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

March 16, 2017

Electronic Devices

Specialist's Factual Report
By Bill Tuccio, Ph.D.

1. EVENT SUMMARY

Location:	Houston, Texas
Date:	July 8, 2016
Aircraft:	Piper PA-32R-300
Registration:	N32KK
Operator:	Private
NTSB Number:	CEN16FA261

On July 8, 2016, about 1615 central daylight time (CDT), a Piper model PA-32R-300 single-engine airplane, N32KK, was destroyed during a postimpact fire following a loss of control shortly after takeoff from the West Houston Airport (IWS), Houston, Texas. The private pilot and his three passengers were fatally injured. The airplane was registered to and operated by the pilot under the provisions of 14 *Code of Federal Regulations* Part 91 without a flight plan. Day visual meteorological conditions (VMC) prevailed for the personal cross-country flight that had an intended destination of Gillespie County Airport (T82), Fredericksburg, Texas.

2. GROUP

A group was not convened.

3. DETAILS OF INVESTIGATION

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

Device:	**Apple iPad 4**
Serial Number:	**DMPKKCFPF18W**
Identifier:	**IIC-001**

Device:	**Apple iPad (Model Unknown)**
Serial Number:	**Unknown**
Identifier:	**IIC-002**

Device:	**Apple iPad (Model Unknown)**

Serial Number: **Unknown**
Identifier: **IIC-003**

Device: **Apple iPad Mini**
Serial Number: **Unknown**
Identifier: **IIC-004**

Device: **Apple iPhone 5S**
Serial Number: **Unknown**
Identifier: **IIC-005**

Device: **Aspen EFD1000 Pro**
Serial Number: **Unknown**
Identifier: **IIC-006**

Device: **Electronics International UBG-16**
Serial Number: **Unknown**
Identifier: **IIC-007**

Device: **Electronics International MUX-8A**
Serial Number: **Unknown**
Identifier: **IIC-008**

Device: **Electronics International FP-5L**
Serial Number: **097646**
Identifier: **IIC-009**

3.1. Device Description

Apple iPads and iPhones are personal electronic devices capable of portable computing and communication functions.

The Aspen EFD1000 Pro is a multi-function cockpit display capable of displaying primary flight display information (including airspeed and altitude) as well as navigational information. According to the manufacturer, the unit does not record any historical information.

The Electronics International UBG-16 is an engine monitor capable of displaying exhaust gas temperature, cylinder head temperature, and other engine parameters depending upon installed options. The FP-5L is a fuel computer, capable of displaying instantaneous fuel flow and total fuel usage/remaining information. The UBG-16 and FP-5L do not store historical data.

The MUX-8A is a recording device that interfaces with other Electronics International devices, such as the UBG-16 and FP-5L, as well as RS-232 Global Positioning System (GPS) data. Recorded channels, time-out period, factory reset, and recording rate are configurable at time of installation by a set of 12 dip switches. Depending on configuration,

the unit can record up to 600 hours of data to non-volatile memory;[1] once the memory is full, the oldest data is overwritten. The data may be downloaded using the manufacturer's proprietary software and cabling. The MUX-8A uses an internal timer powered by an integrated, 10-year battery. When data is downloaded, the local time of the PC is used as a time reference to adjust all internal timer data to local time.

3.2. Device Condition

All devices received were exposed to heat and/or structural damage, as follows:

- **IIC-001: Apple iPad 4.** Figure 1 shows the device as received. An internal inspection revealed the memory board was intact, as shown in figure 2, and further recovery efforts were made (as described in the following sections of this report).

- **IIC-002: Apple iPad.** Figure 3 shows this device experienced significant heat and structural damage. Damage precluded further recovery efforts.

- **IIC-003: Apple iPad.** Figure 4 shows this device experienced significant heat and structural damage. Damage precluded further recovery efforts.

- **IIC-004: Apple iPad Mini.** Figure 5 shows this device experienced significant heat and structural damage. Damage precluded further recovery efforts.

- **IIC-005: Apple iPhone 5s.** Figure 6 shows this device experienced significant heat and structural damage. Damage precluded further recovery efforts.

