

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



DCA23FA417

FLIGHT DATA RECORDER

Specialist's Factual Report

July 15, 2024

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A. ACCIDENT

Location: Santa Ana, California
Date: August 20, 2023
Time: 2315 Pacific daylight time (PDT)
0615 August 21, 2023, coordinated universal time (UTC)
Airplane: Boeing 737-890, Alaska Airlines, AS1288, N516AS

B. FLIGHT DATA RECORDER SPECIALIST

Specialist: Michael Portman
Senior Aerospace Engineer – Recorder Specialist
National Transportation Safety Board (NTSB)

C. FEDERAL CARRIAGE REQUIREMENTS

The event aircraft, N516AS, was operating under Title 14 *Code of Federal Regulations* (CFR) Part 121. The event aircraft was manufactured in 2008 and was operating such that it was required to be equipped with a flight data recorder (FDR) that recorded, at a minimum, 91 parameters, as cited in 14 CFR Part 121.344(f).

D. DETAILS OF THE INVESTIGATION

An FDR group was not convened. The NTSB Vehicle Recorder Division received the following FDR:

Recorder Manufacturer/Model: L3 FA2100
Part Number: 2100-4043-00
Recorder Serial Number: 000297792

1.0 L3 FA2100 Description

This model FDR records airplane flight information in a digital format using solid-state flash memory as the recording medium. The FA2100 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 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, airspeed) has a specifically assigned word

number within the subframe. The FA2100 is designed to meet the crash-survivability requirements of TSO-C124a.

1.1 Recorder Condition

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

1.2 Recording Description

The FDR recording contained approximately 52 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 was approximately 2 hours and 39 minutes. The parameters evaluated for the purpose of this report appeared to be in accordance with federal FDR carriage requirements, except left brake pressure (Brake Press-LT) and right brake pressure (Brake Press-RT). The operator was informed of these parameter deficiencies.

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

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

1.4 Time Correlation

Correlation of the FDR data from SRN to the event local time, PDT, was established by using the recorded Greenwich mean time (GMT) Hours, GMT Minutes, and GMT Seconds and then applying an additional 7 hours offset to change GMT to PDT.²

Accordingly, the time offset for the event flight data from SRN to PDT is the following: $PDT = SRN - 103,301$. Therefore, for the rest of this report, all times are referenced as PDT, not SRN.

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 = +, Left Aileron Trailing Edge Down = -, Right Aileron Trailing Edge Up = +, Pitch Up = +, Elevator Trailing Edge Up = +, Right Rudder = +.

² GMT is Greenwich mean time which is also known as coordinated universal time (UTC).

E. FIGURES AND TABULAR DATA

Figures 1 to 8 contain FDR data recorded during the event on August 20, 2023. All the parameters listed in table 1 are plotted except Key VHF-1, Key VHF-2, GMT Hours, GMT Minutes, and GMT Seconds.

Figures 1 through 3 show basic parameters for the entire flight, the final approach, and the landing sequence, respectively. Figures 4 through 6 show control related parameters for the entire flight, the final approach, and the landing sequence, respectively. Figures 7 and 8 show additional control related parameters for the final approach, and the landing sequence, respectively.

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.

