

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



CEN23LA337

ELECTRONIC FLIGHT INSTRUMENT SYSTEM (EFIS)

Specialist's Factual Report

October 16, 2023

A. ACCIDENT

Location: Winsted, Minnesota
Date: July 30, 2023
Time: 1655 central daylight time (CDT)
Airplane: Cub Crafters CCX-2000, private operator, N967DT

B. ELECTRONIC FLIGHT INSTRUMENT SYSTEM (EFIS) SPECIALIST

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

C. DETAILS OF THE INVESTIGATION

A cockpit display - recorded flight data group was not convened. The NTSB Vehicle Recorder Division received the following device:

Recorder Manufacturer/Model: Garmin G3X SD Data Card
Serial Number: BI1926650878G

1.0 Garmin G3X Device Description

The Garmin G3X is a series of displays certified to be installed on certified aircraft. The model comes in 10.6" and 7" display versions. The unit employs a touch-screen user interface and can be utilized as a Primary Flight Display (PFD), Multi-Function Display (MFD), Engine Monitoring Device (EDM), or a combination of all, depending on how the unit is integrated with other compatible avionics products. The unit can record data via an externally removable SD card mounted under the center of the screen, or internally on a series of non-volatile memory (NVM) chips.¹

1.1 Garmin G3X SD Data Card Data Recovery

The Garmin G3X SD card was in good condition, and the data were read out normally.

1.2 Garmin G3X SD Data Card Data Description

The G3X SD card received stores flight data in individual flight logs. The SD card contained 805 log files. The accident flight recording was identified and was approximately 1 hour and 11 minutes.

¹ Non-volatile memory is semiconductor memory that doesn't require power for data retention.

1.2.1 Garmin G3X SD Data Card Engineering Unit Conversions

The recorded flight log data was in comma separated value (CSV) format, and no conversion was performed.

Appendix A, table 1 lists the parameters verified and provided in this report.

1.3 Garmin G3X SD Card Time Correlation

The data was provided in the event local time, CDT, and therefore no additional offsets are required. All times in this report are referenced as CDT.

D. FIGURES AND TABULAR DATA

Figures 1 to 4 contain data recorded during the event on July 30, 2023. All the parameters listed in table 1 are plotted except Latitude, Longitude, and Baro Setting.

Figures 1 and 2 present time history plots for engine parameters for the entire flight and a one minute forty second window surrounding the accident, respectively.

Figures 3 and 4 present time history plots for basic aerodynamic and engine parameters for the entire flight and a one minute forty second window surrounding the accident, 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 data show the following:

- **16:00:08 CDT:** The aircraft departed runway 32 at Crystal airport (KMIC) in Minneapolis, Minnesota.
- **16:01:00 CDT:** GPS altitude was 1524 feet (ft), and the aircraft began a left turn. The takeoff, cruise, and approach were uneventful.
- **16:54:33 CDT:** GPS altitude was 1806 ft, indicated airspeed was 57 knots (kts) (61 kts ground speed), magnetic heading was 281 degrees (deg), engine rpm was 1820 revolutions per minute (RPM), and engine power was 23%. Cylinder head temperature (CHT) and exhaust gas temperature (EGT) (averaged across all 4 cylinders) were 285 degrees Fahrenheit (degF) and 1103 degF, respectively.
- **16:54:34 CDT:** Engine rpm was 1500 RPM, engine power was 21%, and manifold pressure was 10 inches of mercury (inHg).

