

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

October 28, 2019

Flight Data Recorder

Specialist's Factual Report **By Kyle Garner**

1. EVENT SUMMARY

Location: Newark, New Jersey
Date: June 15, 2019
Aircraft: Boeing 757-200
Registration: N26123
Operator: United Airlines
NTSB Number: DCA19CA167

On June 15, 2019, about 12:55 pm eastern daylight time (EDT), United Airlines flight 627, a Boeing 757-200, registration N26123, operating as a domestic passenger flight from Denver International Airport (DEN), Denver, Colorado, bounced and had a subsequent hard landing on runway 22L at Newark International Airport (EWR), Newark, New Jersey. The flight was operated under the provisions of 14 *Code of Federal Regulations (CFR)* Part 121 as a scheduled passenger flight with 166 passengers and 6 crewmembers onboard. There were no reported injuries to the passengers or crew, however, the airplane received substantial damage.

2. FLIGHT DATA RECORDER GROUP

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

3. FDR Carriage Requirements

The event aircraft, N26123, was manufactured on November 30, 1997 and was operating such that it was required to be equipped with an FDR that recorded, at a minimum, 34 parameters, as cited in Title 14 CFR Part 121.344.

4. DETAILS OF FDR INVESTIGATION

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

Recorder Manufacturer/Model: **L-3/Fairchild FA2100**
Recorder Serial Number: **000141834**

4.1. 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

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 words appear at proper 64-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.

4.1.1. Recorder Condition

The recorder was in good condition and the data were extracted normally from the recorder using the manufacturer's procedures and the NTSB's equipment.

4.1.2. Recording Description

The FDR recording contained approximately 165 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 3 hours and 5 minutes.

Throughout the entire recording data for longitudinal acceleration was not valid, therefore it is not included in this report. Longitudinal acceleration is a required flight data recorder parameter as mandated by Title 14 CFR Part 121.344(a). The operator was notified that the recording contained invalid data for longitudinal acceleration.

All other parameters evaluated for the purpose of this report appeared to be in accordance with federal FDR carriage requirements.

4.1.3. Engineering Units Conversions

The engineering units conversions used for the data contained in this report are based on documentation from the operator and 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

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. Pressure Altitude

This FDR records pressure altitude, which is based on a standard altimeter setting of 29.92 inches of mercury (inHg). 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.

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 = +, Pitch Up = +, Elevator Trailing Edge Up = +, Right Rudder = +.

4.2. Time Correlation

Correlation of the FDR data from SRN to the event local time, EDT, was established by using the recorded Time GMT² hours, Time GMT Minutes, and Time GMT Seconds and then applying an additional -4.0 hours offset to change GMT to EDT.

Accordingly, the time offset for the event flight data from SRN to local EDT is the following:

$$\text{EDT} = \text{SRN} - 545580.$$

Therefore, for the rest of this report, all times are referenced as EDT, not SRN.

4.3. FDR Plots and Corresponding Tabular Data

Figures 1 to 3 contain FDR data recorded during the June 15, 2019 event.

These plots 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.

Figure 1 is an overview of the flightpath into Newark's runway 22L from latitude and longitude data retrieved from the FDR. Google Earth was used to overlay the data on satellite imagery. The weather, season, and lighting conditions in Google Earth are not representative of the conditions at the time of the accident.

Figure 2 contains FDR data from the entire incident flight and Figure 3 contains FDR data from approximately the last thirty seconds of the recording during the approach and landing in EWR.

In Figure 2, the data shows that the aircraft departed Denver at approximately 09:51 EDT. The aircraft climbed to a pressure altitude of 38,000 feet. The aircraft cruised at or near that altitude on a heading between 90 to 140 degrees for about two hours. It then descended to a pressure altitude of about 2,500 feet and made a turn to the runway heading at approximately 12:52 EDT.

