

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



ERA24LA124

COCKPIT DISPLAY - RECORDED FLIGHT DATA

Specialist's Factual Report

June 14, 2024

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A. ACCIDENT

Location: Sanford, Florida
Date: February 27, 2024
Time: 1820 eastern standard time (EST)
2320 coordinated universal time (UTC)
Airplane: Cirrus SR20, Aerosim Academy Inc, N485DA

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: 700-00006-000
Recorder Serial Number: 20055247

Recorder Manufacturer/Model: Avidyne MFD
Part Number: 700-00004-008
Recorder Serial Number: 20019237

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 in good condition and the data were downloaded using the manufacturer's procedure. Figure 1 presents the Avidyne PFD as received by the NTSB Vehicle Recorder Laboratory.



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

1.2 Avidyne PFD Recording Description

The PFD recording contained records of 19 power cycles and approximately 16.27 hours of data. The accident flight was associated with the last power cycle.¹ The duration of the last power cycle was approximately 1 hour and 5 minutes. Timing of the PFD data is measured in seconds from power-on.

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.

1.2.1 Avidyne PFD Parameters Provided

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

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)
Baro Bug (inHg)	Display Barometric Correction Setting (inches of Mercury)
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

Correlation of the PFD data to EST was established using the recorded GPS time parameter from the PFD data. Recorded GPS time is updated in 6-second intervals on the PFD.² The GPS time is recorded in UTC. The difference between EST and UTC is 5 hours, or 18,000 seconds. The PFD starts recording when power is applied to the unit. For each power cycle, the timing begins at 0 seconds and the PFD data is measured in seconds from power-on. 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 EST.

Due to the six second update rate of the GPS time, the times noted in this report could be up to six seconds off from actual GPS time.

² GPS information is recorded at 4 second (0.25 Hz) intervals; however, it is possible to have the same UTC time recorded in consecutive GPS data records due to the 6 second update rate of the GPS time parameter.

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 Card Data Recovery

The NTSB Vehicle Recorder Laboratory received the entire Avidyne MFD unit. The Avidyne MFD Compact Flash card was removed from the unit and was in good condition. The data were downloaded normally using the manufacturer's procedure.

2.2 Avidyne MFD Recording Description

The MFD CF card contained 114 data files. One data file was identified as recording during the accident flight. The data file was approximately 1 hour and 7 minutes in duration.

2.2.1 Avidyne MFD Parameters Provided

Table 2 lists the MFD parameters verified and provided in this report.

Table 2. Avidyne MFD data parameters provided.

Parameter Name (unit)	Parameter Description (unit)
C# (degF)	Engine Cylinder Head Temperature # ³ (degrees Fahrenheit)
E# (degF)	Engine Exhaust Gas Temperature # (degrees Fahrenheit)
EBUS (V)	Essential Bus Voltage (V)
FF (gph)	Fuel Flow (gallons per hour)
LAT (deg)	Latitude (degrees)
LON (deg)	Longitude (degrees)
MAP (inHg)	Engine Manifold Pressure (inches of Mercury)
MBUS (V)	Main Bus Voltage (volts)
OIL P (psi)	Oil Pressure (pounds per square inch)
OIL T (degF)	Oil Temperature (degrees Fahrenheit)
PALT (ft)	Pressure Altitude (feet)
SPD (RPM)	Engine Speed (revolutions per minute)
USED (gal)	Fuel Used (gallons)

2.3 Avidyne MFD Time Correlation

Correlation of the MFD data to EST 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 during flight and landing against the PFD parameters.

To correlate the time between the MFD and the PFD, a 7 second offset was applied to the MFD recorded data time.

D. FIGURES AND TABULAR DATA

Figures 2 and 3 contain PFD data and figures 4 and 5 contain MFD data recorded during the event on February 27, 2024. All the parameters listed in tables 1 and 2 for the PFD and MFD, respectively, are plotted except UTC Hours, UTC Minutes, UTC Seconds, Baro Bug, Latitude, and Longitude.

Figures 2 and 3 present time history plots of the same parameters from the Avidyne PFD for the entire flight (17:16:00 EST to 18:21:00 EST) and the final 4 minutes (18:17:00 EST to 18:21:00 EST), respectively.

Figures 4 and 5 present time history plots of the same parameters from the Avidyne MFD for the entire flight (17:15:00 EST to 18:22:00 EST) and the final 3 minutes and 13 seconds (18:17:00 EST to 18:20:30 EST), respectively.