- **IIC-006: Aspen EFD1000.** Figure 7 shows this device experienced significant heat and structural damage. An internal inspection revealed the internal components were intact, as shown in figure 8. However, according to the manufacturer, the device did not retain any data.

- **IIC-007: Electronics International UBG-16.** Figure 9 shows this device experienced significant heat damage. Damage precluded further recovery efforts.

- **IIC-008: Electronics International MUX-8A.** Figure 10 shows this device experienced significant heat damage. An internal inspection revealed the internal components were intact, as shown in figures 11 and 12. Further recovery efforts were attempted as described in the following sections of this report.

- **IIC-009: Electronics International FP-5L.** Figure 13 shows this device experienced significant heat damage. Damage precluded further recovery efforts.

[1] Non-volatile memory does not require a power source to retain information.

Figure 1. IIC-001: Apple iPad 4 as received.

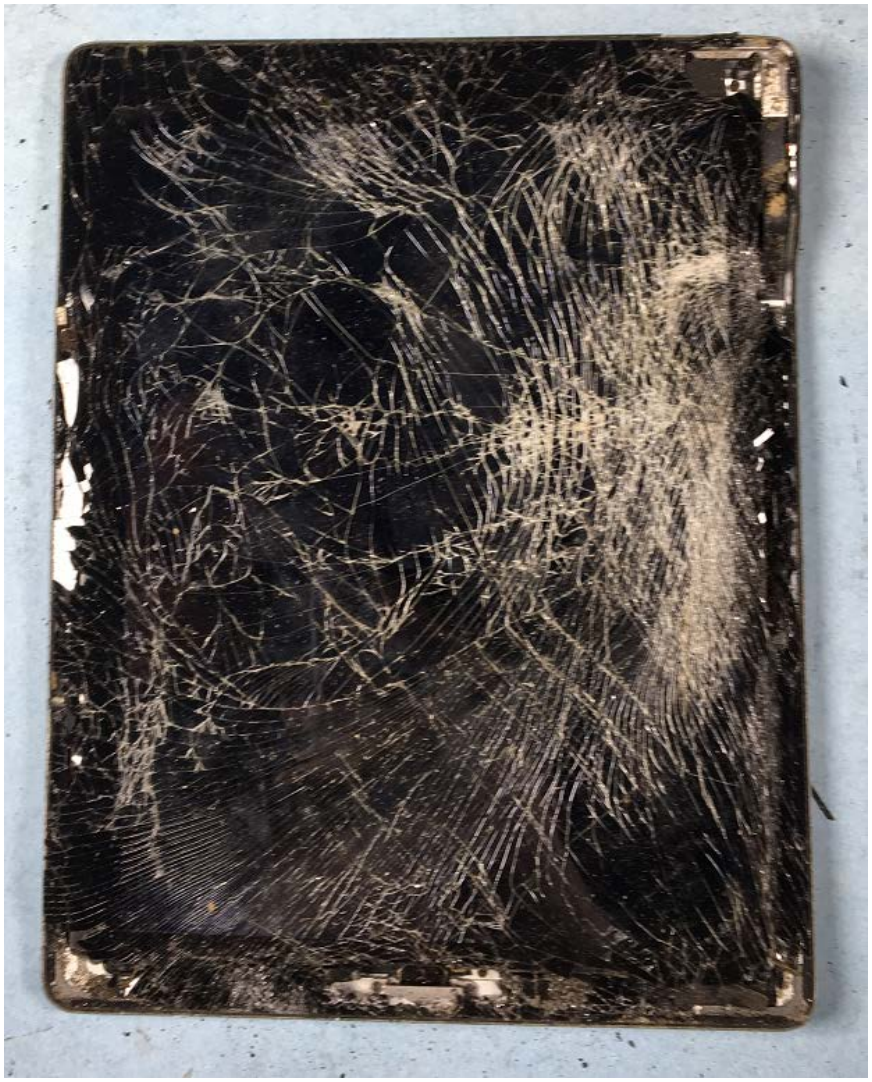

Figure 2. IIC-001: Apple iPad 4, internal main board (expanded in inset).

