

# National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



CEN22LA117

## **ONBOARD FLIGHT RECORDERS**

Specialist's Factual Report

February 6, 2023

## **A. ACCIDENT**

Location: Lincoln, Nebraska  
Date: February 10, 2022  
Time: 2006 central daylight time (CDT)  
0106 February 11, 2022 coordinated universal time (UTC)  
Airplane: Cirrus SR22T, N317KJ

## **B. ONBOARD FLIGHT RECORDERS SPECIALIST**

Specialist Michael Portman  
Aerospace Engineer – Recorder Specialist  
National Transportation Safety Board (NTSB)

## **C. DETAILS OF THE INVESTIGATION**

An onboard flight recorders group was not convened. The NTSB Vehicle Recorder Division received the following electronic devices:

Recorder Manufacturer/Model: Appareo RDM-300  
Part Number: 153510-000064  
Recorder Serial Number: 000316

Recorder Manufacturer/Model: Garmin G1000 SD Cards  
Part Number: Unknown  
Recorder Serial Number: Unknown

### **1.0 Appareo RDM-300 Description**

The Appareo recoverable data module (RDM) is a data storage unit incorporating some crash and fire protection features installed in the tail of some Cirrus aircraft. The unit records flight, engine, and autopilot parameters. Data is logged and stored on non-volatile memory installed inside the enclosure. When the storage limit of the memory device is reached, the oldest recording is deleted.

### **1.1 Appareo RDM-300 Data Recovery**

The RDM-300 was in good condition and the data were downloaded using the manufacturer's procedure. Upon consultation with the Investigator-In-Charge (IIC), review of the data contained in the RDM-300 was unnecessary for the investigation. Therefore, no data were analyzed from this device.

## **2.0 Garmin G1000 Secure Digital Data Card Description**

The Garmin G1000 Integrated Flight Deck is a collection of multiple avionics units which include flight displays, air data computers, attitude/heading reference system (AHRS), communications and other systems. A typical installation includes a primary flight display (PFD) and a multi-function display (MFD). Each display includes two secure digital (SD) card slots, an upper and a lower slot. The lower SD card slot is used by the system for software updates and various databases.<sup>1</sup>

Depending on the display unit software, the G1000 can include a data logging feature. The data logging feature must be enabled by the aircraft operator. If the data logging feature is available and enabled, a SD card has to be installed in the upper slot of the MFD. Depending on the airframe and engine combination as many as 64 parameters can be stored at a rate of one sample per second (1Hz). According to the manufacturer of the display unit, one flight hour can be stored in approximately 2 megabytes (MB). The SD card typically used is 2 gigabyte (GB) in size and can store over 1,000 flight hours.

### **2.1 Garmin G1000 SD Data Card Data Recovery**

The Garmin G1000's SD card were removed from the display and shipped to the NTSB's Vehicle Recorder Lab. The Garmin G1000 SD card was in good condition and the data were downloaded using the manufacturer's procedure.

### **2.2 Garmin G1000 SD Data Card Data Description**

The G1000 SD card received stores flight data in individual flight logs. The SD card contained 1,041 log files. The accident/incident flight recording was identified and was approximately 3 hours and 34 minutes.

#### **2.2.1 Garmin G1000 SD Data Card Engineering Unit Conversions**

The flight log data stored in the individual files was converted to engineering units by the display unit.

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

### **2.3 Garmin G1000 SD Card Time Correlation**

The G1000 SD card records time with the first data sample based on the unit's internal clock. This clock is set and updated by the unit and is based off GPS time. The internal clock was set to UTC-5 (UTC with a 5-hour offset).

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<sup>1</sup> Databases can include terrain data, obstacle data, SafeTaxi charts, flight charts and airport terrain databases

Correlation of the data to the event local time, CST, was established by using the recorded time and then applying an additional 1 hour offset to change coordinated universal time (UTC) to CST. Therefore, for the rest of this report, all times are referenced as CST, not recorded time.

## **D. FIGURES AND TABULAR DATA**

Figures 1 to 8 contain data recorded during the event on February 10, 2022. All the parameters listed in table 1 are plotted except latitude and longitude.

Figures 1, 2, and 3 show basic parameters for the entire flight, descent, and end of flight, respectively. Figures 4, 5, and 6 show engine related parameters for the entire flight, descent, and end of flight, respectively. Figures 7 and 8 show graphical overlays, made in Google Earth, of the entire flight track and the end of the flight, respectively.

