

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

April 28, 2020

Flight Data Recorder

Specialist's Factual Report By Cassandra Johnson

1. EVENT SUMMARY

Location: Oroville, California
Date: August 21, 2019
Aircraft: Cessna 560XL
Registration: N91GY
Operator: Delta Private Jets
NTSB Number: WPR19FA230

On August 21, 2019, about 1132 Pacific daylight time (PDT), a Cessna 560XL airplane, N91GY, was destroyed when it was involved in an accident near Oroville, California. The two airline transport pilots, and eight passengers were not injured. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 135 on-demand charter flight.

2. FLIGHT DATA RECORDER GROUP

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

3. FDR CARRIAGE REQUIREMENTS

The event aircraft, N91GY, was manufactured in 2003, and was operating such that it was not required to be equipped with an FDR.

4. DETAILS OF FDR INVESTIGATION

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

Recorder Manufacturer: **Honeywell SSFDR**
Recorder Model/Serial Number: **Model 980-4700-025/SSFDR-11053¹**

4.1. Honeywell SSFDR, Model 980-4700-025 Description

The Honeywell solid state flight data recorder (SSFDR) records airplane flight information in a digital format using solid-state flash memory as the recording medium. The SSFDR can receive data in the ARINC 573/717/747 configurations and can record a minimum of 25 hours of flight data. It is configured to record 64 12-bit words of digital information every second. Each grouping of 64 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

¹ The recorder's part number and serial number were provided by the operator since the information was unreadable on the recorder due to the extensive heat damage as shown in figure 1.

words appear at proper 64-word intervals. Each data parameter (for example, altitude, heading, and airspeed) has a specifically assigned word number within the subframe. The SSFDR is designed to meet the crash-survivability requirements of TSO-C124a.

4.1.1. Recorder Condition

The recorder sustained severe heat damage as shown in figure 1. The memory module was removed from the recorder (see figure 2). The memory module's red rubberized RTV was peeled back in order to reveal the temperature dot² underneath (see figure 3). The temperature dot had not turned black thus indicating the memory module was not compromised by heat exposure. A new ribbon cable was attached to the memory module and the memory module was downloaded using NTSB's equipment and the recorder manufacturer's software.



Figure 1. Damaged exterior of flight data recorder



Figure 2. Memory module removed from the recorder

² The temperature dot or temperature sensor helps to indicate the potential for the memory board being exposed to a temperature in excess of 149° Celsius (C) (300° Fahrenheit (F)). If the temperature exceeds 149° C (300° F), the dot will change color to black. In this instance it is possible for the solder of the components to reflow and may cause shorting.

