

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



DCA23LA185

FLIGHT DATA RECORDERS

Specialist's Factual Report

November 18, 2024

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A. INCIDENT

Location: Burbank, California
Date: February 22, 2023
Time: 1855 Pacific standard time (PST)
0255 coordinated universal time (UTC) on February 23, 2023
Airplane 1: Bombardier CL-600-2D24 (CRJ900), Mesa Airlines¹, N954LR
Airplane 2: Embraer ERJ 170-200 LL, SkyWest Airlines², N619UX

B. FLIGHT DATA RECORDERS SPECIALIST

Specialist: Steven Smith
Mechanical Engineer (Recorder Specialist)
National Transportation Safety Board (NTSB)

C. FEDERAL CARRIAGE REQUIREMENTS

Both airplanes involved were operating under the provisions of Title 14 *Code of Federal Regulations* (CFR) Part 121 and were required to be equipped with a flight data recorder (FDR) that recorded, at a minimum, 88 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 from airplane 1 (Mesa):

Recorder Manufacturer/Model: L-3/Fairchild FA2100
Part Number: 2100-2045-22
Recorder Serial Number: 00904855

Additionally, the NTSB Vehicle Recorder Division received an electronic file containing the FDR data from airplane 2 (SkyWest).

1.0 FDR Description

An FDR records airplane flight information in a digital format using solid-state flash memory as the recording medium. FDRs receive data in the ARINC 573/717/747 configurations and are required to record a minimum of 25 hours of flight data. FDRs are configured to record a set number of 12-bit words of digital information every second. Each grouping of words is called a subframe and is identified with a

¹ Referred to as Mesa in this report.

² Referred to as SkyWest in this report.

subframe reference number (SRN). 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. Each data parameter (altitude, heading, and airspeed) has a specifically assigned word number within the subframe.

Airplane 1 (Mesa):

The L-3/Fairchild FA2100 was configured to record 512 12-bit words of digital information every second and was designed to meet the crash-survivability requirements of TSO-C124b.

Airplane 2 (SkyWest):

The FDR file was configured to record 512 12-bit words of digital information every second.

1.1 Recorder Condition

The FDR from airplane 1 (Mesa) was in good condition and the data were extracted normally from the recorder using instructions provided by the recorder manufacturer.

1.2 Recording Descriptions

Airplane 1 (Mesa):

The FDR recording contained approximately 154.9 hours of data. The incident flight was the eighth to last flight of the recording, and its duration was approximately 1 hour and 25 minutes. The parameters evaluated for the purpose of this report appeared to be in accordance with federal FDR carriage requirements.

Airplane 2 (SkyWest):

The FDR recording contained approximately 140.8 hours of data. The incident flight was the third to last flight of the recording, and its duration was approximately 1 hour and 17 minutes. The parameters evaluated for the purpose of this report appeared to be in accordance with federal FDR carriage requirements.

1.2.1 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

1.3 Time Correlation

Airplane 1 (Mesa):

Correlation of the FDR data to local time, PST, was established by using the recorded UTC Hours, UTC Minutes, and UTC Seconds and then applying an additional 8 hours offset to change UTC to PST. The offset is provided in table 1.

Airplane 2 (SkyWest):

Correlation of the FDR data to the event local time, PST, was established by using the recorded UTC Hours, UTC Minutes, and UTC Seconds and then applying an additional 8 hours offset to change UTC to PST. The offset is provided in table 1.

Table 1. FDR time offset.

Airplane	SRN to PST offset
1	-441,888 seconds
2	-424,648 seconds

For the remainder of this report, all times are referenced as PST.

1.4 Pressure Altitude

Both FDRs record pressure altitude, which is based on a standard altimeter setting of 29.92 inches of mercury (inHg). The altitude information presented in the FDR plots and in the tabular data have not been corrected for the local altimeter setting at the time of the incident.

1.5 TCAS Vertical Resolution from Airplane 1 (Mesa)

The manufacturer of the Mesa aircraft was contacted and informed the NTSB that the aircraft contained Traffic Collision Avoidance System (TCAS), Traffic Surveillance System (TSS) model number 4100 and part number 822-2132-001. The system contained data concentrator unit (DCU) part number 822-1310-007. The operator confirmed this information. With this equipment, the manufacturer informed the NTSB that TCAS Vertical Resolution, which includes parameters TCAS Vertical Control, TCAS Combined Control, TCAS Up Advisory and TCAS Down Advisory, did not record data; therefore, these parameters are not provided.

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

E. FIGURES AND TABULAR DATA

Figures 1 to 13 contain FDR data recorded during the incident on February 22, 2023. In these figures, parameters with the suffix ASH are from airplane 1's (Mesa) FDR and parameters with the suffix SKW are from airplane 2's (SkyWest) FDR. Table 2 is a summary of the figures provided in this report.

Table 2. Summary of figures.

Figure	Time (PST)	Data Source	Summary of parameters in the figure
Figure 1	18:54:00 to 18:58:00	Both Airplanes	Basic parameters for both airplanes
Figure 2	17:45:00 to 19:10:00 (Entire Flight)	Airplane 1 (Mesa)	Basic parameters
Figure 3			Autopilot parameters
Figure 4			Flight control input and surface movements
Figure 5			Engine parameters
Figure 6			Basic parameters
Figure 7	18:54:00 to 18:58:00		Autopilot parameters
Figure 8			Flight control input and surface movements
Figure 9			Engine parameters
Figure 10			TCAS parameters
Figure 11			18:55:00 to 18:58:00
Figure 12	Flight control input and surface movements		
Figure 13	Engine and TCAS parameters		

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. A dashed line representing the time of the initiation of the go-around by airplane 1 (Mesa) is shown on each figure for reference.

Table 3 lists the FDR parameters verified and provided in this report for airplane 1 (Mesa). Table 4 lists the FDR parameters verified and provided in this report for airplane 2 (SkyWest). Additionally, table 5 describes the unit and discrete state abbreviations used in this report.

The tabular data from 17:45:00 PST to 19:10:00 CDT for all the parameters listed in table 3 for airplane 1 (Mesa) are provided in electronic comma-separated value (CSV) format as attachment 1 to this factual report. Additionally, tabular data from 18:55:00 PST to 18:58:00 PST for all the parameters listed in table 4 for airplane 2 (SkyWest) are provided in CSV format as attachment 2 to this factual report.

Submitted by:

Steven Smith
Mechanical Engineer (Recorder Specialist)

