

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

February 24, 2020

Electronic Devices

Specialist's Factual Report
By W. Deven Chen

1. EVENT SUMMARY

Location: Monclova, Ohio
Date: September 11, 2019
Aircraft: Convair 440
Registration: N24DR
Operator: Ferreteria E Implementos San Francisco
NTSB Number: CEN19MA312

On September 11, 2019, at 0239 eastern daylight time, a Convair 440 airplane, N24DR, impacted trees and terrain while on final approach to runway 25 at the Toledo Express Airport (TOL). The accident site was located about 1/2-mile from the runway arrival threshold in Monclova, Ohio. Both pilots were fatally injured. The airplane was destroyed by impact forces and a postimpact fire. The airplane was registered to a private individual and operated by Ferreteria E Implementos San Francisco under Title 14 *Code of Federal Regulations* Part 125 as a non-scheduled cargo flight. Night visual meteorological conditions prevailed, and the flight was being operated on an instrument flight rules flight plan. The flight originated from the Millington-Memphis Airport (NQA), Millington, Tennessee, at 2314 central daylight time and was destined for TOL.

2. GROUP

A group was not convened.

3. DETAILS OF INVESTIGATION

The National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following electronic devices:

Recorder Manufacturer/Model: **Appareo Stratus 2S**
Recorder Serial Number: **011983**

Recorder Manufacturer/Model: **Apple iPad Pro**
Recorder Serial Number: **DMPWL56NHPDV**

3.1. Appareo Stratus 2S Description

The Appareo Stratus 2S device is a self-contained battery powered unit that contains an internal AHRS¹, GPS/WAAS receiver², and ADS-B³ receiver in one compact unit. The unit communicates wirelessly with compatible devices (iPad, iPhone etc.) to display all the acquired information. In addition to communicating with compatible devices, the Stratus device records GPS position and AHRS information internally on a non-volatile flash memory⁴ chip. Internal memory has the space to store over 13 hours of flight data that is sampled at approximately 5 data records per second (5 Hz).

3.1.1. Appareo Stratus 2S Data Recovery

Upon arrival at the Vehicle Recorder Division, an exterior examination revealed the device had sustained impact damage, as shown in Figure 1. An internal examination revealed there was no obvious visual damage on the circuit boards (Figure 2), which were then transferred to a surrogate device. The device powered up normally and the stored data was downloaded to a ForeFlight mobile application on an iPad via Wi-Fi. There were 26 track logs downloaded, as shown in Figure 3. However, none of the track logs were related to the accident. To confirm the result, a chip level recovery was performed. The NVM of the device was removed, readout, and converted to engineering units using laboratory tools. After the verification process, it was confirmed that the accident flight was not recorded. Thus, no accident related data were recovered from the device.



Figure 1: Front and back of Appareo Stratus 2S as received.

¹ The Attitude Heading Reference System consists of a set of 3-axis gyroscope, accelerometers and heading reference sensors that enable the unit to compute pitch, roll, and yaw motions.

² The Wide Area Augmentation System (WAAS) is an air navigation aid to augment the Global Positioning System (GPS), by improving its accuracy, integrity, and availability.

³ Automatic Dependent Surveillance-Broadcast (ADS-B) is a surveillance technology deployed throughout the national airspace system. The ADS-B system is composed of aircraft avionics and a ground infrastructure. Onboard avionics determine the position of the aircraft by using the GPS and transmit its position along with additional information about the aircraft to ground stations for use by air traffic control (ATC) and other ADS-B services. This information is transmitted at a rate of approximately once per second. Operators equipped with ADS-B realize additional benefits from ADS-B broadcast services: Traffic Information Service - Broadcast (TIS-B) (traffic information) and Flight Information Service - Broadcast (FIS-B) (weather information).

⁴ Non-volatile memory (NVM) is semiconductor memory that does not require external power for data retention.



Figure 2: Circuit boards of the Appareo Stratus 2S.

Figure 3: Total of 26 track logs downloaded to ForeFlight from the Appareo Stratus 2S.

