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

November 18, 2014

Electronic Devices Factual Report

Specialist's Factual Report
by Bill Tuccio, Ph.D.

1. EVENT

Location:	Big Creek, Idaho
Date:	June 29, 2014
Aircraft:	Cessna 182Q
Registration:	N132K
Operator:	Private
NTSB Number:	WPR14LA271

On June 29, 2014, about 0815 mountain daylight time, a Cessna 182Q, N132K, was substantially damaged when it impacted trees and terrain during approach to Big Creek airport (U60), Big Creek, Idaho. The owner/pilot was seriously injured. The personal flight was conducted under the provisions of Title 14 *Code of Federal Regulations* Part 91. Visual meteorological conditions prevailed, and no Federal Aviation Administration (FAA) flight plan was filed for the flight.

2. DETAILS OF DEVICE INVESTIGATION

The Safety Board's Vehicle Recorder Division received the following devices:

Device 1:	Garmin GPSMAP 695
Device 1 Serial Number:	1H700201
Device 2:	JPI Engine Monitor EDM-930
Device 2 Serial Number:	01403

2.1. Garmin GPSMAP 695 Device Description

The Garmin GPSMAP 695 is a battery-powered portable multi-function display and GPS receiver with a 7-inch diagonal high resolution LCD display screen. The unit includes a built-in Jeppesen database and is capable of receiving XM satellite radio for flight information including NEXRAD Radar, lightning, METARs, TAFs, and TFRs. The unit can also perform and store weight and balance calculations. A built-in AOPA Airport Directory and SafeTaxi airport diagrams are included for selected airfields. The unit stores date, route-of-flight, and flight-time information for up to 50 flights. A flight record is triggered when groundspeed exceeds 30 knots and altitude exceeds 250 feet, and ends when groundspeed drops below 30 knots for 10 minutes or more. A detailed track

log—including latitude, longitude, date, time, and GPS altitude information for an unspecified number of points—is stored within the unit whenever the receiver has a lock on the GPS navigation signal. Position is updated within the track log as a function of time or distance moved, depending on how the unit has been configured. Once the current track log memory becomes full, new information either overwrites the oldest information or recording stops, depending on how the unit is configured. The current track log can be saved to long-term memory and additional track logs can be maintained in addition to the current track log. Track log storage may be activated or de-activated at user discretion. All recorded data is stored in non-volatile[1] memory. The unit contains hardware and software permitting the download of recorded waypoint, route, and track log information to a PC via a built-in USB port.

2.1.1. Garmin GPSMAP 695 Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed the device had not sustained any damage. Power was applied to the device and information was downloaded normally, without difficulty.

2.1.2. Garmin GPSMAP 695 Data Description

The data extracted included 40 sessions (6,145 data points) from November 15, 2013, through June 29, 2014. The last two recording sessions covered accident flight related activity from 13:16:59 UTC through 14:08:35 UTC on June 29, 2014.

2.1.3. Garmin GPSMAP 695 Parameters Provided

Table 1 describes data parameters provided by the GPS device. Date, Time, Latitude, Longitude, and GPS Altitude are recorded by the device. Groundspeed and Track are derived from the recorded parameters.

Table 1: GPS Data Parameters

Parameter Name	Parameter Description
Date	Date for recorded data point (MM/DD/YYYY)
Time	Time (EDT) for recorded data point (HH:MM:SS)
Latitude	Recorded Latitude (degrees)
Longitude	Recorded Longitude (degrees)
GPS Alt	Recorded GPS Altitude (feet (ft)), MSL)
Groundspeed	Average groundspeed (knots (kts))
Track	Average true course (degrees)

Note: MSL means altitude above mean sea level

[1] Non-volatile memory is semiconductor memory that does not require external power for data retention.

2.1.4. Garmin GPSMAP 695 Overlays and Corresponding Tabular Data

Figures 1 through 4 were generated using data extracted from the Garmin GPSMAP 695 and overlaid using Google Earth. The weather depicted in Google Earth is not necessarily representative of the weather conditions experienced by the accident flight.

