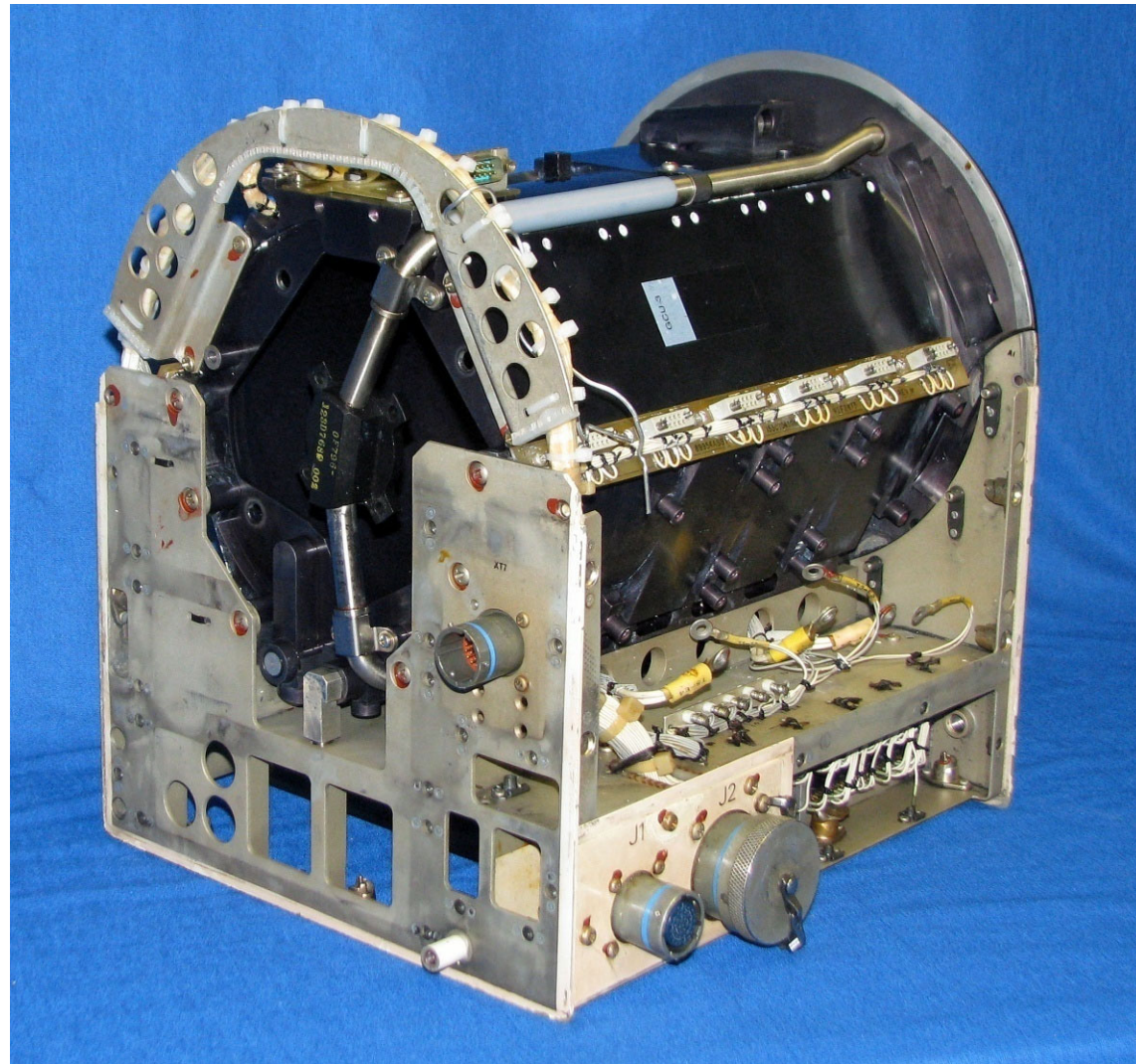




Generator Converter Unit (GCU) Intermittent Fault Detection & Isolation System (IFDIS) Testing

GCU Chassis



GCU Problem

- GCU is the second highest degrader Weapons Replaceable Assembly (WRA) in the United States Navy inventory
- There are intermittent problems in the GCU chassis that the conventional testers cannot find
- A better solution is needed

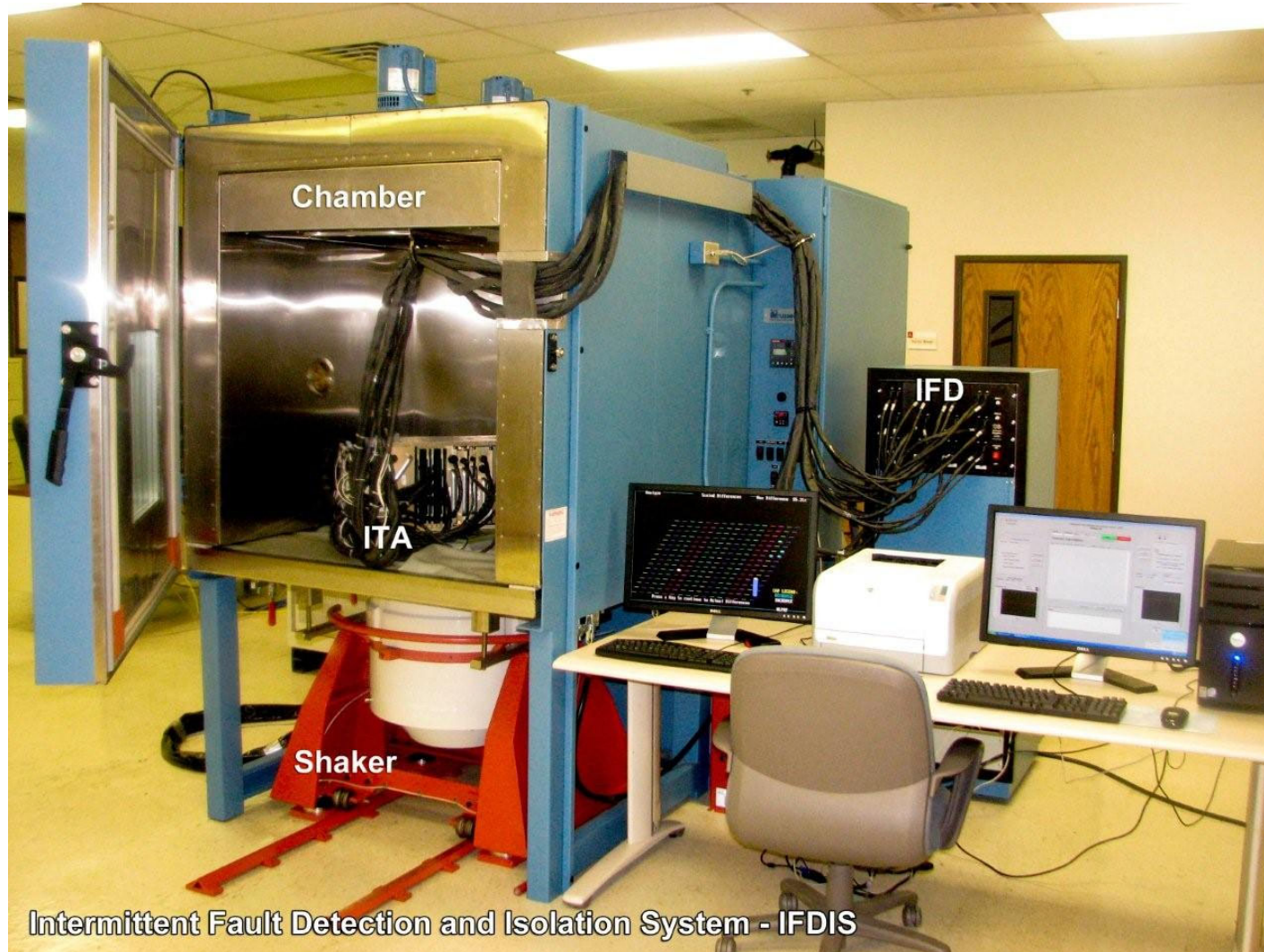
GCU Solution

- Employ a tester specifically designed to detect and isolate intermittent faults
- Repairing an intermittent circuit is not difficult
- The challenge is detecting and isolating the intermittency
- The IFDIS is such a tester
- Currently configured to test chassis wiring

What is the IFDIS?

- Intermittent Fault Detector developed and patented by Universal Synaptics
 - Neural network analog instrument
 - ***Simultaneously*** and ***continuously*** monitors hundreds of circuit paths
 - Detects and records even momentary discontinuities as short as ***50 nanoseconds***
- Shake table
- Environmental chamber
- Interface Test Adaptor (ITA)

IFDIS Configuration

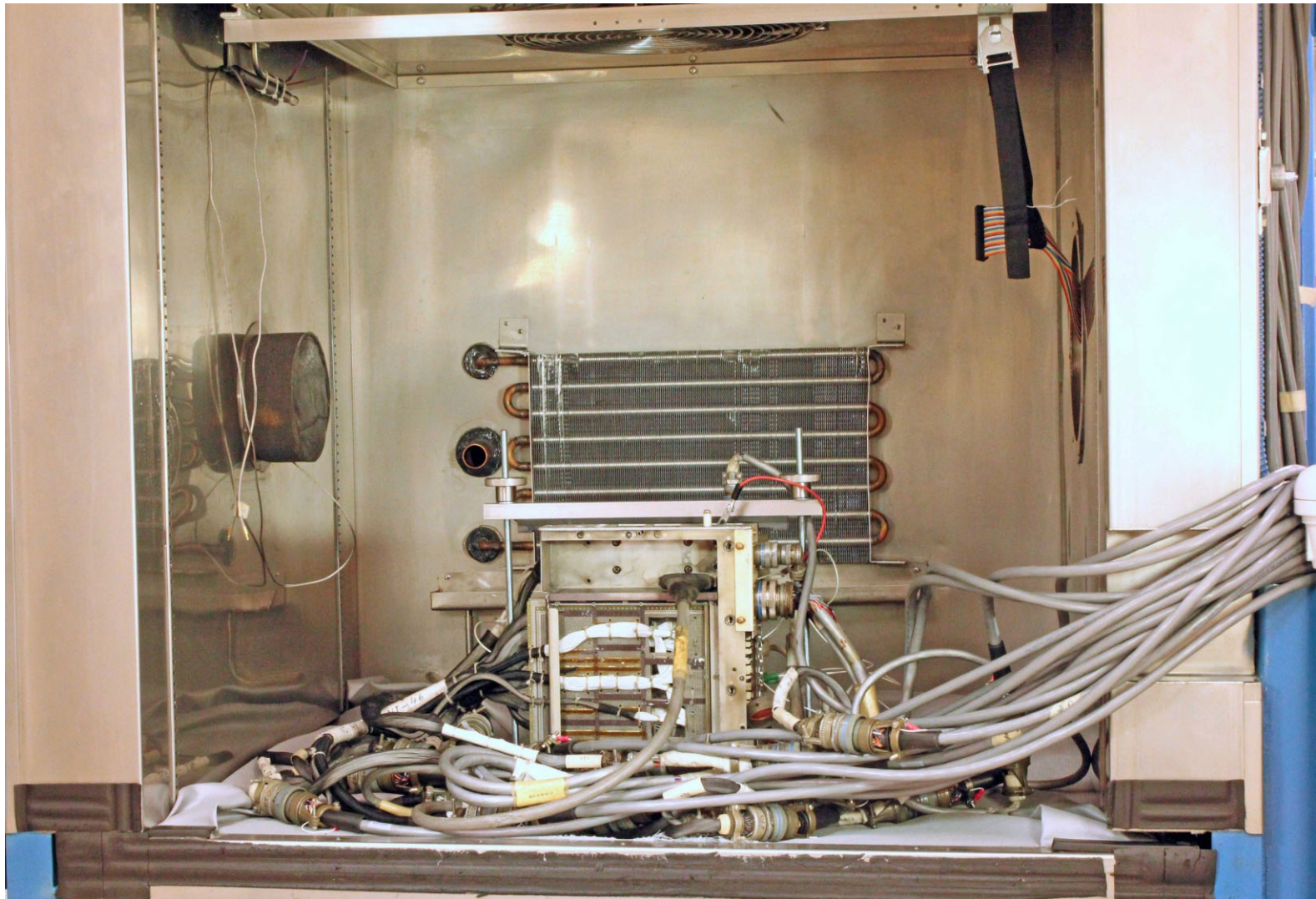


Intermittent Fault Detection and Isolation System - IFDIS

GCU Test Preparation

- Fabricated adaptor cables to interface the Navy provided Interface Test Adaptor (ITA) to the Intermittent Fault Detector (IFD)
- Received ITA and five GCU chassis
- Fabricated GCU hold down adapter
- Studied schematics and identified GCU connector points to load into the IFDIS
- Assembled the system
- Created a Gold map

