

NATIONAL TRANSPORTATION SAFETY BOARD

Vehicle Recorder Division
Washington, D.C. 20594

March 17, 2020

Electronic Devices

Specialist's Factual Report by Gerald Kawamoto

1. EVENT

Location: Moab, UT
Date: June 30, 2019
Aircraft: CCK-1865
Registration: N66DN
Operator: Private
NTSB Number: WPR19FA182

On June 30, 2019, about 0900 mountain daylight time, an experimental amateur-built, CCK-1865 airplane, N66DN, was substantially damaged when it collided with terrain about 11 miles south of Moab, Utah. The private pilot and student pilot were fatally injured. The airplane was registered to Carroll Drilling LLC and operated by the pilot under the provisions of Title 14 *Code of Federal Regulations* Part 91 as a personal flight. Visual meteorological conditions prevailed, and no flight plan was filed for the local flight. The flight originated from Canyonlands Field Airport (CNY), Moab, Utah, about 0830.

2. DETAILS OF INVESTIGATION

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

Device 1:	Dynon FlightDEK-D180
Device 1 Serial Number:	003328
Device 2:	Garmin Aera 796
Device 2 Serial Number:	2CY003914

2.1. Dynon FlightDEK-D180 Device Description

The Dynon FlightDEK-D180 is a 7" wide screen display mounted in the cockpit of non-type certificated aircraft. The instrument integrates multiple flight instruments including airspeed, altitude, gyro-stabilized magnetic compass, turn rate, slip/skid ball, bank angle, pitch angle, and vertical speed. The unit also has other functions that include a clock/timer, g-meter, voltmeter, and a density altitude/true airspeed calculator. The unit contains an Air Data, Attitude and Heading Reference System (ADAHRS) to provide air data, attitude and heading information to the display. Depending on the installation in the operator's aircraft, certain parameters might not be displayed, for example angle-of-attack. The instrument also integrates up to 16 engine related instruments including manifold pressure, temperatures, RPM, and fuel system information. Depending on the

type of engine installed in the aircraft and pilot preferences, not all display options may be available.

Depending on the firmware version on the unit, the ability to log data to internal memory exists. According to the manufacturer, firmware versions 3.0 and later contain the ability to log certain engine parameters and firmware versions 5.0 and later contain the ability to log certain Electronic Flight Information System (EFIS) and GPS parameters. The data logging must be configured by the operator to enable logging and set the data log interval. The unit can also be configured to start logging data automatically at boot-up. The data logging interval can be set to store at 1, 3, 5, 10, 30, and 60 second intervals. The internal memory can store at least 30 minutes of cumulative data at a 1 second recording interval or at least 30 hours at a 60 second data recording interval. When the recording limit in the internal memory is reached, the oldest record is dropped and a new record is added.

2.1.1. Dynon FlightDEK-D180 Data Recovery

Upon arrival at the Vehicle Recorder Division, an exterior examination revealed the unit had sustained impact damage resulting in damage to the display and exterior housing as shown in Figure 1.

Figure 1. Dynon FlightDEK-D180 as received.



2.1.2. Dynon FlightDEK-D180 Data Description

The D180 received contained firmware version 5.4.3.239. Based on information from the manufacturer, the unit stores data. The operator had the datalog function enabled and it was set to record information at a 10 second interval and start recording at boot-up. The recording contained data from May 3, 2019¹, through June 30, 2019. The accident flight recording was the last event logged on the device and was approximately 28 minutes. Timing of the data is measured in seconds.

¹ All dates and times referenced to Coordinated Universal Time (UTC).

2.1.3. Dynon FlightDEK-D180 Parameters Provided

Conversion of the data from the raw recorded information to engineering units is performed by the Dynon product support download program. Table 1 describes data parameters provided by the device.