Figure 1 shows an overview of the accident flight. The recording began at 13:16:59 UTC and ended at 14:08:35 UTC. The recording began at McCall Municipal Airport (MYL) and ended at U60, a distance of about 36 nm.

Figure 2 shows ground operations at MYL. The recording began at 13:16:59 UTC. By 13:20:00 UTC, the aircraft moved north to the terminal apron area. At about 13:34:40 UTC, the aircraft began to move towards runway 16, stopping short of runway 16 from about 13:37:05 UTC until 13:42:19 UTC. By 13:43:12 UTC, the aircraft began its takeoff roll on runway 16 at MYL.

Figures 3 and 4 show the traffic pattern operations through the end of the recording at U60. At 14:06:22 UTC, the aircraft was descending through 7,008 ft MSL and slowing through 88 kts groundspeed. By 14:07:16 UTC, the aircraft was descending through 6,444 ft and slowing through 78 kts, while at a location similar to left downwind for runway 19 at U60.

From 14:08:07 UTC through the end of the recording at 14:08:35 UTC, the aircraft maneuvered similar to a left base then turned towards a final approach for runway 19 at U60, while descending at groundspeeds calculated between 53 and 59 kts.

The groundspeeds after 14:08:26 UTC may not be reliable due to rapid changes in the aircraft track.

Tabular data used to generate figures 1 through 4 are included as attachment 1 in electronic comma-delimited (.CSV) format.

Figure 1. Accident flight, as recorded by Garmin 695.

