

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

October 14, 2020

Electronic Devices

Specialist's Factual Report By W. Deven Chen

1. EVENT SUMMARY

Location: San Juan, Puerto Rico
Date: June 2, 2020
Aircraft: Piper PA-23-250
Registration: N14181
Operator: Private
NTSB Number: ERA20LA202

On June 2, 2020, about 1333 Atlantic standard time, a Piper PA-23-250, N14181, was substantially damaged when it was involved in an accident during takeoff from Fernando Luis Ribas Dominicci Airport (TJIG), San Juan, Puerto Rico. The airline transport pilot and one passenger were fatally injured while another passenger was seriously injured. The airplane was operated as a Title 14 *Code of Federal Regulations Part 91* post-maintenance flight test.

2. GROUP

A group was not convened.

3. DETAILS OF INVESTIGATION

The National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following electronic devices:

Device 1 Manufacturer/Model: **Garmin GTN 650**
Serial Number: **5FP001010**

Device 2 Manufacturer/Model: **Garmin GPSMAP 696**
Serial Number: **1N6014320**

Device 3 Manufacturer/Model: **JPI EDM 960 Display Unit**
Serial Number: **020603**

3.1. Garmin GTN 650 Description

Garmin GTN 650 is a flight GPS navigation instrument by Garmin Ltd. The panel-mount units are equipped with touchscreens, remote audio control, flight planning and electronic chart capabilities. There is a built-in terrain database that shows when potential conflicts are

ahead. There is also XM Satellite weather, traffic and lightning available on a moving map. The units also allow pilots to fly GPS-guided LPV (localizer performance with vertical guidance) glidepath approaches down to ILS (Instrument Landing System) minimums.

3.1.1. Garmin GTN 650 Data Recovery

The device was submerged in water upon arrival at the Vehicle Recorder Division and an exterior examination revealed the device had no impact damage, as shown in Figure 1. The device was cleaned and dried; however, it did not power up normally. The device itself did not have a data storage system to store flight data, thus no data were recovered from this device.



Figure 1: Garmin GTN 650 as received.

3.2. Garmin GPSMAP 696 Description

The Garmin GPSMAP 696 is a portable GPS receiver capable of storing date, route-of-flight, and flight-time information for up to 50 flights. A detailed tracklog, including latitude, longitude, date, time, and groundspeed information – is stored within the unit whenever the receiver has a lock on the GPS navigation signal. All recorded data is stored in non-volatile memory. The unit contains hardware and software permitting the download of recorded

waypoint, route, and tracklog information to a PC via a built-in serial port. The unit can also communicate with external devices such as a computer using 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.

3.2.1. Garmin GPSMAP 696 Data Recovery

The device was submerged in water upon arrival at the Vehicle Recorder Division, and an exterior examination revealed the device did not have impact damage, as shown in Figure 2. The device was cleaned and dried; however, the device did not power up normally. The non-volatile memory¹ was removed, readout and converted to engineering units using laboratory tools. The data showed a total of 301 sessions from August 23, 1999 to April 4, 2019. The last flight on April 4, 2019 was a short flight from Jose Aponte de la Torre airport to Antonio Rivera Rodrigues airport. The accident flight was not captured; thus, no accident related data were recovered from this device.



Figure 2: Garmin GPSMAP 696 as received.

3.3. JPI EDM 960 Description

The JPI EDM-960 is a twin-engine monitor instrument with one display unit and one Data Acquisition Unit (DAU) per engine. The color display unit allows the operator to monitor and

¹ Non-volatile memory (NVM) is semiconductor memory that does not require external power for data retention.

record up to 24 parameters related to engine operations. Depending on the installation, engine parameters monitored can 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 (RPM), Compressor Discharge Temperature, Fuel Flow, Carburetor Temperature, and Battery Voltage.

The instrument can also calculate in real time, percent of maximum horsepower, fuel used, shock cooling rate, engine hours (Hobbs time) and EGT differentials between highest and lowest cylinder temperatures. The calculations are also based on the aircraft installation.

The instrument contains NVM 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 60 seconds per sample. The memory can store up to 800 hours of data at a 6 second-per-sample rate. The data can then be downloaded by the operator using the J.P. Instruments software.

