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

May 2, 2011

Flight Data Recorder - 10

Specialist's Factual Report
By Bill Tuccio

1. EVENT SUMMARY

Location: Kansas City, Missouri
Date: March 26, 2011
Aircraft: Embraer-145, N931AE
Operator: American Eagle, Flight 4355
NTSB Number: CEN11LA250

On March 26, 2011, about 0735 central daylight time (CDT), an Embraer-145LR, N931AE, operated by American Eagle Airlines as flight 4355, sustained no damage when it encountered turbulence as it climbed north of Kansas City, Missouri, en-route to the Chicago O'Hare International Airport, Chicago, Illinois. The 2 pilots and 49 passengers were uninjured. A flight attendant sustained a serious injury and the flight diverted to the Kansas City International Airport (MCI), near Kansas City, Missouri. The scheduled domestic passenger flight was conducted under 14 Code of Federal Regulations Part 121. Visual meteorological conditions prevailed and an activated instrument flight rules flight plan was on file. The flight originated from the Will Rogers World Airport, near Oklahoma City, Oklahoma. The flight attendant reported to the flightcrew that she sustained an injury during the turbulence. The flight diverted to MCI where the flight attendant received medical attention once the flight landed.

2. FLIGHT DATA RECORDER GROUP

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

3. DETAILS OF FLIGHT DATA RECORDER INVESTIGATION

Following the event, the operator, American Eagle, removed the FDR from the incident aircraft. American Eagle downloaded the FDR data to an electronic file and sent it to the Safety Board's Vehicle Recorder Division for analysis.

3.1. Recorder Description

The FDR data in the electronic file was configured such that approximately every second 256 12-bit words of digital information were recorded. Each grouping of 256 words 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.

3.2. FDR Carriage Requirements

Federal regulations regarding the carriage requirements of FDRs on aircraft can be found in the following regulations: 14 CFR 121.343, 14 CFR 121.344, 14 CFR 121.344a and 14 CFR 135.152. Newly manufactured aircraft are required to be equipped with an FDR that records a minimum of 88 parameters. Specifically, the aircraft, N931AE, was operating such that it was required to be equipped with an FDR that recorded 88 parameters, as cited in 14 CFR 121.344(f).

The aircraft recorded invalid information for the Aileron-1 parameter for the entire 27.2 hours of the recording. Discussion with American Eagle confirmed this was a maintenance issue with the sensor on this particular aircraft, N931AE. Subsequent to notification, American Eagle corrected the Aileron-1 sensor.

3.3. Recording Description

The FDR recording contained approximately 27.2 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 eleventh flight prior to the last flight of the recording and its duration was approximately 1 hour and 13 minutes.

3.4. Time Correlation

The FDR recorded a universal coordinated time (UTC) parameter. This parameter was used to establish a correlation between SRN and UTC time of the event flight. An offset of -8787 seconds was applied to the FDR data in order to convert from SRN to CDT. All plots and tabular data contained within the report are shown in CDT.

3.5. 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, changes to the conversions have been made to ensure the parameters conform to the Safety Board's standard sign convention that climbing right turns are positive (CRT=+).[1]

3.6. Parameters Provided and Verified

Table 1 lists the FDR parameters provided and verified in this report.

Table 1: FDR Parameters

Parameter Name	Parameter Description[2]
1. Accel Lat (g)	Lateral Acceleration (g)
2. Accel Long (g)	Longitudinal Acceleration (g)
3. Accel Vert (g)	Vertical Acceleration (g)

[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 = +, Right Aileron Trailing Edge Up = +, Pitch Up = +, Elevator Trailing Edge Up = +.

[2] 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.