³ This aircraft engine is configured with 6 cylinders. In the data plots, the '#' is replaced with the appropriate cylinder ID.

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 data show the following:

- **17:17:25 EST:** The approximate time that the takeoff roll was initiated from Orlando Sanford International Airport (KSFB), Sanford, Florida. The takeoff and cruise portion of the flight were uneventful.
- **17:19:47 EST:** The PFD began to record data.
- **17:30:25 EST:** The aircraft began conducting a series of turning maneuvers southeast of KSFB.
- **17:53:05 EST:** The aircraft began to make a descent from 3,450 ft.
- **17:58:43 EST:** The aircraft exited from the turning maneuvers area and was on a northwest heading of 300 deg.
- **18:01:56 EST:** The baro bug was set to 30.11 inHg.
- **18:17:35 EST:** The aircraft began to make a descent from 1,533 ft.
- **18:17:37 EST:** Engine speed and fuel flow began to reduce from 2400 RPM and 11.7 gph, respectively.
- **18:18:49 EST:** The aircraft altitude was 857 ft, and indicated airspeed was 105 kts. Engine speed and fuel flow were 2040 RPM and 3.2 gph, respectively. EGT for all 6 cylinders began to significantly reduce.
- **18:19:01 EST:** EGT reduced approximately 500 degF across all 6 cylinders before it began to increase. Fuel flow was reduced to 2.5 gph.
- **18:19:49 EST:** Engine speed, fuel flow, and manifold pressure were 2060 RPM, 13.8 gph, and 12.8 inHg, respectively.
- **18:19:55 EST:** Engine speed, fuel flow, and manifold pressure were 2500 RPM, 13.8 gph, and 27.1 inHg, respectively. Pressure altitude was 103 ft.
- **18:20:13 EST:** The last recorded MFD data sample. The PFD continued to record until after the accident. The total fuel used was 13.5 gal.
- **18:24:43 EST:** The last recorded PFD data sample.

Figures 6 and 7 are graphical overlays derived from the Avidyne MFD data and generated using Google Earth presenting the entire accident flight from KSFB and the final minute and 24 seconds of the recording, 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 PFD tabular data used to create figures 2 and 3 are provided in electronic comma-separated value (CSV) format as attachment 1 to this report. The corresponding MFD tabular data used to create figures 4 through 7 are provided in electronic CSV format as attachment 2 to this report.

Submitted by:

Steven Smith
Mechanical Engineer (Recorder Specialist)

