

NATIONAL TRANSPORTATION SAFETY BOARD

Vehicle Recorder Division
Washington, D.C. 20594

April 22, 2020

Flight Data Recorder

Specialist's Factual Report
By Kyle Garner

1. EVENT SUMMARY

Location: Charlotte, North Carolina
Date: August 15, 2015
Aircraft: Airbus A321-200
Registration: N564UW
Operator: American Airlines
NTSB Number: DCA15LA173

On August 15, 2015, about 1837 eastern daylight time (EDT), American Airlines flight 1851, an Airbus A321, N564UW, reportedly encountered wind shear while on final approach to the Charlotte Douglas International Airport (CLT), Charlotte, North Carolina. The airplane touched down short of the runway in the paved overrun area and performed a go-around before circling back and successfully landing. There were no injuries to the 6 crew members and 153 passengers onboard. The airplane was substantially damaged when it struck several runway end lights and experienced a tail strike during the go around. The flight was operating under the provisions of Title 14 *Code of Federal Regulations (CFR)* Part 121, as a scheduled domestic passenger flight and originated from Hartsfield Jackson Atlanta International Airport (ATL), Atlanta, Georgia.

2. FLIGHT DATA RECORDER GROUP

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

3. FDR CARRIAGE REQUIREMENTS

The event aircraft, N564UW, was manufactured in November 2012 and was operating such that it was required to be equipped with an FDR that recorded, at a minimum, 88 parameters, as cited in CFR 121.344(f).

4. DETAILS OF FDR INVESTIGATION

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

Recorder Manufacturer/Model: **L-3/Fairchild FA2100 1024 wps**
Recorder Serial Number: **820550**

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 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 (e.g. 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. L-3/Fairchild FA2100 Recorder Condition

The recorder was in good condition and the data were extracted normally from the recorder using manufacturer instructions and NTSB lab equipment.

4.1.2. L-3/Fairchild FA2100 Recording Description

The FDR recording contained approximately 113 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 55 minutes. The parameters evaluated for the purpose of this report appeared to be in accordance with federal FDR carriage requirements.

4.2. 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

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.

4.3. Pressure Altitude

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

4.4. Time Correlation

Correlation of the FDR data from SRN to local time, EDT, was established by using the recorded Time GMT² hours, Time GMT Minutes, and Time GMT Seconds and applying an

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 = +.

² GMT is Greenwich Mean Time which is also known as UTC.

offset of -4 hours. Accordingly, the time offset for the event flight data from SRN to EDT is the following:

EDT = SRN + 62956.

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

4.5. FDR Plots and Corresponding Tabular Data

Figures 1 to 9 contain FDR data recorded during the event on August 15, 2015. All the parameters listed in table A-1 are plotted except Time GMT Hours, Time GMT Minutes, and Time GMT Seconds. Most of the plots are grouped into sets of parameters which are plotted for two different time ranges from the incident flight. The time ranges are:

- Full Flight – covers the complete incident flight from 17:58:00 to the arrival at KCLT at approximately 18:58:00
- Tailstrike – beginning at 18:36:00 and covers one minute and forty-five seconds surrounding the event at approximately 18:37:33

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.

Below approximately 30 knots, when the aircraft was on the ground, the computed airspeed parameter recorded a non-computed data (NCD) pattern which is expected normal behavior and indicative that the raw data was no longer reliable or not available.

Figure 1 and 2 show a basic parameter set which includes aircraft accelerations (lateral, longitudinal, and vertical), attitude (pitch and roll), air and ground speeds, wheel speeds, and altitude.

Figure 3 and 4 show a set of parameters related to pitch control, including pitch angle, longitudinal sidestick position, slat and flap positions, horizontal stabilizer position, elevator position, spoiler positions and autopilot discretes. Altitude and vertical acceleration are also shown for reference.

Figure 5 and 6 show a set of parameters related to roll control, including roll angle, lateral sidestick position, heading, aileron position, rudder position, and autopilot discretes. Altitude and vertical acceleration are also shown for reference.

Figure 7 and 8 show a set of parameters related to engine operation, including throttle lever angles, engine N1, thrust reverser deployment, EPR, and autopilot and auto throttle discretes. Altitude and airspeed are also shown for reference.

Figure 9 shows a set of miscellaneous parameters during the tailstrike event including drift angle, wind direction and speed, windshear alerts, and glideslope and localizer deviations. Altitude and airspeed are also shown for reference.

The corresponding tabular data used to create figures 1 to 9, including Time GMT Hours, Time GMT Minutes, and Time GMT Seconds, are provided in electronic comma separated value (*.csv) format as attachment 1 to this report.