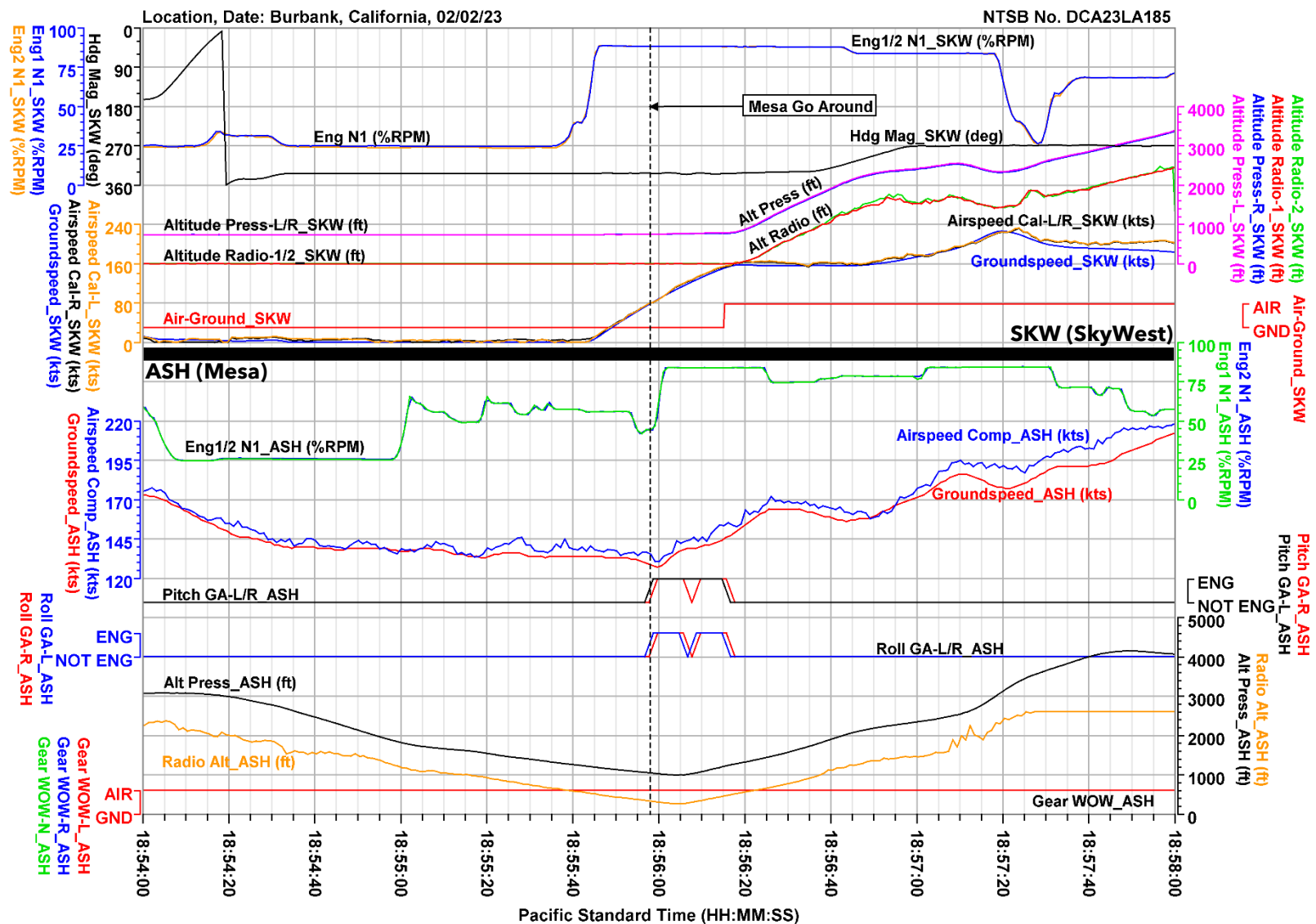


Figure 1. Time history plot of basic parameters during the incident - Airplane 1 (Mesa) and Airplane 2 (SkyWest).

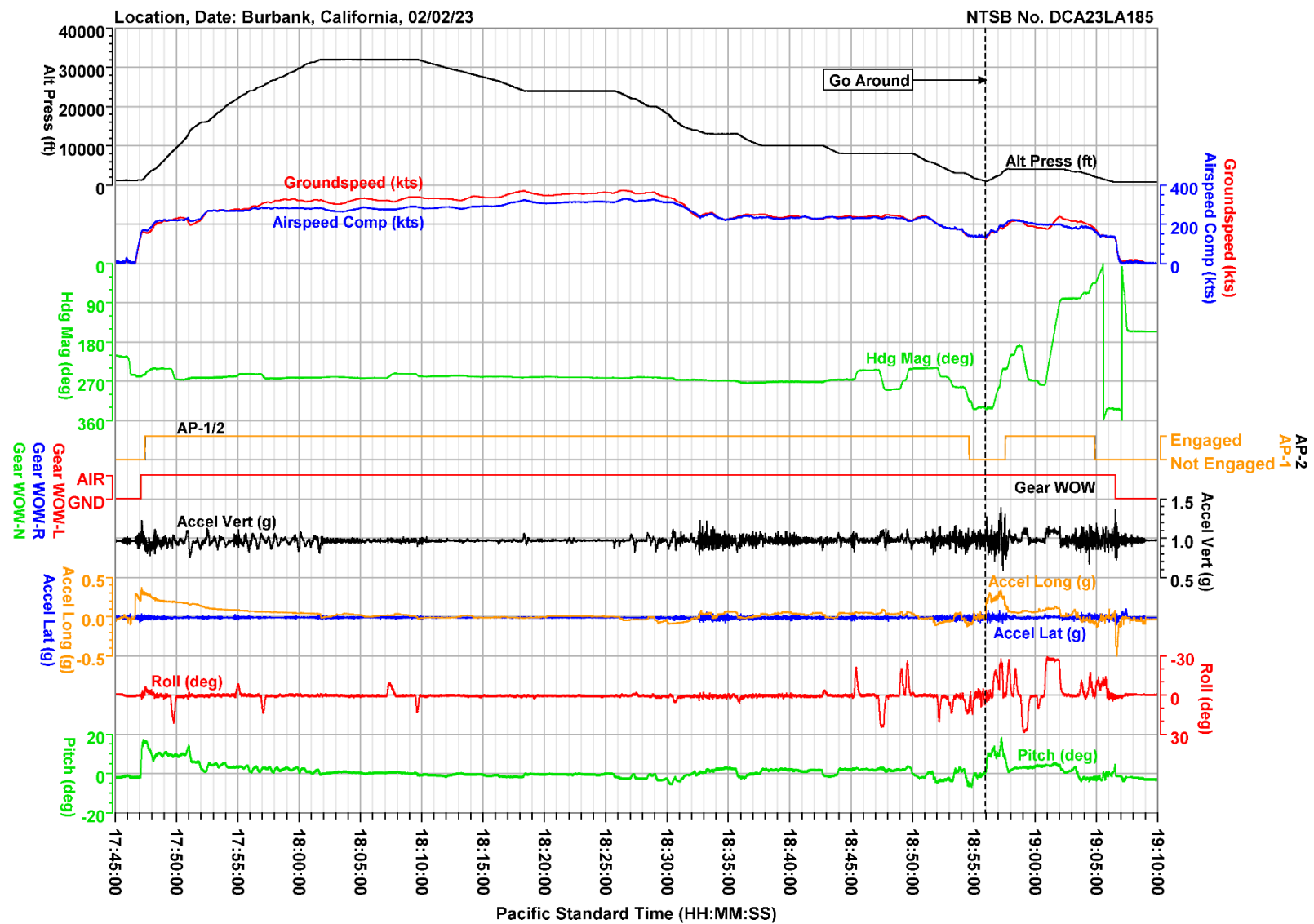


Figure 2. Time history plot of basic parameters for the full incident flight - Airplane 1 (Mesa).

