

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

December 2, 2019

Cockpit Displays – Recorded Flight Data

**Specialist's Factual Report
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1. EVENT

Location: Metlakatla, Alaska
Date: May 20, 2019
Aircraft: de Havilland DHC-2
Registration: N67667
Operator: Taquan Air
NTSB Number: ANC19FA019

On May 20, 2019, about 1556 Alaska daylight time (AKDT), a float-equipped de Havilland DHC-2 (Beaver) airplane, N67667, overturned and partially sank during a landing in Metlakatla Harbor, Metlakatla, Alaska. The commercial pilot and passenger sustained fatal injuries, and the airplane sustained substantial damage. The airplane was registered to Blue Aircraft, LLC and operated by Venture Travel, LLC, dba Taquan Air, Ketchikan, Alaska, under the provisions of Title 14 *Code of Federal Regulations* Part 135 as a scheduled commuter flight. Company flight following procedures were in effect and visual meteorological conditions prevailed. The flight originated from the Ketchikan Harbor Seaplane Base (5KE), Ketchikan, about 1540 as Flight 20, and was destined for the Metlakatla Seaplane Base (MTM) in Metlakatla.

2. RECORDED FLIGHT DATA GROUP

A recorded flight data group was not convened.

3. DETAILS OF INVESTIGATION

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

Recorder Manufacturer/Model: **Chelton Integrated Display Unit (IDU)**
Recorder Serial Number: **34234**

Recorder Manufacturer/Model: **Chelton IDU**
Recorder Serial Number: **47195**

3.1.1. Chelton IDU

The IDU devices are identical part numbers and are configured to operate as primary flight displays (PFD) or multi-function displays (MFD). Using external sensors, including solid state Air Data and Attitude Heading Reference System (ADAHRS), the PFD displays aircraft

parameter data including altitude, airspeed, attitude, vertical speed, and heading. The MFD displays navigational information by way of a moving map. Additionally, the units in the accident included a terrain awareness and warning system (TAWS) that may provide aural and color-coded warnings of terrain depending on pilot selections. As part of the TAWS system, the PFD is capable of providing a profile view of terrain ahead of aircraft (“synthetic vision”). The FAA’s Instrument Flying Handbook (FAA-H-8083-15B) uses the Chelton IDU to explain the concept of synthetic vision, stating,

“Synthetic vision provides a realistic depiction of the aircraft in relation to terrain and flightpath. Systems such as those produced by Chelton Flight Systems, Universal Flight Systems, and others provide for depictions of terrain and course. Figure 5-46 [figure 1 in this report] is an example of the Chelton Flight System providing both 5-dimensional situational awareness and a synthetic highway in the sky, representing the desired flightpath. Synthetic vision is used as a PFD, but provides guidance in a more normal, outside reference format.” (Chapter 5)

Figure 1. Chelton display as depicted in the FAA instrument Flying Handbook.



Figure 5-46. The benefits of realistic visualization imagery, as illustrated by Synthetic Vision manufactured by Chelton Flight Systems. The system provides the pilot a realistic, real-time, three-dimensional depiction of the aircraft and its relation to terrain around it.

Each IDU contains two internally mounted flash memory devices (PCMCIA¹ format) capable of logging flight data. Figure 2 shows a screen capture from the Chelton Installation Manual² of data parameters potentially recorded by each IDU once per second; the actual parameters recorded varies depending upon the installation. The recording logic retains up to five hours of data from each of the last five flights. The recording begins after the pilot acknowledges

¹ Personal Computer Memory Card International Association or PC Card

² Chelton Flight Systems EFIS-SV Installation Guide, 64-000038 Revision C

the installed database dates by pressing a button on the IDU bezel and after internal diagnostics verify primary sensors are available. Additionally, every five seconds the IDU snapshots two binary files: (a) external parameters received by the IDU in an “ac.dat” file and (b) internal menu parameters indicating how the system was being operated in the “settings.dat” file.

Figure 2. Potential parameters recorded by each IDU.

