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

January 23, 2014

Enhanced Ground Proximity Warning System

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

1. EVENT SUMMARY

Location:	Santa Monica, CA
Date:	September 29, 2013
Aircraft:	Cessna 525A
Registration:	N194SJ
Operator:	Private
NTSB Number:	WPR13FA430

On September 29, 2013, at 1820 Pacific daylight time, a Cessna 525A Citation, N194SJ, veered off the right side of runway 21 and collided with a hangar at the Santa Monica Municipal Airport (SMA), Santa Monica, California. The private pilot and three passengers were fatally injured, and the airplane was destroyed by a post-crash fire. The airplane was registered to CREX-MML LLC, and operated by the pilot as a 14 *Code of Federal Regulations*, Part 91 flight. Visual meteorological conditions prevailed for the flight, which operated on an instrument flight rules flight plan. The flight originated at Friedman Memorial Airport (SUN), Hailey, Idaho, about 1614.

2. ENHANCED GROUND PROXIMITY WARNING SYSTEM DATA GROUP

An enhanced ground proximity warning system (EGPWS) data group was not convened.

3. DETAILS OF EGPWS INVESTIGATION

The Safety Board's Vehicle Recorder Division received the following EGPWS:

Recorder Manufacturer/Model:	**Honeywell Mark VIII EGPWS**
Recorder Serial Number:	**2027**

3.1. Honeywell Mark VIII EGPWS Description

The EGPWS non-volatile memory (NVM) does not continuously record, rather the EGPWS device stores data to NVM only when certain criteria are met. The readout process at the manufacturer's facility produces several files of flight history data that encompass operational, documentary, fault, and warning information.

The flight history data warning file outputs performance data as related to the operation of the aircraft. These data do not continuously record, rather if an alert or warning related to

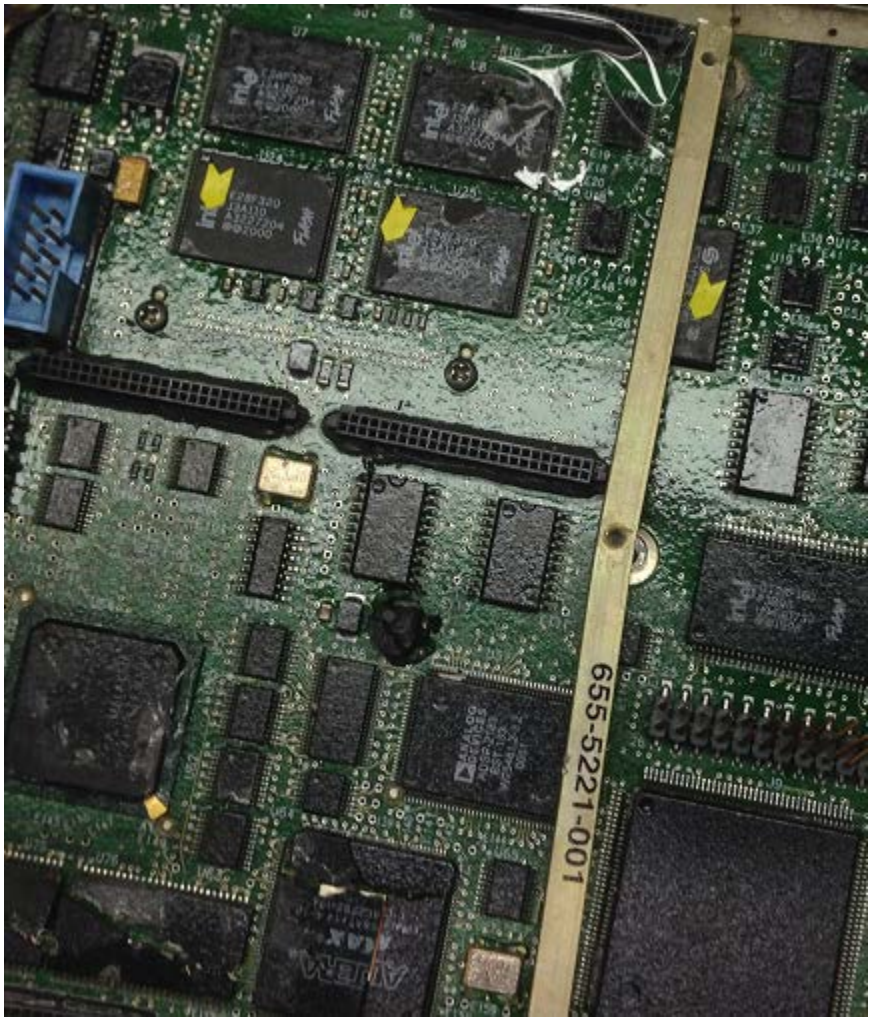
the EGPWS function activates, the unit retains data points for 20 seconds prior to the activation of the warning and 10 seconds afterwards. The EGPWS parameters are only sampled 1 time per second, but the actual time of occurrence can be anywhere within the second.

