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

October 17, 2011

Flight Data Recorder - 10

Specialist's Factual Report
By Christopher Babcock

1. EVENT SUMMARY

Location:	Moline, Illinois
Date:	8/29/2011
Aircraft:	Embraer EMB-145XR
Registration:	N27152
Operator:	ExpressJet Airlines, Flight 5821
NTSB Number:	ENG11SA047

On August 29, 2011, at about 1236 central daylight time (CDT), ExpressJet Airlines flight 5821, an Embraer EMB-145XR, registration N27152, departed the left side of Runway 10 during the landing roll out at Quad City International Airport, Moline, Illinois. The airplane sustained minor damage. The airplane was operated by ExpressJet Airlines under the provisions of 14 Code of Federal Regulations (CFR) Part 121 as domestic passenger flight from Denver International Airport. The flight data recorder (FDR) was recovered and sent to the National Transportation Safety Board's Vehicle Recorder Laboratory for evaluation.

2. FLIGHT DATA RECORDER GROUP

A FDR group was not convened.

3. FDR Carriage Requirements

The incident aircraft was manufactured in November 2003, and was operating such that it was required to be equipped with an FDR that recorded, at a minimum, the 88 parameters, as cited in Title 14 CFR 121.344(f).

4. DETAILS OF FLIGHT DATA RECORDER INVESTIGATION

The Safety Board's Vehicle Recorder Division received the following FDR:

Recorder Manufacturer/Model:	**Honeywell SSFDR, Model 980-4700-042, 256 Word**
Recorder Serial Number:	**9753**

4.1. Flight Recorder Description

The Honeywell Solid State Flight Data Recorder (SSFDR) records airplane flight information in a digital format using solid-state flash memory as the recording medium. The SSFDR 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 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 either 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 (e.g. altitude, heading, airspeed) has a specifically assigned word number within the subframe. The SSFDR is designed to meet the crash-survivability requirements of TSO–C124.

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 27 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 50 minutes. The parameters evaluated for the purpose of this investigation appeared to be in accordance with the federal FDR carriage requirements with the exception of the “Aileron-1”, “Elevator-1”, and “Elevator-2” parameters, for which valid data was not recorded. The operator has been notified of the anomaly.

4.1.3. Engineering Units Conversions

The engineering units 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]

Appendix A lists the FDR parameters verified and provided in this report.

4.2. Time Correlation

Correlation of the FDR data from SRN to local central daylight time, was established by using the recorded “Time GMT[2] Hrs”, “Time GMT Min”, and “Time GMT Sec” parameters and then applying an additional 5 hours offset to convert GMT to central daylight time.

Accordingly, the time offset for the event flight data from SRN to local central daylight time is the following: CDT = SRN - 52378. All times are referenced central daylight time; however, previous landings are referenced as SRN.

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[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] Greenwich Mean Time.

4.3. FDR Plots and Corresponding Tabular Data

Figures 1 through 4 display flight data from the incident landing. Figures 5 through 8 show flight data from the previous landing. 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 corresponding tabular data used to create these figures are provided in electronic (*.csv[3]) format as Attachment 1 to this report.

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Vehicle Recorder Division

[3] comma separated value format

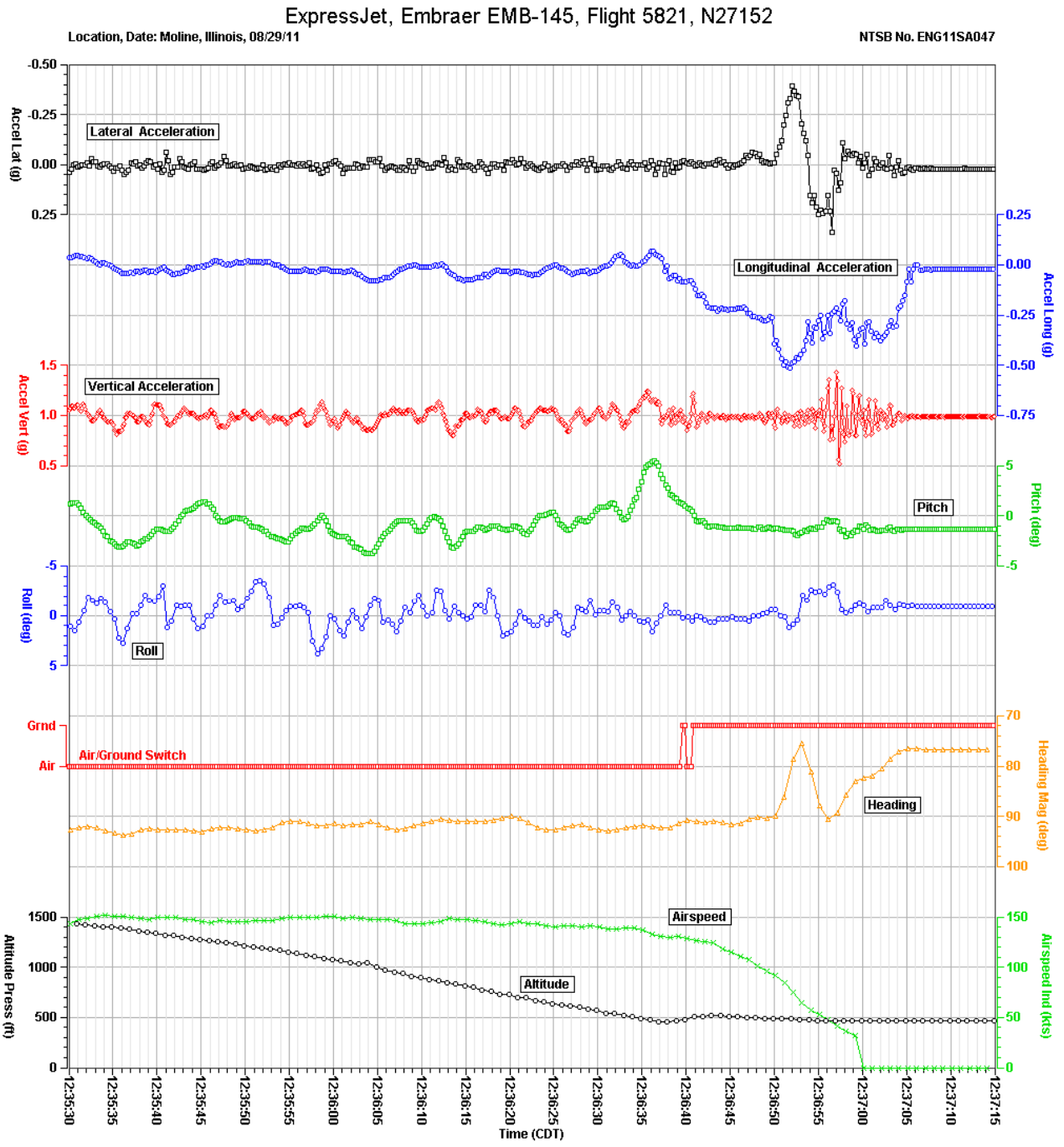
ExpressJet, Embraer EMB-145, Flight 5821, N27152
Location, Date: Moline, Illinois, 08/29/11
NTSB No. ENG11SA047
Lateral Acceleration
Accel Lat (g)
Longitudinal Acceleration
Accel Long (g)
Vertical Acceleration
Accel Vert (g)
Pitch
Pitch (deg)
Roll
Roll (deg)
Air/Ground Switch
Grnd
Air
Heading
Heading Mag (deg)
Airspeed
Airspeed Ind (kts)
Altitude
Altitude Press (ft)
Time (CDT)
Revised: 4 October 2011
Basic Parameters - Incident Approach
National Transportation Safety Board