GCU in Chamber



GCU Tied to IFDIS



GCU #1 (0314) Test Results

- Continuity – Passed
- Shorts – Passed
- Intermittents – Passed
- This was the first unit we received
- May have been a “Gold” chassis
- Used to create the “Gold” GCU file

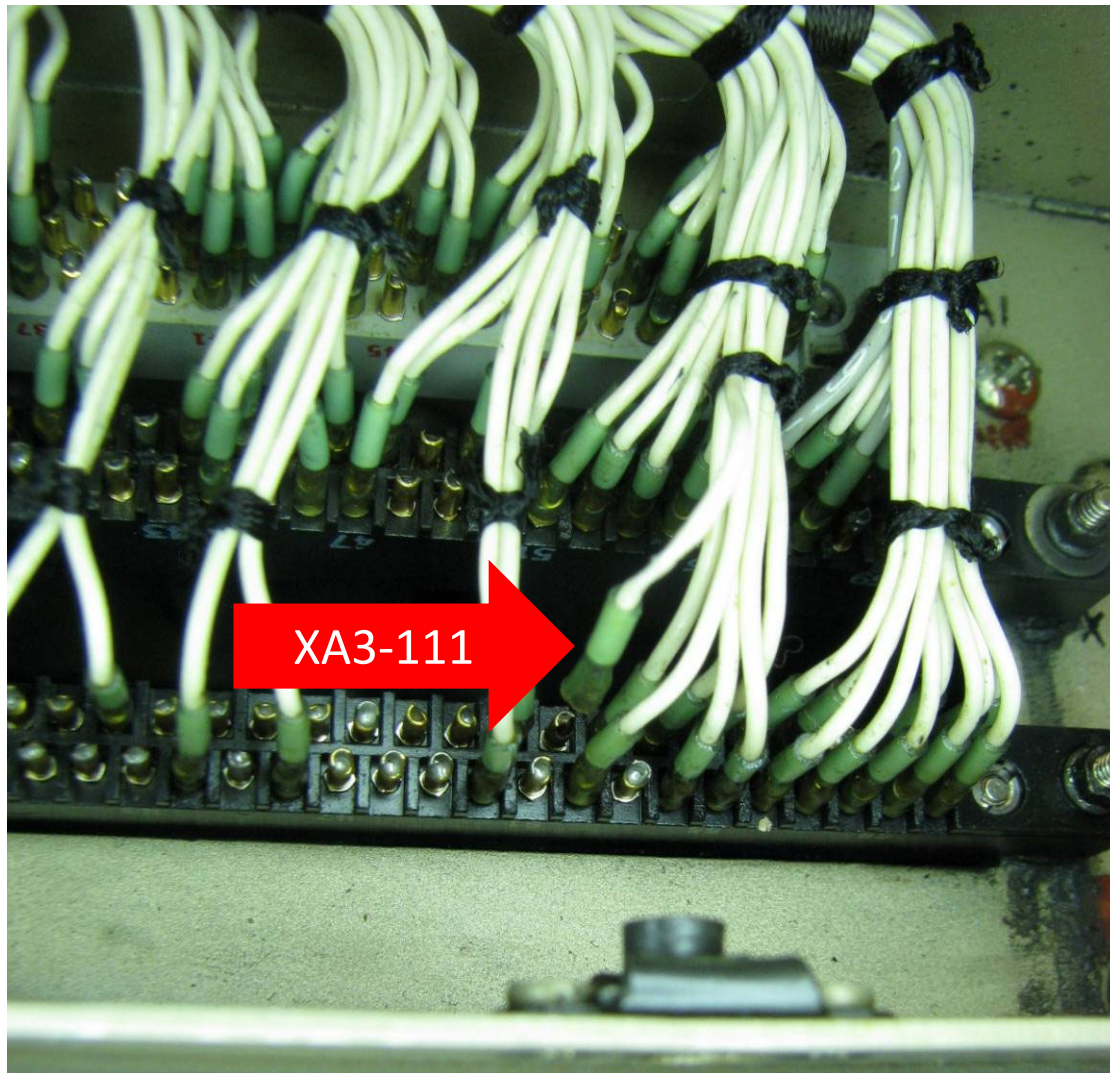
GCU #2 Test Results

- Continuity – Passed
- Shorts – Passed
- Intermittents – Failed – XA3-111
- First detected at -22 degrees C at 68 Hz during vibration sine sweep
- Found wire was broken at connector, but the sleeve was holding it in place
- Had experienced micro arcing for some time

