

# NATIONAL TRANSPORTATION SAFETY BOARD

Vehicle Recorder Division  
Washington, D.C. 20594

March 28, 2016

## Non-Volatile Memory Devices

Specialist's Factual Report  
By Ben Hsu

### 1. EVENT SUMMARY

Location: Argyle, Texas  
Date: February 4, 2015  
Aircraft: Cessna 441  
Registration: N441TG  
Operator: Del Air Enterprises II, LLC  
NTSB Number: CEN15FA136

### 2. DETAILS OF INVESTIGATION

The National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following devices containing non-volatile<sup>1</sup> memory:

|                            |                     |
|----------------------------|---------------------|
| Device Manufacturer/Model: | Apple iPhone 6 Plus |
| Serial Number:             | 352066060811234     |
| Device Manufacturer/Model: | Apple iPad          |
| Serial Number:             | DMPLL56LFKYC        |
| Device Manufacturer/Model: | Appareo Stratus 2   |
| Serial Number:             | 230331              |

The Apple iPhone 6 Plus exhibited major damage due to impact forces (Figure 1). The device was examined using laboratory hardware and software. No accident-related data was found on the device.

The Apple iPad exhibited minor damage due to impact forces (Figure 2). The device was examined using laboratory hardware and software.

The Appareo Stratus 2 exhibited minor damage due to impact forces (Figure 3). Internal inspection revealed additional damage to the Wi-Fi module. The device was repaired and examined using laboratory hardware and software.

#### 2.1. Apple iPhone 6 Plus and iPad Description

The Apple iPhone 6 Plus and iPad are personal electronic devices (PEDs). PEDs are a category of devices comprised primarily of portable computing devices and mobile phones. Portable computing devices are typically capable of internet access, email,

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<sup>1</sup> Non-volatile memory is semiconductor memory that does not require external power for data retention.

messaging services, and can run user-installed applications to perform specific tasks. Depending on the model, mobile phones can perform many of the same tasks as portable computing devices, plus have voice call and text messaging capabilities. PED user and system data is typically stored on non-volatile memory and can be accessed through manufacturer-provided interfaces.

### **2.1.1. Apple iPhone 6 Plus and iPad Data Description**

Both devices were inspected using mobile device forensic software. No accident-related data was found on the iPhone 6 Plus or iPad. Information regarding previous flights was recovered (Figures 4-10).

### **2.2. Appareo Stratus 2 Description**

The Appareo Stratus 2 is a battery operated ADS-B receiver with GPS capability designed to interface with an iPad running ForeFlight via Wi-Fi . The Stratus uses ADS-B to provide access to NEXRAD radar, METARs, TAFs, NOTAMs and other FAA products via the ForeFlight App installed on a mobile device. The Stratus supports limited reception and display of ADS-B traffic information. Certain models include a complete Attitude Heading Reference System (AHRS) that permits supplemental attitude information on the connected mobile device.

Stratus PRX V2 units with firmware version 1.6 and later have the ability to record up to 20 hours of flight data at a rate of 5 samples per second. The records consist of the following parameters:

- GPS 3-D position
- Altitude
- Groundspeed
- AHRS Pitch, Roll and Yaw
- AHRS 3-D accelerations
- Heading
- Ground Track

