

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



ENG22FA009

FLIGHT DATA RECORDER

Specialist's Factual Report

September 26, 2022

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A. INCIDENT

Location: Las Vegas, Nevada
Date: February 4, 2022
Time: About 0119 Pacific standard time (PST)
Airplane: Boeing 737-800, Sun Country Airlines, N817SY

B. FLIGHT DATA RECORDER SPECIALIST

Specialist Kyle Garner
Aerospace Engineer – Recorder Specialist
National Transportation Safety Board (NTSB)

C. FEDERAL CARRIAGE REQUIREMENTS

The incident airplane, N817SY, was operating under the provisions of Title 14 *Code of Federal Regulations* (CFR) Part 121. The incident airplane was manufactured in 2001 and was operating such that it was required to be equipped with a flight data recorder (FDR) that recorded, at a minimum, 57 parameters, as cited in 14 CFR Part 121.344(e)

In addition, Boeing 737 model airplanes manufactured after August 18, 2000, are required to record additional parameters listed in 14 CFR 121.344(n).

D. DETAILS OF THE INVESTIGATION

An FDR group was not convened. The National Transportation Safety Board (NTSB) Vehicle Recorder Division received an electronic file containing the FDR data downloaded by the operator.

1.1 Recording Description

The FDR recording contained approximately 48 hours of data. Timing of the FDR data is measured in subframe reference number (SRN), where each SRN equals one elapsed second. The incident flight was the last flight of the recording, and its duration was approximately 40 minutes. The parameters evaluated for this report appeared to be in accordance with federal FDR carriage requirements.

1.1.1 Engineering Unit Conversions

The engineering unit conversions used for the data contained in this report are based on documentation from the airplane 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 1 lists the FDR parameters verified and provided in this report. Additionally, table 2 describes the unit abbreviations used in this report.

1.2 Time Correlation

Correlation of the FDR data from SRN to the incident local time, PST, was established by using the recorded Greenwich Mean Time (GMT) Hours, GMT Minutes, and GMT Seconds and then applying an additional 8 hours offset to change GMT to PST.

Accordingly, the time offset for the incident flight data from SRN to PST is the following: FDR PST = SRN - 168971.

Therefore, for the rest of this report, all times are referenced as PST unless otherwise noted.

E. FIGURES AND TABULAR DATA

Figures 1 to 3 contain data from the full incident flight, 00:40:00 to 01:20:00 PST. Figures 4 and 5 contain data from the incident flight landing, 01:17:55 to 01:19:55 PST.

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 the following (all time is in PST):

- **00:40:28** - The airplane departed Harry Reid International Airport (KLAS), Las Vegas, Nevada.
- **00:40:31** - Nose and main landing gear warning parameters indicated "Warn", consistent with the crew moving the landing gear lever to the 'Up' position².
- **00:40:32** - The nose and left main 'Gear Down' parameters simultaneously indicated 'Up'. The right main 'Gear Down' parameter remained in 'Down' status.
- **00:40:38** - The right main 'Gear Down' parameter indicated 'Up'.

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 The position of the landing gear lever was not recorded in this dataframe.