- **16:54:37 CDT:** Engine rpm was 970 RPM, engine power was 12%, CHT and the average EGT were 282 degF and 829 degF, respectively.
- **16:54:42 CDT:** Engine rpm was 860 RPM, engine power was 13%, manifold pressure was 12 inHg, the average CHT and EGT were 277 degF and 645 degF, respectively.
- **16:55:13 CDT:** GPS altitude was 1241 ft, indicated airspeed was 51 kts (54 kts ground speed), magnetic heading was 107 deg. Engine rpm was 730 RPM, engine power was 14%, manifold pressure was 15 inHg, and the average CHT and EGT were 247 degF and 380 degF, respectively.
- **16:55:33 CDT:** Normal acceleration was 1.659 g, the baro setting was 30.14 inHg, GPS altitude was 1015 ft, indicated airspeed was 40 kts (41 kts ground speed), magnetic heading was 87 deg, engine rpm was 0 RPM, manifold pressure was 29 inHg, and engine power was 0%. This recorded sample is consistent with landing on runway 9 at Winsted municipal airport (K10D) in Winsted, Minnesota.
- **16:55:38 CDT:** The last recorded sample. GPS altitude was 1015 ft, indicated airspeed was 18 kts (24 kts ground speed), magnetic heading was 105 deg, and roll angle was 19.66 deg. The average CHT and EGT were 227 degF and 298 degF, respectively.

The ignition back-up and left and right ignition off discretes were briefly active only during preflight. The integrated battery back-up system (IBBS) in use discrete was never active for the entire accident flight.

Figures 5 and 6 are graphical overlays generated using Google Earth presenting the entire flight from KMIC in Minneapolis, Minnesota, to K10D in Winsted, Minnesota, and the landing, 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 tabular data used to create figures 1 to 6, including Latitude, Longitude, and Baro Setting are provided in electronic CSV format as attachment 1 to this report.

Submitted by:

Steven Smith
Mechanical Engineer (Recorder Specialist)

