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## Intermittent Fault Detector (IFD-256™)

**[REDACTED] - Total Air Temperature (TAT) Probes**

### IFD-256 Test Summary



**Prepared and Submitted by:**

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**10 July 2019**

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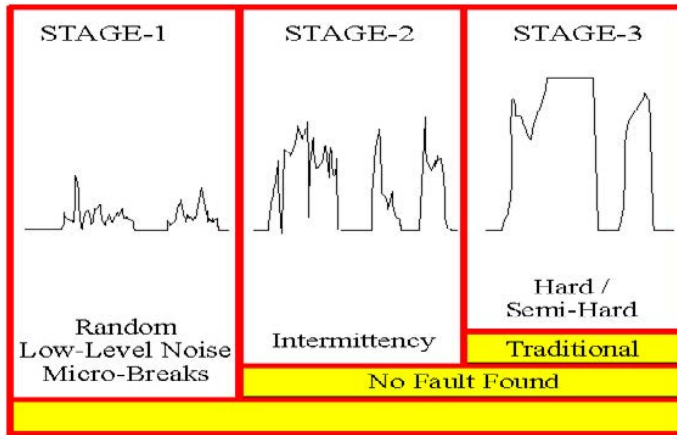
**Total Air Temperature (TAT) Probes (P/Ns 102LA2AG, 102LJ2AG)  
S/Ns: A80547, A29936**

**Introduction:**

The subject [REDACTED] Total Air Temperature (TAT) Probes were tested at the request of [REDACTED] for the purpose of demonstrating the advanced diagnostic capability of the Intermittent Fault Detector™ (IFD™). Universal Synaptics received the TAT Probes on 28 June 2019, testing began on 2 July 2019 using the portable Intermittent Fault Detector (IFD-256™). The Interface Test Adaptor (ITA) was designed and manufactured by Universal Synaptics for this test project.

**Test Procedures:**

- AutoMap™ – discovered the UUT true as-wired configuration (No OEM data/schematics required if “Gold” units are provided; OEM data was used for building correct baseline map due to both TAT Probes being in non-working condition)
- 1. Continuity – tests for open circuits
- 2. Shorts – provides shorts indication and shorts tracing
- 3. Intermittence – monitors all circuits to detect and isolate *all three Stages* of intermittent faults (see Graphic 1)

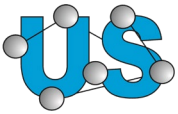


**Stage 1** – random low-level nanosecond micro-breaks, likely not operationally evident yet, but on curve of degradation to become Stage 2