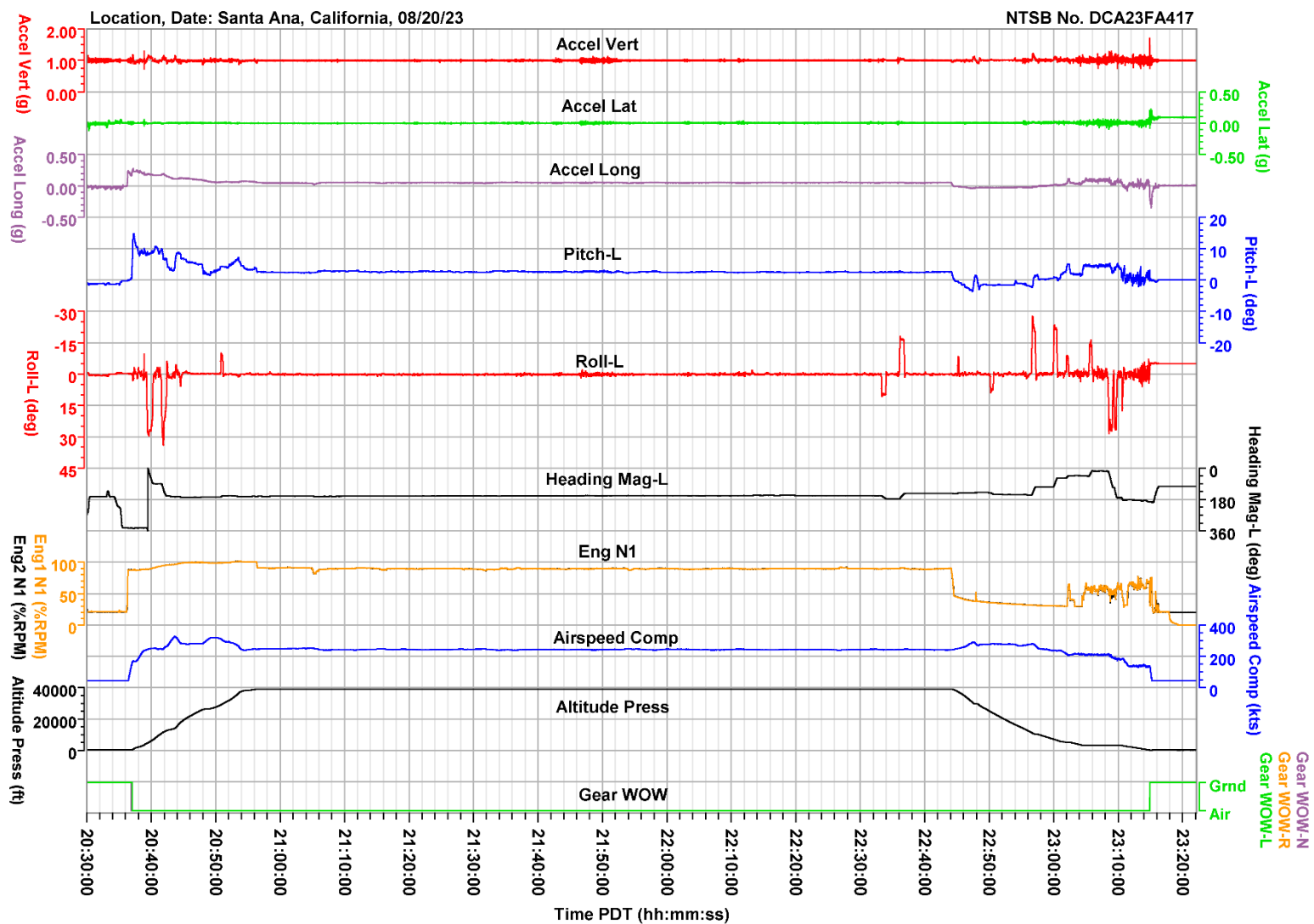
In summary, the FDR data indicated the following sequence of events:

- The aircraft took off from Seattle-Tacoma International Airport at approximately 2037 PDT and climbed to a cruising altitude of 39,000 feet (ft). No FDR data abnormalities were noted during the cruise.
- The aircraft began its descent at approximately 2245 PDT.
- During the aircraft's final approach, as shown in figure 7, the aircraft encountered a 60-degree crosswind with recorded windspeeds reaching 43 knots (kts) before reducing closer to touchdown.
- At 23:14:57 PDT, the main gear touched down, and the nose gear touched down shortly thereafter at 23:14:58 PDT. The maximum vertical acceleration recorded at touchdown was approximately 1.71g.
- Thrust reverser and spoiler deployment occurred normally.
- The aircraft came to rest at an approximately 5 degree left roll.

The corresponding tabular data used to create figures 1 to 8, including Key VHF-1, Key VHF-2, GMT Hours, GMT Minutes, and GMT Seconds, are provided in electronic comma-separated value (CSV) format as attachment 1 to this report.

Submitted by:

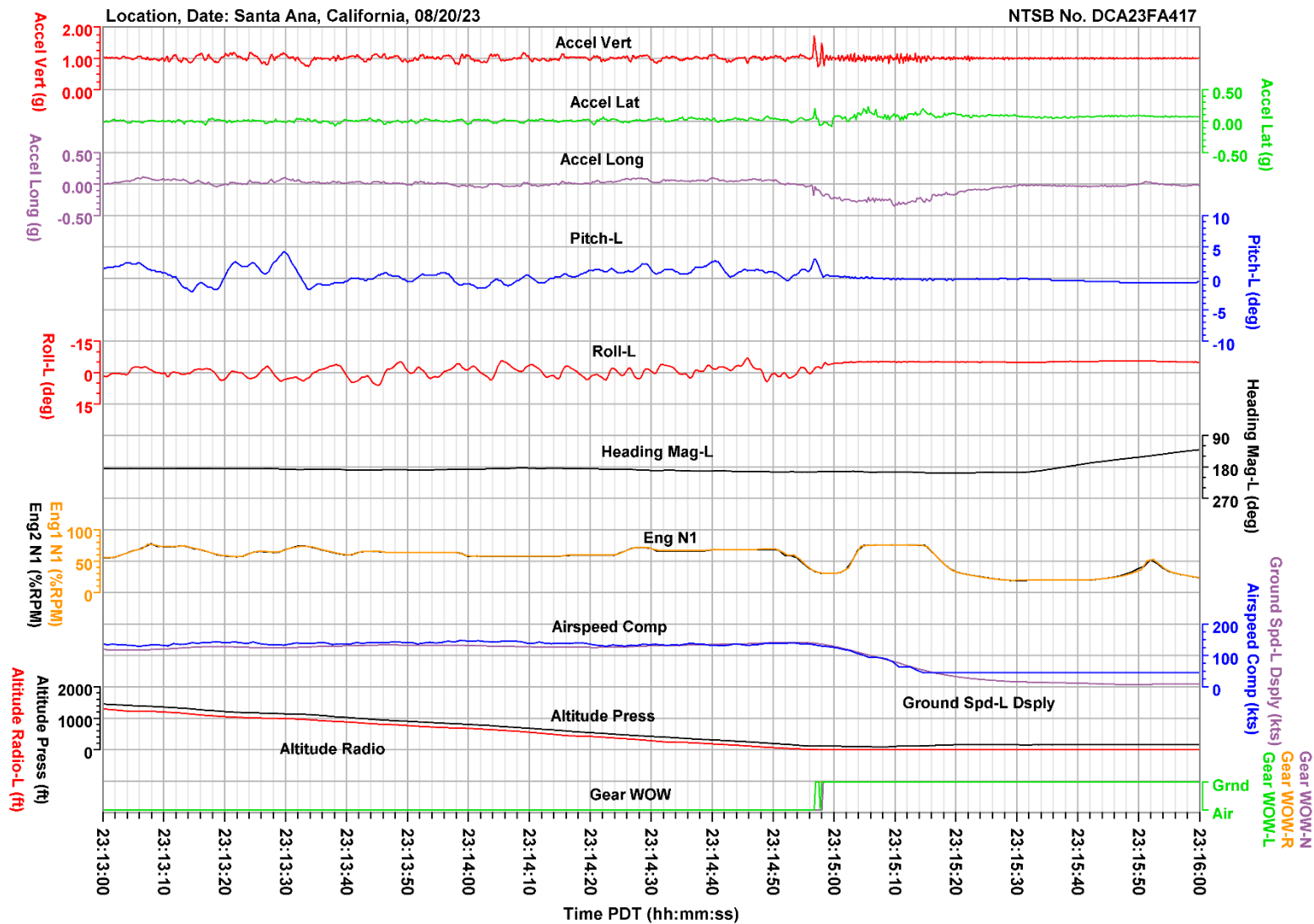
Michael Portman
Sr. Aerospace Engineer - Recorder Specialist



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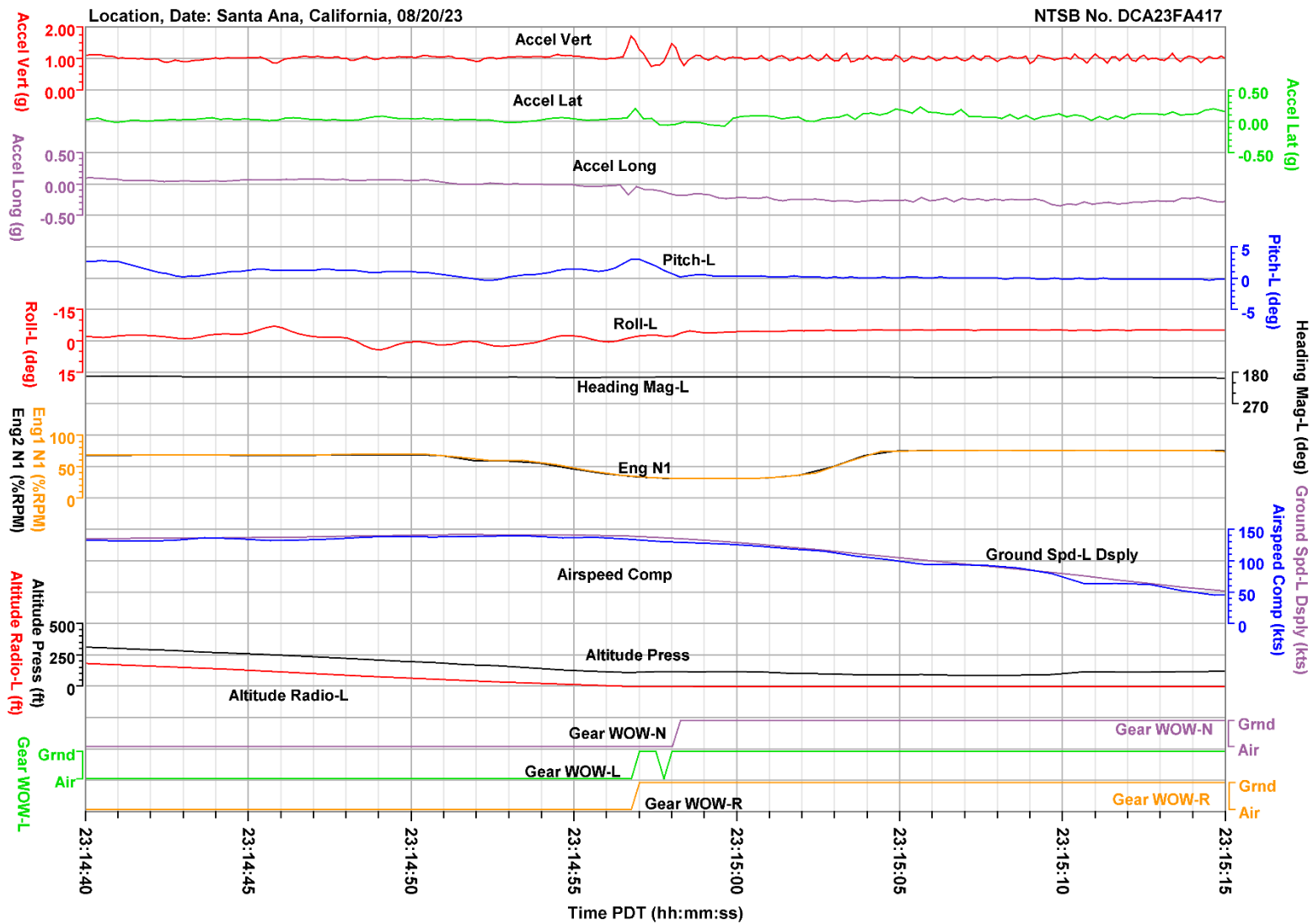
Figure 1. Plot of basic parameters for the entire event flight.



