

# NATIONAL TRANSPORTATION SAFETY BOARD

Vehicle Recorder Division  
Washington, D.C. 20594

October 29, 2015

## Flight Data Recorder (FDR)

### Specialist's Factual Report By George Haralampopoulos

#### 1. EVENT SUMMARY

Location: Philadelphia, Pennsylvania  
Date: March 13, 2014  
Aircraft: Airbus A320-200  
Registration: N113UW  
Operator: US Airways  
NTSB Number: DCA14MA081

On March 13, 2013, at about 1830 eastern daylight time (EDT), US Airways flight 1702, an Airbus A320, N113UW, experienced a nose gear collapse and other damage after aborting the takeoff on runway 27L at Philadelphia International Airport (KPHL), Philadelphia, Pennsylvania. The airplane came to rest on the edge of the runway, and the passengers exited the aircraft via the emergency slides. There were no injuries to the passengers and crew members and the airplane was substantially damaged. The flight was operating under 14 *Code of Federal Regulations* Part 121 as a regularly scheduled passenger flight between KPHL and Fort Lauderdale / Hollywood International Airport, Fort Lauderdale, Florida.

#### 2. FLIGHT DATA RECORDER GROUP

A group was not convened.

#### 3. FDR CARRIAGE REQUIREMENTS

The event aircraft, N113UW, was manufactured in 1999, and was operating such that it was required to be equipped with an FDR that recorded, at a minimum, 34 parameters, as cited in Title 14 *Code of Federal Regulations* Part 121.344(d)

#### 4. DETAILS OF FLIGHT DATA RECORDER INVESTIGATION

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

Recorder Manufacturer/Model: **Allied Signal/HoneyWell SSFDR 128 wps**  
Recorder Serial Number: **6019**

##### 4.1. Allied Signal/Honeywell SSFDR Description

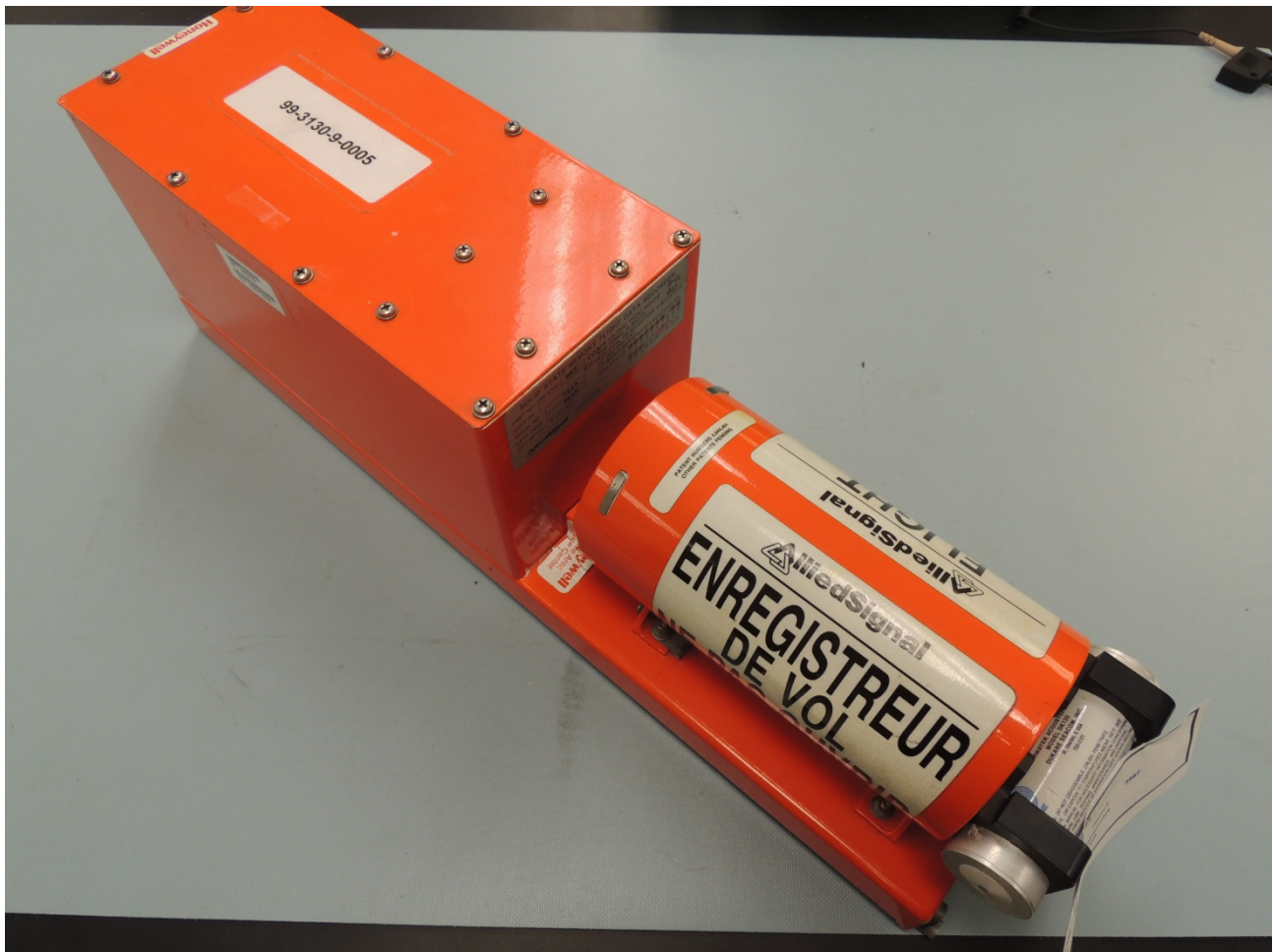
The Allied Signal/Honeywell Solid State Flight Data Recorder (SSFDR) records airplane flight information in a digital format using solid-state flash memory as the recording

