

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



CEN22FA298

ELECTRONIC DEVICES

Specialist's Factual Report

January 31, 2023

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A. ACCIDENT

Location: St. Jacob, Illinois
Date: July 2, 2022
Time: 1135 Central Daylight Time (CDT)
Airplane: Piper PA-24-250, private operator, N5235P

B. ELECTRONIC DEVICES SPECIALIST

Specialist: Gerald Kawamoto
Recorder Specialist
National Transportation Safety Board (NTSB)

C. DETAILS OF THE INVESTIGATION

An electronic devices data group was not convened.

The NTSB Vehicle Recorder Division received the following electronic devices:

Recorder Manufacturer/Model: Appareo Stratus 2S
Part Number: 153510-000008
Recorder Serial Number: 013788

Recorder Manufacturer/Model: Electronics International FP-5L
Recorder Serial Number: 257078

1.0 Appareo Stratus 2S Description

The Appareo Stratus 2S device is a self-contained battery-powered unit that contains an internal AHRS, GPS/WAAS receiver, and ADS-B receiver in one compact unit.^{1, 2, 3} The unit communicates wirelessly with compatible devices to display all the

¹ The Attitude Heading Reference System consists of a set of 3-axis gyroscope, accelerometers and heading reference sensors that enable the unit to compute pitch, roll, and yaw motions.

² The Wide Area Augmentation System (WAAS) is an air navigation aid to augment the Global Positioning System (GPS), by improving its accuracy, integrity, and availability.

³ Automatic Dependent Surveillance-Broadcast (ADS-B) is a surveillance technology deployed throughout the national airspace system. The ADS-B system is composed of aircraft avionics and a ground infrastructure. Onboard avionics determine the position of the aircraft by using the GPS and transmit its position along with additional information about the aircraft to ground stations for use by air traffic control (ATC) and other ADS-B services. This information is transmitted at a rate of approximately once per second. Operators equipped with ADS-B realize additional benefits from ADS-B broadcast services: Traffic Information Service - Broadcast (TIS-B) (traffic information) and Flight Information Service - Broadcast (FIS-B) (weather information).

acquired information. In addition to communicating with compatible devices, the Stratus device records GPS position and AHRS information internally on a non-volatile flash memory chip.⁴ Internal memory has the space to store over 13 hours of flight data that are sampled at approximately 5 data records per second (5 Hz).

1.1 Appareo Stratus Data Recovery

Upon arrival at the Vehicle Recorder Division, an external examination revealed the device was for the most part in good condition, as shown in Figure 1. Minor damage was sustained to the USB-C connector. The device powered on and data were extracted normally using the manufacturer's procedures.



Figure 1. Appareo Stratus 2S as received.

1.2 Appareo Stratus 2S Recording Description

The recorded data included nine sessions from June 30, 2022, through July 2, 2022 UTC. The session containing the accident event started at 15:51:55 UTC and ended at 16:36:27 UTC. The session contained multiple takeoff and landing events and the final takeoff event of the session was determined to correspond to the accident event. Accuracy of gyroscopic parameters such as pitch angle and bank angle are dependent on the orientation of the device in the aircraft and proper calibration of the device.

⁴ Non-volatile memory (NVM) is semiconductor memory that does not require external power for data retention.

2.0 Electronics International FP-5L Description

The Electronics International FP-5L is a digital fuel computer with the capability to display fuel related parameters such as fuel flow, horsepower, fuel remaining, and fuel used. The non-volatile memory is limited to fuel remaining and fuel used. The fuel remaining parameter is not a measurement of fuel in the tanks, rather it is a calculation based on the starting fuel level the operator programmed into the device minus the fuel used while the engine was running. Accuracy of the parameters is dependent on proper calibration.

2.1 Electronics International FP-5L Data Recovery

The device sustained minor damage, as shown in Figure 2. The device powered on normally and non-volatile parameters were noted.



Figure 2. Electronics International FP-5L as received.