**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)

**Graphic 1 – Three Stages of an Intermittent Fault**

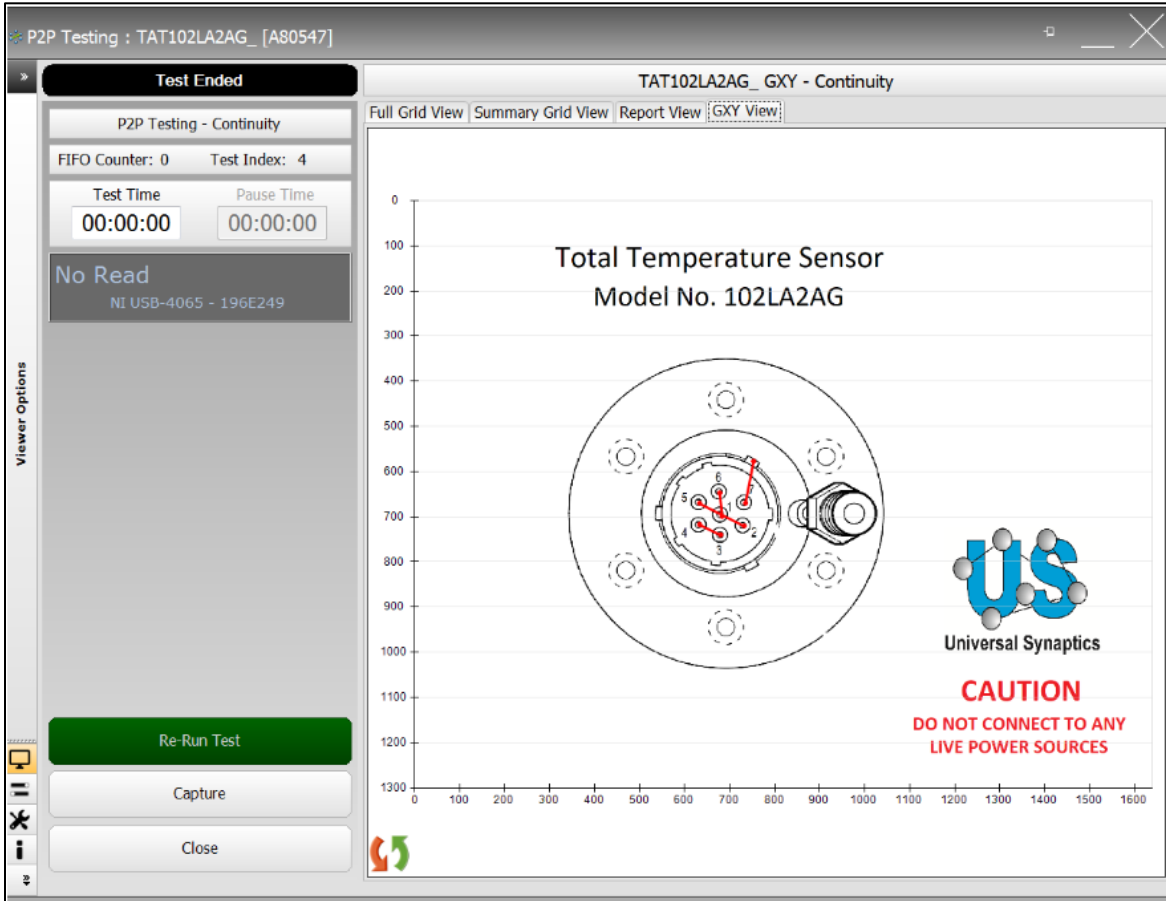


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**Results:**

**S/N: A80547**

1. IFD-256 Continuity testing conducted – test points 4, 5, 6, and shield (TP#8) were outside ohmic measurement tolerances (see Graphics 2 and 3)
2. IFD-256 Shorts testing conducted – shorted circuits were detected on test points 3 and 7 and traced back to test point 2 (see Graphics 4 and 5)
3. IFD-256 Intermittence testing conducted – 2 intermittent events detected on test point 4 and 3 intermittent events detected on test point 6 (see Graphics 6, 7, and 8)



**Graphic 2 - Continuity Graphic (GXY View) - S/N: A80547**

Results Report Header for - Continuity Test

Test Information:

Unit being tested ..... TAT102LA2AG\_  
 Unit serial number ..... A80547  
 Date tested (yyyy-mm-dd) ..... 2019-07-02  
 Time tested ..... 13:25:46  
 Operator ..... User Administrator

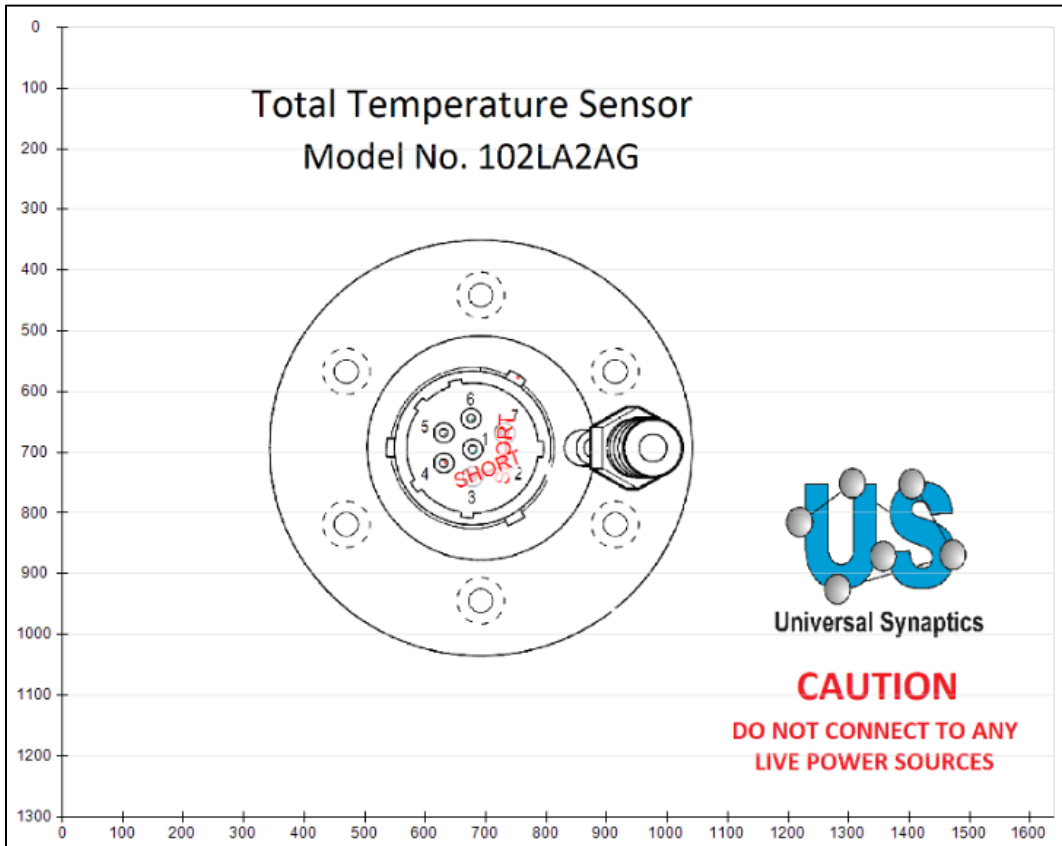
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A80547 SUMMARY OF NODAL CONTINUITY TEST RESULTS FOR: TAT102LA2AG\_  
 TP# NOMEN NODE GOLD MEAS(DIFF) DIAGNOSTIC  
 6 TP-06 1 22.00 46.76 (24.76) CON-Default FAIL @TP-01  
 5 TP-05 2 500.00 23.31 (476.69) CON-Default FAIL @TP-02  
 4 TP-04 3 500.00 23.37 (476.63) CON-Default FAIL @TP-03  
 8 TP-08 4 0.010 18.54 (18.53) CON-Default FAIL @TP-07  
 Continuity Test Completed in 0:00:01

