

NATIONAL TRANSPORTATION SAFETY BOARD
Vehicle Recorder Division
Washington, D.C. 20594

August 26, 2020

Global Positioning System Devices

Specialist's Factual Report **By W. Deven Chen**

1. EVENT SUMMARY

Location: Mechanicsburg, Pennsylvania
Date: January 9, 2020
Aircraft: Robinson R66
Registration: N450MC
Operator: Private
NTSB Number: ERA20FA074

On January 9, 2020, about 2029 eastern standard time (EST), a Robinson R66, N450MC, experienced an in-flight break-up near Mechanicsburg, Pennsylvania. The private pilot and one passenger were fatally injured, and the helicopter was destroyed. The helicopter was operated under the provisions of title 14 *Code of Federal Regulations* Part 91 personal flight. Night visual meteorological conditions prevailed at the time and no flight plan was filed for the flight. The flight originated about 1958 from Martin State Airport (MTN), Baltimore, Maryland, and was destined for Buffalo Niagara International Airport (BUF), Buffalo, New York.

2. GROUP

A group was not convened.

3. DETAILS OF INVESTIGATION

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

Device Manufacturer/Model: **Garmin GTN 750**
Serial Number: **1ZA023294**

Device Manufacturer/Model: **Garmin GDU 1060**
Serial Number: **3M4001124**

3.1. Garmin GTN 750 Description

The Garmin GTN 750 is a panel-mounted GPS receiver featuring an 800 x 600 pixel, 6.9 inch color liquid crystal (LCD) display. It has a GPS/SBAS engine and is TSO C146c certified for primary domestic, oceanic, and remote navigation including en route, terminal, and non-precision approaches, and approaches with vertical guidance, such as LPV and LNA/VNAV.

The unit can simultaneously give aviators vital approach information and weather and traffic data in relation to their position on a large, color moving map display. Its color moving map features a built-in database that shows cities, highways, railroads, rivers, lakes, and coastlines. The unit has a slot on the front for a Jeppesen database containing all airports, VORs, NDBs, intersections, FSSs, approaches, DPs/STARs and SUA information. A flight plan composed of multiple waypoints, including user-defined waypoints, can be programmed in the unit. The GTN 750 also includes a TSO'd airborne VHF communications transceiver and TSO'd airborne VOR/Localizer and Glideslope receivers. The unit contains an internal SD card storing flight log data, which can be accessed through the slot in the right side of the unit.

3.1.1. Garmin GTN 750 Data Recovery

Upon arrival at the Vehicle Recorder Division, an exterior examination revealed the device had minor impact damage, as shown in Figure 1. The device did not power up normally. The data were downloaded by extracting the internal SD card and using a surrogate device for data conversion.

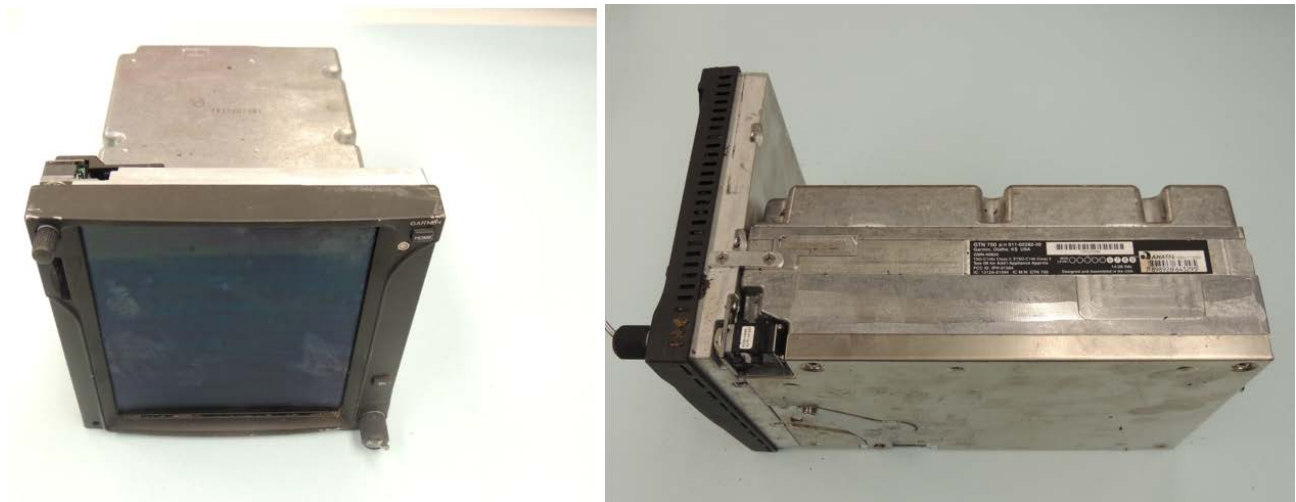


Figure 1: Front and side views of Garmin GTN 750 as received.

