

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



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ELECTRONIC DEVICE

Specialist's Factual Report

October 25, 2022

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A. EVENT SUMMARY

Location: Raeford, North Carolina
Date: July 29, 2022
Time: 14:04 eastern daylight time (EDT)
Airplane: CASA 212-200, N497CA

B. ELECTRONIC DEVICE SPECIALIST

Specialist: W. Deven Chen
National Transportation Safety Board (NTSB)
Washington, DC

C. DETAILS OF THE INVESTIGATION

A recorder group was not convened. The NTSB Vehicle Recorder Division received the following electronic device:

Recorder Manufacturer/Model:	Appareo Stratus 3
Recorder Serial Number:	023211

1.0 Recorder Description

The Appareo Stratus 3 device is a self-contained battery powered unit that contains an internal AHRS¹, GPS/WAAS receiver², and ADS-B³ receiver in one compact unit. The unit communicates wirelessly with compatible devices (iPad, iPhone etc.) to display all the acquired information. In addition to communicating with compatible devices, the Stratus device records GPS position and AHRS information internally on a non-volatile flash memory⁴ chip.

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).

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

1.1 Recorder Condition and Data Recovery

The device was in good condition upon arrival at the Vehicle Recorder Division, as shown in Figure 1. The device was paired, via WiFi, to an iPad with ForeFlight⁵ installed, and its stored track logs were downloaded to the ForeFlight account. The track log associated with the event flight was identified, however, the data only contained GPS data and no AHRS data. The manufacturer was contacted and provided another data download method, with which the track logs were downloaded and contained both GPS and AHRS data at the device's maximum sample rate.



Figure 1. Front and back of the Appareo Stratus 3 as received.

1.2 Recording Description

The downloaded data contained three track log recordings on July 29, 2022, the date when the event occurred. Table 1 shows a summary of the recordings. The last track log was identified to be associated with the event. The event flight recording was approximately 1 hour 15 minutes and 3 seconds in duration and with 5 Hz sampling rate. The event flight data are further discussed in this report, and the data of the two previous flights are included as attachments to this report.

Table 1. Summary of recordings on July 29, 2022, from the Appareo Stratus 3.

Track Log 1	Track Log 2	Track Log 3
Previous Flight 1	Previous Flight 2	Event Flight
11:35:14 - 12:36:13 EDT	13:06:09 - 13:37:39 EDT	13:38:20 - 14:53:23 EDT

⁵ForeFlight is a software application used as an electronic flight bag by aircraft pilots.

1.2.1 Parameters Provided

Table 2 lists the recorder parameters verified and provided in this report.

Table 2. Appareo Stratus 3 data parameters provided.

Parameter Name (unit)	Parameter Description
Altitude HAE (ft)	Geometric altitude above Ellipsoid (feet)
Altitude HMSL (ft)	Geometric altitude above Mean Sea Level (feet)
BFram Acc X (g)	Device body frame acceleration in X-axis (g)
BFram Acc Y (g)	Device body frame acceleration in Y-axis (g)
BFram Acc Z (g)	Device body frame acceleration in Z-axis (g)
BFram Rot X (deg/s)	Device body frame rotational speed in X-axis (degrees per second)
BFram Rot Y (deg/s)	Device body frame rotational speed in Y-axis (degrees per second)
BFram Rot Z (deg/s)	Device body frame rotational speed in Z-axis (degrees per second)
Ground Speed (kts)	Average groundspeed between current and previous data point (knots)
Ground Track (deg)	Path on the surface of the Earth directly below aircraft (degrees)
Latitude (deg)	Geometric latitude (degrees)
Longitude (deg)	Geometric Longitude (degrees)
Pitch (deg)	Pitch Angle (degrees)
Roll (deg)	Roll Angle (degrees)
Slip (g)	Lateral acceleration (g)
True Heading (deg)	Direction relative to true north (degrees)
Turn Rate (deg/s)	Turn rate (degrees per second)
Vertical Speed (ft/s)	Vertical Speed (feet per second)

1.3 Time Correlation

The data was recorded in GPS time, which was converted to coordinated universal time (UTC), and then was converted to EDT, the local time of the event.

