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

April 4, 2017

Cockpit Display(s) – Recorded Flight Data

Specialist's Factual Report
By James Cash

1. EVENT SUMMARY

Location: Houston, Texas
Date: June 09, 2016
Aircraft: Cirrus SR22
Registration: N4252G
Operator: Private
NTSB Number: CEN16FA211

On June 9, 2016, about 1309 central daylight time, a Cirrus SR20 single-engine airplane, N4252G, was substantially damaged after it impacted terrain following a loss of control during initial climb at the William P. Hobby Airport (HOU), Houston, Texas. The pilot and the two passengers were fatally injured. The airplane was registered to and operated by Safe Aviation, LLC, Moore, Oklahoma, as a 14 Code of Federal Regulations Part 91 business flight. Visual meteorological conditions (VMC) prevailed and a visual flight rules (VFR) flight plan had been filed. The airplane had departed from University of Oklahoma Westheimer Airport (OUN), Norman, Oklahoma, about 1000 and was destined for HOU.

2. RECORDED FLIGHT DATA GROUP

A recorded flight data group was not convened.

3. DETAILS OF INVESTIGATION

The National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following devices:

Recorder Manufacturer/Model: SD Memory Card removed from a Garmin G-1000 MFD Display Top Slot

Recorder Manufacturer/Model: SD Memory Card removed from a Garmin G-1000 MFD Display Bottom Slot

Recorder Manufacturer/Model: SD Memory Card removed from a Garmin G-1000 Display labeled Chart Unlock

Recorder Manufacturer/Model: SD Memory Card removed from a Garmin G-1000 Display labeled Chart Unlock

Recorder Manufacturer/Model: SD Memory Card removed from a Garmin G-1000 Display labeled Enhanced AFCS Unlock

Recorder Manufacturer/Model: SD Memory Card removed from a Garmin G-1000 Display labeled Supplemental Data

Recorder Manufacturer/Model: SD Memory Card removed from a Garmin G-1000 Display labeled TAWS Unlock

Recorder Manufacturer/Model: Heads Up Technologies RDM
Recorder Serial Number: 8680

3.1. Garmin G1000 SD Data Card 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 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 display unit software, the aircraft 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 can be stored in approximately 2 MB. The SD card typically used is 2 GB in size and can store over 100 flight hours.

3.1.1. Data Recovery

The SD memory card that was recovered from the upper slot of the pilot's MFD card was in good condition and the data were extracted normally from the memory card.

The SD memory cards that were recovered from the other various Garmin Integrated Flight Deck avionic units were examined for relevant flight data but none was found. The data that they contained was either system software, terrain maps, or databases needed for the unit's operation.

3.1.2. Data Description

The G1000 SD card received stores flight data in individual flight logs. The SD card contained 820 log files. The accident flight recording was the last file recorded and it contained approximately 3 hour and 10 minutes of data.

3.1.3. Engineering Units Conversions

The flight log data stored in the individual files was converted to engineering units by the display unit.

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

3.2. Heads Up Technologies RDM Device Description

The Heads Up Technologies RDM data recorder is a light weight impact and fire hardened data recorder mounted in the tail of the Cirrus aircraft. The unit is capable of recording approximately 150 hours of aircraft data at a rate of one record per second. Each record includes approximately 105 positional, aircraft flight and engine parameters.

3.2.1. Heads Up Technologies RDM Data Recovery

Upon arrival at the Vehicle Recorder Division, an exterior examination revealed the unit had not sustained any impact or heat/fire damage. The unit powered up normally and the recorded information was extracted using the manufacturer's software, without difficulty.

3.2.2. Heads Up Technologies RDM Data Description

The data extracted included 522,220 total data records. The accident flight was the last session recorded (approximately 12,000 total data records (seconds)).

3.2.3. Engineering Units Conversions

The flight log data recovered from the RDM recorder was converted to engineering units by the Garmin system prior to sending the data to the recorder.

3.3. Time Correlation

The G1000 records time with the first data sample based on the unit's internal clock. This clock is set and updated by the unit and is based off GPS time.

Correlation of the data to the event local time, Central Daylight Time (CDT), was established by using the recorded time and then applying an additional 1 hour offset to change Central Standard Time (CST) to Central Daylight Time. Therefore, for the rest of this report, all times associated with the Garmin G1000 data are referenced as CDT, not recorded time.

The data recovered from the Heads Up Technologies RDM had a UTC time tag associated with each record. A time conversion of 5 hours was applied to the RDM data to change the time base to Central Daylight Time. Therefore, for the rest of this report, all times associated with the RDM data are referenced as CDT, not recorded time.

