

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



WPR22FA304

ELECTRONIC DEVICES

Specialist's Factual Report

February 7, 2023

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A. ACCIDENT

Location: Yellow Pine, Idaho
Date: August 15, 2022
Time: 0630 mountain daylight time (MDT)
Airplane: Aviat Aircraft A-1A, N26HV

B. ELECTRONIC DEVICES 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 devices:

Device Manufacturer/Model:	Appareo Stratus 3
Serial Number:	3021612
Device Manufacturer/Model:	Apple iPhone 12 (pilot's)
IMEI Number:	357504270852015

1.0 Appareo Stratus 3 - Device 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

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).

with compatible devices, the Stratus device records GPS position and AHRS information internally on a non-volatile memory⁴ chip.

1.1 Appareo Stratus 3 - Condition and Data Recovery

The device had sustained impact damage upon arrival at the Vehicle Recorder Division, as shown in figure 1. The main circuit board was removed from the device, and the non-volatile memory chip was found nearly dislodged from the circuit board due to the impact damage. The memory chip did not show visible damage, and its wire bonds appeared to be non-damaged under x-ray examination, however, the memory chip could not be read out on chip readers. It is likely that the internal die of the memory chip was damaged during the accident impact. Thus, there was no data recovered from the device.



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

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

2.0 Apple iPhone 12 - Device Description

Apple iPhone 12 is a type of personal electronic devices (PEDs), 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. Depending on the model, mobile phones can perform many of the same tasks as portable computing devices, plus have voice call and text messaging capabilities. PED user and system data is typically stored on non-volatile memory and can be accessed through manufacturer-provided interfaces

2.1 Apple iPhone 12 - Condition and Data Recovery

The device had sustained impact damage upon arrival at the Vehicle Recorder Division, as shown in figure 2. The device powered up normally and was unlocked with a provided passcode. The device was connected to a PC and read using forensic evidence recovery software for PEDs.



Figure 2. Front and back of the Apple iPhone 12 as received.

2.2 Apple iPhone 12 - Recording Description

Upon review of the data stored on the device, only data in ForeFlight⁵ were considered pertinent to this investigation. Figure 3 shows a screenshot of some of the track logs recorded in ForeFlight. The track logs had recorded data sourced either from the iPhone 12 or a Stratus device (Appareo Stratus 3 detailed in section 1.0). The track log recorded on August 15, 2022, was determined to be related to the accident. This accident track log had recorded data sourced from the iPhone, which suggested that the Appareo Stratus 3 was likely not in use during the accident flight.

The accident track log was downloaded, and it contained recordings from 12:25:16 to 12:37:16 coordinated universal time (UTC), with a sampling rate of 1 Hz.

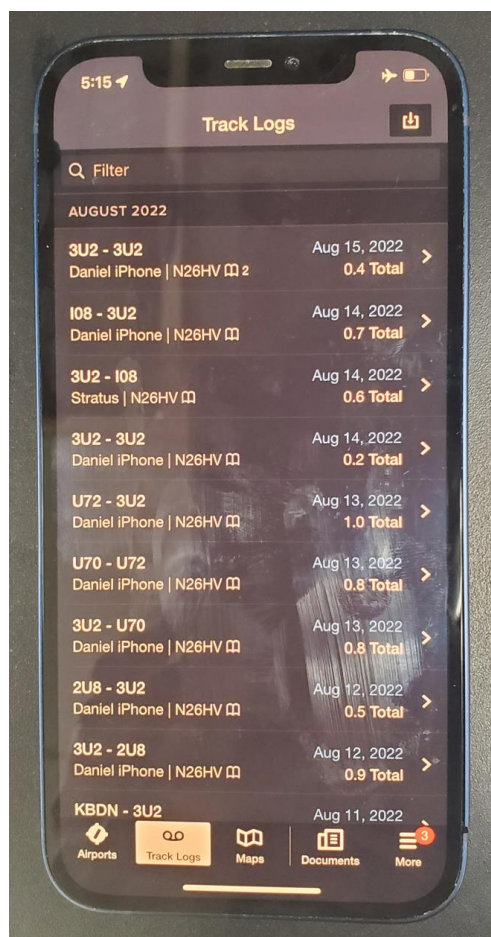


Figure 3. Screenshot of some of the track logs recorded on ForeFlight on the Apple iPhone 12.

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

2.2.1 Apple iPhone 12 - Parameters Provided

Table 1 lists the parameters verified and provided in this report. Note that since the source device of the accident track log was the Apple iPhone 12, the precision of the parameters in table 1 were based on the GPS device and accelerometers of the Apple iPhone 12. The track log contained additional parameters - vertical acceleration and horizontal acceleration, with a range of 0-16 g-force, which were considered invalid.

Table 1. ForeFlight track log data parameters provided.

