#### NATIONAL TRANSPORTATION SAFETY BOARD

Vehicle Recorder Division Washington, D.C. 20594

July 20, 2017

# Flight Data Recorder

# Specialist's Factual Report By Cassandra Johnson

#### 1. EVENT SUMMARY

Location: Sugar Land, Texas

Date: July 26, 2016

Aircraft: Embraer EMB-505

Registration: N362FX

Operator: Flight Options LLC NTSB Number: CEN16FA286

On July 26, 2016, at 1509 central daylight time (CDT), an Embraer EMB-505 airplane, N362FX, was substantially damaged during a runway excursion on landing at the Sugar Land Regional Airport (SGR), Sugar Land, Texas. The two pilots sustained minor injuries; the sole passenger was not injured. The airplane was registered to FlexJet LLC and operated by Flight Options LLC under the provisions of Title 14 *Code of Federal Regulations* Part 135 as a corporate/executive flight. Visual meteorological conditions were reported at the airport; however, instrument meteorological conditions prevailed in the local area. The flight was operated on an instrument flight rules flight plan. The flight originated from the Scottsdale Airport (SDL), Scottsdale, Arizona, at 1029 mountain standard time.

#### 2. FLIGHT DATA RECORDER GROUP

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

#### 3. FDR Carriage Requirements

The event aircraft, N362FX, was manufactured in 2014, and was operating such that it 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 Cockpit Voice and Data Recorder (CVDR):

Recorder Manufacturer/Model: L-3/Fairchild FA2100-3083

Recorder Serial Number: 000603248

## 4.1. L-3/Fairchild FA2100-3083 Description

The L-3 Cockpit Voice and Data Recorder (CVDR) is a dual function recorder providing both FDR and Cockpit Voice Recorder (CVR) functions. The FDR function records airplane flight information in a digital format using solid-state flash memory as the recording medium. The FA2100-3083 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 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 CVDR is designed to meet the crash-survivability requirements of TSO-C123a and TSO-C124a. For the rest of this report, the CVDR will be referred to as an FDR.

## 4.1.1. Inertia Switch Logic

The FDR is equipped with an inertia switch (also known as a "g-switch" or "negative acceleration sensor"). According to Embraer, the inertia switch is designed to remove power from the FDR when the inertia switch is subjected to load of 5 g or more. For more information regarding the inertia switch, refer to the Cockpit Voice Recorder Group Chairman's Report.

#### 4.1.2. Recorder Condition

The recorder was in good condition and the data were extracted normally from the recorder.

## 4.1.3. Recording Description

The FDR recording contained approximately 217 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 2 hours and 41 minutes.

#### 4.1.4. 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=+).<sup>1</sup>

Table A-1 lists the FDR parameters verified and provided in this report and includes the parameter names, parameter descriptions, and the units. Additionally, table A-2 describes the unit and discrete abbreviations used in this report.

## 4.1.5. Non-Computed Data Pattern

A non-computed data (NCD) pattern is indicative that the raw data for a given parameter is no longer reliable or not available. The Distance Measurable Equipment Distance-1 (DME Dist-1) parameter had a NCD pattern when its system was not activated.

 $<sup>^{1}</sup>$  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, CDT, was established by using the recorded Coordinated Universal Time (UTC) time parameters (Time UTC-Hrs, Time UTC-Min, and Time UTC-Sec) and then applying an additional 5 hours offset to change UTC to CDT. Accordingly, the time offset for the event flight data from SRN to local CDT is the following: CDT = SRN + 92,770. Therefore, for the rest of this report, all times are referenced as CDT, not SRN.

## 4.3. FDR Plots and Corresponding Tabular Data

Figures 1 to 8 contain FDR data recorded during the event on July 26, 2016. All the parameters listed in table A-1 are plotted except Time UTC-Hrs, Time UTC-Min, Time UTC-Sec, Latitude-1, Latitude-2, Longitude-1, and Longitude-2. 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.

Figures 1 to 4 cover the entire event flight from 12:25:00 CDT to the end of the FDR recording at 15:10:31 CDT (the x-axis ends at 15:15:00 CDT). Figures 5 to 8 have expanded scales from 15:09:45 CDT to 15:10:35 CDT covering the final approach from a radio altitude of 91 feet (ft) through landing. Figures 1 and 5 contain basic parameters; figures 2 and 6 contain select parameters; figures 3 and 7 contain select engine parameters; and figures 4 and 8 contain additional select parameters.