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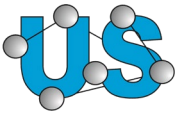
FULL NODAL CONTINUITY TEST RESULTS FOR: TAT102LA2AG\_  
 TP# NOMEN NODE TOLERANCE METHOD GOLD MEAS (DIFF) DIAGNOSTIC  
 6 TP-06 1 +5%-5% OneRead 22 46.76 (24.76) CON-Default FAIL @TP-01  
 5 TP-05 2 +5%-5% OneRead 500 23.31 (476.69) CON-Default FAIL @TP-02  
 4 TP-04 3 +5%-5% OneRead 500 23.37 (476.63) CON-Default FAIL @TP-03  
 8 TP-08 4 +5%-5% OneRead 0.01 18.54 (18.53) CON-Default FAIL @TP-07

Graphic 3 - Continuity Report & Results (Report View) - S/N: A80547



Graphic 4 - Shorts Graphic - S/N: A80547





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Results Report Header for - Trace Test

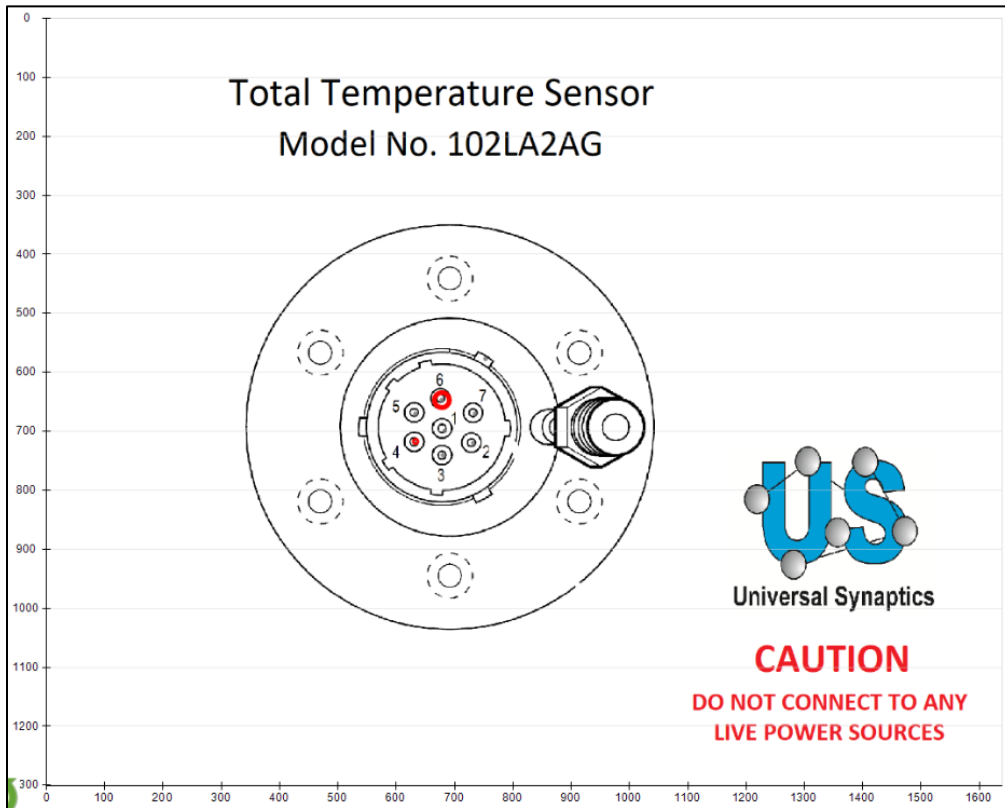
Test Information:

Unit being tested ..... TAT102LA2AG_
Unit serial number ..... A80547
Date tested (yyyy-mm-dd) ..... 2019-07-02
Time tested ..... 13:22:16
Operator ..... User Administrator

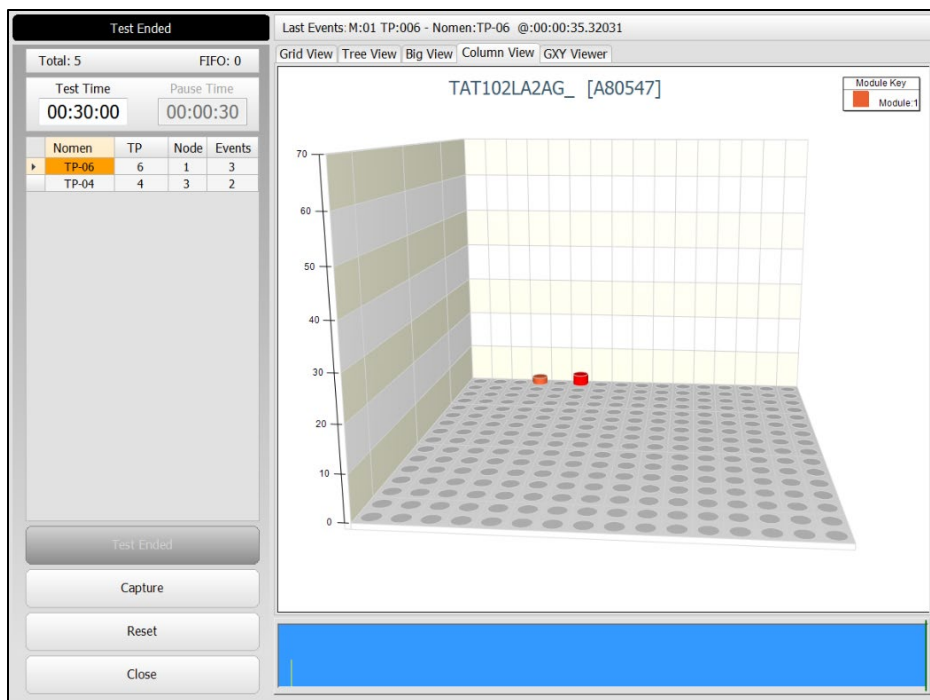
A80547 SUMMARY OF TRACE TEST RESULTS FOR: TAT102LA2AG_
Short from TP-03 node:3 traced to TP-02 node:2 by 28.42Ohms
Short from TP-07 node:4 traced to TP-02 node:2 by 23.15Ohms