#### **2.2.1. Appareo Stratus 2 Data Description**

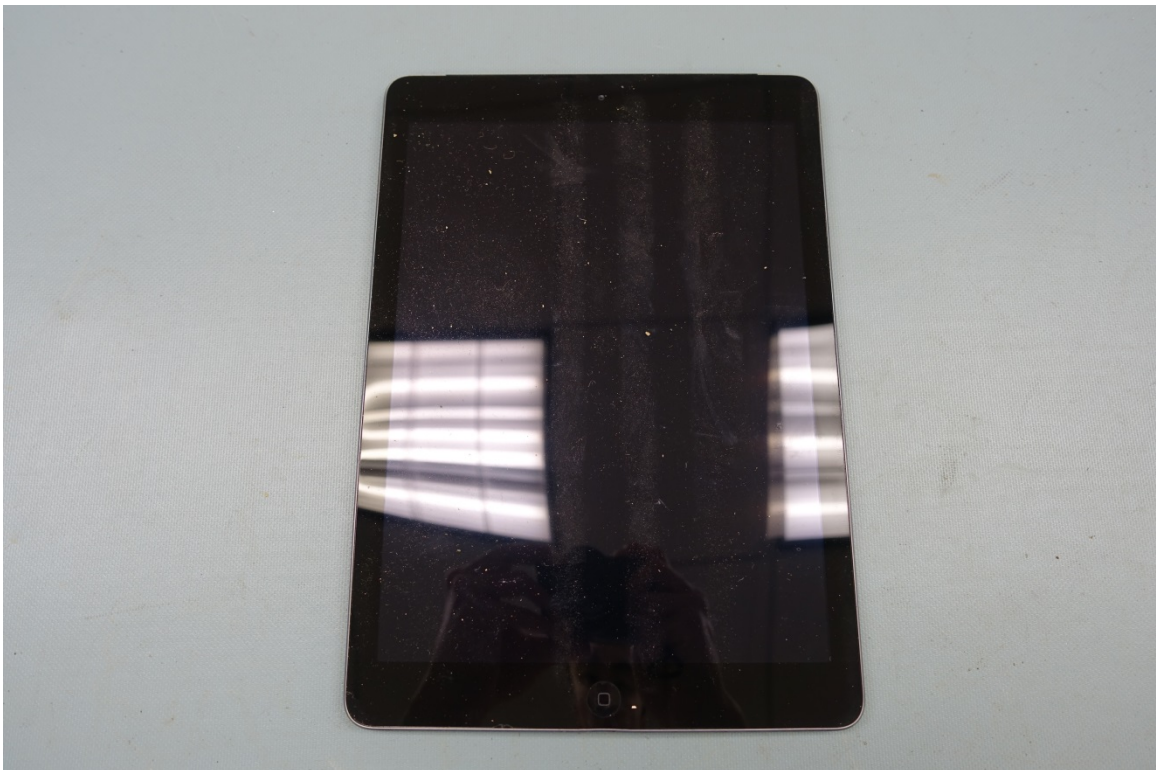
The Stratus 2 was disassembled and the Wi-Fi module was repaired using a socket and jumpers (Figures 11-12). The device was connected to a laboratory iPad via Wi-Fi and data downloaded using the ForeFlight application. Data recorded on February 4, 2015, was determined to be related to the accident and is included in this report.

### **3. OVERLAYS AND TABULAR DATA**

Figure 13 is a Google Earth overlay of data recovered from the Appareo Stratus 2. Tabular data used to create this overlay is included as Attachment 1 in electronic comma-separated value (CSV) format.



