

National Transportation Safety Board

Office of Research and Engineering

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COCKPIT DISPLAY - RECORDED FLIGHT DATA

Specialist's Factual Report

October 21, 2024

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A. ACCIDENT

Location: Fort Pierce North, Florida
Date: March 30, 2024
Time: 1320 eastern daylight time (EDT)
1730 coordinated universal time (UTC)
Airplane: Piper PA-44-180, private operator, N595ND

B. COCKPIT DISPLAY - RECORDED FLIGHT DATA SPECIALIST

Specialist: Steven Smith
Mechanical Engineer (Recorder Specialist)
National Transportation Safety Board (NTSB)

C. DETAILS OF THE INVESTIGATION

A group was not convened. The NTSB Vehicle Recorder Division received the following electronic devices:

Recorder Manufacturer/Model: Avidyne PFD
Part Number: 700-00006-002
Recorder Serial Number: 22592135

Recorder Manufacturer/Model: Avidyne MFD Compact Flash Card
Part Number: Unknown
Recorder Serial Number: Unknown

1.0 Avidyne Primary Flight Display Description

The Avidyne primary flight display (PFD) unit includes 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 PFD unit has external pitot/static inputs for altitude, airspeed, and vertical speed information. Each PFD contains two flash memory devices mounted on a riser card. The flash memory stores information the PFD unit uses to generate the various PFD displays. Additionally, the PFD has a data logging function, which is used by the manufacturer for maintenance and diagnostics. Maintenance and diagnostic information recording consist of system information, event data and flight data.

The PFD samples and stores several data streams in a sequential fashion; when the recording limit of the PFD is reached, the oldest record is dropped, and a new record is added. Data from the Attitude/Heading Reference System (AHRS) is recorded at a rate of 5 Hz. Air data information such as pressure altitude, indicated airspeed, and vertical speed are recorded at 1 Hz. Global Positioning System (GPS) and navigation display and setting data are recorded at a rate of 0.25 Hz, and

information about pilot settings of heading, altitude, and vertical speed references are recorded when changes are made.

1.1 Avidyne PFD Data Recovery

The Avidyne PFD was damaged in the event. The front screen was cracked and the connectors in the back of the unit were bent. However, the device was able to be connected to and powered up normally. The extent of the damage is shown in figure 1. The data were downloaded using the manufacturer's procedure and converted to engineering units using laboratory tools.



Figure 1. Front of Avidyne PFD as received by the NTSB Vehicle Recorder Laboratory.

1.2 Avidyne PFD Recording Description

The PFD recording contained records of 11 power cycles and approximately 17.67 hours of data. The accident flight was associated with the last power cycle.¹ The duration of the last power cycle was approximately 50 minutes. Timing of the PFD data is measured in seconds from power-on. The last recorded position sample does not align with the reported wreckage location. The last recorded position at 13:19:49 EDT, is approximately 500 feet from the reported wreckage location.

1.2.1 Avidyne PFD Parameters Provided

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

¹ During the normal data retrieval process, power is applied to the PFD. Therefore, the accident data is not necessarily the last power cycle recorded.

Table 1. Avidyne PFD data parameters provided.

Parameter Name (unit)	Parameter Description (unit)
Accel Lat (g)	Lateral Acceleration (gravitational acceleration)
Accel Long (g)	Longitudinal Acceleration (gravitational acceleration)
Accel Vert (g)	Vertical Acceleration (gravitational acceleration)
Airspeed Ind (kts)	Indicated Airspeed (knots)
Alt Press (ft)	Pressure Altitude (feet)
Groundspeed (kts)	Groundspeed (knots)
Hdg Mag (deg)	Magnetic Heading (degrees)
Latitude (deg)	Latitude (degrees)
Longitude (deg)	Longitude (degrees)
Pitch (deg)	Pitch Angle (degrees)
Roll (deg)	Roll Angle (degrees)
Time UTC Hrs (hrs)	Coordinated Universal Time Hours (hours)
Time UTC Min (min)	Coordinated Universal Time Minutes (minutes)
Time UTC Sec (sec)	Coordinated Universal Time Seconds (seconds)

1.3 Avidyne PFD Time Correlation

The Avidyne PFD data was recorded in UTC. The difference between EDT and UTC is 4 hours, or 14,400 seconds. The accident flight data has been offset from the recorded PFD time to EDT by subtracting 14,400 seconds.

2.0 Avidyne Multi-Function Display Description

The Avidyne multi-function flight display (MFD) unit is able to display the pilot checklist, terrain/map information, approach chart information and other aircraft/operational information depending on the specific configuration and options that are installed. One of the options available is a display of comprehensive engine monitoring and performance data.

Each MFD contains a compact flash (CF) memory card located in a slot on the side of the unit. This memory card contains all of the software that the MFD needs to operate. Additionally, this card contains all of the checklist, approach charts, and map information that the unit uses to generate the various cockpit displays.

During operation, the MFD display receives information from several other units that are installed on the aircraft. Specifically, the MFD receives GPS position, time and track data from the aircraft's GPS receiver. The MFD may also receive information from the aircraft concerning altitude, engine and electrical system parameters, and outside air temperature. This data is also stored on the unit's CF memory card.

The MFD generates new data files for each MFD power-on cycle. The oldest file is dropped and replaced by a new recording once the storage limit has been reached. MFD data are sampled every six seconds and is recorded to memory once every minute. If an interruption of power occurs during the minute between MFD memory write cycles, data sampled during that portion of a minute are not recorded.

2.1 Avidyne MFD Compact Flash Data Recovery

The Avidyne MFD Compact Flash card was in good condition and the data were downloaded using the manufacturer's procedure.

2.2 Avidyne MFD Compact Flash Recording Description

The MFD CF card contained 102 data files. One data file was identified as recording during the accident flight. The data file was approximately 56 minutes in duration.

