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

September 18, 2012

17 - GPS Factual Report

by Bill Tuccio

A. EVENT

Location:	Peru, West Virginia
Date:	October 2, 2011
Aircraft:	Piper PA-32R-300
Registration:	N115CL
Operator:	Private
NTSB Number:	ERA12FA012

B. GROUP - No Group

C. SUMMARY

On October 2, 2011, about 2045 eastern daylight time, a Piper PA 32R-300, N115CL, was substantially damaged when it impacted the trees and terrain in a mountainous, wooded area near Peru, West Virginia. The airplane departed from Danville Regional Airport (DAN), Danville, Virginia, about 1930 with an intended destination of John Murtha Johnstown-Cambria County Airport (JST), Johnstown, Pennsylvania. Night instrument meteorological conditions (IMC) prevailed and no flight plan was filed. The private pilot and two passengers were fatally injured. The personal flight was conducted under the provisions of 14 Code of Federal Regulations Part 91.

D. DETAILS OF INVESTIGATION

On October 11, 2011, the NTSB Vehicle Recorder Laboratory received the following device:

GPS Manufacturer/Model:	Garmin GPSMAP 496
Serial Number:	Unknown

Garmin GPSMAP 496 Device Description

The Garmin GPSMAP 496 is a battery-powered portable 12-channel GPS receiver with a 256-color TFT 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 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 500 feet, and ends when groundspeed drops below 30 knots for 10 minutes or more. A detailed tracklog – 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 tracklog as a function of time or distance moved, depending on how the unit has been configured. Once the current tracklog memory becomes full, new information either overwrites the oldest information or the recording stops, depending on how the unit is configured. The current tracklog can be saved to long-term memory and 15 saved tracklogs can be maintained in addition to the current tracklog. Tracklog storage may be activated or de-activated at user discretion. All recorded data is stored in non-volatile memory[1]. 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 using the NMEA 0183 version 2.0 protocol. 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.

GPS Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed that the unit had sustained major damage from impact as shown in figure 1. An internal inspection was performed and numerous components were found to be damaged (see figures 2-3). It was concluded that accident damage had rendered the unit irreparable.

The non-volatile memory chip was identified on the printed circuit board (PCB) as shown in figures 4 and 5. The memory chip was removed from the PCB using precision heat application. The 7x8 ball grid array (BGA) (56 ball connectors) on the memory chip was manually repaired (i.e., re-balled) as shown in figures 6 and 7, and the chip was read using an EPROM programming device. The chip memory was decoded to extract the track history.

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

Figure 1. Photo of damaged device, front.

Figure 2. Photo of disassembled unit.

