

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



ERA23FA078

COCKPIT DISPLAY - RECORDED FLIGHT DATA

Specialist's Factual Report

May 19, 2023

A. ACCIDENT

Location: Beverly, Massachusetts
Date: December 4, 2022
Time: 1135 eastern standard time (EST)
Airplane: Rotorsport UK LTD Cavalon, N401GR

B. COCKPIT DISPLAY - RECORDED FLIGHT DATA SPECIALIST

Specialist: W. Deven Chen
Electrical Engineer - Recorder Specialist
National Transportation Safety Board (NTSB)

C. DETAILS OF THE INVESTIGATION

A recorder group was not convened. The NTSB Vehicle Recorder Division received the following two cockpit displays:

Recorder Manufacturer/Model:	Garmin GDU 450
Recorder Serial Number:	34V000376
Recorder Manufacturer/Model:	Garmin GDU 450
Recorder Serial Number:	34V000380

1.0 Recorder Description

The Garmin GDU 450 is a panel-mounted GPS receiver with 7-inch color liquid crystal (LCD) landscape display. It is a variant of the Garmin G3X Touch series. The Garmin G3X series employ a touch-screen user interface and can be utilized as a primary flight display (PFD), multi-function display (MFD), engine monitoring device (EDM), or a combination of all, depending on how the unit is integrated with other compatible avionics products. The unit has the ability to record data via an externally removable SD card mounted on the screen, or internally on a series of non-volatile memory (NVM) chips.

If not disabled, the unit is capable of logging historical information at a variable rate of up to 10 Hertz (Hz) to the internal NVM. Historical logs may be copied to a standard SD card inserted into the slot provided on the front of the unit in configuration mode. Data is exported in engineering units, in a comma-separated value (CSV) format. Each record contains coordinated universal time (UTC) date and time, as well as an integer number of milliseconds since the unit was last powered.

1.1 Recorder Condition and Data Recovery

The two Garmin GDU 450 cockpit displays arrived in good condition, as shown in figure 1. The two displays were labeled left and right screen respectively. The SD card from the right screen contained recorded data logs.



Figure 1. The two Garmin GDU 450 cockpit displays as received.

1.2 Recording Description

The SD card contained 101 data log files. The last log file recorded on December 4, 2022, was determined to be associated with the accident flight. The recording was approximately 20 minutes and 24 seconds in duration and with a 1Hz sampling rate.

1.2.1 Parameters Provided

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

Table 1. Garmin GDU 450 data parameters provided.

Parameter Name (unit)	Parameter Description
Baro Altitude (ft)	Barometric altitude (feet)
Batt Amps	Battery bus current in amperes
Carb T (deg F)	Carburetor temperature (degrees Fahrenheit)
Cool T (deg F)	Coolant temperature (degrees Fahrenheit)
EGT1-4 (deg F)	Exhaust gas temperature (degrees Fahrenheit)
FF (gal/hr)	Fuel flow rate (gallons per hour)
Fuel P (psi)	Fuel pressure (pound per square inch)
GPS Altitude (ft)	Altitude above Mean Sea Level (feet)

Parameter Name (unit)	Parameter Description
GPS Ground Speed (kt)	Average groundspeed between current and previous data point (knots)
Heading (deg)	Heading direction relative to magnetic north (degrees)
Indicated Airspeed (kt)	Indicated airspeed (knots)
Lateral Acc (G)	Lateral acceleration (G)
Latitude (deg)	Geometric latitude (degrees)
Longitude (deg)	Geometric longitude (degrees)
Mani P (inch Hg)	Manifold pressure (inches of mercury)
Normal Acc (G)	Normal acceleration (G)
OAT (deg F)	Measured outside air temperature (degrees Fahrenheit)
Oil P (PSI)	Oil pressure (pounds per square inch)
Oil T (deg F)	Oil temperature (degrees Fahrenheit)
Pitch (deg)	Pitch angle (degrees)
Pressure Altitude (ft)	Pressure altitude (feet)
Roll (deg)	Roll angle (degrees)
RPM	Engine revolution per minute
Track (deg)	GPS ground track (degrees)
True Airspeed (kt)	True airspeed (knots)
Volts	Battery bus voltage (volts)
Vertical Speed (ft/min)	Vertical Speed (feet per minute)

1.3 Time Correlation

The data were recorded in UTC, and were converted to EST, the local time of the accident.

