

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

August 13, 2019

Cockpit Displays – Recorded Flight Data

Specialist's Factual Report
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1. EVENT SUMMARY

Location: Hydaburg, Alaska
Date: July 10, 2018
Aircraft: de Havilland DHC3T
Registration: N3952B
Operator: Taquan Air Service
NTSB Number: ANC18FA053

On July 10, 2018, about 0835 Alaska daylight time, a single-engine, turbine-powered, float-equipped de Havilland DHC3T Otter airplane, N3952B, sustained substantial damage during an impact with rocky, mountainous, rising terrain about 9 miles east of Hydaburg, Alaska. The airplane was registered to Blue Aircraft, LLC and operated by Taquan Air as a visual flight rules (VFR) on-demand commercial flight under the provisions of 14 *Code of Federal Regulations* Part 135 when the accident occurred. Of the 11 occupants on board, the airline transport pilot was uninjured, four passengers sustained minor injuries, and six passengers sustained serious injuries. Marginal visual meteorological conditions prevailed, and company flight following procedures were in effect. The flight departed Steamboat Bay about 0747 destined for Ketchikan, Alaska.

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 electronic devices:

Recorder Manufacturer/Model: **Chelton Integrated Display Unit (IDU)**
Recorder Serial Number: **34383**

Recorder Manufacturer/Model: **Chelton IDU**
Recorder Serial Number: **34554**

3.1. 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)

3.1.1. Chelton IDU Data Recovery

Both IDUs sustained minor impact damage. Each unit contained two PCMCIA cards, which were removed from the unit. 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.

3.1.2. 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 July 9, 2018 UTC³, through July 10, 2018. The last two flight logs corresponded to the date of the accident. The last flight log, LOG 00

³ Coordinated Universal Time

corresponds to the accident flight. Data from both IDUs were compared and confirmed to contain the same data; as such, only the data from IDU serial number 34383 are used in this report. Table 1 summarizes each flight on the date of the accident.

Table 1. Summary of recorded flights on date of accident.

LOG	Start UTC	End UTC
01	July 10, 2018 14:32:03	July 10, 2018 15:19:01
00	July 10, 2018 15:44:03	July 10, 2018 16:29:23

3.1.3. 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 PFD parameters verified and provided in this report.

3.1.4. Chelton IDU Settings Data

With assistance from the manufacturer, the ac.dat and settings.dat files were decoded. Values pertinent to this investigation from IDU serial number 34383 include:

- TAWS was set to the inhibit position;
- Altimeter setting was 30.09 inHg;
- Above Ground Level (AGL) altitude used by TAWS was -275 feet; and
- Altitude indicated on the IDU was 2,515 feet

The IDU records barometric altitude as shown on the IDU, which is based on the altimeter setting set by the pilot.

3.2. Time Correlation

Each IDU record contains GPS date and time recorded in UTC.

3.3. Plots and Corresponding Tabular Data

The following 7 figures contain data recordings from the July 10, 2018, accident flight.

Figure 3 is a graphical overlay generated using Google Earth showing the last two flight logs 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 accident flight.

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 = +.

Figure 5 is a graphical overlay generated using Google Earth showing the end of the accident flight.

Figure 6 is a plot of basic parameters from the Chelton IDU for the entire accident flight. The time interval is 15:44:00 to 16:30:00 UTC.

Figure 7 is a plot of basic parameters from the Chelton IDU at the end of the accident flight. The time interval is 16:26:00 to 16:29:30 UTC.

Figure 8 is a plot of additional parameters from the Chelton IDU for the entire accident flight. The time interval is 15:44:00 to 16:30:00 UTC.

Figure 9 is a plot of additional parameters from the Chelton IDU at the end of the accident flight. The time interval is 16:26:00 to 16:29:30 UTC.

Figure 3. Google Earth overlay of last two flight logs from Chelton IDU. LOG00 is the last recorded data log.