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 128 12-bit words of digital information every second. Each grouping of 128 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 128-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-C124a.

#### 4.1.1. Recorder Condition

The recorder was in good condition and the data were extracted normally from the recorder using the manufacturer's recommended procedures. (figure 1).

Figure 1. SSFDR as received.



#### 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 accident event was identified from the last 5 minutes of the recording.

### 4.1.3. Engineering Units Conversions

The engineering units conversions used for the data contained in this report are based on documentation from the manufacturer of the data acquisition unit installed in the aircraft. 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>

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

### 4.2. Time Correlation

Correlation of the FDR data from SRN to the event local time, EDT, was established with an offset provided by the Cockpit Voice Recorder Group Chairman in the Factual Report, "Cockpit Voice Recorder".

Due to a discontinuity in the FDR data at 97,804.9 SRN, two alignments with the CVR were required.

Accordingly, the time offset for the event flight data from SRN to local EST is the following:

For  $SRN \leq 97,804.90$ ,  $18:19:34.5 \text{ EDT} = 97,750.8 \text{ FDR SRN}$

For  $SRN \geq 97,810.03$ ,  $18:21:25.8 \text{ EDT} = 97,866.0 \text{ FDR SRN}$

$EDT = SRN - 31786$  for a SRN lower than 97,804.9 and  $EDT = SRN - 31780$  for a SRN greater than 97,810. For the rest of this report, all times are referenced as EDT, not SRN.

### 4.3. FDR Plots and Corresponding Tabular Data

The following three figures contain FDR data recorded during the March 13, 2014, event. Appendix A lists the FDR parameters verified and provided in this report.

Figure 3 shows a basic overview of the accident event that contains aircraft air data, accelerations, attitudes and discrete information. Events from the CVR are shown on the plot and represented as dashed lines. Table 1 shows a summary of the CVR dialogue at its associated time stamp. Non-computed values are recorded for indicated airspeed until it passes 30 knots<sup>2</sup>.

Figure 4 shows an overview of the accident event that highlights parameters from both engines. Similarly, figure 5 shows an overview of the accident that highlights flight control parameters from the longitudinal axis<sup>3</sup>.

The data shown prior to 18:23:34 EDT is consistent with the aircraft takeoff. Indicated Airspeed begins to increase, corresponding with an increase in both engine Throttle Lever Angles (TLA). As the airspeed continues to increase, both engine TLAs drop briefly to 28 degrees around 18:23:54 EDT before returning to 33 degrees.

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<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 = +.

<sup>2</sup> The Cockpit Voice Recorder Group Chairman Report can be accessed in the public docket.