In Figure 3, at the beginning of the plot at 12:54:54 EDT, the aircraft is on final approach for runway 22L at EWR with the autopilot off, glideslope mode engaged, and both captain and first officer flight directors on. The first indication the main landing gear (MLG) had touched down on the runway occurred at 12:55:14 EDT. At touchdown the recorded pitch angle was 2.81 degrees, the flap handle position was set at 30 degrees, and the speed brake handle was set in the down (not armed) position. Approximately three seconds later, at 12:55:17, the MLG weight-on-wheels parameter indicated "Air" again for one second before going back to "Ground" one second later. One second later, at 12:55:19, the MLG weight-on-wheels parameter indicated "Air" again for one second before finally indicating "Ground" one second later. At 12:55:20 the nose gear weight-on-wheels indicated "Ground" for the first time. Both left and right engine thrust reversers indicated deployed six seconds after initial MLG touchdown.

² GMT is Greenwich Mean Time which is also known as Coordinated Universal Time (UTC).

At 12:55:16 EDT (one second after the initial MLG touchdown) variations in the vertical acceleration, pitch, elevator, and control column parameters increased in magnitude. The largest magnitude vertical acceleration of 1.6042 g's occurred at 12:55:20 EDT.

The recording ended at 12:55:21 EDT, seven seconds after the initial recorded indication of touchdown on the MLG. The total flight time was about 3 hours and 5 minutes. Below approximately 30 knots, when the aircraft was on the ground, the computed airspeed, wind speed, and wind direction parameter recorded a non-computed data (NCD) pattern which is indicative that the raw data was no longer reliable or not available.

The corresponding tabular data used to create Figures 1 to 3 are provided in electronic comma separated value (*.csv) format as Attachment 1 to this report.

Figure 1. Map overlay of flight path inbound to Newark International Airport (EWR).