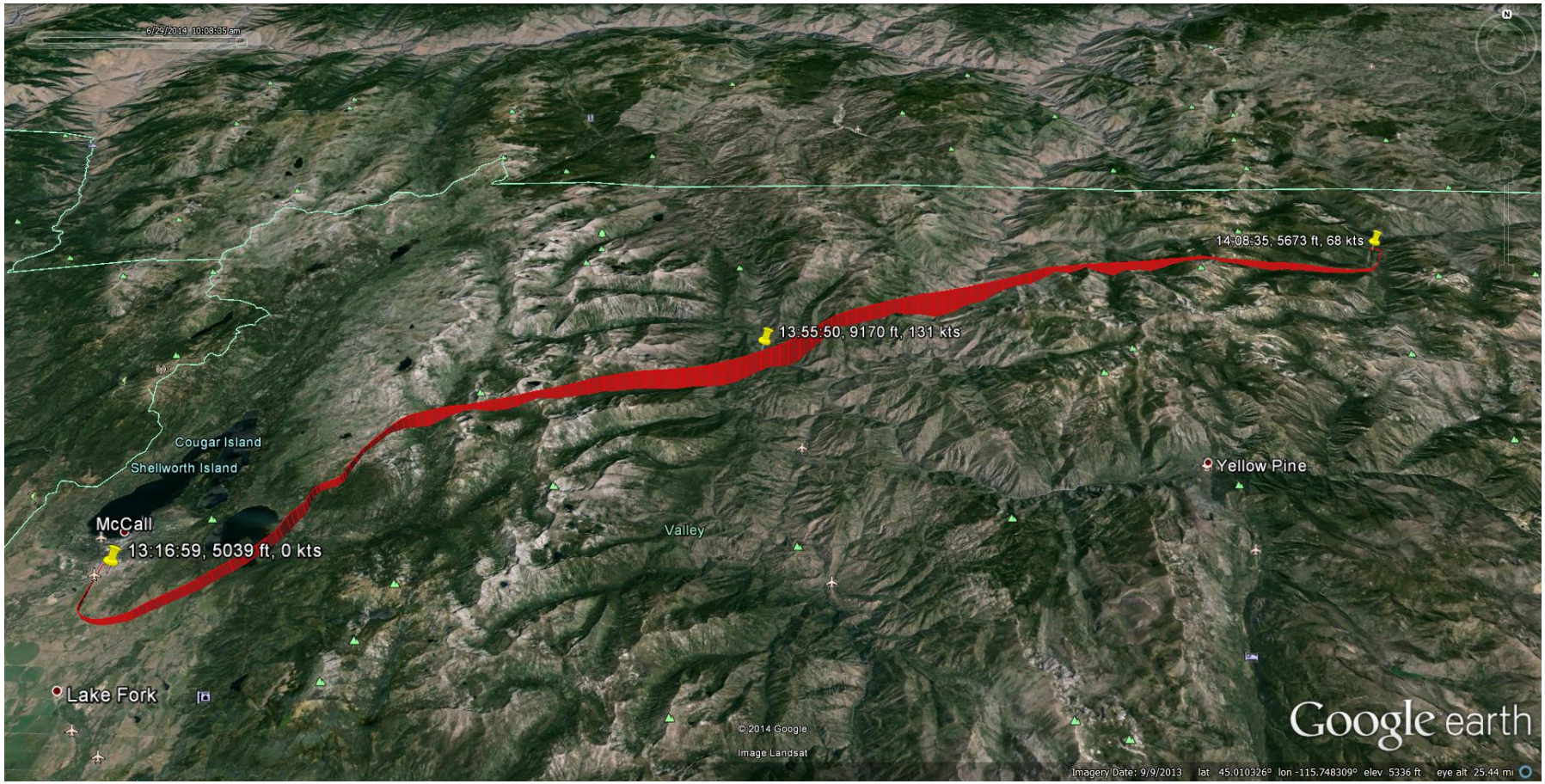


Figure 2. Accident flight ground operations at MYL (departure airport), as recorded by Garmin 695.

Figure 3. Accident flight traffic pattern through end of recording at U60, as recorded by Garmin 695.