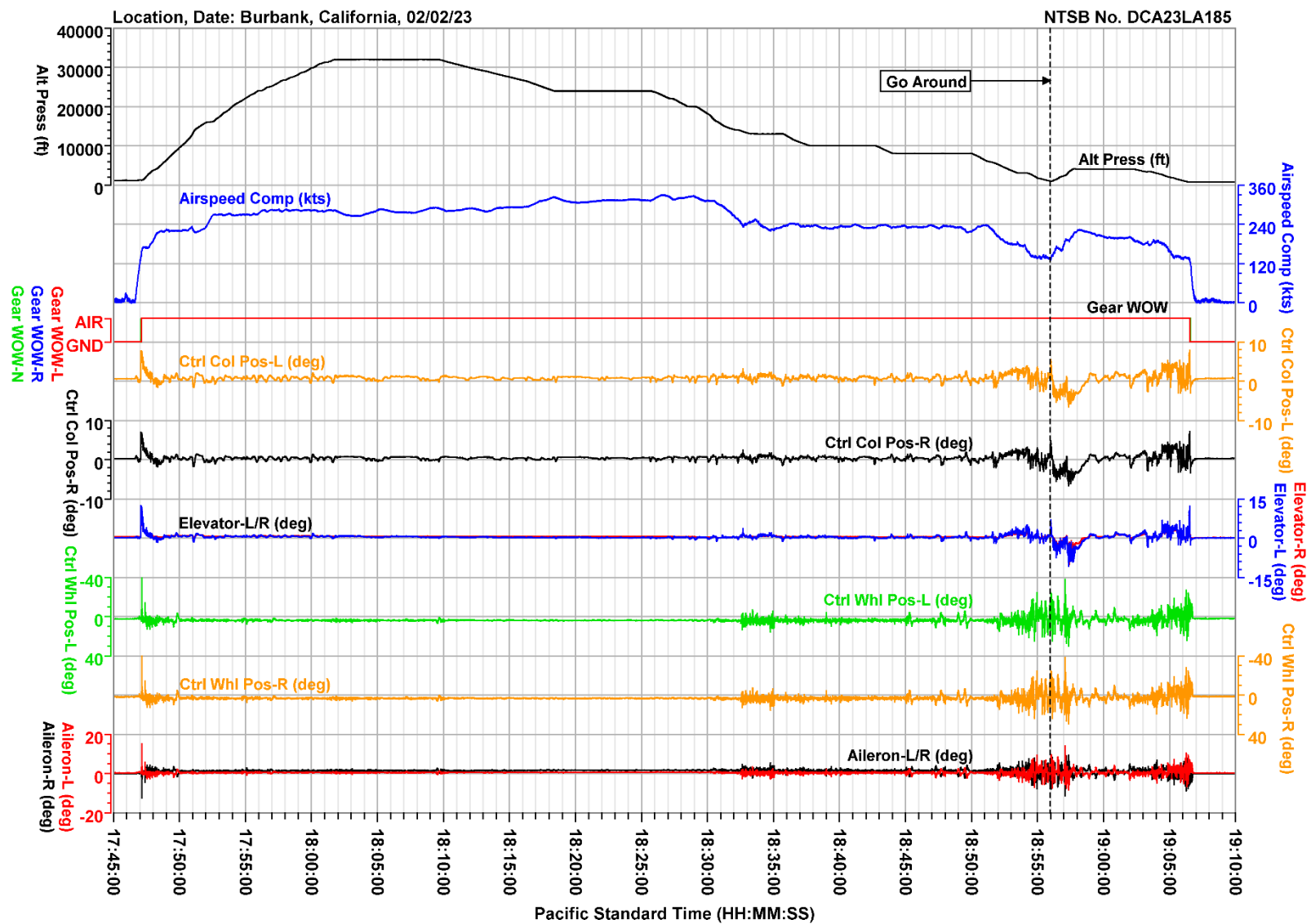


Figure 4. Time history plot of flight control parameters for the full incident flight - Airplane 1 (Mesa).

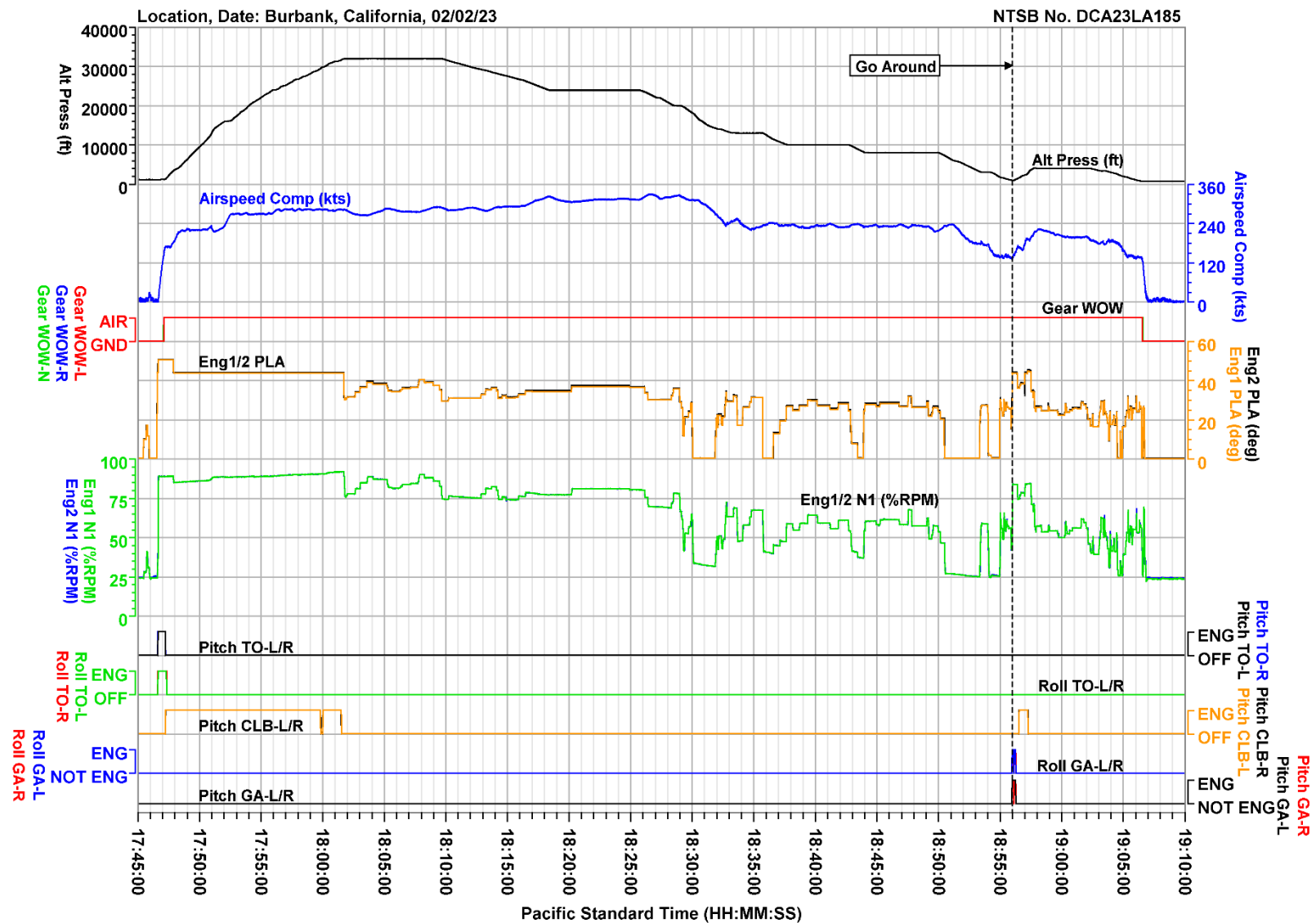


Figure 5. Time history plot of engine parameters for the full incident flight - Airplane 1 (Mesa).