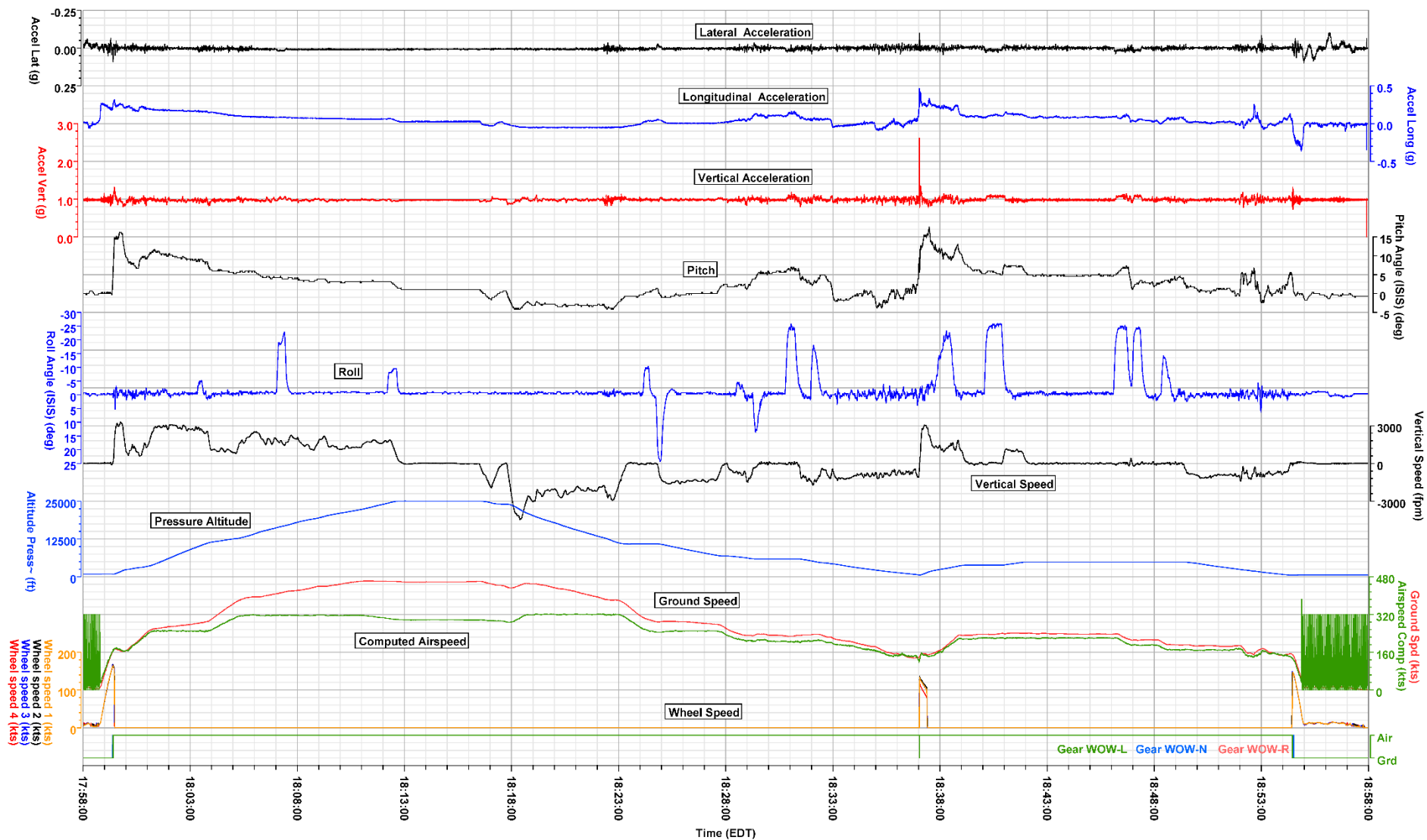


Figure 1. Plot of Basic Parameters for Full Flight.

