

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



ERA24LA007

RECORDED FLIGHT DATA REPORT

Specialist's Factual Report

April 7, 2025

TABLE OF CONTENTS

A. ACCIDENT.....	3
B. RECORDED FLIGHT DATA SPECIALIST	3
C. DETAILS OF THE INVESTIGATION	3
1.0 Appareo RDM-300 Description	3
1.1 RDM Data Recovery.....	3
1.2 RDM Recorded Data Description	4
1.2.1 RDM Engineering Unit Conversions.....	4
1.3 RDM Time Correlation.....	5
2.0 Garmin G1000 Secure Digital Data Card Description	5
2.1 Garmin G1000 SD Data Card Data Recovery.....	5
2.2 Garmin G1000 SD Data Card Data Description	5
2.2.1 Garmin G1000 SD Data Card Engineering Unit Conversions	6
2.3 Garmin G1000 SD Card Time Correlation.....	6
D. FIGURES AND TABULAR DATA.....	6

A. ACCIDENT

Location: Martinsville, Virginia
Date: October 11, 2023
Time: 22:50 eastern daylight time (EDT)
Airplane: Cirrus SR22, Private, N253BC

B. RECORDED FLIGHT DATA REPORT SPECIALIST

Specialist: Olivia Fowler
Mechanical Engineer – Vehicle Recorders Specialist
National Transportation Safety Board (NTSB)

C. DETAILS OF THE INVESTIGATION

A recorded flight data group was not convened.

The NTSB Vehicle Recorder Division received the following electronic files from the N253BC aircraft:

Device:	Appareo Recoverable Data Module RDM-300
Electronic File #1:	arinc_20231025_115337_237.csv
Device:	Garmin G1000 running Cirrus Perspective+ software
Electronic File #2:	log_231012_024156_KMTV.csv

1.0 Appareo RDM-300 Description

The Appareo recoverable data module (RDM) is designed for Cirrus aircraft to record flight data in a crash and fire-resistant housing. The unit records flight, engine, and autopilot parameters. Depending on the recording software, several hundred parameters may be recorded. Data is logged up to five times per second and stored internally on a single ball grid array memory chip inside the crash-hardened enclosure. When the storage limit of the memory device is reached, the oldest recording is overwritten.

1.1 RDM Data Recovery

The RDM data were extracted and converted to comma-separated value (CSV) format by the aircraft manufacturer, Cirrus Aircraft, and provided to the NTSB Vehicle Recorders Division via electronic file transfer.

1.2 RDM Recorded Data Description

The RDM file provided to the NTSB Vehicle Recorders Division contained data from the accident flight and two previous flights. The accident flight was approximately 12.5 minutes in duration. The data for the accident flight began at 22:40:31 EDT when the aircraft was powered on at Blue Ridge Airport in Martinsville, VA (KMTV). The data captures the entire flight and ended at 22:52:53 EDT after the aircraft landed back at the airport.

1.2.1 RDM Engineering Unit Conversions

Where applicable, changes to the conversions have been made to ensure the parameters conform to the Safety Board's standard sign convention that climbing right turns are positive (CRT=+).¹

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

Table 1. Verified and provided parameters.

Parameter Name (units)	Parameter Description
Autopilot (discrete ²)	Automatic Flight Control System On/Off
Airspeed Ind (kts)	Indicated Airspeed (knots)
Altitude GPS (ft)	GPS Altitude (feet)
CHT 1-6 (degF)	Cylinder Head Temperature Cylinder # ³ (degrees Fahrenheit)
EGT 1-6 (degF)	Exhaust Gas Temperature Cylinder # ³ (degrees Fahrenheit)
Essential Bus Voltage (V)	Essential Bus Voltage (volts)
Fuel Flow (gph)	Engine Fuel Flow (gallons per hour)
Fuel Qty-L (gal)	Left Fuel Quantity (gallons)
Fuel Qty-R (gal)	Right Fuel Quantity (gallons)
Ground Speed (kts)	Ground Speed (knots)
Gross Weight (lbs)	Aircraft Gross Weight (pounds)
Heading (deg)	Magnetic Heading (degrees)
Oil Press (psi)	Engine Oil Pressure (pounds per square inch)
Oil Temp (degC)	Engine Oil Temperature (degrees Celsius)
Percent Power (%)	Percent Power
Pitch Angle (deg)	Pitch (degrees)
Roll Angle (deg)	Roll (degrees)
Vertical Speed (fpm)	Vertical Speed (feet per minute)
Terrain Alert (discrete ²)	Terrain Alert
Time (hh:mm:ss)	Recorded Time (hours:minutes:seconds)

¹ CRT=+ means that for any parameter recorded that indicates a climb or a right turn, the sign for that value is positive. Also, for any parameter recorded that indicates an action or deflection, if it induces a climb or right turn, the value is positive. Examples: Right Roll = +, Left Aileron Trailing Edge Down = -, Right Aileron Trailing Edge Up = +, Pitch Up = +, Elevator Trailing Edge Up = +, Right Rudder = +.

