

NATIONAL TRANSPORTATION SAFETY BOARD

Vehicle Recorder Division
Washington, D.C. 20594

July 19, 2022

Electronic Devices

Specialist's Factual Report by Gerald Kawamoto

1. EVENT

Location: Fostoria, Ohio
Date: February 22, 2022
Aircraft: Piper PA-32-260
Registration: N3952W
Operator: Private
NTSB Number: CEN22FA131

2. DETAILS OF INVESTIGATION

The National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following devices:

Device 1:	Appareo Stratus 3
Device 1 Serial Number:	021031
Device 2:	Apple iPhone XR
Device 2 IMEI:	356449101380292

2.1. Appareo Stratus 3 Description

The Appareo Status 3 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 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 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 is semiconductor memory that does not require external power for data retention.

2.1.1. Appareo Stratus 3 Data Recovery

Upon arrival at the Vehicle Recorder Division, an external examination revealed the device sustained minor impact damage to the housing, as shown in Figure 1. An internal examination revealed damage to the printed circuit boards, rendering the device inoperable. The NVM chip was removed, read out, and converted to engineering units using laboratory equipment.



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

2.1.2. Appareo Stratus 3 Data Description

The data extracted included a session recorded on February 23, 2022, which corresponded to the accident event.⁵ The session started at 1:44:24.1 UTC and ended at 3:41:46.3 UTC. 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.

2.2. Apple iPhone XR Description

The Apple iPhone XR is a type of Personal Electronic Device (PED), which are a category of devices comprised primarily of portable computing devices and mobile phones. Portable computing devices are typically capable of internet access, email, messaging services, and can run user-installed applications to perform specific tasks. PED user and system data is typically stored on non-volatile memory and can be accessed through manufacturer-provided interfaces.

⁵ All dates and times are referenced to Coordinated Universal Time (UTC). The difference between UTC and Eastern Standard Time is 5 hours.

2.2.1. Apple iPhone XR Data Recovery

Upon arrival at the Vehicle Recorder Division, an external examination revealed the device was in good condition, as shown in Figure 2. The device powered on normally and was accessed using a passcode provided to the investigation team.

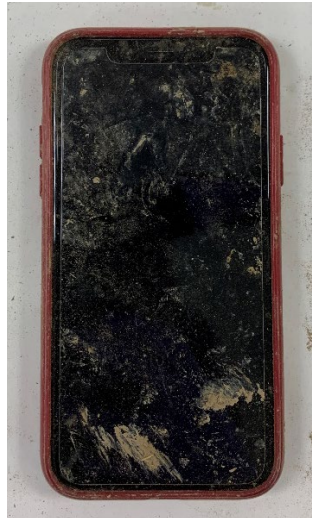


Figure 2. iPhone XR as received.

2.2.2. Apple iPhone XR Data Description

The content of the device was reviewed, and it was determined that there were no data relevant to the event stored in the non-volatile memory, thus, no data from this device are included in this report.

3. PLOTS AND TABULAR DATA

The following six figures contain data recorded during the February 22, 2022, event.

Figure 3 is a Google Earth overlay of the entire event flight tracklog recording. The weather and lighting conditions in Google Earth are not necessarily the weather and lighting conditions present at the time of the recording.

Figure 4 is a Google Earth overlay showing approximately the last minute of the event flight tracklog.

Figure 5 is a Google Earth overlay showing approximately the last 6 seconds of the event flight tracklog and the reported wreckage location (red pin).

Figure 6 is a plot of parameters for the entire event flight. The time interval displayed is 1:40:00 to 3:45:00 UTC.

Figure 7 is a plot of parameters of approximately the last minute of the event flight tracklog. The time interval displayed is 3:40:50 to 3:41:50 UTC.

Figure 8 is a plot of parameters of approximately the last 6 seconds of the event flight tracklog. The time interval displayed is 3:41:40 to 3:41:47 UTC.

The corresponding tabular data used to create these three plots are provided in electronic (*.csv) format as Attachment 1 to this report.⁶

⁶ Comma Separated Value format.