Figure 1.

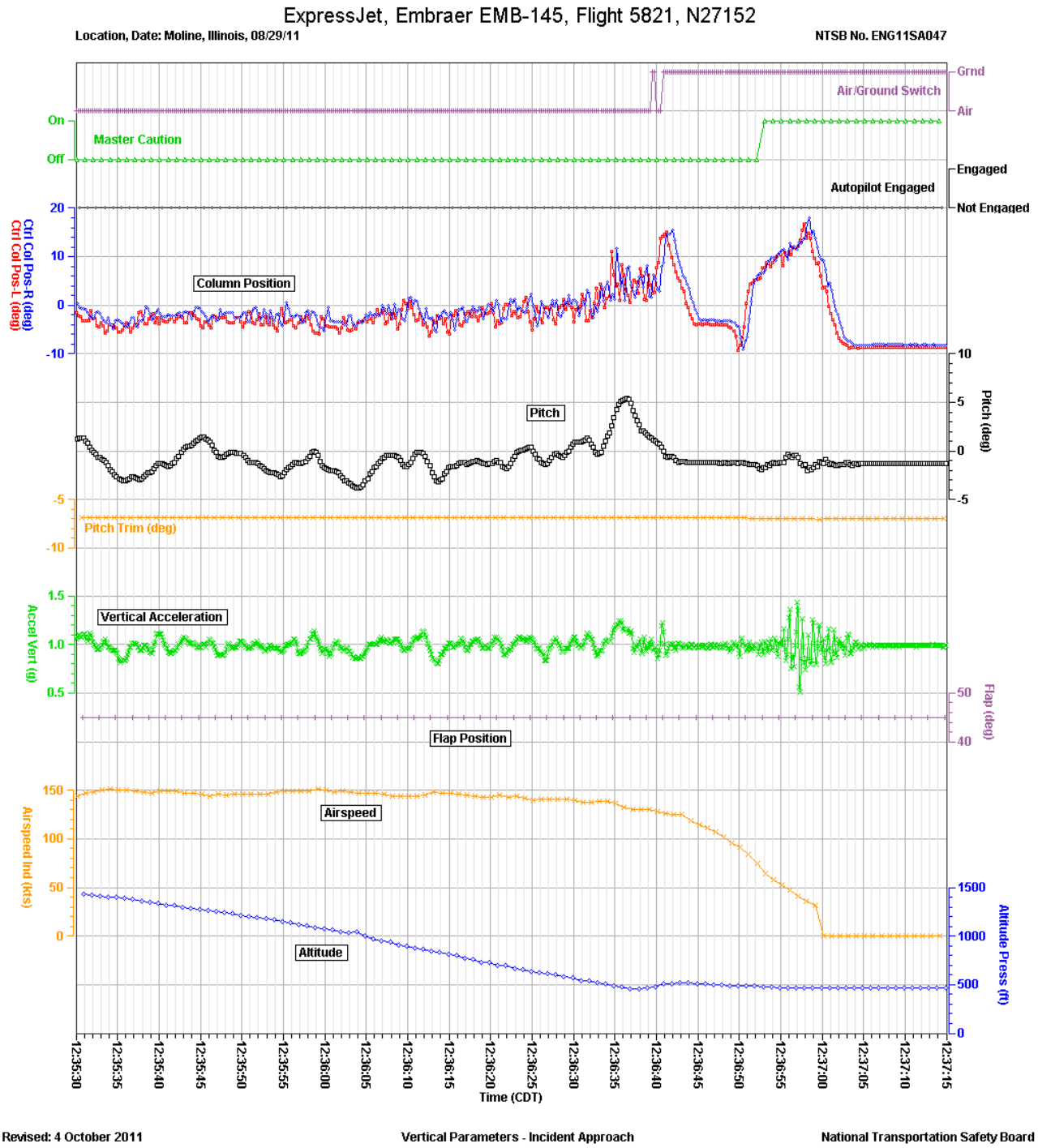
ExpressJet, Embraer EMB-145, Flight 5821, N27152
Location, Date: Moline, Illinois, 08/29/11
NTSB No. ENG11SA047
Grnd
Air/Ground Switch
Air
On
Master Caution
Off
Engaged
Autopilot Engaged
Not Engaged
20
10
0
-10
Ctrl Col Pos-R (deg)
Ctrl Col Pos-L (deg)
Column Position
10
5
0
-5
Pitch (deg)
Pitch
-5
-10
Pitch Trim (deg)
1.5
1.0
0.5
Accel Vert (g)
Vertical Acceleration
50
40
Flap (deg)
Flap Position
150
100
50
0
Airspeed Ind (kts)
Airspeed
1500
1000
500
0
Altitude Press (ft)
Altitude
12:35:30
12:35:35
12:35:40
12:35:45
12:35:50
12:35:55
12:36:00
12:36:05
12:36:10
12:36:15
12:36:20
12:36:25
12:36:30
12:36:35
12:36:40
12:36:45
12:36:50
12:36:55
12:37:00
12:37:05
12:37:10
12:37:15
Time (CDT)
Revised: 4 October 2011
Vertical Parameters - Incident Approach
National Transportation Safety Board

Figure 2.