**Figure 1. Photo of Apple iPhone 6 Plus**



**Figure 2. Photo of Apple iPad**



**Figure 3. Photo of Appareo Stratus 2**

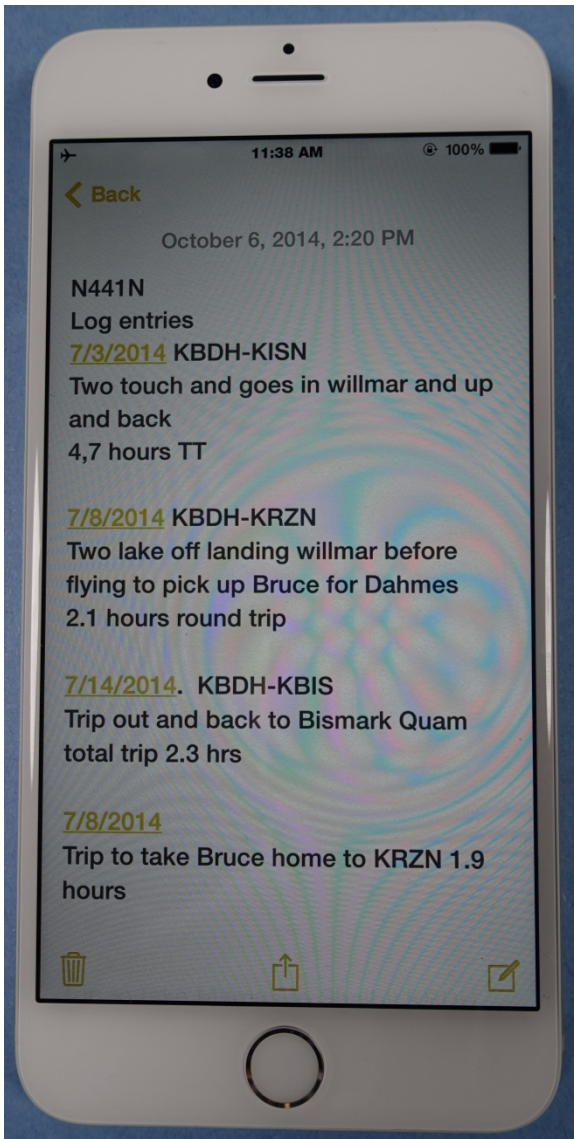


Figure 4. Previous flights logged