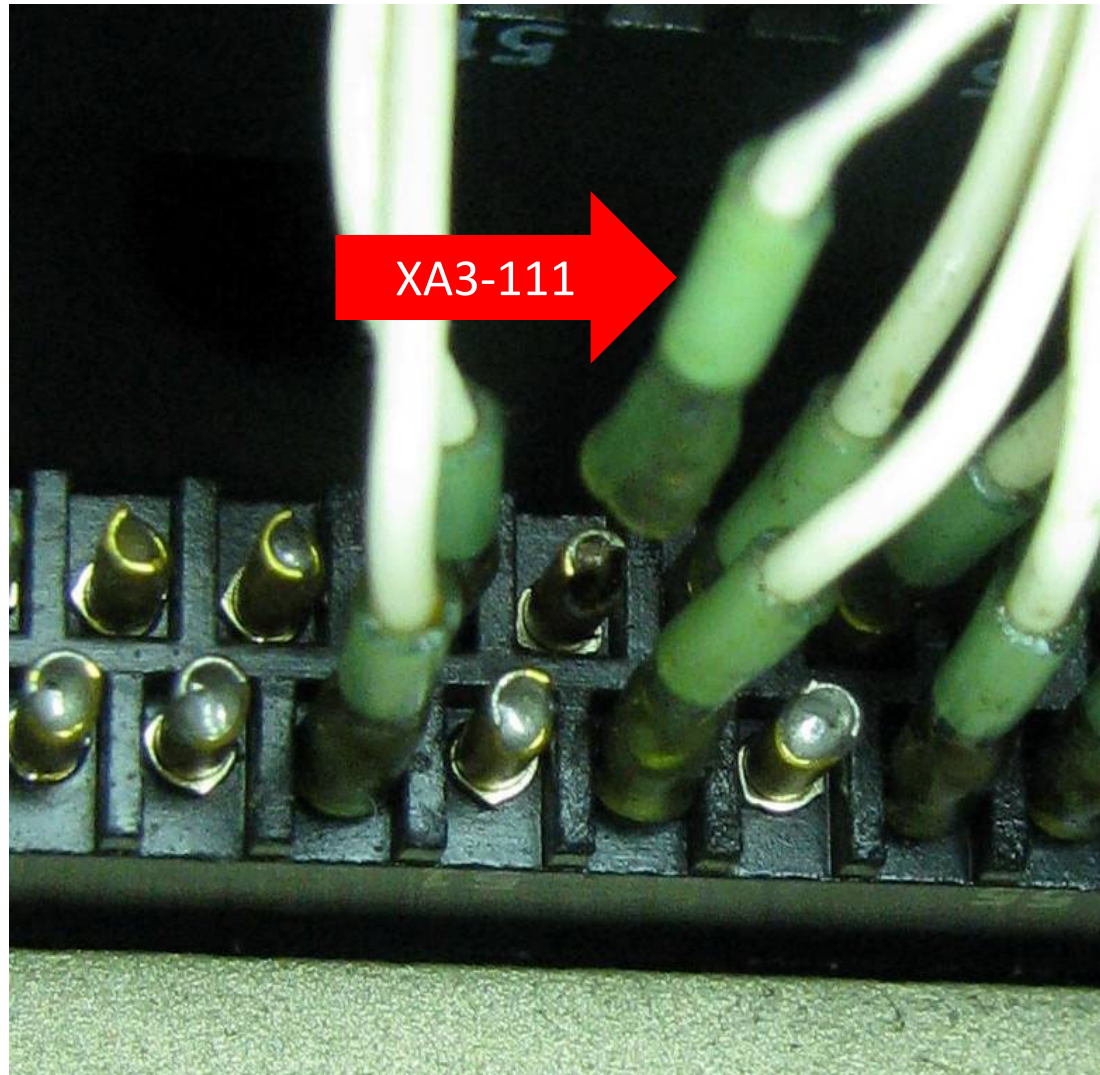
GCU #2 IFDIS Screen Shot



GCU #2 Problem



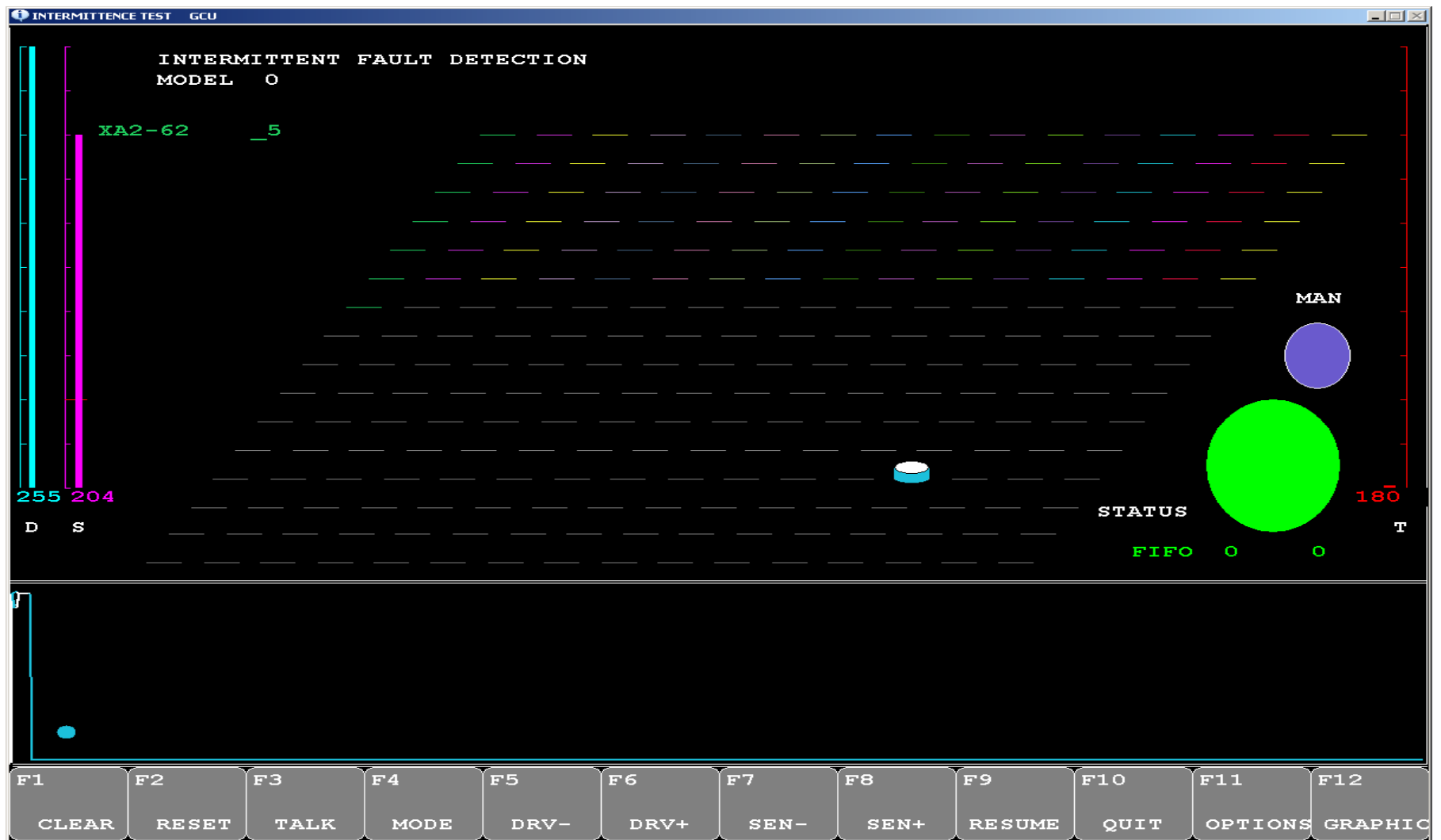
GCU #2 Problem



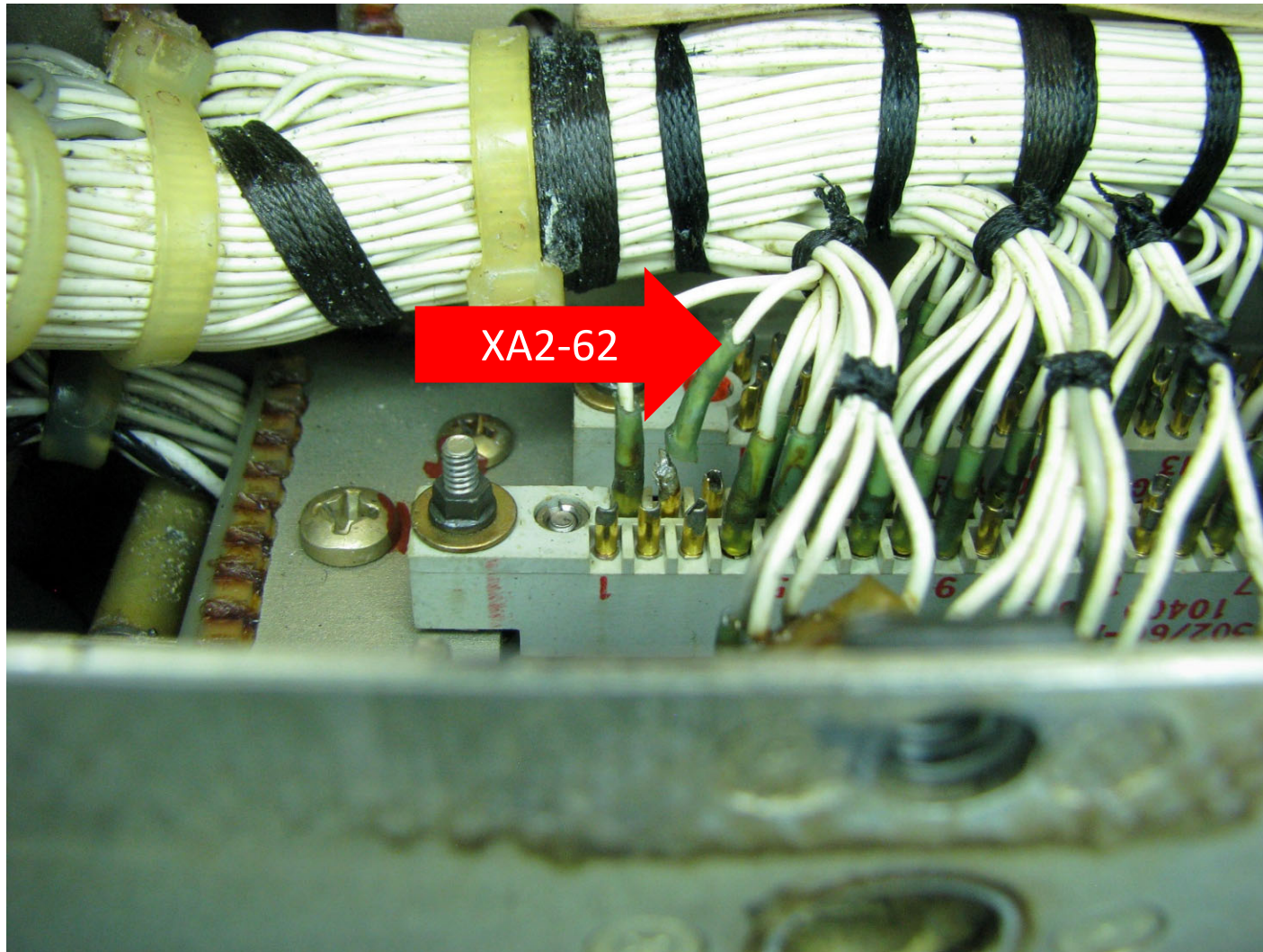
GCU #3 Test Results

- Continuity – Passed
- Shorts – Passed
- Intermittents – Failed – XA2-62 and XZ10-7
- XA2-62 found at 0 degrees C and 56 Hz during vibration sine sweep
- XZ10-7 found at -15 degrees C during random vibration profile
- XA2-62 was broken at connector, but the sleeve was holding it in place