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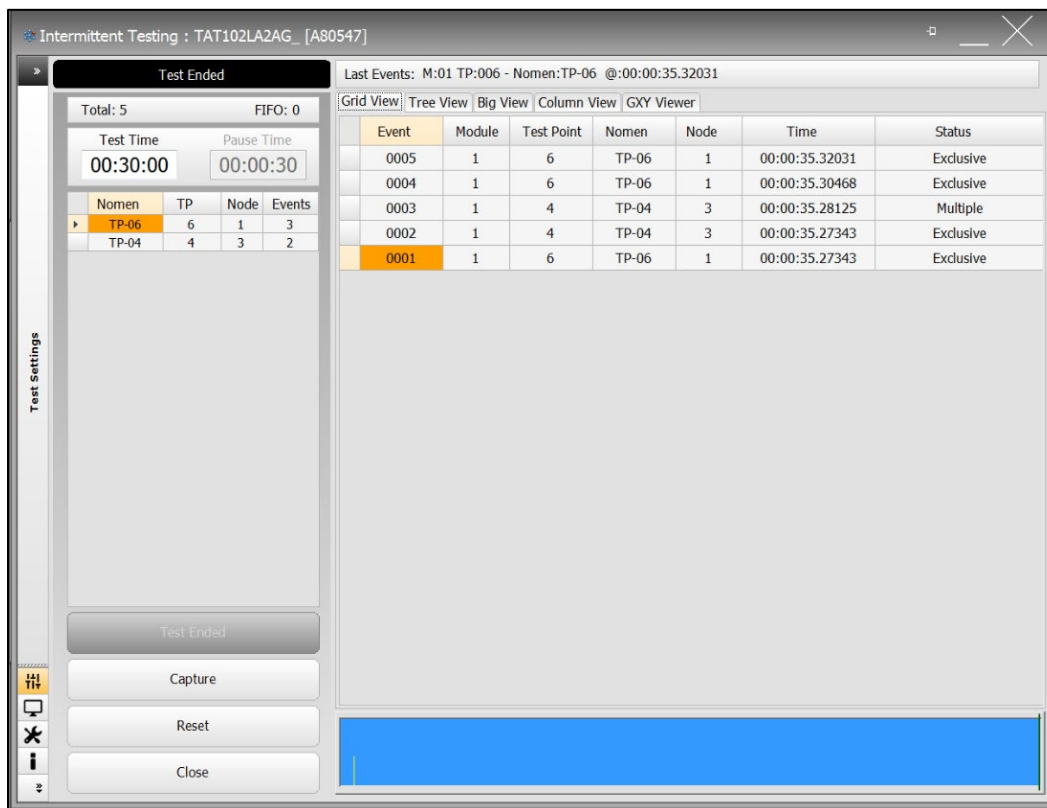
Graphic 5 - Shorts Report & Results - S/N: A80547



Graphic 6 - Intermittence Graphic (GXY View) - S/N: A80547



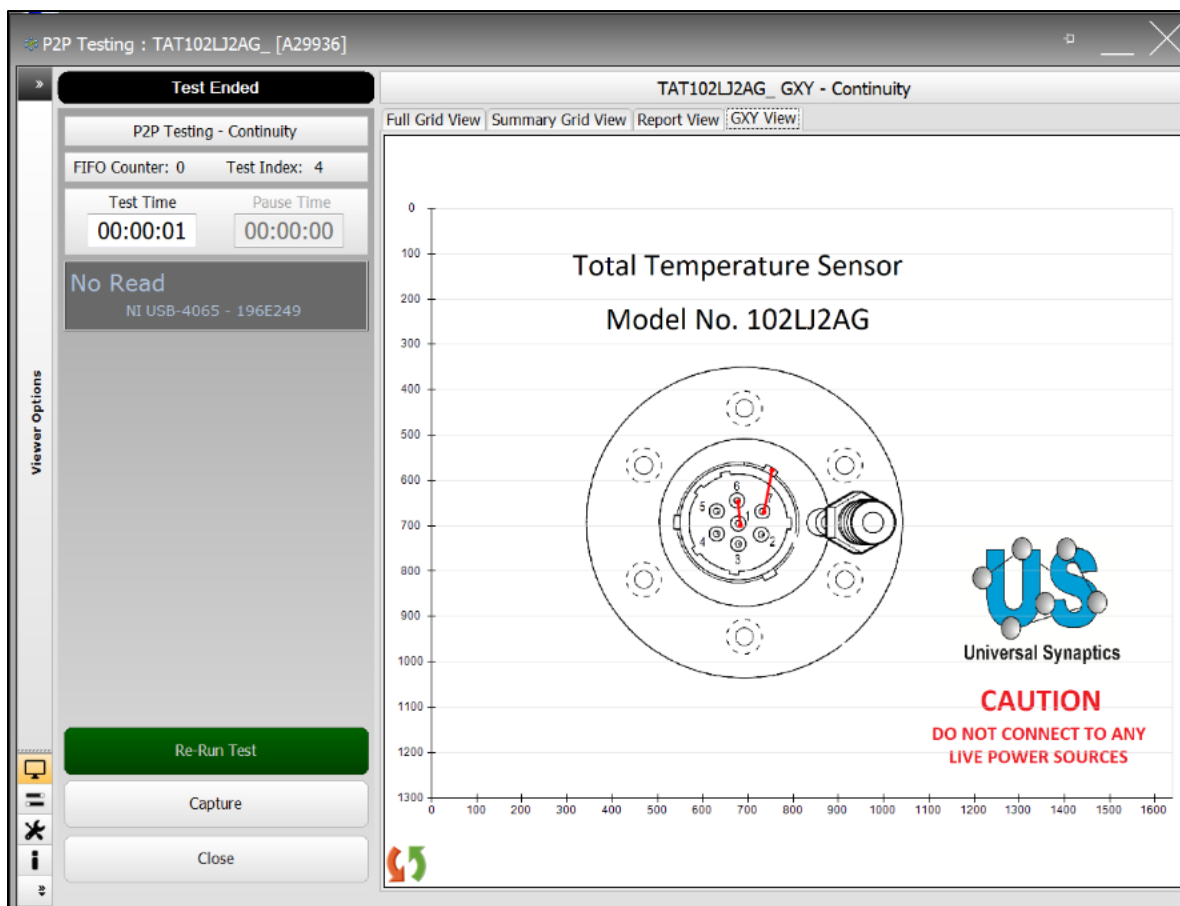
Graphic 7 - Intermittence Graphic (Column View) - S/N: A80547



