

NATIONAL TRANSPORTATION SAFETY BOARD

Vehicle Recorder Division
Washington, D.C. 20594

February 24, 2022

Flight Data Recorder

Specialist's Factual Report
By Michael Portman

1. EVENT SUMMARY

Location: Jacksonville, Florida
Date: December 16, 2020
Aircraft: Embraer EMB-500
Registration: N661EP
Operator: Executive Aviation Investors Inc.
NTSB Number: ERA21LA077

A solid-state cockpit voice and data recorder (CVDR) was sent to the National Transportation Safety Board (NTSB) Vehicle Recorder Division for evaluation.¹

2. FLIGHT DATA RECORDER GROUP

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

3. FDR CARRIAGE REQUIREMENTS

The event aircraft, N661EP, was manufactured in 2009, and was not required to be equipped with an FDR.

4. DETAILS OF FDR INVESTIGATION

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

Recorder Manufacturer/Model: **L-3 FA2100-3083**
Recorder Serial Number: **000604266**

4.1. L-3 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

¹This report only details the flight data recovered from the CVDR, thus, for the remainder of this report the CVDR will be referred to as a flight data recorder (FDR). For information on the cockpit audio data recovered from the CVDR, refer to the *Cockpit Voice Recorder - Specialist's Factual Report* which is available in the docket for this event.

data. It is configured to record 256 12-bit words of digital information every second. Each grouping of 256 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 256-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.

4.1.2. Recording Description

The FDR recording contained approximately 271 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 1 hour and 3 minutes.

4.1.3. 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=+).²

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.

4.2. Time Correlation

Correlation of the FDR data from SRN to the event local time, eastern standard time (EST), was established by using the recorded Coordinated Universal Time (UTC) hours, Time UTC Minutes, and Time UTC Seconds and then applying an additional 5 hours offset to change UTC to EST.³

Accordingly, the time offset for the event flight data from SRN to local EST is the following: $EST = SRN - 925,341.7$. Therefore, for the rest of this report, all times are referenced as EST, not SRN.

² 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 = +.

³ UTC is Coordinated Universal Time which is also known as Greenwich Mean Time (GMT).

4.3. FDR Plots and Corresponding Tabular Data

Figures 1 to 5 contain FDR data recorded during the event on December 16, 2020. All the parameters listed in table A-1 are plotted except Latitude, Longitude, Time UTC Hours, Time UTC Minutes, and Time UTC Seconds.

Figures 1 to 3 are plots of basic parameters for the entire event flight, the descent portion of the flight, and the touchdown and rollout, respectively.

