

NATIONAL TRANSPORTATION SAFETY BOARD
Investigative Hearing

Alaska Airlines Flight 1282

Boeing 737-9, N704AL

Left Mid Exit Door Plug Separation in Portland, OR

January 5, 2024

Docket No.	SA-543
EXHIBIT	
10A	

**Flight Data Recorder's
Specialist's Factual Report**
(27 Pages)

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



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FLIGHT DATA RECORDER'S

Specialist's Factual Report

April 29, 2024

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A. ACCIDENT

Location: Portland, Oregon
Date: January 5, 2024
Time: 1714 Pacific standard time (PST)
Airplane: Boeing 737-9, Alaska Airlines Inc, N704AL

B. FLIGHT DATA RECORDER'S SPECIALIST

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

C. FEDERAL CARRIAGE REQUIREMENTS

The accident aircraft, N704AL, was operating as Title 14 *Code of Federal Regulations* (CFR) Part 121. The accident aircraft was manufactured in 2023 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).

QARs (Quick Access Recorders) are typically used in Flight Data Monitoring or Flight Operations Quality Assurance programs. QARs have no Federal Aviation Administration carriage requirements.

D. DETAILS OF THE INVESTIGATION

A group was not convened. NTSB Vehicle Recorder Division received the following FDR and QAR file:

Recorder Manufacturer/Model: L-3/Fairchild FA2100
Part Number: 2100-4945-22
Recorder Serial Number: 002107622

QAR File: DAR.DAT

1.0 L-3/Fairchild 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 1024 12-bit words of digital information every second. Each grouping of 1024 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 1024-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-C124b.

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 68.25 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 was approximately 20 minutes.

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=+).¹

2.0 QAR Data File Description

The QAR data in the electronic file was configured such that 2048 12-bit words of digital information were recorded every second. Each grouping of 2048 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 2048-word intervals. Each data parameter (for example, pressure altitude, pitch angle, roll angle, and magnetic heading) has a specifically assigned word number within the subframe.

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 = +.

2.1 Recording Description

The QAR recording contained approximately 31.75 hours of data. Timing of the QAR data is measured in SRN where each SRN equals one elapsed second. The event flight was the last flight of the recording, and its duration was approximately 20 minutes.

2.1.1 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=+).

3.0 Time Correlation

Correlation of the FDR and QAR data from SRN to the event local time, PST, was established by using the recorded coordinated universal time (UTC) Hours, UTC Minutes, and UTC Seconds and then applying an additional 8 hours offset to change UTC to PST.

In addition to the event flight, two previous flights were also reviewed as part of this investigation:²

- Alaska Airlines Flight 1284 from Seattle, Washington, to San Francisco, California, on January 3, 2024.
- Alaska Airlines Flight 356 from San Francisco, California, to Boston, Massachusetts, on January 4, 2024.

Table 1 lists the conversions for the FDR and QAR from SRN to PST.

Table 1. FDR and QAR time correlation for accident and previous flights.

Flight Number	Departure	Arrival	Date	FDR Offset (seconds)	QAR Offset (seconds)
1284	Seattle, Washington	San Francisco, California	January 3, 2024	PST = SRN -95870	PST = SRN + 34862
356	San Francisco, California	Boston, Massachusetts	January 4, 2024	PST = SRN - 131756	PST = SRN - 156
1282 ³	Portland, Oregon	Portland, Oregon	January 5, 2024	PST = SRN -182676	PST = SRN - 51196

² Flights AS1284 and AS356 are reviewed due to the reported cabin pressure controller AUTO FAIL amber light being active.

³ Denotes the accident flight on January 5, 2024.

3.1 QAR Time Difference

The FDR and QAR both source from the Flight Data Acquisition Unit (FDAU) but use two different partitions. The QAR receives non-FDR data parameters from the optional aircraft condition monitoring partition, whereas the FDR sources from the mandatory partition. However, FDR parameters that are recorded to the QAR also source from the mandatory partition of the FDAU. This results in the QAR data being partially non-time-aligned, which means that some parameters have lost their original timestamp. For the parameters that have lost their original timestamp, the data are buffered and output in “clusters” of data, corresponding to common sample rates. Then, post-processing tools evenly distribute the data samples throughout each sample interval based on sample rate, without knowledge of when that event occurred on the airplane. For example, a parameter that is recorded at 4 samples per second will have the recorded data points evenly distributed at 0.00, 0.25, 0.50, and 0.75 seconds within a given second. As a result, there may be an error in time when comparing recorded data points to UTC and to other parameters. Thus, caution should be exercised when interpreting these data and comparing to the FDR. As a result of the time alignment difference between the QAR and FDR, the QAR will be referred as QAR Pacific Standard Time. QAR Pacific Standard Time has been time aligned to QAR UTC time parameters but does not accurately correlate to the FDR timing.

4.0 Verified and Provided FDR/QAR Parameters

Table 2 lists the FDR and QAR parameters verified and provided in this report. Additionally, table 3 describes the unit and discrete state abbreviations used in this report.

E. FIGURES AND TABULAR DATA

Figures 1 to 15 contain FDR and QAR data recorded during the event flight on January 5, 2024, previous flight AS1284 on January 3, 2024, and previous flight AS356 on January 4, 2024. All the parameters listed in table 2 are plotted except UTC Hours, UTC Minutes, UTC Seconds, Latitude, and Longitude.⁴

- Figures 1 to 5 present flight data from the accident flight, AS1282 on January 5, 2024.
- Figures 6 to 10 present flight data from previous flight, AS1284 on January 3, 2024.

⁴ Only FDR and QAR data from the accident flight (AS1282) are discussed in this report. Reference the System’s Group Chair’s Factual Report in the docket for more information on previous flights AS1284 and AS356.

- Figures 11 to 15 present flight data from previous flight, AS356 on January 4, 2024.
- Figures 1, 6, and 11 present FDR flight data plots for the entire flight for flights AS1282, AS1284, and AS356, respectively.
- Figures 2, 7, and 12 present FDR flight data plots with zoomed in time windows around master cautions for flights AS1282, AS1284, and AS356, respectively.
- Figures 3, 8, and 13 present FDR flight data plots for the entire flight presenting aircraft automation for flights AS1282, AS1284, and AS356, respectively.
- Figures 4, 9, and 14 present QAR flight data plots for the entire flight for flights AS1282, AS1284, and AS356, respectively.
- Figures 5, 10, and 15 present QAR flight data plots with zoomed in time windows around master cautions for flights AS1282, AS1284, and AS356, respectively.

The FDR data show the following:

- **17:06:47 PST:** The aircraft departed runway 28L at Portland International Airport (PDX).
- **17:12:33 PST:** The recorded cabin pressure dropped from 14.09 to 11.64 pounds per square inch (psi) when the aircraft was at 14,830 ft and 271 kts. The "Cabin Altitude Greater than (>) 10k ft Warning" activated.
- **17:12:34 PST:** The master caution activated. The cabin pressure continued decreasing and was 9.08 psi at 14,850 ft and 271 kts. The aircraft magnetic heading was 123 deg.
- **17:12:52 PST:** The master caution deactivated.
- **17:13:36 PST:** The cabin pressure was 7.89 psi and was at the lowest value recorded. The aircraft was at 16,293 ft and 278 kts.
- **17:13:41 PST:** The aircraft continued to climb and reached a maximum altitude of 16,320 ft and began to descend. The airspeed was 276 kts on a magnetic heading of 120 deg.
- **17:13:48 PST:** The cabin pressure began to increase from 7.89 psi to 7.91 psi. The aircraft was at 16,266 ft and was descending.
- **17:13:56 PST:** The selected altitude changed from 23,000 ft to 10,000 ft. The cabin pressure was 7.95 psi and continued to increase for the remainder of the flight.

- **17:14:35 PST:** The master caution activated for 3 seconds.
- **17:16:56 PST:** The aircraft began a left turn from 121 deg. The altitude was approximately 10,120 ft.
- **17:17:00 PST:** The aircraft descended below 10,000 ft.
- **17:18:05 PST:** The aircraft altitude was approximately 9,050 ft and the airspeed was 271 kts. The "Cabin Altitude Greater than (>) 10k ft Warning" deactivated. The cabin pressure was 10.48 psi.
- **17:26:46 PST:** The aircraft landed on runway 28L at PDX.

The QAR data show the following:

- **17:06:48 QAR PST:** The aircraft departed runway 28L at PDX. Cabin pressure controller (CPC) 1 was in automatic control.
- **17:12:33 QAR PST:** The cabin differential pressure dropped from 5.72 psi to 3.28 psi and 2.48 psi for CPC1 and CPC2, respectively.
- **17:12:34 QAR PST:** The recorded cabin pressure dropped from 14.09 to 10.67 psi for CPC1 when the aircraft was at 14,859 ft and 271 kts. CPC2 did not record a change in pressure.
- **17:12:35 QAR PST:** The "Cabin Altitude Greater than (>) 10k ft Warning" activated. The cabin pressure dropped to 9.43 psi and 10.67 psi for CPC1 and CPC2, respectively, at 14,883 ft and 271 kts. The aircraft magnetic heading was 122 deg. The differential pressure was 0.22 psi and 0.17 psi for CPC1 and CPC2, respectively.
- **17:12:40 QAR PST:** The outflow valve (OFV) switch was activated.
- **17:14:28 QAR PST:** The OFV switch was deactivated. The OFV position began to increase from 1.06 deg and -0.63 deg to 8.19 deg and 1.69 deg for CPC1 and CPC2, respectively.
- **17:14:37 QAR PST:** The OFV position reached a maximum 109.50 deg and 108.69 deg for CPC1 and CPC2, respectively.
- **17:15:05 QAR PST:** The OPMODE for CPC1 changed from auto to manual.
- **17:15:06 QAR PST:** The automatic CPC1 in control changed from operational to standby. The OPMODE for CPC2 changed from auto to manual.
- **17:17:00 QAR PST:** The aircraft descended below 10,000 ft. The "Cabin Altitude Greater than (>) 10k ft Warning" deactivated.
- **17:26:47 QAR PST:** The aircraft landed on runway 28L at PDX.

