

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



CEN22FA208

COCKPIT DISPLAYS

Specialist's Factual Report

September 21, 2022

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A. EVENT SUMMARY

Location: Broomfield, Colorado
Date: May 22, 2022
Time: 1149 mountain daylight time (MDT)
Airplane: Piper PA-32-260, N85CT

B. COCKPIT DISPLAYS SPECIALIST

Specialist: W. Deven Chen
National Transportation Safety Board (NTSB)
Washington, DC

C. DETAILS OF THE INVESTIGATION

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

Recorder Manufacturer/Model:	Dynon SV HDX1100
Recorder Serial Number:	23399
Recorder Manufacturer/Model:	Avidyne IFD540
Recorder Serial Number:	M220316651

1.0 Recorders Description

The **Dynon SV HDX1100** has an 11" screen with both a touchscreen and softkey interface. The device can serve as either a Primary Flight Display (PFD) or a Multifunction Display (MFD) depending on the installation. The unit has a solid-state Air Data and Attitude Heading Reference System (ADAHRS) and displays aircraft parameter data including altitude, airspeed, attitude, vertical speed, and heading. The unit also has external pitot/static inputs for altitude, airspeed, and vertical speed information. The device contains an internal flash memory device. The flash memory stores information sampled every 60 milliseconds for the last two hours of flight in a file called a "BLACK_BOX_LOG_DATA," detailed alert logs that show both caution, warning and aural alerts generated by the display in a file called "ALERT_DATA," as well as a flight history log which is sampled at a lower rate that can record many more hours of operation. The flight history is recorded as a file called "USER_LOG_DATA" and is sampled about every 250 milliseconds.

The **Avidyne IFD 540** is a Flight Management System (FMS), GPS, and Navigator. It is capable of monitoring, displaying, and recording navigational information and records parameters including, but not limited to, heading, latitude, and longitude. Additionally, the IFD540 can be connected to external measurement

devices to record other parameters such as attitude, attitude rates, body accelerations, pressure altitude, and airspeed. If configured properly, the IFD 540 can also record engine parameters as provided to the unit by external engine monitors. The IFD 540 stores its historical logs on an internal compact flash (CF) card.

1.1 Recorders Condition and Data Recovery

The Dynon SV HDX1100 and Avidyne IFD540 were both undamaged upon arrival at the Vehicle Recorder Division, as shown in figures 1 and 2. The devices were powered up, and the recorded data were downloaded to an external USB thumb drive.



Figure 1. Front and back views of the Dynon SV HDX1100 as received.



Figure 2. Top and front views of the Avidyne IFD540 as received.

1.2 Recording Description

The downloaded data from the Dynon SV HDX1100 contained nine sessions, from April 26 to May 22, 2022. However, only two sessions, April 30 and May 22, had flight data. The other seven sessions of recording did not have any flight data. This could be the result of the Dynon device being powered on, but the aircraft did not take off. The session recorded on May 22, 2022, was determined to be associated with the event. For the event flight recording, the BLACK_BOX_LOG_DATA had

sampling frequency of 16 Hz, but only had the last portion of the event flight, from the takeoff to the end of the recording. The USER_LOG_DATA had the entire flight recording, including the taxiing to runway portion, but only had 4 Hz sampling frequency. To have a best data set, the data from the BLACK_BOX_LOG_DATA and USER_LOG_DATA were combined for this report. The ALERT_DATA file did not contain data related to the event flight. The duration of the entire event flight recording was approximately 57 minutes and 41 seconds. Both the event flight and the flight recorded on April 30 are included in this report.

The downloaded data from the Avidyne IFD540 contained less parameters and did not provide additional pertinent parameters not already covered in the Dynon data. Thus, the data downloaded from the Avidyne IFD540 is not included in this report.

1.2.1 Parameters Provided

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

Table 1. Dynon SV HDX1100 data parameters provided.

Parameter Name (unit)	Parameter Description
Amps	Electric bus current (amps)
CHT # (deg F)	Cylinder head temperature cylinder # (degrees Fahrenheit)
Density Altitude (ft)	Altitude relative to standard atmospheric conditions (feet)
EGT # (deg F)	Exhaust gas temperature cylinder # (degrees Fahrenheit)
Fuel Flow (gal/hr)	Fuel flow rate (gallons per hour)
Fuel Pressure (PSI)	Fuel pressure (pound per square inch)
Fuel Remaining (gal)	Fuel remaining (gallon)
GPS Altitude (ft)	Geometric altitude above Mean Sea Level (feet)
Ground Speed (kts)	Average groundspeed between current and previous data point (knots)
Ground Track (deg)	Path on the surface of the Earth directly below aircraft (degrees)
Indicated Speed (kts)	Airspeed read from airspeed indicator onboard (knots)
Latitude (deg)	Geographic latitude (degrees)
Longitude (deg)	Geographic longitude (degrees)
Lateral Accel (g)	Lateral acceleration (g)
Magnetic Heading (deg)	Direction relative to magnetic north (degrees)
Manifold Pressure (inHg)	Manifold Pressure (inch of mercury)
Oil Pressure (PSI)	Oil Pressure (pound per square inch)
Oil Temp (deg F)	Oil temperature (degrees Fahrenheit)
Pitch (deg)	Pitch angle (degrees)
Power (%)	Engine power (percent)
Pressure Altitude (ft)	Altitude recorded at Barometer pressure setting (feet)
Roll (deg)	Roll angle (degrees)
RPM	Engine revolution speed (revolution per minute)
True Speed (kts)	Airspeed corrected for temperature and pressure altitude (knots)

Parameter Name (unit)	Parameter Description
Vertical Accel (g)	Vertical acceleration (g)
Vertical Speed (ft/min)	Aircraft vertical speed (feet per minute)
Volts	Electric bus voltage (volts)

1.3 Time Correlation

The data was recorded in coordinated universal time (UTC) and converted to MDT, the local time of the event, for the rest of the report.

D. FIGURES AND TABULAR DATA

Figures 3 to 20 contain the Dynon SV HDX110 data recorded during the event on May 22, 2022, and the previous flight on April 30, 2022. All the parameters listed in table 1 are plotted.

Figures 3 to 7 show basic parameters plots of the event flight with various time ranges, and figures 7 to 12 show engine parameters plots of the event flight.

Figures 13 and 14 show basic parameters plots of the previous flight with various time ranges, and figures 15 and 16 show engine parameters plots of the previous flight.

The above plots 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 17 to 19 show Google Earth overlays of the event flight, and figure 20 shows Google Earth overlay of the previous flight. 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 for the event flight is provided in electronic comma-separated value (CSV) format as attachment 1 to this report. The corresponding tabular data for the previous flight is provided as attachment 2 to this report.

Submitted by:

W. Deven Chen
Electrical Engineer – Recorder Specialist

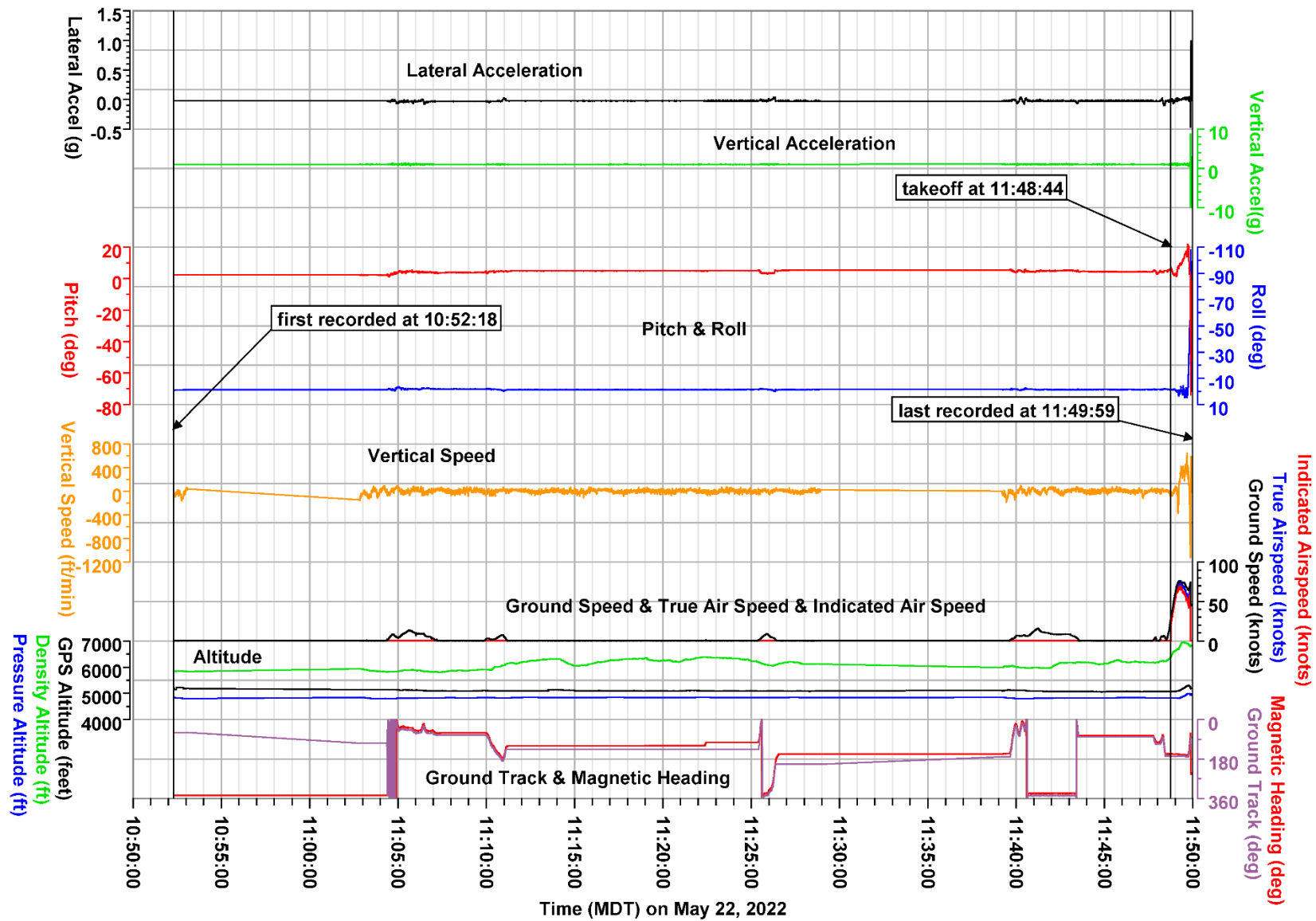


Figure 3. Plot of basic parameters for the entire event flight recording.

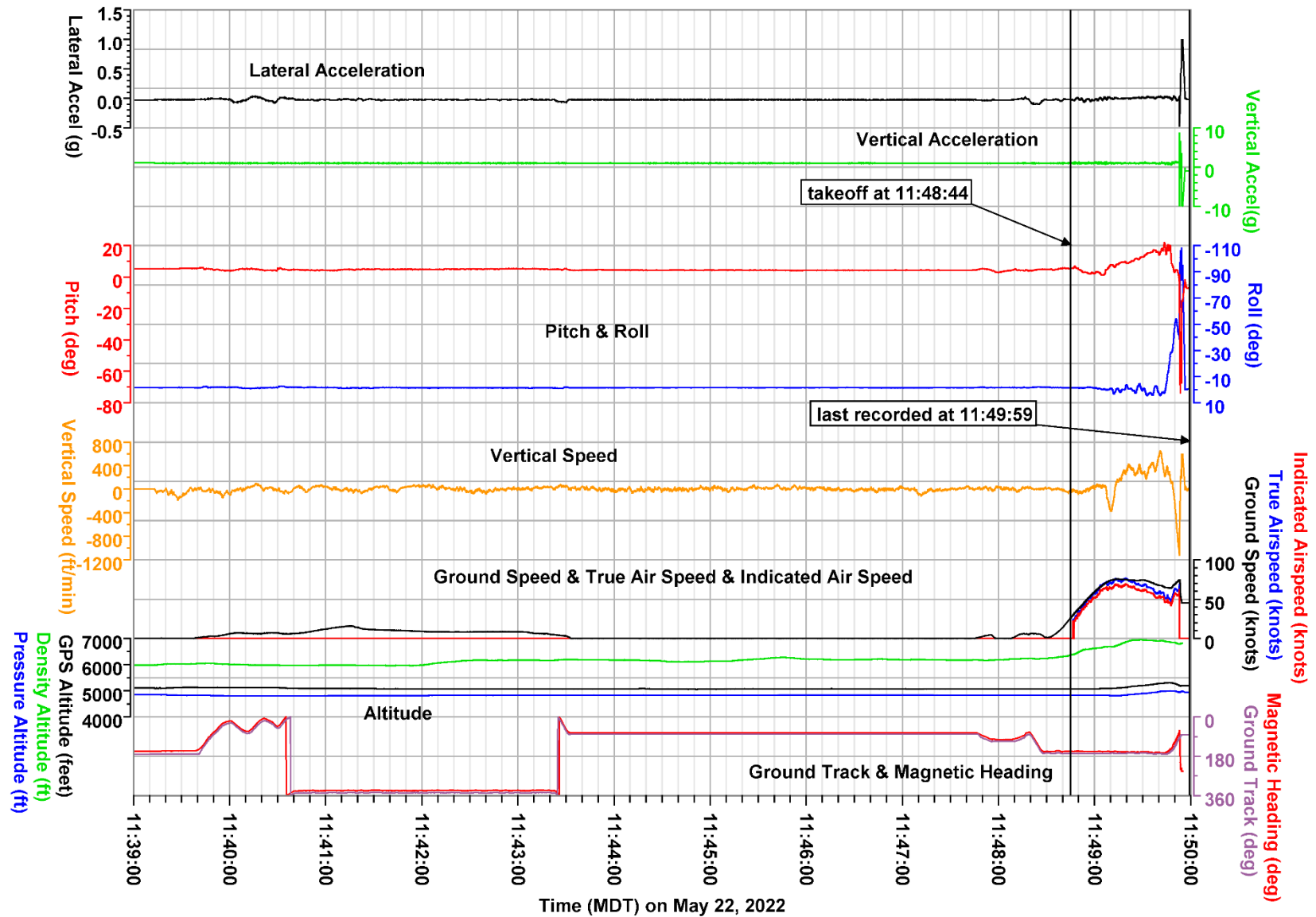


Figure 4. Plot of basic parameters for the event flight from the taxiing to the end of recording.

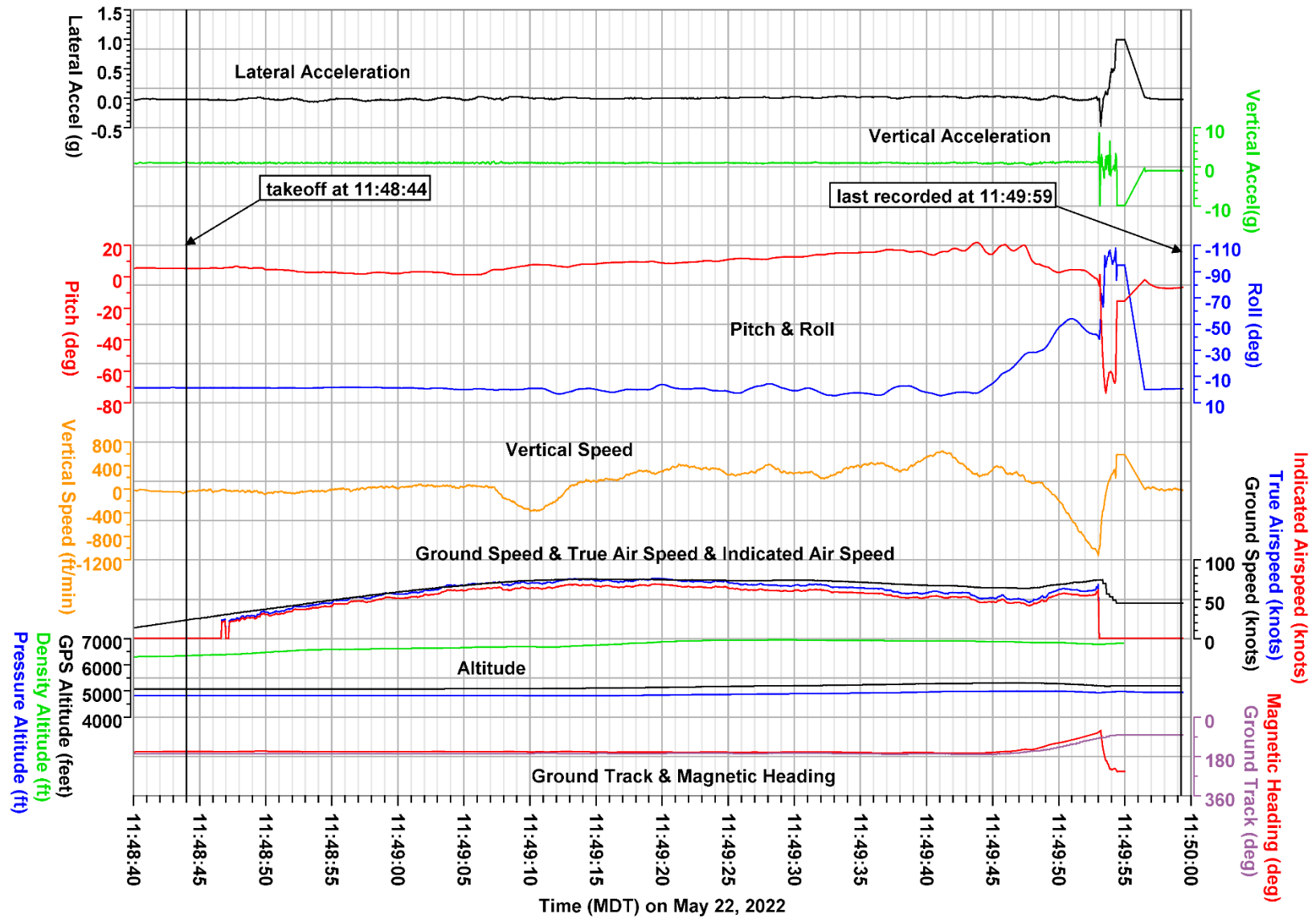


Figure 5. Plot of basic parameters for the event flight from the takeoff to the end of the recording.