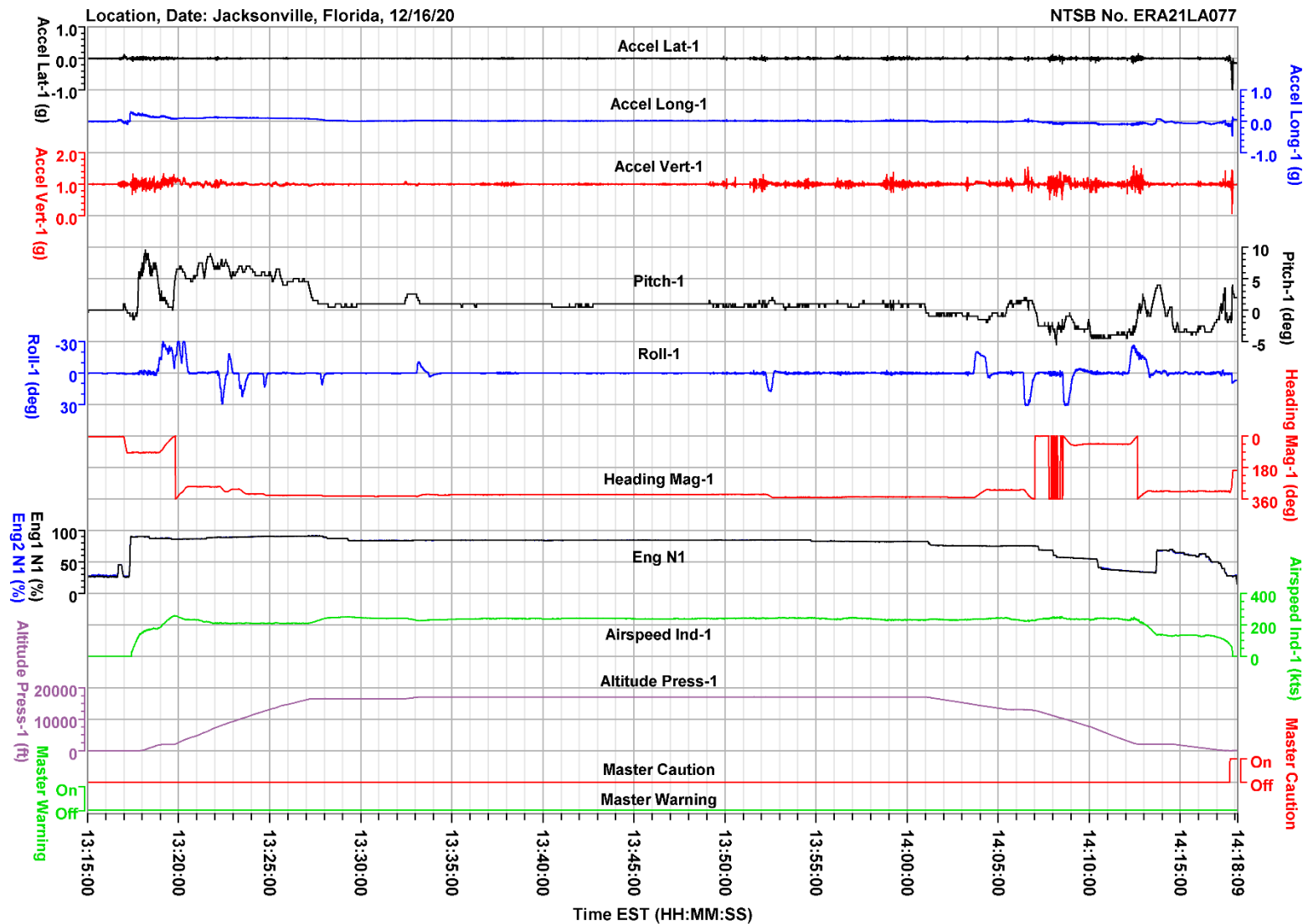
Figures 4 and 5 show wheel and braking related parameters during the touchdown and rollout.

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.

During the touchdown and rollout phase of flight, the wheels began to spin up at 14:17:28, and both left and right weight on wheel sensors indicated ground contact one second later, at 14:17:29. During this period, the aircraft was traveling at an airspeed of approximately 100 knots and was located between 30.33822996 and 30.33848746 degrees north and between 81.51277206 and 81.51311538 degrees west.

Between 14:17:40 and 14:17:41, the parking brake was applied and shortly thereafter, both wheel speeds reduce to 0 kts. Between 14:17:42 and 14:17:43, the anti-skid system began to register as failed. The parking brake was released between 14:17:49 and 14:17:50, and the wheels again began to move. The aircraft continued to decelerate until stopping at approximately 14:17:55.