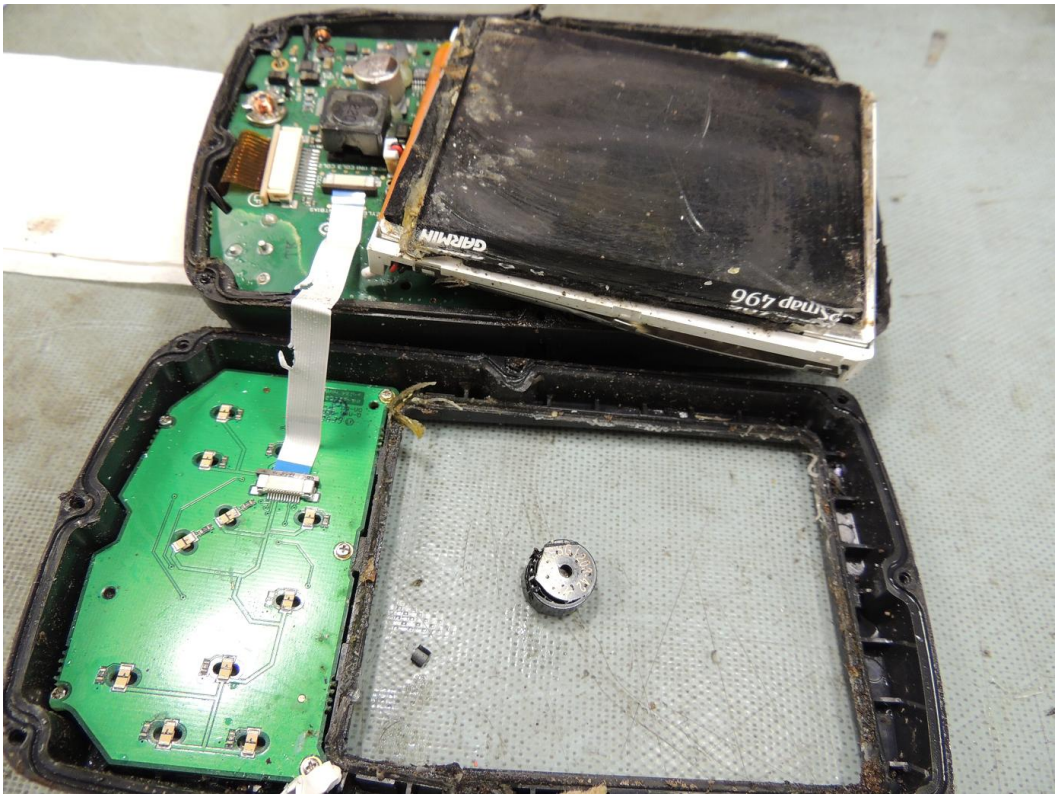


Figure 3. Photo of internal damage to PCB.

Figure 4. Non-volatile memory chip on printed circuit board.

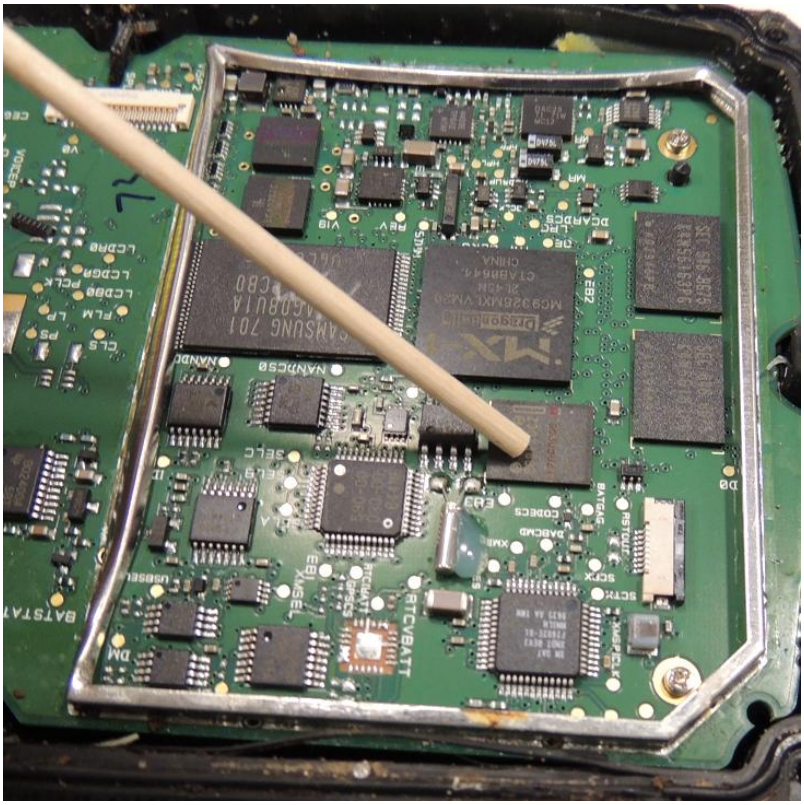


Figure 5. Microscopic photo of non-volatile memory chip on PCB.