The corresponding FDR tabular data used to create figures 1 to 3 are provided in electronic comma-separated value (CSV) format as attachment 1 to this report. The corresponding QAR tabular data used to create figures 4 and 5 are provided in electronic CSV format as attachment 2 to this report.

The corresponding FDR tabular data used to create figures 6 to 8 are provided in electronic CSV format as attachment 3 to this report. The corresponding QAR tabular data used to create figures 9 and 10 are provided in electronic CSV format as attachment 4 to this report.

The corresponding FDR tabular data used to create figures 11 to 13 are provided in electronic CSV format as attachment 5 to this report. The corresponding QAR tabular data used to create figures 14 and 15 are provided in electronic CSV format as attachment 6 to this report.

Submitted by:

Steven Smith
Mechanical Engineer (Recorder Specialist)

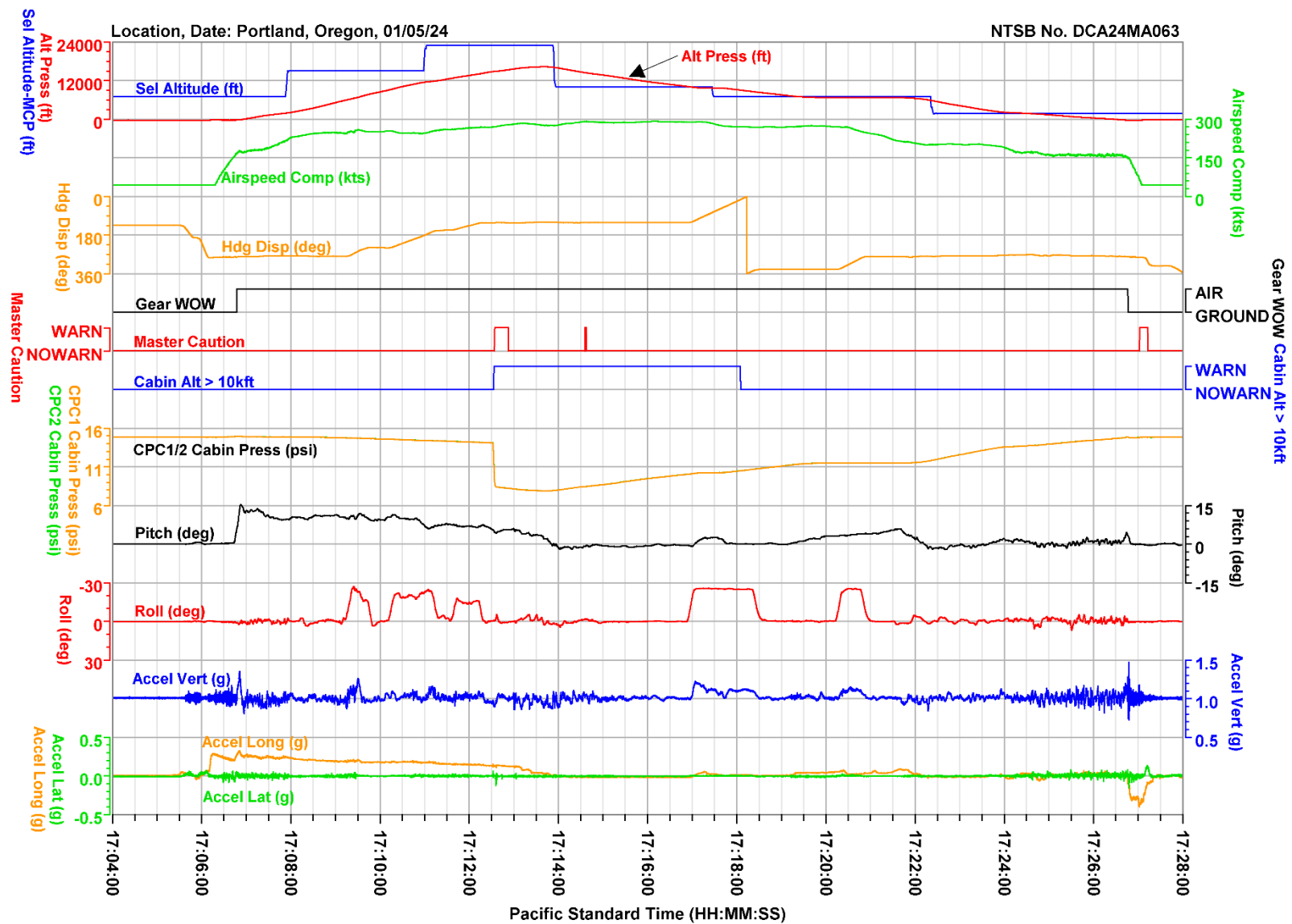


Figure 1. Time history plot of FDR data presenting the entire accident flight.

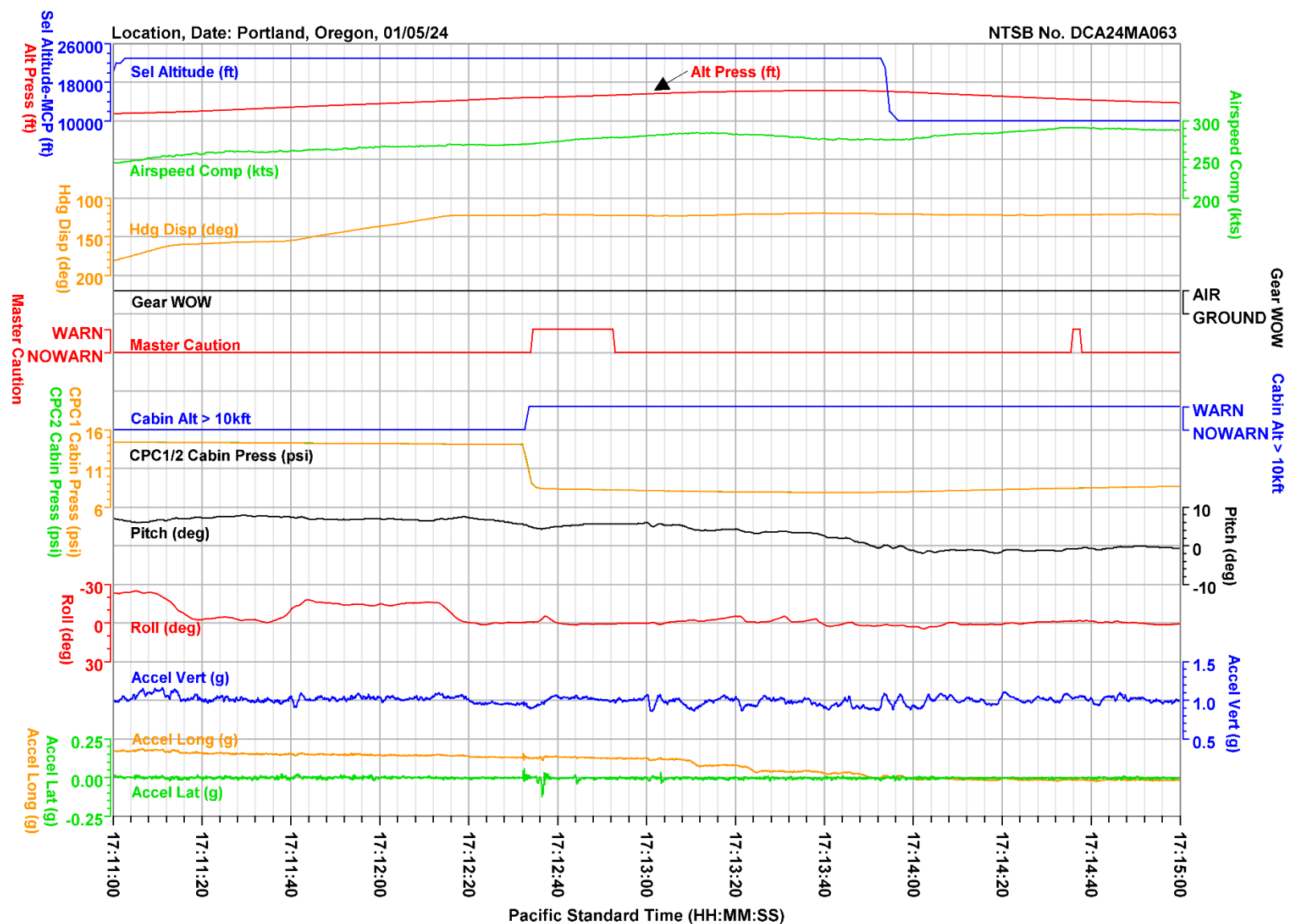


Figure 2. Time history plot of FDR data presenting the 4-minute window surrounding the accident.