The FDR data indicated at about 15:09:55 CDT, approximately 2 hours 41 minutes after takeoff, the left and right main landing gear weight on wheel parameters (Gear WOW-L1, Gear WOW-L2, Gear WOW-R1, and Gear WOW-R2) transitioned from Not Weight on Wheels (Not WOW) to WOW and remained WOW for the rest of the FDR recording. At this time, ground speed (Ground Spd-1 and Ground Spd-2) was about 128 knots (kts). Less than 3 seconds later at 15:09:57.6 CDT, the Anti Skid Fail parameter transitioned from Normal to Fail and remained Fail for the rest of the FDR recording. At this time, the right brake pressure (Brake Press-R) increased from 220 pounds per square inch (psi) to 1000 psi, the ground speed decreased to 123 kts, and the left brake pressure (Brake Press-L) remained at about 80 psi. Less than 2 seconds later at 15:09:59.1 CDT, the right brake pressure increased to 2,950 psi and remained at about 2,950 psi for the rest of the recording. Additionally, ground speed decreased to 119 kts. About 4 seconds later at 15:10:03.1 CDT until 15:10:05.1 CDT, the left brake pressure increased from 70 psi to 2,980 psi and remained at about 2,980 psi for the rest of the recording, except the last data recorded was 240 psi. Also from 15:10:03.1 CDT to 15:10:05.1 CDT, ground speed decreased from 110 kts to 105 kts and the Engine Indication and Crew Alerting System -Anti Skid Fail parameter (EICAS Anti Skid Fail) transitioned from Off to On and remained On for the rest of the recording. About 25 seconds later at 15:10:30.4 CDT, the ground speed reduced to 60 knots and less than 1 second later, at 15:10:31.2 CDT, the data ended. In this accident, the inertia switch removed power from the FDR before the aircraft came to a complete stop.

The tabular data from 12:25:00 CDT to 15:10:31 CDT for all the parameters listed in table A-1 are provided in electronic comma separated value (.csv) format as attachment 1 to this factual report.

NTSB No. CEN16FA286 Location, Date: Sugar Land, Texas, 07/26/16 **Not WOW** Gear WOW-L1 Gear WOW-L1 WOW Not WOW Gear WOW-L2 Gear WOW-L2 WOW **Not WOW** Gear WOW-R1 Not WOW Gear WOW-R2 Gear WOW-R2 WOW Key Key VHF-1 Not Keyed Key Key VHF-2 Not Keyed Accel Vert (g) Key VHF-2 Accel Vert Accel Long (g) 0.0 0.0 -0.3 Accel Long Accel Lat (g) **Accel Lat** Pitch-2 (deg) Pitch-1 (deg) 0 Pitch Roll-2 (deg) Roll-1 (deg) Roll Heading Mag-2 (deg) Heading Mag-1 (deg) **Heading Mag** 90 500007 180 Altitude Press Altitude Press-2 (ft) Altitude Press-1 (ft) 40000 270 30000 360 20000 10000 Groundspeed Airspeed Ind **Engaged**7 AP Engaged 12:45:00 12:55:00 13:00:00 13:10:00 13:20:00 13:25:00 13:30:00 13:40:00 14:00:00 14:10:00 14:30:00 14:40:00 14:55:00 15:00:00 15:05:00 15:10:00 12:35:00 12:50:00 13:05:00 13:15:00 13:35:00 13:45:00 13:50:00 13:55:00 14:05:00 14:15:00 14:20:00 14:25:00 14:35:00 14:45:00 14:50:00 15:15:00 CDT (HH:MM:SS) Revised: 20 July 2017 Flight Options, Embraer EMB-505, N362FX **National Transportation Safety Board** 

Figure 1. Plot of basic parameters during entire flight.