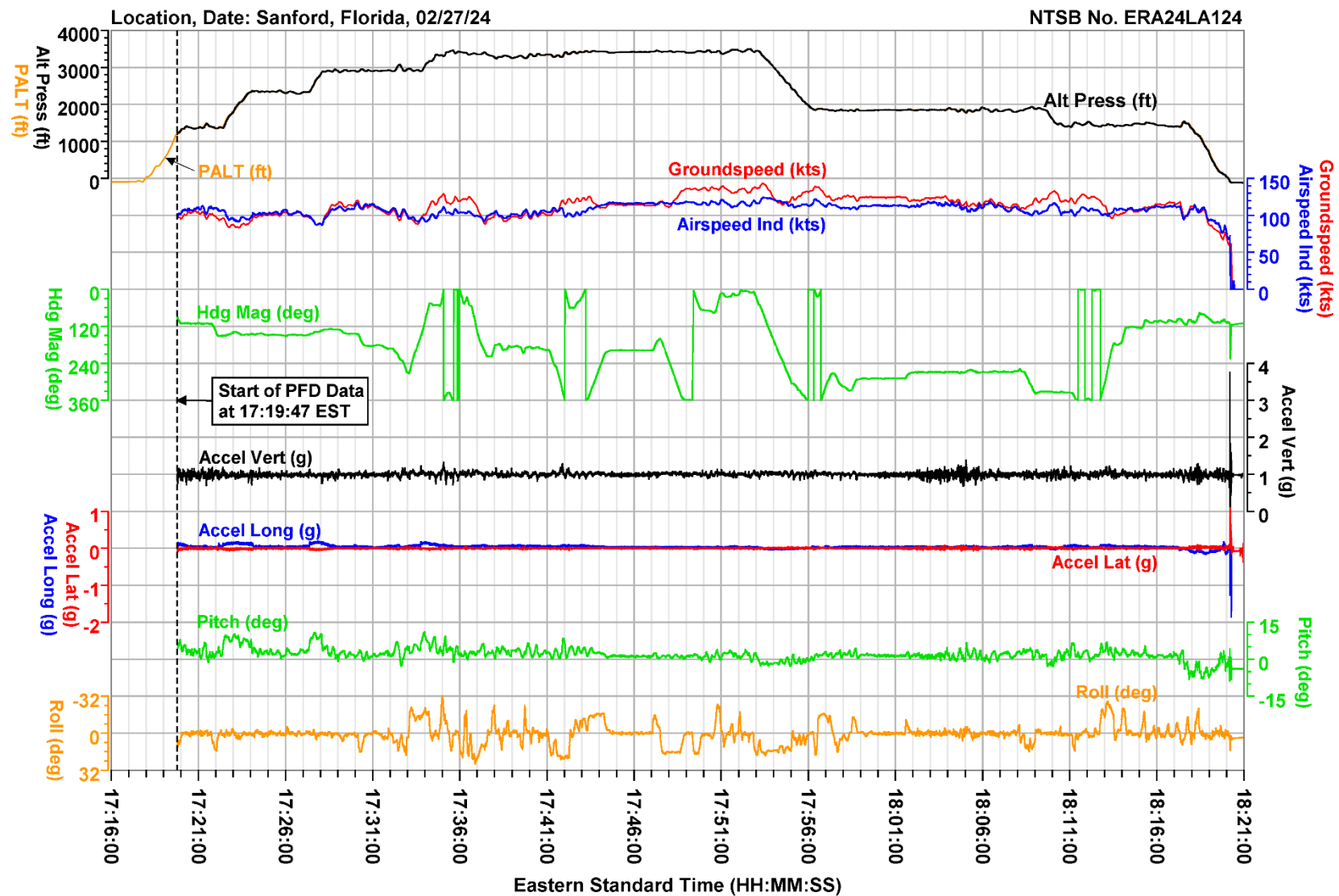


Figure 2. Time history plot for PFD parameters for the entire accident flight.

