

NATIONAL TRANSPORTATION SAFETY BOARD
Vehicle Recorder Division
Washington, D.C. 20594

September 25, 2020

Electronic Flight Instrument System (EFIS)

Specialist's Factual Report
By Sean Payne

1. EVENT SUMMARY

Location: Charleston, SC
Date: March 21, 2020
Aircraft: Cessna 310
Registration: N8080M
Operator: Private
NTSB Number: ERA20LA132

On March 21, 2020, about 1859 eastern daylight time, a Cessna 310, N8080M, was substantially damaged when it was involved in an accident in Charleston, South Carolina. The pilot was fatally injured. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 personal flight.

2. DETAILS OF INVESTIGATION

The National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following Electronic Flight Instrument System (EFIS).

Recorder Manufacturer/Model: **Garmin GDU 1060 (G500 TXi)**
Recorder Serial Number: **3M5001661**

2.1. Garmin GDU 1060 Description

The Garmin GDU 1060 is marketed under the TXi product line. The GDU-1060 is a versatile Electronic Flight Instrument System (EFIS) that can serve as a primary flight display (PFD), Multi-Function Display (MFD), Engine Information System (EIS), or a combination of all, depending on configuration. The unit comes in a variety of display sizes and orientations and utilizes a color, touch-screen interface. The unit contains an Attitude Heading Reference System (AHRS) device and is capable of providing attitude information and air data information. The unit interfaces with a number of other compatible products and can display navigation, terrain, engine, weather, traffic and other parametric data streams. The unit is synthetic vision capable.

The unit records internally to a non-volatile memory (NVM) chip on an internal board, as well as externally, on a SD card (if installed).¹

¹ Non-volatile Memory (NVM) – Semi-conductor memory that does not need power applied to retain data.

2.1.1. Data Recovery

The recorder was damaged in the event. The extent of the damage is shown in figure 1. Data was extracted from one of the unit's SD card which was installed in the PFD during the accident flight. The SD card contained the flight data. Additionally, the device was sent to the manufacturer for a retrieval of the unit's internal data contents. The manufacturer was unable to retrieve the internal data.



Figure 1. Damaged exterior of damaged EFIS.

2.1.2. Data Description

The EFIS recording contained a number of data recordings over a number of different power cycles. The event flight was the last flight of the recording and its duration was approximately one and a half hours.

2.1.3. Engineering Units Conversions

The engineering units conversions used for the data contained in this report are based on documentation from the manufacturer of the PFD. In general, the units are associated with each data parameter by the device when the data is extracted.

Appendix A lists the PFD parameters verified and provided in this report.

2.2. Time Correlation

The EFIS records time with the first data sample based on the units' internal clock. The internal clock is based on GPS information. The unit auto-offsets the device's time to the local time.

The local time of this accident was eastern daylight time (EDT). Therefore, for the rest of this report, all times are referenced as EDT, not recorded time.

2.3. Plots and Corresponding Tabular Data

The following seven figures contain EFIS data recorded during the March 21, 2020, event.

Figure 2 is a Google Earth depiction of the route of flight for the entire accident recording.

Figure 3 is a Google Earth depiction of the aircraft's descent to the accident location.

Figure 4 is a detailed Google Earth depiction of the aircraft's descent to the accident location, zoomed in to the accident site.

Figure 5 is a detailed view of the aircraft's ground and altitude track in the immediate vicinity of the accident site. Note the wreckage location is subject to GPS errors of the collection device.

Figure 6 is a plot of selected recorded parameters from the entire accident flight, between 17:30 EDT and 19:00 EDT.

Figure 7 is an expanded time range plot of selected recorded parameters between 18:45 EDT and 19:00 EDT.

Figure 8 is plot of selected recorded parameters, including EGT and CHT values for an expanded time range between 18:45 EDT and 19:00 EDT.