3.4. Plots and Corresponding Tabular Data

The following five figures contain data recorded during the June 9, 2016 event. 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.

Figure 1 is a Google Earth representation of the entire 3 hour 10 minute flight from Oklahoma City, Oklahoma to Houston Texas. Figures 2 and 3 are Google Earth representations of the multiple approaches at the Houston Hobby Airport, Houston Texas. Figures 4 and 5 are graphical representations of the recorded flight and engine data recovered from the Garmin G1000 MFD and the Heads Up Technologies RDM.

The corresponding tabular data used to create these five figures are provided in electronic (*.csv[2]) format as Attachment 1 to this report.

Appendix A lists the parameters from the Heads Up Technologies RDM and the Garmin G1000 MFD that were verified and provided in this report.

[2] Comma Separated Value format.

Figure 1. Google Earth presentation of the entire flight from Oklahoma City to Houston Texas.

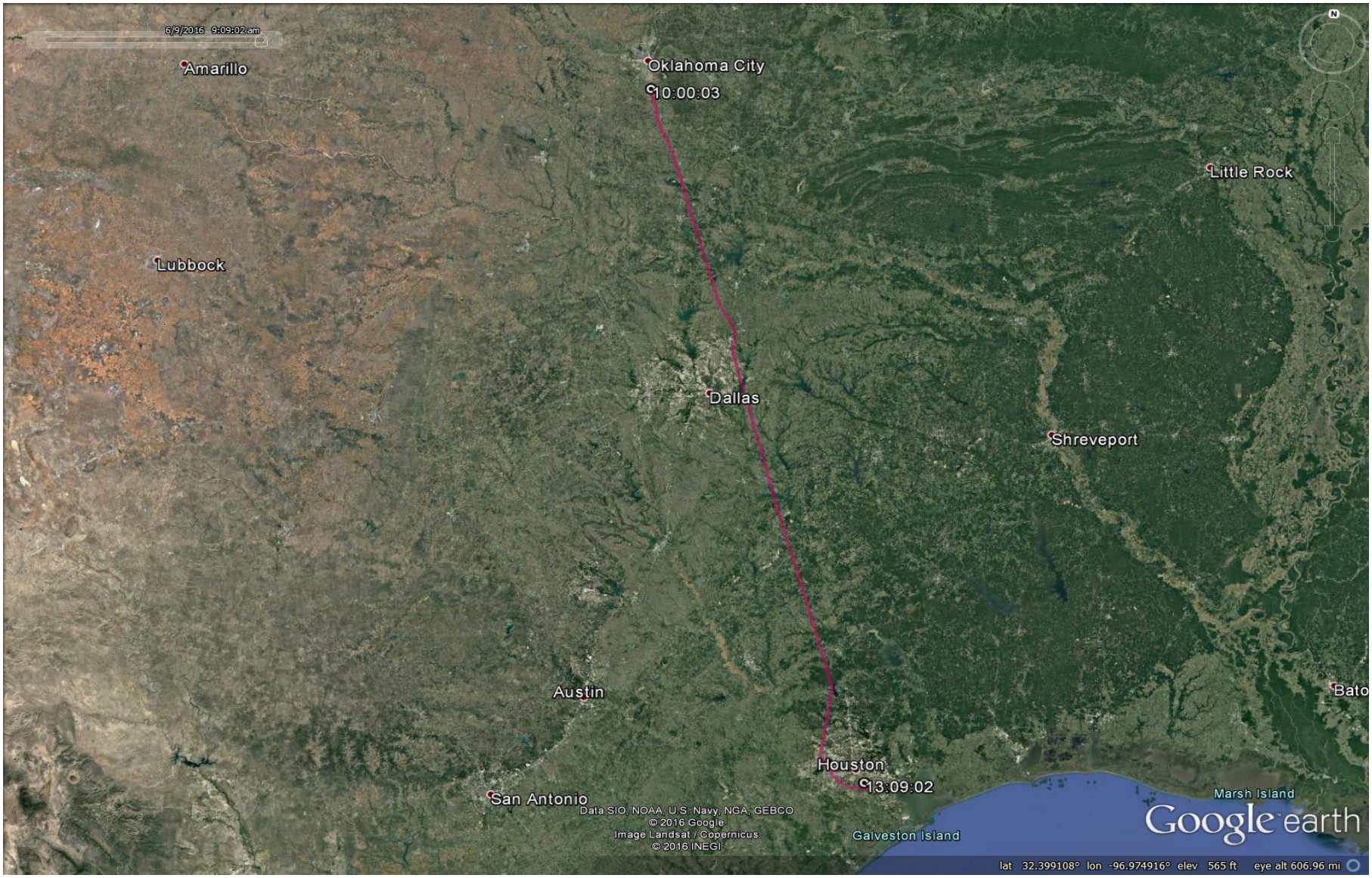


Figure 2. Google Earth presentation of the multiple approaches at Houston Hobby Airport.