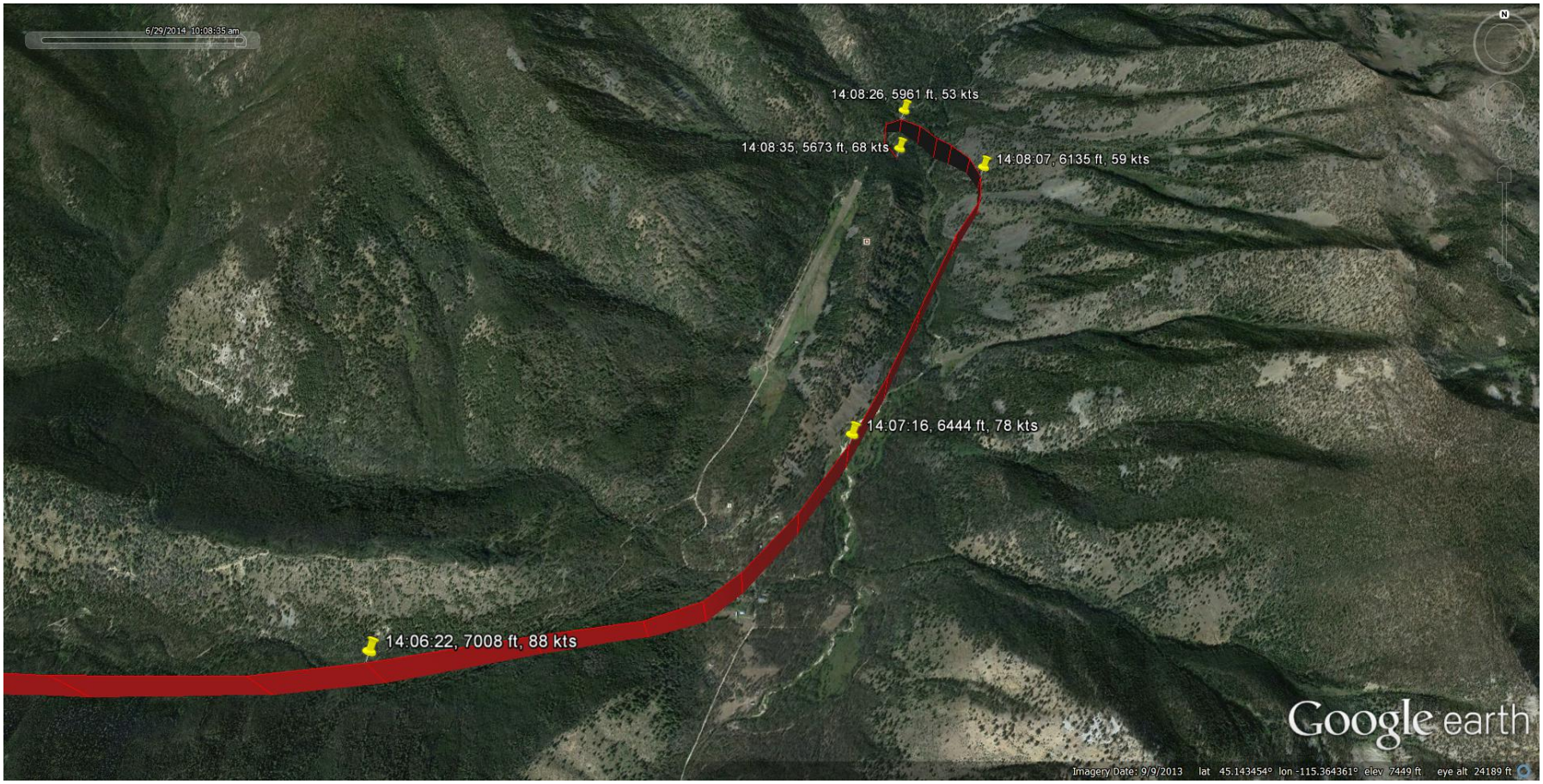