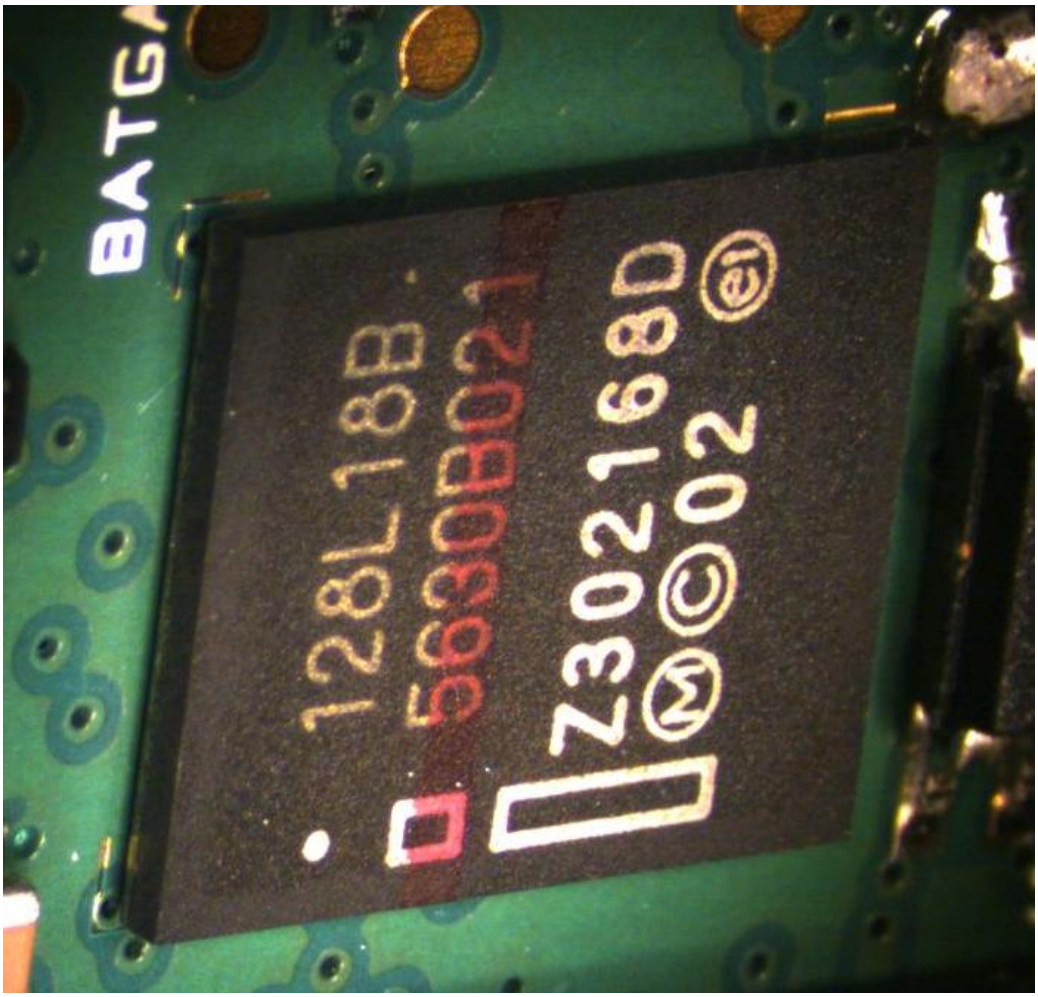


Figure 6. Microscopic photo of non-volatile memory chip after removal from PCB.

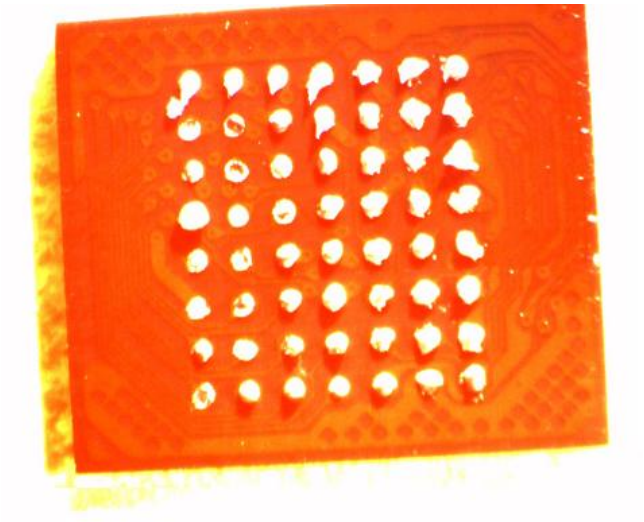
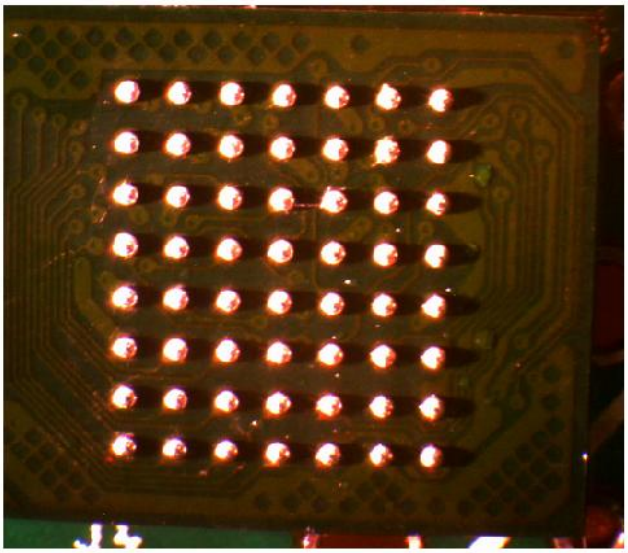


Figure 7. Microscopic photo of non-volatile memory chip after repair of BGA.



GPS Data Description

The data extracted included 21,487 tracklog history data points from September 2, 2008 through July 29, 2011. The accident flight was not contained in the tracklog history. The tracklog history did show flights predominately in the western United States, with many flights operating out of the Yuba County Airport, California.