Figure 3. Google Earth overlay of the entire event flight recorded on the Appareo Stratus 3.

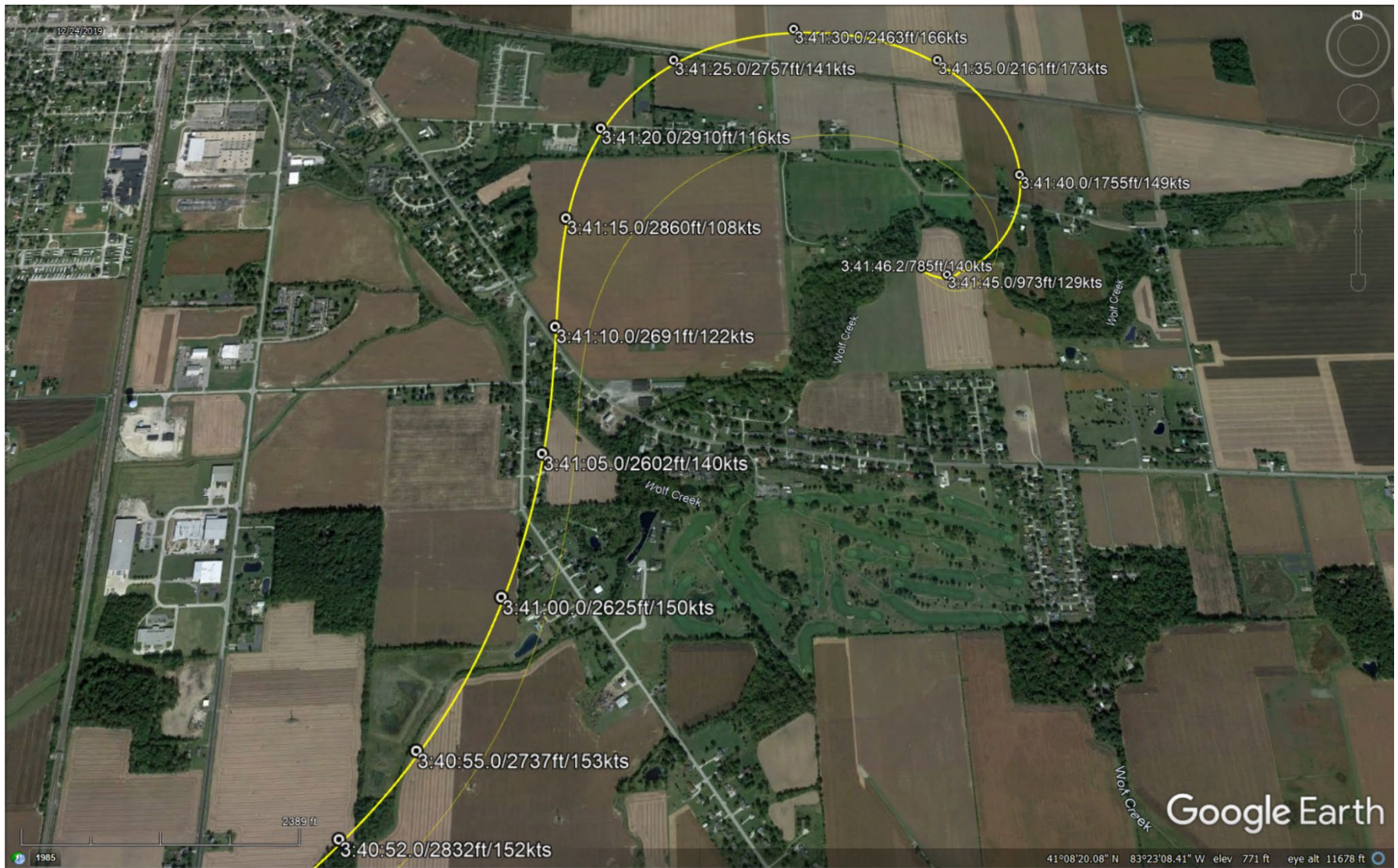


Figure 4. Google Earth overlay of approximately the final minute of the event flight.