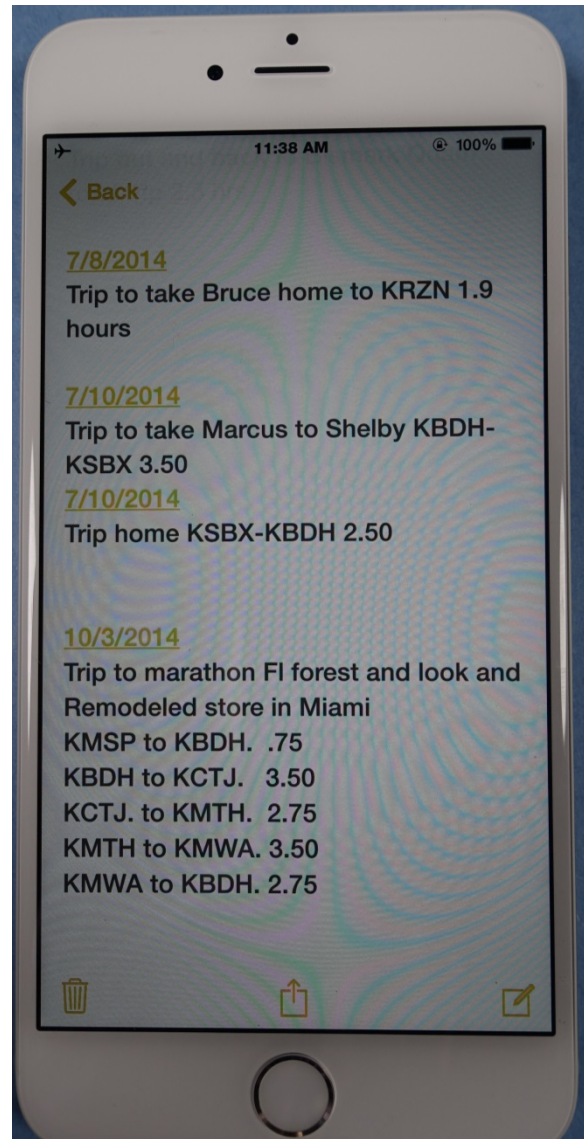


Figure 5. Previous flights logged

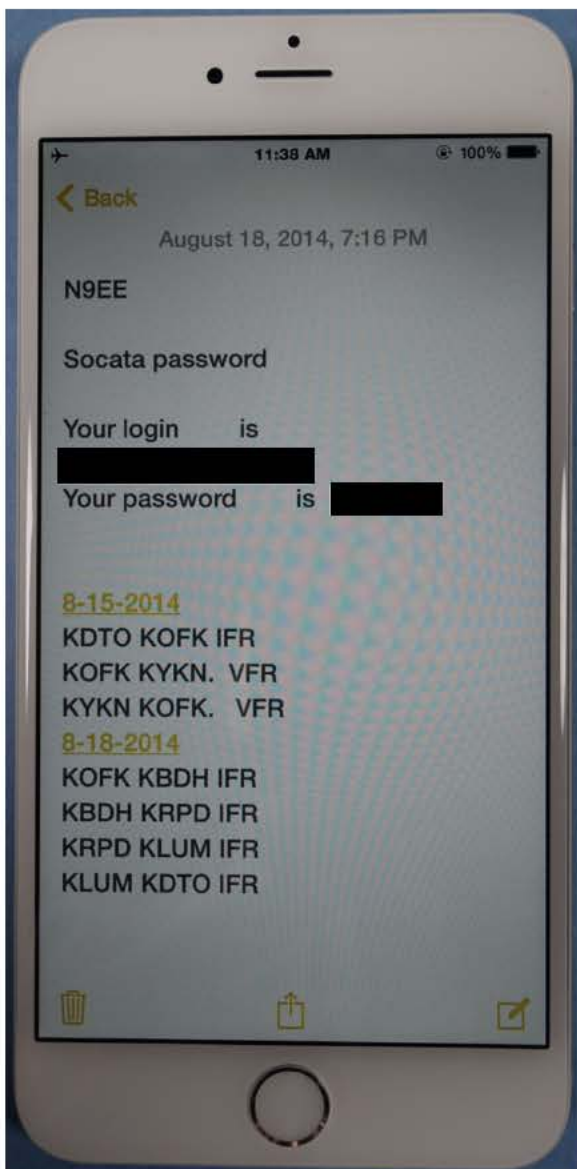


Figure 6. Previous flights logged

