

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



CEN22FA111

COCKPIT DISPLAY - RECORDED FLIGHT DATA

Specialist's Factual Report

November 3, 2022

A. ACCIDENT

Location: Hutchinson, Minnesota
Date: January 31, 2022
Time: 1256 central standard time (CST)
Airplane: Cirrus Design SR22, Black Dog Aviation, LLC, N227BD

B. COCKPIT DISPLAY - RECORDED FLIGHT DATA SPECIALIST

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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 G1000 electronic data files from the N227BD aircraft.

1.0 Garmin G1000 Data 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.¹

Depending on the software installed, the display units 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 generates approximately 2 megabytes (MB) of data. The SD card typically used is 2 gigabyte (GB) in size and can store over 1,000 flight hours of data.

¹ Databases can include terrain data, obstacle data, SafeTaxi charts, flight charts and airport terrain databases

1.1 Garmin G1000 Data Description

The G1000 data contained flight data in individual flight logs starting from December 24, 2015, to the accident flight on January 31, 2022.

1.1.1 Garmin G1000 Data Engineering Unit Conversions

The flight log data in the individual files were provided in engineering units. Table 1 lists the parameters verified and provided in this report.

1.2 Garmin G1000 Data Time Correlation

The G1000 data provided was in local time, CST.

D. FIGURES AND TABULAR DATA

Figures 1 to 6 contain the G1000 data recorded during the event on January 31, 2022. All the parameters listed in table 1 are plotted. Figures 1 to 3 cover the entire flight from 11:15:00 CST to the end of the data at 12:56:30 and figures 4 to 6 focuses on the end of the flight from 12:44:00 CST to 12:56:30 CST. Figures 1 and 4 contain the basic parameters, figures 2 and 5 contain engine parameters, and lastly, figures 3 and 6 contain select basic parameters and engine parameters.

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 G1000 data indicated the aircraft took off at about 11:45:20 CST and 1 hour, 11 minutes and 10 seconds later at 12:56:30 CST the data ended.

The corresponding tabular data used to create figures 1 to 6 are provided in electronic comma separated value (CSV) format as attachment 1 to this report.

Submitted by:

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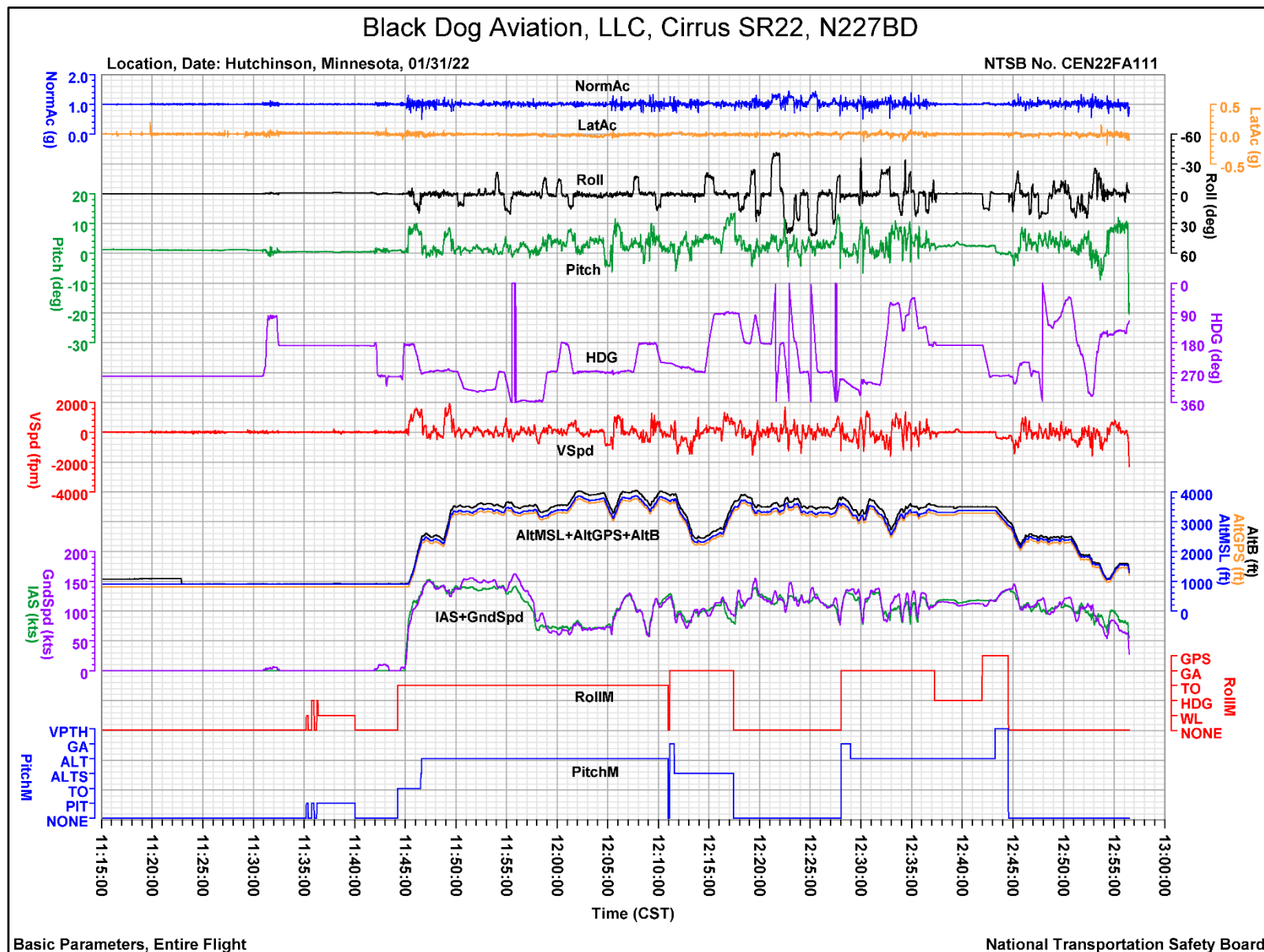