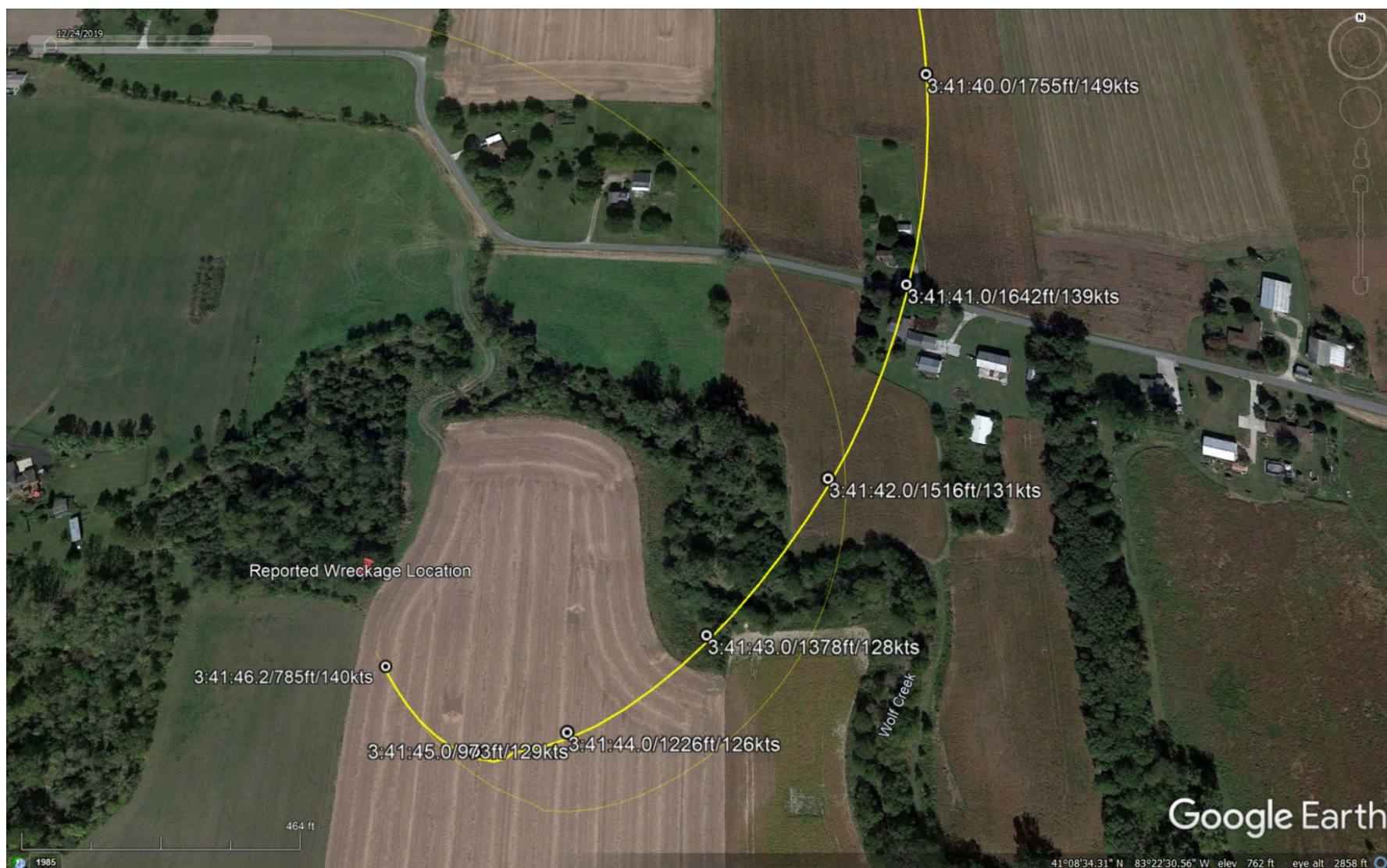


Figure 5. Google Earth overlay of the very end of the event flight. The reported wreckage location is shown with a red pin.