- **00:40:39** - The nose and left main 'Gear Warn' parameters transitioned from 'Warn' to 'No Warn'. The right 'Gear Warn' parameter remained in 'Warn' status. The airplane continued to climb.
- **About 00:43:30** - The airplane leveled off at about 9,500 feet MSL.
- **About 00:53:00** - The airplane descended and leveled off at 7,500 feet MSL.
- **About 01:10:40** - The airplane started to descend and maneuver back for an approach at KLAS.
- **01:14:37** - The airplane was on approach for KLAS at an altitude of about 5,300 feet MSL. The right main 'Gear Warn' parameter continued to indicate 'Warn'. The nose and left main 'Gear Warn' parameters transitioned to 'Warn', consistent with the crew moving the landing gear lever to the 'Down' position. The airplane continued to descend.
- **01:14:44** - The nose 'Gear Down' parameter transitioned from 'Up' to 'Down'. Simultaneously, the 'Gear Warn-N' parameter transitioned to 'No Warn'.
- **01:14:47** - The left main 'Gear Down' parameter transitioned to 'Down' and simultaneously, the 'Gear Warn-L' parameter transitioned to 'No Warn'.
- **01:14:48** - The right main 'Gear Down' parameter transitioned to 'Down' and simultaneously, the 'Gear Warn-R' parameter transitioned to 'No Warn'. The airplane continued to descend.
- **01:18:59** - The nose, left main, and right main landing gear WOW all indicated 'Grnd (Ground)'.
- **01:19:00** - The right main 'Gear Down' and right main 'Gear Warn' parameters transitioned to 'Up' and 'Warn', respectively. The recorded roll angle began to increase (right wing down).
- **01:19:04** - Both engine's thrust reversers indicated full deployment. Air and ground speed continued to decrease.
- **01:19:19** - The 'Eng2 Fire' parameter briefly indicated 'Fire'. One second later, the parameter transitioned back to 'No Fire' for about 26 seconds.
- **01:19:22** - Both engine thrust reversers indicated they were no longer deployed. The recorded groundspeed was about 17 knots.
- **01:19:27** - The recorded groundspeed was 0 knots.
- **01:19:47** - The 'Eng2 Fire' parameter indicated 'Fire'. This indication persisted for the duration of the recording.

The corresponding tabular data used to create figures 1 to 5 are provided in electronic comma-separated value (.CSV) format as compressed (.ZIP) attachment 1 to this report.

Submitted by:
 Kyle Garner
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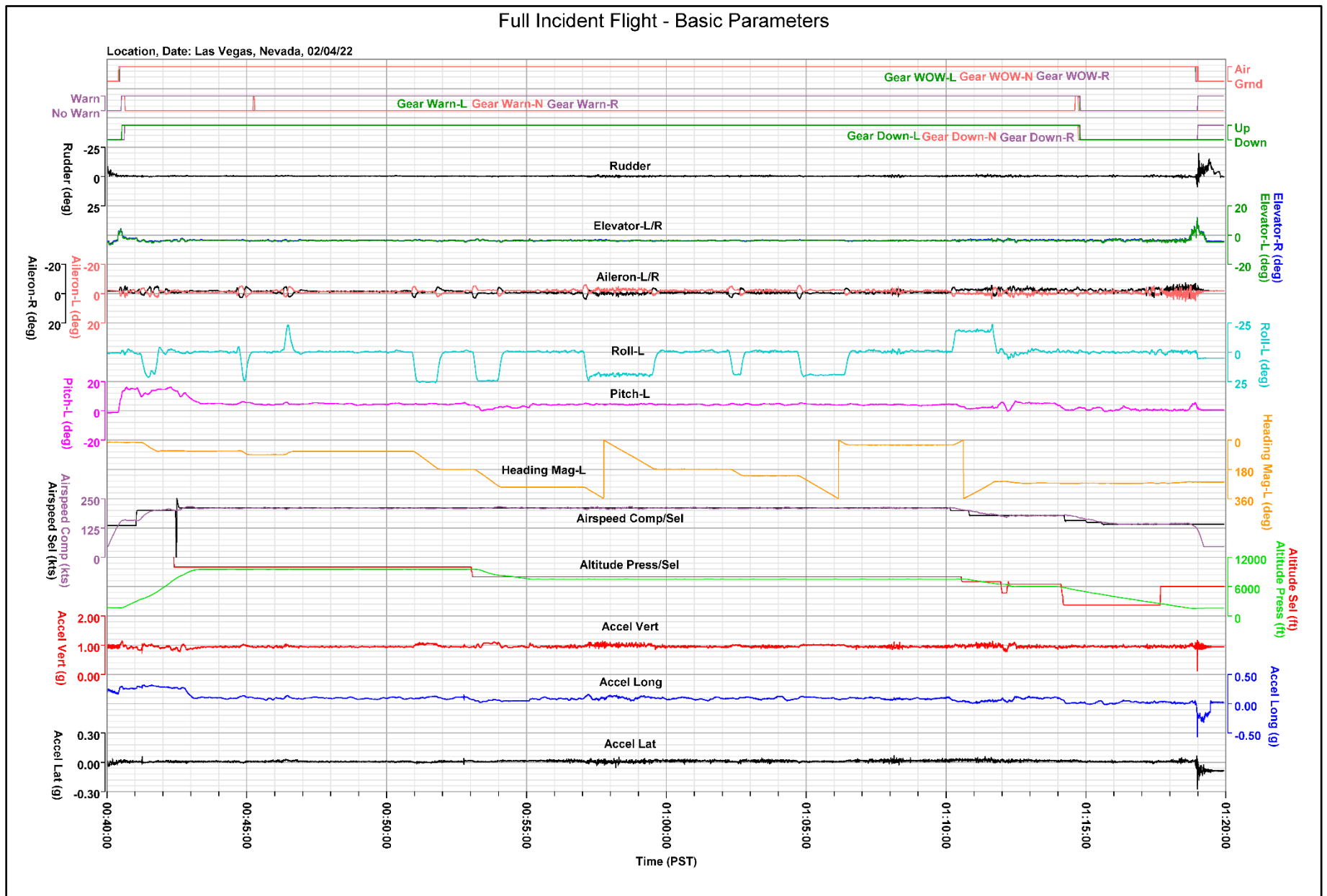