The corresponding tabular data used to create these seven graphics are provided in electronic (*.csv²) format as Attachment 1 to this report. The attachment contains additional parameters that were recorded by the unit during the accident flight. Only parameters that appear in table A1 have been validated by the specialist.

² Comma Separated Value format.

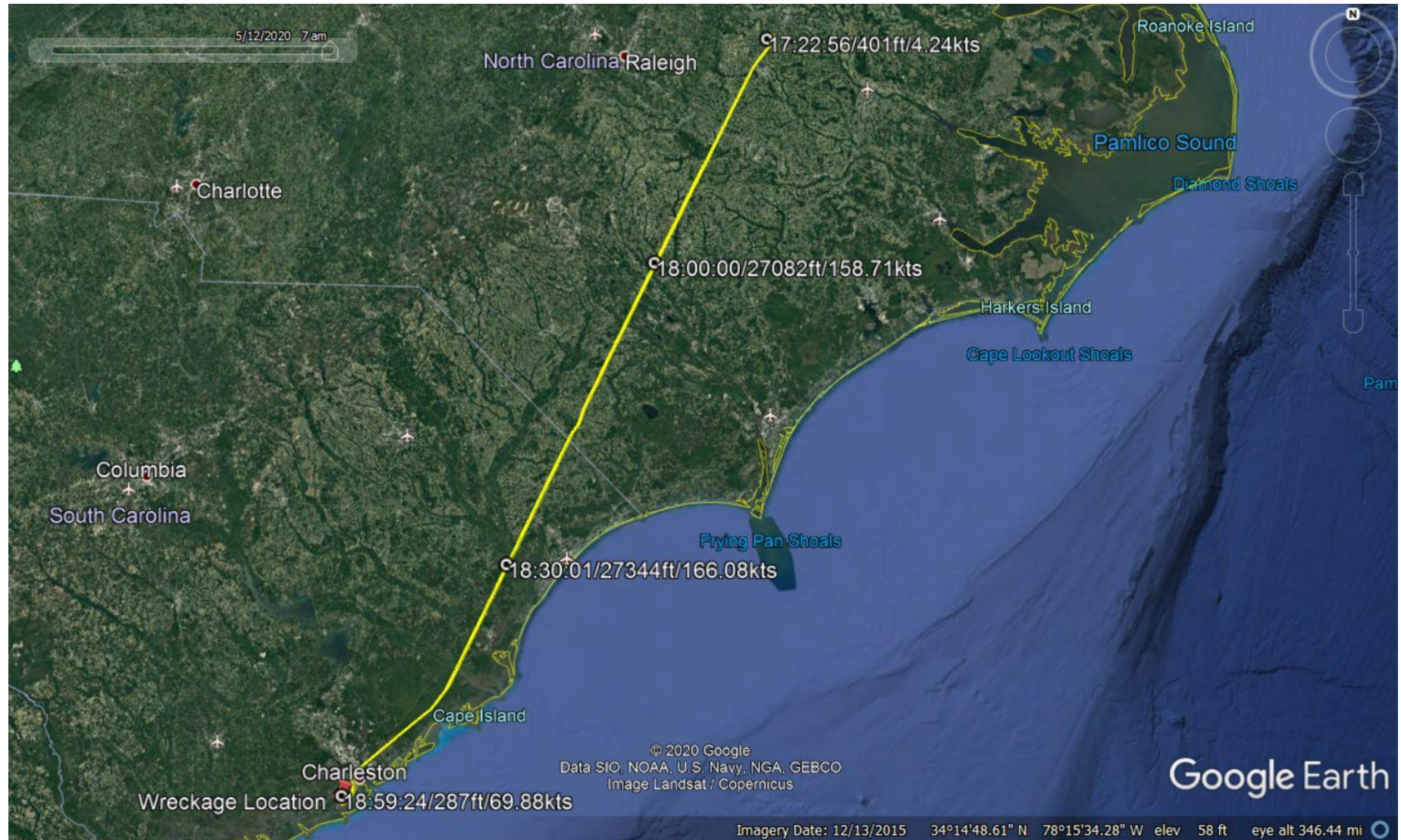


Figure 2. A Google Earth depiction of the route of flight for the entire accident recording.

