

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



GPS Factual Report

SEA08LA158

by

Joseph A. Gregor

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A. EVENT

Location:	Sierraville, California
Date/Time:	July 2, 2008 / 1307 Pacific Daylight Time (PDT)
Aircraft Type/ID:	Mauck RV-6A / N27WR
Operator:	Private
NTSB Number:	SEA08LA158

B. GROUP - No Group

C. SUMMARY

On July 2, 2008, about 1307 Pacific daylight time, a Mauck RV-6A, N27WR, was substantially damaged when it impacted trees while maneuvering near Sierraville, California. The airplane was registered to Tahoe Athletic Adventures Inc, of Tahoe City, California, and operated by the pilot under the provisions 14 Code of Federal Regulations Part 91. Visual meteorological conditions prevailed, and no flight plan was filed for the personal local flight that originated from the Truckee-Tahoe Airport, Truckee California, about 1254.

D. DETAILS OF INVESTIGATION

On August 11, 2008, the NTSB Vehicle Recorder Laboratory received the following device(s):

GPS Manufacturer/Model:	Garmin GPS III Pilot
Serial Number:	40903064

GPS Description: GPS III Pilot

The Garmin GPS III Pilot is a battery operated, portable 12-channel GPS receiver equipped with a 16 color LCD display. An external antenna, attached via a BNC-style connector, is required for reliable satellite reception. The GPS III Pilot is capable of storing position and altitude information for up to 500 waypoints in *volatile*¹ memory. Twenty routes, each representing a linked list of up to 30 waypoints, may also be stored in memory. A detailed tracklog - composed of latitude, longitude, date, time, and groundspeed information sampled at intervals while the unit is powered up and receiving satellite signals - can also be stored. The unit contains hardware and software permitting the download of recorded waypoint, route, and track log information via a Garmin proprietary interface. The communicates with other electronic devices via a serial port employing the NMEA 0183 protocol. 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 that the unit had sustained moderate damage from impact forces (see figures 1 - 5). After applying +12VDC to the unit via the serial port connector, an internal inspection was performed. The battery case was found to be ruptured and 0.05v was measured across the battery terminals to the main PC board. The internal backup battery was tested and found to be producing 3.0 volts. However, one terminal of the internal backup battery was disconnected from the board by impact forces. 1 ferrite coil was found damaged and two others were disconnected from the main PC board. One SMD² 'chip' capacitor was found disconnected from the main PC board due to impact forces. All coils were repaired and continuity verified. The chip capacitor and backup battery were electrically re-attached. The main PC board was removed from the accident unit and placed into a surrogate case, LCD, and soft-key subassembly. Power was applied to the unit after making all practicable repairs and no response was observed.

¹ Volatile memory requires a constant application of power to retain data. The instant power is removed from a volatile memory device, all stored data is lost.

² Surface Mount Device. A part designed to be soldered to pads residing on one face of a printed circuit board.

An Intel TE28F160 FLASH memory device was found present the main PC board. In order to determine if any recorded data was stored in *non-volatile* memory, a surrogate GPS III Pilot was obtained and the recorded data downloaded from this unit. The FLASH memory device was then removed from the accident GPS III Pilot and soldered into the surrogate. Power was again applied to the surrogate and recorded data downloaded. No change in downloaded data was observed. All power was removed from the surrogate and the internal backup battery was momentarily disconnected from the main PC board. Power was again applied to the surrogate and recorded data downloaded. The downloaded data was found cleared and corresponded to that found in an unused factory-new unit.

It has been verified that the GPS III Pilot stores recorded data in *volatile*³ memory (SRAM).⁴ Datasheets for the candidate SRAM chip⁵ within this unit (Mitsubishi M5M51016BTP) indicate that this devices require at least 2.0 volts in order to retain stored data. Since the backup battery was electrically disconnected from the main PC board, all recorded data was lost when prime power to the unit was interrupted.

GPS Data Description

No data was recovered from the unit.

Joseph A. Gregor
Electronic Engineer

³ Volatile memory requires a constant application of power to retain data. The instant power is removed from a volatile memory device, all stored data is lost.

⁴ Static Random Access Memory is a form of volatile memory that can retain data without need for periodic refreshing, provided that power is maintained to the device at all times.

⁵ Chip: colloquial term for an integrated circuit device.