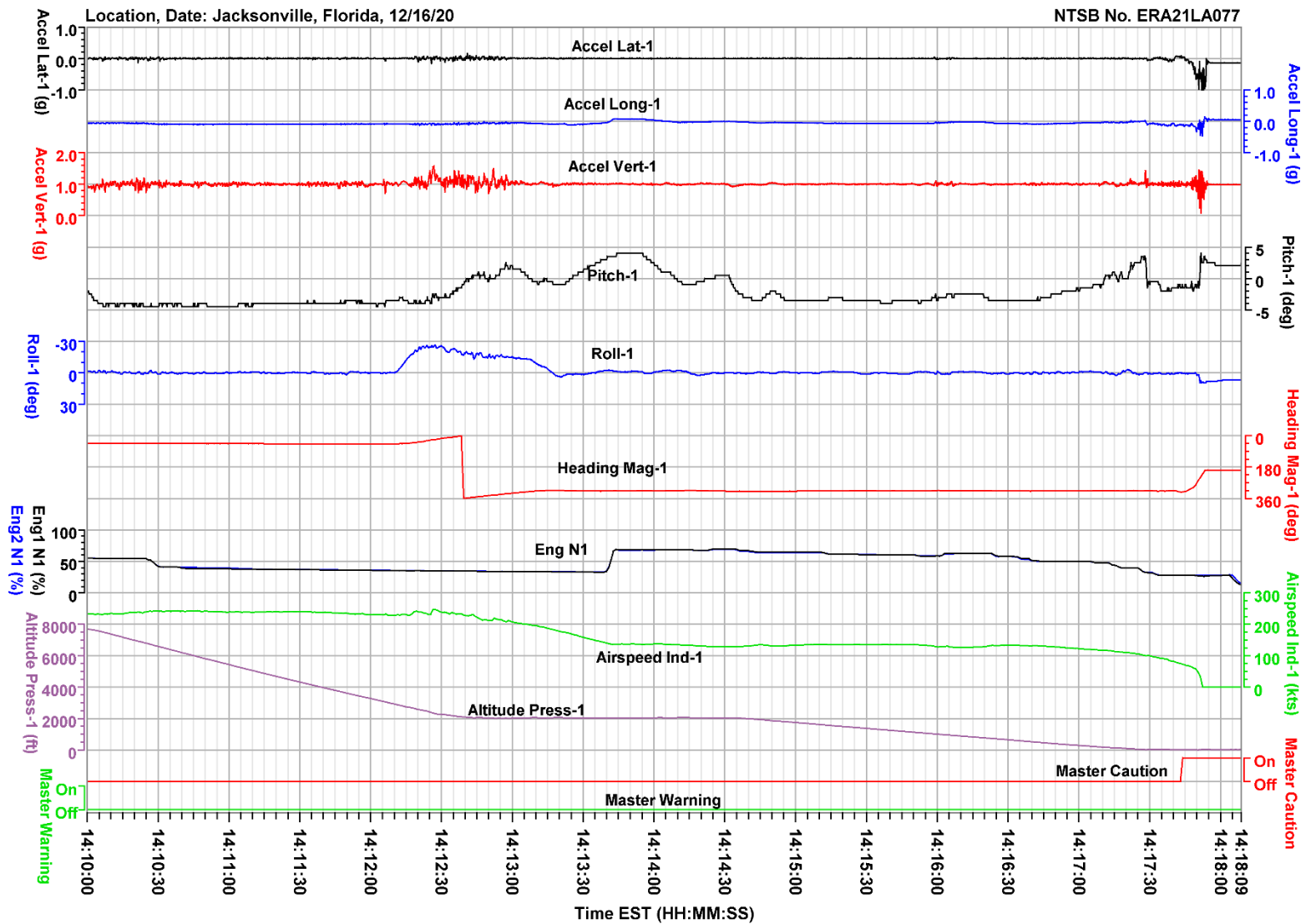
The corresponding tabular data used to create figures 1 to 5, including Latitude, Longitude, Time UTC Hours, Time UTC Minutes, and Time UTC Seconds, are provided in electronic comma separated value (CSV) format as attachment 1 to this report.



