

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

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Cockpit Displays – Recorded Flight Data

Specialist's Factual Report
By Sean Payne

1. EVENT SUMMARY

Location: Fishers, Indiana
Date: August 31, 2017
Aircraft: Vans Aircraft RV-12
Registration: N212ZF
Operator: Private
NTSB Number: CEN17FA334

On August 31, 2017, about 1130 eastern daylight time (EDT), a Vans Aircraft Inc. RV-12 airplane, N212ZF, impacted terrain following a takeoff from runway 15 at the Indianapolis Metropolitan Airport (UMP), near Fishers, Indiana. The private pilot, who was the sole occupant, was fatally injured. The airplane was destroyed during the impact and a post impact ground fire. The airplane was registered to and operated by the pilot as a 14 *Code of Federal Regulations* Part 91 personal flight. Day visual meteorological conditions prevailed in the area about the time of the accident, and the flight was not operated on a flight plan. The local flight was originating from UMP at the time of the accident.

2. RECORDED FLIGHT DATA GROUP

A recorded flight data group was not convened.

3. DETAILS OF INVESTIGATION

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

Recorder Manufacturer/Model: **Dynon FlightDEK-D180**
Recorder Serial Number: **2850**

3.1. Dynon FlightDEK-D180 Description

The Dynon FlightDEK-D180 is a 7" wide screen display mounted in the cockpit of non-type certificated aircraft. The instrument integrates multiple flight instruments including airspeed, altitude, gyro-stabilized magnetic compass, turn rate, slip/skid ball, bank angle, pitch angle and vertical speed. The unit also has other functions that include a clock/timer, g-meter, voltmeter and a density altitude/true airspeed calculator. The unit contains an Air Data, Attitude and Heading Reference System (ADAHRS) to provide air data, attitude and heading information to the display. Depending on the installation in the operator's aircraft, certain parameters might not be displayed, for example angle-of-attack. The instrument also

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integrates up to 16 engine related instruments including manifold pressure, temperatures, RPM and fuel system information. Depending on the type of engine installed in the aircraft and pilot preferences, not all display options can be available.

Depending on the firmware version on the unit, the ability to log data to internal memory exists. According to the manufacturer, firmware versions 3.0 and later contain the ability to log certain engine parameters and firmware versions 5.0 and later contain the ability to log certain EFIS and GPS parameters. The data logging must be configured by the operator to enable logging and set the data log interval. The unit can also be configured to start logging data automatically at boot-up. The data logging interval can be set to store at 1,3,5,10,30 and 60 second intervals. The internal memory can store at least 30 minutes of cumulative data at a 1 second recording interval or at least 30 hours at a 60 second data recording interval. When the recording limit in the internal memory is reached, the oldest record is dropped and a new record is added.

3.1.1. Dynon FlightDEK-D180 Data Recovery

The recorder was damaged in the event. The extent of the damage is shown in figure 1. The data were extracted by identifying the non-volatile memory¹ (NVM) chip inside the device, removing it via a de-soldering process, and reading the NVM's binary contents in a forensic reader. The binary contents were then converted to engineering units using documentation supplied by the manufacturer with the assistance of NTSB laboratory software.

Figure 1. Damaged exterior of Dynon FlightDEK-D180.



¹ Non-volatile memory (NVM) – semi-conductor memory that does not require power in order to retain data.

3.1.2. Dynon FlightDEK-D180 Data Description

Based on information from the manufacturer, the unit does store data. The operator had the datalog function enabled and it was set to record information at a one second interval and started recording at boot up. The recording contained approximately 100 minutes of data. The accident/incident flight recording was approximately nine minutes long. The data from the unit ended prematurely, this condition could have been a result of data buffering prior to being written to the unit's NVM.

3.1.3. Dynon FlightDEK-D180 Engineering Units Conversions

Conversion of the PFD data from the raw recorded information to engineering units is performed by referencing documentation from the manufacturer.

The convention for the engine instruments to record cylinder head temperature (CHT) is numbered in a manner that does not correspond to the numbered cylinder head in the engine. Information from the engine manufacturer indicates that only cylinder head temperatures of cylinders 2 and 3 are monitored. CHT-1 reflects the values for CHT on cylinder number 2 and CHT-2 reflects the values for cylinder number 3.