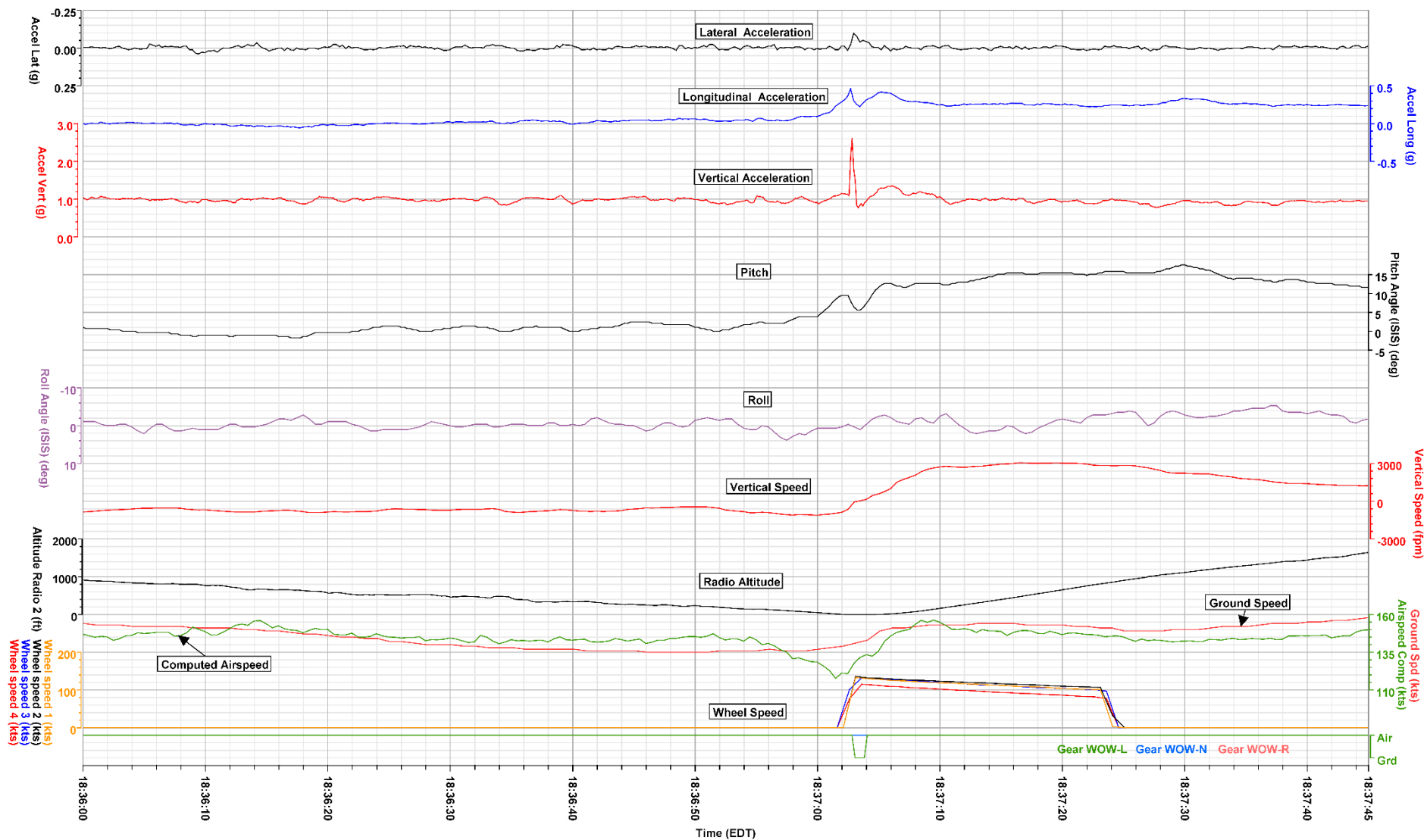


Figure 2. Plot of Basic Parameters During Tailstrike.

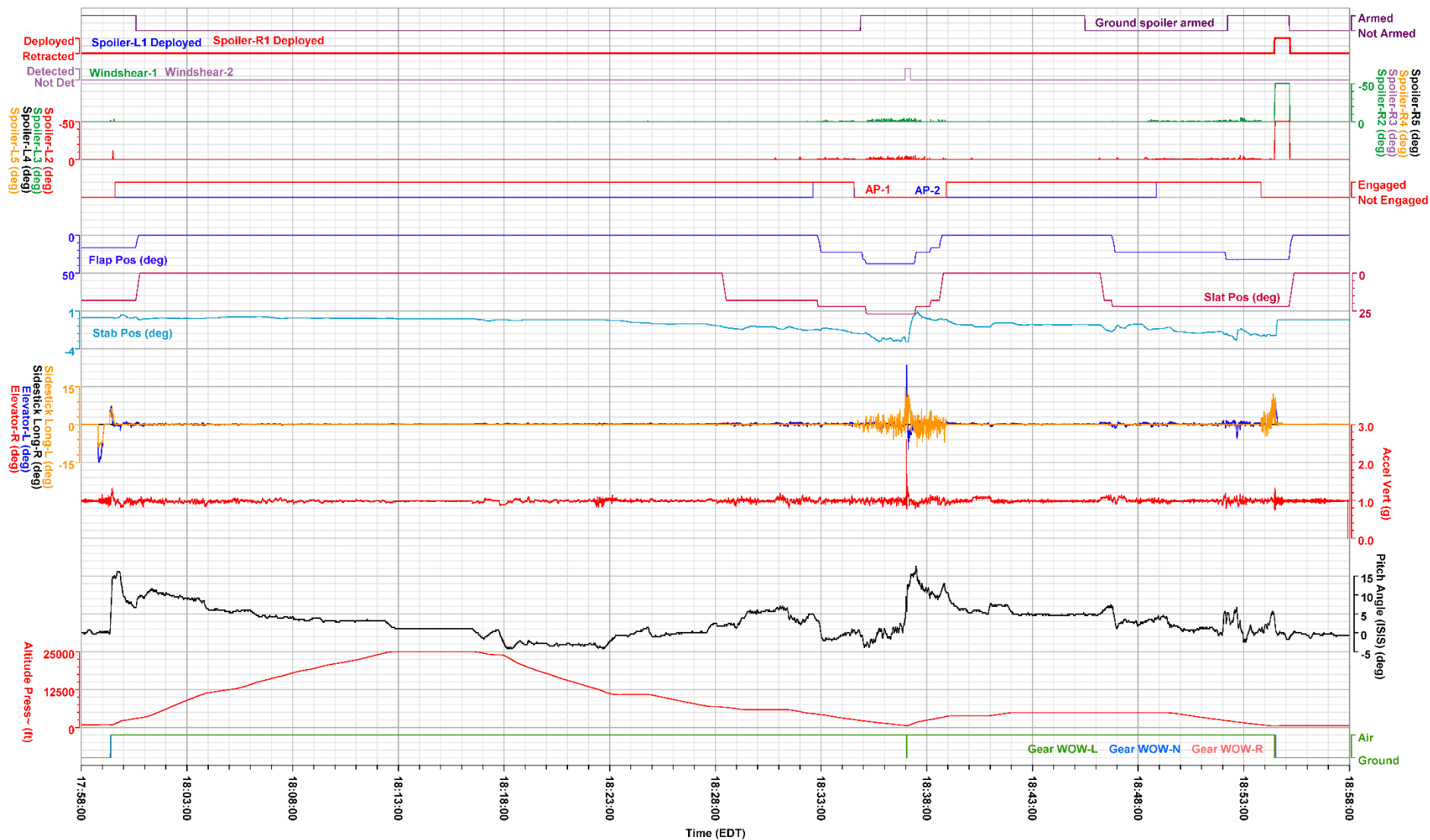


Figure 3. Plot of Flight Control Parameters for Full Flight - Pitch.