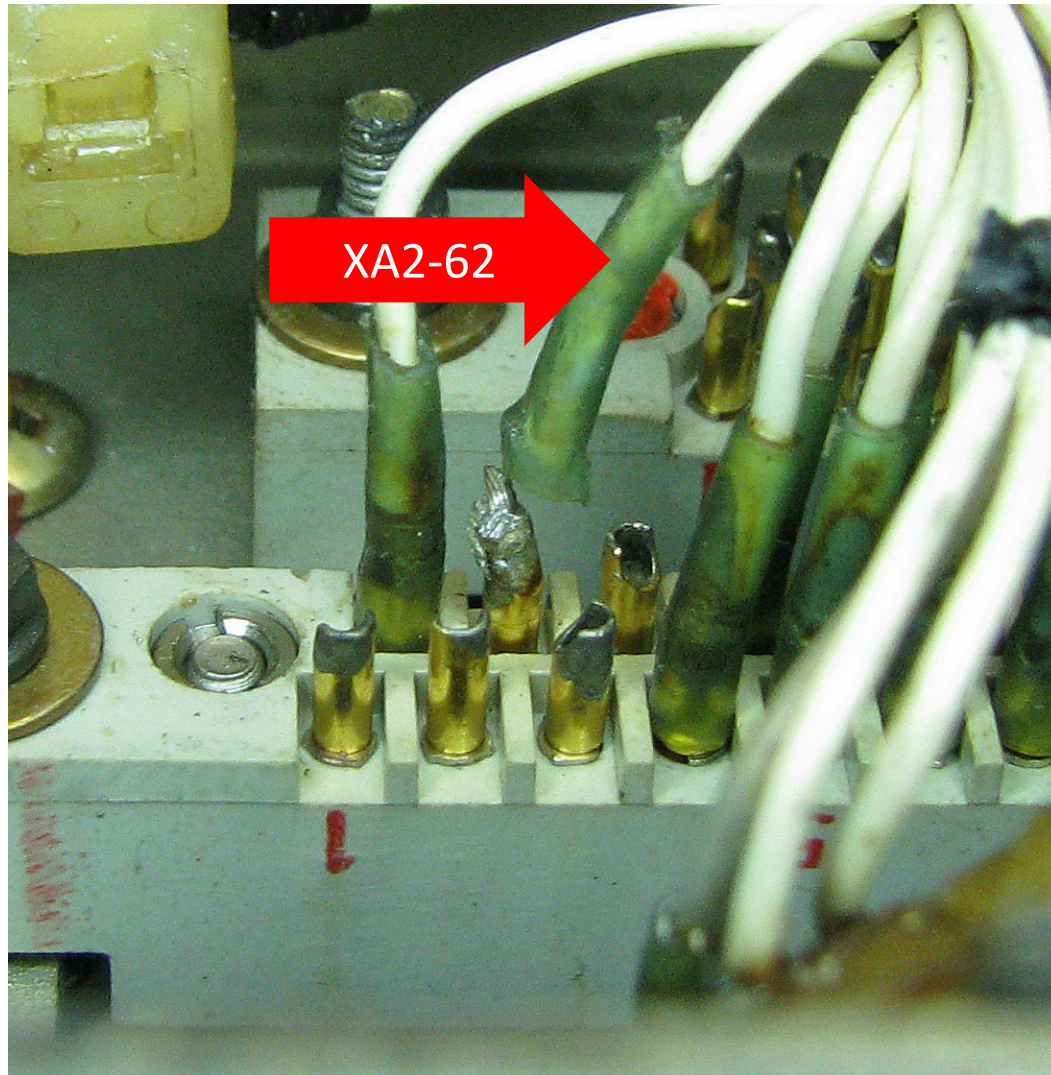
GCU #3 IFDIS Screen Shot



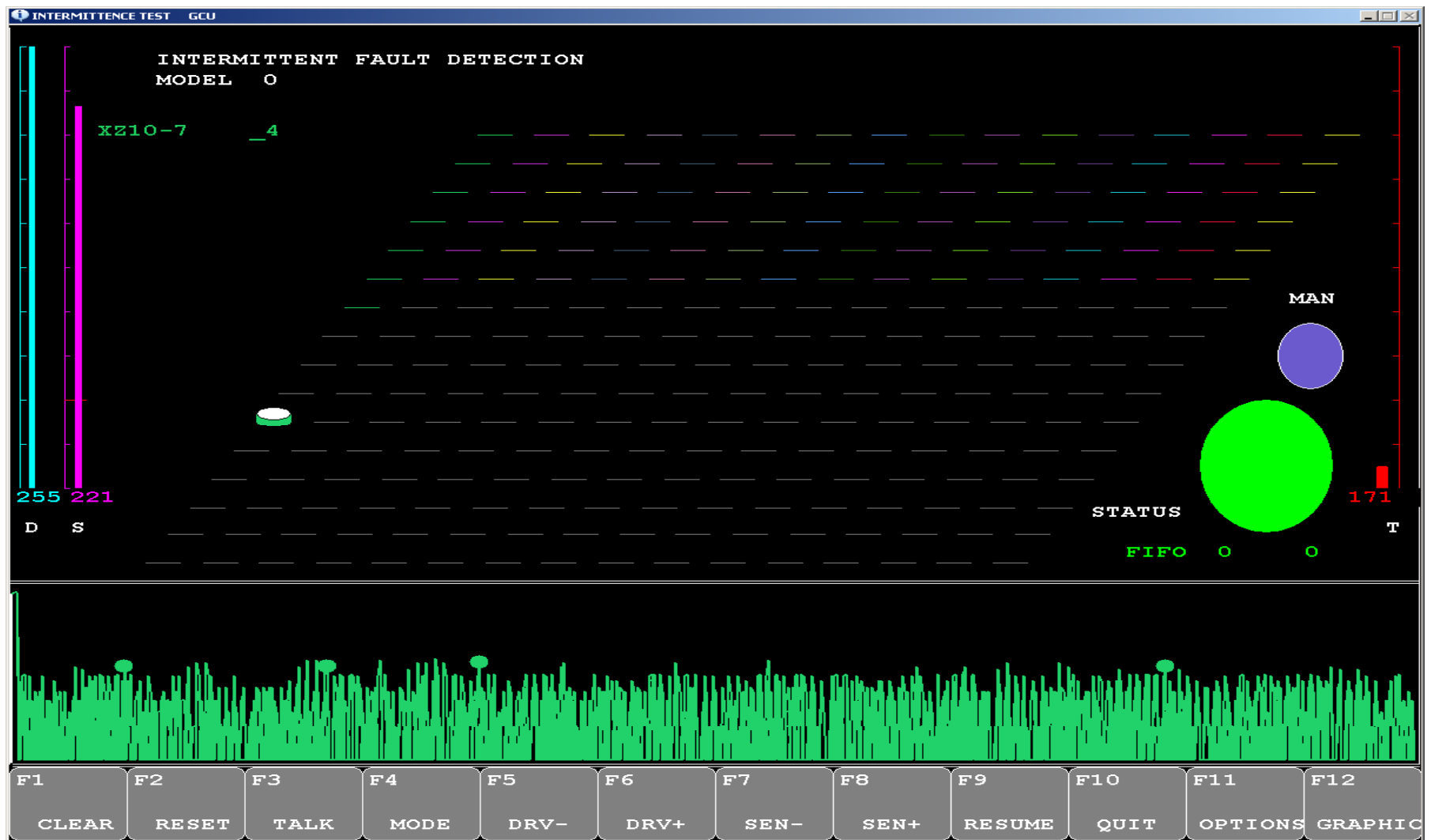
GCU #3 Problem



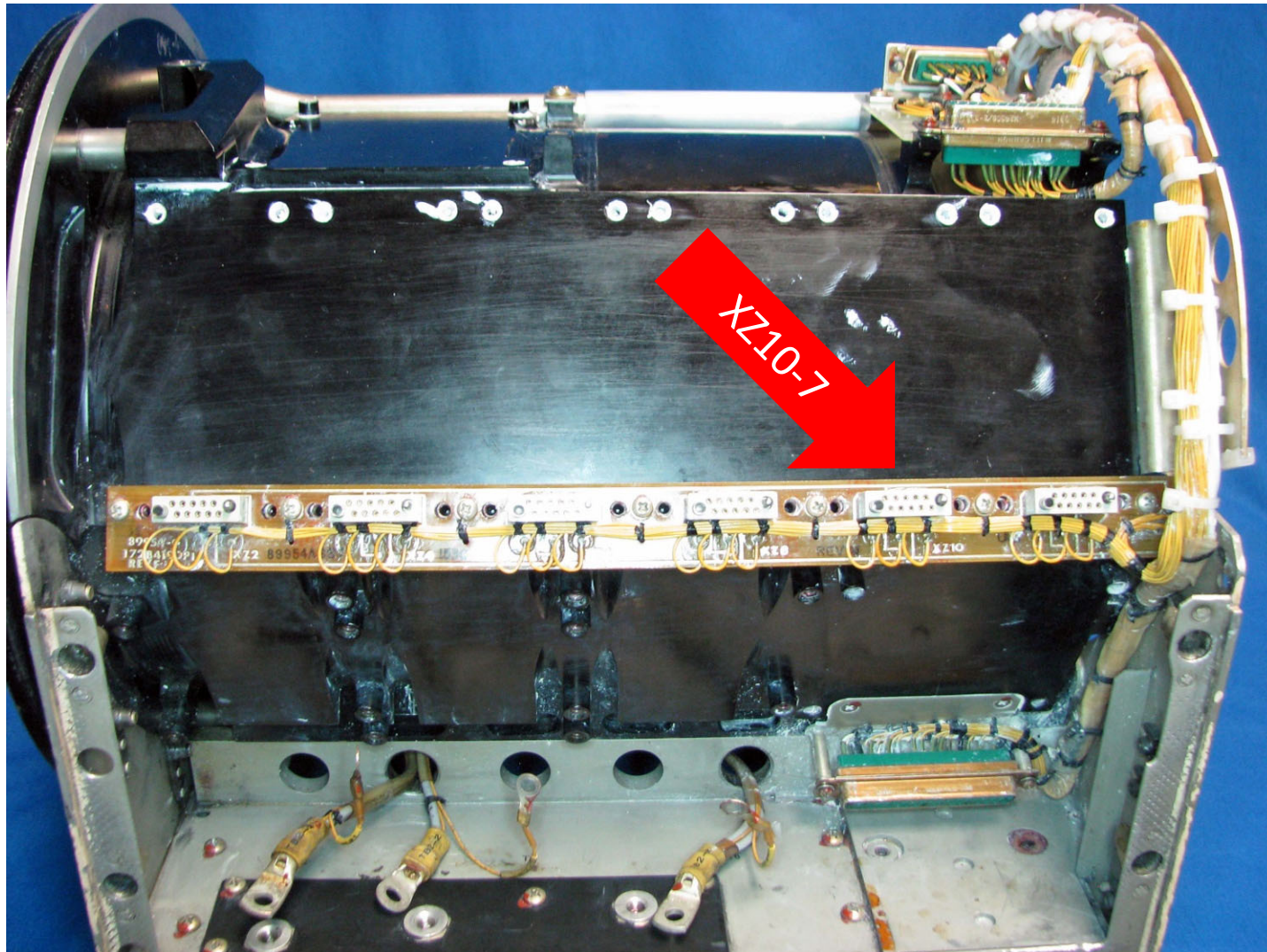
GCU #3 Problem



GCU #3 IFDIS Screen Shot



GCU #3 Problem

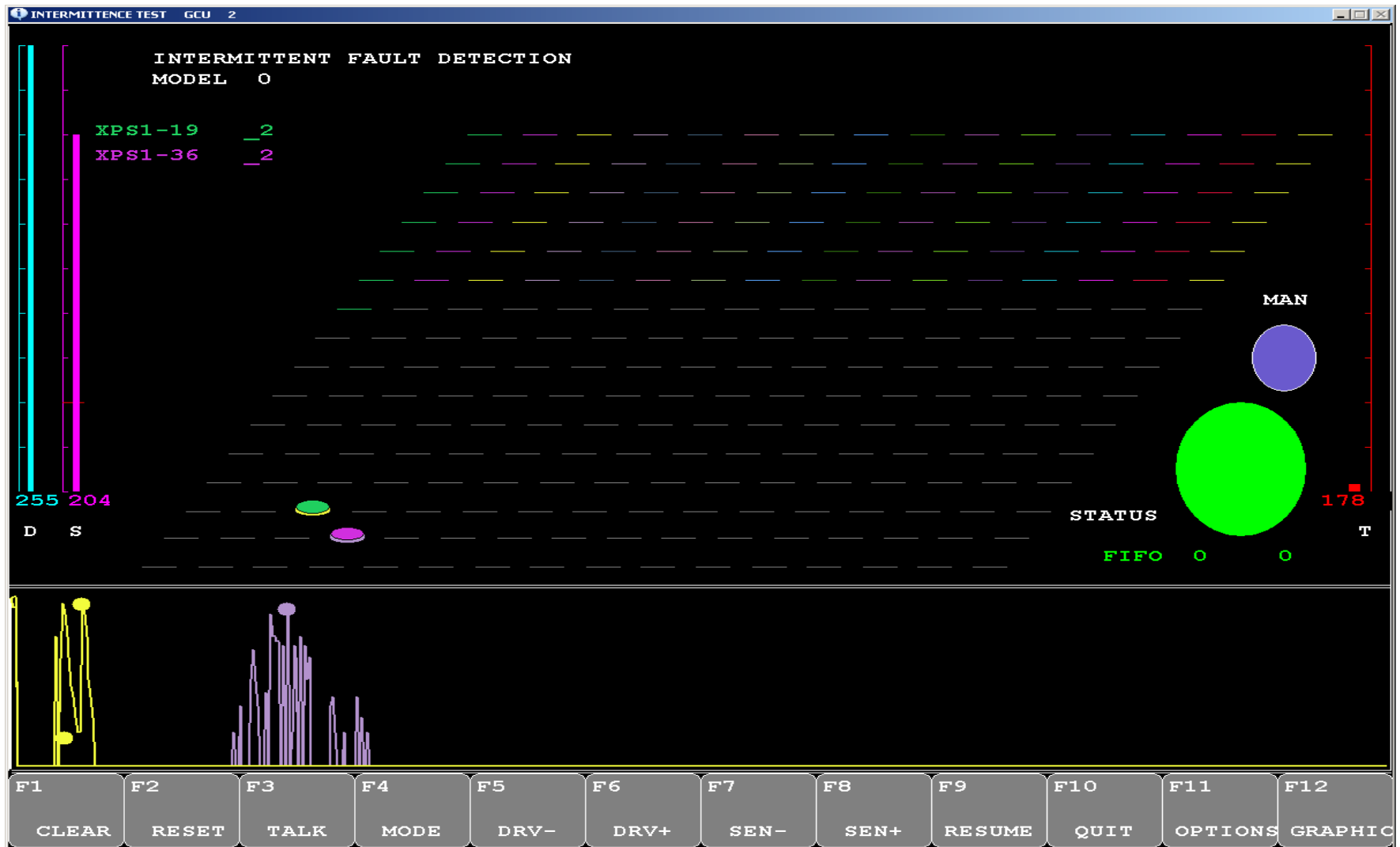


GCU #4 (3242) Test Results

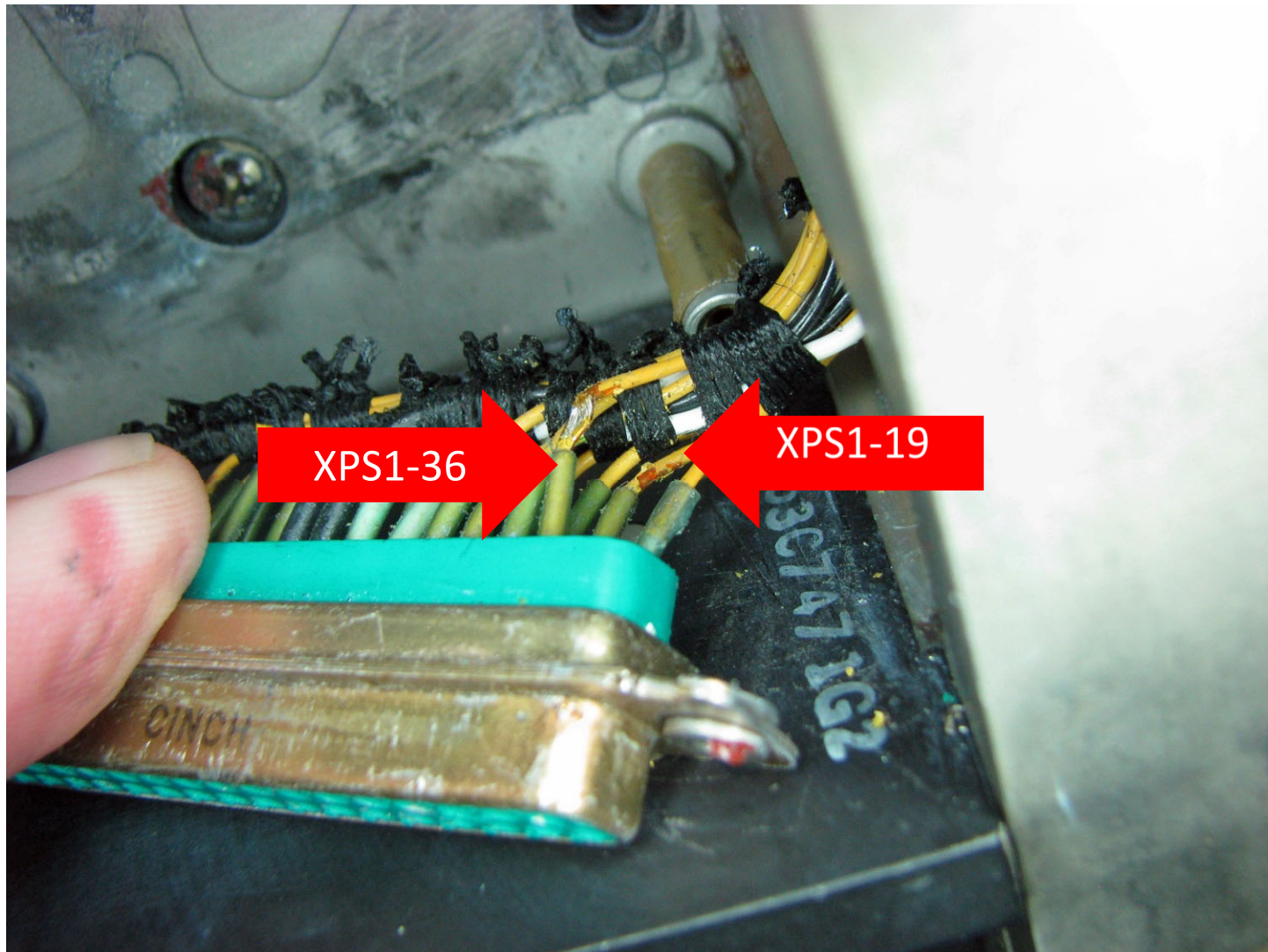
- Continuity – Passed
- Shorts – Passed
- Intermittents – Failed – XPS1-36 and XPS1-19
- First detected at -26 degrees C during random vibration profile
- Found wires are broken at connector, but the sleeve is holding them in place
- Wire insulation is degrading near terminals