Figure 1. Plot of basic parameters - full incident flight.

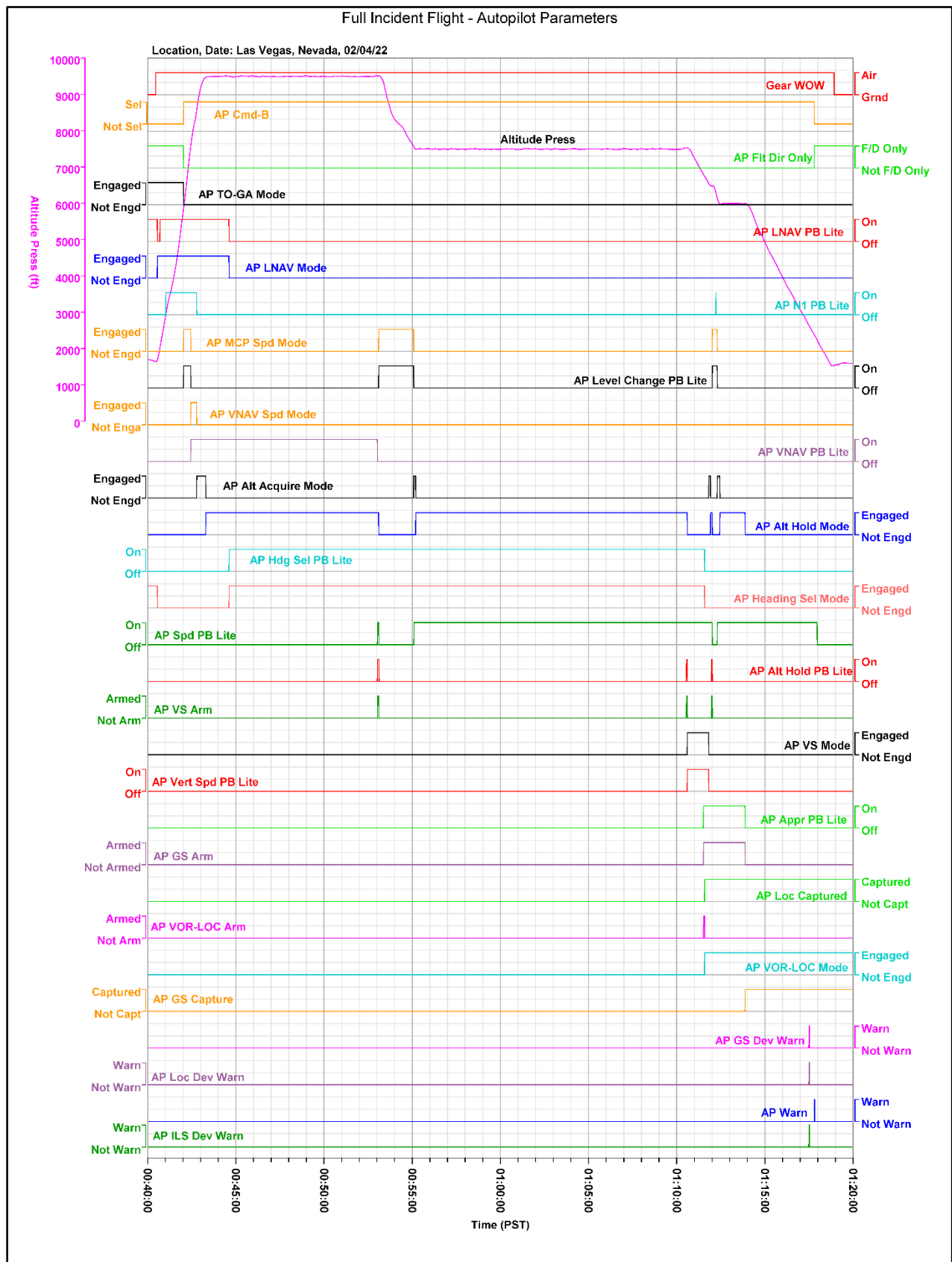


Figure 2. Plot of autopilot parameters - full incident flight.