First Line (Flight)	Second Line (Engine #1)	Third Line (Engine #2)
Latitude (°)	RPM	RPM
Longitude (°)	Fuel Flow (GPH)	Fuel Flow (GPH)
MSL Altitude (ft)	Aux. 1	Aux. 1
Pitch Angle (°)	Left Fuel (Gal.)	--
Bank Angle (°)	Right Fuel (Gal.)	--
Heading (° Mag.)	Fuel Pressure (PSI)	Fuel Pressure (PSI)
Track (° Mag.)	Aux. 5	Aux. 5
IAS (kts)	Oil Temperature (°F)	Oil Temperature (°F)
TAS (kts)	Oil Pressure (PSI)	Oil Pressure (PSI)
Ground Speed (kts)	Volts	Volts
VSI (fpm)	EGT #1 (°F)	EGT #1 (°F)
Glidepath (°)	CHT #1 (°F)	CHT #1 (°F)
G-force	EGT #2 (°F)	EGT #2 (°F)
Wind Speed (kts)	CHT #2 (°F)	CHT #2 (°F)
Wind Direction (° Mag.)	EGT #3 (°F)	EGT #3 (°F)
OAT (°F)	CHT #3 (°F)	CHT #3 (°F)
Density Altitude (ft)	EGT #4 (°F)	EGT #4 (°F)
Fuel Totalizer Qty. (Gal.)	CHT #4 (°F)	CHT #4 (°F)
--	EGT #5 (°F)	EGT #5 (°F)
--	CHT #5 (°F)	CHT #5 (°F)
--	EGT #6 (°F)	EGT #6 (°F)
--	CHT #6 (°F)	CHT #6 (°F)
--	Aux. Temp. 1 (°F)	Aux. Temp. #1 (°F)
--	Aux. Temp. 2 (°F)	Aux. Temp. #2 (°F)
--	Induction Temperature (°F)	Induction Temperature (°F)

3.2. Chelton IDU Data Recovery

Both IDUs were recovered from salt-water. Each unit contained two PCMCIA cards, which were removed from the units, cleaned and dried. One card from each unit contained the flight log, “ac.dat,” and “settings.dat” files. These files were copied off the card using a PCMCIA card reader.

3.3. Chelton IDU Data Description

Each IDU flight log recording contained records of five power cycles corresponding to the last five flights. The last five flights took place from May 19, 2019 UTC³, through May 20,

³ Coordinated Universal Time

2019. The dates recorded on the devices were October 3, 1999, through October 4, 1999, which are exactly 1024 weeks offset from the 2019 dates. This phenomenon, known as GPS Week Number Rollover, can occur due to GPS date being stored in 10 binary digits, which equates to a range of 0 to 1023. The rollover occurred on the night of April 6 to April 7, 2019. Software not coded to anticipate the rollover can potentially display dates that are 20 or 40 years back in time.

The GPS location information from the LOG files was used to validate the accident flight based on known information about takeoff and impact locations. The last flight log, LOG 00, was determined to be the accident flight and started at 23:41:04 UTC and ended at 23:56:12 UTC. Each IDU record contains GPS date and time recorded in UTC. The difference between AKDT and UTC is 8 hours or 28,800 seconds. Data from both IDUs were compared and confirmed to contain the same data; as such, only the data from IDU serial number 34234 are used in this report. Table 1 summarizes each flight on the date of the accident.

3.4. Chelton IDU Engineering Units Conversions

The IDU records information in engineering units; therefore no conversions were necessary. Where applicable, changes may have been made to ensure the parameters conform to the NTSB's standard sign convention that climbing right turns are positive (CRT=+).⁴

APPENDIX A lists the IDU parameters verified and provided in this report.

3.5. Chelton IDU Settings Data

With assistance from the manufacturer, the ac.dat and settings.dat files were decoded. Values pertinent to this investigation are included. According to the manufacturer, sudden gusts of wind will not be reflected in the values for the following parameters:

IDU serial number 34234:

- The wind direction was 105.9 degrees
- The wind speed was 8.4 knots

IDU serial number 47195:

- The wind direction was 103.9 degrees
- The wind speed was 6.8 knots

⁴ 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, that value is positive. Examples: Right Roll = +, Left Aileron Trailing Edge Down = -, Right Aileron Trailing Edge Up = +, Pitch Up = +, Elevator Trailing Edge Up = +.

3.6. Plots and Corresponding Tabular Data

The following four figures contain data from the May 20, 2019, accident flight.

Figure 3 is a graphical overlay generated using Google Earth showing the accident flight from the Chelton IDU. 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 graphical overlay generated using Google Earth showing the end of the accident flight.

Figure 5 is a plot of parameters from the Chelton IDU for the entire accident flight. The time interval displayed is 23:41:00 UTC to 23:57:00 UTC.

Figure 6 is a plot of parameters from the Chelton IDU at the end of the accident flight. The time interval displayed is 23:54:20 UTC to 23:56:20 UTC.