2.2 Electronics International FP-5L Recording Description

Fuel used (since last fill up), as shown in Figure 3, displayed 37.7 gallons. Fuel remaining, as shown in Figure 4, displayed 20.3 gallons.

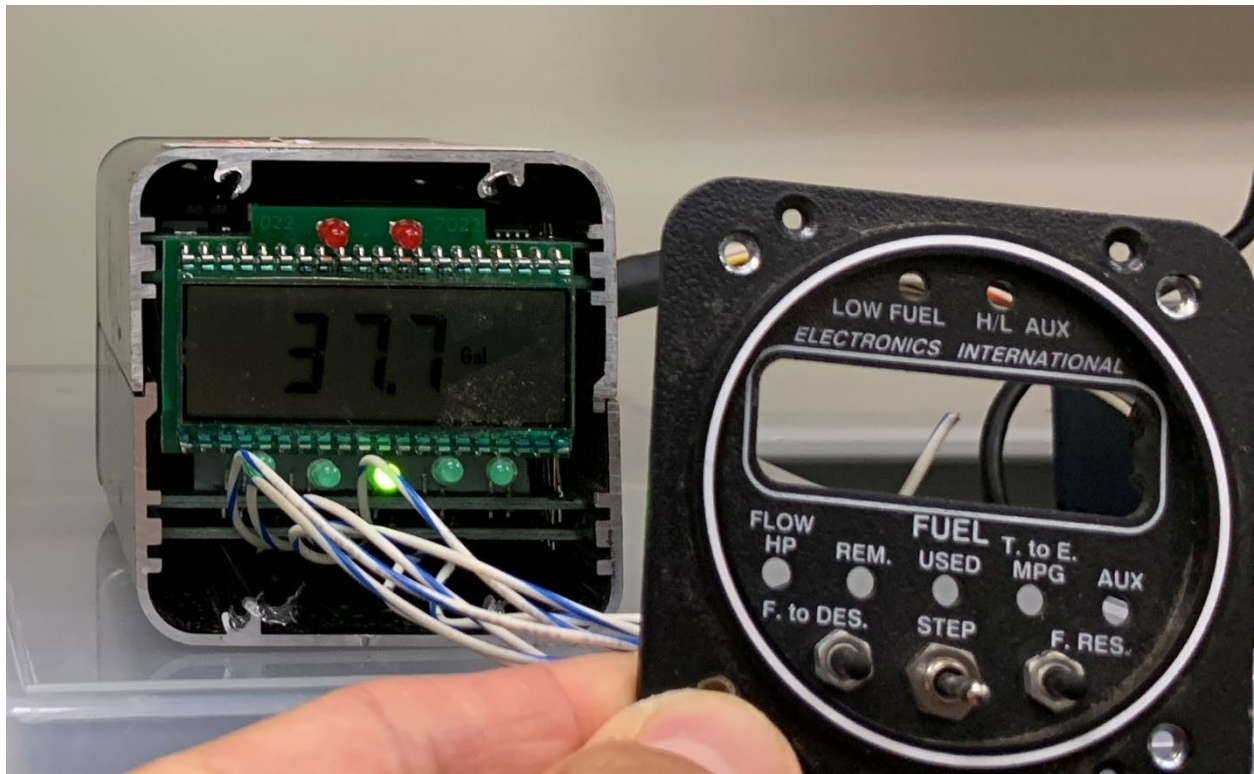


Figure 3. Fuel Used parameter showing 37.7 Gallons.