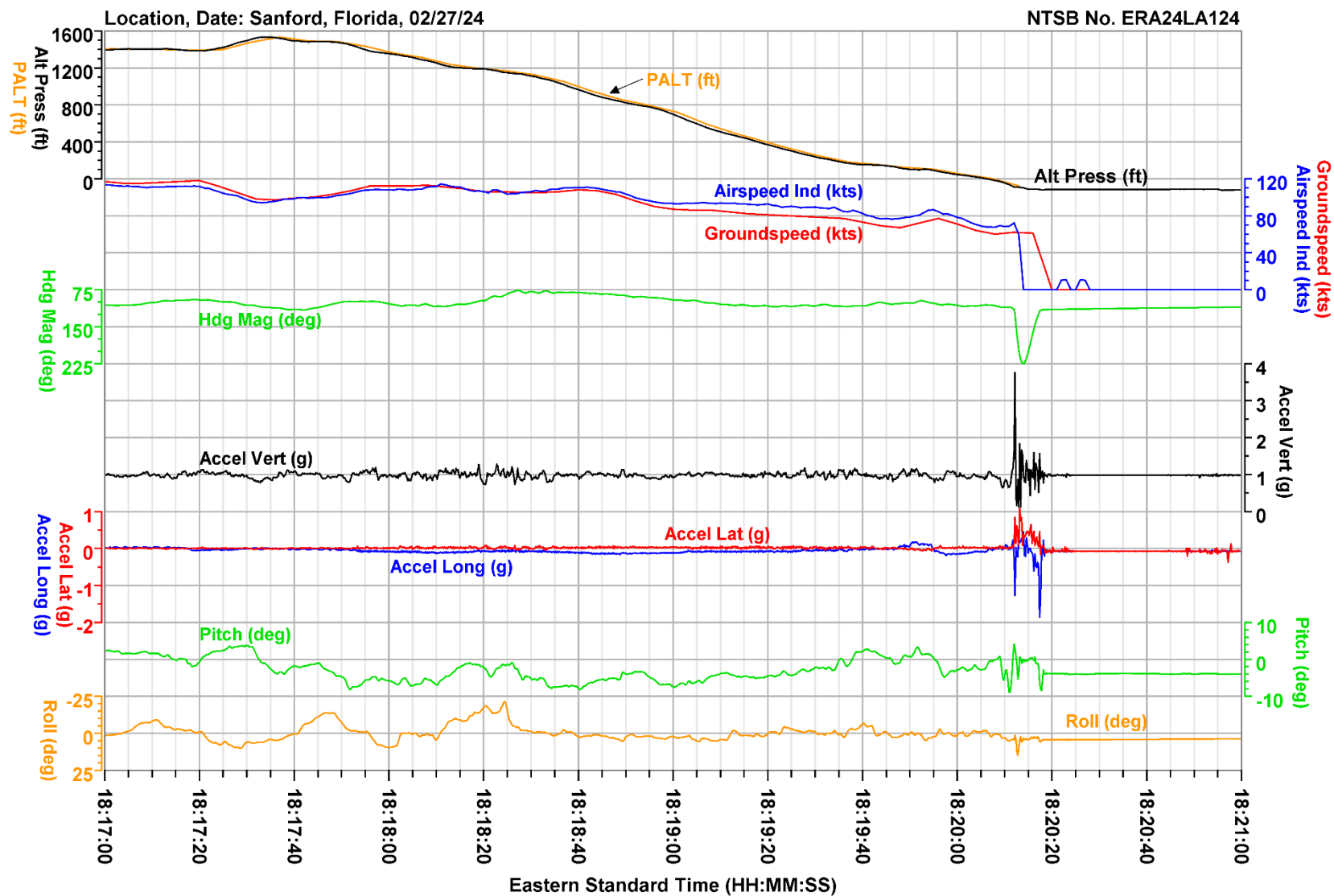


Figure 3. Time history plot for PFD parameters for the final 4 minutes of the recording. Note that the data continued to record after the accident occurred.