Figure 1. Plot of basic parameters for the entire flight from 11:15:00 to the end of the data at 12:56:30

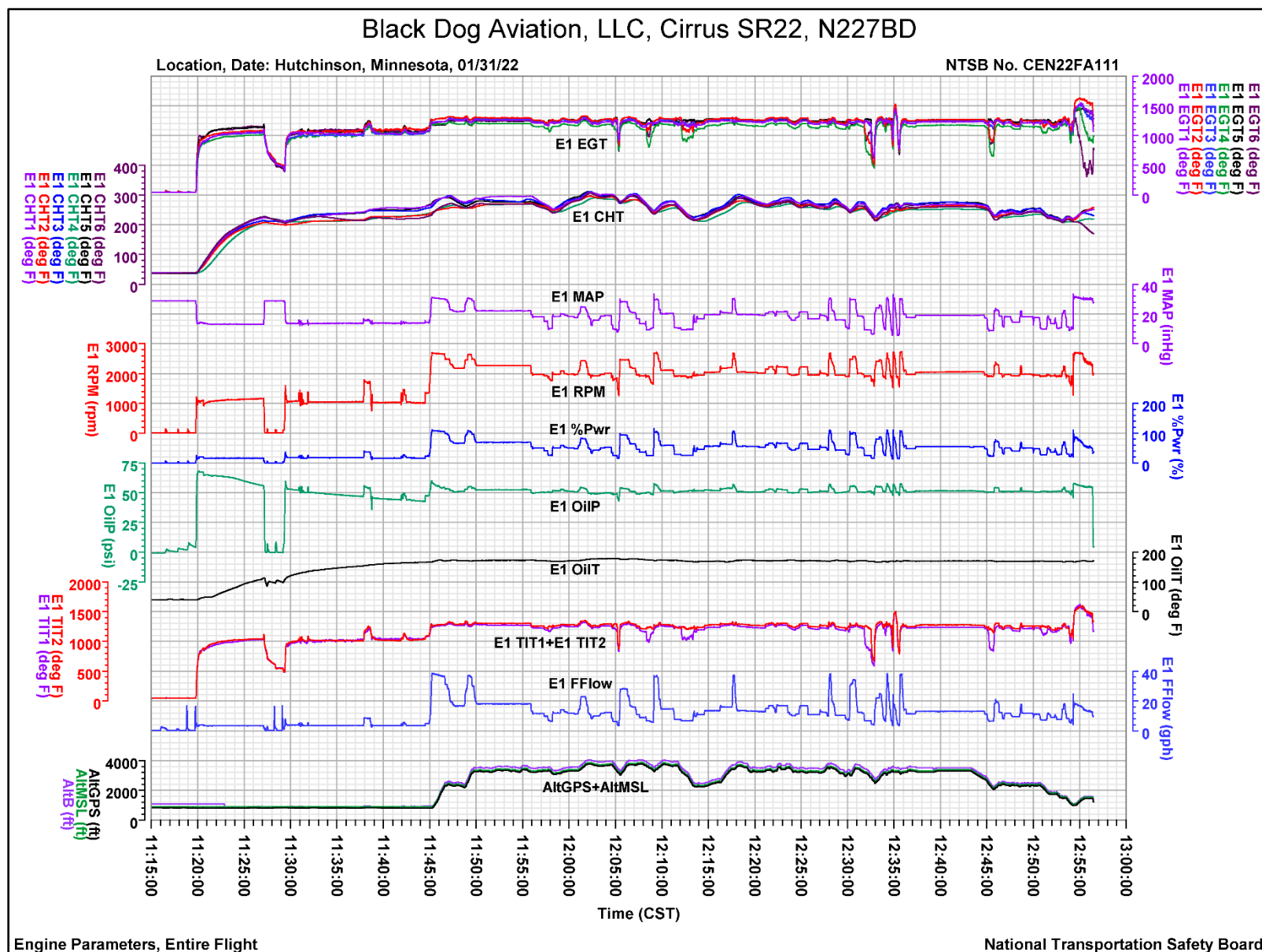


Figure 2. Plot of engine parameters for the entire flight from 11:15:00 to the end of the data at 12:56:30