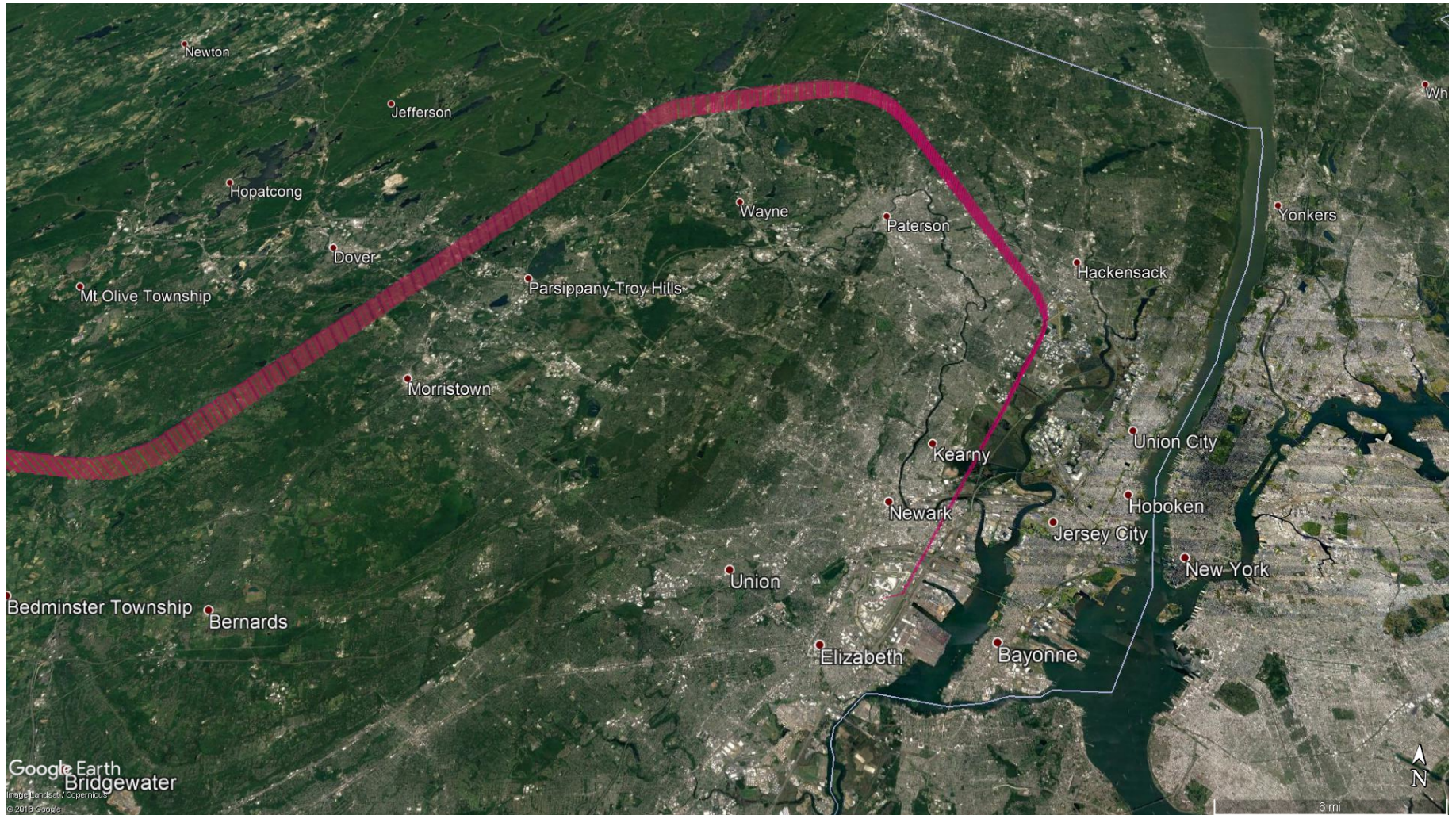


Figure 2. Plot of basic parameters during entire incident flight.