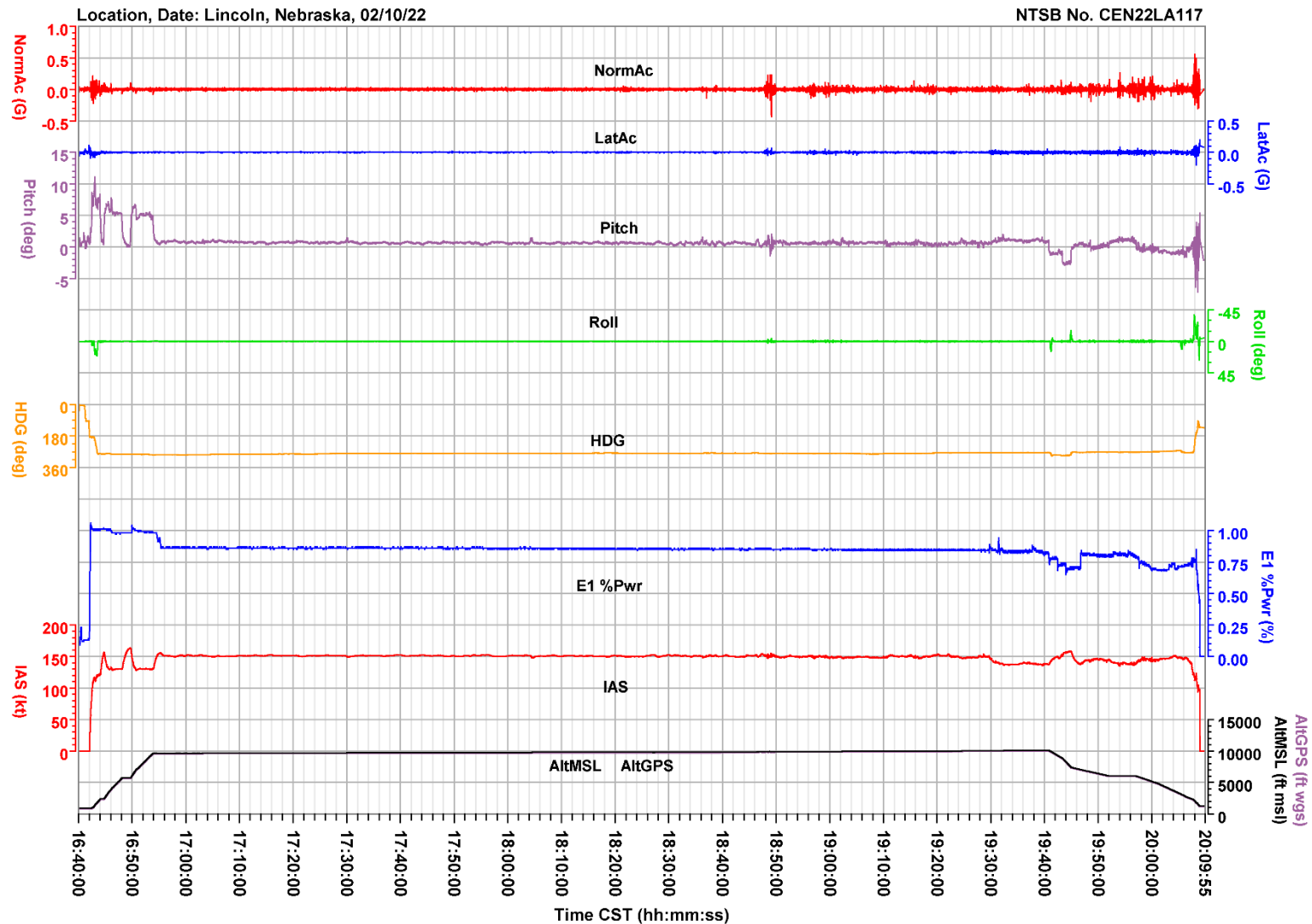
These figures are configured such that right turns are indicated by the trace moving toward the bottom of the page, left turns towards the top of the page, and nose up attitudes towards the top of the page.

In summary, the aircraft took off at approximately 1642 CST, climbed to a cruising altitude of between 9,700 ft and 10,000 ft, and flew generally westward. At approximately 1930 CST, while cruising at 10,000 ft approximately 100 miles east of the intended destination of Lincoln, Nebraska, the #3 cylinder began showing signs of distress, with several parameters showing a momentary surge shortly thereafter, at 1931:30. At 1941, the aircraft began descending. At 2007:25, while the aircraft was descending through 2,400 ft, the engine began showing signs of further deterioration, with RPM dropping rapidly to zero at 2009. The recording ended at 2009:55.

The corresponding tabular data used to create figures 1 to 8 including latitude and longitude, are provided in electronic comma separated value (CSV) format as attachment 1 to this report.