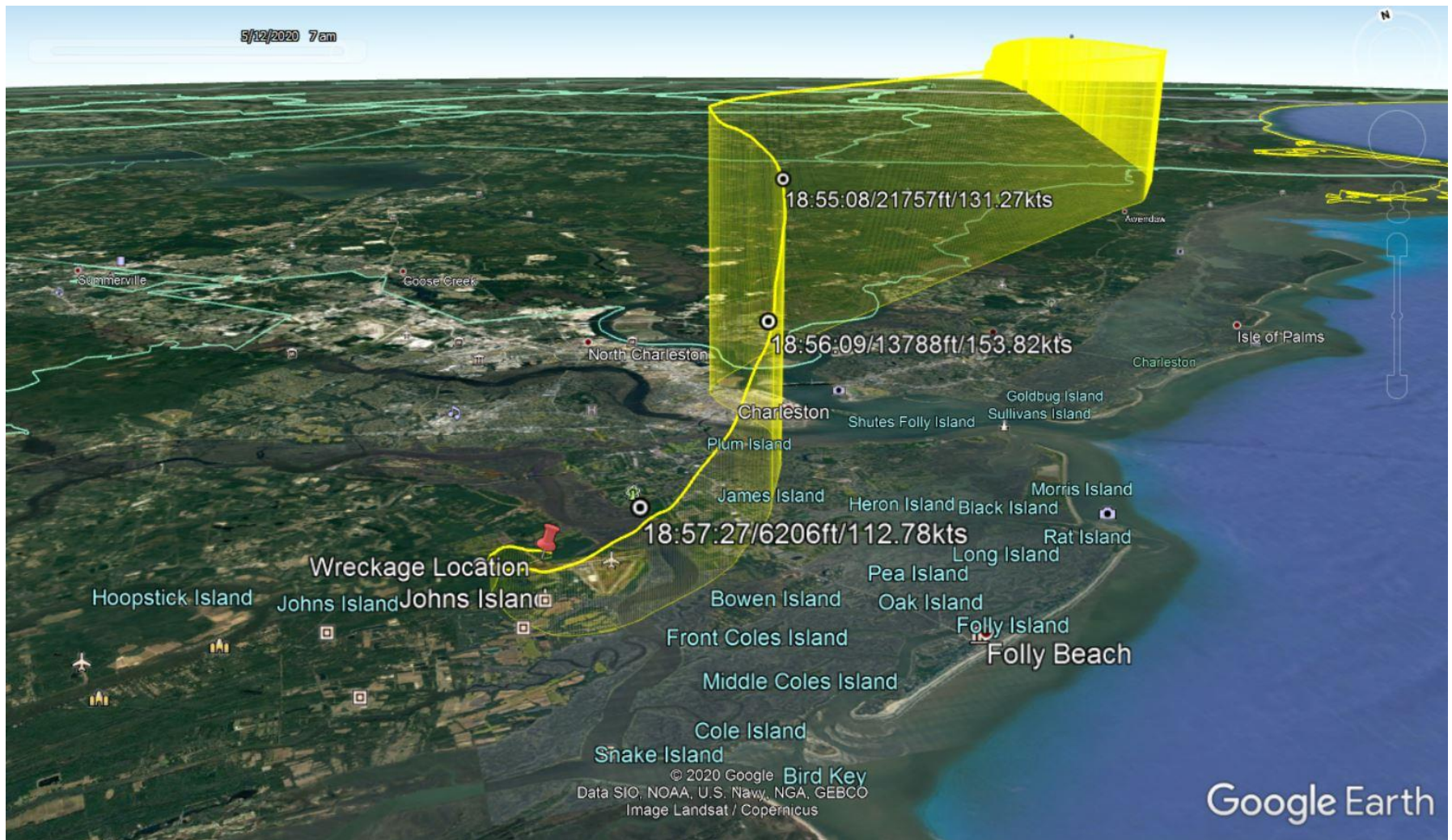


Figure 3. A Google Earth depiction of the aircraft's descent to the accident location.