2.2.1 Avidyne MFD Compact Flash Parameters Provided

Table 2 lists the MFD parameters verified and provided in this report. Note, this aircraft is a twin-engine aircraft with the number one (left) and number two (right) engine denoted as 1 and 2, respectively. On the plots, the parameters will be denoted with either a "_1" or "_2" for left and right, respectively.

Table 2. Avidyne MFD data parameters provided.

Parameter Name (unit)	Parameter Description (unit)
AMPS (A)	Bus Current (amps)
CHT (degF)	Cylinder Head Temperature ² (degrees of Fahrenheit)
E# (degF)	Exhaust Gas Temperature # ³ (degrees of Fahrenheit)
FF (gph)	Fuel Flow (gallons per hour)
LAT (deg)	Latitude (degrees)
LON (deg)	Longitude (degrees)
MAP (inHg)	Manifold Pressure (inches of Mercury)
OILP (psi)	Oil Pressure (pounds per square inch)
OILT (degF)	Oil Temperature (degrees of Fahrenheit)
PALT (ft)	Pressure Altitude (feet)
SPD (rpm)	Engine Speed (revolutions per minute)
USED (gal)	Used Fuel (gallons)

² There is a single CHT probe on each engine located in the aft inboard cylinder. The CHT probe is in cylinder 3 for the left engine (_1) and cylinder 4 for the right engine (_2).

³ This aircraft engine is configured with 4 cylinders. In the data plots, the '#' is replaced with the appropriate cylinder ID.

Parameter Name (unit)	Parameter Description (unit)
UTC TIME (HH:MM:SS)	Coordinated Universal Time (Hours:Minutes:Seconds)
VOLTS (V)	Bus Voltage (volts)

2.2.2 Avidyne MFD Compact Flash Exhaust Gas Temperature

The engine 2 exhaust gas temperature parameters (E1_2 through E4_2) appeared to be invalid when the engine was either turned off or brought to an idle speed.

2.3 Avidyne MFD Compact Flash Time Correlation

Correlation of the MFD data to EDT was established by using the recorded GPS time, pressure altitude, latitude, and longitude parameters from the PFD data. The MFD data contained the same parameters and therefore they were compared at takeoff and landing against the PFD parameters.

To correlate the time between the MFD and the PFD, a 3 second offset was applied to the MFD recorded data time.

D. FIGURES AND TABULAR DATA

Figures 2 to 11 contain Avidyne PFD and MFD data recorded during the event on March 30, 2024. All the parameters listed in tables 1 and 2 are plotted except UTC Hours, UTC Minutes, UTC Seconds, Latitude, and Longitude.

Figures 2 and 3 are time history plots of Avidyne PFD parameters for the entire flight and the final 11 minutes of the recording, respectively.

Figures 4 and 5 are time history plots of the engine 1 Avidyne MFD parameters for the entire flight and the final 3 minutes and 40 seconds of the recording, respectively. Figures 6 and 7 are time history plots of the engine 2 Avidyne MFD parameters for the entire flight and the final 10 minutes and 40 seconds of the recording, respectively. Figures 8 and 9 are time history plots of both engine Avidyne MFD parameters for the entire flight and the final 10 minutes and 40 seconds of the recording, 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.

The Avidyne PFD and MFD data indicated the following sequence of events:

- **12:39:30 EDT:** The aircraft began takeoff roll at Treasure Coast International Airport (KFPR) from runway 14.

- **12:43:36 EDT:** The aircraft had climbed and leveled at 4,350 ft.
- **12:45:03 EDT:** The aircraft had climbed and leveled at 4,800 ft.
- **12:45:15 EDT:** Engine 2 speed was 2650 rpm.
- **12:47:21 EDT - 12:51:21 EDT:** During this time, engine parameters such as bus current, CHT, EGT, engine speed, fuel flow, manifold pressure, and oil pressure are consistent with loss of engine power in engine 2.
- **12:51:27 EDT:** Engine 2 speed was 1540 rpm.
- **12:56:47 EDT:** The aircraft began descending from 4,900 ft.
- **13:08:39 EDT:** Altitude was 2,824 ft. Engine 2 speed was 2380 rpm, and engine 2 fuel flow was 10.7 gph.
- **13:09:09 EDT:** Altitude was 2,558 ft, and groundspeed was 127 kts. Engine 2 speed was 2380 rpm, and engine 2 fuel flow was 5.2 gph.
- **13:10:09 EDT:** Altitude was 2,360 ft, and engine 2 fuel flow was 1.2 gph. Engine 2 speed was 1820 rpm.
- **13:15:09 EDT:** Engine 2 fuel flow and speed were 4 gph and 1290 rpm, respectively.
- **13:18:09 EDT:** Altitude was 80 ft, and groundspeed was 78 kts. Engine 2 fuel flow and speed were 3.1 gph and 1220 rpm, respectively.
- **13:18:21 EDT:** Engine 2 fuel flow and speed were 11 gph and 1280 rpm, respectively.
- **13:19:33 EDT:** Last recorded MFD sample.
- **13:19:52 EDT:** Last recorded PFD sample.

Figures 10 and 11 are graphical overlays derived from the Avidyne PFD data and generated using Google Earth presenting the entire accident flight from KFPR and the final minute and 32 seconds of the recorded data, respectively. Weather and lighting conditions in Google Earth are not necessarily the weather and lighting conditions present at the time of the recording.

The corresponding Avidyne PFD tabular data used to create figures 2 and 3 and figures 10 and 11 are provided in electronic comma-separated value (CSV) format as attachment 1 to this report. The corresponding Avidyne MFD tabular data used to create figures 4 to 9 are provided in CSV format as attachment 2 to this report.