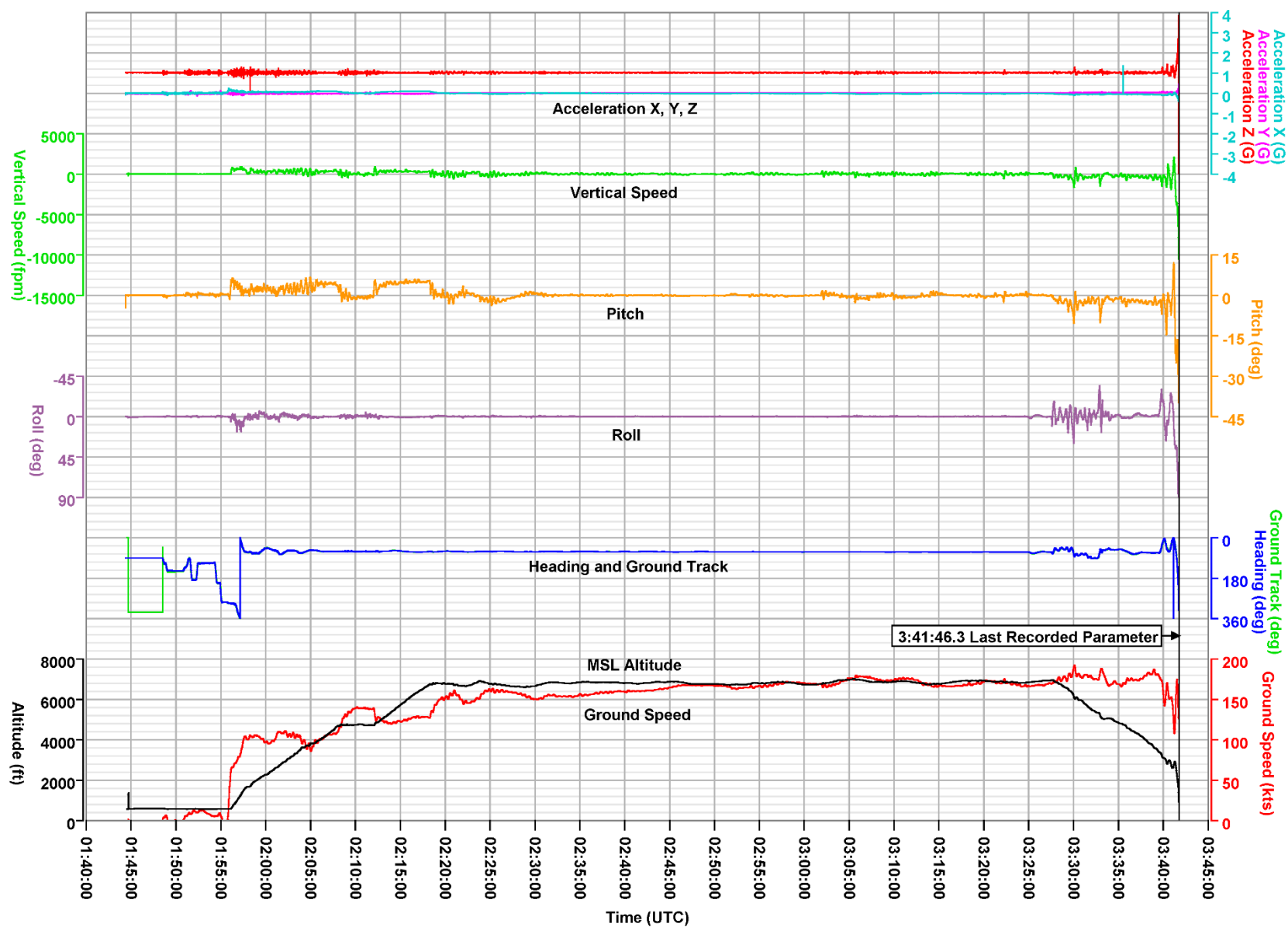


Figure 6. Plot of parameters recorded on the Appareo Stratus 3 for the entire event flight.