Table 1: Dynon Data Parameters

Parameter Name	Parameter Description
airspeed (kts)	Indicated Airspeed (knots)
altitude (ft)	Pressure Altitude (feet)
CHT # (degF)	Cylinder Head Temperature # (degrees Fahrenheit)
EGT # (degF)	Exhaust Gas Temperature # (degrees Fahrenheit)
fuel flow (gph)	Fuel Flow (gallons per hour)
gals rem	Fuel Remaining (gallons)
gps alt (ft)	GPS Altitude (feet)
grnd spd (kts)	Derived Ground Speed (kts)
gz (g)	Vertical Acceleration (acceleration)
heading (deg)	Magnetic Heading (degrees)
grnd trk (deg)	Derived Ground Track (degrees)
man pres (inHg)	Manifold Pressure (inches of Mercury)
oil pres (psi)	Oil Pressure (pounds per square inch)
oil temp (degF)	Oil Temperature (degrees Fahrenheit)
pitch (deg)	Pitch (degrees)
roll (deg)	Roll (degrees)
RPM (rpm)	Engine RPM (revolutions per minute)
vert spd (fpm)	Vertical Speed (feet per minute)

2.1.4. Time Correlation

The unit records clock time, either external or internal. The time is set by the operator for the internal clock or if the unit is connected to a GPS, the unit will use the GPS system time. The latitude, longitude, and time parameters directly correlated to the coordinates recorded on the Garmin Aera 796 device, therefore it was determined that the time recorded was UTC.

2.2. Garmin Aera 796 Device Description

The Garmin aera 796 is a battery-powered multi-function display and GPS receiver with a 7-inch diagonal high resolution touch screen. The unit includes a built-in Jeppesen database and can receive XM satellite radio for flight information including NEXRAD Radar, lightning, METARs, 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. With appropriate subscriptions, the unit can store and display geo-referenced VFR and IFR navigation charts, including IFR approach charts. The unit also has a “scratch pad” feature, allowing the user to hand write electronic notes.

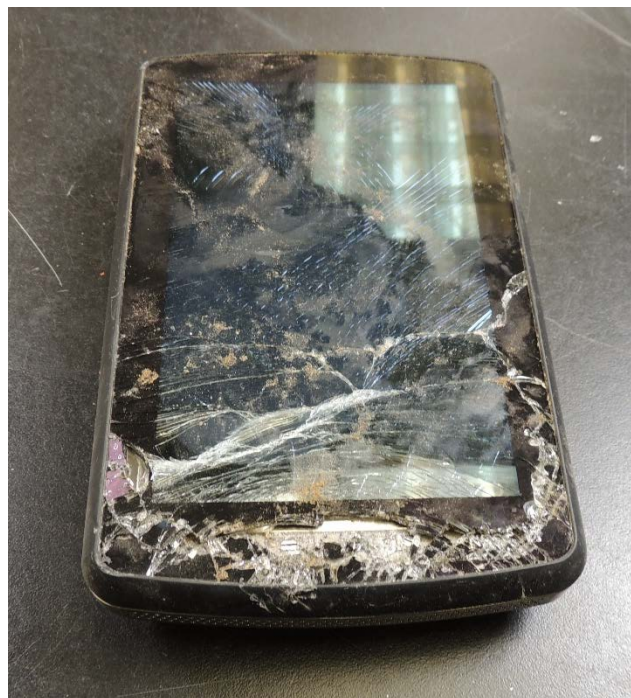
The unit stores date, route-of-flight, and flight-time information for up to 50 flights. A detailed track log – including latitude, longitude, date, time, and GPS altitude information for an unspecified number of points – is stored within the unit whenever the receiver has a lock on the GPS navigation signal. Position is updated within the track log as a function of time or distance moved, depending on how the unit has been configured. The current track log can be saved to long-term memory. Track log storage may be activated or deactivated at user discretion. All recorded data is stored in non-volatile 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. An internal button-battery is used to back up power to the internal memory and real-time clock during those periods when main power is removed.

2.2.1. Garmin Aera 796 Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed the unit had sustained impact damage resulting in damage to the screen as shown in Figure 2. Further inspection of the device indicated the damage was cosmetic and the device powered on normally and the data was extracted using laboratory tools.

Figure 2. Garmin Aera 796 as received.



2.2.2. Garmin Aera 796 Data Description

The data extracted included 31 sessions from June 10, 2019, through June 30, 2019. The accident flight was the last session, recorded starting at 14:08:30 UTC and ending at 17:37:10 UTC. The last point recorded showing the aircraft was in motion was recorded at 14:36:54 UTC, and the device continued to record static data for an additional 3 hours until the recording ended.

Table 2 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 2: GPS Data Parameters

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

3. Plots and Corresponding Tabular Data

Figures 3 through 6 are graphical overlays generated in Google Earth for the accident flight. Weather and lighting conditions shown in Google Earth may not be representative of the conditions at the time of the accident flight. Flight tracks for both the Garmin (green) and Dynon (purple) are included.

