

NATIONAL TRANSPORTATION SAFETY BOARD

Vehicle Recorder Division

Washington, D.C. 20594

June 16, 2015

Electronic Devices Factual Report

Specialist's Factual Report

By Sean Payne

1. EVENT SUMMARY

Location: Ranger, Texas
Date: August 16, 2014
Aircraft: Lancair LC-40
Registration: N6500Z
Operator: Private
NTSB Number: CEN14FA437

2. RECORDER GROUP

A group was not convened.

3. SUMMARY

On August 16, 2014, about 2325 central daylight time, a Lancair LC40-550FG, N6500Z, impacted terrain after departing the Cook Canyon Ranch Airport (TA25), Ranger, Texas. The pilot and two passengers were fatally injured and the aircraft was destroyed. The aircraft was registered to and operated by River Bend Energy, LLC under the provisions of 14 Code of Federal Regulations Part 91 as a personal flight. Night visual meteorological conditions prevailed for the flight, which departed without a flight plan. The flight was originating at the time of the accident.

4. DETAILS OF RECORDER INVESTIGATION

4.1. Devices Received

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

Recorder Manufacturer/Model:	JPI EDM-730
Recorder Serial Number:	32122

Recorder Manufacturer/Model:	Shadin Fuel Flow Indicator
Recorder Serial Number:	8882

Recorder Manufacturer/Model:	Appareo Stratus PRX V2
Recorder Serial Number:	223439
Recorder Manufacturer/Model:	Apple iPad Mini
Recorder Serial Number:	F4KN0HVF19G
Recorder Manufacturer/Model:	Apple iPhone 5
Recorder Serial Number:	013424007725382
Recorder Manufacturer/Model:	Apple iPhone 5
Recorder Serial Number:	013328006997829
Recorder Manufacturer/Model:	Apple iPhone 4S
Recorder Serial Number:	N/A

4.2. Device Descriptions

4.1.1. JPI EDM-730

The J. P. Instruments EDM-730 is a panel mounted gauge that the operator can monitor and record up to 24 parameters related to engine operations. Depending on the installation, engine parameters monitored can include:

- Exhaust Gas Temperature (EGT)
- Cylinder Head Temperature (CHT)
- Oil Pressure and Temperature
- Manifold Pressure
- Outside Air Temperature
- Turbine inlet Temperature
- Engine Revolutions per Minute
- Compressor Discharge Temperature
- Fuel Flow
- Carburetor Temperature
- Battery Voltage

The unit can also calculate, in real-time, horsepower, fuel used, shock cooling rate and EGT differentials between the highest and lowest cylinder temperatures. The calculations are also based on the aircraft installation.

The unit contains non-volatile memory¹ for data storage of the parameters recorded and calculated. The rate at which the data is stored is selectable by the operator from 2 to 500 seconds per sample. The memory can store up to 20 hours of data at a 6 second sample rate. The data can then be downloaded by the operator using the J.P. Instruments software.

¹ Non-volatile memory – NVM - semiconductor memory that retains data in the absence of external power.

4.1.2. Shadin Fuel Flow Indicator

The Shadin Miniflo-L is a compact panel mounted fuel flow transducer that displays fuel flow information via an electronic numerical display. The device has the capability to interface to a GPS receiver to receive navigational data such as groundspeed, distance and estimated time enroute. When interfaced with a GPS device, the Miniflo-L can provide the following parameters:

- Specific Range
- Fuel to Destination
- Fuel Reserve
- Endurance
- Fuel Flow
- Fuel Used
- Fuel Remaining

The unit contains limited non-volatile memory for data storage and records the fuel set state at the beginning of the flight (user selection of the amount of fuel onboard) and the amount of fuel used during the flight.

4.1.3. Appareo Stratus PRX V2

The Appareo Stratus PRX V2 is a battery operated ADS-B² receiver with WAAS³ GPS capability designed to interface with an iPad running ForeFlight via WiFi⁴. The Stratus uses ADS-B to provide access to NEXRAD radar, METARs, TAFs, NOTAMs and other FAA products via the ForeFlight App installed on an iPad. The Stratus does not support the reception and display of ADS-B traffic information. Stratus includes a complete Attitude Heading Reference System (AHRS) that permits supplemental attitude information on the connected iPad.

Stratus PRX V2 units with firmware version 1.6 and later have the ability to record up to 20 hours of flight data at a rate of 5 samples per second. The records consist of the following parameters:

- GPS 3-D position
- Altitude
- Groundspeed
- AHRS Pitch, Roll and Yaw
- AHRS 3-D accelerations
- Heading
- Ground Track

² Automatic Dependent Surveillance - Broadcast; a supplement to the traditional radar-based aircraft surveillance system that uses aircraft transponder emissions to inform nearby aircraft of traffic location and movement. The system also supports the passing of weather information.

³ Wide-Area Augmentation System; an air navigation aid designed to augment traditional GPS by improving the accuracy, integrity, and availability of the GPS signal by using a network of ground-based reference stations to correct for small variations in the baseline GPS satellites signal.

