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

November 5, 2014

Electronic Devices

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

1. EVENT

Location:	Lolo Pass, Idaho
Date:	July 28, 2014
Aircraft:	Meyer-Lancair, Legacy
Registration:	N29MM
Operator:	Private
NTSB Number:	WPR14FA316

On July 28, 2014, about 0853 Pacific daylight time, an amateur built, experimental, Meyer-Lancair, Legacy, N29MM, sustained substantial damage during a forced landing following a reported loss of engine power during cruise flight. The airplane was registered to and operated by the pilot under the provisions of Title 14 *Code of Federal Regulations* Part 91. The commercial pilot, sole occupant of the airplane, was fatally injured. Visual meteorological conditions prevailed and a visual flight rules flight plan was filed for the cross-country flight. The flight departed Richland Airport (RLD) Richland, Washington, at an undetermined time with a destination of Baker Municipal Airport, Baker, Montana (BHK).

2. DETAILS OF DEVICE INVESTIGATION

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

Devices with No Data

Device 1:	Garmin GA-27C Antenna
Device 1 Serial Number:	N/A
Device 2:	PS Engineering PMA 7000 Audio Selector
Device 2 Serial Number:	F03289-E03305
Device 3:	SPOT Personal Tracker
Device 3 ESN:	0-2440731
Device 4:	Garmin GNS 480 GPS
Device 4 Serial Number:	25701207

Devices with Recoverable Data

Device 5:	Garmin GTX 327 Transponder
Device 5 Serial Number:	83720690
Device 6:	Garmin SL30 Navigation/Communications (Nav/Com) Transceiver
Device 6 Serial Number:	25901299
Device 7:	Grand Rapids Technology (GRT) Engine Information System (EIS) 6000
Device 7 Serial Number:	83720690
Device 8:	Apple iPad 2
Device 8 Serial Number:	DN6FVD0UDFJ3

2.1. Devices with No Data

The following damaged devices were determined to contain no recorded information: Garmin GA-27C (figure 1), PS Engineering PMA 7000 (figure 2), and SPOT Personal Tracker (figure 3). The Garmin GNS 480 (figure 4) sustained minor impact damage; attempts to start the device were unsuccessful and no information was recovered[1].

Figure 1. Garmin GA-27C.

[1] The Garmin GNS 480 does not record any historical information; only last frequency and configuration information.

Figure 2. PS Engineering PMA7000.

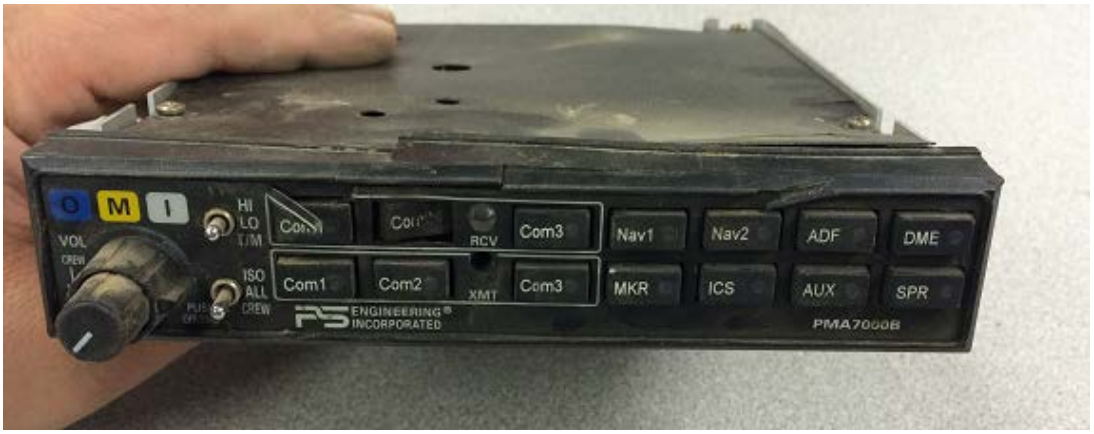


Figure 3. SPOT personal tracker.