Location, Date: Sugar Land, Texas, 07/26/16 NTSB No. CEN16FA286 Gear WOW-R2
Gear WOW-R1
Gear WOW-L2
Gear WOW-L1 Gear WOW-L1+L2+R1+R2 WOW Fail Brake Fail Brake Fail Normal Fail Anti Skid Fail Anti Skid Fail Normal Or **EICAS Anti Skid Fail Master Caution** Master Caution **Master Warning Master Warning** Off Brake Accumulator Press (psi) Applied<sup>-</sup> Parking Brake Parking Brake **Brake Accumulator Press** Brake Ped Pos Pilot-R (mm)
Brake Ped Pos Pilot-L (mm) 30007 1500 **Brake Press Brake Ped Pos Pilot** Groundspeed Wheel Speed Heading Mag-2 (Heading Mag-1) **Heading Mag** Spoiler-R (deg) Eng1 TLA (deg)
Spoiler-L (deg) Eng1 TLA (deg) (deg) Spoiler -L+R Eng N1 Temp TAT (deg ( %) 으ූ ූ ළි **Eng TLA** Temp TAT 12:40:00 12:50:00 12:55:00 13:00:00 13:05:00 13:10:00 13:20:00 13:45:00 13:50:00 13:55:00 14:00:00 14:05:00 14:10:00 14:15:00 14:20:00 14:25:00 14:30:00 14:45:00 14:50:00 15:05:00 15:10:00 12:45:00 14:40:00 12:35:00 13:15:00 13:25:00 13:30:00 13:35:00 14:35:00 14:55:00 15:00:00 15:15:00 12:30:00 13:40:00 CDT (HH:MM:SS) Revised: 20 July 2017 Flight Options, Embraer EMB-505, N362FX **National Transportation Safety Board** 

Figure 2. Plot of select parameters during entire flight.

Location, Date: Sugar Land, Texas, 07/26/16 NTSB No. CEN16FA286 Eng2 N1 (%) Eng N1 Eng2 N2 (%) Eng1 N2 (%) 50 0 Eng N2 Eng2 TLA (deg) Eng1 TLA (deg) 50 Eng TLA Eng2 2000 Fuel Flow (pph) 11 Fuel Flow (pph) 0 **Eng Fuel Flow** Eng2 Oil Press (psi) **Eng Oil Press** Eng2 Oil Temp (degC)
Eng1 Oil Temp (degC)
S S S (psi) 1 10 Eng2 Chip Detector Sensor (Volts) Eng1 Chip Detector Sensor (Volts) **Eng Oil Temp Eng Chip Detector Sensor Low Press Eng Oil Press Low** Eng2 Oil Press Low Normal Eng1 Overspeed Exceedance Overspeed Eng Overspeed Exceedance Eng2 Overspeed Exceedance Normal Eng1 FADEC Failure-Fault Eng2 FADEC Failure-Fault Airspeed Ind-1 (kts) **Eng FADEC Failure-Fault** Norma Airspeed Ind-1 50000 200 Altitude Press-1 Altitude Press-1 (ft) 40000 30000 Gear WOW-L1 20000 10000 Gear WOW-L1 13:10:00 13:55:00 14:00:00 14:05:00 14:10:00 14:40:00 14:55:00 15:10:00 13:40:00 13:45:00 13:50:00 14:25:00 14:50:00 12:30:00 12:40:00 12:45:00 12:50:00 12:55:00 13:00:00 13:05:00 13:15:00 13:20:00 13:25:00 13:30:00 14:15:00 14:30:00 14:35:00 14:45:00 15:00:00 15:05:00 15:15:00 12:25:00 13:35:00 14:20:00 CDT (HH:MM:SS) Revised: 20 July 2017 Flight Options, Embraer EMB-505, N362FX **National Transportation Safety Board** 

Figure 3. Plot of select engine parameters during entire flight.

Location, Date: Sugar Land, Texas, 07/26/16 NTSB No. CEN16FA286 Ice Detect Ice Detect Ice Detect No Ice Detect On Wing Stab Anti-Ice Cockpit Sw Wing Stab Anti-Ice Cockpit Sw Off On AP Engaged Off Valid AOA Valid-L+R AOA Valid-L Not Valid Cmd Open Speed Brk Cockpit Lever Pos CDME Dist-1 (Nm) Gilde Slope Dev-2 (ddm) Gilde Slope Dev-1 (ddm) Gilde Slope Dev-1 (ddm) Flap-R (deg)

Nav Frequency 1 (MHz)