3.3.1. JPI EDM 960 Display Unit Data Recovery

The device was submerged in water upon arrival at the Vehicle Recorder Division, and an exterior examination revealed the device did not have impact damage, as shown in Figure 3. The device was cleaned and dried; however, the device did not power up normally. The device was sent to the manufacturer for data recovery. The manufacturer sent back a raw data file, and this file was converted into engineering units using a software of the manufacturer at the Vehicle Recorder Division.



Figure 3: JPI EDM 960 Display Unit as received.

3.3.2. JPI EDM 960 Display Unit Data Description

The recovered data contained 353 sessions from February 9, 2017 to June 2, 2020. There were two sessions recorded on June 2, 2020, and the last session was determined to be the accident flight. Both of those two sessions are included in this report.

3.3.3. JPI EDM 960 Display Unit Parameters Provided

Table 1 describes data parameters recorded by the device.

It was determined that parameters preceded with “L” refer to parameters recorded on the left engine and parameters preceded with “R” refer to parameters recorded on the right engine.

Table 1: JPI EDM 960 Data Parameters.

Parameter Name	Parameter Description
Date	Date for recorded data point (MM/DD/YYYY)
Time	Device Time for recorded data point (HH:MM:SS)
L/REGT 1-6 (degF)	Left or Right Engine Exhaust Gas Temperature Cylinder # (degrees Fahrenheit)
L/RCHT 1-6 (degF)	Left or Right Engine Cylinder Head Temperature Cylinder # (degrees Fahrenheit)
L/RCLD (degF/min)	Left or Right Engine Shock Cooling Rate (degrees Fahrenheit per minute)
OAT (degF)	Outside Air Temperature (degrees Fahrenheit)
L/RMAP (inHg)	Left or Right Engine Manifold Pressure (inches of mercury)
L/RFF (GPH)	Left or Right Engine Fuel Flow (gallons per hour)
L/RRPM (rpm)	Left or Right Engine Rotational Speed (revolutions per minute)
L/ROILT (F)	Left or Right Engine Oil Temperature (degrees Fahrenheit)
L/ROILP (PSI)	Left or Right Engine Oil Pressure (pounds per square inch)
L/RHP (%)	Left or Right Engine Percent of Maximum Horsepower (percentage)
BAT (V)	Bus Voltage (voltage)
AMP (A)	Bus Load Current (amperes)
AMP2 (A)	Bus Load Current 2 (amperes)

3.3.4. JPI EDM 960 Display Unit Time Correlation

JPI EDM devices record data in Coordinated Universal Time (UTC) and record time with the first data sample based on the devices’ internal clocks. These internal clocks tend to drift from UTC over time. The offset usually can be determined upon powering on the devices.

Since the JPI DEM 960 did not power up, the offset was undeterminable. All times are referenced as device time in this report.

3.4. Plots and Corresponding Tabular Data

The following four figures contain data recorded on the JPI EDM 960 on June 2, 2020. Two of the figures for each engine data parameters of the accident flight, and the other two for each engine data parameters of the flight before the accident flight. The shock cooling rate were all 0 Fahrenheit per minute for both engines and for both flights, and this parameter was not plotted.

Figure 4 is a plot of the left engine parameters for the accident flight recorded on June 2, 2020. The time interval displayed is 17:11:00 to 17:13:30 device time. The yellow highlight shows the percentage of the maximum horsepower was approximately between 20-25 percent, and the engine rotational speed was approximately between 1000-1300 RPM.

Figure 5 is a plot of the right engine parameters for the accident flight recorded on June 2, 2020. The time interval displayed is 17:11:00 to 17:13:30 device time. The yellow highlight shows the percentage of the maximum horsepower was approximately 12 percent, and the engine rotational speed was approximately between 600-800 RPM.

Figure 6 is a plot of the left engine parameters for the flight prior to the accident flight recorded on June 2, 2020. The time interval displayed is 15:39:00 to 15:48:00 device time.

Figure 7 is a plot of the right engine parameters for the flight prior to the accident flight recorded on June 2, 2020. The time interval displayed is 15:39:00 to 15:48:00 device time.

