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

December 19, 2011

17 - GPS Factual Report

Specialist's Factual Report
by Bill Tuccio

1. EVENT

Location:	Crystal Lake, Illinois
Date:	November 26, 2011
Aircraft:	Cirrus SR20
Registration:	N223CD
Operator:	Private
NTSB Number:	CEN12FA083

On November 26, 2011, about 1025 central standard time (CST), a Cirrus Design SR20, N223CD, impacted a tree and terrain near Crystal Lake, Illinois. The pilot and three passengers were fatally injured. The airplane was substantially damaged. The aircraft was registered to Marion Pilots Club and operated by the pilot under the provisions of 14 Code of Federal Regulations Part 91 as personal flight, which was not operated on a flight plan. Instrument meteorological conditions prevailed in the vicinity of the accident site. The flight originated from Marion Regional Airport (MZZ), Marion, Indiana about 0830. The intended destination was DuPage Airport (DPA), West Chicago, Illinois.

2. DETAILS OF DEVICE INVESTIGATION

The Safety Board's Vehicle Recorder Division received the following devices on December 2, 2011:

Device 1:	Garmin GPSMAP 396
Device 1 Serial Number:	28210195
Device 2:	Apple iPhone 4
Device 2 Serial Number:	C8VF42NXDDP9
Device 3:	Motorola A956 Droid 2 Global
Device 3 Serial Number:	KAUG0048CF
Device 4:	Sagem Avionics ICDS Compact Flash (CF) Card
Device 4 Serial Number:	SM9FLAPC128M5 PM040621-M35

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 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 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.

2.1.1. Garmin GPSMAP 396 Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed that the unit had sustained major damage from impact and water damage (see figures 1 and 2). An external inspection was performed. Power was applied to the unit after the external inspection, however the unit did not power up or connect to the host computer for download. It was concluded that accident damage had rendered the unit irreparable.

The Garmin GPSMap 396 stores recorded data in non-volatile memory (FLASH)[2]. This particular model stores recorded data on an AMD29SL160C FLASH memory device mounted to the main printed circuit board (PCB). The main PCB was removed and cleaned using methanol and Cirozane electronic component cleaner. The FLASH memory device was removed from the PCB (see figures 3 and 4). Raw-data binary readout of the chip[3] was attempted using a Xeltek SP-3000u EEPROM programmer. However, the chip could not be read and no further recovery efforts were made.

[1] Non-volatile memory is semiconductor memory that does not require external power for data retention.
[2] 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.
[3] Chip: colloquial term for an integrated circuit device.

Figure 1. GPSMap 396, front of unit.

Figure 2. GPSMap 396, back of unit.

Figure 3. Memory chip removal.