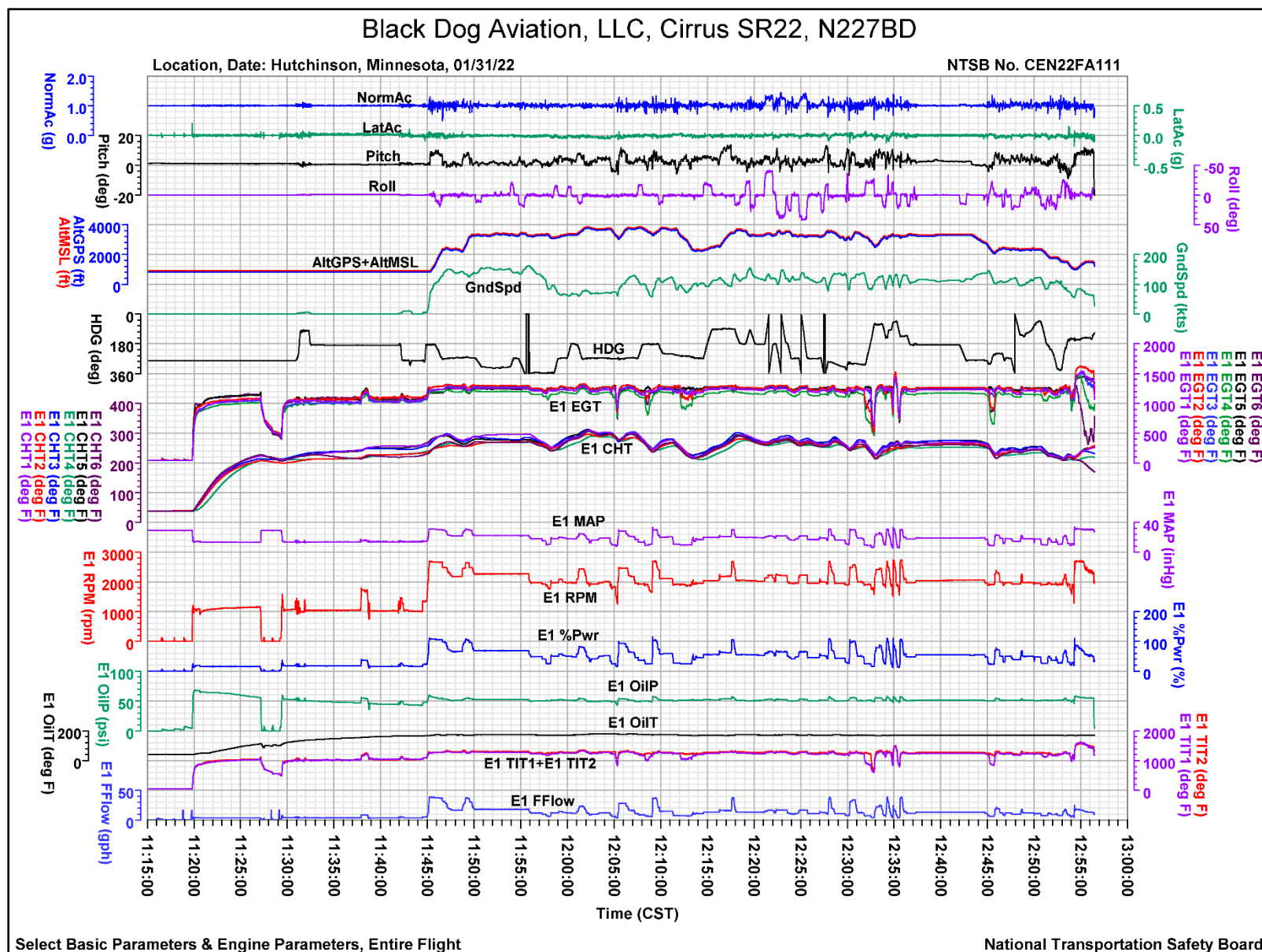


Figure 3. Plot of select basic parameters and engine parameters for the entire flight from 11:15:00 to the end of the data at 12:56:30