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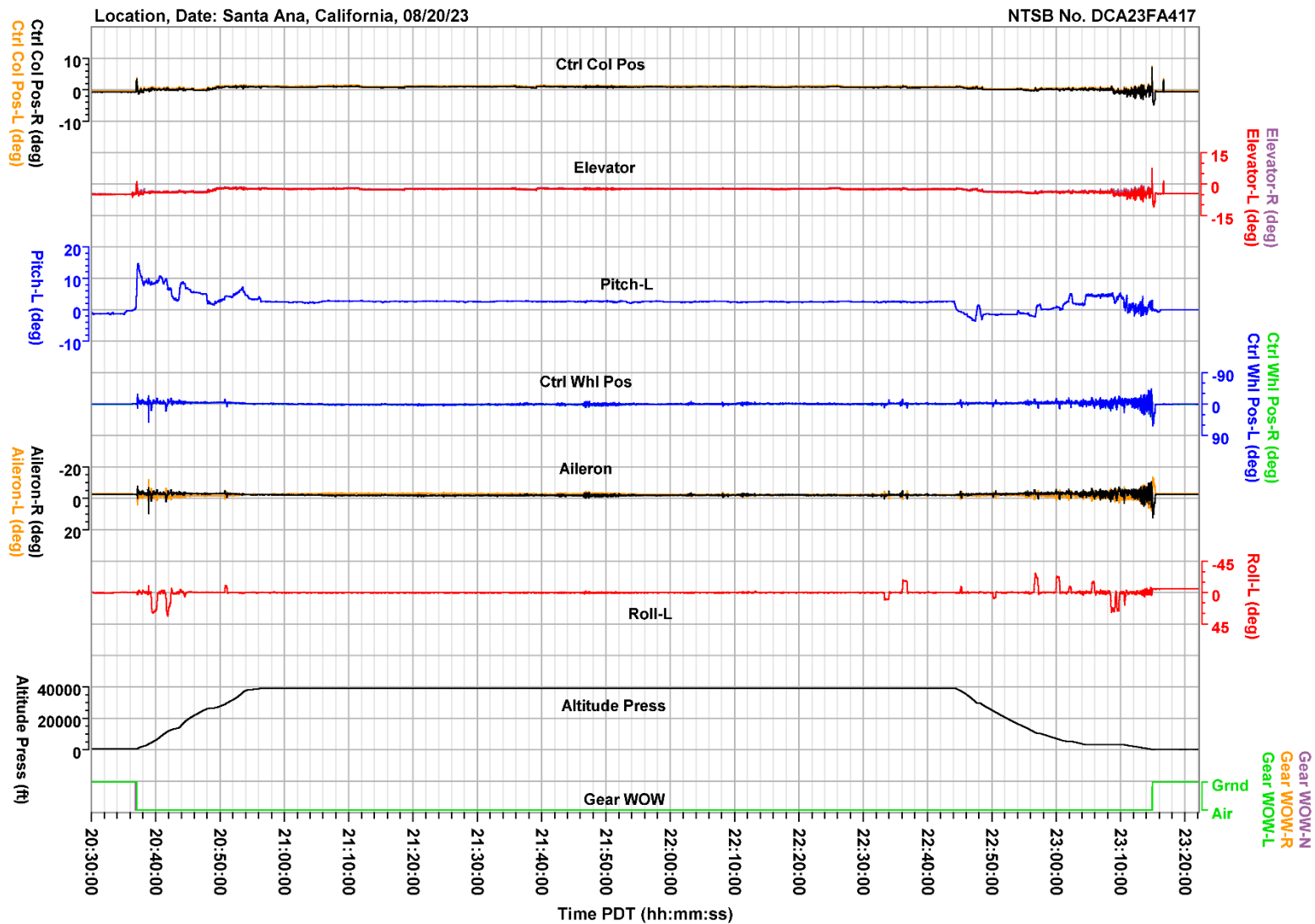
Figure 2. Plot of basic parameters during the final approach.