A review of engine parameters data from normal flights recorded prior to the accident date showed that when the accident aircraft took off from airports the horsepower reached above 70 percent and the engine rotational speeds were around 2300 RPM for both the left and right engines. The fact that the horsepower and RPM were at much lower values as shown on figures 4 and 5, indicates that the JPI EDM 960 only recorded data when the accident aircraft was on the ground at the airport and did not capture any data during takeoff for the accident flight.

The corresponding tabular data used to create figures 4-7 are provided in electronic comma-delimited (.csv) format as Attachment 1 to this report. Not every additional parameter has been validated by the specialist.

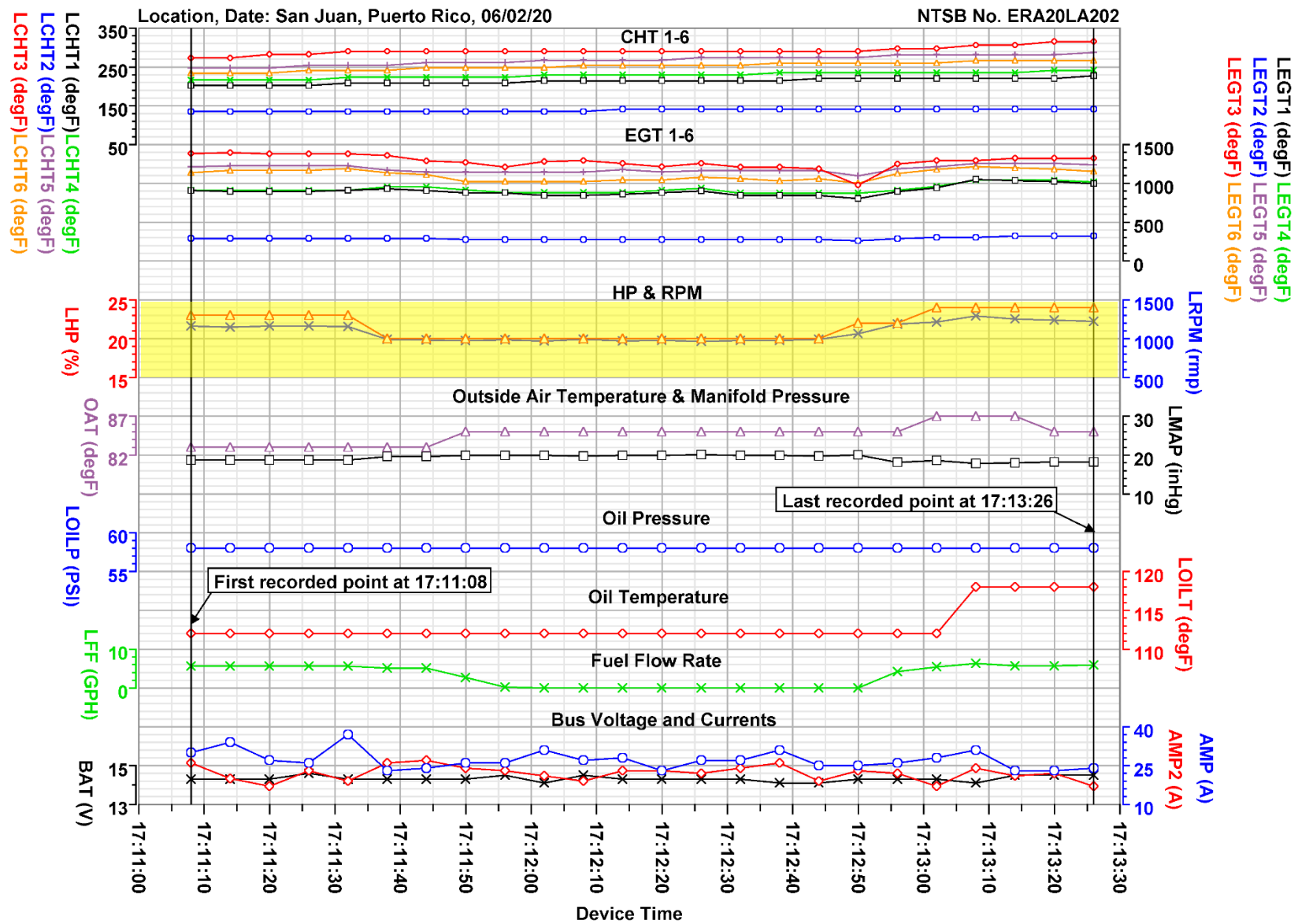


Figure 4: Plot of JPI EDM 960 left engine parameters for the accident flight recorded on June 2, 2020.