3.1.2. Garmin GTN 750 Data Description

The downloaded data contained 37 sessions, ranging from August 5, 2019 to January 9, 2020. One flight log was identified as the recording during the accident flight. The flight log was approximately 36 minutes and 42 seconds, recorded from 19:52:31 to 20:29:13 EST on January 9, 2020. The data was recorded at an approximately 1 second-per-sample rate.

3.1.2.1. Parameters Provided

Table 1 describes data parameters provided by the Garmin GTN 750.

Table 1: Validated Parameters from Garmin GTN 750.

Parameter Name	Parameter Description
Time	Time (EST) for recorded data point (HH:MM:SS)
Present Position Latitude (deg)	GPS position latitude in degrees

Parameter Name	Parameter Description
Present Position Longitude (deg)	GPS position longitude in degrees
LatAC (G)	Lateral direction Acceleration in G
NormAC (G)	Normal direction Acceleration in G
HDG (deg)	Magnetic heading in degrees
Roll Angle (deg)	Roll angle in degrees
Pitch Angle (deg)	Pitch angle in degrees
IAS (knots)	Indicated Air Speed in knots
GndSpd (knots)	Aircraft ground speed in knots
VSpd (fpm)	Vertical Speed in feet per minute
AltMSL(ft)	Altitude above Mean Sea Level in feet
AltB (ft)	Baro Altitude in feet

3.2. Garmin GDU 1060 Description

The Garmin GDU 1060 is marketed under the TXi product line. The GDU-1060 is a versatile Electronic Flight Instrument System (EFIS) that can serve as a primary flight display (PFD), Multi-Function Display (MFD), Engine Information System (EIS), or a combination of all, depending on configuration. The unit comes in a variety of display sizes and orientations and utilizes a color, touch-screen interface. The unit contains an Attitude Heading Reference System (AHRS) device and is capable of providing attitude information and air data information. The unit interfaces with a number of other compatible products and can display navigation, terrain, engine, weather, traffic and other parametric data streams. The unit is synthetic vision capable.

The unit records internally to a non-volatile memory ¹(NVM) chip on an internal board, as well as externally, on a SD card (if installed).

3.2.1. Garmin GDU 1060 Data Recovery

Upon arrival at the Vehicle Recorder Division, an exterior examination revealed the device sustained impact damage, as shown in Figure 2. There was no flight data SD card found on the unit. The internal circuit board containing the NVM chip was sent to the manufacturer for a retrieval of the data contents. The manufacturer then sent back the extracted data electronically.

¹ Non-volatile Memory (NVM) – Semi-conductor memory that does not need power applied to retain data.



Figure 2: Front and side views of the Garmin GDU 1060 as received.

3.2.2. Garmin GDU 1060 Data Description

The data contained a number of sessions over a number of different power cycles. The last flight log was identified to be the accident flight. The log data showed no recording of engine information system data, and there were no engine information system data found on the previous flight logs. It was likely that the unit was not configured to do so. The parameters recorded on this unit were found to be mostly the same as the parameters recorded on the Garmin GTN 750 detailed in section 3.1. The data from both units were compared and found to be matching up each other mostly, with very minimal variations during the last 10 seconds of the flight.

3.3. Plots and Corresponding Tabular Data

The following figures contain data recorded during the January 9, 2020 event.

Figure 3 is a Google Earth overlay showing the overview of the accident flight. The flight originated near Baltimore, MD and headed northwest. 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 the aircraft took off at Martin State Airport at about 19:52:31 EST.

Figure 5 is a Google Earth overlay showing the aircraft's descent to the accident location. The aircraft was last recorded in Mechanicsburg, PA at 20:29:13 EST. The reported wreckage location is shown with a red pin.

