

NATIONAL TRANSPORTATION SAFETY BOARD

Vehicle Recorder Division

Washington, D.C. 20594

October 11, 2018

Global Positioning System Device

Specialist's Factual Report

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1. EVENT SUMMARY

Location: Minden, Nevada
Date: February 19, 2018
Aircraft: Piper PA-34-200T
Registration: N14GQ
Operator: Private
NTSB Number: WPR18FA091

On February 19, 2018, about 1130 Pacific standard time, a Piper PA-34-200T airplane, N14GQ, collided with the ground northwest of the Minden-Tahoe Airport (MEV), Minden, Nevada. The commercial pilot was fatally injured. The airplane was destroyed. The airplane was registered to the Stunad, LLC, and operated by the pilot under the provisions of Title 14 *Code of Federal Regulations* Part 91 as a personal flight. Visual meteorological conditions prevailed and a flight plan was not filed. The flight originated from Meadows Field Airport (BFL), Bakersfield, California, about 0900 with an intended destination of MEV.

2. GROUP

A group was not convened.

3. DETAILS OF INVESTIGATION

The National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following global positioning system (GPS) device:

Manufacturer/Model:	Appareo Stratus PRX V2
Serial Number:	221509

3.1. Device Description

The Appareo Status 2 device is a self-contained battery powered unit that contains an internal AHRS,¹ GPS/WAAS receiver,² and ADS-B³ receiver in one compact unit. The unit communicates wirelessly with the pilot's iPad or iPhone ("iOS Device") to display all of the acquired information. The pilot needs to have a particular software application called ForeFlight⁴ installed on their iOS Device to view the Stratus data. In addition to communicating with the iOS Device, the Stratus device records GPS position and AHRS information internally on a non-volatile⁵ flash memory chip. Internal memory has the space to store over 13 hours of data.

3.2. Data Recovery

The device is pictured below in figure 1. The device appeared undamaged externally. Movement of internal parts were heard when the unit was disturbed. The device was opened and examined. The device's Wi-Fi module was found to be displaced from the unit's main circuit board. An attempt at resoldering the Wi-Fi module to the unit's main board was unsuccessful.

The device's internal memory chip was identified and removed using a hot air rework station. The chip was cleaned and read with the appropriate model reader. A binary image was collected of the internal memory. Laboratory software tools were then used to convert the binary data to engineering units.

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 GNSS and transmit its position along with additional information about the aircraft to ground stations for use by 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).

⁴ iOS Device app (program) that communicates wirelessly with the Appareo Status unit to display aircraft's attitude, navigation, weather, and traffic information.

⁵ Type of solid state memory that does not require electrical power to retain information.



Figure 1. Photo of damaged Appareo Stratus.

3.3. Data Description

The data extracted included a number of sessions which corresponded with various different flights. Because of the device's internal time schema, each flight was not individually parsed. The accident flight was identified and was segregated from data from other flights.

The accident flight was recorded starting at 17:26:40 UTC and data ended at 19:25:15 UTC on February 18, 2018.

Vertical Speed and Acceleration Z were found to be reversed when compared to other data. These data were then inversed in the plotted information and tabular data provided in this report. It was unclear whether the device was mounted upside down by the pilot, or if there was a conversion error in the translation of the binary data to engineering units.

3.4. Parameters Provided

Table 1 describes data parameters provided by the GPS device. Date, Time, Latitude, Longitude, Pitch, Roll, Acceleration (X,Y,&Z) and GPS Altitude are recorded by the device. Groundspeed, Ground Track and Vertical Speed are derived from the recorded parameters.