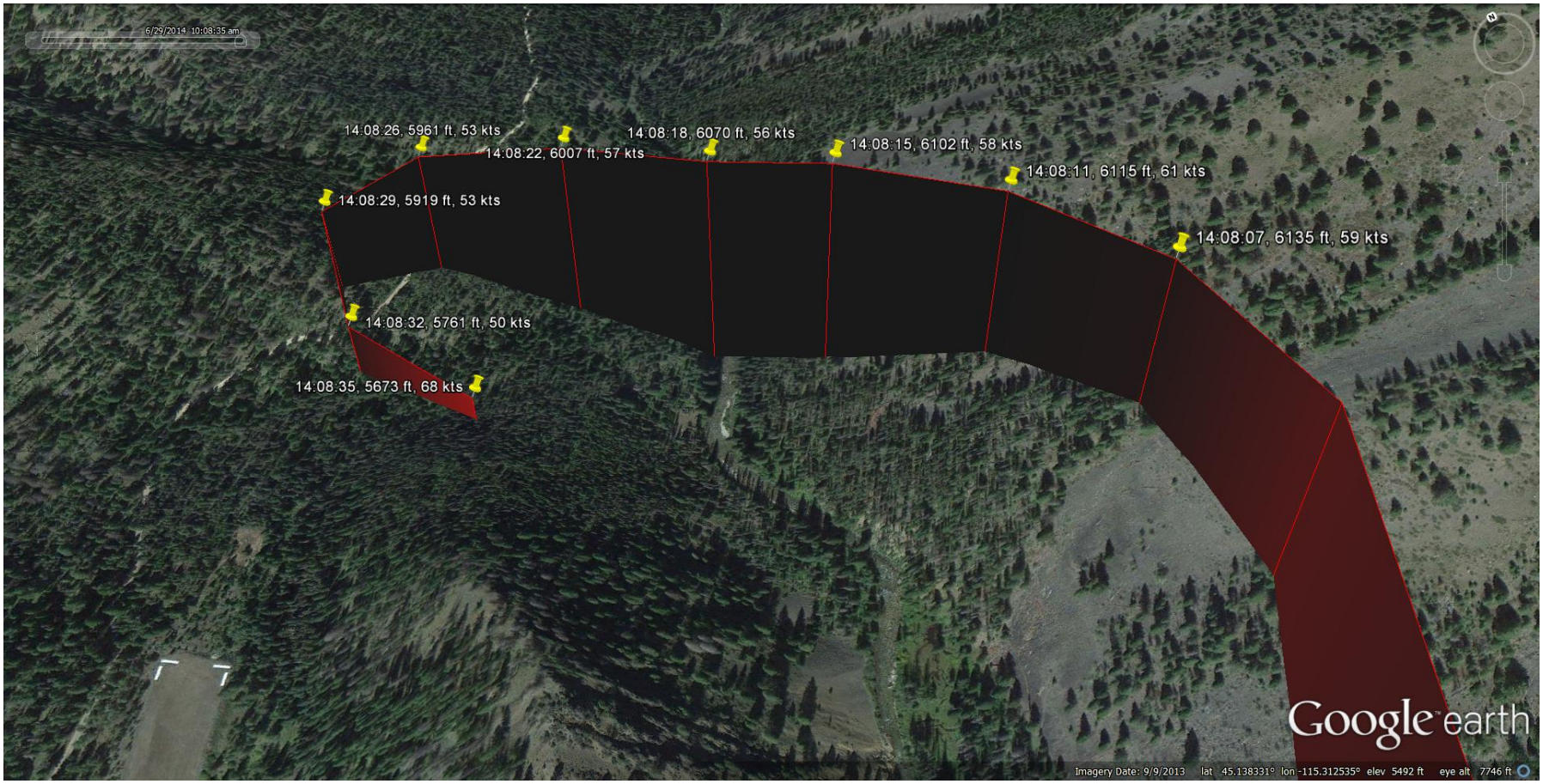