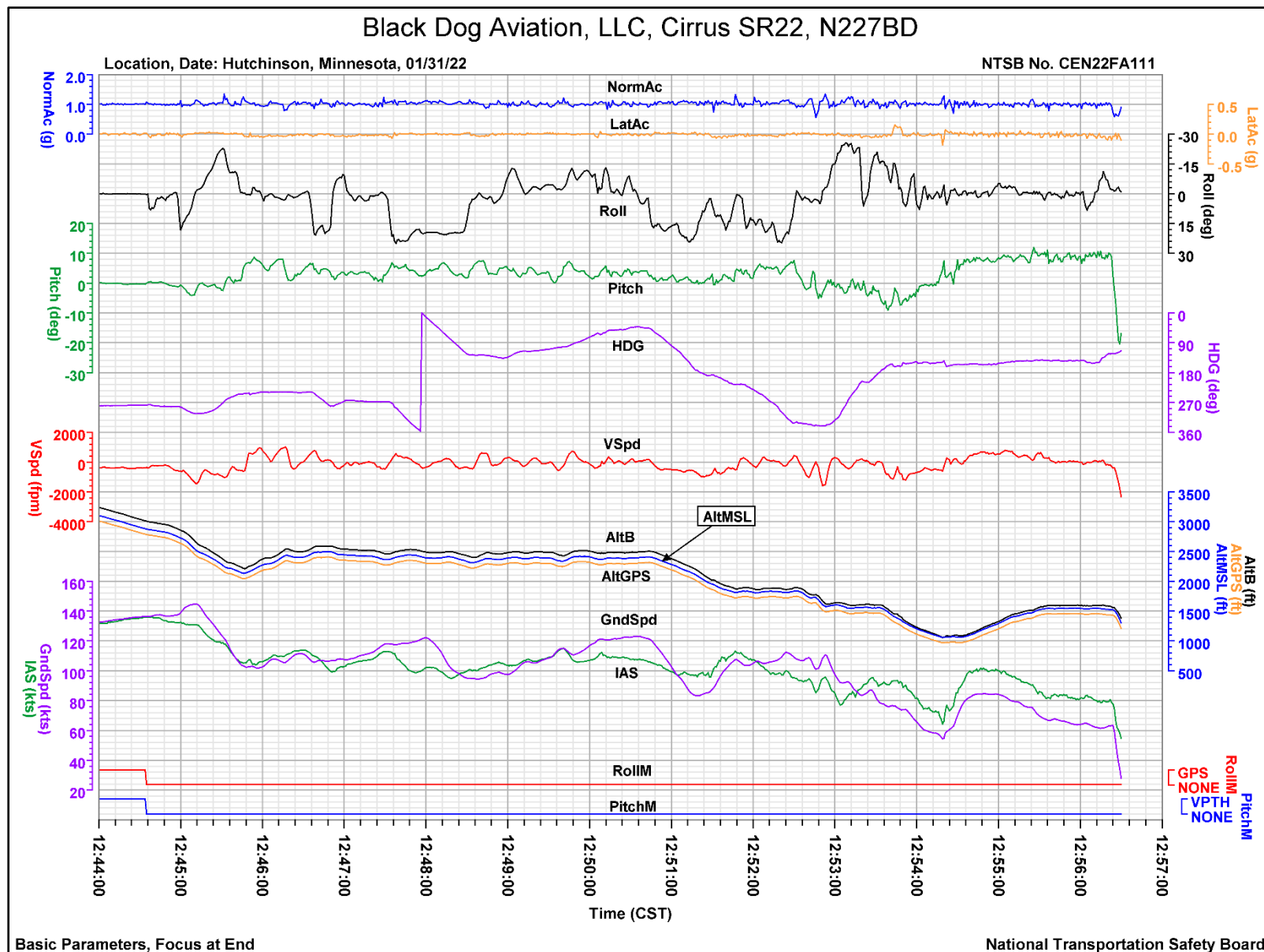


Figure 4. Plot of basic parameters focus on end of flight from 12:44:00 to the end of the data at 12:56:30