Submitted by:

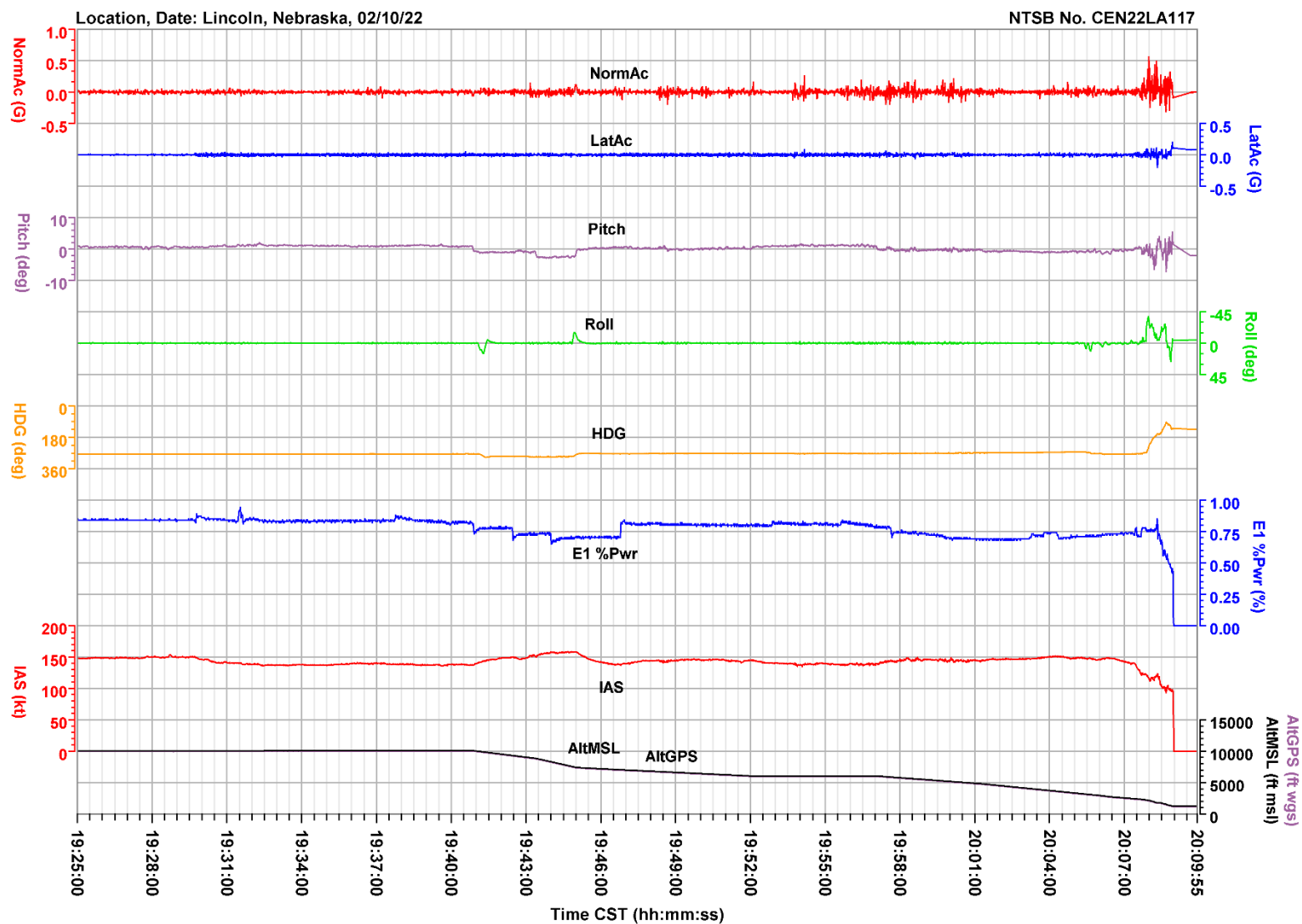
Michael Portman  
Aerospace Engineer – Recorder Specialist