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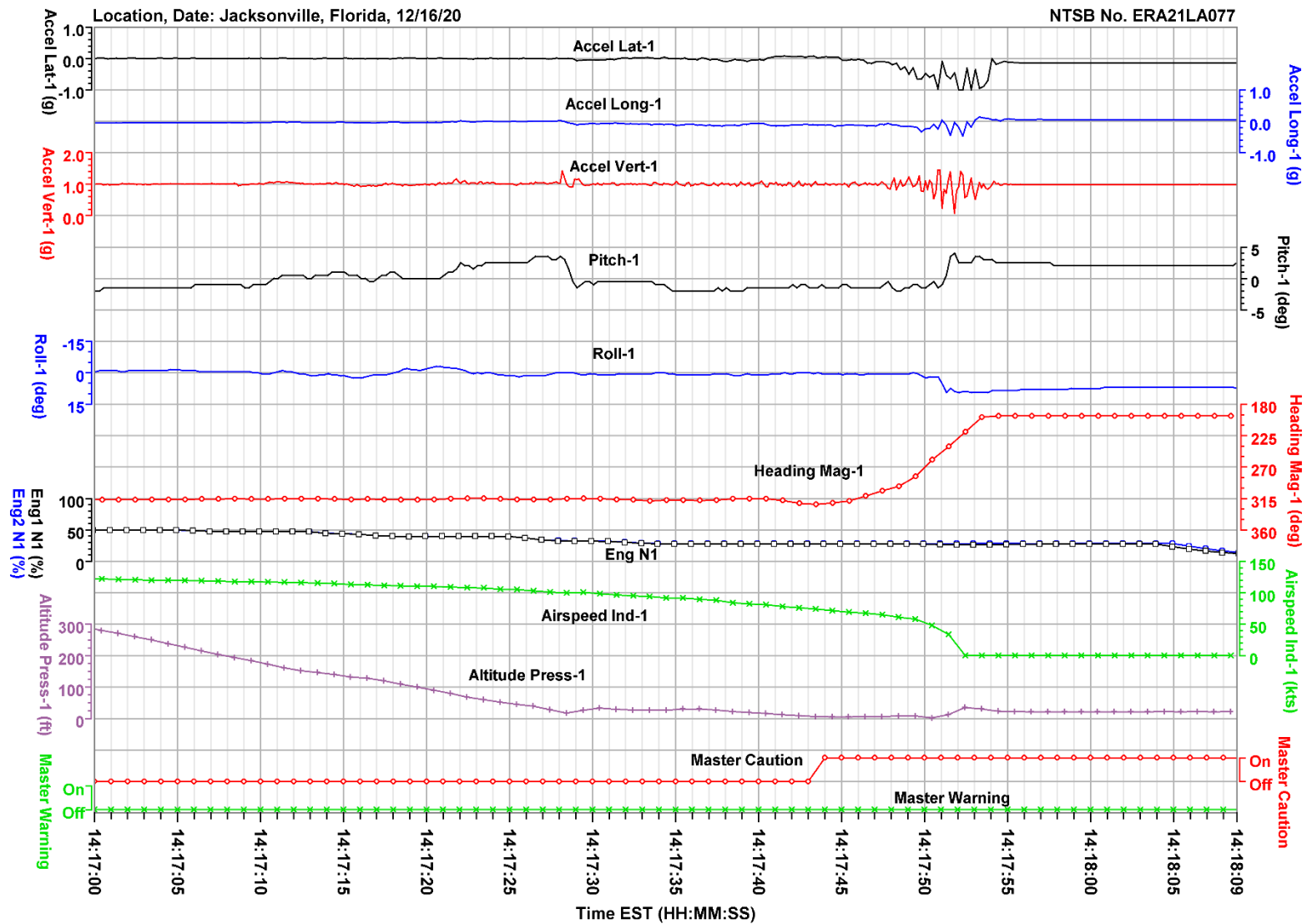
Figure 1. Plot of basic parameters for the entire event flight.