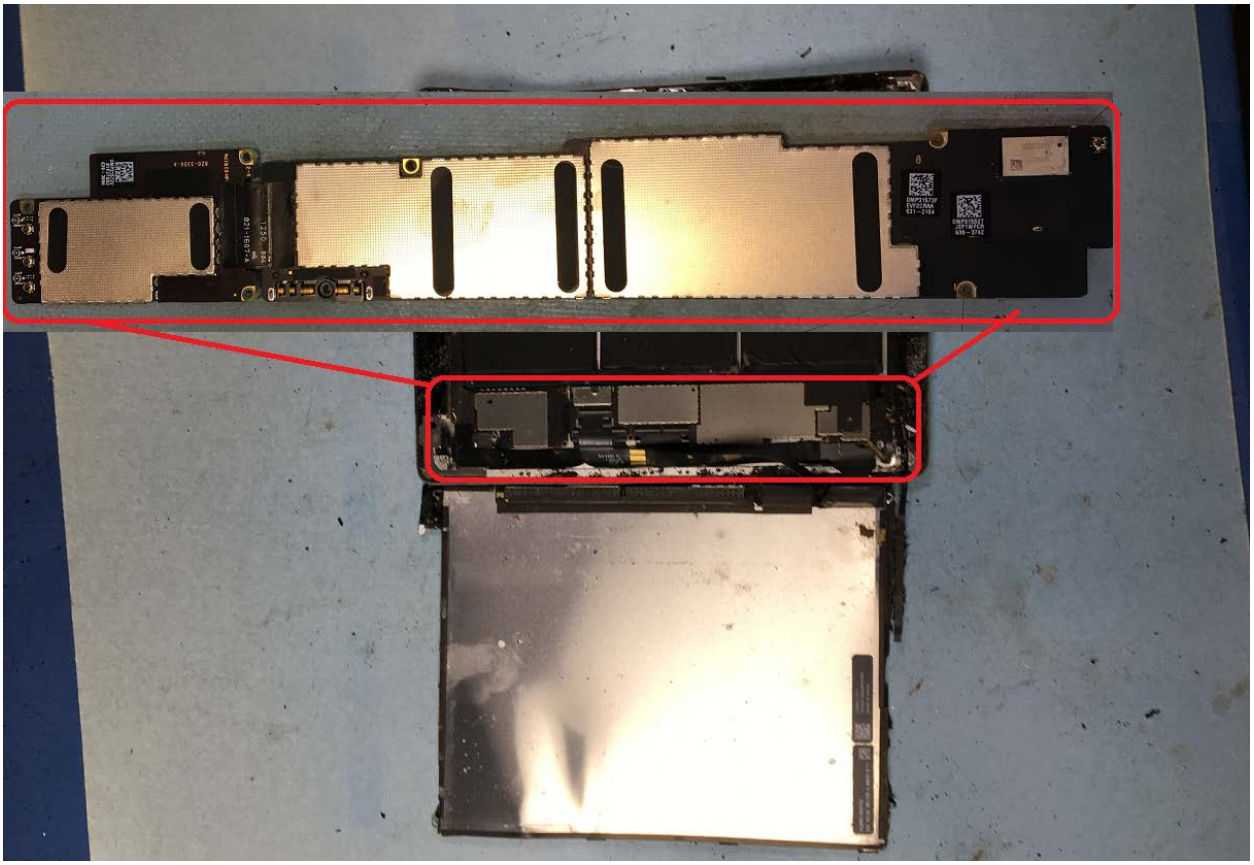

Figure 3. IIC-002: Apple iPad, model unknown due to damage.

Figure 4. IIC-003: Apple iPad, model unknown due to damage.

Figure 5. IIC-004: Apple iPad Mini, model unknown due to damage.

Figure 6. IIC-005: Apple iPhone 5s.

Figure 7. IIC-006: Aspen EFD1000 Pro, as received.

