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

February 15, 2022

Flight Data Recorder

Specialist's Factual Report
By Kyle Garner

1. EVENT SUMMARY

Location:	Chamberlain, South Dakota
Date:	November 30, 2019
Aircraft:	Pilatus PC-12
Registration:	N56KJ
Operator:	Private
NTSB Number:	CEN20FA022

2. FLIGHT DATA RECORDER GROUP

A flight data recorder (FDR) group was not convened.

3. FDR CARRIAGE REQUIREMENTS

The event aircraft, N56KJ, was manufactured in 2013 and was not required to be equipped with an FDR, however, the aircraft was equipped with an L3Harris Lightweight Data Recorder (LDR).

4. DETAILS OF FDR INVESTIGATION

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

Recorder Manufacturer/Model:	**L3Harris LDR**
Recorder Serial Number:	**000891678**

4.1. LDR Description

The LDR is a small and lightweight recorder unit providing crash protected recording of audio, image (if equipped), and flight data on small general aviation helicopters and fixed-wing aircraft typically aircraft carrying up to six passengers. The LDR records airplane flight information in a digital format using solid-state flash memory as the recording medium. The LDR can receive data in the ARINC 717/429 configurations and can record a minimum of 25 hours of flight data. It is configured to record 256 12-bit words of digital information every second. Each grouping of 256 words (each second) is called a subframe. Each subframe has a unique 12-bit synchronization (sync) word identifying it as subframe 1, 2, 3, or 4. The sync word is the first word in each subframe. The data stream is "in sync" when successive sync words appear at proper 256-word intervals. Each data parameter (for example, altitude, heading, and airspeed) has a specifically assigned word number within the subframe.

4.1.1. Recorder Condition

The recorder was in good condition and the data were extracted normally from the recorder.

4.1.2. Recording Description

The FDR recording contained approximately 25 hours of data. Timing of the FDR data is measured in subframe reference number (SRN), where each SRN equals one elapsed second. The event flight was the last flight of the recording and its duration (from aircraft power on to the accident) was approximately 18 minutes.

4.1.3. Engineering Unit Conversions

The engineering unit conversions used for the data contained in this report are based on documentation from the aircraft manufacturer. Where applicable, the conversions have been changed to ensure that the parameters conform to the NTSB's standard sign convention that climbing right turns are positive (CRT=+).[1]

Table A-1 lists the FDR parameters verified and provided in this report. Additionally, table A-2 describes the unit and discrete abbreviations used in this report.

4.2. Time Correlation

Correlation of the FDR data from SRN to the event local time, CST, was established by using the recorded Coordinated Universal Time (UTC) GPS hours, UTC GPS Minutes, and UTC GPS Seconds and then applying an additional -6.0 hours offset to change UTC to CST.

Accordingly, the time offset for the event flight data from SRN to local CST is the following:

Local Time CST = SRN + 44080

Therefore, for the rest of this report, all times are referenced as CST, not SRN.

4.3. FDR Plots and Corresponding Tabular Data

Figures 1 to 8 contain FDR data recorded during the November 30, 2019 event.

Figures 1, 3, and 5 contain data encompassing the full accident flight from engine power on to the accident. Figure 1 contains aircraft basic parameters, figure 3 contains engine parameters, and figure 5 contains discrete and icing parameters.

Figures 2, 4, 6, and 7 contain data from the start of the takeoff roll until the accident one minute and twenty seconds later. Figure 2 contains aircraft basic parameters, figure 4 contains engine parameters, figure 6 contains discrete and icing parameters and figure 7 contains flight path parameters.

[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 = +, Pitch Up = +, Elevator Trailing Edge Up = +, Right Rudder = +.

Figure 8 is a map overlay created in Google Earth of the aircraft position and altitude data from aircraft power on to the accident. Weather and atmospheric conditions in the overlay are not representative of conditions at the time of the flight.

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 data show that the aircraft's engine powered on at 12:19:02 and the aircraft sat stationary on the apron for about 10 minutes before taxiing to the runway for departure. The outside air temperature (OAT), as measured by both OAT probes, varied between 1.25 and 3.0 degC (34 to 37 degF) during the 10-minute wait on the apron and taxi out to the runway.

About one minute after the engine was powered on, static heat, left and right windshield heat, right pitot heat, and left and right angle of attack (AOA) sensor heat indicated on.

The left pitot heat indicated on briefly at 12:21:26 but then remained off for the duration of the recording. Prop heat indicated on at 12:26:45 and remained on for the duration of the recording. Three seconds later, at 12:26:48, the de-ice boot power switch indicated on and the de-ice boots began to operate on a 3-minute cycle. At 12:27:09, the inertial separator door indication switched from closed to open.