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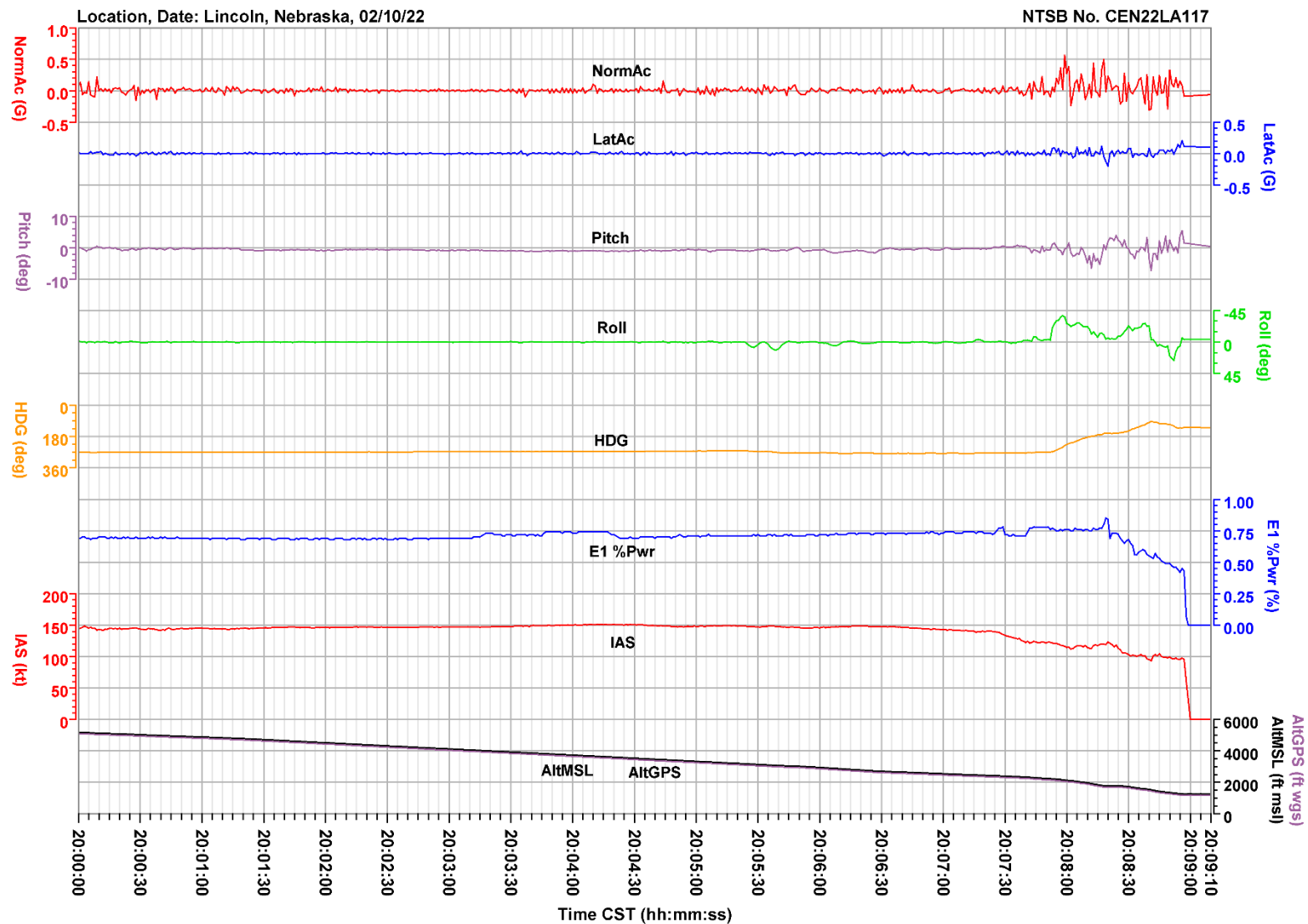
**Figure 1.** Plot of basic parameters for the entire accident flight.



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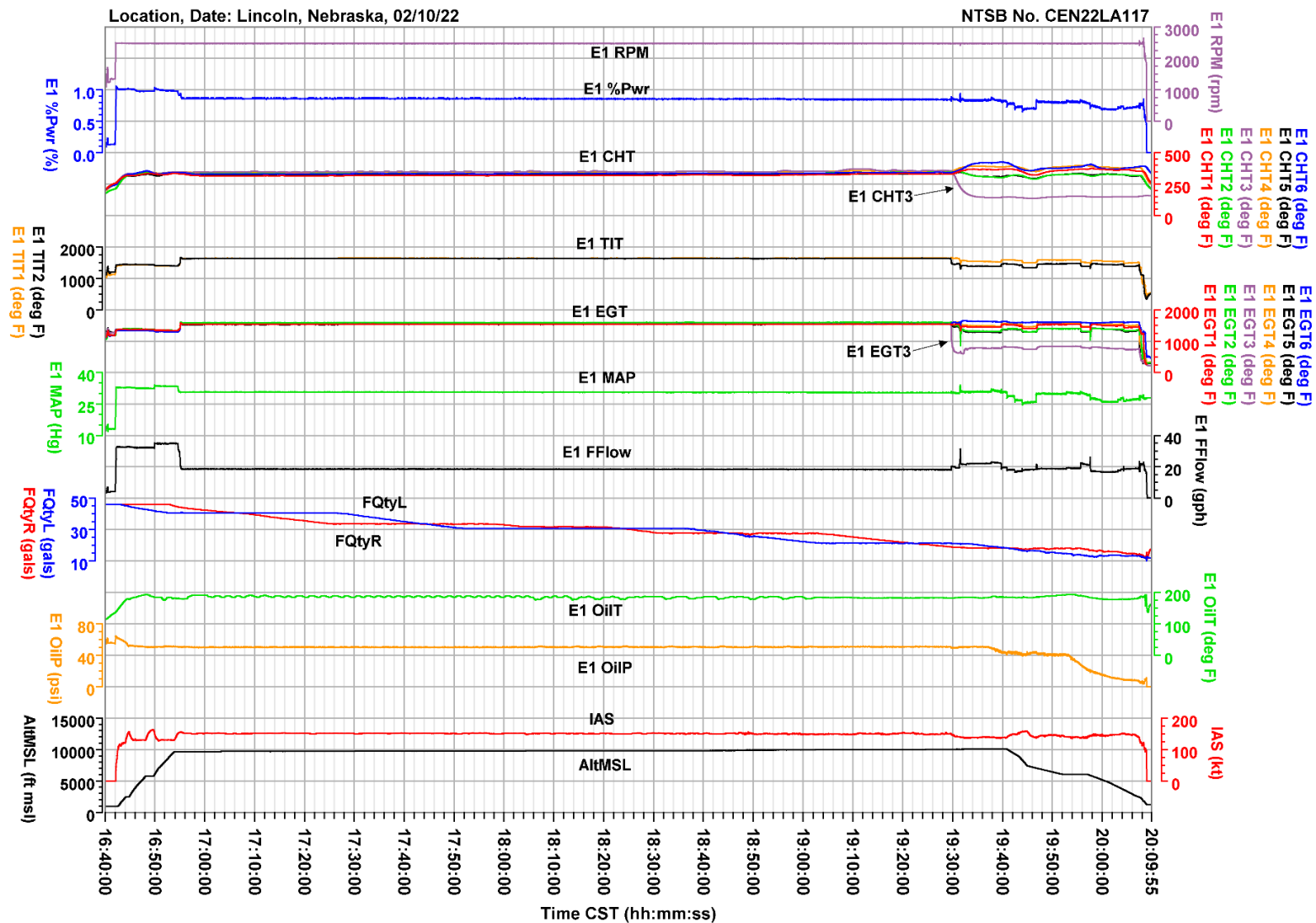
**Figure 2.** Plot of basic parameters for the descent portion of the flight.