The corresponding tabular data used to create Figures 3 through 6 are provided in electronic (*.csv⁵) format as Attachment 1 to this report.

⁵ Comma Separated Value format.

Figure 3. Google Earth overlay of the entire accident flight. IAS values are shown.



Figure 4. Google Earth overlay of the end of the accident flight. IAS values are shown.

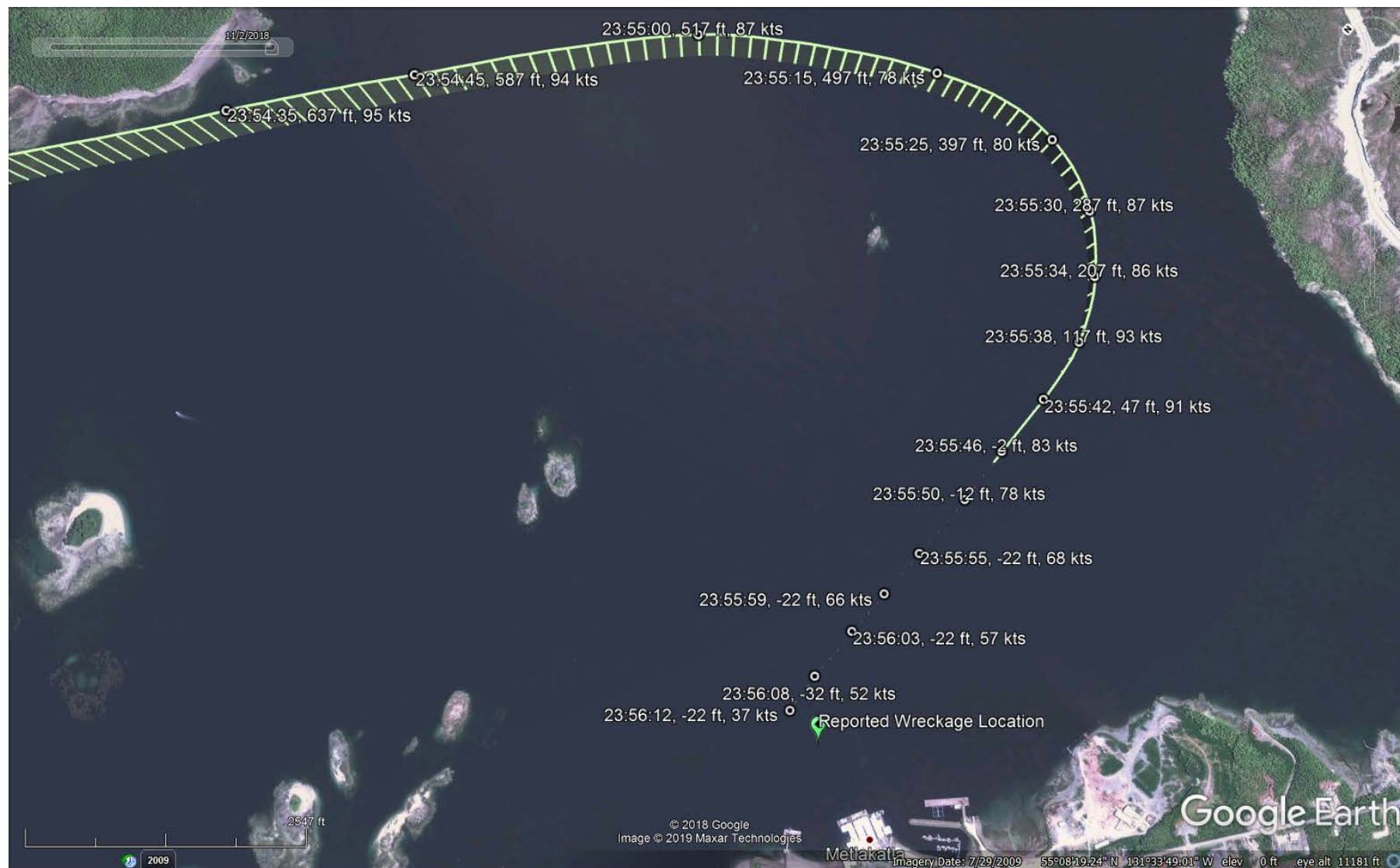


Figure 5. Plot of parameters for the entire accident flight.