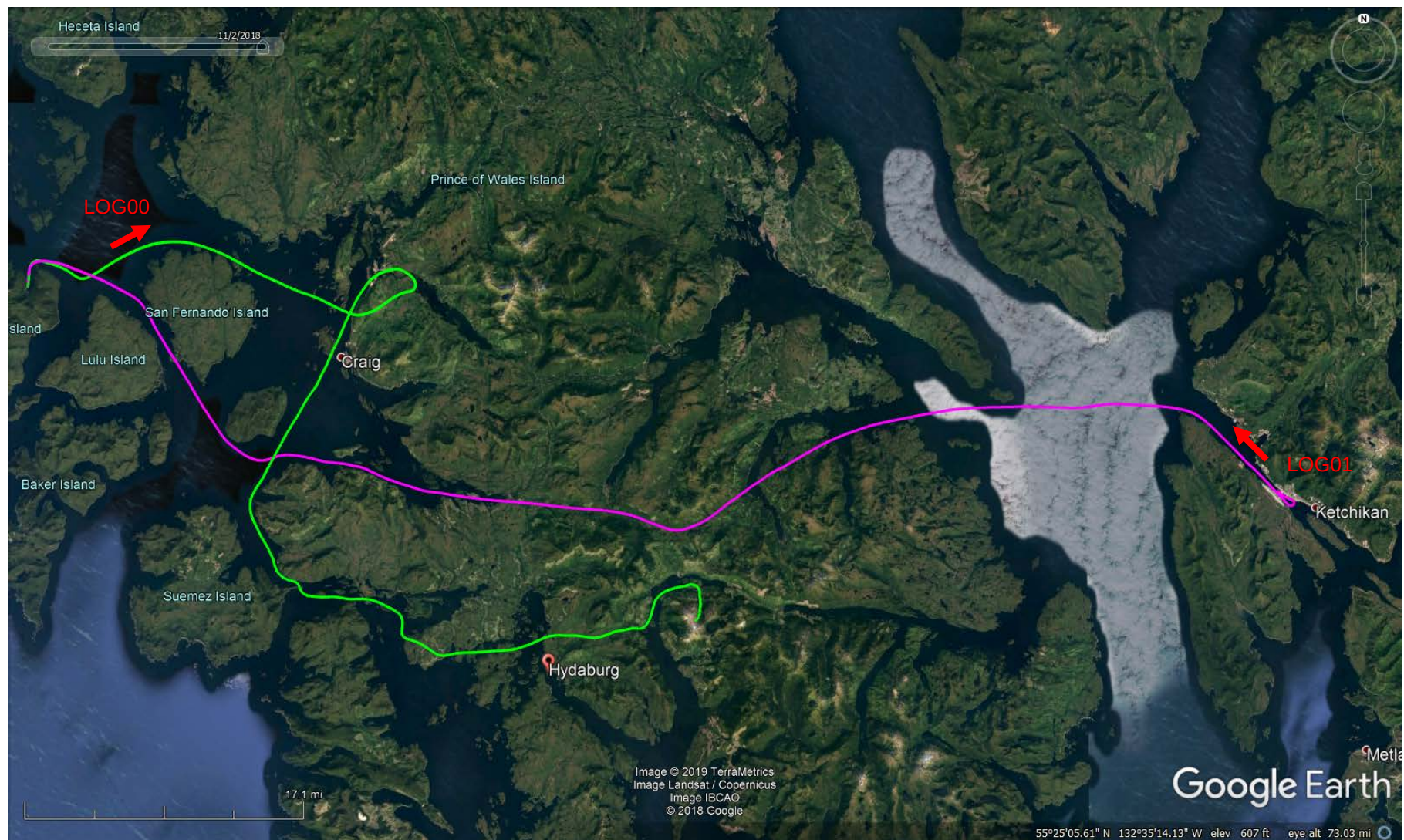


Figure 4. Google Earth overlay of the entire accident flight on July 10, 2018. IAS values are shown.