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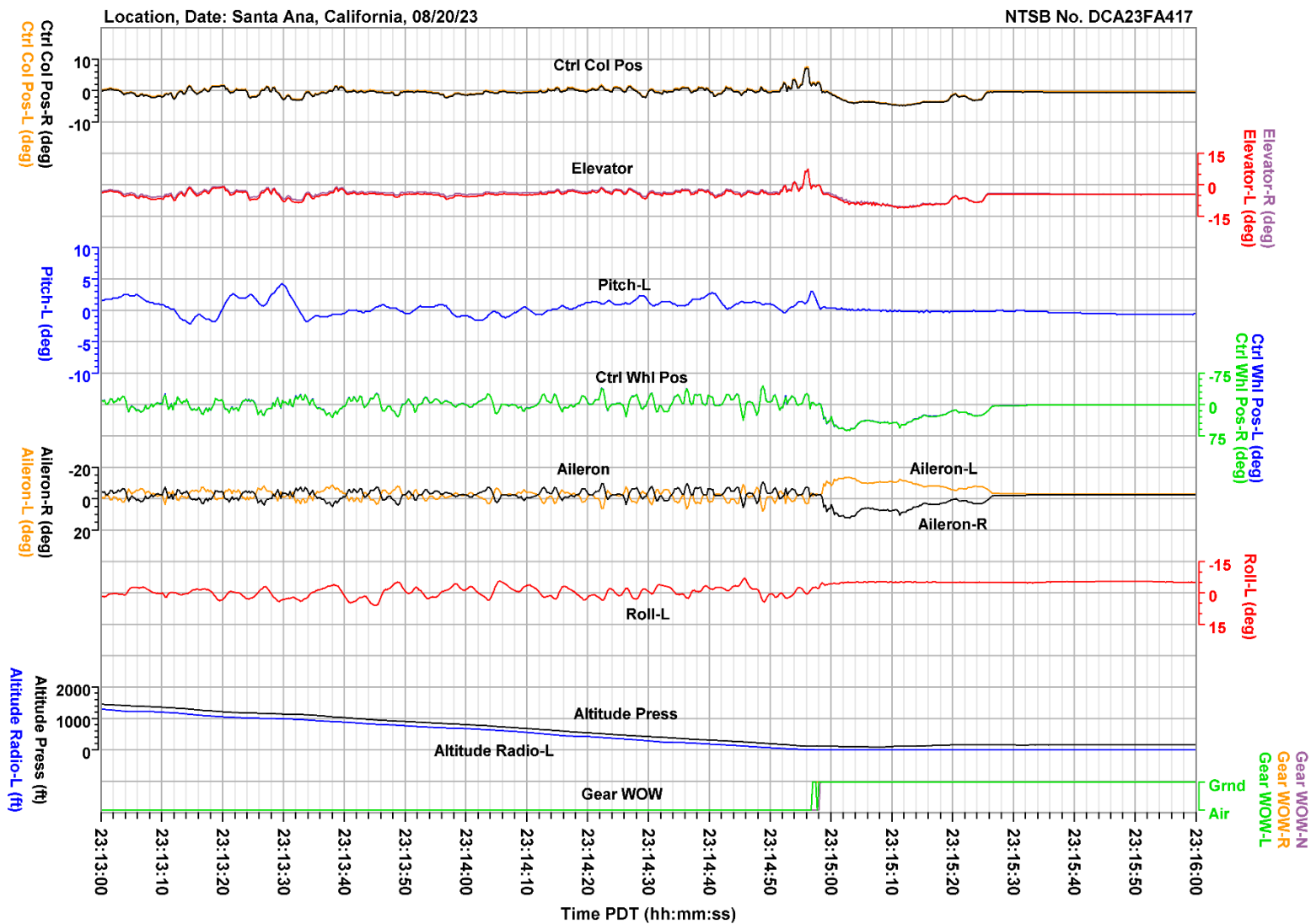
Figure 3. Plot of basic parameters during the touchdown and rollout.