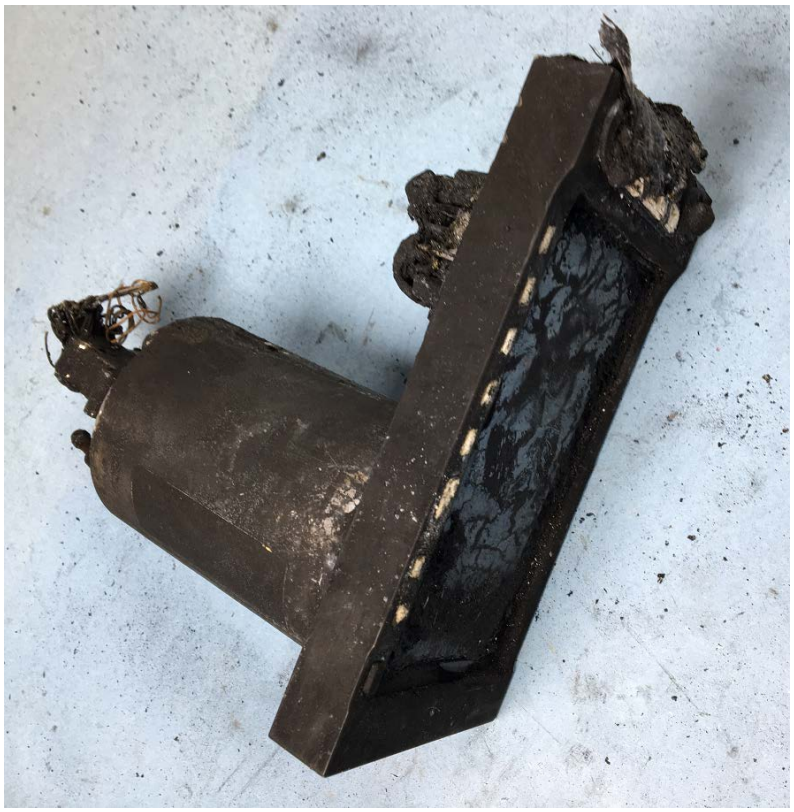

Figure 8. IIC-006: Aspen EFD1000 Pro, internal components.

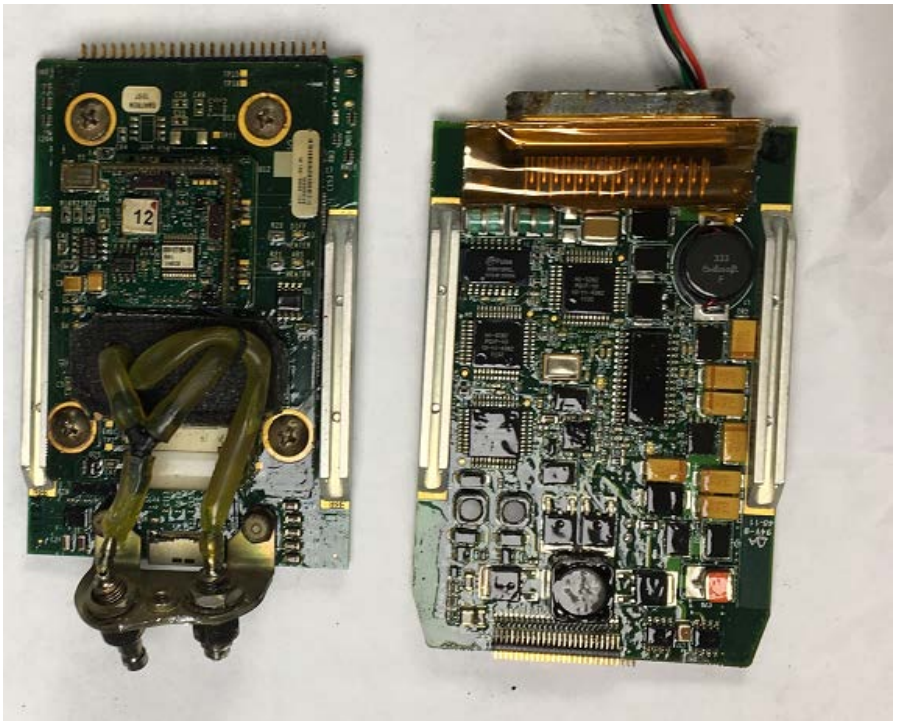

Figure 9. IIC-007: Electronics International UBG-16.

Figure 10. IIC-008: Electronics International MUX-8A, as received.

Figure 11. IIC-008: Electronics International MUX-8A, internal main boards.