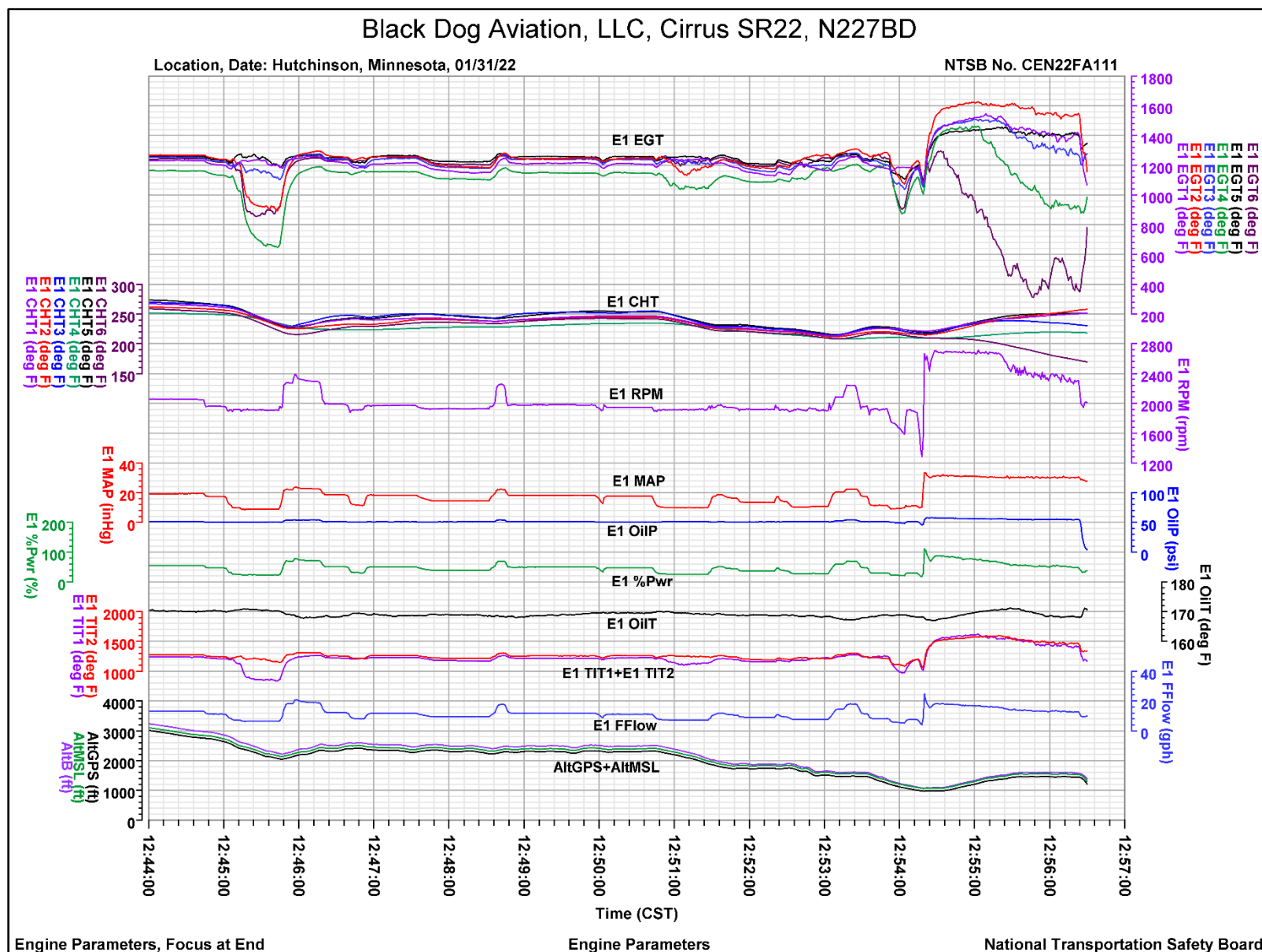


Figure 5. Plot of engine parameters focus on end of flight from 12:44:00 to the end of the data at 12:56:30