Table 1: GPS Data Parameters

Parameter Name	Parameter Description
Date	Date for recorded data point (MM/DD/YYYY)
Time	Time (UTC) for recorded data point (HH:MM:SS)
Latitude	Recorded Latitude (degrees)
Longitude	Recorded Longitude (degrees)
Altitude HAMSL	Height Above Mean Sea Level (feet)

Ground Speed	Groundspeed (kts)
Ground Track	Groundtrack (deg.)
Vertical Speed	Vertical Speed (fpm)
Pitch	Pitch (deg.)
Roll	Roll (deg.)
Acceleration X	Acceleration in X-Axis (g)
Acceleration Y	Acceleration in Y-Axis (g)
Acceleration Z	Acceleration in Z-Axis (g)

3.5. OVERLAYS AND TABULAR DATA

All times are presented in Universal Coordinated Time (UTC).

Figure 2 is an overlay on Google Earth of the aircraft's departure from BFL. The recording originated around 17:26 near a ramp area in the southwest corner of BFL. By 17:34:31, the aircraft had entered runway 30R. By 17:35:34, the aircraft had departed straight out from runway 30R at BFL.

Figure 3 is an overlay of Google Earth of the aircraft's enroute portion of flight. Around 18:17, the aircraft was in the vicinity of Fresno, California. By 18:33, the aircraft had begun a new course toward the north. By 18:45, the aircraft began a track to the northeast toward the accident site.

Figure 4 is an overlay on Google Earth of the final recorded tracklog points in the dataset. At 19:23:06 the aircraft began a right turn in the vicinity of Indian Hills, Nevada. The aircraft continued into a descending right spiral. Around 19:24:25, the aircraft had completed one 360 degree turn and had descended. By 19:24:49, the last resolute recorded tracklog point was recorded. The remaining tracklog points logged after 19:24:49 may be anomalous, however, the last recorded tracklog point at 19:25:15 was in agreement with the GPS coordinates of the wreckage location provided by the Investigator-In-Charge (IIC).

Figure 5 is a plot of basic flight data from the Appareo device during the entire accident flight. The plotted time interval is between 17:25:00 and approximately 19:30:00.

Figure 6 is a plot of basic flight data from the Appareo device during the accident portion of flight. The plotted time interval is between 19:21:00 and approximately 19:26:00. At the start of the plot, the Appareo data shows level flight at an altitude of around 14,000 feet MSL and 160 knots groundspeed. Around 19:21:33, there is a slight perturbation in roll of about 10 degrees right. The aircraft continues in level flight until about 19:22:00 when the recorded data begins to show instability about the roll axis. Around 19:22:56, roll was recorded as about 25 degrees right, vertical speed and pitch began to change. The derived data for ground track showed a significant heading change to the right. At this time, acceleration in the Z axis began to grow from 1 g.

In the next minute, roll continued to increase to the right, ground track also showed a right turn. By 19:24:07, pitch began to change rapidly and increased to a maximum of about

-50 degrees nose down. Data showed the aircraft in a flight profile consistent with a tight right downward spiral. Acceleration in the Z axis increased to about +2.75 g at 19:24:42.

At 19:24:42, derived parameters showed instability, possibly consistent with invalid data. For the next approximate 10 seconds, acceleration in the Z axis continued to increase until it reached almost +4 g by 19:24:56.

At 19:24:56, data appeared to become invalid for most parameters.⁶ The recording ended at 19:25:15.

Tabular data used to generate figures 2 through 6 are included as Attachment 1. This attachment is provided in electronic comma-delimited (.CSV) format.

⁶ The Appareo Stratus device is a removeable device and can be placed by user in various places throughout the aircraft's cockpit. The most popular methods of mounting the device are either using a suction cup or a rubber pad that sits on the aircraft's glareshield. If the device became free of its mounting location, the device would tumble, but continue to record data.



Figure 2. Google Earth overlay showing the aircraft's departure from BFL.