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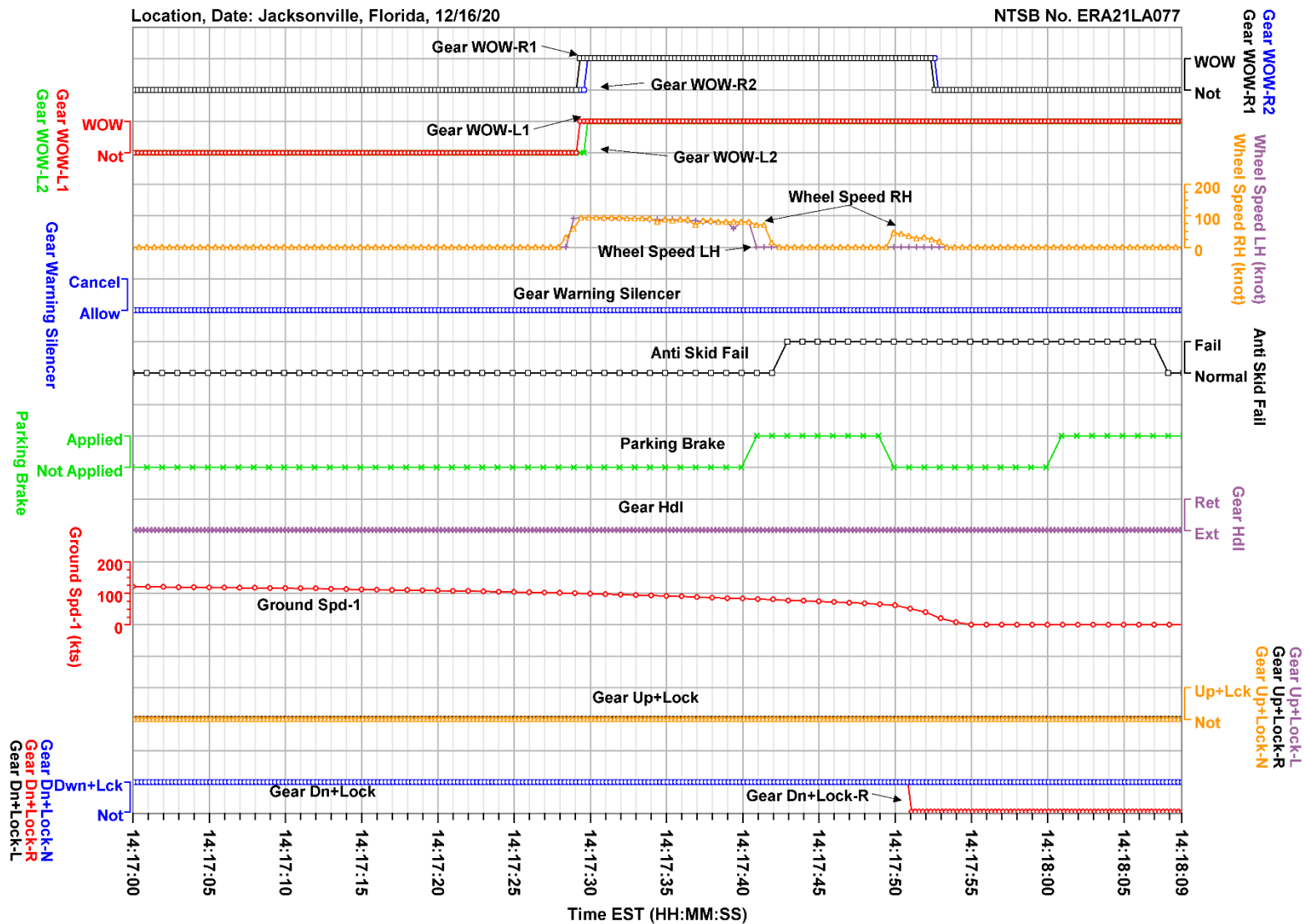
Figure 2. Plot of basic parameters for the descent portion of the event flight.