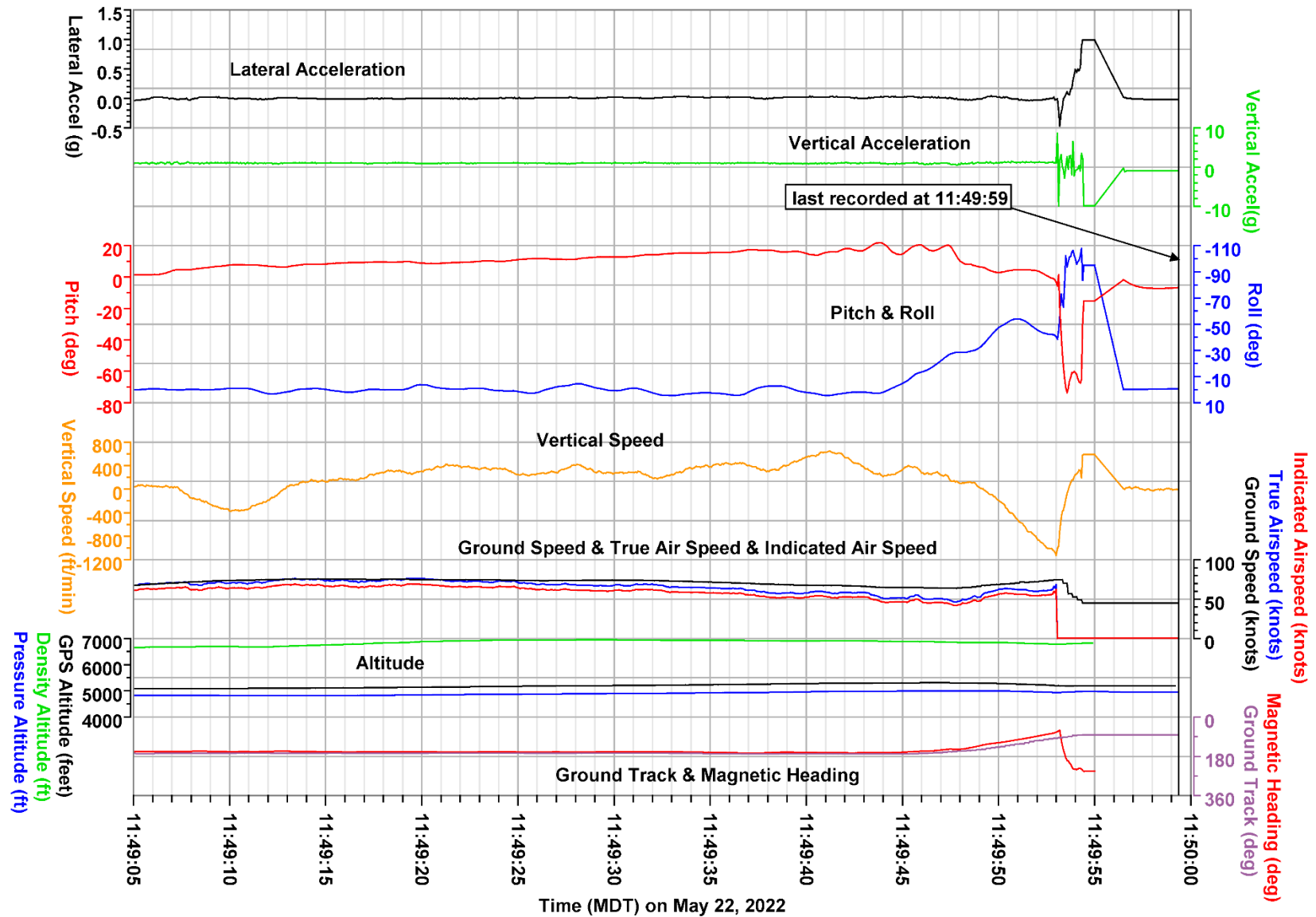


Figure 6. Plot of basic parameters for the event flight for the last one minute of recording.

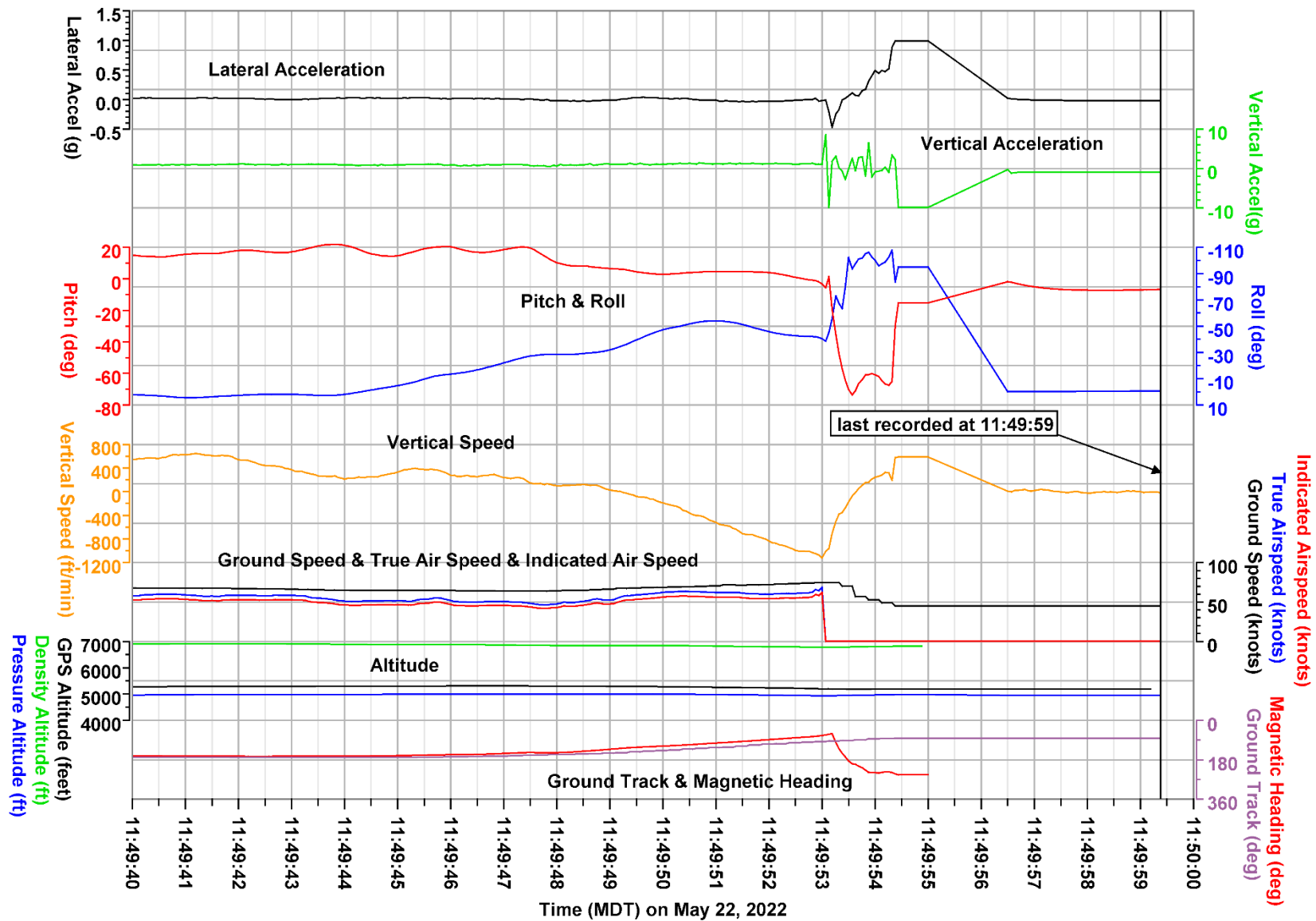


Figure 7. Plot of basic parameters for the event flight for the last 20 seconds of recording.

