

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

March 21, 2016

Cockpit Displays Factual Report

Specialist's Factual Report
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1. EVENT SUMMARY

Location:	Springfield, Missouri
Date:	December 12, 2014
Aircraft:	Piper PA-32-301T
Registration:	N3127R
Operator:	Integrity Home Care, Inc.
NTSB Number:	CEN15LA077

On December 12, 2014, about 1730 central standard time, a Piper PA-32-301T, single-engine airplane, N3127R, was substantially damaged after impacting an obstruction and terrain during an approach to landing at Downtown Airport (3DW), Springfield, Missouri. The pilot and one passenger were seriously injured and the other two passengers sustained minor injuries. The airplane was registered to PPG Properties, LLC; and was operated Integrity Home Care, Inc.; both of Springfield, Missouri. Night low visual meteorological conditions (VMC) prevailed at the time of the accident and an instrument flight rules (IFR) flight plan had been filed for the 14 *Code of Federal Regulations* Part 91 business flight. The airplane had departed Lee's Summit Municipal Airport (LXT), Lee's Summit, Missouri, about 1620 and was destined for 3DW.

2. DETAILS OF RECORDER INVESTIGATION

The NTSB Vehicle Recorder Laboratory received the following device(s):

Manufacturer/Model:	Avidyne Multi-Function Display (MFD)
Serial Number:	20164454

Manufacturer/Model:	Avidyne Primary Flight Display (PFD)
Serial Number:	21327414

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, an exterior examination revealed that the MFD had negligible impact damage (figure 1). The internal Compact Flash (CF) card was removed and placed in an avidyne test bench and the data was successfully extracted using the manufacturer's recommended procedure (figure 2).

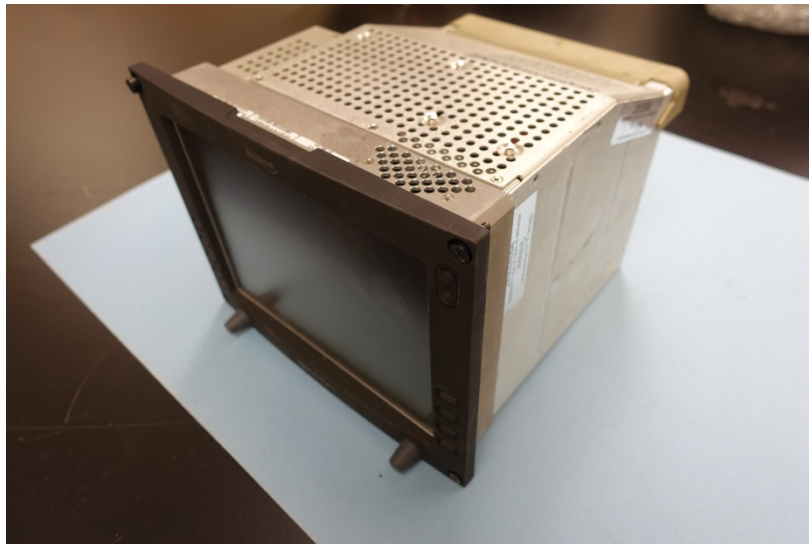


Figure 1. Avidyne MFD as received.



Figure 2. Internal CF card removed from MFD.

2.1.2 Avidyne MFD Data Description

The CF card contained 77 recorded events from July 3, 2011, to December 12, 2014¹. The accident event was identified by the recorded date and time parameters and spanned from 22:13:18 to 23:29:48 UTC.

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 Flash memory chips mounted on a circuit board. 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 negligible impact damage (figure 3). The PFD was placed in an avidyne

¹ Times from the MFD are referenced in Coordinated Universal Time (UTC).

test bench and the data was successfully extracted using the manufacturer's recommended procedure.



Figure 3. Avidyne PFD as received.

3.2.2 Avidyne PFD Data Description

The PFD contained recorded events from October 22, 2014, to December 12, 2014². The accident event was identified by the recorded date and time parameters from 23:13:02 to 23:33:05 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 PFD data contained in this report were verified by the display 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=+).³

² Times from the PFD are referenced in Coordinated Universal Time (UTC).

³ 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 = +.

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

3.5 Plots and Corresponding Tabular Data

Figures 4 and 5 are google earth overlays created using the recorded latitude and longitude from the PFD.

Figure 4 shows the event flight's entire track (north up) starting at 22:22:32 UTC, and ending at 23:30:24 UTC. An arrow is drawn to show the direction of flight. Figure 5 highlights the aircraft's track as it passed through an area containing a cell phone tower. The cellular tower location was provided by the investigator in charge.