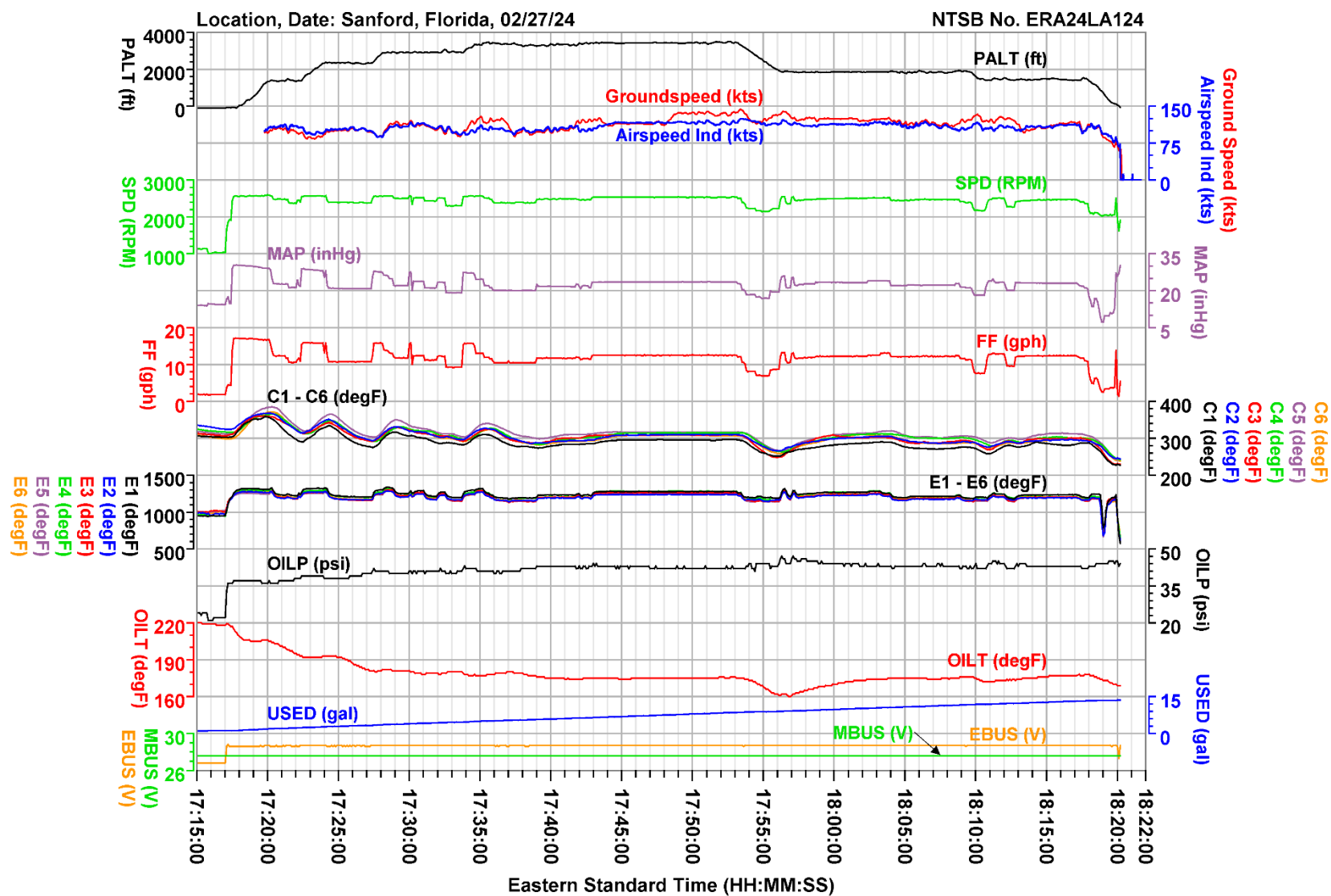


Figure 4. Time history plot of MFD parameters for the entire accident flight.