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=+).²

APPENDIX A lists the PFD parameters verified and provided in this report.

3.2. Time Correlation

Correlation of the Dynon data to EDT was established using the recorded GPS time parameter from the Dynon FlightDEK-D180 data. The GPS time is recorded in Universal Coordinated Time (UTC). The difference between EDT and UTC is 4 hours, or 14,400 seconds. The Dynon starts recording when power is applied to the unit. An offset is applied to each power cycle plotted to display the data with the local time zone. Therefore, for the rest of this report, all times are referenced as EDT, not recorded time.

3.3. Plots and Corresponding Tabular Data

The following seven figures contain EDM data recorded during the August 31, 2017, event and during a previous flight on August 30, 2017.

Figure 2 is a plot of the flight previous to the accident. The flight took place on August 30, 2017. The plotted time interval is from 12:38:00 to 13:30:00 EDT on August 30, 2017.

² 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 = +, Left Aileron Trailing Edge Down = -, Right Aileron Trailing Edge Up = +, Pitch Up = +, Elevator Trailing Edge Up = +.

Figure 3 is a plot of the entire accident flight on August 31, 2017. The plotted time interval is from 11:15:12:26 EDT on August 31, 2017. Data shows that the takeoff roll began just after 11:25:00 EDT. Data was lost at 11:25:54 EDT.

Figure 4 is an expanded time scale plot of the accident flight around the time of takeoff and subsequent data loss. The data shows the aircraft reached nearly full power around 11:25:30 EDT. The aircraft began a climb around 11:25:40 EDT. Just prior to data loss at 11:25:54 EDT, values for pitch and roll indicated that the aircraft became pitched down greater than -10 degrees and was rolling to the left. Engine parameters prior to this point were nominal. In the seconds prior to data loss, values for manifold pressure and engine RPM were trending downward.

Figure 5 is a Google Earth overlay of the entire previous flight on August 30, 2017.

Figure 6 is a Google Earth overlay showing detail of the departure and arrival profile of the aircraft during the previous flight on August 30, 2017.

Figure 7 is a Google Earth overlay showing the entire recorded tracklog points for the accident flight.

Figure 8 is a Google Earth overlay oriented to show the entire recorded tracklog points for the accident flight in relation to the wreckage location which is displayed as a yellow pushpin near the departure end of the runway.

A review of available EFIS and engine monitoring alerting parameters revealed that no alerts or warnings were displayed or triggered just prior to the time of the accident. Furthermore, a review of available alert and warning data triggered as active during the engine start sequence and behaved appropriately during this time, indicating that these alert and warning data were functional and valid. The alert and warning information was too numerous to be included in the plotted information in the figures below and was not included in tabular data.

The corresponding tabular data used to create these seven plots are provided in electronic (*.csv³) format as Attachment 1 to this report.

³ Comma Separated Value format.

Figure 2. Plot of flight data from the flight previous to the accident.