Figure 4. Garmin GNS 480.

2.2. Garmin GTX 327 Transponder Description

The Garmin GTX 327 is a panel-mounted transponder. The transponder is a radio transmitter and receiver that operates on radar frequencies, receiving ground radar or traffic collision avoidance system (TCAS) interrogations at 1030 MHz and transmitting a coded response of pulses to ground-based radar on a frequency of 1090 MHz. Between power cycles the unit retains certain information, including the last transponder code entered.

2.2.1. Garmin GTX 327 Transponder Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed the unit had sustained minor impact damage. The device was powered on, as shown in figure 5.

Figure 5. Garmin GTX 327 transponder.

2.2.2. Garmin GTX 327 Transponder Data Description

The transponder indicated a last code of 7700. According to the Aeronautical Information Manual (AIM), "When a distress or urgency condition is encountered, the pilot of an aircraft with a coded radar beacon transponder, who desires to alert a ground radar facility, should squawk Mode 3/A, Code 7700/Emergency and Mode C altitude reporting and then immediately establish communications with the ATC facility" (July 2012, Section 6-2-2).

2.3. Garmin SL30 Nav/Com Description

The Garmin SL30 Nav/Com is a panel-mounted navigation and communications transceiver. The device can retain user-customized frequencies as well as the last 10 navigation and communication frequencies used. Between power cycles, the unit retains the last entered active and standby frequencies.

2.3.1. Garmin SL30 Nav/Com Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed the unit had sustained minor impact damage. The device was powered on, as shown in figure 6. The last navigation and communication frequencies were observed; however, due to knob selector damage the last 10 frequencies used could not be retrieved.

Figure 6. Garmin SL30 nav/com.

2.3.2. Garmin SL30 Nav/Com Data Description

The last active navigation frequency was “112.8” and the last standby navigation frequency was “108.40.” The last active communication frequency was “121.5” and the last standby communication frequency was “133.15.” According to the AIM, “Pilots are encouraged to monitor 121.5 MHz and/or 243.0 MHz while inflight to assist in identifying possible emergency ELT transmissions” (July 2012, Section 6-2-5) and “Although the frequency in use or other frequencies assigned by ATC are preferable, the following emergency frequencies can be used for distress or urgency communications, if necessary or desirable: (1) 121.5 and 243.0 MHz. Both have a range generally limited to line of sight. 121.5 MHz is guarded by direction finding stations and some military and civil aircraft” (July 2012, Section 6-3-1).

2.4. GRT EIS 6000 Device Description

The GRT EIS Model 6000 is a panel mounted engine monitor. The device contains a back-lit, sunlight readable display providing the operator graphical and digital displays of various engine parameters. The device also assists the pilot to lean the engine, and allows for various alarms when monitored systems exceed various settings. Engine parameters that may be monitored and displayed include:

- Exhaust Gas Temperatures (EGT);
- Cylinder Head Temperatures (CHT);
- Tachometer (engine rpm);
- Oil Temperature;
- Oil Pressure;
- Manifold Pressure;
- Fuel Pressure; and
- Flight Timers.

The device also contains a serial output port for the operator to allow for data recording to a laptop PC or a compatible Electronic Flight Information System (EFIS) display. The device does not contain any internal memory for the recording of engine information.

2.4.1. GRT EIS 6000 Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed the unit had sustained minor impact damage. The device was powered on, as shown in figure 7. During power on, the unit displayed a "Check Entries" message, which indicates retained information may be suspect.

Figure 7. GRT EIS 6000.

2.4.2. GRT EIS 6000 Data Description

The screen shown in figure 7 was pertinent to the accident investigation. It showed the last flight time was 58 minutes and the accumulated engine time was 248.5 hours.