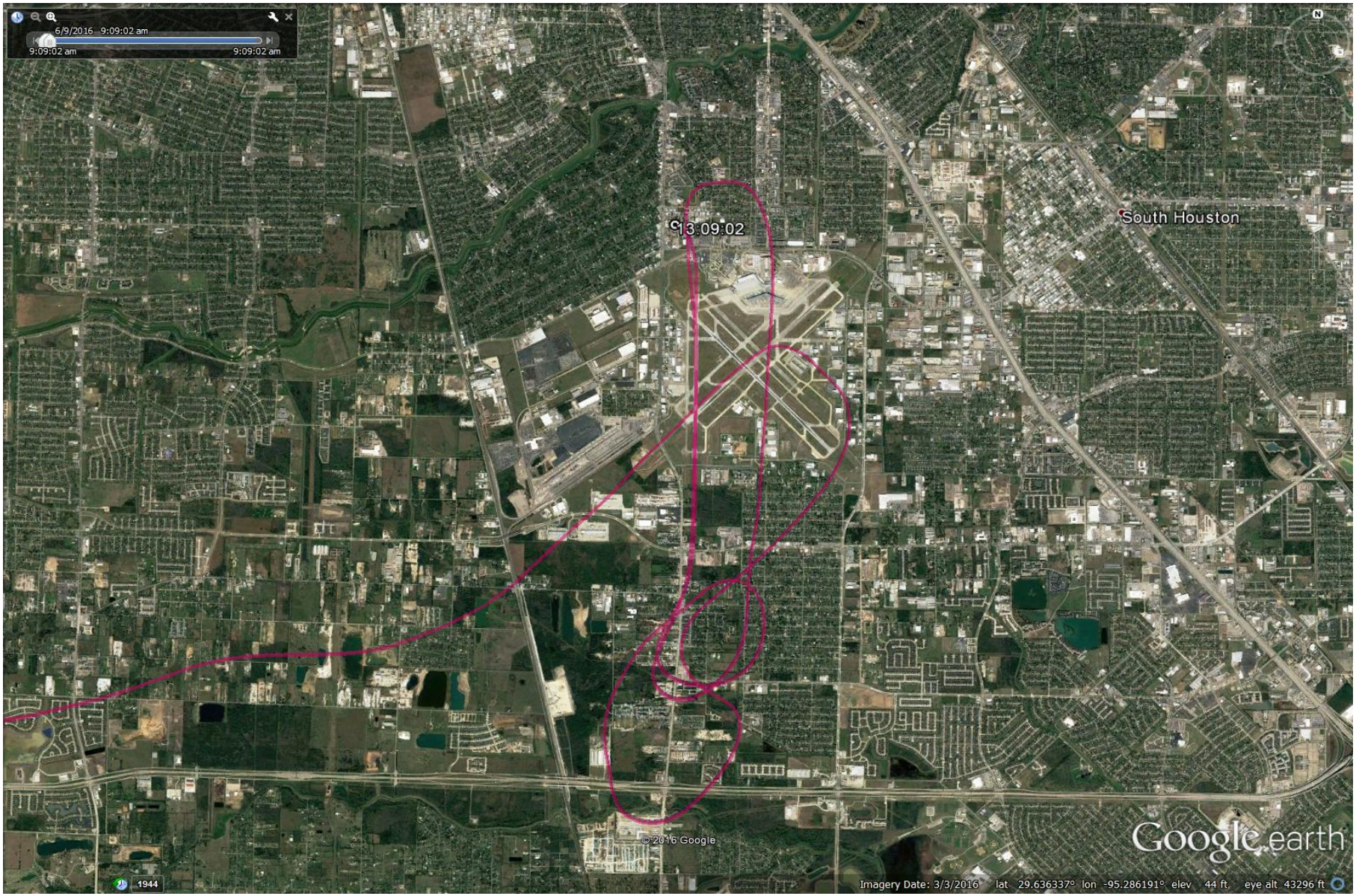


Figure 3. Google Earth presentation depicting the last recorded data point.

Figure 4. Graphical depiction of the basic flight and engine data of the accident flight.

