

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

December 4, 2014

Engine Data Monitor (EDM) and GPS

Specialist's Factual Report
By George Haralampopoulos

1. EVENT SUMMARY

Location: Bronx, New York
Date: January 4, 2014
Aircraft: Piper PA-28-180
Registration: N9409J
Operator: Private
NTSB Number: ERA14LA085

On January 4, 2014, about 1519 Eastern standard time, a Piper PA-28-180, N9409J, was substantially damaged during a forced landing on an expressway in Bronx, New York. The private pilot and two passengers were not injured. The airplane was registered to and operated by a private individual, under the provisions of 14 Code of Federal Regulations (CFR) Part 91, as a personal flight. Visual meteorological conditions prevailed at the time and no flight plan was filed; VFR flight following was obtained. The flight originated from Danbury Municipal Airport, Danbury, CT, about 1426.

2. DETAILS OF ENGINE DATA MONITOR INVESTIGATION

The National Transportation Safety Board's Vehicle Recorder Division received the following devices:

Recorder Manufacturer/Model: **JPI EDM-700**
Recorder Serial Number: **33284**

Recorder Manufacturer/Model: **Garmin GPSMAP 696**
Recorder Serial Number: **1H6014811**

2.1. Garmin GPSMAP 696 Device Description

The Garmin GPSMAP 696 is a battery-powered portable multi-function display and GPS receiver with a 7-inch diagonal high resolution LCD display screen. The unit includes a built-in Jeppesen database and is capable of receiving XM satellite radio for flight information including NEXRAD Radar, lightning, METARs, TAFs, and TFRs. The unit can also perform and store weight and balance calculations. A built-in AOPA Airport Directory and SafeTaxi airport diagrams are included for selected airfields.

A detailed track log – including latitude, longitude, date, time, and GPS altitude information for an unspecified number of points – is stored within the unit whenever the receiver has a

lock on the GPS navigation signal. Position is updated within the track log as a function of time or distance moved, depending on how the unit has been configured.

Once the current track log memory becomes full, new information either overwrites the oldest information or recording stops, depending on how the unit is configured. The current track log can be saved to long-term memory and 15 saved track logs can be maintained in addition to the current track log. Track log storage may be activated or de-activated at user discretion.

All recorded data is stored in non-volatile memory. The unit contains hardware and software permitting the download of recorded waypoint, route, and track log information to a PC via a built-in USB port. An internal button-battery is used to back-up power to the internal memory and real-time clock during those periods when main power is removed.

2.1.1. Garmin GPSMAP 696 Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior inspection revealed that the Garmin 696 unit had sustained negligible damage. The unit was powered on normally and the data was extracted using the manufacturer's recommended procedures.

2.1.2. Garmin GPSMAP 696 Data Description

The data extracted included 70 total logs from September 20, 2013¹ through January 4, 2014. The event flight was identified by the recorded date and time starting at 19:12:22 UTC and ending at 20:20:03 UTC on January 4, 2014.

A track log containing a ground event was identified prior to the event flight starting at 18:12:32 to 18:48:21 UTC on January 4, 2014 and is included in this report.

2.2. EDM 700/800 Device Description

The J. P. Instruments EDM-700/800 is a panel mounted gauge that the operator can monitor and record up to 24 parameters related to engine operations. Depending on the installation, engine parameters that are monitored include:

- Exhaust Gas Temperature (EGT)
- Cylinder Head Temperature (CHT)
- Oil Pressure and Temperature
- Manifold Pressure
- Outside Air Temperature
- Turbine inlet Temperature
- Engine Revolutions per Minute
- Compressor Discharge Temperature
- Fuel Flow
- Carburetor Temperature

¹ The GPS records data in Coordinated Universal Time (UTC).

- Battery Voltage

The unit can also calculate, in real-time, horsepower, fuel used, shock cooling rate and EGT differentials between the highest and lowest cylinder temperatures. The calculations are also based on the aircraft installation.

The unit contains non-volatile memory for data storage of the parameters recorded and calculated. The rate at which the data is stored is selectable by the operator from 2 to 500 seconds per sample. The memory can store up to 20 hours of data at a 6 second sample rate. The data can then be downloaded by the operator using the J.P. Instruments software.