Figure 3 is an overlay of the entire accident flight. The timestamps and data points shown were recorded on the Garmin.

Figure 4 is an overlay generated showing the flight tracks recorded between 14:23:46 and 14:24:13 UTC.

Figure 5 is an overlay generated showing the flight tracks recorded between 14:28:58 and 14:29:59 UTC. The altitude values recorded by the devices may be less than the altitude values associated with the terrain model in Google Earth, thus the flight track is not visible for approximately 40 seconds of the data points recorded.

Figure 6 is an overlay at the end of the accident flight. The timestamps and data points shown were recorded on the Dynon with exception to the 14:34:19 data point. That Garmin data point was the second to last data point recorded showing the device was in motion. There were 2 minutes and 35 seconds between that data point and the last recorded data point showing the Garmin device in motion (14:36:54 UTC).

Figure 7 is a plot of Dynon FlightDEK-D180 basic parameters. The time interval displayed is 14:07:00 to 14:37:00 UTC.

Figure 8 is a plot of Dynon FlightDEK-D180 engine parameters. The time interval displayed is 14:07:00 to 14:37:00 UTC.

The corresponding tabular data used to create Figures 3 through 8 are provided in electronic comma separated value (csv) format as Attachment 1 for Garmin data and Attachment 2 for Dynon data to this report.

Figure 3. Google Earth overlay of the entire accident flight. The green flight track was recorded on the Garmin Aera 796 and the purple was recorded on the Dynon FlightDEK-D180. The timestamps and data values shown were recorded on the Garmin.