D. FIGURES AND TABULAR DATA

Figures 2 to 8 contain data recorded on the Garmin GDU 450 during the accident flight on December 4, 2022. All the parameters listed in table 1 are plotted except latitude and longitude.

Figures 2 to 6 are parameter plots during the accident flight. 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 7 and 8 show Google Earth overlays of the accident flight track. Figure 8 shows the takeoff with reference to the centerline of the runway. The reported wreckage location is shown with a red pin. Note that the weather and lighting conditions in Google Earth are not necessarily the weather and lighting conditions present at the time of the recording.

The corresponding tabular data used to create figures 2 to 8 are provided in electronic comma-separated value (CSV) format as attachment 1 to this report.

Submitted by:

W. Deven Chen
Electrical Engineer – Recorder Specialist

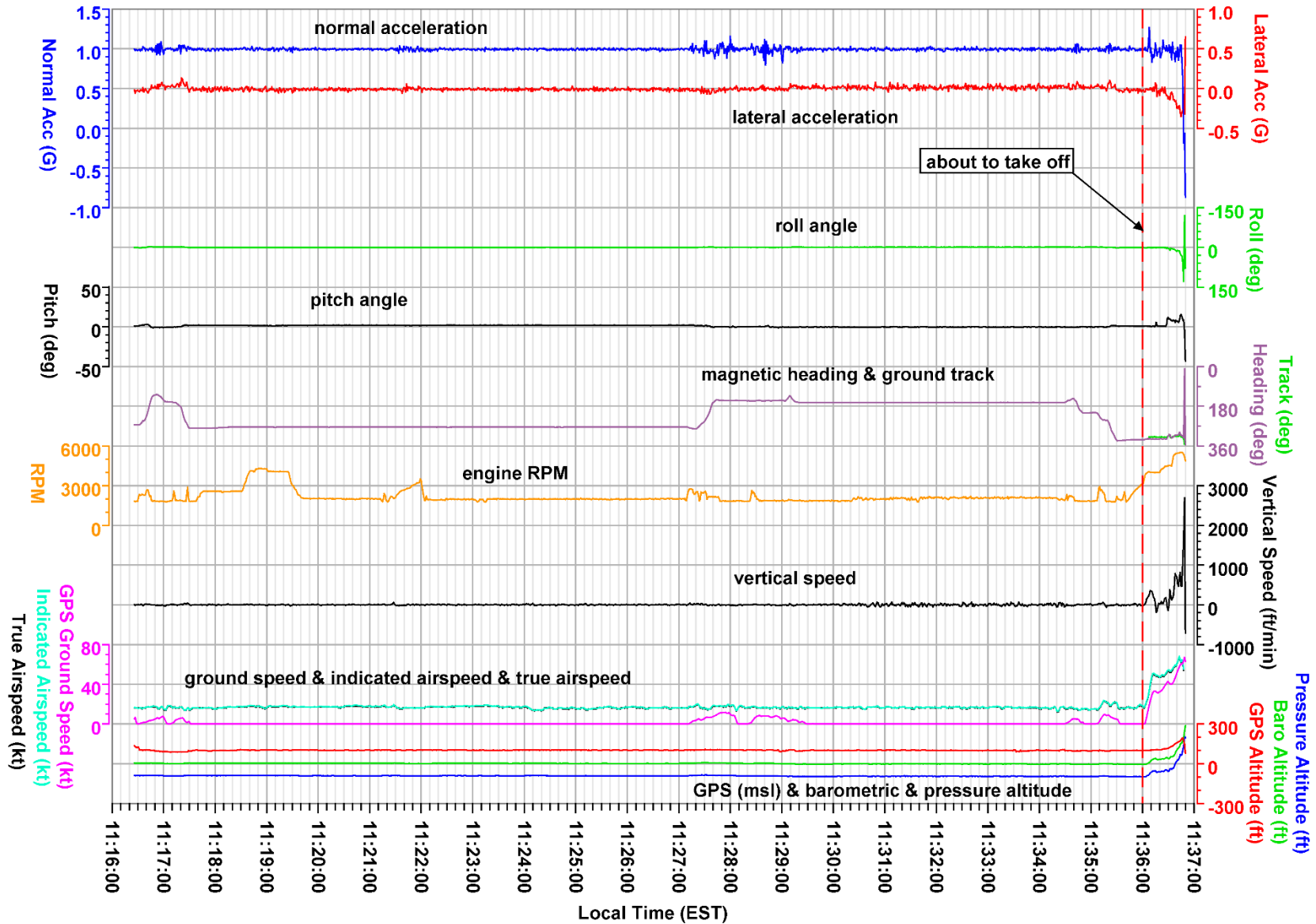


Figure 2. Plot of basic parameters for the entire accident flight recording.

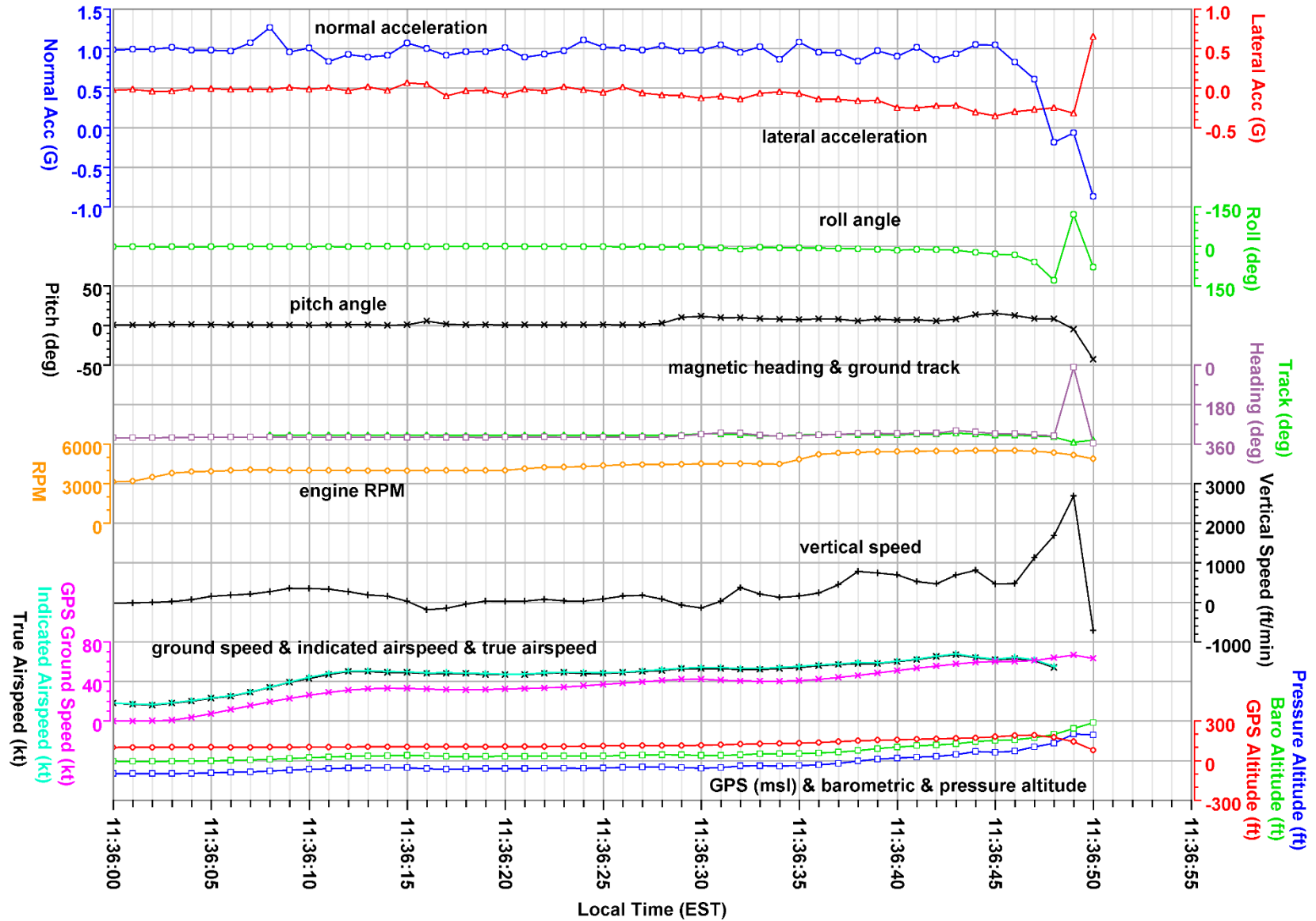


Figure 3. Plot of basic parameters for the session between 11:36:00 and the last recorded point.