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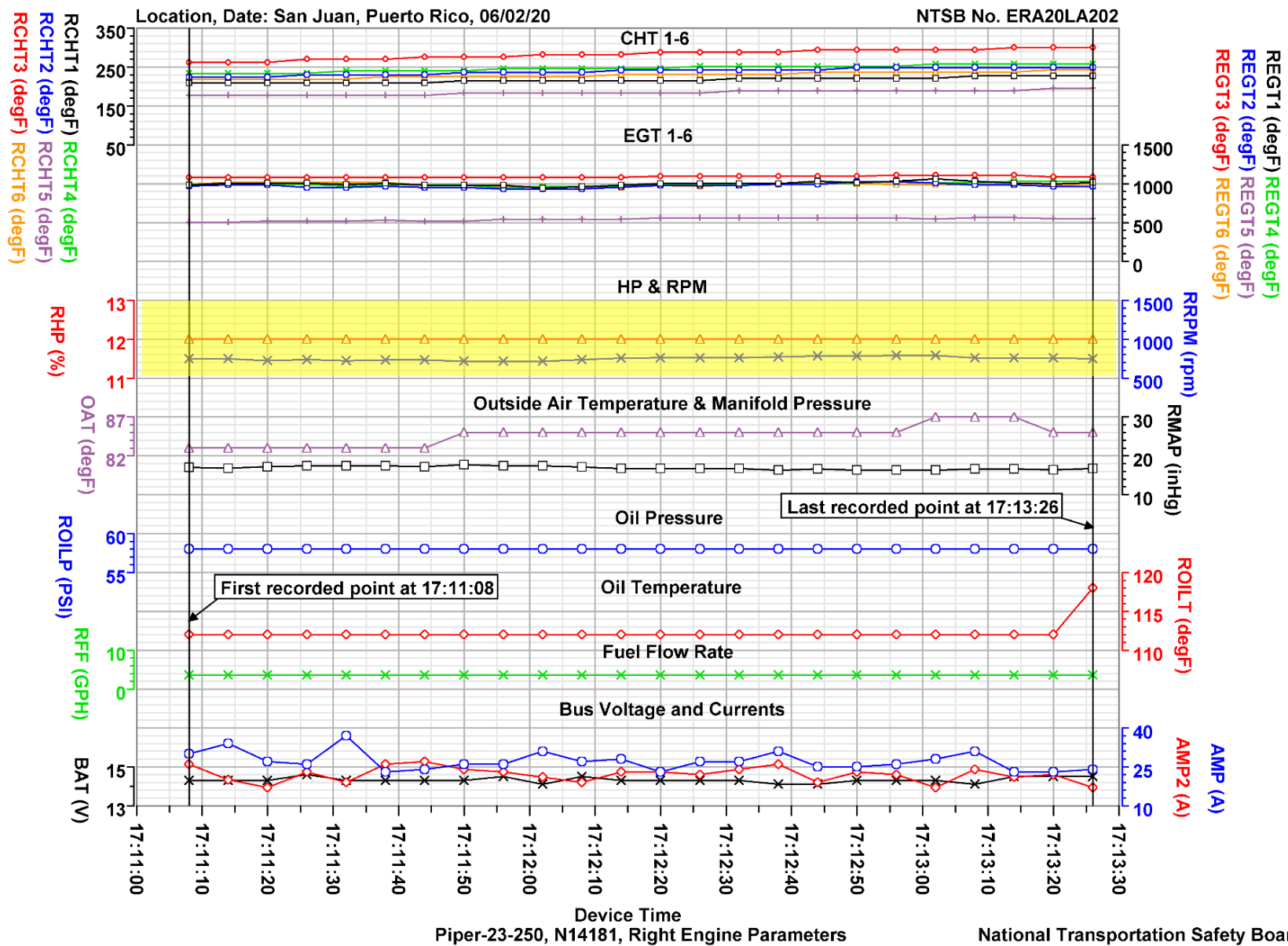


Figure 5: Plot of JPI EDM 960 right engine parameters for the accident flight recorded on June 2, 2020.