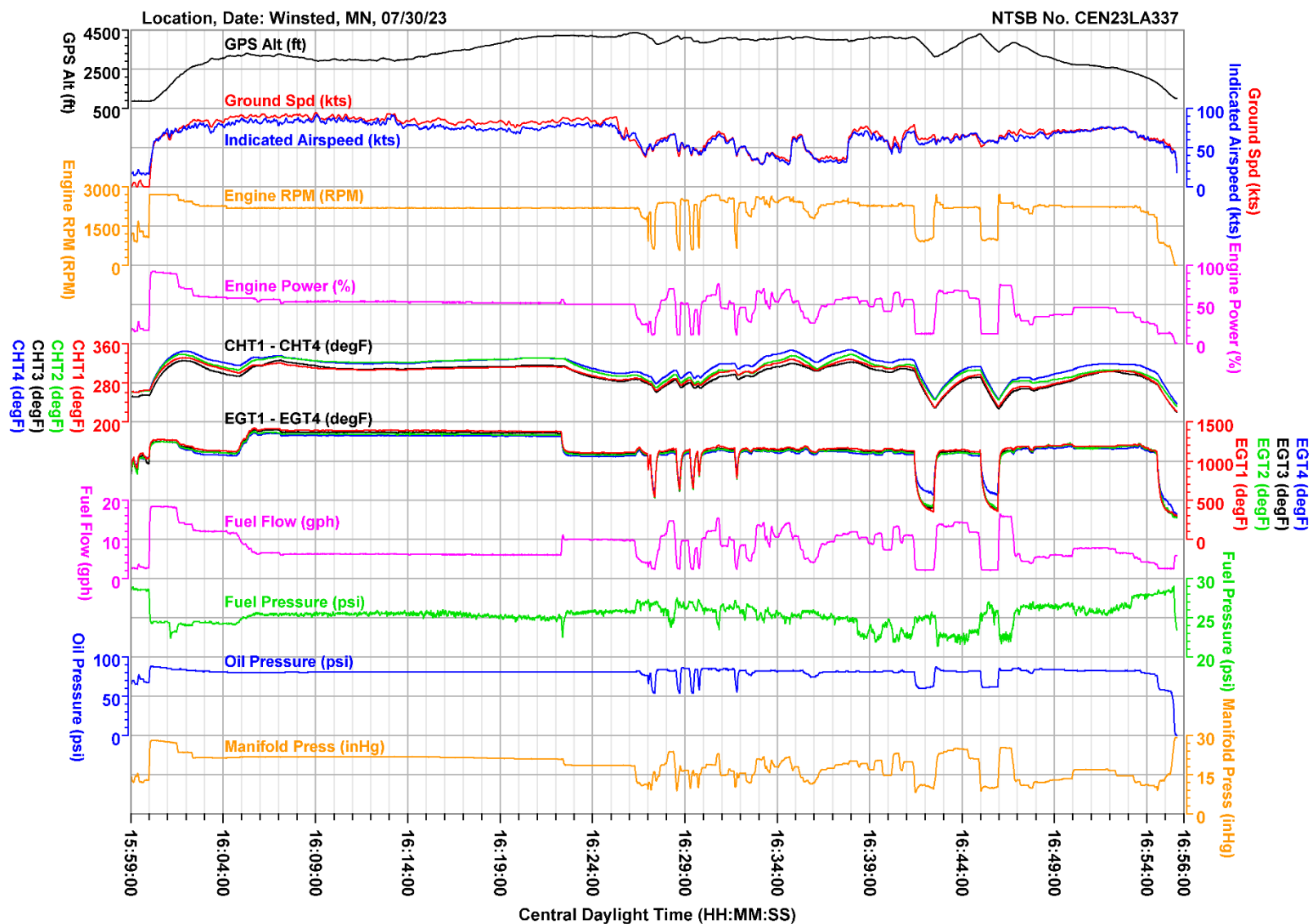


Figure 1. Time history plot of engine parameters for entire flight.