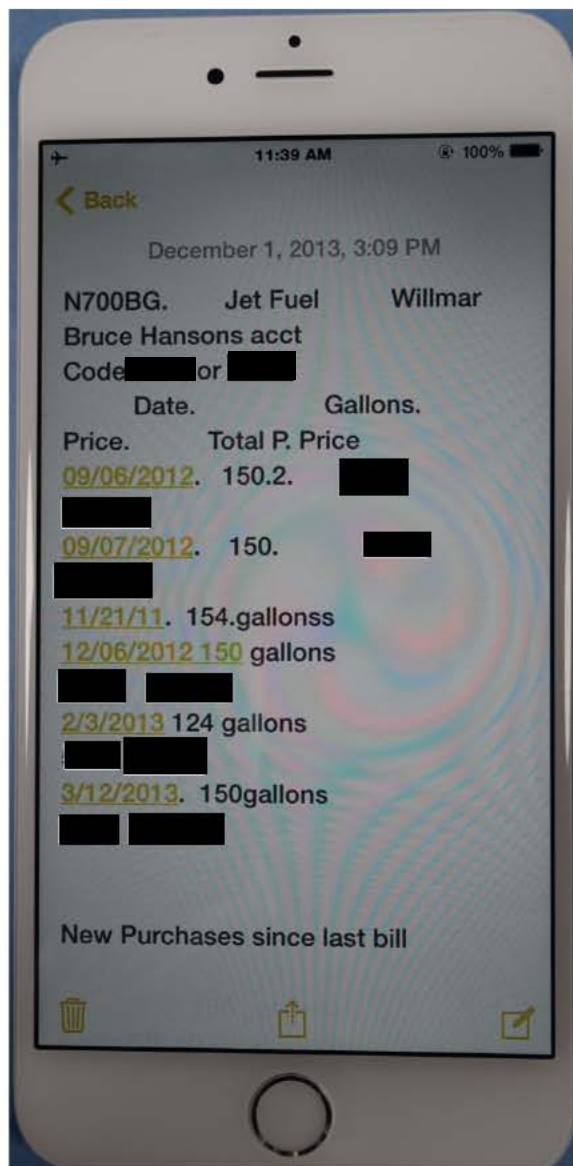


Figure 7. Previous flights logged



Figure 8. Previous flights logged

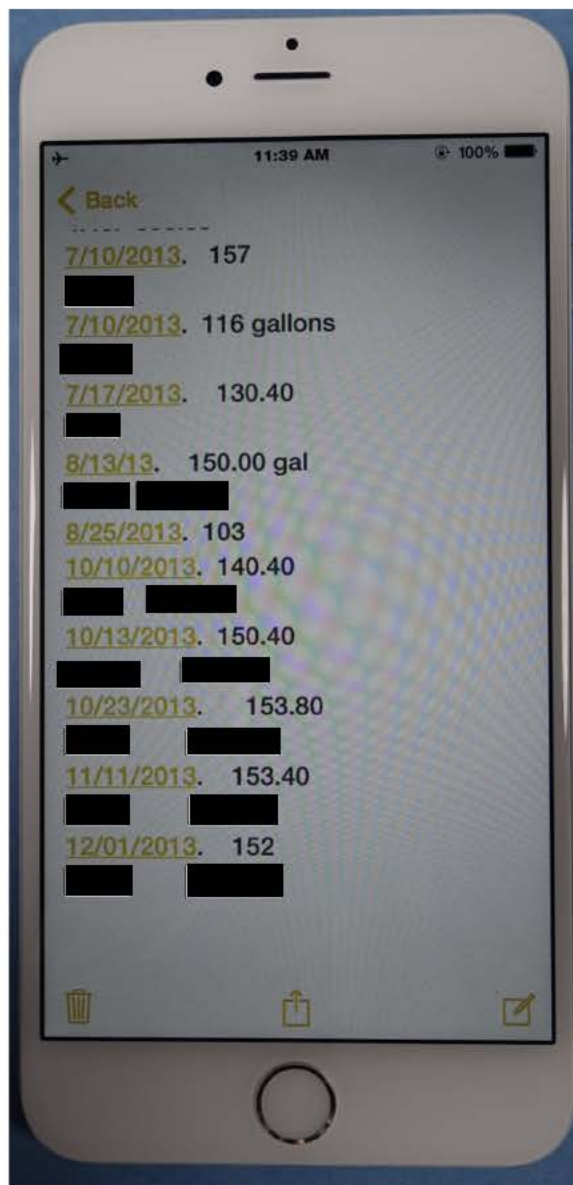


Figure 9. Previous flights logged