Figure 1. External front view of the Garmin GPS III Pilot (s/n 40903064) showing signs of impact damage to the outer case and display.



Figure 2. External rear view of the Garmin GPS III Pilot (s/n 40903064) showing signs of impact damage to the outer case and display.

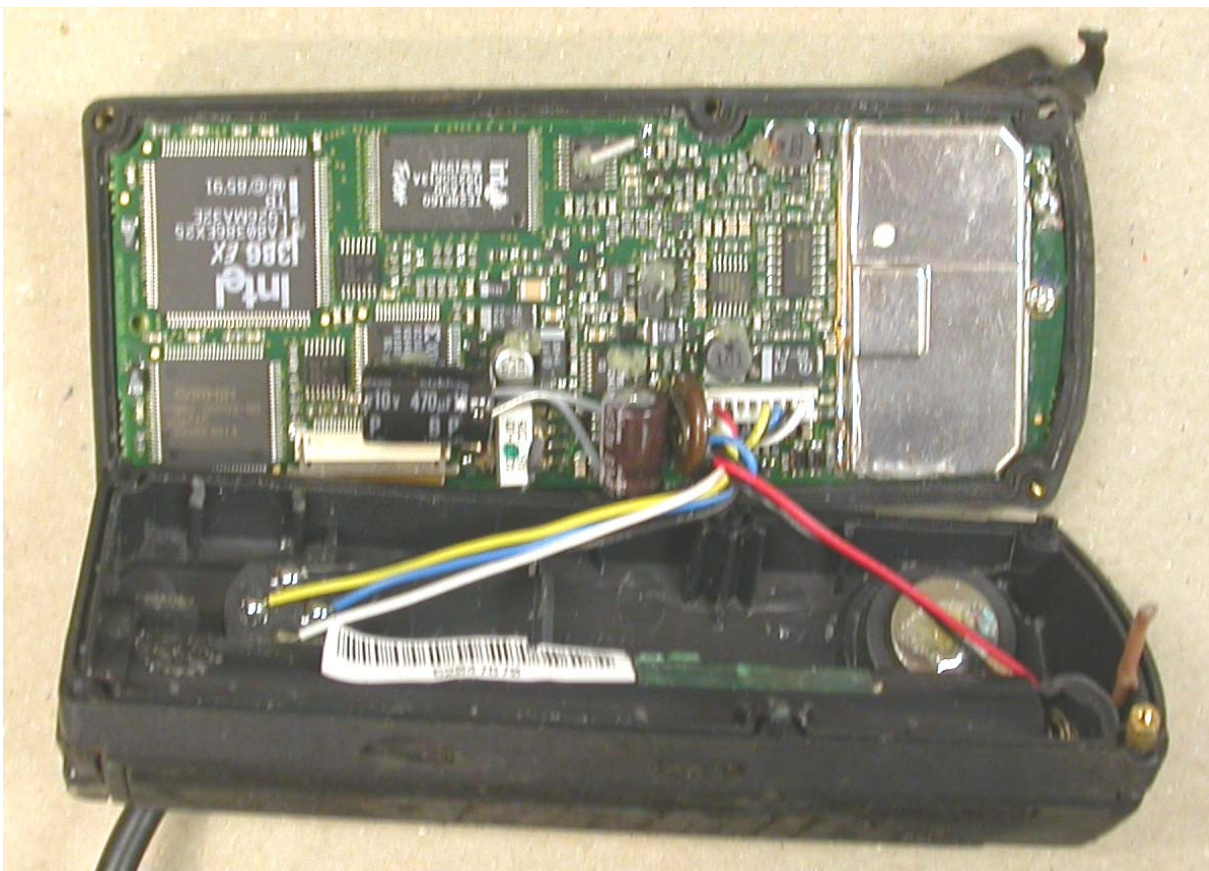


Figure 3. Internal view of the Garmin GPS III Pilot (s/n 40903064) showing signs of impact damage to the internal circuitry.