2.5. Apple iPad 2 Description

The Apple iPad is a tablet computer with a high-resolution color touch-screen interface. All iPad devices support WiFi and Bluetooth connectivity, and use either 16, 32, or 64 GB of non-volatile memory for storage (depending on model). Some devices also support data connectivity via existing cell-phone networks. The iPad also includes front and back cameras. 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[2] 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.

2.5.1. Apple iPad 2 Data Recovery

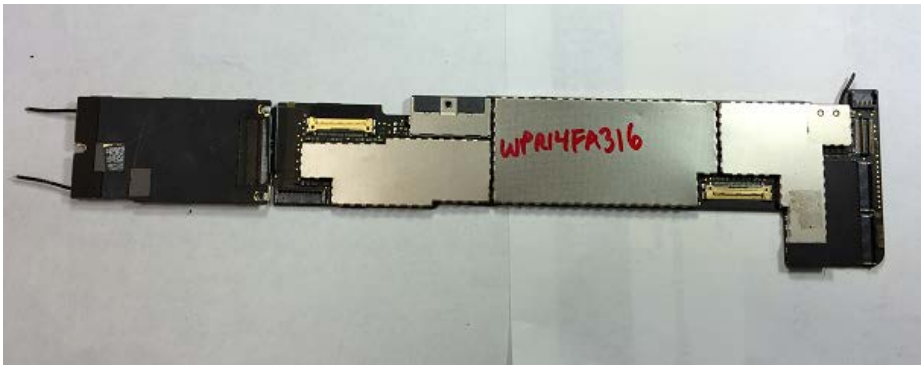
Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed the unit had sustained significant impact damage, as shown in figure 8. The unit was

[2] Non-volatile memory is semiconductor memory that does not require external power for data retention.

disassembled and the internal processor board removed, as shown in figure 9. The internal board was placed in an NTSB surrogate device and powered on normally. Contents were downloaded using forensic software and select screens were photo documented.

Figure 8. Apple iPad 2.

Figure 9. Apple iPad 2 internal board.



2.5.2. Apple iPad 2 Data Recovery

The iPad had about 82 applications installed. None of the applications recorded a geographic track history.

2.5.2.1. ForeFlight Application

The ForeFlight application contained an active route from RLD to BHK. When started, the ForeFlight “Maps” page displayed the image shown in figure 10 (the location of “Lolo Pass” is annotated for reference).

Figure 10. ForeFlight opening map page.