Figure 4. A detailed Google Earth depiction of the aircraft's descent to the accident location, zoomed in to the accident site.



Figure 5. A detailed view of the aircraft's ground and altitude track in the immediate vicinity of the accident site. Note the wreckage location is subject to GPS errors of the collection device.

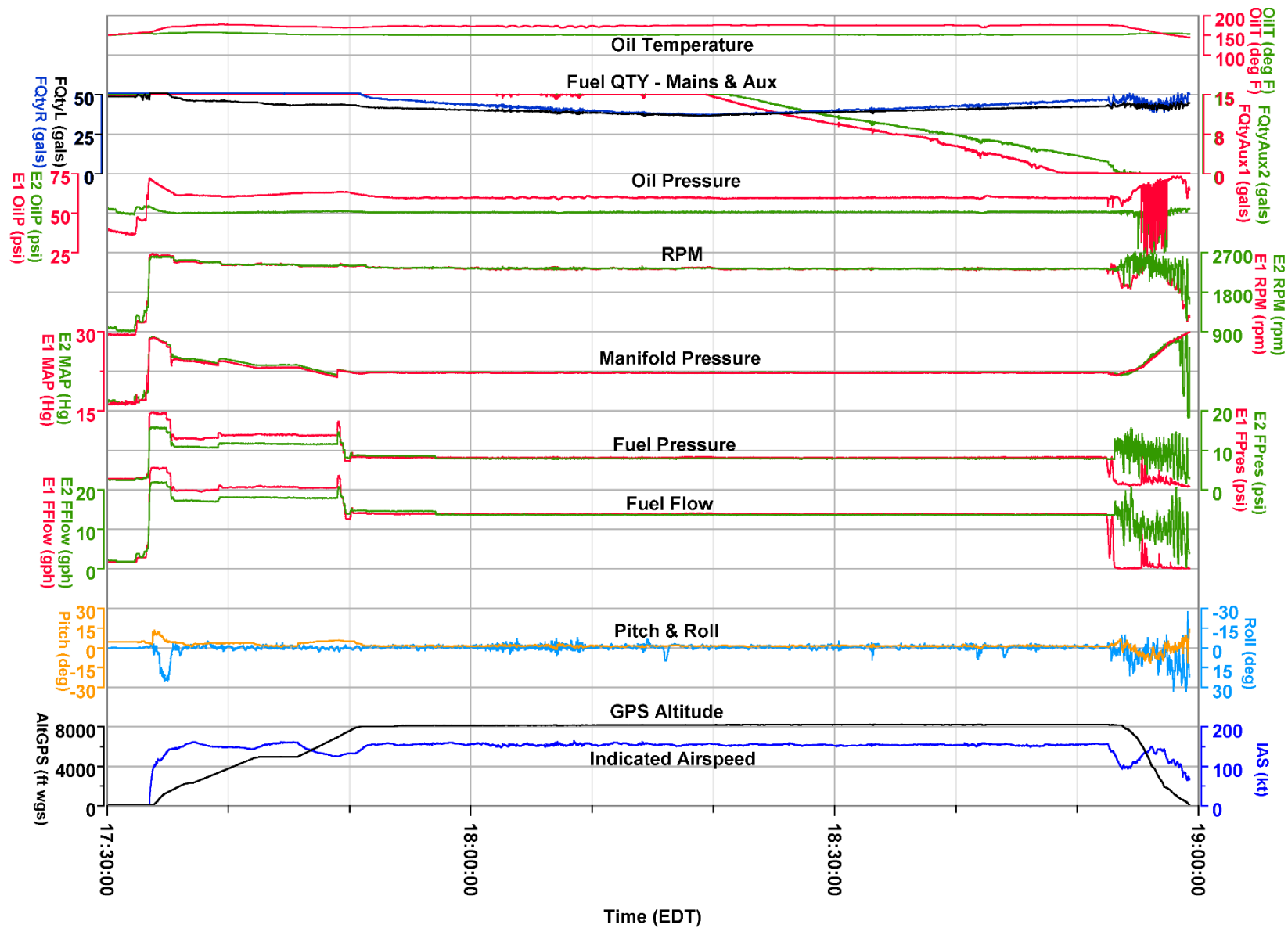


Figure 6. A plot of selected recorded parameters from the entire accident flight, between 17:30 EDT and 19:00 EDT.