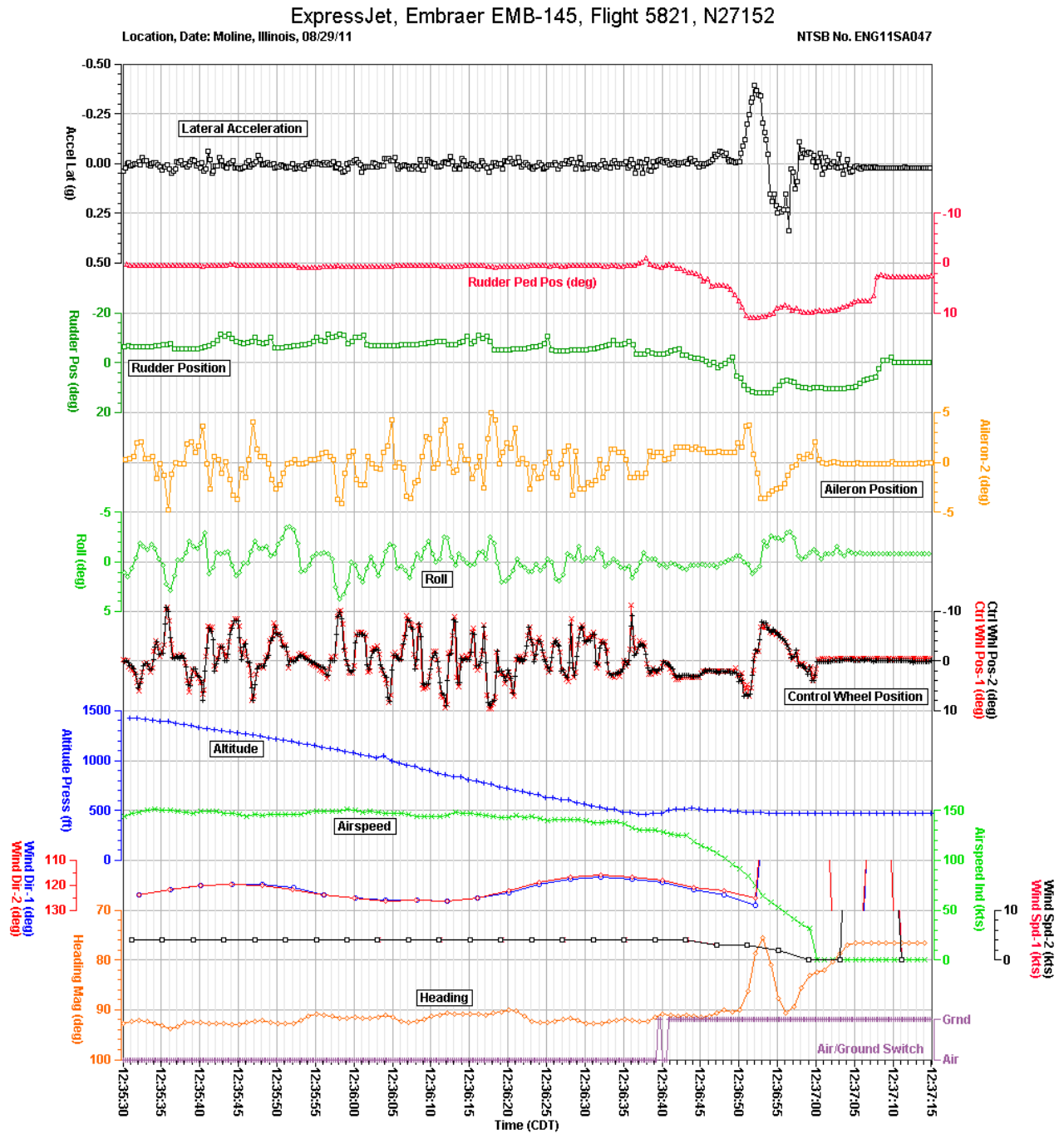
ExpressJet, Embraer EMB-145, Flight 5821, N27152
Location, Date: Moline, Illinois, 08/29/11
NTSB No. ENG11SA047
Lateral Acceleration
Accel Lat (g)
Rudder Ped Pos (deg)
Rudder Position
Rudder Pos (deg)
Aileron Position
Aileron-2 (deg)
Roll
Roll (deg)
Control Wheel Position
Ctrl Whl Pos-2 (deg)
Ctrl Whl Pos-1 (deg)
Altitude
Altitude Press (ft)
Airspeed
Airspeed Ind (kts)
Wind Dir-1 (deg)
Wind Dir-2 (deg)
Wind Spd-2 (kts)
Wind Spd-1 (kts)
Heading
Heading Mag (deg)
Air/Ground Switch
Grnd
Air
Time (CDT)
Revised: 4 October 2011
Lateral/Directional Parameters - Incident Approach
National Transportation Safety Board

Figure 3.