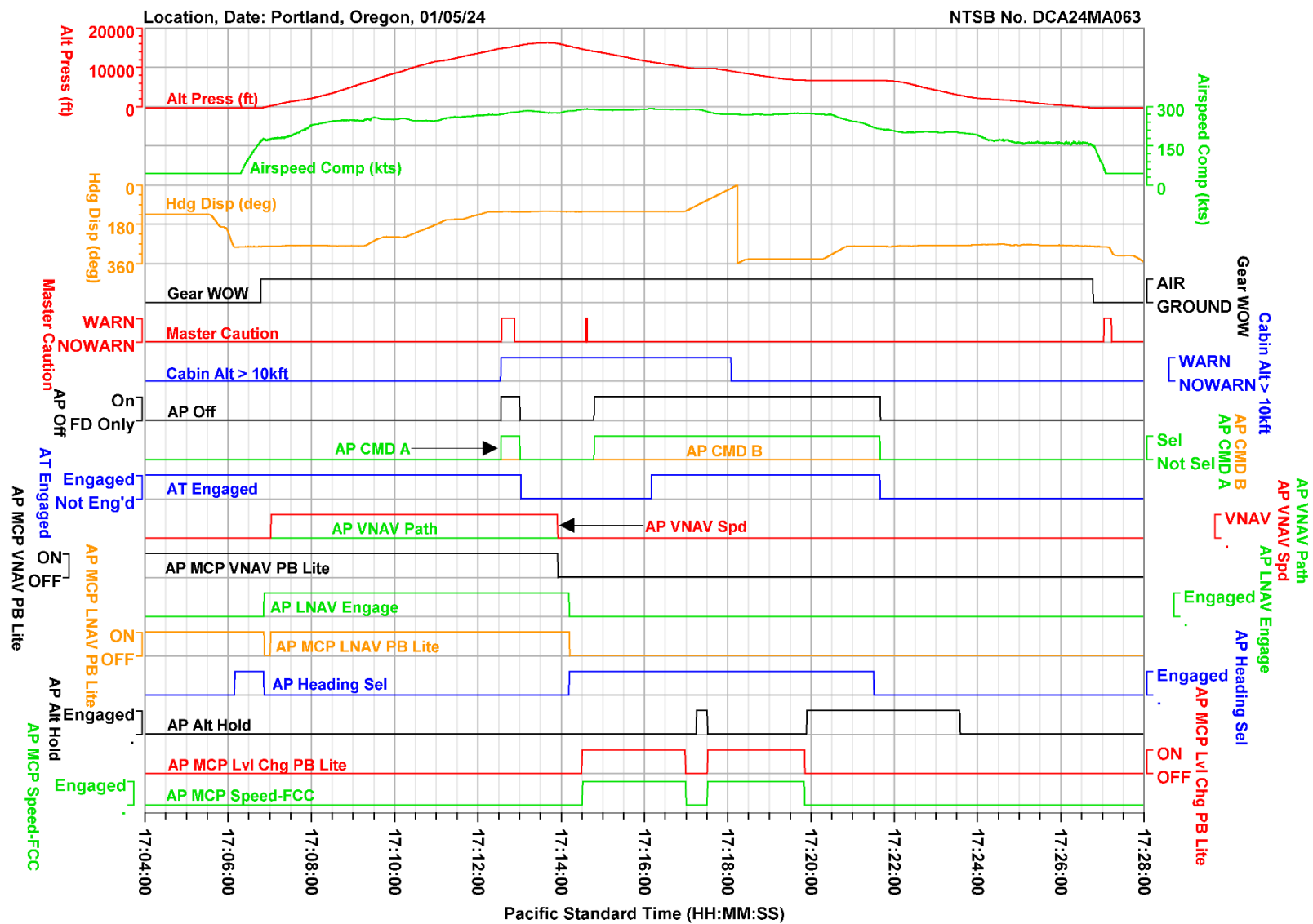


Figure 3. Time history plot of FDR data presenting aircraft automation for the entire flight.

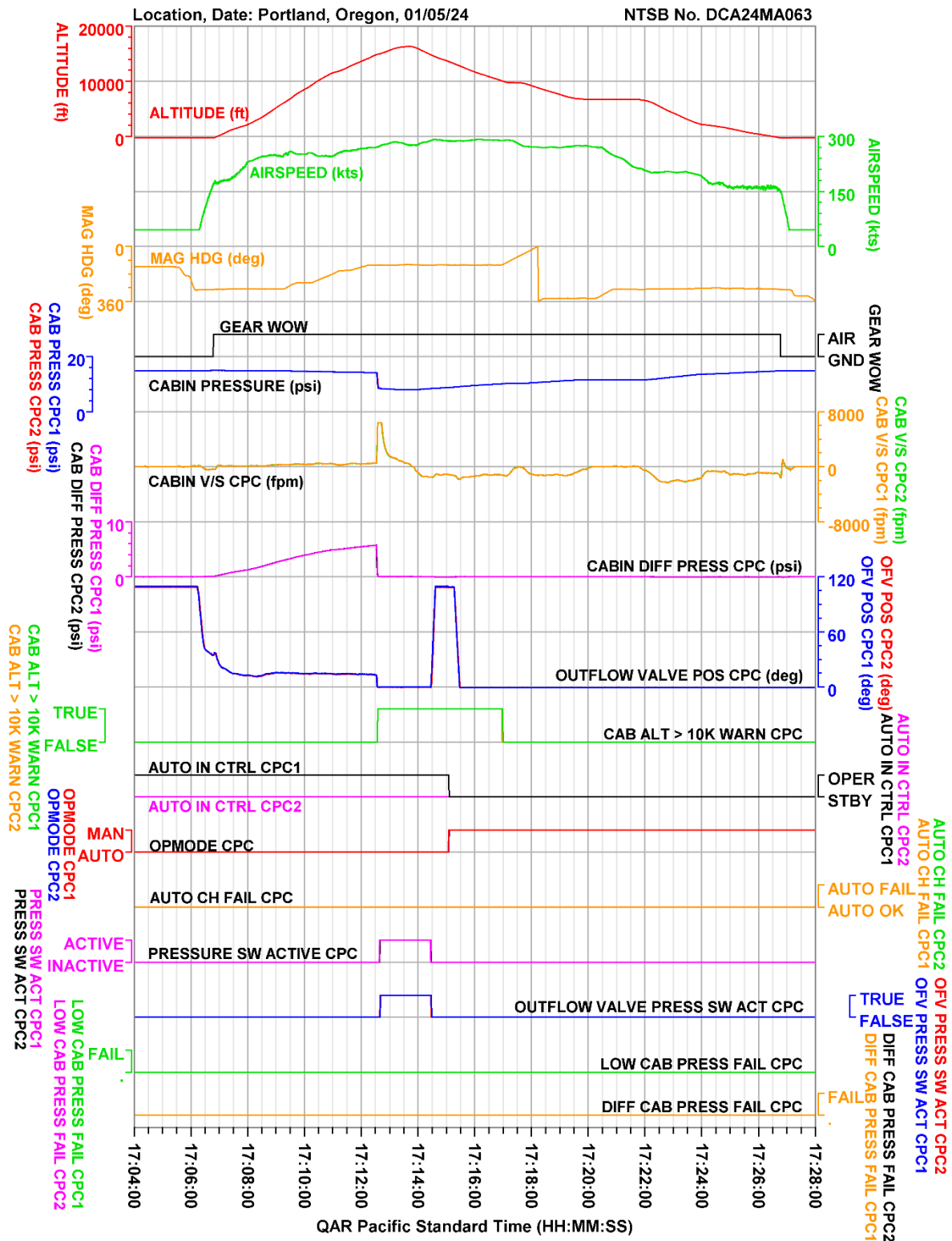


Figure 4. Time history plot of QAR data for the entire flight.