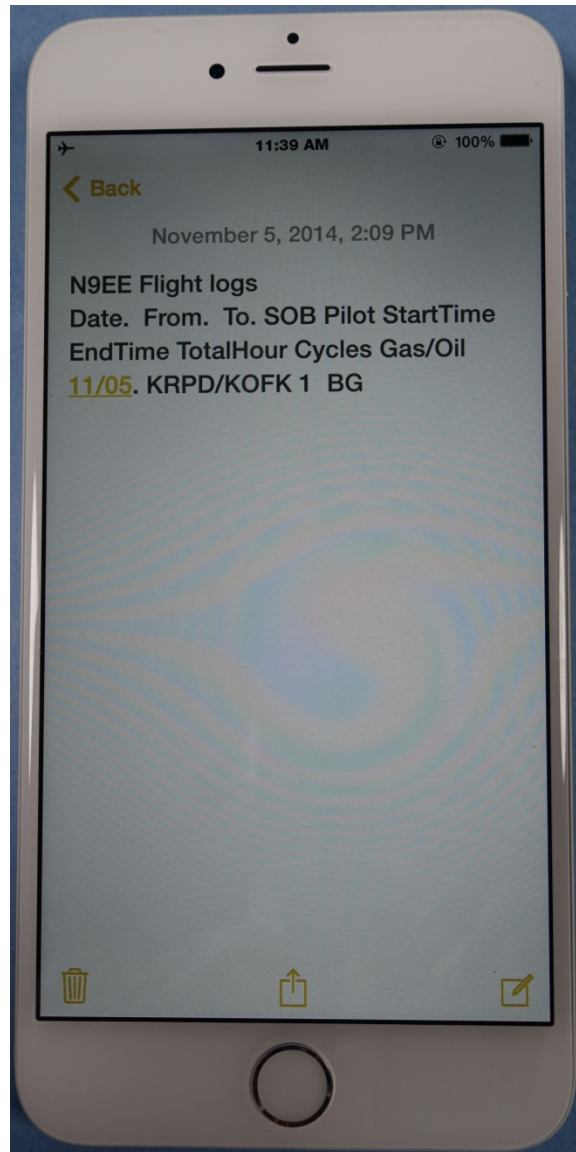


Figure 10. Previous flights logged

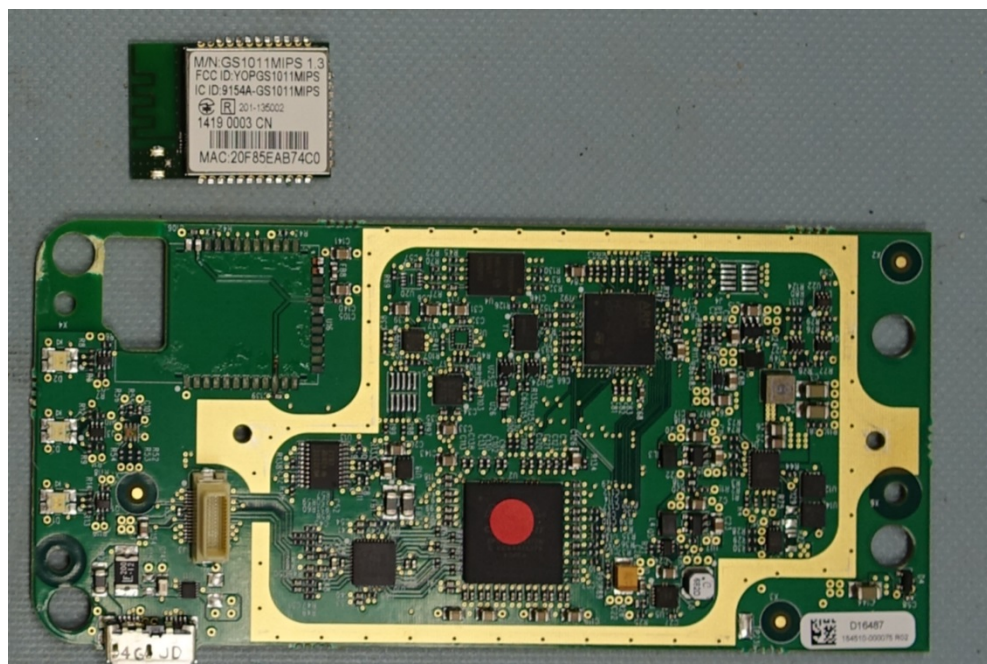


Figure 11. Stratus 2 circuit card after disassembly

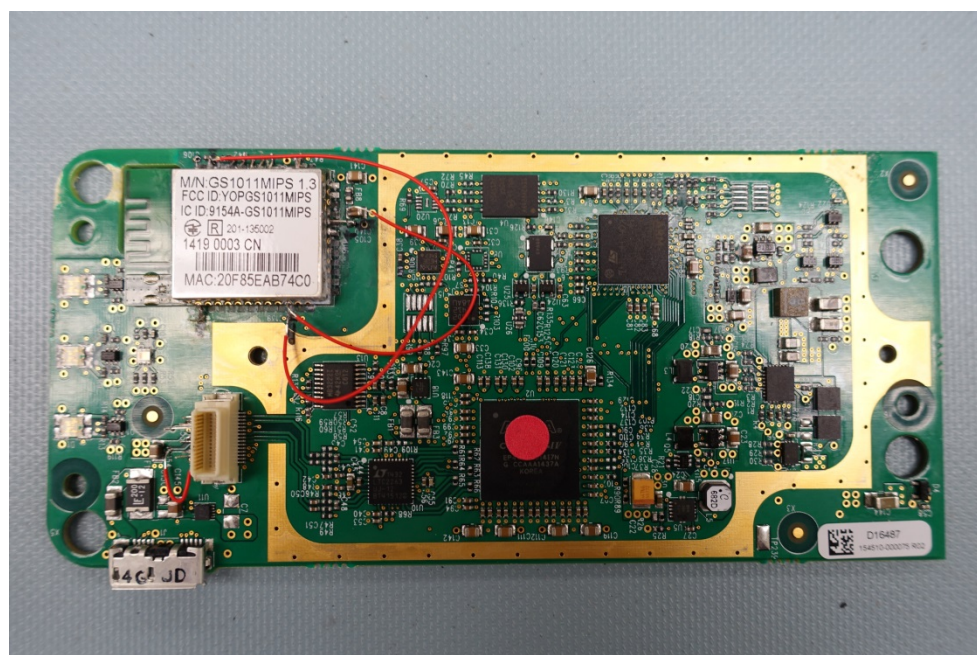