GCU #4 (3242) IFDIS

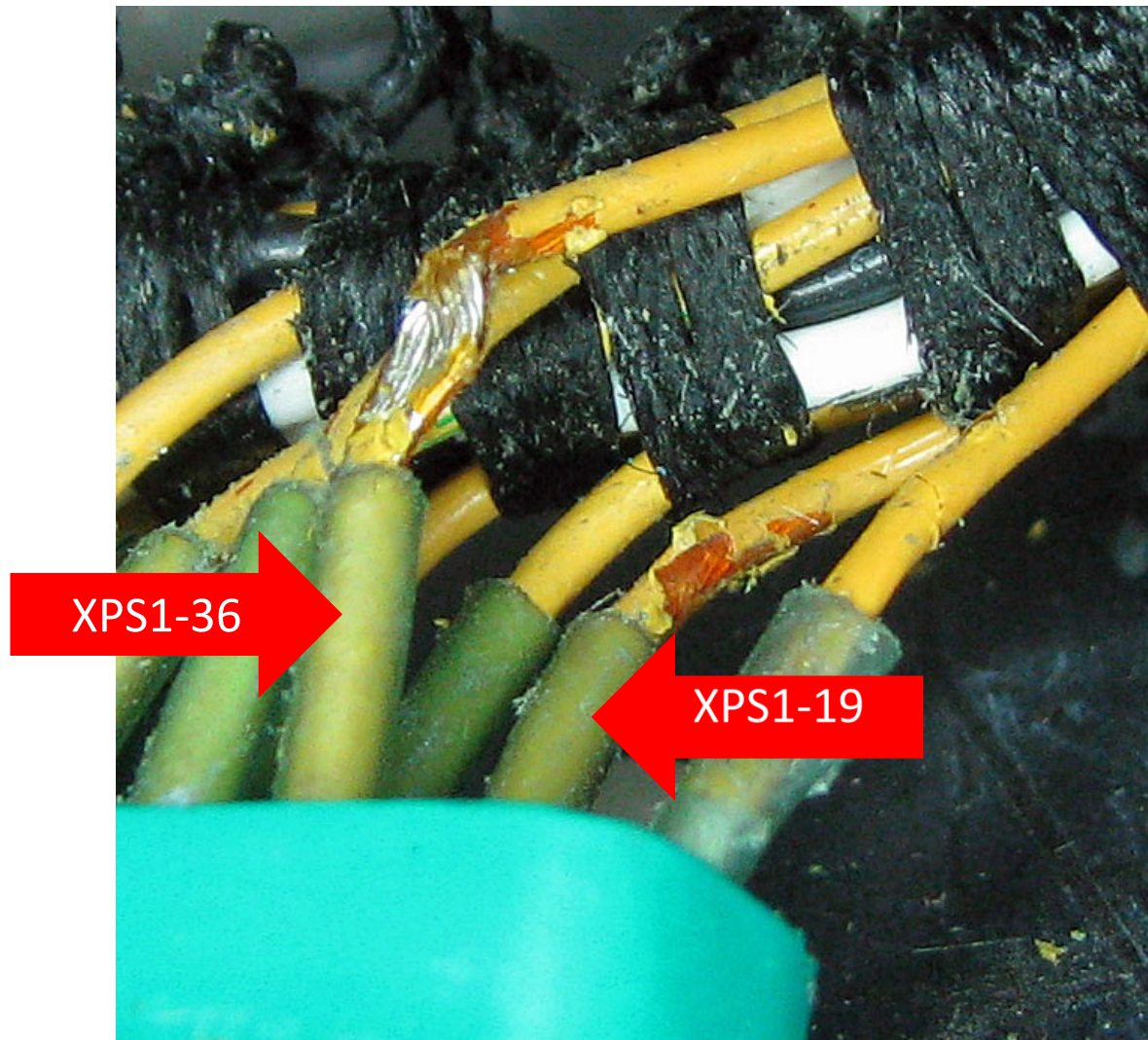
Screen Shot



GCU #4 (3242) Problem



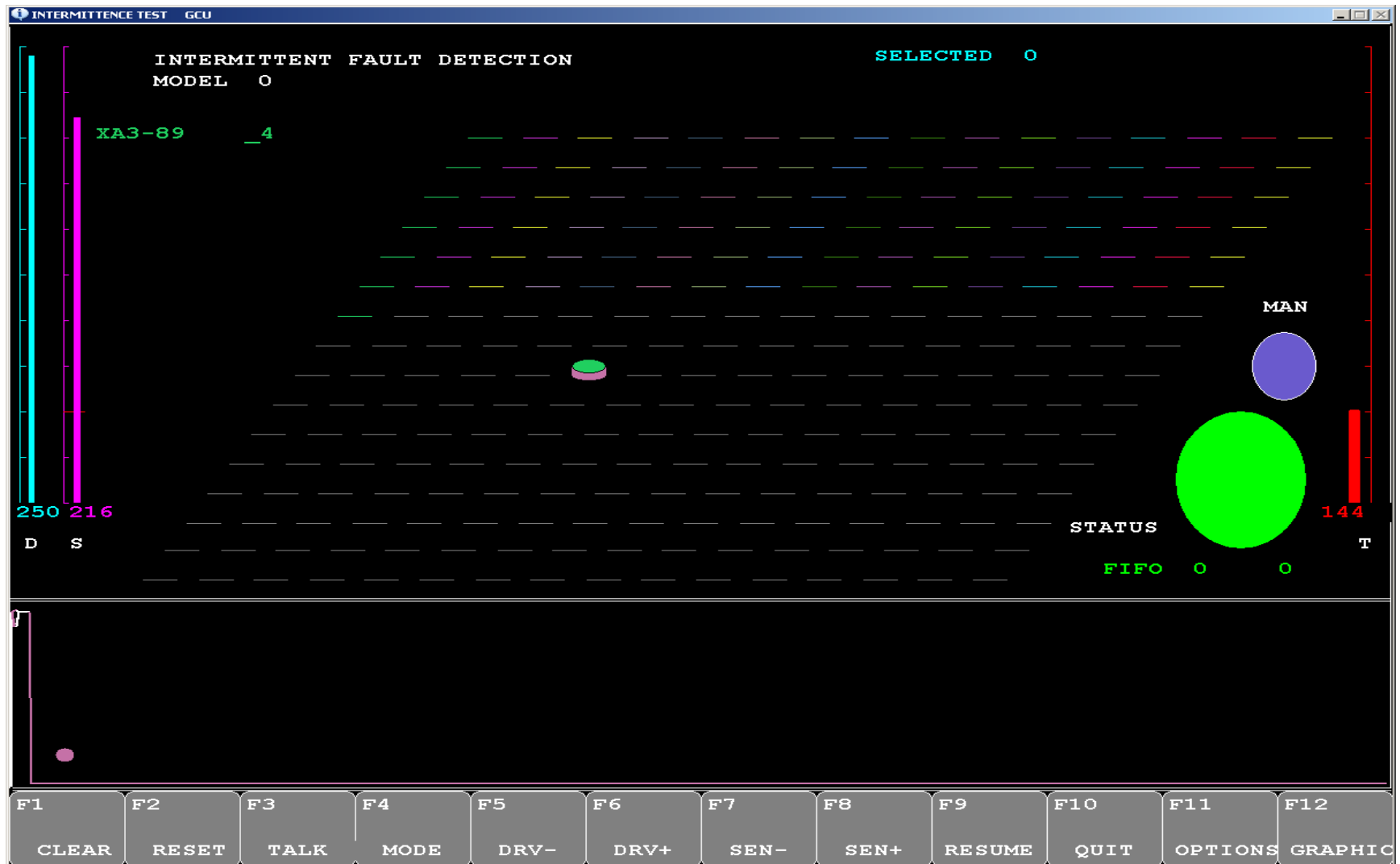
GCU #4 (3242) Problem



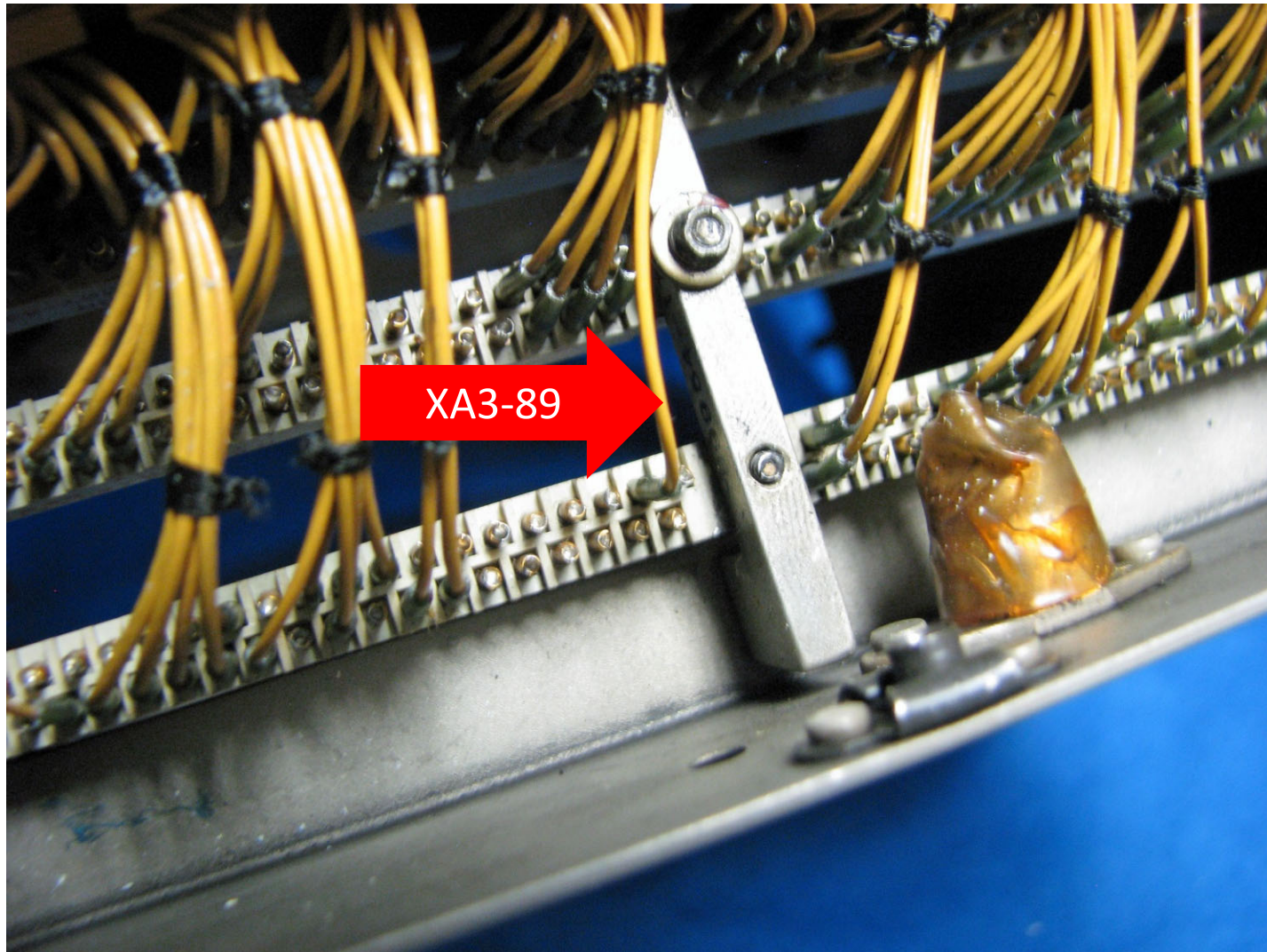
GCU #5 Test Results

- Continuity – Passed
- Shorts – Passed
- Intermittents – Failed – XA3-89
- First detected at -26 degrees C during random vibration profile
- Found wire is broken at connector, but the sleeve is holding it in place

GCU #5 IFDIS Screen Shot



GCU #5 Problem



GCU Testing Summary

- GCU #1 – No problems found
- GCU #2 – One intermittent detected and isolated
- GCU #3 – Two intermittents detected and one isolated
- GCU #4 – Two intermittents detected and isolated
- GCU #5 – One intermittent detected and isolated

Serial Number Tracking

- Recommend that GCU chassis failure and repair data be tracked by serial number
- Enables quick identification of “bad actors” and “good actors”
- Enables comparing Mean Time Between Failure before and after IFDIS testing
- Enables much better asset management

Production GCU IFDIS Test ITA

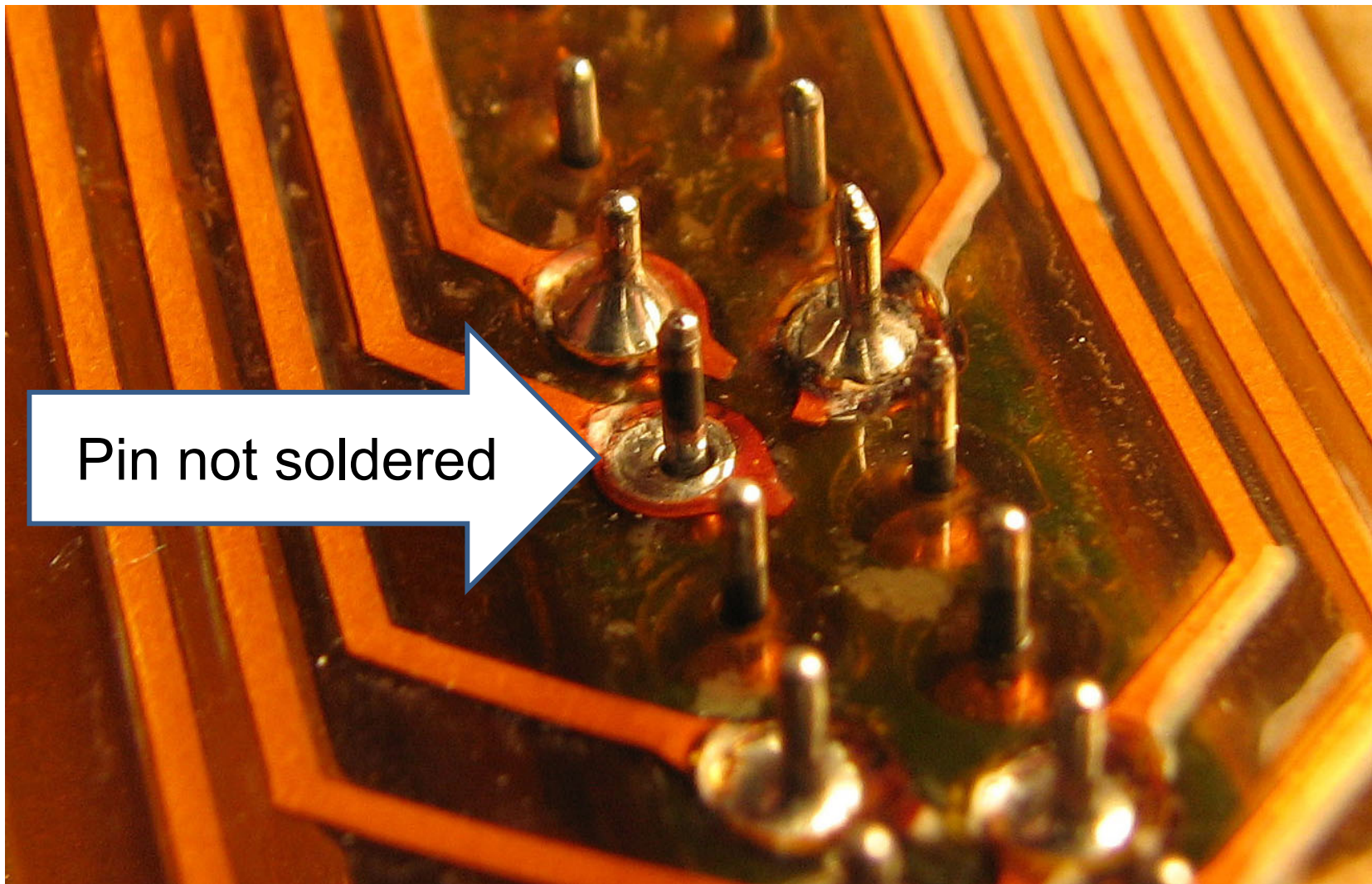
- Design & Fabricate Form, Fit & Interface simulated SRUs as part of ITA
 - Connect to all chassis points
 - Mount with production screws – proper torque
- Refine ITA design as appropriate
- Fabricate production ITA
- Design & fabricate production three axis hold down fixture

Next Step

- Continue testing GCUs on IFDIS
- Procure an IFDIS configured to test the F/A-18 GCU and other high NFF boxes
- Other ideas?