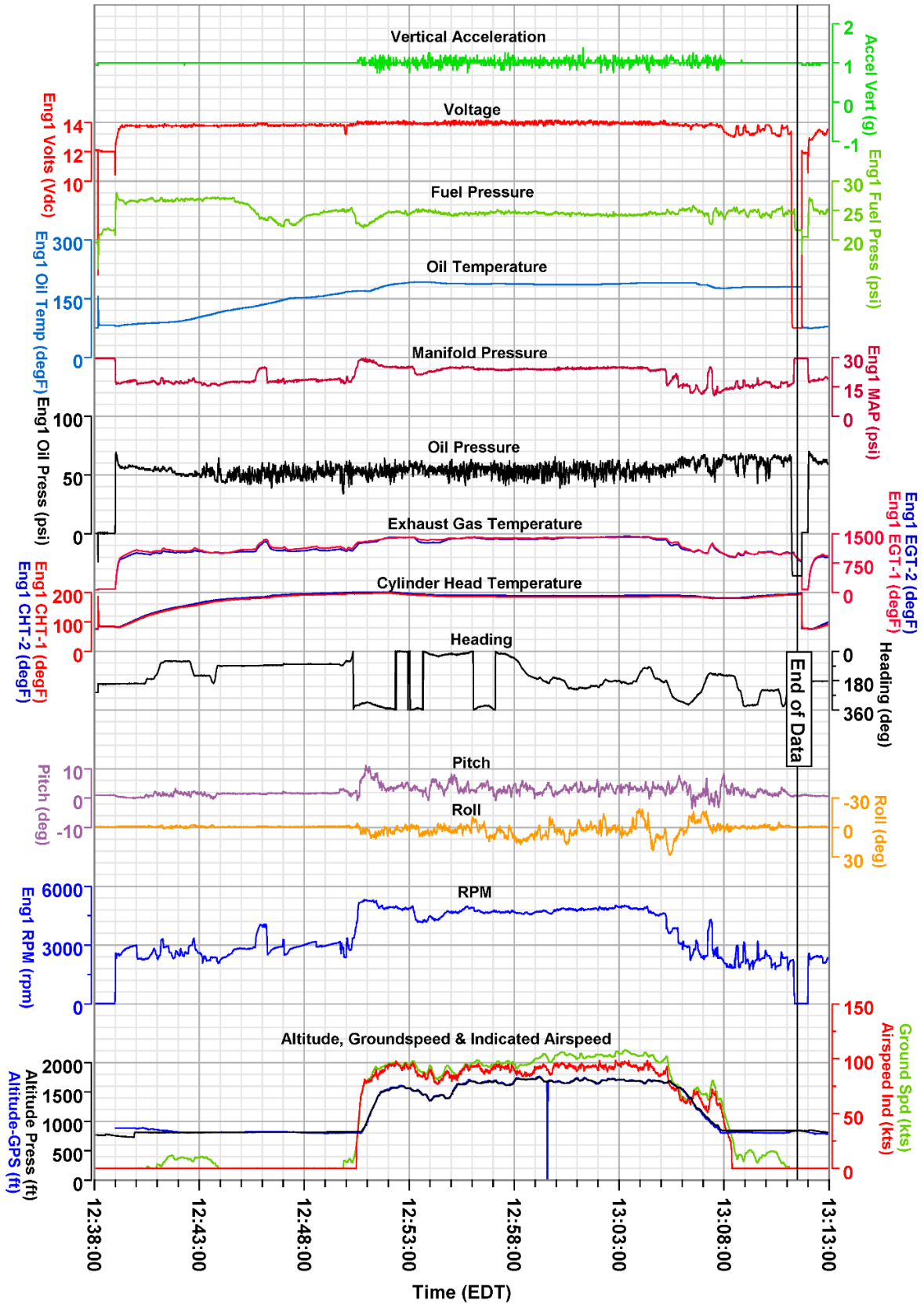


Figure 3. Plot of flight data from the entire accident flight recording.