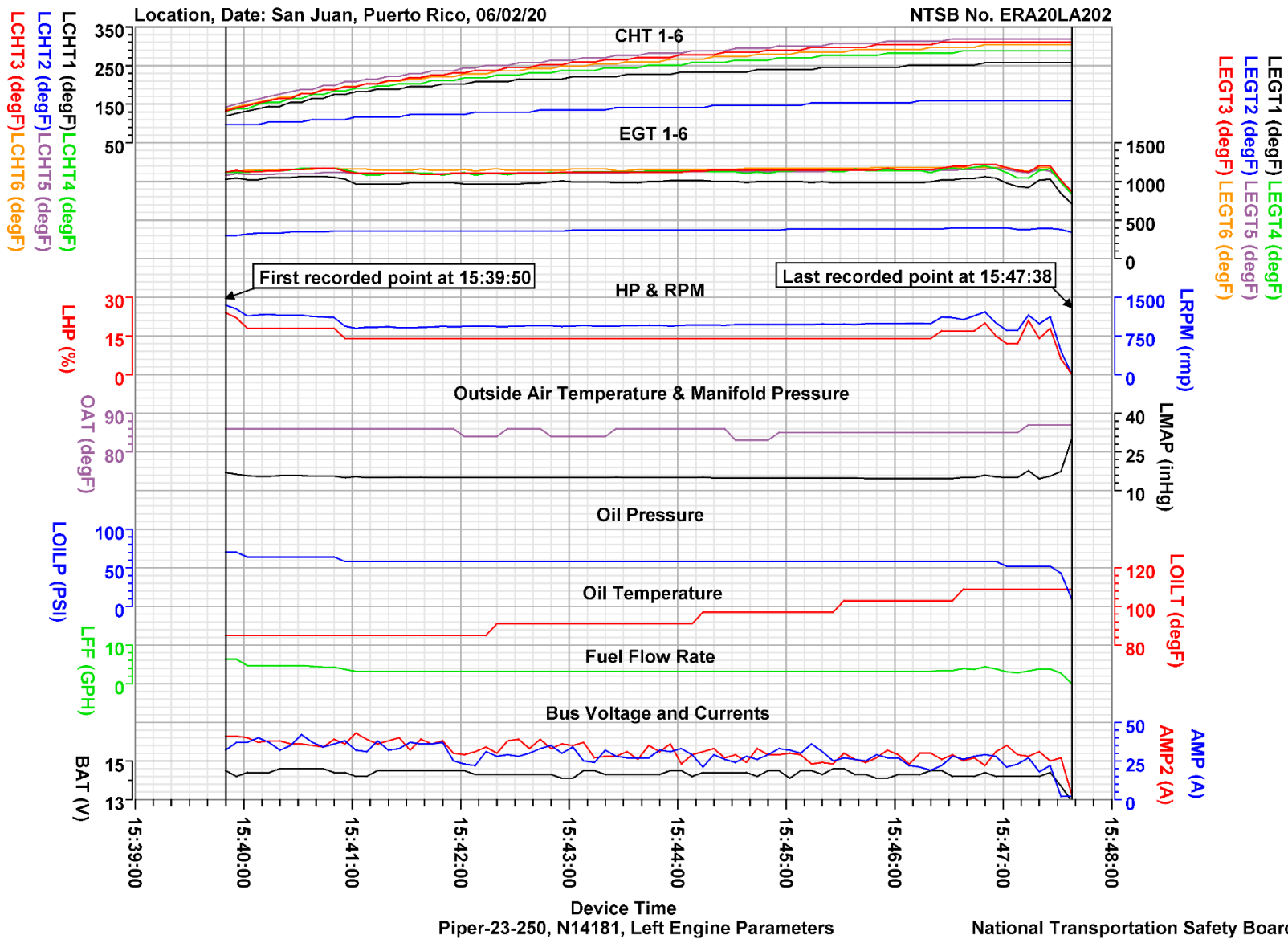


Figure 6: Plot of JPI EDM 960 left engine parameters for the flight before the accident recorded on June 2, 2020.