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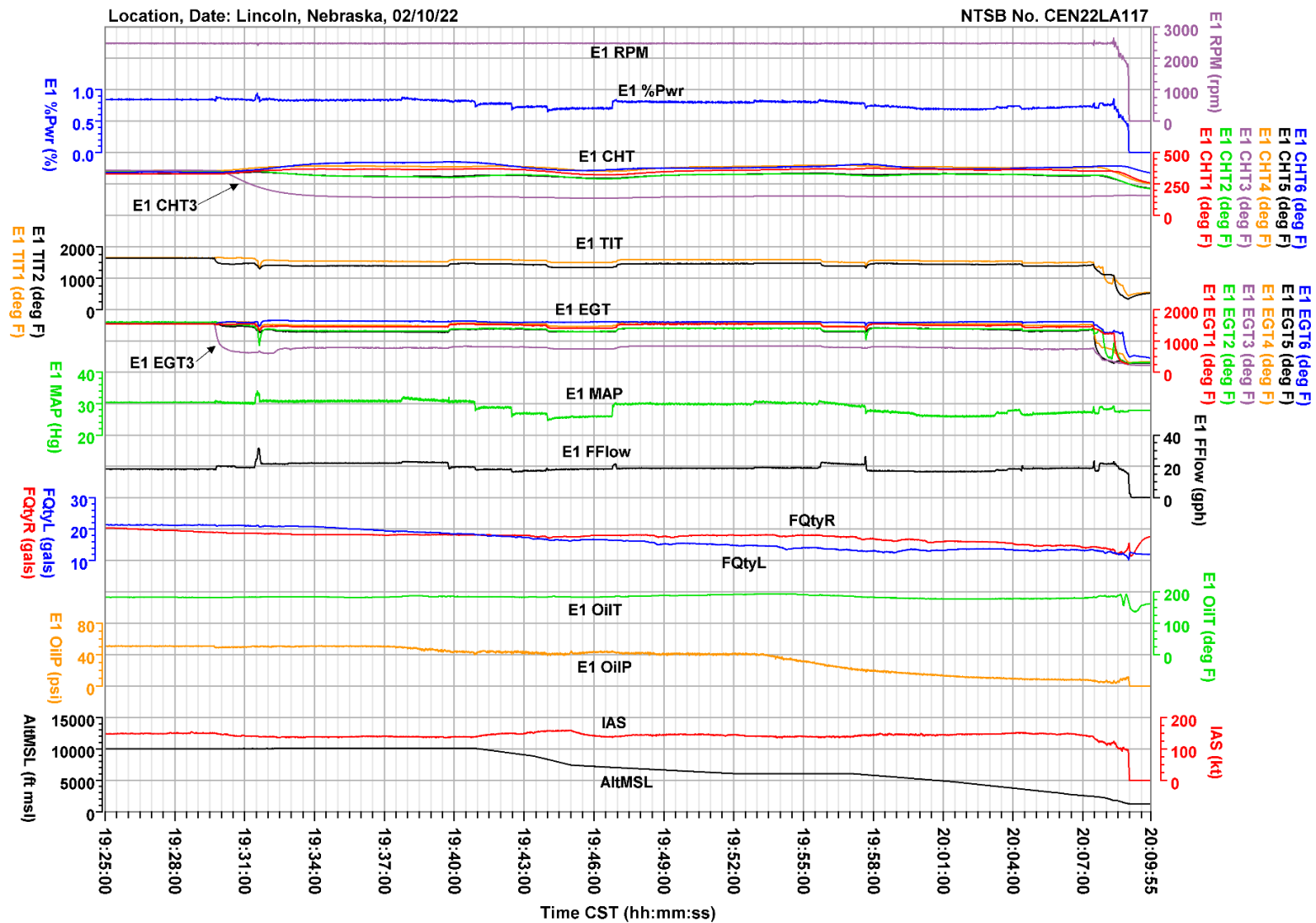
**Figure 3.** Plot of basic parameters for the end of the flight.