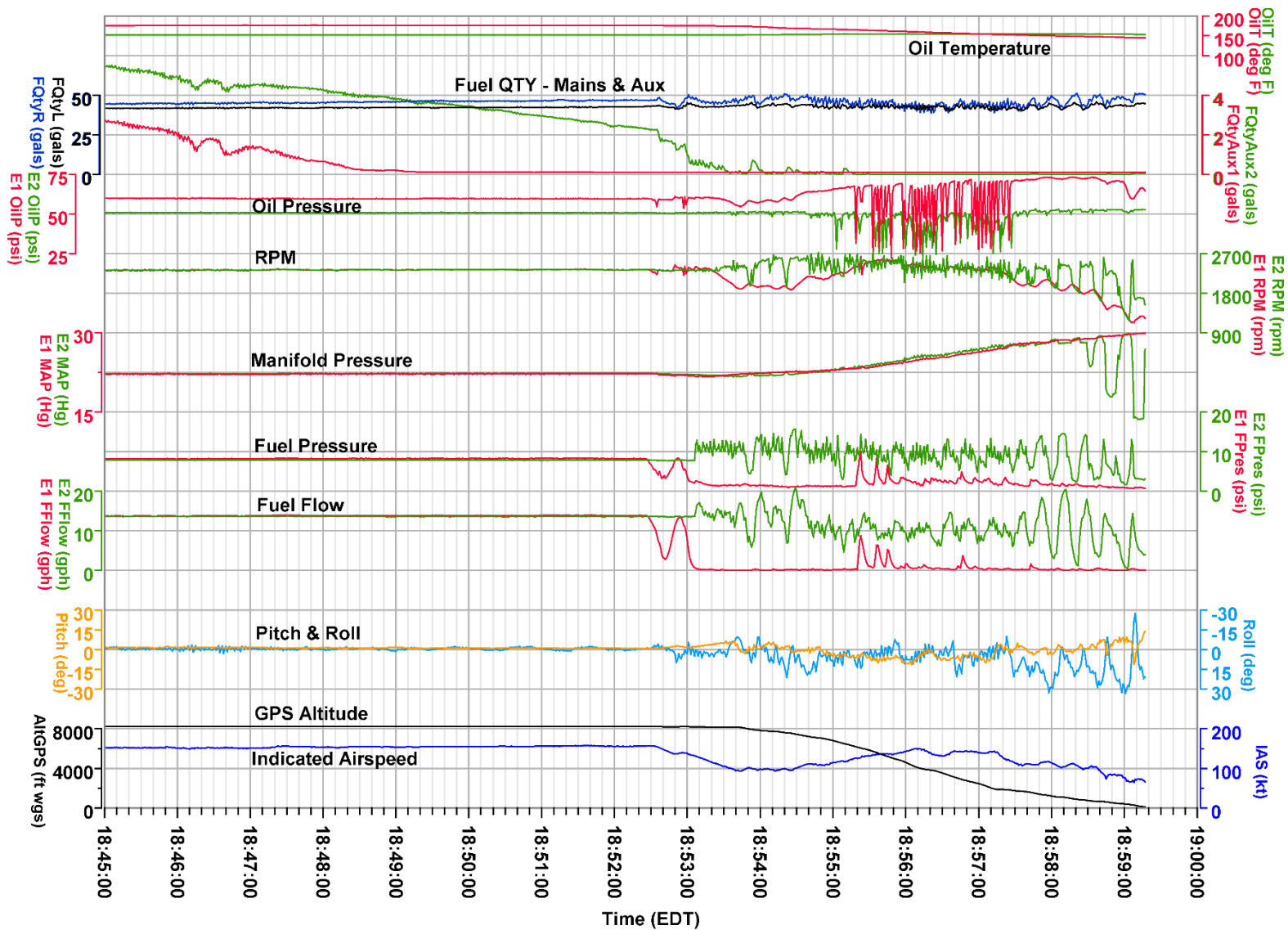


Figure 7. An expanded time range plot of selected recorded parameters between 18:45 EDT and 19:00 EDT.