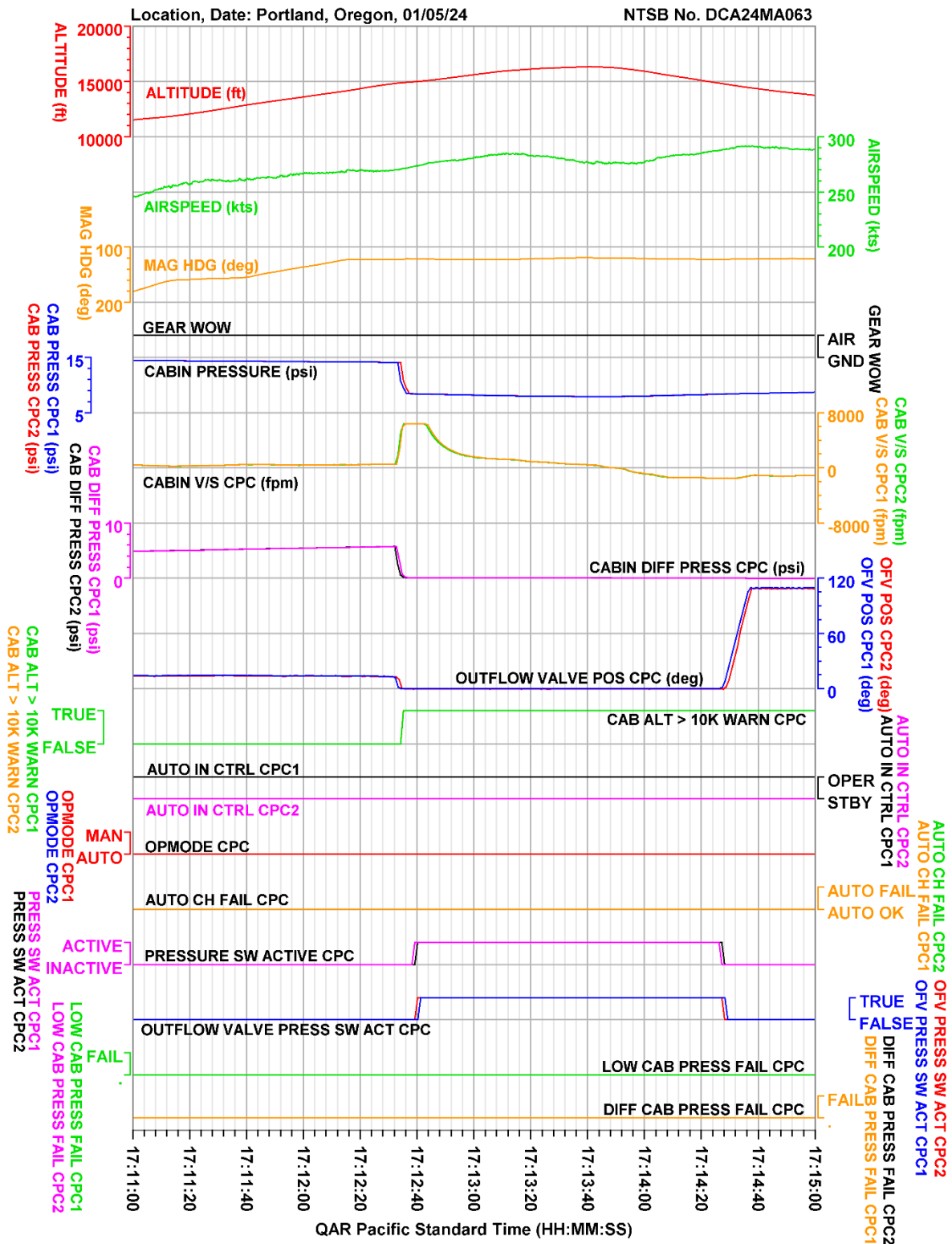


Figure 5. Time history plot of QAR data presenting the 4-minute window surrounding the accident.

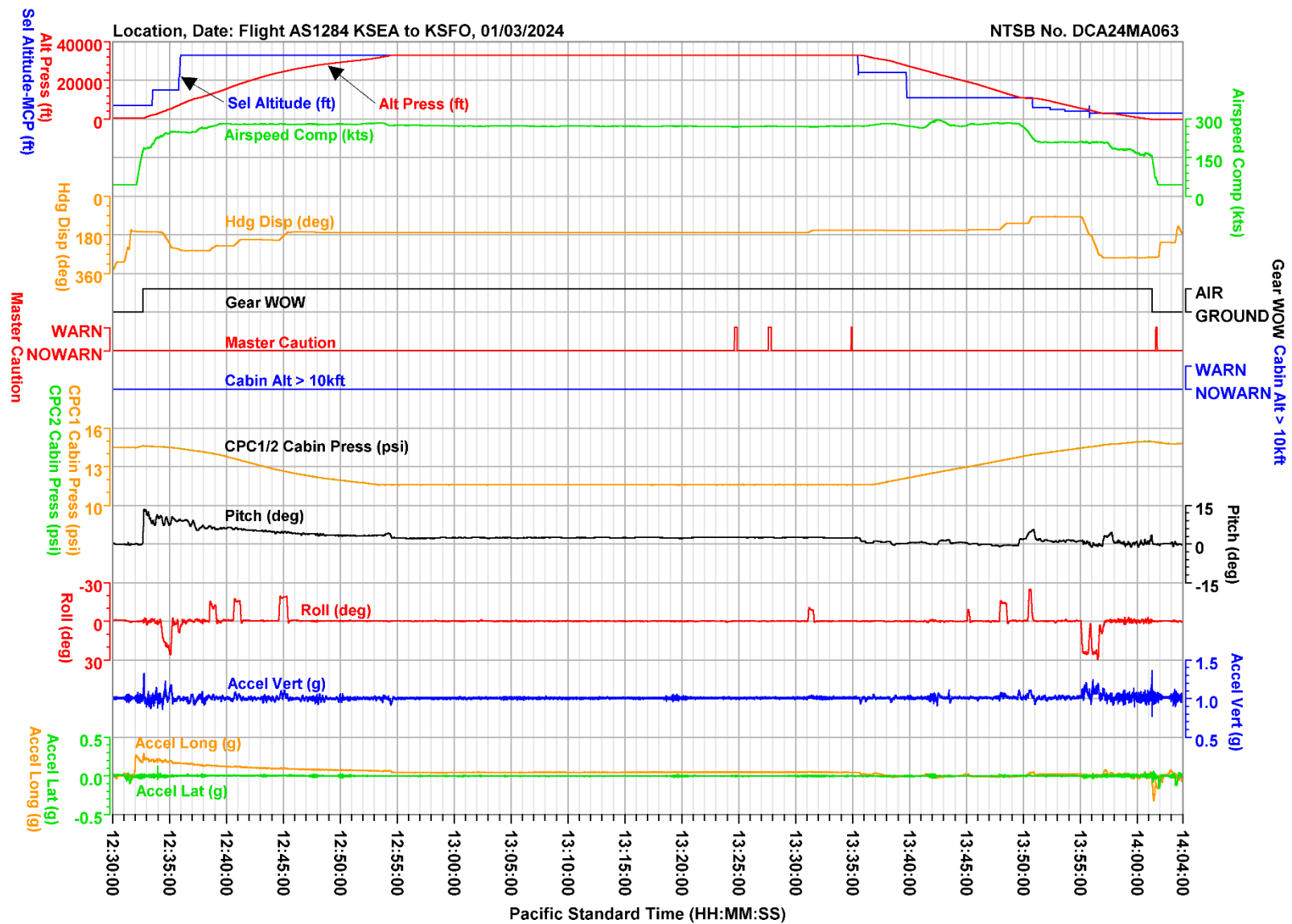


Figure 6. Time history plot of FDR data presenting the entire previous flight AS1284 on January 3, 2024.

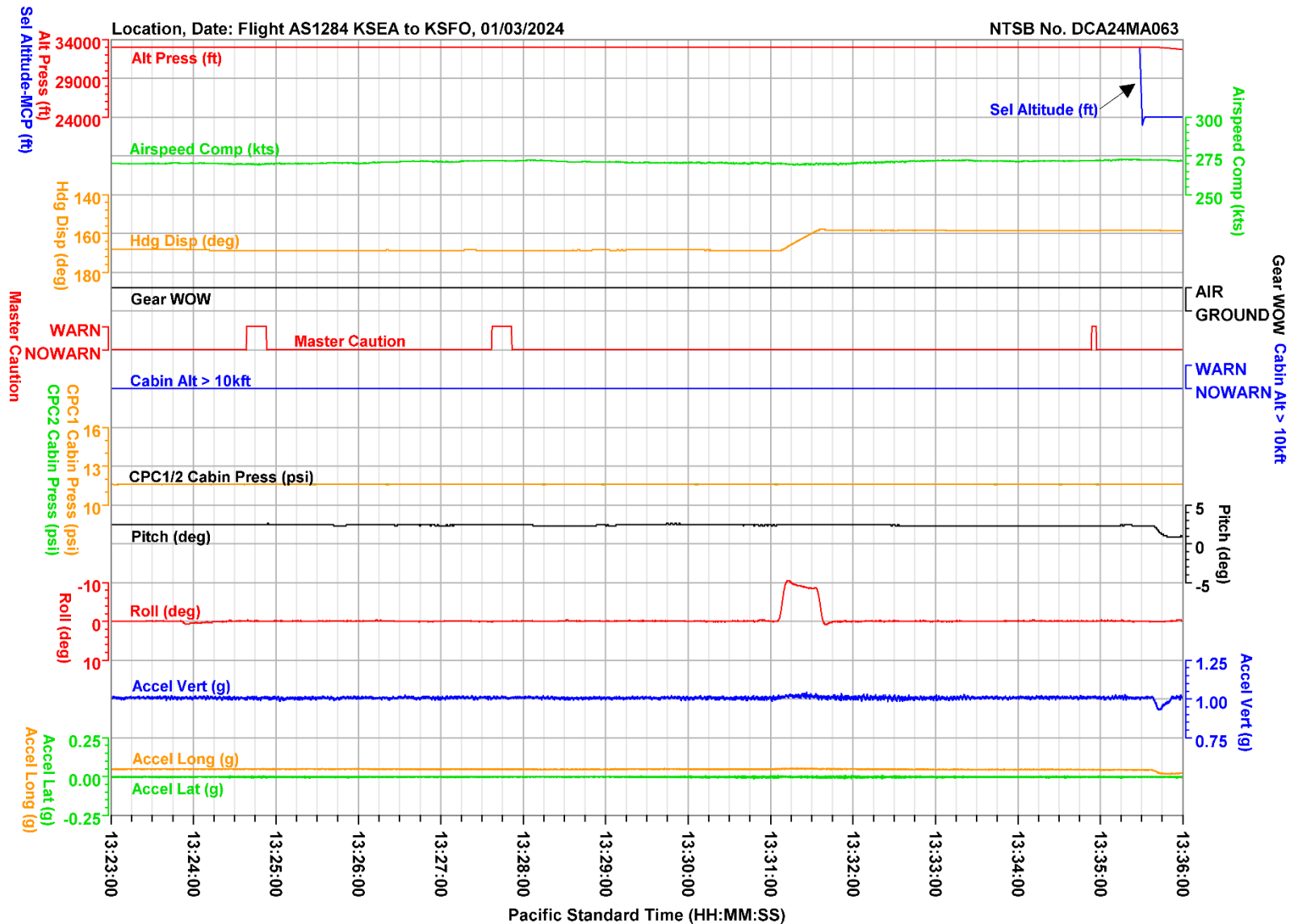


Figure 7. Time history plot of FDR data presenting the 13-minute window surrounding master cautions for previous flight AS1284 on January 3, 2024.