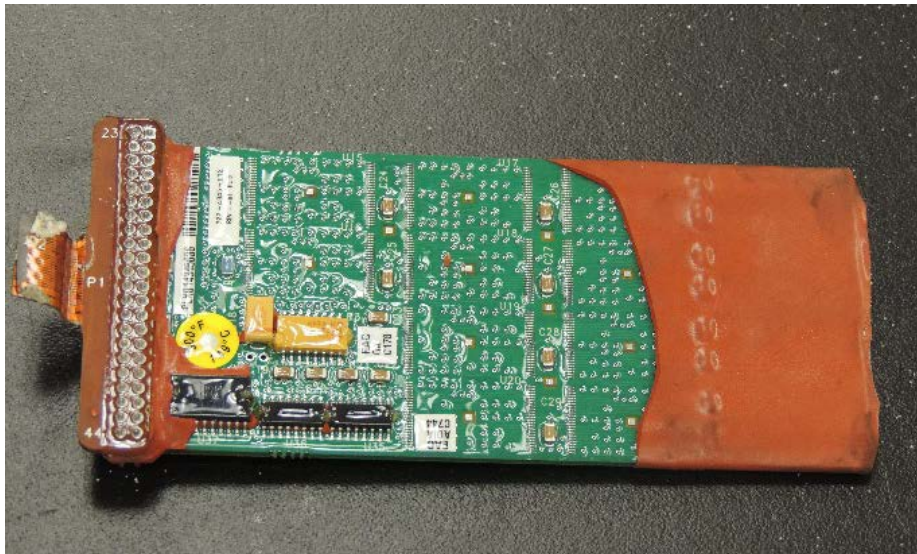


Figure 3. Memory module with part of the red rubberized RTV removed

4.1.2. Recording Description

The FDR recording contained approximately 30 hours of data. Timing of the FDR data is measured in subframe reference number (SRN), where each SRN equals one elapsed second. The event was recorded at the end of the FDR data.

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=+).³

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.

4.1.4. Parameters Recorded Invalid Data

Throughout the event and entire FDR recording, the following 16 parameters recorded invalid data:

- Airspeed
- Engine 1 Fan Speed (Eng1 N1)
- Engine 2 Fan Speed (Eng2 N1)
- Indicated Airspeed Source (IAS Source)
- Magnetic Heading (Heading)
- Outside Air Temperature Source (Temp OAT)
- Pitch Attitude (Pitch)
- Pitch Attitude Source (Pitch Source)

³ 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 = +.

- Pressure Altitude (Alt Press)
- Roll Attitude (Roll)
- Roll Attitude Source (Roll Source)
- Select Airspeed (Sel AS)
- Select Altitude Source (Sel Alt Source)
- Select Heading (Sel HDG)
- Select Heading Source (Sel HDG Source)
- Select Vertical Speed (Sel VS)

The operator was informed of the invalid recorded data. The operator downloaded and reviewed the FDR recording from a similar aircraft with the same FDR and Digital Flight Data Acquisition Unit (DFDAU) installation and discovered the same behavior.

The operator plans to fix the problem at the next heavy maintenance visit of each aircraft that has the same FDR and DFDAU installation.

4.2. Time Correlation

Correlation of the FDR data from SRN to the event local time, PDT, was established with an offset provided by the Cockpit Voice Recorder (CVR) Group Chairman.⁴

Accordingly, the time offset for the event flight data from SRN to local PDT is the following: $PDT = SRN - 67,303$. Therefore, for the rest of this report, all times are referenced as PDT, not SRN.