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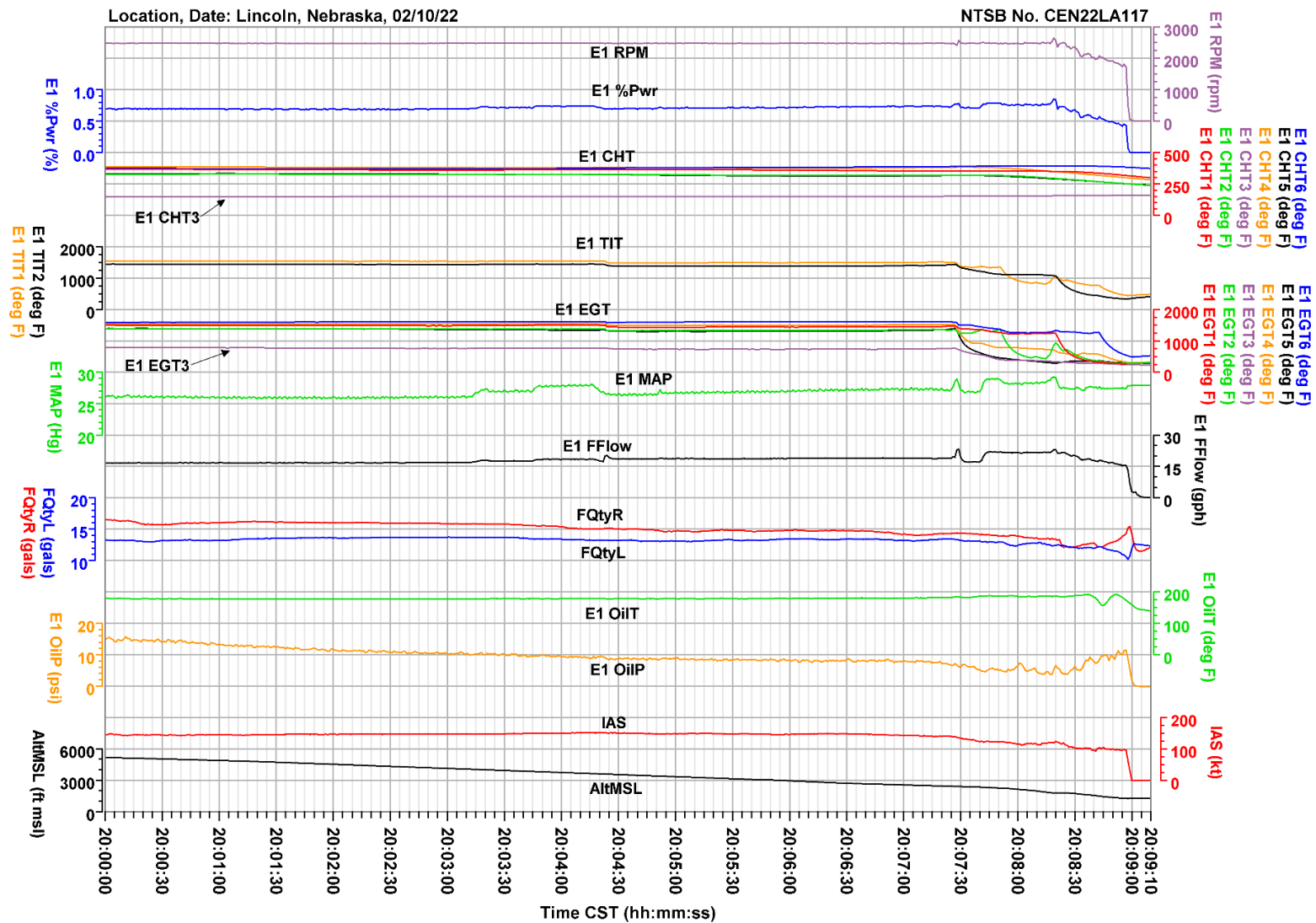
**Figure 4.** Plot of engine parameters for the entire accident flight.