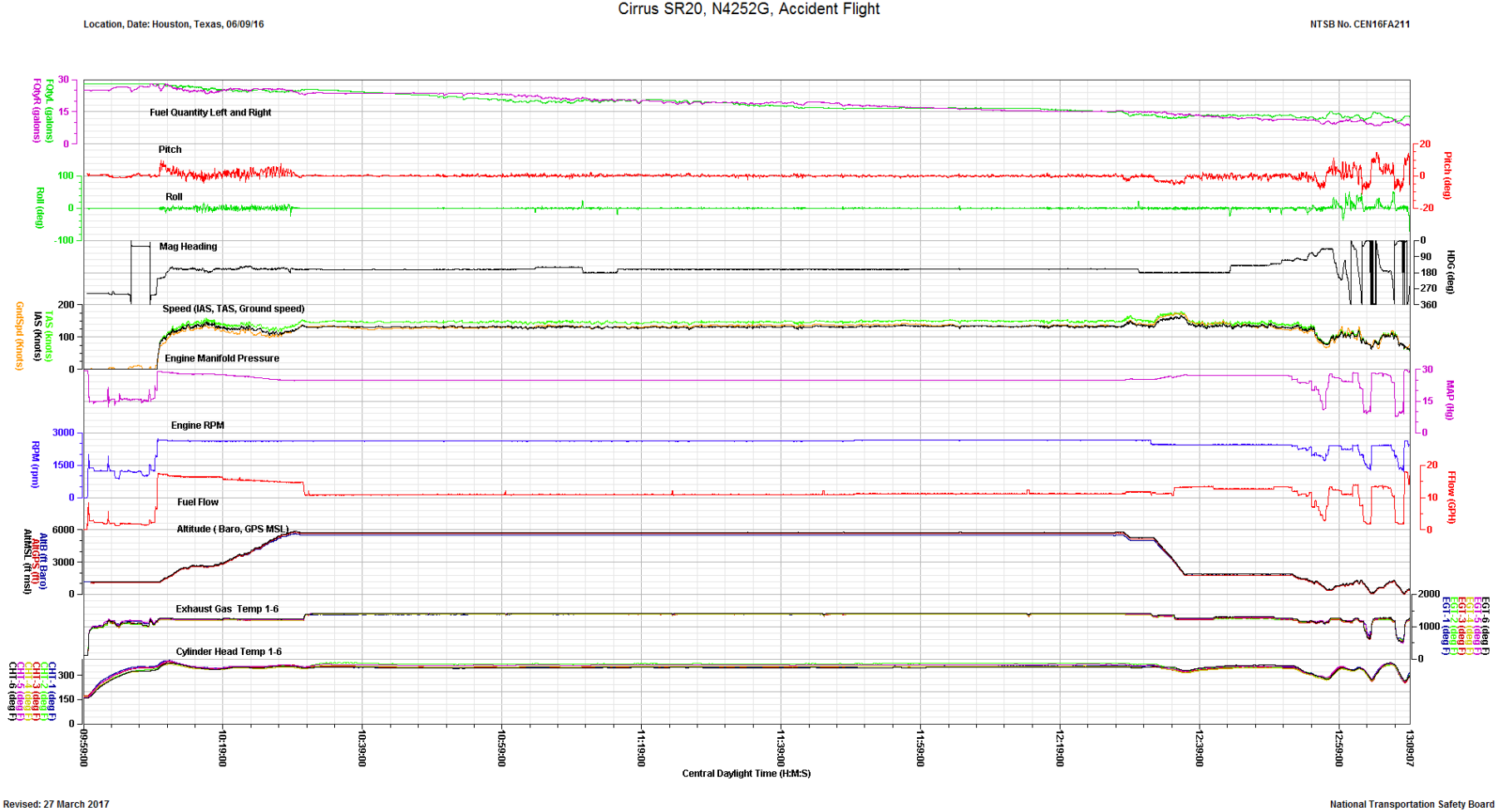
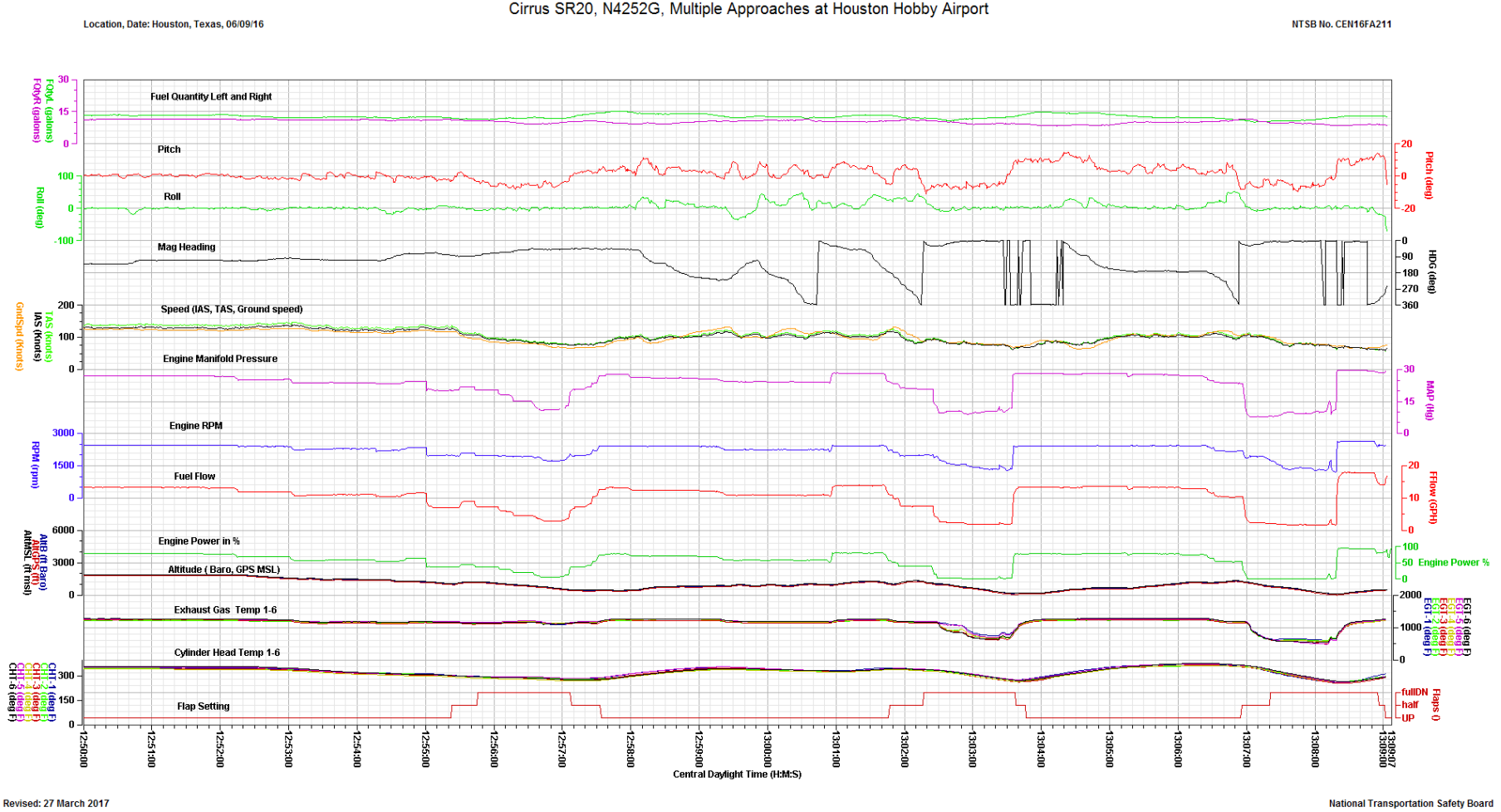