⁴ WiFi – A local area wireless network.

4.1.4. Apple iPad Mini

The Apple iPad Mini is a tablet computer with a high-resolution color touch-screen interface. All iPad devices support WiFi and Bluetooth connectivity, and contain either 16, 32, or 64 GB, of non-volatile memory for storage (depending on model). Some devices also support data connectivity via the 3-G and LTE cell-phone networks. The iPad implements its functionality by running programs called “Apps” capable of supporting web-browsing, email, audio/video playback, contact and calendar management, and numerous other specialized functions. User-installed Apps can be used to support functionality for electronic flight bags, flight planning and filing, aviation weather depiction, and electronic flight charts. Application data is stored in non-volatile memory and may include image, video, and position location information. Specialized application data may be stored in a proprietary file structure using numerous proprietary file formats. The amount and type of data stored varies based on the software version and configuration of the specific device.

4.1.5. Apple iPhone

The Apple iPhone is a touchscreen smartphone capable of voice calls, text messaging, email, photo/video recording, and many other functions depending on the specific application(s) loaded. Data is stored on non-volatile¹ memory and may include call logs, text messaging logs, photos, videos, and location information. The amount and types of data stored varies based on the device’s software version and configuration.

4.3. Data Recovery

The following sections summarize the data recovered from each electronic device.

4.3.1. JPI EDM-730

The device arrived at the laboratory in a non-functional state (figure 1). The device exhibited heavy impact damage and was broken into five major pieces. The screen had detached from the device and the main board had become separated from the device’s mounting components. The main board was covered in a heavy layer of dirt. The portion of the device containing the NVM was cleaned and the critical data chip was identified as the U16 indexing chip. The U16 chip was removed from the board and was readout via PC through the appropriate binary chip fixture.

The binary data read from the chip was attempted to be converted through existing methods but did not reveal any flight data. The binary data revealed a brief engine log dated April 14, 2013 but was not a complete flight. Additionally, the binary data revealed an empty flight log file “flt00063” dated on August 17, 2014. The file, however, was 0 kilobytes in file size and did not contain any flight data. The process was repeated and the subsequent readout produced the same results.

Figure 1. The JPI EDM-700 as recovered from the wreckage site.



4.3.2. Shadin Fuel Flow Indicator

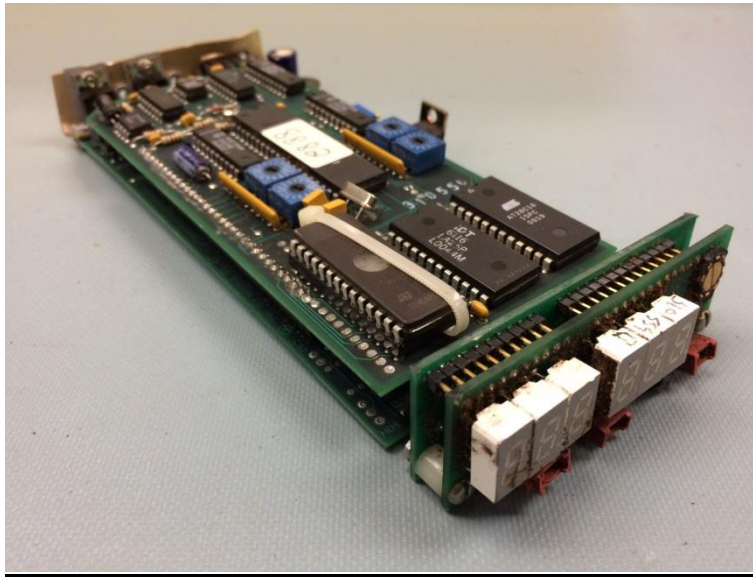
The Shadin Miniflo-L exhibited heavy impact damage to the device's exterior casing (figure 2). The exterior casing was removed and the internal components were evaluated for physical damage (figure 3). The device's internal components appeared damaged in the area near the display boards. Switches near the display boards were broken and the lower power board near the connector appeared damaged. The top processor board where the memory is housed, appeared mostly undamaged.

The manufacturer of the device was contacted and the possibility of conducting a binary readout of the chip was discussed. Since the only data that would be recovered was initial fuel state and fuel used until the time of power interruption (impact), in consultation with the Investigator-In-Charge, binary download of the device was not pursued.

Figure 2. The Shadin MiniFlo-L as recovered from the wreckage site.



Figure 3. The Shadin MiniFlo-L with the exterior housing removed.



4.3.3. Appareo Stratus PRX V2

The device arrived at the laboratory in a non-functional state (figure 4). The device's outer casing exhibited a general misalignment and some punctures. The device's outer casing was removed and the internal electronics were inspected. The power pins from the battery to the device were bent and not making contact with the internal electronic board. The pins were straightened and the device was secured back together to ensure the power pins would make contact with the electronic board. The device was then able to power on.