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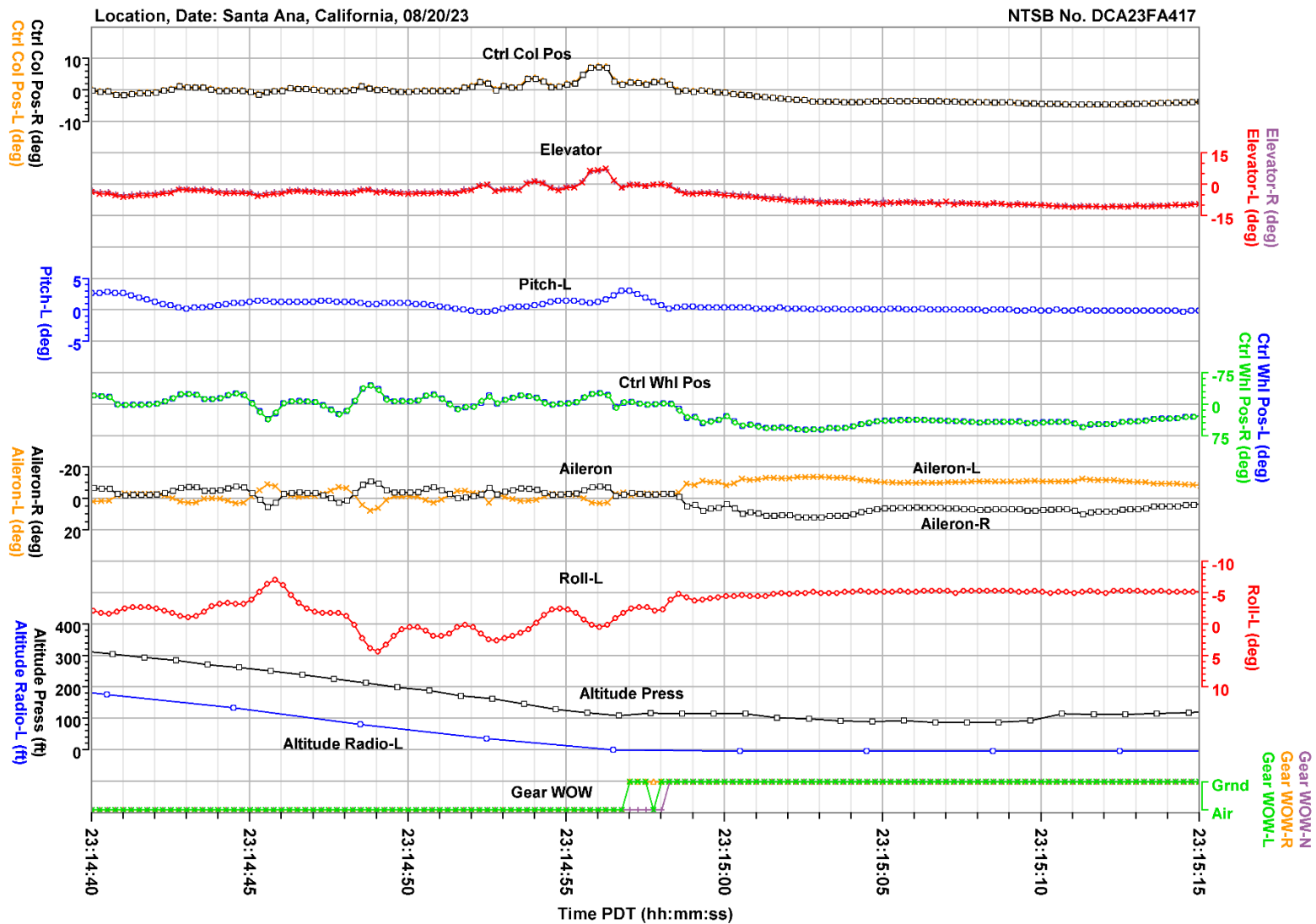
Figure 4. Plot of control related parameters for the entire event flight.