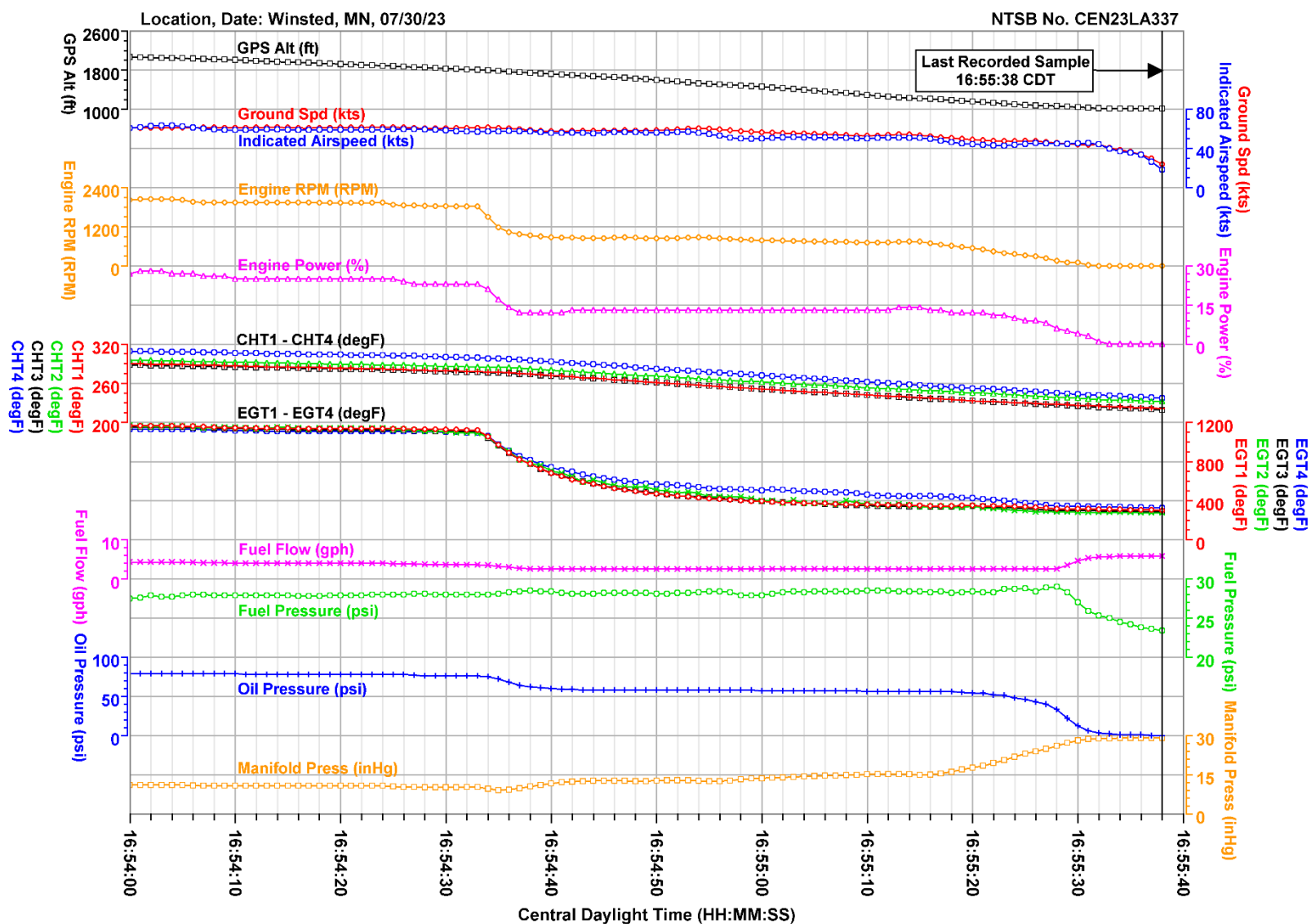


Figure 2. Time history plot of engine parameters for one minute forty second window surrounding the accident.

