

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

April 1, 2016

## **Cockpit Displays Factual Report**

**Specialist's Factual Report**  
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### **1. EVENT SUMMARY**

|               |                     |
|---------------|---------------------|
| Location:     | Lake Wales, Florida |
| Date:         | July 22, 2015       |
| Aircraft:     | Cirrus SR-20        |
| Registration: | N610DS              |
| Operator:     | Private             |
| NTSB Number:  | ERA15FA277          |

On July 22, 2015, about 1044 eastern daylight time, a Cirrus SR20, N610DS, was destroyed when it impacted terrain while performing a go-around at Lake Wales Municipal Airport (X07), Lake Wales, Florida. The certified flight instructor (CFI) was seriously injured, and the student pilot was fatally injured. Visual meteorological conditions prevailed, and an instrument flight rules (IFR) flight plan was filed for the flight from the Orlando Sanford International Airport (SFB), Sanford, Florida to Page Field Airport (FMY), Fort Myers, Florida. The instructional flight was conducted under the provisions of Title 14 *Code of Federal Regulations* Part 91.

### **2. DETAILS OF RECORDER INVESTIGATION**

The NTSB Vehicle Recorder Laboratory received the following devices:

|                     |                                      |
|---------------------|--------------------------------------|
| Manufacturer/Model: | Avidyne Multi-Function Display (MFD) |
| Serial Number:      | Compact Flash (CF) Card only         |

|                     |                                      |
|---------------------|--------------------------------------|
| Manufacturer/Model: | Avidyne Primary Flight Display (PFD) |
| Serial Number:      | 20335305                             |

#### **2.1 Avidyne MFD Description**

The 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 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. The flight log data is also stored on the unit's CF memory card.

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.

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 are 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.

### **2.1.1 Avidyne MFD Data Recovery**

Upon arrival at the Vehicle Recorder Laboratory, the internal CF card was placed in an Avidyne test bench and the data were successfully extracted using the manufacturer's recommended procedure (figure 1).



Figure 1. Internal CF card from Avidyne MFD as received.

### **2.1.2 Avidyne MFD Data Description**

The CF card contained 68 recorded events from July 3, 2015, to July 22, 2015<sup>1</sup>. The accident event was identified by the recorded date and time parameters and spanned from 13:52:18 to 14:40:30 UTC.

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<sup>1</sup> Times from the MFD are referenced in Coordinated Universal Time (UTC).

### **2.1.3 Data Anomalies from the MFD Exhaust Gas Temperature**

Evaluation of the exhaust gas temperature parameters from the event flight showed zero value readings for the even cylinders (2, 4, and 6) towards the final recorded data points. According to the display manufacturer, the zero values from the even EGT sensors were due to the sensors being out of their calibrated range. The valid EGT sensor range is 500 to 1650 degF. Outside that range, the MFD returns invalid values.

## **3.2 Avidyne PFD Description**

The PFD unit includes a solid state Air Data and Attitude Heading Reference System (ADAHRS) and displays aircraft flight data including altitude, airspeed, attitude, vertical speed, and heading. The PFD unit has external pitot and static port inputs for altitude, airspeed, and vertical speed information. Each PFD contains two TSOP 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.

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 ADAHRS is recorded at 5 Hz. Air data information such as pressure altitude, indicated airspeed, and a vertical speed are recorded at 1 Hz. Global Positioning System (GPS) and navigation display and setting 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.

### **3.2.1 Avidyne PFD Data Recovery**

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed that the PFD had visible impact damage to the rotary knobs (figure 2). However, damage sustained was mostly cosmetic; the PFD was placed in an Avidyne test bench and the data was successfully extracted using the manufacturer's recommended procedure.