Nav Frequency 2 (MHz)

Nav Frequency 2 (MHz) GrossWt Unit Display GrossWt Unit Display DME Dist-1 8000 7000 GrossWt Nav Frequency 1+2 Localizer Dev-1+2 Glide Slope Dev-1+2 AOA-L (deg) AOA-R (deg) AOA-L+R Flap Cons and Flap-L+R Full Flap Pos 3 Pever Pos 1 Pever Pos 0 30 0 DME Dist-2 (Nm) Flap Lever Altitude Radio (ft) DME Dist-2 Altitude Radio Not WOW Gear WOW-L1 Gear WOW-L1 12:45:00 13:25:00 13:55:00 14:00:00 14:20:00 15:00:00 15:10:00 12:55:00 13:00:00 13:05:00 13:15:00 13:20:00 13:35:00 13:45:00 13:50:00 14:10:00 14:15:00 14:30:00 14:35:00 14:40:00 14:45:00 14:50:00 14:55:00 15:15:00 12:30:00 12:35:00 12:40:00 12:50:00 13:10:00 13:30:00 13:40:00 14:05:00 14:25:00 15:05:00 CDT (HH:MM:SS)

Figure 4. Plot of additional select parameters during entire flight.

Location, Date: Sugar Land, Texas, 07/26/16 NTSB No. CEN16FA286 **Not WOW** Gear WOW-L1 Gear WOW-L1 WOW Not WOW Gear WOW-L2 Gear WOW-L2 WOW **Not WOW** Gear WOW-R1 ear WOW-R1 Not WOW Gear WOW-R2 Gear WOW-R2 wow Key VHF-1 Key VHF-1 Not Keyed Key Accel Lat (g)

Accel Lat (g) Key VHF-2 Key VHF-2 Not Keyed **Accel Vert** Accel Long Pitch-2 (deg)
Pitch-1 (deg)
5 10 Accel Lat 0 Pitch -15 -10 Roll-2 (deg) Roll-1 (deg) Roll 10 **Heading Mag** Altitude Press-2 (ft) Altitude Press-1 (ft) 0 Altitude Press Groundspeed Airspeed Ind Engaged<sup>-</sup> AP Engaged Not Engaged 15:10:10:10:CDT (HH:MM:SS) 15:10:25 15:09:50 15:09:55 15:10:05 15:10:20 15:10:30 15:09:45 15:10:00 15:10:15 15:10:35 Revised: 20 July 2017 Flight Options, Embraer EMB-505, N362FX **National Transportation Safety Board** 

Figure 5. Plot of basic parameters during final descent through the end of the FDR recording.

Location, Date: Sugar Land, Texas, 07/26/16 NTSB No. CEN16FA286 Gear WOW-R2 Gear WOW-R1 Gear WOW-L2 Gear WOW-L1 Gear WOW-L1+L2+R1+R2 Fail Brake Fail Normal Anti Skiď Fáil Anti Skid Fail Normal **EICAS Anti Skid Fail EICAS Anti Skid Fail** Off Master Caution Master Caution On Master Warning Master Warning Applied<sup>1</sup> Parking Brake Not Applied 2800 ⋛ Brake Accumulator Press **Brake Accumulator Press** 2600 Brake Press-R (psi) Brake Press-L (psi) <del>6</del> 3000-Brake Press-R Brake Press Brake Ped Pos Pilot-R (mm)
Brake Ped Pos Pilot-L (mm) 1500 Brake Press-L **Brake Ped Pos Pilot** Wheel Speed-L (kts)
Ground Spd-2 (kts)
Ground Spd-1 (kts) **Heading Mag** Groundspeed Heading Heading Wheel Speed-L Wheel Speed Wheel Speed Wheel Speed Wheel Speed-R Eng2 TLA (deg) Eng1 TLA (deg) **Heading Mag** (deg) Eng TLA Eng TLA Eng N1 Eng N1 Temp TAT Spoiler-R (deg) Spoiler-L (deg) 20 Spoiler-L+R O 15:10:10:10:CDT (HH:MM:SS) 15:09:50 15:10:05 15:09:45 15:09:55 15:10:00 15:10:15 15:10:20 15:10:25 15:10:30 15:10:35 Revised: 20 July 2017 Flight Options, Embraer EMB-505, N362FX **National Transportation Safety Board** 

Figure 6. Plot of select parameters during final descent through the end of the FDR recording.