4.3. FDR Plots and Corresponding Tabular Data

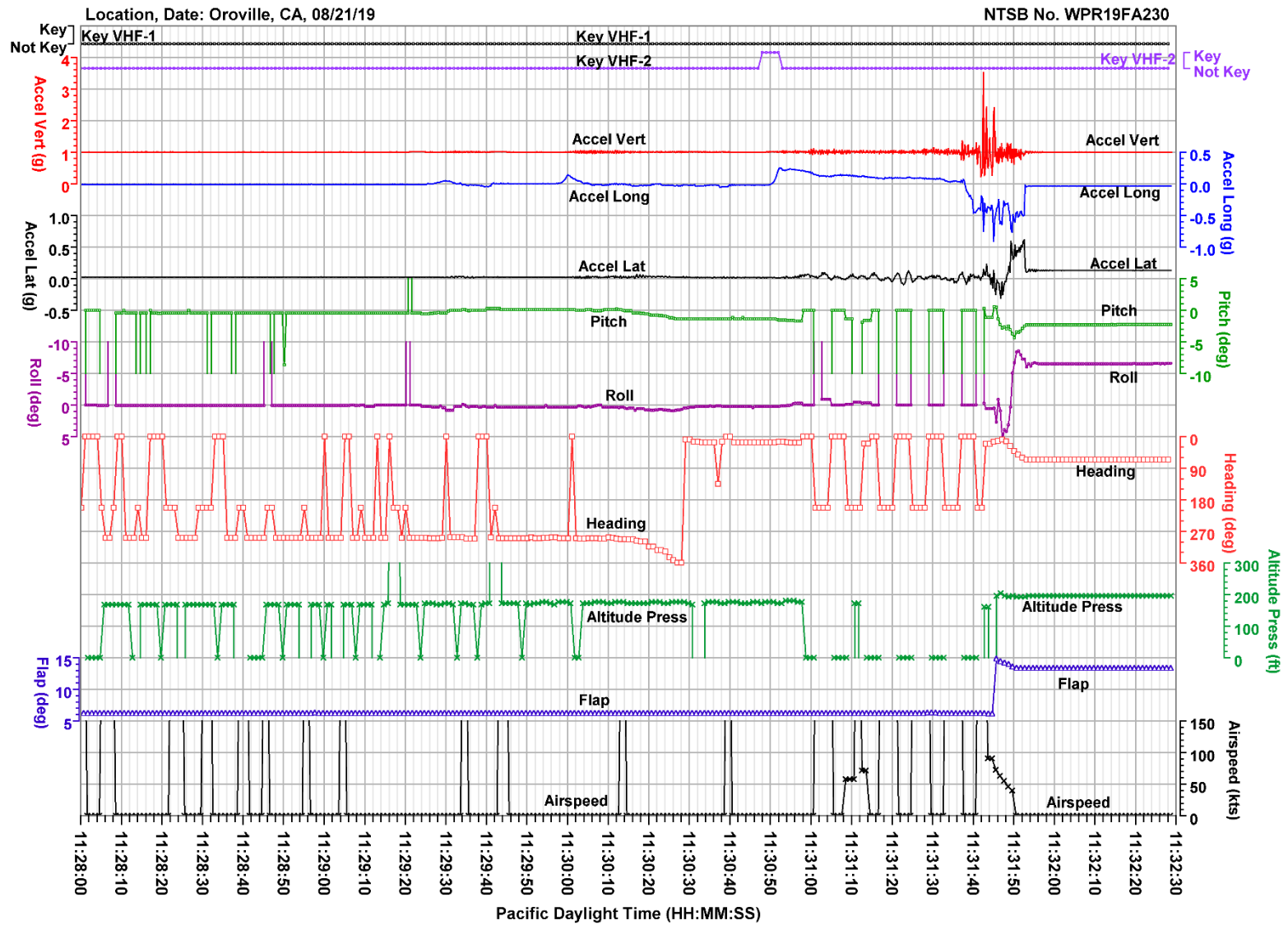
Figures 4 to 7 contain FDR data recorded during the event on August 21, 2019. All the parameters listed in table A-1 are plotted. These four figures cover 4.5 minutes of data from 11:28:00 PDT to 11:32:30 PDT (the recorded data ends at 11:32:28 PDT).

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 FDR data indicated at about 11:30:50 PDT, the aircraft began its takeoff roll and 1 minute and 3 seconds later at 11:31:53 PDT came to a complete stop. During this time, the vertical acceleration peaked at 3.51 g.