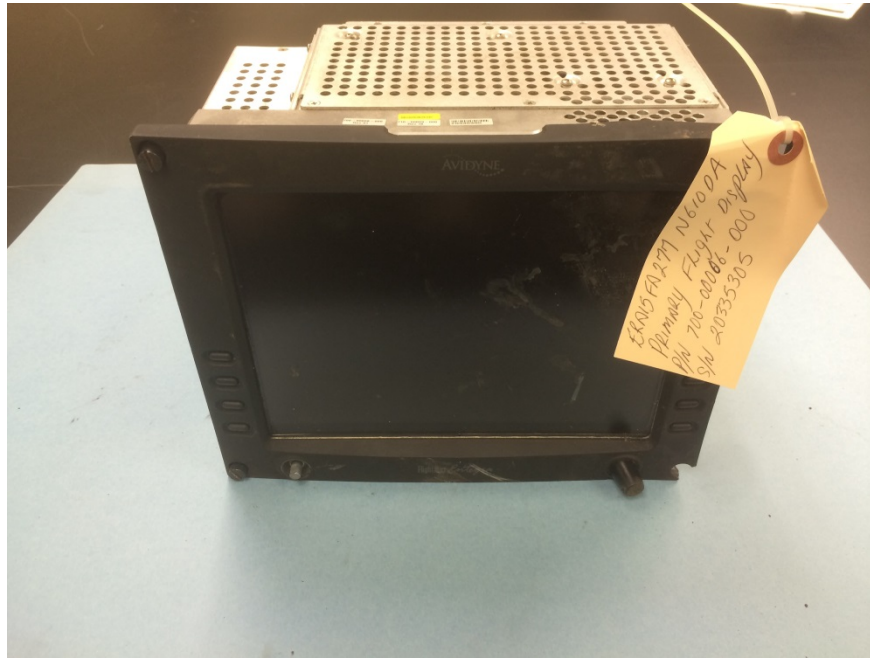


Figure 2. Avidyne PFD as received.

### 3.2.2 Avidyne PFD Data Description

The PFD contained recorded events from July 18, 2015, to July 22, 2015<sup>2</sup>. The accident event was identified by the recorded date and time parameters from 13:52:14 to 14:41:22 UTC.

### 3.3 Time Correlation

The Avidyne MFD and PFD receive their time from the aircraft's GPS receiver. Correlation of time between the MFD and PFD was established by using both devices' respective recorded time parameters in UTC.

### 3.4 Engineering Units Conversions

The engineering units conversions used for the data contained in this report are based on documentation from the manufacturer. Where applicable, the conversions have been changed to ensure that the parameters conform to the NTSB's standard sign convention that climbing right turns are positive (CRT=+).<sup>3</sup>

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

<sup>2</sup> Times from the PFD are referenced in Coordinated Universal Time (UTC).

<sup>3</sup> CRT=+ means that for any parameter recorded that indicates a climb or a right turn, the sign for that value is positive. Also, for any parameter recorded that indicates an action or deflection, if it induces a climb or right turn, the value is positive. Examples: Right Roll = +, Pitch Up = +, Elevator Trailing Edge Up = +, Right Rudder = +.

### **3.5 Plots and Corresponding Tabular Data**

Figures 3 and 4 are google earth overlays created using the recorded latitude and longitude from the PFD. The weather and lighting conditions in Google Earth may not be representative of the weather and lighting conditions present at the time of the recording.

Figure 3 is an overlay that shows the duration of the event flight. Figure 4 highlights the descent into Lake Wales airport and last recorded data points. All speeds shown in figure 4 are indicated airspeed.

Figures 5 through 7 are plots containing air data, aircraft attitudes, and engine parameters from the MFD and PFD. A dashed line shows the end of the MFD data at 10:40:30 EDT. Figure 6 shows an overview of the entire event flight from 10:00:00 to 10:41:25 EDT. Figure 7 is a six and a half minute segment of figure 6 that highlights the last recorded data points. Figure 8 is the same six and a half minute segment with additional aircraft attitude information.

The flight was uneventful until 10:35:38 EDT, when the recorded engine oil pressure dropped from 38 psi to a value of 2 psi. Beginning at 10:35:56 EDT, the aircraft altitude decreased over a period of 30 seconds from 5000 ft, to 4000 ft.