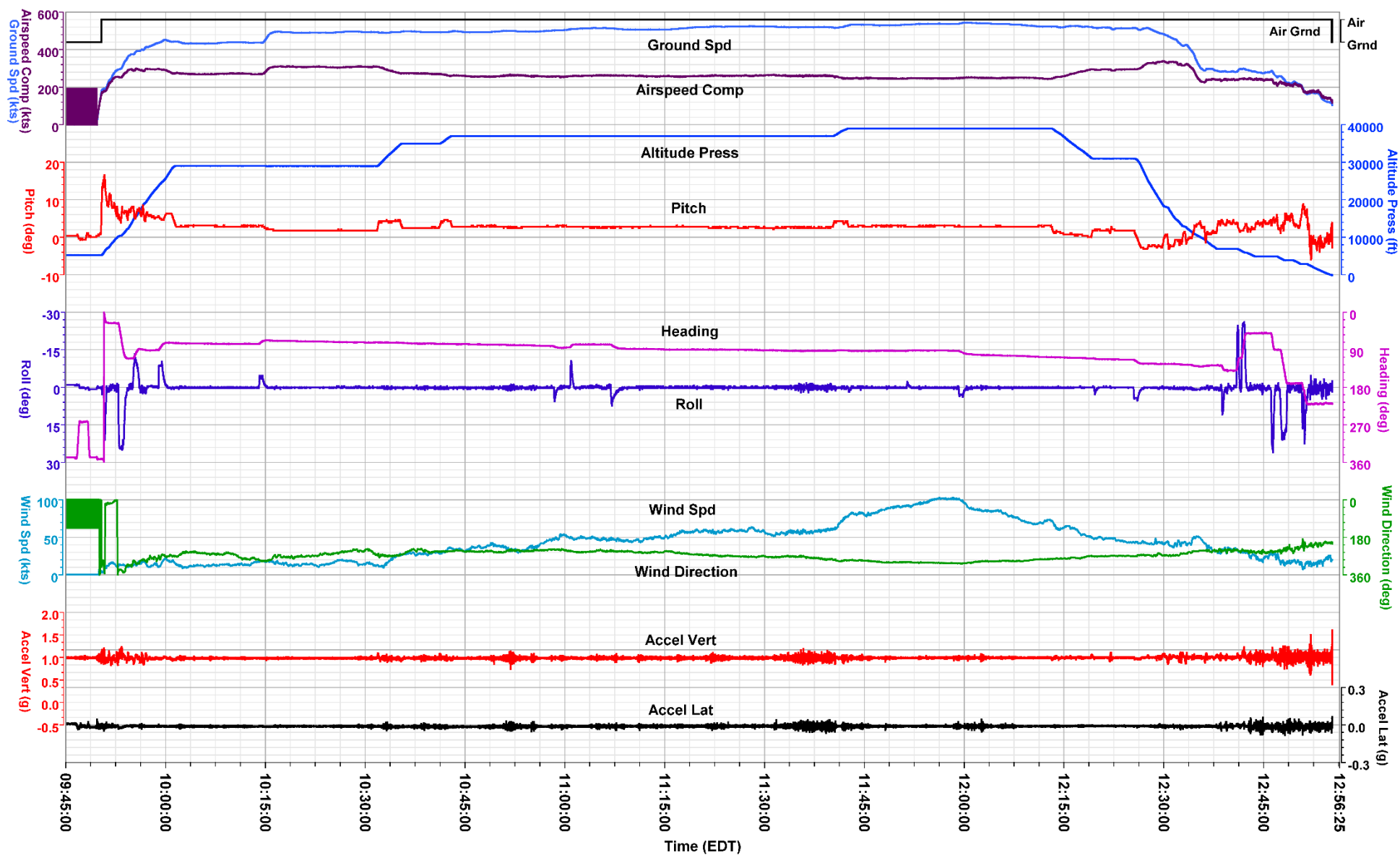
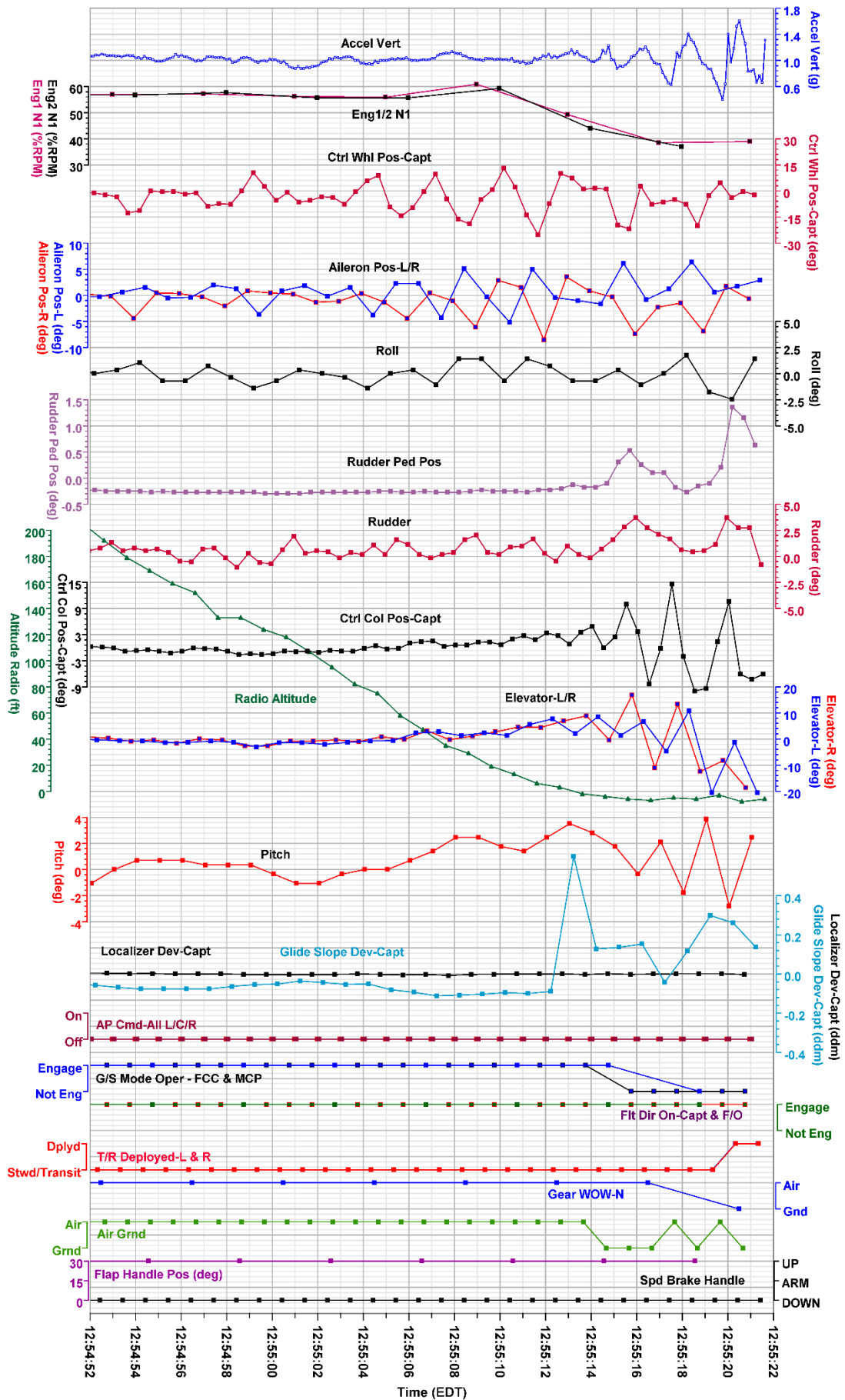