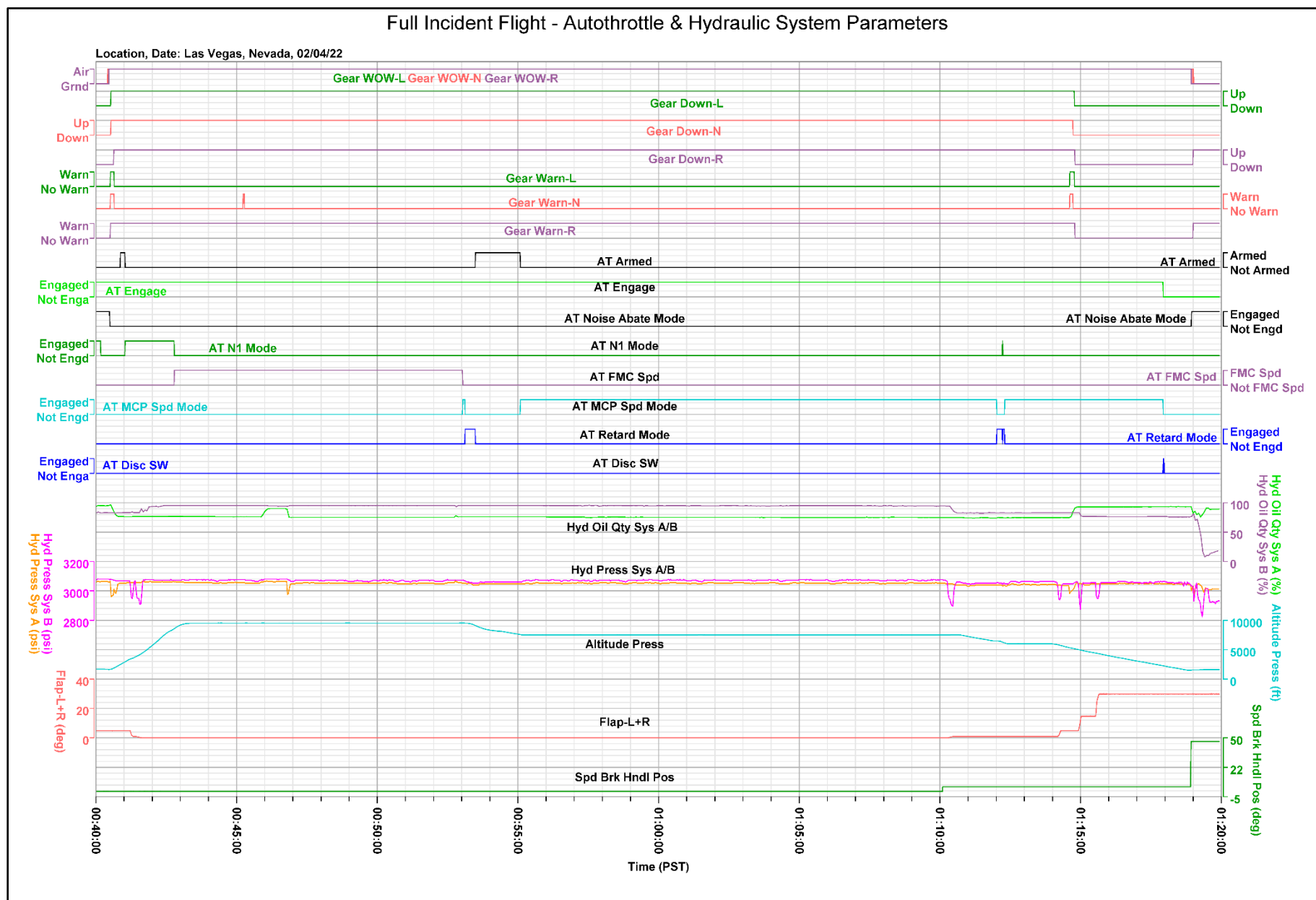


Figure 3. Plot of autothrottle and hydraulic system parameters – full incident flight.

