

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



WPR24FA270

ELECTRONIC DEVICE

Specialist's Factual Report

August 20, 2025

A. ACCIDENT

Location: Augusta, Montana
Date: August 8, 2024
Time: 13:01 mountain daylight time (MDT)
Airplane: Cessna 182K, N2764Q

B. ELECTRONIC DEVICE SPECIALIST

Specialist: Jonny Xue
Recorder Specialist
National Transportation Safety Board (NTSB)

C. DETAILS OF THE INVESTIGATION

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

Recorder Manufacturer/Model: Appareo Stratus 3
Part Number: 153510-000113

1.0 Appareo Stratus 3 Description

The Appareo Stratus 3 is a self-contained 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 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

¹ The Attitude Heading Reference System (AHRS) 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 Appareo Stratus 3 Data Recovery

The device was in damaged condition and is shown in Figure 1. The non-volatile memory chip was removed from the main circuit board, read out, and converted into engineering units using laboratory tools.



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

1.2 Appareo Stratus Recording Description

The recorded data included the accident event which started at 11:20:00 MDT (local time) and ended at 13:01:48 MDT on August 8, 2024. The sampling rate was 5 Hz. Accuracy of gyroscopic parameters such as pitch angle and bank angle are dependent on the orientation of the device and proper calibration of the device in the aircraft.

1.2.1 Appareo Stratus Parameters Provided

Table 1 lists the Appareo Stratus parameters verified and provided in this report.

Table 1. Appareo Stratus parameters provided.

Parameter Name (unit)	Parameter Description (unit)
Altitude HMSL (ft)	Altitude above Mean Sea Level (feet)
Bframe Acceleration X (gs)	Device body frame acceleration in X-axis (gravitational unit of acceleration)
Bframe Acceleration Y (gs)	Device body frame acceleration in Y-axis (gravitational unit of acceleration)
Bframe Acceleration Z (gs)	Device body frame acceleration in Z-axis (gravitational unit of acceleration)
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)
Heading (degrees)	Direction relative to true north (degrees)
Latitude (deg)	Geographic latitude (degrees)
Longitude (deg)	Geographic longitude (degrees)
Pitch (deg)	Pitch angle (degrees)
Roll (deg)	Roll angle (degrees)
Vertical Speed (fpm)	Vertical speed (feet per minute)

D. FIGURES AND TABULAR DATA

Figures 2 through 4 are graphical overlays generated using Google Earth showing the accident session from the Appareo Stratus 3. The reported wreckage location is shown with a red pin. Weather and lighting conditions in Google Earth are not necessarily the weather and lighting conditions present at the time of the recording. Figures 5 through 7 are plots of the downloaded Stratus parameters at various ranges of time.

Figure 2 is an overview of the entire recorded session.

Figure 3 shows the final 2 minutes of the recorded session.

Figure 4 shows the final 20 seconds of the recorded session.

Figure 5 is a plot of parameters from the Stratus 3 for the entire session.

Figure 6 is a plot of parameters from the Stratus 3 for the final 7 minutes of the session.

Figure 7 is a plot of parameters from the Stratus 3 for the final 18 seconds of the session.

The engineering units conversions used for the data contained in this report are based on documentation from the device manufacturer. Where applicable, the conversions have been changed to ensure that the parameters conform to the NTSB's standard sign convention that climbing right turns are positive (CRT=+).

The corresponding tabular data used to create figures 2 through 7 are provided in electronic comma-separated value (CSV) format as attachment 1.

Submitted by:

Jonny Xue
Recorder Specialist



Figure 2. Google Earth overlay of the entire session.



Figure 3. Google Earth overlay of the final 2 minutes of the recorded session.