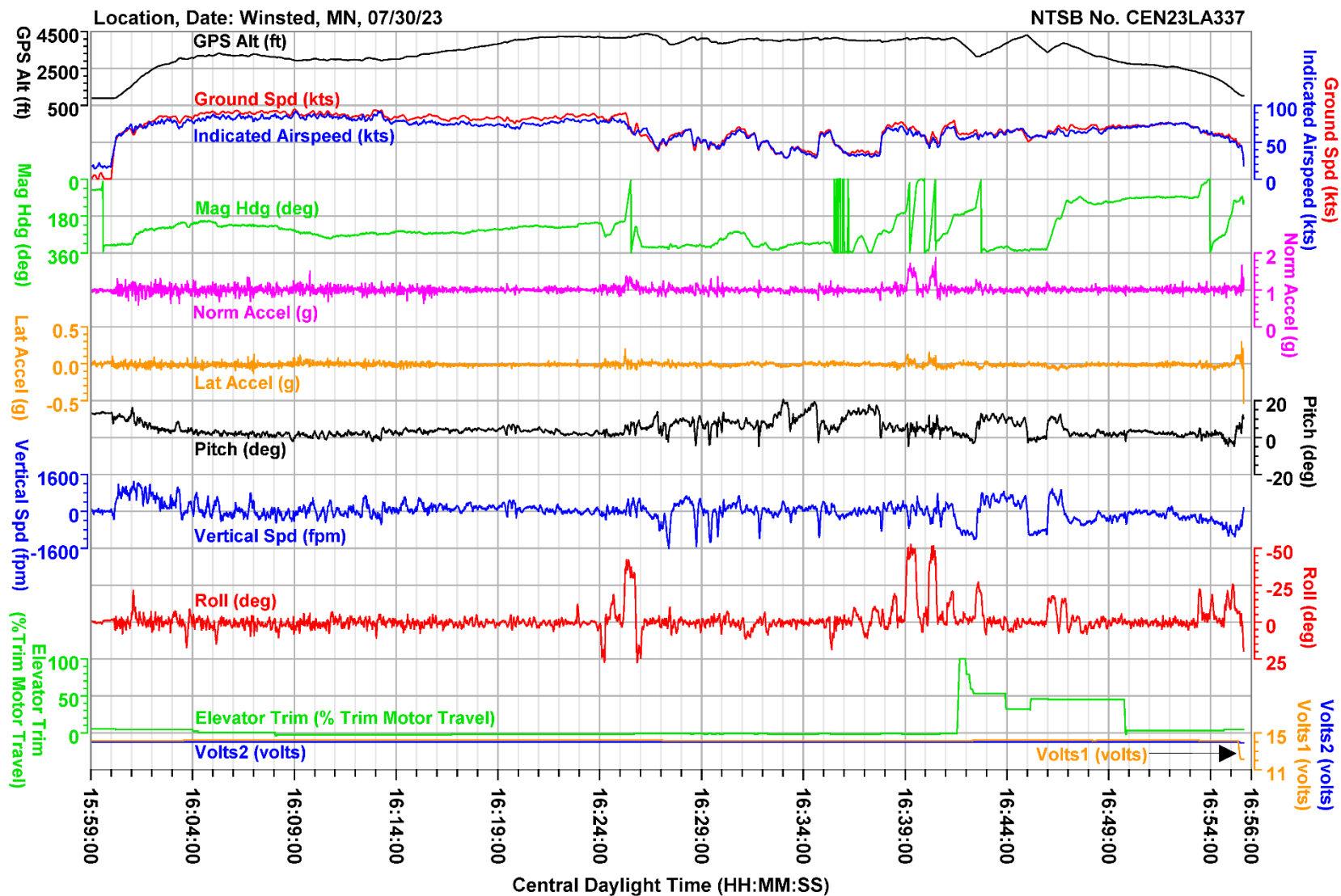


Figure 3. Time history plot of basic aerodynamic and engine parameters for the entire flight.