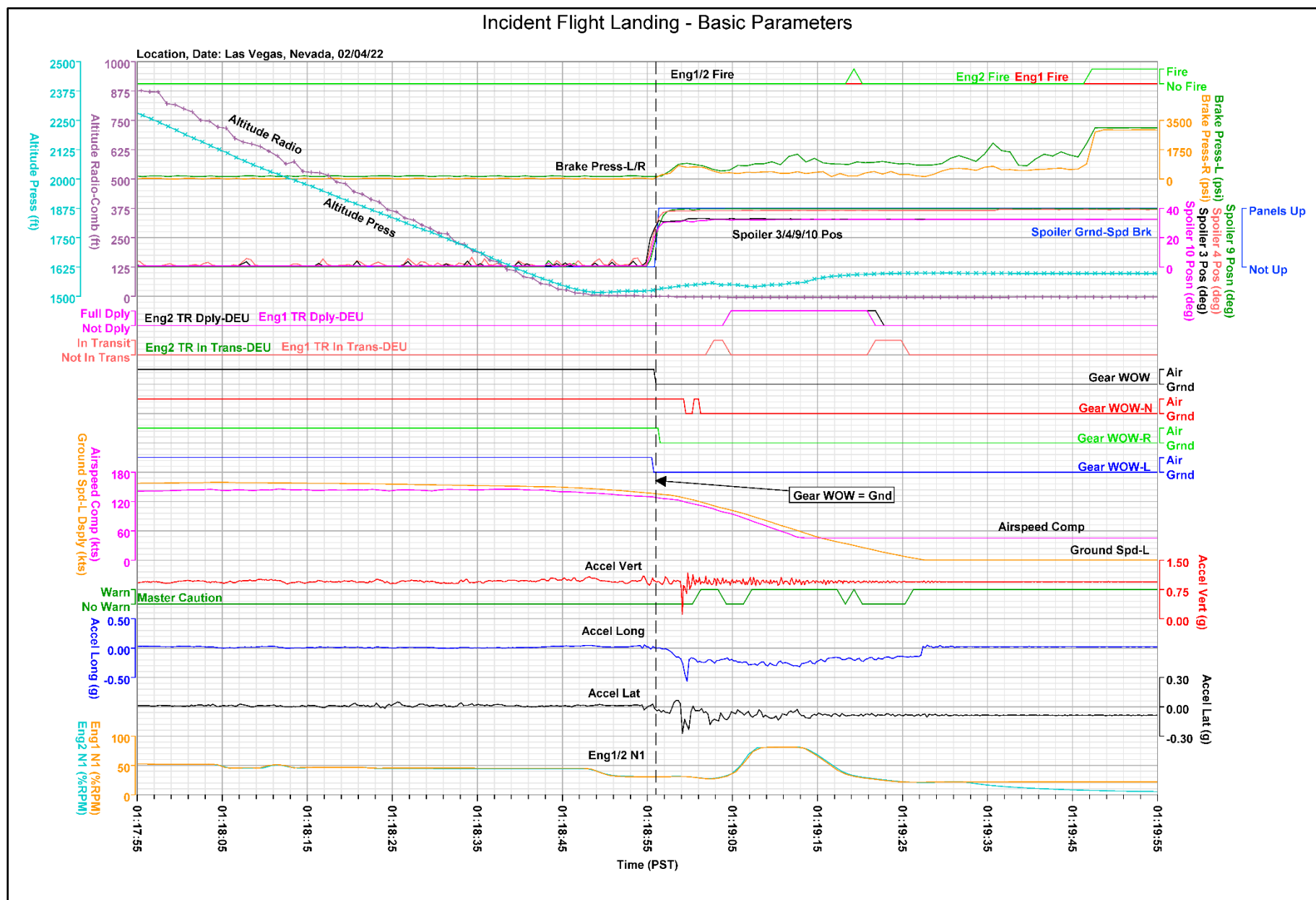


Figure 4. Plot of basic parameters - incident flight landing.