At 12:29:47 ground speed began to increase indicating the aircraft had begun to taxi to the runway for departure. The flap position indicated 15 deg. About two minutes later, at 12:31:58, engine Np and Ng increased, ground speed increased, and the aircraft began its takeoff roll on runway 31.

The aircraft lifted off 30 seconds later, at 12:32:28. The stall warning and stick shaker became active approximately one second after liftoff. The stick pusher became active about 15 seconds after liftoff. All three continued intermittently for the duration of the recording.

At 12:32:44, the aircraft entered a left bank, peaking at 64° left at 12:32:53. The aircraft then entered a descent that continued until impact. The recording ended at 12:32:59.

All the parameters listed in table A-1 are plotted or provided in compressed electronic comma-separated value (*.csv) format as Attachment 1 to this report.

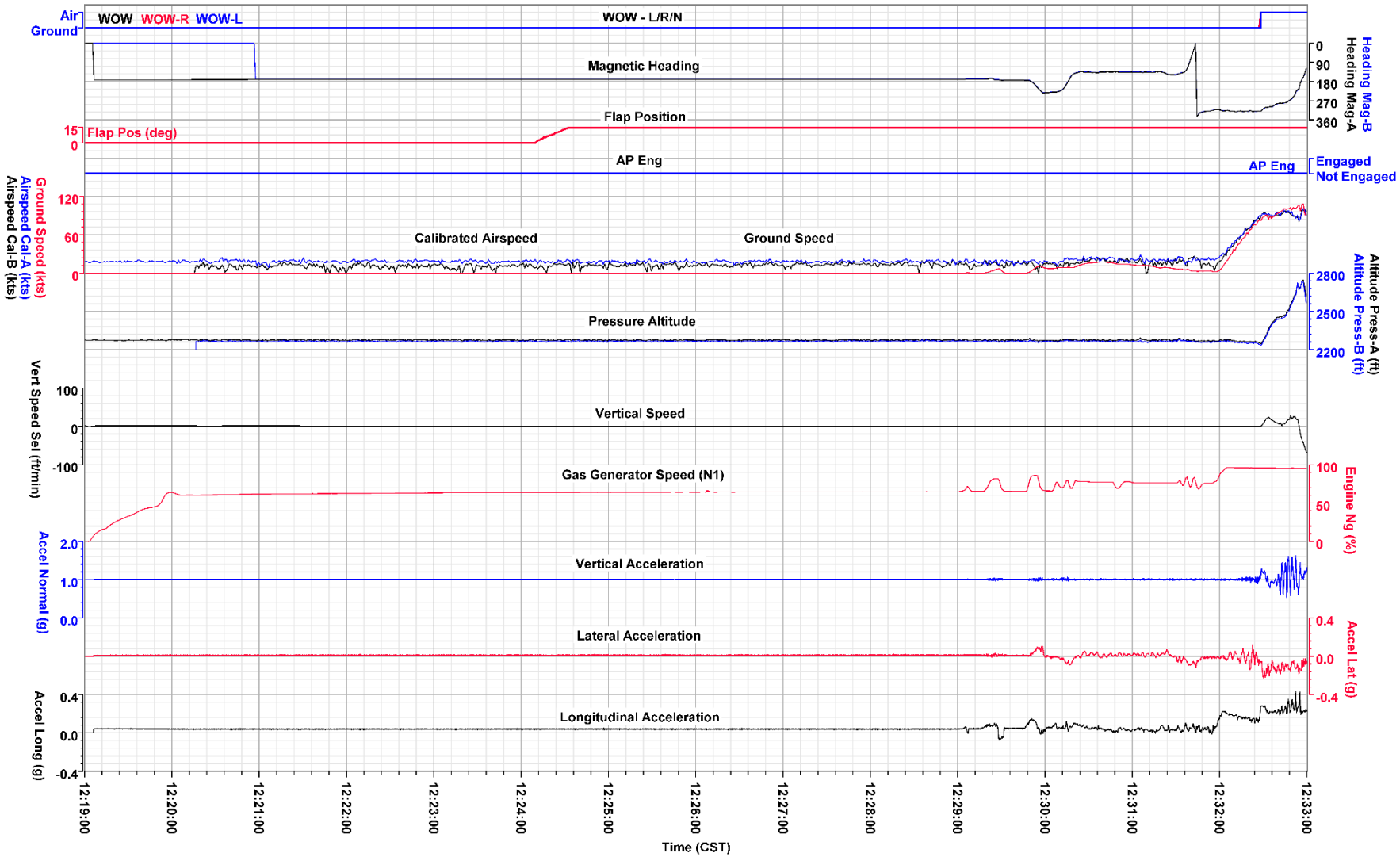

Figure 1. Plot of Basic Parameters for Full Accident Flight.