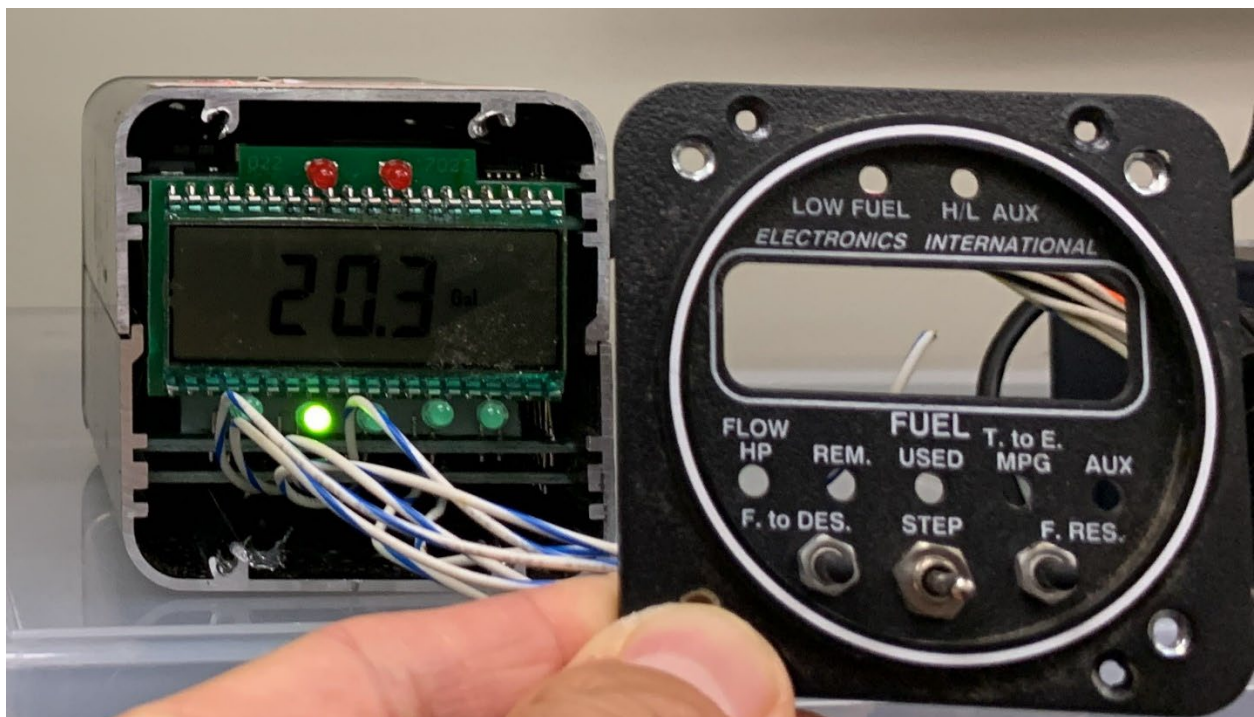


Figure 4. Fuel Remaining parameter showing 20.3 Gallons.

D. FIGURES AND TABULAR DATA

Figures 5 to 8 are graphical overlays generated using Google Earth showing the accident session from the Appareo Stratus. Weather and lighting conditions in Google Earth are not necessarily the weather and lighting conditions present at the time of the recording.

Figure 5 is an overview of the entire session.

Figure 6 shows end of the session. The final takeoff of the session, which corresponded to the accident event, is depicted.

Figure 7 shows the end of the accident event and reported wreckage location.

Figure 8 shows the final apparent valid data point at 16:34:42 UTC and the reported wreckage location.

Figure 9 is a plot of parameters for the entire session. The time shown is 15:50:00 to 16:37:00 UTC.

Figure 10 is a plot of parameters at the end of the session, depicting the final takeoff portion and accident event. The time shown is 16:34:00 to 16:34:43 UTC.

The corresponding tabular data used to create Figures 5 to 10 are provided in electronic comma separated value (CSV) format as attachment 1 to this report.