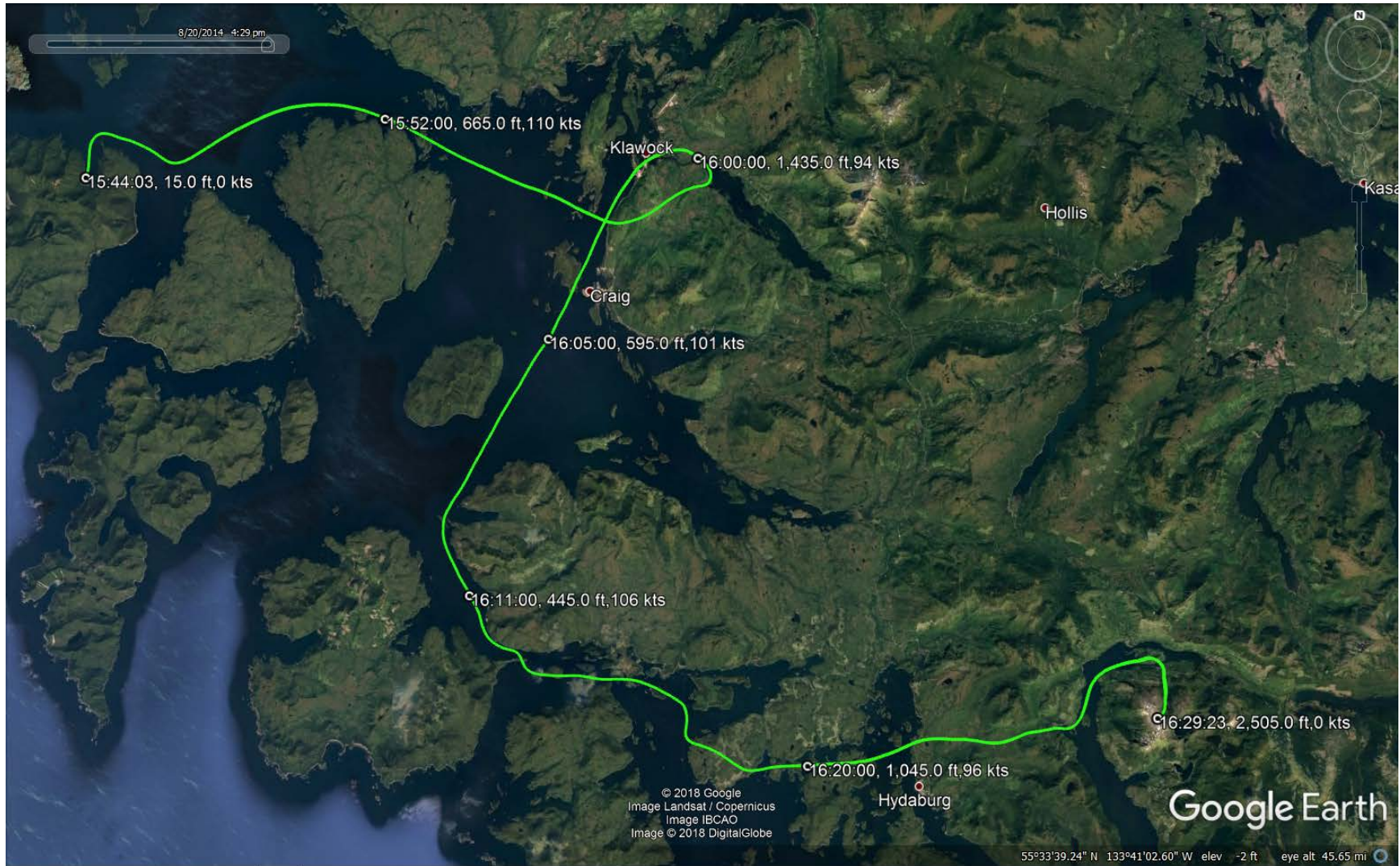


Figure 5. Google Earth overlay at the end of the accident flight. IAS values are shown.