At 10:36:26 EDT, the aircraft held at 4000 feet for an additional 25 seconds before continuing its descent. Recorded latitude and longitude data indicate the aircraft was headed to Lake Wales Municipal Airport.

During this time, the recorded engine manifold air pressure (MAP), engine rpm, and fuel flow parameters decreased concurrently from their original values of 23 in-Hg, 2600rpm, and 10 gph, to 11 in-Hg, 2100rpm, and 4 gph, respectively. These parameters remained steady until 10:39:25 EDT, when the aircraft passed through 2000 ft. At this time the fuel flow and MAP dropped to 2 gph and 9 in-Hg, respectively. Additionally, the MFD recorded EGT data recorded erratic or invalid values.

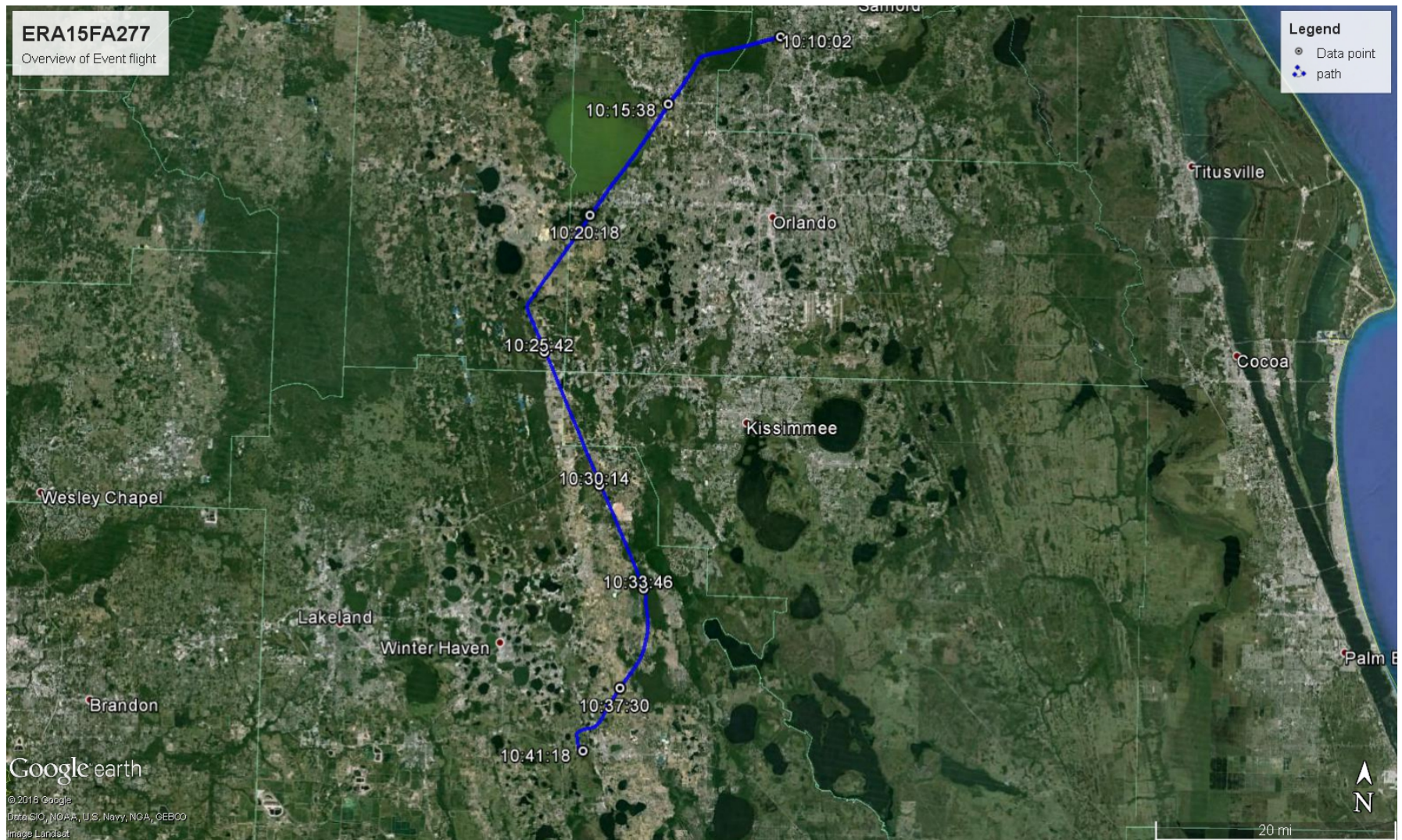
The aircraft continued to descend until 10:40:32 EDT, when the MAP, rpm, and fuel flow parameters jumped concurrently to 24 in-Hg, 2550 rpm, and 14 gph, respectively. Additionally, the aircraft pitch began increasing to 10 degrees. The altitude started to increase from 209 ft at 10:40:36 to roughly 500 ft at 10:41:01 EDT, when the roll recorded sharp movements to the left and right. The indicated airspeed at this time was about 70 knots.