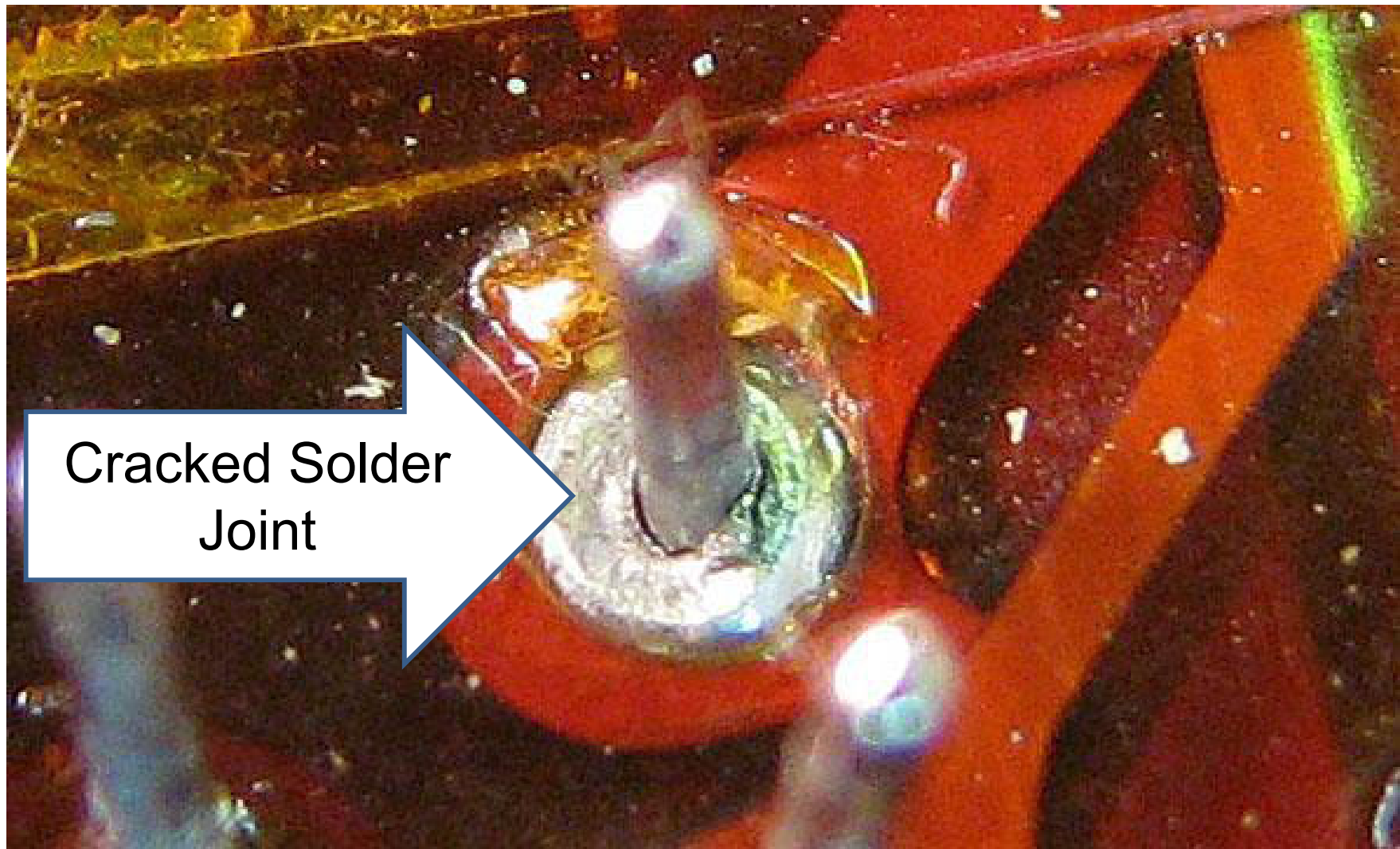
Backup Slides

Intermittent Fault Causes

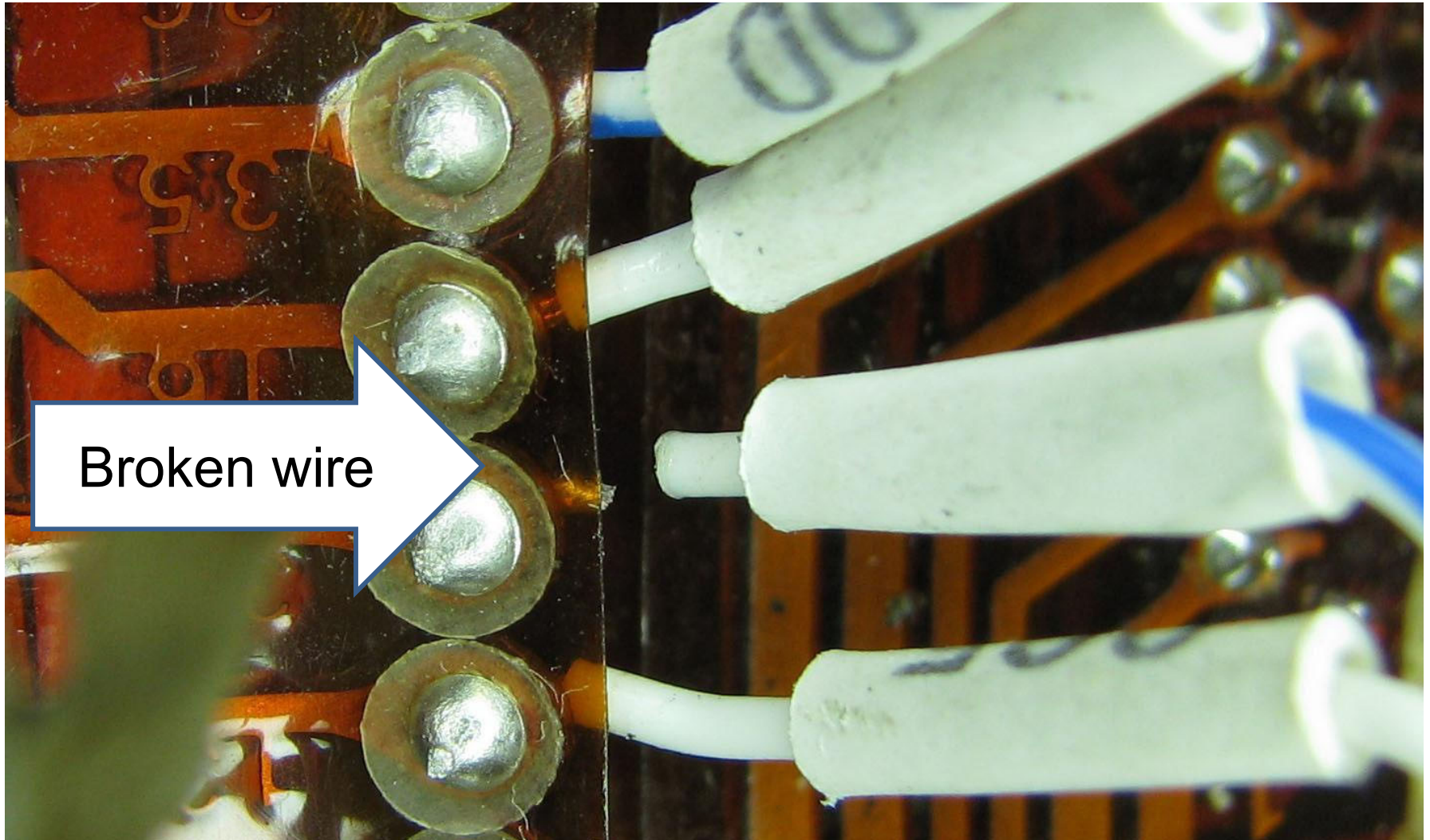


Pin not soldered

Intermittent Fault Causes



Intermittent Fault Causes

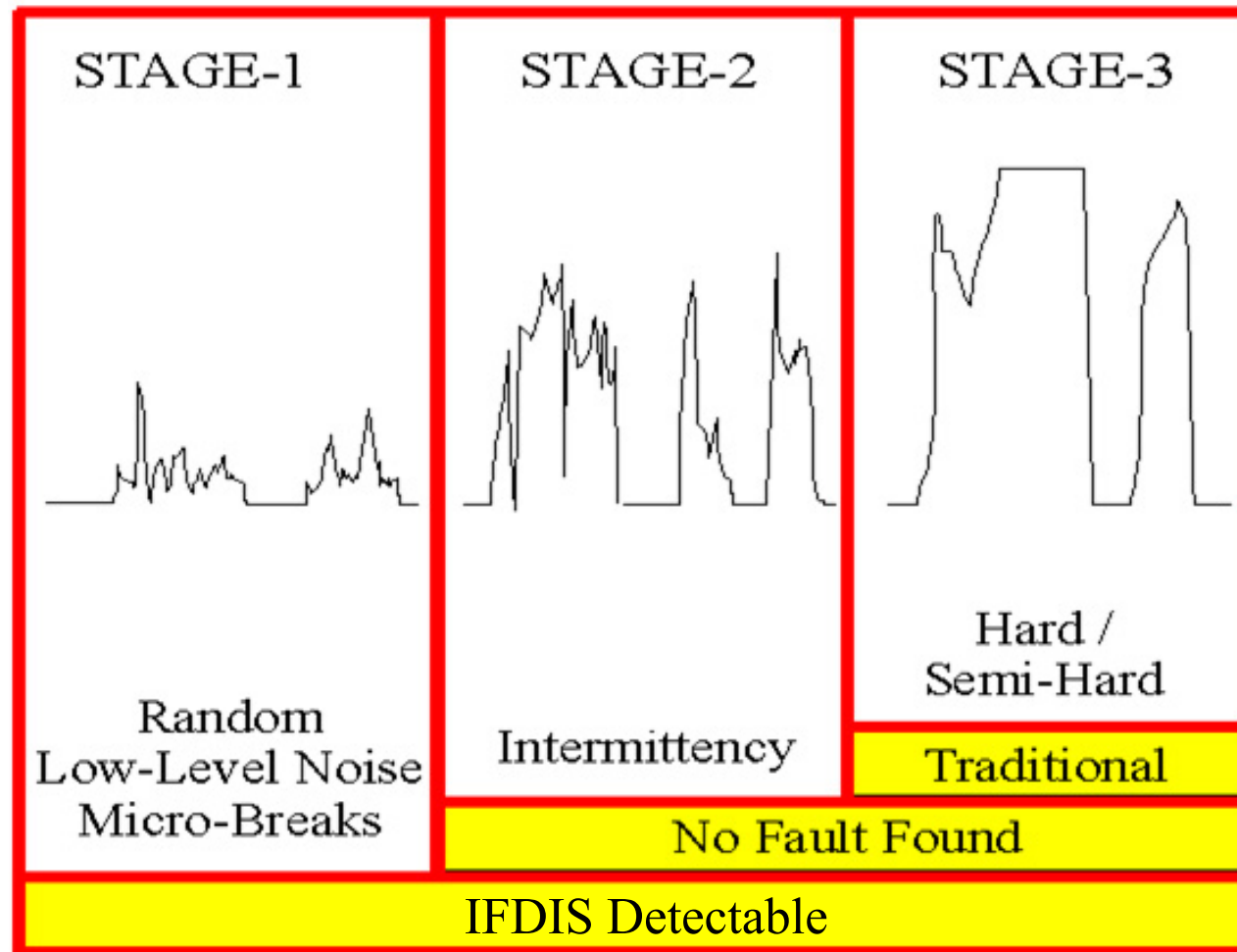


Intermittent Fault Detection Challenge

- Consistent discontinuity (hard failure) can be detected using conventional equipment
 - Though it may be difficult to isolate
- Discontinuity is often very short in duration
