

**NATIONAL TRANSPORTATION SAFETY BOARD**

Vehicle Recorder Division

Washington, D.C. 20594

August 8, 2013

## **GPS Factual Report**

**Specialist's Factual Report  
by Bill Tuccio**

**A. EVENT**

Location: Birdseye, Utah  
Date: June 27, 2013  
Aircraft: Cessna 172  
Registration: N4459R  
Operator: IMSAR Aviation  
NTSB Number: WPR13FA294

**B. GROUP - No Group**

**C. SUMMARY**

On June 27, 2013, about 1020 mountain daylight time, a Cessna 172M, N4459R, was substantially damaged when it struck powerlines and terrain during an attempted emergency landing on a road near Birdseye, Utah. The airplane was owned and operated by IMSAR Aviation, a wholly owned subsidiary of IMSAR, Springville, Utah. The commercial pilot was seriously injured, and the required crewmember received fatal injuries. The radar equipment test flight was operated under the provisions of Title 14 *Code of Federal Regulations* Part 91. Visual meteorological conditions prevailed, and no flight plan was filed for the flight.

**D. DETAILS OF INVESTIGATION**

The NTSB Vehicle Recorder Laboratory received the following device:

GPS Manufacturer/Model:	Lowrance AIRMAP 1000
Serial Number:	12087064

## Lowrance AIRMAP 1000 Description

The Lowrance AIRMAP 1000 is a WASS<sup>1</sup>-capable, battery operated hand-portable 12-channel mapping GPS unit equipped with a 320 x 320 pixel 16-level grayscale LCD display, soft key controls, and support for custom maps. The unit has the capability of performing E-6B<sup>2</sup> calculations. It contains a slot for a multi-media card (MMC) or Secure Digital (SD) FLASH<sup>3</sup> memory card. This card may be used to transfer and store custom map, waypoint<sup>4</sup>, route<sup>5</sup>, and trail<sup>6</sup> data to and from a desktop PC to the GPS unit. A serial interface using NMEA 0183<sup>7</sup> communication protocols is mounted in the back of the GPS unit, but the internal operating software does not support the download of saved data via this serial port.

The Lowrance AIRMAP 1000 can store up to 100 routes composed of up to 100 waypoints each. The unit can also store trail data composed of up to 10,000 latitude-longitude points per trail. Up to 100 individual trails may be named and saved by the user. Once the limit has been reached for recording continuously updated trail data trail, older latitude/longitude points are overwritten with new data on a first-in, first-out basis. The AIRMAP 1000 may be programmed to update trail data in one of three ways: automatically, by time, or by distance traveled. The default 'automatic' mode only updates trail data when the GPS unit senses that position has changed by at least 0.1 miles, or that direction has changed by 2° or more. Updating by time may be set to record a new latitude / longitude point every 1 to 9,999 seconds. Updating by distance may be set to record a new latitude/longitude point whenever the distance traveled from the last update exceed anywhere from 0.01 miles to 9.99 miles. All recorded data is stored internally in non-volatile memory<sup>8</sup>, and may be copied to a MMC or SD card inserted in a card slot in the battery compartment. The data is stored in a Lowrance proprietary \*.usr file format. This card may be read using a standard desktop PC running the Microsoft Windows operating system.

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<sup>1</sup> Wide Area Augmentation System. WAAS is based on a network of approximately 25 ground reference stations that covers a very large service area. Signals from GPS satellites are received by wide area ground reference stations (WRSs). Each of these precisely surveyed reference stations receive GPS signals and determine if any errors exist. Each WRS in the network relays the data to the wide area master station (WMS) where correction information is computed. The WMS calculates correction algorithms and assesses the integrity of the system. A correction message is prepared and uplinked to a geosynchronous satellite via a ground uplink system (GUS). The message is then broadcast from the satellite on the same frequency as GPS (L1, 1575.42MHz) to receivers on board aircraft (or hand-held receivers) which are within the broadcast coverage area of the WAAS. WAAS-capable receivers are capable of basic GPS accuracy to approximately 7 meters vertically and horizontally.

<sup>2</sup> E-6B is refers to mechanical and electronic tools assisting common flight related computations.

<sup>3</sup> 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

<sup>4</sup> Geographical point specified by a set of latitude and longitude data along with descriptive information.

<sup>5</sup> An ordered list of waypoints.

<sup>6</sup> Linked list of latitude and longitude data representing the position of the aircraft as a function of time.

<sup>7</sup> NMEA, National Marine Electronics Association. NMEA Standard 0183 is an ASCII-based serial communication protocol.

<sup>8</sup> Non-volatile memory is semiconductor memory that does not require external power for data retention.

## GPS Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed that the unit not sustained structural damage, but the display screen was damaged, as shown in figure 1. Power was applied to the accident unit but it did not start. The unit was disassembled and an internal inspection revealed no apparent damage, as shown in figure 2. Power was once again applied to the unit, but it did not start.

The Lowrance AIRMAP 1000 only records a sequence of latitude and longitude positions, without altitude or time. The recording mode may be such that positions are not recorded at fixed time or distance intervals, making groundspeed calculations imprecise or impossible. Current chip-level recovery techniques do not permit a discovery of the trail recording method (e.g., off, automatic, time intervals, or distance intervals). Further, a replacement screen was not available.

Given these considerations, no further recovery efforts were attempted.

**Figure 1. Front of Lowrance AIRMAP 1000.**



Figure 2. Disassembled Lowrance AIRMAP 1000.