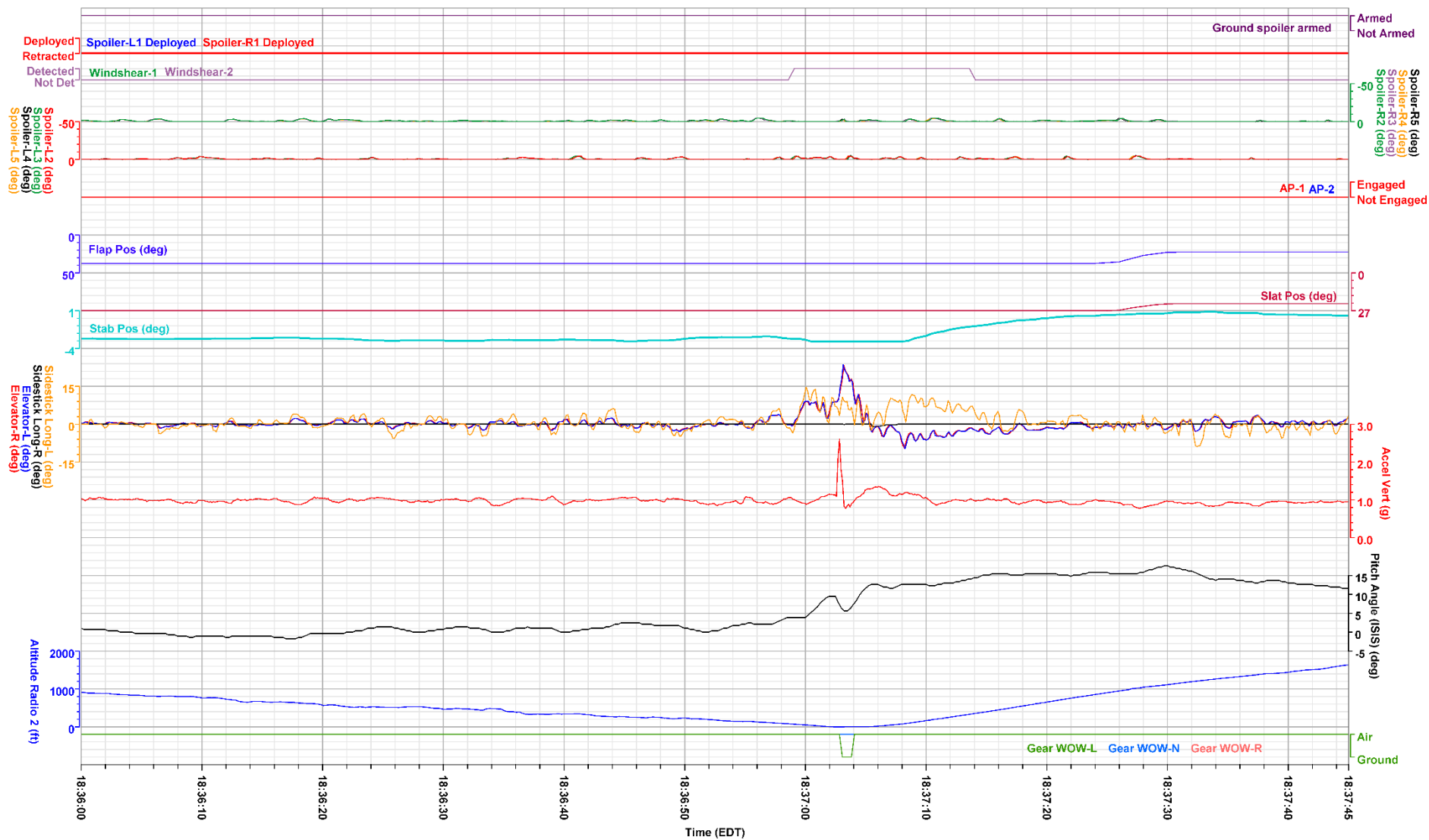


Figure 4. Plot of Flight Control Parameters During Tailstrike - Pitch.