- Often only seen during stress situations
 - High G loading – Thermal extremes
 - Vibration – Combination of stresses
- Most ground test is done on a workbench at room temperature
- Traditional testers are not designed to detect intermittent faults

Intermittent Faults

Intermittent Fault Detectability



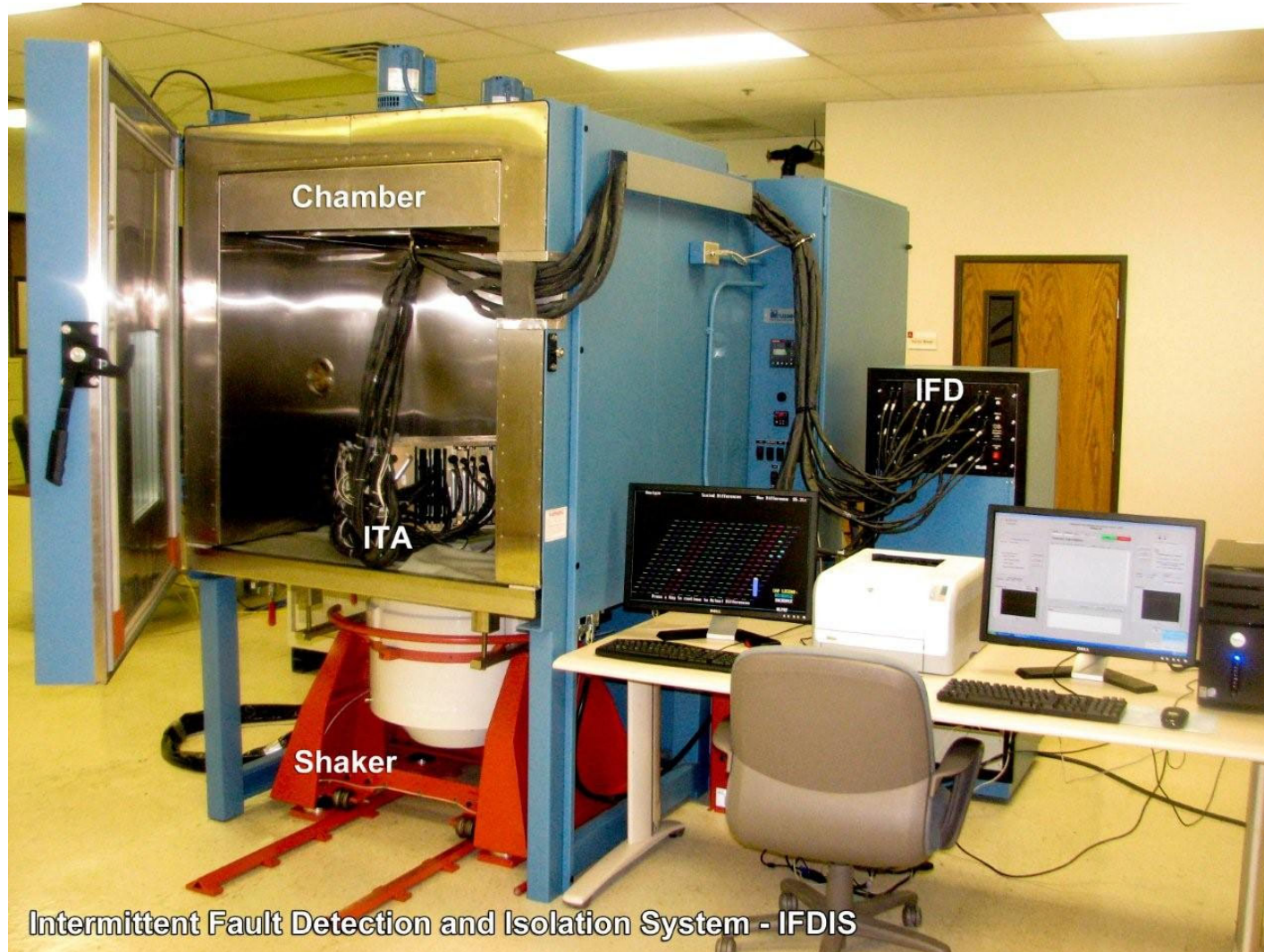
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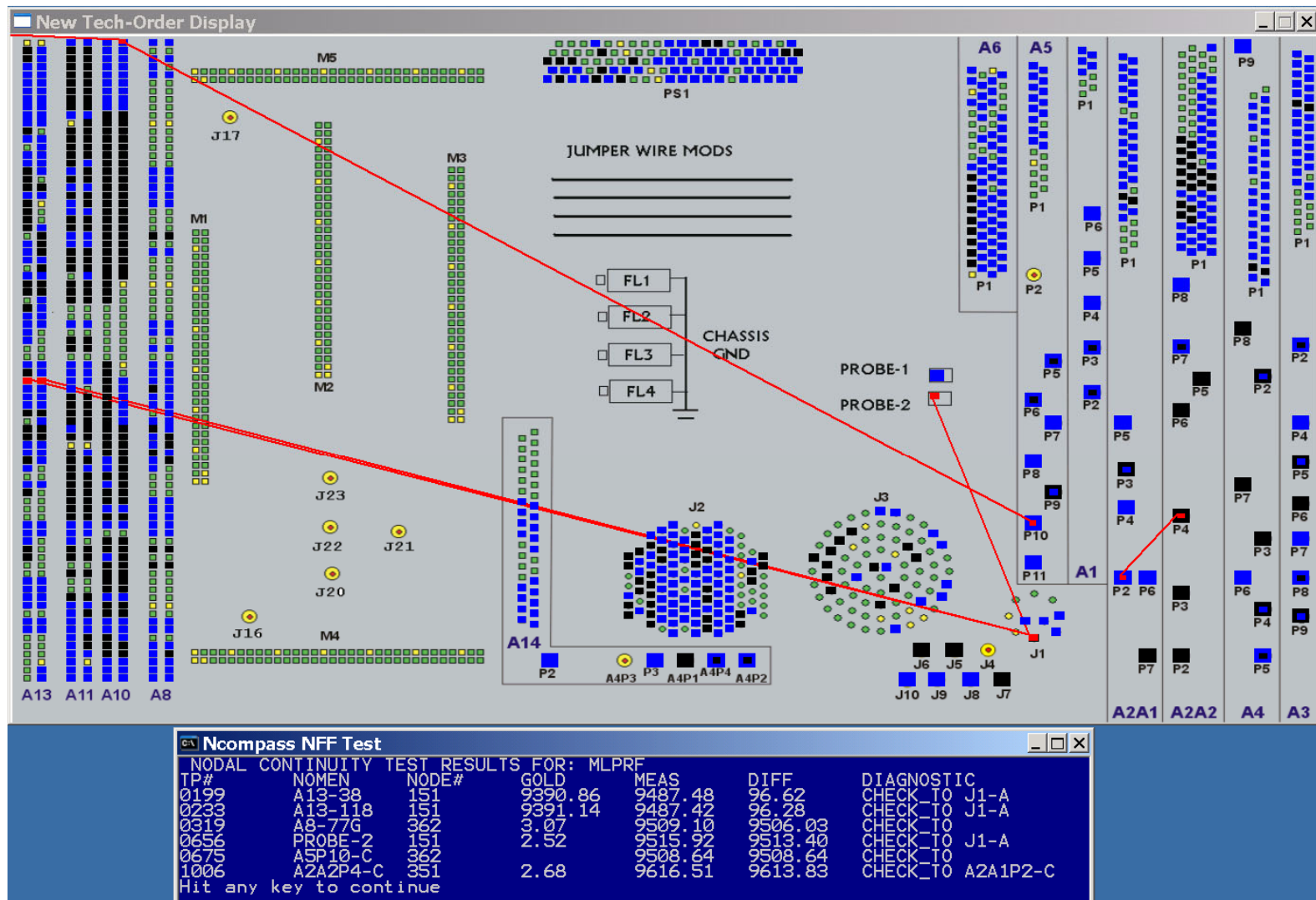