Figure 4. Accident flight change in groundspeed before course reversal, as recorded by Garmin 695.



2.2. JPI EDM-930 Device Description

The J.P. Instruments (JPI) EDM-930 is a panel mounted instrument enabling the operator to monitor and record multiple engine parameters related to engine operations and GPS parameters, if connected. Depending on the installation, engine parameters monitored may include:

- Exhaust Gas Temperature (EGT)
- Cylinder Head Temperature (CHT)
- Oil Pressure and Temperature
- Manifold Pressure
- Outside Air Temperature
- Turbine Inlet Temperature
- Engine Revolutions per Minute
- Compressor Discharge Temperature
- Fuel Flow
- Fuel Pressure
- Fuel Level
- Carburetor Temperature
- Battery Voltage

The unit can also calculate, in real-time, horsepower, fuel used, shock cooling rate, and EGT differentials between the highest and lowest cylinder temperatures. The calculations are also based on the aircraft installation.

The unit contains non-volatile memory for data storage of the parameters recorded and calculated. The rate at which the data is stored is selectable by the operator. Data recording typically begins when EGTs are greater than 500°F or RPM is greater than 500 rpm. The memory can store up to 20 hours of data at a 6 second sample rate. For a non-damaged unit, the data can then be downloaded by the operator using a USB flash drive and following the instructions on the unit.

2.2.1. JPI EDM-930 Data Recovery

The device was in good condition and the data were extracted normally. Figure 5 shows a picture of the unit with power applied in the NTSB's Vehicle Recorder Division laboratory.

Figure 5. JPI EDM-930.

2.2.2. JPI EDM-930 Data Description

The unit contained data recorded at a sample rate of once every 6 seconds. The recorded data included three recording sessions on June 29, 2014, as recorded by the unit's internal clock. The parameters recorded were EGT, CHT, voltage, outside air temperature, manifold pressure, RPM, oil pressure, oil temperature, fuel pressure, fuel flow, fuel used, and fuel remaining. Additionally, the calculated shock cooling rate and maximum difference between EGT sensors were also recorded. No other parameters were recorded by the unit.