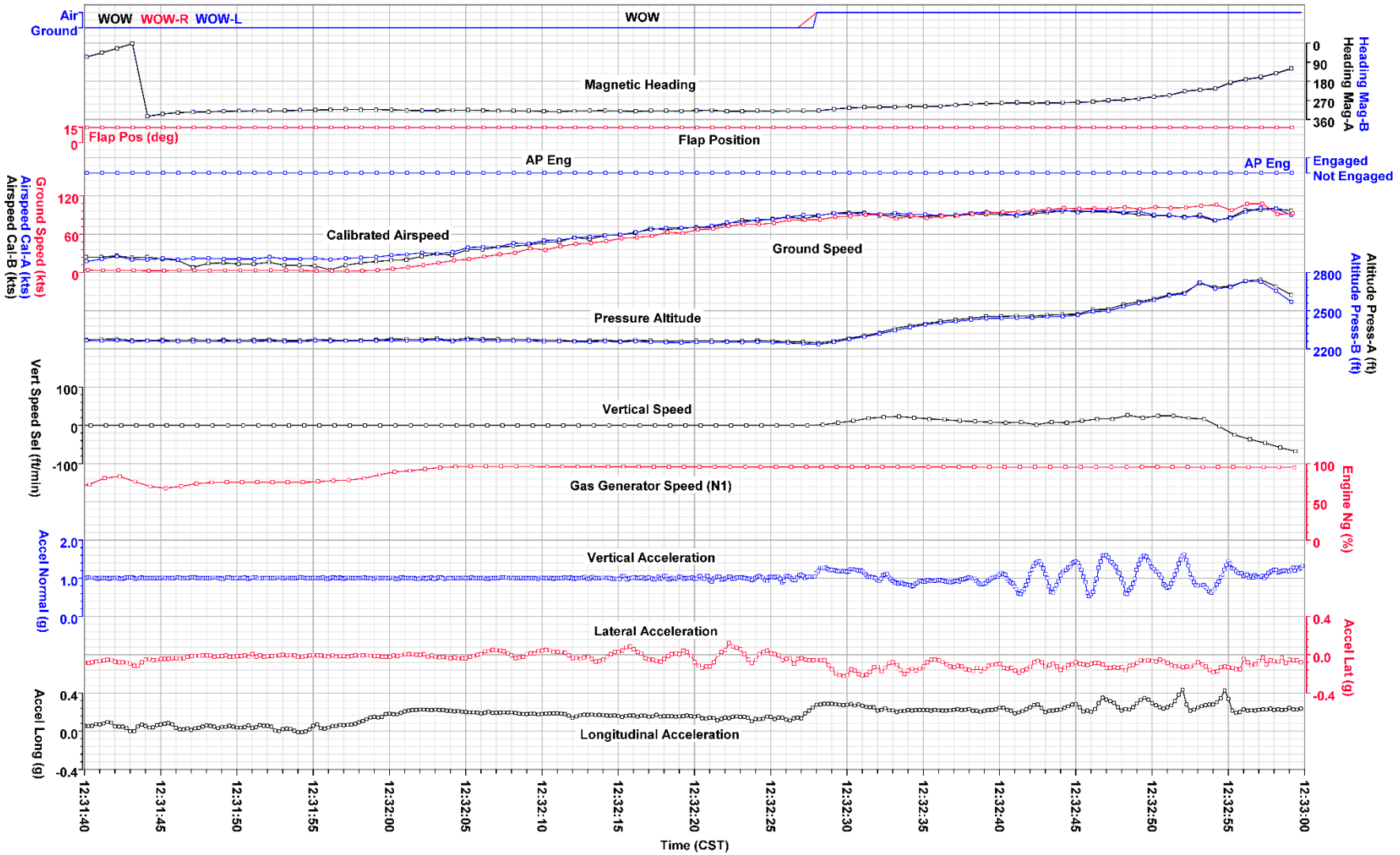

Figure 2. Plot of Basic Parameters from Takeoff to Accident.