Submitted by:

Gerald Kawamoto
Recorder Specialist

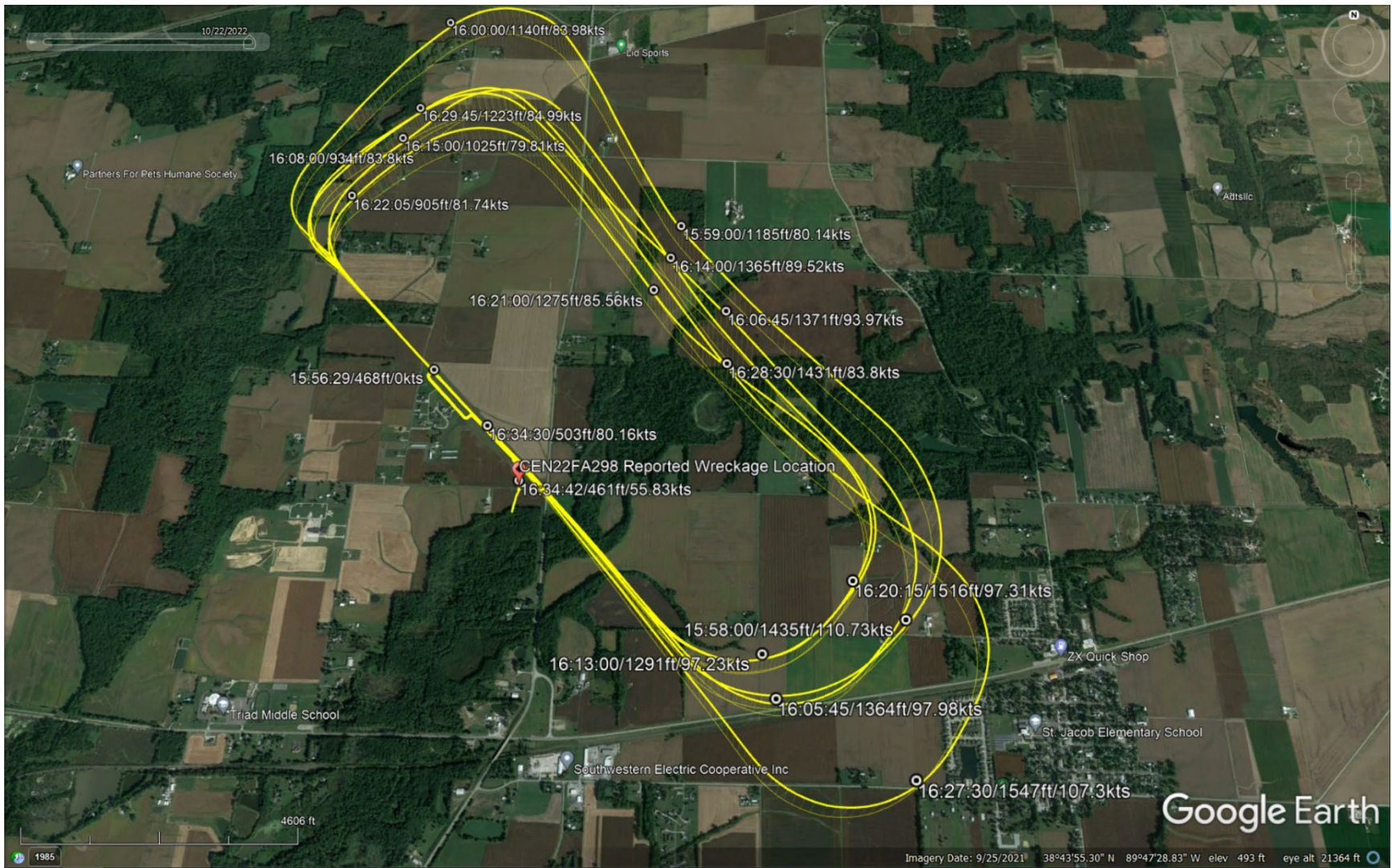


Figure 5. Google Earth overlay of the entire session.



Figure 6. Google Earth overlay showing the final takeoff of the accident session.