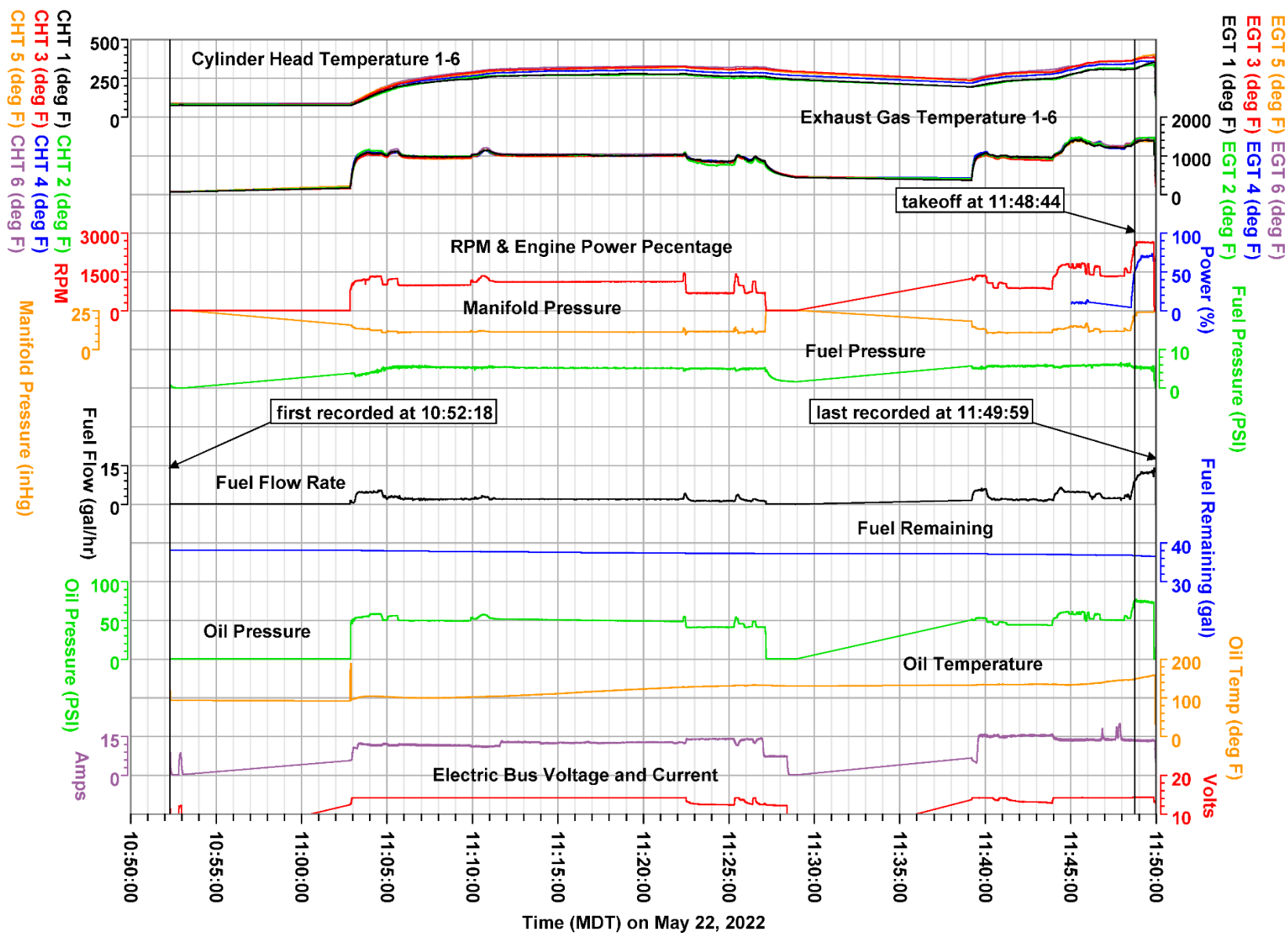


Figure 8. Plot of engine parameters for the entire event flight recording.

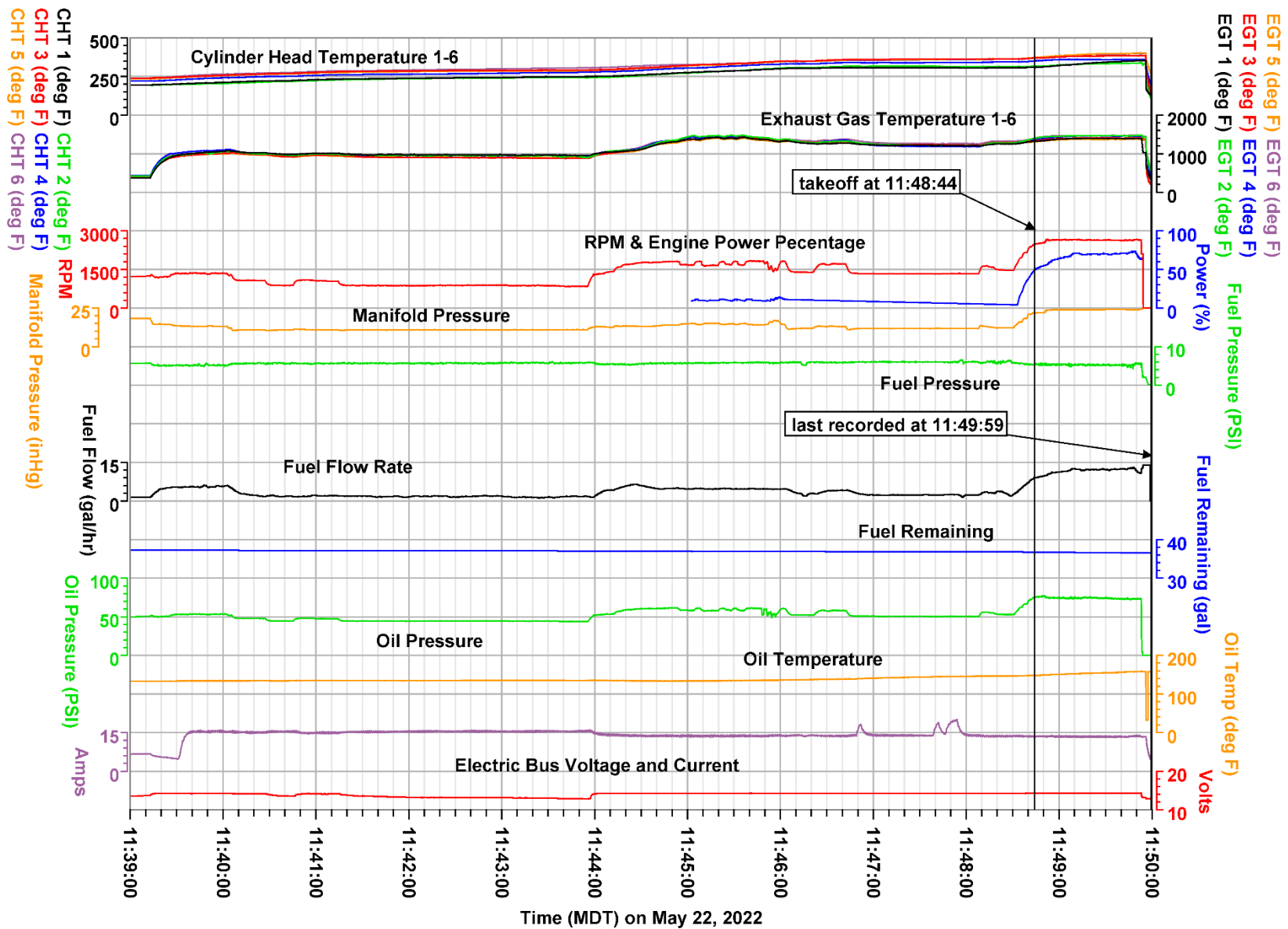


Figure 9. Plot of engine parameters for the event flight from the taxiing to the end of recording.

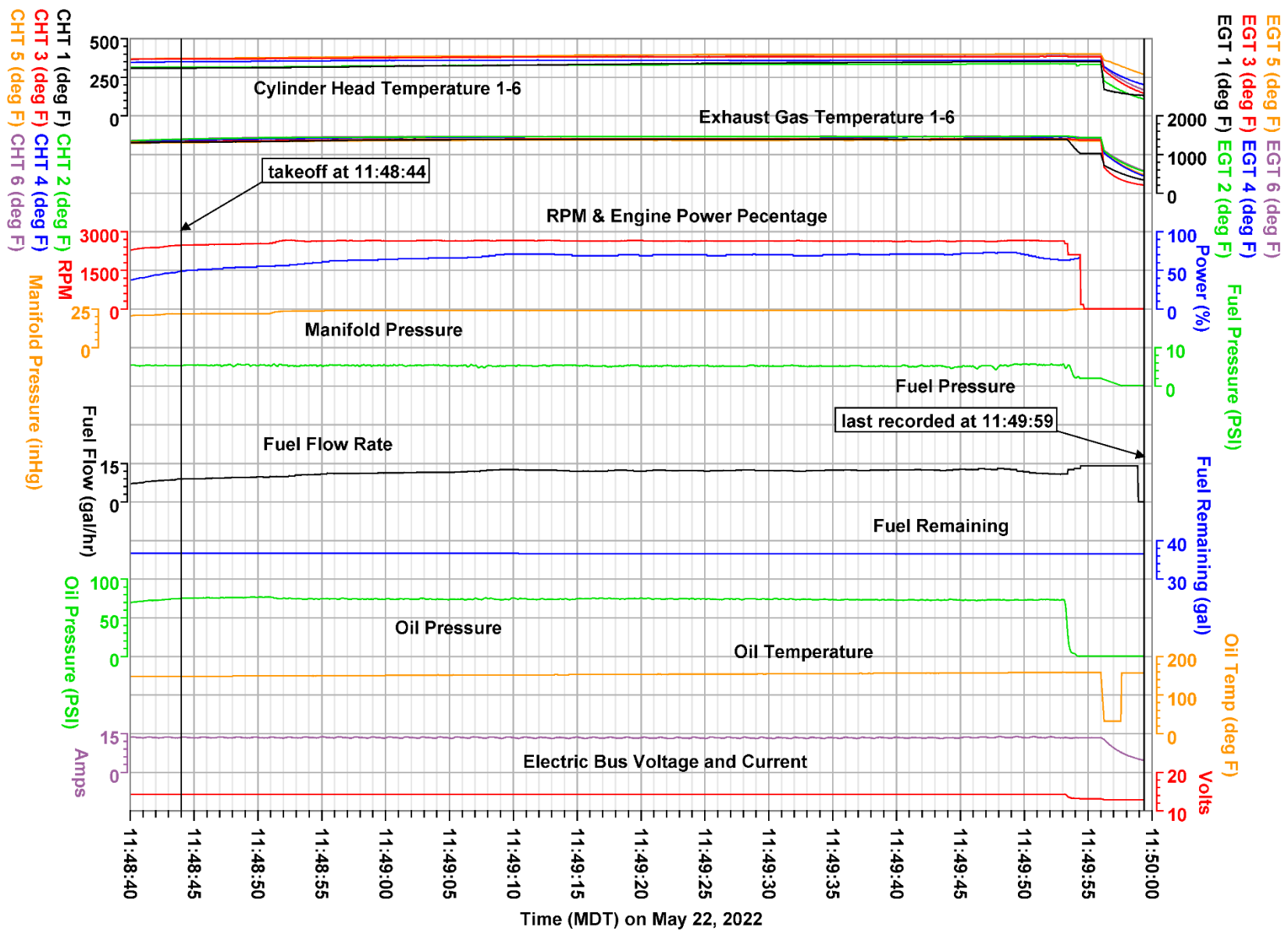


Figure 10. Plot of engine parameters for the event flight from the takeoff to the end of recording.