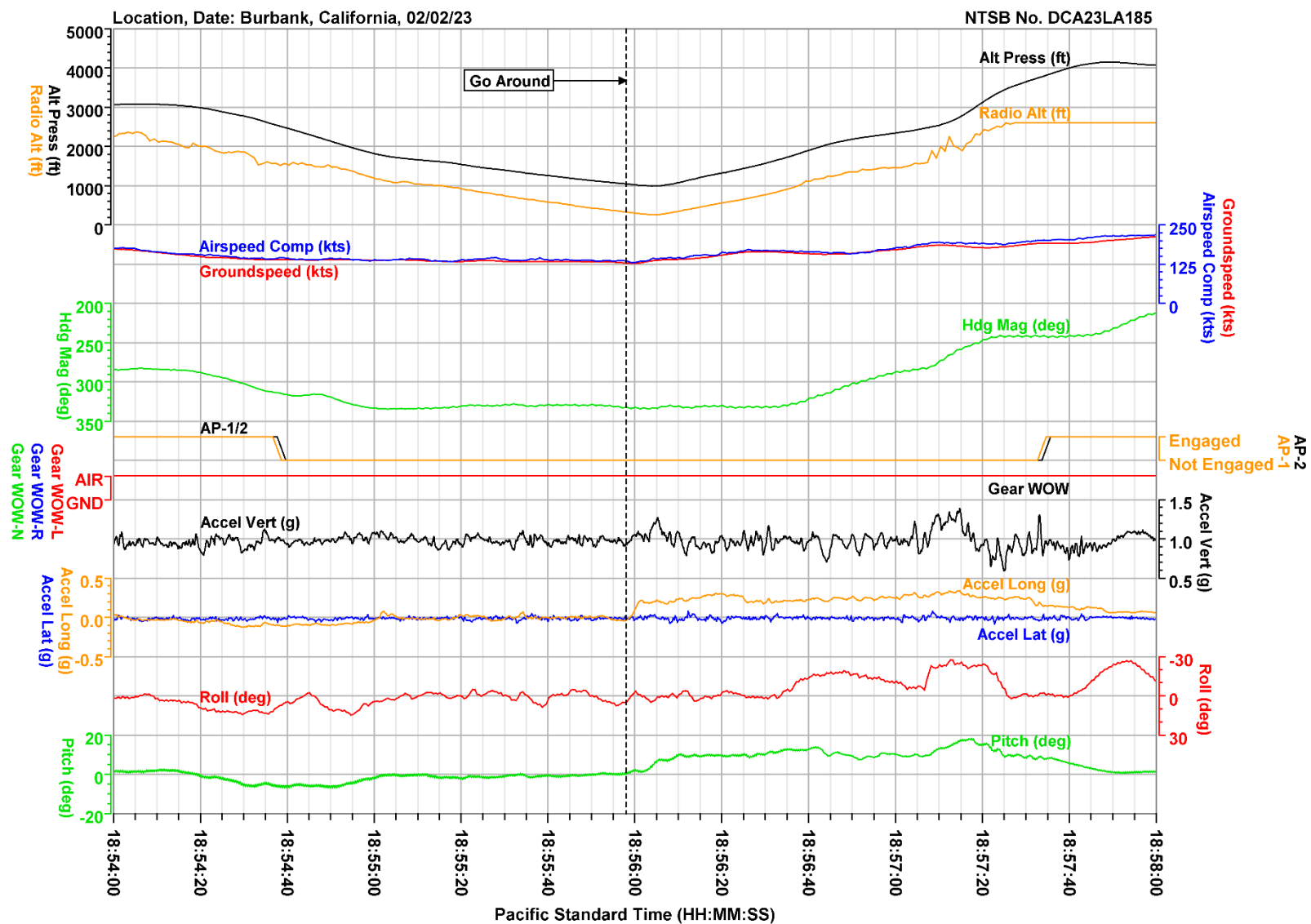


Figure 6. Time history plot of basic parameters during the incident – Airplane 1 (Mesa).

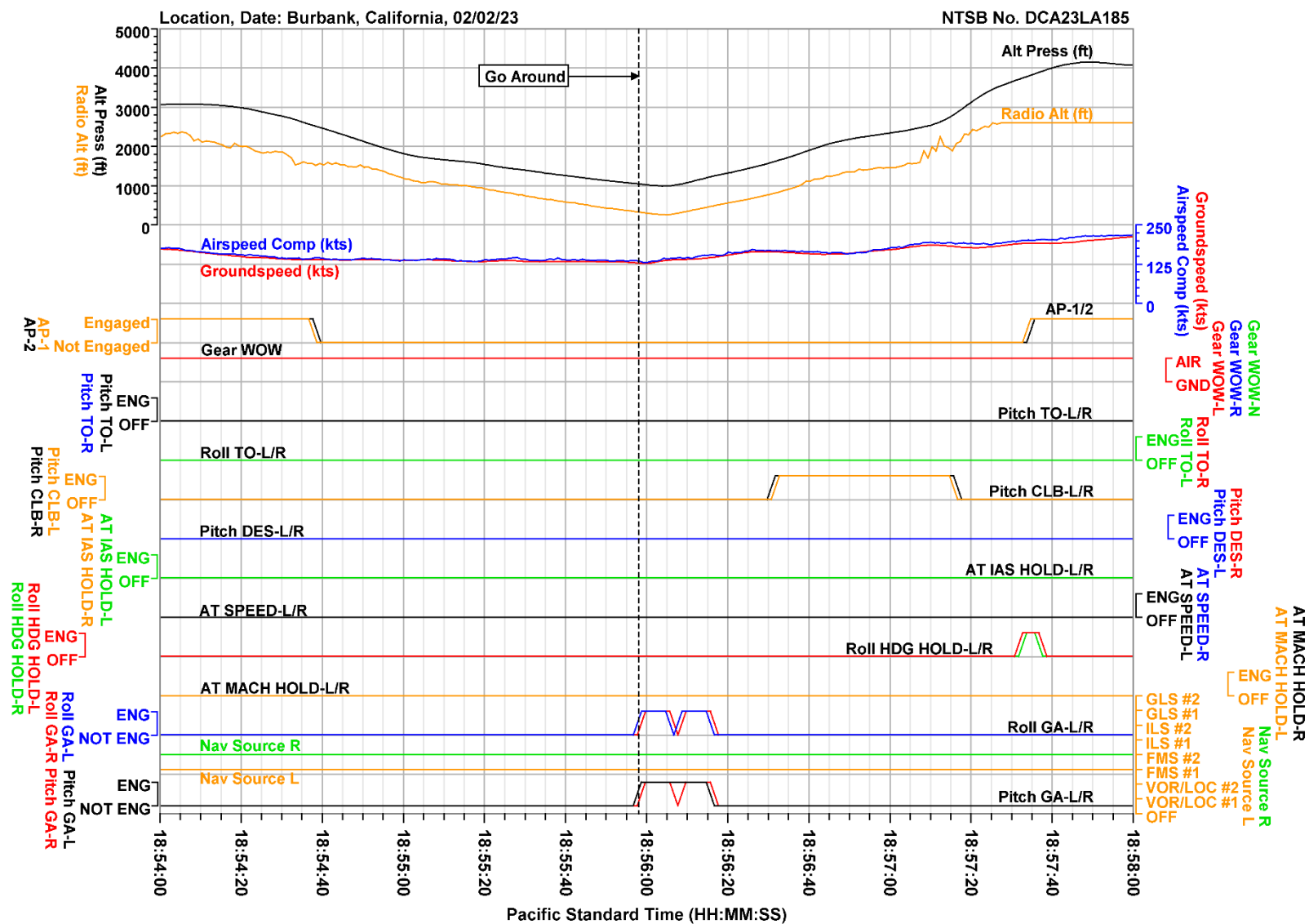


Figure 7. Time history plot of autopilot parameters during the incident - Airplane 1 (Mesa).