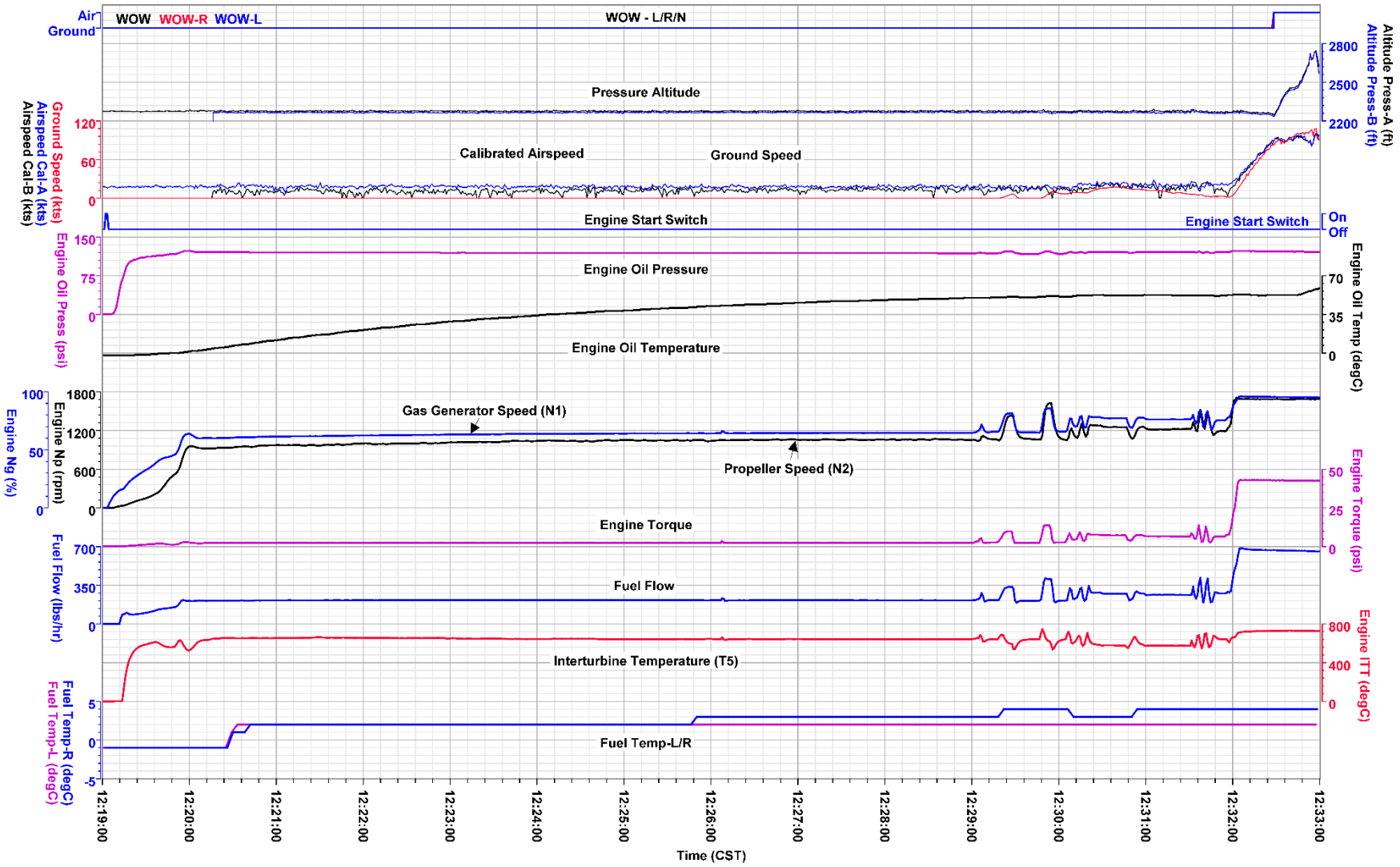

Figure 3. Plot of Engine Parameters for Full Accident Flight.