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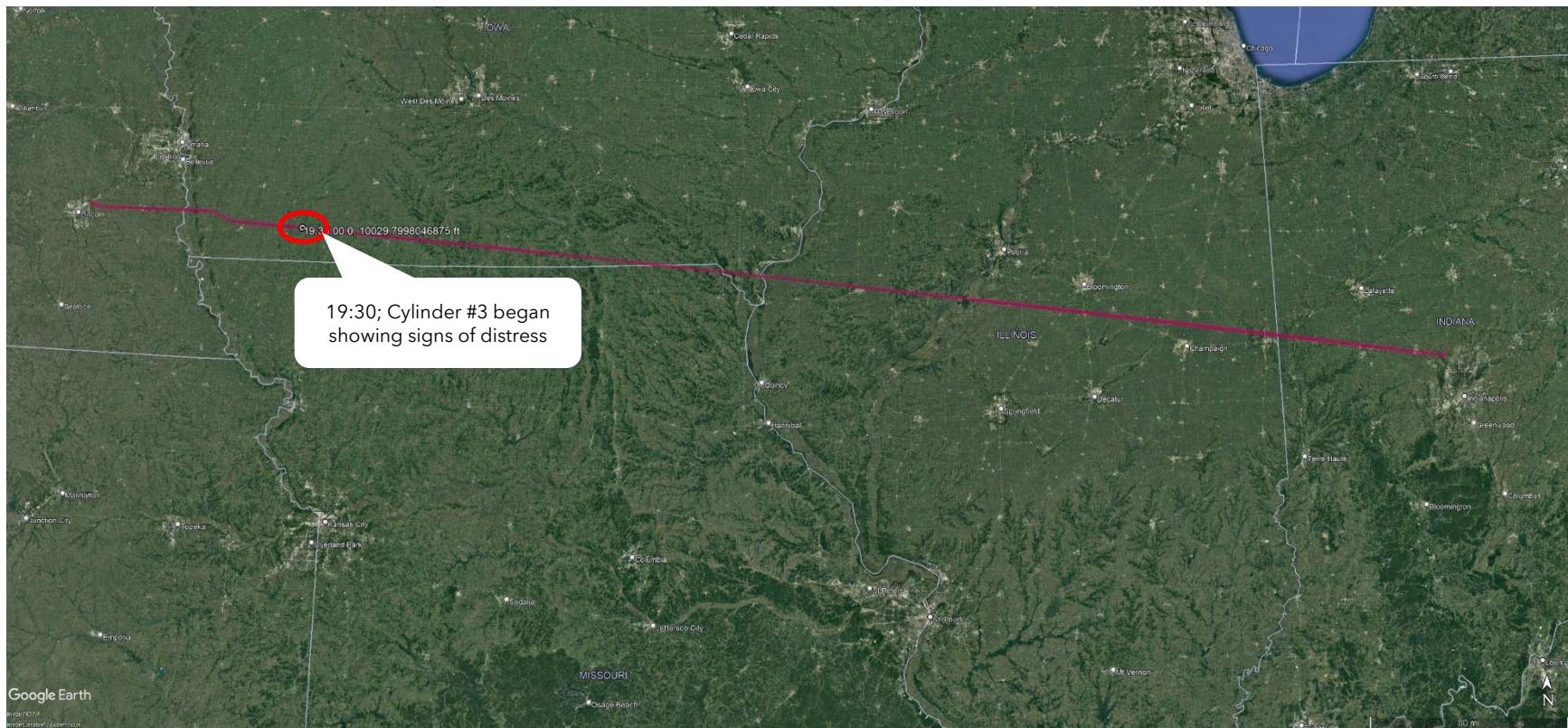
**Figure 5.** Plot of engine parameters for the descent portion of the flight.