Parameter Name (unit)	Parameter Description
Altitude (ft)	Geometric altitude above Mean Sea Level (feet)
Bank (deg)	Bank Angle (degrees)
Course (deg)	Path on the surface of the Earth directly below aircraft (degrees)
Speed (kts)	Average groundspeed between current and previous data point (knots)
Latitude (deg)	Geometric latitude (degrees)
Longitude (deg)	Geometric Longitude (degrees)
Pitch (deg)	Pitch Angle (degrees)

2.2.2 Apple iPhone 12 - Time Correlation

The accident track log was recorded in UTC and was converted to MDT, the local time of the event, for the rest of the report.

D. FIGURES AND TABULAR DATA

Figures 4 and 5 show parameter plots of the data recorded during the accident on August 15, 2022. These figures are configured such that right turns are indicated by the trace moving toward the bottom of the page, left turns toward the top of the page, and nose up attitudes toward the top of the page.

Figures 6 and 7 show Google Earth overlays of the entire accident flight. Figure 8 shows Google Earth overlays of the final portion of the accident flight. 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 figures 4 to 8 are provided in electronic comma-separated value (CSV) format as attachment 1 to this report.

Submitted by:

W. Deven Chen
Electrical Engineer - Recorder Specialist

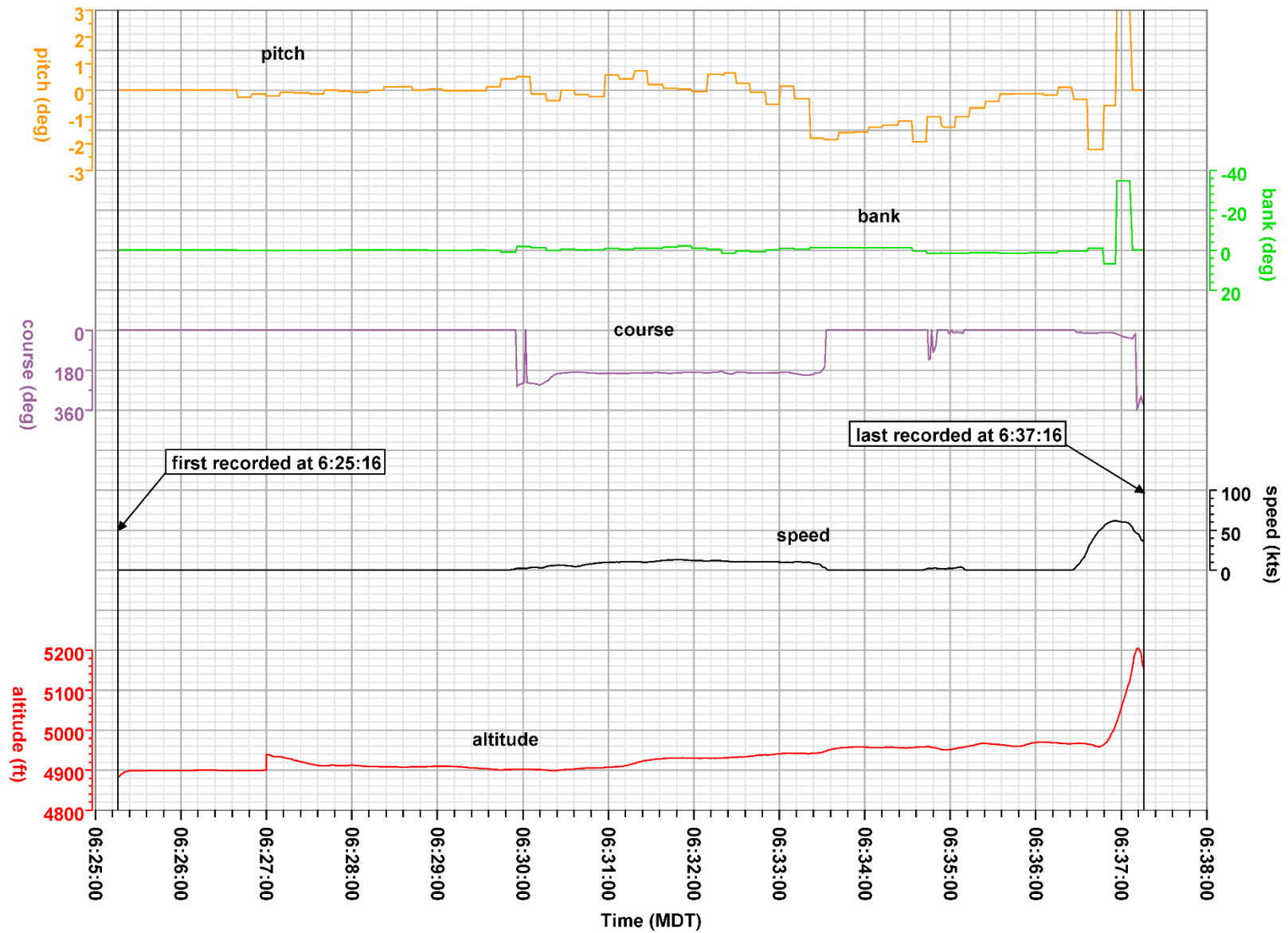


Figure 4. Plot of data parameters of the entire accident flight recording.