D. FIGURES AND TABULAR DATA

Figures 2 and 3 show parameter plots of the data recorded during the event on July 29, 2022. These figures are configured such that right turns are indicated by the trace moving toward the bottom of the page, left turns towards the top of the page, and nose up attitudes towards the top of the page.

Figure 4 shows Google Earth overlays of the entire event flight. The approximated location where the second-in-command (SIC) body was located is shown with a blue pin. The weather and lighting conditions in Google Earth are not necessarily the weather and lighting conditions present at the time of the recording.

The corresponding tabular data used to create Figure 2 to 4 are provided in electronic comma-separated value (CSV) format as attachments to this report. The

attachment 1 is event flight GPS data, and the attachment 2 is event flight AHRT data. The GPS and AHRT data of the two previous flights are provided as attachment 3 and attachment 4, respectively.

Submitted by:

W. Deven Chen
Electrical Engineer - Recorder Specialist

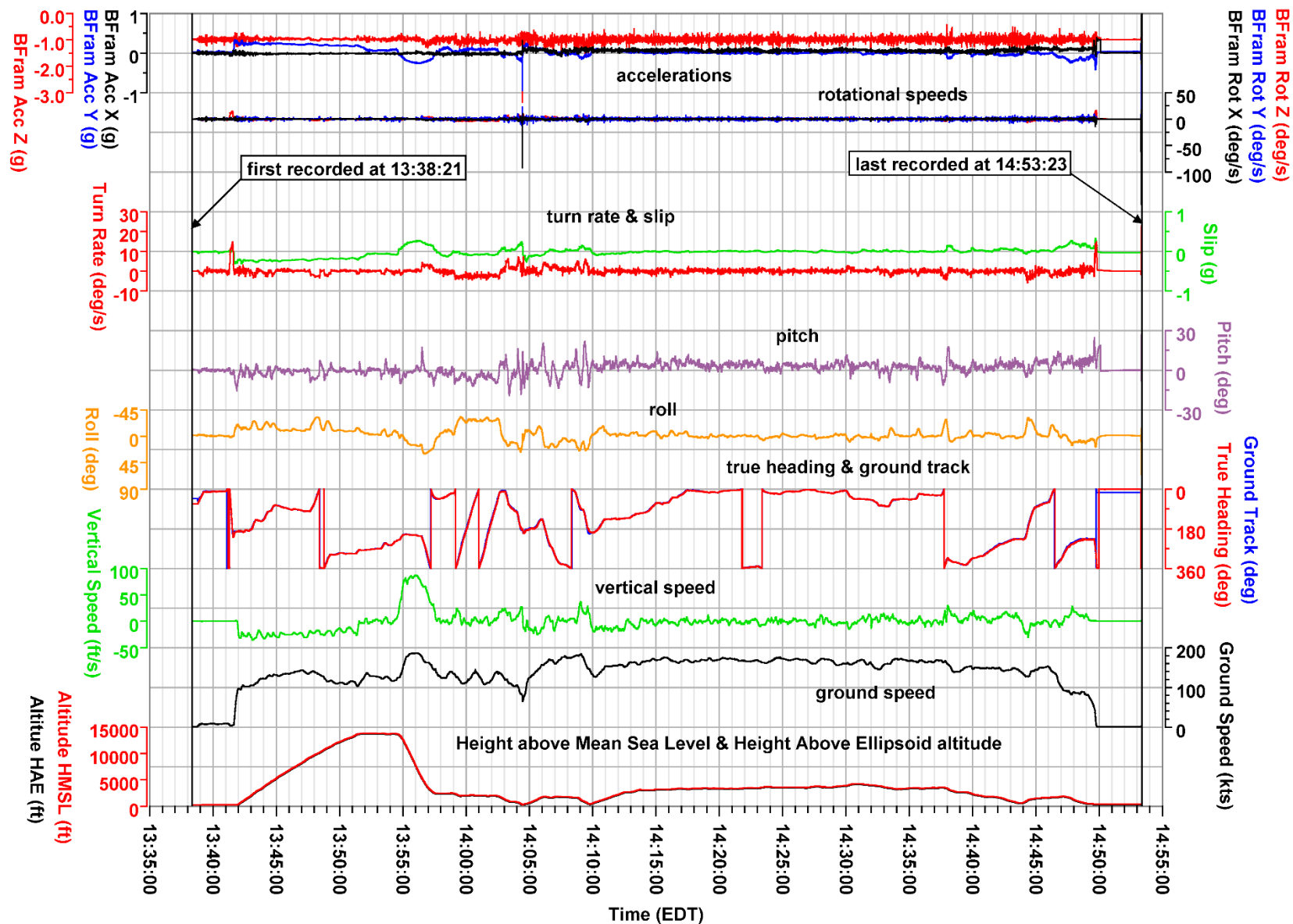


Figure 2. Plot of data parameters for the entire event flight recording.