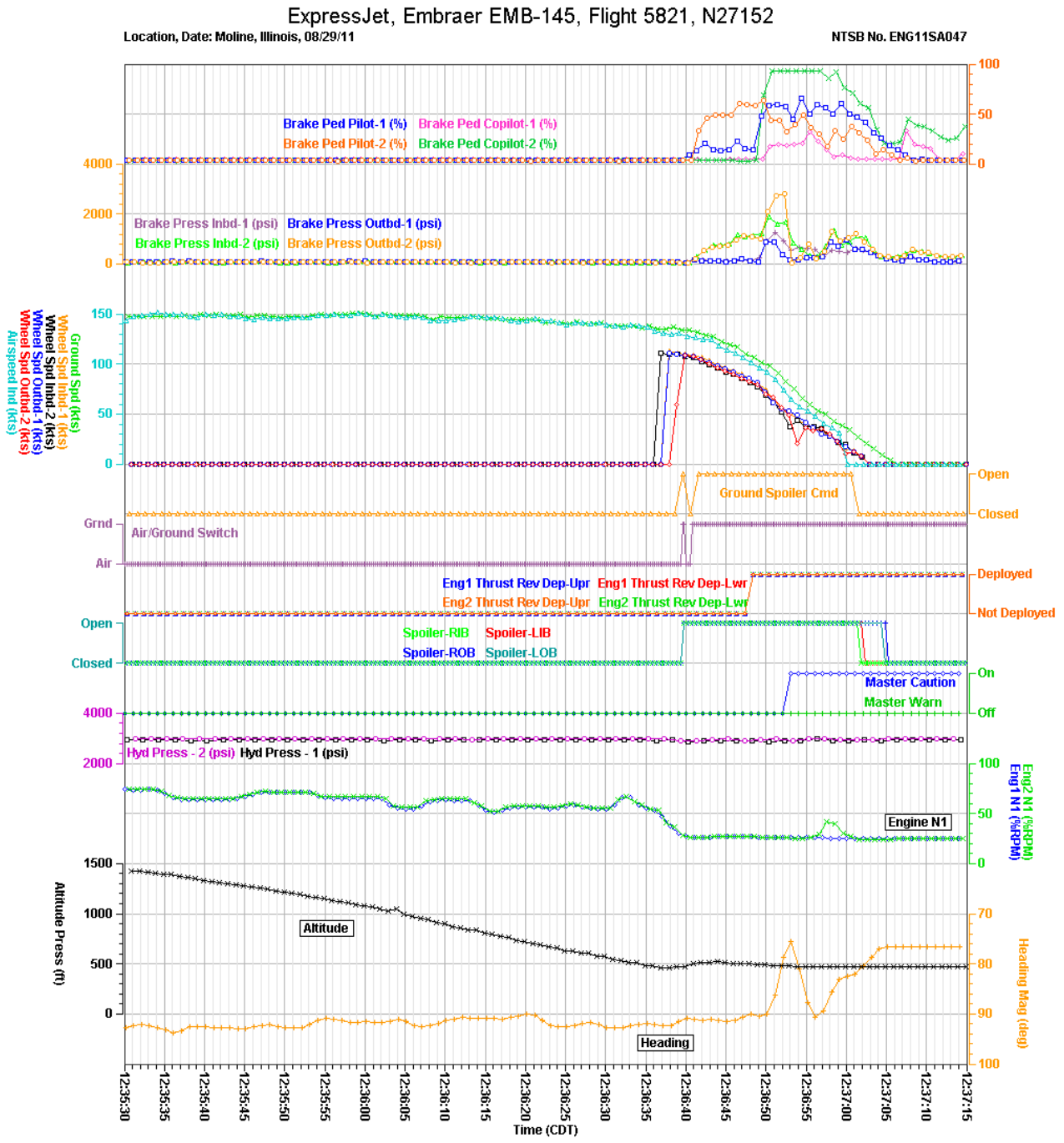
ExpressJet, Embraer EMB-145, Flight 5821, N27152
Location, Date: Moline, Illinois, 08/29/11
NTSB No. ENG11SA047
Brake Ped Pilot-1 (%)
Brake Ped Copilot-1 (%)
Brake Ped Pilot-2 (%)
Brake Ped Copilot-2 (%)
Brake Press Inbd-1 (psi)
Brake Press Outbd-1 (psi)
Brake Press Inbd-2 (psi)
Brake Press Outbd-2 (psi)
Airspeed Ind (kts)
Wheel Spd Outbd-2 (kts)
Wheel Spd Outbd-1 (kts)
Wheel Spd Inbd-2 (kts)
Wheel Spd Inbd-1 (kts)
Ground Spd (kts)
Ground Spoiler Cmd
Air/Ground Switch
Grnd
Air
Eng1 Thrust Rev Dep-Upr
Eng1 Thrust Rev Dep-Lwr
Eng2 Thrust Rev Dep-Upr
Eng2 Thrust Rev Dep-Lwr
Spoiler-RIB
Spoiler-LIB
Spoiler-ROB
Spoiler-LOB
Master Caution
Master Warn
Hyd Press - 2 (psi)
Hyd Press - 1 (psi)
Engine N1
Eng2 N1 (%RPM)
Eng1 N1 (%RPM)
Altitude
Altitude Press (ft)
Heading
Heading Mag (deg)
Time (CDT)
Revised: 16 September 2011
Brakes, Engine, Gear, Hydraulics - Incident Approach
National Transportation Safety Board

Figure 4.