² A discrete is typically a 1-bit parameter that is either a 0 state or a 1 state where each state is uniquely defined for each parameter.

³ In the data plots the '#' is replaced with the appropriate cylinder ID.

1.3 RDM Time Correlation

RDM data was recorded in universal coordinated time (UTC). The difference between eastern daylight time (EDT) and UTC is 4 hours, or 14,400 seconds. The accident flight data has been offset from the recorded RDM time to EDT by subtracting 14,400 seconds.

2.0 Garmin G1000 Secure Digital Data Card Description

The Garmin G1000 Integrated Flight Deck is a collection of multiple avionics units which include flight displays, air data computers, attitude/heading reference system (AHRS), communications and other systems. A typical installation includes a primary flight display (PFD) and a multi-function display (MFD). Each display includes two secure digital (SD) card slots, an upper and a lower slot. The lower SD card slot is used by the system for software updates and various databases.⁴

Depending on the installed software, the display unit can include a data logging feature. The data logging feature must be enabled by the aircraft operator. If the data logging feature is available and enabled, a SD card must be installed in the upper slot of the MFD. Depending on the airframe and engine combination as many as 64 parameters can be stored at a rate of one sample per second (1Hz). According to the manufacturer of the display unit, one flight hour generates approximately 2 megabytes (MB) of data. The SD card typically used is 2 gigabyte (GB) in size and can store over 1,000 flight hours of data.

This aircraft was also equipped with a RDM, which recorded all parameters recorded by the G1000 as well as additional aircraft parameters. Therefore, the data recorded by the RDM was used to create the plots and analysis for this investigation. However, the GPS data was stored on the RDM in a format that results in a less precise position, therefore the GPS data from the G1000 was used to produce the maps.

2.1 Garmin G1000 SD Data Card Data Recovery

The Garmin G1000 SD card data was extracted by the aircraft manufacturer, Cirrus Aircraft, and provided to the NTSB Vehicle Recorders Division via electronic file transfer.

2.2 Garmin G1000 SD Data Card Data Description

The G1000 SD card received stores flight data in individual flight logs. The SD card contained 227 log files. The accident flight recording was identified and was

⁴ Databases can include terrain data, obstacle data, SafeTaxi charts, flight charts and airport terrain databases

approximately 12 minutes long. The data recorded does not indicate that there was any interruption in power during the flight.

The G1000 SD card also contained aircraft reports, recording the status of various systems. The aircraft report from the accident date indicated that the terrain database was successfully loaded with an effective date of April 8, 2020, and no expiration date. The obstacle database and SafeTaxi map were successfully loaded, both with an effective date of October 5, 2023, and expiration date of November 30, 2023. The airport terrain database was missing.

2.2.1 Garmin G1000 SD Data Card Engineering Unit Conversions

Table 2 describes the G1000 parameters provided and verified in this report.

Table 2. Verified and provided parameters.

Parameter Name (units)	Parameter Description
Latitude (deg)	Latitude
Longitude (deg)	Longitude
Time (hh:mm:ss)	Time in hours:minutes:seconds

2.3 Garmin G1000 SD Card Time Correlation

The G1000 SD card records time with the first data sample based on the unit's internal clock. This clock is set and updated by the unit and is based off GPS time, which is based on UTC.

Correlation of the data to the event local time, EDT, was established by using the recorded time and then applying an additional 4 hours offset to change UTC to EDT. Therefore, for the rest of this report, all times are referenced as EDT, not recorded time.

D. FIGURES AND TABULAR DATA

Figure 1 to Figure 3 contain RDM data recorded during the event on October 11, 2023. All the parameters listed in table 1 are plotted except UTC Time.

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.

The airspeed parameter becomes invalid after the apparent tree impact.