2.2.1. EDM Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior inspection revealed that the JPI-700 unit had sustained negligible damage. The unit was powered on normally and the data was extracted using the manufacturer's recommended procedures.

2.2.2. EDM Data Description

The EDM recorded approximately 10,689 points of data over 27 flights. The event flight was located by the file's recorded date of January 4, 2014 and contained approximately 897 valid points of data over a span of about 1 hours and 4 minutes and 41 seconds.

Data from a ground event prior to the event flight was identified prior to the event flight on January 4, 2014 and is included in this report.

2.2.3. Engineering Units Conversions

The engineering units conversions used for the data contained in this report are based on documentation from the manufacturer of the EDM.

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

2.3. Time Correlation

The EDM records time based on the unit's internal clock. The internal clock is set and updated by the operator and displayed upon power up². The JPI was powered on and the internal time was recorded as 8 minutes ahead of UTC.

Correlation of the EDM data to UTC, was established by taking the unit's internal time and applying an 8 minute offset.

The GPS records time in UTC and no offset was required. All times are referenced as UTC for the rest of this report.

3. GPS PARAMETERS PROVIDED

Table 1 describes data parameters provided by the GPS device. Date, Time, Latitude, Longitude, and GPS Altitude are recorded by the device. Groundspeed and Track are derived from the recorded parameters.

² Time displayed on the JPI is in hours and minutes only.

Table 1: GPS Data Parameters

Parameter Name	Parameter Description
Date	Date for recorded data point (MM/DD/YYYY)
Time	Time (UTC) for recorded data point (HH:MM:SS)
Latitude	Recorded Latitude (degrees)
Longitude	Recorded Longitude (degrees)
GPS Alt	Recorded GPS Altitude (feet, MSL ³)
Groundspeed	Average groundspeed between current and previous data point (knots)
Track	Average true course between current and previous data point (degrees)

4. PLOTS AND CORRESPONDING TABULAR DATA

The following figures contain EDM and GPS data recorded during the January 4, 2014 event flight.

Figure 1 is a Google Earth overlay of the entire event flight which shows the aircraft takeoff originating from Danbury, Connecticut. The first and last recorded data points are shown at 19:12:22 to 20:20:03 UTC, respectively.

Figure 2 is a segment of figure 1 that highlights the last recorded data points. The aircraft is northbound when it began a right turn with a corresponding drop in groundspeed. The aircraft is set down on the Major Deegan Expressway at about 20:19:37 UTC and ultimately came to rest.

Figures 3 and 4 are plots from the event flight that contains engine and GPS parameters. The plot began at 19:15:30 UTC. The duration of the flight is uneventful until the Engine Exhaust Gas (EGT), and Cylinder Head Temperature (CHT) parameters begin to drop at 20:16:47 UTC. The last recorded data point for the EDM was at 20:19:47 UTC.

Figure 5 and 6 are Google Earth overlays from a ground event on January 4, 2014 that preceded the event flight. Figure 5 begins at 18:12:32 UTC. At 18:13:51 UTC the aircraft begins to cross the taxiway holding lines and move at an average groundspeed of 13 knots to the run-up area. The recording ends at 18:31:46 UTC.

Figure 6 begins at 18:43:04 UTC. At 18:43:46 UTC the aircraft begins to return to the parking area at an average groundspeed of 5 knots. The recording ends at 18:48:21 UTC. No engine data was available for the duration of figure 6.

The corresponding tabular data from the GPS and EDM used to create the overlays and plots from the event flight and previous flight are provided in electronic (*.csv⁴) format as Attachments 1 and 2, respectively, to this report.

³ MSL means altitude above mean sea level.

⁴ Comma Separated Value format

Figure 1. Overlay of aircraft track during event flight.