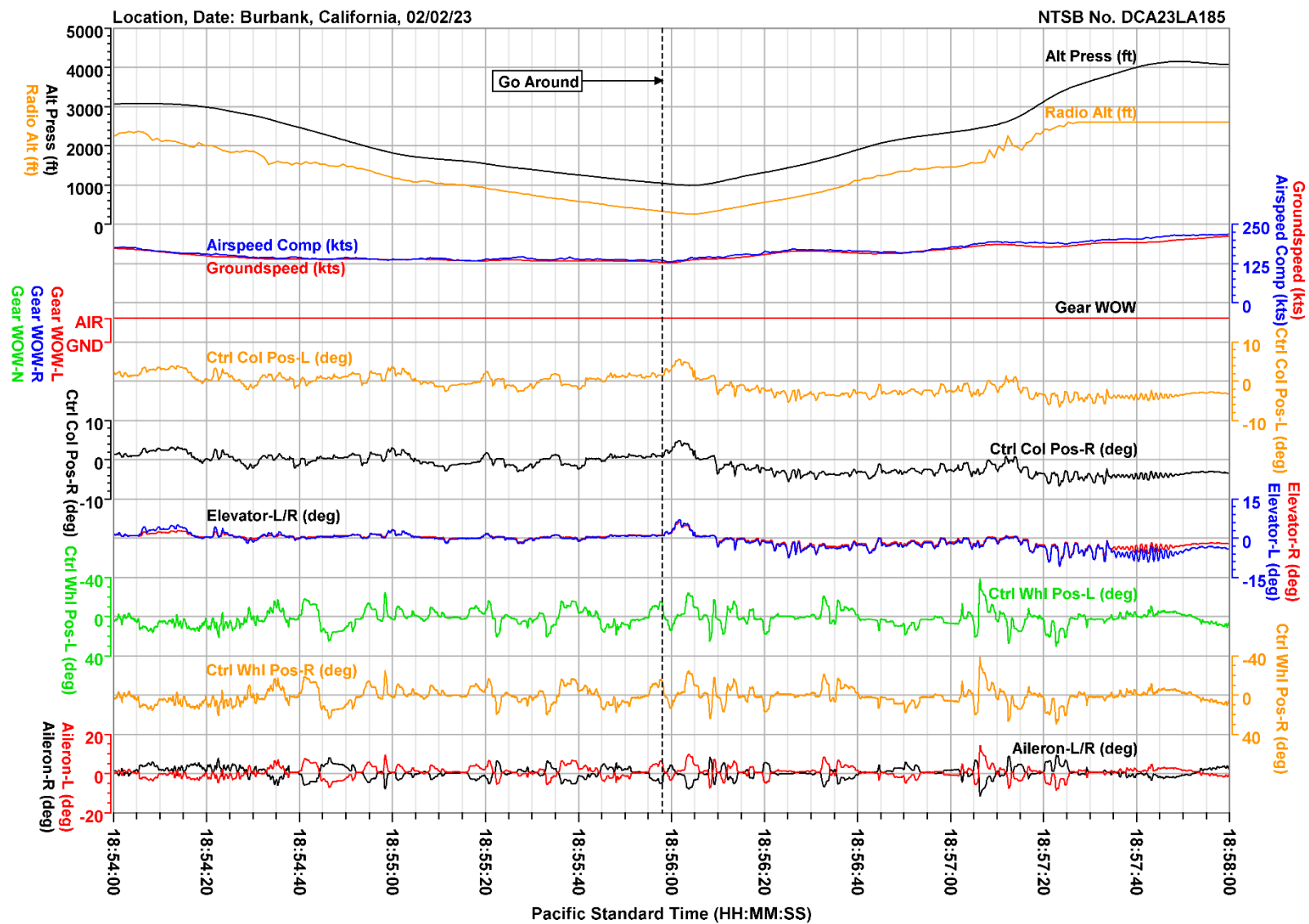


Figure 8. Time history plot of flight control parameters during the incident - Airplane 1 (Mesa).

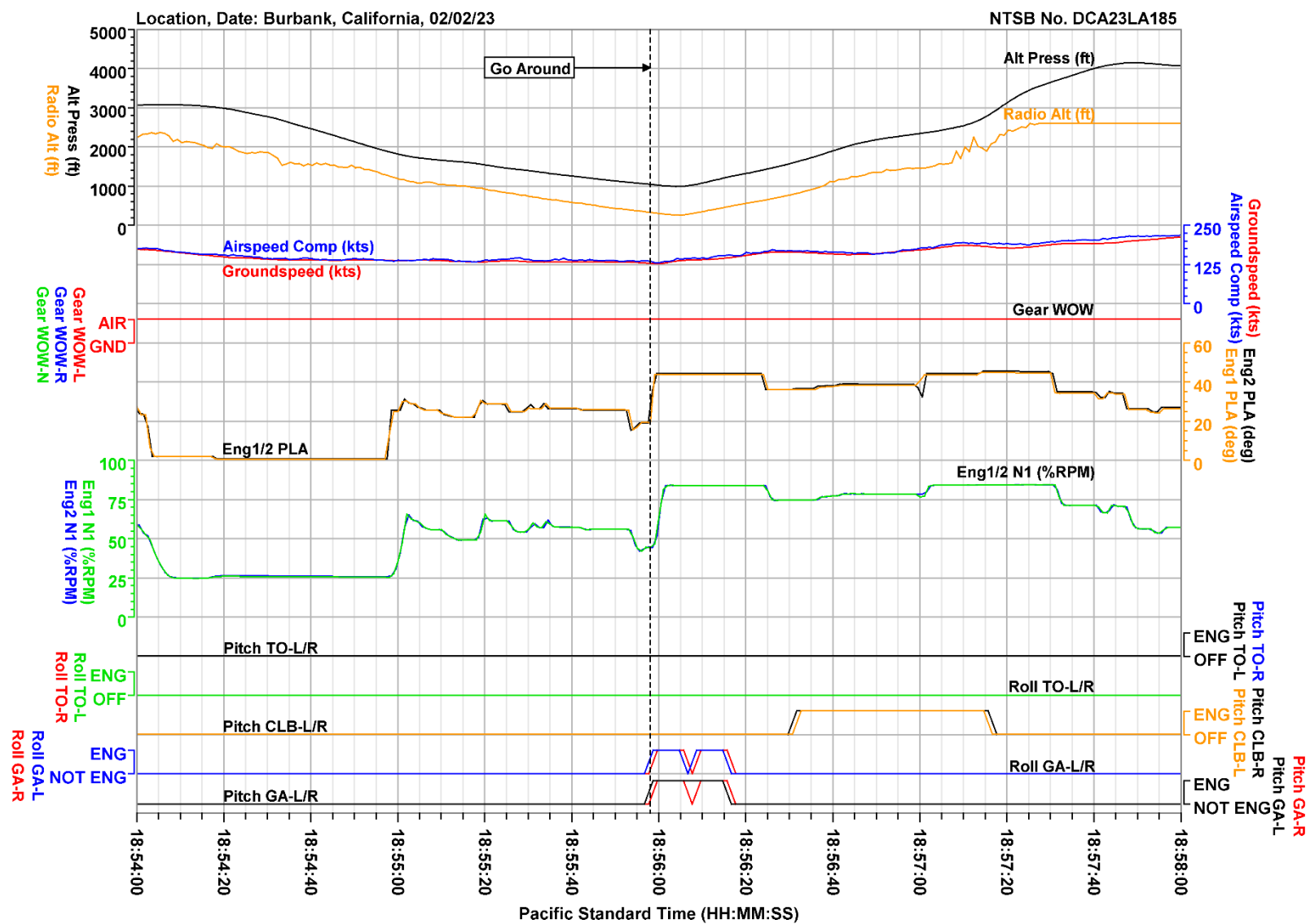


Figure 9. Time history plot of engine parameters during the incident - Airplane 1 (Mesa).