The gross weight parameter indicates that the aircraft had a gross weight of 3782.5 pounds at takeoff. The maximum takeoff weight indicated by the manufacturer in the pilot's operating handbook is 3600 pounds. Aircraft gross weight

is calculated using the empty weight of the aircraft and values entered by the pilot for fuel onboard and weights of passengers and baggage.

An excerpt from the Cirrus Perspective+ Pilot's Guide showing the Negative Climb Rate After Takeoff Alert is included in attachment 1 to this report. During the accident flight, the aircraft was operated within the performance envelope that would trigger a "Too Low, Terrain" caution message and the terrain would be illuminated amber on the PFD. The terrain alert parameter only records warnings, not cautions, and did not trigger during this flight.

The corresponding tabular data used to create Figure 1 to Figure 3 are provided in CSV format as attachment 2 to this report.

Figure 4 and Figure 5 contain GPS data from the G1000 and show a graphical overlay of the entire accident flight generated using Google Earth. Figure 4 shows the entire accident flight and Figure 5 shows the path from takeoff through the impact with the tree. The weather and lighting conditions in Google Earth are not representative of the weather and lighting conditions present at the time of the accident.

The corresponding tabular data used to create Figure 4 and Figure 5 is provided in CSV format as attachment 3 to this report.

Submitted by:

Olivia Fowler
Mechanical Engineer - Vehicle Recorders Specialist

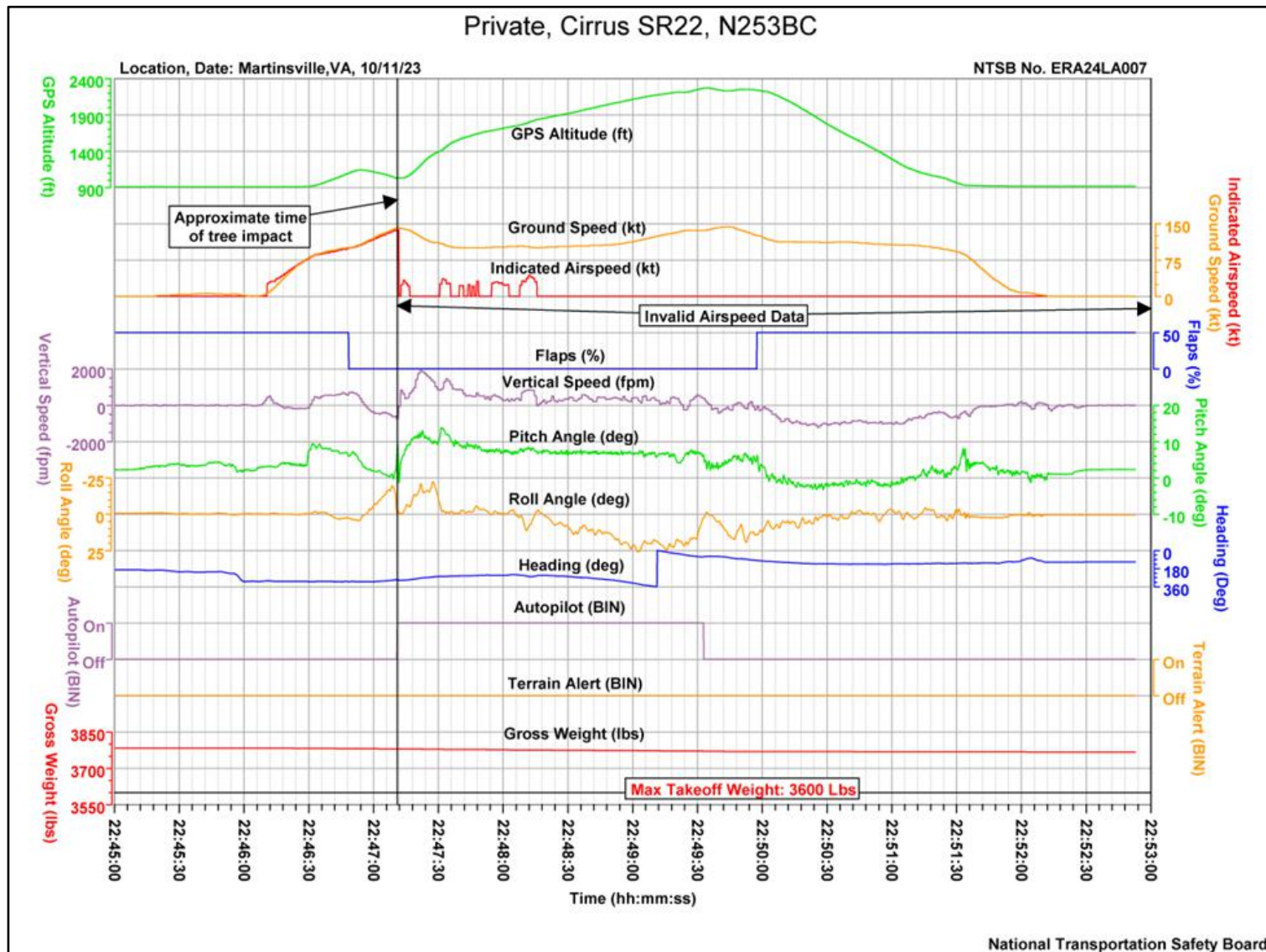


Figure 1. Plot of basic parameters for entire flight.

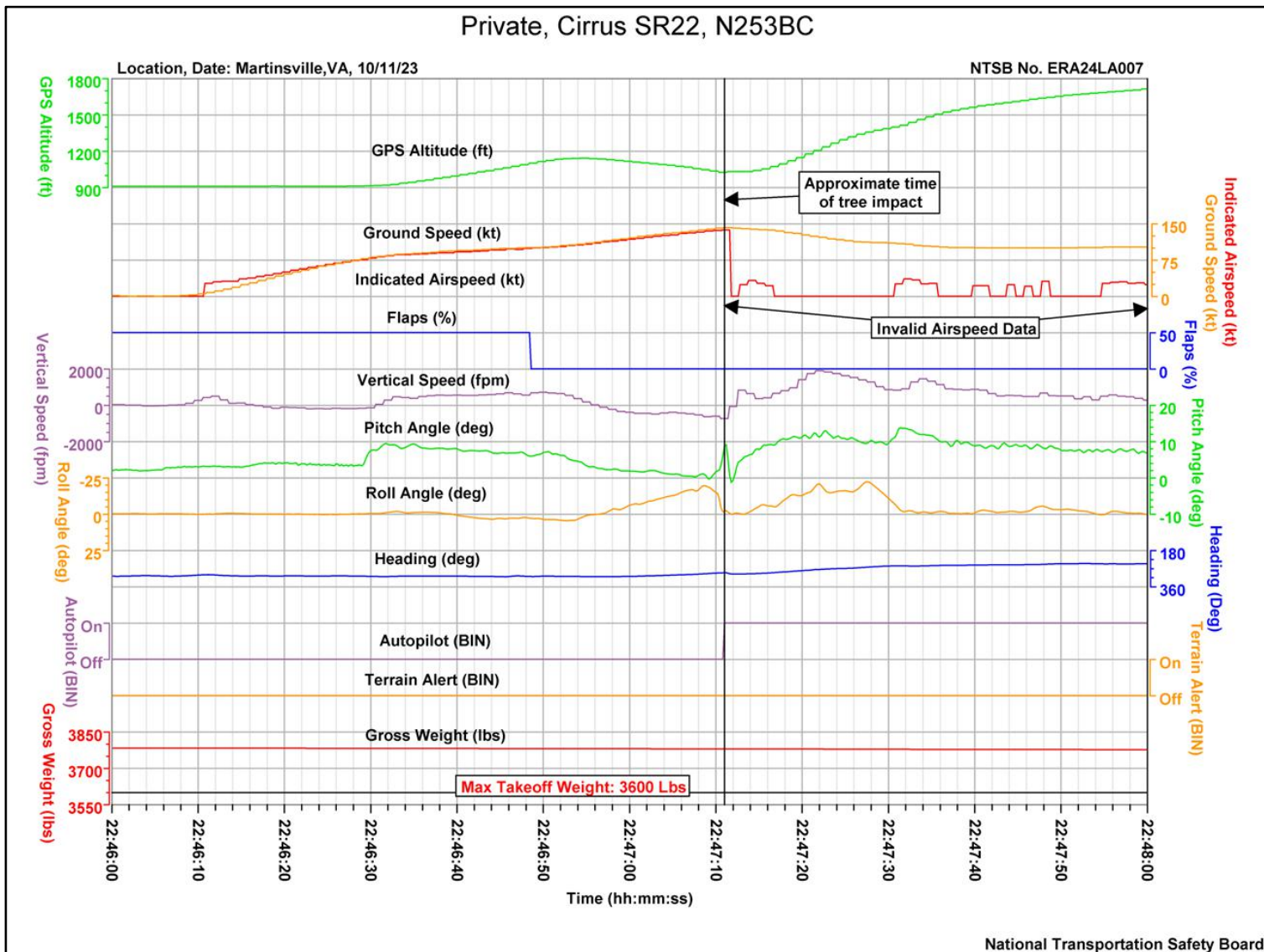


Figure 2. Plot of basic parameters focused on the impact with the tree.