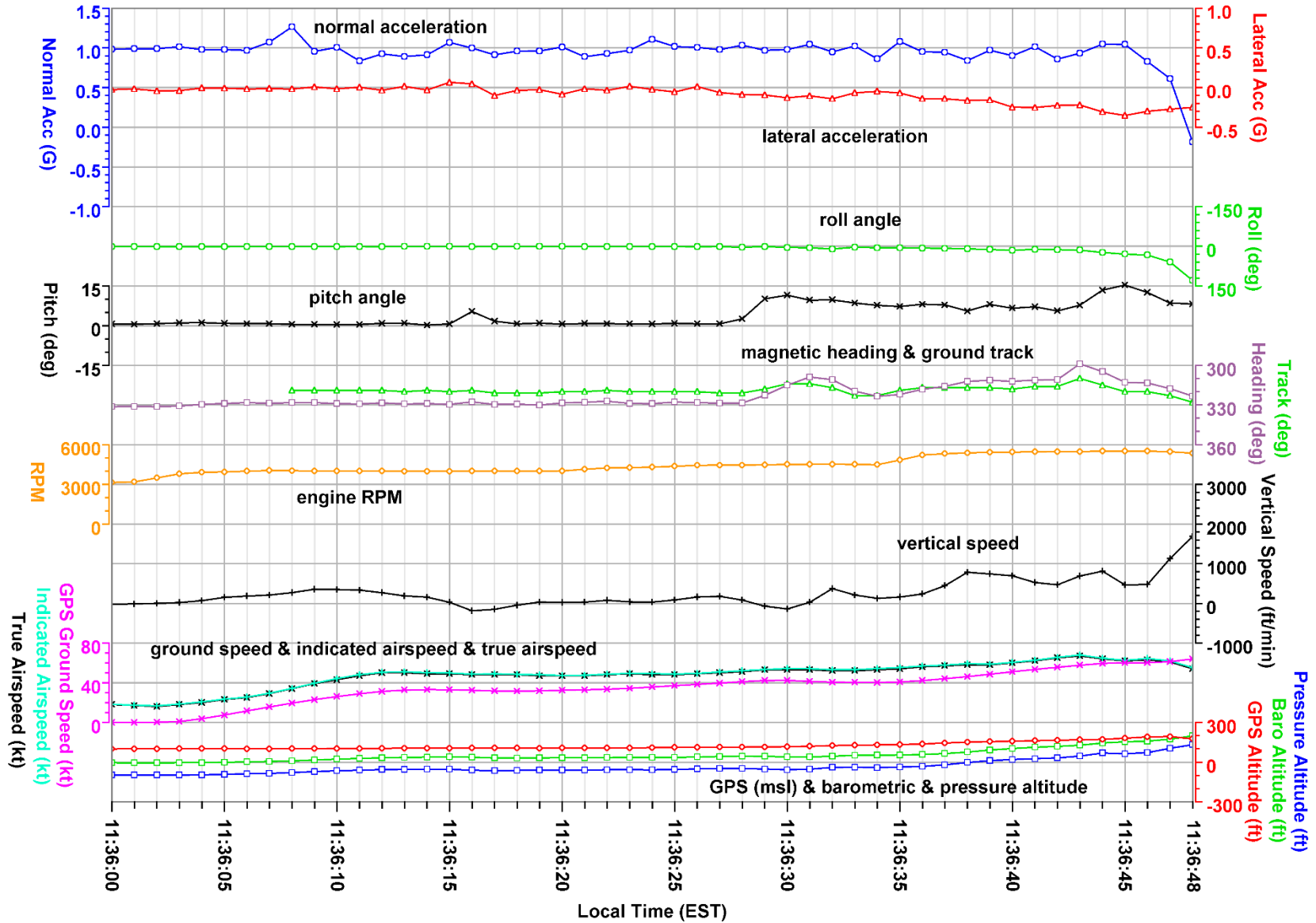


Figure 4. Plot of basic parameters for the session between 11:36:00 and 11:36:48.