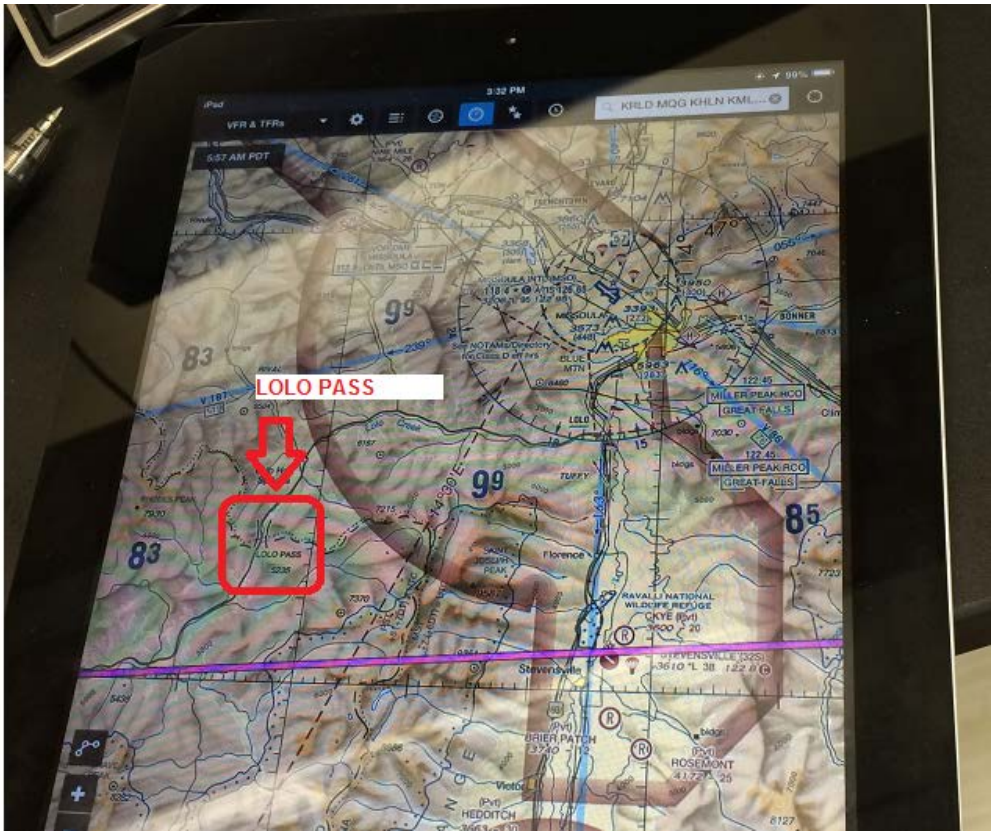


Figure 11 shows an iPad internally generated ForeFlight screen capture. The image was captured at 08:44:54 PDT and is similar to the opening map page shown in figure 10. Details observed in figure 11 include: the last time the weather was updated by ForeFlight (05:57 PDT); the aircraft current position, shown by the blue dot; vertical speed of -925 feet per minute; and GPS time of 15:44 Zulu.

Figure 12 shows the entire route from RLD to BHK by way of MQG KHLN and KMLS.

Figure 11. iPad generated ForeFlight screen capture at 08:44:54 PDT.