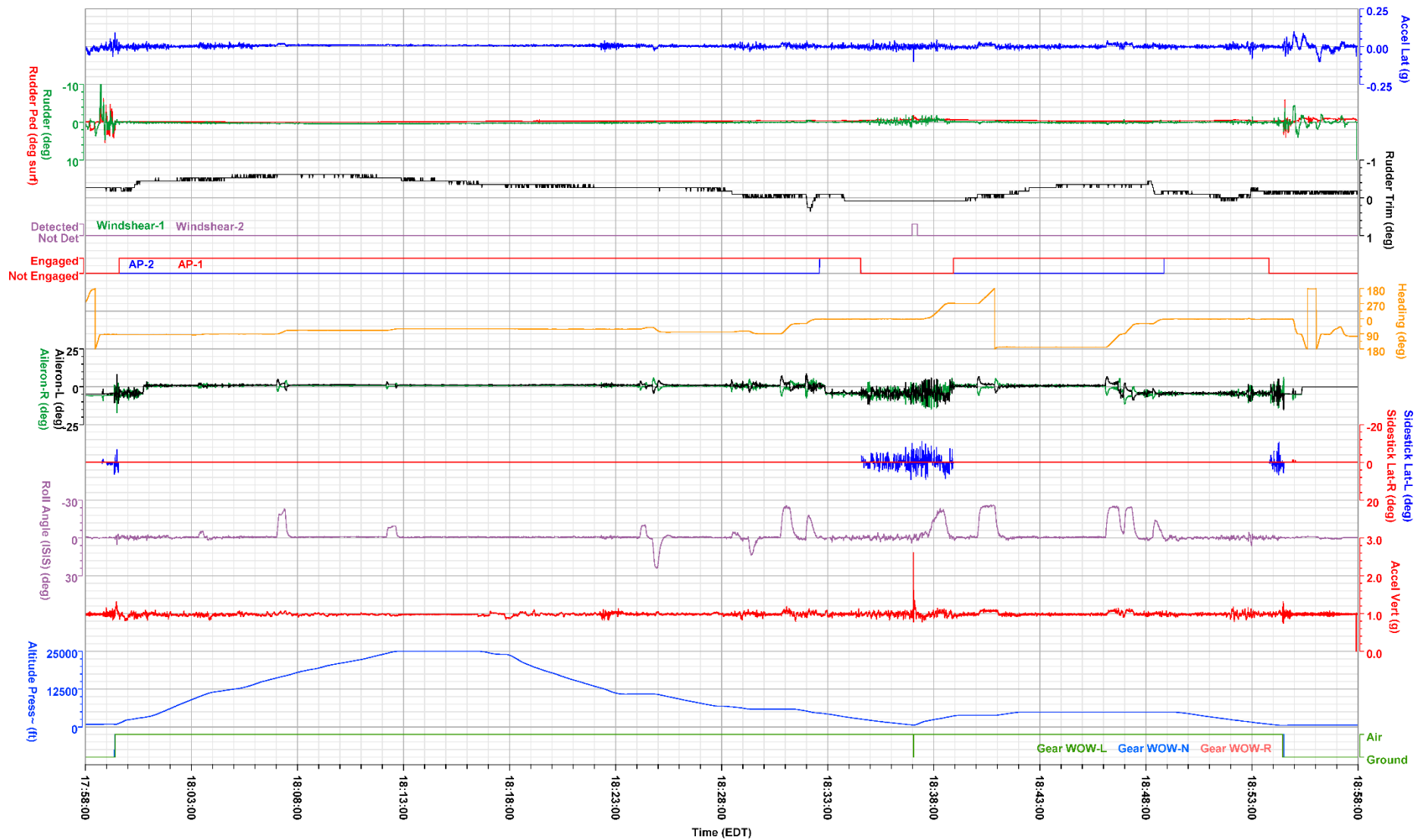


Figure 5. Plot of Flight Control Parameters for Full Flight - Roll.

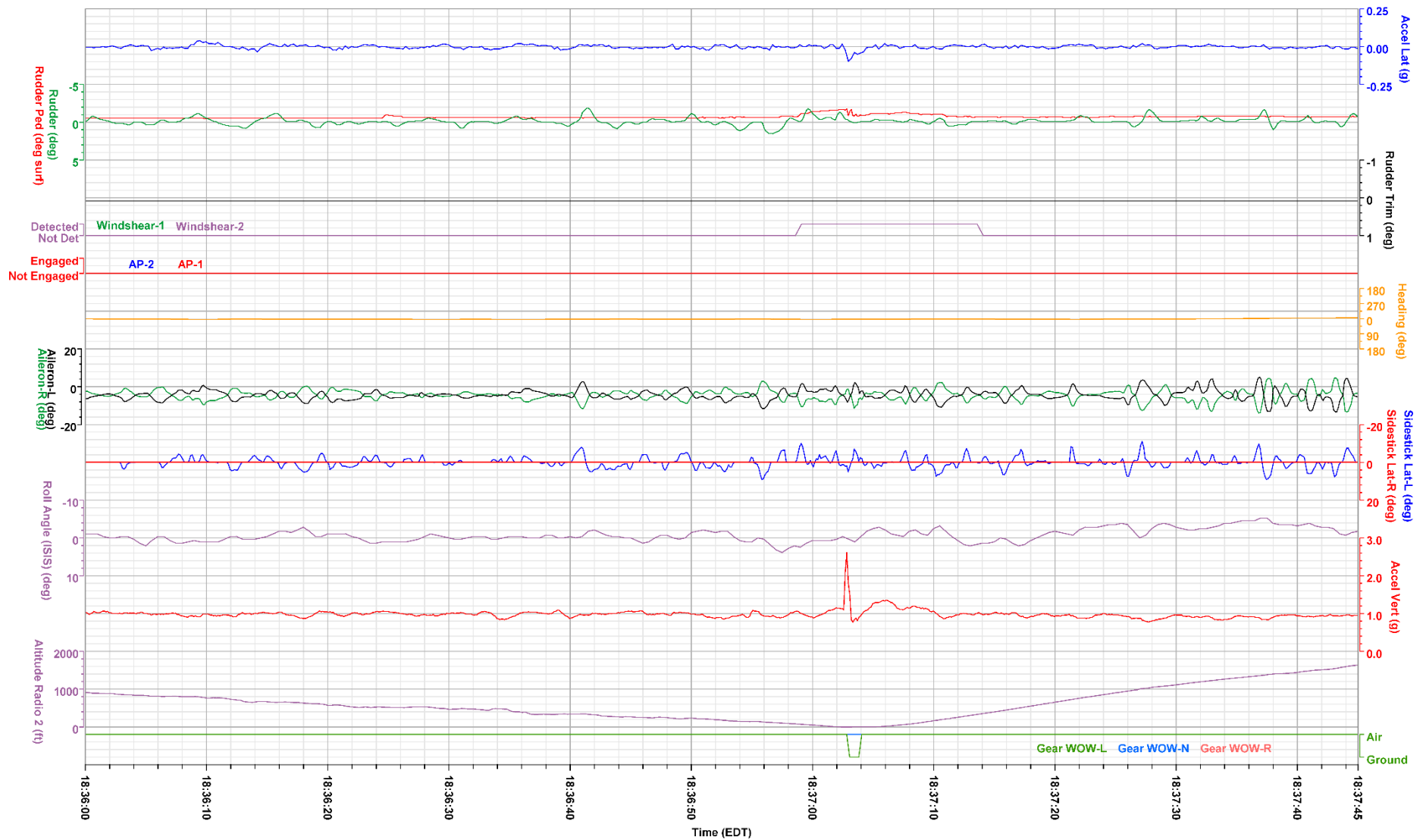


Figure 6. Plot of Flight Control Parameters During Tailstrike - Roll.