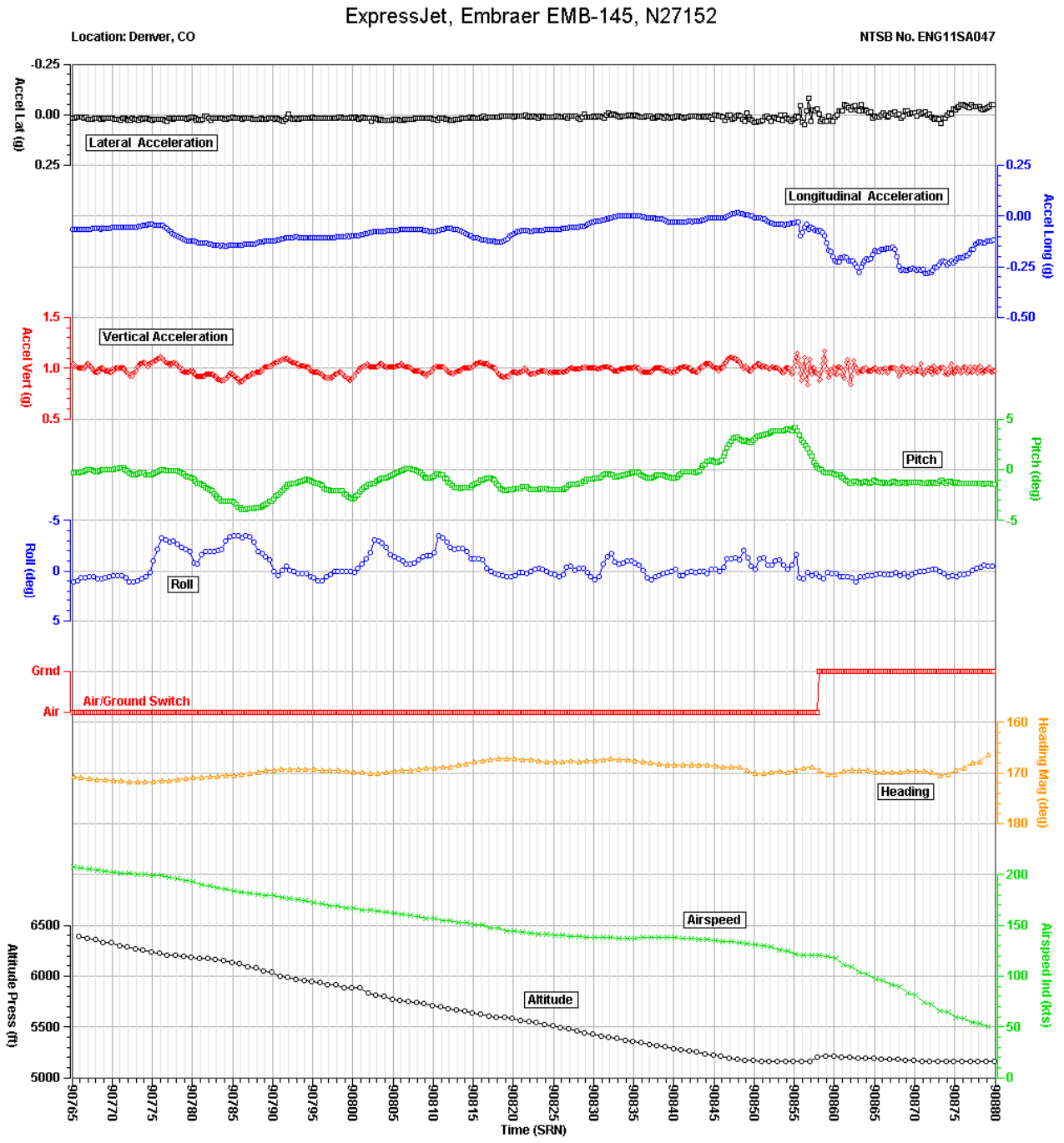
ExpressJet, Embraer EMB-145, N27152
Location: Denver, CO
NTSB No. ENG11SA047
Accel Lat (g)
-0.25
0.00
0.25
Lateral Acceleration
Longitudinal Acceleration
Accel Long (g)
0.25
0.00
-0.25
-0.50
Accel Vert (g)
1.5
1.0
0.5
Vertical Acceleration
Pitch (deg)
5
0
-5
Pitch
Roll (deg)
-5
0
5
Roll
Grnd
Air
Air/Ground Switch
Heading Mag (deg)
160
170
180
Heading
Airspeed Ind (kts)
200
150
100
50
0
Airspeed
Altitude Press (ft)
6500
6000
5500
5000
Altitude
90765
90770
90775
90780
90785
90790
90795
90800
90805
90810
90815
90820
90825
90830
90835
90840
90845
90850
90855
90860
90865
90870
90875
90880
Time (SRN)
Revised: 4 October 2011
Basic Parameters - Previous Approach
National Transportation Safety Board

Figure 5.