2.2.3. JPI EDM-930 Parameters Provided

The engineering units conversions used for the data contained in this report are based on documentation from the manufacturer of the EDM-930, JPI.

Table 2 describes data parameters provided by the EDM-930. Time is set by the operator and is maintained by an internal clock. When the unit was powered on at the NTSB's Vehicle Recorder Laboratory, the EDM-930 time displayed 18:18:01. This time corresponded to September 2, 2014, at 17:06:00 UTC. This time was further compared to data from the Garmin GPSMAP 695 (as previously discussed in this report). As a result, 4,176 seconds was subtracted from EDM-930 time to convert to UTC. Given

tolerances of the EDM-930 internal clock and alignment ambiguity to events on the Garmin GPSMAP 695, EDM-930 corrected time in this report relative to GPS time may be off by up to 2 minutes.

Table 2: JPI EDM-930 Data Parameters

Parameter Name	Parameter Description
1. AMP (amp)	Bus or Battery Amperage Current
2. BAT (Volts)	Bus or Battery Voltage
3. C1 (degF)	Cylinder Head Temperature Cylinder 1
4. C2 (degF)	Cylinder Head Temperature Cylinder 2
5. C3 (degF)	Cylinder Head Temperature Cylinder 3
6. C4 (degF)	Cylinder Head Temperature Cylinder 4
7. C5 (degF)	Cylinder Head Temperature Cylinder 5
8. C6 (degF)	Cylinder Head Temperature Cylinder 6
9. E1 (degF)	Exhaust Gas Temperature Cylinder 1
10. E2 (degF)	Exhaust Gas Temperature Cylinder 2
11. E3 (degF)	Exhaust Gas Temperature Cylinder 3
12. E4 (degF)	Exhaust Gas Temperature Cylinder 4
13. E5 (degF)	Exhaust Gas Temperature Cylinder 5
14. E6 (degF)	Exhaust Gas Temperature Cylinder 6
15. FF (gph)	Fuel Flow
16. FP (psi)	Fuel Pressure
17. MAP (inHg)	Manifold Pressure
18. OILP (psi)	Oil Pressure
19. OILT (degF)	Oil Temperature
20. RPM (rpm)	Propeller Revolutions per Minute
21. Time (hh:mm:ss)	Time of Data Sample
22. USD (gals)	Fuel Used

Note: amp is Amperes; degF is degrees Fahrenheit; gph is gallons per hour; gals is gallons; psi is pounds per square inch; and inHg is inches of Mercury.

2.2.4. JPI EDM-930 Plots and Corresponding Tabular Data

Figure 6 shows the entire accident flight recording and figure 7 expands the time scale to the end of the recording. No data was recorded between 13:19:22 UTC and 13:32:48 UTC, consistent with the pause in GPS movement shown in figure 2.

At about 13:43:06 UTC, fuel flow, manifold pressure, RPM, EGTs, and CHTs increased. The fuel flow reached a maximum of about 21 gph, decreasing to about 13 gph from 13:54:12 UTC to 14:03:30 UTC. At about 14:03:30 UTC, manifold pressure, RPM, and fuel flow decreased.

The last two sample points of the recording, covering a 12-second period, show an increase in manifold pressure, RPM, fuel flow, and fuel pressure.

The fuel used showed an increasing amount throughout the flight. However, the initial value of the fuel used must be reset by the pilot; as such, the total fuel used shown on the plot (about 50 to 56 gallons) may not reflect the actual fuel quantity on board the aircraft. Subtracting the last fuel used from the first fuel used at 13:32:48 UTC, yields a difference of 6.2 gallons used for the accident flight.

Tabular data used to generate figures 6 and 7 is included as attachment 2 in CSV format.

Figure 6. JPI EDM-900 plot of June 29, 2014 Recorded Data.