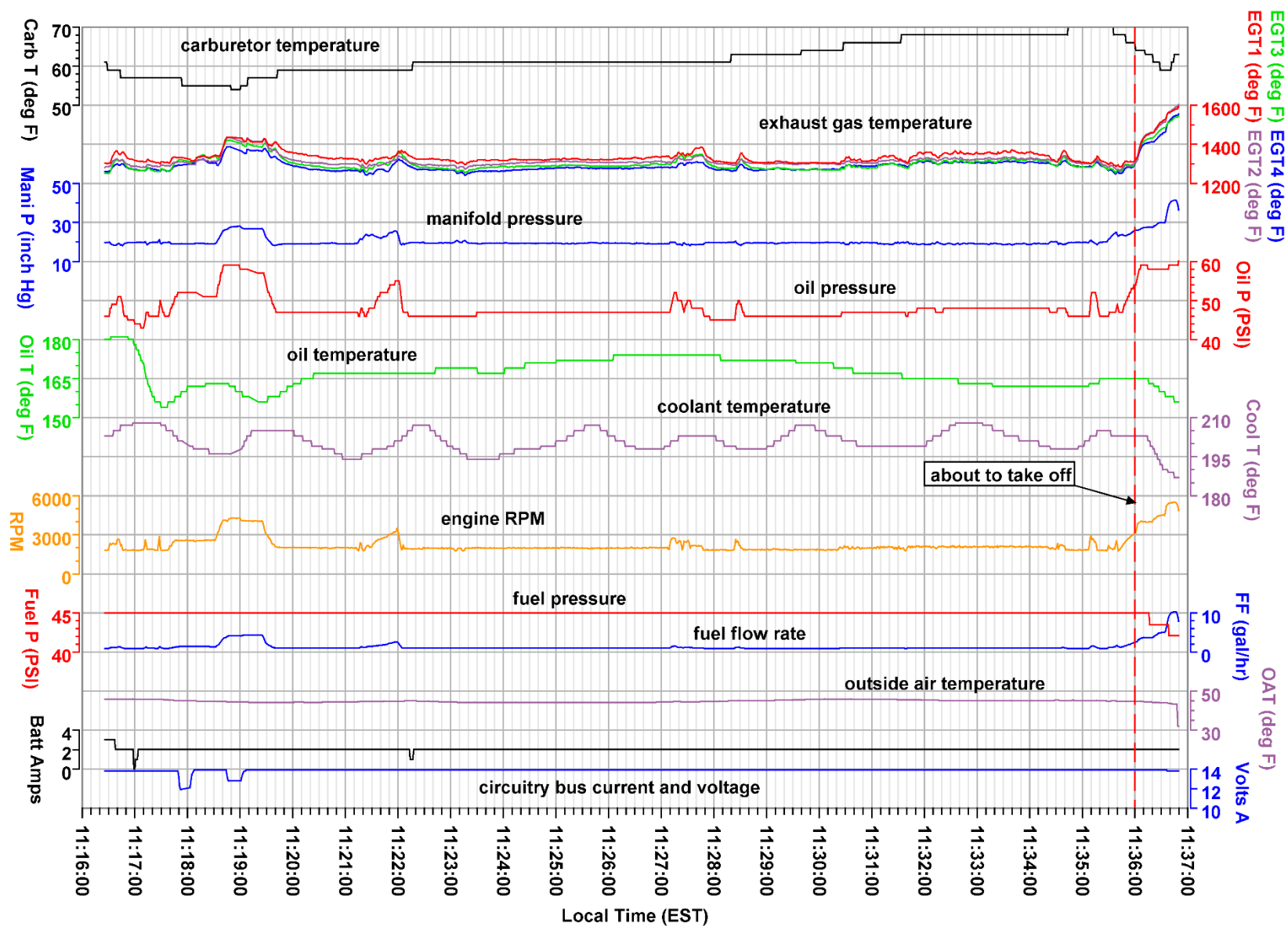


Figure 5. Plot of engine parameters for the entire accident flight recording.