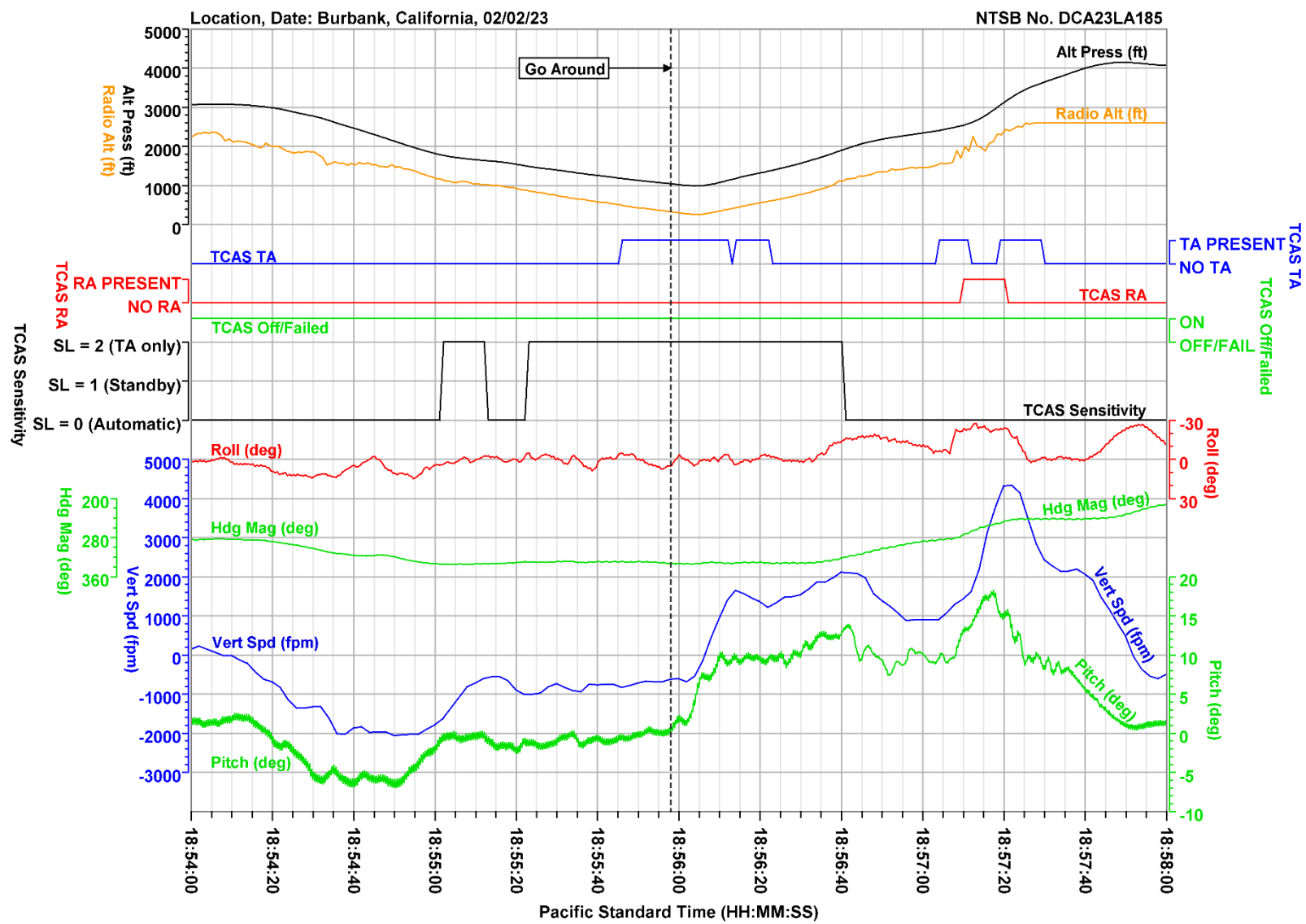


Figure 10. Time history plot of TCAS parameters during the incident - Airplane 1 (Mesa).

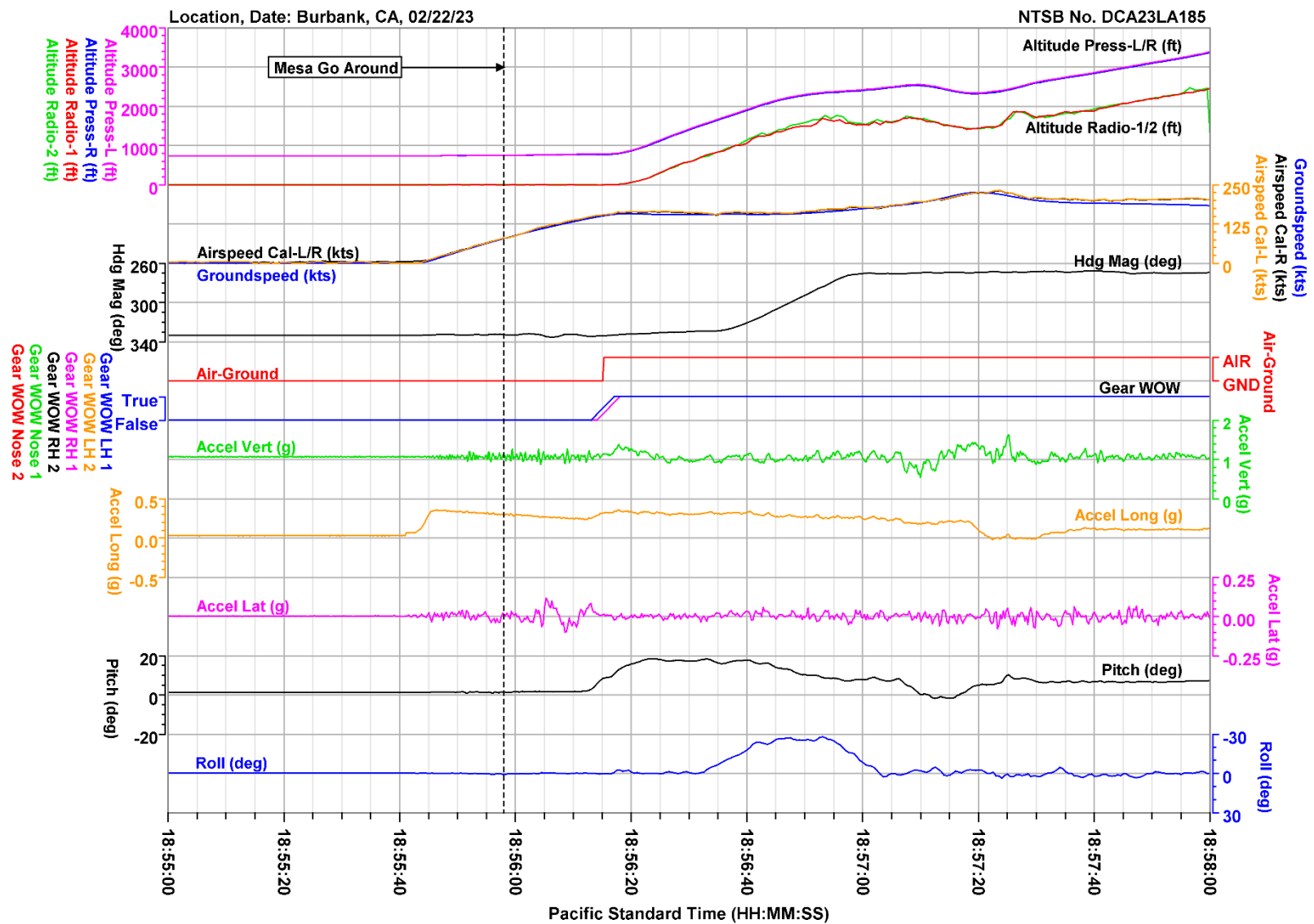


Figure 11. Time history plot of basic parameters during the incident - Airplane 2 (SkyWest).