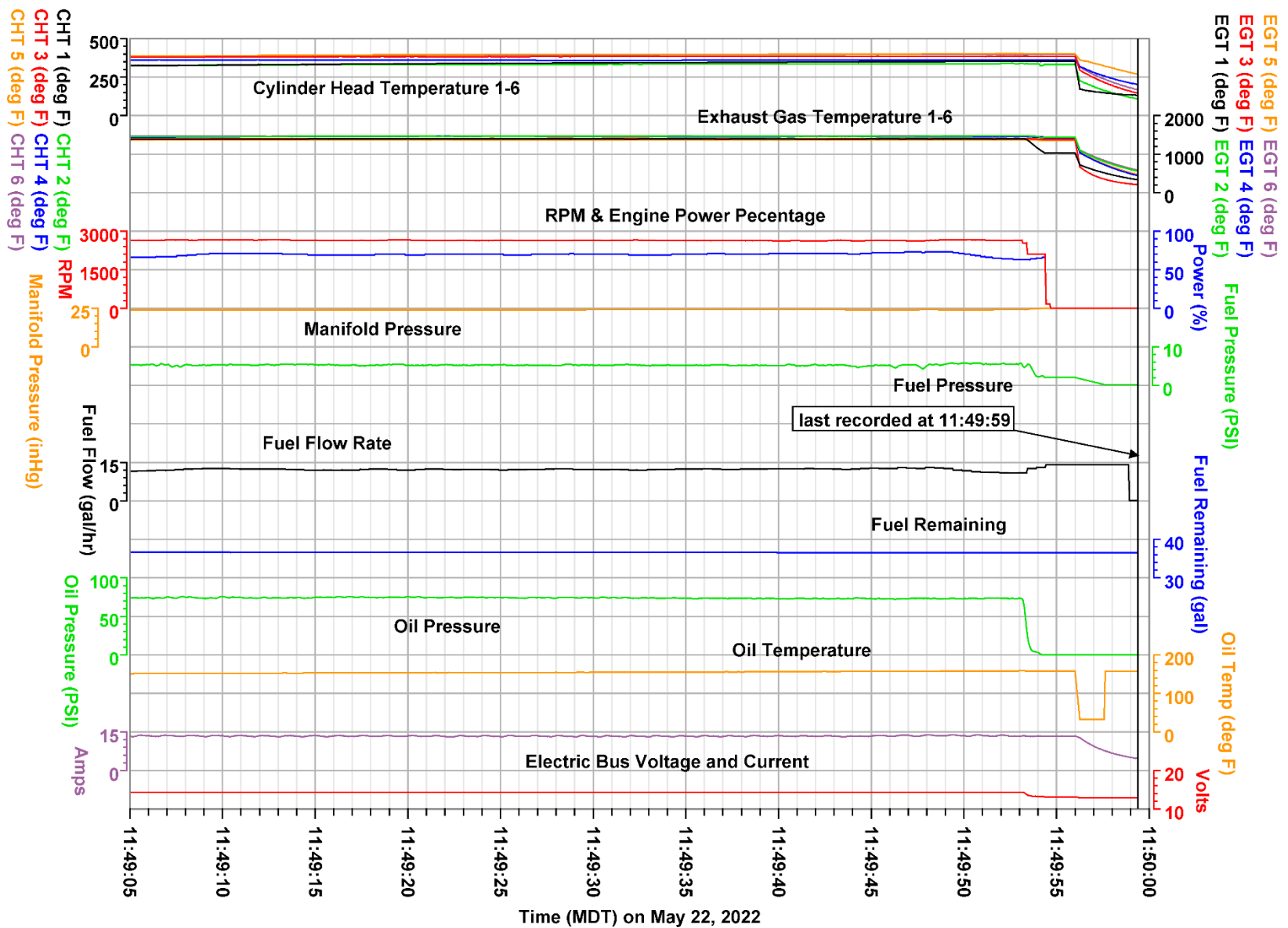


Figure 11. Plot of engine parameters for the event flight for the last one minute of recording.

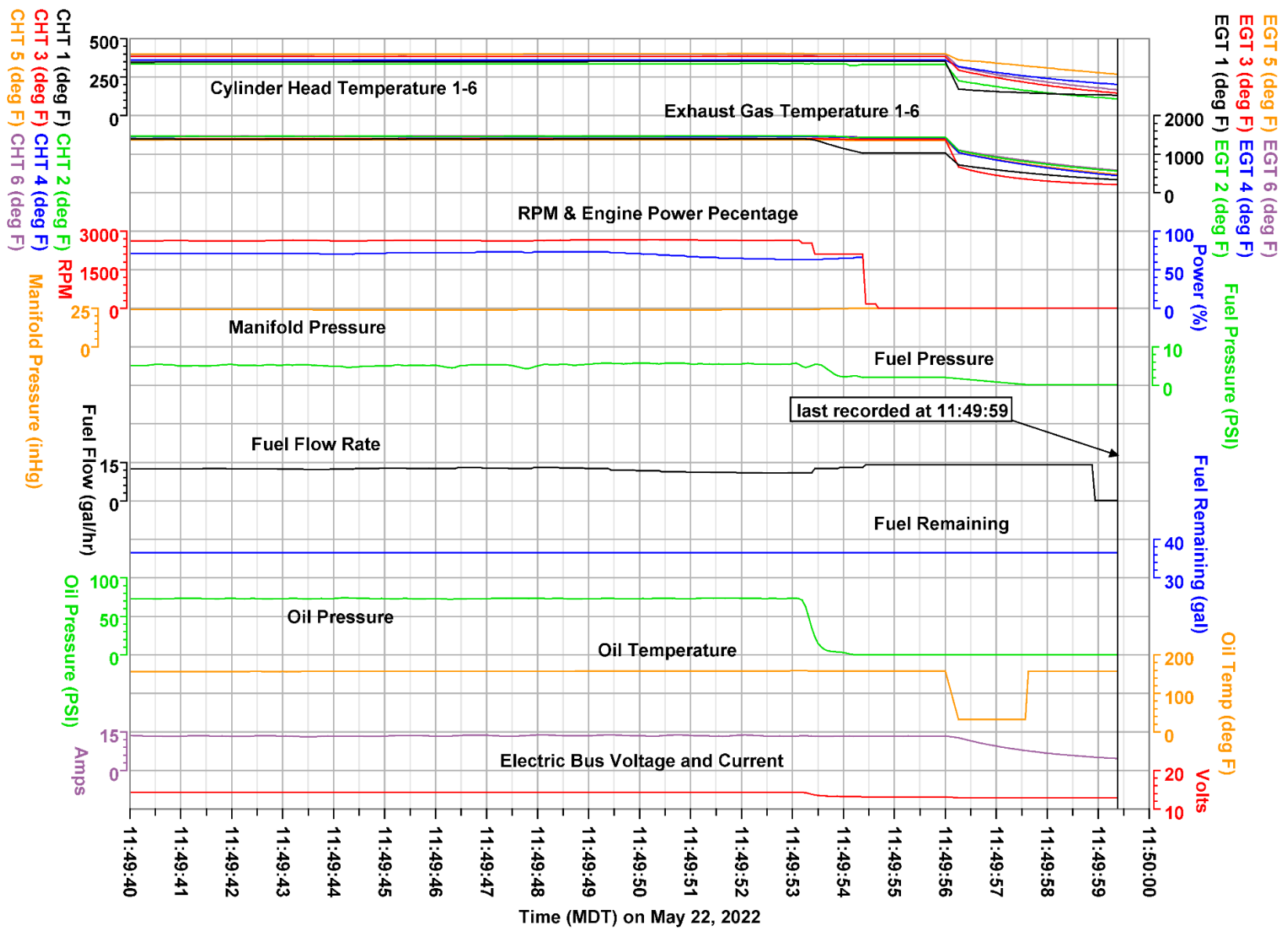


Figure 12. Plot of engine parameters for the event flight for the last 20 seconds of recording.