Submitted by:

Steven Smith
Mechanical Engineer (Recorder Specialist)

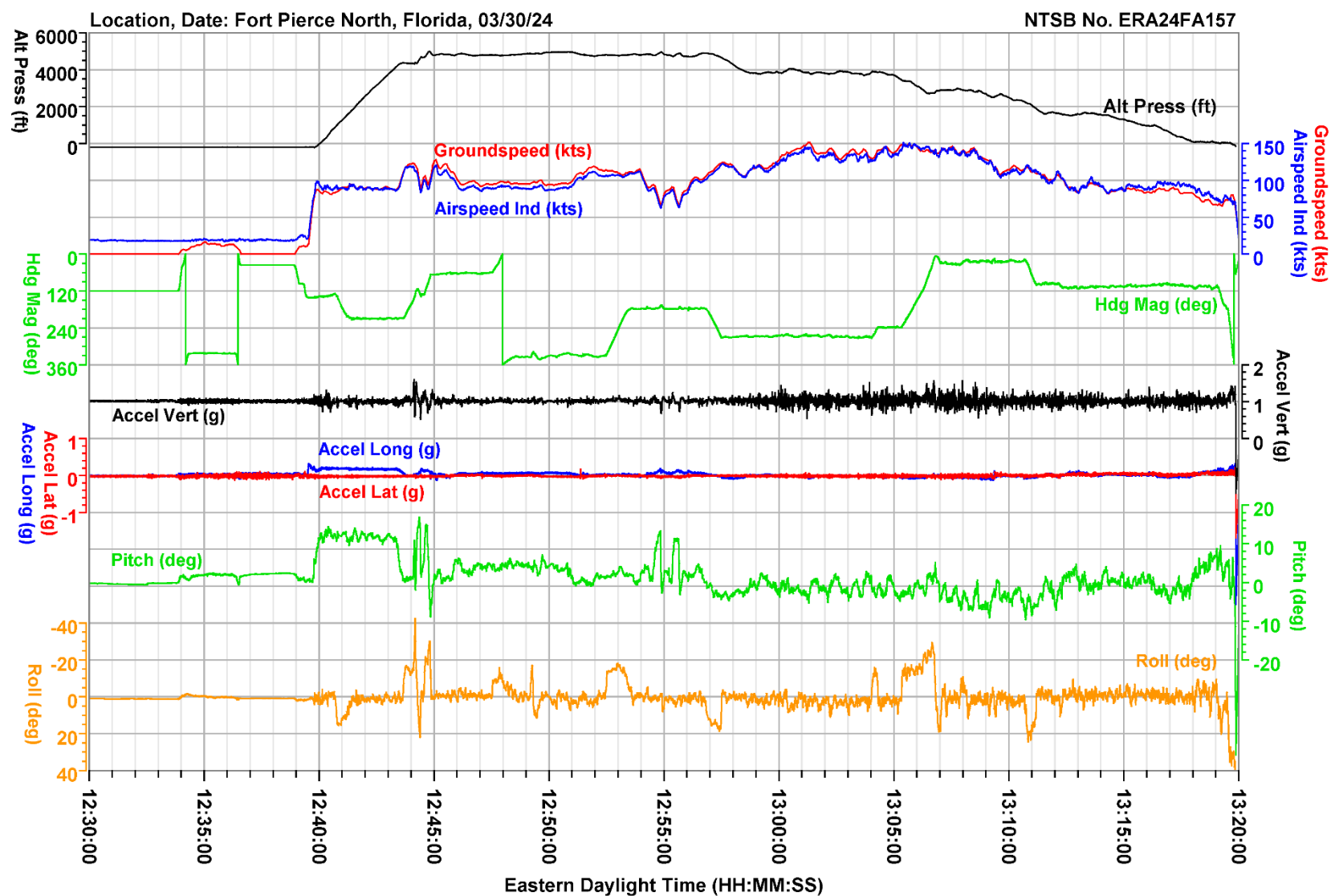


Figure 2. Time history plot of PFD parameters for the entire flight.