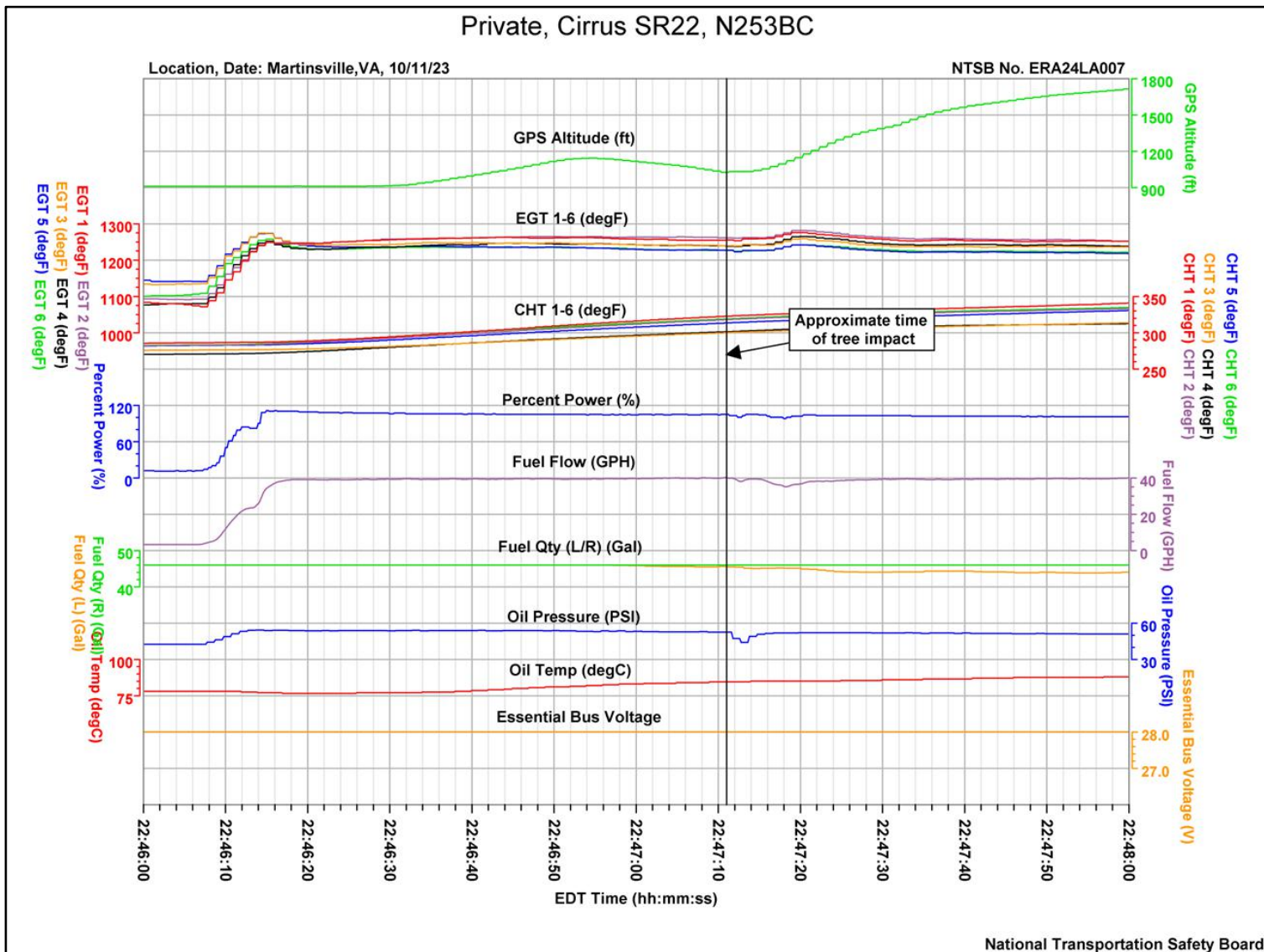


Figure 3. Plot of engine and electrical parameters focused on the impact with the tree.