Figures 6 and 7 are plots containing data from the MFD and PFD. Figure 6 shows basic parameters of the entire event flight from 22:22:30 to 23:30:30 UTC. Figure 7 is segment of figure 5 that shows the period when the aircraft passed the cell tower.

At 23:28:49 UTC, the aircraft's vertical acceleration recorded a negative 0.6g spike about the time the aircraft passed the cellular tower. At 23:29:34 UTC, the aircraft recorded a spike in all 3 accelerations with a concurrent nose down pitch of 80 degrees, consistent with impact.

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 (*.csv⁴) format as Attachment 1 to this report.

⁴ Comma Separated Value format.

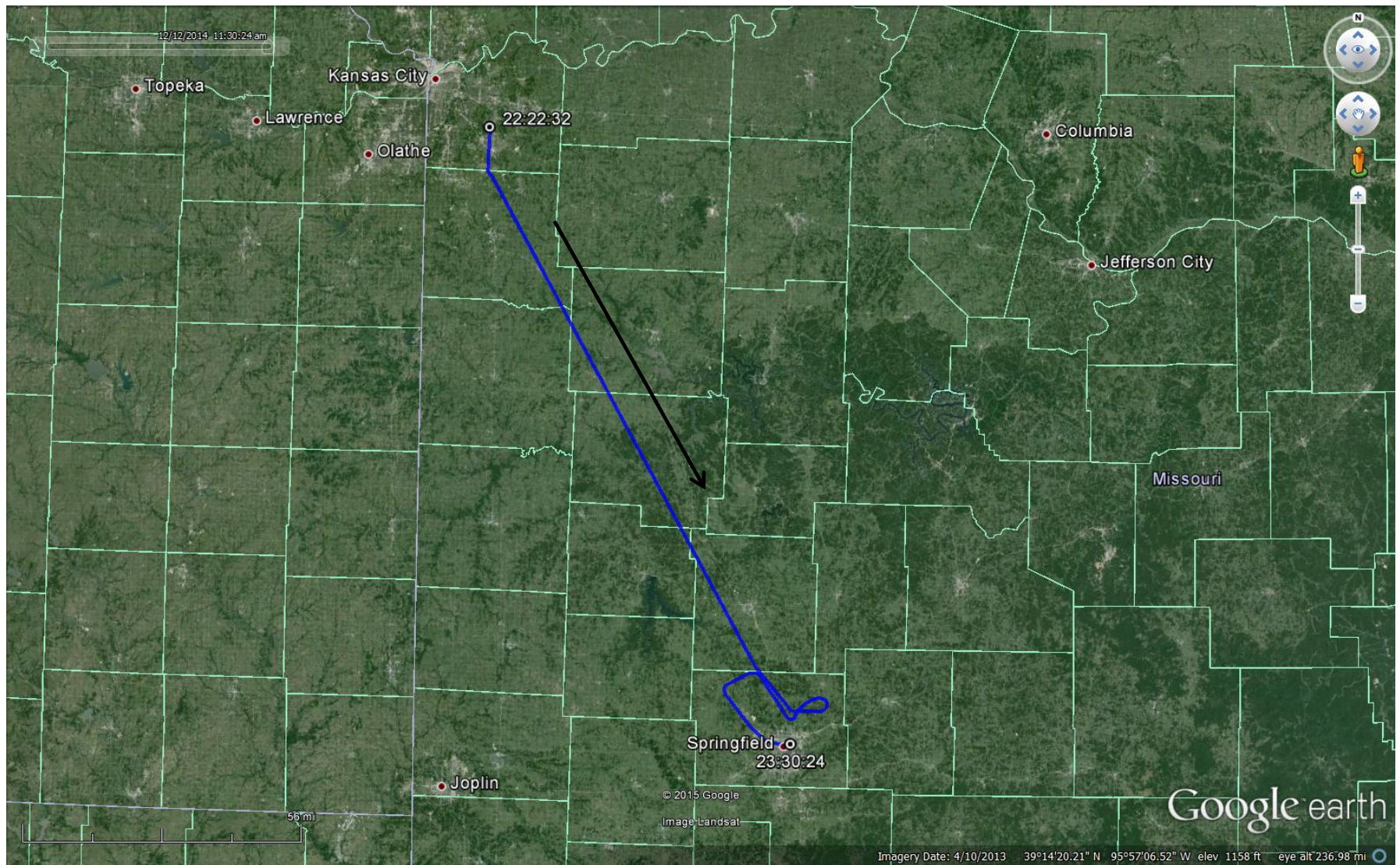


Figure 4. Google Earth overlay for event flight.