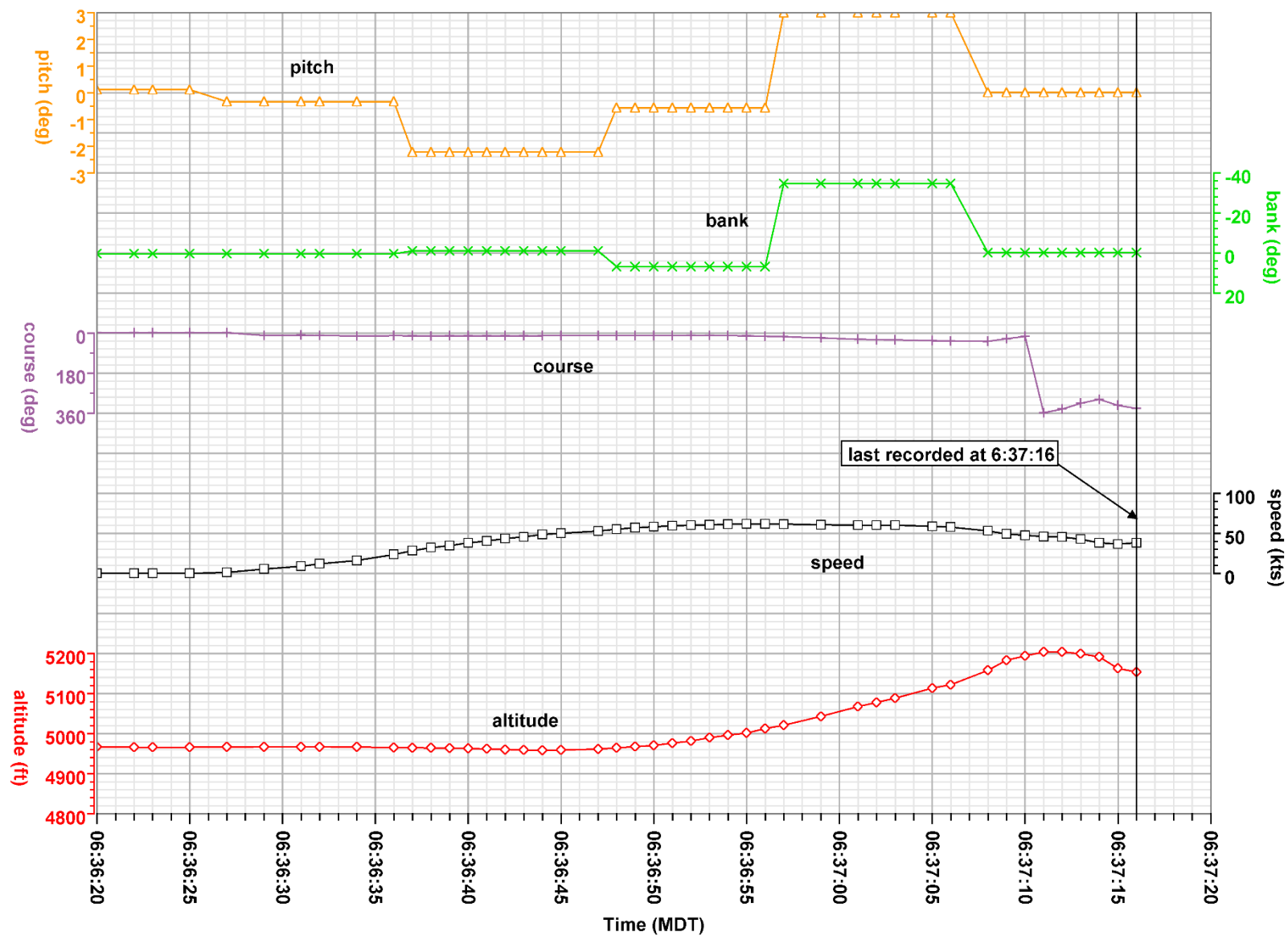


Figure 5. Plot of data parameters recording of approximately the last 1 minute of the accident flight recording.



Figure 6. Google Earth overfly of the entire accident flight.



Figure 7. Google Earth overly of the entire accident flight at a different view angle.



Figure 8. Google Earth overly of the final portion of the accident flight.