Figure 6 is a plot of the recorded data parameters from the Garmin GTN 750 of the accident flight, from 19:52:31 to 20:29:13 EST.

Figure 7 is a plot of the last 23 seconds recorded data parameters from the Garmin GTN 750 of the accident flight, from 20:28:50 to 20:29:13 EST.

Figure 8 is a comparison plot of the recorded data parameters from the Garmin GTN 750 and Garmin GDU 1060 at the end of the accident flight. The parameters from the Garmin GDU 1060 are labeled with names ended with G1060.

The corresponding tabular data used to create figures 3-7 were from the Garmin GTN 750 and are provided in electronic comma-delimited (.csv) format as Attachment 1 to this report. Figure 8 was created using tabular data from the both units. The data from the Garmin GDU 1060 are provided in electronic comma-delimited (.csv) format as Attachment 2 to this report. The attachments contain additional parameters that were recorded during the accident flight. Not every additional parameter has been validated by the specialist.

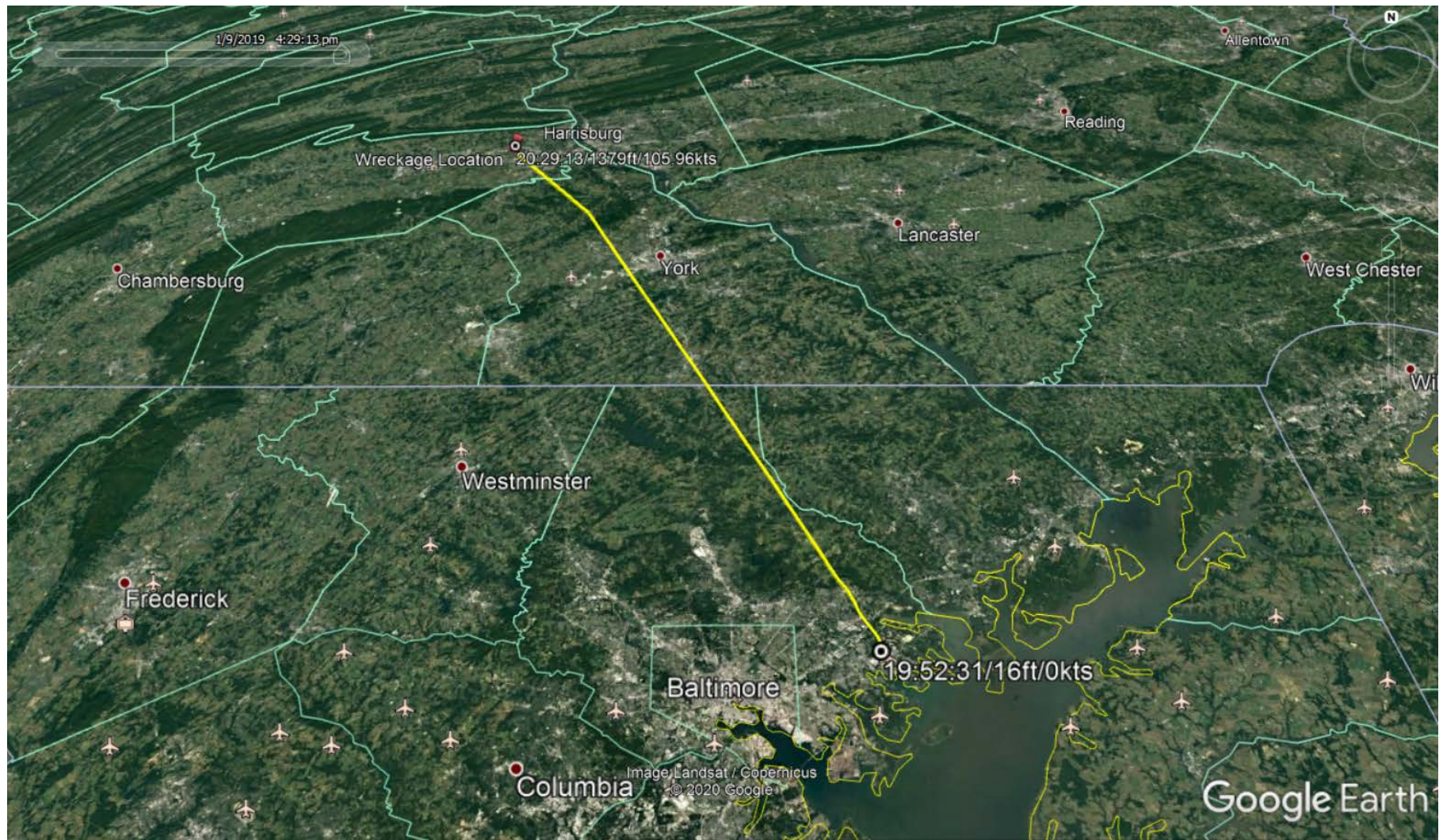


Figure 3: Google Earth overlay showing the overview of the entire flight.