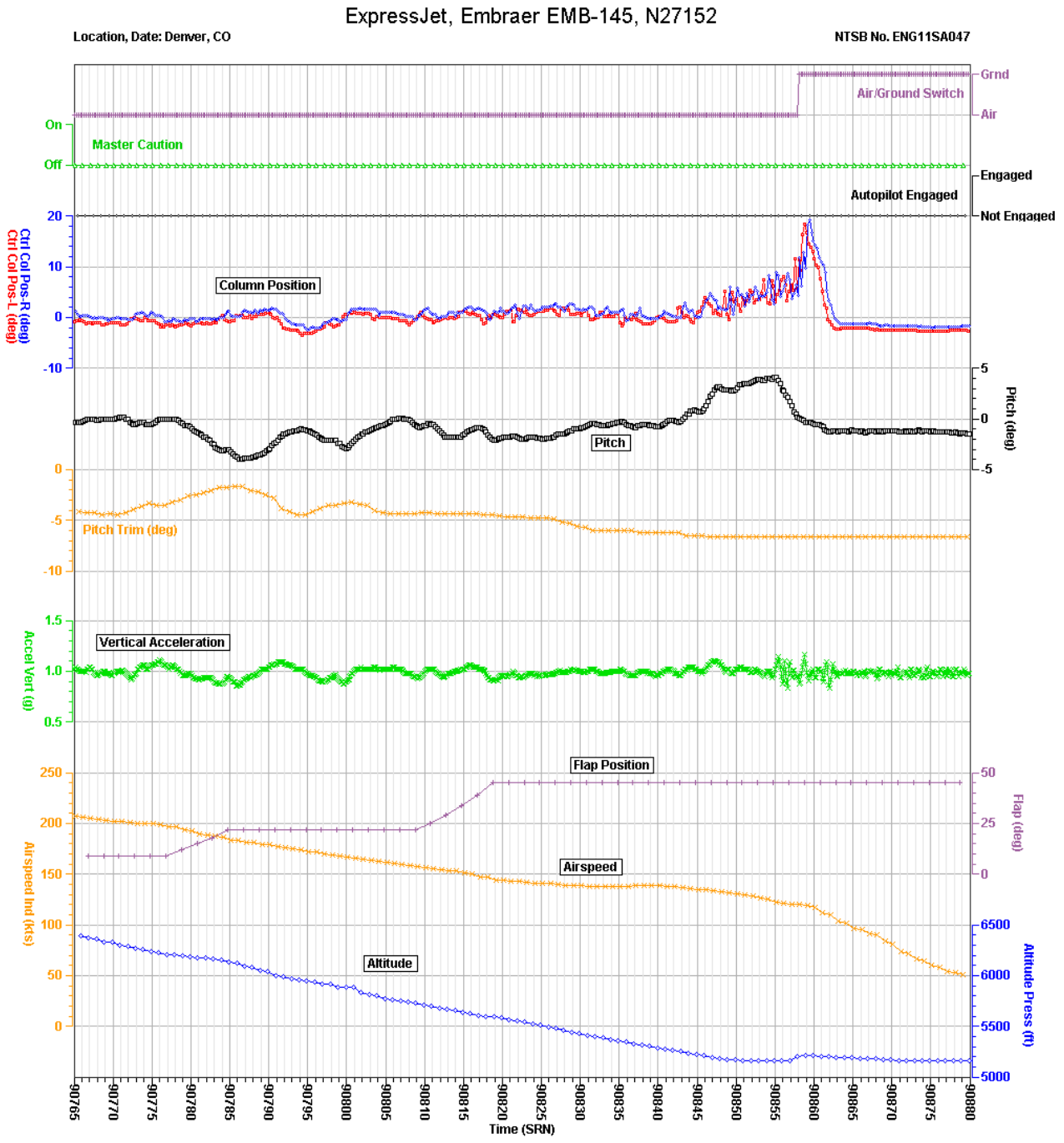
ExpressJet, Embraer EMB-145, N27152
Location, Date: Denver, CO
NTSB No. ENG11SA047
Grnd
Air/Ground Switch
Air
On
Master Caution
Off
Engaged
Autopilot Engaged
Not Engaged
20
10
0
-10
Ctrl Col Pos-R (deg)
Ctrl Col Pos-L (deg)
Column Position
5
0
-5
Pitch (deg)
Pitch
0
-5
-10
Pitch Trim (deg)
1.5
1.0
0.5
Accel Vert (g)
Vertical Acceleration
250
200
150
100
50
0
Airspeed Ind (kts)
Flap Position
50
25
0
Flap (deg)
Airspeed
6500
6000
5500
5000
Altitude Press (ft)
Altitude
00765
00770
00775
00780
00785
00790
00795
00800
00805
00810
00815
00820
00825
00830
00835
00840
00845
00850
00855
00860
00865
00870
00875
00880
Time (SRN)
Revised: 4 October 2011
Vertical Parameters - Previous Approach
National Transportation Safety Board

Figure 6.

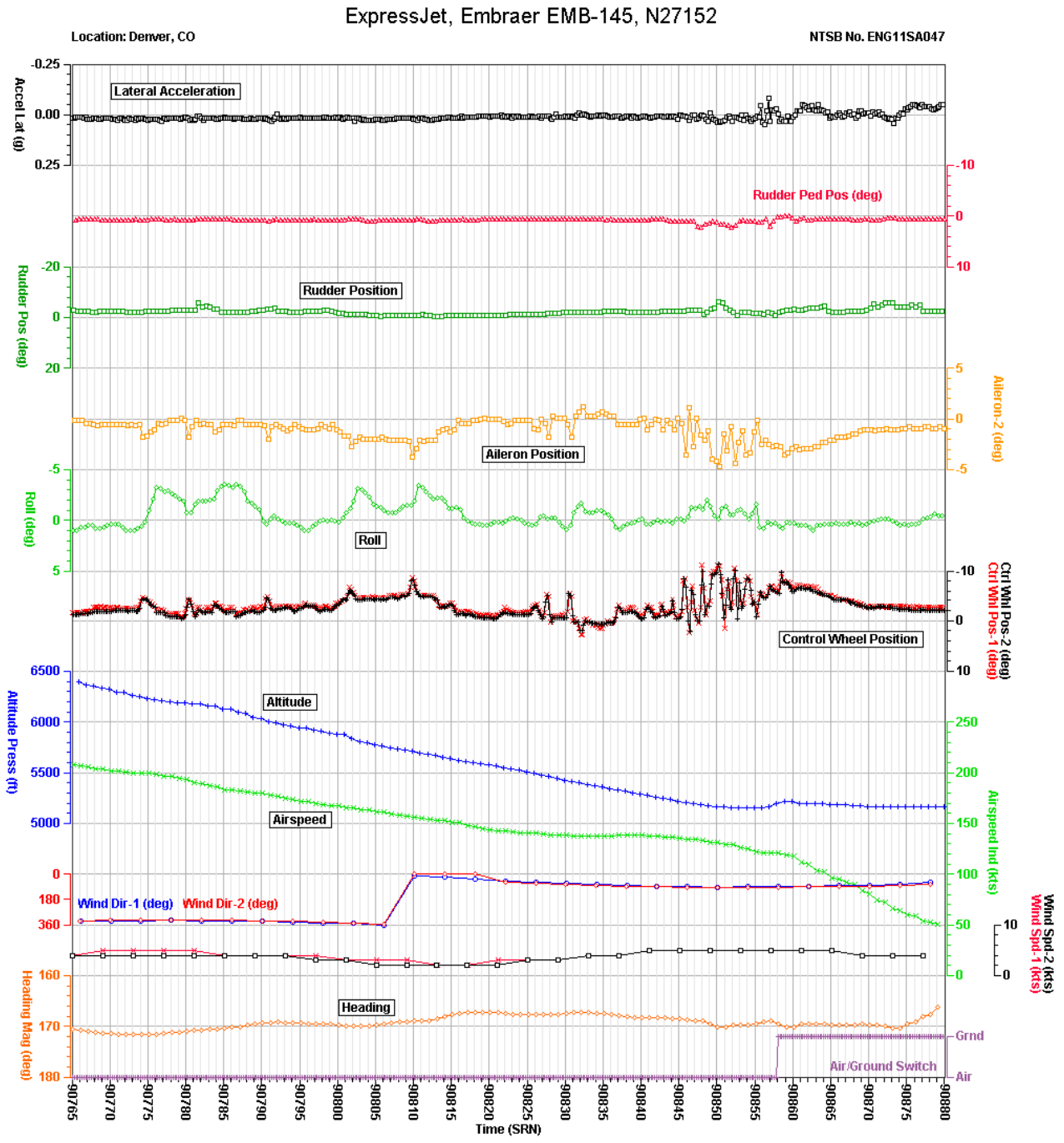
ExpressJet, Embraer EMB-145, N27152
Location: Denver, CO
NTSB No. ENG11SA047
Lateral Acceleration
Accel Lat (g)
Rudder Ped Pos (deg)
Rudder Position
Rudder Pos (deg)
Aileron Position
Aileron-2 (deg)
Roll
Roll (deg)
Control Wheel Position
Ctrl Whl Pos-2 (deg)
Ctrl Whl Pos-1 (deg)
Altitude
Altitude Press (ft)
Airspeed
Airspeed Ind (kts)
Wind Dir-1 (deg)
Wind Dir-2 (deg)
Wind Spd-2 (kts)
Wind Spd-1 (kts)
Heading
Heading Mag (deg)
Air/Ground Switch
Grnd
Air
Time (SRN)
Revised: 4 October 2011
Lateral/Directional Parameters - Previous Approach
National Transportation Safety Board