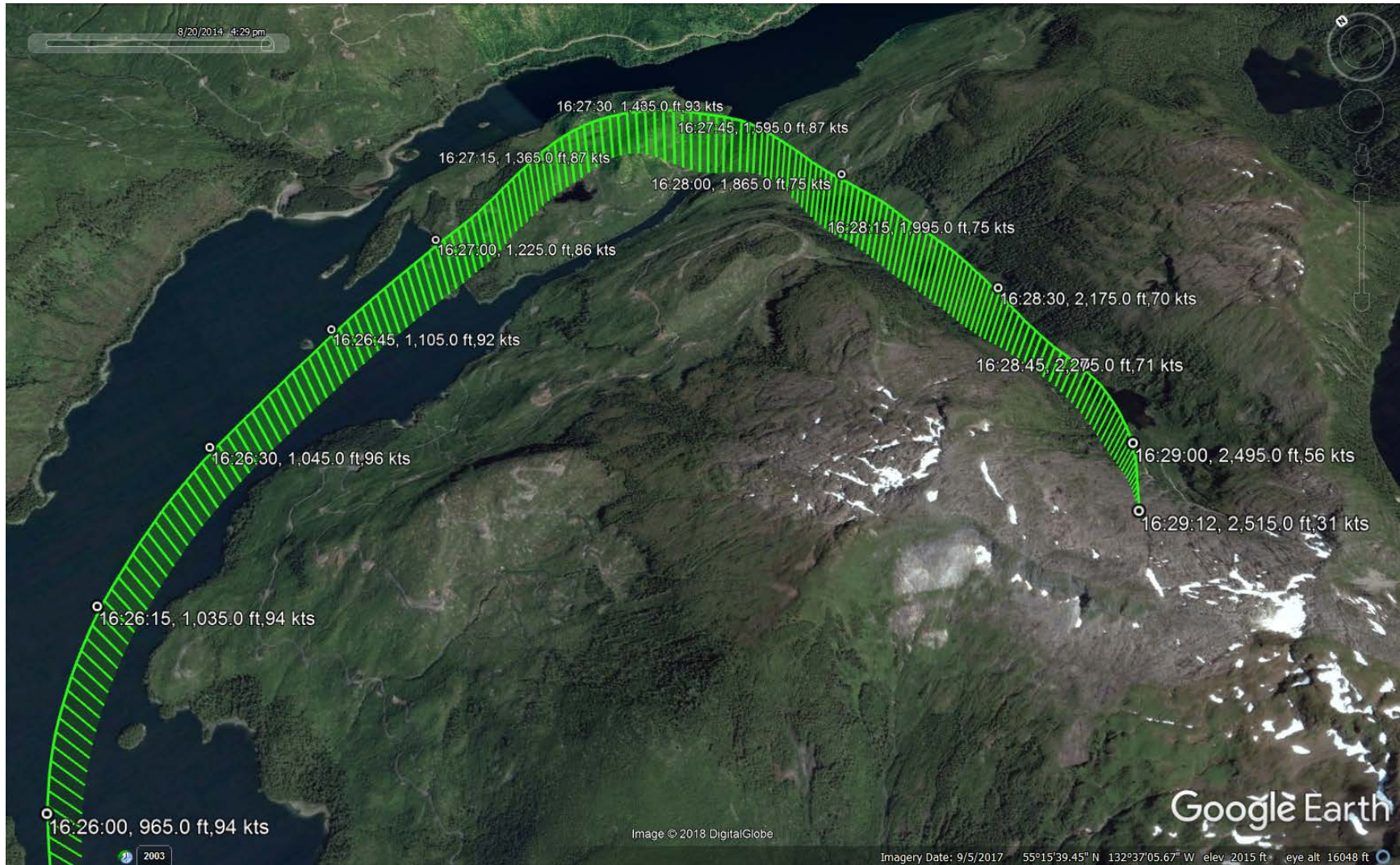


Figure 6. Plot of basic parameters for the entire accident flight.