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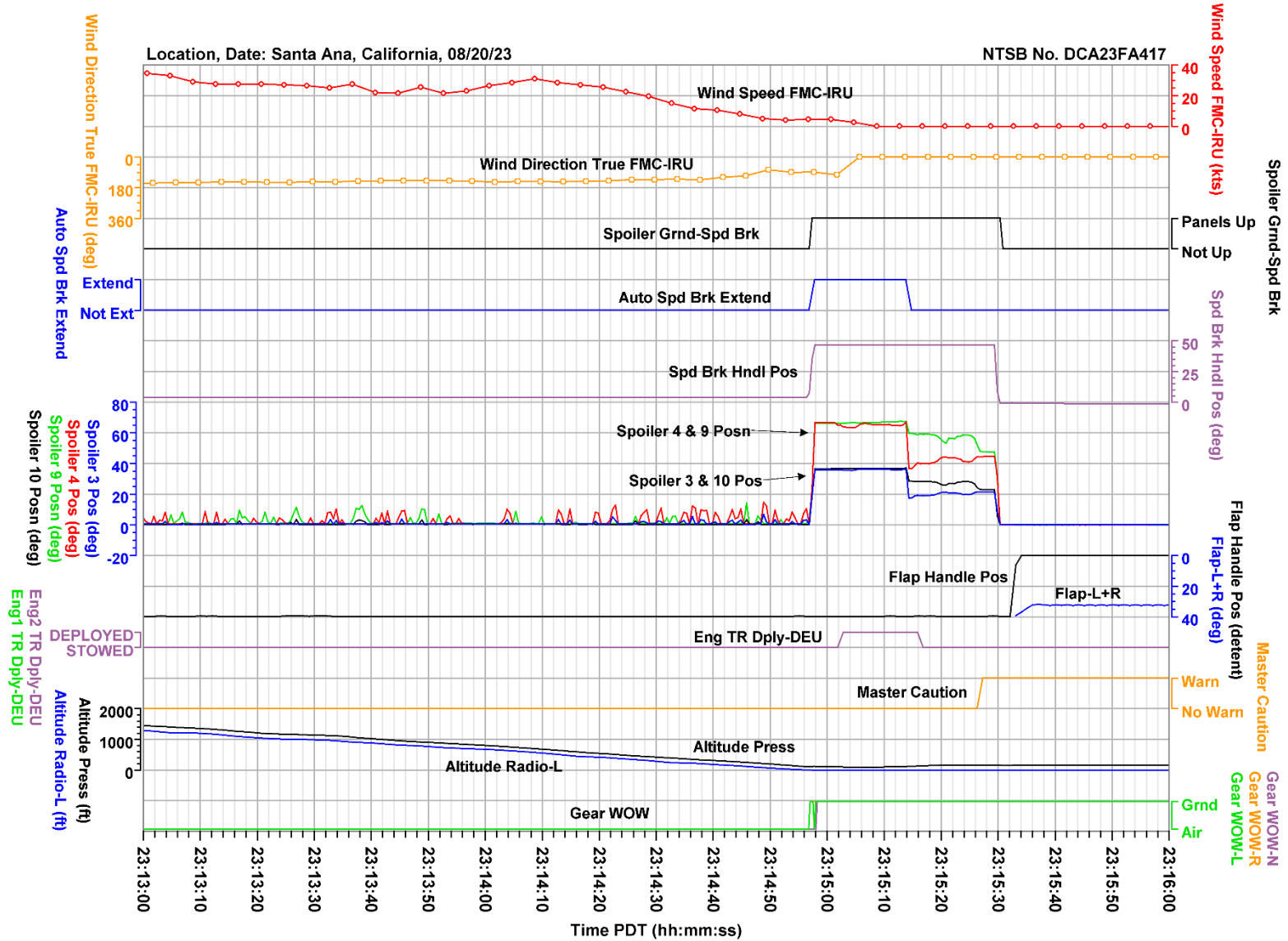
Figure 5. Plot of control related parameters during the final approach.



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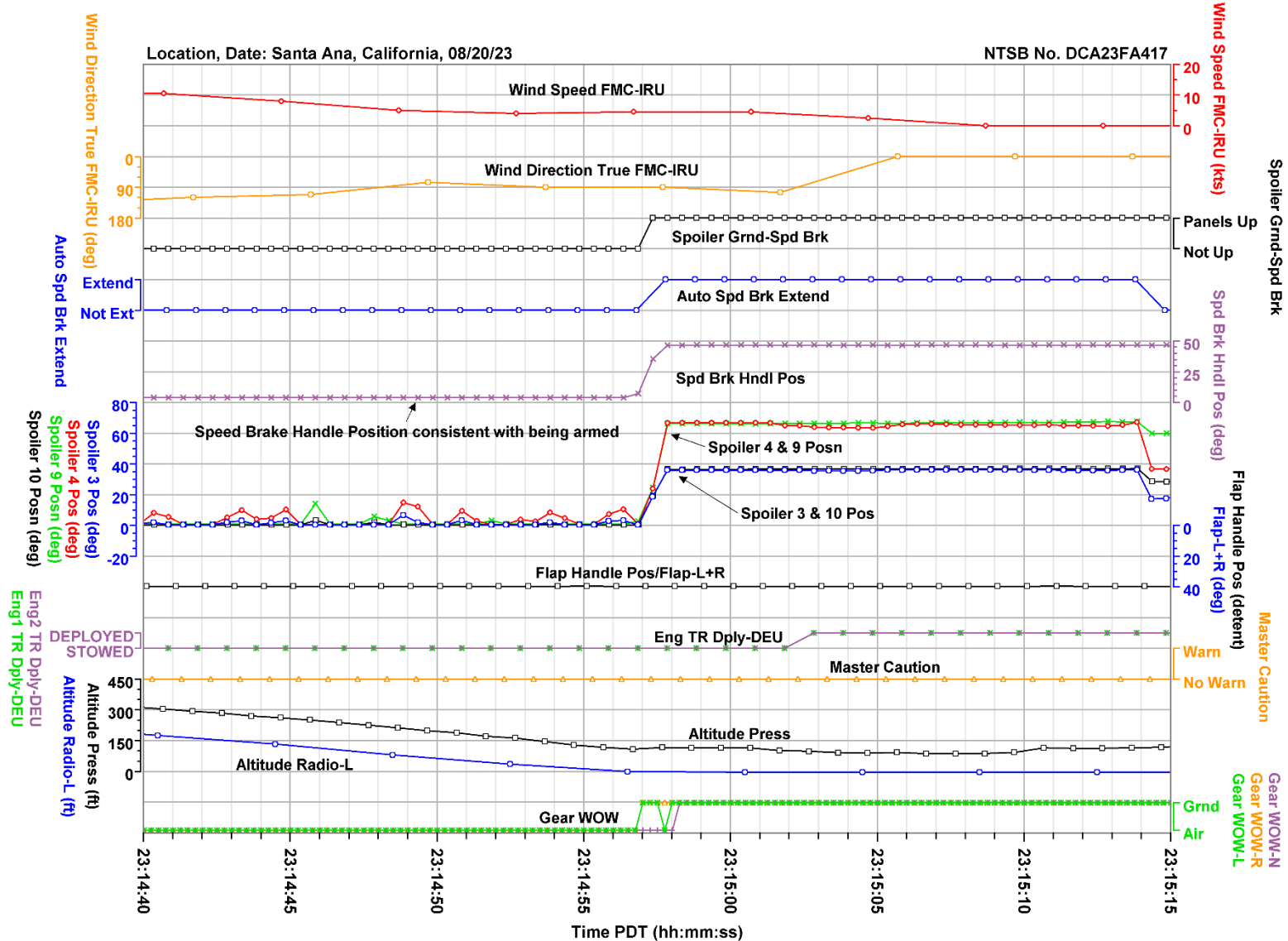
Figure 6. Plot of control related parameters during the landing and rollout.