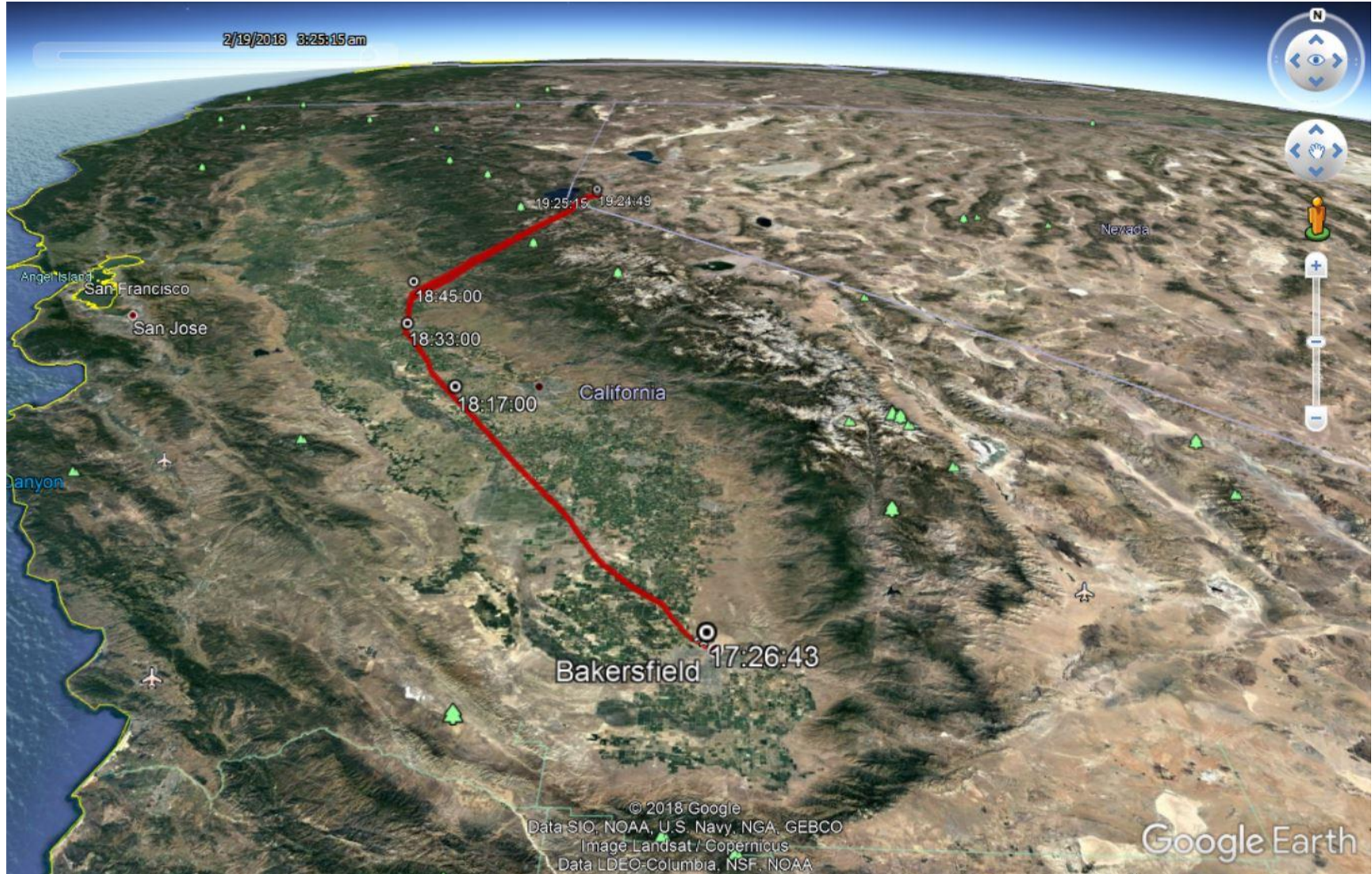


Figure 3. Google Earth overlay showing the aircraft's enroute portion of flight.