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 corresponding tabular data used to create these six plots are provided in electronic (\*.csv<sup>4</sup>) format as Attachment 1 to this report.

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<sup>4</sup> Comma Separated Value format.



**Figure 3. Google Earth overlay for event flight.**

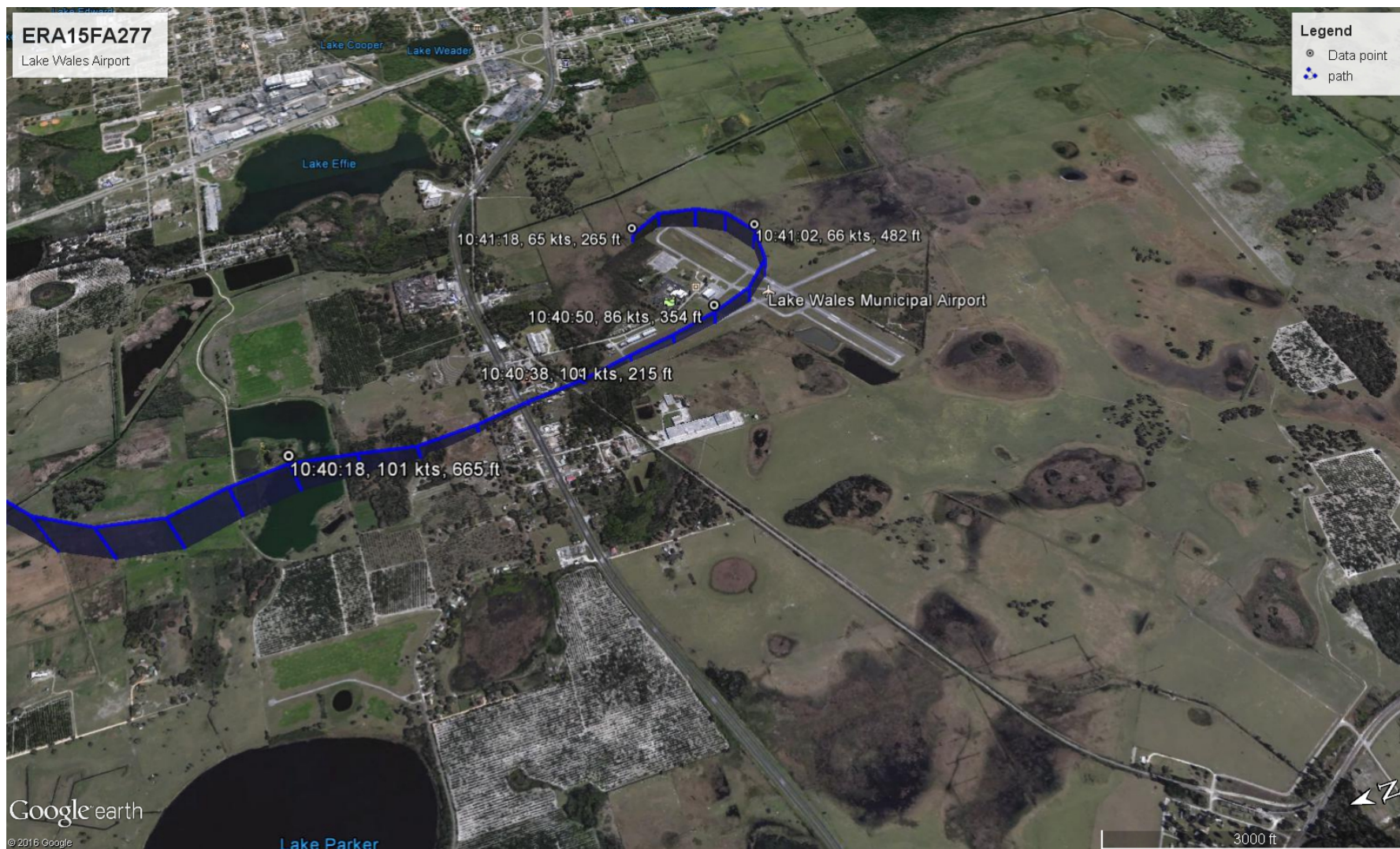
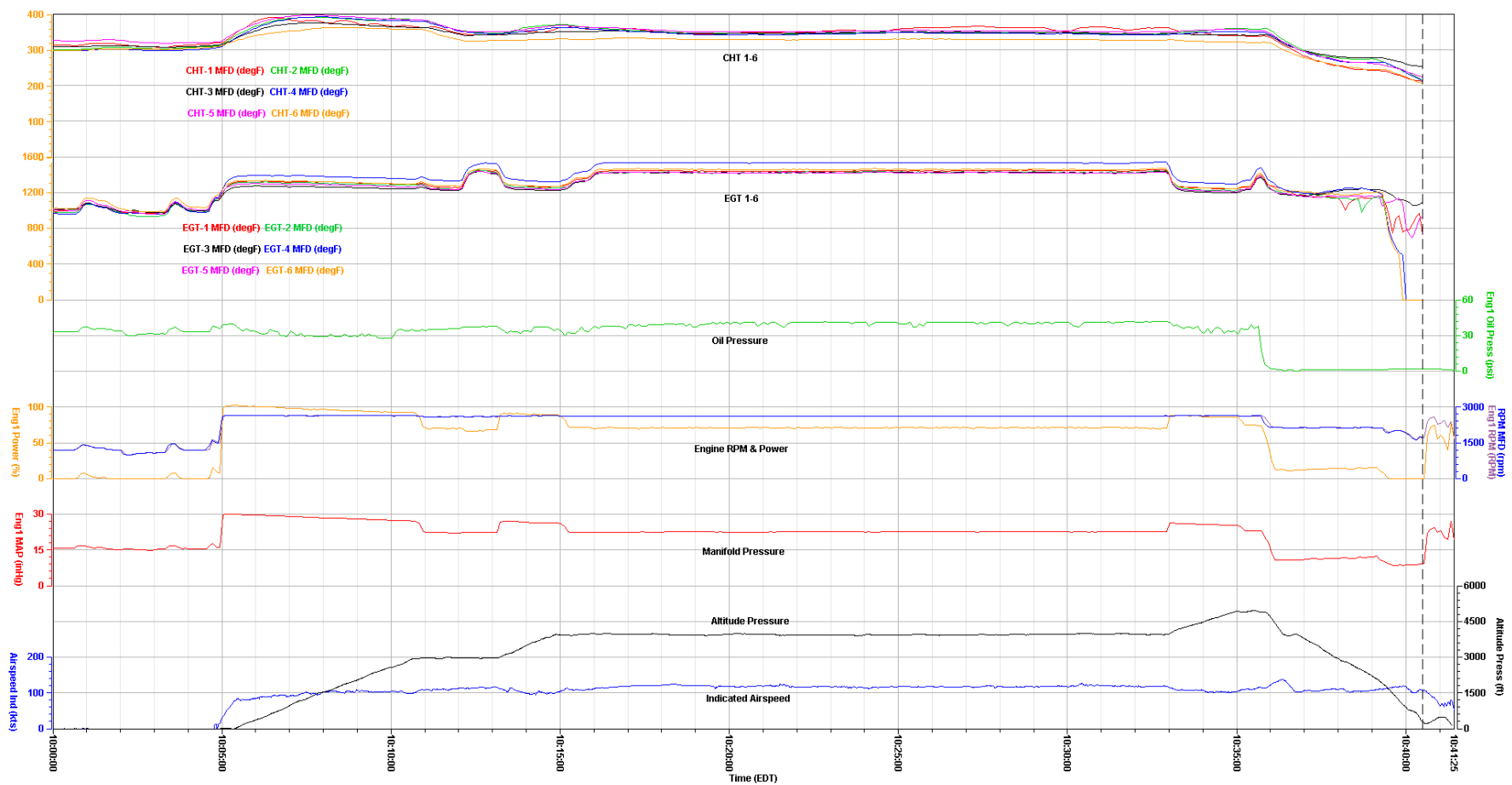
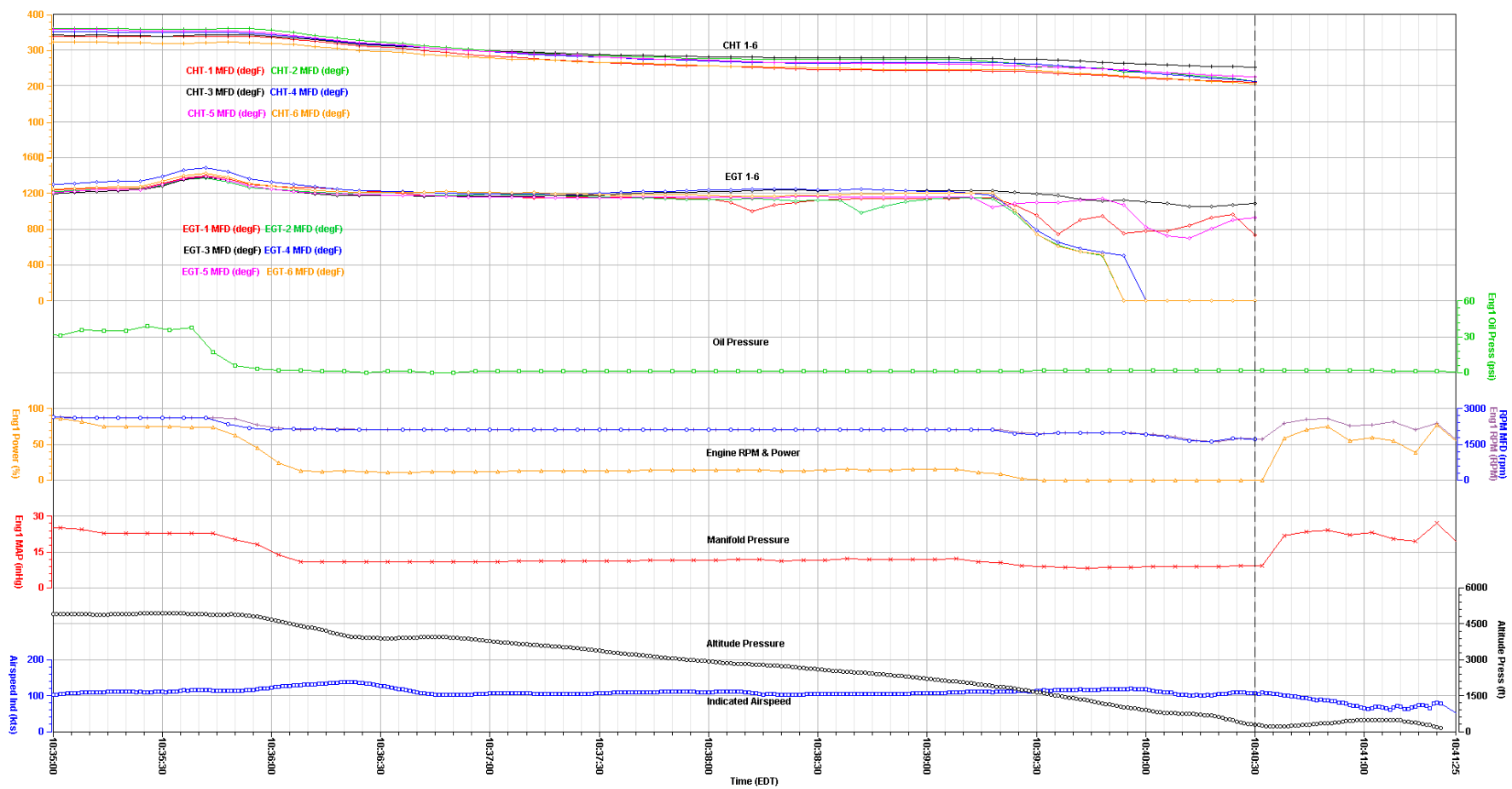