Figure 4: Google Earth overlay showing the start of the accident flight.



Figure 5: Google Earth overlay showing the aircraft's descent to the accident location.

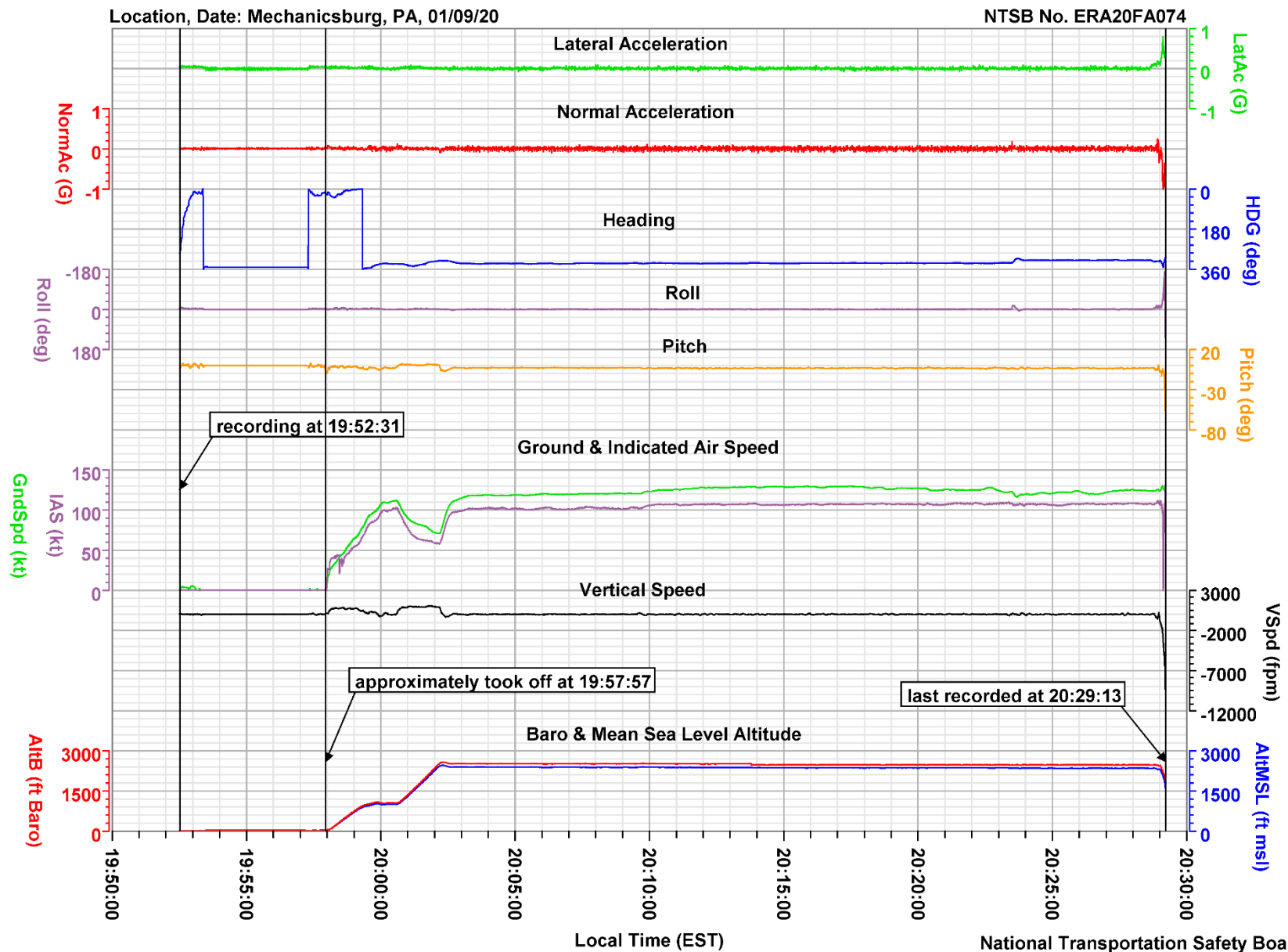


Figure 6: Plot of data parameters from Garmin GTN 750 of the accident flight.