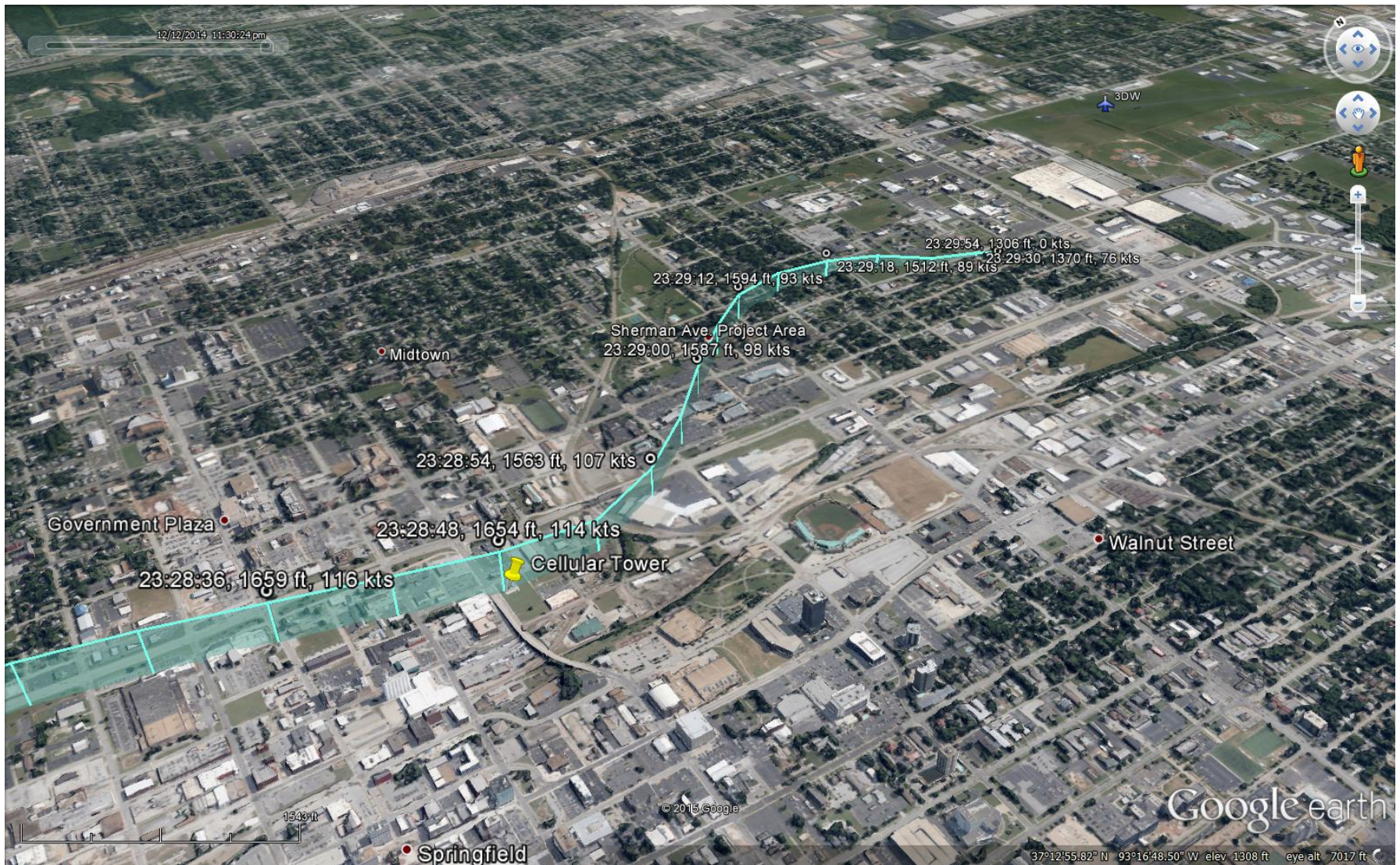
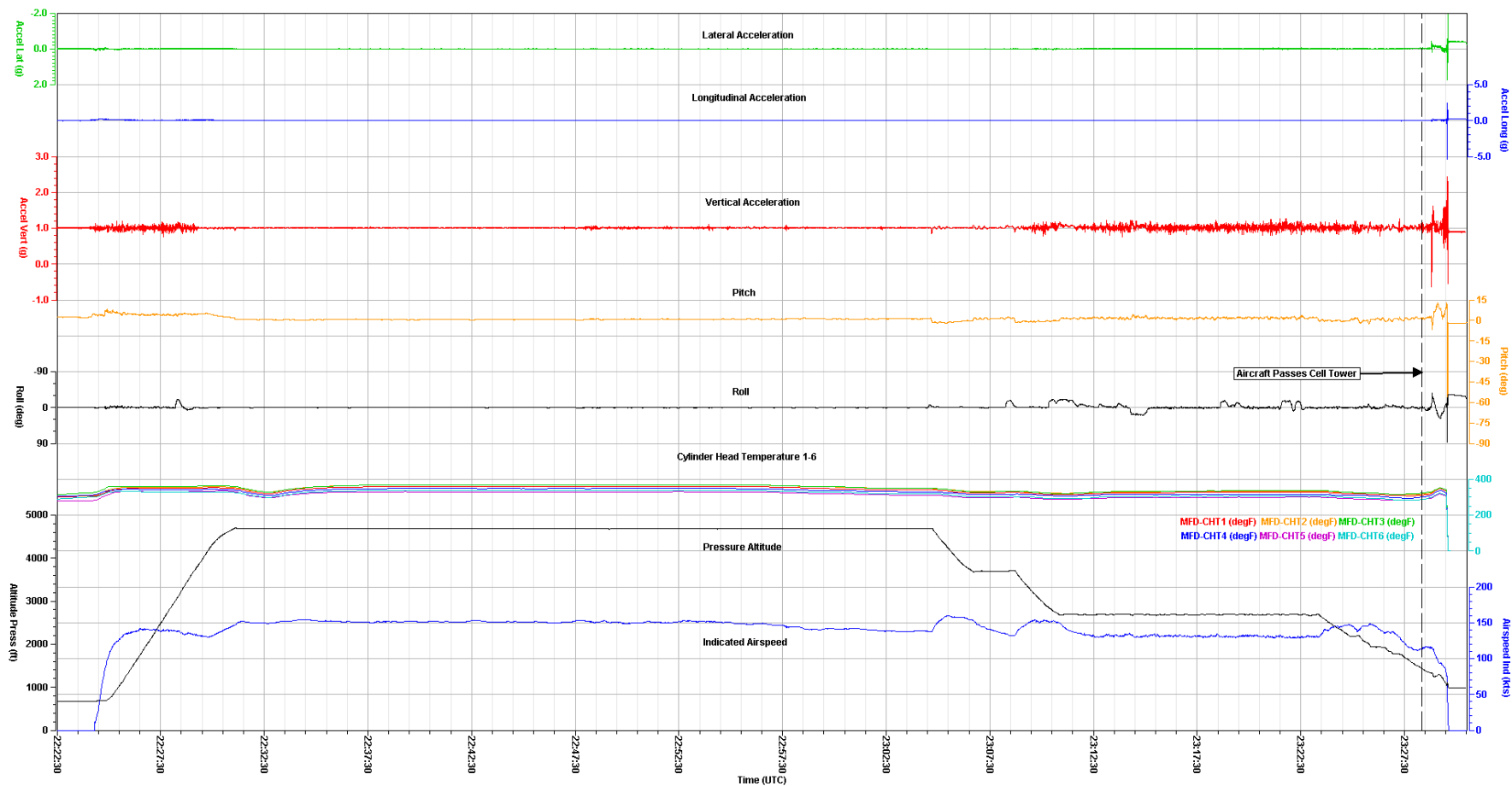


