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

December 3, 2014

GPS Factual Report

Specialist's Factual Report
by Alice Park

1. EVENT

Location:	Clay, Alabama
Date:	February 14, 2014
Aircraft:	Cessna 210L
Registration:	N732EJ
Operator:	SOUTHERN SEAPLANE INC.
NTSB Number:	ERA14FA120

On February 14, 2014, about 2221 Central Standard Time (CST), a Cessna 210L, N732EJ, crashed in a heavily wooded area near Clay, Alabama. The flight originated from Jackson-Medgar Wiley Evars International airport (JAN), Jackson Mississippi, about 2109 CST, and was destined for Birmingham-Shuttleworth International Airport (BHM), Birmingham Alabama.

2. DETAILS OF DEVICE INVESTIGATION

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

Device:	Circuit board of Garmin GPSMAP 396
Device S/N:	Unknown

2.1. Garmin GPSMAP 396 Device Description

The Garmin GPSMAP 396 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 NEXTRAD 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 track log – including latitude, longitude, date, time, and groundspeed 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.[1] 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 15 saved 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*[2] 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 serial port using the NMEA 0183 version 2.0 protocols. 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] A third "Resolution" setting is available which records a new track point only when the direction and speed have changed significantly. In this mode the unit examines current 2-D position, velocity, and ground track once per-second, and calculates a projected position. If the unit's actual position 1-second later differs from the projected position by a set value (25 meters, or 82 feet, by default), or if the ground track changes by more than 5°, a new track point is recorded. This saves memory during non-maneuvering flight.

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

2.1.1. Garmin GPSMAP 396 Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, the separated main circuit board of the Global Positioning System (GPS) was cleaned (see figure 1 and 2).

The GPSMAP 396 stores recorded data in *non-volatile* memory (FLASH).[3] This particular model stores recorded data on an AM29SL160CB12VD FLASH memory device mounted to the main PCB (see figure 1 and 2). The FLASH memory device was removed from the PCB using a hot air re-work station, reballed using an infrared re-work station, and a raw-data binary readout of the chip[4] was obtained using a *Xeltek SP-3000u* EEPROM programmer. Recorded track log data was identified and converted to engineering units using an in-house software program.

2.1.2.2.1. Garmin GPSMAP 396 Data Description

Track log data dated from June 26, 2012 to July 13, 2012 was recovered from the unit. No track log data was identified correlating with the date of the accident.

[3] FLASH Memory is a form of re-writeable, non-volatile memory that can retain data without external power - provided that the chip is not heated beyond the data retention temperature limit as stated in the datasheet.
[4] Chip: colloquial term for an integrated circuit device.

Figure 1. Internal view of the Garmin 396 main Printed Circuit Board (Flash memory device shown circled in red (front side)

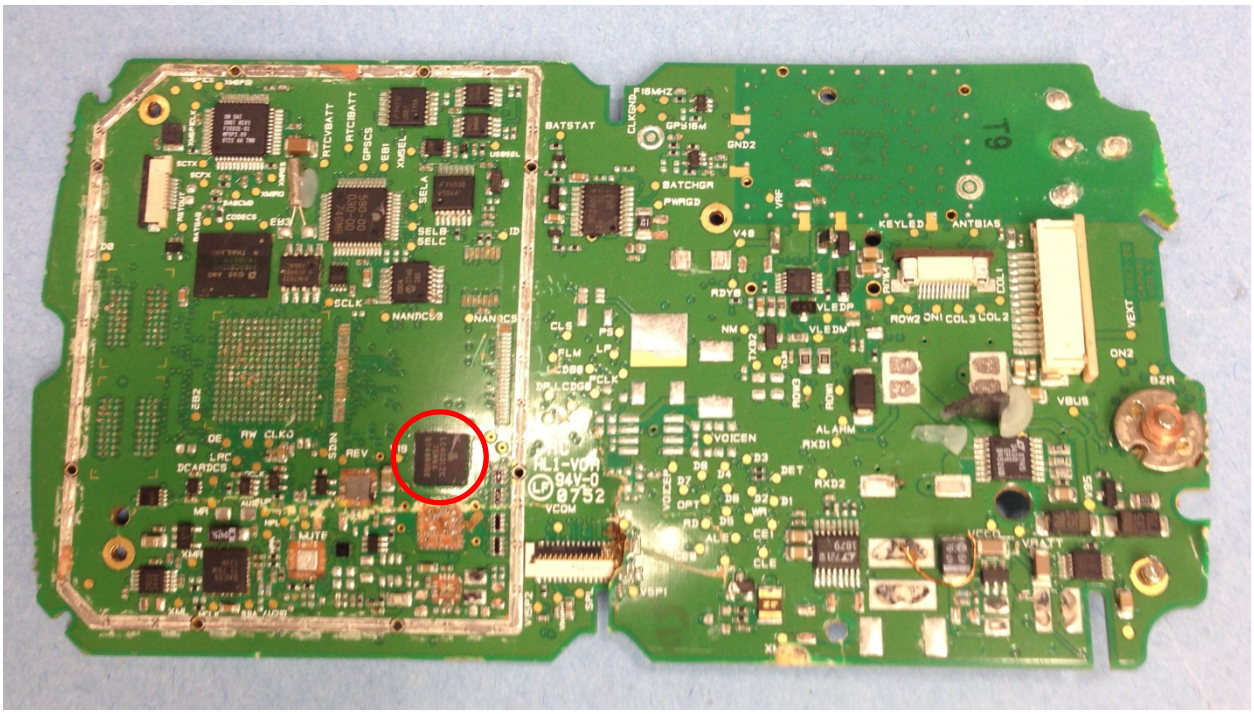

Figure 2. Internal view of the Garmin 396 main Printed Circuit Board (backside).