Figure 12. Stratus 2 circuit card after repair

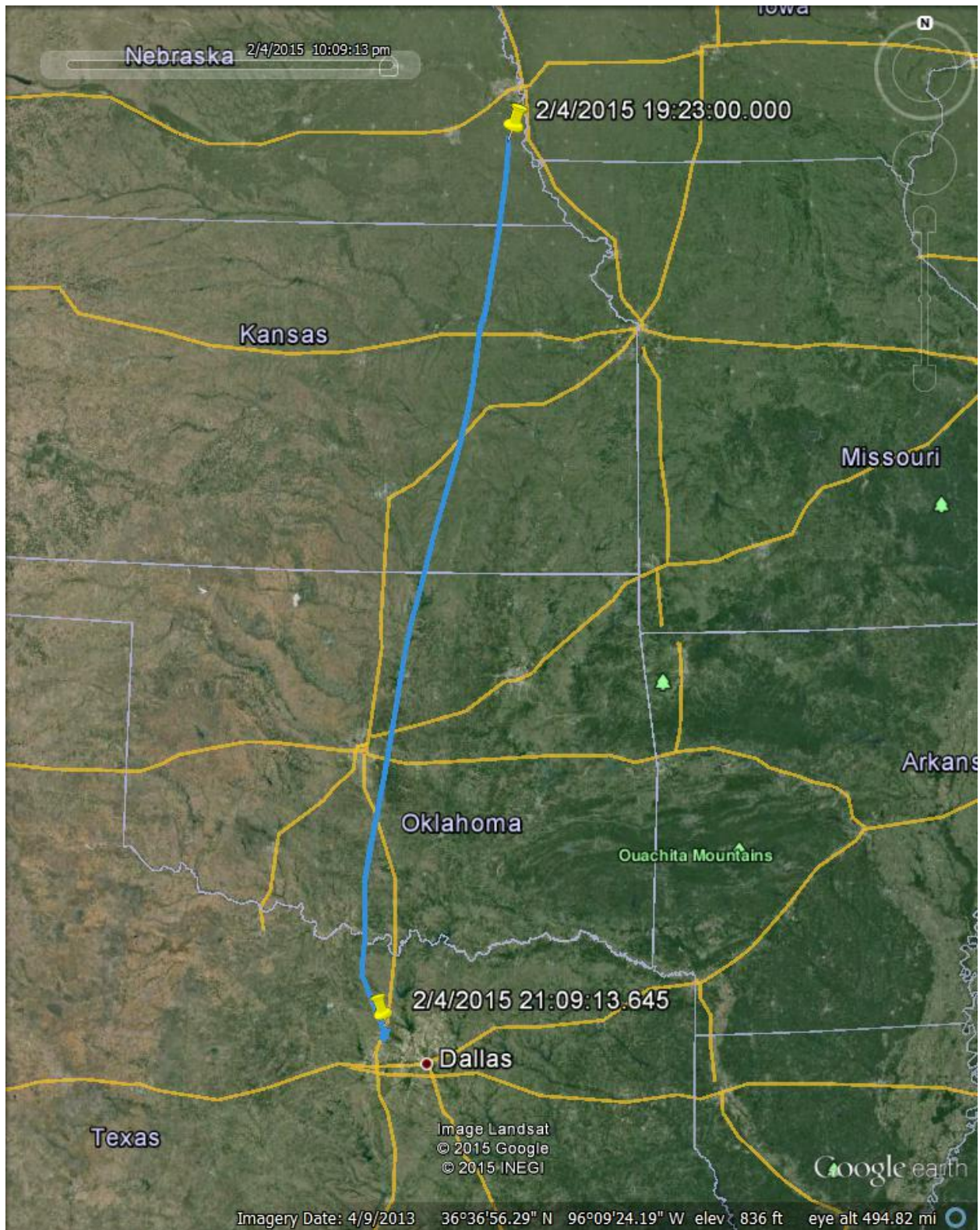


Figure 13. Google Earth overlay of flight data recovered from the Appareo Stratus 2