Figure 7.

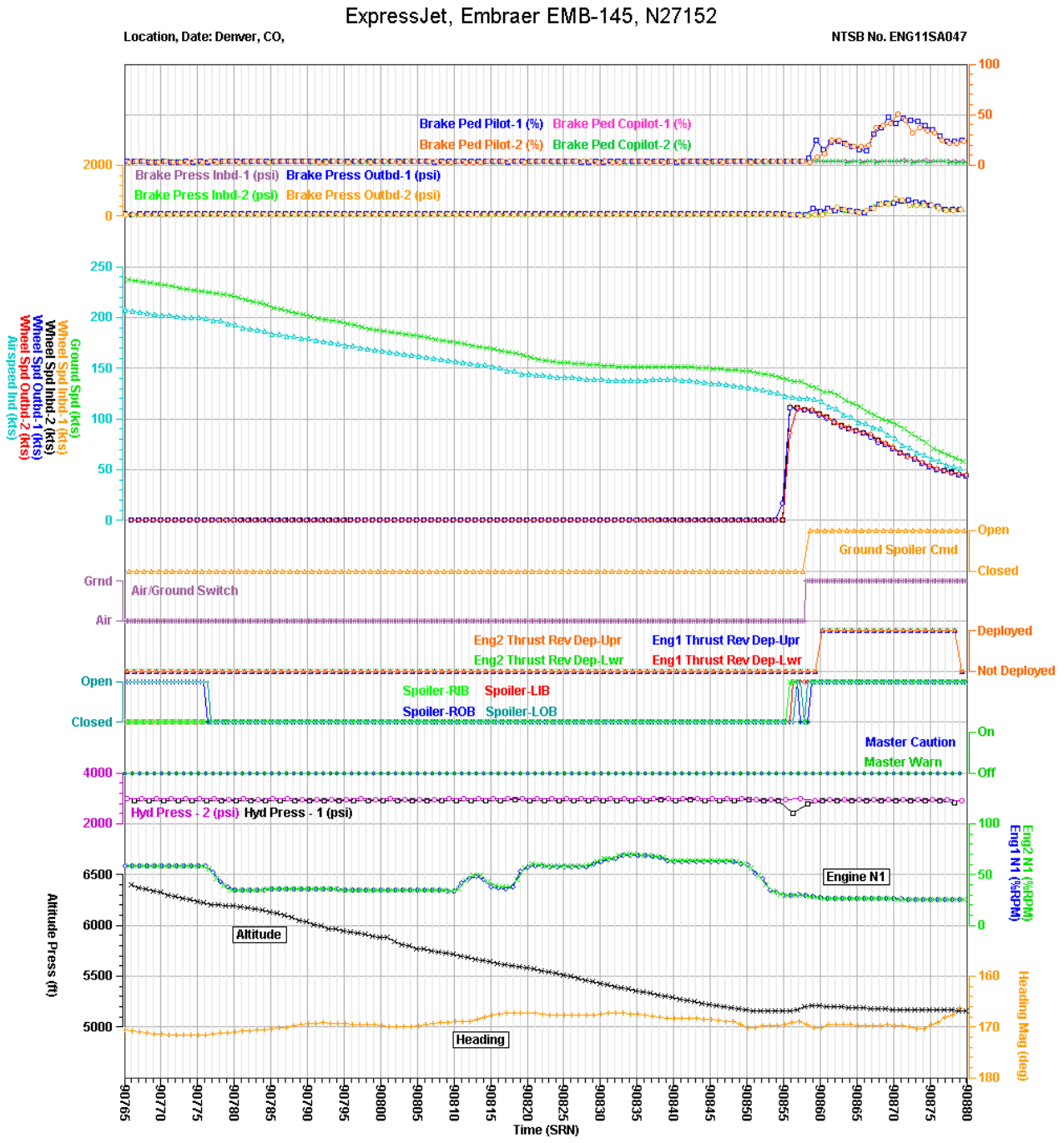
ExpressJet, Embraer EMB-145, N27152
Location, Date: Denver, CO,
NTSB No. ENG11SA047
Brake Ped Pilot-1 (%)
Brake Ped Copilot-1 (%)
Brake Ped Pilot-2 (%)
Brake Ped Copilot-2 (%)
Brake Press Inbd-1 (psi)
Brake Press Outbd-1 (psi)
Brake Press Inbd-2 (psi)
Brake Press Outbd-2 (psi)
Ground Spd (kts)
Wheel Spd Inbd-1 (kts)
Wheel Spd Inbd-2 (kts)
Wheel Spd Outbd-1 (kts)
Wheel Spd Outbd-2 (kts)
Airspeed Ind (kts)
Ground Spoiler Cmd
Open
Closed
Air/Ground Switch
Grnd
Air
Eng2 Thrust Rev Dep-Upr
Eng1 Thrust Rev Dep-Upr
Eng2 Thrust Rev Dep-Lwr
Eng1 Thrust Rev Dep-Lwr
Deployed
Not Deployed
Spoiler-RIB
Spoiler-LIB
Spoiler-ROB
Spoiler-LOB
Master Caution
Master Warn
On
Off
Hyd Press - 2 (psi)
Hyd Press - 1 (psi)
Engine N1
Eng2 N1 (%RPM)
Eng1 N1 (%RPM)
Altitude
Altitude Press (ft)
Heading
Heading Mag (deg)
Time (SRN)
Revised: 4 October 2011
Brakes, Engine, Gear, Hydraulics - Previous Approach
National Transportation Safety Board