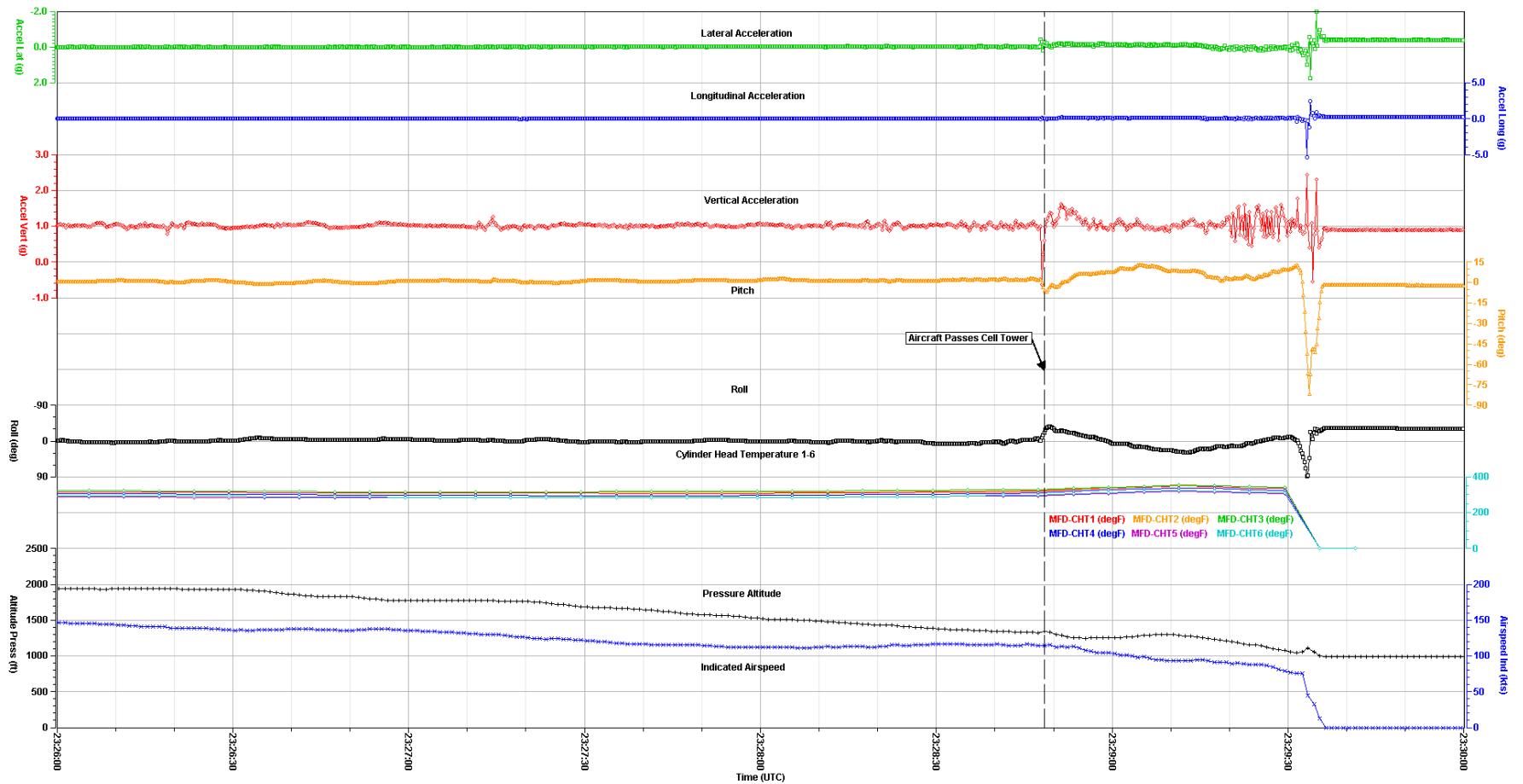
Figure 5. Google Earth overlay showing flight path near cellular tower.