Figure 3. Plot of parameters for last 30 seconds of recording.



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 Vert	Vertical Acceleration	g
Aileron Pos-L	Left Outboard Aileron Position	deg
Aileron Pos-R	Right Outboard Aileron Position	deg
Air Grnd	Air/Ground	-
Airspeed Comp	Computed Airspeed	kts
Altitude Press	Pressure Altitude	ft
Altitude Radio	Radio Altitude	ft
A/P CMD-C/L/R – All	Autopilot Command – Center/Left/Right – All	-
Ctrl Col Pos-Capt	Control Column Position – Captain	deg
Ctrl Whl Pos-Capt	Control Wheel Position – Captain	deg
EDT Time	EDT Time Hours, Minutes, Seconds	HH:mm:ss
Elevator-L	Left Elevator Position	deg
Elevator-R	Right Elevator Position	deg
Eng1 N1	Engine #1 (L/H) Indicated N1	%
Eng2 N1	Engine #2 (R/H) Indicated N1	%
Flap Handle Pos	Flap Handle Position	deg
Flt Dir On – Capt & F/O	Flight Director On – Captain and First Officer	-
Gear WOW-N	Nose Gear Weight on Wheels	-
Glide Slope Dev-Capt	Glide Slope Deviation – Captain	ddm
Ground Spd	Ground Speed	kts
G/S Mode Oper – FCC & MCP	Glideslope Mode Operation – Flight Control Computer & Mode Control Panel	-
Heading	Magnetic Heading	deg
Latitude	Latitude	deg
Localizer Dev-Capt	Localizer Deviation – Captain	ddm
Longitude	Longitude	deg
Pitch	Pitch Angle	deg
Roll	Roll Angle	deg
Rudder	Rudder Position	deg
Rudder Ped Pos	Rudder Pedal Position	deg
Spd Brake Handle	Speed Brake Handle Position	deg
T/R Deployed L/R	Thrust Reverser Deployed – Left or Right	-
T/R Intransit L/R	Thrust Reverser Intransit – Left or Right	-
Wind Direction	Wind Direction	deg
Wind Spd	Wind Speed	kts

NOTE: This FDR records pressure altitude, which is based on a standard altimeter setting of 29.92 inches of mercury (inHg). 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
deg	degrees
ddm	difference in the depth of modulation
EDT	eastern daylight time
ft	feet
g	g
hrs	hours
kts	knots
min	minutes
sec	seconds