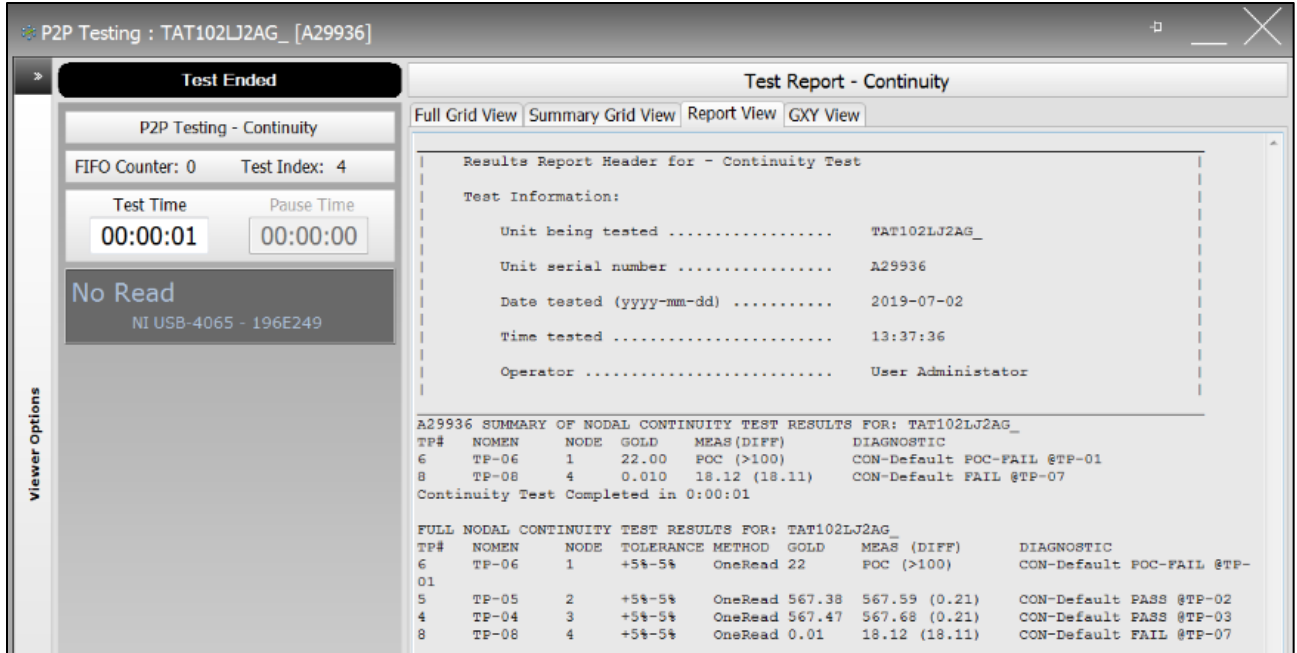
Graphic 8 - Intermittence Graphic (Grid View) - S/N: A80547