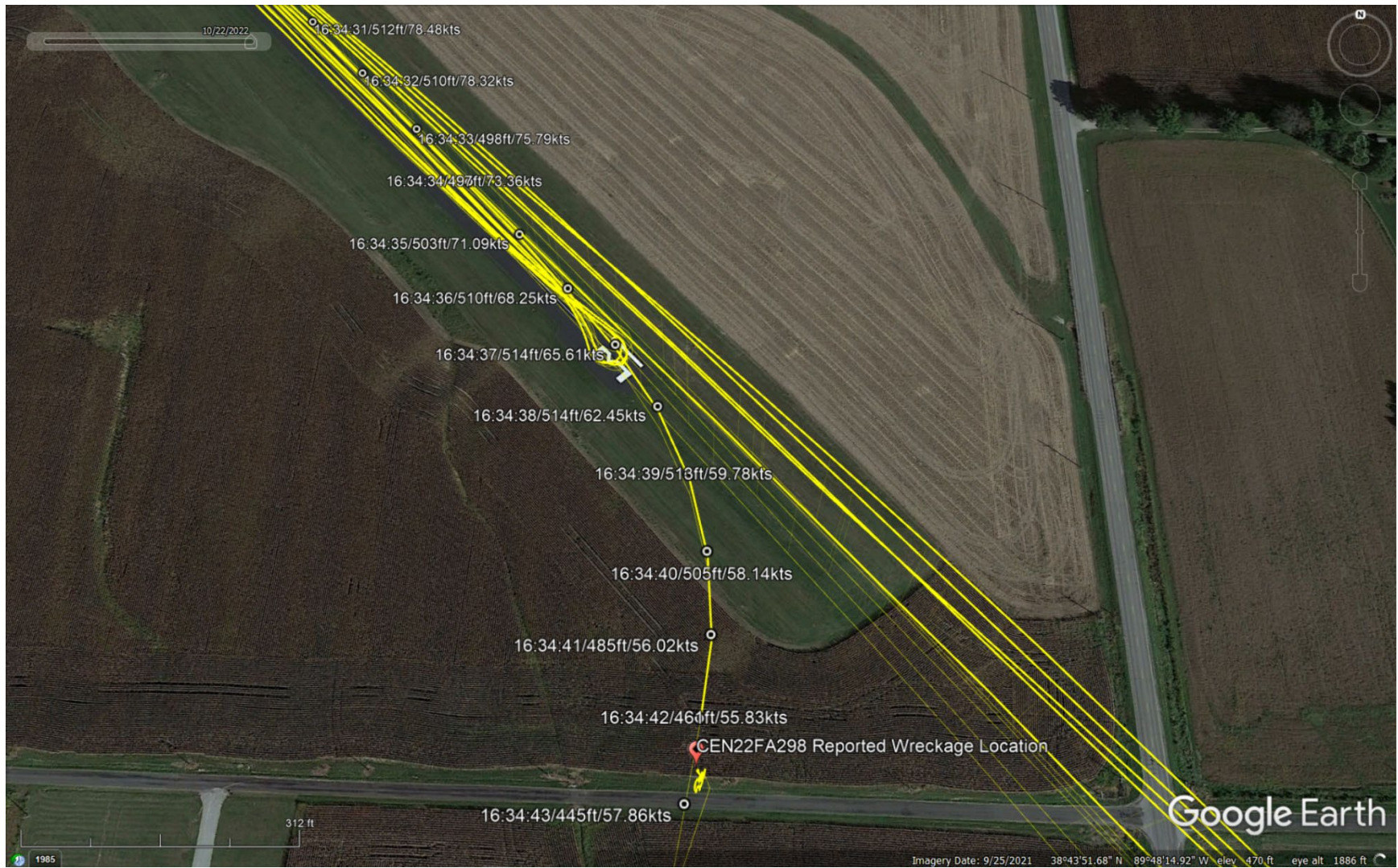


Figure 7. Google Earth overlay showing the end of the accident event.