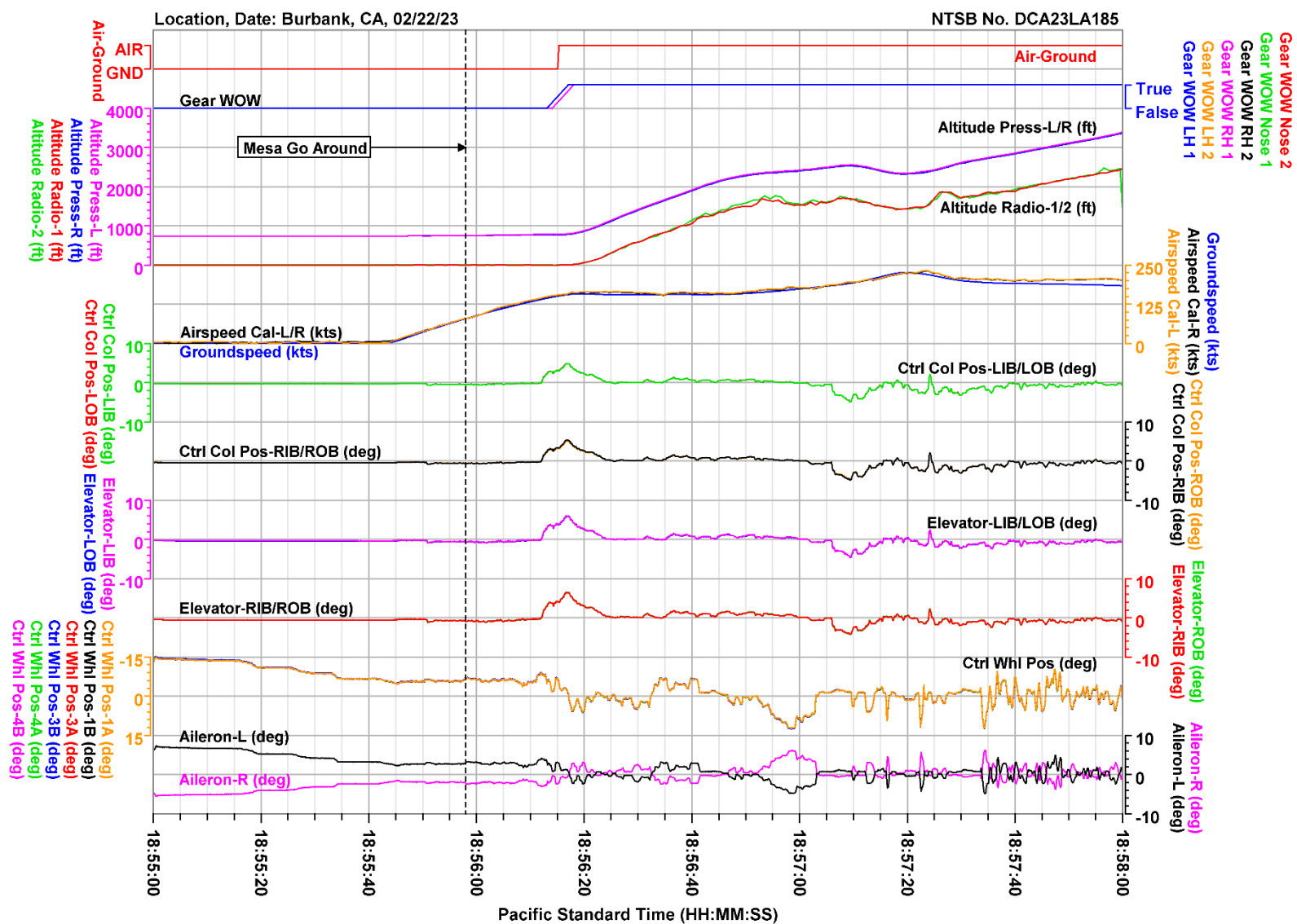


Figure 12. Time history plot of flight control parameters during the incident - Airplane 2 (SkyWest).

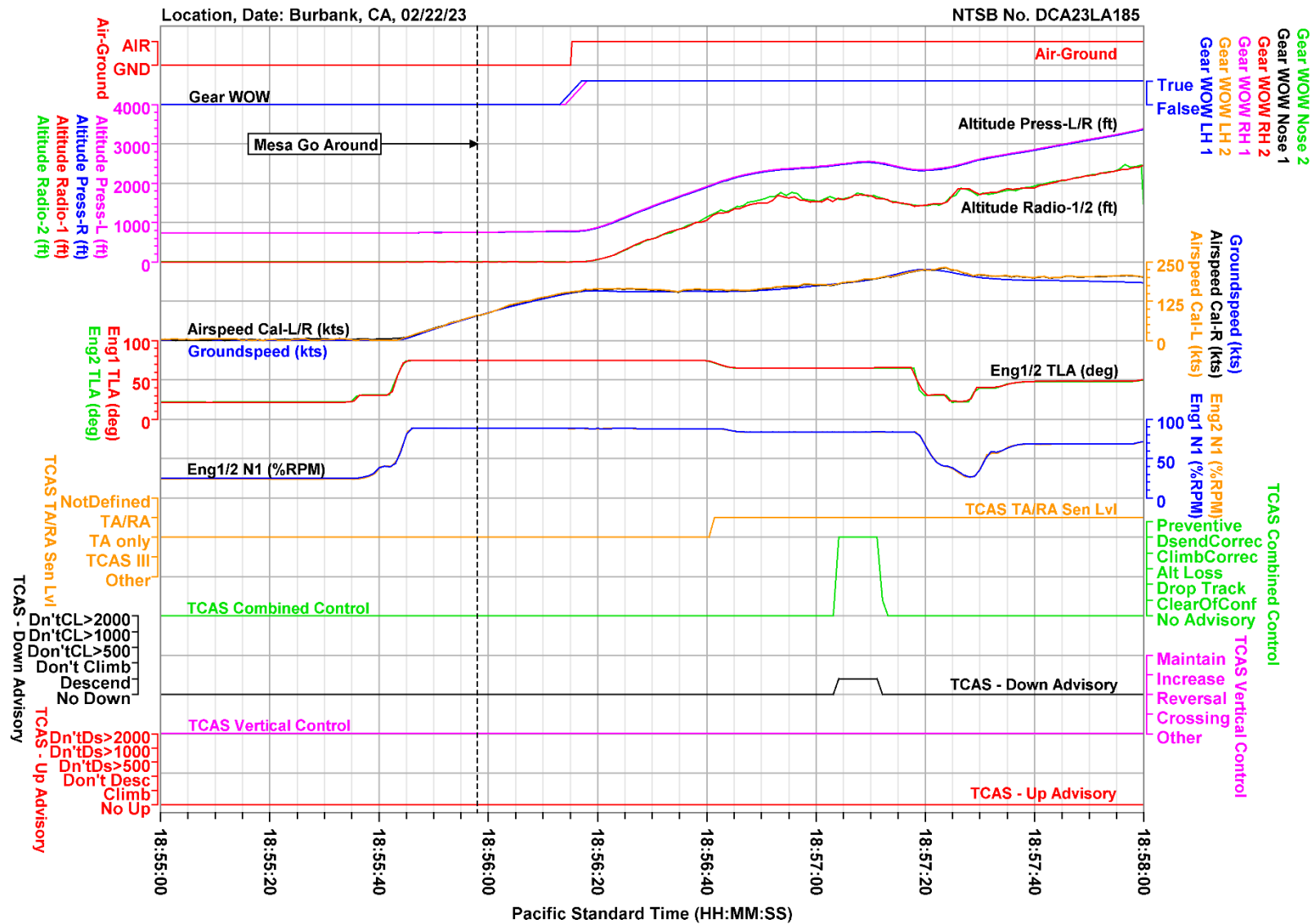


Figure 13. Time history plot of engine and TCAS parameters during the incident - Airplane 2 (SkyWest).

APPENDIX A. VERIFIED AND PROVIDED PARAMETERS

This appendix describes the parameters provided and verified in this report. Table 3 and table 4 lists the plot/table labels, parameter names, and units for airplane 1 (Mesa) and airplane 2 (SkyWest), respectively. Parameters that do not have units are discretes.⁴ Table 5 describes the unit and discrete state abbreviations used in this report.