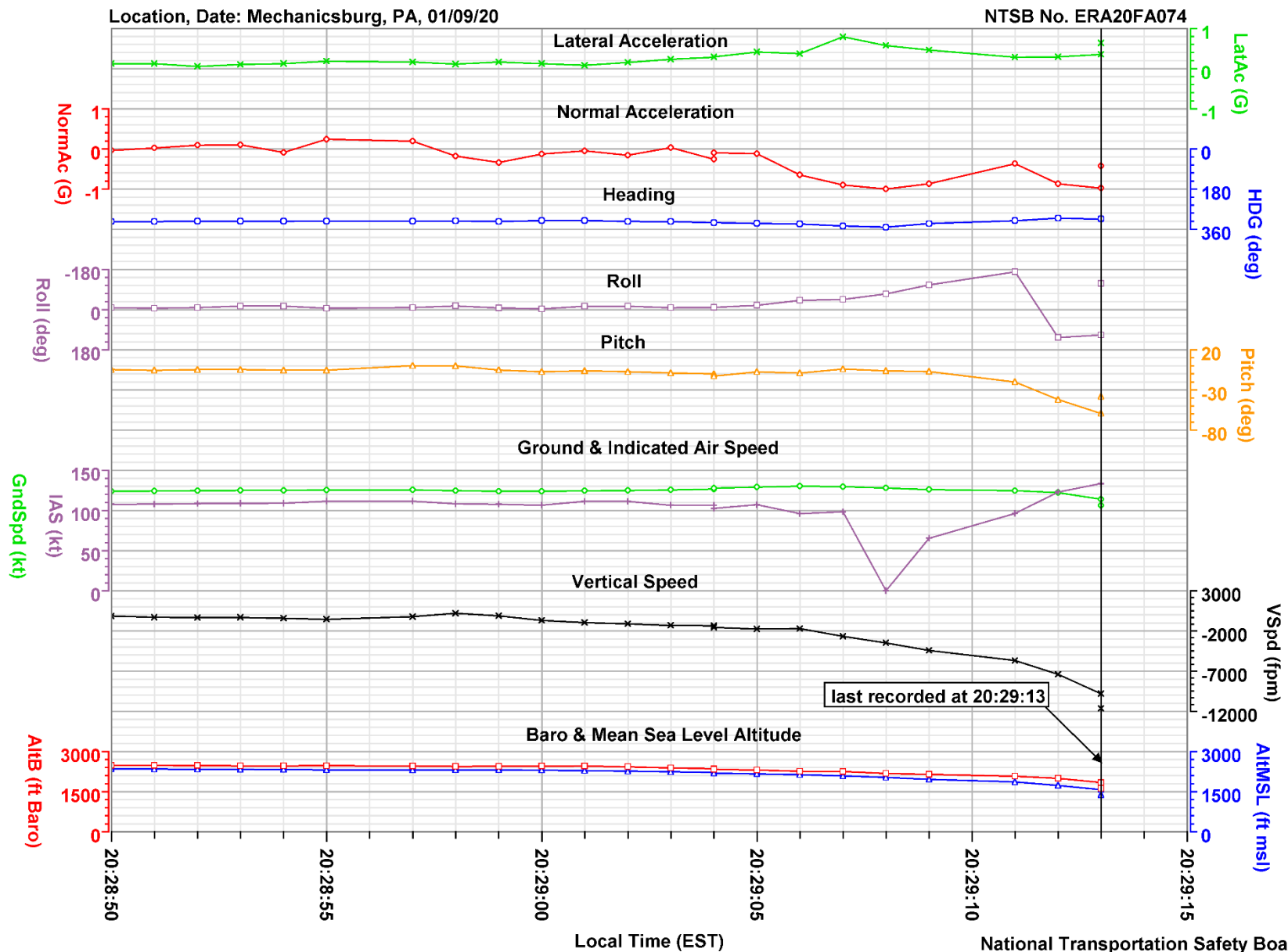


Figure 7: Plot of the last 23 seconds data parameters from Garmin GTN 750 of the accident flight.