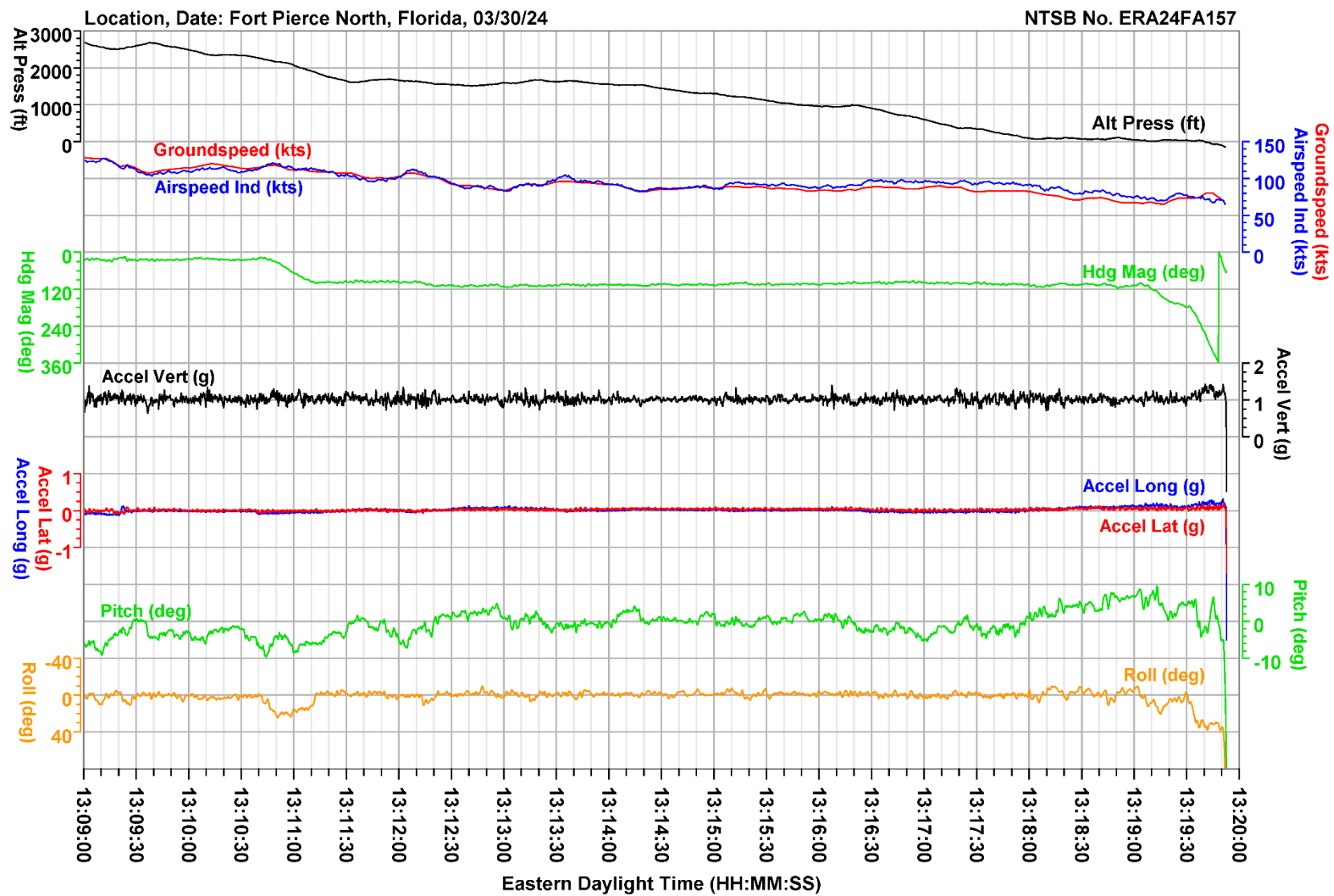


Figure 3. Time history plot of PFD parameters for the final 11 minutes of the recording.

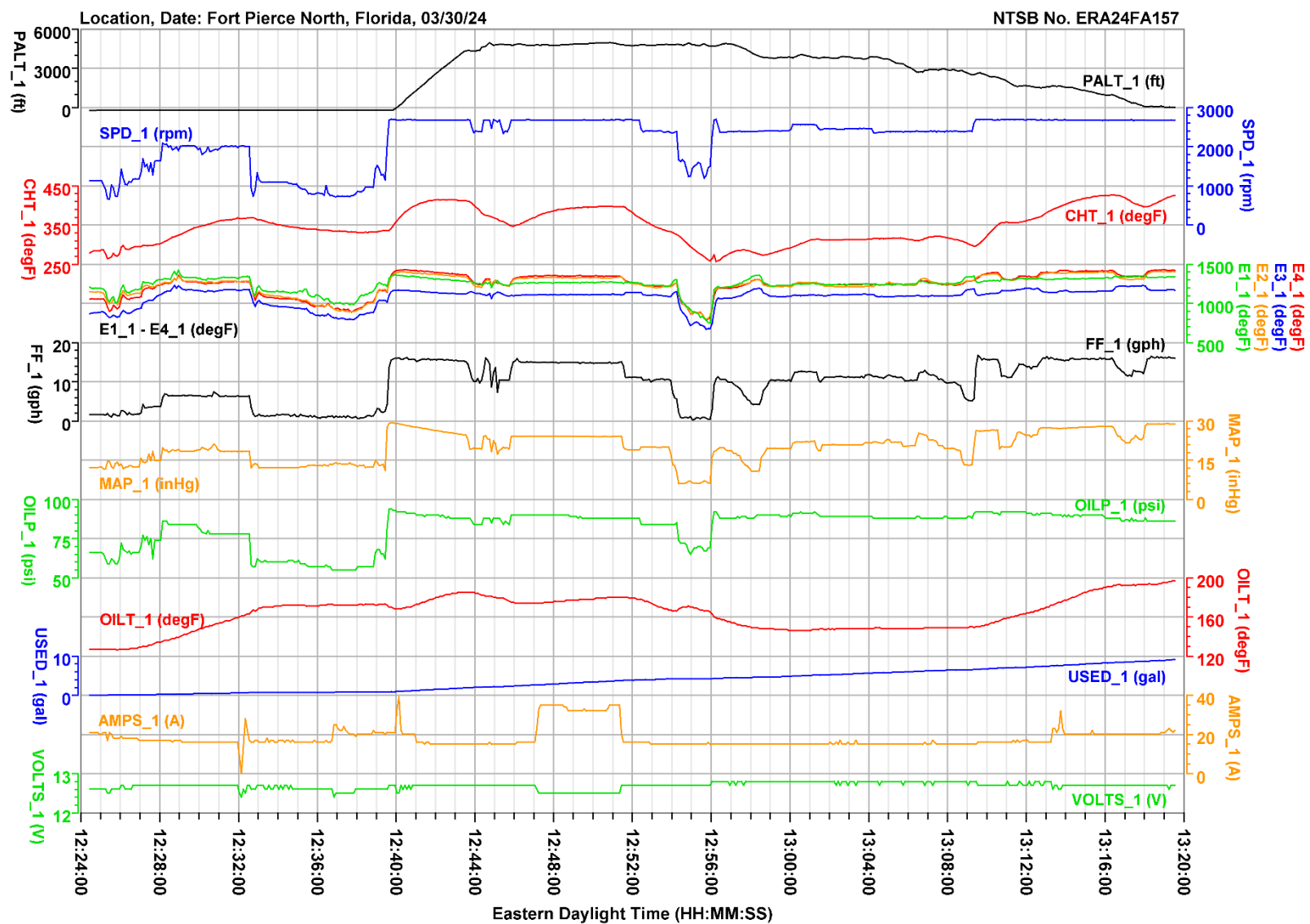


Figure 4. Time history plot of the number 1 engine MFD parameters for the entire flight.