Figure 8.

APPENDIX A

This appendix describes the parameters provided and verified in this report. Table A-1 lists the parameters and table A-2 describes the unit abbreviations used in this report.

Table A-1. Provided and verified parameters.

Plot Label	Parameter Description
Accel Lat (g)	Vertical Acceleration
Accel Long (g)	Longitudinal Acceleration
Accel Vert (g)	Lateral Acceleration
Aileron-1 (deg)	Left Aileron Position
Aileron-2 (deg)	Right Aileron Position
Air/Ground Switch	Air Ground Discrete
Airspeed Ind (kts)	Indicated Airspeed
Altitude Press (ft)	Pressure Altitude
Autopilot Engaged	Autopilot Engaged Discrete
Brake Ped Copilot-1 (%)	Copilot Left Brake Pedal Position
Brake Ped Copilot-2 (%)	Copilot Right Brake Pedal Position
Brake Ped Pilot-1 (%)	Pilot Left Brake Pedal Position
Brake Ped Pilot-2 (%)	Pilot Right Brake Pedal Position
Brake Press Inbd-1 (psi)	Left Inboard Brake Pressure
Brake Press Inbd-2 (psi)	Right Inboard Brake Pressure
Brake Press Outbd-1 (psi)	Left Outboard Brake Pressure
Brake Press Outbd-2 (psi)	Right Outboard Brake Pressure
Ctrl Col Pos-L (deg)	Pilot Control Column Position
Ctrl Col Pos-R (deg)	Copilot Control Column Position
Ctrl Whl Pos-1 (deg)	Pilot Control Wheel Position
Ctrl Whl Pos-2 (deg)	Copilot Control Wheel Position
Elevator-1 (deg)	Left Elevator Position
Elevator-2 (deg)	Right Elevator Position
Eng1 N1 (%rpm)	Left Engine N1
Eng1 Thrust Rev Dep-Lwr	Left Lower Thrust Reverser Deployed Discrete
Eng1 Thrust Rev Dep-Upr	Left Upper Thrust Reverser Deployed Discrete
Eng2 N1 (%rpm)	Right Engine N1
Eng2 Thrust Rev Dep-Lwr	Right Lower Thrust Reverser Deployed Discrete
Eng2 Thrust Rev Dep-Upr	Right Upper Thrust Reverser Deployed Discrete
Flap (deg)	Flap Position
Ground Spd (kts)	Ground Speed
Ground Spoiler Cmd	Ground Spoiler Command Discrete
Heading Mag (deg)	Magnetic Heading
Hyd Press – 1 (psi)	Hydraulic System #1 Pressure
Hyd Press – 2 (psi)	Hydraulic System #2 Pressure
Key PTT	VHF Push-to-Talk Discrete
Master Caution	Master Caution Discrete
Master Warn	Master Warning Discrete
Pitch (deg)	Pitch Attitude
Pitch Trim (deg)	Pitch Trim Setting
Roll (deg)	Roll Attitude
Rudder Ped Pos (deg)	Rudder Pedal Position
Rudder Pos (deg)	Rudder Deflection
Spoiler-LIB	Left Inboard Spoiler Deployed Discrete
Spoiler-LOB	Left Outboard Spoiler Deployed Discrete

Plot Label	Parameter Description
Spoiler-RIB	Right Inboard Spoiler Deployed Discrete
Spoiler-ROB	Right Outboard Spoiler Deployed Discrete
Time GMT Hrs	UTC Hours
Time GMT Min	UTC Minutes
Time GMT Sec	UTC Seconds
Wheel Spd Inbd-1 (kts)	Left Inboard Wheel Speed
Wheel Spd Inbd-2 (kts)	Right Inboard Wheel Speed
Wheel Spd Outbd-1 (kts)	Left Outboard Wheel Speed
Wheel Spd Outbd-2 (kts)	Right Outboard Wheel Speed
Wind Dir-1 (deg)	Air Data Computer 1 Wind Direction
Wind Dir-2 (deg)	Air Data Computer 2 Wind Direction
Wind Spd-1 (kts)	Air Data Computer 1 Wind Speed
Wind Spd-2 (kts)	Air Data Computer 2 Wind Speed

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.

Table A-2. Unit abbreviations.

Units Abbreviation	Description
deg	degrees
kts	knots
g	unit of acceleration
discrete	discrete
degC	degrees Celsius
in	inches
ft	feet
hrs	hours
min	minutes
sec	seconds
%rpm	percent revolutions per minute
psi	pounds per square inch

NOTE: For parameters with a unit description of discrete, 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.