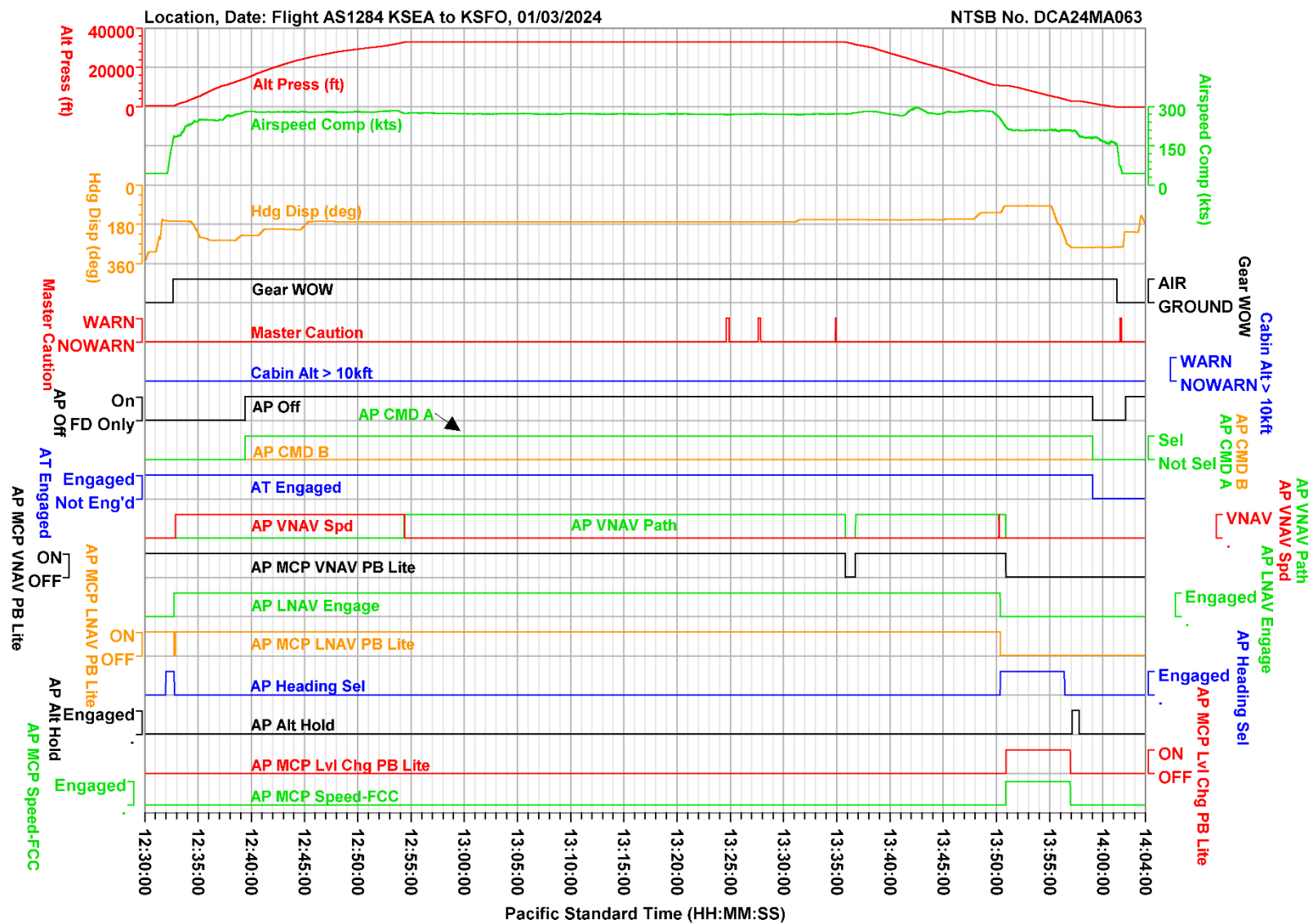


Figure 8. Time history plot of FDR data presenting aircraft automation for previous flight AS1284 on January 3, 2024.

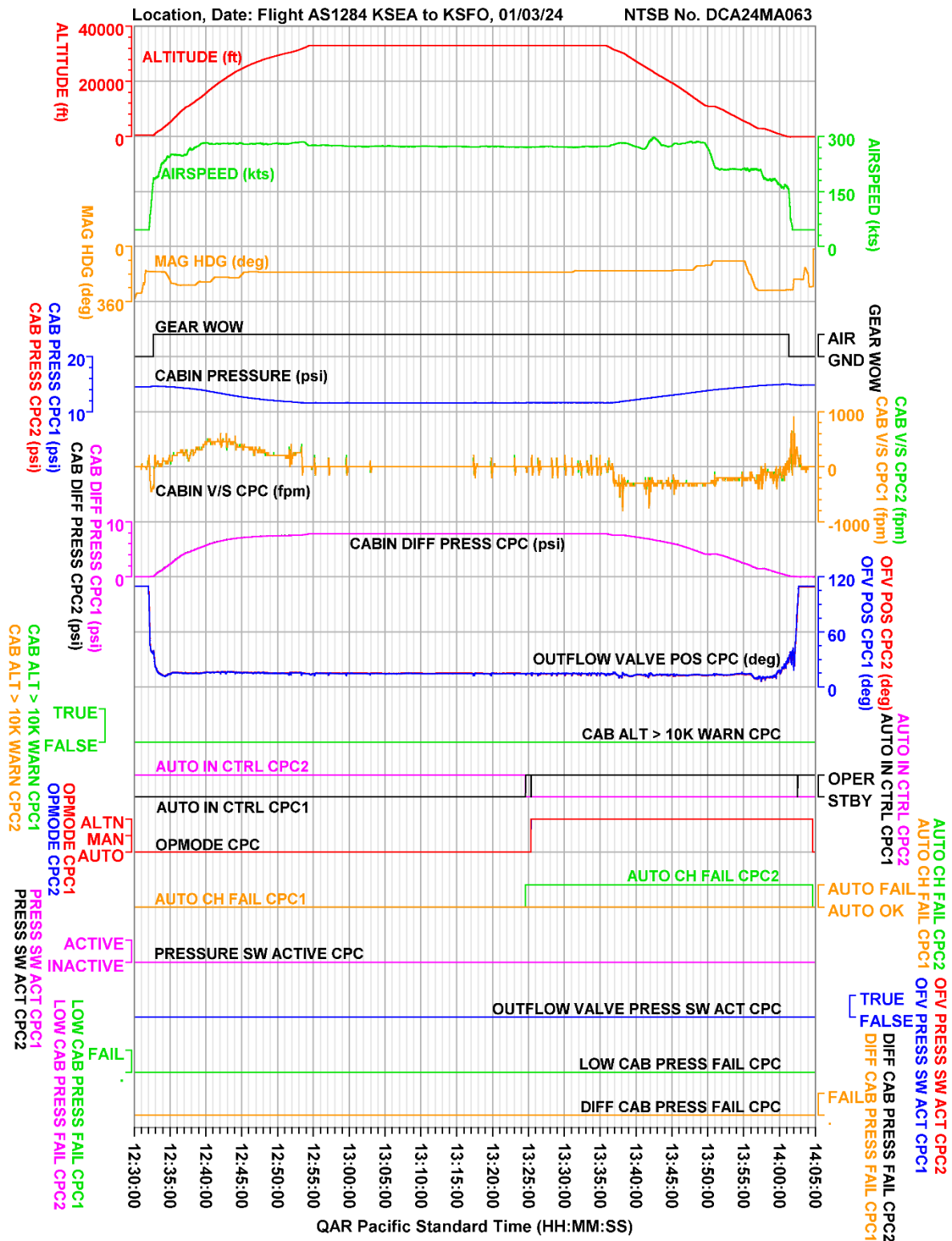


Figure 9. Time history plot of QAR data for the entire previous flight AS1284 on January 3, 2024.