Figure 4. Google Earth overlay highlighting position near Lake Wales airport.



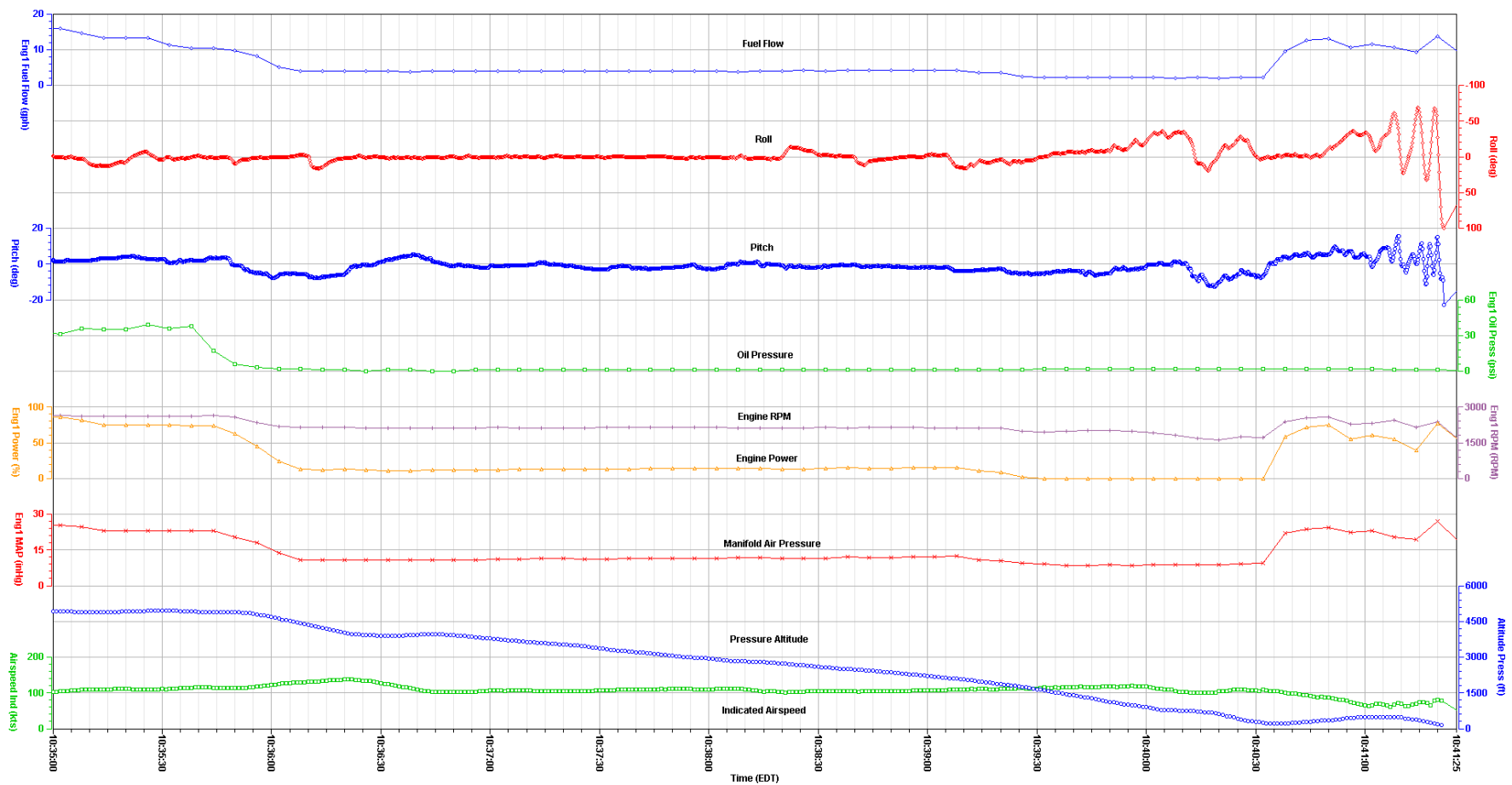
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Figure 5. Plot of engine parameters for duration of event flight.