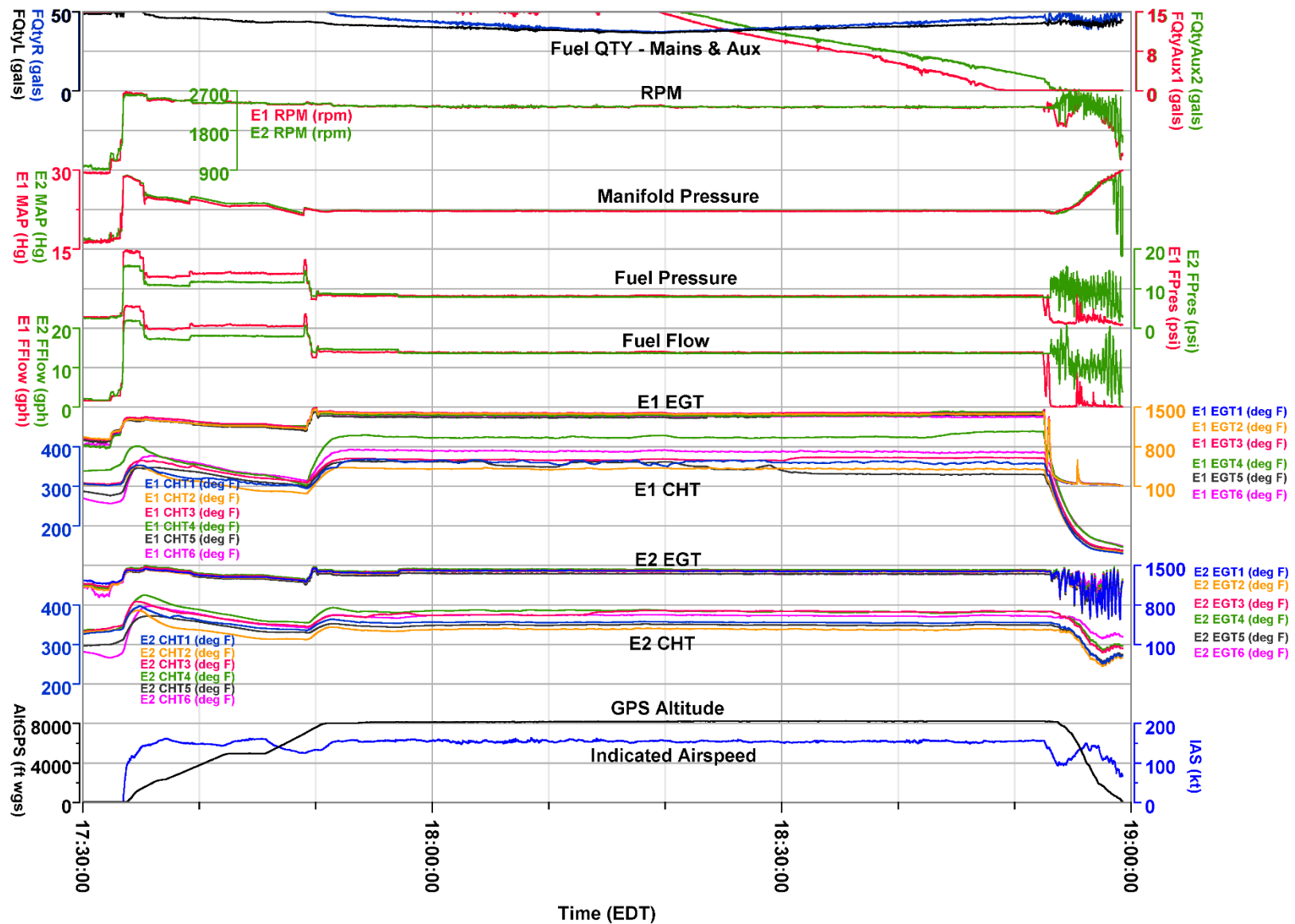


Figure 8. A plot of selected recorded parameters, including EGT and CHT values, from the entire accident flight, between 17:30 EDT and 19:00 EDT.