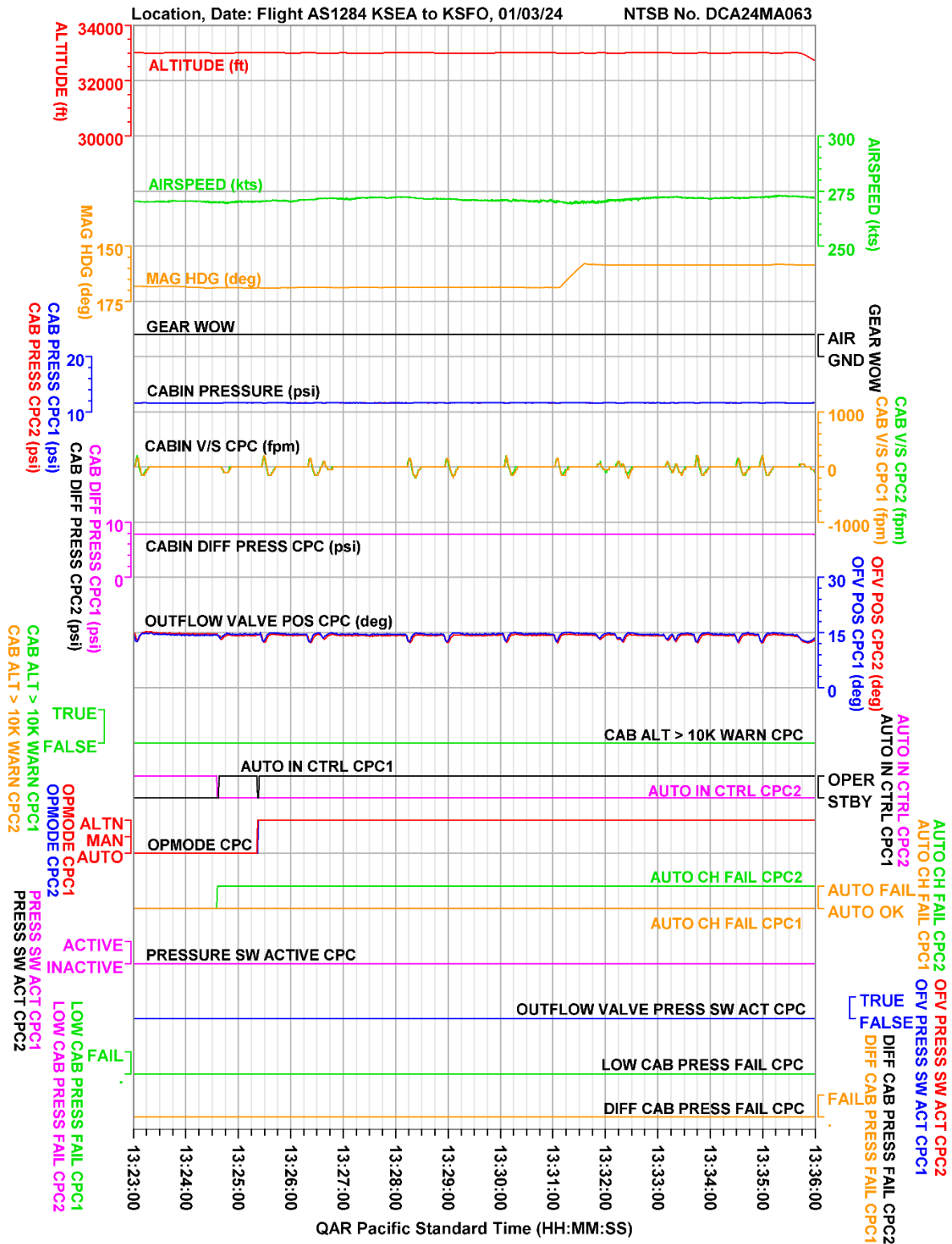


Figure 10. Time history plot of QAR data presenting the 13-minute window surrounding master cautions for previous flight AS1284 on January 3, 2024.

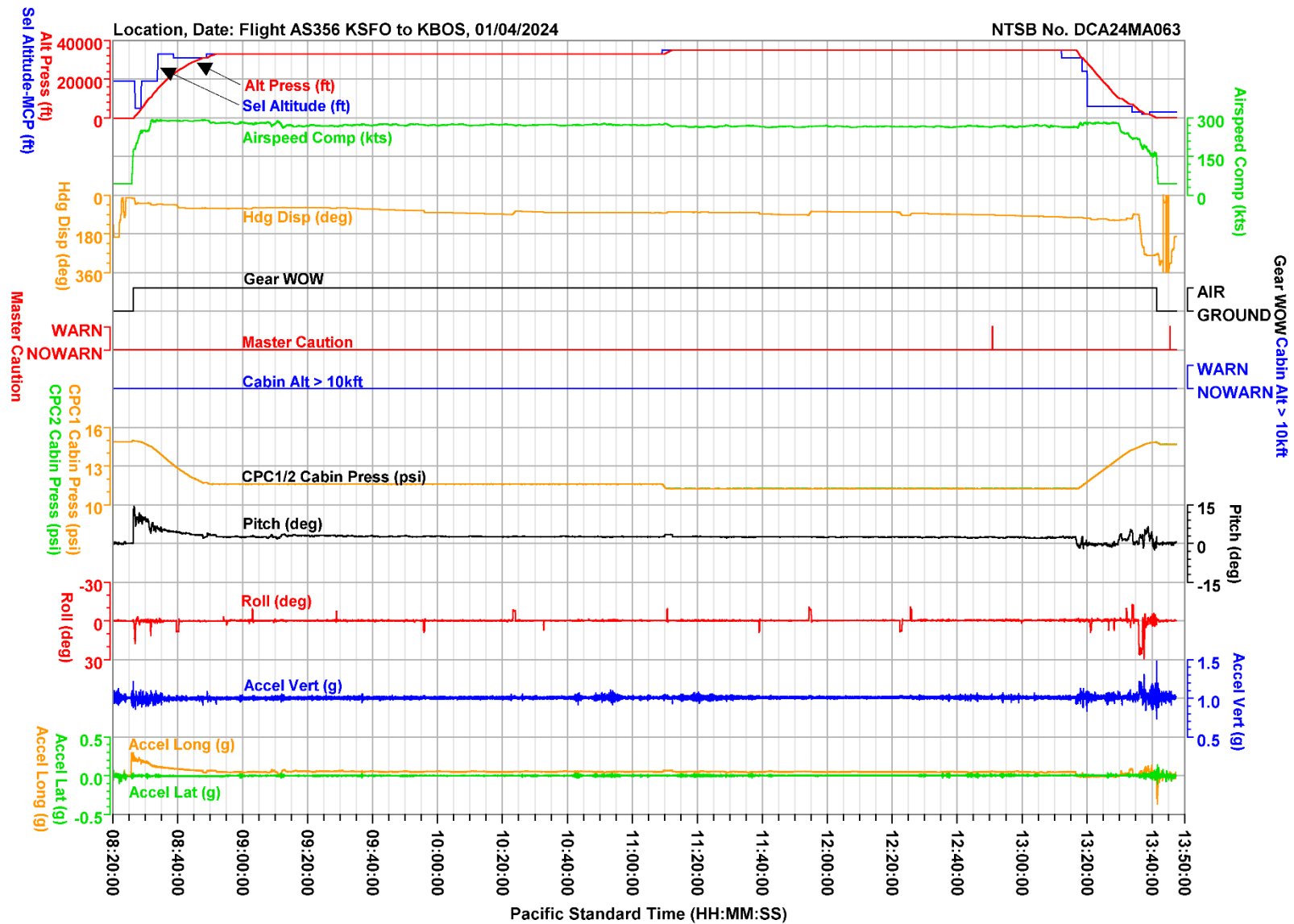


Figure 11. Time history plot of FDR data presenting the entire previous flight AS356 on January 4, 2024.

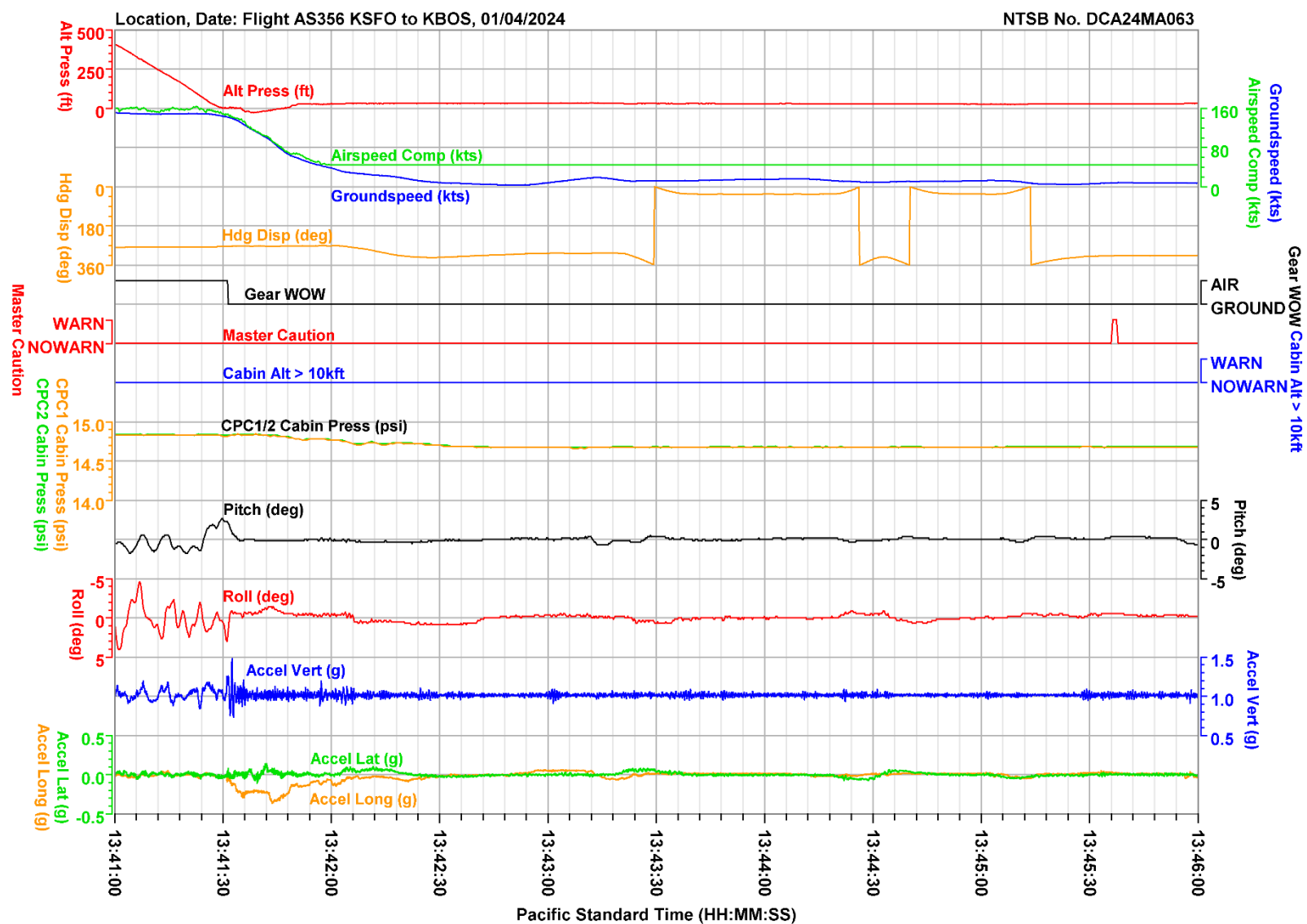


Figure 12. Time history plot of FDR data presenting the 5-minute window surrounding the master caution for previous flight AS356 on January 4, 2024.