Parameter Name	Parameter Description[2]
4. Airspeed Ind (kts)	Indicated Airspeed (knots)
5. Ground Spd (kts)	Ground Speed (knots)
6. Altitude Press (ft)	Pressure Altitude (feet)
7. Autopilot Engaged	Autopilot (discrete)
8. Ctrl Col Pos-L (deg)	Left Control Column Position (degrees)
9. Ctrl Whl Pos-1 (deg)	Control Wheel Position 1 (degrees)
10. Heading Mag (deg)	Magnetic Heading (degrees)
11. Pitch (deg)	Pitch Angle (degrees)
12. Roll (deg)	Roll Angle (degrees)
13. Rudder Pos (deg)	Rudder Position (degrees)
14. Rudder Ped Pos (deg)	Rudder Pedal Position (degrees)
15. Elevator-2 (deg)	Elevator Position 2 (degrees)
16. Aileron-2 (deg)	Aileron Position 2 (degrees)
17. Wind Spd-1 (kts)	Wind Speed (knots)
18. Wind Dir-1 (kts)	Wind Direction (deg)
19. Temp SAT (degC)	Temp SAT (deg Celsius)
20. Air/Ground Switch (discrete)	Air/Ground Switch (discrete)
21. Latitude-1 (deg)	Latitude-1 (deg)
22. Longitude-1 (deg)	Longitude-1 (deg)
23. Time GMT Hrs (hours)	Time GMT Hrs (hours)
24. Time GMT Min (minutes)	Time GMT Min (minutes)
25. Time GMT Sec (seconds)	Time GMT Sec (seconds)

3.6.1. Pressure Altitude

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.

3.7. FDR Plots and Corresponding Tabular Data

The following 4 plots contain FDR data recorded during the March 26, 2011 event. All of the FDR parameters listed in Table 1 are plotted except the time parameters, the air/ground switch, latitude-1, and longitude-1.

Plot 1 contains basic parameters for the entire accident flight. The accident flight departed at approximately 7:05 CDT and the upset event occurred during the climb at approximately 7:29:35 CDT.

Plot 2 contains parameters related to flight controls.

Plot 3 contains basic parameters in the time frame immediately surrounding the upset event. The plot shows the vertical acceleration ranged from 1.54g to 0.60g in a 1 second period of time.

Plot 4 contains parameters related to flight controls in the time frame immediately surrounding the upset event.

The upset event occurred while the aircraft climbed through 29,900 feet pressure altitude at approximately N37:54:44 latitude and W93:35:23 longitude.

Additionally, 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.

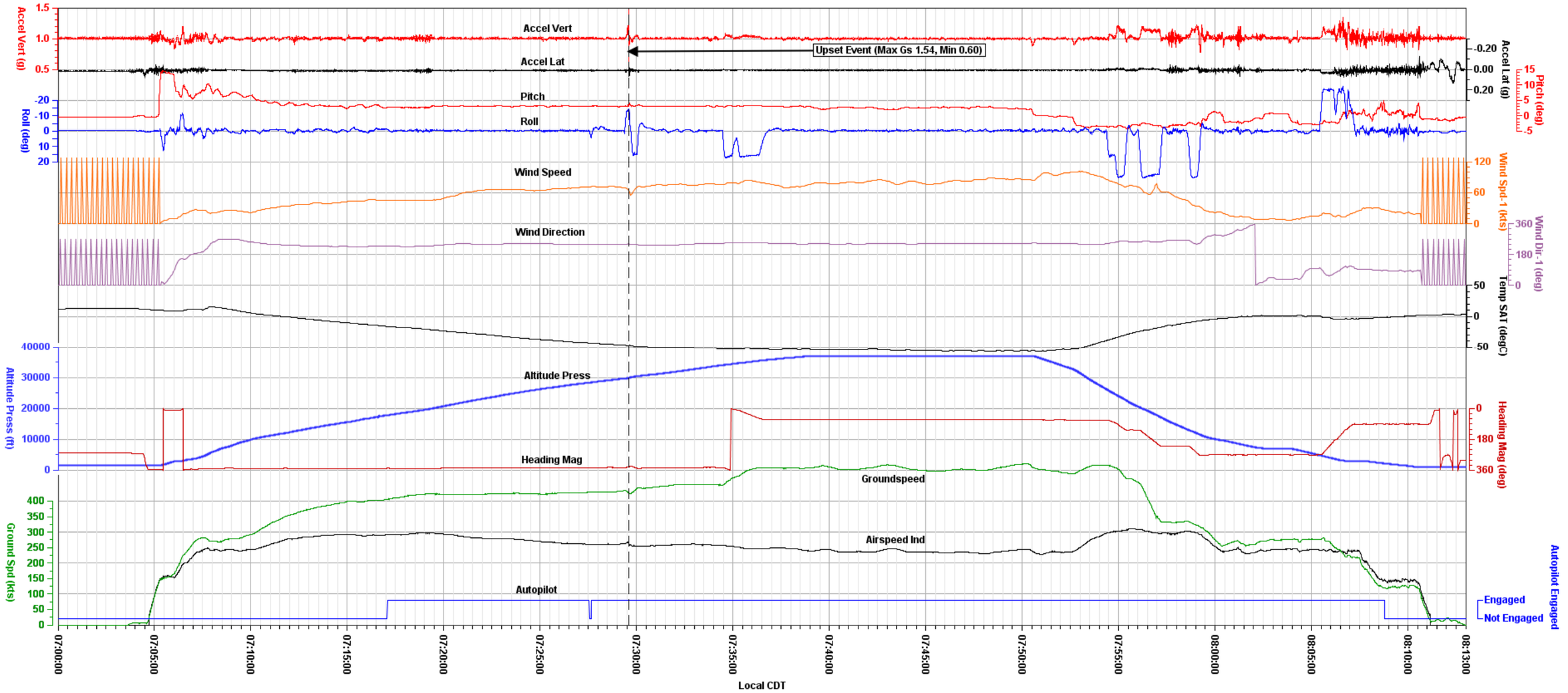
The corresponding tabular data used to create these 2 plots are provided in electronic (.CSV) format as Attachment 1 to this report.