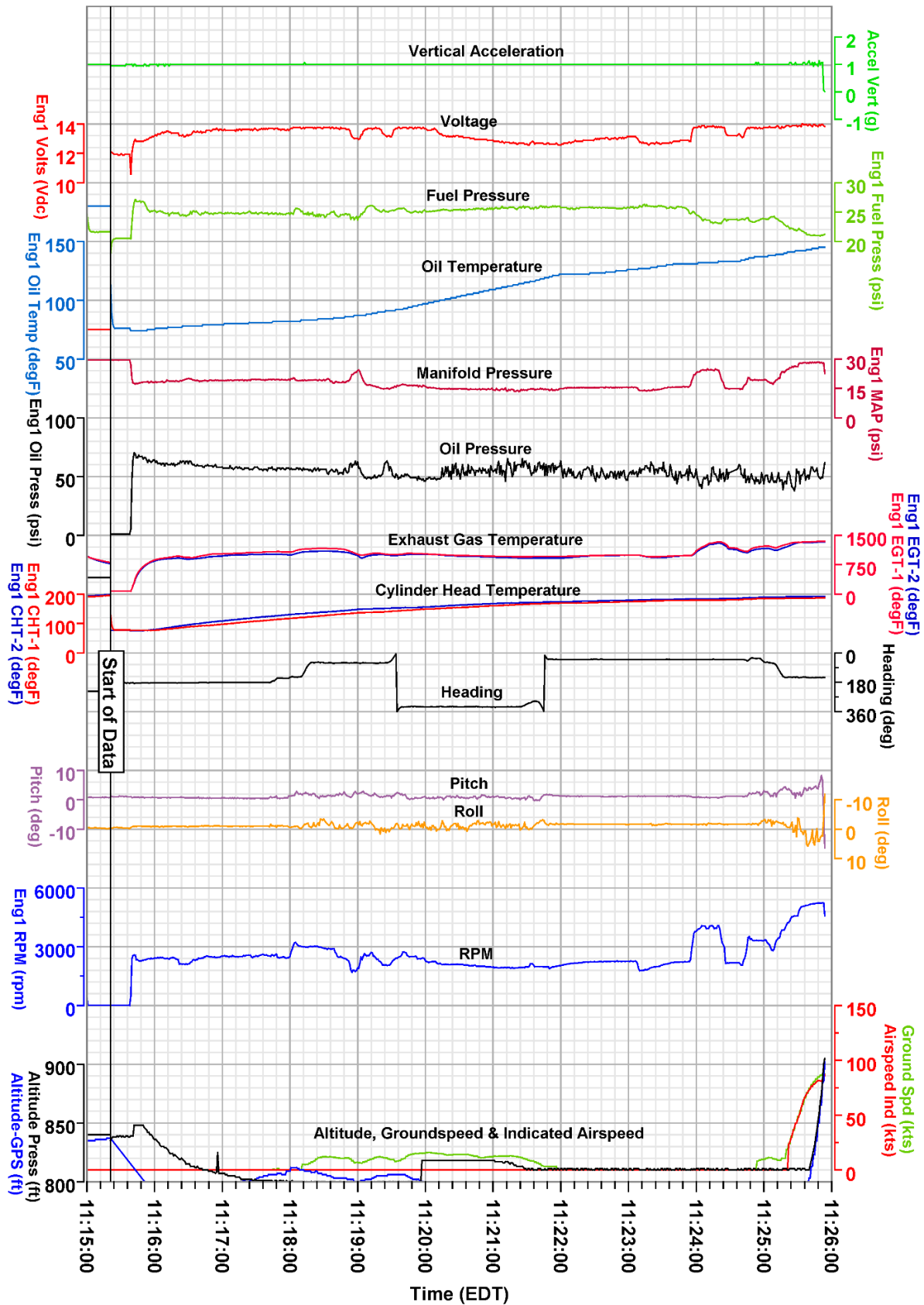


Figure 4. Plot of flight data from the last portion of recorded data during the accident flight.