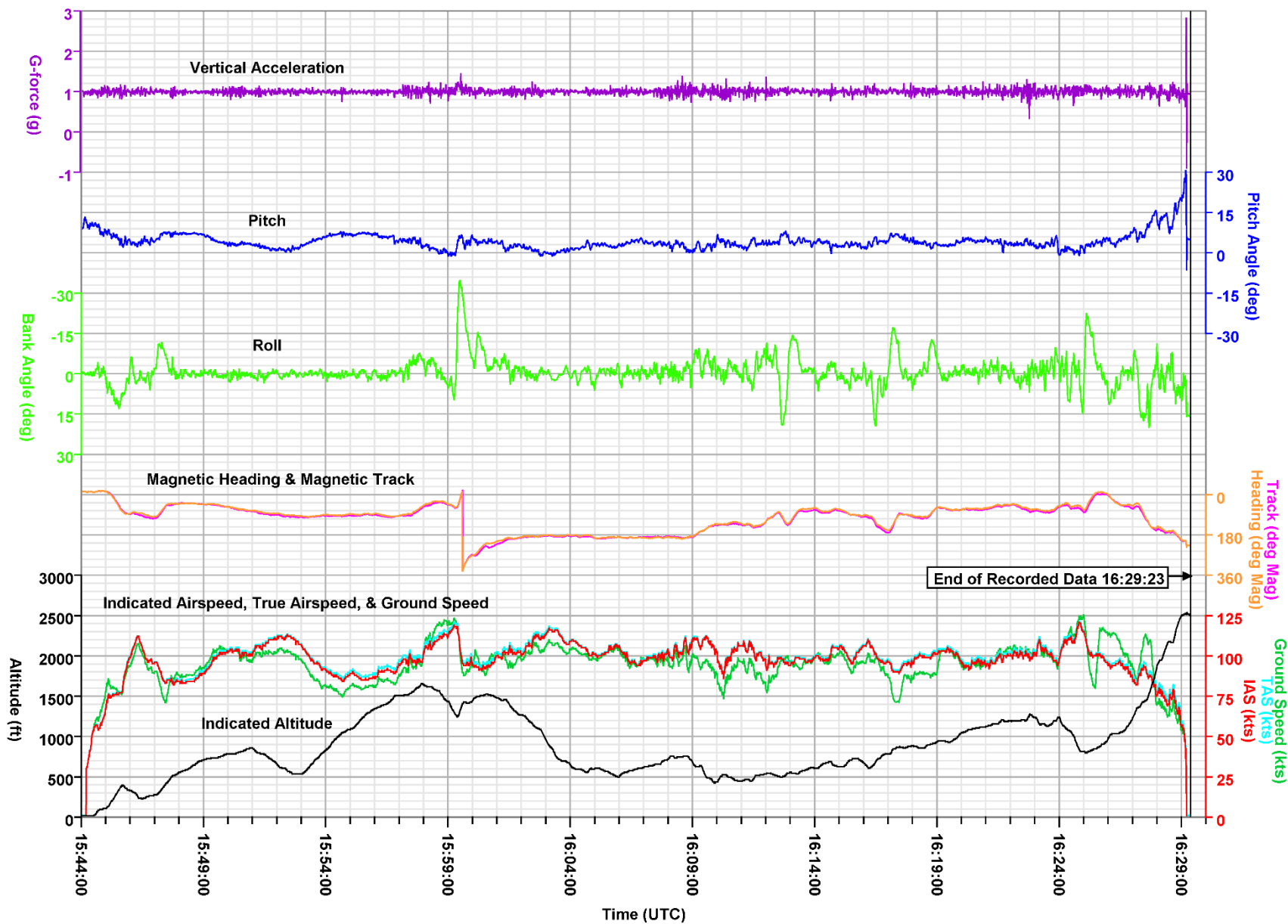


Figure 7. Plot of basic parameters at the end of the accident flight.