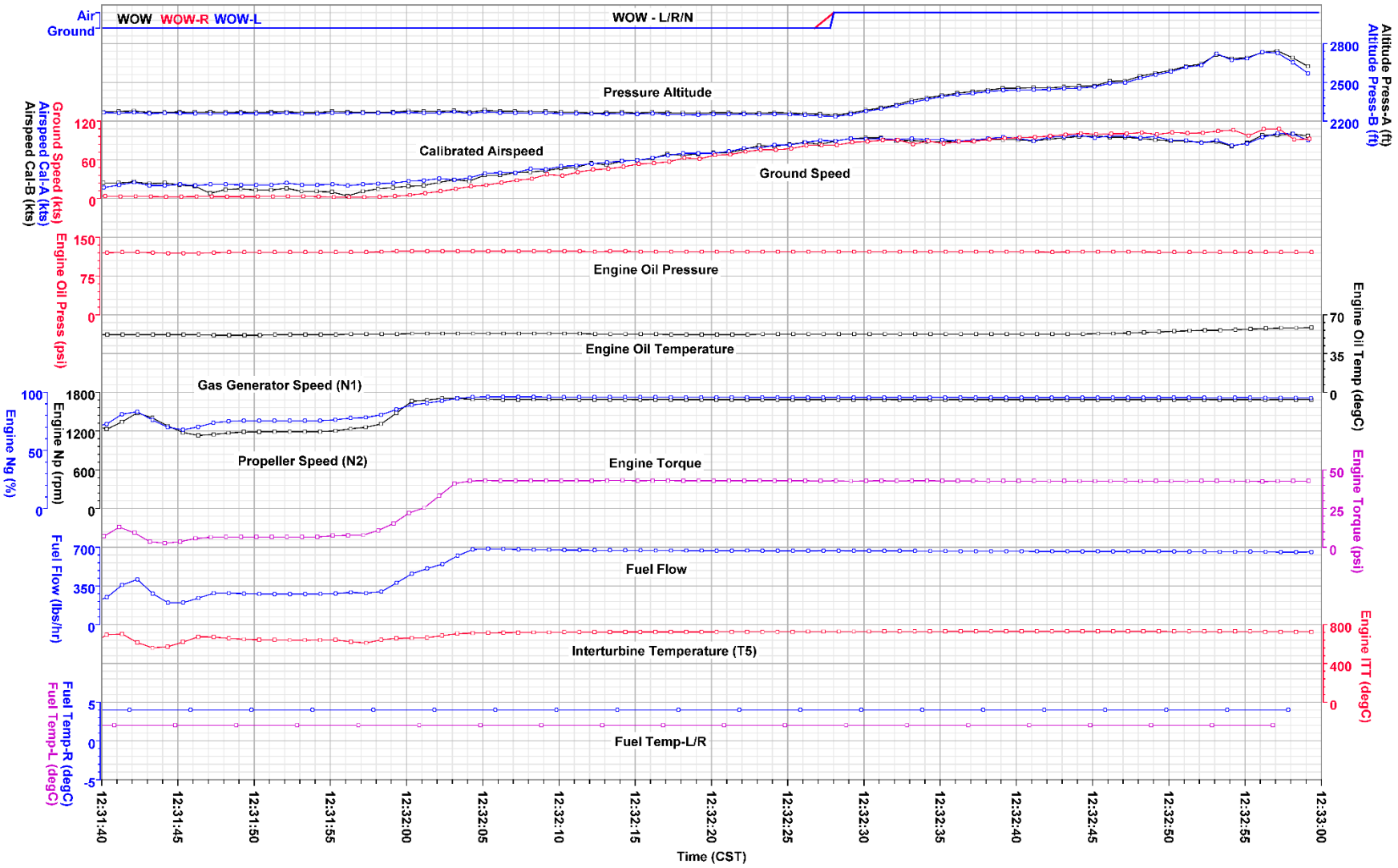

Figure 4. Plot of Engine Parameters from Takeoff to Accident.