<sup>3</sup> Flight control parameters from the lateral axis are not plotted in this report; however, they are included in tabular form as an attachment.

At 18:24:10 EDT, the nose gear weight on wheels (WOW) transitions to “In air” for 4 seconds. During this time the aircraft reached an airspeed of 173 knots and a maximum nose-up pitch attitude of 6 degrees. Subsequently, the aircraft pitches down followed by a 3.76g spike in vertical acceleration at 18:24:14 EDT; consistent with impact. The recording ended at 18:24:31 EDT.

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. Non-computed data are recorded in Groundspeed, Indicated Airspeed, and Heading parameters and are reflected on the plotted figures as intermittently moving between zero state and high value state.

The corresponding tabular data used to create these two plots are provided in electronic (\*.csv<sup>4</sup>) format as Attachment 1 to this report.

**Table 1. Excerpted audio from CVR displayed on figure 2.**

<b>CVR Event</b>	<b>Source</b>	<b>Time Stamp (EDT)</b>
1. line up and wait two seven left. Cactus seventeen zero two.	RDO-2	18:22:37.2
2. taxi checklist to the line complete. runway and FMS verify runway two seven left.	HOT-2	18:22:49.4
3. tthh...we've gotta put the different runway in	HOT-2	18:23:00.2
4. Cactus seventeen zero two fly heading two three zero. runway two seven left clear for take-off.	TWR	18:23:24.6
5. two tree zero and cleared for take-off. Cactus seventeen zero two.	RDO-2	18:23:29.0
6. flex	HOT-1	18:23:43.4
7. [sound of single chime, similar to level two caution ]	HOT	18:23:46.9
8. engine thrust levers not set.	HOT-2	18:23:49.8
9. they're set.	HOT-1	18:23:2.8
10. retard <sup>5</sup>	FWC	18:23:54.3
11. what did you do? you didn't load. we lost everything .	HOT-1	18:23:55.7
12. (no)	HOT-2	18:24:00.4
13. we'll get that straight when we get airborne .	HOT-1	18:24:03.1

<sup>4</sup> Comma Separated Value format.

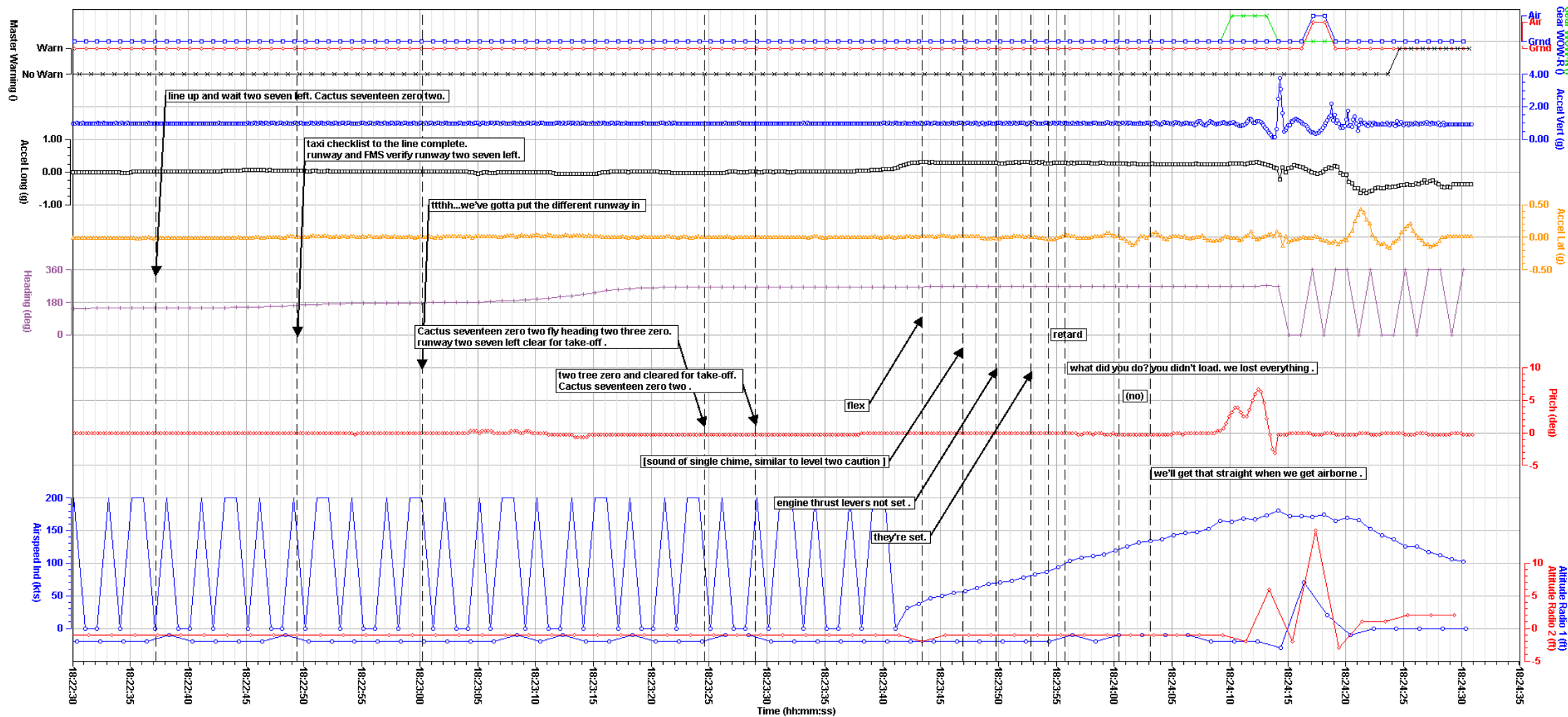
<sup>5</sup> Retard automated warning begins and continues until first impact.

