

NATIONAL TRANSPORTATION SAFETY BOARD

Vehicle Recorder Division

Washington, D.C. 20594

November 28, 2018

Non-Volatile Memory (NVM) Factual Report

by Joe Gregor

A. EVENT

Location: Cash, Arkansas
Date: July 8, 2017
Aircraft: Air Tractor Inc. AT-602
Registration: N4257R
Operator: Quad Rabbit Inc.
NTSB Number: CEN17FA259

B. SUMMARY

On July 8, 2017, about 1456 central daylight time, an Air Tractor Inc. AT-602 airplane, N4257R, was destroyed after impact with terrain near Cash, Arkansas. The airplane was registered to and operated by Quad Rabbit Inc. under the provisions of 14 *Code of Federal Regulations* Part 137 as an aerial spraying flight. Day visual meteorological conditions prevailed for the local flight, which departed from a private airstrip about 1431.

C. DETAILS OF INVESTIGATION

On July 21, 2017, the NTSB Vehicle Recorder Laboratory received the following devices from the AT-602 (N4257R):

NVM Manufacturer/Model:	Satloc M3 CPU
Serial Number:	1002-10724-0015

NVM Manufacturer/Model:	Hemisphere GPS Crescent R101
Serial Number:	Unknown

Hemisphere GPS Crescent R101

The Hemisphere GPS Crescent R101 is part of a GPS-based flight system designed to programmatically control aerial spray application using vendor and user specified mapping. This device does not record flight information.

Satloc M3 CPU

The Satloc M3 CPU is part of an on-board control system designed to programmatically control spray rates based on vendor and user specified mapping. It interfaces with other devices that provide GPS position location information and control aerial product application over specified spray routes. The M3 CPU records and retains a limited set of aircraft flight information on an internally mounted non-volatile¹ solid-state Flash drive (see figure 2).

NVM Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed that both units had sustained moderate impact damage. The internal Flash drive was removed from the Satloc M3 CPU and imaged using standard computer forensic tools. Flight log files corresponding to the date of the accident were recovered and decoded using the manufacturer's proprietary *MapStar* software.

NVM Data Description

Figures 3 – 4 are Google earth overlays² of the most recent track log recovered from the Satloc M3 CPU. Figure 3 shows the aircraft departing from an operating field approximately 4 miles southwest of Cash, Arkansas and performing aerial application operations on three fields close to the departure point. The aircraft then flew to another field approximately 3 miles east of Cash, Arkansas and performed aerial application operations on that field. The aircraft performed 14 passes and was in the process of actively spraying and near the end of the last pass when recorded data ended.

Data is buffered in volatile memory³ continuously during recording, and periodically written to the internal Flash drive. The length of this data buffer will vary depending on the internal processor workload, but can be on the order of 10-20 seconds, or longer. Data stored in the buffer and not written to the Flash drive is permanently lost when power is interrupted to the Satloc M3 CPU, as occurred in this accident.

Tabular data corresponding to this flight is provided in attachment 1 to this report. A key to this tabular data is given in appendix A.

¹ Non-volatile memory is semiconductor memory capable of retaining stored data in the absence of external power.

² Weather and seasonal conditions will generally vary from those extant at the time of the accident.

³ Volatile memory requires a continuous application of power to retain data. Any power interruption will result in irreversible data loss.

Figure 1. External view of the SATLOC M3 CPU.



Figure 2. Internal view of the SATLOC M3 CPU showing internal Flash drive.



Figure 3. Google Earth 2-D overlay depicting the accident flight from takeoff to the end of the recording.