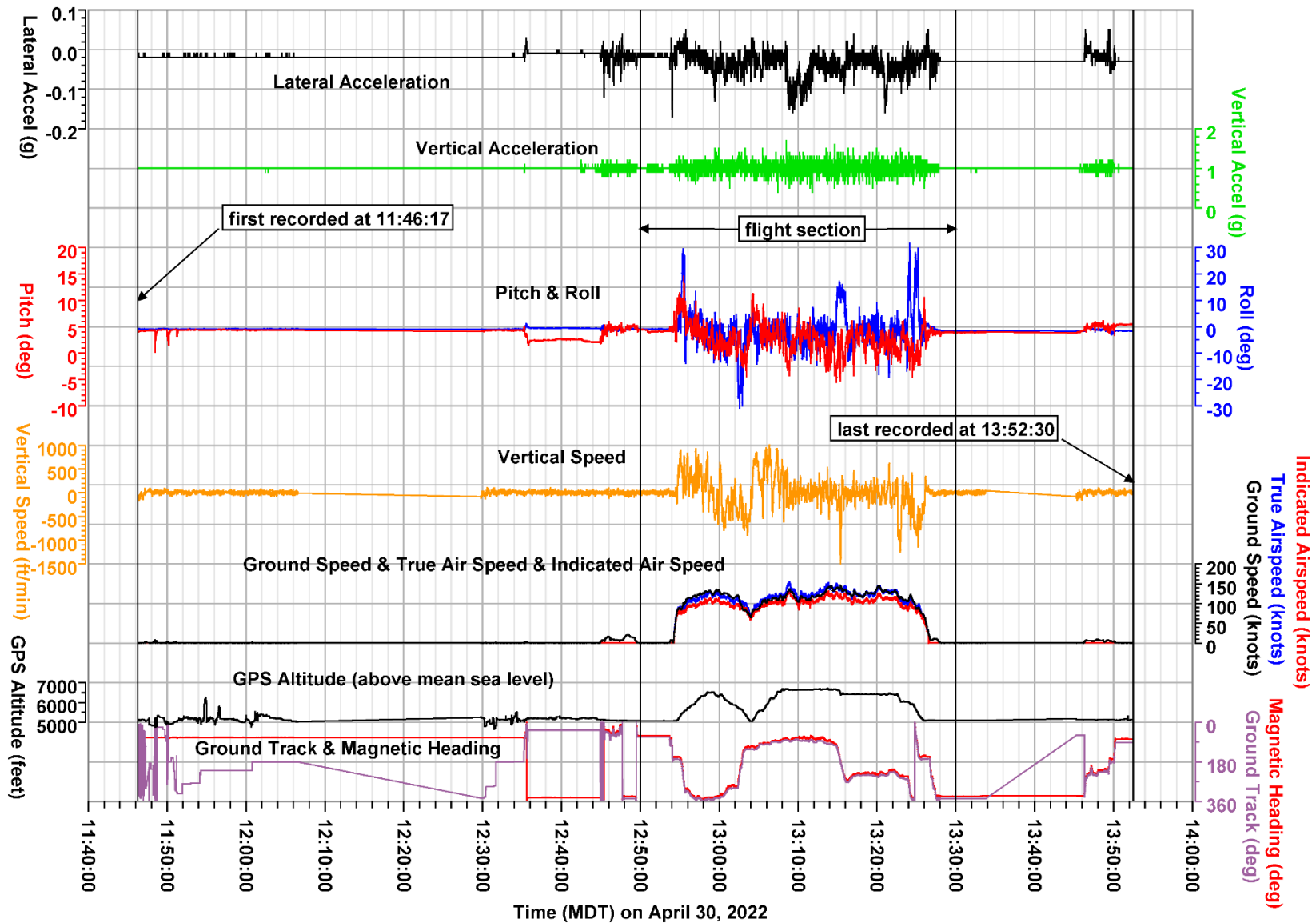


Figure 13. Plot of basic parameters for the entire previous flight recorded on April 30, 2022.

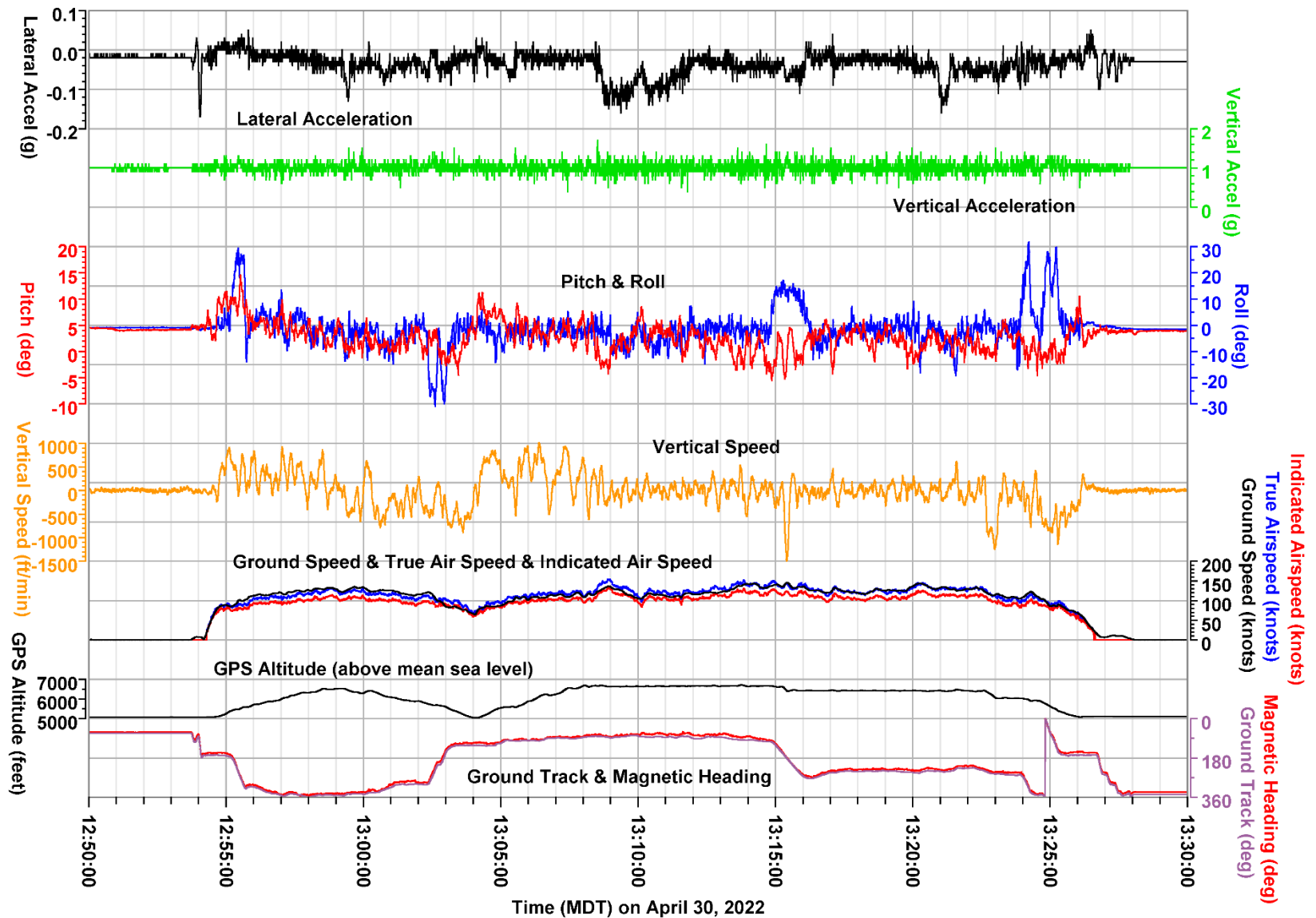


Figure 14. Plot of basic parameters for the flight portion of the previous flight recorded on April 30, 2022.