Location, Date: Sugar Land, Texas, 07/26/16 NTSB No. CEN16FA286 Eng 30 N 25 Eng N1 Eng2 N2 Eng1 N2 S 20 Eng2 TLA (deg) Eng1 TLA (deg) Eng N2 50 🕏 🕃 Eng TLA 300 Fuel Flow (pph) 300 En Eng2 Oil Press (psi)
Eng1 Oil Press (psi)
Eng2 Chip Detector Sensor (Volts)
Eng1 Chip Detector Sensor (Volts) Eng1 Fuel Flow Eng2 Fuel Flow Eng1 Oil Press Eng2 Oil Temp (degC)
Eng1 Oil Temp (degC)
70 65 60 Eng2 Oil Press Eng2 Oil Temp Eng1 Oil Temp **Eng Chip Detector Sensor** Low Press **Eng Oil Press Low** Eng1 Oil Press Low Eng1 Overspeed Exceedance Overspeed Eng2 Overspeed Exceedance Eng Overspeed Exceedance Eng1 FADEC Failure-Fault Fault Eng2 FADEC Failure-Fault Eng FADEC Failure-Fault Normal Airspeed Ind-1 Press-1 (ft) 100 50 Altitude Press-1 (kts 50 Gear WOW-L1 Not WOW Gear WOW-L1 15:10:35 15:09:45 15:10:00 15:10:20 15:10:25 15:09:50 15:09:55 15:10:05 15:10:15 15:10:30 15:10:10 CDT (HH:MM:SS) Revised: 20 July 2017 Flight Options, Embraer EMB-505, N362FX **National Transportation Safety Board** 

Figure 7. Plot of select engine parameters during final descent through the end of the FDR recording.

Location, Date: Sugar Land, Texas, 07/26/16 NTSB No. CEN16FA286 Wing Stab Anti-Ice Cockpit Sw Wing Stab Anti-Ice Cockpit Sw Off ^ ^AÔA Valid-L+R OA Valid-R AOA Valid-L Not Valid On **AP Engaged** AP Engaged Ice Detect Ice Detect Ice Detect No Ice Detect Cmd Open Speed Brk Cockpit Lever Pos Speed Brk Cockpit Lever Pos **Cmd Close** DME GrossWt Unit Display kg GrossWt Unit Display lb Dist-1 (Nm) DME Dist-1 GrossWt (kg) 6500 6000 1-1 (Nm) Gilde Slope Dev-2 (ddm) Figure Cy 1 (MHz) Figure Cy 2 (MHz) Figure Cy 2 (MHz) Figure Cy 2 (MHz) Figure Cy 2 (MHz) GrossWt Nav Frequency 1+2 Localizer Dev-1+2 Glide Slope Dev-1+2 AOA-L (deg) AOA-R (deg) AOA-L+R Flap-R (deg) Flap-L (deg) Flap Cons (deg) Flap Cons and Flap-L+R DME Dist-2 (Nm) Flap Lever DME Dist-2 Altitude Radio (ft) 50 0 Altitude Radio Not WOW Gear WOW-L1 Gear WOW-L1 wow-15:10:10:10:00 (HH:MM:SS) 15:10:05 15:10:35 15:09:45 15:09:50 15:10:00 15:10:25 15:09:55 15:10:20 15:10:30 Revised: 20 July 2017 Flight Options, Embraer EMB-505, N362FX **National Transportation Safety Board** 

Figure 8. Plot of additional select parameters during final descent through the end of the FDR recording.

## **APPENDIX A**

This appendix describes the parameters provided and verified in this report. Table A-1 lists the parameter names, parameter descriptions, and units. Table A-2 contains the unit and discrete state abbreviations for the parameters.