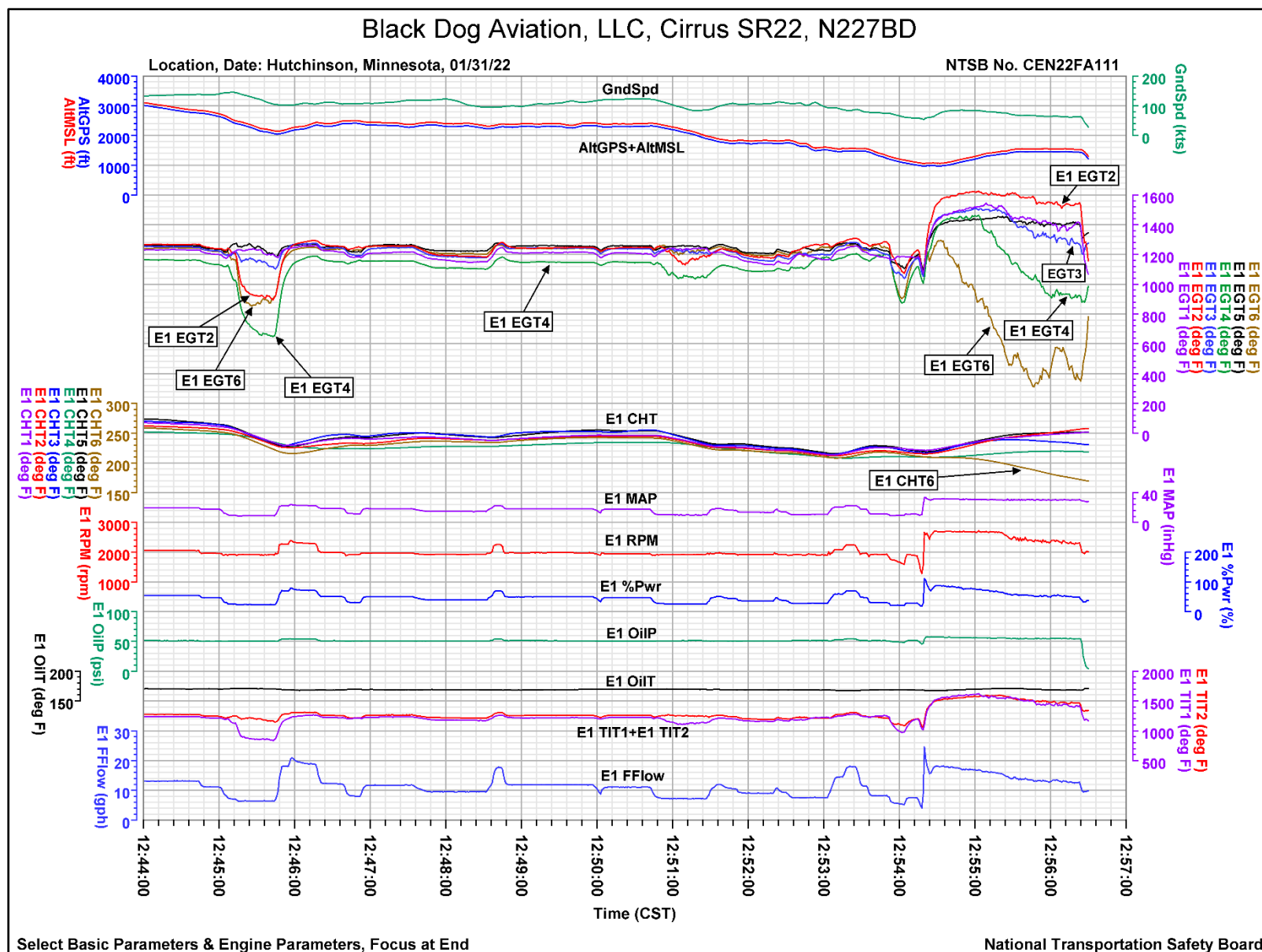


Figure 6. Plot of select basic parameters and engine parameters focus on end of flight from 12:44:00 to the end of the data at 12:56:30

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. Additionally, tables 3 and 4 describes the pitch mode abbreviations and the roll mode abbreviations, respectively.

Table 1. Verified and provided parameters

Parameter Name	Parameter Description	Units
AltB	Barometric Altitude	ft
AltGPS	GPS Altitude	ft
AltMSL	Mean Sea Level Pressure Altitude	ft
E1 %Pwr	Engine Percent Power	%
E1 CHT1	Engine Cylinder Head Temperature Cylinder 1	deg F
E1 CHT2	Engine Cylinder Head Temperature Cylinder 2	deg F
E1 CHT3	Engine Cylinder Head Temperature Cylinder 3	deg F
E1 CHT4	Engine Cylinder Head Temperature Cylinder 4	deg F
E1 CHT5	Engine Cylinder Head Temperature Cylinder 5	deg F
E1 CHT6	Engine Cylinder Head Temperature Cylinder 6	deg F
E1 EGT1	Engine Exhaust Gas Temperature Cylinder 1	deg F
E1 EGT2	Engine Exhaust Gas Temperature Cylinder 2	deg F
E1 EGT3	Engine Exhaust Gas Temperature Cylinder 3	deg F
E1 EGT4	Engine Exhaust Gas Temperature Cylinder 4	deg F
E1 EGT5	Engine Exhaust Gas Temperature Cylinder 5	deg F
E1 EGT6	Engine Exhaust Gas Temperature Cylinder 6	deg F
E1 FFlow	Engine Fuel Flow	gph
E1 MAP	Engine Manifold Pressure	inHg
E1 OilP	Engine Oil Pressure	psi