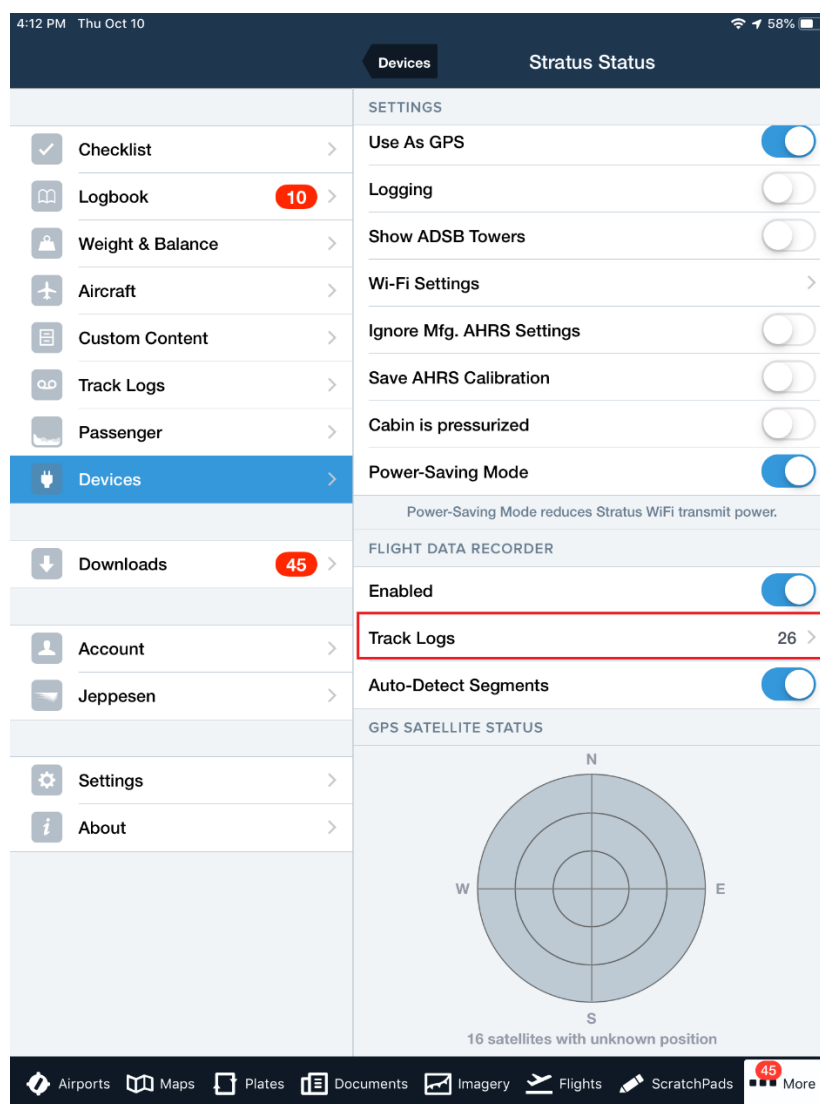


Figure 3: Total of 26 track logs downloaded to ForeFlight from the Appareo Stratus 2S.

3.2. Apple iPad Pro Description

The Apple iPad Pro is a personal electronic device (PED). PEDs are a category of devices comprised primarily of portable computing devices and mobile phones. Portable computing devices are typically capable of internet access, email, messaging services, and can run user-installed applications to perform specific tasks. Depending on the model, mobile phones can perform many of the same tasks as portable computing devices, plus have voice call and text messaging capabilities. PED user and system data is typically stored on non-volatile memory and can be accessed through manufacturer-provided interfaces.

3.2.1. Apple iPad Pro Data Recovery

Upon arrival at the Vehicle Recorder Division, an exterior examination revealed the device had severe impact and postimpact fire damage, as shown in Figure 4. The circuit board (Figure 5) was removed and sent to a data recovery facility. The full data of the device was recovered into an iTunes backup file which was then restored onto a surrogate device. There

were 14 flights found under the ForeFlight account on the iPad. However, none of the 14 flights were related the accident flight. Thus, no accident related data were recovered.



Figure 4: Apple iPad Pro as received.



Figure 5: Apple iPad Pro circuit board.