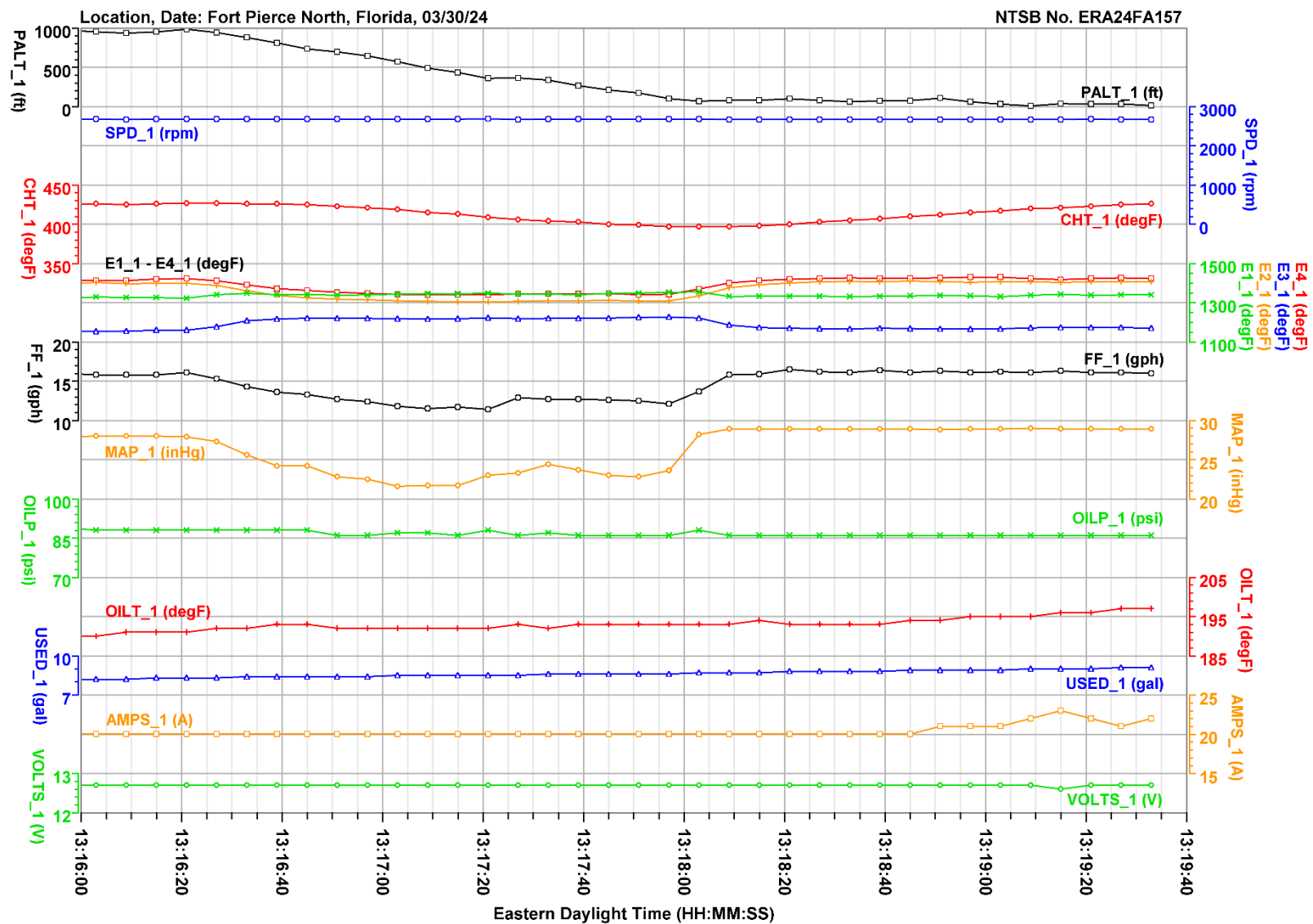


Figure 5. Time history plot of the number 1 engine MFD parameters for the final 3-minutes and 40 seconds of the recording.