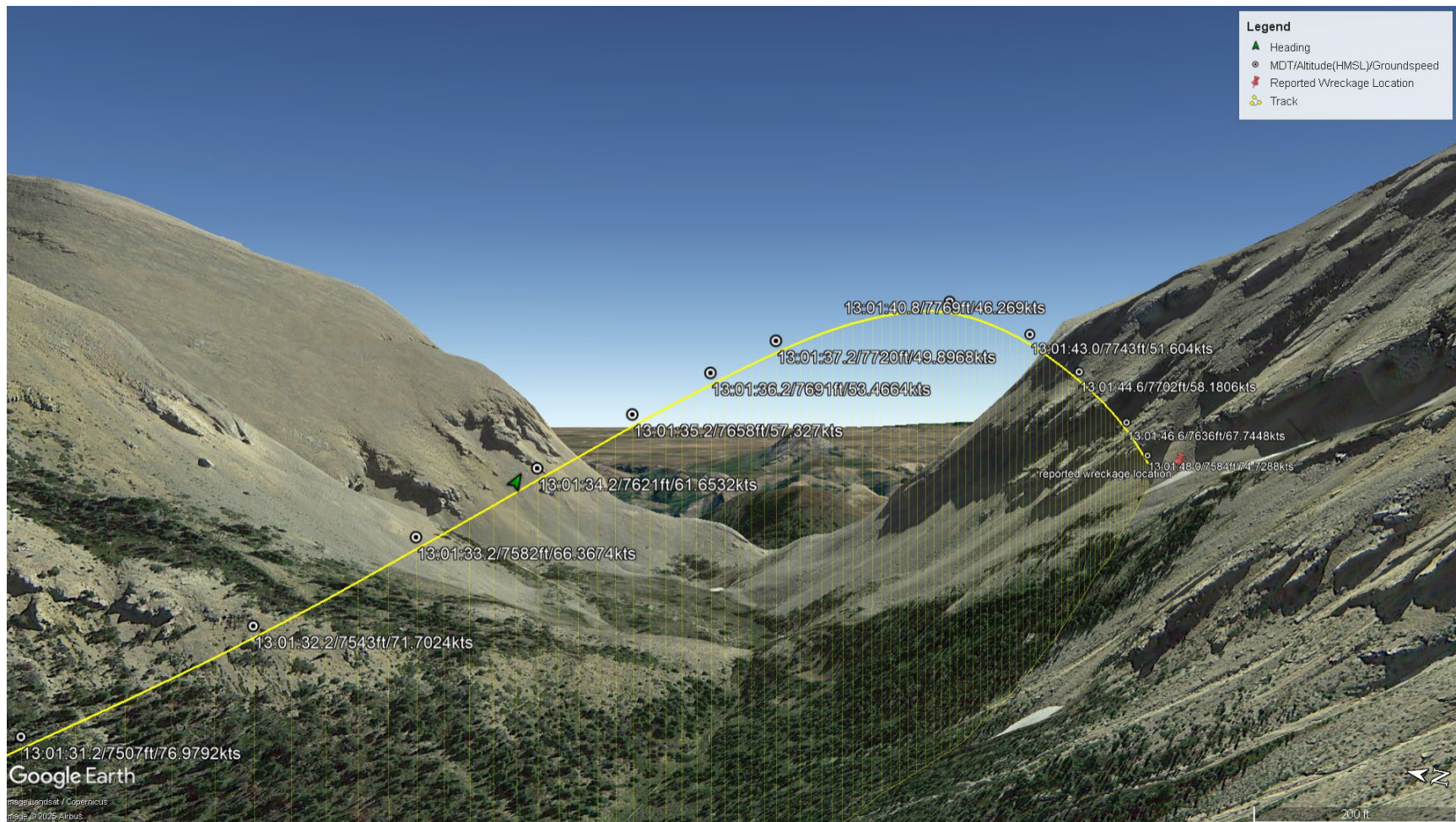


Figure 4. Google Earth overlay of the final 20 seconds of the recorded session.