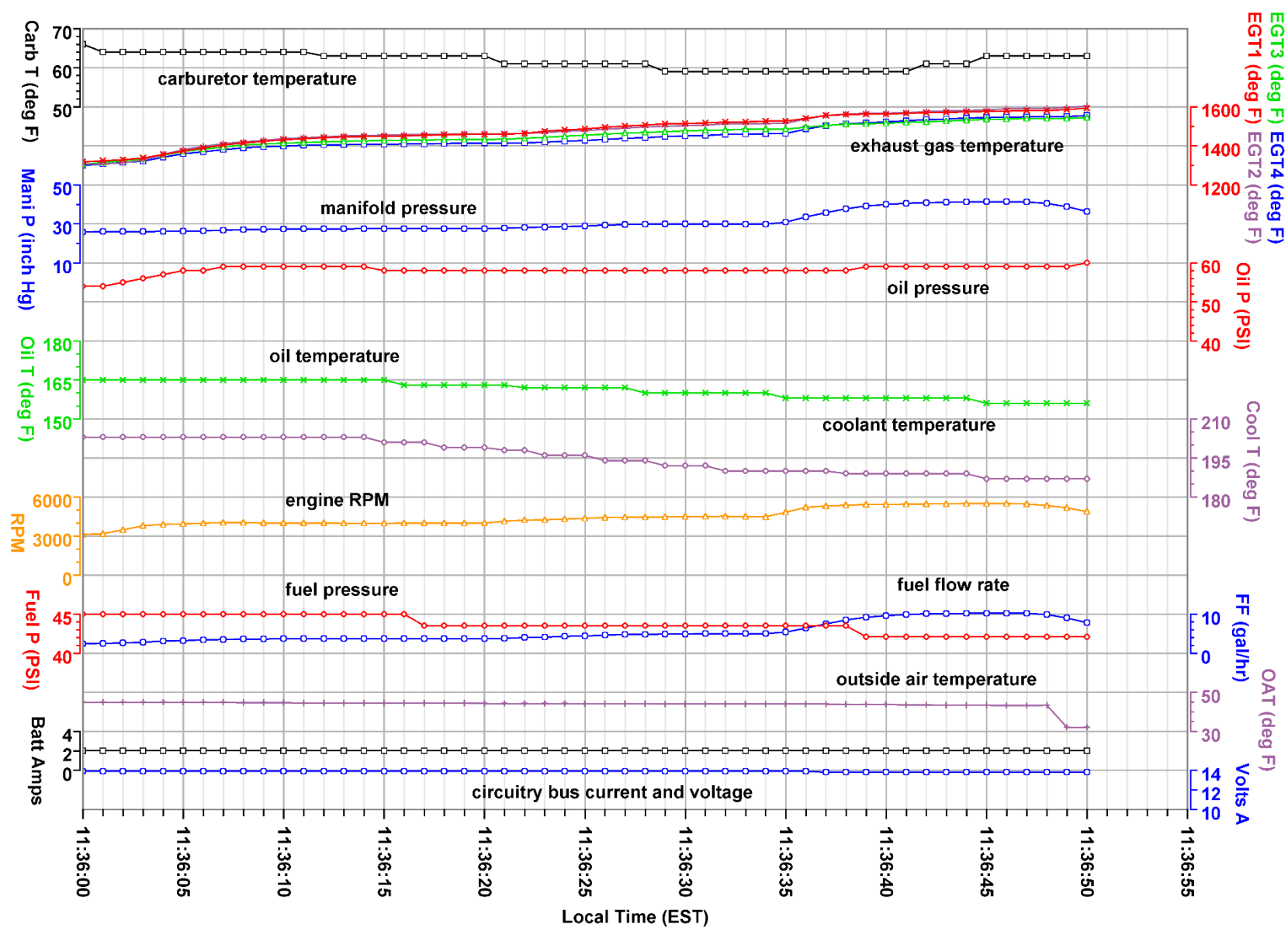


Figure 6. Plot of engine parameters for the session between 11:36:00 and the last recorded point.



Figure 7. Google Earth overlay of the entire accident flight track.



Figure 8. Google Earth overlay showing the takeoff with reference to the centerline of Runway 34.