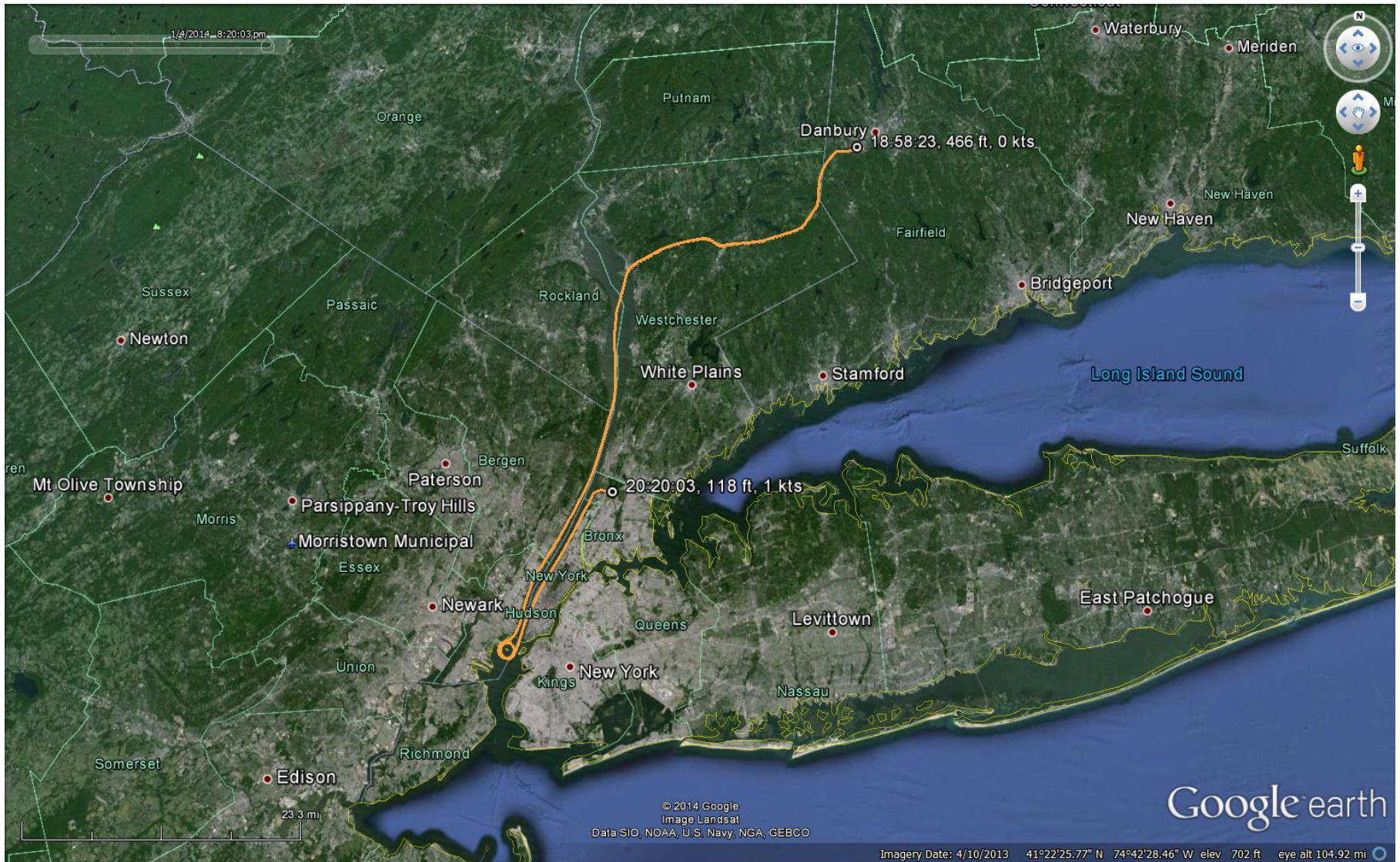


Figure 2. Overlay of aircraft track highlighting forced landing.