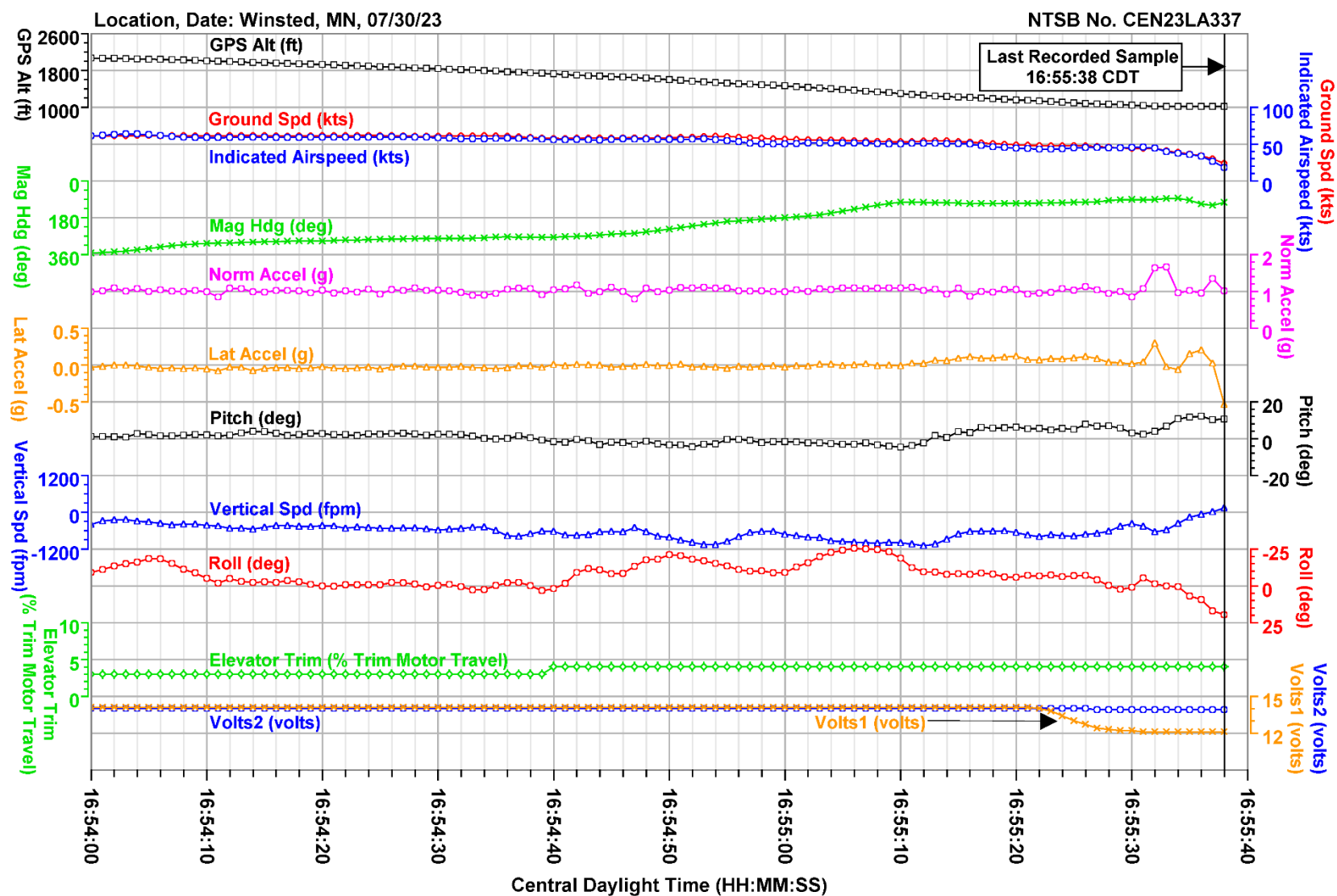


Figure 4. Time history plot of basic aerodynamic and engine parameters for one minute forty second windowing surrounding the accident.