Figure 2. Plot of basic aircraft parameters for accident event.

US Airways, Airbus A320, Flight 1702, N113UW

Location, Date: Philadelphia PA, 03/13/14

NTSB No. DCA14MA081



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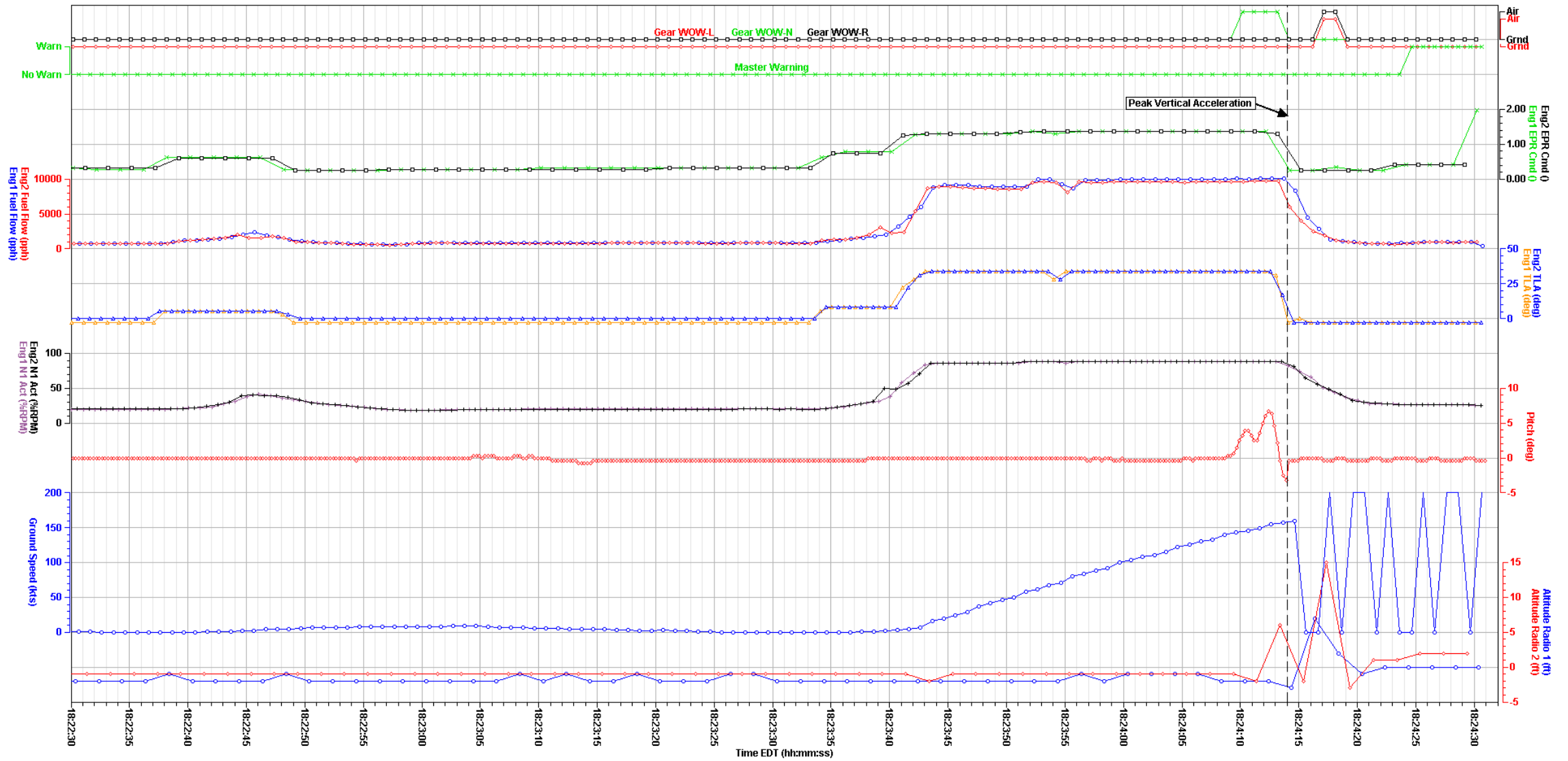
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Figure 3. Plot of engine parameters for accident event.