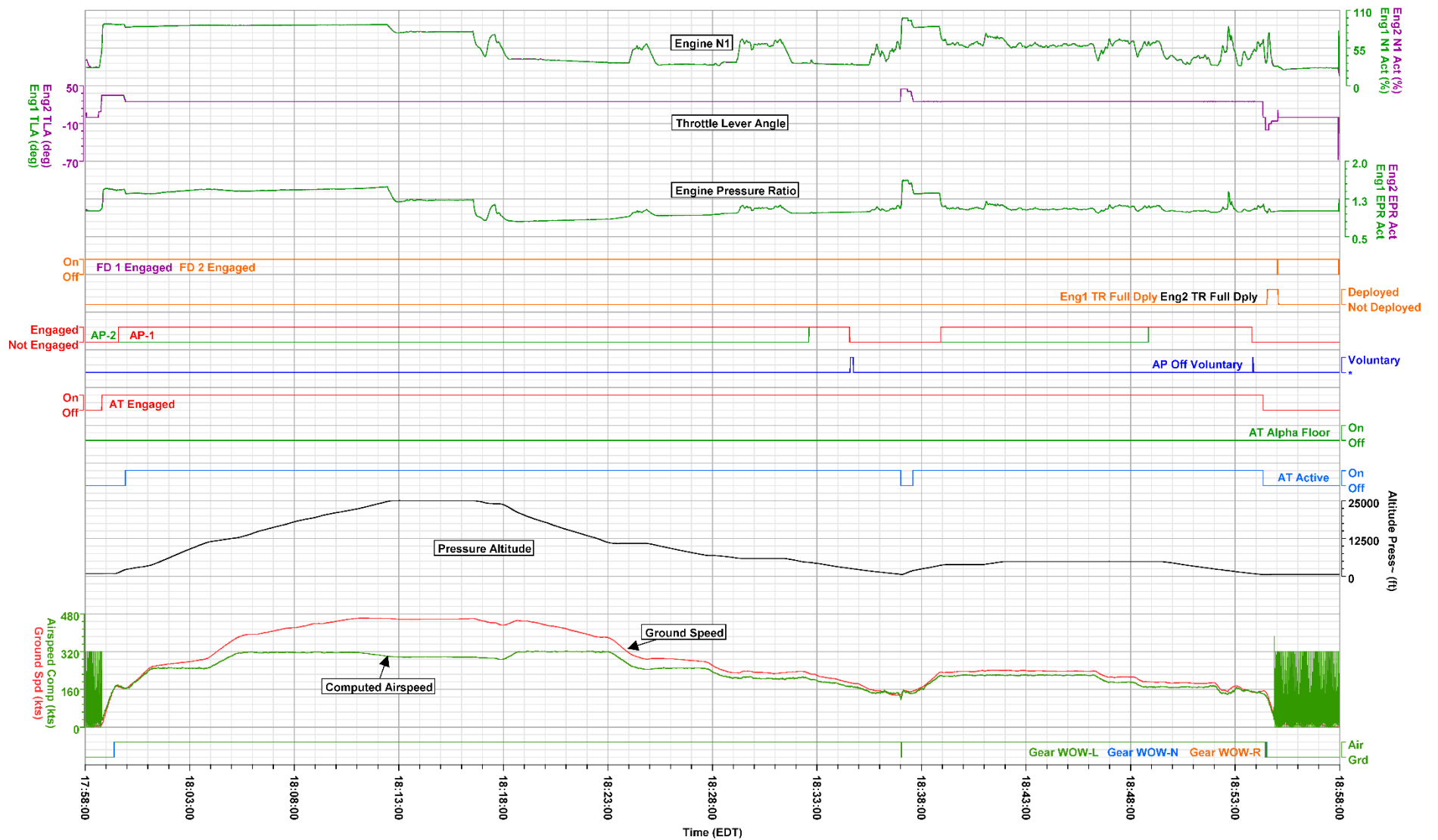


Figure 7. Plot of Engine Parameters for Full Flight.