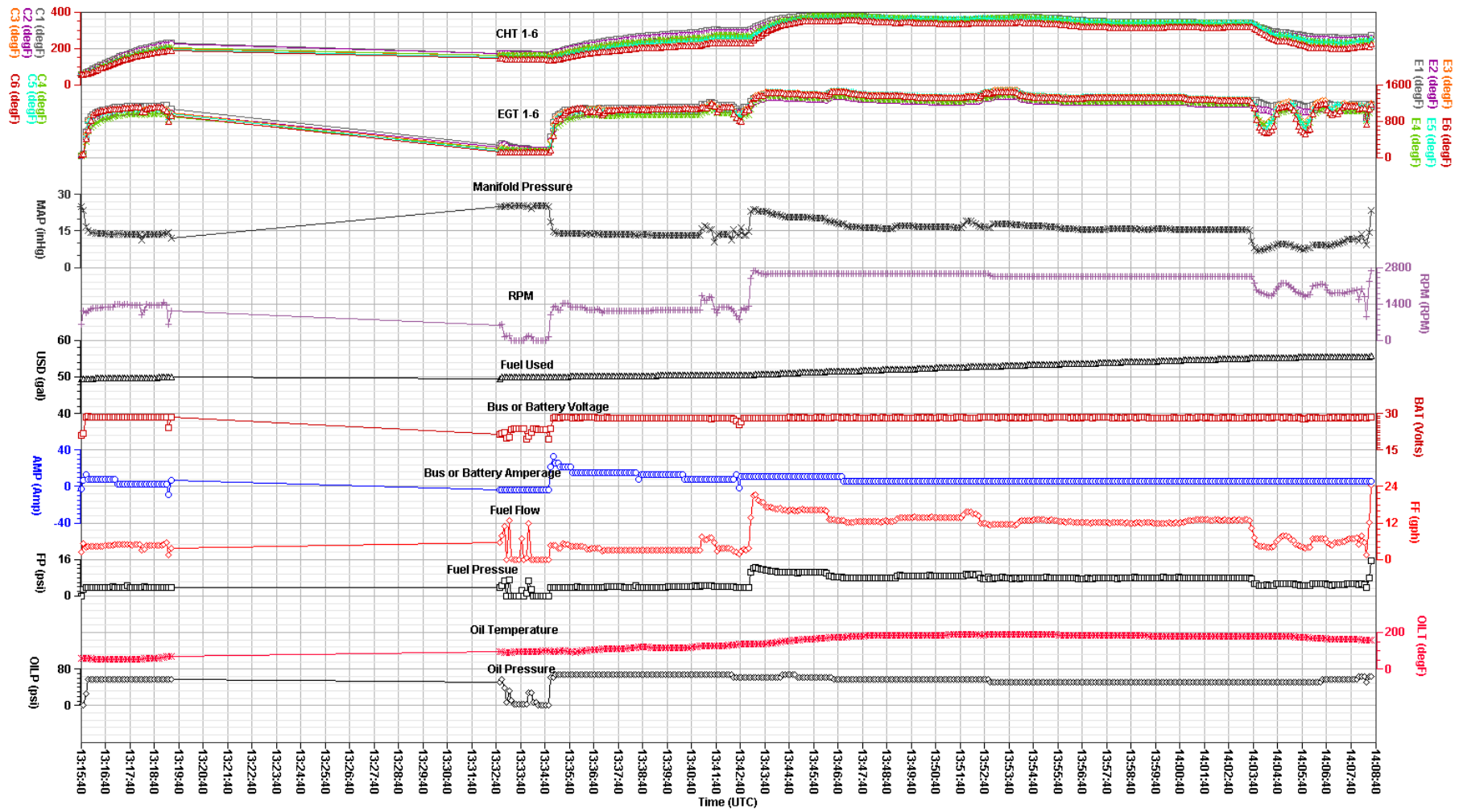


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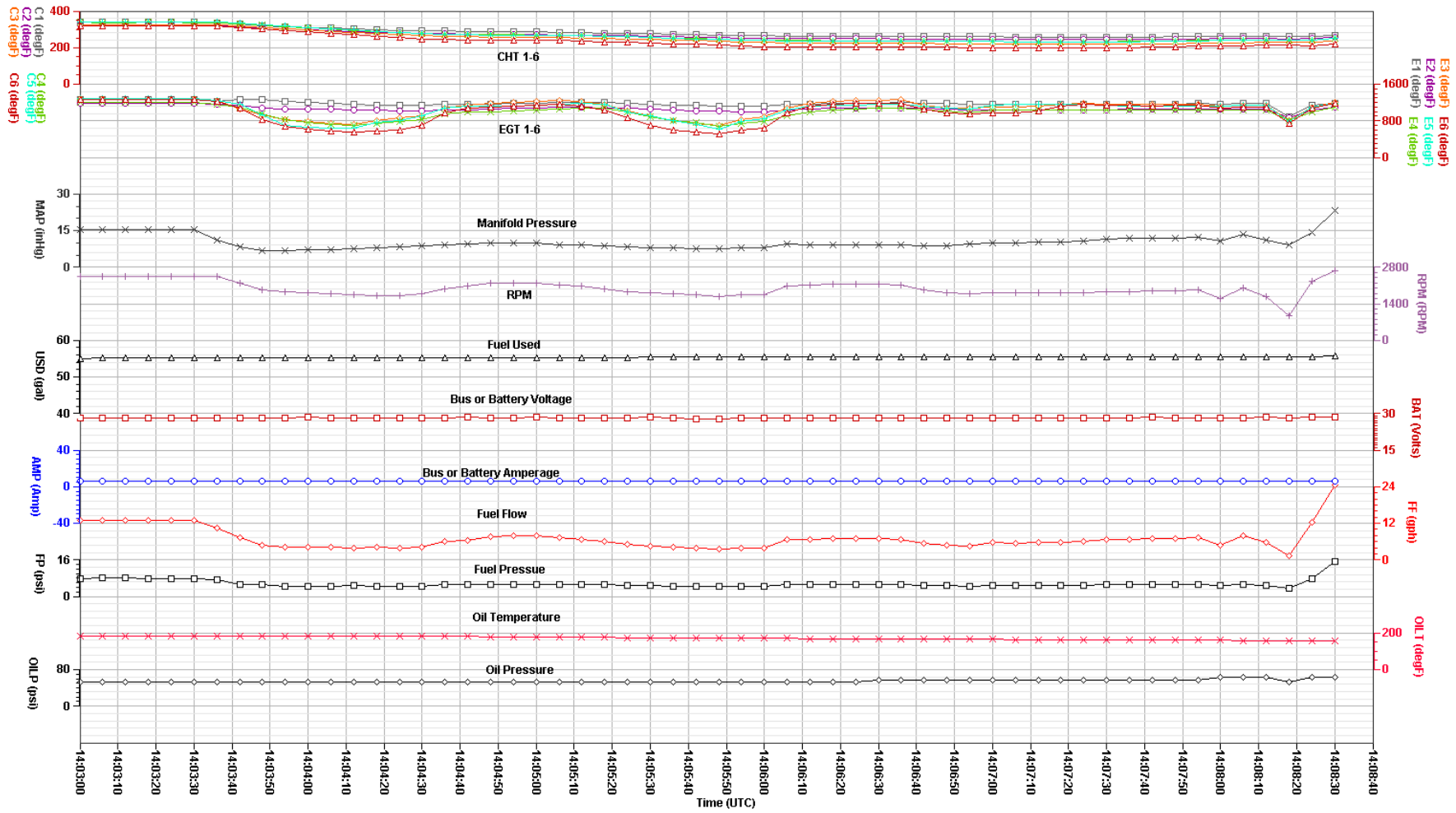
Figure 7. JPI EDM-930 end of recording.



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