Plot 1: Event Flight - Basic Parameters

American Eagle, Embraer EMB-145, Flight #4355, N931AE

Location, Date: Kansas City, Missouri, 03/26/11

NTSB No. CEN11LA250



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Event Flight - Basic Parameters

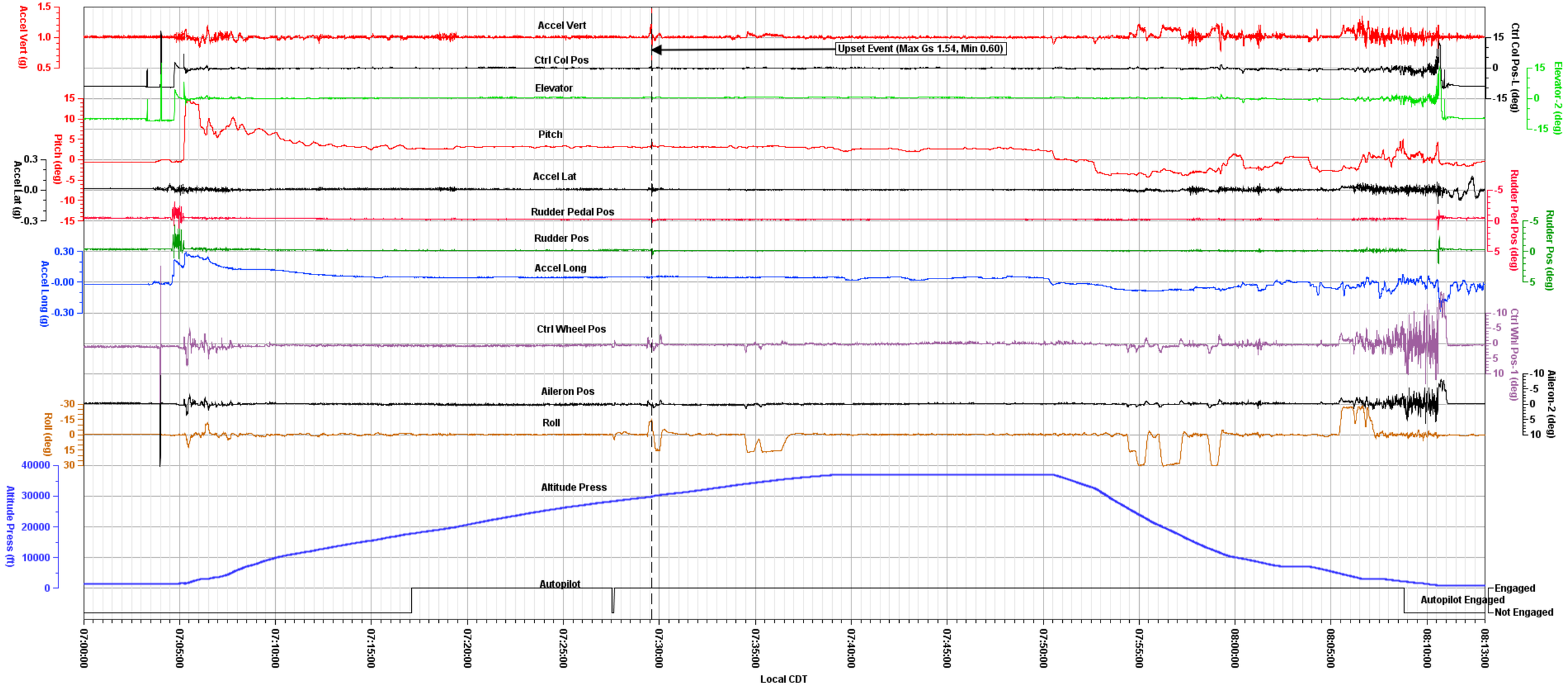
National Transportation Safety Board

Plot 2: Event Flight - Flight Controls

American Eagle, Embraer EMB-145, Flight #4355, N931AE