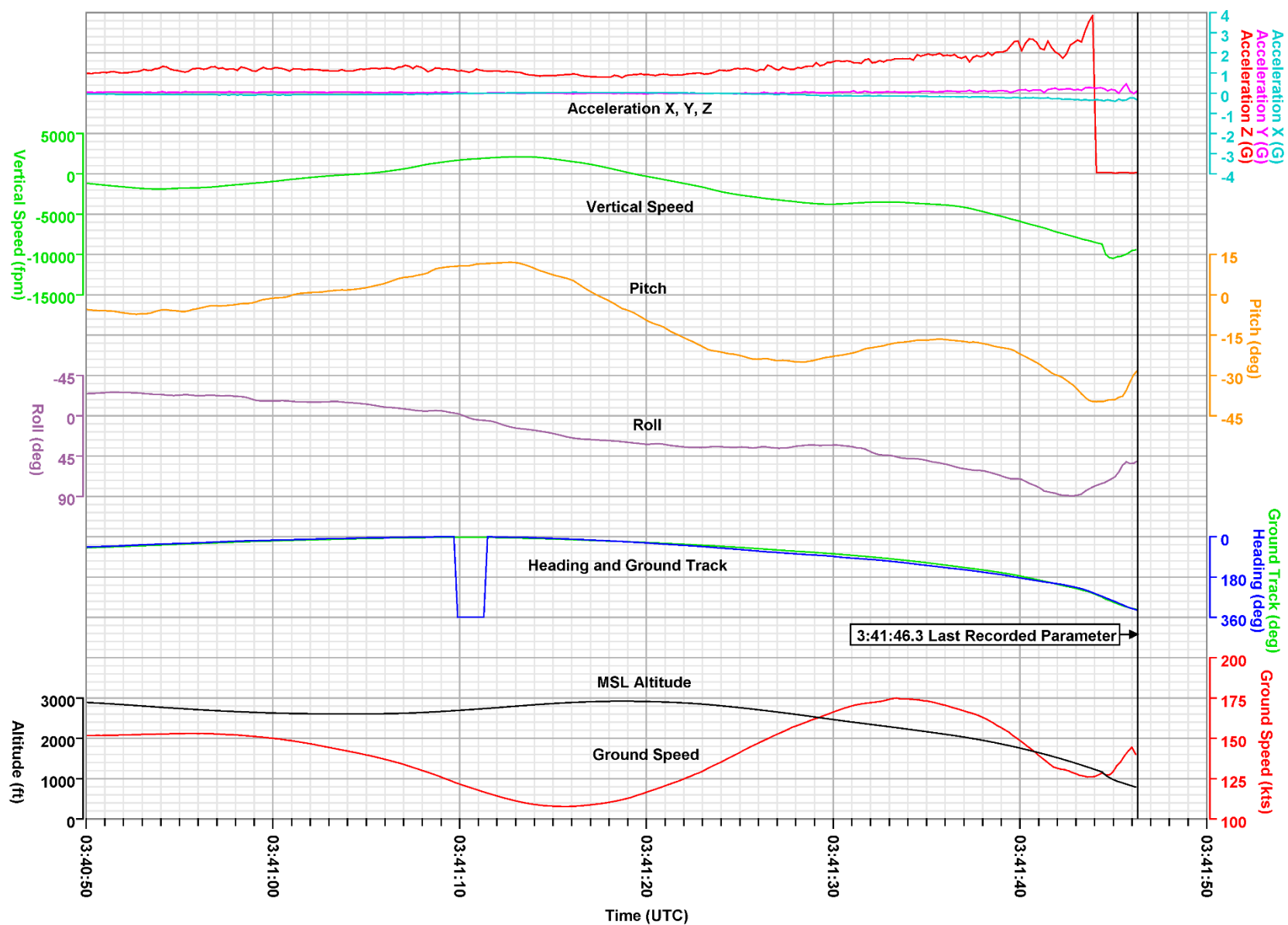


Figure 7. Plot of parameters of approximately the final minute of the event flight.