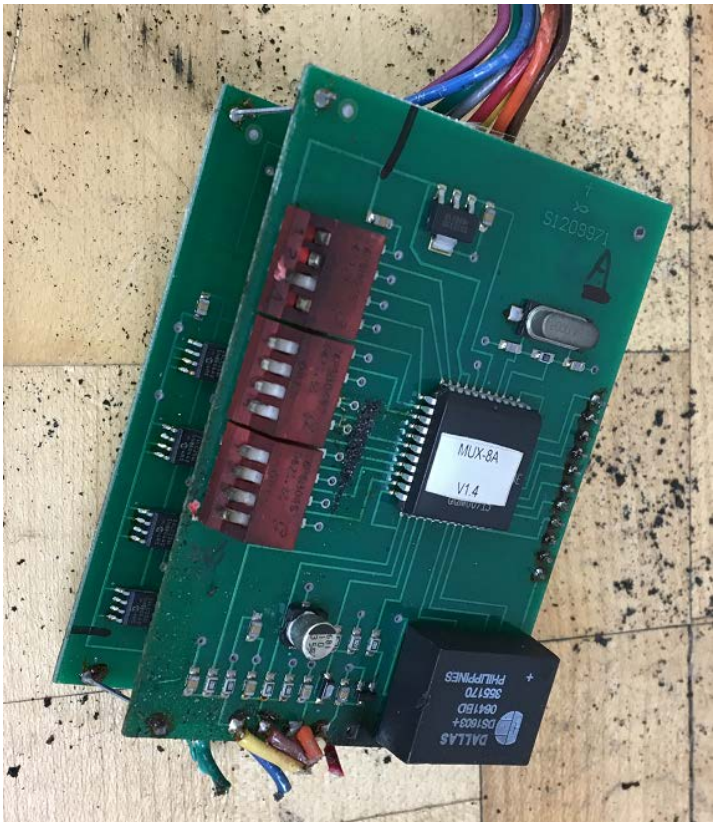

Figure 12. IIC-008: Electronics International MUX-8A, dip switches and non-volatile memory (annotated).