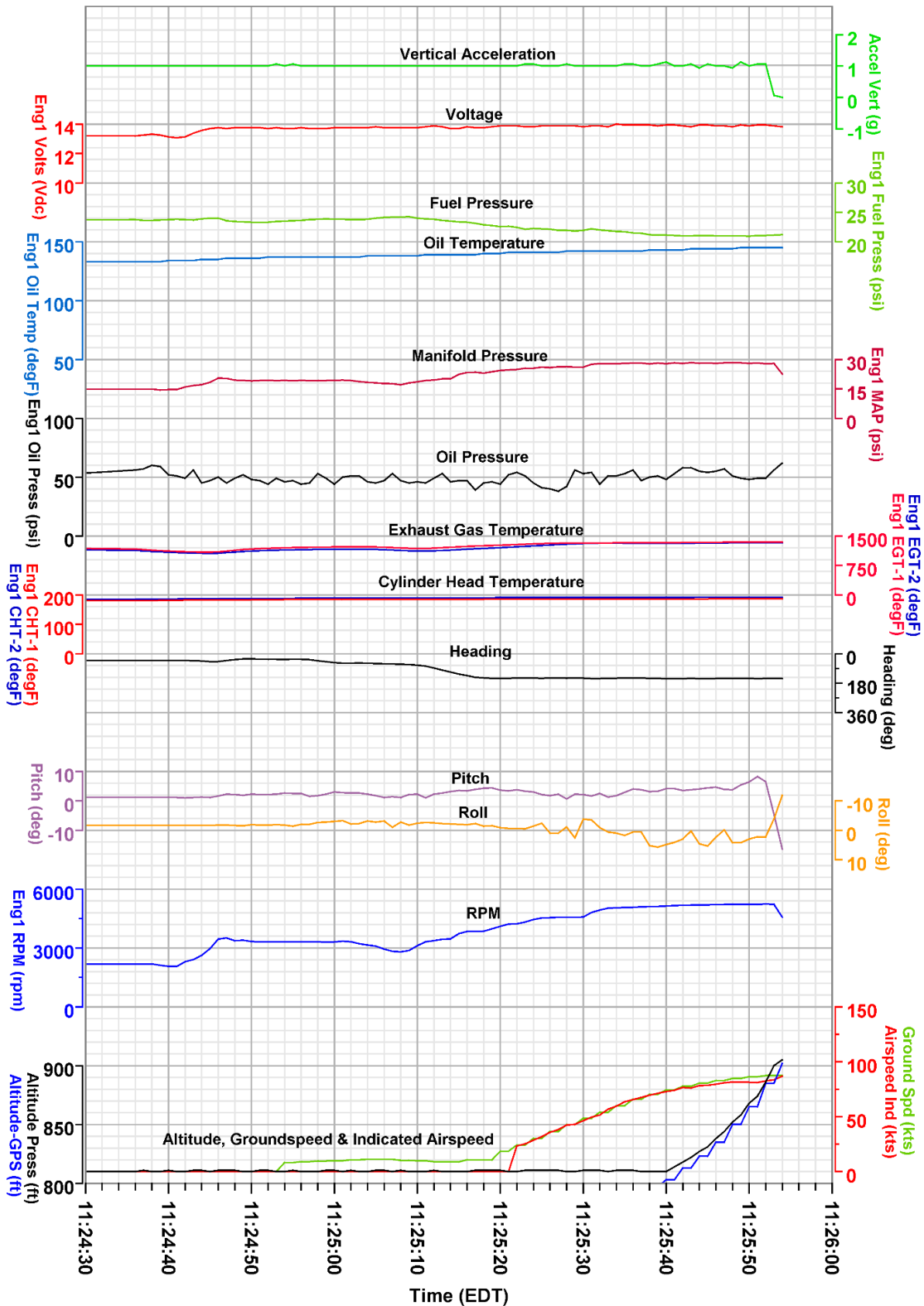


Figure 5. A Google Earth overlay of the entire flight previous to the accident flight.