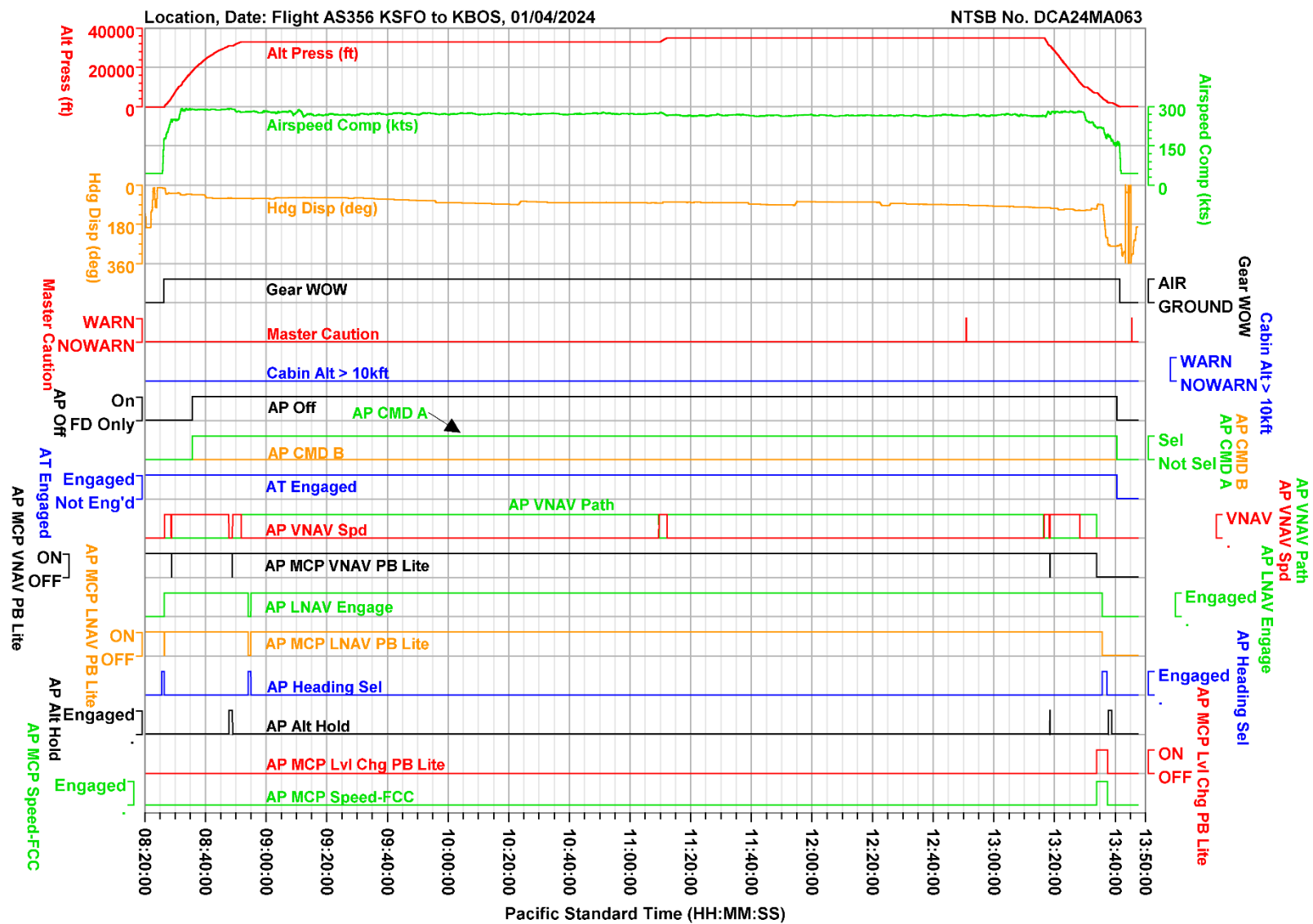


Figure 13. Time history plot of FDR data presenting aircraft automation for previous flight AS356 on January 4, 2024.

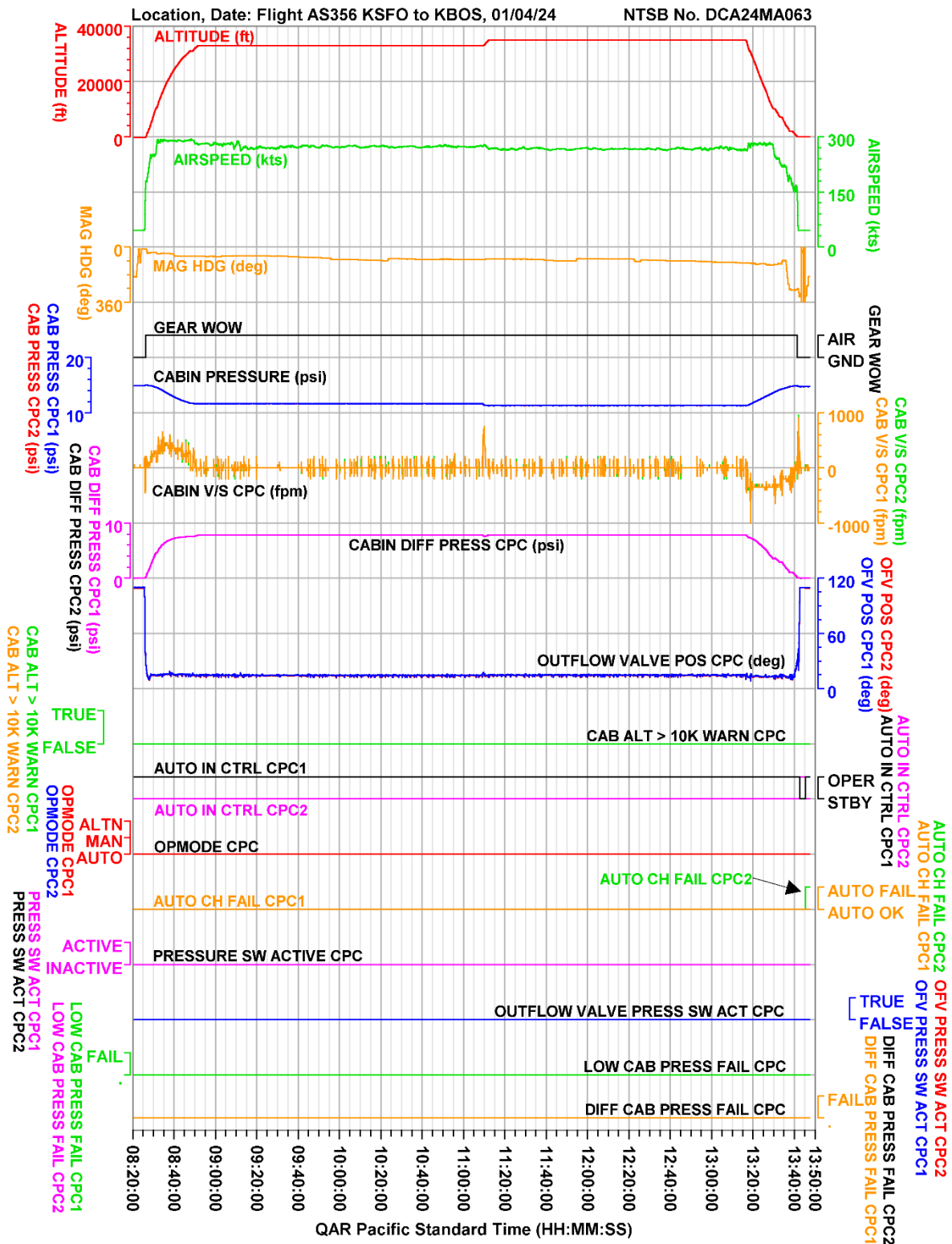


Figure 14. Time history plot of QAR data for the entire previous flight AS356 on January 4, 2024.