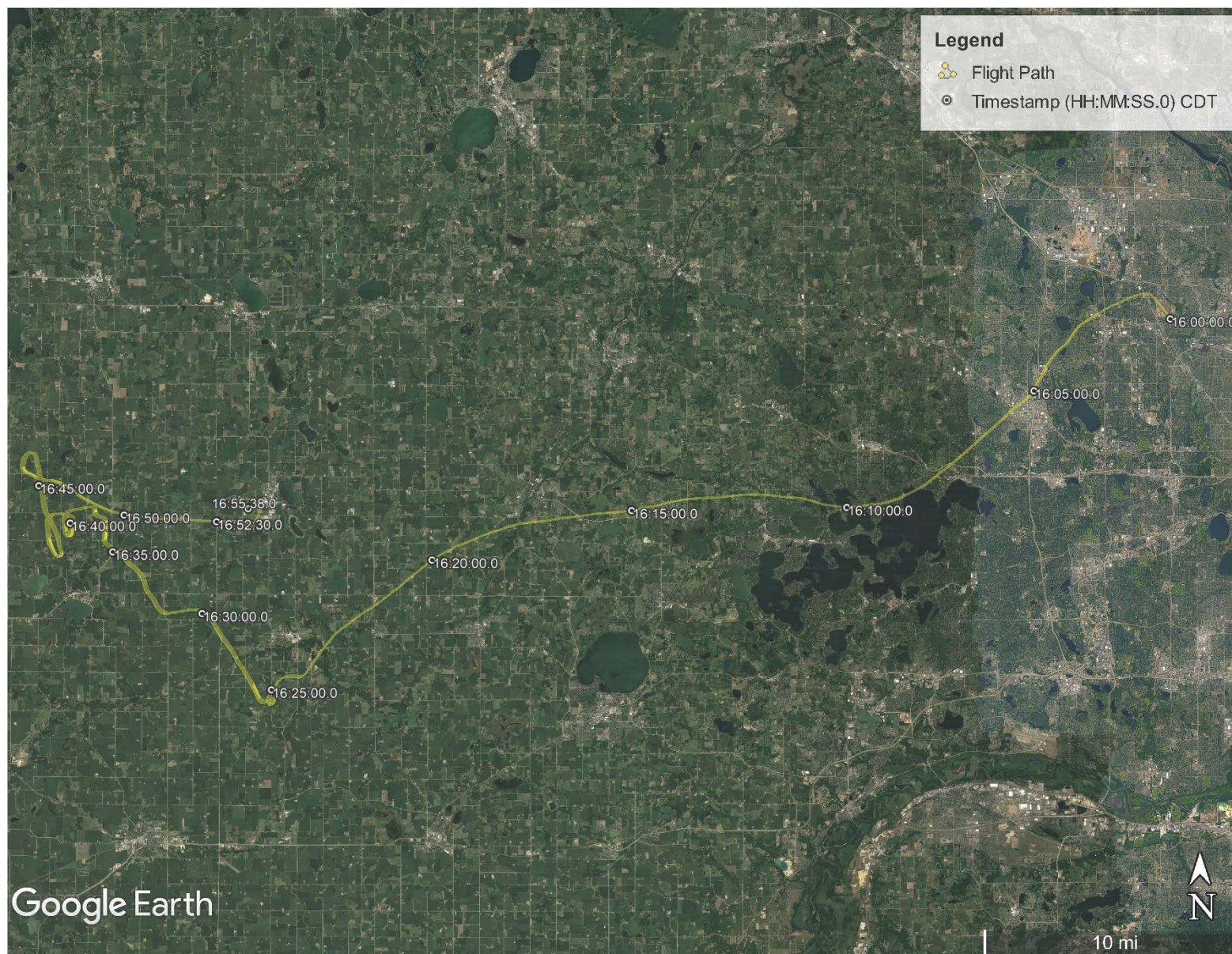


Figure 5. Google Earth overlay of the entire flight.