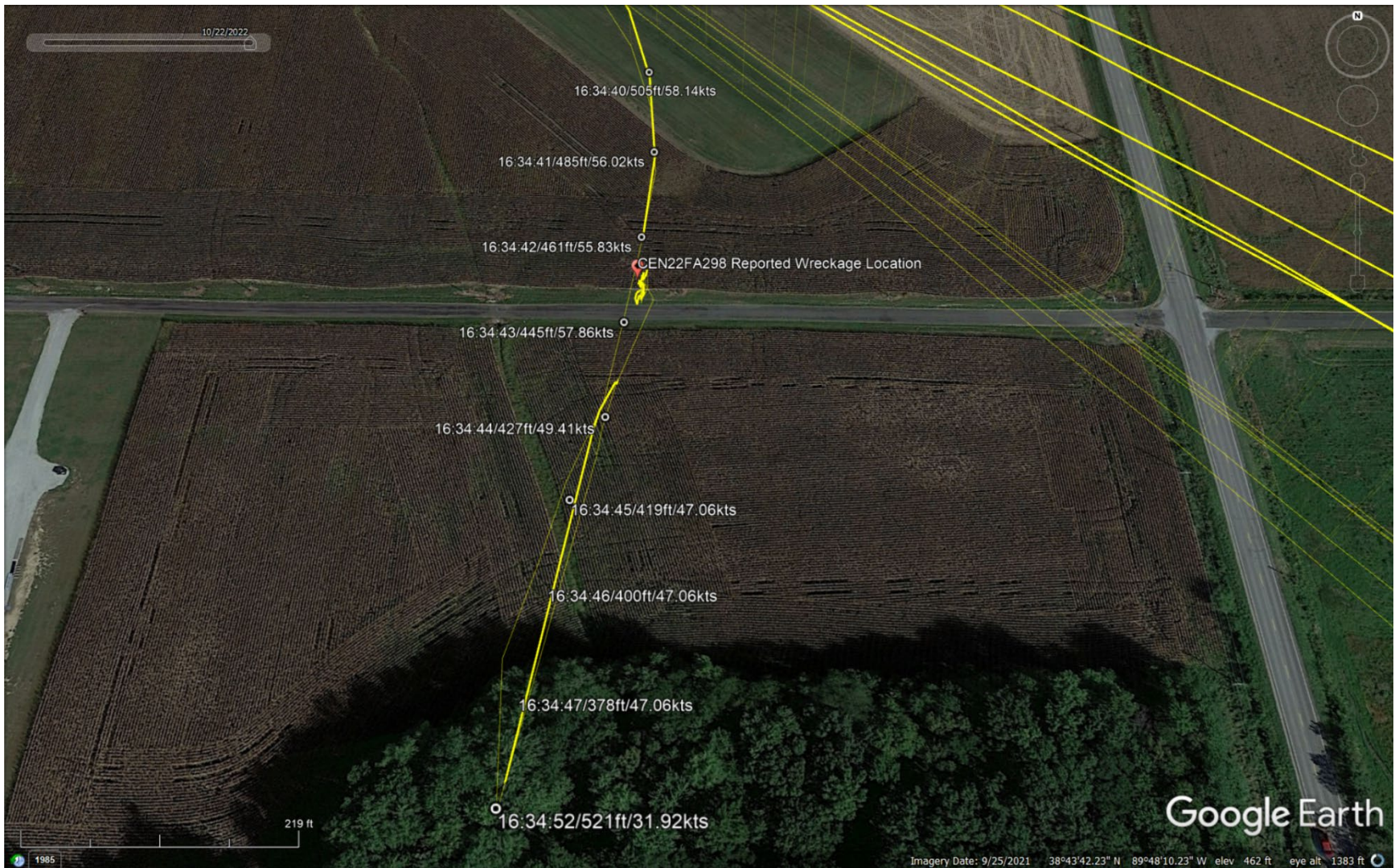


Figure 8. Google Earth overlay showing the end of valid data. The final valid data point appears to be at 16:34:42 UTC.