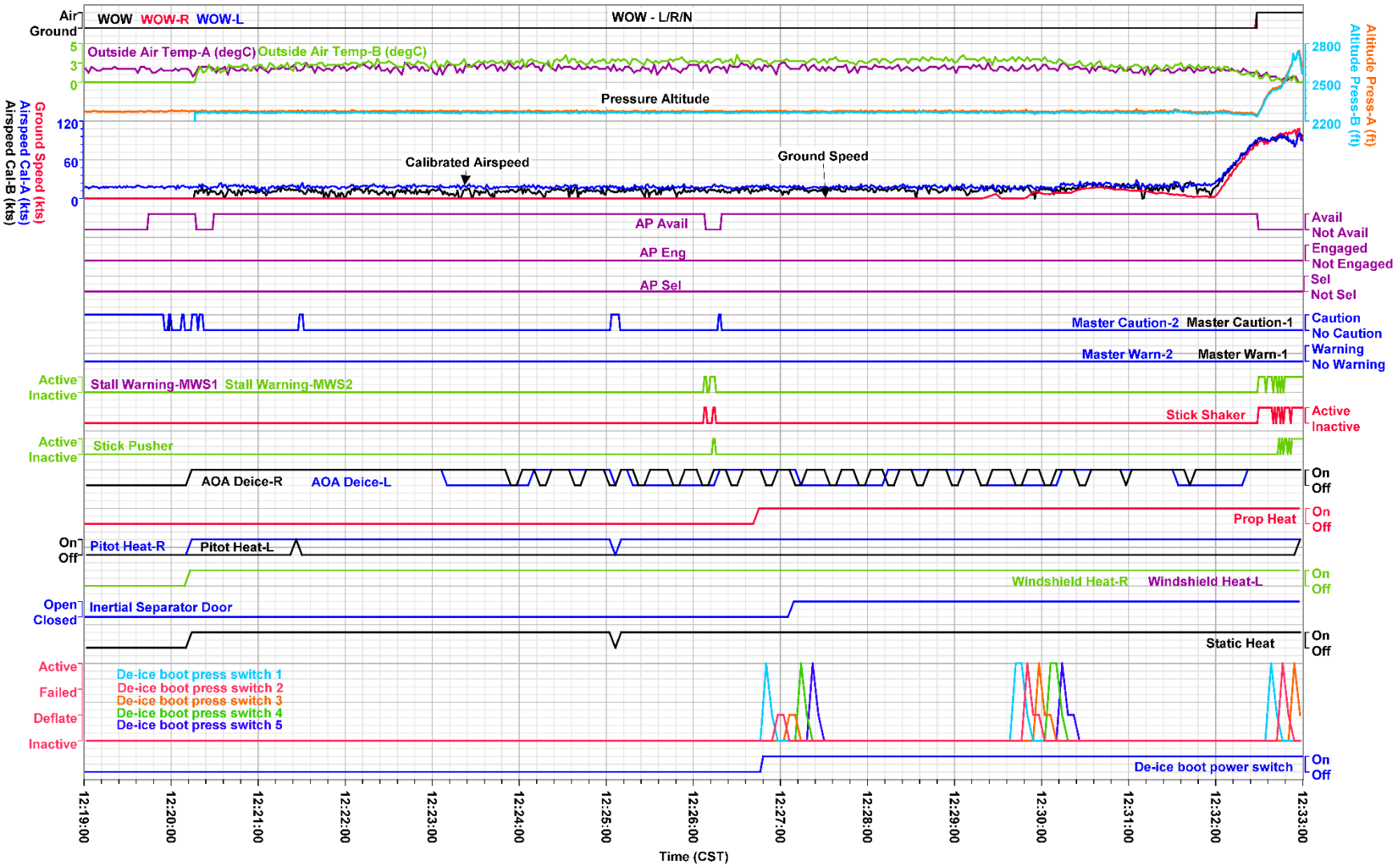

Figure 5. Plot of Discrete and Icing Parameters for Full Accident Flight.