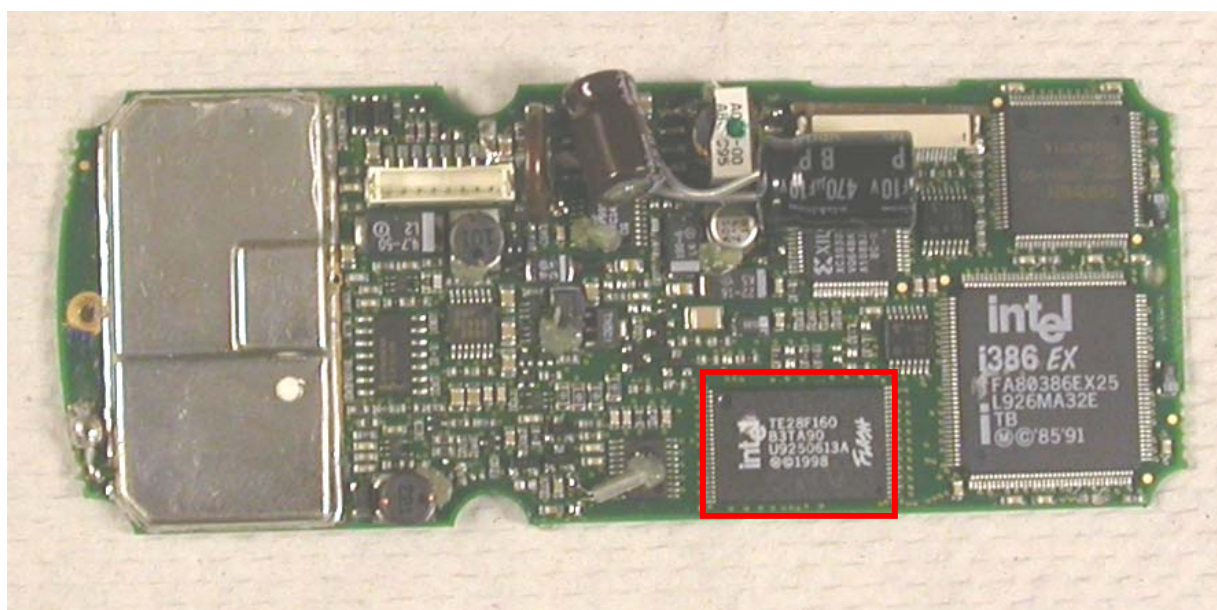


Figure 4. Obverse view of the GPS III Pilot (s/n 40903064) main PC board after repairs. The Intel TE28F160 FLASH memory device is indicated in red.

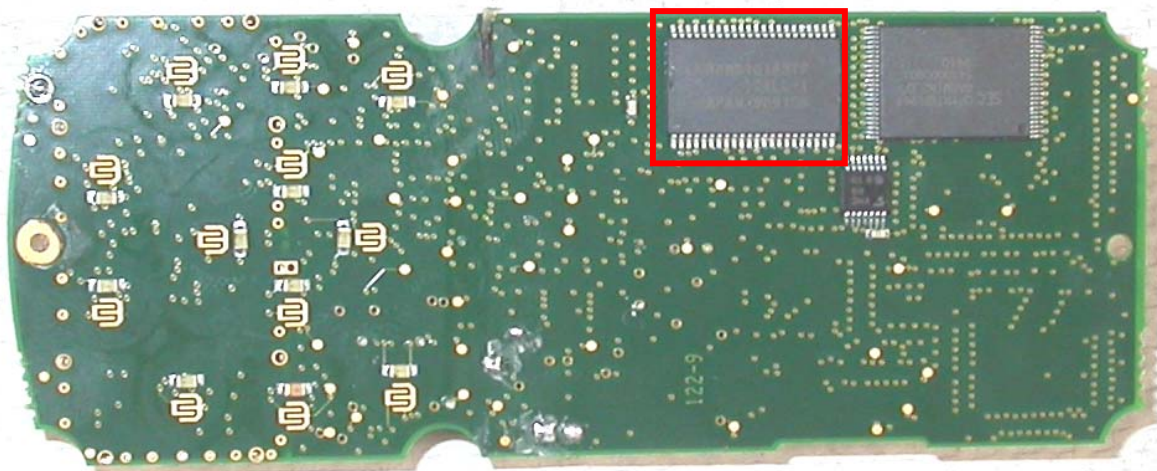


Figure 5. Reverse view of the GPS III Pilot (s/n 40903064) main PC board. The Mitsubishi M5M51016BTP SRAM device (*volatile memory*) is indicated in red.