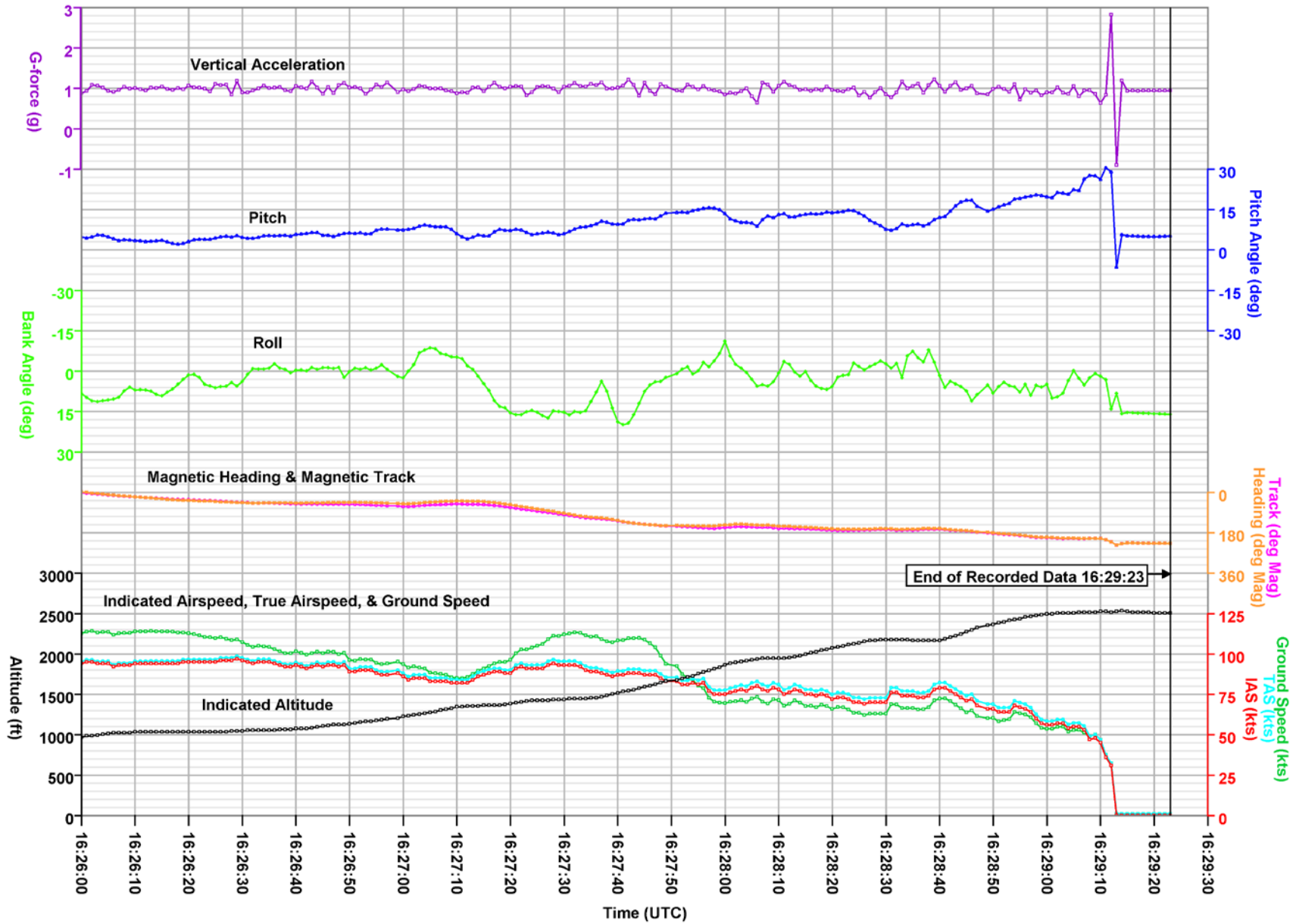


Figure 8. Plot of additional parameters for the entire accident flight.