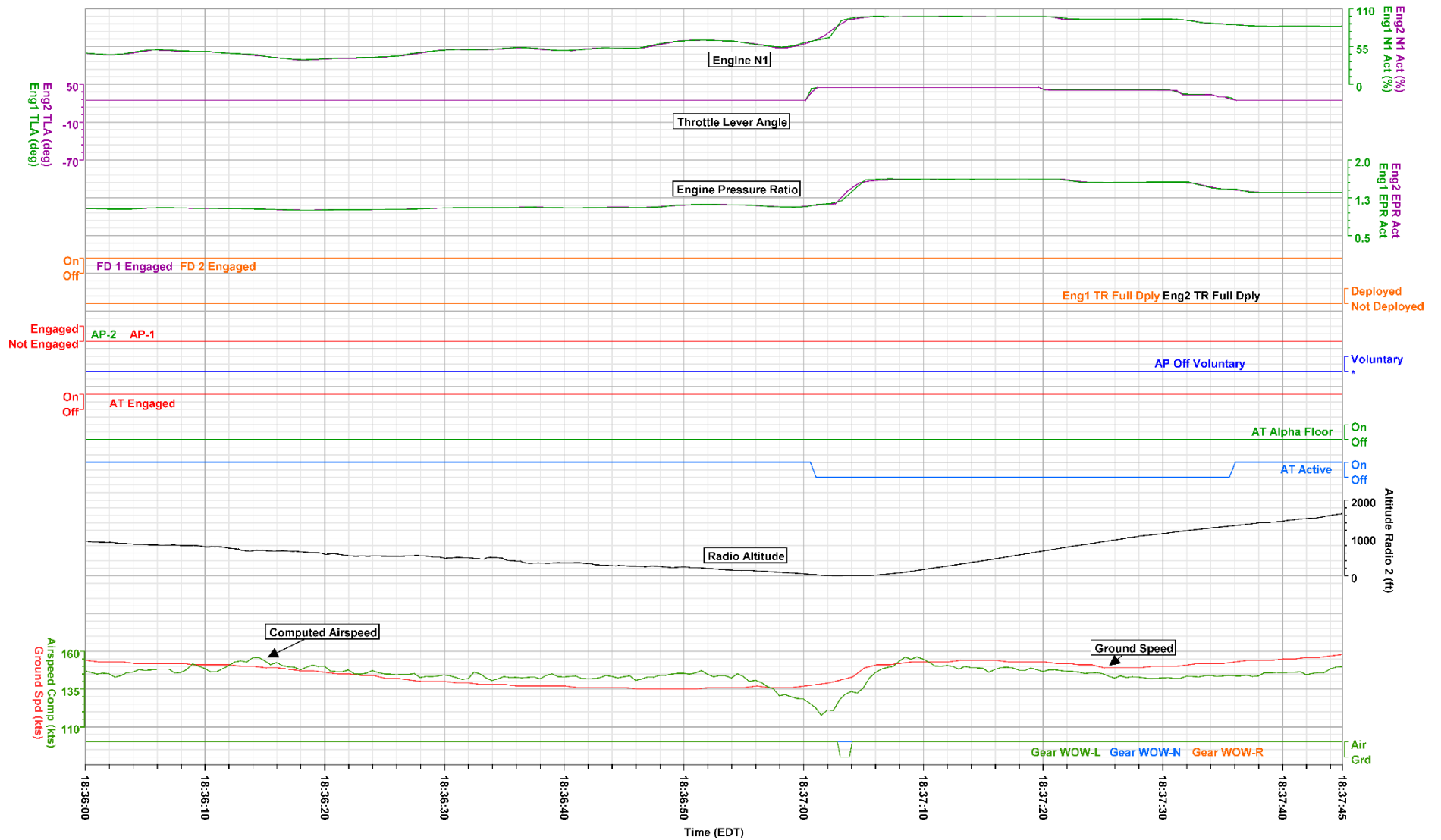


Figure 8. Plot of Engine Parameters During Tailstrike.