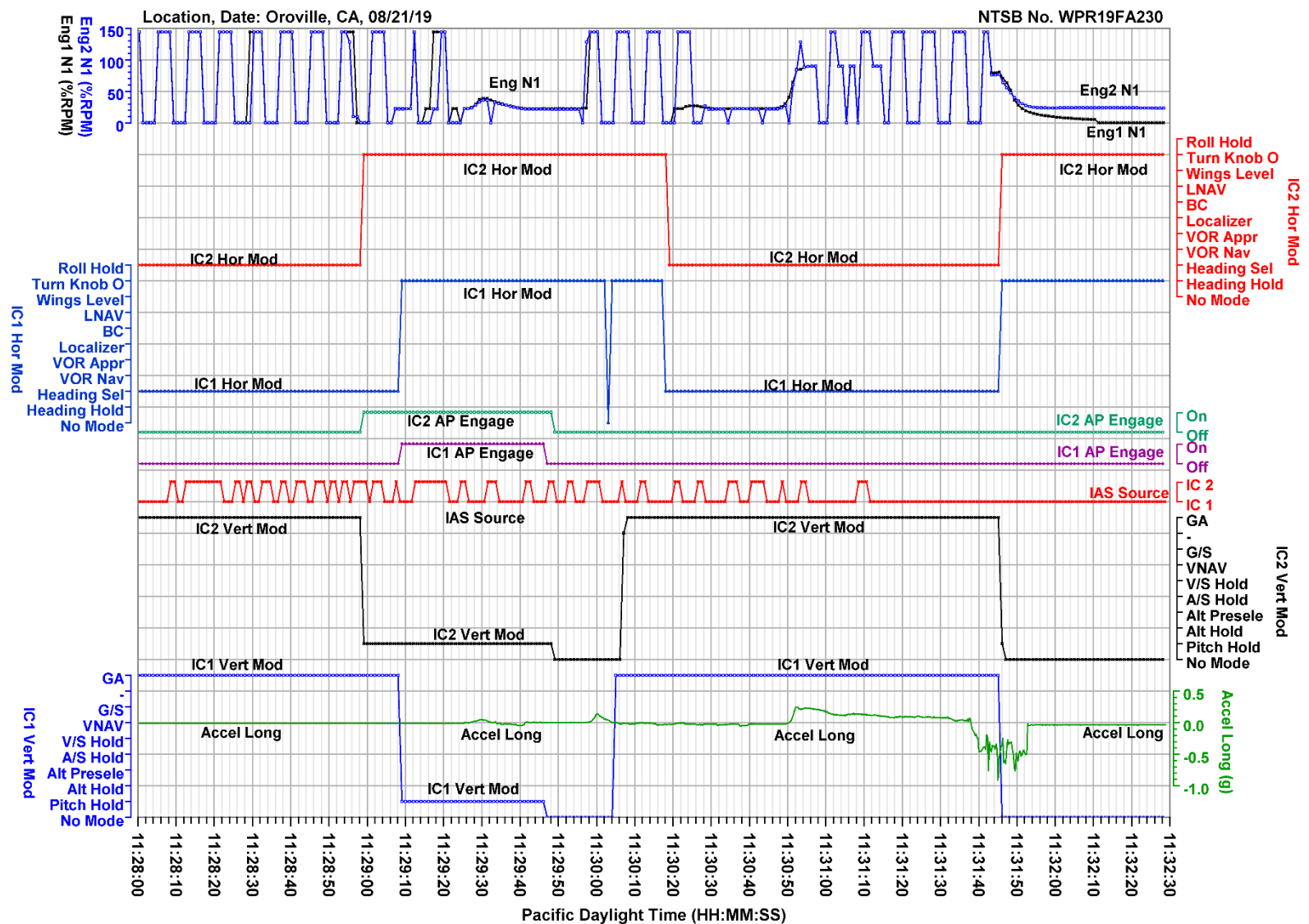
The corresponding tabular data used to create figures 4 to 7 are provided in electronic comma separated value (*.csv) format as attachment 1 to this report.

⁴ For more details, refer to NTSB's CVR Group Chairman's Factual Report.



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Figure 4. Plot of basic parameters