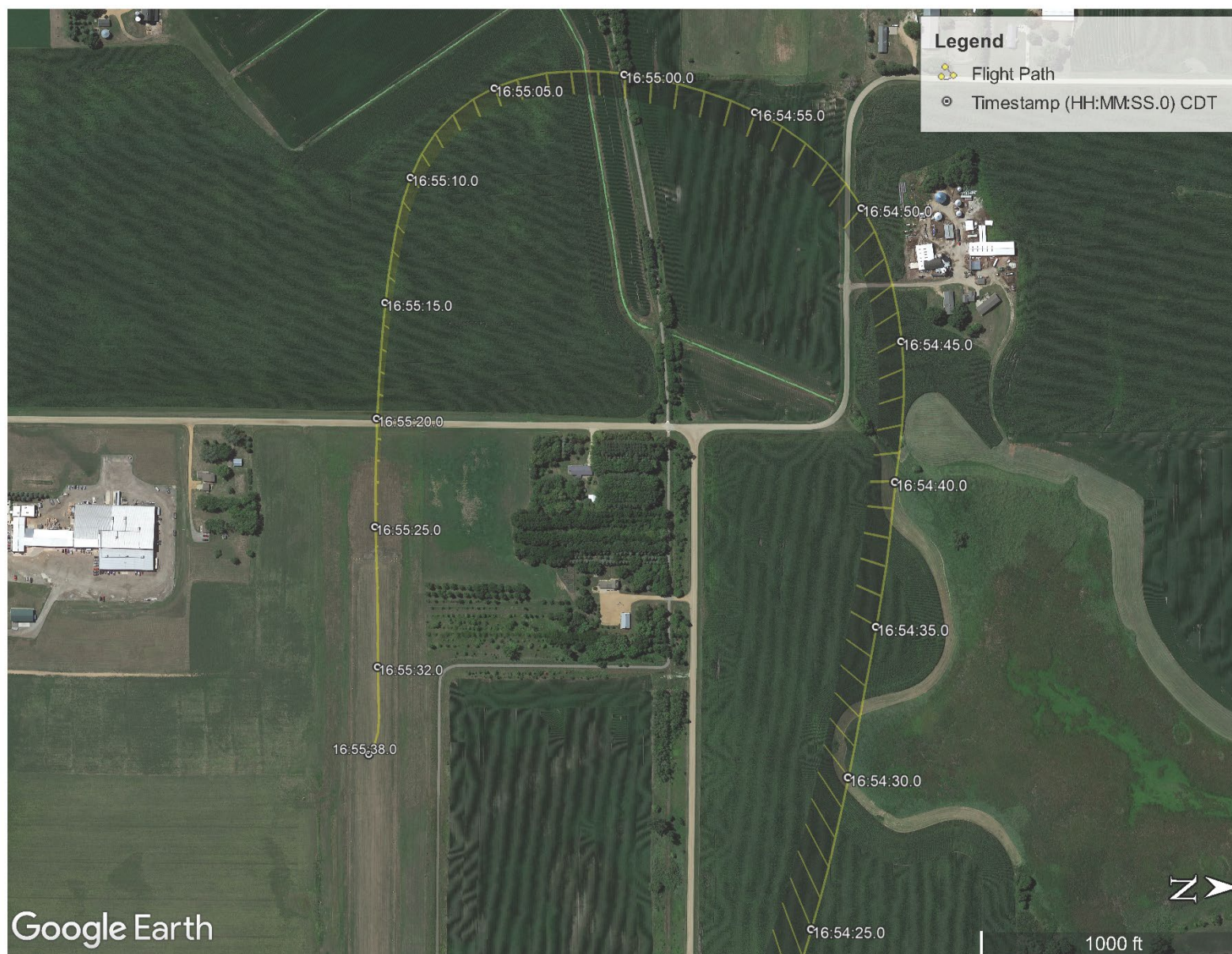


Figure 6. Google Earth overlay of the landing.

APPENDIX A. VERIFIED AND PROVIDED PARAMETERS G3X

This appendix describes the parameters provided and verified in this report. Table 1 lists the G3X parameters and table 2 describes the unit abbreviations used in this report for G3X parameters.

Table 1. Verified and provided parameters

Parameter Name	Parameter Description	Units
Baro Setting	Altimeter Barometric Setting	inHg
CHT # ²	Engine Cylinder Head Temperature	degF
EGT #	Engine Exhaust Gas Temperature	degF
Elevator Trim	Elevator Trim	% Trim Motor Travel
Engine Power	Engine Power	%
Engine RPM	Engine Revolutions per Minute	RPM
Fuel Flow	Engine Fuel Flow	gph
Fuel Pressure	Engine Fuel Pressure	psi
GPS Alt	GPS Altitude	ft
Ground Spd	Ground Speed	kts
Heading	Magnetic Heading	deg
IBBS IN USE	Integrated Battery Back-up System in Use	
IGN BACKUP	Ignition Back-up	
Indicated Airspeed	Indicated Airspeed	kts
L IGN OFF	Left Ignition Off	
Lat Accel	Lateral Acceleration	g
Latitude	Latitude	deg
Longitude	Longitude	deg
Mag Hdg	Magnetic Heading	deg
Manifold Press	Engine Manifold Pressure	inHg
Norm Accel	Normal Acceleration	g
Oil Pressure	Engine Oil Pressure	psi
Pitch	Pitch	deg
R IGN OFF	Right Ignition Off	
Roll	Roll	deg
Vertical Spd	Vertical Speed	fpm
Volts1	Main/Auxiliary Bus Power	V
Volts2	Main/Auxiliary Bus Power	V

² Depending on aircraft configuration, the number of cylinders that are instrumented varies. In the data plots, the “#” is replaced with the appropriate cylinder ID.

Table 2. Unit abbreviations

Unit Abbreviations	Descriptions
%	percent
deg	degrees
degF	Degrees Fahrenheit
ft	feet
gph	gallons per hour
inHg	inches of Mercury
kts	knots
psi	pounds per square inch
RPM	revolutions per minute
V	Volts DC