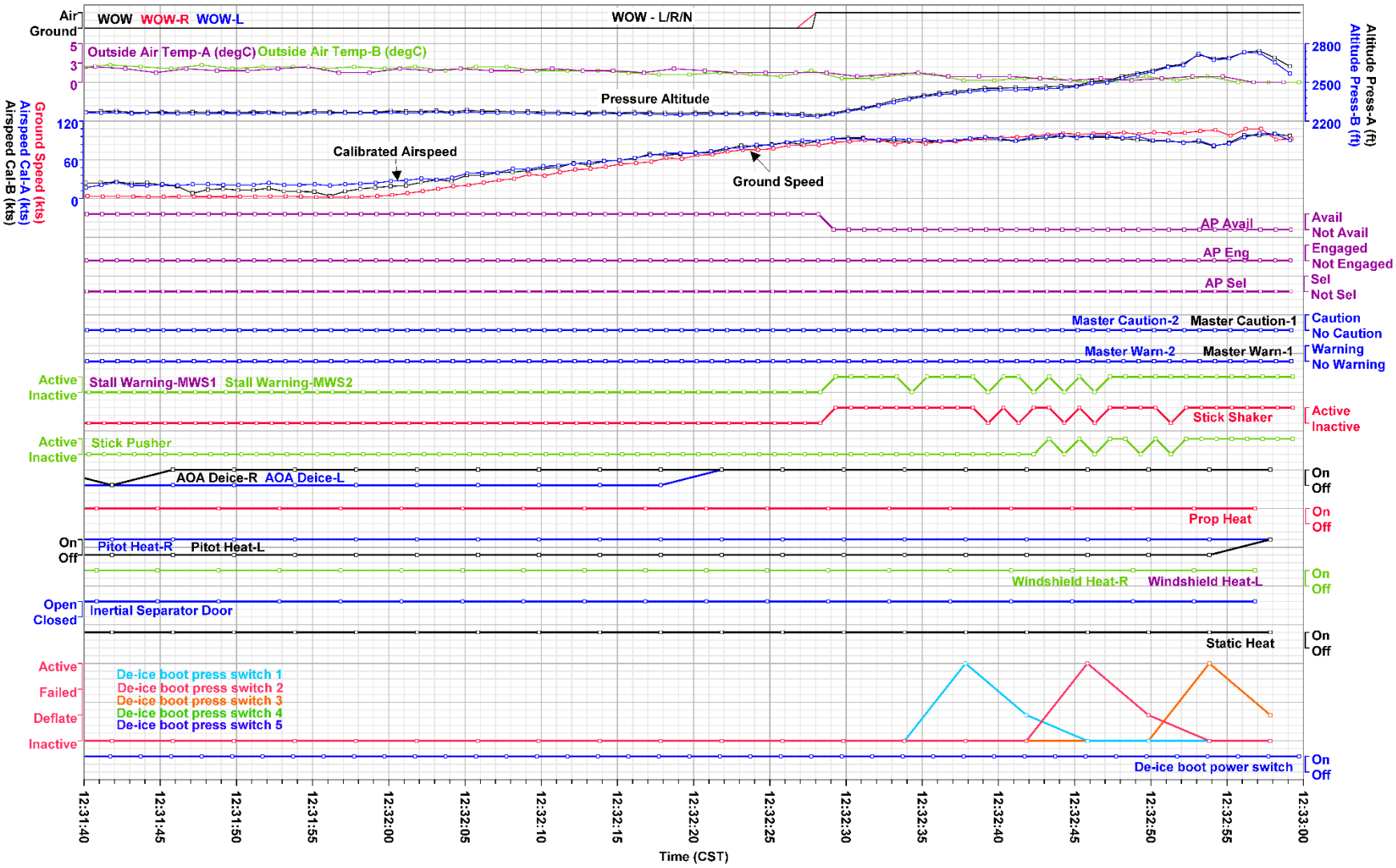

Figure 6. Plot of Discrete and Icing Parameters from Takeoff to Accident.