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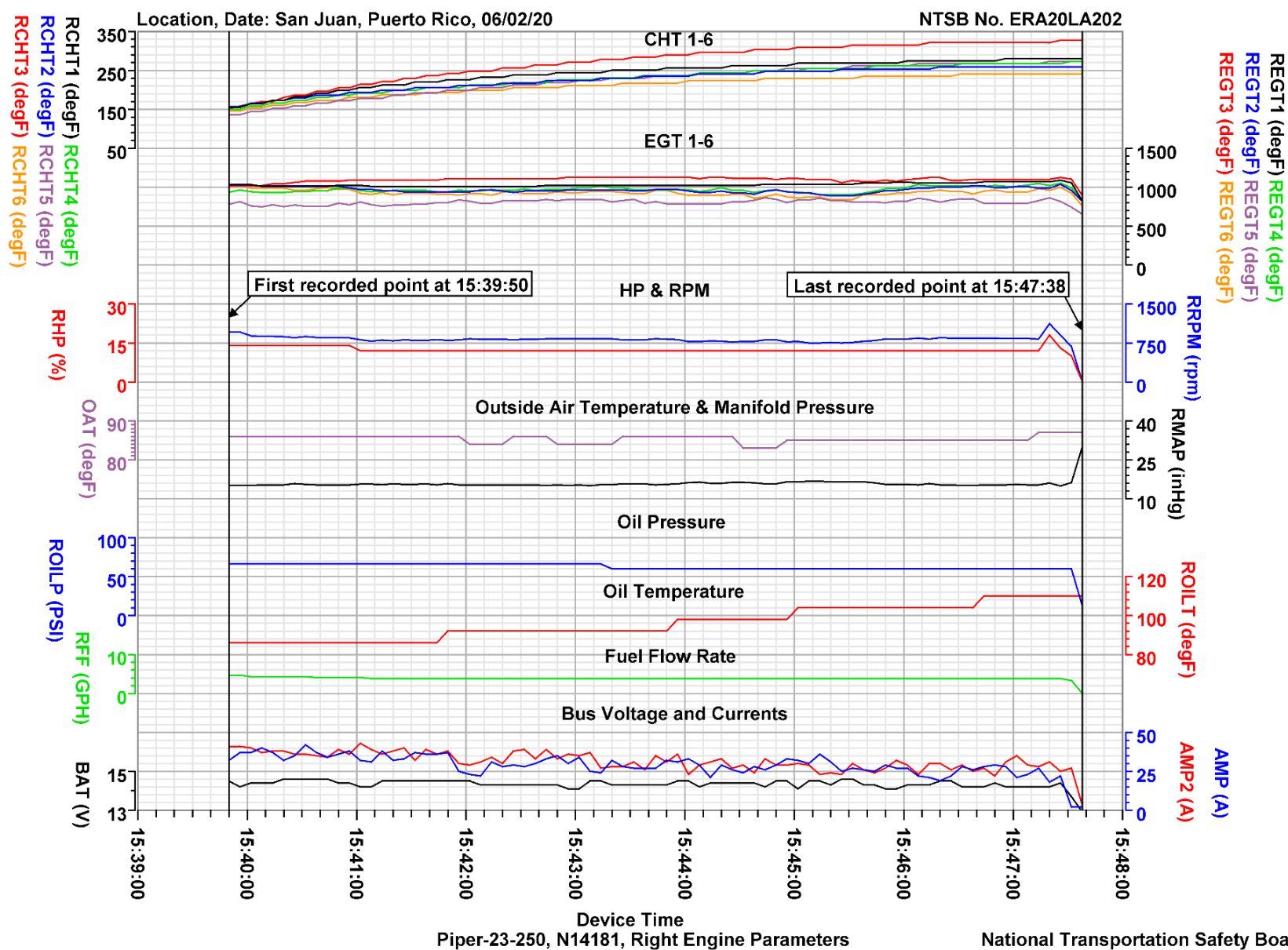


Figure 7: Plot of JPI EDM 960 right engine parameters for the flight before the accident recorded on June 2, 2020.

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