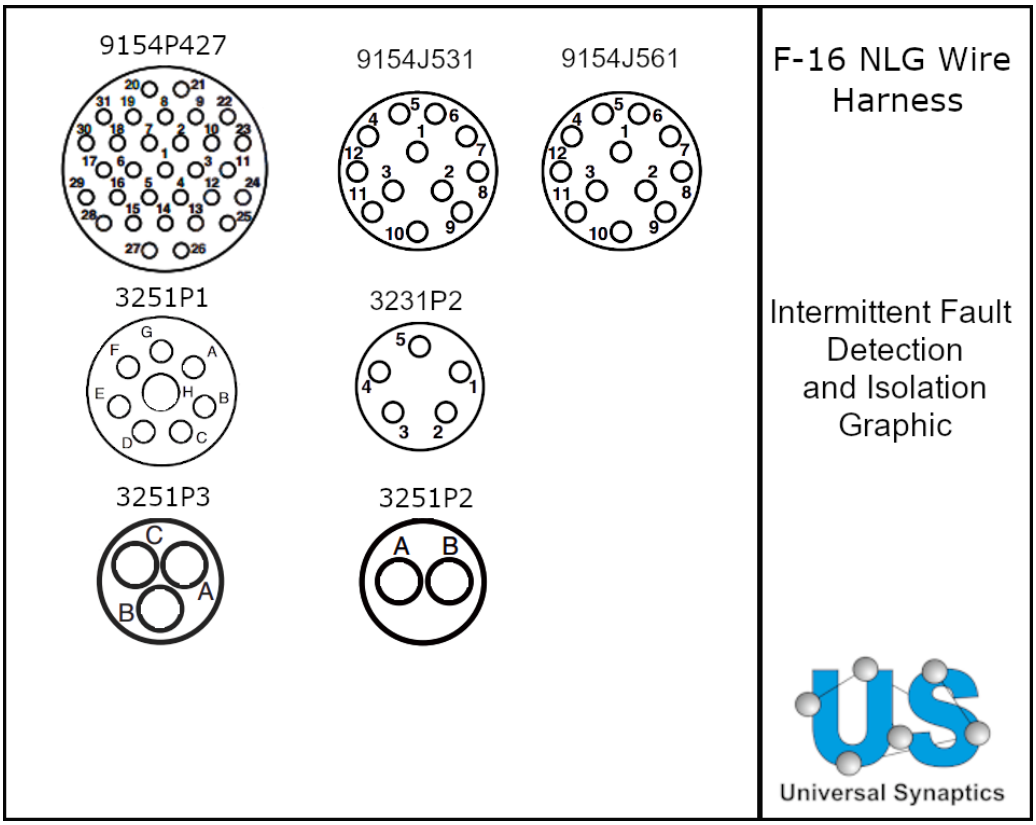


Photo of IFD Test Set Screen during Test – **Red** Pin Indicates Intermittent Event

Graphic 1. Intermittence Test Screen



Graphic 2. IFD Fault Isolation Graphic for the F-16 NLG Wire Harness

Recommendations:

CUSTOMER RECOMMENDATIONS REMOVED

Observations:

- Conventional ATE / troubleshooting tools and techniques are severely limited and did not find the intermittent faults detected and isolated by the IFD
- User feedback:
  - ✓ “super easy to use, hook up and press start”
  - ✓ “clean, smooth operation, very impressive tester”
  - ✓ “IFD test report is simple and easy to read”

Summary:

Universal Synaptics' patented Intermittent Fault Detection technology has proven to increase aircraft component reliability. As proven by this demonstration, the IFD-256 once implemented will increase the reliability of F-16 aircraft wiring systems by ensuring that open circuits, shorted circuits and intermittent circuits are rapidly identified in the wire bundle assemblies / wiring harnesses installed on F-16 aircraft (breaking the cycle of No Fault Found). The IFD is wholly agnostic and can be utilized on all weapon systems.

The ability to detect and isolate intermittent faults in wiring harnesses and components, thus resolving problems instead of No Fault Found (NFF) test scenarios, will save REDACTED unnecessary expenses associated with troubleshooting wiring harnesses with conventional test methods and equipment. Reductions in NFF, root cause failure data, and accurate repair has proven to significantly increase aircraft system readiness.

From time of arrival at the aircraft hangar, electrical hook up, and IFD testing (to include): AutoMap™, continuity testing, shorts testing, intermittent fault detection, and fault isolation was accomplished in less than an hour.

IFD Test Report is attached in Appendix A.

Appendix A

IFD Test Report

Universal Synaptics

Intermittent Fault Detection (IFD) Test Equipment

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Date: 06-29-2020

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Map Group: F-16

Map: NLG Rev 1

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UUT S/N:

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Continuity

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* TPs | Nomenclatures | Expected | Measured | Tol +/- ohms |

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Passed

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*

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Shorts

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* TPs | Nomenclatures | Expected | Measured | Tol +/- ohms |

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Passed

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Intermittence

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*	TP	Nomenclature	Events
*	74	9154-J561-02	3
*	97	9154-J531-01	1
*	98	9154-J531-02	1
*	73	9154-J561-01	1
*	67	3251-P1-C	1
*	71	3251-P1-G	2
*	76	9154-J561-04	1
*	66	3251-P1-B	1
*	53	3251-P1-05	12

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End of Report