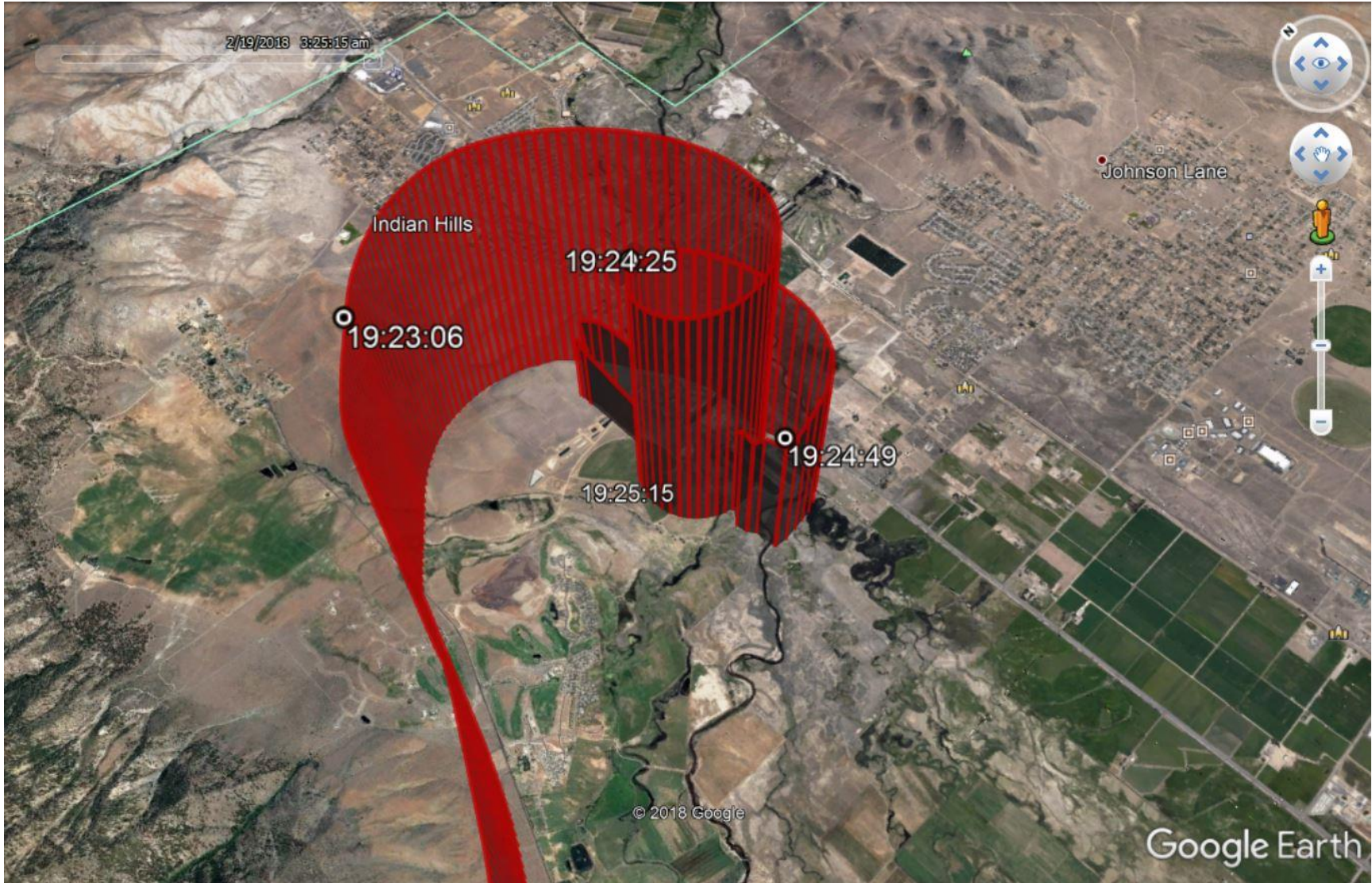


Figure 4. Google Earth overlay showing the aircraft's final recorded tracklog points.