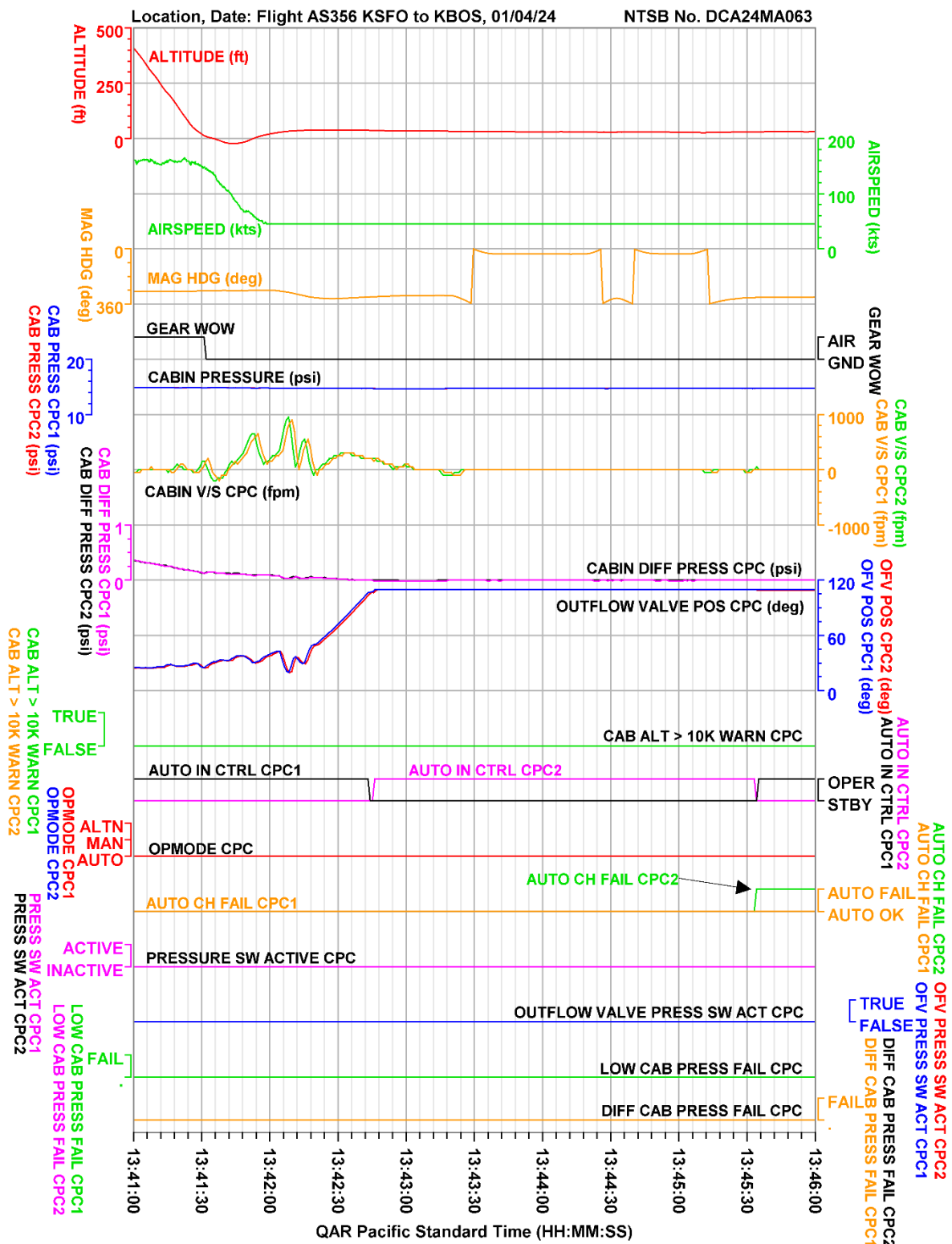


Figure 15. Time history plot of QAR data presenting the 5-minute window surrounding the master caution for previous flight AS356 on January 4, 2024.

APPENDIX A. VERIFIED AND PROVIDED PARAMETERS

This appendix describes the parameters provided and verified in this report. Table 2 lists the plot/table labels, parameter names, and units. Additionally, table 3 describes the unit and discrete state abbreviations used in this report.

Table 2. Verified and provided FDR/QAR parameters.

Plot/Table Labels	Parameter Names	Units	Source
Accel Lat	Lateral Load Factor	g	FDR
Accel Long	Longitudinal Load Factor	g	FDR
Accel Vert	Vertical Load Factor	g	FDR
Airspeed Comp	Computed Airspeed	kts	FDR
AIRSPEED	Computed Airspeed	kts	QAR
Alt Press	Pressure Altitude	ft	FDR
ALTITUDE	Pressure Altitude	ft	QAR
AP Alt Hold	Autopilot Altitude Hold		FDR
AP CMD A	Autopilot A Engaged Status		FDR
AP CMD B	Autopilot B Engaged Status		FDR
AP Heading Sel	Autopilot Heading Selected		FDR
AP LNAV Engage	Autopilot Lateral Navigation Engaged		FDR
AP MCP LNAV PB Lite	Autopilot Mode Control Panel Lateral Navigation Push Button Light		FDR
AP MCP Lvl Chg PB Lite	Autopilot Mode Control Panel Level Change Push Button Light		FDR
AP MCP Speed-FCC	Autopilot Mode Control Panel Speed - Flight Control Computer		FDR
AP MCP VNAV PB Lite	Autopilot Mode Control Panel Vertical Navigation Push Button Light		FDR
AP Off	Autopilot Engaged		FDR
AP VNAV Path	Autopilot Vertical Navigation Path		FDR
AP VNAV Spd	Autopilot Vertical Navigation Speed		FDR
AT Engaged	Autothrottle Engaged		FDR
AUTO CH FAIL CPC1	Cabin Pressure Controller 1 has an AUTO FAIL (multiple different failures can result in an AUTO FAIL)		QAR
AUTO CH FAIL CPC2	Cabin Pressure Controller 2 has an AUTO FAIL (multiple different failures can result in an AUTO FAIL)		QAR
AUTO IN CTRL CPC1	Cabin Pressure Controller 1 in Control or in Backup/Standby		QAR
AUTO IN CTRL CPC2	Cabin Pressure Controller 2 in Control or in Backup/Standby		QAR
CAB ALT > 10K WARN CPC1	Cabin Altitude Warning Light Cabin Pressure Controller 1		QAR
CAB ALT > 10K WARN CPC2	Cabin Altitude Warning Light Cabin Pressure Controller 2		QAR
Cabin Alt > 10kft	Cabin Altitude Warning Light ⁵		FDR

⁵ Illuminates (red) when cabin altitude exceeds 10,000 feet and will extinguish when cabin altitude descends below 10,000 feet.

Plot/Table Labels	Parameter Names	Units	Source
CAB DIFF PRESS CPC1	Cabin Differential Pressure Cabin Pressure Controller 1	psi	QAR
CAB DIFF PRESS CPC2	Cabin Differential Pressure Cabin Pressure Controller 2	psi	QAR
CAB PRESS CPC1	Cabin Pressure Cabin Pressure Controller 1	psi	QAR
CAB PRESS CPC2	Cabin Pressure Cabin Pressure Controller 2	psi	QAR
CAB V/S CPC1	Cabin Rate Cabin Pressure Controller 1	fpm	QAR
CAB V/S CPC2	Cabin Rate Cabin Pressure Controller 2	fpm	QAR
CPC1 Cabin Press	Cabin Pressure Controller 1 Cabin Pressure	psi	FDR
CPC2 Cabin Press	Cabin Pressure Controller 2 Cabin Pressure	psi	FDR
DIFF CAB PRESS FAIL CPC1	Cabin Pressure Controller 1 Fault Message if Differential Pressure is greater than 8.75 psi and the Outflow Valve Position is less than 20 deg		QAR
DIFF CAB PRESS FAIL CPC2	Cabin Pressure Controller 2 Fault Message if Differential Pressure is greater than 8.75 psi and the Outflow Valve Position is less than 20 deg		QAR
Gear WOW	Main Landing Gear Weight on Wheels		FDR
GEAR WOW	Main Landing Gear Weight on Wheels		QAR
Groundspeed	Ground Speed	kts	FDR
Hdg Disp	Magnetic Heading	deg	FDR
Latitude	Latitude Coordinate	deg	FDR
LATITUDE	Latitude Coordinate	deg	QAR
Longitude	Longitude Coordinate	deg	FDR
LONGITUDE	Longitude Coordinate	deg	QAR
LOW CAB PRESS FAIL CPC1	Cabin Pressure Controller 1 Fault Message if Cabin Pressure is less than 8.0 psi and Outflow Valve Position is greater than 5 deg		QAR
LOW CAB PRESS FAIL CPC2	Cabin Pressure Controller 2 Fault Message if Cabin Pressure is less than 8.0 psi and Outflow Valve Position is greater than 5 deg		QAR
MAG HDG	Magnetic Heading	deg	QAR
Master Caution	Master Caution		FDR
OFV POS CPC1	Outflow Valve Position Cabin Pressure Controller 1	deg	QAR
OFV POS CPC2	Outflow Valve Position Cabin Pressure Controller 2	deg	QAR
OFV PRESS SW ACT CPC1	Cabin Pressure Controller 1 Fault Message that indicates the Outflow Valve Pressure Switch has Activated		QAR
OFV PRESS SW ACT CPC2	Cabin Pressure Controller 2 Fault Message that indicates the Outflow Valve Pressure Switch has Activated		QAR

Plot/Table Labels	Parameter Names	Units	Source
OPMODE CPC1	Identifies which Mode Cabin Pressure Controller 1 is Operating in		QAR
OPMODE CPC2	Identifies which Mode Cabin Pressure Controller 2 is Operating in		QAR
Pitch	Pitch Angle	deg	FDR
PRESS SW ACT CPC1	Cabin Pressure Controller 1 Signal that the Outflow Valve Pressure Switch has Activated		QAR
PRESS SW ACT CPC2	Cabin Pressure Controller 2 Signal that the Outflow Valve Pressure Switch has Activated		QAR
Roll	Roll Angle	deg	FDR
Sel Altitude	Selected Altitude	ft	FDR
Time UTC-Hr	Coordinated Universal Time Hour	hrs	FDR
Time UTC-Min	Coordinated Universal Time Minutes	min	FDR
Time UTC-Sec	Coordinated Universal Time Seconds	sec	FDR
UTC TIME-Hours	Coordinated Universal Time Hour	hrs	QAR
UTC TIME-Minutes	Coordinated Universal Time Minutes	min	QAR
UTC TIME-Seconds	Coordinated Universal Time Seconds	sec	QAR

Note: This FDR/QAR 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/QAR 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 2 are discrete parameter, which 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 3. Unit and discrete state abbreviations

Unit and Discrete State Abbreviations	Descriptions
ALTN	alternative
AUTO	automatic
CPC	Cabin Pressure Controller
deg	degrees
Eng	Engaged
fpm	feet per minute
ft	feet
hrs	hours
in Hg	inches of Mercury
kts	knots
MAN	manual
min	minutes
OPER	operational
psi	pounds per square inch
sec	seconds
STBY	standby
WOW	Weight on Wheels