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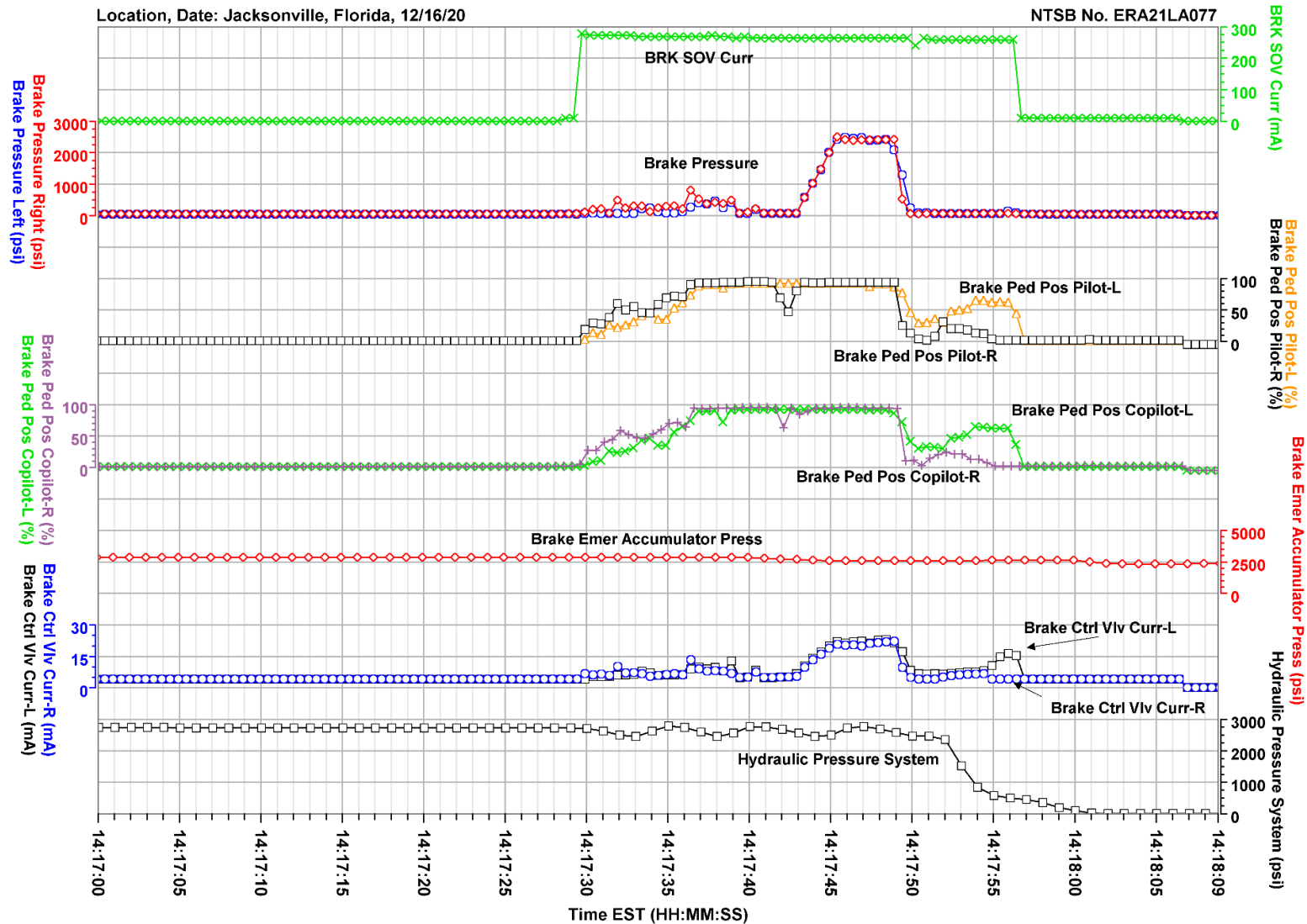
Figure 3. Plot of basic parameters for the landing and rollout of the event flight.