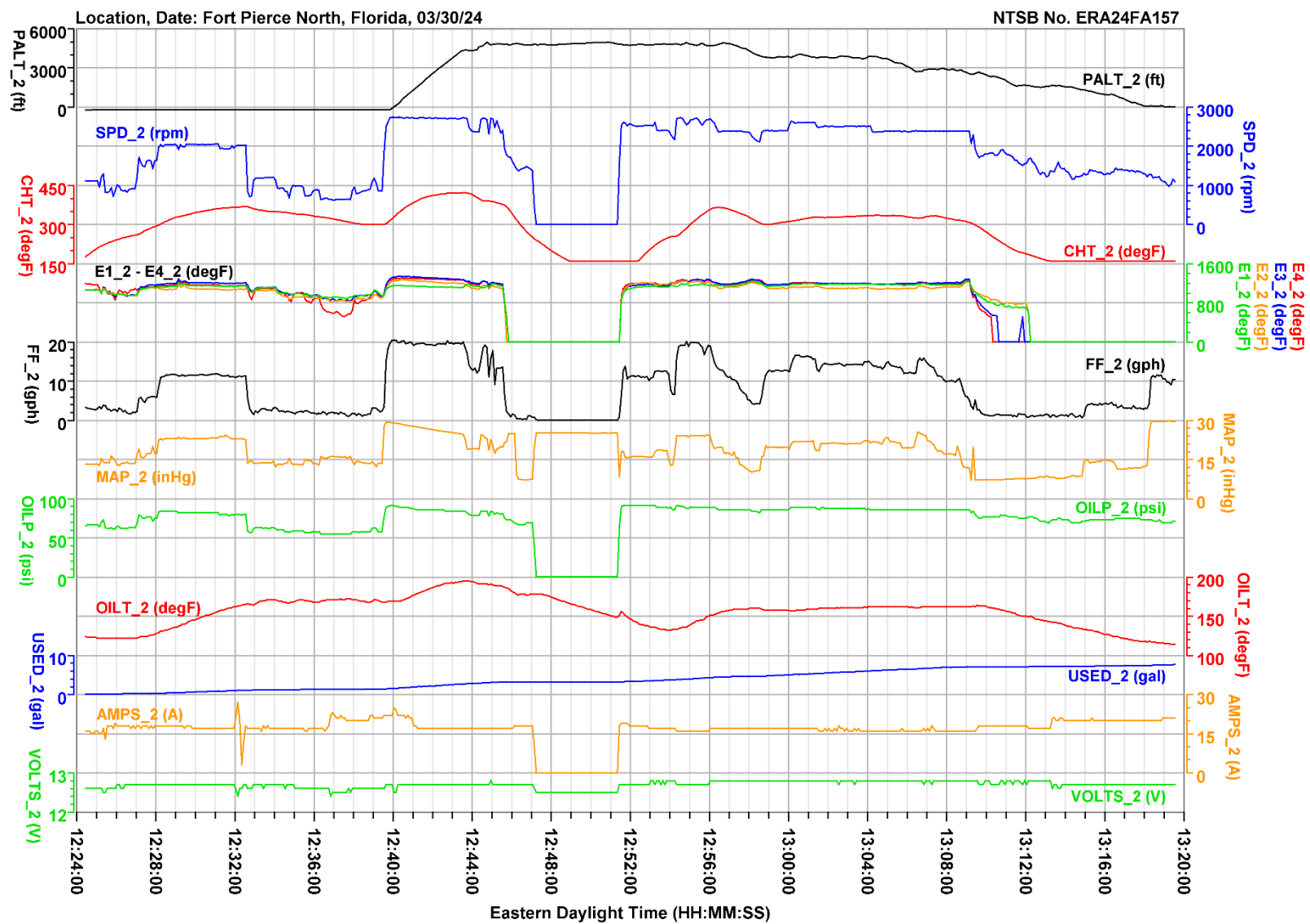


Figure 6. Time history plot of the number 2 engine MFD parameters for the entire flight.

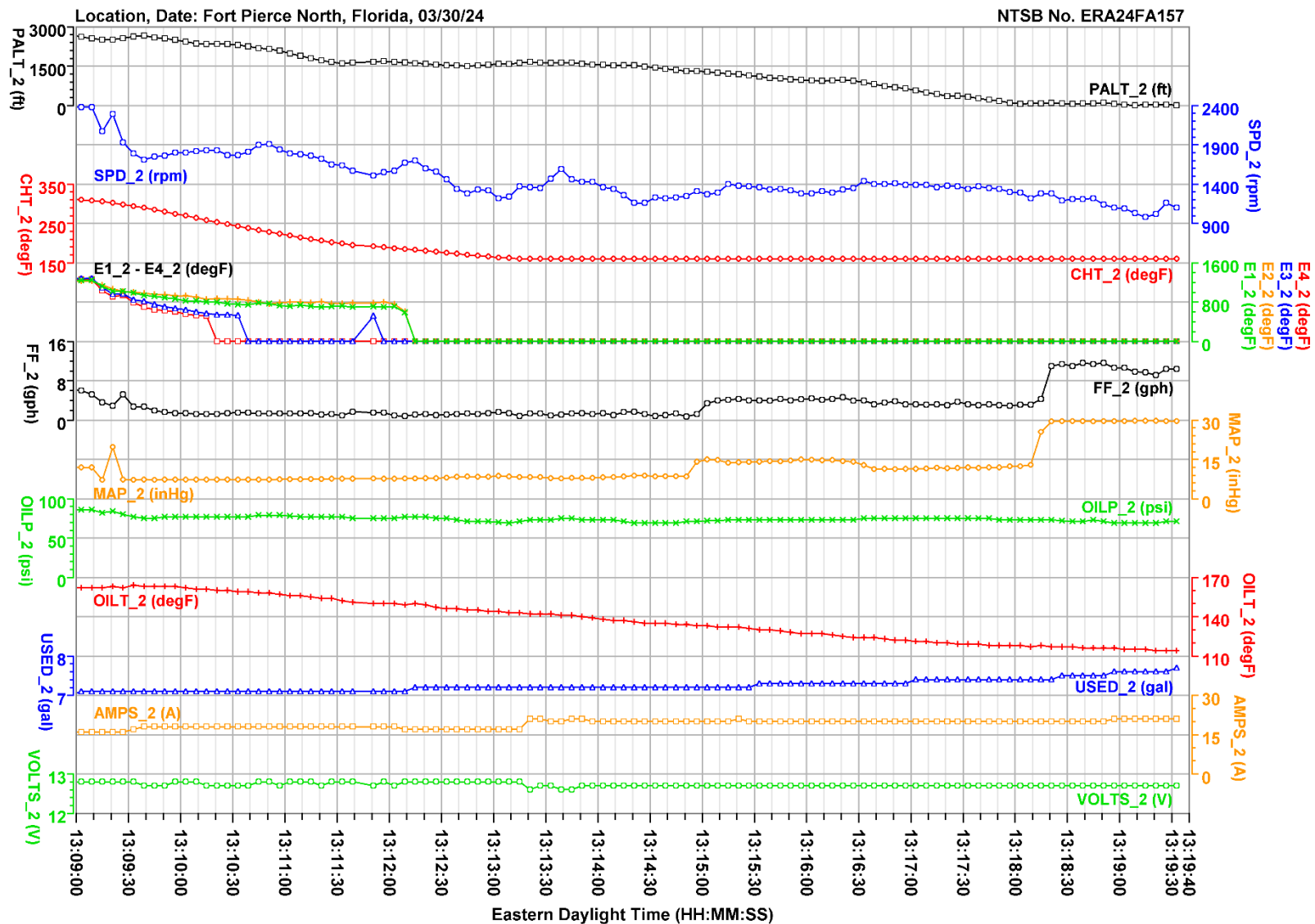


Figure 7. Time history plot of the number 2 engine MFD parameters for the final 10-minutes and 40 seconds of the recording.