3.2. Honeywell Mark VIII EGPWS Condition and Recovery

The device was damaged in the event. The extent of the damage is shown in figure 1, with the side data plate expanded. The device was disassembled, and the internal board containing the NVM was found to be intact, as shown in figure 2. Figure 2 also annotates the U24, U25, and U23 NVM chips (from left to right in figure 2). Under NTSB supervision, the EGPWS manufacturer desoldered the three NVM chips. The U24 and U25 chips were imaged and decoded by the manufacturer; the U23 chip was not necessary for the decoding.

Figure 1. Damaged exterior of EGPWS.

Figure 2. Internal board with NVM chips annotated.



3.3. Time Correlation

The downloaded files contain data logged based on hours of operation (operational time) of the individual EGPWS unit and have no reference to any other time base. In the data files, each power cycle is tagged with a sequential flight leg number. The accident flight was identified as flight leg 1592. Only warning data pertaining to the event flight, 1592, were extracted for use in this report.

The data in the warning file for flight leg 1592 began recording at operational time 2614:08:08. The event that triggered this recording was an excessive bank angle warning that occurred at 2614:08:28 operational time, when the aircraft was at about 15,000 feet about 3 minutes after take-off. There were no other warnings on the accident flight. The tabular data from this warning's recording are provided in electronic (*.csv[1]) format as Attachment 1 to this report.

[1] Comma Separated Value format.

3.4. Engineering Units Conversions

The operational data is converted during the readout process by Honeywell software and the files contain engineering units. Where applicable, changes to the conversions have been made to ensure the parameters conform to the Safety Board's standard sign convention that climbing right turns are positive (CRT=+).[2]

3.5. Parameters Provided and Verified

Table 1 lists the EGPWS parameters provided and verified in this report.

Table 1. Verified and provided EGPWS parameters.

EGPWS Parameter	EGPWS File Name
EGPWS Terrain Elevation (feet)	Terr Elv
Flight Leg	Flt Leg
GPS Altitude (feet)	GPS Alt
Ground Speed (knots)	Gspd
Latitude (degrees)	Lat
Line Number	Line No
Longitude (degrees)	Long
Operating Time	Oper Time
Pitch (degrees)	Pitch
Rate of Descent (feet per minute)	Alt Rte
Record Identification	Rec ID
Roll (degrees)	Roll
Track, Mag (degrees)	Mag Trk
Track, True (degrees)	Tru Trk
True Heading (degrees)	Tru Hd
Warning Description	Warning Description

3.6. EGPWS Recorded Takeoff Information

The EGPWS also recorded takeoff and landing event data for the accident flight. Table 2 contains the recorded takeoff data and table 3 the landing data.

Table 2. EGPWS recorded takeoff data.

Operating Time (HH:MM:SS)	2614:04:52
GPS Altitude (feet)	5338.0
Airport	KSUN
Latitude/Longitude	43.50431 / -114.29610

Table 3. EGPWS recorded landing data.

Operating Time (HH:MM:SS)	2616:08:04

[2] CRT=+ means that for any parameter recorded that indicates a climb or a right turn, the sign for that value is positive. Also, for any parameter recorded that indicates an action or deflection, if it induces a climb or right turn, the value is positive. Examples: Right Roll = +, Pitch Up = +, Elevator Trailing Edge Up = +, Right Rudder = +.

GPS Altitude (feet)	192.0
Airport	KSMO
Latitude/Longitude	34.02088 / -118.44514