US Airways, Airbus A320, Flight 1702, N113UW

Location, Date: Philadelphia PA, 03/13/14

NTSB No. DCA14MA081



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## 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. Verified and provided FDR parameters.**

Parameter Name	Parameter Description
1. Accel Lat (g)	Lateral Acceleration
2. Accel Long (g)	Longitudinal Acceleration
3. Accel Vert (g)	Vertical Acceleration
4. Heading (deg)	Magnetic Heading
5. Pitch (deg)	Pitch Angle
6. Roll (deg)	Roll Angle
7. Airspeed Ind (kts)	Indicated Airspeed
8. Ground Spd (kts)	Ground Speed
9. Altitude Press (ft)	Pressure Altitude
10. Altitude Radio 1 (ft)	Radio Altitude source #1
11. Altitude Radio 2 (ft)	Radio Altitude source #2
12. Master Warning (discrete)	Master Warning
13. Gear WOW-L (discrete)	Left Gear Weight on Wheels
14. Gear WOW-R (discrete)	Right Gear Weight on Wheels
15. Gear WOW-N (discrete)	Nose Gear Weight on Wheels
16. Eng1,2 TLA (deg)	Engine 1 or 2 Thrust Lever Angle
17. Eng1,2 N1 Act (%RPM)	Engine 1 or 2 N1 Actual
18. Eng1,2 Fuel Flow (pph)	Engine 1 or 2 Fuel Flow
19. Eng1,2 EPR Cmd (nd)	Engine 1 or 2 Engine Pressure Ratio Commanded
20. Stabilizer Pos (deg)	Horizontal Stabilizer Position
21. Flap (deg)	Flap Position
22. Slat Pos (deg)	Slat Position
23. Elevator L,R (deg)	Left or Right Elevator Position
24. Stick Long L,R (deg)	Left or Right Sidestick longitudinal input
25. AOA L,R (deg)	Angle of Attack Left or Right source
26. Flight Phase <sup>a</sup> (discrete)	Flight Phase
27. Rudder <sup>a</sup> (deg)	Rudder
28. Rudder Ped Pos <sup>a</sup> (deg)	Rudder Pedal Position
29. Aileron L-R <sup>a</sup> (deg)	Left or Right Aileron Position
30. Time GMT Hrs <sup>a</sup> (hrs)	Time GMT Hours
31. Time GMT Min <sup>a</sup> (min)	Time GMT Minutes
32. Time GMT Sec <sup>a</sup> (sec)	Time GMT Seconds

<sup>a</sup> Data is provided in tabular form only

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.**

<b>Units Abbreviation</b>	<b>Description</b>
deg	degrees
kts	knots
g	g
discrete	discrete
ft	feet
hrs	hours
min	minutes
sec	seconds
%RPM	percent revolutions per minute
nd	non-dimensional
pph	pounds per hour

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.