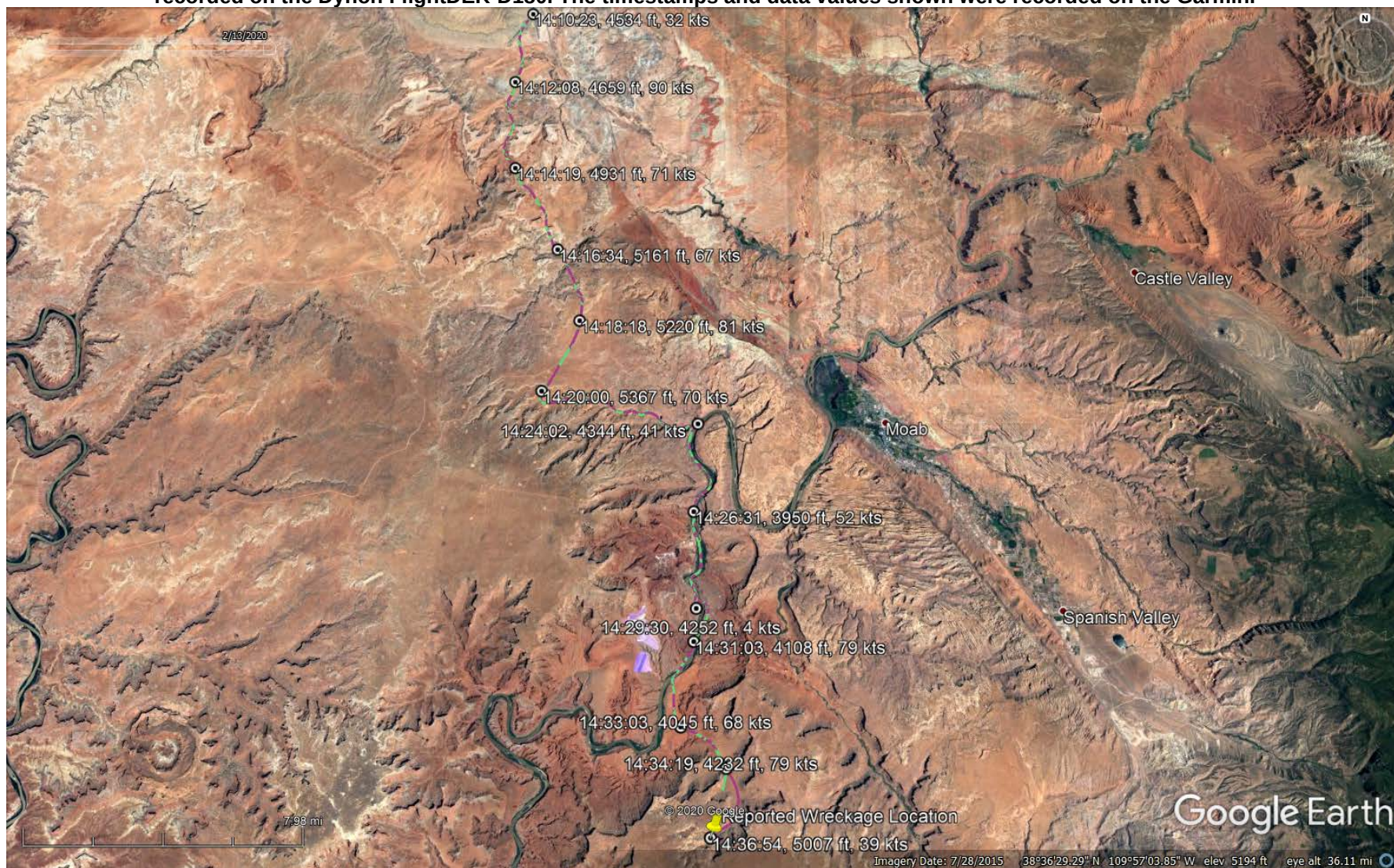


Figure 4. Google Earth overlay showing flight tracks recorded between 14:23:46 and 14:24:13 UTC. Garmin (green). Dynon (purple).