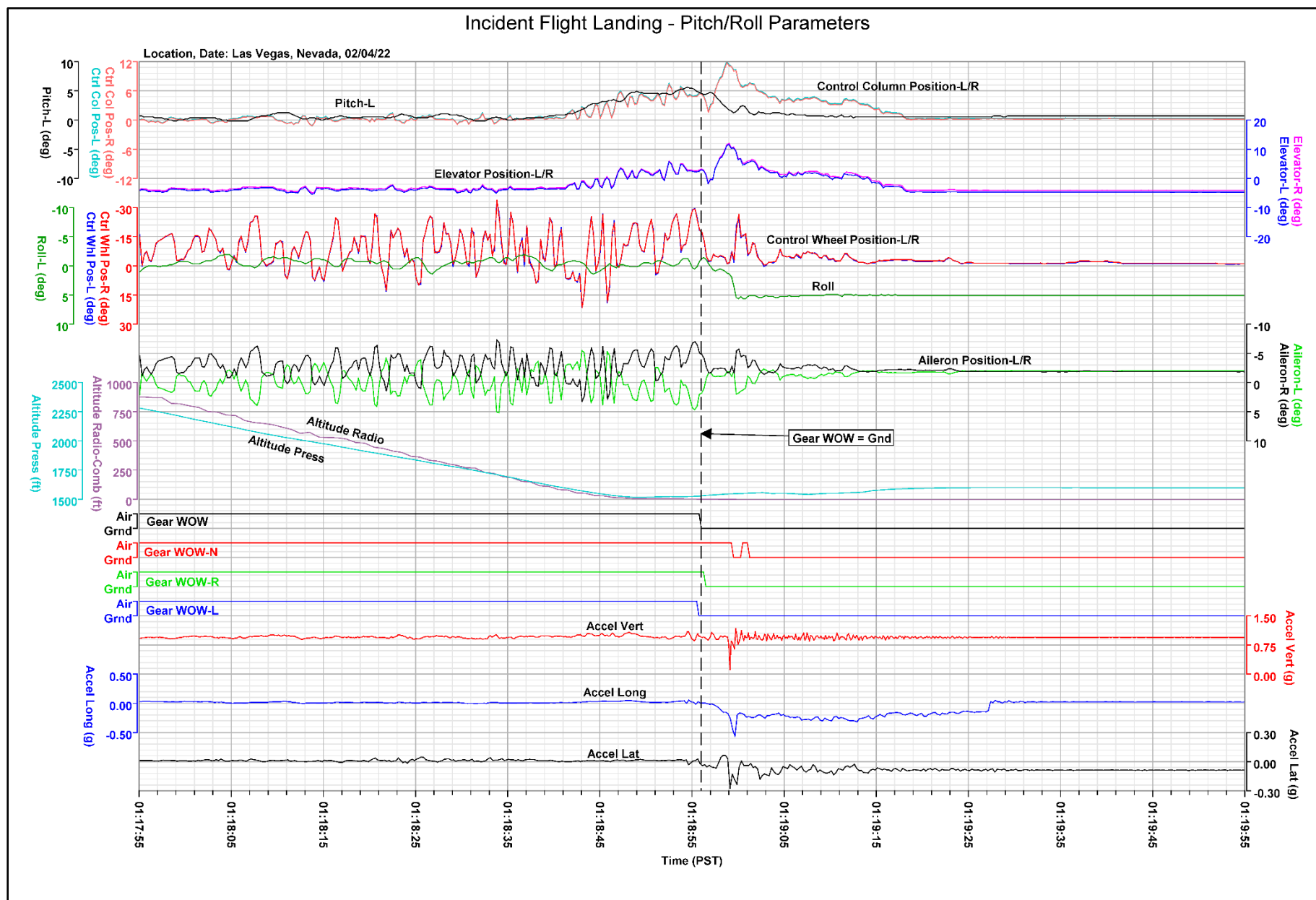


Figure 5. Plot of pitch/roll-related parameters - incident flight landing.

APPENDIX A. VERIFIED AND PROVIDED PARAMETERS

This appendix describes the parameters provided and verified in this report. Table 1³ lists the plot/table labels, parameter names, and units. Additionally, table 2 describes the unit and discrete abbreviations used in this report.

Table 1. Verified and provided FDR parameters.

Plot/Table Labels	Parameter Names	Units
Accel Lat	Lateral Load Factor	g
Accel Long	Longitudinal Load Factor	g
Accel Vert	Vertical Load Factor	g
Aileron-L	Left Aileron Position	deg
Aileron-R	Right Aileron Position	deg
Airspeed Comp	Computed Airspeed	kts
Airspeed Sel	Selected Airspeed	kts
Altitude Press	Pressure Altitude	ft
Altitude Radio-Comb	Radio Altitude	ft
Altitude Sel	Selected Altitude	ft
AP Alt Acquire Mode	AP Altitude Acquire Mode Engaged	
AP Alt Hold Mode	AP Altitude Hold Mode Engaged	
AP Alt Hold PB Lite	AP Altitude Hold PB Lite	
AP Appr PB Lite	AP Approach PB Lite	
AP Cmd-A*	AP Cmd Selected-A	
AP Cmd-B	AP Cmd Selected-B	