**S/N: A29936**

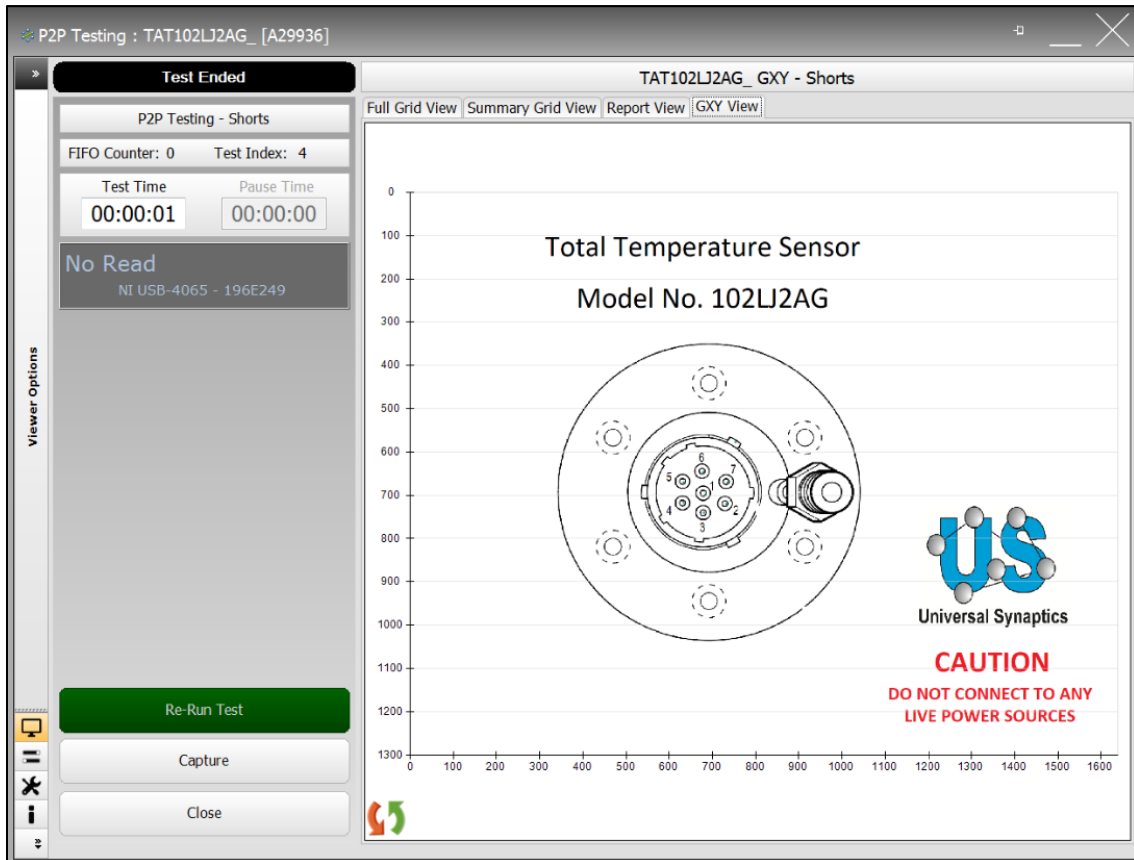
1. IFD-256 Continuity testing conducted – test points 6 and shield (TP#8) read open circuit and outside ohmic measurement tolerances, respectively (see Graphics 9 and 10)
2. IFD-256 Shorts testing conducted – no shorted circuits were detected on this UUT (see Graphics 11 and 12)
3. IFD-256 Intermittence testing conducted – 4 intermittent events detected on shield (TP#8) (see Graphics 13 and 14)



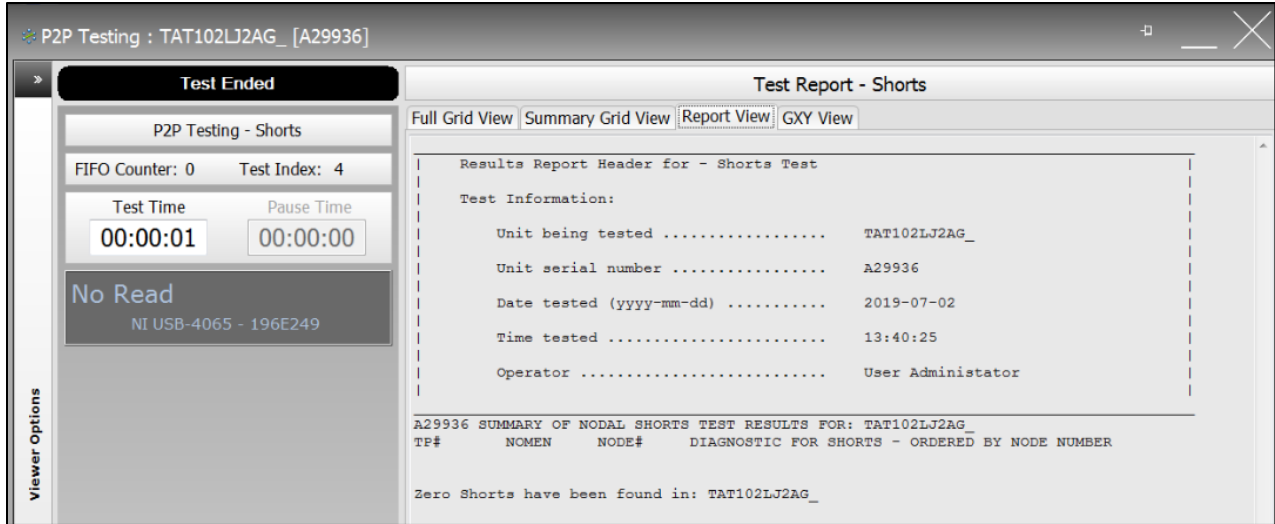
**Graphic 9 - Continuity Graphic (GXY View) - S/N: A29936**