Figure 5. Graphical depiction of the basic flight and engine data of the multiple approaches at the Houston Hobby Airport.



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.

Parameter Name	Parameter Description
1. Airspeed Ind (kts)	Indicated Airspeed
2. Airspeed True (kts)	True Airspeed
3. Altitude Baro (ft)	Barometric Corrected Altitude
4. Altitude GPS (ft)	GPS Altitude
5. Altitude Press (ft)	Pressure Altitude
6. Eng1 CHT-# (deg)	Cylinder Head Temperature Cylinder #[3]
7. Eng1 EGT-# (deg)	Exhaust Gas Temperature Cylinder #[3]
8. Eng1 Fuel Flow (gph)	Engine Fuel Flow
9. Fuel Qty-L (gal)	Left Fuel Quantity
10. Fuel Qty-R (gal)	Right Fuel Quantity
11. Eng1 ITT-1 (deg)	Engine Inter Turbine Temperature-1
12. Eng1 MAP (inHg)	Engine Manifold Pressure
13. Eng1 RPM (rpm)	Engine Revolutions per minute
14. Ground Spd (kts)	Ground Speed
15. Heading (deg)	Magnetic Heading
16. Latitude (deg)	Latitude
17. Longitude (deg)	Longitude
18. Pitch (deg)	Pitch
19. Roll (deg)	Roll

Table A-2. Unit abbreviations.

Units Abbreviation	Description
deg	degrees
degF	Degrees Fahrenheit
discrete	discrete
ft	feet
gal	gallons
gph	gallons per hour
inHg	inches of Mercury
rpm	revolutions per minute
kts	knots

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