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Figure 4. Plot of wheel and brake related parameters for the landing and rollout of the event flight.



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Figure 5. Plot of additional wheel and brake related parameters for the landing and rollout of the event flight.

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 Label	Parameter Name	Unit
Accel Lat-1	Lateral Acceleration - Attitude and Heading Reference System (AHRS) 1	g
Accel Long-1	Longitudinal Acceleration - AHRS 1	g
Accel Vert-1	Vertical Acceleration - AHRS 1	g
Airspeed Ind -1	Indicated Airspeed - Air Data System (ADS) 1	kts
Altitude Press-1	Pressure Altitude - ADS 1	ft
Anti Skid Fail	Anti-Skid Braking System Failure	
Brake Ctrl Vlv Curr-L	Brake Control Valve Current - Left	mA
Brake Ctrl Vlv Curr-R	Brake Control Valve Current - Right	mA
Brake Emer Accumulator Press	Brake Emergency Accumulator Pressure	psi
Brake Ped Pos Copilot-L	Brake Pedal Position Copilot - Left	%
Brake Ped Pos Copilot-R	Brake Pedal Position Copilot - Right	%
Brake Ped Pos Pilot-L	Brake Pedal Position Pilot - Left	%
Brake Ped Pos Pilot-R	Brake Pedal Position Pilot - Right	%
Brake Pressure Left	Brake Pressure Left	psi
Brake Pressure Right	Brake Pressure Right	psi
BRK SOV Curr	Brake Solenoid Valve Current	mA
Eng1 N1	Engine 1 Fan Speed	%rpm
Eng2 N1	Engine 2 Fan Speed	%rpm
Gear Dn+Lock-L	Gear Down and Locked - Left	
Gear Dn+Lock-N	Gear Down and Locked - Nose	
Gear Dn+Lock-R	Gear Down and Locked - Right	
Gear Hdl	Gear Handle Position	
Gear Up+Lock-L	Gear Up and Locked - Left	
Gear Up+Lock-N	Gear Up and Locked - Nose	
Gear Up+Lock-R	Gear Up and Locked - Right	
Gear Warning Silencer	Gear Warning Silencer	
Gear WOW-L1	Left Main Landing Gear Weight on Wheels - Sensor 1	
Gear WOW-L2	Left Main Landing Gear Weight on Wheels - Sensor 2	
Gear WOW-R1	Right Main Landing Gear Weight on Wheels - Sensor 1	
Gear WOW-R2	Right Main Landing Gear Weight on Wheels - Sensor 2	
Ground Spd-1	Ground Speed - Flight Management System (FMS) 1	kts
Heading Mag-1	Magnetic Heading - AHRS 1	deg
Hydraulic Pressure System	Hydraulic Pressure System	psi
Latitude-1	Latitude Position - FMS 1	deg
Longitude-1	Longitude Position - FMS 1	deg
Master Caution	Master Caution	
Master Warning	Master Warning	
Parking Brake	Parking Brake Applied	
Pitch-1	Pitch Angle - AHRS 1	deg
Roll-1	Roll Angle - AHRS 1	deg
Time UTC-Hr	Coordinated Universal Time Hours	hrs
Time UTC-Min	Coordinated Universal Time Minutes	min
Time UTC-Sec	Coordinated Universal Time Seconds	sec
Wheel Speed LH	Left Main Landing Gear Wheel Speed	kts

APPENDIX A

Plot/Table Label	Parameter Name	Unit
Wheel Speed RH	Right Main Landing Gear Wheel Speed	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 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 Abbreviations	Descriptions
deg	degrees
Dwn+Lck	down and locked
Ext	extended
ft	feet
g	units of gravitational acceleration
hrs	hours
kts	knots
mA	milliamps
min	minutes
psi	pounds per square inch
Ret	retract
sec	seconds
Up+Lck	up and locked
WOW	weight on wheels
%rpm	percent revolutions per minute