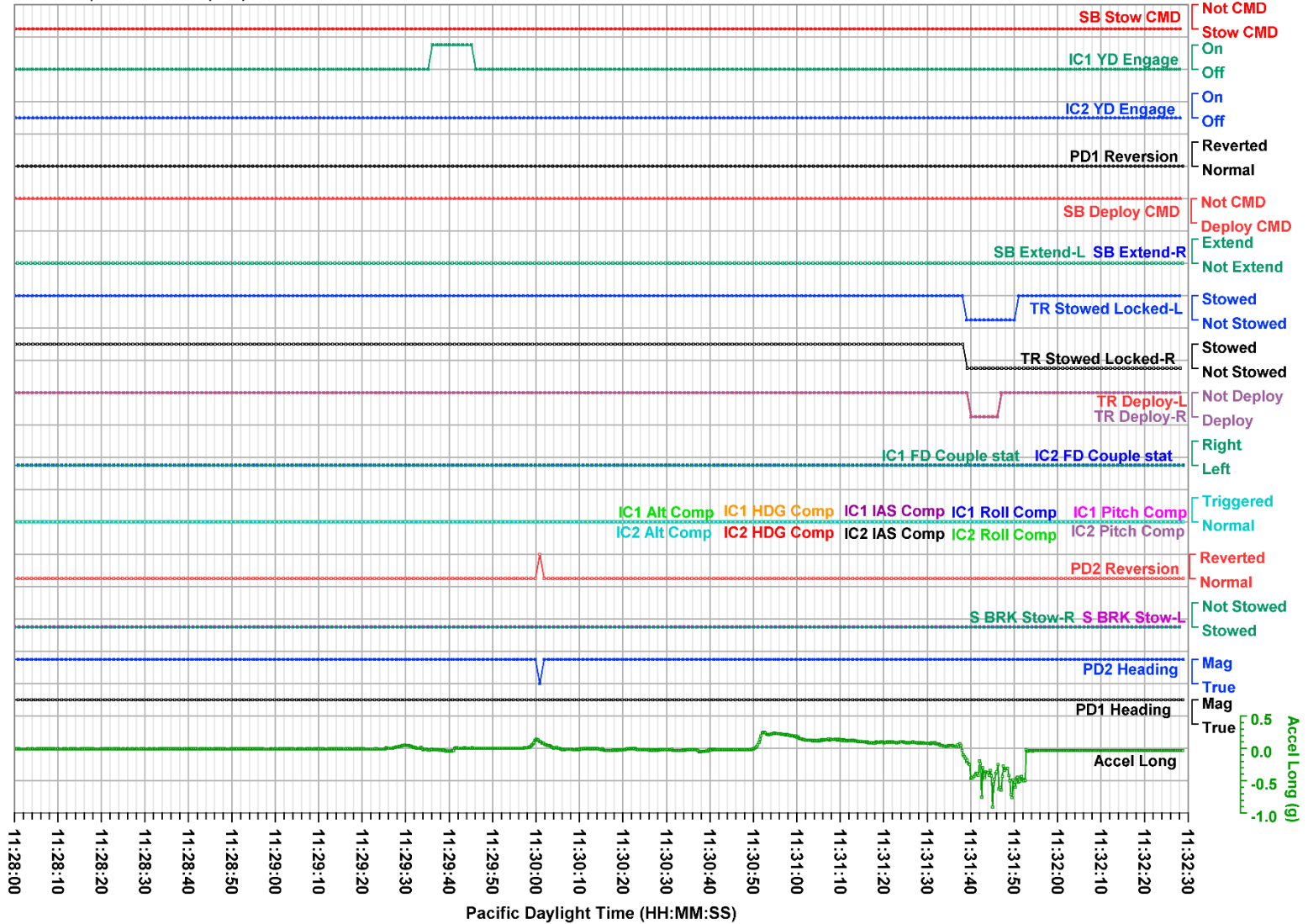


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Figure 5. Plot of integrated avionics computer parameters and two engine parameters