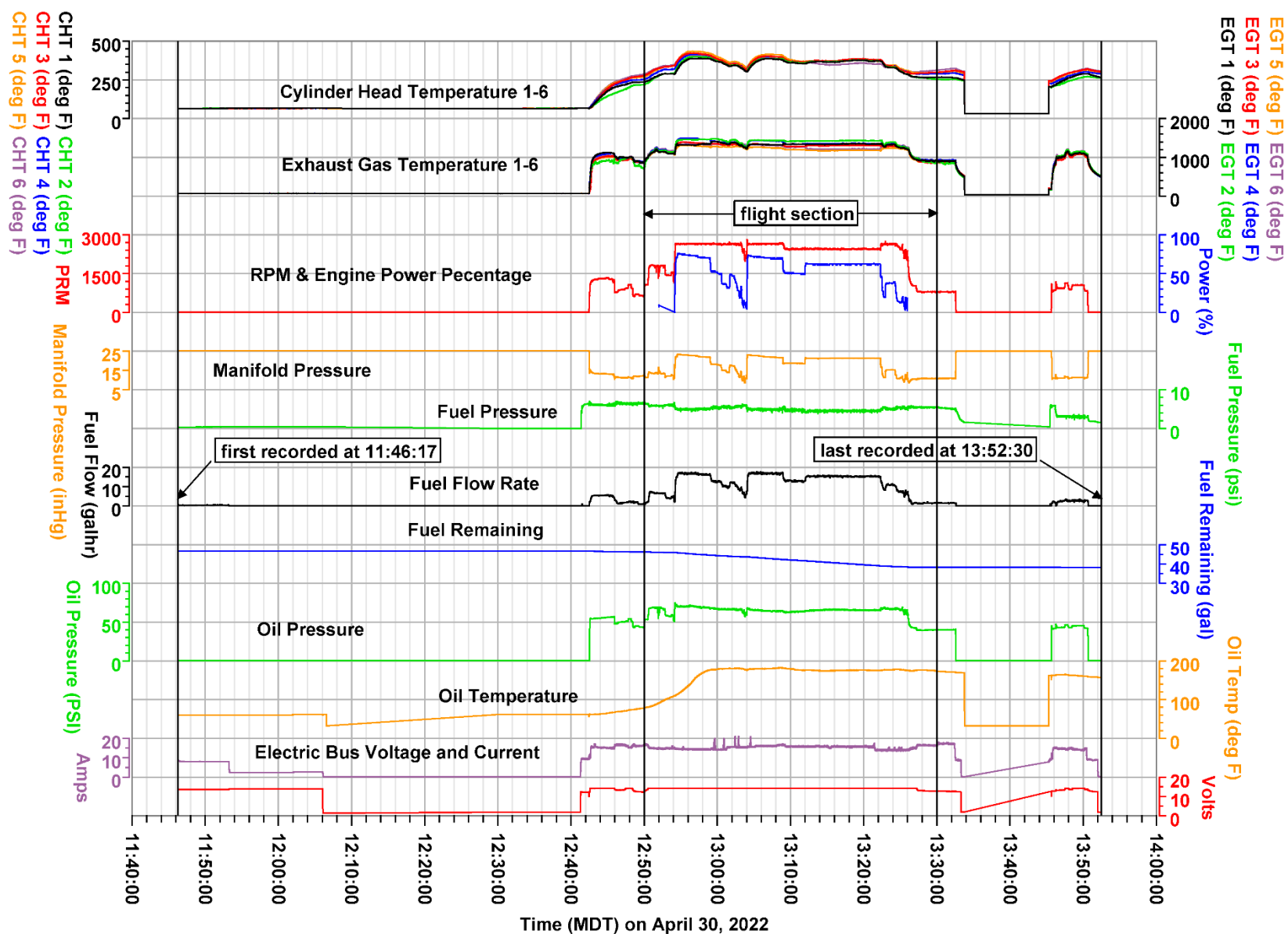


Figure 15. Plot of engine parameters for the entire previous flight recorded on April 30, 2022.

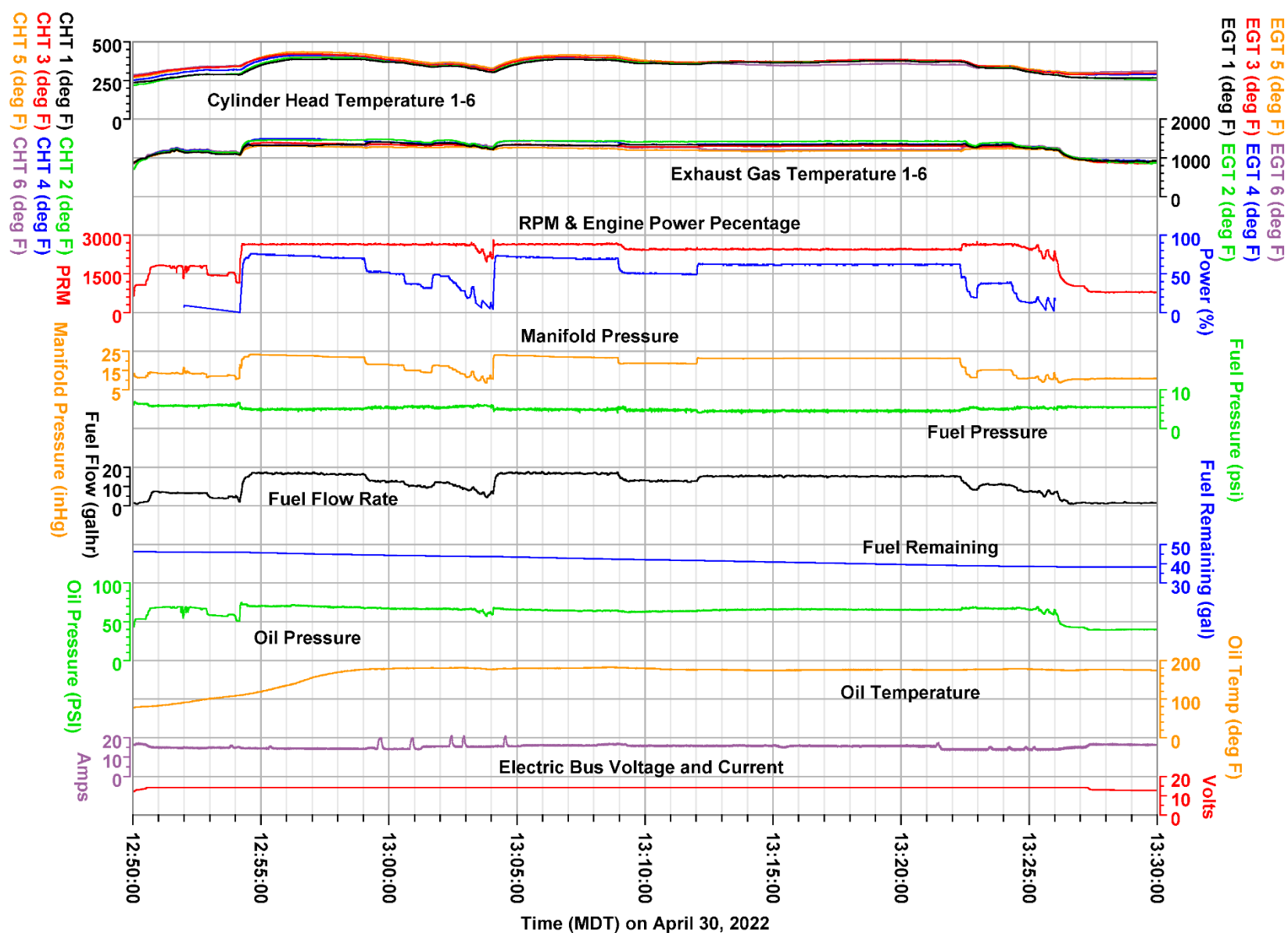


Figure 16. Plot of engine parameters for the flight portion of the previous flight recorded on April 30, 2022.

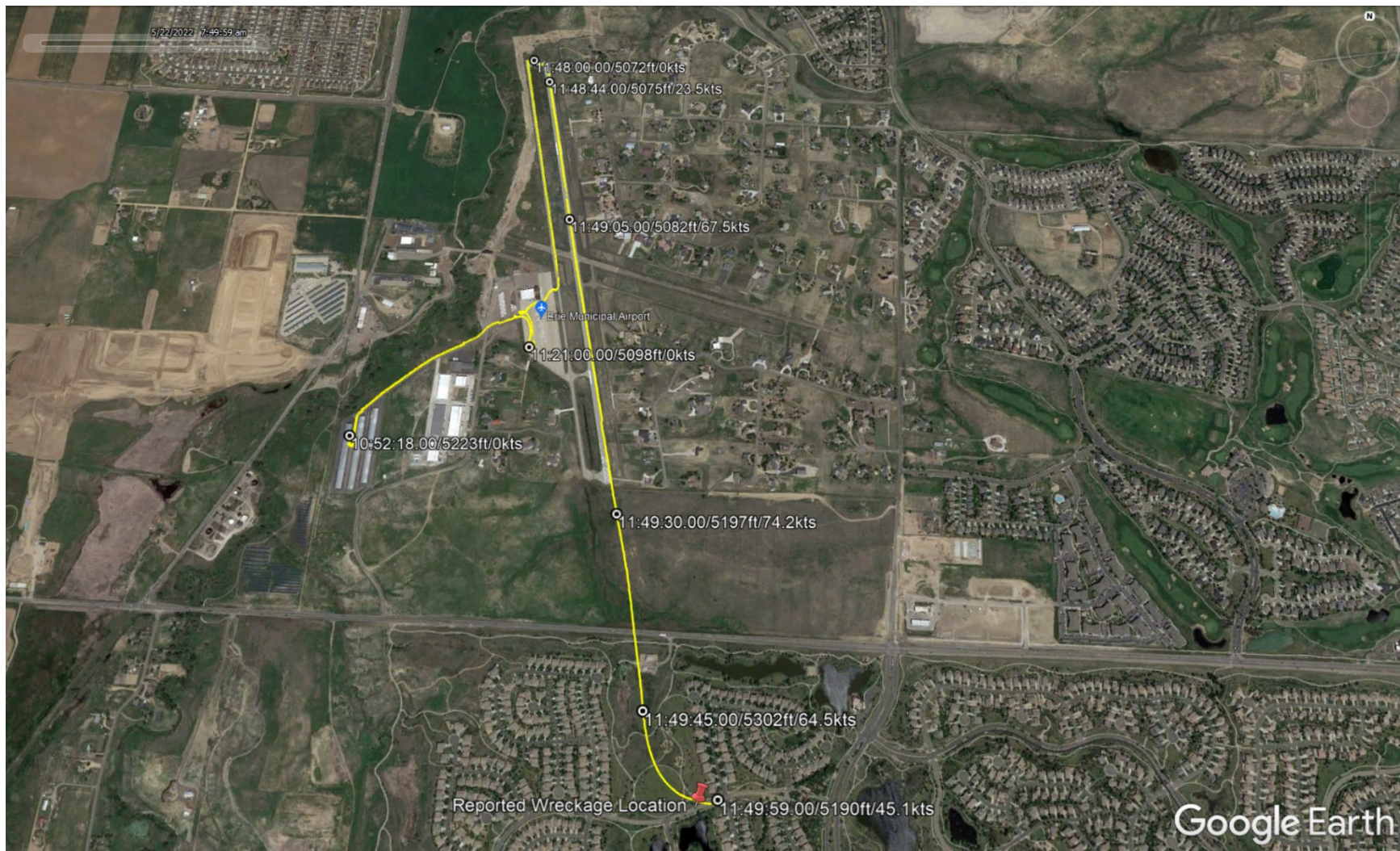


Figure 17. Google Earth overfly of the entire event flight recorded on May 22, 2022.