IFDIS Fault Display

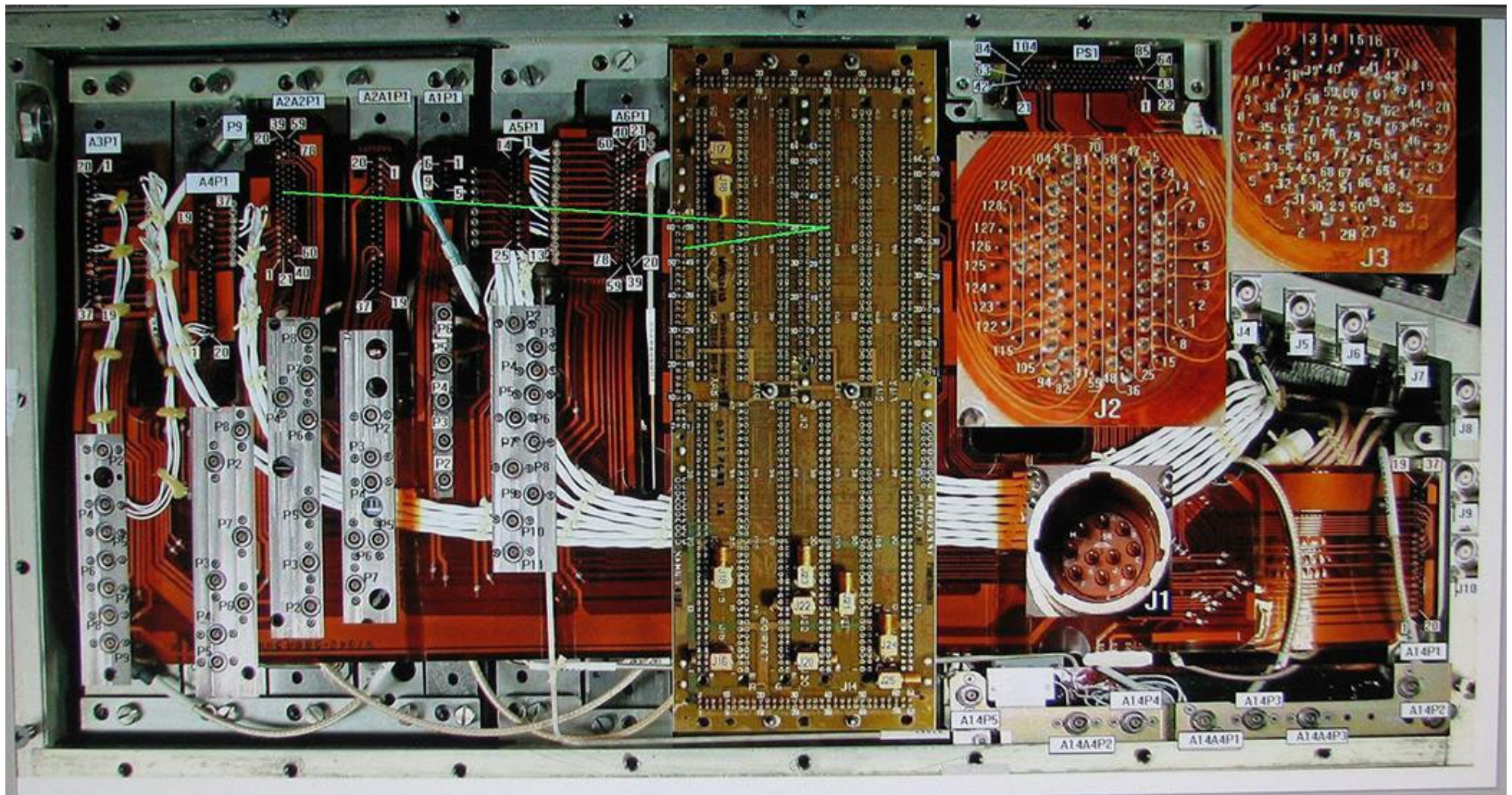


Intermittent
Faults

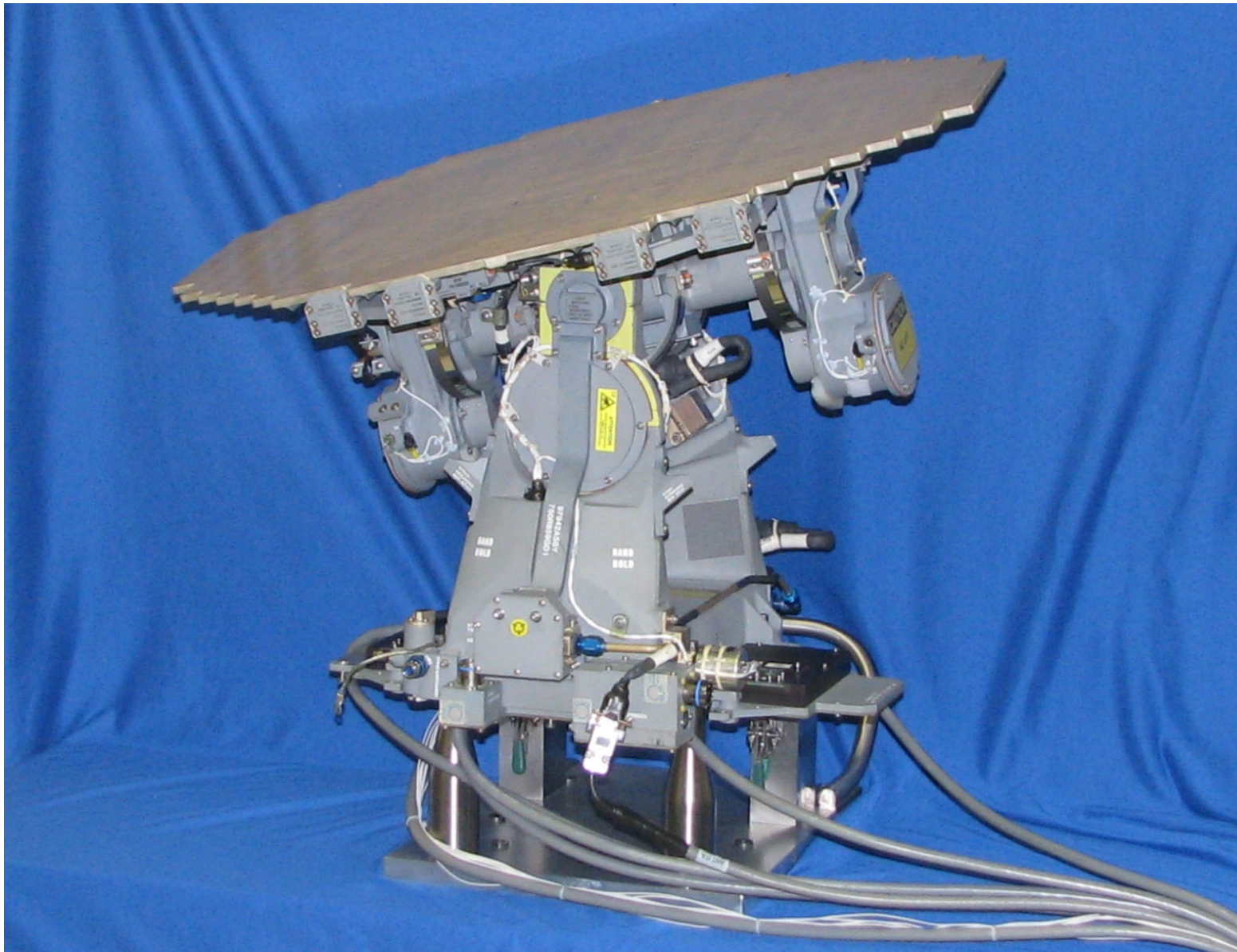
Repair Technician Graphic Aid



Repair Technician Graphic Aid



Radar Antenna Adaptation



Radar Antenna Adaptation



Summary

- IFDIS is substantially reducing the MLPRF cost of ownership
- Thus far, over \$212,000,000 return on the \$2,200,000 investment for the USAF
- This is for one LRU family on the F-16
- There are many LRUs on many aircraft platforms that have intermittent problems
- Anticipate similar results with other units