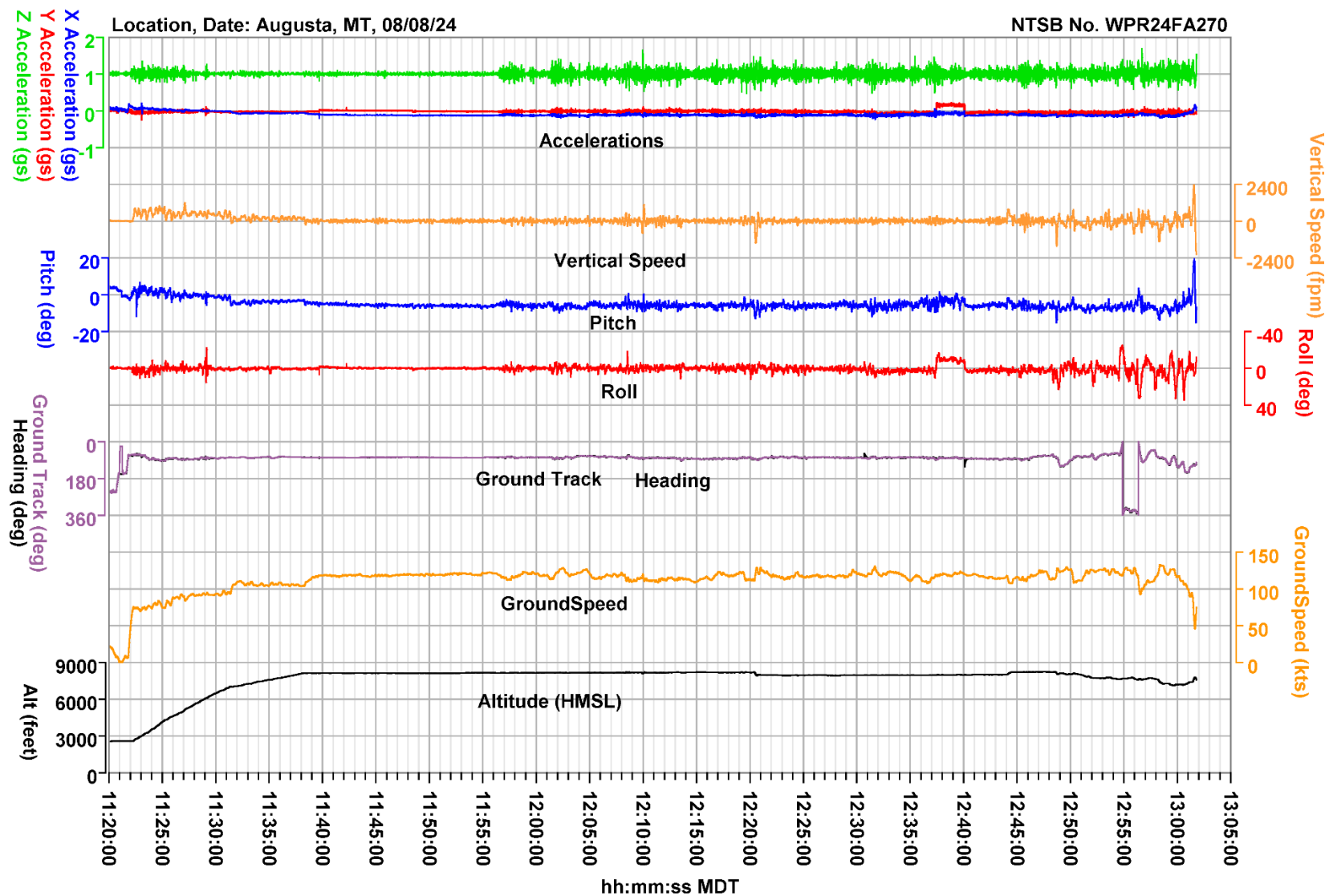


Figure 5. Plot of parameters for the entire session.