Figure 4. Google Earth overlay of the whole accident flight. Not representative of weather or lighting conditions at the time of the flight.

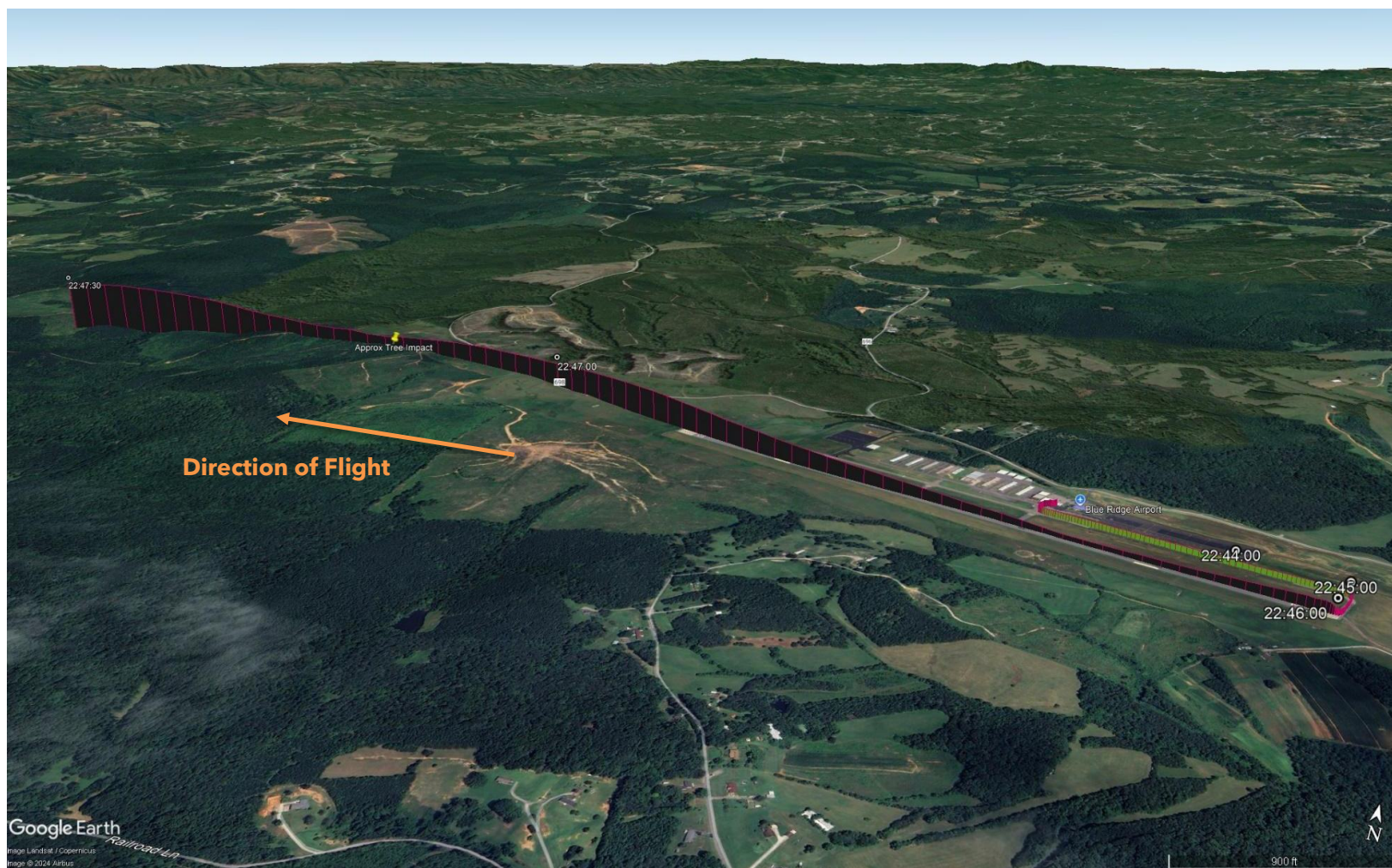


Figure 5. Google Earth overlay of the accident flight from takeoff through the impact with the tree. Not representative of weather or lighting conditions at the time of the flight.