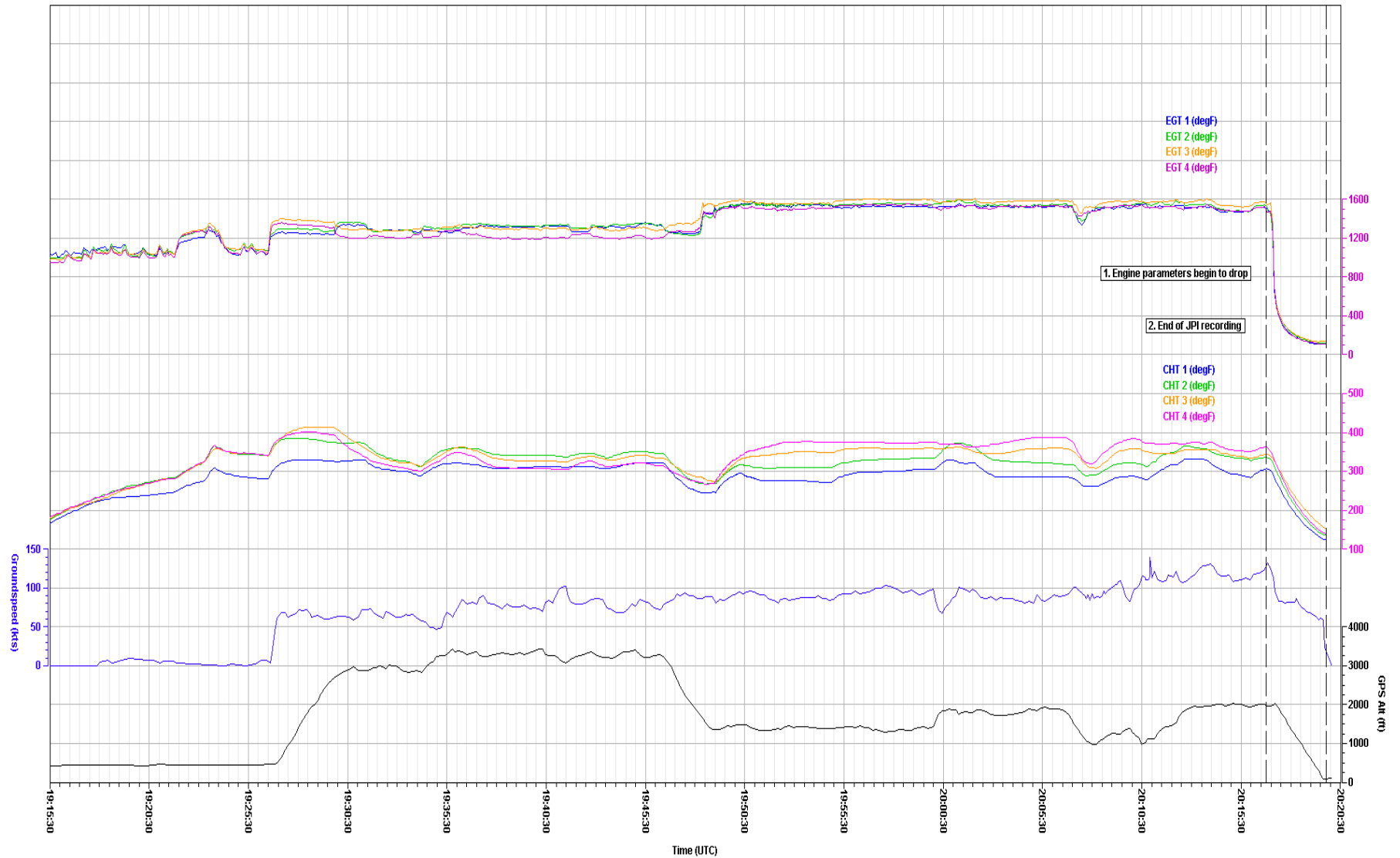


Figure 3. Plot of Engine and GPS parameters during event flight.