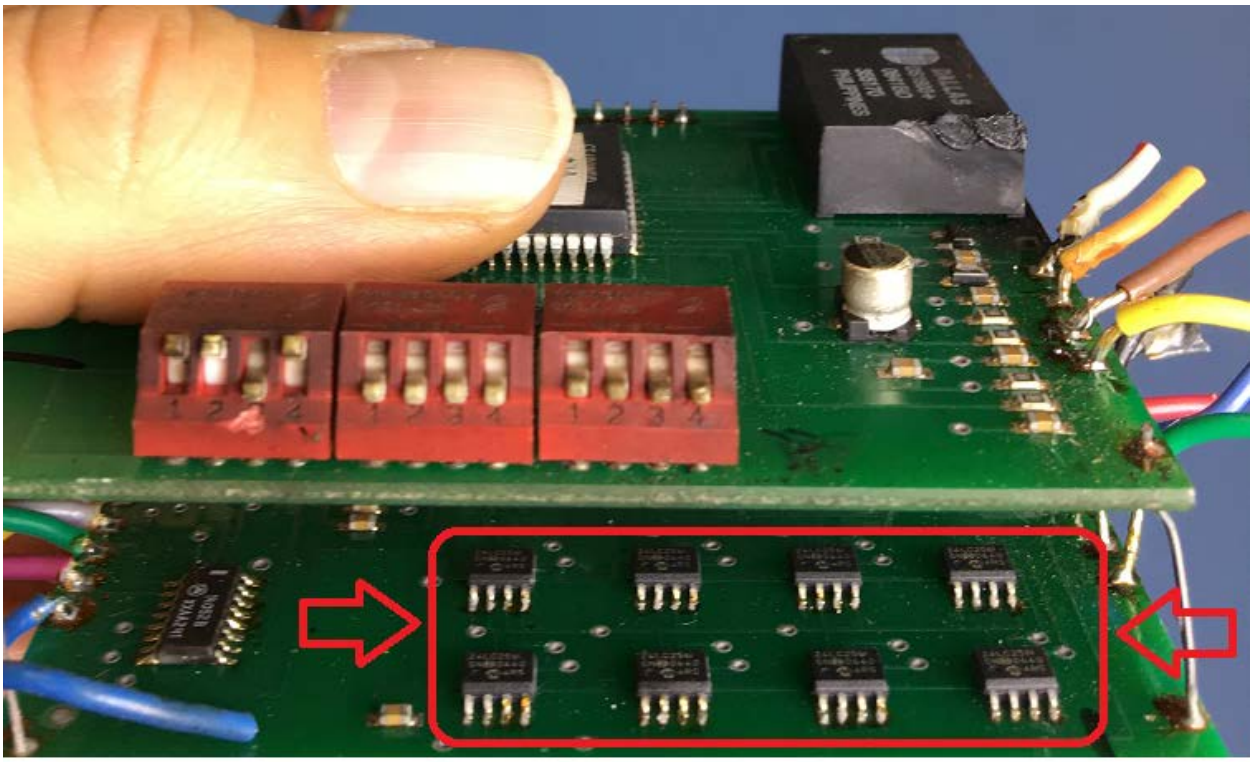

Figure 13. IIC-009: Electronics International FP-5L.

3.3. Data Recovery Attempts and Description

The extent of the damage to devices other than IIC-001 and IIC-008 precluded normal recovery procedures and additional attempts were unsuccessful in yielding usable data. Therefore, no data were recovered.

3.3.1. IIC-008: Electronics International MUX-8A

Cables from an exemplar MUX-8A were re-attached to the accident MUX-8A and, using the manufacturer's proprietary software, information was downloaded normally. The download revealed the last recorded data occurred about one year before the accident. The internal clock accuracy was verified by comparing aircraft usage logs to downloaded data. Furthermore, all eight non-volatile memory chips were removed, read out, and compared to the normally downloaded data. This comparison validated the normally downloaded data contained all recorded data.

As a result of these downloads and validation, it was confirmed no data pertinent to the accident flight were recorded.

3.3.2. IIC-001: Apple iPad 4

The iPad 4 was repaired and successfully started. Information on the iPad indicated it belonged to the accident pilot. Review of the iPad revealed no pertinent text message, photo, video, documents, or social media information.

The electronic flight bag application, ForeFlight, was installed on the iPad. The ForeFlight subscription was current at the time of the accident. A review of the logbook pages, as well as prior tracklogs, showed about 1.5 hours of flying in the prior month (entries prior to July were in April, 2016), as shown in figure 14.

Figure 15 shows the maps page from ForeFlight with a route from IWS to T82.

Foreflight recorded the track history from the accident flight in Universal Coordinated Time (UTC). For this report, 5 hours was subtracted from UTC to convert to CDT. Recorded data indicated the source of the tracklog was the iPad's built-in GPS. ForeFlight was set to automatically record flights; a consequence of this autorecord function was that data before ForeFlight's logic determined the plane was in flight were recorded without a reliable timestamp. With assistance from ForeFlight, it was determined a reasonable estimate of times (in this case, before 1616:25 CDT) could be achieved by assuming each recorded point occurred at 1-second intervals. Therefore, times from 1613:22 CDT to 1616:24 CDT are estimated in this report.

Figures 16 through 19 show the accident flight overlaid on satellite imagery in Google Earth. Weather, lighting, and geographic features may not be representative of weather, lighting, and geographic features at the time of the accident. Track lines shown in black are based on estimated times (and the times are prefixed with an "*").

Collectively, these figures show:

- The recording began about 1613:22 CDT. The aircraft was stopped short of runway 15 until about 1615:51 CDT.

- By 1616:04 CDT, the aircraft began its takeoff roll on runway 15, with recorded GPS altitudes of about 117 feet (ft).[2]

- By 1616:31 CDT, at a groundspeed of 74 knots (kts) and GPS altitude of 128 ft, the aircraft began to deviate left of the runway 15 centerline.

- The aircraft path approximately followed a left hand arc, with the highest recorded altitude of 179 ft at 1616:53 CDT.

- From the time the aircraft proceeded left of the runway, groundspeeds varied between 66 and 85 kts, with 85 kts occurring towards the end of the recording.

- The last non-zero groundspeed point was recorded at 1617:03 CDT (the recording continued until 1617:34 CDT at 0 groundspeed, consistent with the iPad remaining functional after impact).