Table A-1. Verified and provided FDR parameters.

| Parameter Names               | Parameter Descriptions  | Units |
|-------------------------------|---|-------|
| 1. Accel Lat                  | Lateral Acceleration  | g     |
| 2. Accel Long                 | Longitudinal Acceleration   | g     |
| 3. Accel Vert                 | Vertical Acceleration   | g     |
| 4. Airspeed Ind-1             | Indicated Airspeed-1  | kts   |
| 5. Airspeed Ind-2             | Indicated Airspeed-2  | kts   |
| 6. Altitude Press-1           | Pressure Altitude-1   | ft    |
| 7. Altitude Press-2           | Pressure Altitude-2   | ft    |
| 8. Altitude Radio             | Radio Altitude  | ft    |
| 9. Anti Skid Fail             | Anti Skid Fail  |       |
| 10. AOA Valid-L               | Angle of Attack Valid - Left                                      |       |
| 11. AOA Valid-R               | Angle of Attack Valid - Right                                     |       |
| 12. AOA-L                     | Angle of Attack - Left  | deg   |
| 13. AOA-R                     | Angle of Attack - Right   | deg   |
| 14. AP Engaged                | Autopilot Engaged   |       |
| 15. Brake Accumulator Press   | Brake Accumulator Pressure  | psi   |
| 16. Brake Fail                | Brake Fail  |       |
| 17. Brake Ped Pos Pilot-L     | Brake Pedal Position Pilot - Left                                 | mm    |
| 18. Brake Ped Pos Pilot-R     | Brake Pedal Position Pilot - Right                                | mm    |
| 19. Brake Press-L             | Brake Pressure - Left   | psi   |
| 20. Brake Press-R             | Brake Pressure - Right  | psi   |
| 21. DME Dist-1                | Distance Measurable Equipment Distance-1                          | Nm    |
| 22. DME Dist-2                | Distance Measurable Equipment Distance-2                          | Nm    |
| 23. EICAS Anti Skid Fail      | Engine Indication and Crew Alerting System - Anti Skid Fail       |       |
| 24. Eng1 Chip Detector Sensor | Engine 1 Chip Detector Sensor                                     | Volts |
| 25. Eng1 FADEC Failure-Fault  | Engine 1 Full Authority Digital Engine Controller Failure - Fault |       |
| 26. Eng1 Fuel Flow            | Engine 1 Fuel Flow  | kph   |
| 27. Eng1 N1                   | Engine 1 N1   | %     |
| 28. Eng1 N2                   | Engine 1 N2   | %     |

| Parameter Names               | Parameter Descriptions  | Units |
|-------------------------------|---|-------|
| 29. Eng1 Oil Press            | Engine 1 Oil Pressure   | psi   |
| 30. Eng1 Oil Press Low        | Engine 1 Oil Pressure Low   |       |
| 31. Eng1 Oil Temp             | Engine 1 Oil Temperature  | degC  |
| 32. Eng1 Overspeed Exceedance | Engine 1 Overspeed Exceedance                                     |       |
| 33. Eng1 TLA                  | Engine 1 Thrust Lever Angle                                       | deg   |
| 34. Eng2 Chip Detector Sensor | Engine 2 Chip Detector Sensor                                     | Volts |
| 35. Eng2 FADEC Failure-Fault  | Engine 2 Full Authority Digital Engine Controller Failure - Fault |       |
| 36. Eng2 Fuel Flow            | Engine 2 Fuel Flow  | kph   |
| 37. Eng2 N1                   | Engine 2 N1   | %     |
| 38. Eng2 N2                   | Engine 2 N2   | %     |
| 39. Eng2 Oil Press            | Engine 2 Oil Pressure   | psi   |
| 40. Eng2 Oil Press Low        | Engine 2 Oil Pressure Low   |       |
| 41. Eng2 Oil Temp             | Engine 2 Oil Temperature  | degC  |
| 42. Eng2 Overspeed Exceedance | Engine 2 Overspeed Exceedance                                     |       |
| 43. Eng2 TLA                  | Engine 2 Thrust Lever Angle                                       | deg   |
| 44. Flap Cons                 | Flap Consolidated Surface Position                                | deg   |
| 45. Flap Lever                | Flap Lever Position   |       |
| 46. Flap-L                    | Flap Position - Left  | deg   |
| 47. Flap-R                    | Flap Position - Right   | deg   |
| 48. Gear WOW-L1               | Weight on Wheels Left Main Landing Gear Sensor 1                  |       |
| 49. Gear WOW-L2               | Weight on Wheels Left Main Landing Gear Sensor 2                  |       |
| 50. Gear WOW-R1               | Weight on Wheels Right Main Landing Gear Sensor 1                 |       |
| 51. Gear WOW-R2               | Weight on Wheels Right Main Landing Gear Sensor 2                 |       |
| 52. Glide Slope Dev-1         | Glideslope Deviation - 1  | ddm   |
| 53. Glide Slope Dev-2         | Glideslope Deviation - 2  | ddm   |
| 54. GrossWt                   | Gross Weight  | kg    |
| 55. GrossWt Unit Display      | Gross Weight Unit Crew Display                                    |       |
| 56. Ground Spd-1              | Ground Speed - 1  | kts   |
| 57. Ground Spd-2              | Ground Speed - 2  | kts   |
| 58. Heading Mag-1             | Magnetic Heading - 1  | deg   |
| 59. Heading Mag-2             | Magnetic Heading - 2  | deg   |
| 60. Ice Detect                | Ice Detected  |       |
| 61. Key VHF-1                 | Microphone Keying-1   |       |
| 62. Key VHF-2                 | Microphone Keying-2   |       |