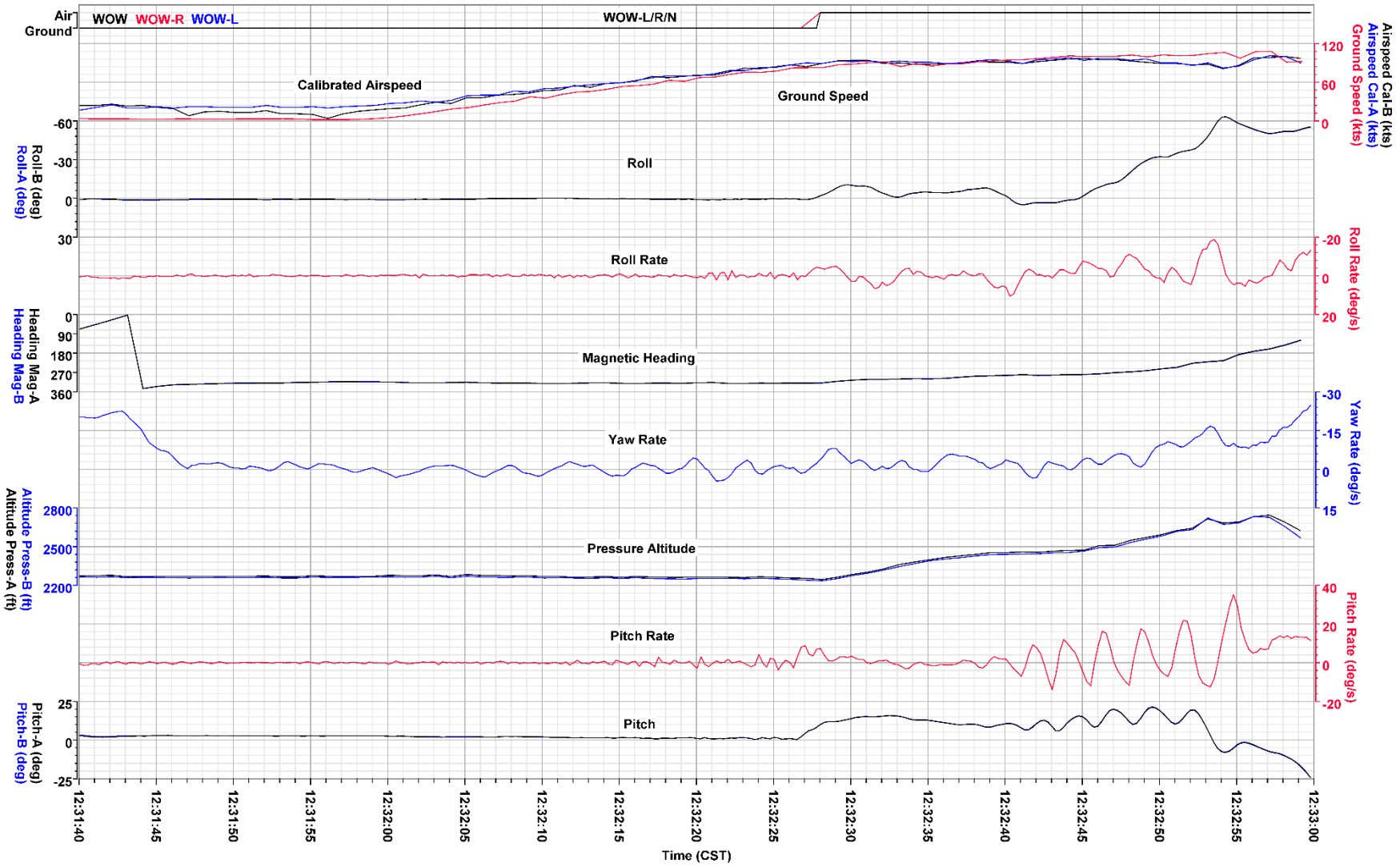

Figure 7. Plot of Flight Path Parameters from Takeoff to Accident.

Figure 8. Google Earth Overlay of Full Accident Flight Path.

APPENDIX A

This appendix describes the parameters provided and verified in this report. Table A-1 lists the plot/table labels, parameter names, and units. Additionally, table A-2 describes the unit and discrete abbreviations used in this report.

Table A-1. Verified and provided FDR parameters.

Plot/Table Labels	Parameter Names	Units
Accel Lat	Lateral Acceleration	g
Accel Long	Longitudinal Acceleration	g
Accel Normal	Vertical (Normal) Acceleration	g
Airspeed Cal – A/B	Calibrated Airspeed – A/B	kts
Altitude Press – A/B	Pressure Altitude – A/B	ft
AOA Deice – L/R	Angle-of-Attack De-ice – Left/Right	-
AOA Vane	Angle-of-Attack Vane Angle	deg
AP Avail	Autopilot Available	-
AP Eng	Autopilot Engaged	-
AP Sel	Autopilot Selected	-
De-ice boot power switch	De-ice Boot Power Switch	-
De-ice boot press switch 1/2/3/4/5	De-ice Boot Status – boot 1/2/3/4/5	-
Engine ITT	Engine Interturbine Temperature (T5)	deg C
Engine Ng	Gas Generator Speed (N1)	%
Engine Np	Propeller Speed (N2)	rpm
Engine Oil Press	Engine Oil Pressure	psi
Engine Oil Temp	Engine Oil Temperature	deg C
Engine Start Switch	Engine Start Switch	-
Engine Torque	Engine Torque	psi
Flap Pos	Flap Position	deg
Fuel Flow	Fuel Flow	lbs/hr
Fuel Temp – L/R	Fuel Temperature – Left/Right	deg C
Ground Speed	Ground Speed	kts
Heading Mag – A/B	Magnetic Heading – A/B	deg
Inertial Separator Door	Inertial Separator Door	-
Master Caution – 1/2	Master Caution – 1/2	-
Master Warn – 1/2	Master Warning – 1/2	-
Outside Air Temp – A/B	Outside Air Temperature – A/B	deg C
Pitch – A/B	Pitch Angle – A/B	deg
Pitch Rate	Pitch Rate	deg/sec
Pitot Heat – L/R	Pitot Heat – Left/Right	-
Prop Heat	Propeller Heat	-
Roll – A/B	Roll Angle – A/B	deg
Roll Rate	Roll Rate	deg/sec
Stall Warning – MWS1/2	Stall Warning – Monitor Warning System 1/2	-
Static Heat	Static Heat	-
Stick Pusher	Stick Pusher	-
Stick Shaker	Stick Shaker	-
Time GPS Hours	Time GPS Hours	hrs
Time GPS Min	Time GPS Minutes	min
Time GPS Sec	Time GPS Seconds	sec
Vert Speed Sel	Selected Vertical Speed	ft/sec
Windshield Heat – L/R	Windshield Heat – Left/Right	-
WOW – L/R/N	Weight-on-Wheels – Left/Right/Nose	-
Yaw Rate	Yaw Rate	deg/sec

NOTE: This FDR records pressure altitude, which is based on a standard altimeter setting of 29.92 inches of mercury (in Hg). The pressure altitude information presented in the FDR plots and the electronic data has not been corrected for the local altimeter setting at the time of the event.

NOTE: Parameters with a blank unit description in table A-1 are discretes. 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.

Table A-2. Unit and discrete abbreviations.

Unit and discrete Abbreviations	Descriptions
deg	degrees
deg C	degrees Celsius
ft	feet
hr	hour
kts	knots
lbs	pounds
min	minutes
psi	pounds per square inch
rpm	revolutions per minute
sec	seconds