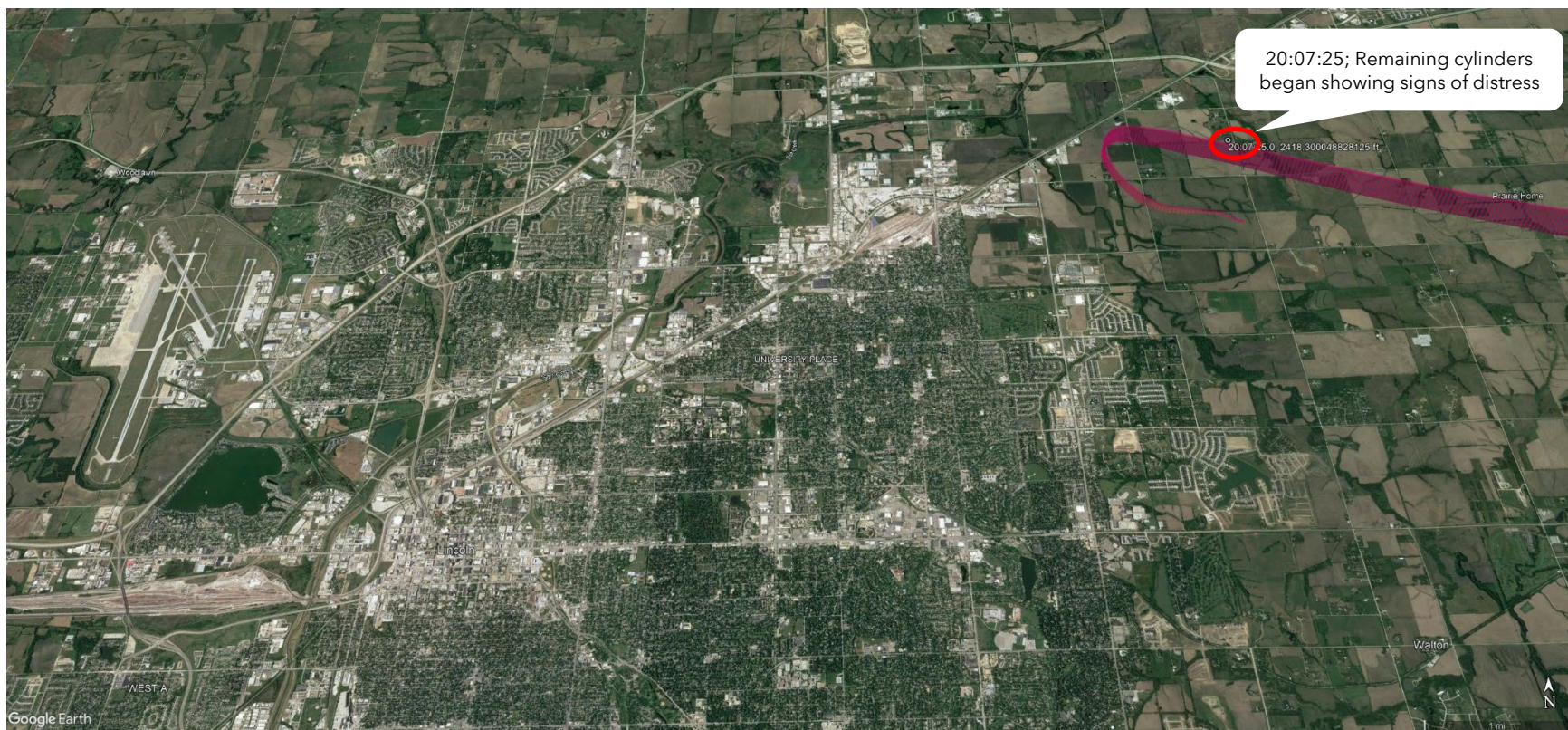
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**Figure 6.** Plot of engine parameters for the end of the flight.



**Figure 7.** Graphical overlay of the entire accident flight.



**Figure 8.** Graphical overlay of the end of the flight, showing the intended destination to the left.

## APPENDIX A. VERIFIED AND PROVIDED PARAMETERS

This appendix describes the parameters provided and verified in this report. Table 1 lists the G1000 parameters and table 2 describes the unit abbreviations used in this report for G1000 parameters.

**Table 1.** Verified and provided parameters.

| Parameter Name (units) | Parameter Description                             |
|------------------------|---------------------------------------------------|
| AltGPS (ft)            | GPS Altitude                                      |
| AltMSL (ft)            | Altitude above Mean Sea Level                     |
| E1 %Pwr (%)            | Engine Percent Total Power                        |
| E1 CHT# (deg F)        | Cylinder Head Temperature Cylinder # <sup>2</sup> |
| E1 EGT# (deg F)        | Exhaust Gas Temperature Cylinder # <sup>2</sup>   |
| E1 FFlow (gph)         | Engine Fuel Flow                                  |
| E1 MAP (Hg)            | Engine Manifold Pressure                          |
| E1 OilP (psi)          | Engine Oil Pressure                               |
| E1 OilT (deg F)        | Engine Oil Temperature                            |
| E1 RPM (rpm)           | Engine Revolutions per minute                     |
| E1 TIT-1 (deg F)       | Engine Turbine Inlet Temperature-1                |
| E1 TIT-2 (deg F)       | Engine Turbine Inlet Temperature-2                |
| FQtyL (gals)           | Left Fuel Quantity                                |
| FQtyR (gals)           | Right Fuel Quantity                               |
| HDG (deg)              | Magnetic Heading                                  |
| IAS (kts)              | Indicated Airspeed                                |
| LatAc (g)              | Lateral Acceleration                              |
| Latitude (deg)         | Latitude                                          |
| Longitude (deg)        | Longitude                                         |
| NormAc (g)             | Vertical Acceleration                             |
| Pitch (deg)            | Pitch                                             |
| Roll (deg)             | Roll                                              |

Note: The G1000 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 2.** Unit abbreviations.

| Unit Abbreviations | Descriptions       |
|--------------------|--------------------|
| %                  | percent            |
| deg                | degrees            |
| deg F              | degrees Fahrenheit |
| ft                 | feet               |
| gals               | gallons            |
| gph                | gallons per hour   |
| Hg                 | inches of Mercury  |
| kts                | knots              |
| msl                | mean sea level     |

<sup>2</sup> Depending on aircraft configuration number of cylinders that are instrumented varies. In the data plots the '#' is replaced with the appropriate cylinder ID.

| Unit Abbreviations | Descriptions           |
|--------------------|------------------------|
| psi                | pounds per square inch |
| rpm                | revolutions per minute |