| Parameter Names                   | Parameter Descriptions                  | Units |
|-----------------------------------|---|-------|
| 63. Latitude-1                    | Latitude Position - 1                   | deg   |
| 64. Latitude-2                    | Latitude Position - 2                   | deg   |
| 65. Localizer Dev-1               | Localizer Deviation - 1                 | ddm   |
| 66. Localizer Dev-2               | Localizer Deviation - 2                 | ddm   |
| 67. Longitude-1                   | Longitude Position - 1                  | deg   |
| 68. Longitude-2                   | Longitude Position - 2                  | deg   |
| 69. Master Caution                | Master Caution                          |       |
| 70. Master Warning                | Master Warning                          |       |
| 71. Nav Frequency 1               | Navigation Frequency 1                  | MHz   |
| 72. Nav Frequency 2               | Navigation Frequency 2                  | MHz   |
| 73. Parking Brake                 | Parking Brake                           |       |
| 74. Pitch-1                       | Pitch Angle - 1                         | deg   |
| 75. Pitch-2                       | Pitch Angle - 2                         | deg   |
| 76. Roll-1                        | Roll Angle - 1                          | deg   |
| 77. Roll-2                        | Roll Angle - 2                          | deg   |
| 78. Speed Brk Cockpit Lever Pos   | Speed Brake Cockpit Lever Position      |       |
| 79. Spoiler-L                     | Spoiler Position - Left                 | deg   |
| 80. Spoiler-R                     | Spoiler Position - Right                | deg   |
| 81. Temp TAT                      | Total Air Temperature                   | deg C |
| 82. Time UTC-Hr                   | Coordinated Universal Time - Hours      | Hrs   |
| 83. Time UTC-Min                  | Coordinated Universal Time - Min        | min   |
| 84. Time UTC-Sec                  | Coordinated Universal Time - Sec        | sec   |
| 85. Wheel Speed-L                 | Wheel Speed - Left                      | kts   |
| 86. Wheel Speed-R                 | Wheel Speed - Right                     | kts   |
| 87. Wing Stab Anti-Ice Cockpit Sw | Wing Stabilizer Anti-Ice Cockpit Switch |       |

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                      |
|---------------------------------|-----------------------------------|
| %                               | percentage                        |
| Cmd                             | Command                           |
| ddm                             | difference in depth of modulation |
| deg                             | degrees                           |

| Unit and discrete Abbreviations | Descriptions           |
|---------------------------------|------------------------|
| degC                            | degrees Celsius        |
| Detect                          | Detected               |
| ft                              | feet                   |
| hrs                             | hours                  |
| kg                              | kilograms              |
| kph                             | kilograms per hour     |
| kts                             | knots                  |
| lb                              | pounds                 |
| MHz                             | Megahertz              |
| min                             | minutes                |
| mm                              | millimeters            |
| Nm                              | Nautical Miles         |
| Pos 0                           | Position 0             |
| Pos 1                           | Position 1             |
| Pos 2                           | Position 2             |
| Pos 3                           | Position 3             |
| Press                           | Pressure               |
| psi                             | pounds per square inch |
| sec                             | seconds                |
| Volts                           | Volts                  |
| WOW                             | weight on wheels       |