Location, Date: Kansas City, Missouri, 03/26/11

NTSB No. CEN11LA250



Revised: 22 April 2011

Event Flight - Flight Controls

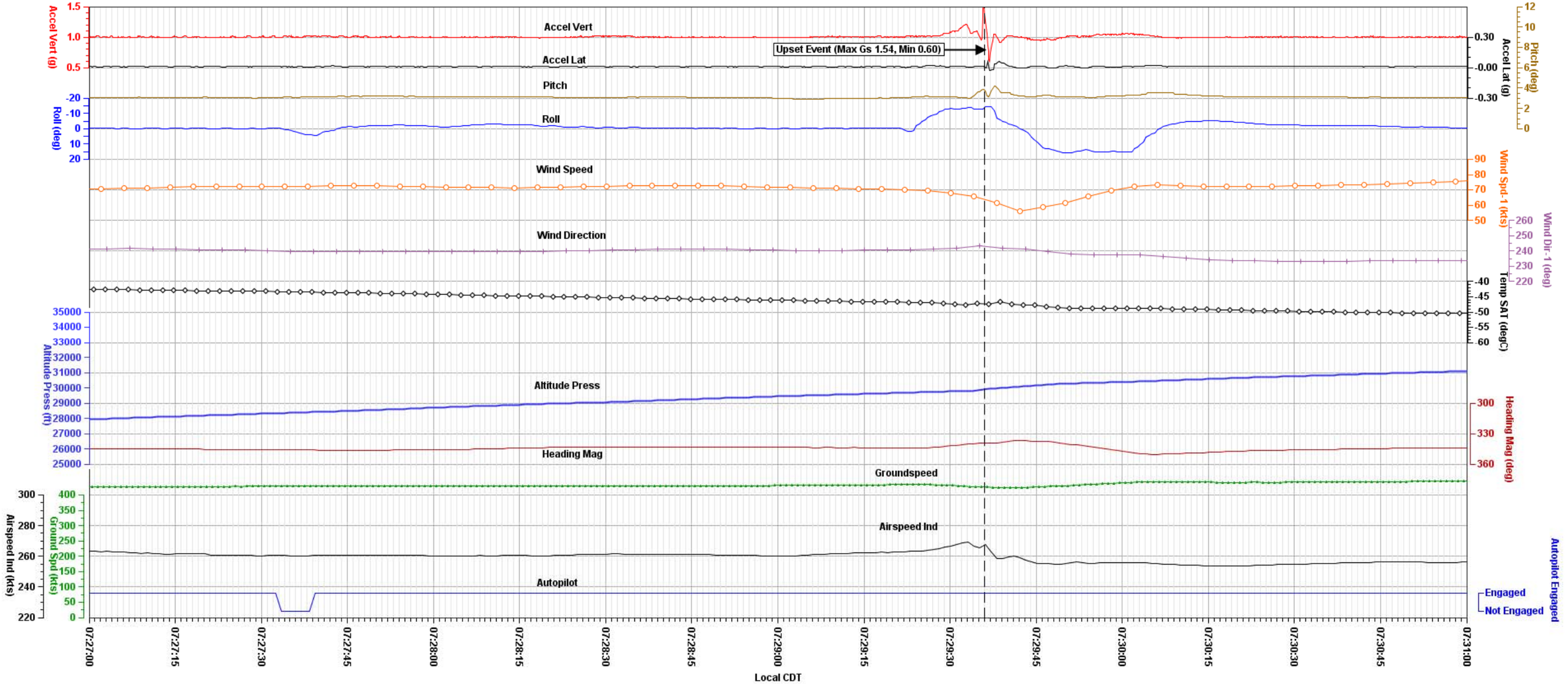
National Transportation Safety Board

Plot 3: Upset Event - Basic Parameters

American Eagle, Embraer EMB-145, Flight #4355, N931AE

Location, Date: Kansas City, Missouri, 03/26/11

NTSB No. CEN11LA250



