

NATIONAL TRANSPORTATION SAFETY BOARD

Vehicle Recorder Division
Washington, D.C. 20594

November 24, 2015

Non-Volatile Memory Devices

Specialist's Factual Report By Ben Hsu

1. EVENT

Location: Kuttawa, Kentucky
Date: January 2, 2015
Aircraft/ID: Piper PA-34-200T
Registration: N81291
Operator: Private
NTSB Number: ERA15FA088

2. DETAILS OF DEVICE INVESTIGATION

The National Transportation Safety Board's (NTSB) Vehicle Recorder Division received the following devices containing non-volatile memory¹:

Device: Garmin GPSMAP 496
Device Serial Number: 19727089

Device: Garmin GPSMAP 696
Device Serial Number: 1HG014068

Device: Apple iPhone 5s
Device Serial Number: DNQLJ6PQFNJL

All three devices exhibited minor damage due to the accident (Figures 1, 2, and 3). The devices were examined using laboratory hardware and software.

2.1. GPS Device Description

The Garmin GPSMAP 496 and 696 are portable GPS receivers capable of storing date, route-of-flight, and flight-time information for up to 50 flights. A detailed tracklog – including latitude, longitude, date, time, and groundspeed information – is stored within the unit whenever the receiver has a lock on the GPS navigation signal. All recorded data is stored in non-volatile memory. The unit contains hardware and software permitting the download of recorded waypoint, route, and tracklog information to a PC via a built-in serial port. The unit can also communicate with external devices such as a computer using 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.

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

2.2. GPS Data Description

The data extracted from the Garmin GPSMAP 496 included 7 sessions from October 28, 2014,² through January 2, 2015. The last recorded session was determined to be related to the accident and is included in this report.

The data extracted from the Garmin GPSMAP 696 included 53 sessions from November 20, 2013, to January 2, 2015. The last recorded session was determined to be related to the accident and is included in this report.

2.3. Parameters Provided

Table 1 describes data parameters provided by the GPS device. Date, Time, Latitude, Longitude, and GPS Altitude are recorded by the device. Course and Groundspeed are derived from the recorded 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 Altitude (feet)
Groundspeed	Average groundspeed between current and previous data point (knots)
Track	Average course between current and previous data point (degrees)

Table 1. GPS Data Parameters

2.4. Apple iPhone 5s Device Description

The Apple iPhone 5s is a personal electronic device (PED). PEDs are a category of devices comprised primarily of portable computing devices and mobile phones. Portable computing devices are typically capable of internet access, email, messaging services, and can run user-installed applications to perform specific tasks. Depending on the model, mobile phones can perform many of the same tasks as portable computing devices, plus have voice call and text messaging capabilities. PED user and system data is typically stored on non-volatile memory and can be accessed through manufacturer-provided interfaces.

2.4.1. Apple iPhone 5s Data Description

No accident-related data was found on the device.

3. OVERLAYS AND TABULAR DATA

Figure 4 is a graphical overlay generated using Google Earth for the end of the last session of both Garmin GPSMAP devices. Both devices recorded similar datasets, but the Garmin GPSMAP 496 recorded data for approximately 7 seconds longer than the Garmin GPSMAP 696.

² All dates and times are referenced to Coordinated Universal Time (UTC) unless otherwise specified.

The tabular data corresponding to the last session recorded by the Garmin GPSMAP 496 is included as Attachment 1.

The tabular data corresponding to the last session recorded by the Garmin GPSMAP 696 is included as Attachment 2.

These attachments are provided in electronic comma-separated value (CSV) format.