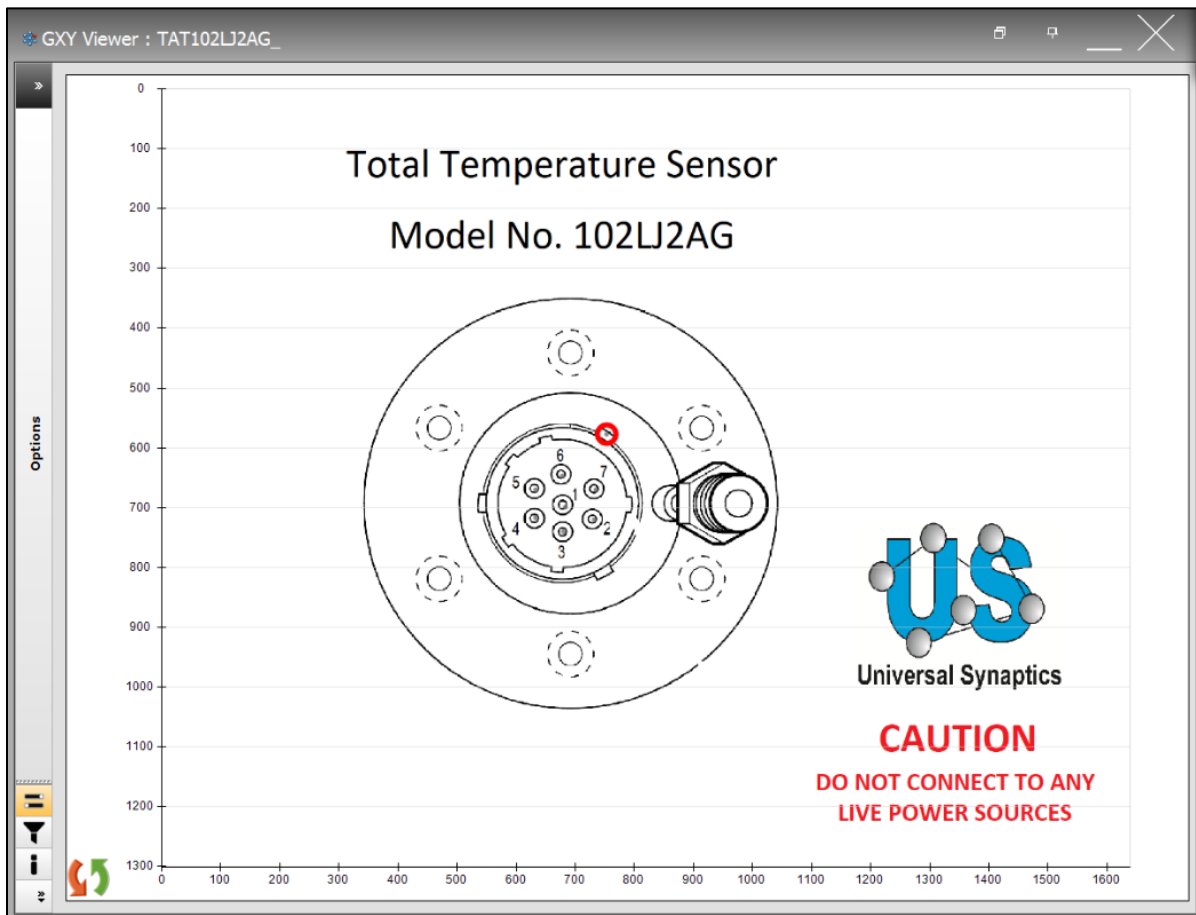
Graphic 10 - Continuity Report & Results (Report View) - S/N: A29936



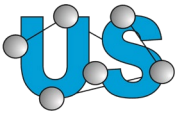
Graphic 11 - Shorts Graphic (GXY View) - S/N: A29936



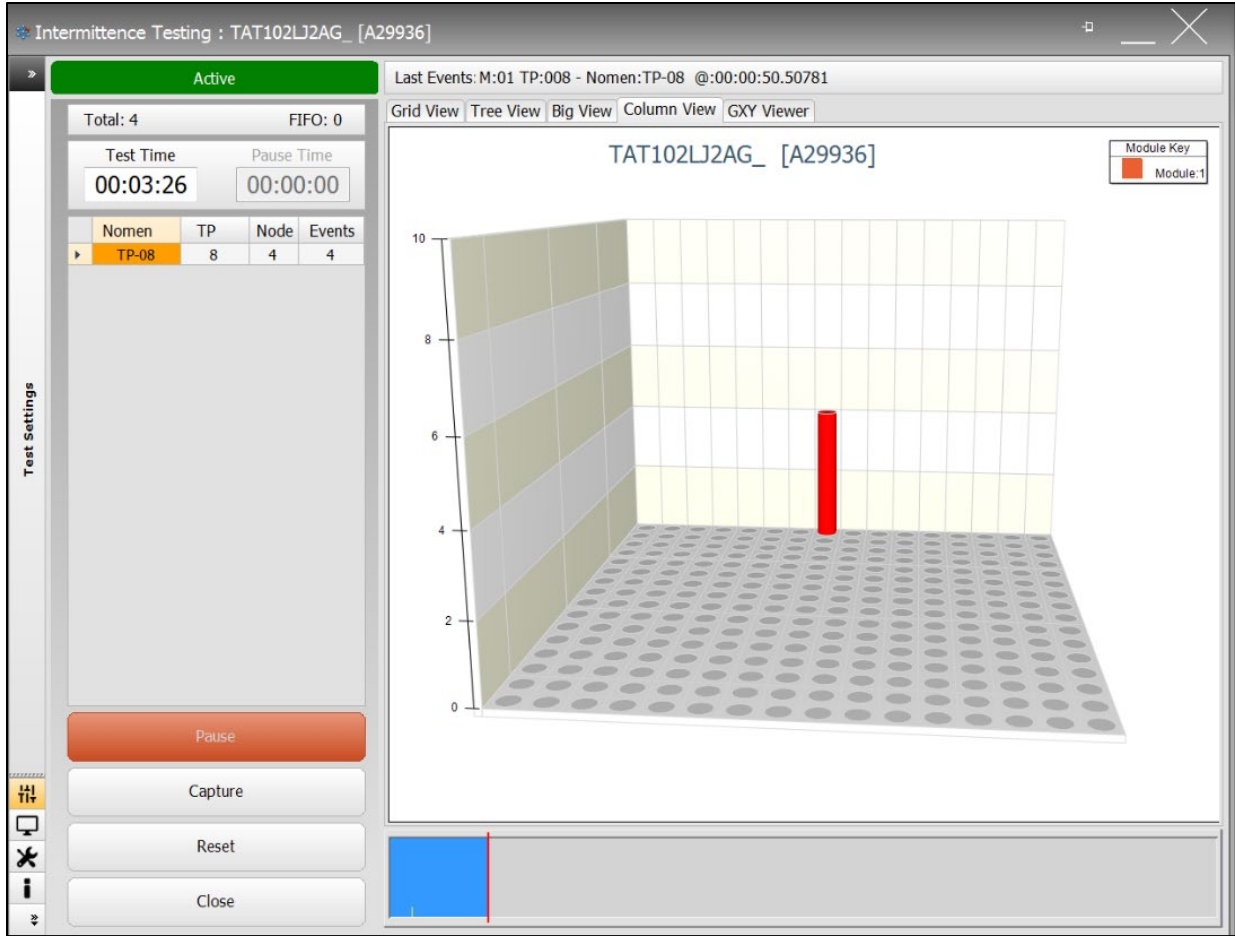
Graphic 12 - Shorts Report & Results (Report View) - S/N: A29936