AP Flt Dir Only	AP Flight Director Only	
AP GS Arm	AP Glideslope Mode Armed	
AP GS Capture	AP Glideslope Captured	
AP GS Dev Warn	AP Glideslope Deviation Warning	
AP Hdg Sel PB Lite	AP Heading Select PB Lite	
AP Heading Sel Mode	AP Heading Select Mode Engaged	
AP ILS Dev Warn	AP ILS Deviation Warning	
AP Level Change PB Lite	AP Level Change PB Lite	
AP LNAV Mode	AP Lateral Navigation Mode Engaged	
AP LNAV PB Lite	AP Lateral Navigation PB Lite	
AP Loc Captured	AP Localizer Captured	
AP Loc Dev Warn	AP Loc (LOC) Deviation Warning	
AP MCP Spd Mode	AP MCP Speed Mode Engaged	
AP N1 PB Lite	AP N1 PB Lite	
AP Spd PB Lite	AP Speed PB Lite	
AP TO-GA Mode	AP Takeoff-Go Around Mode Engaged	
AP Vert Spd PB Lite	AP Vertical Speed PB Lite	
AP VNAV PB Lite	AP Vertical Navigation PB Lite	
AP VNAV Spd Mode	AP Vertical Navigation Speed Mode Engaged	
AP VOR-LOC Arm	AP VOR-LOC Mode Armed	
AP VOR-LOC Mode	AP VOR-LOC Mode Engaged	
AP VS Arm	AP Vertical Speed Mode Armed	
AP VS Mode	AP Vertical Speed Mode Engaged	

³ Parameters with an * in the table were not plotted and are only provided in the tabular data.