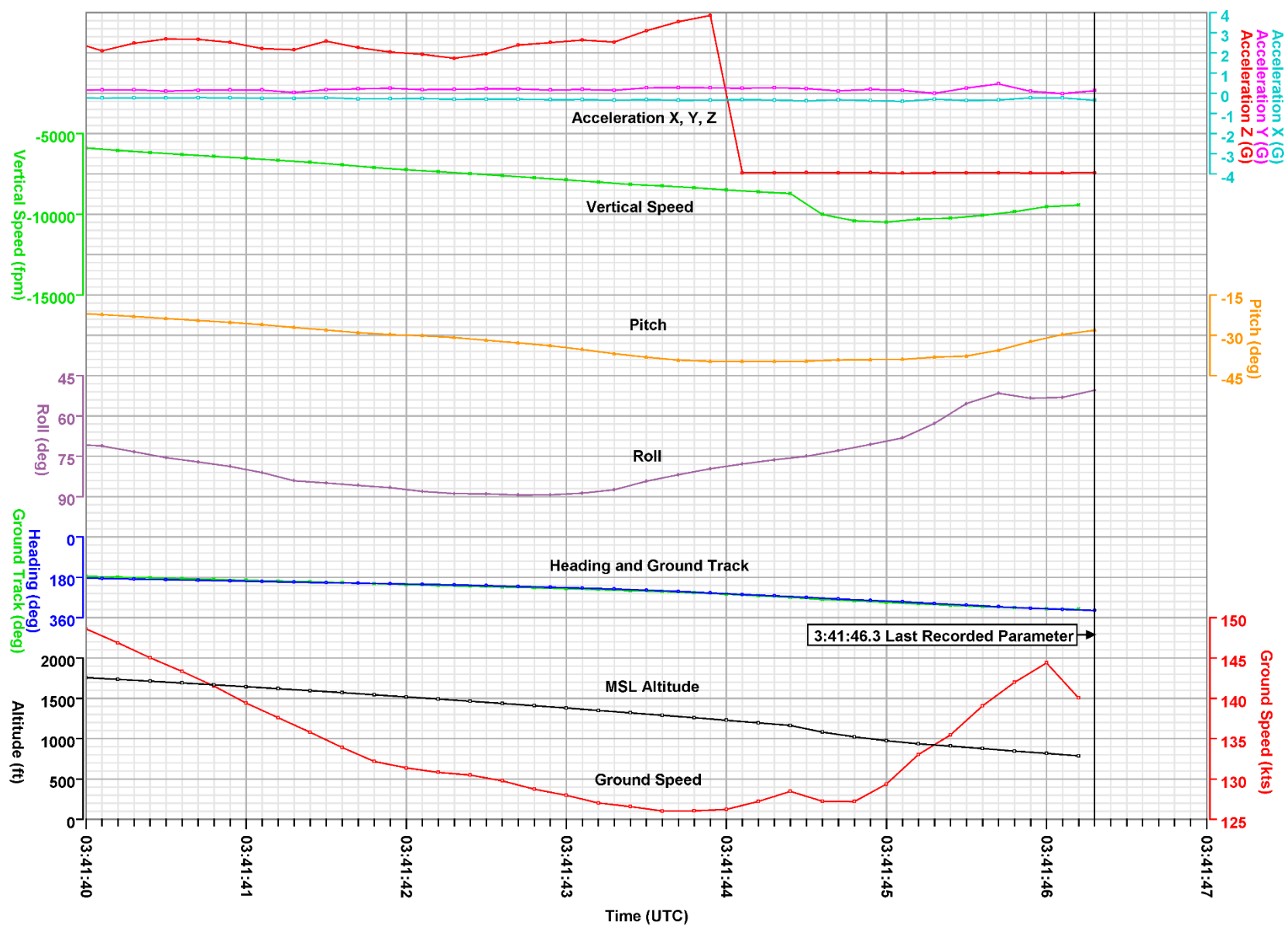


Figure 8. Plot of parameters of the very end of the event flight.