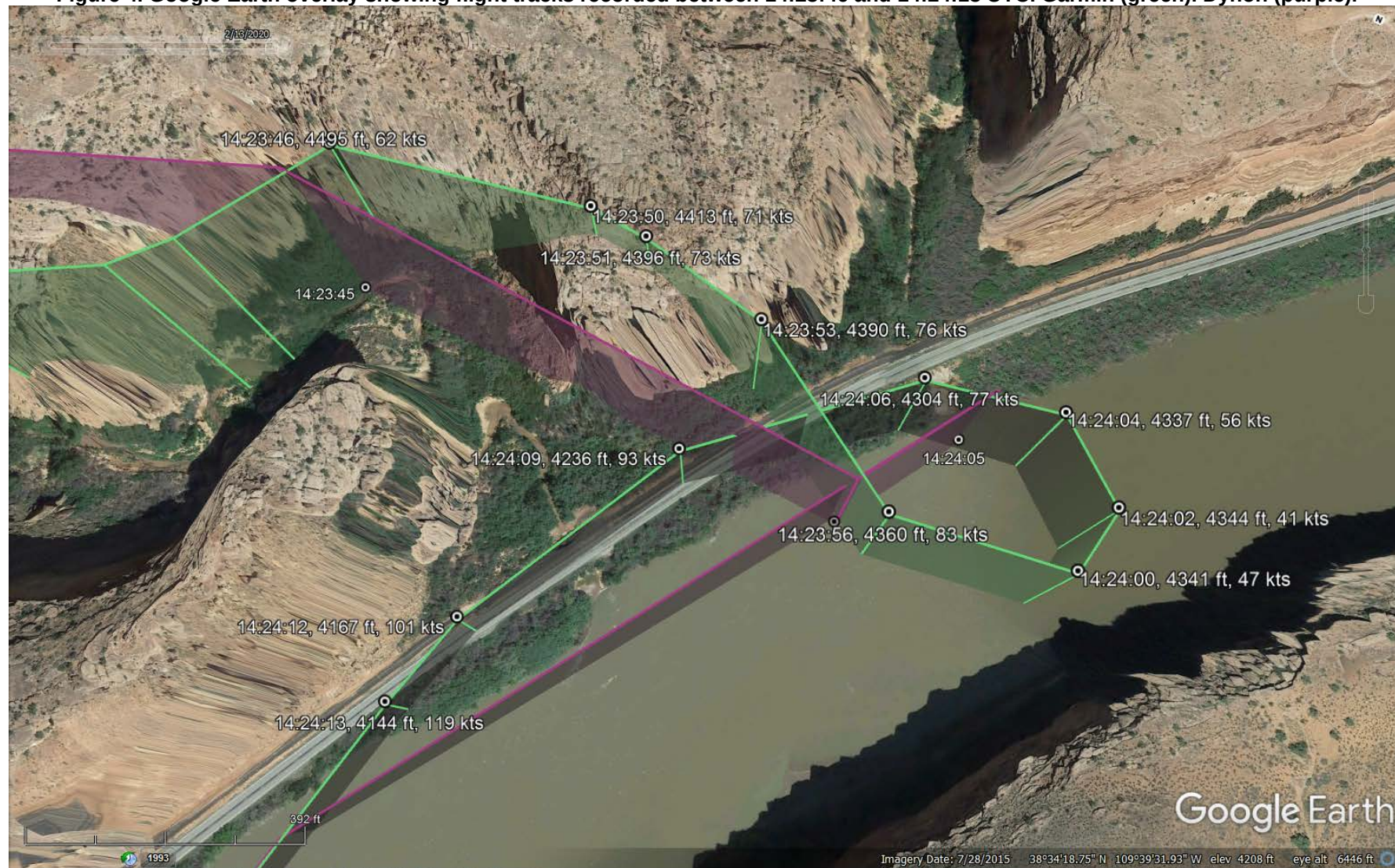


Figure 5. Google Earth overlay showing flight tracks recorded between 14:28:58 and 14:29:59 UTC. Garmin (green). Dynon (purple).