Figure 1. Photo of Garmin GPSMAP 496



Figure 2. Photo of Garmin GPSMAP 696



Figure 3. Photo of Apple iPhone 5s

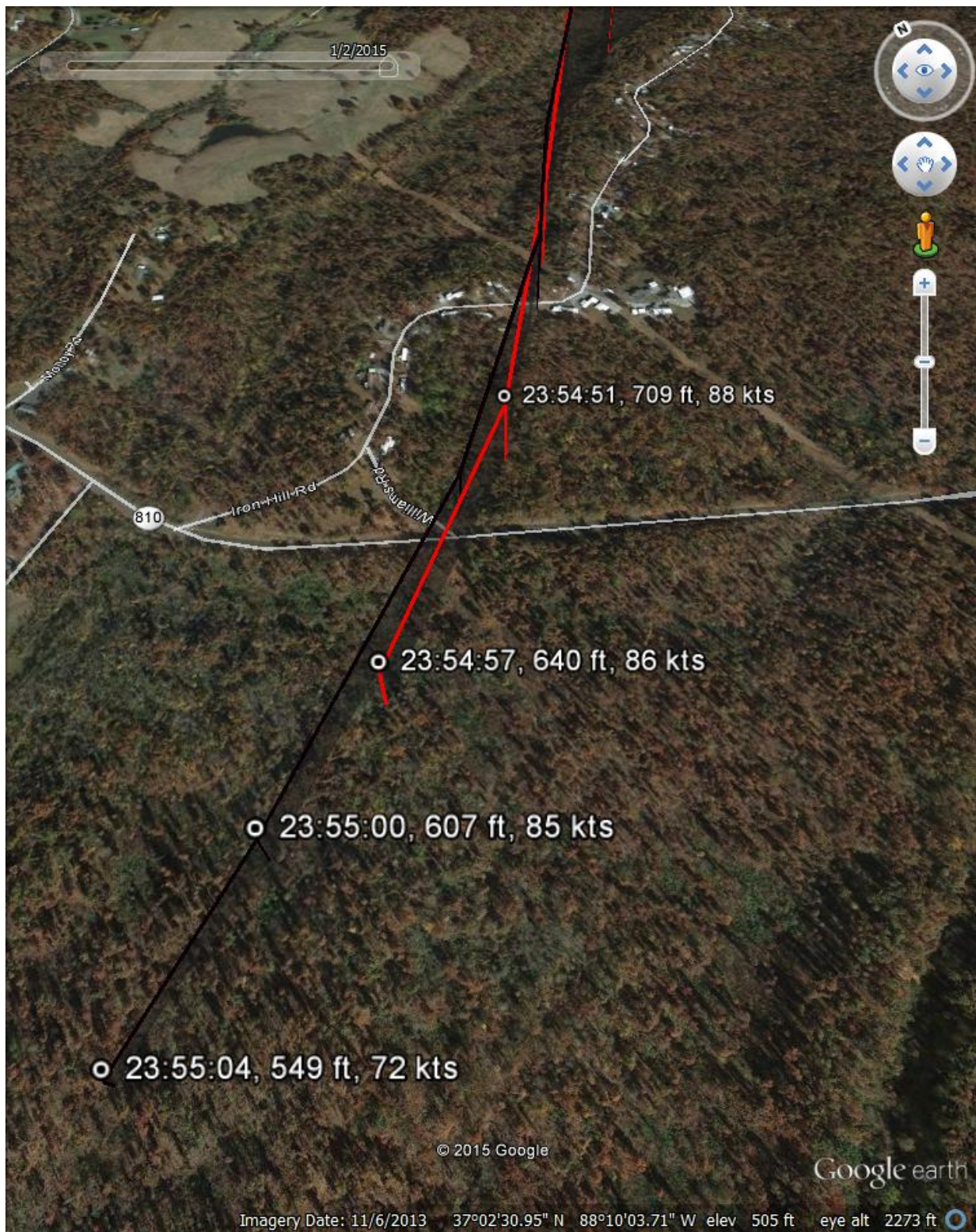


Figure 4. Google Earth Overlay of end of data recorded by the Garmin GPSMAP 496 (Black) and Garmin GPSMAP 696 (Red)