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Figure 7. Plot of additional control related parameters during the final approach.



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Figure 8. Plot of additional control related parameters during the landing and rollout.

APPENDIX A. VERIFIED AND PROVIDED PARAMETERS

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

Table 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
Aileron-L	Left Aileron Position	deg
Aileron-R	Right Aileron Position	deg
Airspeed Comp	Computed Airspeed	kts
Altitude Press	Pressure Altitude	ft
Altitude Radio-L	Radio Altitude-Left	ft
Auto Spd Brk Extend	Automatic Speed Brake Extended	
Ctrl Col Pos-L	Control Column Position-Left	deg
Ctrl Col Pos-R	Control Column Position-Right	deg
Ctrl Whl Pos-L	Control Wheel Position-Left	deg
Ctrl Whl Pos-R	Control Wheel Position-Right	deg
Elevator-L	Left Elevator Position	deg
Elevator-R	Right Elevator Position	deg
Eng1 N1	Engine 1 Fan Speed	%
Eng1 TR Dply-DEU	Engine 1 Thrust Reverser Deployed	
Eng2 N1	Engine 2 Fan Speed	%
Eng2 TR Dply-DEU	Engine 2 Thrust Reverser Deployed	
Flap Handle Pos	Flap Handle Position	detent
Flap-L+R	Flap Surface Position-Left and Right	deg
Gear WOW-L	Left Main Landing Gear Weight on Wheels	
Gear WOW-N	Nose Gear Weight on Wheels	
Gear WOW-R	Right Main Landing Gear Weight on Wheels	
Ground Spd-L Dsply	Ground Speed-Left Display	kts
Heading Mag-L	Magnetic Heading-Left	deg
Key VHF-1	Microphone Keying Very High Frequency-1	
Key VHF-2	Microphone Keying Very High Frequency-2	
Master Caution	Master Caution	
Pitch	Pitch Angle	deg
Roll	Roll Angle	deg
Spd Brk Hndl Pos	Speed Brake Handle Position	deg
Spoiler 10 Posn	Spoiler Surface 10 Position	deg
Spoiler 3 Posn	Spoiler Surface 3 Position	deg
Spoiler 4 Posn	Spoiler Surface 4 Position	deg
Spoiler 9 Posn	Spoiler Surface 9 Position	deg
Spoiler Grnd-Spd Brk	Spoiler Ground-Speed Brake	
Time Clock GMT Hrs	Greenwich Mean Time Hours	hrs
Time Clock GMT Min	Greenwich Mean Time Minutes	min
Time Clock GMT Sec	Greenwich Mean Time Seconds	sec
Wind Direction True FMC-IRU	Wind Direction-True	deg

Plot/Table Labels	Parameter Names	Units
Wind Speed FMC-IRU	Wind Speed	kts

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 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 2. Unit and discrete state abbreviations.

Unit and Discrete State Abbreviations	Descriptions
%rpm	percent revolutions per minute
deg	degrees
DEU	Display Electronics Unit
Eng	Engaged
FMC	Flight Management Computer
ft	feet
g	unit of gravitation acceleration
Grnd	Ground
hrs	hours
IRU	Inertial Reference Unit
kts	knots
min	minutes
sec	seconds