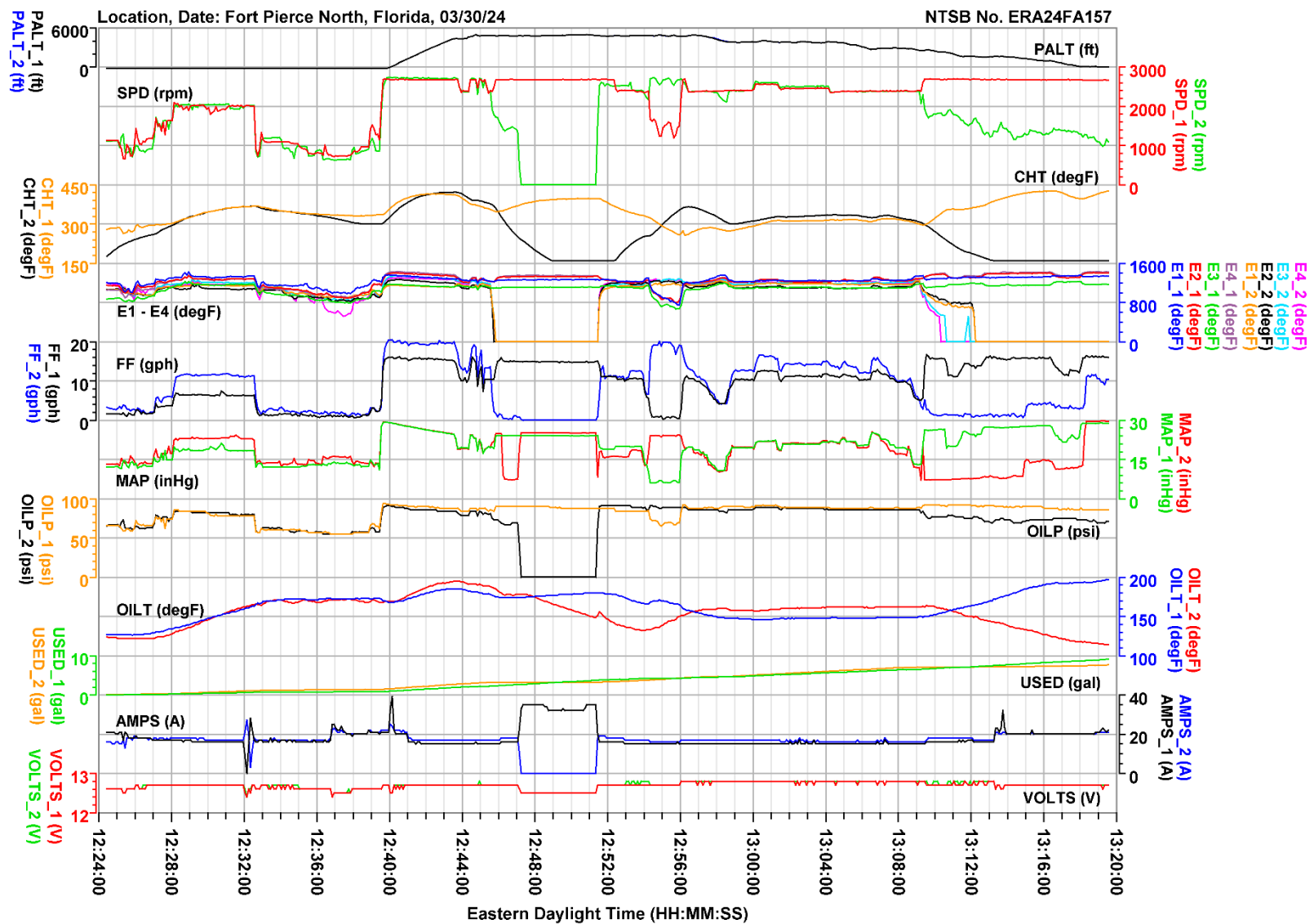


Figure 8. Time history plot of both engine MFD parameters for the entire flight.