Plot/Table Labels	Parameter Names	Units
AP Warn	AP Warning	
AT Armed	AT Armed	
AT Disc SW	AT Disconnect Switch	
AT Engage	AT Engaged	
AT FMC Spd	AT FMC Speed Mode Engaged	
AT MCP Spd Mode	AT MCP Speech Mode Engaged	
AT N1 Mode	AT N1 Mode Engaged	
AT Noise Abate Mode	AT Noise Abatement Mode Engaged	
AT Retard Mode	AT Retard Mode Engaged	
Brake Press-L	Brake Pressure-Left	psi
Brake Press-R	Brake Pressure-Right	psi
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
Drift Angle*	Drift Angle	deg
Elevator-L	Left Elevator Position	deg
Elevator-R	Right Elevator Position	deg
Eng1 Fire	Engine 1 Fire	
Eng1 N1	Engine 1 Fan Speed	%
Eng1 TR Dply-DEU	Engine 1 Thrust Reverser Deployed-DEU	
Eng1 TR In Trans-DEU	Engine 1 Thrust Reverser In Transit-DEU	
Eng2 Fire	Engine 2 Fire	
Eng2 N1	Engine 2 Fan Speed	%
Eng2 TR Dply-DEU	Engine 2 Thrust Reverser Deployed-DEU	
Eng2 TR In Trans-DEU	Engine 2 Thrust Reverser In Transit-DEU	
Flap-L+R	Flap Surface Position-Left+Right	deg
Flap Handle Pos*	Flap Handle Position	detent
Gear Down-L	Left Main Landing Gear Down	
Gear Down-N	Nose Landing Gear Down	
Gear Down-R	Right Main Landing Gear Down	
Gear Warn-L	Left Main Landing Gear Warning	
Gear Warn-N	Nose Landing Gear Warning	
Gear Warn-R	Right Main Landing Gear Warning	
Gear WOW	All Landing Gear Weight on Wheels	
Gear WOW-L	Left Main Landing Gear Weight on Wheels	
Gear WOW-N	Nose Landing Gear Weight on Wheels	
Gear WOW-R	Right Main Landing Gear Weight on Wheels	
Ground Spd-L Dsply	Ground Speed-L	kts
Heading Mag-L	Magnetic Heading-Left	deg
Hyd Oil Qty Sys A/B	Hydraulic Oil Quantity System A/B	%
Hyd Press Sys A/B	Hydraulic Pressure System A/B	%
Key VHF-1*	Microphone Keying-1	
Key VHF-2*	Microphone Keying-2	
Key VHF-3*	Microphone Keying-3	
Latitude FMC-IRU*	Latitude Coordinate-FMC/IRU	deg
Longitude FMC-IRU*	Longitude Coordinate-FMC/IRU	deg
Master Caution	Master Caution	
Pitch-L	Pitch Angle-Left	deg
Roll-L	Roll Angle-Left	deg

Plot/Table Labels	Parameter Names	Units
Rudder	Rudder Position	deg
Spd Brk Hndl Pos	Speed Brake Handle Position	deg
Spoiler 3/4/9/10 Pos	Spoiler 3/4/9/10 Surface Position	deg
Spoiler Grnd-Spd Brk	Spoiler Ground Speed Brake Panels Up	
Temp Static Air-FMC*	Static Air Temperature-FMC	degC
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
Temp Total Air*	Total Air Temperature	degC
Wind Direction True FMC-IRU*	Wind Direction True-FMC/IRU	deg
Wind Speed FMC-IRU*	Wind Speed-FMC/IRU	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 incident.

Note: Parameters with a blank unit description in table 1 are discrettes. 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 abbreviations.

Unit and Discrete Abbreviations	Description
AP	autopilot
AT	autothrottle
deg	degrees
degC	degrees Celsius
DEU	display electronics unit
FMC	flight management computer
ft	feet
g	unit of gravitation acceleration
hrs	hours
ILS	instrument landing system
IRU	inertial reference unit
kts	knots
LOC	localizer
MCP	mode control panel
min	minutes
PB	pushbutton
psi	pounds per square inch
sec	seconds
VOR	VHF Omni Range
WOW	Weight on Wheels