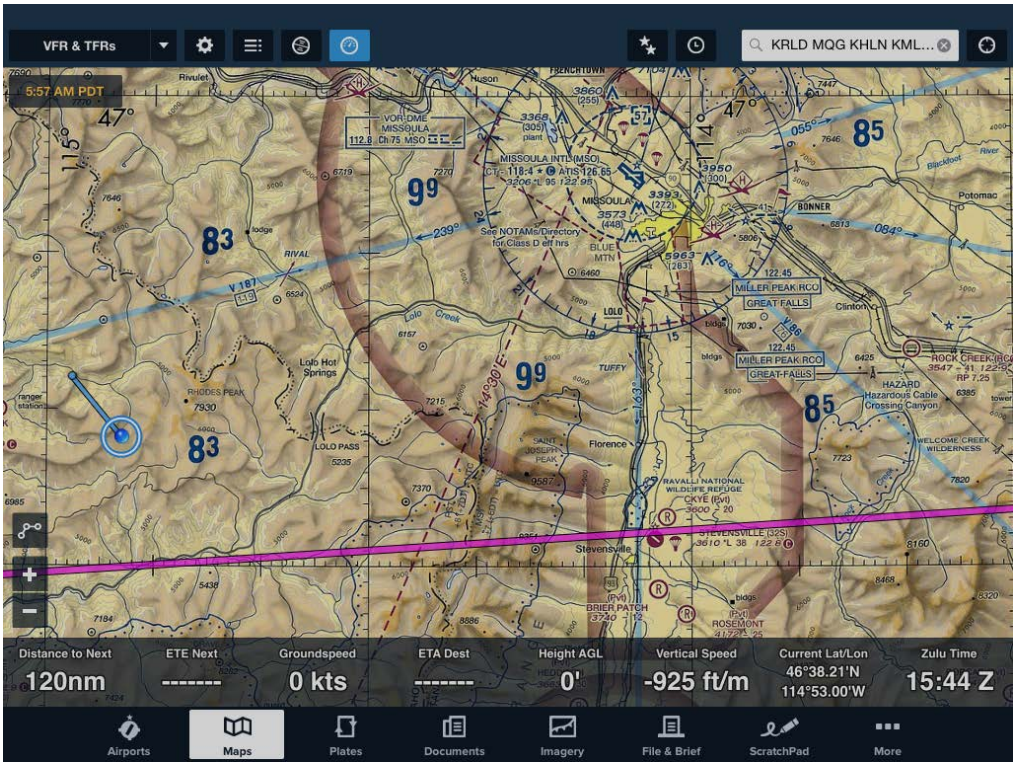


Figure 12. ForeFlight full route.

2.5.2.2. Email, Text Messages, and Internet Browser History

Email, text messages, and internet browser history included content related to engine oil issues.

On May 19, 2014, the accident pilot engaged in an email conversation referencing a Lancair Mailing List article titled, “IO-550 and TSIO-550 Engine Oil Loss;” this article is included as attachment 1 to this report. The email conversation started by the accident pilot began by referencing a link to the article. The email recipient responded, “Good article, I think the descent profile causing the issue makes sense. My breather tube goes in the exhaust, that might be adding enough back pressure to keep the vacuum at the cowl exit from pulling oil out the breather line. Can you put you [sic] breather tube into the exhaust?”

The accident pilot responded, “The left side (same as breather tube side) a heat muff is used on outside of exhaust for cabin heat. Do not think right side has the muff. Neither side is connected to breather? Are you saying a ‘T’ or branch is used for breather? Can u provide a photo? I think either decent [sic] or landing is my cause but not consistent. Another possible problem is oil slosh during landing.” The email recipient responded, “You can see the breather line going into the exhaust, black hose with the hose clamp after the waste gate.” The email conversation concluded with some off-hand remarks and thanks.

A text message conversation about an oil “dump” on July 1 and July 2, 2014, is shown in table 1. The photo exchanged at the start of the email conversation is expanded in Figure 13, which shows oil spray over a white/blue/white/red painted nose section of an airframe with a triangular air inlet.

Table 1. Text message conversation 7/1/14 through 7/2/14.

Direction	Date/Time	Content
Outgoing	July 1, 16:51:28 PDT	Dumped Qt overboard Still running tests Likely front crankcase seal with reduced power during approaches[a] 
Outgoing	July 1, 16:53:36 PDT	Breather dumps oil sometimes
Incoming	July 2, 13:37:20 PDT	Most likely breather.
Incoming	July 2, 13:37:20 PDT	Crank case seal would make a mess all of the inside of cowling.
Outgoing	July 2, 13:48:00 PDT	This is breather but why ?
Incoming	July 2, 13:50:02 PDT	You don't have an air oil separator.
Outgoing	July 2, 13:51:58 PDT	Correct This time I was doing instrument approaches I have a pressure sensor installed but still have not captured event
Outgoing	July 2, 13:52:16 PDT	Hope u have a great 4 th
Outgoing	July 2, 13:52:16 PDT	I will continue to track
Incoming	July 2, 13:53:45 PDT	You as well!

[a]See figure 13 for an large-sized photo.

Figure 13. Picture referenced in 7/1/14 text message at 16:51:28 PDT.

On July 25 and July 26, 2014, iPad browser history contained searches for “how to monitor oil spray” and “continental engine crankcase vent pressure.” Teledyne Continental Service Bulletin “Excessive Crankcase Pressures,” number M89-9, was downloaded on the iPad on July 26, 2014; this service bulletin is included as attachment 2 to this report.

Other aviation pertinent activity on the browser history included:

- a Pilots of America message board thread titled, “When is leaking oil ‘OK’?”;
- an AOPA Air Safety Foundation IFR pilot quiz;
- tips on engine care;
- best practices for leaning an engine;
- information about EAA Air Venture 2014; and
- login to the SPOT Personal Tracker website.