Tabular data used to generate figures 16 through 19 are included as attachment 1. This attachment is provided in electronic comma-delimited (.CSV) format.

[2] According the FAA Chart Supplement publication, the airport elevation was 111 ft.

Figure 14. ForeFlight tracklog and draft logbook history.

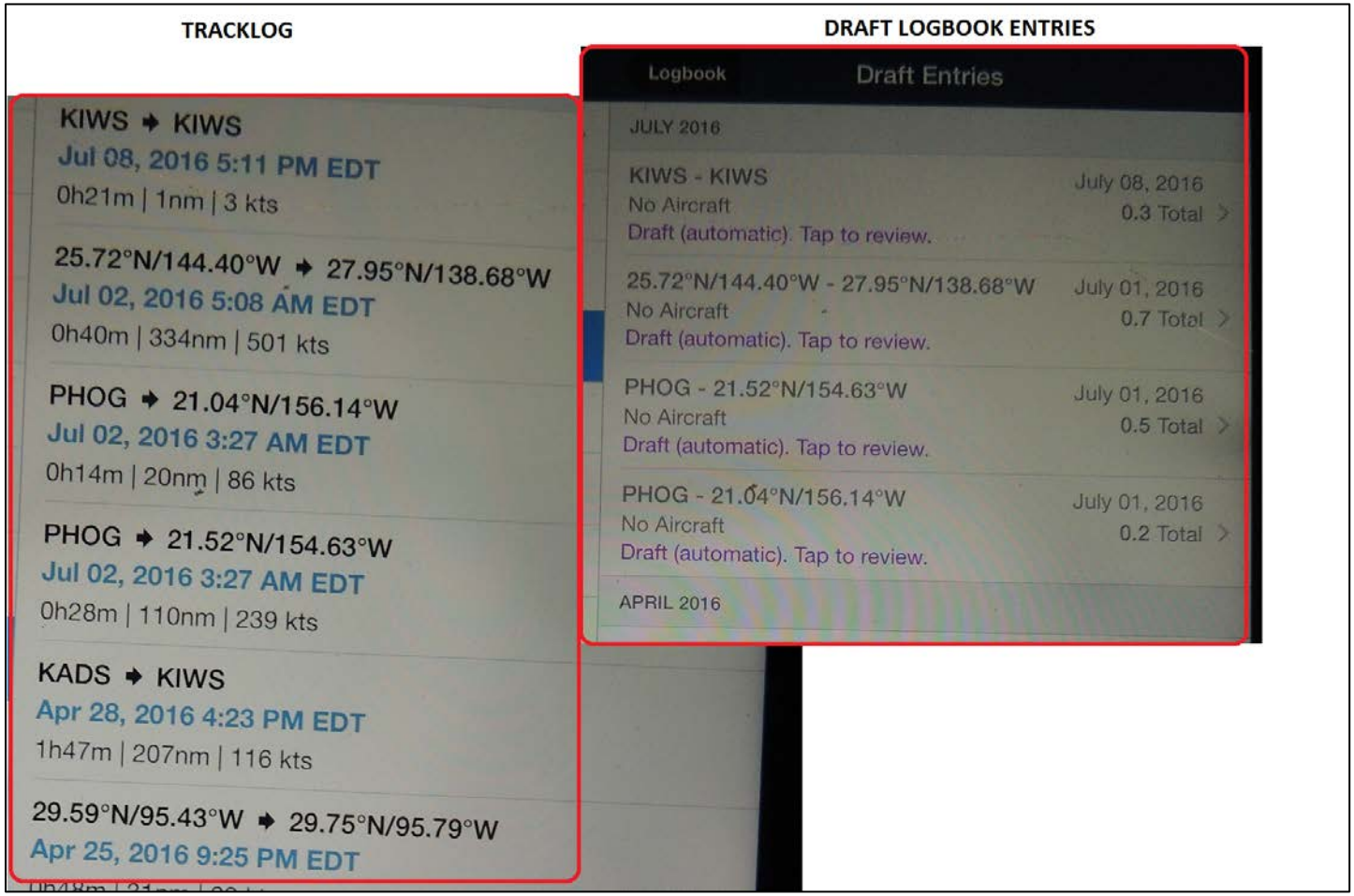

Figure 15. ForeFlight maps page (with Route Editor window inset).