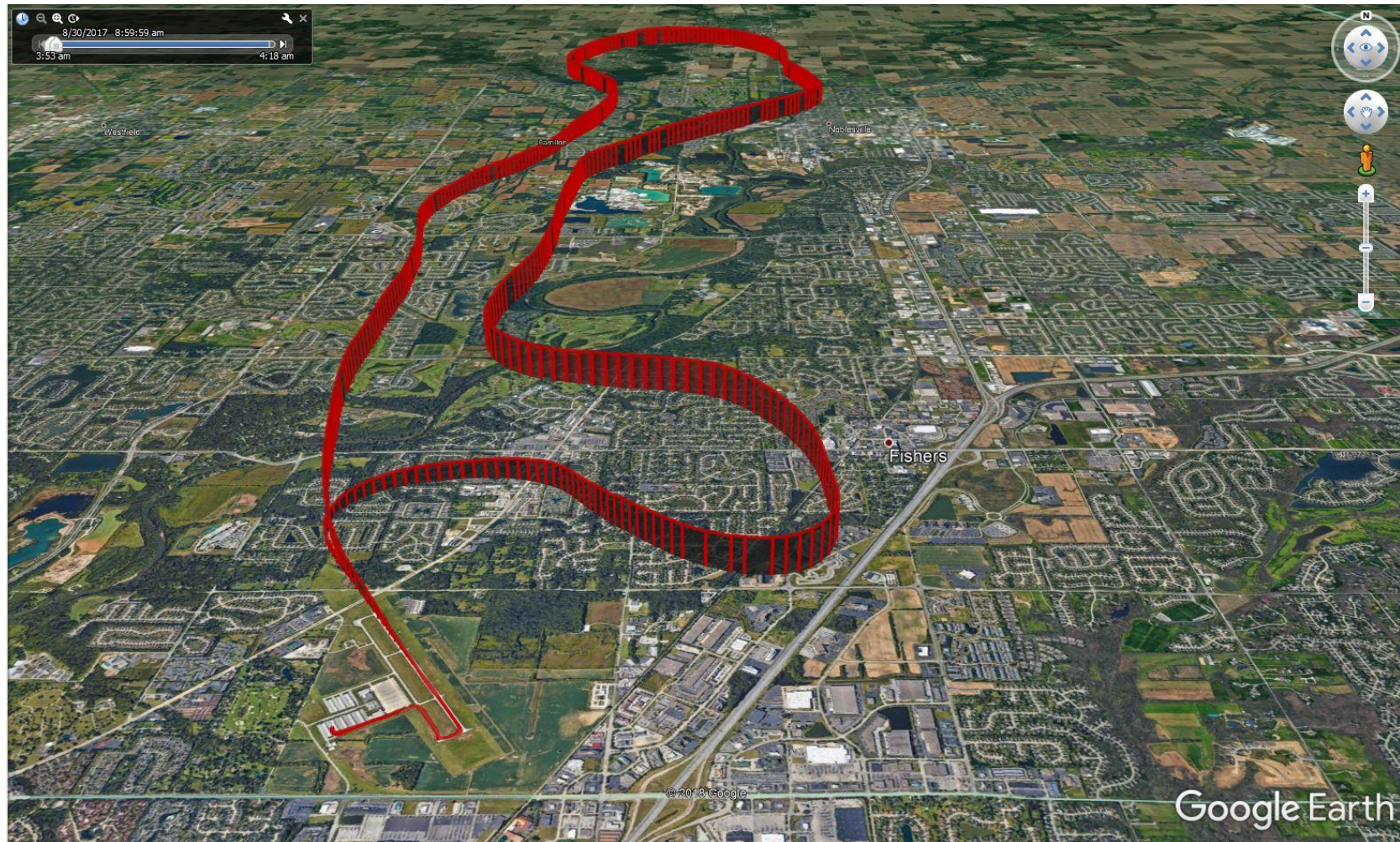


Figure 6. A Google Earth overlay showing the aircraft's flightpath during the arrival and departure phase of the flight previous to the accident flight.