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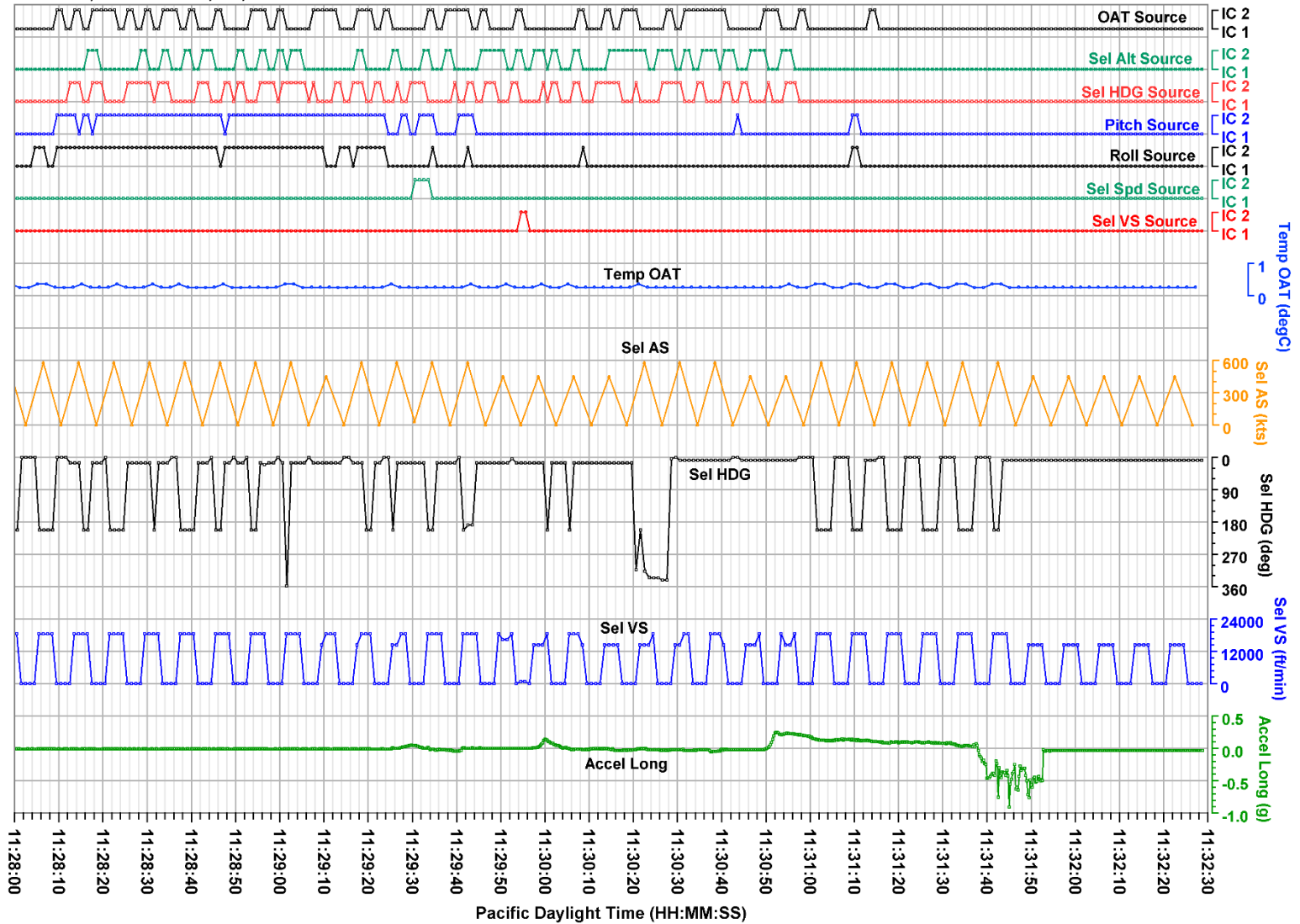


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Figure 6. Plot of discrete parameters

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Figure 7. Plot of additional parameters