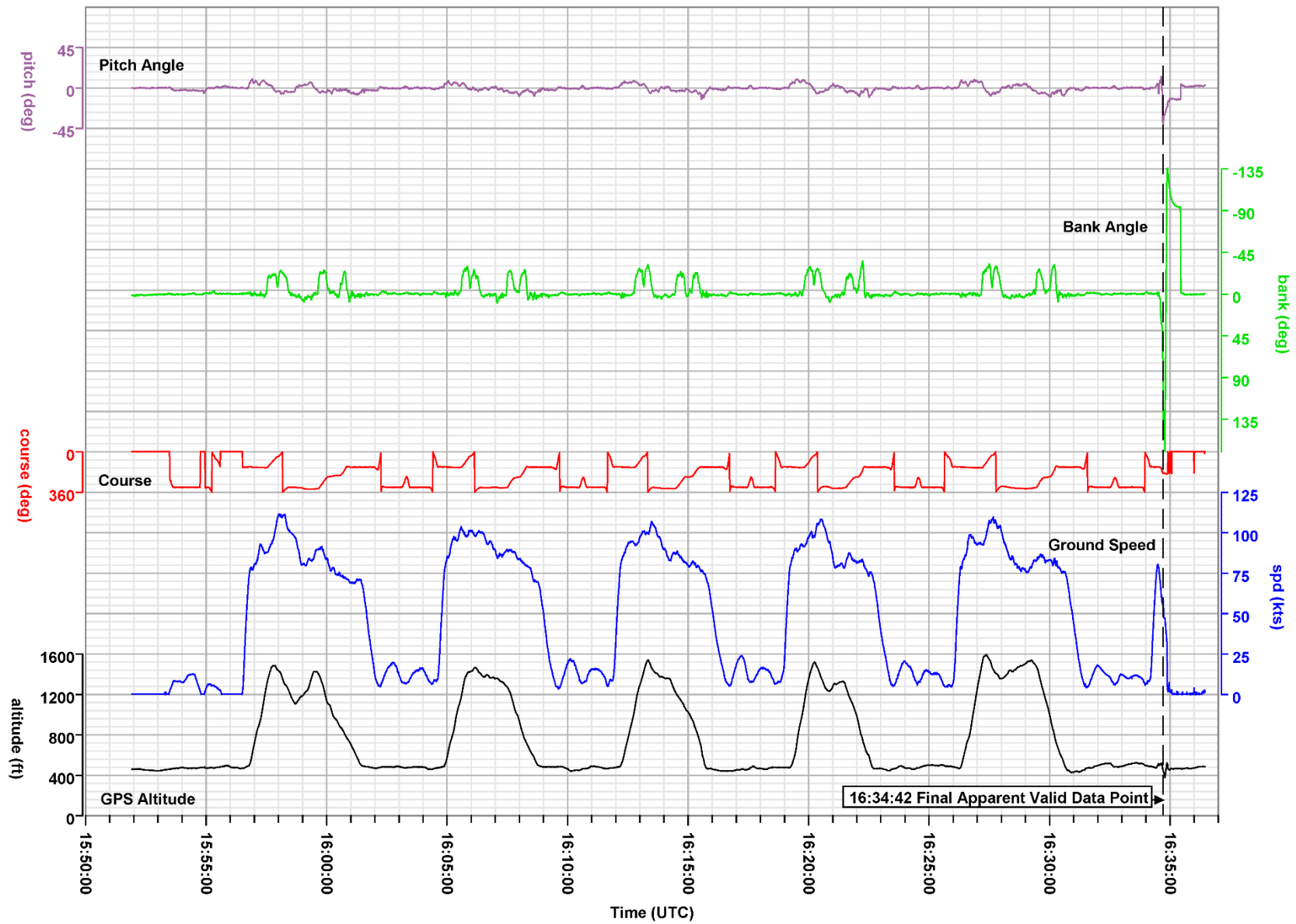


Figure 9. Plot of parameters for the entire session.