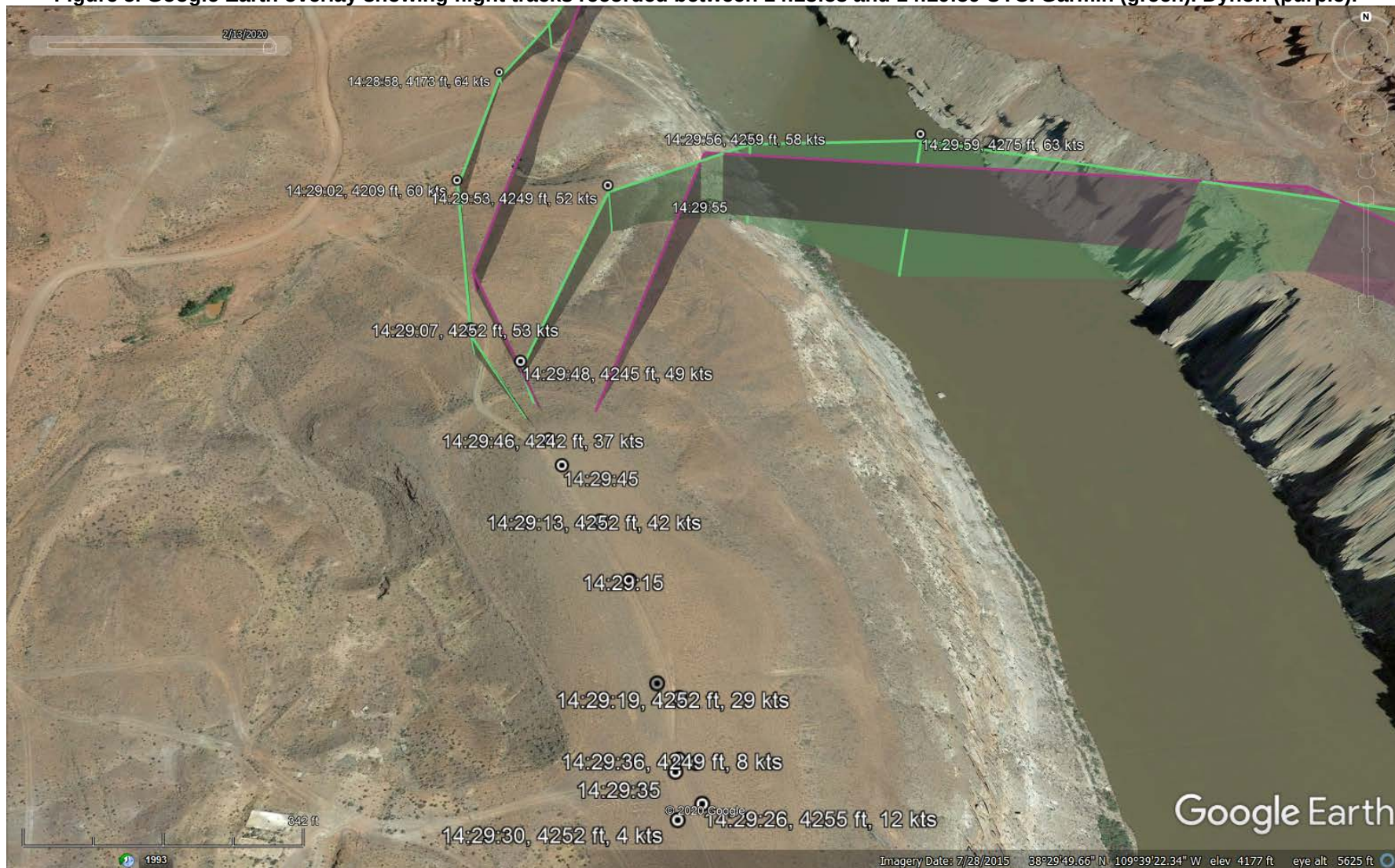


Figure 6. Google Earth overlay at the end of the accident flight. Garmin (green). Dynon (purple).

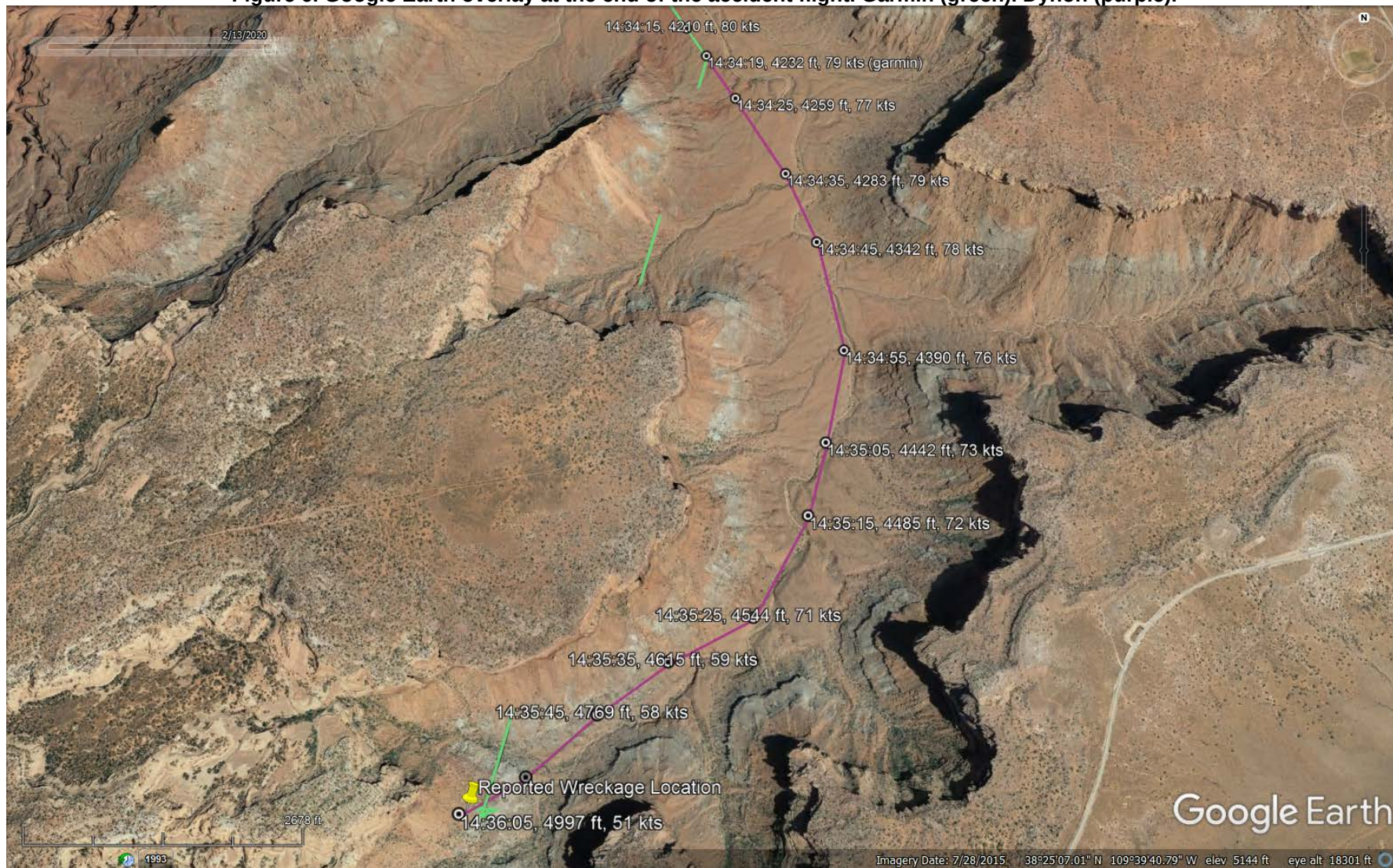


Figure 7. Plot of basic parameters recorded on the Dynon FlightDEK-D180.