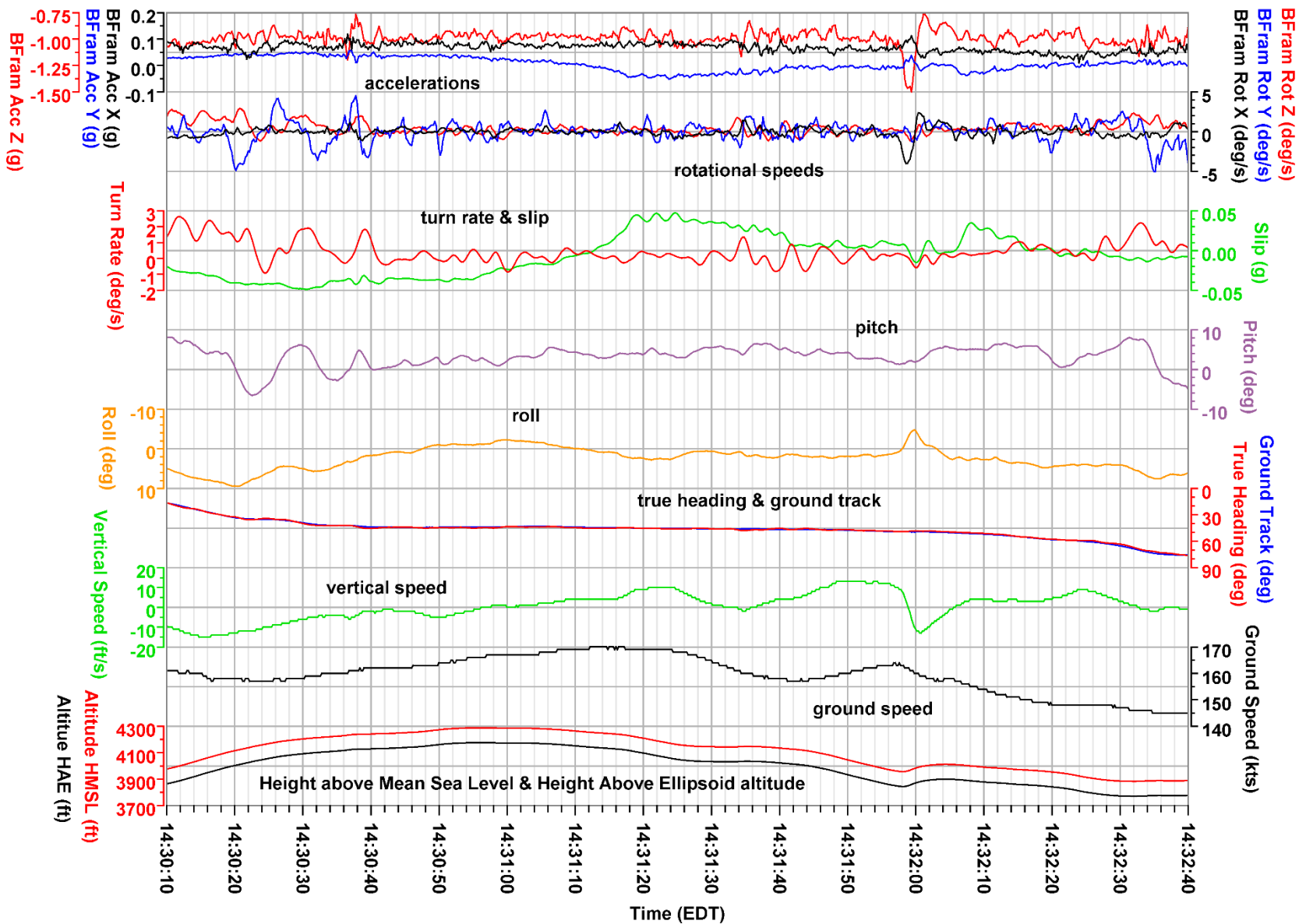


Figure 3. Plot of data parameters recording from 14:30:10 to 14:32:40 of the event flight recording.