Revised: 21 April 2011

Upset Event - Basic Parameters

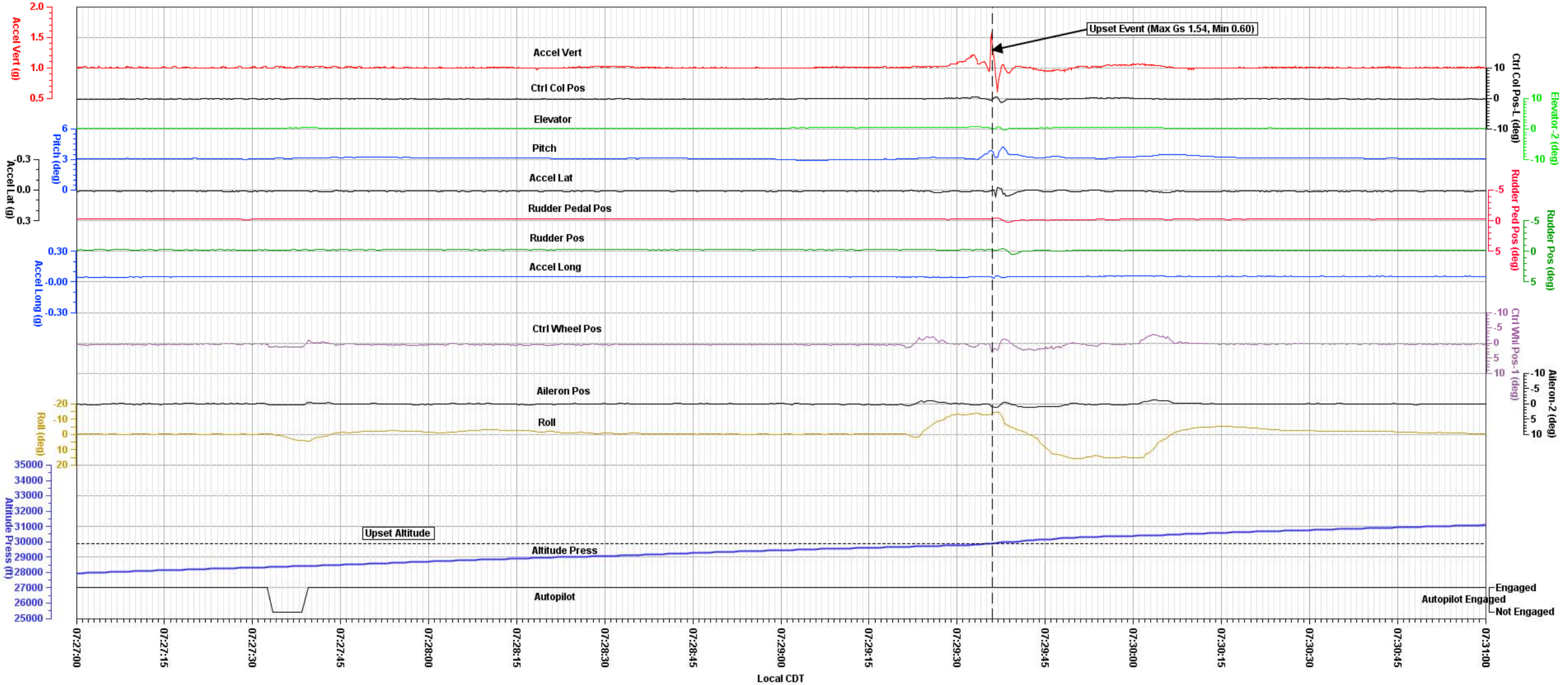
National Transportation Safety Board

Plot 4: Upset Event - Flight Controls

American Eagle, Embraer EMB-145, Flight #4355, N931AE

Location, Date: Kansas City, Missouri, 03/26/11

NTSB No. CEN11LA250



Revised: 22 April 2011

Upset Event Detail- Flight Controls

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