Graphic 13 - Intermittence Graphic (GXY View) - S/N: A29936



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Graphic 14 - Intermittence Graphic (Column View) - S/N: A29936



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## Summary:

Universal Synaptics' patented Intermittent Fault Detection technology has proven to detect and isolate intermittent faults which results in an increase in aircraft component reliability. As proven by this demonstration, the IFD-256 will increase the reliability of the aircraft by ensuring that quality TAT Probes are installed on [REDACTED] aircraft, subsequently preventing Operational Difficulty Index (ODI) events and customer dissatisfaction.

### S/N: A80547

[REDACTED] provided details:

- Installed: 12/15/2012
  - Removed: 6/9/2019
  - Time Since Overhaul (TSO) / Cycles Since Overhaul (CSO): 9,338 FH / 5,061 FC
  - No previous removal history
  - Believed to be a new probe, not a repaired probe
- 
- Continuity, Shorts, and Intermittence tests indicate a catastrophic failure of this probe
  - Based on the curve of degradation from a Stage 1 (random low-level micro-breaks) to a Stage 2 (intermittent that causes operational failure) to a Stage 3 (semi-hard or hard broke), this asset was a candidate for IFD testing prior to install
    - All Stage 3 continuity and shorts found during testing could have likely been manifesting as Stage 1 faults and repaired prior to install, thus extending time-on-wing greater than 9,338 FH

### S/N: A29936

[REDACTED] provided details:

#### 1<sup>st</sup> Install

- Installed on A/C #6707: 12/15/2015
- Removed from A/C #6707: 3/22/2017
- Reason for removal: proactive replacement of TAT due to trend shift on both engines
- Unit overhauled by [REDACTED]: 5/1/2017 (overhauled with latest and greatest Repair Specification)

#### 2<sup>nd</sup> Install

- Installed on A/C #6717: 6/15/2018
- Removed from A/C #6717: 6/6/2019
- Time Since Overhaul (TSO) / Cycles Since Overhaul (CSO): 3,074 FH / 1,294 FC
- Reason for removal: EICAS message for TAT Probe
- Unit last overhauled: 5/1/2017





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- Continuity and Intermittence tests indicate a catastrophic failure of this probe
- Based on the curve of degradation from a Stage 1 (random low-level micro-breaks) to a Stage 2 (intermittent that causes operational failure) to a Stage 3 (semi-hard or hard broke), this asset was a candidate for IFD testing prior to install
  - All Stage 3 continuity and shorts found during testing could have likely been manifesting as Stage 1 or 2 faults and repaired prior to install, thus extending time-on-wing greater than 3,074 FH

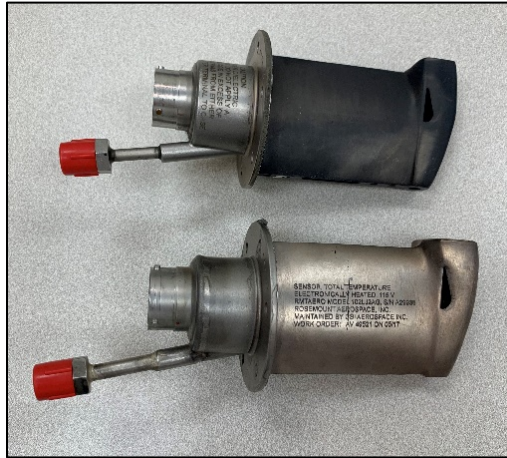


Image 1 – Total Air Temperature Probes – S/N: A80547 and S/N: A29936