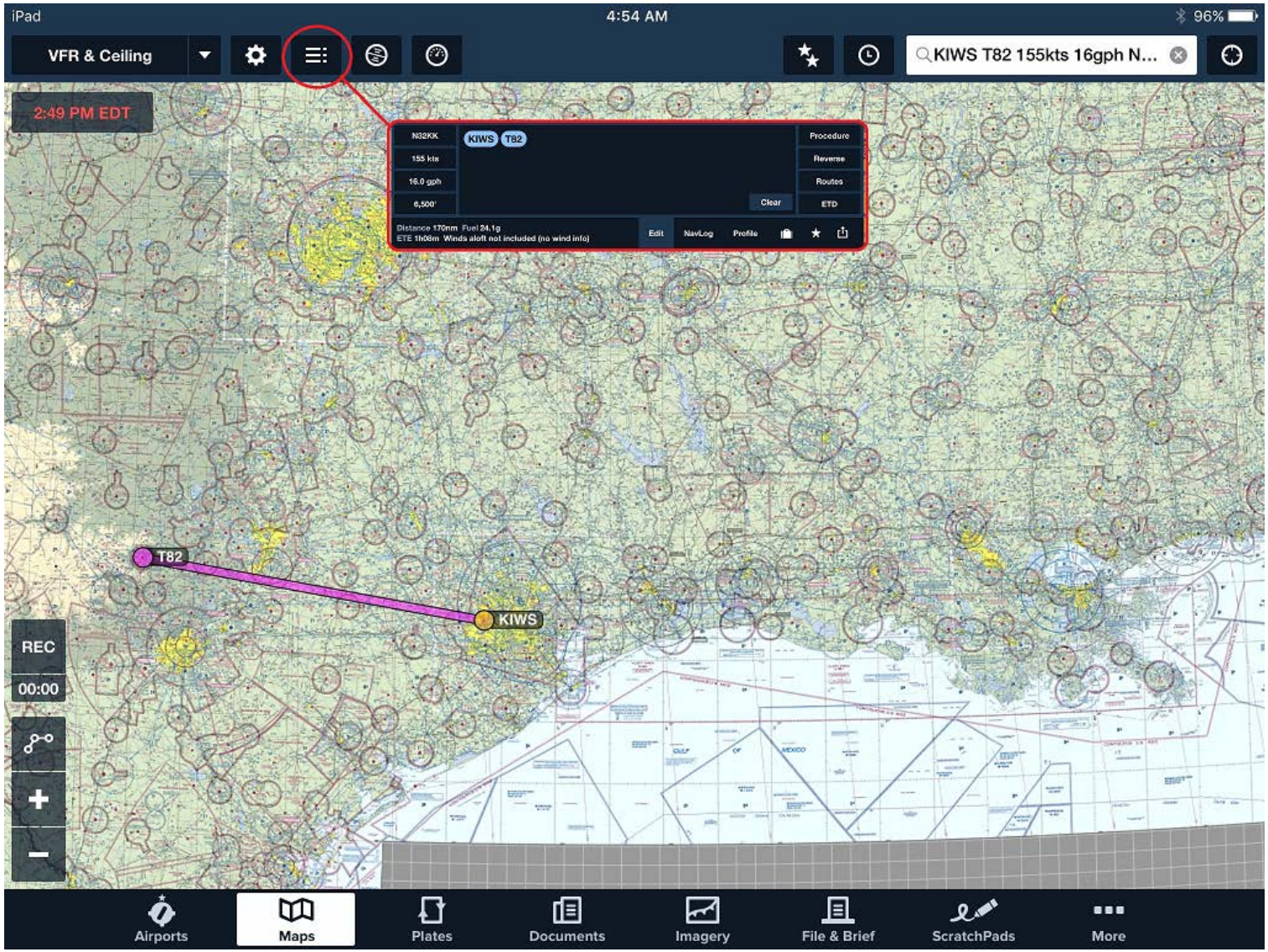

Figure 16. Entire accident flight.

Figure 17. Accident flight, start of recording.

Figure 18. Accident flight, end of recording.

Figure 19. Accident flight, end of recording.