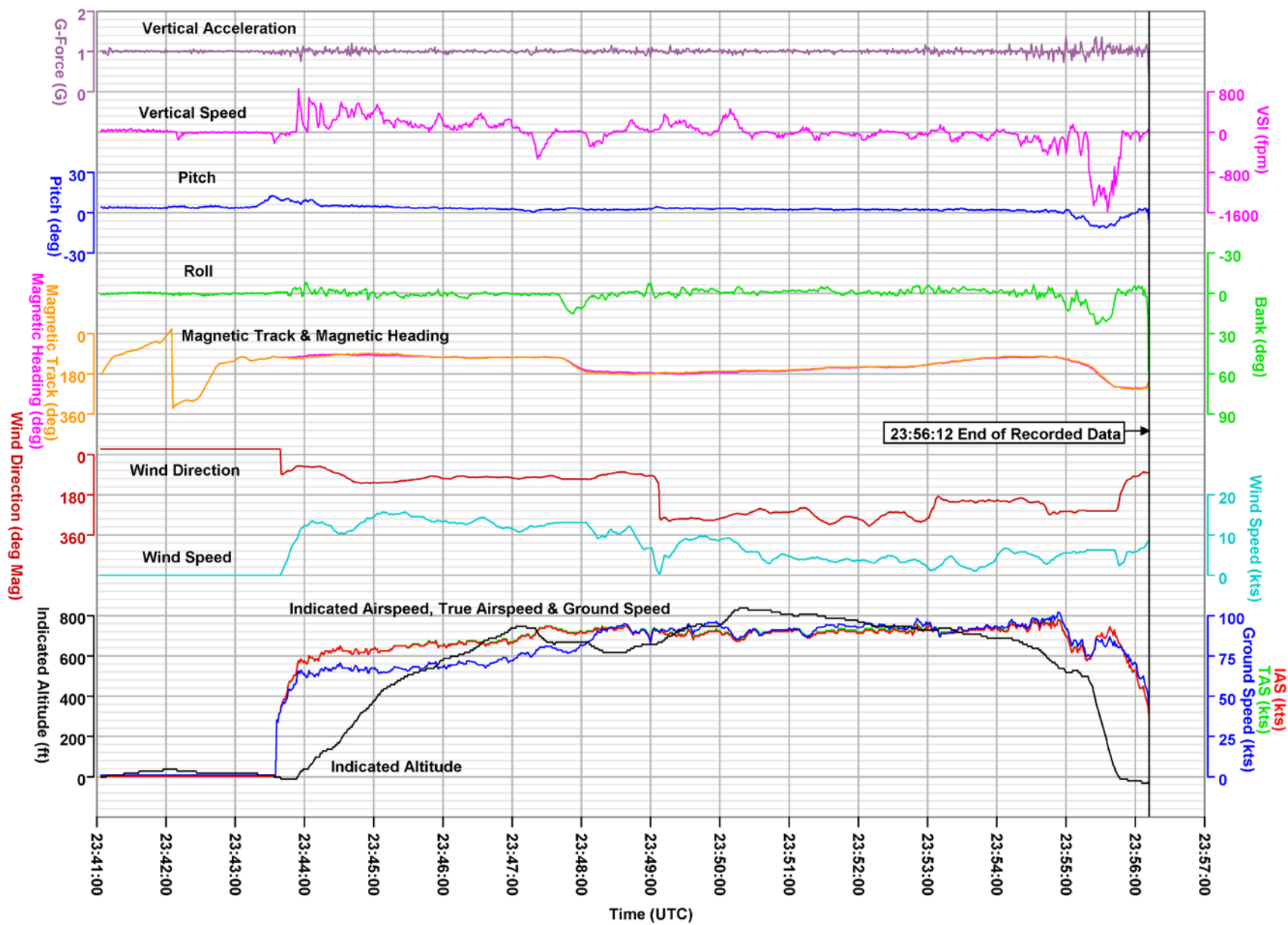
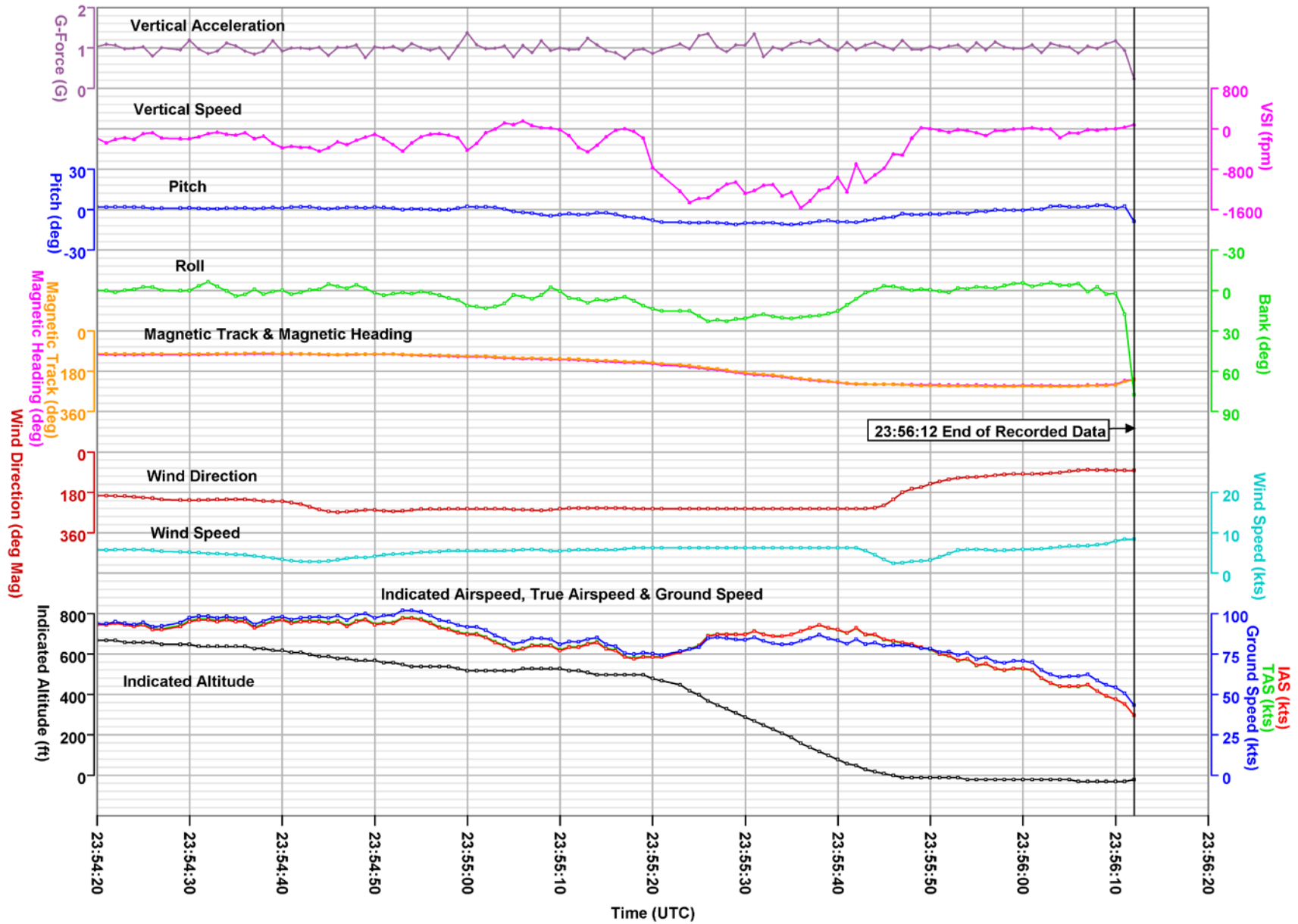


Figure 6. Plot of parameters at the end of the accident flight.



APPENDIX A - IDU Parameters

This appendix describes the parameters provided and verified in this report. Table A-1 lists the IDU parameters.

Table A-1 - Verified and provided parameters.

Parameter Name	Parameter Description
Altitude (ft)	Indicated Altitude (feet)
Bank (deg)	Roll Angle (degrees)
G-Force (g)	Vertical Acceleration (gs)
Ground Speed (kts)	Ground Speed (knots)
Heading (deg Mag)	Magnetic Heading (degrees)
IAS (kts)	Indicated Airspeed (knots)
Latitude (deg)	Latitude (degrees)
Longitude (deg)	Longitude (degrees)
Pitch (deg)	Pitch Angle (degrees)
TAS (kts)	True Airspeed (knots)
Time (HH:MM:SS)	UTC Time (hours:minutes:seconds)
Track (deg Mag)	Magnetic Track (degrees)
VSI (fpm)	Vertical Speed (feet per minute)
Wind Direction (deg Mag)	Wind Direction (degrees)
Wind Speed (kts)	Wind Speed (knots)