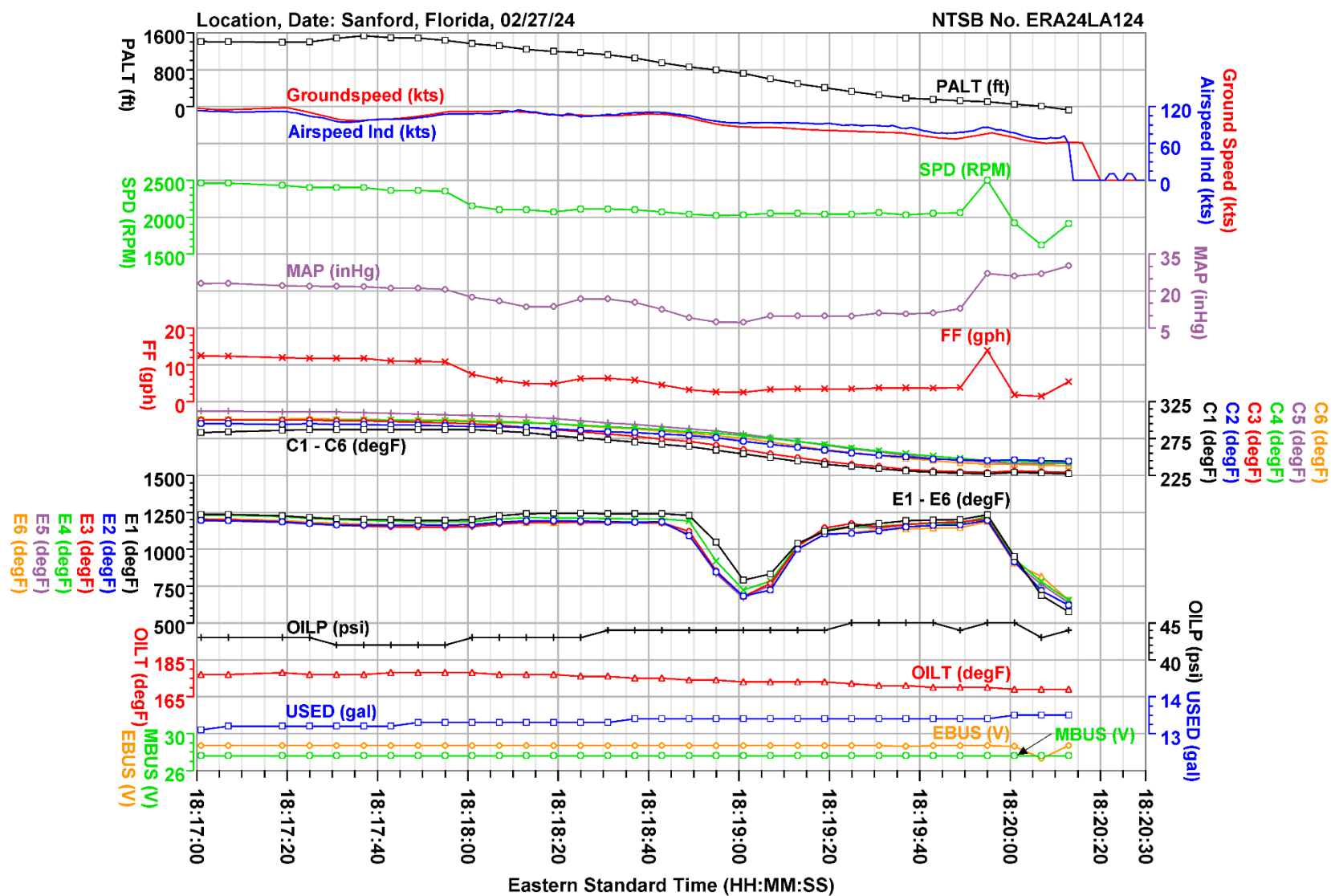


Figure 5. Time history plot of MFD parameters for the final 3 minutes and 13 seconds of the recording.

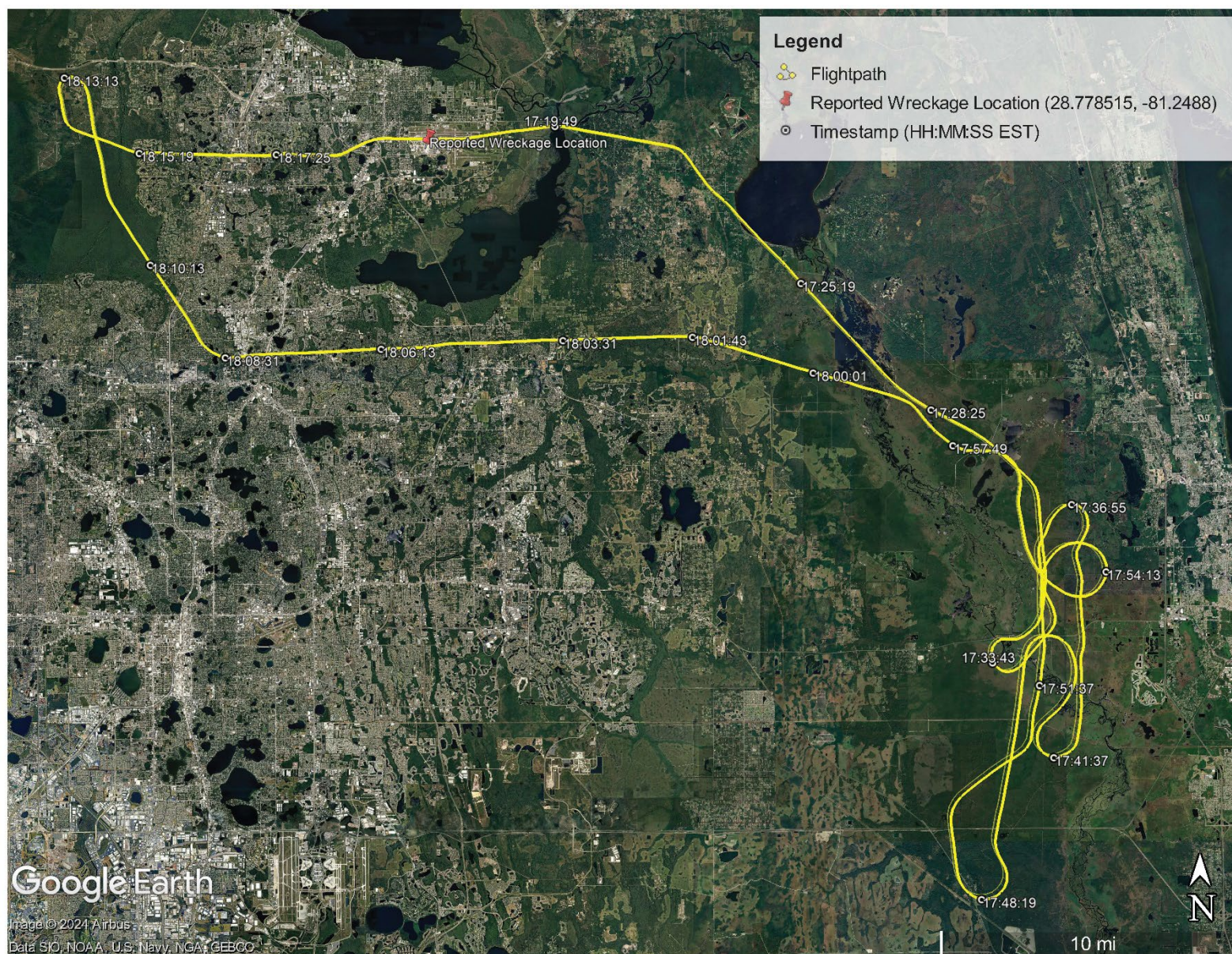


Figure 6. Google Earth overlay of the entire accident flight.