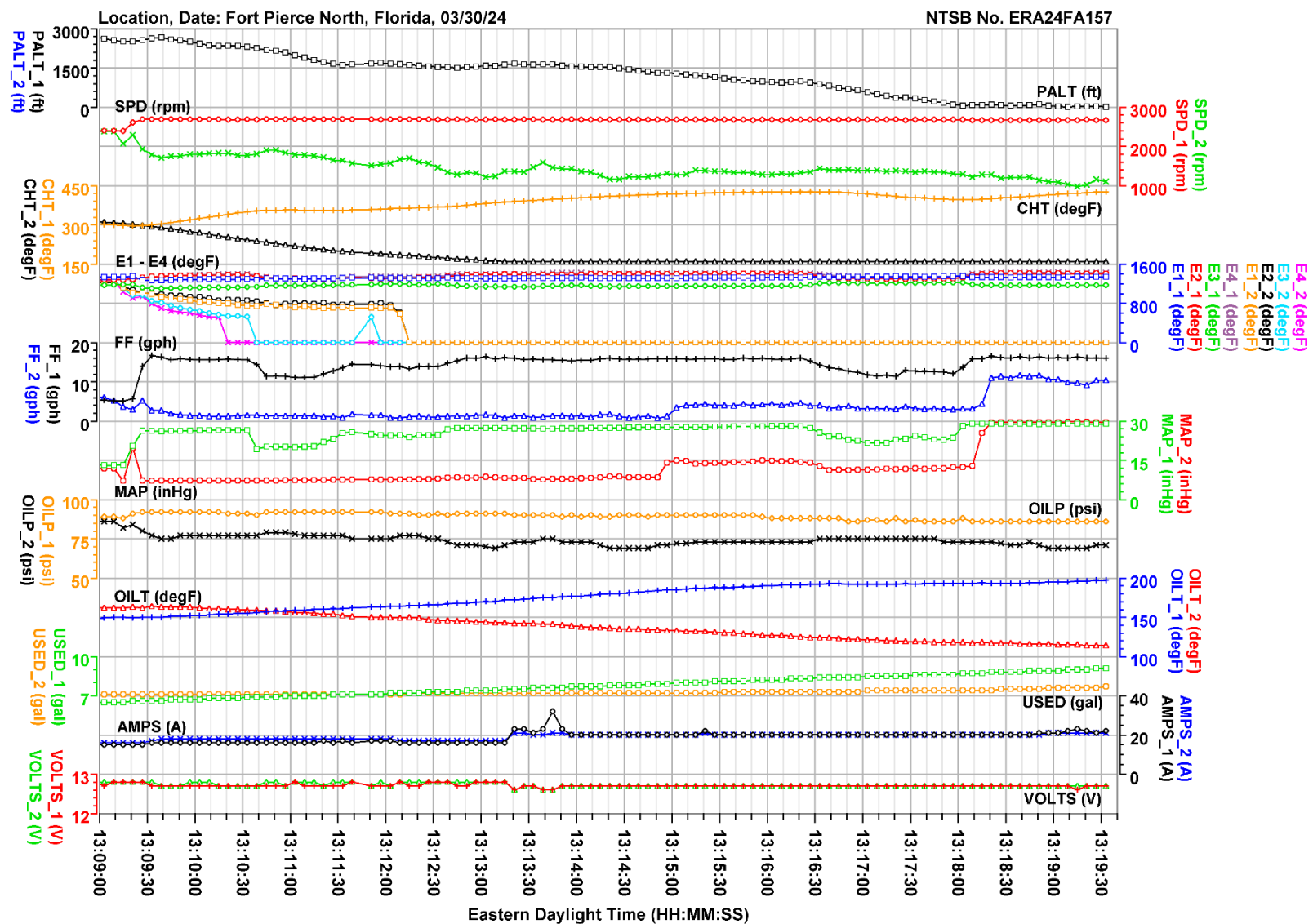


Figure 9. Time history plot of the both engine MFD parameters for the final 10-minutes and 40 seconds of the recording.

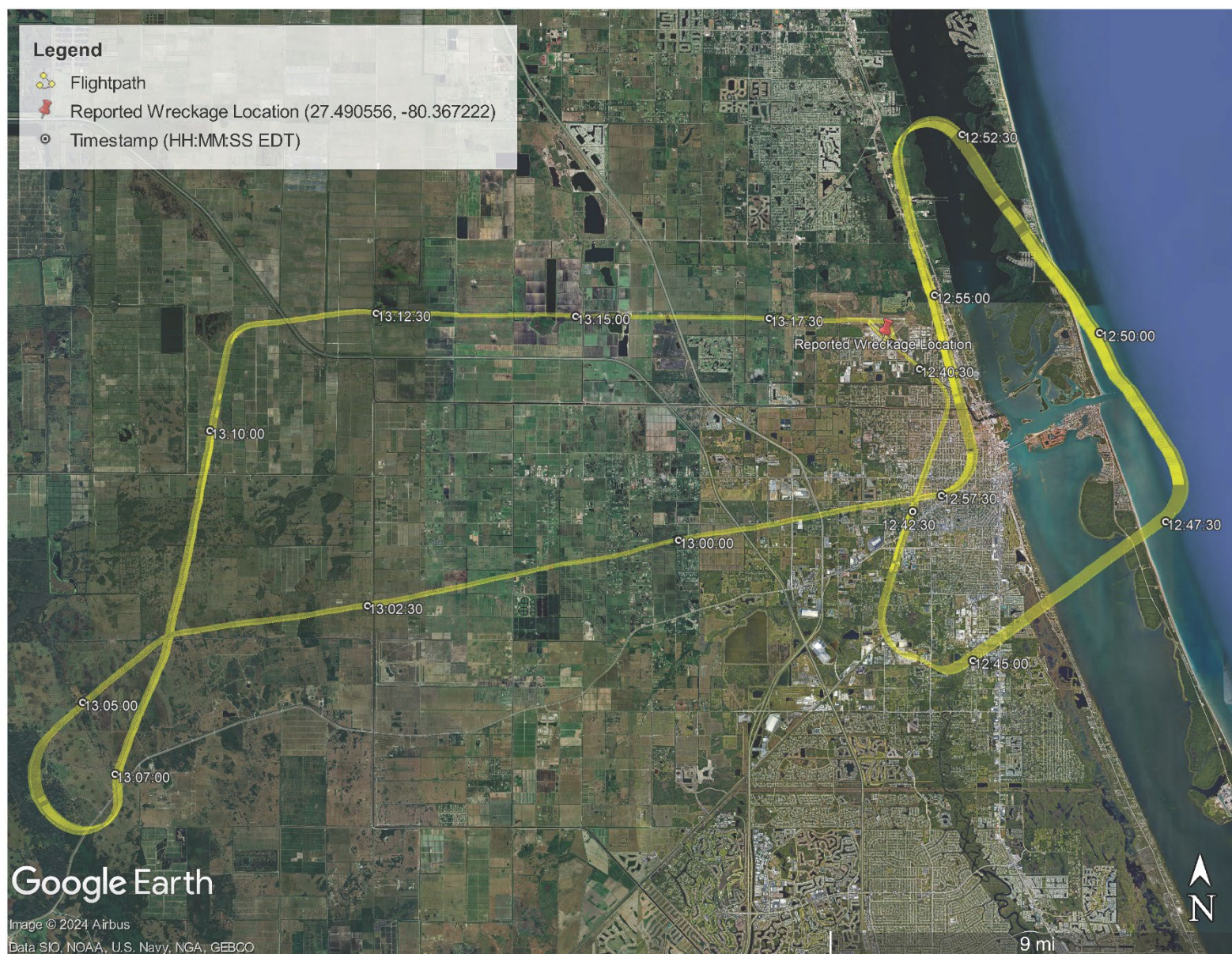


Figure 10. Google Earth overlay of the entire event flight using PFD data.



Figure 11. Google Earth overlay of the final portion of the PFD recording.