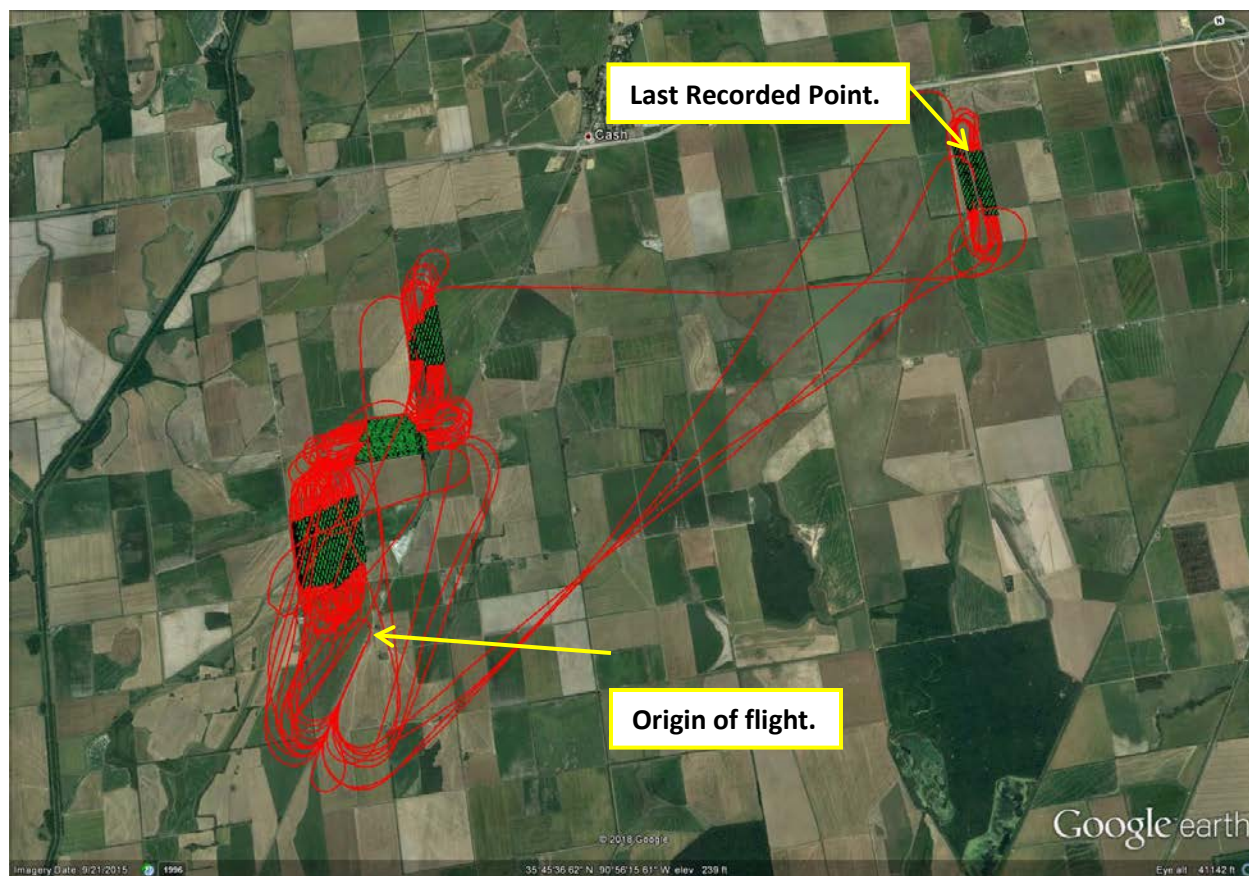


Figure 4. *Google Earth* 2-D overlay depicting the spray pattern followed at the last field to be treated during the accident flight.



APPENDIX A

Tabular data corresponding from a Satloc M3 CPU (s/n 1002-10724-0015) recovered from an Air Tractor Inc. AT-602, N4257R, that crashed during an agricultural application flight near Cash, Arkansas on July 8, 2017 is contained in Attachment 1 to this report.

LEGEND

Date	Date of recorded data point
Time	Time (CDT) of recorded data point
Latitude	Latitude coordinate in degrees
Longitude	Longitude coordinate in degrees
GPS Ellipsoidal Altitude	Altitude above a mathematical reference ellipsoid representing an average position of the earth surface (approximate to MSL)
Ground Speed	Computed ground speed in mph
Course	Computed true course in degrees