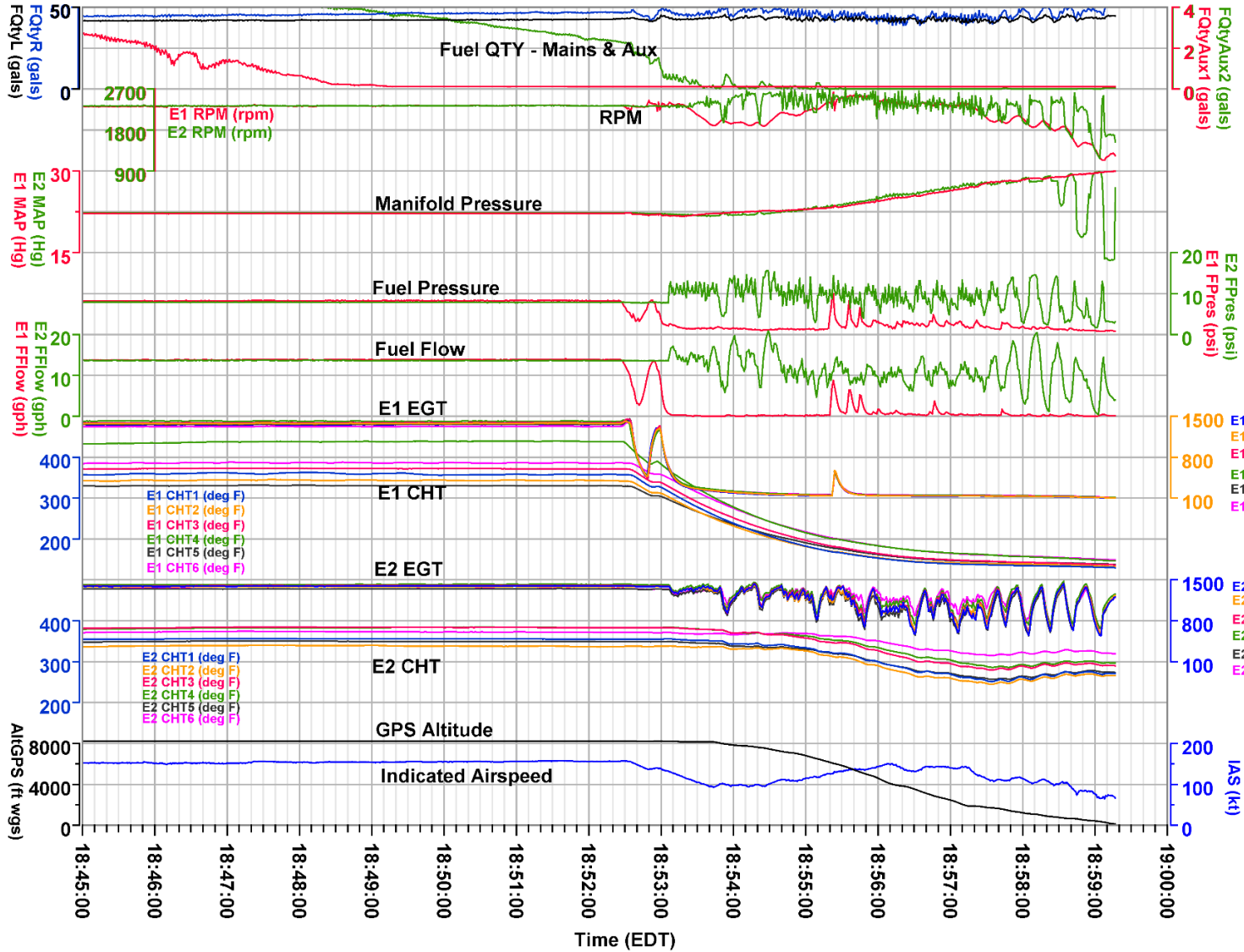


Figure 9. A plot of selected recorded parameters, including EGT and CHT values for an expanded time range between 18:45 EDT and 19:00 EDT.

APPENDIX A

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

Table A-1. Verified and provided parameters for Garmin GDU-1060.

Parameter Name	Parameter Description
1. FQtyAux1 (gal)	Left Auxiliary Fuel Tank Level (Left Wing Tank)
2. FQtyAux2 (gal)	Right Auxiliary Fuel Tank Level (Right Wing Tank)
3. FQtyL (gal)	Left Main Tank Fuel Level (Left Tip Tank)
4. RQtyL (gal)	Right Main Tank Fuel Level (Right Tip Tank)
5. Eng1 CHT-# (deg)	Left Cylinder Head Temperature Cylinder # ³
6. Eng1 EGT-# (deg)	Left Exhaust Gas Temperature Cylinder #
7. Eng1 Fuel Flow (gph)	Left Engine Fuel Flow
8. Eng1 Fuel Press (psi)	Left Engine Fuel Pressure
9. Eng1 MAP (inHg)	Left Engine Manifold Pressure
10. Eng1 Oil Press (psi)	Left Engine Oil Pressure
11. Eng1 Oil Temp (deg)	Left Engine Oil Temperature
12. Eng1 RPM (rpm)	Left Engine Revolutions per minute
13. Eng2 CHT-# (deg)	Right Cylinder Head Temperature Cylinder #
14. Eng2 EGT-# (deg)	Right Exhaust Gas Temperature Cylinder #
15. Eng2 Fuel Flow (gph)	Right Engine Fuel Flow
16. Eng2 Fuel Press (psi)	Right Engine Fuel Pressure
17. Eng2 MAP (inHg)	Right Engine Manifold Pressure
18. Eng2 Oil Temp (deg)	Right Engine Oil Temperature
19. Eng2 RPM (rpm)	Right Engine Revolutions per minute
20. GPS Altitude	GPS Altitude
21. Indicated Airspeed	Indicated Airspeed
22. Latitude (deg)	Latitude
23. Longitude (deg)	Longitude
24. Pitch	Pitch
25. Roll	Roll

Table A-2. Unit abbreviations.

Units Abbreviation	Description
deg F	degrees Fahrenheit
ft	feet
gal	gallons
gph	gallons per hour
kts	knots
psi	pounds per square inch
rpm	revolutions per minute
sec	seconds

NOTE: For parameters with a unit description of discrete, 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.

³ Depending on aircraft configuration number of cylinders that are instrumented varies. In the data plots the '#' is replaced with the appropriate cylinder ID.