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 Vert	Vertical Acceleration	g
Airspeed	Airspeed	kts
Altitude Press	Pressure Altitude	ft
Eng1 N1	Engine 1 Fan Speed	%RPM
Eng2 N1	Engine 2 Fan Speed	%RPM
Flap	Flap Position	deg
Heading	Magnetic Heading	deg
IAS Source	Indicated Airspeed Source	
IC1 Alt Comp	Integrated Avionics Computer 1 - Altitude Comparison Monitor	
IC1 AP Engage	Integrated Avionics Computer 1 - Autopilot Engage	
IC1 FD Couple stat	Integrated Avionics Computer 1 - Flight Director Couple Status	
IC1 HDG Comp	Integrated Avionics Computer 1 - Heading Comparison Monitor	
IC1 Hor Mod	Integrated Avionics Computer 1 – Lateral Flight Director Modes	
IC1 IAS Comp	Integrated Avionics Computer 1 - Indicated Airspeed Comparison Monitor	
IC1 Pitch Comp	Integrated Avionics Computer 1 - Pitch Comparison Monitor	
IC1 Roll Comp	Integrated Avionics Computer 1 - Roll Comparison Monitor	
IC1 Vert Mod	Integrated Avionics Computer 1 - Vertical Flight Director Modes	
IC1 YD Engage	Integrated Avionics Computer 1 - Yaw Damper Engage	
IC2 Alt Comp	Integrated Avionics Computer 2 - Altitude Comparison Monitor	
IC2 AP Engage	Integrated Avionics Computer 2 - Autopilot Engage	
IC2 FD Couple stat	Integrated Avionics Computer 2 - Flight Directory Couple Status	
IC2 HDG Comp	Integrated Avionics Computer 2 - Heading Comparison Monitor	
IC2 Hor Mod	Integrated Avionics Computer 2 – Lateral Flight Director Modes	
IC2 IAS Comp	Integrated Avionics Computer 2 - Indicated Airspeed Comparison Monitor	
IC2 Pitch Comp	Integrated Avionics Computer 2 - Pitch Comparison Monitor	
IC2 Roll Comp	Integrated Avionics Computer 2 - Roll Comparison Monitor	
IC2 Vert Mod	Integrated Avionics Computer 2 - Vertical Flight Director Modes	
IC2 YD Engage	Integrated Avionics Computer 2 - Yaw Damper Engage	
Key VHF-1	Microphone Keying-1	
Key VHF-2	Microphone Keying-2	
OAT Source	Outside Air Temperature Source	
PD1 Heading	Primary Flight Display 1 - Heading	
PD1 Reversion	Primary Flight Display 1 - Reversion	
PD2 Heading	Primary Flight Display 2 - Heading	
PD2 Reversion	Primary Flight Display 2 - Reversion	
Pitch	Pitch Attitude	deg
Pitch Source	Pitch Attitude Source	
Roll	Roll Attitude	deg
Roll Source	Roll Attitude Source	
S BRK Stow-L	Speed Brake Stowed - Left	
S BRK Stow-R	Speed Brake Stowed - Right	
SB Deploy CMD	Speed Brake Deploy Command	
SB Extend-L	Speed Brake Extended - Left	
SB Extend-R	Speed Brake Extended - Right	

APPENDIX A

Plot/Table Labels	Parameter Names	Units
SB Stow CMD	Speed Brake Stow Command	
Sel Alt Source	Selected Altitude Source	
Sel AS	Selected Airspeed	kts
Sel HDG	Selected Heading	deg
Sel HDG Source	Selected Heading Source	
Sel Spd Source	Selected Airspeed Source	
Sel VS	Selected Vertical Speed	ft/min
Sel VS Source	Selected Vertical Speed Source	
Temp OAT	Outside Air Temperature	degC
TR Deploy-L	Thrust Reverser Deploy - Left	
TR Deploy-R	Thrust Reverser Deploy - Right	
TR Stowed Locked-L	Thrust Reverser Stowed and Locked - Left	
TR Stowed Locked-R	Thrust Reverser Stowed and Locked - Right	

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 in 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
%RPM	percent revolutions per minute
A/S	Airspeed
Alt	Altitude
BC	Back Course
CMB	Command
deg	degrees
degC	degrees Celsius
ft	feet
ft/min	feet per minute
G/S	Glideslope
GA	Go Around
hrs	hours
IC	Integrated Avionics Computer
kts	knots
LNAV	Lateral Navigation
Mag	Magnetic
min	minutes
Presele	Preselect
sec	seconds
Sel	Select
Turn Knob O	Turn Knob Out of Detent
VNAV	Vertical Navigation
VOR Appr	VHF Omnidirectional Radio Range VOR Approach
VOR Nav	VOR Navigation