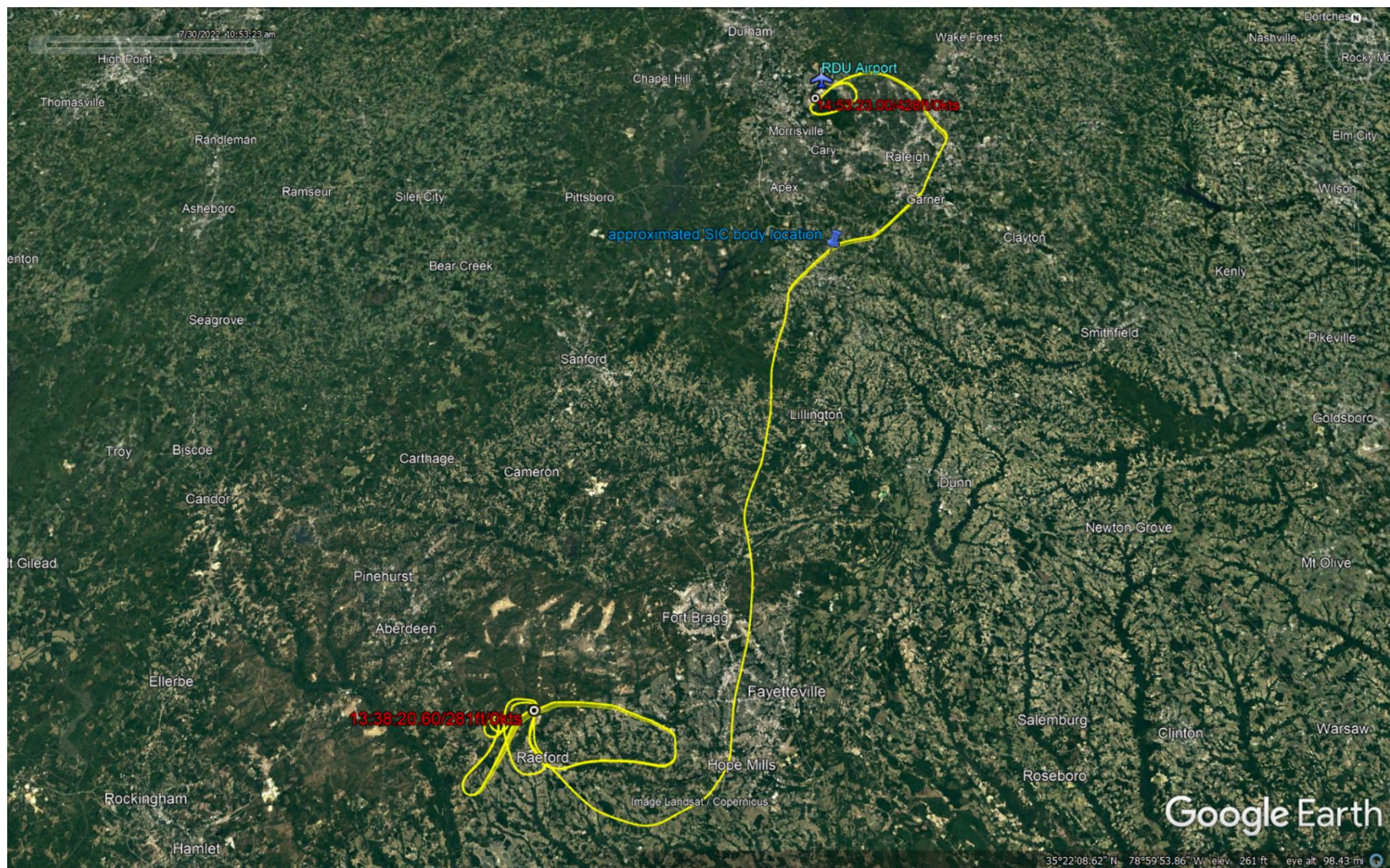


Figure 4. Google Earth overfly of the entire event flight.