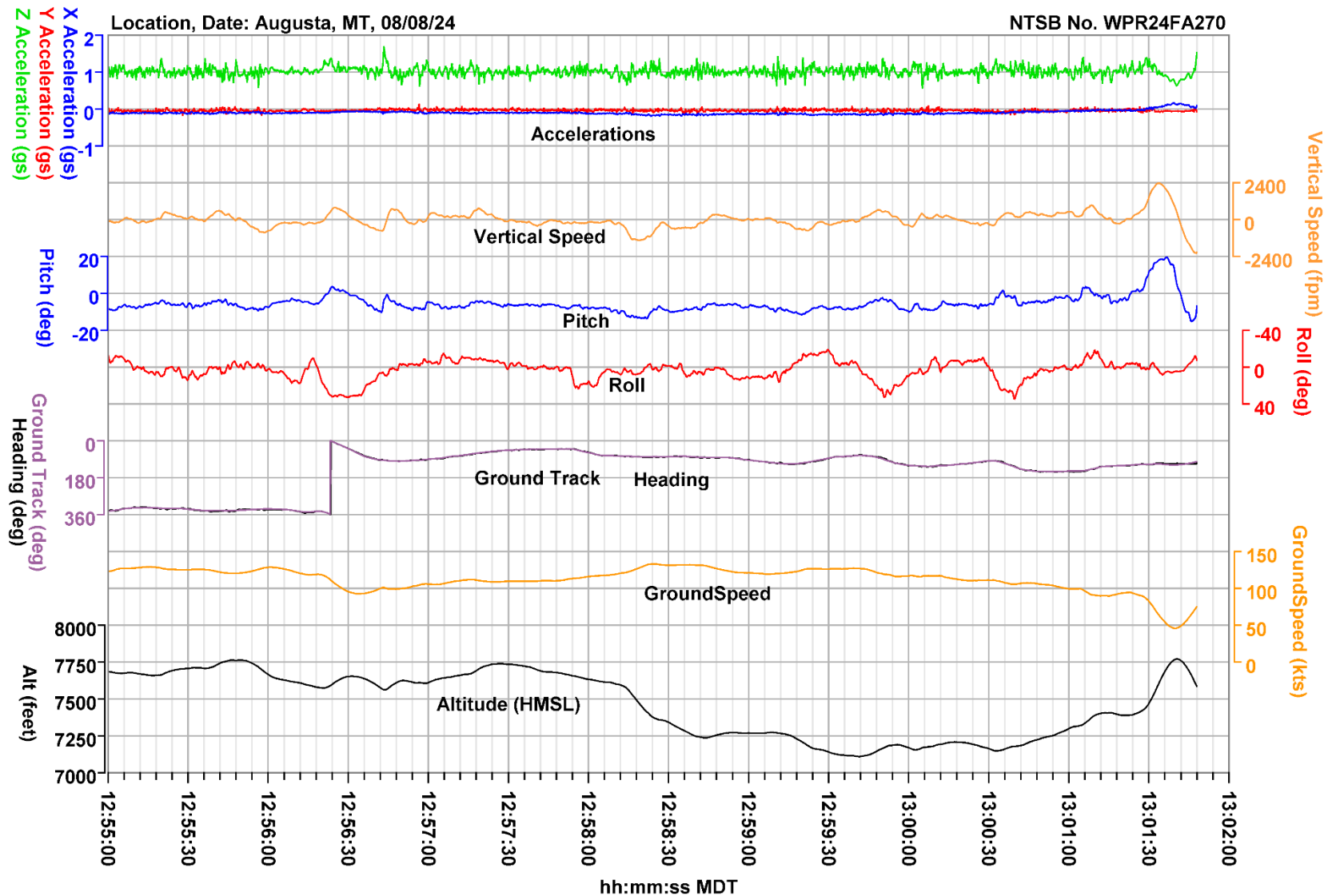


Figure 6. Plot of parameters for the last 7 minutes of flight.