The manufacturer indicated that this unit would not have contained a firmware update that would have allowed recording of data to non-volatile memory. The crash occurred in August and the manufacturer did not offer the software update until late November of 2014. It was determined that the device contained no flight data.

Figure 4. The Appareo Stratus PRX V2 as recovered from the wreckage site.



4.3.4. Apple iPad Mini

The device was found to be in an extremely damaged state (figure 5). The screen was shattered and portions of the device were missing. The device's chassis was heavily bent throughout and many of the internal components were damaged or displaced. The device was covered in dirt and debris. The internal memory portion of the device was extracted and examined (figure 6). The main functional memory board was found to be cracked in a portion of the board (figure 7). Additionally, the board was bent and chips exhibited the possibility that they were electrically detached from the board. Figure 6 shows the memory board removed from the unit on the laboratory work station. Figure 7 shows the extent of the damage to this portion of the memory board. It was determined that the device was damaged beyond repair and further recovery attempts were not made.

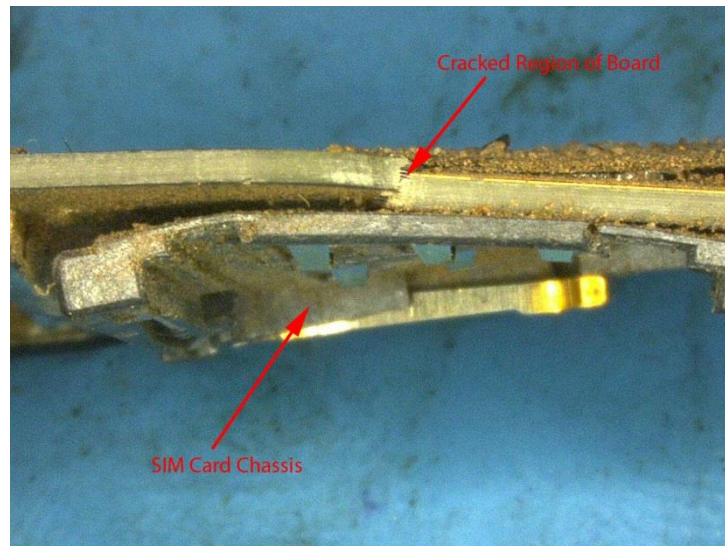
Figure 5. The Apple iPad Mini as recovered from the wreckage site.



Figure 6. The iPad mini's memory board removed from the device.



Figure 7. A crack through a portion of the iPad mini's memory board.



4.3.5. Apple iPhone5 (Passenger)

The Apple iPhone 5 was determined to belong to a passenger who was seated in the rear right seat of the aircraft during the accident flight. The iPhone was housed in a plastic case which protected the device from the impact forces of the crash. When the device was removed from its case, it was found in a mostly undamaged state (figure 8). The device was charged and was found to function normally. Upon powerup the device was found to be password protected. The password was obtained from a relative of the passenger and was used to unlock the device.

A review of the device's internal electronic contents revealed 4 photos that were determined to be taken near the time of the accident flight. These photos captured the

instrument panel and occupants, including the pilot, seated in the aircraft prior to take off. No inflight photos or videos were found on the device.

Figure 8. The Apple iPhone 5 as recovered from the wreckage site.



4.3.6. Apple iPhone 5 (Pilot)

An additional Apple iPhone 5 was determined to belong to the pilot of the accident aircraft who was seated in the front left seat of the aircraft during the accident flight. The phone arrived heavily damaged (figure 9). The screen was cracked and was non-functional. The device was also slightly bent. The device was opened in the laboratory and the unit's internal memory was extracted and placed in a surrogate device.

The device was not able to boot successfully. No data was recovered from the device.

Figure 9. The Apple iPhone 5 as recovered from the wreckage site.



4.3.7. Apple iPhone 4S

The Apple iPhone 4S was determined to belong to a passenger who was seated in the front right seat of the aircraft during the accident flight. The screen exhibited complete shattering and was non-functional (figure 10). The device was also bent. The device was opened in the laboratory and the unit's internal memory was extracted and placed in a surrogate device.

The surrogate device was powered successfully and the device was found to be password protected. The password was obtained from a relative of the passenger and was used to unlock the device.

A review of the device's internal electronic contents revealed 10 photos that were determined to be taken at the time near the accident flight. These photos captured the instrument panel and occupants, including the pilot, seated in the aircraft prior to take off. No inflight photos or videos were found on the device.

Figure 10. The Apple iPhone 4S as recovered from the wreckage site.



4.4. Time Correlation

4.4.1. Apple iPhone 5 (Passenger)

An examination of the recovered photos' metadata revealed the photos relevant to the investigation were taken on August 16, 2014 between 11:14 P.M. and 12:21 A.M. on the 17th. Additional timestamp validation was not explored.

4.4.2. Apple iPhone 4S

An examination of the recovered photos' metadata revealed the photos relevant to the investigation were taken on August 16, 2014 between 11:16 P.M. and 11:22 P.M. Additional timestamp validation was not explored.