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Figure 6. Plot of basic parameters for duration of event flight.



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Figure 7. Plot of basic parameters highlighting impact and cellphone tower passing.

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 (g)	Longitudinal Acceleration
2. Accel Vert ^a (g)	Vertical Acceleration
3. Accel Lat (g)	Lateral Acceleration
4. Heading Mag ^b (deg)	Magnetic Heading
5. Pitch (deg)	Aircraft Pitch
6. Roll (deg)	Aircraft Roll
7. Altitude Press (ft)	Altitude Press
8. Airspeed Ind (kts)	Indicated Airspeed
9. AP AP_AP ^{b,d} (discrete)	Auto Pilot On/Off
10. Latitude (deg)	Latitude
11. Longitude (deg)	Longitude
12. Time UTC Hrs (hrs)	UTC Time Hours
13. Time UTC Min (hrs)	UTC Time Minutes
14. Time UTC Sec (hrs)	UTC Time Seconds

Table A-2. Verified and provided MFD parameters.

Parameter Name	Parameter Description
1. MFD-CHT # ^c (degF)	Cylinder Head Temperature #
2. MFD TIT ^b (degF)	Turbine Inlet Temperature
3. MFD-RPM ^b (%)	Engine Revolutions per Minute

Table A-3. Unit abbreviations.

Units Abbreviation	Description
degF	degrees Fahrenheit
kts	knots
deg	degrees
ft	feet
discrete ^c	discrete
g	g-force
%	% revolutions per minute
hrs, min, sec	hours, minutes, seconds

NOTE:

^a the datum for Vertical Acceleration is 1g.

^b provided in tabular data only.

^c # denotes Cylinder numbers 1 through 6.

^d 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.