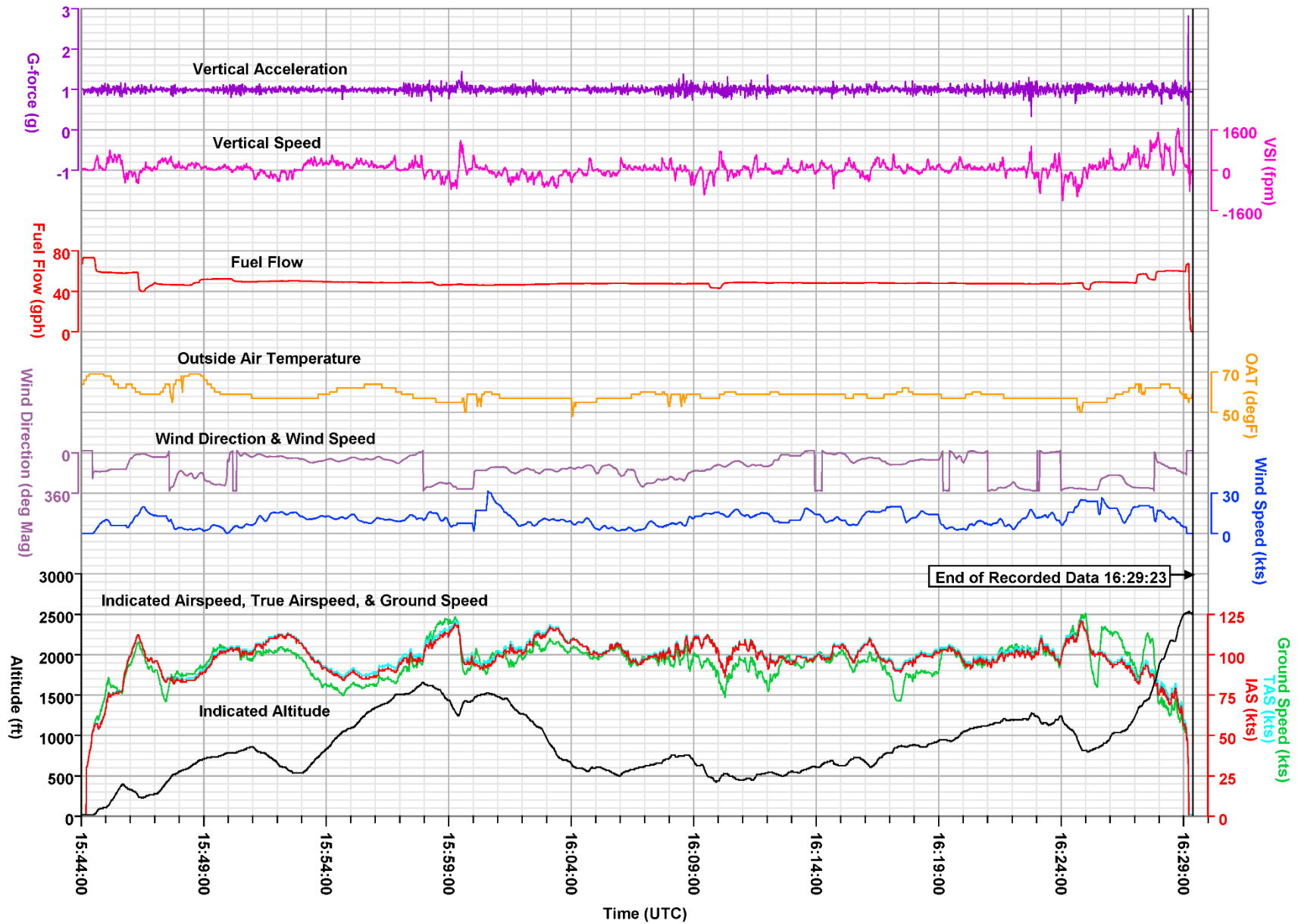
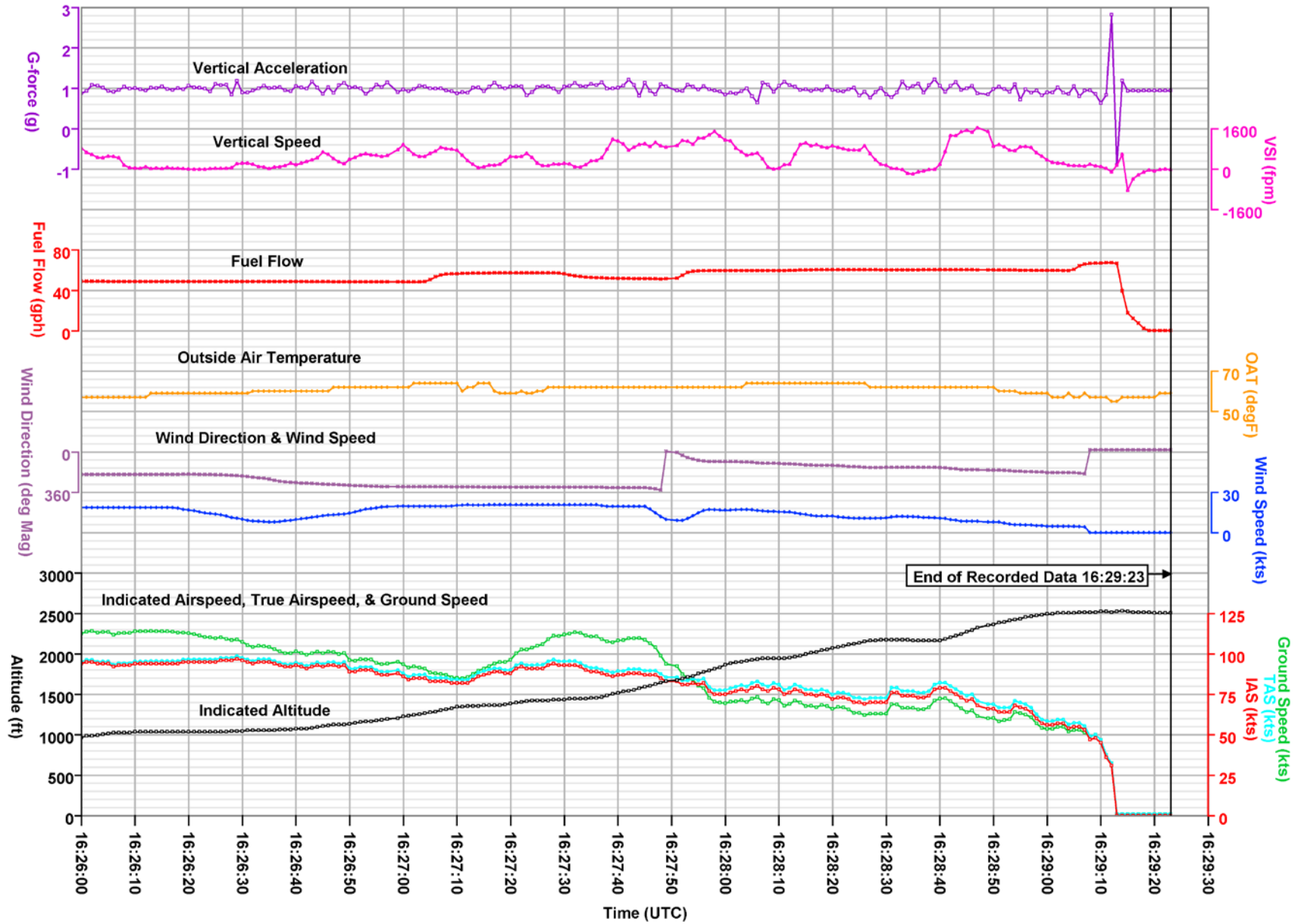


Figure 9. Plot of additional parameters at the end of the accident flight.



APPENDIX A - PFD Parameters

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

Table A-1 - Verified and provided parameters.

Parameter Name	Parameter Description
Altitude (ft)	Indicated Altitude (feet)
Bank (deg)	Roll Angle (degrees)
Fuel Flow (gph)	Fuel Flow (gallons per hour)
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)
OAT (degF)	Outside Air Temperature (degrees Fahrenheit)
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)