E1 OilT	Engine Oil Temperature	deg F
E1 RPM	Engine Revolutions per minute	rpm
E1 TIT1	Engine Turbine Inlet Temperature-1	deg F
E1 TIT2	Engine Turbine Inlet Temperature-2	deg F
GndSpd	Groundspeed	kts
HDG	Magnetic Heading	deg
IAS	Indicated Airspeed	kts
LatAc	Lateral Load Factor	g
NormAc	Vertical Load Factor	g
Pitch	Pitch Angle	deg
PitchM	Autopilot Pitch Mode	
Roll	Roll Angle	deg
RollM	Autopilot Roll Mode	
VSpd	Vertical Speed	fpm

Note: The Garmin 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.

Note: Parameters with a blank unit description in table 1 are discretes. A discrete is typically a 1-bit parameter that is either a 0 state or a 1 state where each state is uniquely defined for each parameter.

Table 2. Unit abbreviations

Unit Abbreviations	Descriptions
%	percent
deg	degrees
deg F	degrees Fahrenheit
fpm	feet per minutes
ft	feet
g	unit of gravitation acceleration
gph	gallons per hour
inHg	inches of mercury
kts	knots
psi	pounds per square inch
rpm	revolutions per minute

Table 3. Pitch Mode Abbreviations

Abbreviations	Descriptions
ALT	Altitude Hold
ALTS	Selected Altitude Capture
GA	Go Around
PIT	Pitch Hold
TO	Takeoff
VPTH	Vertical Path Tracking

Table 4. Roll Mode Abbreviations

Abbreviations	Descriptions
GA	Go Around
GPS	Navigation Global Positioning System
HDG	Heading Select
TO	Takeoff
WL	Wings Level