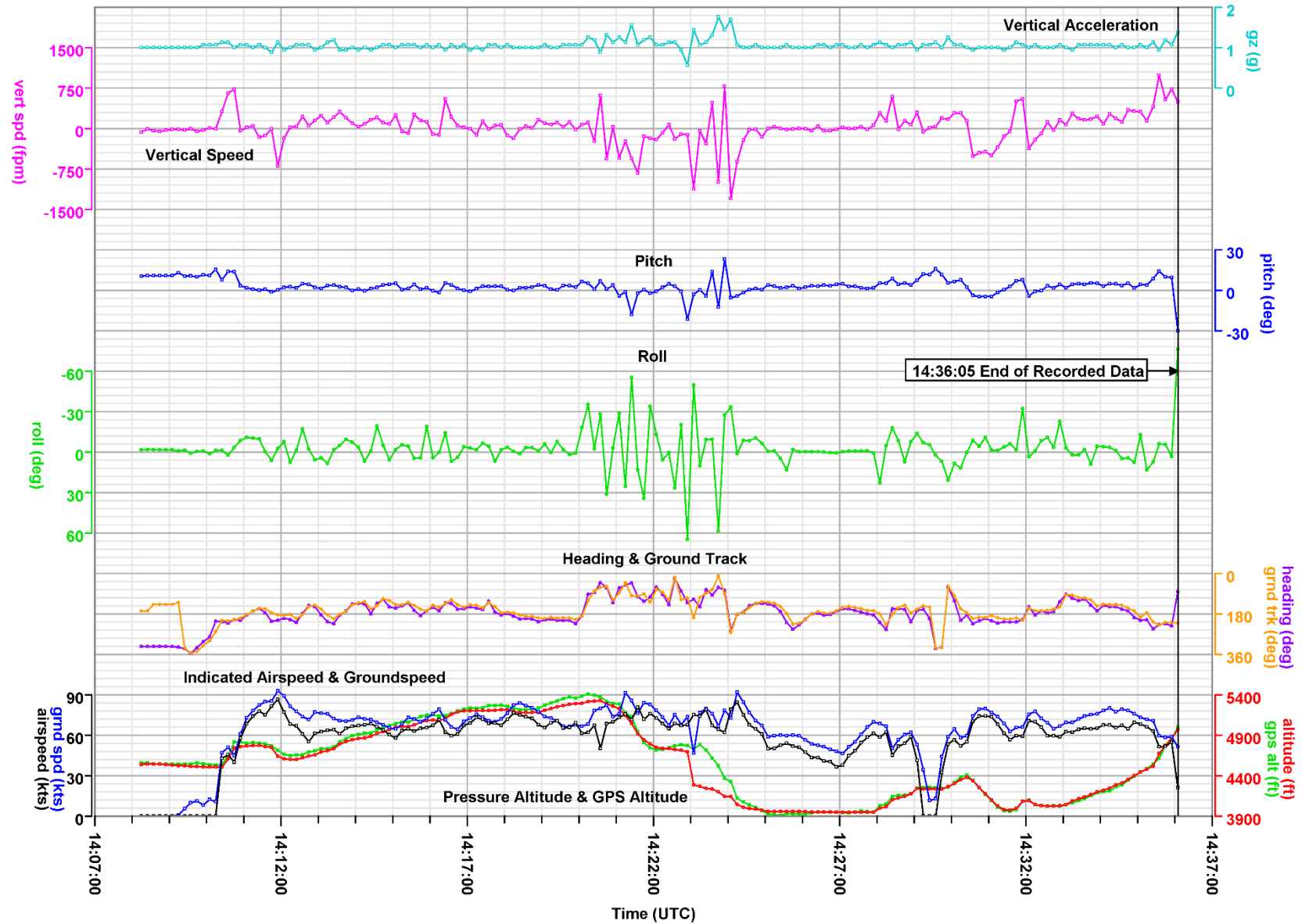


Figure 8. Plot of engine parameters recorded on the Dynon FlightDEK-D180.