Figure 18. Google Earth overfly of the takeoff portion of the event flight recorded on May 22, 2022.

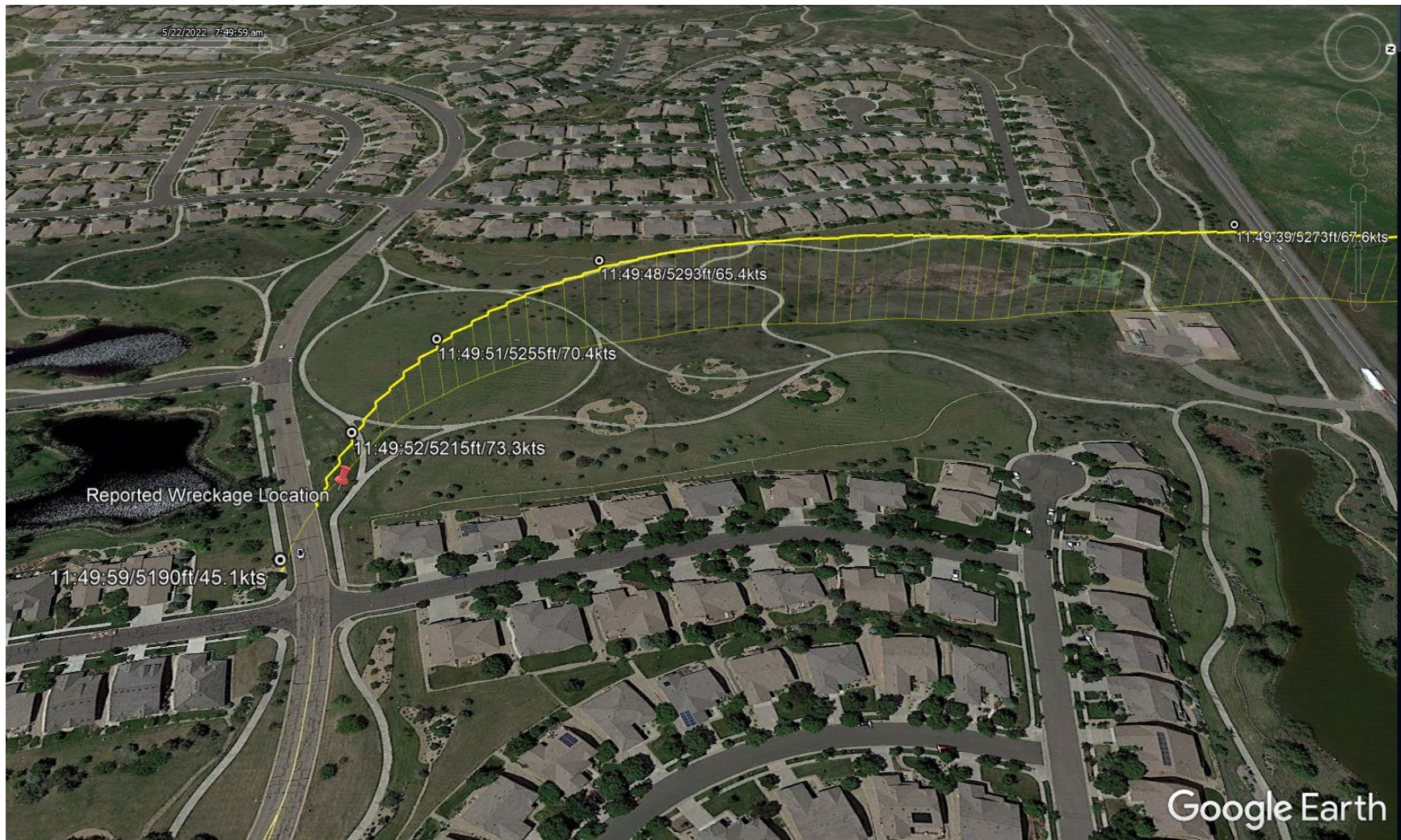


Figure 19. Google Earth overfly of the final portion of the event flight recorded on May 22, 2022.

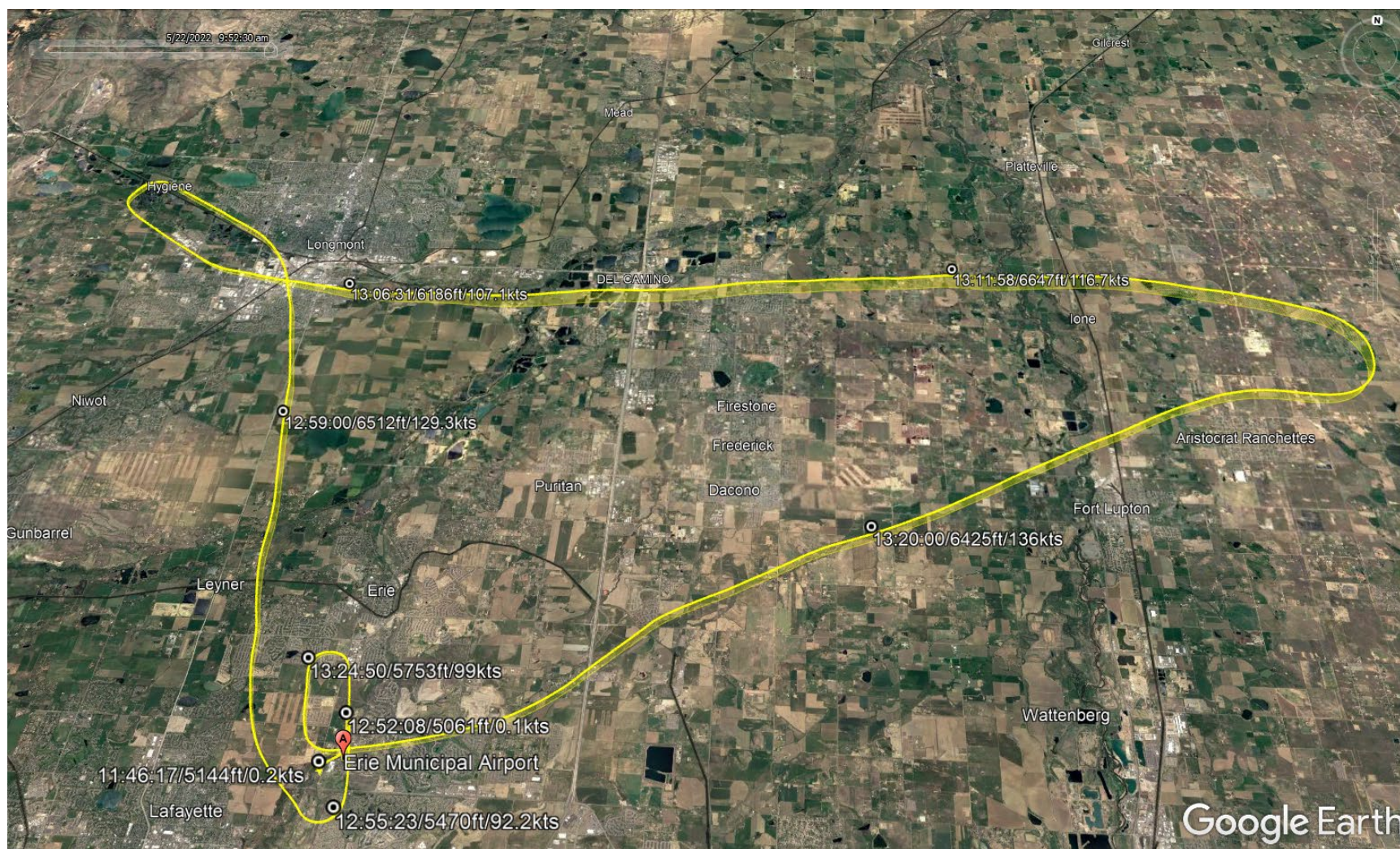


Figure 20. Google Earth overfly of the entire previous flight recorded on April 30, 2022.