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Figure 6. Plot of engine parameters highlighting last recorded data points.



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Figure 7. Plot of additional parameters highlighting last recorded data points.

## APPENDIX A

This appendix describes the parameters provided and verified in this report. Table A-1 and A-2 lists the parameters from the PFD and MFD respectively, and Table A-3 describes the unit abbreviations used in this report.

**Table A-1. Verified and provided PFD parameters.**

| Parameter Name                    | Parameter Description     |
|-----------------------------------|---------------------------|
| 1. Accel Long <sup>a</sup> (g)    | Longitudinal Acceleration |
| 2. Accel Vert <sup>a</sup> (g)    | Vertical Acceleration     |
| 3. Accel Lat <sup>a</sup> (g)     | Lateral Acceleration      |
| 4. Heading Mag <sup>a</sup> (deg) | Magnetic Heading          |
| 5. Pitch (deg)                    | Aircraft Pitch            |
| 6. Roll (deg)                     | Aircraft Roll             |
| 7. Altitude Press (ft)            | Pressure Altitude         |
| 8. Airspeed Ind (kts)             | Indicated Airspeed        |
| 9. Eng1 MAP (inHg)                | Manifold Air Pressure     |
| 10. Eng1 RPM (rpm)                | Engine Speed              |
| 11. Eng1 Power (%)                | Calculated Power Setting  |
| 12. Eng1 Oil Pressure (psi)       | Oil Pressure              |
| 13. Eng1 Fuel Flow (gph)          | Fuel Flow                 |
| 14. Latitude (deg)                | Latitude                  |
| 15. Longitude (deg)               | Longitude                 |

NOTE: <sup>a</sup> provided in tabular data only.  
<sup>b</sup> # denotes Cylinder numbers 1 through 6.

**Table A-2. Verified and provided MFD parameters.**

| Parameter Name               | Parameter Description       |
|------------------------------|-----------------------------|
| 1. CHT # <sup>b</sup> (degF) | Cylinder Head Temperature # |
| 2. EGT # <sup>b</sup> (degF) | Exhaust Gas Temperature #   |
| 3. RPM MFD (rpm)             | Engine Speed MFD Source     |

**Table A-3. Unit abbreviations.**

| Units Abbreviation | Description            |
|--------------------|------------------------|
| degF               | degrees Fahrenheit     |
| kts                | knots                  |
| deg                | degrees                |
| ft                 | feet                   |
| psi                | pounds per square inch |
| g                  | g-force                |
| %                  | percentage             |
| gph                | gallons per hour       |
| rpm                | rotations per minute   |
| in-Hg              | inches of mercury      |