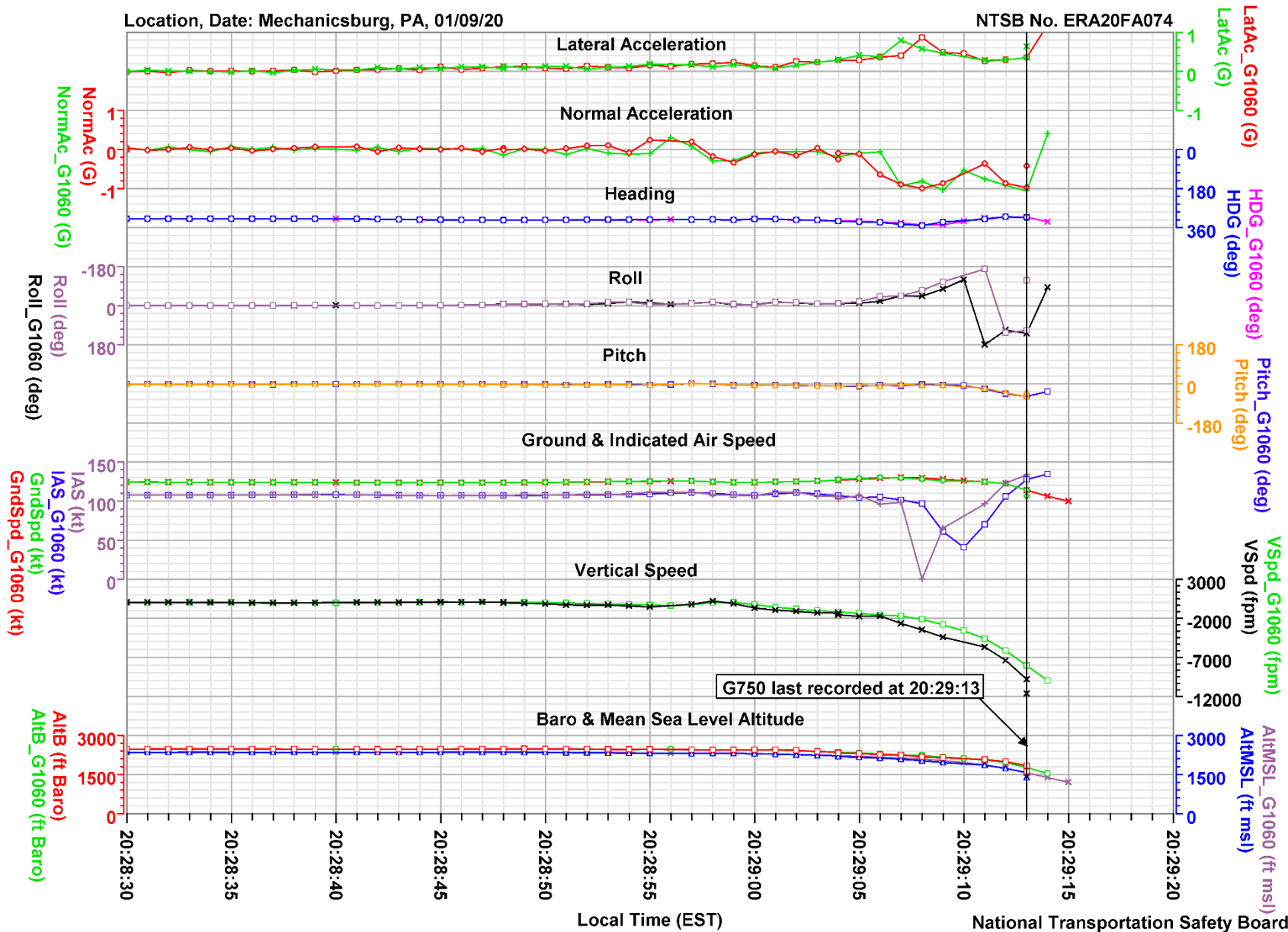


Figure 8: Plot of data parameters from both Garmin GTN 750 and Garmin GDU 1060 at the end of the accident flight.