Table 3. Verified and provided FDR parameters for airplane 1 (Mesa).

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
Alt Press	Pressure Altitude	ft
AP-1	Left Autopilot Engaged (Source Flight Control Computer)	
AP-2	Right Autopilot Engaged (Source Flight Control Computer)	
AT IAS HOLD-L	Autothrottle: Left Indicated Airspeed Hold (Source Flight Control Computer)	
AT IAS HOLD-R	Autothrottle: Right Indicated Airspeed Hold (Source Flight Control Computer)	
AT MACH HOLD-L	Autothrottle: Left Mach Hold (Source Flight Control Computer)	
AT MACH HOLD-R	Autothrottle: Right Mach Hold (Source Flight Control Computer)	
AT SPEED-L	Autothrottle: Left Speed (Source Flight Control Computer)	
AT SPEED-R	Autothrottle: Right Speed (Source Flight Control Computer)	
Ctrl Col Pos-L	Pilot Control Column Position	deg
Ctrl Col Pos-R	Co-Pilot Control Column Position	deg
Ctrl Whl Pos-L	Pilot Control Wheel Position	deg
Ctrl Whl Pos-R	Co-Pilot Control Wheel Position	deg
Elevator-L	Left Elevator Position	deg
Elevator-R	Right Elevator Position	deg
Eng1 N1	Engine 1 Fan Speed	%RPM
Eng1 PLA	Engine 1 Power Lever Angle	deg
Eng2 N1	Engine 2 Fan Speed	%RPM
Eng2 PLA	Engine 2 Power Lever Angle	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	
Groundspeed	Groundspeed	kts
Hdg Mag	Magnetic Heading	deg
Latitude	Latitude Coordinate	deg
Longitude	Longitude Coordinate	deg
Nav Source L	Left Active Navigation Source	
Nav Source R	Right Active Navigation Source	
Pitch	Pitch Angle	deg
Pitch CLB-L	Left Climb (Source Flight Control Computer)	
Pitch CLB-R	Right Climb (Source Flight Control Computer)	
Pitch DES-L	Left Descend (Source Flight Control Computer)	
Pitch DES-R	Right Descend (Source Flight Control Computer)	
Pitch GA-L	Left Vertical Go Around (Source Flight Control Computer)	

⁴ 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.

Plot/Table Labels	Parameter Names	Units
Pitch GA-R	Right Vertical Go Around (Source Flight Control Computer)	
Pitch TO-L	Left Vertical Take Off (Source Flight Control Computer)	
Pitch TO-R	Right Vertical Take Off (Source Flight Control Computer)	
Radio Alt	Radio Altitude	ft
Roll	Roll Angle	deg
Roll GA-L	Left Lateral Go Around (Source Flight Control Computer)	
Roll GA-R	Right Lateral Go Around (Source Flight Control Computer)	
Roll HDG HOLD-L	Left Heading Hold (Source Flight Control Computer)	
Roll HDG HOLD-R	Right Heading Hold (Source Flight Control Computer)	
Roll TO-L	Left Lateral Takeoff (Source Flight Control Computer)	
Roll TO-R	Right Lateral Takeoff (Source Flight Control Computer)	
TCAS Off/Failed	Traffic Collision Avoidance System Off/Failed	
TCAS RA	Traffic Collision Avoidance System Resolution Advisory	
TCAS Sensitivity	Traffic Collision Avoidance System Sensitivity Level Control	
TCAS TA	Traffic Collision Avoidance System Traffic Advisory	
Time UTC-Hr	Coordinated Universal Time Hour	hrs
Time UTC-Min	Coordinated Universal Time Minutes	min
Time UTC-Sec	Coordinated Universal Time Seconds	sec
Vert Spd	Vertical Speed	fpm

Table 4. Verified and provided FDR parameters for airplane 2 (SkyWest).

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
Air-Ground	Air-Ground Switch	
Airspeed Cal-L	Calculated Airspeed-Left	kts
Airspeed Cal-R	Calculated Airspeed -Right	kts
Altitude Press-L	Pressure Altitude-Left	ft
Altitude Press-R	Pressure Altitude-Right	ft
Altitude Radio-L	Radio Altitude-Left	ft
Altitude Radio-R	Radio Altitude-Right	ft
Ctrl Col Pos-LIB	Left Inboard Control Column Position Sensor	deg
Ctrl Col Pos-LOB	Left Outboard Control Column Position Sensor	
Ctrl Col Pos-RIB	Right Inboard Control Column Position Sensor	
Ctrl Col Pos-ROB	Right Outboard Control Column Position Sensor	
Ctrl Whl Pos-1A	Control Wheel Position Sensor 1A	deg
Ctrl Whl Pos-1B	Control Wheel Position Sensor 1B	deg
Ctrl Whl Pos-3A	Control Wheel Position Sensor 3A	deg
Ctrl Whl Pos-3B	Control Wheel Position Sensor 3B	deg
Ctrl Whl Pos-4A	Control Wheel Position Sensor 4A	deg
Ctrl Whl Pos-4B	Control Wheel Position Sensor 4B	deg
Day	Day	
Elevator-LIB	Left Inboard Elevator Position	deg
Elevator-LOB	Left Outboard Elevator Position	deg
Elevator-RIB	Right Inboard Elevator Position	deg
Elevator-ROB	Left Outboard Elevator Position	deg
Eng1 N1	Engine 1 Fan Speed	%RPM
Eng1 TLA	Engine 1 Throttle Lever Angle	deg
Eng2 N1	Engine 2 Fan Speed	%RPM
Eng2 TLA	Engine 2 Throttle Lever Angle	deg
Gear WOW LH1	Left Gear Weight on Wheels Sensor 1	

Plot/Table Labels	Parameter Names	Units
Gear WOW LH2	Left Gear Weight on Wheels Sensor 2	
Gear WOW Nose 1	Nose Gear Weight on Wheels Sensor 1	
Gear WOW Nose 2	Nose Gear Weight on Wheels Sensor 2	
Gear WOW RH1	Right Gear Weight on Wheels Sensor 1	
Gear WOW RH2	Right Gear Weight on Wheels Sensor 2	
Groundspeed	Groundspeed	kts
Hdg Mag-1	Magnetic Heading	deg
Latitude	Latitude Coordinate	deg
Longitude	Longitude Coordinate	deg
Month	Month	
Pitch	Pitch Angle	deg
Roll	Roll Angle	deg
TCAS Combined Control	Traffic Collision Avoidance System Combined Control	
TCAS - Down Advisory	Traffic Collision Avoidance System Down Advisory	
TCAS TA/RA Sen Lvl	Traffic Collision Avoidance System Traffic Advisory/Resolution Advisory Sensitivity Level	
TCAS - Up Advisory	Traffic Collision Avoidance System Up Advisory	
TCAS Vertical Control	Traffic Collision Avoidance System Vertical Control	
Time UTC-Hr	Coordinated Universal Time Hour	hrs
Time UTC-Min	Coordinated Universal Time Minutes	min
Time UTC-Sec	Coordinated Universal Time Seconds	sec

Table 5. Unit and discrete state abbreviations

Unit and Discrete State Abbreviations	Descriptions
%RPM	percent revolutions per minute
AT	autothrottle
deg	degrees
Eng	Engaged
FCC	Flight Control Computer
fpm	feet per minute
ft	feet
g	unit of gravitation acceleration
GND	ground
hrs	hours
inHg	inches of Mercury
kts	knots
L	Left
min	minutes
R	Right
RA	Resolution Advisory
sec	Seconds
TA	Traffic Advisory
TCAS	Traffic Collision Avoidance System
WOW	Weight on Wheels