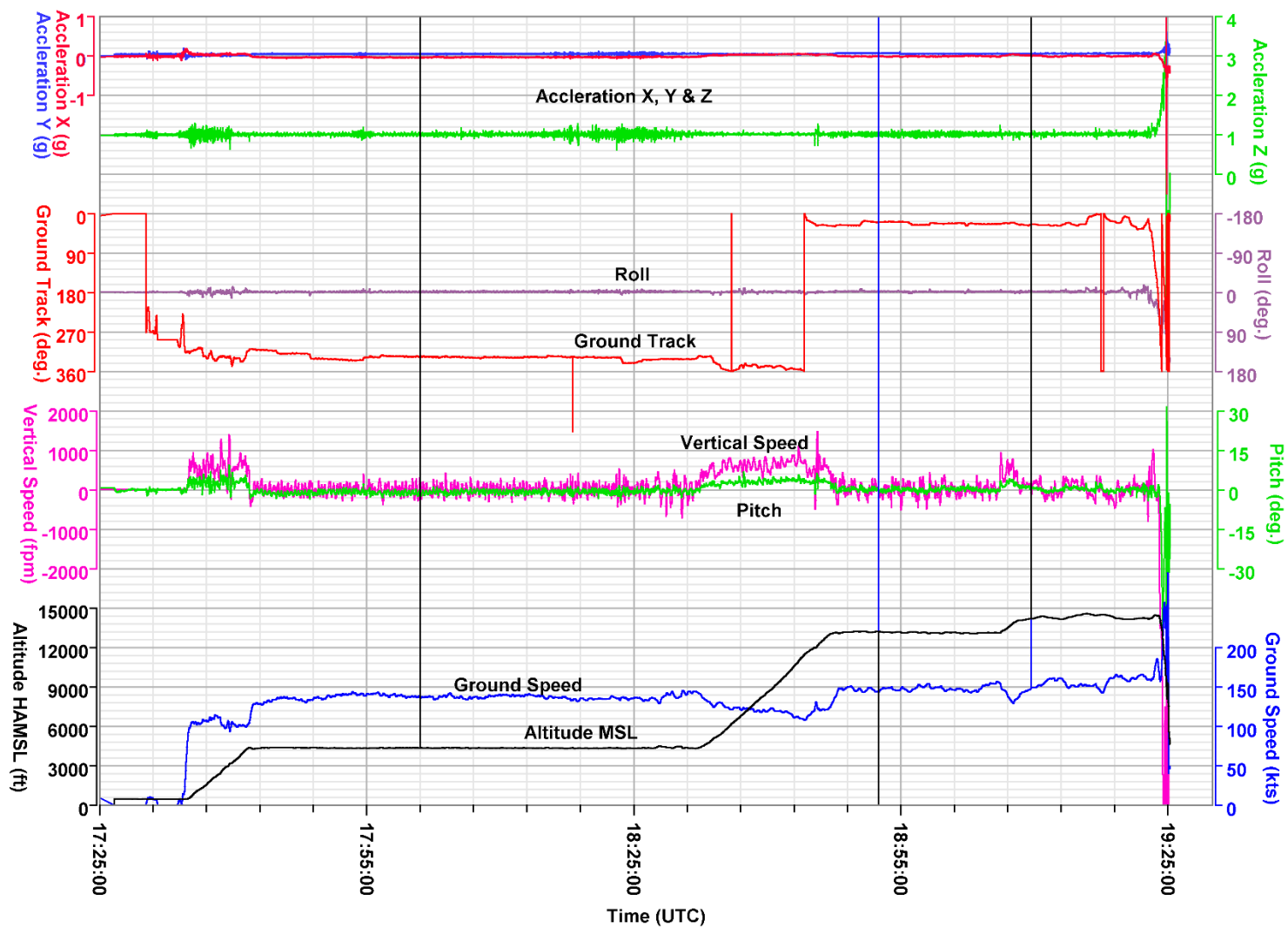


Figure 5. Plot of basic parameters from the Appareo Stratus for the entire flight.