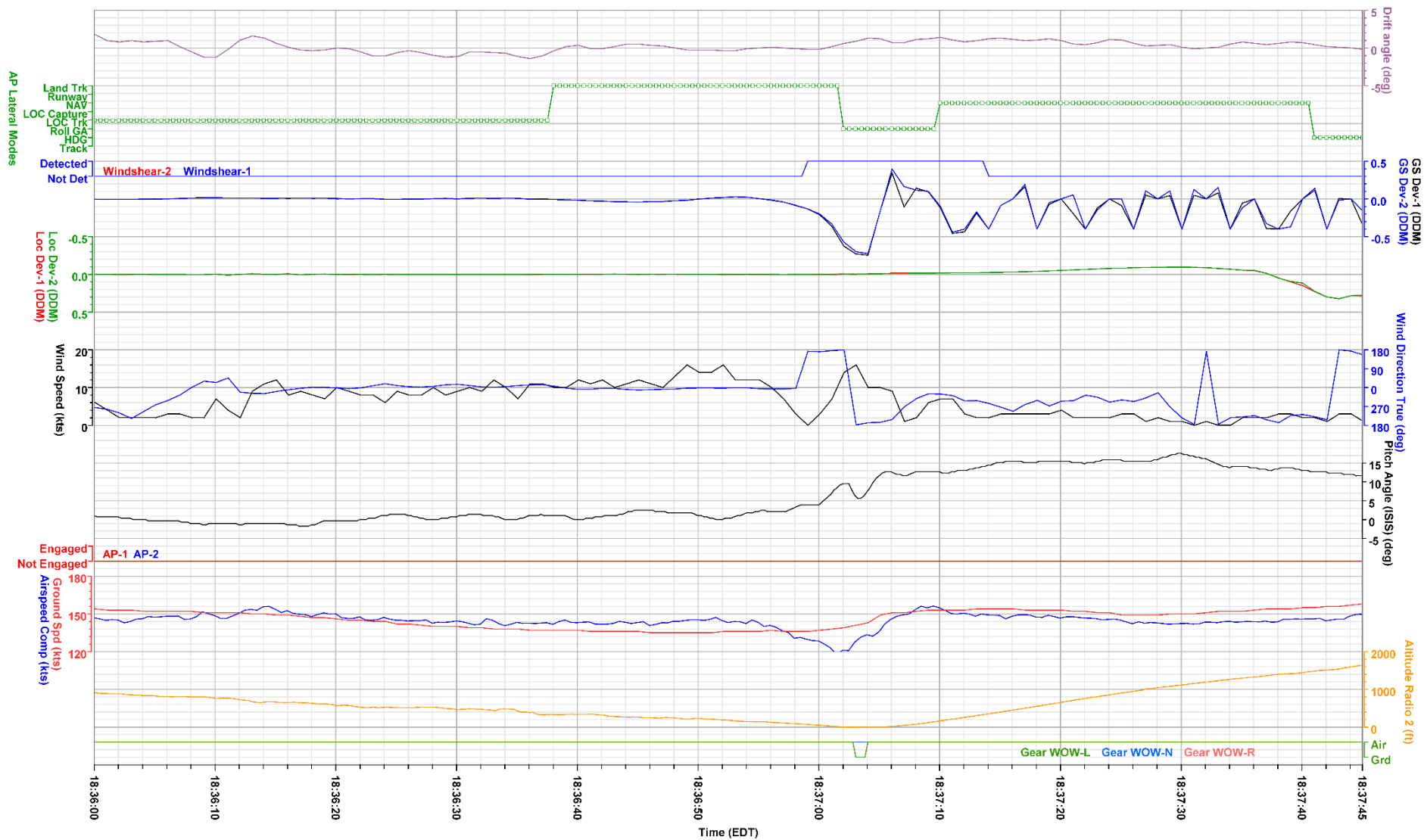


Figure 9. Plot of Miscellaneous Parameters During Tailstrike.

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 Long	Longitudinal Acceleration	g
Accel Vert	Vertical Acceleration	g
Aileron-L	Aileron Position – L	deg
Aileron-R	Aileron Position – R	deg
Airspeed Comp	Computed Airspeed	kts
Altitude Press	Pressure Altitude	ft
Altitude Radio 2	Radio Altitude	ft
AP Lateral Modes	Autopilot Lateral Mode	-
AP Off Voluntary	Autopilot Off – Voluntary	-
AP-1	Autopilot 1 Active	-
AP-2	Autopilot 2 Active	-
AT Active	Auto Throttle Active	-
AT Alpha Floor	Auto Throttle Alpha Floor Active	-
AT Engaged	Auto Throttle Engaged	-
Drift Angle	Drift Angle	deg
Elevator-L	Elevator Position – L	deg
Elevator-R	Elevator Position – R	deg
Eng1 EPR Act	Engine 1 – Engine Pressure Ratio – Actual	-
Eng1 N1 Act	Engine 1 – Rotational Speed	%
Eng1 TLA	Engine 1 – Throttle Lever Angle	deg
Eng1 TR Full Dply	Engine 1 – Thrust Reverser Full Deployment	-
Eng2 EPR Act	Engine 2 – Engine Pressure Ratio – Actual	-
Eng2 N1 Act	Engine 2 – Rotational Speed	%
Eng2 TLA	Engine 2 – Throttle Lever Angle	deg
Eng2 TR Full Dply	Engine 2 – Thrust Reverser Full Deployment	-
FD 1 Engaged	Flight Director Engaged – L	-
FD 2 Engaged	Flight Director Engaged – R	-
Flap Pos	Flap Position	deg
Gear WOW-L	Gear Weight-on-Wheels – L MLG	-
Gear WOW-N	Gear Weight-on-Wheels – Nose	-
Gear WOW-R	Gear Weight-on-Wheels – R MLG	-
Ground Spd	Ground Speed	kts
Ground Spoiler Armed	Ground Spoiler Armed	-
GS Dev-1	Glideslope Deviation – 1	ddm
GS Dev-2	Glideslope Deviation – 2	ddm
Heading	Magnetic Heading	deg
Loc Dev-1	Localizer Deviation – 1	ddm
Loc Dev-2	Localizer Deviation – 2	ddm
Pitch Angle (ISIS)	Pitch Angle	deg
Roll Angle (ISIS)	Roll Angle	deg
Rudder	Rudder Position	deg
Rudder Ped	Rudder Pedal Position	deg surf
Rudder Trim	Rudder Trim Position	deg
Sidestick Lat-L	Lateral Sidestick Position – L	deg

Plot/Table Labels	Parameter Names	Units
Sidestick Lat-R	Lateral Sidestick Position – R	deg
Sidestick Long-L	Longitudinal Sidestick Position – L	deg
Sidestick Long-R	Longitudinal Sidestick Position – R	deg
Slat Pos	Slat Position	deg
Spoiler-L1 Deployed	Spoiler Deployed – L1	-
Spoiler-L2/3/4/5	Spoiler Position – L2/3/4/5	deg
Spoiler-R1 Deployed	Spoiler Deployed – R1	-
Spoiler-R2/3/4/5	Spoiler Position – R2/3/4/5	deg
Stab Pos	Horizontal Stabilizer Position	deg
Vertical Speed	Vertical Speed	fpm
Wheel speed 1/2/3/4/5/6/7/8	Wheel Speed 1/2/3/4/5/6/7/8	kts
Wind Direction True	Wind Direction – True	deg
Wind Speed	Wind Speed	kts
Windshear-1	Windshear Alert – 1	-
Windshear-2	Windshear Alert – 2	-
Time Hrs	Time UTC Hours	hrs
Time Min	Time UTC Minutes	min
Time Sec	Time UTC Seconds	sec

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 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
kts	knots
g	g
ddm	difference in the depth of modulation
ft	feet
hrs	hours
min	minutes
sec	seconds
%	percent
fpm	feet per minute
deg surf	degrees surface