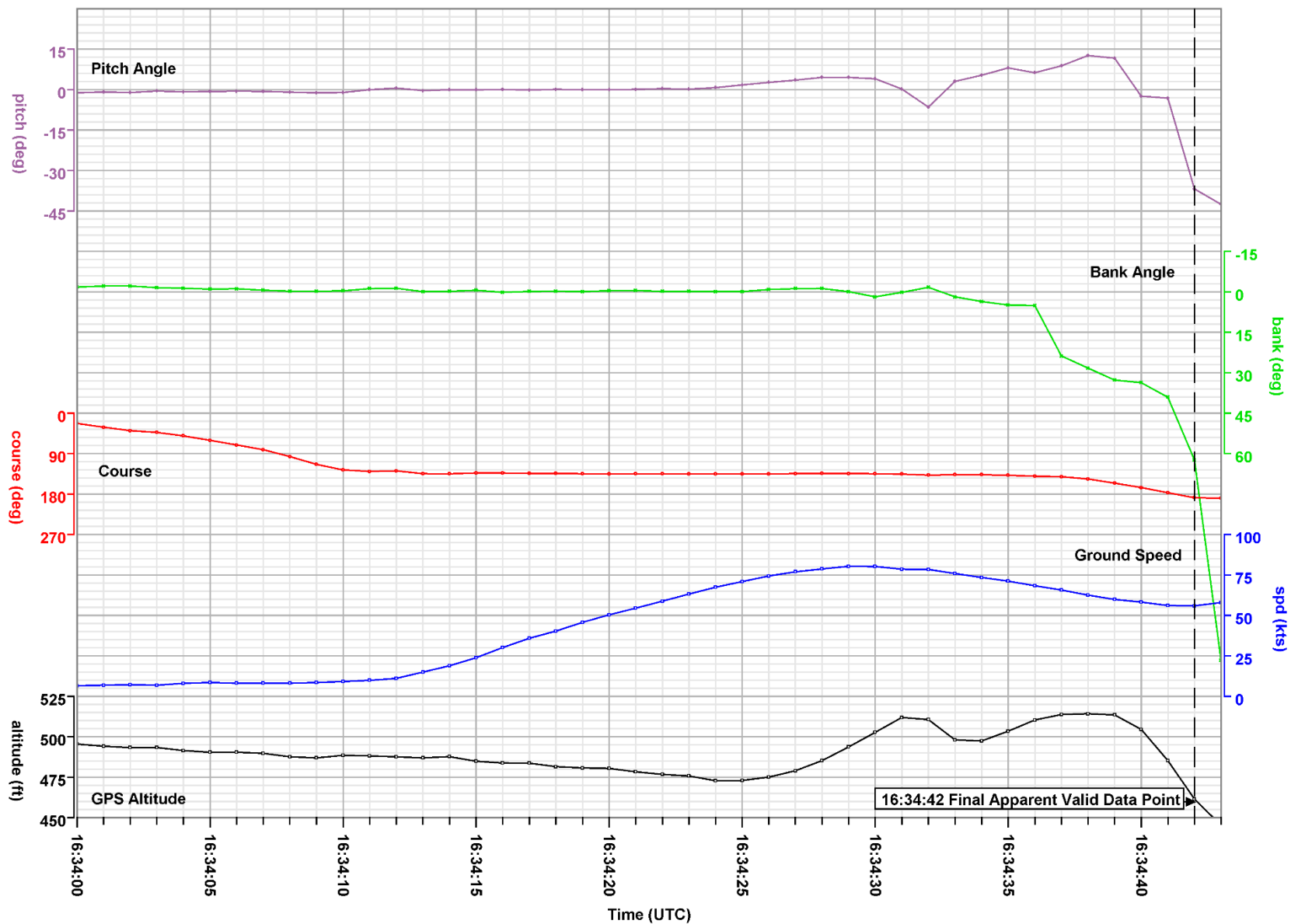


Figure 10. Plot of parameters at the end of the session. The final takeoff is depicted.