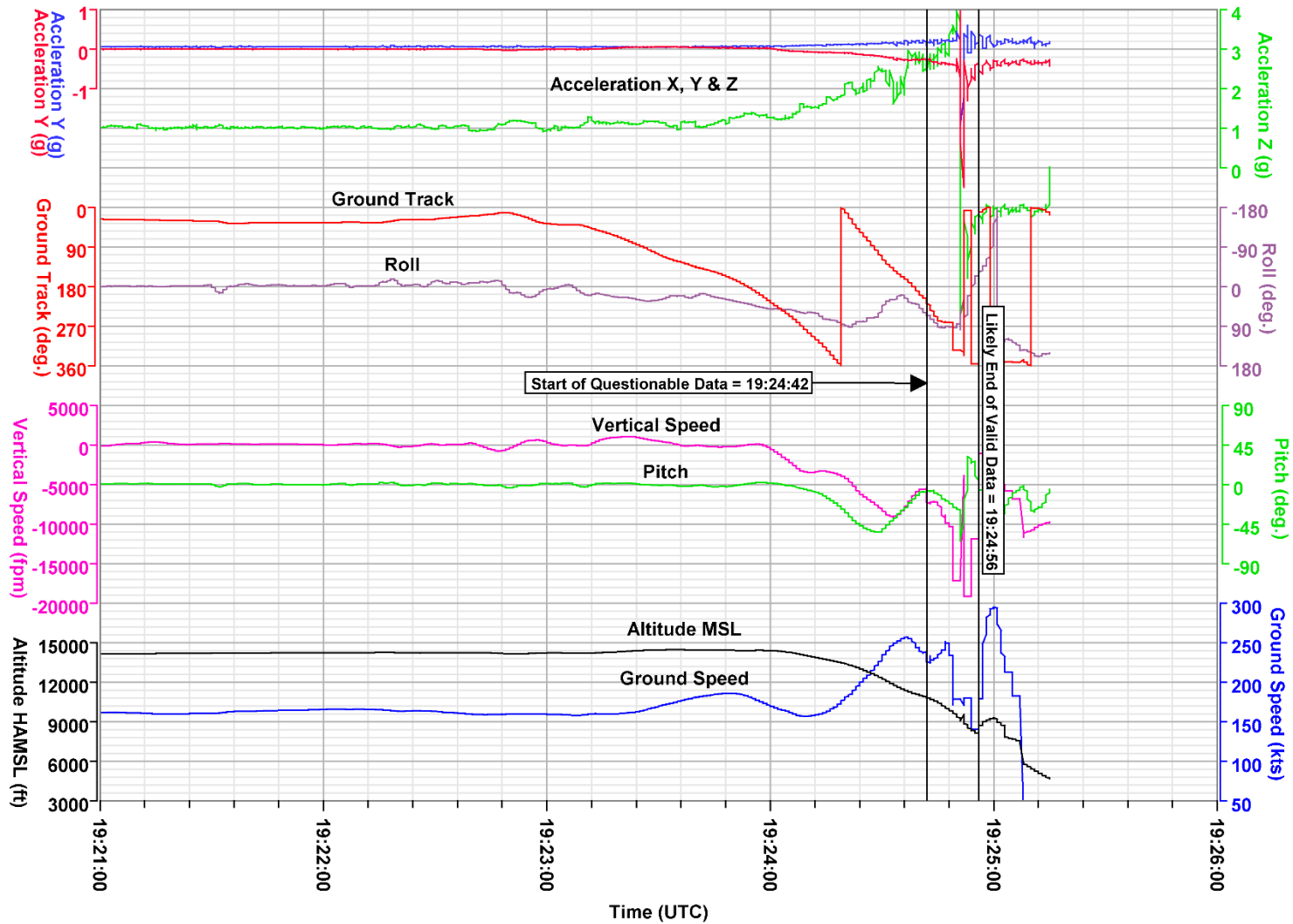


Figure 6. Plot of basic parameters from the Appareo Stratus for the accident portion of the flight.