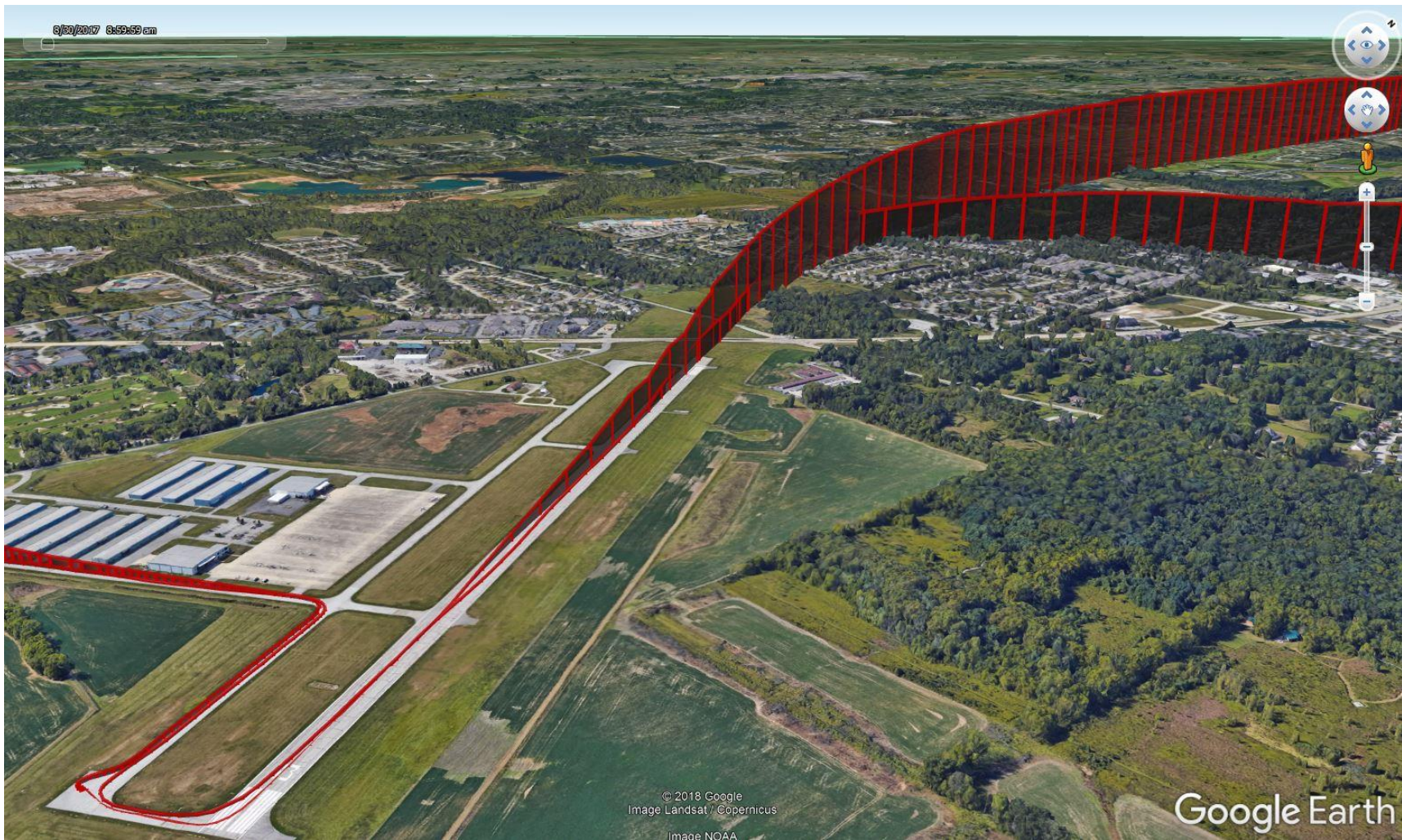


Figure 7. A Google Earth overlay of the entire accident flight recording.



Figure 8. A Google Earth overlay of the accident recording in relation to the wreckage location.



APPENDIX A - Dynon FlightDEK-D180 Parameters

This appendix describes the parameters provided and verified in this report. Table A-1 lists the PFD parameters and table A-2 describes the unit abbreviations used in this report for PFD parameters.

Table A-1 - Verified and provided parameters.

Parameter Name	Parameter Description
Accel Vert (g)	Vertical Acceleration
Eng1 Volts (Vdc)	Voltage
Eng1 Fuel Press (psi)	Fuel Pressure
Eng1 Oil Temp (degF)	Oil Temperature
Eng1 MAP (psi)	Manifold Pressure
Eng1 Oil Press (psi)	Oil Pressure
Eng1 EGT-# (degF)	Exhaust Gas Temperature - System #
Eng1 CHT-1 (degF)	Cylinder Head Temperature – Cylinder #2
Eng1 CHT-2 (degF)	Cylinder Head Temperature – Cylinder #3
Heading (deg)	Magnetic Heading
Pitch (deg)	Pitch
Roll (deg)	Roll
Eng1 RPM (rpm)	Engine RPM
Altitude Press (ft)	Pressure Altitude
Altitude-GPS (ft)	GPS Altitude
Ground Spd (kts)	Groundspeed
Airspeed Ind (kts)	Indicated Airspeed

The Dynon FlightDEK-D180 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 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.

Units Abbreviation	Description
g	Acceleration
rpm	Revolutions per minute
psi	Pounds per square inch
degF	Degrees Fahrenheit
Ft	Feet
kts	Knots
deg	Degrees
Vdc	Volts DC