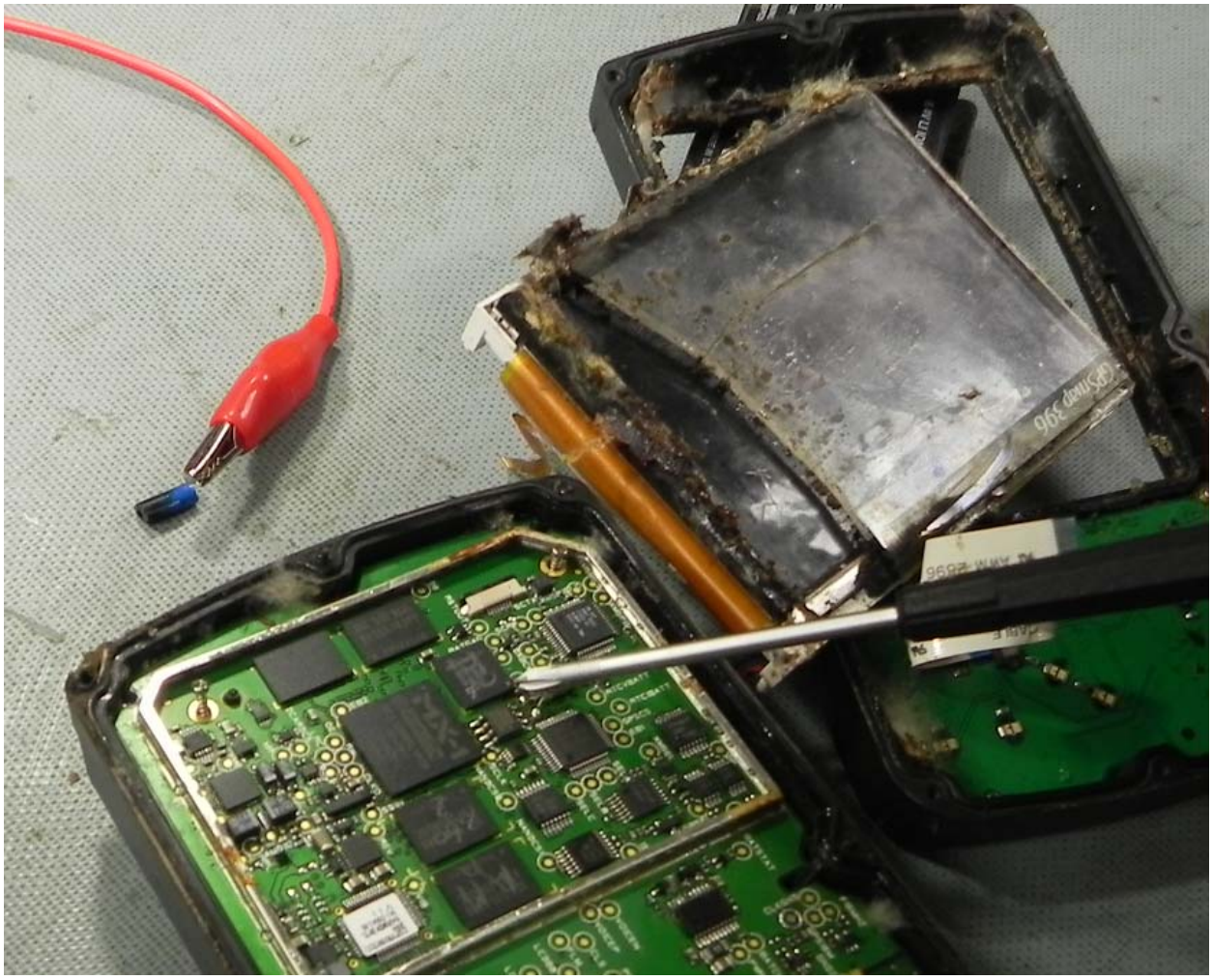
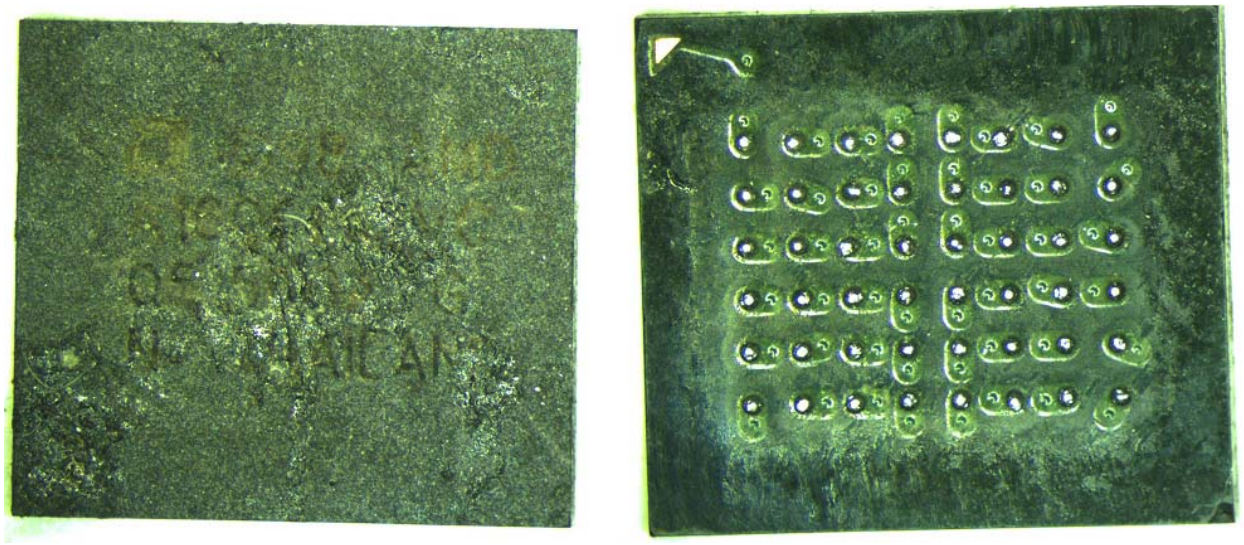


Figure 4. Magnified view of memory chip.



2.2. Apple iPhone 4 Device Description

The Apple iPhone is a touch-screen smart-phone capable of voice calling, text messaging, email, photo/video recording, audio (music) playback, and numerous other specialized functions depending on configuration. Specialized functions are supported by additional user-installed program applications (Apps). Application data is stored in non-volatile memory and may include call logs, text messaging logs, image, video, and position location information. In addition, the specialized application data may be stored in a proprietary file structure using numerous file formats. The amount and type of data stored varies based on the software version and configuration of the specific device.

2.2.1. Apple iPhone 4 Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed that the unit had sustained minimal damage. Power was applied to the unit and it was determined the unit was in Airplane Mode and wi-fi was also disabled. Further analysis determined there was no pertinent information for the investigation on the device.

2.3. Motorola A956 Droid 2 Global

The Motorola A956 Droid 2 Global is a touch-screen smart-phone capable of voice calling, text messaging, email, photo/video recording, audio (music) playback, and numerous other specialized functions depending on configuration. Specialized functions are supported by additional user-installed program applications (Apps). Application data is stored in non-volatile memory and may include call logs, text messaging logs, image, video, and position location information. In addition, the specialized application data may be stored in a proprietary file structure using numerous file formats.

2.3.1. Motorola A956 Droid 2 Global Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed that the unit had sustained minimal damage, though the battery was missing (see Figure 5). A replacement battery was inserted, power was applied to the unit, and the unit started normally. Further analysis determined there was no usable information for the investigation on the device.

Figure 5. Back of Droid showing minor damage and missing battery.

2.4. Sagem ICDS CF Card

The Sagem Integrated Cockpit Display System (ICDS) is a multi-function flight display unit. The Sagem ICDS CF Card is a data card that plugs into the unit.

2.4.1. Sagem ICDS CF Card Data Recovery

No information pertinent to the investigation was discovered on the CF card.