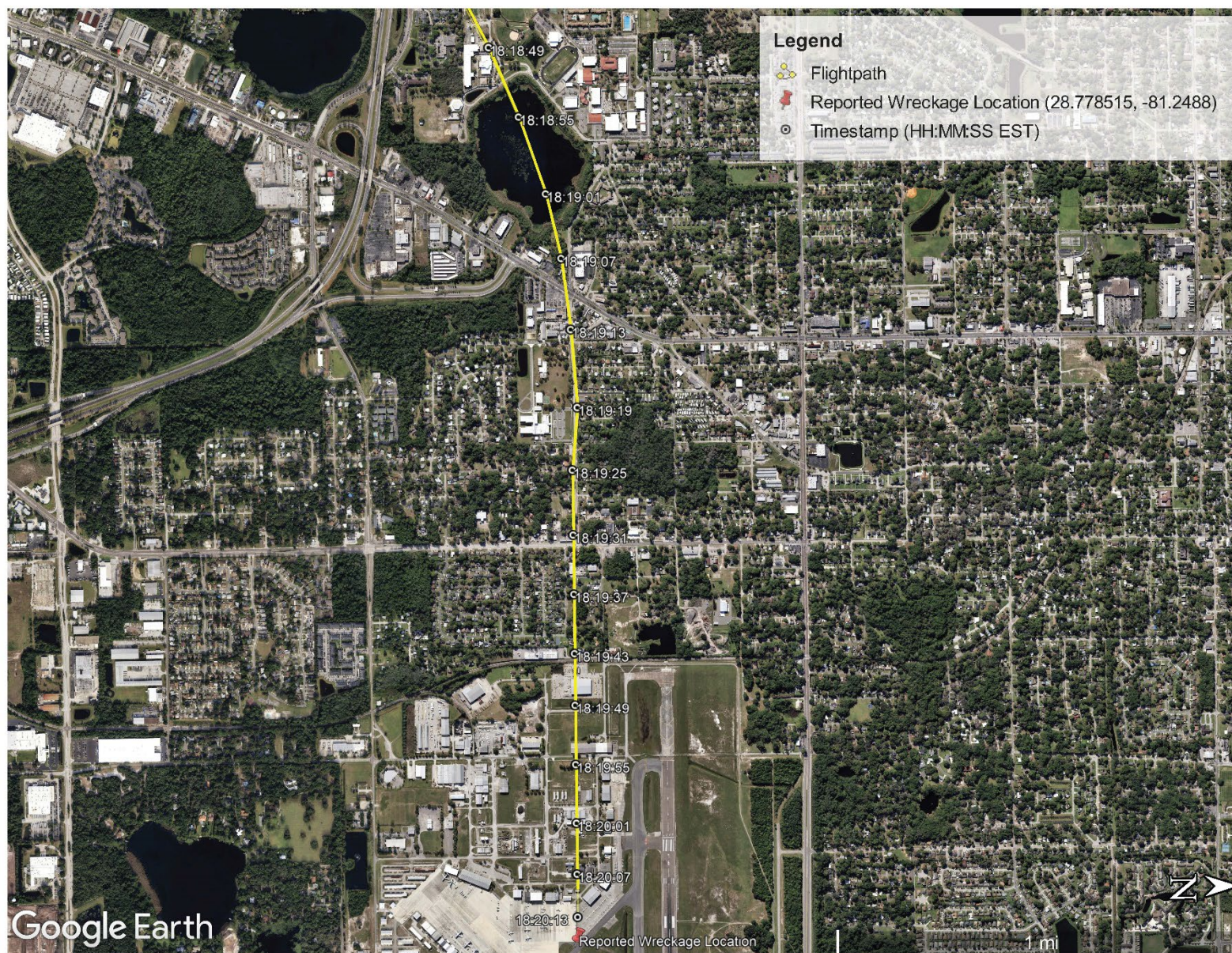


Figure 7. Google Earth overlay of the final minute and 24 seconds prior to the accident.