Private, Piper PA-28, N9409J

Location, Date: Bronx NY, 01/04/14

NTSB No. ERA14LA085



Revised: 13 August 2014

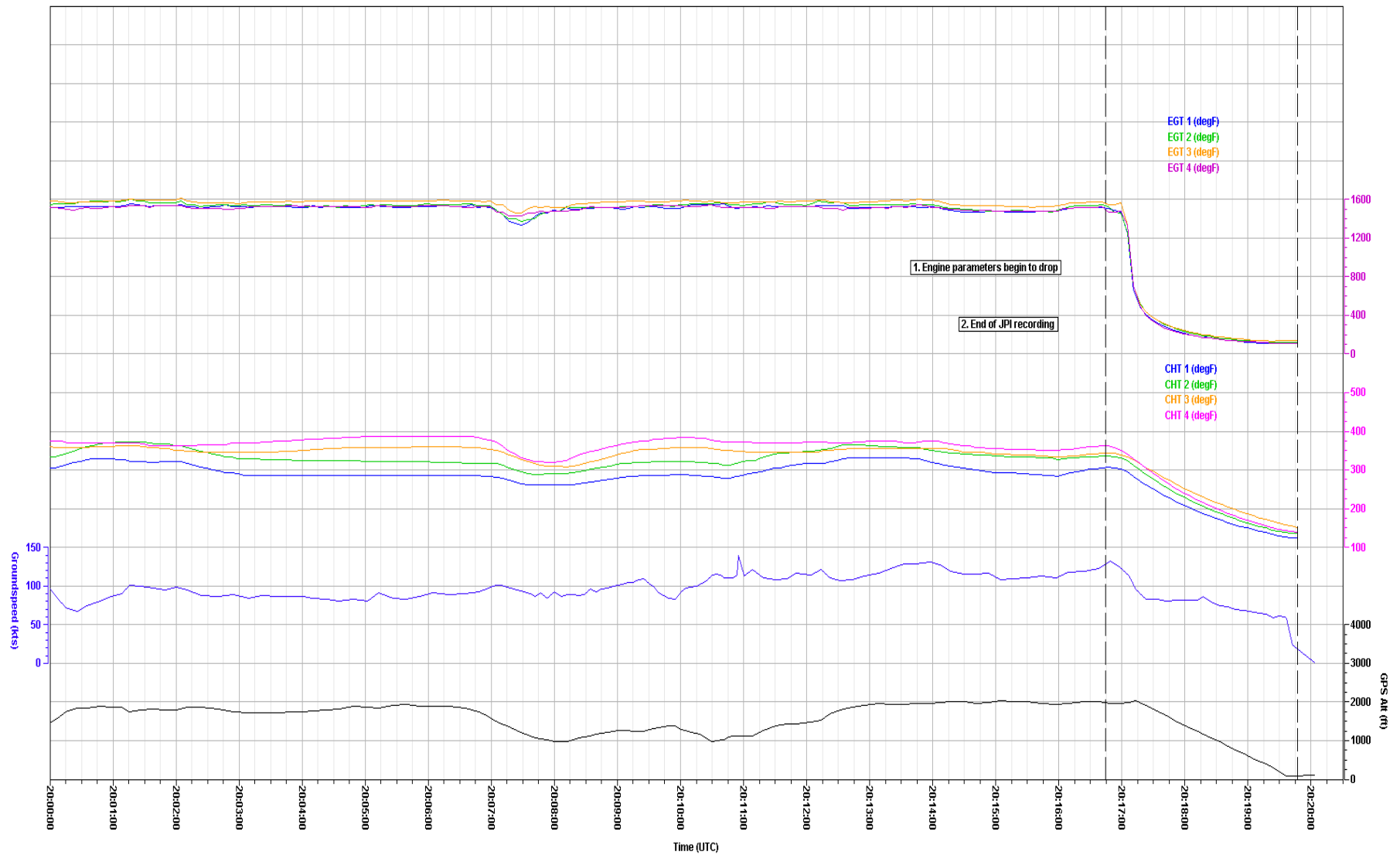
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Figure 4. Plot of Engine and GPS parameters highlighting last 20 minutes.

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Revised: 13 August 2014

National Transportation Safety Board

Figure 5. Overlay of aircraft taxiing out to runway 26.



Figure 6. Overlay of aircraft returning to parking area.



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 parameters.

Parameter Name	Parameter Description
1. Eng1 CHT-# (degF)	Engine Cylinder Head Temperature Cylinder #
2. Eng1 EGT-# (degF)	Engine Exhaust Gas Temperature Cylinder #
3. GPS Alt ^a (ft)	GPS altitude
4. Groundspeed ^a (kts)	Groundspeed

^a Source of parameter is from GPS

Table A-2. Unit abbreviations.

Units Abbreviation	Description
degF	Degrees Fahrenheit
ft	feet
kts	knots