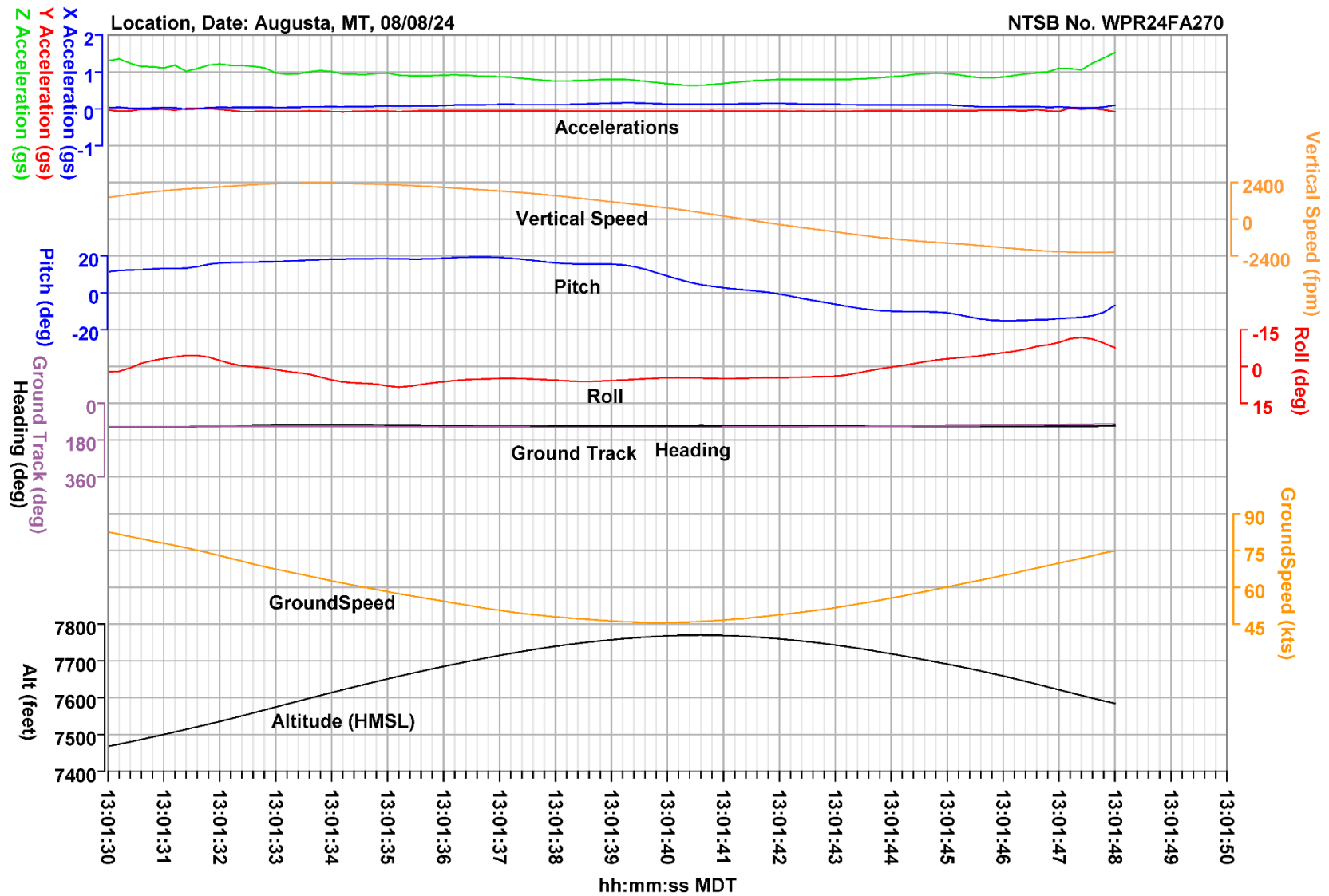


Figure 7. Plot of parameters for the last 18 seconds of flight.